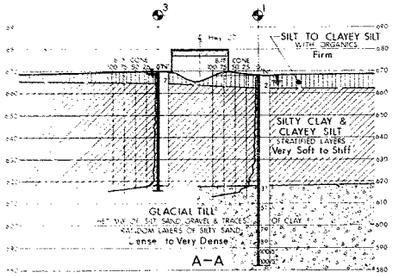
CONT. 72-25

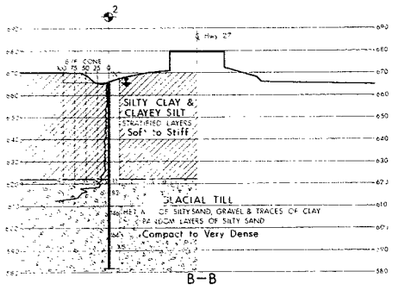
WYE RIVER

+ HWY. 27

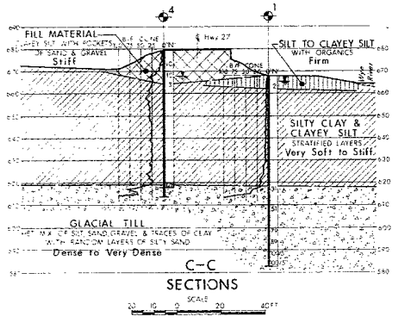
31D-109



A–A



B–B



C–C

SECTIONS

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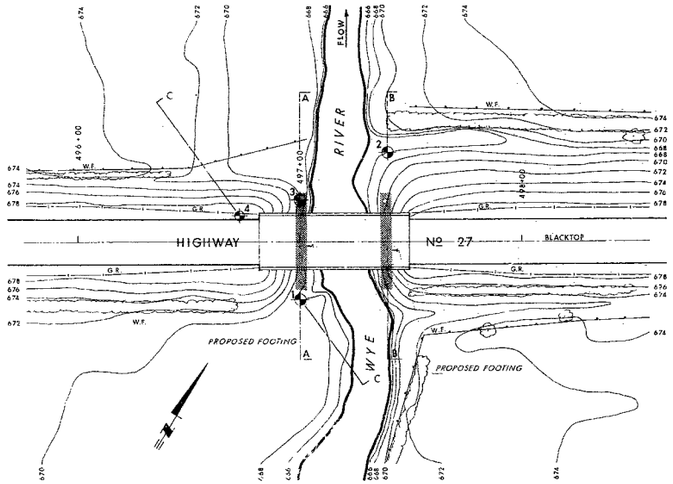

PLAN

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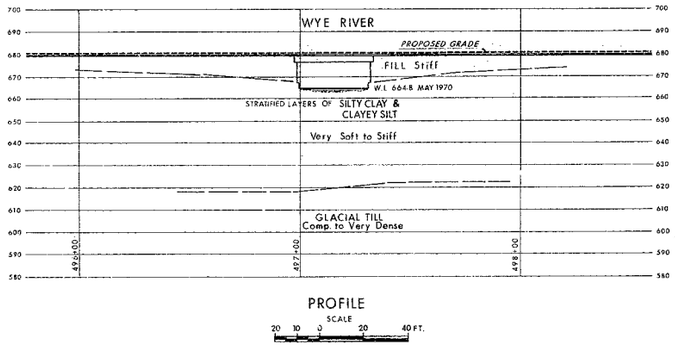

PROFILE

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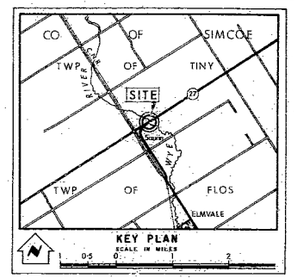
REF. No E - 4883 - 1



KEY PLAN
SCALE IN MILES

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. AUG 1970

NO.	ELEVATION	STATION	OFFSET
1	668.0	497+00	26' RT.
2	666.0	497+40	40' LT.
3	670.0	497+00	19' LT.
4	679.4	496+73	11' LT.

– 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

PRINT RECORD

NO	FOR	DATE

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

WYE RIVER

KING'S HIGHWAY NO. 27 DIST. NO. 5
CO. SIMCOE
TWP. FLOS & TINY LOT 5 & 13 CON. 2 & 1

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D V.K.	CHECKED	W.P. NO. 282-66-00	W.S.T. DRAWING NO. 70-11069A
DRAWN G.G.	CHECKED ✓	JOB NO. 70-11009	
DATE Oct. 28, 1970		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

GEOCRES NO. 31D-109

72-25

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

31D-109

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

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

Attention: Mr. S. McCombie

Date: October 20, 1970

Our File Ref.

In reply to NOV 3 - 1970

Subject:

31D - 109
GEOCRES No.

FOUNDATION INVESTIGATION REPORT
For
Proposed Structure at the Crossing of
Wye River and Hwy. #27
Township of Flos - County of Simcoe
District No. 5 (Owen Sound)
W.O. 70-11069 -- W.P. 282-66-00
Cont 72-025 site 30-57

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.

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS/MJeP
Attach.

cc: Messrs. B. R. Davis
H. A. Tregaskes
D. W. Farren
W. Zonnenberg
G. M. Sinclair
A. P. Watt (2)
J. Roy
B. A. Singh

Foundations Files
Gen. Files

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
For
Proposed Structure at the Crossing of
Wye River and Hwy. #27
Township of Flos - County of Simcoe
District No. 5 (Owen Sound)
W.O. 70-11069 -- W.P. 282-66-00

1. INTRODUCTION:

The Foundation Section was requested to carry out an investigation for the proposed structure at the crossing of Wye River and Hwy. #27, Twp. of Flos, County of Simcoe. The new structure is to replace the existing one. The request was contained in a memo from Mr. A. P. Watt, Regional Bridge Planning Engineer, Southwestern Region, dated July 21, 1970. An investigation was subsequently carried out by this Section to determine the subsoil conditions at the site.

This report contains the results of the investigation together with recommendations pertaining to the foundations of the proposed structure and the stability of the approach fill embankments.

2. DESCRIPTION OF THE SITE AND GEOLOGY:

The site is located about 2.5 miles north of Elmvale Village, at a point where Hwy. #27 crosses the Wye River. The northerly flowing river meanders along the floor of a broad, flat valley, the surface of which varies between elevation 670 and 672. The river channel is approximately 22 feet wide and 6 feet deep.

The existing structure, crossing the river, is a single-span (33 feet) concrete beam bridge, the abutments of which are supported on piles. The associated approach embankments have a maximum height of 9 feet and 15 feet in the transverse and

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

longitudinal direction, respectively. The structure is in a poor state of repair exhibiting massive concrete deterioration. The existing approaches, which are standing with side slopes of approximately 2:1, seem to be stable.

The profile of the approaches, in the vicinity of the structure, is, however, dish-shaped. The asphalt pavement is cracked in numerous places and further, there are definite signs that Hwy. #27 has been re-surfaced at least once. These facts would seem to indicate that the existing fill sections have settled considerably since the fall of 1929, when they were placed.

The site is located in an area known as the Elmvale Clay Plain, which forms a part of the physiographic region referred to as the "Simcoe Lowlands". The Elmvale Clay Plain is characterized by a deep marly stratified clay stratum which has been laid down in glacial Lake Algonquin. The cohesive stratum is underlain by an extensive glacial till deposit. The overburden is underlain by limestone bedrock of the Trenton and Black River formation, Ordovician Period.

3. FIELD AND LABORATORY WORK:

Four sampled boreholes, each accompanied by a dynamic cone penetration test, were put down at this site. The borings were advanced by means of a conventional diamond drill adapted for soil sampling purposes.

Samples of the cohesive subsoil were recovered at required depths in 2" I.D. Shelby tubes, which were pushed manually into the soil. In the granular deposit material was obtained in a split-spoon sampler which was hammered into the soil in accordance with the specifications for the Standard Penetration Test. The same method was used to advance the dynamic cone penetration tests. Field vane tests were also carried out, where possible, to determine the undrained shear strength of the cohesive deposits.

..... 3

3. FIELD AND LABORATORY WORK: (cont'd.) ...

The locations and elevations of all the borings were surveyed in the field by personnel from the Foundation Section; they are shown on Drawing 70-11069A, together with estimated stratigraphical sections across the site. All elevations in the report are referenced to a geodetic datum.

All samples were visually examined and identified in the field and later in the laboratory. Following this, laboratory tests were carried out on selected representative samples to determine the following physical properties:

- Atterberg Limits
- Natural Moisture Contents
- Bulk Densities
- Grain-Size Distributions
- Undrained Shear Strength
- Consolidation Characteristics

The results of the laboratory testing are plotted on the Record of Borelog sheets and summarized on Figures #1 to 5, located in the Appendix of the report.

4. SUBSOIL CONDITIONS:

4.1) General:

The site is covered with a layer (1 to 5.5 feet) composed of firm silt to clayey silt with some organics. The surficial layer is underlain by the predominant stratum across the site composed of a very soft to stiff stratified silty clay to clayey silt whose thickness varies from 42.5 to in excess of 47 feet. The cohesive stratum is underlain by an extensive competent glacial till deposit.

up to 15 feet of fill has been placed over the natural occurring overburden deposits to form the approaches to the existing structure.

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

4.2) Clayey Silt, with Pockets of Sand and Gravel (Fill):

Fifteen feet of fill was encountered at B.H. #4, which was put down through the existing south approach. The fill is composed of a stiff ('N' values 10 blows/ft.) clayey silt with numerous random pockets of sand and gravel throughout.

4.3) Stratified Silty Clay and Clayey Silt:

Beyond the limits of the existing approaches, the site is covered with a layer of silt (loose) to clayey silt (soft to firm) with some organic matter. The thickness of this layer varies from 1 to 5.5 feet.

The surficial layer, or the fill, is underlain by a cohesive stratified stratum, the thickness of which varies between 42.5 and 47 feet. The composition of the individual layers varies from silty clay to clayey silt; the thickness of the layers varies from 2 to 4 inches. Random seams of silt, up to 1/2 inch thick, are present throughout the stratum. Grain-size distribution testing was performed on samples from the stratum; the results are plotted in envelope form on Figure #2, in the Appendix to this report.

The individual layers, from selected samples of the stratified stratum, were separated in order to determine their characteristic physical properties. Other samples, however, were tested wholly, in order to obtain the undrained shear strength of the overall deposit. The various physical properties are plotted on the Record of Borelog sheets and summarized in the table which immediately follows:

..... 5

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

4.3) Stratified Silty Clay and Clayey Silt: (cont'd.) ...

Identity Tests:		Silty Clay Layers	Clayey Silt Layers
Liquid Limit (%)	(W_L)	36 - 45.5	25 - 31
Plastic Limit (%)	(W_P)	17.5 - 24.5	17 - 22
Natural Moisture Content (%)	(W)	43.5 - 62.5	29 - 38
Liquidity Index	(I_L)	1.3 - 2.0	1.1 - 2.0
Bulk Density (p.c.f.)	(γ)	109 - 112	107 - 119

Compressibility Characteristics:

		Silty Clay Layers	Clayey Silt Layers
Initial Void Ratio	(e_o)	2.2	1.1
Compression Index	(C_c)	1.4	0.58
Degree of Preconsolidation (p.s.f.)	($P_c - P_o'$)	600	1,800

1 Test

*Undrained Shear Strength:

(p.s.f.)	(C_u)
Insitu Field Vane Tests	200 - 1,100
Laboratory Tests	150 - 900
Sensitivity (S_t)	3 - 10

*NOTE: All testing carried out on composite samples.

..... 6

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

4.3) Stratified Silty Clay and Clayey Silt: (cont'd.) ...

The Atterberg limit test results, given in the table, are also summarized on the Plasticity Chart, Figure #1. The testing indicates that the stratum is inorganic; further, the silty clay and clayey silt layers exhibit an intermediate and low plasticity, respectively. The natural moisture content of the individual layers varies randomly throughout the deposit. It is consistently above the liquid limit; this was exemplified by the high liquidity index values obtained.

The field and laboratory shear strength results are plotted on the Record of Borelog sheets and summarized on the Undrained Shear Strength vs. Elevation Profile, Figure #3. The results indicate that the stratum has a consistency which ranges from very soft, in the upper portion, increasing to stiff with depth.

Based on conventional stress-strain theory, the cohesive stratum, located beneath the approaches, should exhibit an increase in strength with time following fill placement due to the consolidating effect of the fill loadings. Referring to Figure #3, it can be seen that the pattern of strength vs. elevation is similar for those borings (B.H.'s #1, 2 and 3) put down solely through the natural ground and the boring (B.H. #4) put down through the approach fill. This would indicate that this increase has not occurred. It is believed that this is due to the fact that the ratio of the induced stress to the initial undrained shear strength of the cohesive stratum is relatively high and thus the deposit has been 'overstressed'. Case histories have indicated that the expected increase in shear strength is often not realized within that portion of the deposit which has been significantly overstressed.

The consolidation characteristics of the cohesive stratum were determined by carrying out two laboratory consolidation tests, the results of which are shown as Void Ratio vs. Pressure plots on Figure #4. Referring to the table, it can be seen that the upper

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

4.3) Stratified Silty Clay and Clayey Silt: (cont'd.) ...

portion of the stratum is preconsolidated by as little as 500 to 600 p.s.f. in excess of the existing overburden pressure. At greater depth, however, the preconsolidation could be of the order of 1,800 to 2,000 p.s.f. The values quoted for the Compression Index (C_c) and Initial Void Ratio (e_o) are typical for the type of subsoil encountered.

4.4) Heterogeneous Mixture of Silt, Sand and Gravel, trace of Clay (Glacial Till):

This deposit directly underlies the cohesive stratum. The glacial till was not fully penetrated at any of the boring locations; it was, however, proven to extend for a depth of 39 feet at B.H. #2. In general, the deposit is composed of a heterogeneous mixture of silt, sand and gravel with a trace of clay. Random layers of silty sand, up to 1 inch thick, are present throughout. Grain-size distribution curves, for representative samples, are shown on Fig. #5.

Standard penetration tests were performed within the deposit. This testing gave 'N' values which range between 11 blows/ft. and 100 blows for 5 inches. Based on these results, it is estimated that the relative density ranges from compact to very dense, being generally very dense.

5. GROUNDWATER CONDITIONS:

Groundwater level observations have been carried out in the open boreholes during the period of investigation. These observations are recorded on the Borelog sheets as well as on Drawing 70-11069A. These observations indicate that the groundwater level varies from elevation 666 to 669, which is slightly above the water level in the river at the time of the investigation (elev. 665). These elevations are in close proximity to the existing ground surface along the flat terrain located adjacent to the Wye River.

6. DISCUSSION AND RECOMMENDATIONS:

6.1) General:

It is proposed to replace the existing 25 feet wide single-span (33 feet) concrete beam bridge at the crossing of Hwy. #27 and the Wye River, in the Township of Flos, County of Simcoe. The new single-span structure will have a span length of 38 feet and a width of 40 feet.

The proposed profile grade of Hwy. #27, in the vicinity of the crossing, will be about elevation 681. To realize this grade the height of the existing approach fills will have to be increased by about 1-1/2 feet - i.e., to a maximum height of 11 feet above existing ground level. Further, the existing fills will be widened in both a northerly and southerly direction.

The predominant stratum across the site is composed of a very soft to stiff stratified silty clay to clayey silt; the thickness of this stratum ranges from 42.5 to 47 feet. The cohesive stratum is underlain by an extensive competent glacial till deposit. The site is covered by a thin layer of silt to clayey silt with a trace of organic matter.

The presence of the soft, compressible cohesive stratum at a shallow depth below ground surface is the governing factor from a foundation point of view. It will be necessary to ensure that it is not 'overstressed' by either the embankment or structure surcharge loadings. These aspects will be discussed in the sub-sections to follow.

6.2) Approach Embankments:

6.2.1) Stability Considerations:

It is understood that it is proposed to employ closed-type abutments which will retain the approaches in the forward direction. The critical location, as far as the stability of the fills is concerned, will, therefore, be in the longitudinal direction.

..... 9

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

6.2) Approach Embankments: (cont'd.) ...

6.2.1) Stability Considerations - (cont'd.) ...

a) Existing Approaches -

The stability of the existing approaches was studied in detail in order to:

i) define the existing conditions in the light of the factual information obtained from this investigation; and

ii) aid in determining the feasibility of increasing the profile grade of Hwy. #27 as proposed.

The analyses have been carried out in terms of total stresses (ϕ = 0) both manually and by the use of the electronic computer. In this approach the stability is governed by the applied loads and by the stress-strain and undrained shear strength characteristics of the foundation and embankment soils. The following parameters were assumed for the various soil strata.

Elevation	Soil	Bulk Density (p.c.f.)	Undrained Shear Strength (Cu (p.s.f.)
-	Embankment Fill (Clayey Silt)	120	1,000
666 - 655	Stratified Silty Clay to Clayey Silt	100	300
655 - 645		100	400
645 - 637		100	550
637 - 627		100	700

The computations indicate that the existing approach fills (maximum height 9.5 feet - 2:1 slopes) are stable in the transverse direction. As discussed previously, closed-type abutments presently retain the approaches in the forward direction. Here the profile grade of Hwy. #27 is about 15 feet above the invert of the Wye River. The analyses indicate that, in this the longitudinal direction, the approaches are in a state of limiting equilibrium - i.e., the factor of safety is close to unity.

..... 10

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

6.2) Approach Embankments: (cont'd.) ...

6.2.1) Stability Considerations - (cont'd.) ...

b) Proposed Scheme:

It is proposed to employ closed-type abutments; further the grade of Hwy. #27 is to be raised to elevation 681 (an increase of about 1-1/2 feet). Since, in the longitudinal direction, the existing approaches are in a state of limiting equilibrium, the proposed sections will have a factor of safety with respect to stability of less than unity. This, from an engineering standpoint, is unacceptable. Therefore, if closed-type abutments are to be adopted, it will be necessary to maintain the existing grade of Hwy. #27.

If it is imperative to increase the grade to elevation 681, then an alternate scheme will be required to ensure the stability of the approaches in the longitudinal direction. The most feasible scheme would be to construct approaches which spill through in the forward direction. Computations carried out indicate that a 20-foot wide mid-height berm (with standard 2:1 slopes) will be required, in the longitudinal direction, to ensure stability. This will entail lengthening the structure by about 73 feet over that proposed. In the transverse direction fills, of the maximum height contemplated (11 feet), will be inherently stable providing standard 2:1 slopes are maintained.

The earth embankments, within the confines of the Nye River, should be protected against the scour action of the river; this protection should extend to a level above the maximum high water level recorded. It is understood that recommendations pertaining to this will be presented by the Hydrology Section.

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

6.2) Approach Embankments: (cont'd.) ...

6.2.2) Settlement Considerations -

The compressible cohesive stratum will undergo settlement, due to consolidation over a period of time, under the weight of the approach fills. Settlement computations were, therefore, carried out.

If a closed-abutment scheme is adopted, the profile grade of Hwy. #27 will be maintained as is; the existing embankments will, however, be widened considerably in both directions. Differential settlements will, therefore, occur between the old and new fill sections. It is estimated that the magnitude of this differential settlement could be about 2 to 3 inches; it should be realized within a period of about 10 years.

If the spill-through scheme is adopted, the embankments will be heightened as well as widened. In this case, it is estimated that the total consolidation settlement, beneath the centre-line of the revised section, could be of the order of 3 to 4 inches. A maximum differential settlement of about 2 inches is expected between the old and new fill sections. The total amount of this settlement should occur within a period of time similar to that quoted in the previous paragraph.

It is recommended that:

i) the topsoil be completely removed from the existing slopes; and

ii) the new fill be 'keyed' into the old in accordance with current D.H.O. practices, in order to provide a smooth transition between the existing and future expanded sections.

6.3) Structure Foundations:

The structure elements should be supported on end-bearing piles, no matter which of the alternate schemes discussed previously is adopted, since the subsoil is soft and compressible. The

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

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

end-bearing piles can be driven to practical refusal within the lower portion of the competent glacial till deposit. For estimating purposes, it can be assumed that the piles would meet practical refusal between elevations 590 and 600. The allowable pile load would be dependent on the section chosen - for example, 14 BP 74 steel H-piles could be designed to carry 95 tons/pile. The pile driving, within the glacial till deposit, should be controlled by employing the Hiley Dynamic Pile Driving formula, in accordance with current D.H.O. practice.

A temporary dewatering scheme will be required to prevent water from the river flowing into pile cap excavations located within close proximity of the Wye River. A relatively impervious dyke located between the excavation and the river would be a suitable solution. This dyke could be composed of the locally available cohesive soil. Any minor seepage or surface run-off into the excavations could be controlled by pumping from sumps.

7. MISCELLANEOUS:

The field work, performed during the period of August 5 to 14, and October 26, 1970, was carried out under the immediate supervision of Mr. V. Korlu, Project Foundation Engineer.

The equipment was owned and operated by Master Soil Investigation Ltd., Toronto.

This report was prepared by Mr. V. Korlu and Mr. B. T. Darch, Senior Foundation Engineer. The project was carried out under the general supervision of Mr. M. Devata, Supervising Foundation Engineer, who reviewed this report.

October, 1970

APPENDIX I

FORM OB-MT-126 (REV 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 70-11069 LOCATION Hwy.27 & Wye River Sta. 497 + 00 26' Rt. ORIGINATED BY VK
W.P. 282-66-00 BORING DATE August 5, 1970 COMPILED BY VK
DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY

ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS / FOOT	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
668.0	Ground Level					
0.0	Silt to clayey silt with organics.					
662.5		1	SS	2	2.6%	
5.5	Stratified layers of silty clay and clayey silt Soft to Stiff	2	TW	PM		
		3	TW	PM	109 107	0 0 45 55 0 0 80 20
		4	TW	PM		
		5	TW	PM		
		6	TW	PM		
618.5						
49.5	Het.mix.of silt, sand, gravel and traces of clay (Glacial Till) with random layers of silty sand Dense to Very Dense	7	SS	31		5 46 32 17
		8	SS	51		0 96 (4)
		9	SS	79		
		10	SS	89		12 48 35 5
		11	SS	100/5"		
582.0		12	SS	100/5"		
86.0	End of Borehole					

ELEV SCALE: 660, 650, 640, 630, 620, 610, 600, 590, 580

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE — 400 800 1200 1600 2000

+2 +6 +7 +9 +9 ×+7 +4

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w

WATER CONTENT % — 15 30 45

20
15 ⟡ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 70-11069 LOCATION Hwy. 27 & Wye River Sta. 497 + 40 40' Lt. ORIGINATED BY VK
W.P. 282-66-00 BORING DATE August 10, 1970 COMPILED BY VK
DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY

ELEV. DEPTH	SOIL PROFILE DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
666.0	Ground Level					
0.0	Topsoil					
1.5	Stratified layers of Silty clay & clayey silt Soft to Stiff		1	TW	PM	660
			2	TW	PM	
			3	TW	PM	650
			4	TW	PM	
			5	TW	PM	640
			6	TW	PM	
622.0						630
44.0	Het.mix.of silty sand, gravel & traces of clay (glacial Till) with random layers of silty sand. Compact to Very Dense		7	SS	11	620
			8	SS	82	
			9	SS	146	610
			10	SS	164	600
			11	SS	100/5"	590
582.5						
83.5	End of Borehole					580

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100
SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE
400 800 1200 1600 2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 15 30 45

BULK DENSITY γ P.C.F.

REMARKS

GR SA SI CL

0 2 81 17

20 45 27 8

0 96 (4)

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM GS-MT-116 (REV. 1966) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 70-11069 LOCATION Hwy. 27 & Wye River ORIGINATED BY VK
W.P. 282-66 BORING DATE Aug. 14, 1970 COMPILED BY VK
DATUM Geodetic BOREHOLE TYPE Washboring -NX Casing CHECKED BY [illegible]

SOIL PROFILE ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT (20 40 60 80 100) SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE) (400 800 1200 1600 2000)	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w WATER CONTENT % (15 30 45)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
670.0	Ground level									
0.0	Silt to clayey silt with organics									
665.0	Firm		1	SS	7				2.6%	0 36 61 3
5.0			2	TW	PM		+6			
	Stratified layers of		3	TW	PM	660	+4		117	
	Silty clay & clayey		4	TW	PM		+6		112.5	0 0 57 43 Co=2.21 Pc=0.68 tsf Cc=1.38
	silt		5	TW	PM		+8			
							+10			
	Very Soft to Stiff		6	TW	PM	650				
							+8			
			7	TW	PM		×	H ○ ○	120	0 0 85 15 0 0 62 38 Co=1.652 Cc=0.575
							+6			
			8	TW	PM	640				
							+5			
							+6			
			9	TW	PM		○ ×	○	119	0 0 30 70 0 2 63 15 0 0 78 22
							+10			
618.0							+9			
52.0	End of Borehole									

20
15 ⊹ 5 % STRAIN AT FAILURE
10

FORM OB-MT-126 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 70-11069 LOCATION Hwy.#27 & Wye River Sta.496+73 o/s 11' Lt. ORIGINATED BY BTD
W.P. 282-66-00 BORING DATE October 26, 1970 COMPILED BY BTD
DATUM Geodetic BOREHOLE TYPE Washboring-NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT
679.4	Ground Level				
0.0	Clayey silt, pockets of sand & gravel (Fill)		1	SS	10
	Mottled Grey & Brown Stiff		2	SS	10
664.4			3	SS	3
15.0	Stratified layers of Silty clay and clayey silt		4	TW	PM
			5	TW	PM
			6	TW	PM
			7	TW	PM
			8	TW	PM
	Very Soft to Stiff		9	TW	PM
			10	TW	PM
619.4					
617.9	(Glacial Till) Very Dense		11	SS	128
61.5	End of Borehole				
613.6					
65.8	End of Cone Test				

ELEV. SCALE: 670, 660, 650, 640, 630, 620, 610

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 20 40 60 80 100

SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000

+s3 +s5 +s6 +s4 +s7 +s6 +s3 +s9 +s6 +s4 +s5 +s5 +s6 +s3

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %

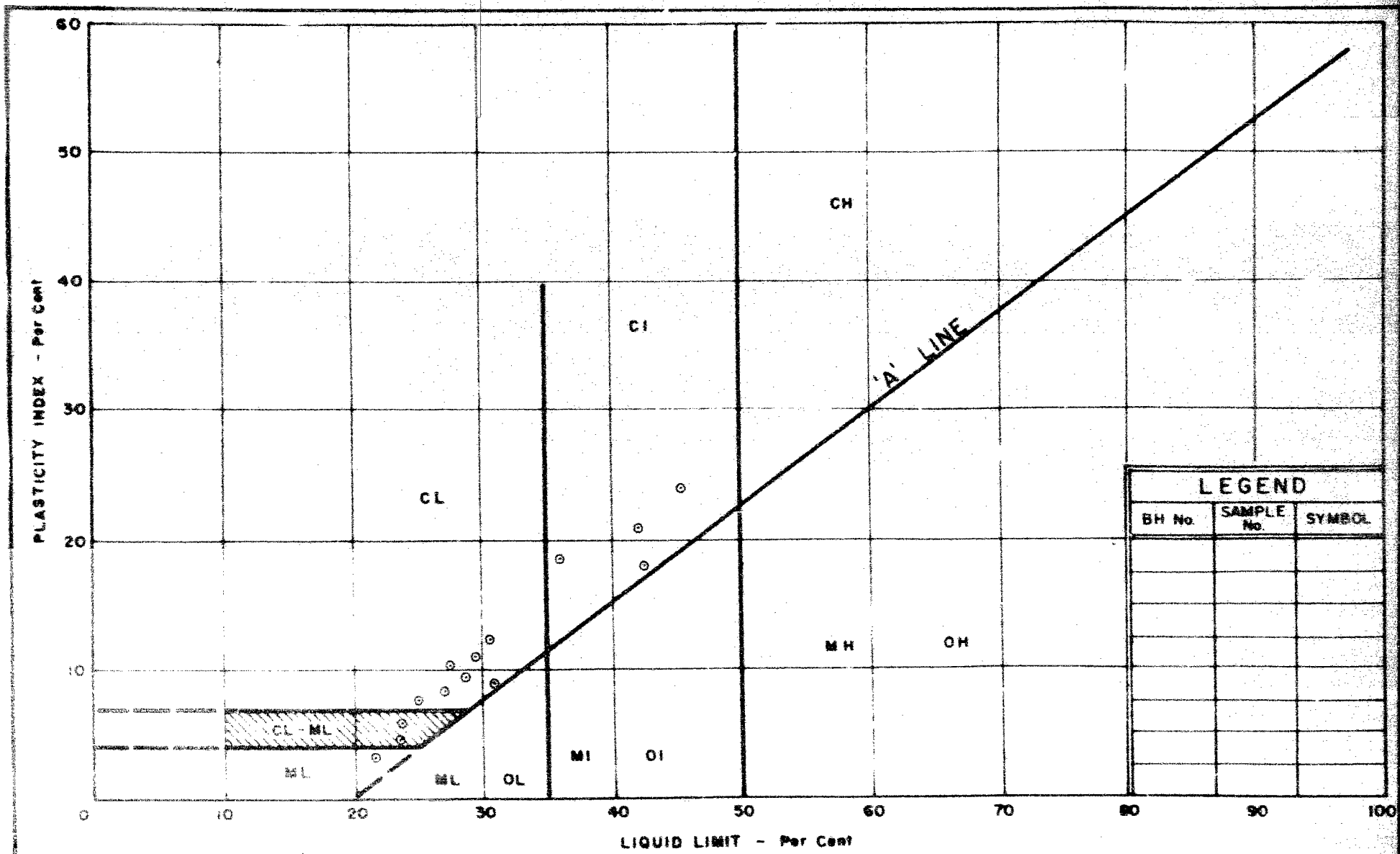
BULK DENSITY γ P.C.F.

REMARKS
GR.SA.SI.CL.

667.5
WL in open BH Oct.26/70

20
15 ✛ 5 % STRAIN AT FAILURE
10

FORM QB-[illegible]252
REVISED JULY, 1966

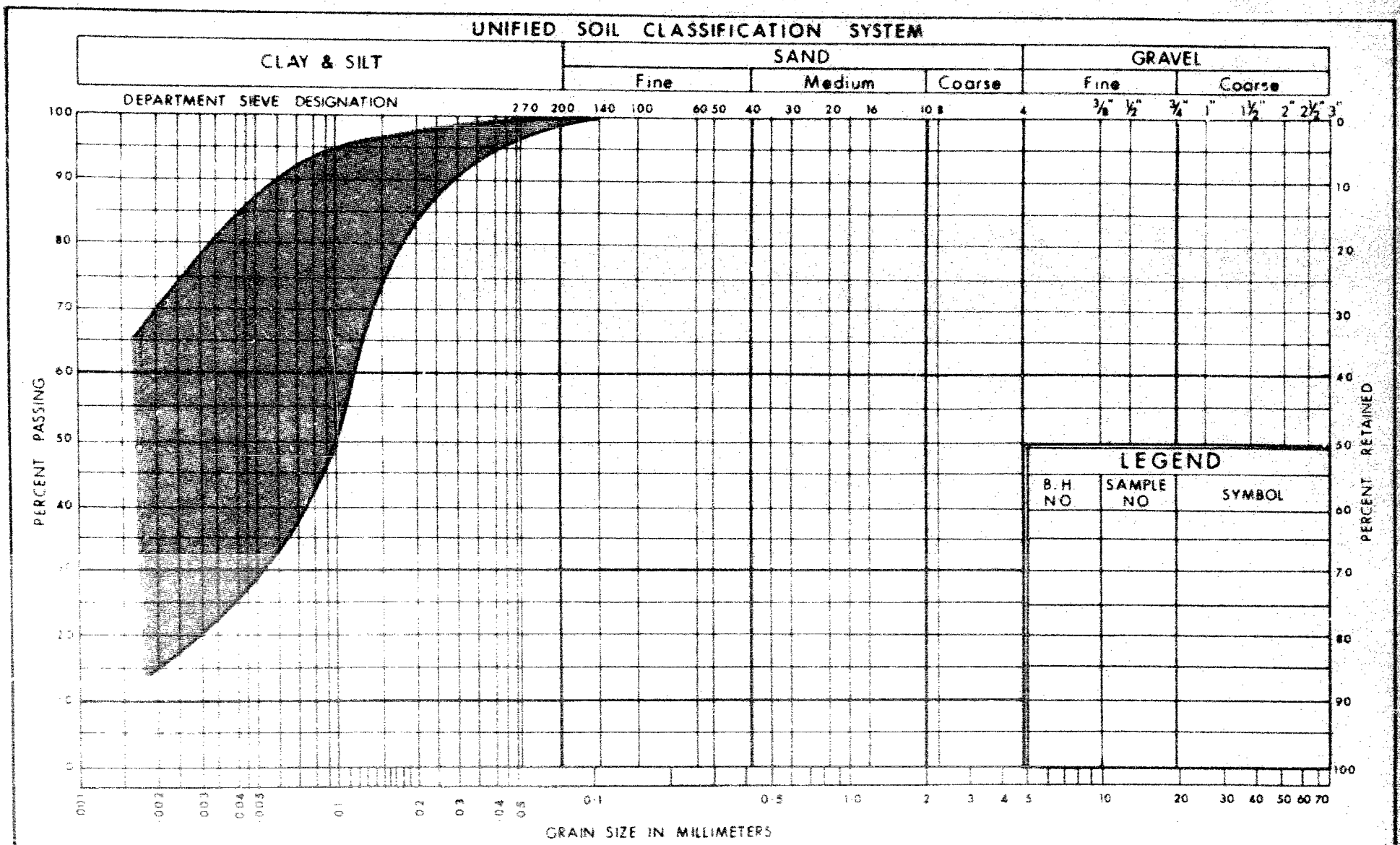


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

W.P. No. 282-66-00
JOB No. 70-11069
FIG. NO. 1

FORM 08 MT-
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

SILTY CLAY TO CLAYEY SILT

W.P No. 282-66-00

JOB No: 70-11069

FIG. NO. 2

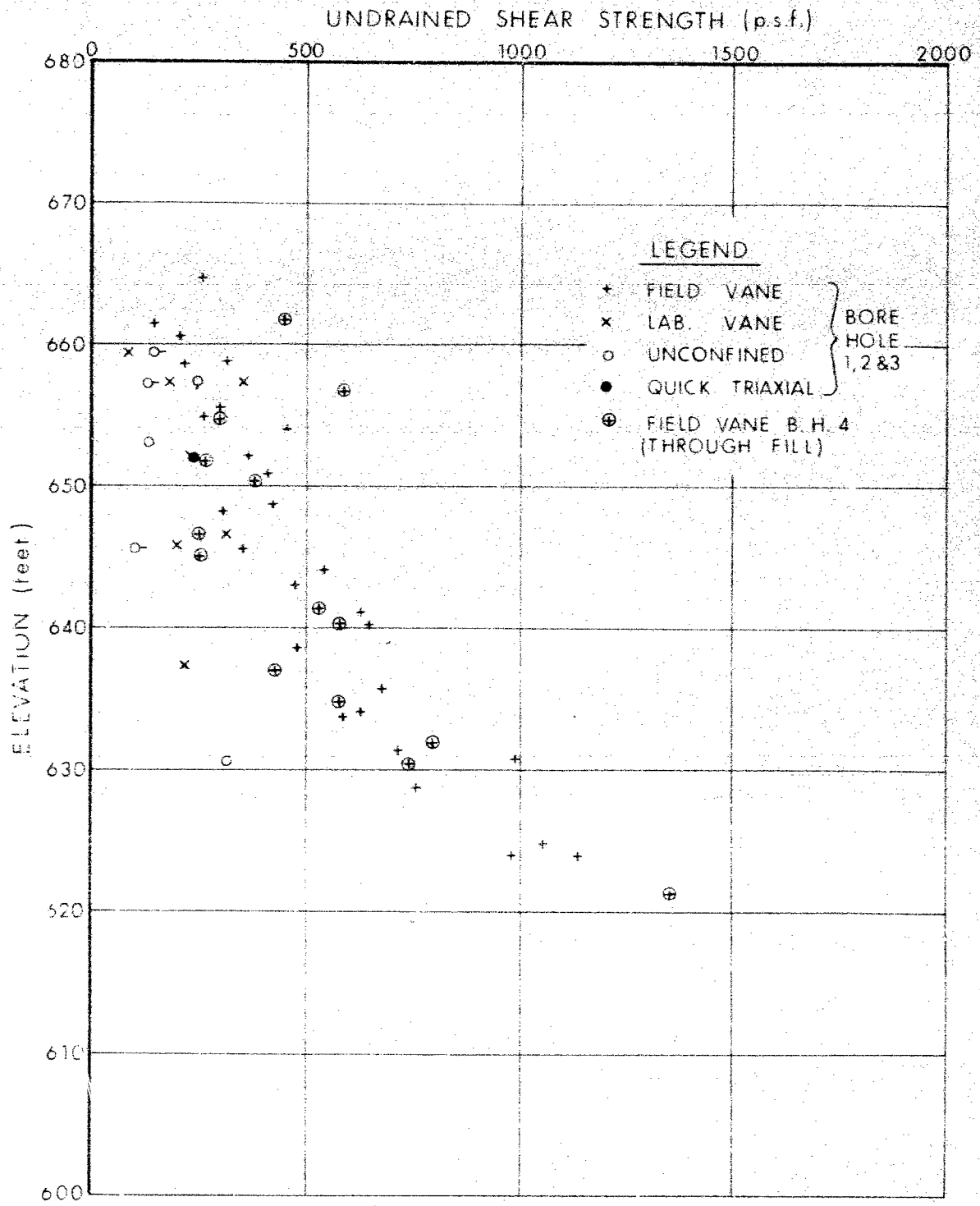
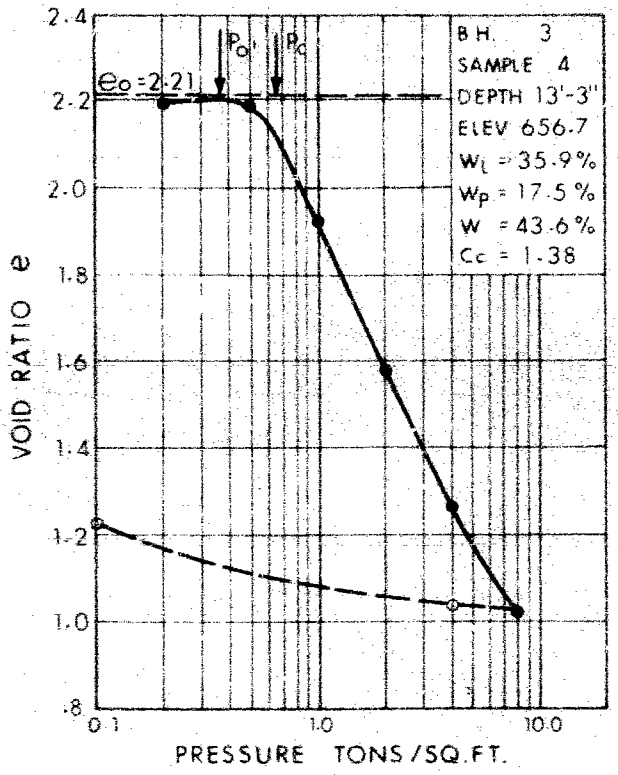


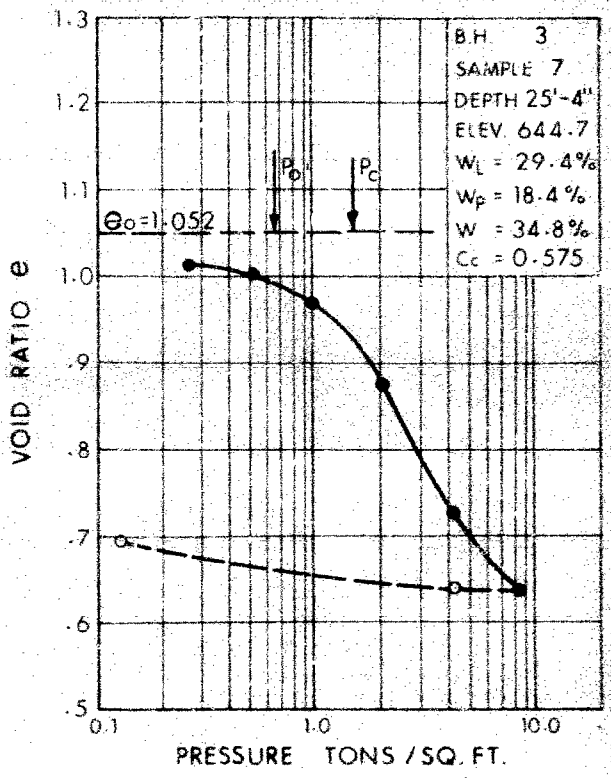
Fig. 3

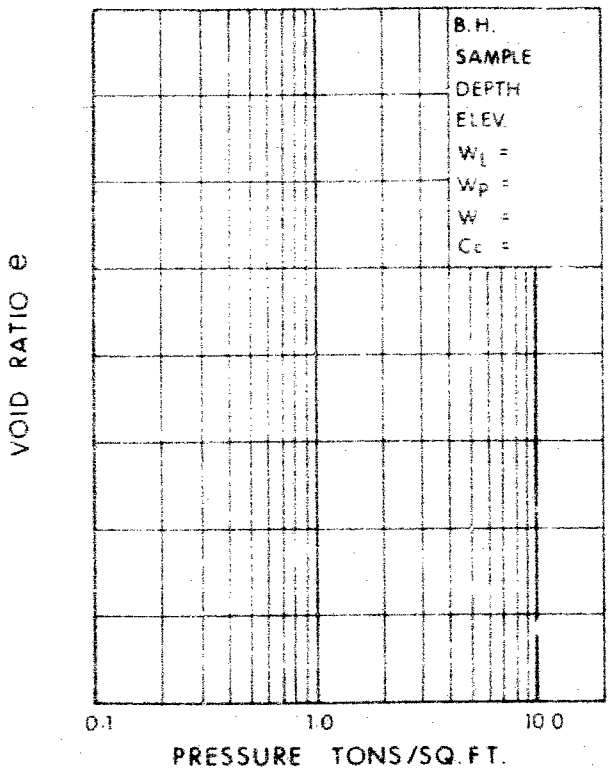
Job 70-11069

VOID RATIO – PRESSURE CURVES

JOB NO. 70-11069







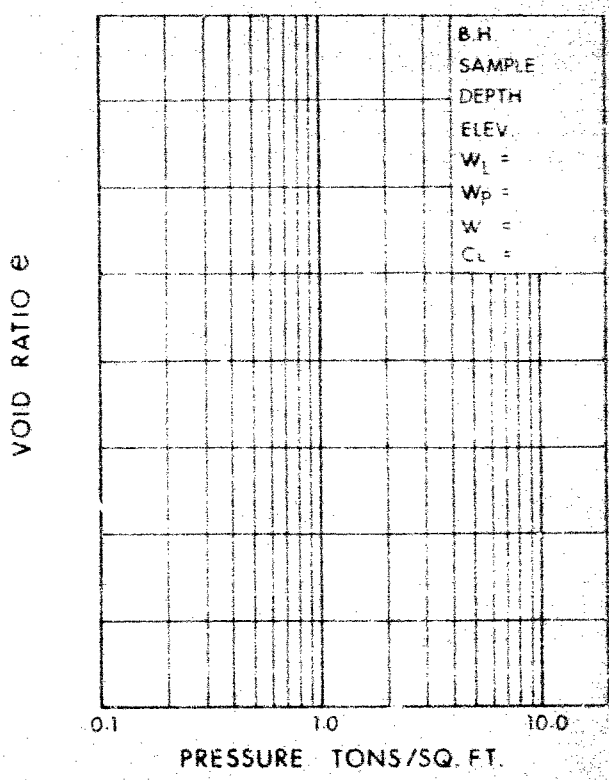
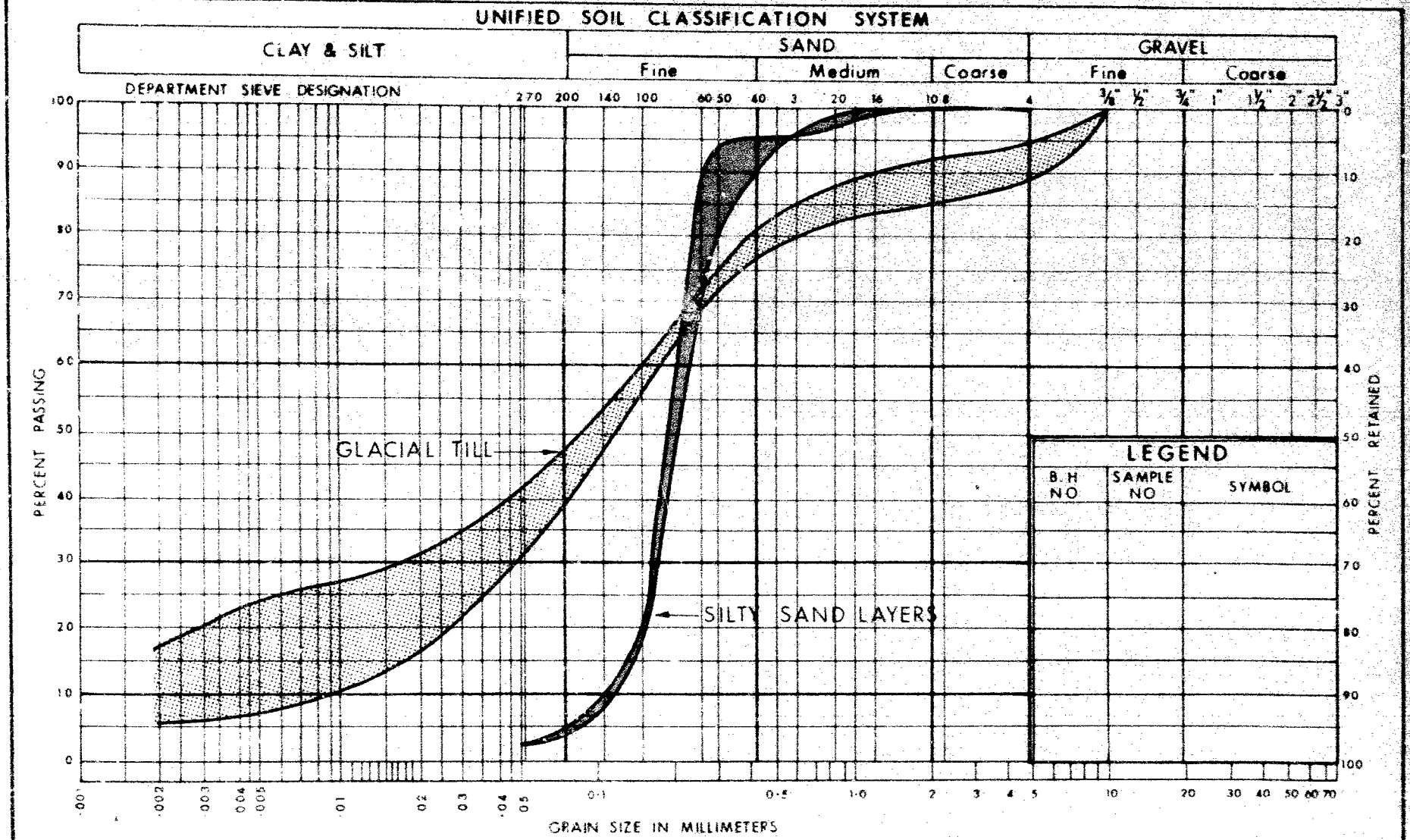


FIG. 4

FORM 08 MT - 17
REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

HET. MIXTURE OF SILT, SAND & GRAVEL (GLACIAL TILL) WITH RANDOM LAYERS OF SILTY SAND.

W.P. No. 282 - 66 - 00

JOB No: 70 - 11069

FIG. NO. 5

SUMMARY OF PILE DRIVING RECORDS

W.O. 70-11069 W.P. 282-66-00 CONT. 72-25 DIST. 5

SITE WYE RIVER ℄ HWY # 27

DATE DRIVEN JUNE /72 WEIGHT OF ANVIL 1,100 LBS

HAMMER TYPE B-225 WEIGHT 1.425 T. ENERGY 25,000 FT.LBS

LOCATION OF PILES	PILE				ESTIMATED TIP EL. (ft.)	DIFFERENCE Longer(+) Shorter(-) Than Estimated (ft.)	REMARKS
	TYPE	NO.	LENGTH (ft.)	TIP EL. (ft.)			
WEST PIER	12-BP-53	16	79	-586	-590 - 600	+4.0	TO TIP OF DRIVEN GLACIAL

OVER

Form OB-MT-285

DEPARTMENT OF HIGHWAYS — ONTARIO

MATERIALS AND TESTING OFFICE

FOUNDATION SECTION

Lot 12 70-11069

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 5 CONTRACT NO. 72-25 STRUCTURE WYE RIVER BRIDGE

CONTRACTOR [redacted] Construction Ltd. DESIGN LOAD OF PILE 70 TONS

HAMMER DETAILS: TYPE B 225 WEIGHT 1.925 TON HEIGHT OF FALL OR ENERGY 25,000 ft-#

TYPE OF ANVIL OR CAP _____ WEIGHT OF ANVIL OR CAP 1100 #

PILE DETAILS 12" x 53# H-PILE

PILE NO. 16 LOCATION WEST PIER DATE DRIVEN 16 JUNE 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.
50'	1	0	50'	26	0	100'	51	9	100'	76	47
	2	0		27	1/4		52	9	100'	77	69
	3	0		28	1/4		53	10	100'	78	105
	4	0		29	1/4		54	18	100'	79	SEE REMARKS
	5	0		30	1/4		55	20		80	
	6			31	1/2		56	21		81	
	7			32	1/2		57	23		82	
	8			33	1/2		58	22		83	
	9		"	34	1/2		59	22		84	
	10			35	1/2	"	60	21		85	
	11			36	1/2		61	22		86	
"	12			37	1/2		62	21		87	
	13	"		38	1/2		63	22		88	
	14			39	2		64	21		89	
	15			40	2		65	22		90	
	16			41	3		66	26		91	
	17			42	6		67	28		92	
	18			43	9		68	27		93	
	19			44	9		69	27		94	
	20			45	10		70	34		95	
	21			46	10		71	34		96	
	22		50'	47	10		72	39		97	
	23		100'	48	9		73	39		98	
	24		100'	49	9		74	38		99	
50'	25	0	100'	50	9	100'	75	48		100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH	10	12	12	14	20	20
MEASURED REBOUND IN INCHES					0.1	0.1

FINAL LENGTH OF PILE 79.00' FINAL CUT OFF ELEVATION 665.00

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

SIGNED D. B. Murrall

NAME (PRINT) D.B. MURRALL

DATE 26 JUNE 72

ATTACH SKETCH OF PILE NUMBERING SYSTEM

665
79
744

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. 12¾" O.D. steel tube x 0.25l" @ 33 lbs. per ft. Vertical. 12¾" x ½" steel plate shoe.

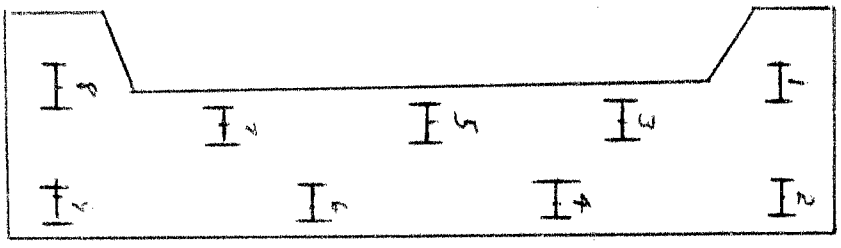
Details for the final six inches of penetration must be completed for all piles except in the case of an end bearing pile driven to bedrock. Final length of pile, and final cut off elevation must always be given.

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

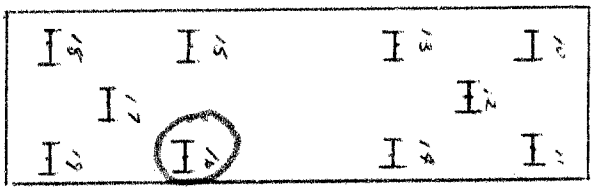
The penetration in blows per foot must be recorded for every foot of penetration of the pile.

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

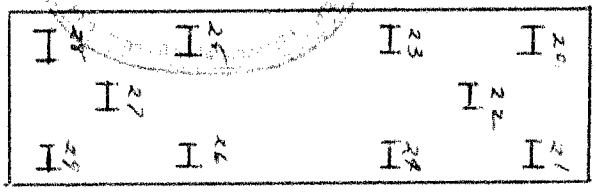
PILE NUMBERING SYSTEM



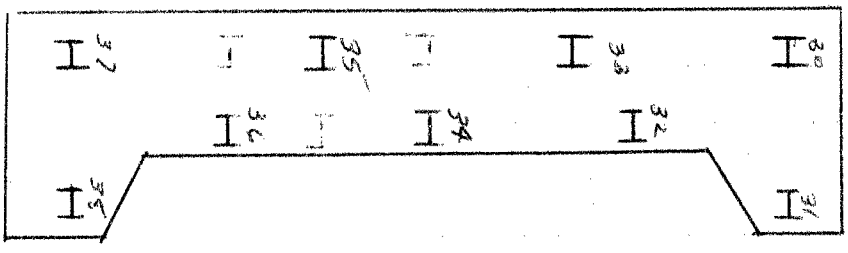
WEST ABUT.



WEST PIER



EAST PIER



EAST ABUT.

Department of Highways Ontario
Copy for the information of
FOUNDATION OFFICE.

Mr. A. Stermac,
Principal Foundation Engineer,
Room 107, Lab. Bldg.

C. S. Grebski,
Structural Office.

September 27, 1971.

Wye River Bridge,
W.P. 282-66-00, Site #30-57,
Highway #27, District #5.

70-11-069

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,
Structural Design Engineer.

CSG/mh
ENCL*
cc: Foundation Office.

No Comments.
M. Dunta
Sept 29th 1971.

Department of Highways Ontario
Copy for the information of
Mr. A. Stermac

Mr. A. P. Watt,
Regional Bridge Planning Engineer,
LONDON REGIONAL OFFICE.

Bridge Office,
Downsview.

May 26, 1971.

Wye River Bridge
W.P. 3282-66-00, Site #30-57
Highway #27, District #5.

70-1-069

Attached herewith are prints of the Preliminary Bridge Plan Drawing B-6977-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is $82,000 which includes tender, materials, engineering and sundry construction.

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

C. S. Grebski,
Bridge Design Engineer.

CSG/mh
encl.
cc: B. D. Davis,
A. Stermac (2),
J. Anderson,
A. Crowley.

Reduce the load per bib at the abutment location by 20% for possible negative skin frictional forces

M. Devata
May 28/71.

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. C. S. Grebski,
Bridge Design Engineer,
Bridge Office,
Admin. Bldg.

Attention:

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

Date: April 30, 1971

Our File Ref.

In reply to

Subject:

Wye River Bridge - Site #30-57,
2.4 Miles North of Hwy. #92,
Hwy. #27, Dist. #5 (Owen Sound),
W.P. 28-66-00 -- W.O. 70-11069

We have reviewed the Preliminary Bridge Drawing D-6977-P1 for the above mentioned structure, and submit the following comments:

Stability analyses have been carried out in terms of total stresses ($\phi = 0$) by the use of electronic computer, with parameters quoted in our foundation report (page 9), for the proposed geometry of the above structure. Computations carried out indicate that a 20-ft. wide, mid-height berm (with standard 2:1 slopes) will be required, in the longitudinal direction, to ensure stability. This will entail lengthening the structure by about 40 ft. over that proposed.

MD/MdeF

M. Devata
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac
PRINCIPAL FOUNDATION ENGR.

cc: Messrs. S. McCombie
A. P. Watt
Foundations Files
Gen. Files

70-11069

1. A temporary dewatering scheme will be required to prevent water from the river flowing into pile cap excavations located within close proximity of the Wye River. (Foundation Report 70-11069 p. 12)

2. No beam requirements have been met in the longitudinal direction as per p. 10.

S. Shaker Ahmed
April 20/71

Department of Highways Ontario

Copy for the information of Mr. A. Stermac

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

Bridge Office,
Downsview

April 16, 1971

Wye River Bridge
2.4 Miles North of Highway 92
W.P. 282-66-00, Site No. 30-57
Highway 27, District No. 5

70-110 69

Attached herewith are prints of the Preliminary Bridge Plan Drawing D-6977-P1 for the above-mentioned structure.

The estimated cost of the proposed structure is $55,000. This cost includes tender, materials, engineering and sundry 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. Davis
A. Stermac (2)
J. Anderson
A. Crowley

CC: Foundations Files (Rm. 110)

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

TO: Mr. J. P. Watt,
Regional Bridge Planning Engr.,
Bridge Section,
LONDON, Ontario.

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

ATTENTION:

DATE: November 23, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: Wye River Bridge - Bridge Site 30-57
2.4 Miles North of Hwy. #92 in Elmvale
Hwy. #27 - W.P. 282-66-00 - W.O. 70-11069
District No. 5 (Owen Sound)

Further to your memo of November 2, 1970, with regard to the proposed detour for the above mentioned structure construction, our comments are as follows:

Scheme 1 -

If a Bailey Bridge scheme is considered for the detour at this location, the fill heights to be restricted to 7 ft. and 9 ft. above the ground at East and West Abutment locations, respectively (Ref. Dwg. 70-11069B), in order to ensure stability in the longitudinal direction. The aforementioned fill heights are based on the assumption that the proposed grade will be at elev. 679.5.

Scheme 2 -

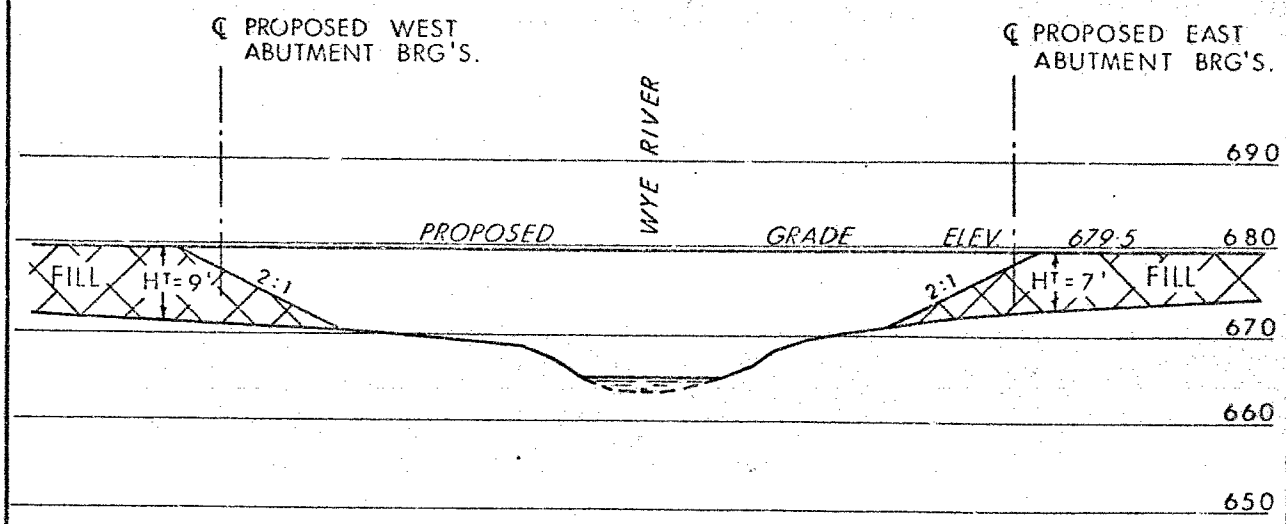
A detour incorporating a multi-plate pipe arch may be considered at this location. In order to ensure stability in the longitudinal and transverse direction, the fill heights, with standard 2:1 slopes, should not extend beyond 11 ft. above the river bed or natural ground surface. This will restrict the proposed detour grade to elev. 674.0. However, higher detour grades may be possible, but berms will be required on either side of the roadway in the transverse direction. If the detour grade has to be maintained at elev. 679.5, a transverse mid-height berm of 20 ft. will be required on either side of the detour roadway for a maximum fill height of 16.5 ft.

We believe that the aforementioned data will be adequate for your detour design requirements. Please contact our Office if you need any additional information with regard to this project.

MD/AdeF
cc: Messrs. B. McComb
R. Jenkins
J. Roy

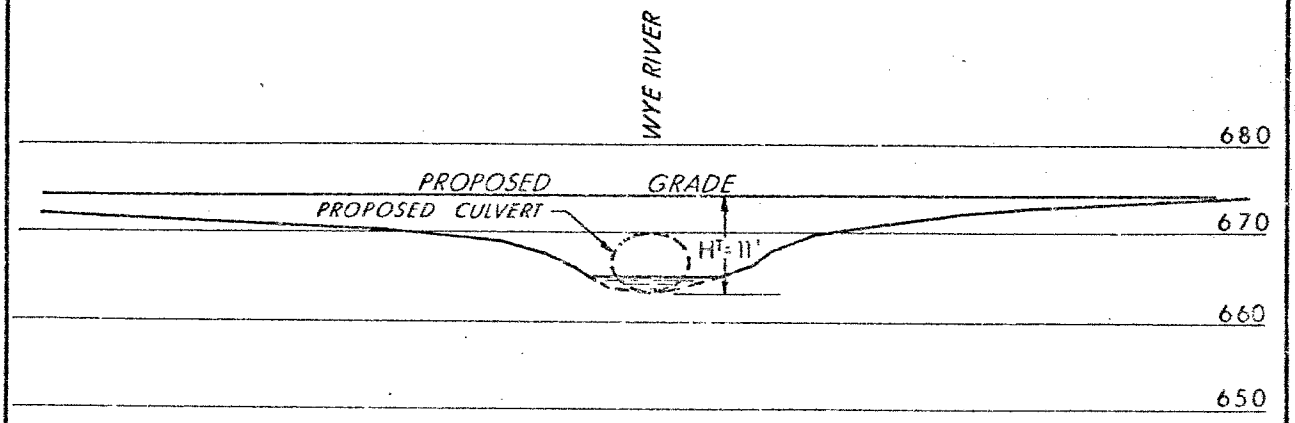
Foundations Files ✓
Gen. Files

M. Devata,
SUPERVISING FOUNDATION ENGR.
For:
A. G. Stermac,
PRINCIPAL FOUNDATION ENGR.



SCHEME 1 - BAILEY BRIDGE

SCALE 1" = 20'



SCHEME 2 - MULTI-PLATE PIPE ARCH CULVERT

SCALE 1" = 20'

DEPARTMENT OF HIGHWAYS MATERIALS and TESTING DIVISION ONTARIO	PROPOSED DETOUR WYE RIVER & HIGHWAY 27 W.P. 282-66-00 DIST. 5	
DATE 17 NOV. 1970	APPROVED	DRAWING NO. 70-11069 B

W.O. 70-11069

70-11069

A96

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

TO: Mr. A. G. Stermac
Principal Foundation Engineer
Bridge Office
DOWNSVIEW, Ontario

FROM: Bridge Planning
Southwestern Region
LONDON, Ontario

ATTENTION: Mr. M. DeVata

DATE: November 2, 1970

OUR FILE REF.

IN REPLY TO

SUBJECT: W.P. 282-66-00, Bridge Site 30-57
Wye River Bridge
2.4 miles north of Hwy. #92 in Elmvale
Highway 27
District 5, Owen Sound

Please be advised that the Road Side Detour for the construction of the above bridge will be at an offset of 90 feet northwest of the present bridge. The detour roadway will tie into the existing roadway 200 feet either side of the detour structure over the river. The proposed grade over the detour structure is assumed to be the same as the existing roadway approximately elevation 679.5.

Would you kindly comment on the stability of this proposal.

A.P. WATT
Regional Bridge Planning Engineer
Southwestern Region

APW/om
c.c. E. LaFombie
T. Jenkins

DEPARTMENT OF HIGHWAYS ONTARIO

70-11069

MEMORANDUM

To: Mr. A.G. Stermac,
Principal Foundation Eng.,
Downsview.

From: A.P. Watt,
Reg. Bridge Planning Eng.,
Southwestern Region.

Attention:

Date: July 21, 1970.

Our File Ref.

In reply to

Subject:

RE: W.P. 282-66-00, Bridge Site 30-57,
Wye River Bridge,
2.4 miles north of Hwy. 92,
Hwy. 27,
District 5, Owen Sound.

Would you kindly arrange to have a foundation investigation conducted at the above location. I have enclosed two copies of the bridge site plan E-4883-1 with the probable footing locations marked in red.

I have also enclosed the field reconnaissance report for your use.

A.P. WATT,
Reg. Bridge Planning Eng.,
Southwestern Region.

APW/ij

cc: S. McCombie.
A. Crowley.
J. Anderson.

SEPT 16. 1970.