

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 30 M4 - 57

W.P. No. —

CONT. No. —

W. O. No. —

STR. SITE No. —

HWY. No. 6

LOCATION HWY 6 & BLACK CREEK,

NORTH OF CALEDONIA

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. NONE

REMARKS: \_\_\_\_\_

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BA 467  
50M4-57  
GEOGRAPHIC No.

# RACEY, MACCALLUM AND ASSOCIATES LIMITED

A COMPANY OWNED, DIRECTED AND OPERATED BY

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ISOTOPE PRODUCTS LIMITED,  
RADIOGRAPHERS

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QUEBEC LAND SURVEYOR

THE VIBRATION ENGINEERING COMPANY

REPORT NO. S-500-543/55/T-155-1

310 Odeon Building,  
20 Carlton Street,  
Toronto, Ontario.

The Department of Highways for Ontario,  
Duncan, Hopper & Associates,  
38A Mattson Road,  
DOWNSVILLE, Ontario.

11 November 1955.

Attention: Mr. A.D.Duncan

RE: FOUNDATION INVESTIGATION,  
NEW BRIDGE, HIGHWAY NO.6,  
CROSSING THE BLACK CREEK  
NORTH OF CALEDONIA, SENeca  
TOWNSHIP, ONTARIO.

Dear Sirs:

The field work covering the drilling of four boreholes at the above site is completed, several laboratory tests have been carried out and we are now in a position to report on our findings as follows:-

THE LOCATION OF THE SITE AND OF THE BOREHOLES

The bridge site is located where Highway No.6 crosses the Black Creek, approximately two and a half miles north of Caledonia, Ontario.

The location of the boreholes is shown on the layout sketch on Enclosure No.1. Boreholes Nos. 1 and 3, located on the north embankment of the creek, could not be drilled accurately on the spot proposed by the client, as they had to be moved away 5 and 7 feet more from the centre line, due to existing telephone and hydro-electric lines and poles. Boreholes Nos. 2 and 4 are located in the present river bed. Boreholes Nos. 1 and 3 serve to determine foundation conditions for the future northern abutment, whereas boreholes Nos. 2 and 4 serve the same purpose for the future southern abutment. The location of the new bridge was chosen with the intention of straightening the direction of the creek flow.

The boreholes were marked off and the elevations determined by our engineer in the field.

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11 November 1955.

THE FIELD WORK

The drillers arrived at the site on October 12th, 1955, unloaded their equipment, moved the drill into position and started borehole No.1 the same day. This borehole was completed on October 14th. Drilling on borehole No.2 was started on the 15th and completed on the 19th of October. The drilling equipment was subsequently removed from the creek, towed across the Highway and set up for borehole No.3. Drilling was begun the same day. Borehole No.3 was completed on October 20th. On October 21st the equipment was moved into the creek and set up for borehole No.4, which was completed on October 22nd. The drilling equipment was subsequently loaded and returned to the Warehouse in Toronto.

The drilling equipment consisted of a standard diamond drill manufactured by BYRE. 3" diameter heavy duty drive pipe was driven into the ground by a 350 lb. hammer, dropped 20". Soil sampling was carried out by means of a 2" split barrel sampler, driven by a 140 lb. hammer dropped 30", and undisturbed samples were taken by pushing a 2" thin walled tube sampler into the soil.

Soil samples were taken generally at 5 foot intervals. These samples will be stored on our premises for one half year from now and will be destroyed thereafter, if no instructions are received to the contrary.

DISCUSSION OF THE RESULTS

The soils profile, as revealed by the four boreholes, is presented on the attached engineering data sheets, (Enclosures Nos.2 to 5). These data sheets show a description of the soil, a profile of the soil demonstrated by symbols and diagrams giving the penetration values for the standard 2" split barrel sampler, as well as for the drive pipe and, furthermore, giving the results of the laboratory tests carried out on several soil samples, which cover the water contents, consistency limits and unconfined compressive strength.

Three main soil strata may be distinguished to characterise the soils profile, disclosed by the four boreholes. The main difference between the boreholes is that the transition from one soil type to the other does not occur at the same respective levels.

The upper part of the soils body consists of a generally stiff clay. The superficial three to four feet below the creek bed are, naturally, relatively soft. The clay is of brown colour, calcareous and more or less silty. Below approximately 15 feet depth, the brown colour changes to grey. From the consistency limits of three representative specimens, the clay is to be classified as a clay of medium plasticity.

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11 November 1955

The unconfined compressive strength of this clay was determined on five specimens. The results are shown in the following table:-

<u>BOREHOLE NO.</u>	<u>DEPTH</u>	<u>ELEVATION</u>	<u>UNCONFINED COMPRESSIVE STRENGTH</u>
2	5.5 ft.	647	0.84 tons per sq.ft.
3	6 ft.	647	1.0 tons per sq.ft.
3	16 ft.	638	0.71 tons per sq.ft.
3	21 ft.	633	0.54 tons per sq.ft.
4	6 ft.	647	0.85 tons per sq.ft.

The clay is underlain by a soil type which we consider to be a glacial till, as it consists of a dense mixture of clay, silt, sand and gravel. The fraction of the latter, however, varies in the different boreholes. There was no sample recovered of the glacial till in borehole No.2 and it appeared that the till consists of very gravelly material. The transition from the clay to the glacial till takes place in borehole No.1 at elevation 643, in borehole No.2 at the approximate elevation 634, in borehole No.3 gradually below elevation 628 and in borehole No.4 at elevation 633.

The glacial till in turn is resting on boulders, which mostly consist of dolomite with some limestone. This rock type obviously is identical with the strata exposed at the Niagara escarpment and probably underlying the investigated area. However, no attempt was made to encounter bedrock, as sufficiently sound conditions for foundation purposes had been found to discontinue the boreholes after drilling several feet into the boulder zone.

No natural ground water level was observed during the drilling procedure, due to the low permeability of the clay and the glacial till. It may be reported, however, that the wash water was lost in borehole No.3 at 32 feet depth (elevation 622) completely.

#### CONCLUSIONS

It is understood that the anticipated 30 foot span bridge structure will rest on abutments of about 7 foot width, and the unit load will be of the order of 2 tons per sq.ft. It is intended to place the abutments at 6 foot depth below the creek bed, or at about elevation 646, with due consideration of possible scour.

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11 November 1955

The values of the unconfined compressive strength  $q_u$  of the clay specimens tested amounts at this level to 0.84 tons per sq.ft. in borehole No.2, to 0.85 tons per sq.ft. in borehole No.4 and to 1.0 tons per sq.ft. in borehole No.3, this latter value however, is liable to be too high as its strength may have been slightly increased due to a loss of moisture, the paraffin seal being found defective when the sample was extruded in the laboratory.

The maximum bearing capacity of the clay at El.646, based on the above strength values is for the required size of abutments equal to  $p_{max} = 3.22$  tons per sq.ft. A load of 2 tons per sq.ft., therefore, would have a factor of safety of 1.6, for the foundation at 6 foot depth below the creek bed (El.646). The bearing capacity of the soil is quite often obtained by plotting the penetration values as obtained by driving the standard 2" diameter split barrel sampler by means of a 140 pound drive hammer, one foot into the soil. The correlation between the number of blows per foot of penetration and the unconfined compressive strength has been proved. We found that for the subject project, the bearing capacity of the brown layered clay representing the bearing stratum at 6 foot depth, would be of the order of about 2 tons per sq. foot, with a factor of safety of 3. The gap between these values and those permissible on the basis of laboratory tests is obvious. The correlation of the penetration values gives evidently too favourable values, but it also emphasizes that the laboratory test results may be too conservative, due to the possible weakening of the soil by driving the sampler tube into the soil.

As the strength of the soil decreases with depth, the permissible values become lower.

We feel, therefore, that the clay will carry the design load of 2 tons per sq.foot at 6 foot depth below the creek bed with a fair, but not conservative, margin of safety. Some remarks on possible differential settlement will follow.

Of equal importance in the case of bridge foundations, is the settlement problem. We estimate that due to the consistency and varying thickness of the clay below the northern abutment, there may, gradually over years, develop some differential settlement of the order of two or three inches, the east side of the abutment settling more, (approximately 1 inch) than the west one (approximately 3 to 4 inches). The final settlement of the abutment in the creek will probably be fairly uniform, in the order of 2 to 3.5 inches.

If the above data is not felt acceptable, it will be recommendable to resort to a pile foundation with point bearing piles. The loads are to be transferred to the glacial till which occurs at various depths, as will be noted from the enclosures. The approximate minimum lengths of the piles would be between 5 feet and 21 feet, as found from boreholes Nos. 1 and 3, for the northern abutment and about 12 to 14 feet for the southern abutment.

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11 November 1955

The actual lengths are governed by the resistance of the pile to driving, and to be adequate for the design load by the pile driving contractor.

We believe that the above information will be of assistance for the design of the bridge foundation. Please do not hesitate to get in touch with us if you feel that any further discussion or clarification of the matter is desirable.

Yours very truly,  
RACEY, MACCALLUM AND ASSOCIATES LTD.

*K. Tubbesing*

KT/MD

K. Tubbesing, P. Eng.

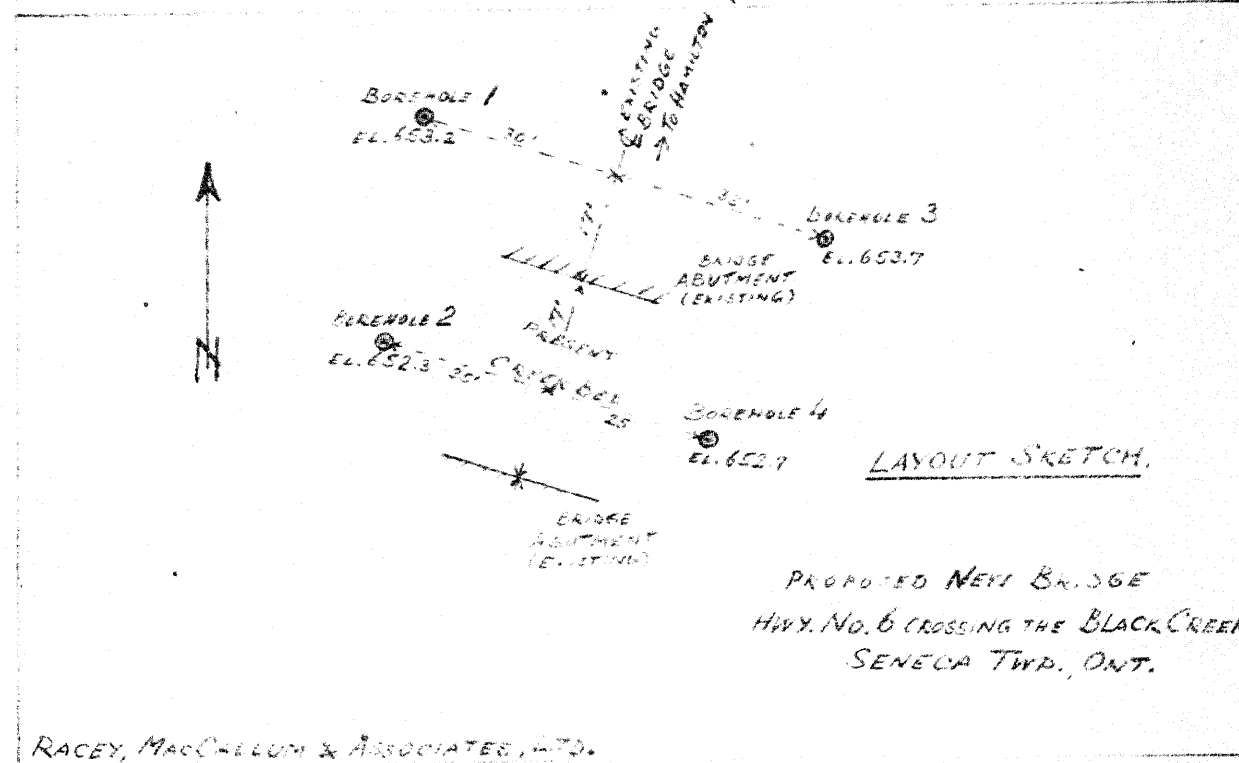
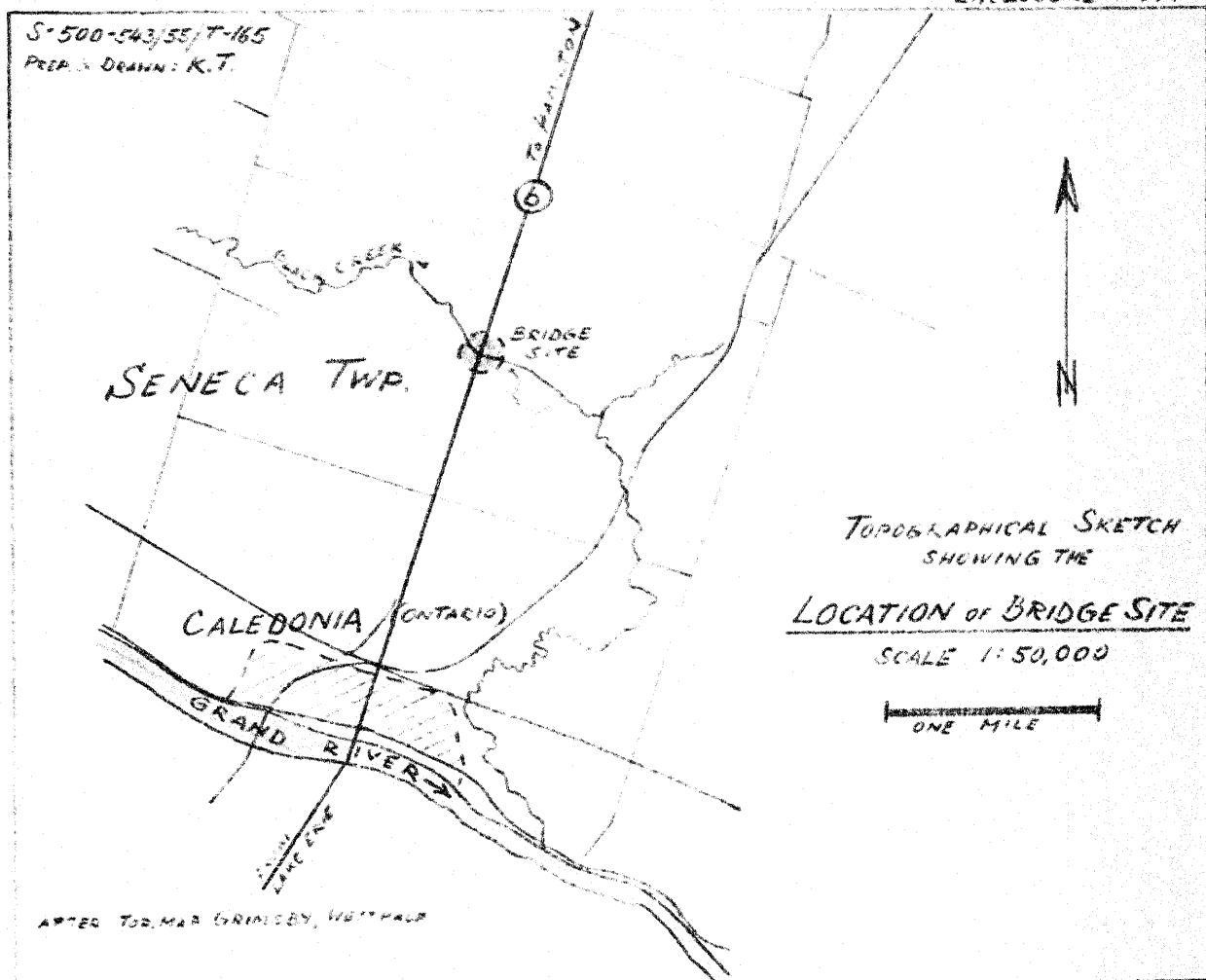
Original and 2 copies - Duncan, Hopper & Associates, Downsview, Ontario.

c.c's.

2 - Soils Engineer,

1 - Racey, MacCallum &amp; Associates Ltd., Montreal.

S-500-543/55/T-165  
 PREP. & DRAWN: K.T.



Order No.: S-502-9-1057-65 RACEY, MCCALLUM AND ASSOCIATES

J. MARYKUSA  
Driller

Hole Begun 12/10/1955

Foundation Engineering Division

Hole Ended 14/10/55

Engineering Data Sheet for Borehole: 1

Helper

Job Name PROPOSED NEW BRIDGE, CROSSING THE BLACK CREEK, SENECA TWP.

K. TUBBESING

Job Located APPROX. 3 MILES EAST OF CALEDONIA, HWY. #6

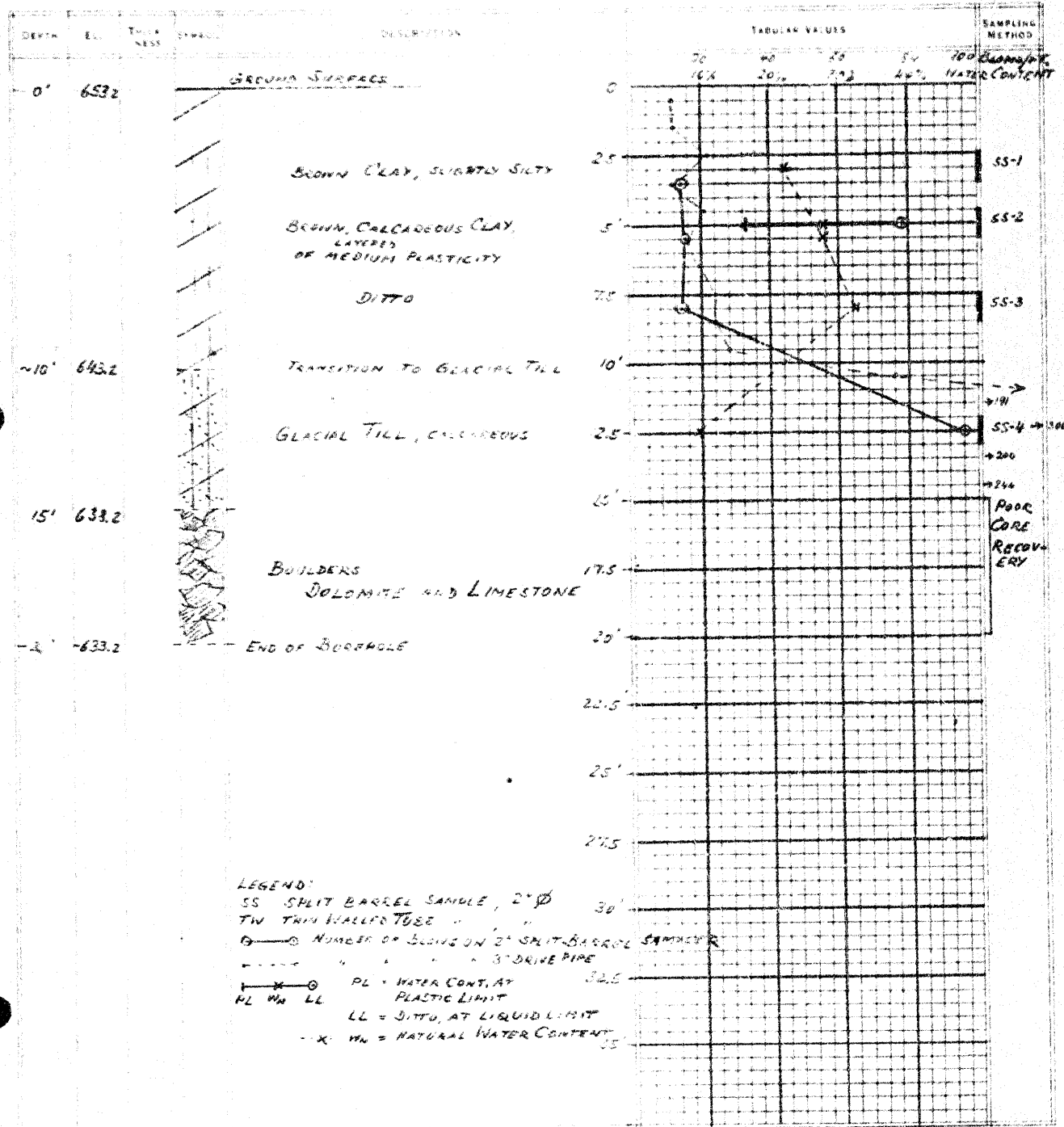
Checked by

Hole Located AS SHOWN ON THE ATTACHED SKETCH (ENCL. NO. 1)

Hole Elevation: 653.2 Datum: M.S.L.

NOV. 5th, 1955

Day Month Year



Order No. S-550-542/55/T-45 RACEY, MACCALLUM AND ASSOCIATES

J. NARYKUHA

LIMITED

Driller

Hole Begun 15/10/55

Foundation Engineering Division

Hole Ended 19/10/55Engineering Data Sheet for Borehole: 2

Helper

Job Name: PROPOSED NEW BRIDGE, CROSSING THE BLACK CREEK, SENECA TWP.

K. TUBBESING

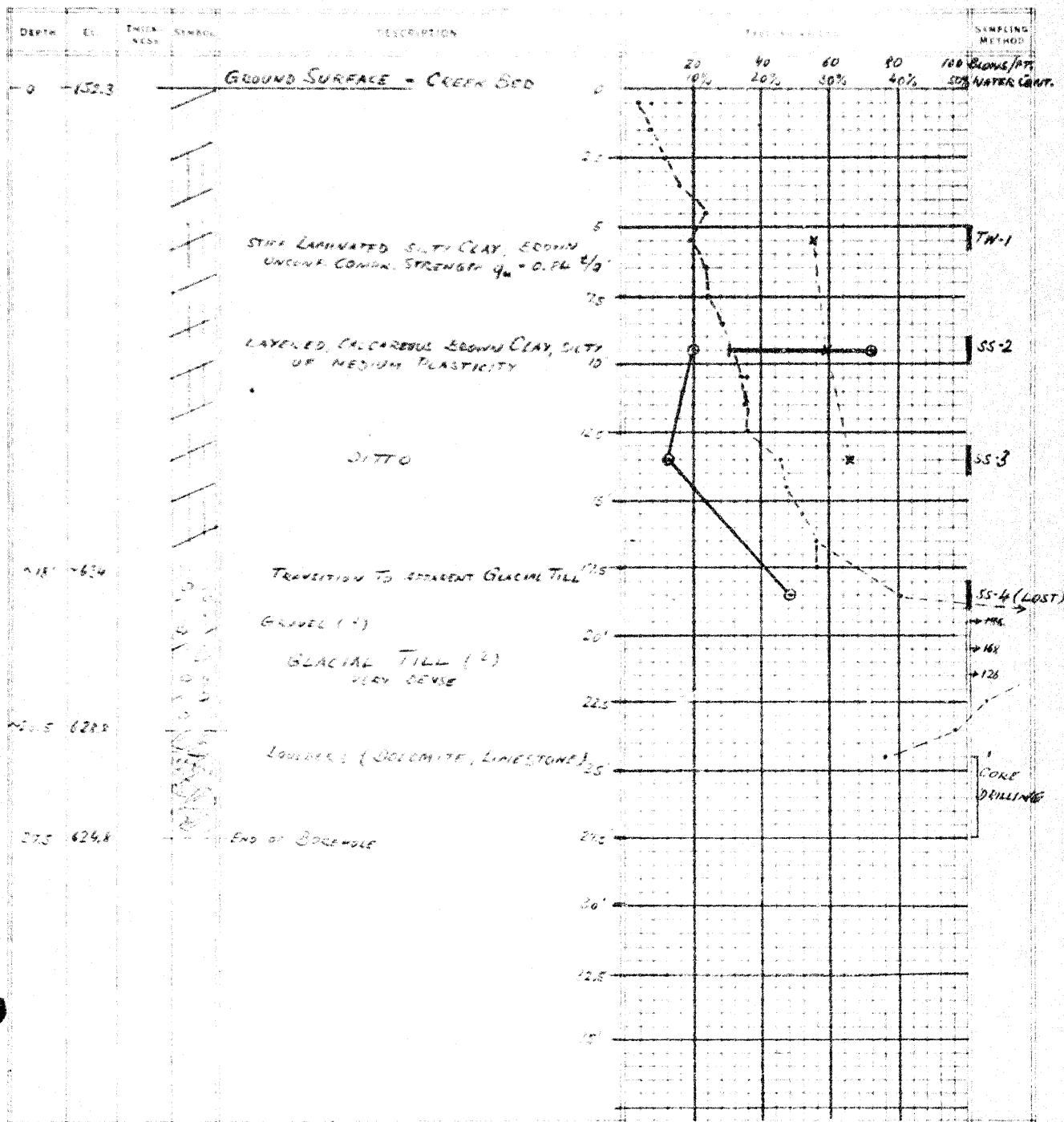
Job Located: APPROX. 3 MILES EAST OF CALEDONIA, MI 48

Checked by

Hole Located: AS SHOWN ON THE ATTACHED SKETCH (ENCL. NO. 1)Hole Elevation: 652.3 Datum: M.S.L.

NOV. 7th, 1955

Day Month Year



Order No.: S-500-542/55/T-65 RACEY, MACCALLUM AND ASSOCIATES

J. MACYKUCA

Driller

LIMITED

Hole Begun 19/10/55

Foundation Engineering Division

Hole Ended 20/10/55

Engineering Data Sheet for Borehole:

3

Helper

Job Name: PROPOSED NEW BRIDGE CROSSING THE BLACK CREEK, SENECA TWP.

K. TURBESING

Job Located: APPROX. 3 MILES EAST OF CALEDONIA, N.Y. #1

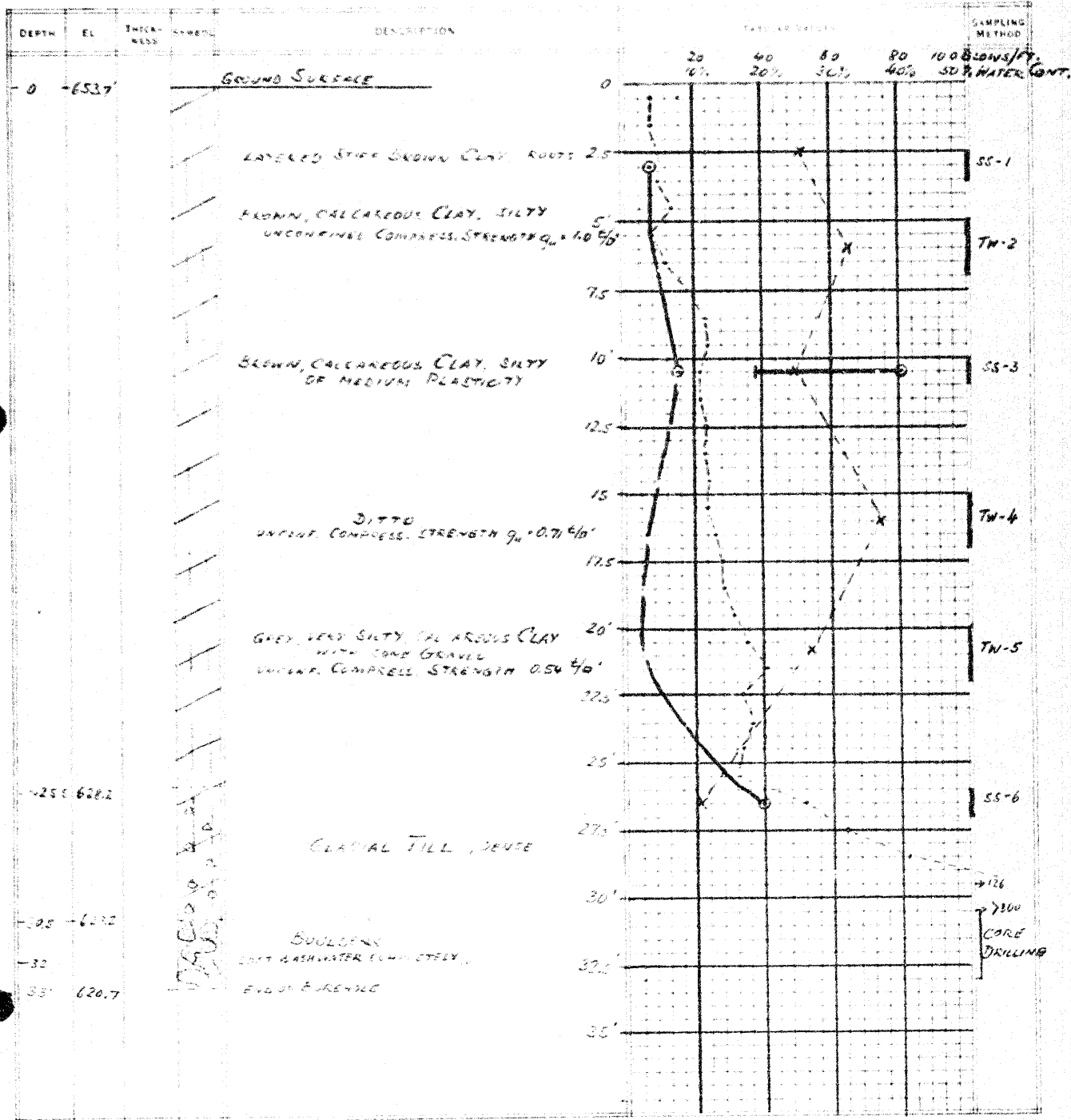
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Hole Located: AS SHOWN ON THE ATTACHED SKETCH (ENCL NO. 1)

Hole Elevation: 653.7 Datum: M.S.L.

Nov. 7th, 1955

Day Month Year



Order No. S-500-S4/55/T-65 RACEY, MACCALLUM AND ASSOCIATES  
LIMITEDJ. HADY RUCA  
DrillerHole Begun 21/12/55

Foundation Engineering Division

Hole Ended 22/10/55Engineering Data Sheet for Borehole: 4

Helper

Job Name: PROPOSED NEW BRIDGE, CROSSING THE BLACK CREEK, SENECA TWP. K. TUBBESINGJob Located: APPROX 3 MILES EAST OF CALEDONIA, WY. #6

Checked by

Hole Located: AS SHOWN ON THE ATTACHED SKETCH (ENCL. NO. 1)Hole Elevation: 652.7 Datum: M.S.L.

Nov. 24, 1955

Day Month Year

