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GEOCRES No. 40J8-37

W.P. No. 91-60

CONT. No. \_\_\_\_\_

W. O. No. \_\_\_\_\_

STR. SITE No. \_\_\_\_\_

HWY. No. \_\_\_\_\_

LOCATION JEANNETTE CREEK ON  
MARKET RD., 1100 FT. W.  
OF KENT CO. RD. 27

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OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

NONE

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

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WILLIAM A. TROW AND ASSOCIATES LTD.

SITE INVESTIGATIONS  
AND  
SOIL MECHANICS CONSULTATION

BA 954  
4018-37  
ENGINEERING NO.

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Project: J420

October 15, 1959

Mr. A. Rutka,  
Department of Highways of Ontario,  
Materials and Research Branch,  
Parliament Buildings,  
Toronto 5, Ontario.

Attention: Mr. L.G. Soderman, P. Eng.,  
Principal Soils and Foundation Engineer.

Re: Foundation Investigation, Proposed Bridge over  
Jeannette Creek on Market Road - 1100 Ft. West  
of Kent County Road No. 27, W.P. 91-60.

Dear Sirs:

Enclosed herewith is our report on the soil conditions underlying the proposed county road bridge crossing of Jeannette Creek, indicated above.

The soil conditions here are essentially similar to those noted for the other two bridge sites investigated in this vicinity and, as a consequence, no foundation difficulties are anticipated.

Abutment footings must be placed at or below elevation 574 feet in order to provide sufficient overburden protection against frost action and possible river scour. This is about 5 feet below the level of the existing creek channel. The safe bearing value at this depth is 4300 psf. Although the river flow should be quite sluggish in this area some rip-rap cover should be provided to prevent the erosion of the loose backfill of the abutment footing excavations.

We hope that the contents of this report assist you in the design of this structure.

Yours very truly,

W. A. Trow

William A. Trow, P. Eng.

WAT/kb  
ENC.

DEPARTMENT OF HIGHWAYS OF ONTARIO  
MATERIALS AND RESEARCH BRANCH  
PARLIAMENT BUILDINGS, TORONTO, ONTARIO

FOUNDATION INVESTIGATION  
PROPOSED BRIDGE OVER JEANNETTE CREEK  
ON MARKET ROAD - 1100 FT. WEST OF KENT COUNTY ROAD No. 27  
W.P. 91-60

Project: J420

Oct. 15, 1959

William A. Trow & Associates Ltd.

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FOUNDATION INVESTIGATION  
PROPOSED BRIDGE OVER JEANNETTE CREEK  
ON MARKET ROAD - 1100 FT. WEST OF KENT COUNTY ROAD No. 27  
W.P. 91-60

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This report describes the soils investigation carried out at the above site. The type of foundation most suitable for the proposed structure and for the existing soil conditions is outlined. The safe bearing capacity is indicated in this report for the foundation recommended.

Description of Site

A small stream tributary to Jeannette Creek presently flows through the site of the proposed structure. This tributary stream intersects Jeannette Creek a short distance to the north. The surrounding terrain is relatively flat farmland with a surface level at elevation 589 approximately. Jeannette Creek and its tributary have eroded their beds to about elevation 579. A reinforced concrete bridge with a clear opening of 18 feet carries a market road over the stream at the location of the proposed structure.

Banks of the stream are very steep at the existing bridge being in excess of 45° at some locations. The bed and sides of the creek are heavily overgrown and no indications of erosion were observed.

It is proposed to divert Jeannette Creek through the channel presently spanned by the market road bridge. The channel will have to be widened to accommodate peak creek flows. The clear span of the new bridge will probably be from 30 to 40 feet.

Soil Types Encountered

Brown slightly sandy silt was found to exist from ground surface to elevation 581 approximately, at both hole locations. In hole 7 at the site of the north abutment, the more clayey silt extended from elevation 581 feet to 579 feet. Below these levels silty clay to clayey silt containing a small amount of sand with fine to medium gravel sizes was encountered. This glacial drift deposit was proven to elevation 559 by hole 8.

The shallow silt deposit described above is medium dense. The underlying clay-silt stratum is stiff to very stiff. The profile of drawing 1 presents the estimated subsoil stratigraphy outlined above.

The elevation of the natural ground water was not obtained conclusively. Hole 7, which was allowed to remain open for a period of one day after completion, failed to collect any water. It may be concluded from this observation that no seepage problems are to be expected during excavation for the new bridge foundations.

Foundation Considerations

As stated in the foregoing section dealing with the site description the existing creek bed at this location has been eroded to elevation 579 feet. However, observations made at the location of the existing structure to determine conditions of scour would not be applicable to the new bridge. With Jeannette Creek diverted, the flow that will be experienced will be considerably larger. In the absence of hydrographic information on flood levels and information on the size of channel that will be dug, it is impossible to state precisely at what elevation foundations should be placed.

Presumably the existing stream bed elevation 579 feet will be maintained and therefore footings must be placed deep enough below this level to provide protection against frost and scour. It is understood that normal practice by the DHO is to specify a minimum of eight feet of soil cover around bridge footings. Therefore the probable footing level is elevation 571 feet.

Footings placed at or below elevation 574 will bear on stiff silt-clay soil outlined by the strength measurements of boring 8. The shearing resistance at this level is of the order of 1700 psf. A comparison of the natural water content profiles of the two holes suggests that soil of the same consistency exists at the hole 7 location at and below this elevation. The safe bearing capacity of deep spread footings placed at elevation 571 on till, having a shear strength value of 1700 psf, is computed from the expression

$$q_a = \frac{C N_c}{F} + \gamma d$$

- where  $C$  = shear strength of soil beneath the footing = 1700 psf  
 $N_c$  = bearing capacity factor approx. 7 for deep rectangular footings  
 $\gamma d$  = effective weight of the least cover adjacent to the footing;  
 assume scour to elevation 576, footings at elevation 571  
 $d = 5$  feet and  $\gamma = 70$  pcf the submerged weight of soil  
 $F$  = factor of safety = 3

$$\begin{aligned} q_a &= \frac{1700 \times 7}{3} + 70 \times 5 \\ &= 4300 \text{ psf.} \end{aligned}$$

Thus the total weight of the bridge reaction, abutment and foundations must not impart a load in excess of 4300 psf to the soil. This gross bearing value will vary with footing depth.

The soil within the highly stressed zone below the footing is at a natural moisture content very nearly equal to the plastic limit of the material. Because of this fact it can be reasoned that the soil is heavily overconsolidated and therefore is relatively insensitive to normal footing pressures. Experience

indicates that a factor of safety of three ensures that settlements will not exceed a value of 1 inch under these circumstances. Widening the channel will provide a stress relief which may reduce this movement to an even lesser value.

Summary of Comments and Conclusions

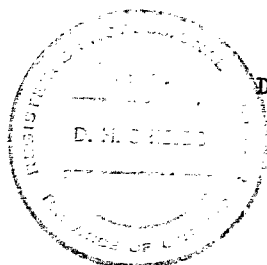
A 10 foot thick deposit of medium dense brown silt extends from the ground surface to a median elevation of 580 feet. Stiff glacial till made up of clayey silt to silty clay with sand and gravel sizes underlies this upper silt.

The invert of the channel, in which Jeannette Creek will flow, will be at elevation 579 approximately. This means that spread footings for the bridge abutment foundations must be placed at or below elevation 574 in order to provide a protective cover against possible frost action or creek bed scour.

Footings placed at or below elevation 574 will bear on stiff till. The safe bearing value of this soil is 4300 psf.

No difficulties with ground water are anticipated during excavation.

DHS/kb  
Oct. 15, 1959  
J420



*DH Shields*

Donald H. Shields, P. Eng.

Description of Field Work

One boring was put down at each abutment location as shown in drawing 1. Continuous flight auger equipment was used to form the boreholes. The holes were 5 inches in diameter and were uncased to full depth.

Samples were recovered at various intervals as the holes progressed. Both disturbed and undisturbed samples were taken depending upon the soil encountered. A standard 2 inch O.D. split spoon was used to recover disturbed soil samples. This sampler was driven into the soil using a hammer transmitting 350 ft.lbs. of energy. The number of hammer blows of this magnitude required to drive the sampler from 6 to 18 inches penetration into the undisturbed soil ahead of the boring was recorded. This numerical value is the penetration resistance of the soil at the sampling depth. On withdrawal the sampler was dismantled and the soil classified and retained in moisture-proof containers.

Relatively undisturbed samples of the soil ahead of the boring were taken with thin-walled Shelby tubes. The tubes were 2 inch inside diameter and they were pushed into the soil on each occasion. On withdrawal, the samples were sealed in the steel tubes and brought into the laboratory.

When the augers were withdrawn prior to each sampling operation, the soil retained in the flights was identified. In this way a continuous record of the subsoil types was made. Careful note was also taken of the ground water conditions in each boring both during the advance of the hole and for a period of time after its completion.

The ground surface at each borehole location was referenced to the centre-line elevation of the existing bridge structure which in turn was referenced to a bench mark in the south root of a 2 ft. maple tree 305 feet right of station 132+82 on proposed Highway 401. The elevation of this benchmark is given as 591.3 feet on DHO Profile F 3533-3.

In addition to the sampling one field vane measurement was made of the shear strength of the cohesive soil in borehole 8. A  $2\frac{3}{4}$  inch diameter four-bladed vane was pushed into the undisturbed soil. The torque required to rotate the vane was recorded. When this value is related to the vane dimensions, the shear strength of the soil can be computed. The soil was then completely remoulded by rotating the vane several times. The ratio of the torque required to rotate the vane in undisturbed and remoulded material is recorded as the sensitivity of the soil to disturbance.

A log showing sampling intervals, the field vane measurement, soils types encountered and water level observations is presented for each boring. Drawings 2 and 3 are the logs for borings 7 and 8 respectively.

Laboratory Testing

Measurement was made of the natural moisture content of each sample taken in the field. Atterberg limit determinations were carried out on selected representative samples. The natural unit weight of the soil was computed from the volume-weight measurements of the Shelby tube samples.

An undrained triaxial test was performed on each 2 inch diameter Shelby tube sample. A cylindrical specimen of soil was surrounded by a confining pressure equal at least to the total pressure existing in the soil at the depth from which the sample was taken. The sample was then failed in axial compression at a constant rate of strain. No drainage of the sample was permitted. The shear strength of the soil was considered to be  $\frac{1}{2}$  of its compression strength.

The results of these laboratory determinations are presented in table 1. The field vane measurement is also recorded here.

Actual stress-strain curves recorded during the triaxial and unconfined tests are presented in drawing 4.

All of the laboratory and field vane measurements are recorded in the borehole logs.

SUMMARY OF LABORATORY AND FIELD TEST RESULTS

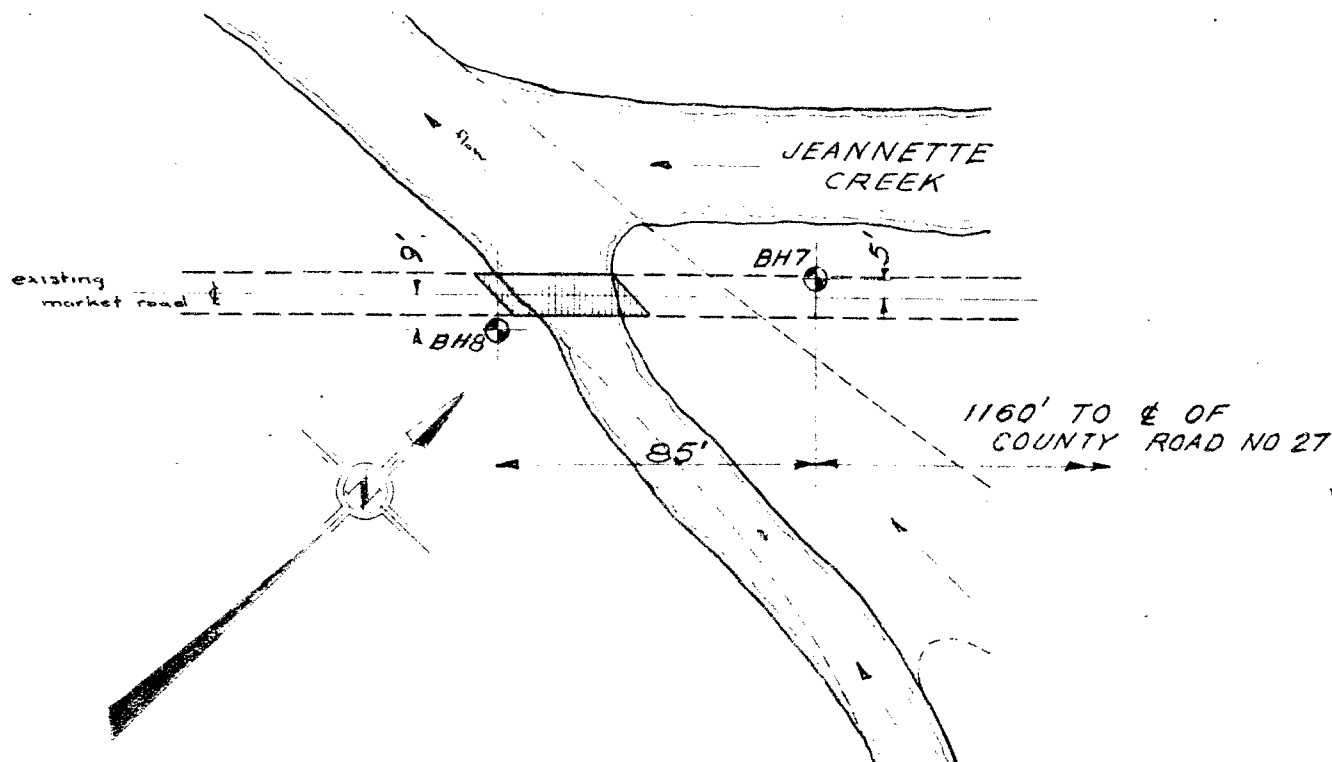
Hole No.	Sample No.	Depth Ft.	Description	Shear Strength		Natural Moisture % dry wt.	Atterberg Limits		Natural Unit Weight pcf
				Field Vane psf	Undrained Triaxial psf*		PL	LL	
7	2	5-6 $\frac{1}{2}$	Brown silt with little organic material.			15.2	16.2	38.7	
	5	19-20 $\frac{1}{2}$	Grey clayey silt, little fine sand and fine to med. gravel sizes.			16.8	16.1	29.1	
8	8	12-13 $\frac{3}{4}$	Brown slightly sandy clayey silt and fine to med. gravel sizes.		1300	22.3			127
		15		2100					
	9	16-17 $\frac{5}{4}$	Grey slightly sandy clayey silt and fine to medium gravel sizes.		1700	17.4			136

Legend

\* Tested at overburden pressure.

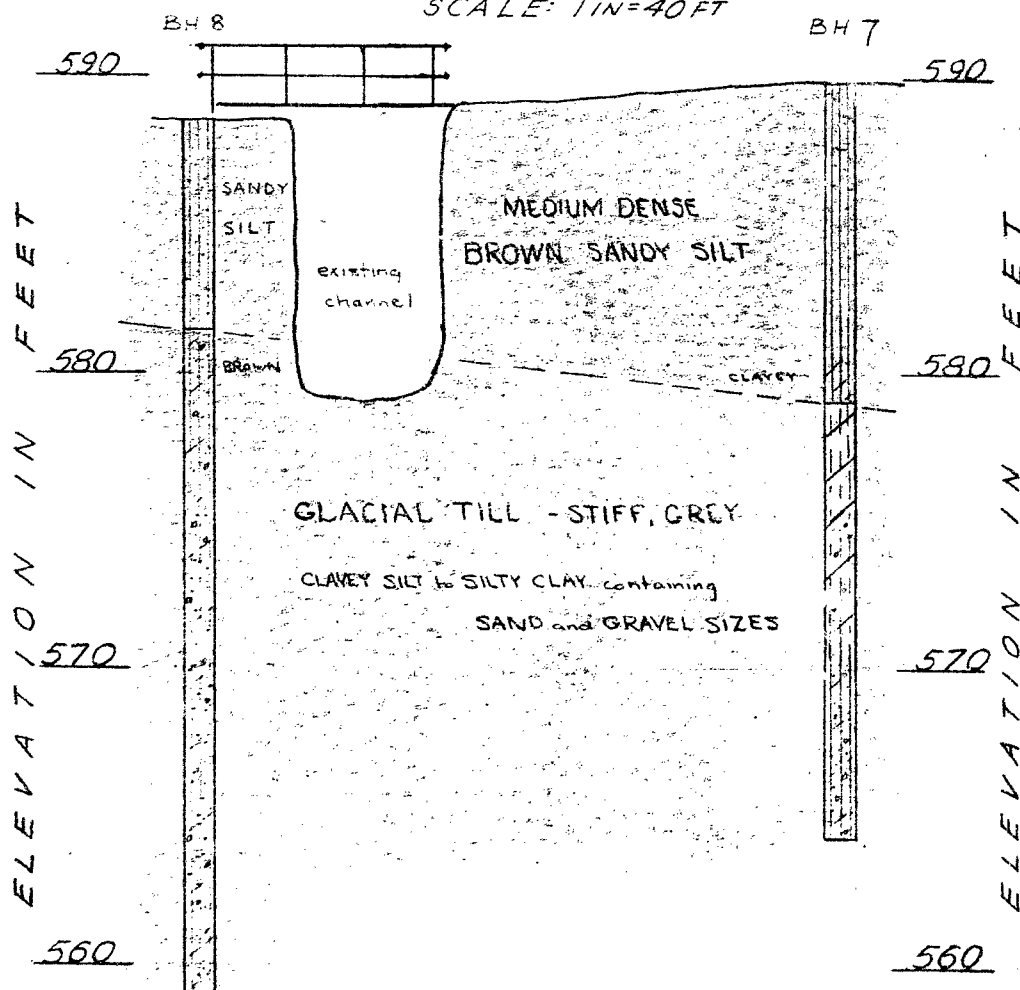
PL = Plastic Limit.

LL = Liquid Limit.



## LOCATIONS OF BOREHOLES

SCALE: 1 IN = 40 FT



PROFILE BETWEEN BH8 & BH7

SCALES: HORIZONTAL 1 IN = 20 FT  
VERTICAL 1 IN = 5 FT

PROJECT NO. J421

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SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

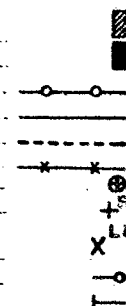
PROJECT Proposed Bridge over Jeannette Creek  
 LOCATION 1100 Ft. W of Bloomfield Rd. W.P. 91-60  
 HOLE LOCATION See diag. No. 1  
 HOLE ELEVATION AND DATUM 589.8 C.L. E. End of  
 existing bridge = 589.0

BOREHOLE NO. 7  
 FIELD SUPERVISOR  
 DRILLER  
 PREP.

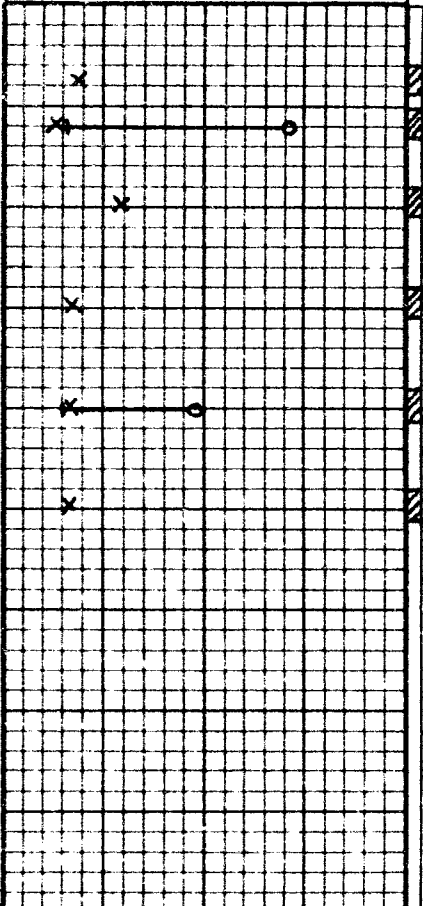
DRAWING NO. 2

## LEGEND

2" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 CASING  
 2" SHELBY  
 1/2 UNCONFINED COMPRESSION (QU)  
 VANE TEST (C) AND SENSITIVITY (SI)  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				Strength	P.S.F.
		589.8	0		
	Brown slightly sandy silt - little organic material at first.				
	Clayey below 9 feet.	579	10		
	Grey silty clay to clayey silt containing little fine sand and fine to medium gravel sizes.		20		
	End of hole.	564.3	30		
	Notes: 1) Hole drilled by continuous flight auger equipment; uncased to full depth. 2) Hammer energy of 350 ft.-lb. used to drive sampler. 3) Hole dry to full depth after 24 hours.				

CONSISTENCY			SAMPLE	NATURAL UNIT WT P. C. F.
MOIST. CONTENT- % DRY WT.				
20	30	40		
 <p>The flowchart consists of a grid with 10 columns and 20 rows. The columns are labeled 20, 30, and 40 at the top. The rows are labeled 1 through 6 on the right side. The data points are as follows:</p> <ul style="list-style-type: none"><li>Row 1: 'x' at column 20.</li><li>Row 2: 'x' at column 20, connected by a horizontal line to a circle at column 40.</li><li>Row 3: 'x' at column 30.</li><li>Row 4: 'x' at column 20.</li><li>Row 5: 'x' at column 20, connected by a horizontal line to a circle at column 30.</li><li>Row 6: 'x' at column 20.</li></ul>			1	
			2	
			3	
			4	
			5	
			6	

PROJECT NO. J421

## WILLIAM A. TROW &amp; ASSOCIATES LTD.

SITE INVESTIGATIONS AND SOIL MECHANICS CONSULTATION

PROJECT Proposed Bridge over Jeanette Creek  
 LOCATION 1100 Ft. W of Bloemfield Rd. W.P. 91-60  
 HOLE LOCATION See dwg. No. 1  
 HOLE ELEVATION AND DATUM 588.4 C.L. End of  
 existing bridge = 589.0

BOREHOLE NO. C  
 FIELD SUPERVISOR  
 DRILLER  
 PREP.

DRAWING NO. 3

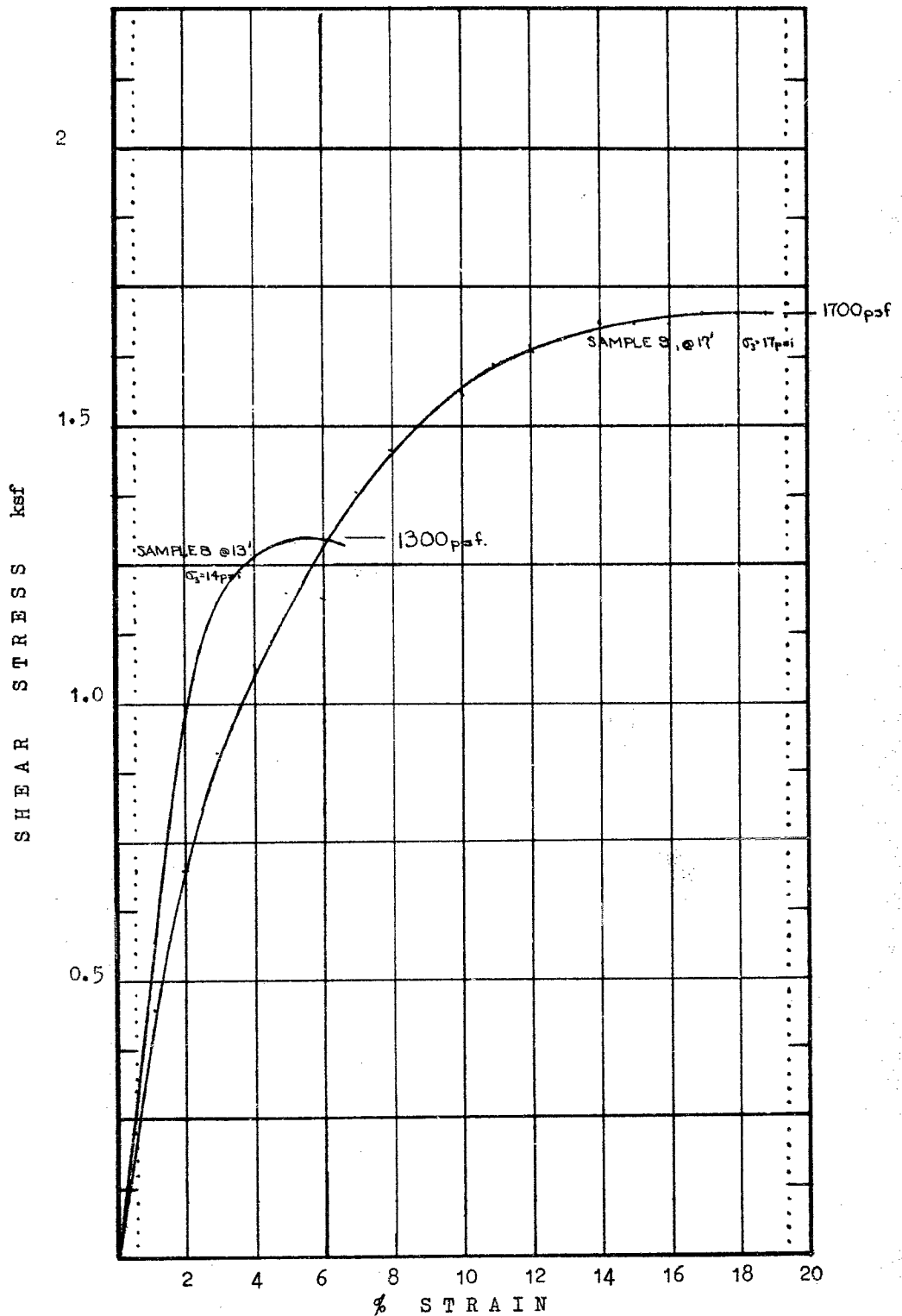
## LEGEND

2" DIA. SPLIT TUBE  
 2" SHELBY TUBE  
 2" SPLIT TUBE  
 2" DIA. CONE  
 CASING  
 2" SHELBY  
 1/2 UNCONFINED COMPRESSION (Qu)  
 VANE TEST (C) AND SENSITIVITY (S)  
 NATURAL MOISTURE AND  
 LIQUIDITY INDEX  
 LIQUID LIMIT  
 PLASTIC LIMIT



SYMBOL	DESCRIPTION	ELEV. FEET	DEPTH FEET	STRENGTH AND PENETRATION RESISTANCE	
				Shear Strength 1000	P.S.F. 2000
				BLOWS/FT.	
				10	20 30 40
	Brown slightly sandy silt and some organic material.	588.4	0		
		581.4	10		
	Brown, turning grey, clayey silt, slightly sandy with fine to med. gravel sizes.		20		
	End of hole.	580.9	30		
	Notes: 1) and 2) as in hole 7. 3) Hole dry on completion.				

CONSISTENCY			SAMPLE	NATURAL UNIT WT. P.C.F.
MOIST. CONTENT- % DRY WT.				
20	30	40		
			1	
			2	
			3	
			4	127
			5	136
			6	
			7	



TRIAXIAL TEST RESULTS - Samples from Hole 8



Looking West Along Market Road  
Existing Bridge over Tributary  
to Jeannette Creek in Middle of Picture