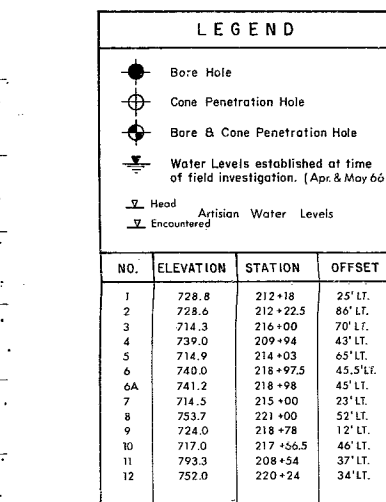
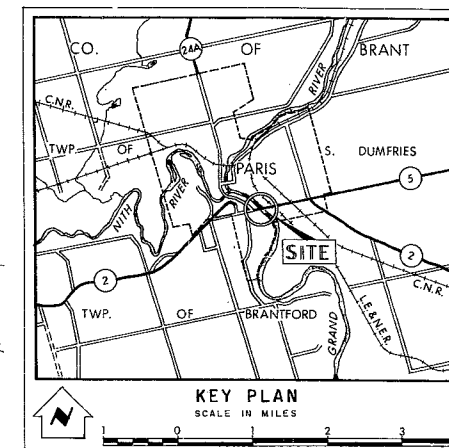


66-F-35
W.P. 233-65
HWY. #2
GRAND RIVER
AT PARIS



- 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 DIVISION - FOUNDATION SECTION

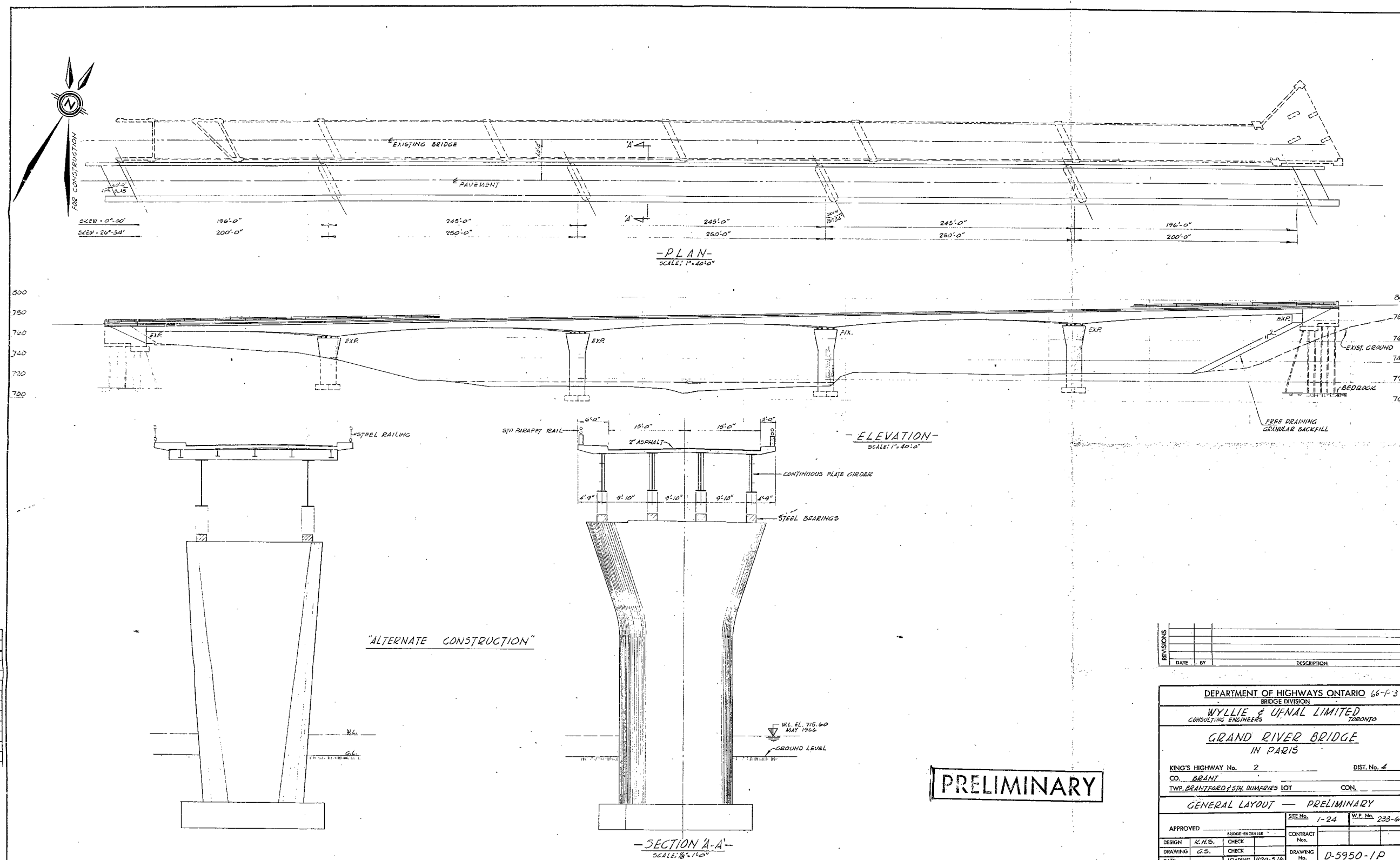
GRAND RIVER

KING'S HIGHWAY NO. 5 [DUNDAS ST.] DIST. NO. 4

CO. BRANT PARIS

TWP. S. DUMFRIES LOT CON.

BORE HOLE LOCATIONS & SOILS STRATA			
SUBM'D L.R.	CHECKED <i>5/1/72</i>	W.P. NO. 233 - 65	M.B.T. DRAWING NO.
DRAWN DGH	CHECKED <i>5/1/72</i>	JOB NO. 66-F-35	66-F-35A
DATE 22 JUNE 1966		SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>A. J. Steiner</i> ENGINEER, REG. NO. 2552		CONT. NO.	

[illegible][illegible]

DEPARTMENT OF HIGHWAYS 66-73 BRIDGE DIVISION			
WYLLIE & JENAL LIMITED CONSULTING ENGINEERS TORONTO			
<u>GRAND RIVER BRIDGE</u> <u>IN PARIS</u>			
KING'S HIGHWAY No. <u>2</u>		DIST. No. <u>4</u>	
CO. <u>BRANT</u>			
TWP. <u>BRANTFORD & 5TH DUMFRIES</u> LOT		CON. <u></u>	
GENERAL LAYOUT — PRELIMINARY			
APPROVED _____ BRIDGE ENGINEER		SITE No. <u>1-24</u>	W.P. No. <u>233-6</u>
DESIGN <u>K.M.S.</u> CHECK _____	CONTRACT No. _____		
DRAWING <u>G.S.</u> CHECK _____	DRAWING No. <u>D-5950-1P</u>		
DATE _____	LENDING <u>1/20-5/16</u>		

cc: GEN. FILES

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

W.P. 233-65.

TO: Mr. B. R. Davis,
Bridge Engineer,
Bridge Division.

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

Attention: Mr. S. McCombie

DATE: June 17, 1966

OUR FILE REF.

IN REPLY TO

JUN 24 1966

SUBJECT:

FOUNDATION INVESTIGATION REPORT

For

Hwy. #2 Crossing of Grand River
District #3 (Stratford)

W.J. 66-F-35 -- W.P. 233-65

4 (HAM-CTOW)

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

We believe that the factual data and recommendations contained therein, will suffice for your design requirements.

Should additional information be required, please feel free to contact our Office.

AGS/MdeF
Attach.

cc: Messrs. B. R. Davis (2)

H. A. Tregaskes

D. W. Farren

~~A. Gater~~ G. KUNTER (2)

~~J. G. Tillecock~~ H. GREENLAND

~~J. Roy~~ T. J. KOVICH

A. Watt

A. G. Stermac
A. G. Stermac,
PRINCIPAL FOUNDATION ENGINEER

Foundations Office
Gen. Files

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FOUNDATION INVESTIGATION REPORT
For

Hwy. #2 Crossing of Grand River
District ~~#3 (Stratford)~~ 4 (HAMILTON)
W.J. 66-F-35 -- W.P. 233-64

1. INTRODUCTION:

A verbal request was received from Mr. S. McCombie, Bridge Planning Engineer, on April 11, 1966, to investigate the subsoil conditions for the crossing by Highway #2 of the Grand River at Paris, Ontario.

It is proposed to construct a multi-span bridge on the south side and parallel to the existing structure to carry Highway #2 over the Grand River. The site is located within the town of Paris, near the south-eastern town limits, in the County of Brant.

A foundation investigation was carried out by this Section in order to determine the subsoil conditions existing at the site. Field data and laboratory test results are presented in this report, together with our recommendations pertaining to future structure foundations and embankments.

cont'd. /2 ...

2. DESCRIPTION OF SITE:

2.1) Topography:

At the site a 2-lane multi-span structure carried Highway #2 over the Grand River. The river flows southerly and is 300 feet wide and one to three feet deep under normal conditions. During flood conditions, however, levels may be up to ten feet above normal.

The river valley is bounded by steep banks. On the west side there is a narrow flood plain (about 50 - 60 feet wide) at the foot of a 30-foot bank which is lightly tree-covered. On the east side, the flood plain is somewhat wider naturally, and has been built up 10 to 12 feet and widened by an old town garbage dump and by more recent brick yard development. A brick yard occupies the plain area back to the toe of a 70- to 90-foot bank. This bank is tree-covered in the lower portion, and has been excavated for its gravel content at the top. The gravel pit is still being used by the town of Paris. The area above the river banks on both sides of the river is lightly residentially developed with some commercial development.

2.2) Geology:

The site lies within an area which was glaciated during the Pleistocene period. As the glaciers retreated, some glacial-lacustrine deposits occurred and then, during the life of glacial Lake Whittlesey, a spillway developed through this area between the Paris and Galt moraines. The present river has cut a wide winding valley through the resulting alluvial gravels and glacial deposits to expose the top of the Salina formation which is of Silurian age (Paleozoic era).

cont'd. /3 ...

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

2.2) Geology: (cont'd.) ...

*

"Bedrock encountered in the drilling of rock cores for this bridge site belongs to the top of the Salina formation of the Silurian (age) system."

2.3) Existing Structures:

The existing high-level bridge, built in 1930 - 1931, is in poor condition structurally and from the point of view of foundations. The river bed is scoured at least eight feet deeper than normal near the centre-most pier. Scour is also evident at the west pier in the river. It is believed that the present bridge is founded on spread footings.

An older, low-level bridge built about 1877, is upstream of the present bridge and appears to be founded on spread footings which are still apparently sound, although the bridge is not useable structurally. There is less evidence of scour about these piers.

3. FIELD WORK:

Using conventional diamond drilling equipment adapted for soil sampling purposes, thirteen sampled boreholes and twelve dynamic cone penetration tests were carried out at the site. A drilling energy of 350 ft.-lbs. per blow was used for the dynamic cone penetration tests.

*

Description by B. K. Glassford, Geologist.

cont'd. /4 ...

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

Samples were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications of the Standard Penetration Test. Bedrock was sampled using both BXL and AXT size core barrels.

All samples were visually examined and classified in the field and subsequently in the laboratory. Laboratory tests were conducted on selected representative samples to determine, where applicable, Atterberg limits, grain-size distribution and natural moisture content.

Field and laboratory test results, together with the location and elevation of the boreholes, are presented in Appendix I of this report. All boreholes are located with respect to the centre-line of the existing alignment of Highway #2.

4. SOIL TYPES AND SUBSOIL CONDITIONS:

4.1) General:

Subsoil at the site consists mainly of a deposit of clay to clayey silt underlain by a deposit of clayey silt with sand, gravel and occasional boulders (glacial till). These deposits overlie bedrock which is extensively weathered in some areas. In the river, much of the subsoil has been eroded. On the east side of the valley, the natural subsoil is covered with a 10- to 12-foot thick fill and a 70-foot fill has been constructed at the east bank for the existing bridge.

cont'd. /5 ...

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

4.2) Fill:

The fill material on the east and west banks is composed of silt, sand and gravel, and has a relative density of compact to very dense with 'N' values between 10 and much in excess of 100 blows/foot. The fill is 7 to 11 feet thick on the west bank and about 70 feet thick at the highest point of the east road embankment.

The fill material in the east lowland is composed of silt, sand and gravel as well as ashes, cinders and organics. Towards the river, increasing quantities of brick and broken concrete blocks are in the fill. It has a relative density of very loose to compact. This fill is about 12 to 13 feet thick.

4.3) Clay to Clayey Silt:

This material was encountered in all boreholes on land except boreholes 9 and 10 which were located on the river flood plain. On the west side the deposit varied from 20 to 30 feet in thickness, and on the east side the deposit was 3.5 to 13 feet thick. The consistency of the material varied from stiff to hard with 'N' values between 10 and 51 blows per foot.

The following is a summary of the physical properties of the clayey silt deposit:

Liquid Limit ($W_L\%$)	19.3 - 56.3
Plastic Limit ($W_p\%$)	12.1 - 29.1
Moisture Content ($W\%$)	7.4 - 30.9

cont'd. /6 ...

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

4.4) Clayey Silt, Sand and Gravel - occasional Boulders - (Glacial Till):

This deposit was encountered in all boreholes, either immediately beneath the clayey silt to silty stratum or at surface, and varied in thickness from 4 to 9.5 feet. Boulders up to 2 feet in diameter were encountered occasionally in this deposit, particularly in the river area. The relative density of the deposit varied from compact to very dense with 'N' values between 11 and much in excess of 100 blows per foot.

Typical grain-size distribution of the deposit is 27% gravel, 46% sand, 18% silt, 9% clay.

4.5) Bedrock:

*"Bedrock encountered in the drilling of rock cores for this bridge site belongs to the top of the Salina formation of the Silurian (age) system.

"The drilling in rock encountered the same types of formations in all holes; all of which are closely related as to elevations, classification, thickness of stratum, and physical description. The strata appear to be irregularly interbedded shales, shaley dolomite and dolomite. The shales are thinly bedded argillaceous, soft and dark grey coloured. The dolomite is hard, medium textured, and a light grey colour. Drilling had broken up some sections of the strata, so that core recovery has been limited, broken and missing, thus making the section disjointed. Gypsum and anhydrite is present in the form of nodules and lenses within the bedding planes. The shale and shaley rock types weather quickly and would present a poor bearing capacity in this respective weathered zone."

* Description by B. K. Glassford, Geologist.

cont'd. /7 ...

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

4.5) Bedrock: (cont'd.) ...

Extensively weathered zones were encountered in all boreholes varying from 2 to 10 feet in thickness. Split-spoon samples were taken in this zone and 'N' values varied from 14 blows per foot to much in excess of 100 blows per foot where rock core sampling began. The delineation between the weathered and sound rock is somewhat difficult to make precisely, and the extent of weathered rock can be expected to vary considerably depending upon natural fracturing and availability of water, among other things.

5. GROUND WATER CONDITIONS:

Ground water levels were observed where possible, in the boreholes and are indicated on the borehole log sheets. The boreholes in the river all encountered artesian water pressure of about 20 inches above the river level. During the drilling of borehole 3, the river level rose about 2 feet and it was observed that the artesian head remained at about 20 inches above the river level at all times.

*"At this specific foundation site the ground waters and hydraulic gradient waters possibly have a high sulphate content due to the gypsum and anhydrite minerals present in the ground and in the underlying sediments of the area. This would probably influence the type of concrete and cement to be used to avoid a sulphate basic interreaction on the pier footings."

* From Geological Report by B. K. Glassford, Geologist.

cont'd. /8 ...

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to construct a five-span (200' - 250' - 250' - 250' - 200') structure some 40 ft. south of the present crossing of Highway #2 and Grand River, thereby replacing the existing structure. The proposed grade is approximately the same as the existing structure; therefore, a fill about 60 ft. will be required at the east abutment location and of about 20 ft. at the west abutment location.

6.1) West Abutment:

At this location there is a deposit of 7 ft. fill consisting of a mixture of silt, sand, gravel with boulders, 30 ft. of clay to clayey silt, 5 ft. of glacial till, and then bedrock. Approximately 20 ft. of fill is required for the proposed west approaches at this location. No stability problems are anticipated for the embankment provided that standard 2:1 slopes are constructed.

The abutment may be founded in the fill on caissons drilled at least one foot into the sound rock (22" Ø O.D. caissons could be designed for 150 tons). Bedrock will be encountered at about elev. 711; however, drilling may penetrate several feet before encountering sound rock.

As an alternative, the abutment may be founded on end-bearing steel H-piles driven to practical refusal to the sound bedrock. Design loads to be used are dependent on the pile section selected and may be 90 tons per pile in the case of 12 BP 74 steel H-piles. Care should be taken to avoid the use of boulders in the new fill where piles have to be driven.

In view of the presence of boulders in the subsoil which might tend to complicate the driving of steel H-piles, consideration should be given to the use of bored-in caissons.

cont'd. /9 ...

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

6.2) Pier Foundations:

According to the preliminary drawing (D-5950-1P) from the general layout, it appears that there will be two piers in the river and one pier on the east and one on the west bank of the river valley.

In the river the bedrock is extensively weathered for at least 7 to 10 ft. above the sound rock. The weathered rock is overlain by some 8 to 11 ft. of till-like material containing occasional boulders up to 2 ft. in diameter. Since the sound bedrock is not more than 18 to 20 ft. below the river bottom, spread footing type foundations may be feasible. Footings established on sound shale may be designed for a safe load of 10 t.s.f. A dewatering scheme will be required since excavations for the pier footings in the river will be carried out below river water level.

Piers located on the banks including the piers situated in the river, could be founded on piles as described elsewhere in the report for "West Abutment."

The ground water may have a high sulphate content which could influence the type of concrete to be used for piers to avoid a sulphate base interreaction with the footings.

6.3) East Abutment:

The proposed location of this abutment and the proposed grade will necessitate at least 60 ft. fill above the existing ground surface. In B.H. #1, 2 and 4, some organic material was observed in the upper 10 ft. In order to ensure the stability of the east approach fill, it is recommended that a number of additional borings be carried out within the limits of the proposed fill to establish whether or not the organic material is present in sufficient quantity to warrant its removal by excavation.

cont'd. /10 ...

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

6.3) East Abutment: (cont'd.) ...

The proposed east abutment can be founded on end-bearing piles driven to practical refusal in shale bedrock. The design loads to be used are dependent on the pile section selected and may be as high as 90 tons in the case of 12 BP 74 steel H-piles.

7. SUMMARY:

A foundation investigation of the proposed crossing of the Grand River and relocated Hwy. #2 is reported.

Subsoil consists in general, of a deposit of clay to clayey silt underlain by clayey silt, sand and gravel and occasional boulders (glacial till). These deposits overlies bedrock which is extensively weathered. In the river area, much of the subsoil has been eroded and in several areas, fill material overlies the natural deposits.

Alternative types of foundations utilizing piles or spread footings are recommended for the proposed structure. Details are given in Section 6 above.

Generally speaking, there are no stability problems with regard to the proposed approach embankments. However, further field work to determine the extent of possible organic deposits is recommended in the area of the proposed east approach fills.

8. MISCELLANEOUS:

The supervision of the field work, performed during the period April 18 to May 12, 1966, and the subsequent preparation of this report, were carried out by Mr. L. Palmer, Project Foundation Engineer.

Equipment used was owned and operated by Canadian Longyear Limited.

The general supervision of the project and the review of this report were carried out by Mr. M. Devata, Senior Foundation Engineer.

June 1966

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 1

FOUNDATION SECTION

JOB 66-F-35LOCATION Hwy. #2 & Grand River, Paris. Sta. 212+18 25' Lt. ofORIGINATED BY L.P.W.P. 233-65BORING DATE April 18, 1966E of Old BridgeCOMPILED BY W.T.E. & L.P.DATUM GeodeticBOREHOLE TYPE Cone, Washboring, Diamond Drill

CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w _L PLASTIC LIMIT ——— w _p WATER CONTENT ——— w			BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					w _p ——— w ——— w _L	WATER CONTENT %				
							20	40	60	80	100			20			40
728.8	Ground Level						SHEAR STRENGTH P.S.F.										
0.0	Sand, Gravel, Silt & Clay. Some Cinders & Organic matter (Fill). Very Loose to Compact					720									Y	Org. Cont. 13.5%	
1			SS	2													
2			SS	5													
3			SS	16													
716.3	Clayey Silt Very Stiff		4	SS	15	710									Gr.12 Sa.61 Si.25 Cl.2 715.5?		
12.5			5	SS	16												
712.9	Heterogeneous mixture of Clayey Silt, Sand & Gravel - occasional boulders (Till) Hard		6	RCAX	31%	710									Gr.1 Sa.14 Si.55 Cl.30		
15.9			7	SS	40												
			8	SS	42												
			9	RCAX	No Recovery												
704.0	Bedrock - very extensively weathered		10	SS	21	700									Gr.37 Sa.29 Si.34 Cl.—		
24.8			11	SS	27												
696.8	Sound		12	RC	No Recovery	690											
32.0			13	RC	90%												
690.8	End of Borehole		14	AXT	85%	680											
38.0																	

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 66-F-35LOCATION Hwy. #2 & Grand River, Paris Sta. 212+22.5 o/s 86' Lt.

FOUNDATION SECTION

W.P. 233-65BORING DATE April 27, 1966of 1 Old BridgeORIGINATED BY L.P.DATUM GeodeticBOREHOLE TYPE Washboring NX CasingCOMPILED BY W.T.E. & L.P.

CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— w_L			BULK DENSITY	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	20	40	60	80	100	PLASTIC LIMIT ——— w_p	WATER CONTENT ——— w		
728.6	Ground Level															
0.0	Sand, Gravel, Silt, Clay. Some Cinders & organic matter (Fill) Loose		1	SS	6											
			2	SS	5	720										
			3	SS	4											
715.6			4	SS	26											
13.0	Clayey Silt, Very Stiff		5	TW	Driven/17											
711.6			6	SS	26	710										
17.0	Heterogeneous mixture of Clayey Silt, Sand & Gravel		7	SS	49											
704.6	V. Stiff to Hard (Till)															
24.0	Bedrock - Very extensively Weathered		8	SS	47	700										
696.6			9	SS	66											
32.0	Sound			RC												
691.6			10	AXT	66%	690										
37.0	End of Borehole					680										

50/5* & Bouncing

W.L. 724.3

Gr. 19%
Sa. 59%
Si. 17%
Cl. 5%
Org. Cont. 8.5%

Gr. 9Sa. 44
Si. 37 Cl. 10

Gr. 30 Sa. 42
Si. 20 Cl. 8

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 4

FOUNDATION SECTION

JOB 66-F-35

LOCATION Hwy. #2 & Grand River, Paris, Sta. 209/94- 43' Lt. of

ORIGINATED BY L.P.

W.P. 233-65

BORING DATE April 22, 1966
E of Old Bridge

COMPILED BY W.T.E. & L.P.

DATUM Geodetic

BOREHOLE TYPE Cone, Washboring, Diamond Drill

CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W			BULK DENSITY Y P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					WATER CONTENT %				
							20	40	60	80	100	WP	W	WL		
739.0 0.0	Gravel, Sand, Silt and some Clay. Trace of organics. (Fill material)		1	SS	8	730										Gr.2 Sa.20 Si.&Cl. 78
			2	SS	28											
			3	SS	13											
			4	SS	47											
721.0 18.0			5	SS	15											
	Silty Clay to Clayey Silt. Very Stiff, occasional thin Silt layers or pockets		6	SS	20	720										Gr.43 Sa.32 Si.&Cl. 25
			7	SS	20											
708.0 31.0			8	SS	60											
	Heterogeneous mixture of Clayey Silt, Sand and Gravel (Till)		9	SS	63	710										Gr.7 Sa.40 Si.&Cl. 53
700.0 39.0			10	SS	40/3											
698.2 40.8	Bedrock - weathered		11	AXT	59%	700										
	Sound		12	AXT	Test											
691.7 47.3	End of Borehole					690										

65-1831

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 66-F-35

LOCATION Hwy. #2 & Grand River, Paris, Sta. 214+03.0/s 65' Lt.

ORIGINATED BY L.P.

W.P. 233-65

BORING DATE April 25, 1966

COMPILED BY W.T.E. & L.P.

DATUM Geodetic

BOREHOLE TYPE Cone, Washboring, Diamond Drill

CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT — w_L		BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	PLASTIC LIMIT — w_p	WATER CONTENT — w	WATER CONTENT %		
714.90	Waterlevel											
712.7	Ground Level											
2.2	Heterogeneous mixture of Clayey Silt, Sand & Gravel (Till)		1	SS	12	710						
704.7	Stiff, ecc. Boulders		2	SS	13							
10.2	Bedrock - very extensively weathered		3	SS	53							
			4	SS	23 1/2"	700						
			5	SS	100 1/4"							
			6	SS	28 1/2"							
694.2			7	AXT	44%							
20.7	Sound		8	AXT	75%	690						
689.0												
25.9	End of Borehole					680						

FOUNDATION SECTION

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE		LIQUID LIMIT ——— WL PLASTIC LIMIT ——— WP WATER CONTENT ——— W		BULK DENSITY P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT	SHEAR STRENGTH P.S.F.	WP	WL			WATER CONTENT %
							20						
740.0	Ground Level												
0.0	Silty Clay to Clayey Silt Very Stiff to Hard Occasional thin Silt layers or pockets		1	SS	16	730							
			2	SS	26								
			3	SS	19								
			4	SS	33								
			5	SS	36								
721.0			6	SS	45/2"	720							
19.0	Heterogeneous mixture of Clayey Silt, Sd. & Gr.			RC									
717.0	Hard (Till)		7	AXT	10%	Recovery							
23.0			8	RC									
714.0	Bedrock - weathered		9	BXL	55%								
26.0	Sound		10										
708.8			11	AXT	29%	710							
31.2	End of Borehole					700							

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO. 6A

FOUNDATION SECTION

JOB 66-F-35 LOCATION Hwy. #2 & Grand River 218/98, e/s 45' Lt. ORIGINATED BY L.P.
W.P. 233-65 BORING DATE April 27, 1966 COMPILED BY WE & LP
DATUM Geodetic BOREHOLE TYPE Washboring CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT _____ WL PLASTIC LIMIT _____ WP WATER CONTENT _____ W				BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		20	40	60	80	100	WP	WL	W		
741.2	Ground Level															
0.0	Borehole washed to 20.0', not sampled See Borehole #6					740.0										
						730.0										
721.2																
20.0	Heterogeneous mixture of Clayey Silt, Sand & Gravel		1	SS	44/5	720.0										
23.0	Hard (fill)		2	RC												
716.2	Bedrock - weathered		3	BXL	46%											
25.0	Sound		4	RC												
			5	BXL	100%											
			6	BXL	25%	710.0										
			7	RC												
				BXL	81%											
704.9																
36.3	End of Borehole					700.0										

W.L.
(in casing)
Elev. 716.8

FOUNDATION SECTION

ORIGINATED BY L.P.

COMPILED BY W.E. L.P.

CHECKED BY

[illegible]

DEPARTMENT OF HIGHWAYS - ONTARIO

RECORD OF BOREHOLE NO. 8

FOUNDATION SECTION

MATERIALS & TESTING DIVISION

JOB 66-F-35 LOCATION Hwy. #2 & Grand River, Paris Sta. 221+00, 52' Lt.
W.P. 233-65 BORING DATE May 2, 1966
DATUM Geodetic BOREHOLE TYPE Washboring NX CasingORIGINATED BY L.P.
COMPILED BY W.T.E. L.P.
CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100 SHEAR STRENGTH P.S.F.	LIQUID LIMIT — WL PLASTIC LIMIT — WP WATER CONTENT — W WP — W — WL WATER CONTENT % 20 40 60	BULK DENSITY P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
753.7	Ground Level									
0.0	Silt, Sand, Gravel & Boulders (Fill)		1	SS	40	750				
746.7			2	SS	82					
7.0	Clay to Clayey Silt laminated, ecc. thin silt layers, Stiff to Hard		3	SS	44					
			4	SS	33	740				
			5	SS	22					
			6	SS	15					
			7	SS	16	730				
			8	SS	26					
			9	SS	10	720				
716.0			10	SS	36					
37.7	Heterogeneous mixture of clayey Silt, Sand & Gravel Hard (Till)		11	EXL	44%	710				
42.4	Bedrock - weathered		12	RC	6%					
707.0			13	RC	EXL 75%					
46.7	Sound		14	EXL	100%	700				
701.2										
52.5	End of Borehole					690				

W.L. = 733.2

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

RECORD OF BOREHOLE NO.9

FOUNDATION SECTION

JOB 66-P-35 LOCATION Hwy. #2 & Grand River, Paris Sta. 218+78, 12' Lt. of E ORIGINATED BY L.P.
W.P. 233-65 BORING DATE May 3, 1966 Old Str. COMPILED BY W.T.E. L.P.
DATUM Geodetic BOREHOLE TYPE Washboring NX Casing CHECKED BY _____

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE					LIQUID LIMIT — W _L		BULK DENSITY γ _s P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		BLOWS / FOOT					PLASTIC LIMIT — W _P			
							20	40	60	80	100	WATER CONTENT — W			
							SHEAR STRENGTH P.S.F.					W _P — W — W _L		WATER CONTENT %	
724.0	Ground Level														
0.0	Heterogeneous mixture of Silt, Sand & Gravel, very Stiff to Hard (Till) Occ. Boulders		1	SS	18	720									
716.0			2	SS	126										
714.5	Bedrock Extensively weathered		3	S	20/1"										
9.5			4	BKL	95%										
	Sound		5	BKL	100%	710									
707.75			6	BKL	82%										
16.25	End of Borehole														

50/3"

W.L.
716.0

DEPARTMENT OF HIGHWAYS - ONTARIO

MATERIALS & TESTING DIVISION

JOB 66-P-35

W.P. 233-65

DATUM Geodetic

RECORD OF BOREHOLE NO. 10

LOCATION Hwy. #2 & Grand River, Sta. 217+66.5, 46' Lt.

BORING DATE May 4, 1966

BOREHOLE TYPE Washboring - NX Casing

FOUNDATION SECTION

ORIGINATED BY L.P.

COMPILED BY W.T.E. L.P.

CHECKED BY

[illegible]

MATERIALS & TESTING DIVISION

FOUNDATION SECTION

ORIGINATED BY L.P.

COMPILED BY W.E. L.P.

CHECKED BY

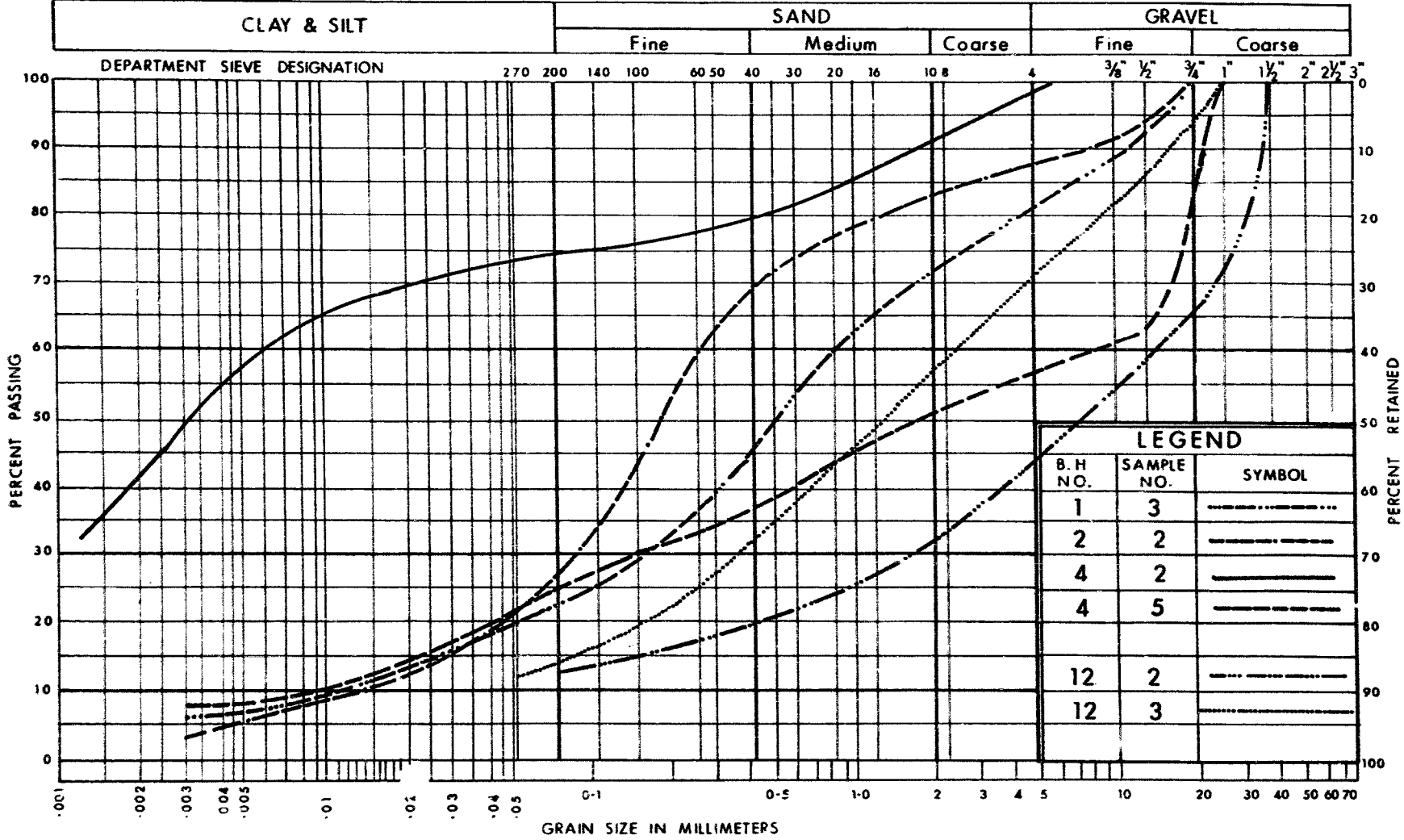
[illegible]

FOUNDATION SECTION

JOB 66-P-35 LOCATION Hy. #2, Grand River, Paris; Sta. 220+24 34' Lt. of E ORIGINATED BY L.P.
W.P. 233-65 BOKING DATE May 6, 1966 Old Bridge COMPILED BY W.T.E. L.P.
DATUM Geodetic BOREHOLE TYPE Washboring - NX Casing CHECKED BY _____

[illegible]

UNIFIED SOIL CLASSIFICATION SYSTEM



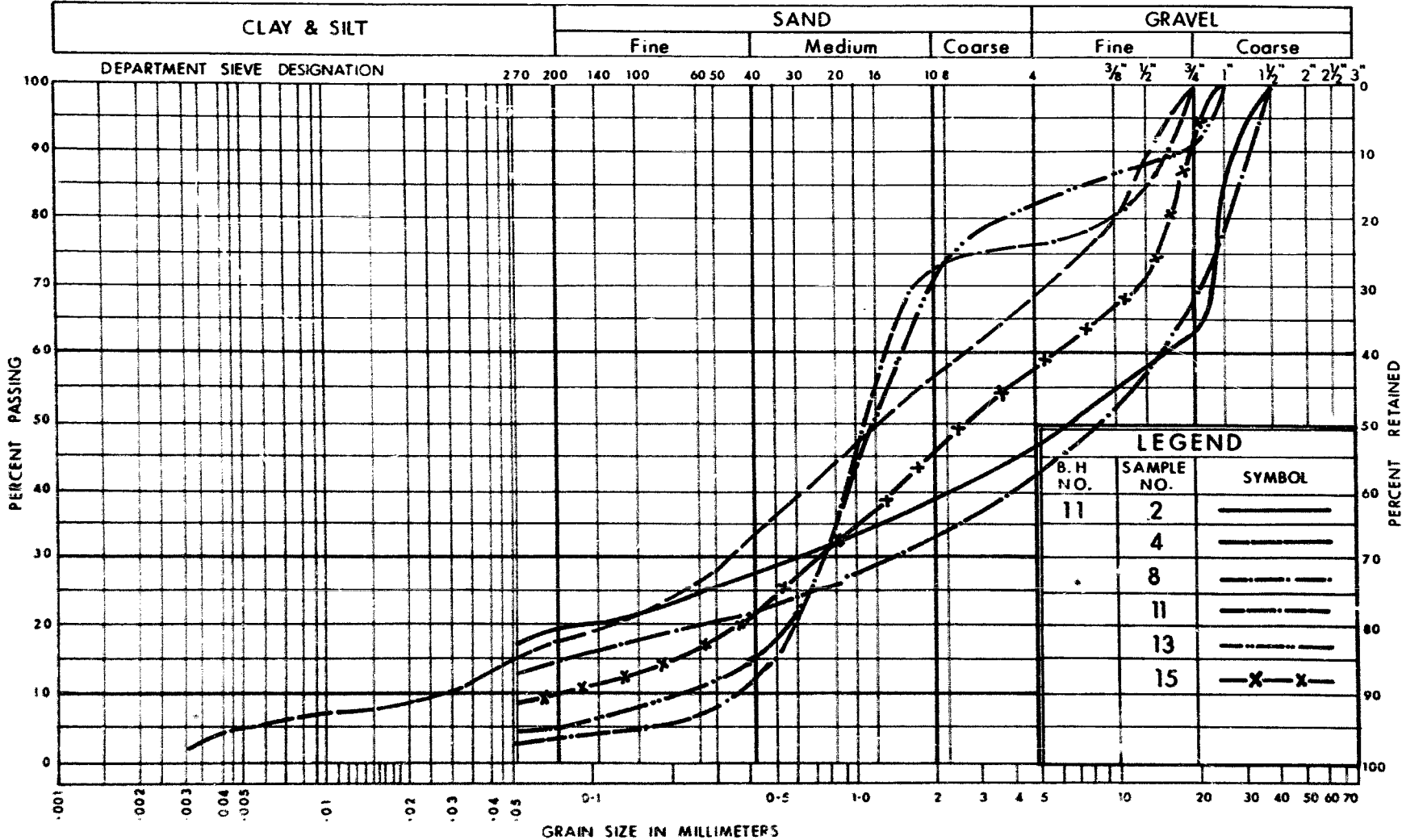
DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GRAIN SIZE DISTRIBUTION

FILL MATERIAL

W.P. No.	233 - 65
JOB No.	66-F- 35

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION
FILL MATERIAL

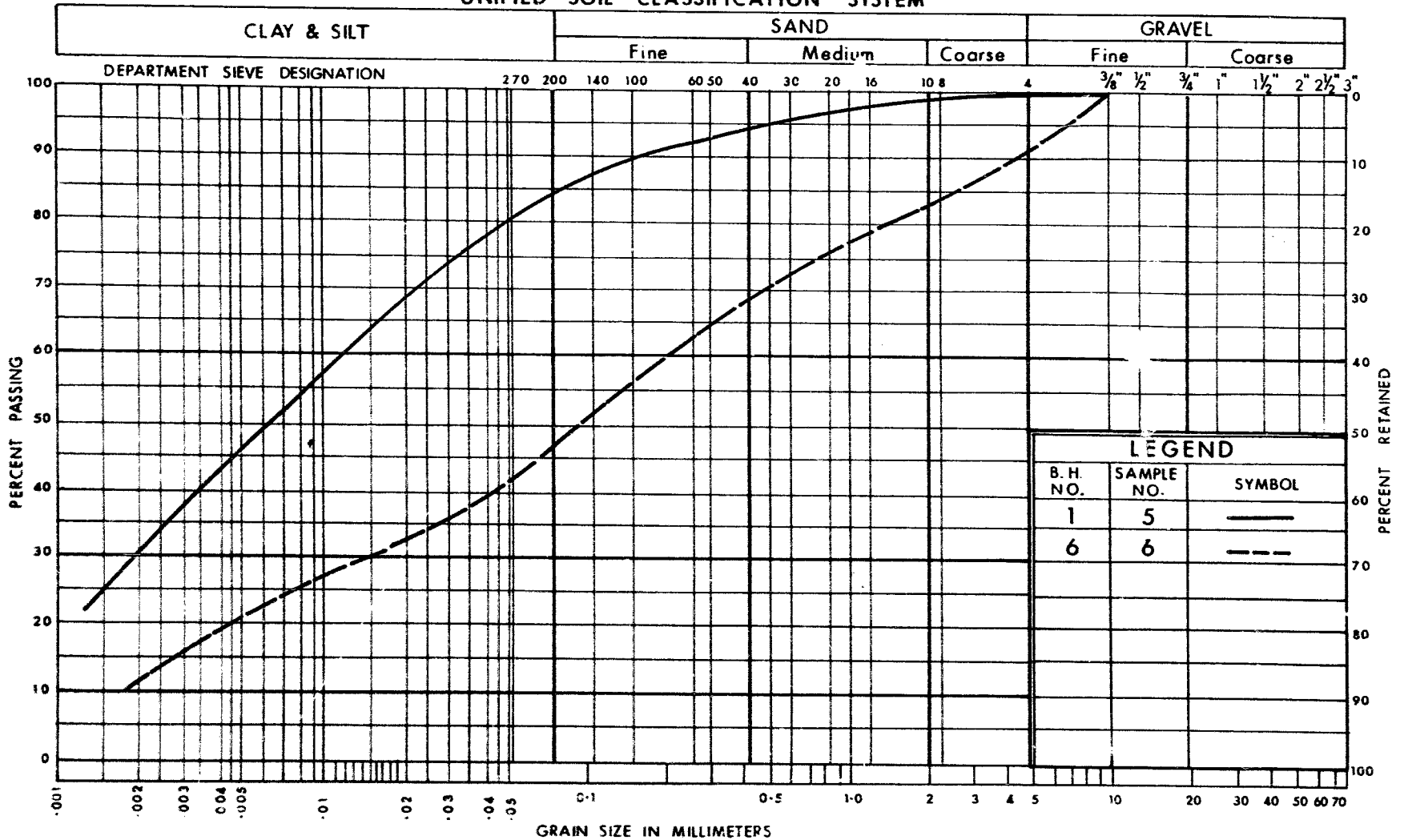


DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

W.P. No. 233-65

JOB No. 66-F-35

UNIFIED SOIL CLASSIFICATION SYSTEM



GRAIN SIZE DISTRIBUTION

CLAY TO CLAYEY SILT



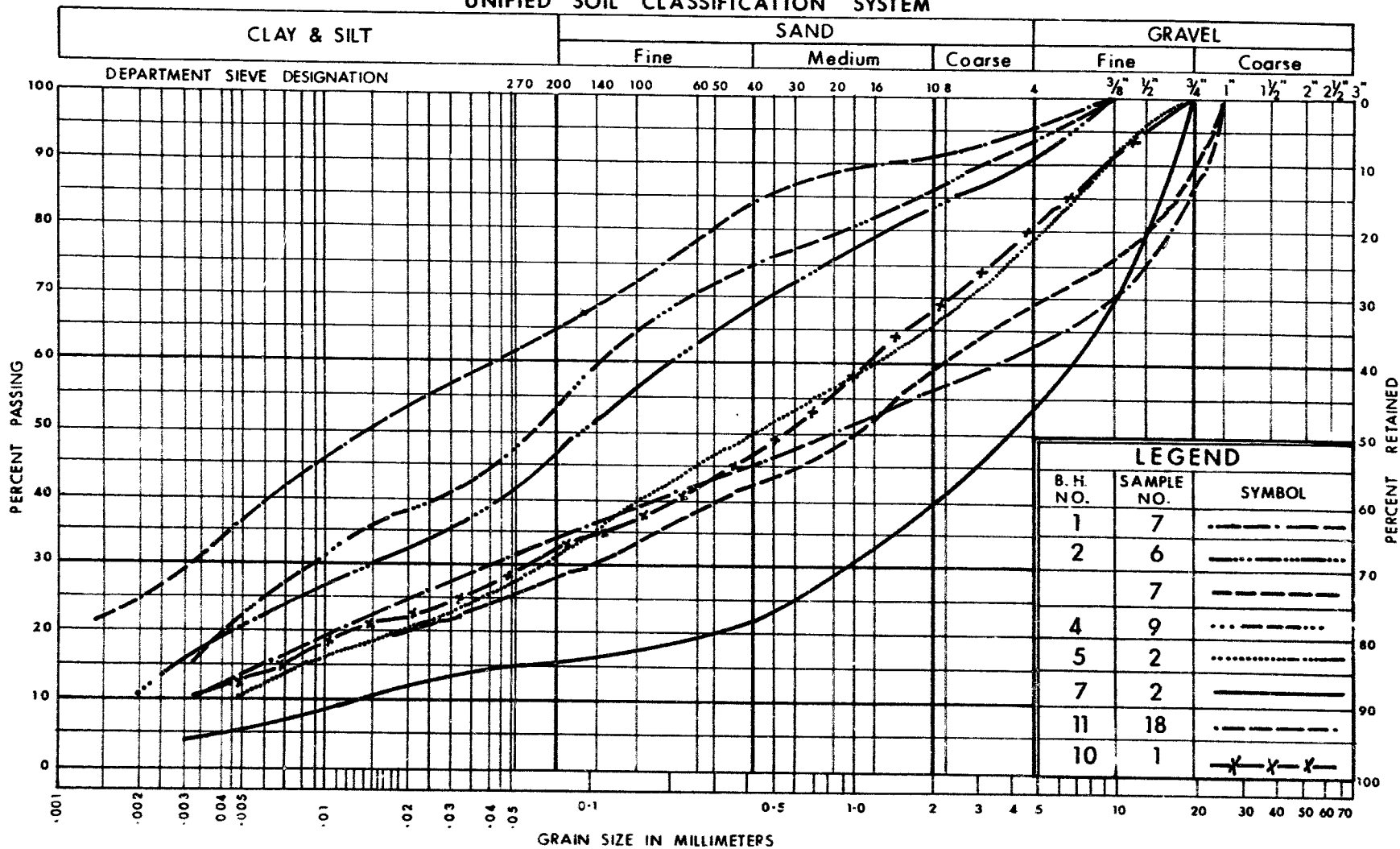
ONTARIO

DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

W.P. No. 233 - 65

JOB No. 66 - F - 35

UNIFIED SOIL CLASSIFICATION SYSTEM



DEPARTMENT OF HIGHWAYS
MATERIALS and
TESTING
DIVISION

GLACIAL TILL

GRAIN SIZE DISTRIBUTION

HET. MIXTURE OF SILT TO
CLAYEY SILT, WITH SAND & GRAVEL.

W.P. No. 233-65

JOB No. 66-F-35

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

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 INTERCEPT
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
β	PERMEABILITY

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

Downsview 464, Ontario.
July 22, 1969.

Dufferin Materials and Construction Limited,
2700 Dufferin Street,
Toronto 19, Ontario.

Attention: Mr. J. H. R. Crumb

Re: Claim on Contract 66-283
Grand River Bridge at Paris

Dear Sir:

This will confirm this morning's conversation in which it was agreed that we can hold a meeting in this office on Friday, August 1, 1969 at 2:00 p. m. in order to discuss your claim.

Yours truly,

J. W. MacDougall,
Claims Engineer.

JWM/wm

c. c. - Mr. H. Greenland
Mr. A. Rutka
Mr. A. Stermac ✓
Mr. A. E. McKim
Mr. P. Wilson

PIER N°	TOP OF FOOTING ELEVATION	STATION AT C OF PIER
1	718.5	218+96
2	699.0	216+51
3	699.0	214+06
4	703.5	211+61

MEMORANDUM

To: Mr. J.H.L. Palmer,
Foundation Section.

From: B.K. Glassford

Date: May 27th. 1966

Our File Ref.

In Reply To

SUBJECT:

Re: W.P. 233-65, Grand River Bridge,
Hwy. #2. (66-F-35)

Bedrock encountered in the drilling of rock cores for this bridge site belongs to the top of the Salina formation of the Silurian (age) system.

The drilling in rock encountered the same types of formations in all holes; all of which are closely related as to elevations, classification, thickness of stratum, and physical description. The strata appear to be irregularly interbedded shales, shaley dolomite and dolomite. The shales are thinly bedded, argillaceous, soft and dark grey coloured. The dolomite is hard, medium textured, and a light grey colour. Drilling has broken up some sections of the strata, so that core recovery has been limited, broken, and missing, thus making the section disjointed. Gypsum and anhydrite is present in the form of nodules and lenses within the bedding planes. The shale and shaley rock types weather quickly and would present a poor bearing capacity in this respective weathered zone.

It is recommended that footings or caissons be placed into the sound rock horizon to a depth of 12 inches. Local conditions at each bearing site will determine the amount of excavation necessary to establish sound rock levels.

Your attention is directed to the fact that at this specific foundation site the ground waters and the hydraulic gradient waters possibly have a high sulphate content due to the gypsum and anhydrite minerals present in the ground and in the underlying sediments of the area. This would probably influence the type of concrete and cement to be used to avoid a sulphate basic interreaction on the pier footings.

B.K. Glassford

B.K. Glassford,
Geologist.

BKG:ph

cc: W.R. Bennett
P. Wilson
T. Kovich

Mr. W. S. Melinyshyn,
Regional Bridge Location Engr.,
Central Region (Toronto),
Admin. Bldg.

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

August 25, 1966

Grand River Bridge in Paris,
Hwy. #2 - Dist. #4 (Hamilton)
W.P. 233-65

Further to your memo of July 26, 1966, additional borings have been carried out by Central Regional Materials Division. Recommendations pertaining to sub-excavation of any organic material at the east approach fill location, were submitted to you by Mr. T. J. Kovich, Regional Materials Engineer.

We have reviewed the Preliminary Plan D-5950-1 for the above mentioned project. The designer appears to have complied with the recommendations contained in the foundation report.

MD/hdeF

cc: Foundations Office ✓
Gen. Files

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

Mr. W. Melinyshyn,
Regional Bridge Location Engr.

Material & Testing Division.

August 11th, 1966.

Re: W.P.#233-65, Hwy. #2, Grand River
Bridge, Paria, Hamilton District.

Section 6.3 of the Foundation report dated June 17, 1966, recommends that additional borings be placed within the limits of the east fill to establish whether or not the organic material warrants removal.

Six boreholes to a maximum depth of 12' were placed recently. At two of them, about 18" of dry, compressed organic topsoil was found under 6' of fill. Considering the condition of the organic and its relative location within the proposed fill, we do not recommend removal.

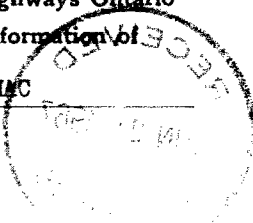
TJK/hd
c.c. G.K. Hunter,
H. Greenland,
A. Sternac,
G.A. Wrong.

T.J. Kovich,
Regional Materials Engineer.

Department of Highways Ontario

Copy for the information of

A. STERMAN



66-F-35

Box 279, Burlington
June 27, 1967

Dufferin Materials & Construction
Limited
2700 Dufferin Street
Toronto, Ontario

Attention: J. E. R. Crumb

Re: Contract No. 66-281 - Grand River Bridge

Dear Sir:

Attached please find core results for three bore holes drilled into the transverse concrete which was poured in pier footing number 4.

It is readily observed that this concrete is not satisfactory due to the many interspersed layers of loose aggregate.

As requested during our telephone conversation of to-day's date, please advise this office what proposal your Company intends in order to rectify the condition in which this concrete now exists.

I might add that the core may be viewed at our Laboratory in Downsview at your convenience. Your immediate attention in this matter is greatly appreciated.

Yours very truly
H. Greenland
District Engineer

Per:

Attach.
RB:ms

R. Britton
District Construction Engineer

c.c. H. A. Tregaskes
A. McKim
A. Sterman



DEPARTMENT OF HIGHWAYS

Re: Grand River at Paris
Cont. #66-283, Hwy. 2, Dist. 4

Resumé of a meeting held in the Hamilton District board-room, Friday, June 30, 1967, 10:00 to 11:30 A. M.

Present:

H. Greenland	-	Dist. Eng. D.H.O.
P. Britton	-	Dist. Constr. Eng. D.H.O.
A. Sternac	-	Prin. Foundation Eng. D.H.O.
A. McKim	-	Br. Control Eng. D.H.O.
H. Crumb	-	Dufferin Mat. & Constr. Ltd.
L. Robson	-	" " " "
J. D. Crowley	-	J.D.Crowley & Associates, Ground Water Specialists.

The meeting was held at the request of the contractor to discuss the water problem and the construction of the footing for Pier #3. Mr. Crowley outlined the rock conditions in the area as he understood them, especially drawing attention to an aquifer (water bearing) layer of rock. This layer is reputed to carry the second largest volume of water of any known layer in North America and is causing the contractor his problems with unwatering.

A general discussion was held on the knowledge of this layer and why the Department and Contractor were unaware of it prior to start of construction. The contractor felt that it was the responsibility of the Dept. to inform bidders of conditions such as this, while the Department considered that this should be part of a contractor's investigations during the preparation of his estimate. No agreement was reached on this matter.


The construction of the foundation for Pier No. 3 was discussed at some length, with different courses of action being considered. The Department representatives felt that the work could be done in the dry by driving the sheeting to sound rock and cutting off the flow of water. The contractor is prepared to take the sheeting to sound rock but believes that the flow of water and pressure are so great that this will not work. Grouting behind the

Re: Grand River at Paris -
Cont. #56-283, Hwy. 2, Dist. 4

sheeting to seal the rock was not considered feasible. Since the contractor believes it impossible to pour the footing in the dry, he is to submit to the Department an alternate proposal using tremie concrete. If this proposal is accepted by the Department, it will be dependent on three factors:

- 1) Successful grouting of the tremie for Pier #4.
- 2) Sheet piling to be taken approximately 6" into sound bedrock so no tremie will ever be exposed to flowing water.
- 3) The sheet piling to remain in place to the top of tremie.

At Pier No. 2, Mr. Crowley felt that if any excavation was done similar to that carried out at Piers 3 & 4 without grouting the rock, the contractor would be unable to pump the water coming into the excavation. Discussion on this pier was very general, and no definite proposals were put forth by the contractor.


A. E. McKin,
Bridge Control Engineer.

AEMCK/vk



DEPARTMENT OF HIGHWAYS

Re: Grand River at Paris
Cont. #66-283, Hwy. 2, Dist. 4

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Present:

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R. Britton	-	Dist. Constr. Eng. D.H.O.
A. Stermac	-	Prin. Foundation Eng. D.H.O.
A. McKim	-	Br. Control Eng. D.H.O.
H. Crumb	-	Dufferin Mat. & Constr. Ltd.
L. Robson	-	" " " "
J. D. Crowley	-	J.D.Crowley & Associates, Ground Water Specialists.

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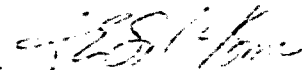
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Re: Grand River at Paris -
Cont. #66-283, Hwy. 2, Dist. 4

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- 1) Successful grouting of the tremie for Pier #4.
- 2) Sheet piling to be taken approximately 6" into sound bedrock so no tremie will ever be exposed to flowing water.
- 3) The sheet piling to remain in place to the top of tremie.

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A. E. McKim,
Bridge Control Engineer.

AEMCK/vk

MEMORANDUM

*file will report
Agg*

To: Mr. H. Tregaskes,
Construction Engineer,
Operations Branch,
Room 224, Lab. Building

FROM: Bridge Division,
Downsview, Ontario

DATE: July 14, 1967

OUR FILE REF.

IN REPLY TO

SUBJECT: Grand River Bridge at Paris
W.F. 233-65, Site No. 1-24
Highway 5, District No. 4

The site was visited on July 12 by A. McKim, F. Wilson and the writer.

Pier Footing #3 was excavated to final level about one foot above the level shown on the plans. Sound bedrock was reached at this elevation. Pumping was in progress, but the excavation could not be completely dewatered. The reason for this was that the majority of sheet piles composing the cofferdam were not driven to sound bedrock but stopped one to two feet short in the softer shale rock. A few sheet piles were driven to bedrock, and at these points no water entered the excavation. No water was coming up from the bottom and 75% of the water was coming in from the river side through the 2'-3' layer of shale. This footing could have been completely dewatered if longer and heavier sheet piling had been used by the contractor.

It is recommended that at Pier #3 another ring of sheet piling be driven to bedrock about two feet from the existing piling. This sheet piling can be reused later at Pier #2. It is further recommended that the contractor not be allowed to use tremie concrete at Piers #2 and #3, as these are in the stream bed proper and would be subject to severe scour.

The contractor had not started any work at Pier #2. At Pier #4 he was drilling the tremie concrete and attempting without success to grout the gravel pockets within this concrete. Apparently the grout could not be forced into the voids, although when air was forced into one drilled hole it came out of several other holes, and bubbles percolated from the surface of the concrete as though it were a large sponge. The contractor is optimistic that he can grout this concrete to the Department's satisfaction.

RE: Grand River Bridge in Paris
Highway 5, District No. 4

In general it can be said that the unwatering difficulties encountered are entirely due to the fact that the contractor used sheet piling which was too light and too short in construction of his cofferdams. The heavier sheet piling would be able to penetrate the soft shale and rest on the sound bedrock, thus cutting off the inward flow of water.

It would appear that this contractor has had little or no previous experience with this type of work, i.e. placing footings at depth within the stream bed of a large river. It would further appear that he has not had any experience in the placing of tremie concrete, judging from the results obtained at Pier #4. This is a specialized type of work in which experience determines failure or success.



C.S. Grebski,
Bridge Design Engineer

CSG:rd

c.c. A. McKim
A. Stermac ✓
B. Davis
P. Wilson
H. Greenland

Downsview 464, Ontario.
August 5, 1969.

Dufferin Materials and Construction Limited,
2700 Dufferin Street,
Toronto 19, Ontario.

Attention: Mr. W. R. McKensie, President

Re: Claim on Contract 66-283
Grand River Bridge at Paris

Dear Sir:

This will confirm the meeting held at Downsview last Friday afternoon, August 1, 1969, in which we discussed the four claims submitted on this contract. Three claims pertained to unwatering and the fourth claim was for the placing and removing of tremie concrete.

Those present at the meeting from Dufferin were yourself and ^{al} Mr. J. H. R. Crumb. The Department personnel were Mr. A. Stermac, Principle Foundation Engineer, Mr. A. E. McKim, Bridge Control Engineer, Mr. G. P. Wilson, Senior Materials Engineer (Concrete), Mr. H. Greenland, District Engineer, Mr. J. J. Regan, Construction Supervisor, Hamilton District and the undersigned.

Mr. Crumb discussed the unwatering claims in general and expressed the opinion that the Department's information was incomplete and that conditions encountered in the field were not indicative of those stated in the Foundation Report and on the contract drawings. Mr. Stermac outlined the information

given by the Department and he contends that the information was correct and expressed the views that the volume of water flowing through an aquifer really does not apply to the unwatering problem - the main problem being the amount of head on the water. This was indicated in the contract drawings in various bore holes and should have been considered at the time of bidding. In general, Mr. Stermac presented the Department's side of this claim and the undersigned agrees with these conclusions.

Mr. Crumb and yourself agreed that you would review the matter and advise the undersigned of your conclusions.

The claim regarding the tremie concrete was secondary depending upon the conclusions you reach of who was responsible for the unwatering and should it be decided that you will not pursue the unwatering claims, then the tremie concrete claim will also not be pursued.

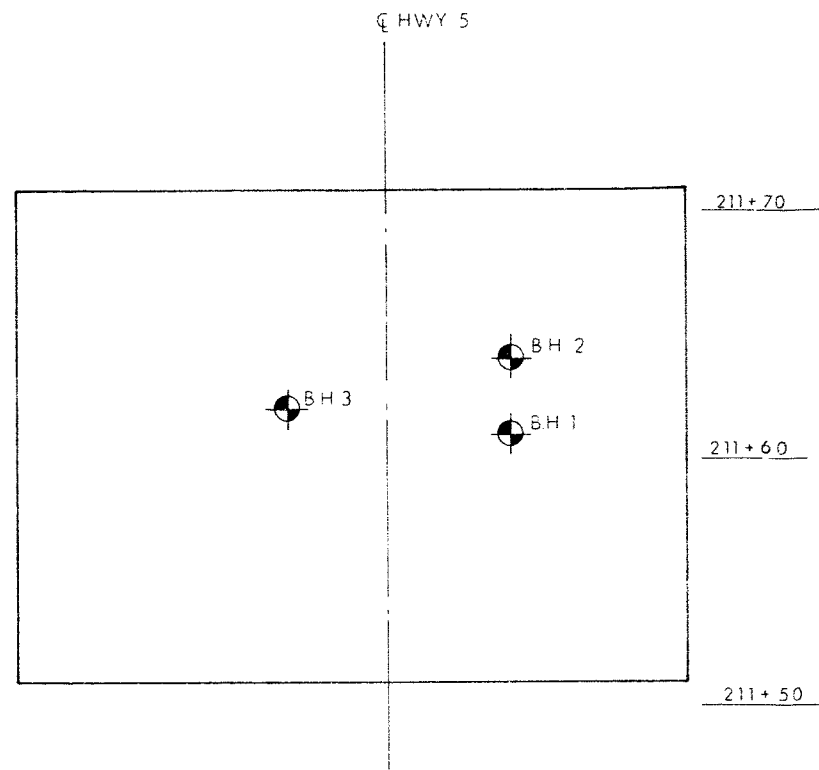
When you have reviewed your claims, would you kindly advise the undersigned of your intentions.

Yours truly,

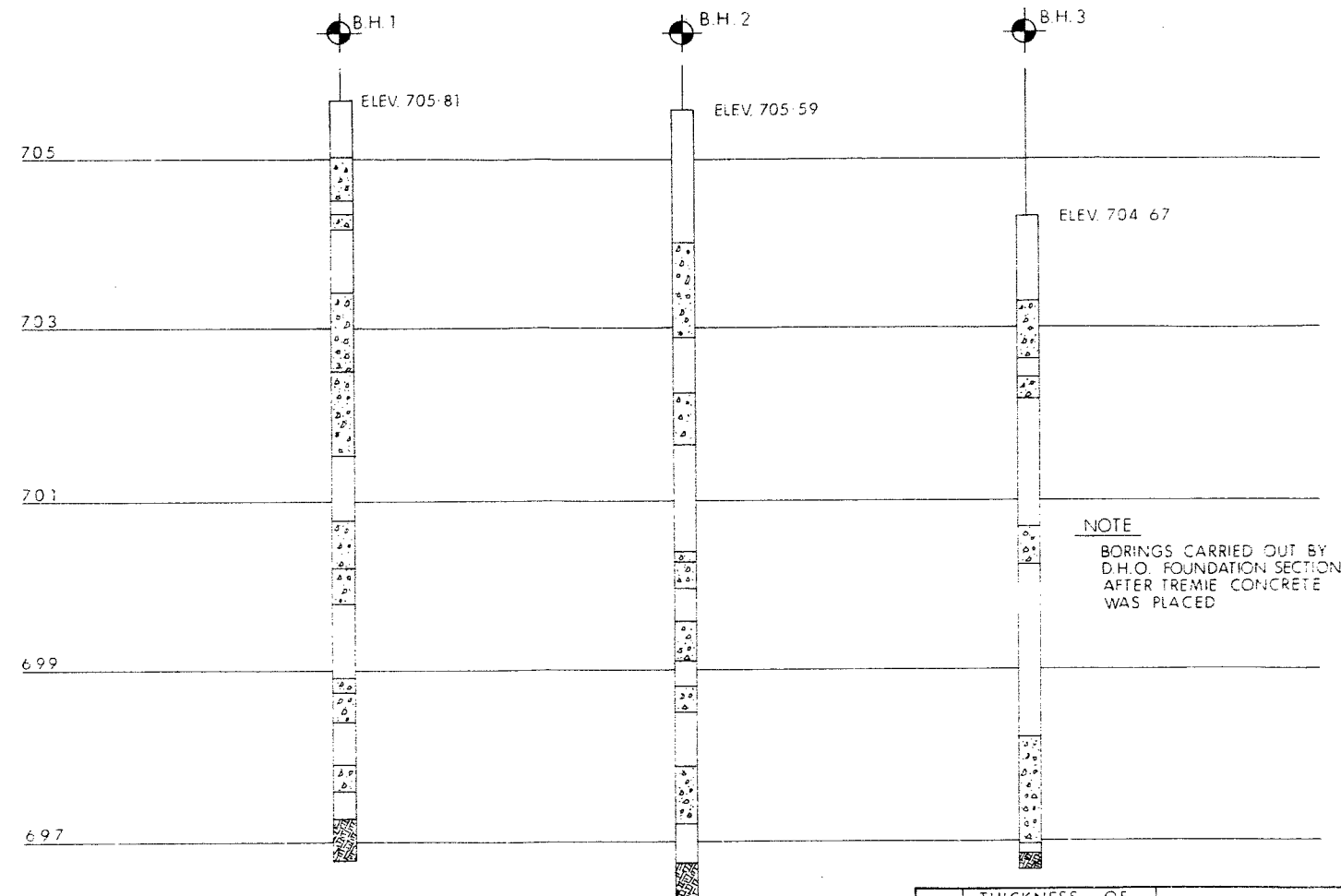
J. W. MacDougall,
Claims Engineer.

JWM/wm

c. c. - A. Stermac
G. P. Wilson
A. E. McKim
H. Greenland






PLAN
PIER NO 4 FOOTING
SCALE 1" = 5'





NOTE
BORINGS CARRIED OUT BY
D.H.O. FOUNDATION SECTION
AFTER TREMIE CONCRETE
WAS PLACED

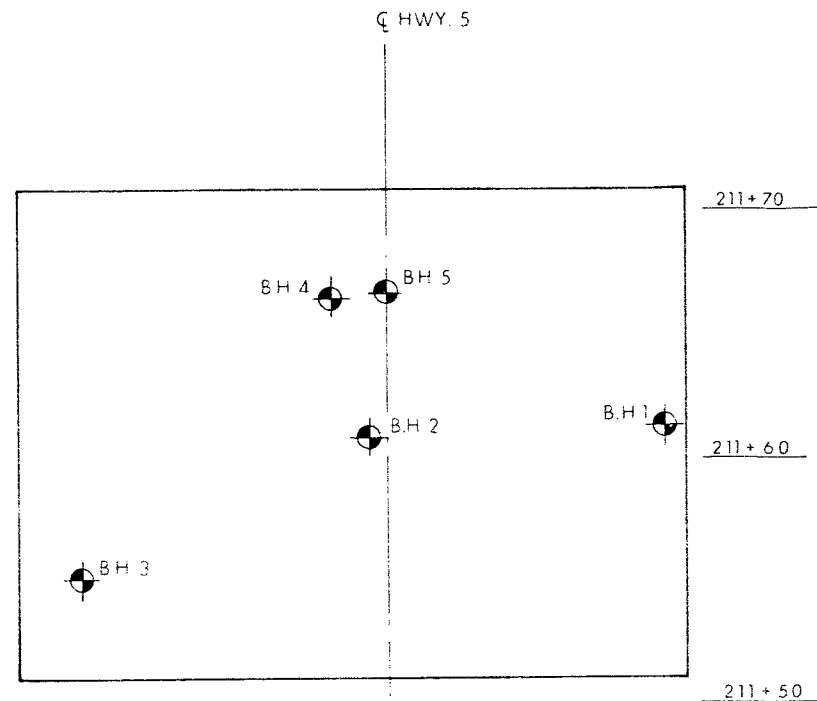
LEGEND

-  SOLID CONCRETE
-  LOOSE AGGREGATE
-  BEDROCK

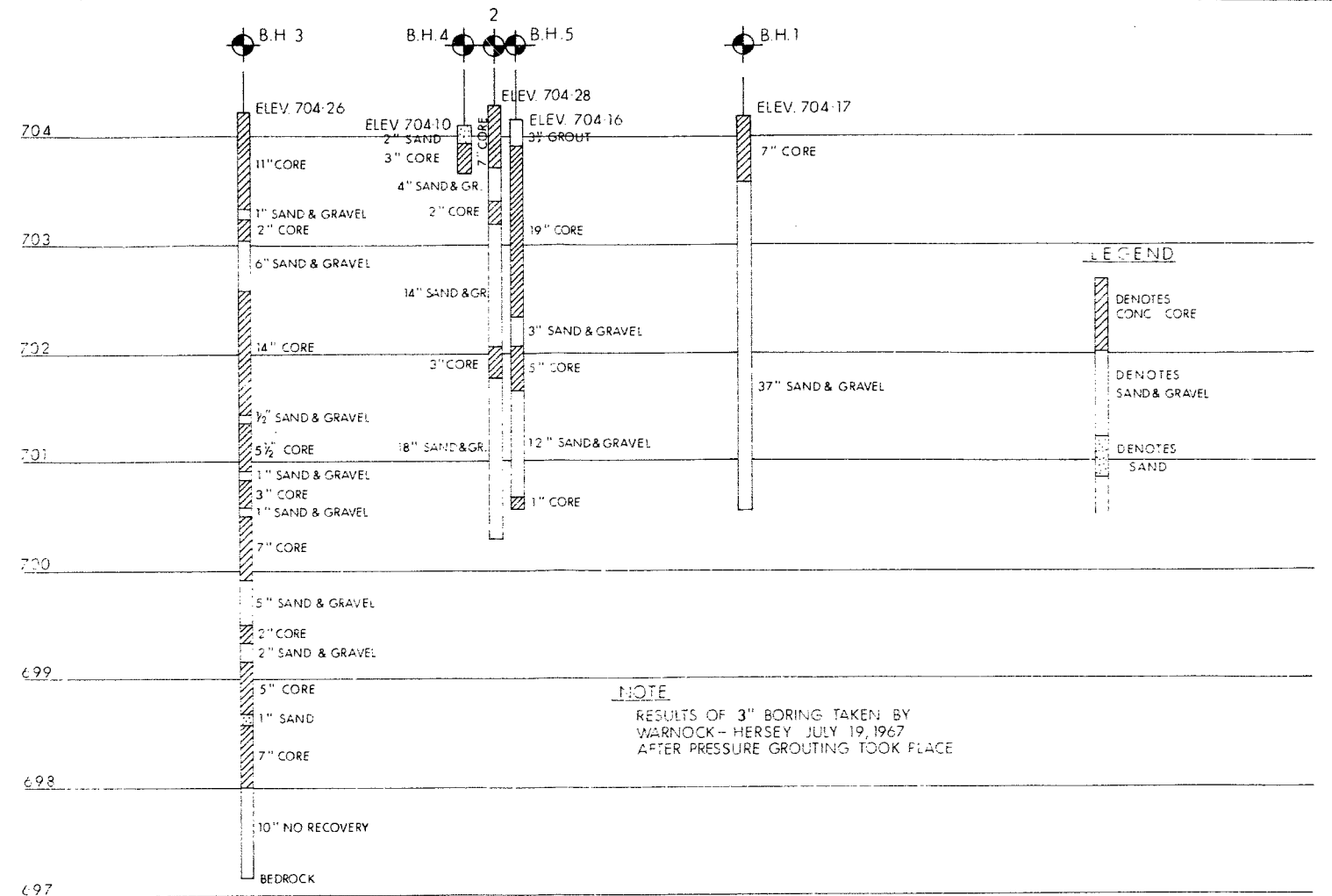
PROFILE
SCALE 3/4" = 1'

B H	THICKNESS OF CONCRETE	CONCRETE RECOVERY
1	8' - 5"	4' - 0"
2	8' - 9"	3' - 0 1/2"
3	7' - 4"	2' - 8"

 ONTARIO DEPARTMENT OF HIGHWAYS MATERIALS and TESTING DIVISION	GRAND RIVER BRIDGE AT HWY. 5 PIER NO 4 FOOTING (PARIS - ONTARIO)	
	WP 233-65	CONTRACT 66-283
DATE JUNE 26, 1967	APPROVED 	DRAWING NO. 66-F-35 B



PLAN
PIER NO 4 FOOTING
SCALE 1" = 5'



PROFILE
SCALE VERT 1" = 1'
HORIZ. 1" = 5'

 ONTARIO	DEPARTMENT OF HIGHWAYS MATERIALS and TESTING DIVISION	GRAND RIVER BRIDGE AT HWY. 5 PIER NO 4 FOOTING (PARIS - ONTARIO)	
	DATE JULY 19, 1967	APPROVED <i>[Signature]</i>	W.P. 233-65
		DRAWING NO. 66-F-35 C	

CLAIMS ON CONTRACT 66-283
DUFFERIN MATERIALS & CONSTRUCTION LIMITED

With respect to the letter of December 24, 1968, by Dufferin Materials & Construction Limited, to Mr. J. W. MacDougall, D.H.O. Claims Engineer regarding the claim on Contract No. 66-283, we herewith submit our comments:

The Foundation Section was basically and primarily involved with the problems that occurred at Pier No. 4. For the other piers the Section was consulted only on a few occasions.

These comments will therefore be limited to our actions only. We understand that the other D.H.O. representatives who were also involved, will make separate comments regarding their own activities and recommendations.

Upon hearing about the problems at the bridge site on June 8, 1967, and having been asked to come to the site, Mr. M. Devata, Supervising Foundation Engineer, under whose supervision the foundation investigation was carried out, visited the site the next day - i.e., on Friday, June 9, 1967.

It was Mr. Devata's impression that the cofferdam for Pier No. 4 was improperly constructed, and consequently the dewatering of the excavation was practically impossible. This was conveyed through the District representative to the Contractor, who insisted on further discussion and meetings.

On Monday, June 12, 1967, Mr. Devata and the undersigned visited the site again.

The dewatering of the excavation was indeed impractical because of the very poor and incompetent way the steel sheet cofferdam was built.

The Contractor had driven very light sheeting into the ground which, below elev. 713, contains occasional boulders (as stated in the Foundation Report dated June 17, 1966, B.H. 1) and the sheet piling was therefore bent, buckled and in places, hung up at higher elevations and not driven to the required depth. Water was pouring into the excavation from all sides. Due to the fact that sound rock was not yet reached, water naturally entered the excavation also through the broken and fissured bedrock at the bottom.

The undersigned realized, while at the site, that in order to dewater the excavation, a new row of heavier steel sheet piles would have to be driven outside and around the existing one. The undersigned believed this to be the right way of completing the job in the manner it was bid on and awarded - i.e., to excavate to the required elevation (Min. 695.5') in the sound rock and pour the footings in the dry.

This operation would have, however, caused a significant delay. In addition, the Contractor was in no way agreeable to this suggestion, but instead proposed tremie concrete. This was quite understandable because, to remedy the situation in the manner described above, would have been very expensive for the Contractor.

Because pouring tremie concrete requires proper equipment and certain experience, the Contractor was specifically asked whether he possessed both. To this question he gave an emphatic affirmative answer.

The undersigned contacted, from the site, Mr. C. Grebski, Bridge Design Engineer, and discussed the whole problem in great detail. After considering all available alternatives, it was agreed to grant the Contractor the permission to change the construction method and pour tremie concrete seal and then pour the footing in the dry. The Contractor was also advised that the

acceptance of the tremie concrete seal would be subject to the findings of the test drilling and results of the strength tests of the concrete cores. It was also stressed to him that the Department was doing this to help him get out of the predicament he got himself into.

The control drilling by the Department was performed on June 21, 22, 23 and 26, 1967, and the results showed a very poor concrete quality. In places there were voids, while in others there was no cement at all, but only sand and gravel. On the insistence of the Contractor, we drilled in locations of his choice but the results were equally poor.

It became obvious to everybody, even to the Contractor, that the concrete was very poor and therefore unacceptable. The Contractor suggested grouting as a remedial measure. Because the Contractor expressed the opinion that the equipment and drilling methods used by the Department were not appropriate for checking purposes, we suggested - and the Contractor agreed - to hire an independent testing company. Warnock-Hersey Limited were hired and they carried out the control drilling of the grouted tremie concrete. The results showed the grouting to have been ineffective and the concrete still to be very poor. Thus the concrete was condemned and the only alternative that remained was to remove the concrete and to pour it again. The results of the Department's and Warnock-Hersey's control drilling are given in Appendix I.

The arguments by the Contractor regarding the mix for the tremie concrete will be commented upon by others.

These are the events as they are recorded and as we remember them.

We would, however, also like to comment on a few statements made by the Contractor in Claim No. 1 - Dewatering Pier No. 4.

On page 1 the Contractor states that " borehole #1, being nearest to the location of Pier No. 4 showed an artesian condition occurring in the clayey silt stratum at approximate elevation 715.5. This same borehole indicated that the weathered shale occurred from elevation 704.0 to 696.8, at which level sound bedrock was to be encountered."

The foregoing statement is not correct because the ground elevation at B.H. 1 was 728.8 and the groundwater level indicated at elev. 715.5 - i.e., 13.3 ft. below ground level. An artesian condition would imply that the groundwater or piezometric level is, or can arise above ground, which was not the case here.

Again on page 1 the Contractor states: "In actual fact, we encountered another layer of water-bearing rock between elevation 702 and 700.5, or thirteen feet below the level as indicated on the borelogs."

The above statement is also not correct because the water-bearing stratum at this location is the till layer (elev. 712.9 to 704.0) and the underlying zone of very extensively weathered bedrock (elev. 704.0 to 696.8). It was to be expected to encounter variable, but considerable inflow of water from all sides, into the excavation until sound bedrock was reached. Consequently, the Contractor's statement on page 2, which reads: "We believe that the D.H.O. were totally unaware of this aquifer occurring at elevation 702 to 700.5, although fairly extensive foundation investigations were undertaken." - does in no way describe our understanding of the problem.

A more careful study of the information contained in the Foundation Investigation Report would have enabled the Contractor to realize and understand the groundwater conditions at this site and thus choose appropriate procedures and equipment from the very beginning.

The statement by Mr. J. David Crawley of J. D. Crawley Associates, Groundwater Specialists, as to the presence of an aquifer having either the second or third (he should decide which) highest rate of transmissibility on the North American Continent, is irrelevant in this case. It was never intended to dewater the excavation by pumping from the aquifer and thus reduce the inflow of water into the excavation but, rather to seal off the aquifer by driving steel sheet piling to sound bedrock. Consequently, the pumping test would have been superfluous. Had the transmissibility been so important, one pumping test would not have necessarily disclosed the governing rate of transmissibility because of the variable nature of the overburden and the irregular fissuring and weathering characteristics of the bedrock, and could have thus been quite misleading.

March 26, 1969

A. G. Stermac

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

To: A. Rutka (3 copies)

cc: Messrs. C. S. Grebski
A. McKim
P. Wilson

Foundations Files
Gen. Files



66-F-35

DUFFERIN MATERIALS & CONSTRUCTION LTD.

2700 DUFFERIN STREET • TORONTO 19, ONTARIO • TELEPHONE 789-3311

December 24, 1968

Department of Highways, Ontario,
Downsview, Ontario.

Attention: Mr. J.W. MacDougall,
Claims Engineer

Gentlemen:

Re: D.H.O. Contract 66-283
Claims 1 to 4

Enclosed are breakdowns of our claims for the above mentioned job as per your request.

Yours very truly,

DUFFERIN MATERIALS & CONSTRUCTION LTD.

J.H.R. Crumb, P.Eng.,
Assistant Manager,
Special Projects Division.

/je
encl.





DUFFERIN MATERIALS & CONSTRUCTION LTD.

Dept. of Highways, Ontario.
Re: Contract 66-283

Dec. 24/68

CLAIM NO. 1 DENATERING PIER NO. 4

According to the Soils Report available to bidders as prepared by the Foundation Section, Materials and Testing Division of the D.H.O. dated June 17, 1966, borehole # 1, being nearest to the location of Pier No. 4 showed an artesian condition occurring in the clayey silt stratum at approximate elevation 715.5. This same borehole indicated that the weathered shale occurred from elevation 704.0 to 696.8, at which level sound bedrock was to be encountered.

In order to reduce this flow of artesian water into the footing excavation to a minimum, we drove a sheet pile cofferdam to refusal in the weathered shale area with the toe of the sheet piling at approximate elevation 702; i.e., approximately two feet of penetration into the weathered shale.

In actual fact, we encountered another layer of water-bearing rock between elevation 702 and 700.5, or thirteen feet below the level as indicated on the borelogs. This layer was of such porosity that it required up to four six-inch electric pumps to keep the water under control, or a flow of approximately 6,000 U.S. GPM. As the excavation proceeded, the sheet piling was tapped and re-tapped until the sheets were founded on the bottom of the excavation. This procedure only caused the sheets to curl away from the rockline and leave a void between the sheets and the rock face, but this method was undertaken at the request of the D.H.O.

During the period of excavation, several informal meetings and discussions took place, both at the site and at Downsview, between our forces and the D.H.O. supervisors. No decisions were made at these meetings except that we were to try and re-tap the sheets and make the cofferdam as watertight as possible.

A meeting was held at the site on June 2, with representatives of the Engineer, the D.H.O., and ourselves present. No changes were instituted as a result of this meeting, and we were told that we must pour the concrete in the dry, regardless of how we did it. We filed a Notification of Intent to Claim as a result of this meeting. Efforts were made to tighten the cofferdam by introducing cinders around the perimeter of the cofferdam, but the volume of water was too great.

Another meeting was held at the site on June 9, with representatives of the Foundation Section of D.H.O. and ourselves. Again we were told that the concrete was to be poured in the dry, regardless of the methods used. Another meeting was held at the site on June 12, with senior representatives of the Foundation Section of the D.H.O. and ourselves. It was decided that the best and fastest method to combat this water problem would be to pour a tremie slab to cover this layer of water-bearing material and to place the designed pier footing of this tremie slab. Permission from Downsview was received, and preparations were made to pour the tremie concrete the following day.

CN



Claim No. 1 - Dewatering Pier No. 4

This method was discussed as early as May 25, but permission was not given until June 12, 2½ weeks later.

We believe that the D.H.O. were totally unaware of this aquifer occurring at elevation 702 to 700.5, although fairly extensive foundation investigations were undertaken. We also believe that, because of this oversight on the part of the D.H.O., we should not be held liable for this excessive water condition.

We requested a meeting on June 30 in the district office of the D.H.O. and introduced Mr. J. David Crowley of J.D. Crowley & Associates, Ground Water Specialists. Mr. Crowley informed those present that the Paris area was famous for the presence of an aquifer that had the third highest rate of water transmissability on the North American Continent. He claimed that this information was a matter of record with the Ontario Water Resources Commission and to people specializing in ground water services through publications of the O.W.R.C. We maintain that the onus for the design of any structure rests on the Owner, or his representatives, and these persons should be responsible for the foundation investigation and subsequent design and not the Contractor. Mr. Crowley suggested that because of the nature of rock in the Paris area, a complete pumping test should have been performed as part of the foundation investigations, and the pumping requirements for excavation could have been indicated to all concerned.

We believe that, because of this excessive flow of artesian water, the structure could not have been built according to the plans and specifications in our original contract, and a design change was required in order to proceed with the construction. We maintain that, because of this change in design, we should not be held liable for these changes, and hope that the D.H.O. will honour our claim.



DUFFERIN MATERIALS & CONSTRUCTION LTD.

Dept. of Highways, Ontario,
Re: Contract 66-283

Dec. 24/68

CLAIM NO. 2 - DEMATERING PIER NO. 3

Borehole No. 5 of the afore-mentioned Soils Report was nearest to the location of pier No. 3. This borehole showed an artesian condition occurring in the weathered shale area at approximate elevation 703.0, and that sound bedrock would be encountered at elevation 694.

In order to reduce this flow of artesian water into the footing excavation to a minimum, we again drove a sheet pile cofferdam to refusal in the weathered shale area with the toe of the sheet piling at approximate elevation 701; i.e., approximately three feet of penetration into the weathered shale.

We again encountered another layer of water-bearing rock between elevation 698 and 696.5, or five feet below the level as indicated on the borelogs. This flow of water also required four six-inch electric pumps to keep it under control. Again, as the excavation proceeded, the sheet piling was tapped and re-tapped until the sheets were founded on the bottom of the excavation. Again, the sheets curved away from the rockline, and left a void between the sheets and the rock face. This procedure was followed again at the request of the D.H.O.

Again, several informal discussions were held during the period of excavation between the D.H.O. and ourselves at which time we were instructed that the concrete must be poured in the dry. We re-tapped the sheets and tried to make the cofferdam watertight, but all methods employed could not stop the volume of water from entering the footing area.

A meeting was held at the District Office on Aug. 9 with senior representatives of the D.H.O. and ourselves present. It was again decided that the best and fastest method to combat this water problem would be to pour a tremie slab to cover this layer of water-bearing material and to place the designed pier footing on this tremie slab. Permission from Downsview was received, and preparations were made to pour the tremie concrete as soon as possible.

We again believe that the structure could not have been built according to the plans and specifications in our original contract because of this excessive flow of water. We believe that a design change was required and, since we cannot be held responsible for the design of the structure, we hope that the D.H.O. will honour our claim.



DUFFERIN MATERIALS & CONSTRUCTION LTD.

Dept. of Highways, Ontario,
Re: Contract 66-283

Dec. 24/68

CLAIM NO. 3 - REMOVING AND REPLACING TREMIE CONCRETE FOR PIER NO. 4

We retained the services of Mr. Karl Pullerits, P. Eng., of the firm of Gibb, Albery, Pullerits & Dickson, Consulting Engineers, to inspect the tremie concrete placed in pier No. 4 on June 13, that proved to have seams throughout the pour. This concrete had been designed by the D.H.O. and placed under the supervision of the D.H.O.

Because of the flow patterns and seams present in the tremie pour, it was his opinion that the concrete had not flowed fluidly throughout the footing area. It was his opinion that the design of the concrete mix was the main reason for the poor flow characteristics of the concrete. From past experience and from various published articles, he submitted a mix design that included a retardant, and maintained that this retardant would ensure the desired flowability of the tremie concrete.

Articles published in the ACI Journal state that retarded mixes provide best results from laboratory and field tests done on tremie concrete. These retarded mixes produce a more uniform tremie concrete and the cohesiveness and gravity flow qualities were noticeably improved.

We maintain that the mix, as furnished by the D.H.O., was not a proper tremie mix suitable for the conditions as they existed, and that we should not be held liable for placing and removing this faulty mix.

We hope that the D.H.O. will honour our claim.



DUFFERIN MATERIALS & CONSTRUCTION LTD.

Dept. of Highways, Ontario,
Re: Contract 66-283

Dec. 24/68

CLAIM NO. 4 - Dewatering Pier No. 2

Borehole No. 3 of the afore-mentioned Soils Report was nearest to the location of pier No. 2. This borehole showed an artesian condition occurring in the clay, silt, sand and gravel layer at approximate elevation 702.3, six inches above the weathered shale layer and ten feet above the sound bedrock at elevation 692.5.

At the request of the D.H.O., heavier sheet piling was used to drive an over-sized sheet pile cofferdam to refusal in the weathered shale area. At the direction of the D.H.O., the sheets were further driven by pre-excavating behind the sheets as the footing excavation proceeded. This method of pre-excavating was used until the sheet piling was driven to the bottom of the excavation, all at the direction of the D.H.O. The cofferdam was again unable to stop the flow of artesian water from entering the pier footing area.

A meeting was held at the Downsview office on Sept. 28 with senior representatives of the D.H.O. and ourselves present. It was again decided to pour a tremie slab to cover the layer of water-bearing material and to place the designed footing on this tremie slab.

Although we followed the instructions of the D.H.O. in constructing the cofferdam for this pier footing, we were not able to stop the flow of artesian water into the footing area. We believe that this exercise clearly pointed out to all concerned that this volume of water was uncontrollable and, therefore, a re-design was required to overcome the water problem. We again maintain that the responsibility for the proper design of the structure rests with the Owner, or his representatives, and not with the Contractor. We therefore state again that we should not be held liable for this re-design.

We hope that the D.H.O. will honour our claim.

Downsview 464, Ontario.
February 6, 1970.

Dufferin Materials and Construction Limited,
2700 Dufferin Street,
Toronto 19, Ontario.

Attention: Mr. J. H. R. Crumb

Re: Claim on Contract 66-283
Grand River Bridge at Paris

66-F-35
W P 222-65

Dear Sir:

In reply to your letter dated November 18, 1969 to Mr. H. Greenland, Hamilton District Engineer, I would like to advise that he has forwarded this to me for reply.

As you will recall, on August 1, 1969 a meeting was held to discuss the various claims submitted on this contract and the Department did not recognize any additional payment on the claims as the contract documents indicated conditions that were actually encountered in the field on the unwatering item on the various piers. Mr. Stermac outlined the Department's feelings and it was felt at that time that you would like to review the contract drawings and information, etc., and advise the undersigned of your conclusions. This was confirmed to you in my letter of August 5, 1969.

Your letter of November 18 does not present any new information regarding the claim and, therefore, the Department's stand has not changed. We feel that the information given to contractors in our documents was quite adequate and sufficient.

You have requested a release of 25 per cent holdback on the contract Item 34 "Unwatering Foundations" in the amount of \$16,669.50. I have discussed this with Mr. H. W. Adcock and Mr. Greenland and the Department's decision to reduce the unwatering item by 25 per cent is due to the fact that the foundations were not unwatered and that tremie concrete was placed in them and, therefore, the Department does not feel that we should pay the entire amount for the unwatering item as bid.

Regarding the waiving of the liquidated damages in the amount of \$14,400.00, I am not in a position to make any comments on this matter but I am forwarding it to Mr. T. C. Muir, Contract Control Engineer, who, I am sure, will take the matter under advisement and advise you of the final Department decision.

Your November 18 letter indicates that you encountered severe expenditures while attempting to combat the excessive amount of ground water. This is in direct relation to your previous claim and the Department does not feel that we have any responsibility here, as already mentioned above.

Yours truly,

J. W. MacDougall,
Claims Engineer.

JWM/wm

c. c. - Mr. T. C. Muir
Mr. H. Greenland
Mr. A. Stermac ✓
Mr. G. P. Wilson
Mr. A. E. McKim