

ENGINEERING MATERIALS OFFICE  
PAVEMENT & FOUNDATION DESIGN SECTION

WP 131-77-01 DIST 17  
HWY 144N STR SITE 46-308

Underpass Interchange at  
Hwy. 17N and Hwy. 144N

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# FOUNDATION INVESTIGATION REPORT

For

Underpass Interchange at Hwy. 17N and Hwy. 144N  
W.P. 131-77-01, Site 46-308  
District 17, Sudbury

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## INTRODUCTION

This report contains the results of a foundation investigation carried out at this site by the Pavement and Foundation Design Section during the period of November 5 to November 7, 1979. Fieldwork consisted of advancing 6 sampled boreholes, one of which was accompanied by a dynamic cone penetration test, and 4 augered probe holes. The depth of borings ranged from 2.2 m to 7.5 m below the ground surface. Disturbed samples of the overburden were recovered by means of a split spoon sampler which was driven into the ground in accordance with the specifications for Standard Penetration Test. Bedrock was proven by obtaining up to 3 m of BX size rock core samples.

## SITE AND GEOLOGY

The site is located on Hwy. 17N, about 3.2 km west of Reg. Rd. 24 and the Town of Lively in the Regional Municipality of Sudbury, Town of Walden.

The surrounding terrain is rolling with some rock outcrops nearby, and heavily forested. A number of rock cuts can be seen along Hwy. 17N in this area. Hwy. 17N, which was under construction, is a four lane divided highway with a 24 m wide median.

Geologically, the site is located in the Canadian Shield. This region was subjected to extensive glacial erosion during the Pleistocene epoch, resulting in most of the pre-glacial deposits being eroded away. The present overburden consists mainly of glacial or post glacial deposits. Bedrock in this Sudbury area is composed of a metasedimentary of the McKim formation or metavolcanics of the Copper Cliff formation.

According to available geological information, the Meatbird fault, an off shoot of the Murray fault, traverses this general area.

#### SUBSURFACE CONDITIONS

The subsurface conditions at this site were found to be relatively uniform. Underneath a thin mantle of clayey silt, about 0.5 to 0.7 m thick, is a deposit of sandy silt to silty sand. This granular deposit extends to bedrock surface and has a thickness ranging from 1.6 m to 3.9 m. Bedrock is a greywacke, which is a metamorphosed sedimentary rock.

The location and elevation of the boreholes are shown on Drawing No. 1317701-A, which also contains three subsoil stratigraphical sections inferred from the borehole data. A description of the subsoil and bedrock types encountered, as well as the groundwater conditions, is as follows.

##### Clayey Silt

The natural ground outside the roadway of Hwy. 17N is covered with a thin layer of clayey silt. This cohesive layer has a thickness of about 0.5 m to 0.7 m. The clayey silt is brown in colour and has a low plasticity and a firm to stiff consistency.

##### Sandy Silt to Silty Sand

Underneath the cohesive subsoil is the predominant deposit at the site composed of sandy silt to silty sand, some gravel, with occasional cobbles and boulders. This granular deposit extends to bedrock surface and has a thickness ranging from 1.6 m to 3.9 m approximately. The 'N' values varied from 13 to 41 blows/0.3 m. Accordingly, the relative density of the granular subsoil is estimated to be compact to dense, but generally in the compact range.

##### Bedrock

Bedrock surface varies from elevation 265.1 to elevation 269.2

across the site. Bedrock is a greywacke, dark grey in colour, and fine to medium textured. According to the generally very high recovery ratio's and rock quality designation values of the rock cores, which vary from 85% to generally close to 100%, bedrock is sound with only occasional slightly fractured zones. The generally very long rock cores recovered suggest that the spacings of the jointings are moderately close to wide, being in the order of 0.5 m to 1.3 m apart. In addition, most of the joints are tight.

#### Groundwater Conditions

The groundwater level at this site was found to vary between elevation 267.6 and elevation 268.3. Because of the shallow depth of the overburden and the granular nature of the sub-soil, it is expected that the groundwater level would conform more or less to the topography of the terrain or the bedrock surface.

## APPENDIX



## HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE No 1

METRIC

W.P. 131-77-01 LOCATION Co-ords. N 5 141 783.8; E 290 732.5 ORIGINATED BY BL  
 DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers and BX Rock Core COMPILED BY BL  
 DATUM Geodetic DATE 1979 11 07 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)
								20 40 60 80 100										
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE											
271.7	Ground Level															GR SA SI CL		
271.2	Clayey Silt																	
0.5	Sandy silt to silty sand. Some gravel, occasional cobbles and boulders Compact to dense		1	SS	18		270											
			2	SS	41		268											
267.6	4.1 Greywacke Bedrock		3	BX RC	REC 87%		266									R.Q.D. 85%		
	Slightly fractured																	
	Sound and massive		4	BX RC	REC 100%											R.Q.D. 100%		
265.3																		
6.4	End of Borehole																	

## RECORD OF BOREHOLE No 2

METRIC

W.P. 131-77-01 LOCATION Co-ords. N 5 141 785.9; E 294 739.7 ORIGINATED BY BL  
 DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers COMPILED BY BL  
 DATUM Geodetic DATE 1979 11 07 CHECKED BY *CP*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)  GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80					

\*3, x5: Numbers refer to Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

REPORT ON SOIL EXPLORATION

ON SOIL EXPLORATION



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HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 2A

METRIC

W P 131-77-01 LOCATION Co-ords. N 5 141 784.9; E 290 736.1 ORIGINATED BY BL  
DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers COMPILED BY BL  
DATUM Geodetic DATE 1979 11 07 CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
271.6	Ground Level																
0.0	Sandy silt to silty sand (inferred)					*	270										
268.8																	
2.8	End of Borehole  <u>Note:</u> Refusal to augering on probable bedrock at elev. 268.8  * Water level not established.																

RECORD OF BOREHOLE No 3

METRIC

W P 131-77-01 LOCATION Co-ords. N 5 141 787.0; E 290 747.6 ORIGINATED BY BL  
DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers and BX Rock Core COMPILED BY BL  
DATUM Geodetic DATE 1979 11 07 CHECKED BY *GP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
271.2	Ground Level																
0.0	Sandy silt to silty sand (inferred)					*	270										
268.9																	
2.3	Greywacke Bedrock fine to medium textured, sound		1	BX RC	REC 95%		268										R.Q.D. 95%
267.4																	
3.8	End of Borehole  * Water level not established																

\*3, x5: Numbers refer to  
Sensitivity

20  
15  $\div$  5 (%) STRAIN AT FAILURE  
10

REPORT ON SOIL EXPLORATION

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HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 4

METRIC

W P 131-77-01 LOCATION Co-ords. N 5 141 824.7; E 290 726.5 ORIGINATED BY BL  
DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers COMPILED BY BL  
DATUM Geodetic DATE 1979 11 06 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
270.3	Ground Level																GR SA SI CL
0.0	Sandy silt to silty sand (inferred)					*	270										
							268										
266.1	End of Borehole																
4.2	Note: Refusal to augering on probable bedrock at elev. 266.1  * Water level not established																

RECORD OF BOREHOLE No 5

METRIC

W P 131-77-01 LOCATION Co-ords. N 5 141 825.8; E 290 734.3 ORIGINATED BY BL  
DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers and BX Rock Core COMPILED BY BL  
DATUM Geodetic DATE 1979 11 06 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
270.5	Ground Level																GR SA SI CL
0.0	Clayey silt						270										
269.9																	
0.6	Sandy silt to silty sand, some gravel, cobbles and boulders		1	SS	17												
267.7	Compact						268										
2.8	Greywacke Bedrock		2	BX RC	REC 100%												R.Q.D. 100%
	Sound																
	Slightly fractured		3	BX RC	REC 90%		266										R.Q.D. 90%
264.7			4	BX RC	REC 100%												R.Q.D. 100%
5.8	End of Borehole																

+3, x5: Numbers refer to Sensitivity  
20  
15 5 (%) STRAIN AT FAILURE  
10





## HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE No 6

METRIC

W P 131-77-01 LOCATION Co-ords. N 5 141 826.7; E 290 742.2 ORIGINATED BY BL  
 DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers and EX Rock Core COMPILED BY BL  
 DATUM Geodetic DATE 1979 11 06 CHECKED BY *CP*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20					
270.7	Ground Level												GR SA SI CL
0.0	Sandy silt to silty sand (inferred)				*	270							
268.2													
2.5	Greywacke Bedrock Sound		1	EX RC	REC 100%	268							R.Q.D. 100%
266.7													
4.0	End of Borehole												
	* Water level not established												

## RECORD OF BOREHOLE No 7

METRIC

W P 131-77-01 LOCATION Co-ords. N 5 141 858.8; E 290 721.8 ORIGINATED BY BL  
 DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers and Cone Test COMPILED BY BL  
 DATUM Geodetic DATE 1979 11 06 CHECKED BY *CP*

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20						40
269.7	Ground Level													
0.0														
269.2	Clayey silt													
0.5	Sandy silt to silty sand, some gravel, cobbles and boulders. Compact		1	SS	17									
			2	SS	25									
265.1														
4.6	End of Borehole													
	Note: Refusal to augering on probable bedrock at 265.1													

+3, x5 : Numbers refer to Sensitivity

20  
15  $\div$  5 (%) STRAIN AT FAILURE  
10

REPORT ON SOIL EXPLORATION

REPORT ON SOIL EXPLORATION



Highway Engineering Division  
Engineering Materials Office  
Soil Mechanics Section

# HIGHWAY ENGINEERING DIVISION-ENGINEERING MATERIALS OFFICE-SOIL MECHANICS SECTION

## RECORD OF BOREHOLE No 8

METRIC

W.P. 131-77-01 LOCATION Co-ords N 5 141 859.8; E 290 729.7 ORIGINATED BY BL  
DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers COMPILED BY BL  
DATUM Geodetic DATE 1979 11 06 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
269.8	Ground Level																
0.0	Sandy silt to silty sand (inferred)					*											
							268										
							266										
265.2																	
4.6	End of Borehole Note: Refusal to augering on probable bedrock at 265.2  *Water level not established.																

ON SOIL EXPLORATION

## RECORD OF BOREHOLE No 9

METRIC

W.P. 131-77-01 LOCATION Co-ords. N 5 141 860.9; E 290 737.6 ORIGINATED BY BL  
DIST 17 HWY 144 NWBP BOREHOLE TYPE Hollow Stem Augers and BX Rock Core COMPILED BY BL  
DATUM Geodetic DATE 1979 11 05-06 CHECKED BY *CP*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	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					
270.2	Ground Level																
0.0	Clayey silt						270										
269.5																	
0.7	Sandy silt to silty sand. Some gravel, cobbles and boulders. Compact		1	SS	25		268										
			2	SS	13												
							266										
265.5			3	SS	17	150 mm and Bouncing											
4.7	Greywacke Bedrock		4	BX RC	REC 90%												RQD 90%
	Sound, fine to medium textured		5	BX RC	REC 100%		264										RQD 100%
262.6																	
7.8	End of Borehole																

REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to Sensitivity  
20  
15 → 5 (%) STRAIN AT FAILURE  
10

## 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 (R Q D), 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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	$\text{kPa}^{-1}$	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$C_v$	$\text{m}^2/\text{s}$	COEFFICIENT OF CONSOLIDATION
H	m	DRAINAGE PATH
$T_v$	1	TIME FACTOR
U	%	DEGREE OF CONSOLIDATION
$\sigma'_{vo}$	kPa	EFFECTIVE OVERBURDEN PRESSURE
$\sigma'_p$	kPa	PRECONSOLIDATION PRESSURE
$\tau_f$	kPa	SHEAR STRENGTH
$c'$	kPa	EFFECTIVE COHESION INTERCEPT
$\phi'$	-°	EFFECTIVE ANGLE OF INTERNAL FRICTION
$c_u$	kPa	APPARENT COHESION INTERCEPT
$\phi_u$	-°	APPARENT ANGLE OF INTERNAL FRICTION
$\tau_R$	kPa	RESIDUAL SHEAR STRENGTH
$\tau_r$	kPa	REMOULDED SHEAR STRENGTH
$S_t$	1	SENSITIVITY = $\frac{c_u}{\tau_r}$

### STRESS AND STRAIN

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

### PHYSICAL PROPERTIES OF SOIL

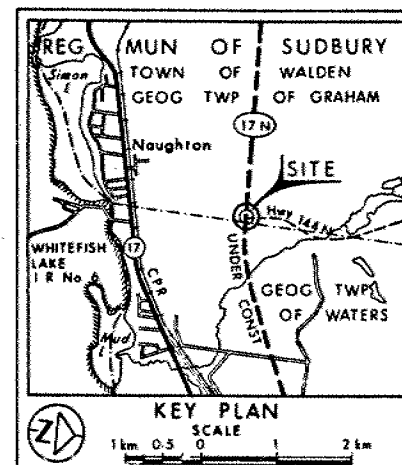
$\rho_s$	$\text{kg}/\text{m}^3$	DENSITY OF SOLID PARTICLES	e	1, %	VOID RATIO	$e_{min}$	1, %	VOID RATIO IN DENSEST STATE
$\gamma_s$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOLID PARTICLES	n	1, %	POROSITY	$I_D$	1	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
$\rho_w$	$\text{kg}/\text{m}^3$	DENSITY OF WATER	w	1, %	WATER CONTENT	D	mm	GRAIN DIAMETER
$\gamma_w$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF WATER	$S_r$	%	DEGREE OF SATURATION	$D_n$	mm	n PERCENT - DIAMETER
$\rho$	$\text{kg}/\text{m}^3$	DENSITY OF SOIL	$w_L$	%	LIQUID LIMIT	$C_u$	1	UNIFORMITY COEFFICIENT
$\gamma$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SOIL	$w_p$	%	PLASTIC LIMIT	h	m	HYDRAULIC HEAD OR POTENTIAL
$\rho_d$	$\text{kg}/\text{m}^3$	DENSITY OF DRY SOIL	$w_s$	%	SHRINKAGE LIMIT	q	$\text{m}^3/\text{s}$	RATE OF DISCHARGE
$\gamma_d$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF DRY SOIL	$I_p$	%	PLASTICITY INDEX = $w_L - w_p$	v	m/s	DISCHARGE VELOCITY
$\rho_{sat}$	$\text{kg}/\text{m}^3$	DENSITY OF SATURATED SOIL	$I_L$	1	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$	i	1	HYDRAULIC GRADIENT
$\gamma_{sat}$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SATURATED SOIL	$I_C$	1	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$	k	m/s	HYDRAULIC CONDUCTIVITY
$\rho'$	$\text{kg}/\text{m}^3$	DENSITY OF SUBMERGED SOIL	$e_{max}$	1, %	VOID RATIO IN LOOSEST STATE	j	$\text{kN}/\text{m}^2$	SEEPAGE FORCE
$\gamma'$	$\text{kN}/\text{m}^3$	UNIT WEIGHT OF SUBMERGED SOIL						

CONT No  
WP No 131-77-01

HWY 17N & HWY 144N  
UNDERPASS INTERCHANGE  
BORE HOLE LOCATIONS & SOIL STRATA

SHEET

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



**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.L. at time of investigation 1979 11
- W.L. Not Established in BH#2, 2A, 3, 4, 6 & 8

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	271.7	5 141 783.8	290 732.5
2	271.4	5 141 785.9	290 739.7
2A	271.6	5 141 784.9	290 736.1
3	271.2	5 141 787.0	290 747.6
4	270.3	5 141 824.7	290 726.5
5	270.5	5 141 825.8	290 734.3
6	270.7	5 141 826.7	290 742.2
7	269.7	5 141 858.8	290 721.8
8	269.8	5 141 859.8	290 729.7
9	270.2	5 141 860.9	290 737.6

**NOTE**

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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No 411-113  
HWY No 144 NWBP  
SUBNO B1 CHECKED  
DRAWN CHECKED  
DATE 1979 11 22  
SITE 46-308  
APPROVED  
DWG 1317701-A

