

G.I.-30 SEPT. 1976

GEOCRES No. 30M11-182
30M11-180DIST. 6 REGION _____W.P. No. 33-76-16
33-76-02CONT. No. 79-118

W. O. No. _____

STR. SITE No. _____

HWY. No. NWMALOCATION Kodak Access RoadSouth of Eglinton AveNo of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____

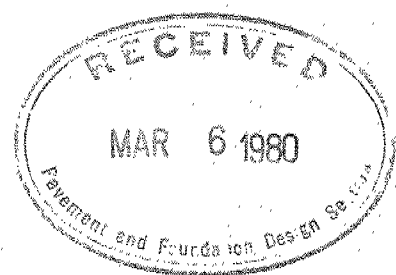
FOUNDATION INVESTIGATION REPORT

CONTRACT NO 79-118



Ontario

Ministry of
Transportation and
Communications



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	W.P. 33-76-16 Retaining Walls at Kodak Access Road South of Eglinton Avenue Parallel to C.P.R.

NOTE: For purposes of the contract these reports supercede all other foundation reports prepared by or for the Ministry in connection with the above mentioned projects.

EXPLANATION OF TERMS USED IN REPORT

'K' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON "A" SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4"+ 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. CU_u = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_L - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{2.4 \mu m \text{ Soil Fraction}}$
 O_m ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 α_v COEFFICIENT OF VOLUME CHANGE
 α_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

FOUNDATION INVESTIGATION REPORT

For

Design of Relocated Baseball
Diamond Light Pole Bases
Northwest Metro Arterial
W.P. 33-76-02, District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the above mentioned site during the period of March 6 to March 8, 1978. The fieldwork consisted of eight sampled boreholes advanced by means of a continuous flight auger machine equipped with hollow stem augers. These borings were located beside the proposed light pole base locations and were advanced to depths ranging from 26.5 feet to 66.5 feet.

SITE DESCRIPTION

The site is located within the boundaries of Metropolitan Toronto immediately northeast of the intersection of Eglinton Avenue West and the proposed Northwest Metro Arterial. The site is presently parkland composed of a low lying swampy area bounded to the east by Black Creek flowing in an open channel towards the south and to the west by Keelesdale Road.

Physiographically, the site is located within the upper reaches of Lake Iroquois in the geological past. Under a thin mantle of lacustrine deposits or recent alluvial deposits by Black Creek, the subsoil in this area consists of a series of cohesive glacial and predominantly granular interglacial deposits of the Pleistocene epoch. Man-made fill of varying depths overlies most of the site.

SUBSURFACE CONDITIONS

In general, two major subsurface soil types were encountered. A surficial granular stratum of silty sand to sandy silt overlies the site. Gravel beds mixed with sand was found

within this surficial deposit in several borings. Surficial organics and occasional sections of decayed wood were also encountered. Depths of this surficial deposit ranged from 3.0 feet to 14.5 feet over the site. The denseness of this material based on Standard Penetration Tests results was found to vary from very loose to compact, but generally very loose throughout.

The predominant deposit underlying the surficial granular deposit consisted of a cohesive glacial till composed of a heterogeneous mixture of clayey silt, some sand and traces of gravel. Occasional sand layers or silt lenses were found in various locations. This till deposit was explored to a maximum depth of 52 feet with consistency ranging from firm to hard but generally stiff to very stiff with depth.

Typical results from lab testing performed on selected representative samples are summarized in the following table.

		<u>Range</u>	<u>Average</u>
Natural Moisture Content	(W) %	12 - 29	16
Liquid Limit	(W _L) %	18 - 35	28
Plastic Limit	(W _p) %	13 - 21	15
Bulk Density	p.c.f.	128 - 140	

Undrained Shear Strength as determined by

In situ field vane	1050 ->2000	1800
Unconfined Compression Test	1050 - 1500	

These results would indicate the material to be an inorganic clay of low plasticity (CL).

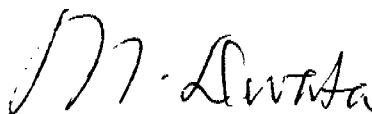
Groundwater

Due to the marshy nature of the area and visible free standing water at various locations, groundwater can be assumed to be at or immediately below ground surface.

A summary of the Record of Borehole Sheets describing the boundaries between the various soil types are attached. The locations and elevations of the borings are shown on Figure 1 in the appendix.



T. Kazmierowski, P. Eng.
Project Foundation Engineer.



M. Devata, P. Eng.
Senior Foundation Engineer.

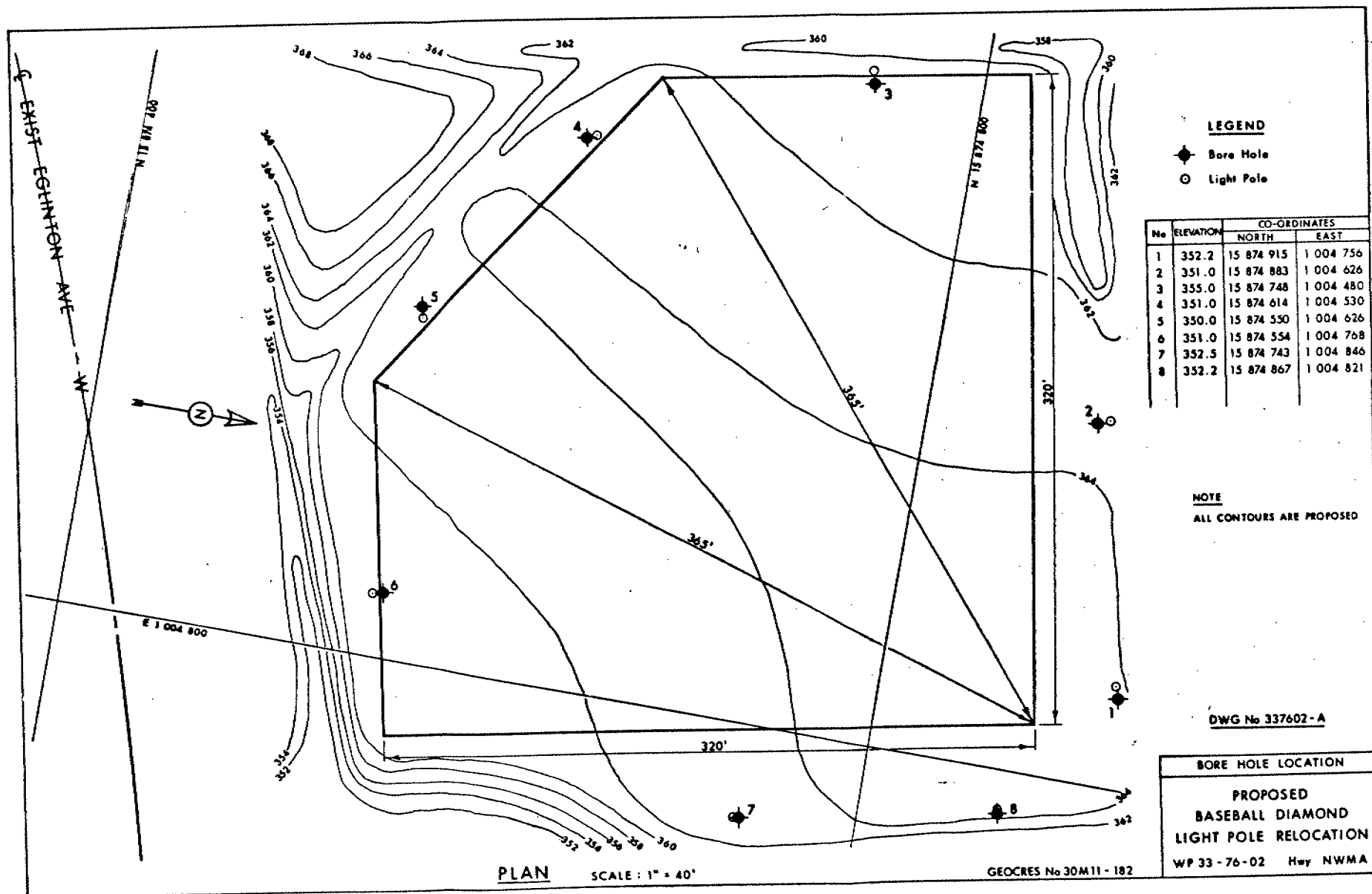
September, 1979.

APPENDIX

SUMMARY OF BOREHOLE LOG SHEETS

<u>B.H. #</u>	<u>Elevation</u>	<u>Subsurface Conditions</u>	
1	352 ₊	0-11'	silty sand very loose to loose occasional wood chips
		11'-28'+	clayey silt stiff
2	351 ₊	0-10.5'	silty sand very loose (organics to 2.0')
		10.5'-26.5'+	clayey silt stiff to very stiff
3	355 ₊	0-11'	silty sand to sandy silt very loose to compact (organics to 3.0')
		11-40.5'+	clayey silt stiff to very stiff
4	351 ₊	0-1'	ice
		1'-6'	organic silt very loose
		6'-8'	gravelly sand loose
		8'-26.5'+	clayey silt stiff to very stiff occasional silt layers
5	350 ₊	0-13.5'	sandy silt to silty sand very loose to loose
		13.5-26.5'+	clayey silt stiff to very stiff
6	351 ₊	0-14.5'	silty sand loose to compact (organics to 3.5')
		14.5-66.5'+	clayey silt stiff to very stiff
7	352 ₊	0-3'	silty sand
		3-28'+	clayey silt stiff to very stiff
8	352 ₊	0-10'	silty sand very loose to loose
		10-51.5'+	clayey silt stiff to very stiff

For borehole locations refer to appended drawing



FOUNDATION INVESTIGATION REPORT

For

Retaining Walls at Kodak Access Road
South of Eglinton Avenue, Parallel to C.P.R.
W.P. 33-76-16, NWMA, DISTRICT 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of October 26-27, 1978. The fieldwork consisted of eight sampled boreholes advanced by means of a continuous flight auger machine equipped with solid and hollow stem augers. The boreholes ranged in depth from 16.5 to 36.5 feet below ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located about 750 feet south of Eglinton Avenue and Kodak Road crossing in Metropolitan Toronto.

Physiographically the site lies in the South Slope Region at the north boundary of "Iroquois Plain". The subsoil consists of sand deposits underlain by clayey silt till deposited during the Pleistocene Epoch.

SUBSURFACE CONDITIONS

Factual data of the subsurface conditions is shown on the Record of Borehole Sheets. The location and elevation of the borings, together with the estimated stratigraphical profiles, are shown on Contract Drawing 2.

The subsoil in the investigated area consists of mainly silty sand with trace of clay and occasional gravel deposits which was explored to a maximum depth of 36.5 feet below the ground surface. At one boring at the proposed toe wall the upper 6.5 feet is fill material composed of clayey silt with some sand and organics (mostly decayed wood). Also in the same area at one location (B.H. 3) the upper 2.5 feet is composed

of fill material consisting of black silty sand mixed with ash and burnt wood.

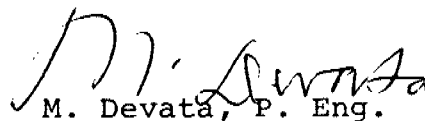
As described previously, the predominant deposit in this area is a granular material composed of silty sand with traces of clay and occasional gravel. The Standard Penetration Test results gave 'N' values generally ranging from 20 to over 100 blows per foot. However, in some localized areas in the upper portion the 'N' values are as low as 6 to 12 blows/foot. The deposit has mostly a dense to very dense relative density, except in some localized upper sections where it is loose to compact.

Groundwater

Groundwater level observations were carried out during the period of the field investigation (October, 1978). The observed water levels, where encountered, are presented on the individual Record of Borehole Sheets, as well as on Contract Drawing No. 2. The results indicate that the groundwater level varies between elevations 365 and 372 which corresponds to levels ranging from 7 to 26 feet below the existing ground surface.



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Project Foundation Engineer.



M. Devata, P. Eng.
Senior Foundation Engineer.

September, 1979.

APPENDIX

RECORD OF BOREHOLE No 1

W P 33-76-16 LOCATION Coords. N 15 873 630; E 1 004 068 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 27, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			SHEAR STRENGTH										WATER CONTENT (%)
								20 40 60 80 100										
397.0	Ground Level																	
0.0	Topsoil		1	SS	12													
	Silty Sand to Sandy Silt With Some Clay and Organics		2	SS	11		390											
			3	SS	12													
384.0	Compact		4	SS	8													
13.0			5	SS	7		380											
	Silty Fine Sand		6	SS	21													
370.5	Loose to Very Dense		7	SS	68	W.L.												
26.5	End of Borehole																	

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (% STRAIN AT FAILURE)

RECORD OF BOREHOLE No 2

W P 33-76-16 LOCATION Coords. N 15 873 584; E 1004 137 ORIGINATED BY V.K.
 DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
 DATUM Geodetic DATE October 27, 1978 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL						
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100										SHEAR STRENGTH			WATER CONTENT (%)		
																		○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			10 20 30		
394.0	Ground Level																						
0.0	Topsoil																						
	Silty Sand With Occasional Gravel		1	SS	30		390									6 83 (11)							
			2	SS	40											5 85 (10)							
			3	SS	38																		
			4	SS	64		380									0 89 (11)							
			5	SS	63																		
			6	SS	43																		
			7	SS	73		370																
						W.L.																	
362.5	Dense to Very Dense		8	SS	85																		
31.5	End of Borehole																						

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 3

W P 33-76-16 LOCATION Coords. N 15 873 538; E 1 004 205 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Augers COMPILED BY V.K.
DATUM Geodetic DATE October 27, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	SHEAR STRENGTH					
392.0	Ground Level							○ UNCONFINED + FIELD VANE		10	20	30		
389.5	Dark Silty Sand, Ashes	×						● QUICK TRIAXIAL x LAB VANE						
2.5			1	SS	28									
			2	SS	8									
	Loose		3	SS	6									
	Silty Sand With Trace of Clay and Occasional Gravel		4	SS	24									
			5	SS	51									
			6	SS	51									
	Gravelly Sand		7	SS	52									
			8	SS	70									
			9	SS	82									
355.5	Compact to Very Dense													
36.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

+3, x5 : Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 4

W P 33-76-16 LOCATION Coords. N 15 873 483; E 1 004 287 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 26, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
390.0	Ground Level																
0.0	Topsoil		1	SS	11												
			2	SS	7												
	Loose to Compact		3	SS	8												
			4	SS	50												
	Silty Sand With Trace of Clay and Occasional Gravel		5	SS	85												
			6	SS	68												
			7	SS	62												
			8	SS	45												
353.5	Dense to Very Dense		9	SS	20												
36.5	End of Borehole																

OFFICE REPORT ON SOIL EXPLORATION

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 5

W P 33-76-16 LOCATION Coords. N 15 873 428; E 1 004 369 ORIGINATED BY V.K.
 DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
 DATUM Geodetic DATE October 26, 1978 CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			20 40 60 80 100						
389.0	Ground Level												
0.0	Topsoil												
	Silty Sand With Trace of Clay and Occasional Gravel		1	SS	15								15 72 (13)
			2	SS	18								
			3	SS	52								
			4	SS	56								
			5	SS	70								
			6	SS	57								
			7	SS	73								0 65 30 5
	Compact to Very Dense		8	SS	60								
352.5	Brown Grey		9	SS	22								
36.5	End of Borehole												

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 6

W.P. 33-76-16 LOCATION Coords. N 15 873 372; E 1 004 453 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 26, 1978 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100				
387.0	Ground Level															
0.0	Topsoil															
	Silty Sand With Trace of Clay and Occasional Gravel		1	SS	37											
			2	SS	32											5 85 (10)
			3	SS	105											
			4	SS	52											
			5	SS	68											8 73 (19)
			6	SS	67											
			7	SS	45											
			8	SS	30											2 23 68 7
350.5	Dense to Very Dense		9	SS	59											
36.5	End of Borehole															

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 7

W P 33-76-16 LOCATION Coords. N 15 873 329; E 1 004 553 ORIGINATED BY V.K.
 DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
 DATUM Geodetic DATE October 26, 1978 CHECKED BY OP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
385.0	Ground Level													
0.0	Topsoil													
	Loose Silty Sand With Trace of Clay and Occasional Gravel		1	SS	6									
			2	SS	7									
			3	SS	30									
			4	SS	54									
			5	SS	55									
			6	SS	75									
			7	SS	22									
			8	SS	32									
348.5	Very Dense		9	SS	59									
36.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE No 10

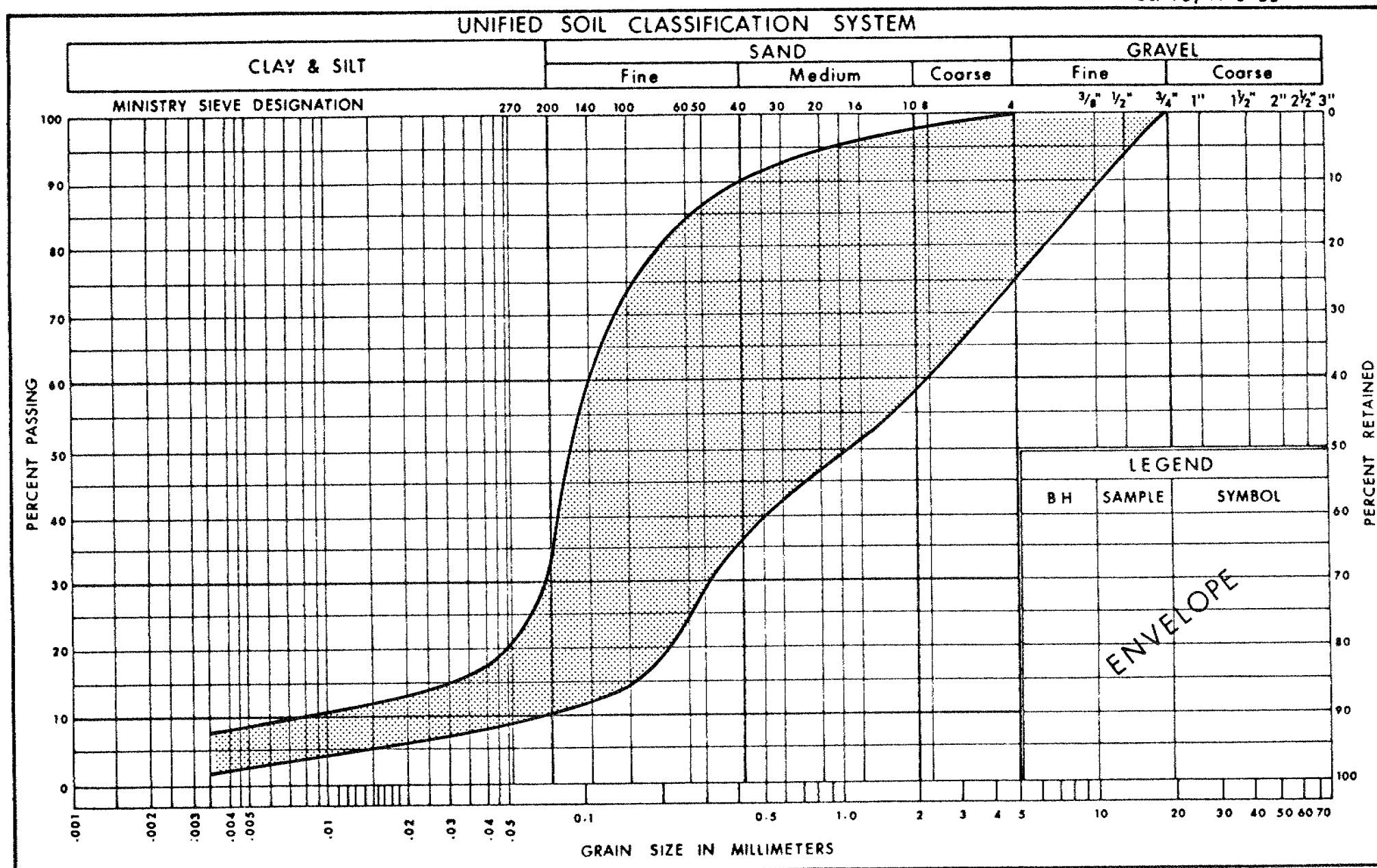
W P 33-76-16 LOCATION Coords. N 15 873 549; E 1 004 278 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 27, 1978 CHECKED BY

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 Y	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100							
376.0	Ground Level														
0.0	Clayey Silt With Pieces of Decayed Wood and Organics - Fill		1	SS	5		370								7 33 45 15
369.5			2	SS	6										4 78 (18)
6.5	Loose		3	SS	18										
	Silty Sand With Trace of Clay and Occasional Gravel		4	SS	37										
359.5	Dense		5	SS	40										
16.5	End of Borehole						360								
					</										

OFFICE REPORT ON SOIL EXPLORATION

+³, x⁵: Numbers refer to
Sensitivity

20
15-5 (%) STRAIN AT FAILURE
10



ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 33-76-02

DIST 6

HWY NWMA

STR SITE

Design of Relocated Baseball
Diamond Light Pole Bases

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SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	79 04 30	M.A
TUBES	"	"
ROCK CORES	—	—

FOUNDATION INVESTIGATION REPORT

For

Design of Relocated Baseball
Diamond Light Pole Bases
Northwest Metro Arterial
W.P. 33-76-02, District 6, Toronto

INTRODUCTION

We have now completed the foundation investigation fieldwork and analysis for the above mentioned project. In consideration of the urgency of your request dated 1979 02 09, this memorandum will summarize our assessment of the subsoil conditions encountered and detail our recommendations with regards to light pole base design. We trust that the following information will be sufficient for design purposes and, hence, have no intention of submitting a formal report.

SCOPE OF INVESTIGATION

The fieldwork was performed during the period of 79 03 06 to 79 03 08 utilizing an auger machine equipped with hollow stem continuous flight augers. The fieldwork consisted of eight sampled boreholes located beside the proposed light pole bases. These borings were advanced to depths ranging from 26.5 feet to 66.5 feet.

SITE DESCRIPTION

The site is located within the boundaries of Metropolitan Toronto immediately northeast of the intersection of Eglinton Avenue West and the proposed Northwest Metro Arterial. The site is presently parkland composed of a low lying swampy area bounded to the east by Black Creek flowing in an open channel towards the south and to the west by Keelesdale Road.

Physiographically, the site is located within the upper reaches of Lake Iroquois in the geological past. Under a thin mantle of lacustrine deposits or recent alluvial deposits by Black Creek, the subsoil in this area consists of a series of cohesive glacial

and predominantly granular interglacial deposits of the Pleistocene epoch. Man-made fill of varying depths overlies most of the site.

SUBSURFACE CONDITIONS

In general, two major subsurface soil types were encountered. A surficial granular stratum of silty sand to sandy silt overlies the site. Gravel beds mixed with sand was found within this surficial deposit in several borings. Surficial organics and occasional sections of decayed wood were also encountered. Depths of this surficial deposit ranged from 3.0 feet to 14.5 feet over the site. The denseness of this material based on Standard Penetration Tests results was found to vary from very loose to compact, but generally very loose throughout.

The predominant deposit underlying the surficial granular deposit consisted of a cohesive glacial till composed of a heterogeneous mixture of clayey silt, some sand and traces of gravel. Occasional sand layers or silt lenses were found in various locations. This till deposit was explored to a maximum depth of 52 feet with consistency ranging from firm to hard but generally stiff to very stiff with depth.

Typical results from lab testing performed on selected representative samples are summarized in the following table.

		<u>Range</u>	<u>Average</u>
Natural Moisture Content	(W) %	12- 29	16
Liquid Limit	(W _L) %	18- 35	28
Plastic Limit	(W _P) %	13- 21	15
Bulk Density	p.c.f.	128-140	
Undrained Shear Strength as termed by			
In situ field vane		1050->2000	1800
Unconfined Compression Test		1050- 1500	

These results would indicate the material to be as inorganic clay of low plasticity (CL).

Groundwater

Due to the marshy nature of the area and visible free standing water at various locations, groundwater can be assumed to be at or immediately below ground surface.

A summary of the Record of Borehole Sheets describing the boundaries between the various soil types are attached. The complete Record of Borehole Sheets are retained on file at the Soil Mechanics Section, Downsview. The locations and elevations of the borings are shown on Drawing No. 337602-A.

DISCUSSION AND RECOMMENDATIONS

As part of the contract package for the extension of Hwy. 400 south to Weston Road, a baseball diamond will be constructed for the Borough of York at the proposed location. Eight light poles approximately 70 feet high will be relocated around the perimeter of the baseball diamond. Present grading details call for the existing low lying ground surface to be raised approximately 12 feet. Proposed fill material will consist of 2.0 feet of a clay seal on existing ground surface underlying approximately 6.0 feet of sanitary landfill which is overlain by approximately 4.0 feet of earthfill.

In view of the height and effects of wind loading on the light pole structure, the pole foundation will be required to resist large horizontal loads while minimixing the deflection required to mobilize subgrade reaction of the surrounding subsoils.

Light Pole Foundations

The caisson can be designed to withstand the lateral load and over-turning moment by using either the modulus of subgrade reaction or the passive resistance of the soil. Analysis by both methods were carried out assuming a 42 inch caisson (as required for proper imbedment of the anchor bolts) and the following parameters:

$$\begin{aligned} K_s &= \text{coefficient of subgrade reaction of stiff clayey} \\ &\quad \text{silt deposit} \\ &= 60 \text{ tons/ft}^3 \end{aligned}$$

γ = bulk unit weight of clayey silt
 = 120 p.c.f.

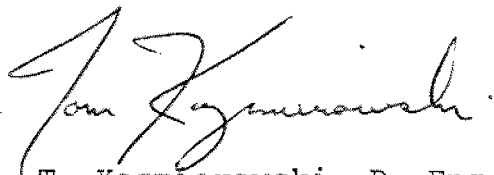
N_{ϕ} = bearing capacity factor for embedment stratum
 = 2.77 for ϕ' equal to 28°

Results indicate that to insure a minimum deflection of the top of the light pole under maximum wind loading, the 42" ϕ caisson should be embedded a minimum of 10 feet into the stiff clayey silt stratum. This would generally require the caissons to extend 32 feet below the proposed fill grade (approx. elev. 363).

Prior to placement of fill material subexcavation of localized organic material at the caisson locations should be carried out for the full depth of organics.

In addition, all fill material within a five foot radius of the caisson locations should consist of a well compacted granular material acting as a free draining granular core, thus providing additional lateral resistance to horizontal loading.

Due to the presence of a high water table at the site and the loose nature of the surficial soils, a temporary liner socketed a minimum of two feet into the stiff clayey silt deposit will be required to prevent cave-ins and allow unwatering of the caissons. It is suggested the concrete be placed to the required elevation prior to removal of the liner and the concrete be vibrated while the liner is being withdrawn.



T. Kazmierowski, P. Eng.
 Project Engineer



M. Devata, P. Eng.
 Supervising Engineer

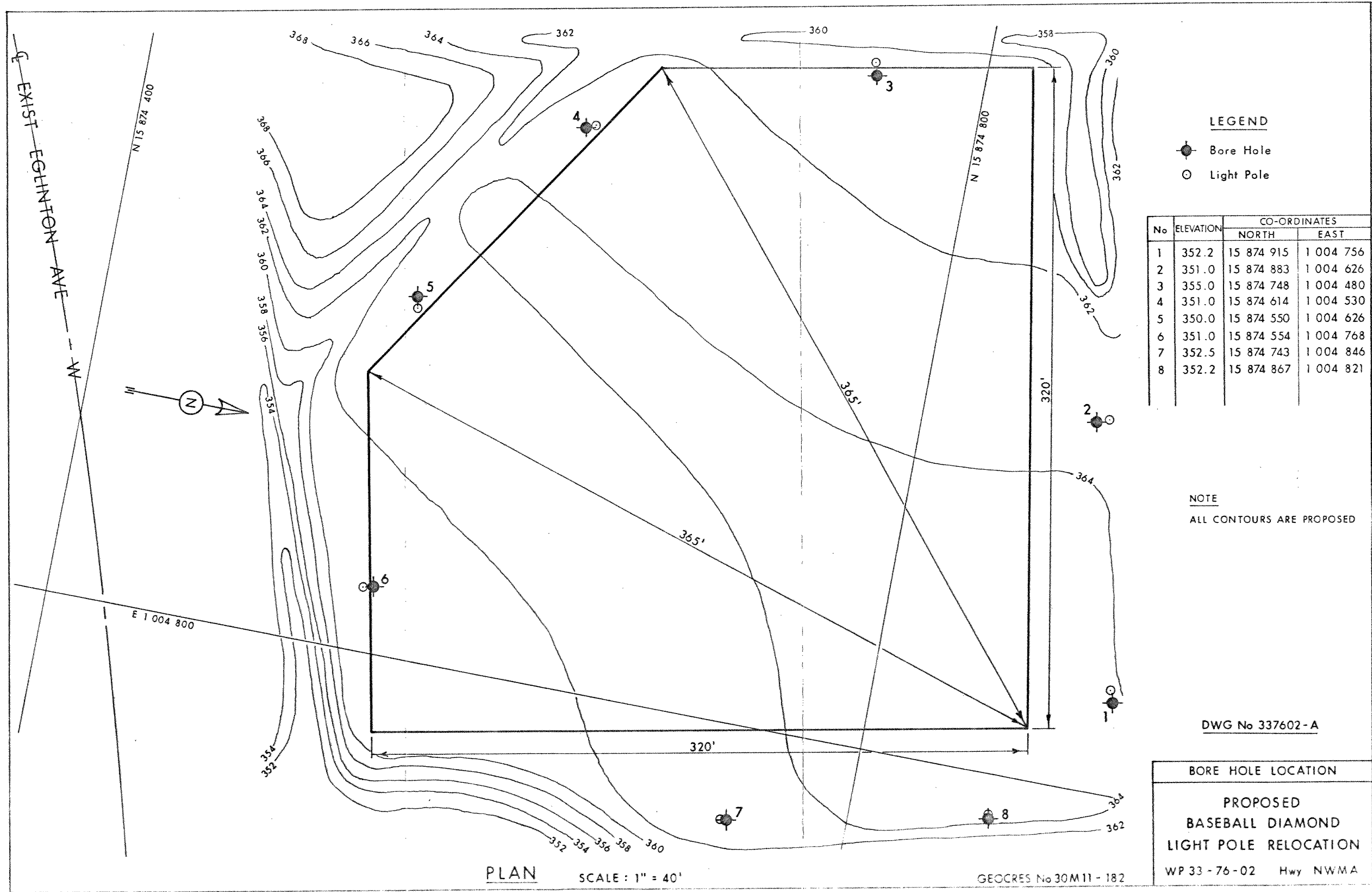
April, 1979

APPENDIX

SUMMARY OF BOREHOLE LOG SHEETS

<u>B.H. #</u>	<u>Elevation</u>	<u>Subsurface Conditions</u>	
1	352 ₊	0-11'	silty sand very loose to loose occasional wood chips
		11'-28'+	clayey silt stiff
2	351 ₊	0-10.5'	silty sand very loose (organics to 2.0')
		10.5'-26.5'+	clayey silt stiff to very stiff
3	355 ₊	0-11'	silty sand to sandy silt very loose to compact (organics to 3.0')
		11-40.5'+	clayey silt stiff to very stiff
4	351 ₊	0-1'	ice
		1'-6'	organic silt very loose
		6'-8'	gravelly sand loose
		8'-26.5'+	clayey silt stiff to very stiff occasional silt layers
5	350 ₊	0-13.5'	sandy silt to silty sand very loose to loose
		13.5-26.5'+	clayey silt stiff to very stiff
6	351 ₊	0-14.5'	silty sand loose to compact (organics to 3.5')
		14.5'-66.5'+	clayey silt stiff to very stiff
7	352 ₊	0-3'	silty sand
		3-28'+	clayey silt stiff to very stiff
8	352 ₊	0-10'	silty sand very loose to loose
		10-51.5'+	clayey silt stiff to very stiff

For borehole locations refer to appended drawing



EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS \bar{N} .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4" 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS




LABORATORY TESTING

TRIAxIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}U$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE 
 w SLOPE ANGLE-BACKFACE OF WALL 
 β ANGLE OF SLOPE 
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_P PLASTIC LIMIT
 w_S SHRINKAGE LIMIT
 I_P PLASTICITY INDEX = $w_L - w_P$
 I_L LIQUIDITY INDEX = $\frac{w - w_P}{I_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_P}$
 A_c ACTIVITY = $\frac{I_P \text{ of soil}}{2.5 \mu m \text{ Soil Fraction}}$
 Om ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u(\text{undisturbed})}{S_u(\text{remoulded})}$

STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, n STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

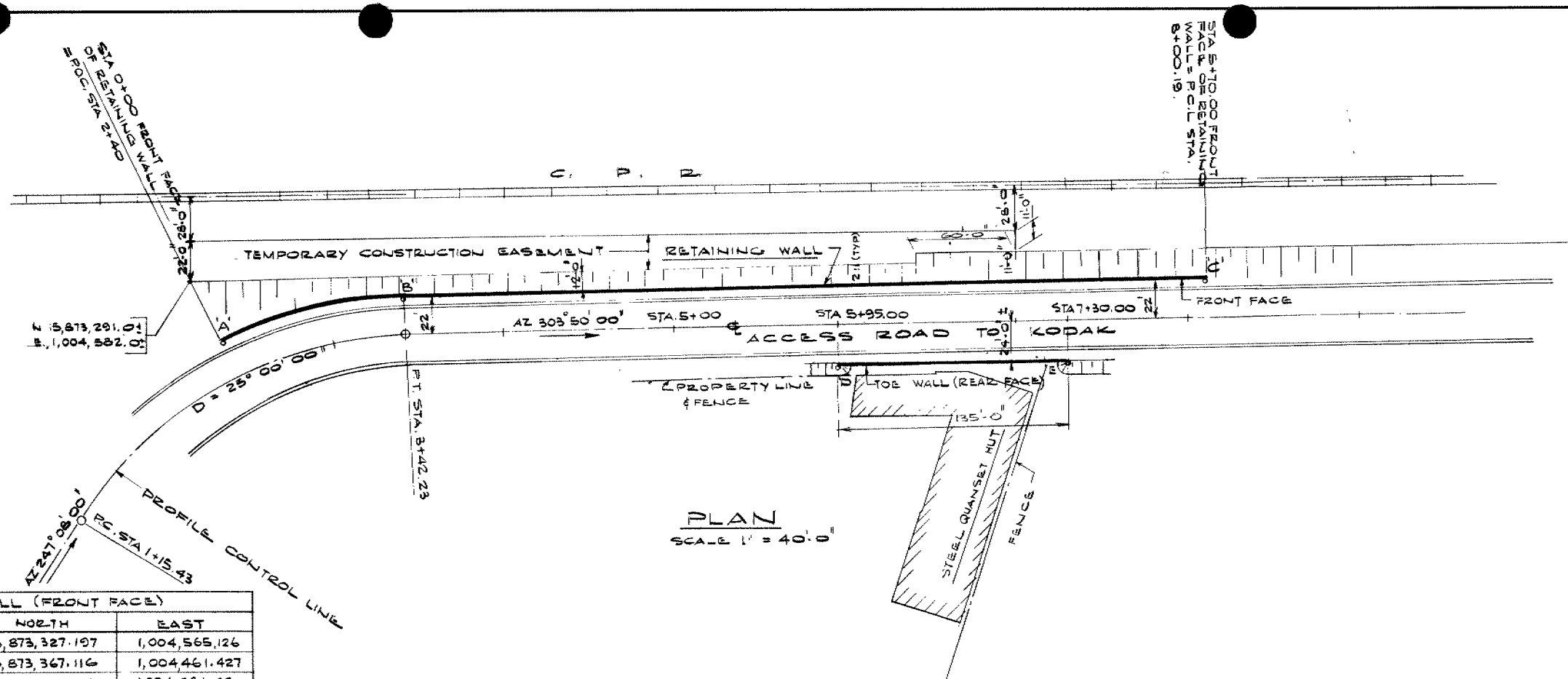
h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 O_r OVERCONSOLIDATION RATIO (OCR)

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 ϕ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ' = EFFECTIVE NORMAL STRESS



CURVE DATA	
$\Delta = 56^{\circ} 42' 00''$	
$D = 25^{\circ} 00' 00''$	
$R = 229.18'$	
$T = 123.66'$	
$L = 226.80'$	
$E = 31.23'$	

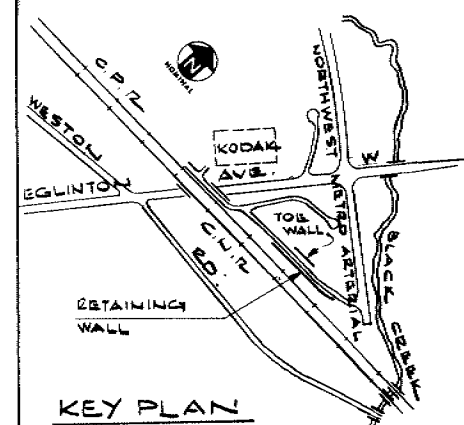
RETAINING WALL (FRONT FACE)				
POINT	STATION	OFFSET	NORTH	EAST
A	0+00	22'	15,873,327.197	1,004,565.126
B	1+12.04	22'	15,873,367.116	1,004,461.427
C	5+70.00	22'	15,873,622.097	1,004,081.020
ACCESS ROAD TO KODAK				
POINT	STATION	NORTH	EAST	
P.C.	1+15.43	15,873,364.593	1,004,690.336	
P.T.	3+42.23	15,873,383.391	1,004,473.676	
TOE WALL (REAR FACE)				
POINT	STATION	OFFSET	NORTH	EAST
D	5+95.00	24'±	15,873,546.0±	1,004,277.0±
E	7+30.00	24'±	15,873,621.0±	1,004,165.0±



CONT No
WP No 33-76-16

NORTHWEST METRO ARTERIAL
RETAINING WALL AT
ACCESS ROAD TO KODAK
GENERAL ARRANGEMENT

SHEET
1



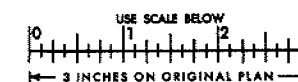
FENCO
FENCO CONSULTANTS LTD.

NOTES
FOR GENERAL NOTES DWG#3

LIST OF DRAWINGS

1. GENERAL ARRANGEMENT
2. BORE HOLE LOCATIONS AND SOIL STRATA
3. ELEVATION AND DETAILS
4. PANELS (A), (B) AND TOE WALL
5. CONSTRUCTION TABLE
6. REINFORCING STEEL SCHEDULE
7. REINFORCING STEEL SCHEDULE

FOR REDUCED PLAN



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	WYC	CHECK	WYC
DRAWING	WYC	CHECK	WYC

FENCO DWG NO 8452-1K-1

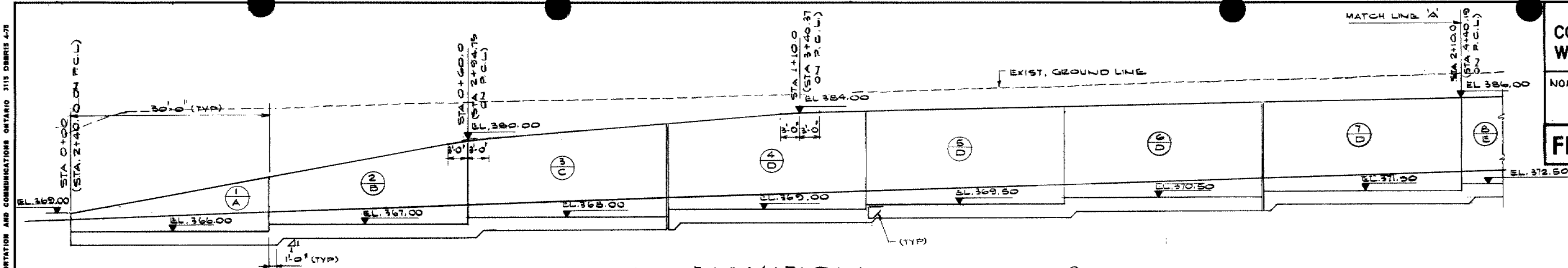
CONT No
WP No 33-76-16

NORTHWEST METRO ARTERIAL
RETAINING WALL AT
ACCESS ROAD TO KODAK
ELEVATION & DETAILS

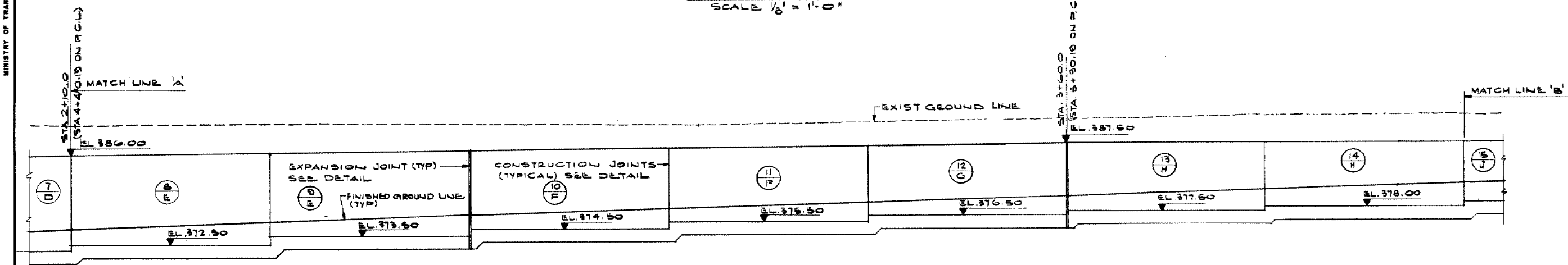
SHEET
3

FENCO

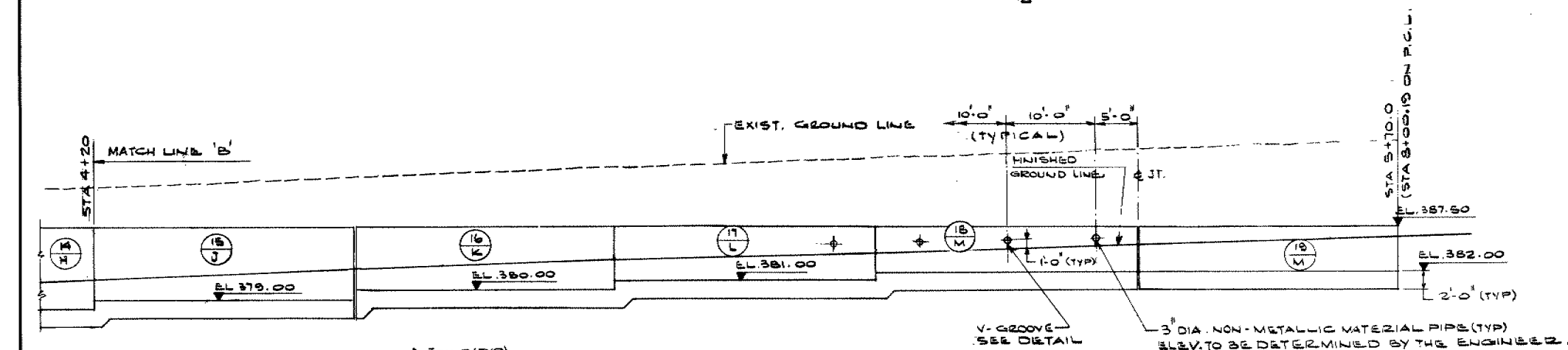
FENCO CONSULTANTS LTD.



ELEVATION
SCALE 1/8" = 1'-0"



ELEVATION
SCALE 1/8" = 1'-0"



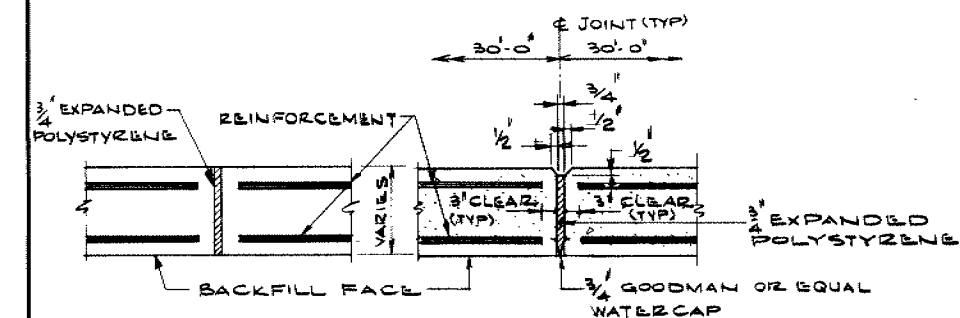
ELEVATION
SCALE 1/8" = 1'-0"

GENERAL NOTES:-

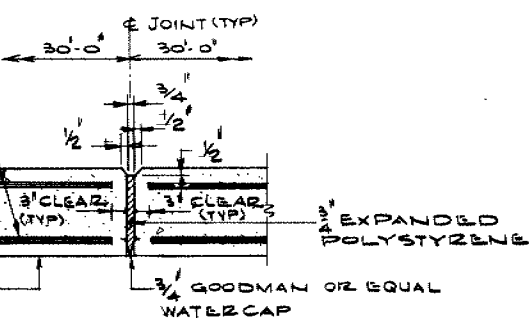
- CLASS OF CONCRETE:**
THE MINIMUM 28 DAY COMPRESSIVE STRENGTH SHALL BE AS FOLLOWS:-
RETAINING WALL - WALL = 4000 P.S.I. FTG = 3000 P.S.I.
TOE WALL = 3000 P.S.I.
- CLEAR COVER ON REINFORCING STEEL = 3"**
- REINFORCEMENT: ALL REINFORCING STEEL SHALL BE GRADE 400**

QUANTITIES:-

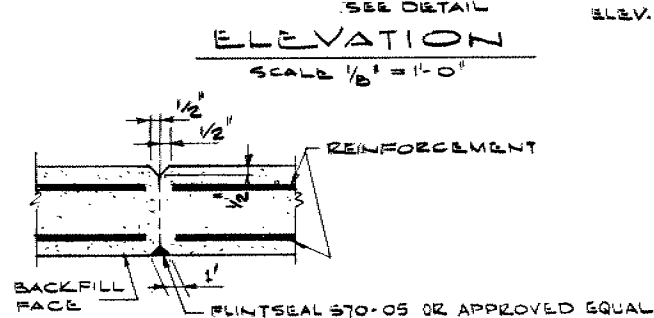
CONCRETE QUANTITIES FOR THE LUMP SUM
CONCRETE TENDER ITEMS:-
CONCRETE IN RETAINING WALL = 352 C.Y.
CONCRETE IN TOE WALL = 104 C.Y.



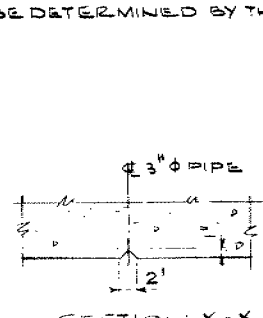
EXPANSION JT.
IN FOOTINGS



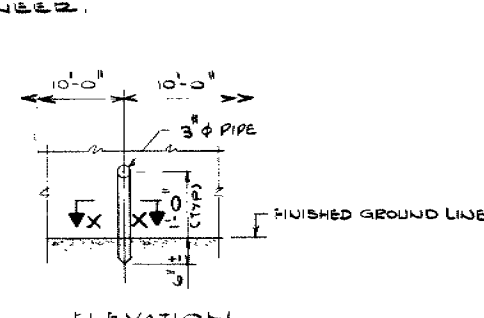
EXPANSION JT.
IN WALLS



CONSTRUCTION JT.
IN WALLS



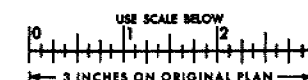
SECTION X-X



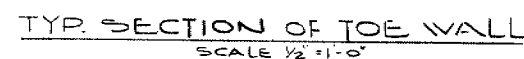
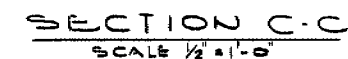
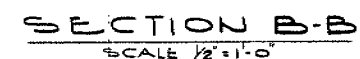
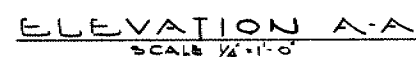
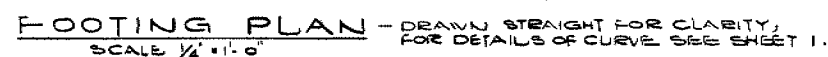
ELEVATION

V-GROOVE BELOW DRAINS

FOR REDUCED PLAN



REVISIONS	DATE BY	DESCRIPTION	DATE
1	DESIGN WVC	CHECK RVM	LOADING
2	DRAWING WVC	CHECK RVM	SITE No
3			



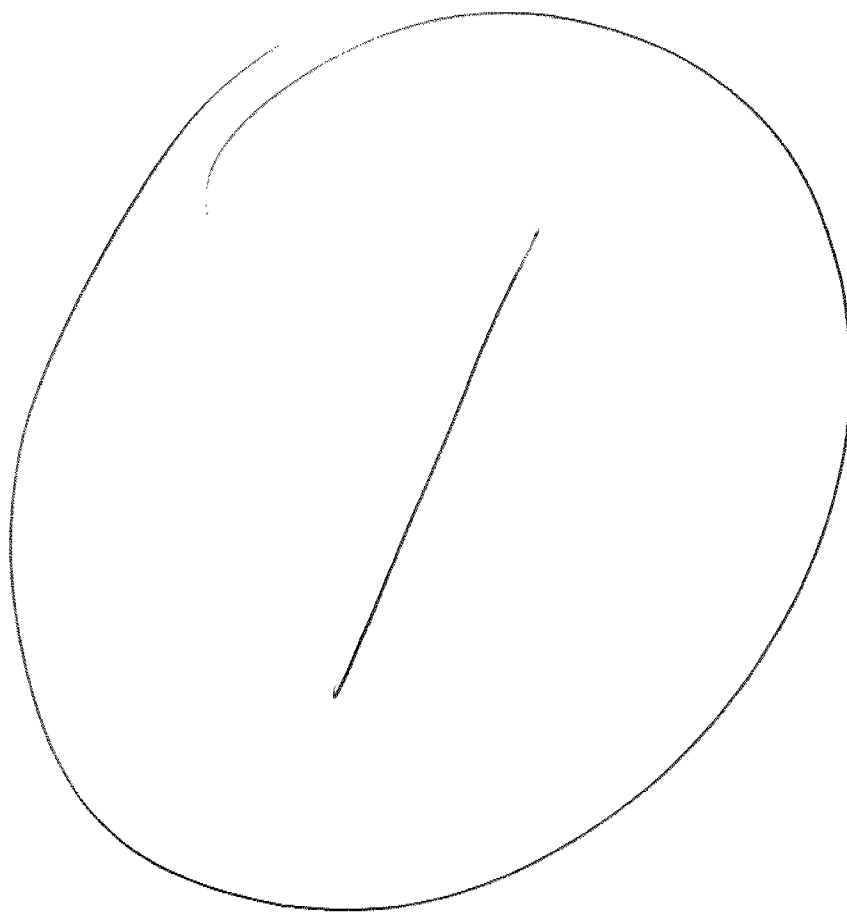
1. ALL EXCAVATION FOR JOE WALL TO BE BACKFILLED WITH GRANULAR B MATERIAL.
2. CLASS OF CONCRETE : 20.7 MPa (3000 PSI)
3. ALL REINFORCING BARS TO HAVE A 3" COVER.

- FOR GENERAL NOTES SEE SHEET NO. 3
- THIS DWG. TO BE READ IN CONJUNCTION WITH SHEET NO. 3 & 5.
- FOR REINFORCING STEEL SCHEDULE SEE SHEET NO. 6 & 7.

3	REVISIONS				
	DATE	BY	DESCRIPTION		
	DESIGN W.Y.C.	CHECK RVH	LOADING	DATE FEB 79	
	DRAWING T.O.	CHECK RVH	SITE No	DWG 4	

35MM

DRAWING





Golder Associates

CONSULTING GEOTECHNICAL AND MINING ENGINEERS

REPORT

TO

MINISTRY OF TRANSPORTATION
AND COMMUNICATIONS

SUBSURFACE INVESTIGATION
EXISTING SANITARY SEWER
NORTHWEST METRO ARTERIAL ROAD
AND EGLINTON AVENUE

BOROUGH OF YORK ONTARIO

Distribution:

- 7 copies - Ministry of Transportation and Communications
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- 2 copies - Golder Associates
MISSISSAUGA, Ontario

November, 1980

801-1310

GEOCRES N° 30M11-182



Golder Associates

CONSULTING GEOTECHNICAL AND MINING ENGINEERS

November 17, 1980

Ministry of Transportation
and Communications
1201 Wilson Avenue
DOWNSVIEW, Ontario
M3M 1J8

ATTENTION: Mr. M. Devata, P. Eng.

RE: SUBSURFACE INVESTIGATION
EXISTING SANITARY SEWER
NORTHWEST METRO ARTERIAL ROAD
AND EGLINTON AVENUE
BOROUGH OF YORK, ONTARIO

Dear Sirs:

This letter reports the results of a subsurface investigation carried out at the above site (refer to Figure 1 for location).

BACKGROUND

Our terms of reference for this investigation were discussed at a meeting on November 5, 1980, between your Mr. Devata and our Messrs. Heffernan and Dubin. As discussed, we were to arrange to put down two detailed sampled borings as close as practicable to an existing 54 in. diameter concrete sanitary sewer which crosses the site. Based on our interpretation of the conditions encountered in the borings, we were to provide comments relating to:

1. The nature of the material underlying the sewer.
2. The nature of the fill material overlying the sewer with particular emphasis on the density of the fill.
3. Our opinion regarding the effect on the sewer of increased loadings due to recent fill placement.

It is understood that the existing sanitary sewer which crosses the site, was constructed in 1950, at an invert elevation of about 332 ft. Recently ground surface in the area has been raised from about elevation 350 to about elevation 370, by placement of a sanitary landfill. The original plans were to raise the area to elevation 362. Further, the fill area is to be used for construction of a baseball diamond.

It is understood that some concern has been expressed regarding whether or not the existing sewer pipe can withstand the increased loads due to the presence of the fill.

PROCEDURE

On November 6, 1980, two detailed sampled borings were put down at the locations shown on Figure 2. The borehole locations were laid out in the field from M.T.C. stakes set out to mark the sewer centreline, and were confirmed by representatives of the Metropolitan Toronto Works Department.

The borings were advanced to depths of 36.5 and 41.5 ft. below ground surface using a track mounted power auger drill-rig supplied and operated by a specialist contractor. In each boring, standard penetration tests were carried out at 5 ft. intervals of depth within the upper approximately 15 ft. of the landfill and continuously down through the old sewer trench backfill. Samples of the overburden were obtained

using a standard 1½ in. I.D. split spoon sampler. Both borings were advanced to depths sufficient to fully penetrate the fill materials and to obtain samples of the native material at sewer invert level. Following the completion of both borings, piezometers were sealed into the holes to permit monitoring of the groundwater level.

The field work was supervised throughout by a member of our engineering staff, who located the borings in the field, supervised the drilling and sampling operations and cared for the samples.

All of the samples obtained were sealed into airtight containers and brought to our laboratory for detailed examination and testing.

The borehole locations and ground surface elevations were established in the field by members of our engineering staff. The ground surface elevations were obtained from a temporary bench mark consisting of the top surface of a man-hole located as shown on Figure 2. The elevation of this bench mark was given to us as elevation 364.89 ft. Geodetic datum.

RESULTS OF INVESTIGATION

The detailed conditions encountered in the borings are given on the attached Record of Borehole sheets, together with the results of the laboratory testing.

In summary, the borings encountered fill to depths of 32.7 ft. (BH 1) and 33.3 ft. (BH 2). At both locations, the fill consists of an upper layer of inorganic clayey silt,

underlain by variable random organic sandy fill, with a second clayey silt layer. This material is, in turn, underlain by loose to compact silty fine sand comprising the original trench backfill. This trench fill is underlain by compact, clayey, sandy silt till, which transitioned to very stiff, faintly laminated clayey silt containing a trace to some sand and gravel.

The water content of the fill ranges from about 13 to 39 per cent and is generally below 20 per cent. Based on our assessment of the fill samples, together with the standard penetration test results, the estimated unit weight of the fill ranges from about 100 to 115 lb/cu.ft., as indicated on the Record of Borehole logs.

A total of nine laboratory unit weight determinations were carried out on the samples of the fill obtained during the course of this investigation and yielded values of bulk unit weight ranging from about 103 to 137 lb/cu.ft. However, it should be noted that a certain amount of densification of these samples will probably have occurred as a result of the sampling operations and in our opinion, these results are probably not accurate.

Borehole 1 was dry on the completion of drilling operations, and groundwater was encountered in Borehole 2 during drilling at a depth of about 15 ft. Four days after the completion of drilling, the groundwater levels were measured in Boreholes 1 and 2 at depths of 15.5 and 12.0 ft., respectively.

Figure 3 attached shows a schematic cross section of the sewer. Although the two borings are offset from each other by some 200 ft., there is good agreement in the geometry of the trench backfill - native soil interface. Based on the

two boreholes, it appears that the sewer trench cut slopes up from the sewer invert at about 1 (horizontal) to $1\frac{1}{2}$ (vertical).

DISCUSSION

Based on the results of this investigation and assuming that no softening/loosening of the soil underlying the sewer occurred during construction, the sewer appears to be bedded in competent material.

From the standard penetration test values recorded during this investigation, the bearing capacity of the undisturbed native soils at invert elevation will be of the order of 6000 lb/sq.ft. As the soil is fine grained, some minor consolidation settlement may occur due to increased loads. The total settlement due to this increased loading is estimated to be about 0.5 in. With the uniform bedding conditions the differential settlement should be negligible.

Assuming the trench backfill geometry is as noted previously (i.e. the trench was cut at 1 (horizontal) to $1\frac{1}{2}$ (vertical) and an average unit weight of the overlying fill of 115 lb/cu.ft., the total load at the top of the sewer will be as much as about 41,000 lb/lin.ft. of pipe, distributed over the full width of the sewer.* This represents an increase of about 22,000 lb/lin.ft. from the condition which existed prior to the fill placement, assuming full load transference through the trench backfill.

* Reference, Spangler, M.G. "Culverts and Conduits" Foundation Engineering, Leonards, G.A. ed., McGraw-Hill, 1962.

Provided that installation was carried out in accordance with the construction drawings, and provided reasonable construction practice was adhered to, we believe that the sewer should withstand this increased loading.

RECOMMENDATIONS

As there is no evidence of distress to the pipe at this time, we have not included specific recommendations for remedial measures.

However, in our opinion, the sewer should be inspected internally and any evidence of recent distress (i.e. cracking, deformation) noted. In the event that such distress is found, remedial action should be considered. These remedial measures could include strengthening of the sewer by means of an inside steel or concrete liner, or treatment of the backfill to effect an 'imperfect backfill' condition. The latter action would require excavation of large amounts of the existing fill.

When considering possible remedial action, it must be noted that based on the conditions observed in the boreholes, excavation of the fill material will be difficult, due to the loose, random nature of the fill, and the possibility of encountering some groundwater.

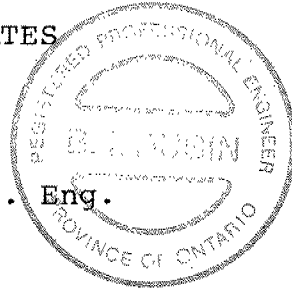
We trust that the information contained in this letter is sufficient for your present purposes. If you have any questions, please call us.

Yours truly,

GOLDER ASSOCIATES



B. I. Dubin, P. Eng.



F. J. Heffernan, P. Eng.

BID:FJH:rc
801-1310

Att: Record of Boreholes
Figures 1 to 3

LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

I. SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
DS Denison type sample
FS foil sample
RC rock core
ST slotted tube
TO thin-walled, open
TP thin-walled, piston
WS wash sample

II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

WH sampler advanced by static weight—weight, hammer
PH sampler advanced by pressure—pressure, hydraulic
PM sampler advanced by pressure—pressure, manual

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Relative Density	<i>N</i> , blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	<i>c_u</i> , lb./sq. ft.
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

IV. SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH combined analysis, sieve and hydrometer¹
Q undrained triaxial²
R consolidated undrained triaxial²
S drained triaxial
U unconfined compression
V field vane test

NOTES:

¹Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

²Undrained triaxial tests in which pore pressures are measured are shown as \bar{Q} or \bar{R} .

LIST OF SYMBOLS

I. GENERAL

π	= 3.1416
e	= base of natural logarithms 2.7183
$\log_e a$ or $\ln a$	natural logarithm of a
$\log_{10} a$ or $\log a$	logarithm of a to base 10
t	time
g	acceleration due to gravity
V	volume
W	weight
M	moment
F	factor of safety

II. STRESS AND STRAIN

u	pore pressure
σ	normal stress
σ'	normal effective stress ($\bar{\sigma}$ is also used)
τ	shear stress
ϵ	linear strain
ϵ_{xy}	shear strain
ν	Poisson's ratio (μ is also used)
E	modulus of linear deformation (Young's modulus)
G	modulus of shear deformation
K	modulus of compressibility
η	coefficient of viscosity

III. SOIL PROPERTIES

(a) Unit weight

γ	unit weight of soil (bulk density)
γ_s	unit weight of solid particles
γ_w	unit weight of water
γ_d	unit dry weight of soil (dry density)
γ'	unit weight of submerged soil
G_s	specific gravity of solid particles $G_s = \gamma_s / \gamma_w$
e	void ratio
n	porosity
w	water content
S_r	degree of saturation

(b) Consistency

w_L	liquid limit
w_P	plastic limit
I_P	plasticity index
w_S	shrinkage limit
I_L	liquidity index = $(w - w_P) / I_P$
I_C	consistency index = $(w_L - w) / I_P$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
D_r	relative density = $(e_{max} - e) / (e_{max} - e_{min})$

(c) Permeability

h	hydraulic head or potential
q	rate of discharge
v	velocity of flow
i	hydraulic gradient
k	coefficient of permeability
j	seepage force per unit volume

(d) Consolidation (one-dimensional)

m_v	coefficient of volume change = $-\Delta e / (1+e) \Delta \sigma'$
C_c	compression index = $-\Delta e / \Delta \log_{10} \sigma'$
c_c	coefficient of consolidation
T_v	time factor = $c_v t / d^2$ (d , drainage path)
U	degree of consolidation

(e) Shear strength

τ_f	shear strength
c'	effective cohesion
ϕ'	effective angle of shearing resistance, or friction
c_u	apparent cohesion*
ϕ_u	apparent angle of shearing resistance, or friction
μ	coefficient of friction
S_f	sensitivity

$\left. \begin{array}{l} \text{in terms of effective stress} \\ \tau_f = c' + \sigma' \tan \phi' \end{array} \right\}$

$\left. \begin{array}{l} \text{in terms of total stress} \\ \tau_f = c_u + \sigma \tan \phi_u \end{array} \right\}$

*For the case of a saturated cohesive soil, $\phi_u = 0$ and the undrained shear strength $\tau_f = c_u$ is taken as half the undrained compressive strength.

PENETRATION TEST HAMMER WEIGHT — DROP —

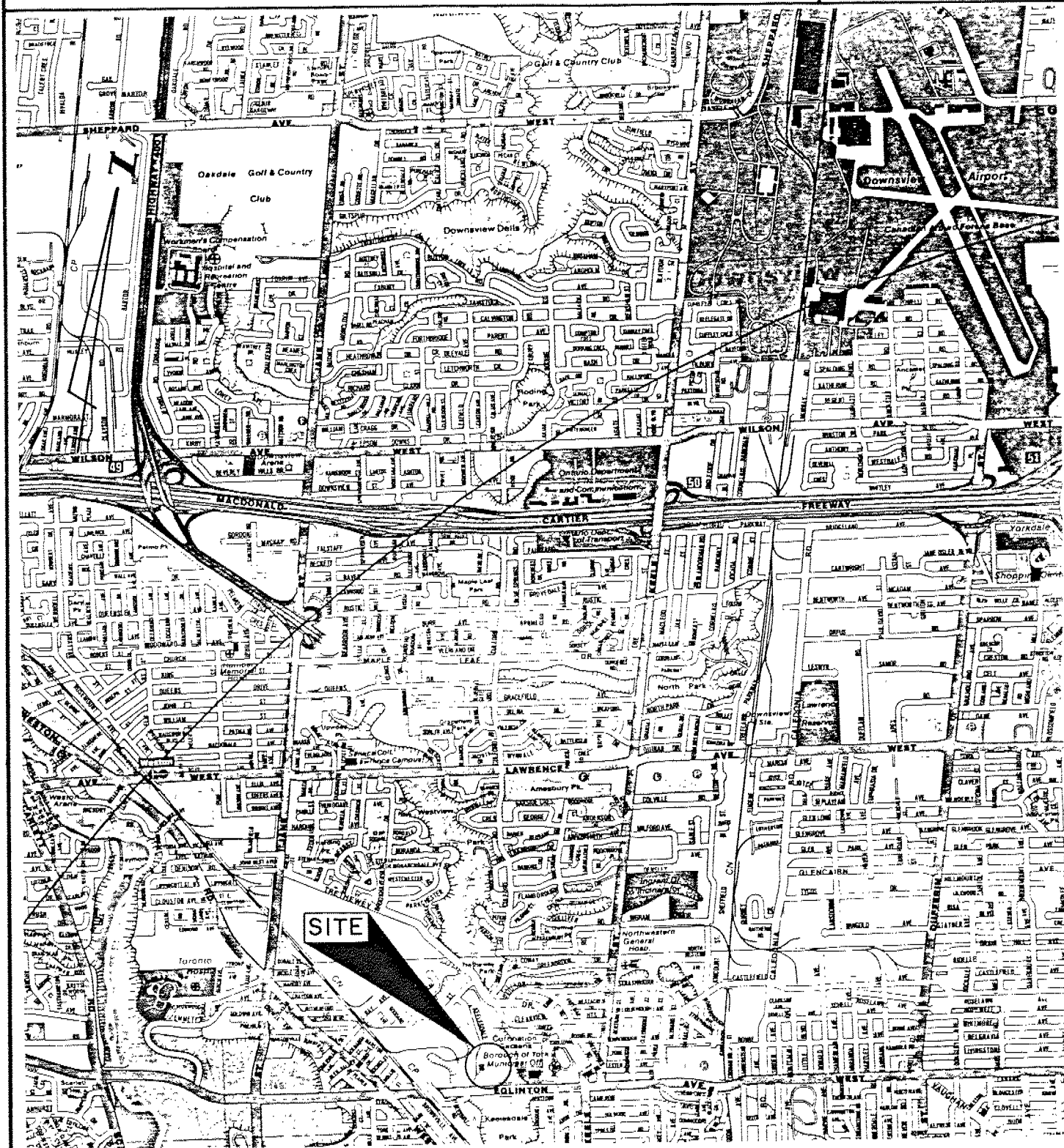
DRAWN SM
CHECKED BIP

PENETRATION TEST HAMMER WEIGHT — DROP —

[illegible]

SITE LOCATION PLAN

FIGURE 1



SCALE



Date NOV. 13, 1980
Project No. 801-1310

Golder Associates

Drawn SM
Chkd -----

IDEALIZED SECTION ACROSS SEWER

FIGURE 3

STA. 2+00

EAST
(OFFSET 100' S)

WEST
(OFFSET 100' N.)

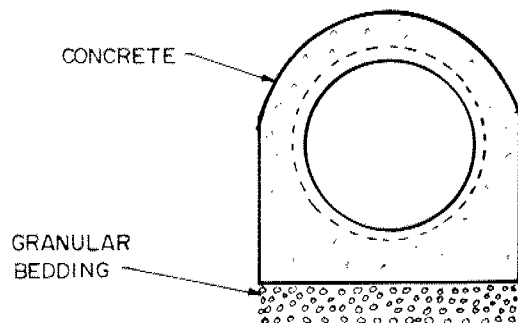
NOTE

- 1) SEWER CONFIGURATION BASED ON COPY OF UNTITLED CONSTRUCTION DRAWING SUPPLIED BY MTC.
- 2) FOR LOCATION OF SECTION REFER TO FIGURE 3.

SCALE
1 INCH TO 5 FEET

SPECIAL NOTE

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT.



SECTION A-A

ASSUMED SIDE SLOPE



370
365
360
355
350
345
340
335
330

ELEVATION IN FEET

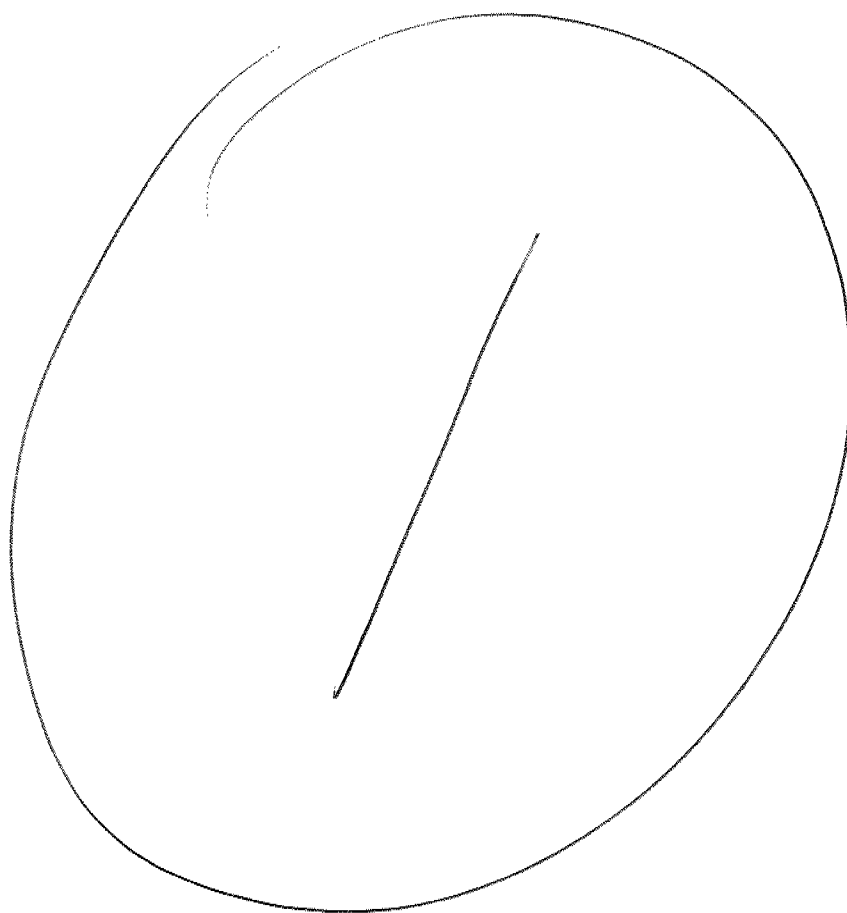
Date NOV. 17, 1980
Project No. 801-1310

Golder Associates

Drawn SM
Chkd BID

35MM

DRAWING



ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 33-76-16

DIST 6

HWY NWMA

STR SITE N/A

Retaining Walls at Kodak
Access Road South of
Eglinton Avenue

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TYPE	DISCARD AFTER	RECOMM. BY
JARS	79 01 31	M-A
TUBES	-	-
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FOUNDATION INVESTIGATION REPORT

For

Retaining Walls at Kodak Access Road
South of Eglinton Avenue, Parallel to C.P.R.
W.P. 33-76-16, NWMA, District 6, Toronto

INTRODUCTION

This report contains the results of a foundation investigation carried out at the site of the above mentioned project during the period of October 26-27, 1978. The fieldwork consisted of eight sampled boreholes advanced by means of a continuous flight auger machine equipped with solid and hollow stem augers. The boreholes ranged in depth from 16.5 to 36.5 feet below ground surface.

SITE DESCRIPTION AND GEOLOGY

The site is located about 750 feet south of Eglinton Avenue and Kodak Road crossing in Metropolitan Toronto.

Physiographically the site lies in the South Slope Region at the north boundary of "Iroquois Plain". The subsoil consists of sand deposits underlain by clayey silt till deposited during the Pleistocene Epoch.

SUBSURFACE CONDITIONS

The subsoil in the investigated area consists of mainly silty sand with trace of clay and occasional gravel deposits which was explored to a maximum depth of 36.5 feet below the ground surface. In an isolated area (B.H. 10) the upper 6.5 feet is fill material composed of clayey silt with some sand and organics (mostly decayed wood). Also in the same area at one location (B.H. 3) the upper 2.5 feet is composed of fill material consisting of black silty sand mixed with ash and burnt wood.

As described previously, the predominant deposit in this area is a granular material composed of silty sand with traces of clay and occasional gravel. The Standard Penetration Test results gave 'N' values generally ranging from 20 to over 100 blows per foot. However, in some localized areas in the upper portion the 'N' values are as low as 6 to 12 blows/foot. The deposit has mostly a dense to very dense relative density, except in some localized upper sections where it is loose to compact.

Groundwater

Groundwater level observations were carried out during the period of the field investigation (October, 1978). The observed water levels, where encountered, are presented on the individual Record of Borehole Sheets, as well as on Drawing No. 337616-A. The results indicate that the groundwater level varies between elevations 365 and 372 which corresponds to levels ranging from 7 to 26 feet below the existing ground surface.

DISCUSSION AND RECOMMENDATIONS

General

It is proposed to extend the existing access road to Kodak in a southeasterly direction in order to provide direct access to the Northwest Metro Arterial roadway. The extended Kodak Access Road which runs parallel to the existing CPR tracks will be situated in a cut section. Due to the property restrictions in this area, it was decided to retain the roadway cut for the access road by means of a retaining wall on the south side and by constructing a toe wall on the north side. The topography of the general area and the proposed grades of the access road extension are such that cuts up to a maximum depth of 15 feet will be required and in addition, a retaining structure will be necessary on the south side between Sta. 2+40 and Sta. 8+40, together with a toe wall from Sta. 5+95 to Sta. 7+25 on the north side.

Foundation Considerations

The proposed retaining wall can be founded on spread footings within the dense to very dense granular subsoil with suggested footing base elevations as given in the following table. In all cases the base of the footing should have a minimum cover of 4 feet in all directions to prevent any damage due to frost action. If footings are founded as suggested below, an allowable bearing pressure up to 4 t.s.f. may be used for design of shallow foundations in the granular subsoil. In such a case the net settlements will not be more than one inch.

Retaining Wall Details Between Sta. 2+40 to Sta. 8+40

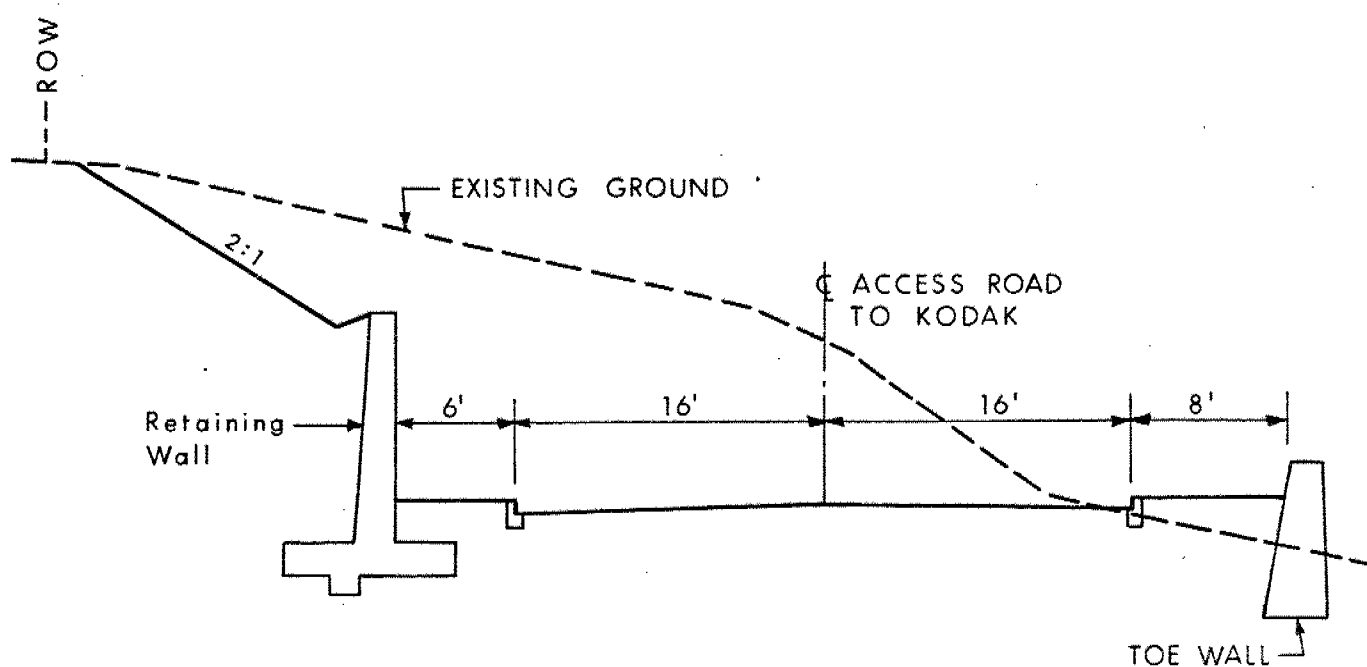
Station	Elevation			
	Top of Retaining Wall	Finished Ground Line	Footing Base at or Below	Reference B.H. No.
2+40	368.00	368.04	364.0	#7
2+50	370.00	368.36	364.5	7
3+00	380.00	369.96	366.0	7 & 6
3+50	384.00	371.56	368.0	6
4+00	385.00	373.16	369.0	6 & 5
4+50	386.00	374.76	371.0	5
5+00	386.50	376.36	373.0	5 & 4
5+50	387.00	377.96	374.0	5
6+00	387.50	379.56	376.0	4 & 3

Station	Elevation			
	Top of Retaining Wall	Finished Ground Line	Footing Base at or Below	Reference B.H. No.
6+50	387.50	381.16	377.0	#3
7+00	387.50	382.76	378.0	3 & 2
7+50	387.50	384.36	380.0	2
8+00	387.50	385.96	380.0	1
8+40	387.50	387.24	380.0	1

Toe Wall Between Sta. 5+95 and 7+25

The toe wall should be as per M.T.C. Standards SD-9-35 and the base of the toe wall should be located at least 4 feet below the finished grade of the roadway. In this area some localized fill material with organics was observed. Such materials should be excavated to its full depth and replaced with well compacted granular material prior to placing the toe wall. If such measures are carried out no foundation problems are anticipated provided the bearing pressures are limited to 2 t.s.f.

A typical section showing the location of a retaining wall on the south side and a toe wall on the north side is given below:



Typical Section

Other Considerations

The backfill and drainage measures should be as per current MTC methods. Free draining granular material should be specified as backfill to retaining structures. In computing the sliding resistance between the base of the rough concrete footing and the granular soil, a coefficient friction of 0.58 may be used.

If the retaining structure is to be of a concrete cantilever type and some movement at the top of the wall is permitted, a coefficient of active pressure (K_a) of 0.33 may be used for the granular backfill behind the wall when designing the wall section.

In addition, the effects due to the sloping surcharge of the ground behind the retaining structure and or the use of heavy vibratory compaction equipment, should also be taken into account in the computation of earth pressures.

In order to relieve the build-up of excess hydrostatic pressure behind the retaining wall, suitable drainage measures should be provided. Backfill behind the wall should be carried out in accordance with current MTC practices.

Construction

A major portion of the retaining structure will be situated above the prevailing water level and consequently no major dewatering problems are anticipated. In some areas, however, the footing base will be located at or below the prevailing water level. In such areas care should be exercised to prevent 'boiling' of the foundation base due to unbalanced hydrostatic head. One method of preventing 'boiling' of the base of the excavation is by means of driving sheeting to a depth below the footing base equal to the hydrostatic head above the footing excavation. Care should be exercised to prevent loosening of the foundation base excavation by surface run-off into the excavations. Temporary cut slopes in the granular subsoil should be steeper than 1:1. If steeper slopes are to be contemplated, soldier piles with timber lagging may be incorporated during construction of foundations for the retaining structures.

Construction joints should be provided at various intervals for the long retaining wall.

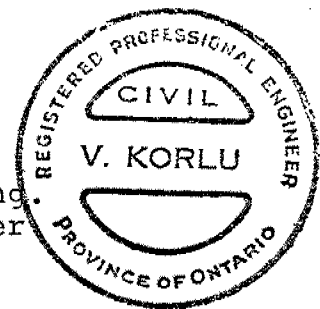
MISCELLANEOUS

The fieldwork was carried out during October 26-27, 1978 under the supervision of Mr. V. Korlu, Project Engineer, who also prepared this report.

The equipment was owned and operated by Eastern Soil Investigation Ltd. of Toronto.

This report was reviewed by Mr. M. Devata, Supervising Engineer.

V. Korlu
V. Korlu, P. Eng.
Project Engineer



M. Devata
M. Devata, P. Eng.
Supervising Engineer

January, 1979

APPENDIX



RECORD OF BOREHOLE No 1

W P 33-76-16 LOCATION Coords. N 15 873 630; E 1 004 068 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 27, 1978 CHECKED BY

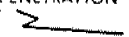
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
								SHEAR STRENGTH									

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 2

W P 33-76-16 LOCATION Coords. N 15 873 584; E 1004 137 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 27, 1978 CHECKED BY CP.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) 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										10 20 30		
394.0	Ground Level																			
0.0	Topsoil																			
	Silty Sand With Occasional Gravel		1	SS	30		390									6 83 (11)				
			2	SS	40											5 85 (10)				
			3	SS	38															
			4	SS	64		380									0 89 (11)				
			5	SS	63															
			6	SS	43															
			7	SS	73		370													
						W.L.														
362.5	Dense to Very Dense		8	SS	85															
31.5	End of Borehole																			



RECORD OF BOREHOLE No 3

W P 33-76-16 LOCATION Coords. N 15 873 538; E 1 004 205 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Augers COMPILED BY V.K.
DATUM Geodetic DATE October 27, 1978 CHECKED BY ep

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			SHEAR STRENGTH		W _p	W	W _L		
								○ UNCONFINED ● QUICK TRIAXIAL	+ FIELD VANE x LAB VANE	WATER CONTENT (%) 10 20 30				
392.0	Ground Level													
389.5	Dark Silty Sand, Ashes Organics - Fill						390							
2.5	Loose Silty Sand With Trace of Clay and Occasional Gravel		1	SS	28									
			2	SS	8									
			3	SS	6									
			4	SS	24									
			5	SS	51									
			6	SS	51									
			7	SS	52									
			8	SS	70									
	Gravelly Sand													
355.5	Compact to Very Dense		9	SS	82									
36.5	End of Borehole													

RECORD OF BOREHOLE No 4

W P 33-76-16 LOCATION Coords. N 15 873 483; E 1 004 287 ORIGINATED BY V.K.
 DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
 DATUM Geodetic DATE October 26, 1978 CHECKED BY CP.

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40					
390.0	Ground Level													
0.0	Topsoil													
	Loose to Compact Silty Sand With Trace of Clay and Occasional Gravel		1	SS	11									0 74 25 1
			2	SS	7									
			3	SS	8									
			4	SS	50									
			5	SS	85									
			6	SS	68									
			7	SS	62									
			8	SS	45									
353.5	Dense to Very Dense		9	SS	20									
36.5	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 5

W P 33-76-16 LOCATION Coords. N 15 873 428; E 1 004 369 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 26, 1978 CHECKED BY [Signature]

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 _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES								
389.0	Ground Level												
0.0	Topsoil												
	Silty Sand With Trace of Clay and Occasional Gravel		1	SS	15								15 72 (13)
			2	SS	18								
			3	SS	52								
			4	SS	56								
			5	SS	70								
			6	SS	57								
			7	SS	73								
			8	SS	60								
	Compact to Very Dense												0 65 30 5
352.5			9	SS	22								
36.5	End of Borehole												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No 6

W P 33-76-16 LOCATION Coords. N 15 873 372; E 1 004 453 ORIGINATED BY V.K.
DIST 6 HWY NKMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 26, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
387.0	Ground Level																
0.0	Topsoil																
	Silty Sand With Trace of Clay and Occasional Gravel		1	SS	37		380										5 85 (10)
			2	SS	32												
			3	SS	105												
			4	SS	52												
			5	SS	68		370										8 73 (19)
			6	SS	67												
			7	SS	45												
			8	SS	30		360										2 23 68 7
350.5	Dense to Very Dense		9	SS	59												
36.5	End of Borehole																



RECORD OF BOREHOLE No 7

W P 33-76-16 LOCATION Coords. N 15 873 329; E 1 004 553 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 26, 1978 CHECKED BY OP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
385.0	Ground Level																
0.0	Topsoil																
	Loose Silty Sand With Trace of Clay and Occasional Gravel		1	SS	6		380										13 67 16 4
			2	SS	7												
			3	SS	30												
			4	SS	54												
			5	SS	55		370										4 80 11 5
			6	SS	75												
			7	SS	22		360										
			8	SS	32												
348.5	Very Dense		9	SS	59		350										0 41 57 2
36.5	End of Borehole																

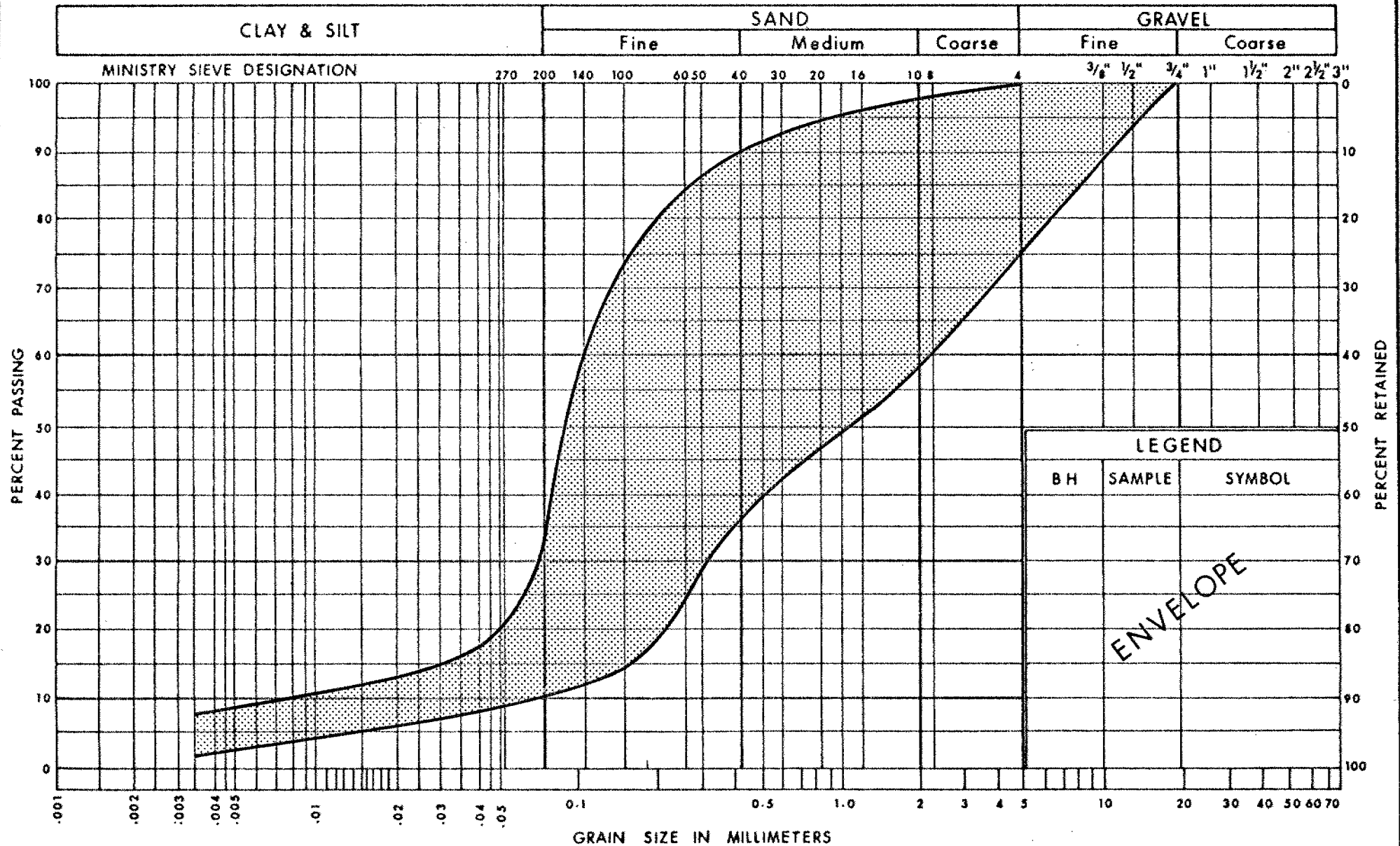


RECORD OF BOREHOLE No 10

W P 33-76-16 LOCATION Coords. N 15 873 549; E 1 004 278 ORIGINATED BY V.K.
DIST 6 HWY NWMA BOREHOLE TYPE Solid Stem Auger COMPILED BY V.K.
DATUM Geodetic DATE October 27, 1978 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20	40	60	80	100					
376.0	Ground Level																
0.0	Clayey Silt With Pieces of Decayed Wood and Organics - Fill		1	SS	5		370										7 33 45 15
369.5			2	SS	6												4 78 (18)
6.5	Loose Silty Sand With Trace of Clay and Occasional Gravel Dense		3	SS	18												
			4	SS	37												
359.5			5	SS	40												
16.5	End of Borehole						360										

UNIFIED SOIL CLASSIFICATION SYSTEM



Ontario

 Ministry of
Transportation and
Communications

GRAIN SIZE DISTRIBUTION
SILTY SAND
WITH TRACE OF CLAY & OCCASIONAL GRAVEL

FIG No 1

W P 33-76-16

EXPLANATION OF TERMS USED IN REPORT

'N' VALUE: AN INDICATOR OF SUBSOIL QUALITY. IT IS OBTAINED FROM THE STANDARD PENETRATION TEST (CSA STD. A119.1). SPT 'N' VALUE IS THE NUMBER OF BLOWS REQUIRED TO CAUSE A STANDARD 2 INCH O.D. SPLIT-BARREL SAMPLER TO PENETRATE 12 INCHES INTO UNDISTURBED GROUND IN A BOREHOLE WHEN DRIVEN BY A HAMMER WEIGHING 140 POUNDS, FALLING FREELY A DISTANCE OF 30 INCHES. FOR PENETRATIONS OF LESS THAN 12 INCHES 'N' VALUES ARE INDICATED AS THE NUMBER OF BLOWS FOR THE PENETRATION ACHIEVED. 'N' VALUES CORRECTED FOR OVERBURDEN PRESSURE ARE DENOTED THUS N_c .

DYNAMIC CONE PENETRATION TEST (CSA STD. A119.3): CONTINUOUS PENETRATION OF A CONICAL STEEL POINT (2" O.D. 60 CONE ANGLE) DRIVEN BY 350 FT-LB IMPACTS ON 'A' SIZE DRILL RODS. THE RESISTANCE TO CONE PENETRATION IS MEASURED AS THE NUMBER OF BLOWS FOR EACH 12 INCH ADVANCE OF THE CONICAL POINT INTO THE UNDISTURBED GROUND.

SOIL QUALITY: SOILS ARE DESCRIBED BY THEIR COMPOSITION AND CONSISTENCY OR DENSITY.

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

S_u (PSF)	0 - 250	250 - 500	500 - 1000	1000 - 2000	2000 - 4000	> 4000
	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD

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

'N' (BLOW/FT)	0 - 5	5 - 10	10 - 30	30 - 50	> 50
	VERY LOOSE	LOOSE	COMPACT	DENSE	VERY DENSE

ROCK QUALITY: 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 DRILLED IN THAT CORING RUN.

MODIFIED RECOVERY: SUM OF THOSE NATURALLY FRACTURED CORE PIECES, 4"+ 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	2"	2" - 12"	1' - 3'	3' - 10'	> 10'
JOINTING	VERY CLOSE	CLOSE	MOD. CLOSE	WIDE	VERY WIDE
BEDDING	VERY THIN	THIN	MEDIUM	THICK	VERY THICK

ABBREVIATIONS & SYMBOLS

LABORATORY TESTING

TRIAXIAL TESTS ARE DESCRIBED IN TERMS OF WHETHER THEY ARE CONSOLIDATED (C) OR NOT (U) ISOTROPICALLY (I) OR NOT (A) AND SHEARED DRAINED (D) OR UNDRAINED (U) WITH PORE PRESSURE MEASUREMENTS (BAR OVER SYMBOLS) EG. $\bar{C}U$ = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

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

EARTH PRESSURE TERMS

μ COEFFICIENT OF FRICTION
 δ ANGLE OF WALL FRICTION
 k_o COEFFICIENT OF EARTH PRESSURE AT REST
 k_A COEFFICIENT OF ACTIVE EARTH PRESSURE
 k_P COEFFICIENT OF PASSIVE EARTH PRESSURE
 i ANGLE OF INCLINATION OF SURCHARGE
 w SLOPE ANGLE-BACKFACE OF WALL
 β ANGLE OF SLOPE
 N_q, N_c BEARING CAPACITY FACTORS
 D_f DEPTH OF FOOTING
 B, L FOOTING DIMENSIONS

INDEX PROPERTIES

γ UNIT WEIGHT OF SOIL (BULK DENSITY)
 γ_w UNIT WEIGHT OF WATER
 γ_d UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
 γ' UNIT WEIGHT OF SUBMERGED SOIL
 G_s SPECIFIC GRAVITY OF SOLIDS
 e VOIDS RATIO
 e_o INITIAL VOIDS RATIO
 e_{max} e IN LOOSEST STATE
 e_{min} e IN DENSEST STATE
 D_r RELATIVE DENSITY = $\frac{e_{max} - e}{e_{max} - e_{min}}$
 n POROSITY
 w WATER CONTENT
 w_L LIQUID LIMIT
 w_p PLASTIC LIMIT
 w_s SHRINKAGE LIMIT
 I_p PLASTICITY INDEX = $w_L - w_p$
 I_L LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
 A_c ACTIVITY = $\frac{I_p \text{ of soil}}{I_p \text{ of } 2 \mu m \text{ Soil Fraction}}$
 Om ORGANIC MATTER CONTENT
 S_r DEGREE OF SATURATION
 S SENSITIVITY = $\frac{S_u \text{ (undisturbed)}}{S_u \text{ (remoulded)}}$

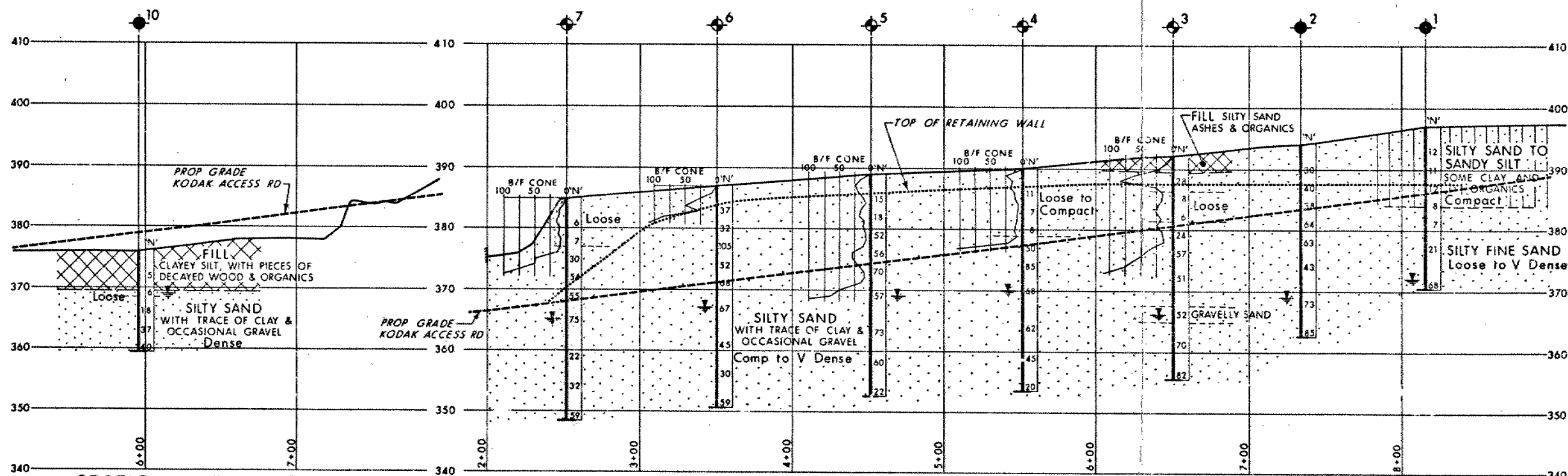
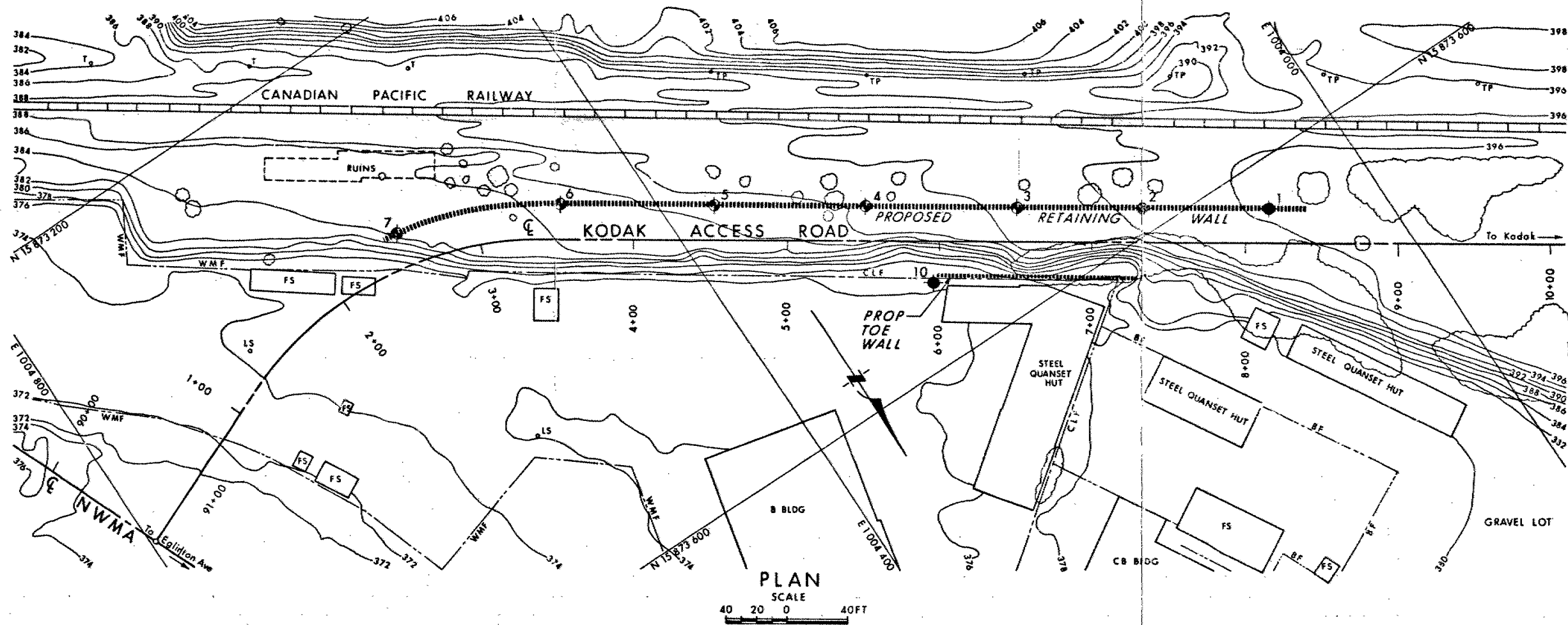
STRENGTH PARAMETERS

ϕ ANGLE OF SHEARING RESISTANCE
 τ_f PEAK SHEAR STRENGTH
 τ_R RESIDUAL SHEAR STRENGTH
 c COHESION INTERCEPT
 $\sigma_1, \sigma_2, \sigma_3$ NORMAL PRINCIPAL STRESSES
 u PORE WATER PRESSURE
 u_e EXCESS u
 r_u PORE PRESSURE RATIO
 q_u UNCONFINED COMPRESSIVE STRENGTH
 s_u UNDRAINED SHEAR STRENGTH
 ϵ LINEAR STRAIN
 γ SHEAR STRAIN
 ν POISSON'S RATIO
 E MODULUS OF ELASTICITY
 G MODULUS OF SHEAR DEFORMATION
 k_s MODULUS OF SUBGRADE REACTION
 m, D STABILITY COEFFICIENTS
 A, B PORE PRESSURE COEFFICIENTS

HYDRAULIC TERMS

h HYDRAULIC HEAD OR POTENTIAL
 q RATE OF DISCHARGE
 v VELOCITY OF FLOW
 i HYDRAULIC GRADIENT
 j SEEPAGE FORCE PER UNIT VOLUME
 η COEFFICIENT OF VISCOSITY
 k COEFFICIENT OF HYDRAULIC CONDUCTIVITY
 k_h k IN HORIZONTAL DIRECTION
 k_v k IN VERTICAL DIRECTION
 m_v COEFFICIENT OF VOLUME CHANGE
 c_v COEFFICIENT OF CONSOLIDATION
 C_c COMPRESSION INDEX
 C_r RECOMPRESSION INDEX
 d DRAINAGE PATH DISTANCE
 T_v TIME FACTOR
 U DEGREE OF CONSOLIDATION
 OCR OVERCONSOLIDATION RATIO (OCR)

NOTE: EFFECTIVE STRESS PARAMETERS ARE DENOTED BY USE OF APOSTROPHE ABOVE THE SYMBOL, THUS:
 σ' = EFFECTIVE ANGLE OF SHEARING RESISTANCE;
 σ'_1 = EFFECTIVE NORMAL STRESS

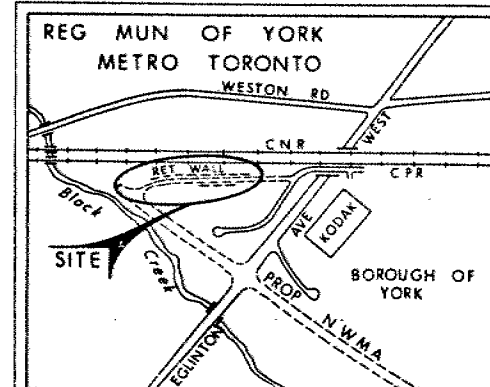


CONT No
WP No 33-76-16

RETAINING WALL
(KODAK ACCESS RD South of EGLINTON)
BORE HOLE LOCATIONS & SOIL STRATA



SHEET



KEY PLAN

LEGEND

- Bore Hole
- ⊕ Dynamic Cone Penetration Test (Cone)
- ⊕ Bore Hole & Cone
- "N" Blows/ft (Std Pen Test 350 ft lbs energy)
- CONE Blows/ft (60° Cone, 350 ft lbs energy)
- ↓ WL at time of investigation Oct 1978

No	ELEVATION	CO-ORDINATES NORTH	EAST
1	397.0	15 873 630	1004 068
2	394.0	15 873 584	1004 137
3	392.0	15 873 538	1004 205
4	390.0	15 873 483	1004 287
5	389.0	15 873 428	1004 369
6	387.0	15 873 372	1004 453
7	385.0	15 873 329	1004 553
10	376.0	15 873 549	1004 278

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

REVISIONS	DATE	BY	DESCRIPTION

Geocres No 30M11-180
HWY No N.W.M.A. DIST 6
S.B.M.C.V.M. CHECKED DATE Jan 4, 1979 SITE
DRAWN BY CHECKED BY D.A.G. 337616-A

memorandum



Ontario

Hiles

To: Mr. R.D. Gunter
Head, Regional Geotechnical Section
Central Region

Date: 1980-11-20

From: Pavement & Foundation Design Section
Room 313, Central Building

Re: Existing 54" ϕ Sanitary Sewer
Under Baseball Diamond
W.P. 33-76-02, Cont. 79-118
Hwy. NWMA, Dist. #6

It is understood that some concern has been expressed by Metro Works Department regarding whether or not the above mentioned existing sewer can withstand the increased loads due to the fill material which was placed on M.T.C. Contract 79-118. As discussed in our meeting with Mr. Lankinen on 1980-11-10, we have subsequently requested Golder Associates, Consulting Geotechnical and Mining Engineers to carry out a subsurface investigation in order to assess the following:

- i) The nature and composition of the recent sanitary fill material placed over the sewer and its bulk density.
- ii) The type and properties of the backfill material around and over the sewer pipe constructed in 1950 with particular emphasis on the geometry of the cut slopes of the sewer excavation.
- iii) The strength and compressibility characteristics of the foundation subsoil at invert elevation of the sanitary sewer.

Our comments based on this recent subsurface investigation were presented in a meeting held at Fenco Consultant's Office on 1980-11-18 and subsequently in another meeting held at Metro Works Department on 1980-11-17.

This memo summarizes our comments presented to the Region and Metro Works Department, and are as follows.

The investigation revealed that the subsurface conditions are generally uniform within the length of the sewer located beneath the baseball diamond. The recent fill extends to a maximum depth of 19 ft. below the existing ground surface. The upper 3 to 5 ft. of fill material is an inorganic clayey silt followed by sanitary land fill of random composition. This new fill is underlain by a second layer of clayey silt which, in turn is underlain by loose to compact silty fine sand comprising the original sewer trench backfill. The trench

backfill is underlain by competent very stiff glacial till composed of clayey silt with sand and gravel at a depth of 32 to 33 ft. below the existing ground surface. The ground water level was found to be at or above the original ground surface (elev. 352+) prior to the placement of new fill material during 1980 in this area.

Discussion

Based on the limited number of boreholes, it appears that the sewer trench was cut at 1 horizontal to 1.5 vertical. The original sewer trench backfill consists of loose to compact silty fine sand which exists in a poor to moderate state of compaction. There is some evidence that the trench backfill was consolidated when compared with the results of the borings carried out outside the trench excavation limits (Ref. our foundation report for Baseball Diamond Light Poles submitted by this Office during April, 1979).

The existing concrete sewer was encased in 9" of concrete all around and constructed with a granular bedding and is founded on a very stiff glacial till stratum. The bearing capacity of the native soil at the invert elevation of the sewer will be in the order of 6000 p.s.f. Some consolidation settlements will probably occur due to the additional loading, however with the uniform bedding and excellent foundation conditions the differential settlements should be negligible within the length of the sewer pipe. In view of this, no cracking of the pipe is anticipated as a result of the additional surcharge loading placed under Cont. 79-118.

In our opinion, the most critical period for any distress to the pipe would have occurred when the full surcharge loading was first in place. It is understood that the placement of the fill was completed during the spring of 1980, some 6 months ago. As we have already indicated, the sewer pipe is located on a competent glacial till with uniform bedding and there is evidence that some consolidation of the original granular backfill material over the pipe has occurred. In view of this we feel that the sewer should be able to withstand the additional loading, however due to the many variable and indeterminate parameters involved it is not possible to determine precisely what forces will actually be imposed on the pipe. Therefore, it is imperative that a careful inspection of the pipe in the concerned area be carried out. If there is any cracking, or deformation of the sewer pipe is observed during this inspection, a further observation should be carried out after a period of 12 months from the date when the surcharge loading was completed. This will enable us to determine whether any specific remedial measures are warranted.

It was understood at the recent Metro Works Department meeting, that their inspection of the sanitary sewer did not show any signs of distress. In order to complete this study, we agree with the Metro Works Department that a further inspection should be carried out

during the spring of 1981, at which time if there is no evidence of any further distress of the sewer the Ministry can conclude that the sewer pipe is in good condition and their responsibility in this matter is thereby ended.

We are herewith enclosing a copy of the foundation investigation report prepared by Golder Associates. If you require any further clarification, please contact our Office.

M. Devata
M. Devata
Senior Foundations Engineer

MD:ea

cc: W. Lankinen
R. Northwood
B. Adachi
Files

Encl.