

FOUNDATION INVESTIGATION REPORT

CONTRACT NO. 95-214



Ministry of
Transportation

Ontario

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Note: For purposes of the contract, this report supersedes all other Foundation Reports prepared by, or for the Ministry in connection with the above mentioned project.

N VALUE - THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 50mm O.D. SPLIT BARREL SAMPLER TO PENETRATE 300mm UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 762mm. PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUES ARE DENOTED THUS: N.

DYNAMIC CONE PENETRATION TEST - CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (50mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON A SET OF 11 KIDS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY - COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDEFORMED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS - COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND /OR STRENGTH.

RECOVERY - SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY - SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (R.Q.D.), FOR MODIFIED RECOVERY, IS:

R.Q.D. (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING

SPACING	< 50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S.S. SPLIT SPOON	T.P. THINWALL PISTON
W.S. WASH SAMPLE	O.S. OSTERRBERG SAMPLE
S.T. SLOTTED TUBE SAMPLE	R.C. ROCK CORE
B.S. BLOCK SAMPLE	P.H. T.W. ADVANCED HYDRAULICALLY
C.S. CHUNK SAMPLE	P.M. T.W. ADVANCED MANUALLY
T.W. THINWALL OPEN	F.S. FOIL SAMPLE

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	-	COMPRESSION INDEX
C_s	-	SWELLING INDEX
C_α	-	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	-	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
s_f	-	SENSITIVITY = $\frac{c_u}{\tau_r}$

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
u_p	kPa	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	-	COEFFICIENT OF FRICTION

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kN/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	-	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kN/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	-	UNIFORMITY COEFFICIENT
γ	kN/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_u	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_u	kN/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX	v	m/s	DISCHARGE VELOCITY
γ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	-	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	-	HYDRAULIC GRADIENT
γ_{sat}	kN/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	-	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kN/m ³	SEEPAGE FORCE
γ'	kN/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

FOUNDATION INVESTIGATION REPORT
for
McGillvray Creek Bridge
Proposed Southbound Lanes, Highway 11
W.P.590-92-01
District 13, North Bay

INTRODUCTION

This report summarizes the information obtained from the foundation investigation carried out at the above noted site. The investigation was carried out at the request of the Northern Region Structural Section to design a bridge required for the proposed four laning of Highway 11. The field work was carried out on 93 02 02 to 93 02 04 and consisted of six (6) sampled boreholes and five (5) dynamic cone penetration tests at the structure location.

SITE DESCRIPTION

The site is located on the proposed southbound lanes of Highway 11, approximately 7.4 km north of the intersection of Highway 522 and 65 m west of the existing Highway 11 embankment in the Township of South Himsworth, District of Parry Sound.

The existing ground surface elevations range from 257.6 to 257.8 m north of McGillvray Creek and the ground profile slopes up to 260.2 to 262.5 m south of the creek. The slope to the south of the creek is heavily vegetated with tall trees. The low-lying area to the north of the creek is covered with extensive tag alder brush. To the south of the creek, the original houses in the area have been removed and the property is presently a vacant platform. Land use in the adjacent areas includes the highway corridor and livestock pasture. According to the Northern Ontario Engineering Geology Terrain Study published by the Ministry of Natural Resources, the site is located in a Sandy Glaciolacustrine Plain.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in-situ and laboratory testing. The procedures employed are discussed below.

Field

The field work for the investigation was carried out on 93 02 02 to 93 02 04 and consisted of six (6) sampled boreholes and five (5) dynamic cone penetration tests advanced to depths of 1.8 to 12.5 m. Rock cores were obtained in BH 2 and BH 5.

The boreholes were advanced using conventional hollow stem augering techniques with two track mounted continuous flight auger machines. The sampling program consisted of disturbed samples taken directly from the augers in the surface soil and by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586) for the subsurface strata. Standard Penetration ('N') values were recorded for assessment of the denseness of the materials encountered. All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing. Wire line rock coring techniques were applied in retrieving rock core samples for rock quality determination and classification purposes. Standard NQ core barrels and casings were utilized.

Groundwater level was monitored in open boreholes throughout the investigation. All boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Northern Region Surveys and Plans Section.

Laboratory

The laboratory testing on selected soil samples consisted of the following:

- Atterberg Limit Test

- Grain Size Distribution
- Natural Moisture Content Determination
- Unit Weight Determination
- Unconfined Compressive Test
- Consolidation Test

Laboratory results are given in the following section of this report and are illustrated on Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

General

The Record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes are shown in Dwg. No. 5909201-A.*

Following are the specific descriptions of the materials encountered in the investigation:

Topsoil

Organic material was encountered at the surface in all boreholes. For BH 1 to 3 which are located to the south of the creek, the material is described as silty sand, some organics. Standard Penetration Resistance 'N' values range from 4 to 8 blows/0.3 m indicating very loose to loose state of denseness. The material encountered in BH 4 to 6 is a clayey topsoil with high organic content.

Silty Sand

This non-cohesive deposit is a Thin layer (0.5 to 1.5 m) contacted in BH 1 to 3. The Standard Penetration Resistance 'N' values range widely from 2 blows to 31 blows/0.3 m, indicating very loose to dense state of denseness.

Two grain size distribution tests carried out on selected samples indicate 0-1%

* Dwg. No 2, (Sheet 227) of the Contract Drawings.

gravel, 63-77% sand and 23-36% silt and clay.

Clayey Silt

This cohesive material was encountered in BH 4 to 6 underlying the organic layer. The thickness of this stratum ranges from 3.0 to 3.8 m.

Five field vane shear tests were conducted in this material resulting in undrained shear strengths of 22 to 70 kPa with sensitivities of 1 to 4. The results of the two unconfined compressive tests carried out indicate undrained shear strengths of 50.9 and 53.4 kPa. The consistency of this material is generally firm to stiff.

Typical properties of this material as determined by laboratory tests carried out on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Test</u>
Natural Moisture Content(w%)	22.5-31.0	5
Liquid Limit (w_L)	23.0-25.0	2
Plastic Limit (w_p)	20.0-23.0	2
Unit Weight (kN/m^3)	18.9-19.4	2

Three consolidation tests carried out indicate compression indice of 0.127 to 0.174 and initial void ratios of 0.65 to 0.82. The preconsolidation pressures obtained range from 11.7 kPa to 90 kPa.

Heterogeneous Mixture of Sand, Silt and Gravel (Glacial Till)

To the south of the creek, this material is encountered at $2 \pm$ m depth in BH 2 and 3.

In BH 2, it becomes bouldery below 9.5 m depth and extends to bedrock at 12.1 m. Standard Penetration Resistance 'N' values range from 12 to 75 blows/0.3 m indicating compact to very dense state of denseness, but typically dense.

To the north of the creek, this material is encountered at $4 \pm$ m in BH 5 and 6 below the clayey silt stratum. In BH 5, it becomes bouldery below 5.3 m depth and extends down to bedrock at 6.0 m. In BH 6, it extends to a hard stratum with auger refusal at 6.4 m. Standard Penetration Resistance 'N' values range from 13 blows/0.3 m to 60 blows/0.28 m indicating compact to very dense state of denseness.

Bedrock

Bedrock was encountered at El. 248.1 m (BH 2) to the south of the creek and El. 251.6 m (BH 5) to the north.

Bedrock was cored in BH 2 and 5. The rock cores obtained were used for rock quality determination and classification. Detailed description of the rock are attached in the Appendix. Bedrock is a slightly weathered to unweathered granite. Core recoveries and Rock Quality Designations are 35-79% and 0-61% respectively.

Groundwater

Groundwater level was monitored during the course of the investigation. The water level measured in BH 2 and BH 3 to the south of the creek is at El. $257 \pm$ m. To the north of the creek, groundwater level is generally at the ground surface. In BH 5, artesian pressure was encountered during bedrock coring and the water level stabilized at 0.7 m above the ground surface.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the direct supervision of D. Kwok, Project Foundation Engineer and B. Liegler, Engineering in Training, utilizing equipment owned and operated by Dominion Soil Investigation Inc.

This report was written by D. Kwok and was reviewed by M.S. Devata, P. Eng. Chief Foundation Engineer.



A handwritten signature in cursive script, appearing to read 'P. Payer'.

P. Payer, P. Eng.
Senior Foundation Engineer

APPENDIX

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 590-92-01 LOCATION Co-ords. N5 101 010.5, E 33 F 752.7 ORIGINATED BY BL
 DIST 1.3 HWY 11 BOREHOLE TYPE 115 Auger, Cone Penetration Test COMPILED BY BL
 DATUM Geodetic DATE 93 02 02 CHECKED BY BL

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE q_{10}^*		PLASTIC LIMIT w_p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20					
261.3	Ground Surface												
0.0 260.8 0.4	Silty sand with organics dark brown (topsoil)		1	SS	4	*							
	grey												
	Silty sand dense		2	SS	31								
	brown												
259.5			3	SS	25	/8cm Rod bouncing							
1.8	End of Borehole												
	* Water Level not Established upon completion of borehole												

RECORD OF BOREHOLE No 2

1 OF 1 METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 020.2, E 316 740.9 ORIGINATED BY DK
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Cone Penetration Test, Rock Core COMPILED BY BL
 DATUM Geodetic DATE 93 02 02 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
260.2	Ground Surface													
0.0	Silty sand some organics dark brown (Topsoil)		1	SS	7		260							
258.8	silt band		2	SS	8		259							
1.4	Sand, some silt, brown/black with brown silt seams compact		3	SS	22	/31cm Rod bouncing on rock	258							1 63 34 2
258.3														
1.9			4	SS	35		257							
			5	SS	25		256							
			6	SS	44		255							
			7	SS	24		254							
			8	SS	23		253							
			9	RC NQ	REC 38%		252							
			10	RC NQ	REC 74%		251							
			11	RC NQ	REC 35%		250							
248.1			12	RC NQ	REC 79%		249							
12.1	Granitic bedrock						248							
247.7														
12.5	End of Borehole													

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 590.92.01 LOCATION Co-ords: N5 101 021.8, E 316 754.2 ORIGINATED BY BL
DIST 13 HWY 11 BOREHOLE TYPE 15 Auger COMPILED BY BL
DATUM Geodetic DATE 93.02.02 CHECKED BY BL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa									
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	× LAB VANE						
262.5	Ground Surface						20	40	60	80	100						
0.0	Silty Sand Some Organics Dark brown (Topsoil)		1	AS													
261.9																	
0.6			2	SS	2												
	Silty sand Yellowish to medium brown Very loose to loose		3	SS	1												
260.4																	
2.1			4	SS	38												
			5	SS	31												
			6	SS	24												
	Heterogeneous mixture of silt, sand, and gravel Compact to very dense (glacial till)																
			7	SS	75												
			8	SS	12												
255.8																	
8.7	End of Borehole																

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 053.7; E 316 728.7 ORIGINATED BY BL
DIST 13 HWY 11 BOREHOLE TYPE H5 Auger, Cone Penetration Test COMPILED BY BL
DATUM Geodetic DATE 93 02 04 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _P	W	W _L	WATER CONTENT (%) 10 20 30		
257.7	Ground Surface													
0.0 257.1	Topsoil dark brown													
0.6	brown/grey Clayey Silt Firm Occasional Organic pockets grey		1	SS	7									
			2	TW	PH									
254.1														
3.6	End of Borehole *													
253.1														
4.6	End of Cone Test													
	• Auger refusal at Elev. 254.1m although penetration cone was advanced to Elev. 253.1m. May possibly be boulders below Elev. 254.1m.													
		</												

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 057.9; E 316 739.2 ORIGINATED BY DK
DIST 13 HWY 11 BOREHOLE TYPE 45 Auger, Cone Penetration Test, Rock Core COMPILED BY BL
DATUM Geodetic DATE 93 02 04 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	10 20 30				
257.6	Ground Surface													
0.0	Organic Topsoil													
257.0														
0.6														
	Clayey Silt Occasional Organic packets. Firm to stiff grey		1	SS	6								19.4	
			2	1W	PH									
253.2			3	SS	2									
4.4	Heterogeneous mixture of sand, some gravel, trace silt, dense (Glacial till)		4	SS	30									
	granitic boulders		5	RC NQ	REC 56%									
251.6			6	RC NQ	REC 79%									
6.0	Granitic bedrock													ROD 3.3%
250.7														
6.9	End of Borehole													
	* During drilling Artesian conditions encountered to El 258.3m on 93 02 04													

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 069.1, E 316 731.8 ORIGINATED BY BL
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Cone Penetration Test COMPILED BY BL
 DATUM Geodetic DATE 93 02 03 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)			
257.8	Ground Surface													
0.0	Organic topsoil block													
257.0														
0.8			1	SS	3		257							
	Clayey Silt Occasional Woodchip and organic pockets trace sand brown Firm						256							
			2	TW	PH		255							
254.1							254							
3.7							253							
	Heterogeneous mixture of silt, sand, and gravel (glacial till) Compact to very dense		3	SS	13		252							
251.4			4	SS	61	/28cm								
6.4	End of Borehole *													
250.8														
7.0	End of Cone Test													
	* Auger refusal at Elev. 251.4m although penetration cone was advanced to Elev. 250.8m. Possible boulders below Elev. 251.4m.													

ROCK CORE DESCRIPTION

WP 590-92-01

Page 1 of 1

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
2	9	9.53-10.29	38	0	9.53-12.06	OVERBURDEN (till).
	10	10.29-10.97	74	61	12.06-12.47	GRANITE (hornblende-bearing, chloritized, and garnetiferous), moderate orange pink to dark reddish brown to dark greenish grey; fine to coarse grained; strong; unweathered to slightly weathered; fractures moderate spaced, near vertical to dipping, undulating to planar, rough to smooth.
	11	10.97-11.76	35	0		
	12	11.76-12.47	79	57		
5	5	5.21-6.02	56	27	5.21-6.02	OVERBURDEN (till).
	6	6.02-6.86	79	33	6.02-6.86	GRANITE (hornblende-bearing, chloritized, garnetiferous, and gneissic in part), greyish orange pink to dark greenish grey; fine to coarse grained; strong; unweathered to slightly weathered; fractures close to very close spaced, near vertical to flat, undulating to planar, smooth to rough.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

FOUNDATION INVESTIGATION REPORT

For

Highway 534/Highway 11, Powassan

Overpass

W.P. 211-90-01, Site No. 44-363

District 13, North Bay

INTRODUCTION

This report summarizes the results of a foundation investigation conducted at the aforementioned site. It is proposed to construct a two span structure that will carry the existing secondary Highway 534/Clarke Street over Highway 11. This report describes the subsurface conditions at the site.

SITE DESCRIPTION AND GEOLOGY

The site is located at the intersection of Clarke Street (Highway 534) and Highway 11 in the Township of south Himsworth (Town of Powassan) District of Parry Sound. Highway 11 currently consists of 4 lanes and Clarke Street two lanes, both of which are paved roadways surrounded by flat to gently undulating grasslands. A residential home is located to the west with the west approach and abutment located on its driveway. To the northeast an Ontario Provincial Police station and at approximately 1/2 km east is the Town of Powassan with many residential homes. The groundsurface elevation ranged from east to west 245.4 m to 250.5 m with it rising gently to the west.

Overhead wires ran directly above the proposed overpass beside Clarke Street and Highway 534 running east/west.

The terrain surrounding the site is generally flat and used primarily as agricultural farmland.

Physiographically, the site is located in the geological domain known as the Algonquin Highlands. This region in much of the area is underlain by granite and other hard precambrian rocks. There are frequent outcrops of bare rock but they do not amount to more than 5% of the total area. The soils are generally shallow but thicknesses over the bedrock varies greatly over short distances.

Highway 11 from Gravenhurst to North Bay follows a narrow strip in which sand, silt and clay

deposits occupy the hollows. The deep soils developed on the fine sand, silt and clay have been cleared and support farming settlements.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in situ and laboratory testing. The procedures employed are discussed below.

FIELD INVESTIGATION

The fieldwork for the site investigation was carried out between 91 08 13 and 91 08 31 and consisted of seven boreholes placed at approach, abutment and pier locations. East and west of Highway 11 at Clarke Street/Highway 534.

Five boreholes were sampled and advanced to a maximum depth of 30.9 m below the ground surface. Rock core samples were retrieved upon encountering bedrock or boulders. Cone penetration tests were employed from the invert of the two approach boreholes and from the ground surface at the abutment and pier locations.

Truck mounted CME 55 equipment employing hollow stem augering techniques was used to advance all boreholes with wash boring and rock coring techniques being utilized at abutment and pier locations. In general, disturbed subsoil samples were retrieved at 0.75 m intervals for the surficial 4.5 m and 1.5 m thereafter. All samples were identified in the field and then returned to the laboratory for applicable testing. Rock core sampling was performed down 3.5 m into bedrock at one borehole. In situ vane tests were also conducted in cohesive materials to determine the undisturbed and remoulded undrained shear strengths of the soil. The test was conducted employing standard MTO 'N' vane in accordance with ASTM D2583.

Groundwater levels were obtained by monitoring the levels in the open boreholes throughout the duration of the field investigation. Two piezometers were installed, one on each side of Highway 11. All boreholes were backfilled at the completion of the fieldwork.

Survey information related to the location and elevation of boreholes were provided by MTO Surveys and Plans Section, Northern Region.

LABORATORY ANALYSIS

The following laboratory tests were carried out on select soil samples.

- 1) Atterberg Limits Test
- 2) Grain Size Analysis
- 3) Natural Moisture Contents
- 4) Unit Weights

Laboratory test results are given in the following section of this report and are illustrated on figures and borehole logs included in the Appendix

SUBSURFACE CONDITIONS

General

The subsoil stratigraphy encountered at this site consisted of a thin 60 cm deep surficial sand, trace clay with organics underlain by clayey silt, trace sand deposit which was encountered more predominantly towards the east ranging in thickness of 3.7 m to 11.6 m. Occasional sandy silt seams were encountered. A 1 m to 17 m (east to west) deposit of sandy silt and a sand and gravel, trace silt deposit was found to underly the above layer. The material contains more gravel at greater depths with numerous boulders encountered. At one location bedrock was established at a depth of 27.9 m.

The location of borings and the stratigraphical profile are shown on Drawing No. 2119001-A,* (Drawing No. 2, [Sheet 240] of the Contract Drawings) in the attached Appendix. The field and laboratory test results are plotted on the record of borehole sheets and in the appendix of this report. A brief description of the different soil types is given below.

Clayey Silt, Trace Sand

The surficial deposit spread across the site increasing with depth towards the east with a thickness of 3.7 m to 11.6 m consisting of a cohesive clayey silt, trace sand with a thin 60 cm layer of silty sand, with organics at the surface. Occasional sandy silt seams were encountered interbedded in the clayey silt, trace sand.

Results of Grain Size Distribution tests carried out on select samples are shown in Figure 1 in

* Dwg. No 2, (Sheet 240) of the Contract Drawings.

the Appendix, in an envelope form. The results indicate the material contains a large percentage of clay and silt with a trace of sand. The deposit is comprised primarily of 0-3% gravel, 1-3% sand, 53-77% silt and 21-44% clay.

The results from tests performed are summarized as follows:

	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (W)	26-42%	8
Liquid Limit (W_L)	28-40%	8
Plastic Limit (W_P)	16-21%	8
Plastic Index (I_P)	11-19%	8
Unit Weight (kN/m^3)	17.1-20.7	8

From the plasticity chart (Figure 2), the layer can be classified as a clayey silt.

In this stratum the standard penetration resistance 'N' values ranged from 1 to 30 blows/0.3 m. The values of undrained shear strength obtained using the filed vane range from 30 to 66 kPa with one test >120 kPa possibly due to a presence of gravel. Range of sensitivity was 2.7 to 5. The consistency may be classified as Firm to Stiff.

Sandy Silt, Trace of Clay

Underlying the above deposits throughout the site was 1 m to 17 m (east to west) thick sandy silt. The material contained a greater percentage of sand at greater depths.

Results of Grain Size distribution tests carried out on select samples are shown on Figure 3 in the Appendix. The results summarize Grain Size Distribution tests carried out on this material throughout the site. The above figure confirmed a greater percentage of sand. The deposit comprised primarily of 0-1% gravel, 18-98% sand, 3-63% silt and 1-8% clay.

Standard Penetration Tests carried out in this deposit revealed 'N' values just slightly higher than those of the previous deposit ranging from 3 to 46 blows/0.3 m. This indicates a very loose to dense state of denseness.

Sand and Gravel, trace Silt, Cobbles and Boulders (Glacial Till)

Underlying all the above deposits throughout the site extending down past the termination depths of the boreholes is a non-cohesive heterogeneous mixture of silt, sand and gravel with random boulders encountered. This deposit contained a greater percentage of gravel at greater depths. Augering through this material was a slow process with recovery in split spoons being low and rock coring techniques being implemented to bore through boulders. In one borehole (BH 7) bedrock was confirmed.

Results of Grain Size Distribution tests carried on select samples are shown on Figure 4 in the Appendix. This figure indicates a high percentage of gravel was encountered. The deposit comprised primarily of 10-100% gravel, 0-90% sand and 1-9% of silt.

Standard Penetration tests carried out in this deposit revealed 'N' values >120 blows/0.15 m with a great increase over the overlying deposits. Thus this material has a very dense state of denseness. Cone penetration tests conducted at various locations generally hit refusal (blows >120/0.3 m) within or near this deposit.

Bedrock

Bedrock was encountered at the west abutment location (BH7) at a depth of 27.4 m. 3.35 m of rock core was retrieved to confirm that it was bedrock.

A petrographer described the bedrock as granite of the Prenville Province, medium to coarse grained, strong, unweathered to slightly weathered: undulating rough to smooth. This confirms the general type of bedrock encountered in this area.

GROUNDWATER CONDITIONS

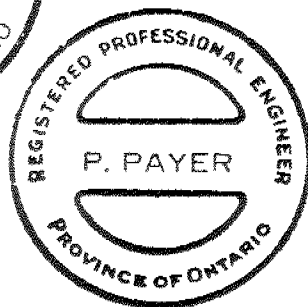
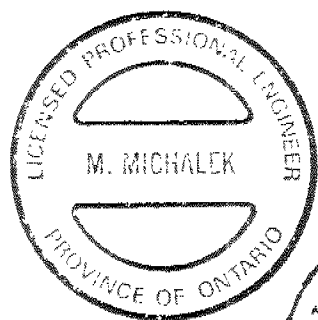
Observations of the groundwater level were carried out by measuring the water level in open boreholes and in two piezometers placed at each end of the site.

Groundwater levels determined at the time of this investigation varied throughout the site with elevations of 245 m (6 m depth) to 240 m (7 m depth) from west to east. Groundwater levels, however, are subject to seasonal fluctuations and hence can vary throughout the season.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of M Michalek, Junior Foundation Engineer and P. Thase, Student Engineer, utilizing equipment owned and operated by Master Soil Investigations Ltd.

The project was carried out under the general supervision of B. Iyer, Senior Foundation Engineer. The report was written by M. Michalek, reviewed by B. Iyer and approved by M. Devata, Chief Foundation Engineer.

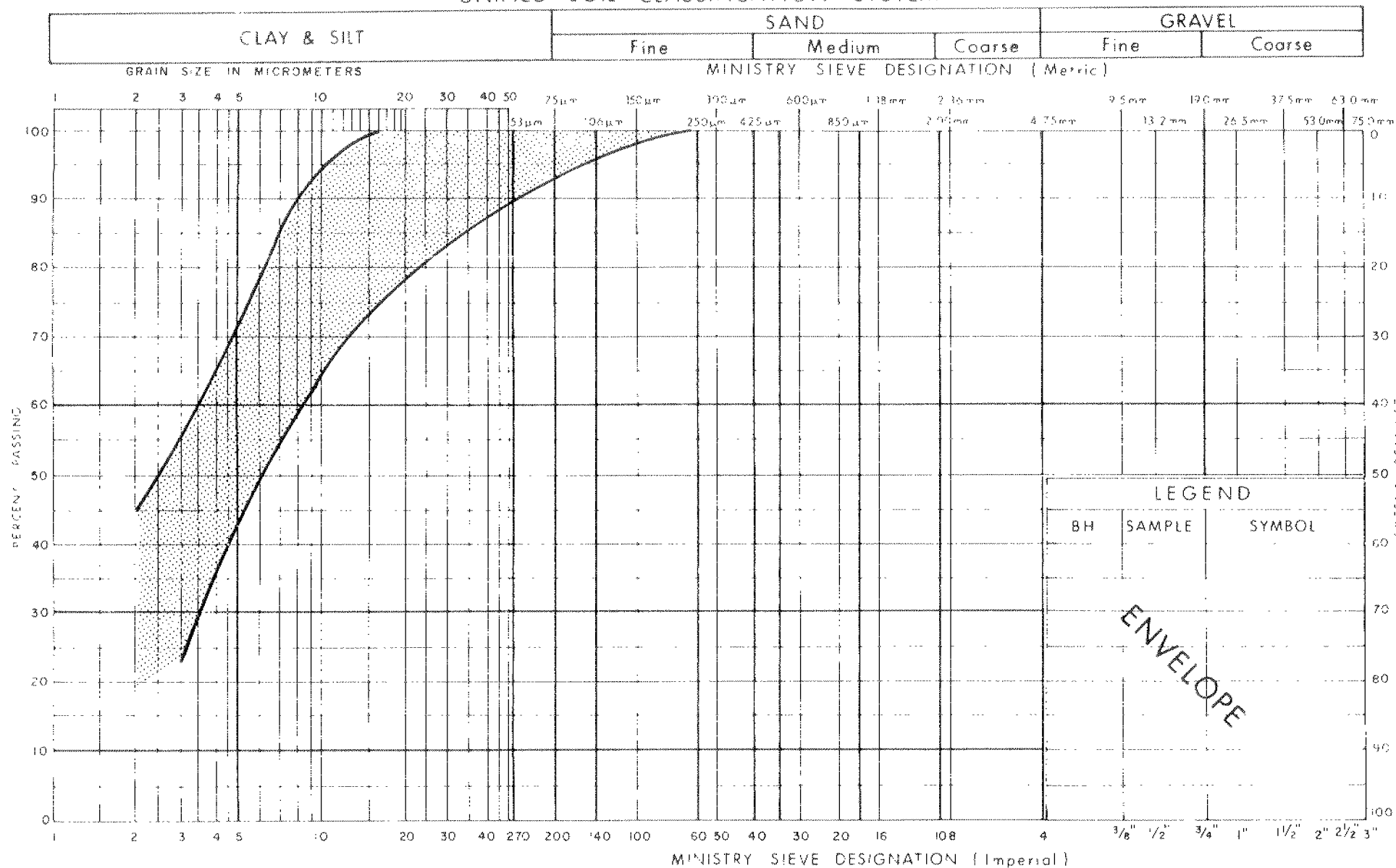


P. Payer, P. Eng.

Senior Foundation Engineer

APPENDIX

UNIFIED SOIL CLASSIFICATION SYSTEM



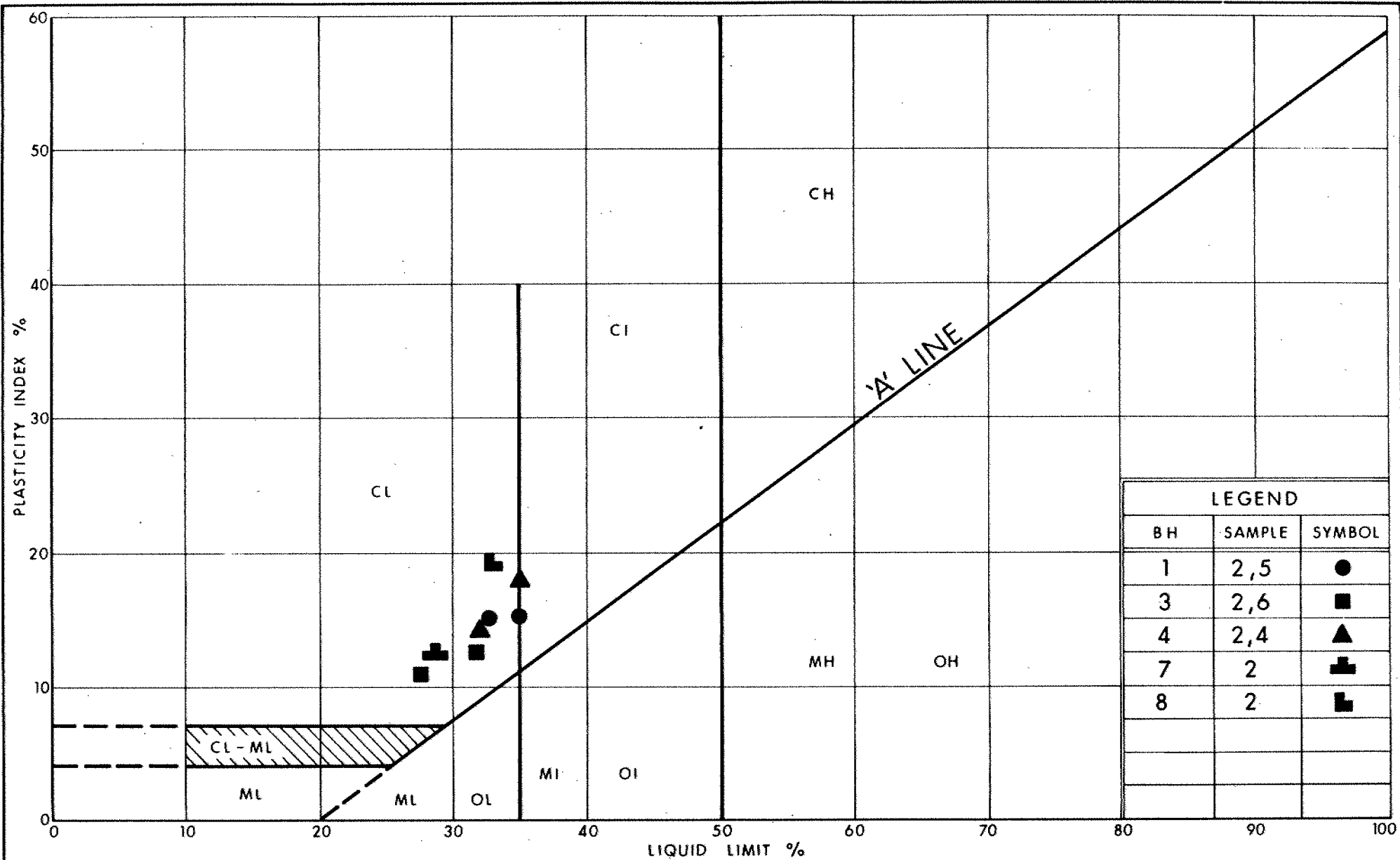
Ministry of
Transportation

GRAIN SIZE DISTRIBUTION

CLAYEY SILT, TRACE SAND

FIG No 1

W P 211-90-01



Ontario

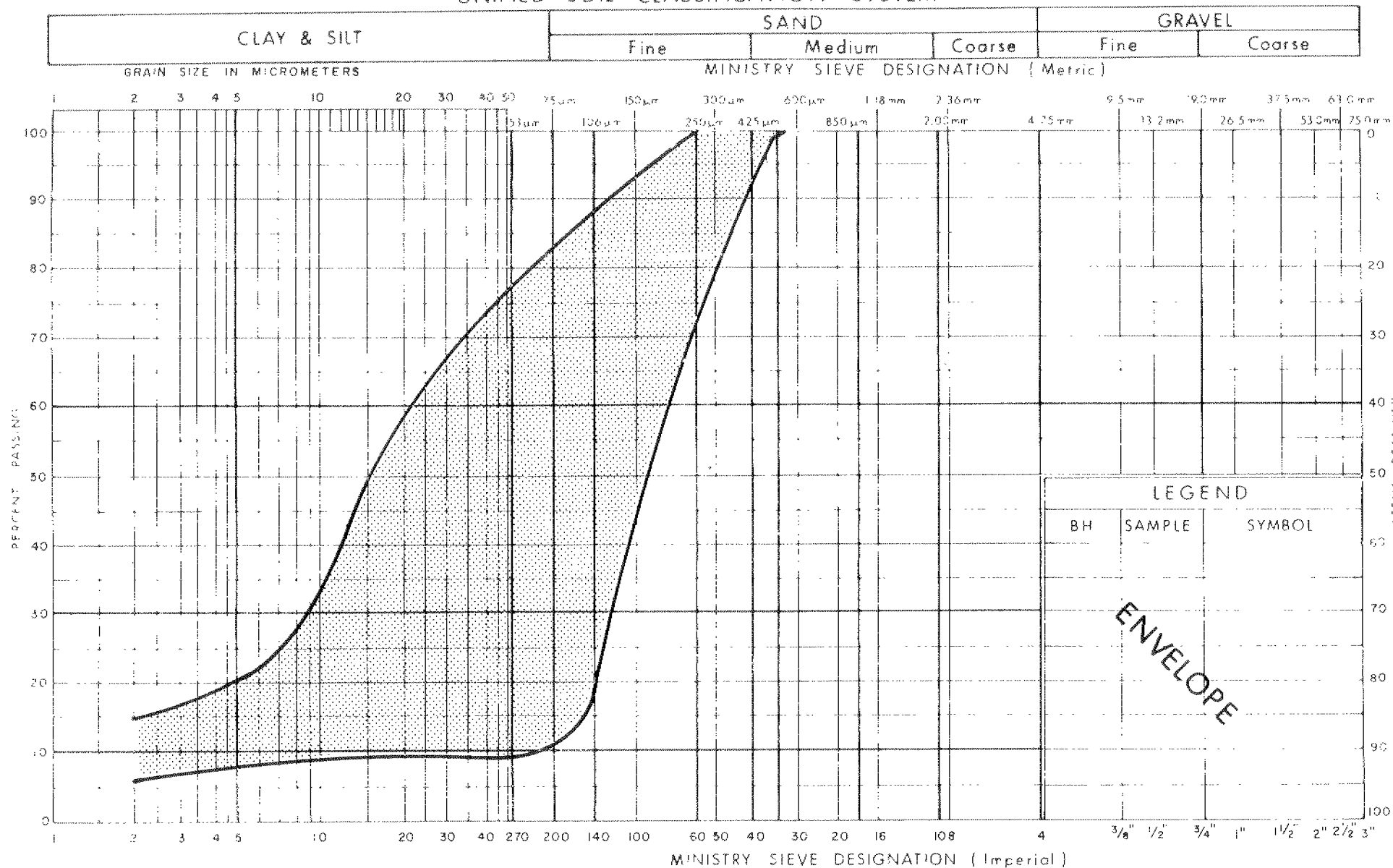
Ministry of
Transportation

PLASTICITY CHART CLAYEY SILT, TRACE SAND

FIG No 2

W P 211-90-01

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
SANDY SILT

FIG No 3

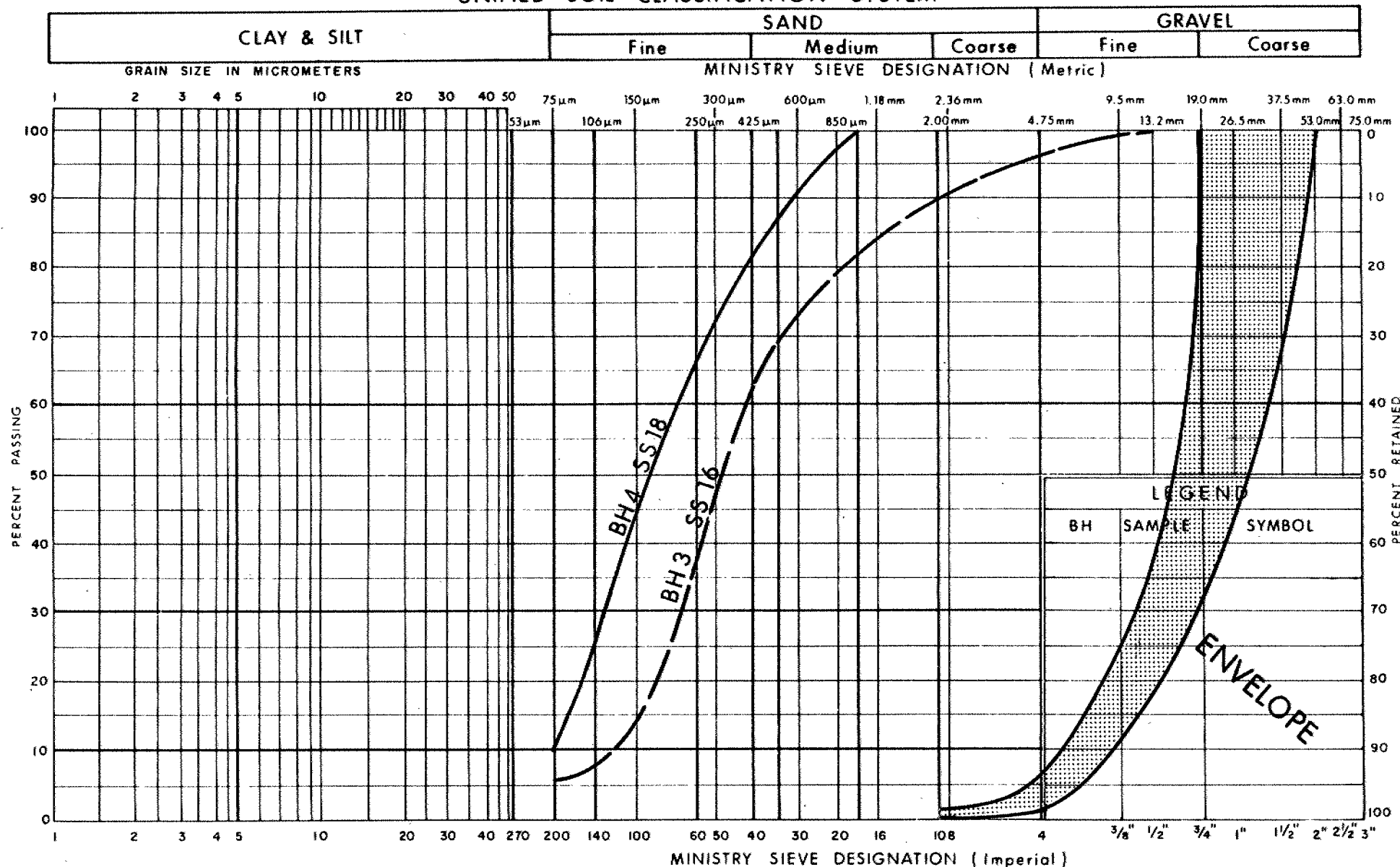
W P 211-90-01



Ontario

Ministry of
Transportation

UNIFIED SOIL CLASSIFICATION SYSTEM



**GRAIN SIZE DISTRIBUTION
SAND & GRAVEL
TRACE SILT**

FIG No 4

W P 211-90-01



Ontario

Ministry of
Transportation

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 711-90-01

LOCATION COORDS. N 5 104 352.2; E 315 011.8

ORIGINATED BY M.M.

DIST 13 HWY 11/534BOREHOLE TYPE H S. AUGER, DYNAMIC CONCL

COMPILED BY A.H.

DATUM GEOIDETIC

DATE 91/08/13

CHECKED BY B.I.

[illegible]

+3, x5; Numbers refer to Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 211-90-01 LOCATION COORDS. N 5 104 336.7; E 314 991.6 ORIGINATED BY M.M.
DIST 13 HWY 11/534 BOREHOLE TYPE H.S. AUGER, WASH BORING, DYNAMIC CONE COMPILED BY A.H.
DATUM GEODETIC DATE 91/08/13 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 KN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	WATER CONTENT (%)			
246.0	GROUND SURFACE													
0.0	ORGANICS		1	SS	29								20.7	0 1 74 25
			2	SS	15									
	CLAYEY SILT TRACE SAND FIRM TO STIFF		3	SS	10									
			4	SS	10									
			5	SS	4									
	BROWN GREY		6	SS	3								18.5	0 2 77 21
			7	SS	1									
			8	SS	24									
237.5			9	SS	8									
8.5			10	SS	6									0 52 42 6
	SANDY SILT TRACE CLAY LOOSE TO COMPACT		11	SS	19									
			12	SS	11									0 50 47 3
			13	SS	16									
			14	SS	6									
228.5			15	RC	REC	0%								
17.5	SAND AND GRAVEL TRACE SILT VERY DENSE		16	SS	72	/8cm								1 98 1 0
	VERY LOOSE		17	SS	1	/15cm								
			18	SS	98	/15cm								
	OCCASIONAL COBBLES AND BOULDERS		19	SS	53	/8cm								
			20	SS	64	/13cm								98 0 2 0
219.2														
26.8	End of Borehole													

RECORD OF BOREHOLE No 4

1 OF 2

METRIC

W.P. 211-90-01 LOCATION COORDS. N 5 104 331.4; E 314 948.0 ORIGINATED BY M.M.
DIST 1.5 HWY 11/234 BOREHOLE TYPE HOLLOW STEM AUGER, WASH BORING COMPILED BY A.H.
DATUM GEODETIC DATE 91/08/18 CHECKED BY B.L.

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							
245.9	GROUND SURFACE							20 40 60 80 100				10 20 30			
244.0	CLAYEY SILT TRACE SAND FIRM TO STIFF		1	SS	13		244							21.0	0 1 69 30
			2	SS	11										
			3	SS	7										
			4	SS	5										
	BROWN GREY		5	TW	PH		242							18.7	0 3 53 44
			6	SS	7										
240.4			7	SS	5		240								
238.0			8	SS	1		238								
			9	SS	7		236								
	SANDY SILT TRACE CLAY VERY LOOSE TO COMPACT		10	SS	6		234								
			11	SS	7										0 46 51 3
			12	SS	5		232								
			13	SS	12		230								
228.2	DENSE		14	SS	46		228								
226.0			15	SS	46		226								0 93 3 4
	SAND AND GRAVEL TRACE SILT VERY DENSE		16	SS	120		224								
			17	SS	2		222								
	VERY LOOSE		18	SS	2		220								0 91 9 0
			19	SS	60	/8cm	218								
	OCCASIONAL CORRUGS AND BOULDERS		20	SS	80	/15cm	216								

Continued

3, x 5, Numbers refer to 20
Sensitivity 15-25 (%) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 4

2 OF 2

METRIC

W.P. 211-90-01 LOCATION COORDS. N 5 104 331.4; E 314 948.0 ORIGINATED BY M.M.
DIST 13 HWY 11/534 BOREHOLE TYPE HOLLOW STEM AUGER, WASH BORING COMPILED BY A.H.
DATUM GEODETIC DATE 91/08/18 CHECKED BY B.J.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT			UNIT WEIGHT	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100	W _P	W	W _L		
							SHEAR STRENGTH kPa					WATER CONTENT (%)				
							○ UNCONFINED + FIELD VANE • QUICK TRIAXIAL * LAB VANE									
							20	40	60	80	100	10	20	30	7	GR SA SI CL
215.0	Continued		21	SS	120 / 5cm											99 0 1 0
30.9	End of Borehole															

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 211-90-01 LOCATION COORDS. N 5 104 321.2; E 314 952.2 ORIGINATED BY M.M.
DIST 13 HWY 11/5.34 BOREHOLE TYPE DYNAMIC CONE COMPILED BY A.H.
DATUM GEODETIC DATE 91/08/28 CHECKED BY B.I.

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			20	40	60	80	100		
246.2	GROUND SURFACE												
0.0													
240.4	PROBABLE CLAYEY SILT TRACE SAND FIRM TO STIFF												
5.8													
	PROBABLE SANDY SILT TRACE CLAY VERY LOOSE TO DENSE												
227.9													
18.3	End of Cone Test PROBABLE BOULDER												

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 211-90-01 LOCATION COORDS. N 5 104 314.8; E 314 909.0 ORIGINATED BY M.M.
DIST 13 HWY 11/534 BOREHOLE TYPE DYNAMIC CONE COMPILED BY A.H.
DATUM GEODETIC DATE 91/08/28 CHECKED BY B.I.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL 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	20 40 60 80 100	W _p	W	W _L		
248.1	GROUND SURFACE													
0.0	PROBABLE CLAYEY SILT TRACE SAND STIFF TO VERY STIFF													
244.0														
4.1	PROBABLE SANDY SILT VERY LOOSE TO COMPACT													
230.7														
17.4	End of Cone Test													

+3, x³: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 7

1 OF 2

METRIC

W.P. 211-90-01 LOCATION COORDS. N 5 104 304.5; E 314 913.3 ORIGINATED BY M.M.
 DIST 13 HWY 11/534 BOREHOLE TYPE H.S. AUGER, WASH BORING, ROCK CORE COMPILED BY A.H.
 DATUM GLOUCESTER DATE 91/08/26 CHECKED BY B.L.

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		
248.0	GROUND SURFACE												
0.0	SAND, TRACE GRAVEL		1	SS	30								
	CLAYEY SILT TRACE SAND STIFF TO VERY STIFF		2	SS	14								
			3	SS	10								
244.3			4	SS	18								
3.7			5	SS	17								
			6	SS	7								
			7	SS	3								
			8	SS	12								
	SANDY SILT VERY LOOSE TO COMPACT		9	SS	6								
			10	SS	6								
			11	SS	3								
			12	SS	10								
	SAND		13	SS	10								
			14	SS	12								
			15	SS	15								
			16	SS	16								
227.3			17	SS	120	/3cm							
20.7	SAND AND GRAVEL TRACE SILT VERY DENSE		18	SS	5								
	LOOSE		19	SS	120	/3cm							
			20	SS	41								
	OCCASIONAL COBBLES AND BOULDERS		21	SS	60	/8cm							
220.1			22	RC	REC	92%							
27.9	BEDROCK GRANITE SLIGHTLY WEATHERED		23	RC	REC	100%							

Continued

+3, x5, Numbers refer to
Sensitivity

20
15-25 (%) STRAIN AT FAILURE
10

Continued

RECORD OF BOREHOLE No 7

2 OF 2

METRIC

W.P. 211-90-01 LOCATION COORDS. N 5 104 304.5; E 314 913.3 ORIGINATED BY M.M.
DIST 13 HWY 11/534 BOREHOLE TYPE H.S. AUGER, WASH BORING, ROCK CORE COMPILED BY A.H.
DATUM GEODETIC DATE 91/08/26 CHECKED BY B.I.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT 7 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		
217.2	Continued		23	RC	REC	100%										
30.8	End of Borehole															

RECORD OF BOREHOLE No 8

1 OF 1

METRIC

W.P. 211-90-01 LOCATION COORDS. N 5 104 293.5; E 314 875.0 ORIGINATED BY M.M.
DIST 13 HWY 11/534 BOREHOLE TYPE H.S. AUGER, DYNAMIC CONE COMPILED BY A.H.
DATUM GEODLIC DATE 91/08/28 CHECKED BY B.J.

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	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100	W _p W W _L	10 20 30			
250.5	GROUND SURFACE												
250	CLAYEY SILT TRACE SAND STIFF TO VERY STIFF	1	SS	18		250						18.8	0 1 56 43
248		2	SS	15		248							0 1 83 15
246		3	SS	10		246							
		4	SS	12									
		5	SS	23									
		6	SS	23									
244.2	SANDY SILT VERY LOOSE TO COMPACT	7	SS	20		244							0 13 72 15
242		8	SS	5		242							
		9	SS	17									
		10	SS	11									0 96 3 1
237.8	SAND	11	SS	15		238							
12.6	End of Borehole												
231.3													
19.2	End of Cone Test + PROBABLE BOULDERS												

ROCK CORE DESCRIPTION **WP 211-90-01**

Page 1 of 1

CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
7	22	27.43-29.26	92	60	27.43-30.78	GRANITE (biotite-bearing and gneissic), greyish red to moderate reddish orange; medium to coarse grained; strong; unweathered to slightly weathered; fractures moderately close to very close spaced, near vertical to flat, undulating, rough to smooth.
	23	29.26-30.78	100	83		

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section

FOUNDATION INVESTIGATION REPORT

for

McGillvray Creek, South Crossing
Proposed Southbound Lanes, Highway 11

W.P.589-92-01, Site No. 44-40A

District 13, North Bay

INTRODUCTION

This report summarizes the information obtained from the foundation investigation carried out at the above noted site. The investigation was carried out at the request of the Northern Region Structural Section for a new culvert required due to the proposed four laning of Highway 11. The field work, carried out between 93 02 05 and 93 02 12, consisted of three (3) sampled boreholes and three (3) dynamic cone penetration tests along the length of the proposed culvert site.

SITE DESCRIPTION

The site is located on the proposed southbound lanes of Highway 11, approximately 4 km south of the intersection of Highway 534 and 100 m west of the existing Highway 11 embankment in the Township of South Himsworth, District of Parry Sound.

The immediate area is moderately rolling with swampy areas near the creek bed. The site is heavily vegetated with trees. Land use in the adjacent areas includes the highway corridor and livestock pasture. According to the Northern Ontario Engineering Geology Terrain Study published by the Ministry of Natural Resources, the site is located on the edge of a Sandy Glaciolacustrine Plain.

The existing Highway 11 embankment is approximately 4 m high at this location with the watercourse accommodated by a rigid frame concrete bridge.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in-situ and laboratory testing. The procedures employed are discussed below.

Field

The field work for the investigation was carried out between 93 02 05 and 93 02 12 and

consisted of three (3) sampled boreholes and three (3) dynamic cone penetration tests. BH 2 and BH 3 were advanced to refusal at depths of 15.0 m and 12.2 m respectively. Borehole No.1 was advanced to a depth of 8.1 m and terminated in the Silty Sand stratum common to all the boreholes.

The boreholes were advanced using conventional hollow stem augering techniques with two track mounted continuous flight auger machines. The sampling program consisted of split spoon and shelly tube samples collected in the overburden. Disturbed subsoil samples were retrieved by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586). Standard Penetration ('N') values were recorded for assessment of the denseness of the materials encountered. Relatively undisturbed samples were randomly retrieved in the cohesive stratum using thin walled shelly tube samplers in accordance with Standard Practice (ASTM D1587). All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing.

Dynamic Cone Penetration tests were carried out at the location of each borehole. In situ vane shear tests were also carried out in the cohesive strata to determine the undisturbed and remoulded undrained shear strengths of these soils. The test was conducted employing the standard MTO 'N' vane.

Groundwater levels were measured in each borehole and in the watercourse. All boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Northern Region Surveys and Plans Section.

Laboratory

The laboratory testing on selected soil samples consisted of the following:

- Atterberg Limit Test
- Grain Size Distribution
- Natural Moisture Content Determination
- Unit Weight Determination
- Consolidation Test
- Unconfined Compressive Test

Laboratory results are given in the following section of this report and are illustrated on Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

General

The Record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations of the boreholes are shown in Dwg. No. 5899201-A.

The predominant soil strata encountered in the boreholes consisted of Organic Silty clay, Organic Clayey Silt and Silty Sand. A thin layer of Silt was contacted in BH 1. Non-cohesive glacial till was encountered in BH 2. A subsurface profile is shown in Dwg. No. 5899201-B.

Following are the specific descriptions of the materials encountered in the investigation:

Organic Silty Clay/Organic Clayey Silt

This material was encountered at the surface to a depth of 2.7 m in BH 1, 4.4 m in BH 2 and 5.2 m in BH 3. The Standard Penetration Resistance 'N' values recorded in BH 2 were 1 to 5 blows/0.3 m.

Four field vane shear tests were conducted in this material resulting in an undrained shear strengths of 34 to 48 kPa with sensitivities of 3 to 7. The results of the two unconfined compressive tests carried out indicate undrained shear strengths of 19.8 kPa and 26.9 kPa. These values are much lower than the field vane tests values probably due to sample disturbance.

Typical properties of the material, as determined by laboratory tests on representative samples may be summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Test</u>
Natural Moisture Content (w%)	31.5-68.5	7
Unit Weight (kN/m ³)	14.5-15.8	2
Liquid Limit (w _L %)	40-64	4
Plastic Limit (w _P %)	29-43	4
Grain Size Distribution(%)		5
-Gravel	0	
-Sand	1-44	
-Silt	50-81	
-Clay	6-18	

The consolidation test carried out indicates compression index of 0.18 and initial void ratio of 0.91. The preconsolidation pressure obtained is 120 kPa which is higher than the overburden pressure.

Silty Sand, Trace Gravel & Clay

This non-cohesive material was found in all three boreholes at a depth of 2.7 to 5.2 m below the organic layers. Standard Penetration Resistance 'N' values ranged from 7 to 28 blows/0.3 m indicating loose to compact state, but typically compact. One very low 'N' value of 1 blow/0.3 m was recorded in BH 1. This low blowcount is due to unbalanced hydrostatic head and does not represent the denseness of the material.

Typical properties of this material, as determined by laboratory tests may be summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Test</u>
Natural Moisture Content (w%)	19.5-39.0	3
Grain Size Distribution (%)		3
-Gravel	0-9	
-Sand	8-75	
-Silt	9-77	
-Clay	6-15	

Heterogeneous Mixture of Silt, Sand, and Gravel (Glacial Till)

This non-cohesive deposit is only contacted in BH 2 just above bedrock. The remaining boreholes were generally terminated in the silty sand stratum. The material is described as a heterogeneous mixture of silt, sand and gravel, occasional boulders and cobbles. Standard Penetration Resistance 'N' value ranges from 16 blows/0.3 m to 82 blows/0.15 m, indicating compact to very dense state of denseness.

Groundwater

The groundwater level measured in the boreholes was typically close to the ground surface at El. 257 to 258.1 m. During the time of the investigation, the water level in the creek was at El. 257.2 m.

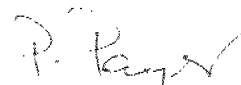
Groundwater levels are subject to seasonal fluctuations and hence may vary from the elevations given in this report.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of D. Kwok, Project Foundation Engineer, B. Liegler, Engineering Trainee and L. Sheppard, Pavement Design and Evaluation Officer, using the equipment owned and operated by Dominion Soil Investigation Inc.

The project was carried out by D. Kwok under the general supervision of B. Iyer, Senior Foundation Engineer. The report was written by D. Kwok, reviewed by B. Iyer, and approved by M. Devata, Chief Foundation Engineer.




P. Payer, P. Eng.
Senior Foundation Engineer

APPENDIX

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 589-92-01 LOCATION Co-ords. N 5 100 634.1 E 316 888.4 ORIGINATED BY UK/LS
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY DK
DATUM Geodetic DATE 93 02 11 CHECKED BY BI



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 7 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							SHEAR STRENGTH kPa		WATER CONTENT (%)	
258.1	Ground Surface																	
0.0	Organic Silty Clay With Wood Fibres	Brown Grey	1	AS	-								14.5					
255.4			2	TW	PH													
2.7	silt layers		3	SS	16									0 8 77 15				
	Silty Sand Trace Clay and Gravel Brown, Compact		4	SS	**1									6 75 13 6				
	becoming more Gravelly		5	SS	11													
250.0			6	SS	28													
3.1	End of Borehole																	
	Probable Silty Sand Some Gravel																	
245.3																		
12.8	End of Cone Test																	
	* Unstabilized Water Level recorded at completion of drilling																	
	** Low blowcount due to unbalanced hydrostatic head																	

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

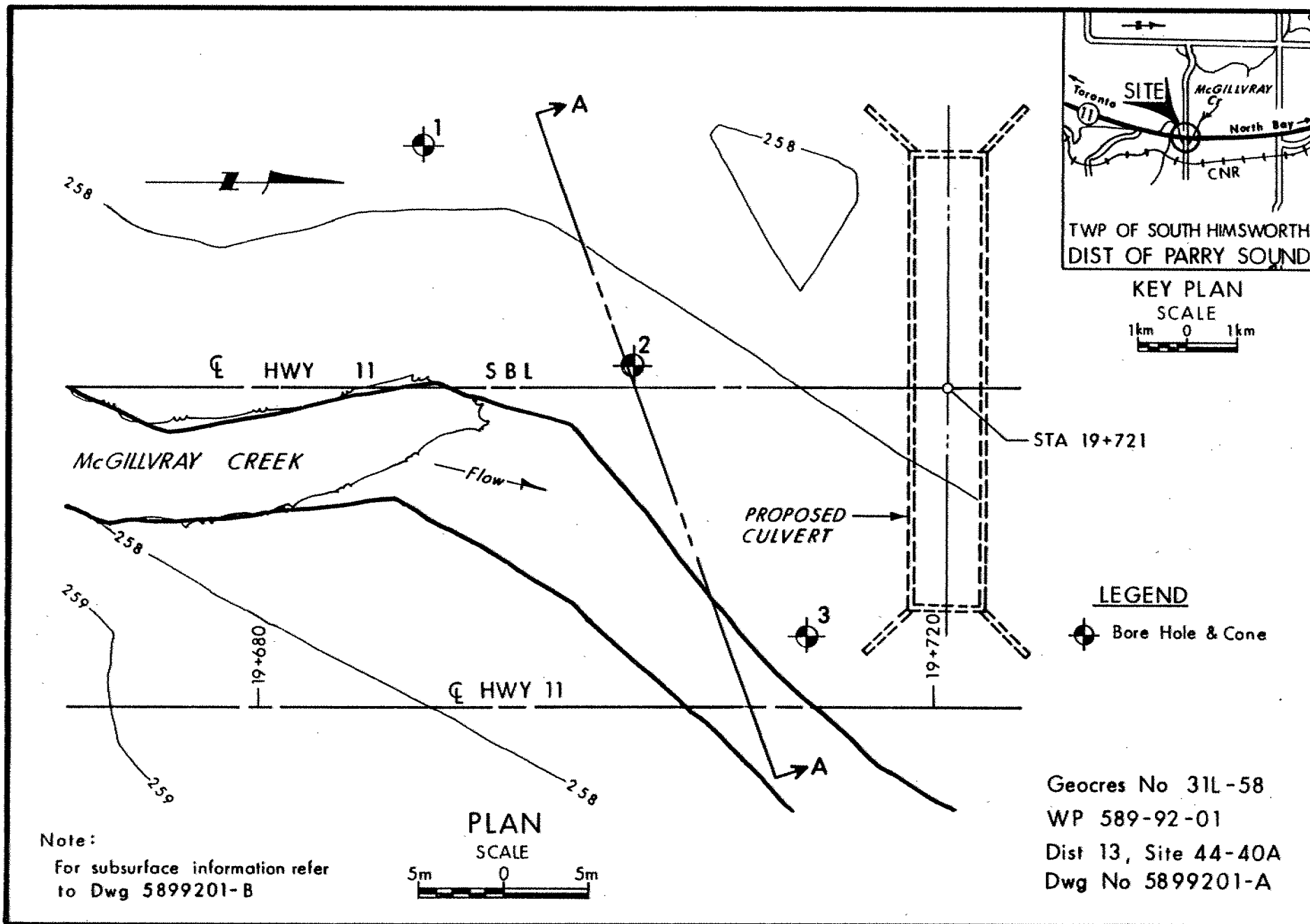
W.P. 589-92-01 LOCATION Co-ords : N 5 100 560.4 E 316 895.7 ORIGINATED BY DK/LS
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Cone Test COMPILED BY LS
DATUM Geodetic DATE 93 02 05 CHECKED BY BI

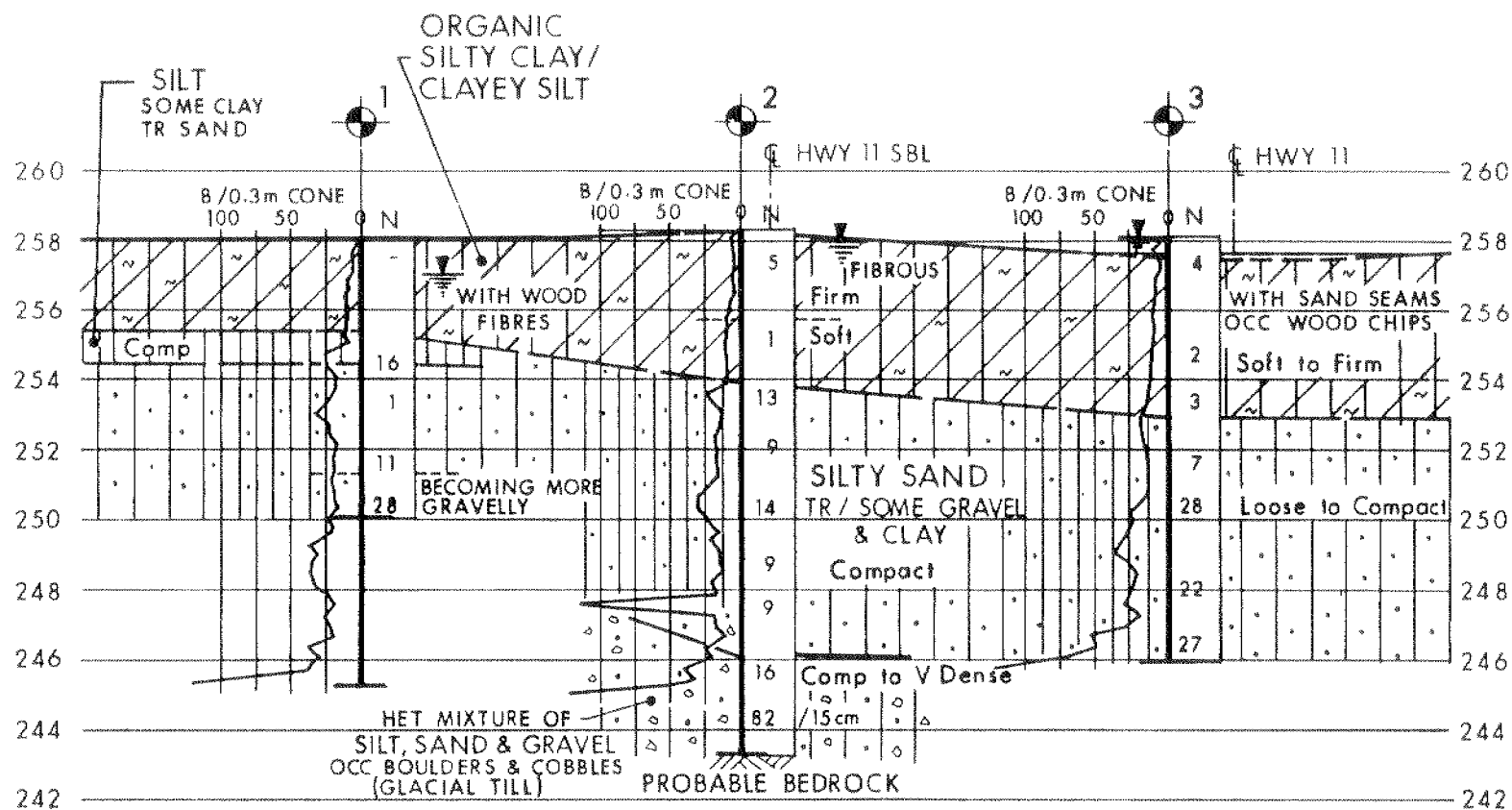
SOIL PROFILE			SAMPLES			GROUND WATER * CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa						
258.3	Ground Surface							20 40 60 80 100	10 20 30 40 50	20 40 60				
0.0	Organic Silty Clay Fibrous Firm, Grey ----- Soft Dark Brown		1	SS	5		258							
			2	TW	PH		256						15.8	0 1 81 18
			3	SS	1									
253.9			4	SS	13		254							
4.4	Silty Sand Trace Gravel and Clay Pink to Brown Loose to Compact		5	SS	9		252							
			6	SS	14		250							9 75 9 7
			7	SS	9		248							
			8	SS	9									
246.1			9	SS	16		246							
12.2	Heterogeneous mixture of Silt, Sand and Gravel Occasional Boulders and Cobbles Pink to Brown (Glacial Till) Compact to Very Dense		10	SS	82		244							
243.3														
15.0	End of Borehole Auger Refusal Probable Bedrock * Water level recorded 2 hours after the completion of augering.													

METRIC

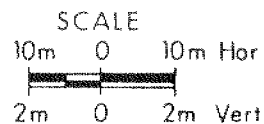
DATUM Geodetic DATE 95.02.05 CHECKED BY BI

+3, x⁵: Numbers refer to Sensitivity





SECTION A-A



Note :

For Plan refer to Dwg 5899201-A

Geocres No 31L-58

WP 589-92-01

Dist 13, Site 44-40A

Dwg No 5899201-B

FOUNDATION INVESTIGATION REPORT

for

McGillvray Creek Culvert

Proposed Northbound Lanes, Highway 11

W.P. 645-92-01, Site No. 44-40

District 13, North Bay

INTRODUCTION

This report summarizes the information obtained from the foundation investigation carried out at the above noted site. The investigation was carried out at the request of the Northern Region Structural Section to design a culvert required to replace the existing crossing at this location. The field work, carried out between 93 02 04 and 93 02 09, consisted of two (2) sampled boreholes and two (2) dynamic cone penetration tests. BH 1 was located on the west side of Highway 11 and BH 2 was placed on the east side.

SITE DESCRIPTION

The site is located at the southmost crossing of McGillvray Creek on Highway 11, approximately 4 km south of the intersection of Highway 534 in the Township of South Himsworth, District of Parry Sound. The immediate vicinity is moderately rolling with swampy areas near the creek bed. According to the Northern Ontario Engineering Geology Terrain Study published by the Ministry of Natural Resources, the site is located on the edge of a Sandy Glaciolacustrine Plain.

The existing structure is a rigid frame concrete bridge with short wingwalls. Existing grade is to be raised by about $1\text{m}\pm$ for the new Highway 11 profile. The existing structure is in poor conditions and is considered incapable of accommodating the proposed grade change. Existing embankment gradient is 3H:1V or flatter. Cracks and patches can be found on the existing pavement at the location of the crossing.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in-situ and laboratory testing. The procedures employed are discussed below

Field

The field work for the investigation, carried out between 93 02 04 and 93 02 09, consisted of two (2) sampled boreholes and two (2) dynamic cone penetration tests. The boreholes were advanced to refusal at depths of 10.4 m on the west side and 12.2 m on the east.

The boreholes were advanced using conventional hollow stem augering techniques with two track mounted continuous flight auger machines. The sampling program consisted of split spoon and shelly tube samples collected in the overburden. Disturbed subsoil samples were retrieved by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586). Standard Penetration ("N") values were recorded for assessment of the denseness of the materials encountered. Relatively undisturbed samples were randomly retrieved in the cohesive stratum using thin walled shelly tube samplers in accordance with Standard Practice (ASTM D1587). All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing.

Dynamic Cone Penetration tests were carried out adjacent to each borehole. In-situ vane shear tests were also carried out in the cohesive strata to determine the undisturbed and remoulded undrained shear strengths of these soils. The test was conducted employing the standard MTO "N" vane.

Groundwater level was monitored in open boreholes throughout the investigation. The water level in the creek during the time of the investigation was also measured. All boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Northern

Region Surveys and Plans Section.

Laboratory

The laboratory testing on selected soil samples consisted of the following:

- Atterberg Limit Test
- Unit Weight Determination
- Grain Size Distribution
- Natural Moisture Content Determination
- Unconfined Compressive Test

Laboratory results are given in the following section of this report and are illustrated on figures and Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

General

The Record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes are shown in Dwg. No. 6459201-A.

The four soil strata that were encountered before refusal in each of the boreholes are silt with clayey and sandy layers, silty clay, sandy silt, and non-cohesive glacial till.

Following are the specific descriptions of the materials encountered in the investigation.

Silt

Silt material was encountered at the surface in both boreholes. In BH 1 the material was sandy near the surface but becoming clayey towards the bottom of the layer at a depth of 2.1 m. The material was found to be more organic in nature at BH 2 and extended only to 1.2 m. The Standard Penetration "N" values recorded for the three split spoon samples taken in this material were all 3 blows/0.3 m indicating a very loose denseness.

Laboratory testing was carried out on a representative sample and the results are 44% moisture content and a grain size distribution of 0% gravel, 21% sand and 79% silt and clay.

Silty Clay with Organics, Trace Sand

This cohesive stratum was encountered from 2.1 to 3.5 m in BH 1 and from 1.2 to 4.3 m in BH 2. The material is typically described as silty clay with organics, trace sand.

The Standard Penetration Resistance "N" values were 4 and 5 blows/0.3 m. Field vane shear tests conducted at 2.0 m and 2.7 m in BH 2 give undrained shear strengths of 50 kPa and 28 kPa respectively with associated sensitivities of 6 and 5. Undrained shear strength values obtained from unconfined compressive tests carried out in the laboratory are 14 and 25 kPa. The lower values are probably due to sample disturbance.

Typical properties of the material, as determined by laboratory tests on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	27.0 - 46.5	3
Unit Weight (kN/m ³)	16.5 - 18.7	2
Liquid Limit (w _L)	31	1
Plastic Limit (w _P)	19	1
Grain Size Distribution (%)		
Gravel	0	
Sand	5	
Silt and Clay	95	

Sandy Silt

This material was found in both borcholes below the silty clay materials. It extends from a depth of 3.5 m to 7.3 m in BH 1 and from 4.3 m to 8.8 m in BH 2. Standard Penetration Resistance

"N" values were 2 and 6 blows/0.3 m in BH 1 indicating a very loose to loose natural state. The "N" values ranged from 14 to 23 blows/0.3 m in BH 2 indicating a compact natural state. In BH 2, the top of this layer contains occasional clayey silt zones and some organics.

Typical properties of this material, as determined by laboratory tests on representative samples may be summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Tests</u>
Natural Moisture Content (w)	17.0 - 25.0	2
Grain Size Distribution (%)		2
Gravel	0 - 19	
Sand	29 - 36	
Silt and Clay	52 - 64	

Heterogeneous Mixture of Silt, Sand and Gravel

This stratum was found to underlie the sandy silt layer at both borehole locations. The lower boundary is assumed to be at levels where auger refusals were met. (El. 247.4, BH 1 and El. 245.9, BH 2). The material in the deposit consists of a heterogeneous mixture of silt, sand and gravel with cobbles and boulders. The Standard Penetration Tests "N" values ranged from 11 blows/0.3 m to 102 blows/21 cm, indicating compact to very dense condition.

Groundwater

Observations of the Groundwater level were carried out by measuring the water level in open boreholes.

Groundwater level determined at the time of the investigation was at El. 257.8 m in BH 1 and El. 256.9 m in BH 2. Water level in the creek was at El. 257.6 m in the vicinity of BH 1.

Groundwater level, however, are subject to seasonal fluctuations and hence may vary from the elevations given in this report.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of D. Kwok, Project Foundation Engineer, B. Liegler, Engineering Trainee and L. Sheppard, Pavement Design and Evaluation Officer, using the equipment owned and operated by Dominion Soil Investigation Inc.

The project was carried out by D. Kwok under the general supervision of B. Iyer, Senior Foundation Engineer. The report was written by D. Kwok, reviewed by B. Iyer, and approved by M. Devata, Chief Foundation Engineer.



P. Payer
P. Payer, P. Eng.
Senior Foundation Engineer

APPENDIX

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 545-92-01 LOCATION Co-ords : N5 100 776.6 , F 316 920.6 ORIGINATED BY BL
DIST 13 HWY 11 BOREHOLE TYPE H.S Auger & Cone Test COMPILED BY LS
DATUM Geodetic DATE 93_02_04 CHECKED BY BI

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	SHEAR STRENGTH kPa						WATER CONTENT (%)	
								○ UNCONFINED	* FIELD VANE							● QUICK TRIAXIAL
257.8	Ground Surface															
0.0																
	Silt Very Loose		1	SS	3											
	Sandy Trace Organics Dark Grey															
	Cloyey Some Organics Brown to Grey		2	SS	3											
255.7																
2.1	Silty Clay with Organics Trace Sand Occasional Sand Seams & Woodchips Brown to Grey Firm		3	SS	5											
			4	1W	PH											
254.3																
3.5																
	Sandy Silt Trace Clay Pink and Brown Very Loose to Loose		5	SS	2											
			6	SS	6											
250.5																
7.3	Heterogeneous Mixture of Silt Sand and Gravel Cobbles and Boulders (Glacial Till) Grey, Compact		7	SS	22											
			8	SS	11											
247.4																
10.4	End of Borehole Auger Refusal Probable Bedrock															
	* Water level at ground surface on 93 07 05															

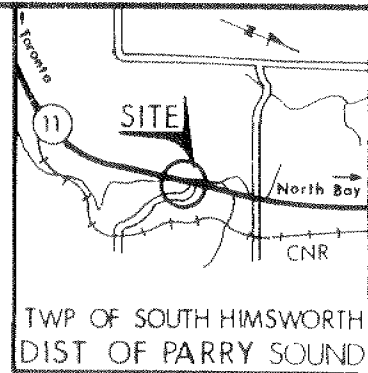
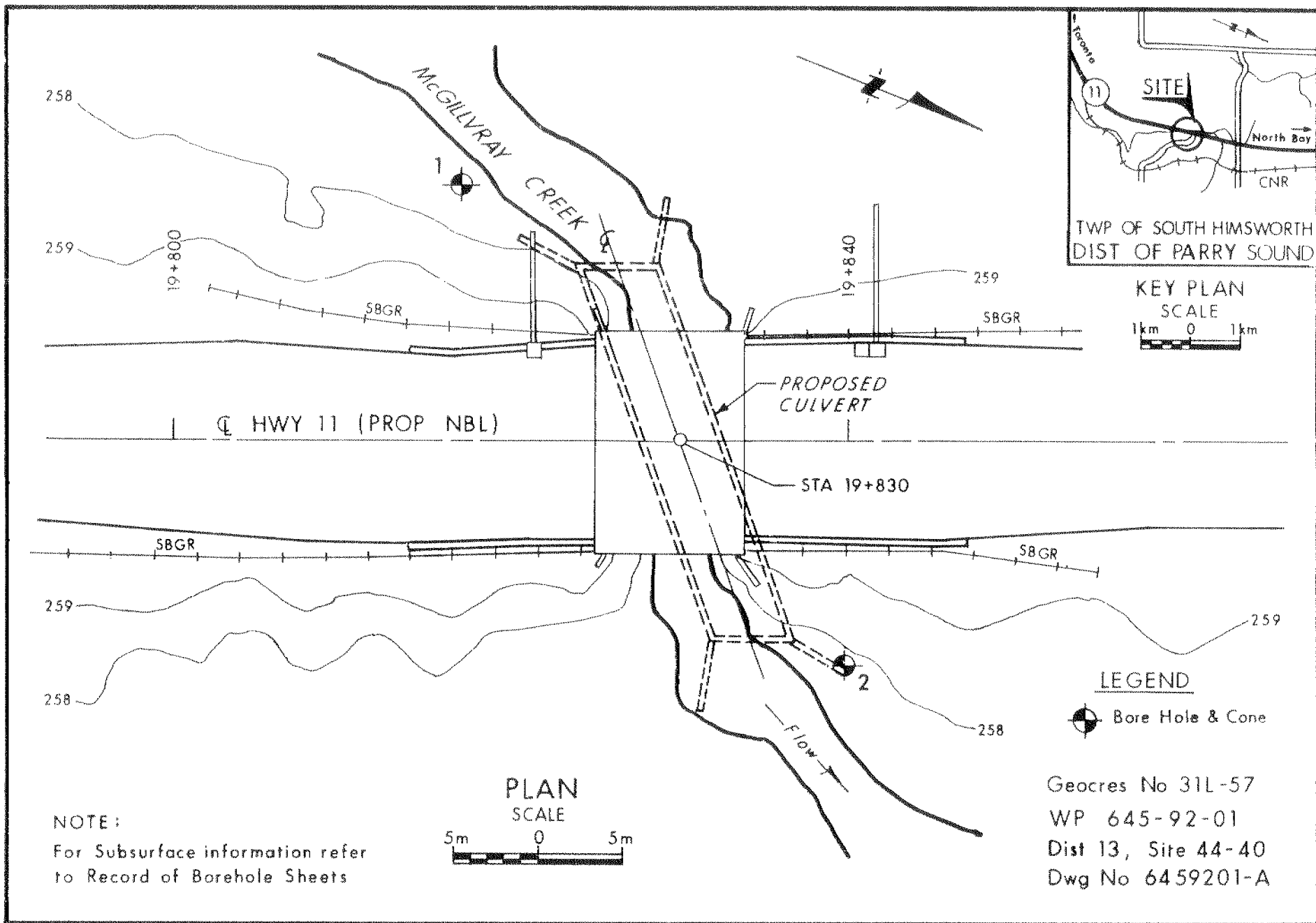
RECORD OF BOREHOLE No 2

1 OF 1


METRIC

W.P. 645-92-01 LOCATION Co-ords: N5 100 808.0; E 316 938.5 ORIGINATED BY DK/LS
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger & Cone Test COMPILED BY LS
DATUM Geodetic DATE 93 02 08 - 93 02 09 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p W W _L	WATER CONTENT (%)				
258.1	Ground Surface						258							
0.0	Silt with Organics Some Sand and Clay Dark Brown, Very Loose		1	AS	-		258							
256.9			2	SS	3		257							0 21 66 13
1.2	Silty Clay with Organics, Trace Sand Brown to Grey Firm		3	SS	4		256							0 5 74 21
255.2			4	TW	PH		255						18.7	
2.9	Occasional Clayey Silt Zones Some Tree Roots and Organics		5	SS	14		254							
	Sandy Silt Some Gravel Pink and Brown, Compact		6	SS	23		253							19 29 44 8
			7	SS	22		252							
249.3			8	SS	102		249							
8.8	Heterogeneous Mixture of Silt, Sand and Gravel Cobbles and Boulders (Glacial Till) Pink and Brown Very Dense				21cm		248							
245.9							247							
12.2	End of Borehole Auger Refusal Probable Bedrock						246							
	* 93 02 09													

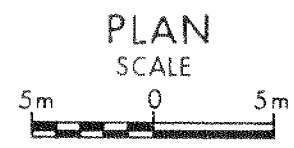


LEGEND

 Bore Hole & Cone

Geocres No 31L-57
WP 645-92-01
Dist 13, Site 44-40
Dwg No 6459201-A

NOTE:
For Subsurface information refer
to Record of Borehole Sheets



FOUNDATION INVESTIGATION REPORT

for

Tributary to McGillvray Creek Culvert
Proposed Southbound Lanes, Highway 11W.P. ~~51-75-01~~ 17-93-01District 13, North Bay**INTRODUCTION**

This report summarizes the information obtained from the foundation investigation carried out at the above noted site. The investigation was carried out at the request of the Northern Region Structural Section to design a culvert required for the proposed four laning of Highway 11. The field work was carried out on 93 02 10 and 93 02 11 and consisted of three (3) sampled boreholes and three (3) dynamic cone penetration tests along the length of the proposed culvert site. In addition, one (1) sampled borehole and one (1) dynamic cone penetration test were advanced approximately 50 m north of the culvert location where high fill is expected.

SITE DESCRIPTION

The site is located on the proposed southbound lanes of Highway 11, approximately 2.0 km south of the intersection of Highway 534 and 50 m west of the existing Highway 11 embankment in the Township of South Himsforth, District of Parry Sound.

The immediate area is moderately rolling with scattered surficial boulders and mainly grassy vegetation. The property on which the site is located is presently used as livestock pasture. According to the Northern Ontario Engineering Geology Terrain Study published by the Ministry of Natural Resources, the site is located in a Sandy Glaciolacustrine Plain.

The existing Highway 11 embankment is 8 m to 10 m high at this location with the watercourse accommodated by a 3.05 m x 3.05 m x 32 m rigid frame concrete box culvert.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in-situ and laboratory testing. The procedures employed are discussed below.

Field

The field work for the investigation was carried out on 93 02 10 and 93 02 11 and consisted of four (4) sampled boreholes and four (4) dynamic cone penetration tests advanced to depths of 3.3 to 7.9 m. 2.3 m of rock core was obtained in BH 2.

The boreholes were advanced using conventional hollow stem augering techniques with a track mounted continuous flight auger machine. The sampling program consisted of disturbed samples taken directly from the auger in the surface soil and by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586) for the subsurface strata. Standard Penetration ('N') values were recorded for assessment of the denseness of the materials encountered. All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing.

Groundwater level was monitored in open boreholes throughout the investigation. Water level in the creek was also measured during the time of the investigation. All boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Northern Region Surveys and Plans Section.

Laboratory

The laboratory testing on selected soil samples consisted of the following:

- Atterberg Limit Test
- Grain Size Distribution
- Natural Moisture Content Determination
- Organic Content Determination

Laboratory results are given in the following section of this report and are illustrated on Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

General

The Record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes are shown in Dwg. No. ~~517501-A~~ 179301-A.

The subsurface stratigraphy in BH 1 to 3 typically comprises of a 3.7 to 5 m thick layer of silt overlying a 1.6 to 2.9 m sand deposit. Depth to bedrock in these boreholes ranges from 5.3 to 7.9 m. In BH 4, a 3 m thick layer of sandy silt was found overlying a minor layer (0.3 m thick) of non-cohesive glacial till. Bedrock was encountered at shallow depth (3.3 m). In order to verify bedrock, 2.3 m of rock core was taken from BH 2. A subsurface profile is shown in Dwg. No. ~~517501-B~~ 179301-B.

Following are the specific descriptions of the materials encountered in the investigation:

Silt, Some Sand, Trace Clay, Occasional Clayey and Sandy Zones

This material was encountered at the surface in BH 1 to BH 3 to a depth of 3.7 m to 5.0 m. It is typically described as Silt, Some Sand, Trace Clay. In BH 3 occasional clayey pockets and sandy zones were recorded. The Standard Penetration Resistance 'N' values range from 3 to 24 blows/0.3 m indicating very loose to compact denseness. Occasional rootlets and organics were found in this stratum in both BH 1 and BH 2. Typical properties of this material as determined by laboratory tests carried out on representative samples are summarized as follows :

<u>Property</u>	<u>Range</u>	<u>No. of Test</u>
Natural Moisture Content (w%)	19.0-65.5	9
Liquid Limit (w_L)	20-31	4
Plastic Limit (w_p)	15-28	4
Grain Size Distribution (%)		7
Gravel	0-3	
Sand	9-41	
Silt & Clay	58-91	
Organic Content (%)	2.1-4.3	2

Sandy Silt, Some Clay

This non-cohesive stratum was contacted at the surface in BH 4 to a depth of 3.0 m. It is typically described as Sandy Silt, Some Clay. The Standard Penetration Resistance 'N' values ranged from 5 to 10 blows/0.3 m, indicating a loose to compact denseness. Laboratory tests carried out on a representative sample indicated a natural moisture content of 29.5% and grain size distribution of 0% gravel, 36% sand and 64% silt and clay.

Silty Sand, Trace to Some Gravel

This material was encountered in BH 1 to 3 overlying bedrock. The Standard Penetration Resistance 'N' values ranged from 20 to 68 blows/0.3 m, indicating a compact to very dense state of denseness. Laboratory tests carried out on a representative sample indicated a natural moisture content of 12% and grain size distribution of 16% gravel, 53% sand and 31% silt and clay.

Heterogeneous Mixture of Sandy Silt Trace Gravel (Glacial Till)

This material was encountered from 3.0 m to 3.3 m in BH 4. It lies directly over bedrock and the Standard Penetration Resistance 'N' value was 25 blows/8 cm with the split spoon sampler bouncing on bedrock. Laboratory tests carried out on a representative sample indicated a natural moisture content of 10% and grain size distribution of 19% gravel, 49% sand and 32% silt and clay.

Bedrock

Bedrock was encountered at shallow depth at El. 255.7 m (BH 4) on the west side and found sloping down to El 251.1 m (BH 1) at the east end.

Bedrock was cored in BH 2. The rock cores obtained were used for rock quality determination and classification. Detailed description of the rock are attached in the Appendix. Bedrock is a slightly weathered to unweathered granite. Core recoveries and Rock Quality Designations are 100%. The rock is considered strong.

Groundwater

During the time of the investigation, the water level in the creek was at El. 257.5 m. It is probable that the creek elevation rises considerably during periods of high runoff.

Ground water level was measured in the boreholes to be between El. 258.0 and EL. 259.0 m approximately.

Groundwater levels are subject to seasonal fluctuations and hence may vary from the elevations given in this report.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of D. Kwok, Project Foundation Engineer and L. Sheppard, Pavement Design and Evaluation Officer, using the equipment owned and operated by Dominion Soil Investigation Inc. Bedrock was classified by MTO petrographer D. Williams.

The project was carried out by D. Kwok under the general supervision of B. Iyer, Senior Foundation Engineer. The report was written by D. Kwok, reviewed by B. Iyer, and approved by M. Devata, Chief Foundation Engineer.



P. Payer
P. Payer, P. Eng.
Senior Foundation Engineer

APPENDIX

METRIC

+3, x 5: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 17-93-01 LOCATION Co-ords. N 5 102 742.0 E 316 091.3 ORIGINATED BY DK/LS
 DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger, Dynamic Cone & NQ Core Barrel COMPILED BY LS
 DATUM Geodetic DATE 93 02 10 CHECKED BY BI

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				
259.1	Ground Surface															
0.0	Silt Some Sand Trace Clay Brown to Grey Very Loose		1	AS	-											
			2	SS	4		258									0 24 62 14
			3	SS	4		257									
			4	SS	4		256									1 17 57 25
			5	SS	6		255									
255.4							254									
3.7	Silty Sand Trace Gravel Brown Compact to Dense		6	SS	68		253									
253.8							252									
5.3	Granitic Bedrock		7	RC	REC	100%										RQD 100%
			8	RC	REC	100%										RQD 100%
251.5																
7.6	End of Borehole * Water Level measured on 93 02 11															

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. ~~17-93-01~~ 17-93-01

LOCATION Co-ords. N 5 102 78.5 E 316 069.5

ORIGINATED BY DK/LS

DIST 13 HWY 11

BOREHOLE TYPE H.S. Auger & Dynamic Cone Penetration Test

COMPILED BY J.S

DATUM Geodetic

DATE 93 02 10

CHECKED BY BI

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			70 40 60 80 100						
261.1	Ground Surface													
0.0	Clayey		1	AS	-									
	Silt		2	SS	24		260							0 9 78 13
	Trace Clay		3	SS	16		259							
	Brown, Compact		4	SS	18		258							1 41 39 19
	Sandy		5	SS	13		257							0 36 53 11
256.1			6	SS	10		256							
5.0							255							
	Silty Sand		7	SS	30		254							
	Trace Gravel													
	Brown, Dense													
253.2														
7.9	End of Borehole													
	Auger Refusal													
	Probable Bedrock													
	* Water level measured three hours after the completion of drilling													

RECORD OF BOREHOLE No 4

1 OF 1

METRIC

W.P. 17-93-01 LOCATION Co-ords. N 5 102 711.7 E 316 067.7 ORIGINATED BY DK/LS
DIST 13 HWY 11 BOREHOLE TYPE H.S. Auger & Dynamic Cone Penetration Test COMPILED BY LS
DATUM Geodetic DATE 93 02 09 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _P W W _L					
259.0	Ground Surface							SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%) 10 20 30				
0.0	brown grey Sandy Silt, Some Clay Loose to Compact		1	AS	-									
			2	SS	7									
			3	SS	5									
			4	SS	10									
256.0			5	SS	25									
255.7	See Note 1 for description					/8cm							19 49 21 11	
3.3	End of Borehole Auger Refusal Probable Bedrock													
	Note 1: Heterogeneous mixture of Sandy Silt, some Clay and Gravel (Glacial Till) reddish brown very dense													
	• Water Level measured on 93 02 10													

ROCK CORE DESCRIPTION

WP ~~51-75-01~~ 17-93-01

Page 1 of 1

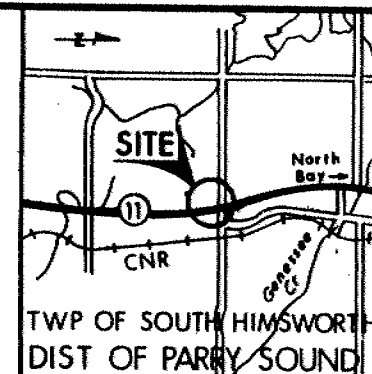
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
2	7	5.33-6.86	100	100	5.33-7.57	GRANITE (biotite-bearing, garnetiferous, and gneissic), moderate reddish orange to moderate orange pink to dark grey; fine to coarse grained; strong; unweathered to slightly weathered; fractures wide to close spaced, near vertical to flat planar to undulating, smooth to rough.
	8	6.86-7.57	100	100		

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

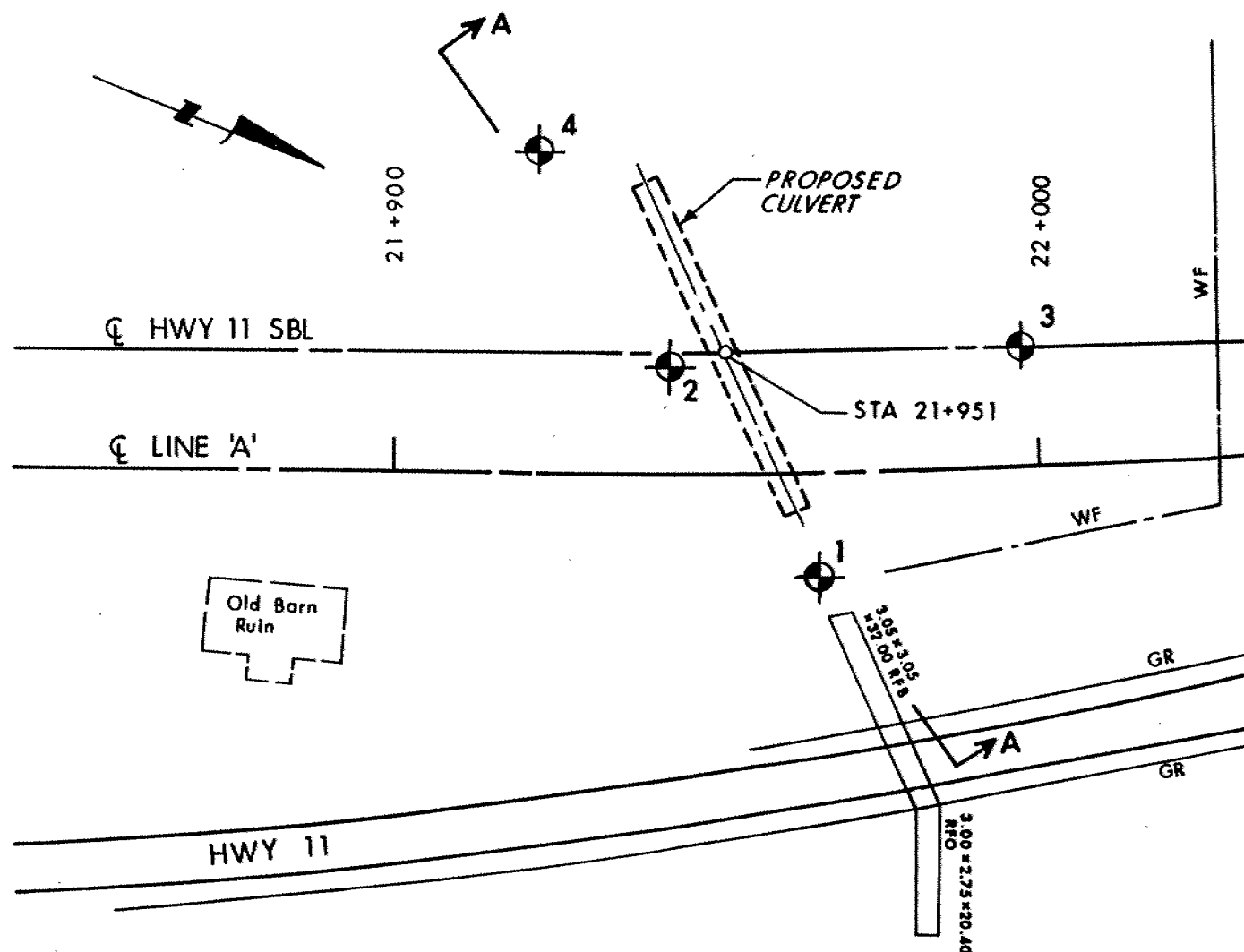
Logged by: DAW, Soils and Aggregates Section



KEY PLAN
SCALE
1km 0 1km

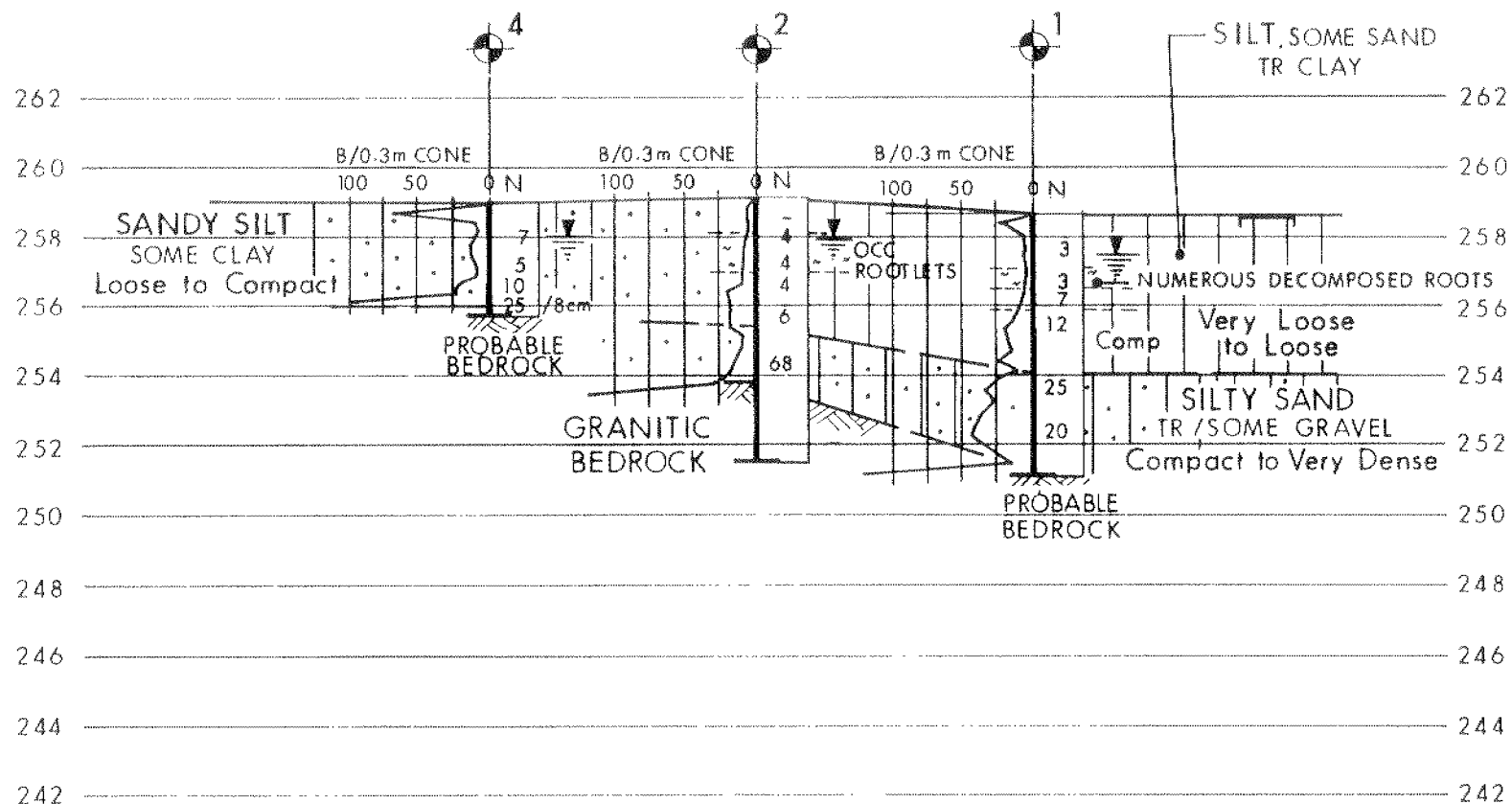
LEGEND
 Bore Hole & Cone

Geocres No 31L-59
 WP 17-93-01
 Dist 13, Site 44-366
 Dwg No 179301-A

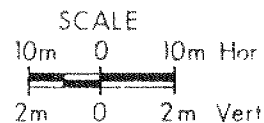


PLAN
SCALE
10m 0 10m

Note:
 For subsurface information refer
 to Dwg 179301-B and
 Record of Borehole Sheets.



SECTION A-A



Note :

- For Plan refer to Dwg 179301-A
- For Subsoil information of BH-3 refer to Record of Borehole sheets

Geocres No 31L-59
WP 17-93-01
Dist 13 , Site 44-366
Dwg No 179301-B

FOUNDATION INVESTIGATION REPORT
for
Genesee Creek Culvert
Proposed Southbound Lanes, Highway 11
W.P.591-92-01, Site No. 44-242
District 13, North Bay

INTRODUCTION

This report summarizes the information obtained from the foundation investigation carried out at the above noted site. The investigation was carried out at the request of the Northern Region Structural Section for an extension of the existing culvert required due to the proposed four laning of Highway 11. The field work, carried out on 93 06 07 and 93 06 08, consisted of two (2) sampled boreholes and three (3) dynamic cone penetration tests along the length of the proposed culvert site.

SITE DESCRIPTION

The site is located on the proposed southbound lanes of Highway 11, approximately 0.4 km north of the intersection of Highway 534 in the Township of South Himsforth, District of Parry Sound.

The immediate area is flat to moderately rolling. The site is grassed with trees on both sides of the creek. Land use in the adjacent areas includes the highway corridor and livestock pasture. According to the Northern Ontario Engineering Geology Terrain Study published by the Ministry of Natural Resources, the site is of Glaciofluvial Landform with kame moraine. The material expected typically comprises sand and gravel.

The existing Highway 11 embankment is approximately 4 m high at this location with the watercourse accommodated by a rigid concrete box culvert.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in-situ and laboratory testing. The procedures employed are discussed below.

Field

The field work for the investigation was carried out on 93 06 07 and 93 06 08 and

consisted of two (2) sampled boreholes and three (3) dynamic cone penetration tests. BH 1 was basically a probe hole where a dynamic cone penetration test was carried out. BH 3 was advanced to 11.1 m depth whereas BH 2 was advanced to refusal at 17.1 m depth.

The boreholes were advanced using conventional hollow stem augering techniques with a track mounted continuous flight auger machine. The sampling program consisted of split spoon samples collected in the overburden. Disturbed subsoil samples were retrieved by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586). Standard Penetration ('N') values were recorded for assessment of the denseness of the materials encountered. All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing. Dynamic Cone Penetration tests were carried out at the location of each borehole.

Groundwater levels were measured in each borehole and in the watercourse. All boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Northern Region Surveys and Plans Section.

Laboratory

The laboratory testing on selected soil samples consisted of the following:

- Grain Size Distribution
- Natural Moisture Content Determination
- Organic Content Determination

Laboratory results are given in the following section of this report and are illustrated on Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

General

In 1985, a preliminary foundation investigation was carried out by this office for the proposed Hwy 11 & 534 interchange, with a borehole (BH 7) sunk at the southwest

corner of the existing culvert at Genesee Creek. The Record of Borehole sheet produced therein together with the current ones are attached in the Appendix. The locations of the boreholes are shown in Dwg. No. 5919201-A.

The predominant soil stratum encountered in the boreholes consisted of Silty Sand. Some organics are found from ground surface to 2 - 3 m depths. Dynamic Cone Penetration tests and augering reached refusal at probable bedrock at 15.8 - 17.4 m depths (222.6 - 223.3 m) in BH 1 - 3.

Following are the specific descriptions of the materials encountered in the investigation:

Silty Sand

This is the major deposit in the area. It extends from the ground surface to a hard bottom (probable bedrock) at depth. The material is generally described as silty sand although the proportion of silt to sand varies with depth. Some organics was encountered at the surface to a depth of 2 to 3 m. Trace gravel was found below El. $231 \pm$ m. The Standard Penetration Resistance 'N' values recorded range from 0 to 10 blows/0.3 m down to EL $231-232 \pm$ m, indicating very loose to loose state of denseness. The material becomes compact to dense below that elevation with 'N' values of 15 to 33 blows/0.3 m. One very low 'N' value of 1 blow/0.3 m was recorded in BH 2 close to the termination depth. This low blowcount is due to unbalanced hydrostatic head and does not represent the denseness of the material.

Typical properties of the material, as determined by laboratory tests on representative samples may be summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Test</u>
Natural Moisture Content (w%)	19.0-40.5	8
Organic Content Determination(%)	0.23-2.54	2
Grain Size Distribution(%)		8
-Gravel	0-13	
-Sand	47-95	
-Silt	1-47	
-Clay	2-3	

Groundwater

The groundwater level measured in the boreholes was typically close to the ground surface at approximately El. 238 to 239 m. During the time of the investigation, the water level in the creek was at El. 238.7 m.

Groundwater levels are subject to seasonal fluctuations and hence may vary from the elevations given in this report.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the supervision of D. Kwok, Project Foundation Engineer using the equipment owned and operated by Master Soil Investigation Ltd.

The project was carried out by D. Kwok under the general supervision of B. Iyer, Senior Foundation Engineer. The report was written by D. Kwok, reviewed by B. Iyer, and approved by M. Devata, Chief Foundation Engineer.



P. Payer
P. Payer, P. Eng.
Senior Foundation Engineer

APPENDIX

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 591-92-01 LOCATION Co-ords. N 5 104 726.8 E 314 843.7 ORIGINATED BY DK
DIST 1.3 HWY 11 BOREHOLE TYPE Cone Test COMPILED BY 01
DATUM Geodetic DATE 93 06 07 CHECKED BY 01

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						
240.0	Ground Surface									20 40 60 80 100	20 40 60					
0.0																
	Probable Silty Sand Trace Gravel															
222.6																
17.4	End of Cone Test Probable Bedrock									120/17cm						

RECORD OF BOREHOLE No 2

1 OF 1

METRIC

W.P. 591-92-01 LOCATION Co-ords: N 5 104 725.0 ; E 314 827.8 ORIGINATED BY DK
DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger, Cone Test COMPILED BY DT
DATUM Geodetic DATE 93 06 07 CHECKED BY BI

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					
239.7	Ground Surface													
0.0	Trace Gravel Trace Organics & Rootlets Brown, Very Loose		1	SS	1		238							13 84 1 2
			2	SS	2		236							0 88 10 2
			3	SS	1									
			4	SS	6									
	Silty Sand Pinkish Brown Very Loose to Loose		5	SS	1		234							
			6	SS	3		232							1 81 15 3
	Trace Gravel becoming Compact		7	SS	7		230							
			8	SS	17		228							
			9	SS	20		226							
			11	SS	33		224							
			12	SS	1	**								
222.6														
17.1	End of Borehole • 93 06 07 ** Material disturbed due to unbalanced hydrostatic head	Probable Bedrock								120/23cm				

RECORD OF BOREHOLE No 3

1 OF 1

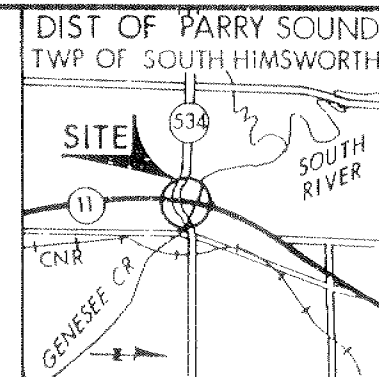
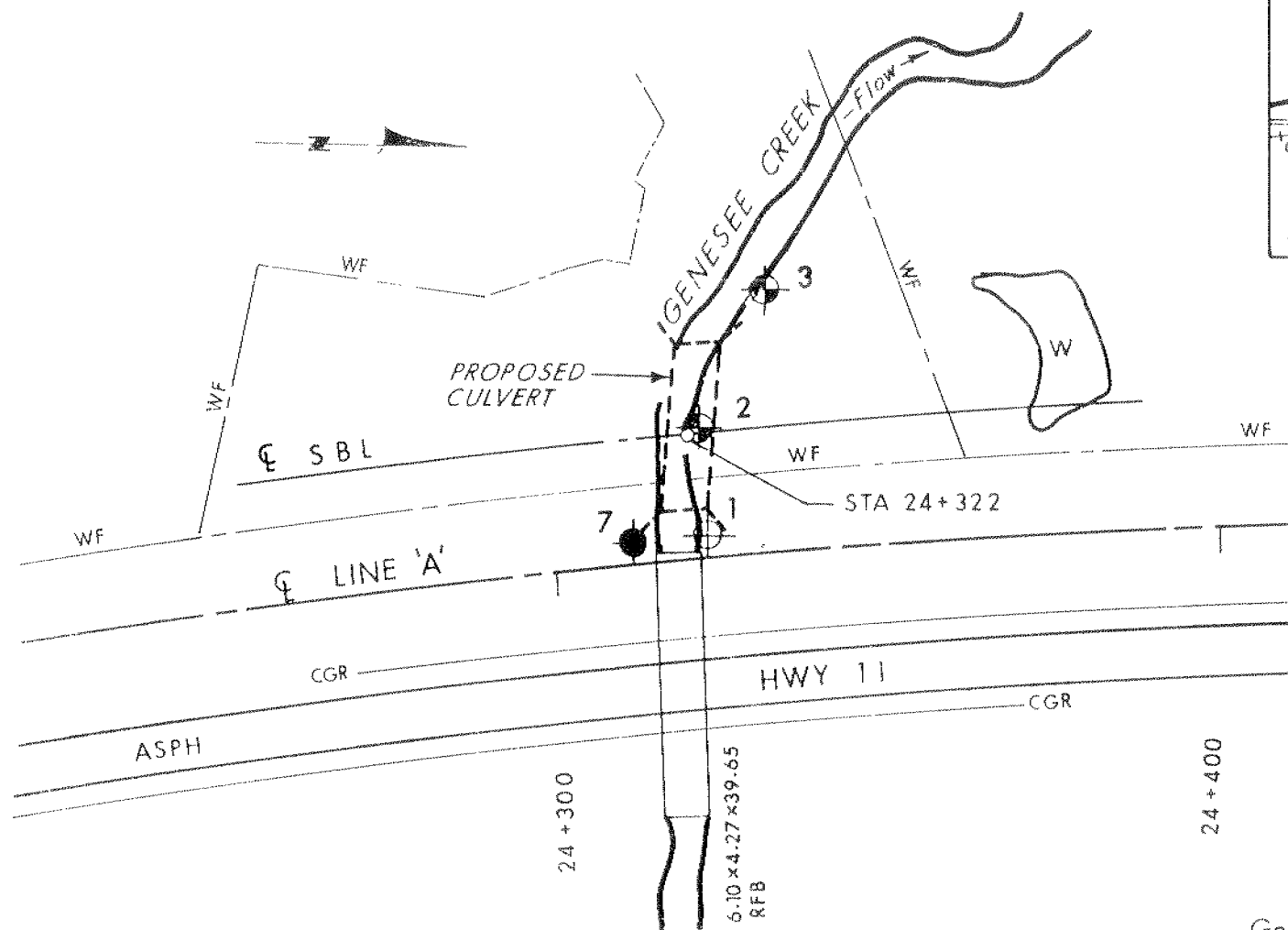
METRIC

W.P. 991-92-01 LOCATION Co-ords. N 5 014 734.6 E 314 806.8 ORIGINATED BY DK
DIST 13 HWY 11 BOREHOLE TYPE Hollow Stem Auger, Cone Test COMPILED BY DJ
DATUM Geodetic DATE 93 06 08 CHECKED BY HI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
239.1	Ground Surface													
0.0			1	SS	2	▼*	238							0 52 46 2
	With Organics and Rootlets Very Loose		2	SS	1									
			3	SS	0									
			4	SS	3		236							0 95 2 3
	Trace Silt		5	SS	2		234							
	Silty Sand		6	SS	7									3 47 47 3
	Pinkish Brown		7	SS	10		232							
	Very Loose to Loose		8	SS	15		230							
	becoming Compact Trace Gravel		9	SS	17									
228.0														
11.1	End of Borehole													
	Probable Silty Sand Trace Gravel													
223.3														
15.8	End of Cone Test													
	* 93 06 08													

RECORD OF BOREHOLE No 7										METRIC						
W P <u>591-92-01</u> <u>84-05-0022</u>		LOCATION <u>381.5 m North of Clarke St.; O/S 19.4 m West of Hwy. 11</u>				ORIGINATED BY <u>SW</u>										
DIST <u>13</u> HWY <u>11 & 534</u>		BOREHOLE TYPE <u>Hollow Stem Auger & NX Washboring</u>				COMPILED BY <u>SW</u>										
DATUM <u>Geodetic</u>		DATE <u>85 03 22</u>				CHECKED BY <u>[Signature]</u>										
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W _p	W	W _L	WATER CONTENT (%)	10 20 30			
239.9	Ground Level															
0.0	SILTY SAND trace gravel clay Very Loose to Compact		1	SS	5											
			2	SS	4											
			3	SS	2											
			4	SS	2											
			4A	SS	10											
			4B	SS	7											
			5	SS	16											
			6	SS	14											
227.3			7	SS	20											
12.6	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION



KEY PLAN
SCALE
1km 0 1km

- LEGEND
- Cone Test
 - Borehole & Cone
 - Borehole (Previous Investigation)
WO 84-05-0022

Geocres No 31L-61
WP 591-92-01
Dist 13, Site 44-242
Dwg No 5919201-A

Note :
For subsurface information refer
to Record of Borehole sheets

PLAN
SCALE
10m 0 10m

FILE COPY



Ministry
of
Transportation

FOUNDATION DESIGN SECTION

**foundation
investigation and
design report**

F

ENGINEERING MATERIALS OFFICE
FOUNDATION DESIGN SECTION

CONT. 95-214
WP 590-92-01 DIST 13
HWY 11 STR SITE 44-365

McGillivray Creek Bridge
Proposed Southbound Lanes

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FOUNDATION INVESTIGATION REPORT
for
McGillvray Creek Bridge
Proposed Southbound Lanes, Highway 11
W.P.590-92-01
District 13, North Bay

INTRODUCTION

This report summarizes the information obtained from the foundation investigation carried out at the above noted site. The investigation was carried out at the request of the Northern Region Structural Section to design a bridge required for the proposed four laning of Highway 11. The field work was carried out on 93 02 02 to 93 02 04 and consisted of six (6) sampled boreholes and five (5) dynamic cone penetration tests at the structure location.

SITE DESCRIPTION

The site is located on the proposed southbound lanes of Highway 11, approximately 7.4 km north of the intersection of Highway 522 and 65 m west of the existing Highway 11 embankment in the Township of South Himsworth, District of Parry Sound.

The existing ground surface elevations range from 257.6 to 257.8 m north of McGillvray Creek and the ground profile slopes up to 260.2 to 262.5 m south of the creek. The slope to the south of the creek is heavily vegetated with tall trees. The low-lying area to the north of the creek is covered with extensive tag alder brush. To the south of the creek, the original houses in the area have been removed and the property is presently a vacant platform. Land use in the adjacent areas includes the highway corridor and livestock pasture. According to the Northern Ontario Engineering Geology Terrain Study published by the Ministry of Natural Resources, the site is located in a Sandy Glaciolacustrine Plain.

INVESTIGATION PROCEDURES

Soil data and inherent properties were obtained by in-situ and laboratory testing. The procedures employed are discussed below.

Field

The field work for the investigation was carried out on 93 02 02 to 93 02 04 and consisted of six (6) sampled boreholes and five (5) dynamic cone penetration tests advanced to depths of 1.8 to 12.5 m. Rock cores were obtained in BH 2 and BH 5.

The boreholes were advanced using conventional hollow stem augering techniques with two track mounted continuous flight auger machines. The sampling program consisted of disturbed samples taken directly from the augers in the surface soil and by split spoon sampler in accordance with Standard Penetration Test (ASTM D1586) for the subsurface strata. Standard Penetration ('N') values were recorded for assessment of the denseness of the materials encountered. All subsoil samples were identified in the field and returned to the laboratory for further examination and appropriate testing. Wire line rock coring techniques were applied in retrieving rock core samples for rock quality determination and classification purposes. Standard NQ core barrels and casings were utilized.

Groundwater level was monitored in open boreholes throughout the investigation. All boreholes were backfilled upon completion of the field work.

Surveying required to ascertain borehole locations and elevations was carried out by the Northern Region Surveys and Plans Section.

Laboratory

The laboratory testing on selected soil samples consisted of the following:

- Atterberg Limit Test

- Grain Size Distribution
- Natural Moisture Content Determination
- Unit Weight Determination
- Unconfined Compressive Test
- Consolidation Test

Laboratory results are given in the following section of this report and are illustrated on Record of Borehole sheets included in the Appendix.

SUBSURFACE CONDITIONS

General

The Record of Borehole sheets in the Appendix illustrate the subsurface conditions at the borehole locations. The locations and elevations of the boreholes are shown in Dwg. No. 5909201-A.

Following are the specific descriptions of the materials encountered in the investigation:

Topsoil

Organic material was encountered at the surface in all boreholes. For BH 1 to 3 which are located to the south of the creek, the material is described as silty sand, some organics. Standard Penetration Resistance 'N' values range from 4 to 8 blows/0.3 m indicating very loose to loose state of denseness. The material encountered in BH 4 to 6 is a clayey topsoil with high organic content.

Silty Sand

This non-cohesive deposit is a minor layer (0.5 to 1.5 m) contacted in BH 1 to 3. The Standard Penetration Resistance 'N' values range widely from 2 blows to 31 blows/0.3 m, indicating very loose to dense state of denseness.

Two grain size distribution tests carried out on selected samples indicate 0-1%

gravel, 63-77% sand and 23-36% silt and clay.

Clayey Silt

This cohesive material was encountered in BH 4 to 6 underlying the organic layer. The thickness of this stratum ranges from 3.0 to 3.8 m.

Five field vane shear tests were conducted in this material resulting in undrained shear strengths of 22 to 70 kPa with sensitivities of 1 to 4. The results of the two unconfined compressive tests carried out indicate undrained shear strengths of 50.9 and 53.4 kPa. The consistency of this material is generally firm to stiff.

Typical properties of this material as determined by laboratory tests carried out on representative samples are summarized as follows:

<u>Property</u>	<u>Range</u>	<u>No. of Test</u>
Natural Moisture Content(w%)	22.5-31.0	5
Liquid Limit (w_L)	23.0-25.0	2
Plastic Limit (w_p)	20.0-23.0	2
Unit Weight (kN/m^3)	18.9-19.4	2

Three consolidation tests carried out indicate compression indice of 0.127 to 0.174 and initial void ratios of 0.65 to 0.82. The preconsolidation pressures obtained range from 11.7 kPa to 90 kPa.

Heterogeneous Mixture of Sand, Silt and Gravel (Glacial Till)

To the south of the creek, this material is encountered at $2 \pm$ m depth in BH 2 and 3. This layer was not penetrated at the termination depth (8.7 m) in BH 3. In BH 2, it becomes bouldery below 9.5 m depth and extends to bedrock at 12.1 m. Standard Penetration Resistance 'N' values range from 12 to 75 blows/0.3 m indicating compact to very dense state of denseness, but typically dense.

To the north of the creek, this material is encountered at $4 \pm$ m in BH 5 and 6 below the clayey silt stratum. In BH 5, it becomes bouldery below 5.3 m depth and extends down to bedrock at 6.0 m. In BH 6, it extends to a hard stratum with auger refusal at 6.4 m. Standard Penetration Resistance 'N' values range from 13 blows/0.3 m to 60 blows/0.28 m indicating compact to very dense state of denseness.

Bedrock

Bedrock was encountered at El. 248.1 m (BH 2) to the south of the creek and El. 251.6 m (BH 5) to the north.

Bedrock was cored in BH 2 and 5. The rock cores obtained were used for rock quality determination and classification. Detailed description of the rock are attached in the Appendix. Bedrock is a slightly weathered to unweathered granite. Core recoveries and Rock Quality Designations are 35-79% and 0-61% respectively.

Groundwater

Groundwater level was monitored during the course of the investigation. The water level measured in BH 2 and BH 3 to the south of the creek is at El. $257 \pm$ m. To the north of the creek, groundwater level is generally at the ground surface. In BH 5, artesian pressure was encountered during bedrock coring and the water level stabilized at 0.7 m above the ground surface.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct a new bridge over the McGillvray Creek as part of the twinning of Hwy 11 (SBL). The proposed structure will be a 34 m long single span structure with an approximate finished grade of about El. 265 m. This will result in approach fills of 4 m in height south of the creek and 8 m in height north of the creek.

Recommendations for the design and construction for the design and construction of structure foundations are as follows.

Structure Foundations

It is considered that the surficial soil layers are not competent to support shallow spread footings. This, together with the relatively high approach fills to be constructed at both abutments, would make the perched foundation on compacted Granular "A" pad to be the most suitable foundation at this site. Typical details of a perched foundation are shown on Figure 1.

At the north abutment, it is recommended that the surficial layer of topsoil be excavated prior to the placement of the compacted granular pad. The foundation shall then be designed using an SLS Type II capacity of 350 kPa and a factored ULS capacity of 720 kPa.

At the south abutment, it is recommended that the surficial layer of topsoil and/or loose silty sand be excavated to a depth of 1.4 m to 2 m below the existing ground surface. Footings founded on compact Granular "A" pad shall be designed using an SLS Type II capacity of 350 kPa and a factored ULS capacity of 900 kPa.

Alternatively, the abutments may also be supported on steel H piles driven to bedrock. Bedrock was established during this investigation only in one borehole in each abutment location. For preliminary design purposes, bedrock elevation may be taken as 248.1 m in the south abutment area and 251.6 m in the north abutment area. However, if this design option is favoured, additional boreholes

may have to be drilled to verify the pile lengths in both abutment areas. Steel H piles driven to bedrock shall be designed using the following factored ULS capacities. SLS Type II capacities do not control the design of piles driven to bedrock.

<u>Pile Type</u>	<u>Factored ULS Capacity</u>
310 X 110 steel H pile	1600 kN
310 X 79 steel H pile	1150 kN

To facilitate driving of piles through the overburden, especially through the boulders encountered within the glacial till layer, it is recommended that piles shall be provided with standard MTO tip reinforcement as per OPSD 3301.

All shallow spread footings or pile caps shall be provided with a minimum of 2.0 m of earth cover for frost protection purposes.

Approach Fills

Approach fills having a height of 4 m at the south abutment and 8 m at the north abutment shall be constructed using 2H to 1V slopes. Any organic soil/surficial organics encountered within the limits of the approach fills should be excavated and removed. It is considered that the settlement of the approach fills will be relatively small.

Backfill Pressures

Backfill pressures on retaining walls shall be calculated using the following coefficients.

	<u>Granular "A"</u>	<u>Granular "B"</u>
Angle of internal friction	35°	30°
Unit weight (kN/m ³)	22.8	21.2
Active earth pressure coefficient, Ka	0.27	0.33

General

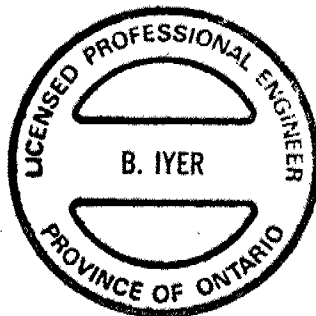
For calculation of sliding resistance of footings resting on compacted Granular "A" pad, an unfactored angle of internal friction of 35° shall be used.

No major construction problems are anticipated with the perched foundation option. However, if the pile foundation option is selected, special considerations would be required regarding the fill type, sequence of construction, etc. to avoid problems associated with the artesian groundwater condition encountered especially in the north abutment area. If this option is favoured, this office will provide additional comments on the above items.

MISCELLANEOUS

The fieldwork for this investigation was carried out under the direct supervision of D. Kwok, P. Eng. and B. Liegler, Engineer in Training, utilizing equipment owned and operated by Dominion Soil Investigation Inc.

The factual part of the report was written by D. Kwok and B. Leigler. The discussion and recommendation part of the report was written by B. Iyer, P. Eng., Senior Foundation Engineer. This report was reviewed by M.S. Devata, P. Eng., Chief Foundation Engineer.



B. Iyer

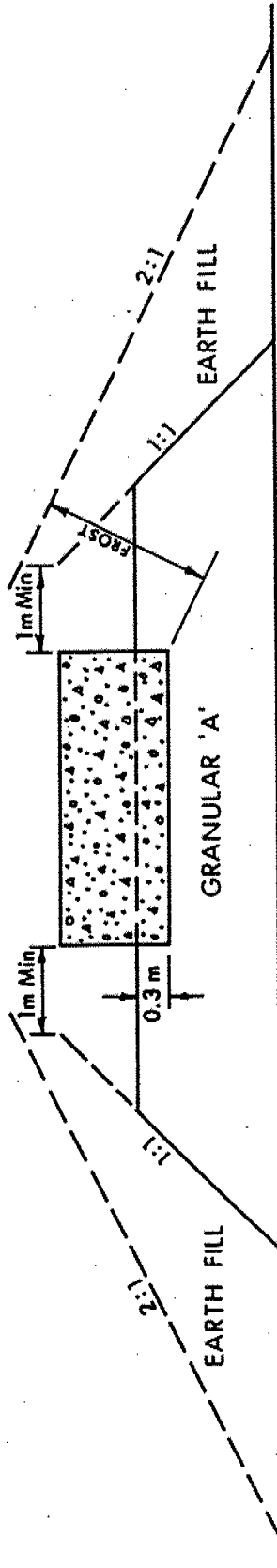
B. Iyer, P. Eng.
Senior Foundation Engineer



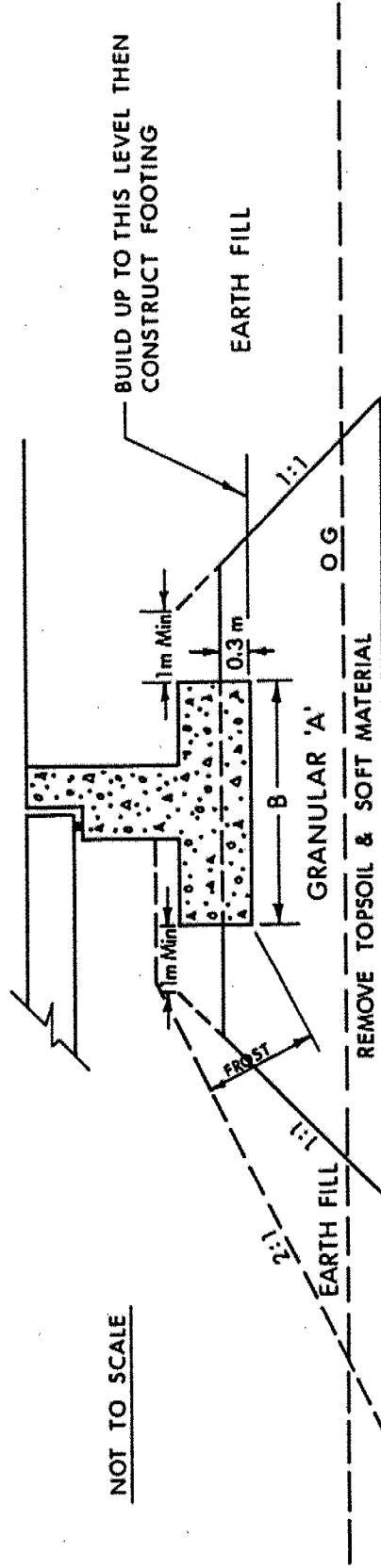
M.S. Devata

M.S. Devata, P. Eng.
Chief Foundation Engineer

APPENDIX



X SECTION



LONGITUDINAL SECTION

- NOTES:
- 1- REMOVE TOPSOIL &/OR SOFT SUBSOIL UNDER AREA OF COMPACTED GRANULAR 'A' & EARTH FILL.
 - 2- PLACE GRANULAR 'A' & EARTH FILL TO BOTTOM OF FOOTING LEVEL, COMPACTED ACCORDING TO CURRENT M T O STANDARDS.
 - 3- CONSTRUCT CONCRETE FOOTING.
 - 4 - PLACE REMAINDER OF GRANULAR 'A' & EARTH FILL AS REQUIRED.

NOT TO SCALE

Ministry of
Transportation



ABUTMENT ON COMPACTED FILL
SHOWING GRANULAR 'A' CORE

FIG No 1

W P 590 -92 -01

EXPLANATION OF TERMS USED IN REPORT

N VALUE: THE STANDARD PENETRATION TEST (SPT) N VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 51mm O.D SPLIT BARREL SAMPLER TO PENETRATE 0.3m INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WITH A MASS OF 63.5kg, FALLING FREELY A DISTANCE OF 0.76m. FOR PENETRATIONS OF LESS THAN 0.3m N VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. AVERAGE N VALUE IS DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST: CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (51mm O.D. 60° CONE ANGLE) DRIVEN BY 475 J IMPACT ENERGY ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 0.3m ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSENESS.

CONSISTENCY: COHESIVE SOILS ARE DESCRIBED ON THE BASIS OF THEIR UNDRAINED SHEAR STRENGTH (c_u) AS FOLLOWS:

c_u (kPa)	0 - 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

DENSENESS: COHESIONLESS SOILS ARE DESCRIBED ON THE BASIS OF DENSENESS AS INDICATED BY SPT N VALUES AS FOLLOWS:

N (BLOWS/0.3m)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCKS ARE DESCRIBED BY THEIR COMPOSITION AND STRUCTURAL FEATURES AND /OR STRENGTH.

RECOVERY: SUM OF ALL RECOVERED ROCK CORE PIECES FROM A CORING RUN EXPRESSED AS A PERCENT OF THE TOTAL LENGTH OF THE CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE INTACT CORE PIECES, 100mm+ IN LENGTH EXPRESSED AS A PERCENT OF THE LENGTH OF THE CORING RUN. THE ROCK QUALITY DESIGNATION (RQD), FOR MODIFIED RECOVERY, IS:

RQD (%)	0 - 25	25 - 50	50 - 75	75 - 90	90 - 100
	VERY POOR	POOR	FAIR	GOOD	EXCELLENT

JOINTING AND BEDDING:

SPACING	50mm	50 - 300mm	0.3m - 1m	1m - 3m	> 3m
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS AND SYMBOLS

FIELD SAMPLING

S S	SPLIT SPOON	T P	THINWALL PISTON
W S	WASH SAMPLE	O S	OSTERBERG SAMPLE
S T	SLOTTED TUBE SAMPLE	R C	ROCK CORE
B S	BLOCK SAMPLE	P H	T W ADVANCED HYDRAULICALLY
C S	CHUNK SAMPLE	P M	T W ADVANCED MANUALLY
T W	THINWALL OPEN	F S	FOIL SAMPLE

STRESS AND STRAIN

u_w	kPa	PORE WATER PRESSURE
r_u	1	PORE PRESSURE RATIO
σ	kPa	TOTAL NORMAL STRESS
σ'	kPa	EFFECTIVE NORMAL STRESS
τ	kPa	SHEAR STRESS
$\sigma_1, \sigma_2, \sigma_3$	kPa	PRINCIPAL STRESSES
ϵ	%	LINEAR STRAIN
$\epsilon_1, \epsilon_2, \epsilon_3$	%	PRINCIPAL STRAINS
E	kPa	MODULUS OF LINEAR DEFORMATION
G	kPa	MODULUS OF SHEAR DEFORMATION
μ	1	COEFFICIENT OF FRICTION

MECHANICAL PROPERTIES OF SOIL

m_v	kPa ⁻¹	COEFFICIENT OF VOLUME CHANGE
C_c	1	COMPRESSION INDEX
C_s	1	SWELLING INDEX
C_α	1	RATE OF SECONDARY CONSOLIDATION
c_v	m ² /s	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
T_v	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
σ'_{vo}	kPa	EFFECTIVE OVERBURDEN PRESSURE
σ'_p	kPa	PRECONSOLIDATION PRESSURE
τ_f	kPa	SHEAR STRENGTH
c'	kPa	EFFECTIVE COHESION INTERCEPT
ϕ'	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
c_u	kPa	APPARENT COHESION INTERCEPT
ϕ_u	-°	APPARENT ANGLE OF INTERNAL FRICTION
τ_R	kPa	RESIDUAL SHEAR STRENGTH
τ_r	kPa	REMOULDED SHEAR STRENGTH
S_t	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

PHYSICAL PROPERTIES OF SOIL

ρ_s	kg/m ³	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	e_{min}	1, %	VOID RATIO IN DENSEST STATE
γ_s	kn/m ³	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	I_D	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
ρ_w	kg/m ³	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
γ_w	kn/m ³	UNIT WEIGHT OF WATER	S_r	%	DEGREE OF SATURATION	D_n	mm	n PERCENT - DIAMETER
ρ	kg/m ³	DENSITY OF SOIL	w_L	%	LIQUID LIMIT	C_u	1	UNIFORMITY COEFFICIENT
γ	kn/m ³	UNIT WEIGHT OF SOIL	w_p	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
ρ_d	kg/m ³	DENSITY OF DRY SOIL	w_s	%	SHRINKAGE LIMIT	q	m ³ /s	RATE OF DISCHARGE
γ_d	kn/m ³	UNIT WEIGHT OF DRY SOIL	I_p	%	PLASTICITY INDEX = $\frac{w_L - w_p}{w_p}$	v	m/s	DISCHARGE VELOCITY
ρ_{sat}	kg/m ³	DENSITY OF SATURATED SOIL	I_L	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
γ_{sat}	kn/m ³	UNIT WEIGHT OF SATURATED SOIL	I_C	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
ρ'	kg/m ³	DENSITY OF SUBMERGED SOIL	e_{max}	1, %	VOID RATIO IN LOOSEST STATE	j	kn/m ³	SEEPAGE FORCE
γ'	kn/m ³	UNIT WEIGHT OF SUBMERGED SOIL						

RECORD OF BOREHOLE No 1

1 OF 1

METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 010.5, E 316 752.7 ORIGINATED BY BL
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Cone Penetration Test COMPILED BY BL
 DATUM Geodetic DATE 93 02 02 CHECKED BY BI

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						
261.3	Ground Surface							20 40 60 80 100						
0.0 260.9	Silty sand with organics dark brown (topsoil)		1	SS	4	*	261	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL * LAB VANE						
0.4	grey													
	Silty sand dense		2	SS	31									
	brown		3	SS	25									
259.5						/8cm Rod bouncing	260							
									120/	23cm	Rod	bouncing		
1.8	End of Borehole													
	• Water Level not Established upon completion of borehole													

RECORD OF BOREHOLE No 2

1 OF 1 METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 020.2, E 316 740.9 ORIGINATED BY DK
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Cone Penetration Test, Rock Core COMPILED BY BL
 DATUM Geodetic DATE 93 02 02 CHECKED BY BI

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						
260.2	Ground Surface							20 40 60 80 100	20 40 60 80 100	10 20 30				
0.0	Silty sand some organics dark brown trace gravel (Topsoil)		1	SS	7		260							
258.8	silt band		2	SS	8		259							
1.4	Sand, some silt, brown/black with brown silt seams compact		3	SS	22	/31cm Rod bouncing on rock	258							1 63 34 2
258.3			4	SS	35		257							
1.9			5	SS	25		256							
			6	SS	44		255							
			7	SS	24		254							
			8	SS	23		253							
			9	RC NQ	REC 38%		252							
			10	RC NQ	REC 74%		251							RQD 0%
			11	RC NQ	REC 35%		250							RQD 61%
			12	RC NQ	REC 79%		249							RQD 0%
248.1	Granitic bedrock						248							RQD 57%
12.1 247.7	End of Borehole													

RECORD OF BOREHOLE No 3

1 OF 1

METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 021.8; E 316 754.2 ORIGINATED BY BL
DIST 13 HWY 11 BOREHOLE TYPE HS Auger COMPILED BY BL
DATUM Geodetic DATE 93 02 02 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
262.5	Ground Surface																
0.0	Silty Sand Some Organics Dark brown (Topsoil)		1	AS			262										
261.9																	
0.6			2	SS	2		261										
	Silty sand Yellowish to medium brown Very loose to loose																
			3	SS	7		260										
260.4																	
2.1			4	SS	38		259										
			5	SS	31		258										
			6	SS	24		257										
	Heterogeneous mixture of silt, sand, and gravel Compact to very dense (glacial till)		7	SS	75		256										
			8	SS	12		255										
253.8							254										
8.7	End of Borehole																

RECORD OF BOREHOLE No 4

1 OF 1 METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 053.7; E 316 728.7 ORIGINATED BY BL
 DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Cone Penetration Test COMPILED BY BL
 DATUM Geodetic DATE 93 02 04 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
257.7	Ground Surface													
0.0	Topsoli dark brown													
257.1														
0.6	brown/grey		1	SS	7									
	Clayey Silt Firm		2	TW	PH								18.9	
	Occasional Organic pockets grey													
254.1														
3.6	End of Borehole *													
253.1														
4.6	End of Cone Test													
	* Auger refusal at Elev. 254.1m although penetration cone was advanced to Elev. 253.1m. May possibly be boulders below Elev. 254.1m.													

RECORD OF BOREHOLE No 5

1 OF 1

METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 057.9; E 316 739.2 ORIGINATED BY DK
DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Cone Penetration Test, Rock Core COMPILED BY BL
DATUM Geodetic DATE 93 02 04 CHECKED BY BI

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	20 40 60 80 100					
257.6	Ground Surface													
0.0	Organic Topsoil													
257.0														
0.6			1	SS	6									
	Clayey Silt Occasional Organic pockets Firm to stiff grey		2	TW	PH								19.4	
253.2			3	SS	2									
4.4			4	SS	30									
	Heterogeneous mixture of sand, some gravel, trace silt, dense (Glacial till)													
	granitic boulders		5	RC NQ	REC 56%									RQD 27%
251.6														
6.0			6	RC NQ	REC 79%									
	Granitic bedrock													RQD 33%
250.7														
6.9	End of Borehole													
	• During drilling Artesian conditions encountered to El 258.3m on 93 02 04													

RECORD OF BOREHOLE No 6

1 OF 1

METRIC

W.P. 590-92-01 LOCATION Co-ords: N5 101 069.1, E 316 731.8 ORIGINATED BY BL
DIST 13 HWY 11 BOREHOLE TYPE HS Auger, Cone Penetration Test COMPILED BY BL
DATUM Geodetic DATE 93 02 03 CHECKED BY BL

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		NATURAL 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	20 40 60 80 100	W _P W W _L				
257.8	Ground Surface													
0.0	Organic topsoil block													
257.0														
0.8			1	SS	3									
	Clayey Silt Occasional Woodchip and organic pockets trace sand brown Firm													
254.1			2	TW	PH									
3.7														
	Heterogeneous mixture of silt, sand, and gravel (glacial till) Compact to very dense		3	SS	13									
251.4			4	SS	61	/28cm								
6.4	End of Borehole *													
250.8														
7.0	End of Cone Test													
	* Auger refusal at Elev. 251.4m although penetration cone was advanced to Elev. 250.8m. Possible boulders below Elev. 251.4m.													

ROCK CORE DESCRIPTION WP 590-92-01

Page 1 of 1

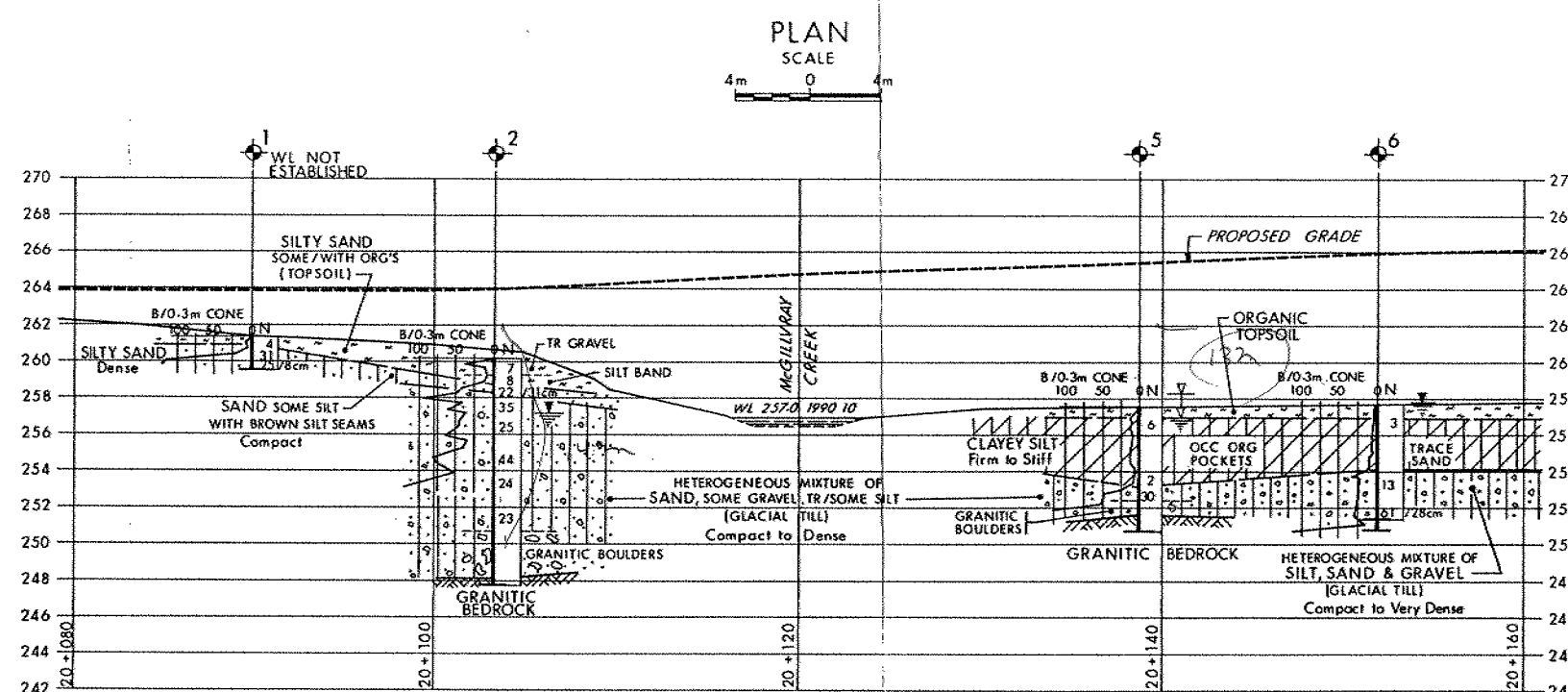
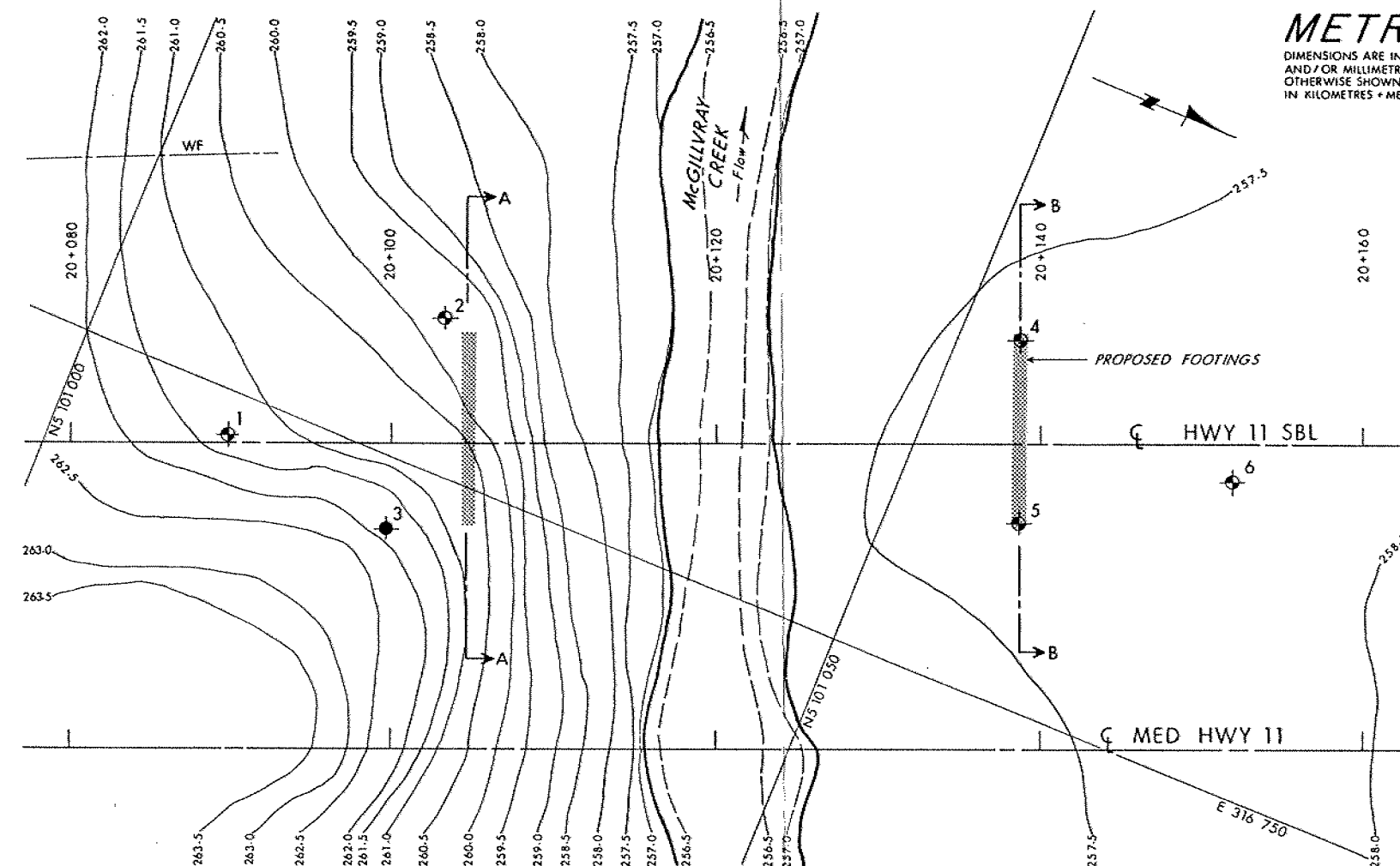
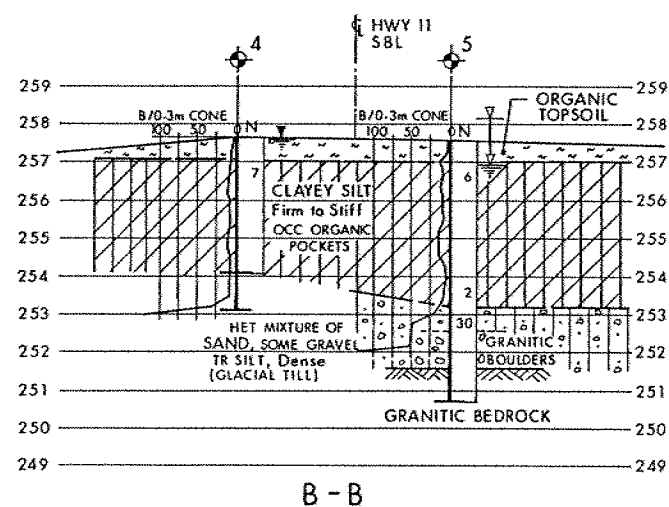
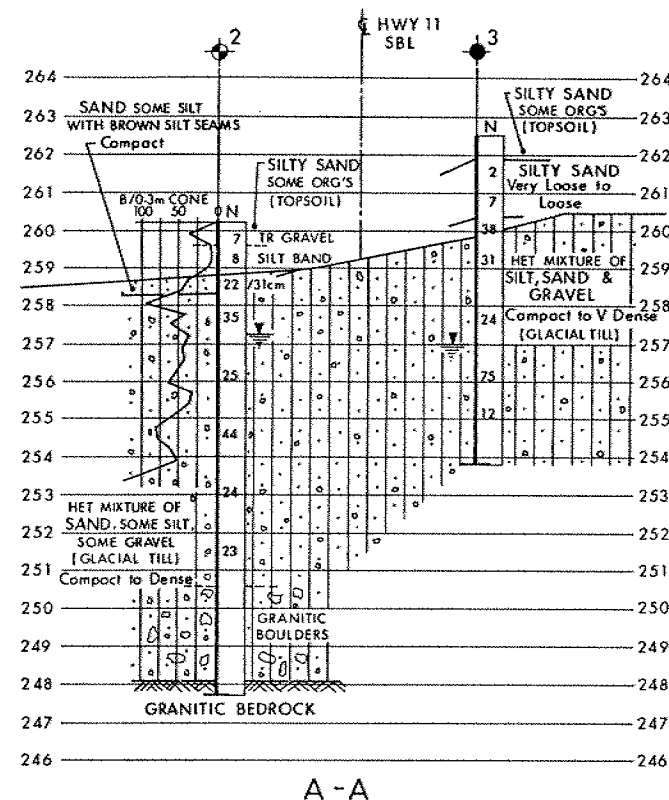
CORE RECOVERY					CORE DESCRIPTION	
BH#	RC#	DEPTH (m)	% CR*	% RQD*	DEPTH (m)	DESCRIPTION
2	9	9.53-10.29	38	0	9.53-12.06	OVERBURDEN (till).
	10	10.29-10.97	74	61	12.06-12.47	GRANITE (hornblende-bearing, chloritized, and garnetiferous), moderate orange pink to dark reddish brown to dark greenish grey; fine to coarse grained; strong; unweathered to slightly weathered; fractures moderate spaced, near vertical to dipping, undulating to planar, rough to smooth.
	11	10.97-11.76	35	0		
	12	11.76-12.47	79	57		
5	5	5.21-6.02	56	27	5.21-6.02	OVERBURDEN (till).
	6	6.02-6.86	79	33	6.02-6.86	GRANITE (hornblende-bearing, chloritized, garnetiferous, and gneissic in part), greyish orange pink to dark greenish grey; fine to coarse grained; strong; unweathered to slightly weathered; fractures close to very close spaced, near vertical to flat, undulating to planar, smooth to rough.

*CR = CORE RECOVERY

*RQD = ROCK QUALITY DESIGNATION

(NOTE: Depths are approximated where core recovery is less than 100%)

Logged by: DAW, Soils and Aggregates Section



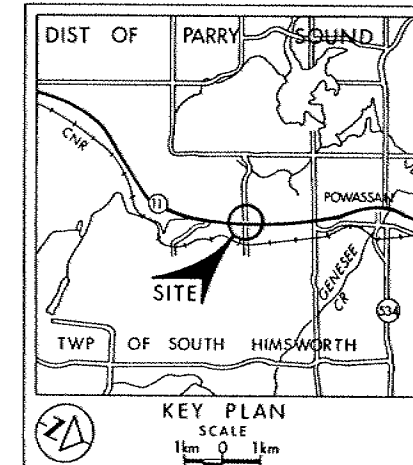
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES UNLESS
OTHERWISE SHOWN. STATIONS
IN KILOMETRES + METRES.

CONT No
WP No 590-92-01

McGILLIVRAY CREEK
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊙ Bore Hole & Cone
- N Blows/0.3m (Std Pen Test, 475 J/blow)
- CONE Blows/0.3m (60° Cone, 475 J/blow)
- W at time of investigation 93 02

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	261.3	5 101 010.5	316 752.7
2	260.2	5 101 020.2	316 740.9
3	262.5	5 101 021.8	316 754.2
4	257.7	5 101 053.7	316 728.7
5	257.6	5 101 057.9	316 739.2
6	257.8	5 101 069.1	316 731.8

NOTE

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

NOTE: The complete foundation investigation and design report for this project and other related documents may be examined at the Engineering Materials Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with the conditions of Section GC 2.01 of OPS Gen Cond

REV.	DATE	BY	DESCRIPTION
1			

Geacres No 31L-60

HWY No 11	DIST 13
SUBMITTAL CHECKED	DATE 1993 05 14
DRAWN DT	CHECKED

REF No E-509-11-3, 1990 10





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

DIST 13 CONT No X WP No 590-92-01	
McGILLVRAY CREEK BRIDGE GENERAL ARRANGEMENT	

SHEET

LIST OF ABBREVIATIONS

1/A DENOTES TOP OF ASPHALT
W.P. DENOTES WORKING POINT
1/A.H. DENOTES TOP OF FOOTING
W.L. DENOTES WATER LEVEL

GENERAL NOTES

CLASS OF CONCRETE

ALL CONCRETE 30 MPa

CLEAR COVER TO REINFORCING STEEL

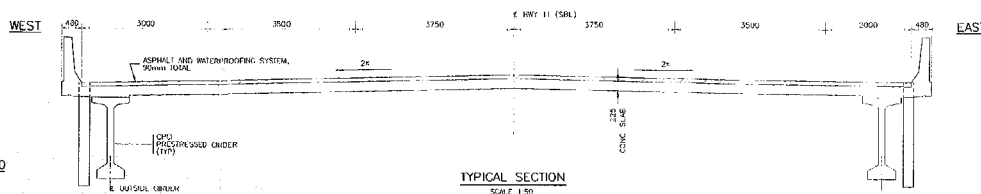
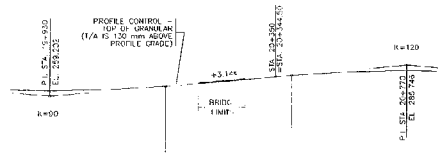
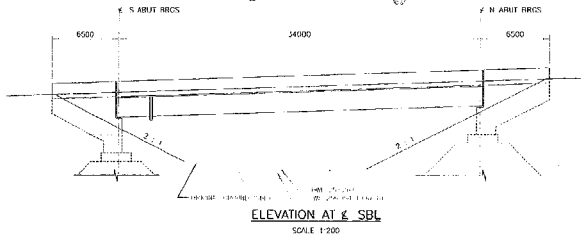
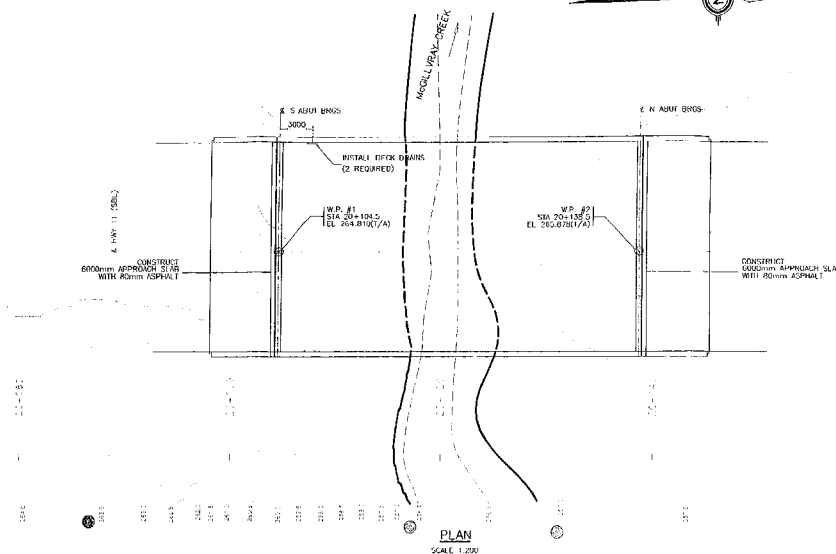
JOINTS 100mm
SUBMENTS, WALLS AND RETAINING WALLS
FRONT FACE 80mm
BACK FACE 70mm
DECK TOP 70mm
BOTTOM 40mm
REINFORCING 70mm
(UNLESS OTHERWISE NOTED)

REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BAR MARKS WITH SUFFIX C DENOTE COATED BARS

CONSTRUCTION NOTES

IF THE ACTUAL BEARING HEIGHTS ARE DIFFERENT FROM THE ASSUMED BEARING HEIGHTS GIVEN WITH THE BEARING LOCATION DATA, THE CONTRACTOR SHALL ADJUST THE BEARING SLAB ELEVATIONS AND THE REINFORCING STEEL TO SUIT THE ACTUAL HEIGHTS.



APPLICABLE STANDARD DRAWING

0950 3006.02 BRIDGE BACK WALL/ROOFING
0950 3006.03 BRIDGE DECK WATERPROOFING DETAILS

DESIGN	CHK	CODE	CHG	LOAD	CL	DATE	DATE
0950 3006.02	0950 3006.03	0950 3006.03	0950 3006.03	0950 3006.03	0950 3006.03	0950 3006.03	0950 3006.03

B.M. 258.110
TOP OF T. BRG.
80.0 M. 20+108.2

DRAWING NOT TO BE USED FOR
100 mm ON ORIGINAL DRAWING