

**FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH FILL EMBANKMENTS, DEEP CUTS AND SWAMP CROSSINGS
HIGHWAY 11/17 FOUR-LANING FROM 1.0 KM WEST OF
HODDER AVENUE/COPENHAGEN ROAD EASTERLY FOR 5.8 KM
W.P. 334-94-00**

Geocres Number: 52A-146

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the locations of proposed high fill embankments, deep cuts and swamp crossings required for widening of Highway 11/17 in Thunder Bay, Ontario.

The proposed works to widen Highway 11/17 include twinning of the existing highway, construction of a new interchange and grade separation structure at Hodder Avenue/Copenhagen Road, and realignment of the Terry Fox Access Road.

The purpose of the investigation was to explore the subsurface conditions at the proposed embankment/cut locations, and based on the data obtained, to provide borehole location plans, borehole logs, stratigraphic profiles, cross-sections, and written descriptions of the subsurface conditions. A model of the subsurface conditions was developed using the data obtained during the present investigation as well as previous investigations conducted by others. This model summarizes the expected geotechnical conditions influencing design and construction of the fill embankments, cuts and swamp crossings.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation, under the Ministry of Transportation Ontario (MTO) Agreement Number 6008-E-0005.

2 SITE DESCRIPTION

The project site lies at the northeast limit of the City of Thunder Bay and extends from 1.0 km west of Hodder Avenue/Copenhagen Road to 1.0 km east of Highway 527. Highway 11/17 is presently a two-lane undivided highway, and will be upgraded to a four lane divided section. Hodder Avenue/ Copenhagen Road and Highway 527 are two-lane undivided roadways.

Highway grades are broadly undulating, and slope down to the Current River at the west project limits. The surrounding lands are typically forested. A swampy area is present north of Highway 11/17 at Copenhagen Road. The Terry Fox Monument is located on an elevated rock outcrop on

the north side of the highway near the centre of the project. A works yard is located at the northwest corner Highway 527 intersection and a seasonal trailer park is located south of Highway 11/17 east of Highway 527.

The locations and existing conditions at each section of high fill, deep cut and swamp crossing investigated during the current investigation are summarized below:

Highway 11/17 EBL, Sta. 26+200 to 27+100 – The existing highway is located above an embankment slope on the south side. The embankment height decreases from approximately 20 m at the west limit to about 4 m at the east end, corresponding to the descending grade of the highway. Fill has been placed on the south side of the highway in the west part of the section, increasing the distance between the highway and slope crest. The ground surface generally rises on the north side of the highway, with approximate 10 to 12 m high rock outcrops near Station 26+400 (Terry Fox monument) and 26+700.

Highway 11/17 EBL, Sta. 29+400 to 29+900 - The south side of Highway 11/17 typically consists of an embankment up to 8.5 m high with the Ishkibibble Creek running east to west along the toe of the embankment slope. The lands to the south consist of a seasonal trailer park and low scrubland. A low rock outcrop is present on the south side of the highway near Station 29+725.

Highway 11/17 WBL, Sta. 29+460 to 30+000 – The ground surface on the north side of the highway typically rises in elevation and is undulating with intermittent rock outcrops. A low, wet area is present near Station 29+500. These lands are heavily treed.

Copenhagen Road, Station 9+540 to 9+955 – The lands adjacent to Copenhagen Road are generally low, flat, wet and densely vegetated with brush and small trees. Savigny Creek crosses the roadway near the north end of the section.

Hodder Avenue E-N/S Ramp, Station 10+540 to 10+780 – The lands in the northeast quadrant of the Highway 11/17 – Hodder Avenue intersection are generally flat to slightly undulating, wet and vegetated by brush and trees. Areas of fill are evident.

Hodder Avenue S-E Ramp, Station 10+000 to 10+650 – The lands in the southeast quadrant of the Highway 11/17 – Hodder Avenue intersection rise to the south and are heavily treed with the exception of the cleared Hydro corridor running parallel to the highway. Low rock outcrops are present along the south side of Highway 11/17.

Hodder Avenue N-E Ramp, Station 10+050 to 10+200 – The lands in the southwest quadrant of the Highway 11/17 – Hodder Avenue intersection rise to the south and are heavily treed with the exception of the cleared Hydro corridor running parallel to the highway.

Hodder Avenue W-N/S Ramp, Station 10+060 to 10+260 – The lands along the proposed ramp alignment rise to the south and east, and are heavily treed with the exception of the cleared Hydro corridor running parallel to the Highway 11/17.

Geologically, the site area is located within the physiographic region known as the Canadian Shield, characterized by Pre-Cambrian bedrock typically occurring as rounded knobs and ridges where exposed. The bedrock consists of the Gunflint Formation, a sequence of limestone, graphitic shale, tuff, taconite, chert-carbonite and chert. Intrusions/sills of diorite are present locally. The bedrock is overlain by a discontinuous layer of glacial till comprising a heterogeneous mixture of clayey silt, silt, sand and gravel.

3 SITE INVESTIGATION AND FIELD TESTING

Thurber carried out site investigation and field testing at the location of each proposed high fill, deep cut and swamp crossing during the period June 26, 2009 to January 31, 2010. The site investigation consisted of drilling and sampling boreholes supplemented by dynamic cone penetration testing (DCPT). A series of six test pits were also excavated on the existing embankment opposite the Terry Fox monument.

A summary of the locations and depths of the boreholes and test pits carried out in each of the study areas is provided in Table A1, Appendix A. The approximate locations of the boreholes, DCPT tests and test pits are shown on the Borehole Locations and Soil Strata Drawings in Appendices B to I.

The borehole locations (stations and offsets from centreline) were established by Thurber relative to centreline staking by J.D. Barnes Limited. Where boreholes were drilled for concurrent foundation investigations at structure locations, the borehole locations and offsets were provided by J.D. Barnes Limited. Prior to the start of drilling, utility clearances and property access were obtained.

In general, hollow stem augers were used to advance the boreholes and samples were obtained using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). At several locations, BQ and NQ rock coring was used to prove bedrock or penetrate bouldery material.

Standpipe piezometers were installed in selected boreholes to monitor groundwater levels. The piezometer installations typically consisted of 19 mm PVC pipe with a 1.5 m slotted tip surrounded by filter sand. A bentonite seal was placed above the filter sand and the remainder of the borehole was grouted with bentonite grout to the ground surface. Details of the piezometer installations are shown on the Record of Borehole sheets in Appendices B to I and summarized in Table A2, Appendix A.

Boreholes not containing piezometers were backfilled with drill cuttings and/or bentonite grout.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The inspector logged the soil and groundwater conditions encountered in the boreholes, and collected, labelled, and arranged for transport of the recovered samples to Thurber's laboratory.

In addition to the borehole data obtained during the current investigation, select factual data from the preliminary investigation was incorporated into the assignment (Preliminary Foundation

Investigation and Design Report, High Fill and Deep Cuts, Peto MacCallum Ltd., June 18, 2007, Geocres No. 52A-131).

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. The results of this testing are shown on the Record of Borehole sheets in Appendices B to I. Selected samples were also subjected to gradation analysis and Atterberg Limits testing where appropriate. The results of this testing program are shown on the Record of Borehole sheets and figures contained in Appendices B to I.

Point load testing was conducted on rock core samples retrieved from the boreholes. The results of the point load tests are shown on the borehole logs in the appendices.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and the Borehole Locations and Soil Strata Drawings in Appendices B to I of this report. The stratigraphy recorded in the test pits excavated on the embankment opposite the Terry Fox monument is presented in Table B1 included in Appendix B.

A general description of the stratigraphy based on the conditions encountered in the boreholes is given in the following paragraphs. However, the factual data presented in the borehole logs takes precedence over this general description and interpretation of the site conditions.

The specific conditions encountered at individual sites vary. Generalized descriptions of the individual strata at each fill, cut or swamp area are presented below.

5.1 Highway 11/17 EBL, Station 26+200 to 27+100 (Appendix B)

General

In general, the site stratigraphy consists of surficial embankment fill and/or peat underlain by sand and silt till. Bedrock, probable bedrock or boulders were encountered at depths of 0.3 to 6.2 m.

Fill

Fill was encountered in all boreholes and test pits drilled on the existing highway embankment. The fill was described as sand to sand and silt with gravel, cobbles and boulders. Rock fill and silty clay fill were encountered in Test Pit 09-1. Surficial organic material was identified on the fill surface in the test pits.

The fill was typically brown, locally dark brown. In addition to rock fragments, minor amounts of roots, rootlets, wood fragments, and "organic specs" were noted in the fill.

The thickness of the fill layer ranged from 1.0 to 4.7 m where the lower boundary was encountered or refusal to auger/excavate was met. Test Pits 4 to 6 were terminated in the fill at depths of 3.5 to 3.8 m.

The results of laboratory grain size distribution tests carried out on samples of the fill are shown on the borehole logs and also presented in Figure B1, Appendix B for the current investigation. The results were as follows:

Gravel (%)	10 to 51	
Sand (%)	35 to 57	
Silt (%)	15 to 45	
Clay (%)	1 to 9	(14 to 42 silt & clay)

SPT 'N' values obtained in the fill ranged from 5 to 40 blows/0.3 m, indicating a loose to dense condition. Typically, the 'N' values were in the order of 8 to 18 blows/0.3 m (loose to compact).

The moisture content of the fill ranged from 9 to 23%.

Peat and Topsoil

Peat or topsoil was encountered surficially in all boreholes drilled near the toe of the existing embankment slope. The thickness of the organic layer ranged from 0.1 to 1.2 m at the borehole locations.

A moisture content of 150% was recorded in a sample of the peat during the preliminary investigation.

Sand and Silt Till

A till deposit variously described as sand, silty sand, sand and silt, and locally a mixture of rock fragments, gravel, sand and silt was encountered below the organic layer in all but two boreholes (boreholes 102 and 103) drilled near the toe of the embankment slope, and below the fill in two boreholes drilled on the embankment (boreholes 10-97 and 3).

The identification of this material as till on the borehole sheets is not consistent from the various stages of investigation. Portions of the deposit were not described as till and may represent glaciofluvial or alluvial deposits. Clear differentiation between the deposits is not always possible based on the existing data, and for the purposes of this report, all of the undisturbed native soil has been grouped together in this section.

In the boreholes drilled near the toe of the embankment slope, the upper boundary of the till/sand/silt was encountered at depths of 0.1 to 1.2 m. In boreholes 10-97 and 3 located above the slope, the upper boundary was at 4.7 and 1.5 m depth, respectively. Bedrock or auger refusal was met below the deposit at depths of 1.1 to 6.2 m in all but one borehole.

Borehole 115 was terminated in the till at 6.9 m depth. The thickness of this deposit ranged from 0.2 to 6.0 m.

The results of laboratory grain size distribution tests carried out on samples of the till/sand/silt during the current investigation are presented in Figures B2 and B3, Appendix B. The results from the current and previous investigations were as follows:

	<u>Current and 2005 Studies</u>	<u>1991 Study</u>
Gravel (%)	0 to 17	59
Sand (%)	45 to 79	22
Silt (%)	24 to 48*	19 (silt & clay)
Clay (%)	2 to 10	

* 4% in one sample

SPT 'N' values obtained in the till deposit varied widely from 2 blows/0.3 m to 100 blows/0.05 m, indicating a very loose to very dense condition. The values less than 30 blows/0.3 m (loose to compact) were obtained in the upper 1.5 to 2.1 m of the deposit, in approximately half of the boreholes.

The moisture content of samples from this deposit ranged from 6 to 21%, typically 9 to 19%.

Refusal and Bedrock

Bedrock or refusal to further penetration on probable bedrock or boulders was encountered in all boreholes except borehole 115. The depth to bedrock or refusal ranged from 0.3 to 6.2 m.

Eight boreholes were advanced 0.3 to 1.4 m into bedrock by augering. Based on the auger cuttings, the bedrock was described as black shale. SPT 'N' values obtained in the rock ranged from 38 blows/0.3 m to 50 blows/0.05 m.

Boreholes 10-96 to 10-98, 3 and 4 were extended 2.2 to 5.7 m into the underlying bedrock by coring. The bedrock recovered in the cores was described as the Chert Iron Formation in the 1991 boreholes and chert carbonate limestone of the Gunflint Formation in the current study. Core recovery was between 92 and 100%, and RQD values ranged from 37 to 93%, indicating poor to excellent rock quality. The unconfined compressive strength of the rock, estimated from the results of point load tests, ranges between 27 and 100 MPa, indicating a medium strong to strong intact rock.

Groundwater

The depths to groundwater observed in the boreholes upon completion of drilling are shown in Table 5.1.

Table 5.1 – Observed Depths to Groundwater

Borehole	Date	Depth to Water (m)	Event
09-79	16-Jul-09	3.1	Upon completion
09-80	16-Jul-09	0.9	Upon completion
105	14-Dec-05	0.6	Upon completion
107	14-Dec-05	0.7	Upon completion
109	14-Dec-05	0.3	Upon completion
113	13-Dec-05	1.2	Upon completion
115	13-Dec-05	1.5	Upon completion

The above water levels reflect the conditions in the boreholes upon completion of drilling. The observations are very short-term and seasonal fluctuations of the groundwater level are to be expected.

5.2 Highway 11/17 EBL, Station 29+400 to 29+900 (Appendix C)

General

In general, the site stratigraphy consists of surficial embankment fill and/or peat underlain by sand and silts, overlying a discontinuous gravelly sand layer. Auger refusal was met on probable bedrock or boulders at depths of 1.4 to 10.9 m.

Fill

Boreholes 10-105, 10-115, 10-118 and 10-121 were drilled on the shoulder of existing Highway 11/17 and encountered the existing pavement structure overlying embankment fill. The existing pavement structure consisted of 75 to 100 mm of asphalt overlying 0.8 to 1.4 m of sand and gravel. The underlying embankment fill consisted primarily of silt in borehole 10-118 and sand in the other boreholes. The sand/silt fill was 0.8 to 2.6 m thick with a lower boundary at depths of 2.3 to 4.1 m.

Fill was also encountered in boreholes 10-104 and 10-122 drilled at the toe of the embankment slope. The fill comprised sand and gravel in borehole 10-104 and silty sand in borehole 10-122. The fill was brown to dark brown with organics, and was 0.8 m thick.

The results of laboratory grain size distribution tests carried out on two samples of sand fill and one sample of silt fill are presented in Figure C1, Appendix C. The results were as follows:

	<u>Sand Fill</u>	<u>Silt Fill</u>
Gravel (%)	21 to 22	0
Sand (%)	57 to 59	11
Silt (%)		84
Clay (%)	20 to 21	5

SPT 'N' values of 16 blows/0.3 m to 100 blows/0.125 m were obtained in the fill, indicating a compact to very dense condition.

The moisture content of the pavement granular material and embankment fill ranged from 3 to 20%, typically 6 to 11%. Moisture contents of 30 and 31% were measured in fill samples from the toe of the embankment slope (boreholes 10-104 and 10-122), indicative of the organic content.

Peat

Peat was encountered surficially in boreholes 10-116, 10-117 and 10-123, and below the fill in borehole 10-122. The peat thickness ranged from 1.5 to 2.3 m, and the lower boundary was encountered at depths of 1.5 to 2.6 m. A 0.8 m thick layer of sand mixed with peat was encountered below the peat in borehole 10-116, extending to 2.3 m depth.

SPT 'N' values of 0 to 6 blows/0.3 m were recorded in the peat and underlying sand/peat layer, indicating a loose to very loose condition.

Moisture contents of 68 to 500% were recorded in the peat. A moisture content of 34% was measured in the mixed sand/peat layer.

Sands and Silts

A deposit grading from sand with trace silt to silt with some sand was encountered at the ground surface in two boreholes and below the fill and peat in all other boreholes. The upper boundary of the sand/silt was encountered at depths of up to 4.1 m. Auger refusal was met in or below the sand/silt deposit at depths of 1.4 to 5.1 m in six boreholes, and the lower boundary was encountered at depths of 4.6 to 10.7 m in five boreholes. The thickness of this deposit ranged from 0.6 to 6.6 m.

The results of laboratory grain size distribution tests carried out on samples of the sands and silts are presented in Figures C2 and C3, Appendix C. The results were as follows:

	<u>Sand to Silty Sand</u>	<u>Silt to Sandy Silt</u>
Gravel (%)	0 to 12	0 to 1
Sand (%)	65 to 95	17 to 32
Silt (%)		62 to 77
Clay (%)	5 to 32	3 to 5

SPT 'N' values obtained in the sands and silts typically varied from 4 to 20 blows/0.3 m, indicating a loose to compact condition. Several values ranging from 35 blows/0.3 m to 100 blows/0.125 m were also recorded, indicating very dense zones and/or cobbles and boulders.

The moisture content of samples from this deposit generally ranged from 5 to 22%, with several values of 26 to 31% recorded.

Gravelly Sand

A layer of gravelly sand was encountered below the sands and silts in boreholes 10-115, 10-116, 10-118 and 10-121 at depths of 4.6 to 10.7 m. Auger refusal was encountered within or at the base of this material at depths of 6.5 to 10.9 m, indicating a thickness of at least 0.2 to 5.9 m.

The results of laboratory grain size distribution tests carried out on three samples of the gravelly sand are shown in Figure C4, Appendix C. The results are summarized below.

Gravel (%)	14 to 31
Sand (%)	64 to 72
Silt % Clay (%)	5 to 15

‘N’ values of 26 blows/0.3 m to 100 blows/0.125 m were recorded in the gravelly sand in boreholes 10-115, 10-116 and 10-118, indicating a compact to very dense condition. “N” values of 0 to 19 blows/0.3 m were obtained in borehole 10-121; these lower values may reflect hydraulic disturbance during sampling.

Moisture contents in the gravelly sand ranged from 8 to 18%.

Silty Sand Till

An isolated layer very dense silty sand till was encountered below the sand in borehole 10-122. The till is dark grey and contains some gravel. Auger refusal was met in/below the till at 9.9 m depth, indicating a thickness of at least 0.8 m.

The results of a laboratory grain size distribution test carried out on a sample of the till are illustrated in Figure C5, Appendix C. The results are summarized below.

Gravel (%)	15
Sand (%)	50
Silt (%)	31
Clay (%)	4

An SPT ‘N’ value of 100 blows/0.2 m and moisture content of 7% were obtained in the till.

Refusal

Refusal to further penetration by the augers was met on probable bedrock or boulders in all boreholes at depths of 1.4 to 10.9 m.

Groundwater

The depths to groundwater observed in the boreholes upon completion of drilling and subsequently measured in the piezometers are shown in Table 5.2.

Table 5.2 – Groundwater Depths

Borehole	Date	Depth to Water (m)	Event
10-115	21-Jan-10	4.2	Upon completion
10-116	27-Jan-10	1.7	Upon completion
10-117	28-Jan-10	1.3	Upon completion
	31-Jan-10	0.7	In piezometer
	01-Mar-10	0.7	In piezometer
10-118	21-Jan-10	3.8	Upon completion
10-119	28-Jan-10	2.8	Upon completion
10-120	29-Jan-10	4.2	Upon completion
10-121	26-Jan-10	4.1	Upon completion
10-122	28-Jan-10	3.8	Upon completion
	31-Jan-10	1.4	In piezometer
	01-Mar-10	1.5	In piezometer

The above water levels reflect the conditions in the boreholes upon completion of drilling or the piezometric head at the level of the piezometer tips at the time of the readings. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

5.3 Highway 11/17 WBL, Station 29+460 to 30+000 (Appendix D)

General

In general, the site stratigraphy consists of surficial peat or topsoil layer underlain by sands and silts. Auger refusal was met on probable bedrock or boulders at depths of 0.7 to 15.9 m.

Fill

A 0.7 m thick layer of crushed rock was encountered in borehole 10-106 and a 0.8 m thick layer of silty sand fill was encountered in borehole 10-107A. 'N' values of 52 and 17 blows/0.3 m were obtained in the crushed rock and silty sand fill, respectively. Auger refusal was met at the base of the fill.

Peat and Topsoil

A 0.6 to 1.9 m thick layer of peat was encountered surficially in boreholes 10-108 to 10-110. SPT 'N' values of 5 to 9 blows/0.3 m recorded in the peat are believed to reflect a frozen condition. Moisture contents of 77 to 610% were recorded.

A 0.8 m thick layer of topsoil was encountered in borehole 10-112. An 'N' value of 3 blows/0.3 m and moisture content of 143% were obtained in the topsoil layer.

Sands and Silts

A deposit typically grading from sand with some gravel and silt, to silt with trace sand was encountered at the ground surface or below the peat in all other boreholes except boreholes 10-106 to 10-107A. Zones of this deposit also graded to gravely sand or sand and gravel locally in boreholes 10-108 to 10-110. Auger refusal was met in or below the sand/silt deposit at depths of 2.2 to 15.9 m.

The sand and silt was generally described as brown to dark brown in the upper part of the boreholes and becoming grey with depth.

The results of laboratory grain size distribution tests carried out on samples of the sands and silts are presented in Figures D1 to D4, Appendix D. The results were as follows:

	<u>Sand to Silty Sand</u>	<u>Sand and Silt</u>	<u>Silt to Sandy Silt</u>
Gravel (%)	0 to 29	0	0 to 2
Sand (%)	53 to 90	58	2 to 34
Silt (%)			60 to 93
Clay (%)	10 to 27	42	6 to 11

SPT 'N' values obtained in the sands and silts ranged from 4 to 76 blows/0.3 m, typically from 10 to 41 blows/0.3 m. These values indicate that the sands and silts are typically compact to dense with zones of loose and very dense material. Several values of 100 blows for less than 0.3 m were recorded at the base of three boreholes, believed to reflect the presence of probable bedrock or boulders.

The moisture content of samples from this deposit ranged from 5 to 69%. Three samples indicating a moisture content of 35 to 69% were obtained immediately below the upper boundary of this deposit and probably reflect an organic component. The moisture contents typically ranged from about 8 to 20%.

Refusal

Refusal to further penetration by the augers was met on probable bedrock or boulders in all boreholes at depths of 0.7 to 15.9 m. Borehole 10-107 was located on a bedrock outcrop.

Groundwater

The depths to groundwater observed in the boreholes upon completion of drilling and subsequently measured in the piezometers are shown in Table 5.3.

Table 5.3 – Groundwater Depths

Borehole	Date	Depth to Water (m)	Event
10-108	08-Jan-10	0.8	Upon completion
10-109	31-Jan-10	1.0	In piezometer
	01-Mar-10	1.1	
10-110	07-Jan-10	2.3	Upon completion
10-111	07-Jan-10	6.3	Upon completion
10-112	31-Jan-10	1.5	In piezometer
10-113	06-Jan-10	7.8	Upon completion

The above water levels reflect the conditions in the boreholes upon completion of drilling or the piezometric head at the level of the piezometer tips at the time of the readings. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

5.4 Copenhagen Road, Station 9+540 to 9+955 (Appendix E)

General

In general, the site stratigraphy consists of a surficial topsoil layer or 0.3 to 1.2 m of peaty organics underlain by a discontinuous layer of clayey silt to silty clay, overlying silty sand till. Auger refusal was met on probable bedrock or boulders at depths of 0.5 to 5.4 m.

Fill

Road embankment fill was encountered in borehole 09-64 drilled on existing Copenhagen Road at the north limit of the investigation. The fill consisted of gravely sand to 1.1 m depth, and clayey silt from 1.1 to 1.6 m depth. An SPT 'N' value of 7 blows/0.3 m indicates that the clayey silt fill is firm.

The results of a laboratory grain size distribution analysis carried out on a sample of the gravely sand fill are shown in Figure E1 in Appendix E. Measured moisture contents were 4% and 9% in the sand fill and 50% in the clayey silt fill.

Peat and Topsoil

A 0.3 to 2.0 m thick layer of peaty organics was encountered in all boreholes excluding four boreholes near the centre of the study area (Nos. 09-52 to 09-55 at Sta. 9+750 to 9+825), and one borehole near the north end (No.09-62A). In borehole 09-64 at the north end, the peat was buried below road fill, between 1.6 and 2.2 m depth. Moisture contents in the peat varied from 63 to 323%.

A 50 to 200 mm thick layer of topsoil was encountered in the boreholes where peat was not identified.

Clayey Silt to Silty Clay

In all but three boreholes where peat was encountered, the peat was underlain by a deposit of clayey silt to silty clay. This cohesive layer was typically 0.4 to 1.5 m thick, with a lower boundary at depths of 1.4 to 3.1 m. A 0.2 m thick layer of loose, grey sand was encountered between the peat and clay in borehole 09-64. The colour of the silt/clay was described as dark brown, brown or grey.

In two boreholes (Nos. 09-57 and 10-63B), the silt deposit was non- to slightly plastic and thicker than in the other boreholes. In these boreholes, the total thickness of the silt and silty clay was 3.0 and 2.9 m, and the lower boundary was at depths of 3.8 and 4.9 m.

The results of a laboratory grain size distribution tests carried out on samples of the silt/clay are illustrated in Figure E2, Appendix E. The results of Atterberg Limits testing are presented in Figure E6. The results were as follows:

Gravel (%)	0 to 5
Sand (%)	1 to 19
Silt (%)	57 to 88
Clay (%)	11 to 22
Liquid Limit	27 to 33
Plastic Limit	18 to 20

The above results indicate that the clayey silt to silty clay is of low plasticity with a group symbol of CL.

The silt/clay is very soft to firm, with SPT 'N' values of 1 to 8 blows/0.3 m, typically 1 to 5 blows/0.3 m. Below 1.4 m depth in borehole 09-57, the silt is stiff with 'N' values of 9 to 11 blows/0.9 m. The silt in borehole 10-63B is loose to compact with 'N' values of 16 and 8 blows/0.3 m.

The moisture content of samples from this deposit ranged from about 15 to 49%.

Auger refusal was encountered in/below the silt/clay at depths of 1.4 and 3.1 m in boreholes 09-51 and 09-64, respectively.

Silty Sand Till

A glacial till deposit consisting of silty sand, grading locally to sand and silt or clayey silt and sand, was encountered below the peat, topsoil, clayey silt and silty clay layers in all boreholes except 09-51 and 09-64. The upper boundary of this deposit was at depths of 0.1 to 4.9 m. The till is typically brown, locally grey and dark brown, and contains gravel, cobbles and boulders.

Auger refusal was met in/below the till in all but two boreholes (09-57 and 09-59) where the till was encountered, at depths of 0.7 to 3.8 m. The till thickness penetrated by the boreholes prior to refusal ranged from 0.3 to 2.4 m. Boreholes 09-57 and 09-59 were terminated in the till at depths of 4.8 and 5.6 m, indicating layer thicknesses of at least 1.0 and 3.4 m.

The results of laboratory grain size distribution tests carried out on samples of the till are illustrated in Figures E3 to E5, Appendix E. The results are summarized below. An additional sample indicating a gravel content of 39% (borehole 09-59) is omitted from the summary.

Gravel (%)	1 to 13
Sand (%)	34 to 59
Silt (%)	23 to 48
Clay (%)	4 to 14

SPT 'N' values obtained in the till varied from 4 to 66 blows/0.3 m, indicating a loose to very dense condition. 'N' values of 50 or 100 blows for less than 0.3 m of penetration were obtained at the base of many boreholes where sampling commenced immediately above the refusal depths.

The moisture content of samples from this deposit ranged from about 8 to 19%, with one sample indicating 31%.

Refusal

Refusal to further penetration by the augers or DCPT was met on probable bedrock or boulders in all boreholes except boreholes 09-57 and 09-59. The depth to refusal ranged from 0.5 to 5.4 m.

Groundwater

The depths to groundwater observed in the boreholes upon completion of drilling and subsequently measured in the piezometers are shown in Table 5.4.

Table 5.4 – Groundwater Depths

Borehole	Date	Depth to Water (m)	Event
09-49	23-Nov-09	0.6	In piezometer
09-57	11-Jul-09	0.9 ags*	Upon completion
09-58	13-Jul-09	0.6	Upon completion
09-59	23-Nov-09	1.4	In piezometer
	01-Mar-10	1.2	In piezometer
09-61	13-Jul-09	2.2	Upon completion
09-62A	13-Jul-09	0.8	Upon completion
10-62C	31-Jan-10	1.4	Upon completion
09-63	13-Jul-09	1.4	Upon completion
10-63B	31-Jan-10	0.7	Upon completion

* above ground surface (artesian)

The above water levels reflect the conditions in the boreholes upon completion of drilling or the piezometric head at the level of the piezometer tips at the time of the readings. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

5.5 Hodder Avenue E-N/S Ramp, Station 10+540 to 10+780 (Appendix F)

General

In general, the site stratigraphy consists of surficial fill, peaty organics and/or topsoil to depths of up to 2.2 m, underlain by a discontinuous layer of clayey silt to silty clay, overlying silty sand to sandy silt till. Auger refusal was met on probable bedrock or boulders at depths of 0.2 to 5.1 m.

Fill

Fill was encountered surficially in 12 boreholes drilled between Station 10+580 and 10+755. The fill consisted primarily of sand and locally silty clay, clayey silt, and sand and silt. The fill contains gravel, cobbles, rock fragments and asphalt pieces. The surficial 75 to 300 mm of fill in the majority of the boreholes contained organics and was described as topsoil. The fill thickness at the borehole locations ranged from 0.3 to 1.4 m.

SPT 'N' values of 6 blows/0.3 m were obtained in the fill at two locations, indicating a loose condition. 'N' values of 51 to 70 blows/0.3 m obtained in three boreholes are believed to reflect the presence of cobbles and asphalt chunks in the fill. 'N' values of 100 blows for less than 0.3 m of penetration were obtained at the base of two boreholes where sampling commenced immediately above the refusal depths.

The moisture content of fill samples ranged from 3 to 22%.

Peat and Topsoil

A 0.1 to 1.6 m thick layer of peaty organics was encountered surficially or below the fill in 12 boreholes. The lower boundary of the organic layer was encountered at depths of 0.8 to 2.2 m. SPT 'N' values of 1 to 6 blows/0.3 m and moisture contents of 100 to 314% (44% in one sample) were recorded in the peat.

In addition to the organic layer encountered at the ground surface in fill areas, a 50 to 200 mm thick layer of topsoil was documented in seven other boreholes where fill and/or peat were not encountered.

Clayey Silt to Silty Clay

In eight boreholes, the fill, peat or topsoil were underlain by a layer of clayey silt to silty clay. This cohesive layer was 0.3 to 1.6 m thick, with a lower boundary at depths of 1.0 to 3.0 m. Auger refusal was encountered in/below the silt/clay in five of these boreholes. The colour of the silt/clay was described as dark brown, brown or grey.

The results of laboratory grain size distribution tests carried out on two samples of the clayey silt to silty clay are presented in Figure F1, Appendix F. The results were as follows:

Gravel (%)	0 to 1
Sand (%)	21 to 26
Silt (%)	53 to 60
Clay (%)	18 to 20

The silt/clay is very soft to stiff, with SPT 'N' values of 2 to 9 blows/0.3 m recorded.

The moisture content of samples from this deposit ranged from 20 to 36%.

Sand, Sand and Silt

A 0.6 m thick sand layer was encountered below the peaty organics in borehole 09-38. An 'N' value of 20 blows/0.3 m (compact) and moisture content of 28% were obtained in the sand.

A sand and silt deposit was encountered below the topsoil in borehole 09-46. Auger refusal was met at 1.4 m depth in this borehole, indicating a layer thickness of 1.3 m. An 'N' value of 10 blows/0.3 m (compact) and moisture content of 17% were obtained. The results of a laboratory grain size distribution tests carried out on a sample of the sand and are presented in Figure F2, Appendix F.

Silty Sand to Sandy Silt Till

A glacial till deposit consisting of silty sand to sandy silt was encountered below the topsoil and other layers in 12 of 22 boreholes drilled in this section. The till is typically brown, locally grey and dark brown, and contains gravel, cobbles and boulders.

Auger refusal was met in/below the till in all boreholes where the till was encountered, at depths of 0.8 to 5.1 m. The till thickness penetrated by the boreholes prior to refusal ranged from 0.4 to 2.6 m.

The results of laboratory grain size distribution tests carried out on samples of the till are illustrated in Figures F3 and F4, Appendix F. The results are summarized below.

Gravel (%)	2 to 21
Sand (%)	42 to 58
Silt (%)	22 to 45
Clay (%)	4 to 10

SPT 'N' values obtained in the till varied from 4 blows/0.3 m to 100 blows/0.025 m, indicating a loose to very dense condition. The 'N' values typically increase with depth.

The moisture content of samples from this deposit ranged from 6 to 31%, typically 10 to 22%.

Refusal

Refusal to further penetration by the augers or DCPT was met on probable bedrock or boulders in all boreholes at depths of 0.2 to 5.1 m.

Groundwater

The depths to groundwater observed in the boreholes upon completion of drilling and subsequently measured in the piezometers are shown in Table 5.5.

Table 5.5 – Groundwater Depths

Borehole	Date	Depth to Water (m)	Event
09-28	08-Jul-09	0.7	Upon completion
09-29	08-Jul-09	0.4	Upon completion
09-30	23-Nov-09	1.7	In piezometer
09-33	08-Jul-09	1.7	Upon completion
09-36	07-Jul-09	0.9	Upon completion
09-38	07-Jul-09	2.1	Upon completion
09-40	23-Nov-09	1.8	In piezometer
	01-Mar-10	1.9	In piezometer
09-41	07-Jul-09	0.3	Upon completion

The above water levels reflect the conditions in the boreholes upon completion of drilling or the piezometric head at the level of the piezometer tips at the time of the readings. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

5.6 Hodder Avenue S-E Ramp, Station 10+000 to 10+650 (Appendix G)

General

In general, the site stratigraphy consists of surficial topsoil layer overlying silty sand till. Auger refusal was met on probable bedrock or boulders at depths of 1.4 to 5.5 m.

Topsoil

A 100 to 200 mm thick layer of topsoil was encountered surficially in boreholes 09-06 to 09-16 drilled along the ramp centreline.

Silty Sand Till

A glacial till deposit consisting of silty sand, grading locally to sand and silt or sandy clayey silt, was encountered below the topsoil in all boreholes drilled in this section. The till is typically brown, locally grey and dark brown, and contains gravel, cobbles and boulders.

Auger refusal was met in/below the till in all boreholes at depths of 1.4 to 5.5 m. The till thickness penetrated by the boreholes prior to refusal ranged from 1.2 to 5.5 m.

The results of laboratory grain size distribution tests carried out on samples of the till are presented in Figures G1 to G3, Appendix G. The results are summarized below.

Gravel (%)	1 to 16
Sand (%)	26 to 58
Silt (%)	25 to 57
Clay (%)	4 to 16

The results of Atterberg limits testing conducted on a sample of the till grading to clayey silt are plotted on Figure G4, Appendix G. A liquid limit of 31 and plastic limit of 19 classifies this material as low plastic.

SPT 'N' values obtained in the till varied significantly from 7 blows/0.3 m to 100 blows/0.05 m, indicating a loose to very dense condition, locally firm to very stiff. The 'N' values typically increase with depth.

The moisture content of samples from this deposit ranged from 3 to 31%, typically 8 to 15%.

Sand and Gravel

Auger refusal was encountered at depths of 2.9 and 3.3 m in boreholes 10-70 and 10-72, and the boreholes were continued using coring equipment. Observation of the wash water during coring and examination of the limited core recovery indicates that the coring extended through very dense silty sand and gravel with cobbles and boulders. The lower

boundary of the sand and gravel was encountered at depths of 5.8 and 8.5 m, indicating a thickness of 2.9 and 5.2 m in boreholes 10-70 and 10-72, respectively.

Refusal

Refusal to further penetration by the augers was met on probable bedrock or boulders in all boreholes. The depth to refusal ranged from 1.4 to 5.5 m. As noted above, two boreholes were advanced below the refusal depth and encountered sand and gravel above the bedrock surface, encountered at 5.8 and 8.5 m depth.

Boreholes 10-70 and 10-72 were extended 2.7 and 3.1 m into the underlying bedrock. The bedrock recovered in the cores was described as calcareous grainstone of the Gunflint Formation. Core recovery was between 72 and 100%, and RQD values ranged from 32 to 100%, indicating poor to excellent rock quality. The unconfined compressive strength of the rock, estimated from the results of point load tests, ranges between 84 and 185 MPa, indicating a strong to very strong intact rock.

Groundwater

Groundwater was not observed in the boreholes during or upon completion of drilling. The depths to groundwater subsequently measured in the piezometers are shown in Table 5.6.

Table 5.6 – Groundwater Depths

Borehole	Date	Depth to Water (m)	Event
09-12	23-Nov-09	Dry	In piezometer
09-16	23-Nov-09	Dry	In piezometer
10-70	01-Mar-10	4.3	In piezometer
10-72	01-Mar-10	6.3	In piezometer

The above water levels reflect the conditions in the boreholes upon completion of drilling or the piezometric head at the level of the piezometer tips at the time of the readings. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

5.7 Hodder Avenue N-E Ramp, Station 10+050 to 10+200 (Appendix H)

General

In general, the site is underlain by a discontinuous topsoil, fill and/or sand/silt layers overlying glacial till consisting of silty sand to silt and sand. Sand and gravel as well as bedrock were encountered below the till.

Fill

Silty sand fill was encountered in borehole 09-20 drilled adjacent to Highway 11/17. The fill was 1.4 m thick. An SPT 'N' value of 10 blows/0.3 m was obtained in the fill,

indicating a loose to compact condition. The moisture content ranged from 4 to 8%. The results of a grain size analysis conducted on the fill are shown in Figure H1, Appendix H

Silty Clay to Clayey Silt Till

A 0.6 and 1.4 m thick stratum of cohesive till was encountered surficially in boreholes 09-17 and 09-19. The till consisted of silty clay to clayey silt, sandy, trace gravel.

An 'N' value of 14 blows/0.3 m was recorded in the clayey silt till, indicating a stiff consistency. Moisture contents ranged from 18 to 27%.

The results of laboratory grain size distribution tests carried out on two samples of the cohesive till are presented in Figure H2, Appendix H. Atterberg Limits test results from one of the samples are plotted on Figure H4. The results are summarized below.

Gravel (%)	4 to 5
Sand (%)	32 to 38
Silt (%)	38 to 49
Clay (%)	15 to 20
Liquid Limit	33
Plastic Limit	21

The above results show that the silty clay till is of low plasticity with a group symbol of CL.

Sand

A 0.5 m thick layer of sand was encountered below the clay till in borehole 09-17. An 'N' value of 100 blows/0.05 m was recorded, indicating a very dense condition. A moisture content of 4% was determined in the sand.

Silty Sand to Sand and Silt Till

A glacial till deposit grading from silty sand to sand and silt was encountered surficially or below the fill and clay/silt till in boreholes 09-18 to 09-20. The till is brown and contains trace to some gravel and frequent cobbles and boulders.

Auger refusal was met in the till at depths of 2.0 and 1.9 m in boreholes 09-19 and 09-20. These boreholes were advanced by coring a further 2.9 and 0.8 m in the till prior to encountering bedrock at depths of 4.9 and 2.7 m. In borehole 09-18, the till was underlain by bedrock at 1.5 m depth. The total thickness of the sand/silt till ranged from 1.3 to 3.5 m.

The results of laboratory grain size distribution tests carried out on a sample of the silty sand till are presented in Figure H3, Appendix H. The results are summarized below.

Gravel (%)	4
Sand (%)	53
Silt (%)	33
Clay (%)	10

Prior to encountering refusal, SPT 'N' values of 17 blows/0.3 m (compact), 104 blows/0.3 m (very dense) and 100 blows/0.2 m (very dense) were recorded in the till.

The moisture content of samples from this deposit ranged from 11 to 29%.

Bedrock

Bedrock was encountered and proved by coring in all boreholes. The depth to bedrock ranged from 1.1 to 4.9 m.

A 1.4 to 1.6 m length of rock core was recovered from the boreholes. The bedrock recovered in the cores was described as chert carbonate of the Gunflint Formation. The bedrock is thinly bedded and fresh to moderately weathered. The colour is charcoal grey.

Core recovery in the bedrock was between 67 and 100%. RQD values varied from 10 to 93% indicating very poor to excellent rock quality.

Unconfined compressive strength values estimated from the results of point load tests conducted on the core samples ranged from 158 to 305 MPa, indicating a very strong to extremely strong intact rock. The point load test results are included on the borehole logs in Appendix H.

Groundwater

Groundwater was not observed in the boreholes during drilling. Water was introduced into all boreholes as part of the coring operation and therefore water levels were not recorded upon completion.

The groundwater level measured in the piezometer in borehole 09-20 on November 23, 2009 was at 2.2 m below the ground surface.

The measured water level reflects the piezometric head at the level of the piezometer tip at the time of the reading. The measurement is a short-term observation and seasonal fluctuations of the groundwater level are to be expected.

5.8 Hodder Avenue W-N/S Ramp, Station 10+060 to 10+260 (Appendix I)

General

In general, the site is underlain by discontinuous topsoil, fill and/or sand/silt layers overlying glacial till consisting of silty sand to silt and sand. Sand and gravel as well as bedrock were encountered below the till.

Fill

Fill was encountered in boreholes 10-86 and 10-90. The fill consisted of clayey silt, silt, and sandy silt with trace to some gravel and organics. The fill was described as brown in borehole 10-86 and brown to black in borehole 10-90. The fill was 2.1 and 1.8 m thick in boreholes 10-86 and 10-90, respectively.

SPT 'N' values of 3 to 11 blows/0.3 m obtained in the fill indicate a firm or very loose to compact condition. The moisture content ranged from 12 to 22% in borehole 10-86, and was 43% in borehole 10-90.

Topsoil

A 1.1 and 0.2 m thick layer of topsoil was encountered surficially in boreholes 09-01 and 09-88, respectively.

Sand to Sandy Silt

A relatively thin layer of sand to sandy silt was encountered below the topsoil in boreholes 09-01 and 09-88, and surficially in boreholes 09-02, 10-87 and 10-89. The sand/silt layer was 0.3 to 1.4 m thick with a lower boundary at elevation 258.9 to 263.0 m.

'N' values of 8 to 21 blows/0.3 m were recorded in the sand/silt, indicating a loose to compact condition. Moisture contents ranged from 9 to 22%.

Silty Sand to Silt and Sand Till

A glacial till deposit grading from silty sand to silt and sand was encountered surficially or below the fill and topsoil in all boreholes drilled in this section. The till is brown and contains trace to some gravel and frequent cobbles and boulders.

Auger refusal was met in or below the till in all boreholes at depths of 2.7 to 5.9 m. Refusal at these depths was encountered on bedrock in three of the boreholes and on very dense sand and gravel in three boreholes. Boreholes 09-02, 09-03 and 09-86 were cored 1.4 to 3.2 m in sand/silt till prior to encountering bedrock or sand and gravel, and borehole 09-01 was cored from 5.3 to 9.3 m depth without encountering either. Where penetrated, the lower boundary of the sand/silt till deposit was encountered at depths of 2.7 to 7.6 m (elevation 249.6 to 263.8 m, rising to the east), indicating a till thickness of 1.3 to 7.6 m.

The results of laboratory grain size distribution tests carried out on samples of the till are presented in Figures I1 to I3, Appendix I. The results for all but one sample are summarized below. A piece of gravel was included in the sample tested from borehole 10-85, resulting in a higher gravel content of 39%.

Gravel (%)	2 to 15
Sand (%)	30 to 57
Silt (%)	26 to 52
Clay (%)	5 to 15

The till is typically dense to very dense with SPT 'N' values ranging from 34 blows/0.3 m to 100 blows/0.125 m. The upper 0.8 to 3.0 m of this unit was loose to compact in six boreholes, with 'N' values ranging from 16 to 29 blows/0.3 m and locally 5 to 9 blows/0.3 m in the upper 0.8 to 1.5 m of boreholes 09-03 and 09-04.

The moisture content of samples from this deposit ranged from 7 to 30%, typically 9 to 19%.

Sand and Gravel

Auger refusal was encountered at depths of 2.7 to 5.8 m in boreholes 10-85, 10-87 and 10-90, and the boreholes were continued using coring equipment. NW casing and coring equipment with SPT sampling were used to advance borehole 09-88 below the refusal depth. Observation of the wash water return and examination of the limited recovery indicates that very dense silty sand and gravel with cobbles was encountered below 7.0 m depth in borehole 09-88 and below the refusal depths in the remaining boreholes.

Borehole 09-88 was terminated in the sand and gravel at 15.4 m depth (elevation 246.7 m). The lower boundary of the sand and gravel in the remaining boreholes was encountered at depths of 6.9 to 14.1 m, indicating a thickness of 4.2 to 8.8 m.

The results of laboratory grain size distribution tests carried out on samples of the sand and gravel are presented in Figure I4, Appendix I. The results are summarized below.

Gravel (%)	45 to 58
Sand (%)	37 to 51
Silt & Clay (%)	4 to 5

Bedrock

Bedrock was encountered and proved by coring in all boreholes except boreholes 09-01 and 09-88. The depth to bedrock ranged from 2.9 to 14.1 m, typically shallower to the east. The bedrock surface ranged from elevation 243.6 m in borehole 10-85 to elevation 263.8 m in borehole 09-04.

A 3.1 to 4.4 m length of rock core was recovered from the boreholes encountering rock. The bedrock recovered in the cores consisted of a complex interbedding of various rock types considered to be part of the Gunflint Formation. The rock was described as chert carbonate, calcareous siltstone and wackestone. Shale laminations, calcite veining, and iron-stained fractures were also noted.

The bedrock is typically described as thinly bedded and fresh to slightly weathered. The colour is dark/charcoal grey to light grey.

Core recovery in the bedrock was between 79 and 100%. RQD values typically ranged from 80 to 100% indicating good to excellent rock quality. Lower RQD values of 50 to 60% (fair quality rock) were obtained in five core runs, and RQD values of 0 and 15% (very poor quality) were recorded in the first two runs in borehole 10-89.

The unconfined compressive strength of the rock is highly variable depending upon the actual bedding layer of rock tested. Strength values estimated from the results of point load tests conducted on the core samples ranged from 31 to 337 MPa, indicating a medium strong to extremely strong intact rock. The point load test results are included on the borehole logs in Appendix I.

Groundwater

The groundwater depths and elevations observed in the boreholes upon completion of drilling and subsequently measured in the piezometers are shown in Table 5.7.

Table 5.7 – Groundwater Depths and Elevations

Borehole	Date	Measured Water Level		Event
		Depth(m)	Elevation (m)	
09-02	23-Nov-09	9.2	254.5	In piezometer
	01-Mar-10	9.4	254.3	In piezometer
09-03	23-Nov-09	10.4	252.7	In piezometer
09-04	23-Nov-09	6.0	261.4	In piezometer
	01-Mar-10	6.8	260.6	In piezometer
09-88	17-Dec-09	8.0	254.1	Upon completion

Where rock coring was carried out, water was introduced into the boreholes as part of the coring operation and therefore water levels were not recorded upon completion of these boreholes.

The above water levels reflect the conditions in the boreholes upon completion of drilling or the piezometric head at the level of the piezometer tips at the time of the readings. The measurements are short-term observations and seasonal fluctuations of the groundwater level are to be expected.

6 MISCELLANEOUS

J.D. Barnes Limited staked the centreline alignment prior to drilling of the boreholes. The borehole locations were established by measuring offset distances from the centreline staking.

TBT Engineering Consulting Group of Thunder Bay, Ontario supplied and operated the drilling and sampling equipment for the field program. Full time supervision of the field activities, including obtaining utility clearances, was carried out by Mr. Stephane Loranger of Thurber.

Supervision of the field program, interpretation of the field data, and preparation of the report was performed by Mr. Tony Harte and Mr. Murray Anderson, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

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Review Principal



**FOUNDATION INVESTIGATION AND DESIGN REPORT
HIGH FILL EMBANKMENTS, DEEP CUTS AND SWAMP CROSSINGS
HIGHWAY 11/17 FOUR-LANING FROM 1.0 KM WEST OF
HODDER AVENUE/COPENHAGEN ROAD EASTERLY FOR 5.8 KM
W.P. 334-94-00**

Geocres Number: 52A-146

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 INTRODUCTION

This report presents interpretation of the geotechnical data in the factual report and presents foundation design recommendations for high fill embankments, deep cuts and swamp crossings required for widening of Highway 11/17 in Thunder Bay, Ontario.

The proposed works to widen Highway 11/17 include twinning of the existing highway, construction of a new interchange at Hodder Avenue/Copenhagen Road, and realignment of Copenhagen Road north of Highway 11/17.

Eight sections of high fill, deep cut or swamp crossing are addressed in this report. A summary of the sections, including locations, lengths, maximum fill height and cut depths, generalized stratigraphy and groundwater conditions, is presented on Table A3 in Appendix A. The factual data for each section has been assigned to an appendix, Appendix B through I, and the respective appendix designation is included in Table A3.

The project information used for preparation of this report, including plans and profiles of the proposed alignments as of December 2009, were provided by McCormick Rankin Corporation (MRC).

The discussion and recommendations presented in this report are based on the information provided by MRC and the factual data obtained during the course of the investigation. Factual data obtained during previous investigations is also referenced where appropriate.

8 ENGINEERING ANALYSIS METHODOLOGY

8.1 General

The subsurface conditions at the high fill, deep cut and swamp crossing locations were investigated to assess the stability of the fill and cut slopes, potential embankment settlement issues, and construction concerns. Major factors governing embankment and cut design on this project include:

- Embankment geometry (height, slope angle, berms);
- Embankment material type (earth fill, rockfill, SSM);
- Extent and thickness of organic, compressible and/or excessively loose soils within the embankment footprint;
- Thickness and engineering properties of the foundation soils;
- The elevations and properties of bedrock;
- Groundwater conditions and permanent drainage;
- Stability of temporary and permanent slopes;
- Post-construction settlement of embankments.

The geotechnical analyses summarized in this report include assessment of the global stability of the embankment and cut slope geometries and material types for both short and long term conditions. Assessment of immediate and long-term settlements, including magnitude and time rate, was also carried out for the embankments. The analyses were based on the soil profiles and properties encountered at various locations, selected for less favourable conditions.

For the purpose of preparing geotechnical design recommendations, a number of assumptions have been made that are consistent with MTO's standard highway design practices:

- The high fills will be constructed using select subgrade material (SSM), granular fill or rock fill.
- High fills will be constructed with side slopes not exceeding 2H:1V for earth and granular fill, and 1.25H:1V for rock fill.
- Embankment slopes greater than 8 m high in earth fill and 10 m high in rock fill will be provided with a 2 m wide mid-height berm.
- Deep cuts will be constructed with side slopes not exceeding 2H:1V in earth, and 0.25H:1V in rock cuts over 10 m in height.
- Earth cut slopes greater than 6 m high will be provided with a 2 m wide mid-height berm.
- Organic deposits, topsoil, peat or other deleterious material will be removed prior to constructing fill embankments.
- Drainage will be provided along the highway that will also serve to drain the cut.

8.2 Stability and Settlement Analyses

Where the planned fill height or cut depth exceeds 4.5 m and the foundation does not consist of bedrock, stability analyses were carried out. The commercially available slope stability program GSLOPE developed by Mitre Software Inc. with the option for Bishop's modified method of slices was used for the limit equilibrium analyses.

Based on consideration of the risk involved and past experience with highway embankment design/monitoring, a factor of safety of 1.3 is considered appropriate to achieve both short and long-term stability for embankments founded on cohesionless soils. For cohesive foundation soils, the recommended factor of safety is 1.3 for short-term conditions and 1.5 for long-term conditions.

Immediate settlements due to compression of the embankment foundation soils have been estimated based on the methods described in CHBDC Commentary Section C6.6.

Cohesive soils are present at only two of the sites investigated (Copenhagen Road and the E-N/S Ramp) and comprise a discontinuous layer of less than 1.6 m in thickness at these locations. These soils underlie peat deposits and are typically soft to firm. It is recommended that the soft cohesive layer be subexcavated prior to embankment construction as part of the peat and soft soil removal operations. Therefore long-term consolidation settlement of the foundation soils will not be an issue on this project.

The effects of compression of the fill materials used to construct the embankments were also taken into consideration following the latest Northwestern Region guidelines.

8.3 Design Alternatives

Design alternatives considered during analysis of the embankments would typically include the following:

- Sub-excavation of the peat and organic soils;
- Provision of berms and flattening of slopes to improve global stability;
- Ground improvement techniques such as preloading/surcharging and geosynthetic reinforcement;
- Construction techniques such as wick drain installation or staged construction;
- Use of lightweight fill.

The analyses carried out for this project have indicated that, with the exception of peat and soft soil sub-excavation, measures to address stability or settlement issues will not be required.

8.4 Seismic Considerations

The following seismic parameters have been considered in design:

Velocity Related Seismic Zone	0
Zonal Velocity Ratio	0.0
Acceleration Related Seismic Zone	0
Zonal Acceleration Ratio	0.0

The soil profile type at all sites has been classified as Type I. Therefore, according to Table 4.4.6.1 of the CHBDC, a Site Coefficient “S” (ground motion amplification factor) of 1.0 should be used in seismic design.

A peak horizontal acceleration (PHA) at the ground surface of 0.02 g, where g is the acceleration due to gravity, has been used. The PHA values correspond to a probability of exceedance of 10% in 50 years. The foundation soils at the site are assessed as not being prone to liquefaction.

9 EMBANKMENT DESIGN AND CONSTRUCTION (INCLUDING SWAMPS)

9.1 General

The generalized subsurface conditions and embankment heights for the various alignments are summarized on Table A3 of Appendix A. The groundwater level was near the ground surface in most sections of proposed fill.

9.2 Peat/Topsoil Removal and Swamp Treatment

It is standard procedure on MTO projects to sub-excavate all peat deposits not exceeding 6 m in depth from within the footprint of the embankment, and backfill the resulting excavation with rock or granular fill. Where firm mineral soils are encountered at depths of less than 6.0m, full peat removal is an economical and efficient method of improving stability during construction and minimizing the potential for large post-construction settlements.

Within the high fill areas addressed in this report, the depth of peat and organic soils including any overlying fill is less than 2.6 m. It is therefore recommended that all peat and organic soils should be sub-excavated from within the proposed fill footprint. In some locations, a relatively thin layer of soft clayey silt to silty clay underlies the peat, and this layer should be removed as well.

The anticipated depth of sub-excavation for peat, topsoil and soft silt/clay removal along the proposed alignments is included in Table 9.1. The depth of stripping is based on the thickness of organics and soft material noted at the borehole locations. Stripping depths may vary at locations between and away from the boreholes.

Table 9.1 - Recommended Depth of Peat and Soft Soil Subexcavation

Appendix	Alignment	Stations	Maximum Embankment Height (m)	Depth of Peat, Topsoil and Soft Silt/Clay (m)	
				Range	Average
B	Hwy 11/17 EBL, Toe of Embankment	26+200 to 27+100	20.0	0.1 to 1.5	0.6
C	Hwy 11/17 EBL, Toe of Embankment	29+400 to 29+620	8.5	2.3	2.3
		29+730 to 29+950	7.5	1.5 to 2.6	2.1
D	Hwy 11/17 WBL	29+460 to 29+560	7.0	0.6 to 1.9	1.1
E	Copenhagen Road (swamp crossing)	9+540 to 9+730	2.9	0.2 to 2.2	1.7
		9+730 to 9+830	2.6	0.1 to 0.6	0.3
		9+830 to 9+955	3.5	1.4 to 2.2	1.8
F	Hodder Avenue, E-N/S Ramp (swamp crossing)	10+540 to 10+780	2.5	0.1 to 2.6	1.4

The foundation area should be backfilled with rock or granular material as described later in this report. Placement of rock fill is recommended where standing water is encountered.

In the stability and settlement analyses, it has been assumed that the soft and organic deposits have been removed and replaced with rock or granular material as appropriate.

9.3 Stability Analysis

Analyses were carried out for both earth fill and rock fill embankments, under static and seismic loading conditions. The soils on this project are essentially cohesionless, and therefore short-term (undrained) and long-term (effective stress) conditions will be alike. Embankment slope inclinations of 2H:1V for earth /granular fill and 1.25H:1V for rock fill were assumed. Mid-height berms of 2 m width were applied to all slope heights exceeding 8 m in earth fill and 10 m in rock fill.

Results of the stability analyses carried out at selected critical locations are summarized in Table 9.2. The results indicate that the Factor of Safety (FS) for all embankment geometries analysed will be greater than 1.3 for static conditions and greater than 1.0 for seismic conditions. Therefore stabilizing berms, slope flattening and geosynthetic reinforcement are not required.

The input parameters and soil model used in the stability analyses, including soil stratigraphy, engineering properties, groundwater conditions, and embankment geometry, are shown for sample analyses on Figures A1 to A6 in Appendix A.

Table 9.2 - Results of Stability Analyses - Embankments

Appendix	Alignment	Analysis Profile Location (Sta.)	Embankment Height (m)	Factor of Safety Short and Long-Term Conditions			
				Earth Fill		Rock Fill	
				Static	Seismic	Static	Seismic
B	Hwy 11/17 EBL	26+650	13.0	1.40	1.32	1.33	1.27
C	Hwy 11/17 EBL	29+500	8.5	1.62	1.53	1.47	1.40
D	Hwy 11/17 WBL	29+500	5.5	1.65	1.57	1.82	1.73
E	Copenhagen Road	-	< 3.5	Low fill - not analysed			
F	Hodder Avenue E-N/S Ramp	-	< 2.5	Low fill - not analysed			

9.4 Settlement Analysis

Foundation Settlement

Settlement analysis involved computation of the immediate settlement of the foundation soils under the imposed embankment loading using elastic theory. The foundation soils at the site, following stripping of the peat and soft clayey soils, are considered cohesionless, and therefore long-term consolidation of the foundation soils is not an issue.

The results of the settlement analyses and engineering properties of the soils used in the analyses are summarized in Table A4 of Appendix A. The estimated elastic settlement at all embankment locations is less than 50 mm, and is expected to occur essentially during embankment construction.

Embankment Compression

The estimated settlement of earth or granular fill embankments due to compression of the compacted earth fill is 0.5% of the embankment height and is expected to be completed within one to two years after construction.

Settlement of rockfill due to particle re-orientation and degradation of the interparticle contacts is expected to continue at a decreasing rate for many years. In accordance with the MTO document "Post-Construction Rock Fill Settlement and Guidelines for Estimating Rock Fill Quantity" (April 12, 2010), the magnitude of this settlement in compacted rock fill is expected to range from 0.5 to 1.0% of the embankment height within 1 year of embankment construction (90% in the first 6 months), and a further 0.1% after the 1 year period.

The estimated settlements due to embankment compression at the maximum height of embankment in each section are included in Table A4 of Appendix A.

To mitigate the effects of the settlement, it is recommended that the embankments be constructed at least six months in advance of pavement construction. Embankment and

platform width design should allow for the anticipated foundation and embankment compression settlements.

9.5 Embankment Construction

Embankment construction should be carried out in accordance with SP 206S03. Earth fill may consist of granular materials and Select Subgrade Material (SSM) in compliance with Special Provision 110F13. Rock size should be controlled in accordance with SP 206S03.

Rock fill placed above the water table should be placed in a controlled manner (not end dumped) including blading, dozing and chinking of the rock to minimize voids and bridging. Rock fill used to backfill subexcavated areas below the water table may be placed by end dumping and SP 206S03 will not apply. Earth or granular material must not be used to backfill excavations below the water table.

At the pavement subgrade level or if earth fill is to be placed over rock fill, the rock fill subgrade must be blinded with spall material and covered by a minimum 600 mm thickness of OPSS Granular B Type II fill.

Mid-height berms comprising 2 m wide benches should be incorporated along the length of embankments with heights exceeding 8 m in earth fill and 10 m in rockfill. Where the embankment is constructed of earth fill, the bench should maintain a 2% slope to shed surface run-off.

Construction of new embankments over swamp should be carried out in accordance with OPSS 209 “Construction Specification for Embankments Over Swamps”, March 1998, with specific reference to OPSD 203.010 “Embankments Over Swamp, New Construction”.

Where new embankment fill is placed against existing embankment slopes or on a sloping ground surface, the existing earth or fill slope must be benched in accordance with OPSD 208.010.

The existing embankment fill adjacent to the south side of Highway 11/17 opposite the Terry Fox monument (Station 26+200 to 26+700) generally comprises compact to loose silty sand. The upper 2 m of this fill appears to be relatively well compacted. Considering that finished grades will not be raised significantly in this area, construction of the new eastbound lanes over the existing fill is considered feasible. Construction should include:

- Stripping of all vegetation and organic matter prior to placement of any new fill;
- Proofrolling of the existing fill subgrade to detect any soft areas which should be subexcavated and replaced with compacted granular fill;
- Stripping of all topsoil, peat and loose materials on the face of the existing slope;

- Benching of the existing fill slope prior to placement of any new fill to widen the embankment;
- Stripping of all peat and organics under the footprint of the widened embankment beyond the toe of the existing embankment;
- The existing rock fill along the toe of the embankment between approximate Station 26+610 to 26+730 should be removed and all peat and organics stripped from below this material prior to placement of new embankment fill.

Earth fill embankment slopes must be provided with erosion protection in accordance with Special Provision SP572SO1.

10 CUT SLOPE DESIGN AND CONSTRUCTION

10.1 General

The generalized subsurface conditions and cut depths for the various alignments are summarized on Table A3 of Appendix A.

10.2 Stability Analysis

Results of the stability analyses carried out at selected critical cut locations are summarized in Table 10.1. The results indicate that the Factor of Safety (FS) for all cut slopes analysed will be greater than 1.3 for slope inclinations of 2H:1V under static conditions, and greater than 1.0 for seismic conditions.

Table 10.1 - Results of Stability Analyses – Deep Cuts

Appendix	Alignment	Analysis Profile Location (Sta.)	Cut Depth (m)	Factor of Safety Short and Long-Term Conditions	
				Static	Seismic
D	Hwy 11/17 WBL	29+670	8.0	1.31	1.25
G	Hodder Avenue S-E Ramp	-	12.5	Base of cut in bedrock - not analyzed	
H	Hodder Avenue N-E Ramp	-	9.0	Base of cut in bedrock - not analyzed	
I	Hodder Avenue W-N/S Ramp	12+360	12.0	1.53	1.45

The input parameters and soil model used in the stability analyses, including soil stratigraphy, engineering properties, groundwater conditions, and slope geometry, are shown for sample analyses on Figures A7 and A8 in Appendix A.

10.3 Cut Construction

Excavation for cut slope construction should be carried out in accordance with SP 206S03.

Slope inclinations in earth cuts should not exceed 2H:1V. Mid-height berms comprising 2 m wide benches should be incorporated along the length of embankments with heights exceeding 6 m. The bench should maintain a 2% slope to shed surface run-off.

Rock cuts should be designed in conformity with the Northwestern Region Rock Cut Design Guidelines. Rock cuts over 10 m in height are to be constructed at 0.25H:1V.

Rock excavation utilizing blasting should be carried out in accordance with OPSS 120, including blast design by a qualified Engineer/firm, explosive use by a competent blasting contractor, monitoring by a blast monitoring consultant, preparation of a pre-blast survey, and notification of any nearby utility authorities.

Rock mapping should be carried out prior to blast design to determine pertinent conditions such as the locations and orientation of joints and fractures in the rock mass. After blasting, the rock cuts should be examined by a rock slope specialist to identify any areas of unstable rock requiring removal or stabilization.

Temporary drainage of the cuts should be provided to maintain a relatively dry, stable excavation. Measures may include temporary drainage ditches or gravel sheeting of earth slopes to maintain surficial stability before permanent drainage measures are in effect.

Permanent drainage of the cut must also be provided. Roadside ditches are expected to provide an adequate level of permanent drainage in most areas. An interceptor ditch should be provided at the top of the earth cut as per OPSD 200.020 and 201.020.

The earth cut at Station 29+570 to 29+900 of Highway 11/17 WBL will extend through sands and silts. Locally in borehole 10-112 (Station 29+670), the groundwater level was measured at 1.5 m depth, approximately 8 m above the anticipated cut depth. In this regard, the following are noted:

- It is recommended that the cut be constructed in conjunction with the remainder of mainline construction to enable drainage of the sand and silt deposits and lowering of the groundwater table.
- Some sloughing may occur within the sands and silts as a result of groundwater seepage during excavation. It may be necessary to allow the seepage to diminish for permanent drainage and lowering of the groundwater table.
- The finished cut slope should be inspected and gravel sheeting (along with subdrains if appropriate) should be provided over any areas where continuing seepage is experienced. The rock protection should be underlain by a geotextile fabric, extend from the ditch invert to above level of the seepage, and be constructed in accordance with OPSS 511/SP 511S01.

At the proposed Hodder Avenue underpass structure, groundwater was measured at levels up to 3.1 m above finished highway grade. At this location, it is recommended that the mainline cut be completed at least 3 months in advance of bridge construction to allow drawdown of the groundwater to occur prior to foundation construction. The cut should begin at the low end of the highway (Current River) and proceed easterly to permit drainage as excavation progresses.

11 SUMMARY OF SITE-SPECIFIC RECOMMENDATIONS

A summary of the primary recommendations for each specific area of high fill, deep cut or swamp crossing is presented on Table A5 in Appendix A. The summary is based on the discussions presented above, and these discussions should be referenced for further detail.

12 CONSTRUCTION CONCERNS

During construction, qualified geotechnical staff should be retained to observe activities related to embankment construction and advise the Contract Administrator on construction concerns or issues related to embankment stability or settlement.

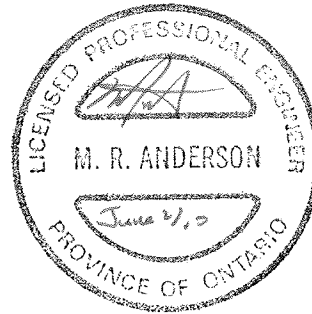
Potential construction concerns include, but are not necessarily limited to:

- The thickness and presence of organic deposits were investigated at the borehole locations only. Organic deposits may extend to greater depths or be encountered at other locations between boreholes.
- Geotechnical confirmation is required that all organics, peat and soft silt/clay materials within the proposed embankment footprint are sub-excavated and replaced with approved backfill.
- Movement of construction equipment may be difficult in areas of organic or excessively soft, loose and/or saturated subgrade. Disturbance of the subgrade by construction traffic should be minimized.
- Bedrock elevations may vary between and beyond the borehole locations. The cut slope geometry may require modification during construction based on the conditions encountered during excavation.
- Areas of ongoing seepage emerging from cut slopes may require gravel sheeting or rock protection to provided drainage of the seepage and prevent erosion of the slope face.

13 CLOSURE

Engineering analysis and preparation of the foundation design report were carried out by Mr. Murray Anderson, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.
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Senior Geotechnical Engineer



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Review Principal



Appendix A

Tables, Figures and Special Provisions

Table A1
Borehole Summary

Borehole	Location			Total Depth (m)	Length of Core in Bedrock (m)
	Station	Offset (m)	Description		
Hwy 11/17 EBL, Sta. 26+200 to 27+100					
09-074	26+450	65 RT	New toe of slope	2.8	-
09-075	26+550	57 RT	New toe of slope	2.6	-
09-076	26+650	50 RT	New toe of slope	4.2	-
09-077	26+750	47 RT	New toe of slope	2.7	-
09-078	26+850	42 RT	New toe of slope	6.2	-
09-079	26+950	35 RT	New toe of slope	3.1	-
09-080	27+050	35 RT	New toe of slope	5.7	-
10-096	26+250	28 RT	On existing fill	4.3	2.2
10-097	26+350	29 RT	On existing fill	8.8	2.6
10-098	26+422	18 RT	On existing fill	6.9	2.3
10-099	26+400	38 RT	On existing fill	3.7	-
3	26+615.9	16.7 RT	On existing fill	4.5	2.0
4	26+637.3	16.5 RT	On existing fill	6.7	5.5
101	26+300	80 RT	New toe of slope	1.8	-
102	26+400	70 RT	New toe of slope	1.7	-
103	26+500	70 RT	New toe of slope	1.7	-
105	26+600	58.5 RT	New toe of slope	3.1	-
107	26+700	58.5 RT	New toe of slope	3.2	-
109	26+798.5	48.8 RT	New toe of slope	2.6	-
111	26+900	43 RT	New toe of slope	2.5	-
113	27+000	33 RT	New toe of slope	3.8	-
115	27+100	32 RT	New toe of slope	6.9	-
TP09-1	26+615	15 RT	On existing fill	2.8	-
TP09-2	26+575	14 RT	On existing fill	2.5	-
TP09-3	26+500	14 RT	On existing fill	2.2	-
TP09-4	26+400	16 RT	On existing fill	3.8	-
TP09-5	26+325	16 RT	On existing fill	3.7	-
TP09-6	26+250	20 RT	On existing fill	3.5	-
Hwy 11/17 EBL, Sta. 29+400 to 29+900					
10-104	29+896	46 RT	New toe of slope	1.4	-
10-105	29+929	16 RT	On existing highway	4.2	-
10-115	29+500	28 RT	On existing highway	10.9	-
10-116	29+500	47 RT	New toe of slope	8.0	-
10-117	29+550	47 RT	New toe of slope	4.4	-
10-118	29+620	29 RT	On existing highway	6.5	-
10-119	29+620	44 RT	New toe of slope	3.5	-
10-120	29+690	39 RT	New toe of slope	5.1	-
10-121	29+760	30 RT	On existing highway	10.5	-
10-122	29+760	40 RT	New toe of slope	9.9	-
10-123	29+830	45 RT	New toe of slope	2.2	-

Table A1
Borehole Summary

Borehole	Location			Total Depth (m)	Length of Core in Bedrock (m)
	Station	Offset (m)	Description		
Hwy 11/17 WBL, Sta. 29+460 to 30+000					
10-106	29+943	0.1 LT	Proposed CL	0.7	-
10-107	29+975	35 LT	New WBL	0.0	-
10-107A	29+959	26 LT	New WBL	0.8	-
10-108	29+485	20 LT	New WBL	4.9	-
10-109	29+510	45 LT	New toe of slope	2.2	-
10-110	29+535	20 LT	New WBL	3.6	-
10-111	29+600	42 LT	Cut slope	12.0	-
10-112	29+670	48 LT	Cut slope	15.9	-
10-113	29+740	17 LT	New WBL	14.5	-
10-114	29+870	45 LT	Cut slope	3.8	-
C-001	29+510	1 LT	Proposed CL	0.9	-
Copenhagen Road, Sta. 9+540 to 9+955					
09-047	9+953.5	CL	Proposed CL	2.6	-
09-048	9+925	10 LT	Embankment toe	2.5	-
09-049	9+900	CL	Proposed CL	3.3	-
09-050	9+875	10 RT	Embankment toe	2.7	-
09-051	9+850	CL	Proposed CL	1.4	-
09-052	9+825	10 LT	Embankment toe	0.8	-
09-053	9+800	CL	Proposed CL	0.7	-
09-054	9+775	10 RT	Embankment toe	2.1	-
09-055	9+750	CL	Proposed CL	1.5	-
09-056	9+725	10 LT	Embankment toe	1.5	-
09-057	9+700	CL	Proposed CL	4.8	-
09-058	9+675	10 RT	Embankment toe	3.8	-
09-059	9+650	CL	Proposed CL	5.6	-
09-060	9+625	10 LT	Embankment toe	1.8	-
09-061	9+600	CL	Proposed CL	3.2	-
09-062A	9+578	10 RT	Embankment toe	1.5	-
09-062B	9+570	CL	Proposed CL	1.7	-
09-063	9+576	5 LT	Embankment toe	1.5	-
09-064	9+550	CL	Proposed CL	3.1	-
C-012	9+925	10 RT	Embankment toe	2.7	-
C-013	9+875	10 LT	Embankment toe	3.0	-
C-014	9+825	10 RT	Embankment toe	0.5	-
C-015	9+775	10 LT	Embankment toe	1.2	-
C-016	9+725	10 RT	Embankment toe	2.3	-
C-017	9+675	10 LT	Embankment toe	4.8	-
C-018	9+625	10 RT	Embankment toe	3.6	-
C-019	9+580	10 LT	Embankment toe	2.0	-

Table A1
Borehole Summary

Borehole	Location			Total Depth (m)	Length of Core in Bedrock (m)
	Station	Offset (m)	Description		
Hodder Avenue E-N/S Ramp, Sta. 10+540 to 10+780					
09-027	10+543	CL	Ramp CL	1.6	-
09-028	10+555	10 LT	Ramp embankment toe	2.2	-
09-029	10+568	CL	Ramp CL	2.4	-
09-030	10+580	10 RT	Ramp embankment toe	5.1	-
09-031	10+593	CL	Ramp CL	3.7	-
09-032	10+605	10 LT	Ramp embankment toe	3.0	-
09-033	10+618	CL	Ramp CL	3.0	-
09-034	10+630	10 RT	Ramp embankment toe	1.7	-
09-035	10+643	CL	Ramp CL	2.1	-
09-036	10+655	10 LT	Ramp embankment toe	2.8	-
09-037	10+668	CL	Ramp CL	1.7	-
09-038	10+680	10 RT	Ramp embankment toe	3.8	-
09-039	10+693	CL	Ramp CL	1.4	-
09-040	10+705	10 LT	Ramp embankment toe	3.5	-
09-041	10+718	CL	Ramp CL	1.2	-
09-042	10+730	10 LT	Ramp embankment toe	1.0	-
09-043	10+743	CL	Ramp CL	1.0	-
09-044	110+755	10 RT	Ramp embankment toe	1.1	-
09-045	10+768	CL	Ramp CL	0.2	-
09-046	10+790	10 LT	Ramp embankment toe	1.4	-
09-051	9+850	CL	Ramp CL	1.4	-
09-052	9+825	10 LT	Ramp embankment toe	0.8	-
C-002	10+555	10 RT	Ramp embankment toe	4.7	-
C-003	10+580	10 LT	Ramp embankment toe	2.4	-
C-004	10+605	10 RT	Ramp embankment toe	3.4	-
C-005	10+630	10 LT	Ramp embankment toe	3.1	-
C-006	10+655	10 RT	Ramp embankment toe	1.4	-
C-007	10+680	10 LT	Ramp embankment toe	2.0	-
C-008	10+705	10 RT	Ramp embankment toe	4.8	-
C-009	10+730	10 RT	Ramp embankment toe	1.0	-
C-010	10+755	10 LT	Ramp embankment toe	1.3	-
C-011	10+785	10 RT	Ramp embankment toe	0.5	-

Table A1
Borehole Summary

Borehole	Location			Total Depth (m)	Length of Core in Bedrock (m)
	Station	Offset (m)	Description		
Hodder Avenue S-E Ramp, Sta. 10+000 to 10+650					
09-006	10+010	CL	Ramp CL	2.7	-
09-007	10+125	CL	Ramp CL	3.3	-
09-008	10+250	CL	Ramp CL	1.7	-
09-009	10+300	CL	Ramp CL	2.8	-
09-010	10+350	CL	Ramp CL	1.4	-
09-011	10+400	CL	Ramp CL	2.2	-
09-012	10+450	CL	Ramp CL	4.9	-
09-013	10+500	CL	Ramp CL	4.5	-
09-014	10+550	CL	Ramp CL	2.8	-
09-015	10+600	CL	Ramp CL	2.6	-
09-016	10+650	CL	Ramp CL	3.6	-
10-068	10+160	15 RT	Ramp cut slope	5.5	-
10-070	10+200	17 RT	Ramp cut slope	8.5	2.7
10-071	10+240	18 RT	Ramp cut slope	3.8	-
10-072	10+280	18 RT	Ramp cut slope	11.6	3.1
10-073	10+320	17 RT	Ramp cut slope	3.8	-
Hodder Avenue N-E Ramp, Sta. 10+050 to 10+200					
09-017	10+050	CL	Ramp CL	2.6	1.5
09-018	10+100	CL	Ramp CL	2.9	1.4
09-019	10+150	CL	Ramp CL	6.5	1.6
09-020	10+240	CL	Ramp CL	4.3	1.6
Hodder Avenue W-N/S Ramp, Sta. 10+060 to 10+260					
09-001	10+100	7 RT	Ramp cut slope	9.3	-
09-002	10+138	2 RT	Ramp CL	10.8	4.3
09-003	10+124	10 RT	Ramp cut slope	10.7	3.1
09-004	10+175	2 RT	Ramp CL	7.3	3.7
09-005	10+235	CL	Ramp CL	6.7	3.8
10-085	10+075	30 RT	Ramp cut slope	14.8	3.0
10-086	10+113	9 RT	Ramp cut slope	10.9	3.6
10-087	10+150	7 RT	Ramp cut slope	10.4	3.5
09-088	10+117	2 LT	Ramp CL	15.4	-
10-089	10+128	12 LT	Ramp cut slope	9.0	4.4
10-090	10+108	7 LT	Ramp cut slope	17.7	3.6

Table A2
Piezometer Installation Details

Borehole	Piezometer Tip Depth (m)	Installation Details
09-02	10.8	Piezometer with 1.5 m slotted screen installed, sand filter from 10.8 to 5.8 m, bentonite seal from 5.8 m to ground surface.
09-03	10.7	Piezometer with 1.5 m slotted screen installed, sand filter from 10.7 to 5.6 m, bentonite seal from 5.6 m to ground surface.
09-04	7.3	Piezometer with 1.5 m slotted screen installed, sand filter from 7.3 to 3.6 m, bentonite seal from 3.6 m to ground surface.
09-12	4.9	Piezometer with 1.5 m slotted screen installed, sand filter from 4.9 to 3.1 m, bentonite seal from 3.1 to 2.3 m, cuttings to ground surface.
09-16	3.6	Piezometer with 1.5 m slotted screen installed, sand filter from 3.6 to 2.3 m, bentonite seal from 2.3 to 1.0 m, cuttings to ground surface.
09-20	4.3	Piezometer with 1.5 m slotted screen installed, sand filter from 4.3 to 2.0 m, bentonite seal from 2.0 m to ground surface.
09-30	2.7	Piezometer with 1.5 m slotted screen installed, sand filter from 2.7 to 1.5 m, bentonite seal from 1.5 to 0.6 m, cuttings to ground surface.
09-32	3.0	Piezometer with 1.5 m slotted screen installed, sand filter from 3.0 to 1.5 m, bentonite seal from 1.5 to 0.3 m, cuttings to ground surface.
09-40	3.5	Piezometer with 1.5 m slotted screen installed, sand filter from 3.5 to 2.1 m, bentonite seal from 2.1 to 0.4 m, cuttings to ground surface.
09-49	3.3	Piezometer with 1.5 m slotted screen installed, sand filter from 3.3 to 2.2 m, bentonite seal from 2.2 to 1.4 m, cuttings to ground surface.
09-59	5.0	Piezometer with 1.5 m slotted screen installed, sand filter from 5.0 to 3.1 m, bentonite seal from 3.1 to 2.2 m, cuttings to ground surface.
10-70	6.1	Piezometer with 1.5 m slotted screen installed, sand filter from 6.1 to 3.1 m, bentonite seal from 3.1 m to ground surface.
10-72	8.5	Piezometer with 1.5 m slotted screen installed, sand filter from 8.5 to 5.5 m, bentonite seal from 5.5 m to ground surface.
09-78	6.2	Piezometer with 1.5 m slotted screen installed, sand filter from 6.2 to 4.9 m, bentonite seal from 4.9 to 1.8 m, cuttings to ground surface.
10-109	2.1	Piezometer with 1.5 m slotted screen installed, sand filter from 2.1 to 0.6 m, bentonite seal from 0.6 m to ground surface.
10-112	15.8	Piezometer with 1.5 m slotted screen installed, sand filter from 15.8 to 12.2 m, bentonite seal from 12.2 m to ground surface.
10-117	4.4	Piezometer with 1.5 m slotted screen installed, sand filter from 4.4 to 2.3 m, bentonite seal from 2.3 m to ground surface.
10-122	4.9	Piezometer with 1.5 m slotted screen installed, sand filter from 4.9 to 2.7 m, bentonite seal from 2.7 m to ground surface.

Table A3

Summary of Embankment, Cut and Swamp Locations and Conditions

Appendix	Alignment	Stations	Length of Section (m)	Section Type	Maximum Embankment Height or Cut Depth (m)	Boreholes/ Test Pits/ Cones	Generalized Stratigraphy	Depth to Base of Peat, Topsoil or Soft Soil (m)	Groundwater Conditions
B	Hwy 11/17 EBL	26+200 to 27+100	900	High Fill	20.0 Fill	09-74 to 09-80 10-96 to 10-99 3, 4 101 to 115 TP's 09-01 to 09-06	<u>On Existing Fill Embankment:</u> FILL, sand to sand and silt, with gravel, cobbles and boulders, loose to dense, 1.0 to 4.7 m deep. BEDROCK or auger refusal at 1.0 to 6.2 m depth. <u>At Toe of Embankment:</u> PEAT, 0.1 to 1.2 m thick; over SAND and SILT TILL, very loose to very dense, 0.2 to 6.0 m thick. BEDROCK or auger refusal at 0.6 to 6.2 m depth.	0.1 to 1.2	0.3 to 3.1 m depth upon completion of drilling; 0.5 m depth in piezometer
C	Hwy 11/17 EBL	29+400 to 29+900	500	High Fill	8.5 Fill	10-104, 10-105 10-115 to 10-123	FILL (on existing embankment), sand and silt, compact to very dense, 2.3 to 4.1 m depth; or PEAT (near embankment toe), 1.5 to 2.3 m thick, discontinuous; over SANDS and SILTS, loose to compact, 0.6 to 6.6 m thick; over SAND, gravely, compact to very dense, 0.2 to 5.9 m thick. Auger refusal at 1.4 to 10.9 m depth.	1.5 to 2.6	1.3 to 4.2 m depth upon completion of drilling; 0.7 to 1.7 m depth in piezometers
D	Hwy 11/17 WBL	29+460 to 30+000	540	High Fill Deep Cut	7.0 Fill 14.5 Cut	10-106 to 10-114 Cone C-01	PEAT and TOPSOIL, 0.6 to 1.9 m thick; over SANDS and SILTS, compact to dense, 0.7 to 15.1 m thick. Auger refusal at 0.7 to 15.9 m depth.	0.6 to 1.9	0.8 to 7.8 m depth upon completion of drilling; 1.0 to 1.5 m depth in piezometers
E	Copenhagen Road	9+540 to 9+955	415	Swamp Crossing	3.5 Fill	09-47 to 09-64 Cones C-12 to C-19	PEAT and TOPSOIL, 0.05 to 1.2 m thick; over CLAY, silty, to SILT, clayey, very soft to firm, 0.4 to 1.5 m thick; over SAND TILL, silty, loose to very dense, 0.3 to 3.6 m thick. Auger refusal at 0.5 to 4.8 m depth.	0.05 to 2.2	0.9 m artesian to 2.2 m depth upon completion of drilling; 0.6 to 1.4 m depth in piezometers
F	Hodder Avenue E-N/S Ramp	10+540 to 10+780	240	Swamp Crossing	2.5 Fill	09-27 to 09-46 09-51, 09-52 Cones C-02 to C-11	FILL, sand, with cobbles, loose, 0.3 to 1.4 m thick; and/or PEAT and TOPSOIL, 0.05 to 1.6 m thick; over SILT, clayey to CLAY, silty, very soft to stiff, 0.3 to 1.6 m thick; and/or SAND to SILT TILL, loose to very dense, 0.4 to 2.6 m thick. Auger refusal at 0.2 to 5.1 m depth.	0.05 to 2.5	0.3 to 2.1 m depth upon completion of drilling; 1.7 to 1.9 m depth in piezometers
G	Hodder Avenue S-E Ramp	10+000 to 10+650	650	Deep Cut	12.5 Cut	09-06 to 09-16 10-68 10-70 to 10-73	TOPSOIL over SAND TILL, silty, loose to very dense, 1.3 to 5.5 m. BEDROCK or auger refusal at 1.4 to 5.5 m depth.	0.125 to 0.2	4.3 to 6.3 m depth in piezometers
H	Hodder Avenue N-E Ramp	10+050 to 10+200	150	Deep Cut	9.0 Cut	09-17 to 09-20	CLAY to SILT TILL, stiff, 0.4 to 1.4 m thick; over SAND and SILT TILL, compact to very dense, 1.3 to 3.5 m thick. BEDROCK at 1.4 to 4.9 m depth.	-	2.2 m depth in piezometer
I	Hodder Avenue W-N/S Ramp	10+060 to 10+260	200	Deep Cut	13.5 Cut	09-1 to 09-5 10-85 to 10-90	SAND to SILT, sandy, loose to compact, 0.3 to 1.4 m thick; over SILT and SAND TILL, dense to very dense, 1.3 to 7.9 m thick; over SAND and GRAVEL, silty, very dense, 4.2 to 8.4 m thick. BEDROCK at 2.9 to 14.1 m depth.	0.2 to 1.1	8.0 m depth upon completion of drilling; 6.0 to 10.4 m depth in piezometers

Table A4
Results of Settlement Analyses

Appendix	Alignment	Analysis Profile Location (Sta.)	New Embankment Height at Analysis Location (m)	Soil Type	Elastic Modulus (MPa)	Elastic Settlement (mm)	Embankment Compression (mm)		
							Earth Fill	Short-term	Long-term
B	Hwy 11/17 EBL	26+650	12.5	Less than 3 m of compact to very dense silt/sand till over bedrock	20 to 50	< 25	65	125	< 15
C	Hwy 11/17 EBL	29+500 29+760	8.5	Up to 7.3 m of loose to compact sands and silts over probable bedrock	15 to 20	50	45	80	< 15
D	Hwy 11/17 WBL	29+485	7.0	Less than 3.0 m of loose to compact sands and silts over probable bedrock	15 to 20	25	35	70	< 10
E	Copenhagen Road	9+700	3.5	Typically very dense sand and silt till over probable bedrock	15 to 30	< 25	< 20	35	< 10
F	Hodder Avenue E-N/S Ramp	10+600	2.5	Loose to dense sand and silt till over probable bedrock	15 to 30	< 25	< 15	30	< 10

* Includes dumped rock fill below the water table and compacted rock fill above this level.

Table A5

Summary of Recommendations for Embankment Construction, Cut Slopes and Swamp Treatments

Appendix	Alignment	Stations	Length of Section (m)	Section Type	Maximum Embankment Height or Cut Depth (m)	Summarized Recommendations
B	Hwy 11/17 EBL	26+200 to 27+100	900	High Fill	20.0 Fill	<p>Stability: Standard embankment sideslopes of 1.25H:1V in rock fill and 2H:1V in earth fill in conjunction with mid-height berms should be stable. Peat and topsoil should be stripped, and the existing embankment slope should be benched prior to new fill placement.</p> <p>Settlement: Settlement of foundation soils is expected to occur essentially as embankment construction proceeds. Embankment construction should be carried out at least six months in advance of pavement construction to allow for compression of embankment materials.</p>
C	Hwy 11/17 EBL	29+400 to 29+900	500	High Fill	8.5 Fill	<p>Stability: Standard embankment sideslopes of 1.25H:1V in rock fill and 2H:1V in earth fill in conjunction with mid-height berms should be stable. Peat and topsoil should be stripped, and existing embankment slopes should be benched prior to new fill placement.</p> <p>Settlement: Settlement of foundation soils is expected to occur essentially as embankment construction proceeds. Embankment construction should be carried out at least six months in advance of pavement construction to allow for compression of embankment materials.</p>
D	Hwy 11/17 WBL	29+460 to 30+000	540	High Fill Deep Cut	7.0 Fill 14.5 Cut	<p>Stability: Standard embankment sideslopes of 1.25H:1V in rock fill and 2H:1V in earth fill in conjunction with mid-height berms should be stable. Peat and topsoil should be stripped, and existing embankment slopes should be benched prior to new fill placement.</p> <p>Standard cut slope inclinations of 0.25H:1V to vertical in rock and 2H:1V in earth in conjunction with mid-height berms are considered suitable. Cuts should be constructed in conjunction with mainline construction to allow drainage of sand and silt deposits and permanent lowering of the groundwater table. Gravel sheeting may be required in areas of continuing seepage.</p> <p>Settlement: Settlement of foundations soils is expected to occur essentially as embankment construction proceeds. Embankment construction should be carried out at least six months in advance of pavement construction to allow for compression of embankment materials.</p>
E	Copenhagen Road	9+540 to 9+955	415	Swamp Crossing	3.5 Fill	<p>Swamp Treatment: Existing peat, topsoil and soft silt/clay should be stripped prior to embankment construction.</p> <p>Stability: Standard embankment sideslopes of 1.25H:1V in rock fill and 2H:1V in earth fill are considered suitable.</p> <p>Settlement: Provided the peat, topsoil and soft silt/clay are removed, embankment settlement is not an issue.</p>
F	Hodder Avenue E-N/S Ramp	10+540 to 10+780	240	Swamp Crossing	2.5 Fill	<p>Swamp Treatment: Existing peat, topsoil and soft silt/clay should be stripped prior to embankment construction.</p> <p>Stability: Standard embankment sideslopes of 1.25H:1V in rock fill and 2H:1V in earth fill are considered suitable.</p> <p>Settlement: Provided the peat, topsoil and soft silt/clay are removed, embankment settlement is not an issue.</p>
G	Hodder Avenue S-E Ramp	10+000 to 10+650	650	Deep Cut	12.5 Cut	<p>Stability: Standard cut slope inclinations of 0.25H:1V to vertical in rock and 2H:1V in earth in conjunction with mid-height berms are considered suitable.</p>
H	Hodder Avenue N-E Ramp	10+050 to 10+200	150	Deep Cut	9.0 Cut	<p>Stability: Standard cut slope inclinations of 0.25H:1V to vertical in rock and 2H:1V in earth in conjunction with mid-height berms are considered suitable.</p>
I	Hodder Avenue W-N/S Ramp	10+060 to 10+260	200	Deep Cut	13.5 Cut	<p>Stability: Standard cut slope inclinations of 0.25H:1V to vertical in rock and 2H:1V in earth in conjunction with mid-height berms are considered suitable.</p>

Thurber Engineering Ltd. - Toronto
 19-1351-156
 Hwy 11/17 Widening
 April 2010
 Embankment opposite Terry Fox
 Rockfill Slope

	Gamma C	Phi	Piezo
	kN/m3	deg	Surf.
Rockfill	20	0	42
Existing Fill	20	0	31
Till	21	0	34
Bedrock	24	50000	0

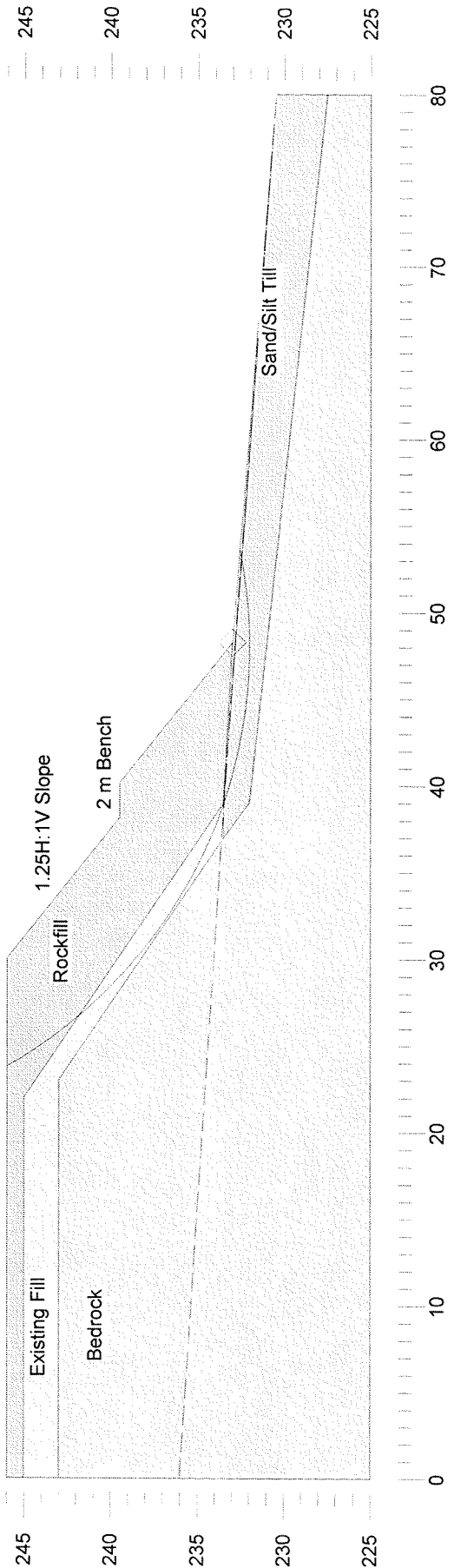
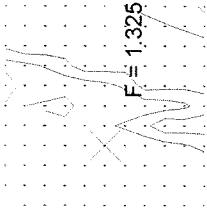


Figure A1

	Gamma	C	Phi	Piezo
	kN/m3	kPa	deg	Surf.
Earth Fill	20	0	30	1
Existing Fill	20	0	31	1
Till	21	0	34	1
Bedrock	24	50000	0	1

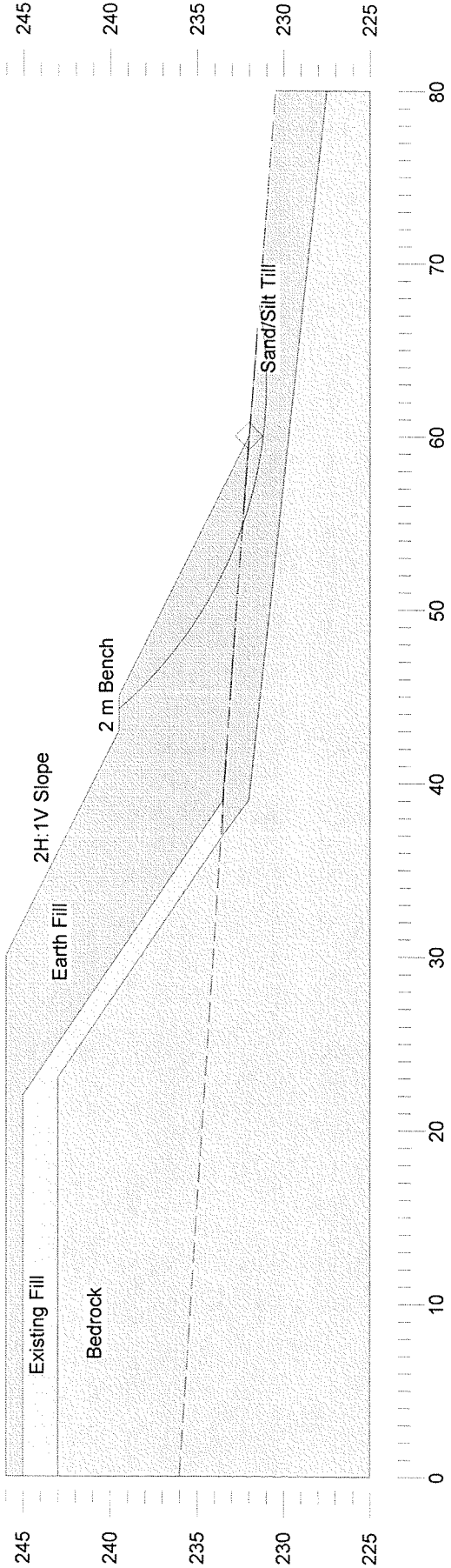
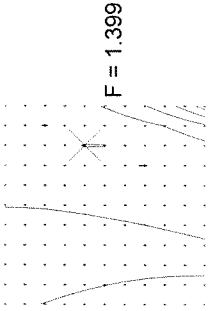


Figure A2

	Gamma	C	Phi	Piezo
	kN/m3	kPa	deg	Surf.
Rockfill	20	0	42	1
Peat	10	20	0	1
Existing Fill	21	0	33	1
Sand	20	0	32	1
Silt	20	0	30	1
Bedrock	24	50000	0	1

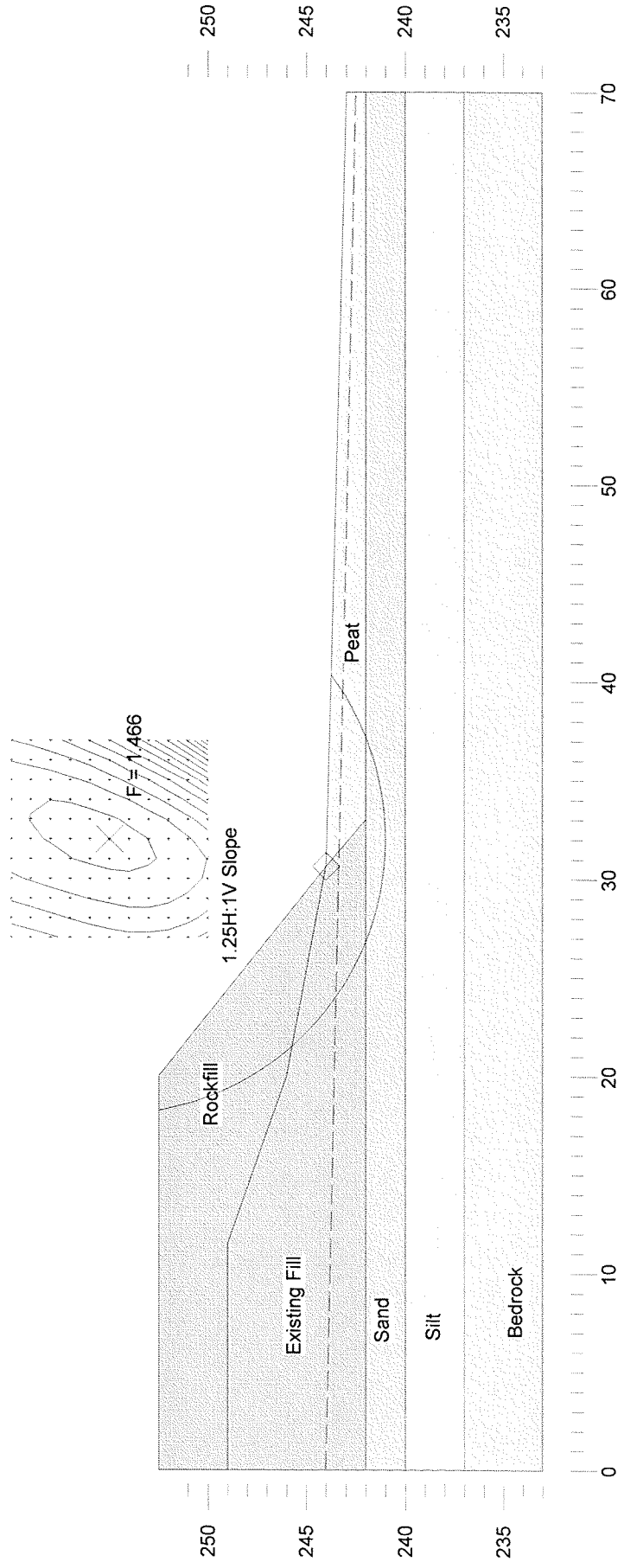


Figure A3

	Gamma	C	Phi	Piezo
	kN/m3	kPa	deg	Surf.
Peat	10	20	0	1
Earth Fill	20	0	30	1
Existing Fill	21	0	33	1
Sand	20	0	32	1
Silt	20	0	30	1
Bedrock	24	50000	0	1

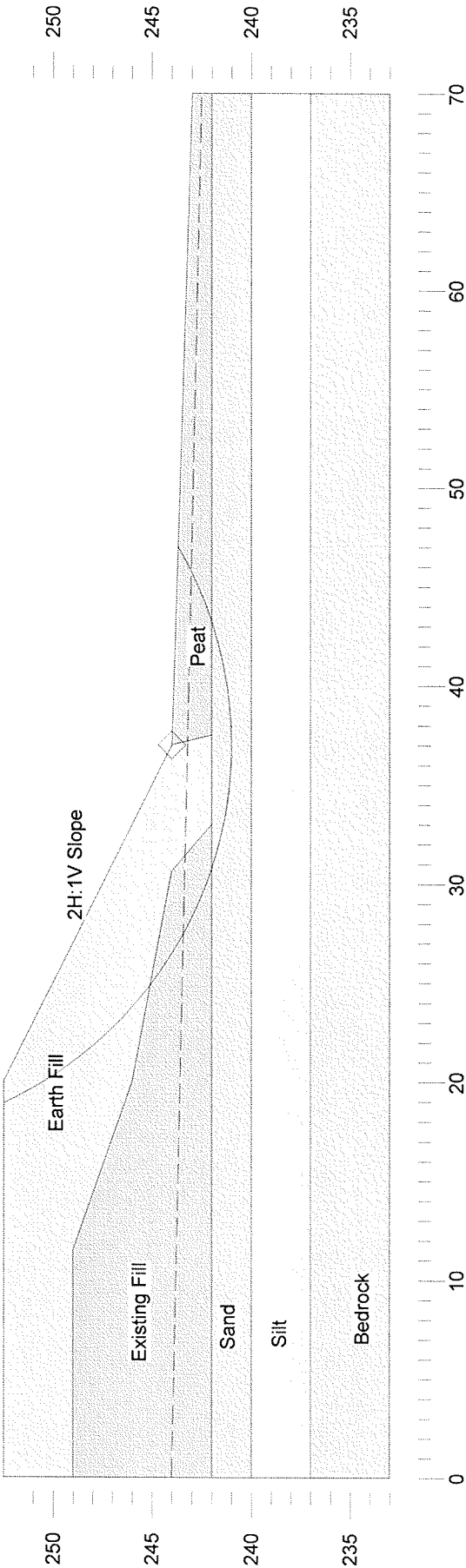
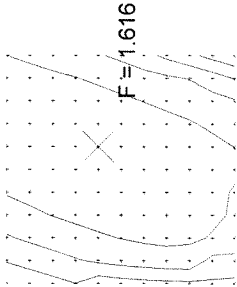


Figure A4

Thurber Engineering Ltd. - Toronto
 19-1351-156
 Hwy 11/17 Widening
 April 2010
 East Limit WBL Embankment
 Rockfill Slope

	Gamma	C	Phi	Piezo
	kN/m ³	kPa	deg	Surf.
Peat	10	20	0	1
Rockfill	20	0	42	1
Sand and Silt	20	0	32	1
Silt	20	0	30	1
Bedrock	24	50000	0	1

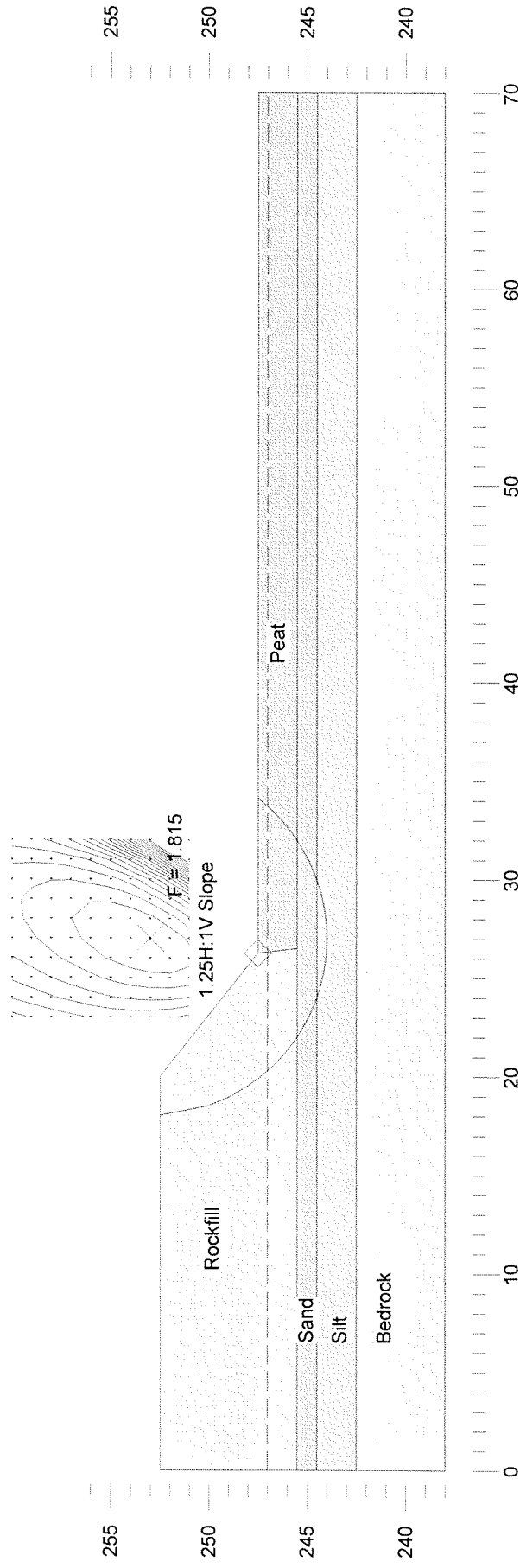


Figure A5

Thurber Engineering Ltd. - Toronto
 19-1351-156
 Hwy 11/17 Widening
 April 2010
 East Limit WBL Embankment
 Earth Fill Slope

	Gamma	C	Phi	Piezo
	kN/m ³	kPa	deg	Surf.
Peat	10	20	0	1
Earth Fill	20	0	30	1
Sand and Silt	20	0	32	1
Silt	20	0	30	1
Bedrock	24	50000	0	1

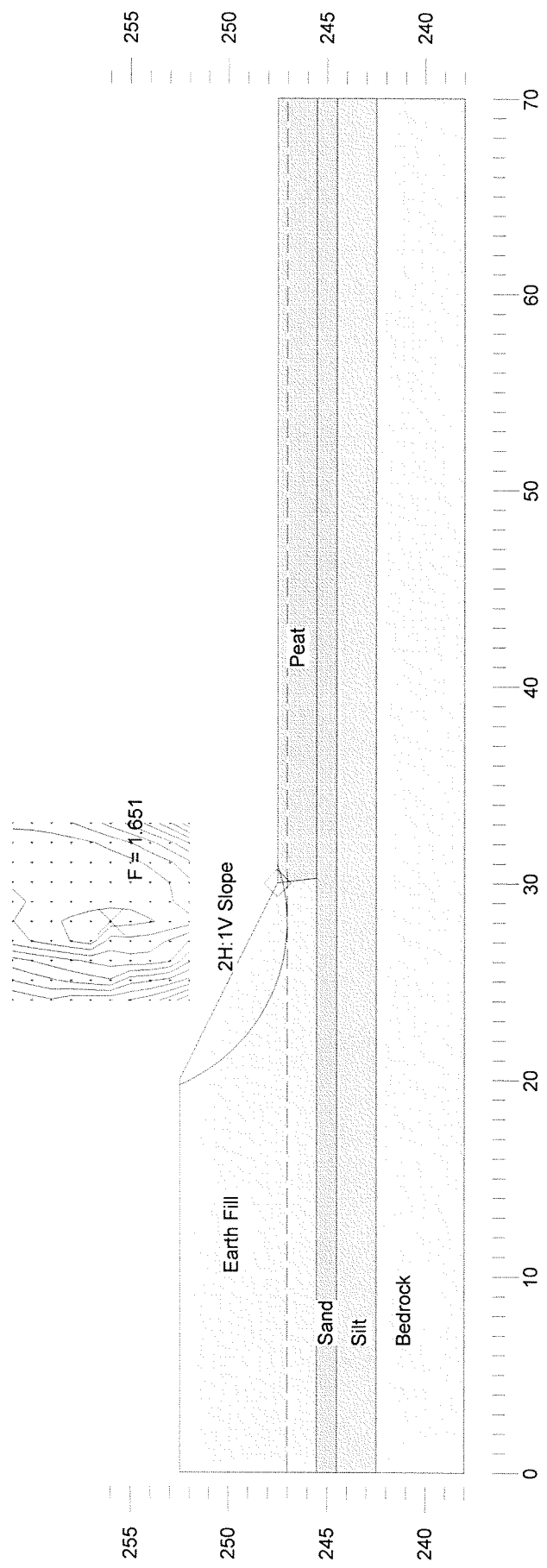


Figure A6

	Gamma	C	Phi	Piezo
	kN/m ³	kPa	deg	Surf.
Sand/Silt	20	0	30	1
Bedrock	24	50000	0	1

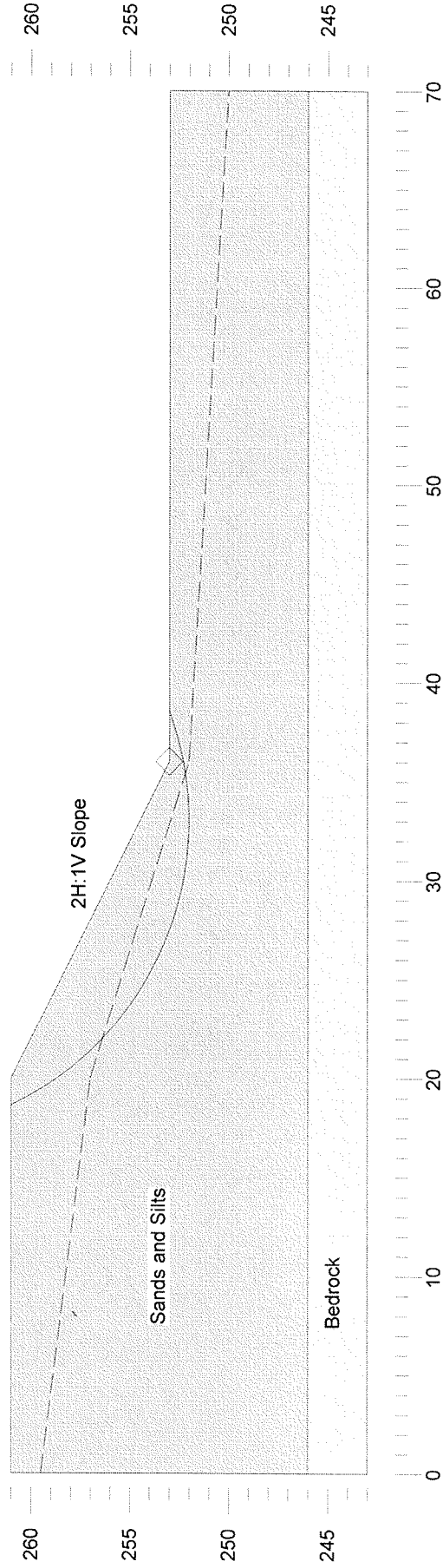
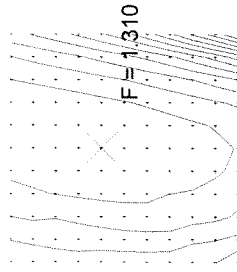
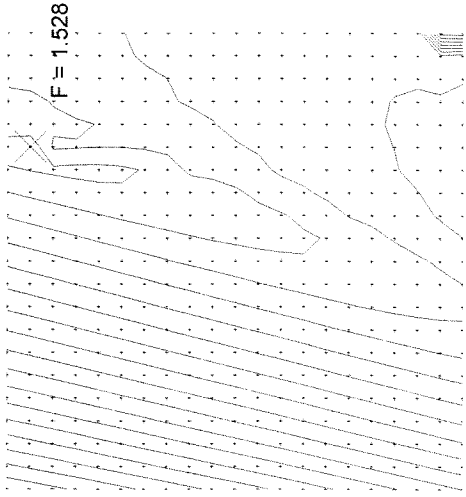


Figure A7



Thurber Engineering Ltd. - Toronto
 19-1351-156
 Hwy 11/17 Widening
 April 2010
 W-N/S Ramp
 Cut Slope

	Gamma C	Phi	Piezo
	kN/m3	deg	Surf.
Sand & Silt Till	20	34	1
Sand and Gravel	21	38	1
Bedrock	24	50000	1

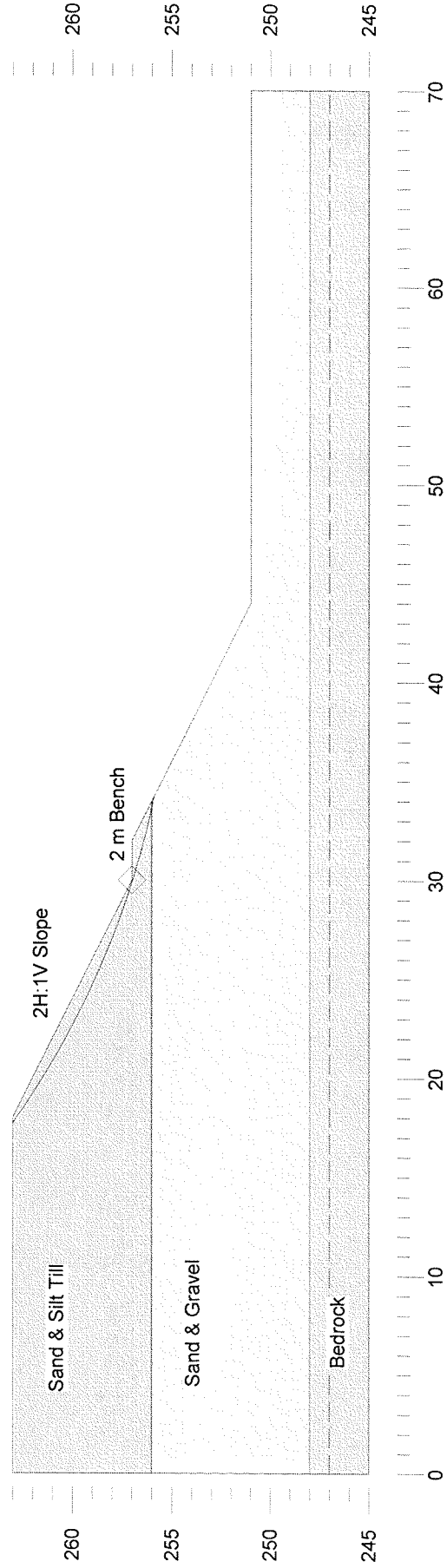


Figure A8

1. List of Special Provisions and OPSS Documents Referenced in this Report

- SP 110F13
- SP 206S03
- SP 511S01
- SP 572S01
- OPSS 120
- OPSS 206
- OPSS 209
- OPSS 511
- OPSS 1010
- OPSD 200.020
- OPSD 201.020
- OPSD 203.010
- OPSD 208.010

Appendix B

Highway 11/17 EBL

Station 26+200 to 27+100

Boreholes 09-74 to 09-80, 10-96 to 10-99

Test Pits 09-01 to 09-06

Previous Boreholes 3, 4, and 101 to 115

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT ⁽¹⁾ 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

- 1) Laboratory Triaxial Testing
- 2) Field Insitu Vane Testing
- 3) Laboratory Vane Testing
- 4) SPT value
- 5) Pocket Penetrometer


4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample	TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure	PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

 Water Level


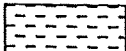



C_{pen} Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. $(W_L < 30\%)$.
		CI	Inorganic clays of medium plasticity, silty clays. $(30\% < W_L < 50\%)$.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION		SYMBOLS	
Fresh (FR)	No visible signs of weathering.		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		CLAYSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

DISCONTINUITY SPACING		STRENGTH CLASSIFICATION			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
		Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
		Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
		Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS	
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

RECORD OF BOREHOLE No 09-074

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 26+450, 65m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.16 - 2009.07.16 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 × LAB VANE						
0.0	TOPSOIL, with roots and rootlets (250mm)													
0.3	Silty SAND, trace gravel, trace roots and rootlets Dense Brown Moist		1	SS	35								○	
1.4	Silty SAND, some clay, with shale fragments Dense Brown													
1.8	(TILL) GUNFLINT FORMATION (shale), highly weathered Black		2	SS	38								○	
			3	SS	82/ 250								○	
2.8	END OF BOREHOLE AT 2.8m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 2.7m, THEN CUTTINGS TO SURFACE.													

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 10 (%) STRAIN AT FAILURE

METRIC

G.W.P. <u>334-94-00</u>	LOCATION <u>HWY 11/17, Sta. 26+550, 57m RT</u>	ORIGINATED BY <u>SLL</u>
HWY <u>11/17</u>	BOREHOLE TYPE <u>Hollow Stem Augers</u>	COMPILED BY <u>AN</u>
DATUM <u>Geodetic</u>	DATE <u>2009.07.16 - 2009.07.16</u>	CHECKED BY <u>TH</u>

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 09-076

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 26+650, 50m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.16 - 2009.07.16 CHECKED BY TH

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100					W P	W	W L		
0.0	ORGANICS, peat Black																
0.4	Silty SAND, trace gravel, trace clay, with shale fragments Compact to Dense Brown Moist (TILL) occasional cobbles		1	SS	17												3 59 34 4
			2	SS	32												
			3	SS	45												4 61 31 4
			4	SS	55												
3.4	GUNFLINT FORMATION (shale), weathered Black																
4.2	END OF BOREHOLE AT 4.2m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 1.8m, THEN CUTTINGS TO SURFACE.																

METRIC

G.W.P.	334-94-00	LOCATION	HWY 11/17, Sta. 26+750, 47m RT	ORIGINATED BY	SLL
HWY	11/17	BOREHOLE TYPE	Hollow Stem Augers	COMPILED BY	AN
DATUM	Geodetic	DATE	2009.07.16 - 2009.07.16	CHECKED BY	TH

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 09-078

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 26+850, 42m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.16 - 2009.07.16 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
							20	40	60	80	100	20	40	60			
0.0	TOPSOIL, with roots and rootlets (150mm)																
0.2	Silty SAND, trace gravel, trace clay, shale fragments Loose to Very Dense Brown Moist to Wet (TILL)		1	SS	5												
			2	SS	41										6 61 30 4		
			3	SS	33												
			4	SS	41										3 57 38 2		
			5	SS	100/ 200												
6.2	END OF BOREHOLE AT 6.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.91m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m)		6	SS	100/ 200												

RECORD OF BOREHOLE No 09-079

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 26+950, 35m RT ORIGINATED BY SP/L
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.16 - 2009.07.16 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
								20	40	60	80	100					
0.0	TOPSOIL, with roots and rootlets (100mm)																
0.1	Silty SAND Brown Moist																
0.6	Silty SAND, trace gravel, trace clay, occasional cobbles Compact to Dense Brown Moist (TILL)		1	SS	19												
			2	SS	45												
			3	SS	35												
			4	SS	100/												4 62 31 3
3.1	END OF BOREHOLE AT 3.1m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN AND WATER LEVEL AT 3.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 2.5m, THEN CUTTINGS TO SURFACE.				.100												

METRIC

G.W.P. <u>334-94-00</u>	LOCATION <u>HWY 11/17, Sta. 27+050, 35m RT</u>	ORIGINATED BY <u>SLL</u>
HWY <u>11/17</u>	BOREHOLE TYPE <u>Hollow Stem Augers</u>	COMPILED BY <u>AN</u>
DATUM <u>Geodetic</u>	DATE <u>2009.07.16 - 2009.07.16</u>	CHECKED BY <u>TH</u>

[illegible]


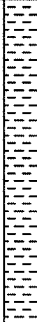

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 10-096

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 26+250 28m RT ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.17 - 2010.01.17 CHECKED BY TH

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	× LAB VANE						
							20	40	60	80	100						
0.0	Silty SAND , some gravel, occasional rock fragments Compact Dark Brown Moist (FILL)																
			1	SS	40												
			2	SS	11												
2.1	GUNFLINT FORMATION, strong (chert carbonate limestone), bluish grey to light grey, sub-horizontal planar fractures		1	RUN													
			2	RUN													
4.3	END OF BOREHOLE AT 4.3m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																

+³, X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-097

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 26+350 29m RT ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.17 - 2010.01.17 CHECKED BY TH

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					
0.0	Silty SAND, some gravel, trace clay, frequent cobbles Loose to Compact Brown Moist (FILL)		1	SS	18												14 43 36 7
			2	SS	23												
			3	SS	8												
			4	SS	5												
4.7	Silty SAND, some gravel, occasional rock fragments Compact Brown Moist (TILL)		5	SS	20												11 56 28 5
			6	SS	50/												
6.2	GUNFLINT FORMATION, strong (chert carbonate limestone), fresh, laminated, blue-grey, fine grained, occasional sub-horizontal planar fractures		1	RUN	.075												RUN 1# TCR=100%, SCR=96%, RQD=64% UCS=62MPa
			2	RUN													RUN 2# TCR=100%, SCR=90%, RQD=90% UCS=79MPa
8.8	END OF BOREHOLE AT 8.8m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																

+ ³ . × ³ : Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE



ONTMT4S 1156.GPJ 4/15/10

RECORD OF BOREHOLE No 10-098

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 26+422 18m RT ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.18 - 2010.01.18 CHECKED BY TH

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										WATER CONTENT (%)
								20 40 60 80 100										
								20 40 60 80 100										
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
0.0	SAND and SILT , some gravel, trace clay, occasional cobble Loose to Compact Brown Moist (FILL) Occasional rootlets and woob fibers															GR SA SI CL		
			1	SS	12													
			2	SS	18											10 44 37 9		
			3	SS	11													
			4	SS	9													
4.6	GUNFLINT FORMATION , medium strong to strong (chert carbonate limestone), fresh, blue-grey to light grey, sub-horizontal fractures		1	RUN											FI	RUN 1# TCR=100%, SCR=100%, RQD=93% UCS=27MPa		
			2	RUN												RUN 2# TCR=100%, SCR=50%, RQD=50% UCS=69MPa		
6.9	END OF BOREHOLE AT 6.9m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																	

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-099

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 26+400 38m RT ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.18 - 2010.01.18 CHECKED BY TH

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W _p W W _L	20 40 60	20 40 60		
0.0	Silty SAND, some gravel, trace clay, occasional rock fragments Loose to Compact Brown Moist (FILL)		1	SS	6												25 57 15 3
			2	SS	30												
3.7	END OF BOREHOLE AT 3.7m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

+³, X³; Numbers refer to
Sensitivity 20
15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3

METRIC

W P 141/142-90-01 LOCATION Station 26 + 615.9m (EBL), 2.1m Lt of prop. EBL E
DIST 19 HWY 11 & 17 BOREHOLE TYPE Solid stem auger, bicone, BQ rock core
DATUM Geodetic DATE 91 09 11-12
ORIGINATED BY SM
COMPILED BY SM
CHECKED BY SB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH kPa	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
245.2	Ground surface													
0.0	Sand and Silt some gravel, trace of clay, organic specs, brown, compact		1	SS	13	Dry	245							GR SA SI CL
243.7	(FILL)		2	SS	10		244							15 39 45 1
1.5	Sandy Gravel some silt, oxidized, compact		3	SS	27		243							59 22 (19)
2.1	Chert Iron Formation Bedrock black-grey to olive grey, fine to medium grained, medium strong, very close to moderately close spacing, good quality		4	RC BQ	REC 100%		242							RQD 82%
240.7			5	RC BQ	REC 100%		241							RQD 79%
4.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 4

METRIC

W P 141/142-90-01 LOCATION Station 26 + 637.3m (EBL), 2.3m Lt of prop. EBL 8
 DIST 19 HWY 11 & 17 BOREHOLE TYPE Solid stem auger, bicone, BQ rock core
 DATUM Geodetic DATE 91 09 12-14
 ORIGINATED BY SM
 COMPILED BY SM
 CHECKED BY SB

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W _p	W	W _L		
244.7	Ground surface																GR SA SI CL
0.0	Sand and Silt some gravel, trace of clay, organic specs, brown, compact (FILL)		1	SS	16	Dry	244							0			20 38 (42)
243.7																	
1.0	Chert Iron Formation Bedrock black-grey to olive grey, fine to medium grained, medium strong, very close to moderately close spacing, fair to excellent quality		2	RC BQ	REC 93%		243										RQD 53%
			3	RC BQ	REC 100%		242										RQD 62%
			4	RC BQ	REC 100%		241										RQD 86%
			5	RC BQ	REC 92%		240										RQD 81%
			6	RC BQ	REC 100%		239										RQD 92%
238.0																	
6.7	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 101

1 of 1

METRIC

G.W.P. 334-94-00 LOCATION Co-ords: 5 371 930 N; 366 225 E
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Continuous Flight Hollow Stem Augers
DATUM Geodetic DATE December 14, 2005

ORIGINATED BY F.P.
COMPILED BY F.P.
CHECKED BY

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					
234.1	Ground Surface																
0.0	Peat, fine fibrous		1	AS	-		234										Top 25cm frozen
233.2	Black																
0.9																	
233.0	Silty sand, organic inclusions		2	SS	45		233										
1.1	Dense Brown Wet Black Shale bedrock, weathered		3	SS	50/10cm												
232.3	End of borehole																
1.8	Refusal on bedrock																
	* Borehole dry on completion of drilling																

RECORD OF BOREHOLE No 102

1 of 1

METRIC

G.W.P. 334-94-00 LOCATION Co-ords: 5 371 965 N; 366 326 E Sta. 26+400, o/s 70m Rt. ORIGINATED BY F.P.
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY F.P.
DATUM Geodetic DATE December 14, 2005 CHECKED BY

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					
232.9	Ground Surface																
0.0	Topsoil		1	AS	-												Top 20cm frozen
0.3	Black Shale bedrock, weathered		2	SS	80/18cm		232										
231.2			3	SS	65/18cm												
1.7	End of borehole Refusal on probable bedrock Borehole redrilled 1.5m north and obtained refusal at 0.3m depth. * Borehole dry on completion of drilling																

RECORD OF BOREHOLE No 103

1 of 1

METRIC

G.W.P. 334-94-00 LOCATION Co-ords: 5 371 998 N; 366 426 E
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Continuous Flight Hollow Stem Augers
DATUM Geodetic DATE December 14, 2005

ORIGINATED BY F.P.
COMPILED BY F.P.
CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT 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		
231.8	Ground Surface															
0.0	Peat, fine fibrous		1	AS	-											Top 30cm frozen
231.2	Dark brown															
0.6	Black Shale bedrock weathered		2	SS	73	231										
230.1			3	SS	50/5cm											
1.7	End of borehole Refusal on bedrock															
	* Borehole dry on completion of drilling															

METRIC

Co-ords: 5 372 050 N; 366 518 E
Sta. 26+600, o/s 58.5m Rt.

ON MOT VER3 05TF040.GPJ ON MOT.GDT 1/19/2006 9:29:16 AM

$+^7, \times^5$: Numbers refer to Sensitivity

METRIC

G.W.P.	334-94-00	LOCATION	CO Stgs. 3 572 036 N, 300 011 E Sta. 26+700, o/s 58.5m Rt.	ORIGINATED BY	F.P.
DIST	Thunder Bay	HWY	11/17	BOREHOLE TYPE	Continuous Flight Hollow Stem Augers
DATUM	Geodetic	DATE	December 14, 2005	COMPILED BY	F.P.
				CHECKED BY	

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							20 40 60	
231.4 0.0	Ground Surface Peat, fine fibrous Black		1	AS	-	* *	231									
230.6 0.8	Sand and silt, trace clay, trace gravel, cobbles Dense Brown Moist to very dense to wet		2	SS	76		230									
			3	SS	48											
			4	SS	46		229									
			5	SS	60/15cm											
228.2 3.2	End of borehole Refusal on probable bedrock															
<div>* 2005 12 14</div> <div> Water level observed during drilling</div> <div> Water level measured after drilling</div>																

RECORD OF BOREHOLE No 109

1 of 1

METRIC

G.W.P. 334-94-00

LOCATION

Co-ords: 5 372 156 N; 366 692 E
Sta. 26+798.5, o/s 48.8m Rt.

ORIGINATED BY F.P.

DIST Thunder Bay HWY 11/17

BOREHOLE TYPE

Continuous Flight Hollow Stem Augers

COMPILED BY F.P.

DATUM Geodetic

DATE

December 14, 2005

CHECKED BY

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					
232.4	Ground Surface																
0.0	Peat, fine fibrous		1	AS	-	↓* ↓*										Top 30cm frozen	
0.3	Black Sand and silt, trace clay, trace gravel, cobbles and boulders																
230.6	Dense Brown Wet to very dense		2	SS	50/15cm												
1.8	Probable Shale bedrock, weathered																
229.8																	
2.6	End of borehole Refusal on probable bedrock																
	* 2005 12 14																
	▽ Water level observed during drilling																
	▼ Water level measured after drilling																
	Note: Refusal encountered at original borehole location at 0.3m depth, borehole moved 1.5m westerly.																

RECORD OF BOREHOLE No 111

1 of 1

METRIC

G.W.P. 334-94-00 LOCATION Co-ords: 5 372 213 N; 366 776 E
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Continuous Flight Hollow Stem Augers
DATUM Geodetic DATE December 14, 2005

ORIGINATED BY F.P.

COMPILED BY F.P.

CHECKED BY

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			
234.0	Ground Surface																
0.0	Peat, fine fibrous		1	AS	-												
0.3	Black Sand and silt, trace clay, trace gravel, cobbles and boulders		2	AS	-												
	Dense Brown Moist to very dense		3	SS	50/15cm												
231.5			4	SS	30/5cm												
2.5	End of borehole Refusal on probable bedrock * Borehole dry on completion of drilling Note: Borehole moved 1.5m north, auger refusal at 2.3m																

RECORD OF BOREHOLE No 113

1 of 1

METRIC

G.W.P. 334-94-00 LOCATION Co-ords: 5 372 272 N; 366 857 E
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Continuous Flight Hollow Stem Augers
DATUM Geodetic DATE December 13, 2005

ORIGINATED BY F.P.

COMPILED BY F.P.

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT 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		
234.6	Ground Surface																
0.0	Peat, fine fibrous, cobbles and boulders Dark brown		1	AS	-											Top 30cm frozen	
233.4																	
1.2	Silt and sand, trace to with gravel, trace clay, cobbles Compact Grey Wet to dense (TILL)		2	SS	19												
			3	SS	38												
			4	SS	20/0cm												
230.8																	
3.8	End of borehole Refusal on probable bedrock Sampler bouncing on boulder at 3.0m depth. * 2005 12 13 ▽ Water level observed during drilling ▽ Water level measured after drilling																

RECORD OF BOREHOLE No 115

1 of 1

METRIC

G.W.P. 334-94-00 LOCATION Co-ords: 5 372 324 N; 366 942 E ORIGINATED BY F.P.
DIST Thunder Bay HWY 11/17 BOREHOLE TYPE Continuous Flight Hollow Stem Augers COMPILED BY F.P.
DATUM Geodetic DATE December 13, 2005 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
236.6	Ground Surface													
0.0	Peat, amorphous Dark brown		1	AS	-									Top 25cm frozen
235.6			2	SS	7								150	
1.0	Silty sand, trace to some gravel, trace clay, cobbles and boulders													
	Compact Brown Wet to grey (TILL)		3	SS	8									7 61 30 2
			4	SS	29									
			5	SS	47									15 46 37 2
	Dense Grey Moist to very dense		6	SS	20/8cm									
			7	SS	20/5cm									
			8	SS	50/8cm									
			9	SS	50/8cm									
229.7	End of borehole													
6.9	Sampler bouncing on cobbles from 3.8m depth.													
	* 2005 12 13													
	Water level observed during drilling													
	Water level measured after drilling													

Table B1

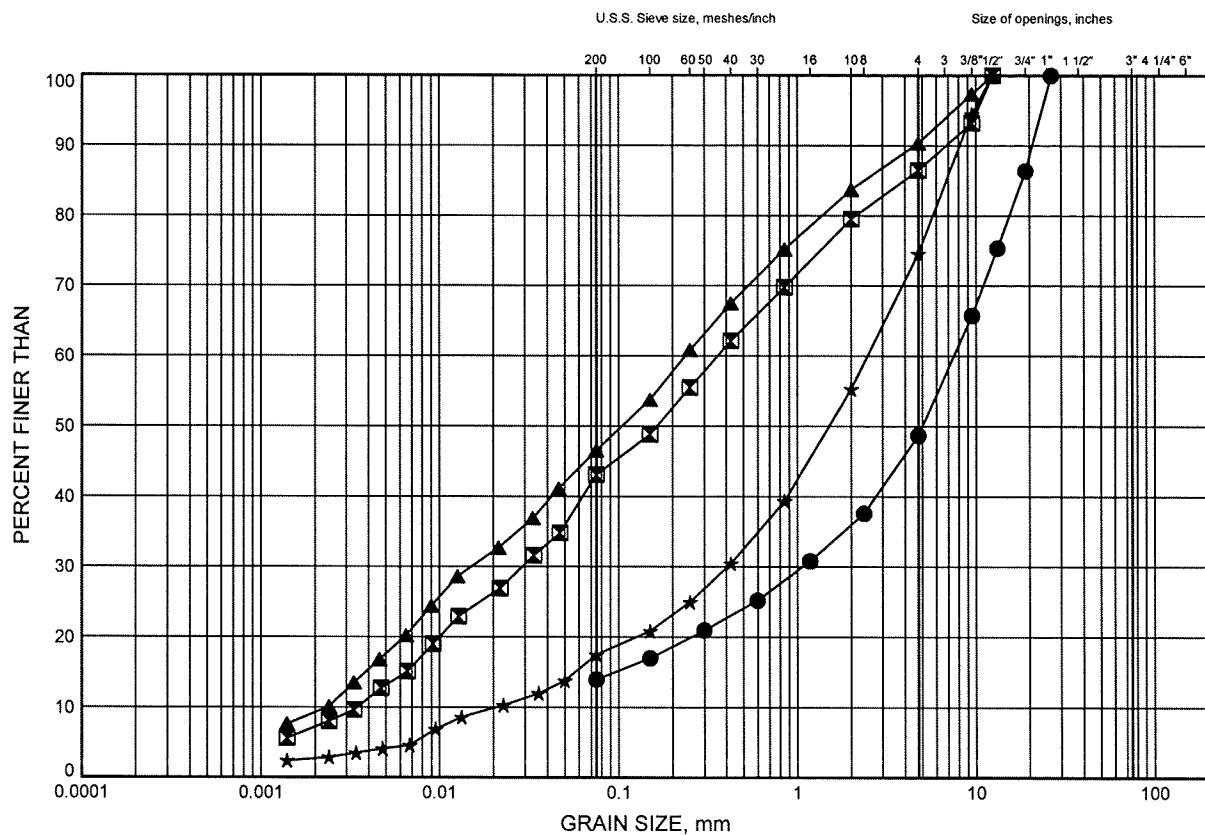
Record of Test Pits

Test Pit No.	Station	Offset	Depth (m)	Soil Profile
09-1	26+615	15 m RT	0.0 - 1.0 1.0 - 2.8 2.8	Rockfill Silty Clay Fill, firm, dark brown Refusal No water observed
09-2	26+575	14 m RT	0.0 - 0.2 0.2 - 2.5 2.5	Organics Sand Fill, some silt, mixed with silty clay, with cobbles and boulders Refusal No water observed
09-3	26+500	14 m RT	0.0 - 0.2 0.2 - 2.2 2.2	Organics Sand Fill, some silt and clay, trace roots Refusal No water observed
09-4	26+400	16 m RT	0.0 - 0.2 0.2 - 1.0 1.0 - 3.8	Organics Sand Fill, some gravel, brown Sand Fill, some silt, some clay, with rootlets, dark brown No water observed
09-5	26+325	16 m RT	0.0 - 0.2 0.2 - 1.0 1.0 - 3.7	Organics Sand Fill, some gravel, brown Sand Fill, some silt, trace gravel and clay, with roots, with cobbles and boulders No water observed
09-6	26+250	20 m RT	0.0 - 0.2 0.2 - 1.1 1.1 - 3.5	Organics Sand Fill, some gravel, brown Sand Fill, some silt, trace gravel, with cobbles and boulders No water observed. Sidewalls collapsed.

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE B1

FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-096	1.79	
■	10-097	2.59	
▲	10-098	1.83	
★	10-099	3.35	

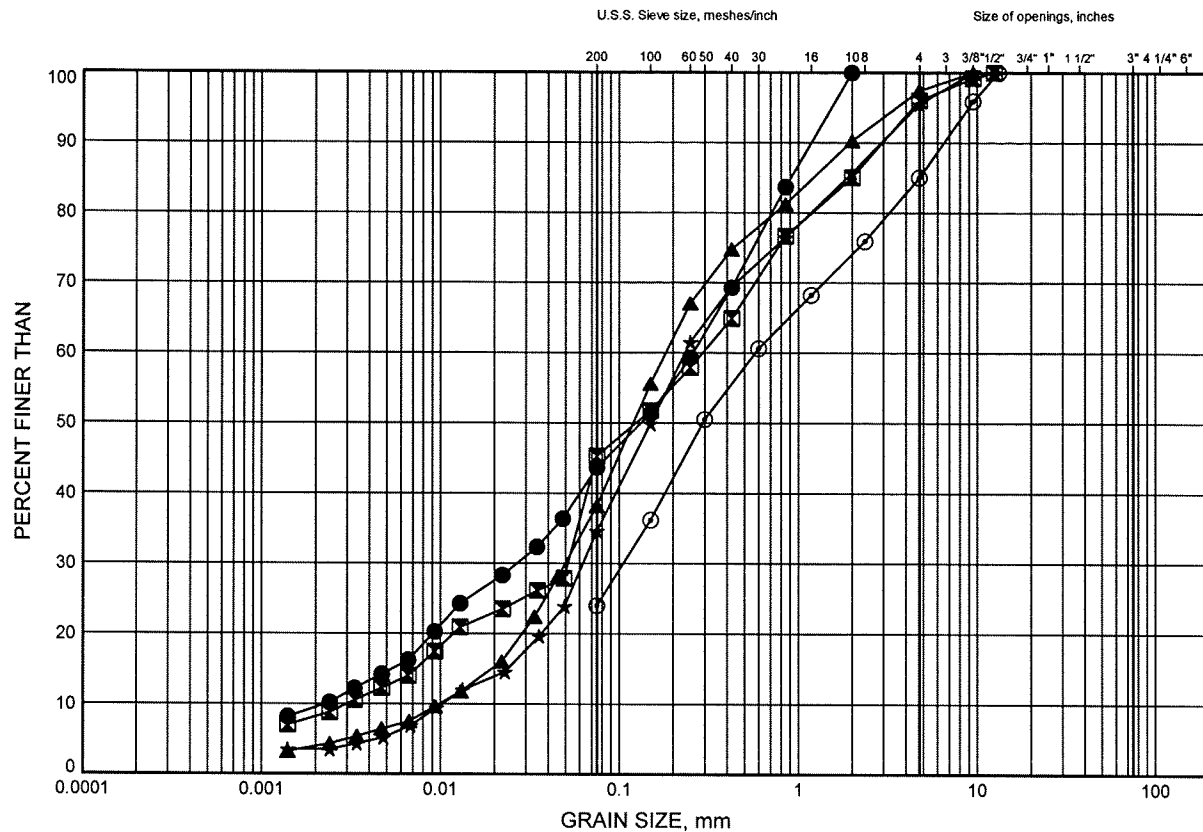


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND			GRAVEL		SIZE

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-074	1.83	
⊠	09-075	1.07	
▲	09-076	1.07	
★	09-076	2.59	
⊙	09-077	1.07	

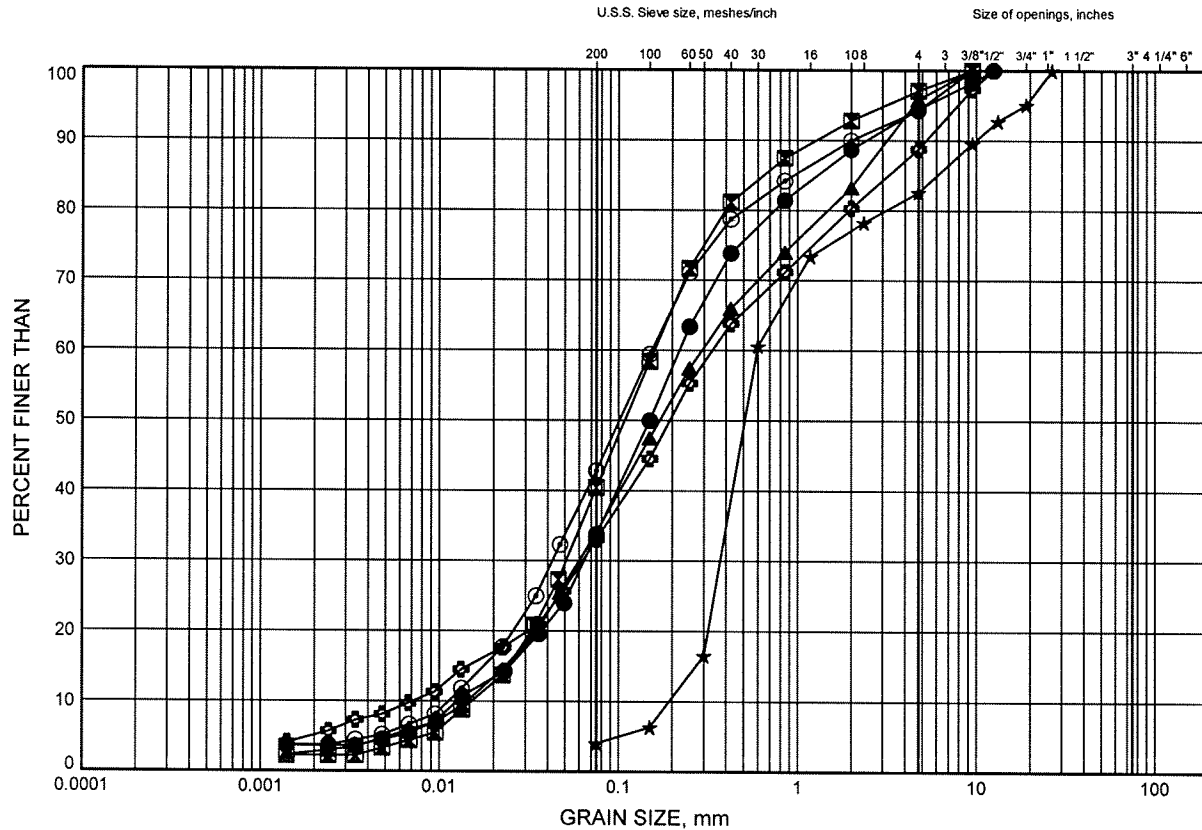


W.P.# 334-94-00
Prepared By .AN.
Checked By .MRA.

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE B3

SAND & SILT TILL



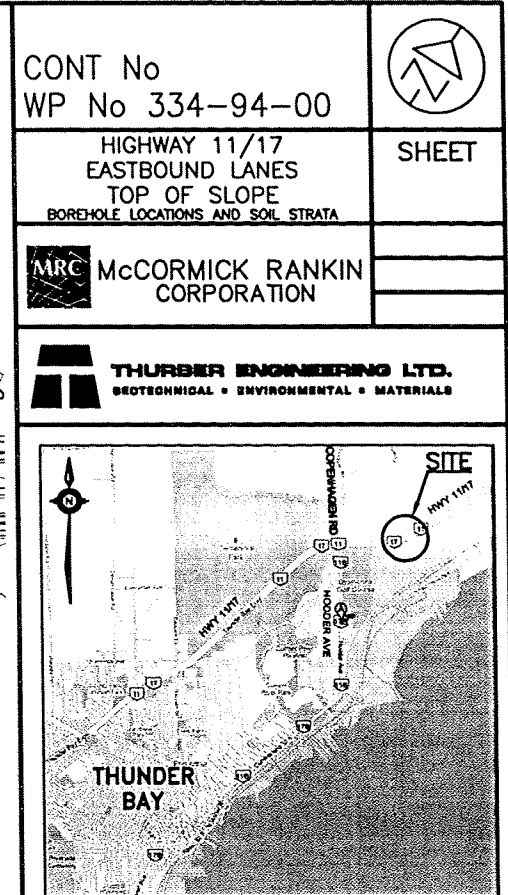
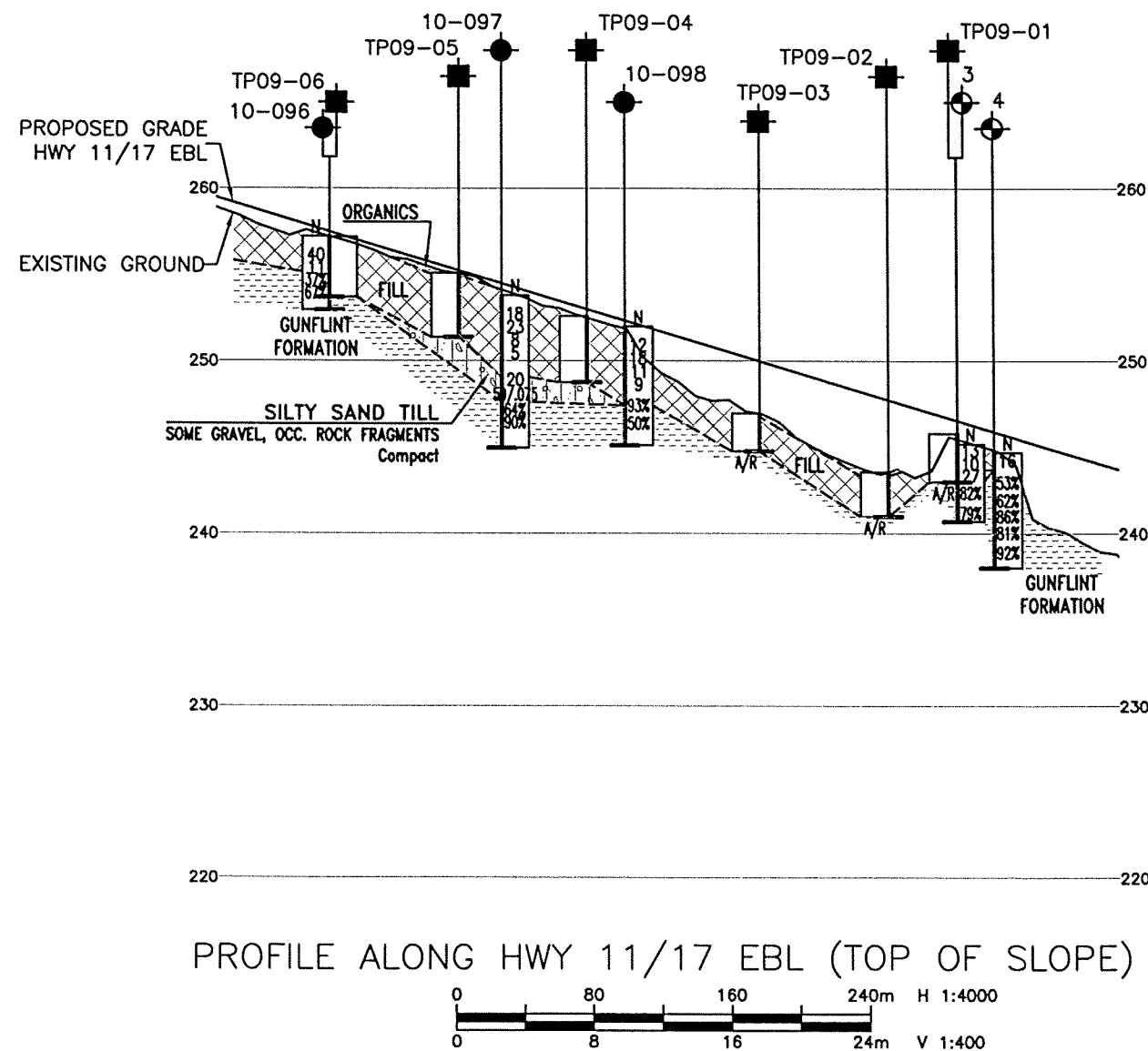
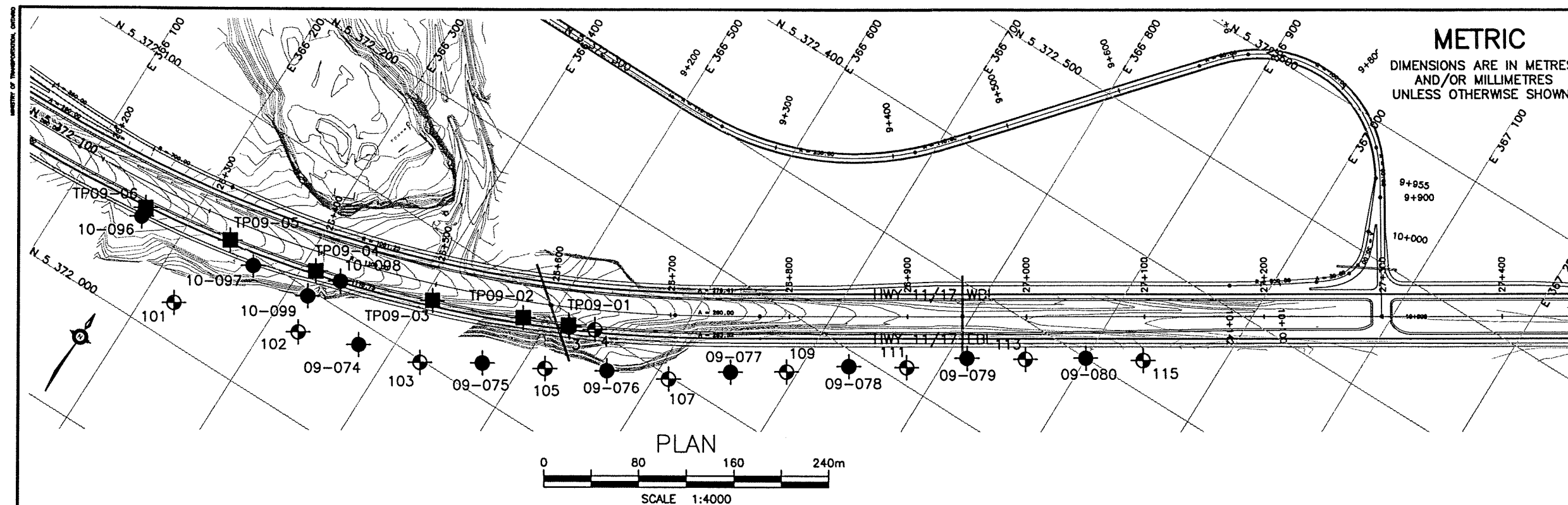
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		







LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-078	1.83	
⊠	09-078	3.35	
▲	09-079	2.59	
★	09-080	1.83	
⊙	09-080	5.11	
⊕	10-097	4.88	



W.P.# .334-94-00.....
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Checked By .MRA.....



L E G E N D		
	Borehole	
	Borehole by Others (1991 and 2005)	
	Test Pit	
N	Blows /0.3m (Std Pen Test, 475J/blow)	
CONE	Blows /0.3m (60° Cone, 475J/blow)	
PH	Pressure, Hydraulic	
	Water Level	
	Head Artesian Water	
	Piezometer	
90%	Rock Quality Designation (RQD)	
A/R	Auger Refusal	

NO	STATION	℄ OFFSET
10-096	26+250	28m RT.
10-097	26+350	29m RT.
10-098	26+422	18m RT.
10-099	26+400	38m RT.
TP09-01	26+615	15m RT.
TP09-02	26+575	14m RT.
TP09-03	26+500	14m RT.
TP09-04	26+400	16m RT.
TP09-05	26+325	16m RT.
TP09-06	26+250	20m RT.
3	26+615.9	16.7m RT.
4	26+637.3	16.5m RT.

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146

[illegible]

Appendix C

Highway 11/17 EBL

Station 29+400 to 29+900



Boreholes 10-104, 10-105, and 10-115 to 10-123

RECORD OF BOREHOLE No 10-104

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 373 948.9 E 369 222.6 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.29 - 2010.01.29 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
251.7								20	40	60	80	100					
0.0	SAND and GRAVEL , occasional cobbles, trace organics Dark Brown to Brown Frozen to Moist (FILL)		1	AS											○		
250.9							251										
0.8	Silty SAND , trace to some gravel, occasional cobbles, occasional roots Compact Brown		1	SS	17										○		
250.3																	
1.4	END OF BOREHOLE AT 1.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 1.4m, AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

+³ x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-105

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 373 992.0 E 369 230.0 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.27 - 2010.01.27 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
261.3														
0.0 0.1	ASPHALT: (75mm)													
	SAND and GRAVEL Brown Frozen to Moist (FILL)		1	AS			261							
			2	AS			260							
259.8														
1.5	SAND, some gravel, some silt Dense to Very Dense Dark Brown Moist (FILL)		1	SS	47		259							
			2	SS	55									
258.3														
3.0	Silty SAND, some gravel Very Dense Dark Brown to Brown Moist		3	SS	42		258							
257.1														
4.2	END OF BOREHOLE AT 4.2m UPON AUGER REFUSAL ON PROBABLE BEDROCK OR BOULDERS. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH SAND TO 2.4m, THEN BENTONITE TO 0.2m, THEN ASPHALT TO SURFACE.													

+³ ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-115

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+500 28m RT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.21 - 2010.01.21 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0 0.1	ASPHALT: (75mm) SAND and GRAVEL Very Dense Dark Brown Moist (FILL)		1	AS										
			1	SS	100/ .125									
1.5	SAND, some silt, some gravel Very Dense to Compact Brown Moist (FILL)		2	SS	70									22 57 21 (SI+CL)
			3	SS	47									
			4	SS	25									
4.1	Silty SAND, trace gravel Compact Brown Moist to Wet		5	SS	16									3 65 32 (SI+CL)
			6	SS	11									
7.6	Sandy SILT, trace gravel Dense to Loose Grey Moist to Wet		7	SS	35									
			8	SS	6									0 21 76 3

Continued Next Page

+³, X³: Numbers refer to 20
15 10 5 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-115

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+500 28m RT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.21 - 2010.01.21 CHECKED BY TH

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 LAB VANE					WATER CONTENT (%) W P W W L				
	Continued From Previous Page																
10.7	Gravelly SAND, trace silt Very Dense Grey Moist to Wet		9	SS	100/												
10.9	END OF BOREHOLE AT 10.9m UPON AUGER REFUSAL. BOREHOLE OPEN TO 9.9m, AND WATER LEVEL AT 4.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 3.2m, THEN BENTONITE TO 0.15m, THEN ASPHALT TO SURFACE.				.125												

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 10-117

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+550 47m RT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.27 - 2010.01.28 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								20	40	60	80	100				

+³ X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100 	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L 		
							SHEAR STRENGTH kPa				
							○ UNCONFINED + FIELD VANE				
							● QUICK TRIAXIAL × LAB VANE				
							20 40 60 80 100		20 40 60		

[illegible]




+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 10-120

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+690 39m RT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.29 - 2010.01.29 CHECKED BY TH

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								
								○ UNCONFINED	+ FIELD VANE											
								● QUICK TRIAXIAL	× LAB VANE											
								20	40	60	80	100		20	40	60				
0.0	Silty SAND , trace to some gravel Brown Frozen to Moist		1	AS										○						
0.8	SAND , some to trace silt, trace gravel Loose to Compact Brown Moist		1	SS	4									○						
			2	SS	9										○					
			3	SS	11										○					
			4	SS	6									○						
4.6	SILT , some sand, trace gravel Dense Grey Moist		5	SS	37									○						
5.1	END OF BOREHOLE AT 5.1m UPON AUGER REFUSAL. BOREHOLE OPEN TO 4.8m, AND WATER LEVEL AT 4.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 1.5m, THEN BENTONITE TO SURFACE.																			

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-121

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+760 30m RT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.22 - 2010.01.26 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
0.0 0.1	ASPHALT: (75mm)						20	40	60	80	100						
	SAND and GRAVEL Brown Moist (FILL)		1	AS													
			1	SS	100/												
0.9	SAND, trace silt, some gravel Compact Brown Moist (FILL)				.125												
			2	SS	16												
			3	SS	21												
2.6	SAND, trace silt, trace gravel Compact Brown Moist																
			4	SS	41												
4.6	SAND, some gravel to gravelly, some silt Dark Brown Loose to Compact Wet		5	SS	4											21 64 15 (SI+CL)	
	Moist to Wet Grey		6	SS	11												
			7	SS	19											14 72 14 (SI+CL)	
			8	SS	0												

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-121

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+760 30m RT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.22 - 2010.01.26 CHECKED BY TH

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			20	40	60	80	100	W _P	W	W _L		
	Continued From Previous Page																
10.5	END OF BOREHOLE AT 10.5m UPON AUGER REFUSAL. BOREHOLE OPEN TO 4.5m, AND WATER LEVEL AT 4.1m UPON COMPLETION. BOREHOLE BACKFILLED WITH SAND TO 3.0m, THEN BENTONITE TO 0.15m, THEN ASPHALT TO SURFACE.																

ONTMT4S 1156.GPJ 4/15/10

METRIC

G.W.P. <u>334-94-00</u>	LOCATION <u>HWY 11/17, Sta. 29+760 40m RT</u>	ORIGINATED BY <u>JM</u>
HWY <u>11/17</u>	BOREHOLE TYPE <u>Hollow Stem Augers</u>	COMPILED BY <u>AN</u>
DATUM <u>Geodetic</u>	DATE <u>2010.01.28 - 2010.01.28</u>	CHECKED BY <u>TH</u>

[illegible]

(%) STRAIN AT FAILURE

ONTMT4S 1156.GPJ 4/15/10

RECORD OF BOREHOLE No 10-122

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+760 40m RT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.28 - 2010.01.28 CHECKED BY TH

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			20	40	60	80	100	W _P	W	W _L										
9.9	<p>Continued From Previous Page</p> <p>END OF BOREHOLE AT 9.9m. UPON AUGER REFUSAL. BOREHOLE OPEN TO 4.8m, AND WATER LEVEL AT 3.8m UPON COMPLETION.</p> <p>Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.</p> <p>WATER LEVEL READINGS:</p> <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (m)</th> <th>ELEV. (m)</th> </tr> </thead> <tbody> <tr> <td>2010.01.31</td> <td>1.4</td> <td>-</td> </tr> <tr> <td>2010.03.01</td> <td>1.5</td> <td>-</td> </tr> </tbody> </table>	DATE	DEPTH (m)	ELEV. (m)	2010.01.31	1.4	-	2010.03.01	1.5	-															
DATE	DEPTH (m)	ELEV. (m)																							
2010.01.31	1.4	-																							
2010.03.01	1.5	-																							

RECORD OF BOREHOLE No 10-123

1 OF 1

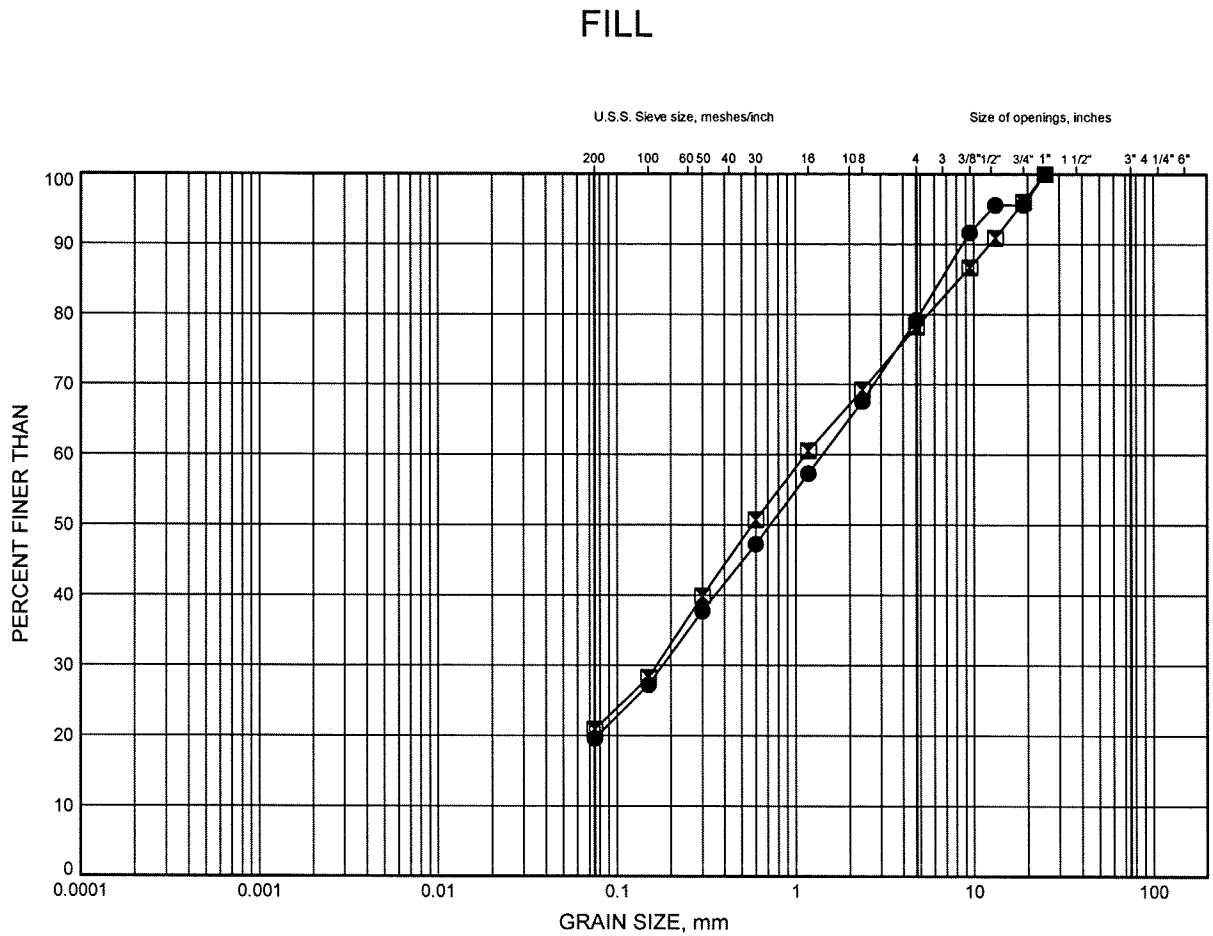
METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+830 45m RT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.28 - 2010.01.28 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W P W W L				
								○ UNCONFINED + FIELD VANE					WATER CONTENT (%)				
								● QUICK TRIAXIAL × LAB VANE									
						20	40	60	80	100	20	40	60				
0.0	ORGANICS, peat, silt and sand Dark Brown Frozen to Moist		1	AS													
			1	SS	6												
1.5	SAND, some gravel, trace silt, occasional cobbles, with organics Compact Dark Brown Moist to Wet		2	SS	16												
2.2	END OF BOREHOLE AT 2.2m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE C1



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-105	2.59	258.71
⊠	10-115	1.83	

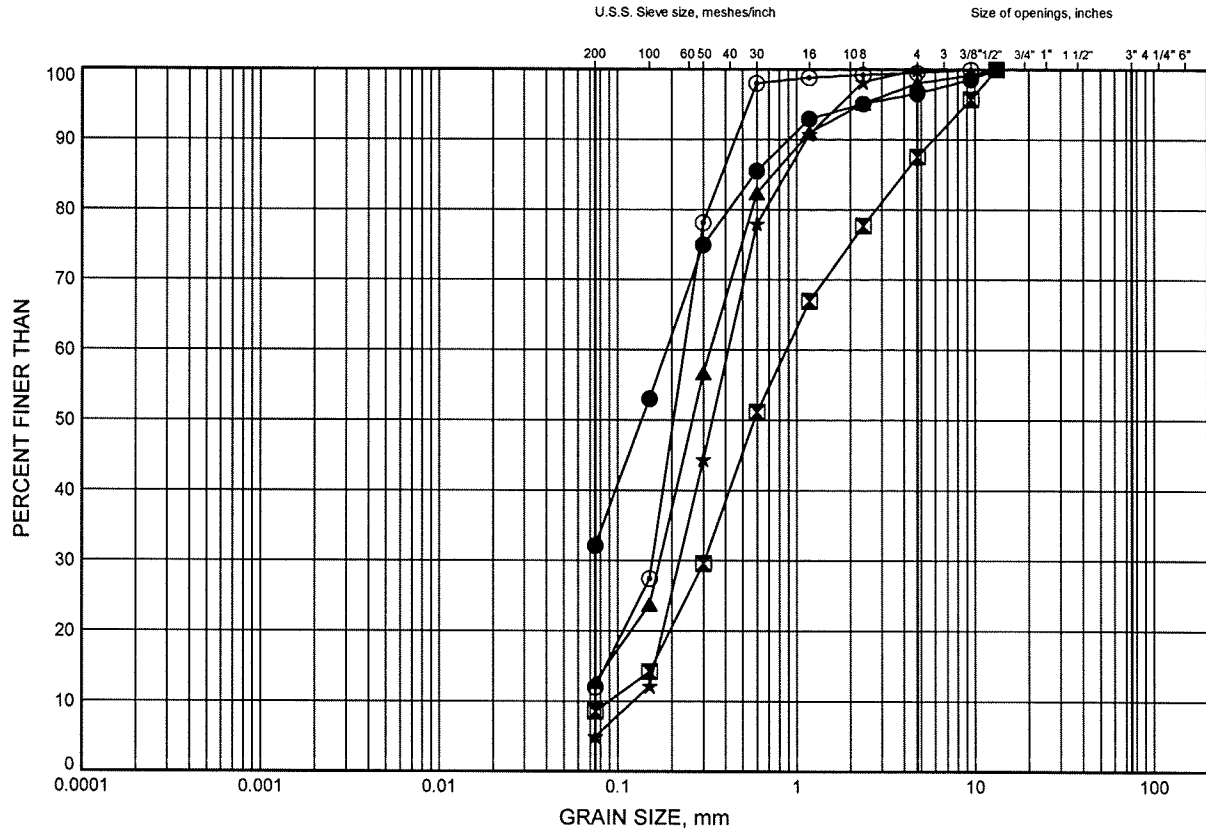


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE C2

SAND to SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-115	4.88	
⊠	10-116	2.59	
▲	10-117	2.59	
★	10-120	2.59	
⊙	10-122	6.40	

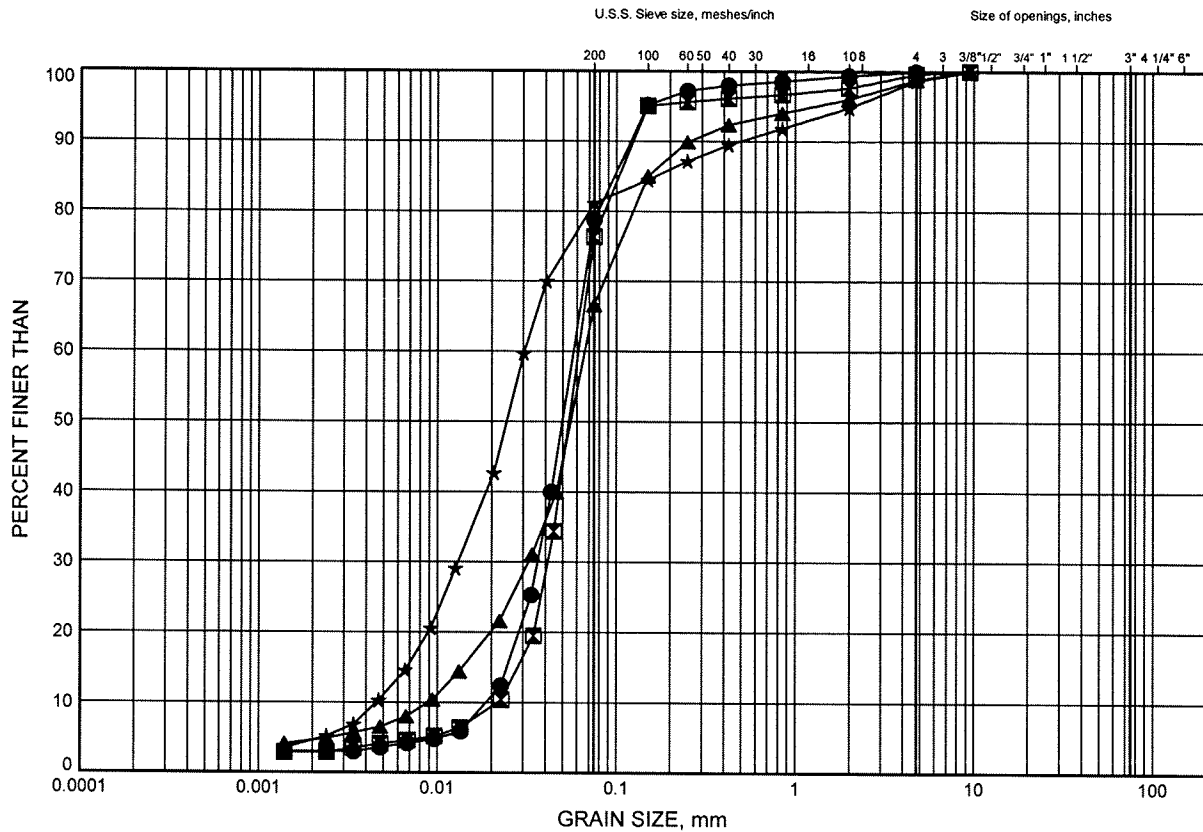


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE C3

SILT to SANDY SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-115	9.45	
⊠	10-116	4.88	
▲	10-119	2.59	
★	10-120	4.82	

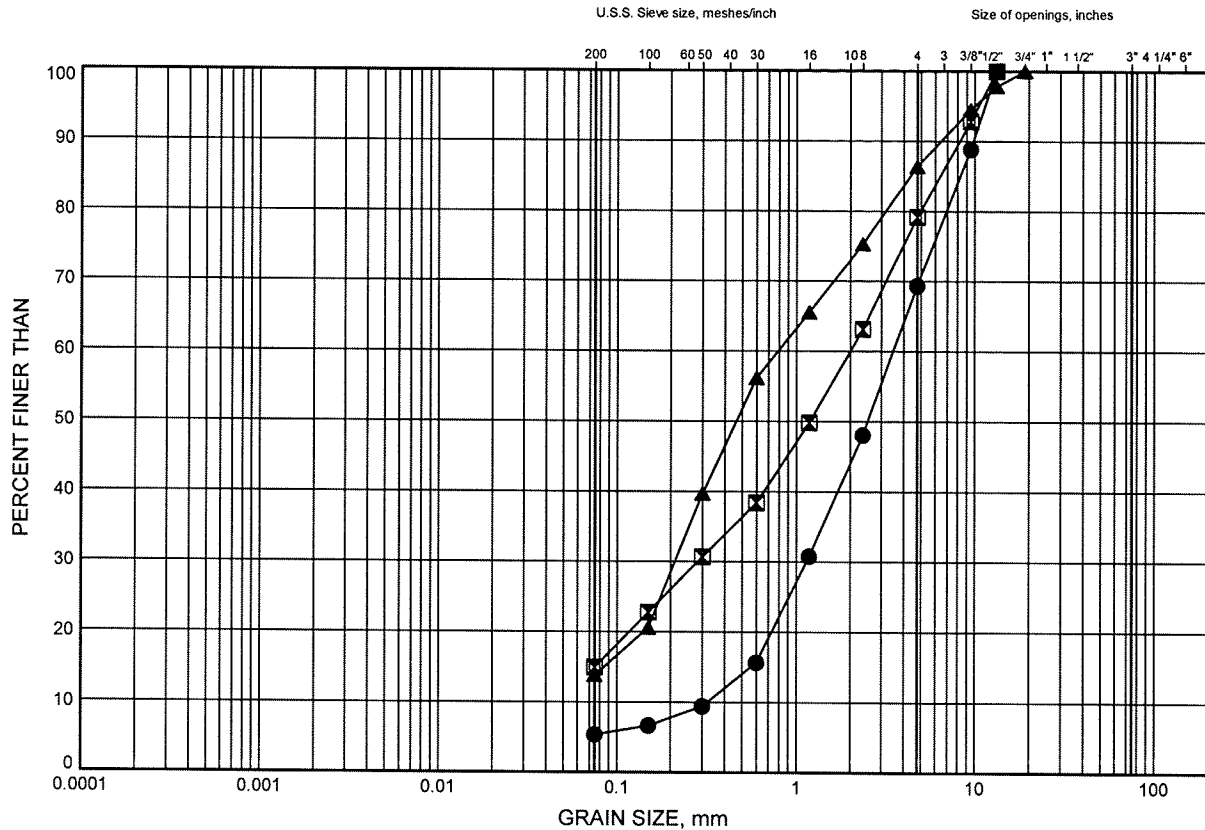


W.P.# .334-94-00.....
Prepared By .AN.....
Checked By .MRA.....

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE C4

GRAVELLY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-118	6.30	
⊠	10-121	4.88	
▲	10-121	7.92	

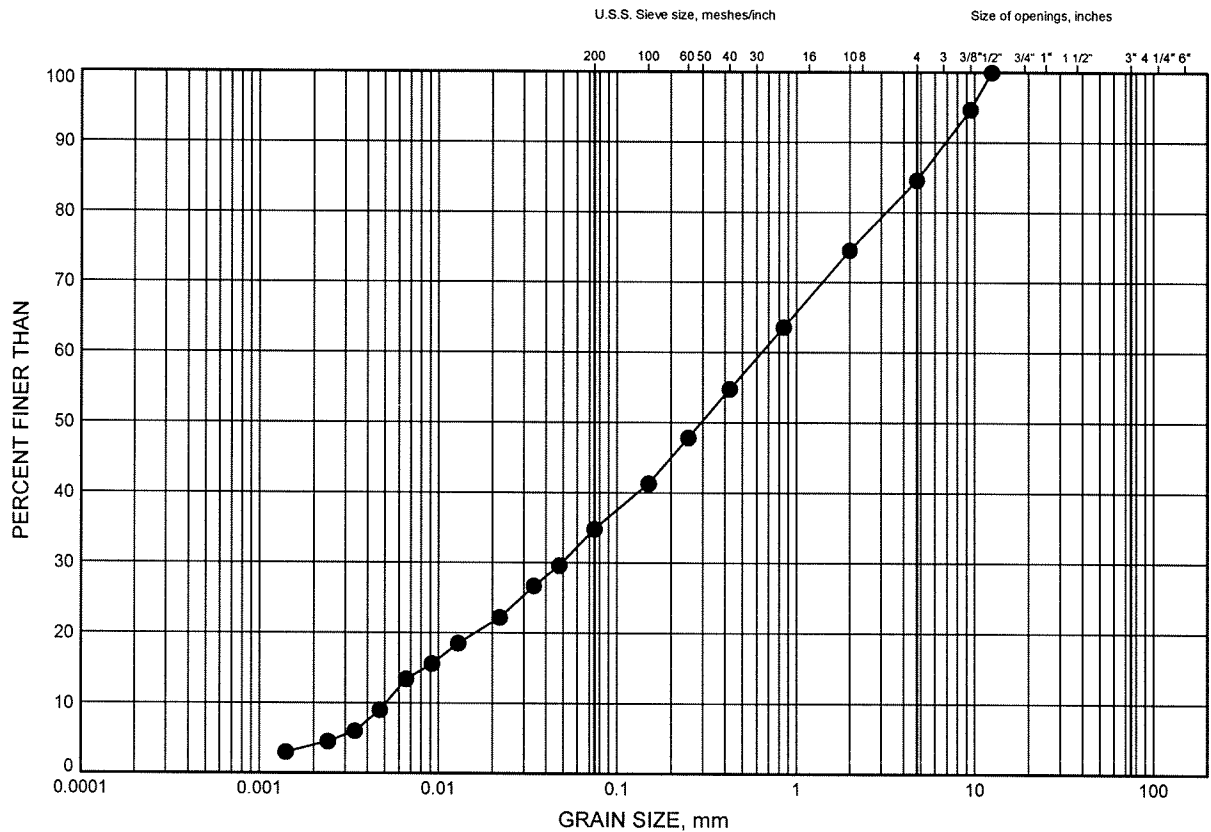


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Checked By .MRA.....

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE C5

SILTY SAND TILL



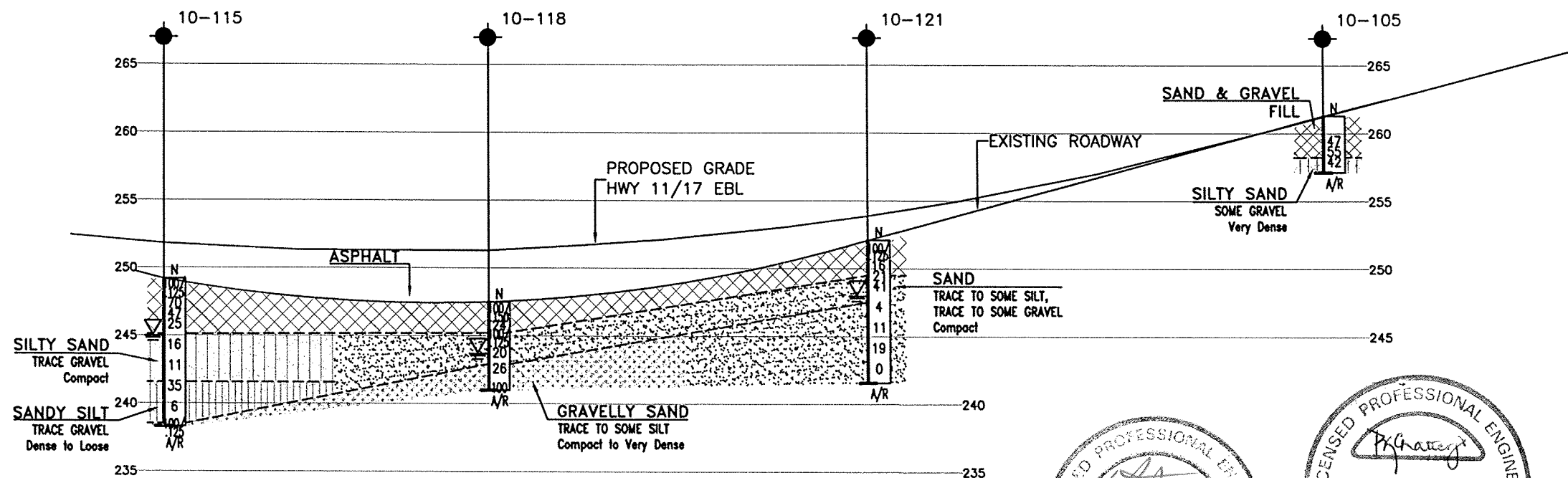
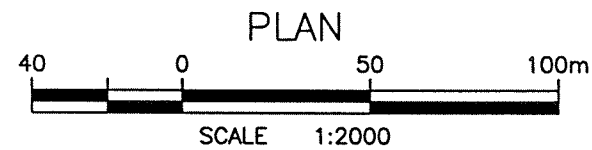
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-122	9.32	



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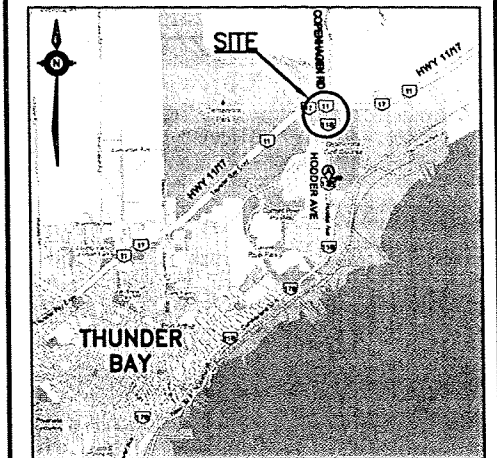
CONT No
WP No 334-94-00

HIGHWAY 11/17
EASTBOUND LANES
TOP OF SLOPE
BOREHOLE LOCATIONS AND SOIL STRATA






MRC **McCORMICK RANKIN**
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KEYPLAN
LEGEND

	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

[illegible]

-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146

REVISIONS									
	DATE	BY	DESCRIPTION				DATE	JUN. 2010	
DESIGN	MRA	CHK AEG	CODE	LOAD					
DRAWN	AN	CHK PKC	SITE	STRUCT	DWG	C1			

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

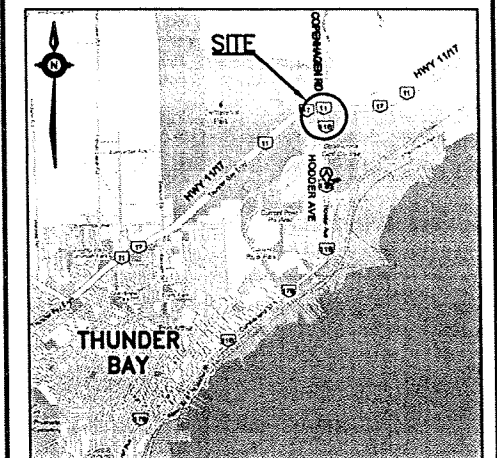
CONT No
WP No 334-94-00

HIGHWAY 11/17
EASTBOUND LANES
TOE OF SLOPE
BOREHOLE LOCATIONS AND SOIL STRATA

MRC **McCORMICK RANKIN**
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KEYPLAN

L E G E N D

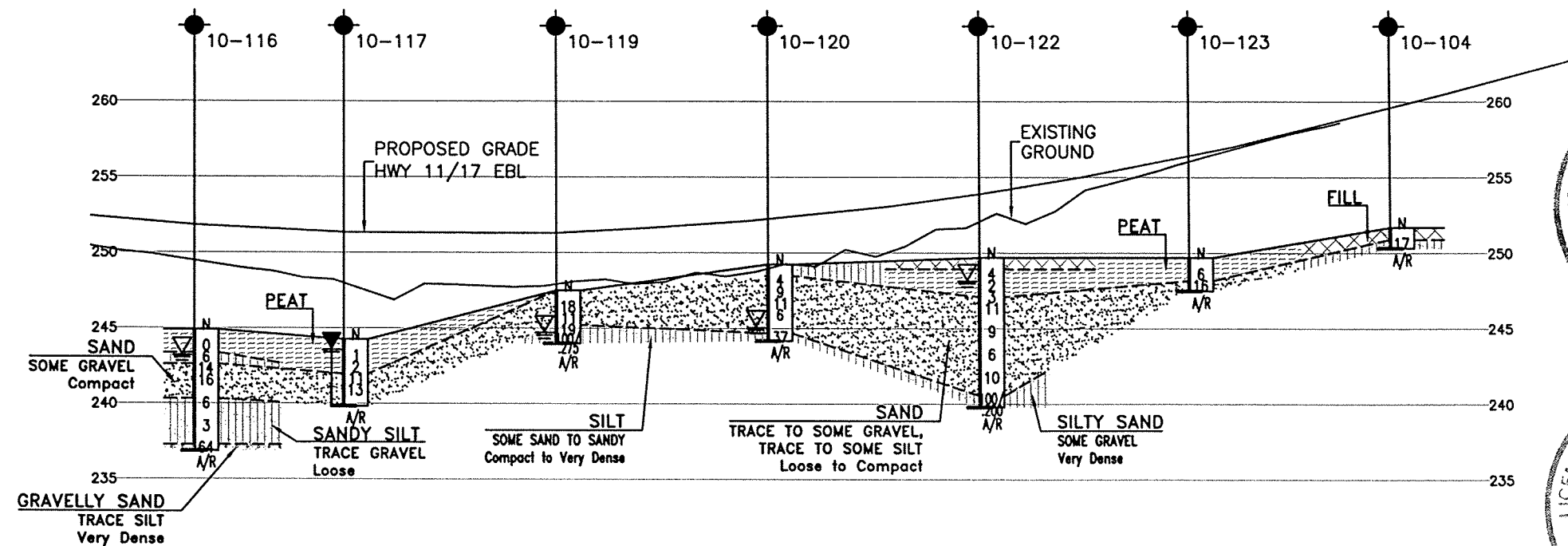
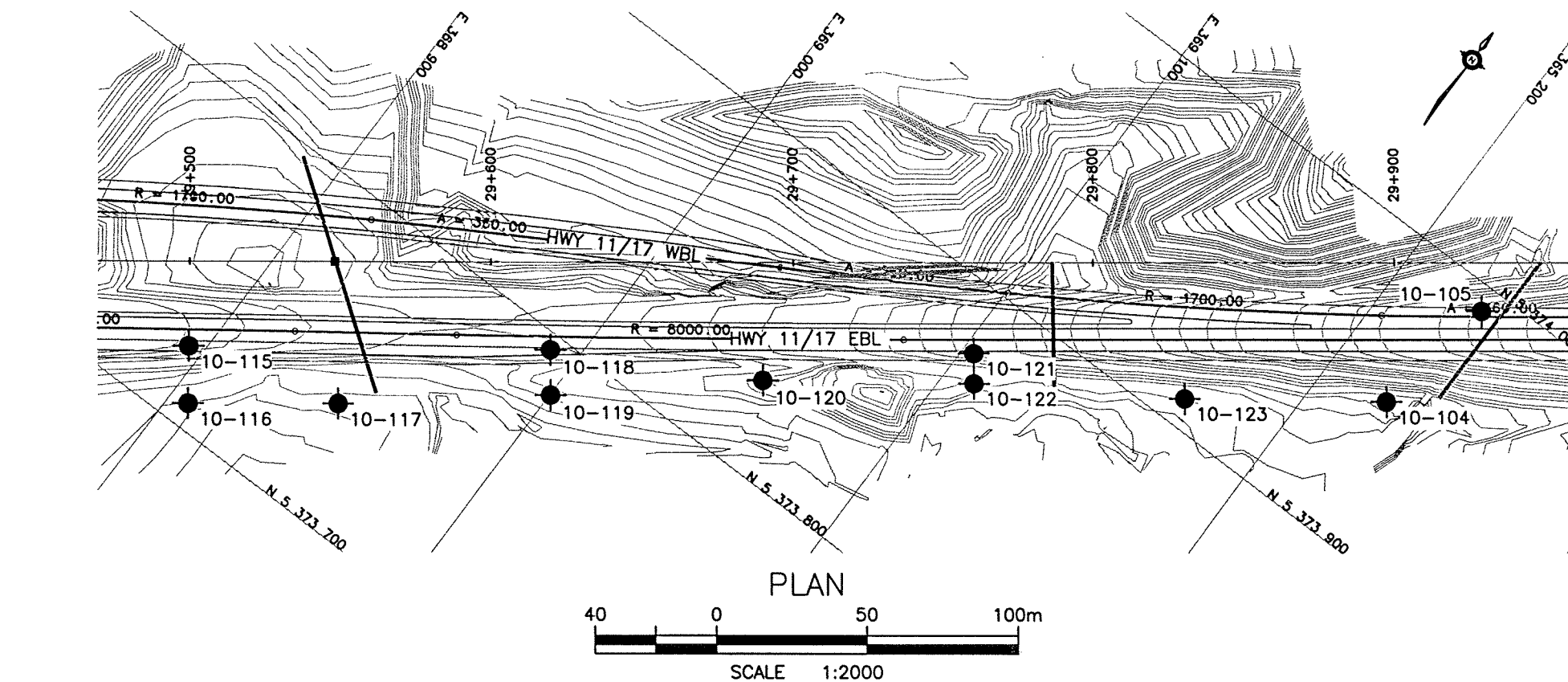
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	STATION	℄ OFFSET
10-104	29+896	46m RT.
10-116	29+500	47m RT.
10-117	29+550	47m RT.
10-119	29+620	44m RT.
10-120	29+690	39m RT.
10-122	29+760	40m RT.
10-123	29+830	45m RT.

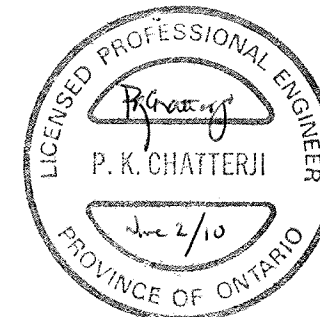
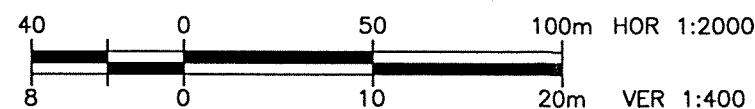
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146



PROFILE ALONG HWY 11/17 EBL (TOE OF SLOPE)



REVISIONS									
	DATE	BY	DESCRIPTION						
DESIGN	MRA	CHK	AEG	CODE	LOAD	DATE JUN. 2010			
DRAWN	AN	CHK	PKC	SITE	ISTRUCT	DWG	C2		

Appendix D

**Highway 11/17 WBL
Station 29+450 to 30+000**

**Boreholes 10-106 to 10-114
Cone C-01**

RECORD OF BOREHOLE No 10-106



1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 374 013.8 E 369 231.2 ORIGINATED BY JM
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2010.01.22 - 2010.01.22 CHECKED BY TH

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			20	40	60	80	100	W _p	W	W _L		
255.8																	
0.0	CRUSHED ROCK, some organics Dark Brown (FILL)		1	SS	52												
255.1																	
0.7	END OF BOREHOLE AT 0.7m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.						255										

METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100				
263.6							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	WATER CONTENT (%) 20 40 60			GR SA SI	

[illegible]


+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 10-107A

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 374 044.2 E 369 228.7 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.23 - 2010.01.23 CHECKED BY TH

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
260.5								20	40	60	80	100					
0.0	Silty SAND , some gravel, occasional roots Compact Brown Frozen (FILL)		1	SS	17												
259.8							260										
0.8	END OF BOREHOLE AT 0.8m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

+³ . X³ : Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-108

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+485 20m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.08 - 2010.01.08 CHECKED BY TH

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									
								20	40	60	80	100					

+³, X³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-111

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+600 42m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.07 - 2010.01.07 CHECKED BY TH

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										
								20 40 60 80 100										
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
							WATER CONTENT (%)					20 40 60			GR SA SI CL			
0.0	Sandy SILT, trace gravel, some roots Compact to Loose Dark Brown to Brown Frozen to Moist		1	SS	25													
			2	SS	9													
			3	SS	20													0 24 70 6
2.3	SILT, some sand Compact to Loose Brown Moist to Wet		4	SS	14													
			5	SS	7													0 2 93 6
4.6	SAND, trace silt Compact Brown Moist to Wet		6	SS	16													
6.1	SILT, some clay, trace sand Loose to Compact Brown Moist Occasional cobble		7	SS	10												0 7 82 11	
7.6	SAND, some silt, trace gravel, occasional cobbles Compact to Very Dense Grey Moist		8	SS	27													
			9	SS	35													

Continued Next Page

+³, x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-111

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+600 42m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.07 - 2010.01.07 CHECKED BY TH

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 LAB VANE					WATER CONTENT (%)				
						20	40	60	80	100	W _P	W	W _L				
	Continued From Previous Page																
	SAND, some silt, trace gravel, some rock fragments Very Dense Grey Moist		10	SS	53												
12.0	END OF BOREHOLE AT 12.0m UPON AUGER REFUSAL. BOREHOLE OPEN TO 11.4m AND WATER LEVEL AT 6.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																

RECORD OF BOREHOLE No 10-112

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+670 48m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.09 - 2010.01.09 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	TOPSOIL, some roots Dark Brown Frozen		1	SS	3									
0.8	SAND, some silt to silty Loose to Compact Brown Moist		2	SS	4									
			3	SS	11									
			4	SS	20									
			5	SS	18									
			6	SS	20									
			7	SS	20									
			8	SS	24									
9.1	Sandy SILT, trace clay Loose to Compact Brown Wet		9	SS	5									

Continued Next Page

+ 3, X 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-112

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+670.48m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.09 - 2010.01.09 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
	Continued From Previous Page																
	Sandy SILT, some clay Compact Brown Wet		10	SS	12											0 34 60 6	
			11	SS	23												
			12	SS	25												
14.2	SAND, some gravel, trace silt Compact to Very Dense Grey Wet		13	SS	100/ 0.125											15 75 10 (SI+CL)	
15.9	END OF BOREHOLE AT 15.9m UPON AUGER REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.01.31 1.5 -																

RECORD OF BOREHOLE No 10-113

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+740 17m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.06 - 2010.01.06 CHECKED BY TH

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 × LAB VANE		
								20	40	60	80	100						20	40	60
0.0	SAND , some silt to silty, trace gravel Compact to Very Dense Brown Moist 																			

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-113

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+740 17m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.06 - 2010.01.06 CHECKED BY TH

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	×						LAB VANE		
	Continued From Previous Page							20	40	60	80	100	20	40	60	kN/m ³	GR SA SI CL			
	SILT, some sand, trace clay Dense Brown Moist		9	SS	14												0 20 73 7			
12.2	SAND, some silt Compact Brown to Grey Wet		10	SS	25															
13.7	Sandy SILT, trace gravel Compact Brown to Grey Wet		11	SS	16												2 30 62 6			
14.5	END OF BOREHOLE AT 14.5m UPON AUGER REFUSAL. BOREHOLE OPEN TO 10.4m AND WATER LEVEL AT 7.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																			

RECORD OF BOREHOLE No 10-114

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+870 45m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.09 - 2010.01.09 CHECKED BY TH

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 × LAB VANE												
0.0	SAND, some silt, trace gravel, roots Loose to Compact Brown Moist		1	SS	59												7 73 20 (SI+CL)			
			2	SS	18															
			3	SS	12															
			4	SS	5															
			5	SS	20												3 73 19 5			
3.8	END OF BOREHOLE AT 3.8m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																			

+³ . X³ : Numbers refer to
Sensitivity

20
15
10


(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C-001

1 OF 1

METRIC

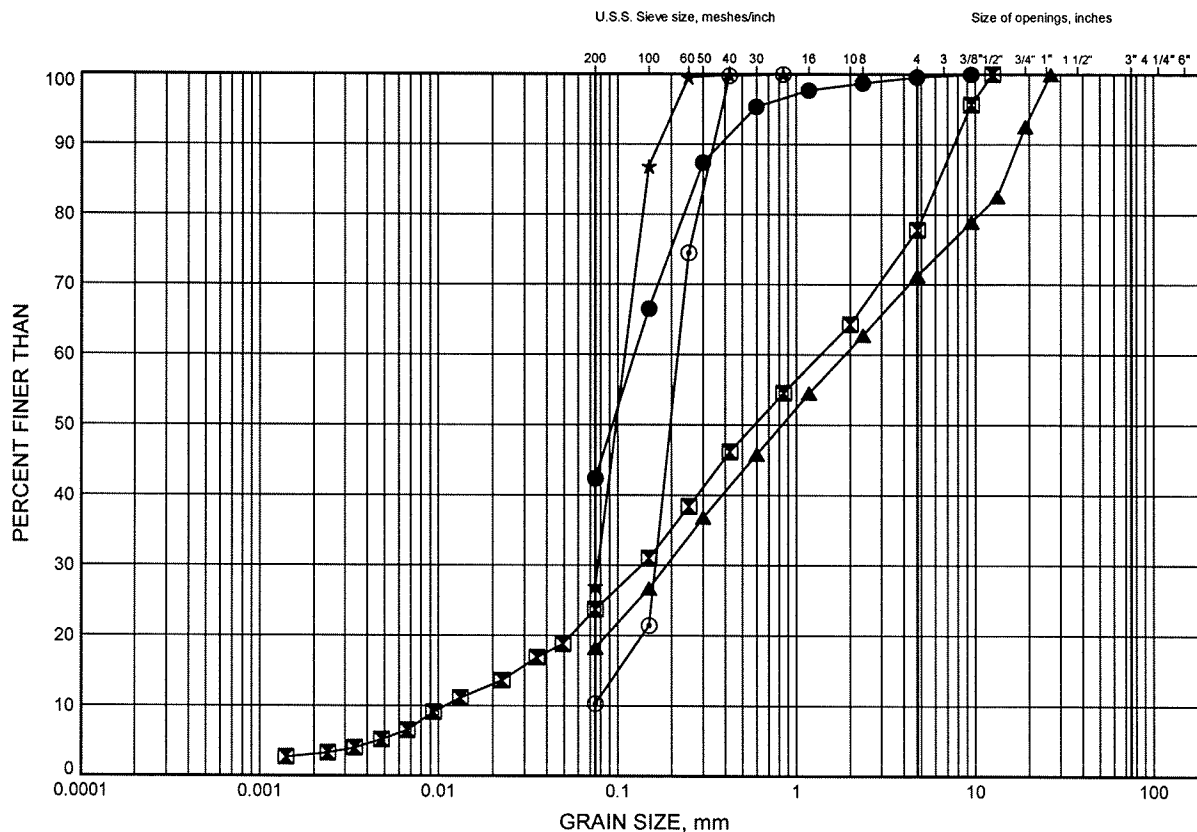
G.W.P. 334-94-00 LOCATION HWY 11/17, Sta. 29+510, 1m LT ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.08 - 2010.01.08 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	WATER CONTENT (%)	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							
0.0	ICE											
0.3	DCPT from surface											
0.9	END OF DCPT AT 0.9m.											

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE D1

SAND to SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-108	2.51	
⊠	10-109	1.83	
▲	10-110	2.59	
★	10-112	3.35	
⊙	10-112	6.40	

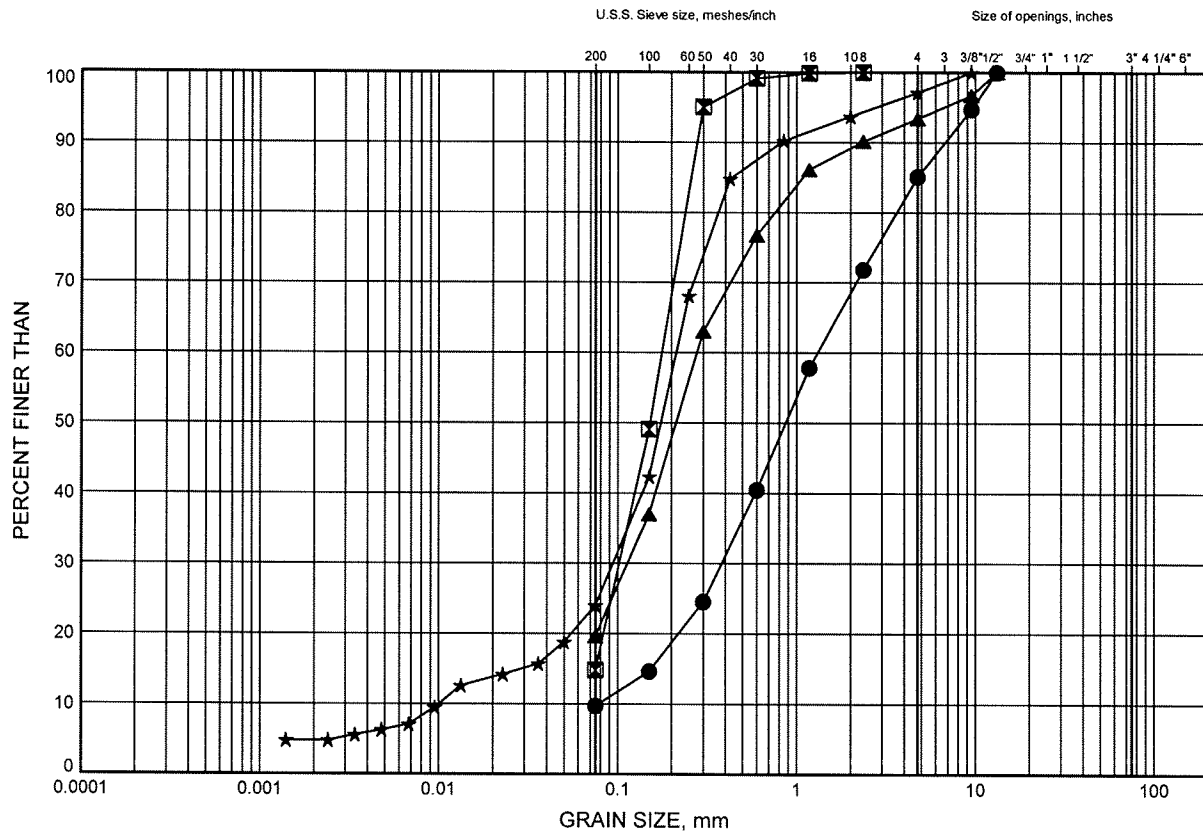


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Prepared By .AN.....
Checked By .MRA.....

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE D2

SAND to SILTY SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-112	15.47	
⊠	10-113	2.59	
▲	10-114	1.83	
★	10-114	3.35	

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 4/15/10

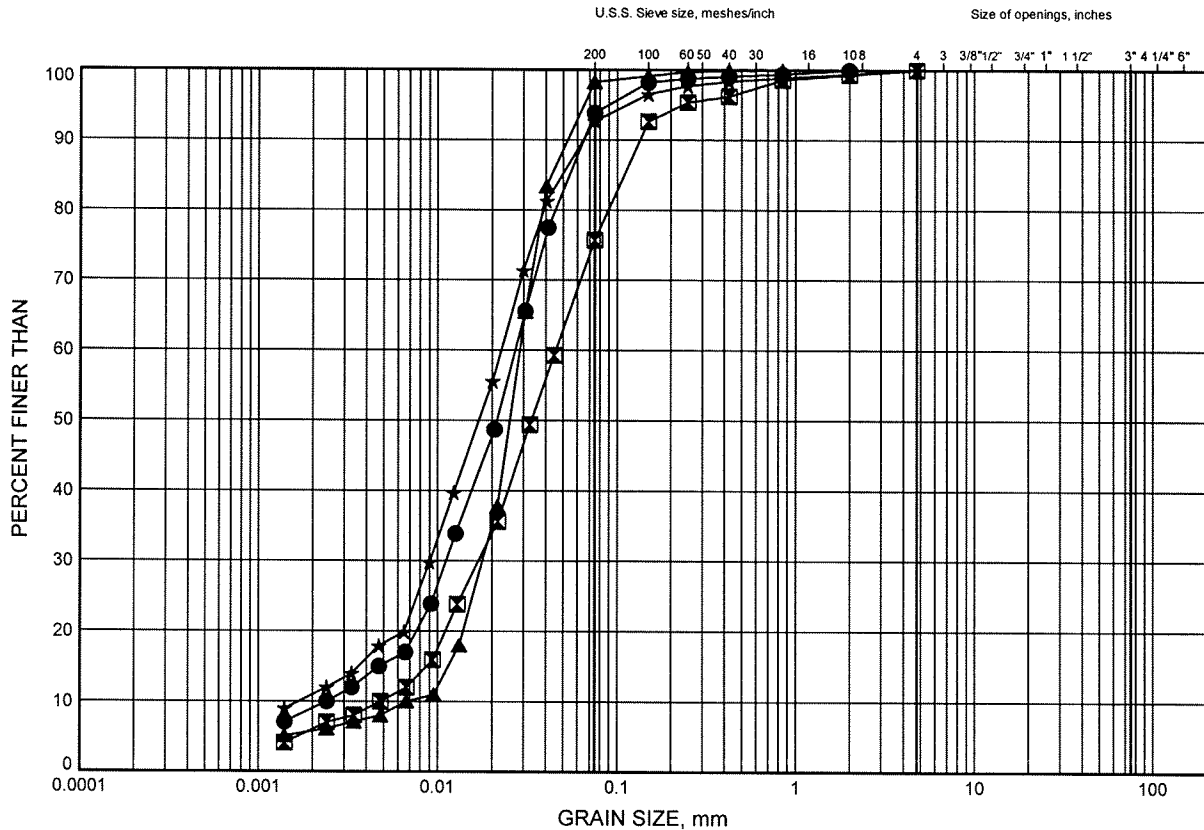
W.P.# 334-94-00
Prepared By AN
Checked By MRA



Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE D3

SILT to SANDY SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-108	2.82	
⊠	10-111	1.83	
▲	10-111	3.35	
★	10-111	6.40	

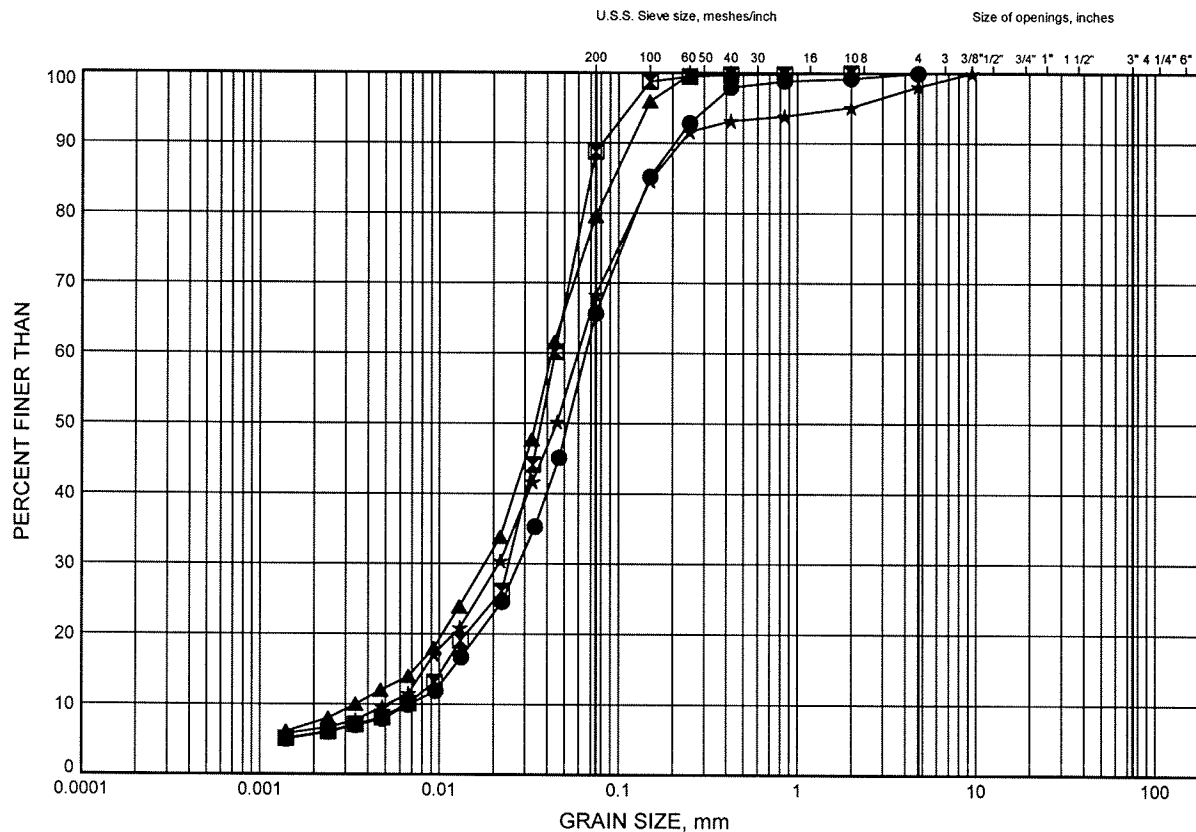


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Prepared By .AN.....
Checked By .MRA.....

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE D4

SILT to SANDY SILT



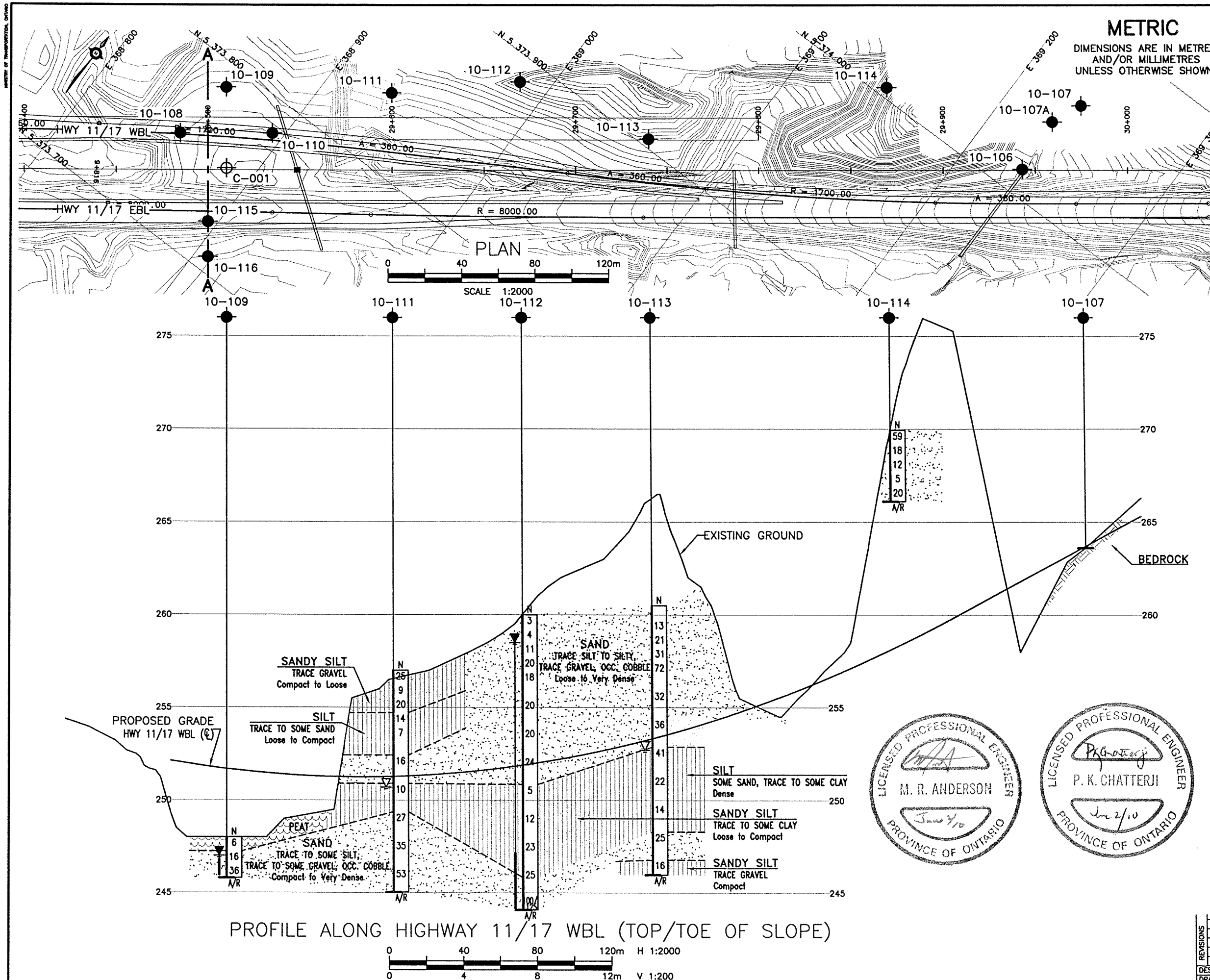
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-112	10.97	
⊠	10-113	7.92	
▲	10-113	10.97	
★	10-113	14.00	



W.P.# .334-94-00.....
Prepared By .AN.....
Checked By .MRA.....



CONT No
WP No 334-94-00

HIGHWAY 11/17
WESTBOUND LANES
29+450 TO 30+000
BOREHOLE LOCATIONS AND SOIL STRATA

MRC MCCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

KEYPLAN
LEGEND

◆ Borehole
⊕ Cone
N Blows /0.3m (Std Pen Test, 475J/blow)
CONE Blows /0.3m (60° Cone, 475J/blow)
PH Pressure, Hydraulic
W Water Level
H Head Artesian Water
P Piezometer
90% Rock Quality Designation (RQD)
A/R Auger Refusal

NO	ELEVATION	NORTHING	EASTING
10-106	255.8	5 374 013.8	369 231.2
10-107	263.6	5 374 060.7	369 235.9
10-107A	260.5	5 374 044.2	369 228.7

NO	STATION	OFFSET
10-108	29+485	20m LT.
10-109	29+510	45m LT.
10-110	29+535	20m LT.
10-111	29+600	42m LT.
10-112	29+670	48m LT.
10-113	29+740	17m LT.
10-114	29+870	45m LT.
10-115	29+500	28m RT.
10-116	29+500	47m RT.
C-001	29+510	1.0m LT.

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146

REVISIONS

DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG
DRAWN	MFA	CHK PKC

LOAD DATE JUN. 2010
STRUCT DWG D1

PLANNING JUN 01, 2010 - 2:46pm

Appendix E

Copenhagen Road

Station 9+550 to 9+950

Boreholes 09-47 to 09-64

Cones C-12 to C-19

RECORD OF BOREHOLE No 09-047


1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 030.9 E 365 262.0 ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.14 - 2009.07.14 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
260.4														
0.0	ORGANICS, peat, with roots and rootlets Brown						260							
259.5														
0.9	Clayey SILT, topsoil stained, trace roots and rootlets Firm Dark Brown		1	SS	8		259							
258.9														
1.5	Clayey SILT and SAND, trace gravel Hard Brown (TILL)		2	SS	61									4 34 48 14
257.8							258							
2.6	END OF BOREHOLE AT 2.6m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.		3	SS	50/126									

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _P W W _L	WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE × LAB VANE					
							20 40 60 80 100							
							20 40 60 80 100							

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 09-049

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+900 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
20 40 60 80 100														
○ UNCONFINED + FIELD VANE							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT					WATER CONTENT (%)		
● QUICK TRIAXIAL x LAB VANE							w _p w w _L							
20 40 60 80 100							20 40 60					GR SA SI CL		
0.0	ORGANICS, peat Black		1	AS								31.4		
			1	SS	2									
1.2	Clayey SILT, trace sand Soft Brown to Grey		2	SS	3									
2.2	Silty SAND, trace clay, trace gravel Very Dense Brown to Grey Moist to Wet (TILL)		3	SS	65								9 56 30 6	
			4	SS	50/									
3.3	END OF BOREHOLE AT 3.3m UPON AUGER REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.76m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.11.23 0.6 -				.050									

+³, x³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-050

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+875, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 × LAB VANE											
							20	40	60	80	100								

RECORD OF BOREHOLE No 09-051

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+850 CL ORIGINATED BY SLL
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL x LAB VANE						
								20 40 60 80 100						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
								w _p w w _L						
								WATER CONTENT (%)						
0.0	ORGANICS, peat Black		1	AS									253	
0.9	Clayey SILT, trace sand Soft Grey		2	SS	3									
1.4	END OF BOREHOLE AT 1.4m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.													

+³ x³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-052

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+825, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

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 (%)				
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					W _P — W — W _L						
						20	40	60	80	100	20	40	60				
0.0	TOPSOIL, with roots: (50mm)																
	Silty SAND, with shale fragments																
	Brown																
	Moist																
	(TILL)		1	SS	100/												
0.8	END OF BOREHOLE AT 0.8m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.				.025												

RECORD OF BOREHOLE No 09-053

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta 9+800 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _p	W	W _L		
0.0	TOPSOIL, with roots and rootlets (150mm)																
0.2	Silty SAND, with shale fragments Brown Moist (TILL)		1	SS	100/.125												
0.7	END OF BOREHOLE AT 0.7m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

ONTMT4S 1156.GPJ 3/17/10

METRIC

ELEV. DEPTH	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 (%)	
	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						WATER CONTENT (%)
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
							<div style="text-align: center;"> <p>20 40 60 80 100</p> </div> <div style="text-align: center;"> <p>20 40 60 80 100</p> </div>							

[illegible]

+³, ×³: Numbers refer to Sensitivity

METRIC

[illegible][illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 09-056

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+725, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
0.0	ORGANICS, peat Black		1	AS										
0.4	Silty SAND, trace clay, trace gravel Loose Brown (TILL)		1	SS	7									3 59 31 6
1.5	END OF BOREHOLE AT 1.5m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No 09-057

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+700 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa											
								20 40 60 80 100											
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
WATER CONTENT (%)					20 40 60					kN/m ³					GR SA SI CL				
0.0	ORGANICS, peat, with roots and rootlets Black Wet		1	AS												175			
0.8	Clayey SILT, trace sand Very Soft Grey		1	SS	1														
1.4	SILT, some clay to clayey, trace sand Stiff Grey with thin sand seams		2	SS	9												0 3 86 11		
			3	SS	11											0 6 72 22			
			4	SS	9														
3.8	Silty SAND, some gravel Compact Grey Wet (TILL)		2	AS															
			5	SS	100/														
4.8	END OF BOREHOLE AT 4.8m. ARTESIAN PRESSURE AT APPROX. 0.9m ABOVE GROUND SURFACE. BOREHOLE SEALED WITH BENTONITE TO SURFACE.				.050														

+³ ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-058

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+675, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	ORGANICS, peat Black		1	AS										
0.7	Clayey SILT, trace gravel, trace rootlets Firm Brown		1	SS	5									
1.4	Silty SAND, some gravel, trace clay, occasional cobbles Dense to Compact Brown Wet (TILL)		2	SS	40									
			3	SS	13									
			4	SS	14									
3.8	END OF THE BOREHOLE AT 3.8m UPON AUGER REFUSAL. BOREHOLE OPEN TO 1.9m AND WATER LEVEL AT 0.6m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 1.2m THEN CUTTINGS TO SURFACE.													

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100			
								W _p — W — W _L			
								WATER CONTENT (%) 20 40 60			

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 09-060

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+625, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)				
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					20 40 60 w _p w w _L				GR SA SI CL		
0.0	ORGANICS, peat Black																
0.5	Silty SAND, some gravel, trace clay, occasional cobbles Loose to Dense Dark Brown Moist (TILL)		1	SS	6											11 50 33 6	
			2	SS	50/												
1.8	END OF BOREHOLE AT 1.8m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 09-061

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+600 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
0.0	ORGANICS, with roots and rootlets					▽											
0.3	Clayey SILT, some sand, trace gravel, trace rootlets Soft Dark Brown		1	SS	3												
			2	SS	46												
1.8	Silty SAND, trace clay, trace gravel, occasional cobbles Dense Dark Brown to Brown Moist (TILL)																
			3	SS	44											1 58 37 4	
			4	SS	507												
3.2	END OF BOREHOLE AT 3.2m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 2.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 2.1m, THEN CUTTINGS TO SURFACE.				.075												

RECORD OF BOREHOLE No 09-062A

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 403.2 E 365 250.9 ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
256.2														
0.0	TOPSOIL, with roots and rootlets													
0.2	Silty SAND, some gravel, trace clay Loose Brown Wet (TILL)		1	SS	4									
254.6														
1.5	END OF BOREHOLE AT 1.5m UPON AUGER REFUSAL. BOREHOLE OPEN TO 1.1m AND WATER LEVEL AT 0.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.													

+³, X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-062B

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 421.6 E 365 255.9 ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.14 - 2009.07.14 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
256.8																	
0.0	ORGANICS, with roots and rootlets Black																
256.5																	
0.3	Silty CLAY, topsoil stained, trace roots and rootlets Soft to Firm Dark Brown		1	SS	4												
255.4																	
1.4	Silty SAND		2	SS	507												
255.1	Very Dense Brown																
1.7	(TILL)				.075												
	END OF BOREHOLE AT 1.7m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 10-062C

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 404.5 E 365 240.7 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.31 - 2010.01.31 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)								
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					PLASTIC LIMIT w _p NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L							
256.0							20	40	60	80	100									
0.0	PEAT, trace roots Dark Brown Frozen		1	AS		▽	256											155		
			1	SS	3		255												152	
254.4																				
1.5	SAND and SILT, some gravel Compact Grey Moist (TILL)		2	SS	15		254													
253.6			3	SS	100/															
2.4	END OF BOREHOLE AT 2.4m UPON AUGER REFUSAL. BOREHOLE OPEN TO 1.7m, AND WATER LEVEL AT 1.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 1.2m, THEN BENTONITE TO SURFACE.				0.100															

+³, X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-063

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 405.5 E 365 261.0 ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
256.3														
0.0	ORGANICS, peat		1	AS										
256.0	Black													
0.3	SAND and SILT, some clay, trace gravel Compact Grey Wet (TILL)		1	SS	17		256							
254.7							255							4 48 38 10
1.5	END OF BOREHOLE AT 1.5m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 1.4m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.													

+³ . X³: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-063B

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 372 428.0 E 365 280.1 ORIGINATED BY JM
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.31 - 2010.01.31 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
256.5								20 40 60 80 100						
0.0	PEAT, trace roots Dark Brown Frozen to Moist		1	AS				○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
	Occasional silt Very Loose		1	SS	0									
			2	SS	0									
254.5														
2.0	SILT, some clay, trace sand Loose to Compact Grey Moist		3	SS	16									
			4	SS	8									
252.3														
4.3	Silty CLAY, some sand, trace gravel Firm Grey Moist		5	SS	8									
251.7														
4.9	Silty SAND, trace gravel Loose to Compact Grey Moist													
251.1														
5.4	END OF BOREHOLE AT 5.4m UPON AUGER REFUSAL. BOREHOLE OPEN TO 3.7m, AND WATER LEVEL AT 0.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 2.1m, THEN BENTONITE TO SURFACE.													

+³, X³: Numbers refer to Sensitivity 20 15 10 5 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-064

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+550 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.14 - 2009.07.14 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
0.0	Gravelly SAND, some silt Brown Moist (FILL)		1	AS										
1.1	Clayey SILT, topsoil stained Firm Brown (FILL)		1	SS	7									22 61 17 (SI+CL)
1.6	ORGANICS, peat, with roots Firm to Soft Black		2	SS	5									
2.2	SAND													
2.4	Loose Grey Wet Silty CLAY, trace sand Firm Grey		3	SS	4									
3.1	END OF BOREHOLE AT 3.1m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE TO 2.3m, THEN CUTTINGS TO SURFACE.		4	SS	50/ .100									

+³, X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C-012

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+925, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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	20 40 60 80 100	20 40 60 80 100	20 40 60 80 100		
0.0	DCPT from surface.													
2.7	END OF DCPT AT 2.7m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.													

ONTMT4S 1156.GPJ 3/17/10

RECORD OF BOREHOLE No C-013

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+875, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

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 (%)					
0.0	DCPT from surface.													
3.0	END OF DCPT AT 3.0m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.													

RECORD OF BOREHOLE No C-014

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+825, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

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
0.0	DCPT from surface.																	
0.5	END OF DCPT AT 0.5m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.																	

RECORD OF BOREHOLE No C-015

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta 9+775, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
0.0	DCPT from surface.													
1.2	END OF DCPT AT 1.2m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.													

RECORD OF BOREHOLE No C-016

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+725, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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		
0.0	DCPT from surface.													
2.3	END OF DCPT AT 2.3m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.													

+³, X³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C-017

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+675, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

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			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
0.0	DCPT from surface.													
4.8	END OF DCPT AT 4.8m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.													

ONTMT4S 1156.GPJ 3/17/10

RECORD OF BOREHOLE No C-018

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+625, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

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 (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
0.0	DCPT from surface.							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE						
3.6	END OF DCPT AT 3.6m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.													

ONTMT4S 1156.GPJ 3/17/10

RECORD OF BOREHOLE No C-019

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+580, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.13 - 2009.07.13 CHECKED BY TH

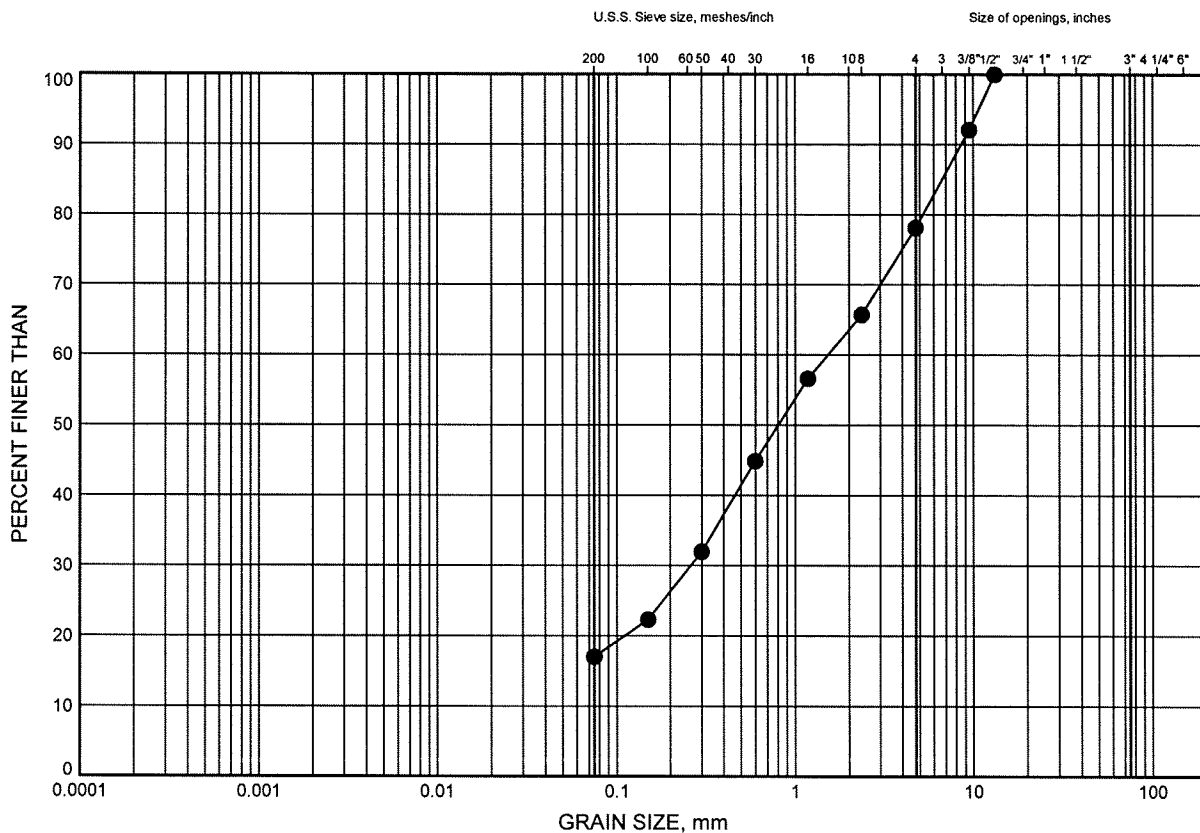
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _P	W	W _L		
0.0	DCPT from surface.																
2.0	END OF DCPT AT 2.0m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.																

ONTWT4S 1156.GPJ 3/17/10

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE E1

FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-064	0.91	

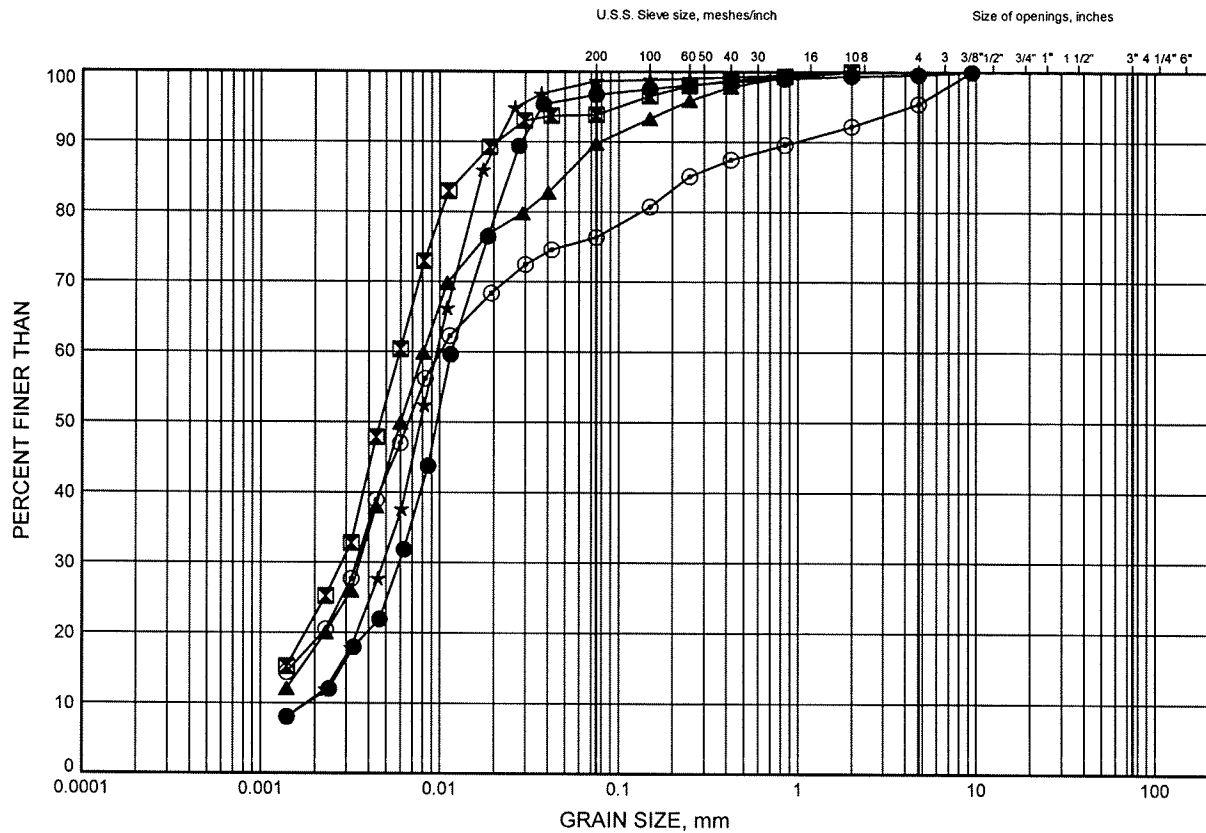


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE E2

CLAYEY SILT to SILTY CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-057	1.83	
⊠	09-057	2.59	
▲	09-059	1.83	
★	10-063B	2.59	253.94
⊙	10-063B	4.80	251.73

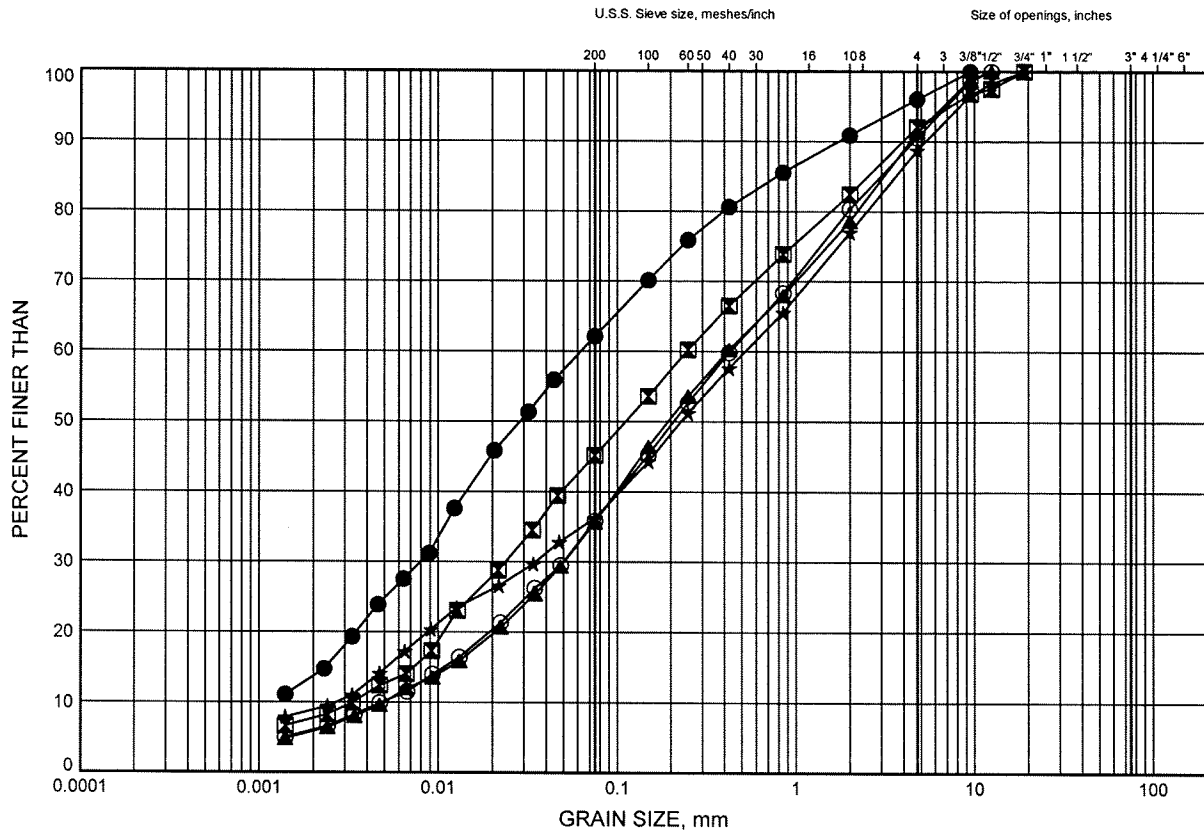


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE E3

SILTY SAND TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-047	1.83	258.57
⊠	09-048	1.83	
▲	09-049	2.59	
★	09-050	2.48	
⊙	09-054	1.76	

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 4/15/10

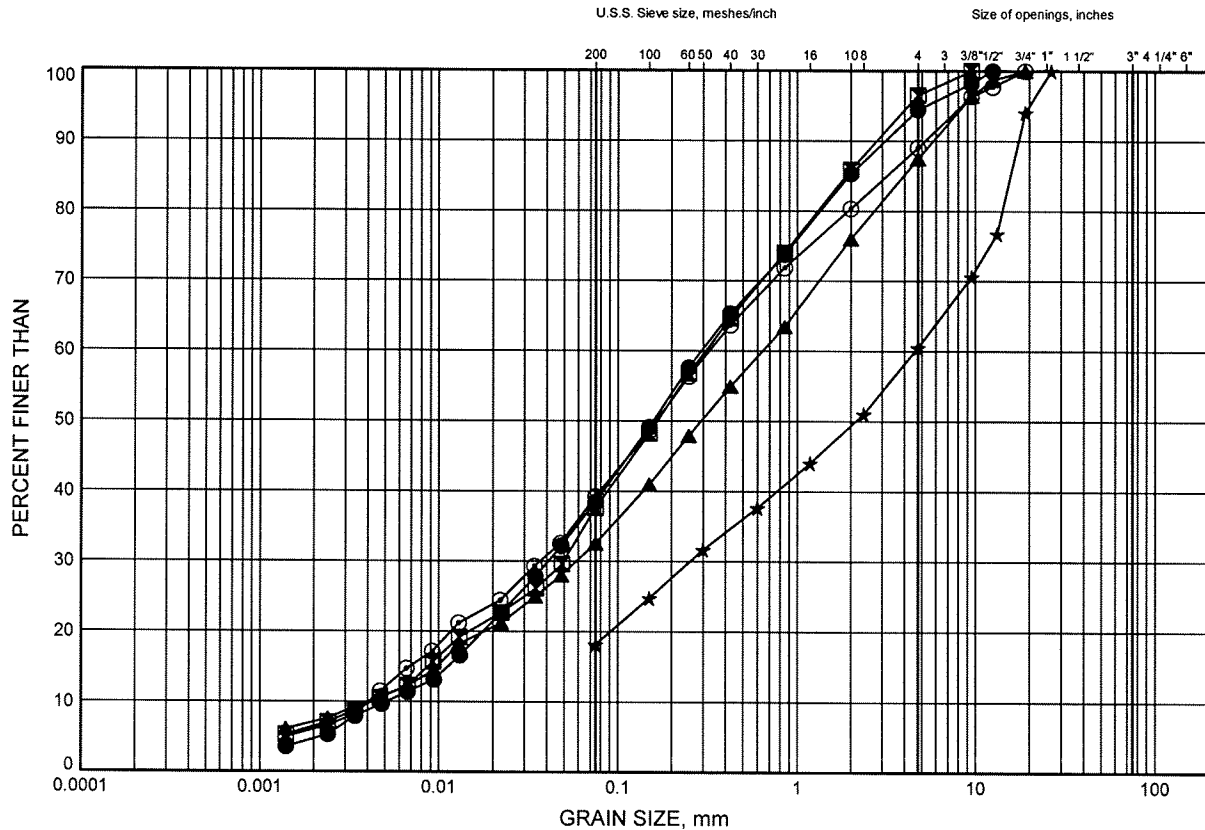
W.P.# 334-94-00
 Prepared By AN
 Checked By MRA



Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE E4

SILTY SAND TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-055	1.07	
⊠	09-056	1.07	
▲	09-058	3.35	
★	09-059	3.35	
⊙	09-060	1.07	

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 4/15/10

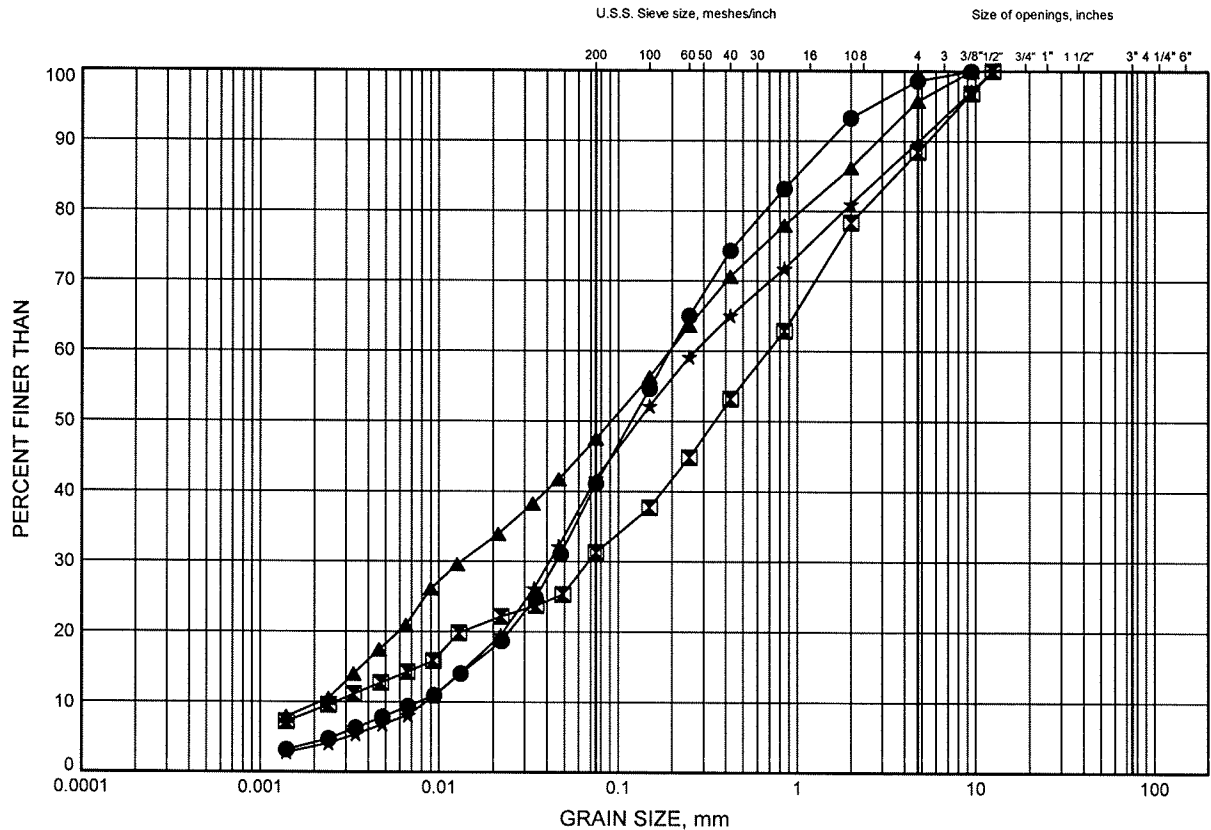
W.P.# 334-94-00
 Prepared By AN
 Checked By MRA



Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE E5

SILTY SAND TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND			GRAVEL		SIZE

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-061	2.57	
⊠	09-062A	1.07	255.11
▲	09-063	1.07	255.21
★	10-062C	1.83	254.14

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 4/15/10

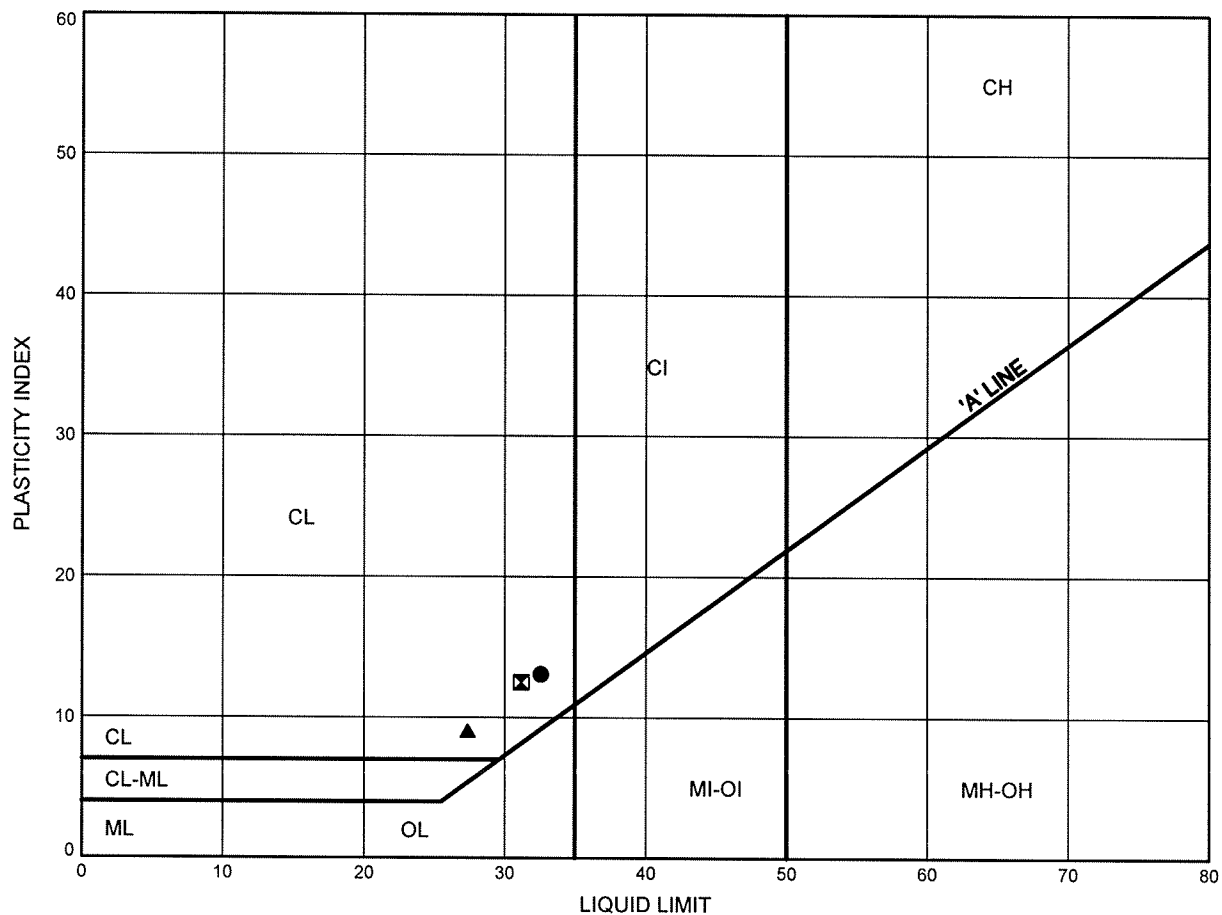
W.P.# 334-94-00
Prepared By AN
Checked By MRA



Hwy 11/17 Hodder Avenue
ATTERBERG LIMITS TEST RESULTS

FIGURE E6

CLAYEY SILT to SILTY CLAY

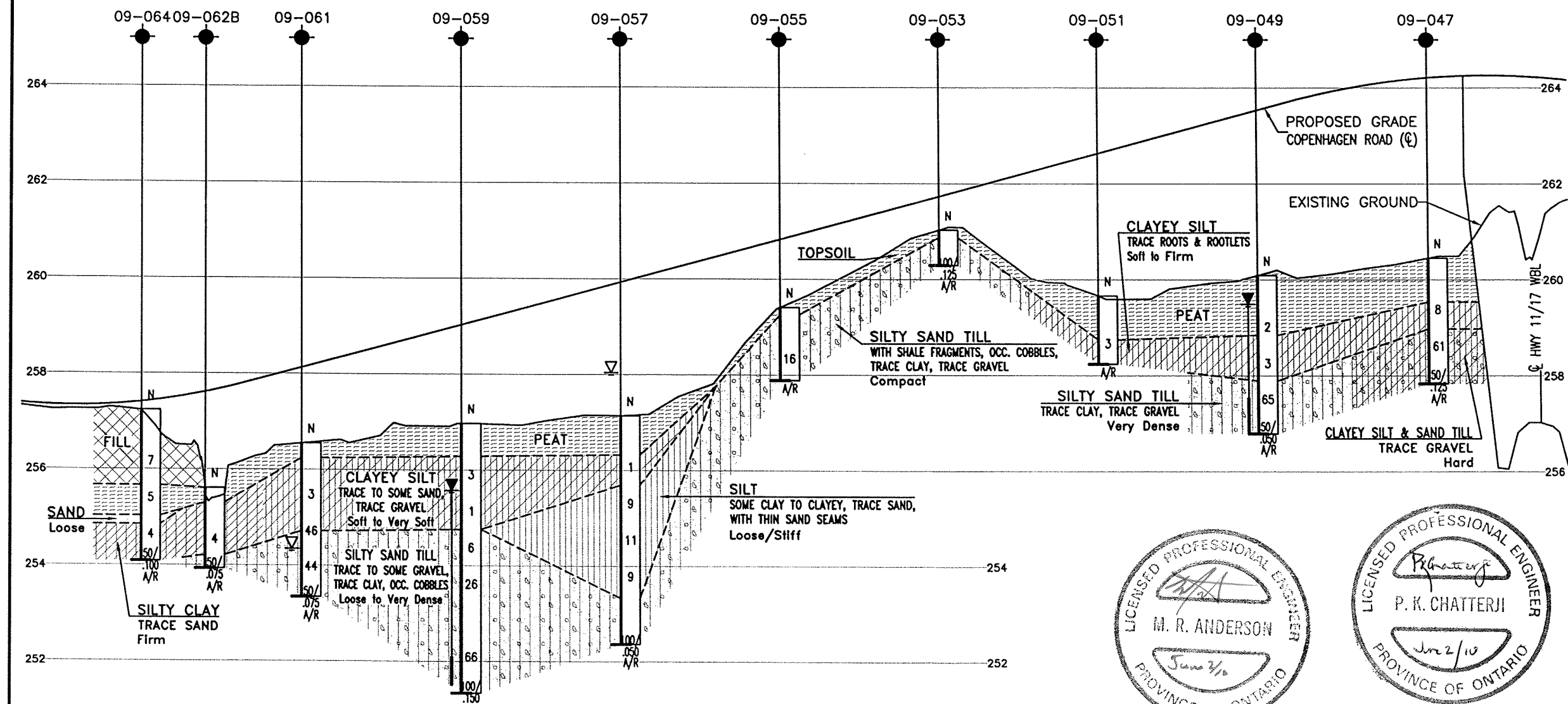
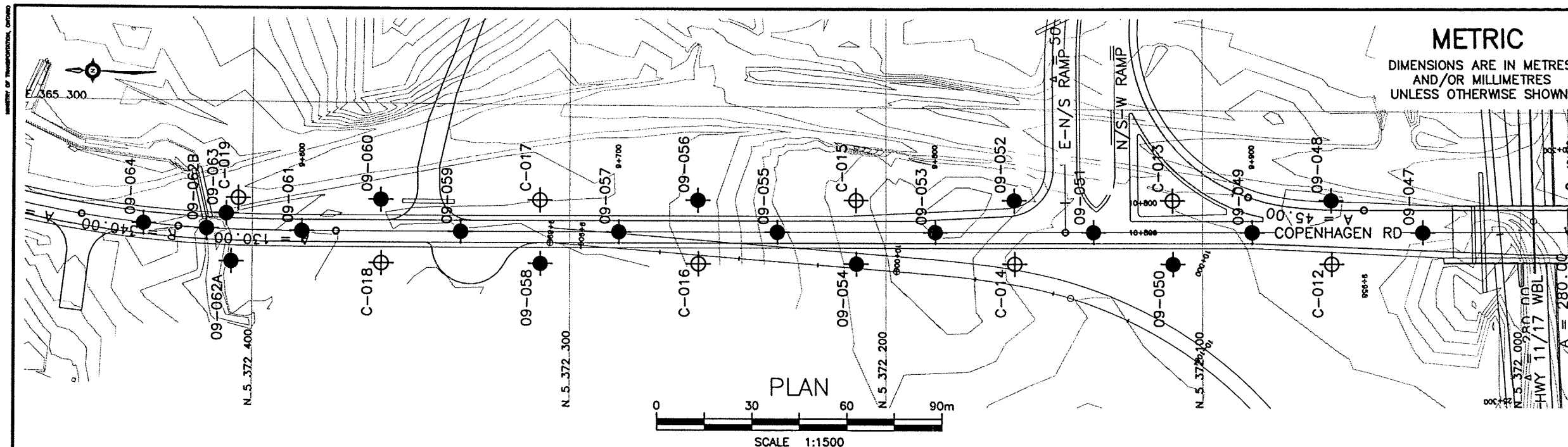


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	09-057	2.59	
⊠	09-059	1.83	
▲	10-063B	4.80	251.73

Date April 2010
 Project 334-94-00



Prep'd AN
 Chkd. MRA



CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
COPENHAGEN ROAD (C)
BOREHOLE LOCATIONS AND SOIL STRATA

MRC **MCCORMICK RANKIN CORPORATION**

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

KEYPLAN
LEGEND

- Borehole
- Cone
- Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60' Cone, 475J/blow)
- PH Pressure, Hydraulic
- Water Level in Open Borehole
- Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	STATION	C OFFSET
09-047	9+953.5	0m
09-049	9+900	0m
09-051	9+850	0m
09-053	9+800	0m
09-055	9+750	0m
09-057	9+700	0m
09-059	9+650	0m
09-061	9+600	0m
09-062B	9+570	0m
09-064	9+550	0m

NOTES

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146

REVISIONS

DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG
DRAWN	MFA	CHK PKC

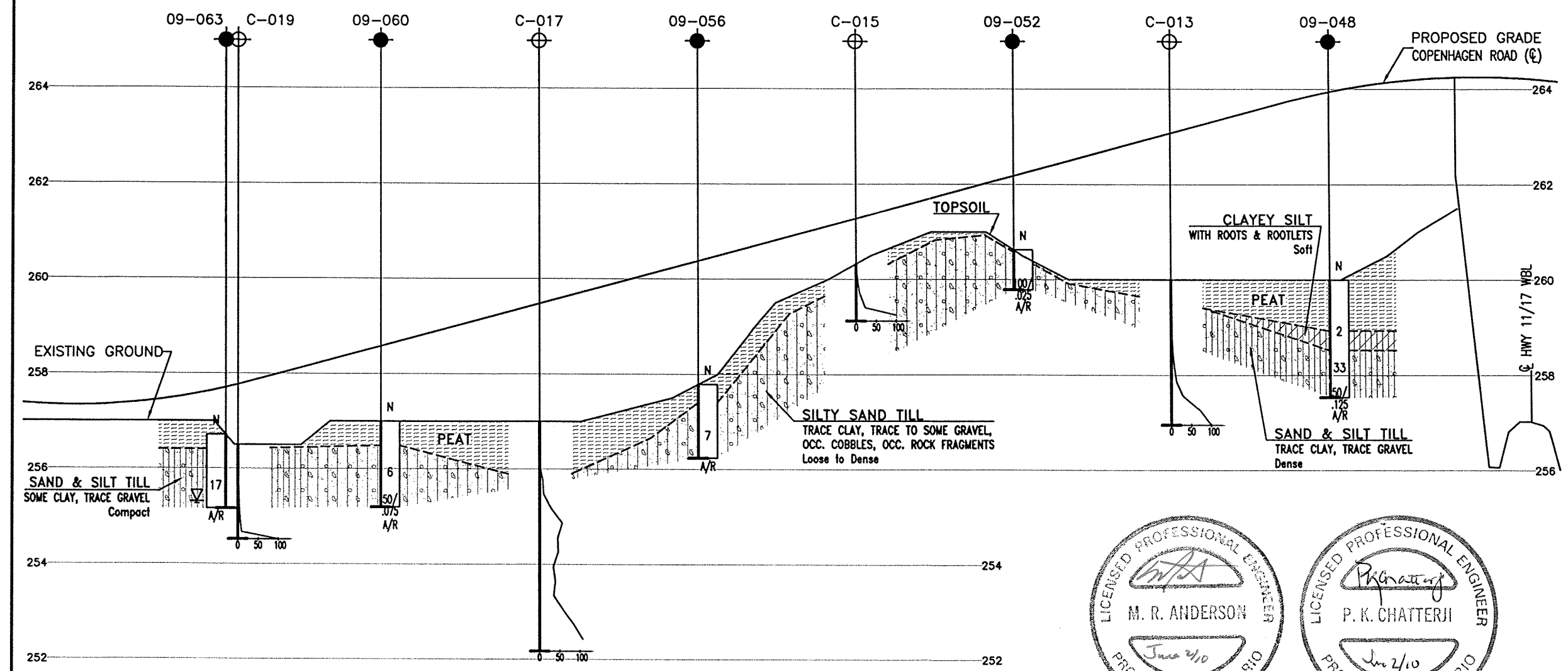
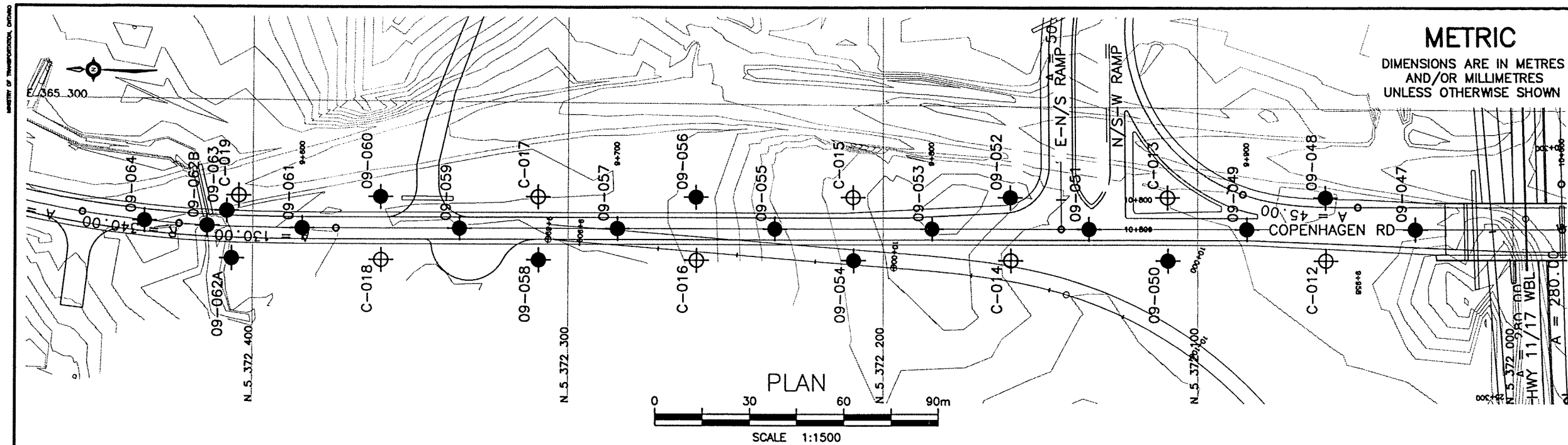
PROFESSIONAL ENGINEER
M. R. ANDERSON
PROVINCE OF ONTARIO

PROFESSIONAL ENGINEER
P. K. CHATTERJI
PROVINCE OF ONTARIO

DATE JUN. 2010

DESIGN MRA CHK AEG CODE LOAD DATE JUN. 2010

DRAWN MFA CHK PKC SITE STRUCT DWG E1



CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
COPENHAGEN ROAD (10m LT. OF CL)
BOREHOLE LOCATIONS AND SOIL STRATA

MCCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

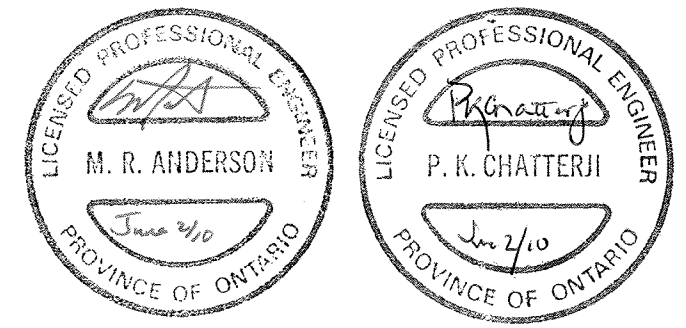
KEYPLAN
LEGEND

Borehole
 Cone
 Borehole and Cone
N Blows /0.3m (Std Pen Test, 475J/blow)
CONE Blows /0.3m (60' Cone, 475J/blow)
PH Pressure, Hydraulic
 Water Level in Open Borehole
 Head Artesian Water
 Piezometer
90% Rock Quality Designation (RQD)
A/R Auger Refusal

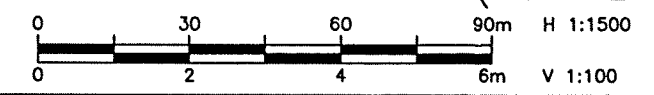
NO	STATION	CL OFFSET
09-048	9+925	10m LT.
09-052	9+825	10m LT.
09-056	9+725	10m LT.
09-060	9+625	10m LT.
09-063	9+576	5m LT.
C-013	9+875	10m LT.
C-015	9+775	10m LT.
C-017	9+675	10m LT.
C-019	9+580	10m LT.

-NOTES-
1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146

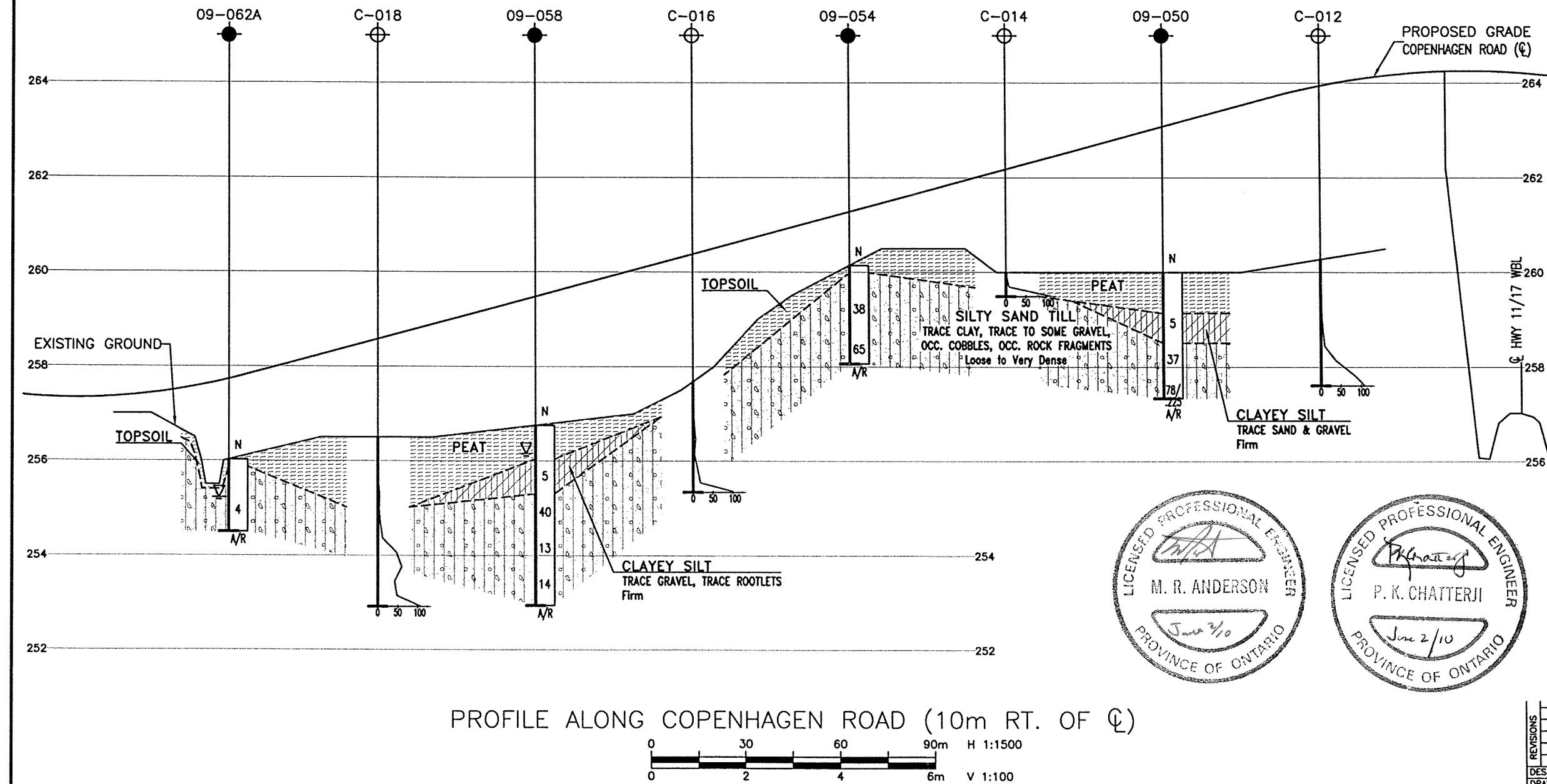
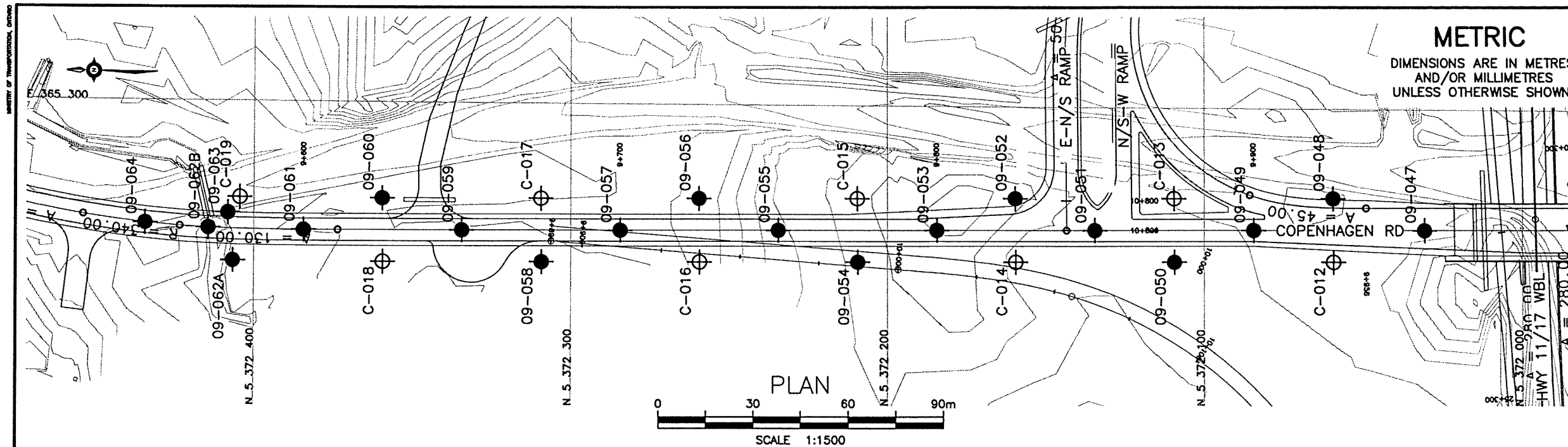


PROFILE ALONG COPENHAGEN ROAD (10m LT. OF CL)



REVISIONS		DATE	BY	DESCRIPTION
DESIGN	MRA	CHK	AEG	CODE
DRAWN	MFA	CHK	PKC	SITE
STRUCT				
DATE	JUN, 2010			

FILENAME: c:\working\18\1351\1361\1361155-Copenhagen Road (Plan&Profile).dwg
PLOTDATE: Jun 01, 2010 - 2:34pm



CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
COPENHAGEN ROAD (10m RT. OF \mathcal{Q})
BOREHOLE LOCATIONS AND SOIL STRATA

MRC McCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

KEYPLAN
LEGEND

- Borehole
- Cone
- Borehole and Cone
- N
Blows /0.3m (Std Pen Test, 475J/blow)
- CONE
Blows /0.3m (60' Cone, 475J/blow)
- PH
Pressure, Hydraulic
- W
Water Level in Open Borehole
- H
Head Artesian Water
- P
Piezometer
- 90%
Rock Quality Designation (RQD)
- A/R
Auger Refusal

NO	STATION	\mathcal{Q} OFFSET
09-050	9+875	10m RT.
09-054	9+775	10m RT.
09-058	9+675	10m RT.
09-062A	9+578	10m RT.
C-012	9+925	10m RT.
C-014	9+825	10m RT.
C-016	9+725	10m RT.
C-018	9+625	10m RT.

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146

REVISIONS

DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG
DRAWN	MFA	CHK PKC

LOAD DATE JUN. 2010
STRUCT OWS E3

FILENAME: G:\Drawing\19\1351\1351.dwg
PLOTDATE: Jun 01, 2010 - 2:34pm

Appendix F

Hodder Avenue Interchange E-N/S Ramp

Station 10+543 to 10+809

Boreholes 09-27 to 09-46, 09-51 and 09-52

Cones C-02 to C-11

RECORD OF BOREHOLE No 09-027

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+543 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

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						
0.0	TOPSOIL, with roots and rootlets (200mm)													
0.2	Silty SAND, trace gravel, trace clay Loose Brown (TILL)		1	SS	9									9 58 27 6
1.6	END OF BOREHOLE AT 1.6m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.													

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-028

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+555, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

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											
0.0	TOPSOIL, with roots and rootlets (125mm)					▽		20 40 60 80 100					20 40 60			GR SA SI CL			
0.1	SAND and SILT, trace clay, trace gravel Loose to Very Dense Brown Moist to Wet (TILL)		1	SS	4			20 40 60 80 100											
			2	SS	72			20 40 60 80 100					20 40 60				8 43 40 9		
2.2	END OF BOREHOLE AT 2.2m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 0.7m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																		

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-029

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+568 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

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	× LAB VANE									
								20	40	60	80	100						20	40	60
0.0	ORGANICS, peaty, fibrous Black Wet		1	AS		▽											GR SA SI CL			
0.8	Silty SAND, trace clay and gravel Loose to Dense Brown Moist to wet (TILL) Becoming grey		1	SS	8													6 57 31 6		
			2	SS	38															
			3	SS	100/															
2.4	END OF BOREHOLE AT 2.4m UPON AUGER REFUSAL. BOREHOLE OPEN AND WATER LEVEL AT 0.4m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.				.150															

+³, x³: Numbers refer to
Sensitivity





20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-030

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+580, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.09 - 2009.07.09 CHECKED BY TH

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 × LAB VANE									WATER CONTENT (%)		
0.0	ORGANICS , with roots and rootlets: (75mm) ASPHALT : (150mm) SAND : (150mm) (FILL) ORGANICS , peaty, fibrous Soft to Very Soft Black Wet																		
0.1																			
0.3																			
0.4																			
			1	SS	6										313				
			2	SS	2										171				
2.0	Silty CLAY , trace gravel Soft Dark Brown																		
2.5	SAND and SILT , trace clay and gravel Compact to Very Dense Brown Moist (TILL)		3	SS	11														
			4	SS	56													2 48 40 10	
			5	SS	100/ 275														
5.1	END OF BOREHOLE AT 5.1m UPON AUGER REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.91m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.11.23 1.7 -																		

+³ ×³: Numbers refer to
Sensitivity

20
15
10






(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-031

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+593 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

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	× LAB VANE							
20	40	60	80	100	20	40	60	80	100	20	40	60	kN/m ³	GR	SA	SI	CL	
0.0	SAND , some brick and concrete fragments Brown Moist (FILL)																	
0.5	ORGANICS , peaty, fibrous Very Soft Black Wet		1	SS	1													
1.6	SAND and SILT , trace gravel and clay, with wood fragments Loose Brown Wet (TILL)		2	SS	4													
			3	SS	7													
	Becoming dense Dark brown		4	SS	36													
3.7	END OF BOREHOLE AT 3.7m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE TO 2.4m, THEN CUTTINGS TO SURFACE.																	

+³ ×³: Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-032

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+605, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

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									
								20	40	60	80	100					
0.0	TOPSOIL, with roots (100mm)																
0.1	SAND, some gravel Dark Brown Moist (FILL)																
0.6	SAND and SILT, with organics, trace gravel Loose Dark Brown (FILL)		1	SS	6												
1.4	ORGANICS, fibrous		2	SS	7												
1.5	SAND and SILT, trace clay and gravel Loose to Compact Brown Moist (TILL)		3	SS	22												3 42 45 10
3.0	END OF BOREHOLE AT 3.0m UPON AUGER REFUSAL. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.91m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.11.23 Could not find																

+³, X³: Numbers refer to Sensitivity 20 15 10 (% STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-034

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+630, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-035

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+643 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT										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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W P W L			
0.0	TOPSOIL, with roots and rootlets (100m)												
0.1	Silty CLAY, trace sand Brown (FILL)												
0.5	ORGANICS, peaty, fibrous Very Soft Black Moist		1	SS	2								
1.7	Silty CLAY, topsoil stained Very Soft Dark Brown		2	SS	2								
2.2	Silty SAND, some gravel, trace clay Very Dense Brown Wet (TILL)		3	SS	100/250								21 52 22 5
2.8	END OF BOREHOLE AT 2.8m UPON AUGER REFUSAL. BOREHOLE OPEN TO 2.1m AND WATER LEVEL AT 0.9m. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.												

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 09-037

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+668 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

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					
0.0	TOPSOIL, mixed with sand, with roots and rootlets																
0.3	SAND Brown Moist (FILL)																
0.8	ORGANICS		1	SS	2												
1.3	Silty SAND, trace gravel and clay Loose to Very Dense Brown		2	SS	100/												
1.7	Moist (TILL)				.125												
	END OF BOREHOLE AT 1.7m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 09-038

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+680, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

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									
								20	40	60	80	100					
								○ UNCONFINED									
								● QUICK TRIAXIAL									
										</							

+³, ×³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-039

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+693 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT										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 × LAB VANE						
0.0	SAND, some gravel, occasional cobbles Brown Moist (FILL)																		
0.7	Clayey SILT, some sand, trace gravel, occasional boulder Very Stiff Dark Brown Moist (FILL)		1	SS	70														
1.4	Moist (FILL)																		
END OF BOREHOLE AT 1.3m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																			

RECORD OF BOREHOLE No 09-040

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+705, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

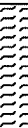


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
								20 40 60 80 100						
								○ UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL × LAB VANE						
								20 40 60 80 100						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
								w _p w w _L						
								WATER CONTENT (%)						
								20 40 60						
0.0 0.1	TOPSOIL, trace roots and rootlets (75mm)													
0.6	SAND, some gravel, occasional cobble Brown Moist (FILL)		1	SS	66									
1.4	Sandy SILT, some gravel, occasional cobble and boulders Compact Brown (FILL)		2	SS	6									
1.7	ORGANICS, peaty, fibrous Black													
2.1	Clayey SILT, sandy Firm Brown		3	SS	18									
	Sandy SILT, some clay, trace gravel Compact to Very Dense Brown Moist to Wet (TILL)		4	SS	100/ 275									
3.5	END OF BOREHOLE AT 3.5m UPON AUGER REFUSAL ON PROBABLE BEDROCK. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.91m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.11.23 1.8 - 2010.03.01 1.9 -													

RECORD OF BOREHOLE No 09-041

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+718 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

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									
0.0	ORGANICS, peaty, fibrous Black																
0.9	Clayey SILT, trace gravel Firm Brown		1	SS	103/ 250												
1.2	END OF BOREHOLE AT 1.2m UPON AUGER REFUSAL. BOREHOLE OPEN TO 0.6m AND WATER LEVEL AT 0.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 09-042

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+730, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

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									
								20	40	60	80	100					

RECORD OF BOREHOLE No 09-043

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+743 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					

+³, X³: Numbers refer to
Sensitivity

20
15 10 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-044

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+755, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					
0.0	TOPSOIL, with roots and rootlets (75mm)																
0.1																	
0.3	ROCKFILL																
	SAND, some gravel Very Dense Brown Moist (FILL)		1	SS	100/												
1.1	END OF BOREHOLE AT 1.0m UPON AUGER REFUSAL. BOREHOLE OPEN TO 0.6m AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 09-052

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Copenhagen Road, Sta. 9+825, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.11 - 2009.07.11 CHECKED BY TH

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					20 40 60 W _P W W _L						
0.0	TOPSOIL, with roots: (50mm)																
0.0	Silty SAND, with shale fragments Brown Moist (TILL)		1	SS	100/												
0.8	END OF BOREHOLE AT 0.8m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.				.025												

METRIC

G.W.P. <u>334-94-00</u>	LOCATION <u>Hodder Ave E-N/S Ramp, Sta. 10+555, 10m RT</u>	ORIGINATED BY <u>SLL</u>
HWY <u>11/17</u>	BOREHOLE TYPE <u>Dynamic Cone Penetration Test</u>	COMPILED BY <u>AN</u>
DATUM <u>Geodetic</u>	DATE <u>2009.07.08 - 2009.07.08</u>	CHECKED BY <u>TH</u>

SOIL PROFILE				SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	SHEAR STRENGTH kPa										W _P	W	W _L		
262.5									20	40	60	80	100							
0.0	DCPT from surface.																			

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No C-003

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+580, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.09 - 2009.07.09 CHECKED BY TH

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 60 80 100					
262.5 0.0	DCPT from surface.						262							
261														
260.1 2.4	END OF DCPT AT 2.4m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.													

RECORD OF BOREHOLE No C-004

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+605, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	20 40 60			
263.0 0.0	DCPT from surface.						263							GR SA SI CL
259.6 3.4	END OF DCPT AT 3.4m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.						260							

ONTMT4S 1156.GPJ 3/17/10

+³, ×³: Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C-005

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+630, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.08 - 2009.07.08 CHECKED BY TH

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								
262.5 0.0	DCPT from surface.												GR SA SI CL
259.4 3.1	END OF DCPT AT 3.1m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.												

ONTMT4S 1156.GPJ 3/17/10

RECORD OF BOREHOLE No C-006

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+655, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

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			20 40 60 80 100	20 40 60 80 100	W _p W W _L				
262.5														
0.0	DCPT from surface.													
261.1														
1.4	END OF DCPT AT 1.4m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.													

ONTMT4S 1156.GPJ 3/17/10

RECORD OF BOREHOLE No C-007

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+680, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE 20 40 60 80 100	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								
262.5													
0.0	DCPT from surface.												
260.5													
2.0	END OF DCPT AT 2.0m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.												

+³, x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No C-008

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+705, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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 LAB VANE				
262.0 0.0	DCPT from surface.						262					
257.2 4.8	END OF DCPT AT 4.8m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.											

RECORD OF BOREHOLE No C-009

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+730, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

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			20	40	60	80	100	w _p	w	w _L		
261.0							261										
0.0	DCPT from surface.																
260.0																	
1.0	END OF DCPT AT 1.0m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.																

RECORD OF BOREHOLE No C-010

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+755, 10m LT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

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								
260.5													
0.0	DCPT from surface.												
259.2													
1.3	END OF DCPT AT 1.3m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.												

RECORD OF BOREHOLE No C-011

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave E-N/S Ramp, Sta. 10+785, 10m RT ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Dynamic Cone Penetration Test COMPILED BY AN
 DATUM Geodetic DATE 2009.07.09 - 2009.07.09 CHECKED BY TH

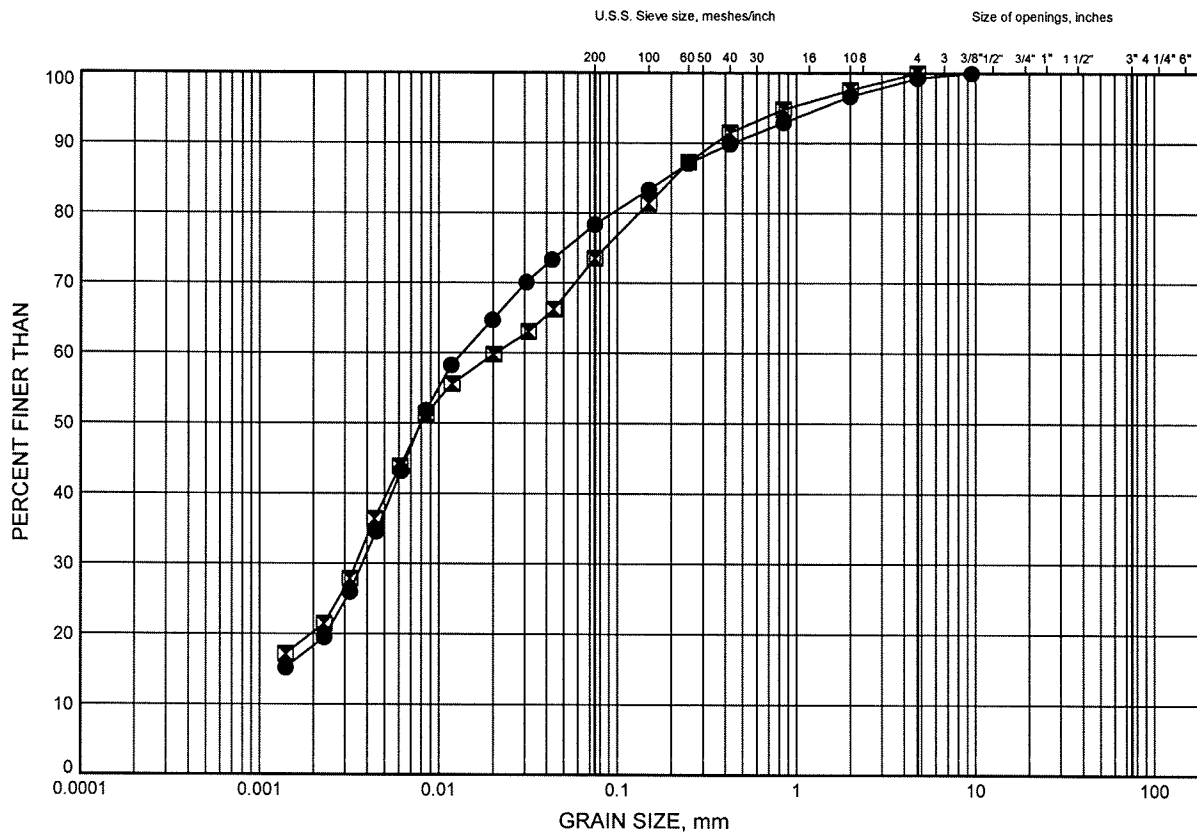
SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20 40 60 80 100	20 40 60 80 100	W P W W L	20 40 60		
0.0	DCPT from surface.												
0.5	END OF DCPT AT 0.5m. DCPT BACKFILLED WITH BENTONITE TO SURFACE.												

ONTMT4S 1156.GPJ 4/15/10

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE F1

CLAYEY SILT to SILTY CLAY



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-033	2.59	
⊠	09-040	1.94	

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 4/15/10

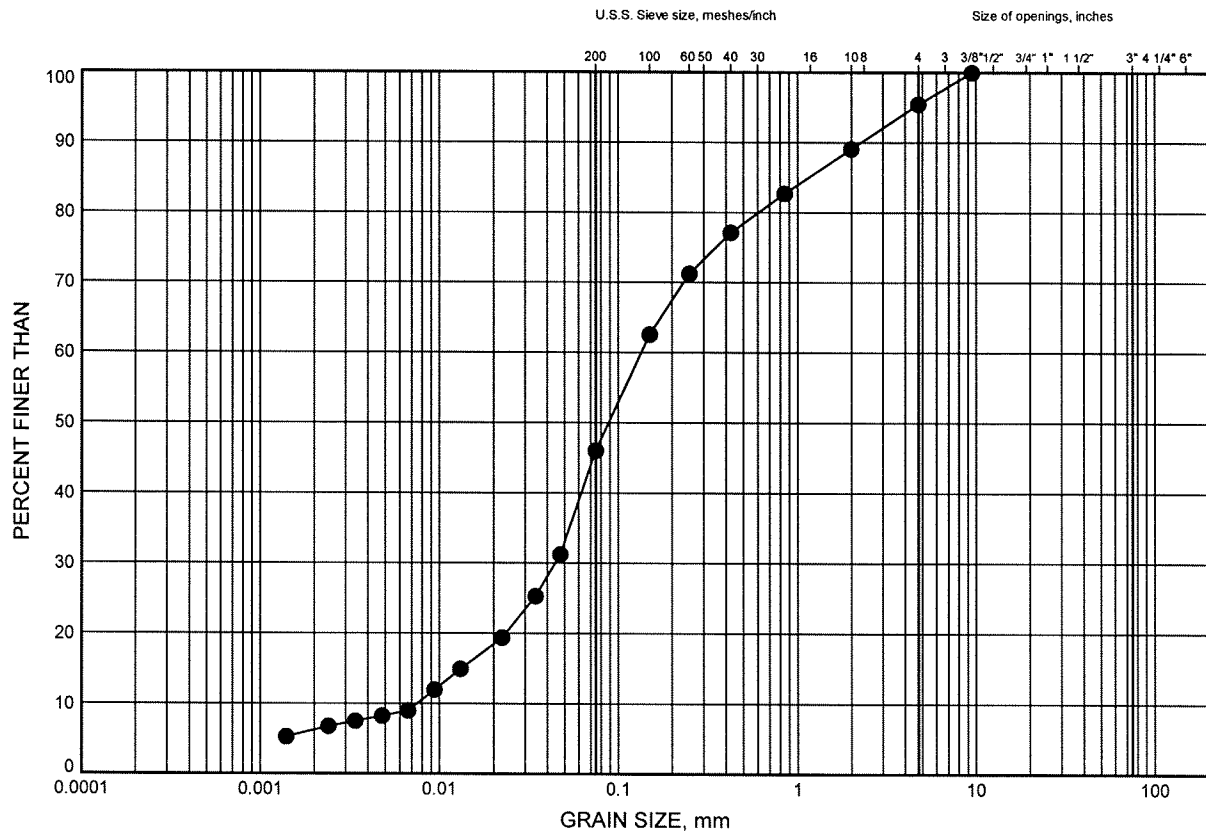
W.P.# 334-94-00
 Prepared By AN
 Checked By MRA



Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE F2

SAND & SILT



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND			GRAVEL		SIZE

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-046	1.07	

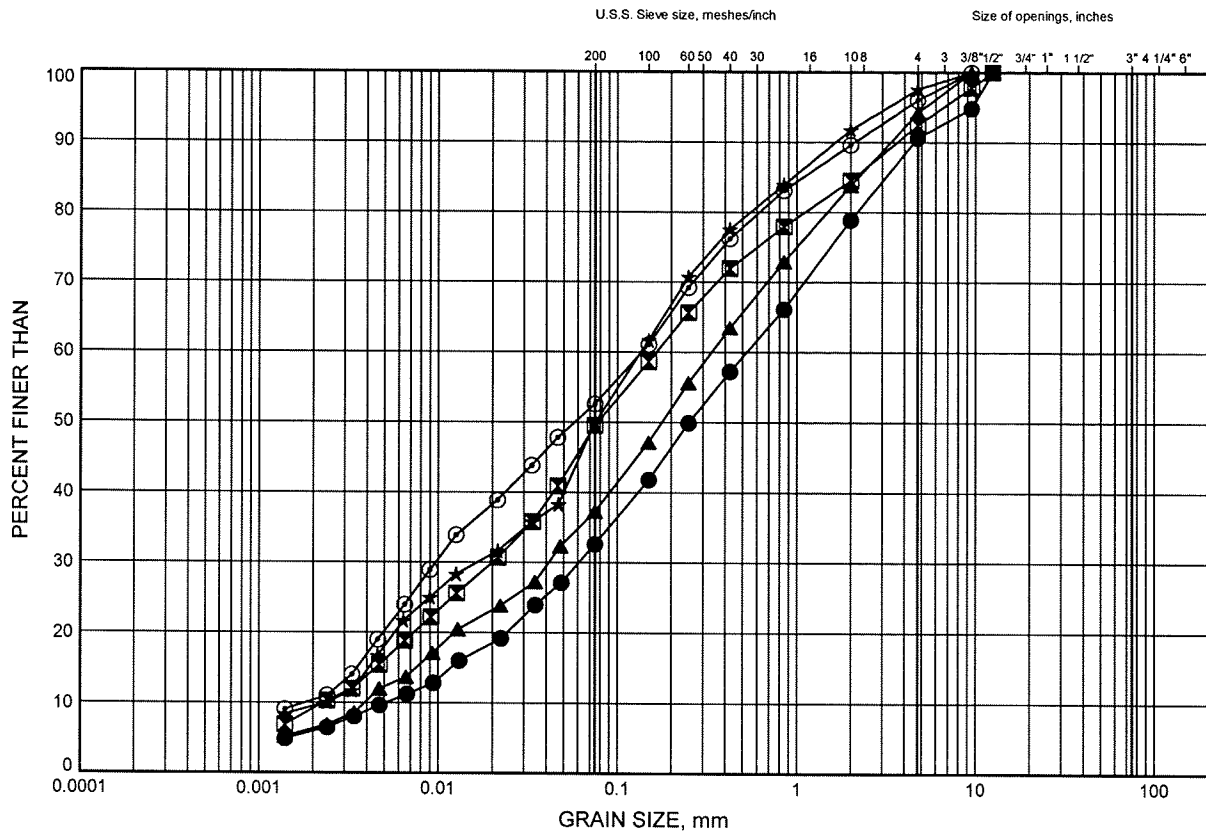


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE F3

SILTY SAND to SANDY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-027	1.07	
⊠	09-028	1.07	
▲	09-029	1.83	
★	09-030	3.35	
⊙	09-031	1.83	

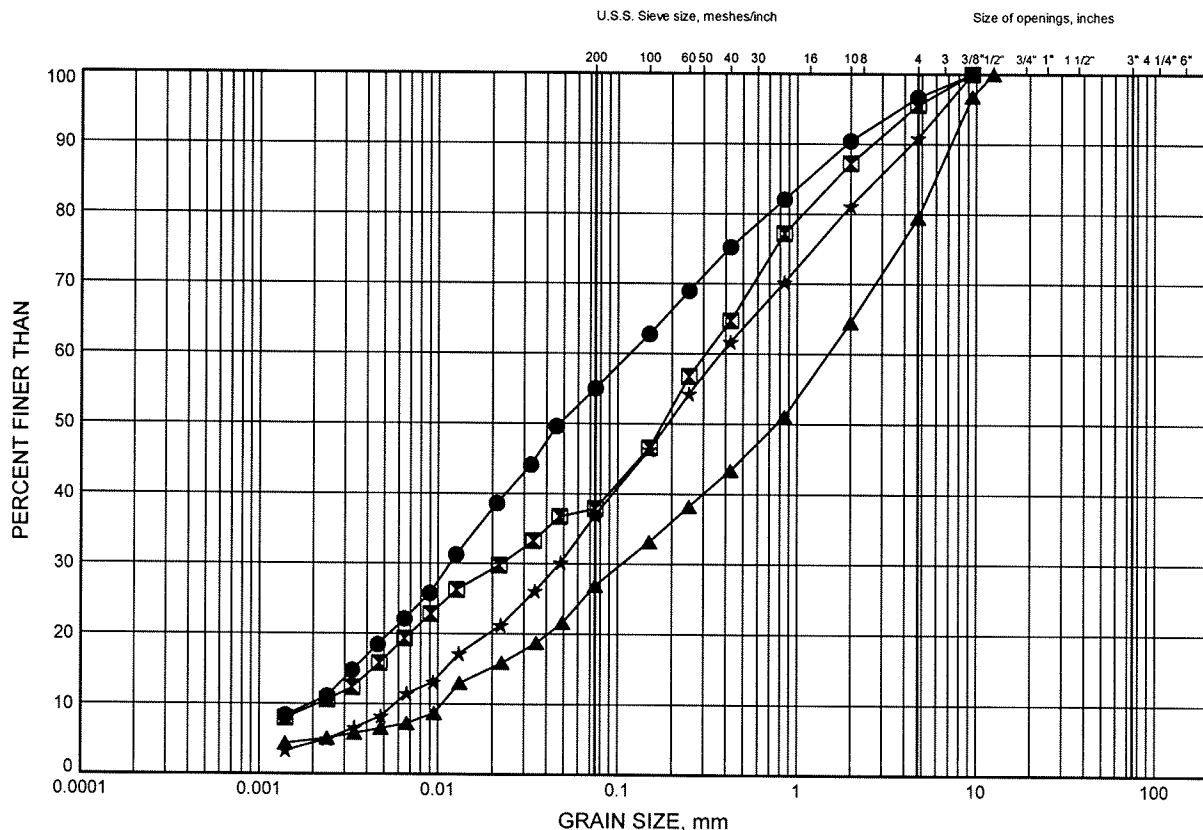


W.P.# .334-94-00.....
Prepared By .AN.....
Checked By .MRA.....

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE F4

SILTY SAND to SANDY SILT TILL



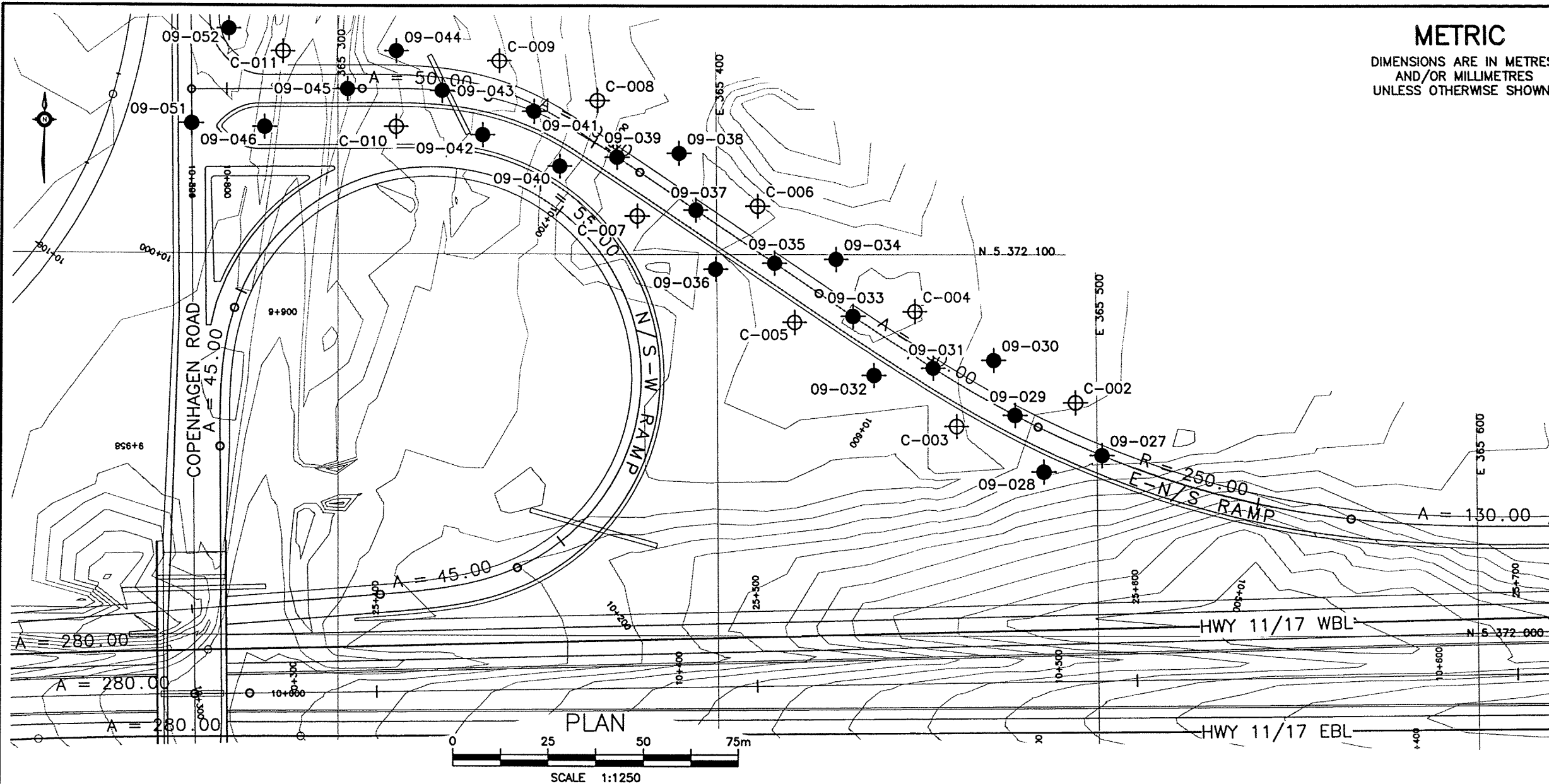
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-032	1.83	
⊠	09-035	1.78	
▲	09-036	2.49	
★	09-038	2.59	



W.P.# .334-94-00.....
 Prepared By .AN.....
 Checked By .MRA.....



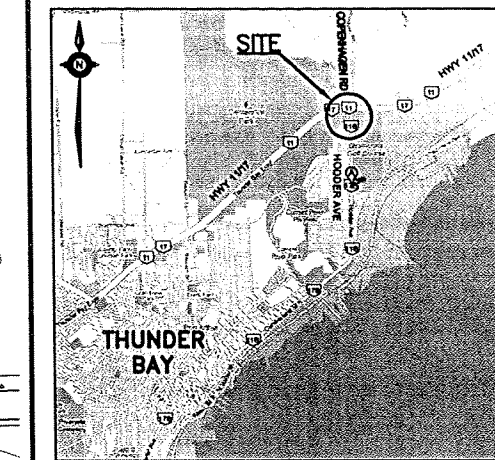
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
E-N/S RAMP (C)
BOREHOLE LOCATIONS AND SOIL STRATA

MRC MCCORMICK RANKIN
CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



**KEYPLAN
LEGEND**

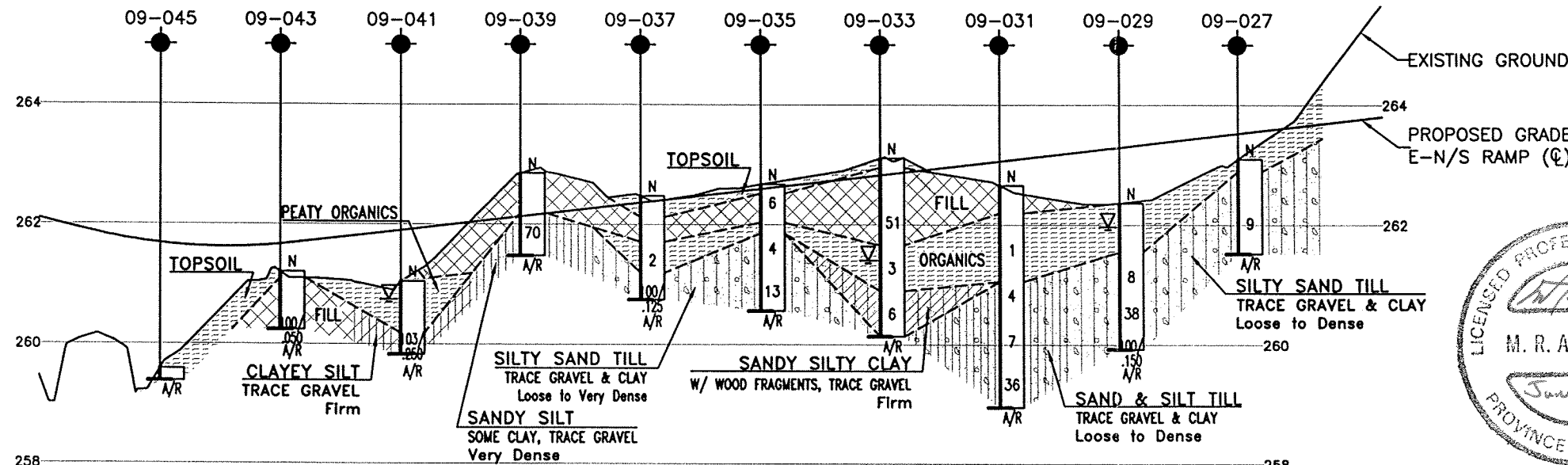
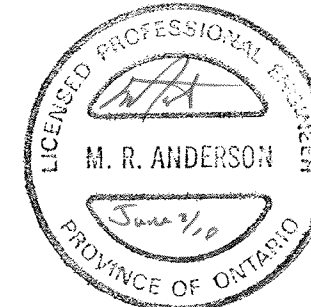
- ◆ Borehole
- ⊕ Cone
- ⊕ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- HA Head Artesian Water
- PZ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	STATION	⊕ OFFSET
09-027	10+543	0m
09-029	10+568	0m
09-031	10+593	0m
09-033	10+618	0m
09-035	10+643	0m
09-037	10+668	0m
09-039	10+693	0m
09-041	10+718	0m
09-043	10+743	0m
09-045	10+768	0m

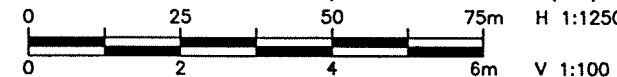
-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

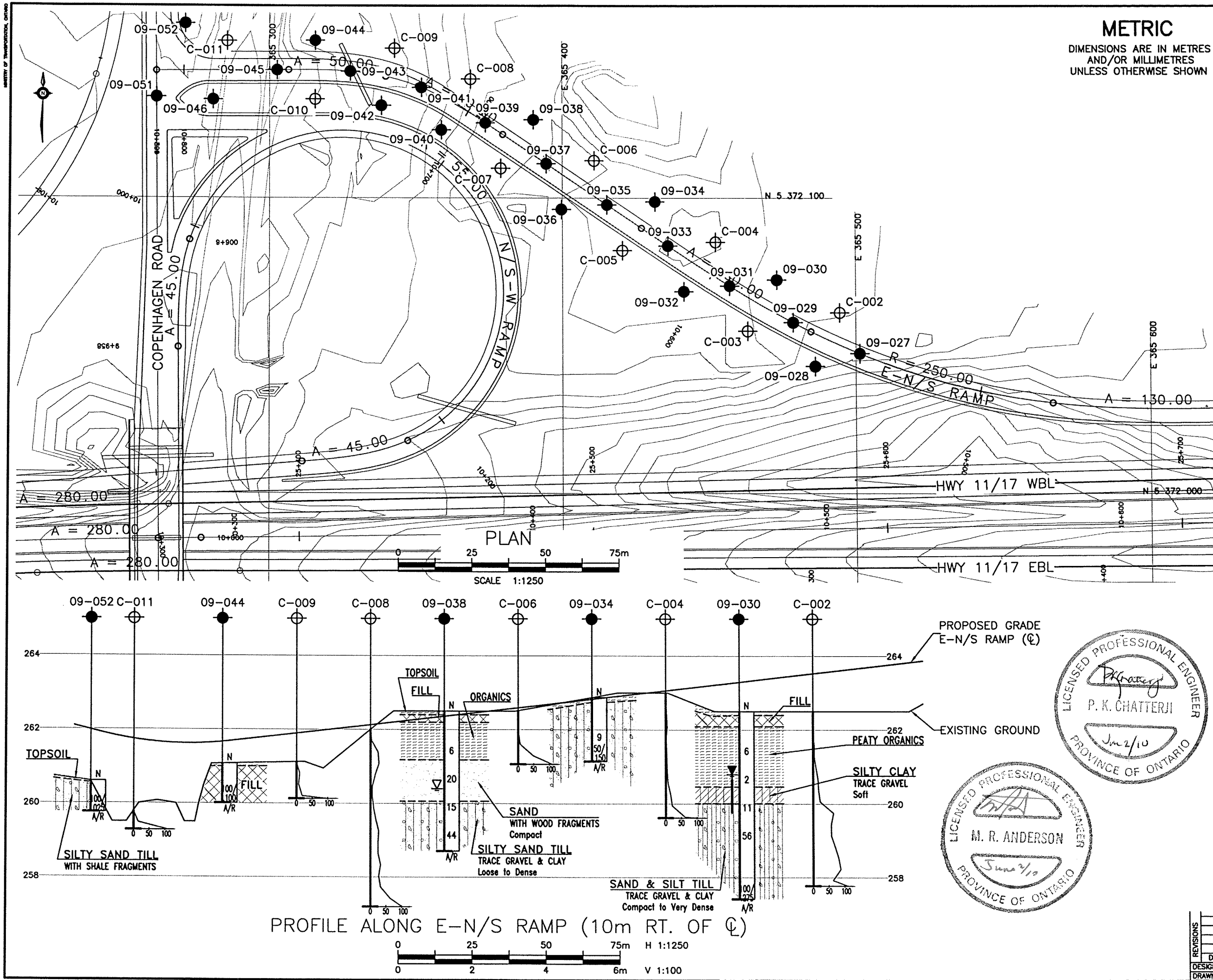
GEOCRES No. 52A-146



PROFILE ALONG E-N/S RAMP (C)



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG	CODE
DRAWN	MFA	CHK PKC	SITE
			LOAD
			STRUCT
			OWG F1
			DATE JUN. 2010



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

CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
E-N/S RAMP (10m RT. OF C)
BOREHOLE LOCATIONS AND SOIL STRATA

McCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

KEYPLAN
LEGEND

- Borehole
- Cone
- Borehole and Cone
- N
Blows /0.3m (Std Pen Test, 475J/blow)
- CONE
Blows /0.3m (60' Cone, 475J/blow)
- PH
Pressure, Hydraulic
- W
Water Level
- Head Artesian Water
- Piezometer
- 90%
Rock Quality Designation (RQD)
- A/R
Auger Refusal

NO	STATION	C OFFSET
09-030	10+580	10m RT.
09-034	10+630	10m RT.
09-038	10+680	10m RT.
09-044	10+755	10m RT.
09-052	10+794.4	16.1m RT.
C-002	10+555	10m RT.
C-004	10+605	10m RT.
C-006	10+655	10m RT.
C-008	10+705	10m RT.
C-009	10+730	10m RT.
C-011	10+785	10m RT.

NOTES:
1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146

REVISIONS		DATE	BY	DESCRIPTION
DESIGN	MRA	CHK	AEG	CODE
DRAWN	MFA	CHK	PKC	SITE
LOAD		DATE	JUN. 2010	
STRUCT		OWG	F3	

FILENAME: d:\working\191\351\356\101156-Hodder Ave E-N/S Ramp (Plan&Profile).dwg
PLOTDATE: Jun 01, 2010 - 2:14pm

Appendix G

Hodder Avenue Interchange S-E Ramp

Station 10+120 to 10+650

Boreholes 09-06 to 09-16, 10-68, 10-70 to 10-73

RECORD OF BOREHOLE No 09-006

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+010 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.09 - 2009.07.09 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT										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 LAB VANE												
0.0	TOPSOIL, with roots and rootlets (150mm)																			
0.2	SAND and SILT, trace clay, trace gravel, occasional cobbles and boulders Loose to Very Dense Brown Moist (TILL)		1	SS	7															
			2	SS	100/ .100															
			3	SS	100/ .200															
2.7	END OF BOREHOLE AT 2.7m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																			

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-007

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+125 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.07 - 2009.07.07 CHECKED BY TH

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		
0.0	TOPSOIL, with roots and rootlets (130mm)																
0.1	Silty SAND, some gravel, trace clay, occasional cobbles Compact to Very Dense Brown (TILL)		1	SS	21												
			2	SS	48												12 55 27 6
			3	SS	73												
			4	SS	100/												
3.3	END OF BOREHOLE AT 3.3m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 2.4m, THEN CUTTINGS TO SURFACE.				125												

+³, X³: Numbers refer to
Sensitivity

20
15 10 5 0
(%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 09-009

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+300 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.10 - 2009.07.10 CHECKED BY TH


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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	× LAB VANE					
							20	40	60	80	100	20	40	60		
0.0	TOPSOIL, with roots and rootlets (200mm)															
0.2	Silty SAND, some gravel, trace clay Compact to Very Dense Brown (TILL)		1	SS	23											
			2	SS	31											12 54 26 8
			3	SS	100/ 250											
2.8	END OF BOREHOLE AT 2.8m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.															

RECORD OF BOREHOLE No 09-010

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+350 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.10 - 2009.07.10 CHECKED BY TH

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										
0.0	TOPSOIL, with roots and rootlets (125mm)							20	40	60	80	100						
0.2	Silty SAND, some clay, trace gravel Compact Brown Moist (TILL)		1	SS	14			○ UNCONFINED	+	FIELD VANE								
								● QUICK TRIAXIAL	x	LAB VANE								
1.4	END OF BOREHOLE AT 1.4m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																	

+³ x³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-011

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+400 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.10 - 2009.07.10 CHECKED BY TH


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
								20	40	60	80	100					

RECORD OF BOREHOLE No 09-012

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+450 CL ORIGINATED BY SLL
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2009.07.10 - 2009.07.10 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 LAB VANE							PLASTIC LIMIT w _P NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)
0.0	TOPSOIL, with roots and rootlets (125mm)														
0.1	Silty SAND, trace to some gravel, trace clay, occasional cobbles Compact to Very Dense Brown (TILL)		1	SS	22										
			2	SS	34										4 58 33 5
			3	SS	80										
			4	SS	85										14 52 30 4
			5	SS	100/ .125										
		6	SS	100/ .150											
4.9	END OF BOREHOLE AT 4.9m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.91m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.11.23 Dry -														

ONTMT4S 1156.GPJ 3/17/10

RECORD OF BOREHOLE No 09-013

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+500 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.10 - 2009.07.10 CHECKED BY TH

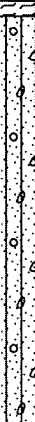
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%) W _P W W _L				
0.0	TOPSOIL, with roots and rootlets (150mm)																
0.2	Clayey SILT, sandy, trace gravel, topsoil stained, trace rootlets Firm Dark Brown (TILL)		1	SS	7												
1.4	Silty SAND, some clay, trace gravel, occasional cobbles Dense to Very Dense Brown Moist (TILL)		2	SS	36												7 48 34 11
			3	SS	41												
			4	SS	45												4 50 35 11
			5	SS	75												
4.5	END OF BOREHOLE AT 4.5m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 2.5m, THEN CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 09-014

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+550 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.10 - 2009.07.10 CHECKED BY TH

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 × LAB VANE										
0.0	TOPSOIL, with roots and rootlets (100mm) Silty SAND, trace clay, trace gravel, occasional cobbles Compact to Very Dense Brown (TILL)																	
0.1			1	SS	73													
			2	SS	22													7 52 32 8
			3	SS	75													
2.8	END OF BOREHOLE AT 2.8m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																	

+³ . x³ : Numbers refer to
Sensitivity

20
15 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-015

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+600 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.10 - 2009.07.10 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
								20	40	60	80	100					
0.0	TOPSOIL, with roots and rootlets (150mm)																
0.2	Silty SAND, trace clay, trace gravel, occasional cobbles Compact to Very Dense Brown (TILL)		1	SS	10												
			2	SS	44												5 51 36 8
			3	SS	100/ 150												
2.6	END OF BOREHOLE AT 2.6m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

+³, X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-016

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave S-E Ramp, Sta. 10+650 CL ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2009.07.10 - 2009.07.10 CHECKED BY TH

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	×	LAB VANE										
						20	40	60	80	100		20	40	60						
0.0	TOPSOIL, with roots and rootlets (200mm)																			
0.2	Silty SAND, some gravel, trace clay, occasional cobbles Compact to Very Dense Brown (TILL)		1	SS	13															
			2	SS	47											13 50 33 4				
			3	SS	75															
			4	SS	100/ 250															
3.6	END OF BOREHOLE AT 3.6m UPON AUGER. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 0.76m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.11.23 Dry -																			

ONTMT4S 1156.GPJ 3/17/10

METRIC

G.W.P.	<u>334-94-00</u>	LOCATION	<u>Hodder Ave., S-E Ramp, Sta. 10+160 15m RT</u>	ORIGINATED BY	<u>LG</u>
HWY	<u>11/17</u>	BOREHOLE TYPE	<u>Hollow Stem Augers</u>	COMPILED BY	<u>AN</u>
DATUM	<u>Geodetic</u>	DATE	<u>2010.01.15 - 2010.01.15</u>	CHECKED BY	<u>TH</u>

[illegible]

20
15 — 5
10

RECORD OF BOREHOLE No 10-070

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave., S-E Ramp, Sta. 10+200 17m RT ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.15 - 2010.01.15 CHECKED BY TH

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										WATER CONTENT (%)			GR	SA	SI	CL
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE	20						40	60	80				
0.0	Silty SAND , some gravel, trace clay Compact to Very Dense Brown Moist (TILL) Occasional cobbles		1	SS	21																			
			2	SS	18													16 54 25 5						
			3	SS	62/ 0.275																			
	Auger refusal at 2.9m. Began coring.																							
2.9	Silty SAND and GRAVEL , cobbles and boulders Very Dense Brown		1	RUN														RUN 1# TCR=0%, SCR=0%, RQD=0%						
			2	RUN														RUN 2# TCR=13%, SCR=3%, RQD=0%						
5.8	GUNFLINT FORMATION , very strong (grainstone), slightly weathered 250mm vertical fracture at 6.7m 75mm vertical fracture at 7.9m		3	RUN												FI >3 >3 1 >2 0 0 2 1	RUN 3# TCR=72%, SCR=32%, RQD=32% UCS=109MPa							
			4	RUN														RUN 4# TCR=100%, SCR=92%, RQD=92% UCS=185MPa						
8.5	END OF BOREHOLE AT 8.5m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.03.01 4.3 -																							

ONTMT4S 1156.GPJ 4/15/10

RECORD OF BOREHOLE No 10-071

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave., S-E Ramp, Sta. 10+240 18m RT ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.18 - 2010.01.18 CHECKED BY TH

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			20	40	60	80	100					
0.0	Silty SAND, some gravel, trace clay Loose to Very Dense Brown Moist (TILL) Occasional cobbles		1	SS	9												
			2	SS	31												
			3	SS	74/ 275												13 53 27 7
			4	SS	97												
3.8	END OF BOREHOLE AT 3.8m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No 10-072

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave., S-E Ramp, Sta. 10+280 18m RT ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.16 - 2010.01.16 CHECKED BY TH

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									
								20	40	60	80	100					
								○ UNCONFINED	+ FIELD VANE								
								● QUICK TRIAXIAL	× LAB VANE								
								20	40	60	80	100					
0.0	Silty SAND , trace gravel, trace clay Compact to Very Dense Brown Moist (TILL)																

Continued Next Page

+³ ×³ : Numbers refer to
Sensitivity

20
15-5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-072

2 OF 2

METRIC

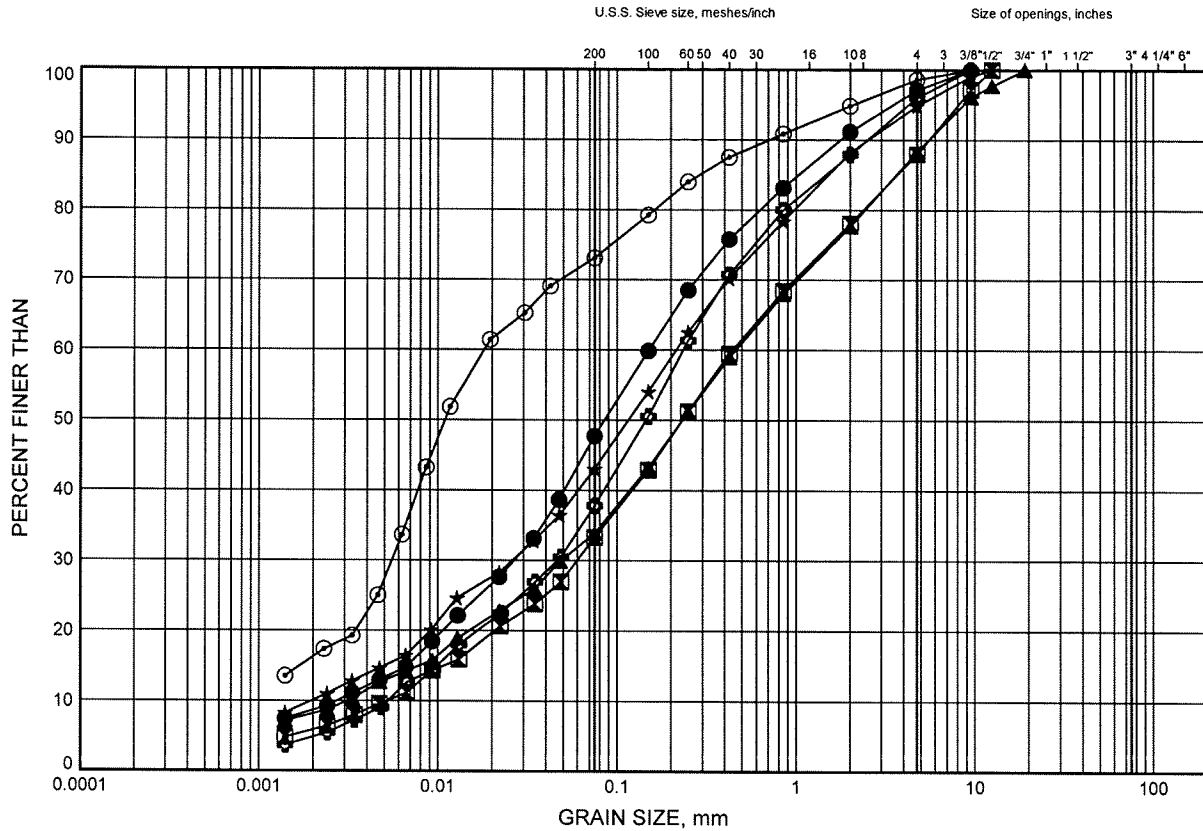
G.W.P. 334-94-00 LOCATION Hodder Ave., S-E Ramp, Sta. 10+280 18m RT ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2010.01.16 - 2010.01.16 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100	W _P	W	W _L		
	Continued From Previous Page		6	RUN												GR SA SI CL	
11.6	END OF BOREHOLE AT 11.6m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.03.01 6.3 -															RUN 6# TCR=100%, SCR=100%, RQD=100% UCS=84MPa	

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE G1

SILTY SAND TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-006	1.07	
⊠	09-007	1.83	
▲	09-009	1.83	
★	09-010	0.99	
⊙	09-011	1.07	
⊗	09-012	1.83	

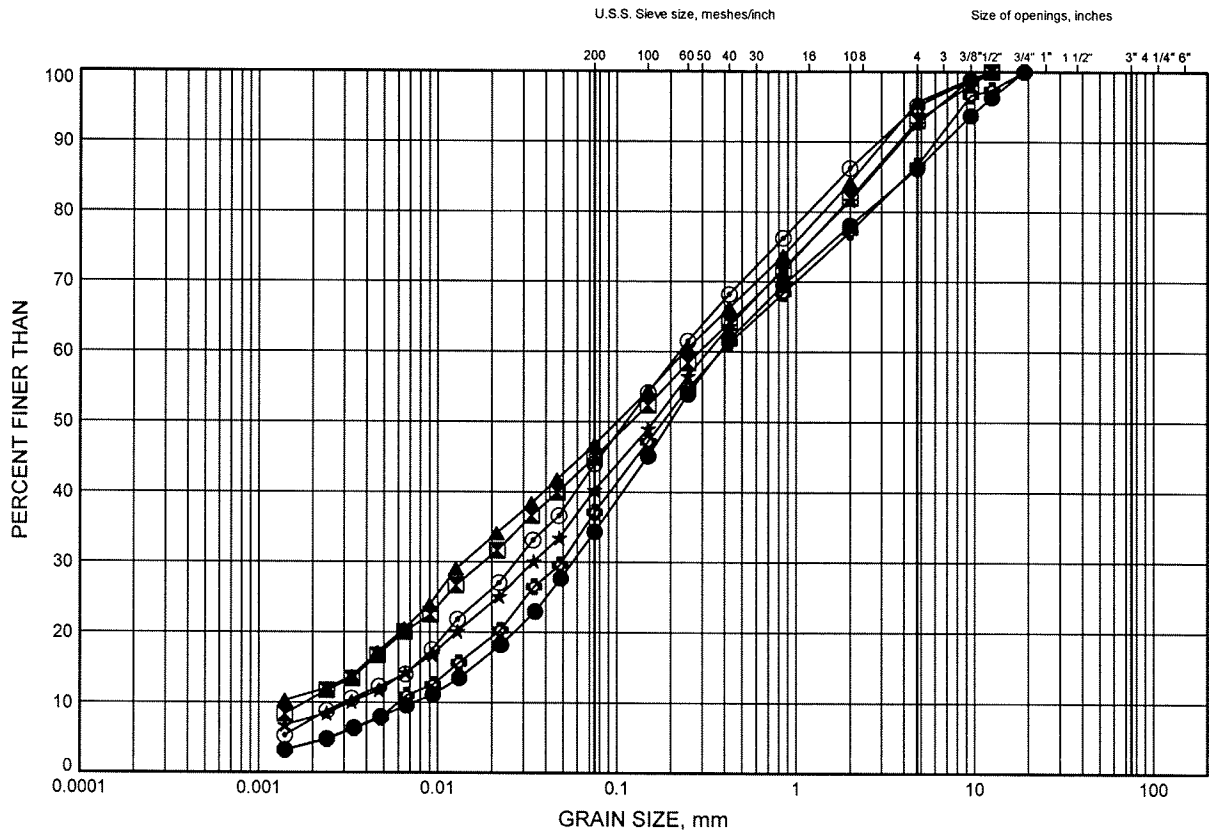


W.P.# 334-94-00
 Prepared By AN
 Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE G2

SILTY SAND TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND			GRAVEL		SIZE

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-012	3.35	
⊠	09-013	1.83	
▲	09-013	3.35	
★	09-014	1.83	
⊙	09-015	1.83	
⊕	09-016	1.83	

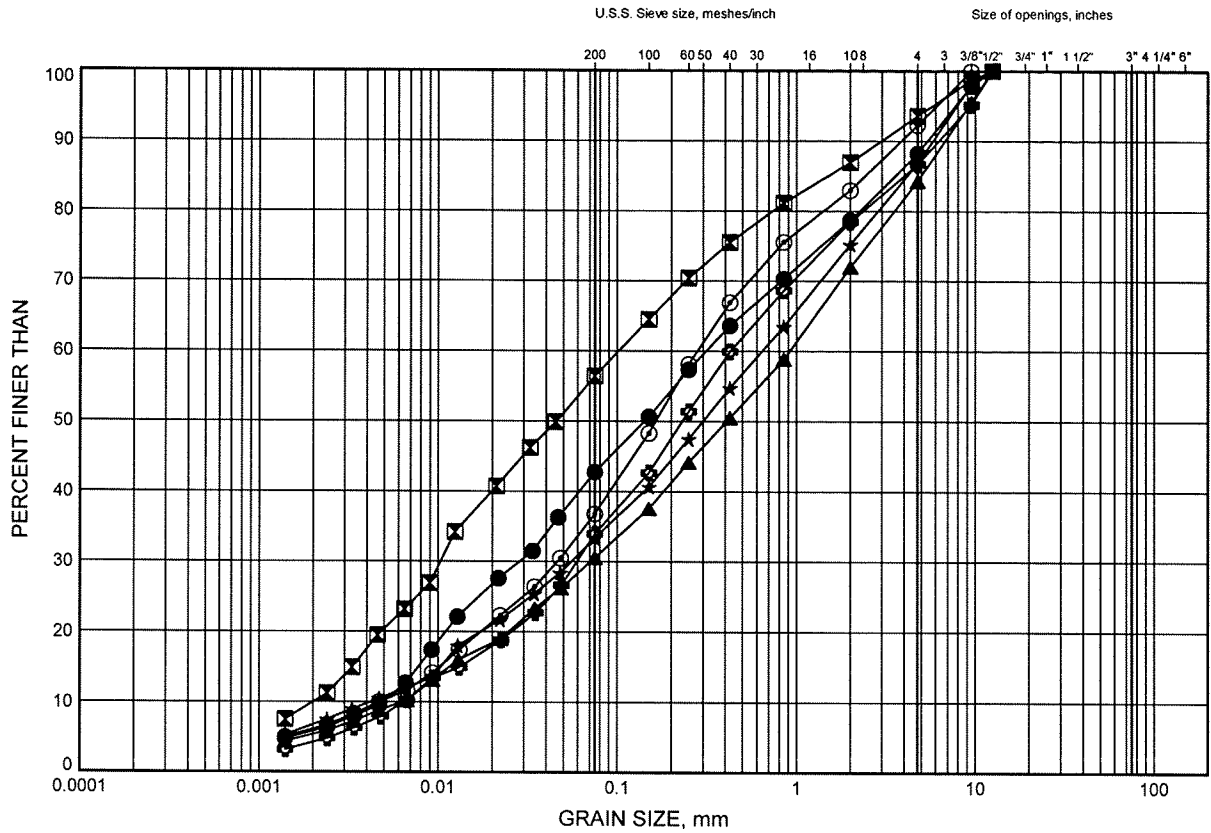


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE G3

SILTY SAND TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE
FINE GRAINED	SAND			GRAVEL		SIZE

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	10-068	2.44	
⊠	10-068	4.65	
▲	10-070	1.83	
★	10-071	2.51	
⊙	10-072	2.47	
⊕	10-073	1.83	

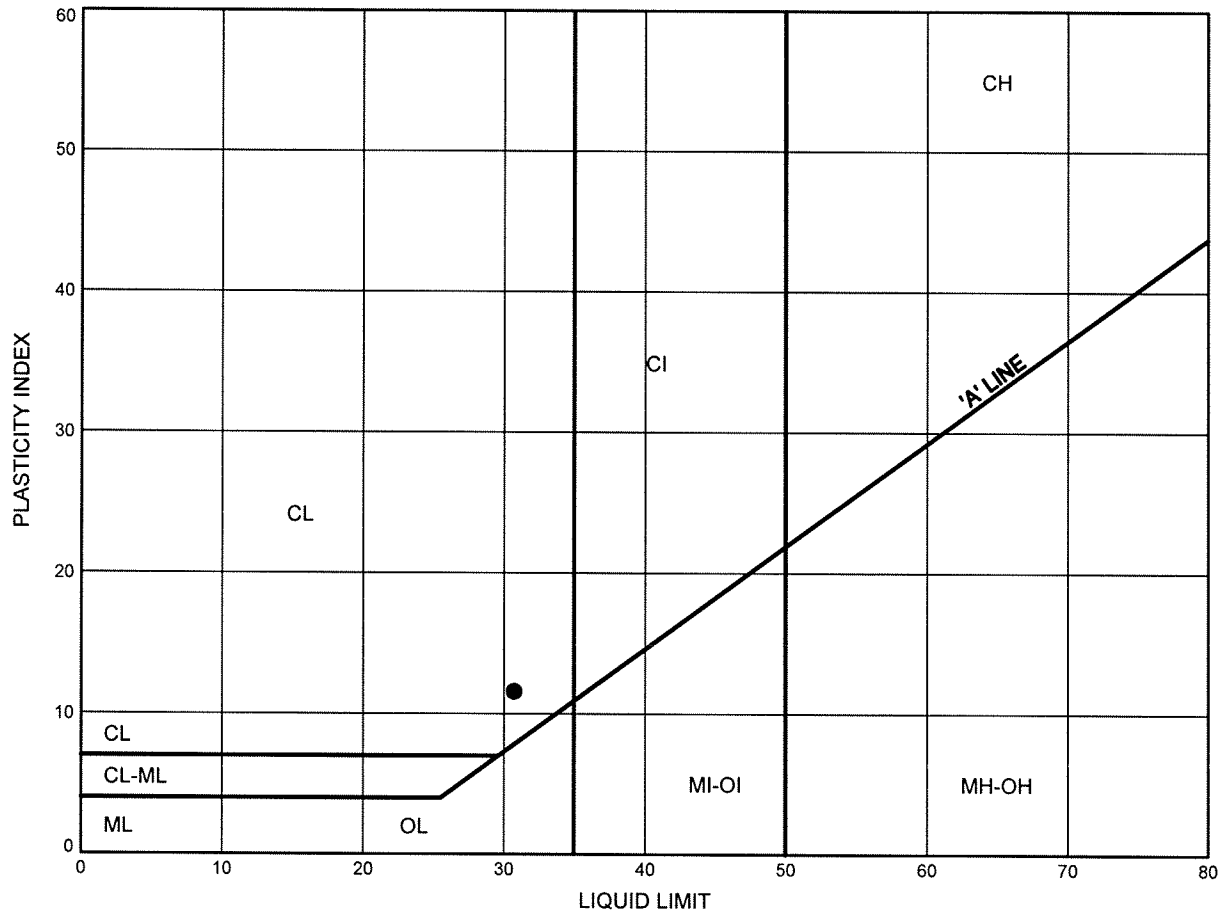


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue
ATTERBERG LIMITS TEST RESULTS

FIGURE G4

SILTY SAND TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	09-011	1.04	

Date April 2010
 Project 334-94-00



Prep'd AN
 Chkd. MRA

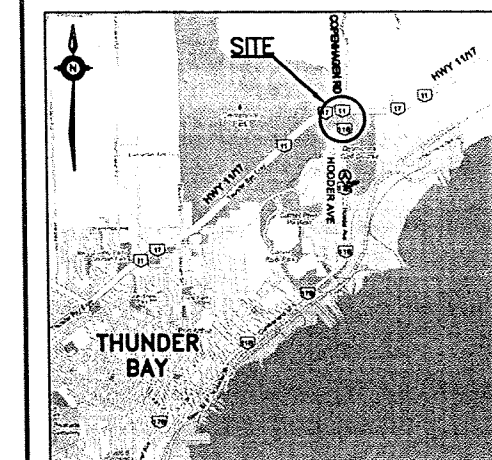
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
S-E RAMP (C)
BOREHOLE LOCATIONS AND SOIL STRATA

MRC **McCORMICK RANKIN**
CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN
LEGEND

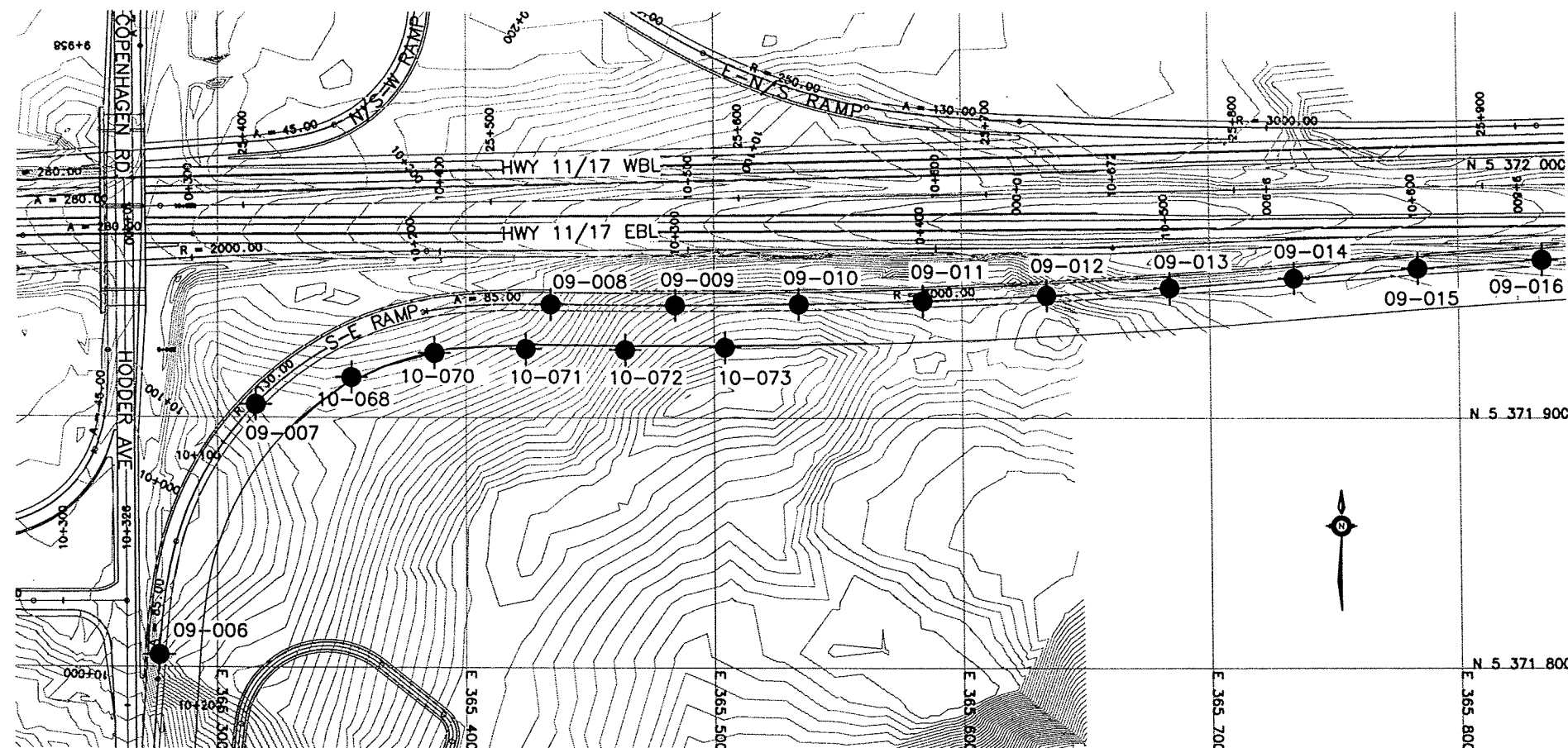
- ◆ Borehole
- ◆ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- ↑ Head Artesian Water
- ⊥ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	STATION	CL OFFSET
09-006	10+010	0.0m
09-007	10+125	0.0m
09-008	10+250	0.0m
09-009	10+300	0.0m
09-010	10+350	0.0m
09-011	10+400	0.0m
09-012	10+450	0.0m
09-013	10+500	0.0m
09-014	10+550	0.0m
09-015	10+600	0.0m
09-016	10+650	0.0m

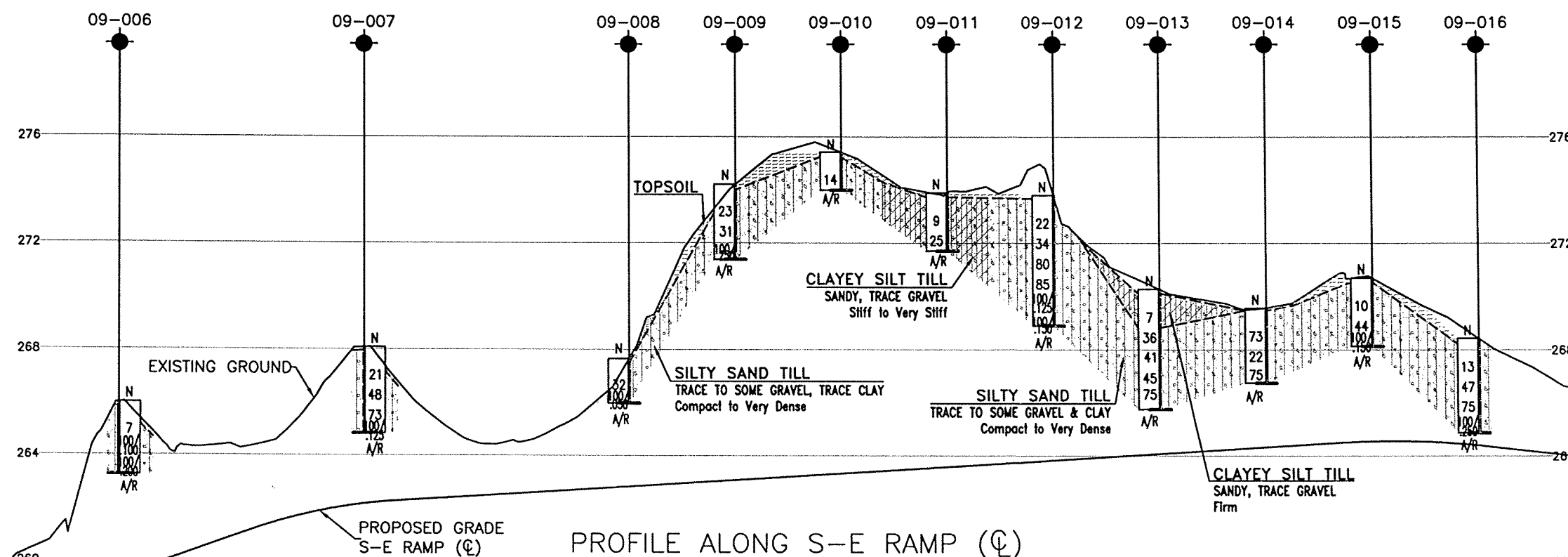
NOTES

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146



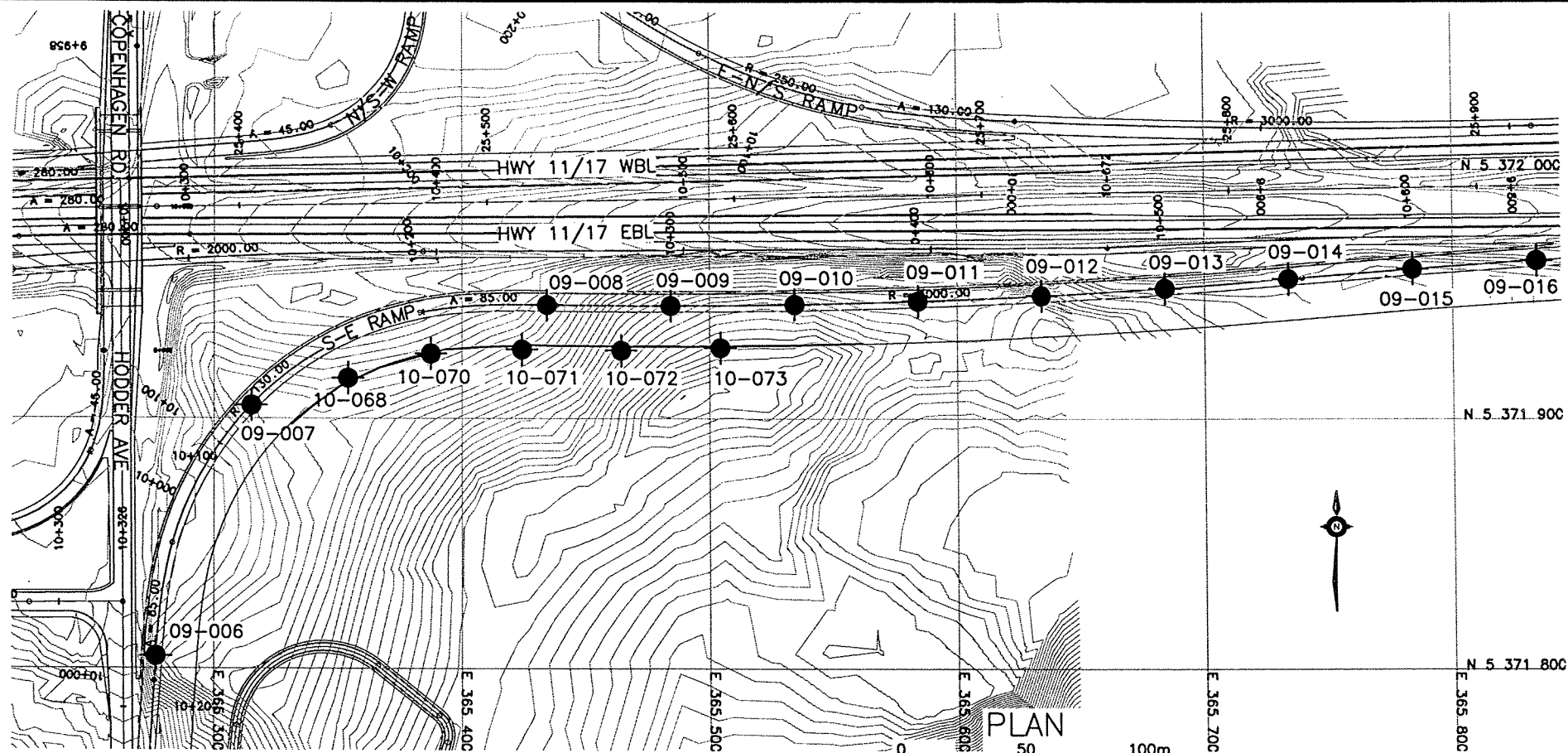
PLAN
0 50 100m
SCALE 1:2500



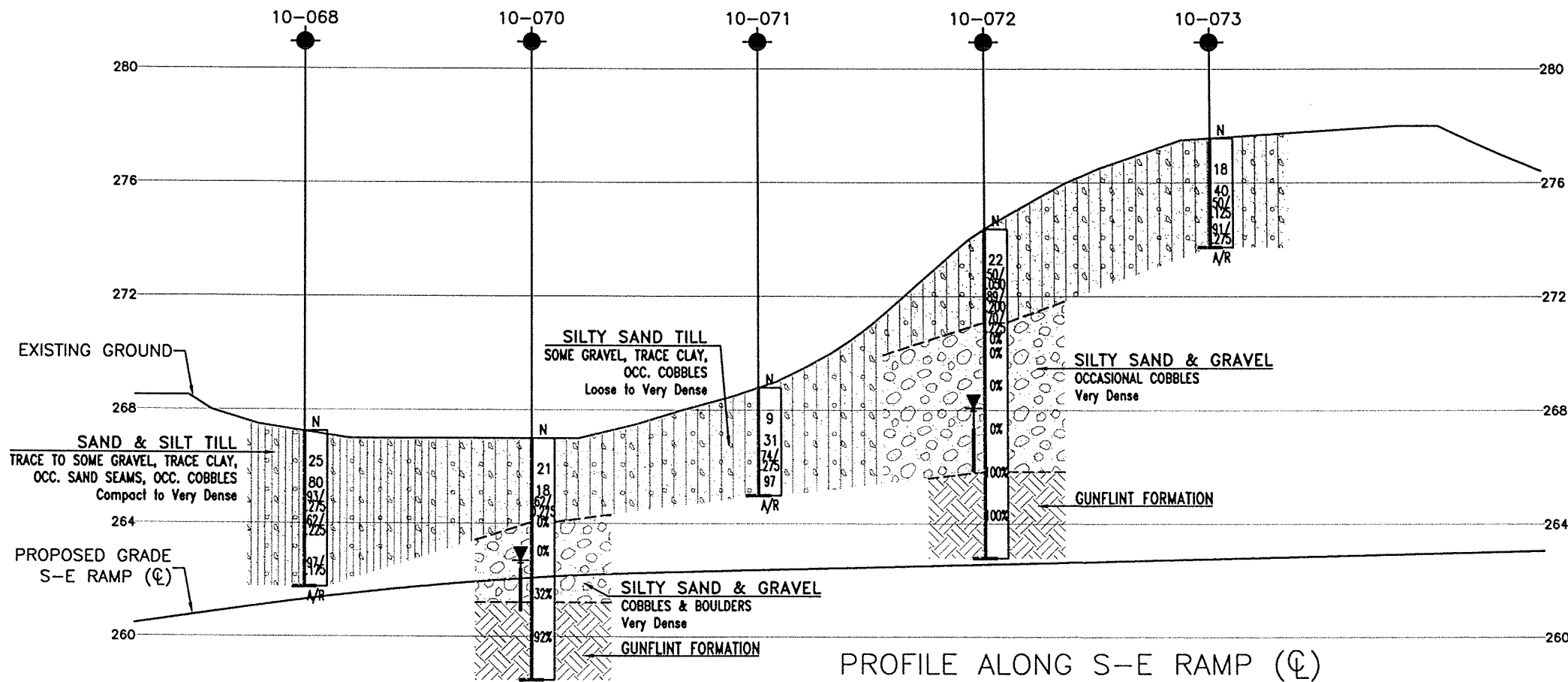
PROFILE ALONG S-E RAMP (C)

0 50 100m H 1:2500
0 4 8m V 1:200

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG	CODE
DRAWN	AN	CHK PKC	SITE
			STRUCT
			DWG G1



SCALE 1:2500



0 20 40m H 1:1000
0 4 8m V 1:200

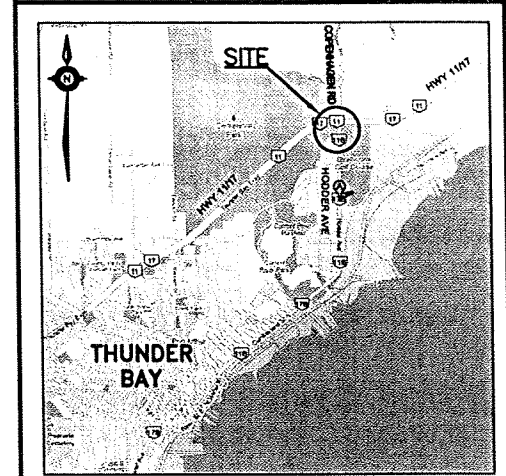
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
S-E RAMP (RT. OF Q)
BOREHOLE LOCATIONS AND SOIL STRATA

MCCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
 GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



**KEYPLAN
LEGEND**

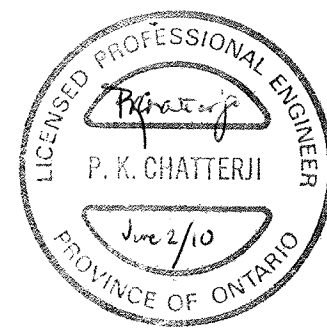
- ◆ Borehole
- ◆ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- ↑ Head Artesian Water
- ↑ Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	STATION	Q OFFSET
10-068	10+160	15m RT.
10-070	10+200	17m RT.
10-071	10+240	18m RT.
10-072	10+280	18m RT.
10-073	10+320	17m RT.

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG	CODE
DRAWN	MFA	CHK PKC	SITE
		STRUCT	DWG G2
			DATE JUN. 2010

Appendix H

Hodder Avenue Interchange N-E Ramp

Station 10+100 to 10+300

Boreholes 09-17 to 09-20

RECORD OF BOREHOLE No 09-017

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave N-E Ramp, Sta. 10+050 CL ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2009.07.01 - 2009.07.01 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT										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 × LAB VANE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
0.0	Silty CLAY , sandy, trace gravel Brown (TILL)		1	AS				20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								</

METRIC[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 09-019

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave N-E Ramp, Sta. 10+150 CL ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2009.07.01 - 2009.07.01 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W P W W L				
								○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE	20 40 60 80 100	20 40 60	20 40 60					
0.0	Clayey SILT , sandy, trace gravel, roots Stiff Brown (TILL)		1	AS													
			1	SS	14												5 32 49 15
1.4	Silty SAND , some gravel, trace clay, with cobbles and boulders Very Dense Brown Moist (TILL) Auger refusal on boulder at 2.0m. Began coring.		2	SS	104												
			1	RUN													RUN 1# TCR=18%, SCR=18%, RQD=2%
			2	RUN													RUN 2# TCR=35%, SCR=33%, RQD=2% UCS=358MPa
4.9	GUNFLINT FORMATION , very strong to extremely strong (chert carbonate), thinly banded, grey, slightly weathered, calcite veining		3	RUN												FI	RUN 3# TCR=80%, SCR=70%, RQD=70% UCS=305MPa
			4	RUN												>4	RUN 4# TCR=100%, SCR=93%, RQD=93% UCS=158MPa
6.5	END OF BOREHOLE AT 6.5m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																

+³ . X³ : Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-020

1 OF 1

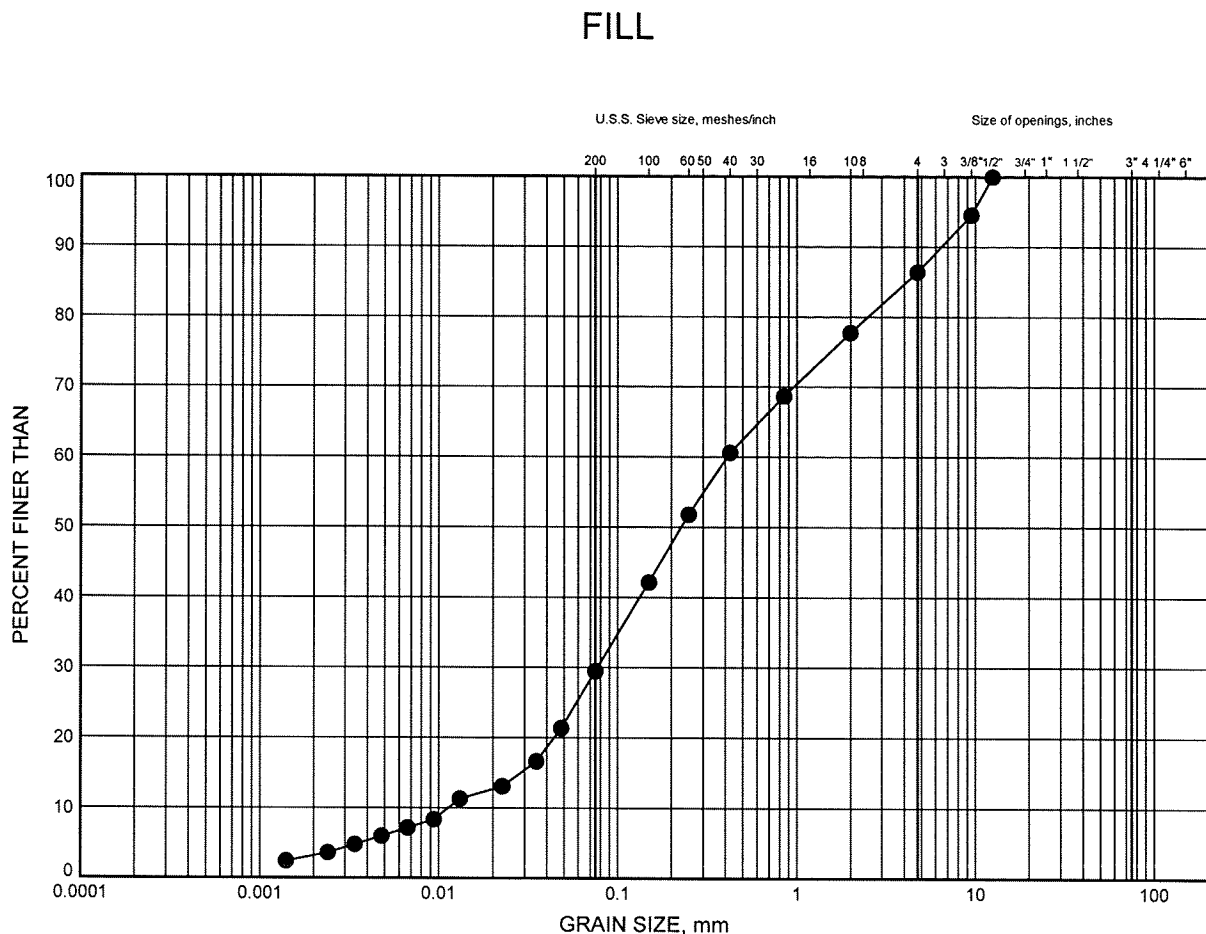
METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave N-E Ramp, Sta. 10+240 CL ORIGINATED BY LG
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
DATUM Geodetic DATE 2009.07.02 - 2009.07.02 CHECKED BY TH

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									
								20	40	60	80	100					
								○ UNCONFINED	+	FIELD VANE							
								● QUICK TRIAXIAL	x	LAB VANE							
								20	40	60	80	100					

Hwy 11/17 Hodder Avenue GRAIN SIZE DISTRIBUTION

FIGURE H1



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-020	1.07	

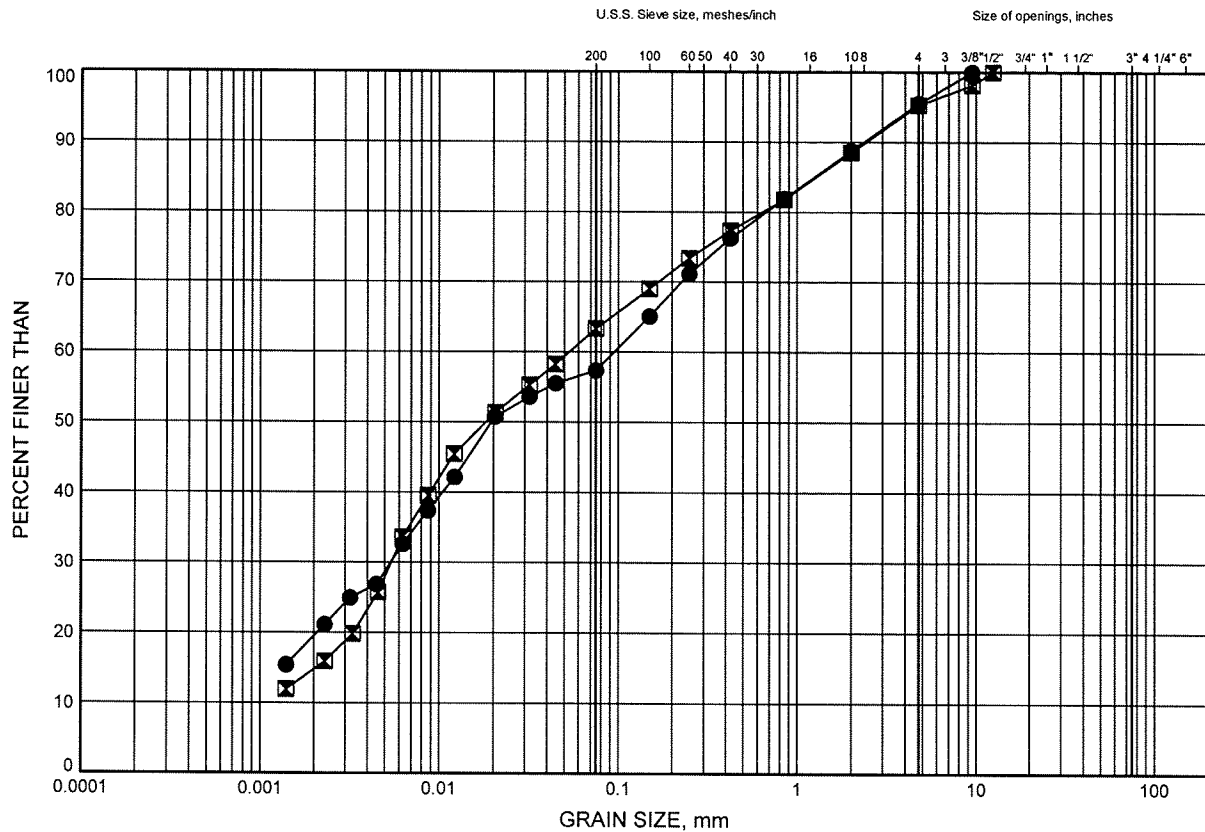


W.P.# 334-94-00
Prepared By AN
Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE H2

CLAYEY SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-017	0.38	
⊠	09-019	1.07	

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 4/15/10

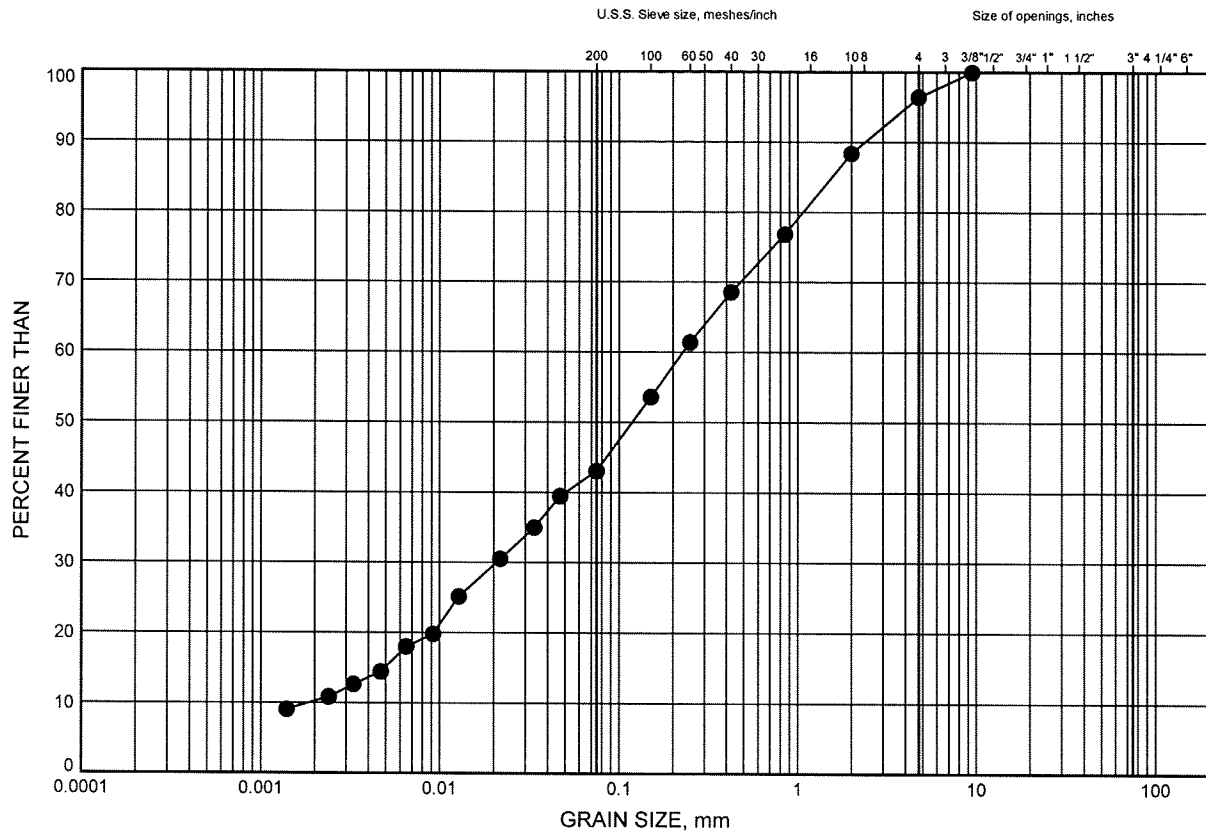
W.P.# 334-94-00
Prepared By AN
Checked By MRA



Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE H3

SILTY SAND TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-018	1.07	

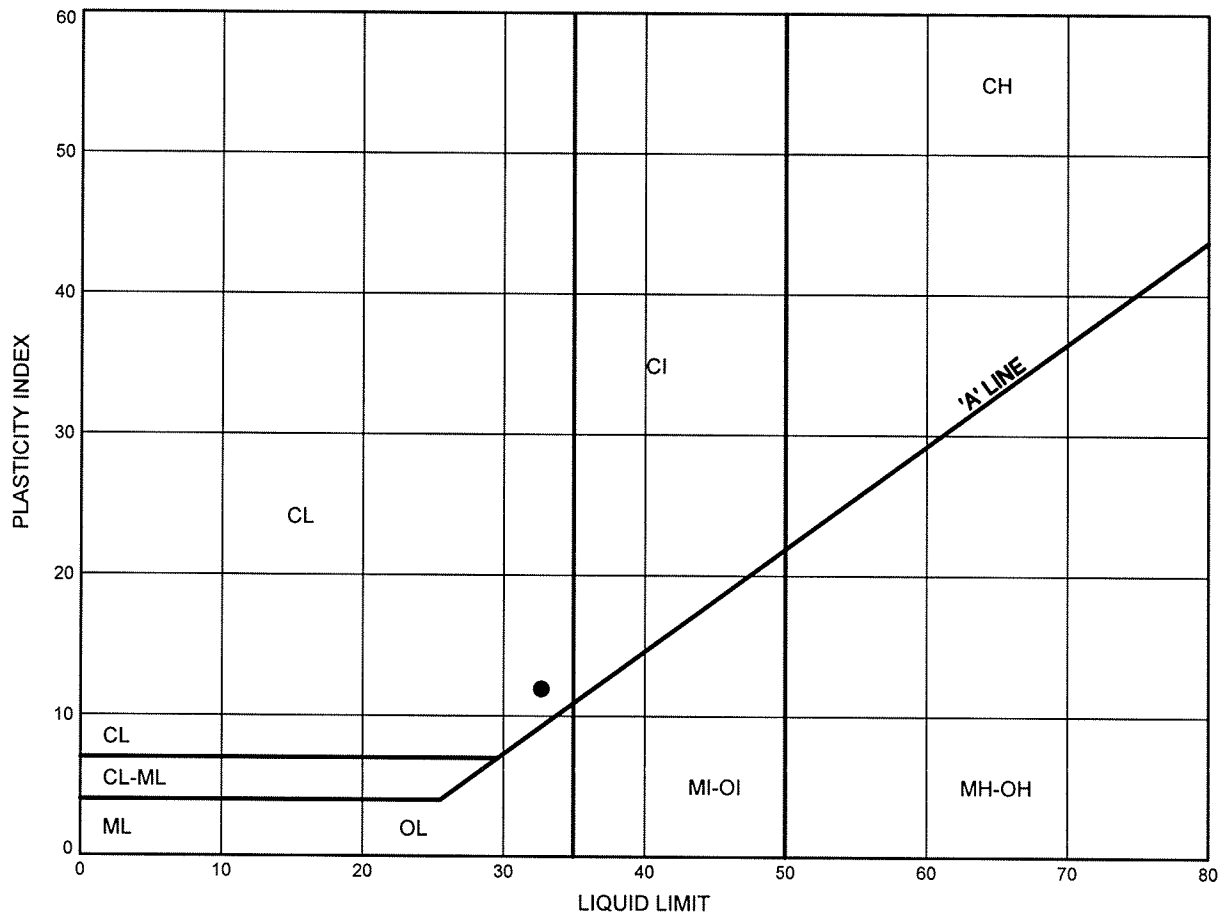


W.P.# .334-94-00.....
Prepared By .AN.....
Checked By .MRA.....

Hwy 11/17 Hodder Avenue
ATTERBERG LIMITS TEST RESULTS

FIGURE H4

SILTY CLAY TILL

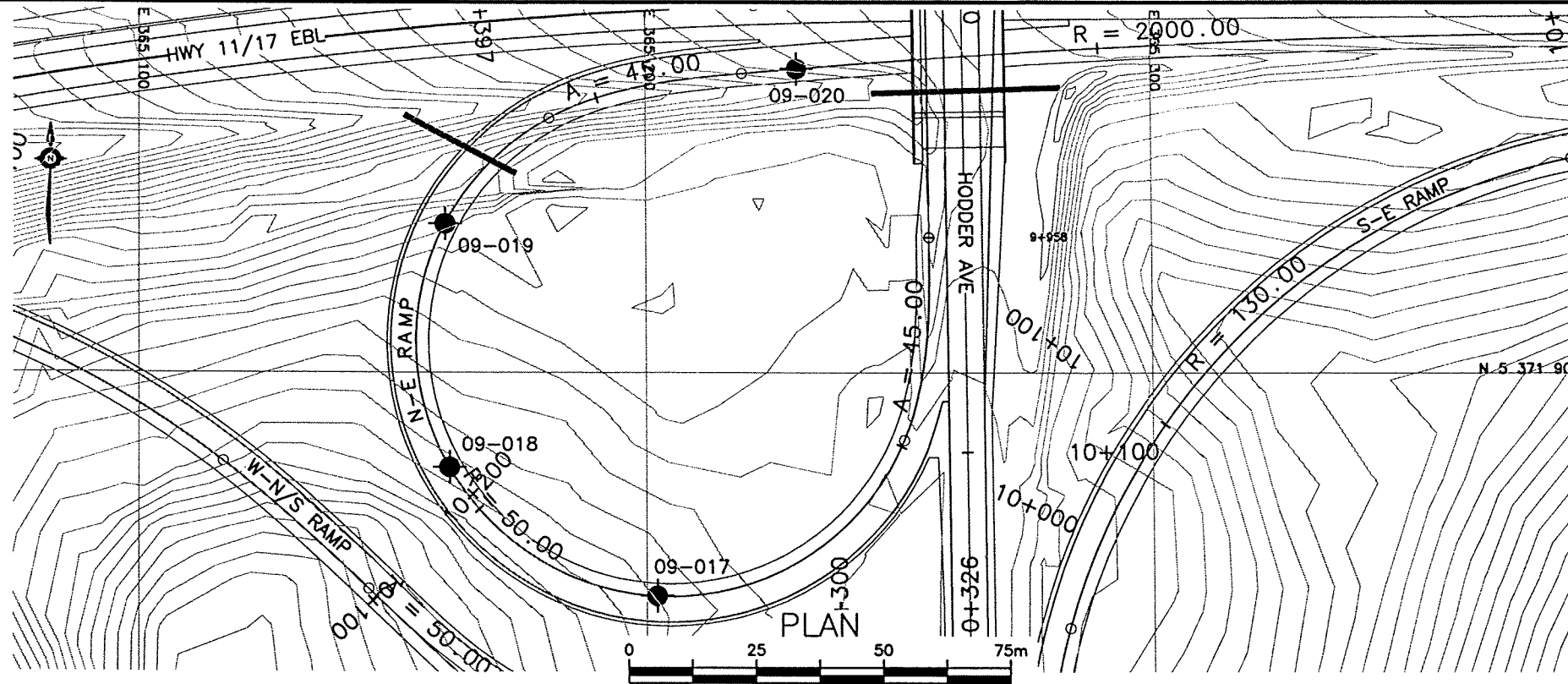


SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	09-017	0.38	

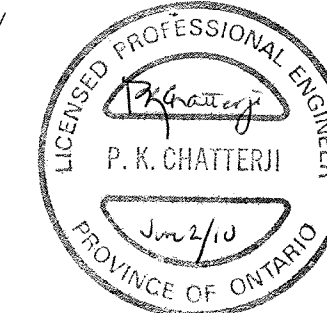
Date April 2010
 Project 334-94-00



Prep'd AN
 Chkd. MRA



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

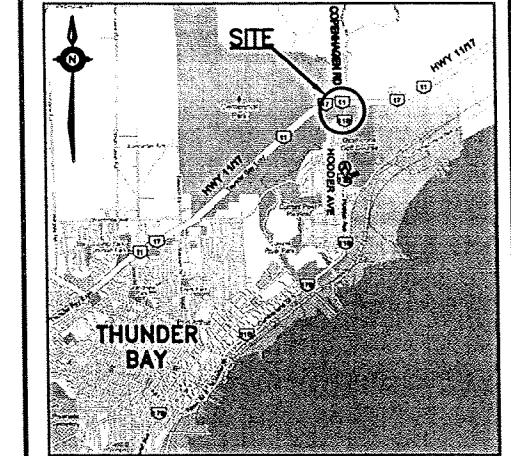


CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
N-E RAMP (C)
BOREHOLE LOCATIONS AND SOIL STRATA

MRC McCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



KEYPLAN
LEGEND

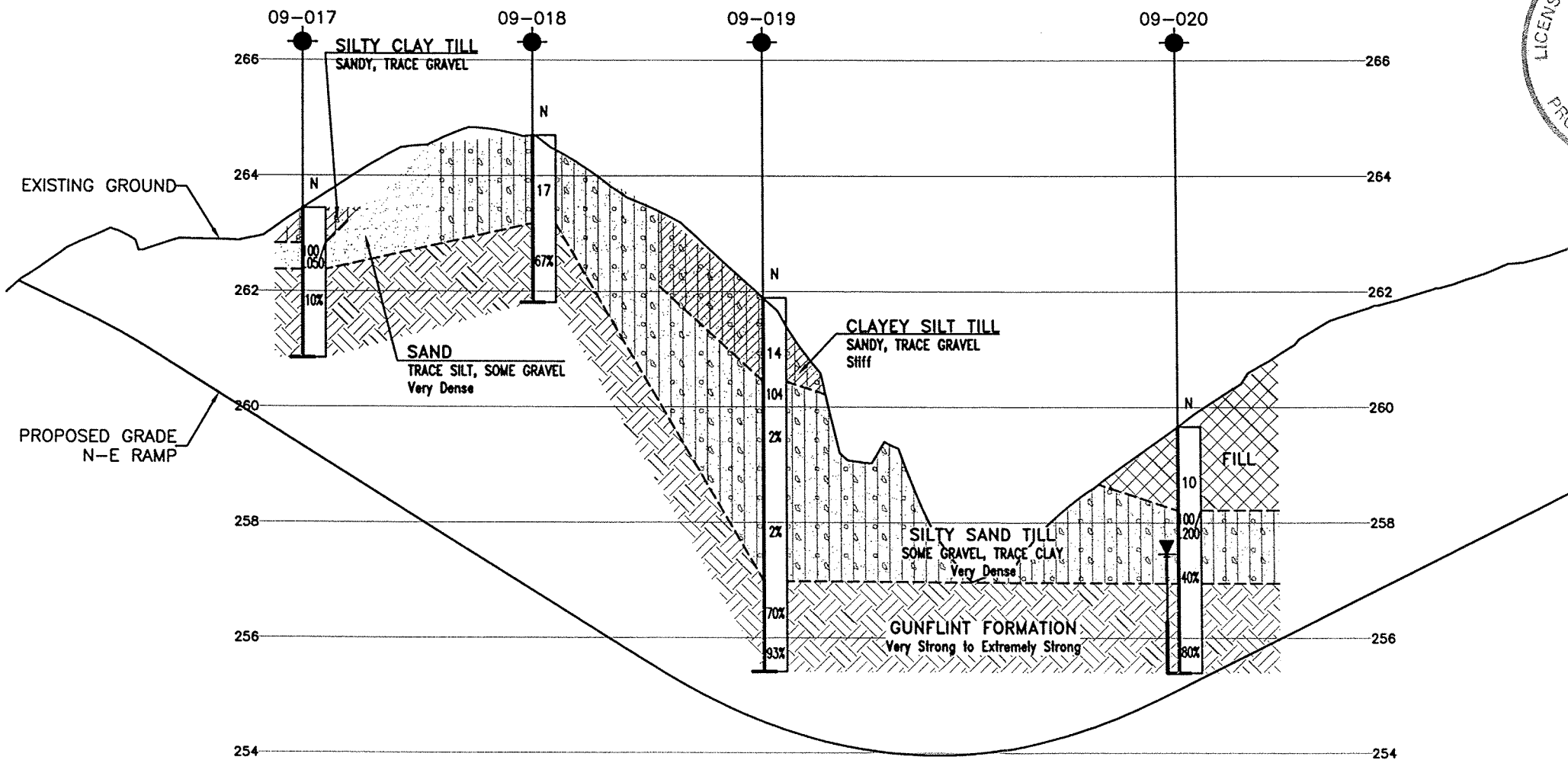
- ◆ Borehole
- ◆ Borehole and Cone
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- W Water Level
- ↑ Head Artesian Water
- Piezometer
- 90% Rock Quality Designation (RQD)
- A/R Auger Refusal

NO	STATION	CL OFFSET
09-17	10+050	0.0m
09-18	10+100	0.0m
09-19	10+150	0.0m
09-20	10+240	0.0m

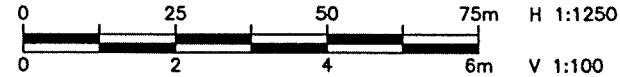
NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146



PROFILE ALONG N-E RAMP (C)



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG	CODE
DRAWN	AN	CHK PKC	SITE
LOAD	DATE	JUN. 2010	
STRUCT	DWG	H1	

Appendix I

Hodder Avenue Interchange W-N/S Ramp

Station 10+100 to 10+235

Boreholes 09-01 to 09-05, and 10-85 to 10-90

RECORD OF BOREHOLE No 09-001

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 905.0 E 365 060.4 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2009.06.29 - 2009.06.29 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
260.4														
0.0	TOPSOIL, roots, organics													GR SA SI CL
259.3			1	SS	21									
1.1	SAND, trace silt, trace gravel, trace organics													
258.9	Compact													
1.4	Dark brown		2	SS	29									
	Moist													
	SAND and SILT, trace clay, trace to some gravel													
	Compact to Very Dense													
	Brown		3	SS	42									6 54 34 6
	Moist													
	(TILL)													
			4	SS	66									
			5	SS	83/ 200									12 47 35 7
	with frequent cobbles and boulders													
	Auger refusal on boulder at 5.3m. Began coring.		1	RUN										RUN 1# TCR=53%, SCR=28%, RQD=28%
			2	RUN										RUN 2# TCR=30%, SCR=0%, RQD=0%
			3	RUN										RUN 3# TCR=40%, SCR=0%, RQD=0%
251.1														
9.3	END OF BOREHOLE AT 9.3m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.													

ONTMT4S 1156.GPJ 3/17/10

+³, X³: Numbers refer to Sensitivity 20 15 10 5 0 (-) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-002

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 893.6 E 365 096.5 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2009.06.26 - 2009.06.26 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
20								40	60	80	100			20	40	60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
263.7																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-002

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 893.6 E 365 096.5 ORIGINATED BY LG
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
DATUM Geodetic DATE 2009.06.26 - 2009.06.26 CHECKED BY TH



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 LAB VANE					WATER CONTENT (%) W _P W W _L				
	Continued From Previous Page		4	RUN													
252.8							253										
10.8	END OF BOREHOLE AT 10.8m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.11.23 9.2 254.5 2010.03.01 9.4 254.3																

RECORD OF BOREHOLE No 09-003

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 893.1 E 365 081.2 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2009.06.29 - 2009.06.29 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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 × LAB VANE				
263.1							20 40 60 80 100	20 40 60 80 100	20 40 60 80 100			
0.0	SILT and SAND , trace to some clay, trace gravel Loose to Very Dense Brown Moist (TILL)		1	SS	5							
			2	SS	8							
			3	SS	28							
	with cobbles and boulders		4	SS	63							
			5	SS	67							
			6	SS	100/ 0.150							
	Auger refusal on boulder at 4.4m. Began coring. Frequent cobbles and boulders		1	RUN							FI	
			2	RUN								RUN 2# TCR=2%, SCR=0%, RQD=0%
			3	RUN								RUN 3# TCR=52%, SCR=2%, RQD=2%
255.4			4	RUN							0	RUN 4# TCR=100%, SCR=100%, RQD=100% UCS=73MPa
7.6	GUNFLINT FORMATION , strong (chert carbonate), thinly banded, slightly weathered, charcoal grey, sub-horizontal fractures, calcite veining		5	RUN							1	
											0	
											1	
											2	RUN 5# TCR=100%, SCR=100%, RQD=100% UCS=99MPa
											0	
											0	

RECORD OF BOREHOLE No 09-003

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 893.1 E 365 081.2 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2009.06.29 - 2009.06.29 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60	W _p W W _L	WATER CONTENT (%)	20 40 60	20 40 60			
	Continued From Previous Page						253										
252.4																	
10.7	END OF BOREHOLE AT 10.7m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.11.23 10.4 252.7																

RECORD OF BOREHOLE No 09-004

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 871.1 E 365 127.8 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2009.06.30 - 2009.06.30 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
267.4								20 40 60 80 100	20 40 60	20 40 60	20 40 60																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
0.0	SAND and SILT, trace clay, trace gravel, occasional cobble Compact to Very Dense Brown Moist (TILL)		1	SS	9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										

+³ ×³: Numbers refer to Sensitivity 20 15 10 5 0 5 10 15 20 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-005

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION Hodder Ave W-N/S Ramp, Sta. 10+235 CL ORIGINATED BY LG
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/BQ Coring COMPILED BY AN
DATUM Geodetic DATE 2009.06.30 - 2009.06.30 CHECKED BY TH

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 (%)				
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					w _p w w _L				
							20	40	60	80	100		20	40	60		
0.0	SAND and SILT, trace clay, trace to some gravel Dense to Very Dense Brown Moist (TILL)		1	SS	39												
			2	SS	59												10 57 28 5
			3	SS	62												
2.9	GUNFLINT FORMATION, very strong to extremely strong (chert carbonate), slightly weathered, thinly banded, iron stained fractures, calcite veining		1	RUN												FI	RUN 1# TCR=82%, SCR=85%, RQD=50% UCS=169MPa
			2	RUN												>3	RUN 2# TCR=93%, SCR=90%, RQD=83% UCS=194MPa
			3	RUN												2	RUN 3# TCR=100%, SCR=100%, RQD=92% UCS=267MPa
6.7	END OF BOREHOLE AT 6.6m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.															1	

RECORD OF BOREHOLE No 10-085

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 889.1 E 365 032.3 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.08 - 2010.01.09 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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 × LAB VANE						
							WATER CONTENT (%)							
							20 40 60 80 100							
							PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT							
							w _p w w _L							
							20 40 60							
255.4														
0.0	Silty SAND , some gravel, trace clay Compact to Very Dense Brown Moist (TILL)													
			1	SS	21									
	Pocket of clayey silt, trace sand		2	SS	16									
			3	SS	23									
			4	SS	79/ 225									
			5	SS	50/ .075									
													</	

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

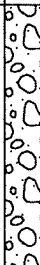

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-085

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 889.1 E 365 032.3 ORIGINATED BY LG
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2010.01.08 - 2010.01.09 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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 LAB VANE						PLASTIC LIMIT w _P NATURAL MOISTURE CONTENT w LIQUID LIMIT w _L WATER CONTENT (%)
	Continued From Previous Page						20 40 60 80 100							
	Silty SAND and GRAVEL , frequent cobbles and boulders		4	RUN			245							RUN 4# TCR=63%, SCR=42%, RQD=0%
243.6							244							
11.8	GUNFLINT FORMATION , strong (interbedded calcareous wackestone, siltstone and occasional shale laminations), light to dark grey, sub-horizontal fractures		5	RUN			243							RUN 5# TCR=100%, SCR=83%, RQD=83% UCS=54MPa
							242							RUN 6# TCR=100%, SCR=100%, RQD=100% UCS=73MPa
			6	RUN			241							
240.5														
14.8	END OF BOREHOLE AT 14.8m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.													

ONTMT4S 1156.GPJ 4/15/10

RECORD OF BOREHOLE No 10-086

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 898.8 E 365 071.6 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.06 - 2010.01.06 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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						
261.8							20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
0.0	Clayey SILT , some sand, trace gravel, trace organics Firm Brown Moist (FILL)		1	AS			261							
260.4			1	SS	7									
1.4	SILT , some sand, trace gravel, trace organics Very Loose Brown Moist (FILL)		2	SS	3		260							
259.7														
2.1	Silty SAND , some gravel, trace clay, occasional cobbles Very Dense Brown Moist (TILL)		3	SS	62/ 250		259							
			4	SS	83/ 250									14 47 33 6
							258							
			5	SS	76/ 225		257							
	Auger refusal at 5.9m. Began coring.		1	RUN			256							RUN 1# TCR=100%, SCR=0%, RQD=0%
	Numerous cobbles		2	RUN			255							RUN 2# TCR=67%, SCR=11%, RQD=0%
254.5														
7.3	GUNFLINT FORMATION , medium strong to very strong (interbedded fine grained wackestone and siltstone), dark grey, sub-horizontal fractures		3	RUN			254						FI 0 0 0	RUN 3# TCR=100%, SCR=100%, RQD=100% UCS=146MPa
							253						1 0 0 0	RUN 4# TCR=100%, SCR=100%, RQD=100% UCS=64MPa
	675mm vertical fracture at 9.7m		4	RUN			252						0	

Continued Next Page

+³ ×³: Numbers refer to 20 15 10 5 0
 Sensitivity (%) STRAIN AT FAILURE

ONTWT4S 1156.GPJ 4/15/10

RECORD OF BOREHOLE No 10-086

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 898.8 E 365 071.6 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.06 - 2010.01.06 CHECKED BY TH

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		
	Continued From Previous Page							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE					WATER CONTENT (%)			kN/m ³	GR SA SI CL
250.9			5	RUN			251									0	RUN 5# TCR=100%, SCR=100%, RQD=100% UCS=31MPa
10.9	END OF BOREHOLE AT 10.9m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.															0	

ONTMT4S 1156.GPJ 4/15/10

+³.X³: Numbers refer to
Sensitivity

20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-087

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 883.3 E 365 102.6 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.14 - 2010.01.14 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
264.4							20 40 60 80 100	○ UNCONFINED + FIELD VANE		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			
							20 40 60 80 100	● QUICK TRIAXIAL × LAB VANE		w _p w w _L			
								WATER CONTENT (%)					
0.0	Sandy SILT , trace gravel Loose Brown Moist		1	SS	8								GR SA SI CL
263.0													
1.4	Silty SAND , some gravel, trace clay, occasional cobbles Compact to Very Dense Brown Moist (TILL)		2	SS	34								12 56 26 6
	Auger refusal at 2.7m. Began coring.		3	SS	50/ 0.075								
261.7													
2.7	Silty SAND and GRAVEL , frequent cobbles Very Dense Brown		1	RUN									RUN 1# TCR=29%, SCR=10%, RQD=0%
			2	RUN									RUN 2# TCR=25%, SCR=0%, RQD=0%
			3	RUN									RUN 3# TCR=77%, SCR=73%, RQD=73% UCS=302MPa
257.5													
6.9	GUNFLINT FORMATION , very strong to extremely strong (interbedded calcareous siltstone and fine grained wackestone), dark grey, sub-horizontal fractures		4	RUN									RUN 4# TCR=83%, SCR=52%, RQD=52% UCS=255MPa
			5	RUN									RUN 5# TCR=100%, SCR=60%, RQD=60% UCS=243MPa

Continued Next Page

+³, X³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-087

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 883.3 E 365 102.6 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.14 - 2010.01.14 CHECKED BY TH

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		
	Continued From Previous Page																
254.0																	
10.4	END OF BOREHOLE AT 10.4m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.						254										

ONTMT4S 1156.GPJ 4/15/10

+³, ×³: Numbers refer to
Sensitivity

20
15 10 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-088

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 905.7 E 365 080.6 ORIGINATED BY SLL
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NW Casing/BQ Core COMPILED BY AN
 DATUM Geodetic DATE 2009.12.14 - 2009.12.17 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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 × LAB VANE					WATER CONTENT (%) W P W W L			
262.1							20	40	60	80	100					
0.0	TOPSOIL, with roots and rootlets (200mm)															
0.2	Sandy SILT, with roots and rootlets Compact Brown Moist		1	SS	16											
260.7																
1.4	SAND and SILT, trace clay, trace gravel Dense to Very Dense Brown Moist (TILL)		2	SS	34											
			3	SS	85/ 250											
	Occasional cobbles Auger refusal at 3.0m Advanced using NW casing and BQ coring		4	SS	50/ .125											
			5	SS	50/ .125											
			6	SS	50/ .150											
255.1																
7.0	SAND and GRAVEL, some silt, occasional cobble Very Dense Grey Moist to Wet		7	SS	100/ .100											
			8	SS	100/ .100											

Continued Next Page

+³. X³: Numbers refer to
Sensitivity

20
15 10 5
10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 09-088

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 905.7 E 365 080.6 ORIGINATED BY SLL
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NW Casing/BQ Core COMPILED BY AN
DATUM Geodetic DATE 2009.12.14 - 2009.12.17 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
	Continued From Previous Page							20	40	60	80	100					
	SAND and GRAVEL, some silt, occasional cobble Very Dense Grey Wet		9	SS	100/ .050												
	Clayey silt pockets		10	SS	100/ .225								○				58 37 5 (SI+CL)
													○				
			11	SS	100/ .225								○				
246.7			12	SS	50/ .125								○				45 51 4 (SI+CL)
15.4	END OF BOREHOLE AT 15.4m. BOREHOLE OPEN TO 14.8m, AND WATER LEVEL AT 8.0m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 0.4m, THEN SAND TO SURFACE.																

RECORD OF BOREHOLE No 10-089

1 OF 1

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 911.1 E 365 095.9 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.08 - 2010.01.08 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)				
								○ UNCONFINED + FIELD VANE		● QUICK TRIAXIAL × LAB VANE		w _p w w _L				
								20	40	60	80	100	20	40		
262.2																
0.0	Silty SAND , trace gravel, occasional shale fragments Compact Reddish Brown Moist		1	SS	19											
260.8																
1.4	SAND and SILT , trace to some gravel, trace clay, occasional cobbles Compact to Very Dense Brown Moist (TILL)		2	SS	27											
			3	SS	55											
			4	SS	61											
257.6																
4.6	GUNFLINT FORMATION , very strong to extremely strong (interbedded calcareous siltstone and fine grained wackestone), slightly weathered to fresh, dark to light grey, sub-horizontal fractures		1	RUN												
			2	RUN												
			3	RUN												
253.2	175mm vertical fracture at 7.2m															
9.0	END OF BOREHOLE AT 9.0m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.															

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+³, X³: Numbers refer to
Sensitivity 20
15 10 5
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 10-090

1 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 914.7 E 365 074.9 ORIGINATED BY LG
 HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
 DATUM Geodetic DATE 2010.01.07 - 2010.01.07 CHECKED BY TH

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								UNCONFINED		FIELD VANE						
								QUICK TRIAXIAL	LAB VANE	WATER CONTENT (%)						
260.6						20	40	60	80	100	W _P	W	W _L		GR SA SI CL	
0.0	Sandy SILT, some gravel, trace organics and wood, occasional cobbles Compact Brown/Black Moist (FILL)															
258.8			1	SS	11											
			2	SS	50/ .125											
1.8	Silty SAND, some gravel, trace silt, occasional cobbles Very Dense Brown Moist (TILL)															
			3	SS	79											15 52 28 5
			4	SS	100/ .175											
			5	SS	100/ .125											
255.3	Auger refusal at 5.3m. Began coring.															
5.3	SAND and GRAVEL, numerous cobbles Very Dense Brown		1	RUN												RUN 1# TCR=75%, SCR=75%, RQD=0%
			2	RUN												RUN 2# TCR=28%, SCR=13%, RQD=0%
			3	RUN												RUN 3# TCR=43%, SCR=0%, RQD=0%
			4	RUN												RUN 4# TCR=80%, SCR=80%, RQD=70%
																RUN 5# TCR=57%, SCR=14%, RQD=0%
			5	RUN												
																</

Continued Next Page

+ 3 . X 3 : Numbers refer to 20 15 10 (% STRAIN AT FAILURE
Sensitivity

RECORD OF BOREHOLE No 10-090

2 OF 2

METRIC

G.W.P. 334-94-00 LOCATION N 5 371 914.7 E 365 074.9 ORIGINATED BY LG
HWY 11/17 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN
DATUM Geodetic DATE 2010.01.07 - 2010.01.07 CHECKED BY TH

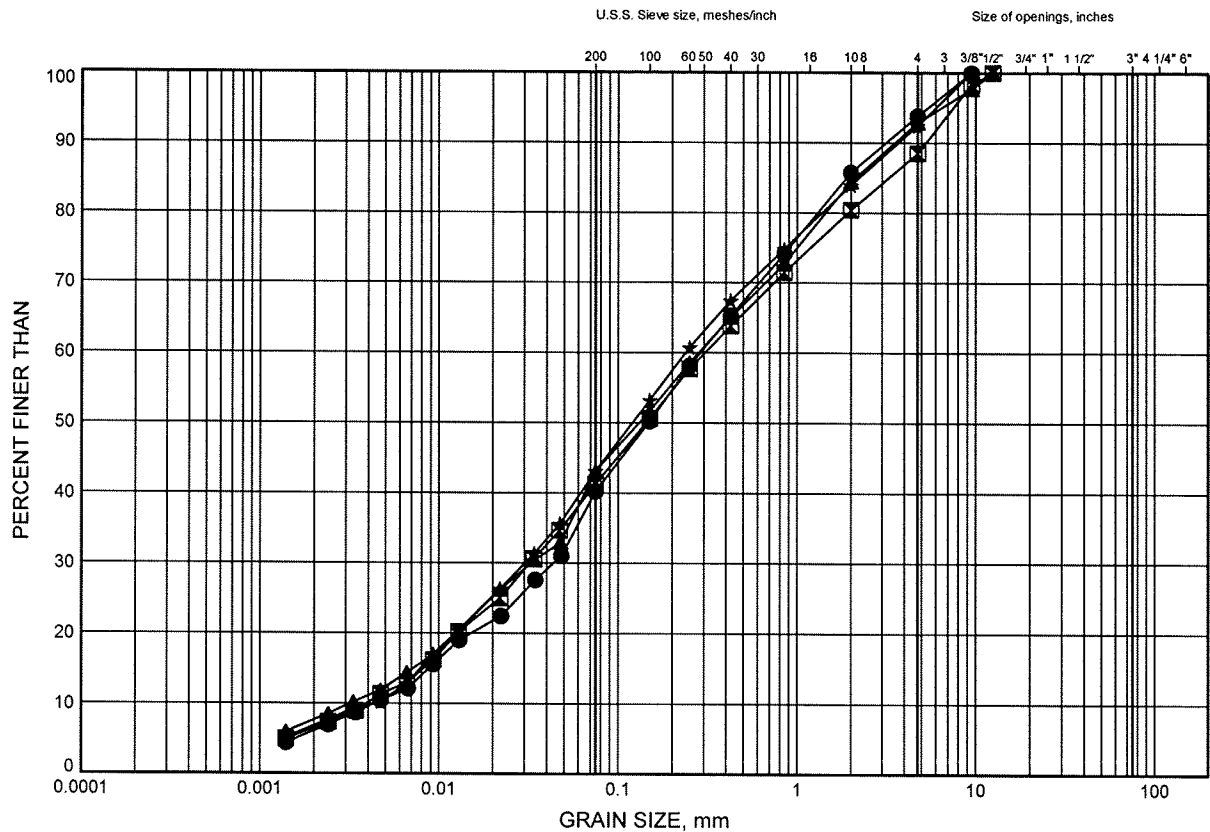
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100					
	Continued From Previous Page																
	SAND and GRAVEL, numerous cobbles		6	RUN			250										RUN 6# TCR=12%, SCR=3%, RQD=0%
			7	RUN			249										RUN 7# TCR=12%, SCR=3%, RQD=0%
			8	RUN			247										RUN 8# TCR=70%, SCR=28%, RQD=0%
246.5			9	RUN			246										RUN 9# TCR=100%, SCR=100%, RQD=100%
14.1	GUNFLINT FORMATION, strong to very strong (interbedded calcareous siltstone to calcareous fine grained wackestone), light to dark grey, sub-horizontal fractures		10	RUN			245										RUN 10# TCR=100%, SCR=97%, RQD=57% UCS=131MPa
			11	RUN			244										RUN 11# TCR=100%, SCR=97%, RQD=97% UCS=53MPa
242.9							243										
17.7	END OF BOREHOLE AT 17.7m. BOREHOLE BACKFILLED WITH BENTONITE TO SURFACE.																

ONTMT4S 1156.GPJ 4/15/10

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE 11

SILTY SAND to SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-001	2.53	257.84
⊠	09-001	4.75	255.62
▲	09-002	1.83	261.83
★	09-002	4.11	259.54

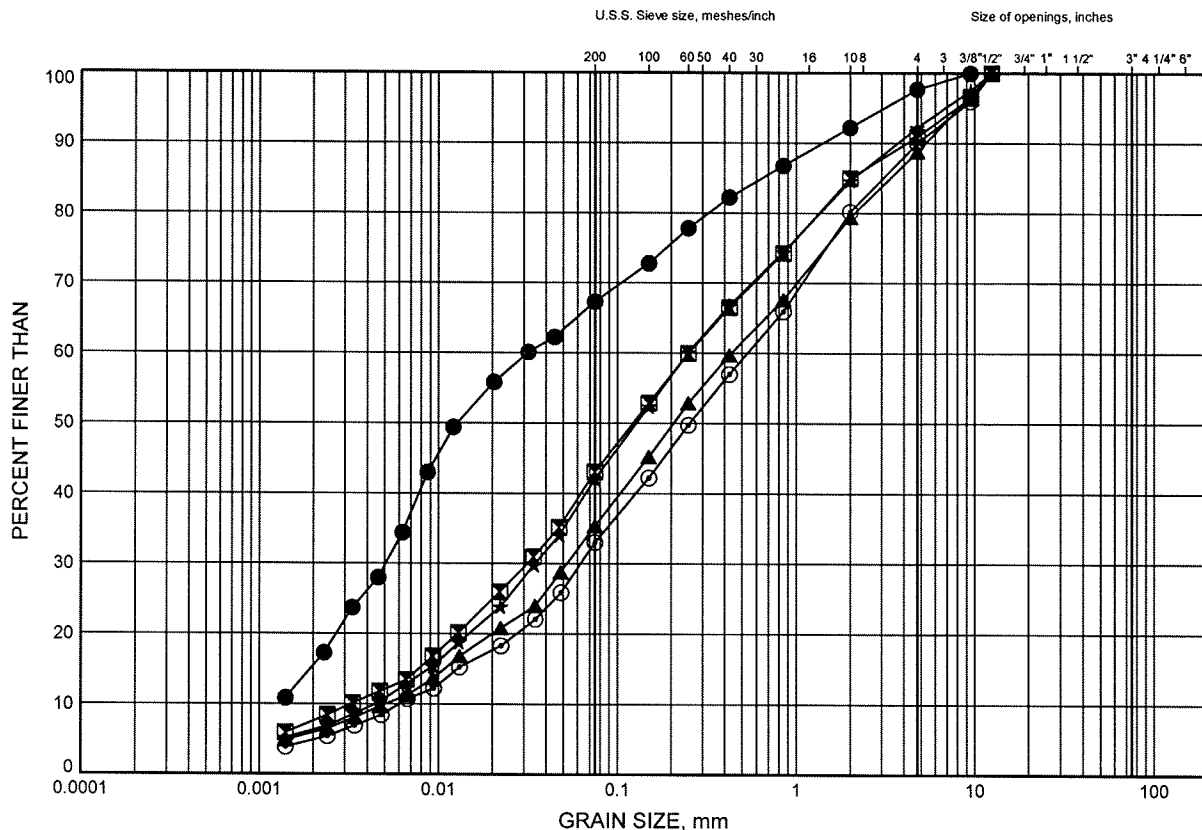


W.P.# 334-94-00
 Prepared By AN
 Checked By MRA

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE 12

SILTY SAND to SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-003	1.07	262.00
⊠	09-003	3.35	259.72
▲	09-004	1.07	266.31
★	09-004	2.59	264.78
⊙	09-005	1.83	

GRAIN SIZE DISTRIBUTION - THURBER 1156.GPJ 4/15/10

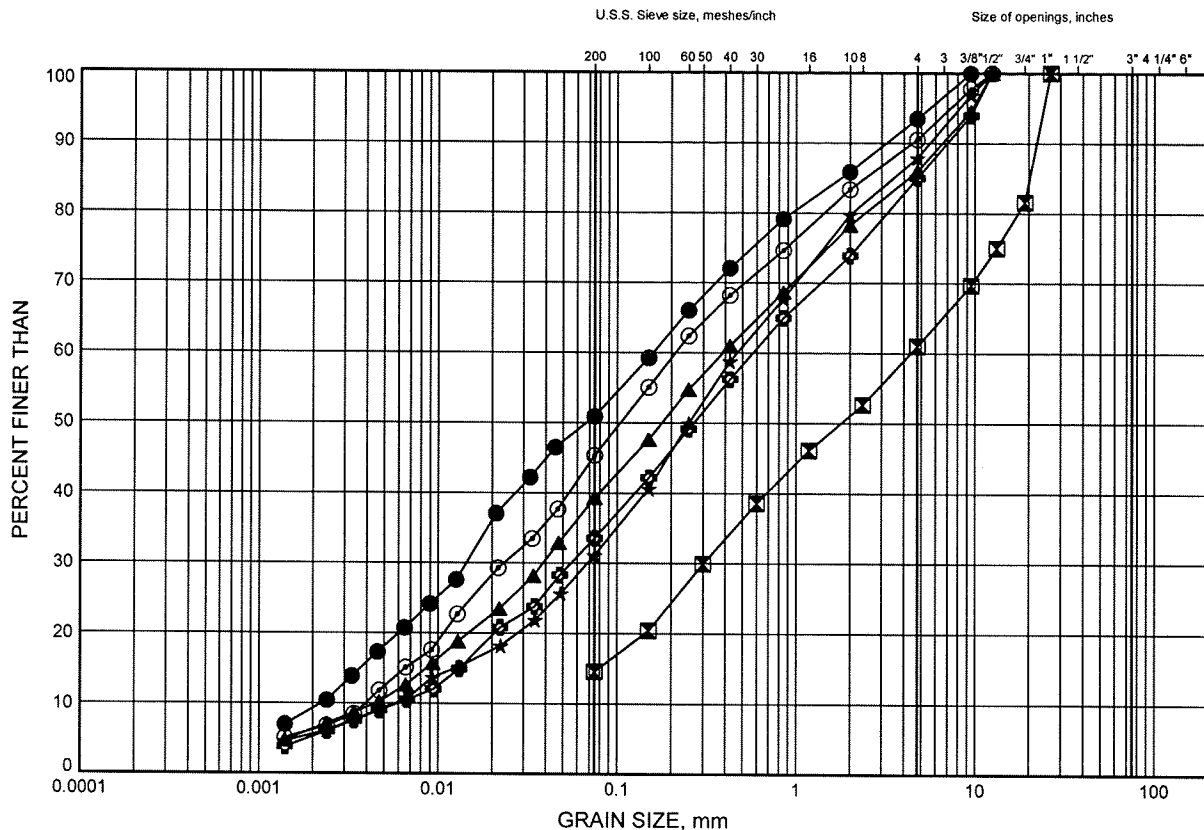
W.P.# 334-94-00
 Prepared By AN
 Checked By MRA



Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE I3

SILTY SAND to SAND & SILT TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-088	1.83	260.27
⊠	10-085	3.24	252.11
▲	10-086	3.25	258.57
★	10-087	1.83	262.57
⊙	10-089	2.59	259.61
⊕	10-090	2.59	258.01

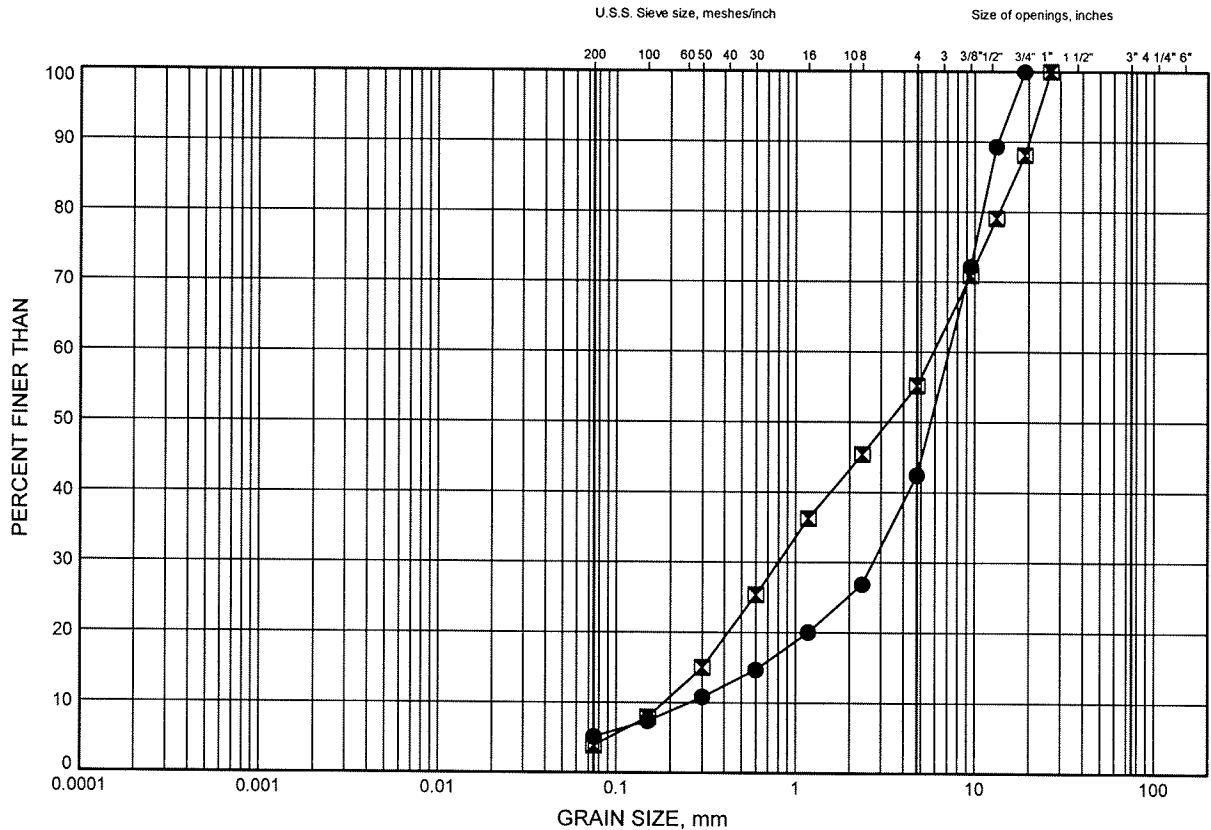


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Prepared By .AN.....
Checked By .MRA.....

Hwy 11/17 Hodder Avenue
GRAIN SIZE DISTRIBUTION

FIGURE I4

SAND & GRAVEL



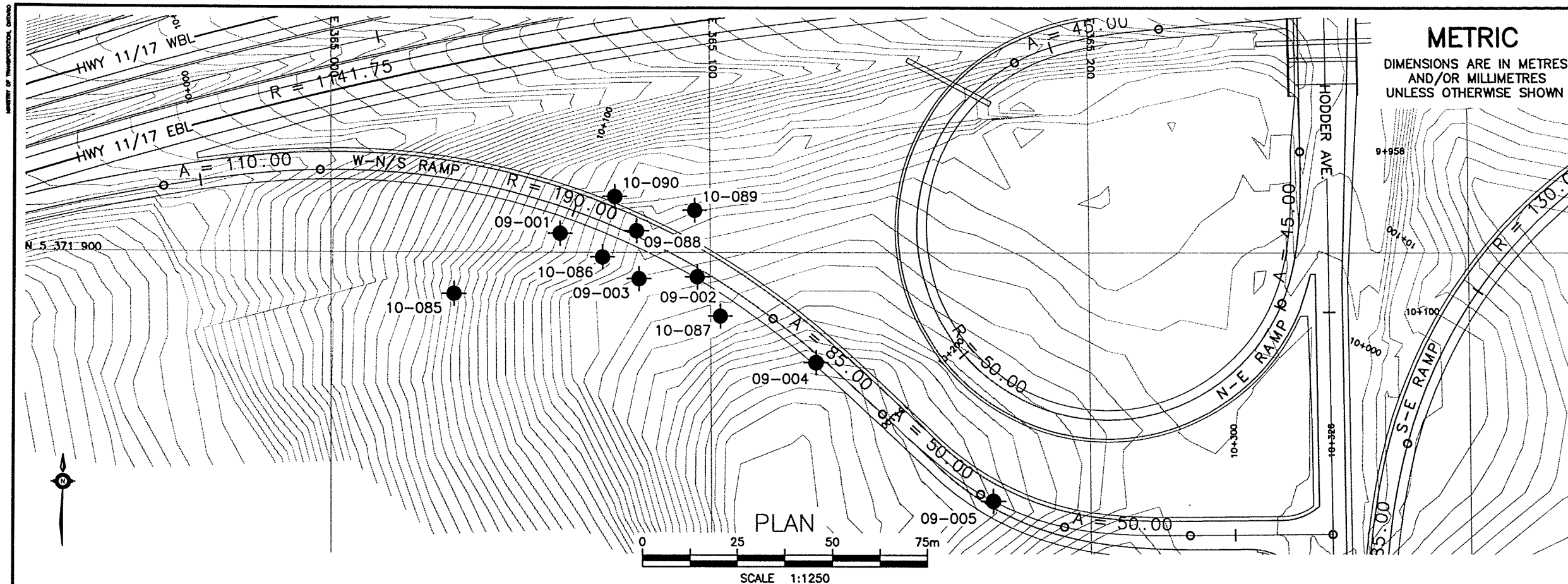
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	09-088	12.36	249.74
■	09-088	15.26	246.84



W.P.# .334-94-00.....
 Prepared By .AN.....
 Checked By .MRA.....

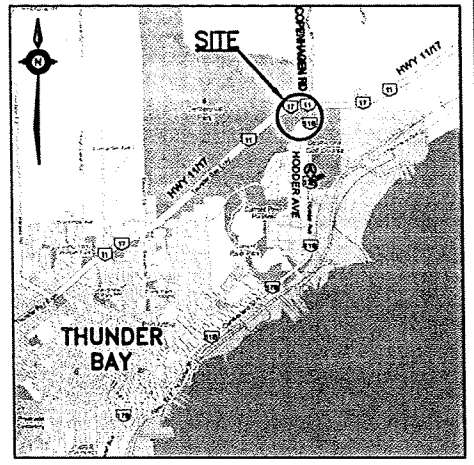


CONT No
WP No 334-94-00

HIGHWAY 11/17
AT HODDER AVENUE
W-N/S RAMP (C)
BOREHOLE LOCATIONS AND SOIL STRATA

MRC McCORMICK RANKIN CORPORATION

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



LEGEND

◆	Borehole
◆	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level
▽	Head Artesian Water
↑	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

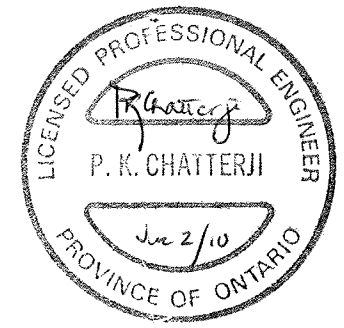
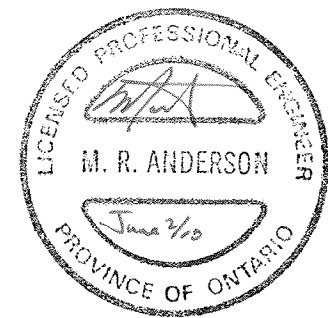
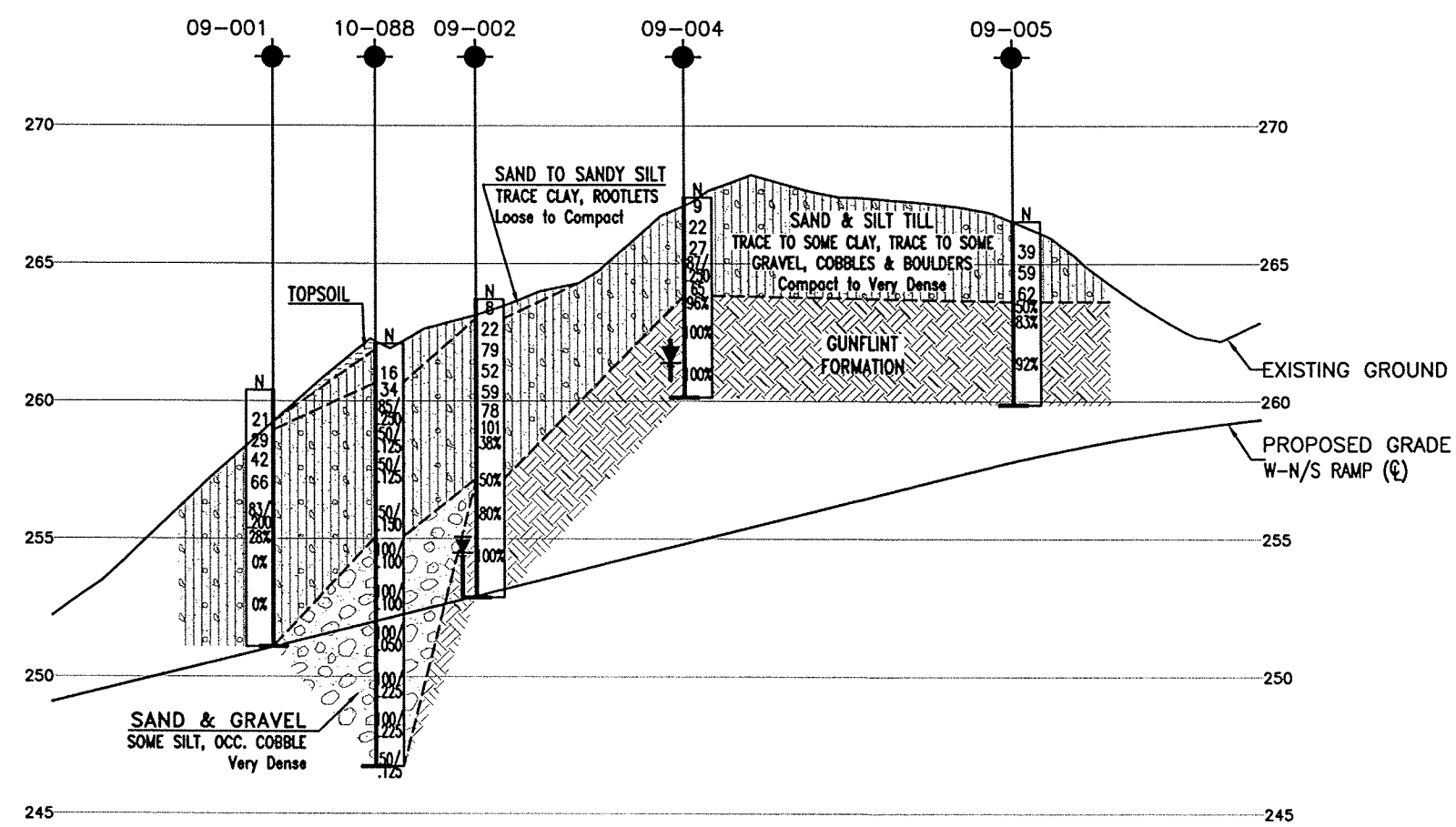
NO	ELEVATION	NORTHING	EASTING
09-001	260.4	5 371 905.0	365 060.4
09-002	263.7	5 371 893.6	365 096.5
09-004	267.4	5 371 871.1	365 127.8
09-088	262.1	5 371 905.7	365 080.6
NO	STATION	C OFFSET	
09-005	10+235	0m	

NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.

2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 52A-146



REVISIONS

DATE	BY	DESCRIPTION
DESIGN	MRA	CHK AEG
DRAWN	MFA	CHK PKC

LOAD DATE JUN. 2010

STRUCT DWG 11

FILENAME: G:\Projects\111351\11351-Hodder Ave W-N/S Ramp (Plan&Profile).dwg
PLOTTED: Jun 01, 2010 1:53pm

