

40 72-11069

MX CH. APRIL 16/73 3:55

DOWN 3, M DEWATA STRUCTURAL FOUNDATIONS

1973 APR 16 AM 9:12

COPY TO: J WEAR PROJECT REVIEW ENGR

LOND 3, A WITTENBERG MANAGER SYSTEMS DESIGN

OP 344-67-01 HWY 3 BLENNHEIM TO MORPETH

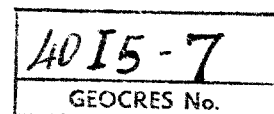
YOU MAY BE INTERESTED THAT AN INVESTIGATION WAS MADE AT THE CULVERT CROSSING ON HWY 3 EAST OF MORPETH IN REGARDS TO ITS STABILITY AND IT WAS DECIDED THAT THE VOIDS AROUND THE CULVERT WOULD BE GROUTED FROM THE INSIDE.

THE DISTRICT WAS NOT ABLE TO FIND A CONTRACTOR IN THIS AREA WHO SPECIALIZED IN THIS TYPE OF WORK. YOU HAD INDICATED THAT THERE WERE A FEW CONTRACTORS IN THE TORONTO AREA WHO DO THIS TYPE OF WORK AND WERE TO ADVISE THE DISTRICT REGARDING SAME. COULD YOU FORWARD A LIST OF CONTRACTORS TO THE DISTRICT FOR OUR INFORMATION AT YOUR EARLIEST CONVENIENCE. COULD YOU ALSO ADVISE AS TO WHAT YOU ESTIMATE THE COST OF THE WORK WOULD TOTAL AND ADVISE MR J WEAR AS WELL SO THAT HE CAN PROVIDE THE NECESSARY FUNDS IN THE CONTRACT UNDER SUNDRY.

W KATARYNCZUK CONST ENGR

1973 APR 19 PM 3:55

CL



MX DOWN APRIL 19/73 5.47 PM VR

CH 2 5 W KATARYNCZUK CONST ENGR

LOND 9 CC A WITTENBERG SYSTEMS DESIGN

DOWN - CC J WEAR SYSTEMS DESIGN

RE GROUTING FOR A CULVERT NEAR MORPETH HWY. 3 WP-844-67-01

WO-72-11069.

FURTHER TO YOUR RECENT TELETYPE OUR COMMENTS ARE AS FOLLOWS:

1. REQUESTED J WEAR'S OFFICE TO CONTACT ESTIMATING OFFICE REGARDING GROUTING COSTS SINCE WE DO NOT HAVE ANY INFORMATION REGARDING COSTS.
2. CEMENTATION CO. (CANADA LTD) CANADIAN LONGYEAR DRILLING CO AND DANSTON DRILLING CO MAY BE ABLE TO CARRY NECESSARY GROUTING WORK.

M DEVATA SUPRG FOUND ENGR

ROB



72-11069

00032

DOWN CHAT 1 MA 8:12 8:33

MR A G STERMAC PRINCIPAL FOUNDATIONS ENGR

COPY TO: W D BIRCH BRIDGE MTCE ENGR

RE: ROAD SETTLEMENT, HWY 53, 1500' EAST OF MORPETH

THE DISTRICT HAS EXPERIENCED SIGNIFICANT SETTLEMENT AT THE ABOVE NOTED CULVERT LOCATION AND HAD REQUESTED MATERIALS AND TESTING TO INVESTIGATE. ALTHOUGH THEIR FINDINGS WERE NEGATIVE IN REGARDS TO THEIR STANDARD SOILS INVESTIGATION THEY HAD INDICATED THAT THE PROBLEM COULD BE ATTRIBUTED TO A FAILURE TO THE CULVERT ITSELF. IN VIEW OF THE FACT THAT THERE IS SUBSTANTIAL FILL OVER THIS CULVERT AND THAT A SURFACING PROJECT IS TENTATIVELY SCHEDULED THROUGH THIS AREA IN THE NEXT ONE TO THREE YEARS COULD YOU PLEASE CARRY OUT AN INVESTIGATION ON THE SITE TO DETERMINE THE PROBABLE CAUSE OF THE SETTLEMENT AND ANY CORRECTIVE MEASURES WHICH SHOULD BE TAKEN TO RECTIFY SAME.

W KATARYNCZUK MTCE ENGR

12-11069

112 JUN 1 PM 2:14

1204

CHAT DOWN 5 JUNE 1/72 205 P

M KATARYNCZYK MTC ENGR

RE ROAD SETTLEMENT 1,500 FT. EAST OF MOREPATH HWY 3
DISTRICT CHATHAM

WOULD YOU PLEASE SEND THE FOLLOWING INFORMATION:

1. HISTORY OF CULVERT CONSTRUCTION.
2. DATE OF CONSTRUCTION INCLUDING SUBSOIL CONDITIONS AND COMPACTION DETAILS OF THE FILL MATERIAL, INCLUDING VARIOUS PROPERTIES.
3. SIZE AND CONSTRUCTION METHODS OPTED FOR CULVERT INSTALLATION.
4. PLAN AND PROFILE OF THE ROADWAY AT THE CULVERT LOCATIONS.
5. ANY SUB-EXCAVATION OF THE SUBSOIL CARRIED OUT AT THE LOCATION OF THE CULVERT PRIOR TO ITS CONSTRUCTION.
6. SETTLEMENT READINGS AND THE MAGNITUDE OF SETTLEMENT WITH RESPECT TO TIME.
7. ANY DIFFERENTIAL SETTLEMENT WITHIN THE LENGTH OF THE CULVERT.
8. WHAT ARE THE GENERAL DRAINAGE CONDITIONS?
9. DETAILED INFORMATION OF PREVIOUS SOIL INVESTIGATIONS
- 10 ANY VISUAL OBSERVATIONS MADE INSIDE THE CULVERT.
- 11 ANY OTHER RELATED INFORMATION WHICH MAY BE HELPFUL FOR THE INVESTIGATION.

A DEVATA, SUPERVISING FOUNDATION ENGINEER

LGE

102 JUN 8 PM 2:27

00216

DOWN CHAT 7 JUNE 8/72 2:24

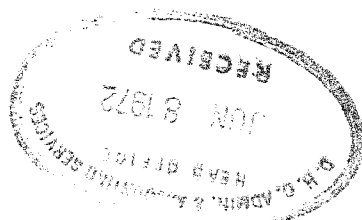
MR M DEVATA SUPERVISING FOUNDATIONS ENGINEER

00217

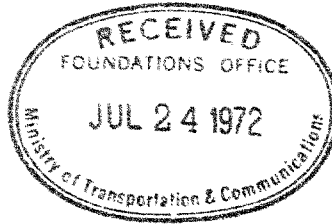
ROAD SETTLEMENT, 1500 FEET EAST OF MORPETH HWY 3

FURTHER TO YOUR TELETYPE OF JUNE 1/72 PLEASE BE ADVISED THAT THE CONCRETE CULVERT WAS INSTALLED IN 1955 AND UNFORTUNATELY WE HAVE VERY LITTLE DATA AVAILABLE IN THE OFFICE IN REGARDS TO SUB SOIL CONDITIONS, COMPACTION, DETAILS OF FILL MATERIAL, AS CONSTRUCTED DATA ETC. THE CULVERT WAS CONSTRUCTED UNDER CONTRACT 55-57 AND YOU MAY BE ABLE TO OBTAIN SOME OF THE CONSTRUCTION DETAIL YOU REQUIRE FROM HEAD OFFICE FILES. DUE TO SETTLEMENT PROBLEMS A MULTI-PLATE PIPE ARCH CULVERT WAS PLACED WITHIN THE CONCRETE CULVERT AND THE VOIDS BETWEEN THE CONCRETE CULVERT AND PIPE ARCH CULVERT WAS GROUTED APPROXIMATELY 2-3 YEARS AFTER THE INITIAL CONSTRUCTION. THE SIZE OF THE ORIGINAL CONCRETE CULVERT INSTALLED WAS 8 X 6 X 82'. DURING THE LAST THREE YEARS THE SETTLEMENT HAS BEEN PRIMARILY DOWNWARD. WE ARE PRESENTLY ARRANGING TO TAKE A PROFILE OF THE ROADWAY AT THE CULVERT LOCATION AND WILL SUBMIT THE PLAN AND PROFILE AS SOON AS THE WORK HAS BEEN COMPLETED. REGRETTABLY WE ARE UNABLE TO SUPPLY YOU WITH ANY RELIABLE INFORMATION AT THIS TIME. IF YOU HAVE ANY FURTHER QUERIES PLEASE ADVISE.

W KATARYNCZUK MTCE ENGR



FILED



00000

1100

[Illegible handwritten signature]

CL

MX DOWN JULY 21/72 4:15 P VR

CHAT 6 W KATARYNCZUK MAINTENANCE ENGR

LOND 7 J FORSTER (REGION)

RE: ROAD SETTLEMENT 1,500 FEET EAST OF MORPETH ON HWY 3 W.O.72-11069

RECENT FIELD INVESTIGATION REVEALED FILL MATERIAL AND NATURAL SUB-SOIL COMPETENT. SETTLEMENT OCCURED IN SPRING 1972 CAN BE ATTRIBUTED TO THE IMPROPER GROUTING WHICH RESULTED FURTHER CRACKING OF THE TOP DECK OF CONCRETE CULVERT. TO PREVENT FURTHER CRACKING AND SETTLEMENT IT WILL BE NECESSARY TO RE-GROUT THE ANNULAR SPACE BETWEEN THE CONCRETE AND PIPE ARCH CULVERTS. WE SUGGEST THE FOLLOWING TO BE CARRIED OUT.

1. TAKE PROFILE OF THE ROADWAY AT THE CULVERT LOCATION REGULARLY TO MONITOR ANY POSSIBLE FURTHER SETTLEMENT.
2. TAKE PROFILE OF THE BOTTOM OF PIPE ARCH CULVERT PERIODICALLY.

M DEVATA SUPERVISING FOUNDATIONS ENGR

LN

TELETYPE
TELETYPE
TELETYPE
TELETYPE
TELETYPE

FIELD BORING LOG

DRILLING CO. Master Soil DATUM ELEV. _____ B.H. NO. 1
 DRILLER Garry GROUND ELEV. 665.9 JOB NO. 72-11069
 ENGINEER C. Parn CASING SIZE Auger - 10" DATE July 5/72
 SITE LOCATION Run 3 near Marpeth
 HOLE LOCATION 18' S. of Hwy #2 and 10' E. of E of culvert
 REMARKS W.L. @ 37
(2' & 3' core used)

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
0'	10'	15, 29, 11, 8, 5, 4, 5, 6, 9, 11		
11'	20'	15, 10, 19, 4, 16, 20, 25, 21, 19, 18		
20'	30'	30, 26, 25, 23, 24, 28, 36, 40, 45, 47		
30'	40'	37, 36, 38, 37, 38, 41, 39, 40, 50, 58		
40'	43'	75, 90, 125.		
0'	4'	auger, 2' of grm in fill then clayey silt fill		(N=7)
4'	5.5'	Fill material - Brown clayey silt with some sand and gravel	SS1	2, 3, 4
4'	8'	auger		(N=12)
8'	9.5'	Fill material - same as above	SS2	5, 5, 7
8'	11'	auger		(N=13)
11'	12.5'	Fill material - same as above	SS3	3, 5, 8
11'	14'	auger		(N=13)
14'	15.5'	Fill mat'l - same as above	SS4	3, 6, 7
14'	17'	auger		(N=12)
17'	18.5'	Fill mat'l - brown clayey silt with some gravel & sand	SS5	4, 5, 8
17'	20'	auger		(N=11)
20'	21.5'	Fill material - same	SS6	5, 5, 9
20'	25'	auger		(N=15)
25'	26.5'	Fill mat'l - same	SS7	4, 5, 10
25'	30'	auger		(N=14)
30'	31.5'	Fill mat'l - brown sand gravel with clayey silt	SS8	9, 8, 6
30'	35'	auger		(N=26)
35'	36.5'	Fill mat'l - brown silty clay with trace of sand and gravel	SS9	7, 11, 15

MATERIALS AND TESTING OFFICE

DRILLING CO. _____ DATUM ELEV. _____ B.H. NO. 1
 DRILLER _____ GROUND ELEV. 665.9 JOB NO. 72-11069
 ENGINEER _____ CASING SIZE 4 1/2 DATE July 5/72
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS _____

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
35'	40'	auger		
		from 27' change to grey sandy & clayey silt with gravel		
0'	41'	Grey sandy and clayey silt with gravel	SS10	58,50 blows
40'	41'	auger (refusal)		
		(End of hole)		
		Summary:		
0'	2'	Granite 'A' fill		
2'	30'	<u>FILL MATERIAL</u> — brown clayey silt with some sand and gravel		
30'	35'	sand and gravel with clayey silt (<u>FILL MATERIAL</u>)		
35'	37'	<u>FILL MATERIAL</u> — silty clay, trace of sand and gravel		
37'	41'	Grey sandy and clayey silt with some gravel.		

FIELD BORING LOG

DRILLING CO. MOORE SONS DATUM ELEV. B.H. NO. 2
DRILLER Garry GROUND ELEV. 693.4 JOB NO. 72-11069
ENGINEER C. Fenn CASING SIZE arger DATE July 5/72
SITE LOCATION Hwy 3 near Marple
HOLE LOCATION 2' E of E of culvert / E. toe of slope
REMARKS W.C. @ 8'

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
0	10'	3, 3, 3, 4, 3, 3, 4, 7, 22, 20		
11	16'	21, 30, 40, 70, 90, 140		
0'	3'	anex		
3'	4.5'	Fill mat'l - brown fine to medium sand with roots, changing to clayey silt with sand trace of gravel @ 4'	SS1	(N=4) 2, 2, 2
3'	6'	anex		
6'	8'	Fill material - brown silty clay with trace of sand changing to grey sand @ 7.5'	SS2	(N=9) 8, 4, 5, 11
8'	10'	Dark grey to black sand & gravel (fill material) sandy changing to grey clayey silt with gravel @ 8.5'	SS3 3/4	(N=15) 17, 7, 8, 14
10'	12'	Dense grey sand, gravel with clayey silt	SS4	(N=32) 7, 13, 20, 28
12'	14'	Grey silty clay with trace of sand & gravel	SS5	(N=12) 20, 24, 28, 36
		(End of clay)		

FIELD BORING LOG

DRILLING CO. _____ DATUM ELEV. _____ B.H. NO. 2
 DRILLER _____ GROUND ELEV. 631.4 JOB NO. 72-11069
 ENGINEER _____ CASING SIZE _____ DATE July 6/72
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS N-L @ 7'

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
14'	16'	Grey silty clay with trace of sand & gravel (v. stiff to hard)	SS 6	(N=34) 714 20.2
16'	17'5"	v. stiff to hard grey silty clay with trace of sand and gravel	TW 7	hy. push
16'	19'	vane test (sat.) $C_u > 2000$ psf		
16'	20'	auger		hy. push
20'	21'5"	same	TW 8	
	23'	vane test $C_u > 2000$ psf		
20'	25'	auger		
25'	26'5"	same	TW 9	
	28'	vane test $C_u > 2000$ psf		
25'	30'	auger, <u>a boulder @ 30'</u>		
30'	31'5"	same	TW 10	"
	33'	vane test $C_u > 2000$ psf		
30'	35'	auger		
35'	36'5"	same (poor recovery)	TW 11	"
	38'	vane test $C_u > 2000$ psf		
35'	40'	auger		
40'	41'6"	same	TW 12	"
		Push vane to 42' (Boulder @ 42')		
	43'	$C_u > 2000$ psf		
40'	45'	auger		
45'	46'6"	same	TW 13	"
	48'	vane test $C_u > 2000$ psf		
45'	50'	auger		
50'	51'	same	TW 14	"
		(boulder @ 51')		

FIELD BORING LOG

DRILLING CO. _____ DATUM ELEV. _____ B.H. NO. 2
DRILLER _____ GROUND ELEV. 62.14 JOB NO. 72-11069
ENGINEER _____ CASING SIZE _____ DATE July 6/82
SITE LOCATION _____
HOLE LOCATION _____
REMARKS _____

DEPTH FEET

FROM TO

DESCRIPTION

SAMPLE
TYPE, NO.
& RECOVERYMETHOD OR
BLOWS &
DISTANCE

57' 53'

anger through boulder

55' 55' 6"

V. stiff is hard gray silty clay
with trace of sand and gravel
vane test on 2000 pcf

TW 15

hydraulic

58'

vane test on 2000 pcf

55' 60'

anger

60' 61' 6"

same

TW 16

1

(hole caved in)

0 48'

lower NX casing
and washed

(End of day)

FIELD BORING LOG

DRILLING CO. _____ DATUM ELEV. _____ B.H. NO. 2
 DRILLER _____ GROUND ELEV. 633.4 JOB NO. 72-11069
 ENGINEER _____ CASING SIZE _____ DATE July 7/72
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS N.L. @ 7'

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
48'	65'	washed ahead of casing		
65'	66.5'	grey silty clay with trace of sand and gravel	TN 17	Hyd. Probe
	68'	vane $C_u > 2000 \text{ psf}$		
65'	70'	washed ahead of casing		
70'	71.5'	same as above	TN 18	"
72'	80'	cone - 22, 35, 46, 52, 57, 75, 88, 90		
80'	84'	75, 75, 100, 145		
		(End of Hole)		
		Summary		
0'	8.5'	Fill material - Brown sand → clayey silt with some sand and gravel → 70' Dark grey to black sand and gravel		
8.5'	12'	Dense grey sandy silt with clay and gravel		
12'	84'	V. stiff to Hard grey silty clay with trace of sand and gravel (Boulders at 30', 42', 51')		

FIELD BORING LOG

DRILLING CO. Master Soil DATUM ELEV. _____ B.H. NO. 4
 DRILLER Garry GROUND ELEV. 635.8 JOB NO. 72-11069
 ENGINEER C. Poon CASING SIZE auger DATE July 10/72
 SITE LOCATION Ham #3 just E. of M. 100th
 HOLE LOCATION N.W. corner of culvert
 REMARKS _____

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
0'	10'	2, 4, 6, 6, 5, 6, 8, 9, 11, 18		
10'	17'	28, 33, 44, 60, 72, 95, 120		
0'	3'	auger - fill material.		
		brown sand and gravel		(N=7)
3'	5'	Brown clayey silt with sand & gravel (FILL MATERIAL)	SS 1	2, 4, 35
3'	6'	auger		(N=7)
6'	7.5'	FILL MATERIAL - clayey silt with sand	SS 2	2, 3, 4
6'	8'	auger		(N=13)
8'	10'	Green silty clay with trace of sand and gravel	SS 3	5, 4, 9, 12
		"		(N=23)
10'	12'	"	SS 4	7, 9, 14, 16
12'	13.5'	"	T.W. 5	Aug. Push
	15'	vane $C_u > 2000$ psf		
12'	16'	auger		
16'	17.5'	"	T.W. 6	"
	19'	vane $C_u > 2000$ psf		
16'	19'	auger		
19'	20'5"	"	T.W. 7	"
	22'	vane $C_u > 2000$ psf		
19'	23'	auger		
23'	24.5'	"	T.W. 8	"
	26'	vane $C_u > 2000$ psf		
23'	27'	auger		
27'	28'3"	"	T.W. 9	"
		(sample disturbed, due to presence of boulders @ 27.5' tube squashed)		

DRILLING CO. _____ DATUM ELEV. _____ B.H. NO. K
 DRILLER _____ GROUND ELEV. 635.8 JOB NO. 72-11069
 ENGINEER _____ CASING SIZE _____ DATE July 10/72
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS Hole dry @ time of investigation

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
	29.5'	vane $C_u > 2000$ psc		
27'	30.5'	auger		
30.5'	32'	Gray silty clay with trace of sand and gravel	T.W. 10	hy. prod.
	33.5'	vane $C_u > 2000$ psc		
33.5'	35'	auger	T.W. 11	
35'	36.5'	"		
	38'	vane $C_u > 2000$ psc		
35'	40'	auger		
40'	41.5'	"	T.W. 12	"
	43'	vane $C_u > 2000$ psc		
		(End of hole)		
		<u>Summary</u>		
0'	8'	FILL MATERIAL - Brown sand and gravel changing to clayey silt with some sand & gravel		
8'	43'	Gray silty clay with trace of sand and gravel (v. stiff to hard)		

FIELD BORING LOG

DRILLING CO. Masta Soil DATUM ELEV. B.H. NO. 5
DRILLER Samy GROUND ELEV. 636.2 JOB NO. 72-11069
ENGINEER C. Poon CASING SIZE DATE July 10/72
SITE LOCATION
HOLE LOCATION
REMARKS Cone only

[illegible]

FIELD BORING LOG

DRILLING CO. Master Soil DATUM ELEV. B.H. NO. 6
DRILLER Garry GROUND ELEV. 666.0 JOB NO. 72-11069
ENGINEER C. Poore CASING SIZE Auger 8 core DATE July 11/72
SITE LOCATION Ham #3 just E of Morpet
HOLE LOCATION 18' N of & of Ham #3 ; 12' W. of & of culvert
REMARKS Hole dry @ 10' & investigation

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
0	10'	16, 21, 8, 7, 6, 7, 6, 7, 10, 15		
11'	20'	20, 14, 16, 14, 13, 18, 18, 18, 22, 27		
21'	30'	21, 26, 25, 29, 32, 30, 33, 33, 45, 60		
31'	40'	60, 47, 43, 42, 37, 37, 33, 36, 40, 50		
41'	42'	88, 140		
0'	3'	auger 2' of granular fill		
3'	5'	Fill Material - Brown clayey silt with sand and gravel	SSI	(N=7) 4, 3, 4, 5
	6.5'	vane $C_u > 2000$ psf		
3'	7'	auger		
7'	9'	"	SSI	(N=15) 3, 6, 9, 11
	10.5'	vane $C_u > 2000$ psf		
7'	11'	auger		
11'	12.5'	"	TW 3	4 hrs. push
	14'	vane $C_u > 2000$ psf		
11'	15'	auger		
15'	16.5'	"	TW 4	H.P.
	18'	vane $C_u > 2000$ psf		
15'	18'	auger		
18'	19.5'	"	TW 5	H.P.
	21'	vane $C_u > 2000$ psf		

FIELD BORING LOG

DRILLING CO. _____ DATUM ELEV. _____ B.H. NO. 6
 DRILLER _____ GROUND ELEV. _____ JOB NO. 72-11069
 ENGINEER _____ CASING SIZE _____ DATE July 11/72
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS _____

DEPTH FEET		DESCRIPTION	SAMPLE TYPE, NO. & RECOVERY	METHOD OR BLOWS & DISTANCE
FROM	TO			
18'	22'	anger		
22'	23.5'	Fill material - brown clayey silt with sand & gravel	TW 6	4 R
	25'	same $C_u > 2000$ pcf		
22'	26'	anger		
26'	27.2'	"	TW 7	4 R
	28'	same $C_u > 2000$ pcf		
		(Boulder @ 27'2")		
26'	29'	anger (change to sand and gravel @ 27.2')		(N=23)
29'	30.5'	Fill material - brown sand and gravel	SS 8	11, 12, 11
29'	33'	anger		(47)
33'	34.5'	Fill material - brown sand and gravel	SS 9	4, 4, 3
		change to clayey silt with sand and gravel @ 34'		
	35.5'	same $C_u > 2000$ pcf		
33'	36'	anger		
<u>36'</u>	37.5'	Grey clayey silt to silty clay, with trace of sand and gravel	TW 10	4 R
	38.5'	same $C_u > 2000$ pcf		
36'	39'	anger		(N=27)
39'	41'	"	SS 11	6, 10, 17, 23
41'	42.5'	"	SS 12	7, 12, 20 (N=20)
42.5'	43.9'	"	TW 13	4 R
	44.9'	same $C_u > 2000$ pcf		
45'	46'	"	TW 14	4 R
		end of hole		

FIELD BORING LOG

DRILLING CO. _____ DATUM ELEV. _____ B.H. NO. 6
 DRILLER _____ GROUND ELEV. _____ JOB NO. 72-11069
 ENGINEER _____ CASING SIZE _____ DATE July 11/72
 SITE LOCATION _____
 HOLE LOCATION _____
 REMARKS _____

[illegible]

1012 JUL 20 PM 2:06

72-11069

CCP52

MX CHAT JULY 28/72 2:12

DOWN 3 M S DEVATA SUPVRG FOUND ENGR

LOND 1 CC J G FORSTER SR SOILS ENGR M AND T

RE ROAD SETTLEMENT 1,500 FEET EAST OF MORPETH ON HWY 3, WO 72-11069

I AM IN RECEIPT OF YOUR T T OF JULY 21/72 RE THE ABOVE AND HAVE NOTED

THAT YOU HAVE RECOMMENDED THE REGROUTING OF THE ANNULAR SPACE

BETWEEN CONCRETE AND PIPE ARCH CULVERT. AS YOU PROBABLY HAVE NOTED

THIS CULVERT WAS ORIGINALLY GROUTED BY THE DRILLING OF HOLES THROUGH

THE FILL FROM THE PAVEMENT DOWNWARDS, THE FILL BEING APPROX 30'

IN DEPTH. IT IS NOW GOING TO BE EXTREMELY DIFFICULT TO LOCATE THE

VOIDS AND THIS PROCEDURE WILL NECESSITATE TRAIL AND ERROR TYPE OF

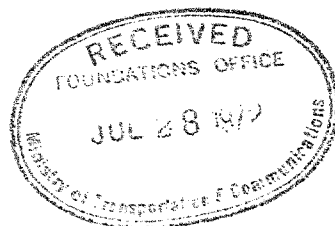
DRILLING AND GROUTING WITH NO ASSURANCE THAT THE ANNULAR SPACE WILL BE

FILLED. AS A RESULT OF YOUR DETAILED INVESTIGATION COULD YOU ADVISE

WHETHER OR NOT THERE WILL BE FURTHER SETTLEMENT AND THE POSSIBLE

REPERCUSSIONS IF THE REGROUTING IS OMITTED?

W KATARYNCZUK NTCE ENGR



MEMORANDUM

4015-7
GEOGRAPHIC No.

TO: Mr. J. E. Wice, (2)
Maintenance Engineer,
District #1, Chatham.

FROM: Foundations Office,
Design Services Branch,
West Bldg., Downsview.

ATTENTION:

DATE: November 9, 1972.

OUR FILE REF.

IN REPLY TO NOV 13 1972

SUBJECT:

FOUNDATION INVESTIGATION REPORT
For
Culvert Distress
Hwy. #3, 1500 ft. East of Morpeth
Township of Howard, County of Kent
District #1 (Chatham)
W.O. 72-11069 -- W.P. 844-67-01

CONT. 73-506

Attached we are forwarding to you our detailed foundation investigation report on the subsoil conditions existing at the above-mentioned 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

A. G. Stermac,
PRINCIPAL FOUNDATIONS ENGINEER.

AGS/ao
Attach.

cc: A. E. Argue
D. M. Hopper
A. Rutka
F. C. Brown
A. McConnell
J. R. Roy
B. J. Giroux

Foundations Files ✓
Documents

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-

FOUNDATION INVESTIGATION REPORT
For
Culvert Distress
Hwy. #3, 1500 ft. East of Morpeth
Township of Howard, County of Kent
District #1 (Chatham)
W.O. 72-11069 --- W.P.

1. INTRODUCTION:

Roadway subsidence up to 9 inches took place on Hwy. #3 (station 263+00) at the location of Culvert crossing some 1500 feet east of Morpeth, during the spring of 1972. The Foundations Office was requested to carry out a subsurface investigation of sufficient scope to determine the probable causes of the subsidence and to provide necessary remedial measures. The request was contained in a teletype from Mr. W. Katarynczuk, Maintenance Engineer, Chatham District, dated May 30, 1972. A detailed investigation was carried out subsequently to determine the subsoil and groundwater conditions in the affected area, together with other data which might aid in the assessment of the problem.

This report includes all the factual data obtained, as well as the relevant visual observations made during the course of field investigation. In addition, an assessment of the causes of the roadway subsidence, together with suggested remedial measures are presented.

2. CONSTRUCTION DETAILS:

According to available information, prior to 1955, a concrete culvert was constructed at the crossing of Hwy. #3 and an unnamed creek some 1500 feet east of Morpeth at station 263+00. At this time, the proposed grade of Hwy. #3 was such that an embankment of 14 feet in height was constructed above the culvert at this location. The fill material used at this time consisted of a mixture of sand and gravel.

In 1955, the grade of Hwy. #3 was revised. As a result, a new rigid frame concrete culvert approximately 8 ft. by 7 ft. (inside dimensions) by 204 ft. long was built under Contract No. 55-57. It is believed that the old culvert which existed at this location was demolished prior to the construction of the 204 feet long culvert. The grade revision necessitated heightening the embankment above the culvert from 14 feet to about 30 feet. This indicates that an additional fill of 16 feet height was placed.

During 1958, cracking of the northern portion of the roof slab of the concrete rigid culvert was observed by the District Maintenance Personnel, Mr. W. Eves, Highway Patrolman. As a result, a 7 feet diameter multi-plate pipe arch was subsequently installed within the concrete culvert, and the space between the concrete culvert and the pipe culvert was grouted. The grouting was carried out by drilling holes from the surface of the embankment through the concrete culvert to reach the open space. Recent discussion with the District indicated that no attempt was made at that time to assess the causes of the structural deformation of the culvert.

Since the completion of the grouting, periodic roadway maintenance was required at this location. The information obtained from the District indicated that this maintenance consisted of -

- i) Patching of the pavement of Hwy. #3 at this location due to longitudinal cracking of the pavement, and
- ii) Replacing of guide rails due to subsidence of the embankment material.

During the spring of 1972, relatively uniform subsidence of the order of 9 inches of the pavement was noticed across the width of the embankment at the culvert location.

The pavement was repaired during mid-June 1972.

3. SITE AND SUBSOIL CONDITIONS:

3.1 General:

The site is located some 1500 ft. east of the Town of Morpeth on Hwy. #3, in the Township of Howard, County of Kent. Physiographically, the site under investigation, is located in the region known as "St. Clair Clay Plain." The characteristic deposit in the vicinity of the site is a clayey silt to silty clay with trace of sand and gravel.

In order to determine the strength and compressibility characteristics of the fill material above the culvert, as well as the natural deposits beneath the culvert, four sampled boreholes and two dynamic Penetration Tests were put down during the course of the field investigation, using a continuous flight auger machine (commercially known as CME 45), adapted for soil sampling purposes. The various soil types and groundwater conditions encountered are presented on the borelog sheets appended to this report. The borehole locations are shown in plan on Drawing No. 72-11069A, together with a stratigraphical profile along the culvert. The surveying of the site was carried out by personnel from Chatham District Office. The elevations in this report are referenced to a Geodetic Datum. The various soil types encountered will be discussed in the subsections to follow.

3.2) Fill Material:

Fill was placed to form the embankment which carries Hwy. #3 across an unnamed creek some 1500 feet east of Morpeth. The thickness of the fill material encountered varies from 8 feet (B.H. #4) to about 37 feet (B.H. #1). The fill material is composed of a clayey silt with some sand and gravel. Up to 6 feet of sand

and gravel were encountered at B.H.'s #1 and #6 below elevation 640. Standard penetration testing carried out in the fill material gave 'N' values ranging from 4 to 26 blows per foot. Field vane tests and laboratory unconfined compressive strength tests indicated that the undrained shear strength of the cohesive fill material varies from 1500 p.s.f. to 3300 p.s.f. It is estimated that the consistency of the cohesive fill material is in the stiff to very stiff range. The engineering properties of the cohesive fill material are plotted in the individual Borelog sheets, as well as summarized in the following table:

<u>Identity Tests</u>	<u>Range</u>	<u>(Average)</u>
Bulk Density (γ) (p.c.f.)	133	(133)
Liquid Limit (W_L) (%)	32-37	(35)
Plastic Limit (W_p) (%)	19-20	(19)
Natural Water Content (W) (%)	16-20	(18)
<u>Undrained Shear Strengths (Cu)</u>	<u>Range</u>	<u>(Average)</u>
In-situ field vane tests (p.s.f.)	>2,000	(>2,000)
Laboratory tests (p.s.f.)	1,480-3,320	(2,600)

Based on these results, it is estimated that the cohesive fill material is inorganic with the plasticity being in the low range (refer to Fig. 1).

3.3) Silty Sand with Clay and Gravel:

A layer of silty sand with clay and gravel was found in B.H.'s #1 and #2 underlying the fill material at the southern portion of the culvert location. The thickness of this stratum is about 4 feet. Standard Penetration Testing carried out in this stratum gave 'N' values from 32 to 108 blows/foot. Based on these values, it is estimated that the relative density of this granular stratum is from dense to very dense. The results of grain size analysis tests carried out in this material were presented on the individual Borelog sheets.

3.4) Clayey Silt to Silty Clay with Trace
of Sand and Gravel:

This is the predominant stratum which is present immediately below the granular deposit where it exists or below the fill material elsewhere. This stratum was not fully penetrated at any boring location. It is estimated that the thickness of this stratum is greater than 70 feet. Various types of laboratory and field testings were carried out and the results were presented on the Borelog sheets and summarized in the following table:

Identity Tests:

		<u>Range</u>	<u>(Average)</u>
Bulk Density	(γ) (p.c.f.)	132-135	(134)
Liquid Limit	(W_L) (%)	30-36	(33)
Plastic Limit	(W_p) (%)	17-20	(19)
Natural Water Content	(W) (%)	16-30	(19)

Undrained Shear Strengths (C_u)

In-situ field vane tests (p.s.f.)	>2,000	(>2,000)
Laboratory tests (p.s.f.)	2,850-5,500	(3,800)

Based on these results, it is estimated that the consistency of this deposit ranges from very stiff to hard and that the clay is inorganic with a plasticity being in the low to intermediate range. (refer to Fig. 1).

4. GROUNDWATER CONDITIONS:

Groundwater level observations were carried out during the period of field investigation in the open boreholes. The observations are presented on the individual borelog sheets as well as on Drawing No. 72-11069A. The results indicate that the groundwater level varies between elevations 626 and 629, which correspond to levels 7 to 37 feet below the existing ground surface. The creek level, at the period of field investigation was at elevation 626.

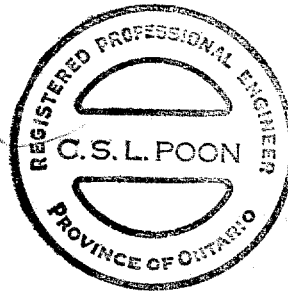
of Mr. C. S. Poon, Project Foundations Engineer, who also prepared this report.

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

This project was carried out under the overall supervision of Mr. M. Devata, Supervising Foundations Engineer, who also reviewed this report.

C. S. Poon

C. S. Poon, P. Eng.



M. Devata

M. Devata, P. Eng.

CSP/ao
Nov. 8, 1972.

APPENDIX I

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 1

FOUNDATION OFFICE

JOB 72-11069 LOCATION Sta. 263 + 58 20' Rt. ORIGINATED BY CSP
 W.P. — BORING DATE July 5, 1972 COMPILED BY CSP
 DATUM Geodetic BOREHOLE TYPE Auger and Cone Test CHECKED BY [Signature]

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	w_p	w	w_L	
665.9	Ground Level														
0.0	Fill Material														
	Clayey silt, with some sand and gravel		1	SS	7	660									
			2	SS	12										
			3	SS	13										
			4	SS	13	650									
			5	SS	13										
			6	SS	14										
	Brown Stiff		7	SS	15	640									
	Sand with gravel		8	SS	14										
	Compact														
628.9			9	SS	26	630									
37.0	Silty sand with clay & gravel. Grey														
624.9	Dense to Very Dense		10	SS	108										
41.0	End of Borehole														
43.0	End of Cone Test refusal to augering, Spoon Bouncing					620									

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 2

JOB 72-11069 LOCATION Sta. 263+ 58 95' Rt. ORIGINATED BY CSP
 W.P. BORING DATE July 5 - 7, 1972 COMPILED BY CSP
 DATUM Geodetic BOREHOLE TYPE Auger and Cone Test CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — W _L PLASTIC LIMIT — W _P WATER CONTENT — W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W _p	W	W _L		
633.4	Ground Level															
0.0	Fill Material															
	Clayey silt with some sand and gravel.		1	SS	4	630										
624.9	Brown Firm		2	SS	9											
8.5	Silty sand with clay and gravel. Grey		3	SS	15											
621.4	Compact to Dense		4	SS	32											
12.0			5	SS	52											
	Clayey silt to silty clay with trace of sand and gravel		6	SS	34											
			7	TW	PH											
			8	TW	PH											
			9	TW	PH											
			10	TW	PH											
			11	TW	PH											
			12	TW	PH											
			13	TW	PH											
	Grey		14	TW	PH											
	Very Stiff to Hard		15	TW	PH											
			16	TW	PH											
			17	TW	PH											
561.9			18	TW	PH											
71.5	End of Borehole					560										
549.4						550										
84.0	End of Cone Test					540										

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 3

JOB 72-11069 LOCATION Sta. 263 + 39 95' Rt.

ORIGINATED BY CSP

W.P. BORING DATE July 7, 1972

COMPILED BY CSP

DATUM Geodetic BOREHOLE TYPE Cone Test Only

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT 20 40 60 80 100	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
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT					
632.3	Ground Level									
0.0										
617.3										
15.0	End of Cone Test									

DESIGN SERVICES BRANCH

RECORD OF BOREHOLE NO 4

FOUNDATIONS OFFICE

JOB 72-11069

LOCATION Sta. 263 + 30 95' Lt.

ORIGINATED BY CSP

W.P.

BORING DATE July 10, 1972

COMPILED BY CSP

DATUM Geodetic

BOREHOLE TYPE Sugar and Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT		LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w		BULK DENSITY γ P.C.F.	REMARKS		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80			100	w_p
635.8	Ground Level													
0.0	Fill Material													
	Sand & gravel changing		1	SS	7									
	to clayey silt with		2	SS	7									
	sand and gravel.													
627.8														
8.0			3	SS	13									
			4	SS	23									
			5	TW	PH									
	Clayey silt to silty		6	TW	PH									
	clay with trace of		7	TW	PH									
	sand and gravel.		8	TW	PH									
			9	TW	PH									
			10	TW	PH									
	Grey		11	TW	PH									
	Very Stiff to Hard		12	TW	PH									
592.8														
43.0	End of Borehole													

RECORD OF BOREHOLE NO 5

JOB 72-11069 LOCATION Sta. 263 + 47 95' Lt.

ORIGINATED BY CSP

W.P. BORING DATE July 10, 1972

COMPILED BY CSP

DATUM	Geodetic	BOREHOLE TYPE	Cone Test Only
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CHECKED BY [Signature]

[illegible]

DESIGN SERVICES BRANCH

FOUNDATIONS OFFICE

RECORD OF BOREHOLE NO 6

JOB 72-11069

LOCATION Sta. 263 + 30 15' Lt.

ORIGINATED BY CSP

W.P.

BORING DATE July 11, 1972

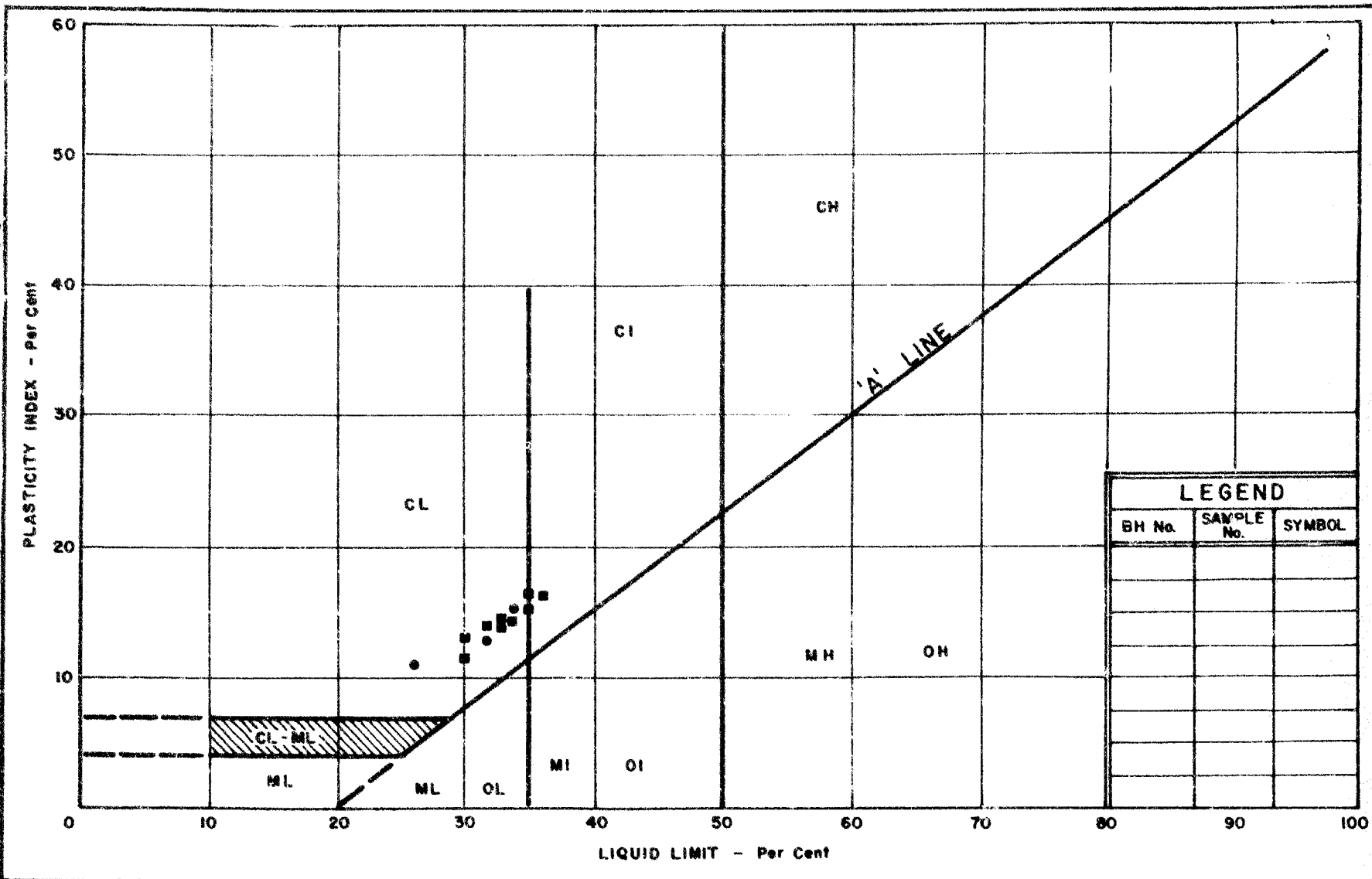
COMPILED BY CSP

DATUM Geodetic

BOREHOLE TYPE Auger and Cone Test

CHECKED BY

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT W_L PLASTIC LIMIT W_P WATER CONTENT W			BULK DENSITY γ	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS/FOOT		20	40	60	80	100	W_p	W	W_L		
666.0	Ground Level															
0.0	Fill Material															
	Clayey silt with sand and gravel.		1	SS	7	660										
			2	SS	15											
			3	TW	PH											
			4	TW	PH	650										
			5	TW	PH											
	Brown		6	TW	PH											
	Stiff to Very Stiff		7	TW	PH	640										
	Sand with gravel		8	SS	23											
	Compact		9	SS	7											
628.5			10	TW	PH	630										
37.5	Clayey silt to silty clay with trace of sand and gravel. Grey		11	SS	27											
			12	SS	32											
	Very Stiff to Hard		13	TW	PH											
620.0			14	TW	PH	620										
46.0	End of Borehole															



DEPARTMENT OF HIGHWAYS
**MATERIALS and
TESTING
DIVISION**

PLASTICITY CHART

● FILL MATERIAL

■ CLAYEY SILT TO SILTY CLAY
TRACE OF SAND & GRAVEL

W.P. No. —

JOB No. 72 - 11069

FIG. 1

VOID RATIO - PRESSURE CURVES

JOB NO. 72-11069

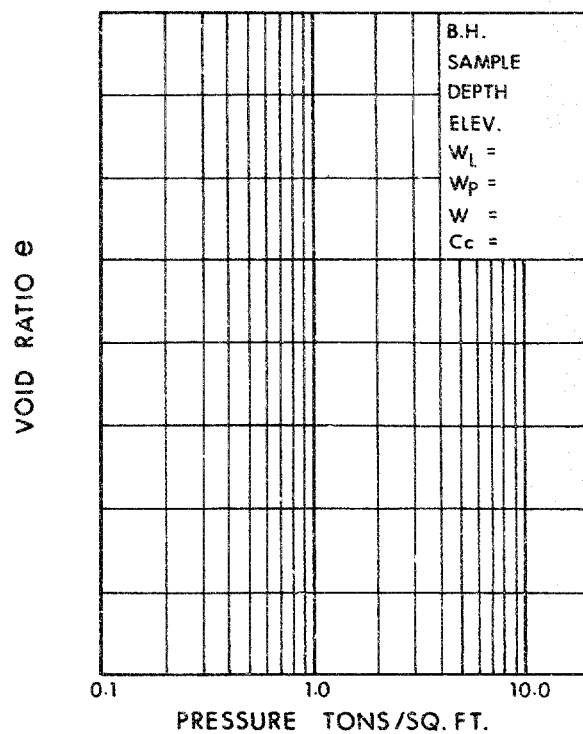
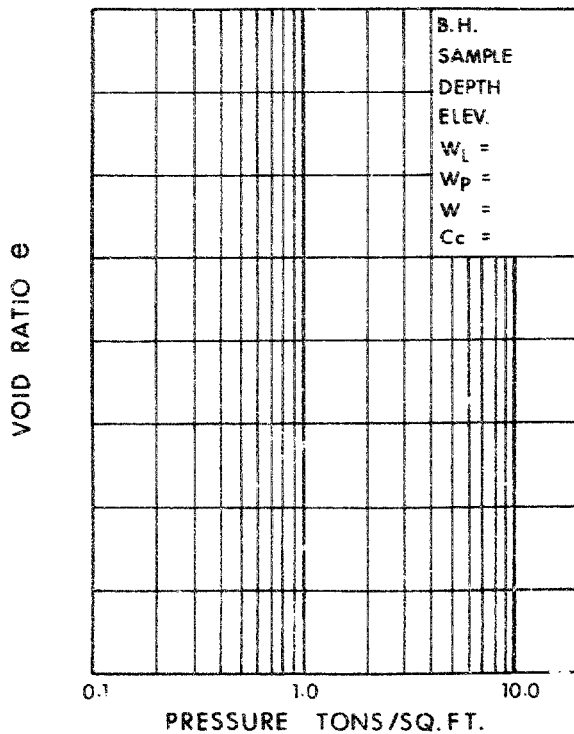
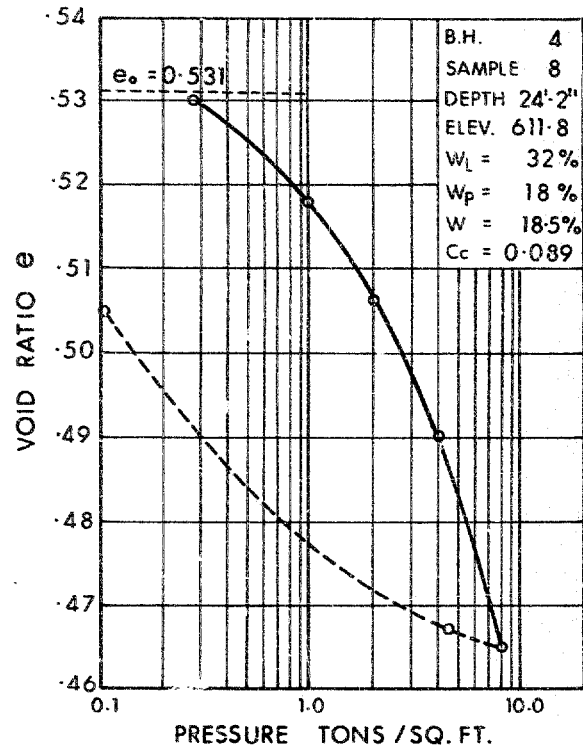
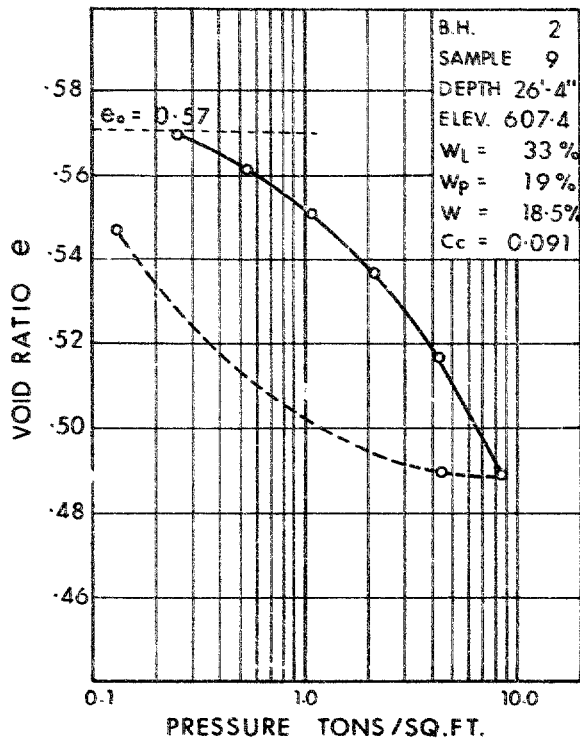


FIG. 2

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.	CHUNK SAMPLE	R.C.	ROCK CORE
S.T.	SLOTTED TUBE SAMPLE		
	P.H. SAMPLE ADVANCED HYDRAULICALLY		
	P.M. SAMPLE ADVANCED MANUALLY		

SOIL TESTS

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

ABBREVIATIONS USED IN THIS REPORT

SOIL PROPERTIES

γ	UNIT WEIGHT OF SOIL (BULK DENSITY)
γ_s	UNIT WEIGHT OF SOLID PARTICLES
γ_w	UNIT WEIGHT OF WATER
γ_d	UNIT DRY WEIGHT OF SOIL (DRY DENSITY)
γ'	UNIT WEIGHT OF SUBMERGED SOIL
G	SPECIFIC GRAVITY OF SOLID PARTICLES $G = \frac{\gamma_s}{\gamma_w}$
e	VOID RATIO
n	POROSITY
w	WATER CONTENT
S_r	DEGREE OF SATURATION
w_L	LIQUID LIMIT
w_p	PLASTIC LIMIT
I_p	PLASTICITY INDEX
s	SHRINKAGE LIMIT
I_L	LIQUIDITY INDEX $= \frac{w - w_p}{I_p}$
I_C	CONSISTENCY INDEX $= \frac{w_L - w}{I_p}$
e_{max}	VOID RATIO IN LOOSEST STATE
e_{min}	VOID RATIO IN DENSEST STATE
I_D	DENSITY INDEX $= \frac{e_{max} - e}{e_{max} - e_{min}}$
	RELATIVE DENSITY D_r IS ALSO USED
h	HYDRAULIC HEAD OR POTENTIAL
q	RATE OF DISCHARGE
v	VELOCITY OF FLOW
i	HYDRAULIC GRADIENT
k	COEFFICIENT OF PERMEABILITY
j	SEEPAGE FORCE PER UNIT VOLUME
m_v	COEFFICIENT OF VOLUME CHANGE $= \frac{-\Delta e}{(1+e)\Delta\sigma}$
c_v	COEFFICIENT OF CONSOLIDATION
C_c	COMPRESSION INDEX $= \frac{\Delta e}{\Delta \log_{10} \sigma}$
T_v	TIME FACTOR $= \frac{c_v t}{d^2}$ (d, DRAINAGE PATH)
U	DEGREE OF CONSOLIDATION
τ_f	SHEAR STRENGTH
c'	EFFECTIVE COHESION 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
S_t	SENSITIVITY

GENERAL

π	= 3.1416
e	BASE OF NATURAL LOGARITHMS 2.7183
$\log_e a$ OR $\ln a$	NATURAL LOGARITHM OF a
$\log_{10} a$ OR $\log a$	LOGARITHM OF a TO BASE 10
t	TIME
g	ACCELERATION DUE TO GRAVITY
V	VOLUME
W	WEIGHT
M	MOMENT
F	FACTOR OF SAFETY

STRESS AND STRAIN

u	PORE PRESSURE
σ	NORMAL STRESS
$\bar{\sigma}$	NORMAL EFFECTIVE STRESS ($\bar{\sigma}$ IS ALSO USED)
τ	SHEAR STRESS
ϵ	LINEAR STRAIN
γ	SHEAR STRAIN
ν	POISSON'S RATIO (μ IS ALSO USED)
E	MODULUS OF LINEAR DEFORMATION (YOUNG'S MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

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

DOCUMENT MICROFILMING IDENTIFICATION

GEOCRES No. 4015-7

W.P. No. 844-67-01

CONT. No. 73-506

W. O. No. 72-11069

STR. SITE No. N/A

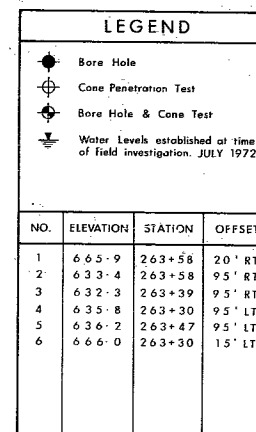
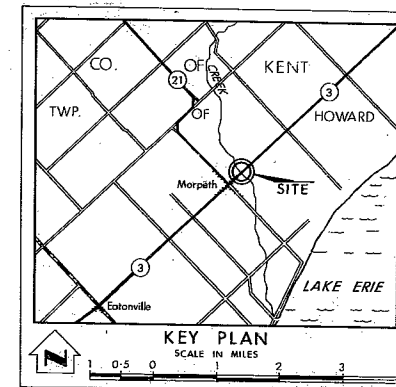
HWY. No. 3 DIST 1

LOCATION CULVERT DISTRESS

(ORD. RES. CONTRACT BLENHEIM E. Lts. E'ly
to 0.4 mi E. of Hwy. 21 @ Morpeth)

OVERSIZE DRAWINGS TO BE INCLUDED WITH THIS REPORT. 1

REMARKS: _____



—NOTE—

The boundaries between soil strata have been established only at Bore Hole locations. Between Bore Holes the boundaries are assumed from geological evidence.

REVISIONS	DATE	BY	DESCRIPTION

GEOCRES № 4015-7

MINISTRY OF TRANSPORTATION & COMMUNICATION
DESIGN SERVICES BRANCH — FOUNDATIONS OFFICE

CULVERT DEFORMATION
(1500 FT. EAST OF MORPETH)

HIGHWAY NO. 3 DIST. NO. 1
CO. KENT

TWP. HOWARD LOT _____ CON. _____

BORE HOLE LOCATIONS & SOIL STRAT

SUBMD. C. P.	CHECKED <i>CP</i>	W.P. NO. _____	DRAWING NO. _____
--------------	-------------------	----------------	-------------------

DRAWN S.O.	CHECKED <i>[initials]</i>	JOB NO. 72-11069	72-11069
------------	---------------------------	------------------	----------

DATE 15 AUG. 1972	SITE NO.	BRIDGE DRAWING NO.
APPROVED <i>[Signature]</i>	ENGINEER	

APPROVED *[Signature]* CONT. NO.
PRINCIPAL FOUNDATION ENGINEER *[Signature]*

[illegible]