

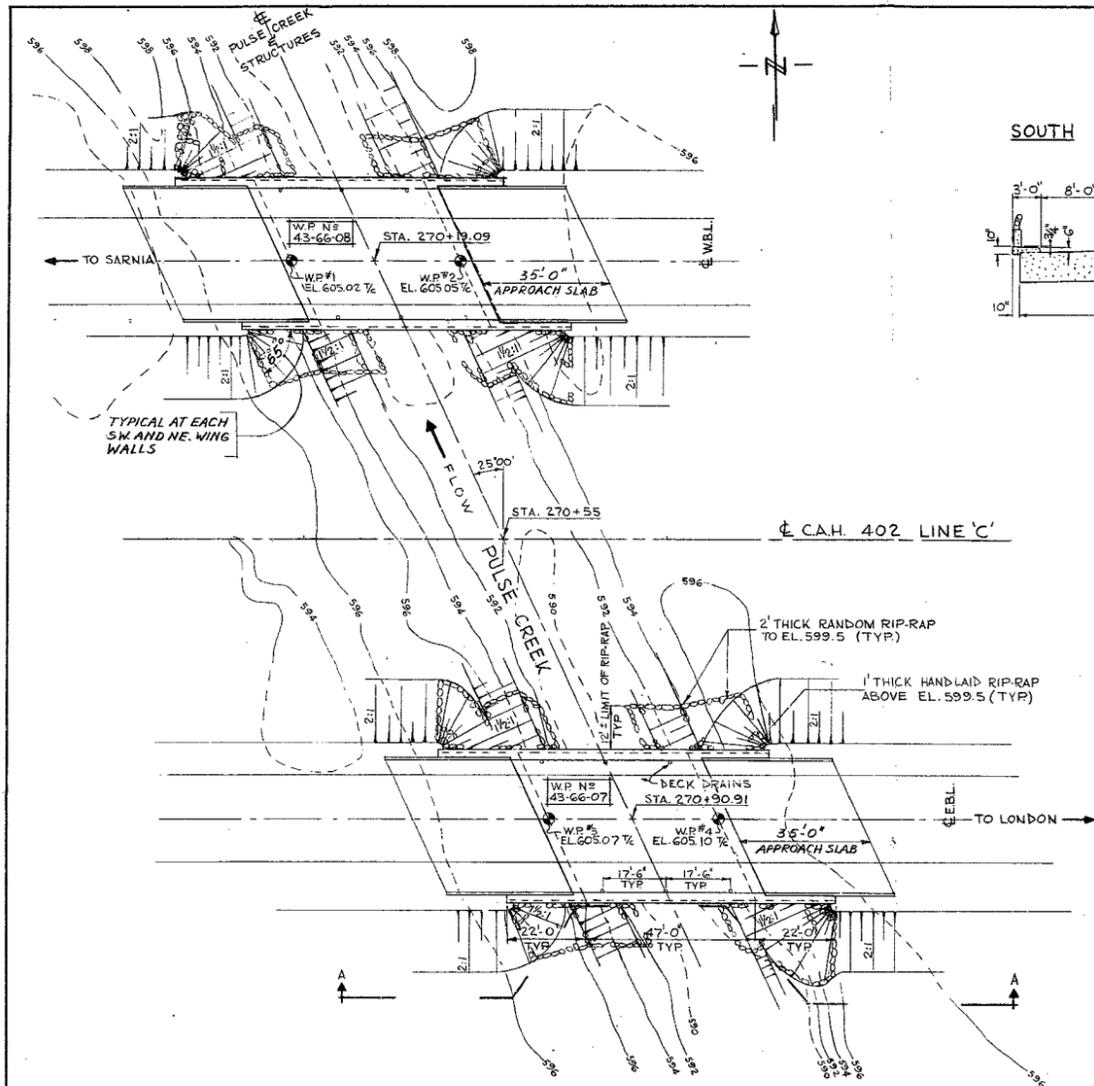
69-F-94

W.P. 43-66-07 AND 08

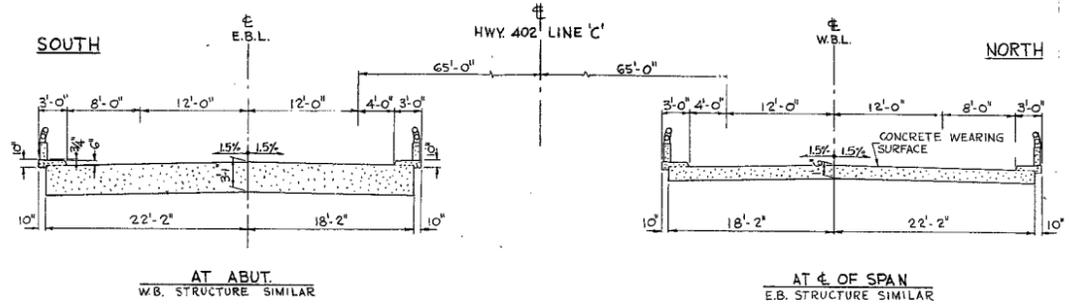
H.W.Y. #402, LINE 'C,'

AND CAH.

PULSE CREEK



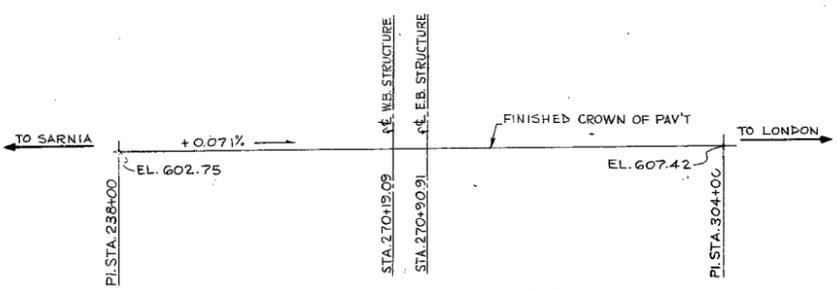
PLAN
SCALE: 1" = 20'-0"



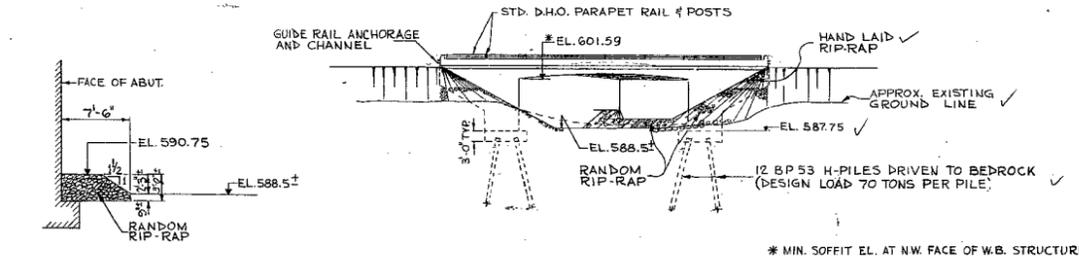
TYPICAL DECK SECTION
SCALE: 1/8" = 1'-0"

NOTE:
T/C DENOTES ELEVATIONS ARE SHOWN TO TOP OF CONCRETE WEARING SURFACE.
W/P DENOTES WORKING POINT.

25°00' SKEW
SIN. 0.4226183
COS. 0.9063078
TAN. 0.4663077
SEC. 1.1033779

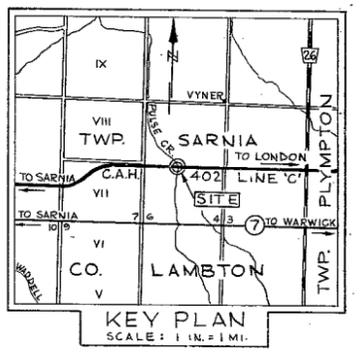


PROFILE OF HWY. 402 LINE 'C'
N.T.S.



ELEVATION A-A
SCALE: 1" = 20'-0"

RIP-RAP UNDER STRUCTURE
SECTION A TO ABUTMENT
N.T.S.



KEY PLAN
SCALE: 1 IN. = 1 MI.

NOTE

CLASS OF CONCRETE
DECK, CURBS AND PARAPET WALLS 4000 psi
REMAINDER 3000 psi OR AS NOTED ON DRAWINGS

CLEAR COVER ON REIN STEEL
FOOTINGS, WING WALLS, ABUTMENTS, DECK: TOP, BOTT.
3' 3' 3' 2 1/2' 2'
CURBS, PARAPET WALLS, APPROACH SLABS.
2' 1 1/2' 2'

CONSTRUCTION NOTES
FALSEWORK SUPPORTING WING WALLS SHALL NOT BE REMOVED UNTIL CONCRETE IN THE DECK SLAB HAS BEEN POURED AND ATTAINED THE MIN. STRENGTH OF 3000 p.s.i.
BACKFILL SHALL BE PLACED SIMULTANEOUSLY BEHIND BOTH ABUTMENTS FOR EACH STRUCTURE KEEPING THE HEIGHTS OF THE BACKFILL APPROXIMATELY THE SAME.
AT NO TIME SHALL THE DIFFERENCE IN ELEVATIONS BE GREATER THAN 2 FEET.

B.M. 597.89
GEODETIC DATUM
N. & W. IN W. ROOT OF 1" MAP.
163' RT. 269+78 LINE 'C'

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

LIST OF DRAWINGS

- D-6780-1 GENERAL LAYOUT
- D-6780-2 BOREHOLE LOCATIONS & SOILS STRATA
- D-6780-3 FOOTINGS & PILE LAYOUT
- D-6780-4 FRAME & CURBS
- D-6780-5 WINGWALLS
- D-6780-6 PARAPET WALL DETAILS
- D-6780-7 APPROACH SLABS
- D-6780-8 STANDARD STEEL PARAPET RAIL
- D-6780-9 STANDARD DETAILS

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

69-F-94

PULSE CREEK BRIDGES E. & W.B. STRUCTURES
1.8 MILES WEST OF COUNTY ROAD NO. 26

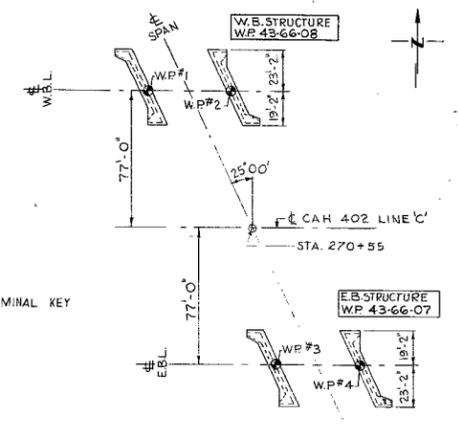
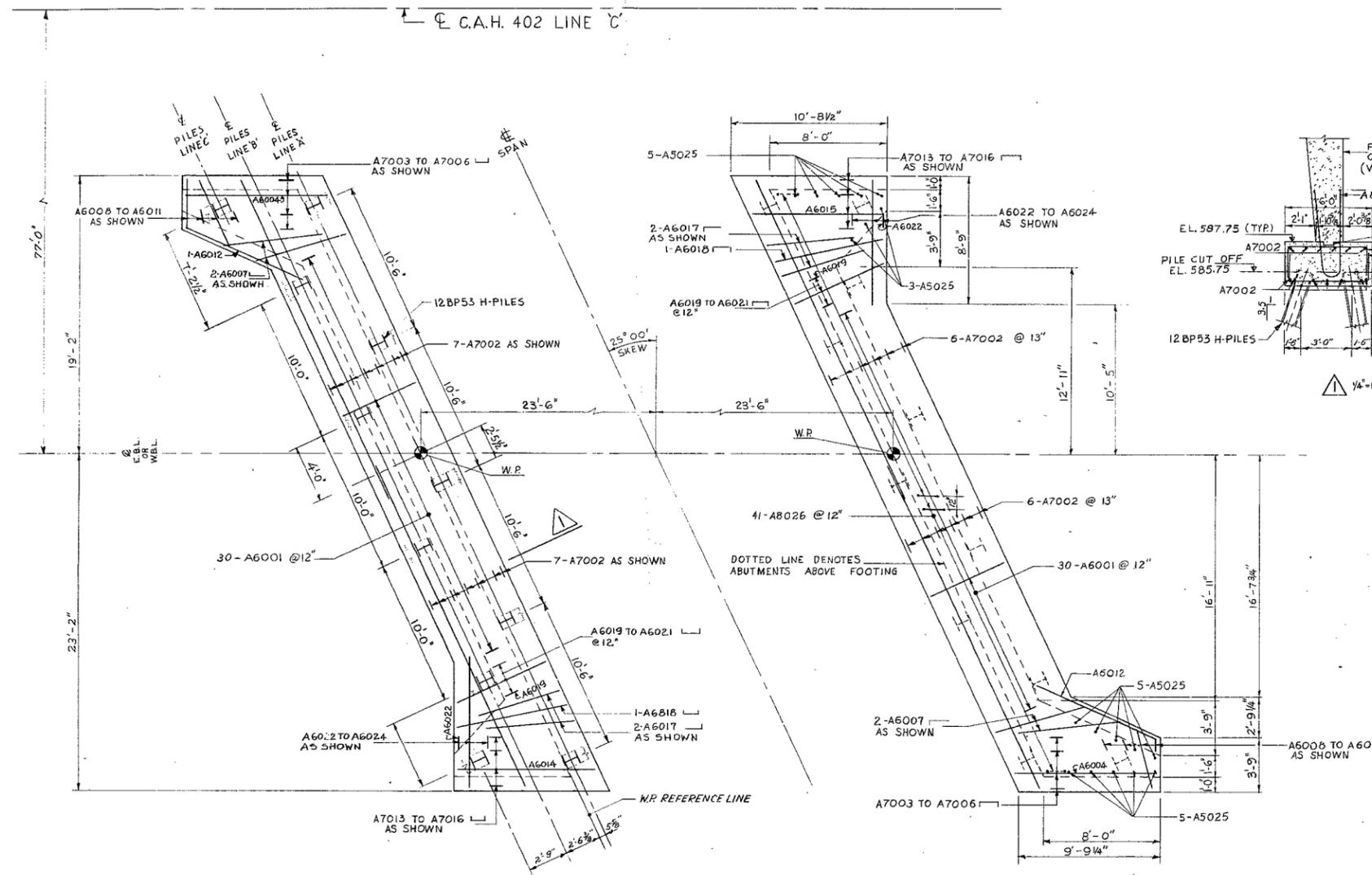
KING'S HIGHWAY No. 402 DIST. No. 1
CO. LAMBTON
TWP. SARNIA LOT 5 CON. 7

GENERAL LAYOUT

APPROVED: [Signature] SITE No. 14-345 W.P. No. 43-66-07608

DESIGN: S.V.V. CHECK: J.Bz. CONTRACT No. []
DRAWING: G.F.M.S. CHECK: J.Sz. DRAWING No. D-6780-1
DATE: AUG 1970 LOADING: HS20-44





LOCATION PLAN OF FOOTINGS
SCALE: 1" = 40'-0"

NOTES

- DIMENSIONS & PILE LAYOUT SIMILAR FOR ALL ABUTMENTS
- ABUTMENT PILE SPACING TO BE MEASURED AT UNDERSIDE OF FOOTINGS.
- ALL PILES ARE 12 BP53 H-PILES
- PILES TO BE DRIVEN TO BEDROCK
- DESIGN LOAD = 70 TONS/PILE

PRINT RECORD		
No.	FOR	DATE

BOTTOM REINFORCEMENT AND PILE LAYOUT

PLAN OF SOUTH STRUCTURE
SCALE: 1/4" = 1'-0"

TOP REINFORCEMENT

PILES SUPPLIED				
LOCATION	N ^o S	LENGTH	TYPE	
NORTH STRUCTURE WEST ABUT.	11	106'	SEE NOTES	✓
NORTH STRUCTURE EAST ABUT.	11	106'		
SOUTH STRUCTURE WEST ABUT.	11	106'		
SOUTH STRUCTURE EAST ABUT.	11	106'		

REVISIONS		
DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE DIVISION

69-F-94

PULSE CREEK BRIDGES E & W.B. STRUCTURES
1.8 MILES WEST OF COUNTY ROAD No 26

KING'S HIGHWAY No. 402 DIST. No. 1
CO. LAMBTON
TWP. SARNIA LOT 5 CON. 7

FOOTINGS & PILE LAYOUT

APPROVED: [Signature] DESIGNER: [Signature] CONTRACT: 14-345 W.P. No. 43-66-07408
 DESIGN: S.W. CHECK: J.Sz. DRAWING: G.F.M./B.H. CHECK: J.Sz. DATE: AUG. 1970 LOADING: 14520-44 DRAWING No. D-6780-3



CRA 1102-1106-0101

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. B. R. Davis,
Bridge Engineer,
Bridge Office,
Admin. Bldg.

FROM: Foundation Section,
Materials & Testing Office,
Room 107, Lab. Bldg.

ATTENTION: Mr. S. McCombie

DATE: December 10, 1969

OUR FILE REF.

IN REPLY TO

DEC 12 1969

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Proposed Crossing at Pulse Creek
And C.A.H. #402, Line 'C'

Lot 5, Concession VII
Twp. of Sarnia -- Co. of Lambton
District #1 (Chatham, Ont.)

W.J. 69-F-94 -- W.P. 43-66-07 & 08

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

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please feel free to contact our Office.

ACS/MSF
Attach.

- cc: Messrs. B. R. Davis (2)
- H. A. Tregaskes
- D. W. Farren
- W. Zonnenberg
- F. C. Brown
- A. P. Watt
- J. Roy
- B. A. Singh

Foundations Files
Gen. Files

A. S. Sternac

A. S. Sternac
PRINCIPAL FOUNDATION ENGINEER

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 2. DESCRIPTION OF THE SITE.
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 - 4.2) Sandy Silt with some Clay and Traces of Organics.
 - 4.3) Clayey Silt with some Sand and Traces of Gravel.
 - 4.4) Silty Clay with some Sand and Traces of Gravel.
 - 4.5) Bedrock.
 5. GROUNDWATER CONDITIONS.
 6. DISCUSSION AND RECOMMENDATIONS:
 - 6.1) General.
 - 6.2) Foundations.
 - 6.3) Approach Embankments.
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-

FOUNDATION INVESTIGATION REPORT
For
Proposed Crossing at Pulse Creek
And C.A.H. #402, Line 'C'
Lot 5, Concession VII
Twp. of Sarnia -- Co. of Lambton
District #1 (Chatham, Ont.)
W.J. 69-F-94 -- W.P. 43-66-07 & 08

1. INTRODUCTION:

A request for a foundation investigation at the crossing of the proposed C.A.H. #402, Line 'C' and Pulse Creek, was received from Mr. A. P. Watt, Regional Bridge Planning Engineer, in a memorandum dated October 6, 1969.

A field investigation was subsequently carried out by the Foundation Section to determine the subsoil conditions existing at the site. This report contains the results of this investigation and our recommendations pertaining to the design of the proposed structure foundations and approach embankments.

2. DESCRIPTION OF THE SITE:

The site of the proposed structure is situated about 8 miles east of Sarnia, approx. 3/4 mile north of Hwy. #7.

The surrounding area is flat with cultivated farm land on the east side and scattered scrub on the west side. The banks of the creek are about 6 ft. high.

Physiographically, the site is located in the region referred to as the St. Clair Clay Plain.

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES:

A total of four sampled boreholes and two dynamic cone penetration tests was carried out during the course of the field work. Two boreholes (#2 and 4) were put down on the top of the bank, and two (#1 and 3) close to the bottom of the creek. Boring

3. FIELD AND LABORATORY INVESTIGATION PROCEDURES: (cont'd.) ...

was achieved by means of a continuous flight auger machine, for soil sampling and diamond drilling purposes. During the field work, disturbed samples were obtained by means of a standard split-spoon sampler: the energy used in driving it, conformed to the requirements of the Standard Penetration Test. Undisturbed samples were recovered using 2-inch I.D. Shelby tubes which were pushed into the soil hydraulically, or by hand. Where possible, field vane tests were carried out at elevations 12 inches below sample depths.

Dynamic cone penetration tests were carried out adjacent to each borehole and also at five other locations. Driving energy used to advance the cone was 350 ft.-lbs. per blow.

The bedrock was proved at one borehole location using BXL rock coring equipment.

All boreholes were surveyed in the field by personnel from London Region Engineering Surveys Section. The locations and elevations of the borings are shown on Drawing No. 69-F-94A, which accompanies this report.

All samples were visually examined and classified at the site as well as in the laboratory. Following this inspection, laboratory tests were carried out on selected samples to determine the following physical properties:

- Atterberg Limits
- Moisture Content
- Grain-Size Distribution
- Undrained Shear Strength
- Bulk Density

The test results are summarized on the Record of Borehole sheets contained in the Appendix of this report.

4. SOIL TYPES AND SOIL CONDITIONS:

4.1) General:

Generally uniform subsoil conditions were found to prevail over the site investigated. The subsoil consists of organic sandy silt followed by a deep deposit of clayey silt and silty clay with some sand and traces of gravel. The combined thickness of these deposits is approximately 110 ft.

The boundaries between different deposits are shown on the Record of Borehole sheets attached to the Appendix. The estimated stratigraphical profile of Dwg. No. 69-F-94A is based upon this information.

From ground level downward, the following soil types were encountered:

4.2) Sandy Silt with some Clay and Traces of Organics:

This surficial material was found in all boreholes from the ground surface to a depth of about 5 ft. The material is sandy silt with some clay and traces of organics, which results in a higher plasticity than would otherwise be the case. Tests on two samples gave the following values of Atterberg Limits:

Liquid Limit	:	37 - 51%
Plastic Limit	:	24 - 35%
Water Content	:	30 - 35%

Grain-size analyses carried out on one sample gave the following distribution: (See Fig. 2)

Gravel	:	1%
Sand	:	41%
Silt	:	43%
Clay	:	15%

The 'N' values ranged between 12 and 18, indicating a compact denseness.

4. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

4.3) Clayey Silt with some Sand and Traces of Gravel:

This deposit was intersected in all borings below the sandy silt layer and extends down to approx. El. 557.0. The material in the deposit consists of clayey silt with some sand and traces of gravel. A plot of Plasticity Index versus Liquid Limit of the material is shown on Figure 1 of the Appendix.

Only B.H. 4 shows the presence of a desiccated crust, presumably because of higher ground and proximity of trees. Other boreholes do not indicate the crust of any appreciably high shear strength.

The consistency of the undesiccated deposit was found to range from firm to stiff. It is generally firm in boreholes 1 and 3 which are near the bottom of the creek, and generally stiff in boreholes 2 and 4 which are on top of the bank. Field and laboratory shear strength measurements indicate values ranging between 550 and 1350 p.s.f. The average in boreholes 1 and 3 is about 800 p.s.f., and that in boreholes 2 and 4, about 1050 p.s.f.

These results are plotted on Figure 4 of the Appendix.

Physical properties of the overall stratum, as determined from field and laboratory tests, are as follows:

Natural Moisture Content (%)	:	16 to 24
Liquid Limit (%)	:	26 to 35
Plastic Limit (%)	:	14 to 17
Bulk Density (PCF)	:	127 to 129
Field Vane Test (PSF)	:	550 to >2000
Unconfined Shear (PSF)	:	770 to 1340
Sensitivity:	:	1.3 to 4.0

Typical grain-size distribution curves are included in the Appendix (Figure 2).

4. SOIL TYPES AND SOIL CONDITIONS: (cont'd.) ...

4.4) Silty Clay with some Sand and Traces of Gravel:

Beneath the clayey silt zone a deep deposit of silty clay with some sand and traces of gravel was encountered. The lower boundary of the deposit was found to be at approximate El. 485 which is also the assumed elevation of the bedrock.

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

Natural Moisture Content (%)	:	19 to 32
Liquid Limit (%)	:	35 to 46
Plastic Limit (%)	:	18 to 23
Unconfined Shear (PSF)	:	720 to 1300
Field Vane Test (PSF)	:	640 to 2000 +
Sensitivity:	:	1.7 to 2.7
'N' Values (Blows/ft.)	:	2 to 100
Bulk Density (PCF)	:	116 to 126

Some of the test results are also plotted on Figures #1 and #4.

Typical grain-size distribution curves are shown on Figure #3 of the Appendix.

4.5) Bedrock:

The bedrock was proven in B.H. 2. In other boreholes the bedrock surface was assumed to be the level at which practical refusal to augering was reached. The rock core obtained shows the bedrock to be shaley limestone in sound condition as indicated by almost 100% recovery. The bedrock surface varies from El. 483.3 to 486.3.

5. GROUNDWATER CONDITIONS:

The following water levels were observed during the field work:

B.H. #1	:	El. 589.5
2	:	588.0
3	:	588.4
4	:	Dry

It is pointed out, that the foregoing quoted figures may not represent the true groundwater levels, due to the relatively impermeable nature of the subsoil and the short duration of the field work.

Natural gas was observed in B.H.'s #1, 2 and 3 near the bedrock.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to build a twin, single-span structure at the crossing of new Hwy. #402, Line 'C' and Pulse Creek. The span of each bridge will be 50 ft. and each will be at a skew to the centre line. The proposed profile grade (El. 606) will be approximately 18 ft. above the bottom of the creek. The surrounding ground level on either side of the creek is about El. 594. Therefore, 12-ft. high embankments will be constructed for approaches.

As described earlier, the subsoil consists of a thin layer of organic sandy silt followed by a deep deposit of clayey silt and silty clay with some sand and traces of gravel.

6.2) Foundations:

Because of relatively low shear strength of the soil and absence of a suitable hard desiccated crust, spread footing type foundations are not considered suitable. Therefore, it is recommended that the proposed bridge be supported on No. 14 'treated' timber piles. For 45 ft. of embedment of friction timber piles, a safe load of 20 tons per pile may be assumed for design purposes.

6. DISCUSSION AND RECOMMENDATIONS: (cont'd.) ...

6.2) Foundations:

It has been decided to carry out a number of pile load tests in this area in the near future. The foregoing recommendation relating to pile capacity, is therefore subject to change if the results of loading test warrant it.

As an alternative, the structure may be supported on steel H-piles driven to bedrock. For design purposes the maximum allowable design load may be used for the particular steel section used. This proposal will require about 100-ft. long piles. In our opinion, this may not be the most economical solution.

The foregoing recommendations must be reviewed in the light of hydrological requirements to ensure that special needs may be fulfilled.

6.3) Approach Embankments:

The proposed 12-ft. raise in grade will result in a maximum height of embankment of 18 ft. above the bottom of the creek. The shear strength of the subsoil is such that it will be able to support the approach embankments constructed with 2:1 forward and side slopes. The fill should consist of well compacted acceptable material.

Scour protection should be provided according to hydrological requirements.

Based on past experience with the structures with somewhat similar subsoil conditions, it is anticipated that maximum settlement of 2 - 3 inches will occur under the approaches.

Consolidation settlements are anticipated to be in the order of 2 - 3 inches.

The topsoil and any organic material should be removed in accordance with the pertinent D.H.O. Standards within the construction area.

7. MISCELLANEOUS:

The field investigation was carried out during the period October 31 - November 6, 1969, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

Equipment was owned and operated by Dominion Soil Investigation Ltd., and George Wimpey Co. Ltd.

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

December 1969

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
 MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-P-94 LOCATION Hwy. 402 Line 'C', Sta 270+40, 95 59' Lt. ORIGINATED BY AP
 W.P. 43-66-08 BORING DATE Oct. 31-Nov. 3, 1969 COMPILED BY AP
 DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger CHECKED BY *SL*

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT PLASTIC LIMIT WATER CONTENT			BULK DENSITY	REMARKS
			NUMBER	TYPE	BLOWS / FOOT		400	800	1200	1600	2000	w _p	w _L	w		
591.3	Ground Level															
0.0	Sandy silt, some clay traces of organics compact Black		1	SS	13	590										589.5
586.3	Clayey silt some sand, traces of gravel Brown & Grey	Stiff	2	SS	10	580										10-17-47-26
5.0			3	TW	PH											
		4	SS	7		+s1.7										
		Firm	5	TW	PH		+s2.3									
			6	SS	7	570	+s3.5									
			7	TW	PH		+s2.5									
		Stiff	8	SS	9	560										
557.0	9		TW	PH		+s2.7										
34.3	Silty Clay, some sand traces of gravel Grey	Firm	10	SS	7	550									3-7-51-39	
			11	TW	PH	540	+s2.3									
		Stiff	12	SS	47	530										
			13	TW	PH	520										
		Very stiff to Hard	14	SS	70	510										
	15		SS	75	490											
483.3	Probable Bedrock End of Borehole					500										
108.0						480										

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-P-94 LOCATION Hwy. 402 Line 10', Sta. 269+80, O/S 86' Lt. ORIGINATED BY AP
W.P. 43-66-08 BORING DATE November 3-4, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Continuous Flight Auger, BX Casing & Core CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT PLASTIC LIMIT WATER CONTENT			BULK DENSITY	REMARKS	
			NUMBER	TYPE	BLOWS/FOOT		SHEAR STRENGTH P.S.F.					w _L	w _p	w			
596.1	Ground Level						100	800	1200	1600	2000	10	20	30			
0.0	Sandy Silt, some clay traces of organics compact Black		1	SS	12												
591.1			2	SS	7	590										588.0	
5.0	Clayey silt some sand, traces of gravel Brown & Grey Stiff Firm		3	SS	14												
			4	SS	8												
			5	TW	PH	580		0								128	
			6	SS	11				+s1.9								
			7	TW	PH	570				+s1.9							
			8	SS	8				+s2.3								
			9	TW	PH	560				+s2.2							
556.1				10	SS	8			+s1.3								
40.0		Silty clay, some sand, traces of gravel Firm Stiff to Very Stiff Grey		11	TW	PH	550		0							116	
				12	SS	8	540			+s2.5							
			13	TW	PH	530			+s2.2								
			14	SS	22	520				+2000							
			15	SS	22	510											1-11-48-40
						500											
485.1	Bedrock	W/S		BXL	100%	480											
480.1	Shaley Limestone		16	RC	REC												
416.0	End of Borehole																

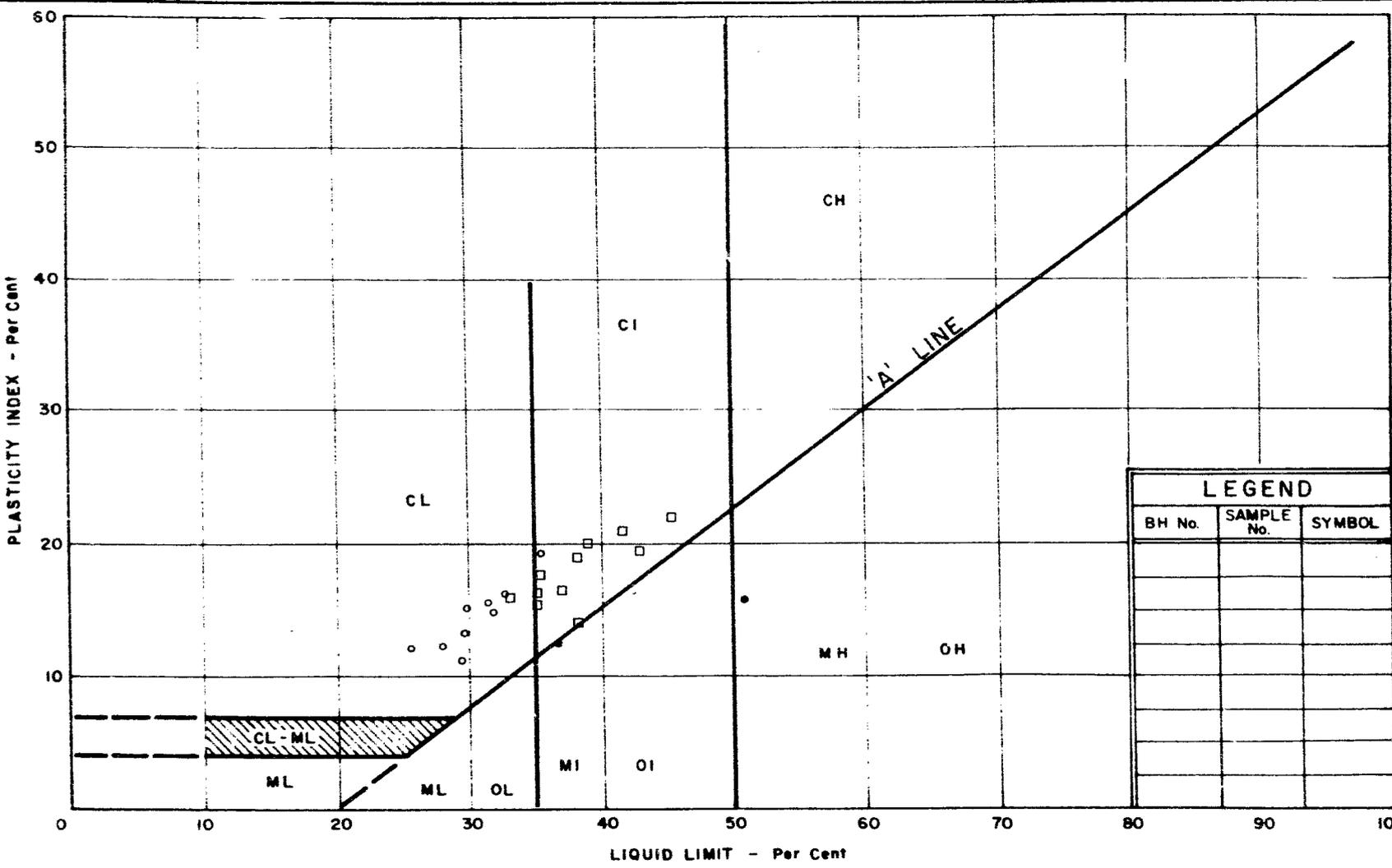
DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-94 LOCATION Hwy. 402 Line 'C', Sta. 271+05, O/S 82' Rt. ORIGINATED BY AP
W.P. 43-66-07 BORING DATE Nov. 4-5, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Bombardier Flight Auger & Cone CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT. PLOT	SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT - - - - - w _L PLASTIC LIMIT - - - - - w _p WATER CONTENT - - - - - w			BULK DENSITY γ P.C.F.	REMARKS		
			NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	400	800	1200			1600	2000
591.4	Ground Level																	
0.0	Sandy silt, some clay					590												588.4
588.0	traces of organics Compact Black		1	SS	15													
3.4			2	TW	PH													
	Stiff Firm		3	SS	9	580												
	Clayey silt, some sand, traces of gravel		4	TW	PH													
	Brown & Grey		5	SS	8													
			6	TW	PM	570											127	2-11-46-41
			7	SS	5													
			8	TW	PM	560												
557.0			9	SS	2													
34.4			10	TW	PM	550												
			11	TW	PM	540												
	Firm		12	SS	11	530												1-7-55-33
	Silty Clay some sand, traces of gravel		13	TW	PM	520												
	Stiff Firm		14	SS	33	510												
	Grey		15	SS	100	500												3-12-55-33
	Very stiff to Hard					490												
484.4						480												
107.0	Probable Bedrock End of Borehole																	



LEGEND		
BH No.	SAMPLE No.	SYMBOL



PLASTICITY CHART

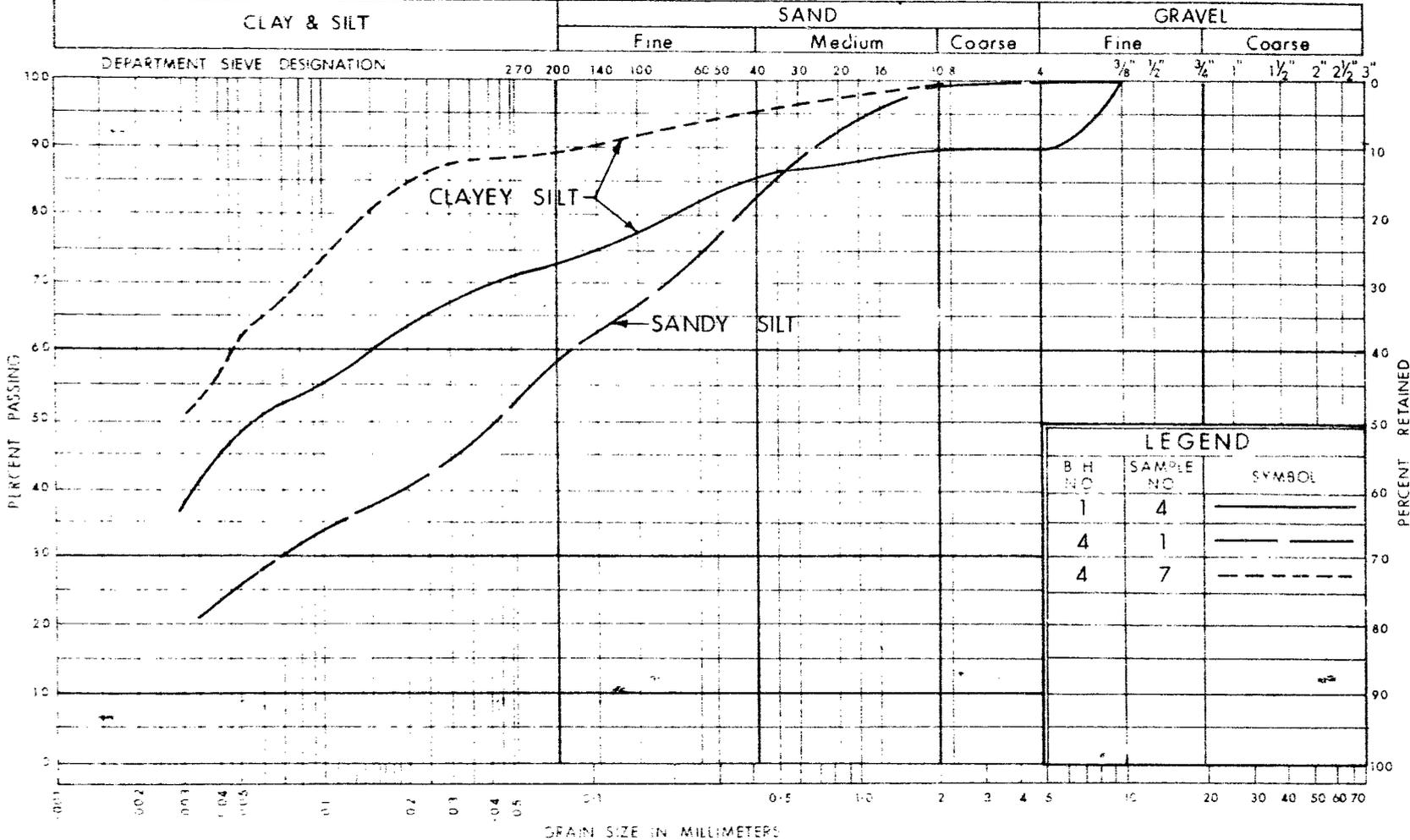
● ORGANIC SANDY SILT ○ CLAYEY SILT □ SILTY CLAY

WP No. 43-66-07 & 08

JOB No. 69-F-94

FIG. 1

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

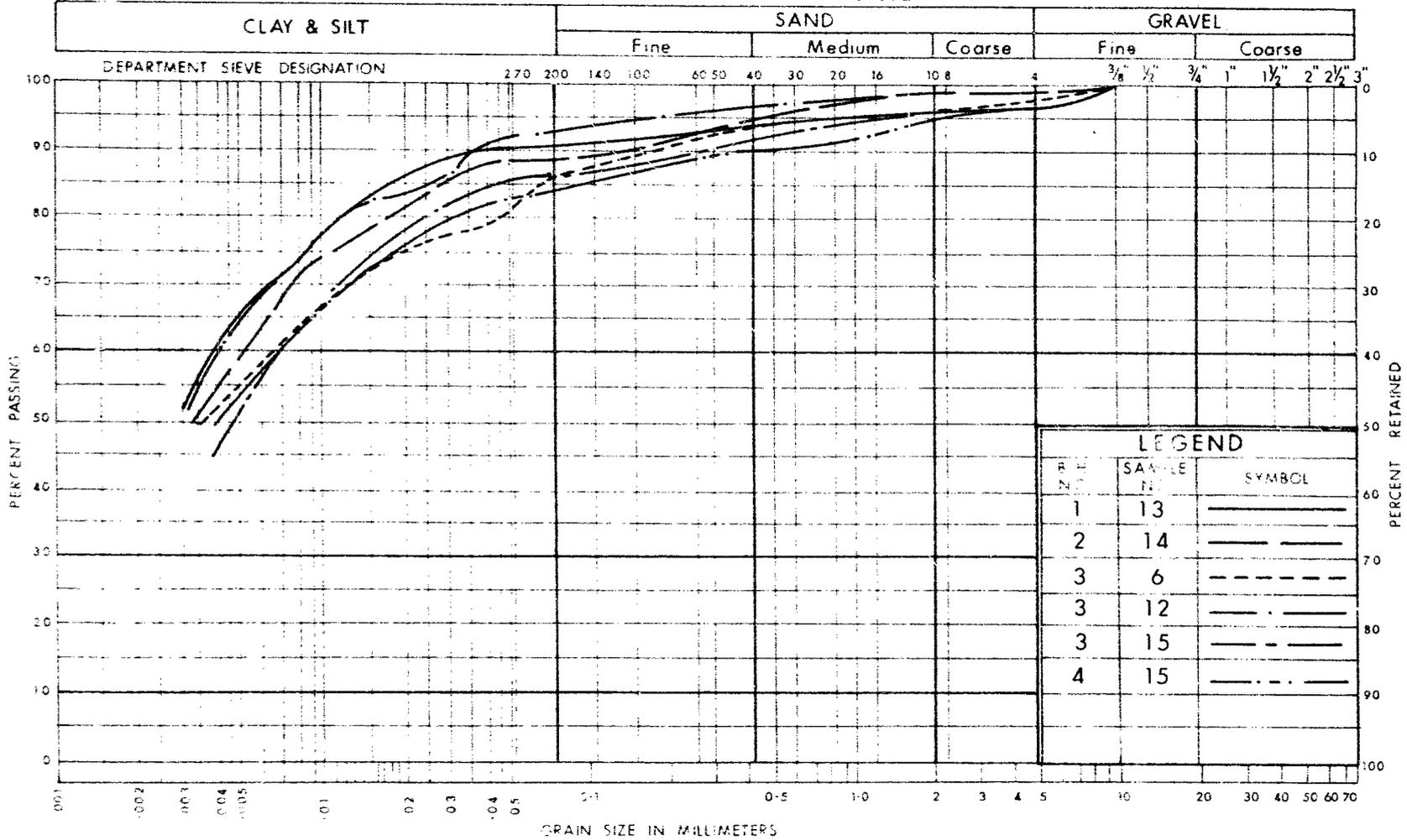
GRAIN SIZE DISTRIBUTION

WP No. 43-66-07 & 08

JOB No. 69-F-94

FIG. 2

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
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DIVISION

GRAIN SIZE DISTRIBUTION
SILTY CLAY

W.P. No. 43-66-07 & 08

JOB No. 69-F-94

FIG. 3

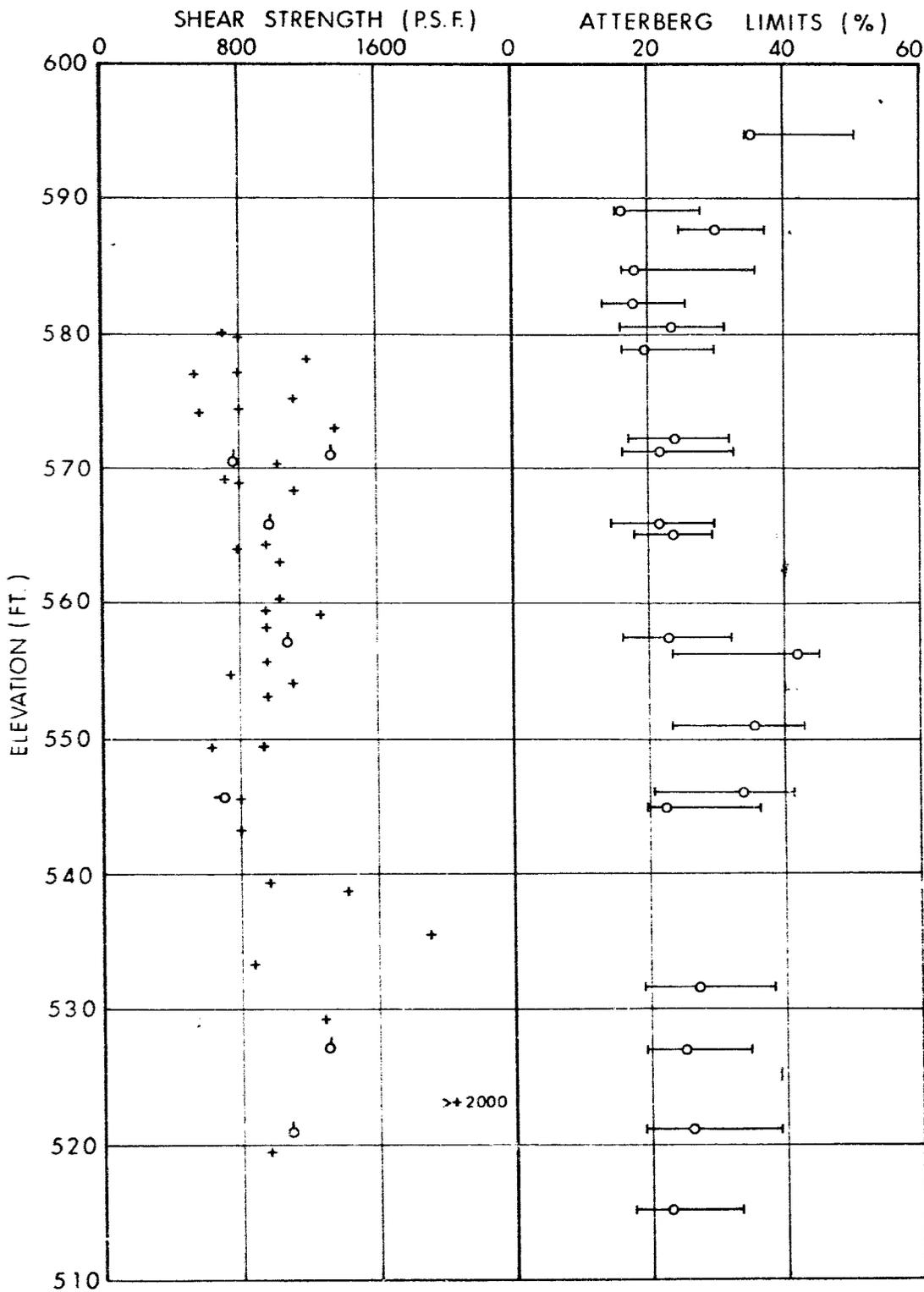


FIG. 4

ABBREVIATIONS USED IN THIS REPORT

PENETRATION RESISTANCE

STANDARD PENETRATION RESISTANCE 'N': - 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:-

<u>CONSISTENCY</u>	<u>'N' BLOWS / FT.</u>	<u>c LB. / SQ. FT.</u>	<u>DENSENESS</u>	<u>'N' BLOWS / FT.</u>
VERY SOFT	0 - 2	0 - 250	VERY LOOSE	0 - 4
SOFT	2 - 4	250 - 500	LOOSE	4 - 10
FIRM	4 - 8	500 - 1000	COMPACT	10 - 30
STIFF	8 - 15	1000 - 2000	DENSE	30 - 50
VERY STIFF	15 - 30	2000 - 4000	VERY DENSE	> 50
HARD	> 30	> 4000		

TYPE OF SAMPLE

S.S	SPLIT SPOON	T.W	THINWALL OPEN
W.S	WASHED SAMPLE	T.P	THINWALL PISTON
S.B	SCRAPER BUCKET SAMPLE	O.S	OESTERBERG SAMPLE
A.S	AUGER SAMPLE	F.S	FOIL SAMPLE
C.S	CHUNK SAMPLE	R.C	ROCK CORE
S.T	SLOTTED TUBE SAMPLE		
	P.H.		SAMPLE ADVANCED HYDRAULICALLY
	P.M.		SAMPLE ADVANCED MANUALLY

SOIL TESTS

Qu	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Qcu	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Qd	DRAINED TRIAXIAL	S	SENSITIVITY

ABBREVIATIONS 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
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
ϕ'	EFFECTIVE ANGLE OF SHEARING RESISTANCE, OR FRICTION
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
μ	COEFFICIENT OF FRICTION
S_t	SENSITIVITY

IN TERMS OF EFFECTIVE STRESS
 $\tau_f = c' + \sigma' \tan \phi'$

IN TERMS OF TOTAL STRESS
 $\tau_f = c_u + \sigma \tan \phi$

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 (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

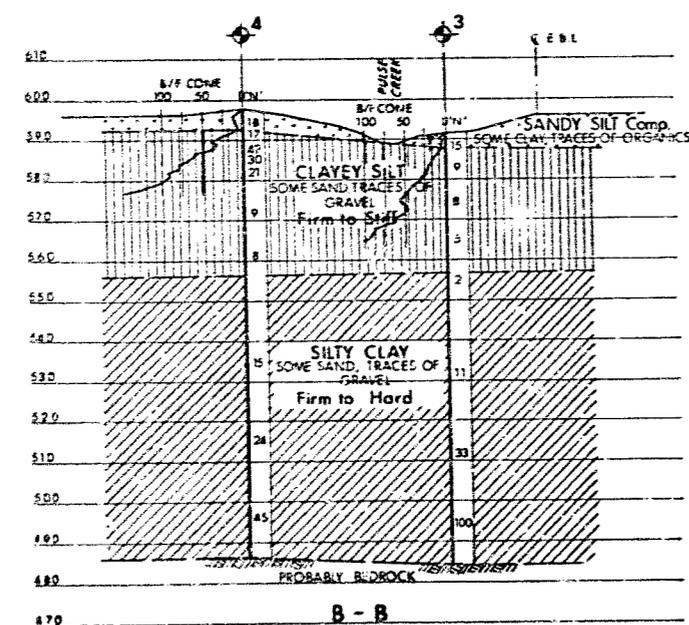
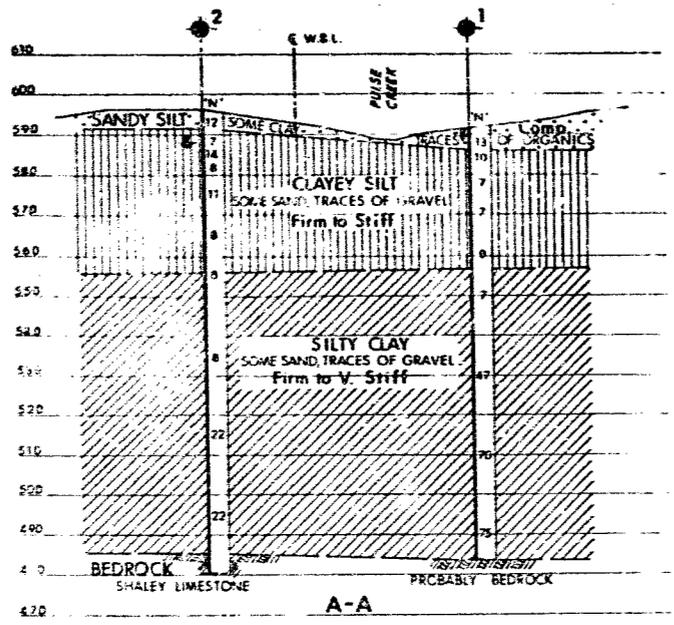
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_0	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

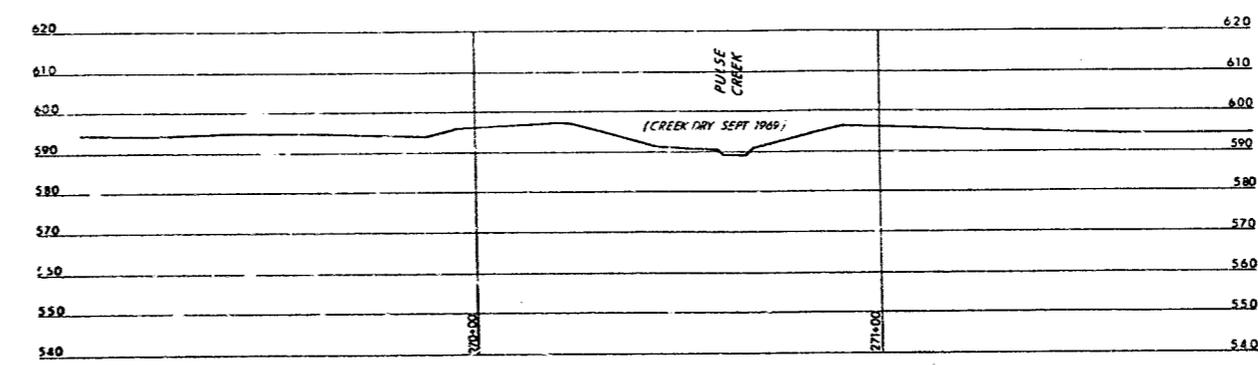
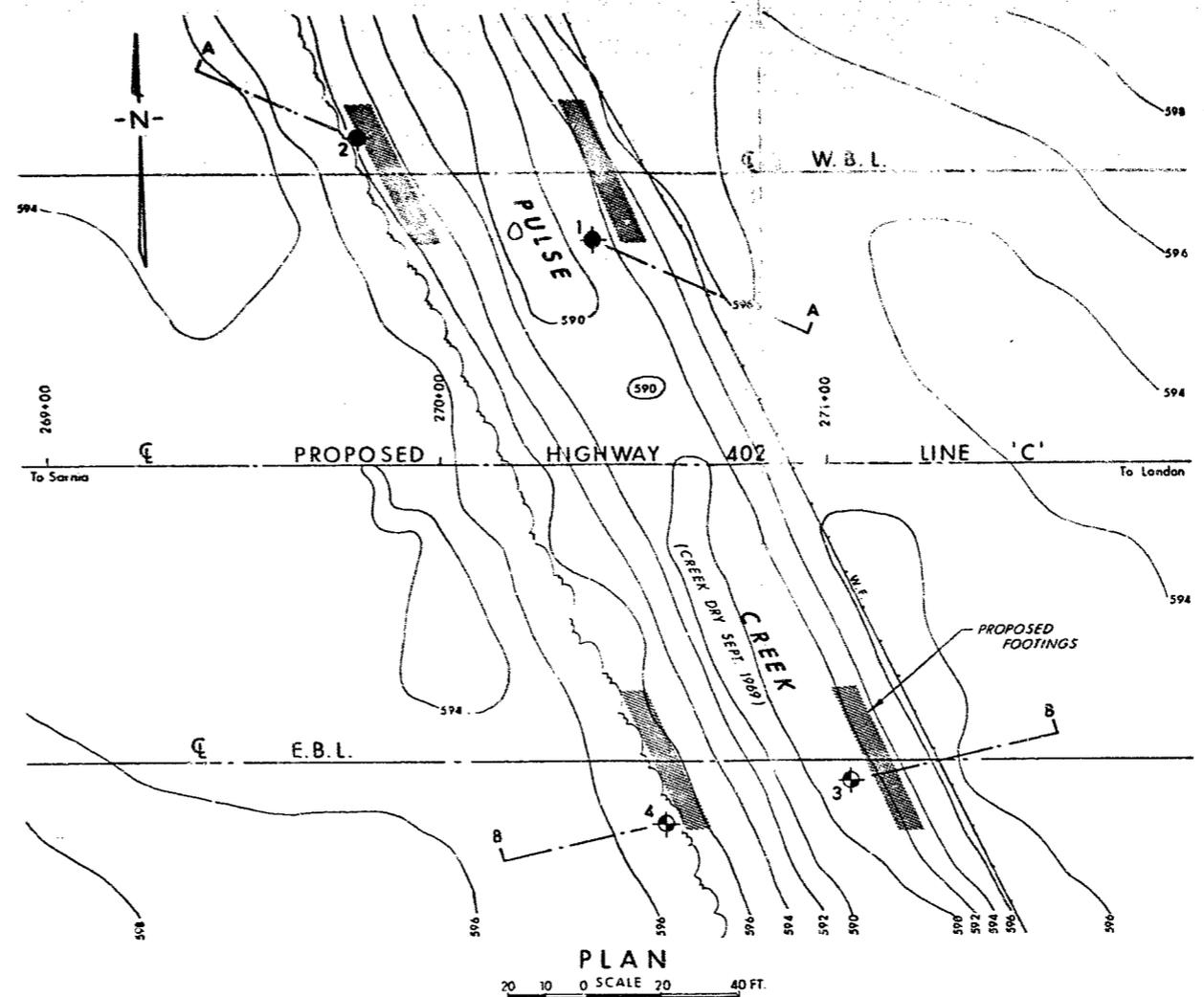
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY, DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

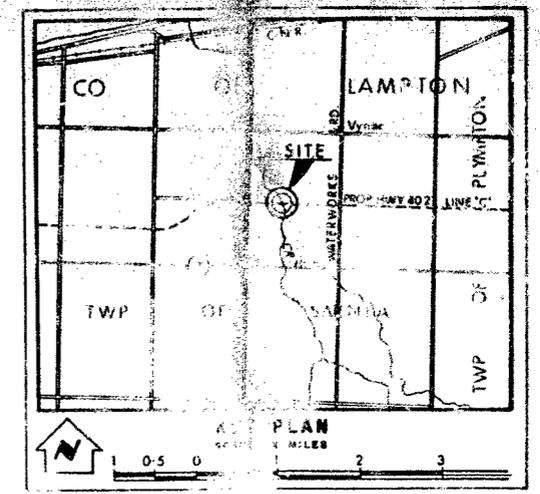
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



SECTIONS
20 10 0 SCALE 20 40 FT.



PROFILE
20 10 0 SCALE 20 40 FT.



LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation, OCT. & NOV. 69
- Water Level not established in Bore Hole 4 at time of field investigation.

NO.	ELEVATION	STATION	OFFSET
1	591.3	270+40	59' LT.
2	596.1	269+80	86' LT.
3	591.4	271+05	82' RT.
4	597.8	270+57	93' 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 and may be subject to considerable error.

REVISIONS	DATE	BY	DESCRIPTION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE - FOUNDATION SECTION

PULSE CREEK

KING'S HIGHWAY NO. 402 LINE 'C' DIST. NO. 1
CO. LAMBTON
TWP. SARNIA LOT 5 CON. VII

BORE HOLE LOCATIONS & SOIL STRATA

SUB'D. A.P.	CHECKED <i>[Signature]</i>	W.P. NO. 43-66-07&08	M.B.T. DRAWING NO.
DRAWN S.O.	CHECKED <i>[Signature]</i>	JOB NO. 69-F-94	69-F-94A
DATE 6 DEC. 1969	SITE NO.	BRIDGE DRAWING NO.	
APPROVED <i>[Signature]</i>	CONT. NO.		

Acc

MEMORANDUM

TO: Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Building

FROM: C.S. Grebski,
Bridge Office

ATTENTION:

DATE: August 25, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 43-66-07 & 08, Site No. 14-345
Pulse Creek Bridges
E. and W.B. Structures
1.8 Mi. W. of County Road No. 26
Highway 402, District No. 1

69-F-94

Attached herewith we are submitting the final bridge drawings which show the foundation design for the above-mentioned structures.

Kindly give us your comments at your earliest convenience.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Office

Forwarded to Mr. Stermac and 1/2 : 1
2:1 as approved and
the drawings will be 1/2 : 1
1/2 : 1

1/29/70
K. L. ...