

G.I.-30 SEPT. 1976

GEOCRES No. 30M12-67DIST. 6 REGION W.P. No. 127-66-48CONT. No. 80-37W. O. No. STR. SITE No. 24-336HWY. No. 403LOCATION Hwy 403 & Coopersville Creek
CulvertNo. of PAGES - OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. REMARKS:

CONT 80-37

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

30M12-67

TO: Mr. G.C.E. Burkhardt, (3) FROM: Foundations Office,
Regional Structural Planning Eng., Design Services Branch,
Central Region, West Bldg., Downsview.
3501 Dufferin St., Downsview.

ATTENTION: DATE: November 20, 1973.

OUR FILE REF. IN REPLY TO NOV 23 1973

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
The Proposed Culvert at the Crossing of
Hwy. 403 and Relocated Cooksville Creek
(Bridge #57) Site #24-336
Town of Mississauga, County of Peel
District #6 (Toronto)
W.O. 73-11076 -- W.P. 127-66-48

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

AGS/ao
Attch.

c.c. E. J. Orr
B. R. Davis
A. Rutka
R. S. Pillar
H. Greenland
B. J. Giroux
C. Mirza
G. A. Wrong
B. A. Singh

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

Foundations Files
Documents

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FOUNDATION INVESTIGATION REPORT
For
The Proposed Culvert at the Crossing of
Hwy 403 and Relocated Cooksville Creek
(Bridge #57) Site #24-336
Town of Mississauga, County of Peel
District #6 (Toronto)
W.O. 73-11076 -- W.P. 127-66-48

1. INTRODUCTION:

In connection with the future extension of new Hwy. 10, it is anticipated to construct a 20' x 8' culvert structure (No. 57) about 700' west of existing Hwy. 10, where the new Hwy. 403 will cross the proposed Cooksville Creek diversion.

The Foundations Office was requested to carry out a subsurface investigation at the above mentioned site. The request was contained in a memo from Mr. G. C. E. Burkhardt, Regional Structural Planning Engineer, Central Region, dated September 13, 1973. Subsequently, an investigation was carried out by this office to determine the subsoil, bedrock and groundwater conditions at the site.

This report presents the factual information obtained from this investigation, together with recommendations pertaining to the foundation design of the proposed structure.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is about 700 feet west of existing Hwy. 10 and 3/4 mile south of Eglinton Avenue in the Town of Mississauga, County of Peel. The topography of the terrain is flat to gently undulating in relief.

The site is located in the physiographic region known as the "Peel Plain". The characteristic deposit in the vicinity of the area under investigation is mainly composed of a cohesive glacial till underlain by shale bedrock.

3. FIELD AND LABORATORY WORK:

The subsoil investigation consisted of 7 sampled boreholes. The borings were advanced by means of a C.M.E.-750 auger machine equipped with hollow stem augers, adapted for soil sampling purposes.

Sampling in the overburden was carried out by driving a 2" O.D. split spoon sampler into the soil in accordance with the specifications for the Standard Penetration Test. In all boreholes the bedrock was proven by obtaining BXL size core samples.

Groundwater levels were observed in the open boreholes during the period of field investigation.

The soil, bedrock and groundwater conditions encountered at the boring locations are presented in the Record of Borehole sheets. The locations and elevations of the various boreholes were surveyed by District #6 (Toronto) construction personnel. The elevations in this report are referenced to a Geodetic datum. Boring locations referenced to a co-ordinate system and elevations together with an estimated stratigraphical profile along the relocated Cooksville Creek are shown on Drawing No. 73-11076A.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following this examination, various laboratory test were carried out on selected representative samples to determine the physical properties of the soil, namely:

Natural Moisture Contents

Atterberg Limits

Grain Size Distribution

The results of these tests are plotted on the Record of Borehole sheets and summarized on Fig. 1 and 2, all contained in

the Appendix of this report.

4. SUBSOIL AND BEDROCK CONDITIONS:

4.1) General:

The predominant stratum across the site is a heterogeneous mixture of clayey silt, sand and gravel (glacial till) ranging in thickness from 3 feet to 7 feet. This cohesive deposit is underlain by shale bedrock.

The boundary between the overburden and the bedrock as determined in the boreholes, are shown on the accompanying Record of Borehole sheets. The stratigraphical profile, shown on Drawing No. 73-11076A have been inferred from this data.

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

The predominant stratum across the site is a deposit of glacial origin ie. a heterogeneous mixture of clayey silt, sand and gravel. It was found directly underlying a nominal topsoil cover (1 foot maximum) at all boring locations. The glacial till is cohesive in nature. The thickness of this deposit varies from 3.0 feet (B.H. #2) to 7.0 feet (B.H. #1).

Atterberg limit tests were performed on samples obtained in the deposit. The results, which are shown on the Record of Borehole sheets and on the plasticity chart (Fig. 1) are as follows:

	<u>Range</u>	<u>Average</u>
Liquid Limit (W_p) %	35 - 23	30
Plastic Limit (W_L) %	22 - 17	19
Natural Moisture Content (W) %	16 - 5	10

Based on the above values, it is estimated that the cohesive deposit has a matrix which is inorganic and generally of low plasticity.

Grain size distribution curves for samples obtained in this stratum are shown in Fig. 2, in the Appendix.

The Standard Penetration Tests, carried out within this deposit, are plotted on the Record of Boreholes sheets. The "N" values, obtained from these tests, range from 17 blows to over 100 blows per foot. It is estimated that the consistency of the overall stratum varies from very stiff to hard.

4.3) Bedrock:

Underlying the glacial till deposit is the shale bedrock which was proven in all of the 7 boreholes by obtaining BXL size core samples.

The bedrock is mainly composed of a dark grey interbedded shale and limestone. The upper 1 to 3 feet of the bedrock is in a weathered condition. The bedrock surface varies in elevation from 516.3 to 520.5.

5. GROUNDWATER CONDITIONS:

The groundwater levels were established in the open boreholes during the period of field investigation (September 1973). The results of the readings are shown on the Record of Borehole sheets as well as on Drawing No. 73-11076A.

The observations indicate that the groundwater level varies in elevation from 515 to 522, which correspond to levels of 1.8 feet to 8.5 feet below the ground surface.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

As part of Contract #8 for the 403 - 410 - 401 project in the Town of Mississauga, it is proposed to construct Hwy. 403 and the 403 Extension between Dixie Road and Hwy. 10. In order to facilitate the construction of the 403/10 interchange, it is proposed to temporarily relocate Cooksville Creek to approximately 580 feet west of Hwy. 10. At such time when Hwy. 403 is extended westerly from Hwy. 10, a new structure will be required to carry

Cooksville Creek under Hwy. 403. The proposed structure location is approximately 140 feet west of the temporary diversion. The proposed invert of the Cooksville Creek culvert will vary in elevation from 511 to 507.

The predominant stratum across the site is a cohesive deposit of clayey silt some sand and gravel (glacial till), which is underlain by shale bedrock at depths of from 3 to 7 feet.

In the subsections to follow, recommendations pertaining to the foundation design of the culvert and the proposed open channels both in the initial and ultimate stages will be discussed.

6.2) Rigid Frame Concrete Box Culvert:

The invert of the proposed culvert will vary from 511 at the upstream end to 507 at the downstream end. This would place the entire culvert within the shale bedrock. A rigid frame open culvert, supported on spread footings, would be satisfactory from the foundation point of view. However, a concrete box culvert was recommended in the Hydrology Report prepared by Mr. M. A. Almer, Structural Planning Engineer, Central Region, in view of the scourable nature of the shale and the anticipated high velocity of flow within the culvert. The following recommendations are, therefore, confined to a box type structure.

The box culvert may be founded on shale bedrock. In designing the culvert base slab, an allowable bearing value of up to 10 tsf may be assumed for the sound shale bedrock.

The excavations for the culvert will extend up to 18 feet below the groundwater level established during the course of the field investigation. The cohesive overburden is relatively impervious. No major dewatering problems are anticipated. It is believed that any minor seepage or surface runoff into the excavations could be controlled by employing conventional techniques, such as pumping from sumps.

In order to prevent the shale bedrock from being softened by water, it may be necessary to pour a lean concrete working slab immediately after the excavation reach the founding elevation.

The culvert will be designed as a rigid frame. Therefore, a coefficient of earth pressure at rest (K_0) of 0.5 should be assumed for the granular back fill behind the wall, when designing the wall sections. In addition, the full effect of the fill material above the top of the culvert should be included in the design.

In order to relieve the buildup of excess hydrostatic pressure behind the walls, suitable drainage measures should be provided. Weep holes, located at the base of the walls, could be employed for this purpose, these holes should be spaced not more than 10 feet apart.

6.3) Open Channel Sections:

6.3.1) Ultimate Stage (Refer to B.H.s #6 & #7)

The Cooksville Creek diversion will be in open channel sections both upstream and downstream of the culvert structure, the lengths of these sections will be 200 and 750 feet, respectively. The proposed invert will vary in elevation from 521 to 511, at the upstream section, and from 507 to 500 at the downstream section. The existing ground surface in the vicinity of the open channel sections is between elevations 516 and 529. The channels will therefore have a maximum depth of 17 feet. The cut for the channel will be made through the glacial till into the shale bedrock. No stability problems are anticipated if 2:1 slopes are employed. The shale is considered to be susceptible to scouring. In view of this and the anticipated high velocity of flow, it may be necessary to protect the channel bed and side slopes with properly designed rock rip rap or gabions.

6.3.2) Initial Stage:

This section is approximately 1,000 feet long, The invert will vary from elevations 520 to 507. The channel will have a maximum depth of 13 feet. From the available subsoil information (B.H. #26, W.O. 72-11053) along this temporary diversion, the channel bed will be within the shale bedrock.

Recommendations given in 6.3.1 will be applicable for this section of diversion. However, this office is presently carrying out additional borings along the alignment of this diversion in order to accurately establish the bedrock surface. This information, when available, will be presented in an addendum form.

7. MISCELLANEOUS:

The field work, performed during the period of September 27th to 28th, 1973, was supervised by Mr. V. Korlu, Project Foundations Engineer, who also prepared this report.

Equipment was owned and operated by the Dominion Soils Co. of Toronto.

The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundations Engineer, who also reviewed the report.

V. Korlu
V. Korlu, P. Eng.



M. Devata
M. Devata, P. Eng.

VK/ji
Oct. 19, 1973.

APPENDIX 1

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 1

JOB 73-11076 LOCATION CO-ORD's 15,841, 972N; 960, 995E ORIGINATED BY VK
 W.P. 127-66-48 BORING DATE September 27, 1973 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Auger and core drill with C.M.E.-750 CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				W_P W W_L WATER CONTENT %				
527.5	Ground level												10 20 30		GR.SA.SI.CL.
0.0	Het.mix.of clayey silt,sand & gravel glacial till.		1	SS	44	520									522.0 16 53 25
			2	SS	47										
520.5	Hard		3	SS	100										
7.0	weathered sound shale bedrock		4	BXL	72% Rec.										
			5	BXL	100% Rec.										
510.5			6	BXL	73% Rec.	510									
17.0	End of Borehole														

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2

JOB 73-11076

LOCATION CO-ORD'S 15,841, 903N; 961, 185E

ORIGINATED BY VK

W.P. 127-66-48

BORING DATE September 27, 1973

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger and core drill with C.M.E.-750

CHECKED BY *W.J.*

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w				BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				w_p — w — w_L WATER CONTENT % 10 20 30					
523.5	Ground Level															
0.0	Het. mix. of clayey si. & grav. - glacial till.		1	SS	100% Rec.	520									21-22-40-17	
520.5	Hard															
3.0	Weathered															
	sound															
	Shale bedrock		2	BXL	100% Rec.										515.0	
			3	BXL	50% Rec.											
508.5			4	BXL	100% Rec.	510										
15.0	End of Borehole															
						500										

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

 RECORD OF BOREHOLE N^o3

JOB 73-11076

LOCATION CO-ORD'S 15, 841, 715N; 961, 290E

ORIGINATED BY VK

W.P. 127-66-48

BORING DATE September 28, 1973

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger and core drill with C.M.E.-750

CHECKED BY P.J.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT % 10 20 30			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							
523.6	Ground level													
0.0	Met. Mix. of clayey silt sand, gravel, glacial till		1	SS	31	520								520.4
518.6	Hard		2	SS	130/11"									22-20-42-16
5.0	Weathered Solid		3	BXL	55% Rec.									
					100% Rec.	510								
508.1	Shale bedrock		4	BXL	Rec.									
15.5	End of Borehole													
						500								


OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4

JOB 73-11076 LOCATION CO-ORD'S 15, 841, 635N; 961, 485E ORIGINATED BY VK
W.P. 127-66-48 BORING DATE September 28, 1973 COMPILED BY VK
DATUM Geodetic BOREHOLE TYPE Auger and core drill with C.M.E.-750 CHECKED BY D.J.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			w_p — w — w_L WATER CONTENT % 10 20 30					
523.2	Ground level														
0.0	Het. Mix. of clayey silt, sand, gravel, glacial till Hard		1	SS	113	10"									520.9
519.2			2	SS	100	6"									11-23-21-15
4.0	weathered sound		3	BXL	Rec.										
					100%										
509.2	Shale bedrock		4	BXL	Rec.	510									
14.0	End of Borehole														
						500									

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE N^o5

JOB 73-11076 LOCATION CO-ORD'S 15, 841, 473N; 961, 586E ORIGINATED BY VK
 W.P. 127-66-48 BORING DATE September 28, 1973 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Auger and core drill with C.M.E.-750 CHECKED BY al./

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT <u>W_L</u> PLASTIC LIMIT <u>W_P</u> WATER CONTENT <u>W</u> <u>W_P — W — W_L</u> WATER CONTENT % <u>Y</u>			BULK DENSITY <u>γ</u> P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
523.4	Ground level												
0.0	Het. mix. of clayey silt, sand, gravel, glacial till Hard		1	SS	118	10"							521.6
518.9			2	SS	166	5"							9-15-49-27
4.5	Weathered												
512.4	Sound Shale bedrock		3	BXL	rec								
11.0	End of Borehole												
						510							

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE N^o6

JOB 73-11076

LOCATION CO-ORD'S 15,841, 418N; 961, 678E

ORIGINATED BY VK

W.P. 127-66-48

BORING DATE September 28, 1973

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger and core drill with C.M.E.-750

CHECKED BY W.L.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		Wp — W — WL 10 20 30			
523.5	Ground level											
0.0	Het. mix. of clayey silty		1	SS	17							
519.0	to silty clay, sand, grav. glac. till, v. stiff		2	SS	121							
4.5	Weathered		3	SS	100							
	sound		4	BXL	75% rec.							
	Shale bedrock				100% rec.							
509.5			5	BXL	rec.							
14.0	End of Borehole											

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 7

JOB 73-11076 LOCATION CO-ORD'S 15, 841, 544N, 961, 975E ORIGINATED BY VK
 W.P. 127-66-48 BORING DATE September 28, 1973 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Auger and core drill with C.M.E.-750 CHECKED BY V.K.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE			WATER CONTENT % 10 20 30				
521.3	Ground level					520								GR.SA.SI.CL.
0.0	Het. mix. of clayey silt, sand, gravel, glacial till		1	SS	76									
516.3	Hard		2	SS	135									
5.0	Weathered		3	SS	140									
	sound		4	EXL	33% rec.									
	Shale bedrock		5	EXL	55% rec.	510								
			6	EXL	62% rec.									
			7	EXL	40% rec.									
503.3			8	EXL	50% rec.									
18.0	End of Borehole					500								

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 26 (72-11053)

JOB 73-11076

LOCATION Co-ords. 842,170 N; 961,095 E.

ORIGINATED BY VK

W.P. 127-66-48

BORING DATE May 8-9, 1972

COMPILED BY AT

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT w_L				BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT				PLASTIC LIMIT w_p					
							SHEAR STRENGTH P.S.F.				WATER CONTENT w					
522.3	Ground Level															
520.8	Clayey sl. with some sand		1	SS	100	520										
1.5			2	BX-RC	55											
	Bedrock - bedded limestone with occ. bands of shale.		3	BX-RC	83											
			4	BX-RC	90											
511.8			5	BX-RC	65											
10.5	Shale with minor bands of limestone		6	BX-RC	95	510										
508.8			7	BX-RC	96											
13.5	End of Borehole															
						500										

OFFICE REPORT SOIL EXPLORATION

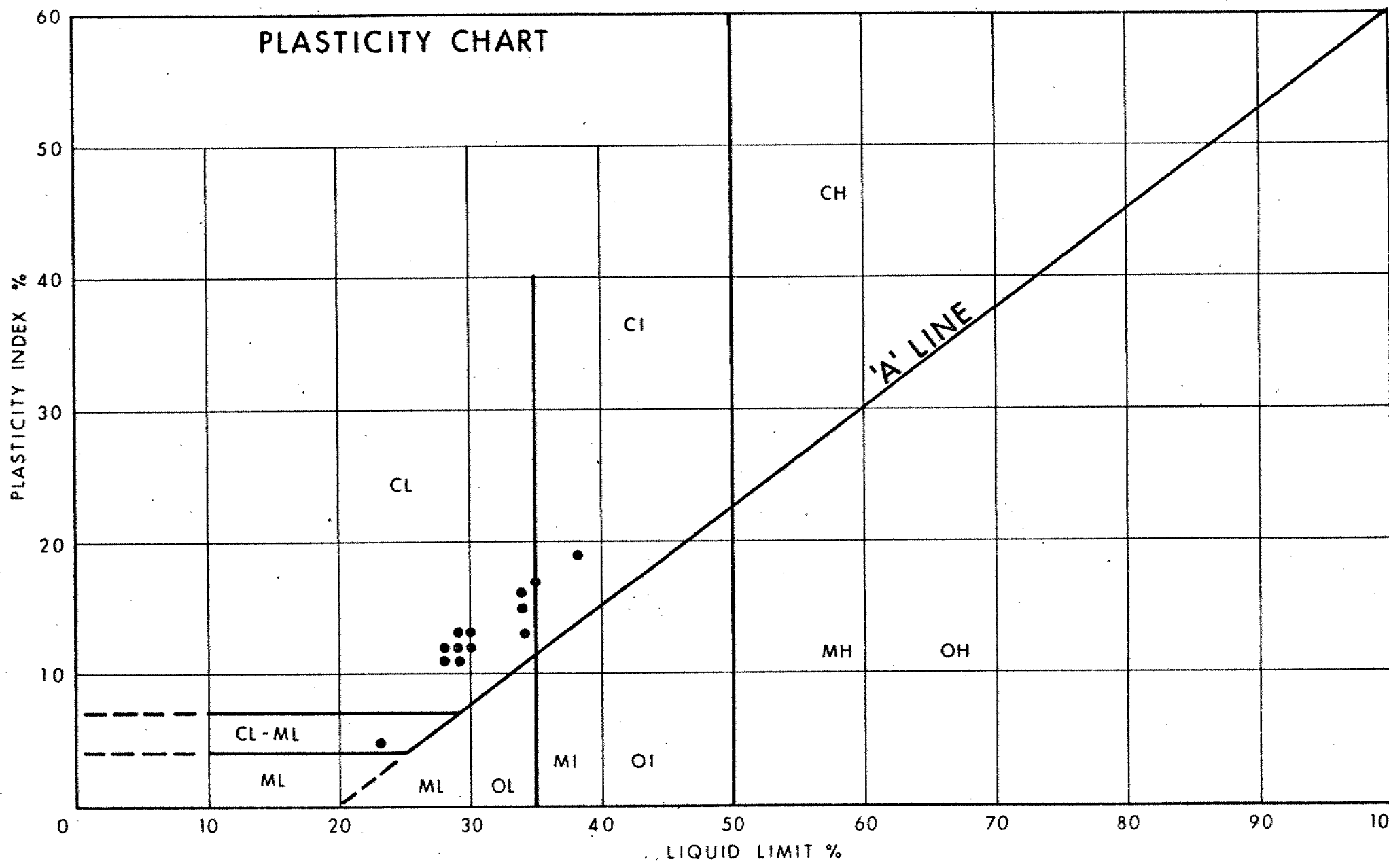
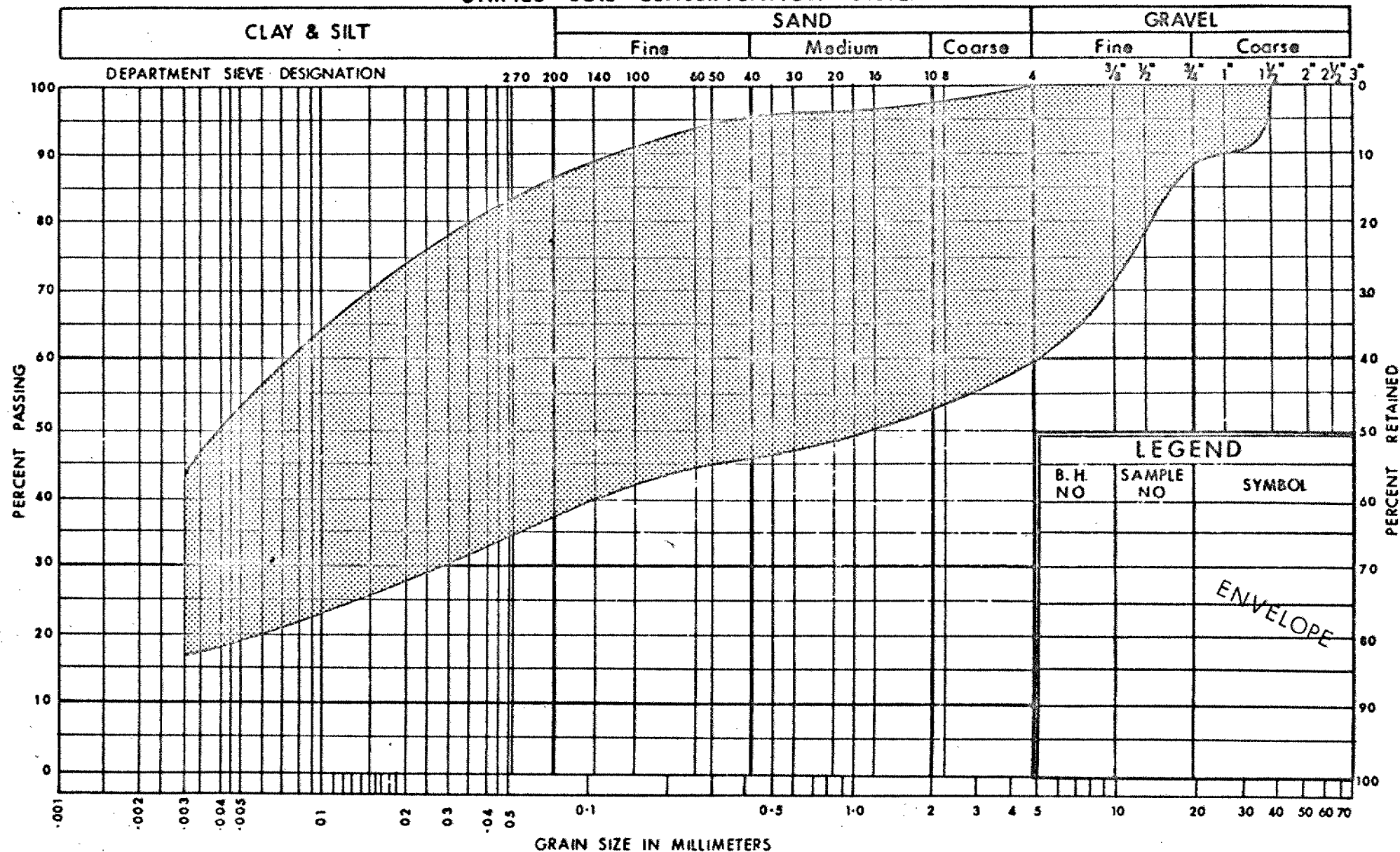


FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT
OF
TRANSPORTATION AND COMMUNICATIONS



DESIGN SERVICES
BRANCH

GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HET. MIX. OF CLAYEY SILT, SAND & GRAVEL

W.P. No. 127-66-48

JOB No. 73 - 11076

FIG. 2.

ABBREVIATIONS & SYMBOLS USED IN THIS REPORTPENETRATION RESISTANCE

'N' STANDARD PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE : - THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL, THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

<u>CONSISTENCY</u>	<u>c LB./SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 250	VERY LOOSE	0 - 4
SOFT	250 - 500	LOOSE	4 - 10
FIRM	500 - 1000	COMPACT	10 - 30
STIFF	1000 - 2000	DENSE	30 - 50
VERY STIFF	2000 - 4000	VERY DENSE	> 50
HARD	> 4000		

TERMS TO BE USED IN DESCRIBING SOILS:-

TRACE < 10 % , SOME 10-25 % , WITH 25-40 % , > 40 % SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

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	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
w_s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX = $\frac{w - w_p}{I_p}$
I_c	CONSISTENCY INDEX = $\frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX = $\frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
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
m_v	COEFFICIENT OF VOLUME CHANGE = $\frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX = $\frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR = $\frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
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_r	SENSITIVITY

IN TERMS OF
EFFECTIVE STRESS
 $\tau_f = c' + \sigma' \tan \phi'$

IN TERMS OF
TOTAL STRESS
 $\tau_f = c_u + \sigma \tan \phi$

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

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	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

EARTH PRESSURE

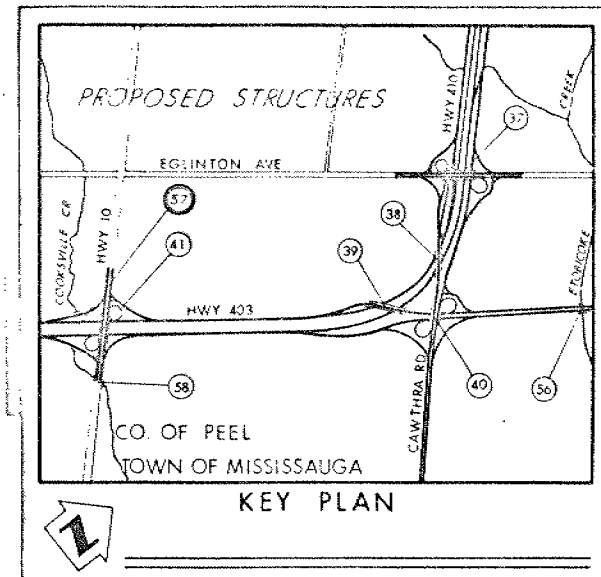
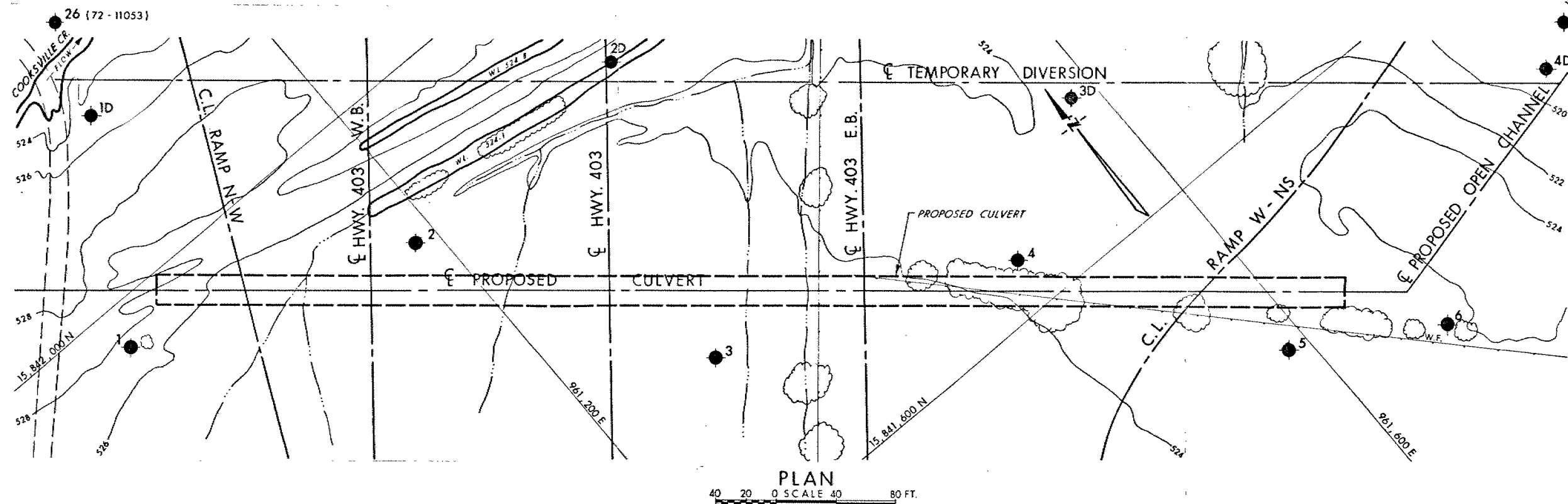
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



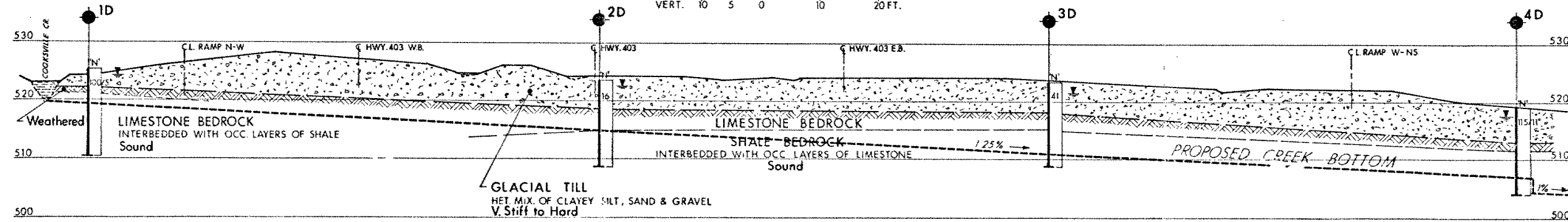
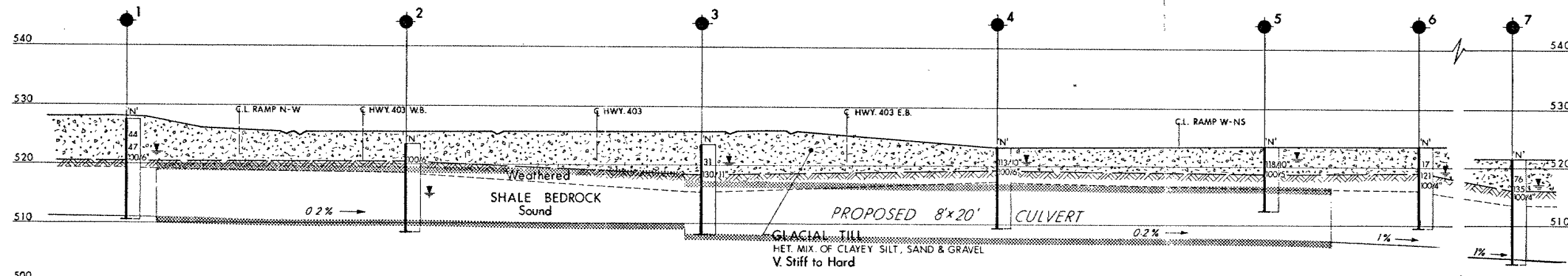
LEGEND

- Bore Hole
- ⊕ Cone Penetration Test
- ⊕ Bore Hole & Cone Test
- Water Levels established at time of field investigation, Sept. 1973.

NO.	ELEVATION	CO-ORDINATES	
		NORTH	EAST
1	527.5	15,841,972	960,995
2	523.5	15,841,903	961,185
3	523.6	15,841,715	961,290
4	523.2	15,841,635	961,485
5	523.4	15,841,473	961,586
6	523.5	15,841,418	961,678
7	521.3	15,841,544	961,975
26	522.3	15,842,170	961,095
ID	525.3	15,842,107	961,073
2D	523.7	15,841,911	961,362
3D	523.3	15,841,695	961,583
4D	519.0	15,841,506	961,938

NOTE

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



NOTE FOR CONTRACT DOCUMENT:

The complete foundation investigation report for this structure may be examined at the Structural Office and Foundations Office, Downsview, and at the TORONTO District Office.

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS—ONTARIO

DESIGN SERVICES BRANCH—FOUNDATIONS OFFICE

BRIDGE No. 57
(COOKSVILLE CREEK)

HIGHWAY NO. 403 DIST. NO. 6

CO. PEEL

TOWN OF MISSISSAUGA LOT CON.

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD V.N.	CHECKED	WP NO. 127-66-38	DRAWING NO.
DRAWN S.R.	CHECKED	WO NO. 73-11076	73-11076A
DATE NOV. 7, 1973	SITE NO.	BRIDGE DRAWING NO.	
APPROVED	CONT. NO.		

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. G.C.E. Burkhardt, (3) Regional Structural Planning Eng., Central Region, 3501 Dufferin St., Downsview.	FROM: Geotechnical Office, Engineering Services Branch, West Bldg., Downsview.
ATTENTION:	DATE: January 4, 1974.
OUR FILE REF.	IN REPLY TO JAN 11 1974

SUBJECT: Additional Boreholes, Temporary Diversion,
Cooksville Creek Near Hwy. 403/Hwy. 10
Interchange, Town of Mississauga, County of Peel
District #6 (Toronto)
W.O. 73-11076 -- W.P. 127-66-48

As part of Contract #8 for the 403-410-401 project in the Town of Mississauga, it is necessary to construct an interchange in the vicinity of Hwy. 10 and Cooksville Creek, designated as 403/10 Interchange. In order to facilitate the construction of this interchange, it was proposed to temporarily relocate the Cooksville Creek to approximately 580 (180 m) feet west of Hwy. 10. This section is approximately 1,000 feet (330 m) long. Preliminary recommendations based on limited subsoil information (B.H.#26, W.O. 72-11053) were discussed in subsection 6.3.2) of our Foundation Report W.O. 73-11076 submitted on November 23, 1973.

Since the submission of the above-mentioned report, four boreholes (#1D, #2D, #3D and #4D) were put down along the proposed alignment of the temporary diversion. The additional boreholes indicated that along the temporary diversion the overburden consists of from 3 to 6 feet (1 to 2 m) of hard heterogeneous mixture of clayey silt, sand and gravel (glacial till), which is underlain by shale bedrock.

The proposed invert will vary from elevations 520 to 507, corresponding to level from 2 to 6 feet (0.7 to 2 m) below the bedrock surface. The existing ground surface is between elevations 519 and 528. The channel will have a maximum depth of 13 feet (4 m). The cut for the channel will be made through the glacial till into the shale bedrock. No stability problems are anticipated if 2:1 side slopes are employed. The shale in this area is considered to be susceptible to scouring. In view of this and the anticipated high velocity of flow, it may be advisable to protect the channel bed and side slopes with properly designed rock rip rap or gabions.

It should be noted that this letter and the accompanying Record of Borehole Sheets and revised Drawing No. 73-11076A should be included in our Foundation Report W.O. 73-11076 submitted on November 23, 1973.

We believe that the above information is sufficient for your present requirements.

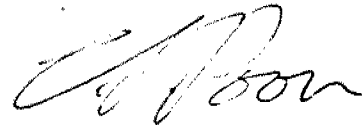
Should you have any queries, please contact this Office.

CSP/ao

Attch.

c.c. E. J. Orr
B. R. Davis
A. Rutka
R. S. Pillar
H. Greenland
B. J. Giroux
C. Mirza
G. A. Wrong
B. A. Singh

Foundations Files
Documents



For: C. S. Poon,
Project Foundations Eng.,
M. Devata,
Supervising Foundations Eng.

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 1D

JOB 73-11076 LOCATION Co.Ord's 15,842,107 N; 961,073 E ORIGINATED BY VK
 W.P. 127-66-48 BORING DATE November 22nd, 1973 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Auger and Core with C.M.E.-55 CHECKED BY S.R.

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE				LIQUID LIMIT w_l			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT				PLASTIC LIMIT w_p				
							SHEAR STRENGTH P.S.F.				WATER CONTENT w				
							O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				w_p w w_l				
						WATER CONTENT %				10 20 30			P.C.F.	GR.SA.SI.CL	
525.3	Ground Level														
0.0	Het.Mix. of clayey silt														524.3
522.3	sa. sgr. (glacial till)		1	SS	100	5"									81 11 (8)
3.0	Weathered Sound		2	BXL	70%										
	Limestone bedrock interbedded with occasional layers of shale.		3	BXL	60% rec										
			4	BXL	30% rec										
510.3															
15.0	End of Borehole					510									

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2D

JOB 73-11076

LOCATION Co.Ord's 15,841,911 N; 961,362 E

ORIGINATED BY VK

W.P. 127-66-48

BORING DATE November 22nd, 1973

COMPILED BY VK

DATUM Geodetic

BOREHOLE TYPE Auger and Core with C.M.E.-55

CHECKED BY SS

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT % 15 30 45			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
523.7	Ground Level					520								GR. SA. SI. CL. 522.7 1 15 55 29
0.0	Het. Mix. of clayey silt, sand & gravel (glacial till), very stiff		1	SS	16									
518.7														
5.0	Limestone bedrock		2	BXL	100% rec									
	Shale interbedded with occasional layers of limestone		3	BXL	100% rec	510								
			4	BXL	100% rec									
508.7						500								
15.0	End of Borehole													

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3D

JOB 73-11076 LOCATION Co.Ord's 15,841,695 N; 961,583 E ORIGINATED BY VK
 W.P. 127-66-48 BORING DATE November 22nd, 1973 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Auger and Core with C.M.E.-55 CHECKED BY SR

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT W_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT W_P	WATER CONTENT W			
523.3	Ground Level												
0.0	Het.Mix. of clayey silt, sand & gravel												
518.3	Glacial till-hard		1	SS	41	520							
5.0	Limestone Bedrock												
	Shale interbedded with occasional layers of limestone		2	BXL	100% rec.								
508.8			3	BXL	80% rec.	510							
14.5	End of Borehole												
						500							

OFFICE REPORT SOIL EXPLORATION

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 4D

JOB 73-11076 LOCATION Co.Ord's 15,841,506 N; 961,838 E ORIGINATED BY VK
 W.P. 127-66-48 BORING DATE November 23rd, 1973 COMPILED BY VK
 DATUM Geodetic BOREHOLE TYPE Auger and Core with C.M.E.-55 CHECKED BY SR

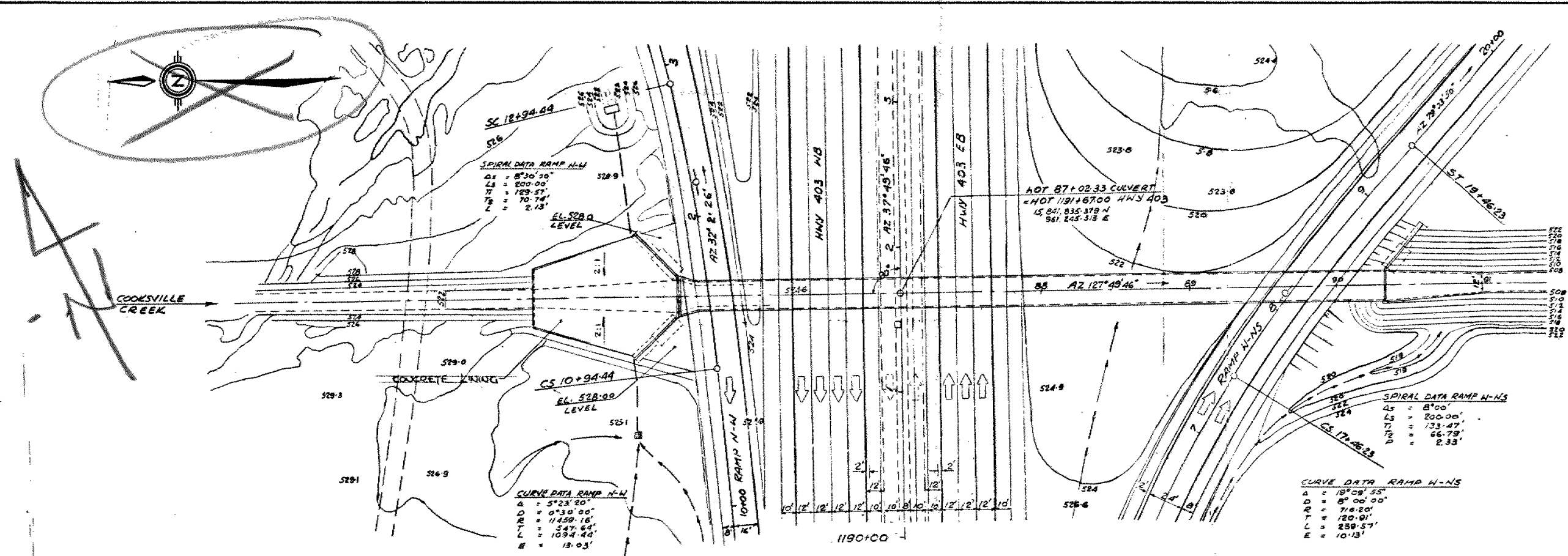
SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT w_L			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	PLASTIC LIMIT w_p	WATER CONTENT w	WATER CONTENT %		
519.0	Ground Level												
0.0	Het.Mix. of clayey silt,sand&gravel		1	SS	115	11"							517.5
513.0	Glacial till-hard												18 16 39 27
6.0	Limestone bedrock		2	BXL	100% rec.	510							
	Shale interbedded with occasional layers of limestone		3	BXL	100% rec.								
504.0	End of Borehole					500							
15.0													

OFFICE REPORT SOIL EXPLORATION

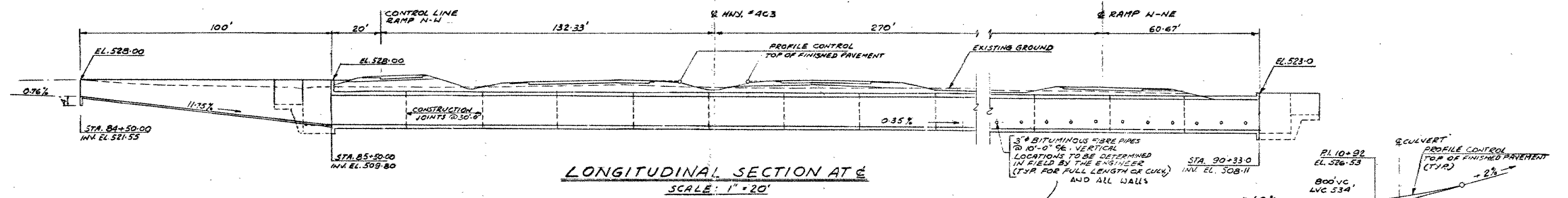
NOTES
CLASS OF CONCRETE:
CULVERT & RETAINING WALLS - 30 MPA
RET. WALL FOOTINGS & CONC LINING - 20 MPA
REINFORCING STEEL - GRADE 400
CLEAR COVER TO REINFORCING STEEL - 3 INS.
(EXCEPT AS NOTED)
FILL SHALL BE PLACED ON BOTH SIDES OF
CULVERT SIMULTANEOUSLY.

- LIST OF DRAWINGS
24-336-1 GENERAL LAYOUT
-2 BORE HOLE LOCATION & SOIL STRATA
-3 CULVERT DETAILS
-4 RETAINING WALLS DETAILS
-5 INLET CHANNEL LINING

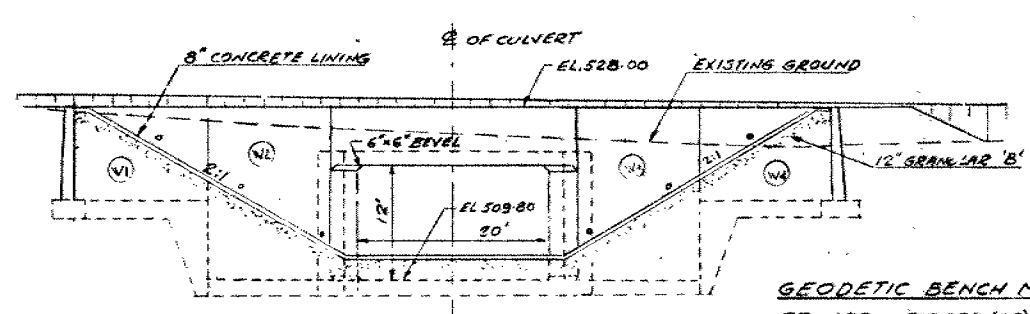
LUMP SUM ITEMS:
CONCRETE QUANTITIES:
CONCRETE QUANTITIES ARE LISTED
BELOW FOR CONCRETE LUMP SUM ITEMS.
-1 CONCRETE IN BOX CULVERT, HEADWALLS AND
APPROXS. - 1958 CY
-2 CONCRETE IN RETAINING WALLS - 96 CY
-3 MASS CONCRETE (INLET CHANNEL LINING) - 164 CY



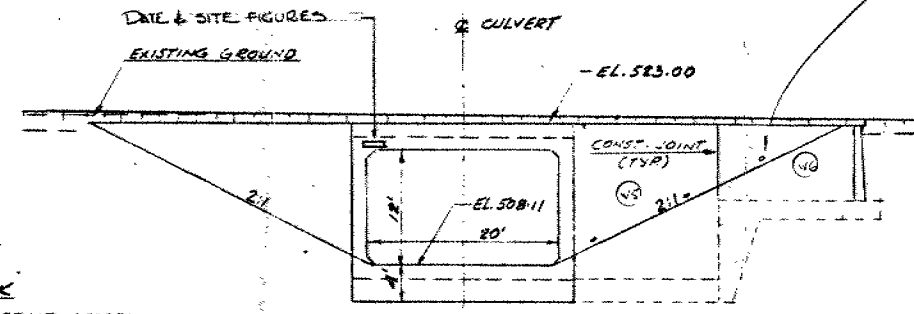
PLAN
SCALE: 1" = 40'



LONGITUDINAL SECTION AT &
SCALE: 1" = 20'

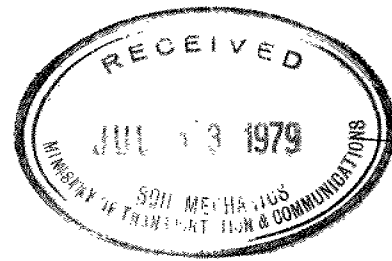


NORTH END VIEW
SCALE: 1" = 10'

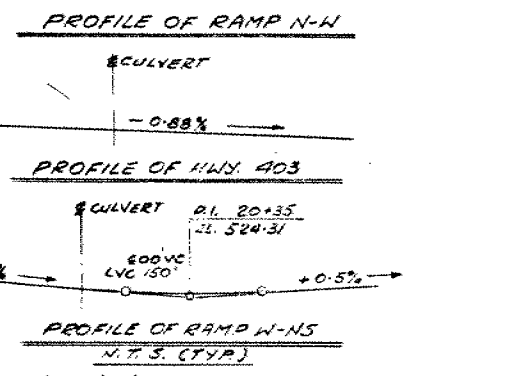
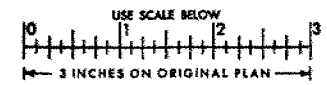


SOUTH END VIEW
SCALE: 1" = 10'

GEODETIC BENCH MARK
TT-45B 508 076 (65) 155.167 METRES
CONCRETE CULVERT UNDER HURONTARIO
STREET (HWY 10) 0.5 MILE NORTHWEST OF
BURNHAMTHORPE ROAD, PLATE ON NORTH
EAST FACE AT NORTH CORNER OF
NORTHEAST END OF CULVERT ESTABLISHED
BY TOWNSHIP OF TORONTO



FOR REDUCED PLAN
USE SCALE BELOW



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	11/20/79	WJ	CHECK
DRAWING	12/10/79	WJ	CHECK

Mr. C.S. Grebski
Head, Central Section
Structural Office
2nd Floor, West Building

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

79 03 15

Re: Hwy. 403 and Cooksville Creek Culvert
W.P. 127-66-48, Site 24-336
District 6, Toronto

We have reviewed the preliminary design drawing (24-336-P1) and would like to submit the following comments.

1. A 3" thick mass concrete working slab should be poured within 3 hours after excavation reaches the foundation level in order to prevent the shale from deteriorating upon its exposure to the atmosphere.
2. The box culvert and the adjoining retaining walls should have a granular backfill. This backfill should be composed of granular 'A' and should be 4 feet thick for the retaining walls and 2 feet thick for the box culvert. The purpose of this backfill is to provide drainage for the retained rockmass, as well as to serve as a cushion for absorbing the lateral stresses released by the bedrock.

B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/MD/gs

cc: G.C.E. Burkhardt
M.R. Ernesaks
D. MacDonald
Files ✓

Mr. G.C.E. Burkhardt
Head, Structural Section
Central Region
3501 Dufferin Street, Downsview

F.I. Hewson
Senior Structural Engineer

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

78 07 27

Re: Hwy. 403 Culvert, Cooksville Creek
Bridge Site 24-336
W.P. 127-66-48, District 6, Toronto

With reference to your memorandum dated 78 07 14, we have reviewed our subsurface information in light of the proposed changes in the structure concept and have reached the following conclusions.

1. The original investigation will adequately cover the revised concept, negating the need for further field investigation.
2. The recommendations contained in our original report will be equally applicable to the new structure concept.

M. Devata
Supervising Engineer

MD/gs

cc: Files ✓

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

Copy for the information of

Mr. M. Devata

Mr. D. McCune,
Structural Standards Engineer,
Structural Services Section,
West Building

Systems Design Office,
Systems Design Branch,
East Building

November 28, 1973

Concrete Culverts

I refer you to a Foundations Report dated November 20, 1973, for the proposed concrete culvert at the crossing of Hwy. 403 and relocated Cooksville Creek (Bridge #57), Site #24-336, in the Town of Mississauga, County of Peel, District 6, under W.P. 127-66-48.

Recommendations are made relating to a proposed rigid frame box structure.

On page 6 the report states that "The culvert will be designed as a rigid frame. Therefore a coefficient of earth pressure at rest (K_0) of 0.5 should be assumed for the granular backfill behind the wall, when designing the wall sections".

Would you please clarify how the above relates to the designer utilizing the Concrete Culvert Design and Detailing Handbook for the 20'x8' structure chosen.

Please advise also what height of fill would be the basis for the culvert design as determined from the Bore Hole Locations and Soil Strata Dwg. 73-11076A contained in the Foundations Report.



J. Wear,
Project Review Engineer
for:
G.K. Hunter,
Systems Design Engineer

JW/jk
cc:
M. Devata
G. Burkhardt
D.J. Zander
G.K. Hunter

