PRELIMINARY
FOUNDATION INVESTIGATION AND DESIGN REPORT
EBYCREST ROAD UNDERPASS
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 408-88-00

Geocres Number: 40P8-150

Report to

Ministry of Transportation Ontario
Southwestern Region

Thurber Engineering Ltd.
2010 Winston Park Drive, Suite 103
Oakville, Ontario
L6H 5R7
Phone: (905) 829 8666
Fax: (905) 829 1166

September 3, 2008
File: 15-64-17

\\Torserver1\Projects\15\64\17 Hwy 7 New\Structures\Ebycrest Rd- RR17\15-64-17 Ebycrest FIDR-FINAL.doc

TABLE OF CONTENTS

Appendices

PRELIMINARY
FOUNDATION INVESTIGATION AND DESIGN REPORT
EBYCREST ROAD UNDERPASS
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 408-88-00

Geocres Number: 40P8-150

PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a preliminary foundation investigation conducted at the site of the proposed underpass structure to carry Ebycrest Road over Highway 7-New in the Regional Municipality of Waterloo, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, a stratigraphic profile, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions under the potential foundation footprint was developed from the data obtained in the course of the investigation.

The information collected in the course of the investigation and presented in this report is intended for preliminary design purposes only. Additional site investigation, field testing and engineering analysis will be required at the detail design stage. The extent of the additional investigation will depend, in part, on the final location and General Arrangement of the structure.

Thurber carried out the investigation for the Ministry of Transportation Ontario, Southwestern Region (MTO) under Purchase Order Number 3006-E-0123.

2 SITE DESCRIPTION

At the site, the Highway 7-New alignment runs approximately 900 m north of the existing Highway 7 and Ebycrest Road intersection. The site lies approximately 2.0 km northeast of a developed area of the City of Kitchener.

The site lies within an area of farms and agricultural lands. There are farmsteads to the east and west of Ebycrest Road, north of the existing Highway 7 alignment.

Based on the Ontario Geological Survey Special Volume 2, The Physiography of Southern Ontario, Third Edition by Chapman and Putnam, the site lies within the physiographic region known as the Waterloo Hills, characterized by ridges of sandy till and kames or kame moraines, with outwash sands occupying the intervening hollows.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field-testing at this site was carried out on June 12, 13 and 16, 2008. Three boreholes, 08-117, 08-118 and 08-119, were drilled approximately at the north abutment, pier and south abutment of a possible two-span structure arrangement. The depths of the boreholes ranged from 15.4 to 17.2 m. The Record of Borehole sheets for the boreholes are included in Appendix A. The approximate locations of the three boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix E.

Prior to commencing the site investigation, clearance was obtained from utility companies having plant in the area.

The boreholes were drilled using hollow stem auger equipment mounted on a CME75 truck-mounted drill rig. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. In Borehole 08-118, drilled at the proposed pier location, a standpipe piezometer consisting of 25 mm diameter PVC pipe with a slotted screen was installed and enclosed in filter sand to permit longer term groundwater level monitoring. The location and completion details of the piezometer are shown in Table 3.1. Boreholes without piezometer installations were grouted with bentonite upon completion. The borehole completion details are also shown in Table 3.1.

The completion of the boreholes and the standpipe piezometer was carried out in accordance with the requirements of O. Reg. 903 (as amended by O. Reg. 372/07).

Table 3.1 – Borehole Completion Details

Foundation Unit	Borehole Location	Piezometer Tip Depth/ Elevation (m)	Completion Details
North Abutment	08-117	No Installation	Bentonite to 0.6 m then holeplug to ground surface.
Pier	08-118	16.5/313.2	Piezometer with 1.5 m slotted screen installed with sand filter to 14.6 m, holeplug to 13.9 m, cement grout to 3.7 , holeplug and cuttings to 0.9m, sand to 0.3 m, then concrete to surface.
South Abutment	08-119	No Installation	Bentonite to 2.4 m, then holeplug to surface.

THURBER

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes and processed the recovered soil samples for transport to Thurber's laboratory for further examination and testing.

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 Appendix A. Selected samples were also subjected to gradation analysis (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets in Appendix A. Details of the encountered soil stratigraphy along the proposed alignment are presented in this appendix and on the "Borehole Locations and Soil Strata" drawing in Appendix E. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general, the site is underlain by granular fill overlying native sand, silty clay till and sandy silt till.

5.1 Fill

Fill was encountered surficially at all three exploration locations at this site. The fill consists of brown sand and gravel presumably placed to construct the existing embankment for Ebycrest Road. The thickness of the fill was 0.6 m.

The natural moisture content ranged from 3 to 5%.

5.2 Upper Sandy Silt Till

Native brown sandy silt till containing trace to some clay, trace gravel and occasional cobbles was contacted below the fill in Boreholes 08-117 and 08-119. Thickness of the upper sandy silt till was 3.5 m and 5.7 m in Boreholes 08-117 and 08-119, respectively.

The depths to the base of the upper sandy silt till were 4.1 m and 6.3 m (Elevation 327.0 and 321.8) in Boreholes 08-117 and 08-119, respectively.

SPT 'N' values in the upper sandy silt till ranged from 11 to 49 blows per 0.3 m of penetration, indicating a compact to dense relative density. The natural moisture contents generally ranged from 10% to 19%.

Grain size distribution curves for three sandy silt till samples tested are presented on the Record of Borehole sheets and on Figure B1 of Appendix B. Atterberg Limits test results are presented on Figure B5 of Appendix B.

The results of laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 2
Sand	38 to 41
Silt	45 to 60
Clay	2 to 12

Liquid Limit	18
Plastic Limit	11

Although not specifically identified in the boreholes, glacial tills are known to contain cobbles and boulders.

5.3 Sand

Layers of native brown sand containing trace silt and trace clay were contacted below the fill at 0.6 m depth (Elevation 329.1) in Borehole 08-118 and at 4.1 m depth (Elevation 327.0) in Borehole 08-117. Thicknesses of the sand layers were 4.5 m and 8.7 m, in Boreholes 08-117 and 08-118, respectively.

The depth to the base of the sand layer was 8.6 m and 9.3 m (Elevations 322.5 and 320.4), in Borehole 08-117 and 08-118, respectively.

A layer of sand was also contacted in Borehole 08-118 at 11.7 m depth (Elevation 318.0). Thickness of this layer was 1.5 m.

SPT 'N' values in the sand ranged from 10 to 82 blows per 0.3 m of penetration, indicating a compact to very dense relative density. The natural moisture contents generally ranged from 5% to 20%.

Grain size distribution curves for four samples of sand tested are presented on the Record of Borehole sheets and on Figure B2 Appendix B. The results of laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 3
Sand	90 to 95
Silt & Clay	2 to 10

5.4 Silty Clay Till

Native layers of grey silty clay till containing some sand to sandy and trace gravel were contacted below the sand, at 8.6 m, 9.3 m and 6.3 m depths (Elevations 322.5, 320.4 and 321.8) in Boreholes 08-117, 08-118 and 08-119, respectively.

Thickness of the silty clay till ranged from 2.4 m to 5.4 m. The depth to the base of the silty clay till was 13.3 m (Elevation 317.9) in Borehole 08-117 and 11.7 m (Elevations 318.0 and 316.4) in Boreholes 08118 and 08-119.

SPT 'N" values in silty clay till generally ranged from 27 to 73 blows per 0.3 m of penetration, indicating a very stiff to hard consistency. The natural moisture contents generally lay in the range of 10 to 19%.

Grain size distribution curves for three silty clay till samples tested are presented on the Record of Borehole sheets and on Figure B3 of Appendix B. Atterberg Limits test results are presented on Figure B6 of Appendix B.

The results of laboratory tests carried are summarized below:

Soil Particles	(%)
Gravel	1 to 4
Sand	18 to 27
Silt	46 to 49
Clay	23 to 32

Liquid Limit	22 to 28
Plastic Limit	11 to 16

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

Although not specifically identified in the boreholes, glacial tills are known to contain cobbles and boulders.

5.5 Lower Sandy Silt Till

Lower deposits of sandy silt till containing trace to some clay, trace to some gravel, numerous cobbles and possible boulders were contacted below the silty clay till in the three boreholes. The boreholes were terminated within the lower sandy silt till at depths ranging from 15.4 to 17.2 m (Elevations 312.7 to 313.9).

SPT 'N" values in the lower sandy silt till layers were generally higher than 100 blows per 0.175 m of penetration indicating a very dense relative density.

The natural moisture contents generally lay in the range of 5 to 17%.

Grain size distribution curves for lower sandy silty till samples tested are presented on the Record of Borehole sheets and on FigureB4 of Appendix B. The results of laboratory tests were as follows:

Soil Particles	(%)
Gravel	1 to 29
Sand	28 to 49
Silt	47 to 56
Clay	9 to 15
Silt & Clay	22

This layer contains cobbles and boulders which may account for some high SPT 'N' values and resistance to augering.

5.6 Groundwater Conditions

Water levels were observed in the boreholes during and upon completion of drilling. A standpipe piezometer was installed in Borehole 08-118 (at the proposed pier) to monitor water levels after completion of drilling. The water levels measured in the piezometer are summarized in Table 5.1, along with the measurements in the boreholes upon completion of drilling.

Table 5.1 – Water Level Measurements

Foundation Unit	Borehole	Date (2008)	Water Level (m)		Comment
			Depth	Elevation	
North Abutment	08-117	June 16	5.2	325.9	During drilling
Pier	08-118	July 23 August 20	5.8 5.8	323.9 323.9	In piezometer
South Abutment	08-119	-	Dry	-	Open borehole

The piezometric reading indicates that the groundwater level is near Elevation 323.9 m.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

6 MISCELLANEOUS

All-Terrain Drilling of Waterloo, Ontario supplied a truck-mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Stephane Loranger, C.E.T. of Thurber, under the direction of Mr. Alastair E. Gorman, P.Eng and Mr. Mark Farrant, P. Eng.

The coordinates for the boreholes and the ground surface elevations were obtained by Thurber Engineering Ltd. using GPS equipment.

Overall supervision of the field program was conducted by Mr. Alastair E. Gorman, P.Eng and Mr. M. Farrant, P. Eng. Interpretation of the data and preparation of the report were carried out by Mr. Alastair E. Gorman, P.Eng and Ms. R. Palomeque Reyna, P.Eng.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations projects, reviewed the report.

Thurber Engineering Ltd
Rocío Palomeque Reyna, P.Eng.
Geotechnical Engineer

LICENSED PROFESSIONAL ENGINEER
R. Palomeque Reyna
100083209
PROVINCE OF ONTARIO

Alastair E. Gorman, P.Eng.,
Senior Foundations Engineer

REGISTERED PROFESSIONAL ENGINEER
A. E. GORMAN
PROVINCE OF ONTARIO

P.K. Chatterji, P.Eng.,
Review Principal, Designated MTO Contact

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
PROVINCE OF ONTARIO

PRELIMINARY

FOUNDATION INVESTIGATION AND DESIGN REPORT

EBYCREST ROAD UNDERPASS

HIGHWAY 7-NEW, KITCHENER TO GUELPH

G.W.P. 408-88-00

Geocres Number: 40P8-150

PART 2: ENGINEERING DISCUSSION AND RECOMMENDATIONS

7 GENERAL

This report presents interpretation of the geotechnical data in the factual report and presents preliminary geotechnical design recommendations to assist the design team to select and design a suitable foundation system for the new structure.

Based on the Plate 7 of the E.A:

- The proposed Highway 7 will be in a cut 4.0 m to 6.0 m deep at Elevation 326.2. Cuts for ditches will be approximately 9.0 m deep.
- Ebycrest Road will be at Elevation 334.4 with approach embankments 3 m to 6 m high

The discussion and recommendations presented in this report are based on our understanding of the project and on the factual data obtained in the course of this investigation.

8 STRUCTURE FOUNDATIONS

The stratigraphy identified in the preliminary investigation consisted of granular fill overlying native compact to very dense sand, hard silty clay till and very dense sandy silt till. The groundwater measured in the piezometer is 5.8 m (Elevation 323.9) below the ground surface.

In the preparation of the preliminary geotechnical design recommendations, consideration was given to the following foundation types:

- Spread footings bearing on native soil
- Spread footings on engineered fill
- Steel H-piles driven into the very dense lower sandy silt till soils

A comparison of the foundation alternatives based on advantages and disadvantages of each is included in Appendix C.

8.1 Spread Footings on Native Soil

Spread footings bearing on native soil generally are the least expensive form of construction.

The existing fill is not considered to be suitable for the support of spread footings and the footings must be placed on the underlying undisturbed native soils.

The design of spread footings bearing on native, compact to very dense sandy silt till or sand must be in accordance with the elevations and bearing resistances given in Table 8.1.

Table 8.1 – Bearing Resistances for Spread Footings

Element	Depth (m)	Elev.	ULS_f (kPa)	SLS (kPa)
North Abutment (BH 08-117)	1.5	329.6	300	200
	4.6	326.5	450	300
Pier (BH 08-118)	1.5	328.2	300	200
	5.7	324.0	600	400
South Abutment (BH 08-119)	0.8	327.3	300	200
	3.0	325.1	450	300

The bearing resistances in Table 8.1 are for vertical, concentric loading. In the case of eccentric or inclined loading, the bearing resistance must be adjusted as shown in the CHBDC (2006) Clause 6.7.3 and Clause 6.7.4.

The geotechnical SLS resistance values given above are based on an estimated total settlement not exceeding 25 mm. This settlement is expected to be substantially complete by the end of construction. Differential settlement is not expected to exceed 20 mm across the width of the structure or between foundation elements.

Founding elevations presented in Table 8.1, are generally above the groundwater level measured in the piezometer (Elevation 323.9). However, if temporary excavations required to construct these footings extend below the water table, groundwater control will be required prior to excavation in order to construct the footing in the dry, to prevent sloughing of the sides and to prevent disturbance of the footing base due to the inflow of groundwater.

8.2 Spread Footings on Engineered Fill

Spread footings can also be founded on Granular "A" engineered fill pads. These would be most useful at the pier or in the case of perched abutments on footings.

If an engineered fill pad is used, all deleterious materials must be stripped from the footprint of the foundation to expose competent native subgrade material. Subexcavation of existing surficial fill soils will be required.

The engineered fill must bear on compact native sandy silt till or sand. The highest permitted founding elevations at which engineered fill pads may be placed, are given in Table 8.2.

Table 8.2 –Founding Elevations for Engineered Fill Pads

North Abutment (BH 08-117)	Pier (BH 08-118)	South Abutment (BH 08-119)
330.3	328.5	327.3

Typically, spread footings on pads of engineered granular fill at least 2 m thick may be designed for the following geotechnical resistances:

- Factored ULS 900 kPa
- SLS 350 kPa

These resistance values are for concentric, vertical loads only. In the case of eccentric or inclined loading, the geotechnical resistance must be calculated as illustrated in the CHBDC Clause 6.7.3 and Clause 6.7.4.

For footings designed on the basis of the geotechnical resistance values given above, total settlement under a footing is expected to not exceed 25 mm. Differential settlements are not expected to exceed 20 mm across the width of the structure or between foundation elements.

The Granular A pad must be compacted to 100% Standard proctor maximum dry density (SPMDD) at optimum moisture content of ±2%. The geometry of the fill pad must conform to the general requirements shown in Figure 1 in Appendix D.

8.3 Steel H-Piles

The soil stratigraphy encountered at this site is considered to be suitable for the support of foundations on driven steel piles.

It is recommended that the H-piles be driven to achieve resistance in the very dense lower sandy silt till encountered at this site. Based on an HP 310 X 110 pile, a minimum embedment depth of 7.0 m is required. The preliminary information in EA Plate 7 indicates that this depth of embedment should be achievable at the abutments and pier.

The depths and elevations at which the H-piles are expected to develop the required resistance are given in Table 8.3.

Table 8.3 – Estimated Pile Tip Elevation

Foundation Unit	Anticipated Pile length below original ground (m)	Highest Pile Tip Elevation
North Abutment (BH 08-117)	15.8	315.3
Pier (BH 08-118)	15.2	314.5
South Abutment (BH 08-119)	13.6	314.5

8.3.1 Axial Resistance

For preliminary design, the vertical, axial, factored geotechnical resistance at Ultimate Limit States (ULS) and geotechnical resistance at Serviceability Limit States (SLS) for a pile section when driven into the very dense lower sandy silt till are presented in Table 8.4.

Table 8.4 – Axial Resistance of Two Pile Sections Founded on Very Dense Soils

Pile Section	Geotechnical Resistance (kN)	
	Factored ULS	SLS
HP 310 X 110	1,600	1,400
HP 360 X 132	1,800	1,600

The structural resistance of the pile must be checked by the structural designer.

Installation of the piles must be in accordance with SP 903S01 and must be controlled using the Hiley Formula and an ultimate resistance of 3,200 kN for an HP 310 X 110 pile and 3,600 kN for the HP 360 X 132 pile.

These are preliminary recommendations and may change during detail design based on the final alignment, final bridge arrangement and the results of the site investigation and field testing to be completed at that time. The analysis must also address the drivability of the piles.

Due to the possible presence of cobbles and boulders in the sandy silt till at the expected founding layer, the tips of all driven piles should be fitted with steel H-Pile driving shoes in accordance with OPSD 3000.100.

Higher geotechnical resistances may be achieved by installing the piles to greater depth. For piles extending below Elevation 312.0 (approximately) at the pier and at the abutments, a greater depth of exploration is required and must be addressed during the detail design phase.

8.3.2 Downdrag

Downdrag on the piles is not an issue at this site.

8.4 Abutment Design Considerations

From a geotechnical perspective, the conditions at this site are considered to be suitable for the design of conventional, semi-integral or integral abutments.

8.5 Frost Cover

The design depth of frost penetration for this site is 1.4 m. All footing bases and undersides of pile caps/abutment stems must be provided with at least 1.4 m of soil cover, or an equivalent combination of soil cover and extruded polystyrene (EPS) insulation. A 25 mm thickness of EPS is equivalent to 600 mm of soil cover.

8.6 Recommended Foundation

From a geotechnical perspective, and based on current information, the recommended abutment foundation consists of steel H-piles driven into the very dense native lower sandy silt till, despite the higher cost noted in Appendix C. The recommended foundation at the pier is a spread footing on very dense soil.

9 BRIDGE APPROACHES AND EMBANKMENTS

Based on the three boreholes drilled at the site, the approach embankments will be constructed over compact, non-cohesive sandy silt till and sand and may incorporate the sand and gravel fill of the existing embankment.

No long term settlement or global stability issues are anticipated for approach embankments built at this site. The 3 to 6 m high embankments likely to be constructed will be stable at side slopes of 2H:1V if constructed using SSM or granular fill.

The Highway 7 cut shown on EA Plate 7 may be at approximately 2.3 m above the groundwater table. During detail design, when the grade has been finalized, permanent drainage to keep water table below base of cut (if necessary) and slope protection requirements must be addressed. The cut slopes will be stable at slopes with a maximum inclination of 2H: 1V. MTO policy requires a mid-height bench in cut slopes higher than 6.0 m.

10 CONSTRUCTION CONCERNS

Based on the Recommended Alignment and the preliminary geotechnical information, potential construction concerns include, but are not necessarily limited to:

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

1. Pile refusal at higher elevation.

Although there was little direct evidence of their presence during drilling, glacial till deposits inherently contain boulders. It is possible that a pile will achieve refusal at a higher elevation than anticipated due to encountering a boulder. If it is suspected that this is happening, the QVE must immediately bring it to the attention of the CA. If the CA cannot resolve the issue, it must be referred to the design team for resolution.

2. Pile fails to develop specified resistance.

If a pile has not developed the specified resistance after being driven 3 m beyond the anticipated pile tip elevation, stop driving and check the Hiley calculation and all input values. If the calculation still shows that the pile has not reached the specified resistance, the following procedure should be implemented:

a) Stop driving in that pile group for 48 hours (minimum)
b) After 48 hours, warm up the hammer on another pile then commence redriving the subject pile and measure the resistance.
c) If the pile still does not reach the specified resistance, the QVE must immediately advise the CA who, in turn, should refer the issue to the design team.

3. Destabilization of excavations

At this site, the proposed 9.0 m cuts into sand deposits for ditches, will extend 2.0 to 3.0 m below the measured groundwater level.

If excavation is carried out in cohesionless soil without prior implementation of adequate measures to control groundwater and surface water, there is a risk that the sides and or base of the excavation will be destabilized. This could lead to a risk to personnel working on site, or to a loss of bearing resistance in the soil.

Accordingly, it must be emphasized to the contractor that proper groundwater and surface water control measures must be in place prior to commencing excavation.

11 INVESTIGATION FOR DETAIL DESIGN

During the detail design phase of the project, additional site investigation and field testing will be required. The following minimum program is recommended:

1. Boreholes for structure foundations.

Additional boreholes may be required for the structure foundations, especially if the structure is built off the current Ebycrest Road alignment and thus removed from the alignment of the current investigation. Particular attention should be paid to groundwater levels and exploration off the existing road embankment is recommended.

2. Pile Design

   For piles extending below Elevations 312.0 (approximately) at the pier and at the abutments, respectively, a greater depth of exploration is required and must be addressed during the detail design phase.

3. Boreholes for approaches.

   A minimum of one borehole is recommended in each approach fill on Ebycrest Road.

4. Cut stability

   At least one borehole is required in the mainline cut to either side of the structure. The boreholes in the cut must include piezometers for groundwater monitoring. Stability of cuts must be investigated during detail design phase.

12 CLOSURE

Engineering analysis and preparation of the report were carried out by Mr. Alastair E. Gorman, P.Eng and Ms. R. Palomeque Reyna, P.Eng.

The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Rocío Palomeque Reyna, P.Eng., M.Eng.
Geotechnical Engineer

Alastair E. Gorman, P.Eng.,
Senior Foundations Engineer

P. K. Chatterji, P.Eng.,
Review Principal

Appendix A

Record of Borehole Sheets

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	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

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

SYMBOLS

CLAYSTONE

SILTSTONE

SANDSTONE

COAL

Bedrock (general)

DISCONTINUITY SPACING

Bedding	**Bedding Plane Spacing**
Very thickly bedded	Greater than 2m
Thickly bedded	0.6 to 2m
Medium bedded	0.2 to 0.6m
Thinly bedded	60mm to 0.2m
Very thinly bedded	20 to 60mm
Laminated	6 to 20mm
Thinly Laminated	Less than 6mm

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.

STRENGTH CLASSIFICATION

Rock Strength	**Approximate Uniaxial Compressive Strength** (MPa)	(psi)	**Field Estimation of Hardness***
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
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

THURBER

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 08-117

METRIC

G.W.P. 408-88-00	LOCATION N 4 816 985.40 E 229 672.22		ORIGINATED BY SA
HWY 7	BOREHOLE TYPE Hollow Stem Augers/Solid Stem Augers		COMPILED BY ES
DATUM Geodetic	DATE 2008.06.16 - 2008.06.16		CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
331.1						
0.0	**SAND** and **GRAVEL**, trace silt Brown to Grey Moist (FILL)	1	AS			
330.5 0.6	Sandy **SILT**, trace gravel, trace to some clay Compact to Dense Brown to Grey Moist (TILL)	1	SS	14		1 39 49 11
		2	SS	17		
		3	SS	49		
	occasional cobbles	4	SS	23		2 41 45 12
327.0 4.1	**SAND**, medium grained, trace gravel, trace silt Very Dense Brown Moist To Wet	5	SS	80	▼ (approx. elev. 326.0)	
	Compact	6	SS	13		3 95 2 (SI+CL)
		7	SS	30		
322.5 8.6	Silty **CLAY**, some sand to sandy, trace gravel Hard Grey (TILL)	8	SS	34		

Plot headings: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH kPa — O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE (20, 40, 60, 80, 100); PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) (20, 40, 60); UNIT WEIGHT γ kN/m³; ELEVATION SCALE 331 – 322.

Continued Next Page

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 08-117

METRIC

G.W.P. 408-88-00 LOCATION N 4 816 985.40 E 229 672.22 ORIGINATED BY SA

HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2008.06.16 - 2008.06.16 CHECKED BY RPR

Continued From Previous Page

ELEV DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Silty CLAY, some sand to sandy, trace gravel Hard Grey (TILL)				321		
		9	SS	65		wP–w–wL plotted	1 22 49 28
					320		
					319		
		10	SS	73		o	
317.9					318		
13.3	Sandy SILT, trace gravel, trace to some clay Very Dense Grey Moist (TILL)						
		11	SS	108		o	
					317		
					316		
	occasional cobbles	12	SS	112/ .225		o	3 37 51 9
					315		
313.9		13	SS	125		o	
17.2	END OF BOREHOLE AT 17.2m. WATER LEVEL OBSERVED AT 5.2m DURING DRILLING. BOREHOLE BACKFILLED WITH BENTONITE TO 0.6m THEN HOLEPLUG TO SURFACE.				314		

Legend: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20, 40, 60, 80, 100); SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE (20, 40, 60, 80, 100); PLASTIC LIMIT wP, NATURAL MOISTURE CONTENT w, LIQUID LIMIT wL; WATER CONTENT (%) (20, 40, 60); UNIT WEIGHT γ kN/m³

+ 3, × 3: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 08-118

METRIC

G.W.P. 408-88-00 LOCATION N 4 816 930.09 E 229 774.81 ORIGINATED BY SLL

HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM

DATUM Geodetic DATE 2008.06.12 - 2008.06.13 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
329.7					
0.0	**SAND**, some gravel, trace silt Brown Moist (FILL)				
329.1 / 0.6	**SAND**, fine grained, trace silt, trace clay Compact Brown Moist	1	SS	10	
		2	SS	28	
		3	SS	27	0 92 8 (SI+CL)
		4	SS	29	
	Wet	5	SS	26	
	Very Dense to Dense	6	SS	82	0 90 10 (SI+CL)
		7	SS	43	
320.4 / 9.3	Silty **CLAY**, sandy, trace gravel Hard Grey (TILL)	8	SS	66	1 27 49 23

Elevation scale: 329, 328, 327, 326, 325, 324 (groundwater level), 323, 322, 321, 320

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE: 20 40 60 80 100

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L; WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

Continued Next Page

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

Ministry of Transportation Ontario

THURBER

RECORD OF BOREHOLE No 08-118

METRIC

G.W.P. 408-88-00 LOCATION N 4 816 930.09 E 229 774.81 ORIGINATED BY SLL

HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY WM

DATUM Geodetic DATE 2008.06.12 - 2008.06.13 CHECKED BY RPR

Continued From Previous Page

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Silty **CLAY**, sandy, trace gravel Hard Grey (TILL)	9	SS	33	319	~12	
318.0 / 11.7	**SAND**, trace silt, trace clay Very Dense Brown Wet	10	SS	51	318, 317	~20	0 92 8 (SI+CL)
316.5 / 13.2	Sandy **SILT**, trace to some gravel, trace to some clay Very Dense Grey Moist (TILL)	11	SS	122/ .175	316	~10	
	numerous cobbles and possible boulders				315		
	gravelly	12	SS	100/ .225	314	~8	29 49 22 (SI+CL)
312.7		13	SS	114	313	~10	6 36 47 11
17.1	END OF BOREHOLE AT 17.07m. BOREHOLE OPEN UPON COMPLETION. Piezometer installation consists of 25mm diameter schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS:						

DATE	DEPTH (m)	ELEV. (m)
2008.07.23	5.8	323.9
2008.08.20	5.8	323.9

Column headings: SOIL PROFILE; STRAT PLOT; SAMPLES; GROUND WATER CONDITIONS; DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100); PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%) 20 40 60; UNIT WEIGHT γ kN/m³

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

ONTMT4S 6417R.GPJ 8/25/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 08-119

METRIC

G.W.P. 408-88-00 | LOCATION N 4 816 874.58 E 229 882.36 | ORIGINATED BY SA

HWY 7 | BOREHOLE TYPE Hollow Stem Augers | COMPILED BY SA

DATUM Geodetic | DATE 2008.06.16 - 2008.06.16 | CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	SAMPLE NUMBER	TYPE	"N" VALUES	WATER CONTENT (%)	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
328.1 / 0.0	**SAND** and **GRAVEL**, trace silt; Grey to Brown; Moist; (FILL)	1	AS		o	
327.5 / 0.6	Sandy **SILT**, trace gravel, trace silt; Compact; Brown to Grey; Moist; (TILL)	1	SS	26	o	
		2	SS	11	o	
		3	SS	14	o	
	Moist To Wet	4	SS	33	o	0 38 60 2
		5	SS	25	o	
321.8 / 6.3	Silty **CLAY**, trace gravel, some sand; Hard; Grey; (TILL)	6	SS	51	o	
		7	SS	28	o	
		8	SS	27	Ho-H	4 18 46 32

Elevation scale: 328, 327, 326, 325, 324, 323, 322, 321, 320, 319

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100
SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE: 20 40 60 80 100
PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L; WATER CONTENT (%): 20 40 60
UNIT WEIGHT γ kN/m³

Continued Next Page

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

RECORD OF BOREHOLE No 08-119

METRIC

G.W.P. 408-88-00 LOCATION N 4 816 874.58 E 229 882.36 ORIGINATED BY SA

HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SA

DATUM Geodetic DATE 2008.06.16 - 2008.06.16 CHECKED BY RPR

Continued From Previous Page

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	WATER CONTENT (%)	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Silty **CLAY**, trace gravel, some sand Hard Grey (TILL)				318		
		9	SS	34		o	
316.4					317		
11.7	Sandy **SILT**, some clay, trace gravel Very Dense Grey Moist (TILL)				316		
		10	SS	108/ .225		o	1 28 56 15
					315		
	occasional cobbles	11	SS	107/ .225		o	
					314		
312.7					313		
15.4	END OF BOREHOLE AT 15.4m. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 2.4m THEN HOLEPLUG TO SURFACE.	12	SS	113/ .175		o	

Column headings: SOIL PROFILE (ELEV DEPTH, DESCRIPTION, STRAT PLOT); SAMPLES (NUMBER, TYPE, "N" VALUES); GROUND WATER CONDITIONS; ELEVATION SCALE; DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100; SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) 20 40 60 80 100; PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L, WATER CONTENT (%) 20 40 60; UNIT WEIGHT γ kN/m³; REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

+ 3, × 3: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

Appendix B

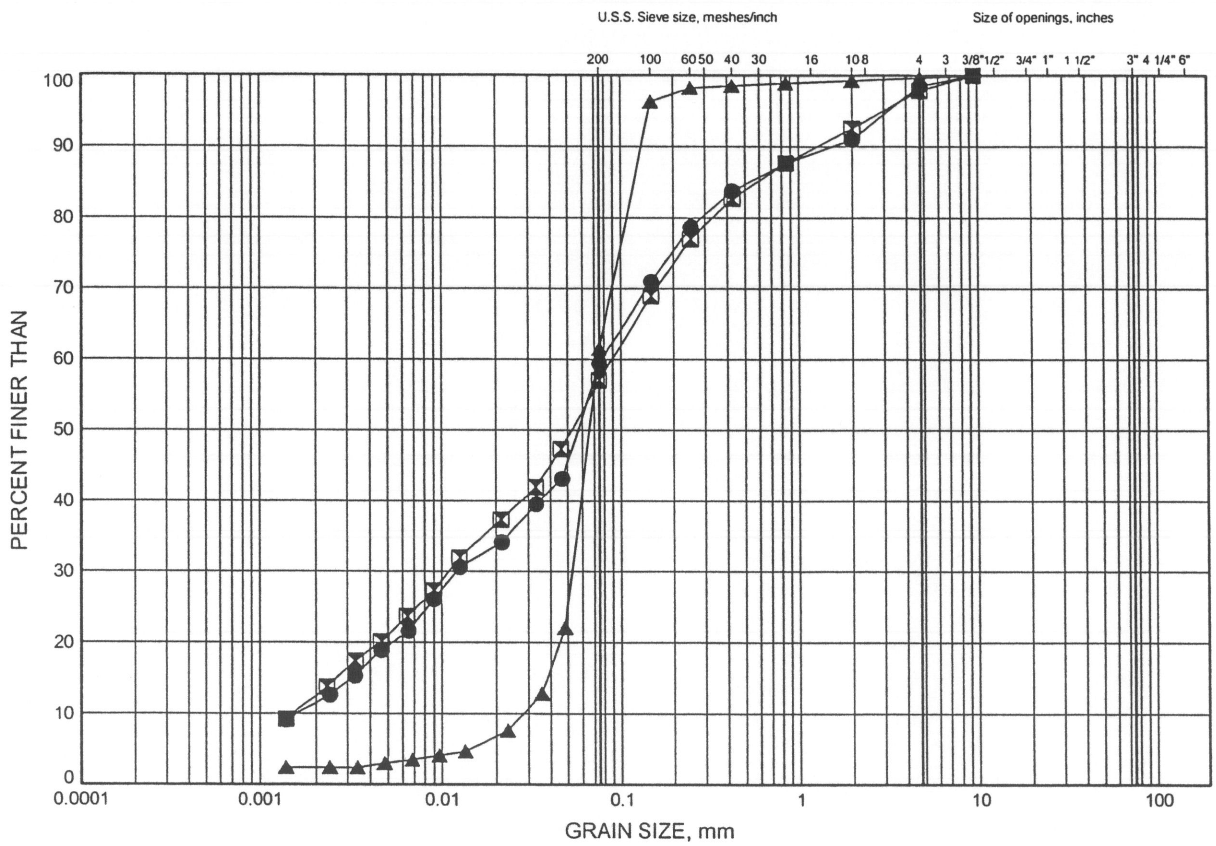
Laboratory Test Results

Highway 7 - New

GRAIN SIZE DISTRIBUTION

FIGURE B1

Upper Sandy Silt Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-117	1.07	330.05
⊠	08-117	3.35	327.77
▲	08-119	3.35	324.79

THURBER

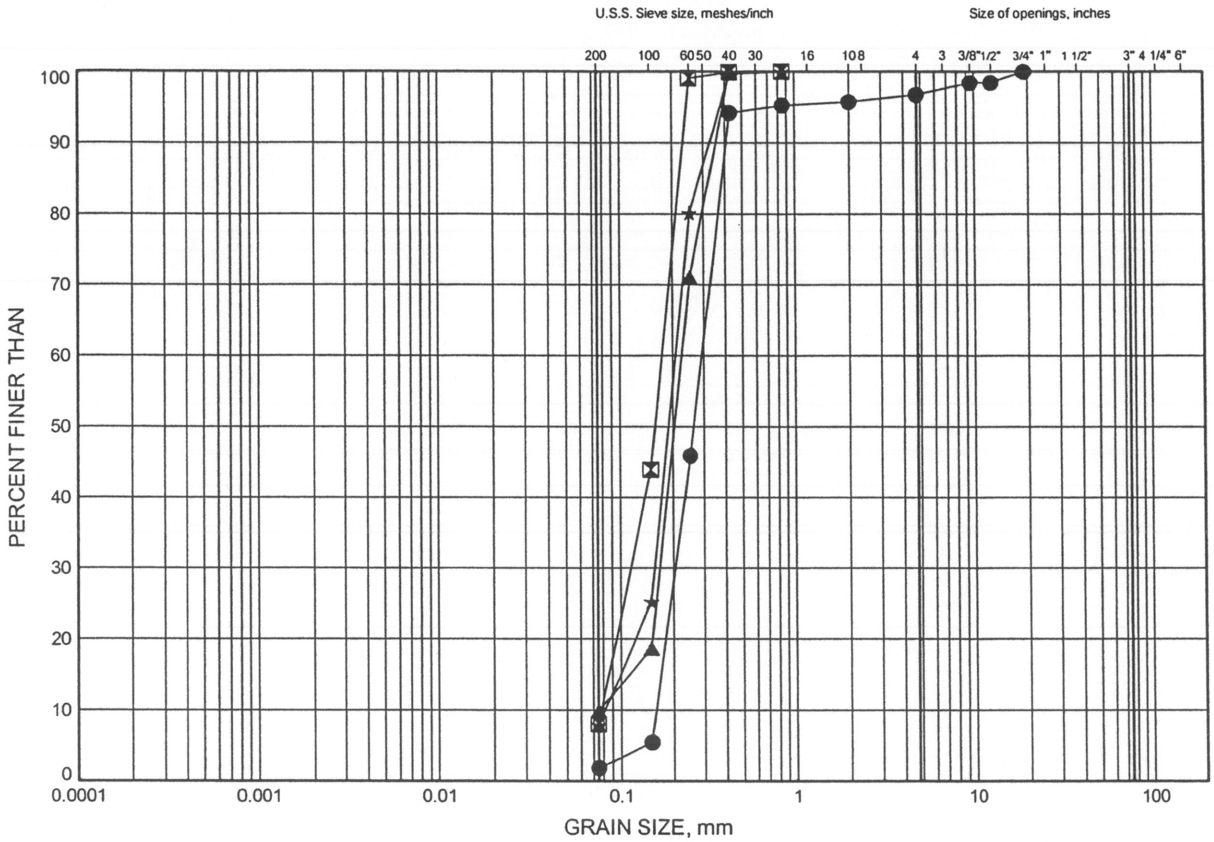
W.P.# 408-88-00
Prepared By SA
Checked By RPR

Highway 7 - New

GRAIN SIZE DISTRIBUTION

FIGURE B2

Sand



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-117	6.40	324.72
⊠	08-118	2.59	327.13
▲	08-118	6.40	323.32
☆	08-118	12.50	317.22

THURBER

W.P.# 408-88-00
Prepared By SA
Checked By RPR

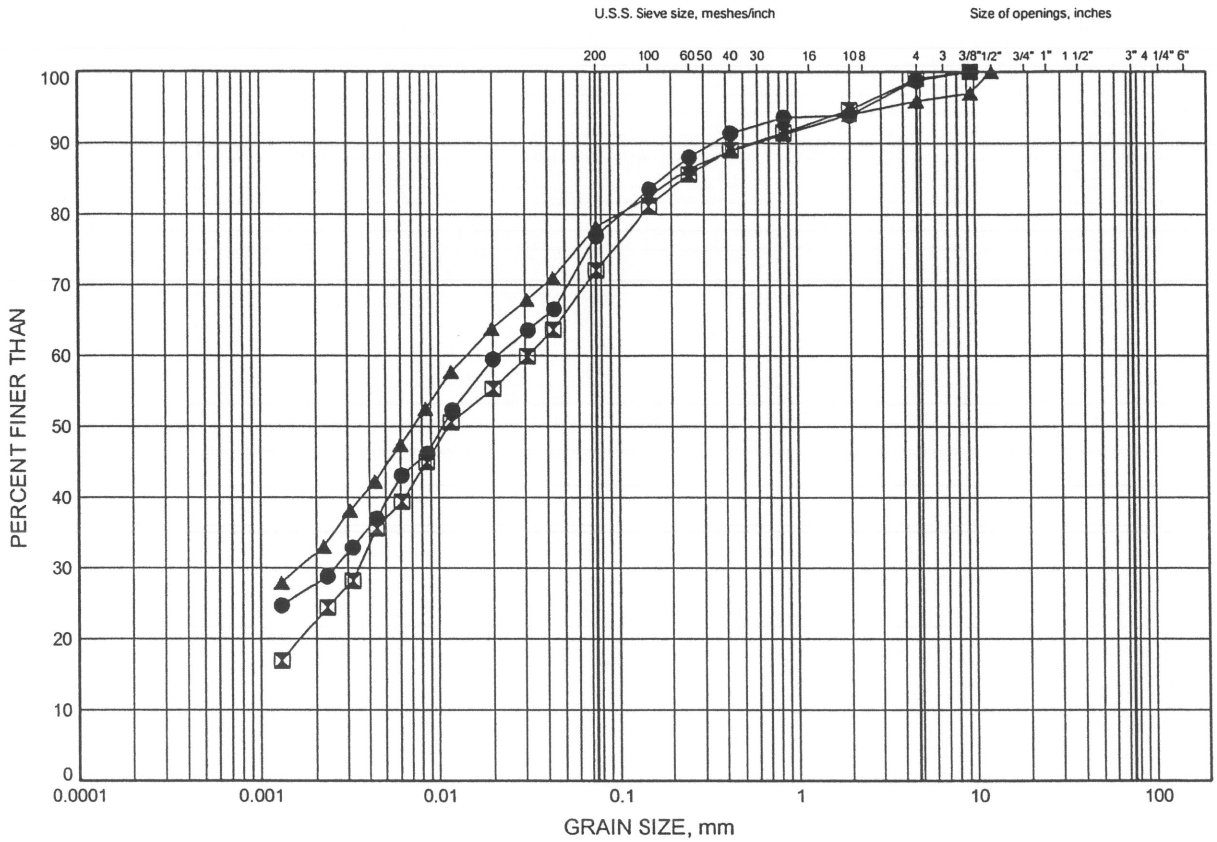
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 31/7/08

Highway 7 - New

GRAIN SIZE DISTRIBUTION

FIGURE B3

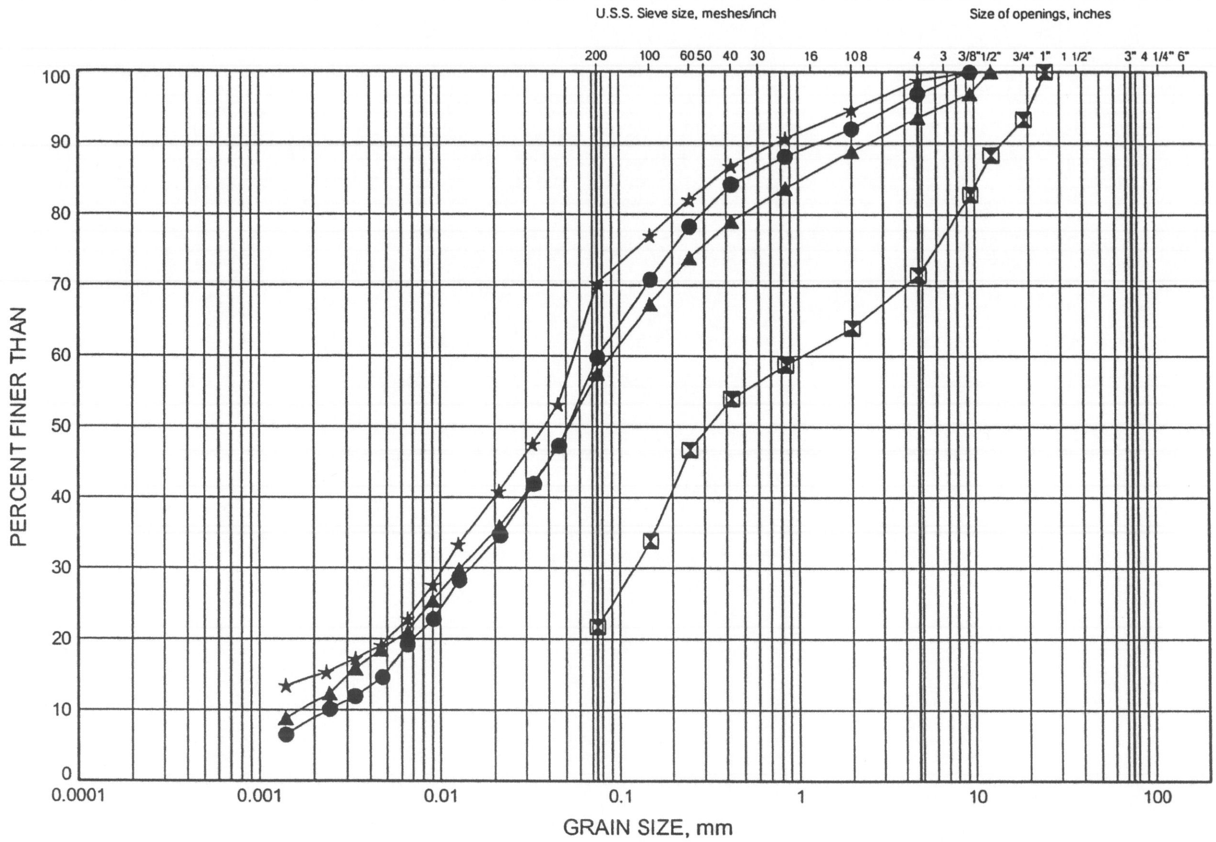
Silty Clay Till



Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE B4

Lower Sandy Silt Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-117	15.35	315.77
⊠	08-118	15.32	314.40
▲	08-118	16.92	312.80
☆	08-119	12.38	315.76

W.P.# 408-88-00
Prepared By SA
Checked By RPR

THURBER

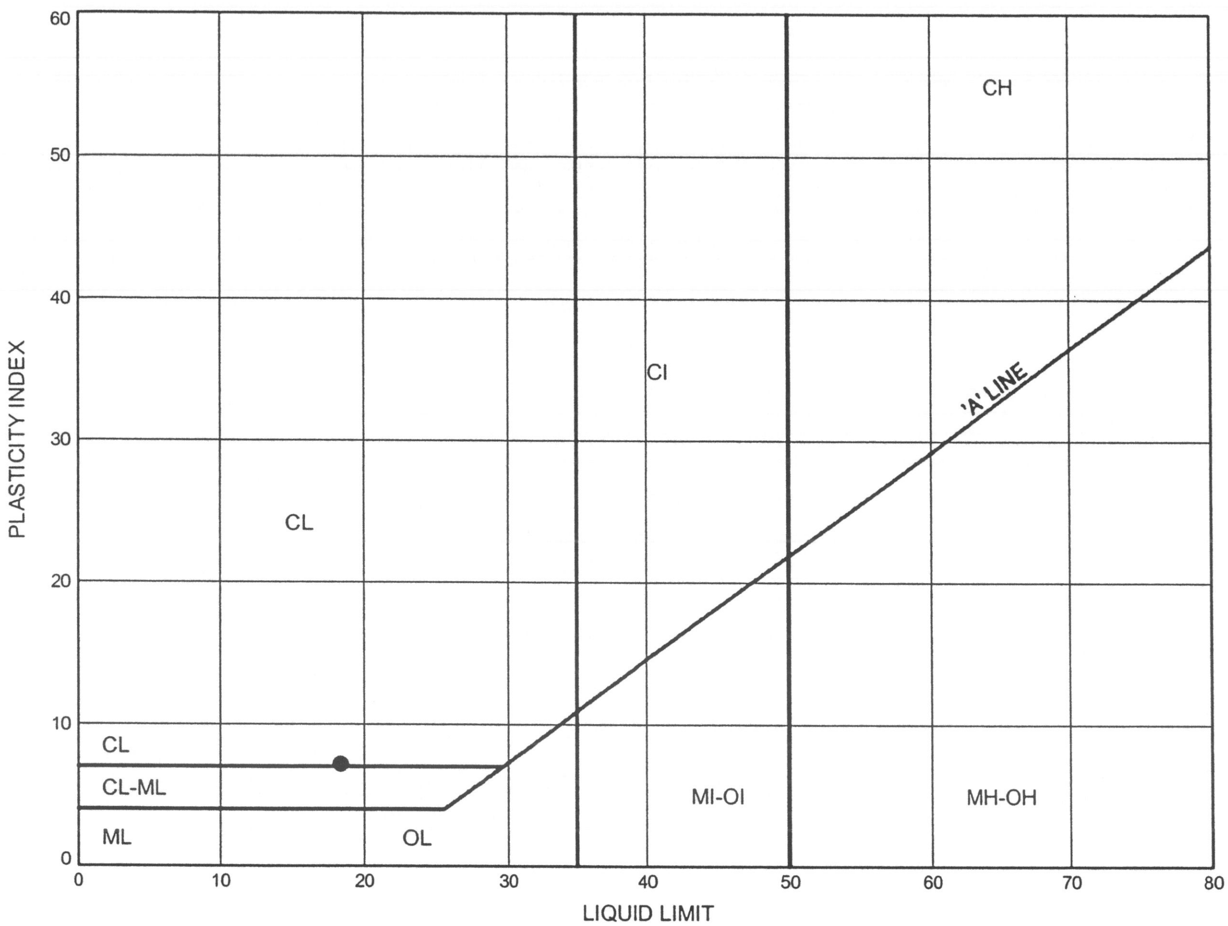
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 31/7/08

Highway 7 - New

ATTERBERG LIMITS TEST RESULTS

FIGURE B5

Upper Sandy Silt Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-117	3.35	327.77

THURBALT 6417R.GPJ 31/7/08

Date July 2008

Project 408-88-00

THURBER

Prep'd SA

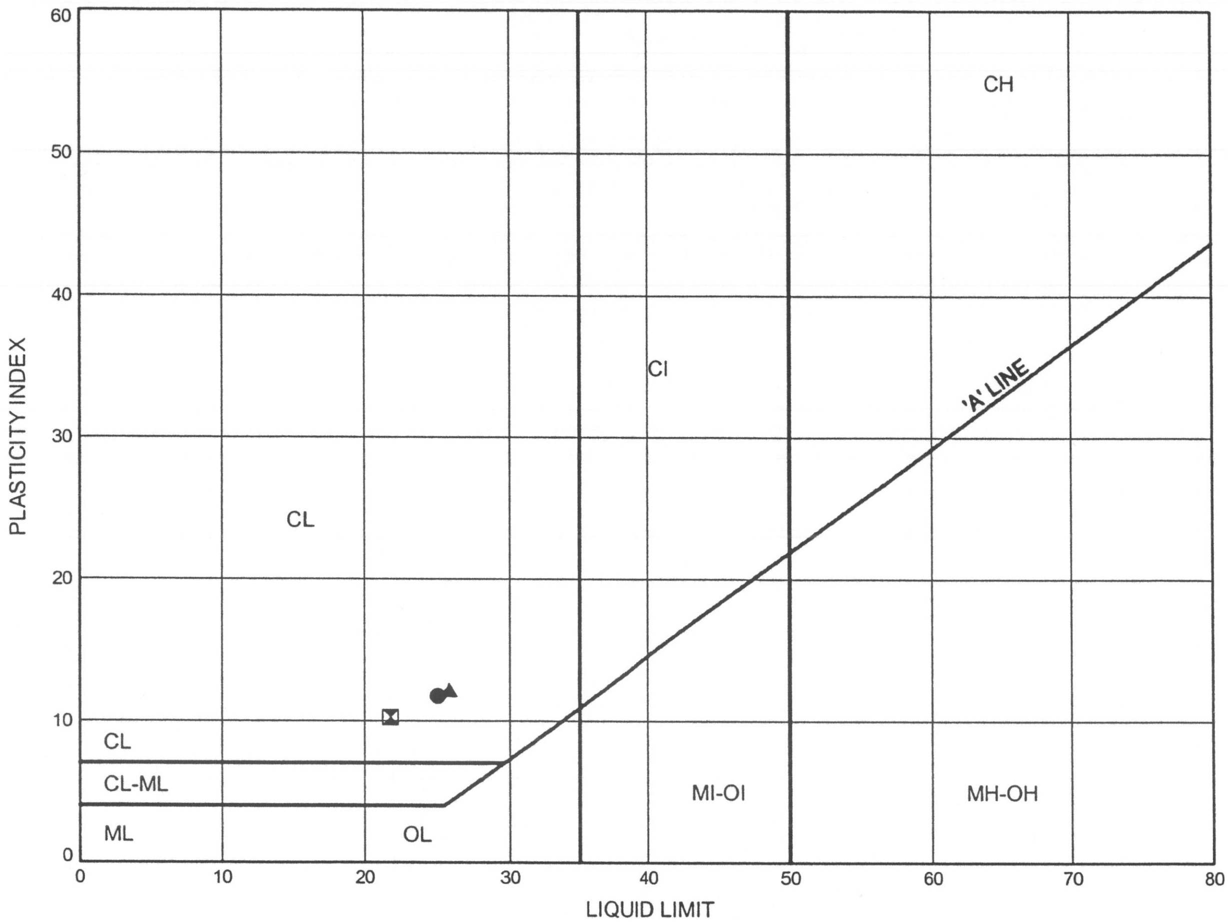
Chkd. RPR

Highway 7 - New

ATTERBERG LIMITS TEST RESULTS

FIGURE B6

Silty Clay Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-117	10.97	320.15
⊠	08-118	9.51	320.21
▲	08-119	9.45	318.69

Date July 2008

Project 408-88-00

THURBER

Prep'd SA

Chkd. RPR

THURBALT 6417R.GPJ 31/7/08

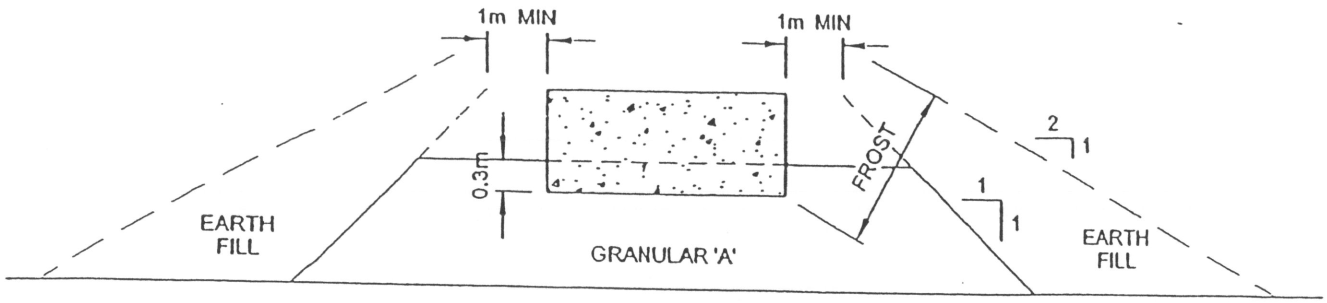
COMPARISON OF FOUNDATION ALTERNATIVES FOR EACH FOUNDATION ELEMENT

Foundation Element	Spread Footings	Spread Footings on Engineered Fill	Driven Piles
Abutments	*Advantages:* i. Generally less costly construction than deep foundation elements. *Disadvantages:* i. Lower geotechnical resistance available due to founding on compact soils near the surface. ii. Dewatering may be required, depending on depth of excavation. **NOT RECOMMENDED**	*Advantages:* i. Generally less costly construction than deep foundation elements. *Disadvantages:* i. Better geotechnical resistance than spread footings on native, but still influenced by the compact soils at the surface. ii. Dewatering may be required, depending on depth of excavation. **NOT RECOMMENDED**	*Advantages:* i. High geotechnical resistance may be developed by driving the piles into very dense/hard soils. ii. Comparatively short abutment stem possible iii. Permits integral abutment design *Disadvantages:* i. Higher unit cost compared to footings. ii. Very dense/hard soils at shallow depth will limit length of pile and geotechnical resistance that can be developed. **RECOMMENDED**
Pier	*Advantages:* i. Generally less costly construction than deep foundation elements. *Disadvantages:* i. Dewatering may be required, depending on depth of excavation. **RECOMMENDED**	*Advantages:* i. Generally less costly construction than deep foundation elements. *Disadvantages:* i. Dewatering may be required, depending on depth of excavation. **NOT RECOMMENDED**	*Advantages:* i. High geotechnical resistance may be developed by driving the piles into very dense/hard soils. *Disadvantages:* i. Higher unit cost compared to footings. ii. Very dense/hard soils at shallow depth will limit length of pile and geotechnical resistance that can be developed. **NOT RECOMMENDED**

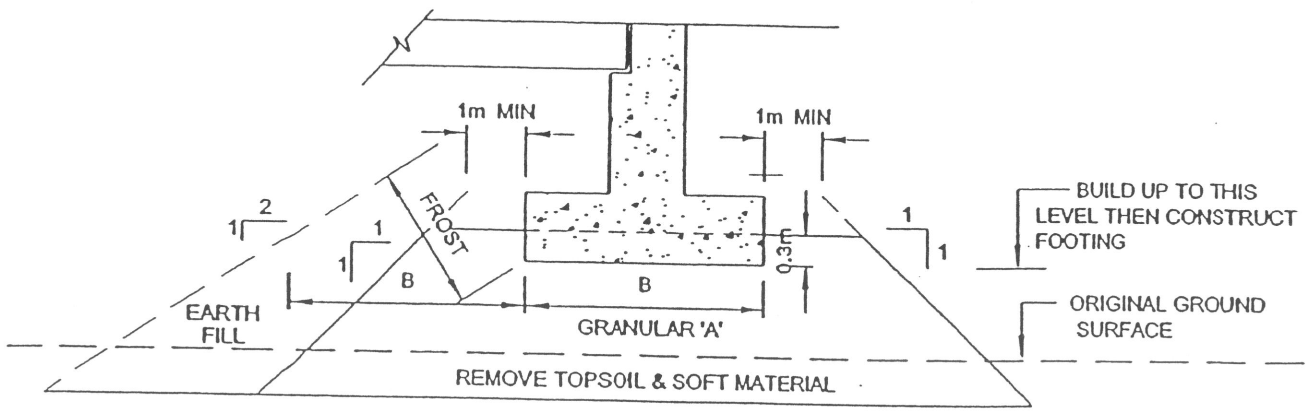
Appendix D

Figure

March , 2004



CROSS-SECTION



LONGITUDINAL SECTION

NOT TO SCALE

NOTES:

1. REMOVE TOPSOIL AND OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' AND EARTH FILL.
2. PLACE GRANULAR 'A' AND EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO O.P.S.S. 501.
3. CONSTRUCT CONCRETE FOOTING.
4. PLACE REMAINDER OF GRANULAR 'A' AND EARTH FILL AS REQUIRED.
5. SOURCE M.T.C. 1982.

ENGINEER AEG	ABUTMENT ON COMPACTED FILL SHOWING GRANULAR A CORE	THURBER
DRAWN SS		
DATE April , 2004		
APPROVED PKC		
SCALE NTS		DWG. NO. FIGURE 1

TED35146.DWG

Appendix E

Drawing titled "Borehole Locations and Soil Strata"

METRIC

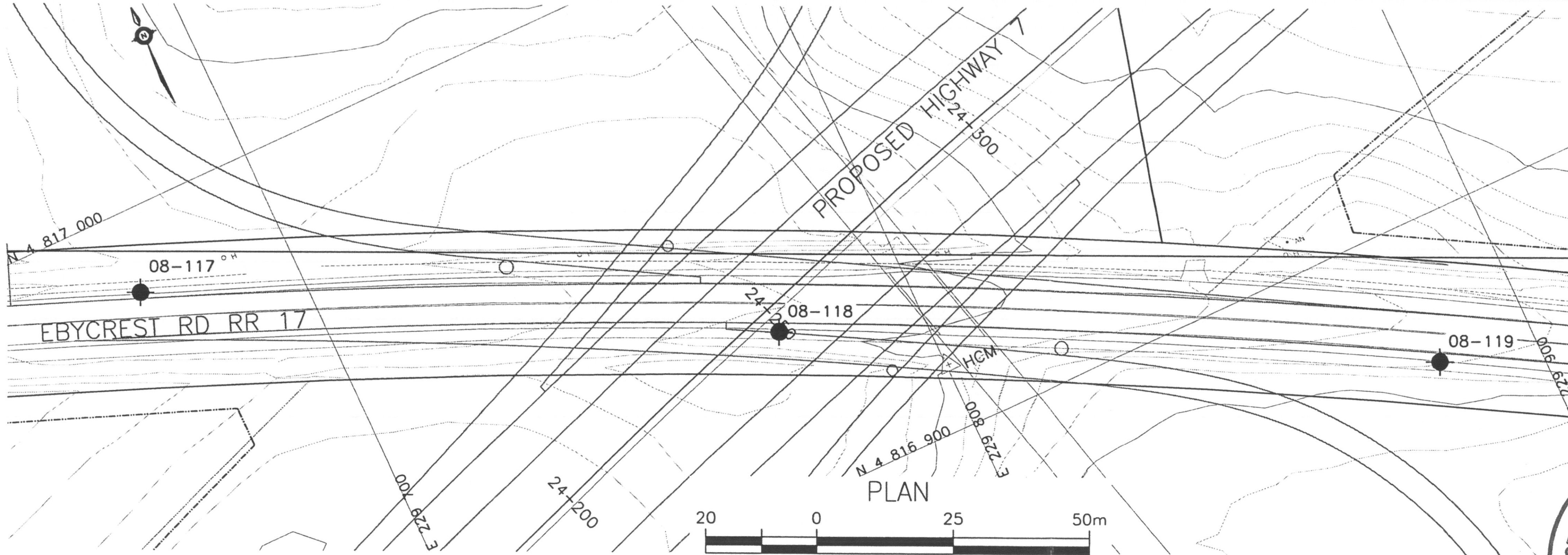
DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No
GWP No 408-88-00

HIGHWAY 7
RECOMMENDED ROUTE
EBYCREST ROAD
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

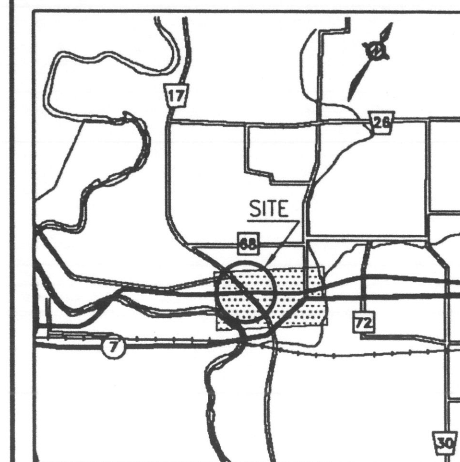
THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



PLAN

SCALE 1:1000

LICENSED PROFESSIONAL ENGINEER
R. Palomeque Reyna
100083209
Sep 03/08
PROVINCE OF ONTARIO

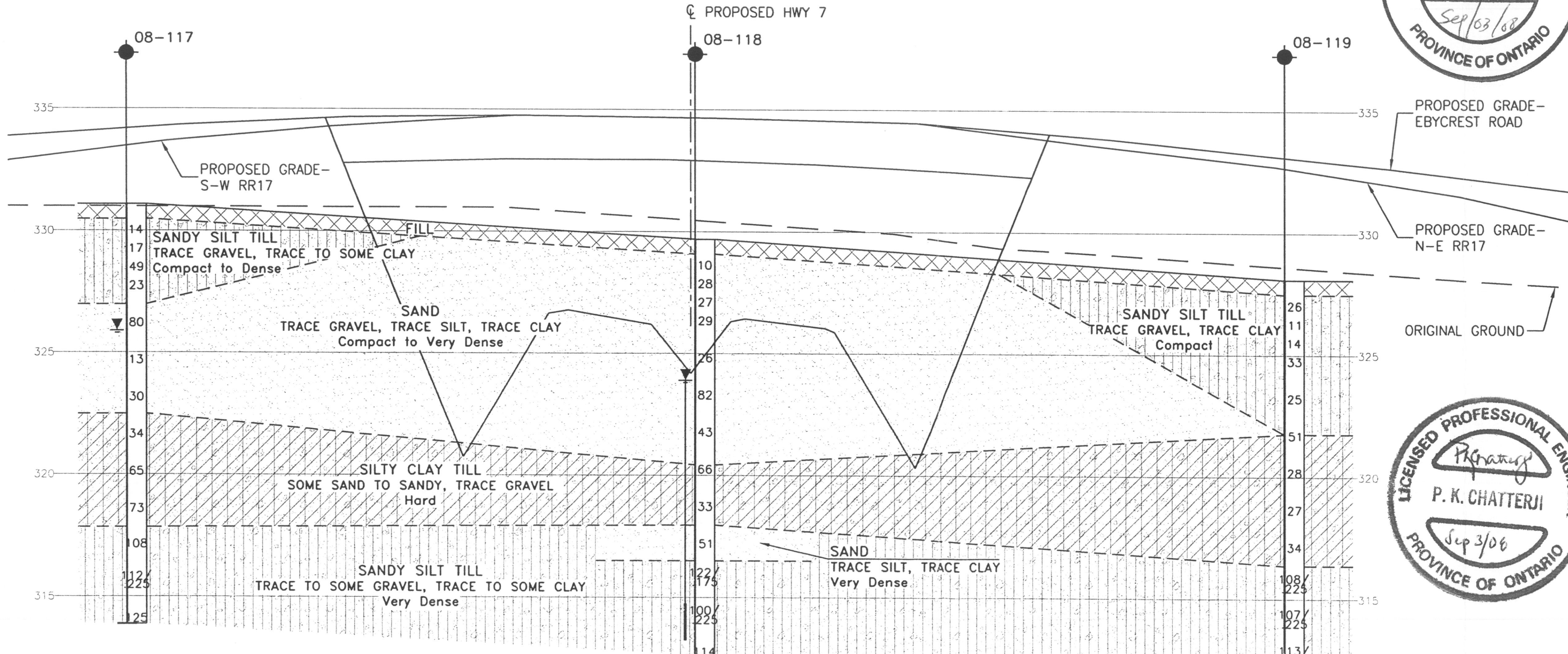


KEYPLAN

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

NO	ELEVATION	NORTHING	EASTING
08-117	331.1	4 816 985.4	229 672.2
08-118	329.7	4 816 930.1	229 774.8
08-119	328.1	4 816 874.6	229 882.4



PROFILE ALONG ℄ OF EBYCREST ROAD

HOR 1:1000

VER 1:200

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Sep 3/08
PROVINCE OF ONTARIO

-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.

3) Proposed grades are from Plate 7 of the E.A. Study.

GEOCRES No. 40P8-150

DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION		
DESIGN AEG	CHK PKC	CODE	LOAD	DATE AUG. 2008	
DRAWN MFA	CHK AEG	SITE	STRUCT	DWG	

FILENAME: H:\Drafting\15\6417\ted6417-EbycrestRoad.dwg
PLOTDATE: Aug 29, 2008 - 9:14am