McROSTIE SETO GENEST
& ASSOCIATES LTD. - CONSULTING ENGINEERS - 393 BELL ST., OTTAWA, ONTARIO
& ASSOCIÉS LTÉE - INGÉNIEURS CONSEILS - 393, RUE BELL - TEL. 232-5334

GEOCRES No.
316-181

1. TERMS OF REFERENCE

We were requested by C. C. Parker and Associates Limited, Consulting Engineers, to carry out a subsurface investigation at the site of a proposed bridge crossing the East Castor River at the Boundary of the Counties of Russell and Dundas, Ontario. The proposed structure would consist of three spans of precast prestressed concrete simple beams with a 28 foot wide roadway. The approach embankments on both shores would be raised by a maximum of 4 feet above the existing approach embankments.

2. RECOMMENDATIONS

2.1 Structure Foundation

A pile type foundation bearing on the dense till or rock is recommended to support both abutments and both piers.

Footings are not recommended due to the low strength of the clay soils encountered at this site.

2.2 Pile Types

The likely economical and feasible type of foundation for the proposed building at this site, is the driven cast in place concrete caisson (Franki, Parco, Petrifond type). This type of pile is so considered since it can be made to bear adequately, on or near the surface of the underlying dense till layer. With this type of pile a bulb is formed at the base of the pile thus reducing the length of pile that would be required with other types of end bearing piles.

2. <u>RECOMMENDATIONS</u> - Cont'd.

2.2 <u>Pile Types</u>

Of course, any alternate type of end bearing piles such as steel H-piles, concrete filled tube piles and driven precast Herkules piles should be considered if they proved economical. However the difficulties of driving through dense till and boulders should be recognized in the selection of pile type.

2.3 <u>Soil Strengths</u>

Since soils are not recommended for support of a footing type foundation for the proposed structure, detailed bearing values are not given here. It can be stated however that the underlying dense till below the site willprovide adequate support for driven cast in place concrete caissons.

2.4 <u>Embankment Foundations</u> (Opened-End Structure)

A stability analysis was made considering a failure longitudinal to the proposed 15 foot high embankment at the abutments. In the analysis it was assumed that no resistance would be developed through the embankment. Furthermore, the value of shear strength along the failure arc was generalized. With the strength values of 0.5, 0.7 and 0.8 K.S.F. assumed along the failure circle, corresponding factors of safety of 1.3, 1.9 and 2.1 were determined. These results show that under the worse assumption the shear strength of the embankment material must be developed in order to obtain a suitable factor of safety against instability of the embankment foundation at this location.

2. RECOMMENDATIONS - Cont'd.

2.4 Embankment Foundations (Opened-End Structure)

A detailed study of the stress-strain characteristics of granular soils which perhaps might be available in this area for the construction of a granular fill embankment over the cohesive soil foundation encountered here was beyond the scope of this report. Furthermore, since clay would be economically available at this site and because the stress-strain characteristics of a clay embankment would likely be more compatible with the stress-strain characteristics of the underlying cohesive foundation material, we recommend that clay be used for the construction of the embankments. In this way the shear strength of the embankment would likely be developed and could be used in a stability analysis. Thus an adequate factor of safety against instability would be obtained.

Any unselected fill or alluvium deposits adjacent to the abutments should of course be removed prior to placing the compacted fill.

Since the clay fill would exert larger pressures on the new bridge abutments, we recommend that a granular fill be placed at the contact area between the clay embankment fill and the abutments.

A surface drainage ditch, which has caused considerable erosion along the north slope of the existing west embankment approach will need to be relocated or the slope provided with erosion protection.

2.5 Negative Friction

Although the present narrow embankment would have had time to consolidate a portion of the underlying compressible stratum, the proposed additional embankment load which represents about a 30% increase in load would cause some amount of negative friction on the pile foundation. Hence, we recommend that some provision be made for negative friction in the design of the pile foundation for the abutments, say about 30% of the pile capacity could be provided for negative friction only.

2.6 Construction Precautions

Pile driving inspection should be considered. Furthermore the provision of an allowance to cover the cost of a pile load test is a helpful addition to construction control of any piling operation.

Variations in depth to rock or boulder till could be encountered at this site and contract payment procedures should make clear which party is to bear the cost of these variations. Finally, if variations in subsurface conditions between boreholes are encountered at the time of construction they should be reported to the Supervising Authority for suitable action.

3. SITE INVESTIGATION

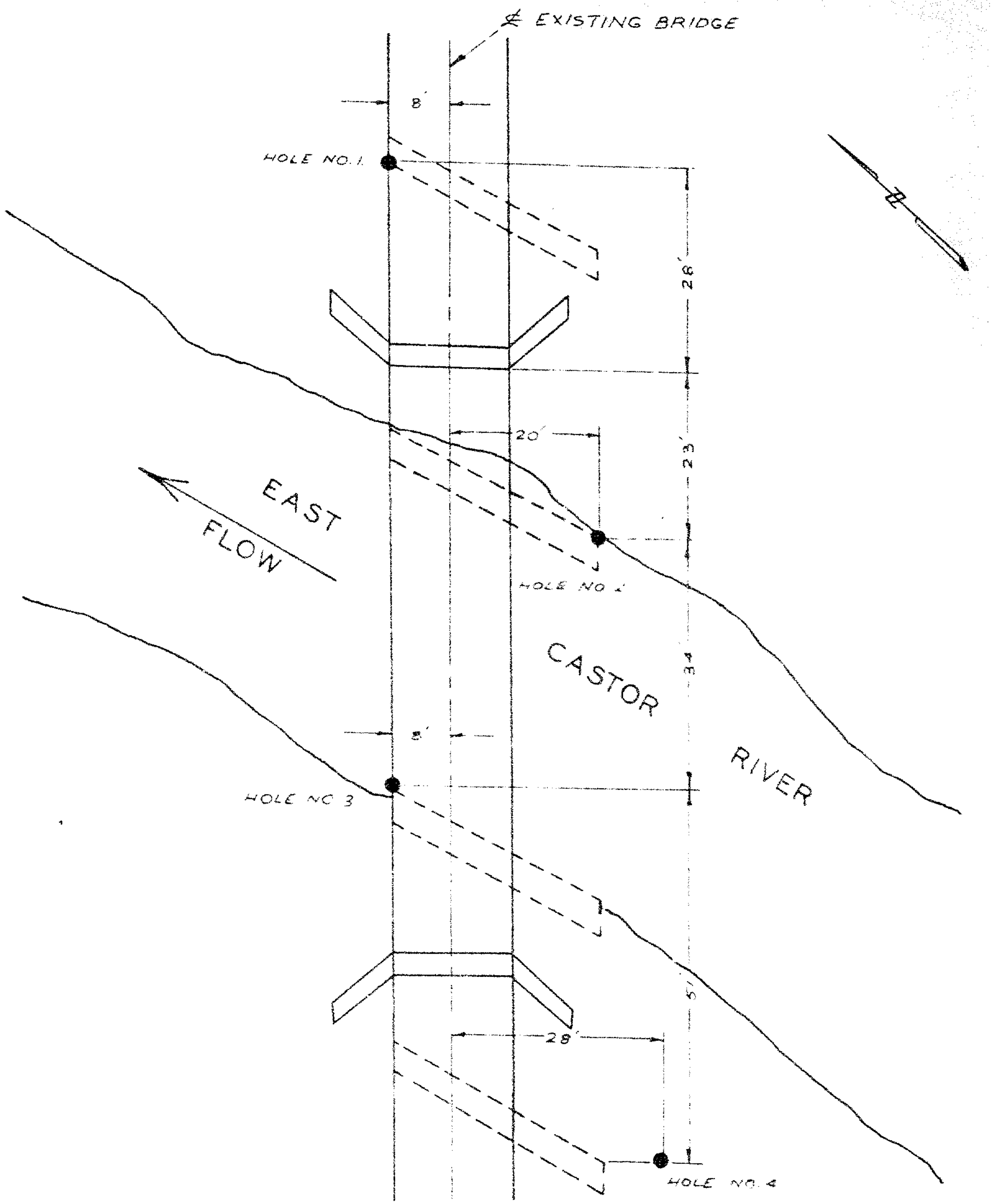
Four boreholes were made at the site with our test drilling rig in the locations shown on Plate No. 1. Split barrel samples were retrieved from the granular subsoil, and Standard Penetration Resistance tests were carried out with the split barrel samples. Two inch tube samples were taken every 5 feet in the cohesive subsoil, and borehole vane tests made in between the tube sampling. Boulders and rock encountered in the boreholes were diamond drilled and the cores were brought to our laboratory for inspection and logging. Groundwater levels were observed during the investigation.

All samples were visually classified and moisture content determinations were made on all samples. Penetrometer tests were made at every 6 inches in the tube samples. The rock cores were logged by an Engineer.

The soils and rock encountered at borehole locations are shown in detail on the accompanying plates No. 2 to No. 5. The subsoil can be generalized as consisting of a layer of fill about 5 feet to 11 feet thick (the 11 feet of fill at borehole No. 1 - is the existing easterly approach fill) underlain by a layer of clay 5 to 15 feet thick and decreasing in consistency from stiff to soft with depth. Below the clay is a layer of loose silt 2.5 feet to 10 feet thick, which overlies a layer of till (mixture of clay, silt, sand, gravel and boulders) 8 feet to 21 feet thick varying in density from loose to dense with depth and underlain by rock. Bedrock is predominantly dolomite rock which is somewhat fractured in the top 1 foot layer.

3. SITE INVESTIGATION - Cont'd.

Artesian flowing conditions were encountered in boreholes 2, 3 and 4, however these boreholes were filled after completion and flowing conditions stopped. Groundwater level in borehole No. 1 which did not reach rock was observed at elevation 88.8 - (depth 8.7 feet).



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BOREHOLE LOCATIONS - POSITIONS DES FORAGES

MARIONVILLE BRIDGE

SCALE ÉCHELLE	1" = 20'	PLATE PLAQUE 1

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OTTAWA CANADA

SOIL PROFILES & TEST SUMMARIES
PROFIL SOUTERRAIN ET RÉSUMÉ DES ESSAIS

MARIONVILLE BRIDGE

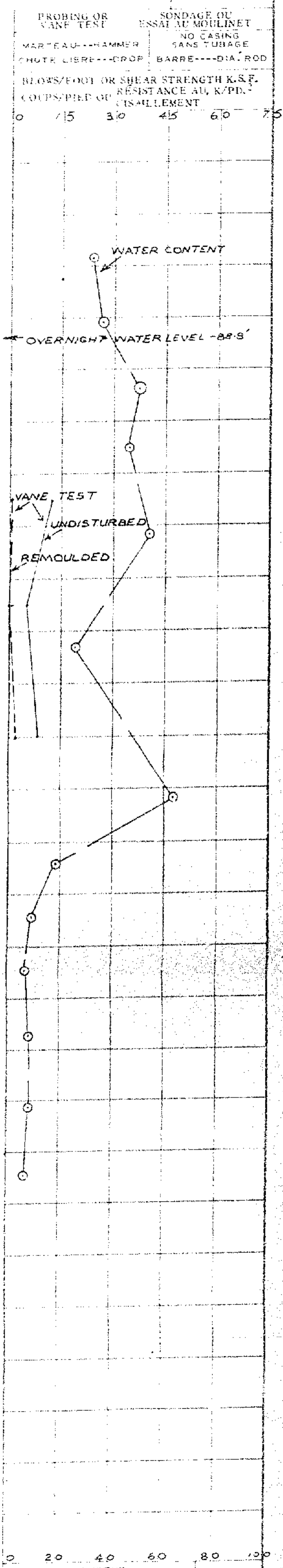
ELEVATION OF GROUND SURFACE (ZERO DEPTH) 97.5
NIVEAU DU SOL (PROFONDEUR ZÉRO)

DATE MAY 20/65

HOLE / FORAGE No. 1

NOTES B.M. (EL. 100.0') ASSUMED TOP OF EXISTING BRIDGE DECK

Compressive Strength K.S.F. / Résistance à la Compression K/Pd.²	Small Scale Penetrometer K.S.F. / Petit Pénétromètre K/Pd.²	Blows/ft. Standard Penetration / Blows-Pied-Coups/pd	Sample No. / Échantillon No.	DESCRIPTION OF SOIL / DU SOL (Ground Surface / Niveau du Sol)	Depth in Feet / Profondeur - Pied	Elevation / Niveau
					0	97.5
				FILL SILTY BROWNISH GRAY CLAY WITH A TRACE OF GRAVEL		
		5	1-1		6.5	
		5 FOR 6"	1-2	FILL GRAVELLY CLAY		
		4	1-3		11.5	86.0
	2.8, 2.5, 3.2 / 3.0, 2.2, 2.2 / 2.0, 2.0, 1.8 / R-1.0		1-4	STIFF GRAY CLAY WITH SOME SILT	15	
	1.6, 1.8, 1.6 / 1.4, 1.8, 1.5 / 1.2, 1.2, 1.2 / 1.0, 1.0, 1.0 / R-0.2		1-5	MEDIUM SOFT GRAY CLAY WITH SOME SILT	20	77.5
	1.6, 1.6, 1.6		1-6	SILT	22.5	
	1.0, 0.8, 0.8 / 1.2, 1.0, 0.8 / 0.8, 0.8, 1.0 / 1.0, 1.0, 0.6 / 1.2, 1.0, 1.2 / R-0.0		1-7	SOFT GRAY CLAY	28	69.5
		22	1-8	MEDIUM DENSE CLAYEY TILL	30	
		28	1-9	MEDIUM DENSE SANDY TILL	32	65.5
		28	1-10	MEDIUM DENSE SILTY TILL		
		22 / 21 FOR 6"	1-11		36	61.5
		60	1-12	DENSE SILTY TILL		
		60	1-13		41.6	55.9
				BOULDERS IN TILL (PENETRATED BY DIAMOND DRILLING)	49.5	48.0
				BOTTOM OF HOLE		



NATURAL / NATURELLE ⊙
LIQUID LIMIT / LIMITE DE LIQUIDITÉ □
PLASTIC LIMIT / LIMITE DE PLASTICITÉ △

316-181

Plate / Plaque No. 2

R = Remoulded - Remanié
CR = Core Recovery / Carotte Récupérée

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OTTAWA CANADA

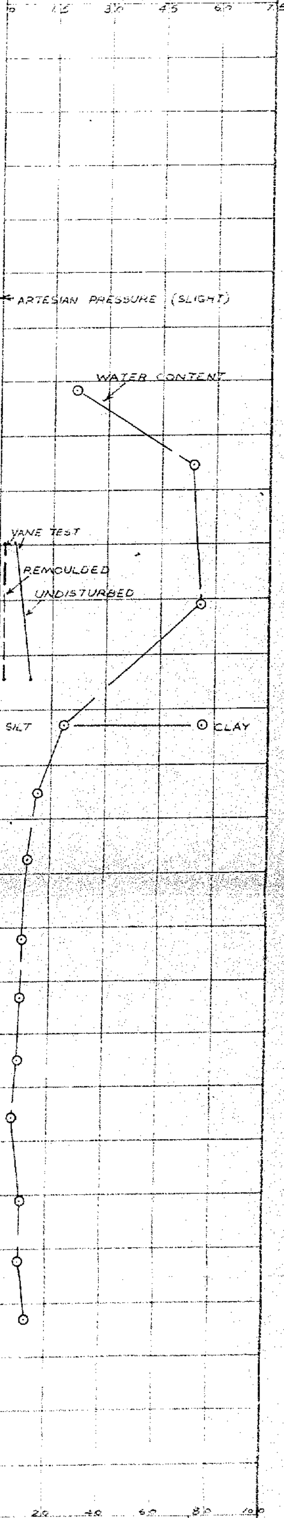
SOIL PROFILE & TEST SUMMARIES
PROFIL SOUTERRAIN ET RÉSUMÉ DES ESSAIS

MARIONVILLE BRIDGE

ELEVATION OF GROUND SURFACE (ZERO DEPTH) / NIVEAU DU SOL (PROFONDEUR ZÉRO): 86.6
DATE: MAY 24, 62
HOLE / FORAGE No.: 2
NOTES: SEE PLATE No 2

Compressive Strength K.S.F. / Résistance à la Compression K/Pd.²	Small Scale Penetrometer K.S.F. / Petit Pénétromètre K/Pd.²	Essai-Standard Penetration Blows/ft–Coups/pd	Sample No. / Échantillon	DESCRIPTION OF SOIL / DU SOL (Ground Surface – Niveau du Sol)	Depth in Feet / Profondeur–Pied	Elevation / Niveau
					0'	86.6'
		2	2-1	FILL SILTY BROWNISH GRAY CLAY		
					5'	81.6'
	0.6, 0.6, 0.6	2	2-2	SOFT SILTY GRAY CLAY		
	0.5, 0.5, 0.5 / 0.6, 0.6, 0.4 / 0.6, 0.6, 0.8 / 0.5, 0.5, 0.5 / 0.6, 0.6, 0.8 / R – 0.0		2-3			
					15'	71.6'
			2-4	SILT WITH A FEW ¼" TO ½" CLAY LAYERS		
					17.5'	
		4, 6 FOR 6"	2-5	LOOSE TO MEDIUM DENSE SILTY TILL		
		13, 5 FOR 6"	2-6			
		6 FOR 6", 7	2-7			
		10	2-8			
		21, 20 FOR 6"	2-9			
					28.5'	58.1'
		35 FOR 6"	2-10	DENSE SILTY TILL		
		33	2-11			
		78	2-12			
		30 FOR 4"	2-13			
					38.3'	48.3'
				WEATHERED OR FRACTURED ROCK CORE RECOVERY 71%		
					40.9'	
				ROCK CORE RECOVERY 78%		
					45.4'	41.2'
				BOTTOM OF HOLE		

PROBING OR VANE TEST / SONDAGE OU ESSAI AU MOULINET
MARTEAU – HAMMER / CHUTE LIBRE – DROP
NO CASING / SANS TUBAGE / BARRE – DIA. ROD
BLOWS/FOOT OR SHEAR STRENGTH K.S.F. / COUPS/PIED OU RÉSISTANCE AU CISAILLEMENT, K/PD.²



WATER CONTENT % TENEUR EN EAU
NATURAL / NATURELLE ⊙
LIQUID LIMIT / LIMITE DE LIQUIDITÉ □
PLASTIC LIMIT / LIMITE DE PLASTICITÉ △

Plate / Planche No. 3

R = Remoulded – Remanié
CR = Core Recovery – Carotte Récupérée

GEOCRES No.

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SOIL PROFILE & TEST SUMMARIES
PROFIL SOUTERRAIN ET RÉSUMÉ DES ESSAIS

MARIONVILLE BRIDGE

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 86.0
NIVEAU DU SOL (PROFONDEUR ZÉRO)
NOTES SEE PLATE No. 2

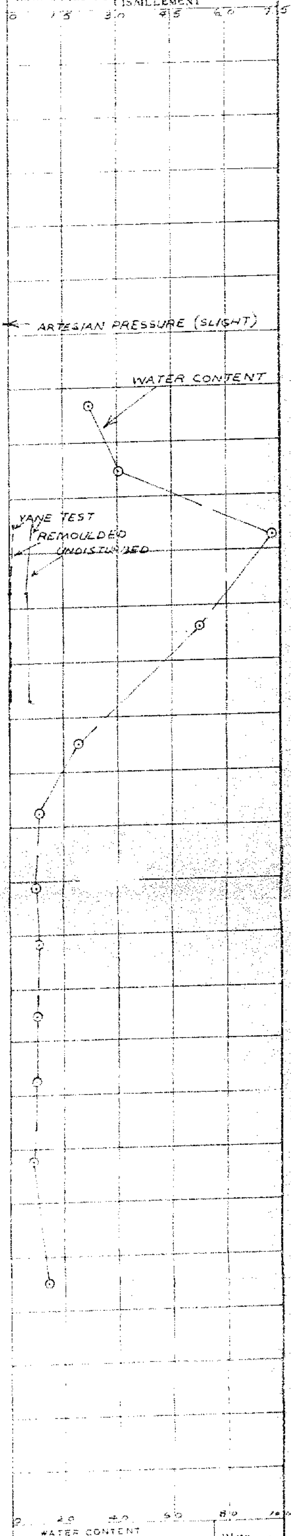
DATE MAY 25, 65

HOLE / FORAGE No. 3

Compressive Strength K.S.F. / Résistance à la Compression K/Pd.²	Small Scale Penetrometer K.S.F. / Petit Pénétromètre K/Pd.²	Blows/Ft. Standard Penetration / Blows En Coups/pd	Sample No. / Échantillon	DESCRIPTION OF SOIL / DU SOL (Ground Surface — Niveau du Sol)	Depth in Feet / Profondeur-Pied	Elevation / Niveau
					0'	86.0'
		4	3-1	FILL SILTY BROWNISH GRAY CLAY WITH A LITTLE SAND	5'	81.0'
	2.0, 1.8, 1.8	4	3-2	MEDIUM SOFT SILTY GRAY CLAY	6.5'	
	0.5, 1.5, 0.5; 0.5, 2.5, 2.0; 0.5, 2.2, 2.0; R-2.0		3-3	SOFT GRAY CLAY WITH A LITTLE SILT		
	0.6, 0.6, 0.8; 0.6, 0.8, 0.8; 1.0, 1.0, 0.8; 0.6, 0.6, 0.6; 1.0, 1.0, 0.8; R-2.0		3-4		12.5'	73.5'
		6	3-5	LOOSE SILT	16.5'	69.5'
		24	3-6	MEDIUM DENSE SILTY TILL	19.5'	
		7	3-7	LOOSE SILTY TILL	22.5'	63.5'
		15	3-8	MEDIUM DENSE SILTY TILL WITH A 1'6" DENSE LAYER		
		63 / 26	3-9			
		15	3-10			
		14	3-11		35'	
		53	3-12	DENSE SILTY TILL	38.2'	47.8'
		DRILLS		WEATHERED OR FRACTURED ROCK — CORE RECOVERY 24%	41.5'	44.5'
				BOTTOM OF HOLE		

↓ — ARTESIAN PRESSURE (SLIGHT)

PROBING OR VANE TEST / SONDAGE OU ESSAI AU MOULINET
MARTEAU — HAMMER / NO CASING — SANS TUBAGE
CHUTE LIBRE — DROP / BARRE — DIA. ROD
BLOWS/FOOT OR SHEAR STRENGTH K.S.F. / COUPS/PIED OU RÉSISTANCE AU CISAILLEMENT K/PD.²



WATER CONTENT / TENEUR EN EAU
NATURAL / NATURELLE ⊙
LIQUID LIMIT / LIMITE DE LIQUIDITÉ ☐
PLASTIC LIMIT / LIMITE DE PLASTICITÉ △

Plate / Plaque No. 4

316-1 81
GEOCRES No.

R = Remoulded — Remanié
CR = Core Recovery — Carotte Récupérée

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SOIL PROFILE & TEST SUMMARIES
PROFIL SOUTERRAIN ET RÉSUMÉ DES ESSAIS

MARIONVILLE BRIDGE

ELEVATION OF GROUND SURFACE (ZERO DEPTH) 88.6
NIVEAU DU SOL (PROFONDEUR ZÉRO)
NOTES SEE PLATE NO. 2

DATE MAY 21, 65

HOLE / FORAGE No. 4

Compressive Strength K.S.F. / Résistance à la Compression K/Pd.²	Small Scale Penetrometer K.S.F. / Petit Pénétromètre K/Pd.²	Standard Penetration Blows/ft. / Essai Standard Pénétration Coups/pd	Sample No. / Échantillon No.	DESCRIPTION OF SOIL / DU SOL — Ground Surface – Niveau du Sol	Depth in Feet / Profondeur – Pied	Elevation / Niveau
					0'	88.6'
				TOPSOIL		
					1'	
	4.2, 3.4, 4.6	4	4-1	VERY STIFF SILTY GRAY CLAY		
					4'	
	2.8, 3.4, 3.6 / 1.6, 1.8, 2.0 / R-0.8		4-2	STIFF GRAY CLAY		
					6.5'	82.1'
	1.0, 1.2, 1.0 / 1.0, 1.0, 1.0 / 1.0, 1.0, 1.0 / 1.0, 1.2, 1.2 / 1.4, 1.2, 1.2 / R-0.0		4-3	MEDIUM SOFT GRAY CLAY		
					15'	
	0.8, 0.8, 0.8 / 1.2, 1.0, 1.0 / 1.0, 1.2, 1.0 / 1.2, 1.0, 1.0 / 1.2, 1.2, 1.4 / R-0.0		4-4	MEDIUM SOFT TO SOFT GRAY CLAY WITH SOME 1/4" TO 1" SILT LAYERS		
	1.6, 1.5, 1.6 / R-0.0				20.5'	68.1'
			4-5	LOOSE SILT		
		7	4-6			
		6	4-7			
		7	4-8			
		7	4-9			
					32.5'	56.1'
		27	4-10	MEDIUM DENSE SILTY TILL		
		25	4-11			
					37.5'	51.1
		37	4-12	DENSE CLAYEY TILL		
					39'	
		24 / 4"	4-13	DENSE SILTY TILL		
					40.6'	48.0'
		1/2" DROP		ROCK CORE RECOVERY 90		
					43.0'	
		1/2" DROP		ROCK CORE RECOVERY 97%		
				BOTTOM OF HOLE	48.1'	37.5'

R = Remoulded – Remanié
C.R. = Core Recovery, Carotte Récupérée

31G - 181
GEOCRES No.

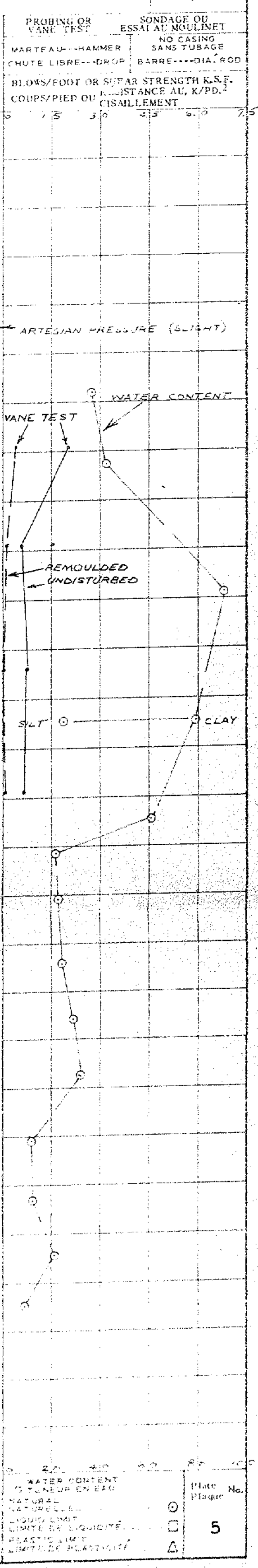


Plate / Plaque No. 5

DOCUMENT MICROFILMING IDENTIFICATION.

G.1-30 SEPT. 1976

GEOCRES No. 31G - 181

DIST. 9 REGION EASTERN

W.P. No.

CONT. No.

W. O. No.

STR. SITE No.

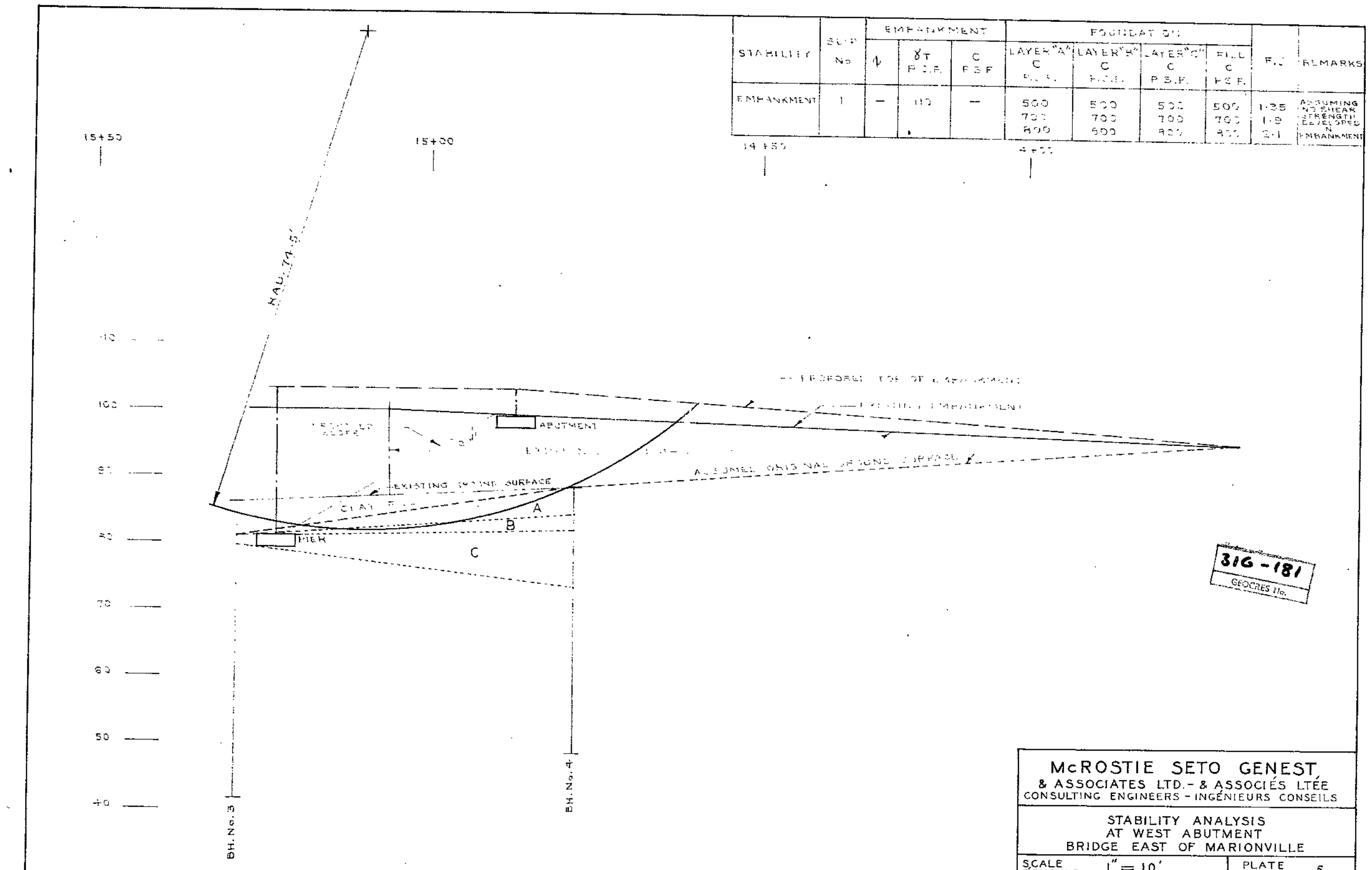
HWY. No.

LOCATION EAST CASTOR RIVER & DUNDAS / RUSSELL BOUNDARY

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 1

REMARKS: DOCUMENTS TO BE UNFOLDED BEFORE MICROFILMED.

IN NEGATIVE DUE



STABILITY	SLIP No	EMBANKMENT			FOUNDATION				F.S.	REMARKS
		ϕ	γ_T P.C.F.	C P.S.F.	LAYER "A" C P.S.F.	LAYER "B" C P.S.F.	LAYER "C" C P.S.F.	FILL C P.S.F.		
EMBANKMENT	1	—	110	—	500 700 800	500 700 900	500 700 800	500 700 800	1·35 1·9 2·1	ASSUMING NO SHEAR STRENGTH DEVELOPED IN EMBANKMENT

McROSTIE SETO GENEST
& ASSOCIATES LTD. - & ASSOCIÉS LTÉE
CONSULTING ENGINEERS - INGÉNIEURS CONSEILS

STABILITY ANALYSIS
AT WEST ABUTMENT
BRIDGE EAST OF MARIONVILLE

SCALE / ÉCHELLE 1" = 10'
PLATE / PLAQUE 6