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GEOCRES No. 40P4-41

DIST. 2 REGION SOUTHWESTERN

W.P. No. _____

CONT. No. _____

W. O. No. _____

STR. SITE No. 19-III

HWY. No. _____

LOCATION TWP. RD. $\frac{1}{2}$ TRIB. OF NAIRN

CK., BRIDGE-44, MIDDLESEX CO.

E. WILLIAMS TWP

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. _____

REMARKS: DOCUMENTS TO BE UNFOLDED

BEFORE MICROFILMED

G.I.-30 SEPT. 1976



DOMINION SOIL INVESTIGATION LIMITED

CONSULTING SOIL & FOUNDATION ENGINEERS

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J. P. MCINTYRE ENGINEERING LTD

CONSULTING ENGINEERS

LONDON

ONTARIO



Report on
SOIL INVESTIGATION FOR
BRIDGE NO. 44
LOT 20 CONCESSION 3
TOWNSHIP OF EAST WILLIAMS

by

DOMINION SOIL INVESTIGATION LIMITED

1220 Trafalgar Street,

London 41

Ontario

May 4, 1971

Report 71-4-L6

8

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I INTRODUCTION

In accordance with a letter of authorization dated April 20, 1971, from J. P. McIntyre Engineering Limited, Consulting Engineers, a soil investigation has been carried out in the Township of East Williams where it is proposed to replace an existing road bridge with a new structure.

The existing 28½ foot span steel-beam structure is located at Lot 20, Concession 3 of the Township, where the road crosses a tributary of Nairn Creek.

It is understood that the proposed structure is either a concrete rigid frame or twin multi-plate pipe arches and that it will be constructed at the same location as the existing bridge, or if the creek is relocated, it will be constructed about 100 feet to the west of the existing structure. The purpose of this investigation was to reveal the subsurface profile at the existing bridge site and also at the alternate site, and to determine the relevant soil properties for the design and construction of the foundations.

II FIELD WORK

The field work, consisting of 1 borehole and 2 dynamic cone penetration tests at each of the proposed locations, was carried out on April 21 and 22, 1971, at the locations

shown on Enclosure 1. The holes were advanced to the sampling depths by a continuous flight auger machine, which was equipped for soil sampling,

Standard penetration tests were performed at frequent intervals of depth, as detailed in Appendix 'A', and the results are recorded on the borehole logs as 'N' values. The dynamic cone penetration tests were performed to compare relative soil properties at each location, and to obtain an indication of soil density and strata changes with depth.

The field work was supervised by a soils engineer, who also determined the ground surface elevations. These were referred to a nail in a tree at the location shown on Enclosure 1. The benchmark was established by the client and was given the assumed value, El. 100 feet.

III SUBSURFACE CONDITIONS

Detailed descriptions of the strata which were encountered in each borehole are given on the borehole logs comprising Enclosures 2 and 3, and a general picture of the soil stratigraphy is presented in the form of a Subsurface Profile on Enclosure 1. The following notes are intended only to amplify this data.

Existing Bridge Site (Borehole 2 and Cones C1 and C2)

The borehole encountered an 8 foot thick layer of silty clay fill which is associated with the construction of the existing road embankment.

The natural subsoil consists of consecutive layers of silty clay, silt and fine sand, and a further layer of silty clay. The consistency of the silty clay strata is described as 'very stiff' based on 'N' values ranging from 27 to 44 blows per foot. Atterberg Limit tests were performed on a sample of the silty clay giving values of Liquid Limit of 42%, Plastic Limit of 17%, and Plasticity Index of 25%. These values indicate that the clay has an intermediate plasticity and medium compressibility. The natural moisture content of the silty clay was found to be 19%, which corresponds to a Liquidity Index of 0.1. This also confirms the 'very stiff' consistency obtained from visual and tactile examination.

'N' values within the silt and fine sand stratum ranged from 61 blows per foot to 100 blows for a 3 inch penetration of the sampler. On the basis of these results the relative density of the silt and fine sand is described as 'very dense'.

Alternate Bridge Site (Borehole 3 and Cones C3 and C4)

The borehole penetrated a 6 foot thick layer of silty clay

fill overlying a topsoil deposit which is probably the original ground surface. The natural subsoil consists of consecutive layers of silt, silty clay, silty fine sand and non-cohesive silt which contains some fine sand.

The silty clay layer has a 'very stiff' consistency as indicated by an 'N' value of 23 blows per foot. This was also confirmed by a Liquidity Index value of 0.16. The layers of silty fine sand and silt, which were encountered below the silty clay layer, have a generally 'very dense' relative density as indicated by 'N' values of 100 blows for less than 1 foot penetration of the sampler. Grading analyses were performed on samples from the silty fine sand and silt strata and the results are presented graphically in the form of grain size distribution curves on Enclosure 4.

IV GROUNDWATER CONDITIONS

Equilibrium water levels were observed in the two boreholes at El. 95.8, and the water level in the adjacent creek was observed at El. 95.9.

V DISCUSSION & RECOMMENDATIONS

Concrete Structure

The creek bed at the existing bridge location extends down

to El. 94, therefore normal concrete spread footing foundations would be constructed at or below El. 90 to provide sufficient protection against frost action. On the basis of the borehole results a maximum allowable soil pressure of 6000 p.s.f. is appropriate for the design of footings at or below El. 90, and this soil pressure incorporates a factor of safety of at least 3 against shear failure of the underlying soil. Total settlement of the footings is estimated to be less than 1 inch, and in view of the generally dense and uniform resistance to penetration of the dynamic cone penetration tests, differential settlement is expected to be negligible.

Due to the different soil profile which was encountered at the proposed locations, the two sites will require different construction techniques. At the existing bridge site, the proposed footing grade is located within the very stiff silty clay stratum therefore no unusual construction problems will be encountered and seepage into excavations may be controlled by normal pumping procedures. At the alternate site (borehole 3) the footing grade is located within the silty fine sand stratum, therefore special dewatering techniques must be used to prevent disturbance of the subgrade due to an out of balance hydrostatic pressure. Dewatering of the excavation can

be carried out inside a sheet pile enclosure which should penetrate to a depth below the footing grade equal to the height of the prevailing water table above the footing grade. The silt and fine sand strata are highly susceptible to disturbance and any form of compaction causing vibration of the soil should be avoided.

Twin Multi-Plate Pipe Arches


Suitable sub-grades for the construction of the pipe arches were encountered at El. 94.7 in borehole 2 and El. 93.7 in borehole 3. It is recommended that the pipes be supported on a 12 inch thick mat of well graded granular material to provide a uniform support along the entire length, and that the granular material be sealed at each end of the pipe with silty clay to prevent any loss of bedding due to seepage. The fill below and on the sides of the pipes should be compacted to at least 98% of the maximum standard Proctor dry density for the particular material used.

In view of the relatively shallow excavations required, no unusual construction problems are envisaged in connection with excavation for the pipe structures.

Yours very truly,

DOMINION SOIL INVESTIGATION LIMITED




C. J. W. Atkinson, M.Sc., P.Eng.,
Branch Manager

CJWA/jj

APPENDIX 'A'.

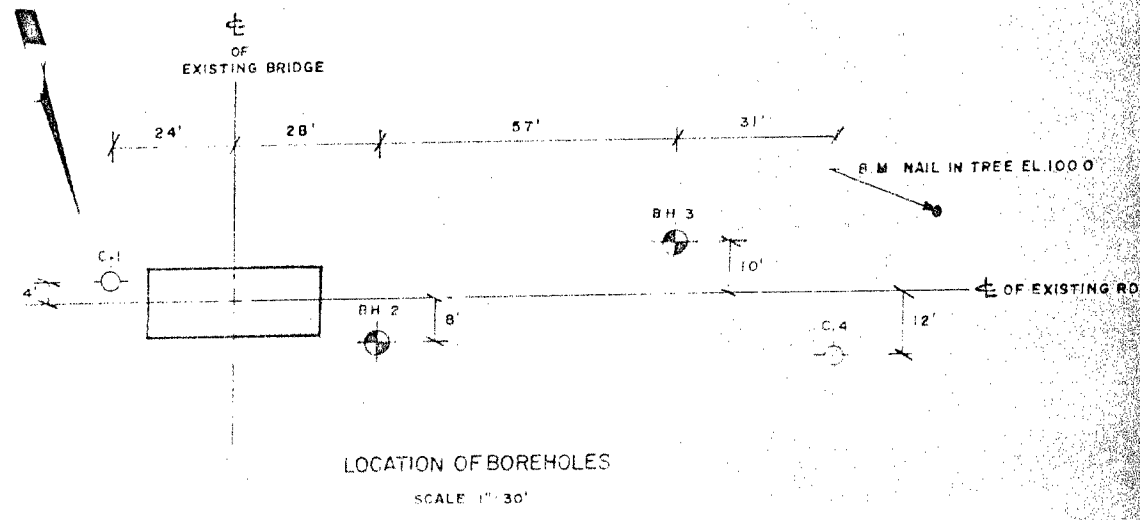
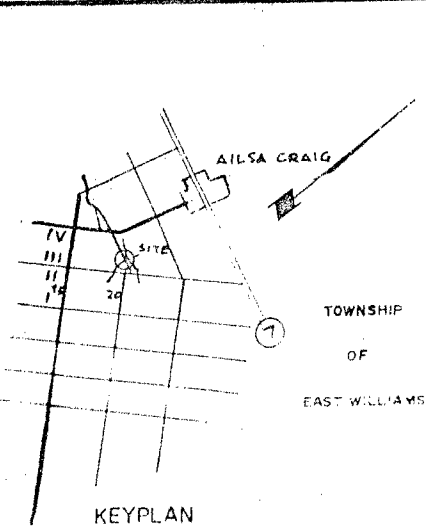
THE STANDARD PENETRATION TEST.

In order to determine the relative density of non-cohesive soils, such as sands and gravels, the standard penetration test has been adopted. The test also gives an indication of the consistency of cohesive soils.

A two inch external diameter thick-walled sample tube is driven into the ground at the bottom of the borehole by means of a 140 lb. hammer falling freely through 30-ins. The tube is first driven an initial 6-inches to allow for the presence of disturbed material at the bottom of the borehole. The number of standard blows (N) required to drive the sampler a further 12-in. is recorded. The sample tube is one originally developed by Raymond Concrete Pile Company in the United States, where a sufficient number of tests have been made in conjunction with field investigations to show that the results, although essentially empirical, may be applied to foundation design.

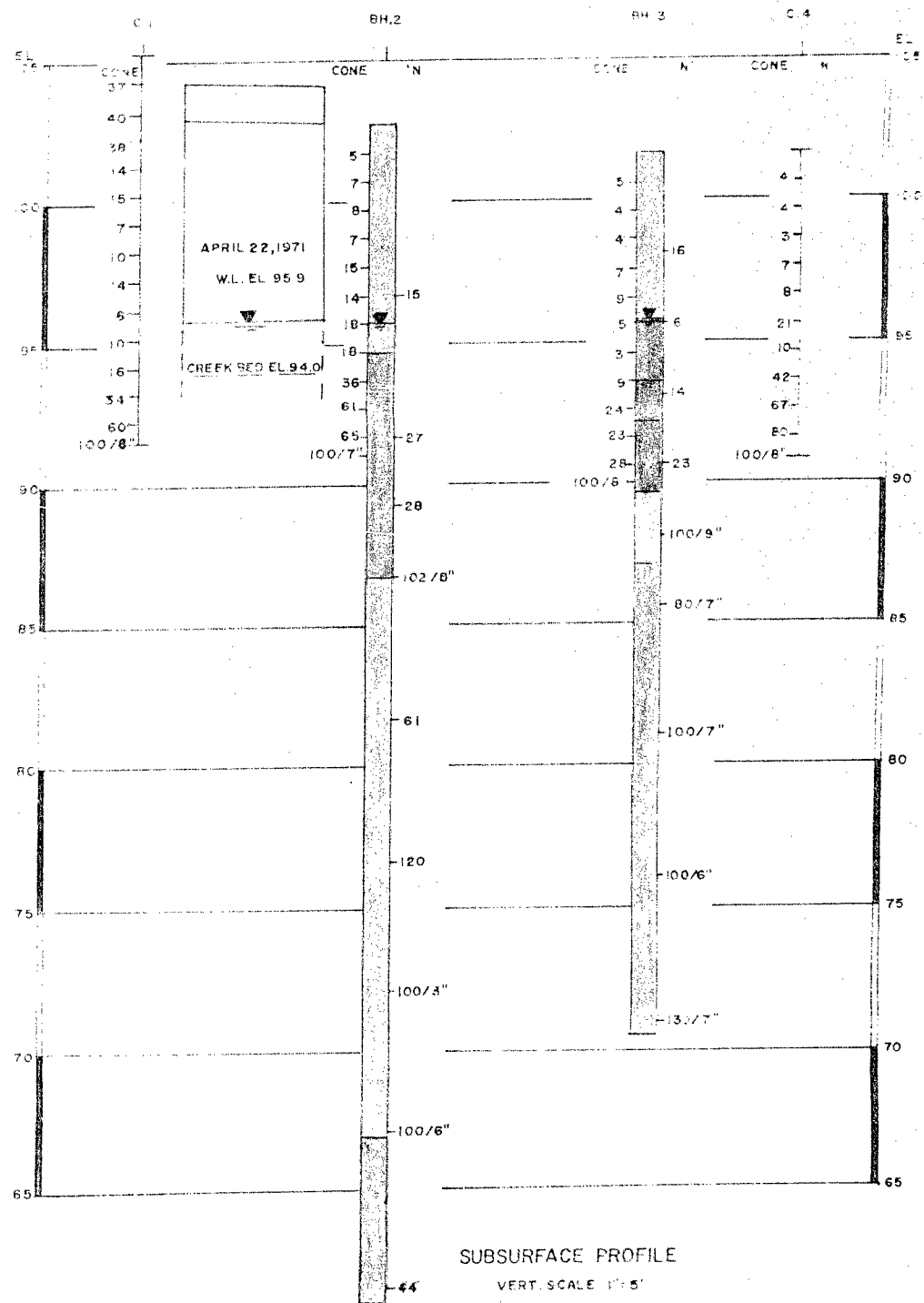
For Sands:-

Values of 'N'.	Density.
Less than 10	Loose
Between 10 and 30	Compact
Between 30 and 50	Dense
Greater than 50	Very dense.



LEGEND

- SILTY CLAY, FILL
- TOPSOIL
- COMPACT SILT
- VERY STIFF SILTY CLAY
- VERY DENSE SILTY FINE SAND
- VERY DENSE SILT AND FINE SAND



LOG OF BOREHOLE 2 and Cores C1 and C2

Enclosure No. 2

Our Reference No. 71-4-16

CLIENT: J. P. McIntyre Engineering Ltd.,
PROJECT: Proposed Bridge No. 44
LOCATION: Lot 20, Conc. 3 Twp. of E. Williams
DATUM ELEVATION: 100 feet (see Enclosure 1)

DRILLING DATA

Method: Auger
Diameter: 4-inch.
Date: April 21, 1971

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE Blows / Foot					WATER CONTENT %			REMARKS						
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	N Blows / Foot	20	40	60	80	100	PLASTIC LIMIT	NATURAL		LIQUID LIMIT					
								UNDRAINED SHEAR STRENGTH					COMPRESSION TEST					W _p	W	W _L	
								FIELD VANE TEST													
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VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: CA CHECKED: 55

LOG OF BOREHOLE 3 and Copes C3 & C4

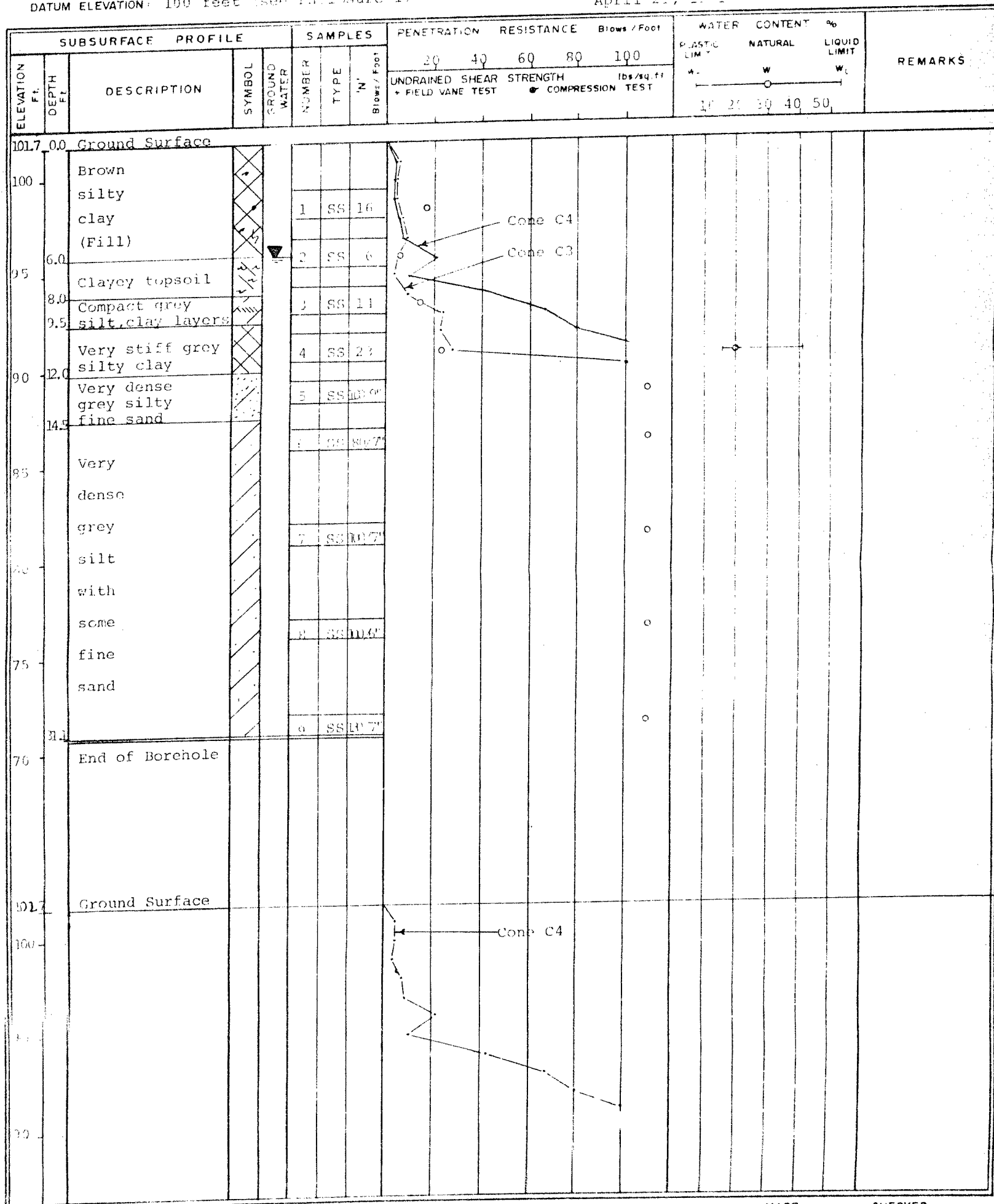
Enclosure No 3

Our Reference No. 71-4-10

CLIENT: J. P. McIntyre Engineering Ltd.,
PROJECT: Proposed Bridge No. 44
LOCATION: Lot 20, Conc. 3, Twp. of E. Williams
DATUM ELEVATION: 100 feet (see Enclosure 1)

DRILLING DATA

Method: Auger
Diameter: 4-inch
Date: April 21, 1971



VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: CA

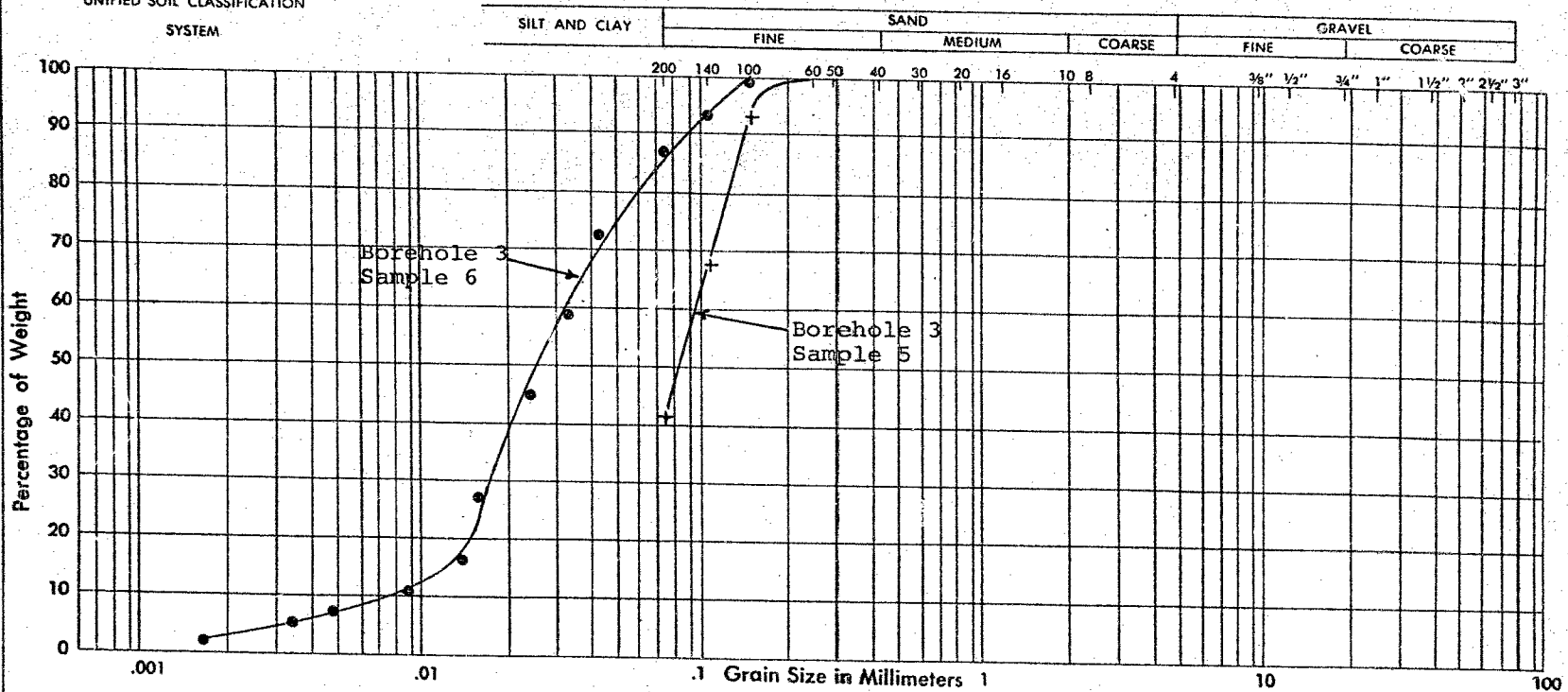
CHECKED: jj

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO. 71-4-L6

UNIFIED SOIL CLASSIFICATION
SYSTEM



PROJECT: Bridge No. 44
 LOCATION: Twp. of E. Williams
 BOREHOLE NO.: 3
 SAMPLE NO.: 5 & 6
 DEPTH OF SAMPLE: 12½ & 15 feet
 ELEVATION OF SAMPLE: 89 and 86 feet

COEFFICIENT OF UNIFORMITY
 COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:
 Sample 5: Silty fine sand
 Sample 6: Silt with some fine sand

PLASTIC PROPERTIES:

LIQUID LIMIT % =
 PLASTIC LIMIT % =
 PLASTICITY INDEX % =
 MOISTURE CONTENT % =
 ACTIVITY =

Enclosure No. 4