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GEOCRES No. 31F-93

DIST. 9 REGION

W.P. No. 78-76-01

CONT. No. 78-42

W. O. No.

STR. SITE No.

HWY. No. 17N

LOCATION Hydro Dam Upper Access Road Overpass

No. OF PAGES -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

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FOUNDATION INVESTIGATION & DESIGN REPORT

W.P. 78-76-01 DIST. 9

HWY. 17N STR. SITE N/A

Hydro Dam Upper Access Road Overpass

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TYPE	DISCARD AFTER	RECOMM. BY
JARS	Dec 29/76	M.D
TUBES	"	"
ROCK CORES	"	"

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GEOCRES

DATE NOV 2 3 1976

INTRODUCTION

It is proposed to construct a new Hwy. 17N and this will bypass the town of Arnprior. In this area this particular portion of the highway is designated as Arnprior Bypass. The Ontario Hydro is completing their hydro dam project over Madawaska River and as a result of this two access roads known as Upper Access Road and Lower Access Road have been constructed. These will cross the proposed Hwy. 17N and the Ministry is contemplating structures at these crossings.

This particular report deals mainly with the Upper Access Road and Hwy. 17N crossing. The fieldwork was carried out for Line 'B'. Since the completion of the fieldwork, revisions in alignment have been made. The new alignment is designated as Line 'C', which is about 14 feet to the south of line 'B' and is shown on Drawing 787601-A.

This report contains the results of the subsurface investigation and recommendations pertaining to the design of foundations for the proposed structure, as well as related approach embankments.

SITE AND GEOLOGY

The site is located near the town of Arnprior on Lot 1, Concession B, Township of McNab, County of Renfrew. The relocated CPR tracks are approximately 550 feet to the east of the Upper Access Road.

The general ground is sloping in a westerly direction towards the Madawaska River. The newly constructed Upper Access Road is on an embankment on the sloping terrain. A ditch on the east side of the Upper Access Road running north and south is approximately 3 feet wide and 1.5 feet deep, covered with rock fill material.

Geologically, the area is located between the Precambrian upland to the north and west, and the Ottawa lowland to the south and east. Bedrock consists of limestone with interbeds of sandstone and shale and has been subjected to faulting, weathering, and erosion. When the Champlain Sea inundated the Ottawa-St. Lawrence lowland, it left deposits of marine clay.

FIELD AND LABORATORY INVESTIGATION

The field investigation consisted of two boreholes advanced by a conventional diamond drill rig adapted for soil sampling purposes. Disturbed samples were obtained using a 2 inch O.D. split spoon sampler driven according to the specifications for the Standard Penetration Test. Undisturbed samples were obtained using 2 inch I.D. shelby tubes pushed manually into the soil. In addition, field vane tests were performed when possible. Bedrock was proven in one of the borings by obtaining BX size rock core samples. The soil,bedrock and groundwater conditions encountered in the borings are presented on the Record of Borehole Sheets and on Drawing 787601-A.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. Following the examination, labatory tests were carried out on representative samples to determine the following engineering properties of the overburden:

Natural Moisture Contents
Atterberg Limits
Bulk Unit Weights
Unconfined Compression Tests

The results of laboratory testing were plotted on the individual Record of Borehole Sheets which are appended to this report.

SUBSURFACE CONDITIONS

The predominant deposit in this area consists of stiff to very stiff clayey silt to silty clay of up to 21 feet in thickness in the area investigated. The cohesive deposit is underlain by a thin layer (up to 2 feet thick) of sand with silt and trace to some gravel, which in turn is followed by limestone bedrock. The overburden is covered with a 2.5 ft. thick layer of fill material (Upper Access Road embankment material) consisting of gravel and sand with some cobbles.

Boundaries between different deposits are shown on the Record of Borehole Sheets which are appended to this report. The locations and elevations of the borings are shown on Drawing No. 787601-A, together with the estimated stratigraphical section. A description of the soil types encountered in the borings is presented below.

Fill Material

The fill material was placed in order to construct the Upper Access Road. It is about 2.5 feet in thickness and consists of gravel and sand with some cobbles. Standard Penetration Tests were not carried out within the fill material, but from the driving of the NX casing, it is inferred that the fill has been well compacted.

Clayey Silt to Silty Clay

The fill material is underlain by the predominant deposit of clayey silt to silty clay with occasional pockets and some seams of silt or sand. The thickness of this cohesive deposit varies from 10 to 21 feet. According to the geology of the area, this cohesive material was deposited by the post glacial Champlain Sea.

The engineering properties of the cohesive subsoil as determined by the field and laboratory testing, are plotted on the Record of Borehole Sheets and summarized in tabular form below.

Index Properties	Range	Average
Natural Moisture Content W(%)	29-43	36
Liquid Limit W_L (%)	28-41	33
Plastic Limit W_p (%)	16-22	18
Liquidity Index I_L	0.8-1.8	1.2
Bulk Unit Weight γ (pcf)	115-123	118
Undrained Shear Strength (Cu) psf		
In Situ Vane Tests	> 2,240	
Unconfined Compression Tests	1,985-2,420	
Standard Penetration 'N' Values-Blows/ft.	6 to 14	

The Atterberg Limit Test results given in the Table are also summarized on the Plasticity Chart, Figure 1. The testing indicates that the cohesive stratum is of low to intermediate plasticity.

The natural moisture content is above the liquid limit as indicated by the liquidity indices which are greater than unity. This is usually typical of the marine clay in this area.

From the undrained shear strength values and the Standard Penetration 'N' values which are presented in the Table, it is estimated that the consistency of the stratum varies from stiff to very stiff.

Sand With Silt, Trace to Some Gravel

This thin granular deposit is sandwiched between the cohesive overburden and limestone bedrock. The thickness of this thin stratum varies from less than a foot to 2 feet and consists mainly of loose sand with silt and trace to some gravel. Based on the limited information it is estimated that the relative density of the deposit is loose.

Bedrock

Bedrock was proven by obtaining some 5 feet of BX size rock core samples in one of the boreholes. It addition, the probable bedrock surface was established in the other borehole by extending the sampling operation of the overburden to the surface of the bedrock where the split spoon sampler was bouncing. The surface of the bedrock varies between elevations 284 and 289, which indicates that the depth to bedrock ranges from 13 feet to 25 feet below ground surface.

The bedrock can be identified as hard, medium to coarse textured, crystalline limestone. It is generally sound, as evidenced by the quality and percentage recovery of the rock cores. Rock Quality Designation (RQD) value of 95% was obtained and indicates that the rock quality is excellent.

GROUNDWATER CONDITIONS

Groundwater levels were established immediately after the completion of the drilling operations. It was found that both the boreholes were dry. This indicates that there is some downward drainage into the thin granular stratum or into the bedrock. Furthermore, the granular stratum which is sandwiched between the upper cohesive overburden and the bedrock may be acting as a drainage layer with the hydraulic gradient towards the river.

DISCUSSION AND RECOMMENDATIONS

The proposed Arnprior Bypass would require a structure at the crossing of Hwy. 17N and the Upper Access Road which leads to the top of the Ontario Hydro Dam. The present proposal calls for a super span elliptical steel pipe structure with a span length of about 29'-6" and a rise of about 21'-7". The invert and the outlet of the structure will be elevation 312.9 and elevation 302.3 respectively. The Hwy. 17N grade at this crossing is about elevation 330. A super span somewhat similar to the one being considered for this project was built on Hwy. 17N EBL for CPR crossing one mile north of the village of Haley Station in Renfrew County and is performing satisfactorily.

The subsoil generally consists of 10 to 21 ft. thick layer of stiff to very stiff clayey silt to silty clay, underlain by a thin granular deposit (less than a foot to 2 feet) of sand with silt and trace to some gravel. The overburden is underlain by limestone bedrock and overlain by about 2.5 ft. thick layer of sand and gravel with some cobbles (Upper Access Road fill material).

Recommendations pertaining to the installation of the super span structure and the related approach embankments are as follows.

Super Span Structure

The subsoil conditions are generally favourable for this type of structure. The strength and compressibility characteristics are such that problems with regards to differential settlements are not anticipated. Since the subsoil is relatively impervious material, no dewatering problems are anticipated for the installation of the super span structure. Any seepage due to surficial runoff can be controlled by conventional pumping methods.

1) The bedding material under the structure should consist of a minimum 12" of uncompacted Granular 'B'. It should be back-dragged and hand levelled before the structure being installed.

2) The backfill should consist of Granular 'B' and gravel sizes in this material should not be greater than 2" within a foot of the structural plate. The backfill should be placed and compacted in layers suitable for the type of compaction equipment used but should not exceed 6" in depth.

3) The backfill should be approximately equal on each side of the structure at all times with the difference in elevation not to exceed 12". The height of backfill cover above the top of the structure should not be less than 4 ft. or as per the manufacturer's requirements.

4) Temporary struts should be provided inside the pipe during the time of backfilling and the placement of cover material. This will help to prevent any undesirable deformations of the pipe. Alternatively, anchors with cable supports to hold the pipe in equilibrium may be adopted similar to the one used at Haley Station. only at ends!

5) Within the pipe beneath the granular base coarse material for the roadway, adequate drainage should be provided by means of sub-drains to relieve water in the structure. Any seepage due to surficial runoff can be controlled by conventional pumping methods.

The success of the installation of such pipe will depend upon careful placement of bedding and backfill material around the pipe with proper supervision in the field.

Embankments

Fill heights of up to about 25 feet and 45 feet will be required for the east and west approaches respectively, to attain the proposed profile grade. Deep seated failures for the approaches are not anticipated because of the stiff to very stiff consistency of the predominant clayey silt/silty clay overburden. The safety of the embankment is to be governed by the stability of the fill itself. The type of fill material for the embankments should consist of earth fill within the limits of the structure. However, rock fill may be used elsewhere. The following are our recommendations with regard to stability of embankments.

Earth Fill		Rock Fill	
Fill Ht.	Stable Configuration	Fill Ht.	Stable Configuration
up to 30'	2:1	up to 35'	1¼:1
30' to 40'	2:1 with 15' berm at mid height	35' to 55'	Overall slope 1½:1 or 1¼:1 slopes with mid height berm of 20' uncompacted stock piled rock fill material or
40' to 50'	2:1 with 20' berm at mid height		

Rock Fill

1¼:1 slopes with 15' mid height berm
Quality assurance of rock fill material

The mid height berm for high fills is recommended from points of view of maintenance, safety and performance of the embankment.

No major settlement problems are anticipated since the induced stresses under the embankment are below the preconsolidation pressure. Thus, settlement will be mainly of a recompression nature and will take place during or immediately after construction.

MISCELLANEOUS

The fieldwork was carried out during the period of July 8 to July 9, 1976 under the supervision of Mr. S. Maloney, Student Technician.

The equipment used for subsoil sampling was owned and operated by Johnston Drilling Co., Ottawa. This report was written by Mr. H. Shah and was reviewed by Mr. M. Devata, Supervising Engineer.

H. Shah

H. Shah, P. Eng.
Project Engineer

M. Devata

M. Devata, P. Eng.
Supervising Engineer

MD/HS/gs
November, 1976

APPENDIX

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

ENGINEERING SERVICES BRANCH - GEOTECHNICAL OFFICE - SOIL MECHANICS SECTION

RECORD OF BOREHOLE No 1

WP 78-76-01 LOCATION Co-ords. 16,505,481 N; 1,039,569 E. ORIGINATED BY SM

DIST 9 HWY 17N BORING DATE July 8, 1976 COMPILED BY SM

DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY GP.

SOIL PROFILE ELEV/DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH PSF ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 400 800 1200 1600 2000	LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W / WATER CONTENT % 20 40 60	UNIT WEIGHT γ P.C.F.	REMARKS % GR SA SI CL
309.7	Ground Level									
0.0	Fill, Dense Gravel and Sand									
307.2										
2.5	Clayey silt to silty clay, occasional pockets and some seams of silt or sand. Stiff to Very Stiff		1	SS	6					
							> +			
			2	TW	PM		○		115	
			3	SS	10	300				
							> +			
			4	TW	PM				119	
			5	SS	11					
							> +			
			6	TW	PM		○		117	
						290				
							> +			
286.7			7	TW	PM				119	
23.0	Sand with silt, trace of gravel. Loose		8	SS	4					
284.5										
25.2	End of Borehole Split spoon bouncing Probable Bedrock									
	Note: Borehole Dry									

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT ON SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

ENGINEERING SERVICES BRANCH – GEOTECHNICAL OFFICE – SOIL MECHANICS SECTION

RECORD OF BOREHOLE Nº 2

WP 78-76-01 LOCATION Co-ords. 16,505,583 N; 1,039,505 E. ORIGINATED BY SM

DIST 9 HWY 17N BORING DATE July 9, 1976 COMPILED BY SM

DATUM Geodetic BOREHOLE TYPE Washboring and BX Rock Coring CHECKED BY

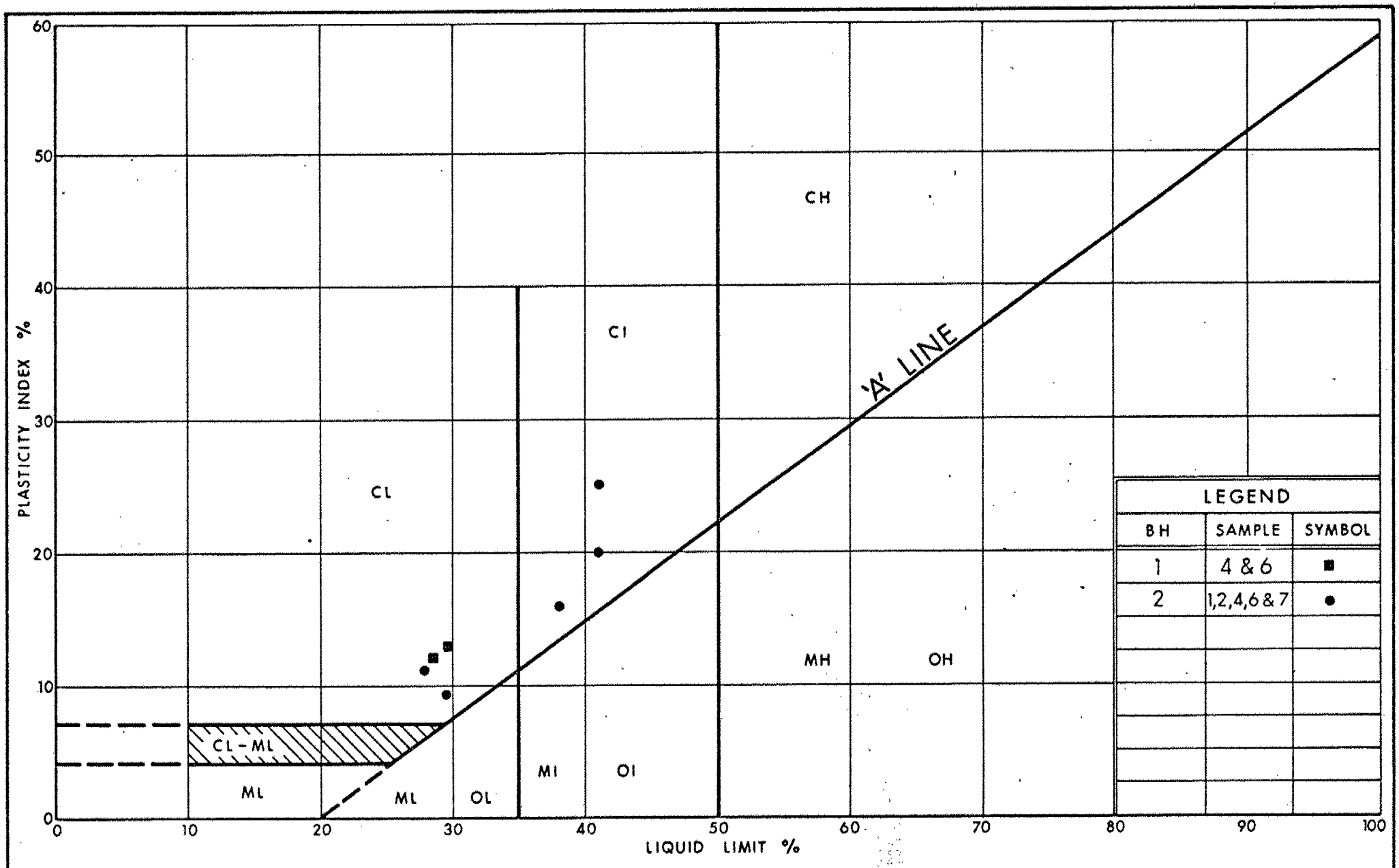
SOIL PROFILE ELEV / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	'N' VALUES	GROUND WATER ELEV	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH PSF (o UNCONFINED, • QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (400 800 1200 1600 2000)	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W (W_P — W — W_L) / WATER CONTENT % (20 40 60)	UNIT WEIGHT γ P.C.F	REMARKS % GR SA SI CL
301.9	Ground Level									
0.0	Fill									
299.4	Gravel, sand, some cobbles. Dense					300				
2.5	Clayey silt to silty clay, occasional pockets & some seams of silt or sand.		1	SS	39*					
			2	TW	PM				115	
			3	SS	14					
			4	TW	PM				122	
	Stiff to Very Stiff		5	SS	9					
289.4			6	TW	PM	290			123	
288.7	Sand with silt, some gravel. Loose		7	SS	3/2"					
13.2	Crystalline Limestone Bedrock		1	RC BX	Rec. 98%					RQD=96%
283.4	Sound									
18.5	End of Borehole									

*Coarse gravel from the fill material obstructed the advancement in sample No.1, thus its blows/foot count is considered to be non-representative.

Note: Borehole Dry

20
15 ⊹ 5 % STRAIN AT FAILURE
10

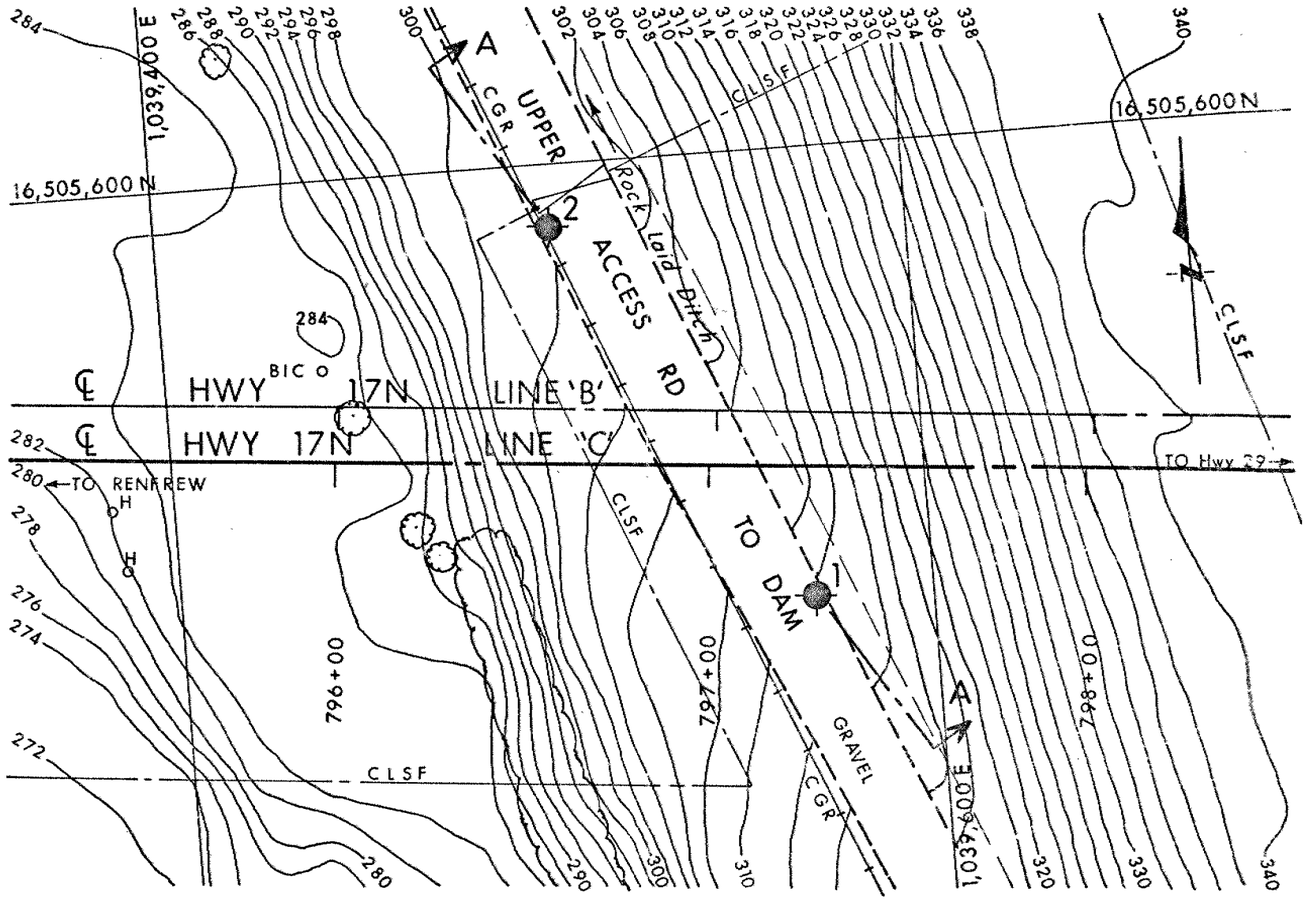
OFFICE REPORT ON SOIL EXPLORATION



Ministry of Transportation and Communications
Ontario
ENGINEERING SERVICES BRANCH

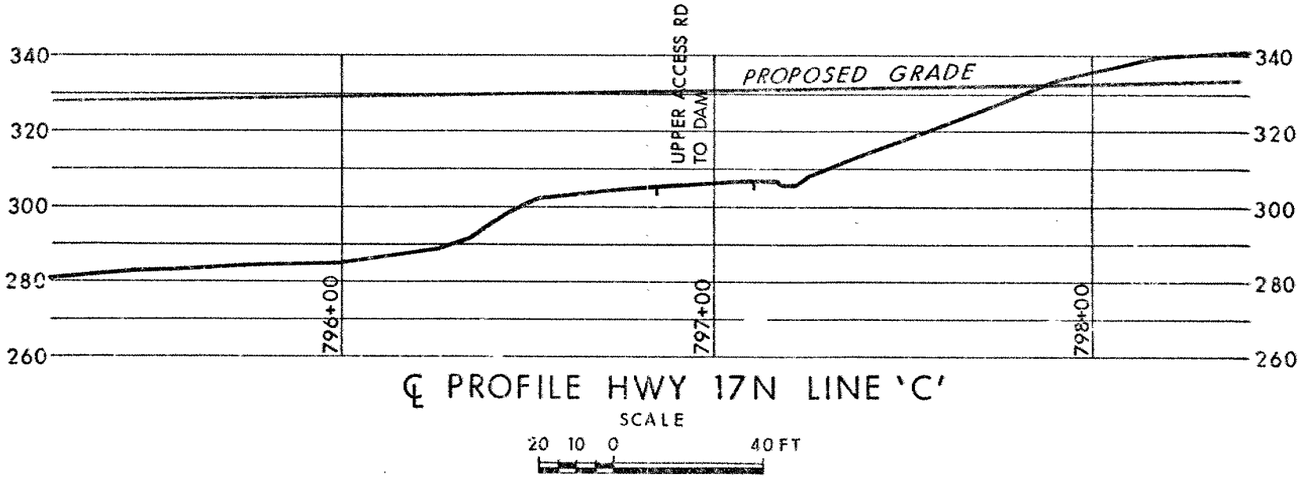
PLASTICITY CHART
CLAYEY SILT TO SILTY CLAY

FIG No 1
W P 78-76-01



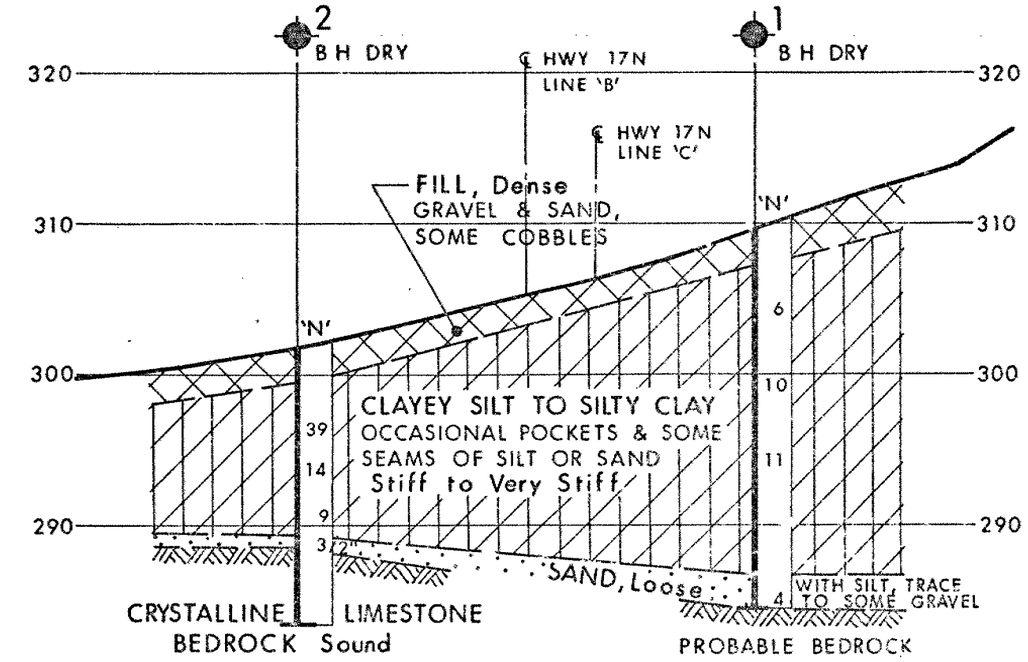
PLAN

SCALE 20 10 0 40FT



℄ PROFILE HWY 17N LINE 'C'

SCALE 20 10 0 40FT

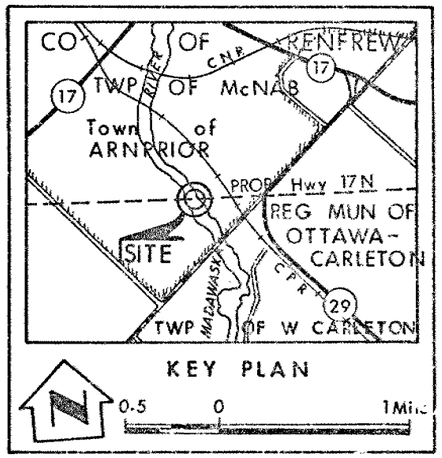


SECTION A-A

SCALE

HORIZ. 40 20 0 40 80 FT

VERT 10 5 0 10 20 FT



LEGEND

Bore Hole

No	ELEVATION	CO-ORDINATES NORTH	CO-ORDINATES EAST
1	309.7	16,505,481	1,039,569
2	301.9	16,505,583	1,039,505

Ministry of Transportation and Communications

Ontario

ENGINEERING SERVICES BRANCH

DATE Oct 19, 1976

HYDRO DAM UPPER ACCESS ROAD & HWY 17N LINE 'C'

CO RENFREW TWP McNAB Town of ARNPRIOR

CON B LOT 1 SITE 29-201 DIST 9

WP 78-76-01 Dwg No 787601-A

REF No E-5274-1; Nov / 76

Mr. K. Bassi
Head, Eastern Section
Structural Office
West Building, Downsview

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

77 10 04

Re: Upper Access Road Overpass
W.P. 78-76-01, Site 29-201
Highway 17N, District #9, Ottawa

In conjunction with our review of the final design drawings for this project, we had a meeting with Mr. K. Bassi on September 29, 1977 to discuss certain drafting modifications in these drawings. It was agreed in the meeting that:

1. The dimensions of the granular backfill to the super span structure shown in Dwg. 29-201-3 should also be shown in Section B-B in DWg. 29-201-1.
2. Material for the west approach shown in Dwg. 29-201-3 should be rockfill instead of earthfill.
3. The slope angles adjacent to the structure outlets shown in PLAN in Dwg. 29-201-1 should read 20(H):1(V), instead of 1:2 or 1:20.

We have no other comments

L-y BL

B. Ly
Senior Engineer
For: M. Devata
Supervising Engineer

BL/bh
cc: Files

Mr. C.S. Grebski
Structural Design Section
West Building, Downsview

Mr. K. Bassi

Soil Mechanics Section
Engineering Materials Office
West Building, Downsview

March 3, 1977

Re: Upper Access Road Overpass
Arnprior Bypass
W.P. 78-76-01, Site 29-201
District #9, Ottawa

We have reviewed the Preliminary Bridge Plan Drawing 29-201-P1 for this project. Our comments are as follows:

1. The proposed rockfill in the area west of Station 796+50 is in the order of 40 to 45 feet high. According to our foundation report, rockfill of such heights should be constructed with the following configurations:

   Uncompacted Stockpiled Rockfill: 1½:1 overall slopes or 1¼:1 slope with 20' mid-height berm.

   Quality Assurance of Rockfill: 1¼:1 slopes with 15' mid-height berm

   In this area, berms longer than as shown in the design drawings will be required.

2. The bedding material under the structure, which is to be hand shaped and to be placed uncompacted, should have a minimum thickness of 12 inches.

B. Ly
Senior Engineer

For: M. Devata
Supervising Engineer

BL/gs

cc: Files
Record Services

35MM
DRAWING