

**FOUNDATION INVESTIGATION REPORT
SOUTH RIVER BRIDGE, NBL
HIGHWAY 11, BURK'S FALLS TO SOUTH RIVER
G.W.P. 759-93-00, W.P. 5041-03-01, SITE 44-373**

Geocres Number: 31E-200

Report to

Marshall Macklin Monaghan

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April 19, 2004

File: 19-1423-12

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NBL\South Riv NBL Investigation.doc

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the site of a proposed bridge to carry realigned Highway 11 over the South River near the village of South River, Ontario. A previous, preliminary investigation had been carried out at the site by Golder Associates Ltd. (Golder) and the factual data from that investigation has been incorporated in the current assignment.

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, borehole logs, stratigraphic profile and cross-sections and a written description of the subsurface conditions. A model of the subsurface conditions was developed through considering a combination of the data from the previous Golder investigation and the data obtained in the course of the present investigation. This model describes the geotechnical conditions influencing design and construction of the foundations and approach embankments for the bridge and the stability of the north bank of the river.

Thurber carried out the investigation as a sub-consultant to Marshall Macklin Monaghan, under the Ministry of Transportation Ontario (MTO) Agreement Number 5005-A-000188.

2 SITE DESCRIPTION

The site lies across the valley of the South River at a location where it is proposed that Highway 11 will cross the river. The site lies in Machar Township, 200 to 300 m west of existing Highway 11 and immediately north of the South river village limits.

The general site area is located within the physiographic region known as the Canadian Shield, characterized by Pre-Cambrian bedrock typically occurring as rounded knobs and ridges where exposed. Locally, however, the site lies in the valley of the South River. The present valley appears to occupy a much deeper valley incised into the bedrock and later filled to the present ground surface elevation with glacial and post glacial soil deposits and recent river alluvium.

The flood plain of the river occupies the entire valley floor, which is approximately 140 m wide, while the normal river channel is approximately 20 m wide and flows at the base of the north valley slope. The maximum river depth at normal water conditions is approximately 3 m.

The south valley wall is approximately 30 m high and sloped at approximately 4H:1V while the north valley wall is approximately 23 m high and sloped at approximately 10H:1V, above the eroded face of the river bank.

The valley slopes are treed with mixed second growth conifers and hardwoods. The valley floor is more sparsely treed but is largely occupied by willow and alder scrub. The site is drained by the west-flowing South River. The local groundwater level is at or slightly above the river level and wet surface conditions are encountered across the site.

There are no buildings in the immediate site vicinity and the closest development is in the village of South River a short distance to the south of the site.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out in two phases between October 20 and November 11, 2003, and between January 19 and January 21, 2004. The current site investigation consisted of drilling and sampling five boreholes (Boreholes 373-1 through 373-5) to depths ranging from 5.8 m at the north approach to 35.0 m at south abutment. The approximate locations of the boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix G.

Surveyors from Marshall Macklin Monaghan Ltd. marked the borehole locations in the field and utility clearances were obtained by Thurber prior to any drilling being carried out. Borehole 373-3 had to be moved from the staked location due to accessibility issues and the new coordinates and elevation have been estimated with an accuracy of 0.5 m and 0.2 m, respectively.

DBW Drilling Limited supplied and operated the drilling and sampling equipment used on the north side of the river and for one of the pier boreholes. All-Terrain Drilling and George Downing Estate Drilling supplied and operated the drilling and sampling equipment used for the remaining foundation boreholes and the approach fill boreholes at the south of the valley. A combination of hollow stem auger and rotary drilling techniques were used to advance the boreholes and samples were obtained using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Where bedrock was encountered, it was proved by coring into it for a distance of approximately 3 m.

The positions of the principal boreholes considered in the preparation of this report, relative to the structure site are as shown in Table 3.1.

Table 3.1 – Borehole Locations Relative to Structure

Location on Structure	Boreholes Considered in Design
North Approach	BH 373-5, BH 373-4, BH 16-1*
North Abutment	BH 373-4, BH 16-1*, BH 16-2*
Pier	BH 373-3, BH 16-3*, BH 16-4*
South Abutment	BH 373-2, BH 16-4*
South Approach	BH 373-1, BH 373-2

* Boreholes drilled by Golder in 2000

The coordinates and elevations of the boreholes are given on the Borehole Locations and Soil Strata Drawing and on the individual Record of Borehole Sheets in Appendix A.

Standpipe piezometers, consisting of 19 mm PVC pipe with slotted tips, were installed in selected boreholes to monitor the groundwater levels. The locations and completion details for the piezometers are shown in Table 3.2.

Table 3.2 – Piezometer Details

Piezometer Location	Piezometer Details	
	Tip Depth/ Elevation	Completion Details
BH 373-2	35.1/295.8	Piezometer with 3 m tip installed at bottom of borehole. Sandy soils in borehole wall collapsed to a depth of 11.6 m. Bentonite seal to 10.7 m. Drill cuttings to ground surface.
BH 373-4	13.4/324.2	Borehole caved to 13.4 m depth, piezometer with 1.5 m tip installed at that depth. Sand backfill from 13.4 to 9.5 m, bentonite to 8.6 m, caved material to 0.9 m and a bentonite seal to the surface.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The inspector logged the boreholes and the recovered samples and processed them for transport to Thurber's Oakville office.

4 LABORATORY TESTING

All recovered soil samples were subjected to visual identification 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 subjected to gradation analysis (sieve and hydrometer) and the results are shown on the Record of Borehole sheets in Appendix A and on the charts in Appendix B. A total of nineteen samples were selected for this testing

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Reference is made to the Record of Borehole sheets in Appendix A and to the Record of Borehole sheets prepared by Golder included in Appendix C. Details of the encountered soil stratigraphy are presented in these appendices and on the attached Borehole Locations and Soil Strata Drawings. An overall description of the stratigraphy is given in the following paragraphs however the factual data presented in the borehole logs governs any interpretation of the site conditions.

The south abutment and pier lie south of the river and in the flood plain with original ground elevations ranging from 330 to 331. The north abutment lies north of the river on the north valley slope with an original ground elevation of approximately 337.6.

The subsoil stratigraphy at the site is governed by the physiography and glacial history of the area. The recent geological history of the site is interpreted to consist of:

- Glaciation and scouring of a valley into the bedrock
- Deposition of a layer of gravelly sand, possibly as moraine material
- Deposition of a layer of fine sands and sandy silts, possibly in a glacial lake environment
- Subsequent erosion and local re-deposition by the South River

In general terms, the site was found to be underlain by a layer of very loose to compact sand and sandy silt. The layer was found to be approximately 8 m thick (base Elevation 329.2) at the north abutment, increasing in thickness to 15 m (base Elevation 315) at the pier and to 29 m (base Elevation 302.3) at the south abutment. This layer is underlain by a compact to very dense gravelly sand found to be in excess of 16 m thick at the north abutment (end of hole Elevation 313.5), in excess of 6 m thick at the pier (end of hole Elevation 309.4) and approximately 3 m (base Elevation 298.9) at the south abutment where it is underlain by bedrock.

As a comparison, the stratigraphy at the SBL structure is similar, except that bedrock was encountered at the north abutment.

More detailed descriptions of the individual strata are presented below.

5.2 Topsoil

At the north approach and north abutment, topsoil was encountered in thicknesses ranging from 100 to 230 mm. On the floodplain, at the pier, south abutment and south approach, the topsoil thicknesses ranged from 200 to 300 mm.

Topsoil thicknesses were established only at borehole locations. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.3 Upper Sand

The upper sand layer lies immediately below the topsoil layer and was identified across the entire site. This stratum is described as sand, trace to some silt to silty.

At the south abutment, the sand stratum extends from the underside of the topsoil (Elevation 330.6) to a depth of 11.5 m (Elevation 319.4). At the pier, it extends to a depth

of 7.2 m (Elevation 323.5) and at the north abutment it extends to a depth of 7.2 m (Elevation 330.4).

At the south abutment and pier and based on SPT values ranging generally from 1 to 7 blows for 0.3 m of penetration, the soil is classified as very loose to loose. There are occasional pockets of the sand in a loose to compact state, based on SPT values approaching 10 blows for 0.3 m of penetration. In this area, the sand is brown at the top, becoming grey below a depth of 4 m. The groundwater is near the surface, controlled by the South River, and the sand is generally saturated and described as wet with moisture contents ranging from 20 to 38%. Some dryer conditions were noted near the surface at the pier location where the borehole was drilled close to the river bank and approximately 2 m above the river level.

On the north side of the river, in the area of the north abutment and approach, the sand is classified as compact, based on SPT values ranging from generally from 13 to 24 blows for 0.3 m of penetration. The sand in this location is brown and dry to moist, with measured natural moisture contents ranging from 5 to 21%.

Typical grain size distributions for this soil are shown in Figure B1 in Appendix B.

5.4 Sandy Silt

Below the upper sand, a layer of sandy silt was identified across the entire site, though the thickness identified at the north abutment was much less than that at the south abutment and pier. This layer is described as silt, sandy, trace clay.

At the south abutment, the silt extended to a depth of 15.5 m (Elevation 315.4) and at the pier it extended to a depth of 13.3 m (Elevation 317.4). At the north abutment, a comparatively thin layer of silt was encountered which was only 1.2 m thick and extended to a depth of 8.4 m (Elevation 329.2).

The silt layer is classified as very loose to compact, based on SPT values ranging from 1 to 17 blows for 0.3 m of penetration. Natural moisture contents ranged from 21 to 24% and the silt is described as wet and it is grey in colour.

Typical grain size distributions for this soil are shown in Figure B2 in Appendix B.

5.5 Lower Sand

The sandy silt is underlain by a stratum that ranges from sand to silty sand that forms a fairly substantial thickness at the south abutment but is much thinner across the balance of the site and appears to be absent at the north abutment.

At the south abutment, the lower sand extends to a depth of 28.6 m (Elevation 302.3). At the pier it is 1.9 m thick, extending to a depth of 15.2 m (Elevation 315.5). The lower

sand was not identified at the north abutment but was identified under the north approach fill.

At the south abutment, the lower sand is described as loose near the top of the layer, becoming compact, dense and very dense with increasing depth. Across the balance of the site, the lower sand layer is described as loose to compact.

The measured natural moisture contents ranged from 8 to 26%.

Typical grain size distributions for this soil are shown in Figure B3 in Appendix B.

5.6 Gravelly Sand

A layer of gravelly sand underlies the silt at the south abutment, pier and north abutment. This layer is described as sand, gravelly, trace to some silt, occasional cobbles and boulders.

At the south abutment, the gravelly sand was found to be 3.4 m thick (base Elevation 298.9). At the pier, the gravelly sand was proved to be at least 6.1 m thick and to extend at least to a depth of 21.3 m (Elevation 309.4) where the borehole was terminated after establishing a minimum of 3 m of soil with an SPT value exceeding 100 blows for 0.3 m of penetration. At the north abutment, the gravelly sand was proved to be 15.7 m thick and to extend at least to a depth of 24.1 m (Elevation 313.5) where the borehole was terminated after establishing a minimum of 3 m of soil with an SPT value exceeding 100 blows for 0.3 m of penetration.

The measured moisture contents ranged from 8 to 32%. Some values may have been influenced by sample disturbance and this soil can be assumed to be saturated.

Typical grain size distributions for this soil are shown in Figure B4 in Appendix B.

5.7 Bedrock

The soils described above were found to be underlain by quartz diorite bedrock of the Pre-Cambrian Canadian Shield. The bedrock was proved by coring in Borehole 373-2. The length of core extracted from the borehole was 3.2 m.

The rock is described as grey/black quartz diorite, fresh, slightly weathered in the joints and very strong to extremely strong.

Core recovery was 100% and RQD values ranged from 0 to 33% to 100%. Based on the RQD values, the rock mass is described as ranging from poor quality to excellent quality. The Fracture Index was generally 0 to 5, except between Elevation 297 and Elevation 296 where a value of greater than 10 was noted.

Based on Point Load Testing, the unconfined shear strength of the bedrock in Borehole 373-2 was estimated to range from 110 MPa to over 305 MPa. Based on these

strength values and the classification system given in the Canadian Foundation Engineering Manual, the rock was classified as very strong to extremely strong.

5.8 Depths to Refusal

The depths at which effective refusal was encountered, defined as an SPT value exceeding 100 blows for 0.3 m of penetration or bedrock, are shown in Table 5.1.

Table 5.1 – Refusal Depths (Elevations)

Location	Borehole	Refusal Elevation (m)	Material
North Abutment	BH 373-4	16.1 (321.5)	Gravelly sand
Pier	BH 373-3	16.3 (314.4)	Gravelly sand
South Abutment	BH 373-2	32.0 (298.9)	Bedrock

5.9 Water Levels

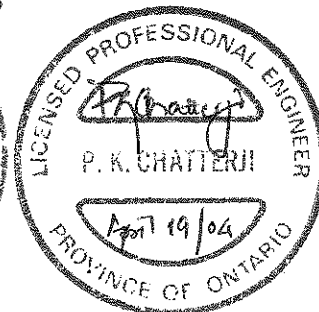
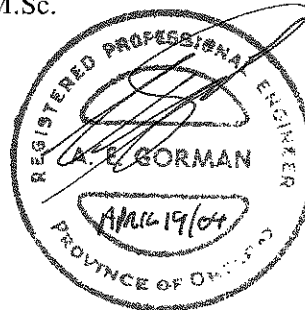
Groundwater levels at this site were measured within standpipe piezometers in the spring of 2000, winter of 2003/2004. The measured depth and elevations are shown in Table 5.2.

Table 5.2 – Groundwater Depths (in metres) and Elevations

Date	BH 373-2		BH 373-4		BH 16-3		BH 16-4	
	Depth	Elev.	Depth	Elev.	Depth	Elev.	Depth	Elev.
Feb. 19, 2000	-	-	-	-	16.2	313.9	1.8	328.3
Mar. 8, 2000	-	-	-	-	1.6	328.5	-	-
Mar. 26, 2000	-	-	-	-	1.5	328.6	-	-
Jan. 29, 2004	1.5	329.4	-	-	-	-	-	-
Jan. 30, 2004	-	-	7.9	329.7	-	-	-	-

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.

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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

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

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
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 200	Greater than 29,200	Requires many blows of geological hammer to break.
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-200	14,600 to 29,200	Requires a few blows of geological hammer to break.
Thinly bedded	60mm to 0.2m				
Very thinly bedded	20 to 60mm	Strong	50-100	7,300 to 14,600	Breaks under single blow of geological hammer.
Laminated	6 to 20mm				
Thinly Laminated	Less than 6mm	Moderately Strong	12.5 to 50.0	1,825 to 7,300	¼" indentations with sharp end of geological pick.
<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Moderately Weak	5.0 to 12.5	730 to 1,825	Too hard to cut by hand into triaxial specimen.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Weak	1.25 to 5.0	182 to 730	Crumbles under firm blows of geological pick.
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.	Very Weak (Rock)	0.60 to 1.25	85 to 182	May be broken in the hand with difficulty.
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

METRIC

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE								
330.1							20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	Wp W Wl WATER CONTENT (%) 20 40 60	γ kN/m ³	GR SA SI (%)		

[illegible]

+ 3, × 3: Numbers refer to Sensitivity

ONTMT4 373SOUTH RIVER BRIDGES.GPJ 30/01/04

METRIC

[illegible]

RECORD OF BOREHOLE No 373-2

1 OF 4

METRIC

W.P. 5041-03-01 LOCATION (N 5 079 340.6 E 313 795.0) South River Bridge NBL Site 44-373 ORIGINATED BY SL
 HWY 11 BOREHOLE TYPE HQ Casing COMPILED BY WM/SS
 DATUM Geodetic DATE 19.01.04 - 21.01.04 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100					
330.9															
0.0															
330.6	ORGANICS														
0.3	SAND, trace silt to silty, trace organics Loose Brown Wet														
			1	SS	5		330								
			2	SS	5		329								
			3	SS	1		328								
			4	SS	3		327								
	Becoming Grey														
			5	SS	2		326								
			6	SS	1		325								
							324								
			7	SS	1		323								
							322								
			8	SS	6		321								

0 71 29
(SI+CL)

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

RECORD OF BOREHOLE No 373-2

2 OF 4

METRIC

W.P. 5041-03-01 LOCATION (N 5 079 340.6 E 313 795.0) South River Bridge NBL Site 44-373 ORIGINATED BY SL
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 DATUM Geodetic DATE 19.01.04 - 21.01.04 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80		
319.4			9	SS	2		320						0 64 36 (SI+CL)
11.5	Sandy SILT, trace clay Very Loose to Compact Grey Wet		10	SS	1		319						0 39 61 (SI+CL)
			11	SS	14		318						
315.4							317						
15.5	Silty SAND Loose, Becoming Compact Then Very Dense Grey Wet		12	SS	6		316						
							315						
			13	SS	8		314						0 61 39 (SI+CL)
							313						
							312						
							311						

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

RECORD OF BOREHOLE No 373-2

3 OF 4

METRIC

W.P. 5041-03-01 LOCATION (N 5 079 340.6 E 313 795.0) South River Bridge NBL Site 44-373 ORIGINATED BY SL
 HWY 11 BOREHOLE TYPE HQ Casing COMPILED BY WM/SS
 DATUM Geodetic DATE 19.01.04 - 21.01.04 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL						
			14	SS	19											
							310									
							309									
			15	SS	34		308									
							307									
							306									
			16	SS	58		305									
							304									
			17	SS	61		303									
302.3							302									
28.6	Gravelly SAND, some silt Very Dense Grey Wet						301									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

METRIC

[illegible]

+ ³, × ³: Numbers refer to Sensitivity

METRIC

W.P.	5041-03-01	LOCATION	(N 5 079 369.7 E 313 826.9) South River Bridge NBL Site 44-373	ORIGINATED BY	MF
DIST	HWY 11	BOREHOLE TYPE	Hollow Stem Augers, NW Casing, NQ Core	COMPILED BY	SS
DATUM	Geodetic	DATE	29.10.03 - 06.11.03	CHECKED BY	AEG/JL

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						WATER CONTENT (%)
								20 40 60 80 100						
SHEAR STRENGTH kPa														
○ UNCONFINED + FIELD VANE														
● QUICK TRIAXIAL × LAB VANE														
330.7														
330.6	TOPSOIL, some roots													
0.2	Dark Brown		1	SS	4									
	SAND, fine grained, some silt to silty													
	Very Loose to Loose													
	Brown to Grey													
	Dry to Wet													
	(SP)		2	SS	4									
			3	SS	4									
			4	SS	3									
	wet below 3m		5	SS	3									
			6	SS	7									
			7	SS	6									

Continued Next Page

+³, ×³: Numbers refer to Sensitivity



METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI C			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					WATER CONTENT (%)		
								20 40 60 80 100							
317.4			10	SS	8										
315.5	Silty SAND, fine grained Loose Grey Wet		11	SS	10										
313.3			12	SS	7										
315.2	Gravelly SAND, medium grained, some silt, occasional cobbles and boulders Very Dense Grey Wet occasional cobbles		13	SS	70										
			14	SS	100/102										
			15	SS	106										
			16	SS	8										

+ 3, × 3: Numbers refer to Sensitivity

ONTMT4 373SOUTH RIVER BRIDGES.GPJ 30/01/04

METRIC

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

Wet

309.4

21.3	<p>END OF BOREHOLE AT 21.34m.</p> <p>BOREHOLE OPEN TO 2.13m.</p> <p>WATER LEVEL IN OPEN BOREHOLE AT 1.52m DEPTH UPON COMPLETION.</p> <p>BOREHOLE BACKFILLED WITH DRILL CUTTINGS.</p>
------	--

21.3

17

55

10

310

SHEAR STRENGTH kPa

○ UNCONFINED	+ FIELD VANE
● QUICK TRIAXIAL	× LAB VANE

20 40 60 80 100

UNIT WEIGHT	γ
-------------	----------

[illegible]

RECORD OF BOREHOLE No 373-4

1 OF 3

METRIC

W.P. 5041-03-01 LOCATION (N 5 079 395.8 E 313 875.4) South River Bridge NBL Site 44-373 ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Hollow Stem Augers, NW Casing, NQ Core COMPILED BY SS
 DATUM Geodetic DATE 20.10.03 - 27.10.03 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							
								WATER CONTENT (%)							
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT							
337.6						20	40	60	80	100	w _p	w	w _L		
0.0															
337.4	TOPSOIL, some roots														
0.2	Dark Brown		1	SS	5										
	Moist														
	SAND, fine grained, trace silt														
	Compact														
	Brown		2	SS	20										
	Dry to Moist														
			3	SS	14										
			4	SS	13										
	occasional silt lenses		5	SS	16										
			6	SS	15										
			7	SS	17										
330.4															
7.2	Sandy SILT, trace clay														
	Compact														
	Brown		8	SS	10										
	Wet														
329.2															
8.4	Gravelly SAND, medium to coarse														
	grained, some silt, occasional cobbles														
	and boulders														
	Very Dense														
	Brown		9	SS	55										
	Wet														

ONTMT4 373SOUTH RIVER BRIDGES GPJ 03/02/04

Continued Next Page

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

RECORD OF BOREHOLE No 373-4

2 OF 3

METRIC

W.P. 5041-03-01 LOCATION (N 5 079 395.8 E 313 875.4) South River Bridge NBL Site 44-373 ORIGINATED BY MF
 HWY 11 BOREHOLE TYPE Hollow Stem Augers, NW Casing, NQ Core COMPILED BY SS
 DATUM Geodetic DATE 20.10.03 - 27.10.03 CHECKED BY AEG

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80			100	PLASTIC LIMIT w _p
									SHEAR STRENGTH kPa						
									○ UNCONFINED + FIELD VANE						
									● QUICK TRIAXIAL × LAB VANE						
									20 40 60 80 100				WATER CONTENT (%)		
									20 40 60 80 100				20 40 60		
	Gravelly SAND, medium to coarse grained, some silt, occasional cobbles and boulders Compact to Very Dense Grey Moist to Wet		10	SS	54		327								
			11	SS	50/ .05		326								
	boulder from 11.99m to 12.29m		12	SS	42		325								
			13	SS	27		324								
			14	SS	26		323								
			15	SS	100/07		322								
			16	SS	100/ .127		321								
			17	SS	100/ .127		320								
	boulder from 18.87m to 19.15m						319								
							318								

Continued Next Page

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

METRIC

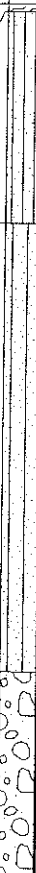


SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60						80	100	20	40
	boulder from 20.42m to 20.73m						317												
			18	SS	100/ .076		315												
313.5			19	SS	100/ .102		314												
24.1	END OF BOREHOLE AT 24.08m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																		
<p>WATER LEVEL READINGS:</p> <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (m)</th> </tr> </thead> <tbody> <tr> <td>30/01/04</td> <td>7.9</td> </tr> </tbody> </table>																DATE	DEPTH (m)	30/01/04	7.9
DATE	DEPTH (m)																		
30/01/04	7.9																		

RECORD OF BOREHOLE No 373-5

1 OF 1

METRIC

W.P. 5041-03-01 LOCATION (N 5 079 402.6 E 313 894.5) South River Bridge NBL Site 44-373 ORIGINATED BY MF
DIST HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY SS
DATUM Geodetic DATE 27.10.03 - 28.10.03 CHECKED BY AEG/JL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					PLASTIC LIMIT W _P NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L
339.3	TOPSOIL, some roots Dark Brown Sandy SILT, trace gravel, trace clay Loose to Compact Reddish Brown to Brown Dry to Moist becoming brown		1	SS	4	339							
338.8			2	SS	21	338							2 22 72 4
337.9	Silty SAND Compact Brown Dry to Moist grey below 3m		3	SS	24	337						0 54 46 (SI+CL)	
			4	SS	20	336							
			5	SS	20	335							
334.9	SAND and GRAVEL, occasional cobbles Very Dense Brown Dry		6	SS	50/ 150	334							
333.5													
5.8	END OF BOREHOLE AT 5.79m. AUGER REFUSAL AT 5.79m. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.												

ONTMT4 373SOUTH RIVER BRIDGES.GPJ 30/01/04

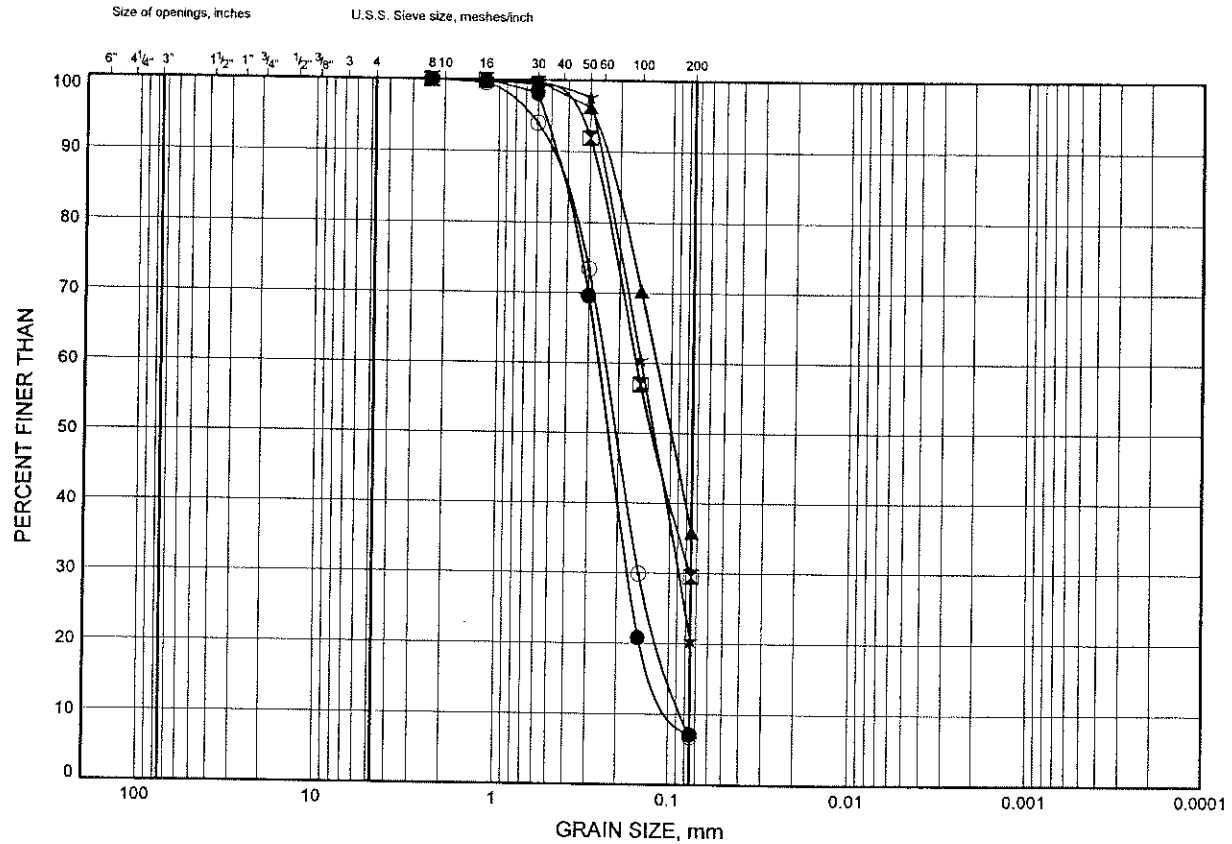
Appendix B

Laboratory Test Results

Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE B1

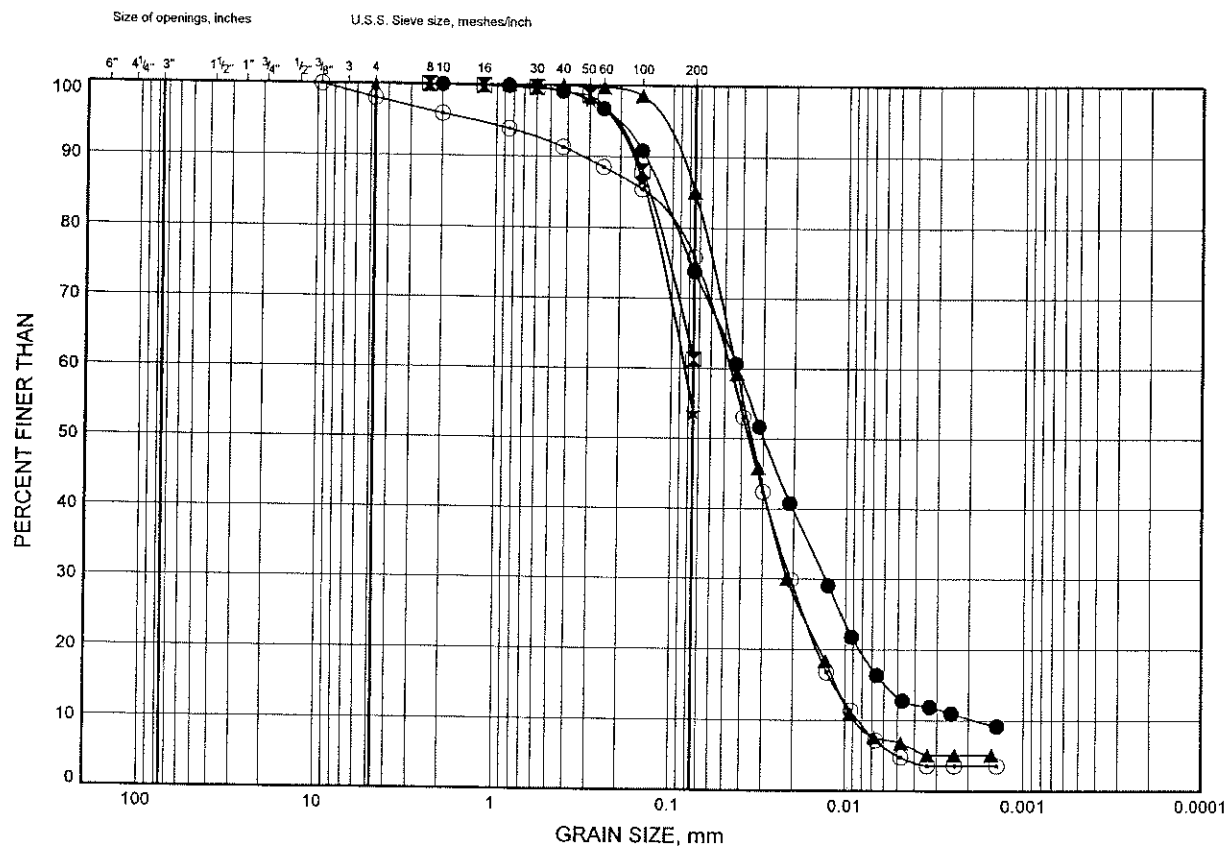
SAND TO SILTY SAND (UPPER SAND)



Hwy 11 Four Laning GRAIN SIZE DISTRIBUTION

FIGURE B2

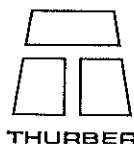
SANDY SILT



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	373-1	7.92	322.18
⊠	373-2	12.50	318.40
▲	373-3	10.97	319.73
★	373-4	7.92	329.68
⊙	373-5	1.07	338.23

Date February 2004
Project 5041-03-01



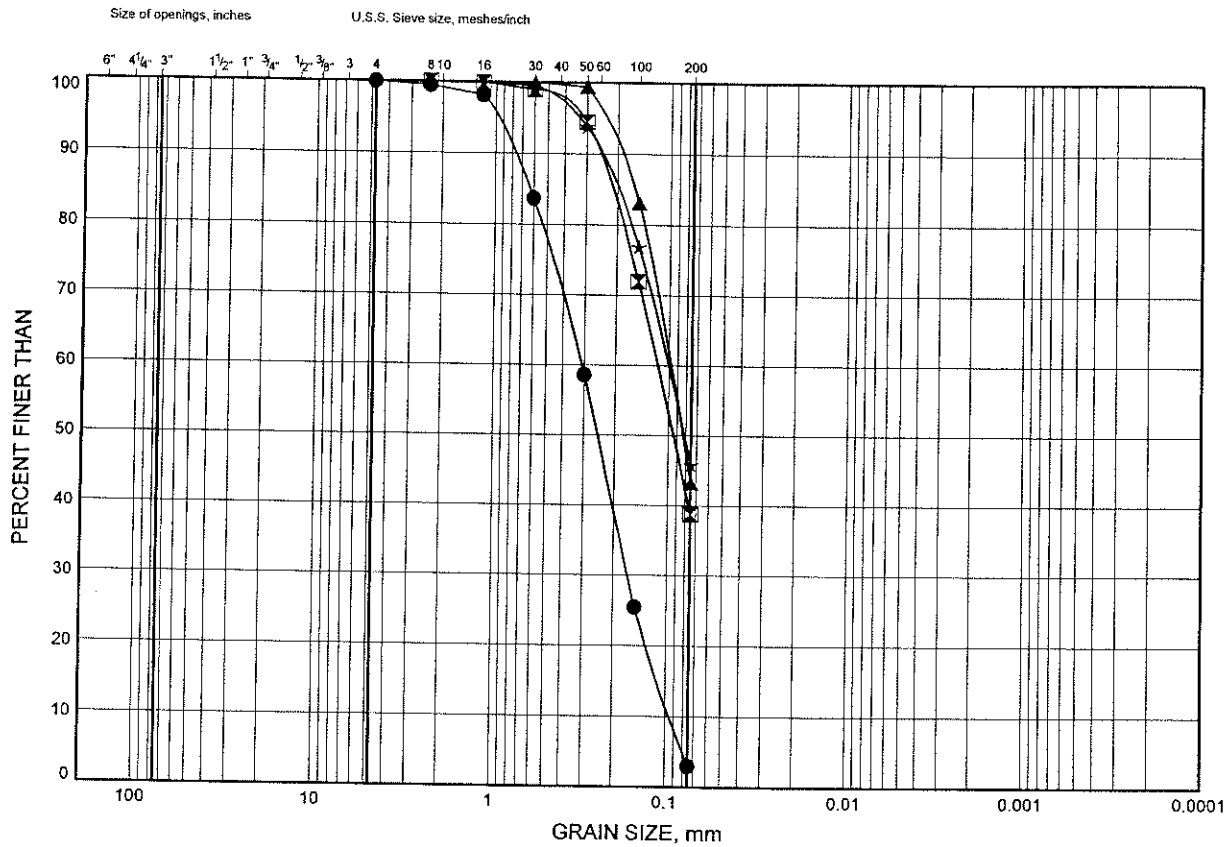
Prep'd SS
Chkd. AEG

Hwy 11 Four Laning

GRAIN SIZE DISTRIBUTION

FIGURE B3

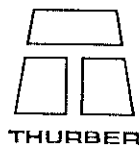
SILTY SAND (LOWER SAND)



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	373-1	15.24	314.86
⊠	373-2	17.07	313.83
▲	373-3	14.02	316.68
★	373-5	1.83	337.47

Date February 2004
Project 5041-03-01



Prep'd SS
Chkd. AEG

FIGURE B4

Size of openings, inches

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

PERCENT FINER THAN

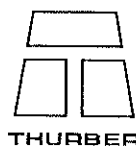
GRAIN SIZE, mm

Grain Size (mm)	Percent Finer Than (Solid Circles)	Percent Finer Than (Open Triangles)
100	100	100
75	100	100
60	100	100
48	100	100
40	100	100
30	100	100
25	100	100
20	100	100
16	100	100
12	100	100
10	100	100
8	98	90
6	95	82
5	90	80
4	88	75
3	85	66
2.5	80	60
2	75	59
1.5	68	55
1.2	62	54
1	58	53
0.8	53	48
0.6	43	38
0.4	29	27
0.2	18	18

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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	373-2	29.95	300.95
☒	373-4	10.82	326.78

Date February 2004
Project 5041-03-01



Prep'd SS
Chkd. AEG

Appendix C

Data From Golder Report

PROJECT 991-1193			RECORD OF BOREHOLE No 16-1			1 OF 1			METRIC										
W.P. 335-98-00			LOCATION N 5079392; E 313587			ORIGINATED BY SB													
DIST 54 HWY 11			BOREHOLE TYPE 108mm I.D. HOLLOW STEM AUGERS			COMPILED BY DKB													
DATUM GEODETIC			DATE Feb 23/00			CHECKED BY ASP													
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	T _N VALUES			20	40	60						80	100	20	40
336.00	GROUND SURFACE																		
0.00	Topsoil																		
0.15	Silty Sand																		
335.24	Brown Moist																		
0.76	Sand, trace to some silt																		
333.79	Compact Brown Moist		1	SS	10														
			2	SS	12														
333.79	Sandy Silt, trace clay																		
2.21	Compact Brown Moist		3	SS	13														
333.03	Sand, trace to some silt																		
2.97	Loose to compact Brown Moist		4	SS	9														
			5	SS	13														
330.82			6	SS	13														
5.18	END OF BOREHOLE																		
	Note: Open borehole dry upon completion of drilling.																		
	Northing and Easting co-ordinate and elevation accurate to nearest metre.																		

ON MOT 991-1193.GPJ ON MOT.GDT 2/14/00

+3, X3: Numbers refer to Sensitivity

PROJECT 991-1193			RECORD OF BOREHOLE No 16-2			2 OF 2			METRIC				
W.P. 335-98-00			LOCATION N 5079383, E 313869			ORIGINATED BY SB							
DIST 54 HWY 11			BOREHOLE TYPE 108mm I.D. HOLLOW STEM AUGERS			COMPILED BY DK9							
DATUM GEODETIC			DATE Feb. 21/00			CHECKED BY ASP							
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT							
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
	— CONTINUED FROM PREVIOUS PAGE —												
	Gravelly Sand, trace to some silt, occ. cobbles and/or boulders Compact to very dense Brown Wet		13	SS	33		319						
			14	SS	12		318						
			15	SS	59		317						
			16	SS	115/15		316						
315.04	END OF BOREHOLE						315						
19.96	END OF CONE HOLE												
314.64	Refusal to further cone penetration; probable bedrock.												
20.36	Refusal to further cone penetration; probable bedrock.												
	Northings and Eastings co-ordinate and elevation accurate to nearest metre.												

ON MOT 991-1193 GPJ ON MOT GDT 24/4/00

PROJECT 991-1193

RECORD OF BOREHOLE No 16-3

1 OF 2

METRIC

W.P. 335-98-00

LOCATION N 5079360.64, E 313637.62

ORIGINATED BY SB

DIST 54 HWY 11

BOREHOLE TYPE 108mm I.D. HOLLOW STEM AUGERS

COMPILED BY DKB

DATUM GEODETIC

DATE Feb 19/00

CHECKED BY ASP

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 (%)					
330.14	GROUND SURFACE													
329.69	Topsoil													
0.20	Sand, trace to some silt, organic matter noted in samples below 3.0m depth Very loose Brown to black Moist to wet		1	SS	2									
			2	SS	1									
			3	SS	1									
	organic content of Sample 4 = 2.6%		4	SS	2									0 89 11 0
			5	SS	3									
			6	SS	2									
324.51														
5.63	Sandy Silt, trace clay Very loose to compact Brown Wet		7	SS	3									
			8	SS	6									0 22 71 7
			9	SS	6									
			10	SS	6									
			11	SS	9									
			12	SS	2									

Continued Next Page

+ 3, X 3: Numbers refer to Sensitivity
O 3% STRAIN AT FAILURE

ON MOT 991-1193.GPJ ON MOT.GDT 24/4/00

PROJECT 991-1193		RECORD OF BOREHOLE No 16-3		2 OF 2 METRIC	
W.P. 335-98-00		LOCATION N 5079350.64; E 313837.62		ORIGINATED BY SB	
DIST 54 HWY 11		BOREHOLE TYPE 108mm I.D. HOLLOW STEM AUGERS		COMPILED BY DKB	
DATUM GEODETIC		DATE Feb 19/00		CHECKED BY ASP	

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIMIT MOISTURE CONTENT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100		w_p	w			w_L		
								SHEAR STRENGTH kPa							WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED							10 20 30	
— CONTINUED FROM PREVIOUS PAGE —																
313.84	Sandy Silt, trace clay Very loose to compact Brown Wet		13	SS	10		315									
16.30	Sand, trace silt Compact Brown Wet		14	SS	10		314									
312.31	Gravelly Sand, trace silt Compact to very dense Brown Wet						313									
17.83			15	SS	18		312									
309.72	END OF BOREHOLE		16	SS	52		311									
20.42							310									
304.50	END OF CONE HOLE Refusal to further cone penetration; probable bedrock Note: 1. Water level measured in piezometer at 16.2m depth (El. 313.9m) upon completion of installation. 2. Water level measured in piezometer at 1.6m depth (El. 328.5m) on March 8, 2000. 3. Water level measured in piezometer at 1.5m depth (El. 328.6m) on March 26, 2000.						309									
25.64							308									
							307									
							306									
							305									

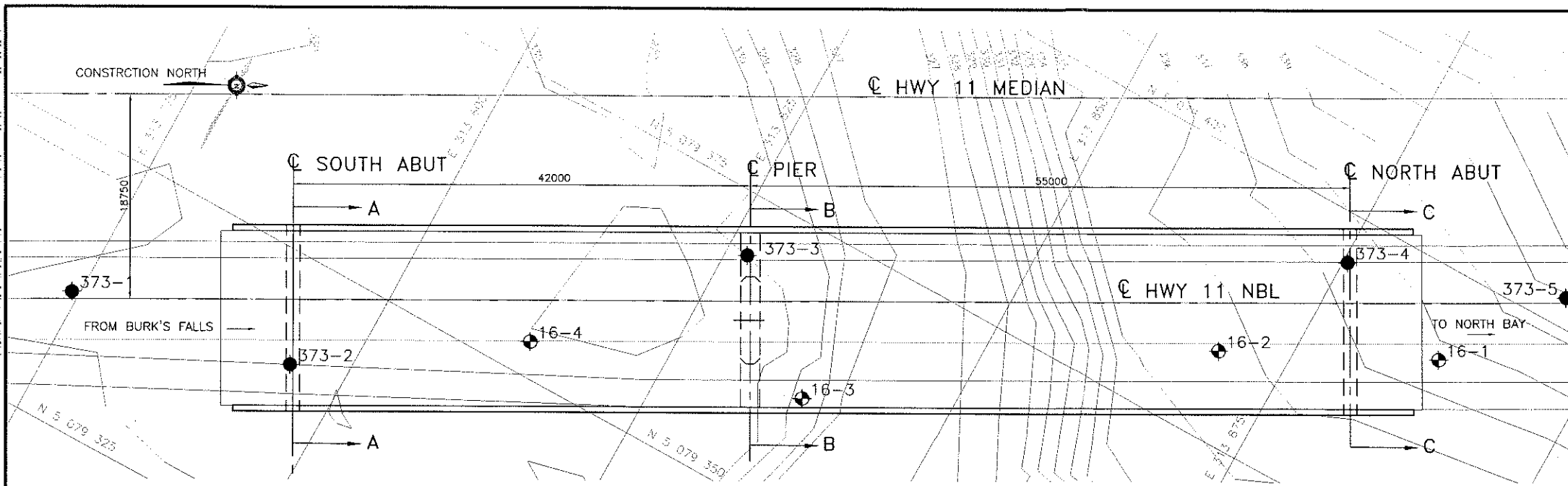
ON MOT 991-1193.GPJ ON MOT.GDT 24/4/00

PROJECT 991-1193			RECORD OF BOREHOLE No 16-4			1 OF 1			METRIC							
W.P. 335-98-00			LOCATION N 5079353.11; E 313613.29			ORIGINATED BY SB										
DIST 54 HWY 11			BOREHOLE TYPE 108mm I.D. HOLLOW STEM AUGERS			COMPILED BY DKB										
DATUM GEODETIC			DATE Feb. 19/00			CHECKED BY ASP										
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x REMOULDED 20 40 60 80 100			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
330.14	GROUND SURFACE															
0.00	Topsoil															
0.30	Sand, trace to some silt, organics/decaying wood matter within samples below 2.2m depth. Very loose Brown to black Moist to wet		1	SS	3		330									
			2	SS	1		329									
			3	SS	1		328									
	organic content of Sample 4 = 4.9%		4	SS	2		327									0 76 24 0
			5	SS	1		326									
			6	SS	2		325									
			7	SS	WH		324									
322.98	Sandy Silt; trace clay Loose Brown Wet		8	SS	5		323									
7.16			9	SS	7		322									
320.39	END OF BOREHOLE						321									
9.75	Note: Water level measured in open borehole at 1.8m depth (El. 328.3m) upon completion of drilling.															

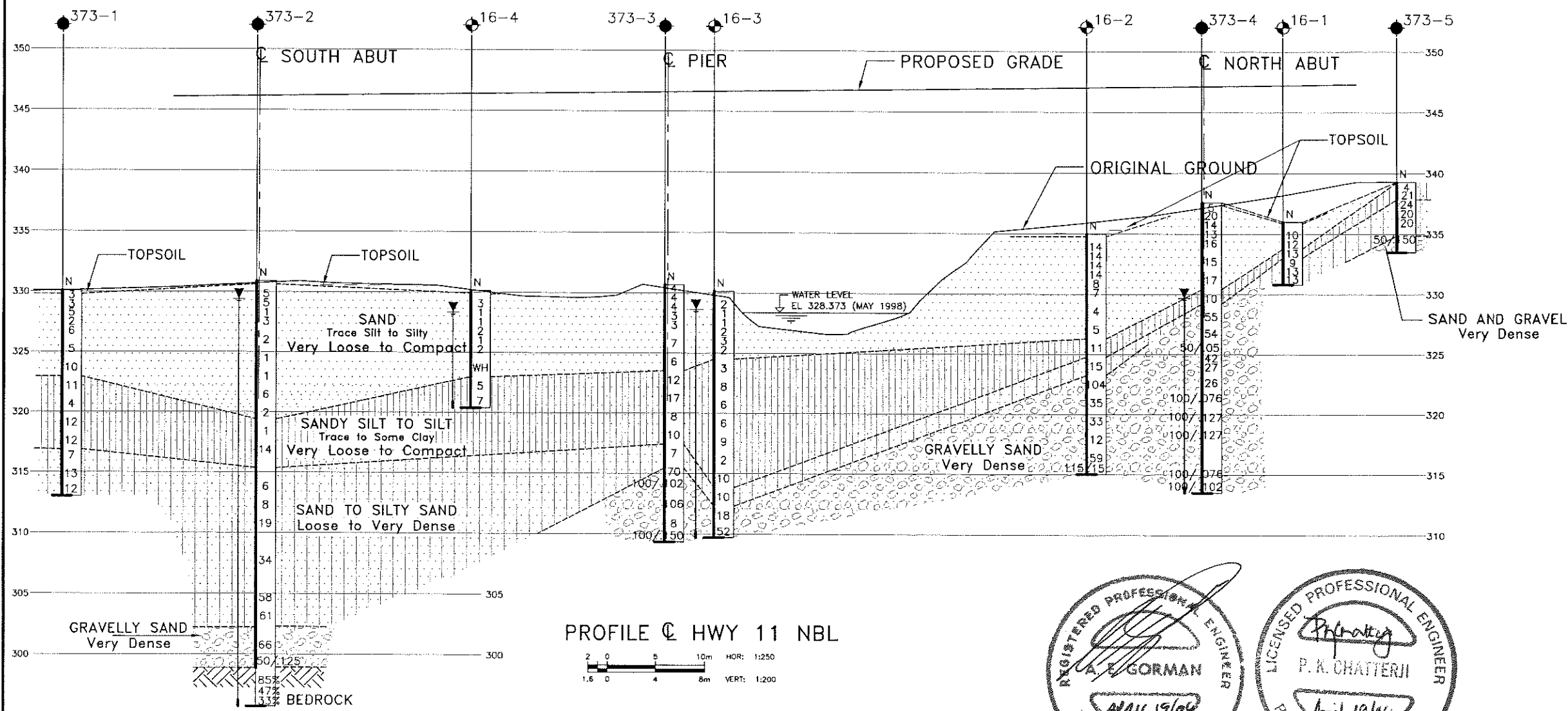
ON MOT 991-1193.GPJ ON MOT.GDT 24/00

Appendix D

Drawings



PLAN
SCALE: 1:250



PROFILE @ HWY 11 NBL

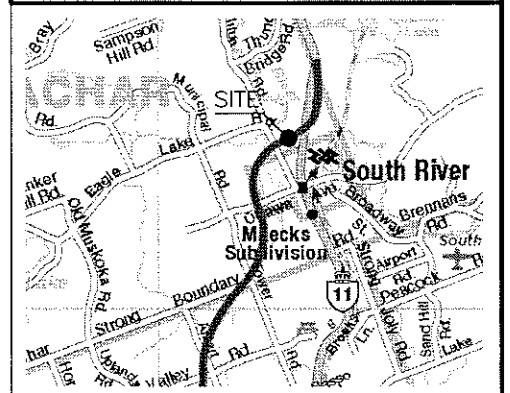
HOR: 1:250
VERT: 1:200

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

HWY 11
CONT No
WP No 5041-03-01
SOUTH RIVER BRIDGE
(NBL)
BOREHOLE LOCATION AND SOIL STRATA

Marshall Macklin Monaghan
PROJECT MANAGERS • ENGINEERS • SURVEYORS • PLANNERS

THURBER ENGINEERING LTD.
THURBER



KEYPLAN

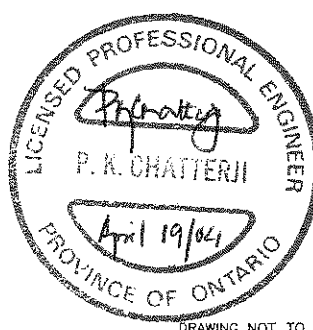
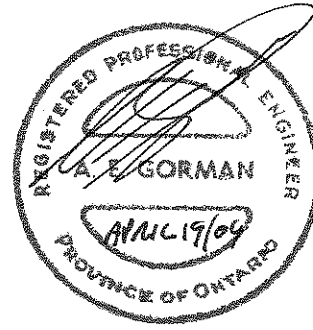
LEGEND

- BoreHole by THURBER
- ⊕ Dynamic Cone Penetration Test (cone)
- ⊙ BoreHole by GOLDER
- N Blows /0.3m (Std Pen Test, 475J/blow)
- CONE Blows /0.3m (60° Cone, 475J/blow)
- PH Pressure, Hydraulic
- WL Head Artesian Water
- ⊕ Piezometer
- 90% Rock Quality Designation (RQD)

NO	ELEVATION	NORTHING	EASTING
373-1	330.1	5 079 336.8	313 774.3
373-2	330.9	5 079 340.6	313 795.0
373-3	330.7	5 079 369.7	313 826.9
373-4	337.6	5 079 395.8	313 875.4
373-5	339.3	5 079 402.6	313 894.5
16-1	336.0	5 079 392.0	313 887.0
16-2	335.0	5 079 383.0	313 869.0
16-3	330.1	5 079 360.6	313 837.6
16-4	330.1	5 079 353.1	313 813.3

NOTE

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	AE	CHK	PKC
DRAWN	SS	CHK	AE
		SITE	44-373
		STRUCT	
		SCHEME	
		DWG	2

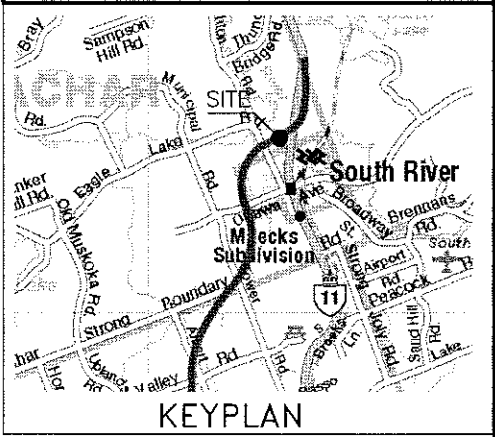
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

HWY 11
CONT No
WP No 5041-03-01

SOUTH RIVER BRIDGE
(NBL)
SOIL STRATA

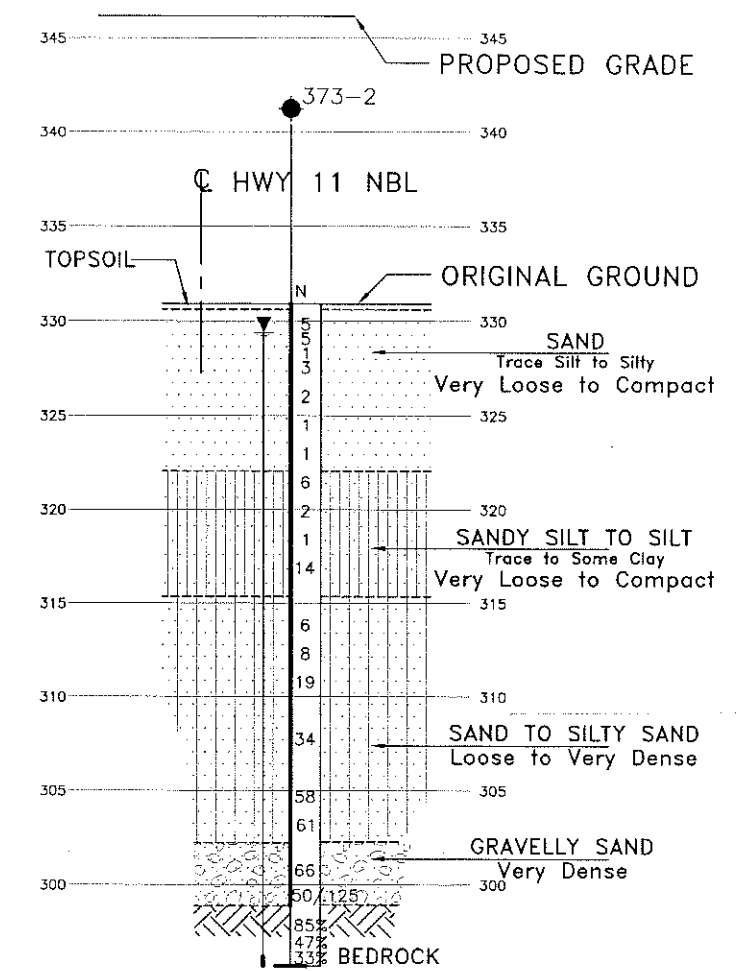
**Marshall
Macklin
Monaghan**
PROJECT MANAGERS • ENGINEERS • SURVEYORS • PLANNERS

THURBER ENGINEERING LTD.

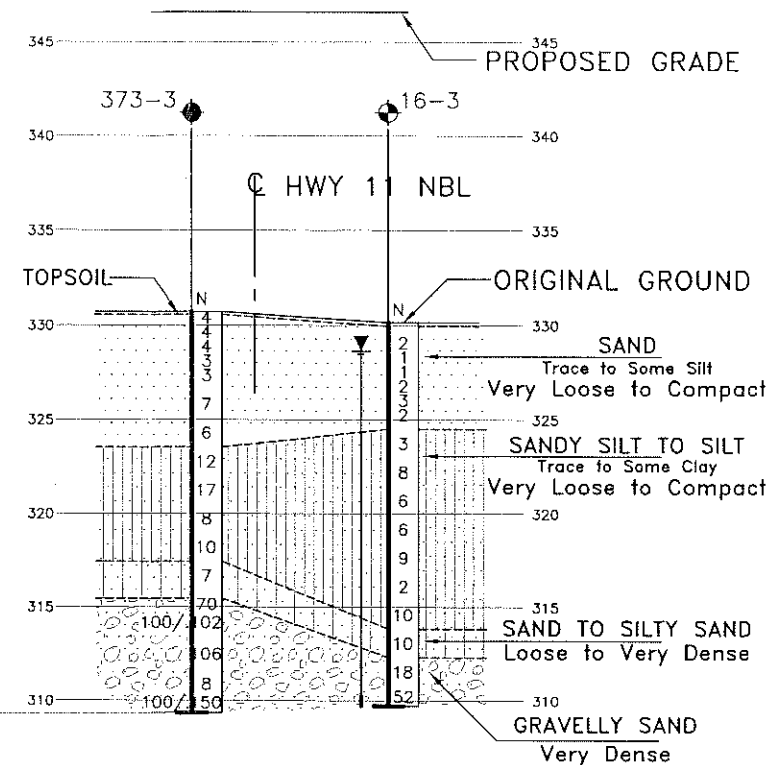


LEGEND			
	BoreHole by THURBER		
	Dynamic Cone Penetration Test (cone)		
	BoreHole by GOLDER		
N	Blows /0.3m (Std Pen Test, 475J/blow)		
CONE	Blows /0.3m (60' Cone, 475J/blow)		
PH	Pressure, Hydraulic		
WL	Head Artesian Water		
	Piezometer		
90%	Rock Quality Designation (RQD)		
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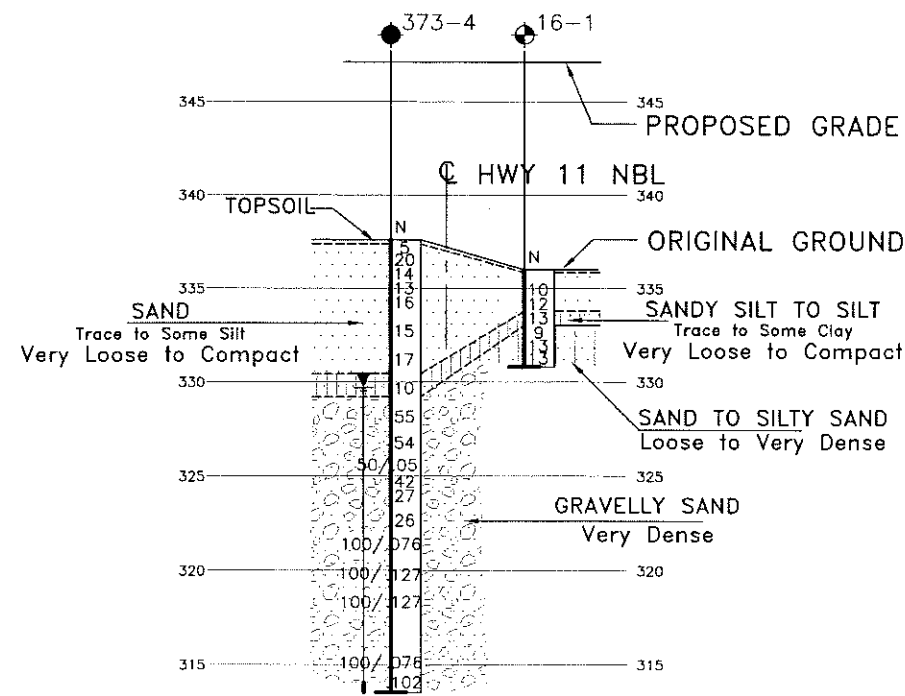
— NOTE —
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SECTION A-A
HOR: 1:250
VERT: 1:200

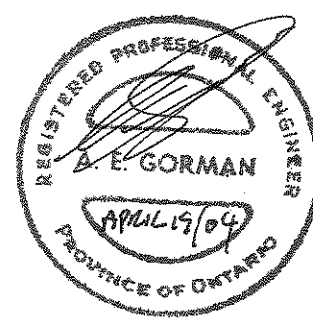


SECTION B-B
HOR: 1:250
VERT: 1:200



SECTION C-C
HOR: 1:250
VERT: 1:200

BENCH MARK



DRAWING NOT TO BE SCALED
100 mm ON ORIGINAL DRAWING

REVISIONS											
	DATE		BY		DESCRIPTION						
DESIGN	SS	AEG	CHK	PKC	CODE	CHBDC	2000	LOAD	CL-625-ONT	DATE	JAN, 2004
DRAWN	SS		CHK	AEG	SITE	44-373	STRUCT		SCHEME	DWG	3