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G.I.-30 SEPT. 1976

GEOCRES No. 40J16-48

DIST. 1 REGION

W.P. No. 43-66-19

CONT. No. 75-27

W. O. No.

STR. SITE No. 14-373

HWY. No. CR

LOCATION Jackson Rd. and Telfer Div.

No. of Pages -

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT.

REMARKS:

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

~~40 J-165~~

GEOCRES No.

TO: Mr. A. P. Watt, (2)
Regional Structural Planning Eng.,
Southwestern Region,
London, Ontario.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION: Mr. S. Jants,
Structural Planning Technician.

DATE: February 14, 1973.

OUR FILE REF.

IN REPLY TO FEB 16 1973

SUBJECT:

40J16-4

GEOCRES No.

FOUNDATION INVESTIGATION REPORT
For
The Proposed Bridge Site 14-373
Jackson Road Bridge Over Telfer Diversion
Channel 0.4 Miles East of Telfer Road
District 1, Chatham
W.O. 72-11126 -- W.P. 43-66-19
CONT. 75-27

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned site.

We believe that the factual data and recommendations contained therein will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attch.
cc: E. J. Orr
B. R. Davis
A. Rutka
A. Wittenberg
F. C. Brown
B. J. Giroux
J. R. Roy
G. A. Wrong
B. A. Singh

Foundations Files
Documents

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
For
The Proposed Bridge Site 14-373
Jackson Road Bridge Over Telfer Diversion
Channel 0.4 Miles East of Telfer Road
District 1, Chatham
W.O. 72-11126 -- W.P. 43-66-19

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1. *INTRODUCTION:*

A foundation investigation was undertaken for the proposed Jackson Road Bridge over Telfer Diversion Channel. The proposal consists of a two-lane, three-span structure. On receiving a request from Mr. S. Jants, Structural Planning Technician for the Southwestern Region, dated October 31, 1972, a field and laboratory investigation was undertaken by this Office so as to determine the existing subsoil and groundwater conditions at the proposed crossing. Presented in this report are the results of the investigation, together with recommendations concerning the structure's foundations.

2. *DESCRIPTION OF SITE:*

At the proposed crossing the area is very flat. There are fields on both sides of Jackson Road. A number of farm buildings are on the north side. To the southeast of the site there is a golf course, Greenwood Golf Club. To the southwest there is a well treed bush area. The corn field immediately to the south of the proposed crossing is drained by tiles and as a result the ditch on the south of Jackson Road has about a foot of water in it at all times. The ditch is approximately 4 feet deep.

Geologically, the site is part of the physiographic region known as the St. Clair Clay Plain. The region is one of

.....2

little relief with a deep deposit of clay. At the site the clay is some 130 feet deep. Most of Lambton County is essentially till plains smoothed by shallow deposits of lacustrine clay which settled in the depressions while the knolls were being lowered by wave action.

3. *FIELD WORK AND LABORATORY INVESTIGATION:*

The field work consisted of three sampled boreholes and nine dynamic cone tests, three of the cones being adjacent to the boreholes. The drilling was done by a Bombardier mounted C.M.E. equipped with hollow stem augers. The bedrock in B.H. #1 was cored by a second C.M.E. using NX casing and a BX core barrel. Samples were obtained by using a split spoon sampler, which was hammered into the soil in accordance with specifications for the Standard Penetration Test. The resulting penetration "N" values were recorded. Thin walled, 21 inch I.D. Shelby tube soil samples were obtained either by advancing the Shelby hydraulically or manually. In situ shear strength was measured using an M.T.C. vane. All field and laboratory test results are recorded on the accompanying borelog sheets.

Soil samples were identified in the field and again upon arrival in the laboratory. Laboratory tests to determine moisture content, grain size and Atterberg Limits were carried out on representative samples. The soil samples obtained from the Shelby tubes were subjected to unconfined compression, quick triaxial, and consolidation tests.

The groundwater levels across the site were determined by recording the water levels in the open boreholes over the period of the investigation.

The locations and elevations of the boreholes as well as a stratigraphical profile are plotted on Drawing 72-11126A attached at the end of this report. The surveying of the site was carried out by personnel from the Southwestern Region Engineering Surveys Section.

4. *SUBSOIL CONDITIONS:*

....3

4.1) General:

Generally, uniform subsoil conditions were found to prevail over the site. The subsoil consists of a deep deposit of cohesive material overlying bedrock. The two main layers samples were clayey silt, some sand and traces of gravel and silty clay, some sand and traces of gravel. A summary of each is given below.

4.2) Clayey Silt, Some Sand and Traces of Gravel:

This deposit was found to extend some 50 to 64 feet below the ground level corresponding to elevations 546 and 534 feet. Standard penetration "N" values within this layer varied between 9 and 54 blows per foot. Laboratory grain size analyses yielded the following results:

Gravel	0 - 7%
Sand	14 - 32%
Silt	33 - 55%
Clay	23 - 65%

The following average physical properties were obtained from field and laboratory tests:

Natural Moisture Content (%)	11 - 22
Liquid Limit (%)	26.5 - 34
Plastic Limit (%)	15 - 19
Bulk Density (p.c.f.)	129 - 134

Undrained Shear Strength

Field Vane (p.s.f.)	580 - 2,000
Unconfined Compression Test (p.s.f.)	625 - 1565
Triaxial Compression Test (p.s.f.)	600 - 1470

Based on the foregoing the consistency of this deposit is estimated to be firm to hard. A typical grain size envelope is included in the Appendix as Fig. 1.

4.3) Silty Clay, Some Sand and Traces of Gravel:

This deposit is below the clayey silt and extends to the bedrock. At its thickest it is some 80 feet deep extending to elevation 466, some 126 feet below the ground surface. Standard

penetration "N" values range between 15 and 41 blows per foot. Laboratory grain size analyses yielded the following results:

Gravel	3 - 9%
Sand	11 - 13%
Silt	46 - 52%
Clay	32 - 40%

The following average physical properties were obtained from field and laboratory tests:

Natural Moisture Content (%)	18 - 36
Liquid Limit (%)	33 - 43.5
Plastic Limit (%)	17 - 25
Bulk Density (p.c.f.)	121.5 - 130
Undrained Shear Strength	
Field Vane (p.s.f.)	650 - 2000
Unconfined Compression Test (p.s.f.)	560 - 3070
Triaxial Compression Test (p.s.f.)	465 - 2715

Based on the foregoing the consistency of this deposit is estimated to be firm to hard. A typical grain size envelope is included in the Appendix as Fig. 2.

4. 4) Bedrock:

A brief description by Mr. K. W. Ingham, Geologist, is given below for the borehole drilled into bedrock at this site, together with the appropriate bedrock elevations.

Hole No. 1 Bedrock at 466.6

466.6 to 471.6 limestone; medium grey, shaley fine grained, generally medium bedded.

5. GROUNDWATER CONDITIONS:

The following groundwater levels were observed during the field investigation:

B.H. #1	Elevation 585.2
B.H. #6	Elevation 568.7

These levels may not be representative of actual groundwater levels due to the relative impermeable nature of the subsoil and the short duration of the field work.

.....5

6. *DISCUSSION AND RECOMMENDATIONS:*

6.1) *General:*

It is proposed to build a three-span (41.8' - 60' - 41.8') structure at the Jackson Road and Telfer Channel Diversion. The profile grade of Jackson Road is not to change and will remain at elevation 597. The base of the channel will be at elevation 575±.

The subsoil at this site consists of a deep deposit of clayey silt and silty clay. The upper 9 to 12 feet is a very stiff to hard desiccated surface crust. Below the crust the undrained shear strength of the material decreased until a minimum value of about 600 p.s.f. is reached, then increases again with depth, with some random variation.

Because of the compressible nature of the subsoil, it is inevitable that consolidation settlements will occur over a long term period due to the imposed loads of the structure. Past experience, however, indicated that these settlements will be of a minor nature.

6.2) *Structure Foundations:*

a) *Spread Footings:*

The entire structure may be supported on spread footings. A safe net pressure of 1.5 t.s.f. may be assumed for design purposes. The abutments may be placed at elevation 586 and the piers at elevation 569.

Settlements at the abutments and piers were calculated to be in the order of 1.5 to 2.0 inches. It is recommended that the structure be built to accommodate 1.0 inch differential settlement between the abutments and piers. The foundations should be protected against undermining by scour. The depth of scour may be obtained from the Hydrology Office.

The subsoil is susceptible to softening on contact with water; therefore, it is recommended that the base of the footing excavations be protected by a concrete working slab, immediately

....6

on exposure.

b) Pile Foundation:

The proposed structure footings may be founded on timber piles (treated if not completely below the groundwater level) driven to the elevation necessary to achieve the required pile capacity. In determining the safe capacity of a timber pile, the following equation may be used.

Q = 0.5 L (Tons)

Q = Safe capacity of one pile

L = Embedded length in original ground (ft.)

Maximum settlements for the pile groups were calculated to be in the order of 1.5 inches. It is recommended that the structure be built to accommodate a 1.0 inch differential settlement between abutments and piers.

As a second alternative, the structure footings may be supported on steel H-piles driven to bedrock, utilizing the maximum allowable design load for the particular steel section adopted.

All footings and/or pile caps should be protected against frost action by at least 4 feet of earth cover.

No major dewatering problems are anticipated because of the relatively impervious nature of the subsoil.

6.3) Channel Slopes:

It is recommended that the proposed channel be constructed with 2:1 slopes and be protected against scour action in the vicinity of the new structure.

7. MISCELLANEOUS:

The field work was carried out from November 22 to November 29, 1972, and was supervised by Mr. P. Korgemagi, Project Foundations Engineer.

The equipment used was owned and operated by P.V.K. & Sons Drilling Ltd., Burford, Ontario.

.....7

This report was written by Mr. P. Korgemagi and reviewed by Mr. K. G. Selby, Supervising Foundations Engineer.

P. Korgemagi

P. Korgemagi, P. Eng.

K. G. Selby

K. G. Selby, P. Eng.

PK/ao
February 13, 1973.

APPENDIX I

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 1

JOB 72-11126 — LOCATION Sta. 99 + 28 o/s 17' Lt. ℄ Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 23 to 28, 1972 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Auger, Washboring & Cone Test — CHECKED BY

OFFICE REPORT – SOIL EXPLORATION

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
596.2	Ground Level					
0.0	Brown		1	SS	22	590
			2	SS	46	
			3	SS	40	
			4	SS	22	
581.2			5	SS	14	
15.0	Grey Clayey silt Some sand Traces of gravel		6	TW	PH	580
			7	SS	17	
			8	TW	PH	570
			9	TW	PH	
			10	SS	19	560
	Stiff to hard		11	SS	25	
546.2			12	SS	12	550
50.0			13	TW	PM	
	Silty clay Some sand Traces of gravel		14	SS	18	540
	Very stiff to hard		15	TW	PH	530
			16	SS	26	520
			17	SS	31	510
			18	SS	24	500

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 25 50 75 100 125

SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE — 1000 2000

LIQUID LIMIT W_L — PLASTIC LIMIT W_P — WATER CONTENT W — WATER CONTENT % 10 20 30

BULK DENSITY γ P.C.F.

BULK DENSITY	REMARKS GR. SA. SI. CL.
	1 25 46 28
130 129	
	7 32 36 25
123 121.5	3 13 44 40
	3 13 52 32

Continued

15 20 10 ⊙ 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 1 Continued

JOB 72-11126 — LOCATION Sta. 99 + 28 o/s 17' Lt. ℄ Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 23 to 28, 1972 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Auger, Washboring & Cone Test — CHECKED BY

SOIL PROFILE ELEV./DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT 25 50 75 100 125; SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 1000 2000	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT % 10 20 30	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
						490				
			19	SS	29			○		
						480				
			20	SS	15	470		⊕		
466.6			21	SS	100/5"					
129.6	Shaly Sound Limestone Bedrock		22	RC BX	90%					
461.2										
135.0	End of B.H.									

OFFICE REPORT SOIL EXPLORATION

15 20 10 5 % STRAIN AT FAILURE

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 2

JOB 72-11126 — LOCATION Sta. 99 + 70 o/s 17' Lt. Ø Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 23, 1972 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Cone Test — CHECKED BY

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE			
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BLOWS / FOOT: 25 50 75 100 125 SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P — w — w_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
596.5	Ground Level									
0.0						590				
						580				
572.5										
24.0	End of Cone Test									

OFFICE REPORT ● SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 3

JOB 72-11126 — LOCATION Sta. 100 + 30 o/s 17' Lt. ℄ Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 23 and Nov. 29, 1972 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Cone Test — CHECKED BY [illegible]

SOIL PROFILE			SAMPLES				DYNAMIC PENETRATION RESISTANCE			
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	BLOWS / FOOT — 25 50 75 100 125	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
596.6	Ground Level						SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE	W_P — W — W_L WATER CONTENT %		
0.0						590				
						580	Start			
						570				
559.8						560				
36.8	End of Cone Tests									

OFFICE REPORT ON SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 4

JOB 72-11126 — LOCATION Sta. 100 + 72 o/s 17' Lt. ℄ Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 22, 1972 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Cone Test — CHECKED BY [illegible]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 25 50 75 100 125; SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w w_P w w_L WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT					
596.4	Ground Level									
0.0						590				
585.5										
12.9	End of Cone Test									

OFFICE REPORT ● SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 5

JOB 72-11126 — LOCATION Sta. 99 + 28 o/s 14' Rt. ℄ Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 22, 1972 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Cone Test — CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 25 50 75 100 125 — SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
596.7	Ground Level									
0.0						590				
584.8										
11.9	End of Cone Test									

OFFICE REPORT — SOIL EXPLORATION

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 6

JOB 72-11126 — LOCATION Sta. 99 + 70 o/s 14' Rt. Ø Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 27 to 28, 1972 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Auger & Cone Test — CHECKED BY [illegible]

OFFICE REPORT - SOIL EXPLORATION

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT (25 50 75 100 125); SHEAR STRENGTH P.S.F. (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (1000 2000)	LIQUID LIMIT W_L, PLASTIC LIMIT W_P, WATER CONTENT W (W_P W W_L); WATER CONTENT % (10 20 30)	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL
596.7	Ground Level									
0.0			1	SS	20					
						590				3 31 43 23
			2	SS	52					
	Brown									
			3	SS	27					
	Very stiff to hard					580				
			4	SS	21					
576.7							> + 2000			
20.0			5	TW	PH				130	
						570				3 13 44 40
			6	SS	20					
			7	TW	PH				130	
									130	
	Clayey silt Some sand Traces of gravel Grey					560				
			8	SS	28					
			9	TW	PH				130.5	
									130.5	
						550				1 19 55 25
			10	SS	9					
	Stiff to very stiff									
			11	TW	PH				126.5	
									127	
						540				0 2 33 65
			12	SS	10					
534.7										
62.0										
			13	TW	PH	530			130	
	Silty clay Some sand Traces of gravel								128.5	
	Very stiff to hard					520				
			14	SS	31					
	Grey									
						510				
			15	SS	27					
498.2						500				9 11 46 34
			16	SS	11					
98.5	End of B.H.									
492.7										
104.0	End of Cone Test									

20
15 ◇ 5 % STRAIN AT FAILURE
10

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS – ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE Nº 7

JOB 72-11126 — LOCATION Sta. 100 + 30 o/s 11' Rt. Ø Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 22/72 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Cone Test — CHECKED BY

SOIL PROFILE ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 25 50 75 100 125 / SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	LIQUID LIMIT W_L / PLASTIC LIMIT W_P / WATER CONTENT W / W_P W W_L / WATER CONTENT %	BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
596.7	Ground Level									
0.0						590				
583.8										
12.9	End of Cone Test									

20
15 ◇ 5 % STRAIN AT FAILURE
10

OFFICE REPORT / SOIL EXPLORATION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS - ONTARIO

DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

RECORD OF BOREHOLE No 8

JOB 72-11126 — LOCATION Sta. 100 + 72 o/s 14' Rt. ℄ Jackson Rd. — ORIGINATED BY PK

W.P. 43-66-19 — BORING DATE Nov. 29, 1972 — COMPILED BY PK

DATUM Geodetic — BOREHOLE TYPE Auger & Cone Test — CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	REMARKS	BULK DENSITY γ P.C.F.	GR.SA.SI.CL
596.5	Ground Level								
0.0			1	SS	20	Dry Hole			
			2	SS	46	590			
			3	SS	54				
	Brown		4	SS	21				1 15 41 43
			5	SS	19				
580.5			6	TW	PH	580		134	
16.0			7	SS	13				5 17 44 34
	Grey Clayey silt Some sand Traces of gravel					570			
			8	TW	PM			129 129	
	Stiff to Hard		9	SS	15				3 14 48 35
			10	TW	PM	560		130 130.5	
			11	SS	21				
						550			
			12	TW	PM				
						540			
532.5			13	SS	48				
64.0	End of B.H.								

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 25 50 75 100 125

SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE — 1000 2000

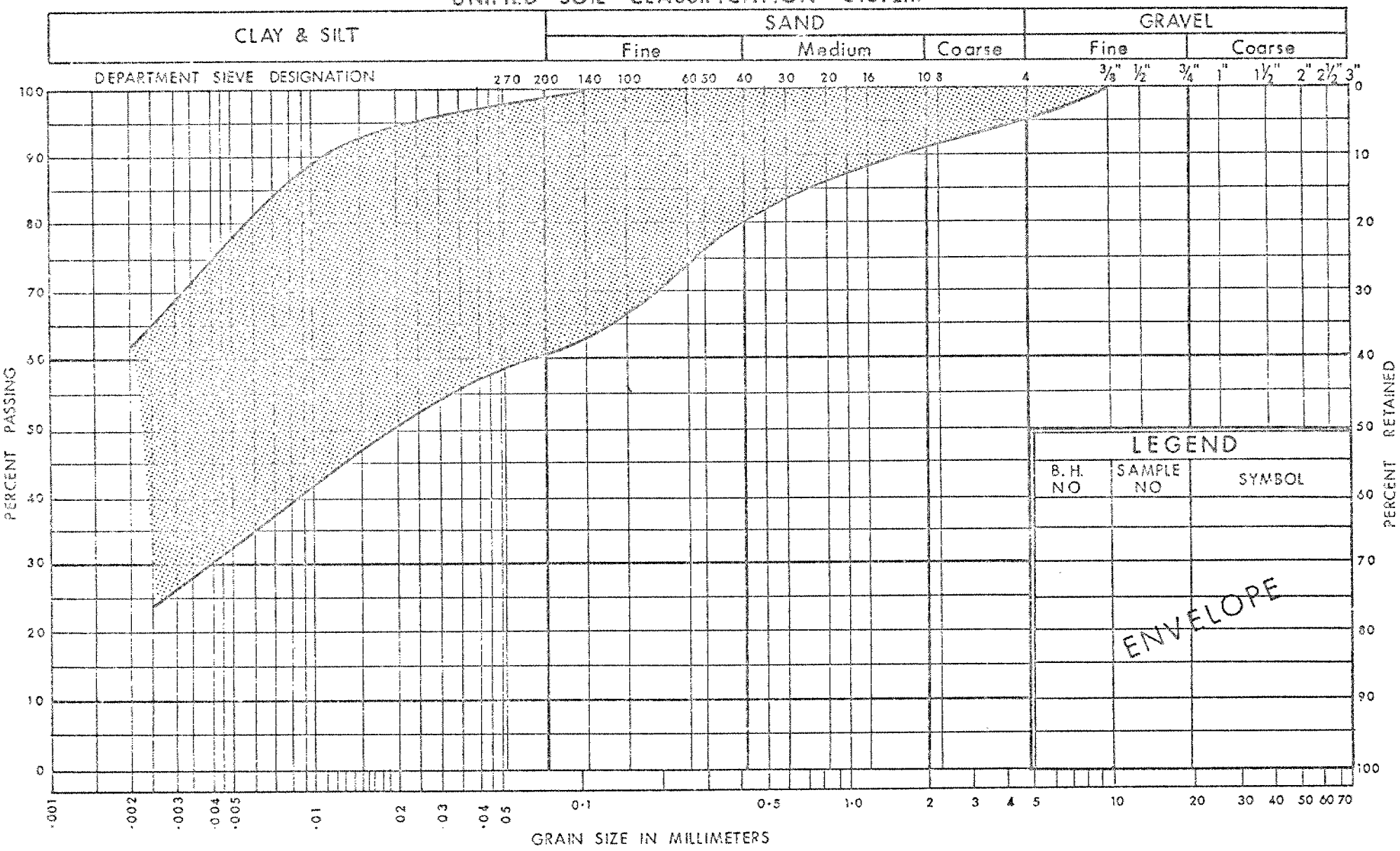
LIQUID LIMIT w_L — PLASTIC LIMIT w_P — WATER CONTENT w — WATER CONTENT % 10 20 30

OFFICE REPORT ● SOIL EXPLORATION

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM 01 MT-37
REV. APR. 1965

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

CLAYEY SILT

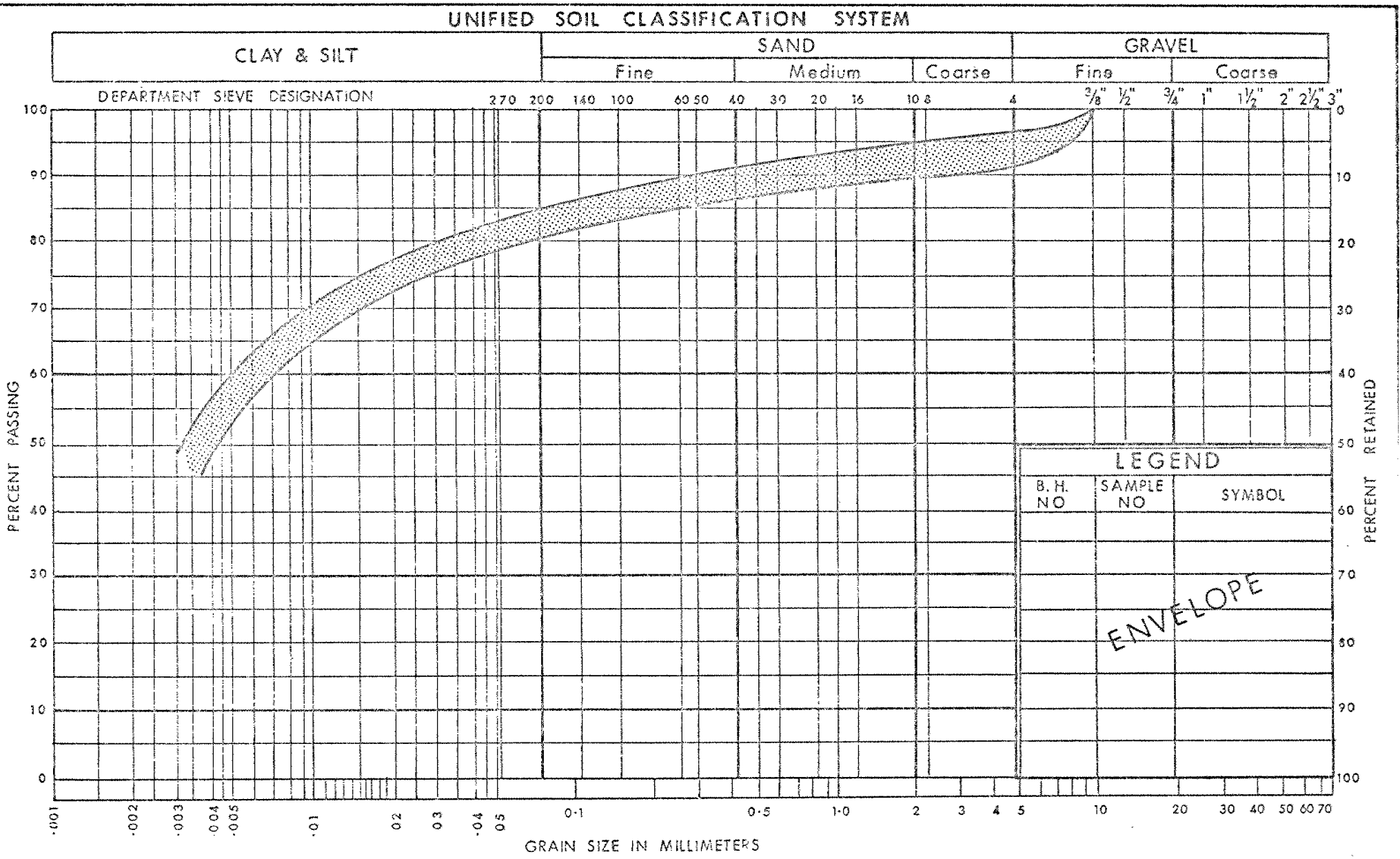
SOME SAND, TRACES OF GRAVEL

W.P. No. 43-66-19

JOB No. 72-11126

FIG. NO. 1

FORM CS MT-17
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

SILTY CLAY

SOME SAND, TRACES OF GRAVEL

W.P. No. 43-66-19

JOB No. 72-11126

FIG. NO. 2

FD-9a (Rev. Jan. 73)

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

PENETRATION RESISTANCE

'N'= STANDARD PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A STANDARD SPLIT SPOON SAMPLER 12 INCHES INTO THE SUBSOIL, DRIVEN BY MEANS OF A 140 POUND HAMMER FALLING FREELY A DISTANCE OF 30 INCHES.

DYNAMIC PENETRATION RESISTANCE :- THE NUMBER OF BLOWS REQUIRED TO ADVANCE A 2 INCH, 60 DEGREE CONE, FITTED TO THE END OF DRILL RODS, 12 INCHES INTO THE SUBSOIL. THE DRIVING ENERGY BEING 350 FOOT POUNDS PER BLOW.

DESCRIPTION OF SOIL

THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE DENSITY OR DENSENESS OF COHESIONLESS SOILS ARE DESCRIBED IN THE FOLLOWING TERMS :-

CONSISTENCY	c LB./SQ.FT.
VERY SOFT	0 - 250
SOFT	250 - 500
FIRM	500 - 1000
STIFF	1000 - 2000
VERY STIFF	2000 - 4000
HARD	> 4000

DENSENESS	'N' BLOWS / FT.
VERY LOOSE	0 - 4
LOOSE	4 - 10
COMPACT	10 - 30
DENSE	30 - 50
VERY DENSE	> 50

TERMS TO BE USED IN DESCRIBING SOILS :-

TRACE < 10% , SOME 10-25 % , WITH 25-40 % , > 40 % SILTY, SANDY, GRAVELLY, CLAYEY ETC.

TYPE OF SAMPLE

S.S.	SPLIT SPOON	T.W.	THINWALL OPEN
W.S.	WASHED SAMPLE	T.P.	THINWALL PISTON
S.T.	SLOTTED TUBE SAMPLE	O.S.	OESTERBERG SAMPLE
A.S.	AUGER SAMPLE	F.S.	FOIL SAMPLE
C.S.	CHUNK SAMPLE	R.C.	ROCK CORE

P.H. SAMPLE ADVANCED HYDRAULICALLY

P.M. SAMPLE ADVANCED MANUALLY

SOIL TESTS

U	UNCONFINED COMPRESSION	L.V.	LABORATORY VANE
UU	UNCONSOLIDATED UNDRAINED TRIAXIAL	F.V.	FIELD VANE
CIU	CONSOLIDATED ISOTROPIC UNDRAINED TRIAXIAL	C	CONSOLIDATION
CID	" " DRAINED "	S	SENSITIVITY
CAU	" ANISOTROPIC UNDRAINED "		
CAD	" " DRAINED "		

FD-9b (Rev. Jan. 73)

ABBREVIATIONS & SYMBOLS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_P	PLASTIC LIMIT
I_P	PLASTICITY INDEX
w_S	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_P}{I_P}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_P}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma'}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma'}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION INTERCEPT
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

GENERAL

π	= 3·1416
e	BASE OF NATURAL LOGARITHMS 2·7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
σ'	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ε	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

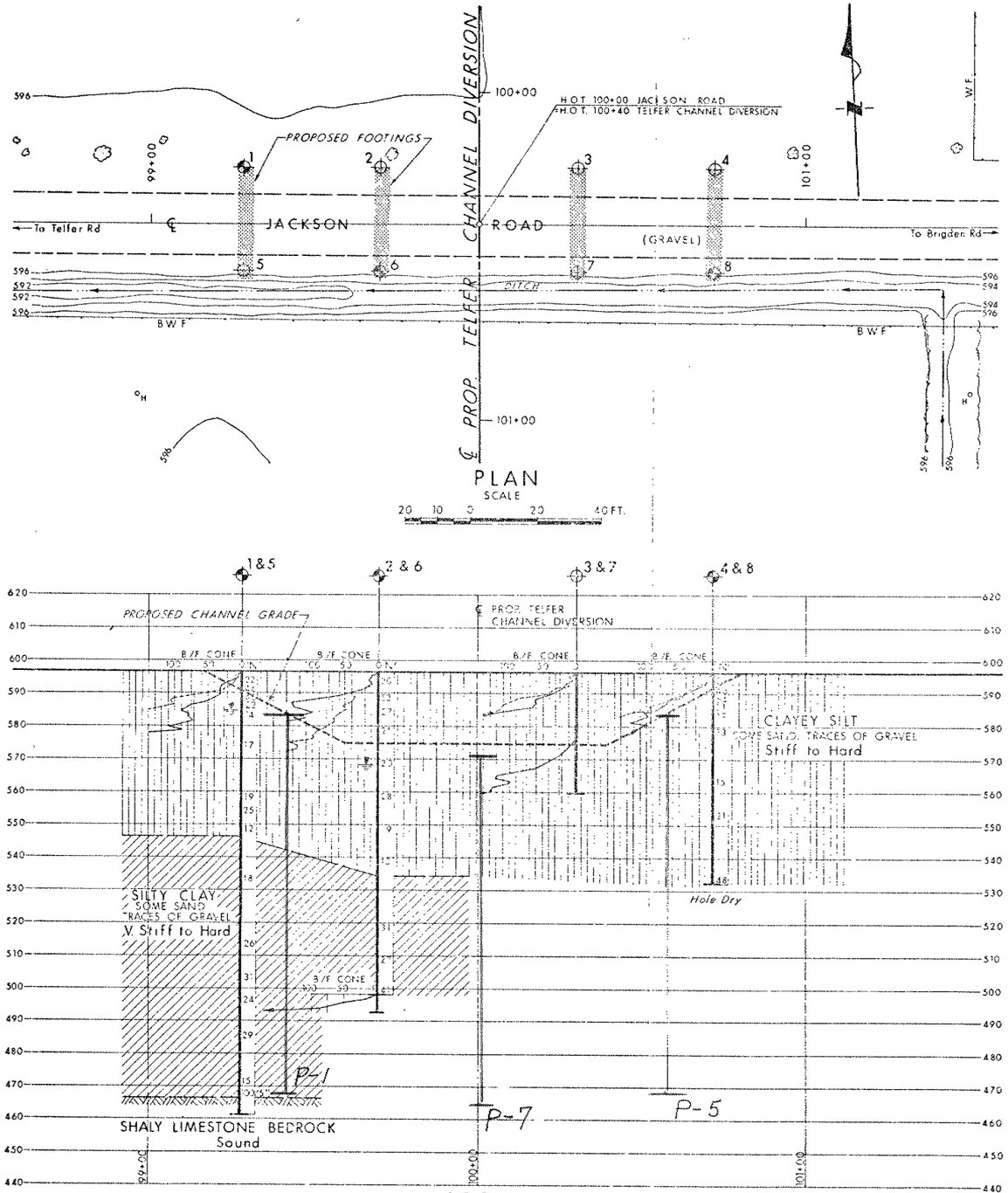
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

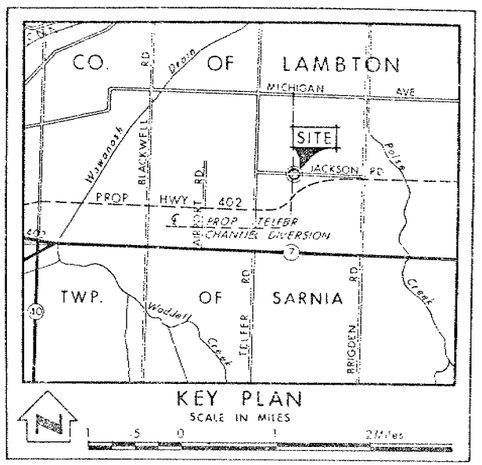
FOUNDATIONS

B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL





LEGEND

- Bore Hole
- Cone Penetration Test
- Bore Hole & Cone Test
- Water Levels established at time of field investigation Nov. 1972

NO.	ELEVATION	STATION	OFFSET
1	596.2	99+28	17' LT.
2	596.5	99+70	17' LT.
3	596.6	100+30	17' LT.
4	596.4	100+72	17' LT.
5	596.7	99+28	14' RT.
6	596.7	99+70	14' RT.
7	596.7	100+30	14' RT.
8	596.5	100+72	14' RT.

— NOTE —

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence

REVISIONS		
DATE	BY	DESCRIPTION

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS ONTARIO
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

JACKSON ROAD & TELFER CHANNEL DIVERSION

HIGHWAY NO _____ DIST. NO. 1
CO LAMBTON
TWP. SARNIA LOT 9 CON VII & VIII

BORE HOLE LOCATIONS & SOIL STRATA

SUBMD P.K.	CHECKED P.K.	W.P. NO. 43-66-19	DRAWING NO. 72-11126A
DRAWN G	CHECKED	W.O. NO 72-11126	
DATE Jan 29, 1973		SITE NO. 76-373	BRIDGE DRAWING NO
APPROVED PRINCIPAL FOUNDATION ENGINEER		CONT NO	

REF NO E-5335-1

SHORTRACE 300-6-72