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GEOCRES No. 40 P14 -12

G.I.-30 SEPT. 1976

W. P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. 2 - 338

HWY. No. _____

LOCATION BRIDGE RELOC. LOT 5-6, CON. 3, CURLOSS TWP.

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. NONE

REMARKS: _____

RACEY, MacCALLUM AND ASSOCIATES
LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers
AND ASSOCIATED STAFF

MONTREAL OTTAWA

TORONTO

DONALD C. MacCALLUM, B.ENG., M.E.I.C., P.ENG
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GEORGE L. HOUGHTON, A.M.I.MECH.E., M.E.I.C., P.ENG

TORONTO DIVISION
59 CURLEW DRIVE
DON MILLS, ONT.

KA 1563

10 P M-12
GEOCRES No.

Reference: S-880/T-3502
- Report -

February 6, 1962

2-338

Mr. B. M. Ross, P.Eng.,
Consulting Engineer,
P.O. Box 699,
GODERICH, Ontario.

RE: SOIL INVESTIGATION FOR PROPOSED
BRIDGE RELOCATION, LOTS 5 - 6, CONCESSION 3,
TOWNSHIP OF CULROSS, COUNTY OF BRUCE

Dear Sir:

The enclosed report presents the results of our soil investigation at the above location.

We hope the report is satisfactory to you; if you have any questions about it please do not hesitate to get in touch with us.

Thank you for this opportunity of being of service to you.

Yours very truly,

RACEY, MacCALLUM AND ASSOCIATES LIMITED

J. J. Schoustra, P.Eng.,
Divisional Soil Engineer

JJS/KA

Mr. B. M. Ross, P.Eng.,
Consulting Engineer,
P.O. Box 699,
Goderich, Ontario.

SOIL INVESTIGATION FOR PROPOSED BRIDGE RELOCATION, LOTS 5 - 6, CONCESSION 3, TOWNSHIP OF CULROSS, COUNTY OF BRUCE.

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SOIL INVESTIGATION FOR PROPOSED BRIDGE RELOCATION, LOTS 5 - 6, CONCESSION 3, TOWNSHIP OF CULROSS, COUNTY OF BRUCE.

INTRODUCTION

The site is located roughly 3 miles N-W of the village of Belmore. At present the road makes a slight bend where it crosses the Teeswater River. It is proposed to divert the creek bed some 170 feet to the North at the road crossing, and to construct a new bridge.

FIELD WORK AND RESULTS

The site is located on a flat stretch of the road which is elevated 6 feet above the river bed. Although the existing profile shows only 2 feet of water in the river, the site area showed signs of having been flooded.

A key plan showing the general area is presented on Enclosure No. 1. A site plan and cross section is shown on Enclosure No. 2. The elevations at the borehole locations are referred to the existing bridge deck at El. 100.0 ft.

Drilling was carried out using a diamond drill equipped for soil sampling by means of thin-walled shelby tubes and of a standard split spoon sampler. The number of blows of a 140 lb. hammer, falling a distance of 30 inches, required to drive the latter sampler one foot, is recorded as the standard penetration resistance. It bears an empirically established relationship to the relative density of granular soils, and hence to the bearing properties. Adjacent to each borehole, a 2-inch diameter cone was driven using the same driving energy as for the split spoon. This method provides a continuous record of the subsoil density changes with depth.

FIELD WORK AND RESULTS - Cont'd

The results of the borings are presented on the engineering data sheets, Enclosures Nos. 3 and 4. A very close agreement exists between the conditions at the two holes. The following principal strata can be distinguished:

a. Fill, used to build up and maintain the existing road-bed and berm. It varies from quite coarse at borehole No. 1 to fine (local) silty soil at No. 2. It extends from the surface to 5 - 6 feet.

b. Loose to medium dense sand and silt with some organics, some clay and some gravel. This layer is stratified and shows all signs of being waterlain; it has a relatively loose composition, shows grain size segregation and has a decomposed organic content. At borehole No. 1, closest to the present river-bed, this layer extends to El. 78 feet, at borehole No. 2 it extends to approx. El. 82 feet.

c. Medium to very dense silty gravelly sand. This deposit has light-brown limestone gravel scattered throughout its matrix, which is typical for the glacial till of the "Teeswater Drumlins" to be expected in this area. Resistance to drilling increased very rapidly in this layer, and the boreholes were terminated after a penetration of 5 - 7 feet.

Groundwater at the time of the borings was slightly above river level. Considering the large amount of snow and the fact that the grade increases towards the North, this can be assumed to be a normal condition.

RECOMMENDATIONS

The bottom of the stream at its present location is at El. 92.5 ft. The existing bridge, although quite old, shows no signs of any scour damage to the concrete abutments. The type of foundation could not be established. The superstructure is not in a very good shape but this, it is felt, cannot be attributed to foundation movements or settlements. Hence it may be assumed that the proposed stream relocation will have roughly the same depth as the existing course, and that the bridge will have about the same length of free span.

Assuming a minimum depth of scour protection of 4 feet, the bridge foundations cannot be placed higher than El. 88 feet. This would be in the relatively loose river deposits varying from gravel to

RECOMMENDATIONS - Cont'd

clayey silt, with an appreciable percentage of organics. Although this layer would be utilised for relatively low foundation loads of, say, up to 1500 psf for spread footings, there are two reasons why this would not be very attractive for the proposed bridge, namely:

1. The stratified nature and the presence of pure silt make excavation and dewatering difficult and costly. Seepage from coarse material would probably make some form of sheeting necessary, whereas the silt would be disturbed and liquefied very easily.

2. The fact that at the North abutment the river deposits do not extend as deep and are denser than those on the South abutment, could cause differential settlements.

It is suggested, therefore, to found the bridge on the underlying till, which exhibits a high density and which is known to extend to bedrock in this area. Excavation to the 15-20 ft. level would not be economical, and piles are recommended. Such piles would be end-bearing and could be driven to approx. El. 75 ft. under the South abutment, and to El. 79 ft. under the North abutment. As end-bearing piles, their capacity could be specified safely by one of the dynamic pile-driving formulae, such as the Hiley formula. For design purposes the safe bearing capacity for different pile types can be taken as follows:

a. Timber piles, 8 inch tip diameter: 15 tons.

b. Any other closed-end pile: 50 tons per square foot of tip diameter.

The above values can be attained for piles driven to the above approximate elevations. They are based on the very high penetration resistance to casing, cone and sampler at those levels. In view of the relatively rapid change in density, the point penetration into the till will be small, hence the low value quoted for timber piles.

Timber piles might nevertheless be an attractive solution. If cut off below the low watermark, untreated piles could be used.

If additional fill will be placed to elevate the road grade, some settlement of the river deposits can be expected. Considering the low clay content, such settlements will take place as fill placement proceeds, and hence will not affect the completion of the road.

CONCLUSIONS

The results of the investigation may be summarised as follows:

1. The soil profile can be divided into three principal layers, namely:

   a. 5 - 6 feet of fill, varying in density and grain size.

   b. 10 - 15 feet of loose to medium dense, fine-grained stream deposits with clear stratification and with an appreciable content of decayed organics. Some gravel was also observed in this layer.

   c. A light-brown glacial till, from 16 - 20 feet down to the maximum depth tested. This till is very dense and contains much gravel.

2. Groundwater at the time of the borings was 1 - 2 ft. above stream level.

3. Relatively low (1500 psf) footing pressures could be tolerated in the stream deposit. It is not recommended for support of the bridge in view of excavation and dewatering problems and of possible differential settlements.

4. A foundation on piles driven into the till layer is recommended. Timber piles would be quite suitable.

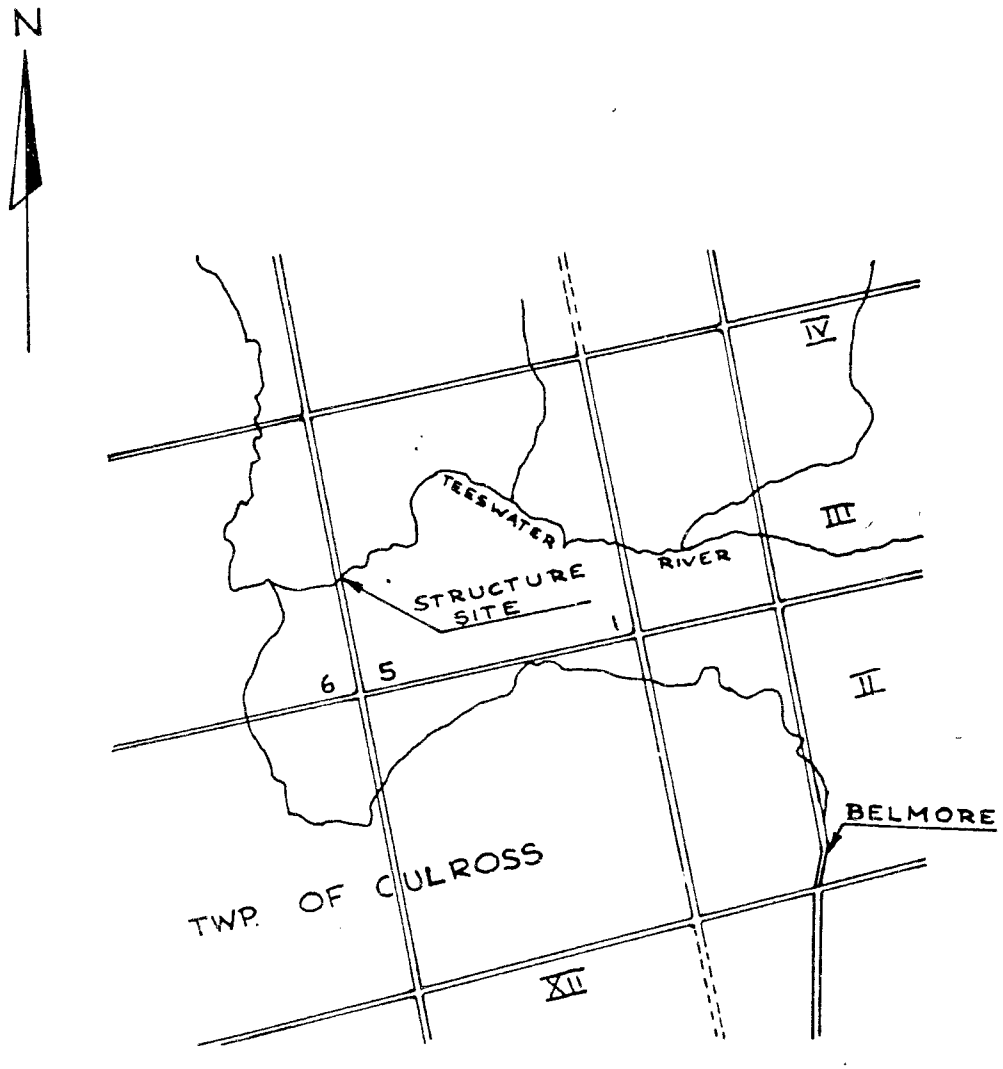
5. No long-time settlements need be expected under any new fill embankment.

J. J. Schoustra, P.Eng.,
Divisional Soil Engineer.

JJS/KA

Order No. S-880/T-3502 Enclosure No. 1

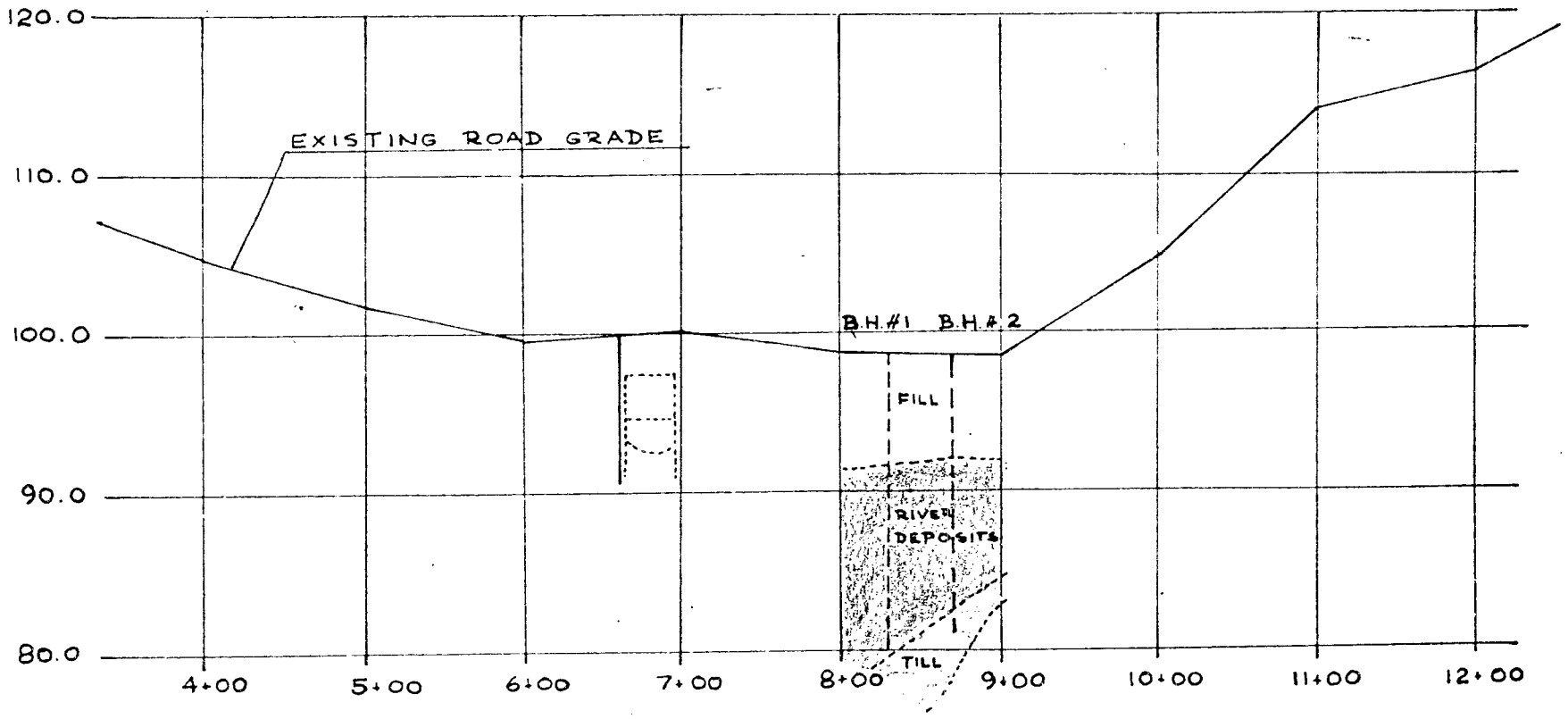
Prep. By H.K.



PROPOSED NEW BRIDGE
LOT 5 & 6, CONCESSION No. 3,
TWP. OF CULROSS.

KEY PLAN

R[illegible]y, MacCallum & Associates Ltd. Scale: 1 : 50,000



PROPOSED NEW BRIDGE
LOT 5 & 6, CONCESSION No.3,
TWP. OF CULROSS.

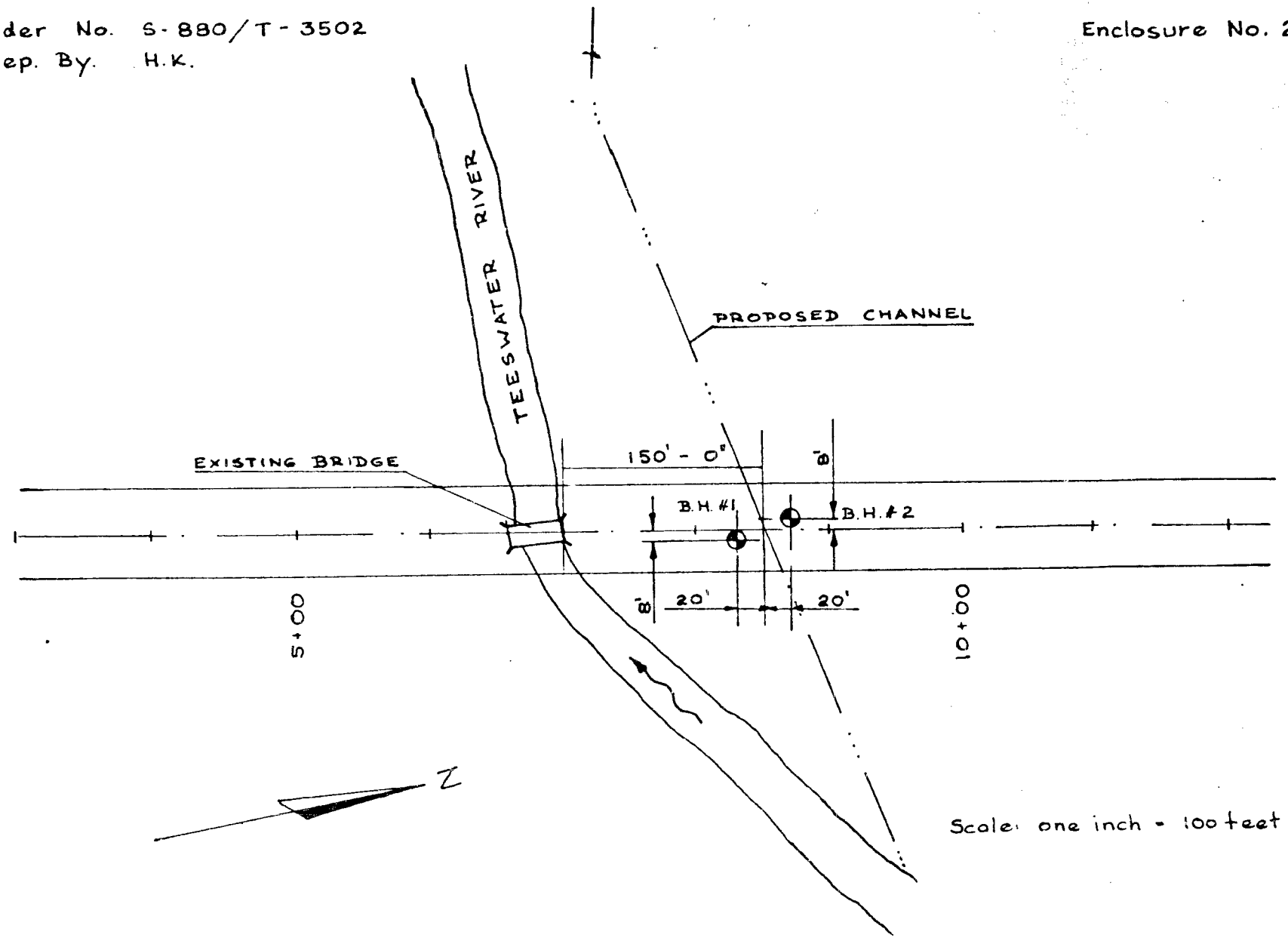
Location of Boreholes.

Scale: horizontal: one inch = 100 feet
vertical : one inch = 10 feet

RACEY, MacCALLUM & ASSOCIATES LTD.

Order No. S-880/T-3502
Prep. By. H.K.

Enclosure No. 2



Order No. S-880/T-3502 Enclosure No. 3

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 1

Project: PROPOSED NEW BRIDGE,
Location: TWP. OF CURLROSS, CONC. 3,
Hole Location: See Enclosure No. 1
Hole Elevation and Datum: 98.40 ft., existing bridge deck = 100ft.
Field Supervisor: J.McG. Prep.: H.K.
Driller: R.R. Checked: J.J.S. Date: 19-1-'62.

LEGEND
Shear Strength (C)
Unconfined compression
Vane test and sensitivity (S)
Penetration Resistance (P)
2" Split tube
2" Dia. Cone
Casing

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Ground Surface	98.4	0
	Fill consisting mainly of medium dense sand, gravel and boulders. (top 12" frozen) Ground water at 2.7 feet) G.W.T.	95.7	
	Loose to medium dense, grey silty sand and sandy silt with some gravel, clay and some seams of organic silt. Stratified. Increasing gravel content with depth.	93.4	5
			10
			15
	Medium dense to very dense, grey-brown silty gravelly sand with some clay. Gravel and boulders below 22 feet.	78.4	20
	End of borehole at 25.2 feet.	73.2	25

STRENGTH AND PENETRATION RESISTANCE
C P.S.F.
P 20 40 60 BLOWS/FT.

SS-1
SS-2
SS-3
SS-4
SS-5
100

Order No. S-880/T-3502 Enclosure No. 4

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 2

Project: PROPOSED NEW BRIDGE,
Location: TWP. OF CURLROSS, CONC. 3,
Hole Location: See Enclosure No. 1
Hole Elevation and Datum: 98.64ft.,existing bridge deck= 100.0ft.
Field Supervisor: J.McG. Prep.: H.K.
Driller: R.R. Checked: J.J.S. Date: 22-1-'62.

LEGEND
Shear Strength (C)
Unconfined compression
Vane test and sensitivity (S) ⊕ $+^{S}$
Penetration Resistance (P:
2" Split tube
2" Dia. Cone
Casing

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET
	Ground Surface	98.6	0
	Sod and organic topsoil (12" frozen) G.W.T.	96.0	
	Fill, consisting mainly of soft clayey silt and sandy silt. Ground water at 1.8 feet.	92.6	5
	Loose to medium dense, grey silty clayey sand and clayey silt with some fine to medium gravel and a trace of organic silt.		10
	Dense to very dense brown clayey silty sand with pockets of coarse sand and gravel Refusal to casing.	80.1	15
	End of boring at 18.5 feet.		20

STRENGTH AND PENETRATION RESISTANCE