

REMARKS: _____



DOMINION SOIL INVESTIGATION LIMITED

CONSULTING SOIL & FOUNDATION ENGINEERS

245 HOWARD AVE. WINDSOR, ONT.

(519) 958-7530

73-F-211M

~~40J-163~~

GEOCRES No.

SOIL INVESTIGATION FOR PROPOSED

BRIDGE OVER HILLMAN CREEK

ON COUNTY ROAD No. 37

40J2-34
GEOCRES No.

DIST

REF. No. 72-6-W1

JUNE 1972

PREPARED FOR

M.M. DILLON LTD.

Distribution:

- 3 copies - M.M. Dillon Ltd.
- 1 copy - Dominion Soil Investigation Limited - Toronto
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C O N T E N T S

	<u>Page</u>
I INTRODUCTION	1
II FIELD WORK	1 & 2
III SUBSURFACE CONDITIONS	2
PEAT and Organic SILT	3
Brown Silty CLAY	3 & 4
Grey Silty - CLAY	4 & 5
IV GROUNDWATER CONDITIONS	5
V DISCUSSION & RECOMMENDATIONS	5 & 6
(a) General	5 & 6
(b) Design	6 & 7
(c) Construction	7

E N C L O S U R E S

	<u>No.</u>
Site Plan	1
Borehole logs (1-3)	2,3 & 4
Shear Strength Profile	5

I INTRODUCTION

In accordance with verbal instructions dated June 7, 1972, from Mr. N.K. Becker P.Eng. of M.M. Dillon Ltd. a soil investigation has been carried out at the bridge over Hillman Creek, on County Road No. 37 on behalf of the County of Essex. It is proposed to replace the existing bridge with a new structure located north and east of the existing bridge.

The new bridge will have a span of 75 feet. Total anticipated live and dead load at the abutments will be approximately 25 kips per foot.

II FIELD WORK

The initial field work, consisting of 2 boreholes, at the locations shown on the site plan, Enclosure 1, was carried out on June 6, 1972. On reviewing the findings of these boreholes, a third borehole (BH. 3) was put down west of the proposed bridge location on June 7, 1972. The boreholes were advanced to the sampling depths using a power auger machine equipped for soil sampling. Standard Penetration Tests were carried out at frequent intervals of depth and the results are shown

D

on the borehole logs as N-values. Undisturbed samples of the strata were obtained by means of thin-walled tube samplers.

All samples were transported to our Windsor laboratory for further classification and shear strength tests.

The field work was supervised by a soils technician who also determined the ground elevation at each borehole location. The elevations were referred to the centre of the road at the west end of the existing bridge as shown on the site plan. This reference datum was given the assumed value of El. 97.2 ft.

III SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered in each borehole are given on the borehole logs comprising Enclosures 2, 3 and 4 and the following notes are intended only to summarise the more significant soil strata encountered.

PEAT and Organic SILT

All three boreholes encountered a surface layer of soft peat which extends to a depth of between 6.5 feet at borehole 3 increasing to 11.5 feet at borehole 1. There is clayey silt below the peat at boreholes 2 and 1, extending a depth of 13.5 feet and 19.0 feet respectively.

Brown Silty CLAY

Below the peat and silt at boreholes 1 and 3 there is mottled brown becoming brown silty clay containing occasional gravel and seams of silt and fine sand. This brown clay extends to a depth of 22 feet and 30.5 feet below the ground surface respectively. Standard Penetration Tests in the stratum gave N-values of 16 to 40 blows per foot.

Unconfined compression tests on selected samples gave undrained shear strengths of 2830 p.s.f. to more than 4770 p.s.f. The natural water content ranged from 19.4% to 25.4%. From all of the foregoing test results the consistency of the clay is described as 'very stiff' becoming 'hard'.

It should be noted that this stratum is not present at borehole 2, and this was the reason for putting down the third borehole.

Grey Silty - CLAY

Below the brown silty clay at boreholes 1 and 3 and the organic silty clay at borehole 2 there is grey silty clay containing gravel and seams of silt and fine sand. This stratum extends to a depth of at least 41.5 feet below the ground surface. Standard Penetration Tests in the stratum gave N-values of 7 to 15 blows per foot.

Unconfined compression tests on selected samples from boreholes 1 and 3 gave undrained shear strengths of 1290 p.s.f. to 1920 p.s.f. Both the N-values and the shear strength showed a general tendency to decrease with depth. The natural water content ranged from 22.9% to 26.6% and showed a general tendency to increase with depth. From all of the foregoing test results, it is considered that the consistency of the clay is of low plasticity with a consistency of 'stiff' to 'very stiff' at boreholes 1 and 3, and a consistency of 'firm' to 'stiff' at borehole 2.

The shear strength profile obtained from the test results at boreholes 1 and 3 is presented on Enclosure 5.

IV GROUNDWATER CONDITIONS

A free groundwater surface was observed in all three boreholes at a depth of 1.0 ft. to 1.2 ft. below the ground surface during the field work.

V DISCUSSION & RECOMMENDATIONS

(a) General

The investigation shows that the subsurface conditions are considerably weaker at borehole 2 (due to the proximity of the creek) and we recommend that the bridge abutments be located at boreholes 1 and 3, where conventional spread foundations can be adopted. It should also be noted that, since an abrupt change in the subsurface conditions occurs between boreholes 1 and 2 (a distance of only 80 feet), the conditions found at boreholes 1 and 3 can only be applied in the immediate vicinity of these borehole locations.

At boreholes 1 and 3 the site is covered by 6.5 feet to 13.5 feet of peat and organic silt underlain by 'very stiff' becoming 'hard' brown silty clay which extends to depths of 22.0 feet to 30.5 feet below the ground surface. Below this is 'stiff' to 'very stiff' grey silty clay which extends to a depth of at least 41.5 feet below the ground surface.

The ground water table is located at a depth of about 1 foot below the ground surface.

b) Design

The foundations are to be located at approximately El. 80.0 ft. Since the base of the hard brown clay stratum is located at El. 72.0 to El. 63.0 this will result in the hard clay acting as a natural raft below the foundations.

Spread footings can be used for the abutments using a maximum bearing pressure of 5000 p.s.f. This will result in a footing about 5 feet to 10 feet wide. The resulting settlement will depend on the actual footing width but we estimate that it will be less than 0.75 inch for a 10 foot wide footing. This is likely to be acceptable for this structure.

Care should be taken to avoid softening of the clay subgrade by disturbance during construction. For this reason, it is recommended that the last few inches of the excavation be carried out by hand and that the excavation be covered by a layer of weak concrete or free-draining granular material as soon as grade level is reached.

The abutments must be designed to resist forward sliding along the base due to lateral pressures from the retained earth. For the calculations of lateral pressures, a unit weight of soil of 130 p.c.f. and a coefficient of lateral earth pressure of 0.4 is recommended. The adhesion of clay on the concrete base can be taken as 1000 p.s.f. and the minimum factor of safety against sliding should be 1.5.

c) Construction

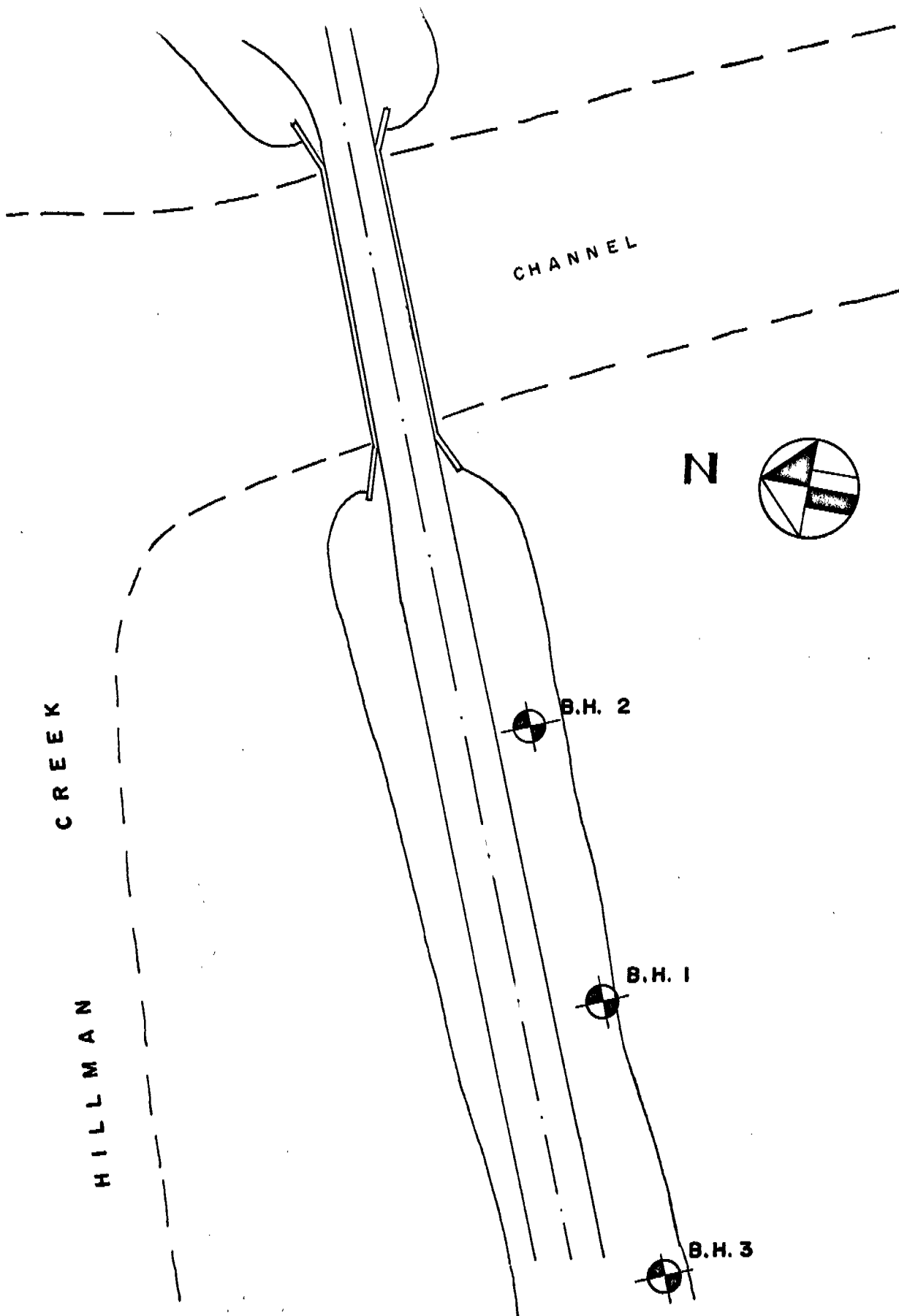
The peat and the high ground water table at the site will give rise to construction difficulties in an open excavation and we would recommend the use of interlocking sheet piling for the construction of the abutments.



Yours very truly,
DOMINION SOIL INVESTIGATION

A handwritten signature in dark ink, appearing to read "V. Wood".

V. Wood, M.Eng. P.Eng.
Windsor Branch Manager



LOG OF BOREHOLE...!

Our Reference No. 72-6-W1

Enclosure No. 2

CLIENT: M.M. Dillon Ltd.
PROJECT: Bridge of Hillman Creek
LOCATION: Mersea Township
DATUM ELEVATION: Local

DRILLING DATA

Method: Auger
Diameter: 4 inch
Date: June 6, 1972

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE Blows / Foot					WATER CONTENT %			REMARKS	
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	10	20	30	40	50	PLASTIC LIMIT	NATURAL		LIQUID LIMIT
								UNDRAINED SHEAR STRENGTH 1000 lbs/sq.ft.					W _p	W		W _L
								+ FIELD VANE TEST • COMPRESSION TEST								
								1.0	2.0	3.0	4.0	5.0	10 20 30 40 50			
93.7	0.0															
90		Soft														
		brown			1	SS	2									
		PEAT														
85																
	10.0	Soft	X		2	SS	3									
		clayey	X													
		SILT	X													
80	13.5				3	SS	17									
		Very stiff	X													
		to hard	X													
		brown	X		4	SS	23									
		silty	X													
75		CLAY.	X		5	SS	25									
		Occasional	X													
		gravel	X													
		seams of	X		6	SS	26									
	22.0	sand	X													
70		Very	X													
		stiff	X													
		becoming	X		7	SS	13									
		stiff	X													
65		grey	X													
		silty	X		8	TW										
		CLAY.	X													
60		Occasional	X													
		gravel.	X		9	SS	10									
		Seams of	X													
55		sand	X													
	40.5	End of Borehole			10	TW										

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: P.V. CHECKED: V.W.

LOG OF BOREHOLE2.....

Our Reference No. 72-6-W1

Enclosure No. 3

CLIENT: M.M. Dillon Ltd.
PROJECT: Bridge of Hillman Creek
LOCATION: Mersea Township
DATUM ELEVATION: Local

DRILLING DATA

Method: Auger
Diameter: 4 inch
Date: June 6, 1972

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE Blows / Foot					WATER CONTENT %					REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	10	20	30	40	50	PLASTIC LIMIT	NATURAL	LIQUID LIMIT		
								UNDRAINED SHEAR STRENGTH 1000 lbs/sq.ft.					W _p	W	W _L		
								+ FIELD VANE TEST • COMPRESSION TEST					1.0 2.0 3.0 4.0 5.0			10 20 30 40 50	
93.6	0.0	Soft															
90		brown															
		PEAT		1	SS	1	o										
85																	
	11.5	Organic															
		SILT		2	SS	1	o										
80		Traces of		3	SS	3	o										
		timber															
		and															
		seams															
		of															
75		sand															
	19.0																
		Firm															
		to		6	SS	10	o										
70		stiff															
		grey															
				7	SS	7	o										
65		silty															
		CLAY.															
		Occasional															
		gravel															
60		and															
		seams															
		of															
55		sand															
41.5		End of Borehole															
50																	

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: P.V. CHECKED: V.W.

LOG OF BOREHOLE...3.....

Our Reference No. 72-6-W1

CLIENT: M.M. Dillon Ltd.
PROJECT: Bridge of Hillman Creek
LOCATION: Mersea Township
DATUM ELEVATION: Local

DRILLING DATA

Method: Auger
Diameter: 4 inch
Date: June 7, 1972

Enclosure 3

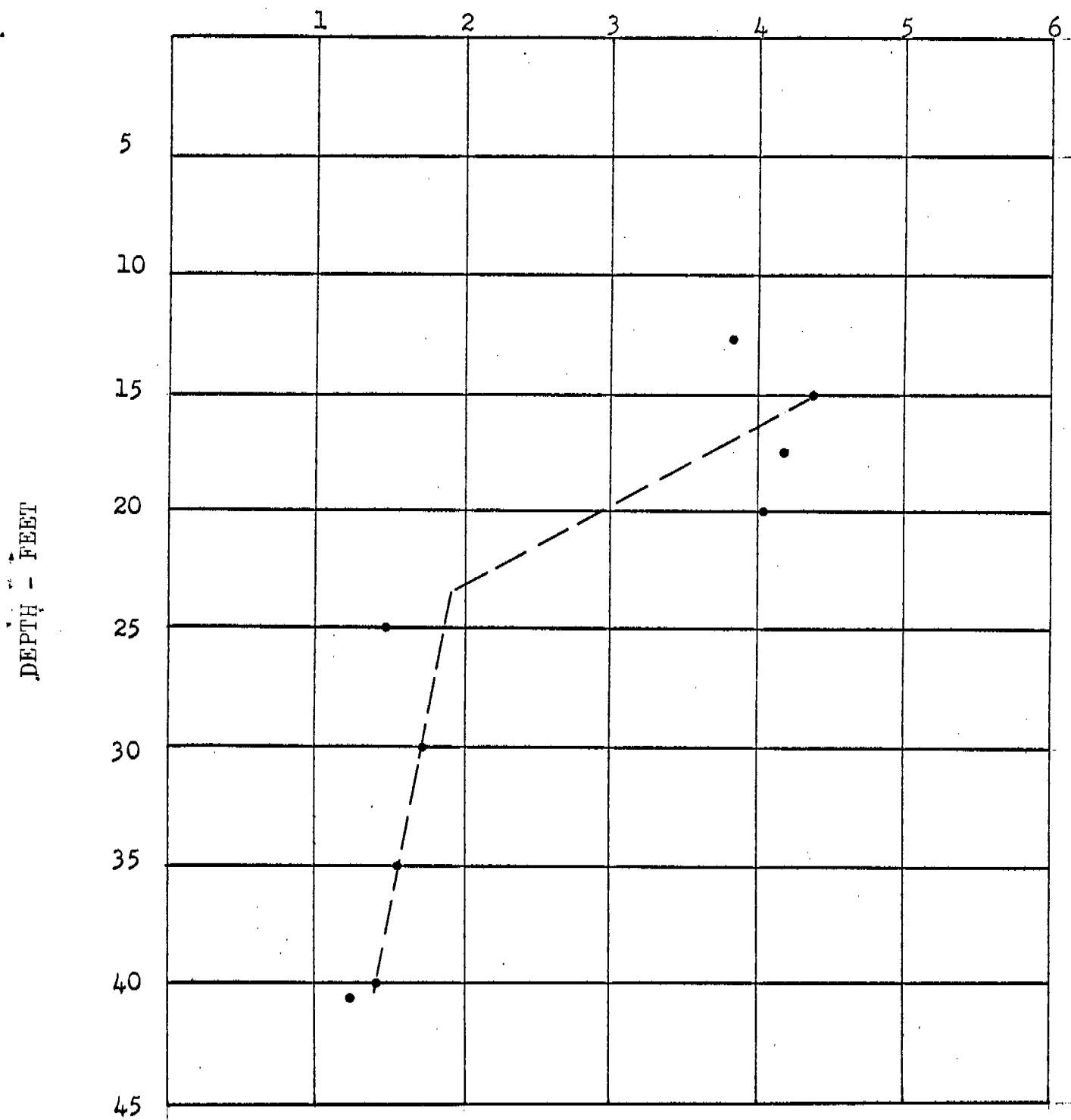
SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %					REMARKS					
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	Blows / Foot					PLASTIC LIMIT			NATURAL		LIQUID LIMIT				
								10	20	30	40	50	UNDRAINED SHEAR STRENGTH 1000 lbs/sq. ft.			W _p		W		W _L		
								+ FIELD VANE TEST					COMPRESSION TEST					10 20 30 40 50			10 20 30 40 50	
								1.0	2.0	3.0	4.0	5.0										
93.2	0.0	Soft																				
90		Dark																				
		brown																				
		PEAT																				
65																						
85		Hard			1	SS	32															
		mottled			2	SS	36															
		brown																				
80		becoming			3	SS	35															
		brown			4	SS	23															
75		silty			5	SS	24															
		CLAY.			6	SS	30															
		Occasional			7	SS	16															
		gravel			8	SS	17															
70		and			9	SS	40															
		seams			10	SS	23															
		of																				
65		sand																				
30.5																						
		Stiff to			11	SS	22															
		very stiff																				
60		grey silty CLAY																				
		occasional																				
		gravel																				
		and seams																				
		of sand			12	SS	15															
36.5																						
		End of Borehole																				
55																						

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: P.V. CHECKED: V.W.

Shear Strength Kips p.s.f.



SHEAR STRENGTH PROFILE



6913-01

DOMINION SOIL INVESTIGATION LIMITED
CONSULTING SOIL & FOUNDATION ENGINEERS
3953 RIVERDY ROAD, WINDSOR, ONTARIO
(416) 969-7830

73-F-211 M

August 16, 1972

40-J-163

M.M. Dillon Ltd.
P.O. Box 697,
Windsor, Ontario.

Ref. No. 72-6-W1A

40J2-34

GEOCRE No.

Attention: Mr. N.K. Becker, P.Eng.

Dear Sirs,

Re: Bridge over Hillman Creek
Mersea Township,
Addition Soil Investigation

The original soil investigation for this project (our Report No. 72-6-W1) indicated that the subsurface conditions varied considerably in this area. Since the second proposed bridge location was about 50 feet north of the original area investigated, it was considered necessary for a further two boreholes to be put down at this second location.

STRUCTURE SITE No. 6-197



FIELD WORK

The field work was carried out on July 18, 1972 at the locations shown on the site plan (Enclosure 1). The boreholes were advanced to the sampling depths by means of a power auger machine equipped for soil sampling.

Standard Penetration Tests were carried out at frequent intervals of depth and the results are shown on the borehole logs as N-values.

The field work was supervised by a soils technician who also determined the ground elevation at each borehole location. The elevations were referred to the centre of the road at the west end of the existing bridge as shown on the site plan. This reference datum was given the assumed value of El. 97.2 feet.



SUBSURFACE CONDITIONS

Detailed descriptions of the strata encountered in each borehole are given on the borehole logs comprising Enclosures 2 and 3 and the following notes are intended only to summarise the engineering properties of the strata:-

It will be noted that the general characteristics of the significant soil strata are similar to those encountered in the original investigation (see Report No. 72-6-W1).

PEAT and Organic SILT

The peat and organic silt extends to depths of 5.5 feet and 16.0 feet below the ground surface at boreholes 4 and 5 respectively.

Brown Silty CLAY

The brown silty clay is present in both boreholes and extends to a depth of 20 feet and 19 feet in boreholes 4 and 5 respectively. At borehole 4 the clay has an unconfined shear strength of more than 3030 p.s.f. and Standard Penetration Tests gave N-values of 21 to 49 blows per foot. From these test results, the consistency of the clay is described as 'very stiff' to 'hard'.

At borehole 5, however, the undrained shear strength was found to be 2020 p.s.f. and the stratum is only 3 feet thick. From the test results the consistency of the clay at this location is described as 'very stiff'.

Grey Silty CLAY

Standard Penetration Tests in the grey clay stratum at borehole 4 gave N-values of 24 and 26 blows per foot. Unconfined

compression tests gave undrained shear strengths of 2230 p.s.f. to 2830 p.s.f. From these test results the consistency of the clay at this location is described as 'very stiff'.

At borehole 5, the Standard Penetration Tests gave N-values of 14 to 18 blows per foot and unconfined compression tests gave undrained shear strength of 1210 p.s.f. to 1615 p.s.f. From these results the consistency of the clay at this location is described as 'stiff'.

DISCUSSION & RECOMMENDATIONS

a) General

The additional boreholes together with the original boreholes indicate that subsurface conditions vary considerably, with the 'very stiff' to 'hard' brown clay crust decreasing in thickness and consistency near the creek. We have attempted to determine the limit of this brown clay stratum by extrapolation and this is shown on the site plan Enclosure 1.

S

b) Design

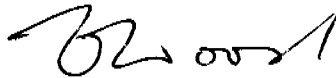
The foundations will require to be located below the peat and organic silt.

Spread footings can still be used for the foundations. However, since the conditions at the east abutment (BH. 5) are poorer than those at the west (BH. 4) we recommend that the footings be designed using 3,000 p.s.f. and 5,000 p.s.f. respectively.

The total settlements for footings designed with these bearing pressures is estimated to be less than 1.25 inches and less than 0.75 for the east and west abutments respectively.

These settlements are likely to be within tolerable limits for the structure.

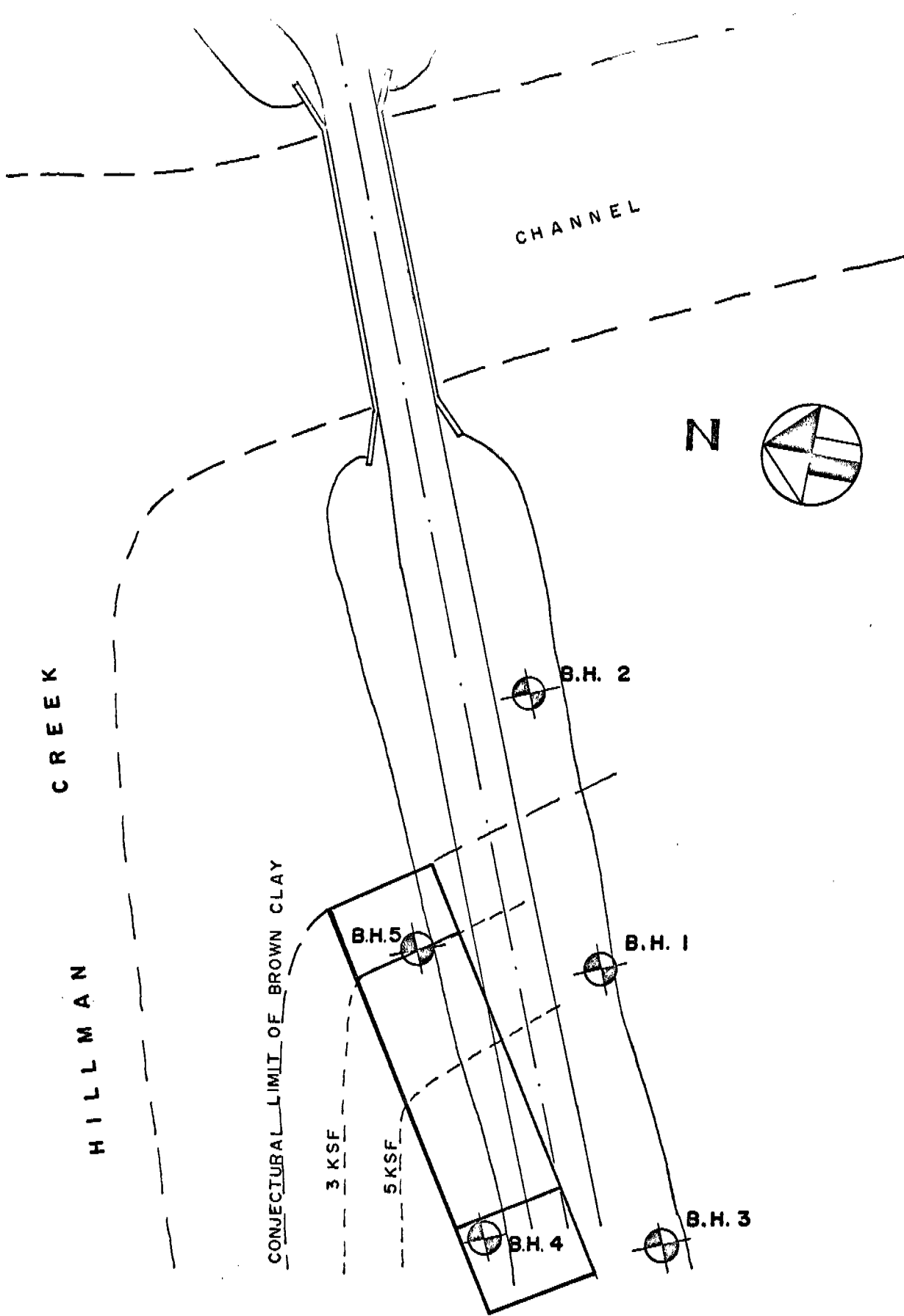
Yours very truly,
DOMINION SOIL INVESTIGATION



V. Wood, B.Sc. M.Eng. P.Eng.
Windsor Branch Manager



ENCLOSURES



LOCATION PLAN
SCALE: 1" = 4' VERT. 1" = 40' HOR.

LOG OF BOREHOLE 4

Our Reference No. 72-6-WIA

Enclosure No. 2

CLIENT: M.M. Dillon Ltd.
PROJECT: Bridge over Hillman Creek
LOCATION: Mersea Township
DATUM ELEVATION: Local

DRILLING DATA

Method: Auger
Diameter: 4 inch
Date: July 18, 1972

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE Blows / Foot					WATER CONTENT %					REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	'N' Blows / Foot	10	20	30	40	50	PLASTIC LIMIT	NATURAL	LIQUID LIMIT		
								UNDRAINED SHEAR STRENGTH 1000 lbs/sq. ft.					W _p	W	W _L		
								+ FIELD VANE TEST	1.0	2.0	3.0	4.0				5.0	
<div>93.0 00</div> <div>90</div> <div>55</div> <div>85</div> <div>80</div> <div>75</div> <div>200</div> <div>70</div> <div>240</div>																	
Soft organic SILT and PEAT																	
Very stiff to hard brown silty CLAY. Occasional gravel and seams of sand																	
Very stiff grey silty CLAY																	
End of Borehole																	

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: P.V. CHECKED: V.W.

LOG OF BOREHOLE..5.....






Our Reference No 72-6-WIA.....

Enclosure No 3.....

CLIENT: M.M. Dillon Ltd.
PROJECT: Bridge over Hillman Creek
LOCATION: Mersea Township
DATUM ELEVATION: Local

DRILLING DATA

Method: Auger
Diameter: 4 inch
Date: July 18, 1972

SUBSURFACE PROFILE				SAMPLES			PENETRATION RESISTANCE					WATER CONTENT %					REMARKS
ELEVATION Ft.	DEPTH Ft.	DESCRIPTION	SYMBOL	GROUND WATER	NUMBER	TYPE	N Blows / Foot	10	20	30	40	50	PLASTIC LIMIT	NATURAL	LIQUID LIMIT		
								UNDRAINED SHEAR STRENGTH 1000 lbs/sq.ft.					W _p	W	W _L		
								+ FIELD VANE TEST • COMPRESSION TEST					1.0 2.0 3.0 4.0 5.0				
92.8	0.0																
90		Soft PEAT			1	SS	3	o									
85																	
80	11.0	Loose grey clayey SILT and fine SAND			2	SS	2	o									
					3	SS	2	o									
	16.0	Very stiff brown silty CLAY			4	SS	9	o									
75																	
	19.0	Stiff grey silty CLAY			5	SS	18	o									
					6	SS	18	o									
70		Occasional gravel. Seams of sand															
	26.5	End of Borehole			7	SS	14	o									
65																	

VERTICAL SCALE: 1 inch to 5 feet

DOMINION SOIL INVESTIGATION LIMITED

MADE: P.V. CHECKED: V.W.