

DOCUMENT MICROFILMING IDENTIFICATION

G.I.-30 SEPT. 1976

GEOCRES No. 30M4-60

DIST. 4 REGION 004

W.P. No. 55-75-03

CONT. No. 81-64

W. O. No. _____

STR. SITE No. 9-130

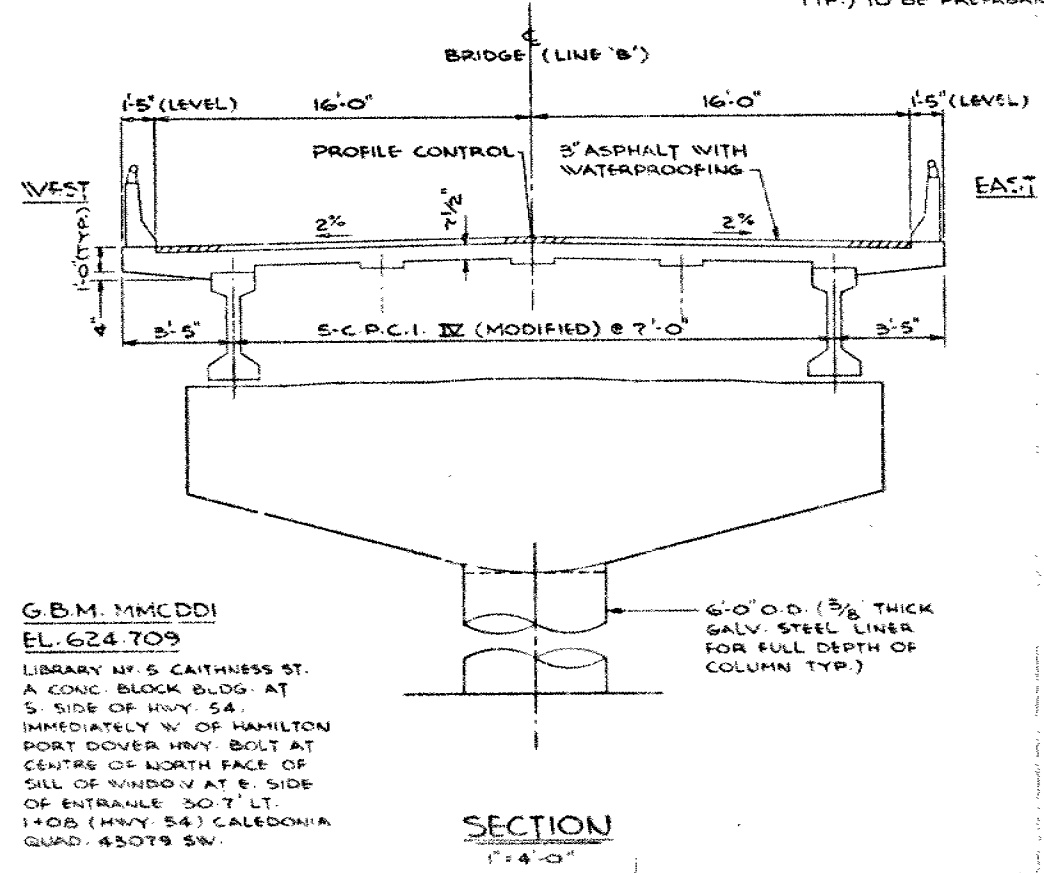
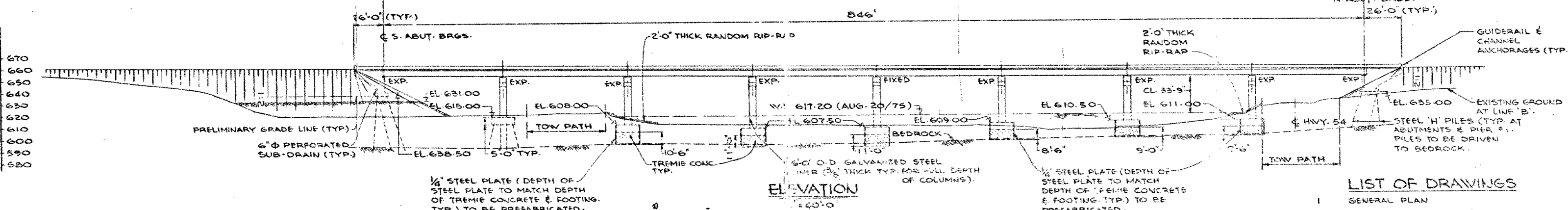
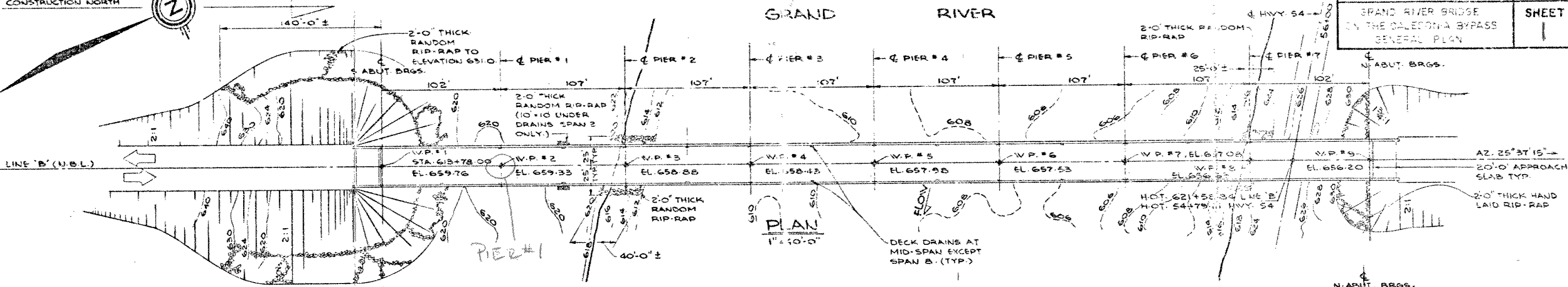
HWY. No. 6 New

LOCATION Grand River Bridges

No of PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: _____



- # LIST OF DRAWINGS
- GENERAL PLAN
 - BORE HOLE LOCATIONS & SOIL STRATA
 - FOOTING DETAILS
 - ABUTMENTS & WINGWALLS
 - PIER DETAILS
 - BEARING DETAILS.
 - PRESTRESSED GIRDERS & BEARINGS
 - DECK DETAILS
 - DECK REINFORCING
 - EXPANSION JOINT DETAILS
 - 20 FOOT APPROACH SLAB
 - BARRIER WALL (2'-8" HIGH)
 - STEEL RAILING (SINGLE TUBE)
 - AS CONSTRUCTED ELEV. & DIM.
 - STANDARD DETAILS I
 - STANDARD DETAILS II

TO BE USED
FOR ESTIMATING
PURPOSES ONLY

GENERAL NOTES

CLASS OF CONCRETE

GIRDERS	6000 P.S.I.
DECK & BARRIER WALLS	4000 P.S.I.
COLUMNS & PIER CAPS	5000 P.S.I.
REMAINDER	3000 P.S.I.

CLEAR COVER TO REINFORCING STEEL

FOOTINGS, ABUTMENTS & COLUMNS	3"
PIER CAPS	2"
DECK	2" TOP & 1" BOTTOM
BARRIER WALLS	1 1/2"

TO ACHIEVE THE MIN. CLEAR COVER OF 2" SPECIFIED, THE TOP LAY R OF DECK REINFORCING SHALL BE PLACED PRIOR TO CONCRETING, WITH A CLEAR COVER OF 2 1/2" \pm 1/2" TOLERANCE.

REINFORCING STEEL SHALL BE C.S.A. 6-50, GRADE 60 EXCEPT COLUMN SPIRALS (GRADE 50).

CONSTRUCTION NOTES

THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS TO THE SPECIFIED ELEVATION WITH A TOLERANCE OF $\pm \frac{1}{8}$ ".

NO CONCRETE SHALL BE PLACED ABOVE THE ABUTMENT BEARING SEATS UNTIL THE CONCRETE IN THE DECK HAS BEEN PLACED.

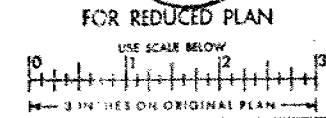
FORMWORK BETWEEN END DIAPHRAGMS & BALLAST WALLS, & END DIAPHRAGMS & BEARING SEATS (E.G. EXPANDED POLYSTYRENE) SHALL BE REMOVED.

CONCRETE QUANTITIES

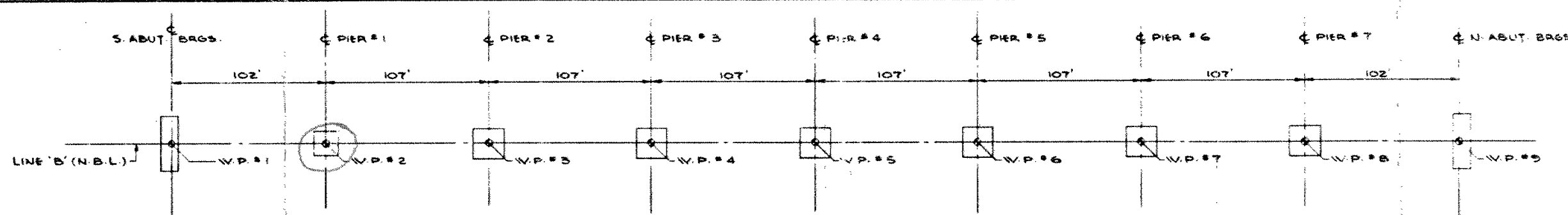
ABUTMENTS & WINGWALLS	=	232	C.YDS
COLUMNS & PIER CAPS	=	571	"
DECK & DIAPHRAGMS	=	766	"
BARRIER WALLS	=	136	"
APPROACH SLABS	=	39	"

G.B.M. MMCD DI
EL. 624-709
 LIBRARY NO. 5 CAITHNESS ST.
 A CONC. BLOCK BLDG. AT
 S. SIDE OF HWY. 54,
 IMMEDIATELY W. OF HAMILTON
 PORT DOVER HWY. BOLT AT
 CENTRE OF NORTH FACE OF
 SILL OF WINDOW AT E. SIDE
 OF ENTRANCE 30' T' LT.
 1+0B (HWY. 54) CALEDONIA
 QUAD. 43079 SW.

DATE RECEIVED JUN 8 1977
MINISTRY OF TRANSPORT AND COMMUNICATIONS
SOIL MECHANICS
O. R. GLUPPE
DIRECTOR OF SOIL MECHANICS
MINISTRY OF TRANSPORT AND COMMUNICATIONS



	REVISIONS					
3	DATE	BY	DESCRIPTION			
	DESIGN	CHECK	LOADING	15	DATE	15
4	DRAWING	CHECK	SITE No		DRG	



CONT No
WP No 55-75-03

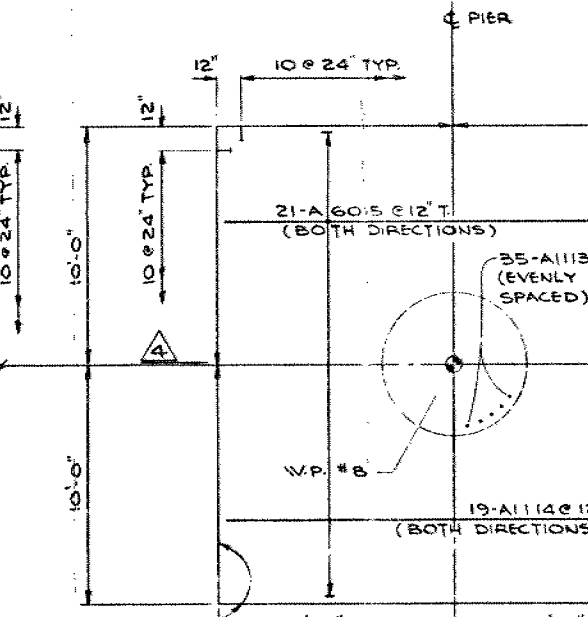
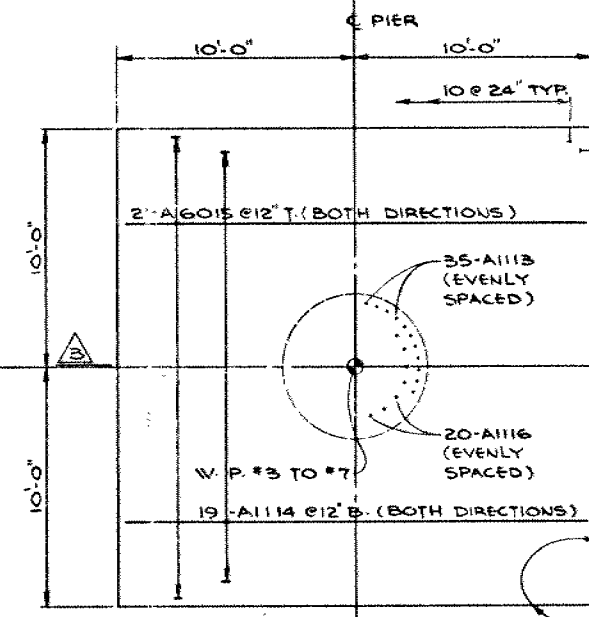
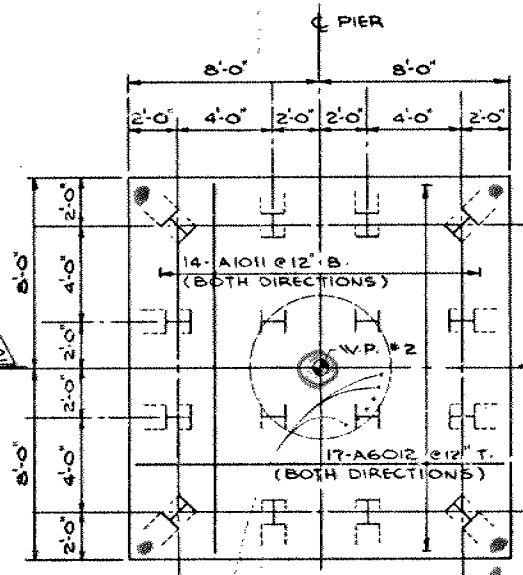
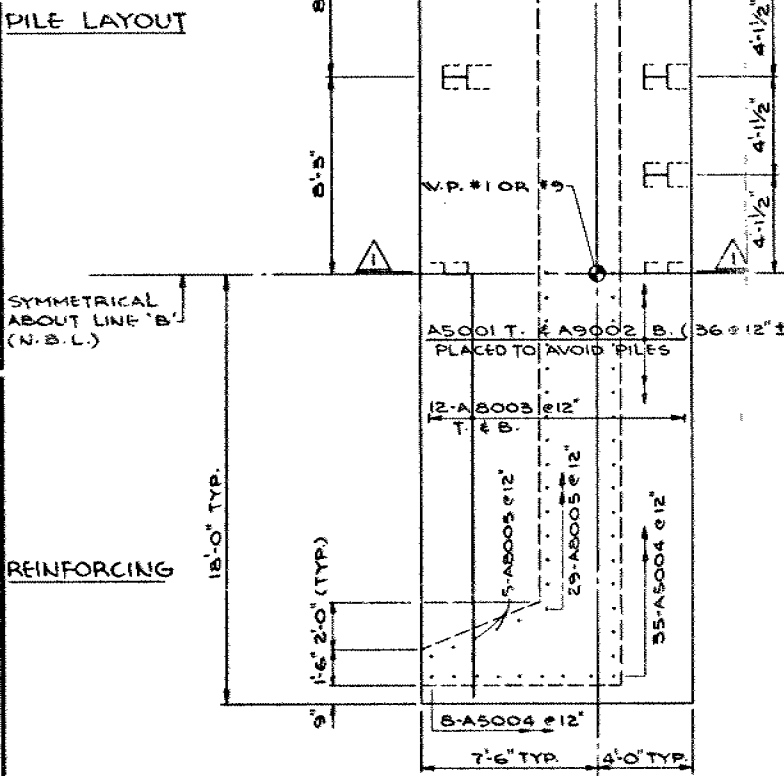
GRAND RIVER BRIDGE
ON THE CALEDONIA BYPASS
FOOTING DETAILS

SHEET
3

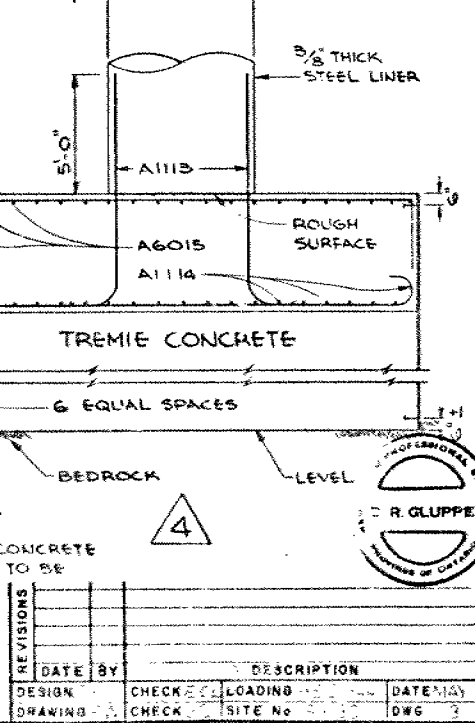
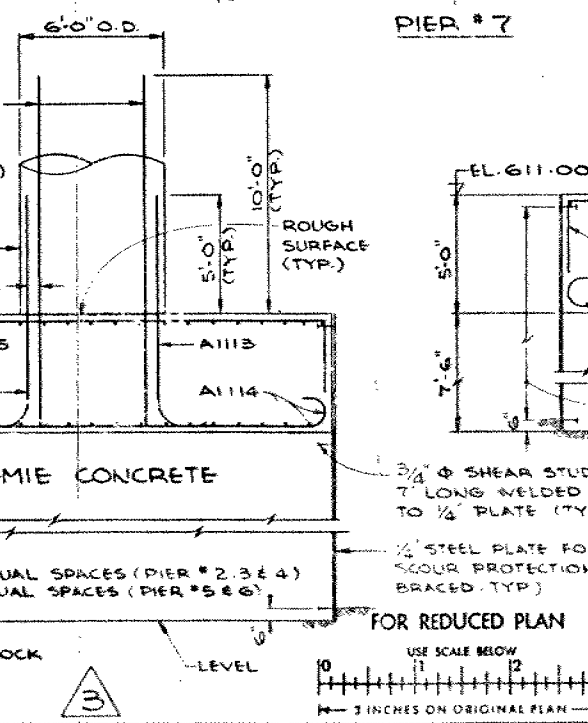
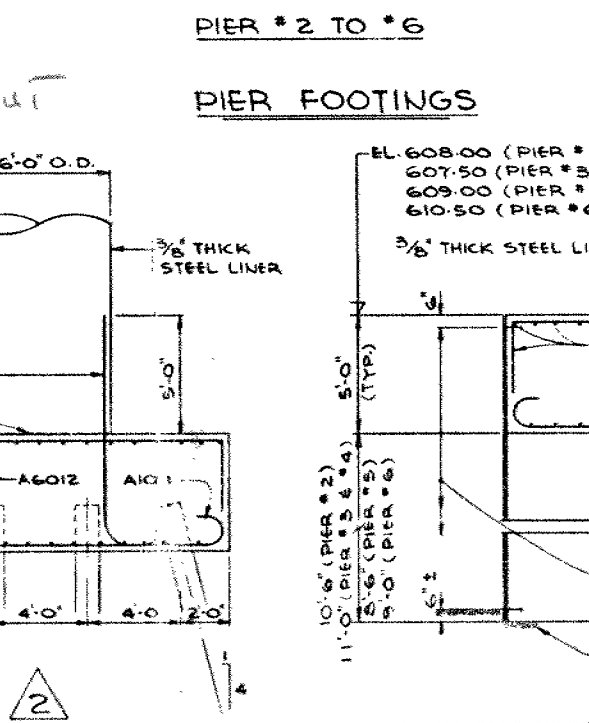
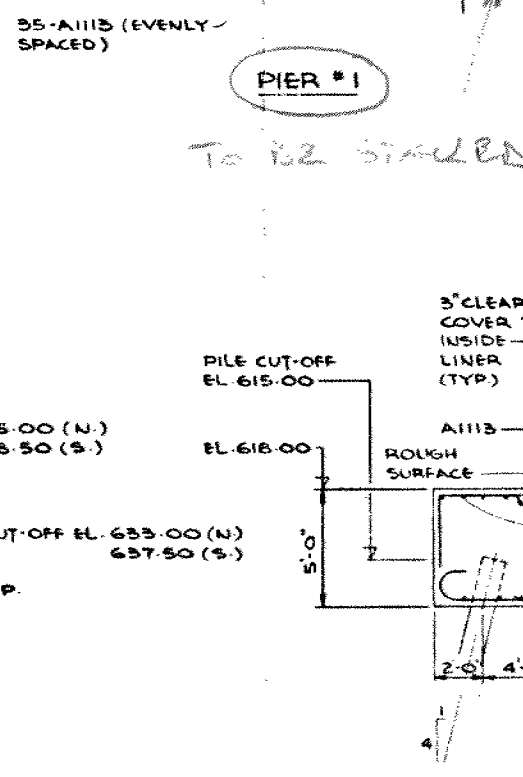
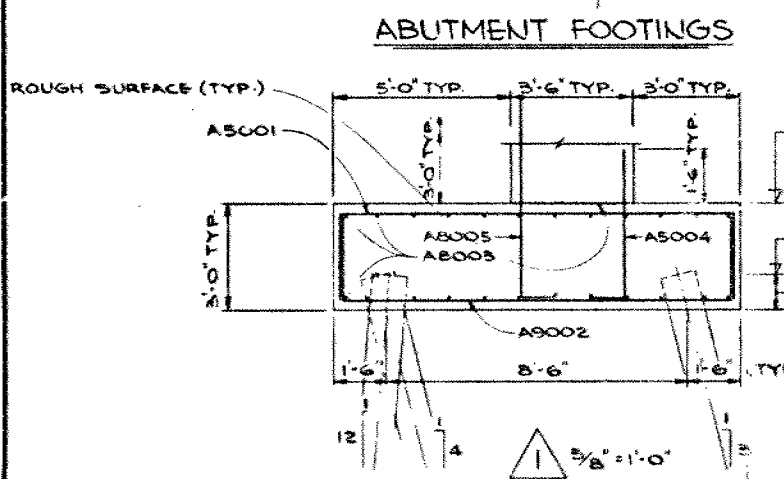
FOOTING LAYOUT

LOCATION	W.P. #1	W.P. #2	W.P. #3	W.P. #4	W.P. #5	W.P. #6	W.P. #7	W.P. #8	W.P. #9
STATION	613+78	614+80	615+87	616+94	618+01	619+08	620+15	621+22	622+24
N	15651650.92	15651742.89	15651839.37	15651935.85	15652032.33	15652128.81	15652225.29	15652321.77	15652418.74
E	873749.84	873793.95	873840.22	873886.48	873932.75	873979.02	874025.29	874071.56	874118.66

PILE DATA					
LOCATION	Nº	BATTER	LENGTH	CUT-OFF ELEVATION	TYPE
S. ABUT.	9	1:3	50'-0"	637.50	4 x 12 IN.
	3	1:12	48'-0"		
	2	1:4	49'-0"		
PIER #1	12	1:4	29'-0"	615.00	
	4	VERT.	28'-0"		
	9	1:3	27'-0"		
N. ABUT.	3	1:12	38'-0"	633.00	
	3	4	39'-0"		
	3	4	39'-0"		



- NOTE:
- PILES SHALL BE DRIVEN TO BEDROCK.
 - PILE SPACINGS MEASURED AT UNDERSIDE OF FOOTINGS.
 - SCALE: 1/4" = 1'-0" UNLESS NOTED.

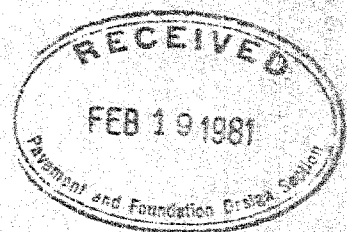


FOR REDUCED PLAN
USE SCALE BELOW
10 11 12 13
3 INCHES ON ORIGINAL PLAN

REVISIONS	DATE	BY	DESCRIPTION
1			
2			
3			

FOUNDATION INVESTIGATION REPORT

CONTRACT NO 81-64



Ministry of
Transportation and
Communications

1

INDEX

<u>Page No.</u>	<u>Description</u>
1	Index
2	Abbreviations & Symbols
3-85	Foundation Investigation Reports For
	W.P. 55-75-03 Grand River Bridge
	W.P. 55-75-05 Hwy. 6N Underpass at 6th Line
	W.P. 55-75-09 Hwy. 6N Underpass at Sterling St.
	W.P. 55-75-11 Domtar Access Road Overpass

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

'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. CUU = CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL WITH PORE PRESSURE MEASUREMENT UNLESS OTHERWISE SPECIFIED IN REPORT ALL TESTS ARE IN COMPRESSION

FIELD SAMPLING

SS SPLIT SPOON
WS WASH SAMPLE
ST SLOTTED TUBE SAMPLE
BS BLOCK SAMPLE
CS CHUNK SAMPLE
TW THINWALL OPEN
TP THINWALL PISTON
OS OSTERBERG SAMPLE
FS FOIL SAMPLE
RC ROCK CORE
PH T.W. ADVANCED HYDRAULICALLY
PM 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 = $\frac{w - w_P}{w_L - w_P}$
 I_c CONSISTENCY INDEX = $\frac{w_L - w_P}{w_L - w_P}$
 A_c ACTIVITY = $\frac{I_P \text{ of soil}}{I_P \text{ of 2}\mu m \text{ Soil Fraction}}$
 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

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_c 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

FOUNDATION INVESTIGATION REPORT

For

Grand River Bridge
on the Caledonia By-Pass
Hwy. 6N (N.B.L.), District 4, Hamilton
W.P. 55-75-03, Site 9-130

INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned project. Fieldwork was done during the periods December 20, 1976 to February 24, 1977 and December 11 to December 13, 1978, utilizing a raft mounted diamond drill for all borings within the waterway and continuous flight auger machines equipped with 2 3/4 inch I.D. and 3 1/4 inch I-D. hollow stem augers for all holes on land. Bedrock was proved by obtaining BXL and NXL size rock core samples.

SITE DESCRIPTION

The site is located approximately one mile upstream of the Town of Caledonia on the Grand River. The river at this point is approximately 535 feet wide with an approximately 280 foot flood plain on the south side. The maximum depth of water is about 15 feet based on a water level of elevation 617.2 which was recorded August 20, 1975.

River water levels are controlled by a flood control dam located approximately 3/4 mile downstream of the proposed bridge site.

This area is located within the physiographic region known as the Haldimand Clay Plain characterized by stratified clay overlying till. Immediately adjacent to the site at the north and south extremities of the proposed structure the till protrudes through this layer in the form of drumlins partially buried within the lacustrine clay beds. The underlying bedrock consisting of Paleozoic beds of dolomite, shale and gypsum, tends to dip slightly to the south under Lake Erie.

The area may be described as having a gently rolling terrain interrupted only by the slow, relatively straight, Grand River with its adjacent flood plain.

In general, farming appears to be the major occupation of the area with the exception of several wood lots in areas where farming is not feasible. A relatively large gypsum mine slightly north of the Town of Caledonia manufactures gyproc wallboard.

SUBSURFACE CONDITIONS

Outside of the Grand River flood plain and river channel, subsoil mainly consists of up to about 35 feet of clayey silt to silt with sand and gravel of glacial origin overlying bedrock. Within the flood plain and river channel subsoil consists mainly of alluvial deposits of silts, sands and gravels containing numerous slab shaped boulders of shale and dolomite underlain by bedrock. The depth of the alluvium ranges from about 6 to 10 feet on the flood plain and from about 8 to 17 feet within the river channel. Boundaries between different soil types are shown on the Record of Borehole Sheets which are contained in the report Appendix, along with the summarized results of all laboratory and field tests. Locations and elevations of all borings are shown on Drawing Nos. 9-130-2A and 9-130-2B. From ground level downward the different soil types encountered during the investigation are described as follows.

Clayey Silt (Outside Flood Plain)

This layer, having a consistency of stiff to hard indicated by average 'N' values ranging between 11 and 47 blows/foot, was encountered within the upper 4 feet to 9 feet of boreholes drilled at the top of the slopes at the north and south extremities of the site. Atterberg Limit tests performed on samples obtained within this layer indicate the following ranges:

Plastic Limit	(w_p) = 16.0-23.0%
Liquid Limit	(w_L) = 23.5-31.0%
Moisture Content	(w) = 8.5-23.0%

Sand and gravel with traces of organics was also encountered within this layer.

Silty Sand (Outside Flood Plain)

This material of glacial-fluvial origin was encountered directly below the clayey silt stratum from depths approximately 7-9 feet to 15-24 feet. Grain size analyses performed on samples from this stratum also indicates some gravel with a trace of clay. Average 'N' values obtained from Standard Penetration Tests, ranged from 13 to 55 blows/foot indicative of a denseness of compact to very dense.

Clayey Silt to Silt (Outside Flood Plain)

This deposit (which is of glacial origin) underlies the silty sand stratum and was encountered in five of the six boreholes drilled outside of the Grand River flood plain. The material consists of clayey silt to silt with sand and some gravel and may be described as 'cohesive' to 'very slightly cohesive' in nature. The thickness of the deposit ranges from 11 to 16 feet. Throughout its full depth numerous slab boulders which consist either of shale or dolomite are contained. The presence of these boulders rendered the S.P.T. 'N' values as being inappropriate as a method of assessing the consistency of the clayey silt matrix. By observation and inspection of samples only, the consistency is estimated to range from stiff to very stiff. Physical properties as determined from laboratory tests are summarized as follows.

		<u>Range</u>	<u>Average</u>
Plastic Limit	(w _p)	15-17%	16%
Liquid Limit	(w _L)	19.5-22%	20.5%
Moisture Content	(w)	11.5-13%	12.5%

As shown on the Plasticity Chart of Figure 1 contained within the Appendix, these results indicate that this material lies within the clayey silt to silt range having low plasticity.

Mechanical analyses tests which were carried out on samples from this stratum were rendered invalid due to the fact that in the preparation process large gravel size particles which consisted

of brittle shale and shaley dolomite fragments were broken down to smaller sized particles.

This deposit is underlain by bedrock at elevation 600+ or is separated from bedrock by a 2 to 4 foot thick layer of very loose to loose sand and gravel.

Alluvial Deposits (Within Flood Plain)

Alluvial deposits consisting of silts, fine to coarse sand and gravels were encountered within the flood plain and river channel area to depths ranging from 8 to 17 feet in the channel and 6 to 10 feet elsewhere. Split spoon samples taken within this stratum also encountered numerous slab shaped boulders of severely weathered shale and dolomite measuring in thickness from approximately 2 to 6 inches. (NX size (3 1/2 inch O.D.) casing was advanced through this stratum using conventional washboring techniques - diamond drilling was not required. Due to the existence of the slabs, severe inconsistencies in 'N' values were obtained. It is, therefore, estimated that the average denseness of the subsoil matrix within this layer is compact. Traces of marine sediments (shell fragments) were also encountered within the upper 5-10 feet of this stratum.

Bedrock

The surface of the bedrock was found to lie between elevation 590 and elevation 616 approximately, over the site area. Within the river channel and on the north side of the river the bedrock surface lies between elevation 590 and elevation 601. On the south side of the river including the flood plain, the bedrock surface lies generally between elevation 609 and elevation 616. Above approximate elevation 590 the bedrock is of the Salina Formation and consists of extensively weathered shaley, silty reef dolomite containing unevenly distributed cavities which occupy about 30 percent of the rock mass. Below approximate elevation 590 the bedrock consists primarily of dolomite to shaley dolomite ranging from soft to hard with layers of gypsum ranging in thickness from approximately 3 inches to 3 feet. It is well known that this type of rock formation contains numerous open fissures

within the bedding and jointing system. NXL size (2 5/32 in. dia.) rock core samples ranging from five to 20 feet in length were obtained in a total of 18 boreholes. 'Apparent' permeabilities were measured with the use of a constant head mechanically expandable packer assembly in three NXL size boreholes cored in rock to a depth of approximately 20 feet. Using the results obtained from these tests, apparent rock permeabilities were calculated based upon the formula published in the Earth Manual, United States Department of the Interior, Bureau of Reclamation, page 544. Where it was possible to determine the apparent rock permeabilities, since some zones were apparently impervious, there appeared to be no apparent uniform pattern throughout the test area. The 'apparent' permeabilities varied from approximately 3.9×10^{-4} cm./sec. to 5.4×10^{-3} cm./sec. with four tests out of a total of 12 indicating no flow. It must be assumed, therefore, that the overall rock formation within the zone investigated has in general a very high permeability.

Groundwater

Groundwater measurements taken in the boreholes outside of the river channel during the period of the subsoil investigation indicated the groundwater to be located approximately one to two feet higher than the prevailing river water level (616+). Groundwater levels within the river channel may be assumed equal to the prevailing river water level.

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

K.G. Selby
K.G. Selby, P. Eng.
Supervising Engineer



APPENDIX

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

9

WP 55-75-03 LOCATION Sta. 622+29 C 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE Dec. 20-27 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE NX Wash-Boring and Cone Test CHECKED BY *[Signature]*

SOIL PROFILE		STRAT. PLOT	SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT				LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION		NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p w w_L		
633.3	Ground Level													
0.0	Clayey Silt Trace of Sand & org. Very Stiff		1	SS	20	630								
626.3			2	SS	18									
7.0	Silty sand some gravel, trace of clay, some pockets of clayey silt		3	SS	46									
			4	SS	35									
			5	SS	29	620								
617.8	Compact to Dense		6	SS	13									
15.5			7	SS	100	3"								
			8	SS	100	3"								
	Sand & Gravel, Trace of clay & silt, Pockets of clayey silt Frequent shale & shaley Dolomite Boulders Weathered		9	RC BXL	REC 11%	610								
			10	SS	18									
			11	RC BXL	REC 100%									
	Dense to Very Dense (Glacial Till)		12	RC BXL	REC 31%	600								
598.8			13	RC BXL	REC 94%									
34.5	Bedrock													
	Dolomite													
	Med. Hard to Hard Intermittent Layers of Gypsum (2"-3")		14	RC BXL	REC 100%	590								
			15	RC BXL	REC 100%									
581.2						580								
52.1	End of Borehole													

OFFICE REPORT ON SOIL EXPLORATION

20
15 \diamond 5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

10

WP 55-75-03 LOCATION Sta. 621+19 C 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE December 29, 1976 - Jan 4, 1977. COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE NX Wash-Boring & Cone Test CHECKED BY P.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
617.7	Ground Level															
0.0	Silty fine sand (org. Gravel, some sand (fill))		1	SS	138											
614.2	Traces of Silt, V. Dense		2	SS	100/3"											
3.5	Sand & Gravel, Trace of Clay and Silt		3	SS	13											
	Pockets of Clayey Silt, Frequent Shale & Shaley Dolomite Boulders, Weathered Comp. to Very Dense (Glacial Till)		4	SS	21											
			5	SS	14											
			6	SS	20											
			7	SS	15											
599.6	Bedrock		8	SS	100/2"											
18.1	Gypsum		9	RC	REC											
	Soft		10	NXL	90%											
	Impregnated with Dolomite		11	RC	REC											
	Med. Hard		12	NXL	94%											
	Dolomite		13	RC	REC											
	Med. Hard			NXL	82%											
	Impregnated with Gypsum															
575.5	Soft															
42.2	End of Borehole Note: Water Level not established															

20
15 ϕ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

11

WP 55-75-03 LOCATION Sta. 620+16 C 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE Jan 566 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE NX Wash-Boring & Cone Test CHECKED BY *el.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
616.6	Ice Level															GR SA SI CL
0.0	Water					610										
606.6	Bottom of River															
10.0	Fine Sand Some Silt & Clay Loose to compact Frequent Boulders of		1	SS	42											
			2	SS	24											
			3	SS	10											
598.1	Weathered Shale (2"-6")		4	SS	7/6	600										
18.5	Bedrock Gypsum Soft Impregnated with Dolomite		5	RC NXL	REC 83%											
			6	RC NXL	REC 100%	590										
			7	RC NXL	REC 70%											
			8	RC NXL	REC 66%	580										
578.1	End of Borehole															
38.5																

OFFICE REPORT ON SOIL EXPLORATION

20
15 ϕ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

12

WP 55-75-03 LOCATION Sta. 619+08 C 'B' ORIGINATED BY R.V.V.
DIST 4 HWY 6N BORING DATE Jan. 11 & 12, 1977 COMPILED BY A.M.
DATUM Geodetic BOREHOLE TYPE NX Wash-Boring & Cone Test CHECKED BY *u.s.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT			LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p — w — w_L		
616.3	Ice Level													
0.0	Water													
606.0	Bottom of River													
10.3	Traces of Org.		1	SS	51									
	Fine Sand, Trace of		2	SS	69									
	Silty & Clay. Loose		3	SS	20									
	to Compact. Frequent		4	SS	6									
	boulders of weathered													
596.6	shale (2"-6")		5	SS	75	5"								
19.7	Bedrock		6	RC	REC									
	Dolomite			NXL	56%									
	Hard													
	Bands of Gypsum		7	RC	REC									
587.6	Soft			NXL	88%	590								
28.7	End of Borehole													

20
15 \diamond 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 5

13

WP 55-75-03 LOCATION Sta. 618+01 C 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE Jan. 14, 17, 19, 20 1977 COMPILED BY R.V.V.
 DATUM Geodetic BOREHOLE TYPE NX Wash Boring & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w $w_p \quad w \quad w_L$ WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
616.0	Ice Level													
0.0	Water													
608.5	Bottom of River													
7.5	Clayey, trace of org. silt with fine sand		1	SS	102									
604.0	Stiff, boulders of weathered shale (2"-3")		2	SS	9									
12.0	Fine Sand		3	SS	26									
	Trace of silt & clay		4	SS	17									
	Compact		5	SS	69									
	Frequent Bounders of		6	SS	24									
	Weathered Shale & Dolomite (2"-6")		7	SS	18									
592.8			8	SS	52/8"									
23.2	Bedrock, Soft		9	RC	REC									
	Gypsum, Soft			NXL	88%									
	Bands of Dolomite		10	RC	REC									
	Med. Hard			NXL	100%									
	Dolomite		11	RC	REC									
	Med. Hard to Hard			NXL	81%									
	Bands of Gypsum		12	RC	REC									
	Soft			NXL	74%									
573.5														
42.5	End of Borehole													

20
15 ϕ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

14

WP 55-75-03 LOCATION Sta. 616+95 C 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE January 21 & 24, 1977 COMPILED BY R.V.V.
 DATUM Coedatic BOREHOLE TYPE NX Wash Boring & Cone Test CHECKED BY L.V.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
615.7	Ice Level															
0.0	Water															
609.7	Bottom of River					610										
6.0	Fine Sand Some Silt & Clay Loose to Compact Frequent Boulders of Weathered Shale (2"-6")		1	SS	34											
			2	SS	24											
			3	SS	6											
			4	SS	33											
			5	SS	36											
			6	SS	35											
			7	SS	15											
			8	SS	3											
593.4	Very Loose		9	SS	20/10											
22.3	Bedrock, Dolomite Bands of Gypsum Soft		10	RC REC NXL 74%		590										
588.4																
27.3	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

20
15 \diamond 5 % STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 7

15

W P 55-75-03 LOCATION Sta. 615+88 @ Line 'B' ORIGINATED BY RVV
DIST 4 HWY 6N BOREHOLE TYPE NX Washboring and Cone Test COMPILED BY RVV
DATUM Geodetic DATE January 25, 26, 28, 1977 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					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT (%)		
615.5	Ice Level													
0.0	Water													
612.5	Bottom of River													
3.0	Trace of Organics		1	SS	1/6									
			2	SS	36									
	Fine Sand		3	SS	207	3"								
	Trace of Silt and Clay, Compact		4	SS	30									
	Frequent Boulders of Weathered Shale (2"-6") and Dolomite		5	SS	23									
			6	SS	26									
			7	SS	607	4"								
			8	SS	16									
594.1	Very Loose		9	SS	1/11	" Bouncing								
21.4	Bedrock Gypsum Soft		10	RC	Rec									
	Bands of Dolomite Medium Hard		11	NXL	86%									
			12	RC	Rec									
	Dolomite, Medium Hard		13	NXL	86%									
	Bands of Gypsum Soft			RC	Rec									
574.1				NXL	74%									
41.2	End of Borehole													

Sampler Sank 12" 610


Hammer 150/9" Bouncing

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 8

16

W P 55-75-03 LOCATION Sta. 614+82 & Line 'B' ORIGINATED BY JM
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE January 20, 1977 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					
619.9	Ground Level												GR 5A SI CL
0.0	Sandy Silt, Some Organics, Trace of Clay, Loose to Compact		1	SS	4								
			2	SS	3								
			4	SS	130	7"							
609.0			5	SS	12								
10.9	Bedrock, Shaley Silty Vuggy Dolomite Weathered		6	SS	100	4"							
			7	SS	29								
			8	SS	100	4"							
			9	SS	52								
			10	SS	77								
			11	SS	24								
590.9			12	SS	102	11"							
29.0	Gypsum, Soft Bands of Dolomite		13	RC BXL	Rec 100%								
580.9	Dolomite Medium Hard to Hard Bands of Gypsum, Soft												
39.0	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 9

17

W P 55-75-03 LOCATION Sta. 613+95 @ Line 'B' ORIGINATED BY JM
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE January 21, 1977 CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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						
618.9	Ground Level													
0.0	Sandy Silt Some Organics Trace of Clay		1	SS	2									
612.4	Very Loose		2	SS	3									
6.5	Bedrock, Shaley Silty Vuggy Dolomite Weathered		3	SS	43									
			4	SS	104									
			5	SS	23									
			6	SS	53									
			7	SS	180/110"									
596.0			8	SS	9									
22.9	Gypsum, Soft Bands		9	SS	100/2"									
592.4	of Dolomite		10	SS	100/5"									
26.5	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 \diamond 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 10

18

W P 55-75-03 LOCATION Sta. 613+08 of Line 'B' ORIGINATED BY JM
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE January 21 & 24, 1977 CHECKED BY *JP*

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	100					
618.9	Ground Level													
0.0	Sandy Silt, Some Organics, Trace of Clay & Gravel, Loose to Compact		1	SS	9									
613.4			2	SS	100/4"									
5.5	Bedrock, Shaley Silty Vuggy Dolomite Weathered		3	SS	83									
			4	SS	54									
			5	SS	136									
			6	SS	43									
			7	SS	100/7"									
598.2			8	SS	100/2"									
20.7	Dolomite Soft Layers of Gypsum, Soft		9	RC BXL	Rec 91%									
589.4														
29.5	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 11

19

W P 55-75-03 LOCATION Sta. 612+21 @ Line 'B' ORIGINATED BY AM
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE January 28-February 2, 1977 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					
640.0	Ground Level													
0.0	Clayey Silt, Some Gravel & Sand, Trace of Organics, Hard		1	SS	47									39 44 13 4
636.0			2	SS	100/5"									
4.0	Sand & Gravel, Some Silt, Very Dense (Glacial Till)		3	SS	50/2"									
631.0			4	SS	13									26 34 32 8
9.0	Compact		5	SS	55									
	Silty Sand, Some Gravel, Pockets of Clayey Silt		6	SS	36									15 20 (65)
	Dense to Very Dense (Glacial Till)		7	SS	25									
616.0			8	SS	85/1"									
24.0	Bedrock, Shaley Silty Vuggy Dolomite Weathered		9	RC BXL	Rec 20%									
			10	SS	100/2"									
			11	SS	114/6"									0 44 46 10
600.0														
40.0	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 12

20

W P 55-75-03 LOCATION Sta. 612+87 @ Line 'A' ORIGINATED BY AM
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE February 3 & 4, 1977 CHECKED BY CP

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	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								
640.7	Ground Level											
0.0	Clayey Silt		1	SS	30							
636.7	Some Organics, Hard		2	SS	17							
4.0	Silty Sand, Traces of Some Organics		3	SS	21							
631.2	Gravel, Compact (Glacial Till)		4	SS	75/	5"						
9.5	Clayey Silt to Silt With Sand		5	SS	100/	1"						
	Some Gravel		6	SS	100/	1"						
	Very Dense		7	SS	100/	1"						
619.2			8	SS	100/	1"						
21.5	Bedrock, Shaley Silty Vuggy Dolomite Weathered											
600.7												
40.0	Dolomite, Shaley Medium Bands of Gypsum		9	SS	100/	3"						
595.7	Soft		10	RC BX	Rec 96%							
45.0	End of Borehole											

+3, x5: Numbers refer to
Sensitivity

20
15 + 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No 13

21

W P 55-75-03 LOCATION Sta. 613+79 & Line 'A' ORIGINATED BY JM
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE January 24, 1977 CHECKED BY CP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	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								
618.6	Ground Level												
0.0	Sandy Silt Some Organics Trace of Clay		1	SS	4								
			2	SS	97								
610.6			3	SS	51								
8.0	Bedrock, Shaley Silty Vuggy Dolomite Weathered		4	SS	100/6"								
			5	SS	82								
			6	SS	52								
600.3			7	SS	75/3"								
18.3	End of Borehole												

+3, x5: Numbers refer to
Sensitivity

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



RECORD OF BOREHOLE No 14

22

W P 55-75-03 LOCATION Sta. 614+66 & Line 'A' ORIGINATED BY JM
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE January 25 & 26, 1977 CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	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								
619.1	Ground Level												
0.0	Sandy Silt Some Organics Trace of Clay		1	SS	3								
612.6	Very Loose		2	SS	6								
6.5	Bedrock, Shaley Silty, Vuggy Dolomite, Weathered		3	SS	-								
			4	SS	10072"								
			5	SS	107								
			6	SS	29								
			7	SS	10074"								
599.1													
20.0	Dolomite Soft to Medium Hard, Bands of Gypsum Soft		8	RC BXL	Rec 12%								
			9	RC BXL	Rec 91%								
589.6	Gypsum Soft												
29.5	End of Borehole												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No 15

23

W P 55-75-03 LOCATION Sta. 615+54 @ Line 'A' ORIGINATED BY JM
DIST 4 HWY 61 BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE January 26, 1977 CHECKED BY CP.

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	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								
620.1	Ground Level											
0.0	Sandy Silt Some Organics Trace of Clay Very Loose		1	SS	4							
			2	SS	2							
			3	SS	0							
610.1			4	SS	100/3"							
10.0	Bedrock, Shaley Silty Vuggy Dolomite Weathered		5	SS	23							
			6	SS	20							
			7	SS	63							
			8	SS	73							
			9	SS	14							
			10	SS								
591.6												
28.5	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 16

24

W P 55-75-03 LOCATION Sta. 616+58 & Line 'A' ORIGINATED BY RVV
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger and Cone Test COMPILED BY KS
DATUM Geodetic DATE February 3 & 4, 1977 CHECKED BY *dp.*

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					
615.2	Ice Level																
0.0	Water																
612.7	Bottom of River																
2.5	Sandy Silt, Some Org. Trace of Cl. V. Loose		1	SS	Sank												
	Occasional Boulders		2	SS	80/ 5"												
606.2	Very Dense		3	SS	45												
9.0	Bedrock, Shaley		4	SS	36												
	Silty Vuggy		5	SS	21												
	Dolomite		6	SS	60/ 6"												
	Weathered		7	SS	48/ 6"												
			8	SS	23												
593.2			9	SS	100												
22.0	Dolomite		10	RC	Rec												
588.2	Bands of Gypsum			NXL	76%												
27.0	End of Borehole																

+3, x5: Numbers refer to
Sensitivity

20
15
10
5 (%) STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 17

25

WP 55-75-03 LOCATION Sta. 617+66 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 9, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Washboring & Cone Test CHECKED BY *Life*

SOIL PROFILE		SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE					
614.9	Ice Level								
0.0	Water								
607.9	Bottom of River								
7.0	Fine to med. sand Some gravel, Trace of silt Compact Frequent boulders of weathered shale (2"-6") Loose		1	SS	26				
			2	SS	17				
			3	SS	23				
			4	SS	69				
			5	SS	65				
			6	SS	6				
			7	SS	4				
592.4			8	SS	105.8				
22.5	Bedrock Layers of Dolomite Med. hard to hard & gypsum soft		9	RC NXL	Rec 90%				
582.4			10	RC NXL	Rec 82%				
32.5	End of Borehole								

OFFICE REPORT ON SOIL EXPLORATION

20
15 ϕ 5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 18

26

WP 55-75-03 LOCATION Sta. 618+72 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 14 & 15, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Washboring & Cone Test CHECKED BY *[Signature]*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
614.6	Ice Level															
0.0	Water															
606.6	Bottom of River															
8.0	Med. to coarse sand some silt, Trace of clay & gravel compact Frequent boulders of Weathered shale (2"-6")		1	SS	10											
			2	SS	11											
			3	SS	29											
			4	SS	85/	6"										
			5	SS	76											
592.8			6	SS	28											
			7	SS	307	3"										
21.8	Bedrock Layers of dolomite Med-Hard and gypsum soft		8	RC NXL	Rec 92%	590										
582.8			9	RC NXL	Rec 84%											
31.8	End of Borehole															

20
15 ϕ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 19

27

WP 55-75-03

LOCATION Sta. 619+78 & Line 'A'

ORIGINATED BY RVV

DIST 4 HWY 6N

BORING DATE Feb. 16&17, 1977

COMPILED BY RVV

DATUM Geodetic

BOREHOLE TYPE NX Washboring & Cone Test

CHECKED BY *el.f.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES					
614.5	Ice Level									
0.0	Water					610				
604.0	Bottom of River									
10.5	V. Loose Marine Sediments		1	SS	4					
	Fine to med. sand		2	SS	60					
	Trace of silt & gravel Compact		3	SS	81					
	Frequent boulders of weathered shale (2"-6") Loose		4	SS	30					
			5	SS	7					
590.2			6	SS	30/4					
24.3	Bedrock									
	Layers of dolomite med. hard and gypsum soft		7	RC NXL	Rec 86%					
			8	RC NXL	Rec 88%					
580.2	Dolomite Hard					580				
34.3	End of Borehole									

4" Sampler sank 12" 50/6" Hammer Bouncing

20
15 ϕ 5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 20

28

WP 55-75-03 LOCATION Sta. 620+83 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 18&21, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Washboring & Cone Test CHECKED BY J.T.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P	W	W_L		
614.5	Ice Level															GR SA SI CL
0.0	Water					610										
602.5	Bottom of River															
12.0	Marine Sediments Med. to coarse sand Trace of silt compact Freq. boulders of weathered shale Very (2"-6") Loose		1	SS	18	600										
			2	SS	12											
			3	SS	1											
591.0			4	SS	4											
23.5	Bedrock Layers of dolomite med. hard to hard & Gypsum soft Dolomite Hard		5	RC NXL	Rec 94%	590										
581.0	Bands of Gypsum		6	RC NXL	Rec 54%											
33.5	End of Borehole															

20
 15 ϕ 5 % STRAIN AT FAILURE
 10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 21

29

WP 55-75-03 LOCATION Sta. 621+91 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 21-24, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Wash-boring & Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20 40 60 80 100					w_p w w_L				
							SHEAR STRENGTH									
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT %					
618.6	Ground Level															
0.0	Clayey silt with sa. & gr. shale boulders		1	SS	17											
614.0	Trace of org. v. stiff		2	SS	45											
4.6	Gravel some sand		3	SS	133/8"											
610.1	Trace of silt very dense		4	SS	64/4"											
8.5	Clayey silt to silt with sand & gravel		5	SS	28											
	Stiff to very stiff		6	SS	10											
	Boulders of weathered		7	SS	35											
	Shale & dolomite		8	SS	16											
598.6	(2"-6") (Glacial Till)		9	SS	80/2"											
20.0	Sand & gravel		10	SS	9											
594.4	Very Loose to loose		11	SS	1											
24.2	Bedrock		12	RC	Rec											
	Gypsum soft			NXL	98%											
	seams of dolomite															
	Dolomite															
	Med. hard to hard		13	RC	Rec											
584.4	Bands of gypsum soft			NXL	84%											
34.2	End of Borehole															
	Note: Water level not established															

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 22

30

WP 55-75-03
DIST 4 HWY 6N
DATUM Geodetic

LOCATION Sta. 622+99 & Line 'A'
BORING DATE Feb. 9, 1977
BOREHOLE TYPE Hollow Stem Auger & Cone Test

ORIGINATED BY AM
COMPILED BY AM
CHECKED BY *es. J.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_P	w	w_L		
633.6	Ground Level															GR SA SI CL
0.0	Clayey silt Trace of sand & organics Stiff to very stiff		1	SS	19	630										9 37 43 11
624.6			2	SS	15											
9.0	Sand some gravel		3	SS	11											
621.6	Trace of clay Compact		4	SS	17											
12.0			5	SS	18											
	Clayey Silt to silt with sand some gravel Very stiff Frequent boulders of weathered shale (Glacial till)		6	SS	22											0 53 40 7
			7	SS	100											
			8	SS	30											
			9	SS	56											0 46 48 6
			10	SS	31											
			11	SS	78											0 52 41 7
603.6			12	SS	5											0 26 56 8
30.0	Sand & gravel Loose		13	SS	100											
601.1			14	SS	75											
32.5	Bedrock Layers of Dolomite & gypsum															
598.6																
35.0	End of Borehole															

20
15 ϕ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION



RECORD OF BOREHOLE No A

31

W P 55-75-03 LOCATION Sta. 614+88 @ Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger H Casing, NX Rock Coring COMPILED BY GP
DATUM Geodetic DATE December 11, 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					
619.6	Ground Level																
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Compact																
608.0																	
11.6	Bedrock Dolomite (Shaley, Silty) Extensively Weathered		1	RC NX	Rec 75%												
			2	RC NX	Rec 70%												
			3	RC NX	52%												
596.1																	
23.5	End of Borehole																

+3, x⁵: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10

RECORD OF BOREHOLE No B

32

W P 55-75-03 LOCATION Sta. 614+80, o/s 25' Rt. & Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger H Casing & Cone Test COMPILED BY GP
DATUM Geodetic DATE December 11, 1978 CHECKED BY GP

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								
619.6	Ground Level												
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Compact					Auger 5'							
609.3							610						
10.3	End of Borehole Probable Bedrock (Extensively Weathered Dolomite)												

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



RECORD OF BOREHOLE No C

33

W P 55-75-03 LOCATION Sta. 614+69; o/s 25' Rt. & Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger H Casing & NX Rock Coring COMPILED BY GP
DATUM Geodetic DATE December 11, 1978 CHECKED BY GP

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					
619.6	Ground Level													
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Compact													
609.8														
9.8	Bedrock Dolomite Shaley & Silty)		1	RC	Rec									
				NX	58%									
602.5	Extensively Weathered		2	RC										
				NX	58%									
16.9	End of Borehole													

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No D

34

W P 55-75-03 LOCATION Sta. 614+72 & Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger & H Casing COMPILED BY GP
DATUM Geodetic DATE December 11, 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					
619.6	Ground Level														
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Very Dense		1	SS	3										
			2	SS	3										
609.3			3	SS	677	5"									
10.3	End of Borehole Probable Bedrock (Extensively Weathered Dolomite)														

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No E												35				
W P 55-75-03		LOCATION Sta. 614+72, o/s 16' Lt. & Line 'B'				ORIGINATED BY PP										
DIST 4 HWY 6N		BOREHOLE TYPE Hollow Stem Auger H Casing & NX Rock Coring				COMPILED BY GP										
DATUM Geodetic		DATE December 11, 1978				CHECKED BY [Signature]										
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 (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES			20 40 60 80 100	Wp	W	W _L	WATER CONTENT (%)				
619.6	Ground Level															
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Compact															
609.3																
10.3	Bedrock Dolomite (Shaley, Silty) Extensively Weathered		1	RC NX	Rec 73%											
599.3			2	RC NX	Rec 50%											
20.3	End of Borehole															

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

RECORD OF BOREHOLE No F

36

W P 55-75-03 LOCATION Sta. 614+92 o/s 15' Lt. & Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger 'H' Casing, NX Rock Coring COMPILED BY GP
DATUM Geodetic DATE December 12, 1978 CHECKED BY GP

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					
619.6	Ground Level															
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Compact															
611.0																
8.6	Bedrock Dolomite (Shaley, Silty) Extensively Weathered		1	RC NX	Rec 67%	610										
			2	RC NX	Rec 62%											
602.0																
17.6	End of Borehole															

+3, x5 : Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No G

37

W P 55-75-03 LOCATION Sta. 614+95, o/s 25' Rt. & Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger COMPILED BY GP
DATUM Geodetic DATE December 12, 1978 CHECKED BY *GP*

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			VALUES	20 40 60 80 100					
619.6	Ground Level												
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Compact												
608.3						610							
11.3	End of Borehole Probable Bedrock (Extensively Weathered Dolomite)												

+3, x5: Numbers refer to
Sensitivity

20
15 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No H

38

W P 55-75-03 LOCATION Sta. 614+95 @ Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger COMPILED BY GP
DATUM Geodetic DATE December 12, 1978 CHECKED BY GP

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					
619.6	Ground Level												
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Compact												
606.8													
12.8	End of Borehole Probable Bedrock (Extensively Weathered Dolomite)												

+3, x5: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



RECORD OF BOREHOLE No J

39

W P 55-75-03 LOCATION Sta. 614+80; o/s 10' L.E. of Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger COMPILED BY GP
DATUM Geodetic DATE December 12, 1978 CHECKED BY *GP*

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					
619.6	Ground Level																
0.0	Sandy Silt Some Organics Trace of Clay Very Loose to Compact					* W.L. Not Est.											
608.9																	
10.7	End of Borehole Probable Bedrock (Extensively Weathered Dolomite)																

+³, x⁵: Numbers refer to
Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



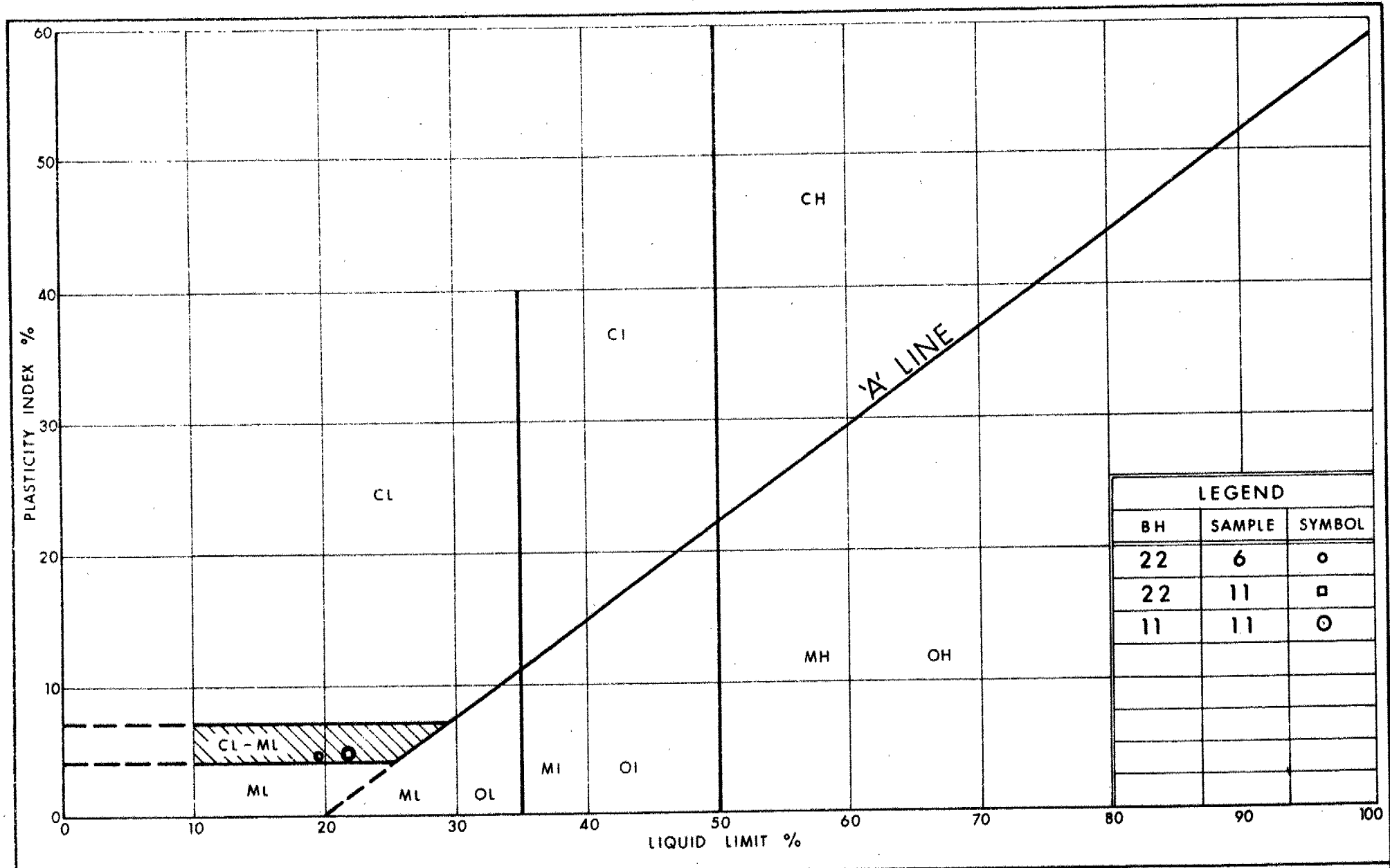
RECORD OF BOREHOLE No K

W P 55-75-03 LOCATION Sta. 614+80, o/s 10' Rt. of Line 'B' ORIGINATED BY PP
DIST 4 HWY 6N BOREHOLE TYPE Hollow Stem Auger COMPILED BY GP
DATUM Geodetic DATE December 12, 1978 CHECKED BY GP

[illegible]

+3, x5 : Numbers refer to Sensitivity

20
15 ϕ 5 (%) STRAIN AT FAILURE
10



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PLASTICITY CHART CLAYEY SILT TO SILT WITH SAND & GRAVEL

FIG No 1

W P 55-75-03



Ministry of
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DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 1 of 10

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N,
Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

DIP
90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		HOLE No. 1			
18'5"	34'5"	Dolomite, shaly, grey, fine textured, med. hard to soft,			core badly broken and ground. 30% Recovery, RQD - 0
34'5"	44'2"	Dolomite buffy-grey, fine textured, med. hard, impregnated with gypsum.			RQD - 60% Horizontal bedding and fractures, some lightly contort.
44'2"	52'1"	Dolomite buffy grey to grey, fine textured, med. hard to hard with three 3" sections of gypsum			RQD - 11% Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 2			
18'1"	30'0"	Gypsum, white soft impregnated with dolomite, buffy grey, medium hard			RQD - 45% Horizontal bedding and fractures, some lightly contorted.
30'0"	32'5"	Dolomite, grey, fine textured, med. hard			1 ft. of core missing RQD - 35% Horizontal bedding and fractures.
32'5"	32'10"	Gypsum, white, soft			
32'10"	35'2"	Dolomite, grey, med. hard with two 2" seams of gypsum			8" of broken core RQD-0

DATE OF EXAMINATION March, 1977

Z. Koniuszy



Ministry of
Transportation and
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DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 2 of 10

DIP

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N,
Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 2 (Cont'd)				RQD 0
35'2"	39'8"	Dolomite, buffy grey, fine textured, med. hard				core badly broken - parallel to the bedding - horizontal.
39'8"	42'2"	Dolomite, buffy, fine textured, med hard, impregnated with gypsum, white, soft.				RQD - 15%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 3				
8'5"	19'10"	Gypsum, white, soft, impregnated with dolomite, buffy grey, fine textured, med. hard				RQD - 10%. Horizontal bedding and fractures, some lightly contorted.
19'10"	21'0"	Dolomite, grey, fine textured, hard				
21'0"	21'6"	Gypsum, white, soft				
21'6"	28'5"	Dolomite, buffy, buffy-grey, fine textured, hard				core badly broken and ground
		HOLE No. 4				
9'4"	11'4"	Dolomite, buffy-grey, fine textured, med. hard with thin seams of gypsum.				9'4" - 10'4" core ground RQD - 0

DATE OF EXAMINATION March, 1977

Z. Koniuszy



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 3 of 10

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N,
Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

DIP
90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 4 (Cont'd)				
11'4"	12'4"	Gypsum, white, soft				RQD - 30%. Horizontal bedding and fractures, some lightly contorted.
12'4"	18'4"	Dolomite, buffy, fine textured, med. hard, impregnated with gypsum, white, soft				RQD - 22%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 5				
15'7"	23'8"	Gypsum, white, soft, impregnated with dolomite, buffy grey, med. hard				RQD - 12%. Horizontal bedding and fractures, some lightly contorted.
23'8"	24'9"	Dolomite, grey, fine textured, med. hard				RQD - 0. Core broken parallel to bedding.
24'9"	25'4"	Gypsum, white, soft				
25'4"	27'0"	Dolomite, grey, med. hard, fine textured with 2" seam of gypsum				RQD - 20%. Vertical joint 26'-27.4" Horizontal bedding and fractures.
27'0"	27'3"	Gypsum, white, soft				

DATE OF EXAMINATION March, 1977

Z. Koniuszy



Ministry of
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DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 4 of 10

PROPERTY LOCATION W.P. 55-75-03
Grand River Bridge, Hwy. 6N,
Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

DIP
90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER		REMARKS
FROM	TO				
		HOLE No. 5 (Cont'd)			
27'3"	30'7"	Dolomite, grey, fine textured, hard with 2 small pockets of gypsum			RQD - 0. Core broken parallel to the bedding - horizontal.
30'7"	35'0"	Dolomite, buffy-grey, hard, fine textured, impregnated with gypsum, white, soft.			30'7" - 31'1" - core ground RQD - 11%. Horizontal and bedding and fractures.
		HOLE No. 6			
16'3"	21'3"	Dolomite, buffy-grey, fine textured, soft impregnated with gypsum, white, soft			1½ feet of core missing RQD - 20%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 7			
18'4"	30'0"	Gypsum, white soft, impregnated with dolomite, buffy grey, med. hard.			18'4" - 20' core badly broken parallel to the bedding. RQD - 0.
30'0"	31'7"	Dolomite, grey, fine textured, med. hard, shaly in places			
31'7"	32'0"	Gypsum, white, soft.			

DATE OF EXAMINATION March, 1977

Z. Koniuszy



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 5 of 10

DIP

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N,
Caledonia, Ontario
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 7				
32'0"	37'8"	Dolomite, grey, med. hard with gypsum seams with clusters				20' - 30' RQD 56%
						30' - 31'7" RQD 55%
37'8"	38'2"	Gypsum, white, soft				31'7" - 38'2" RQD 0. All fractures parallel to horizontal bedding.
		HOLE No. 8				
29'0"	33'0"	Gypsum, white, soft, impregnated with dolomite, buffy				RQD - 60%. Horizontal bedding and fractures, some lightly contorted.
33'0"	36'0"	Dolomite, buffy colour, fine textured, medium hard with gypsum seams				RQD - 50%. Horizontal bedding and fractures, some lightly contorted.
36'0"	37'3"	Dolomite, grey, fine textured, hard				RQD - 0. Core broken parallel to the bedding.
37'3"	37'10"	Gypsum, white, soft				RQD - 100%. Horizontal bedding.
37'10"	38'4"	Dolomite, grey, fine textured, very hard				RQD - 100%. Horizontal bedding.
38'4"	38'7"	Gypsum, white, soft				
38'7"	39'0"	Dolomite, grey, fine textured, hard				

DATE OF EXAMINATION March, 1977

Z. Koniuszy



Ministry of
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Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 6 of 10

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N,
Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

DIP

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 10				
20'0"	21'3"	Dolomite, grey, fine textured, soft, with thin seams of gypsum.				4" of ground core RQD - 50%. Horizontal bedding and fractures, some lightly contorted.
21'3"	25'6"	Dolomite, buffy-grey, fine textured, soft, impregnated with gypsum, white, soft				RQD - 80%. Horizontal bedding and fractures, some lightly contorted.
25'6"	26'5"	Gypsum, white, soft with dolomite, buffy-grey, soft				RQD - 100%. Horizontal bedding and fracture, some lightly contorted.
26'5"	26'9"	Dolomite, buffy-grey, soft				RQD - 100%. Horizontal bedding
26'9"	29'5"	Gypsum, white, soft				RQD - 80%. Horizontal bedding and fractures, lightly contorted.
		HOLE No. 11				
24'	28'	Dolomite, buffy-grey, fine texture, hard.				Core ground & broken, 25% rec. RQD - 0
		HOLE No. 12				
40'	45'	Dolomite, shaly, grey to yellowish grey, fine textured, med. hard with sections impregnated by gypsum, white, soft.				RQD - 12%. Horizontal bedding and fractures, some lightly contorted.

DATE OF EXAMINATION March, 1977

Z. Koniuszy



Ministry of
Transportation and
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DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 7 of 10

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N,
Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

DIP
90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 14				
20'0"	25'0"	Dolomite, greenish-grey, fine textured, soft				Core ground, 4 ft. of core missing
25'0"	27'0"	Dolomite, buffy-grey, fine textured, med. hard impregnated with gypsum, white, soft.				RQD - 75%. Horizontal bedding and fractures, some lightly contorted.
27'0"	29'5"	Gypsum, white, soft				RQD - 70%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 16				
19'5"	24'5"	Dolomite, buffy-grey, fine textured, soft impregnated with gypsum.				1 ft. of core missing RQD - 40%. Horizontal bedding and fractures, some lightly contorted.

DATE OF EXAMINATION March, 1977

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Ministry of
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Communications

DIAMOND DRILL RECORD

DIP

HOLE NO. _____ SHEET NO. 8 of 10

PROPERTY LOCATION W.P. 55-75-03
Grand River Bridge, Hwy. 6N
Caledonia, Ontario
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
15'5"	16'4"	Dolomite, buffy, fine textured, med. hard, impregnated with gypsum, white, soft (lenses and concentrations)				RQD - 40% Horizontal bedding and fractures.
16'4"	20'5"	Gypsum, white, soft with dolomitic sections				Fractured every 2" to 3" RQD - 0. Fractured horizontally.
20'5"	22'6"	Dolomite, buffy-grey, fine textured, med. hard, impregnated with gypsum, white, soft.				RQD - 20% Horizontal bedding and fractures. RQD - 0. 3" vertical joint at 23'8"
22'6"	23'4"	Gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, lightly contorted.
23'4"	25'5"	Dolomite, grey, fine textured, med. hard, to hard				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 18				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
13'8"	15'4"	Dolomite, buffy-grey, fine textured, med. hard, impregnated with gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
15'4"	18'10"	Gypsum, white, soft with seams of dolomite				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
18'10"	23'8"	Dolomite, buffy-grey, fine textured, med. hard, impregnated with gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, some lightly contorted.

DATE OF EXAMINATION March, 1977Z. Koniuszy



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DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 9 of 10

DIP

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N
Caledonia, Ontario
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 19				
13'8"	19'8"	Dolomite, buffy-grey, fine textured, med. hard, interbedded with gypsum, white, soft.				RQD - 30%. Fractured Horizontally. Two 4" sections of pure gypsum
19'8"	21'6"	Dolomite, grey, fine textured, med. hard, with some gypsum				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
21'6"	21'11"	Gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
21'11"	23'8"	Dolomite, grey, fine textured, hard				RQD - 50%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 20				
11'5"	14'9"	Gypsum, white, soft impregnated by dolomite, buffy, med. hard				RQD - 55%. Horizontal bedding and fractures, some lightly contorted.
14'9"	15'7"	Dolomite, buffy grey, med. hard, fine textured, with thin seams of gypsum				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
15'7"	16'5"	Gypsum, white, soft				RQD - 40%. Horizontal bedding and fractures, some lightly contorted.

DATE OF EXAMINATION March, 1977

Z. Koniuszy



Ministry of
Transportation and
Communications

DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 10 of 10

DIP

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N
Caledonia, Ontario
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____

DATUM _____

DATE STARTED _____

DATE COMPLETED _____

DRILLED BY _____

LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 20 (Cont'd)				
16'5"	21'5"	Dolomite, grey, fine textured, hard with 3" section of gypsum.				Last 8" of core ground RQD - 0. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 21				
24'2"	25'6"	Dolomite, grey and buffy grey, fine textured, med. hard with gypsum concentrations and lenses				RQD - 50%. Horizontal bedding and fractures, some lightly contorted.
25'6"	28'6"	Gypsum, white, soft with seams of dolomite				RQD - 10%. Horizontal bedding and fractures, some lightly contorted.
28'6"	30'1"	Dolomite, buffy-grey, fine textured, med. hard with thin lenses and concentrations of gypsum.				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
30'1"	31'8"	Dolomite, buffy-grey, fine textured, med. hard, impregnated with gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
31'8"	34'2"	Dolomite, grey, fine textured, hard, with few small concentrations of gypsum.				RQD - 0. Horizontal bedding and fractures, some lightly contorted.

DATE OF EXAMINATION March, 1977

Z. Koniuszy

**Ministry of
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HOLE NO. A SHEET NO. 1

□ 1 ♀

90°

PROPERTY Grand River Bridge
LOCATION Hwy. 6, Caledonia
W.P. 55-75-03

LATITUDE _____
DEPARTURE _____
BEARING _____

TOTAL FOOTAGE 23' 5"

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

DATE OF EXAMINATION January 4, 1979

Z. Koniuszy



HOLE NO. C SHEET NO. _____

90°

	70
TOTAL FOOTAGE	16 8'

ELEV. COLLAR _____
 DATUM _____
 DATE STARTED _____
 DATE COMPLETED _____
 DRILLED BY _____
 LOGGED BY _____

[illegible]

Z. Koniuszy



01P

90°

PROPERTY _____ Grand River Bridge
LOCATION _____ Hwy. 6, Caledonia
_____ W.P. 55-75-03

LATITUDE _____
DEPARTURE _____
BEARING _____

TOTAL FOOTAGE 17 6'

ELEV. COLLAR
DATUM
DATE STARTED
DATE COMPLETED
DRILLED BY
LOGGED BY

[illegible]

DATE OF EXAMINATION January 4, 1979

2. Koniuszy

FOUNDATION INVESTIGATION REPORT

For

Hwy. 6N Underpass at 6th Line
W.P. 55-75-05, Site 9-129
District 4, Hamilton

INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned project by the Trow Engineering Group Ltd. on behalf of the Ministry. Fieldwork was done during the period January 12 to January 13, 1977, utilizing a continuous flight auger machine equipped with four inch diameter solid augers.

SITE DESCRIPTION

The site is located at the intersection of 6th Line and Hwy. 6N. The area is generally undulating with a gentle slope from east to west. From geological information available, subsoil in this area consists of layered deposits of silty clays and clayey silts overlying cohesive and granular glacial tills; bedrock consists of dolomites with lenses of gypsum or anhydrite.

SUBSURFACE CONDITIONSGeneral

Subsoil at the site was found to consist mainly of layered deposits of silty clay to clayey silt overlying cohesive and granular glacial tills. Bedrock was assumed to be at the level at which refusal to further penetration of the augers was encountered. Reference should be made to the Record of Borehole Sheets which are contained in the report Appendix and on which are shown the boundaries between different soil types and summarized results of all field and laboratory tests. Reference should also be made to Drawing No. 9-129-2 of the Contract Drawings which shows the locations and elevations of borings, together with the inferred soil stratigraphy. Detailed descriptions of the different soil types encountered are given below. For convenience the site has

been divided into three areas: East Side (Boreholes 1 & 6), Centre (Boreholes 2 & 5) and West Side (Boreholes 3 & 4).

East Side (Borings 1 & 6) - Borings 1 and 6 were put down in this area. Soil conditions to the depths investigated are similar in the area of the two borings. The surficial material consists of 4 inches to 2 feet of gravel fill overlying layered silty clay to clayey silt. Laboratory tests on samples of these cohesive soils indicate a range of natural moisture contents from 25 to 36 percent and unit weights from 115 to 125 pcf. Standard Penetration values were 15 to 21 blows per foot. The results of unconsolidated undrained triaxial tests indicate undrained shear strengths of approximately 1900 psf at an 8 foot depth in Borehole 1 and 2600 psf at a 20 foot depth in Borehole 6. This deposit extends to elevation 636 feet approximately at which point layered silty clay and silty fine sand was encountered. A stratum of very dense, slightly cohesive sand till was intercepted at elevation 631 feet approximately. This material extends to the full depth investigated in Borehole 6 (elevation 620.1 feet). Standard Penetration Resistance values in the sand till were 50 blows for negligible penetration. A laboratory test on a split spoon sample indicates a moisture content of 13 percent.

Centre (Borings 2 & 5) - Borings in this area, Boreholes 2 and 5, revealed 0 to 4 inches of topsoil overlying silty clay with traces of organics down to elevation 657 feet approximately. Natural moisture content and unit weight determinations indicate values of 27 percent and 123 pcf respectively. Standard Penetration Resistance is 13 blows per foot. Beneath the silty clay a layered deposit of silty clay to clayey silt extends to elevation 644 feet approximately. Occasional vertical oxidized seams were encountered in this deposit. Moisture contents range from 23 to 36 percent while unit weights vary from 116 to 127 pcf. Standard Penetration Resistances were 12 to 33 blows per foot. An unconsolidated undrained triaxial test on a soil sample from a depth of 15 feet in Borehole 5 indicates undrained shear strengths of 1300 psf approximately. Underlying the layered stratum is clayey silt to silty clay till with a range of natural moisture content from 7 to 17 percent and unit weights from 132 to 141 pcf. Standard Penetration

values were 5 to greater than 50 blows per foot. This stratum extends to elevation 630 feet approximately at which point compact sand and gravel till was encountered. The result of one natural moisture content test indicates a value of 10 percent while the Standard Penetration Resistance is 26 blows per foot. This material extends to the full depth investigated (elevation 626.6 feet) at which level refusal to augering on assumed bedrock was encountered.

West Side (Borings 3 & 4) - Information on subsurface conditions in this area was obtained from Boreholes 3 and 4. The surficial soils consist of 16 inches of sand and gravel fill or 2 inches of topsoil overlying silty clay with traces of organics. The clay has a Standard Penetration Resistance of 11 blows per foot, natural moisture content of 29 percent and unit weight of 124 pcf. It extends to elevation 657 feet approximately at which point layered silty clay to clayey silt was encountered. The moisture contents and unit weights of this material vary from 28 to 34 percent and 118 to 125 pcf respectively. The result of an unconsolidated, undrained triaxial test on a soil sample from an 8 foot depth in Borehole 4 indicated undrained shear strengths of 2650 psf approximately. Clayey silt till with a natural moisture content of 11 percent, unit weight of 142 pcf and Standard Penetration Resistance of 22 blows per foot underlies the layered silty clay and clayey silt down to elevation 643 feet approximately in Borehole 4. Slightly differently graded tills were encountered in Borehole 3. The investigation revealed sandy silt till from elevations 643 to 626 feet approximately. This stratum has moisture contents of 7 to 8 percent, unit weights of 146 to 148 pcf and Standard Penetration values of 50 blows per foot to 50 blows for 5 inches of penetration. Below elevation 626 feet there is a gravelly sand till stratum which extends to the full depth investigated. This material has typical moisture contents of 18 percent and Standard Penetration values greater than 66 blows per foot. Refusal to augers on assumed bedrock was encountered at a depth of 39.8 feet (elevation 621.3 feet) in Borehole 4.

Groundwater

Observations in the temporarily open borings and in a piezometer installed in Borehole 5 approximately one week after its installation revealed a groundwater level at about a 28 foot depth (elevation 636 feet). Due to the nature of the soils encountered and the depth to the water table, it is considered that the groundwater level will be approximately constant across the entire construction site. There may be some minor perched water in more pervious seams at higher elevations.

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



K.G. Selby
K.G. Selby, P. Eng.
Supervising Engineer

APPENDIX

THE TROW ENGINEERING GROUP LTD.

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 55-75-05 LOCATION 100+92, 14'L (North) ORIGINATED BY HL
DIST 4 HWY 6-New BORING DATE January 13, 1977 COMPILED BY SG
DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY *SG*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	WATER CONTENT % w_p — w — w_L				
							SHEAR STRENGTH									
							○ UNCONFINED + FIELD VANE ■ QUICK TRIAXIAL * LAB VANE									
						800	1600	2400	3200	4000	10	20	30			
664.4	Ground Level															
0.0	Fill - gravel															
662.4																
2.0	Silty clay to clayey silt, layered, occasional silt seams. Very stiff Brown		1	SS	20	660							o		124	
			2	SS	16								o		119	
			3	TW	PH	655							o		115	
			4	TW	PH								o		120	
						650										
647.9			5	SS	17								o		120	
16.5	End of Borehole															
<u>NOTES:</u> 1. Borehole put down uncased to 16'6" depth with Bombardier mounted continuous flight auger equipment on Jan. 13/77. 2. Borehole open and dry to 14'9" depth on completion and back-filled.																

OFFICE REPORT ON SOIL EXPLORATION

20
15 \div 5 % STRAIN AT FAILURE
10

THE TROW ENGINEERING GROUP LTD.

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 55-75-05

LOCATION Sta. 100+24, 18'R (South)

ORIGINATED BY HL

DIST 4 HWY 6-New

BORING DATE January 13, 1977

COMPILED BY SC

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY *DLH*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	VALUES		20	40	60	80	100	WATER CONTENT %				
						SHEAR STRENGTH										
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE										
						800 1600 2400 3200 4000					10 20 30					
661.4	Ground Level															
0.3	Silty clay, mottled, 2" thick dense gravel seam @ 3'8" depth		1	SS	31	660										
657.4	Very stiff Brown															
4.0	Silty clay to clayey silt, horizontally layered.		2	SS	33	655										
	Very stiff		3	SS	19											
	Brown		4	SS	17	650										
647.9	Silty clay, horizontally layered.															
13.5	Stiff Grey		5	SS	13	645										
643.9	End of Borehole															
NOTES: 1. Borehole put down uncased to 17'6" depth with Bombardier mounted continuous flight auger equipment on Jan. 13/77. 2. Borehole open and dry to 14'6" depth on completion and back-filled.																

 20
 15 \diamond 5 % STRAIN AT FAILURE
 10

THE TROW ENGINEERING GROUP LTD.

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 55-75-05 LOCATION Sta. 99+05, 13'L (North) ORIGINATED BY HL
 DIST 4 HWY 6-New BORING DATE January 13, 1977 COMPILED BY SG
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY *SG*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS % GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
662.2	Ground Level															
0.0 660.9	Fill-sand and gravel.															
1.3	Silty clay, mottled, decayed wood frag- ments. Stiff Brown		1	SS	14	660									121	
657.2																
5.0	Silty clay to clayey silt, layered. Stiff Brown		2	SS	14	655									118	
652.7			3	SS	12										120	
9.5	Sandy clay till, traces of weathered shale and gravel. Firm		4	SS	7	650										
648.2	Green and Brown															
14.0	Sandy silt till, traces of gravel. Compact Brown		5	SS	13										143	
645.7																
16.5	End of Borehole.															
NOTES: 1. Borehole put down uncased to 16'6" depth with Bombardier mounted continuous flight auger equipment on Jan. 13/77. 2. Borehole open and dry to 14'7" depth on completion and back-filled. 3. Low "N" value for sample 4 possibly as a result of local "quick" condition developed during withdrawal of augers.																

20
15 \diamond 5 % STRAIN AT FAILURE
10



THE TROW ENGINEERING GROUP LTD.

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP 55-75-05

LOCATION Sta. 99+28, 18'R (South)

ORIGINATED BY HL

DIST 4 HWY 6-New

BORING DATE January 12, 1977

COMPILED BY SG

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY [Signature]

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLT	NUMBER	TYPE	W. VALUES		20	40	60	80	100	w_p	w	w_L		
661.1																
0.2	Topsoil					660										
	Silty clay, mottled, traces of organics and fine gravel.		1	SS	11										124	
656.6	Stiff Brown															
4.5	Silty clay to clayey silt, layered.		2	TV	PH	655									125	
	Very stiff Brown		3	TV	PH										118	
651.6																
9.5	Clayey silt till, traces of sand and gravel.		4	TV	PH	650									142	
	Very stiff Brown															
			5	SS	22	645									142	
642.6																
18.5	Sandy silt till, traces of clay and gravel.		6	SS	50/5	640									149	
	Very dense Grayish Brown															
			7	SS	57	635									146	
			8	SS	50	630									148	
626.1																
35.0	Sand and Gravel till, traces of silt, clay and weathered shale.		9	SS	66 11	625										
621.3	Very dense Gray															
39.8	Refusal to Augering															
NOTES: 1. Borehole put down uncased with Bombardier mounted continuous flight auger equipment on January 12, 1977. 2. CME-55 flight auger drill met with refusal to further penetration at 39'10" depth assumed on dolomitic bedrock. 3. Borehole open to 36'10" and water level at 26'1" depth on completion.																

 20
 15 \diamond 5 % STRAIN AT FAILURE
 10

THE TROW ENGINEERING GROUP LTD.

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 55-75-05

LOCATION Sta. 100+04, 15'L (North)

ORIGINATED BY HL

DIST 4 HWY

BORING DATE January 12, 1977

COMPILED BY SG

DATUM Geodetic

BOREHOLE TYPE Auger

CHECKED BY *SG*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
662.9	Ground Level						800	1600	2400	3200	4000	10	20	30		
0.0	Silty Clay, traces of organics.		1	SS	13	660									123	
657.9	Stiff Brown		2	SS	12										119	
5.0	Silty clay to clayey silt, layered, occasional fine sand seams.		3	TW	PH 20/9	655	Note: Sample 3 pushed hydraulically 9 inches and driven 9 inches									
	Stiff to very stiff		4	SS	13										120	
	Brown to Gray					650										
			5	TW	PH		S=5.5								116	
644.9						645										
18.0	Clayey silt to silty clay till, traces of sand and gravel (possible boulders).		6	TW	PH										141	
	Hard to firm					640										
	Gray to Brown		7	SS	10/6	635										
			8	SS	5										134	
629.9						630										
33.0	Sand and gravel till, slightly cohesive, traces of silt, clay and weathered shale.		9	SS	26											
626.6	Compact Gray															
36.3	Refusal to Augering															
NOTES: 1. Borehole put down uncased with Bombardier mounted continuous flight auger equipment on January 12, 1977. 2. CME-55 flight auger drill met with refusal to further penetration at 36'4" depth - assumed to be on dolomitic bedrock. 3. Borehole open to 32'6" & water level at 27'6" depth on completion. 4. Piezometer installed through cave material at 34' depth, sealed with bentonite at 29' depth and borehole backfilled. 5. Water level in piezometer at 28' depth on January 19, 1977.																

 20
 15 \diamond 5 % STRAIN AT FAILURE
 10



THE TRCW ENGINEERING GROUP LTD.

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 55-75-05 LOCATION Jct. 101+14, 18'R (South) ORIGINATED BY _____
 DIST 4 HWY 6-New BORING DATE January 13, 1977 COMPILED BY SG
 DATUM Geodetic BOREHOLE TYPE Auger CHECKED BY *SG*

OFFICE REPORT ON SOIL EXPLORATION

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
664.6	Ground Level															
0.3	Silty clay to clayey silt, layered, traces of fine sand, occasional oxidized fissures.		1	SS	21	660									120	
	Very stiff Brown		2	SS	21	660									120	
			3	SS	15	655									116	
			4	SS	16	655									121	
						650									121	
646.6			5	SS	21	645									124	
18.0	Clayey silt to silty clay, layered, occasional fine sand seams.		6	TW	PH	640									125	
	Very stiff Grey		7	TW	PH	635									135	
635.6			8	TW	PH	630										
29.0	Silty clay and fine sand, layered.					625										
	Very stiff and dense Grey		9	SS	7											
630.6			10	SS	50/0											
34.0	Sand till, some silt and gravel, traces of clay and weathered shale, slightly cohesive.															
	Very dense Grey		11	SS	50/0											
620.1																

44.5 End of Borehole

NOTES:

- Borehole put down uncased with Bombardier mounted continuous flight auger equipment on January 13, 1977.
- Borehole terminated at 44'6" depth after no penetration of a 2" nominal diameter split spoon achieved with 50 blows of the 140 lb. hammer falling 30" at 39 1/2' depth and again at 44 1/2' depth.
- Low "N" value for sample 9 possibly as a result of local "quick" condition developed during withdrawal of augers.
- Ground water level not observed.

20
15 \diamond 5 % STRAIN AT FAILURE
10

FOUNDATION INVESTIGATION REPORT

For

Hwy. 6N Underpass at Sterling Street
W.P. 55-75-09, Site 9-132
District 4, Hamilton

INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned project. Fieldwork was done during the period of February 22 to February 28, 1977 utilizing a continuous flight auger machine equipped with 2 3/4 inch I.D. hollow stem augers. Bedrock was proved by obtaining BXL size rock core samples.

SITE DESCRIPTION

This site is located approximately one mile due west of the Town of Caledonia and about 1/2 mile south of the Grand River.

The area adjacent to the site is primarily occupied by farming with some reforestation. Small wooded areas dot the vicinity where farming is not feasible. In general, the overall area may be described as a gently rolling terrain.

This area is located within the physiographic region known as the Haldimand Clay Plain characterized by stratified clay overlying till. Within the general vicinity of the site the till protrudes through this layer in the form of drumlins partially buried within the lacustrine clay beds. The underlying bedrock consisting of Paleozoic beds of dolomite, shale and gypsum tends to dip slightly to the south under Lake Erie.

SUBSURFACE CONDITIONSGeneral

Generally uniform subsoil conditions were found to prevail over the site. The subsoil consists of 10-12.5 ft. deep cohesive type

deposits (silty clay and/or clayey silt) followed by an 18 to 30 foot thick stratum of glacial till followed by dolomite type bedrock.

The boundaries between different deposits are shown on the Record of Borehole Sheets contained in the Appendix. The estimated stratigraphical profile of Drawing No. 9-132-2 of the Contract Drawings is based upon this information.

From ground level downward the various strata are described in some detail with regard to soil types and properties below.

Silty Clay

This deposit was intersected in Borehole #1 only immediately below a thin layer of topsoil to a depth of about 4 feet.

The consistency may be classified as very stiff.

Clayey Silt, Traces of Sand

Below the topsoil or the above described silty clay stratum, an 8 to 12 foot thick deposit of clayey silt, traces of sand was encountered. A plot of plasticity index versus liquid limit (Figure 1) shows the points to fall within the CL zone. Laboratory tests yielded the following ranges:

Liquid Limit	18-34%
Plastic Limit	11-19%
Natural Moisture Content	9-20%

The overall deposit has a hard consistency; 'N' values range from 38-71 blows per foot.

Gravel, Sand, Silt and Clay (Glacial Till)

The clayey silt deposit is underlain by a stratum of glacial till at every borehole location. The lower boundary was found to vary between elevation 650+ and elevation 658+.

The material in the deposit consists of a heterogeneous mixture of gravel, sand, silt and clay. Laboratory tests indicate a great variety of grain size distributions throughout the overall deposit: Gravel: 8-64%, Sand: 21-57%, Silt and Clay: 12-52%.

This glacial till is basically granular in nature. There are random localized zones, however, where the matrix is cohesive. In addition, fragments of shale and gypsum were also found in the lower 10 feet of the stratum.

Standard Penetration Tests carried out within the deposit gave 'N' values to range from 48 to over 100 blows per foot. Based on these results it is estimated that the relative density is dense to very dense.


The natural moisture content was found to be 10% or less.

Bedrock

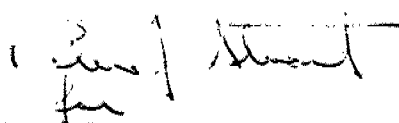
The bedrock at this site as described by Z. Koniuszy, M.T.C. Geologist, is fine textured, soft to medium hard shaley dolomite with horizontal fractures. The depth at which the bedrock was encountered varies between elevation 649.6 and elevation 657.8.

Groundwater

No groundwater was observed in any borehole during the field investigation.


P. Payer, P. Eng.
Senior Engineer




K.G. Selby, P. Eng.
Supervising Engineer

APPENDIX

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

71

WP 55-75-09 LOCATION Sta. 599+53 51' RT C/L Line 'B' ORIGINATED BY A.M.
 DIST 4 HWY 6 N BORING DATE February 25, 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger BXL Rock Core & Cone Test CHECKED BY *d.f.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100	w_p	w	w_L		
682.2	Ground Level															
0.0	Silty Clay															
678.2	Very Stiff		1	SS	26	680										
4.0	Clayey Silt, Traces of Sand		2	SS	49											
	Hard		3	SS	53											
669.7			4	SS	55											
12.5	Heterogeneous Mixture of Gravel, Sand, Silt & Clay (Glacial Till) Occ. Clayey silt layers		5	SS	85/9"	670										
			6	SS	103											
			7	SS	69											
			8	SS	76/6"	660										
			9	SS	100/5"											
649.7	Very Dense															
32.5	Bedrock Weathered Dolomite Sound (Shaly)		10	RC BXL	REC 60%	650										
644.7	End of Borehole Water Level Not Established															
37.5																

20
 15 ϕ 5 % STRAIN AT FAILURE
 10

OFFICE REPORT ON SOIL EXPLORATION

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

72

WP 55-75-09 LOCATION Sta. 600+06 34' Lt. C/L Line 'B' ORIGINATED BY A.M.
 DIST 4 HWY 6 N BORING DATE 22 - 23 February 1977. COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY *g.f.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT % 10 20 30	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
689.6	Ground Level													
0.0	Clayey Silt Traces of Sand		1	SS	30	Borehole Dry 680 10" 6" 6" 6" 6" 1" 0"650								
			2	SS	43									
679.6	Hard		3	SS	46									
10.0	Heterogenous Mixture of Gravel, Sand, Silt & Clay		4	SS	154									
			5	SS	161									
	Occ. Clayey Silt Layers (Glacial Till) Dense to Very Dense		6	SS	85									
			7	SS	105									
			8	SS	84									
			9	SS	110									
	Fragments of Shale & Gypsum		10	SS	48									
			11	SS	100									
649.6			12	SS	50									
40.0	Refusal Probable Bedrock End of Borehole													

20
 15 ϕ 5 % STRAIN AT FAILURE
 10

RECORD OF BOREHOLE NO 3

73

WP 55-75-09 LOCATION Sta. 599+52 113' LT C/L Line "B" ORIGINATED BY A.M.
 DIST 4 HWY 6 N BORING DATE 28 February 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & BXL Rock Core CHECKED BY *W.L.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_P	w	w_L		
687.8	Ground Level															
0.0	Clayey Silt		1	SS	94	680										
	Trace of Sand		2	SS	71											
	Hard		3	SS	42											
675.8			4	SS	38											
12.0	Heterogeneous		5	SS	57	670										
	Mixture of Gravel,		6	SS	120/2"											
	Sand, Silt & Clay		7	SS	-											
	(Glacial Till)		8	SS	57											
	Fragments of		9	SS	75/1 1/2"	660										
	Shale & Gypsum		10	AS												
657.8	Very Dense		11	SS	75/10"											
30.0	Dolomite Bedrock		12	RC	REC											
652.8	Sound			BX	90%											
35.0	End of Borehole															
	Water Level not															
	Established															

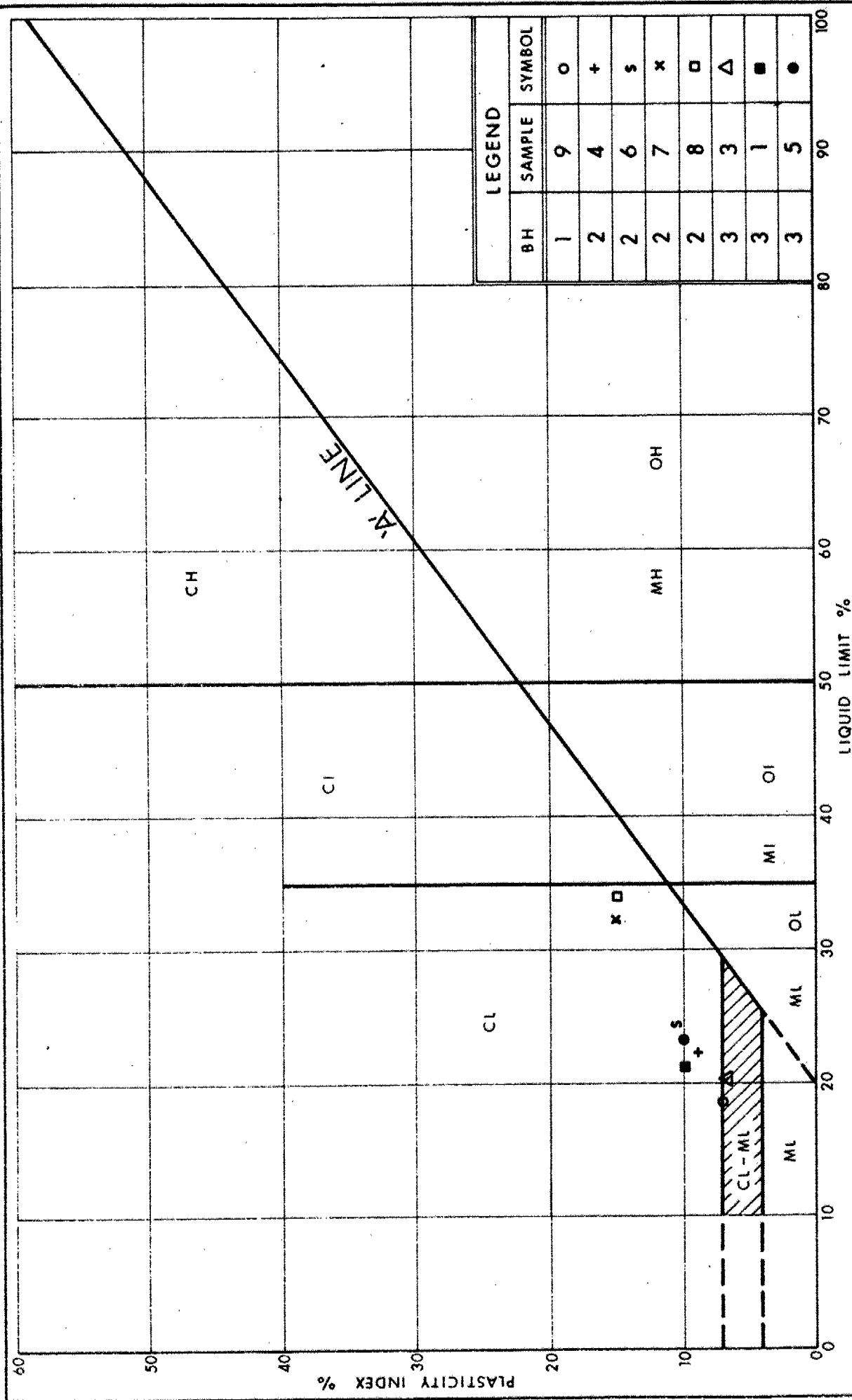


FIG No 1
PLASTICITY CHART
CLAYEY SILT
TRACE OF SAND

Ministry of
Transportation and
Communications



FIG No 1

W P 55-75-09

FOUNDATION INVESTIGATION REPORT

For

Domtar Access Road Overpass
Caledonia Bypass
W.P. 55-75-11, Site 9-133
District 4, Hamilton

INTRODUCTION

This report contains the results of a foundation investigation which was carried out at the site of the above mentioned project. Fieldwork was done during the period February 3 to February 28, 1977 utilizing a continuous flight auger machine equipped with 3 1/4 inch I.D. hollow stem augers. Bedrock was proved by recovering BXL size rock core samples.

SITE DESCRIPTION

The site is located in the vicinity of the Town of Caledonia on the Domtar Limited property. The terrain adjacent to the proposed structure site is flat to gently rolling. The land is being used for grazing purposes. Underground mining (gypsum) operations are being carried out in the vicinity of the future structure site.

Physiographically, the area lies in the region referred to as the Haldimand Clay Plain. This region in most part is covered by a somewhat irregular intermixture of clays and till.

SUBSURFACE CONDITIONSGeneral

The subsoil at the site was found to consist of cohesive type deposits of clayey silt to silt and/or silty clay to clayey silt (stratified), followed by a basically granular type zone of glacial till (heterogeneous mixture of gravel, sand, silt and clay), followed by (in most part) weathered bedrock (gypsum, shale and dolomite). The extent (vertical and horizontal) of the various deposits varies at this location.

The boundaries of the different deposits are shown on the Record of Borehole Sheets attached to the Appendix. The estimated stratigraphical profile shown on Drawing No. 9-133-2 of the Contract Drawing is based upon this information.

From ground level downwards the various soil types encountered are described below.

Clayey Silt to Silt

This deposit was encountered in Boreholes #1 and #4 to an approximate depth of 7 to 9.5 feet. The material may be classified as clayey silt to silt. The consistency was found to be very stiff.

Clayey Silt to Silty Clay

This stratum was intersected at all boring locations immediately at ground surface or below the clayey silt to silt zone. The thickness was found to vary from 29.5 to 53.0 feet in Boreholes #1 and #3 respectively. Reference should be made to the Record of Borehole Sheets for the lower boundary elevations.

The material in the deposit consists mainly of stratified clayey silt and silty clay. Numerous, irregular silt laminations up to 1/2 inch thick were also encountered within the deposit. The consistency or undrained shear strength of the overall deposit was found to vary randomly from stiff to very stiff.

Physical properties of the deposit as determined from laboratory and field tests are as follows:

Plastic Limit	(%)	14- 26
Liquid Limit	(%)	29- 57
Natural Moisture Content	(%)	18- 38
Bulk Density	(PCF)	116-123
Undrained Shear Strength	(PSF)	
Unconfined Compression		1370-3985
Quick Triaxial		995-2345
Field Vane Test		1200-2000 and over
Sensitivity		2.5-6.0

Grain size distribution curves are plotted on Figure 1.

Gravel, Sand, Silt and Clay (Glacial Till)

Immediately beneath the clayey silt to silty clay is a glacial till stratum composed of a heterogeneous mixture of gravel, sand, silt and clay. The thickness of the deposit ranges from seven feet (B.H. #4) to 24 feet (B.H. #2). The matrix of this till is basically granular in nature. There are random localized zones within this material; where the matrix is cohesive, i.e., clayey silt binding coarser sized particles. Grain size distribution tests carried out on samples from the stratum are plotted on Figure 2.

Standard Penetration Tests carried out within the deposit gave 'N' values ranging from 19 blows per foot to 100 blows per two inches. Based on these results it is estimated that the relative density of the stratum varies from compact to very dense.

Bedrock

Dolomite bedrock with gypsum and shale intrusions was encountered at all boring locations immediately below the glacial till deposit at depths ranging from 53 to 62 feet below the ground level. The bedrock surface across the site varies between elevation 614+ and elevation 626+. The upper 2-6 foot portion of the bedrock was found to be weathered.

Groundwater

During the period of investigation groundwater level observations were carried out in the open boreholes and gave the following information:

B.H. #1	Not observed
B.H. #2	Not observed
B.H. #3	Elev. 660+ (16' below ground level)
B.H. #4	Elev. 649+ (27' below ground level)

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

K.G. Selby
K.G. Selby, P. Eng.
Supervising Engineer



APPENDIX

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

79

WP 55-75-11

LOCATION St. 670+00 o/s 95' Lt c Line 'B' Hwy. 6N

ORIGINATED BY R.V.V.

DIST 4 HWY 6 New

BORING DATE February 28, 1977

COMPILED BY J.M.

DATUM Geodetic

BOREHOLE TYPE Hollow Stem 3 1/2" I.D.

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
679.2	Ground Level						400	800	1200	1600	2000	10	20	30	P C F	GR SA SI CL
0.0	Clayey Silt to Silt		1	SS	25											
672.2	Very Stiff		2	SS	16											0 0 76 24
7.0	Silty Clay to Clayey Silt		3	SS	17	670										
			4	TW	PH											
			5	SS	12											
	Brown		6	SS	13											
	Grey		7	SS	17	660										
			8	TW	PH											
	(Stratified)occ. Silt Seams		9	SS	10											
			10	SS	10											
	Stiff to Very Stiff		11	SS	7	650										
			12	TW	PH											
642.7			13	SS	9											
36.5	Heterogeneous Mixture of Gravel, Sand, Silt & Clay		14	SS	91/0"	640										21 32 (47)
	(Glacial Till)		15	SS	100/6"											
	Very Dense		16	SS	100/2"	630										
626.2																
53.0	Dolomite Weathered Bedrock Sound		17	SS	100/1"											
619.2	Bands of Gypsum		18	RC	93% red	620										
60.0	End of Borehole															

20
15 ± 5 % STRAIN AT FAILURE
10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

80

WP 55-75-11

LOCATION Sta. 670+36 o/s 55' L.R. Line 'B' Hwy. 6N

ORIGINATED BY JM

DIST 4 HWY 6 New

BORING DATE February 3, 4 1977

COMPILED BY JM

DATUM Geodetic

BOREHOLE TYPE Power Auger H.S 3 1/2 I.D. Cone Test

 CHECKED BY *e.f.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
676.4	Ground Level															
0.0	Silty Clay		1	SS	18											
	to		2	SS	10	670									53	0 0 28 72
	Brown		3	TW	PH											
	Grey		4	SS	12											
	Clayey Silt		5	TW	PH											
	(Stratified) occ.		6	SS	12	660										
	Silt Seams		7	TW	PH											
	Stiff to		8	SS	15											
	Very Stiff		9	TW	PH											
			10	SS	13	650										
			11	TW	PH											
			12	SS	19											
			13	TW	PH											
641.9			14	SS	88	640										
34.5	Heterogeneous Mixture		15	SS	100	4"										
	of Gravel, Sand,															
	Silt and Clay															
	(Glacial Till)															
	occ. Shale & Gypsum		16	RC	02	630										
	Fragments		17	SS	100	6"										
			18	SS	100	5"										
620.0	Very Dense					620										
56.4	Dolomite Bedrock		19	SS	100	2"										
615.9	Weathered		20	RC	34											
60.5	Gypsum Modules															
	End of Borehole															

 20
15 ϕ 5 % STRAIN AT FAILURE
10

RECORD OF BOREHOLE NO 3

AM &

WP 55-75-11 LOCATION Sta. 670+00 o/s 20' Lt. G Line "B" Hwy. 6 N ORIGINATED BY R. V. V.
 DIST 4 HWY 6 New BORING DATE Feb. 22, 23, 23.25. 1977 COMPILED BY JM
 DATUM Geodetic BOREHOLE TYPE H.S. Power Auger, Cone Test CHECKED BY h.f.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
676.3	Ground Level															
0.0			1	SS	10	670									57	0 0 25 75
			2	SS	17											
			3	SS	15											
			4	SS	10											
			5	TW	PH											
			6	SS	6											
			7	TW	PH											
			8	SS	9											
			9	TW	PH											
			10	SS	8											
			11	TW	PH											
			12	SS	8											
			13	TW	PH											
			14	SS	8											
			15	TW	PH											
			16	SS	9											
			17	SS	8											
623.3			18	SS	57	620										
53.0	Heterogeneous Mixture of Gravel, Sand, Silt and Clay (Glacial Till)		19	SS	25.4"											
614.3	Very Dense		20	SS	100.1"											
62.0	Bedrock Weathered layers of Gypsum, shale & Dolomite		21	SS	25.4"	610										
606.9			22	RC	100%											
70.4	End of Borehole		23	RC	75%											

20
 15 ϕ 5 % STRAIN AT FAILURE
 10

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

82

WP 55-75-11

LOCATION Sta. 670+52 o/s 25' Rt E Line 'B' Hwy. 6 N

ORIGINATED BY JM

DIST 6 HWY 6 New

BORING DATE February 15, 1977

COMPILED BY JM

DATUM Geodetic

BOREHOLE TYPE Power Auger H.S., 3 1/4 I.D., Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
676.0	Ground Level															
0.0	Clayey silt to Silt		1	SS	16											
	Very Stiff		2	SS	29	670										0 0 89 11
666.5			3	SS	28											
9.5	Silty Clay to Clayey Silt		4	SS	18											0 0 54 46
	Brown Grey (stratified)		5	SS	14											
	occ. silt seams		6	TW	PH	660										
	Stiff to Very Stiff		7	SS	13											
			8	TW	PH											
			9	SS	13											
			10	TW	PH											
			11	SS	11											
			12	SS	8											
			13	TW	PH											
			14	SS	9	640										
			15	TW	PH											
			16	SS	10	630										
623.0			17	TW	PH											
53.0	Het. Mixture of gravel, sand, silt & clay (Glacial Till)		18	SS	19	620										
616.0	Compact		19	SS	100 1"											
60.0	Bedrock Weathered layers of Shale and Gypsum		20	SS	100 1/2"	610										
			21	SS	100 3/4"											
			22	SS	100 0"											
600.0	Dolomite		23	RC	21%	600										
76.0	End of Borehole															

20
15 5 % STRAIN AT FAILURE
10

RECORD OF BOREHOLE NO 5

83

WP 55-75-11 LOCATION STA 67+60 O/S 12' LT Q/L Line 'B' Hwy. 6N ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE May 24, 25, 1977 COMPILED BY RNO
 DATUM Geodetic BOREHOLE TYPE Hollow Stem auger, Cone Test CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80	100			
679.0	Ground Level													
0.0														
	Silty clay to Clayey Silt		1	SS	30									
			2	SS	24									
			3	SS	16	670								
	Stratified		4	SS	13									
			5	SS	14									
	Stiff to Very Stiff		6	SS	14									
			7	TW	PH									
			8	SS	9									
			9	TW	PH									
			10	TW	PH									
641.0						640								
38.0	Glacial Till Silty Sand, Clay Gravel		11	SS	110									
			12	SS	100 3"									
	Very Dense		13	SS	100 4"	630								
			14	SS	100 5 1/2"									
621.5														
57.5	Bedrock Dolomite and Gypsum		15	RC BXL	100% Rec RQD =57%	620								
615.7														
63.3	End of Borehole													

20
 15 ϕ 5 % STRAIN AT FAILURE
 10



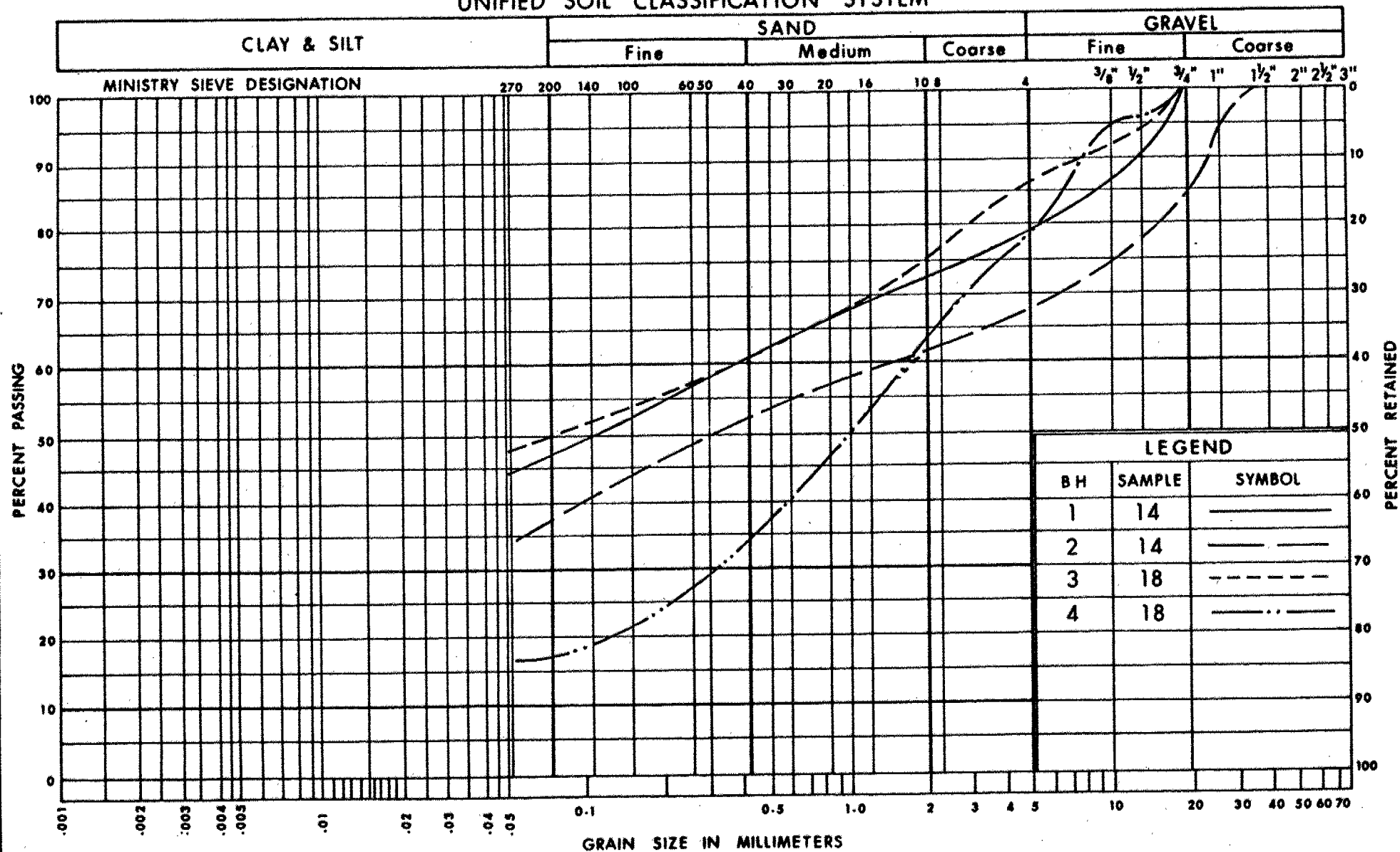
**Ministry of
Transportation and
Communications**

GRAIN SIZE DISTRIBUTION SILTY CLAY TO CLAYEY SILT

FIG No 1

WP 55-75-11

UNIFIED SOIL CLASSIFICATION SYSTEM



Ministry of
Transportation and
Communications

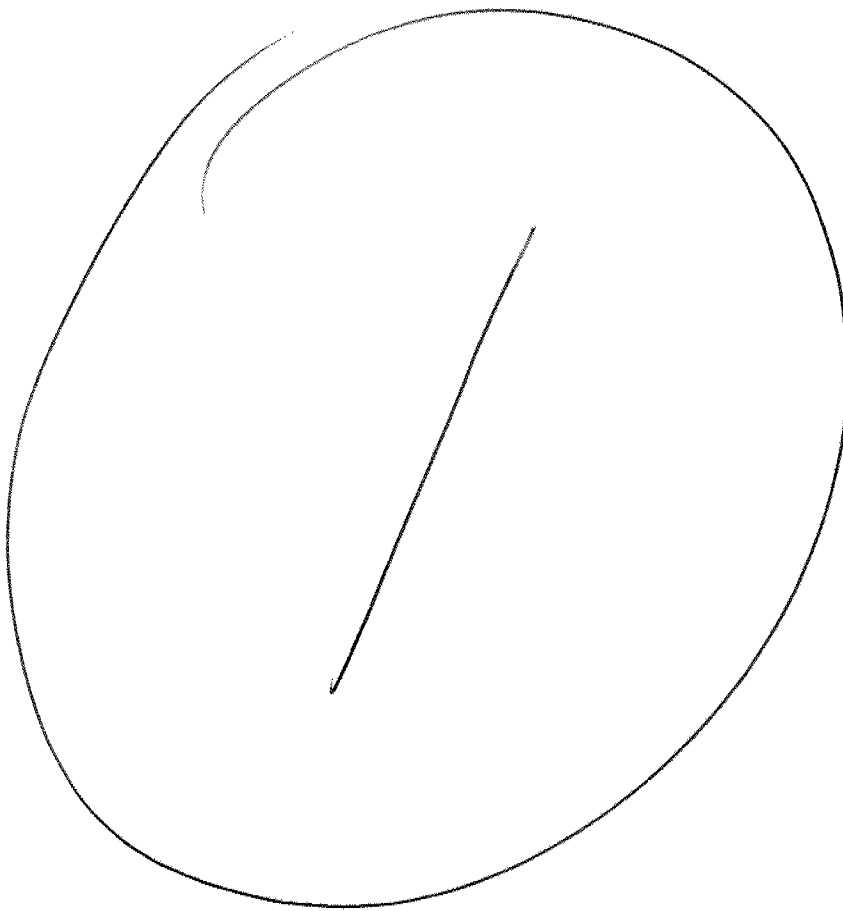
GRAIN SIZE DISTRIBUTION
GLACIAL TILL
HET MIXTURE OF GRAVEL SAND SILT & CLAY

FIG No 2

W P 55-75-11

35MM

DRAWING



ENGINEERING MATERIALS OFFICE
SOIL MECHANICS SECTION

WP 55-75-03

DIST 4

HWY 6N

STR SITE 9-130

Grand River Bridge
Just West of Caledonia

81-64

DISTRIBUTION

G.C.E. Burkhardt (3)
R.D. Gunter
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D.E. Thrasher (2)

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R. Hore

R. Fitzgibbon)
J. Anderson) cover only
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SAMPLE DISPOSITION NOTICE		
TYPE	DISCARD AFTER	RECOMM. BY
JARS	77-05-18	14/8
TUBES	77-05-18	14/8
ROCK CORES	AFTER AWARD	14/8

FOUNDATION INVESTIGATION REPORT

For

Grand River Bridge
Just West of Caledonia
Hwy. 6N, District 4, Hamilton
W.P. 55-75-03, Site 9-130

INTRODUCTION

This report contains the results of a foundation investigation at the above mentioned site. The fieldwork was performed during the period of December 20, 1976 to February 24, 1977, utilizing a Canadian Longyear Junior diamond drill raft mounted for all holes on water and a 2 3/4" hollow stem auger C.M.E. 55 muskeg vehicle mounted for all land holes. BXL and NXL size rock core samples were obtained to prove bedrock.

SITE DESCRIPTION

This site is located approximately 1 mile upstream of the Town of Caledonia over the Grand River. The river at this point is approximately 265 feet wide with an approximately 160 foot flood plain on the south side. River banks approximately 30 and 40 feet in height border the north shore and southern edge of the flood plain respectively.

River water levels are controlled by a flood control dam located approximately 3/4 mile downstream of the proposed bridge site. The average normal river water level has been established at approximate elevation 616 with the design high water level at approximate elevation 630.

This area is located within the Physiographic Region known as the Haldimand Clay Plain characterized by stratified clay overlying till. Immediately adjacent to the site, at the north and south extremities of the proposed structure, the till protrudes through this layer in the form of drumlins partially buried within the lacustrine clay beds. The underlying bedrock, consisting of Paleozoic beds of dolomite, shale and gypsum, tends to dip slightly to the south under Lake Erie.

The area may be described as having a gently rolling terrain interrupted only by the slow, relatively straight, Grand River with its adjacent flood plain.

In general, farming appears to be the major occupation of the area with the exception of several wood lots in areas where farming is not feasible. A relatively large gypsum mine slightly north of the Town of Caledonia manufactures gyproc wallboard.

SUBSURFACE CONDITIONS

General

Outside of the Grand River flood plain, subsoil consists in general of about 11 to 30 feet of clayey silt to silt with sand and gravel of glacial origin, overlying bedrock which consists of argillaceous dolomite containing layers of gypsum. In addition to this, a glacial deposit of essentially non-cohesive sand and gravel overlying bedrock was encountered in one area at the north extremity of the site investigated. Overlying these two predominant deposits are layers approximately 4 to 20 feet thick of silts and sands with gravel also overlain by a stratum approximately 4 to 9 feet thick of clayey silt, sands and gravels, trace of organics.

Within the flood plain and river channel, subsoil consists of alluvial deposits of mainly compact silts, sands and gravels, containing numerous slab shaped boulders of shale and dolomite, all underlain by the above mentioned bedrock. The depth of the alluvium ranges from 9 feet to about 30 feet. Boundaries between different soil types are shown on the Record of Borehole Sheets which are contained in the report Appendix, along with the summarized results of all laboratory and field tests. Locations and elevations of all borings are shown on Drawing No. 557503-A. From ground level downward the different soil types encountered during the investigation are described as follows:

Clayey Silt (Outside Flood Plain)

This layer, having a consistency of stiff to hard, indicated by average 'N' values ranging between 11 and 47 blows/foot, was encountered within the upper 4 feet to 9 feet of boreholes drilled at the top of the slopes at the north and south extremities of the site. Atterberg Limit tests performed on samples obtained within this layer indicate the following ranges:

Plastic Limit	(P_L) = 16.0-23.0%
Liquid Limit	(L_L) = 23.5-31.0%
Moisture Content	(W) = 8.5-23.0%

Sand and gravel with traces of organics was also encountered within this layer.

Silty Sand (Outside Flood Plain)

This material of glacial-fluvial origin was encountered directly below the clayey silt stratum from depths approximately 7-9 feet to 15-24 feet. Grain size analyses performed on samples from this stratum also indicates some gravel with a trace of clay. Average 'N' values, obtained from Standard Penetration tests, ranged from 13 to 55 blows/ft. indicative of a denseness of compact to very dense.

Clayey Silt to Silt (Outside Flood Plain)

This deposit (which is of glacial origin) underlies the silty sand stratum and was encountered in five of the six boreholes drilled outside of the Grand River flood plain. The material consists of clayey silt to silt with sand and some gravel, and may be described as 'cohesive' to 'very slightly cohesive' in nature. The thickness of the deposit ranges from 11 to 31 feet. Throughout its full depth numerous slab boulders which consist either of shale or dolomite, are contained. The presence of these boulders rendered the S.P.T. 'N' values as being inappropriate as a method of assessing the consistency of the clayey silt matrix. By observation and inspection of samples, only the consistency is estimated to range from stiff to very stiff. Physical properties as determined from laboratory tests are summarized as follows:

	<u>Range</u>	<u>Average</u>
Plastic Limit (P _L)	15-17%	16%
Liquid Limit (L _L)	19.5-22%	20.5%
Moisture Content (W)	11.5-13%	12.5%

As shown on the Plasticity Chart of Fig. 1 contained within the Appendix, these results indicate that this material lies within the clayey silt to silt range having low plasticity.

Mechanical analyses tests which were carried out on samples from this stratum were rendered invalid due to the fact that in the preparation process large gravel sized particles which consisted of brittle shale and shaley dolomite fragments were broken down to smaller sized particles.

This deposit is underlain by bedrock at elevation 600± or is separated from bedrock by a 2 to 4 foot thick layer of very loose to loose sand and gravel.

Sand and Gravel (Outside Flood Plain)

A mixture of sand and gravel with a trace of silt and clay of glacial origin directly overlies bedrock from approximate elevation 618 ft. to 599 ft. in only

one location at the south extremity of the site investigated. Average 'N' values ranging from approximately 18 blows/ft. to 100 blows/3" indicate a denseness of compact to very dense.

Alluvial Deposits (Within Flood Plain)

Alluvial deposits consisting of silts, fine to coarse sands and gravels were encountered within the flood plain and river channel area to depths ranging from 8 to 17 feet in the channel and 15-22 feet elsewhere. Split-spoon samples taken within this stratum also encountered numerous slab shaped boulders of severely weathered shale and dolomite measuring in thickness from approximately 2 to 6 inches. NX size (3½ inch O.D.) casing was advanced through this stratum using conventional washboring techniques - diamond drilling was not required. Due to the existence of the slabs, severe inconsistencies in 'N' values were obtained. It is, therefore, estimated that the average denseness of the subsoil matrix within this layer is compact. Traces of marine sediments (shell fragments) were also encountered within the upper 5-10 feet of this stratum.

Bedrock

As indicated on the profile drawings for both the north and southbound lanes on Drawing 557503-A, the bedrock elevation varies from approximately 590 to 601. This was determined in several boreholes by the absolute refusal to penetration by an NX size casing driven by a 450 lb. hammer. Generally, the bedrock surface was found to be highest at both ends of the proposed structure and lowest toward the midspan. As indicated on the Diamond Drill Record Sheets within the Appendix, the bedrock consists primarily of dolomite to shaley dolomite ranging from soft to hard with layers of gypsum ranging in thickness from approximately 3 in. to 3 feet. Gypsum, however, was found to predominate the upper portion of the bedrock for a depth of approximately 4 to 12 feet within the vicinity of boreholes 2, 3, 5, 7, 8 and 21. It is estimated that throughout the site the upper 1 to 2 feet of the bedrock is slightly to moderately weathered. It is well known, however, that this type of rock formation contains numerous open fissures within the bedding and jointing system. NXL size (2 5/32 ins. dia.) rock core samples ranging from 5 to 20 ft. in length were obtained in a total of 18 boreholes. 'Apparent' permeabilities were measured with the use of a constant head mechanically expandable packer assembly in three NXL size boreholes cored in rock to a depth of approximately 20 feet. Using the results obtained from these tests, apparent rock permeabilities were calculated based upon the formula published in the Earth Manual, United States Department of the Interior, Bureau of Reclamation, page 544. Where it was possible to determine the apparent rock permeabilities, since some zones were apparently impervious, there appeared to be no apparent uniform pattern throughout the test area. The 'apparent' permeabilities varied from approximately 3.9×10^{-4} cm./sec. to 5.4×10^{-3} cm./sec. with 4 tests out

of a total of 12 indicating no flow. It must be assumed, therefore, that this rock formation, within the zone investigated, has in general a high permeability.

Groundwater

Groundwater measurements taken in the boreholes outside of the river channel during the period of the subsoil investigation indicated the groundwater to be located approximately 1 to 2 feet higher than the prevailing river water level (616±). Groundwater levels within the river channel may be assumed equal to the prevailing river water level.

DISCUSSION AND RECOMMENDATIONS

It is proposed to construct an eight span two lane structure having end spans of 102 feet in length with the remaining spans being 107 feet long. In addition, future proposals involve the construction of a similar size structure approximately 76 feet upstream to accommodate only southbound traffic. Grades varying from elevation 656 at the north approach to elevation 660 at the south approach will require approach fills having maximum heights of $20\pm$ feet at the north end and $40\pm$ at the south end. For proposed footing locations reference should be made to preliminary plan W.P. 55-75-03, Drawing P2.

Recommendations for all footings are given for both the initial two lane structure, in addition to the future southbound structure. Types of footings, in addition to founding elevations and net bearing capacities, are recommended as follows

South abutment: Pile caps may be constructed within the approach fills and supported on steel H piles driven to sound bedrock.

N.B.L. - Bedrock at elevation 593 \pm

S.B.L. - Bedrock at elevation 599 \pm

Pier 1: Supported on steel H piles driven to sound bedrock.

N.B.L. - bedrock at elevation 590 \pm

S.B.L. - bedrock at elevation 591 \pm

Pier 2: Supported on spread footings directly on sound bedrock.

N.B.L. - bedrock at elevation 593 \pm 10 T.S.F.

S.B.L. - bedrock at elevation 592 \pm 10 T.S.F.

Pier 3: Supported on spread footings directly on sound bedrock.

N.B.L. - bedrock at elevation 592 \pm 10 T.S.F.

S.B.L. - bedrock at elevation 591 \pm 10 T.S.F.

Pier 4: Supported on spread footings directly on sound bedrock

N.B.L. - bedrock at elevation 592 \pm 10 T.S.F.

S.B.L. - bedrock at elevation 592 \pm 10 T.S.F.

Pier 5: Supported on spread footings directly on sound bedrock.

N.B.L. - bedrock at elevation 596 \pm 10 T.S.F.

S.B.L. - bedrock at elevation 589 \pm 10 T.S.F.

Pier 6: Supported on spread footings directly on sound bedrock.

N.B.L. - bedrock at elevation 597 \pm 10 T.S.F.

S.B.L. - bedrock at elevation 590 \pm 10 T.S.F.

Pier 7: Supported on spread footings directly on sound bedrock.

N.B.L. - bedrock at elevation 599± 10 T.S.F.

S.B.L. - bedrock at elevation 594± 10 T.S.F.

Alternatively, pile caps may be constructed within the overburden material and supported on steel H piles driven to sound bedrock.

North abutment: Pile caps may be constructed within the approach fills and supported on steel H piles driven to sound bedrock.

N.B.L. - bedrock at elevation 598±

S.B.L. - bedrock at elevation 600±

Approaches

Maximum approach fill heights of 20 feet at the north approach and 40 feet at the south approach are proposed. No stability problems are anticipated provided that all forward and side slopes are constructed with maximum 2:1 slopes. In order to provide protection against scour all slopes should be covered with rip rap up to the anticipated high water level.

Settlements under the 20 foot high north approach embankment will occur over a long-term period. These should not exceed about 2 inches total. Settlements under the 40 foot high south approach fill will occur as the fill is placed since the overburden is primarily non-cohesive and should not affect the performance of the fill after completion. The fill itself may settle and for a fill of this height experience indicates that about 2 to 3 inches are possible if cohesive type fill is used.

General

Design loads for steel H piles may be the maximum allowable for the steel section used. Tips should be reinforced with flange plates.

In computing resistance to lateral forces a coefficient of friction of $\tan 24^\circ$ may be assumed to apply between the bedrock and the tremie concrete. If the frictional resistance is insufficient dowel bars should be installed to make up the deficiency. These bars should be grouted at least 5 feet into the bedrock.

All footings should have a minimum of 4 feet cover for frost protection.

Construction Procedures

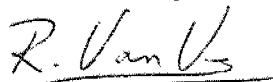
For footings or pier caps located below the ground or river water level a dewatering scheme will be necessary to permit concrete to be poured in the dry since the overburden consists mainly of permeable alluvial deposits of silts, sands and gravels and the underlying bedrock of dolomite contains numerous

open fissures in the joints and bedding planes. Where footings are located within the overburden, dewatering can be achieved by excavating within a sheet pile cofferdam driven to a depth below the footing base equal to the height of the prevailing ground or river water level above the base. For footings located on the bedrock surface, it is considered to be impractical to attempt to dewater the excavation completely since the water inflow under the approximate 23 foot± head would be very high. This is borne out by our own experience on structures over the Grand River at Paris and more recently on the Hwy. 403 crossing west of Paris where the rock formations are somewhat similar. Therefore, for these cases it is recommended that a design utilizing tremie concrete in the lower part of the footing be adopted. To achieve this steel sheet cofferdams should be driven to bedrock and the excavation carried out. Tremie concrete should then be placed to a depth sufficient to balance the full hydrostatic head, after which time the water can be pumped out to the surface of the tremie concrete and the remainder of the concrete work done in the dry. Sheeting may be removed or cut off as required later.

Due to the presence of slab boulders within the overburden, driving of sheet piles may be problematic. Therefore, excavation within the cofferdams may be required as the sheeting is being driven in order to remove boulders which obstruct the sheeting. As an alternative to the driving of sheet pile cofferdams, another method which has been used successfully in the past should be considered. This method requires that excavation be carried to bedrock with side slopes flat enough to remain stable. Within this excavation is placed a prefabricated box of timber, steel or concrete. The tremie concrete is then placed and the remainder of the work carried out as before. The box can be constructed so that the upper part can be easily removed and if necessary, reused.

MISCELLANEOUS

This report was prepared and written by R. Van Veen, Project Engineer. The fieldwork was carried out under the direct supervision of the writer with the use of equipment rented from P.V.K. and Sons Drilling Limited.



R. Van Veen
Project Engineer



K.G. Selby, P. Eng.
Supervising Engineer

APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

WP 55-75-03 LOCATION Sta. 622+29 c 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE Dec. 20-27 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE NX Wash-Boring and Cone Test CHECKED BY R.V.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
633.3	Ground Level															
0.0	Clayey Silt Trace of Sand & org. Very Stiff		1	SS	20	630										
626.3			2	SS	18											
7.0	Silty sand some gravel, trace of clay, some pockets of clayey silt		3	SS	46											
			4	SS	35											
			5	SS	29											
617.8	Compact to Dense		6	SS	13	620										
15.5			7	SS	100/3"											
18.5			8	SS	100/3"											
	Sand & Gravel, Trace of clay & silt, Pockets of clayey silt Frequent shale & shaley Dolomite Boulders Weathered		9	RC BXL	REC 11%	610										
			10	SS	18											
			11	RC BXL	REC 100%											
	Dense to Very Dense (Glacial Till)		12	RC BXL	REC 31%	600										
598.8																
34.5	Bedrock		13	RC BXL	REC 94%											
	Dolomite															
	Med. Hard to Hard Intermittent Layers of Gypsum (2"-3")		14	RC BXL	REC 100%	590										
			15	RC BXL	REC 100%											
581.2						580										
52.1	End of Borehole															

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 2

WP 55-75-03 LOCATION Sta. 621+19 C 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE December 29, 1976 - Jan 4, 1977. COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE NX Wash-Boring & Cone Test CHECKED BY C.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT			LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		SHEAR STRENGTH P.S.F.					W_P W W_L WATER CONTENT %				
							O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL X LAB VANE									
617.7	Ground Level															
614.2	Silty fine sand (org.) Gravel, some sand (Fill) Traces of Silt, v. Dense		1	SS	138											
614.2	Clayey Silt to Silt, some sand with Gravel Stiff to Very Stiff		2	SS	100/3"											
608.0	Frequent boulders of shale & dolomite severely Weathered (Glacial Till)		3	SS	13											
608.0			4	SS	21											
608.0			5	SS	14											
608.0			6	SS	20											
608.0			7	SS	15											
599.6			8	SS	100/2"											
599.6	Bedrock		9	RC NXL	REC 90%											
599.6	Gypsum		10	RC NXL	REC 98%											
599.6	Soft		11	RC NXL	REC 94%											
599.6	Impregnated with Dolomite Med. Hard		12	RC NXL	REC 82%											
599.6	Dolomite Med. Hard		13	RC NXL	REC 80%											
599.6	Impregnated with Gypsum															
599.6	Soft															
575.5	End of Borehole															
42.2	Note: Water Level not established															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 3

WP 55-75-03 LOCATION Sta. 620+16 @ 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE Jan 5&6 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE NX Wash-Boring & Cone Test CHECKED BY el.f.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT			LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					w_p w w_L		
							SHEAR STRENGTH P.S.F.							
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE							
										WATER CONTENT %				
616.6	Ice Level					ELEV								GR SA SI C
0.0	Water					610								
606.6	Bottom of River													
10.0	Fine Sand Some Silt & Clay Loose to compact Frequent Boulders of		1	SS	42									
			2	SS	24									
			3	SS	10									
598.1	Weathered Shale(2"-6")		4	SS	7/6	600								
18.5	Bedrock Gypsum Soft Impregnated with Dolomite		5	RC NXL	REC 83%									
			6	RC NXL	REC 100%	590								
			7	RC NXL	REC 70%									
			8	RC NXL	REC 66%	580								
578.1	End of Borehole													
38.5														

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 4

WP 55-75-03 LOCATION Sta. 619+08 @ 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE Jan. 11 & 12, 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE NX Wash-Boring & Cone Test CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W _P	W	W _L		
616.3	Ice Level															
0.0	Water															
606.0	Bottom of River															
10.3	Traces of Org.		1	SS	51											
	Fine Sand, Trace of		2	SS	69											
	Silty & Clay. Loose		3	SS	20											
	to Compact. Frequent		4	SS	6											
596.6	boulders of weathered		5	SS	75											
	shale (2"-6")		6	RC	75											
19.7	Bedrock		6	NXL	REC											
	Dolomite				56%											
	Hard		7	RC	REC											
587.6	Bands of Gypsum				88%											
	Soft															
28.7	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

WP 55-75-03 LOCATION Sta. 618+01 C 'B' ORIGINATED BY R.V.V.
 DIST 4 HWY 6N BORING DATE Jan. 14, 17, 19, 20 1977 COMPILED BY R.V.V.
 DATUM Geodetic BOREHOLE TYPE NX Wash Boring & Cone Test CHECKED BY W.F.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		UNIT WEIGHT γ	REMARKS % GR SA SI C			
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20	40	60	80			100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE	w_p — w — w_L WATER CONTENT %
616.0	Ice Level														
0.0	Water														
608.5	Bottom of River						610								
7.5	Clayey. Trace of org. silt with fine sand		1	SS	102										
604.0	Stiff. Boulders of weathered shale (2"-3")		2	SS	9										
12.0	Fine Sand		3	SS	26										
	Trace of silt & clay		4	SS	17										
	Compact		5	SS	69										
	Frequent Bounders of weathered shale & dolomite (2"-6")		6	SS	24										
592.8			7	SS	18										
23.2	Bedrock Gypsum, Soft Bands of Dolomite Med. Hard		8	SS	52/8"										
			9	RC NXL	REC 88%		590								
			10	RC NXL	REC 100%										
	Dolomite Med. Hard to Hard Bands of Gypsum Soft		11	RC NXL	REC 81%		580								
			12	RC NXL	REC 74%										
573.5															
42.5	End of Borehole														

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 6

WP 55-75-03 LOCATION Sta. 616+95 @ 'B'
 DIST 4 HWY 6N BORING DATE January 21 & 24, 1977
 DATUM Geodetic BOREHOLE TYPE NX Wash Boring & Cone Test
 ORIGINATED BY R.V.V.
 COMPILED BY R.V.V.
 CHECKED BY *v.f.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
615.7	Ice Level															
0.0	Water															
609.7	Bottom of River					610										
6.0	Fine Sand Some Silt & Clay Loose to Compact Frequent Boulders of Weathered Shale (2"-6")		1	SS	34											
			2	SS	24											
			3	SS	6											
			4	SS	33											
			5	SS	36											
			6	SS	35											
			7	SS	15											
593.4	Very Loose		8	SS	3											
22.3	Bedrock, Dolomite Bands of Gypsum Soft		9	SS	20/10"											
588.4			10	RC NXL	REC 74%	590										
27.3	End of Borehole															

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

WP 55-75-03

LOCATION Sta. 615+88 C 'B'

ORIGINATED BY R.V.V.

DIST 4 HWY 6N

BORING DATE January 25, 26, 28, 1977

COMPILED BY R.V.V.

DATUM Geodetic

BOREHOLE TYPE NX Wash Boring & Cone Test

CHECKED BY *W.J.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w		UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w		
615.5	Ice Level														
0.0	Water														
612.5	Bottom of River														
3.0	Traces of Organics		1	SS	1/6"										
	Fine Sand		2	SS	36										
	Trace of Silt & Clay Compact		3	SS	50/3"										
	Frequent Boulders of Weathered Shale (2"-6") & Dolomite		4	SS	30										
			5	SS	23										
			6	SS	26										
			7	SS	60/4"										
			8	SS	16										
594.1	Very Loose		9	SS	1/11"										
21.4	Bedrock Gypsum Soft		10	RC	REC										
	Sands of Dolomite Med. Hard		11	RC	REC										
			12	RC	REC										
	Dolomite Med. Hard			NXL	86%										
	Bands of Gypsum Soft		13	RC	REC										
574.1				NXL	74%										
41.2	End of Borehole														

OFFICE REPORT ON "SOIL EXPLORATION"

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

WP 55-75-03 LOCATION Sta. 614+ 82 C 'B' ORIGINATED BY J.M.
 DIST 4 HWY 6N BORING DATE January 20, 1977 COMPILED BY J.M.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY J.F.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w WATER CONTENT % w_p w w_L	UNIT WEIGHT γ	REMARKS % GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
619.9	Ground Level													
0.0	Silt with fine sand organic Very Loose		1	SS	4									
611.9			2	SS	3									
8.0			3	SS	130	7"								
609.0			4	SS	12	610								
10.9	Silty fine Sand Trace of Clay Compact Frequent Boulders of Weathered Shale & Dolomite (2"-6")		5	SS	100	4"								
			6	SS	29	4"								
			7	SS	100	4"								
			8	SS	52	600								
			9	SS	77									
			10	SS	24									
590.9			11	SS	102	11"								
29.0	Bedrock, Gypsum Soft, Bands of Dolomite Dolomite Med. Hard to Hard Bands of Gypsum Soft		12	SS	100	590								
580.9			13	RC BXL	REC 100%	580								
39.0	End of Borehole													

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RECORD OF BOREHOLE NO 9

WP 55-75-03 LOCATION Sta. 613+95 p 'B' ORIGINATED BY JM
 DIST 4 HWY 6N BORING DATE Jan. 21, 1977 COMPILED BY JM
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY W.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w WATER CONTENT % $w_p \quad w \quad w_L$	UNIT WEIGHT γ	REMARKS % GR SA SI C.
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
618.9	Ground Level													
0.0	Silt													
	with fine sand		1	SS	2									
	Organic		2	SS	3									
611.4	Very Loose		3	SS	43									
58.5	Silty Fine Sand		4	SS	104	610								
	Trace of Clay		5	SS	23									
	Compact		6	SS	53									
605.4	Frequent Boulders of		7	SS	180	10" 600								
13.5	Weathered Shale		8	SS	9									
	& Dolomite		9	SS	100	2"								
	(2"-6")		10	SS	100	5"								
592.4	End of Borehole													
26.5	Probable Bedrock													

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RECORD OF BOREHOLE NO 10

WP 55-75-03 LOCATION Sta. 613+08 @ 'B' ORIGINATED BY JM
 DIST 4 HWY 6N BORING DATE January 21 & 24, 1977 COMPILED BY JM
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY apf

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		UNIT WEIGHT γ	REMARKS % GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100		w_p ——— w ——— w_L			
							SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT %			
618.9	Ground Level											
0.0	Clayey Silt with fine sand, some gravel, Stiff		1	SS	9							

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RECORD OF BOREHOLE NO 11

WP 55-75-03 LOCATION Sta. 612+21 c 'B' ORIGINATED BY A.M.
 DIST 4 HWY 6N BORING DATE January 28 - February 2, 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY P.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ P.C.F.	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
640.0	Ground Level															
0.0	Clayey Silt, Some & Sand, Trace of Organics Hard		1	SS	47											
636.0			2	SS	100/5"											
4.0	Sand & Gravel, Some Silt, Very Dense (Glacial Till)		3	SS	50/2"											
631.0			4	SS	13											
9.0	Compact Silty Sand, some Gravel, Pockets of Clayey Silt Dense to Very Dense (Glacial Till)		5	SS	55											
			6	SS	36											
			7	SS	25											
616.0			8	SS	85/1"											
24.0	Clayey Silt to Silt with Sand, some gravel Very Stiff Frequent boulders of weathered shale (Glacial Till)		9	RC BXL	REC 20%											
			10	SS	100/2"											
			11	SS	114/6"											
600.0	End of Borehole Probable Bedrock															

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RECORD OF BOREHOLE NO 12

WP 55-75-03 LOCATION Sta. 612+72 C Line 'A' ORIGINATED BY A.M.
 DIST 4 HWY 6N BORING DATE February 3 & 4, 1977 COMPILED BY A.M.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY R.F.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT			LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w			UNIT WEIGHT γ	REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p			w	w_L
							SHEAR STRENGTH P.S.F.					w_p w w_L				
640.7	Ground Level															
0.0	Clayey Silt		1	SS	30	640										
636.7	Some Organics Hard		2	SS	17											
4.0	Silty Sand Traces of Some Gravel Organics		3	SS	21											
631.2	Compact (Glacial Till)		4	SS	75		5"630									
9.5	Clayey Silt to Silt with Sand		5	SS	100		1"									
	Some Gravel		6	SS	100		1"									
	Very Stiff		7	SS	100		1"									
	Frequent boulders of weathered shale (Glacial Till)		8	SS	100		1"									
600.7			9	SS	100	3"600										
40.0	Bedrock, Dolomite Shaley, Med. Hard		10	RC	REC											
595.7	Bands of Gypsum Soft			BX	96%											
45.0	End of Borehole															

OFFICE REPORT ON 'SOIL EXPLORATION

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RECORD OF BOREHOLE NO 13

WP 55-75-03 LOCATION Sta. 613+79 g Line 'A' ORIGINATED BY JM
 DIST 4 HWY 6N BORING DATE January 24, 1977 COMPILED BY JM
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY V.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w WATER CONTENT % $w_p \quad w \quad w_L$	UNIT WEIGHT γ	REMARKS % GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
618.6	Ground Level													
0.0	Silt Trace of Fine Sand Some Organics Very Loose		1	SS	4									
5.0	Trace of Organics		2	SS	97									
613.6			3	SS	51									
608.6	Fine to Med. Sand Some Silt, Trace of Clay, Compact		4	SS	100/5									
10.0	Frequent Boulders of Weathered Shale (2"-6")		5	SS	82									
600.3			6	SS	52									
18.3	End of Borehole Probable Bedrock		7	SS	75/2									

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RECORD OF BOREHOLE NO 14

WP 55-75-03 LOCATION Sta. 614+66 C Line 'A' ORIGINATED BY J.M.
 DIST 4 HWY 6N BORING DATE January 25 & 26, 1977 COMPILED BY J.M.
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT — w w_p — w — w_L WATER CONTENT %			UNIT WEIGHT γ	REMARKS % GR SA SI C
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
619.1	Ground Level															
0.0	Silt, Some fine Sand Trace of Clay & organics Very Loose		1	SS	3											
614.6			2	SS	6											
4.5	Trace of Marine Sediments Loose		3	SS	—											
	Med. to Coarse Sand some Silt, Trace of Clay, Compact		4	SS	100/2"	610										
	Frequent Boulders of Weathered Shale (2"-6")		5	SS	107											
			6	SS	29											
599.1			7	SS	100/4"	600										
20.0	Bedrock Dolomite		8	RC BXL	REC 12%											
	Soft to Med. Hard Bands of Gypsum Soft															
589.6	Gypsum Soft		9	RC BXL	REC 91%	590										
29.5	End of Borehole															

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RECORD OF BOREHOLE NO 15

WP 55-75-03 LOCATION Sta. 615+54 & Line 'A' ORIGINATED BY JM
 DIST 4 HWY 61 BORING DATE January 26, 1977 COMPILED BY JM
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY d.f.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w $w_p \quad w \quad w_L$ WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
620.1	Ground Level													
0.0	Silt													
	Some fine sand, Trace		1	SS	4									
	of clay & organics		2	AS										
613.1	Very Loose		3	SS	2									
7.0	Marine Sediments		4	SS	0									
	Med. to coarse sand		5	SS	100/3	610								
	some silt		6	SS	23									
	Trace of clay, Compact		7	SS	20									
	Frequent boulders		8	SS	63									
	of weathered shale		9	SS	73	600								
	& shaley dolomite		10	SS	14									
	(2"-6")													
	Very Loose													
591.6	End of Borehole													
28.5	Probable Bedrock													

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 16

WP 55-75-03 LOCATION Sta. 616+58 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 3 & 4, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY V.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT —WL PLASTIC LIMIT —WP WATER CONTENT —W Wp — W — WL WATER CONTENT %	UNIT WEIGHT Y	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
615.2	Ice Level													
0.0	Water													
612.7	Bottom of River													
2.5	Stiff fine sand, trace of org. & marine sed.		1	SS	Sand									
610.2	very loose		2	SS	80/									
5.0	Marine Sediments		3	SS	45									
	Fine to Med. Sand		4	SS	36									
	some gravel		5	SS	21									
	Trace of clay		6	SS	60/									
	Compact		7	SS	48/									
	Frequent boulders		8	SS	23									
	of weathered shale		9	SS	100									
	(2"-6")		10	RC	Rec									
593.2	Bedrock													
22.0	Dolomite													
588.2	Bands of Gypsum													
27.0	End of Borehole													

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 17

WP 55-75-03 LOCATION Sta. 617+66 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 9, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Washboring & Cone Test CHECKED BY *el.f.*

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
614.9	Ice Level															
0.0	Water															
607.9	Bottom of River															
7.0	Organic Fine to med. sand Some gravel, Trace of silt Compact Frequent boulders of weathered shale (2"-6") Loose		1	SS	26											
			2	SS	17											
			3	SS	23											
			4	SS	69											
			5	SS	65											
			6	SS	6											
			7	SS	4											
592.4			8	SS	105											
22.5	Bedrock Layers of Dolomite Med. hard to hard & gypsum soft		9	RC NXL	Rec 90%											
582.4			10	RC NXL	Rec 82%											
32.5	End of Borehole															

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 18

WP 55-75-03 LOCATION Sta. 618+72 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 14 & 15, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Washboring & Cone Test CHECKED BY v.f.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT w_L PLASTIC LIMIT w_p WATER CONTENT w w_p — w — w_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
614.6	Ice Level													
0.0	Water													
606.6	Bottom of River													
8.0	Med. to coarse sand some silt, Trace of clay & gravel compact Frequent boulders of Weathered shale (2"-6")		1	SS	10									
			2	SS	11									
			3	SS	29									
			4	SS	85/	6"								
			5	SS	76									
592.8			6	SS	28	3"								
			7	SS	507									
21.8	Bedrock Layers of dolomite Med-Hard and gypsum soft		8	RC NXL	Rec 92%	590								
582.8			9	RC NXL	Rec 84%									
31.8	End of Borehole													

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 19

WP 55-75-03 LOCATION Sta. 619+78 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 16&17, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Washboring & Cone Test CHECKED BY E.F.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w		UNIT WEIGHT γ	REMARKS			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100						w_p ——— w ——— w_L		
							SHEAR STRENGTH						WATER CONTENT %		
						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
614.5	Ice Level					ELEV							GR SA SI C		
0.0	Water					610									
604.0	Bottom of River														
10.5	V. Loose Marine Sediments		1	SS	4										
	Fine to med. sand		2	SS	60										
	Trace of silt & gravel Compact		3	SS	81										
	Frequent boulders of weathered shale (2"-6") Loose		4	SS	30										
			5	SS	7										
590.2			6	SS	30/	4"Sampler sank 12"50/6" Hammer Bouncing									
24.3	Bedrock			RC	Rec										
	Layers of dolomite med. hard and gypsum soft		7	NXL	86%										
			8	RC	Rec										
				NXL	88%										
580.2	Dolomite Hard					580									
34.3	End of Borehole														

OFFICE REPORT ON 'SOIL EXPLORATION

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 20

WP 55-75-03 LOCATION Sta. 620+83 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 18&21, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Washboring & Cone Test CHECKED BY P.J.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W W_P — W — W_L WATER CONTENT %	UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100			
614.5	Ice Level													
0.0	Water					610								
602.5	Bottom of River													
12.0	Marine Sediments Med. to coarse sand Trace of silt compact Freq. boulders of weathered shale Very (2"-6") Loose		1	SS	18	600								
			2	SS	12									
			3	SS	1									
591.0			4	SS	4									
23.5	Bedrock Layers of dolomite med. hard to hard & Gypsum soft Dolomite Hard		5	RC NXL	Rec 94%	590								
581.0	Bands of Gypsum		6	RC NXL	Rec 54%									
33.5	End of Borehole													

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 21

WP 55-75-03 LOCATION Sta. 621+91 & Line 'A' ORIGINATED BY RVV
 DIST 4 HWY 6N BORING DATE Feb. 21-24, 1977 COMPILED BY RVV
 DATUM Geodetic BOREHOLE TYPE NX Wash-boring & Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT		LIQUID LIMIT _____ w_L PLASTIC LIMIT _____ w_p WATER CONTENT _____ w		UNIT WEIGHT γ	REMARKS	
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	N' VALUES		20 40 60 80 100		w_p _____ w _____ w_L				
							SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE		WATER CONTENT %				
618.6	Ground Level												
0.0	Clayey silt with sa. & gr. shale boulders		1	SS	17								
614.0	Trace of org. v. stiff		2	SS	45								
4.6	Gravel some sand		3	SS	133		8"						
610.1	Trace of silt very dense		4	SS	64		2"						
8.5	Clayey silt to silt with sand & gravel	5	SS	28									
	Stiff to very stiff	6	SS	10									
	Boulders of weathered	7	SS	35									
	Shale & dolomite	8	SS	16									
598.6	(2"-6") (Glacial Till)	9	SS	80	6"								
20.0	Sand & gravel	10	SS	9									
594.4	Very Loose to loose	11	SS	1									
24.2	Bedrock	12	RC	Rec									
	Gypsum soft seams of dolomite		NXL	98%									
	Dolomite	13	RC	Rec									
584.4	Med. hard to hard Bands of gypsum soft		NXL	84%									
34.2	End of Borehole												
	Note: Water level not established												

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HIGHWAY ENGINEERING DIVISION - ENGINEERING MATERIALS OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 22

WP 55-75-03 LOCATION Sta. 622+99 1/2 Line 'A' ORIGINATED BY AM
 DIST 4 HWY 6N BORING DATE Feb. 9, 1977 COMPILED BY AM
 DATUM Geodetic BOREHOLE TYPE Hollow Stem Auger & Cone Test CHECKED BY as.f.

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ	REMARKS
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100		
633.6	Ground Level												
0.0	Clayey silt Trace of sand & organics Stiff to very stiff		1	SS	19	630							
624.6			2	SS	15								
9.0	Sand some gravel		3	SS	11								9 37 43 11
621.6	Trace of clay Compact		4	SS	17								
12.0			5	SS	18	620							
	Clayey Silt to silt with sand some gravel Very stiff Frequent boulders of weathered shale (Glacial till)		6	SS	22								0 53 40 7
			7	SS	100/3"								
			8	SS	30								
			9	SS	56	610							0 46 48 6
			10	SS	31								
603.6			11	SS	78								0 52 41 7
30.0	Sand & gravel		12	SS	5								0 26 56 8
601.1	Loose												
32.5	Bedrock Layers of		13	SS	100/1"								
598.6	Dolomite & gypsum		14	SS	75/1"	600							
35.0	End of Borehole												



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DIAMOND DRILL RECORD

HOLE NO. _____ SHEET NO. 1 of 10

DIP

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N,
Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 1				
18'5"	34'5"	Dolomite, shaly, grey, fine textured, med. hard to soft,				core badly broken and ground. 30%-Recovery, RQD - 0
34'5"	44'2"	Dolomite buffy-grey, fine textured, med. hard, impregnated with gypsum.				RQD - 60% Horizontal bedding and fractures, some lightly contort.
44'2"	52'1"	Dolomite buffy grey to grey, fine textured, med. hard to hard with three 3" sections of gypsum				RQD - 11% Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 2				
18'1"	30'0"	Gypsum, white soft impregnated with dolomite, buffy grey, medium hard				RQD - 45% Horizontal bedding and fractures, some lightly contorted.
30'0"	32'5"	Dolomite, grey, fine textured, med. hard				1 ft. of core missing, RQD - 35% Horizontal bedding and fractures,
32'5"	32'10"	Gypsum, white, soft				
32'10"	35'2"	Dolomite, grey, med. hard with two 2" seams of gypsum				8" of broken core RQD-0

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HOLE NO. _____ SHEET NO. 2 of 10

DIP

PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N.
Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 2 (Cont'd)				
35'2"	39'8"	Dolomite, buffy grey, fine textured, med. hard				RQD 0 core badly broken - parallel to the bedding - horizontal.
39'8"	42'2"	Dolomite, buffy, fine textured, med hard, impregnated with gypsum, white, soft.				RQD - 15%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 3				
8'5"	19'10"	Gypsum, white, soft, impregnated with dolomite, buffy grey, fine textured, med. hard				RQD - 10%. Horizontal bedding and fractures, some lightly contorted.
19'10"	21'0"	Dolomite, grey, fine textured, hard				
21'0"	21'6"	Gypsum, white, soft				
21'6"	28'5"	Dolomite, buffy, buffy-grey, fine textured, hard				core badly broken and ground
		HOLE No. 4				
9'4"	11'4"	Dolomite, buffy-grey, fine textured, med. hard with thin seams of gypsum.				9'4" - 10'4" core ground RQD - 0

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DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 4 (Cont'd)				
11'4"	12'4"	Gypsum, white, soft				RQD - 30%. Horizontal bedding and fractures, some lightly contorted.
12'4"	18'4"	Dolomite, buffy, fine textured, med. hard, impregnated with gypsum, white, soft				RQD - 32%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 5				
15'7"	23'8"	Gypsum, white, soft, impregnated with dolomite, buffy grey, med. hard				RQD - 12%. Horizontal bedding and fractures, some lightly contorted.
23'8"	24'9"	Dolomite, grey, fine textured, med. hard				RQD - 0. Core broken parallel to bedding.
24'9"	25'4"	Gypsum, white, soft				
25'4"	27'0"	Dolomite, grey, med. hard, fine textured with 2" seam of gypsum.				RQD - 20%. Vertical joint 26'-27.4" Horizontal bedding and fractures.
27'0"	27'3"	Gypsum, white, soft				

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90°

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LOCATION Grand River Bridge, Hwy. 6N,
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LATITUDE _____
DEPARTURE _____
BEARING _____

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 5 (Cont'd)				
27'3"	30'7"	Dolomite, grey, fine textured, hard with 2 small pockets of gypsum				RQD - 0. Core broken parallel to the bedding - horizontal.
30'7"	35'0"	Dolomite, buffy-grey, hard, fine textured, impregnated with gypsum, white, soft.				30'7" - 31'1" - core ground RQD - 11%. Horizontal and bedding and fractures.
		HOLE No. 6				
16'3"	21'3"	Dolomite, buffy-grey, fine textured, soft impregnated with gypsum, white, soft				1 1/2 feet of core missing RQD - 20%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 7				
18'4"	30'0"	Gypsum, white soft, impregnated with dolomite, buffy grey, med. hard.				18'4" - 20' core badly broken parallel to the bedding. RQD - 0.
30'0"	31'7"	Dolomite, grey, fine textured, med. hard, shaly in places				
31'7"	32'0"	Gypsum, white, soft.				

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HOLE NO. _____ SHEET NO. 5 of 10

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PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N.
Caledonia, Ontario
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
HOLE No. 7						
32'0"	37'8"	Dolomite, grey, med. hard with gypsum seams with clusters				20' - 30' RQD 56%
						30' - 31'7" RQD 55%
37'8"	38'2"	Gypsum, white, soft				31'7" - 38'2" RQD 0. All fractures parallel to horizontal bedding.
HOLE No. 8						
29'0"	33'0"	Gypsum, white, soft, impregnated with dolomite, buffy				RQD - 60%. Horizontal bedding and fractures, some lightly contorted.
33'0"	36'0"	Dolomite, buffy colour, fine textured, medium hard with gypsum seams				RQD - 50%. Horizontal bedding and fractures, some lightly contorted.
36'0"	37'3"	Dolomite, grey, fine textured, hard				RQD - 0. Core broken parallel to the bedding.
37'3"	37'10"	Gypsum, white, soft				RQD - 100%. Horizontal bedding.
37'10"	38'4"	Dolomite, grey, fine textured, very hard				RQD - 100%. Horizontal bedding.
38'4"	38'7"	Gypsum, white, soft				
38'7"	39'0"	Dolomite, grey, fine textured, hard				

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HOLE NO. _____ SHEET NO. 6 of 10

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LATITUDE _____
DEPARTURE _____
BEARING _____

DIP
90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		<u>HOLE No. 10</u>				
20'0"	21'3"	Dolomite, grey, fine textured, soft, with thin seams of gypsum.				4" of ground core RQD - 50%. Horizontal bedding and fractures, some lightly contorted.
21'3"	25'6"	Dolomite, buffy-grey, fine textured, soft, impregnated with gypsum, white, soft				RQD - 80%. Horizontal bedding and fractures, some lightly contorted.
25'6"	26'5"	Gypsum, white, soft with dolomite, buffy-grey, soft				RQD - 100%. Horizontal bedding and fracture, some lightly contorted.
26'5"	26'9"	Dolomite, buffy-grey, soft				RQD - 100%. Horizontal bedding.
26'9"	29'5"	Gypsum, white, soft				RQD - 80%. Horizontal bedding and fractures, lightly contorted.
		<u>HOLE No. 11</u>				
24'	28'	Dolomite, buffy-grey, fine texture, hard.				Core ground & broken, 25% rec. RQD - 0
		<u>HOLE No. 12</u>				
40'	45'	Dolomite, shaly, grey to yellowish grey, fine textured, med. hard with sections impregnated by gypsum, white, soft.				RQD - 12%. Horizontal bedding and fractures, some lightly contorted.

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HOLE NO. _____ SHEET NO. 7 of 10

DIP

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Caledonia, Ontario.
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		<u>HOLE No. 14</u>				
20'0"	25'0"	Dolomite, greenish-grey, fine textured, soft				Core ground, 4 ft. of core missing
25'0"	27'0"	Dolomite, buffy-grey, fine textured, med. hard impregnated with gypsum, white, soft.				RQD - 75%. Horizontal bedding and fractures, some lightly contorted.
27'0"	29'5"	Gypsum, white, soft				RQD - 70%. Horizontal bedding and fractures, some lightly contorted.
		<u>HOLE No. 16</u>				
19'5"	24'5"	Dolomite, buffy-grey, fine textured, soft impregnated with gypsum.				1 ft. of core missing RQD - 40%. Horizontal bedding and fractures, some lightly contorted.

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HOLE NO. _____ SHEET NO. 8 of 10

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LATITUDE _____
DEPARTURE _____
BEARING _____

90°

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
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LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
HOLE No. 17						
15'5"	16'4"	Dolomite, buffy, fine textured, med. hard, impregnated with gypsum, white, soft (lenses and concentrations)				RQD - 40%. Horizontal bedding and fractures.
16'4"	20'5"	Gypsum, white, soft with dolomitic sections				Fractured every 2" to 3" RQD - 0. Fractured horizontally.
20'5"	22'6"	Dolomite, buffy-grey, fine textured, med. hard, impregnated with gypsum, white, soft.				RQD - 20%. Horizontal bedding and fractures.
22'6"	23'4"	Gypsum, white, soft				RQD - 0. 3" vertical joint at 23'8"
23'4"	25'5"	Dolomite, grey, fine textured, med. hard, to hard				RQD - 0. Horizontal bedding and fractures, lightly contorted.
HOLE No. 18						
13'8"	15'4"	Dolomite, buffy-grey, fine textured, med. hard, impregnated with gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
15'4"	18'10"	Gypsum, white, soft with seams of dolomite				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
18'10"	23'8"	Dolomite, buffy-grey, fine textured, med. hard, impregnated with gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, some lightly contorted.

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HOLE NO. _____ SHEET NO. 9 of 10

DIP

90°

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LOCATION Grand River Bridge, Hwy. 6N
Caledonia, Ontario
LATITUDE _____
DEPARTURE _____
BEARING _____

TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
DRILLED BY _____
LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 19				
13'8"	19'8"	Dolomite, buffy-grey, fine textured, med. hard, interbedded with gypsum, white, soft.				RQD - 30%. Fractured Horizontally. Two 4" sections of pure gypsum
19'8"	21'6"	Dolomite, grey, fine textured, med. hard, with some gypsum				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
21'6"	21'11"	Gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
21'11"	23'8"	Dolomite, grey, fine textured, hard				RQD - 50%. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 20				
11'5"	14'9"	Gypsum, white, soft impregnated by dolomite, buffy, med. hard				RQD - 55%. Horizontal bedding and fractures, some lightly contorted.
14'9"	15'7"	Dolomite, buffy grey, med. hard, fine textured, with thin seams of gypsum				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
15'7"	16'5"	Gypsum, white, soft				RQD - 40%. Horizontal bedding and fractures, some lightly contorted.

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HOLE NO. _____ SHEET NO. 10 of 10

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PROPERTY W.P. 55-75-03
LOCATION Grand River Bridge, Hwy. 6N
Caledonia, Ontario
LATITUDE _____
DEPARTURE _____
BEARING _____

90°

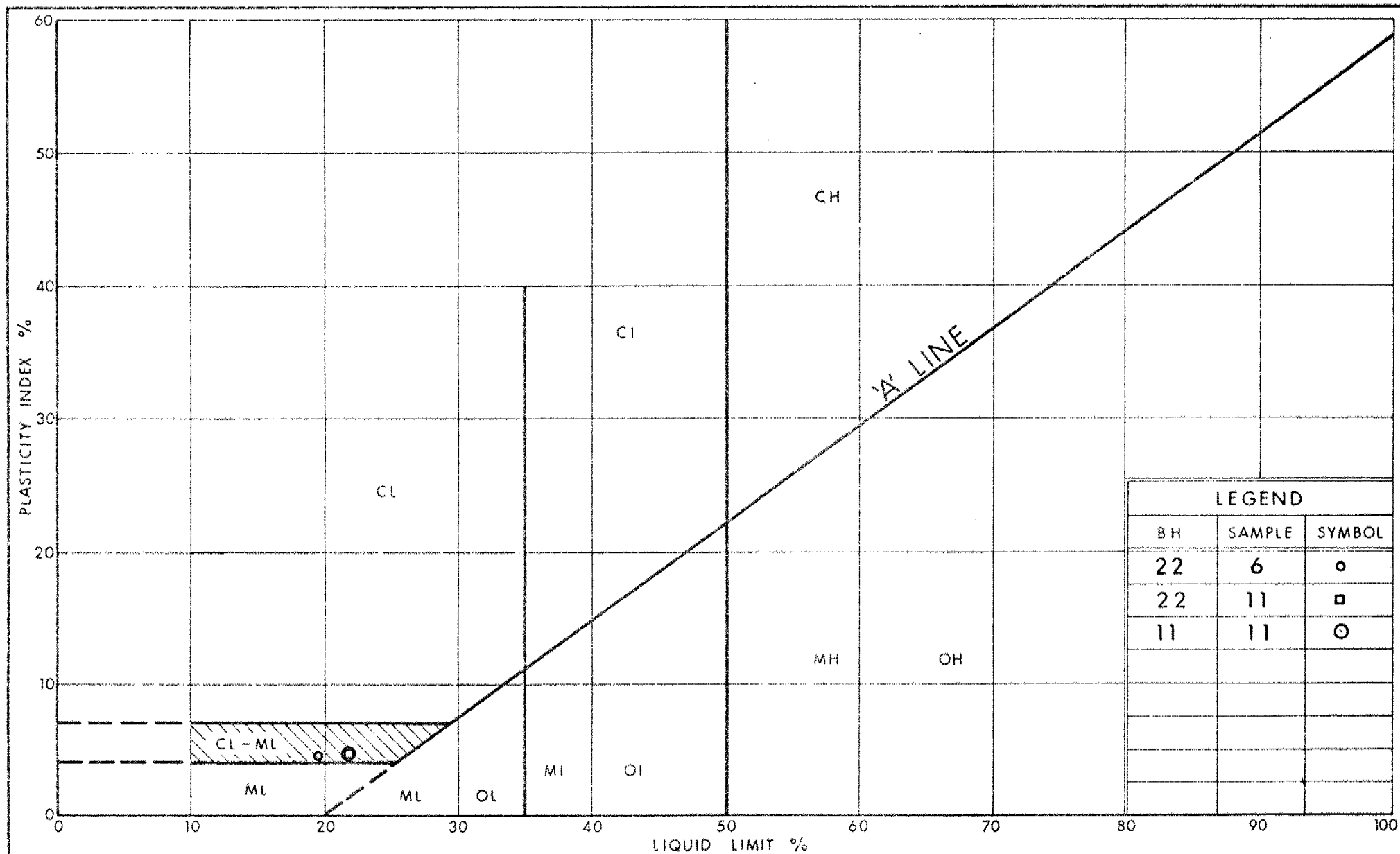
TOTAL FOOTAGE _____

ELEV. COLLAR _____
DATUM _____
DATE STARTED _____
DATE COMPLETED _____
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LOGGED BY _____

FOOTAGE		FORMATION	SAMPLE NUMBER			REMARKS
FROM	TO					
		HOLE No. 20 (Cont'd)				
16'5"	21'5"	Dolomite, grey, fine textured, hard with 3" section of gypsum.				Last 8" of core ground RQD - 0. Horizontal bedding and fractures, some lightly contorted.
		HOLE No. 21				
24'2"	25'6"	Dolomite, grey and buffy grey, fine textured, med. hard with gypsum concentrations and lenses				RQD - 50%. Horizontal bedding and fractures, some lightly contorted.
25'6"	28'6"	Gypsum, white, soft with seams of dolomite				RQD - 10%. Horizontal bedding and fractures, some lightly contorted.
28'6"	30'1"	Dolomite, buffy-grey, fine textured, med. hard with thin lenses and concentrations of gypsum.				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
30'1"	31'8"	Dolomite, buffy-grey, fine textured, med. hard, impregnated with gypsum, white, soft				RQD - 0. Horizontal bedding and fractures, some lightly contorted.
31'8"	34'2"	Dolomite, grey, fine textured, hard, with few small concentrations of gypsum.				RQD - 0. Horizontal bedding and fractures, some lightly contorted.

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PLASTICITY CHART
CLAYEY SILT TO SILT
WITH SAND & GRAVEL

FIG No 1

W P 55-75-03

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_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e \sigma$ or $\ln \sigma$	NATURAL LOGARITHM OF σ
$\log_{10} \sigma$ or $\log \sigma$	LOGARITHM OF σ 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

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION 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

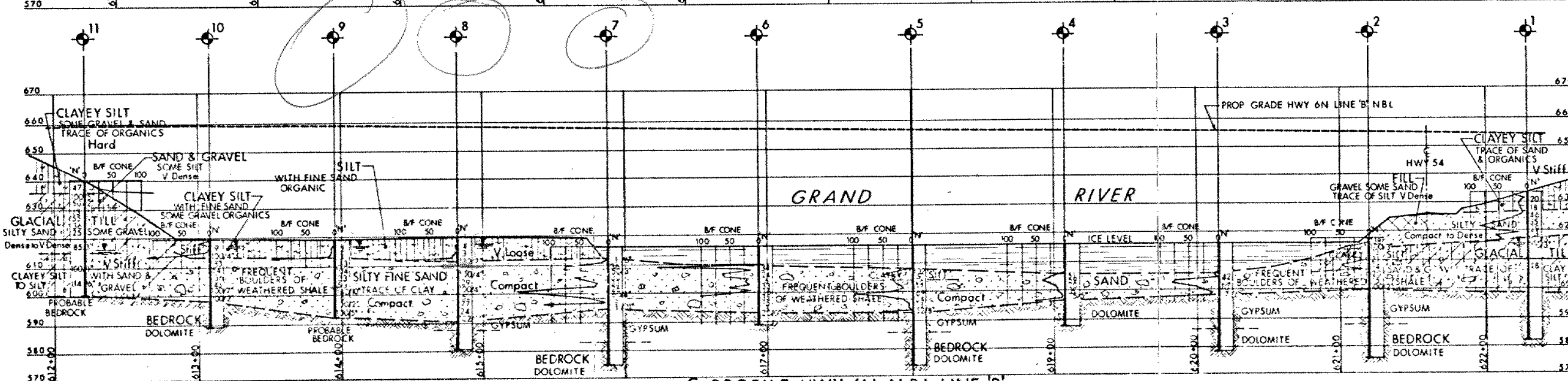
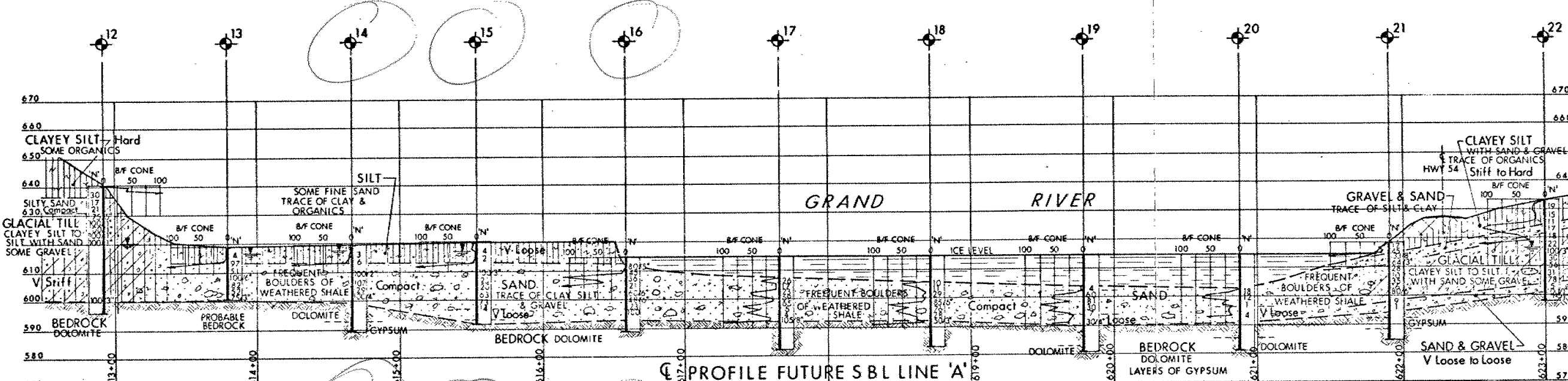
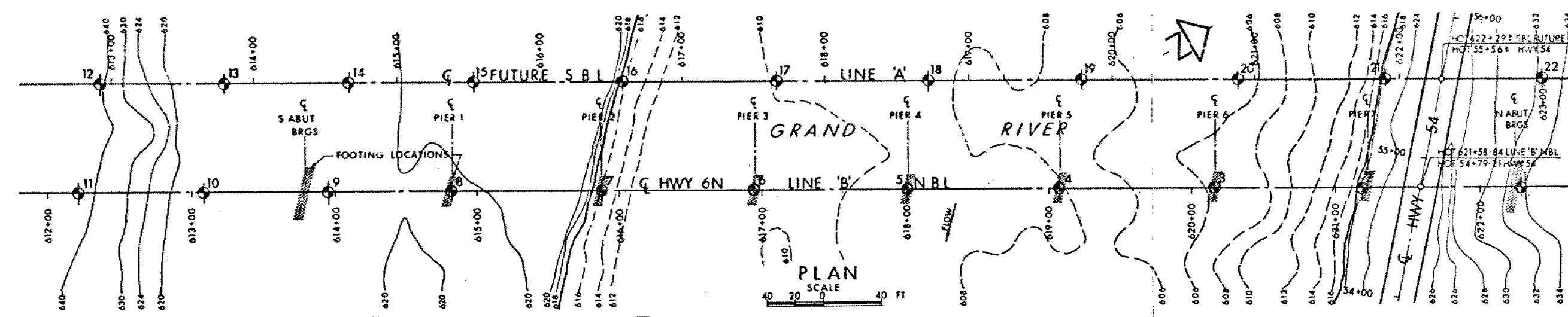
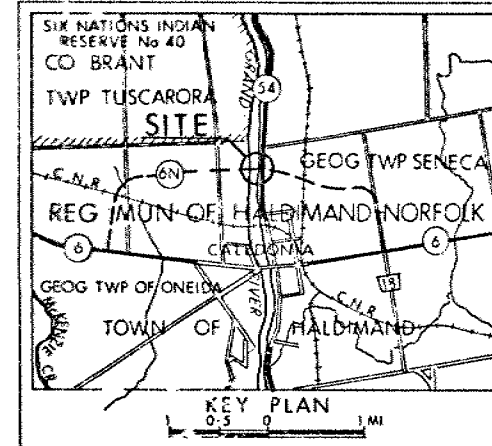
S.S	SPLIT SPOON	T.W	THINWALL OPEN
W.S	WASHED SAMPLE	T.P	THINWALL PISTON
S.T	SLOTTED TUBE SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE

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 "		



LEGEND

- Bore Hole
- Dynamic Cone Penetration Test (Cone)
- Bore Hole & Cone
- "N" Blows/ft (Std Pen Test 350ft lbs energy)
- CONE Blows/ft (60° Cone, 350ft lbs energy)
- WL at time of investigation
DEC 2-N FEB 1977
NO WL established BH No. 2 & 21

No	ELEVATION	STATION	OFFSET
1	633-3	622+29	LINE 'B'
2	617-7	621+19	"
3	616-6	620+16	"
4	616-3	619+08	"
5	616-0	618+01	"
6	615-7	616+95	"
7	615-5	615+88	"
8	619-9	614+82	"
9	618-9	613+95	"
10	618-9	613+08	"
11	640-0	612+21	"
12	640-7	612+72	LINE 'A'
13	618-6	613+79	"
14	619-1	614+66	"
15	620-1	615+54	"
16	615-2	616+58	"
17	614-9	617+66	"
18	614-6	618+72	"
19	614-5	619+78	"
20	614-5	620+83	"
21	618-6	621+91	"
22	633-6	622+99	"

-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



Memorandum

To: Mr. K.G. Selby
Supervising Engineer
Soil Mechanics Section

From: Pavement Design & Management Section
Geology Unit
Room 313, Central Bldg.

Attention:

Date: 79 01 12

Our File Ref.

In Reply to

Subject:

W.P. 55-75-03
Grand River Bridge - Hwy. 6 N

The described cores from drill holes ACEF are from dolomitic rock of the Upper Silurian, Salina Formation. Most of the core shows severely weathered characteristics.

The dolomite is shaly, silty, vuggy, grey to buffy-yellowish in colour depending on the degree of weathering. Hardness varies from very hard to very soft. Most of the core is broken or ground, with some deeply weathered sections showing signs of alteration to clay.

The described cores show low percentage of recovery, which can be explained by:

- a) cavities and fissures in the rock formation,
- b) poor quality of rock.

On the basis of the investigated cores, it could be assumed that suspected cavities are distributed unevenly and they occupy about 30% of the rock mass.

ZK:ea

Z. Koniuszy
Geologist

Mr. W. Lin
Design Engineer, Central Section
Structural Office
2nd Floor, West Building

Soil Mechanics Section
Engineering Materials Office
Room 315, Central Building

79 01 05

Re: Grand River Bridge, Site No. 9-130
Hwy. 6N, District 4, Hamilton
W.P. 55-75-03

Additional field investigation at the location of Pier No. 1 (Sta. 614+80) of the above mentioned project has shown that material previously classified as silty sand containing frequent boulders of weathered shale and dolomite, is in actual fact, bedrock of the Salina Formation which consists of extensively weathered shaley, silty, reef dolomite.

The volume of cavities in this rock strata which extends from elevation 609+ down to elevation 590, is estimated to be in the order of 30%. It will not be possible to advance piles by conventional driving methods through the strata and we, therefore, recommend that the piled foundation design be changed to a spread footing. Due to the poor quality of the rock and the existence of the cavities, the net bearing pressure should not exceed 4 tons per square foot. The existing ground level is about elevation 620 and the groundwater level about elevation 618. Because of the very high permeability of the bedrock it will be very difficult, if not impossible, to lower the groundwater below the rock surface. Therefore, we recommend that a sufficient thickness of tremie concrete be poured to seal the bedrock (i.e. about 4 feet) upon which the actual spread footing can be placed in the dry. For computations of resistance to lateral forces, a friction coefficient equal to $\tan 24^\circ$ (0.45) should be assumed to apply between the rock and the underside of the tremie concrete. The necessary revisions to Drawing 9-130-2 will be made by this Section on receipt of your revised bridge drawings.

Please advise if further information is required.

K.G. Selby
Supervising Engineer

KGS/gs

cc: G.C.E. Burkhardt
P.F. Weber
Files

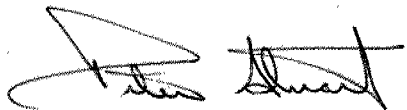
Mr. C.S. Grebski
Structural Design Engineer
Structural Office
West Building, Downsview

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 08 18

Re: Grand River Bridge, Caledonia By-pass
W.P. 55-75-03, Site 9-130
Hwy. 6N, District 4, Hamilton

A review of the final bridge drawings for this project does not lead to
any comments on the soil mechanics related portion of the design.



P. Stuart
Project Engineer

For: K.G. Selby
Supervising Engineer

PS/gs

cc: Files ✓



50 GALAXY BLVD., UNIT 11,
REXDALE, ONTARIO, CANADA M9W 4Y5
TELEPHONE: (416) 675-1440
TELEX: 06-968749

12.8
R. Van Uan
MORTON, DODDS & PARTNERS
CONSULTING GEOTECHNICAL & GEOLOGICAL ENGINEERS

J.D. MORTON, P. ENG.
R.B. DODDS, P. ENG.
D.J. BELSHAW, P. ENG.
K.H. KING, P. ENG.

April 5th, 1977

RE: 01-7703-122

Ontario Ministry of Transportation,
& Communication,
1201 Wilson Avenue,
DOWNSVIEW, Ontario.

ATTENTION: K. SELBY, P. Eng., Esq.

RE: CALEDONIA DAM & DUAL HIGHWAY
BRIDGE PROJECTS



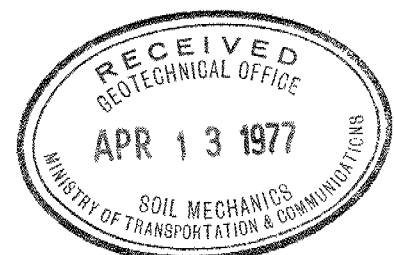
Dear Ken:-

Enclosed are our draft logs of the rock core holes put down by your agency at the Caledonia Highway Bridge site, as prepared by one of our geologists.

We are submitting second copies of these logs to Kilborn Limited, and the Grand River Conservation Authority, in connection with the proposed Caledonia Dam reconstruction adjacent to the bridge site. We understand that three (3) copies of your final Highway Bridge Foundation Report for the project will be forwarded to us in due course for information.

Please note that we have found your own staff's calculation of rock permeabilities to be in error. The corrected values are entered on the attached log sheets. If you have any specific query on this point please contact our Richard King at the Toronto office.

cont'd.....




-2-

RE: 01-7703-122

Your co-operation and assistance in this liason of technical data is very much appreciated.

Yours very truly,

MORTON, DODDS & PARTNERS



JOHN D. MORTON, M. Eng., P. Eng.

JDM/ms

cc: Kilborn Engineering Limited

encls.

Wom Vear.

leg

MORTON, DODDS & PARTNERS
CONSULTING GEOTECHNICAL & GEOLOGICAL ENGINEERS

50 GALAXY BLVD., UNIT 11,
REXDALE, ONTARIO, CANADA M9W 4Y5
TELEPHONE: (416) 675-1440
TELEX: 06-968749

J.D. MORTON, P. ENG.
R.R. DODDS, P. ENG.
D.J. BELSHAW, P. ENG.
K.H. KING, P. ENG.

April 5th, 1977

RE: 01-7703-122

Kilborn Engineering Limited,
36 Parklawn Road,
ETOBICOKE, Ontario,
M8Y 3H8.

ATTENTION: MR. J. JONES, P. ENG.

Dear Sirs:-

RE: Caledonia Dam
Geological & Geotechnical Data from Ministry
Of Transport & Communications regarding pro-
posed Caledonia Bypass bridge sites

Enclosed please find two (2) sets of our draft core logs for the rock test holes recently put down by Ontario Ministry of Transport & Communications at their proposed dual highway bridge site located upstream from the Caledonia Dam Site.

The review of Ministry of Transport & Communications data and logging of the core and insitu testing results was authorized in your telephone call of March 15th, 1977. We consider that the rock conditions defined in the Ministry of Transport & Communications work are likely to be similar to those at the proposed dam site, though some confirmatory test drilling and coring and possibly geophysical work will be necessary. Our comments during our April 4th meeting with you and Gus Ribeiro related. A schedule of proposed follow-up exploratory work and cost estimate will be forwarded to you not later than Thursday April 7th, 1977.

Yours very truly,

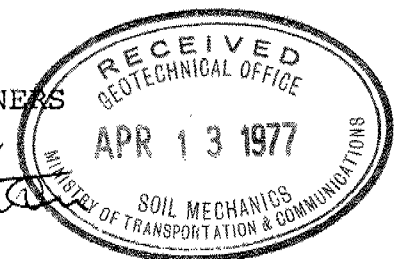
MORTON, DODDS & PARTNERS

J.D. Morton

JOHN D. MORTON, M. Eng., P. Eng.

JDM/ms

cc: Ministry of Transport
& Communications



PROJECT CALEDONIA DAM PROJECT.		JOB No. 01-7703-122 MAY 55. 75. 03		HOLE No. 1		SHEET 1 OF 3 SHEETS																																														
CORE DRILLING LOG																																																				
LOCATION STA. 622 + 29 & B.				ELEVATION TOP OF HOLE 633.3 FT																																																
				DATUM GEODETIC																																																
DRILLING AGENCY		DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN	disturbed	undisturbed	TOTAL No OF CORE BOXES 3																																													
DATE STARTED DEC 20 - 27/76		HOLE INCLINATION VERTICAL		THICKNESS OF OVERBURDEN 28 FT																																																
				DEPTH CORE DRILLED IN ROCK 20 FT																																																
BIT SIZE & TYPE BXL		TOTAL DEPTH OF HOLE 57.1 FT																																																		
GROUND WATER LEVEL		depth	elevation	TOTAL CORE RECOVERY 20.9 FT																																																
GENERAL ABBREVIATIONS & SYMBOLS <table style="width:100%; font-size: small;"> <tr> <td>cl - clay</td> <td>sty.p - stylolitic parting</td> <td>sil - siliceous</td> <td>Dol Dolostone</td> <td> Grit, Conglomerate</td> </tr> <tr> <td>cg - clay gouge</td> <td>h - horizontal</td> <td>calc - calcareous</td> <td>Lst Limestone</td> <td> Breccia</td> </tr> <tr> <td>bc - broken core</td> <td>i - inclined</td> <td>dolc - dolomitic</td> <td>Sst Sandstone</td> <td> Evaporite (H = Salt, G = Gypsum, K = Potash, A = Anhydrite)</td> </tr> <tr> <td>dc - disced core</td> <td>v - vertical</td> <td>chy - cherty</td> <td>Sst Siltstone</td> <td> Igneous</td> </tr> <tr> <td>rc - rubble core</td> <td>foss - fossiliferous</td> <td>argill - argillaceous</td> <td>Mst Mudstone</td> <td> Schist, Gneiss</td> </tr> <tr> <td>bp - bedding plane</td> <td>tr - trace</td> <td>imp - impure</td> <td>Sh Shale</td> <td> Volcanic Ash, Tuff</td> </tr> <tr> <td>fp - fracture plane</td> <td>nod - nodular</td> <td>bedd - bedded</td> <td>Mar Marble</td> <td> Lava</td> </tr> <tr> <td>jp - joint plane</td> <td>lam - laminated</td> <td>* O - Oil</td> <td>Qu Quartz</td> <td></td> </tr> <tr> <td>F - Fault</td> <td>lay - layered</td> <td>* G - Gas</td> <td>Cc Concrete</td> <td></td> </tr> </table>								cl - clay	sty.p - stylolitic parting	sil - siliceous	Dol Dolostone	Grit, Conglomerate	cg - clay gouge	h - horizontal	calc - calcareous	Lst Limestone	Breccia	bc - broken core	i - inclined	dolc - dolomitic	Sst Sandstone	Evaporite (H = Salt, G = Gypsum, K = Potash, A = Anhydrite)	dc - disced core	v - vertical	chy - cherty	Sst Siltstone	Igneous	rc - rubble core	foss - fossiliferous	argill - argillaceous	Mst Mudstone	Schist, Gneiss	bp - bedding plane	tr - trace	imp - impure	Sh Shale	Volcanic Ash, Tuff	fp - fracture plane	nod - nodular	bedd - bedded	Mar Marble	Lava	jp - joint plane	lam - laminated	* O - Oil	Qu Quartz		F - Fault	lay - layered	* G - Gas	Cc Concrete	
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ELEVATION	DEPTH	ROCK LEG-END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	18.5		<div style="border: 1px dashed black; padding: 5px; margin: 5px;"> <p style="text-align: center;">CORE DRILLING CONTINUED</p> <p style="text-align: center;">GREY BROWN FINE GRAINED SILTSTONE. WELL CEMENTED NO REACTION WITH HCL. ACID</p> </div>				<p>RUN #1</p> <p>DRILLED 18.5' - 25.5'</p> <p>PULLED 18.5' - 25.5'</p> <p>ALL ROCK FRAGMENTS EXCEPT 1 x 0.2' PIECE.</p> <p>TABULAR LAYER OVERLYING SOIL</p>
	25.5		<div style="border: 1px dashed black; padding: 5px; margin: 5px;"> <p style="text-align: center;">LOST CORE OR SOIL WASHED OUT OF BARREL.</p> </div>				
	28.0		<div style="border: 1px dashed black; padding: 5px; margin: 5px;"> <p style="text-align: center;">MIXTURE OF GREY BROWN DOLOMITE AND GREY CLAYEY SILT</p> </div>				<p>25.5' - 28.0' NOT CORED</p> <p>SPLIT SAMPLE TAKEN N. 8</p> <div style="border: 2px solid black; border-radius: 50%; padding: 10px; text-align: center; margin: 10px;"> <p>APR 13 1977</p> <p>SOIL MECHANICS MINISTRY OF TRANSPORTATION & COMMUNICATIONS</p> </div>
			<div style="border: 1px dashed black; padding: 5px; margin: 5px;"> <p style="text-align: center;">GREY SILTSTONE. FINE GRAINED. INCIPENT FRACTURES. IRON STAINING ON IRREGULAR JOINT SURFACES</p> </div>	100%	0%		<p>RUN #2</p> <p>DRILLED 28.00' - 30.00'</p> <p>PULLED 28.00' - 30.00'</p> <p>ALL CORE BROKEN.</p>

CORE DRILLING LOG (cont.)			THICKNESS OF OVERBURDEN (DEPTH TO ROCK) 28.00'		HOLE No. 1		SHEET 2 OF 3 SHEETS	
ELEVATION TOP OF HOLE 433.3			HOLE / CORE SIZE RXL		JOB MTC 01-1403-172 72.03			
ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.O.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)	
		bc soil	AREY PARTIALLY WEATHERED SILTSTONE. FRAGMENTS BECOMING HEAVILY WEATHERED PATCHES OF GYPSUM, SOIL AND FRAGMENTS.	1.3' 1.5' = 73%	0%		RUN #3 DRILLED 30.00' - 34.5' PULLED 30.00' - < 34.5'	
			CORE LOSS					
34.5		bc 7 No fps	LIGHT BROWN DOLOMITE MINERALISED WITH GYPSUM (STRONG)	3.4' 3.4' = 100%	3.4' 3.2' 81%		RUN #4 DRILLED 34.5' - 37.9' PULLED 34.5' - < 37.7'	
			SCRUBBING					
37.9		bc 23 No fps	LIGHT BROWN DOLOMITE MINERALISED WITH GYPSUM. OCCASIONAL 0.01' SILTSTONE SCAMS. SOUND CORE EXCEPT WHERE SHOWN. (STRONG)	6.3' 6.3' = 100%	7.95 6.3 = 67%		+ OVERDRILLED RUN #5 DRILLED 37.9' - 44.2' PULLED 37.7' - 44.0'	
44.2		bc 16 No fps	LIGHT BROWN DOLOMITE MINERALISED BY GYPSUM OCCASIONAL 0.01' - 0.02' FACICULAR GYPSUM VEINS	7.9 7.9 = 100%	0		+ OVERDRILLED RUN #6 DRILLED 44.2' - 52.1 PULLED 44.0' - < 52.1	
47.7		bc 7 No fps						
		bc 7 No fps						

CORE DRILLING LOG (cont.)			THICKNESS OF OVERBURDEN (DEPTH TO ROCK) 28.00		HOLE No. 1		SHEET 3 OF 3 SHEETS	
ELEVATION TOP OF HOLE 132.2			HOLE / CORE SIZE 2XL		JOB NO. 01-1703-122 DATE 7.2.02			
ELEVATION	DEPTH	ROCK LOG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.O.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)	
	50.0	9 7 No fps	LIGHT BROWN DOLOMITE MINERALISED BY GYPSUM GREY SILTSTONE. MOD STRONG. BECOMING LIGHT BROWN DOLOMITE WITH GYPSUM BANDS AND POCKETS.				RUN # 6 . CONT'D	
	50.5	21 No fps						
	52.1	13 No fps						
			BOREHOLE COMPLETED					

PROJECT CALIFORNIA DAM PROJECT		JOB No. 01-7703-172 NTC 55-75-03	HOLE No. 2	SHEET 1 OF 2 SHEETS
CORE DRILLING LOG				
BORING DATA FROM CALIFORNIA HWY BRIDGE PROJECT LOCATION STA. 621 + 19 & 'B'		ELEVATION TOP OF HOLE 617.7'		
		DATUM GEODETTIC		
DRILLING AGENCY	DRILL MODEL	TOTAL OF OVERBURDEN SAMPLES TAKEN	disturbed	undisturbed
DATE STARTED DEC 29/76 - JAN 4/77		HOLE INCLINATION VERTICAL	THICKNESS OF OVERBURDEN 18.1'	
BIT SIZE & TYPE NX		DEPTH CORE DRILLED IN ROCK 20.1'		
GROUND WATER LEVEL		TOTAL DEPTH OF HOLE 42.2'		
depth		TOTAL CORE RECOVERY 21.65'		
elevation				

GENERAL ABBREVIATIONS & SYMBOLS

cl - clay cg - clay gouge bc - broken core dc - disced core rc - rubble core bp - bedding plane fp - fracture plane jp - joint plane F - Fault	sty.p - stylolitic parting h - horizontal i - inclined v - vertical foss - fossiliferous tr - trace nod - nodular lam - laminated lay - layered	fis - fissile sil - siliceous calc - calcareous dolc - dolomitic chy - cherty argill - argillaceous imp - impure bedd - bedded * O - Oil * G - Gas	Dol /// Dolostone Lst /// Limestone Sst /// Sandstone Sst /// Siltstone Mst /// Mudstone Sh /// Shale Mar /// Marble Qu /// Quartz Cc /// Concrete	*••• Grit, Conglomerate *••• Breccia /// Evaporite (H = Salt, G = Gypsum K = Potash A = Anhydrite) <<< Igneous SSS Schist, Gneiss *•• Volcanic Ash, Tuff *•• Lava
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ELEVATION	DEPTH	ROCK LEG-END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	18.1	Sc	CORE DRILLING COMMENCED LIGHT BROWN DOLOMITE EXTENSIVELY MINERALISED BY GYPSUM, IN VEINS AND PARTICLES THROUGHOUT THE CORE MOD. STRONG TO STRONG JOINTS & FRACTURES HORIZONTAL, NOT TIGHT.	3.75' 4.1	6.8' 4.1		RUN #1 DRILLED 18.1' - 22.2' PULLED 18.1' - 22.2'
	22.2		CORE LOSS Sc - SCRUBBED CORE.				CORE LOST BY SCRUBBING
	22.2	Sc	AS ABOVE. OCCASIONAL VUGS. GYPSUM CRYSTALLISATION EVIDENT ON SOME JOINT PLANES.	4.8 5.0 = 96%	0		RUN #2 DRILLED 22.2' - 27.2' PULLED 22.2' - 27.2'
	27.2		CORE LOSS				
	27.2	Sc	AS ABOVE. OCCASIONAL CRYSTALLINE VEINS GYPSUM. LIGHT BROWN DOLOMITE LIGHTLY MINERALISED BY GYPSUM.	4.7' 5.0 = 94% - 8%	0.6' 5.0		RUN #3. DRILLED 27.2 - 32.2 PULLED 27.2 - 32.2 OCCASIONAL SCRUBBING MARKS

SHEET 2
OF 2 SHEETS

HOLE / CORE SIZE ANY

JUN 01 - 1963 - 122
JUN 01 - 1963 - 025

ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOVER.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	32.2		GREY SILTSTONE SLIGHTLY CALCAREOUS WITH EXTENSIVE GYPSUM MINERALISATION MOD. STRONG TO STRONG CORE LOSS				RUN # 3 CONT.
	34.8		GREY SILTSTONE, SLIGHTLY CALCAREOUS WITH GYPSUM VEINS \approx 0.3' THICK VUGGY. BECOMING INCREASINGLY DOLOMITIC WITH DEPTH CORE LOSS	$\frac{4.2}{5.0}$ = 84%	0		RUN # 4. DRILLED 32.2 - 37.2 PULLED 32.2 - \leq 37.2
	37.2		LIGHT BROWN DOLOMITE FINE GRAINED WITH GYPSUM MINERALISATION DISCED. CORE LOSS				
	42.2		LIGHT BROWN DOLOMITE OCCASIONAL VUGS. BELOW 39.0 GYPSUM VEINS BECOME EXTENSIVE UP TO 60% OF CORE. STRONG TO MOD STRONG SCREEDING CORE LOSS	$\frac{4.2}{5.0}$ = 84%	0		RUN # 5. DRILLED 37.2 - 42.2' PULLED 37.2 - \leq 42.2'
			BORE HOLE COMPLETED				

PROJECT CALEDONIA DAM PROJECT.		JOB No. 01-7707-122 MTC 55-75-03		HOLE No. 3		SHEET OF 2 SHEETS	
BORING DATA FROM CALEDONIA HWY BRIDGE PROJECT LOCATION STA 620 + 16 & B				CORE DRILLING LOG ELEVATION TOP OF HOLE ICE LEVEL 616.60 RIVER BED LEVEL 606.60			
DRILLING AGENCY _____ DRILL MODEL _____ DATE STARTED JAN. 4.5 / 77 HOLE INCLINATION VERTICAL BIT SIZE & TYPE NX				THICKNESS OF OVERBURDEN 3.5 DEPTH CORE DRILLED IN ROCK 20.00' TOTAL DEPTH OF HOLE 28.50' TOTAL CORE RECOVERY 16.20			
GROUND WATER LEVEL		depth	elevation	TOTAL OF OVERBURDEN SAMPLES TAKEN		disturbed	undisturbed
							TOTAL No OF CORE BOXES 2

GENERAL ABBREVIATIONS & SYMBOLS

cl - clay cg - clay gouge bc - broken core dc - disced core rc - rubble core bp - bedding plane fp - fracture plane jp - joint plane F - Fault	sty.p - stylolitic parting h - horizontal i - inclined v - vertical foss - fossiliferous tr - trace nod - nodular lom - laminated lay - layered	fis - fissile sil - siliceous calc - calcareous dolc - dolomitic chy - cherty argill - argillaceous imp - impure bedd - bedded * O - Oil * G - Gas	Dol /// Dolostone Lst /// Limestone Sst /// Sandstone Sst /// Siltstone Mst /// Mudstone Sh /// Shale Mar /// Marble Qu /// Quartz Cc /// Concrete	*** Grit, Conglomerate *** Breccia /// Evaporite (H = Salt, G = Gypsum K = Potash A = Anhydrite) <<< Igneous SSS Schist, Gneiss <<< Volcanic Ash, Tuff <<< Lava
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ELEVATION	DEPTH	ROCK LEG-END	DESCRIPTION OF MATERIALS. CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
598.1	8.5		CORE DRILLING COMMENCED				
			LIGHT BROWN DOLOMITE EXTENSIVELY MINERALISED BY GYPSUM STRONG, SOUND CORE OCCASIONAL SIGNS OF SCRUBBLING ON GYPSUM SCAMS.	4.4 5.0 = 88%	1.0 5.0 20%	K = 9.5 x 10 ⁻⁴ CMS / SEC.	RUN # 1 DRILLED 8.5 - 13.50 PULLED 8.5 - < 13.50'
	13.5		CORE LOSS				
			AS IN RUN # 1	4.6 5.0 = 92%	0	K = 0. TEST SEC. ON 12.70 - 17.70	RUN # 2 DRILLED 13.5 - 18.5 PULLED 13.5 - < 18.5
	18.5		CORE LOSS				
			DOLOMITE			K = 5.4 x 10 ⁻⁴ CMS / SEC. H = 15.3 FT. TEST SEC.	RUN # 3 DRILLED 18.5 - 23.5 PULLED 18.5 - 23.4
	19.2		GREY SILTSTONE, SLIGHTLY CALcareous, OCCASIONAL POCKETS OF GYPSUM.				

CORE DRILLING LOG (cont.)

THICKNESS OF OVERBURDEN
(DEPTH TO ROCK)

8.5'

HOLE No.

3

SHEET 2

OF 2 SHEETS

ELEVATION TOP OF HOLE

HOLE / CORE SIZE

JUL 21 - 1963

ELEVATION	DEPTH	ROCK LOG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
			SEE PREVIOUS SHEET				
		bc	GREY SILTSTONE				
		GG	THICK GYPSUM SCAM				
		st	LIGHT BROWN DOLOMITE				
		st	WITH OCCASIONAL SILTSTONE SEAMS.				
			CORE LOSS				
	23.5						
			LIGHT BROWN DOLOMITE LITTLE GYPSUM. OCCASIONALLY GREYISH VUGGY. STRONG.				
			CORE LOSS				
	28.5						
			SCREENS COMPLETED				

K = 6.8 x 10⁻⁴ CMS/SEC
H = 9.8 FT.TEST SECTION
H = 12.3
H = 22.7
H = 24.3
K = 1.6 x 10⁻⁶ CMS/SEC
K = 6.0 x 10⁻⁶ CMS/SEC
K = 2.6 x 10⁻⁶ CMS/SEC

OVERDRILLED

RUN #4
DRILLED 23.5-28.5
PULLED 23.5-28.53.3
S.D

66%

0

PROJECT CALLEDONIA DAM PROJECT.		JOB No. 01-7103-122 INC 55-73-03		HOLE No. 14		SHEET 1 OF 1 SHEETS	
PAVING DATA FROM CALLEDONIA DAM BASE PROJECT CORE DRILLING LOG							
LOCATION STA 619 + 08 @ B				ELEVATION TOP OF HOLE ICE LEVEL 616.30' RIVER BED LEVEL 606.30'			
DRILLING AGENCY				DATUM GEODETIC			
DATE STARTED JAN 11 - 12 / 77		HOLE INCLINATION VERTICAL		TOTAL OF OVERBURDEN SAMPLES TAKEN		TOTAL No OF CORE BOXES 1	
BIT SIZE & TYPE NX		THICKNESS OF OVERBURDEN 7.4'		DEPTH CORE DRILLED IN ROCK 8.6'		TOTAL DEPTH OF HOLE 15.00'	
GROUND WATER LEVEL		depth		elevation		TOTAL CORE RECOVERY 6.7'	

GENERAL ABBREVIATIONS & SYMBOLS			
cl - clay	sty.p - stylolitic parting	fis - fissile	Dol Dolostone
cg - clay gouge	h - horizontal	sil - siliceous	Lst Limestone
bc - broken core	i - inclined	calc - calcareous	Sst Sandstone
dc - disced core	v - vertical	dolc - dolomitic	Sst Siltstone
rc - rubble core	foss - fossiliferous	chy - cherty	Mst Mudstone
bp - bedding plane	tr - trace	argill - argillaceous	Sh Shale
fp - fracture plane	nod - nodular	imp - impure	Mar Marble
jp - joint plane	lam - laminated	bedd - bedded	Qu Quartz
F - Fault	lay - layered	* O - Oil	Cc Concrete
		* G - Gas	
			Grit, Conglomerate Breccia Evaporite (H = Salt, G = Gypsum K = Potash A = Anhydrite) Igneous Schist, Gneiss Volcanic Ash, Tuff Lava

ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	9.4		CORE DRILLING COMPLETED				
			GREY TO DARK BROWN ARGILLACEOUS DOLOMITE WITH FINE GYPSUM BANDS BECOMING GYPSUM WITH THIN LAYERS OF DOLOMITE	2.2 4.0 = 55%	0		RUN #1 DRILLED 9.4 - 13.4 PULLED 9.4 - 13.2
	13.40		LIGHT BROWN DOLOMITE WITH EXTENSIVE GYPSUM MINERALISATION. STRONG SOUND ROCK.				OVERDRILLED. RUN #2 DRILLED 13.4 - 18.00 PULLED 13.2 - 18.00
	18.00		CORE HOLE COMPLETED				

PROJECT <u>CALEDONIA DATA PROJECT</u>		JOB No. <u>01-77-5-122</u>		HOLE No. <u>5</u>		SHEET <u>1</u> OF 2 SHEETS	
		NYC <u>55-75-03</u>					
		CORE DRILLING LOG					
LOCATION <u>STN 618 + 01 & B</u>		ELEVATION TOP OF HOLE <u>ICE LEVEL 616.00</u> <u>RIVER BED LEVEL 608.5</u>					
		DATUM <u>GEODETIC</u>					
DRILLING AGENCY		DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN	disturbed	undisturbed	TOTAL No OF CORE BOXES <u>2</u>
DATE STARTED <u>JAN 16-17 1920/77</u>		HOLE INCLINATION <u>VERTICAL</u>		THICKNESS OF OVERBURDEN <u>15.70'</u>			
		BIT SIZE & TYPE <u>NX</u>		DEPTH CORE DRILLED IN ROCK <u>19.30'</u>			
				TOTAL DEPTH OF HOLE <u>35.00'</u>			
GROUND WATER LEVEL		depth	elevation	TOTAL CORE RECOVERY <u>16.75</u>			

GENERAL ABBREVIATIONS & SYMBOLS			
cl - clay	sty.p - stylolitic parting	fis - fissile	Dol <u>///</u> Dolostone
cg - clay gouge	h - horizontal	sil - siliceous	Lst <u>///</u> Limestone
bc - broken core	i - inclined	calc - calcareous	Sst <u>•••</u> Sandstone
dc - disced core	v - vertical	dolc - dolomitic	Sst <u>///</u> Siltstone
rc - rubble core	foss - fossiliferous	chy - cherty	Mst <u>///</u> Mudstone
bp - bedding plane	tr - trace	argill - argillaceous	Sh <u>///</u> Shale
fp - fracture plane	nod - nodular	imp - impure	Mar <u>///</u> Marble
jp - joint plane	lam - laminated	bedd - bedded	Qu <u>///</u> Quartz
F - Fault	lay - layered	* O - Oil	Cc <u>///</u> Concrete
		* G - Gas	
			••• Grit, Conglomerate
			••• Breccia
			/// Evaporite (H = Salt, G = Gypsum, K = Potash, A = Anhydrite)
			/// Igneous
			/// Schist, Gneiss
			/// Volcanic Ash, Tuff
			/// Lava

ELEVATION	DEPTH	ROCK LEG-END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	<u>15.7</u>		<u>CORE DRILLING COMMENCED</u>				
		<u>15.7</u>	<u>LIGHT BROWN DOLOMITE</u>	<u>4.2</u>	<u>0.4</u>	<u>16.5</u>	<u>RUN # 1</u>
		<u>15.7</u>	<u>HEAVILY MINERALISED</u>	<u>5.0</u>	<u>5.0</u>		<u>DRILLED 15.7 - 20.7</u>
		<u>15.7</u>	<u>WITH GYPSUM. MOD. STRONG</u>	<u>= 86%</u>	<u>= 8%</u>		<u>PULLED 15.7 - 20.6</u>
		<u>15.7</u>	<u>TO STRONG</u>				<u>CRACKING EVIDENT ON</u>
		<u>15.7</u>	<u>SOUND CORE</u>				<u>MOST FRACTURE PLANES.</u>
		<u>20.7</u>	<u>CORE LOSS</u>				
	<u>20.7</u>		<u>LIGHT BROWN DOLOMITE</u>				<u>RUN # 2</u>
		<u>20.7</u>	<u>WITH GYPSUM.</u>	<u>4.7</u>		<u>21.5</u>	<u>DRILLED 20.7 - 25.3</u>
	<u>21.4</u>		<u>GREY SILTSTONE BAND</u>	<u>4.7</u>	<u>0</u>		<u>PULLED 20.6 - 25.3</u>
		<u>21.4</u>	<u>LIGHT BROWN DOLOMITE</u>	<u>= 100%</u>			
		<u>21.4</u>	<u>GREY SILTSTONE</u>				
	<u>22.3</u>		<u>GREY SILTSTONE WITH</u>				
		<u>22.3</u>	<u>GYPSUM LAMINATIONS</u>				
		<u>22.3</u>	<u>GREY SILTSTONE PARTIALLY</u>				
		<u>22.3</u>	<u>CALCAREOUS</u>				
		<u>22.3</u>	<u>GYPSUM.</u>				
	<u>25.3</u>		<u>LIGHT BROWN DOLOMITE</u>	<u>4.65</u>	<u>0</u>	<u>25.5</u>	<u>RUN # 3</u>
		<u>25.3</u>	<u>GREY SILTSTONE SLIGHTLY</u>	<u>5.4</u>			<u>DRILLED 25.3 - 30.7</u>
		<u>25.3</u>	<u>CALCAREOUS</u>	<u>= 56%</u>			<u>PULLED 25.3 - 30.7</u>
	<u>26.1</u>		<u>DOLOMITE WITH GYPSUM.</u>				

ORE DRILLING LOG (cont.)

THICKNESS OF OVERBURDEN
(DEPTH TO ROCK)

15.70'

HOLE No.

5

SHEET 2

OF 2 SHEETS

ELEVATION TOP OF HOLE

608.5. RIVER E.D.P.L.

HOLE / CORE SIZE

NX

DATE 01-11-03-122
75-03

ELEVATION	DEPTH	ROCK LOG- IND	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.O.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
		gg 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	SEE PREVIOUS SHEET FOR No OF FRACS. GYPSUM LIGHT BROWN DOLOMITE SILTSTONE LIGHT BROWN DOLOMITE CORE LOSS	86%	0	K ₁ 2.4 x 10 ⁻³ cm/sec H= 10 KI K ₂ 1.6 x 10 ⁻³ cm/sec H= 20 KI 30.5	SEE PREVIOUS SHEET
		bc 45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	GREY SILTSTONE SLIGHTLY CALCARFOUS. BECOMING LIGHT BROWN DOLOMITE WITH EXTENSIVE GYPSUM MINERALISATION. CORE LOSS	3.2 4.3 = 76%	0.5 4.3 11%	H= 10 PSI } NO FLOW. 20 PSI }	RUN # 4. DRILLED 30.7' - 35.00 PULLED 30.7' - 35.00
			END HOLE COMPLETED.				

PROJECT CALDONIA DAM PROJECT		JOB No. 01-7703-122 MTL 55-75-03		HOLE No. 6		SHEET 1 OF 1 SHEETS																																																			
BORING DATA FROM CALDONIA INNY BRIDGE PROJECT				CORE DRILLING LOG																																																					
LOCATION STN 616 + 95 & B		ELEVATION TOP OF HOLE 615.7 ICE LEVEL 609.7 RIVER BED LEVEL		DATUM GEODETTIC																																																					
DRILLING AGENCY		DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN		disturbed undisturbed TOTAL No OF CORE BOXES 1																																																			
DATE STARTED JAN 21 & 24/77		HOLE INCLINATION VERTICAL		THICKNESS OF OVERBURDEN 16.3'																																																					
		BIT SIZE & TYPE NX		DEPTH CORE DRILLED IN ROCK 5.00'																																																					
GROUND WATER LEVEL		depth elevation		TOTAL DEPTH OF HOLE 21.3'		TOTAL CORE RECOVERY 3.5'																																																			
GENERAL ABBREVIATIONS & SYMBOLS																																																									
<table border="0"><tr><td>cl - clay</td><td>sty.p - stylolitic parting</td><td>fjs - fissile</td><td>Dol /// Dolostone</td><td>••• Grit, Conglomerate</td></tr><tr><td>cg - clay gouge</td><td>h - horizontal</td><td>sil - siliceous</td><td>Lst /// Limestone</td><td>••• Breccia</td></tr><tr><td>bc - broken core</td><td>i - inclined</td><td>calc - calcareous</td><td>Sst ••• Sandstone</td><td>//// Evaporite (H = Salt, G = Gypsum, K = Potash, A = Anhydrite)</td></tr><tr><td>dc - disced core</td><td>v - vertical</td><td>dolc - dolomitic</td><td>Mst /// Mudstone</td><td>••• Igneous</td></tr><tr><td>rc - rubbed core</td><td>foss - fossiliferous</td><td>chy - cherty</td><td>Sh /// Shale</td><td>SSSS Schist, Gneiss</td></tr><tr><td>bp - bedding plane</td><td>tr - trace</td><td>argill - argillaceous</td><td>Mar /// Marble</td><td>••• Volcanic Ash, Tuff</td></tr><tr><td>fp - fracture plane</td><td>nod - nodular</td><td>imp - impure</td><td>Qu /// Quartz</td><td>••• Lava</td></tr><tr><td>jp - joint plane</td><td>nod - nodular</td><td>bedd - bedded</td><td>Cc /// Concrete</td><td></td></tr><tr><td>F - Fault</td><td>lam - laminated</td><td>* O - Oil</td><td></td><td></td></tr><tr><td></td><td>lay - layered</td><td>* G - Gas</td><td></td><td></td></tr></table>								cl - clay	sty.p - stylolitic parting	fjs - fissile	Dol /// Dolostone	••• Grit, Conglomerate	cg - clay gouge	h - horizontal	sil - siliceous	Lst /// Limestone	••• Breccia	bc - broken core	i - inclined	calc - calcareous	Sst ••• Sandstone	//// Evaporite (H = Salt, G = Gypsum, K = Potash, A = Anhydrite)	dc - disced core	v - vertical	dolc - dolomitic	Mst /// Mudstone	••• Igneous	rc - rubbed core	foss - fossiliferous	chy - cherty	Sh /// Shale	SSSS Schist, Gneiss	bp - bedding plane	tr - trace	argill - argillaceous	Mar /// Marble	••• Volcanic Ash, Tuff	fp - fracture plane	nod - nodular	imp - impure	Qu /// Quartz	••• Lava	jp - joint plane	nod - nodular	bedd - bedded	Cc /// Concrete		F - Fault	lam - laminated	* O - Oil				lay - layered	* G - Gas		
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ELEVATION	DEPTH	ROCK LEG-END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)																																																		
	16.3		CORE DRILLING COMMENCED																																																						
		SL	LIGHT BROWN FINE GRAINED DOLOMITE HEAVILY MINERALIZED WITH GYPSUM. OCC. SILTSTONE LAYERS AS INDICATED.	3.5 5.0	0.5 5.0		RUN #1 DRILLED 16.3 - 21.3 PULLED 16.3 - 21.3																																																		
		SL	CORE LOSS	70%	10%																																																				
	21.3		BOREHOLE COMPLETED																																																						

PROJECT			JOB No. 01-7403-122		HOLE No. 7		SHEET 1	
CALLEDONIA DAM PROJECT			MTC 55-75-03				OF 2 SHEETS	
POPING DATA FROM CALLEDONIA HWY BRIDGE PROJECT.			CORE DRILLING LOG					
LOCATION			ELEVATION TOP OF HOLE 615.5 ICE ELEVATION 612.5 RIVER BED LEVEL					
57H 615+88 E B'			DATUM GEODETIC					
DRILLING AGENCY		DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN		disturbed		undisturbed
DATE STARTED		HOLE INCLINATION		THICKNESS OF OVERBURDEN		TOTAL No OF CORE BOXES		
JAN. 25, 26, 28/77		VERTICAL		18.6		2		
BIT SIZE & TYPE		N/X		DEPTH CORE DRILLED IN ROCK		22.8		
GROUND WATER LEVEL		depth		elevation		TOTAL DEPTH OF HOLE		
						41.2		
						TOTAL CORE RECOVERY		
						16.55'		
GENERAL ABBREVIATIONS & SYMBOLS								
cl - clay cg - clay gouge bc - broken core dc - disced core rc - rubble core bp - bedding plane fp - fracture plane jp - joint plane F - Fault			sty.p - stylolitic parting h - horizontal i - inclined v - vertical foss - fossiliferous tr - trace nod - nodular lam - laminated lay - layered			fis - fissile sil - siliceous calc - calcareous dolc - dolomitic chy - cherty argill - argillaceous imp - impure bedd - bedded * O - Oil * G - Gas		
			Dol /// Dolostone Lst /// Limestone Sst /// Sandstone Sst /// Siltstone Mst /// Mudstone Sh /// Shale Mar /// Marble Qu /// Quartz Cc /// Concrete			* * * Grit, Conglomerate * * * Breccia /// Evaporite (H = Salt, G = Gypsum K = Potash A = Anhydrite) <<< Igneous SSSS Schist, Gneiss * * * Volcanic Ash, Tuff * * * Lava		
ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION			% CORE RECOV.	R.Q.D.	PUMP TEST DATA
	18.4		CORE DRILLING COMMENCED					
			SCREEDING					
			LIGHT BROWN DOLOMITE					
			HEAVILY MINERALISED			3.8	2.1	19.0
			WITH GYPSUM IN VEINS			5.0	4.4	
			AND ROCKERS.			76%	46%	
			ROCK IS MOD. STRONG TO STRONG.					
			JOINT SURFACES IRREGULAR AND ROUGH.					
			CORE LOSS					
			OCC. VUGS					
	23.4		LIGHT BROWN FINE GRAINED DOLOMITE					
			HEAVILY MINERALISED					
			OCC SIGNS OF SCREEDING			4.8	0	
			ROCK IS STRONG EXCEPT IN DISCED ZONES.			5.0		
			DOLOMITE WITH SILTSTONE LAMINATIONS.					
			LIGHT BROWN GYPSUM.					
			OCC. VUGS.					
	28.4		CORE LOSS					
			WHITE GYPSUM FINE GRAINED WITH OCC. PATCHES OF DOLOMITE.					
			GREY SILTSTONE SLIGHTLY CALCAREOUS.			86%	82%	
	29.2							
RUN #1 DRILLED 18.4 - 23.4 PULLED 18.4 - 22.8 RUN #2 DRILLED 23.4 - 28.4 PULLED 27.8 - 28.4 RUN #3 DRILLED 28.4 - 33.2 PULLED 28.4 - 32.8								

SHEET 2
OF 2 SHEETS

















Nx

JUL 01 - 7703-122
MTC 75-03

37.7	H = 13 PSI NO FLOW.	32.7	$K = 7.0 \times 10^{-4} \text{ cm}^2/\text{sec}$ $H = 8.8$ $V = 7.1 \times 10^{-4} \text{ cm}^3$ $H = 12.2$
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BORING DATA FROM CALEDONIA HWY BRIDGE PROJECT			CORE DRILLING LOG		
LOCATION STN 614 + 82			ELEVATION TOP OF HOLE 617.9		
DRILLING AGENCY			DATUM GEODETTIC		
DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN		disturbed	undisturbed
DATE STARTED 20/JAN/77		HOLE INCLINATION VERTICAL		TOTAL No OF CORE BOXES 1	
BIT SIZE & TYPE BX		THICKNESS OF OVERBURDEN 29.00'		DEPTH CORE DRILLED IN ROCK 10.00'	
GROUND WATER LEVEL		TOTAL DEPTH OF HOLE 39.00'		TOTAL CORE RECOVERY 10.00'	
depth		elevation			

GENERAL ABBREVIATIONS & SYMBOLS

cl - clay	sty.p - stylolitic parting	sil - siliceous	Dol  Dolostone	 Grit, Conglomerate
cg - clay gouge	h - horizontal	calc - calcareous	Lst  Limestone	 Breccia
bc - broken core	i - inclined	dolc - dolomitic	Sst  Sandstone	 Evaporite (H = Salt, G = Gypsum K = Potash A = Anhydrite)
dc - disced core	v - vertical	chy - cherty	Sst  Siltstone	
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bp - bedding plane	tr - trace	imp - impure	Sh  Shale	 Igneous
fp - fracture plane	nod - nodular	bedd - bedded	Mar  Marble	 Schist, Gneiss
jp - joint plane	lam - laminated	* O - Oil	Qu  Quartz	 Volcanic Ash, Tuff
F - Fault	lay - layered	* G - Gas	Cc  Concrete	 Lava

ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	29.0		CORE DRILLING COMMENCED				
		G	GREY SILTSTONE SLIGHTLY CALCARFOUS MOD. STRONG WITH POCKETS OF GYPSON. VUGGY.	100%	29%		LOG #1 DRILLED 29.0 - 39.0 PULLED 29.0 - 39.0
	33.0	bc be					
		G G L L L L G G G G G G G G G	LIGHT BROWN DOLOMITE EXTENSIVELY MINERALISED WITH GYPSON. STRONG SOUND CORE. VUGGY.				
	37.0		Bore hole completed.				

PROJECT CALEDONIA DAM PROJECT.		JOB No. 01-7203-122		HOLE No. 10		SHEET 1 OF 1 SHEETS			
BORING DATA FROM CALEDONIA HWY BRIDGE PROJECT LOCATION STN 613 + 08 E 'B'				CORE DRILLING LOG					
DRILLING AGENCY		DRILL MODEL		ELEVATION TOP OF HOLE 618.9		DATUM GEODETIC			
DATE STARTED 21, 26 / 1 / 77		HOLE INCLINATION VERTICAL		TOTAL OF OVERBURDEN SAMPLES TAKEN		disturbed undisturbed			
GROUND WATER LEVEL		depth elevation		THICKNESS OF OVERBURDEN 20.7		TOTAL No OF CORE BOXES 1			
BIT SIZE & TYPE BX.		DEPTH CORE DRILLED IN ROCK 8.8'		TOTAL DEPTH OF HOLE 29.5		TOTAL CORE RECOVERY 8.8'			
GENERAL ABBREVIATIONS & SYMBOLS									
cl - clay cg - clay gouge bc - broken core dc - disced core rc - rubble core bp - bedding plane fp - fracture plane jp - joint plane F - Fault		sty.p - stylolitic parting h - horizontal i - inclined v - vertical foss - fossiliferous lr - trace nod - nodular lam - laminated lay - layered		fis - fissile sil - siliceous calc - calcareous dolc - dolomitic chy - cherty argill - argillaceous imp - impure bedd - bedded * O - Oil * G - Gas		Dol /// Dolostone Lst /// Limestone Sst /// Sandstone Sst /// Siltstone Mst /// Mudstone Sh /// Shale Mar /// Marble Qu /// Quartz Cc /// Concrete		Grit, Conglomerate Breccia Evaporite (H = Salt, G = Gypsum K = Potash A = Anhydrite) Igneous Schist, Gneiss Volcanic Ash, Tuff Lava	
ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS. CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)		
	20.7		CORE DRILLING COMMENCED.						
			CLAY AND ROCK FRAGMENTS				RUN # 1		
			GREY DOLOMITE				DRILLED 20.7 - 29.5		
			WITH GYPSUM VEINS				PULLED 20.7 - 29.5		
			BECOMING BROWN						
			DOLOMITE EXTENSIVELY						
			TO COMPLETELY	100%	83%				
			MINERALISED.						
			Occ. VUGS.						
			STRONG TO MOD. STRONG						
			SOUND CORE.						
	29.5		BORE HOLE COMPLETED.						

PROJECT CALEDONIA DAM PROJECT.		JOB No. 01-7703-122		HOLE No. 12		SHEET 1 OF 1 SHEETS																																														
BORING DATA FROM CALEDONIA HIGH BRIDGE PROJECT		CORE DRILLING LOG																																																		
LOCATION STA. 612+36 & 'A'		ELEVATION TOP OF HOLE 640.7																																																		
		DATUM GEO. DETIC.																																																		
DRILLING AGENCY		DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN		disturbed undisturbed TOTAL No OF CORE BOXES 1																																														
DATE STARTED 3-4/FEB/77		HOLE INCLINATION VERTICAL		THICKNESS OF OVERBURDEN 60.00																																																
		BIT SIZE & TYPE BX		DEPTH CORE DRILLED IN ROCK 5.00																																																
				TOTAL DEPTH OF HOLE 65.00																																																
GROUND WATER LEVEL		depth elevation		TOTAL CORE RECOVERY 64.90																																																
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ELEVATION	DEPTH	ROCK LEG-END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	60.00		CORE DRILLING COMMENCED.				
		4' sc bc 15' fc bc 9' fc	DARK GREY DOLOMITE WITH THIN GYPSUM SEAMS DOLOMITE IS ARGILLACEOUS AND IS SLIGHTLY EFFERVESENT WITH HCL. MOD. STRONG TO STRONG.	4.9 5.00 98%	0.55 5.0		DR RUN # 1. DRILLED 60.00 - 65.00 PULLED 40.00 - 65.00 REC. 4.9'
	45.00	9.5'	CORE LOSS				
			BOREHOLE COMPLETED. -				

PROJECT CALEDONIA DAM PROJECT		JOB No. 71-1103-112		HOLE No. 14		SHEET 1	
SPRING DATA FROM CALEDONIA HWY BRIDGE PROJECT		DATE 11-25-03		OF SHEETS			
LOCATION STN 614 + 10 & A'		CORE DRILLING LOG					
ELEVATION TOP OF HOLE 619.1		DATUM GEODETIC					
DRILLING AGENCY		DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN		TOTAL No OF CORE BOXES 1	
DATE STARTED 25-26/1/77		HOLE INCLINATION VERTICAL		THICKNESS OF OVERBURDEN 25.00		DEPTH CORE DRILLED 9.50	
BIT SIZE & TYPE BX		TOTAL DEPTH OF HOLE 29.50		TOTAL CORE RECOVERY 4.90			
GROUND WATER LEVEL		depth		elevation			

GENERAL ABBREVIATIONS & SYMBOLS			
cl - clay	sty.p - stylolitic parting	sil - siliceous	Dol /// Dolostone
cg - clay gouge	h - horizontal	calc - calcareous	Lst /// Limestone
bc - broken core	i - inclined	dolc - dolomitic	Sst /// Sandstone
dc - disced core	v - vertical	chy - cherty	Sst /// Siltstone
rc - rubble core	foss - fossiliferous	argill - argillaceous	Mst /// Mudstone
bp - bedding plane	tr - trace	imp - impure	Sh /// Shale
fp - fracture plane	nod - nodular	bedd - bedded	Mar /// Marble
jp - joint plane	lam - laminated	* O - Oil	Qu /// Quartz
F - Fault	lay - layered	* G - Gas	Cc /// Concrete
			*** Grit, Conglomerate
			*** Breccia
			/// Evaporite (H = Salt, G = Gypsum, K = Potash, A = Anhydrite)
			*** Igneous
			*** Schist, Gneiss
			*** Volcanic Ash, Tuff
			*** Lava

ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
20.00			CORE DRILLING CONTINUED				
		bc	GREY SILTSTONE. PARTIALLY WEATHERED CLAY EVIDENT. LOST CORE? PROBABLY DETACHED OR SOIL. SLAB OF ROCK OVERLYING SOIL.	0.7 5.0 = 14%	0		RUN #1 DRILLED 20.00 - 25.00 PULLED 20.00 - 25.00
25.00			LIGHT BROWN DOLOMITE EXTENSIVELY MINERALISED WITH GYPSUM. IN VEINS AND POCKETS. GYPSUM CONTENT INCREASING WITH DEPTH. SCRUBBED SLIGHTLY ARGILLACEOUS IN PLACES. (TRUE BEDROCK).	4.2 4.5 = 93%	3.2 4.5 71%		RUN #2 DRILLED 25.00 - 29.5 PULLED 25.00 - 29.5
29.50			CORE LOSS BOREHOLE COMPLETED				

PROJECT CALE DONIA DAM PROJECT		JOB NO. 01-7103-122		HOLE No. 16		SHEET 1																																																			
BORING DATA FROM CALEDONIA HWY. BRIDGE PROJECT		DATE 55-75-03		OF 1 SHEETS																																																					
LOCATION STN 616 + 03 & 'A'		CORE DRILLING LOG																																																							
		ELEVATION TOP OF HOLE 615.2 ICE LEVEL 612.7 RIVER BED LEVEL																																																							
DRILLING AGENCY		DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN		TOTAL No OF CORE BOXES 1																																																			
DATE STARTED 3-6/2/77	HOLE INCLINATION VERTICAL		THICKNESS OF OVERBURDEN 19.5'																																																						
	BIT SIZE & TYPE NX		DEPTH CORE DRILLED IN ROCK 5.0'																																																						
GROUND WATER LEVEL		depth		elevation		TOTAL DEPTH OF HOLE 24.5'																																																			
						TOTAL CORE RECOVERY 3.9'																																																			
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ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	19.5		CORE DRILLING COMMENCED.				
			LIGHT BROWN DOLOMITE HEAVILY MINERALISED IN VEINS AND POCKETS WITH GYPSUM.	3.9 5.0 = 78%	0.75 5.0 15%		RUN #1 DRILLED 19.5 - 26.5 PULLED 19.5 - & 26.5
			NUMEROUS SCABBED FRACTURES. ROCK IS MOD STRONG TO STRONG. BECOMING EXTENSIVELY MINERALISED TOWARDS CORE LOSS BASE.				
	24.5		BORE HOLE COMPLETED.				

PROJECT CALEDONIA DAM PROJECT.		JOB No. 01-7703-122		HOLE No. 17		SHEET 1 OF 1 SHEETS																																														
BORING DATA FROM CALEDONIA DAM BRIDGE PROJECT		CORE DRILLING LOG																																																		
LOCATION STN 617+10 @ A'		ELEVATION TOP OF HOLE 612.4 ICE LEVEL 607.9 RIVER BED LEVEL																																																		
DRILLING AGENCY		DRILL MODEL		TOTAL OF OVERBURDEN SAMPLES TAKEN		TOTAL No OF CORE BOXES 1																																														
DATE STARTED FEB 9/77		HOLE INCLINATION VERTICAL		THICKNESS OF OVERBURDEN 15.50'		DISTURBED UNDISTURBED																																														
		BIT SIZE & TYPE NXL		DEPTH CORE DRILLED IN ROCK 10.90'																																																
GROUND WATER LEVEL		depth elevation		TOTAL DEPTH OF HOLE 25.50'																																																
				TOTAL CORE RECOVERY 8.60'																																																
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ELEVATION	DEPTH	ROCK LEG-END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
15.50			CORE DRILLING COMMENCED.				
			LIGHT BROWN DOLOMITE WITH GYPSUM MINERALISATION. HEAVY TO EXTENSIVE. THE CORE IS SOUND MODSTRONG WITH OCCASIONAL VUGS.	8.6 10.0 = 86%	0.75 10.90 75%		RUN #1 DRILLED 15.50 - 20.50 PULLED 15.50 - 20.50 NO MARKER IN CORE BOX TO SEPARATE THE CORE RUNS. HENCE % CORE REC. TAKEN OVER BOTH RUNS.
			GREY SILTSTONE. SLIGHTLY CALCAREOUS				RUN #2. DRILLED 20.5 - 25.5 PULLED 20.5 - 25.5
			CORE LOSS				
25.50			BOREHOLE COMPLETED				

CORE DRILLING LOG

ROD LOG DATA FROM CALIFORNIA DAM BRIDGE PROJECT

LOCATION

STN 618 + 16 & 'A'

ELEVATION TOP OF HOLE

614.6 ICE LEVEL
605.6 RIVER BED LEVEL

DATUM

GEODETTIC

DRILLING AGENCY

DRILL MODEL

TOTAL OF OVERBURDEN
SAMPLES TAKEN

disturbed

undisturbed

TOTAL No OF
CORE BOXES

2

DATE STARTED

FEB 14-15/77

HOLE INCLINATION

VERTICAL

THICKNESS OF OVERBURDEN

13.80'

DEPTH CORE DRILLED IN ROCK

10.00'

TOTAL DEPTH OF HOLE

23.80'

GROUND WATER LEVEL

depth

elevation

TOTAL CORE RECOVERY

5.90'

GENERAL ABBREVIATIONS & SYMBOLS

cl - clay

cg - clay gouge

bc - broken core

dc - disced core

rc - rubble core

bp - bedding plane

fp - fracture plane

jp - joint plane

F - Fault

sty.p - stylolitic parting

h - horizontal

i - inclined

v - vertical

foss - fossiliferous

tr - trace

nod - nodular

lam - laminated

lay - layered

fis - fissile

sil - siliceous

calc - calcareous

dolc - dolomitic

chy - cherty









argill - argillaceous

imp - impure

bedd - bedded

* O - Oil

* G - Gas

Dol  DolostoneLst  LimestoneSst  SandstoneSst  SiltstoneMst  MudstoneSh  ShaleMar  MarbleQu  QuartzCc  Concrete

••• Grit, Conglomerate

••• Breccia

//// Evaporite (H = Salt,

G = Gypsum

K = Potash





A = Anhydrite)

••• Igneous

••• Schist, Gneiss

••• Volcanic Ash, Tuff

••• Lava

ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	13.8		CORE DRILLING COMMENCED				
	13.8		LIGHT BROWN DOLOMITE FINE GRAINED MINERALISED WITH GYPSUM.	4.8 5.0 = 96%	0		RUN #1 DRILLED 13.8 - 18.8 PULLED 13.5 - 18.8
	18.8		HEAVY TO EXTENSIVE MINERALISATION. NUMEROUS INDICATIONS OF SCORING				
	18.8		CORE LOSS				
	18.8		AS ABOVE.				RUN #2 DRILLED 18.8 - 23.8 PULLED 18.8 - 23.8
	22.2		GREY SILTSTONE. SLIGHTLY CALCAREOUS. WITH POCKETS OF GYPSUM	4.1 5.0 82%	0		
	23.8		CORE LOSS				
			BOREHOLE COMPLETED.				

BORING DATA FROM CALEDONIA DAM BRIDGE PROJECT

CORE DRILLING LOG

LOCATION

STN 619 + 23 & A

ELEVATION TOP OF HOLE

616.5 ICE LEVEL
604.0 RIVER BED LEVEL

DATUM

GEODETIC

DRILLING AGENCY

DRILL MODEL

TOTAL OF OVERBURDEN
SAMPLES TAKEN

disturbed

undisturbed

TOTAL No OF
CORE BOXES

2

DATE STARTED

16-17 FEB/77

HOLE INCLINATION

VERTICAL

THICKNESS OF OVERBURDEN

13.8

DEPTH CORE DRILLED IN ROCK

10.00

BIT SIZE & TYPE

NX

TOTAL DEPTH OF HOLE

23.8

GROUND WATER LEVEL

depth

elevation

TOTAL CORE RECOVERY


8.9

GENERAL ABBREVIATIONS & SYMBOLS

cl - clay

sty.p - stylolitic parting

fs - fissile

Dol  Dolomite


 Grit, Conglomerate

cg - clay gouge

h - horizontal

sil - siliceous

Lst  Limestone


 Breccia

bc - broken core

i - inclined

calc - calcareous

Sst  Sandstone

 Evaporite (H = Salt,

dc - disced core

v - vertical

dolc - dolomitic


Sst  Siltstone

G = Gypsum

rc - rubble core

foss - fossiliferous

chy - cherty

Mst  Mudstone

K = Potash

bp - bedding plane

tr - trace

argill - argillaceous


Sh  Shale


A = Anhydrite

fp - fracture plane

nod - nodular

imp - impure


Mar  Marble


 Igneous

jp - joint plane

lam - laminated

bedd - bedded


Qu  Quartz


 Schist, Gneiss

F - Fault

lay - layered



* O - Oil

Cc  Concrete

 Volcanic Ash, Tuff

* G - Gas

 Lava

ELEVATION	DEPTH	ROCK LOG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	13.8		CORE DRILLING COMMENCED				
			LIGHT BROWN DOLOMITE HEAVILY MINERALISED WITH GYPSUM. IN VEINS AND PATCHES occ. SILTSTONE PARTINGS occ. VUGGY. MOD. STRONG TO STRONG	4.4 5.0 88%	1.4 5.0 28%		RUN #1 DRILLED 13.8 - 18.8 PULLED 13.8 - 18.8
	18.8		CORE LOSS				
	19.2		AS ABOVE.				RUN #2
			GREY SILTSTONE. SLIGHTLY CALCAREOUS WITH POCKETS AND VEINS OF GYPSUM occ DOLOMITIC ZONES. MOD. STRONG TO STRONG.	4.5 5.0 90%	10%		DRILLED 18.8 - 23.8 PULLED 18.8 - 23.8
	23.8		CORE LOSS				
			BOREHOLE COMPLETELY.				

CORE DRILLING LOG

BORING DATA FROM CALEDONIA DAM PROJECT

LOCATION STN 620 + 31 E 'A'

ELEVATION TOP OF HOLE 614.5 ICE LEVEL
602.5 RIVER BED LEVEL

DATUM

GEODETIC

DRILLING AGENCY

DRILL MODEL

TOTAL OF OVERBURDEN
SAMPLES TAKEN

disturbed

undisturbed

TOTAL No OF
CORE BOXES

DATE STARTED

HOLE INCLINATION

VERTICAL

THICKNESS OF OVERBURDEN

11.5'

DEPTH CORE DRILLED IN ROCK

10.00'

TOTAL DEPTH OF HOLE

21.5'

GROUND WATER LEVEL

depth

elevation

TOTAL CORE RECOVERY

7.5'

GENERAL ABBREVIATIONS & SYMBOLS

cl - clay

sty.p - stylolitic parting

fis - fissile

Dol ~~///~~ Dolostone

••• Grit, Conglomerate

cg - clay gouge

h - horizontal

sil - siliceous

Lst ~~///~~ Limestone

••• Breccia

bc - broken core

i - inclined

calc - calcareous

Sst ••• Sandstone

/// Evaporite (H = Salt,

dc - disced core

v - vertical

dolc - dolomitic

Sst ~~///~~ Siltstone

G = Gypsum

rc - rubble core

foss - fossiliferous

chy - cherty

Mst ~~///~~ Mudstone

K = Potash

bp - bedding plane

tr - trace

argill - argillaceous

Sh ~~///~~ Shale

A = Anhydrite

fp - fracture plane

nod - nodular

imp - impure

Mar ~~///~~ Marble

/// Igneous

jp - joint plane

lam - laminated

bedd - bedded

Qu ~~///~~ Quartz

SSS Schist, Gneiss

F - Fault

lay - layered

* O - Oil

Cc ~~///~~ Concrete

••• Volcanic Ash, Tuff

* G - Gas

••• Lava

ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
	11.5		CORE DRILLING COMMENCED.				
			LIGHT BROWN DOLomite WITH EXTENSIVE GYPSUM MINERALISATION	4.9	2.1		RUN #1 DRILLED 11.5 - 16.5 PULLED 11.5 - 16.5
			occ. VUGS. MOD. STRONG	5.0	5.0		
			occ. GREY SILTSTONE PARTINGS.	98%	42%		
	16.5		CORE LOSS				
	17.5		WELL FRACTURED SCRUBBED				RUN #2 DRILLED 16.5 - 21.5 PULLED 16.5 - 21.5
			GREY SILTSTONE. SLIGHTLY CALCAREOUS WITH occ. GYPSUM POCKETS.				
			CORE LOSS				
			BOREHOLE COMPLETED.				

CORE DRILLING LOG

LOCATION

STA. 621 + 37 @ 'A'

ELEVATION TOP OF HOLE

618.6

DATUM

GEODETIC

DRILLING AGENCY

DRILL MODEL

TOTAL OF OVERBURDEN
SAMPLES TAKEN

disturbed

undisturbed

TOTAL No OF
CORE BOXES

2

DATE STARTED

21-24/2/77

HOLE INCLINATION

VERTICAL

THICKNESS OF OVERBURDEN

26.2'

DEPTH CORE DRILLED IN ROCK

10.00'

TOTAL DEPTH OF HOLE

36.2'

GROUND WATER LEVEL

depth

elevation

TOTAL CORE RECOVERY

4.5'

GENERAL ABBREVIATIONS & SYMBOLS

cl - clay

cg - clay gouge

bc - broken core

dc - disced core

rc - rubbed core

bp - bedding plane

fp - fracture plane

jp - joint plane

F - Fault

sly.p - stylolitic parting

h - horizontal

i - inclined

v - vertical

foss - fossiliferous

tr - trace

nod - nodular

lom - laminated

lay - layered

fis - fissile

sil - siliceous

calc - calcareous

dolc - dolomitic

chy - cherty








argill - argillaceous

imp - impure

bedd - bedded

* O - Oil



* G - Gas
















Dol  DolostoneLst  LimestoneSst  SandstoneSst  SiltstoneMst  MudstoneSh  ShaleMar  MarbleQu  QuartzCc  Concrete Grit, Conglomerate Breccia Evaporite (H = Salt,

G = Gypsum

K = Potash

A = Anhydrite)

 Igneous Schist, Gneiss Volcanic Ash, Tuff Lava

ELEVATION	DEPTH	ROCK LEG- END	DESCRIPTION OF MATERIALS, CLASSIFICATION	% CORE RECOV.	R.Q.D.	PUMP TEST DATA	DRILLING NOTES, REMARKS (drilling depth, core depth, water loss, etc.)
24.2			CORE DRILLING COMMENCED				
			LIGHT BROWN DOLOMITE				RUN #1
			EXTENSIVELY MINERAL				DRILLED 24.2 - 29.2
			USED WITH GYPSUM.				PULLED 24.2 - 29.2
			SOUND CORE.				
			STRONG	100%	0		
29.2							
			AS ABOVE.				RUN # 2
			OCC. VUGS.	45			DRILLED 29.2 - 36.2
				5.0	0		PULLED 29.2 - 36.2
				90%			
32.0			GREY SILTSTONE WITH				
			POCKETS OF GYPSUM.				
			STRONG.				
34.2			CORE LOSS				
			BOREHOLE COMPLETED				

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 1

W.P. 55-75-00

LOCATION STA: 97+76.4

ORIGINATED BY PD

DIST. 4 HWY. 6N

BORING DATE SEP. 8, 9, 1975

COMPILED BY PD

DATUM GEODETIC

BOREHOLE TYPE WATERBORING-BxL Rock CORING

CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT <u> </u> w_L PLASTIC LIMIT <u> </u> w_p WATER CONTENT <u> </u> w			UNIT WEIGHT γ	REMARK % GR. SA. SI.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p	w	w_L		
617.6	RIVER WATER LEVEL															
0.0	WATER					610										
605.6	RIVER BED															
12.0	20' OF SHALE (WEATHERED) SANDY SILT AND SANDY TILL		1	SS	49											
			2	SS	40	600										
			3	SS	12											
595.2			4	SS	14/10											
22.4			5	RC	RC											
				BxL	91%											
			6	RC	RC	590										
				BxL	89%											
	BEDROCK		7	RC	RC											
				BxL	40%											
			8	RC	RC	580										
				BxL	100%											
57.71																
40.5	END OF BOREHOLE															

REPORT ON SOIL EXPLORATION

RECORD OF BOREHOLE NO 2

W.P. 55-75-00

LOCATION STA: 98+27; 2' RT

ORIGINATED BY PP

DIST. 4 HWY. 6N

BORING DATE SEP. 10, 1975

COMPILED BY PP

DATUM GEODETIC

BOREHOLE TYPE DYNAMIC CONE PENETRATION TEST

CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARK % GR. SA. SI.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					w_p w w_L				
							SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT %				
617.6	RIVER WATER LEVEL															
0.0	WATER															
606.6	RIVER BED															
11.0																
595.0																
22.6	END OF CONE TEST (PROBABLE BEDROCK)															

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

W.P. 55-75-00

LOCATION STA: 98+79: 4'25"

ORIGINATED BY PP

DIST. 4 HWY. 62

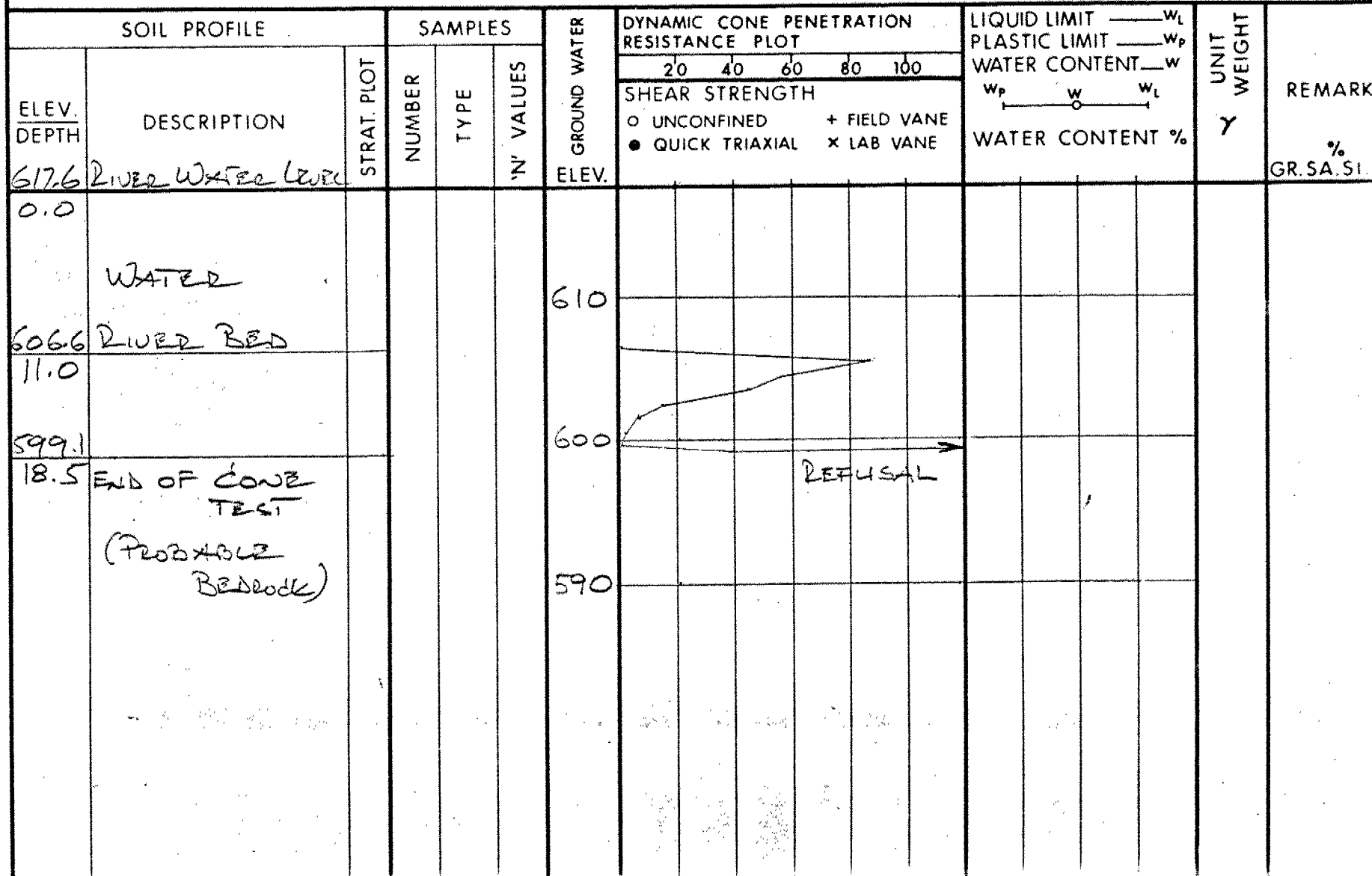
BORING DATE SEP. 10, 1975.

COMPILED BY PP

DATUM Geometric

BOREHOLE TYPE DYNAMIC CONE PENETRATION TEST

CHECKED BY _____



RECORD OF BOREHOLE NO 4

W.P. 55-75-00

LOCATION STA: 99+31; 10' LT

ORIGINATED BY PP

DIST. 4 HWY. 6N

BORING DATE SEP. 10, 1975

COMPILED BY PP

DATUM GEODETIC

BOREHOLE TYPE DYNAMIC CONE PENETRATION TEST

CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARK % GR. SA. SI.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					w_p w w_L				
							SHEAR STRENGTH					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
617.6	RIVER WATER LEVEL															
0.0	WATER															
609.6	RIVER BED					610										
8.0																
595.0						600										
22.6	END OF CONE TEST (PROBABLE BEDROCK)					590										

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 5

W.P. 55-75-00
DIST. 4 HWY. 6N
DATUM GEODETIC

LOCATION STA. 95+50.7 LT.
BORING DATE SEP. 10, 11, 1975
BOREHOLE TYPE WASHBORE, BXL ROCK CORING

ORIGINATED BY PD
COMPILED BY PP
CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			UNIT WEIGHT γ	REMARK % GR. SA. SI.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	W_P W W_L				
							SHEAR STRENGTH									
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE					WATER CONTENT %				
517.6	RIVER WATER LEVEL															
0.0	WATER															
609.6	RIVER BED					610										
8.0	20ZES OF WEATHERED SHALE, SANDY TILL AND SAND		1	SS	24											
			2	SS	48											
			3	SS	18											
			4	SS	28	600										
			5	SS	19											
			6	SS	2 1/26"											
			7	SS	4 1/42"	590										
			7A	SS	12											
			8	SS	50 1/4"											
583.6																
34.0																
			9	RD	RD	580										
				BxL	74%											
			10	RD	RD											
				BxL	88%											
				RD	RD	570										
	BEDROCK															

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 7

W.P. 55-75-00

LOCATION STA: 96+79; E

ORIGINATED BY PP

DIST. 4 HWY. 6N

BORING DATE SEP. 15, 1975

COMPILED BY PP

DATUM GEODETIC

BOREHOLE TYPE DYNAMIC CONE PENETRATION TEST

CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			UNIT WEIGHT γ	REMARKS % GR. SA. SI.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	w_p ——— w ——— w_L				
							SHEAR STRENGTH					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
617.8	RIVER WATER LEVEL															
0.0																
607.8	RIVER BED					610										
10.0						600										
583.7																
24.1	END OF CONE TEST (PROBABLE BEDROCK)					590										

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 8

W.P. 55-75-00
DIST. 4 HWY. 6N
DATUM GEODETIC

LOCATION STA: 97+33; 2' RT.
BORING DATE SEP. 15, 1975
BOREHOLE TYPE DYNAMIC CONE PENETRATION TEST

ORIGINATED BY PP
COMPILED BY PP
CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT ——— w			UNIT WEIGHT γ	REMARK % GR. S.A. SI.		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH					w_p ——— w ——— w_L WATER CONTENT %	
												○ UNCONFINED + FIELD VANE						
												● QUICK TRIAXIAL x LAB VANE						
617.8	RIVER WATER LEVEL																	
0.0	WATER																	
606.8	RIVER BED					610												
11.0																		
597.6						590												
20.2	END OF CONE TEST (PROBABLE BEDROCK)					590												

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 9

W.P. SS-75-00
 DIST. 4 HWY. 6N
 DATUM GEODETIC

LOCATION STA: 94+37; 10' LT
 BORING DATE SEP. 15. 1975
 BOREHOLE TYPE DYNAMIC CONE PENETRATION TEST

ORIGINATED BY PP
 COMPILED BY PP
 CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV.	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARKS % GR. SA. SI.
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20	40	60	80	100	SHEAR STRENGTH ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE				
617.8	RIVER WATER LEVEL															
0.0	WATER															
612.8	RIVER BED															
5.0						610										
601.2																
16.6	END OF CONE TEST					600										

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS-ONTARIO

ENGINEERING SERVICES BRANCH-GEOTECHNICAL OFFICE-SOIL MECHANICS SECTION

RECORD OF BOREHOLE NO 10

WP 55-75-00

LOCATION STA: 95+00; 12' 2"

ORIGINATED BY PP

DIST 4 HWY 6N

BORING DATE SEP 16, 1975

COMPILED BY PP

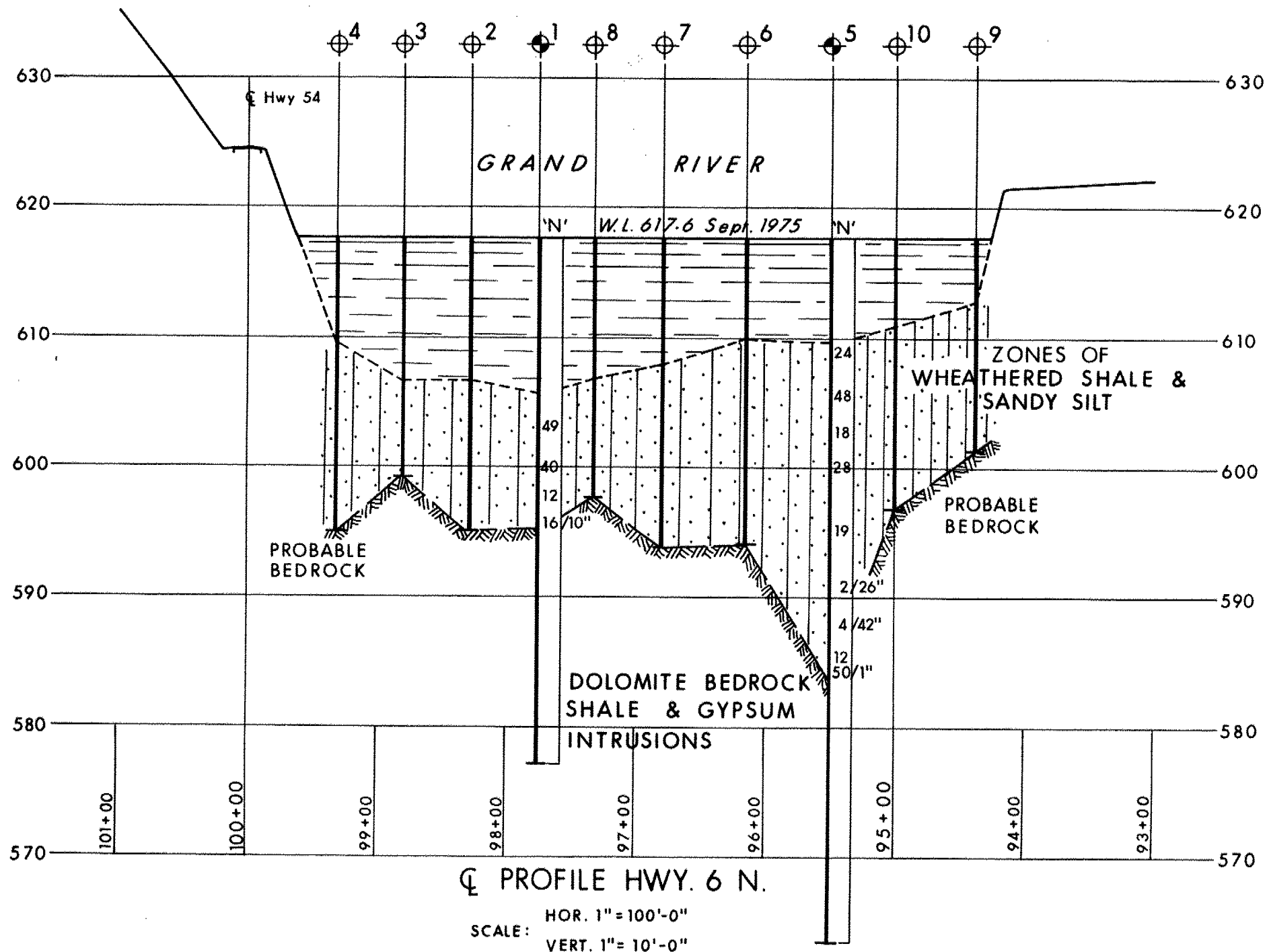
DATUM GEODETIC

BOREHOLE TYPE DYNAMIC CONE PENETRATION TEST

CHECKED BY _____

SOIL PROFILE			SAMPLES			GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT					LIQUID LIMIT ——— w_L PLASTIC LIMIT ——— w_p WATER CONTENT — w			UNIT WEIGHT γ	REMARK % GR SA SI
ELEV DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	'N' VALUES		20 40 60 80 100					w_p ——— w ——— w_L				
							SHEAR STRENGTH					WATER CONTENT %				
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB VANE									
617.8	RIVER WATER LEVEL															
0.0	WATER															
610.8	RIVER BED															
7.0																
596.7																
21.1	END OF CONE TEST															

REPORT ON SOIL EXPLORATION



DIST. 4

W.P. 55-75-00

Mr. G.C.E. Burkhardt,
Regional Structural Planning Engineer,
Central Region,
3501 Dufferin St., Downsview.

Soil Mechanics Section,
Geotechnical Office,
West Building, Downsview.

December 11, 1975.

DEC 16 1975

Proposed Nanticoke to Caledonia
Joint Hwy. #6 Utility Corridor
District #4, Hamilton
W.P. 55-75-00

We have reviewed the available geotechnical data along the proposed alignment of the new hwy. #6 as requested in a memorandum dated October 9, 1975.

Information obtained from Ontario Hydro (Boring and Tower Foundation Installation Records) indicate that the bedrock profile varies along the transmission lines.

A list of the bedrock and ground elevations, together with locations (stations) is attached to this memorandum.

It is pointed out that the proposed centreline is located some 500 feet-1100 feet from the transmission line.

If you have any further queries please contact our office.

P. Payer,
Senior Engineer.

For: K.G. Selby,
Supervising Engineer.

Enclosures

cc: C. Grebski,
G.A. Wrong,
D. Gunter,
R. Fitzgibbon,
J. Anderson,
Files,
Record Services.

STATION	ORIG. GROUND	ELEVATION	BEDROCK
376 + 00	690.0		668±
412 + 00	690.0		680±
458 + 00	695.0		682±
487 + 20	699.0		694±
487 + 50	696.0		696±
526 + 50	690.0		680±
531 + 80	692.0		690±
532 + 00	692.5		690±
548 + 50	707.5		703±
618 + 20	716.0		705±
660 + 00	719.5		710±
677 + 50	725.0		716±
419 + 50	693.0		686±
426 + 70	697.0		693±
433 + 80	697.5		696±
482 + 00	692.5		682±
492 + 00	699.0		690±
498 + 70	703.5		696±
507 + 30	700.0		693±
512 + 80	697.0		690±
520 + 00	693.0		690±
525 + 50	690.0		682±
537 + 00	700.0		707±
542 + 00	703.0		713±
548 + 50	707.5		705±
555 + 00	710.0		710.0±
575 + 50	704.5		703.0±
582 + 50	705.0		704±
596 + 70	708.5		698±
611 + 40	715.5		712±
625 + 70	716.0		715±
641 + 00	715.0		716±
648 + 30	715.0		715±
663 + 00	720.0		710±
670 + 00	726.0		716±
670 + 20	724.0		710±
670 + 70	725.0		715±

STATION

ELEVATION

ORIG. GROUND

BEDROCK

166 + 50	723.5	700±
178 + 70	689.5	674±
193 + 00	679.0	below 663
207 + 00	687.0	" 663
221 + 30	691.2	" 661
235 + 80	690.0	" 656
257 + 40	664.0	" 651
272 + 00	687.0	" 659
286 + 20	680.8	" 651
329 + 60	656.6	" 643
388 + 20	651.0	" 618±
395 + 20	629.5	" 620±
395 + 20	629.5	" 634±
430 + 20	686.0	" 624
113 + 00	727.0	714±
120 + 30	726.5	721±
127 + 60	727.0	721±
135 + 20	728.0	723±
142 + 50	726.0	719±
149 + 70	720.5	714±
157 + 30	726.0	714±
172 + 30	705.0	706±
178 + 70	689.0	694±
470 + 00	661.0	633±
470 + 20	660.5	below 633
480 + 00	666.5	" 638
487 + 00	657.0	" 630
490 + 00	659.0	" 645
510 + 00	663.0	" 624
510 + 70	670.0	" 628
536 + 50	665.5	" 626
538 + 00	665.5	" 628
543 + 50	672.0	" 643
586 + 50	698.0	668.0±
593 + 00	684.0	651.0±
598 + 00	666.5	below 660±
605 + 70	665.0	634±

STATION

ELEVATION

ORIG. GROUND

BEDROCK

605 + 70	665.0	634±
617 + 50	626.0	below 639
617 + 50	626.0	648±
627 + 50	675.5	below 635±
629 + 00	683.0	" 643
634 + 00	686.0	" 654
634 + 00	680.0	" 656
636 + 00	673.5	" 640

Mr. G.C.E. Burkhardt (3)
Reg. Structural Planning Eng.
Central Region
3501 Dufferin St., Downsview

Soil Mechanics Section
Geotechnical Office
West Bldg., Downsview

October 14, 1975

PROPOSED NANTICOKE TO CALEDONIA
JOINT HWY #6 UTILITY CORRIDOR
DISTRICT #4 (HAMILTON ONT)
W.P. 55-75-00

We have reviewed the available geotechnical data along the alignment of the proposed new Hwy. #6 joint use corridor as requested by you in a memorandum dated September 9, 1975.

Information obtained from Ontario Hydro (Boring and Tower Foundation Installation Records) indicate that the bedrock profile varies along the transmission lines located adjacent to the proposed corridor as follows:

Sta: 100 + 00 - Sta: 115 +
Depth: 10 - 15 Ft.

Sta: 115 + - Sta: 180 +
Depth: 0 - 10 Ft.

Sta: 180 + - 615 +
Depth: Over 15 Ft. (With the exceptions of Boston
and McKenzie Creeks)

According to Hydro officials the bedrock consists of shaley dolomite. The upper 1-2 Ft. portion of the bedrock can probably be excavated by conventional methods. Blasting or jack hammering will be required below this zone.

The footings of the subway structure at the Michigan Central Railway (Sta: 175 + 75) will be located well into the bedrock. Blasting will be required for the footing and for the roadway excavations.

At Boston Creek (390 + 00) the bedrock is at elevation 619 which is about 7 Ft. below the creek bed.

The bedrock surface in the vicinity of McKenzie Creek (Sta: 449 + 50) is at the same elevation as the creek bed (elevation 624).

We believe that reviewed available data are sufficient for your present purposes and no further borings are required at this time.

A list of the bedrock and ground elevations together with stations is attached to this memorandum.

If you have any further queries, please contact our office.

P. Payer
Senior Engineer

For: K.G. Selby
Supervising Engineer

C. Grebski
G.A. Wrong
D. Gunter
R. Fitzgibbon
J. Anderson

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STATION

ELEVATION

	ORIG. GROUND	BEDROCK
105 + 50	730	715
113 + 00	727	714
120 + 50	727	720
127 + 50	727	721
135 + 00	728	722
142 + 50	726	719
148 + 50	720	714
157 + 50	726	719
164 + 50	723	722
172 + 50	705	705
178 + 50	689	674
193 + 00	678	640 +
208 + 00	688	660 +
214 + 50	690	653 +
236 + 00	690	656 +
257 + 50	664	651 +
286 + 00	681	651 +
329 + 50	657	643 +
380 + 50	645	617
388 + 00	651	618
395 + 00	630	620
430 + 00	685	625 +
448 + 00	641	624
480 + 00	666	639 +
500 + 00	664	632 +
538 + 50	666	638 +
593 + 00	684	661
606 + 00	662	633

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. G.C.E. Burkhardt (3)
Reg. Structural Planning Eng.
Central Region
Downsview, Ont.

FROM: Soil Mechanics Section
Geotechnical Office
West Building

ATTENTION:

DATE: October 6, 1975

OUR FILE REF.

IN REPLY TO

SUBJECT:

Proposed Nanticoke to Caledonia Highway
Hwy 6N; District 4 (Hamilton)
W.P. 55-75-00

In order to obtain preliminary information regarding the existing subsurface conditions at the proposed combined dam and bridge site (Intersection of Grand River and future new Hwy #6), a field investigation, consisting of two sampled boreholes and ten soundings, was carried out.

The subsoil conditions in general were found to be similar to those encountered approximately 1 mile downstream as reported by W. Trow Associates Ltd. in a Foundation Report issued in November, 1966, a copy of which is in your possession.

From river water level (5'-12' deep) downward the overburden was found to consist of zones of weathered (Decomposed) shale and river sediments (Sands & Silts). The thickness of the overburden is about 15 ft. with the exception of an approx. 150' long section where the thickness is some 25 ft.

The underlying bedrock consists mainly of dolomite, frequently interbedded with zones and seams of shale and gypsum. It is a fact, that gypsum dissolves in water thus creating cavities in the bedrock and letting water to seep through. This condition may dictate some form of seepage control.

The proposed dam may be founded as recommended in the report prepared by W. Trow Associates Ltd; i.e. directly on the bedrock or on a double row of heavy sheet piling driven to bedrock.

For computation of sliding resistance a friction coefficient of 0.45 may be assumed to apply between the base of footings and underlying overburden or bedrock.


The proposed bridge structure should be supported on spread footings within the sound bedrock, some 5 ft. below the bedrock surface or on large diameter concrete caissons installed some 10 to 15 ft. into bedrock.

For spread footings assume a safe bearing capacity of 10 t.s.f. for
caissons assume 50 t.s.f. at 10-15 ft.

The foregoing should enable you to do the following:

1. Compare the cost of a dam at the two sites
2. Prepare a reasonable cost estimate of the bridge structure
3. Determine whether any cost advantage is achieved by incorporating
the bridge and dam structures

Please contact this office if further information or advice is required.

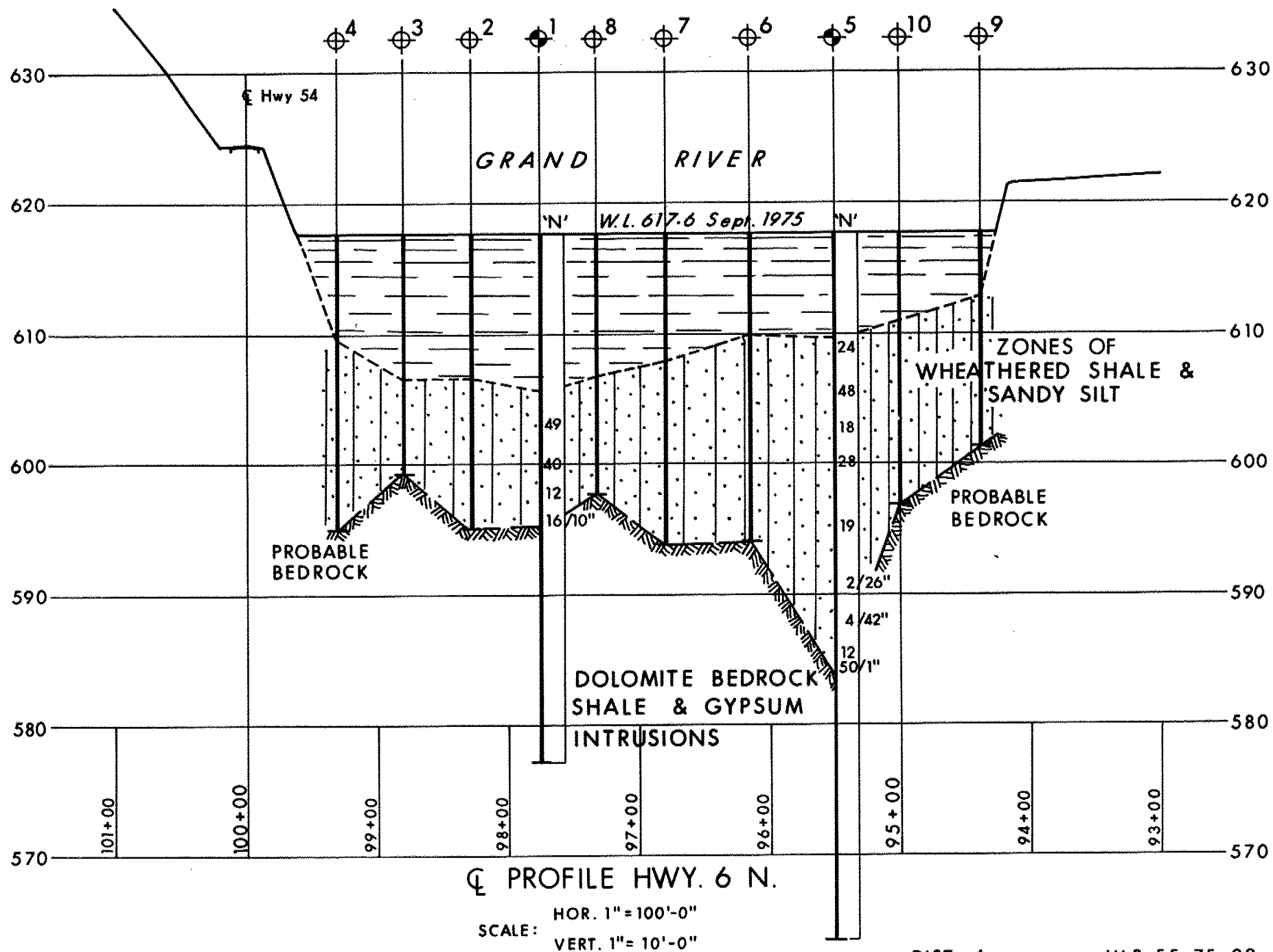

P. Payer, P. Eng.
Senior Engineer

For: K.G. Selby, P. Eng.
Supervising Engineer

PP/bp

cc: C. Grebski
G. A. Wrong
D. Gunter
R. Fitzgibbon
J. Anderson

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Ministry of
Transportation and
Communications

Memorandum

To: Mr. Paul Payer,
Senior Engineer,
Soil Mechanics Section,
West Building.
Attention:

From: Pavement Structure Design Section,
Geotechnical Office,
1st Floor, West Building.

Date: September 26, 1975.

Our File Ref.

In Reply to

Subject:

Work Project 55-75
Highway 54, Caledonia Vicinity

With the examination and logging of the drill cores (holes #1 & #2) and with the correlation of your drilling log for this project, the noticeable amounts of shale, gypsum and large cavities give some concern as to foundation bearings for structural purposes. The gypsum contact in the rock would specify an anti-sulphate reaction cement type. Possibly additional drill holes would give a better understanding of the rock formation at depth on this work project.

B.K. Glassford

B. K. Glassford,
Geologist.

BKG/sd

cc:- G. A. Wrong
Z. Katona
B. K. Glassford
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Memorandum

To: Mr. G.C.E. Burkhardt (3)
Reg. Structural Planning Eng.
Central Region
3501 Dufferin St., Downsview

Attention: Mr. W.W. Kulmatikas

Our File Ref.

From: Soil Mechanics Section
Geotechnical Office
West Building
Downsview, Ontario

Date: August 25, 1975

In Reply to

Subject:

PROPOSED NANTICOKE TO CALEDONIA HIGHWAY
Highway #6N, District #4 (Hamilton)
W.P.: 55-75-00

As requested by your Office in your memo of August 15, 1975, we have reviewed the proposals for a number of structures on Proposed Hwy. 6N at Caledonia, Ontario. We have obtained the records of boreholes in this area which were carried out by Ontario Hydro in 1973. We consider the subsoil information so obtained to be adequate for your present needs and based on this information we have made certain recommendations concerning the design and construction of the various proposed structures between Stas. 523± and 643±. It is understood that your present needs are:

- (1) To prepare a reasonable cost estimate for each structure
- and
- (2) To determine with a reasonable degree of accuracy future property requirements.

We are of the opinion that the following information and recommendations will enable you to achieve objectives (1) and (2).

C.N.R. Crossing: Sta. 523±

B.H.'s #10 and #11

Profile Grade: Overhead: Elev. 689
Subway : Elev. 641

Ground Level: Elev. 665±

Groundwater Level: Elev. 661±

Subsoil

0' - 36' : Silty clay, stiff to very stiff W=27-30% (Natural Moisture Content)
C = 2000 PSF (Undrained shear strength) γ = 120-123 PCF
(Bulk Density)

36' - 42' : Sand and gravel, dense (borings were terminated at elev. 623)

Comments:

No problems are anticipated for the construction of an overhead or subway structure at this location.

Spread footing type foundations may be placed at 4 ft. below the finished ground level. Two t.s.f. is recommended.

End-bearing steel 'H' piles may reach the required capacity at approx. elev. 620±.

The approaches may be constructed (cuts and fills) with 2:1 slopes.

Grand River Crossing: Sta. 613±

Structure and Dam:

Profile Grade (Sta. 613±): Elev. 651±
River Water Level : Elev. 617±
River Bottom Level : Elev. 615±
Profile Grade of Existing Hwy. #54 (Sta. 617+50) Elev. 624±

A structure and a dam is proposed at this location.

The subsoil consists of stiff clayey silt (Sta. 617±). Shale type bedrock is at elev. 614±.

For estimating purposes it may be assumed that the dam should be founded 5 ft. below the shale bedrock surface.

Bridge structure foundations should be keyed and dowelled into sound bedrock. Design pressures up to 10 tsf may be used. For the approaches, 2:1 slopes are recommended.

CNR Crossing: Sta. 643±

Profile Grade: Overhead: Elev. 710±
Subway : Elev. 662±

Ground Level: Elev. 680±

Groundwater Level: Elev. 678±

Subsoil:

0' - 9' : Clayey silt, very stiff
W: 21%
C: 3000 psf
γ: 130 pcf

9' - 42' Silty clay, layers of silt, stiff
W: 26-34%
C: 2000 psf
γ: 119-126 pcf

Comments:

No problems are anticipated for construction of an overhead or subway structure at this location.

Spread footing type foundations may be placed at 4 ft. below the finished ground level. The allowable bearing pressure is in the order of 2 tsf.

End-bearing steel 'H' piles driven to approx. elev. 635± may be designed for the maximum capacity for the pile section chosen.

The approaches (cuts and fills) constructed with 2:1 slopes will be stable.

It is pointed out that the recommendations contained in this memorandum are preliminary only. The investigation was carried out to provide recommendations for preliminary design and cost estimate purposes.

Recommendations, pertaining to the preliminary design for the remainder of the suggested alignment will be reported at a latter date.

If we can be of any further assistance concerning this project please contact this Office.


P. Payer
Senior Engineer

c.c. C. Grebski
G.A. Wrong
D. Gunter
R. Fitzgibbon
J. Anderson

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