

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 41 I - 102

W.P. No. 252 - 59

CONT. No. _____

W. O. No. _____

STR. SITE No. _____

HWY. No. SEC. 544 , DIST. 17

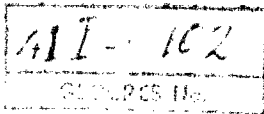
LOCATION WHITSON RIV.,
NEAR CHELMSFORD

=====

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

NONE

REMARKS: _____



ONTARIO
DEPARTMENT OF HIGHWAYS

Memo to Mr. A. M. Toye, Date December 3, 1959.
Bridge Engineer. Subject FOUNDATION IN VESTIGATION by
From Materials & Research Section. Dominion Soil Investigation, Ltd
Attention: Mr. S. McCombie.

Re: Hwy. #544 & Whitson River Crossing,
Sudbury - Dist. #17 - W.P. 252-59.

Enclosed herewith is the report on the foundation conditions existing at the above noted structure location, submitted to us by Dominion Soil Investigation, Ltd. We have reviewed the contents of the report and our comments are as follows:-

1. A pile-supported foundation appears to be more feasible at this site. We are of the opinion that the structure should be supported on short end-bearing piles driven to refusal at the contact of the bedrock. In view of the rather sensitive soft clay deposit encountered above the bedrock, small displacement piles, such as steel 'H' piles, are recommended.
2. An alternative to avoid large horizontal forces exerting on the abutments due to embankment "creep" by removing the clay strata behind the abutments, as recommended by the Consultants, would be to provide battered piles to take the entire horizontal thrust induced by the weight of backfill acting on the abutments.
3. Standard 2:1 approach fill side slopes will be stable. Bank slopes on the upstream side should be protected by rip-rap.

If you have any queries with respect to the contents of this report, or our foregoing comments, please contact our office.

AKL/MdeF
Attach.

cc: Messrs. A. M. Toye (2)
H. A. Tregaskes
D. G. Ramsay
G. K. Hunter
E. A. Cash
E. R. Saint
A. Watt
Fdn. Section
Gen. Files.

L. G. Soderman,
PRINCIPAL SOILS & FOUNDATIONS ENGR.
per:

AKL
(A. K. Loh,
PROJECT FOUNDATION ENGR.)

41I-102

Department of Highways, Ontario
Materials and Research Section
Downsview, Ontario

REPORT ON
FOUNDATION INVESTIGATION
WHITSON RIVER CROSSING
SECONDARY ROAD NO. 544
NEAR CHELMSFORD
DISTRICT OF SUDBURY

Submitted by:

Dominion Soil Investigation Ltd.
88 Eglinton Avenue East
Toronto 12 Ontario

November 10, 1959.

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2. LOCATION AND DESCRIPTION OF SITE	1
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ENGINEERING DATA SHEETS

Location of Boreholes	Enclosure No. 1
Borehole Logs	Encl. No. 2-5 incl.

DOMINION SOIL INVESTIGATION LTD.

SOIL MECHANICS • FOUNDATION ENGINEERING

TORONTO 12, ONTARIO

FOUNDATION INVESTIGATION
WHITSON RIVER BRIDGE CROSSING
SECONDARY ROAD NO. 544
W.P. 252-59

1. INTRODUCTION:

A foundation investigation at the above site was requested by the Materials and Research Section of D.H.O.

The purpose of the investigation is to determine the foundation conditions at the site for construction of a new structure at the same location. Field work was done between October 30, 1959 and November 2, 1959.

This report presents the results of field investigation, the results of laboratory tests on selected samples and recommendations on foundations. Consideration was also given to the stability of approach embankments.

2. LOCATION AND DESCRIPTION OF SITE:

The site is located about $\frac{1}{2}$ mile south of the Town of Chelmsford, Ontario, at the intersection of lots 3 and 4, Concession II & III in Balfour Township, District of Sudbury. Whitson River crosses Secondary Road No. 544 at Station 77 + 25.

Surrounding terrain is flat, probably a post glacial lake, with bedrock outcropping less than 1 mile to the north. River banks are sparsely vegetated with small shrubs and birch trees.

The Whitson River is deeply entrenched and slightly meandering. Erosion of the banks is common due to the loose silty sand and silt subsoil in which the river is entrenched. A 60 ft pony truss supported on gravity type wing back abutments spans the river. An old timber crib filled with rocks (visible below water) under the existing bridge probably formed the abutments for the original timber bridge.

Some boulders and stones line the river bed under the bridge. The north-east wing is being undermined and erosion behind wing wall is starting.

River water level during the investigation was at elevation 861.6.

3. FIELD INVESTIGATION:

Field work was started on October 30, 1959 at borehole 1 at the N.W. corner of the bridge. A cone penetration revealed that the subsoil was loose or soft. Borehole 2 was drilled 30 ft from centreline at the S.W. corner. The difference in bedrock elevation between borehole 1 & 2 necessitated additional elevation points especially near the existing west abutment. Seven jettings were made along the west bank. The locations are shown on Enclosure No. 1. Those located near the bridge met refusal on boulders. Jettings J1, J2 and J7, the latter within an eroded channel, were extended to what is believed to be bedrock since the wash water brought up the same dark grey soil that was found overlying bedrock in boreholes 1 and 2. A subsurface section at the west abutment is also shown on Enclosure No. 1.

Insitu vane shear tests were made in the clay strata in boreholes 1 and 2. Split spoon and 2" shelby tube samples were recovered.

At the south-east corner of the existing bridge a cone penetration test and a jetting to bedrock were made in addition to drilling borehole 3. The steep slope at the north-east corner precluded locating a borehole on the slope. Borehole 4 was drilled from the roadway but obstructed free movement of traffic along the road.

4. SOIL DESCRIPTION:

Three subsurface sections at the site are shown on Enclosure No. 1. A detailed description of the soil along with the results of laboratory test is given on the engineering data sheets, Enclosures 2-5 inclusive.

There is a marked difference in the soil at the abutments. At the west abutment a loose silty sand is followed by a loose to medium dense grey silt. Borehole 1 encountered an 8.5 ft layer of silt with thin sand seams extending to elevation 858.7. A firm grey silty clay underlies the silt and extends to bedrock. The clay has vane shear strengths of 900 - 1100 psf with a sensitivity of 5-6. Natural water contents are 42.7% to 60.5% and two unit weight readings are 106 and 116 pcf. The water contents are well in excess of the liquid limit giving a range of liquidity index from 1.4 to 1.8.

Immediately above bedrock is a 6"-9" layer of very dark grey clayey silt with some coarse sand. It would appear that the bedrock has been decomposed at the contact plane between soil and rock forming a greasy black mixture. In the jettings the same dark grey clayey silt and black decomposed rock mixture was encountered before refusal was met. The rock is a brittle and black with some fractures to a depth of 12"-18".

Bedrock dips to the north from elevation 853-854 at the south end to elevation 844.9 - 847.0 at the north end.

At the east abutment the subsoil was found to be granular throughout. In borehole 3 it was loose throughout. A 1 ft layer of sand with numerous partially rotted wood fibre was encountered at elevation 853. The dark grey clayey silt and decomposed rock mixture followed. Bedrock was encountered at elevation 850.3. Borehole 4 showed granular backfill from the roadway surface to a depth of 10-15 ft. A layer of wood fibre and decayed vegetation was encountered at elevation 858.5. Following the thin layer of blackish clayey silt and coarse sand bedrock was encountered at elevation 852.4.

A cone penetration and jetting at the south-east wing wall revealed that bedrock is at elevation 849.0.

5. FOUNDATION CONDITIONS:

A new structure located in the same general position as the existing bridge may be founded directly on bedrock. The silty clay strata at the west abutment has too low a bearing capacity and is too compressible to adequately sustain abutment loads. It is possible that the clay strata extend to the east abutment but was removed in the immediate vicinity of the abutment during construction. The partially rotted wood and vegetation may have been deposited during the abutment construction in 1925.

Bedrock dips to the north at the west abutment. The difference in elevation is about 7 ft over the normal two lane bridge width. The foundation may be extended to rock by the use of a mass concrete pier or it may be designed to rest on rock at the south end and supported on bearing piles to bedrock beyond the rock support to the north.

The east abutment would rest on bedrock. In view of the fractures noted in the top 1 ft of rock, it is advisable to extend the foundations a minimum of 1 ft into bedrock.

A stability analysis of the west approach was carried out. It was assumed that the final grade is raised by about 3 ft to elevation 880 and 2:1 sideslopes are used. The

factor of safety against a deep seated slide developing was over 1.5. Based on a soil profile similar to that found in borehole 3 a stability analysis for the east approach revealed that the addition of 3 ft of fill above existing grade will not endanger the stability of the embankment.

The rock filled timber crib and isolated rocks at the water side of the existing abutment will obstruct the driving of sheet piling. Most of the remaining timbers are under water and covered by backfill.

If the clay strata at the west abutment is not removed from behind the abutment there is the possibility that under the pressure of additional fill the subsoil will "creep" thus exerting forces on the abutment in excess of the active earth pressure. The clay having a comparatively low shear strength and water contents in excess of the liquid limit makes such a condition possible. There is evidence of the existing abutment moving forward. The backwall is bearing up against the steel superstructure. Although other factors may be responsible in this case, movement or "creep" of the embankment would be dangerous to a rigid frame structure particularly. The condition may be avoided by removing the clay to bottom of footings, or preferably to bedrock for a distance of about 5 ft from the foundation and thereafter at an angle of 45° to the top of the strata. Backfill should be granular and well compacted.

6. CONCLUSIONS AND RECOMMENDATIONS:

The foundation investigation revealed that the soil at the west abutment is silt followed by soft silty clay to bedrock and loose sand at the east abutment. Bedrock is between elevation 854 and 845, with the latter at the N.W. corner of the existing bridge.

Foundations for the proposed bridge may be placed on bedrock. It is recommended that the footings extend a minimum of 1 ft into the rock. A safe bearing capacity of 5 tons per sq ft may be assumed although higher values may be used if required. A mass concrete pier foundation could be used under the west abutment where the bedrock slopes to the north.

Raising of the existing grade by 3 ft will not endanger the stability of the embankments. Side slopes of 2:1 were assumed.

The clay strata behind the proposed abutment should be removed a distance of about 5 ft from the foundation, then at a 45 degree slope. This is felt necessary to avoid the possibility of embankment "creep" which would exert a large horizontal force on an abutment. Granular backfill should be used behind the abutments.

Remnants of old abutments (rock filled timber cribs) may present some difficulties in driving sheet piling near the existing abutments. Rocks and boulders are found in the backfill on the water side of the abutment.

A temporary crossing and detour may be constructed on the upstream side of the bridge. The east approach will, however, require a high fill.

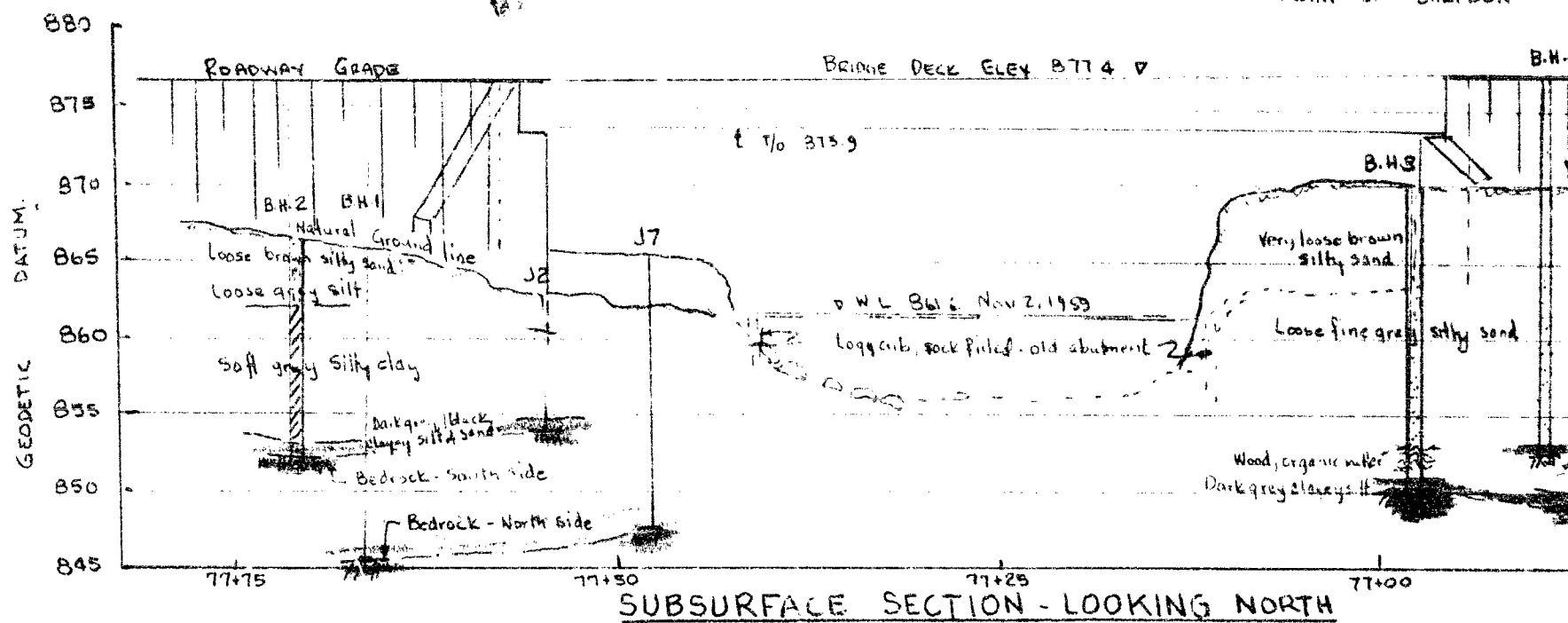
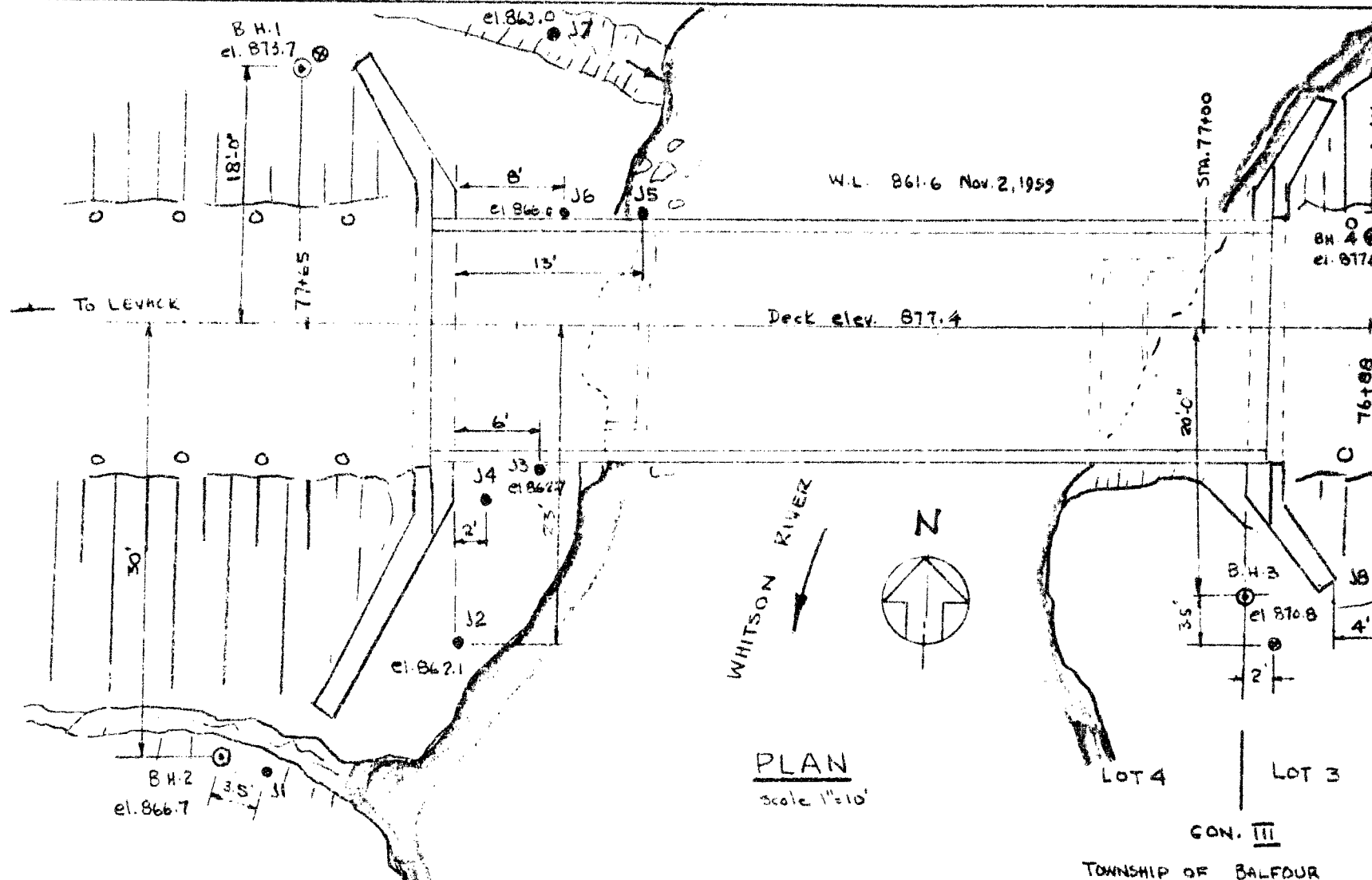


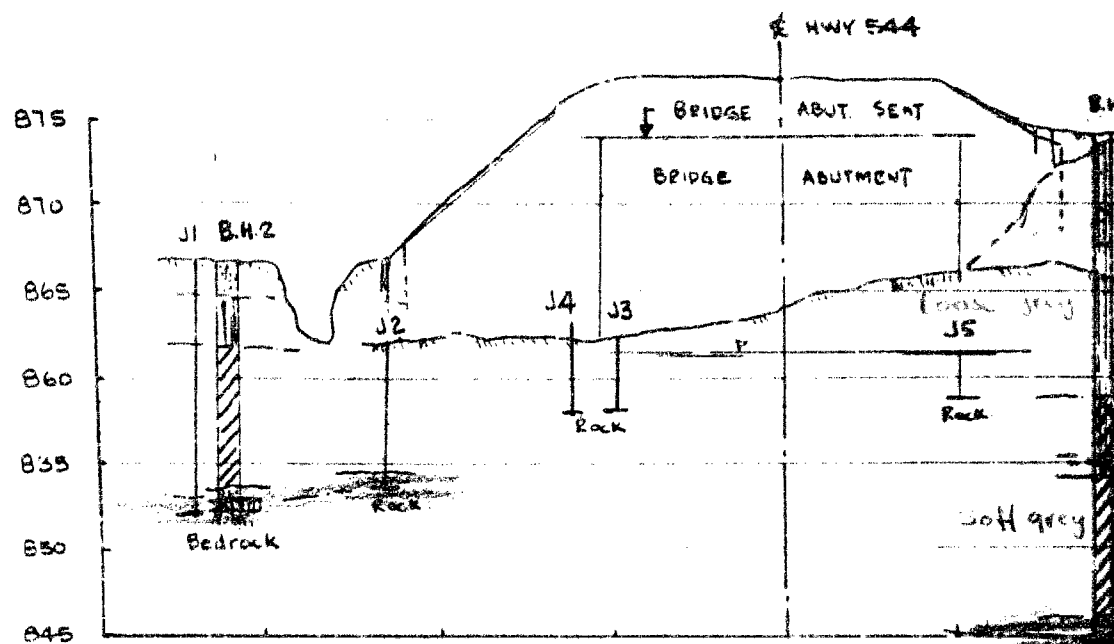
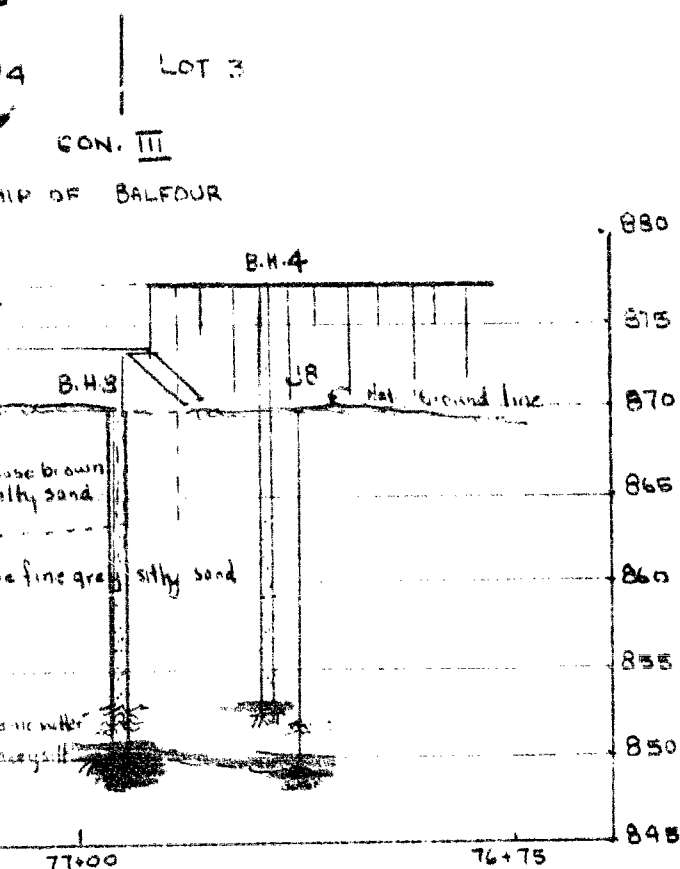
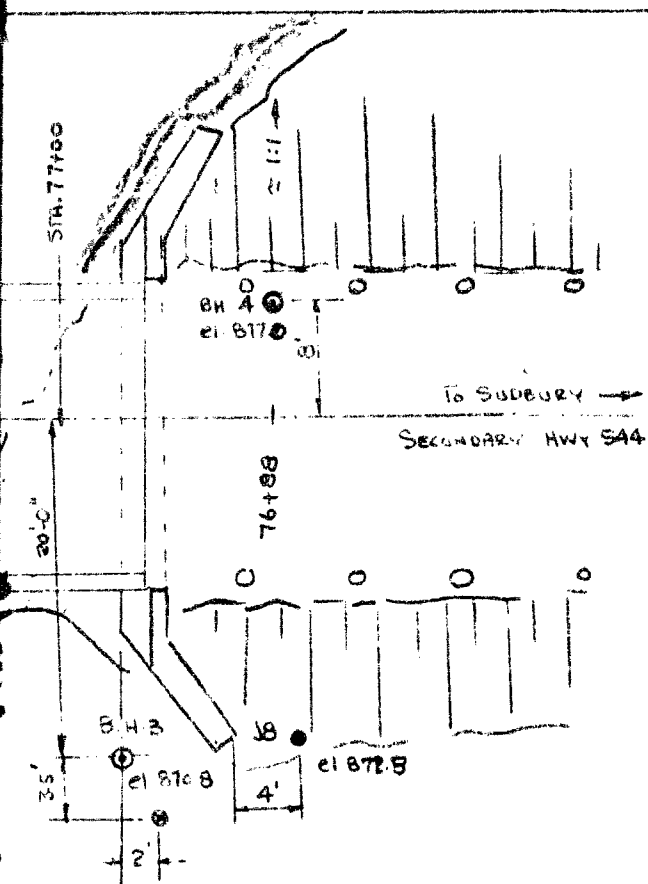
DOMINION SOIL INVESTIGATION LTD.

Kobelak
A. Kobelak, P.Eng.

ENGINEERING DATA SHEETS

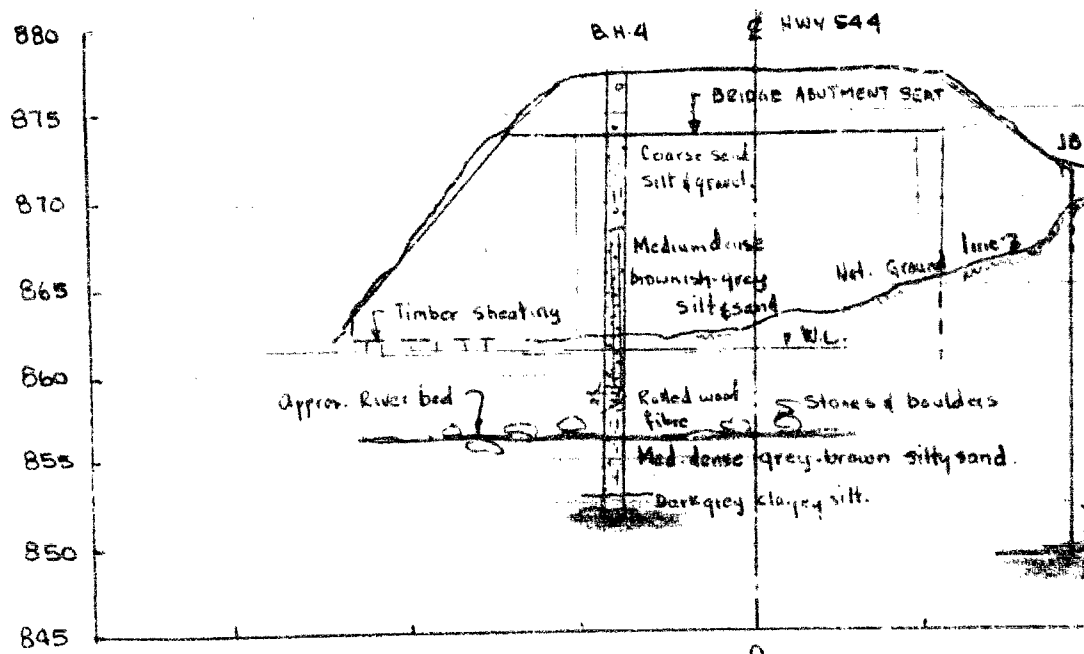
Location of Boreholes	}	. . . Encl. No. 1
Subsurface Sections		
Borehole Logs		Encl. No. 2-5





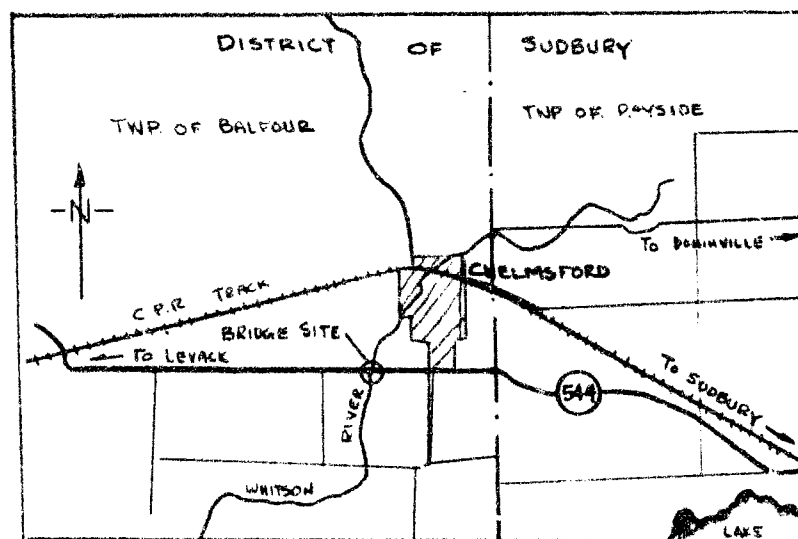
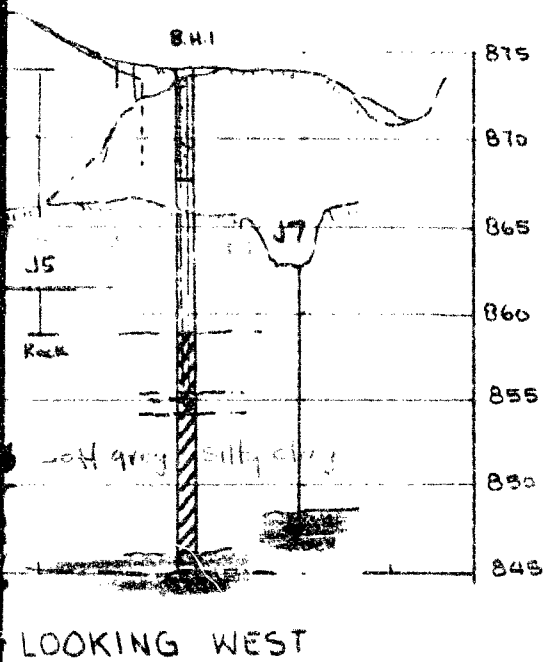
SECTION AT WEST ABUT. - LOOKING

Scale 1" = 10'



SECTION AT EAST ABUT. - LOOKING

Scale 1" = 10'



KEY PLAN

Scale 1" = 2 mi

LEGEND:

- ⊙ BOREHOLE
- JETTING - HAND OR MACHINE
- ⊗ CONE PENETRATION 2" DIA.
- L REFUSAL

41 I - 102

GFOCRES No

WP. 252-59

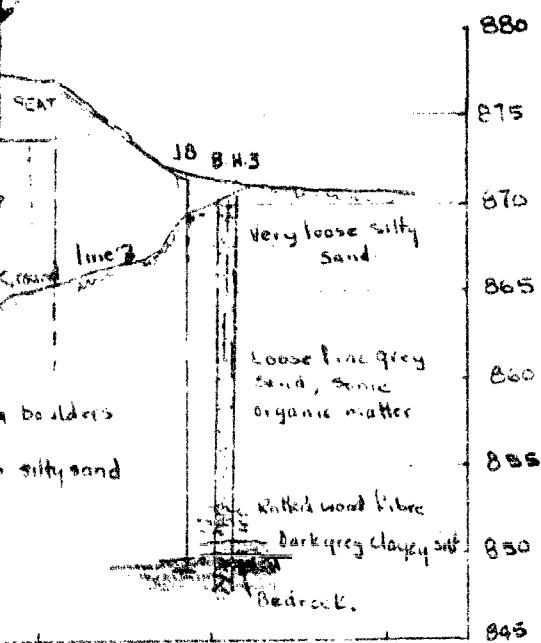
WHITSON RIVER & SEC. ROAD 544

LOCATION OF BOREHOLES
SUBSURFACE SECTIONS

DOMINION SOIL INVESTIGATION LTD.

PREPARED BY: AK DATE: NOV. 5, 1959 JOB NO: 59-172

ENCLOSURE NO. 1



Dominion Soil Investigation Ltd.

Dominion Soil Invest

Engineering Data Sheet

Engineering Data Sheet for Borehole: 1

W.P. 252-59

Date: Oct. 31, 1953

Project: Whitson River Bridge

Location: Sec. Rd. #544, Chelmsford, Ont.

Hole location: Sta. 77+65 18' N of c

Hole Elevation and Datum: 873.7 Geodetic

Field Supervisor: AK Prep.: AK

Driller: CI Checked:

LEGEND

Shear Strength (C)

Unconfined compression

Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

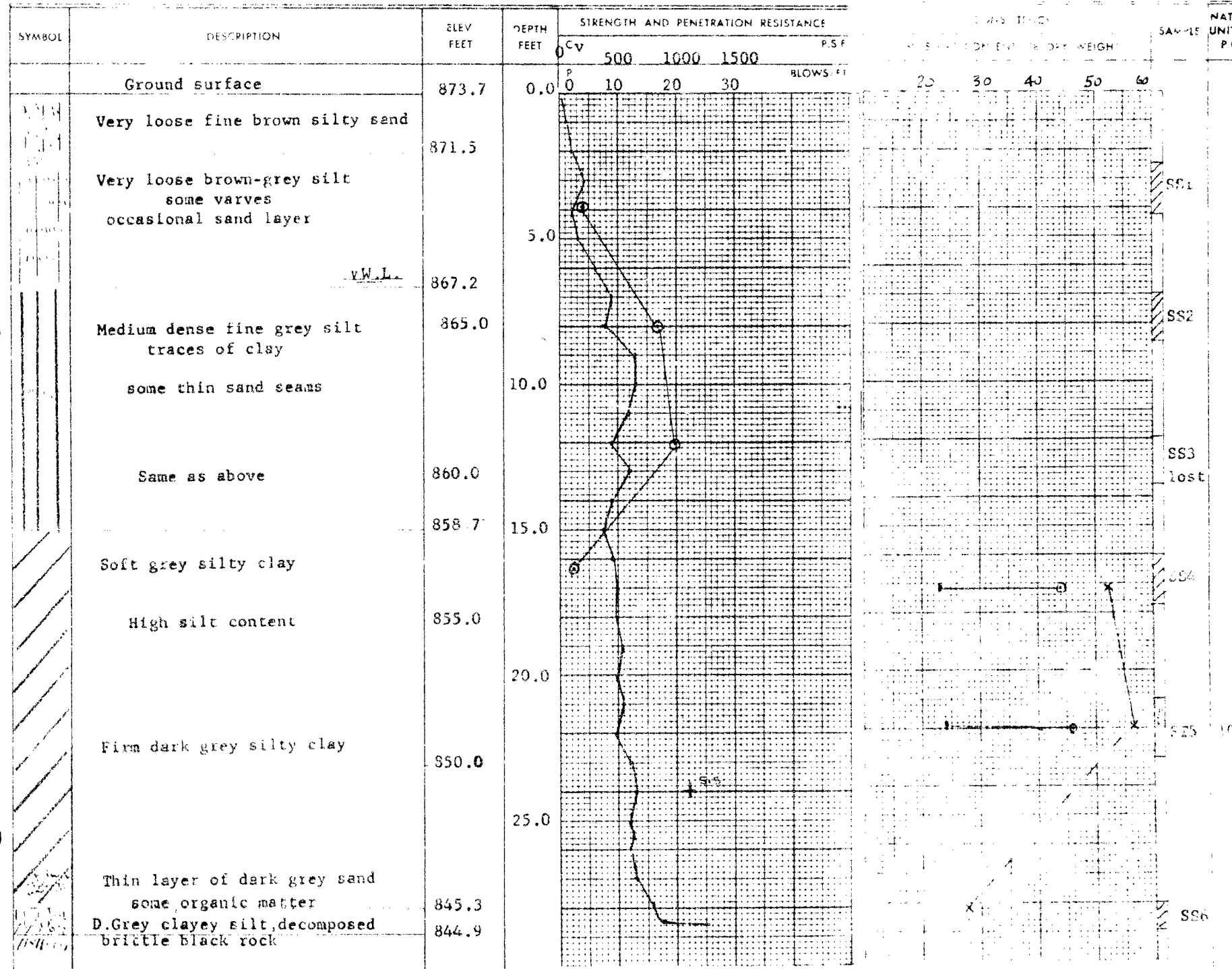
2" Dia. Cone

Casing

Sampling Method

2" Dia. split tube

2" Shelby tube



Soil Investigation Ltd.

Dominion Soil Investigation Ltd.

Data Sheet for Borehole: 1

Engineering Data sheet for Borehole: 1

NO

Date: Oct. 31, 195

Strength (C)

Confined compression
test and sensitivity (S)

Penetration Resistance (P)

Split tube

Dia. Cone

Sampling



Sampling Method

2" Dia split tube

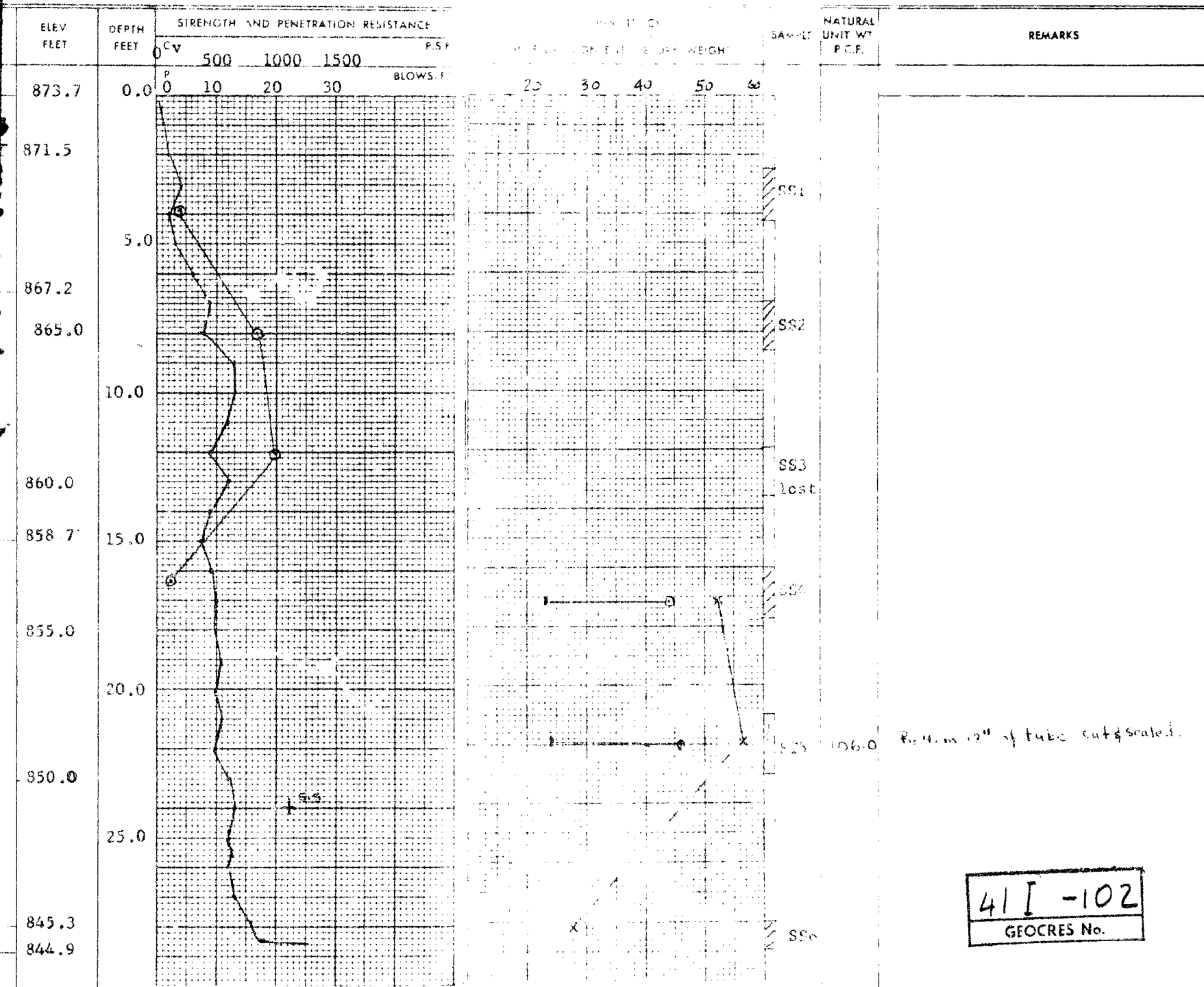
2" Shelby tube



Sampling Method

2" Dia split tube

2" Shelby tube



Dominion Sell Investigation Ltd.

Engineering Data sheet for Borehole: 2

Date: Nov. 1, 1955

1. $\sqrt{10}$

Sampling Method

2nd Dia. split tube

2" Shelby tube

22

1. $\sqrt{10}$

512107

* 0.0001, χ^2 test; and
 * 0.0001, index of dispersion.

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4. *Adaptation to the environment*

Sampling Method

2" Dia. split tube

2' Shelby tube

[illegible]

Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 3

W.P. 252-59

Date: 11-2-59

Project: Whitson River Bridge

Location: Sec. Rd # 544, Chelmsford, Ont.

Hole Location: SE Corner - 20 ft S. of #

Hole Elevation and Datum: 870.8 Geodetic

Field Supervisor: AK Prep.: AK

Driller: CI Checked:

LEGEND

Shear Strength (C)

Unconfined compression
Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube

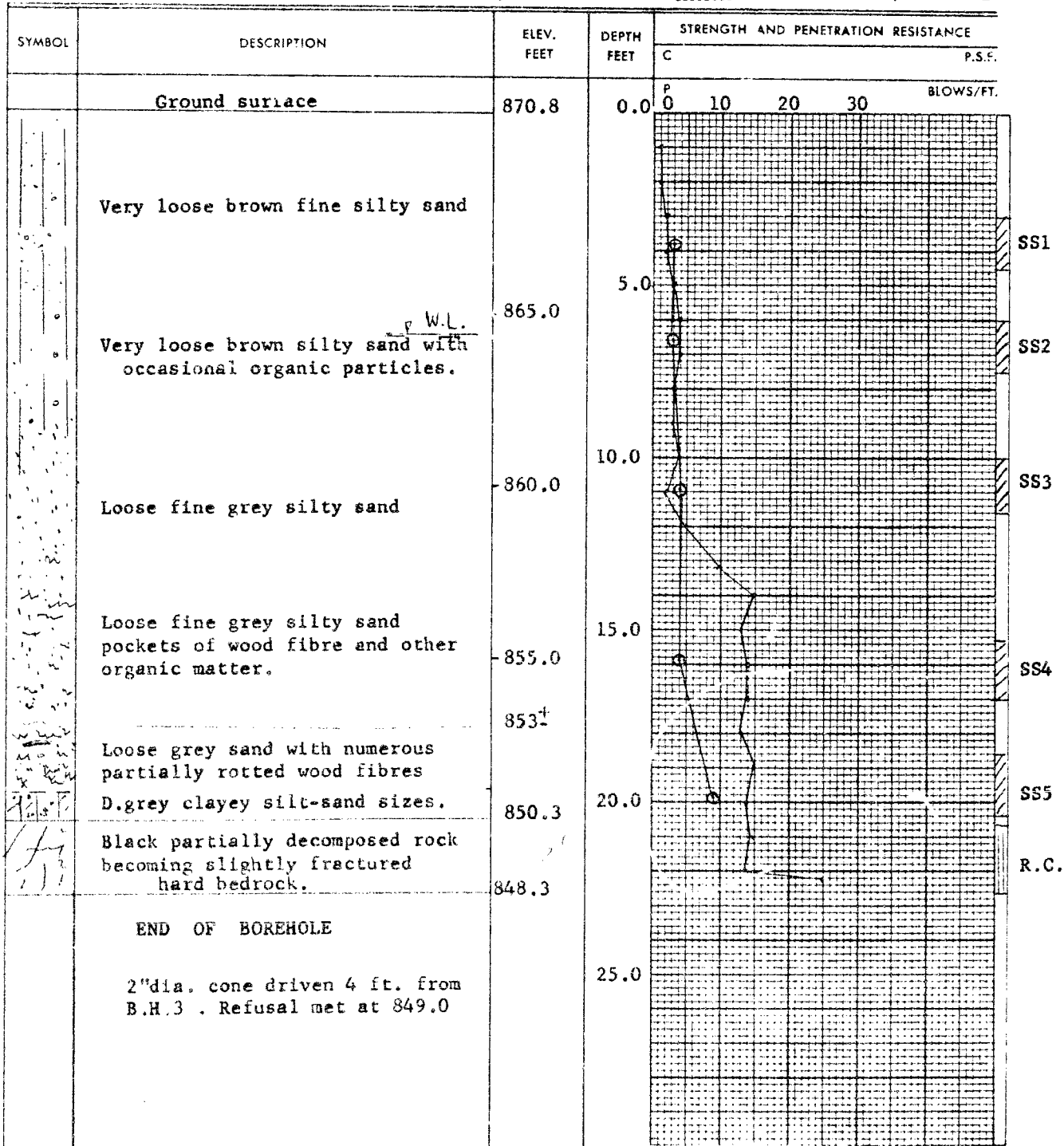
2" Dia. Cone

Casing

Sampling Method

2" Dia. split tube

2" Shelby tube



Dominion Soil Investigation Ltd.

Engineering Data Sheet for Borehole: 4

W.P.252-59

Date: (Nov. 2, 1959.

Project: Whitson River Bridge

Location: Sec. Rd. #544, Chelmsford, Ont.

Hole Location: NE Corner, Top of roadway

Hole Elevation and Datum: 877.0 Geodetic

Field Supervisor: AK

Prep.: AK

Driller: CI

Checked:

LEGEND

Shear Strength (C)

Unconfined compression
Vane test and sensitivity (S)

Penetration Resistance (P)

2" Split tube
2" Dia. Cone
Casing⊕
+*⊕
⊕
⊕

Sampling Method

2" Dia. split tube

2" Shelby tube

