62-F-249m

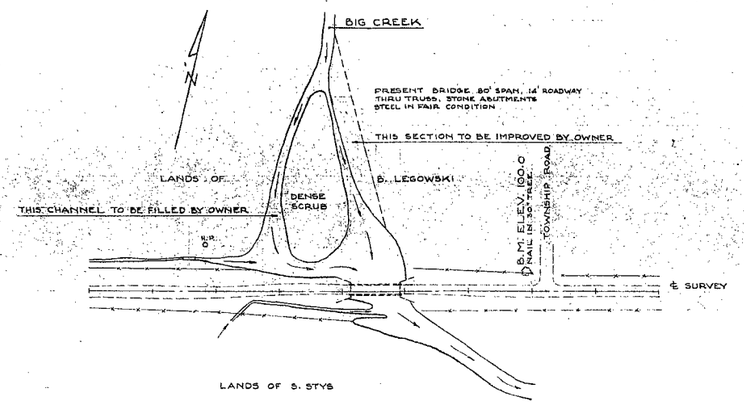
BIG CREEK

BRIDGE

LOT 11, CONXII/XIII

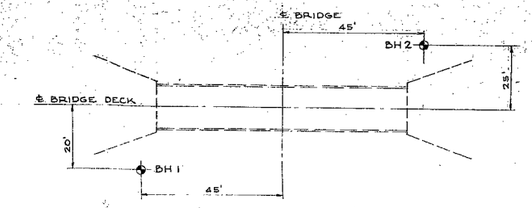
BURFORD.

TWP.



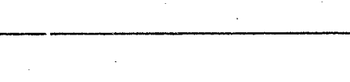
PLAN

1" = 100'



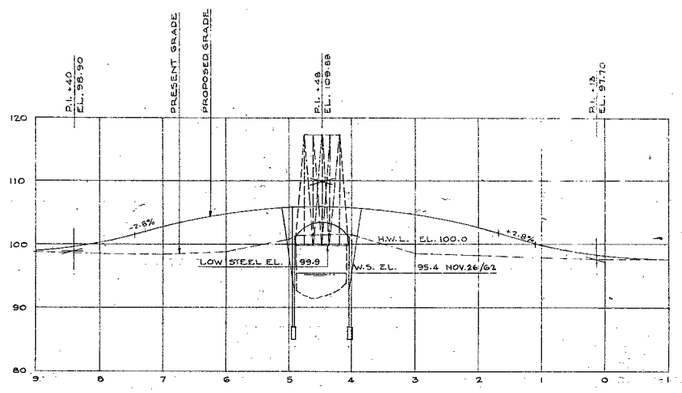
LAYOUT OF BOREHOLES

1" = 20'



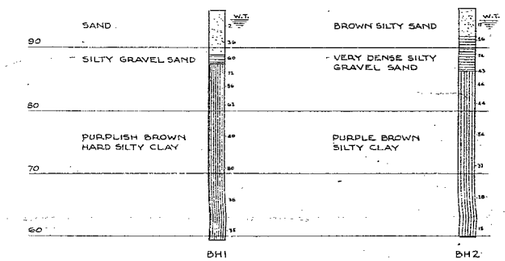
TYPICAL ROADWAY SECTION

1" = 10'



PROFILE

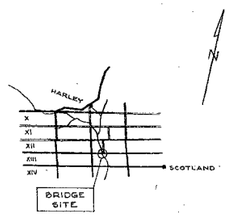
HOR. 1" = 100' VERT. 1" = 10'



BOREHOLE RESULTS

NUMBERS REPRESENT RESULTS OF STANDARD PENETRATION TESTS

STRUCTURE SITE No. 1-126



SCALE 1" = 4 MLS

KEY PLAN.

FOLLOW SEPARATE INSTRUCTIONS FOR PREPARATION OF BRIDGE SITE PLAN WHEN MAKING BRIDGE SURVEY.

DATA.

1. SPECIAL FEATURES: WATERFALLS, DAMS, EXCEPTIONAL FLOODS, ICE, DRIFTWOOD, SLIDING BANKS, ETC. DENSE SCRUB HAS BLOCKED MAIN CHANNEL
2. (A) UPSTREAM & DOWNSTREAM BRIDGES (GIVE LOCATION, LENGTH, HEIGHT ABOVE N.H.W.L., NET CROSS-SECTIONAL AREA AT HIGH WATER & ESTIMATED AGE): UPSTREAM 1 ML. 80-7.5', 40 YRS OLD. VERY LIGHT SCOUR.. DOWNSTREAM 1 ML. -4.20' 3 SPANS, 10' U/S TO BED. 3 YRS OLD
   (B) REASONS WHY THESE BRIDGES ARE, OR ARE NOT, FAIR INDICATIONS OF SIZE OF PROPOSED BRIDGE:
3. REASONS FOR CHANGES IN HEIGHT OR LENGTH FROM THAT OF OLD BRIDGE: BRIDGE RAISED TO CLEAR H.W.L.

DATA (contd.)

4. IS DITCH, STREAM, OR RIVER GRADIENT LIABLE TO BE LOWERED? NO
5. NAVIGATION CLEARANCES REQUIRED, IF ANY:
6. RAILWAY CLEARANCE REQUIRED, IF ANY:
7. IF STRUCTURE IS OVER OR UNDER A RAILWAY HAS APPROVAL BEEN OBTAINED?
   (A) FROM RAILWAY CO.:
   (B) FROM BOARD OF TRANSPORT COMMISSIONERS:
8. HAS APPROVAL BEEN OBTAINED UNDER NAVIGABLE WATERS PROTECTION ACT?
9. IS A TEMPORARY DETOUR REQUIRED? NO
   WHO WILL BUILD IT?
   WHO WILL MAINTAIN IT?
10. INFORMATION AND EVIDENCE OF EXTREME FLOODING WAS OBTAINED FROM LOCAL RESIDENTS AND REFLECTS HIGHEST WATER ELEVATION IN THE AREA OF THIS CONSTRUCTION TO BE 100.0 AND THE LOWEST WATER ELEVATION TO BE 93.4
11. ROAD DESIGN INFORMATION:
    ESTIMATED A.D.T. 0-200 V.P.D.
    DESIGN SPEED: 50 MPH
    STOPPING SIGHT DISTANCE: 350 FT.

STRUCTURE DATA.

1. NET SPAN LENGTH AND TYPE OF BRIDGE: BS CONC. RIGID FRAME
2. ROADWAY WIDTH ON BRIDGE: 20'
3. NUMBER & WIDTH OF SIDEWALKS: NONE
4. SKEW ANGLE: 15°
5. TOTAL LENGTH & TYPE OF PILING:
6. APPROX. VOLUME OF CONCRETE 465 CU. YDS.
7. APPROX. WEIGHT OF STR. STEEL 0 TONS.
8. APPROX. WEIGHT OF REINFORCEMENT 37 TONS.
9. APPROX. VOLUME OF APPROACH FILL 100' EACH SIDE OF STRUCTURE 1,800 CU. YDS.
10. DRAINAGE AREA 46 SQ. MI.

FIELD INVESTIGATION MADE NOV. 26 1962

BY D. AARON
SURVEY ENGINEER.

V. R. ASTROP - CONSULTING ENGINEER

BRIDGE OVER BIG CREEK

OWNER BURFORD TWP. MUNICIPAL DIST. No.

Co. BRANT ROAD No.

TWP. BURFORD LOT 11 CON. 12 & 13

— SITE PLAN. —

REGISTERED PROFESSIONAL ENGINEER — CIVIL — V. R. ASTROP — PROVINCE OF ONTARIO

DEC. 3/62 DATE.

V R Astrop DESIGN ENGINEER.

BRIDGE NAME. BIG CREEK BRIDGE

LOADING.	BRIDGE No.	DWG No.
H20-S16		1

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac
Principal Foundation Engineer,
Materials & Research Section,
Lab. Bldg.,

From: G.C.E. Burkhardt
Bridge Division,

Date: January 21, 1963

Our File Ref. BA 1573

In reply to

Subject: Twp. of Burford,
Big Creek Bridge,
Lot 11, Con XII/XIII,
County of Brant,
Structure Site #1-126,

Attached please find one copy of the Foundation Report, by Dominion Soil Investigation Limited, and one copy of the Preliminary Plans for your comments.

We would like to approve the plans before January 31, 1963 and we would appreciate it very much, if we could have your comments within this month.

G.C.E. Burkhardt,
for K.L. Kleinsteiber,
Municipal Bridge Liaison Engineer.

GCEB/dm

NO COMMENT — BY PHONE.
JAN. 22. 1963. A. Stermac

BA 1573

V. R. ASTROP

CONSULTING ENGINEER

HAMILTON - ONTARIO

62-F-249 M

BRIDGE OVER BIG CREEK

In Burford Township

FOUNDATION CONDITIONS

Submitted by

DOMINION SOIL INVESTIGATION LIMITED
77 Crockford Boulevard
SCARBOROUGH - ONTARIO

OUR REFERENCE: 2-12-11

DECEMBER 1962

CONTENTS

ENCLOSURES

DOMINION SOIL INVESTIGATION LIMITED
77 CROCKFORD BOULEVARD SCARBOROUGH, ONTARIO TELEPHONE 421-2567

BRANCH
3 QUEENS AVENUE
LONDON, ONTARIO
TELEPHONE GE. 3-3851

FOUNDATION ENGINEERS

P.O. BOX 933
SAULT STE. MARIE
ONTARIO
TELEPHONE AL. 4-2615

INTRODUCTION

A letter of authorization dated December 3rd, 1962 was received from Mr. V. R. Astrop, Consulting Engineer, to conduct a foundation investigation at the site of a proposed bridge over the Big Creek in the Township of Burford, County of Brant.

The new structure will replace the existing one, which being too narrow and old cannot meet the requirements of modern traffic.

Number and location of the boreholes were determined by the Client and marked on a drawing (dated December 3, 1962) supplied to us. The actual position of the holes was influenced by the field conditions but they were as close to those specified on the above plan as possible.

The purpose of the investigation was to reveal the subsurface conditions and determine the necessary soil properties for the design and construction of foundations.

.... 2

SUMMARY

(1) Below a shallow alluvial sediment,glacial deposits possessing favourable engineering properties were encountered.

(2) The hard, silty clay till should serve as the foundation material. Elevation 85 is suggested as the highest base level.

(3) Spread footings will be capable of supporting the proposed bridge.

(4) The construction of the foundations should not present unusual difficulties. Surface waters should be diverted and seepage waters can be removed by pumping from the excavation.

.... 3

I. DESCRIPTION OF SITE AND GEOLOGY

The existing bridge is located about four miles west of Scotland. It carries a gravel-surfaced township road over the Big Creek. The land is fairly flat, almost exclusively agricultural. The structure is a steel truss supported freely at both ends.

Southern Ontario is a glaciated region. Vast masses of ice moved southward in the Pleistocene Epoch, meanwhile scouring the bedrock, eroding the earth surface and depositing the dislodged pieces elsewhere. The thoroughly mixed, nonsorted, nonstratified mass is the so-called glacial till. A common characteristic of the tills is that they are densely packed owing to the enormous weight of the ice having lain above for thousands of years.

II. FIELD WORK

Field work was carried out during the period December 6th to 8th, 1962. The subsurface exploration comprised two boreholes and four dynamic penetration tests at the location shown on Enclosure #2. The positions of the test holes were set out on the site with the assistance of a drawing referred to in the Introduction, which was provided to us. Elevations were measured relative to the centre of bridge deck (=101.5).

The boreholes were of 2 7/8 in. diameter. They were lined with Bx casing advanced to the required sampling depths by the repetitious procedure of alternately driving and washing.

Standard penetration tests were made at frequent intervals using a 2 in. outside diameter split spoon driven into the bottom of the clean borehole over a depth of three times six = eighteen inches and applying a constant driving energy: 140 lb. hammer dropping 18 inches. (These tests provided disturbed samples from the substrata indicating their relative density and consistency.)

.... 4

The blows to advance the sampler six inches were counted and thus three values obtained. The first one is discarded because the soil in the vicinity of the bottom of the borehole may have been disturbed by the borings. The second and third values are added and thus the blows required for one foot penetration (=Standard Penetration Resistance) is obtained and recorded on the data sheet.

The dynamic cone penetration test is one type of deep sounding in which the A rods with a 2 in. diameter 60 degree apex cone driving point are driven into the subsoil without casing and applying the same driving energy as above. These tests provided a continuous record of soil density.

The stratification of the subsoil in terms of depth from surface and elevation, the position and type of samples and the results of the penetration tests are recorded on geotechnical data sheets comprising Enclosures #3 and #4.

III. LABORATORY WORK

All samples were shipped to our modern laboratory where they were subjected to a detailed visual and manual examination. Thereafter, those samples whose precise engineering characteristics were of primary interest were further analyzed by exact laboratory methods.

The grain size composition of the silty gravel sand was revealed by sieve analysis (Samples #1/3 and #2/2). For the results, we refer the reader to Enclosure #5.

The silty clay will serve as foundation material; therefore its properties and the variation of them with depth must not be overlooked.

.... 5

The plastic properties were tested by measuring the water content at the liquid and plastic limits. The natural moisture content is a simple but significant index property. From these three data, the liquidity index is derived. The closer this value to zero, the better the subsoil.

We determined the unit weight of four geometrically shaped specimens. The meaning of the high values can be clearly seen by comparing them to the density of concrete: 150 lbs./cu.ft. Assuming 2.73 as the specific gravity of solids, the void ratios can be computed. This index expresses the proportion of the volume of solids to that of void spaces filled either with air or water.

The table below is a summarized list of all laboratory test results:

BH No.	SA No.	Elev.	LL %	PL %	W %	LI	Unit Weight (pcf)	Void Ratio
1	4	85	21.8	13.3	11.85	—.17	-	-
	5	83	-	-	10.35	-	-	-
	6	80	-	-	11.7	-	143	.34
	7	75	-	-	21.0	-	142	.46
	8	70	-	-	16.1	-	-	-
	9	65	-	-	16.2	-	-	-
	10	60	-	-	18.6	-	-	-
2	4	85	24.8	13.7	15.4	.15	-	-
	5	83	-	-	13.95	-	-	-
	6	80	-	-	13.0	-	146	.32
	7	75	-	-	18.2	-	-	-
	8	70	-	-	16.8	-	-	-
	9	65	-	-	15.3	-	136.5	.5
	10	60	-	-	20.3	-	-	-

IV. SUBSURFACE CONDITIONS

Consistent stratigraphy was revealed by the borings and confirmed by the dynamic cone penetration tests. The various materials, their extent and their properties are discussed in the following paragraphs:

From ground level to app. el. 90:	SAND. THE MATERIAL IS ALLUVIAL AND OF RECENT ORIGIN. IT IS LOOSE IN THE UPPER PORTION BUT TURNS TO DENSE IN THE LOWER ONE.
From app.el. 90 to app. el. 86:	SILTY GRAVEL SAND. THE DEPOSIT IS DENSELY PACKED AND HAS A WELL GRADED GRAIN SIZE DISTRIBUTION ILLUSTRATED BY THE ELONGATED S-SHAPED CURVE. SLIGHT CEMENTATION IS OBSERVABLE CAUSED BY LIME. THE MATERIAL IS OF GLACIAL ORIGIN.
From app. el. 86 to	PURPLISH-BROWN HARD, SILTY CLAY. IT IS A COHESIVE TILL. THE PLASTIC PROPERTIES ARE TYPICALLY THOSE OF CANADIAN GLACIAL DEPOSITS. THE MOISTURE CONTENT IS LOW AND OWING TO THE SMALL VOID RATIO, THE SHEAR STRENGTH IS HIGH AND THE MATERIAL IS PRACTICALLY INCOMPRESSIBLE. SCATTERED, FINE ANGULAR GRAVEL WAS FOUND THROUGHOUT THE ENTIRE STRATUM AND OCCASIONAL SILT POCKETS, LAYERS ACCOUNT FOR A VARVED APPEARANCE IN MANY INSTANCES.

A little increase in moisture content and consequent softening with depth was observable in both boreholes. This, however, does not affect the stability of footings placed at higher levels.

The ground water level corresponds to that in the creek.

V. DISCUSSION AND RECOMMENDATIONS

The subsoil conditions at the site are very favourable, both from the point of view of design and construction. Any type of bridge (i.e. statically determinate or indeterminate) can be built. The boreholes revealed a consistent stratigraphy which - in the knowledge of the

.... 7

geological history - permits the inter or extrapolation of the findings within a reasonably confined area.

The purple-brown, silty clay should serve as foundation material. The gross allowable bearing pressure at elevation 85 ft. or lower is 7,000 psf.

Settlements will be negligibly small, considering that the clay is hard, has a low void ratio and - last but not least - it is heavily preconsolidated. (The ice surcharge was much greater than the loads contemplated at present and the enormous weight precompressed the material thereby improving its geotechnical properties).

Construction

The river should be diverted during the period of construction and all surface waters should be kept out of the excavation by means of dikes and temporary trenches.

The water entering the excavation through its walls can be collected in a temporary sump cut into the deepest corner. (No measurable amount of water can seep through the bottom of the pit because the hard, silty clay is practically impermeable.) The seepage waters can be pumped out of the sump without the danger of loosening the subgrade. The walls of the excavation can either be braced or trimmed to a stable slope.

The only difficulty which may be experienced is that after a rain, the bottom of the excavation becomes slippery and muddy. Therefore, it is suggested that as soon as the proposed footing grade has been reached, a lean concrete blanket should be poured over its entire surface. This will prevent the direct contact between the water and the subsoil.

..... 8

The subsoil should be thoroughly checked before pouring the footings. Eventual loose silt pockets should be removed and the cavity backfilled with concrete. Thus, costly surprises can be avoided.

DOMINION SOIL INVESTIGATION LIMITED

L. S. Rolko

LSR/oed

L. S. Rolko, P. Eng.,
Chief Soils Engineer.

VI. REFERENCES

(1) Procedures for Testing Soils, ASTM, April 1958, pp 186 to 198. (Unified Soil Classification System - by A.A. Wagner).

(2) Terzaghi and Peck: Soil Mechanics in Engineering Practice, John Wiley and Sons, New York 1948.

(3) The Physiography of Southern Ontario by L.J.Chapman and D.F. Putnam of the Ontario Research Foundation - University of Toronto Press 1951.

(4) Alapozasok (Foundation Engineering - in Hungarian) by Ch. Szechy Budapest, 1957.

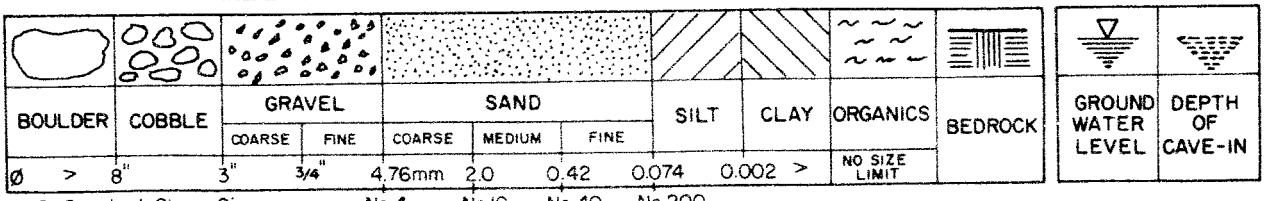
(5) A Contribution to the Settlement Analysis of Foundations on Clay by A. W. Skempton and L. Bjerrum - Geotechnique VII. (1957) and Amendment Thereto by A. M. Muir Wood (Correspondence, Geotechnique Vol. IX).

(6) Strength and Deformation Characteristics of Various Glacial Tills in New England bt Kenneth A. Linell and H. F. Shea - Proc. Research Conference on the Shear Strength of Cohesive Soils, Boulder, Colorado, June 1960.

Enclosures

LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE.

SOIL COMPONENTS AND GROUND WATER CONDITIONS.



SAMPLE TYPES.

AS	Auger sample	RC	Rock core	TP	Piston, thin walled tube sample
CS	Sample from casing	%	Recovery	TW	Open, thin walled tube sample
ChS	Chunk sample	SS	Split spoon sample	WS	Wash sample

SAMPLER ADVANCED BY static weight : w
" pressure : p
" tapping : t

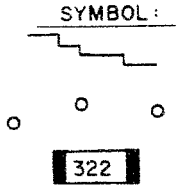
OBSERVATIONS MADE WHILE CORING: Steady pressure; No pressure; Intermittent pressure; Washwater returns; Washwater lost

PENETRATION RESISTANCES.

DYNAMIC PENETRATION RESISTANCE : to drive a 2"ϕ, 60° cone attached to the end of the drilling rods into the ground, expressed in blows per foot.

STANDARD PENETRATION RESISTANCE, -N- : to drive a 2" outside dia, split spoon sampler 1 foot into the ground, expressed in blows per foot.

SYMBOL :



EXTRAPOLATED -N- VALUE

The energy for the penetration resistances is supplied by a 140 lb. hammer falling 30 inches

SOIL PROPERTIES.

W %	Water content	γ	Natural bulk density (unit weight)	k	Coeff. of permeability
LL %	Liquid limit	e	Void ratio	C	Shear strength — in terms of total stress
PL %	Plastic limit	RD	Relative density	ϕ	Angle of int. friction — in terms of total stress
PI %	Plasticity index	C_v	Coeff. of consolidation	C'	Cohesion — in terms of effective stress
LI	Liquidity index	m_v	Coeff. of volume compressibility	ϕ'	Angle of int. friction — in terms of effective stress

UNDRAINED SHEAR STRENGTH.

— DERIVED FROM —

TRIAXIAL COMPRESSION TEST; UNCONFINED TEST; LABORATORY VANE TEST; FIELD VANE TEST; POCKET PENETROMETER TEST

St

Strain at failure is represented by direction of stem

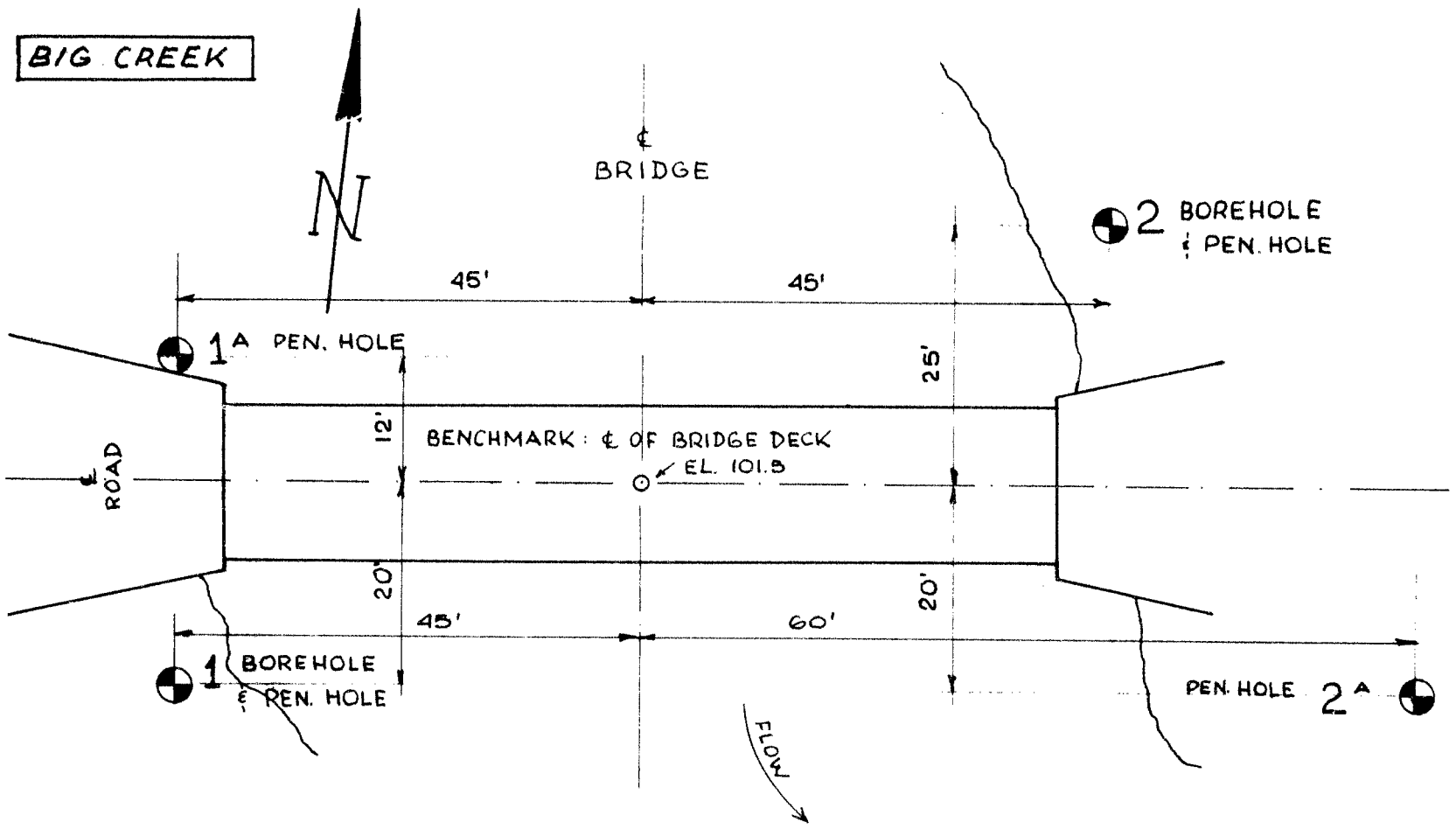
20% 15% 5% 10%

St : sensitivity = $\frac{\text{shear strength in undisturbed state}}{\text{shear strength in remoulded state}}$

SOIL DESCRIPTION.

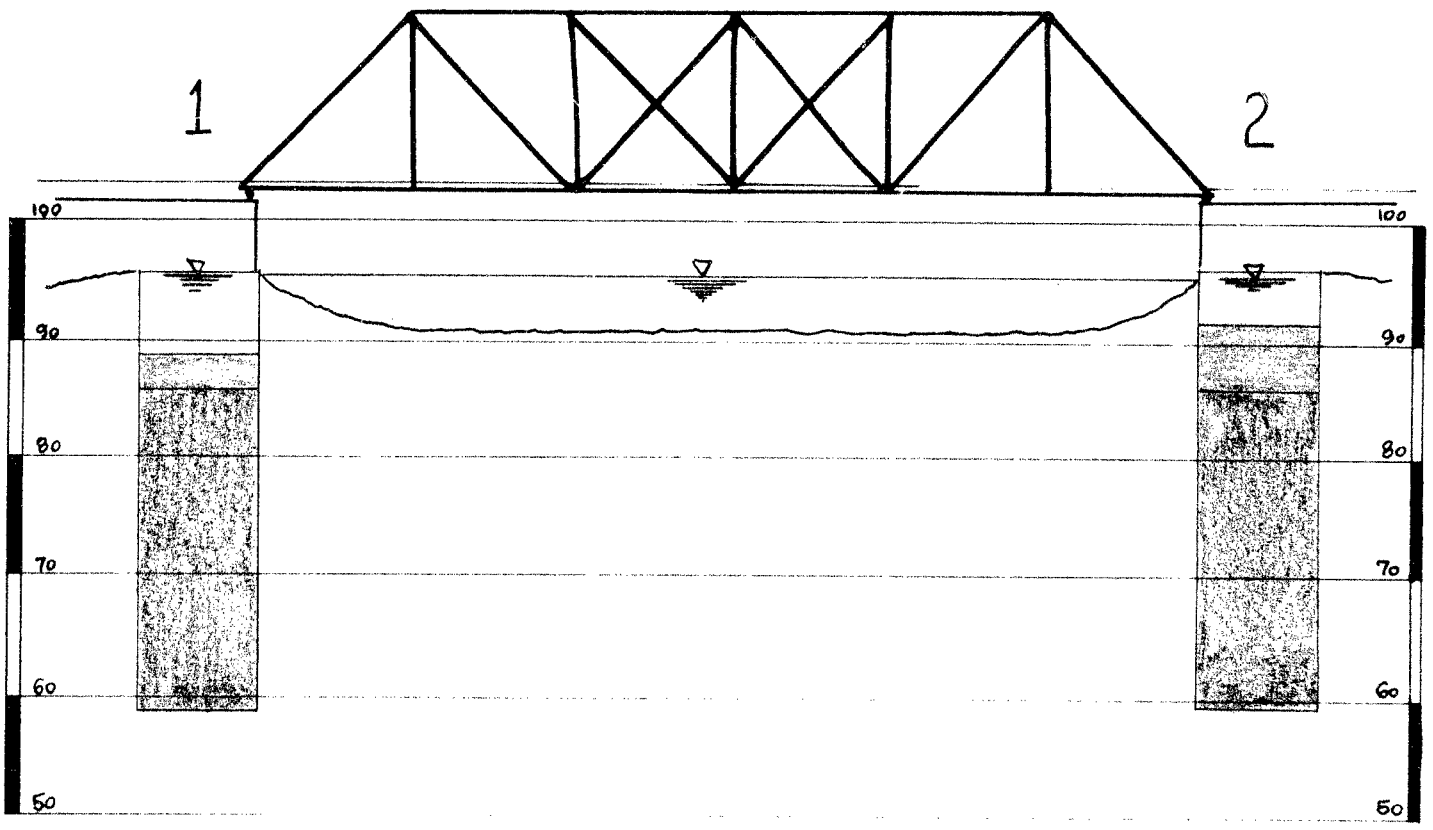
COHESIONLESS SOILS :	RD :	COHESIVE SOILS :	C lbs/sq.ft.
Very loose	0 – 15 %	Very soft	less than 250
Loose	15 – 35 %	Soft	250 – 500
Compact	35 – 65 %	Firm	500 – 1000
Dense	65 – 85 %	Stiff	1000 – 2000
Very dense	85 – 100 %	Very stiff	2000 – 4000
		Hard	over 4000

BIG CREEK



LOCATION OF BOREHOLES

SCALE : 1" TO 15'



LEGEND:

ALLUVIAL SAND

GLACIAL SILTY GRAVEL SAND

HARD SILTY CLAY glacial till

SUBSURFACE PROFILE

SCALE : 1" TO 15'

OUR REF. NO : 2-12-11

ENCLOSURE TWO

DOMINION SOIL INVESTIGATION LIMITED

GEOTECHNICAL DATA SHEET FOR BOREHOLE 1 & CONE 1A

OUR REFERENCE NO. 2-12-11

CLIENT: V.R. ASTROP · CONSULTING ENGINEER
PROJECT: BRIDGE OVER BIG CREEK
LOCATION: BURFORD TOWNSHIP
DATUM ELEVATION: CENTER OF BRIDGE DECK: 101.6

METHODE OF BORING: WASHBORING
DIAMETER OF BOREHOLE: 2 7/8"
DATE: DEC. 7-8, 1962.

ENCLOSURE NO 3

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N or Advancement of Sampler	PENETRATION RESISTANCE blows per foot 0 20 40 60 80 100 / SHEAR STRENGTH lbs/sq ft	CONSISTENCY water content % PL W LL 0 10 20 30 40	REMARKS
95.8	0	SAND loose dense		1	SS	2			
				2	SS	36			
90	5	SILTY GRAVEL SAND very dense		3	SS	60			
				4	SS	72			
85	10			5	SS	56			
				6	SS	62			
80	15	PURPLISH-BROWN HARD SILTY CLAY glacial till occasional silt pockets and layers		7	SS	40			γ = 143 p.c.f.
75	20								
				8	SS	80			
70	25								
				9	SS	38			γ = 142 p.c.f.
65	30								
				10	SS	35			
60	35								

CONE #1
CONE #1A

VERTICAL SCALE: 1 IN. TO 5 FT

DOMINION SOIL INVESTIGATION LIMITED

MADE: MB CH'D: Roello

OUR REFERENCE NO. 2-12-11

GEOTECHNICAL DATA SHEET FOR BOREHOLE 2 & CONE 2A

CLIENT: V·R·ASTROP·CONSULTING ENGINEER
PROJECT: BRIDGE OVER BIG CREEK
LOCATION: BURFORD TOWNSHIP
DATUM ELEVATION: CENTRE OF BRIDGE DECK: 101.5

METHODE OF BORING: WASHBORING
DIAMETER OF BOREHOLE: 2 7/8"
DATE: DEC. 6-7. 1962.

ENCLOSURE NO. 4

ELEVATION ft.	DEPTH ft.	STRATIFICATION DESCRIPTION	STRATIFICATION SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES N - or Advancement of Sampler	PENETRATION RESISTANCE blows per foot 0 20 40 60 80 100 / SHEAR STRENGTH lbs/sq ft	CONSISTENCY water content % PL W LL 10 20 30 40	REMARKS
96.2	0	BROWN SILTY SAND some gravel — loose / compact		1	SS	17			
90	5	VERY DENSE SILTY GRAVEL-SAND slightly cemented conglomerate		2	SS	56			
				3	SS	74			
85	10			4	SS	43			
				5	SS	44			
80	15	PURPLE BROWN SILTY CLAY glacial till occasional silt pockets and layers		6	SS	44			γ = 146 p.c.f.
75	20			7	SS	54			
	25			8	SS	37			
70		— hard / very stiff							
65	30			9	SS	28			γ = 136.5 p.c.f.
60	35			10	SS	15			

CONE # 2
CONE # 2A

VERTICAL SCALE: 1 IN TO 5 FT.

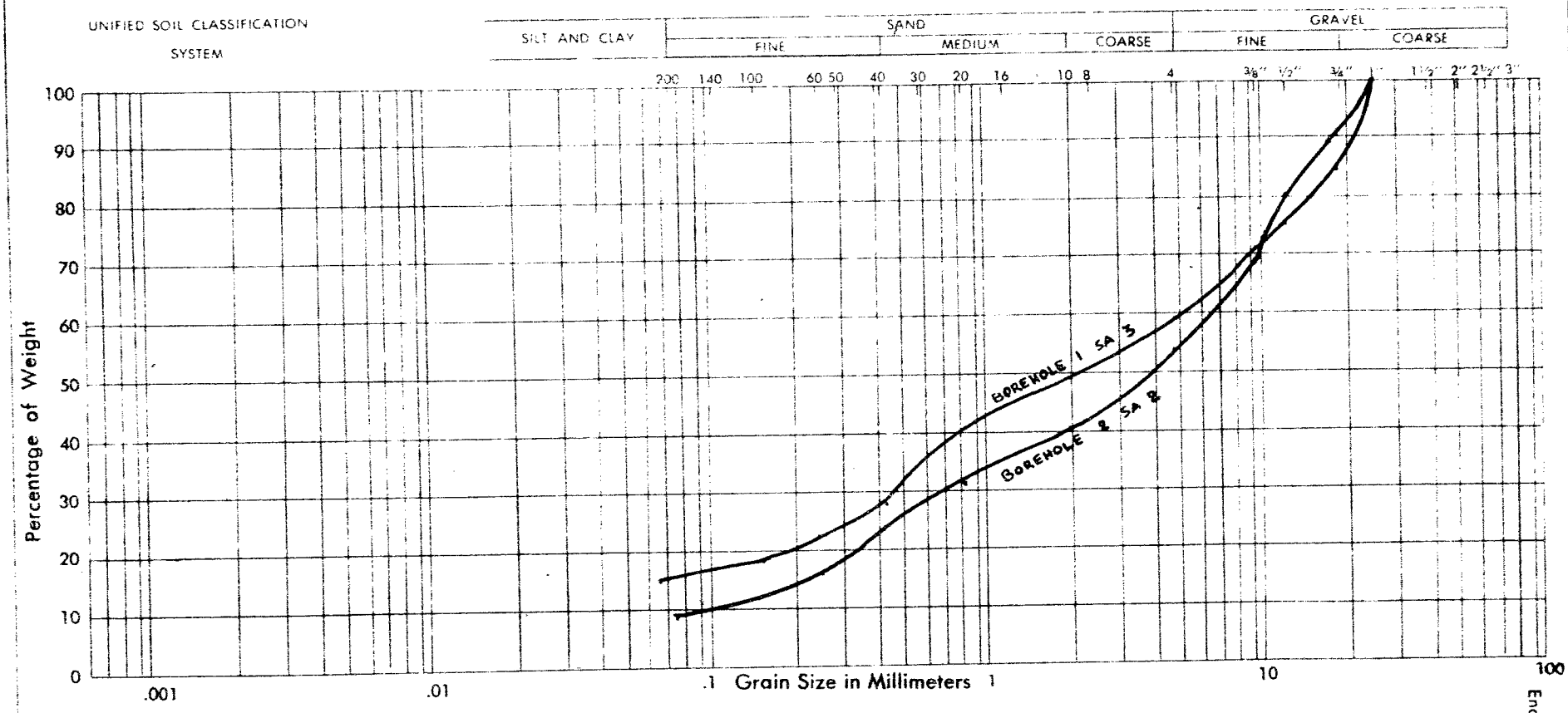
DOMINION SOIL INVESTIGATION LIMITED

MADE: MB CH'D. Rocks

DOMINION SOIL INVESTIGATION LIMITED

GRAIN SIZE DISTRIBUTION

OUR REFERENCE NO 2-12-11



PROJECT: BRIDGE OVER BIG CREEK

LOCATION BURFORD TOWNSHIP

BOREHOLE NO.:	1	2
SAMPLE NO.:	3	2
DEPTH OF SAMPLE:	~8.5'	~6'
ELEVATION OF SAMPLE:	~87.3	~90.2

COEFFICIENT OF UNIFORMITY — NON APPLICABLE

COEFFICIENT OF CURVATURE

Classification of Sample and Group Symbol:

SILTY GRAVEL-SAND

PLASTIC PROPERTIES:

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

Enclosure No. 5.