

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 41K-37

W.P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. 17

LOCATION STOKELY CREEK,
N. OF SAULT ST. MARIE,

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. NONE

REMARKS: _____

BA 818

RACEY, MacCALLUM AND ASSOCIATES
LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

Consulting Engineers
AND ASSOCIATED STAFF

41K-37
GEOREG No.

MONTREAL  VANCOUVER

TORONTO

DONALD C. MACCALLUM, B.ENG., M.E.I.C., P.ENG.

H. JOHN RACEY, B.SC., M.E.I.C., P.ENG.

A. ERIC RANKINE, B.SC., M.E.I.C., A.M.I.ELEC.E., P.ENG.

TORONTO DIVISION
27 CARLTON STREET

Toronto 2.

Reference: S-500/T-1100.

9 October, 1958.

Department of Highways of
Ontario,
Bridge Office,
280, Davenport Road,
TORONTO - Ontario.

Attention: Mr. J. McAllister.

RE: SITE INVESTIGATION FOR HWY. NO 17
BRIDGE, STOKELY CREEK, NORTH OF SAULT
SAINTE MARIE, ONTARIO.

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 do not hesitate to get in
touch with us.

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

Yours sincerely,
RACEY, MacCALLUM AND ASSOCIATES LIMITED,

Ronald F. Scott

Ronald F. Scott, P.Eng.,
Divisional Soil Engineer.

RFS:YDP

Department of Highways of Ontario,
280, Davenport Road,
Toronto.

SITE INVESTIGATION FOR HWY. NO 17
BRIDGE, STOKELY CREEK, NORTH OF SAULT
SAINTE MARIE - ONTARIO.

Reference: S-500/T-11400.

Racey, MacCallum and Associates
Limited.

9 October, 1958.

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MONTREAL



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TORONTO DIVISION
27 CARLTON STREET
Toronto 2.

Reference: S-500/T-1400.

9 October, 1958.

SITE INVESTIGATION FOR HWY. NO 17
BRIDGE, STOKELY CREEK, NORTH OF SAULT
SAINTE MARIE, ONTARIO.

INTRODUCTION :

This report deals with the above investigation which was conducted to determine the suitability of the subsoil to support the proposed structure. The intended bridge site is located within a loop of the present creek bed; it is proposed to divert the stream from its present course to run under the structure, which will have a span of about 35 feet.

FIELD WORK :

Gaining access to the site proved to be the most arduous part of the field operations; the drilling equipment had to be winched a distance of about 300 yards over uneven sometimes swampy ground which was fairly thickly forested. At the bridge site "setting-up" was made difficult because the central part of the area consisted of a depression containing 1 to 2 feet of stagnant water. The actual drilling lasted over the period 16 to 21 September, 1958; during this time two bore-holes were performed to depths of 76 feet, and four cone penetration tests to depths varying between 58 and 78 feet. A plan of the site showing the location of all penetration tests and borings is given on Enclosure No 1.

Standard methods of sampling were employed; undisturbed thin-walled tube samples were taken in the more cohesive soils and standard split spoon penetration tests were used to determine the composition and relative density of the granular soils. Both the standard cone and split spoon penetration tests were performed using the driving force of a 140 lb hammer falling 30 inches, the number of blows of which required to drive the sampler one foot were recorded.

Reference: S-500/T-1400.

9 October, 1958.

- Continued -

RESULTS :

The Engineering Data Sheets, Enclosures No's 2 to 5, give detailed soil profile descriptions for each borehole and the results of field penetration tests and subsequent laboratory tests.

Referring to the Data Sheet for Borehole No 1, the soil profile consists of a 17 to 18 foot thick upper layer of non-cohesive soil made up of loose to medium dense coarse sand and medium gravel, grading to medium dense silty sand. This overlies a medium stiff red and grey varved silty clay containing fine sand and silt layers.

In Borehole No 2 the types of material encountered were similar but the change from generally non-cohesive soil to cohesive occurs at a greater depth, i.e. about 31 feet, than the 17 feet evidenced in Borehole No 1.

Due to the layered, non-homogeneous nature of the sandy varved clay subsoil difficulty is experienced in predicting overall subsoil characteristics. Sand or silt seams contained in a clay sample used for laboratory testing tend to predetermine the eventual planes of failure, and normally dependable unconfined compressive strength measurements are consequently rendered less representative. For this reason it was decided that more refined compression tests should be performed in addition to the normal unconfined compression tests. This modified test consisted of loading the specimen triaxially, a lateral pressure being applied equivalent to the in-situ overburden pressure. Such stressing resulted in a somewhat greater indicated shear strength than experienced during the unconfined compression tests, as witness the Data Sheet for Borehole No 1. It is felt, therefore, that unconfined compressive strength results represent a conservative measure of this soil's strength.

The results of the consistency measurements made on the varved clay are variable, but do generally indicate an insensitive soil of medium plasticity with a natural moisture content close to the liquid limit. There is also a tendency to increased plasticity with depth. Attempts to predict the consolidation characteristics of a varved deposit with reasonable accuracy, especially one containing sand seams, require considerable laboratory testing. This is due to the different drainage and plasticity characteristics of the individual varved layers. Settlement estimates must therefore be given indicating expected maxima and minima only.

The upper stratum of granular material will, of necessity, have to sustain most of the foundation loads of the bridge abutments. Although a piled foundation for the abutments could be utilised which would depend on the friction supplied by the varved clay substratum,

Reference: S-500/T-1100.

9 October, 1958.

- Continued -

it is felt that such a foundation is needlessly expensive for the size of structure under consideration. In addition, unavoidable settlements will take place under the approach fills, which would therefore move relative to a piled abutment. Attention has therefore been directed towards the use of footings for the abutments. A suitable elevation for proposed abutment footings would be about 5 feet below expected river bottom; this would minimize danger of scour, which is probably not great in this area but it is felt that complete protection against scour could only be afforded by sheet piling protection around the toe of the abutments. Such sheet piling should be driven to a depth of at least 20 feet below present ground level, since its presence is also necessary to prevent a possible failure of the fill behind the abutment. A failure circle could pass completely under the footings, having a substantial portion of the shearing surface in the upper layers of varved clay.

The present stream bed elevation at its intersection with the proposed centreline is 622.5 feet and, assuming that the subsequent stream bed will be about the same level, a footing elevation of approximately 617.5 feet is indicated. It is recommended that soil pressures at this elevation do not exceed 3,000 psf; for such pressures the intermediate settlements due to elastic compression in the non-cohesive layer will amount to $1\frac{1}{2}$ to 2 inches, and delayed settlement due to the consolidation of the clay will be in the order of a further inch. This recommended allowable bearing pressure and settlement is high in view of the relatively low penetration values at Borehole No 1, but it is felt that the structure will be adequately safe (if sheet piling around the toe is used) and differential settlements between fill and abutments will be minimised.

Settlement under the approach embankments will be of a higher order, the possible maximum being about 12 inches, 2 to 3 inches of which will take place immediately and about 9 inches over a period of one or two years after construction. By reason of the time element of settlement, we would recommend building the embankment as soon as possible prior to actual construction of the bridge.

It is expected that considerable difficulty will be experienced with ground water during excavation for the bridge footings, and in order to combat this a well point system of drainage will have to be employed. It is probable that the sheet piling already recommended for scour protection could be incorporated into the drainage system required for construction purposes.

CONCLUSIONS :

We may summarise the preceding paragraphs as follows :

- 4 -

Reference: S-57/T-1103.

9 October, 1958.

- Continued -

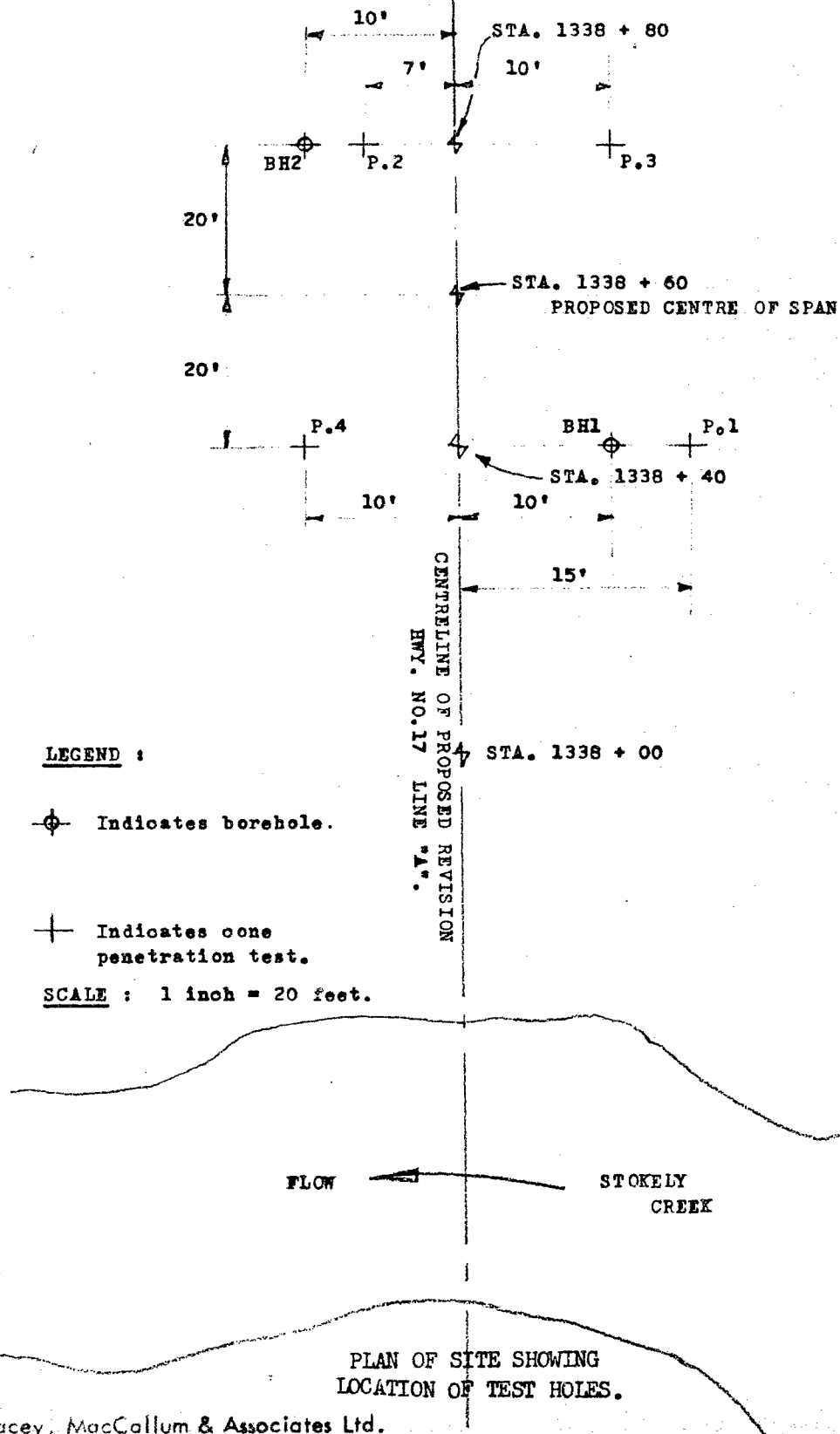
CONCLUSIONS : (Continued)

1. The subsoil at the site consists of a generally non-cohesive loose to medium dense layer comprising soils varying from medium gravel to sandy silt, overlying a cohesive layer composed of medium stiff varved silty clay. The change occurs at depths varying between 17 and 31 feet. The water table is at or near the ground surface.
2. It is recommended that the bridge abutments be supported on footings located at about Elevation 617.5 feet, and that bearing pressures do not exceed 3000 psf. As a protection against scour undermining these footings and to prevent a possible failure including both fill and an abutment, a sheet pile wall should be driven round the toe of the abutments to a depth of at least 20 feet below present ground surface. This piling could probably be incorporated into a well point system of drainage which will be needed during construction.
3. The maximum possible consolidation settlement under the approach embankments, which will take place at a slower rate than settlements under the abutments, will be in the order of 9 inches. Embankment construction should be begun as soon as possible prior to construction proper.

*B. A. Groves*B. A. Groves, P. Eng.,

BAG:YDP

Prep. By B.G.



Racey, MacCallum & Associates Ltd.

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for Borehole: 1

Project: Site Investigation for Hwy.17 Bridge
 Location: Stokely Creek, North of Sault Ste. Marie, Ont.
 Hole Location: See Enclosure No. 1.
 Hole Elevation and Datum: 627.0 Ft.
 Field Supervisor: F.H. Prep.: R.F.S.
 Driller: Checked: Date: 15 Sept. '58

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance (P)

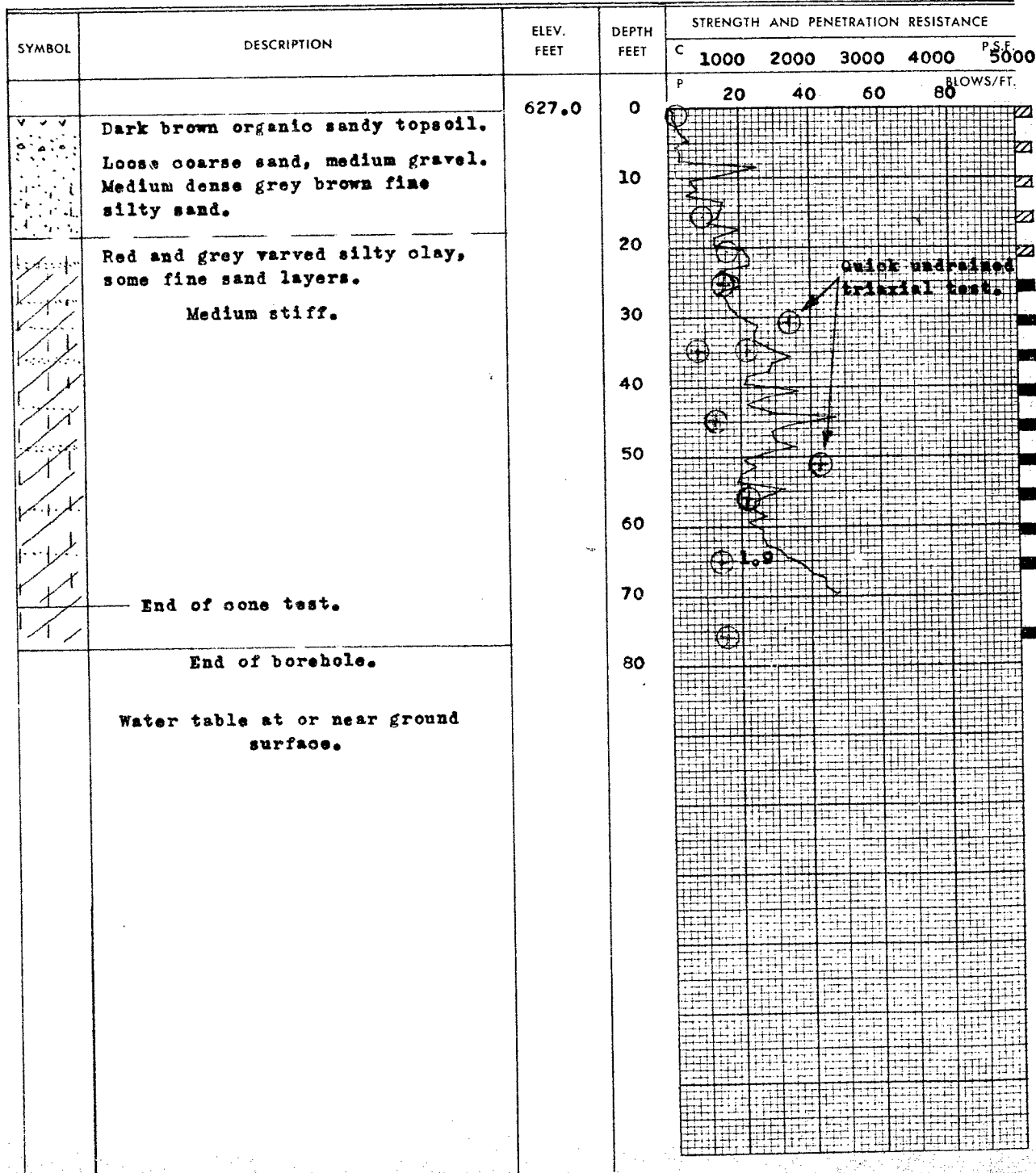
2" Split tube

2" Dia. Cone

Casing

⊕
+s

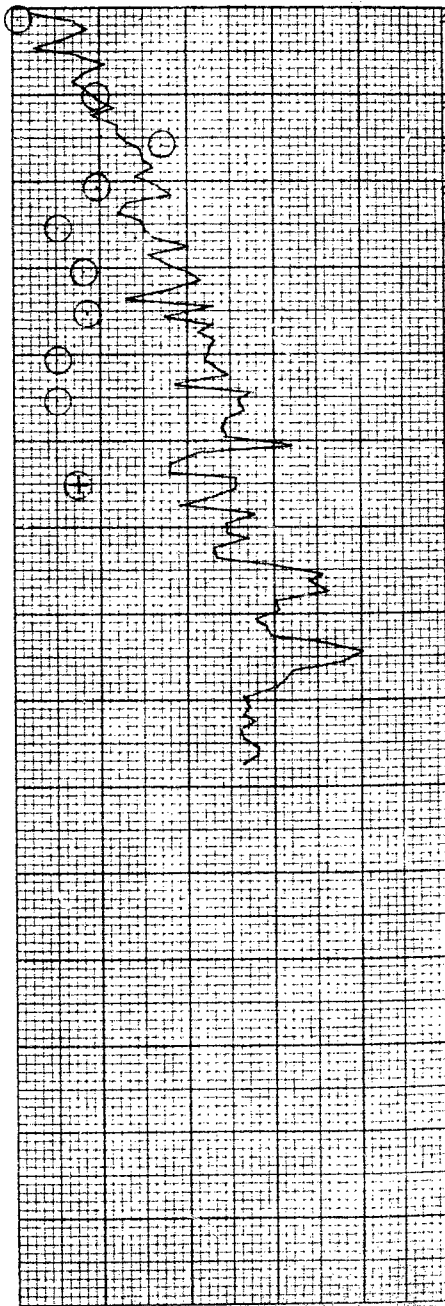
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Engineering Data Sheet for Borehole: 2

Casing

Date: 15 Sept. '58

SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE						
				C	1000	2000	3000	4000	5000	
				P	20	40	60	80	100	
Dark brown organic sandy topsoil. Medium dense fine to medium sand and gravel.	626.5	0								
Medium dense red and grey fine sandy varved silt.			10							
			20							
			30							
			40							
Medium stiff to stiff red and grey varved silty clay with some brown fine sand seams.			50							
			60							
			70							
End of borehole.			80							
End of cone test.			90							
Water table at about 1.0 ft.										

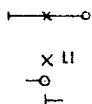
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Foundation Engineering Division

Engineering Data Sheet for Borehole: 1

LEGEND**Consistency**

Natural moisture and
Liquidity Index (LI)
Liquid limit
Plastic limit

**Sampling Method**

2" Dia. split tube



2" Shelby tube



DEPTH FEET	CONSISTENCY				SAMPLE	NATURAL UNIT WT. P.C.F.	REMARKS
	MOISTURE CONTENT, % DRY WEIGHT						
	20	40	60	80			
0					1		
					2		
10					3		
					4		
20					5		
					6	127	
30					7		
					8	{ 114 121	Two tests made on separate portions of same sample. Upper portion red-brown silty sand, lower red silty clay.
40					9		
					10	116	
50					11		
					12	112	
60					13		
					14	110	
70							
					15	112	
80							

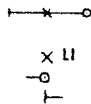
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Foundation Engineering Division

Engineering Data Sheet for Borehole: 2

LEGENDConsistency

Natural moisture and
Liquidity Index (LI)
Liquid limit
Plastic limit

Sampling Method

2" Dia. split tube



2" Shelby tube



DEPTH FEET	CONSISTENCY				SAMPLE	NATURAL UNIT WT. P.C.F.	REMARKS
	MOISTURE CONTENT, % DRY WEIGHT						
	20	40	60	80			
0					1	110	
10					2		
					3		
20					4		
					5		
30					6		
					7		
40					8		
					9		
50					10		
					11		
60					12		
					13		
70					14		
					15		
80							

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Foundation Engineering Division

Engineering Data Sheet for ~~Borehole~~ **Penetration Cone P.3**Project: **Site Investigation for Hwy. 17 Bridge**Location: **Stokely Creek, North of Sault. Ste. Marie, Ont.**Hole Location: **See Enclosure No.1.**Hole Elevation and Datum: **625.5 Ft.**Field Supervisor: **Prep.:**Driller: **Checked:**

Date:

LEGEND

Shear Strength (C)

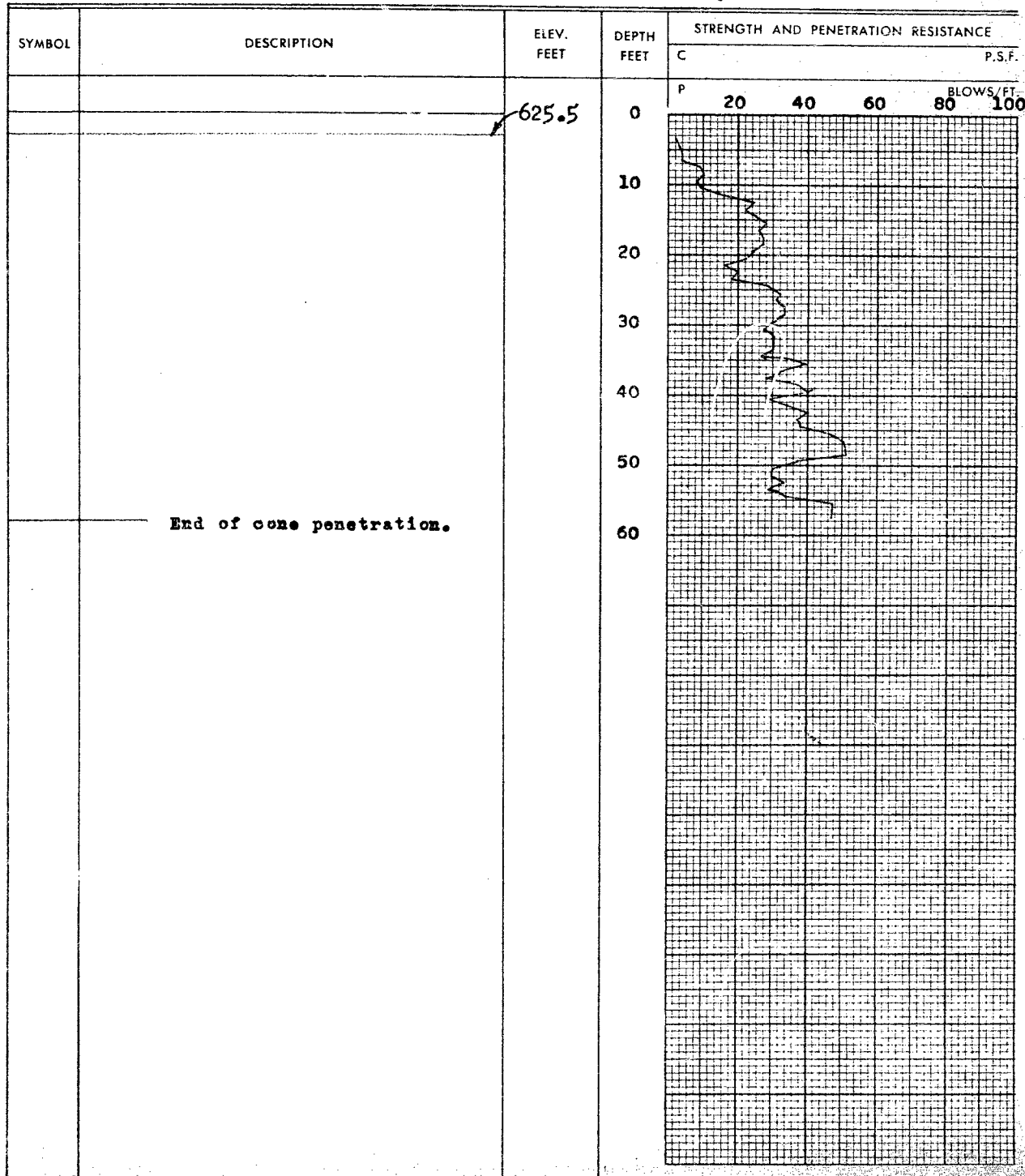
Unconfined compression
Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

⊕
+³

RACEY MacCALLUM AND ASSOCIATES LTD.

Foundation Engineering Division

Engineering Data Sheet for ~~Borehole~~ **Penetration Cone P.4**Project: **Site Investigation for Hwy. 17 Bridge**Location: **Stokely Creek, North of Sault Ste. Marie, Ont.**Hole Location: **See Enclosure No.1.**Hole Elevation and Datum: **625.5 Ft.**Field Supervisor: **Prep.:**Driller: **Checked:**

Date:

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

2" Dia. Cone

Casing

⊕
+5