

GEOCRE'S No:  
30M11-226

# FOUNDATION INVESTIGATION REPORT

CONTRACT NO 87 - 92



Ontario

Ministry of  
Transportation and  
Communications

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Note: For the purpose of this contract, this report supercedes all other foundation reports prepared by or for the Ministry in connection with the above-noted projects.

**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
$\sigma$	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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /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 = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

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

FOUNDATION INVESTIGATION REPORT  
For  
W.P. 30-81-13  
F.T.M.S. CMS Signs  
Hwy. 401, District 6, Toronto

This report summarizes the results of a foundation investigation for proposed F.T.M.S. signs.

The major portion of the field work was conducted between 85 10 19 and 85 11 15 during which time 17 F.T.M.S. sites were investigation. An additional site was investigated on 86 02 27, and a revised location for one of the original sites was investigated on 86 10 20. The site locations are illustrated on the Foundation Contract Drawing. Specific locations are provided in Table 2.

The field work generally involved advancing boreholes near the proposed footing locations. However, at CMS - Allen SW, only one borehole was advanced due to site restrictions.

At all the sites, the subsurface material was found to be predominantly a silty clay till of low plasticity overlain by variable thicknesses of fill material. Occasional boulders and boulder nests are anticipated within this till deposit.

However, the investigation revealed that the subsurface conditions across the site are not consistent, as both cohesive and non-cohesive deposits were encountered.

In zones where the soil is slightly plastic or non-cohesive, and below the groundwater level, it is likely that the sides of an unsupported augered hole will cave in, and seepage will occur. In situations where excavations (or augered holes) extend into cohesionless soils below the groundwater table, 'boiling' may be experienced at the base.

Groundwater levels were measured at the completion of each borehole. The measured levels are shown on each Record of Borehole Sheet. In view of the hard and very dense nature of glacial deposits, it is believed that the measured groundwater levels do not represent stabilized conditions and the actual levels may, in fact, be higher than those indicated on the Record of Borehole Sheets.

Specific subsurface conditions at the borehole locations are illustrated in the appended Record of Borehole Sheets. The boreholes are identified by the F.T.M.S. sign designation and as left or right with respect to lane direction.

Further to our conversation with C.P. Korzenioski of McCormick Rankin and Associates, no surface elevations were provided, hence only depths and relative elevations have been indicated on the borehole sheets.



*D. H. Dundas*

D.H. Dundas, P. Eng.

Senior Foundations Engineer

*M. Devata*

M. Devata, P. Eng.

Chief Foundations Engineer

(East)

**APPENDIX**

TABLE 2SPECIFIC SIGN LOCATIONS

<u>SIGN</u>	<u>SPECIFIC LOCATON</u>
CMS-1E	20 m west of O.H. sign: Islington Ave. North Weston Rd. Black Creek Drive
CMS-409	15 m west of sign: Ramp Speed 70 km/hr
CMS-400	493 metres south of Sheppard Avenue at southbound Hwy 400
CMS-2EE	At sign for Hwy. 400 turn-off
CMS-2EC	Below Hwy. 400 S. B. Lanes
CMS-7WC	At the M.T.C. name on the South wall of the East Building
CMS-6WE	70 m east of Keele St.
CMS-3EE	10 m east of O.H. sign: Avenue Rd. Yonge St. Exit Bayview Ave. 1 km
CMS-Allen	20 m south of Ranee Ave.
CMS-Allen SW	Just south of ramp from Allen Rd. S. B. to 401 E. B.
CMS-4EC	120 m east of Bathurst St.
CMS-5WE	At O.H. sign: Allen Rd Exit 1 km

SPECIFIC SIGN LOCATIONS - cont'd

<u>SIGN</u>	<u>SPECIFIC LOCATON</u>
CMS-4WE	15 m west of sign: Avenue Rd. Exit Bathurst St. 1 km
CMS-4EE	20 m east of sign: Leslie St. Victoria Park Ave. Exit Warden Ave. 1 km
CMS-5WC	100 m east of Leslie St.; west of exit ramp to Leslie St.
CMS-5EC	30 m west of sign: Macdonald Carter Freeway
CMS-3WE	10 m west of sign: Don Valley Pkwy. Exit 1 km
CMS-DVP	Don Valley Pkwy. Northbound, 182.5 m south of Three Valleys Drive



# RECORD OF BOREHOLE No CMS-1E LEFT

METRIC

W P 30-81-13 LOCATION 401 EB East of Dixon Rd. Left elevated shoulder ORIGINATED BY FS  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY FS  
 DATUM ASSUMED DATE 85 10 18 CHECKED BY DD

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	SHEAR STRENGTH								
100.0 0.0	GROUND SURFACE					*										
	Silty Clay (CL) with Sand Some Gravel															
	occ. sand zones		1	SS	14											
	Stiff to Hard		2	SS	14											
			3	SS	18											
	Occ. sand Some fine gravel Very dense		4	SS	57											
			5	SS	9											
			6	SS	19											
			7	SS	62											
			8	SS	120											
90.4 9.6	END OF BOREHOLE															
	*Groundwater elevation not established															

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No CMS-1E RIGHT

METRIC

W P 30-81-13 LOCATION 401 EB, - 200 m E of Dixon - Right Shoulder ORIGINATED BY FS  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY BD  
 DATUM ASSUMED DATE 85 10 09 CHECKED BY DD

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					
100.0	GROUND SURFACE																
0.0	Silty Clay (CL) with sand some gravel  Firm to Hard		1	SS	21												
			2	SS	13												
			3	SS	7												
	Occ. sand Some fine gravel Compact		4	SS	21												
			5	SS	27												
			6	SS	40												
91.9	END OF BOREHOLE		7	SS	83												
8.1	*Groundwater elevation not established																

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



RECORD OF BOREHOLE No CMS-409  
LEFT

METRIC

W P 30-81-13 LOCATION 409 EB, 200 m W. of Kipling Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 409 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 17 CHECKED BY D.D.

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					
100.0	Ground Surface															
0.0	Silty Sand Trace Clay Compact		1	SS	14	*										
98.3			2	SS	13											
1.7	Silty Clay (CL) with Sand some Gravel Stiff to Hard		3	SS	16											
			4	SS	21											
			5	SS	50											
			6	SS	27											
91.9			7	SS	82	/23 cm										
8.1	End of Borehole															
	* Ground water elevation not established.															

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No CMS-409 RIGHT

METRIC

W P 30-81-13 LOCATION 409 EB, 200 m W. of Kipling Right Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 16 CHECKED BY D.D.

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					
100.0	Ground Surface													
0.0	Silty Sand with Clay  Loose		1	SS	5	*								
98.3			2	SS	5									
1.7	Silty Clay (CL) with Sand some Gravel Stiff		3	SS	10									
			4	SS	9									
			5	SS	8									
			6	SS	8									
92.8	Refusal + Concrete Footing +													
7.2	End of Borehole													
	* Ground water elevation not established													

OFFICE REPORT ON SOIL EXPLORATION

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No CMS-2EE LEFT

METRIC

W P 30-81-13 LOCATION 401 EB Express, 200 m W of 400 SBL Left Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE S.S. Auger COMPILED BY B.D.  
 DATUM Assumed DATE 85 10 30 CHECKED BY D.D.

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			SHEAR STRENGTH kPa									
100.0	Ground Surface																
0.0	Silty Sand Trace Gravel Trace Clay Compact					*											
98.6			1	SS	13												
1.4	Silty Clay Trace Gravel Trace Sand Firm to Stiff																
			2	SS	15												
			3	SS	12												
			4	SS	13												
			5	SS	6												
			6	SS	5												
			7	SS	7												
			8	SS	7												
			9	SS	9												
			10	SS	9												
86.9																	
13.1	End of Borehole																
	* Ground water elevation not established																

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No CMS-2EE RIGHT

METRIC

W P 30-81-13 LOCATION 401 EB Express, 200 m W of 400 SBL Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY B.D.  
 DATUM Assumed DATE 85 10 25 CHECKED BY D.D.

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	20 40 60 80 100					
100.0	Ground Surface													
0.0	Silty Sand Trace Clay Some Gravel Compact					*								
98.9			1	SS	17		99							
1.1	Silty Clay Trace/Some Sand Trace Gravel Firm to Very Stiff		2	SS	30		98							
			3	SS	18		97							
			4	SS	23		96							
			5	SS	11		95							
			6	SS	6		94							
			7	SS	9		93							
			8	SS	10		92							
			9	SS	11		91							
			10	SS	16		90							
			11	SS	9		89							
85.8							88							
14.2	End of Borehole						87							
	* Ground water elevation not established						86							

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No CMS-2EC LEFT

METRIC

W P 30-81-13 LOCATION 401 EB Collector, @400 SB Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 17 CHECKED BY D.D.

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	SHEAR STRENGTH kPa					
100.0	Ground Surface													
0.0	Silty Sand Compact					*								
98.0			1	SS	13		99							
2.0			2	SS	15		98							
	occ. Silty Sand Bands		3	SS	19		97							
			4	SS	19		96							
	Silty Clay Trace Sand		5	SS	20		95							
	Stiff to Very Stiff		6	SS	8		94							
			7	SS	8		93							
			8	SS	9		92							
			9	SS	13		91							
			10	SS	9		90							
87.4							89							
12.6	End of Borehole						88							
	* Ground water elevation not established													

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

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

# RECORD OF BOREHOLE No CMS-2EC RIGHT

METRIC

W P 30-81-13 LOCATION 401 EB Collector, At 400 2 m Right of Curb ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 10 CHECKED BY D.D.

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	20 40 60 80 100					
100.0	Ground Surface													
0.0														
	Occ. Silty Clay Zones		1	SS	23		99							
	Silty Sand Very Loose to Compact		2	SS	9		98							
			3	SS	4		97							
			4	SS	2		96							
95.1			5	SS	8		95							
4.9			6	SS	10		94							
	Silty Clay Trace Sand		7	SS	12		93							
	Stiff		8	SS	11		92							
			9	TW	PH		91							
			10	SS	9		90							
			11	SS	10		89							
			12	SS	12		88							
84.9							87							
15.1							86							
							85							

OFFICE REPORT ON SOIL EXPLORATION

Continued

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

Continued



# RECORD OF BOREHOLE No CMS-2EC RIGHT

METRIC

W P 30-81-13 LOCATION 401 EB Collector, At 400 2 m Right of Curb ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 10 10 CHECKED BY D.D.

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 <sub>p</sub>	W		
84.9	Continued															
15.1	Silty Clay		13	SS	9											
84.3	*															
15.7	End of Borehole															
	* Trace Sand Stiff															

# RECORD OF BOREHOLE No CMS-400 LEFT METRIC

W P 30-81-13 LOCATION HWY 400 NB, EAST SHOULDER, 493 m SOUTH OF SHEPPARD AVE ORIGINATED BY DL & DD  
 DIST 6 HWY 400 BOREHOLE TYPE HOLLOW STEM AUGER & CONE TEST COMPILED BY DL  
 DATUM ASSUMED DATE 86 10 20 CHECKED BY DD

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					
100.0	GROUND SURFACE																
0.0																	
	occ silty clay pockets		1	SS	14		98										
	SILTY SAND TO SANDY SILT		2	SS	42												
	Trace Gravel & Clay		3	SS	50												
	Dense to Very Dense		4	SS	52												
	Slightly Plastic																
95.7							96										
4.3	SILTY CLAY		5	SS	40												
	Trace / some Sand, Trace																
	Gravel Hard		6	SS	39		94										
	occ sand seams																
92.4																	
7.6	SILTY SAND TO SANDY SILT		7	SS	48		92										
	Trace Clay																
	Dense to Very Dense																
90.4	Slightly Plastic		8	SS	64												
9.6	END OF BOREHOLE																

# RECORD OF BOREHOLE No CMS-400 RIGHT METRIC

W P 30-81-13 LOCATION HWY 400 SB, WEST SHOULDER, 493 m S OF SHEPPARD AVE ORIGINATED BY DL&DD  
 DIST 6 HWY 400 BOREHOLE TYPE HOLLOW STEM AUGER & CONE TEST COMPILED BY DL  
 DATUM ASSUMED DATE 86 10 20 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
100.0	GROUND SURFACE							SHEAR STRENGTH						
								O UNCONFINED + FIELD VANE						
								● QUICK TRIAXIAL x LAB VANE						
								WATER CONTENT (%)						
								PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT						
								W <sub>p</sub> W W <sub>L</sub>						
0.0	SILTY SAND TO SANDY SILT													
	Trace of Gravel & Clay													
98.5	Compact Slightly Cohesive		1	SS	10									
1.5			2	SS	24		98							
	occ sand seams		3	SS	35									
			4	SS	44									
	SILTY CLAY						96							
	Trace / some Sand													
	Trace Gravel		5	SS	43									
	V Stiff to Hard						94							
			6	SS	40									
	occ sand seams													
92.4														
7.6	SILTY SAND TO SANDY SILT		7	SS	45		92							
	Trace Clay													
	Dense to Very Dense													
90.4	Slightly Plastic		8	SS	79									
9.6	END OF BOREHOLE													

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No CMS-7WC LEFT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 200 m W of Keele Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 10 22 / 23 CHECKED BY D.D.

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					
100.0	Ground Surface															
0.0						*										
	Occ. Sand Zones		1	SS	23											
			2	SS	14											
			3	SS	14											
	Silty Clay Some Sand Trace Gravel		4	SS	14											
	Stiff to Very Stiff		5	SS	14											
			6	SS	15											
			7	SS	18											
	Occ. Boulders		8	SS	15											
			9	SS	15											
			10	SS	19											
87.3																
12.7	End of Borehole															
	* Ground water elevation not determined															

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



RECORD OF BOREHOLE No CMS-7WC METRIC  
RIGHT

W P 30-81-13 LOCATION 401 WB Collector, 200 m W of Keele 2 m Right of Curb ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 11 / 15 CHECKED BY D.D.

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	20 40 60 80 100					
100.0	Ground Surface													
0.0						*								
			1	SS	15		99							
	Occ. Sand Zones		2	SS	14		98							
			3	SS	14		97							
			4	SS	14		96							
	Silty Clay						95							
	Some Sand						94							
	Trace Gravel						93							
	Stiff to Very Stiff		5	SS	11		92							
			6	SS	15		91							
	Occ. Boulders		7	SS	12		90							
			8	SS	11		89							
			9	SS	13		88							
			10	SS	18		87							
85.8			11	SS	14		86							
14.2	End of Borehole													
	* Ground water Elevation not determined.													

+3, x5 : Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No CMS-6WE LEFT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 70 m E of Keele Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 23 CHECKED BY D.D.

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					
100.0	Ground Surface																
0.0	Occ. Sandy Zones					*											
			1	SS	34												
	Silty Clay		2	SS	17												
	Some Sand																
	Trace Gravel		3	SS	12												
			4	SS	10												
	Firm to Hard																
			5	SS	7												
			6	SS	8												
			7	SS	11												
			8	SS	14												
			9	SS	15												
			10	SS	15												
85.8			11	SS	18												
14.2	End of Borehole																
	* Ground water elevation not determined																

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

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

# RECORD OF BOREHOLE No CMS-6WE RIGHT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 70 m E of Keele Right Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 22 CHECKED BY D.D.

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	20 40 60 80 100					
100.0	Ground Surface													
0.0	Occ. Sandy Zones					*								
			1	SS	25		99							
	Silty Clay Some Sand Trace Gravel		2	SS	22		98							
	Stiff to Very Stiff		3	SS	15		97							
			4	SS	14		96							
			5	SS	9		95							
			6	SS	9		94							
			7	SS	16		92							
			8	SS	15		91							
			9	SS	16		90							
87.4			10	SS	18		89							
12.6	End of Borehole						88							
	* Ground water elevation not determined													



RECORD OF BOREHOLE No CMS-3EE  
LEFT

METRIC

W P 30-81-13 LOCATION 401 EB Express, 200 m W of Dufferin Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY B.D.  
DATUM Assumed DATE 85 10 30 CHECKED BY D.D.

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					
100.0	Ground Surface																
0.0	Silty Clay Some Sand Trace Gravel					*											
			1	SS	12												
	Occ. Sand and Gravel Zones		2	SS	20												
			3	SS	30												
	Stiff to Very Stiff		4	SS	19												
			5	SS	20												
93.4																	
			6	SS	28												
6.6	End of Borehole																
	* Ground water elevation not established																

OFFICE REPORT ON SOIL EXPLORATION



## METRIC

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to Sensitivity

# RECORD OF BOREHOLE No **CMS-ALLEN** **LEFT** METRIC

W P 30-81-13 LOCATION Allen Road NB Lane, 720 m S of 401 Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY Allen Road BOREHOLE TYPE S-S Auger COMPILED BY B.D.  
DATUM Assumed DATE 85 10 28 CHECKED BY D.D.

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	20 40 60 80 100					
100.0	Ground Surface													
0.0						*								
	Occ. Sand Zones		1	SS	20		99							
			2	SS	16		98							
	Silty Clay		3	SS	8		97							
	Some Sand		4	SS	6		96							
	Trace Gravel													
	Firm to Hard		5	SS	39		95							
			6	SS	32		94							
							93							
91.9			7	SS	40		92							
8.1	End of Borehole													
	* Ground water elevation not established													

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No CMS-ALLEN RIGHT METRIC

W P 30-81-13 LOCATION Allen Road NB, 720 m S of 401 4 m right of guide Rail ORIGINATED BY F.S.  
 DIST 6 HWY Allen Road BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 10 24 CHECKED BY D.D.

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			SHEAR STRENGTH								
								20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE								
100.0	Ground Surface															
0.0						*										
	Occ. Sand Zones		1	SS	6											
			2	SS	25											
	Silty Clay		3	SS	29											
	Some Sand		4	SS	43											
	Trace Gravel															
	Firm to Hard		5	SS	40											
93.4			6	SS	38											
6.6	End of Borehole															
	* Ground water elevation not determined															

# RECORD OF BOREHOLE No CMS-ALLEN- S-W RIGHT METRIC

W P 30-81-13 LOCATION Ramp from Allen NB to 401 WB, 100 m S of 401 Right Shoulder ORIGINATED BY F.S.  
DIST 6 HWY Allen Road BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 21 CHECKED BY D.D.

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					
100.0	Ground Surface																
0.0	Silty Clay with Sand Trace Gravel					*											
			1	SS	15												
	Occ. Packets of Sand		2	SS	15												
	Stiff to Hard		3	SS	17												
			4	SS	15												
	Occ. Packets of Sand		5	SS	12												
			6	SS	36												
			7	SS	80												
90.6			8	SS	113/28cm												
9.4	End of Borehole																
	* Ground water elevation not determined																

# RECORD OF BOREHOLE No CMS-4EC LEFT

METRIC

W P 30-81-13 LOCATION 401 EB Collector, 120 m E of Bathurst St. Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 18 CHECKED BY D.D.

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					
100.0	Ground Surface														
0.0	Silty Sand Trace Clay Trace/some Gravel Very Loose to Compact		1	SS	12										
			2	SS	4										
97.6															
2.4	Silty Clay with Sand Trace Gravel Stiff to Hard		3	SS	16										
			4	SS	14										
	Occ. Sand Zones		5	SS	8										
			6	SS	13										
			7	SS	77										
90.7															
9.3	End of Borehole		8	SS	60/15 cm										
	* Ground water elevation not established														

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No CMS-4EC RIGHT METRIC

W P 30-81-13 LOCATION 401 EB Collector, 120 m E of Bathurst St. Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY B.D.  
 DATUM Assumed DATE 85 10 11 CHECKED BY D.D.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	WATER CONTENT (%)				
100.0	Ground Surface															
0.0	Silty Sand Trace/some Gravel Compact to Dense		1	SS	34	*	99									
97.9			2	SS	28		98									
2.1	Occ. Silt Zones		3	SS	3		97									
	Occ. Sand Zones		4	SS	4		96									
	Silty Clay with Sand Trace Gravel Soft to Stiff		5	SS	15		95									
							94									
	Refusal		6	SS	6											
93.0	+ Footing +															
7.0	End of Borehole															
	* Ground water elevation not established															

# RECORD OF BOREHOLE No CMS-5WE LEFT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 300 m E of Bathurst St. Left Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY B.D.  
 DATUM Assumed DATE 85 10 28 CHECKED BY D.D.

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					
100.0	Ground Surface																
0.0	Silty Sand Trace Gravel Compact					*											
98.6			1	SS	29												
1.4	Occ. Boulders		2	SS	60	25 cm											
			3	SS	16												
			4	SS	8												
	Silty Clay Some Sand Trace Gravel																
	Stiff to Hard		5	SS	60	15 cm											
	Sand and Gravel																
			6	SS	35												
91.9			7	SS	125	23 cm											
8.1	End of Borehole																
	* Ground water elevation not established																

# RECORD OF BOREHOLE No CMS-5WE RIGHT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 300 m E of Bathurst St. Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 10 21 CHECKED BY D.D.

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	SHEAR STRENGTH					
100.0	Ground Surface													
0.0	Silty Sand Compact					*								
98.9			1	SS	19		99							
1.1	Silty Clay with Sand Trace Gravel Stiff to Hard		2	SS	18		98							
	Occ. Boulders		3	SS	29		97							
			4	SS	8		96							
	Trace Organics		5	SS	11		95							
			6	SS	35		94							
	Occ. Sandy Zones		7	SS	115/28 cm		93							
			8	SS	70/13 cm		92							
90.6							91							
9.4	End of Borehole													
	* Ground water elevation not established													

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No CMS-4WE LEFT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 325 m E of Yonge St. Left Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 10 31 CHECKED BY D.D.

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	SHEAR STRENGTH					
100.0	Ground Surface													
0.0	Silty Sand Trace Clay Trace Gravel Compact		1	SS	19									
98.6			2	SS	12									
1.4	Silty Clay Some Sand Trace Gravel Stiff to Hard		3	SS	15									
			4	SS	11									
			5	SS	18									
			6	SS	27									
			7	SS	78									
91.4														
8.6	Silty Sand Very Dense													
90.4			8	SS	55									
9.6	End of Borehole													

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

# RECORD OF BOREHOLE No CMS-4WE RIGHT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 325 m E of Yonge St. Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 11 05 CHECKED BY D.D.

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					
100.0	Ground Surface													GR SA SI CL
0.0	Silty Sand Trace Clay Some Gravel Dense		1	SS	32	*								
98.6			2	SS	10									
1.4	Trace Organics		3	SS	12									
			4	SS	12									
	Silty Clay Some Sand Trace Gravel Firm to Hard		5	SS	7									
	Occ. Pockets of Silty Sand		6	SS	29									
			7	SS	37									
91.4														
8.6	Silty Sand Compact													
90.4			8	SS	20									
9.6	End of Borehole													
	* Ground water elevation not established													



RECORD OF BOREHOLE No CMS-4EE  
LEFT

METRIC

W P 30-81-13 LOCATION 401 EB Express, 225 m W of Bayview Ave. Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 11 13 CHECKED BY D.D.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
100.0	Ground Surface																
0.0	Silty Sand Trace Gravel					*											
98.9			1	SS	19												
1.1	Occ. Sand Zones		2	SS	9												
			3	SS	7												
			4	SS	6												
	Silty Clay Some Sand Trace Gravel																
	Firm to Hard																
	Trace Organics		5	SS	13												
	Occ. Silty Sand Seams		6	SS	110	/25 cm											
91.9			7	SS	64												
8.1	End of Borehole																
	* Ground water elevation not established																

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

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

# RECORD OF BOREHOLE No CMS-4EE RIGHT

METRIC

W P 30-81-13 LOCATION 401 EB Express, 225 m W of Bayview Ave. Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 11 07 / 08 CHECKED BY D.D.

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					
100.0	Ground Surface															
0.0	Silty Sand Trace Gravel					*										
98.9			1	SS	13											
1.1			2	SS	8											
	Occ. Sand Zones															
			3	SS	8											
	Silty Clay Some Sand Trace Gravel															
			4	SS	8											
	Stiff to Hard															
	Occ. Silt Seams		5	SS	22											
			6	SS	60											
	Occ. Silt Seams															
91.9			7	SS	60											
8.1	End of Borehole															
	* Ground water elevation not established															

# RECORD OF BOREHOLE No CMS-5WC LEFT

METRIC

W P 30-81-13 LOCATION 401 WB Collector, 100 m E of Leslie St. Left Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 11 15 CHECKED BY D.D.

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	SHEAR STRENGTH					
100.0	Ground Surface													
0.0	Silty Sand Trace Gravel Occ. Pockets of Silty Clay Compact		1	SS	27	*	99							
98.6			2	SS	29		98							
1.4	Occ. Sandy Zones		3	SS	10		97							
	Silty Clay Some Sand Trace Gravel Firm to Hard		4	SS	4		96							
			5	SS	32		95							
			6	SS	23		94							
	Occ. Sandy Zones		7	SS	31		93							
			8	SS	38		92							
90.4							91							
9.6	End of Borehole													
	* Ground water elevation not determined													

# RECORD OF BOREHOLE No CMS-5WC RIGHT

METRIC

W P 30-81-13 LOCATION 401 WB Collector, 100 m E of Leslie St. Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 11 06 CHECKED BY D.D.

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	SHEAR STRENGTH					
100.0	Ground Surface													
0.0	Silty Sand Trace Gravel Very Loose to Dense		1	SS	38	*	99							
			2	SS	35		98							
			3	SS	18		97							
	Occ. Silty Clay Zones Very Loose		4	SS	3		96							
96.0							95							
4.0			5	SS	15		94							
	Occ. Sand Zones		6	SS	43		93							
			7	SS	24		92							
	Silty Clay Some Sand Trace Gravel Very Stiff to Hard		8	SS	23		91							
89.9							90							
10.1	Silty Sand Trace Gravel Loose to Compact		9	SS	12		89							
							88							
87.4			10	SS	7									
12.6	End of Borehole													
	* Ground water elevation not established													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No CMS-5EC LEFT

METRIC

W P 30-81-13 LOCATION 401 EB Collector, 400 m E of Leslie St. Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 11 13 CHECKED BY D.D.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH kPa					W <sub>p</sub>	W	W <sub>L</sub>		
								20 40 60 80 100									
100.0	Ground Surface																
0.0	Silty Sand Trace Gravel Occ. Pockets of Silty Clay  Loose		1	SS	20	*											
97.9			2	SS	19												
2.1			3	SS	5												
	Silty Clay with Sand  Trace Gravel  Soft to Very Stiff		4	SS	3												
	Trace Organics																
			5	SS	5												
			6	SS	21												
			7	SS	18												
			8	SS	11												
	Occ. Pockets of Silt																
88.9			9	SS	17												
11.1	End of Borehole																
	* Ground water elevation not determined																

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

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

# RECORD OF BOREHOLE No CMS-5EC RIGHT

METRIC

W P 30-81-13 LOCATION 401 EB Collector, 400 m E of Leslie St. Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 11 08 CHECKED BY D.D.

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					
100.0	Ground Surface													
0.0	Silty Sand Trace Gravel Occ. Pockets of Silty Clay  Loose		1	SS	10	*								
97.9			2	SS	5									
2.1	Silty Clay with Sand  Trace Gravel  Stiff to Hard		3	SS	18									
			4	SS	16									
			5	SS	19									
			6	SS	19									
			7	SS	31									
	Trace Organics													
	Occ. Pockets of Sand													
	Very Stiff		8	SS	16									
			9	SS	33									
87.4			10	SS	9									
12.6	End of Borehole													
	* Ground water elevation not established													

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION



# RECORD OF BOREHOLE No CMS-3WE LEFT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 300 m E of Victoria Park Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S Auger COMPILED BY F.S.  
DATUM Assumed DATE 85 10 31 CHECKED BY D.D.

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	20 40 60 80 100					
100.0	Ground Surface													
0.0														
	Occ. Sandy Zones		1	SS	17		99							
			2	SS	14		98							
	Silty Clay Some Sand Trace Gravel		3	SS	26		97							
	Stiff to Hard		4	SS	42		96							
			5	SS	39		95							
			6	SS	22		94							
			7	SS	16		93							
			8	SS	9		92							
							91							
							90							
							89							
							88							
87.4			9	SS	9									
12.6	End of Borehole													

+3, x5 : Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No CMS-3WE RIGHT

METRIC

W P 30-81-13 LOCATION 401 WB Express, 300 m E of Victoria Park, Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE H-S Auger COMPILED BY F.S.  
 DATUM Assumed DATE 85 11 05 CHECKED BY D.D.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>		
100.0	Ground Surface																
0.0						*											
	Occ. Sandy Zones		1	SS	12												
			2	SS	13												
	Silty Clay		3	SS	25												
	Some Sand		4	SS	43												
	Trace Gravel																
	Stiff to Hard		5	SS	36												
			6	SS	30												
			7	SS	14												
			8	SS	14												
89.0																	
11.0	End of Borehole																
	* Ground water elevation not established																

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No CMS-DVP LEFT METRIC

W P 30-81-13 LOCATION Don Valley Pkwy. NB, 182.5 m South of Three Valleys Drive, ORIGINATED BY B.D.  
 DIST 6 HWY Don Valley Pkwy. BOREHOLE TYPE Solid Stem Auger Left Shoulder COMPILED BY D.P.  
 DATUM Assumed DATE 86 02 27 CHECKED BY F.S.

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					
100.0	Ground Surface																
0.0	Occasional Silty Clay Zones		1	SS	53		99										
			2	SS	7		98										
	Silty Sand Trace Gravel Trace Clay	Occasional Silty Clay Zones	3	SS	24		97										
	Loose to Compact		4	SS	17		96										
95.3																	
4.7	Silty Clay Trace Gravel Occ. Sand Seams		5	SS	4		95										
							94										
	Soft		6	SS	4		93										
			7	SS	4		92										
							91										
90.4			8	SS	3												
9.6	End of Borehole																

+3, x5 : Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE

W P 30-81-13 LOCATION Don Valley Pkwy. NB, 182.5 m South of Three Valleys Drive ORIGINATED BY B.D.  
DIST 6 HWY Don Valley Pkwy. BOREHOLE TYPE Solid Stem Auger Right Shoulder COMPILED BY D.P.  
DATUM Assumed DATE 86 02 27 CHECKED BY F.S.

[illegible]

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

Foundation Investigation Report  
For  
F.T.M.S. - Signs Eastbound  
from West of Bayview Avenue to West of Leslie Street  
W.P. 67-85-01  
Hwy. 401, District 6 - Toronto

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This report summarizes the foundation investigation carried out for the above-noted project. The fieldwork was conducted between 87 06 22 and 87 07 07. The investigation consisted of advancing 2 boreholes to obtain representative site information, and reviewing previous foundation investigations in the area.

Boreholes for this site investigation are numbered: 101 & 102

The location of each borehole is illustrated in the appended Figure 1.

#### **SITE DESCRIPTION**

Physiographically, the site lies within the region known as the South Slope (Ref: Chapman and Putnam, 'The Physiography of Southern Ontario', 3rd Edition, 1984). Specifically, the site is located in a till plain north of the past Lake Iroquois shoreline. The soil is a ground moraine which originated in the Pleistocene Age. Bedrock across the site consists of black and grey shale of the Georgian Bay Formation and is estimated to occur at 70 to 80 m below the ground surface. Boreholes in this investigation were not advanced to these depths.

#### **SUBSURFACE CONDITIONS**

The native deposits across the site are of glacial origin. Deposits of silty clay till, sand and silt till, fine sand, and silt are among the most predominant encountered within

the investigation limits. Occasional boulders and boulder nests are anticipated within this till deposit.

The boundaries between the various soil types, in-situ and laboratory test results, as well as groundwater levels are shown on the Record of Borehole Sheets in the Appendix.

Detailed descriptions of the various soils deposits are not given in this report. However, reference should be made to the appropriate Record of Sheet for subsurface conditions at each borehole.

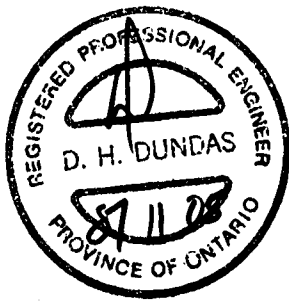
Laboratory tests were carried out on samples in order to determine composition and behaviour of the material. These include Atterberg Limits, Grain Size Distribution and Moisture Content Tests. The results are indicated on the Record of Borehole Sheets.

The groundwater elevation at each borehole was measured after the completion of the hole.

Survey locations were not provided. Hence the elevations which have been indicated on the borehole sheets are based on assumed ground elevation of 100.0 m.

The investigation revealed that the subsurface conditions across the site are not consistent, as both cohesive and cohesionless deposits are encountered throughout. In addition, it was noted that some of the cohesive deposits contain random zones and seams of cohesionless or slightly plastic material, some of which are water-bearing. However, the investigations indicated that the subsurface materials are generally competent.

Groundwater levels were measured at the completion of each borehole. The measured levels are shown on each Record of Borehole Sheet. In view of the hard and very dense nature of glacial deposits, it is believed that the measured groundwater levels do not represent stabilized conditions and the actual levels may, in fact, be higher than those indicated on the Record of Borehole Sheets.

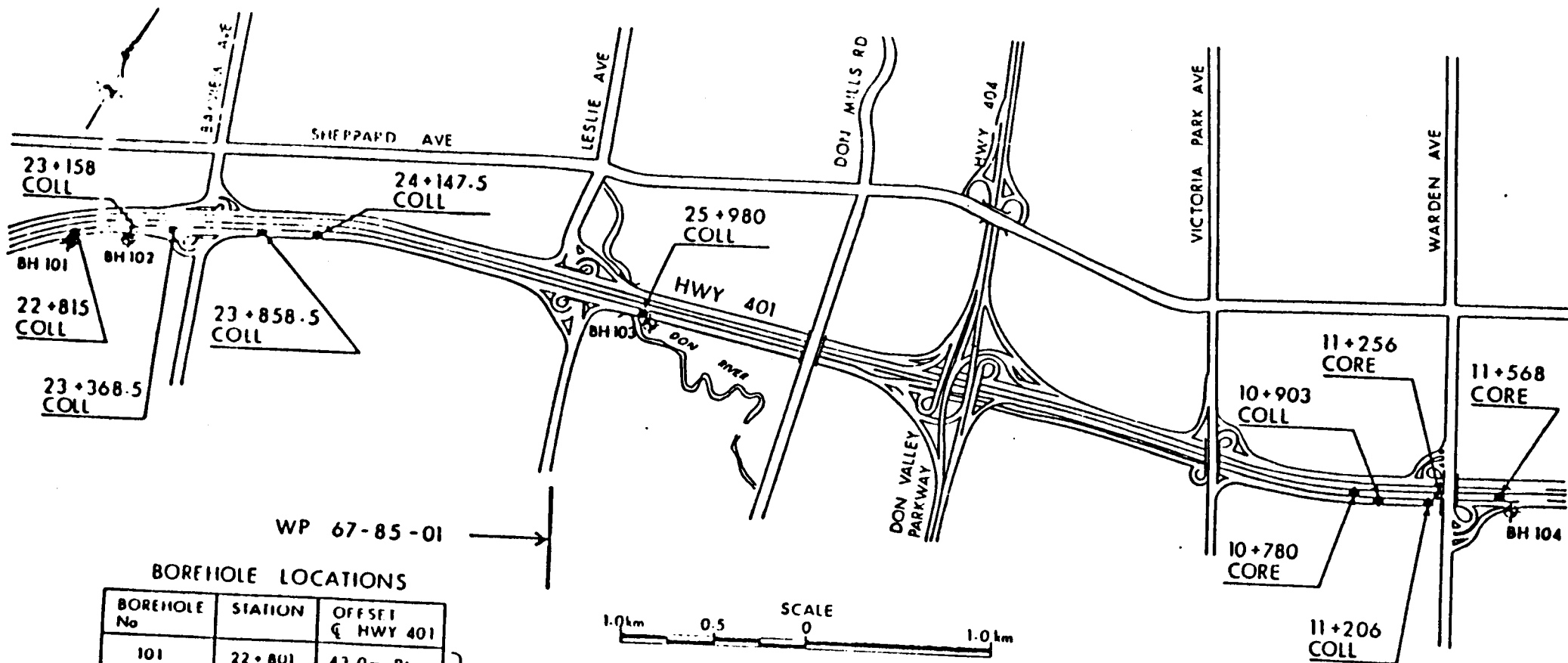


*D. H. Dundas*

D.H. Dundas, P. Eng.  
Sr. Foundations Engineer

*M. Devata*

M. Devata, P. Eng.  
Chief Foundations Engineer  
(East)



#### BOREHOLE LOCATIONS

BOREHOLE No	STATION	OFFSET to HWY 401
101	22+801	43.0m R1
102	23+131	47.0m R1

WP 67-85-01

#### FTMS - CMS LOCATIONS & BOREHOLE LOCATIONS

#### LEGEND

- ⊕ BOREHOLE & CONE TEST
- FTMS - CMS

GEOCREs No 30M14-186  
 WP 67-85-01 & 259-86-01  
 HWY 401  
 DIST 6  
 TORONTO  
 FIGURE 1



# RECORD OF BOREHOLE No 101

METRIC

W P 67-85-01 LOCATION Sta. 23 + 801; O/S 43.0 m Rt. 4 Hwy. 401 ORIGINATED BY DP  
 DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger COMPILED BY DP  
 DATUM Assumed-curb 100 m DATE 87 06 23 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						
103.5 0.0	Ground Surface										
101.6 1.9	Silty Clay (CL) With Sand Occ. Organics Stiff to Very Stiff (Fill)		1	SS	16	*	103				
			2	SS	19		102				
	Silty Sand Loose to Compact (Fill)		3	SS	24		101				
			4	SS	8		100				
99.8 3.7	Silty Clay (CL) With Sand Firm (Fill)		5	SS	7		99				2 42 38 18
98.9 4.6	Probable Concrete Footings of Retaining Wall  End of Borehole * Borehole dry on 87 07 07										

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

# RECORD OF BOREHOLE No 102

METRIC

W P 67-85-01 LOCATION Sta. 23 + 131; O/S 47.0 m Rt. 4 Hwy. 401 ORIGINATED BY DP  
 DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger COMPILED BY DP  
 DATUM Assumed-curb 100 m DATE 87 06 24 CHECKED BY DD

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	W <sub>p</sub> W W <sub>L</sub>					
101.1	Ground Surface													GR SA SI CL
0.0	Sandy Silt to Silty Sand Compact						101							
99.9			1	SS	12		100							
1.2	Silty Sand to Sandy Silt Trace Clay Trace Gravel Compact to Very Dense		2	SS	36		99							3 49 45 3
			3	SS	102/	25 cm	98							
			4	SS	55		97							
			5	SS	52		96							
	Frequent Silt Zones		6	SS	29		95							
			7	SS	101/	23 cm	94							
			8	SS	48		93							
			9	SS	41		92							
			10	SS	86									
	Some Gravel		11	SS	73/	10 cm								13 50 33 4
91.5			12	SS	100/	13 cm								
9.6	End of Borehole													
	* Groundwater Level measured at completion of B.H. Level may not be stabilized													

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

Foundation Investigation  
For  
High Mast Lighting  
Hwy. 401 at Bayview Avenue  
W.P. 67-85-01; Site N/A  
District 6, Toronto

---

### INTRODUCTION

This report summarizes the foundation investigation required for the above-noted high mast lighting (HML).

The fieldwork was conducted between 87 02 04 - 06 and between 87 06 22 - 07 07 utilizing a continuous flight auger machine equipped with 82 mm I.D. hollow stem augers.

This work consisted of advanced sampled boreholes at or near all proposed HML locations.

Boreholes pertaining to this project are numbered BH 1 to 6, corresponding to the identifying number of the associated HML. Borehole locations are shown in plan on Figure 1 in the Appendix.

### SITE DESCRIPTION

Physiographically, the site lies within the region known as the South Slope (Ref: Chapman and Putnam, 'The Physiography of Southern Ontario', 3rd Edition, 1984). Specifically, the site is located in a till plain north of the past Lake Iroquois shoreline. The soil is a ground moraine which originated in the Pleistocene Age. Bedrock across the site consists of black and grey shale of the Georgian Bay Formation and is estimated to occur at 70 to 80 m below the ground surface. Boreholes in this investigation were not advanced to these depths.

## **SUBSURFACE CONDITIONS**

The native deposits across the site are of glacial origin. Deposits of silty clay till, sand and silt till, fine sand, and silt are among the most predominant encountered within the investigation limits. Occasional boulders and boulder nests are anticipated within this till deposit.

The boundaries between the various soil types, in-situ and laboratory test results, as well as groundwater levels are shown on the Record of Borehole Sheets in the Appendix.

Detailed descriptions of the various soils deposits are not given in this report. However, reference should be made to the appropriate Record of Borehole Sheet for subsurface conditions near each HML location.

Laboratory tests were carried out on samples in order to determine composition and behaviour. The results are indicated on the Record of Borehole Sheets.

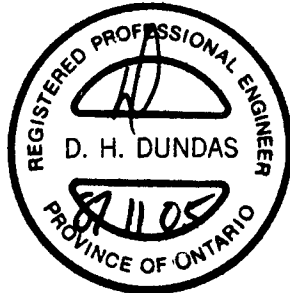
The groundwater elevation at each borehole was measured after the completion of the hole.

Survey locations for BH #1, #2, and #3, were provided by the Central Region Surveys and Plans Section. Surveyed locations were not provided for BH #4, #5 and #6 as the work could not be scheduled by the Central Region Surveys and Plans Section. Hence the elevations which have been indicated on the borehole sheets for these boreholes are approximate.

The investigation revealed that the subsurface conditions across the site are not consistent, as both cohesive and cohesionless deposits are encountered throughout. In addition, it was noted that some of the cohesive deposits contain random zones and seams of cohesionless or slightly plastic material, some of which are water-bearing. Note that concrete was encountered at HML #5 at depths below 6 m.

In zones where the soil is slightly plastic or non-cohesive, and below the groundwater level, it is likely that the sides of an unsupported augered hole will cave in, and seepage will occur. In situations where excavations (or augered holes) extend into cohesionless soils below the groundwater table, 'boiling' may be experienced at the base.

Groundwater levels were measured at the completion of each borehole. The measured levels are shown on each Record of Borehole Sheet. In view of the hard and very dense nature of glacial deposits, it is believed that the measured groundwater levels do not represent stabilized conditions and the actual levels may, in fact, be higher than those indicated on the Record of Borehole Sheets.



*D.H. Dundas*

D.H. Dundas, P. Eng.

Sr. Foundations Engineer

*M. Devata*

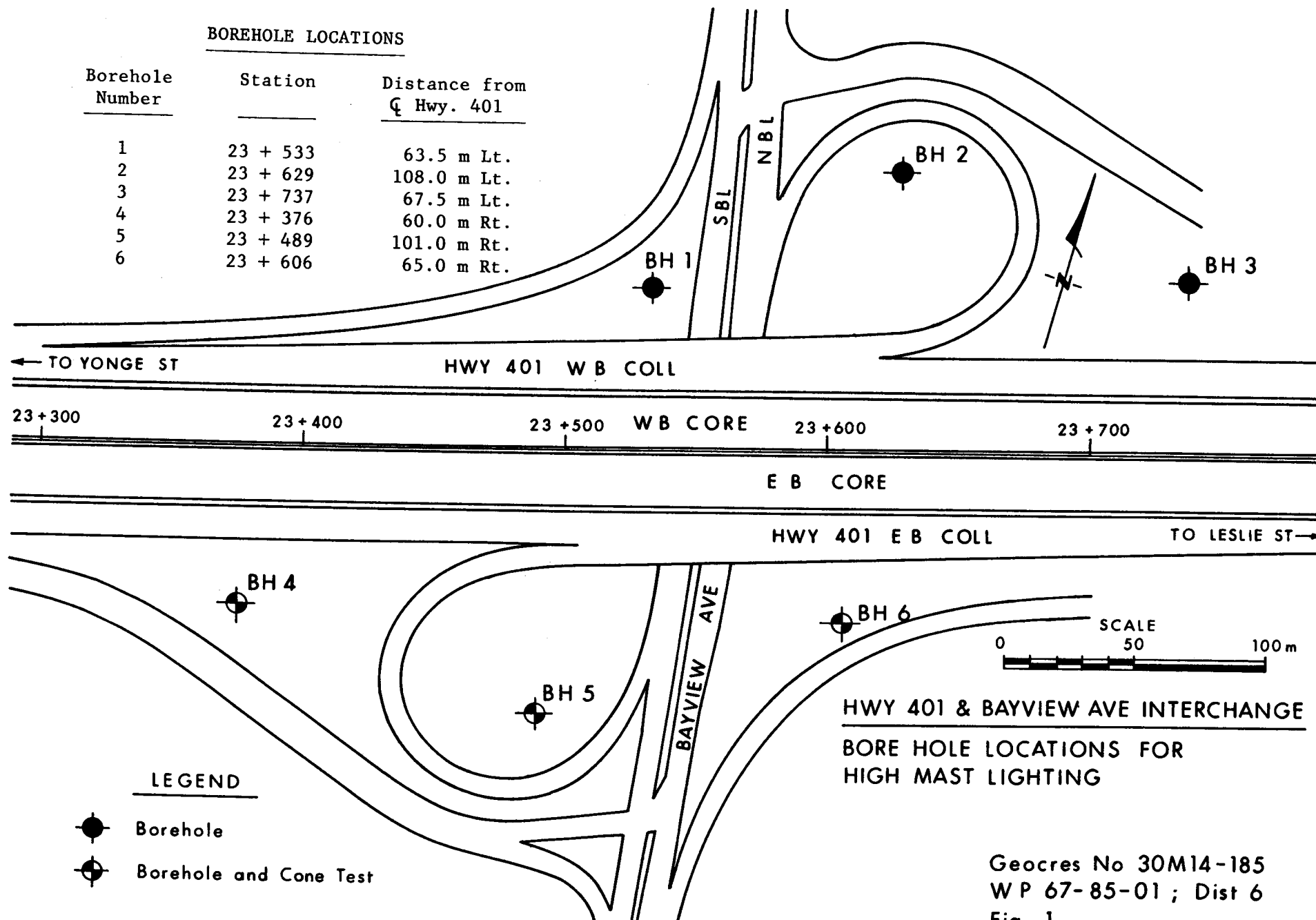
M. Devata, P. Eng.

Chief Foundations Engineer

(East)

# BOREHOLE LOCATIONS

Borehole Number	Station	Distance from Q Hwy. 401
1	23 + 533	63.5 m Lt.
2	23 + 629	108.0 m Lt.
3	23 + 737	67.5 m Lt.
4	23 + 376	60.0 m Rt.
5	23 + 489	101.0 m Rt.
6	23 + 606	65.0 m Rt.



Geocres No 30M14-185  
WP 67-85-01 ; Dist 6  
Fig 1



# RECORD OF BOREHOLE No 1

METRIC

W P 67-85-01 LOCATION Sta. 23 + 533; O/S 63.5 m Lt. of Hwy. 401 E ORIGINATED BY GP  
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DD  
DATUM Geodetic DATE 1987 02 04 CHECKED BY DD

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					
169.5	Ground Surface																
0.0	Silty Sand Very Dense		1	SS	79		168										
167.4			2	SS	85	870206											
2.1 166.6	Silty Clay (CL), Hard		3	SS	50												
2.9	Silty Sand		4	SS	35		166										
165.5	Dense		5	SS	28												
4.0			6	SS	50												
	Silty Clay (CL) With Sand Occ. Silt Seams Hard		7	SS	74		164										
			8	SS	68												
161.4			9	SS	59		162										
8.1			10	SS	20												
			11	SS	36		160										
	Silty Sand to Sandy Silt Compact to Very Dense		12	SS	110												
			13	SS	14	*	158										
			14	SS	61		156										
153.8	Silty Clay		15	SS	77		154										
15.7	End of Borehole																
	* Disturbed N Value																

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 2

METRIC

W P 67-85-01 LOCATION Sta. 23 + 629; 0/S 108.0 m Lt. of Hwy. 401 4  
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Augers ORIGINATED BY GP  
DATUM Geodetic DATE 1987 02 05 COMPILED BY DD  
CHECKED BY DD

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				
172.2	Ground Surface															GR SA SI CL
0.0																
	Silty Sand Compact		1	SS	7		172									
			2	SS	7											
			3	SS	6		170									
168.8			4	SS	14											
3.4	Silty Clay (CL) Hard		5	SS	104/	25 cm	168									
			6	SS	125/	22 cm										
165.9			7	SS	43											
6.3	Silty Sand Very Dense		8	SS	54		166									
164.3			9	SS	64											
7.9	Silty Clay (CL) With Sand Occ. Silt Seams Hard		10	SS	70		164									
			11	SS	72		162									
160.3																
11.9	Silty Sand Very Dense		12	SS	0	*	160									
158.0			13	SS	122											
14.2	End of Borehole * Disturbed N Values															

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
5 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No 3

METRIC

W P 67-85-01 LOCATION Sta. 23 + 737; 0/S 67.5 m Lt. of Hwy. 401 4 ORIGINATED BY GP  
DIST 6 HWY 401 BOREHOLE TYPE Hollow Stem Augers COMPILED BY DD  
DATUM Geodetic DATE 1987 02 05 and 06 CHECKED BY DD

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						
								SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
							WATER CONTENT (%)							
174.5	Ground Surface													
0.0	Mixture of Sand, Silt Clay and Gravel (Fill) Loose		1	SS	9		174							
173.1			2	SS	100/	25 cm								
1.4			3	SS	64		172							
			4	SS	49									
	Silty Clay (CL) With Sand Occ. Silt Seams Very Stiff to Hard		5	SS	54		170							
			6	SS	56									
			7	SS	27									
	Silty Sand		8	SS	17		168							
			9	SS	48									
			10	SS	32		166							
164.4			11	SS	67		164							
10.1			12	SS	52		162							
	Silty Sand to Sandy Silt Very Dense		13	SS	64		160							
160.5			14	SS	60		158							
14.0			15	SS	45									
	Silty Clay (CL) With Sand Occ. Silt Seams Hard													
157.3														
17.2	End of Borehole													

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 4

METRIC

W P 67-85-01 LOCATION Sta. 23 + 376; O/S 60.0 m Rt. of Hwy. 401 ORIGINATED BY DP  
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger COMPILED BY DP  
DATUM Geodetic DATE 1987 06 25-26 CHECKED BY DD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT			UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20 40 60 80 100		W <sub>p</sub>	W	W <sub>L</sub>		
171.0	Ground Surface												
0.0	Silty Sand Compact												
169.8			1	SS	26								
1.2	Silty Clay (CL) With Sand Occ. Silt Seams Firm to Hard		2	SS	8								
			3	SS	8								
			4	SS	11								
	Occ. Organics		5	SS	10								
			6	SS	18								
			7	SS	30								
164.4			8	SS	103/	28 cm							
6.6	Sandy Silt Very Dense		9	SS	120/	10 cm							
163.1			10	SS	92								
7.9	Silty Clay (CL) With Sand Occ. Silt Seams Hard		11	SS	120/	12.5 cm							
158.4			12	SS	129								
12.6	End of Borehole * Groundwater Level measured on 87 06 29												

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No 5

METRIC

W P 67-85-01 LOCATION Sta. 23 + 489; 0/S 101.0 m Rt. of Hwy. 401 ORIGINATED BY DP  
 DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger COMPILED BY DP  
 DATUM Geodetic DATE 1987 06 20-07 02 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 10 20 30	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
171.0 0.0	Ground Surface											
			1	SS	13		170					
			2	SS	17							
			3	SS	17							
			4	SS	18		168					
	Occ. Organics		5	SS	18							
			6	SS	40		166					
	Silty Clay (CL) With Sand Occ. Silt Seams Stiff to Hard		7	SS	81							
			8	SS	89							
			9	SS	57		164				23.9	
	Concrete **		10	SS	93							
161.8 9.2			11	SS	123	25 cm	162					
	Silty Sand to Sandy, Silt Very Dense		12	SS	122	12.5 cm	160					
158.4 12.6	End of Borehole		13	SS	125							
	* Groundwater Level measured on 87 07 02											
	** Note Concrete encountered in BH											

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

# RECORD OF BOREHOLE No 6

METRIC

W P 67-85-01 LOCATION Sta. 23 + 606; O/S 65.0 m Rt. of Hwy. 401  
DIST 6 HWY 401 BOREHOLE TYPE Cone Test, Hollow Stem Auger  
DATUM Geodetic DATE 87 07 03  
ORIGINATED BY DP  
COMPILED BY DP  
CHECKED BY DD

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	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
170.2	Ground Surface														GR SA SI CL
0.0															
	Occ. Organics		1	SS	10										
			2	SS	17										
	Silty Clay (CL) With Sand Occ. Silt Seams Stiff to Hard		3	SS	36										
			4	SS	123/	28 cm									
			5	SS	72/	25 cm									
			6	SS	75										
164.4			7	SS	45										
5.8	Sandy Silt		8	SS	82										
163.6	Very Dense														
6.6															
	Silty Clay (CL) With Sand Occ. Silt Seams Hard		9	SS	118/	25 cm									
			10	SS	122/	23 cm									
159.5															
159.2	Silty Sand V. Dense		11	SS	122/	23 cm									
11.0	End of Borehole														
	* Groundwater Level measured on 87 07 07														

+3, x5: Numbers refer to  
Sensitivity

20  
15  
10

(%) STRAIN AT FAILURE

ENGINEERING MATERIALS OFFICE  
FOUNDATION DESIGN SECTION

WP 30-81-06

DIST #6

HWY #401

STR SITE

F.T.M.S. Changeable Message Signs

GEOCRES

DATE

FOUNDATION INVESTIGATION REPORT  
For  
F.T.M.S.-CMS SIGNS  
W.P. 30-81-06  
Hwy. 401, DISTRICT 6, Toronto

This report summarizes the results of a foundation investigation required for the proposed F.T.M.S. changeable message signs.

The fieldwork was conducted during the period from 85-10-09 to 85-11-15 utilizing a continuous flight auger machine equipped with solid stem augers and 82 mm I.D. hollow stem augers. The work consisted of 33 sampled boreholes.

A total of 17 F.T.M.S. sign sites were investigated. The site locations are illustrated on the attached Key Map, Figure 1. Specific locations are given in Table 2.

The fieldwork generally involved advancing boreholes near the proposed footing locations. However, at CMS-Allen SW, only one borehole was advanced due to site restrictions.

At all the sites, the subsurface material was found to be predominantly a silty clay till of low plasticity overlain by variable thicknesses of fill material. Specific subsurface conditions at the borehole locations are illustrated in the appended Record of Borehole Sheets. The boreholes are identified by the F.T.M.S. sign designation, and as left or right with respect to lane direction.

Further to our conversation with C.P. Korzenioski of McCormick Rankin and Associates, no surface elevations were provided, hence only depths and relative elevations have been indicated on the borehole sheets.

#### DESIGN DETAILS

The signs may be founded on spread footings.

Two alternative design values are recommended, reflecting respective founding elevations as detailed in Table 1.

The two alternatives are:

*These values should be higher 10 (8XN) = 52.5 kPa*

- |  |   |                                      |          |
|--|---|--------------------------------------|----------|
| 1. Factored Bearing Capacity at U.L.S. | = | <sup>150</sup><br><del>75</del> kPa  | 1500 psf |
| Bearing Capacity at S.L.S. Type II     | = | <sup>100</sup><br><del>50</del> kPa  | 1000 psf |
| 2. Factored Bearing Capacity at U.L.S. | = | <sup>15</sup><br><del>37.5</del> kPa | 750 psf  |
| Bearing Capacity at S.L.S. Type II     | = | <sup>50</sup><br><del>25</del> kPa   | 500 psf  |

TABLE 1 RECOMMENDED FOUNDATION ELEVATIONS

SIGN DESIGNATION	RELATIVE FOUNDING ELEVATIONS (metres)			
	LEFT		RIGHT	
	Option 1	Option 2	Option 1	Option 2
† CMS - 1E	98.8	98.8	97.0	98.8
*† CMS - 409	98.8	98.8	NA	98.8
CMS - 400	97.6	98.8	95.5	98.8
CMS - 2EE	NA	98.8	98.8	98.8
CMS - 2EC	98.8	98.8	92.0	98.8
CMS - 7WC	98.8	98.8	98.8	98.8
CMS - 6WE	91.0	98.8	98.8	98.8
CMS - 3EE	98.5	98.8	98.8	98.8
CMS - Allen	95.5	98.8	98.5	98.5
† CMS - Allen SW	98.8	98.8	98.8	98.8
*† CMS - 4EC	94.0	98.0	NA	98.8
CMS - 5WE	95.5	98.8	94.0	98.8
† CMS - 4WE	95.5	98.8	94.0	98.8
† CMS - 4EE	95.5	98.8	95.5	98.8
† CMS - 5WC	95.5	98.8	95.5	98.8
† CMS - 5EC	94.0	98.8	97.7	98.8
CMS - 3WE	98.8	98.8	98.8	98.8

\* Concrete footings encountered. Refer to Figure 2 for details.

† Areas of fill.

# EARTH PRESSURE CALCULATIONS

Computation of earth pressure should be in accordance with Section 6-6.1.2 of the O.H.B.D.C. The passive design case ( $K_p$ ) applies.

The following soil parameters are recommended for the design of the sign foundations:

$\phi$  = apparent angle of internal friction for non-cohesive soils.

C = undrained shear strength.

$\gamma$  = unit weight.

SIGN	DEPTH(m)	TYPE OF	$\phi$	C	$\gamma$
_____	FROM TO	SOIL	_____	(kPa)	(kN/m <sup>3</sup> )
CMS-1E					
LEFT	0.0-2.9	Cohesive	0	60	18.1
	2.9-4.0	Non-cohesive	30°	0	20.4
	4.0-5.2	Cohesive	0	40	17.3
RIGHT	0.0-1.3	Cohesive	0	95	18.9
	1.3-2.1	Cohesive	0	60	18.1
	2.1-2.9	Cohesive	0	29	17.3
	2.9-4.0	Non-cohesive	30°	0	18.9
	4.0-5.6	Cohesive	0	119	18.9
	5.6-7.0	Non-cohesive	0	181	19.6
CMS-409					
LEFT	0.0-1.7	Non-cohesive	30°	0	18.1
	1.7-2.9	Cohesive	0	60	18.1
	2.9-4.0	Cohesive	0	95	18.9
	4.0-5.2	Cohesive	0	238	20.4
RIGHT	0.0-1.8	Non-cohesive	30°	0	17.3
	1.8-5.2	Cohesive	0	38	17.3



SIGN	DEPTH(m) FROM TO	TYPE OF SOIL	$\phi$	c (kPa)	$\gamma$ (kN/m <sup>3</sup> )
CMS-400					
LEFT	0.0-1.4	Cohesive	0	76	18.1
	1.4-2.9	Cohesive	0	52	18.1
	2.9-4.0	Cohesive	0	81	18.1
	4.0-5.5	Cohesive	0	129	18.9
	5.5-6.4	Cohesive	0	71	18.1
RIGHT	0.0-2.1	Cohesive	0	71	18.1
	2.1-2.9	Cohesive	0	19	17.3
	2.9-4.0	Cohesive	0	38	17.3
	4.0-5.5	Cohesive	0	129	18.9
	5.5-8.5	Cohesive	0	57	18.1
CMS-2EE					
LEFT	0.0-1.4	Non-cohesive	30°	0	18.1
	1.4-2.1	Cohesive	0	71	18.1
	2.1-4.0	Cohesive	0	57	18.1
	4.0-5.2	Cohesive	0	29	17.3
RIGHT	0.0-1.1	Non-cohesive	30°	0	18.1
	1.1-2.1	Cohesive	0	143	18.9
	2.1-2.9	Cohesive	0	86	18.1
	2.9-4.0	Cohesive	0	110	18.9
	4.0-5.2	Cohesive	0	52	18.1

SIGN	DEPTH(m) <u>FROM TO</u>	TYPE OF <u>SOIL</u>	$\phi$	c <u>(kPa)</u>	$\gamma$ <u>(kN/m<sup>3</sup>)</u>
CMS-2EC					
LEFT	0.0-1.2	Non-cohesive	30°	0	18.1
	1.2-2.1	Cohesive	0	71	18.1
	2.1-5.2	Cohesive	0	90	18.1
RIGHT	0.0-4.9	Non-cohesive	30°	0	17.3
	4.9-12.0	Cohesive	0	43	18.1
CMS-7WC					
LEFT	0.0-1.4	Cohesive	0	110	18.9
	1.4-5.2	Cohesive	0	67	18.1
RIGHT	0.0-4.0	Cohesive	0	67	18.1
	4.0-5.2	Cohesive	0	52	18.1
CMS-6WE					
LEFT	0.0-1.4	Cohesive	0	162	19.6
	1.4-2.1	Cohesive	0	81	18.1
	2.1-4.0	Cohesive	0	48	18.1
	4.0-7.1	Cohesive	0	33	17.3
	7.1-8.7	Cohesive	0	52	18.1
	8.7-13.0	Cohesive	0	67	18.1
RIGHT	0.0-1.4	Cohesive	0	119	18.9
	1.4-2.1	Cohesive	0	105	18.9
	2.1-4.0	Cohesive	0	67	18.1
	4.0-5.2	Cohesive	0	43	17.3

SIGN	DEPTH(m) FROM TO	TYPE OF SOIL	$\phi$	C (kPa)	$\gamma$ (kN/m <sup>3</sup> )
CMS-3EE					
LEFT	0.0-1.4	Cohesive	0	57	18.1
	1.4-2.1	Non-cohesive	30°	0	18.1
	2.1-2.9	Cohesive	0	143	18.9
	2.9-5.5	Cohesive	0	90	18.1
RIGHT	0.0-1.4	Cohesive	0	71	18.1
	1.4-2.1	Cohesive	0	114	18.9
	2.1-2.9	Cohesive	0	190	19.6
	2.9-5.2	Cohesive	0	119	18.9
CMS-ALLEN					
LEFT	0.0-1.4	Cohesive	0	95	18.1
	1.4-2.1	Cohesive	0	76	18.1
	2.1-4.0	Cohesive	0	29	17.3
	4.0-5.6	Cohesive	0	186	19.6
	5.6-7.1	Cohesive	0	152	19.6
	7.1-8.1	Cohesive	0	190	19.6
RIGHT	0.0-1.4	Cohesive	0	29	17.3
	1.4-2.9	Cohesive	0	119	18.9
	2.9-5.5	Cohesive	0	190	19.6
CMS-ALLEN					
S-W RIGHT	0.0-2.1	Non-cohesive	30°	0	18.1
	2.1-4.0	Cohesive	0	71	18.1
	4.0-5.2	Non-cohesive	30°	0	18.1

SIGN	DEPTH(m) FROM TO	TYPE OF SOIL	$\phi$	C (kPa)	$\delta$ (kN/m <sup>3</sup> )
CMS-4EC					
LEFT	0.0-1.4	Non-cohesive	30°	0	18.1
	1.4-2.4	Non-cohesive	30°	0	17.3
	2.4-4.7	Cohesive	0	67	18.1
	4.7-5.5	Non-cohesive	30°	0	17.3
	5.5-7.1	Cohesive	0	62	18.1
	7.1-9.3	Cohesive	0	300	20.4
RIGHT	0.0-1.4	Non-cohesive	30°	0	19.6
	1.4-2.1	Non-cohesive	30°	0	18.9
	2.1-3.4	Cohesive	0	14	17.3
	3.4-4.0	Non-cohesive	30°	0	17.3
	4.0-5.2	Cohesive	0	71	18.1
CMS-5WE					
LEFT	0.0-1.4	Non-cohesive	30°	0	18.9
	1.4-2.1	Cohesive	0	286	20.4
	2.1-2.9	Cohesive	0	76	18.1
	2.9-4.7	Cohesive	0	38	17.3
	4.7-5.4	Non-cohesive	30°	0	20.4
	5.4-7.1	Cohesive	0	167	19.6
	7.1-8.0	Cohesive	0	300	20.4
RIGHT	0.0-1.1	Non-cohesive	30°	0	18.1
	1.1-2.1	Cohesive	0	86	18.1
	2.1-2.9	Cohesive	0	138	18.9
	2.9-4.0	Cohesive	0	38	17.3
	4.0-5.6	Cohesive	0	52	18.1
	5.6-7.1	Cohesive	0	167	19.6
	7.1-9.4	Cohesive	0	300	20.4

SIGN	DEPTH(m) FROM TO	TYPE OF SOIL	$\phi$	c (kPa)	$\gamma$ (kN/m <sup>3</sup> )
CMS-4WE					
LEFT	0.0-1.4	Non-cohesive	30°	0	18.1
	1.4-2.1	Cohesive	0	57	18.1
	2.1-2.9	Cohesive	0	71	18.1
	2.9-4.0	Cohesive	0	52	18.1
	4.0-5.6	Cohesive	0	86	18.1
	5.6-7.1	Cohesive	0	129	18.9
	7.1-8.5	Cohesive	0	300	20.4
RIGHT	0.0-1.4	Non-cohesive	30°	0	19.6
	1.4-4.0	Cohesive	0	48	17.3
	4.0-5.6	Cohesive	0	33	17.3
	5.6-7.1	Cohesive	0	138	18.9
	7.1-8.6	Cohesive	0	176	19.6
	8.6-9.6	Non-cohesive	30°	0	18.1
CMS-4EE					
LEFT	0.0-1.1	Non-cohesive	30°	0	18.1
	1.1-2.1	Cohesive	0	43	17.3
	2.1-4.0	Cohesive	0	29	17.3
	4.0-5.6	Cohesive	0	62	18.1
	5.6-7.1	Cohesive	0	300	20.4
	7.1-8.1	Cohesive	0	300	20.4
RIGHT	0.0-1.1	Non-cohesive	30°	0	18.1
	1.1-4.0	Cohesive	0	38	17.3
	4.0-5.6	Cohesive	0	105	18.9
	5.6-8.1	Cohesive	0	286	20.4

SIGN	DEPTH(m) FROM TO	TYPE OF SOIL	$\phi$	C (kPa)	$\gamma$ (kN/m <sup>3</sup> )
CMS-5WC					
LEFT	0.0-1.4	Non-cohesive	30°	0	18.9
	1.4-2.1	Cohesive	0	138	18.9
	2.1-2.9	Cohesive	0	48	17.3
	2.9-4.0	Cohesive	0	19	17.3
	4.0-5.6	Cohesive	0	152	19.6
	5.6-7.1	Cohesive	0	110	18.9
	7.1-8.5	Cohesive	0	148	19.6
RIGHT	0.0-2.1	Non-cohesive	30°	0	19.6
	2.1-2.9	Non-cohesive	30°	0	18.1
	2.9-4.0	Non-cohesive	30°	0	17.3
	4.0-5.6	Cohesive	0	71	18.1
	5.6-7.1	Cohesive	0	205	20.4
	7.1-8.5	Cohesive	0	114	18.9
CMS-5EC					
LEFT	0.0-2.1	Non-cohesive	30°	0	18.1
	2.1-2.9	Cohesive	0	24	17.3
	2.9-4.0	Cohesive	0	14	17.3
	4.0-5.6	Cohesive	0	24	17.3
	5.6-8.6	Cohesive	0	86	18.1
	8.6-10.0	Cohesive	0	52	18.1
RIGHT	0.0-2.1	Non-cohesive	30°	0	17.3
	2.1-4.0	Cohesive	0	76	18.1
	4.0-6.5	Cohesive	0	90	18.1

SIGN	DEPTH(m)	TYPE OF	$\phi$	c	$\gamma$
	FROM TO	SOIL		(kPa)	(kN/m <sup>3</sup> )
CMS-3WE					
LEFT	0.0-2.1	Cohesive	0	67	18.1
	2.1-2.9	Cohesive	0	124	18.9
	2.9-5.2	Cohesive	0	186	19.6
RIGHT	0.0-2.1	Cohesive	0	57	18.1
	2.1-2.9	Cohesive	0	119	18.9
	2.9-4.0	Cohesive	0	205	20.4
	4.0-5.2	Cohesive	0	171	19.6

---

#### FROST PROTECTION

For frost protection, a cover of 1.2m is required. Backfill material placed above the frost penetration depth should not be considered to provide any lateral resistance. Should the provision of lateral resistance be required in the upper 1.2m, please contact this office for acceptable alternatives.

#### DE-WATERING

Where excavations extend below the prevailing groundwater elevation, de-watering can be accomplished by a system of oversized excavations and sump pumping.

#### TEMPORARY SLOPE STABILITY

Temporary side slopes of 1H:1V will be stable.

#### FOOTING EXCAVATIONS

All soft or loose material should be removed from the surface of the excavation. The foundation surface should be covered within 6 hours of exposure with a 15 cm (minimum thickness) pad of mass concrete. This can be accomplished by cleaning up the excavation immediately before pouring the mass concrete pad.

#### ADHESION

Computation of adhesion at the soil-footing interface should be in accordance with section 6-7.3.3.2 of the O.H.B.D.C.:

$$AC_f + V \tan \phi_f > H$$

where: H = sum of factored horizontal loads acting, kN

V = sum of factored vertical loads acting, kN

A = area of the underside of the spread footing, m<sup>2</sup>

C<sub>f</sub> = factored cohesion, kPa (factor = 0.5)

$\tan \phi_f$  = factored friction (factor = 0.8)

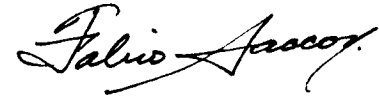


MISCELLANEOUS

The field work for this project was carried out under the supervision of Mr. F. Saccon, Project Foundations Engineer.

The report was written by Mr. F. Saccon and reviewed by Mr. D. Dundas, Foundations Engineer.

The drilling equipment used was owned and operated by Atcost Soil Drilling Inc.



F. Saccon  
Project Foundations Engineer



D. H. Dundas, P.Eng.  
Foundations Engineer

## APPENDIX

## 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:

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	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
$\sigma$	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

### MECHANICAL PROPERTIES OF SOIL

$m_v$	kPa <sup>-1</sup>	COEFFICIENT OF VOLUME CHANGE
$C_c$	1	COMPRESSION INDEX
$C_s$	1	SWELLING INDEX
$C_\alpha$	1	RATE OF SECONDARY CONSOLIDATION
$c_v$	m <sup>2</sup> /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 = $\frac{c_u}{\tau_r}$

### PHYSICAL PROPERTIES OF SOIL

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





# RECORD OF BOREHOLE No CMS-1E RIGHT METRIC

W.P. 30-81-06 LOCATION 401 EB - 200 m E of DIXON - RIGHT SHOULDER ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER COMPILED BY B.D.  
DATUM ASSUMED DATE 85-10-9 CHECKED BY D.D.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT $\Sigma$		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					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
100.0 0.0	GROUND SURFACE												
5	Silty clay (cl) with sand some gravel		1	SS	21	99							
10	Firm to Hard.		2	SS	13	98							
15			3	SS	7	97							
20	Occ. sand some fine gravel		4	SS	21	96							
25	Compact												
30			5	SS	27	95							
35													
40			6	SS	40	94							
45						93							
50			7	SS	83								
55	END OF BOREHOLE												
60	* GROUNDWATER ELEVATION NOT ESTABLISHED												
65													
70													
75													
80													
85													
90													
95													
100													

+3, x5: Numbers refer to  
Sensitivity

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



# RECORD OF BOREHOLE No CMS-409 LEFT

METRIC

W P 30-B1-06 LOCATION 409 EB 200 m W of KIPLING Left Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 409 BOREHOLE TYPE H-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-10-17 CHECKED BY DD

OFFICE REPORT, ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT <u>2</u>		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	SHEAR STRENGTH					
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
100.0	GROUND SURFACE													
0.0														
5	Silty sand tr clay Compact		1	SS	14		99							
5.20			2	SS	13		98							
1.7			3	SS	16		97							
15	Silty clay (CL) with sand Some gravel Stiff to Hard		4	SS	21		96							
10.0			5	SS	50		95							
25			6	SS	27		94							
15.30			7	SS	82	23cm	93							
2.5	END OF BOREHOLE													
8.1														
30	* Ground Water elevation not established.													
65														
35.0														
75														
40.0														
85														
45.0														
95														
99														



# RECORD OF BOREHOLE No CMS-409 RIGHT

METRIC

W.P. 30-81-06 LOCATION 409 EB, 200 m W. OF KIPLING, RIGHT SHOULDER ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S COMPILED BY F.S.  
DATUM ASSUMED DATE 85-10-16 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT <u>2</u> 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%)	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES							
100.0	GROUND SURFACE											
0.0												
5 10	Silty sand with clay Loose		1	SS	5		99					
15 20	Silty clay (cl) with sand some gravel Stiff		2	SS	5		98					
25 30			3	SS	10		97					
35 40			4	SS	9		96					
45 50			5	SS	8		95					
55 60			6	SS	8		94					
65 70	REFUSAL						93					
72.8	↓ CONCRETE FOOTING ↓											
7.2	END OF BOREHOLE											
25 30	* Ground water elevation not established.											
35 40												
45 50												
55 60												
65 70												
75 80												
85 90												
95 100												



# RECORD OF BOREHOLE No CMS-400-LEFT

METRIC

W P 30-B1-06 LOCATION 400 SB 1200m N of 401 LEFT SHOULDER ORIGINATED BY F.S.  
DIST 6 HWY 400 BOREHOLE TYPE H-S AUGER COMPILED BY B.D.  
DATUM ASSUMED DATE 85-10-16 CHECKED BY J.D.

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	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								
100.0	GROUND SURFACE												
6.0						*							
5	Silty clay with sand tr gravel		1	SS	16		99						
5 10	Stiff to Very stiff		2	SS	11		98						
15			3	SS	13		97						
10 20			4	SS	17		96						
25							95						
15 30			5	SS	27		94						
35							93						
20 40	occ. silt zones tr sand		6	SS	15		92						
65							91						
25 50			7	SS	12		90						
85							89						
94.4													
8.6													
30 80	Silty sand trace clay tr gravel Compact		8	SS	27								
65													
35 70	occ. gravel zones very dense		9	SS	85								
88.7													
11.1	END OF BOREHOLE												
75	* GROUNDWATER ELEVATION NOT ESTABLISHED												
40 80													
85													
45 90													
95													
99													

+3, x5: Numbers refer to  
Sensitivity

20  
15 10 5 (%) STRAIN AT FAILURE  
10



## RECORD OF BOREHOLE No CMS-400 RIGHT METRIC

WP 30-81-06 LOCATION 400 SB - 1280m N OF 401 - RIGHT SHOULDER ORIGINATED BY FS  
DIST 6 HWY 400 BOREHOLE TYPE H-S AUGER COMPILED BY BD  
DATUM ASSUMED DATE 85-10-15 CHECKED BY DD

[illegible]

+<sup>3</sup>, x<sup>5</sup> : Numbers refer to Sensitivity

15  $\phi$  5 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No CMS-2EE LEFT METRIC

W P 30-81-06 LOCATION 401 EB EXPRESS, 200 m W of 400 SBL, LEFT SHOULDER ORIGINATED BY FS  
DIST 6 HWY 401 BOREHOLE TYPE SS COMPILED BY B.D.  
DATUM ASSUMED DATE 85-10-30 CHECKED BY DD

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			VALUES	20 40 60 80 100					
100.0	GROUND SURFACE												
0.0	Silty sand trace gravel trace clay Compact		1	SS	13								
1.4	Silty clay trace gravel trace sand Firm to Stiff		2	SS	15								
			3	SS	12								
			4	SS	13								
			5	SS	6								
			6	SS	5								
			7	SS	7								
			8	SS	7								
			9	SS	9								
			10	SS	9								
86.9	END OF BOREHOLE												
13.1	* GROUNDWATER ELEVATION NOT ESTABLISHED												



# RECORD OF BOREHOLE No CMS-2EE RIGHT METRIC

W P 30-81-06 LOCATION 401 EB EXPRESS, 200 m W of 400 SBL, Right Shoulder ORIGINATED BY F. S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER COMPILED BY B.D.  
DATUM ASSUMED DATE 85-10-25 CHECKED BY DD

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					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
100.0	GROUND SURFACE												
0.0													
5	Silty sand trace clay some gravel Compact		1	SS	17								
10	Silty clay Trace/some sand tr gravel Firm to very stiff		2	SS	30								
15			3	SS	18								
20			4	SS	23								
25													
30			5	SS	11								
35													
40			6	SS	6								
45													
50			7	SS	9								
55													
60			8	SS	10								
65													
70			9	SS	11								
75													
80			10	SS	16								
85													
90			11	SS	9								
95													
100	END OF BOREHOLE * GROUNDWATER ELEVATION NOT ESTABLISHED												

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No CMS-2EC LEFT

METRIC

W P 30-81-06 LOCATION 401 E.B. Collector @ 400 S.B. Left Shoulder  
DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER  
DATUM ASSUMED DATE 85-10-17

ORIGINATED BY F.S.  
COMPILED BY F.S.  
CHECKED BY DO

OFFICE REPORT, ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT <u>2</u>		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	20 40 60 80 100					
100.0 0.0	GROUND SURFACE													
5	Silty sand Compact		1	SS	13		99							
5 20			2	SS	15		90							
15			3	SS	19		97							
10 20	occ. Silty sand bands		4	SS	19		96							
25			5	SS	20		95							
15 20	Silty clay tr sand		6	SS	8		99							
35	Stiff to very stiff		7	SS	8		92							
20 20			8	SS	9		91							
45			9	SS	13		89							
25 20			10	SS	9		88							
55														
30 20														
65														
35 20														
75														
40 20														
87.4 12.6	END OF BOREHOLE													
85														
45 90	* Ground water elevation not established.													
95														
99														

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



## METRIC

W P 30-B1-06 LOCATION 401 EB COLL. AT 400, 2m RIGHT OF CURB ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-10-10 CHECKED BY DD

[illegible]

CONTINUED

**+3, x5 : Numbers refer to Sensitivity**

15  $\phi$  5 (%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No

cms-2EC  
RIGHT  
(CONT'D)

## METRIC

W P 30-81-06

LOCATION 401 EB COLL. AT 400, 2 m RT OF CURVE

ORIGINATED BY FS

DIST 6 HWY 401

BOREHOLE TYPE H-S AUGER

COMPILED BY FS

DATUM ASSUMED

DATE 25-10-10

CHECKED BY DB

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					NATURAL MOISTURE CONTENT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			'N' VALUES	20	40	60	80	100	PLASTIC LIMIT W <sub>p</sub>	W		
50	84.8 CONTINUED															
	15.2 Silty clay		13	55	9											
	84.3 *															
5	15.7 END OF BOREHOLE															
55	* trace sand stiff															
10																
15																
20																
25																
30																
35																
40																
45																
50																
55																
60																
65																
70																
75																
80																
85																
90																
95																
99																



## METRIC

ORIGINATED BY F. S.

COMPILED BY F.S.

CHECKED BY DD

[illegible]

**+<sup>3</sup>, x<sup>5</sup> : Numbers refer to Sensitivity**

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



# RECORD OF BOREHOLE No CMS-7WC RIGHT METRIC

W P 30-81-06 LOCATION 401 WB Coll, 200m W of Keele, 2m RIGHT OF CURB ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-10-11/15 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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			SHEAR STRENGTH KPa							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
100.0	GROUND SURFACE							20 40 60 80 100							
0.0						*									
	occ. sand zones		1	SS	15		99								
			2	SS	14		98								
			3	SS	14		97								
			4	SS	14		96								
	Silty clay some sand to gravel		5	SS	11		95								
	Stiff to very stiff		6	SS	15		94								
			7	SS	12		92								
	occ. boulders		8	SS	11		90								
			9	SS	13		89								
			10	SS	18		87								
			11	SS	14		86								
85.8 74.2	END OF BOREHOLE														
	* Ground Water Elevation not determined														

END OF BOREHOLE

\* Ground Water  
Elevation not  
determined

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

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





# RECORD OF BOREHOLE No CMS-6WE LEFT

METRIC

W P 30-81-06 LOCATION 401 WB EXPRESS, 70m E. of Keble, left shoulder  
DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER  
DATUM ASSUMED DATE 85-10-23

ORIGINATED BY F.S.  
COMPILED BY F.S.  
CHECKED BY DO

OFFICE REPORT, ON SOIL EXPLORATION

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			VALUES	20 40 60 80 100					
100.0	GROUND SURFACE												
0.0	occ. sandy zones					*							
5.0	Silty clay some sand tr. gravel		1	SS	34		99						
10.0	Firm to Hard		2	SS	17		98						
15.0			3	SS	12		97						
20.0			4	SS	10		96						
25.0			5	SS	7		95						
30.0			6	SS	8		94						
35.0			7	SS	11		93						
40.0			8	SS	14		92						
45.0			9	SS	15		91						
50.0			10	SS	15		90						
55.0			11	SS	18		89						
60.0							88						
65.0							87						
70.0							86						
75.0													
80.0													
85.0													
90.0													
95.0	END OF BOREHOLE												
99.0	X GROUND WATER ELEVATION NOT DETERMINED.												

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10

# RECORD OF BOREHOLE No CMS-6WE RIGHT METRIC

W P 30-B1-06 LOCATION 401 WB Express, 70m E. of Keok, Right Shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER COMPILED BY F.S.  
 DATUM ASSUMED DATE 85-10-22 CHECKED BY DO

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT <u>2</u>		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						
100.0	GROUND SURFACE													
0.0						*								
5.0	occ. sandy zones.		1	SS	25		99							
10.0	Silty clay some sand tr gravel		2	SS	22		98							
15.0	Stiff to Very stiff		3	SS	15		97							
20.0			4	SS	14		96							
25.0			5	SS	9		95							
30.0			6	SS	9		94							
35.0			7	SS	16		93							
40.0			8	SS	15		92							
45.0			9	SS	16		91							
50.0			10	SS	18		90							
55.0							89							
60.0							88							
65.0														
70.0														
75.0														
80.0														
85.0	END OF BOREHOLE													
90.0	* Ground water elevation not determined.													
95.0														
99.0														

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No CMS-3EE LEFT METRIC

W P 30-B1-06 LOCATION 401 EB EXPRESS 300m W of DUFFERIN LEFT SHOULDER ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY B.D.  
DATUM ASSUMED DATE 85-10-30 CHECKED BY DD

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					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
100.0	GROUND SURFACE												
0.0													
5	Silty clay Some sand tr. gravel.		1	SS	12								
10			2	SS	20								
15	occ. sand and gravel zones		3	SS	30								
20			4	SS	19								
25	Stiff to Very stiff		5	SS	20								
30			6	SS	28								
35													
40													
45	END OF BOREHOLE												
50	* GROUNDWATER ELEVATION NOT ESTABLISHED												
55													
60													
65													
70													
75													
80													
85													
90													
95													
100													



# RECORD OF BOREHOLE No CMS-3EE RIGHT METRIC

W P 30-81-06 LOCATION 401 EB EXPRESS, 200 m W OF DUFFERIN STREET, RIGHT SHOULDER ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY B.D.  
DATUM ASSUMED DATE 85-10-29 CHECKED BY DD

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					
100.0	GROUND SURFACE													
0.0														
	occ. sandy zones					*								
			1	SS	15									
			2	SS	24									
			3	SS	40									
			4	SS	25									
			5	SS	25									
			6	SS	29									
			7	SS	33									
			8	SS	32									
			9	SS	22									
28.9	END OF BOREHOLE													
11.1	* GROUNDWATER ELEVATION NOT ESTABLISHED													



# RECORD OF BOREHOLE No CMS-ALLEN LEFT

METRIC

W P 30-B1-06 LOCATION ALLEN ROAD NB LANE, 720 m S OF 401, LEFT SHOULDER ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY B.D.  
DATUM ASSUMED DATE 85-10-28 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH KPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	PLASTIC LIMIT Wp	NATURAL MOISTURE CONTENT W	LIQUID LIMIT Wl	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
100.0 0.0	GROUND SURFACE												
5	occ. sand zones		1	SS	20		99						
10			2	SS	16		98						
15	Silty clay		3	SS	8		97						
20	some sand tr. gravel		4	SS	6		96						
25	Firm to Hard		5	SS	32		95						
30			6	SS	32		94						
35			7	SS	40		93						
40							92						
45													
50													
55	END OF BOREHOLE												
60	* GROUNDWATER ELEVATION NOT ESTABLISHED												
65													
70													
75													
80													
85													
90													
95													
100													



# RECORD OF BOREHOLE No <sup>CMS-ALLEN</sup> RIGHT METRIC

W P 30-81-06 LOCATION ALLEN NB, 720 m S. of 401, 4m right of guardrail ORIGINATED BY F.S.  
DIST 6 HWY ALLEN RD. BOREHOLE TYPE H-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 05-10-24 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT <u>2</u>		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					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
100.0	GROUND SURFACE												
0.0													
5.0	acc. sand zones		1	SS	G								
10.0			2	SS	25								
15.0	Silty clay Some sand tr gravel		3	SS	29								
20.0	Firm to Hard		4	SS	43								
25.0			5	SS	40								
30.0			6	SS	38								
33.4	END OF BOREHOLE												
35.0	*GROUND WATER ELEVATION NOT DETERMINED												
40.0													
45.0													
50.0													
55.0													
60.0													
65.0													
70.0													
75.0													
80.0													
85.0													
90.0													
95.0													
99.0													



RECORD OF BOREHOLE NO RIGHT CMS-ALLEN-S-W METRIC

W P 30-81-06 LOCATION Ramp from Allen N.B to 401 W.B., 100m S. of 401, Right Shoulder ORIGINATED BY F.S.  
DIST 6 HWY ALLEN RD. BOREHOLE TYPE H-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-10-21 CHECKED BY DD

OFFICE REPORT, ON SOIL EXPLORATION

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT <u>2</u>		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					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
100.0 0.0	GROUND SURFACE												
5	Silty clay with sand tr. gravel		1	SS	15								
5 10	occ. pockets of sand		2	SS	15								
15	Stiff to Hard.		3	GS	17								
10 20			4	SS	15								
25													
15 30	occ. pockets of sand		5	SS	12								
35													
20 40			6	SS	36								
45													
25 50			7	SS	80								
55													
30 60			8	SS	113/20cm								
90.6	END OF BOREHOLE												
65	*Ground water elevation not determined.												
70													
75													
80													
85													
90													
95													
99													



# RECORD OF BOREHOLE No CMS-4EC LEFT METRIC

W P 30-81-06 LOCATION 401 E.B. Collector, 120m E. of Bathurst, left shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-10-18 CHECKED BY DD

OFFICE REPORT, ON SOIL EXPLORATION

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			VALUES	20 40 60 80 100					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
100.0	GROUND SURFACE												
0.0													
5	Silty sand tr clay tr/some gravel		1	SS	12								
5 10	Very loose to compact		2	SS	4								
15			3	SS	16								
10 20	Silty clay with sand tr gravel		4	SS	14								
25	Stiff to Hard												
15 20			5	SS	8								
35	occ. sand zones												
20 40			6	SS	13								
45													
25 30			7	SS	77								
55													
30 40			8	SS	60	15 cm							
65	END OF BOREHOLE												
70	* Ground Water elevation not established.												
75													
80													
85													
90													
95													
99													



+3, x5: Numbers refer to Sensitivity



# RECORD OF BOREHOLE No CMS-5 WE LEFT METRIC

W P 30-81-06 LOCATION 401 WB EXPRESS, 300 m E of BATHURST, LEFT SHOULDER ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H.S. AUGER COMPILED BY B.D.  
DATUM ASSUMED DATE 85-10-28 CHECKED BY D.D.

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					
100.0	GROUND SURFACE													
0.0														
5	Silty sand tr gr. Compact		1	SS	20									
98.0			2	SS	60/25 cm									
1.4	occ. boulders		3	SS	16									
15			4	SS	8									
25	Silty clay Some sand tr gravel		5	SS	60/25 cm									
15	Stiff to Hard.		6	SS	35									
35			7	SS	125/23 cm									
20														
45														
25														
92.0	END OF BOREHOLE													
0.0	* GROUNDWATER ELEVATION NOT ESTABLISHED													
55														
50														
60														
65														
70														
75														
80														
85														
90														
95														
99														



# RECORD OF BOREHOLE No. CMS-5WE RIGHT METRIC

W P 30-81-06 LOCATION 401 W.B. Express, 300m E. of Bathurst, Right Shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE H-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-10-21 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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					
100.0	GROUND SURFACE															GR SA SI CL
0.0																
5	Silty sand Compact		1	SS	19	*										
28.9			2	SS	18											
1.1	Silty clay with sa trgr. Stiff to Hard		3	SS	29											
5			4	SS	8											
15	occ. boulders		5	SS	11											
20			6	SS	35											
25	tr. organics		7	SS	115/28cm											
30	occ. Sandy zones.		8	SS	70/33cm											
70.6	END OF BOREHOLE															
9.4	*Ground water elevation not established															

# RECORD OF BOREHOLE No CMS-4WE

METRIC

W P 30-81-06 LOCATION 401 W.B. Express, 325 m E. of Yonge St. Left shoulder ORIGINATED BY F.S.  
 DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY F.S.  
 DATUM ASSUMED DATE 85-10-31 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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					
100.0	GROUND SURFACE											
0.0												
1.4	Silty sand tr clay tr gravel Compact		1	SS	19							
1.4			2	SS	12							
1.4			3	SS	15							
1.4			4	SS	11							
1.4			5	SS	18							
1.4			6	SS	27							
1.4			7	SS	18							
1.4			8	SS	55							
1.4	Silty sand Very dense.											
1.4	END OF BOREHOLE											

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No. CMS-4WE METRIC

W P 30-81-06 LOCATION 401 WB Express, 325m E. of Yonge St, right shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-11-05 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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			SHEAR STRENGTH									WATER CONTENT (%)
								○ UNCONFINED	+ FIELD VANE	● QUICK TRIAXIAL	x LAB VANE						
100.0	GROUND SURFACE																
0.0	Silty sand tr. clay some gravel Dense		1	SS	32												
98.6			2	SS	10												
1.4			3	SS	12												
5.0			4	SS	12												
15.0	tr. organics		5	SS	7												
25.0	Silty clay some sand tr. gravel Firm to Hard		6	SS	29												
30.0			7	SS	37												
31.4			8	SS	20												
32.6	Silty sand Compact																
34.4																	
36.6	END OF BOREHOLE *ground water elevation not established.																
38.0																	
40.0																	
42.0																	
44.0																	
46.0																	
48.0																	
50.0																	
52.0																	
54.0																	
56.0																	
58.0																	
60.0																	
62.0																	
64.0																	
66.0																	
68.0																	
70.0																	
72.0																	
74.0																	
76.0																	
78.0																	
80.0																	
82.0																	
84.0																	
86.0																	
88.0																	
90.0																	
92.0																	
94.0																	
96.0																	
98.0																	



RECORD OF BOREHOLE No CMS 4EE  
LEFT

METRIC

W P 30-81-06

LOCATION 401 E. Express, 225m W. of Bayview, left shoulder

ORIGINATED BY F.S.

DIST 6 HWY 401

BOREHOLE TYPE S-S AUGER

COMPILED BY F.S.

DATUM ASSUMED

DATE 85-11-13

CHECKED BY DD

SOIL PROFILE

SAMPLES

GROUND WATER  
CONDITIONS

ELEVATION SCALE

DYNAMIC CONE PENETRATION  
RESISTANCE PLOT

20 40 60 80 100

SHEAR STRENGTH KPa

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL x LAB VANE

20 40 60 80 100

PLASTIC  
LIMIT

NATURAL  
MOISTURE  
CONTENT

LIQUID  
LIMIT

W<sub>p</sub>

W

W<sub>L</sub>

WATER CONTENT (%)

UNIT  
WEIGHT  
γ

REMARKS  
&  
GRAIN SIZE  
DISTRIBUTION  
(%)  
GR SA SI CL

ELEV  
DEPTH

DESCRIPTION

STRAT  
PLOT

NUMBER

TYPE

'N' VALUES

GROUND WATER  
CONDITIONS

ELEVATION SCALE

SHEAR STRENGTH KPa

○ UNCONFINED + FIELD VANE

● QUICK TRIAXIAL x LAB VANE

20 40 60 80 100

PLASTIC  
LIMIT

NATURAL  
MOISTURE  
CONTENT

LIQUID  
LIMIT

W<sub>p</sub>

W

W<sub>L</sub>

WATER CONTENT (%)

UNIT  
WEIGHT  
γ

REMARKS  
&  
GRAIN SIZE  
DISTRIBUTION  
(%)  
GR SA SI CL

100.0

GROUND SURFACE

0.0

1

SS

19

\*

99

1

SS

19

99

1

SS

9

98

2

SS

7

97

3

SS

6

96

4

SS

13

95

5

SS

110/25 cm

94

6

SS

64

93

7

SS

64

92

8

SS

64

91

9

SS

64

90

10

SS

64

89

11

SS

64

88

12

SS

64

87

13

SS

64

86

Silty sand  
tr. gravel

occ.  
sand zones

Silty clay  
Some sand  
tr. gravel  
Firm to  
Hard

tr.  
organics

occ.  
Silty sand  
seams.

END OF BOREHOLE  
\*ground water  
elevation not  
established.



RECORD OF BOREHOLE No CMS-4EE  
Right

METRIC

W P 30-81-06 LOCATION 401 E.B. Express, 225m W. of Bayview, Right shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-11-7/8 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE						
100.0	GROUND SURFACE												
0.6													
5	Silty sand to gravel		1	SS	15								
98.9			2	SS	8								
10	occ. Sand zones		3	SS	8								
15			4	SS	8								
20	Silty clay Some sand to gravel		5	SS	22								
25	Stiff to Hard		6	SS	60								
30	occ. silt seams		7	SS	60								
91.9													
8.1	END OF BOREHOLE												
30	* Ground Water elevation not established.												



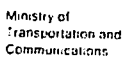
# RECORD OF BOREHOLE No CMS-5WC LEFT

METRIC

W P 30-81-06 LOCATION 401 WB Coll. 100m E. of LESLIE LEFT SHOULDER ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-11-15 CHECKED BY DD

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT <u>2</u>					UNIT WEIGHT Y	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100		
100.0	GROUND SURFACE													
0.0	Silty sand tr gravel occ. pockets of silty clay					*								
98.6	Compact		1	SS	27		99							
5 10 1.4	occ. sandy zones		2	SS	29		98							
15			3	SS	10									
10 20	Silty clay some sand tr gravel		4	SS	4		97							
15							96							
15 20	Firm to Hard		5	SS	32		95							
20 30							94							
20 40	occ Sandy zones		6	SS	23		93							
25 50			7	SS	31		92							
30 60							91							
90.4			8	SS	36									
91.0	END OF BOREHOLE													
35 70	*Ground Water elevation not determined.													
75														
80														
85														
90														
95														
99														





## METRIC

ORIGINATED BY F.S.

COMPILED BY F.S.

CHECKED BY DD

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 $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES	20		40	60	80	100	SHEAR STRENGTH				
100.0 0.0	GROUND SURFACE					*										
99.0	Silty sand tr gravel Very loose to dense		1	SS	38											
98.0			2	SS	35											
97.0			3	SS	18											
96.0	occ. silty clay zones very loose		4	SS	3											
95.0			5	SS	15											
94.0	occ. Sand Zones		6	SS	#3											
93.0			7	SS	24											
92.0	Silty clay Some sand tr. gravel Very stiff to hard		8	SS	23											
91.0			9	SS	12											
90.0			10	SS	7											
89.0																
88.0																
87.0																
86.0																
85.0																
84.0																
83.0																
82.0																
81.0																
80.0																
79.0																
78.0																
77.0																
76.0																
75.0																
74.0																
73.0																
72.0																
71.0																
70.0																
69.0																
68.0																
67.0																
66.0																
65.0																
64.0																
63.0																
62.0																
61.0																
60.0																
59.0																
58.0																
57.0																
56.0																
55.0																

OFFICE REPORT ON SOIL EXPLORATION

**+<sup>3</sup>, x<sup>5</sup> :** Numbers refer to Sensitivity

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



# RECORD OF BOREHOLE No CMS-SEC METRIC

W P 30-B1-06 LOCATION 401 Eb Coll. 100m E. of Leslie, left shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-11-13 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			20	40	60	80	100			
100.0	GROUND SURFACE													
0.0														
5 10	Silty sand tr. gravel. occ. pockets of silty clay Loose		1	SS	20	97								
97.9			2	SS	19	98								
2.1			3	SS	5	97								
10 20	Silty clay with sand tr. gravel soft to very stiff	tr. organics	4	SS	3	96								
25			5	SS	5	95								
20 40			6	SS	21	94								
15			7	SS	18	92								
25 50			8	SS	11	91								
30 60			9	SS	17	90								
35 70						89								
88.9	END OF BOREHOLE													
11.1														
75														
80	*Ground water elevation not determined.													
85														
90														
95														
99														

+3, x5: Numbers refer to  
Sensitivity

20  
15-5 (%) STRAIN AT FAILURE  
10



# RECORD OF BOREHOLE No CMS SEC RIGHT

METRIC

W P 30-81-06

LOCATION 401 EB Coll., 400m E. of Leslie St., Right shoulder

ORIGINATED BY F.S.

DIST 6 HWY 401

BOREHOLE TYPE S-S AUGER

COMPILED BY F.S.

DATUM ASSUMED

DATE 85-11-08

CHECKED BY D.D.

OFFICE REPORT ON SOIL EXPLORATION

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			SHEAR STRENGTH							WATER CONTENT (%)
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE						
100.0	GROUND SURFACE														
0.0						*									
5	Silty sand trace gravel occ. pockets of silty clay Loose		1	SS	10		99								
10			2	SS	5		98								
15	Silty clay with sand tr gravel Stiff to Hard		3	SS	18		97								
20			4	SS	16		96								
25			5	SS	19		95								
30			6	SS	19		94								
35			7	SS	31		93								
40			8	SS	16		92								
45			9	SS	33		91								
50			10	SS	9		90								
55							89								
60							88								
65															
70															
75															
80															
85															
90															
95															
100															
87.4	END OF BOREHOLE														
12.6	*ground water elevation not established														

+<sup>3</sup>, x<sup>5</sup>: Numbers refer to  
Sensitivity

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

# RECORD OF BOREHOLE No CMS-3WE LEFT

METRIC

W P 30-81-06 LOCATION 401 WB Express, 300 m E. of Yk. Park, left shoulder ORIGINATED BY F.S.  
DIST 6 HWY 401 BOREHOLE TYPE S-S AUGER COMPILED BY F.S.  
DATUM ASSUMED DATE 85-10-31 CHECKED BY DD

OFFICE REPORT ON SOIL EXPLORATION

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	20 40 60 80 100					
100.0 0.0	GROUND SURFACE											
0.0												
5.0	occ. sandy zones		1 SS 17		99							
10.0			2 SS 14		98							
15.0	Silty clay Some sand		3 SS 26		97							
20.0	+ gravel		4 SS 42		96							
25.0	Stiff to Hard.		5 SS 39		95							
30.0			6 SS 22		94							
35.0			7 SS 16		93							
40.0			8 SS 9		92							
45.0			9 SS 9		91							
50.0					90							
55.0					89							
60.0					88							
65.0												
70.0												
75.0												
80.0												
85.0												
90.0												
95.0												
100.0												

# RECORD OF BOREHOLE No CMS-3WE

METRIC

W P 30-81-06

LOCATION 401 WB Express, 300m E. of Vic. Park, right shoulder

ORIGINATED BY F.S.

DIST 6 HWY 401

BOREHOLE TYPE H-S AUGER

COMPILED BY F.S.

DATUM ASSUMED

DATE 85-11-5

CHECKED BY D.D.

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 CI
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
100.0	GROUND SURFACE																
0.0																	
5.0	occ. Sandy zones.		1	SS	12												
10.0			2	SS	13												
15.0			3	SS	25												
20.0	Silty clay.		4	SS	43												
25.0	Some sand tr. gravel		5	SS	36												
30.0	Stiff to Hard.		6	SS	30												
35.0			7	SS	14												
40.0			8	SS	14												
45.0																	
50.0																	
55.0																	
60.0																	
65.0																	
70.0																	
75.0	END OF BOREHOLE																
80.0	*Ground Water elevation not established.																
85.0																	
90.0																	
95.0																	
99.0																	

+3, x5: Numbers refer to  
Sensitivity

20  
15 5 (%) STRAIN AT FAILURE  
10

OFFICE REPORT ON SOIL EXPLORATION

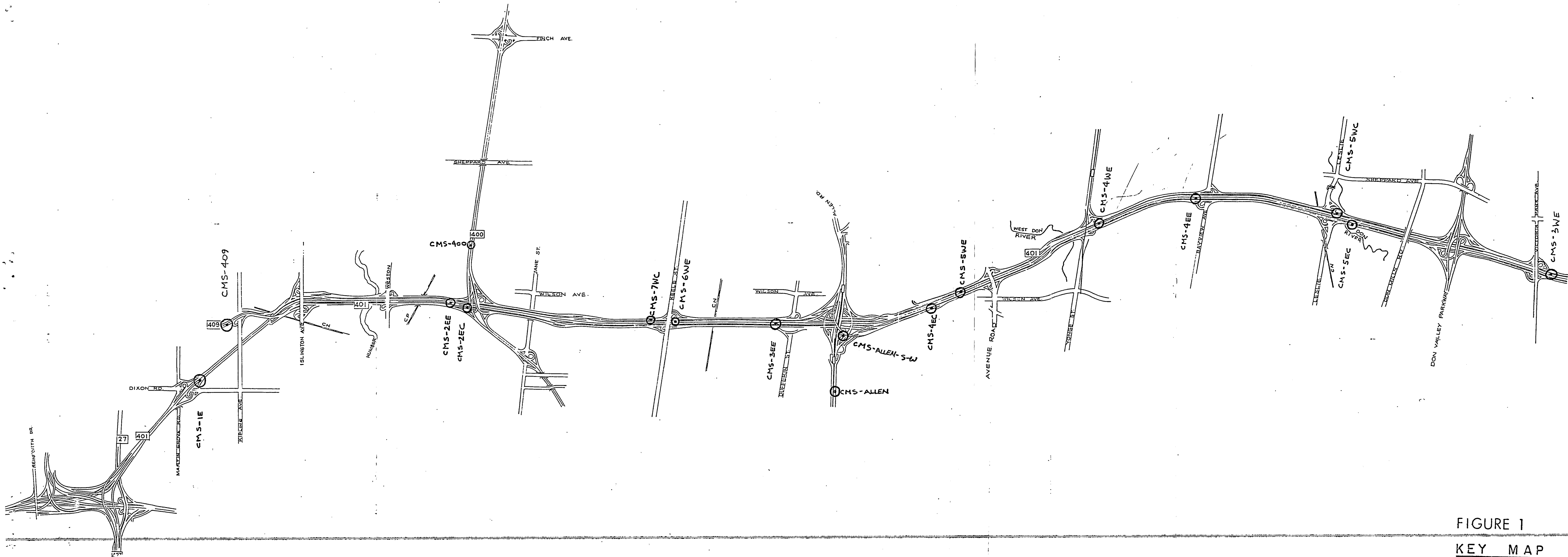


FIGURE 1

KEY MAP  
NOT TO SCALE

TABLE 2SPECIFIC SIGN LOCATIONS

<u>SIGN</u>	<u>SPECIFIC LOCATON</u>
CMS-1E	20 m west of O.H. sign: Islington Ave. North Weston Rd. Black Creek Drive
CMS-409	15 m west of sign: Ramp Speed 70 km/hr
CMS-400	At O.H. sign: Hwy. 401 Black Creek Drive
CMS-2EE	At sign for Hwy. 400 turn-off
CMS-2EC	Below Hwy. 400 S. B. Lanes
CMS-7WC	At the M.T.C. name on the South wall of the East Building
CMS-6WE	70 m east of Keele St.
CMS-3EE	10 m east of O.H. sign: Avenue Rd. Yonge St. Exit Bayview Ave. 1 km
CMS-Allen	20 m south of Ranee Ave.
CMS-Allen SW	Just south of ramp from Allen Rd. S. B. to 401 E. B.
CMS-4EC	120 m east of Bathurst St.
CMS-5WE	At O.H. sign: Allen Rd Exit 1 km

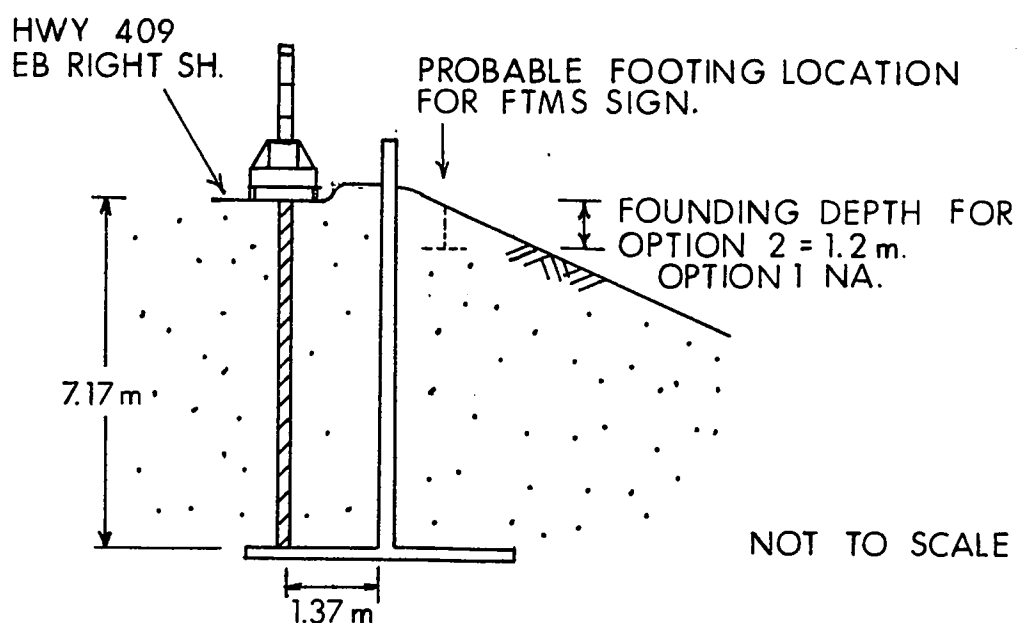
SPECIFIC SIGN LOCATIONS - cont'd

<u>SIGN</u>	<u>SPECIFIC LOCATON</u>
CMS-4WE	15 m west of sign: Avenue Rd. Exit Bathurst St. 1 km
CMS-4EE	20 m east of sign: Leslie St. Victoria Park Ave. Exit Warden Ave. 1 km
CMS-5WC	100 m east of Leslie St.; west of exit ramp to Leslie St.
CMS-5EC	30 m west of sign: Macdonald Carter Freeway
CMS-3WE	10 m west of sign: Don Valley Pkwy. Exit 1 km

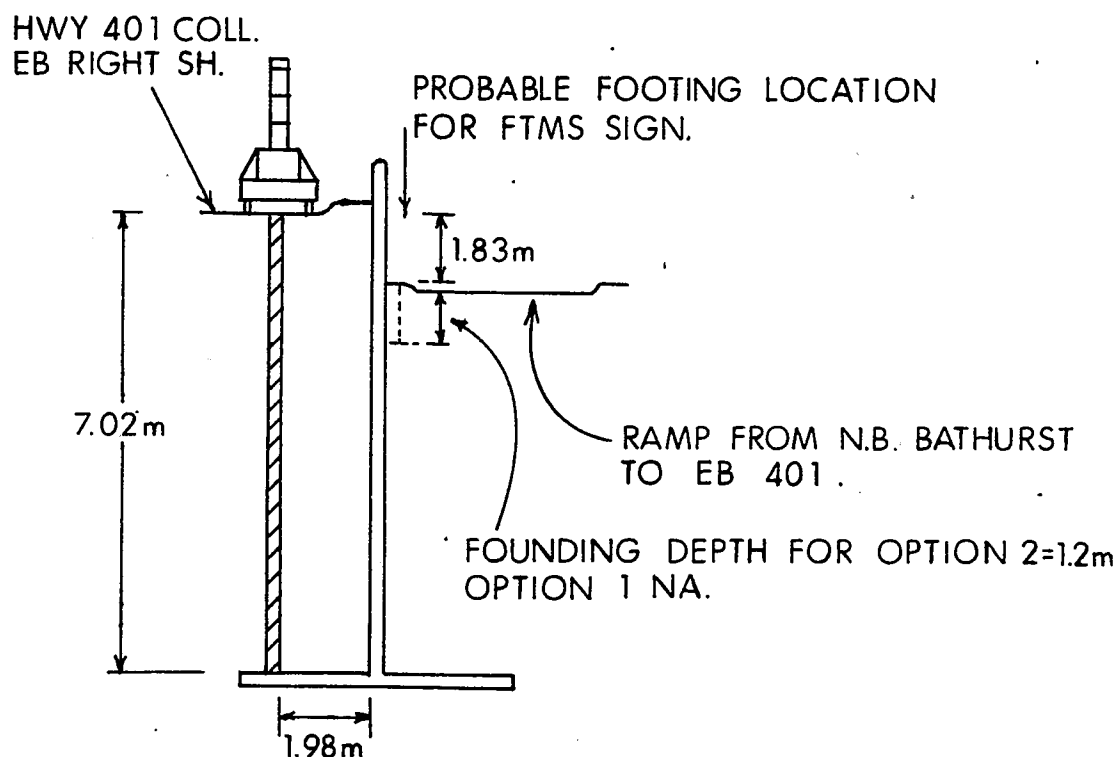


FIG. 2 BOREHOLES TERMINATED AT EXISTING FOOTINGS.

CMS-409 RIGHT



CMS-4EC RIGHT





REPLY THIS COPY FOR FOLLOW UP

WP 30-81-06

7546-101

SEND TO Mr. W. Kennedy  
F.T.M.S.  
Downsview

FROM Frank Chan DEPT. Struct. Section DATE 87-10-05

SUBJECT Cont. 86-313, Hwy. 401 FTMS, footing LW040/EC/VW010/VEC

- The foundation data was reviewed and compared with criteria for designing the footing. It is found that the sand with  $\phi=30^\circ$  is OK. Since the soil below 4.9 m has cohesion of 43 kPa which is slightly below the design data, also combined with the fact that the soil has been disturbed by digging before, we are recommending extending the footing caisson to 6 m. A few more circular stirrup and some straight bars are required to tie to the existing reinf. cage at the bottom to cover this 1 m extra depth.

Since the biggest problem is the sand falling in, we are recommending using a liner (it is agreed by Mr. Dave Dundas of the Foundation Office)

REPLY The liner can be left in place, however, if it is preferable if it can be pulled out.

C.C. Peter Gouett

Frank O. Chan

Dave Dundas

REPLY FROM

REPLY DATE

MEMORANDUM TO:

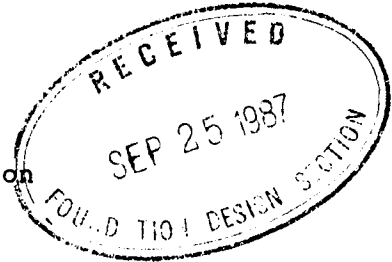
Mr. G. Burkhardt,  
Head,  
Structural Section,  
Central Region,  
5000 Yonge St.

1987 09 24

Attention: Frank Chan, Structural Section

From: Freeway Traffic Management Systems Section  
West Building, 2nd Floor, 235-3538

Re: Cont. 86-313  
Hwy. 401 FTMS Field Provisions from  
Martingrove Road to Keele Street



The contractor attempted to bore the south footing CMS LW040LEC/VW010VEC (see sheet 25) and a large quantity of loose sand was encountered causing the hole to cave in at approx. 2-4 m depth. The hole is now backfilled.

In a field investigation attended by Structural, FTMS and Construction staff the area from 15-20 m west of the CMS was reviewed as a possible alternative. This area was clear of the storm sewer backfill which appeared to be causing the loose sand problem, however a fill embankment begins at this point.

Both Structural and FTMS sections discussed this problem with Foundations section and Mr. Dave Dundas indicated that it would be a minimum of one week to get a new borehole and it was suggested that the same problem may exist. A revised footing design which would accommodate the present location was recommended.

Your recommendation is requested. Because the job is nearing completion a prompt reply would be greatly appreciated. A copy of the plan and foundations report is attached.

A handwritten signature in cursive script, appearing to read "W. Kennedy".

W. Kennedy,  
Project Engineer,  
Systems Design & Implementation Unit.

WK/rh  
Attach.

c.c. P.R. Korpai  
P. Gouett  
D. Dundas  
G. Smallwood

FOUNDATION INVESTIGATION REPORT

For

F.T.M.S. - CMS SIGNS

W.P. 30-81-06

Hwy 401, District 6, Toronto

- ADDENDUM -

We have submitted a detailed foundation investigation report together with our recommendations for the F.T.M.S. changeable message signs on January 10th, 1986. Subsequently, we were requested by Mr. F. Chan in a memorandum dated January 12, 1986 to carry out an additional foundation investigation for the proposed F.T.M.S. changeable message sign 'CMS-DVP.' This report summarizes the results of our investigation and discusses our recommendations. This addendum should be read in conjunction with our foundation investigation report previously submitted.

The field work for this additional investigation was conducted on 86 02 27 utilizing a continuous flight auger machine equipped with solid stem augers. The work consisted of two sampled boreholes.

The site location is illustrated on the attached key Map, Figure 1. More specifically, the location is approximately 6.1 m south of light standard #799 on the northbound lanes of the Don Valley Pkwy. The field work involved advancing boreholes on the east and west shoulders of the roadway, near the proposed footing locations.

At both borehole locations, the subsurface material was found to be predominantly a silty clay of low to medium plasticity at least 5 m thick, and of soft to firm consistency. Overlying the silty clay is a loose to compact silty sand layer approximately 4.5m thick. The ground water level was found at a depth of 3.8 m below the existing ground surface. Specific subsurface conditions at the borehole locations are illustrated in the appended Record of Borehole Sheets. The boreholes are identified as CMS-DVP, and as left or right with respect to lane direction.

Further to our discussion with Mr. C. P. Korzenioski of McCormick Rankin and Associates, no surface elevations were provided, hence only depths and relative elevations have been indicated on the borehole sheets. The ground elevation at all borehole locations was assumed to be 100.0 m.

#### DESIGN DETAILS

The support systems for the signs may be founded on spread footings within the competent silty sand layer.

The design values and founding elevations are as follows:

TABLE 1: RECOMMENDED FOUNDATION ELEVATIONS

	<u>ELEVATION 98.8 m</u>	<u>ELEVATION 97.7 m</u>
U.L.S.	250 kPa	350 kPa
S.L.S. Type II	75 kPa	200 kPa

#### EARTH PRESSURE CALCULATIONS

Computation of earth pressure should be in accordance with section 6-6.1.2 of the O.H.B.D.C. The passive design case ( $K_p$ ) applies.

The following soil parameters are recommended for the design of the sign foundations:

$\phi$  = apparent angle of internal friction for non-cohesive soils.

$c$  = undrained shear strength, kPa

$\gamma$  = unit weight, kN/m<sup>3</sup>

<u>SIGN</u>	<u>DEPTH (m)</u> <u>From-To</u>	<u>TYPE OF SOIL</u>	<u><math>\phi</math></u>	<u><math>c</math></u> <u>(kPa)</u>	<u><math>\gamma</math></u> <u>(kN/m<sup>3</sup>)</u>
CMS-DVP					
<u>Left</u>	0.0-1.4	Non-cohesive	30	0	20.4
	1.4-2.1	Non-cohesive	30	0	17.3
	2.1-2.9	Non-cohesive	30	0	18.9
	2.9-4.7	Non-cohesive	30	0	18.1
	4.7-9.6	Cohesive	0	19	17.3

SIGN	DEPTH (m)		TYPE OF SOIL	$\phi$	C (kPa)	$\gamma$ (kN/m <sup>3</sup> )
	From	To				
<u>Right</u>	0.0	1.4	Non-cohesive	30	0	19.6
	1.4	2.1	Non-cohesive	30	0	17.3
	2.1	4.7	Non-cohesive	30	0	18.1
	4.7	7.1	Cohesive	0	38	17.3
	7.1	9.6	Cohesive	0	29	17.3

#### FROST PROTECTION

For frost protection, a cover of 1.2 m is required. Backfill material placed above the frost penetration depth should not be considered to provide any lateral resistance.

#### DE-WATERING

Since the prevailing groundwater level was found to be at relative elevation 96.2 m, all spread footing excavations may be carried out without any major de-watering requirements. However, any precipitation or runoff into the excavations may be removed using conventional sump pumping techniques.

#### TEMPORARY SLOPE STABILITY

Temporary side slopes of 1.5H:IV will be stable.

#### ADHESION

Computation of adhesion at the soil-footing interface should be in accordance with section 6-7.3.3.2 of the O.H.B.D.C.:

$$AC_f + V \tan \phi_f > H$$

where: H= sum of factored horizontal loads acting, kN  
V= sum of factored vertical loads acting, kN  
A= area of the underside of the spread footing,  
m<sup>2</sup>  
C<sub>f</sub>= factored cohesion, kPa (factor =0.5)  
tan  $\phi_f$ = factored friction (factor =0.8)

MISCELLANEOUS

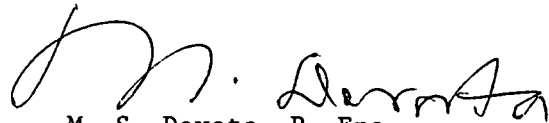
The fieldwork for this project was carried out under the supervision of Miss B. Dolinar, Project Foundations Engineer.

The report was written by Mr. F. Saccon and reviewed by Mr. M. S. Devata, Chief Foundations Engineer.

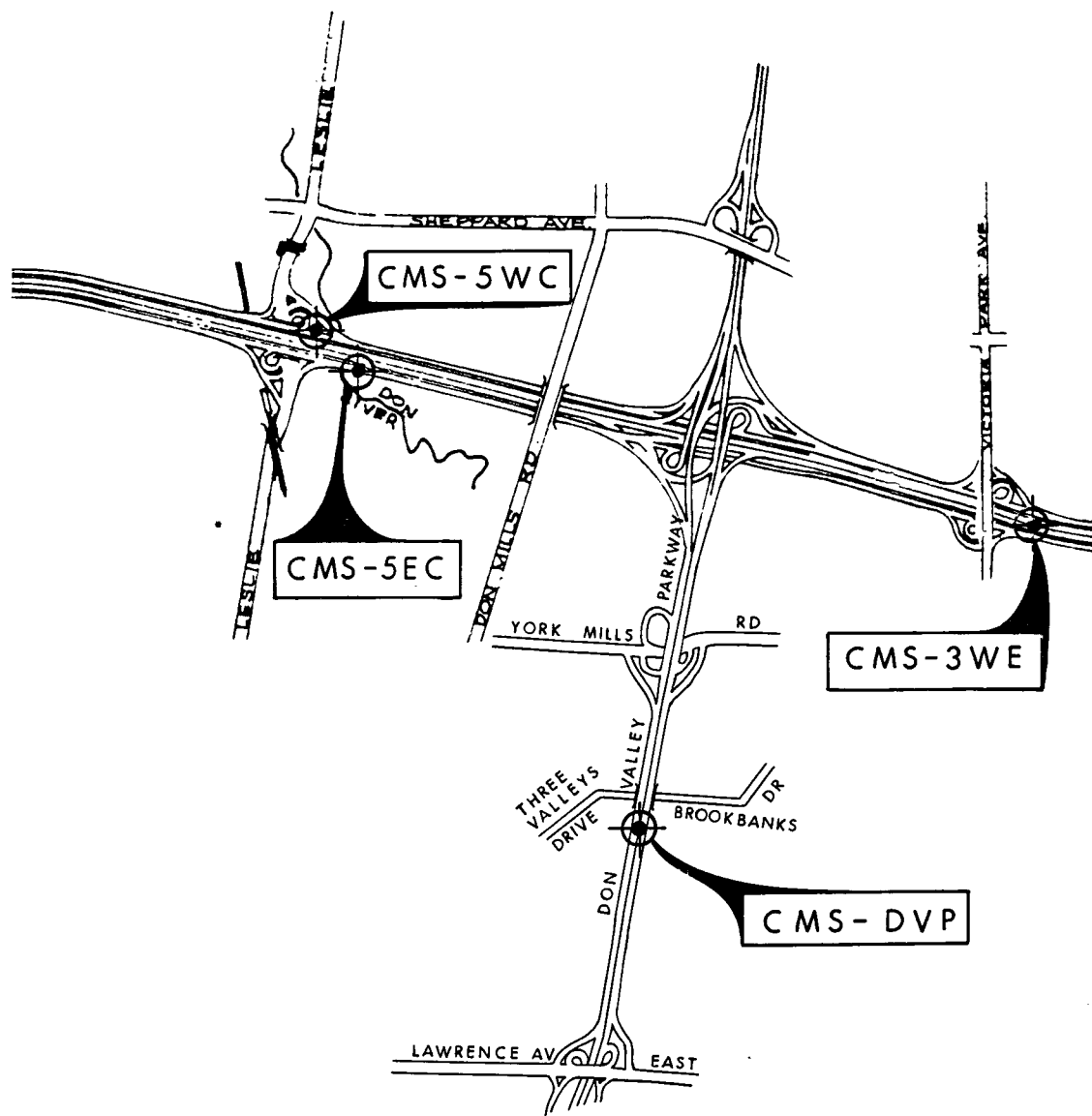
The drilling equipment used was owned and operated by Eastern Soil Drilling Inc.



F. Saccon  
Project Foundations Engineer



M. S. Devata, P. Eng.  
Chief Foundations Engineer  
(East)



## KEY MAP

NOT TO SCALE

HWY 401 FTMS-CMS SIGNS

WP 30-81-06

DIST 6

FIG No 1



# FOUNDATION INVESTIGATION REPORT

FOR

F.T.M.S. - CMS SIGNS

W.P. 30-81-06

HWY. 401, DISTRICT 6, TORONTO

- ADDENDUM -

---

The original Foundation Investigation and Design Report for this project was submitted on 86-01-10. Subsequently an addendum, for the CMS - DVP, sign was submitted.

This report is also an addendum and summarizes the foundation investigation and recommendations for the relocated CMS - 400 sign.

The revised site location is approximately 493 metres south of the Sheppard Avenue bridge. The proposed footing locations are at the shoulder and median of the southbound lanes.

The field work consisted of 2 boreholes, one located on the northbound shoulder, one on the southbound shoulder due to site constraints.

At both borehole locations, the sequence of materials from the surface downwards is

- silty sand to sandy silt
- silty clay
- silty sand to sandy silt

At the time of the field investigation the groundwater was encountered at a depth of 7.6m. Specific subsurface conditions at the borehole locations are illustrated in the appended Record of Borehole Sheets. The boreholes are identified as CMS - 400, and as left or right with respect to lane direction.

Further to our discussions with Mr. C. P. Korzenioski of McCormick and Associates, no geodetic elevations were provided. Therefore, only depths and relative elevations have been indicated on the borehole sheets. The ground elevation at all borehole locations was assumed to be 100.0m.

## DESIGN DETAILS

The signs may be founded on spread footings.

Two alternative design values are recommended, reflecting respective founding elevations as detailed in Table 1.

The two alternatives are:

- 1) Factored Bearing Capacity at U.L.S. = 150 kPa  
Bearing Capacity at S.L.S. Type II = 100 kPa
- 2) Factored Bearing Capacity at U.L.S. = 75 kPa  
Bearing Capacity at S.L.S. Type II = 50 kPa

TABLE 1 RECOMMENDED FOUNDING ELEVATIONS

SIGN DESIGNATION	FOUNDING ELEVATION (metres - relative datum)			
	Left		Right	
	Option 1	Option 2	Option 1	Option 2
CMS - 400 (revised location)	98.5	98.5	98.5	98.5

EARTH PRESSURE CALCULATIONS

Computation of earth pressures should be in accordance with Section 6 - 6.1.2 of the O.H.B.D.C. The passive design case applies.

The following soil parameters are recommended for the design of the sign foundations:

$\phi$  = apparent angle of internal friction  
 $c$  = undrained shear strength  
 $\gamma$  = unit weight

<u>SIGN</u>	<u>DEPTH (m)</u> <u>FROM - TO</u>	<u>SOIL</u> <u>TYPE</u>	<u><math>\phi</math></u>	<u>c</u> (kPa)	<u><math>\gamma</math></u> kN/m <sup>3</sup>
CMS - 400 LEFT (revised location)	0.0 - 1.5	Non-cohesive	28°	0	19.5
	1.5 - 4.3	Non-cohesive	30°	0	20.0
	4.3 - 7.6	Cohesive	0°	150	19.0
	7.6 - 9.6	Non-cohesive	30°	0	20.0
CMS - 400 RIGHT (revised location)	0.0 - 1.5	Non-cohesive	28°	0	19.5
	1.5 - 7.6	Cohesive	0°	125	19.0
	7.6 - 9.6	Non-cohesive	30°	0	20.0

FROST PROTECTION

For frost protection, a cover of 1.2m is required. Backfill material placed above the frost penetration depth should not be considered to provide any lateral resistance. Should the provision of lateral resistance be required in the upper 1.2m, please contact this office for acceptable alternatives.

DE-WATERING

Where excavations extend below the prevailing groundwater elevation, de-watering can be accomplished by a system of oversized excavations and sump pumping.

### TEMPORARY SLOPE STABILITY

Temporary side slopes of 1H:1V will be stable.

### FOOTING EXCAVATIONS

All soft or loose material should be removed from the surface of the excavation. The foundation surface should be covered within 6 hours of exposure with a 15 cm (minimum thickness) pad of mass concrete. This can be accomplished by cleaning up the excavation immediately before pouring the mass concrete pad.

### ADHESION

Computation of adhesion at the soil-footing interface should be in accordance with section 6-7.3.3.2 of the O.H.B.D.C.:

$$AC_f + V \tan \phi_f > H$$

where: H = sum of factored horizontal loads acting, kN  
V = sum of factored vertical loads acting, kN  
A = area of the underside of the spread footing, m<sup>2</sup>  
C<sub>f</sub> = factored cohesion, kPa (factor = 0.5)  
tan  $\phi_f$  = factored friction (factor = 0.8)

### MISCELLANEOUS

The field investigation for this project was carried out under the supervision of Mr. D. Liu, Student Engineer.

The drilling equipment used was owned and operated by Dominion Soil Investigation Inc.

The report was written by D. Dundas, Senior Foundations Engineer and reviewed by M. Devata, Chief Foundations Engineer (East).



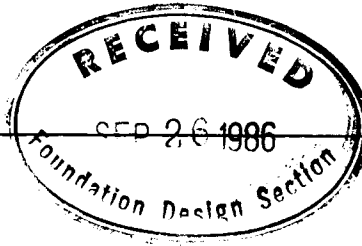
*D. H. Dundas*

D. H. Dundas, P.Eng.  
Sr. Foundations Engineer

*M. Devata*

M. Devata, P. Eng.  
Chief Foundations Engineer  
(East)

MEMORANDUM TO:



1986 09 26

Mr. M.S. Devata,  
Chief Foundations Engineer,  
Foundation Design Section,  
3rd Floor, Central Building.

From: Freeway Traffic Management Systems Section  
West Building, 2nd Floor, 248-7411

Re: W.P. 30-81-06  
Field Provisions for Hwy. 401 FTMS  
Martingrove Rd. to Yonge St.

During the early part of 1986, a foundation investigation was carried out by your section in connection with the above noted project. As part of that work you produced foundation recommendations for a changeable message sign (CMS) structure on the Hwy. 400 S.B.L. to the south of Sheppard Ave. (CMS-400).

Originally it was intended that the new CMS would replace a nearby existing prewarning static sign structure. However, it has recently been determined that the static sign structure will be retained and the CMS will be moved approximately 340 metres north of the location previously proposed. A contract drawing showing the new location is enclosed.

It is my understanding that a new foundation investigation will be required for this site. You are requested to carry out this investigation as soon as possible, as the contract package is scheduled for submission to Contract Preparation and Control on October 31, 1986. Please pass on your revised recommendations to Mr. Frank Chan, Central Region Structural Section, as soon as possible.

Your co-operation and assistance is greatly appreciated.

P.R. Korpai,  
Project Engineer.

PRK/rh  
Encl.

c.c. F. Chan, C. Region Structural  
G. Smallwood, MRAL

# memorandum

F. Chan.



To: Mr. P.R. Korpall  
Project Engineer  
Freeway Traffic Management  
Systems Section  
Engineering Office  
Downsview

Date: 06-17-85



RE: Highway 401, F.T.M.S.,  
W.P. 30-81-06  
Renforth Drive to Victoria Park Avenue,  
Soils Investigation for  
Ten Sign Locations

## (1.) GENERAL DATA

This project, known as the Freeway Traffic Management System (F.T.M.S.), will require the installation of 86 computerized overhead signs throughout the project length. Four of these signs will be bridge mounted.

The types of signs to be used are identified as Changeable Message Sign (CMS), Lane Control Sign (LCS), and a combination of both types.

The Consultant (McCormick Rankin) has recommended a sample survey and evaluation of 10 sign locations. If a close correlation can be found between as-designed and as-constructed cross-section, extensive surveying will be avoided.

A soils investigation was subsequently conducted at the following 10 sample locations:

- Location 1. Vicinity Hwy 427, LCS-3E ✓
- Location 2. Vicinity Islington Avenue, LCS-44WC
- Location 3. Vicinity Weston Road, LCS-11EC
- Location 4. Between Jane Street and Keele Street, LCS-32WE
- Location 5. Between Jane Street and Keele Street, LCS-37WC
- Location 6. Vicinity Dufferin Street, LCS-32WC
- Location 7. Allen Road, Interchange, CMS
- Location 8. Between Allen Road and Avenue Road LCS-22EC
- Location 9. Vicinity Yonge Street, CMS-4WE
- Location 10. Vicinity Leslie Street CMS-5EC

A Key Map and Borehole Logs can be found in Appendix I.

## (2.) SOILS DATA

In general test borings were done, with a Power Auger, as close to the proposed footing locations as possible, and advanced to a

(continued ...2.)

depth of 4 to 5 metres below existing ground elevation.

Borings indicate fairly stable subsurface deposits consisting of a compact crushed gravel, over a compact silty sand, over a firm to stiff silty clay till. A few moist to wet layers were encountered above the silty clay till.

Boreholes which Log wet layers did not show any signs of sloughing and should not pose any construction problems.

(3.) RECOMMENDATIONS

- (a.) Soil conditions at all of the investigated locations are suitable for the excavation and construction of footings using conventional methods.
- (b.) Where there is less than 1 metre of level ground around the footing (ie. side slopes) the embedment depths of the footings are to be increased by 0.5 metres to compensate for the lack of passive resistance due to slope geometry.



P. Ksenych

PK/RDG:tp  
Enclosure

For: R.D. Gunter  
Head, Geotechnical Section

c.c. C.P. Korzeniowski<sup>5</sup> (McCormick Rankin)  
R. Fitzgibbon  
F. Chan

APPENDIX I

Key Map & Borehole Logs

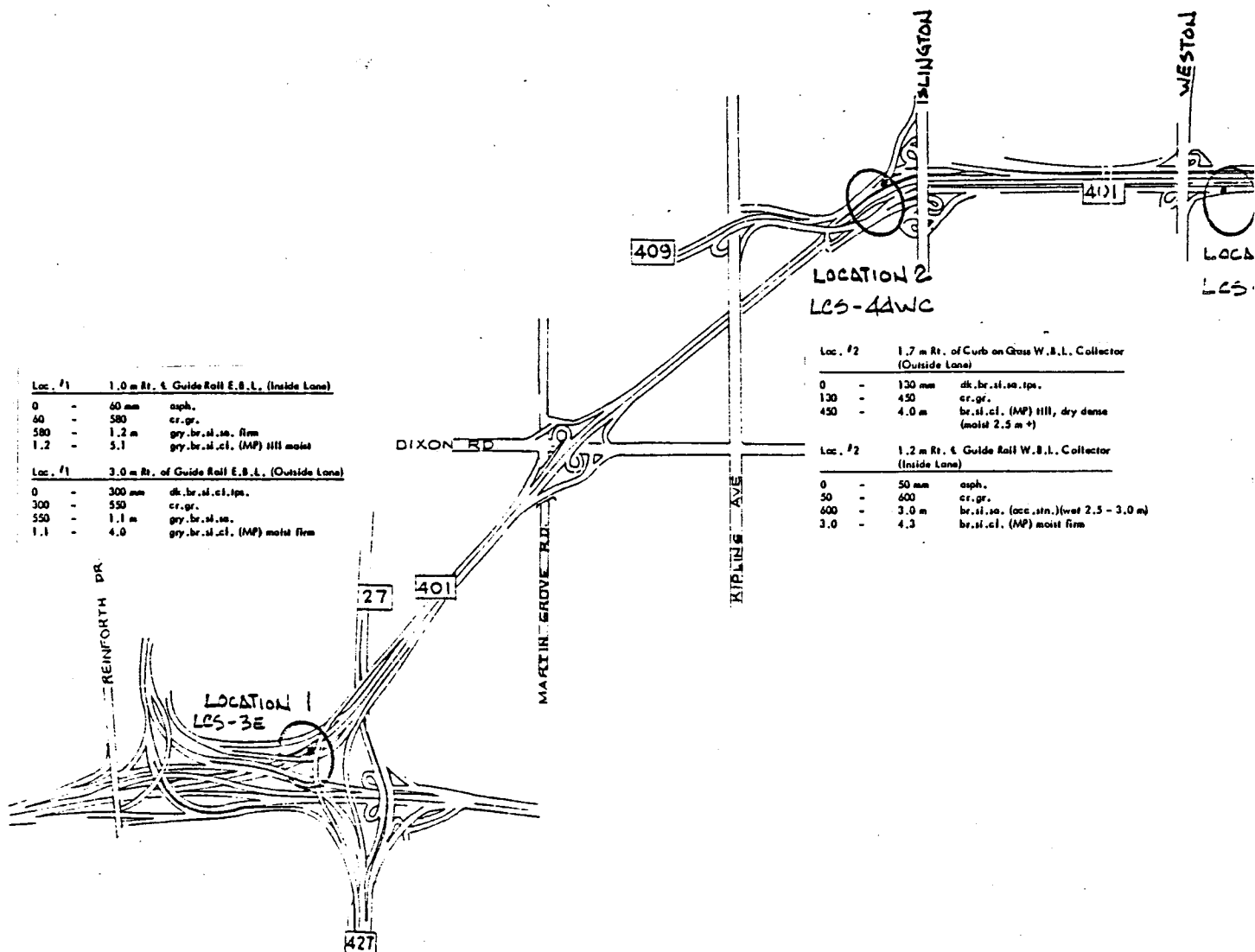
# KEY MAP

## W.P. 30-81-06

### FTMS

HWY. 401-RENFORTH DR. TO  
VICTORIA PARK AVE

BOREHOLE LOGS AT 10 LOCATIONS







SHEPPARD AVE

Loc. #3 1.0 m Rt. of Curb on Grass E.B.L. Collector (Outside Lane)

0	-	100 mm	dk.br.sl.so.tps.
100	-	700	cr.gr.
700	-	1.0 m	br.sl.so. wet
1.0	-	4.0	br.sl.cl. (MP) moist firm

Loc. #3 1.0 m Lt. of Guide Rail E.B.L. Express (Outside Lane)

0	-	60 mm	asph.
60	-	500	cr.gr.
500	-	770	br.sl.so. moist
770	-	4.0 m	br.sl.cl. (MP) still moist firm

Loc. #5 2.2 m Lt. of Guide Rail W.B.L. Collector (Outside Lane)

0	-	200 mm	asph.
200	-	650	cr.gr.
650	-	4.2 m	br.sl.cl. (MP) still moist-dry, firm

Loc. #5 1.8 m Rt. of Guide Rail W.B.L. Collector (Inside Lane)

0	-	70 mm	asph.
70	-	500	cr.gr.
500	-	780	br.so. (SP) moist
780	-	4.0 m	br.sl.cl. (MP) still moist, firm

WESTON

LOCATION 3  
LCS-112C

JANE ST.

WILSON AVE.

LOCATION 4  
LCS 32WE

LOCATION 5  
LCS-37WC

Loc. #4 2.4 m Lt. of Guide Rail W.B.L. Express (Outside Lane)

0	-	140 mm	asph.
140	-	550	cr.gr.
550	-	830	br.sl.so. wet (630 - 850 mm, seepage)
830	-	1.2 m	dk.br.sl.cl.tps.
1.2	-	4.3	br.sl.cl. (MP) still moist firm

Loc. #4 2.1 m Rt. of Guide Rail W.B.L. Express (Inside Lane)

0	-	170 mm	asph.
170	-	600	cr.gr.
600	-	700	br.sl.so. moist
700	-	4.0 m	br.sl.cl. (MP) moist firm

KEEL ST.

WILSON AVE.

LOCATION 6  
LCS-32WC

DUFFERIN ST.

ALLEN RD.

Loc. #6 1.4 m Lt. of Guide Rail W.B.L. Collector (Outside Lane)

0	-	140 mm	asph.
140	-	400	cr.gr.
400	-	730	br.so. (SP)
730	-	3.5 m	br.sl.cl. III (MP) moist, firm
3.5	-	3.8	dk.br.sl.cl.tps. firm
3.8	-	4.4	br.sl.cl. (MP) moist firm

Loc. #6 2.3 m Rt. of Guide Rail W.B.L. Collector (Inside Lane)

0	-	160 mm	asph.
160	-	450	cr.gr.
450	-	700	br.sl.so. moist
700	-	2.5 m	br.sl.cl. (MP) (moist-wet 700 mm - 1.0 m)
2.5	-	2.8	moist
2.8	-	4.0	dk.br.sl.cl.tps. firm
	-		br.sl.cl. III (MP) moist firm

Loc. #8 3.0 m Rt. of Guide Rail E.B.L. Collector (Inside Lane)

0	-	150 mm	asph.
150	-	800	cr.gr. (wet 600 - 800 mm)
800	-	4.0 m	br.sl.cl. (MP) till moist (wet 800 mm - 1.2 m)

Loc. #8 2.5 m Lt. Guide Rail E.B.L. Collector (Outside Lane)

0	-	240 mm	asph.
240	-	450	cr.gr.
450	-	750	br.so. (SP) wet
750	-	4.2 m	br.sl.cl. (MP) till moist (wet 750 mm - 1.0 m)

Loc. #9 1.8 m Rt. of Guide Rail W.B.L. Express (Inside Lane)

0	-	100 mm	asph.
100	-	500	cr.gr.
500	-	780	br.sl.gr. firm
780	-	4.3 m	br.sl.cl. (MP) moist firm

Loc. #9 2.0 m Lt. of Guide Rail W.B.L. Express (Outside Lane)

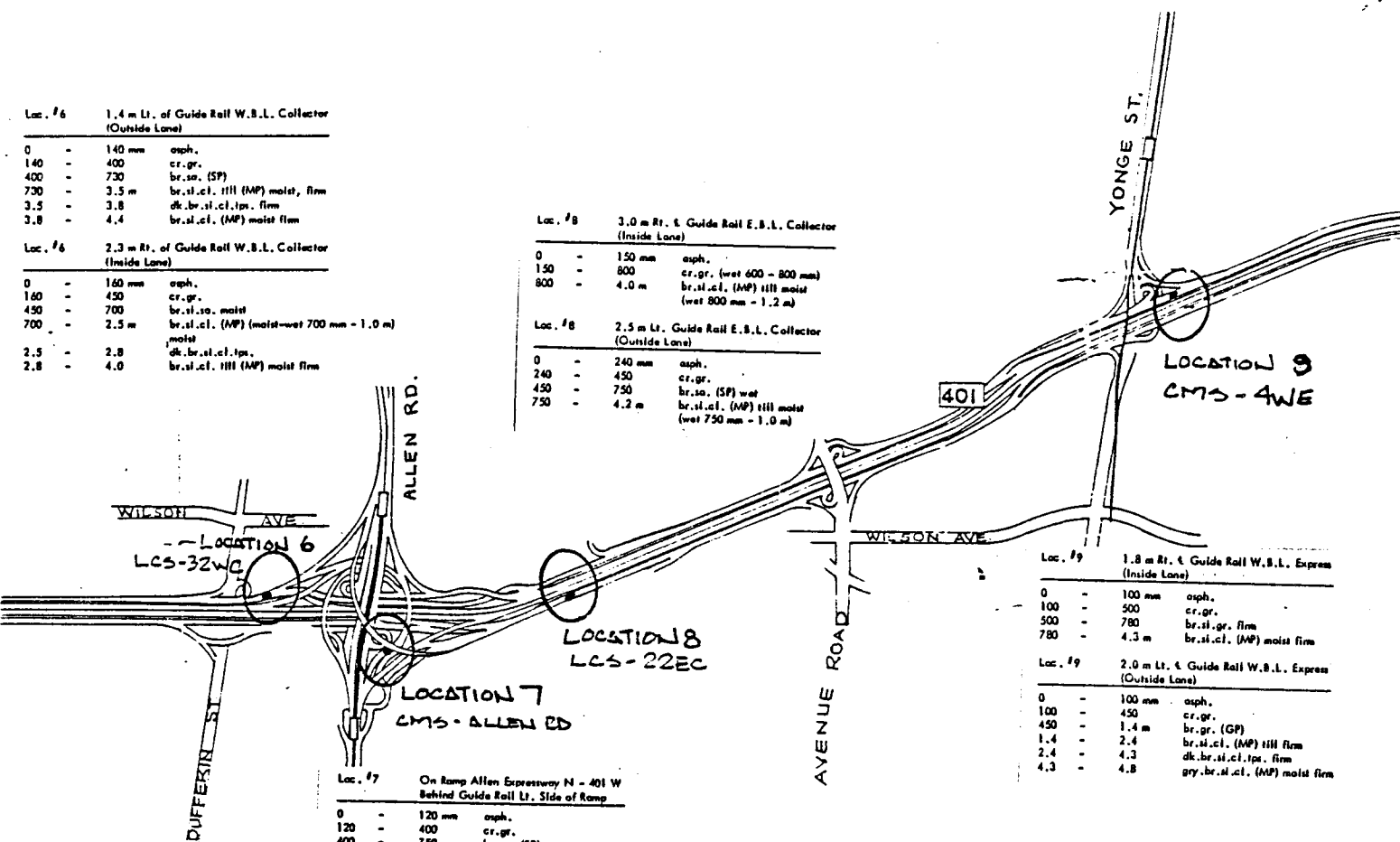
0	-	100 mm	asph.
100	-	450	cr.gr.
450	-	1.4 m	br.gr. (GP)
1.4	-	2.4	br.sl.cl. (MP) till firm
2.4	-	4.3	dk.br.sl.cl.tps. firm
4.3	-	4.8	gry.br.sl.cl. (MP) moist firm

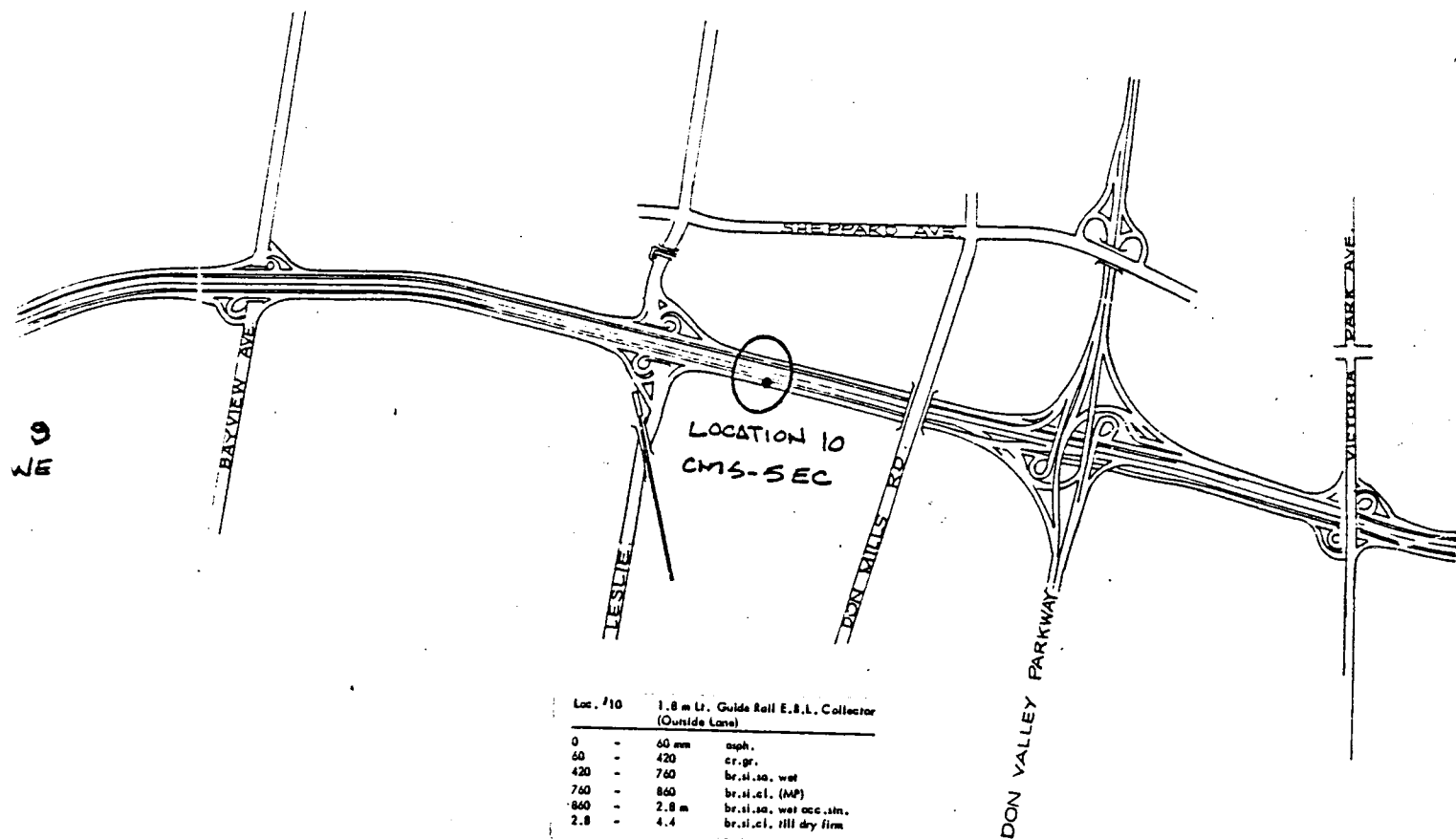
Loc. #7 On Ramp Allen Expressway N - 401 W Behind Guide Rail Lt. Side of Ramp

0	-	120 mm	asph.
120	-	400	cr.gr.
400	-	750	br.so. (SP) wet
750	-	1.3 m	br.sl.so. wet
1.3	-	1.8	br.sl.cl. (wet - 1.7 m) (moist 1.7 m +)
1.8	-	2.4	br.sl.so. no lid
2.4	-	4.5	br.sl.cl. (MP) moist firm

Loc. #7 On Ramp Allen Expressway N - 401 W 1.5 m Lt. of Guide Rail on Rt. Side of Ramp

0	-	80 mm	asph.
80	-	400	cr.gr.
400	-	600	br.so. (SP) moist
600	-	1.5 m	br.sl.cl. till (MP) moist
1.5	-	2.0	br.sl.so. wet
2.0	-	4.0	br.sl.cl. till (MP) moist firm





Loc. #10 1.8 m Lt. Guide Rail E.B.L. Collector (Outside Lane)		
0	-	60 mm asph.
60	-	420 cr.gr.
420	-	760 br.sl.so. wet
760	-	860 br.sl.cl. (MP)
860	-	2.8 m br.sl.so. wet occ.stn.
2.8	-	4.4 br.sl.cl. fill dry firm

Loc. #10 2.2 m Rt. Guide Rail E.B.L. Collector (Inside Lane)		
0	-	100 mm asph.
100	-	600 cr.gr.
600	-	900 br.sl.so. moist
900	-	1.4 m br.sl.sl. dry firm
1.4	-	2.0 br.sl.so. fill moist
2.0	-	5.2 br.sl.cl. fill moist firm
		(sl. wet and firm 3.6 - 4.5 m)

Loc. #1 1.0 m Rt. & Guide Rail E.B.L. (Inside Lane)

0	-	60 mm	asph.
60	-	580	cr.gr.
580	-	1.2 m	gry.br.si.sa. firm
1.2	-	5.1	gry.br.si.cl. (MP) till moist

Loc. #1 3.0 m Rt. of Guide Rail E.B.L. (Outside Lane)

0	-	300 mm	dk.br.si.cl.tps.
300	-	550	cr.gr.
550	-	1.1 m	gry.br.si.sa.
1.1	-	4.0	gry.br.si.cl. (MP) moist firm

Loc. #2 1.7 m Rt. of Curb on Grass W.B.L. Collector (Outside Lane)

0	-	130 mm	dk.br.si.sa.tps.
130	-	450	cr.gr.
450	-	4.0 m	br.si.cl. (MP) till, dry dense (moist 2.5 m +)

Loc. #2 1.2 m Rt. & Guide Rail W.B.L. Collector (Inside Lane)

0	-	50 mm	asph.
50	-	600	cr.gr.
600	-	3.0 m	br.si.sa. (occ.stn.)(wet 2.5 - 3.0 m)
3.0	-	4.3	br.si.cl. (MP) moist firm

Loc. #3 1.0 m Rt. of Curb on Grass E.B.L. Collector (Outside Lane)

0	-	100 mm	dk.br.si.sa.tps.
100	-	700	cr.gr.
700	-	1.0 m	br.si.sa. wet
1.0	-	4.0	br.si.cl. till (MP) moist firm

0	-	70 mm	asph.
70	-	500	cr.gr.
500	-	780	br.sa. (SP) moist
780	-	4.0 m	br.si.cl. (MP) till moist, firm

Loc. #5 1.8 m Rt. of Guide Rail W.B.L. Collector (Inside Lane)

0	-	200 mm	asph.
200	-	650	cr.gr.
650	-	4.2 m	br.si.cl. (MP) till
780	-		moist-dry, firm

Loc. #5 2.2 m Lt. of Guide Rail W.B.L. Collector (Outside Lane)

0	-	170 mm	asph.
170	-	600	cr.gr.
600	-	700	br.si.sa. moist
700	-	4.0 m	br.si.cl. (MP) moist firm

Loc. #4 2.1 m Rt. & Guide Rail W.B.L. Express (Inside Lane)

0	-	140 mm	asph.
140	-	550	cr.gr.
550	-	830	br.si.sa. wet (630 - 850 mm, seepage)
830	-	1.2 m	dk.br.si.cl.tps.
1.2	-	4.3	br.si.cl. (MP) till moist firm

Loc. #4 2.4 m Lt. of Guide Rail W.B.L. Express (Outside Lane)

0	-	60 mm	asph.
60	-	500	cr.gr.
500	-	770	br.si.sa. moist
770	-	4.0 m	br.si.cl. (MP) till moist firm

(Outside Lane)

Loc. #6 1.4 m Lt. of Guide Rail W.B.L. Collector  
(Outside Lane)

0	-	140 mm	asph.
140	-	400	cr.gr.
400	-	730	br.sa. (SP)
730	-	3.5 m	br.si.cl. till (MP) moist, firm
3.5	-	3.8	dk.br.si.cl.tps. firm
3.8	-	4.4	br.si.cl. (MP) moist firm

Loc. #6 2.3 m Rt. of Guide Rail W.B.L. Collector  
(Inside Lane)

0	-	160 mm	asph.
160	-	450	cr.gr.
450	-	700	br.si.sa. moist
700	-	2.5 m	br.si.cl. (MP) (moist-wet 700 mm - 1.0 m) moist
2.5	-	2.8	dk.br.si.cl.tps.
2.8	-	4.0	br.si.cl. till (MP) moist firm

Loc. #7 On Ramp Allen Expressway N - 401 W  
Behind Guide Rail Lt. Side of Ramp

0	-	120 mm	asph.
120	-	400	cr.gr.
400	-	750	br.sa. (SP) wet
750	-	1.3 m	br.cl.sa. wet
1.3	-	1.8	br.sa.cl. (wet - 1.7 m)(moist 1.7 m +)
1.8	-	2.4	br.si.sa. moist
2.4	-	4.5	br.si.cl. (MP) moist firm

Loc. #7 On Ramp Allen Expressway N - 401 W  
1.5 m Lt. of Guide Rail on Rt. Side of Ramp

0	-	80 mm	asph.
80	-	400	cr.gr.
400	-	600	br.sa. (SP) moist
600	-	1.5 m	br.si.cl. till (MP) moist
1.5	-	2.0	br.cl.sa. wet
2.0	-	4.0	br.si.cl. till (MP) moist firm

Loc. #8	2.5 m Lt. Guide Rail E.B.L. Collector (Outside Lane)	0	240 mm	asph.
		240	450	cr.gr.
		450	750	br.sa. (SP) wet
		750	4.2 m	br.si.cl. (MP) till moist (wet 750 mm - 1.0 m)
Loc. #9	1.8 m Rt. & Guide Rail W.B.L. Express (Inside Lane)	0	100 mm	asph.
		100	500	cr.gr.
		500	780	br.si.gr. firm
		780	4.3 m	br.si.cl. (MP) moist firm
Loc. #9	2.0 m Lt. & Guide Rail W.B.L. Express (Outside Lane)	0	100 mm	asph.
		100	450	cr.gr.
		450	1.4 m	br.gr. (GP)
		1.4	2.4	br.si.cl. (MP) till firm
		2.4	4.3	dk.br.si.cl.tps. firm
		4.3	4.8	gry.br.si.cl. (MP) moist firm
Loc. #10	1.8 m Lt. Guide Rail E.B.L. Collector (Outside Lane)	0	60 mm	asph.
		60	420	cr.gr.
		420	760	br.si.sa. wet
		760	860	br.si.cl. (MP)
		860	2.8 m	br.si.sa. wet occ. stn.
		2.8	4.4	br.si.cl. till dry firm

Loc. #10		2.2 m Rt. Guide Rail E.B.L. Collector (Inside Lane)	
0	-	100 mm	asph.
100	-	600	cr.gr.
600	-	900	br.si.sa. moist
900	-	1.4 m	br.sa.si. dry firm
1.4	-	2.0	br.si.sa. till moist
2.0	-	5.2	br.si.cl. till moist firm
			(sl. wet and firm 3.6 - 4.5 m)