

**PRELIMINARY
FOUNDATION INVESTIGATION AND DESIGN REPORT
BRUCE STREET EXTENSION UNDER CNR
HIGHWAY 7-NEW, KITCHENER TO GUELPH
G.W.P. 408-88-00**

Geocres Number: 40P8-163

Report to

**Ministry of Transportation Ontario
West Region**

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

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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 Bruce Street extension under CNR in the Regional Municipality of Waterloo.

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, record 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, West Region (MTO) under Purchase Order Number 3006-E-0123.

In the preparation of this report, general reference has been made to the information on subsurface conditions contained in a previous foundation report. The title of the report is listed as follows:

- Foundation investigation report for C.N.R. Subway, Kitchener-Waterloo Expressway, District #4 (Hamilton), W.J. 66-F-37, W.P. 636-64, Geocres Number 40P8-45, dated July 4, 1966. (Reference 1).

Records of boreholes from the previous report are attached in Appendix C for reference.



2 SITE DESCRIPTION

The site lies on the east side of Kitchener-Waterloo Expressway (KWE), approximately 60.0 m to the east of the existing KWE and CNR bridge and 100.0 m north of Victoria Street. At this location, Bruce Street will be extended from Victoria Street to the north, passing under the existing twin CNR tracks. Approximately 160.0 m west of the existing CNR bridge, the double CNR tracks emerge from a CNR yard with a number of tracks as well as a spur line. The CNR yard extends some 980.0 m west to Lancaster Street East. The site lies within an area of industrial and commercial lands and is generally flat.

At the proposed bridge site, a parking lot is currently situated on the south side of CNR tracks; the lands immediately on the north side of the CNR tracks are vacant and covered with long grass and shrubs.

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.

A photograph of the site, looking at the south embankment (Borehole 08-046) of the existing CNR tracks is included in Appendix E.

3 SITE INVESTIGATION AND FIELD TESTING

The geotechnical investigation plan for this site was to drill two boreholes, one on each side of the tracks for a possible single-span structure arrangement. As permission has not been granted to access the lands on the north side of CN tracks, it has not been possible to drill one of the boreholes yet. This report presents information obtained from a single borehole drilled on the south side of the CNR tracks (near the proposed east abutment).

The site investigation and field testing of the borehole drilled on the south side of the CNR tracks (near the proposed east abutment) was conducted from August 7 to 11, 2008. The borehole was numbered 08-046 it was terminated at 33.7 m depth (Elevation 288.2).

The Record of Borehole sheet for the borehole is included in Appendix A. The approximate location of the borehole is shown on the attached Borehole Location and Soil Strata Drawing in Appendix G.

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

The borehole was drilled using hollow stem auger equipment operated by 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 borehole were observed throughout the drilling operations. In Borehole 08-046, drilled near the proposed east abutment, a standpipe piezometer consisting of 19 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. The installation of 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
East Abutment	08-046	33.5/288.4	Piezometer with 1.5 m slotted screen installed with sand filter to 31.7 m, holeplug to 30.8 m, grout mix with cuttings to 1.2 m, holeplug to 0.6 m, then concrete to surface.

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 sheet 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 sheet in Appendix A and on the figures contained in Appendix B.

Records of boreholes and laboratory test results from the previous report (Reference 1) are attached in Appendix C for reference.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheet 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 G. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheet governs any interpretation of the site conditions.

In general, the site is underlain by sand fill over loose to compact sandy silt, very stiff to hard clayey silt till and silty clay and very dense sand and sandy silt till.

5.1 Fill

Fill was encountered surficially at the borehole location. The fill consists of dark brown to black sand, trace gravel, trace silt with occasional topsoil. A 100-mm layer of black sandy silt was encountered at 2.0 m depth. A strong gasoline odour was noted in the fill layer.

Thickness of the fill was 2.1 m. The depth to the base of the fill was 2.1 m (Elevation 319.9).

The cohesionless fill is classified as compact to very loose based on SPT 'N' values of 13 and 3 blows for 0.3 m of penetration. The natural moisture content ranged from 5% to 30%.

Based on visual observation and the presence of strong gas odour, there is evidence of hydrocarbon contamination in the fill as well as the underlying sandy silt layer.

5.2 Sandy Silt

Native brown sandy silt containing trace to some gravel and occasional cobbles was encountered below the fill. Thickness of the sandy silt layer was 4.3 m. The depth to the base of the silt was 6.4 m (Elevation 315.5). This layer also emitted an odour of gasoline.

The sandy silt is classified as loose to compact, based on SPT 'N' values of 7 to 28 blows for 0.3 m of penetration. The natural moisture content ranged from 17% to 20%.

The grain size distribution for a selected sample of the sandy silt is presented on the Record of Borehole sheet and on Figure B1 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	2
Sand	44
Silt	50
Clay	4

5.3 Clayey Silt Till

Brown to grey clayey silt till containing some sand, trace gravel and occasional silty sand seams was contacted below the native sandy silt at 6.4 m depth (Elevation 315.5). Thickness of the clayey silt till was 2.7 m. The depth to the base of the clayey silt till was 9.1 m (Elevation 312.8).

The cohesive layer is very stiff to hard in consistency, based on SPT 'N' values of 23 and 34 blows per 0.3 m of penetration. The moisture content varied from 10% to 11%.

The grain size distribution for one sample of clayey silt till is presented on the Record of Borehole sheet and on Figure B2 of Appendix B. Atterberg Limits test result is presented on Figure B6 of Appendix B.

The results of the laboratory test are summarized as follows:

Soil Particles	(%)
Gravel	1
Sand	18
Silt	54
Clay	27

Liquid Limit	24
Plastic Limit	14

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

Although not encountered in the borehole, glacial till layers may contain cobbles and boulders.

5.4 Silty Clay

An extensive deposit of grey silty clay containing trace sand and occasional silt seams was contacted below the clayey silt till at 9.1 m depth (Elevation 312.8). Thickness of the silty clay layer was 19.6 m.

The depth to the base of the silty clay was 28.7 m (Elevation 293.3).

Based on SPT 'N' values ranging from 24 to 90 blows per 0.3 m of penetration, the cohesive silty clay layer is very stiff to hard in consistency. An SPT 'N' value of 100 blows per 0.15 m of penetration was measured at 16.6 m (Elevation 305.3). The moisture content varied from 19% to 38%.

The grain size distributions for two samples of silty clay are presented on the Record of Borehole sheet and on Figure B3 of Appendix B. Atterberg Limits test results are presented on Figure B7 of Appendix B.

The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	0
Sand	1 to 3
Silt	34 to 40
Clay	58 to 65

Liquid Limit	41 to 46
Plastic Limit	18 to 19

The above results show that the silty clay is of medium plasticity with a group symbol of CI.

5.5 Sand

Grey sand containing some silt and trace clay was contacted below the silty clay at 28.7 m depth (Elevation 293.3). Thickness of the sand layer was 1.5. The depth to the base of the sand was 30.2 m (Elevation 291.8).

SPT 'N' value was 79 blows per 0.3 m of penetration, indicating a very dense relative density. Moisture content was 12%.

The grain size distribution for a sand sample is presented on the Record of Borehole sheet and on Figure B4 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	5
Sand	69
Silt & Clay	26

5.6 Sandy Silt Till

Grey sandy silt till containing some clay, trace gravel and occasional cobbles was contacted below the sand at 30.2 m depth (Elevation 291.8). Borehole 08-046 was terminated within the sandy silt till at 33.7 m depth (Elevation 288.2).

SPT 'N' values were higher than 100 blows per 0.05 m of penetration, indicating a very dense relative density. Moisture contents ranged from 7% to 10%

The grain size distribution for a sandy silt till sample is presented on the Record of Borehole sheet and on Figure B5 of Appendix B. The results of the laboratory tests are summarized as follows:

Soil Particles	(%)
Gravel	4
Sand	35
Silt	43
Clay	19

This glacial till layer may contain cobbles and boulders which may account for the high SPT 'N' value.

5.7 Groundwater Conditions

Water levels were observed in the borehole during and upon completion of drilling. A standpipe piezometer was installed in Borehole 08-046 (near the proposed east abutment) to monitor water levels after completion of drilling. Unfortunately, the piezometer was destroyed before any reading could be obtained.

Previous geotechnical investigation conducted in 1966 (Reference 1), indicates that groundwater level is near Elevation 318.4.

Water level was measured at 3.2 m depth (Elevation 319.0) on October 5, 2008, on a previous piezometer installed at the site, in close proximity to the existing CN bridge over KWE.

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 CME75 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. Shane Aziz 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 determined 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

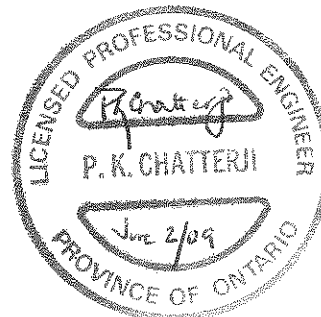
Rocio Palomeque Reyna, P.Eng.
Geotechnical Engineer



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



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



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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. These preliminary recommendations are based on a single borehole drilled on the south side of the CNR tracks.

Based on the Plate 2A of the E.A:

- The proposed Bruce Street extension will pass under the existing double CNR tracks.
- CNR tracks at the site location are at approximate Elevation 326.0.
- Existing ground surface elevations near the proposed east abutment is 321.9.
- The proposed Bruce Street extension grade will be in a cut with base elevation 319.0. A cut of approximately 3.0 m depth will be required to pass Bruce Street extension under CNR tracks.
- Subject to discussions with CNR, construction of the structure will likely have to be done in stages in order to keep at least one track operational. Track protection will be required for this stage of construction.
- A structure carrying S-E Ramp under CNR is also proposed approximately 30.0 m to 40.0 m west of the proposed structure discussed in this report.

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 primarily of compact sand fill overlying native layers of loose to compact sandy silt, very stiff to hard clayey silt till and silty clay and very dense sand and sandy silt till.

Based on previous data (Reference 1), groundwater level was observed at Elevation 318.4 and measured at Elevation 319.0 in a piezometer installed previously.

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 soil

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

8.1 Spread Footings on Native Soil

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

The footings must be placed on the undisturbed native soils.

The footings may be founded on native compact sandy silt present below the base of the cut which is at about elevation 319.0. Bearing resistances for footings planned on the above noted soils below elevation 319.0 are given in Table 8.1.

Table 8.1 – Bearing Resistances for Spread Footings

Element	Depth (m)	Highest Founding Elevation	ULS _r (kPa)	SLS (kPa)	Soil
East Abutment (BH 08-046)	4.3	317.6	450	300	Compact sandy silt

For preliminary design, similar resistances and founding elevations may be assumed for the west abutment.

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 1.0 m below the groundwater level observed at the site during previous investigation. For temporary excavations required to construct these footings extending in cohesionless soils below the water table, groundwater

Table 8.3 – Estimated Pile Tip Elevation

Foundation Unit	Pile Tip Depth Below Existing Ground Surface (m)	Highest Pile Tip Elevation
East Abutment (BH 08-046)	31.4	290.5

For preliminary design, the pile tip and elevation for the west abutment may be assumed to be the same as the east abutment.

8.3.1 Axial Resistance

For preliminary design, axial, factored geotechnical resistance at ULS and geotechnical resistance at SLS for two pile sections when driven into the very dense 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	1,700	1,500
HP 360 X 132	1,900	1,700

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 3,400 kN for an HP 310 X 110 pile and 3,800 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.

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.

8.3.2 Downdrag

The site is underlain by an extensive layer of hard cohesive soils. However, due to the proposed cut alignment there will be a net unloading of these soils and downdrag of the pile will not be 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. However, it is recognized that the bridge will probably be constructed in accordance with AREMA and with conventional 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.

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 sandy silt till, despite the higher cost noted in Appendix D.

9 PERMANENT CUT

Permanent earth cuts are required to extend Bruce Street at this site. The cut will be formed predominantly through 3.0 m of existing sand fill and sandy silt. The cut will also penetrate the railway embankment, but it is anticipated that the embankment fill will be supported by the bridge abutments.

All excavations must be carried out in accordance with the requirements of the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the soils within the likely depth of excavation at this site may be classed as Type 3 soils for fills and native loose sandy silt.

Railway embankment fill typically contains obstructions such as cobbles and boulders.

The proposed cut at Bruce Street extension grade will be at Elevations 319.0, approximately 0.6 m above the groundwater table observed in the site during previous investigations. However, perched water might be also observed during excavation within the sand fill and native silt layers.

During detail design, when the grade has been finalized, permanent drainage and slope protection requirements must be addressed. Subject to depressing the groundwater level below the base of the cut and implementing permanent drainage, 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 8.0 m.

10 TRACK PROTECTION

It is anticipated that track protection (temporary shoring) will be required during staging of construction to support one of the tracks that has to remain in operation. An item titled "Protection System" as per SP 105S19 should be included in the contract documents. It is recommended that Performance Level 1 as per Clause 539.04.02.01 and the alignment of the shoring be specified for this site during final design.

The design of track protection should be the responsibility of the Contractor.

11 CONSTRUCTION CONCERNS

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

1. Pile fails to develop specified resistance.

If a pile has not developed the specified resistance after being driven 2 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 re-driving 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.

2. Destabilization of excavations

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.

12 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. Borehole for structure foundations.

Additional boreholes should be drilled for the detailed design of the structure foundations. Attention should be paid to groundwater levels.

2. If a rail detour is proposed, borehole should be drilled along the detour alignment.

3. Cut stability

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

4. Groundwater impacts.

The potential impact of drainage of the cuts on the local groundwater table must be addressed by a hydrogeologist, who should also consider the need to apply for an MOE Permit to Take Water.

5. Environmental investigation

Soil samples obtained within the upper 4.0 m of sand fill and sandy silt revealed strong gasoline odour. It is recommended that environmental/analytical screening and testing be conducted at this site to determine the quality of the excess excavated soils for soil management purposes (re-use on site and/or off-site disposal).

13 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.

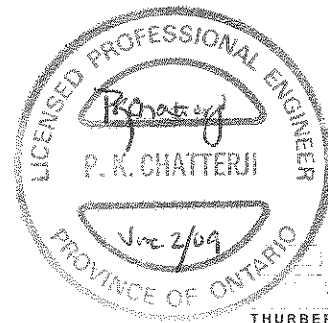
Rocío Palomeque Reyna, P.Eng., M.Eng.
Geotechnical Engineer



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



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



Appendix A

Record of Borehole Sheet

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

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



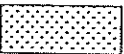


 Water Level
 Shear Strength Determination by Pocket Penetrometer

- (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.		CLAYSTONE
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		SILTSTONE
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SANDSTONE
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		COAL
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		Bedrock (general)
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		

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 08-046

1 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 170.54 E 226 315.49 ORIGINATED BY SA
HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FK
DATUM Geodetic DATE 2008.08.07 - 2008.08.11 CHECKED BY RPR

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							
321.9							20 40 60 80 100				20 40 60				
0.0	SAND, trace gravel, some silt, occasional topsoil Dark Brown to Black Strong Gasoline Odour Compact Moist (FILL)		1	SS	13										
			2	SS	3										
319.9	Layer of black sandy silt (100mm) Very Loose Black														
2.1	Sandy SILT, trace to some gravel, occasional cobbles, gasoline odour Loose to Compact Grey to Brown Wet		3	SS	7										
			4	SS	16										
			5	SS	28										

Continued Next Page

+³ ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-046

2 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 170.54 E 226 315.49 ORIGINATED BY SA
HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FK
DATUM Geodetic DATE 2008.08.07 - 2008.08.11 CHECKED BY RPR

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						
	Silty CLAY, trace sand Very Stiff to Hard Grey		9	SS	24								
			10	SS	32								
			11	SS	42								
			12	SS	70								
			13	SS	100/ .150								
			14	SS	90								

Continued Next Page

+³ × 3⁻: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-046

3 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 170.54 E 226 315.49 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FK
 DATUM Geodetic DATE 2008.08.07 - 2008.08.11 CHECKED BY RPR

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	20 40 60 80 100					
Continued From Previous Page														
	Silty CLAY, trace sand Hard Grey		15	SS	89		302							0 1 34 65
							301							
							300							
			16	SS	52		299							
							298							
							297							
			17	SS	35		296							
							295							
	occasional silt seams		18	SS	50		294							
							293							
293.3														
28.7	SAND, some silt, trace clay Very Dense Grey Wet		19	SS	79									5 69 26 (SI+CL)

Continued Next Page

+ 3. X 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 08-046

4 OF 4

METRIC

G.W.P. 408-88-00 LOCATION N 4 814 170.54 E 226 315.49 ORIGINATED BY SA
 HWY 7 BOREHOLE TYPE Hollow Stem Augers COMPILED BY FK
 DATUM Geodetic DATE 2008.08.07 - 2008.08.11 CHECKED BY RPR

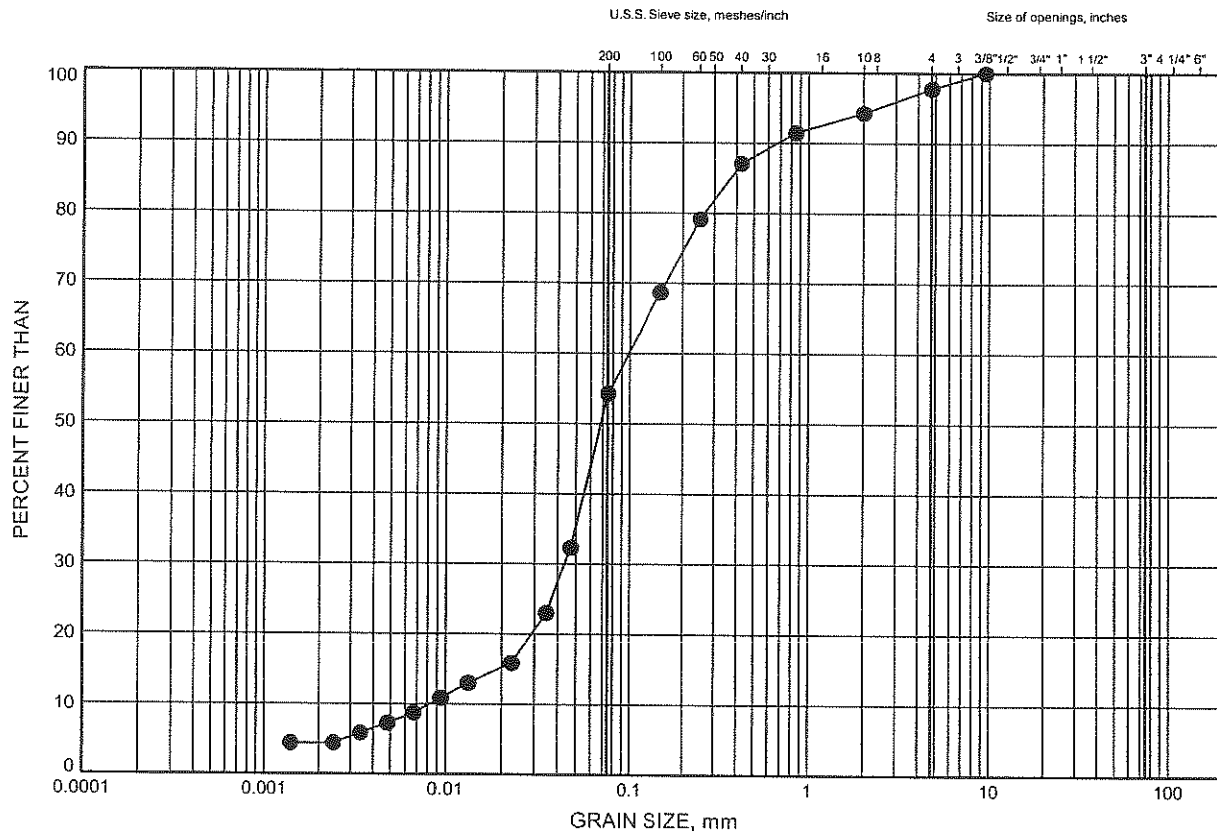
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
291.8	Continued From Previous Page													
30.2	Sandy SILT, some clay, trace gravel, occasional cobbles Very Dense Grey Moist (TILL)		20	SS	100/ .050									4 35 43 19
			21	SS	100/ .075									
288.2			22	SS	80/ .050									
33.7	END OF BOREHOLE AT 33.7m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. Piezometer destroyed													

Appendix B
Laboratory Test Results

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B1

SANDY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-046	3.35	318.58

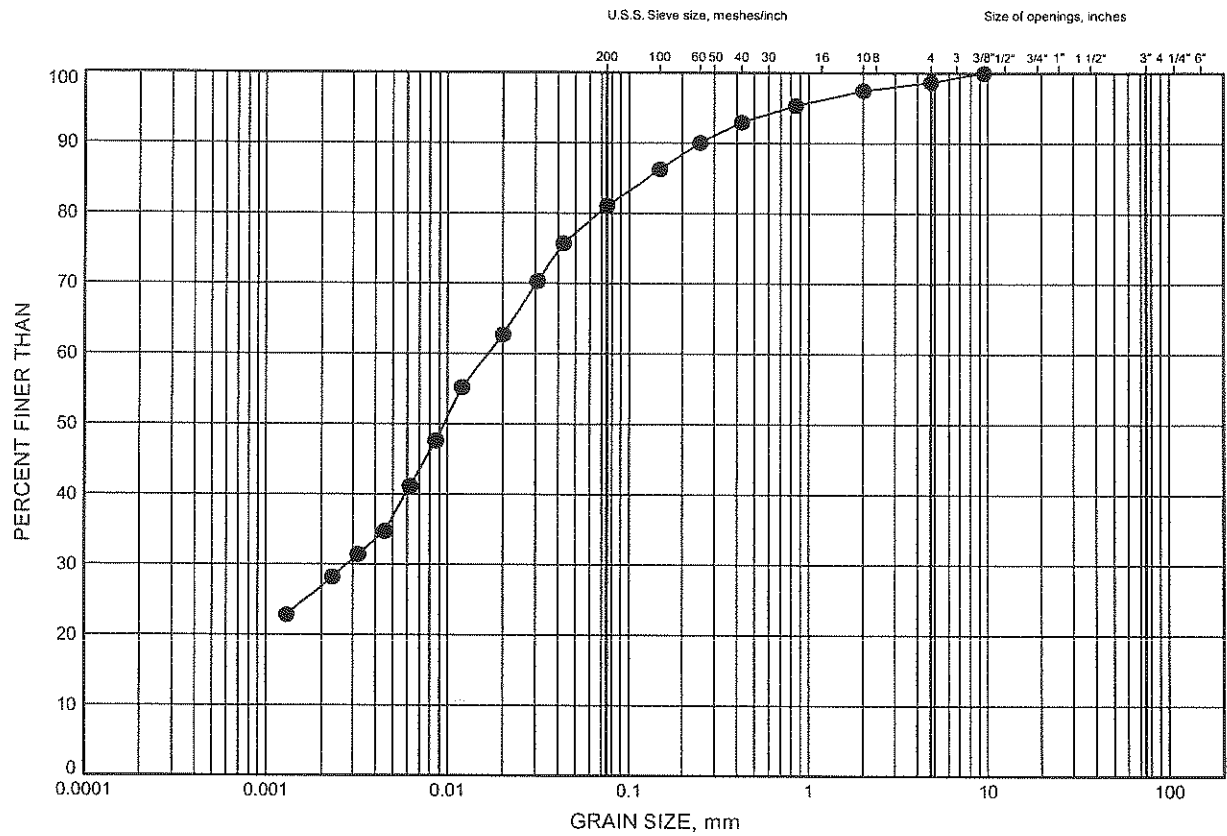


W.P.# 408-88-00
Prepared By AN
Checked By RPR

Highway 7 - New GRAIN SIZE DISTRIBUTION

FIGURE B2

CLAYEY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-046	7.92	314.01



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

FIGURE B3

U.S.S. Sieve size, meshes/inch

Size of openings, inches

PERCENT FINER THAN

GRAIN SIZE, mm

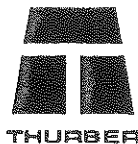
Grain Size (mm)	U.S.S. Sieve Size (meshes/inch)	Size of Opening (inches)	Percent Finer Than (%) - Circles	Percent Finer Than (%) - Squares
0.0015			50	56
0.0025			58	64
0.0035			62	69
0.00475			67	73
0.006			70	80
0.0075			78	84
0.01			83	88
0.015			89	94
0.02			92	95
0.025			95	96
0.03			96	97
0.0425			98	98
0.06	20	0.0025	99	99
0.075	20	0.0025	100	100
0.1	100	0.001	100	100
0.15	60	0.00067	100	100
0.2	50	0.0005	100	100
0.25	40	0.0004	100	100
0.3	30	0.00033	100	100
0.425	16	0.000425	100	100
0.6	10	0.0006	100	100
0.85	8	0.00085	100	100
1.18	4	0.00118	100	100
1.65	3	0.00165	100	100
2.0	3/8	0.002	100	100
2.5	1/2	0.0025	100	100
3.0	3/4	0.003	100	100
3.75	1	0.00375	100	100
4.75	1 1/2	0.00475	100	100
6.0	3	0.006	100	100
7.5	4	0.0075	100	100
10.0	1/4	0.01	100	100
12.5	1/4	0.0125	100	100
15.0	1/4	0.015	100	100
18.0	1/4	0.018	100	100
20.0	1/4	0.02	100	100
25.0	1/4	0.025	100	100
30.0	1/4	0.03	100	100
35.0	1/4	0.035	100	100
40.0	1/4	0.04	100	100
45.0	1/4	0.045	100	100
50.0	1/4	0.05	100	100
55.0	1/4	0.055	100	100
60.0	1/4	0.06	100	100
65.0	1/4	0.065	100	100
70.0	1/4	0.07	100	100
75.0	1/4	0.075	100	100
80.0	1/4	0.08	100	100
85.0	1/4	0.085	100	100
90.0	1/4	0.09	100	100
95.0	1/4	0.095	100	100
100.0	1/4	0.1	100	100

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

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-046	14.02	307.91
⊠	08-046	20.12	301.82

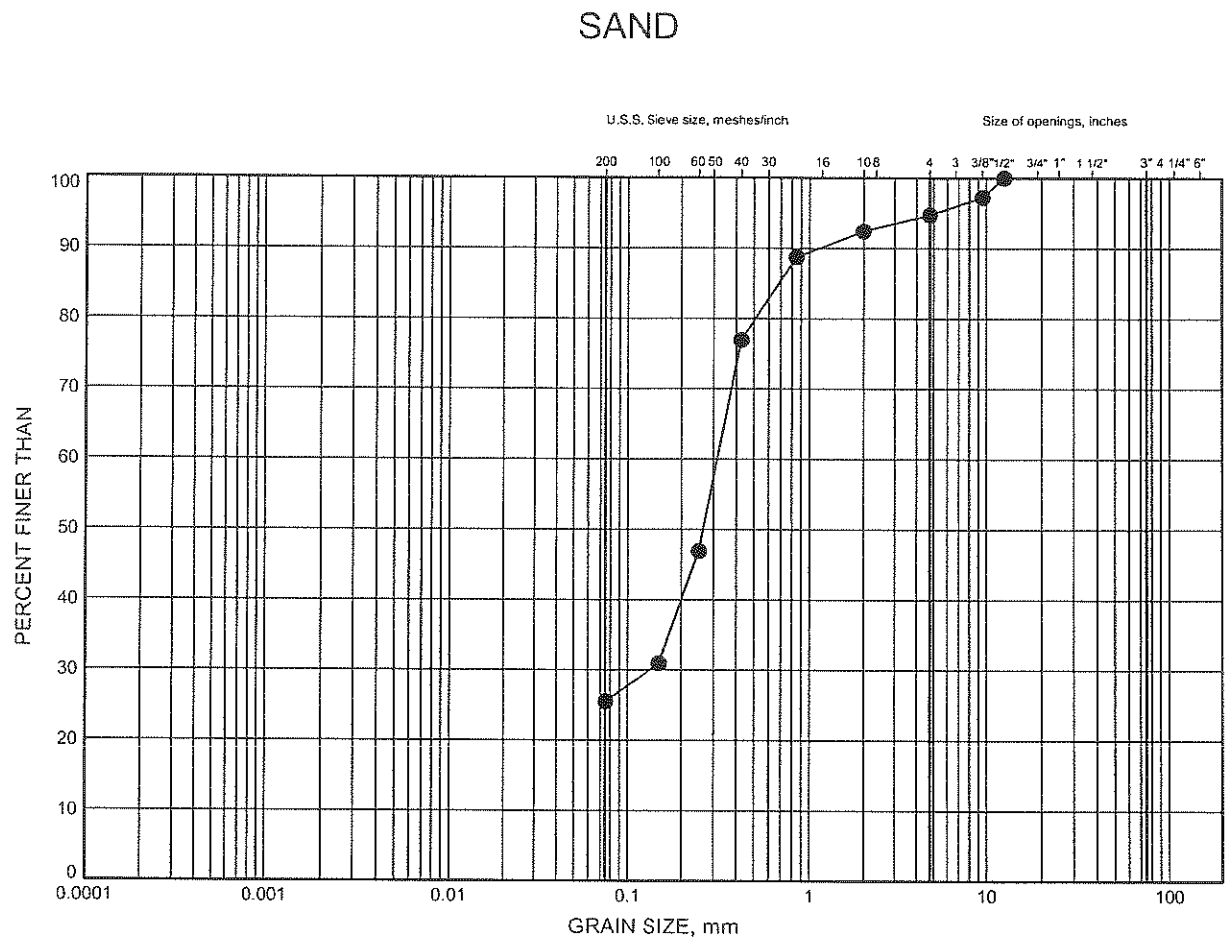
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 11/24/08

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



Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE B4



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-046	29.26	292.67

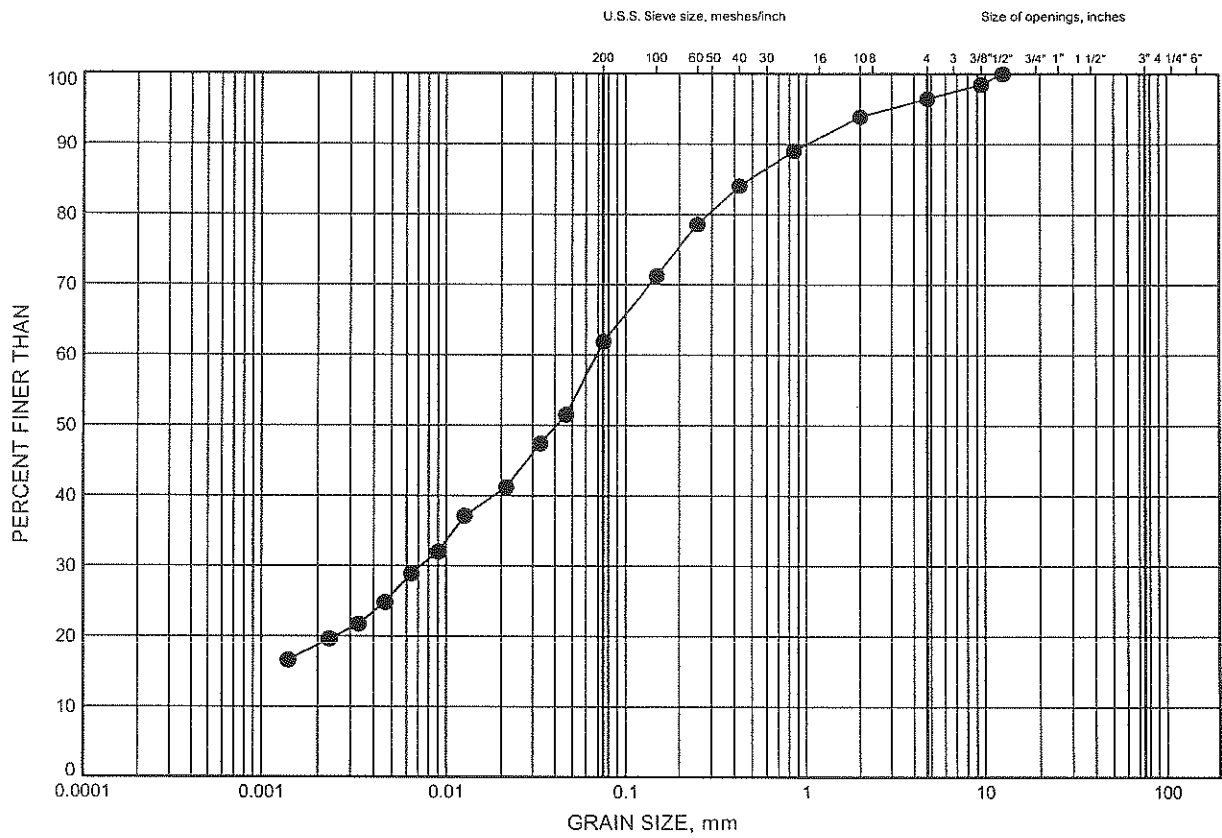


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Checked By RPR.....

Highway 7 - New
GRAIN SIZE DISTRIBUTION

FIGURE B5

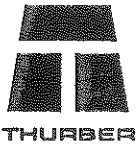
SANDY SILT TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	08-046	30.78	291.15



THURBER

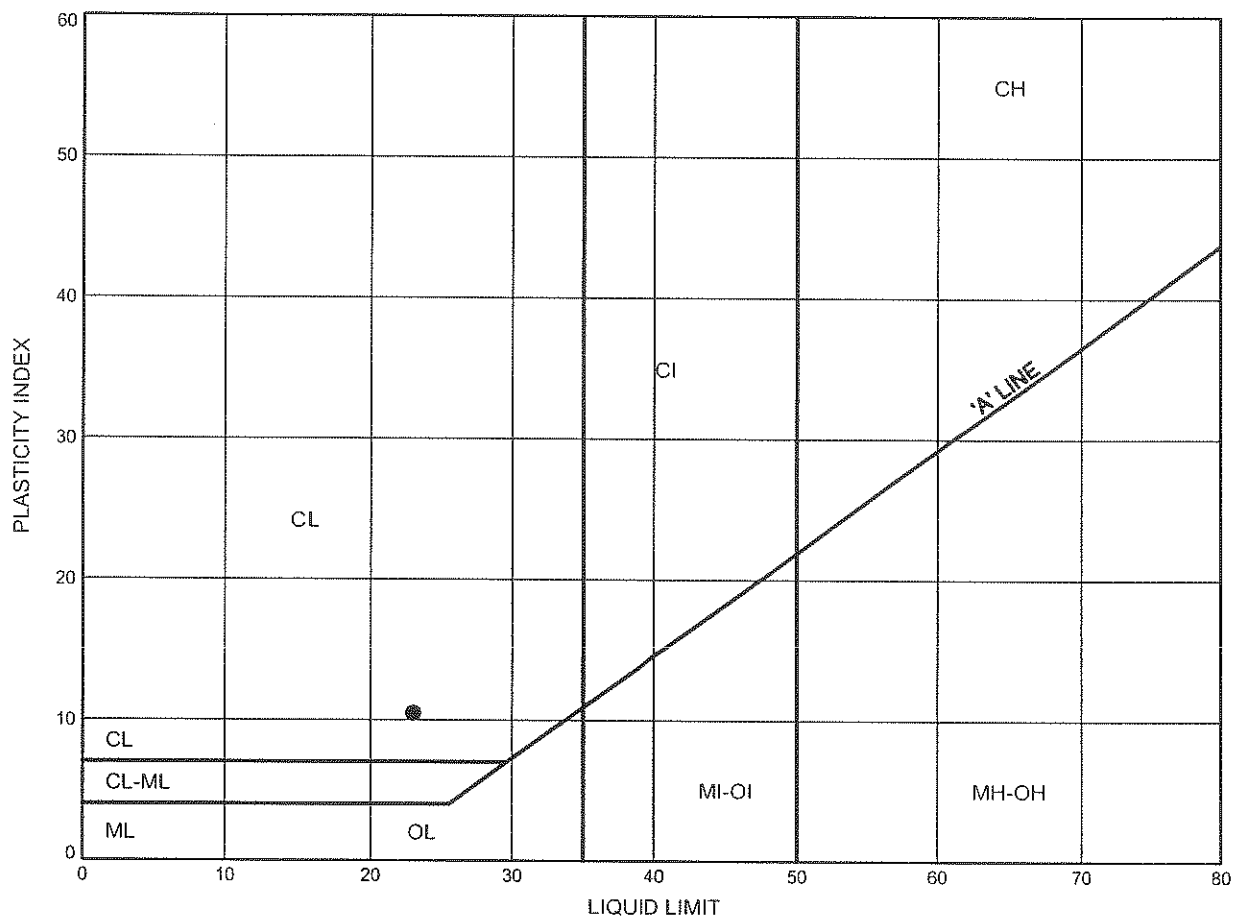
GRAIN SIZE DISTRIBUTION - THURBER 6417R.GPJ 11/24/08

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

Highway 7 - New
ATTERBERG LIMITS TEST RESULTS

FIGURE B6

CLAYEY SILT TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-046	7.92	314.01

Date November 2008
Project 408-88-00

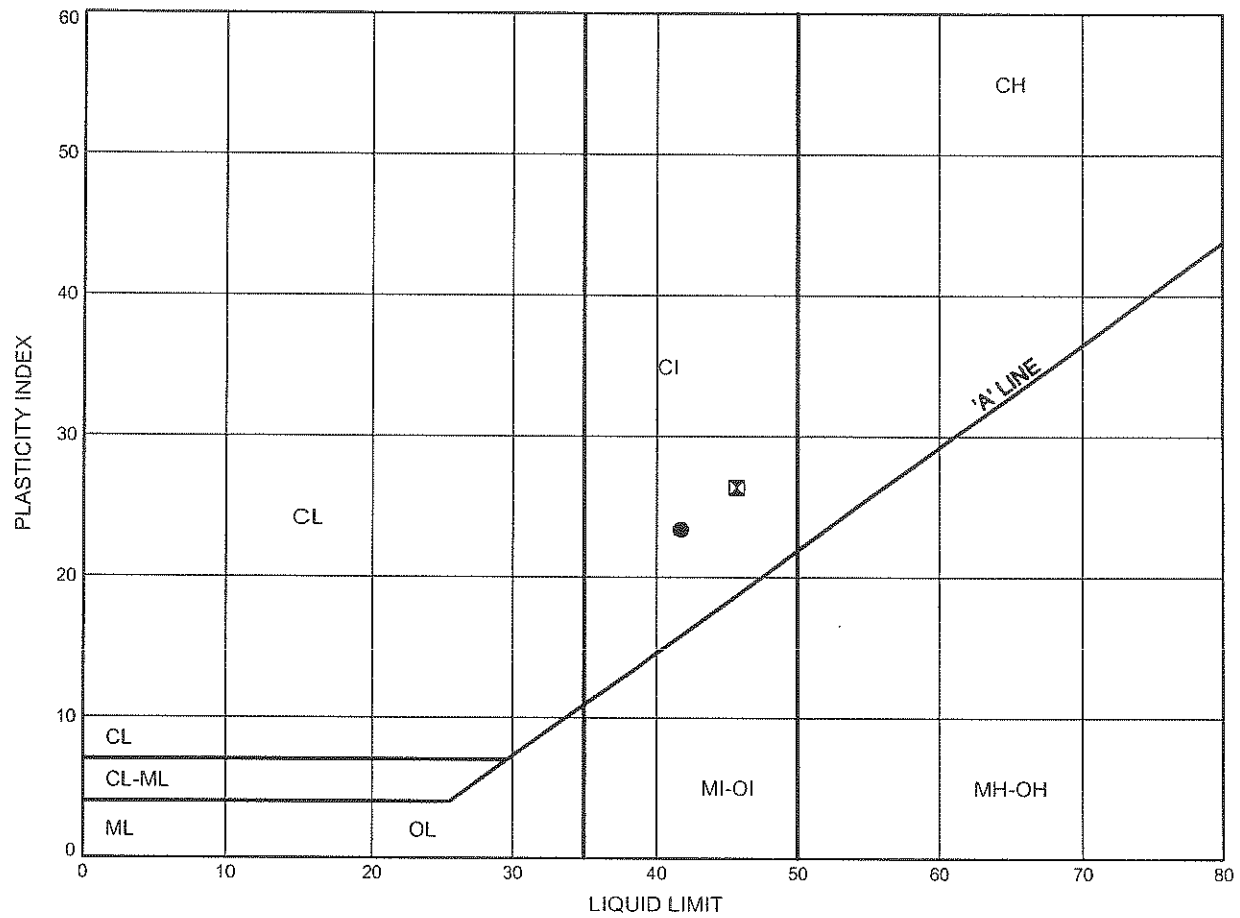


Prep'd AN
Chkd. RPR

Highway 7 - New ATTERBERG LIMITS TEST RESULTS

FIGURE B7

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	08-046	14.02	307.91
⊠	08-046	20.12	301.82

Date November 2008

Project 408-88-00

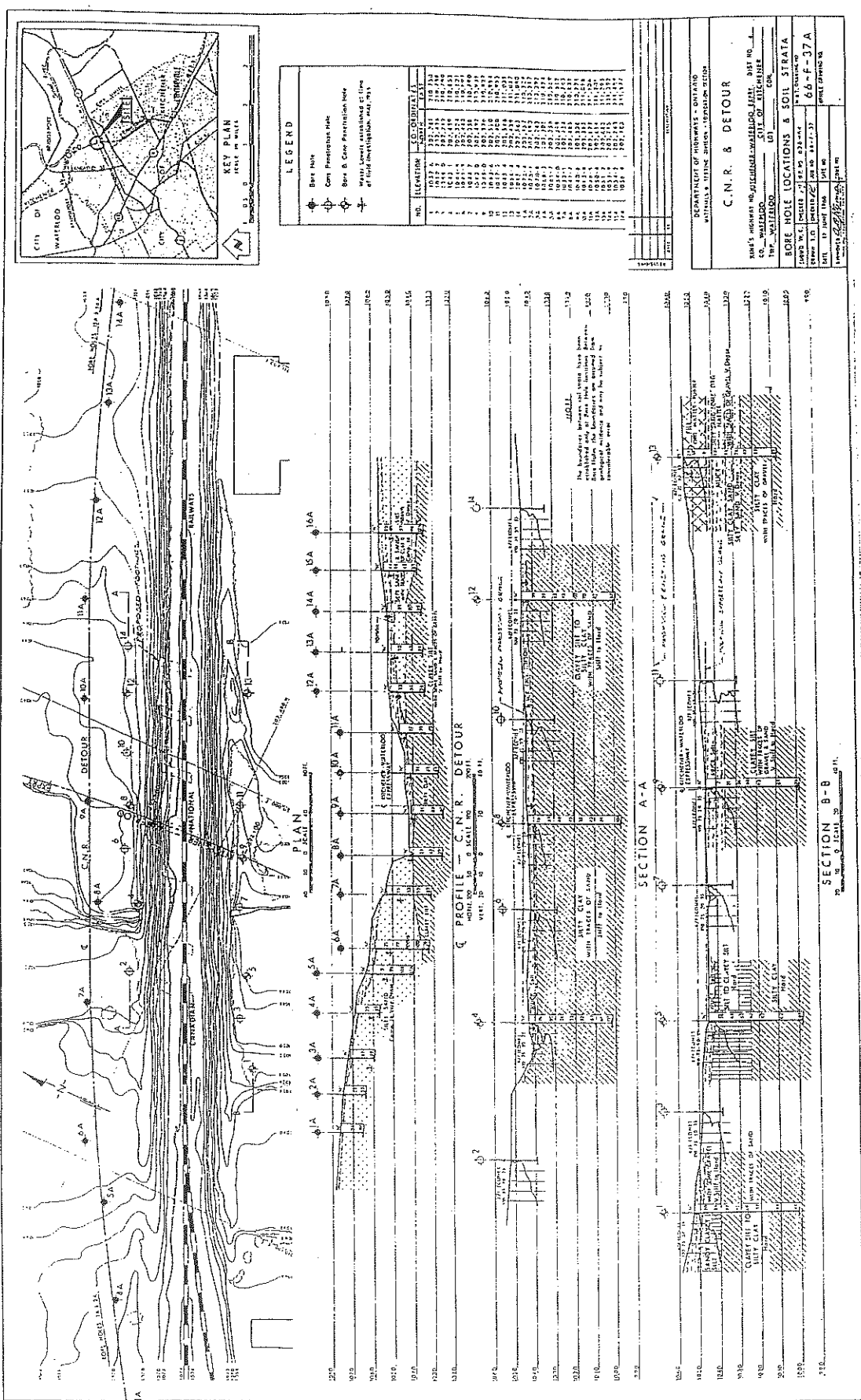


Prep'd AN

Chkd. RPR

Appendix C

Record of Borehole Sheet (Previous Investigation)



Mr. E

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.1

FOUNDATION SECTION

JOB 66-F-37

LOCATION N202, 281.476; E 210, 750.638

ORIGINATED BY W.K.K.

W.P. 636-64

BORING DATE May 3, 1965

COMPILED BY W.E.

DATUM 1052.65

BOREHOLE TYPE Washboring NX Casing

CHECKED BY *W.E.*

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS
		NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.			
1052.65	Ground Level								
1048.6	Muck								
4.0	Soft	1	SS	30					
	Sand Clayey Silt with some Gravel Very Stiff to Hard	2	SS	56					
1039.6		3	SS	77					
13.0	Clayey Silt to Silty Clay	4	SS	62					
	with traces of Sand	5	SS	49					
	Hard	6	SS	57					
		7	SS	46					
1001.15		8	SS	61					
51.5	End of Borehole								

W.L. El. 1051.3
Observed in Casing
Gravel 10%
Sand 34%
Silt 37%
Clay 19%

Sand 8%
Silt 60%
Clay 32%

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1A

FOUNDATION SECTION

JOB 66-P-37 LOCATION N 202,157.733 ; E 210,229.947 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE May 13, 1966 COMPILED BY W.E.
 DATUM 1076.47 BOREHOLE TYPE Washboring NX Casing CHECKED BY W.E.

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT PLASTIC LIMIT WATER CONTENT W.P. ——— W.L. WATER CONTENT ——— W.L. WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
			NUMBER	TYPE	BLOWS / FOOT						
1076.47	Ground Level										
1075.2	Black Org. Topsoil										
1.0	Silty Sand Dense		1	SS	28	1070			0		
1164.9			2	SS	40	1060			0		
11.2	End of Borehole										
											Sand 80% Silty 20% Clay

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 2

FOUNDATION SECTION

JOB 66-F-37

LOCATION N 202, 428, 668; E 210, 788, 941

ORIGINATED BY W.W.K.

W.P. 636-64

BORING DATE May 4, 1966

COMPILED BY W.E.

DATUM 1052.28

BOREHOLE TYPE Penetration Only

CHECKED BY AL

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	NUMBER	TYPE					
1052.28 0.0	Ground Level			1050				
1039.28 13.0	Penetration Only			1040				
	End of Penetration			1030				

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 2A		FOUNDATION SECTION
MATERIALS & TESTING DIVISION				
JOB	66-P-37	LOCATION	N 202, 193.911 ; E 210.317.885	
W.P.	636-64	BORING DATE	May 13, 1966	
DATUM	1075.10	BOREHOLE TYPE	Washboring NX Casing	
		ORIGINATED BY	W.W.K.	
		COMPILED BY	W.E.	
		CHECKED BY	<i>[Signature]</i>	

SOIL PROFILE		SAMPLES			ELEV. SCALE		DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.		WATER CONTENT %			
1075.10	Ground Level											
1074.1	Black Org. Topsoil											
1.0												
1063.6	Silty Sand		1	SS	23				0			
11.5	Compact to Dense		2	SS	33				0			
	End of borehole											
												Sand 89% Silt 11% Clay 11%

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202, 313, 976 : E 210, 790, 670 ORIGINATED BY W.W.K.
W.P. 636-64 BORING DATE May 2, 1966 COMPILED BY W.E.
DATUM 1048.06 BOREHOLE TYPE Penetration Only CHECKED BY [Signature]

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT <u>WL</u> PLASTIC LIMIT <u>WP</u> WATER CONTENT <u>W</u> WATER CONTENT % <u>WP</u> <u>WL</u>	BULK DENSITY <u>γ</u> P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE					
1048.06 0.0	Ground Level							
1038.06 10.0	Penetration Only			1040				
	End of Penetration			1030				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 3A

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202, 243.57 ; E 210, 392.179 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE May 13, 1966 COMPILED BY W.E.
 DATUM 1070.88 BOREHOLE TYPE Washboring NX Casing CHECKED BY all

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WP	WL		
1070.88	Ground Level			1070						
1069.9	Black Org. Topsoil									
1.0	Silty Sand	1	SS 17							
	Compact									
1059.2		2	SS 29	1060						
11.5	End of Borehole			1050						Observed in Casing W.L. El. Y 1061.1 Sand 82% Silt 18% Clay

MATERIALS & TESTING DIVISION

JOB 66-44F-37
W. P. 636-64

W. P. 636-64
 DATUM 1043.16

DATUM 1043.16

RECORD OF BOREHOLE NO. 4

LOCATION N 202, 459.731; E210, 853.370

BORING DATE May 5, 1966

BOREHOLE TYPE Washboring NX Casing

FOUNDATION SECTION

ORIGINATED BY
W.W.K.

COMPILED BY
W. E.

CHECKED BY

SOIL PROFILE			SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT <div><div></div><div>SHEAR STRENGTH P.S.F.</div></div>	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W <div><div></div><div>WATER CONTENT %</div></div>	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLAT	NUMBER	TYPE					
1043.26	Ground Level								
1039.1	Muck Soft		1	SS	26				W.L. El. 1041.7 Observed in Casing Sand 6% Silt 44% Clay 50%
4.0			2	SS	80				
	Silty Clay with Traces of Sand		3	SS	26				
			4	SS	52				Sand 10% Silt 39% Clay 51%
	Stiff to Hard		5	SS	53				
			6	SS	62				
			7	SS	68				
1001.66			8	SS	135				
41.5	End of Borehole								

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4A

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202, 305, 245; E 210, 484, 450 ORIGINATED BY W.W.K.
W.P. 536-64 BORING DATE May 13, 1966 COMPILED BY W.E.
DATUM 1068.28 BOREHOLE TYPE Washboring NX Casing CHECKED BY HL

SOIL PROFILE		SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W			BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WP	WL	W		
1068.28	Ground Level											
1057.28	Black Org. Topsoil											
1.0	Silty Sand Compact to V. Dense	1	SS	23								
1056.7		2	SS	83								
11.5	End of Borehole											
					1060							Observed in Casing W.L. El. <u>1060.2</u> Sand 90% Silt 10% Clay
					1050							

DEPARTMENT OF HIGHWAYS - ONTARIO				FOUNDATION SECTION			
MATERIALS & TESTING DIVISION				RECORD OF BOREHOLE NO. 5			
JOB 66-F-37				LOCATION N 202,324,399 : E 210,831,709			
W.P. 636-64				BORING DATE May 3, 1966			
DATUM 1044.85				BOREHOLE TYPE Washboring NX Casing			
ORIGINATED BY W.W.K.				COMPILED BY W.E.			
CHECKED BY <i>W.E.</i>							
ELEV. DEPTH	SOIL PROFILE	SAMPLES NUMBER TYPE BLOWS / FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT SHEAR STRENGTH P.S.F.	LIQUID LIMIT PLASTIC LIMIT WATER CONTENT W.P. W.L.	BULK DENSITY P.C.F.	REMARKS
1044.85	Ground Level						
1041.8	Muck Soft		1040				
3.0	Silt to Clayey Silt	1 SS 36					
	Hard	2 SS 64	1030				
		3 SS 52					
		4 SS 63	1020				
	Silty Clay	5 SS 62					
	Hard	6 SS 67	1010				
			1000				
998.35		7 SS 84					
45.5	End of Borehole						

W.L. El. 1043.6
Observed in Casing
Sand 14%
Silt 80%
Clay 6%

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 5A

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202.356.975 ; E 210.569.960 ORIGINATED BY W.W.K.

W.P. 636-64 BORING DATE May 11, 1966 COMPILED BY W.E.

DATUM 1061.73 BOREHOLE TYPE Washboring NX Casing CHECKED BY ME

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT PLASTIC LIMIT WATER CONTENT		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WL	WP		
1061.73 Ground Level				1060						
1060.23 Black Org. Topsoil										
1.5	Silty Sand	1	SS							
	Loose to V. Dense	2	SS	1050						
		3	SS							
1040.2		4	SS	1040						
21.5	End of Borehole			1030						

W.L. EL.
▼ 1053.2
Observed in
Casing
Gravel 4%
Sand 88%
Silt 8%
Clay

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 6

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-37 LOCATION N 202.483.115: E 210.897.822 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE May 3, 1966 COMPILED BY W.E.
 DATUM 1041.90 BOREHOLE TYPE Penetration Only CHECKED BY W.E.

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE					
1041.90	Ground Level			1040				
0.0	Penetration Only							
1028.90				1030				
13.0	End of Penetration			1020				

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 66-F-37

W.P. 636-64

DATUM 1059.09

RECORD OF BOREHOLE NO. 6A

FOUNDATION SECTION

LOCATION N 202,399.565 ; E 210,618.220

BORING DATE May 11, 1966

BOREHOLE TYPE Washboring NX Casing

ORIGINATED BY W.V.K.

COMPILED BY M.E.

CHECKED BY *[Signature]*

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WATER CONTENT %			
1052.09 1058.09 1.0	Ground Level Black Org. Topsoil									
	Silty Sand	1	SS	1050	35					
	Dense to V. Dense	2	SS		77					
		3	SS	1046"	100/6"					
1036.09		4	SS	1040	100					
23.0 1032.49 26.6	Clayey Silt with some Sand	5	SS	1030	108					
	End of Borehole			1020						
										W.L. El. 1051.4 Observed in Casing
										Sand 19% Silt 52% Clay 29%

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7

FOUNDATION SECTION

JOB 66-F-37 LOCATION N202.358.827 : E 210.890.628 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE May 3, 1966 COMPILED BY W.E.
 DATUM 1044.77 BOREHOLE TYPE Penetration Only CHECKED BY W.E.

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WP — W — WL WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE					
1044.77 0.0	Ground Level			1040				
1032.77 12.0	Penetration Only			1030				
	End of Penetration							

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 7A

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202,454.512 ; E 210,743.057 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE May 11, 1966 COMPILED BY W.E.
 DATUM 1053.17 BOREHOLE TYPE Washboring NX Casing CHECKED BY dk

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE		SHEAR STRENGTH P.S.F.		WP	WL		
1053.17	Ground Level			1050						
0.0	Silty Sand	1	SS 23							
	Compact to Dense	2	SS 53	1040						
1040.17										
13.0	Clayey Silt with Traces of Sand and Fine Gravel	3	SS 53							
1031.6	Hard	4	SS 82	1030						
21.5	End of Borehole			1020						
										W.L. El. ▼ 1046.1 Observed in Casing

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.8

FOUNDATION SECTION

JOB 66-P-37 LOCATION N 202,497,1114; E 210,938,122 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE May 5, 1966 COMPILED BY W.E.
 DATUM 1043.04 BOREHOLE TYPE Washboring NX Casing CHECKED BY W.E.

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W _c		BULK DENSITY γ P.C.F.	REMARKS			
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	BLOWS / FOOT	20	40	60			80	100	W _P
1043.04	Ground Level												
1039.5	Muck	1	SS	18									
3.5	Silty Clay with Traces of Sand	2	SS	41									
	Stiff to Hard	3	SS	44									
		4	SS	45									
		5	SS	25									
		6	SS	43									
		7	SS	34									
		8	SS	104									
996.54	End of Borehole												
46.5													

W.L. El.
1041.5
Observed in
Casing

Gravel 1%
Sand 2%
Silt 34%
Clay 63%

FOUNDATION SECTION

JOE 66-K-37

79-960

LOCATION _____
BORING DATE _____

May 11, 1966


DATE 1041.76

BOREHOLE TYPE

Washboring NX Casing

ORIGINATED BY
W.W.K.

COMPILED BY
W. T. E.

CHECKED BY 

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
1041.76	Ground Level					1040				
1039.76	Black Org. Topsoil									
2.0										
	Silty Clay with Traces of Sand and occ. Gravel		1	SS	27					
			2	SS	42					
	Very Stiff to Hard		3	SS	77					
1025.2						1030				
16.5	End of Borehole					1020				

RECORD OF BOREHOLE NO. 9

CHECKED BY

[illegible]

MATERIALS & TESTING DIVISION

May 30 1967

THE UNIVERSITY OF CHICAGO

End of Borehole

SHEAR STRENGTH P.S.F.

WATER CONTENT—W

WATER CONTENT %

REMARKS

7:30T

Th. L. El.

Observed in

Casing

Y
A
C

Sand 5%

3115 57% 200

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 10

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202,520,538 ; E 210,984,640 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE May 6, 1966 COMPILED BY W.E.
 DATUM 1043.63 BOREHOLE TYPE Penetration Only CHECKED BY gll

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE					
1043.63 0.0	Ground Level							
1029.63 14.0	Penetration Only			1040				
	End of Penetration			1030				

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 10A

FOUNDATION SECTION

JOB _____ 66-F-37

66-F-37

LOCATION _____ N 202,583.607 ; E 211,016.125

W. P. 635-64

BORING DATE _____ May 10, 1966

DATUM 7013 63

BOREHOLE TYPE Washboring NX Casing

CHECKED BY

COMPILED BY
N. T. E.

CHECKED BY

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W WATER CONTENT % 10 20 30	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT				
1043.63	Ground Level										1041.4 W.L. El. Observed in Casing Gr. 4% Sa. 13% Si. 57% Cl. 26%
1041.63	Black Org. Topsoil					1040					
2.0	Clayey Silt with some Sand and Traces of Gravel Very Stiff to Hard										
		1	SS	24							
		2	SS	41							
1027.1						1030					
16.5											
	End of Borehole										
						1020					
						1010					

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202,400.356 : E 210,983.633 ORIGINATED BY W.W.K.
W.P. 636-64 BORING DATE May 2, 1966 COMPILED BY W.E.
DATUM 1047.23 BOREHOLE TYPE Penetration Only CHECKED BY dl

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT SHEAR STRENGTH P.S.F.	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE					
1047.23	Ground Level							
0.0	Penetration Only			1040				
1029.23				1030				
18.0	End of Penetration							

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 11A

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202,622,339 ; E 211,106,332 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE May 10, 1966 COMPILED BY W.T.E.
 DATUM 1046.54 BOREHOLE TYPE Washboring NX Casing CHECKED BY W.T.E.

SOIL PROFILE		SAMPLES			DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F.	WATER CONTENT % 10 20 30			
1046.54	Ground Level									
1043.54	Black Org. Topsoil	1	SS	17	1040					
3.0	Clayey Silt with some Sand and Traces of Gravel	2	SS	32						
	V. Stiff to Hard	3	SS	72	1030					
1020	End of Borehole				1020					

W.L. 1044.3
 W.P. 1044.3
 Observed
 in Casing
 Gr. 2%
 54.15%
 51.57%
 11.26%

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 12

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202, 546.057 ; E211, 038.933 ORIGINATED BY M.W.K.
 W.P. 636-64 BORING DATE May 6, 1966 COMPILED BY M.C.
 DATUM 1045.43 BOREHOLE TYPE Washboring NX Casing CHECKED BY [Signature]

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT PLASTIC LIMIT WATER CONTENT		BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	BLOWS / FOOT	20 40 60 80 100	W.P. W. O. W.L.	W.P. W. O. W.L.	P.C.F.	
1045.43	Ground Level									
1042.9	Black Org. Topsoil	1	SS	34						W.L. El. <u>1043.2</u> Observed in Casing Gravel 4% Sand 19% Silt 53% Clay 24%
2.5	Clayey Silty to Silty Clay with traces of Sand	2	SS	27						
	Very Stiff to Hard	3	SS	65						
		4	SS	93						
		5	SS	102						
		6	SS	70						Gravel 1% Sand 6% Silt 68% Clay 25%
		7	SS	63						
998.93		8	SS	87						

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 12A

FOUNDATION SECTION

66-E-37

N 202, 654, 890 : E 211, 201, 213

May 10, 1966

BOREHOLE TYPE Washboring NX Casting

CHECKED BY AK

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	WATER CONTENT %			
1050.41	Ground Level										
1047.11	Black Org. Topsoil										
3.3	Silty Sand		1	SS	25						
1043.41	Compact										
7.0	Clayey Silt with some Sand and traces of Gravel.										
1033.9	Hard		2	SS	57						
16.5	End of Borehole		3	SS	78						

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 13

FOUNDATION SECTION

JOB 66-F-37

LOCATION N 202,439.340 ; 211,087.105

ORIGINATED BY W.W.K.

W.P. 636-64

BORING DATE May 2, 1966

COMPILED BY W.E.

DATUM 1054.46

BOREHOLE TYPE Washboring NX Casing

CHECKED BY *W.E.*

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLAT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY γ P.C.F.	REMARKS
			NUMBER	TYPE		20	40	60	80	100	
1054.46	Ground Level										
1043.5	Org. matter - Rubble City Dump Fill		1	SS	29						
			2	SS	39						
1043.5			3	SS	9						
11.0	Muck Silty Sand Some Org. Matter		4	SS	17						
1034.0			5	SS	96						
20.0	Silty Clay Sand with traces of Gravel very Dense		6	SS	74						
24.0	Silty Sand Very Dense		7	SS	40						
1026.5			8	SS	58						
28.0	Silty Clay with Traces of Gravel Hard		9	SS	82						
1007.96											
45.2	End of Borehole										

W.I. El.
1050.7
Observed in
Casing

Gravel 2%
Sand 58%
Silt 35%
Clay 5%

Sand 95%
Silt 5%
Clay 5%

Sand 1%
Silt 48%
Clay 51%

WATER CONTENT %
15

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO		RECORD OF BOREHOLE NO. 13A		FOUNDATION SECTION
MATERIALS & TESTING DIVISION		LOCATION	N 202.683.675 : E 211.295.186	ORIGINATED BY W.K.K.
JOB 66-F-37		BORING DATE	May 10, 1966	COMPILED BY W.T.E.
W.P. 636-64		BOREHOLE TYPE	Washboring NX Casing	CHECKED BY <i>[Signature]</i>
DATUM 1051.75				

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT PLASTIC LIMIT WATER CONTENT	WATER CONTENT %	BULK DENSITY P.C.F.	REMARKS
			NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.				
1051.75	Ground Level										
1048.75	Black Org. Topsoil				1050						
3.0											
1043.75	Sandy Silt Dense		1	SS		30					
8.0											
	Clayey Silt with some Sand and traces of Gravel.		2	SS	1040	47					
1035.2											
16.5	Hard		3	SS		94					
	End of Borehole				1030						
					1020						

1048.6
W.L. Bl.
Observed in
Casing
Gr. 14%
Sa. 14%
Si. 55%
Cl. 27%

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 66-F-37

W.P. 636-64

DATUM 1045.49

RECORD OF BOREHOLE NO. 14

FOUNDATION SECTION

LOCATION N 202,565.448 ; E 211,080.483

BORING DATE May 6, 1966

BOREHOLE TYPE Penetration Only

ORIGINATED BY W.W.K.

COMPILED BY W.E.

CHECKED BY *W.E.*

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE					
1045.49	Ground Level				20 40 60 80 100	<div> <div> <div>WP</div> <div>WL</div> </div> <div> <div>0</div> <div>1</div> </div> </div>		
0.0	Penetration Only			1040				
1033.49								
12.0	End of Borehole			1030				

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 14A

FOUNDATION SECTION

DATE 1052.95 BOREHOLE TYPE Washboring NX Casing CHECKED BY 942

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 15A

FOUNDATION SECTION

JOB 66-F-37 LOCATION N 202,743.706 ; E 211,489.961 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE MAY 9, 1966 COMPILED BY W.T.E.
 DATUM 1054.26 BOREHOLE TYPE Washboring NX Casing CHECKED BY W.T.E.

SOIL PROFILE		STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION		NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.	WATER CONTENT %			
1054.26 0.0	Ground Level	///									
1051.26 3.0	Black Org. Top Soil	///	1	SS	54	1050					W.L. El. <u>1048.5</u>
	Silty Sand with traces of Clay and Gravel	///	2	SS	14						Gr. 28 Sa. 79 Si. 17 Cl. 11
	Compact to V. Dense	///	3	SS	45						Observed in Casing
1037.7 16.5	Clayey Silt with some Sand	///	4	SS	85	1040					
	End of Borehole					1030					

OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 16A

FOUNDATION SECTION

JOB 66-R-37 LOCATION N 202,783.026 ; E 211,577.289 ORIGINATED BY W.W.K.
 W.P. 636-64 BORING DATE MAY 9, 1966 COMPILED BY W.T.E.
 DATUM 1056.47 BOREHOLE TYPE Washboring NX Casing CHECKED BY [Signature]

SOIL PROFILE		SAMPLES		ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W		BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	NUMBER	TYPE		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	wp	w		
1056.47	Ground Level									
1053.47	Black Org. Top Soil	1	SS	20						
3.0	Silty Sand with traces of Clay and Gravel	2	SS	33	1050					
	Compact to V. Dense	3	SS	57						
1038.47		4	SS	74	1040					
18.0	Clayey Silt with some Sand - Hard	5	SS	126/10*						
21.5	End of Borehole				1030					
					1020					

W.L. El. 1049.4
 P.C.F. 1.377
 Observed in Casing

Appendix D

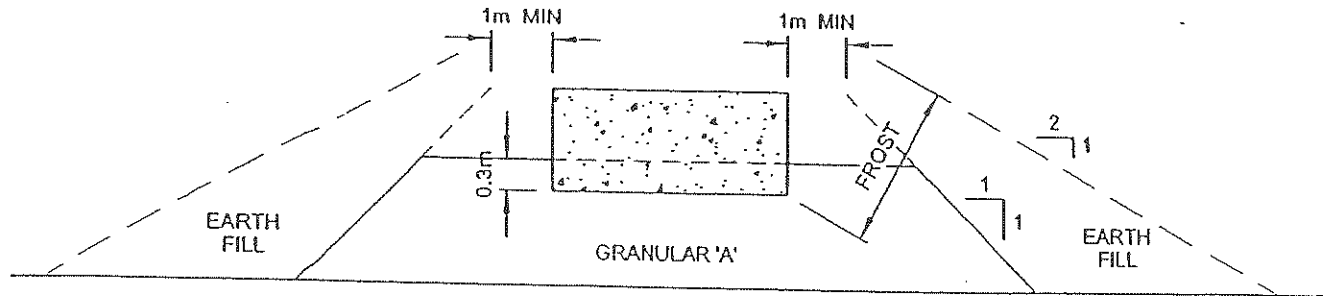
Foundation Comparison

COMPARISON OF FOUNDATION ALTERNATIVES FOR EACH FOUNDATION ELEMENT

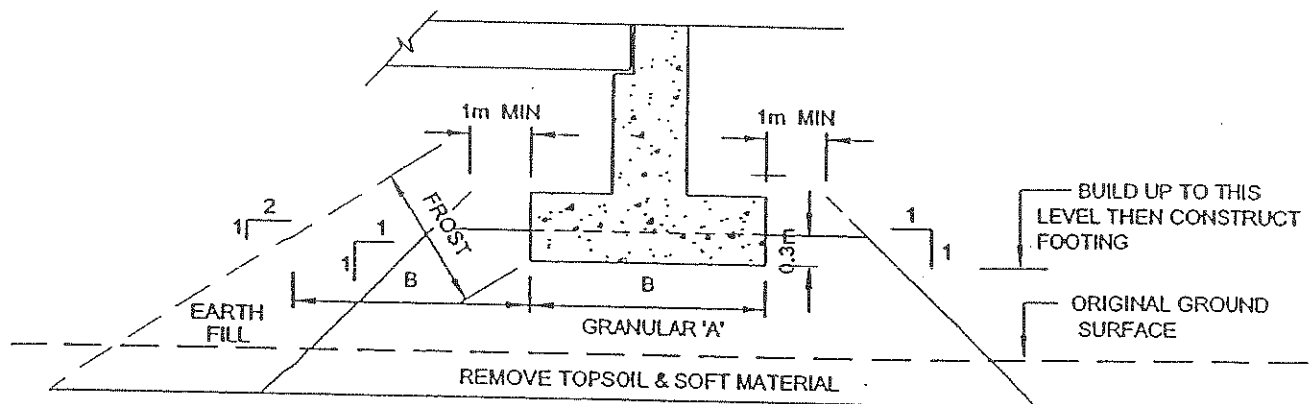
Foundation Element	Spread Footings	Spread Footings on Engineered Fill	Driven Piles
Abutments	<p><i>Advantages:</i></p> <ul style="list-style-type: none"> i. Generally less costly construction than deep foundation elements. <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> i. Lower geotechnical resistance available due to founding on compact soils near the surface. ii. Dewatering may be required, depending on depth of excavation. <p>NOT RECOMMENDED</p>	<p><i>Advantages:</i></p> <ul style="list-style-type: none"> i. Generally less costly construction than deep foundation elements. <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> 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. <p>NOT RECOMMENDED</p>	<p><i>Advantages:</i></p> <ul style="list-style-type: none"> i. High geotechnical resistance may be developed by driving the piles into very dense soils. ii. Comparatively short abutment stem possible iii. Permits integral abutment design <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> i. Higher unit cost compared to footings. <p>RECOMMENDED</p>

Appendix E

Figure



CROSS-SECTION

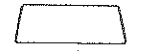


LONGITUDINAL SECTION

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

Appendix F
Site photograph

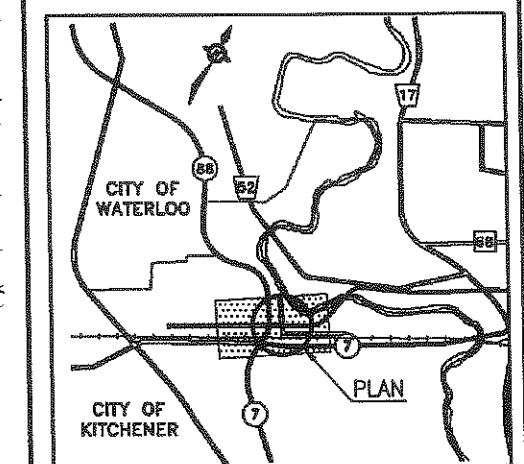
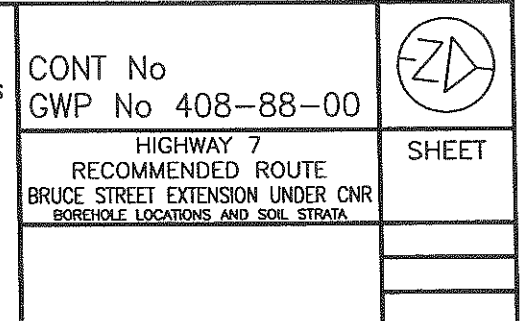
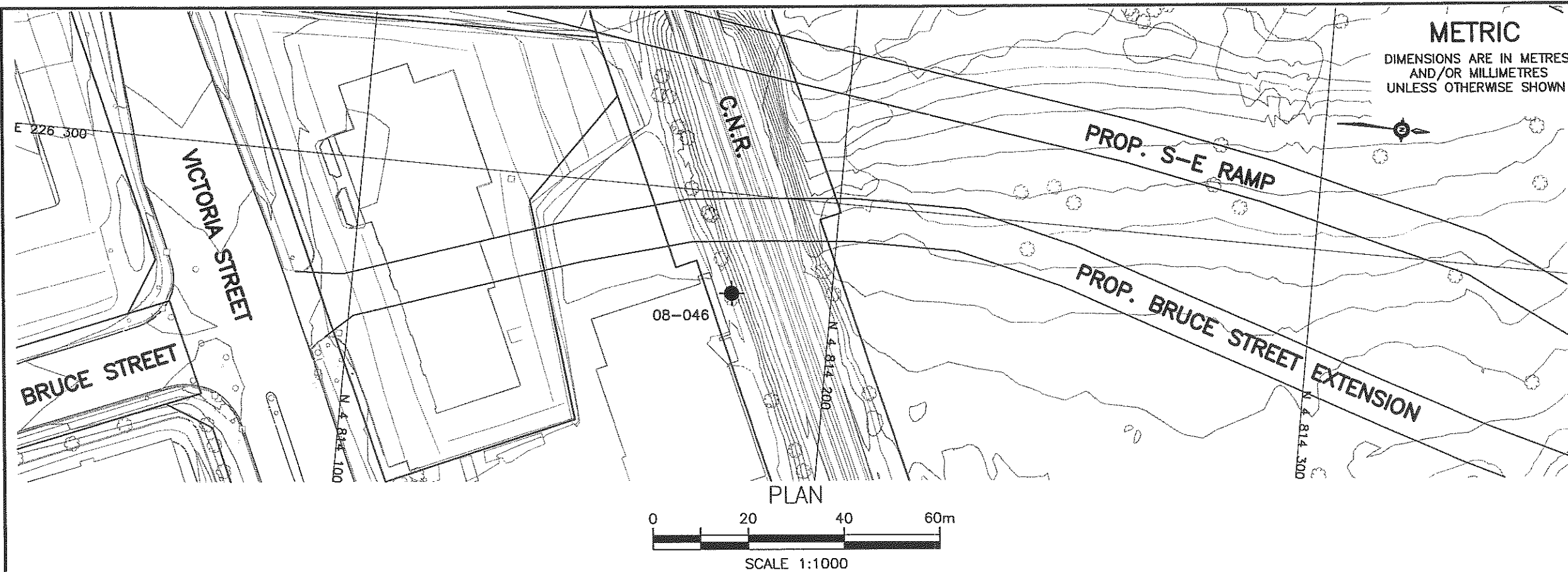
CNR tracks at the
top of the slope








Photo 1. Looking at the south embankment (Borehole 08-046) of the existing CNR tracks

Appendix G

Drawing titled “Borehole Locations and Soil Strata”



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.
- 3) Proposed grades are from Plate 2A of the E.A. Study.
- 4) Water level taken from a previous piezometer installed at the site by others.

GEOCRES No. 40P8-163

REV	REVISIONS						DATE	BY	DESCRIPTION	DATE	JUN. 20
DESIGN	AEG		CHK	PKC	I CODE				LOAD		
DRAWN	MEA		CHK	AFG	SFE				STRUCT	IDWG	