

#68-F-38

W.P. #417-65

HWY #10 LINE 'E'

SAUGEE N RIVER

(ARTEMESIA)

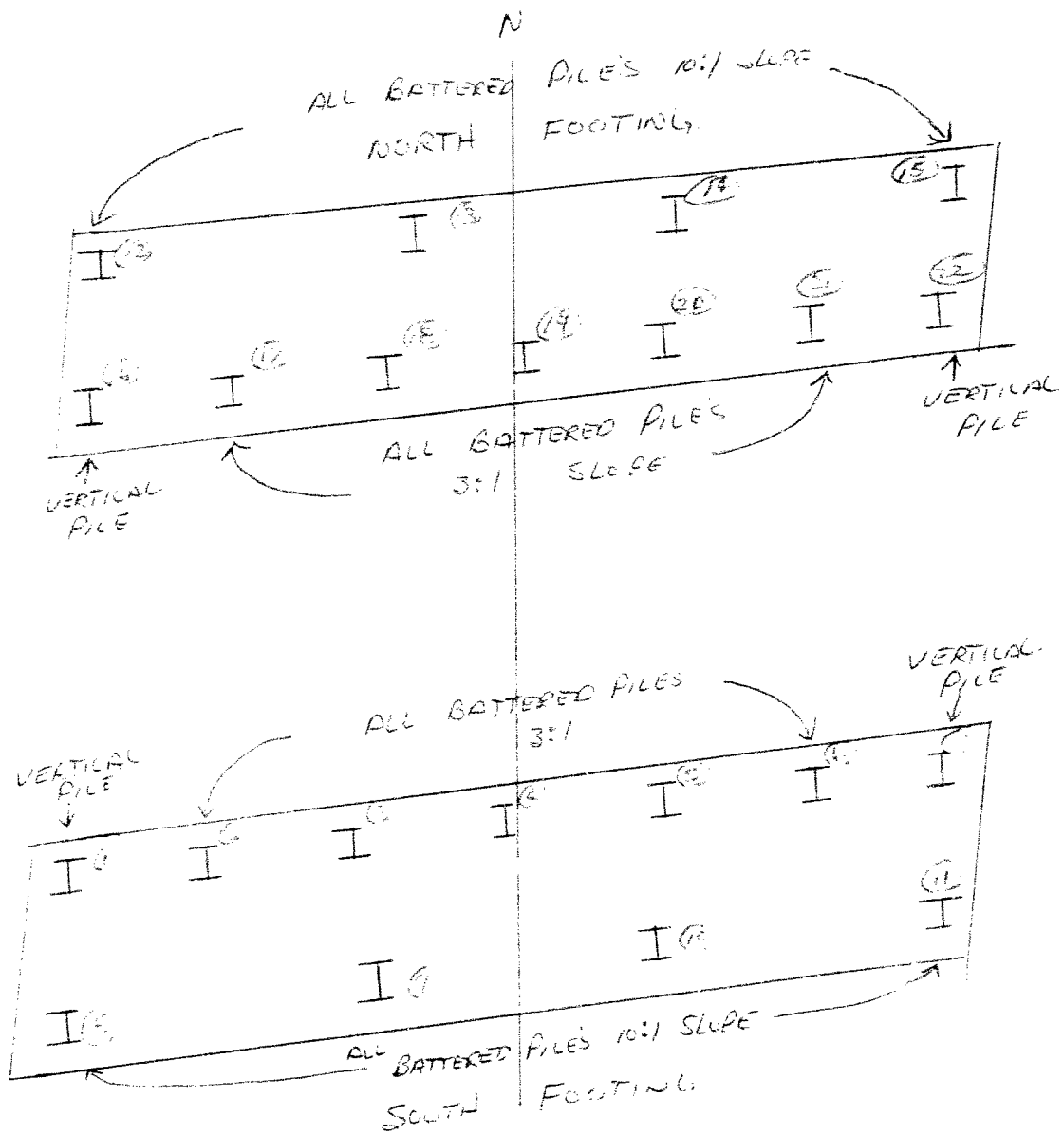
BRIDGE

HAMMER TYPE X-12 WEIGHT 6802 ENERGY 22,600 FT. LB3

[illegible]

PILE LAYOUT DESC.

134-61007
4-1-66
155-1-038



DEPARTMENT OF HIGHWAYS - ONTARIO

Form OB-MT-285

MATERIALS AND TESTING OFFICE FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 5 CONTRACT NO. 72-74 STRUCTURE SAGUENAY RIVER BRIDGE Hwy #10
 CONTRACTOR Down Const DESIGN LOAD OF PILE 70 TONS
 HAMMER DETAILS: TYPE Down D 12 WEIGHT 6800 HEIGHT OF FALL OR ENERGY 23.600
 TYPE OF ANVIL OR CAP _____ WEIGHT OF ANVIL OR CAP 500 LBS
 PILE DETAILS STEEL H PILES, 12BP 334B
 PILE NO. 22 LOCATION From 2500 N. of Highway 10 to Highway 10 DATE DRIVEN SEPT. 15/72

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.
	1	2		26			51			76	
	2	4		27			52			77	
	3	4		28			53			78	
	4	5		29			54			79	
	5	5		30			55			80	
	6	12		31			56			81	
	7	18		32			57			82	
	8	30		33			58			83	
	9	40		34			59			84	
	10	43		35			60			85	
	11	46		36			61			86	
	12	48		37			62			87	
	13	49		38			63			88	
	14	50		39			64			89	
	15	51		40			65			90	
	16	53		41			66			91	
	17	60		42			67			92	
	18	65		43			68			93	
	19	55		44			69			94	
	20	62		45			70			95	
	21	68		46			71			96	
	22	156		47			72			97	
	23			48			73			98	
	24			49			74			99	
2.45	25			50			75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	13	13	13	13	13	13
MEASURED REBOUND IN INCHES	120	120	120	120	120	120
FINAL LENGTH OF PILE	22.45					
FINAL CUT OFF ELEVATION	1583.75					

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER
 MATERIALS & TESTING DIVISION
 DEPARTMENT OF HIGHWAYS
 DOWNSVIEW, ONTARIO

SIGNED H. Davidson
 NAME (PRINT) G. Davidson
 DATE SEPT 15/72

ATTACH SKETCH OF PILE NUMBERING SYSTEM

200-1
 70.45
 1561.30

Notes:-

In general this form should be completed for every tenth pile in a group, but at least one is required for every pier and abutment.

Piles driven vertically should be selected where possible.

File Details must include type, dimensions and weight per foot, details of shoe, and slope of batter: e.g. 12 $\frac{1}{2}$ " O.D. steel tube x 0.251" @ 33 lbs. per ft. Vertical. 12 $\frac{1}{2}$ " x $\frac{1}{2}$ " steel plate shoe.

Details for the final six inches of penetration must be completed for all piles except in the case of an end bearing pile driven to bedrock. Final length of pile, and final cut off elevation must always be given.

The total length being driven is the full length of the pile and remains unchanged until a length is cut off or spliced on.

The penetration in blows per foot must be recorded for every foot of penetration of the pile.

Measured rebounds recorded on this form must be the average for each individual inch for the final six inches of penetration.

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	13	13	14	15	15	15
MEASURED REBOUND IN INCHES	.00	.00	.20	.20	.30	.20
FINAL LENGTH OF PILE	18.0'		FINAL CUT OFF ELEVATION		683.5'	

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Notes:-

In general this form should be completed for every tenth pile in a group, but at least one is required for every pier and abutment.

Piles driven vertically should be selected where possible.

Pile Details must include type, dimensions and weight per foot, details of shoe, and slope of batter: e.g. 12 $\frac{1}{2}$ " O.D. steel tube x 0.251" @ 33 lbs. per ft. Vertical. 12 $\frac{1}{2}$ " x $\frac{1}{2}$ " steel plate shoe.

Details for the final six inches of penetration must be completed for all piles except in the case of an end bearing pile driven to bedrock. Final length of pile, and final cut off elevation must always be given.

The total length being driven is the full length of the pile and remains unchanged until a length is cut off or spliced on.

The penetration in blows per foot must be recorded for every foot of penetration of the pile.

Measured rebounds recorded on this form must be the average for each individual inch for the final six inches of penetration.

MEMORANDUM

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

FROM: C. S. Grebski,
Bridge Office

ATTENTION:

DATE: August 19, 1970

OUR FILE REF.

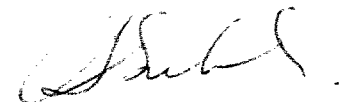
IN REPLY TO

SUBJECT: Saugeen River (Artemesia) Bridge
3.2 miles south of Flesherton
W.P. 417-65, Site No. 8-253
Hwy. No. 10, District No. 5

68-F-38

Attached herewith we are submitting the final
bridge drawings which show the foundation design for
this structure.

Kindly give us your comments at your earliest
convenience.



C. S. Grebski,
Bridge Design Engineer.

CSG:de

Attach.

c.c. Foundation Office



Our comments of our memo of Sept 1968 are still applicable.

M. Sivata
27th Aug/70

Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Division,
Admin. Bldg.

Foundation Section,
Materials & Testing Div.,
Room 107, Lab. Bldg.

September 30, 1968

Saugeen River (Artemesia) bridge
Highway 10, (Line 'E')
District No. 5 (Owen Sound)
W.J. 68-F-378 -- W.P. 417-65

We have reviewed the Preliminary Drawing D-6513-P1 for the above mentioned structure and submit the following comments:

Our foundation investigation of June 1968, considered two alternate schemes for the above mentioned structure. From the Preliminary Design Drawing it is seen that Scheme 1 (crossing across the existing stream channel) has been adopted. For this scheme we have recommended that the abutments be supported on spread footings located at elevation 1575 and designed for a safe bearing value of 2.5 t.s.f. Since the excavations will have to be carried out below the groundwater level in a granular material, we have suggested a dewatering scheme consisting of interlocking steel sheet piling driven to a minimum depth below the excavation bottoms equal to the height of the prevailing water above them, in order to prevent boiling. However, the Preliminary Drawing indicates a piled foundation for this scheme. If a piled foundation is more economical than the use of steel sheet piling for dewatering, it is recommended that these piles be driven to practical refusal in the lower glacial till stratum. It is estimated that the piles will achieve practical refusal at approximate tip elevation of 1560 to 1555 rather than 1555 to 1550, as shown on the Drawing. Piles driven to the aforementioned elevation will attain the maximum allowable load for the section chosen.

LD/ndef

cc: Messrs. S. McCombie
A. P. Watt

Foundations Files
Gen. Files

M. Devata

M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. C. Sterns,
PRINCIPAL FOUNDATION ENGR.

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac

Mr. A. Watt,
Reg. Bridge Location Engineer,
London Regional Office,
London, Ontario

Bridge Division,
Downsview, Ontario

September 24, 1968

Saugeen River (Artemesia) Bridge
3.2 Miles South of Flesherton
H.P. 417-55, Site No. 8-253
Highway 10, District No. 5

Attached herewith are prints of the Preliminary Bridge
Plan Drawing D-6413-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is \$60,000.
This cost includes tender, materials, engineering and sundry
construction but does not include the cost of removal of the
existing structure.

Any comments or revisions you may have should be submitted
within three weeks.

C.S. Grebani,
Bridge Design Engineer

cc: Mr.

Attn:

Mr. A. McConchie
A. Stermac (P)
J. Anderson.

Department of Highways Ontario

Copy for the information of

Mr. A. Stermac

Mr. A. Watt,
Reg. Bridge Location Engineer,
London Regional Office,
London, Ontario

Bridge Division,
Downsview, Ontario

September 24, 1968

Artesia River (Artesia) Bridge
1.5 miles South of Flesherton
Hwy. 107-65, Site No. 8-253
Hwy. 10, District No. 5

Attached herewith are prints of the Preliminary Bridge
drawing D-6513-21 for the above-mentioned structure.

The estimated cost of the proposed structure is \$60,000.
This cost includes tender, materials, engineering and sundry
construction but does not include the cost of removal of the
existing structure.

Any comments or revisions you may have should be submitted
within three weeks.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

C.C. B. Macdonald
A. Stermac (2)
J. Anderson

401 & Keale Street
Downsview, Ontario

April 23, 1968

Dominion Soil Investigation Ltd.
77 Crockford Blvd.
Scarborough, Ontario

Dear Sirs:

This is to confirm our request of April 23, 1968 for the supply of a Diamond Drill together with all necessary equipment, as specified under the terms of our Contract Agreement, at Flossharton, Ontario, after the completion of our present project 68-F-35(R).

This project bears Job Number 68-F-35.

Yours truly,

M. Devata

M. Devata
Supervising Foundation Engineer
for: A. G. Starnes
Principal Foundation Engineer

Wilmot

cc: H. Konings
Foundation Files 110
General File

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

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

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

Attention: Mr. S. McCombie

DATE June 4, 1968

Our File Ref

IN REPLY TO JUN 10 1968

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Proposed Saugeen River Bridge
Highway #10 (Line 'E')
Artemesia Township -- Grey County
District #5 (Owen Sound)
W.J. 68-P-38 -- W.P. 417-65

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 do not hesitate to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. B. R. Davis (2)
H. A. Tregaskes
D. W. Parren
W. Zonnenberg
H. P. Gilbert
A. P. Watt
J. Roy
B. A. Singh

Foundations Files
Gen. Files

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

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-

FOUNDATION INVESTIGATION REPORT
For
Proposed Saugeen River Bridge
Highway #10 (Line 'E')
Artemesia Township -- Grey County
District #5 (Owen Sound)
W.J. 68-F-38 -- W.P. 417-65

1. INTRODUCTION:

The Foundation Section was requested to carry out a subsurface investigation at the site of the proposed structure over Saugeen River some 130 ft. north of the existing crossing of Hwy. #10. Two alternate schemes are contemplated: Scheme 1 - structure over existing Saugeen River and Line 'E' of Hwy. #10; Scheme 2 - structure over relocated Saugeen River and Line 'E' of Hwy. #10. The site is located some 3 miles south of the town of Flesherton in Artemesia Twp., Grey Cty. The request was contained in a memo from the Bridge Division (Mr. A. P. Watt, Regional Bridge Location Engineer), dated April 11, 1968. An investigation was subsequently carried out by this Section, the results of which are presented in this report, together with our recommendations for the design of structure foundations and the stability of the approach embankments.

2. DESCRIPTION OF SITE AND GEOLOGY:

The site is located some 100 ft. east of an existing bridge over the Saugeen River on Highway #10, about 3 miles south of Flesherton. The existing bridge is of concrete rigid frame beam construction and has a clear span of about 40 ft. The bridge was found to be in a deteriorated condition inasmuch as the concrete had spalled in a few places, exposing the reinforcing steel. The abutments of the structure, however, were found to be in a generally sound condition.

cont'd. /2 ...

2. DESCRIPTION OF SITE AND GEOLOGY: (cont'd.) ...

The topography at the site consists of flat-lying farmland with isolated areas of Cedar bush growth along the river banks. At the site, Saugeen River is a shallow - (1 - 4 ft. deep) meandering stream, generally 20 ft. and locally up to 60 ft. in width. The stream bed is covered with gravel and boulders.

Physiographically, the site is located in the "Horseshoe Moraine" region which consists of till ridges, kame moraines and similar glacial deposits. The glacial tills in the area are believed to be derived in part from the Lockport dolomites.

3. FIELD AND LABORATORY WORK:

A total of 4 boreholes, each accompanied by a dynamic cone penetration test, was carried out with a standard trailer-mounted diamond drill rig adapted for soil sampling purposes. Samples were obtained at required depths with a 2" O.D. split-spoon sampler which was hammered into the soil, or by diamond core drilling in AX and AXT sizes. The method of driving the split-spoon sampler conformed to the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests.

The locations and elevations of the boreholes as well as the estimated stratigraphic profile are shown on Dwg. 68-F-38A.

All samples were subjected to a careful visual examination in the field and subsequently in the laboratory. After examination, the following physical properties of representative samples were determined in the laboratory:

Natural Moisture Content
Atterberg Limits
Grain-Size Distributions

The results of these tests are plotted on the individual Borelog sheets as well as on the Figures in Appendix I of this report.

cont'd. /3 ...

4. SUBSOIL CONDITIONS:

4.1) General:

The predominant stratum across the site consists of a heterogeneous mixture of silt, sand and gravel with a trace of clay (glacial till). Within the glacial till deposit a distinct stratum of dense silt, some 5 to 10 ft. thick, is located 10 to 20 ft. below the ground surface. In certain areas the upper portion of the glacial till deposit contains a 3 to 6 ft. thick layer of sandy silt.

From ground surface downwards, the following strata were encountered:

4.2) Heterogeneous Mixture of Silt, Sand and Gravel with a Trace of Clay (Glacial Till):

This deposit was encountered immediately below a surficial stratum of topsoil (B.H.'s #1, 2 and 4) or a 1.5 ft. thick cover of woody peat (B.H. #3). A distinct stratum of silt with clayey silt seams separates the glacial till deposit into two portions. The upper portion of the glacial till deposit varied in thickness between 11 and 19 feet, whereas the lower portion of the deposit was penetrated to a maximum depth of 36 feet below ground surface, that is, to about elevation 1548, at B.H. #1. A layer of sandy silt was encountered at B.H.'s #3 and 4 only, within the upper glacial till deposit at a depth of about 9 ft. below ground surface.

Typical grain-size distribution curves for representative samples from both portions of the glacial till deposit are shown on Figure 1 in the Appendix, and indicate a heterogeneous mixture of silt, sand and gravel-sized particles with a trace of clay. The moisture content of the two portions of the glacial till deposit was found to range between 7% and 12% averaging about 10%. The liquid and plastic limits averaged respectively, about 17% and 14%. The Atterberg limits are also shown plotted on the Plasticity Chart in Figure 3, Appendix I, which indicates the

cont'd. /4 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.2) Heterogeneous Mixture of Silt, Sand and Gravel with a Trace of Clay (Glacial Till): (cont'd.) ...

matrix of the glacial till deposit to be a silt (ML) and occasionally a clayey silt (CL - ML) of very low plasticity. The Standard Penetration Test 'N' values obtained in the glacial till deposit are summarized below:

STANDARD PENETRATION TEST - ('N' Values - Blows/ft.)

	Upper Glacial Till		Lower Glacial Till	
	<u>Range</u>	<u>(Avg.)</u>	<u>Range</u>	<u>(Avg.)</u>
SCHEME 1 -				
(B.H.'s #1 and 2)	22 - 162	(65)	100/6" - 142	(> 100)
SCHEME 2 -				
(B.H.'s #3 and 4)	5 - 28	(20)	84/9" - 100/6"	(> 100)

Based on these 'N' values, the relative density of the upper glacial till is considered to vary from generally compact to very dense, the lower glacial till being very dense.

4.3) Silt with Clayey Silt Seams:

A distinct stratum of grey silt was encountered within the glacial till deposit in all the boreholes between elevations 1572 and 1566, that is, some 12 to 20 ft. below ground surface. The thickness of the stratum was found to increase from about 5 ft. at B.H. #1 to 11 ft. at B.H. #3, and then to decrease to about 9 ft. at B.H. #4. In general, the stratum is estimated to dip gently in a westerly direction. Occasional seams of clayey silt were observed in samples recovered from this deposit. The deposit also contains occasional gravel. The natural moisture content of the stratum ranged between 14% and 19% averaging about 17%. The liquid and plastic limits averaged respectively, 21% and 18%. The Atterberg limits, shown on Figure 4, Appendix I, indicate

cont'd. /5 ...

4. SUBSOIL CONDITIONS: (cont'd.) ...

4.3) Silt with Clayey Silt Seams: (cont'd.) ...

the soil to be a silt (ML). The 'N' values in the stratum ranged between 36 and 52 blows/ft. and averaged about 45 blows/ft., indicating that the deposit is generally dense.

4.4) Sandy Silt:

A layer of sandy silt was encountered at E.H.'s #3 and 4 only, at an average depth of about 9 ft. below ground surface, that is, at about elevation 1577. Typical grain-size distribution curves for samples from this layer are shown on Figure 2, Appendix I, indicating the composition to be a sandy silt. The 'N' values in the stratum ranged between 31 and 49 blows/ft., indicating a compact to dense relative density.

5. GROUNDWATER CONDITIONS:

Observations made in the open boreholes during the course of the investigation indicate a groundwater level at or a few inches below the ground surface. It is inferred that the groundwater in the area of investigation is related to the stream water level.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to construct a structure where revised Hwy. #10 (Line 'E') crosses the existing or relocated Saugeen River. Two alternate schemes are contemplated. Scheme 1 involves the construction of a 75-ft. span structure over the existing river some 130 ft. north of the existing bridge. Scheme 2 involves a 73-ft. span structure across a proposed diversion of the river to a location some 160 ft. west of the present channel. The approach fills in either case, will have a maximum height of about 10 ft.

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

6.1) General: (cont'd.) ...

Subsoil at the site consists of a heterogeneous mixture of silt, sand and gravel with a trace of clay (glacial till). A distinct stratum of dense silt is present within the glacial till deposit. The glacial till above the silt stratum is generally compact to very dense, the lower portion being generally very dense.

6.2) Structure Foundations:

Scheme 1: The subsoil conditions are generally favourable for spread footing type foundations. In the case of the proposed abutments, it is recommended that footings be placed at elevation 1575, some 5 ft. below the river bed within the glacial till deposit, with a safe bearing value of up to 2.5 t.s.f.

As it will be necessary to carry out the excavations for the abutment footings below the groundwater level, a dewatering scheme will be required. The subsoil consists of an essentially fine-grained granular material which is susceptible to boiling under conditions of unbalanced hydrostatic head. If steel sheeting is used for a dewatering scheme, or as a means of scour protection, these should be driven to a minimum depth below the excavation bottoms equal to the height of the prevailing water above them in order to prevent boiling.

Scheme 2: The details concerning the proposed diversion of the present stream channel and the geometry of the structure across the diverted stream for this scheme are not known. It is assumed, however, that the invert elevation for the proposed channel will be about 1580, corresponding to the existing stream bed elevation, requiring, therefore, a cut of approximately 6 ft. below ground level. Subsoil conditions are generally unfavourable for spread footing type foundations for this scheme above elevation 1577.

cont'd. /7 ...

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

6.2) Structure Foundations: (cont'd.) ...

Scheme 2: (cont'd.) ...

The west abutment of the proposed structure may be founded on spread footings located below elevation 1573, whereas the east abutment footings should be located between elevations 1577 and 1573. Such footings may be designed for a safe bearing value of up to 2.5 t.s.f.

A dewatering scheme will be necessary to avoid 'boiling' of the footing excavations. If steel sheet piling is used for dewatering or for scour protection, the depth of penetration of the sheeting below the bottom of the excavation should be at least equal to the height of the prevailing water above the excavation bottom. Alternatively, if the dewatering scheme proves to be uneconomical, the proposed structure may be supported on end-bearing steel H-piles driven to practical refusal to approx. elevation 1555 - 1550. The capacity of the piles will depend on the section chosen; for example, a 14 BP 73 H-pile section could be designed for 90 tons/pile. In any event, the actual proposed safe bearing load should be controlled in the field by means of the Hiley Pile Driving Formula according to current D.H.O. standards.

6.3) Approach Embankments:

No stability problems are anticipated for approach fills constructed with standard 2:1 slopes.

7. MISCELLANEOUS:

The field work, performed during the period April 23 - 26, 1968, was undertaken by Mr. C. Mirza, Project Foundation Engineer, who also prepared this report. The investigation was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer.

Equipment used was owned and operated by Dominion Soil Investigation Ltd.

June, 1968.

ANALYSIS 1

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION:

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

62-5-38

LOCATION Sta. 211 + 03 @ Line 'E', o/s 22.0' Lt.

ORIGINATED BY CM

W 2 127-65

BORING DATE April 22-24, 1963

COMPILED BY _____ CK

DATUM Geodetic

BOREHOLE TYPE Diamond Drill - BX Casing

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

CE 65-232

LOCATION Sta. 211 + 85 @ Line 'E' o/s 22.0' Rt.

ORIGINATED BY CM

W 2 7-65

BORING DATE April 24-25, 1968

COMPILED BY CM

CAYUN Geodetic

BOREHOLE TYPE Diamond Drill - BX Casing

CHECKED BY

[illegible]

RECORD OF BOREHOLE NO. 3

FOUNDATION SECTION:

MATERIALS & TESTING DIVISION

403 69 E-38

LOCATION Sta. 212 + 55 @ Line 'E' o/s 25.0' Lt.

ORIGINATED BY CM

427-65

BORING DATE April 25-26, 1968

COMPILED BY GSI

DATUM 10-2-2010

BOREHOLE TYPE Diamond Drill - BX Casing

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE	LIQUID LIMIT ——— %	BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT ——— %		
							20 40 60 80 100	WATER CONTENT ——— %		
							SHEAR STRENGTH P.S.F.	W.P. ——— %		
								WATER CONTENT %		
								10 20 30		
1586.0	Ground Level									Gr. Sa. Si. Cl
1584.5	Woody Peat	W								
1583.0	1.5 Heterogeneous mixture of silt, sand & gravel with a trace of clay (Gl. Till). Loose to Comp.		1	SS	15	1580				19 22 15
1579.0	(Gl. Till). Loose to Comp.		2	SS	28					(29) 65 6
1578.0	3.0 Sandy Silt.		3	SS	40					(27) 68 5
1572.0	Dense. Grey		4	SS	10					
1570.0	Silt with clayey silt seams.		5	SS	38	1570				
	Dense.		6	SS	52					
	Grey									
1561.0	(Glacial Till)		7	SS	50	1560				
25.0			8	SS	50/9"					
	Very dense.		9	SS	15%					
1551.0			10	SS	50/6"					
34.0	End of Borehole					1550				

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

68-F-38

LOCATION: Sta. 213 + 36 @ Line 'E' o/s 22.0' Rt.

ORIGINATED BY CH

W. P. 417-65

SPRING DATE April 26, 1968

COMPILED BY **CH**

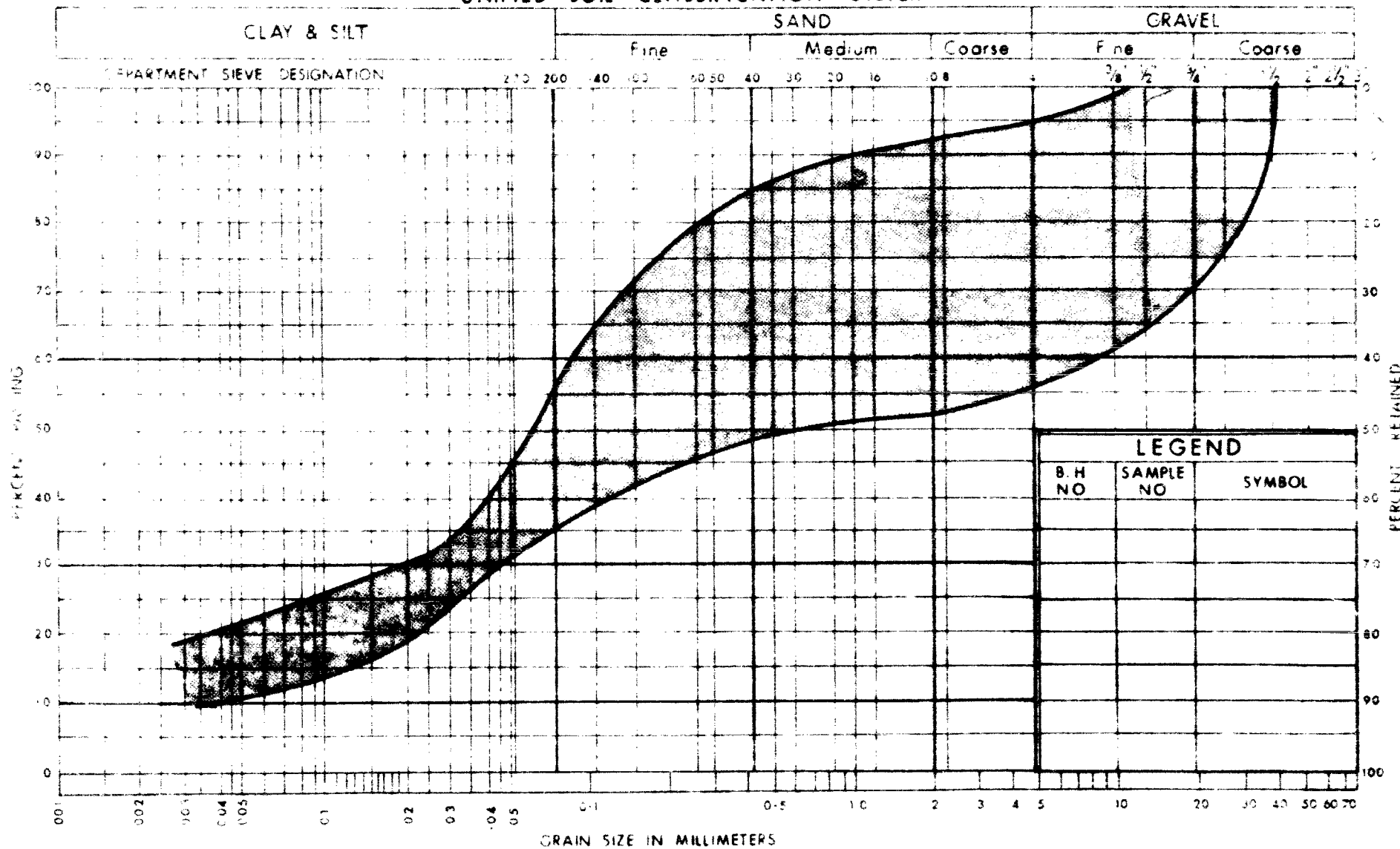
DATUM Geodetic

BOREHOLE TYPE Diamond Drill - BX Casing

CHECKED BY

[illegible]

UNIFIED SOIL CLASSIFICATION SYSTEM



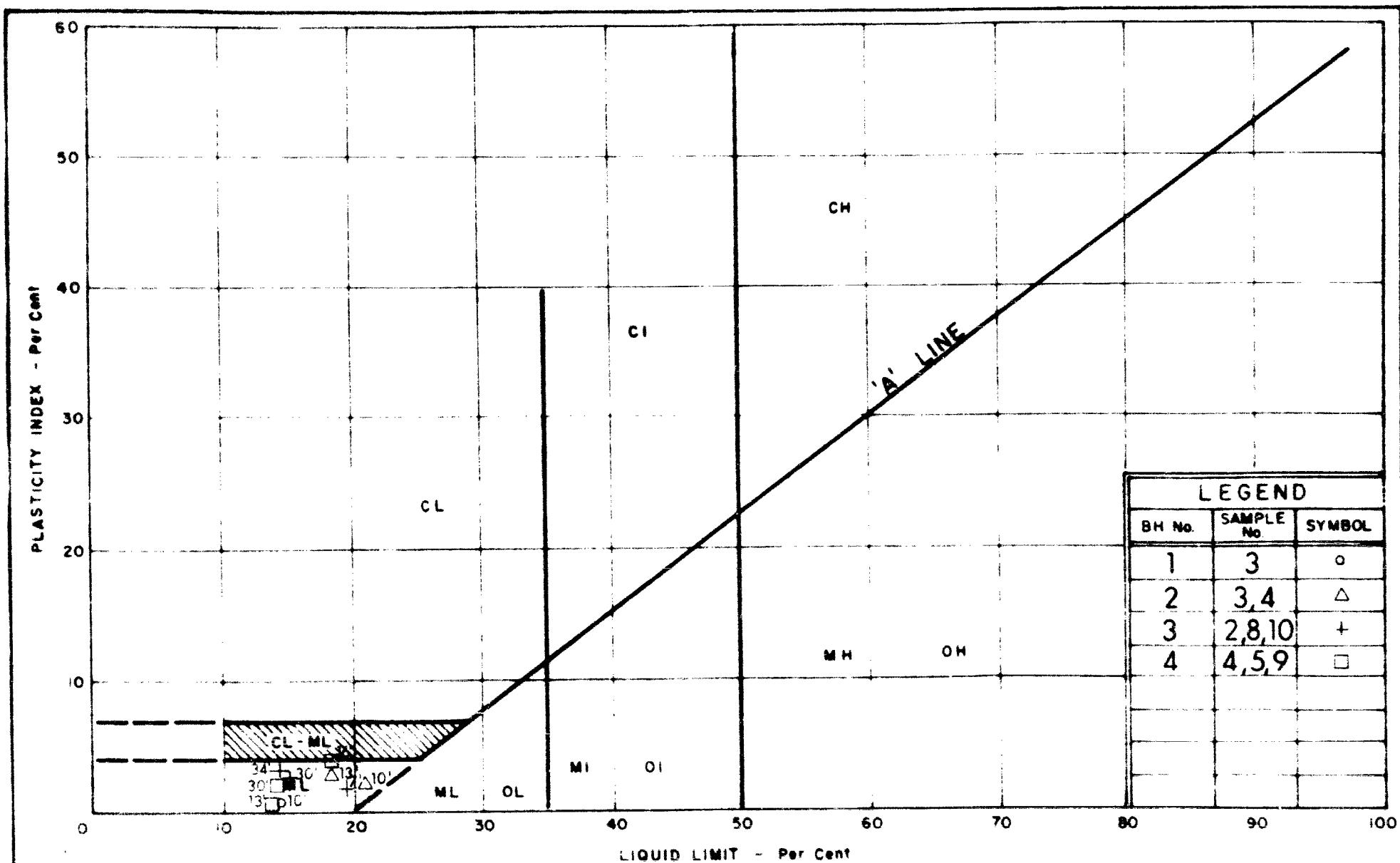
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION GLACIAL TILL

W.P. No. 417-65

JOB No. 68-F-38

FIGURE 1



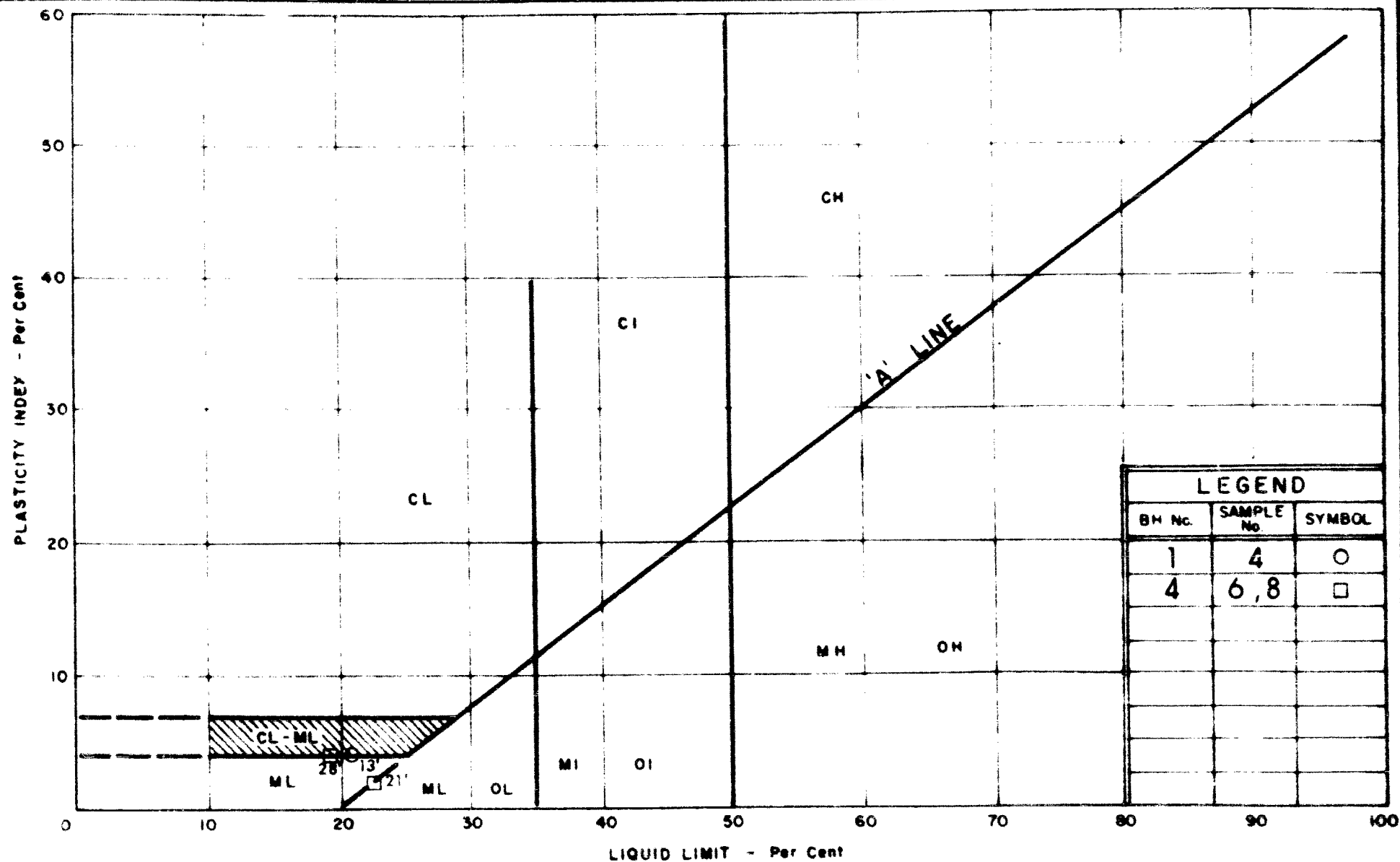
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART GLACIAL TILL

WP No. 417-65

JOB No. 68-F-38

FIGURE 3



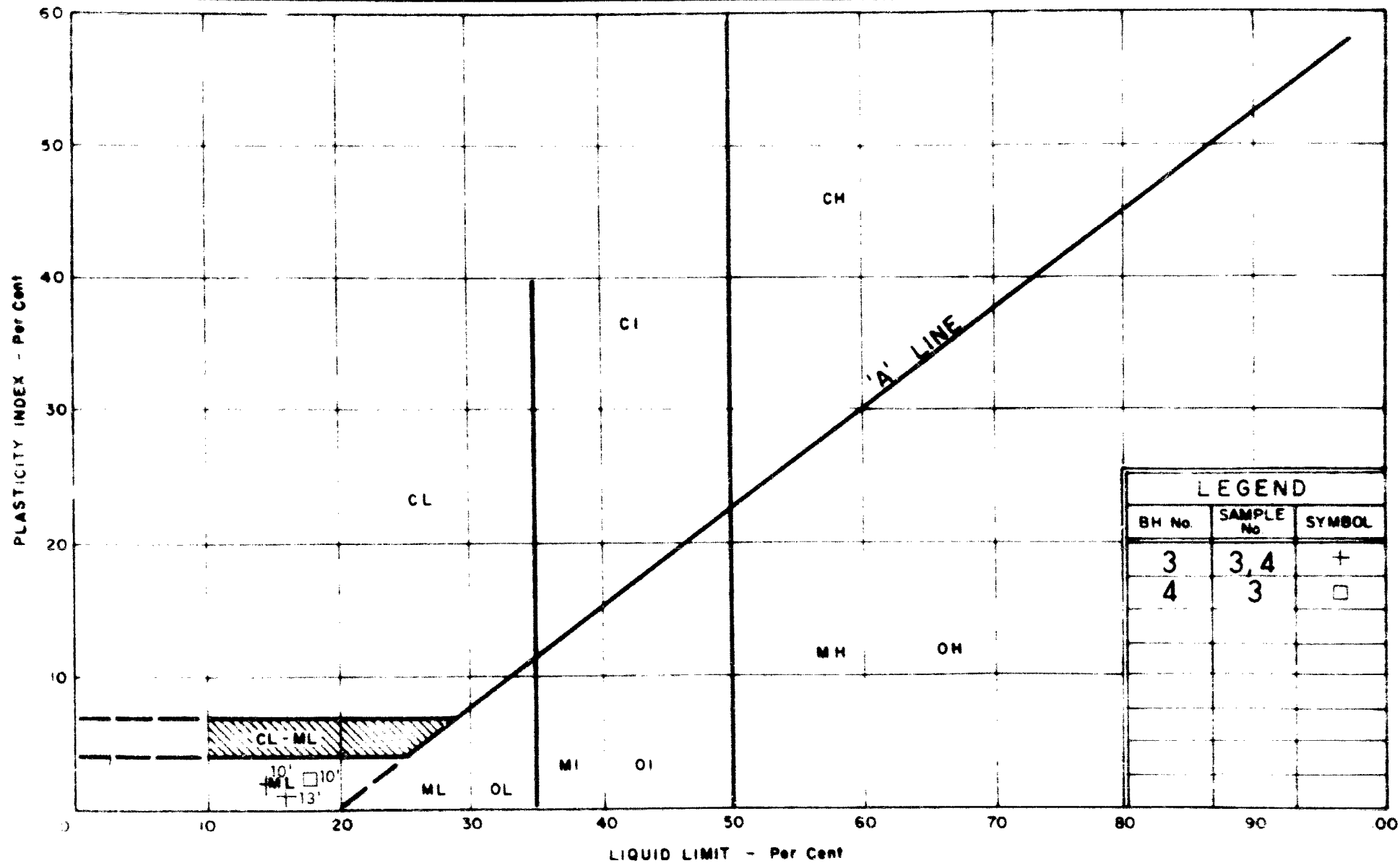
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

PLASTICITY CHART SILT WITH CLAYEY SILT SEAMS

WP No. 417-65

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FIGURE 4



DEPARTMENT OF HIGHWAYS
**MATERIALS and
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DIVISION**

PLASTICITY CHART SANDY SILT

WP No. 417-65

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FIGURE 5

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 SAMPLER
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

Q _u	UNCONFINED COMPRESSION	L.V	LABORATORY VANE
Q	UNDRAINED TRIAXIAL	F.V	FIELD VANE
Q _{cu}	CONSOLIDATED UNDRAINED TRIAXIAL	C	CONSOLIDATION
Q _d	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_i	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
$\bar{\sigma}$	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