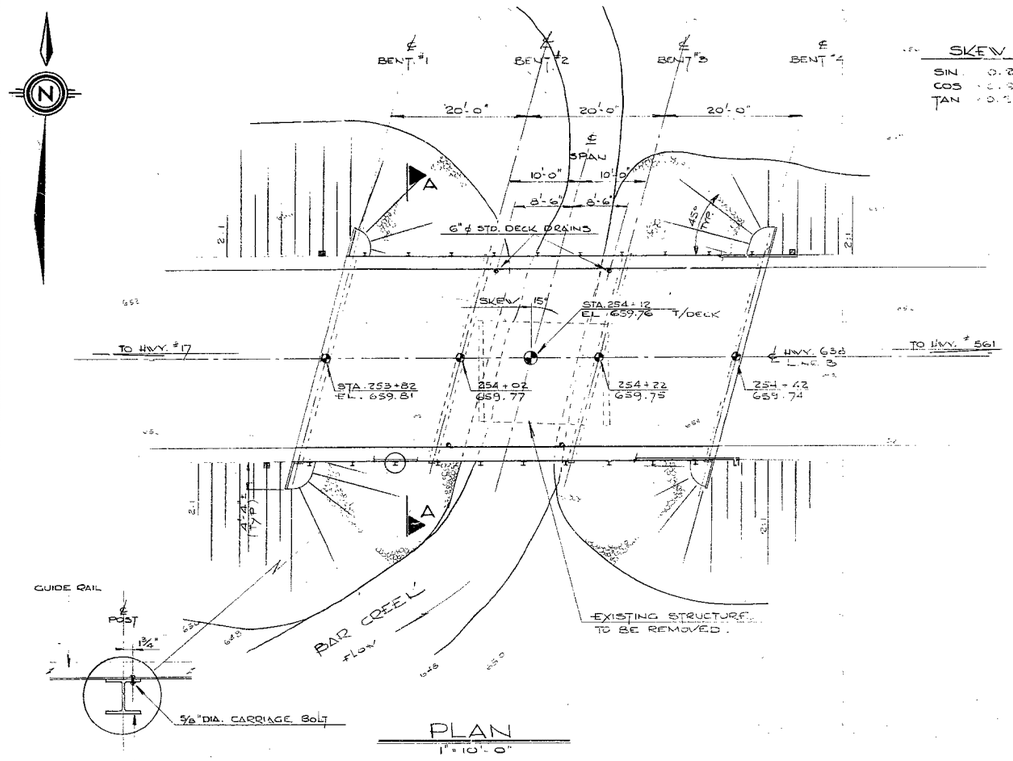
#69-F-42

W.P. 263-66-01

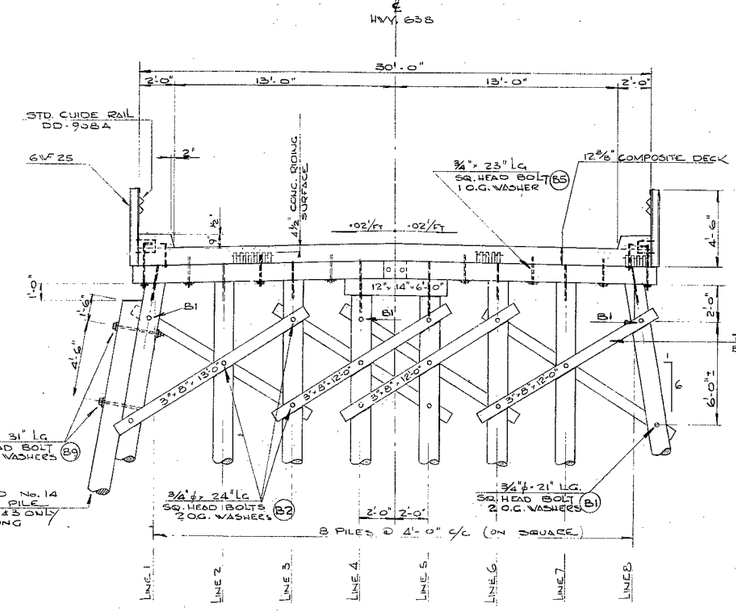
H.W.Y. #638

STATION 149+00 TO

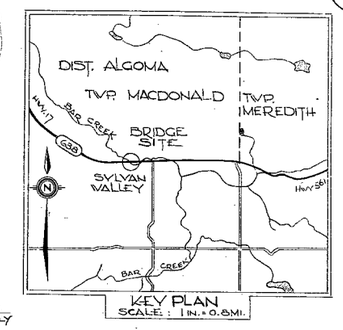
STATION 385+00



PLAN
1" = 10'-0"



SECTION A-A
¼" = 1'-0"



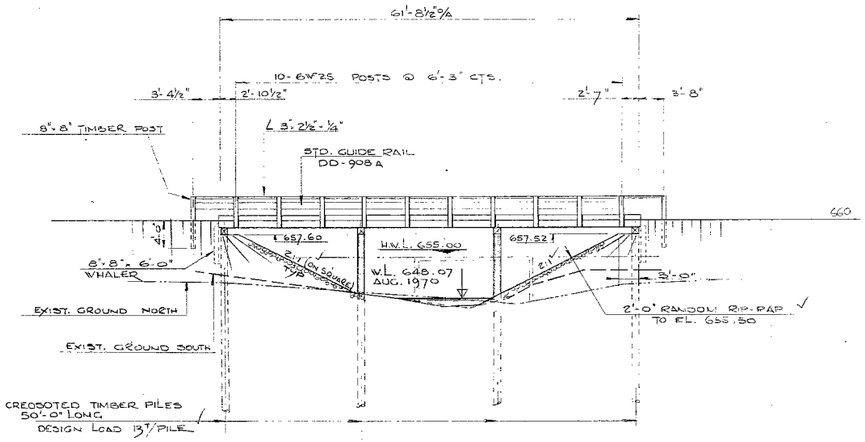
KEY PLAN
SCALE: 1 IN. = 0.8 MI.

NOTES.

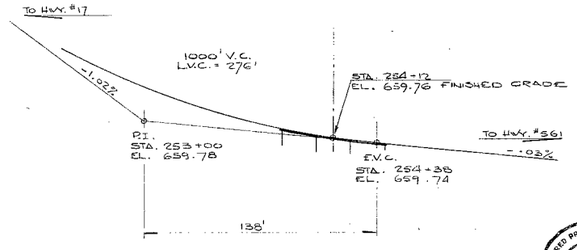
1. CLASS OF CONCRETE - 3000 P.S.I. @ 28 DAYS.
2. CLEAR COVER ON REINFORCING STEEL: 2" CURBS, 1½" DECK SLAB
3. APPROVED ADMIXTURES SUPPLIED BY THE CONTRACTOR WILL BE ADDED TO ALL CONCRETE AS SPECIFIED BY THE ENGINEER.
4. ALL HOLES FOR DRIFT PINS SHALL BE DRILLED IN THE FIELD AND SHALL BE ¾" DIA. ALL HOLES FOR BOLTS SHALL BE DRILLED IN THE FIELD AND SHALL BE 1/16" LARGER IN DIAMETER THAN THE BOLT.
5. BEFORE CUTTING OFF PILES, THE CUT-OFF ELEVATIONS SHALL BE CHECKED BY THE ENGINEER IN THE FIELD TO ENSURE A TRUE GRADE ACROSS THE STRUCTURE.
6. DECK LAMINATIONS TO BE PLACED WITH DRESSED EDGE BEARING ON THE PILE CAPS. EACH STRIP TO BE PLACED VERTICALLY AND TIGHT AGAINST THE PRECEEDING ONE.

PILE CUT-OFF ELEVATIONS

BENT # \ LINE #	1	2	3	4	5	6	7	8
1	657.42	657.51	657.59	656.71	656.71	657.60	657.52	657.44
2	657.39	657.47	657.55	656.67	656.67	657.56	657.48	657.40
3	657.37	657.45	657.53	656.65	656.65	657.53	657.45	657.37
4	657.36	657.44	657.52	656.64	656.64	657.52	657.44	657.36



ELEVATION
1" = 10'-0"



PROFILE ℄ HWY. 638
N.T.S.

List of Drawings.

D-6948-1 GENERAL PLAN
-2 BENTS & DECK DETAILS
-3 BILLS OF MATERIALS
-4 STANDARD DETAILS

B.M. 662.39
GEODETIC DATUM
N. IN. WEST ROOT 1.0" POPLAR
68.5' RT. STA. 242-19

PRINT RECORD		
No.	FOR	DATE

REVISIONS		
DATE	BY	DESCRIPTION

REGISTERED PROFESSIONAL ENGINEER V. F. BOEHNKE PROVINCE OF ONTARIO

FOR REDUCED PLAN
USE SCALE BELOW
10 11 12 13
3 INCHES ON ORIGINAL PLAN

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE OFFICE

69-F-62
68-L-72

SYLVAN VALLEY BRIDGE # 1

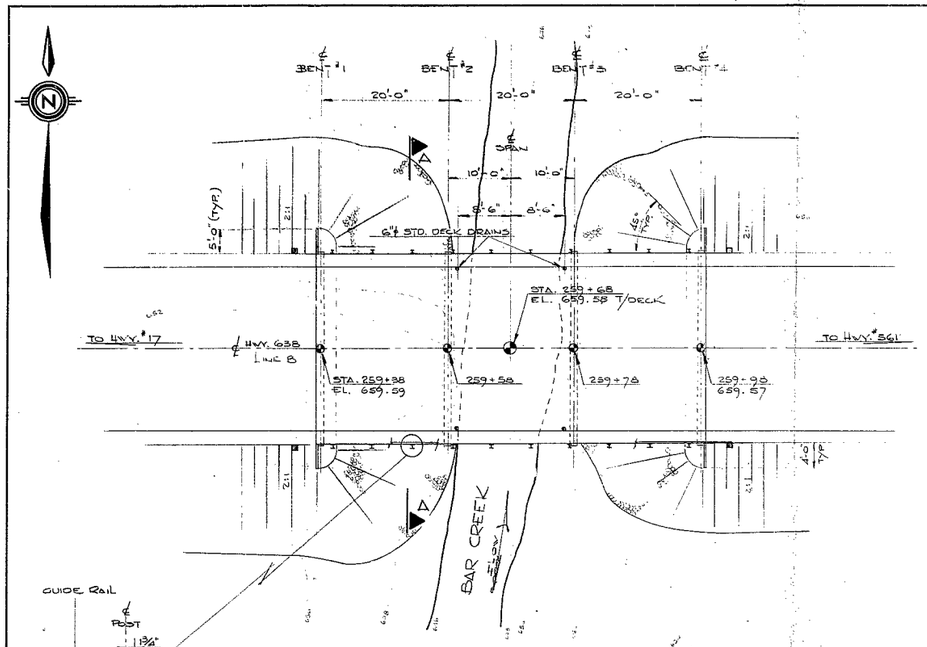
KING'S HIGHWAY No. 638 — DIST. No. 18
DIST. ALGOMA
TWP. MACDONALD — LOT 23 — CON.

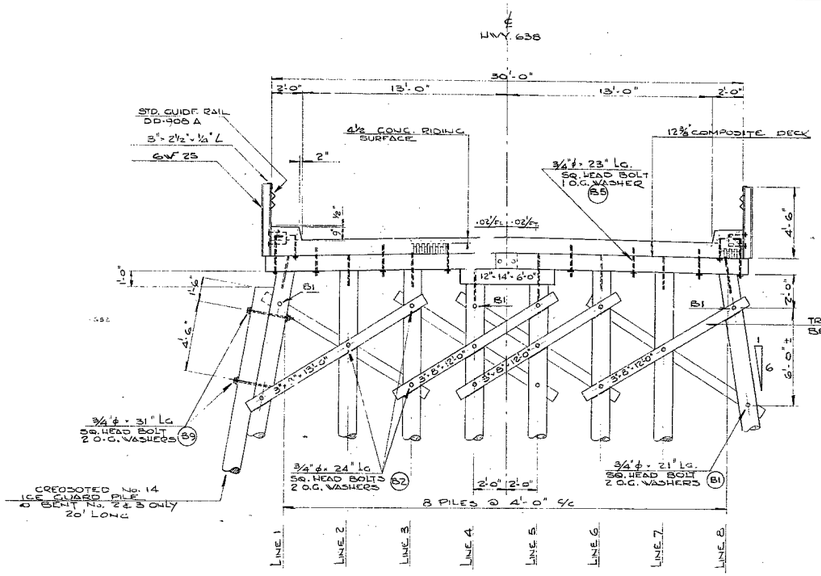
GENERAL PLAN

APPROVED ..... BRIDGE ENGINEER

DESIGN	W.V.	CHECK	V.F.B.	SITE No. 38S-116	W.P. No. 263-66-06
DRAWING	W.V.	CHECK	V.F.B.	CONTRACT Nos.	
DATE	MARCH '71	LOADING	HS 20-44	DRAWING No.	D-6948-1

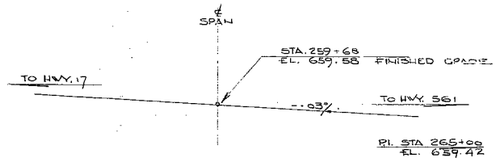
TRANSLAR 1320-10-70



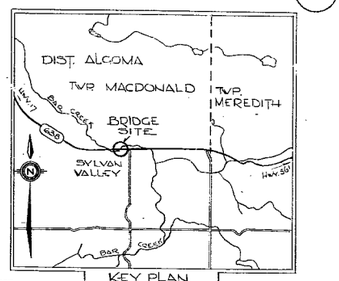


SECTION A-A
½" = 1'-0"

PILE CUT-OFF ELEVATIONS								
BENT \ LINE	1	2	3	4	5	6	7	8
1	657.21	657.29	657.37	656.49	656.49	657.37	657.29	657.21
2	657.20	657.28	657.36	656.48	656.48	657.36	657.28	657.20
3	657.20	657.28	657.36	656.48	656.48	657.36	657.28	657.20
4	657.19	657.27	657.35	656.47	656.47	657.35	657.27	657.19



PROFILE @ ℄ HWY. 638
N.T.S.



NOTES.

1. CLASS OF CONCRETE - 3000 PSI @ 28 DAYS.
2. CLEAR COVER ON REINFORCING STEEL: 2" CURBS 1½" DECK SLAB
3. APPROVED ADMIXTURES SUPPLIED BY THE CONTRACTOR WILL BE ADDED TO ALL CONCRETE AS SPECIFIED BY THE ENGINEER.
4. ALL HOLES FOR DRIFT PINS SHALL BE DRILLED IN THE FIELD AND SHALL BE ¾" DIA. ALL HOLES FOR BOLTS SHALL BE DRILLED IN THE FIELD AND SHALL BE 1/16" LARGER IN DIAMETER THAN THE BOLT.
5. BEFORE CUTTING OFF PILES, THE CUT-OFF ELEVATIONS SHALL BE CHECKED BY THE ENGINEER IN THE FIELD TO ENSURE A TRUE GRADE ACROSS THE STRUCTURE.
6. DECK LAMINATIONS TO BE PLACED WITH DRESSED EDGE BEARING ON THE PILE CAPS. EACH STRIP TO BE PLACED VERTICALLY AND TIGHT AGAINST THE PRECEEDING ONE.

LIST OF DRAWINGS.

B.M. 659.88
GEODETIC DATUM
N. & V. N ROOT 0.5 POPLAR
46.5' RT. 262+17

REVISIONS			
	DATE	BY	DESCRIPTION

PRINT RECORD		
No.	FOR	DATE

FOR REDUCED PLAN
USE SCALE BELOW
0 1 2 3
3 INCHES ON ORIGINAL PLAN

REGISTERED PROFESSIONAL ENGINEER
V. F. BOEHNKE
PROVINCE OF ONTARIO

DEPARTMENT OF HIGHWAYS ONTARIO
BRIDGE OFFICE

69-F-42
69-F-22

SYLVAN VALLEY BRIDGE # 2

KING'S HIGHWAY No. 638 DIST. No. 18
DIST. ALGOMA
TWP. MACDONALD LOT 23 & 24 CON.

GENERAL PLAN

APPROVED				SITE No. 58S-117	W.P. No. 283-66-05
BRIDGE ENGINEER				CONTRACT Nos.	
DESIGN	W.J.	CHECK	V.F.B.		
DRAWING	W.W.	CHECK	V.F.B.	DRAWING No.	D-6949-1
DATE	MARCH '71	LOADING	HS 20-44		

TRANSLAR 1500-10-70

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. H. W. Hurrell,
Regional Road Design Supt.,
Northwestern Regional Office,
FORT WILLIAM, Ontario.

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

Attention:

Date: October 28, 1969

Our File Ref.

In reply to NOV 6 1969

Subject:

FOUNDATION INVESTIGATION REPORT
For
Highway #638
Station 149+00 to Station 385+00
District No. 18 (Sault Ste. Marie)
W.J. 69-F-42 -- W.P. 263-66-01

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

We believe that the factual data and recommendations contained therein, will prove adequate for your design requirements. Should additional information be required, please do not hesitate to contact our Office.

A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

AGS/KdeF
Attach.
cc: Messrs. H. W. Hurrell (2)
D. W. Farren
H. A. Tregaskes
R. G. Gascoyne
B. R. Davis
R. Morgenroth
B. A. Singh

Foundations Files
Gen. Files

TABLE OF CONTENTS

FOUNDATION INVESTIGATION REPORT
For
Highway #638
Station 149+00 to Station 385+00
District No. 18 (Sault Ste. Marie)
W.J. 69-F-42 -- W.P. 263-66-01

1. INTRODUCTION:

A request to carry out a foundation investigation, particularly to check the stability of the proposed embankments along Hwy. #638 from Station 149+00 to Station 385+00, was received from Mr. F. Norman, Regional Materials Engineer, on May 6, 1969. Fifteen locations in all, were to be investigated where the intention was to considerably increase the embankment height.

An investigation was subsequently carried out by this Section to determine the subsoil conditions existing at these sites.

This report contains the results of our field and laboratory investigation, together with our recommendations regarding the stability of the proposed embankments.

2. DESCRIPTION OF SITE:

The section of Hwy. #638 investigated extends from approximate Station 148+00 to 385+00 - i.e., about 3 to 7 miles east of Echo Bay. The land from Station 148+00 to 360+00 in general, is covered with pasture and the topography is flat to gently rolling. Farther east of Station 360+00 the topography is very undulating, with a valley on the north side and hills on the south side of the road.

3. FIELD AND LABORATORY WORK:

The field work at the site consisted of fifteen sampled boreholes and fourteen dynamic cone penetration tests. One borehole

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

was put down at each of the sites investigated. All boreholes were advanced using conventional diamond drilling equipment adapted for soil sampling purposes. A driving energy of 350 ft.-lbs. per blow was used for the dynamic cone penetration tests.

Disturbed samples were obtained using a 2-inch O.D. split-spoon sampler driven according to the specifications of the Standard Penetration Test. Undisturbed samples were obtained by means of 2-inch I.D. Shelby tubes which were pushed into the soil manually.

In-situ vane tests were carried out, wherever possible, at elevations 12 inches below various soil samples.

Samples were visually examined in the field and subsequently in the laboratory. The following tests were carried out on selected samples:

1) Grain-Size Distribution.

2) Atterberg Limits.

3) Natural Moisture Content.

4) Bulk Density.

5) Unconfined Compression Tests.

6) Laboratory Shear Vane Tests.

The results of field and laboratory tests are summarized on the Record of Borehole sheets, which are contained in the Appendix to the report.

The locations and the elevations of boreholes are given on Drawing No. 69-F-42A, which is also contained in the Appendix to this report.

The borehole locations and elevations were surveyed by the Sault Ste. Marie District Office of the D.H.O.

..... 3

4. GENERAL SUBSOIL CONDITIONS:

In general, the subsoil over the whole area, consists of soft to firm sensitive, highly plastic clay, underlain by a mixture of gravel, sand and silt. All the boreholes were terminated in one of the above mentioned deposits. In Boreholes 1 and 3 a thin layer of soft to firm silty clay was found at the ground surface.

A general description of these subsoil types is given below. A description of subsoil conditions existing at each site is given in the section headed, 'Discussion and Recommendations'.

4.1) Silty Clay:

The silty clay layer was encountered only in Boreholes 1, 3 and 9. The thickness of the layer varies from about 2 to 5 ft. Traces of organics were found in Borehole 3. The consistency of the soil is soft to firm. The Atterberg Limit tests indicated the following values:

Liquid Limit	:	35 - 44%
Plastic Limit	:	18 - 23%
Natural Water Content	:	28 - 36%

4.2) Clay:

The clay deposit which was found in all boreholes except B.H. 9, varies in thickness from about 10 ft. to over 70 ft. The material is highly plastic clay with occasional silty clay layers, red in colour with some thin grey layers. The Atterberg Limits carried out on the clay samples from this stratum, show the following range:

Liquid Limit	:	50 - 86%
Plastic Limit	:	20 - 28%
Natural Water Content	:	56 - 100%

..... 4

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

4.2) Clay: (cont'd.) ...

The shear strength values vary from one borehole to another, and are discussed individually in the 'Discussion and Recommendations' section. In general, the consistency is soft to firm and, at some places, it may be stiff. While the field and lab. vane tests gave about similar values of shear strength, unconfined compression tests gave lower values. It is felt that the field vane results are more reliable for assessing the shear strength to be used in computation. It is known from experience that, although field vane results are more reliable, they usually slightly overestimate the shear strength. This fact should be kept in mind while reviewing the results.

4.3) Sandy Silt:

This material was at the bottom of Borehole 9 and top of Borehole 11 to a depth of 7 ft. In Borehole 9 it was probably dense, but in Borehole 11 it was very loose. The two grain-size analyses indicated the following ranges of distribution and are plotted on Fig. 2:

Gravel	:	0 - 3%
Sand	:	20 - 24%
Silt	:	57 - 61%
Clay	:	16 - 19%

4.4) Mixture of Gravel, Sand and Silt:

This underlying soil deposit was encountered in Boreholes 5, 6, 7, 10, 11 and 13. The Standard Penetration Test indicated dense to very dense denseness. The above mentioned boreholes were terminated in this material. The grain-size analyses indicated the following ranges of distribution, and are plotted on Fig. 3:

..... 5

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

4.4) Mixture of Gravel, Sand and Silt: (cont'd.) ...

Gravel	:	17 - 37%
Sand	:	26 - 47%
Silt	:	13 - 42%
Clay	:	1 - 5%

5. GROUNDWATER CONDITIONS:

Groundwater level, in general, was high, being zero to approximately 5 ft. below the ground. In Borehole 1 (while driving the cone), and Boreholes 6 and 11, artesian water was encountered when the layer of mixture of gravel, sand and silt was intersected. The artesian water level rose to approx. 1.0 ft. above the ground in B.H.'s 1 and 6, and 3.5 ft. in the case of B.H. 11.

B.H. No.	Groundwater Level	Ground Level	Remarks:
1	649.5	649.5	Artesian water in cone hole
2	647.9	647.9	
3	648.3	650.8	
4	654.7	657.3	
5	649.0	651.3	
6	649.5	648.4	Artesian
7	712.9	713.4	
8	721.6	725.3	
9	746.0	750.4	
10	687.4	689.9	
11	663.9	663.9	Artesian water to 667.4
12	664.8	667.3	
13	686.7	691.7	Estimated
14	667.0	672.0	"
15	673.7	678.7	"

..... 6

6. DISCUSSION AND RECOMMENDATIONS:

It is proposed to reconstruct Hwy. #638 which will involve a considerable grade raise at many places, particularly where a ditch or creek crosses the highway.

At some places the grades were revised in September 1968. In this report, both the old and the revised grades have been commented upon.

One borehole was put down at each of the sites where it was thought that some stability problems may be encountered. In all, 15 such investigations were requested by Mr. D. Gunter, Project Soils Supervisor, when he visited the site.

In the following pages, each site has been considered individually and commented upon regarding the stability problems existing there.

SITE #1 - Station 149+60 (B.H. #15):

Subsoil:

The subsoil consists of a deep deposit of soft clay. A cone was driven down to a depth of 60.0 ft. with no hard layer being encountered. The borehole was carried down to 43.0 ft. The average shear strength of the clay layer, as determined from the field, is about 400 p.s.f. Slightly higher shear strength values were recorded in the top desiccated zone.

Recommendations:

It was proposed to raise the grade at this site by about 4.0 ft. resulting in a total height of embankment of about 10.0 ft. above the bottom of the ditch. According to Soils Grade, Sept. '68, it is proposed that the grade be raised by another 2.0 ft. The total height of embankment, in that case, would be about 12.0 ft. Based on the total stress analysis, it is recommended that the grade raise be limited to 4.0 ft. (i.e., total embankment height of 10.0 ft.), and 2:1 side slopes should be provided.

..... 7

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

SITE #2 - Station 201+70 (B.H. #14):

Subsoil:

The subsoil at this site is essentially similar to that at Site #1. The cone was driven to a depth of 58.5 ft. where it encountered a hard stratum. The borehole was carried down to a depth of 380 ft. The shear strength, as determined from the field vane tests, ranges generally between 320 and 400 p.s.f. Higher shear strength values were recorded in the desiccated zone.

Recommendations:

It was proposed to raise the grade at this site by about 5.5 ft. resulting in a total height of embankment of about 10.0 ft. According to Soils Grade, Sept. '68, the total height of embankment would be about 10.5 ft. Because of the very low shear strength of the subsoil, it is recommended that for 2:1 side slopes, the total height of the embankment above the bottom of the ditch, should be limited to a maximum of 10.0 ft. In fact, it would be advisable to lower the proposed grade by about 1.0 ft. to ensure an adequate factor of safety.

SITE #3 - Station 211+70 (B.H. #13):

Subsoil:

The subsoil at the consists of a 20.5-ft. thick layer of stiff to firm clay to silty clay, underlain by a layer of mixture of gravel, sand and silt. The cone was stopped at a depth of 21.8 ft. and the borehole was terminated at a depth of 21.5 ft. after intersecting a layer of mixture of gravel, sand and silt at a depth of 20.5 ft. The shear strength of the clay, as measured by the field vane test, varies between 560 and 720 p.s.f. The shear strength in the desiccated zone would be higher than this.

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

SITE #3 - Station 211+70 (B.H. #13): (cont'd.) ...

Recommendations:

It was proposed to raise the grade at this site by about 7.0 ft. resulting in a total height of embankment of about 11.0 ft. The Soils Grade, Sept. '68 proposes another 2.0-ft. raise in the grade. Thus the total height of embankment at this site would be about 13.0 ft. No stability problems are anticipated for 2:1 side slopes of the proposed embankment.

SITE #4 - Station 253+80 (B.H. #1) - and BRIDGE (1) W.R. 261-66-06
SITE #6 - Station 260+20 (B.H. #2): BRIDGE (2) W.R. 261-66-07

Subsoil:

Subsoil conditions at these two sites are very similar and consist of a 2 to 5 ft. thick layer of silty clay followed by a deep deposit of soft to firm clay. The shear strength of the clay deposit, as determined from the field vane tests, varies in general, between 500 and 800 p.s.f., except in the top 8 ft. (from ground level of the desiccated zone, where the shear strength varies from 1000 to 1800 p.s.f.

Recommendations:

If it is decided to follow the old tangent Right-of-Way for the new line, it will be necessary to construct two structures at these two sites, where the Bar Creek crosses the road. At the time of investigation, it was proposed to construct a pipe arch culvert at both the sites. For recommendations regarding the construction of culvert, reference should be made to Report No. 68-F-77, pages 7 - 8. The same recommendations are applicable here.

..... 9

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

SITE #4 - Station 253+80 (B.H. #1) - and
SITE #6 - Station 260+20 (B.H. #2): (cont'd.) ...

Recommendations: (cont'd.) ...

It is proposed to raise the grade such that the total height of the embankment above the creek bed would be about 14.0 ft. The subsoil conditions at these two sites are more favourable than at Station 282+30. No stability problems are anticipated for 14.0-ft. high embankment with 2:1 side slopes.

SITE #5 - Station 256+00 (B.H. #3):

Subsoil:

The subsoil consists of 1.8 ft. of topsoil, followed by 4.7 ft. of soft to firm silty clay with traces of organics underlain by a deep deposit of soft to firm clay. The shear strength, as measured by the field vane test, varies between 500 and 600 p.s.f.

Recommendations:

It is proposed to divert the creek just to the north of Line 'A' and construct the embankment along the proposed Line 'A'. If this scheme is accepted, a grade raise would be necessary between Stations 250+00 and 260+00. The maximum height of the embankment would be about 14.0 ft. No stability problems are anticipated for 2:1 side slopes of the embankment.

..... 10

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

SITE #7 - Station 265+00 (B.H. #4):

Subsoil:

The subsoil consists of a deep deposit of soft to firm clay. The shear strength of the clay, as determined from the field vane tests, varies in general, between 500 and 800 p.s.f.

Recommendations:

If it is decided to construct the road along Line 'A', no relocation of the creek would be necessary, but if it is proposed to follow the old tangent Right-of-Way, it will be necessary to relocate the creek. The total height of the embankment would be about 20.0 ft. The maximum height of the embankment with 2:1 side slopes, that can be constructed without any berms, is about 16.0 ft. An embankment higher than 16.0 ft. would require mid-height berms to ensure its stability. For every 1 ft. height of embankment in excess of 16.0 ft., the length of mid-height berm required would be 5 ft.

SITE #8 - Station 277+50 (B.H. #5):

Subsoil:

The borehole was put down about half-way down the slope. The subsoil consists of 10.0 ft. of firm clay, underlain by a layer of dense mixture of gravel, sand and silt. The borehole was terminated in this layer. The only field vane test indicated a shear strength of 640 p.s.f.

Recommendations:

It is proposed to raise the grade at this location by about 4.0 ft. Assuming the bottom of the creek at elevation 644.0, this would result in a total height of embankment of about 22.0 ft.

..... 11

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

SITE #8 - Station 277+50 (B.H. #5): (cont'd.) ...

Recommendations: (cont'd.) ...

Because of the presence of the underlying dense gravel, sand and silt layer at relatively shallow depth, it is anticipated that 2:1 side slopes would be stable.

SITE #9 - Station 280+00 (B.H. #6):

Subsoil:

At this location also, the borehole was put down about half-way down the slope. The subsoil consists of 21.5 ft. of soft to firm clay underlain by a layer of very dense mixture of gravel, sand and silt. The average shear strength of the clay layer, as measured by the field vane test, is about 500 p.s.f.

Recommendations:

It is proposed to raise the grade at this location by about 6.0 ft. Assuming the bottom of the creek to be at elevation 643.0, the total height of the embankment would be about 19.5 ft. Compared to Site #8, the shear strength of the soil at this site is lower and the hard layer is at greater depth. The maximum height of the embankment with 2:1 side slopes that can be constructed without berms at this site, is about 16.0 ft. Any embankment higher than this would require mid-height berms to ensure stability of the slopes. It is recommended that for 2:1 side slopes, 15.0 ft. mid-height berms be provided at this site.

..... 12

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

SITE #10 - Station 331+00 (B.H. #12):

Subsoil:

The subsoil consists of a firm clay deposit. The borehole was terminated in this deposit at a depth of 37.3 ft. The shear strength, as determined from the field vane tests, varies in general, between 640 and 800 p.s.f. Slightly higher shear strength was recorded near the top and the bottom of the borehole.

Recommendations:

At this site the new line is shifted about 30 ft. to the south of the existing centre-line. The originally proposed grade would result in a total height of the embankment of about 20.0 ft. According to the Soils Grade, Sept. '68, the total height of the embankment would be about 15.0 ft. The maximum height of the embankment with 2:1 side slopes, that the subsoil can support, is 20.0 ft. Any height of embankment in excess of 20.0 ft. would need berms.

SITE #11 - Station 337+00 (B.H. #11):

Subsoil:

The subsoil consists of 7.0 ft. of very loose sandy silt, underlain by 24.0 ft. of firm clay, which in turn, is underlain by a deposit of very dense mixture of gravel, sand and silt. In general, the shear strength of the clay layer, as measured by the field vane test, ranges between 700 and 800 p.s.f. with slightly higher values recorded near the top and the bottom of the borehole.

Recommendations:

At this site also, the new line is shifted about 30 ft. to the south of the existing centre-line. The originally proposed

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

SITE #11 - Station 337+00 (B.H. #11): (cont'd.) ...

Recommendations: (cont'd.) ...

grade would result in a total height of the embankment of about 17.0 ft. According to the Soils Grade, Sept. '68, this height would be about 14.0 ft. No stability problems are anticipated for a 17-ft. high embankment with 2:1 side slopes.

SITE #12 - Station 345+00 (B.H. #10):

Subsoil:

The subsoil consists of about 41.0 ft. of firm to stiff clay, underlain by a layer of mixture of gravel, sand and silt. Both the cone and the borehole were terminated after hitting the latter layer. The average shear strength of the clay, as determined from the field vane tests, is about 700 p.s.f. Higher values of shear strength were recorded near the top and the bottom of the borehole.

Recommendations:

There is a large ponded area to the north of the road. The bottom of the pond is considerably lower than the surrounding ground. It is proposed to raise the grade at this site by about 14.0 ft. The maximum height of the embankment with 2:1 side slopes that may be constructed at this site without berms, would be about 21.0 ft. An embankment higher than 21.0 ft., would require mid-height berms. For every 1 ft. height of embankment in excess of 21.0 ft., the length of the mid-height berm required would be 6 ft.

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

SITE #13 - Station 358+00 (B.H. #7):

Subsoil:

The subsoil consists of about 15.0 ft. of stiff clay underlain by a layer of very dense mixture of gravel, sand and silt. The shear strength of the clay, as determined from the field vane test, is in excess of 1000 p.s.f.

Recommendations:

At this location the new line would be shifted about 80 ft. to the south of the existing centre-line. The proposed grade would result in a total height of embankment of about 18.0 ft. above the bottom of the ditch. No stability problems are anticipated at this site for 2:1 side slopes of the embankment.

SITE #14 - Station 363+00 (B.H. #8):

Subsoil:

The subsoil consists of about 11.0 ft. of firm to stiff clay. The cone encountered a hard layer at 12 ft. The borehole was terminated at a depth of 10.5 ft. The shear strength of the clay layer, as measured by the field vane test, was found to be 800 p.s.f. and more.

Recommendations:

The new centre-line will be close to the existing centre-line. The ground to the south of the road is high ground, and to the north there is an 8-ft. deep ditch or valley. There would be no raise in the grade, and no stability problems are anticipated for 2:1 side slopes.

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

SITE #15 - Station 384+60 (B.H. #9):

Subsoil:

The subsoil consists of about 10.5 ft. of firm to stiff silty clay, underlain by a layer of mixture of sandy silt, some clay and traces of gravel. The cone and the borehole both met practical refusal at about 11 ft. The shear strength of the silty clay layer, as determined from the field vane test, was found to be more than 900 p.s.f.

Recommendations:

The new line will follow the existing centre-line. There is high ground on the south side and a deep gulley on the north side. It was proposed to raise the grade by about 4.0 ft. According to the Soils Grade, the grade would be raised by about 6.0 ft. No stability problems are anticipated for about 25 ft. height of embankment with 2:1 side slopes.

7. MISCELLANEOUS:

The field work for this project was carried out during the period July 5 - 21, 1969, under the supervision of Mr. A. Prakash, Project Foundation Engineer, who also prepared this report.

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

This report was reviewed by Mr. K. G. Selby, Supervising Foundation Engineer.

October 1969

APPENDIX I

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 1

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 253 + 70, o/s 145' Lt. ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 6 - 7, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT
649.5	**Ground Level**				
647.5 / 2.0	**Silty clay. Firm. Red**		1	SS	7
			2	TW	PM
			3	SS	5
	Clay				
	Highly plastic		4	TW	PM
	Red, with grey				
	layers.		5	SS	PM
	Firm		6	TW	PM
623.0			7	SS	2
26.5	**End of Borehole**				
574.0					
75.5	**End of Cone Test**				

ELEV. SCALE: 640, 630, 620, 610, 600, 590, 580, 570

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 10 20 30 40 50

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

+s10.5
+s3.9
+s3.6
×s2.9-3.6
+s4.5
+s2.8
+s2.4
+s6.6
96
77
70
130/6"

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 25 50 75

BULK DENSITY γ P.C.F.: 95

REMARKS
GR. SA. SI CL

Artesian pressure encountered in the core hole rising to el.650.5

20
15 — 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 260+00, o/s 145' Lt. ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 9, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX casing & Cone CHECKED BY [illegible]

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
647.9 / 0.0	Ground Level					
	Clay highly plastic red, with grey layers soft to firm		1	SS	3	
			2	TW	PM	640
			3	SS	2	
			4	TW	PM	
			5	SS	1	630
			6	TW	PM	
			7	SS	2	620
			8	TW	PM	
611.4 / 36.5	End of Borehole					610
607.9 / 40.0	End of Cone Test					600

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 10 20 30 40 50

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

+s3.6
+s3.3
+s5.0
×s2.9-3.6
+s3.2
+s8.0
+s3.5
+s7.2
+s3.2

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

w_P w w_L

WATER CONTENT % 25 50 75

100

BULK DENSITY γ P.C.F.

REMARKS

Caved at 280'

GR. SA. SI CL

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 256+00 ℄ ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 9, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
650.8	Ground Level					
649.8	Top Soil					650
1.8	Silty Clay, traces of org grey, red & brown		1	SS	7	
644.3	Soft to firm		2	TW	PM	
6.5	Clay highly plastic red, with grey layers Soft to firm		3	SS	1	640
			4	TW	PM	
			5	SS	1	630
			6	TW	PM	
			7	SS	-	620
614.3			8	TW	PM	
36.5	End of Borehole					610
600.8						
50.0	End of Cone Test					600

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
10 20 30 40 50

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

×s3.2 +s2.5 +s3.7 +s.4.7 +s3.3 +s5.5 ×s2.9-4.6 +s2.8 +s3.3 +s3.3

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
25 50 75

BULK DENSITY γ P.C.F.	REMARKS GR.SA.SI.CL.
	648.3 ▽ Caved at 26.5'
91.5	Org 4%
100	

FORM OB-M[illegible]26 (REV. 1969) OFFICE REPOR[illegible]N SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 265+35, o/s 50' Lt. ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 10, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring & NX Casing CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT — SHEAR STRENGTH P.S.F. ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE (400 800 1200 1600 2000)	LIQUID LIMIT w_L PLASTIC LIMIT w_P WATER CONTENT w — WATER CONTENT % (25 50 75)	BULK DENSITY γ P.C.F.	REMARKS GR. SA. SI. CL.
657.3	Ground Level									
0.0										▼ 654.7
			1	SS	8					
			2	TW	PM	650	×s1.1-1.7 +s3.4		103	Caved at 250'
	Clay						×s3.7			
	highly plastic		3	SS	2		+s3.6			
	red with grey		4	TW	PM	640	+s2.8			
	Soft to Firm		5	SS	PM		+s3.2			
			6	TW	PM	630	○ × s1.2-2.3 +s4.7		98.5	
			7	SS	PM		+s3.4			
620.8			8	TW	PM					
36.5	End of Borehole					620	+s3.3			

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 5

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 277+50, o/s 30' Lt. ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 10, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS/FOOT (10 20 30 40 50) / SHEAR STRENGTH P.S.F. (○ UNCONFINED ● QUICK TRIAXIAL ÷ FIELD VANE × LAB. VANE) (400 800 1200 1600 2000)	LIQUID LIMIT w_L / PLASTIC LIMIT w_P / WATER CONTENT w — WATER CONTENT % (25 50 75)	BULK DENSITY γ P.C.F.	REMARKS
651.3	Ground Level									
0.0	Clay					650				
	Highly plastic red, with grey layers		1	SS	11					
			2	TW	PM		+84.0			
641.3	Firm									
639.8	Mix of grav., sand & silt. Dense		3	SS	39	640	120/8"	○		26 47 23 2
11.5										

▼ 6490 Caved at 7.3'

FORM CS MT [illegible] (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 6

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 279+82, o/s 32' Lt. ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 14, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY AC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
648.4	Ground Level					
0.0	Clay Highly Plastic Red & Grey Soft to Firm		1	SS	2	640
			2	TW	PH	
			3	SS	1	
			4	TW	PH	630
626.2			5	TW	PH	
21.5	Mix of gray, sand & Silt Very Dense		6	SS	106	
625.4						
23.0	End of Borehole					
621.6	End of Cone Test					620
26.8						

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT
10 20 30 40 50

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

+s4.7
+s.4.2
+s2.8
×s1.7-2.4

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

WATER CONTENT %
25 50 75

BULK DENSITY γ P.C.F.

106

REMARKS
GR. SA. SI. CL.

▽ El. 624.0
Artesian water encountered head to El. 649.5

FORM OB-MT[illegible]6 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 7

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 358+00 ℄ ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 15, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY [illegible]

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT
713.4	Ground Level				
	Clay				
	Highly Plastic		1	SS	6
	Red, Grey & Brown				
	Stiff		2	TW	PM
698.4					
15.0	Mix of Gr. Sand & Silt				
696.9	Very Dense		3	SS	80
16.5	End of Borehole				
694.3					
18.9	End of Conetest				

ELEV. SCALE: 710, 700, 690

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 10 20 30 40 50

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

+s 6.0
>+2000

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
WATER CONTENT % 25 50 75

OH

BULK DENSITY γ P.C.F.

REMARKS

GR. SA. SI. CL.

712.9
Caved at 9.5'

28 46 23 3

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 8

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 363+00, o/s 23' Lt ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 16, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
725.3	Ground Level					
0.0	Clay					
	Highly Plastic		1	SS	8	
	Red		2	TW	PM	720
714.8	Firm to Stiff		3	SS	17	
10.5	End of Borehole					715

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT
10 20 30 40 50

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

+s5.0
×s3.5-4.4
+s3.9
120/11"

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

w_P w w_L

WATER CONTENT %
25 50 75

BULK DENSITY γ P.C.F.: 107

REMARKS: ▼ 721:6 Caved at 5.7'

GR. SA. SI. CL.

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 9

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 384+35, o/s 20'RT ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 16, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
750.4	Ground Level					
0.0	Silty Clay Red & Grey Firm to Stiff		1	SS	12	750
			2	TW	PM	
739.9 10.5	Sandy Silt		3	SS	120/9"	740
10.8	End of Borehole					

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 10 20 30 40 50
SHEAR STRENGTH P.S.F.
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB. VANE
400 800 1200 1600 2000
+s4.8
>+ 2000
71
100/3"

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT %
25 50 75

BULK DENSITY γ P.C.F.

REMARKS
GR. SA. SI. CL.
▼ 746.0
Caved at 7.0'
3 24 57 16

FORM OB-MT-[illegible]6 (REV. 1969) OFFICE REPORT ON SOIL EXPLORATION

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 10

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 344+80, o/s 23' Lt. ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 16, 17, 196[illegible] COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY [illegible]

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT
689.9	Ground Level				
	Clay		1	SS	11
	Highly Plastic		2	TW	PM
	Red, with Grey				
	Layers		3	SS	5
	Firm to Stiff				
			4	TW	PM
			5	SS	3
			6	TW	PM
			7	SS	6
			8	TW	PM
648.9					
41.0	Mix gr. sand & silt		9	SS	-
41.5	End of Borehole				

ELEV. SCALE: 680, 670, 660, 650

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT 10 20 30 40 50

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

+s4.5
+s3.4
+s3.8
×s4.5
+s2.5
+s3.3
+s3.3
+s3.6
×s3.4-4.3
+s6.0

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % 25 50 75

BULK DENSITY γ P.C.F.	REMARKS
	▼ 687.4 Caved at 29.5'
99	
111	
	GR. SA. SI. CL. 17 36 42 5

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

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 11

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 337+15 ℄ ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 17, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS / FOOT
663.9	Ground Level				
0.0	Sandy Silt, some clay, grey				
656.9	Very loose		1	SS	3
7.0	Clay		2	SS	3
	Highly plastic grey				
	Firm red, grey layers		3	TW	PM
			4	TW	PM
			5	SS	3
633.9			6	TW	PM
31.0	Mix of gr., sand &				
629.4	Silt Very Dense		7	SS	71
34.5	End of Borehole				
625.6					
38.3	End of Cone Test				

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

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 10 20 30 40 50

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

+s5.5
×s7.5-15
+s4.5
+s6.7
+s7.0
82
68
50/3"

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
WATER CONTENT % 25 50 75

BULK DENSITY γ P.C.F.
100.5

REMARKS
▽ Art W. 667.4
GR. SA. SI. CL.
0 20 61 19
37 49 13 1

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 12

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 331+00 ℄ ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 18, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
667.3	Ground Level					
	Clay, occasional Silty clay layers Red, with grey Layers		1	SS	13	660
			2	TW	PM	
	Firm		3	SS	4	650
			4	TW	PM	
			5	SS	3	640
			6	TW	PM	
630.0			7	SS	4	630
37.3	End of Borehole					

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT: 10 20 30 40 50

SHEAR STRENGTH P.S.F. — ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB. VANE

400 800 1200 1600 2000

+s3.7 +s9.0 +s8.0 ×s2.0+3.1 +s10.0 +s6.7 +s3.7 +s5.1 100/2"

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

w_p w w_L

WATER CONTENT %

BULK DENSITY γ P.C.F. 107.5

REMARKS

664.8

GR. SA. SI. CL.

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

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 13

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 211+50, o/s 12' Lt. ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 18, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT
691.7	**Ground Level**				
0.0					
	Clay, to Silty Clay		1	SS	16
	Red, with Grey				
	Layers		2	SS	9
			3	TW	PM
	Stiff to Firm				
			4	TW	PM
671.2					
20.5	**Mix of gr. sand & silt**		5	SS	62
21.5	**End of Borehole**				

ELEV. SCALE: 690, 680, 670

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 10 20 30 40 50

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

+s6.0
+s7.0
72
100/10"

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

WATER CONTENT %
25 50 75

BULK DENSITY γ P.C.F.

REMARKS

686.7 Estimated

GR. SA. SI. CL.
17 42 38 3

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 14

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 201+00, o/s 17' Rt ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 19, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/FOOT	ELEV. SCALE
672.0	Ground Level					
0.0	Clay Highly Plastic Red, with Grey Layers		1	SS	15	670
			2	TW	PM	660
	Firm Soft		3	SS	2	
	Soft		4	TW	PM	650
			5	SS	1	
			6	TW	PM	640
634.0			7	SS	2	
38.0	End of Borehole					630
614.5						620
57.5	End of Cone Test					610

DYNAMIC PENETRATION RESISTANCE
BLOWS / FOOT — 10 20 30 40 50

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

×s1.1
●s3.3
+s7.0
×s1.4-2.4
+s10.0
+s8.0
+s8.0
+s5.0
82
100/6"

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_P
WATER CONTENT —— w
w_P w w_L
WATER CONTENT % 25 50 75

BULK DENSITY γ P.C.F.
107.5

REMARKS
GR. SA. SI. CL.
667.0 Estimated

20
15 ⊹ 5 % STRAIN AT FAILURE
10

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 15

FOUNDATION SECTION

JOB 69-F-42 LOCATION Sta. 148+83, o/s 24' Lt. ORIGINATED BY AP
W.P. 263-66-01 BORING DATE July 19, 20, 1969 COMPILED BY AP
DATUM Geodetic BOREHOLE TYPE Washboring, NX Casing & Cone CHECKED BY

ELEV. / DEPTH	DESCRIPTION	STRAT. PLOT	SAMPLES NUMBER	TYPE	BLOWS/FOOT	ELEV. SCALE
678.7	Ground Level					
677.7	Top Soil					
	Firm / Soft Clay		1	SS	7	670
	Highly Plastic Red with Grey Layers		2	TW	PM	
			3	TW	PM	660
	Soft		4	TW	PM	
			5	TW	PM	650
			6	TW	PM	
634.7			7	TW	PM	640
43.0	End of Borehole					630
618.7						620
60.0	End of Cone Test					610

DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT — 10 20 30 40 50

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

+s2.8
×1.9-3.7
σ +s6.4
+s8.0
× s2.7-3.1
σ +s10.0
+s5.7
+s3.0
×s3.0-4.6
○ +s5.0

LIQUID LIMIT —— w_L
PLASTIC LIMIT —— w_p
WATER CONTENT —— w
w_p w w_L
WATER CONTENT %
25 50 75

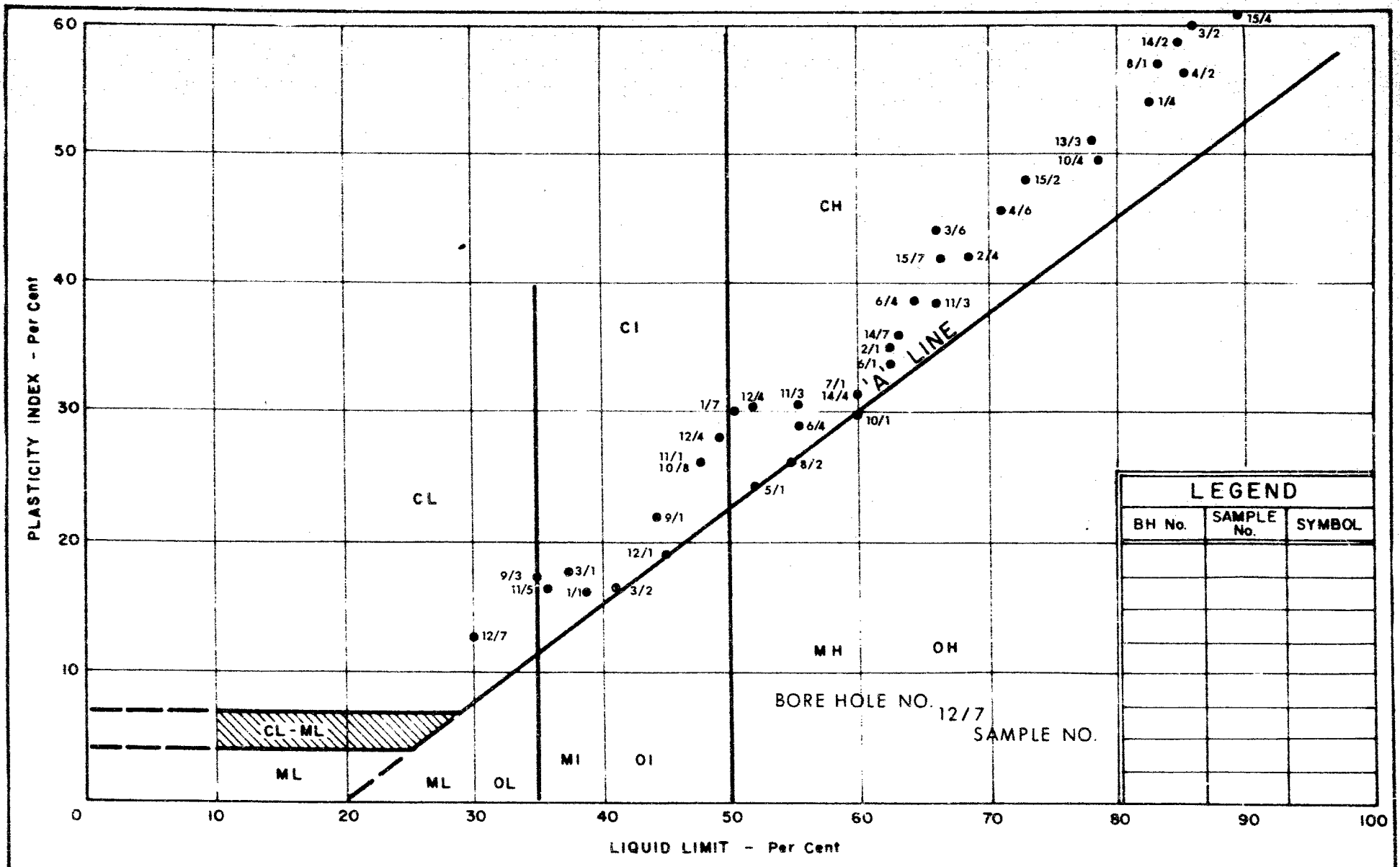
BULK DENSITY γ P.C.F.: 107

REMARKS: GR. SA. SI. CL.

▼ 673.7 Estimated

20
15 ⊹ 5 % STRAIN AT FAILURE
10

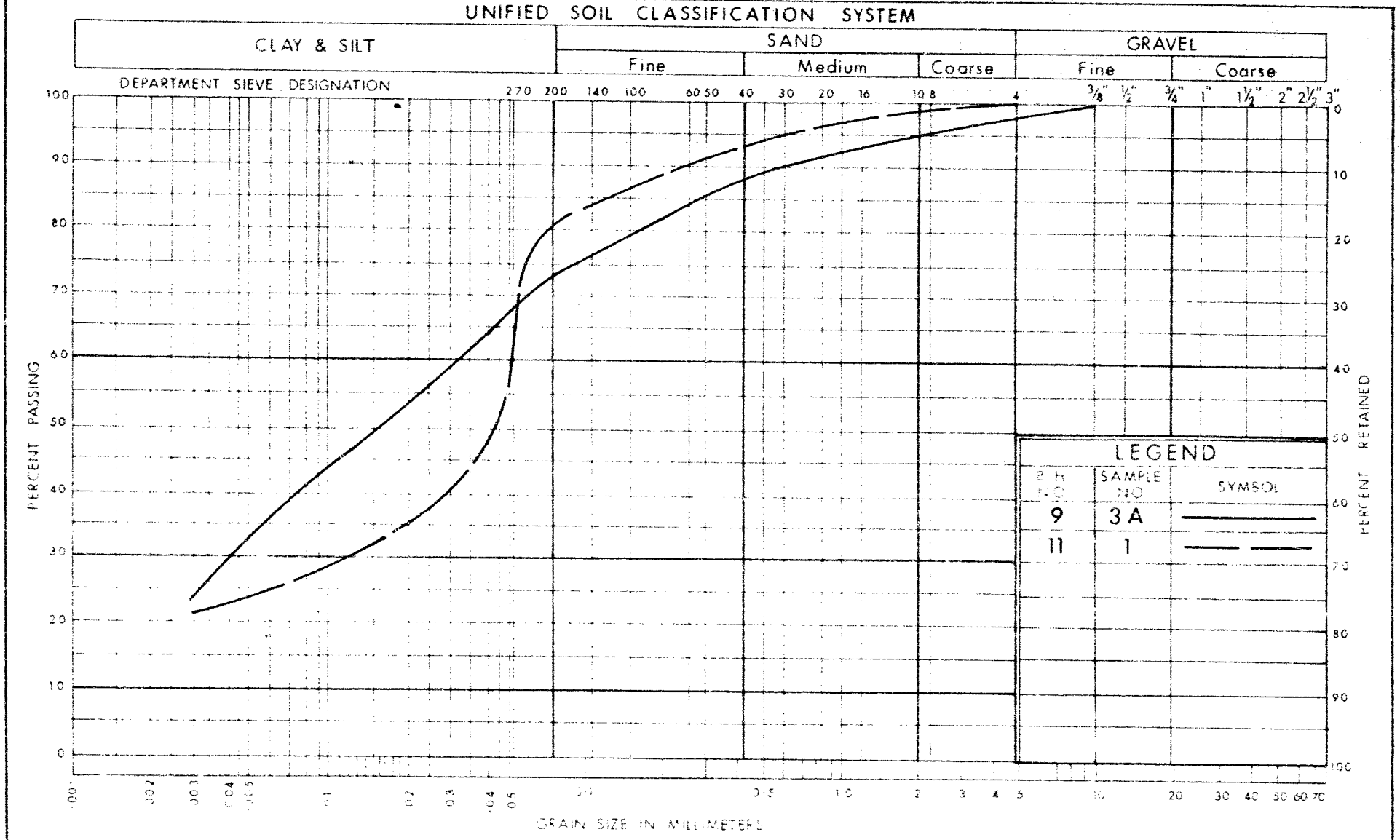
FORM OB-MT-252
REVISED JULY 1966



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

PLASTICITY CHART

W.P. No. 263-66-01
JOB No. 69-F-42
FIG. 1

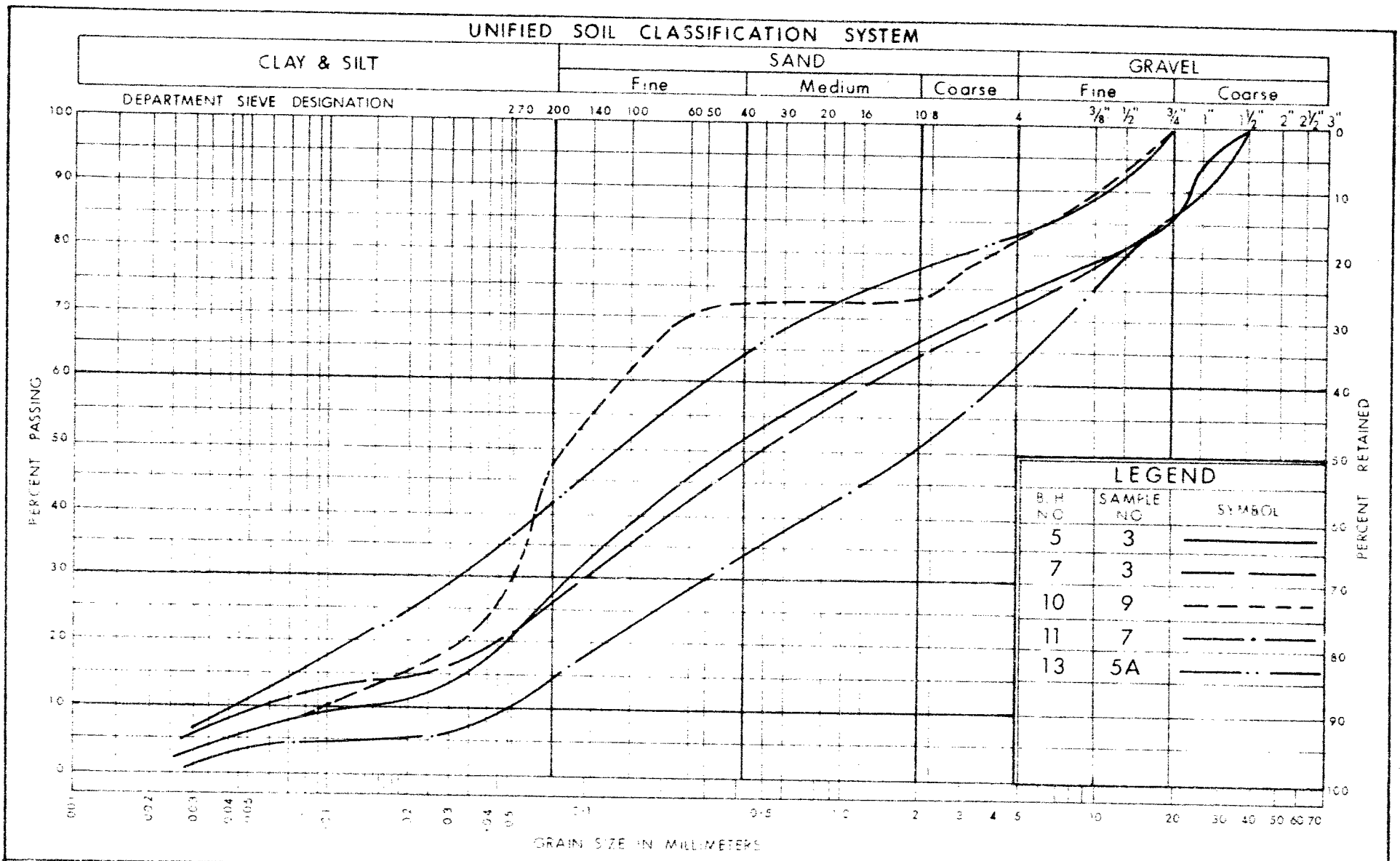


DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION
SANDY SILT

W.P. No.	263-66-01
JOB No.	69-F-42
	FIG. 2

REV. APR. 1965



DEPARTMENT OF HIGHWAYS
MATERIALS and TESTING DIVISION

GRAIN SIZE DISTRIBUTION

MIXTURE OF GRAVEL, SAND & SILT

WP No. 263-66-01

JOB No. 69-F-42

FIG. 3

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 :-

CONSISTENCY	'N' BLOWS/FT.	c LB./SQ. FT.	DENSENESS	'N' BLOWS/FT.
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

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
	IN TERMS OF EFFECTIVE STRESS $\tau_f = c' + \sigma' \tan \phi'$
c_u	APPARENT COHESION
ϕ_u	APPARENT ANGLE OF SHEARING RESISTANCE, OR FRICTION
	IN TERMS OF TOTAL STRESS $\tau_f = c_u + \sigma \tan \phi$
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
σ'	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 (YOUNGS MODULUS)
G	MODULUS OF SHEAR DEFORMATION
K	MODULUS OF COMPRESSIBILITY
η	COEFFICIENT OF VISCOSITY

EARTH PRESSURE

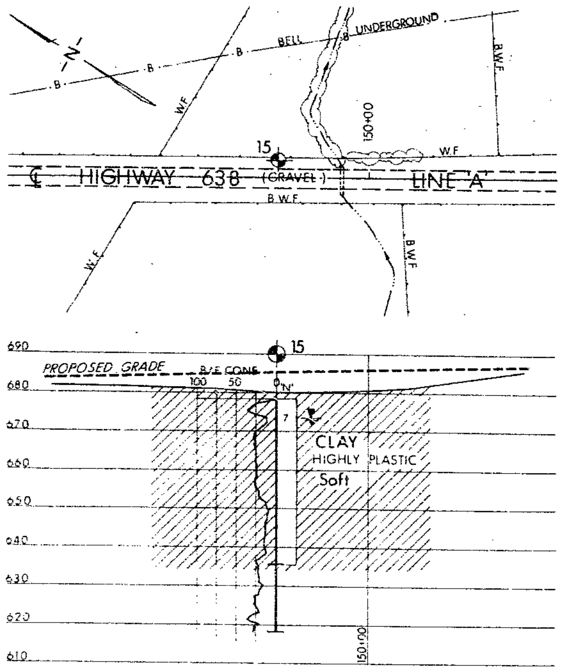
d	DISTANCE FROM TOP OF WALL TO POINT OF APPLICATION OF PRESSURE
δ	ANGLE OF WALL FRICTION
K	DIMENSIONLESS COEFFICIENT TO BE USED WITH VARIOUS SUFFIXES IN EXPRESSIONS REFERRING TO NORMAL STRESS ON WALLS
K_o	COEFFICIENT OF EARTH PRESSURE AT REST

FOUNDATIONS

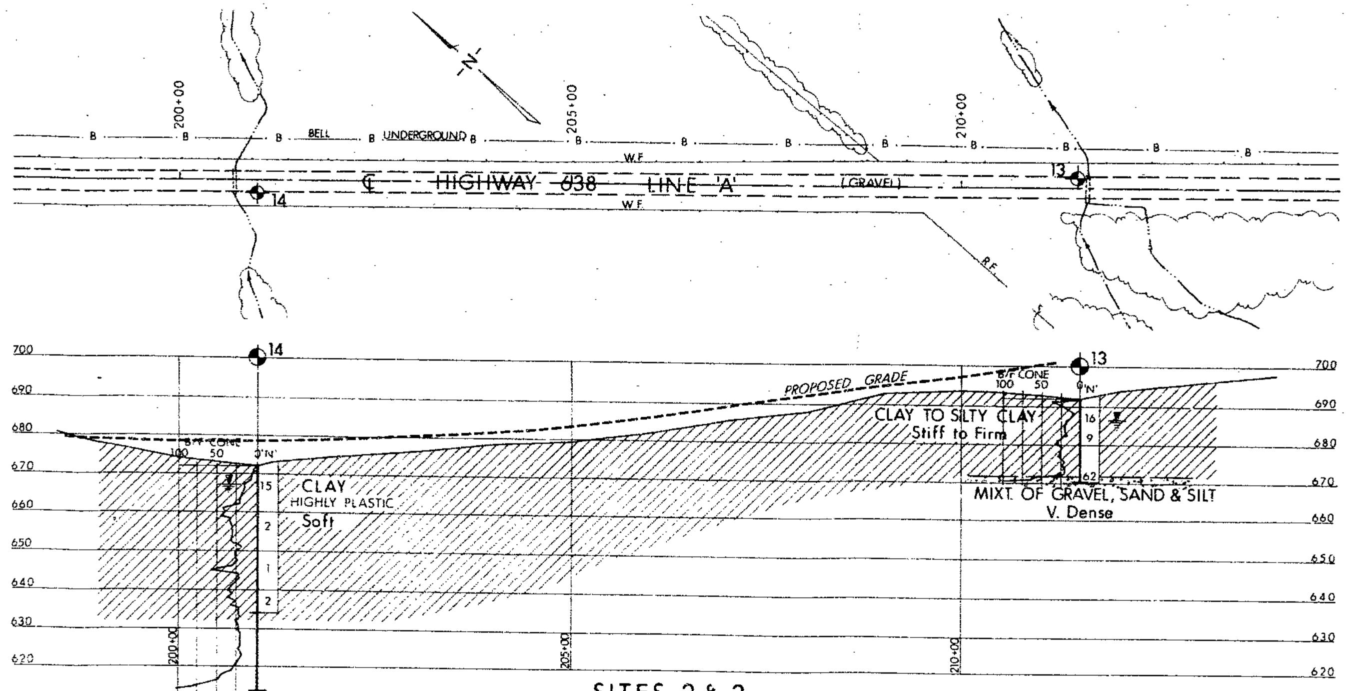
B	BREADTH OF FOUNDATION
L	LENGTH OF FOUNDATION
D	DEPTH OF FOUNDATION BENEATH GROUND
N	DIMENSIONLESS COEFFICIENT USED WITH A SUFFIX APPLYING TO SPECIFIC GRAVITY. DEPTH AND COHESION ETC. IN THE FORMULA FOR BEARING CAPACITY
k_s	MODULUS OF SUBGRADE REACTION

SLOPES

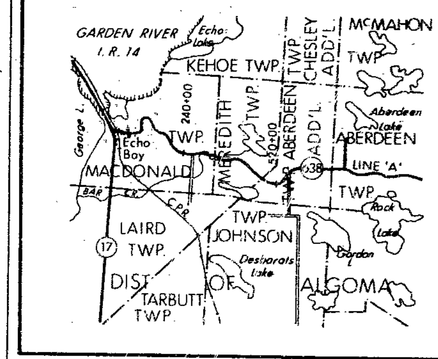
H	VERTICAL HEIGHT OF SLOPE
D	DEPTH BELOW TOE OF SLOPE TO HARD STRATUM
β	ANGLE OF SLOPE TO HORIZONTAL



SITE 1



SITES 2 & 3

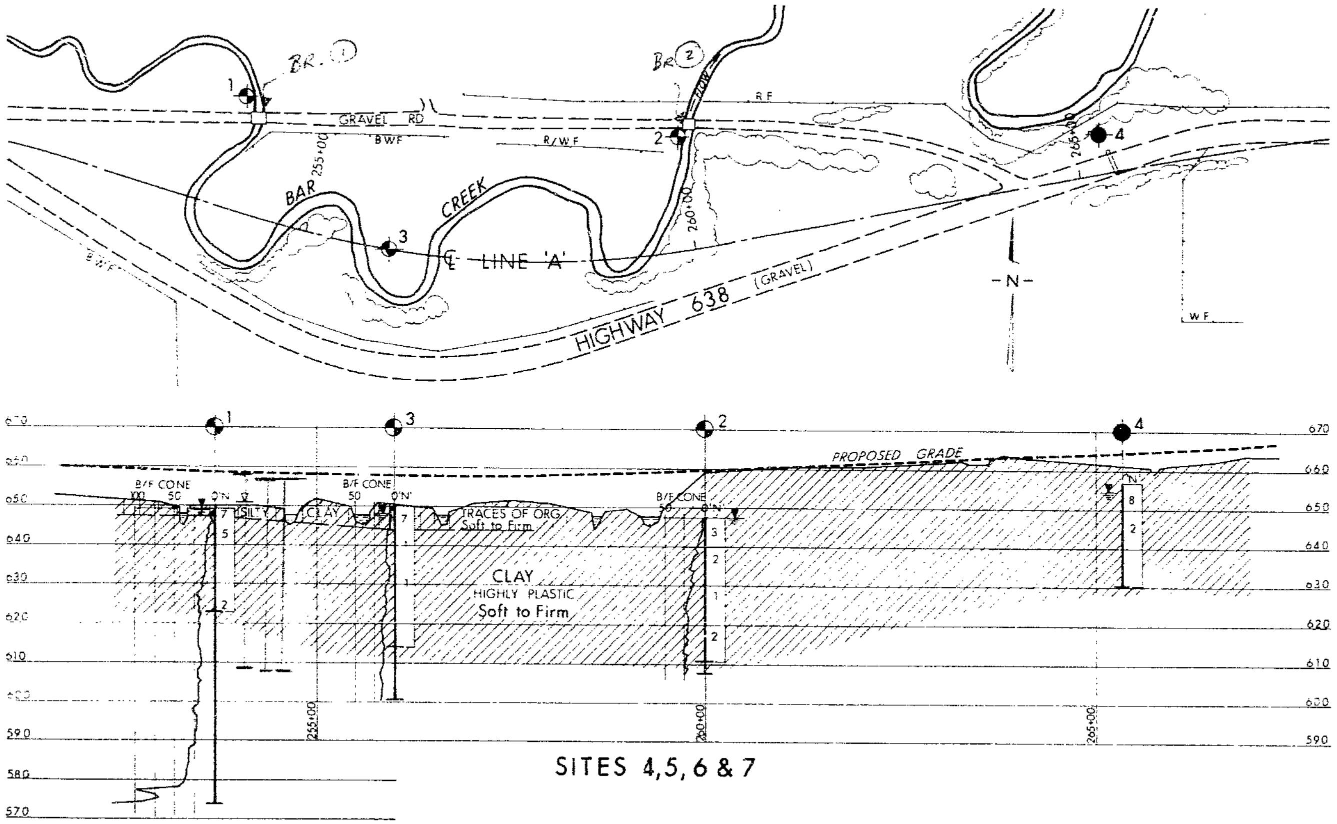


KEY PLAN
SCALE IN MILES
4 2 0 4 8 12

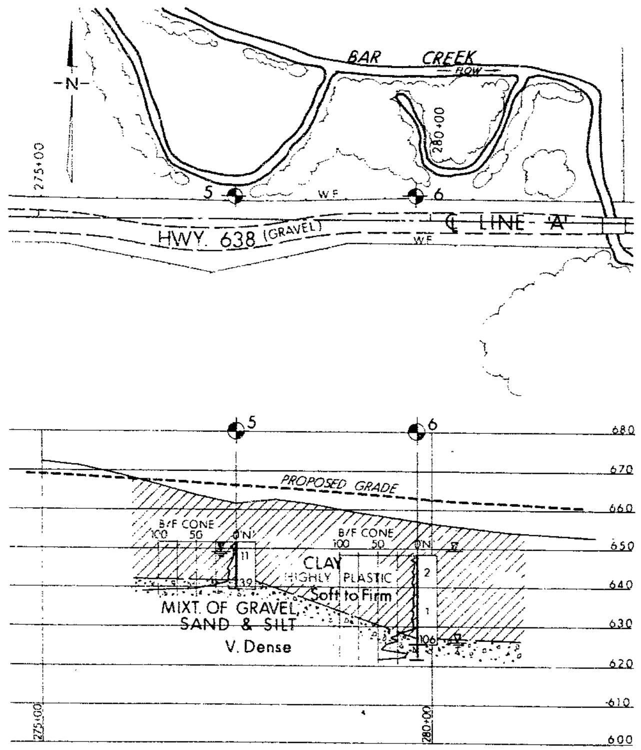
LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. JULY 1969
- Head / Encountered — ARTESIAN CONDITION

NO.	ELEVATION	STATION	OFFSET
1	649·5	253+70	145' LT
2	647·9	260+00	145' LT.
3	650·8	256+00	℄
4	657·3	265+35	50' LT.
5	651·3	277+50	30' LT
6	648·4	279+82	32' LT
7	713·4	358+00	℄
8	725·3	363+00	23' LT
9	750·4	384+35	20' RT
10	689·9	344+80	23' LT
11	663 9	337+15	℄
12	667·3	331+00	℄
13	691·7	211+50	12' LT
14	672·0	201+00	17' RT
15	678 7	148+83	24' LT.



SITES 4,5,6 & 7



SITES 8 & 9

SCALE
100 50 0 100 200 300 FT.

- 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

NT RECORD

FOR	DATE

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

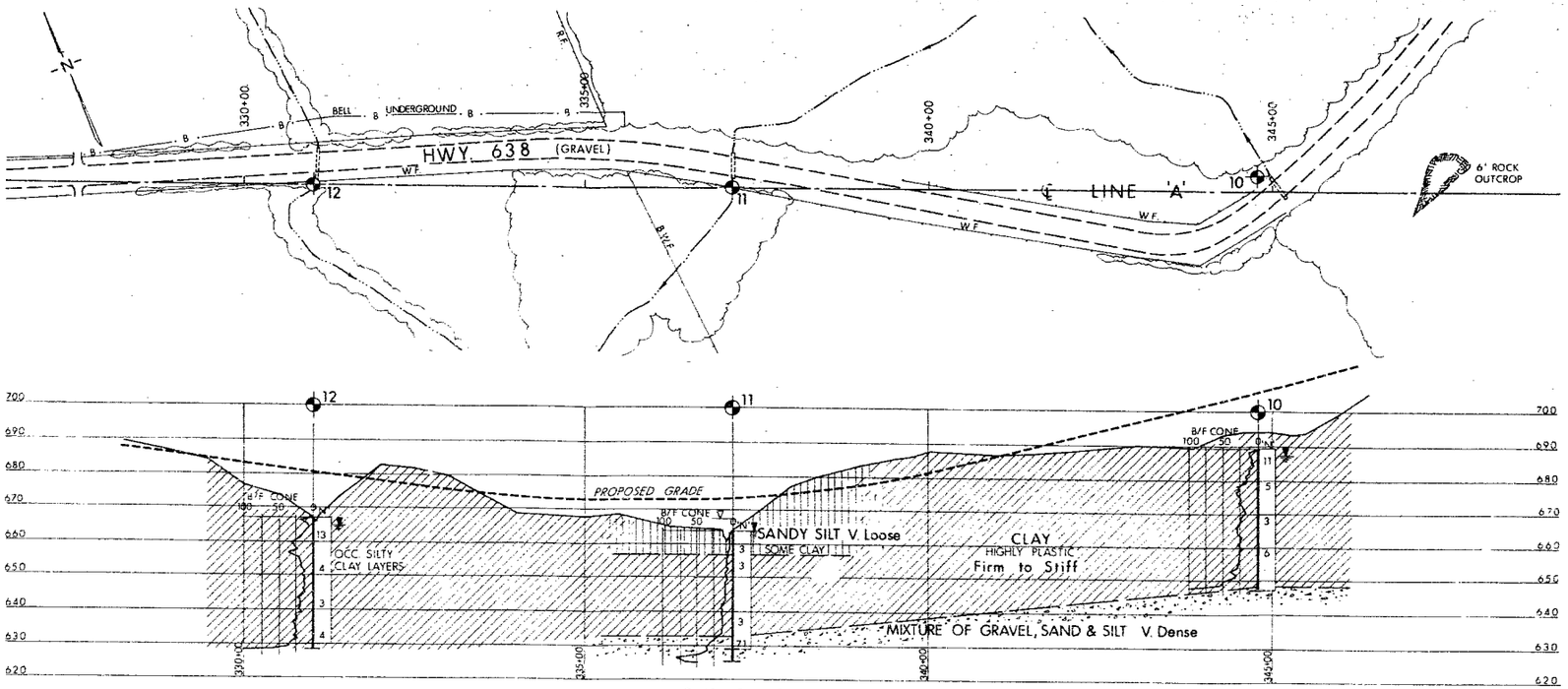
ECHO BAY EASTERLY
(SITES 1 TO 9)

KING'S HIGHWAY NO. 638 LINE 'A' DIST. NO. 18
~~CO.~~ DIST. OF ALGOMA
TWP. ______ LOT ______ CON. ______

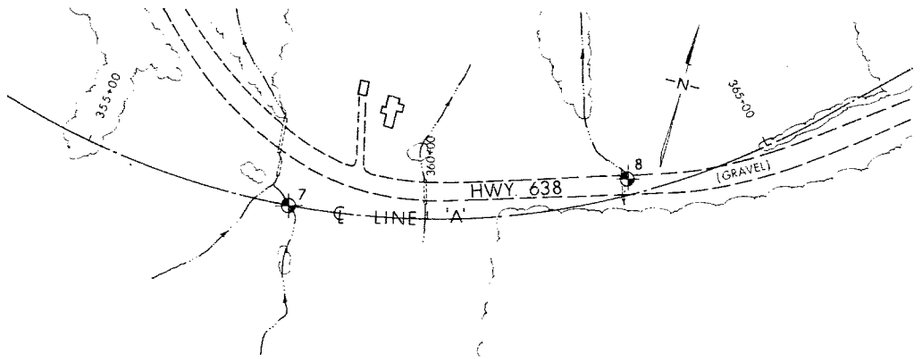
BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D. A P	CHECKED G.Q.	W.P. NO. 263-66-01	M.& T. DRAWING NO. 69-F-42 A
DRAWN S O	CHECKED [signature]	JOB NO. 69-F-42	
DATE 29 OCT. 1969		SITE NO	BRIDGE DRAWING NO.
APPROVED [signature] PRINCIPAL FOUNDATION ENGINEER		CONT. NO.	

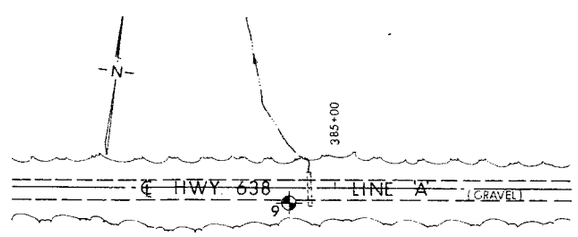
REF. NO. B-603-2 & B-1391-1



SITES 10, 11 & 12



SITES 13 & 14



SITE 15

SCALE
100 50 0 100 200 300 FT

REF NO B-1391-1

SEE DRAWING Nº 69-F-42A

KEY PLAN
SCALE IN MILES

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetration Hole
- Water Levels established at time of field investigation. JULY 1969
  - ▽ Head
  - ▽ Encountered — ARTESIAN CONDITION

NO.	ELEVATION	STATION	OFFSET

- 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 OFFICE - FOUNDATION SECTION

ECHO BAY EASTERLY
(SITES 10 TO 15)

KING'S HIGHWAY NO. 638 LINE 'A' DIST. NO. 18
~~CO.~~ DIST. OF ALGOMA
TWP. _____ LOT _____ CON. _____

BORE HOLE LOCATIONS & SOIL STRATA

SUBM'D A.P	CHECKED J.C.	W.P. NO. 263-66-01	M.B.T. DRAWING NO. 69-F-42B
DRAWN S.O	CHECKED	JOB NO. 69-F-42	
DATE 28 OCT 1969		SITE NO.	BRIDGE DRAWING NO.
APPROVED		CONT. NO.	

PRINT RECORD

	FOR	DATE

SUMMARY OF PILE DRIVING RECORDS

W.O. 69-11042 W.P. 263-66.01 CONT. 71-164 DIST. 18

SITE SYLVAN VALLEY BR. # 1 (ECHO BAY EASTERLY)

DATE DRIVEN OCT 4 - OCT 6/72 WEIGHT OF ANVIL 600 lb.

HAMMER TYPE DELMAG D-12 WEIGHT 1.37 T ENERGY 22 500

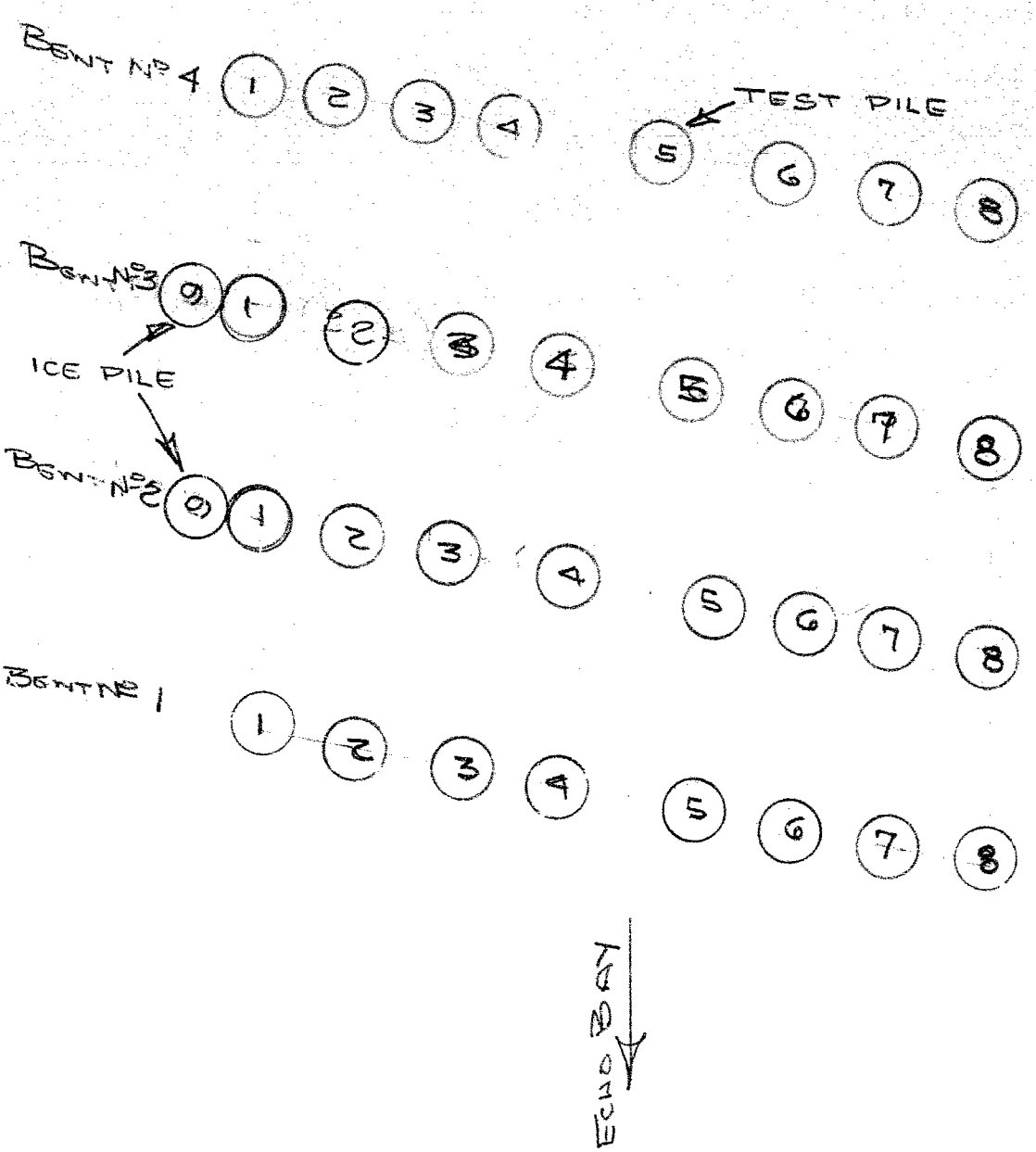
LOCATION OF PILES	PILE				ESTIMATED TIP EL. (ft.)	DIFFERENCE Longer(+) Shorter(-) Than Estimated (ft.)	REMARKS
	TYPE	NO.	LENGTH (ft.)	TIP EL. (ft.)			
BENT NO. 1	JACK PINE CREOSOTED 14"	3	49.2	608.48	607.5	-1.0	DRIVEN TO CLAY OVERBURDEN
BENT NO. 2	-"-	5	49.5	607.26	-"-	+.24	
BENT NO. 4	-"-	5	49.0	607.73	-"-	-.23	

69-F-42

W.P 263-66-06
BRIDGE #1
69-F-42

CONTRACT Nº 71-164

PILE LAYOUT FOR STRUCTURE Nº 1 - STA 254+12



BRIDGE OFFICE DOWNSVIEW OVER

WP 263-66-01
WO 69 F-42

Form OB-ML-285
300 Pads — 61-6025

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 18 CONTRACT NO. 71-164 STRUCTURE SITE No 385-116 STA 25+12

CONTRACTOR KERR, SUB MACLELLAN DESIGN LOAD OF PILE 13 TONS/PILE

HAMMER DETAILS: TYPE DELMAG D-12 WEIGHT 6802 HEIGHT OF FALL OR ENERGY 22,600

TYPE OF ANVIL OR CAP 16" SQUARE WEIGHT OF ANVIL OR CAP 600 LBS ±

PILE DETAILS JACK PINE CREOSOTED No 14

BENT No 1 HWY 638

PILE NO. 3 LOCATION 0.23 MI. EAST OF ECHO BAY EASTERLY 7.23 MI. DATE DRIVEN OCT. 6/72

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

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH 4 BLOWS IN THE	LAST	6"				
MEASURED REBOUND IN INCHES						

FINAL LENGTH OF PILE 49.2± FINAL CUT OFF ELEVATION 657.68

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

657.68
49.2
608.48

SIGNED D.R. Cameron
NAME (PRINT) D.R. CAMERON
DATE OCT. 6/72

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Notes:-

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

Piles driven vertically should be selected where possible.

Pile Details must include type, dimensions and weight per foot, details of shoe, and slope of batter: e.g. $12\frac{3}{4}$" O.D. steel tube x 0.251" @ 33 lbs. per ft. Vertical. $12\frac{3}{4}$" x $\frac{1}{2}$" steel plate shoe.

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

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

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

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

BRIDGE OFFICE DOWNSVIEW OVER

BRIDGE #1

WP 263-66-01

Form OB-ML-265
300 Pads — 61-6025

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

BRIDGE CONSTRUCTION - PILE DRIVING RECORD WO 69 F 42

DISTRICT NO. 18 CONTRACT NO. 71-164 STRUCTURE STR. No. 385116 STR. 254+12

CONTRACTOR KERR; SUB MACLELLAN DESIGN LOAD OF PILE 13 TONS/PILE

HAMMER DETAILS: TYPE DELMAG D-12 WEIGHT 6802 HEIGHT OF FALL OR ENERGY 22,600

TYPE OF ANVIL OR CAP 16" SQUARE WEIGHT OF ANVIL OR CAP 600 LBS. ±

PILE DETAILS JACK PINE CREOSOTED No 14

BENT No 2 HWY 638 7.23 MI.

PILE NO. 5 LOCATION 0.23 mi. EAST OF ECHOBAN EASTERLY DATE DRIVEN OCT. 5/72

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS/FT.
50'	1	DRIVEN WITH DIESEL HAMMER		26	1		51			76	
	2			27	1		52			77	
	3			28	1		53			78	
	4			29	1		54			79	
	5			30	1		55			80	
	6			31	1.5		56			81	
	7			32	1.5		57			82	
	8			33	1.5		58			83	
	9			34	1.5		59			84	
	10			35	1.5		60			85	
	11			36	1.5		61			86	
	12			37	1.5		62			87	
	13			38	2.0		63			88	
	14			39	3.0		64			89	
	15			40	4.0		65			90	
	16			41	5.0		66			91	
	17			42	5.0		67			92	
	18			43			68			93	
	19	1		44			69			94	
	20	1		45			70			95	
	21	1		46			71			96	
	22	1		47			72			97	
	23	1		48			73			98	
	24	1		49			74			99	
	25	1		50			75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH 3 BLOWS IN THE LAST SIX INCHES						
MEASURED REBOUND IN INCHES						

FINAL LENGTH OF PILE 49.5 FINAL CUT OFF ELEVATION 656.76

656.76
49.5
607.26

REPORT TO BE SENT TO:- PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED D.R. Cameron
NAME (PRINT) D.R. CAMERON
DATE OCT. 5/72

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Notes:-

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

Piles driven vertically should be selected where possible.

Pile Details must include type, dimensions and weight per foot, details of shoe, and slope of batter: e.g. $12\frac{3}{4}$" O.D. steel tube x 0.251" @ 33 lbs. per ft. Vertical. $12\frac{3}{4}$" x $\frac{1}{2}$" steel plate shoe.

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

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

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

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

BRIDGE OFFICE
DOWNSUIGN

Form OB-ML-285
300 Pads — 61-6025

OVER

DEPARTMENT OF HIGHWAYS - ONTARIO
MATERIALS & RESEARCH DIVISION
FOUNDATION SECTION

W.P. 263-66-01
W.O. 69-F-42

BRIDGE CONSTRUCTION - PILE DRIVING RECORD

DISTRICT NO. 18 CONTRACT NO. T1-164 STRUCTURE SITE No 385-116 Sta 254+12

CONTRACTOR KERR SUB-MACLELLAN DESIGN LOAD OF PILE 13 TONS / PILE

HAMMER DETAILS: TYPE DELMAG D-12 WEIGHT 6802 HEIGHT OF FALL OR ENERGY 22,600

TYPE OF ANVIL OR CAP 16" SQUARE WEIGHT OF ANVIL OR CAP 600 LBS ±

PILE DETAILS JACK PINE CREOSOTED No 14

BENT No 4 HWY 638

PILE NO. 5 LOCATION 0.23 EAST OF ECHO BAY E'STERLY 7.23 MIS DATE EN OCT. 4/72

TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENGTH BEING DRIVEN	LENGTH IN GROUND	PENETRATION BLOWS / FT.	TOTAL LENG BEING DRIVE	LENGTH IN GROUND	PENETRATION BLOWS / FT.
50'	1	-		26	5½		51			76	
	2	2		27	5		52			77	
	3	3		28	6		53			78	
	4	3		29	6		54			79	
	5	3		30	6		55			80	
	6	3		31	6		56			81	
	7	2		32	6		57			82	
	8	2		33	7		58			83	
	9	3		34	7		59			84	
	10	4		35	7		60			85	
	11	4		36	7		61			86	
	12	4		37	7		62			87	
	13	4		38	9		63			88	
	14	4		39	8		64			89	
	15	4		40	9		65			90	
	16	4		41	10		66			91	
	17	4		42	10		67			92	
	18	4		43	10		68			93	
	19	4		44	11		69			94	
	20	5		45	15		70			95	
	21	5		46	15		71			96	
	22	5		47	16		72			97	
	23	5		48	16		73			98	
	24	6		49			74			99	
	25	6		50			75			100	

DETAILS FOR FINAL SIX INCHES OF PENETRATION	1	2	3	4	5	6
BLOWS PER INCH 8 BLOWS IN	FINAL	6	INCHES			
MEASURED REBOUND IN INCHES						
FINAL LENGTH OF PILE 49'	FINAL CUT OFF ELEVATION 656.73					

656.73
49.00
607.73

REPORT TO BE SENT TO: - PRINCIPAL FOUNDATION ENGINEER
MATERIALS & RESEARCH DIVISION
DEPARTMENT OF HIGHWAYS
PARLIAMENT BUILDINGS
TORONTO, ONTARIO

SIGNED O.R. Cameron
NAME (PRINT) D.R. CAMERON
DATE OCT. 4/72

ATTACH SKETCH OF PILE NUMBERING SYSTEM

Notes:-

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

Piles driven vertically should be selected where possible.

Pile Details must include type, dimensions and weight per foot, details of shoe, and slope of batter: e.g. $12\frac{3}{4}$" O.D. steel tube x 0.251" @ 33 lbs. per ft. Vertical. $12\frac{3}{4}$" x $\frac{1}{2}$" steel plate shoe.

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

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

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

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

68-F-77
69-F-42

1970 MAY 29 AM 9:36

D
TBAR DOWN 2 MAY 29/70 955A VR

S B DAVIDSON RGN BRIDGE PLANNING ENGR

COPIES TOO B DAVIS BRIDGE OFF

S MCCOMBIE BRIDGE OFF

RE WP263-66-06-BRIDGE NUMBER 1

WP263-66-05-BRIDGE NUMBER 2

WP263-66-02-BRIDGE NUMBER 3

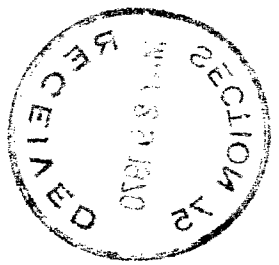
FOR ABOVE STRUCTURES RECOMMENDED DESIGN LOADS FOR TREATED TIMBER PILES ARE AS FOLLOWS.

BRIDGE NUMBER 1 AND BRIDGE NUMBER 2 ONE TON PER 3.0 FEET OF PENETRATION INTO ORIGINAL GROUND.

BRIDGE NUMBER 3 ONE TON PER 3.75 FEET OF PENETRATION INTO ORIGINAL GROUND. NOTE ALL SOFT ORGANIC SOIL MUST BE REMOVED AND REPLACED WITH SUITABLE GRANULAR FILL PRIOR TO DRIVING PILES.

K G SELBY SUPVR FOUND ENGR FOR A G STERMAC MAT AND TEST SECT

BB



TELETYPE TELETYPE TELETYPE TELETYPE TELETYPE

Department of Highways Ontario
Copy for the information of

Foundation Office

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

C.S. Grebski,
Bridge Office

March 30, 1971

69-F-42
68-F-77

W.P. 263-66-06 - Sylvan Valley Bridge #1
W.P. 263-66-05 - Sylvan Valley Bridge #2
W.P. 263-66-02 - Sylvan Valley Bridge #3
Highway 638, District No. 18

Attached herewith we are submitting the final bridge drawings which show the foundation design for these structures.

Kindly give us your comments at your earliest convenience.

C.S. Grebski,
Bridge Design Engineer

CSG:rd

Attach.

c.c. Foundation Office

COMMENTS:

Note for pile driving should read: "No. 14 creosoted timber piles driven to tip el. -- "

(Bridge #1 Tip El. 607.5)
(Bridge #2 Tip El. 608.0)
(Bridge #3 Tip El. 593.0)

Mention of design load might imply use of Hiley Formula which is not valid at this site.

K. G. Selby,
Supervising Foundation Engr.

April 15, 1971

K. G. Selby

cc. A. Radlowski
C. Grebski
Fdn. Report. ✓

3 June 71

69-11042

Mr. H. W. Hurrell,
Regional Road Design Superintendent,
Northwestern Region.

Materials and Testing,
Northwestern Region.

Mr. C. M. Smith,
Office Project Design Engineer.

March 4, 1971.

Work Project 263-66-01
Echo Bay Easterly, Highway 638

As discussed with you on March 4, 1971, this Section agrees to a 1-foot grade raise in the vicinity of Station 345+00 in order to better balance rock cut quantities. However, it is mandatory, in keeping with the Foundation results and recommendations for Site #12, that the total allowable vertical fill height at 21:0 feet not be exceeded.

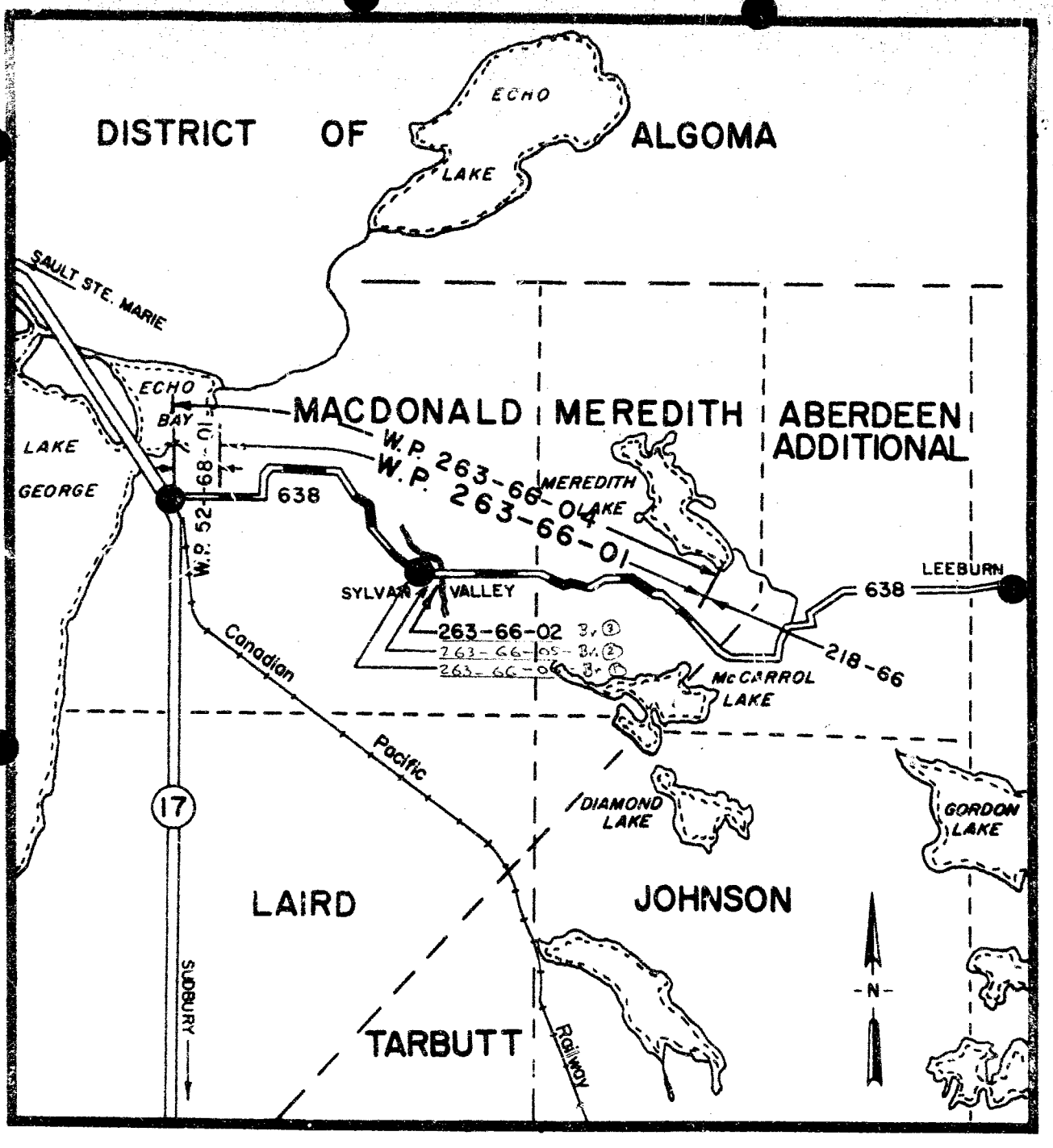
If you require any further information, please contact this office.

R. D. GUNTER,
Senior Soils Supervisor.

FOR:
R. Morgenroth,
REGIONAL MATERIALS ENGINEER.

RDG/mcw

c. c. Messrs. K. Selby,
R. G. Gascoyne.



Plan to accompany Design Criteria for W.P. 263-66-01

Scale 1" = 2 Miles

DEPARTMENT TRANSPORTATION AND COMMUNICATIONS

MEMORANDUM

41K - 3
GEOCRES No.

To: Mr. T. A. Hickey,
Construction Engineer,
Sault Ste. Marie.

From: Materials and Testing,
Northwestern Region.

Attention:

Date: July 28, 1972.

Our File Ref.

In reply to

Subject: Echo Lake Road, Contract 71-164,
Highway 638, from Echo Bay Easterly

The Echo Lake Side Road at Station 81+50 left has a side slope terminating on a muskeg and clay deposit. The soil conditions are the same as those encountered at Centerline on Highway 638 between Station 59+00 and Station 70+00. The subsoil consists of a shallow muskeg (12"±) overlying a deep deposit of very soft clay. The 2:1 side slope on the Echo Lake Road is inadequate to ensure a stable roadway.

On July 25, 1972, a small slip circle failure originating in the fill slope and extending into the underlying muskeg resulted in a three foot high mudwave at the toe of the slope. Considering the total 18 foot height of the fill at Station 1+00, the possibility exists of a deep seated failure resulting in complete failure of the roadway, for this reason the area must be treated.

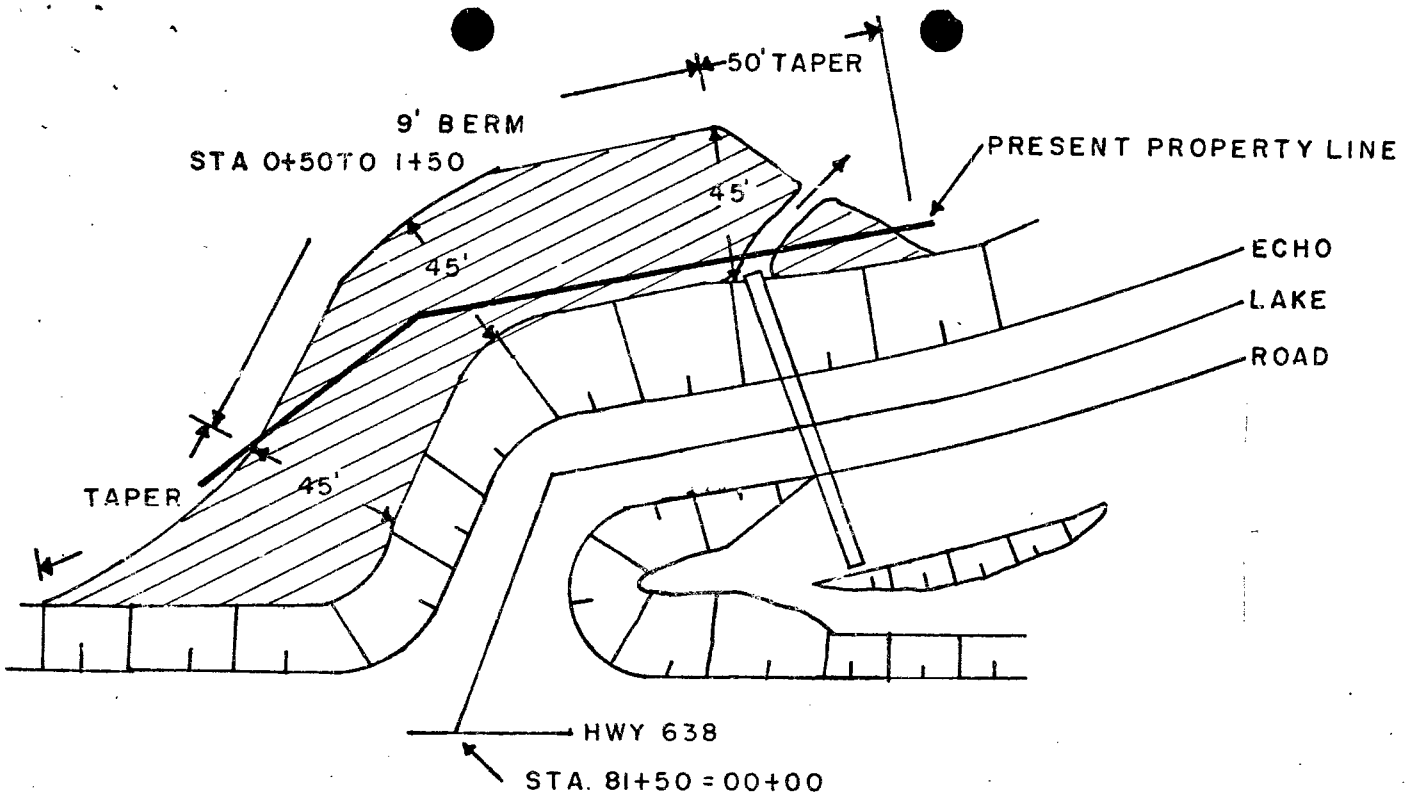
A realignment of the side road entrance onto Highway 638 was considered but because of the existing substandard 25 foot radius at the intersection and property restrictions on the right side of the road, it is unlikely that this course of action would be successful.

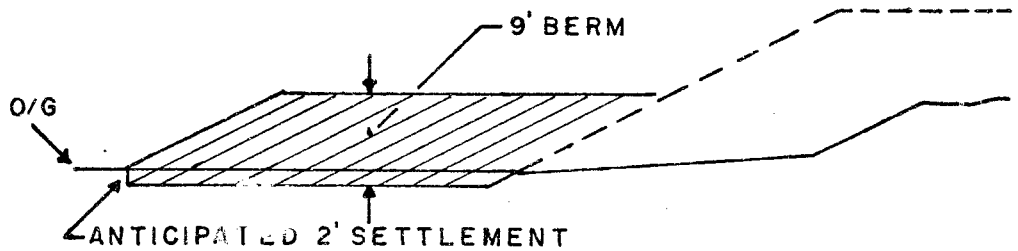
It is recommended that the property adjacent to the left fill on the Echo Lake Road be acquired to a sufficient distance to allow for the construction of a stabilizing berm. The berm should be 45 feet wide and have a total depth of 9 feet over the existing ground. It is anticipated that some settlement will occur, however, the total berm height over the muskeg should not exceed 9 feet. The area to be treated and a typical section are shown on the attached sketch.

Bruce Adamson

RBA/mcf
Attach.
c.c. -
Mr. M. Devata,
Mr. F. Fancy,
Mr. L. Burley,
Mr. A. Rutka,
Mr. G. Wrong,
Mr. G. Jordan,
Mr. W. Ferguson.

R. B. Adamson,
Project Soils Engineer,
for:
R. Morgenroth,
Regional Materials Engineer.





TYPICAL CROSS-SECTION
STA. 1+00

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. H. McArthur (2)
Reg. Rd. Des. Eng.
Northern Region

From: Materials & Testing
Northern Region

Date: September 17, 1968

Our File Ref.

In reply to

Subject:

W.P. 263-66-01, Hwy. #638
0.8 Miles E. of Echo Bay
E'ly 7.1 miles
G.D. & G.B.
District 18

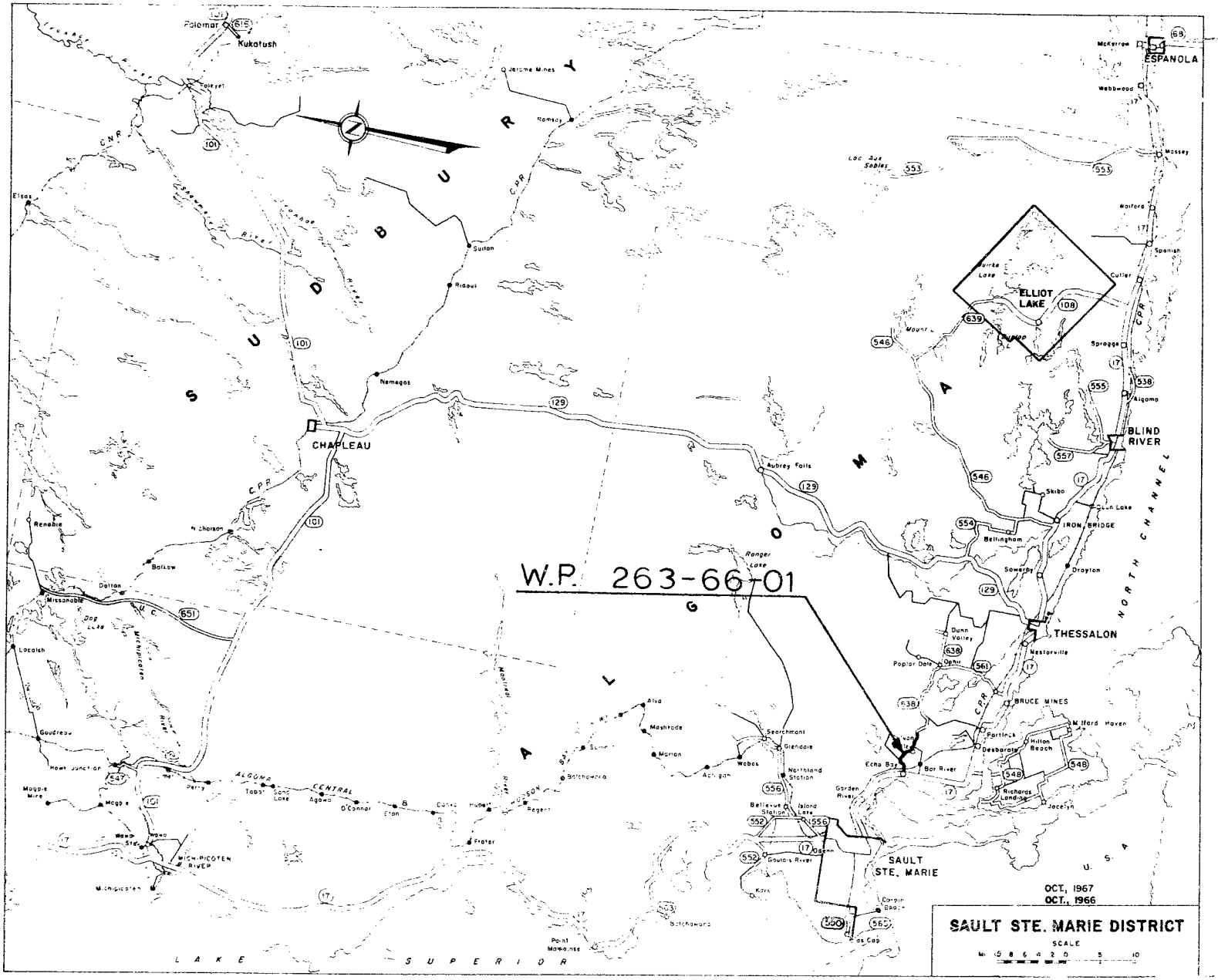
Attached hereto is the Soils Design Report for the above noted work project. Prints of Soils Profile 638N18-1 are also being forwarded for your use.

The soils encountered on this project vary from a gravelly material to a soft clay with some bedrock. The soft clay areas will require special consideration and can be a problem if not properly handled.

Granular materials suitable for all granular requirements can be obtained within the limits of the project. An additional source of sand cushion is located in the Garden River area, to the west of the project.

E.R. Saint
Regional Materials Engineer

ERS/ef
c.c. D. Farren
H.A. Tregaskes
T.C. Muir
W. Wigle
J. Blevins (2)
F. Devisser
M. Stoyanoff
H. Mantle
C. Fraser
Z. Katona
A. Stermac
G.J. Ricker
G.A. Wrong (2)
File


W.P. 263-66-01
SAULT STE. MARIE DISTRICT
SCALE
OCT., 1967
OCT., 1966
SUDBURY
ALGOMA
CHAPLEAU
ELLIOT LAKE
BLIND RIVER
THESSALON
BRUCE MINES
IRON BRIDGE
SAULT STE. MARIE
ESPANOLA
NORTH CHANNEL
LAKE SUPERIOR
U.S.A.
C.N.R.
C.P.R.
ALGOMA CENTRAL

INDEX

Soils Profile No. 638N18-1 accompanies this report.

SOILS DESIGN REPORT

Hwy. #638 7.1 Miles

0.8 Miles East of Hwy. #17 at Echo Bay Easterly

W.P. 263-66-01

Grading, Drainage & Granular Base

District No. 18 Sault Ste. Marie

Plan	Profile	Soils Profile	Township	Line	Station	to Station
B-603-2	C-603-3	638N18-1	MacDonald	A	41+00	240+00
B-1391-1	C-1391-1	638N18-1	MacDonald	A	240+00	321+50
B-1391-1	C-1391-1	638N18-1	Meredith	A	321+50	417+00

GENERAL DATA

This project is located in the above noted townships in the District of Algoma. The west limit of the project is approximately 0.8 miles east of the intersection of Hwy. #17 and 638 at Echo Bay. The east limit of the project is 7.1 miles east of the above point at Station 417+00. This coincides with the west limit of W.P. 218-66.

The new alignment coincides closely with the old for the majority of the project, except where revisions have been employed to improve the existing sub-standard alignment.

There is one creek crossing at Bar Creek. Initially a multi plate pipe arch culvert was proposed for this crossing. However, due to the saturated clay at this site, excessive settlement and unstable fills may be a problem. An alternate proposal is to construct a small structure at this location. At the time of this report, a report

has not been received from the Foundation Section. This structure is scheduled under W.P. 263-66-02.

DESIGN CRITERIA

The Design Criteria issued September 26, 1967 is summarized as follows:

Highway Class No.	50 R.L.
Minimum Stopping Sight Distance	325 feet
Equivalent Vertical Curve	500 feet
Grades Maximum	8 per cent
Curvature Maximum	7 degrees
Pavement Width	20 feet
Shoulder Width	4 feet
Shoulder Rounding	2 feet
Right of Way Width	100 feet

INVESTIGATION

A soils investigation was carried out in July 1968 using both hand and power equipment. Holes were augered at maximum intervals of 200 feet and to a depth of 4 feet below grade unless stopped by boulders or bedrock.

Due to the large number of boulders, at or near the surface in some of the cuts, a sesmic survey was carried out to determine the approximate location of the underlying bedrock.

Also a detailed performance survey was carried out over the existing mulched section of the project in April 1968.

PERFORMANCE

The present highway consists of a twenty foot mulch section for the first 1.6 miles of the project with the remainder being a gravel surface. The shoulders vary in width from four to six feet.

The existing pavement structure is in fair condition except for a few areas which are distorted, cracked, and rough. These areas of deficient performance are predominant in the cut area east of town from Station 96+00 to Station 120+00.

PHYSIOGRAPHY AND SOILS DATA

This project is located in the area of the Canadian Shield within the sub-province known as the North Shore Sudbury Ridges and Pockets. The bedrock underlying the project belongs to the Cobalt Group of the Huronian time. The rock consists of metamorphosed sediments mainly arkose, quartzite and siltstone. Some Post Huronian rock is also present in the form of diabase. The area is overlain by lacustrine deposits consisting of sandy loams, clay loams and medium to heavy clays. These lacustrine deposits were laid down during the Algonquin and Post Algonquin stages of the Great Lakes.

A well developed beach deposit is a preominant feature in the area from Station 80+00± to Station 120+00±. This deposit is a section of the Great Lakes Shore escarpment.

EARTH BORROW AND GRANULAR MATERIALS

Suitable granular borrow material can be obtained adjacent to the project right-of-way in the large beach deposit. Borrow pits have already been developed in this area.

Granular material suitable for the production of G.B.C. Class "A" may be located in a pit already developed approximately 500 feet left of Station 115+00±. Sand cushion can be obtained in pits developed west of Echo Bay in the Garden River area. The cut from Station 104+00 to 124+00 contains material which would be suitable for sand cushion, provided the over sized boulders are removed.

GRADELINE

The gradeline as indicated on the profile by Functional Planning appears generally satisfactory from a soils point of view. However, a few grade revisions have been suggested on the soils profile for the following reasons:

Between Stations 88±00 and 110±00, 117±00 and 129±00, 142±00 and 159±00, 200±00 and 216±00, 310±00 and 325±00, 374±00 and 388±00, grade raises have been indicated to provide a sufficient depth of granular material over the subgrade, which has been contaminated with a clay loam topsoil. Also these proposed grade raises will eliminate a number of minor scratch cuts.

Between Station 325±00 and 344±00 the grade has been

lowered to avoid the possibility of instability problems that may result from the high fills presently proposed in this region.

RECOMMENDATIONS

Contract Type

1) It is recommended that this project be called a sand cushion and G.B.C. Class "A" contract employing full width granular construction.

Granular Depths

2) The following granular depths are recommended over the various subgrade soils:

a) In cuts and fills of fine to medium, medium, and coarse sand and gravel, provide for six inches of granular materials.

b) In cuts and fills of loamy gravel and cobbly gravel, provide for twelve inches of granular materials.

c) In cuts of sandy loam provide for eighteen inches of granular materials. In fills constructed of the above material, provide for twelve inches of granular materials.

d) In cuts of clay loam provide for twenty-four inches of granular materials. In fills constructed of the above material, provide for eighteen inches of granular materials.

e) In cuts of medium to heavy and heavy clay, provide for thirty inches of granular material. In fills

constructed of the above materials, provide for twenty-four inches of granular materials.

f) The above mentioned depths are to consist of six inches of G.B.C. Class "A" and the remainder sand cushion.

3) The following depths of granular materials should be employed in fills over the existing road:

a) Fills nine inches or less, all G.B.C. Class "A".

b) Fills greater than nine inches, and less than thirty inches, six inches of G.B.C. Class "A" and the remainder sand cushion.

c) Fills greater than thirty inches, provide for six inches G.B.C. Class "A" and sand cushion depths, as outlined in recommendation (2), depending upon the type of earth fill used.

4) In areas of roadbed widening, due to a granular lift over the existing road surface, the following granular depths are recommended:

a) The depth of G.B.C. Class "A" placed on any road widening should equal that placed over the existing road, but must be a minimum of six inches.

b) The total depth of granular materials placed on any road widening should equal that placed over the existing road, but must be a minimum depth as outlined in recommendation (2).

Grade Points and Transition Zones

5) All grade points and transition zones should be

treated as per the appropriate standard to a depth "d" equal to four feet. It is recommended that the value of "t" noted in the standards be taken as twenty-four inches in clay materials and eighteen inches in granular materials. The excavation should be properly tapered and drained from the low point.

Topsoil

6) All topsoil should be removed where the fill height is less than four feet. Also, it is recommended that all the topsoil should be stripped from the shoulder slopes under fills over the existing road. For estimating purposes assume a depth for topsoil of six inches.

On some sections within the existing road the topsoil was not completely stripped prior to granular placement. If any topsoil is exposed during an excavation it should be removed to a maximum depth of thirty-six inches and backfilled with granular material.

Culverts

7) Existing foundation conditions over the lacustrine clays require the use of flexible type culverts.

8) All culvert backfill should meet sand cushion requirements.

Compaction

9) The majority of the earth fill on this job will consist of a granular type material obtained from the large cut between Station 104+00 and Station 114+00.

However, some clay type material may also be used. Thus for compaction purposes, assume that a pneumatic tired wobble wheel roller will be required sixty-five per cent of the time and a sheepsfoot roller thirty-five per cent of the time.

10) Due to the bouldery nature of the material in the cuts from Station 96+00 to Station 116+00, it will be necessary to employ the modified layer compaction method in fills constructed of this material. It is recommended that an eighteen inch layer be used to place this type of material.

Treatment of Soft Clay Deposits

11) In the area from Station 58±50 to Station 68±50 a very soft clay was encountered. Vane tests taken at the time of the soils investigation indicate that this material should be capable of supporting the proposed fill without a lateral failure. However, it is anticipated that differential settlement will occur in this area. Thus it is recommended that this fill be constructed prior to others so that as much settlement as possible may occur during the duration of the contract. Also the fill slopes in this area should be 3:1.

Treatment of Swamps

12) A soft amphorous muck deposit was encountered between Station 333+00 and Station 335+00. In this area a maximum depth of 4½ feet of muck is deposited over a stiff heavy clay. It is recommended that this organic material be

excavated as per Standard DD-406. Either rock or a granular material should be used for backfill in this area.

Protection from Effects of Stream Erosion

13) In the areas from Station 277+00 to 277+75 and Station 280+00 to 280+60 the proposed centreline is within forty feet of Bar Creek. The fill slopes in these areas should be protected against eventual erosion by either random rip-rap or a granular mat, placed to 2 feet above the high water level.

Intersection Treatment

14) Where excavations are being carried out at sideroad intersections, the excavation should extend along the sideroad at a 20:1 slope to minimize differential heaving.

September 12, 1968

prepared by: G.J. Ricker
Proj. Soils Eng.
reviewed by: A. Wittenberg
Sr. Soils Eng.

69-F-42
KGS-AP

DEPARTMENT OF HIGHWAYS ONTARIO

MEMORANDUM

To: Mr. A. Stermac,
Principal Foundations Engineer,
DOWNSVIEW.

From: R. D. Gunter,
Materials and Testing,
PORT ARTHUR.

Att'n: Mr. K. G. Selby
Foundation Engineer

Date: May 6, 1969.

Our File Ref.

In reply to

Subject:

W.P. 263-66-01, 0.8 Miles East of
Echo Bay Easterly, Highway 638

As discussed with Mr. A. Stermac and yourself, I feel that a foundation investigation should be carried out on the proposed diversion of Barr Creek, Station 252 to Station 261, Line "A". I have discussed the proposed alignment with the Functional Planning Branch and with the Regional Bridge Locations Engineer and three proposals have been put forward.

1. Stay with proposed Line "A" and divert Barr Creek as planned. Investigation will prove if extensive embankment stabilization is required in this area.

2. Stay on the existing road and move the house at Station 249+75. This will require a reverse curve situation and an estimated $10,000 building move.

3. Use the old tangent right-of-way which involves crossing Barr Creek in two (2) locations and removal of the Orange Hall, Station 249. Dependent on the proposed fill height, stabilization treatment may be required in this area also. Diverting Barr Creek to the north of the present house could also be considered but this would depend on the topography and the cost of the property involved.

Information obtained during the foundation investigation at Barr Creek, Station 282+30 indicated that the subsoil in the general area of Sylvan Valley consists of a soft sensitive clay and that fills over 10 feet in height would be unstable if not treated. With this information in mind, the following route borings at proposed culvert sites are requested:

Mr. A. Stermac May 6, 1969

(i) Station 211+70

(ii) Station 331+00

(iii) Station 337+10

(iv) Station 345+00 - Left of centre-line

(v) Station 358+00

(vi) Station 384+60 - Left of centre-line

Should you require further information in connection with the above, please do not hesitate to contact the writer.

R. D. GUNTER,
Project Soils Supervisor,

FOR:
F. NORMAN,
REGIONAL MATERIALS ENGINEER.

rdg/mh

c.c.: Messrs. G. Wrong
A. Stermac
J. Blevins
B. Davidson
H. A. Mantle

FIELD RECONNAISSANCE REPORT
REQUIRED BY FOUNDATION SECTION
FOR

FF-69
SEPT. 1968

Line "A"

W.P. NO. 263-66-01 HIGHWAY NO. 638 DISTRICT 18 SITE PLAN NO. _____ PROFILE NO. C-1391-1
RIV CROSSING ☒ GRADE SEPERATION ☐ R.R.X. ☐ OTHER (SPECIFY) _____
ALTERNATE SCHEME (IF ANY) Creek Diversion and/or Crossings With Culvert

EXISTING SITE CONDITIONS

DESCRIPTION:
TOPOGRAPHY: HILLY ☐ ROLLING ☐ VALLEY ☒ GULLIED ☒ FLAT ☐
VEGETATION: TREES ☐ BRUSH ☐ GRASS ☐ SWAMP ☐ FARM CROPS ☐ CLEARED ☐
SNOW COVER: 0"-6" ☐ 6"-12" ☐ >12" ☐
ROCK OUTCROP (SPECIFY LOCATIONS) _____

UNDERGROUND UTILITIES:

	UTILITY COMPANY	TELEPHONE NO. FOR DEFINITE LOCATION
1	None Expected At Site of Borings But See	
2	Plan # B-1391-1 For Location of Underground	
3	Bell Telephone.	
4		
5		

EXISTING STRUCTURE(S):
FOUNDATIONS: SPREAD FOUNDATIONS ☐ SIZE _____ ELEVATION(S) _____
PILES ☐ TYPE _____ LENGTH(S) _____
DESIGN LOAD _____ T.S.F. _____ TONS/PILE
CONDITION OF STRUCTURE _____
APPROACHES: CUT ☐ FILL ☒ SIDE SLOPES Old Fill Is Shallow - Prob. Clay
BERMS YES ☐ NO ☐
OTHER OBSERVATIONS (USE BACK OF SHEET TO DESCRIBE ANY FAILURES IN AREA, PAST PERFORMANCE OF EXISTING APPROACHES & STRUCTURE, ETC.)

ACCESSIBILITY

IS STRUCTURE LOCATED ON D.H.O. RIGHT OF WAY? YES ☐ NO ☐ IF NO,
HAS PERMISSION BEEN OBTAINED TO ENTER PROPERTY? YES ☐ NO ☒ IF NO,
PROPERTY OWNER(S):

	NAME	ADDRESS	TELEPHONE NO.
1			
2			
3			
4			

WHO WILL OBTAIN NECESSARY PERMISSION? Foundation Section (Property Sect. If Necess.
HAS SITE BEEN SURVEYED & STAKED? YES ☒ NO ☐ IF YES, DATE OF MOST RECENT SURVEY Prop. Line Staked
WILL CLEARING BE NECESSARY TO ENTER SITE AREA? YES ☐ NO ☒
IS SITE ACCESSIBLE TO WHEELED VEHICLES? YES ☒ NO ☐ Close At Least

IF RIVER CROSSING:
WILL A RAFT BE NECESSARY? YES ☐ NO ☒ IF YES, GIVE MAX. DEPTH OF WATER _____ FT
CURRENT: SWIFT ☐ MODERATE ☐ SLOW ☒

DRILLING OPERATIONS

NEAREST SOURCE OF WATER (GIVE HAULING DISTANCE, IF KNOWN) On Site - Hose Only Req'd. + Pump
ADDITIONAL INVESTIGATION REQUIRED FOR THE FOLLOWING PURPOSES:
ALTERNATE SCHEME: YES ☒ NO ☐ IF YES, SPECIFY 3 Alternate Lines - 2 Require Foundation Checks
HYDROLOGIC REASONS: YES ☐ NO ☐ IF YES, SPECIFY (SCOUR, ETC.) _____

REMARKS

NEAREST AVAILABLE ACCOMODATION: S. S. Marie - Empire Motor Hotel ?
OTHER COMMENTS: Route Borings Also Requested For Sta 331+00, Sta 337+10, 345+00 ± Left of ℄, 358+00 ± , 384+60-Lt ℄, 211+70 ± ,

DATE _____
REGIONAL BRIDGE LOCATION ENGINEER _____ - Touch 'n Field.

72-11121

B.H. #1 STA: 57+03 ; 6.[illegible] RT

0.0 To 5.0	DRIVE NX CASING & WASH OUT MAT'L: SAND, GRAVEL & BOULDERS - FILL		
5.0 To 6.5	SPLIT SPOON: SAND & GRAVEL, odd POCKETS OF COBBLES - V. DENSE FILL MATERIAL	SS# 1	17-29-38
5.0 To 7.0	DRIVE NX CASING & WASH OUT MAT'L: SAME AS ABOVE		
7.0 To 8.5	SPLIT SPOON: (DONE BLOW FOR THE LAST 1½") SAND & GRAVEL, (PIECE OF BOULDER)	SS# 2	27-80-79
7.0 To 8.5	DRIVE NX CASING & WASH OUT		
8.5 To 10.0	SPLIT SPOON: NO RECOVERY (NUMEROUS ATTEMPTS)	SS# 3	15-7-8
8.5 To 10.5	DRIVE NX CASING & WASH OUT MAT'L: MIXTURE OF DIRT & FILL MATERIAL		
10.5 To 12.0	SPLIT SPOON: RECOVERY - CLAYEY SILT WITH SOME SAND & GRAVEL VERY SOFT	SS# 4	1-½-½
12.0 To 13.5	VANE TEST: 20(14+14)x6" = 280 PSF 20(14+14)x3" = 140 PSF S = 2.0		
10.5 To 13.5	DRIVE NX CASING & WASH OUT MAT'L: KNOWN CLAYEY SILT		
13.5 To 15.0	2" SHELBY TUBE	TW# 5	PH

B.H. # 1

15.0 TO 16.5 VANE TEST: 20(18+18)x6° = 360 PSF
20(10+10)x6° = 200 PSF
S = 1.8

13.5 TO 16.5 DRIVE NX CASING & WASH OUT
MAT.: SAME AS ABOVE

END OF DAY W.L.: 3.5' B.G.L.

OCT. 4/72

16.5 TO 18.0 2" SHELBY TUBE TW# 6 PM

18.0 TO 19.5 VANE TEST: 20(10+10)x6° = 200 PSF
20(8+8)x3" = 80 PSF
S = 2.5

16.5 TO 19.5 DRIVE NX CASING & WASH OUT
MAT.: SAME AS ABOVE

19.5 TO 21.0 2" SHELBY TUBE TW# 7 PM

21.0 TO 22.5 VANE TEST: 20(9+9)x6° = 180 PSF
20(7+7)x3" = 70 PSF
S = 2.6

19.5 TO 22.5 DRIVE NX CASING & WASH OUT
MAT.: BROWN SL. CL. TO CL. SI.

22.5 TO 24.0 2" SHELBY TUBE TW# 8 PM

24.0 TO 25.5 VANE TEST: 20(12+12)x6" = 240 PSF
20(10+10)x3° = 100 PSF
S = 2.4

22.5 TO 25.5 DRIVE NX CASING & WASH OUT
MAT.: SAME AS ABOVE

25.5 TO 27.0 2" SHELBY TUBE TW# 9 PM

TP ③

B.H. #1

27.0 TO 28.5 — VANE TEST: 20(12+12)x6" = 240 PSF; 20(12+12)x3" = 120 PSF; S = 2.0

28.5 TO 30.0 — DRIVE NW CASING & WASH OUT. MAT.: BROWN CLAY TO SILT.

30.0 TO 31.5 — 2" SHELBY TUBE — TW# 10 PM

31.5 TO 33.0 — VANE TEST: 20(15+15)x6" = 300 PSF; 20(11+11)x3" = 110 PSF; S = 2.7

30.0 TO 35.0 — DRIVE NW CASING & WASH OUT. MAT.: SAME AS ABOVE

35.0 TO 36.5 — 2" SHELBY TUBE — TW# 11 PM

36.5 TO 38.0 — VANE TEST: 20(20+20)x6" = 400 PSF; 20(12+12)x3" = 120 PSF; S = 3.3

35.0 TO 45.0 — DRIVE NW CASING & WASH OUT. MAT.: SAME AS ABOVE - HARD DRILLING FROM 41' - SOME ROCK SAND

45.0 TO 46.5 — SPLIT SPOON: SS# 12 11-12-15. BROWN + FINE SAND - CONCRETE

END OF BOREHOLE

B.H. #2 STA: 51+00; 47' LT

0.0 - 1.0	DRIVE NX CASING & PULL OUT MAT: BLACK ORG.		
1.0 - 2.5	SPLIT SPOON: 1.0'-1.4': BLACK ORG. & 1.4' to 2.0': GREY - SI. SA. WITH SOME ORGANICS	SS#1	1/20"
1.0 TO 3.0	DRIVE NX CASING & WASH OUT MAT:		
3.0 - 4.5	VANE TEST: 20(6+6)x6" = 120 PSF 20(6+6)x3" = 60 PSF	S = 2.0	
3.0 - 4.5	DRIVE NX CASING & WASH OUT		
4.5 - 6.0	VANE TEST: 20(9+9)x6" = 180 PSF 20(6+6)x3" = 120 PSF S = 1.5		
4.5 - 6.0	NX CASING & WASH MAT:		
6.0 - 7.5	2" SHELBY TUBE	TW#2	PM
7.5 - 9.0	VANE TEST: 20(12+12)x6" = 240 PSF 20(6+6)x3" = 60 PSF	S = 4.0	
6.0 - 9.0	DRIVE NX CASING & WASH OUT MAT:		
9.0 - 10.5	VANE TEST: 20(10+10)x6" = 200 PSF 20(6+6)x3" = 60 PSF	S = 3.3	
9.0 - 10.5	DRIVE NX CASING & WASH OUT MAT:		
10.5 - 12.0	2" SHELBY TUBE	TW#3	PM

B.H.# 2 STA: 57+00 ; 47' LT.

12.0 - 13.5 VANE TEST: 20(11+11) x 6" = 220 PSF
20(6+6) x 3" = 60 PSF
S = 3.7

10.5 - 13.5 DRIVE NX CASING & WASH OUT
MAT.:

13.5 - 15.0 VANE TEST: 20(12+12) x 6" = 240 PSF
20(8+8) x 3" = 80 PSF
S = 3.0

13.5 - 15.0 DRIVE NX CASING & WASH OUT
MAT.: BR. CL. SI.

15.0 - 16.5 2" SHELBY TUBE TW#4 PM

16.5 - 18.0 VANE TEST: 20(13+13) x 6" = 260 PSF
20(8+8) x 3" = 80 PSF
S = 3.3

15.0 - 18.0 DRIVE NX CASING & WASH OUT
MAT.: BR. CLAYEY SILT

18.0 - 19.5 VANE TEST: 20(15+15) x 6" = 300 PSF
20(10+10) x 3" = 100 PSF
S = 3.0

18.0 - 19.5 DRIVE NX CASING & WASH OUT
MAT.: SAME AS ABOVE

19.5 - 21.0 2" SHELBY TUBE TW#5 PM

21.0 - 22.5 VANE TEST 20(14+14) x 6" = 280 PSF
20(12+12) x 3" = 120 PSF
S = 2.3

19.5 - 25.0 DRIVE NX CASING & WASH OUT
MAT.: SAME AS ABOVE

25.0 - 26.5 2" SHELBY TUBE TW# 6 PM

B.H. # 2 — STA: 51+00; 47' LT

11-14-6

26.5 - 28.0 — VANE TEST: 20(14+14) x 6" = 280 PSF
20(10+10) x 3" = 100 PSF
S = 2.8

28.0 - 30.0 — DRIVE NX CASING & WASH OUT
MAT.: SAME AS ABOVE

30.0 - 31.5 — 2" SHELBY TUBE — TW# 7

31.5 - 32.0 — VANE TEST: 20(16+16) x 6" = 320 PSF
20(8+8) x 3" = 80 PSF
S = 4.0

30.0 - 35.0 — DRIVE NX CASING & WASH OUT
MAT.: SAME AS ABOVE

35.0 - 36.5 — 2" SHELBY TUBE — TW# 8
(SAND AT TIP)

35.0 - 40.0 — DRIVE NX CASING & WASH OUT
MAT.: SAND

40.0 - 41.5 — SPLIT SPOON: SS #9 11-14-6
BROWN - SAND - COMPACT

END OF BOREHOLE

B.H. 2A

0' - 2.0' — SS# 1 — 2 BLOWS FOR 24"
BROWN — ORGANIC SILT — V. SOFT

2.0' - 4.0' — SS# 2 — 2 BLOWS FOR 24"
SAND

4.0' - 6.0' — SS# 3 — 1 BLOW FOR 24"
SAND

END OF BOREHOLE

B.H.# 2 — STA: 57+00 ; 20' LT

0.0 - 5.0	DRIVE NX CASING & WASH OUT MAT.: SAND, GRAVEL & BOULDERS, UNABLE TO WASH OUT FROM 4' ; BX ROCK CORING TO 5.5'
5.5' - 7.0'	SPLIT SPOON: — SS#1 — 16-22-49 RED.: SOME SAND & ROCK FIBRES (N.R.)
5.0 - 8.0	DRIVE NX CASING & (WASH OUT) DRILLED OUT WITH BX.
8.0 - 9.5	SPLIT SPOON: — SS#2 — 2 BLOWS FOR 24" RED: SOME ORGANIC SILT AND BROKEN GRAVEL
8.0 - 10.0	DRIVE NX CASING & WASH OUT MAT.: BROWN - ORG. SILT.
10.0 - 11.5	VANE TEST: 20(12+12) x 6" = 240 PSF 20(10+10) x 3" = 100 PSF S = 2.4
11.5 - 13.0	VANE TEST: 20(14+14) x 6" = 280 PSF N.T.
10.0 - 13.0	DRIVE NX CASING & WASH OUT MAT.: BROWN
13.0 - 14.5	SPLIT SPOON: BROWN - — SS#3 — 1/18" ORGANIC SILT (CLAY) WITH SAND - V. SOFT
14.5 - 16.0	VANE TEST: 20(12+12) x 6" = 240 PSF 20(8+0) x 3" = 80 PSF S = 3.0
13.0 - 16.5	DRIVE NX CASING & WASH OUT MAT.: SAND AS ABOVE

NO. L16-190-44- GRAND & TOY LIMITED — 4 SQUARES TO THE INCH

BH #3 STD. STAND. 20' LT

16.5 - 18.0 VANE TEST: 20(13+13) x 6" = 260 PSF
20(10+10) x 3" = 100 PSF
S = 2.6

18.0 - 19.5 VANE TEST: 20(12+12) x 6" = 240 PSF
20(12+12) x 3" = 120 PSF
S = 2.0

16.5 - 19.5 DRIVE NX CASING & WASH OUT
MAT.: SAME AS ABOVE

19.5 - 21.0 SPLIT SPOON: SS# 4 1/16"
BROWN - OLIVE SILT & CLAY - V. SOFT.

21.0 - 22.5 VANE TEST: 20(10+10) x 6" = 200 PSF
20(9+9) x 3" = 90 PSF
S = 2.2

22.5 - 24.0 VANE TEST: 20(12+12) x 6" = 240 PSF
20(10+10) x 3" = 100 PSF
S = 2.4

END OF BOREHOLE

B.H. #4 STA: 51+00 35' RT.

0.0 - 2.0 SPLIT SPOON; MIXTURE OF FILL AND COHESIVE MATERIAL SS#1 2/24"

2.0 - 3.5 VANE TEST: 20(10+10) x 6" = 200 PSF
20(5+5) x 3" = 50 PSF
S = 4.0

3.5 - 5.0 VANE TEST: 20(9+9) x 6" = 180 PSF
20(7+7) x 3" = 70 PSF
S = 2.6

0.0 - 5.0 DRIVE NX CASING & WASH OUT
MAT.: ORG. SILT

5.0 - 6.5 2" SHELBY TUBE TW#2 PM

6.5 - 8.0 VANE TEST: 20(8+8) x 6" = 160 PSF
20(4+4) x 3" = 80 PSF
S = 2.0

8.0 - 9.5 VANE TEST: 20(10+10) x 6" = 200 PSF
20(9+9) x 3" = 90 PSF
S = 2.2

5.0 - 9.5 DRIVE (PUSH) NX CASING & WASH OUT
MAT.: SAME AS ABOVE

9.5 - 11.0 2" SHELBY TUBE TW#3

11.0 - 12.5 VANE TEST: 20(12+12) x 6" = 240 PSF
20(10+10) x 3" = 100 PSF
S = 2.4

12.5 - 14.0 VANE TEST: 20(8+8) x 6" = 160 PSF
20(7+7) x 3" = 70 PSF
S = 2.3

9.5 - 14.0 PUSH NX CASING & WASH OUT
MAT.: SAME AS ABOVE

14.0 - 15.5 SPLIT SPOON: SS# 4 1/12"

15.5 - 17.0 VANE TEST: 20(13 + 13)x 6" = 260 PSF
20(9 + 9) x 3" = 90 PSF
S = 2.8

17.0 - 18.5 VANE TEST = 20(14 + 14)x 6" = 280 PSF
20(10 + 10) x 3" = 100 PSF
S = 2.8

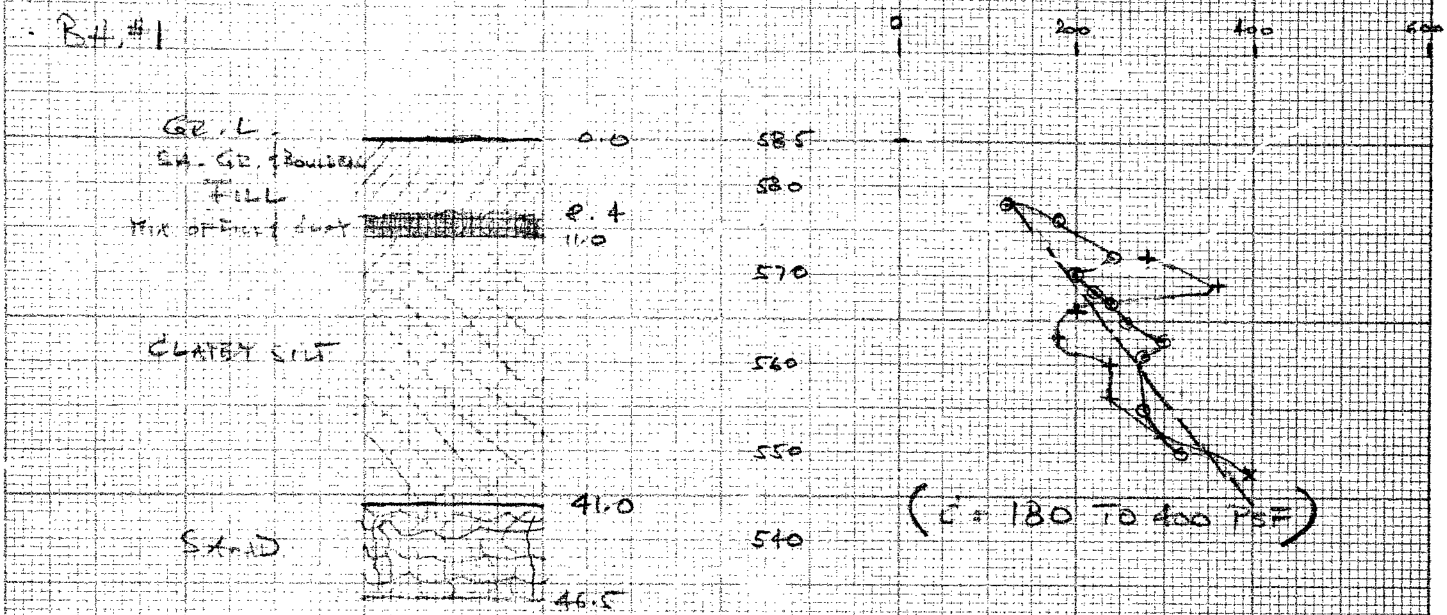
18.5 - 20.0 SPLIT SPOON: SS# 5 1/20"

20.0 - 21.5 VANE TEST: 20(12 + 12) x 6" = 240 PSF
20(4 + 4) x 3" = 80 PSF
S = 3.0

21.5 - 23.0 VANE TEST: 20(13 + 13) x 6" = 260 PSF
20(7 + 7) x 3" = 70 PSF
S = 3.6

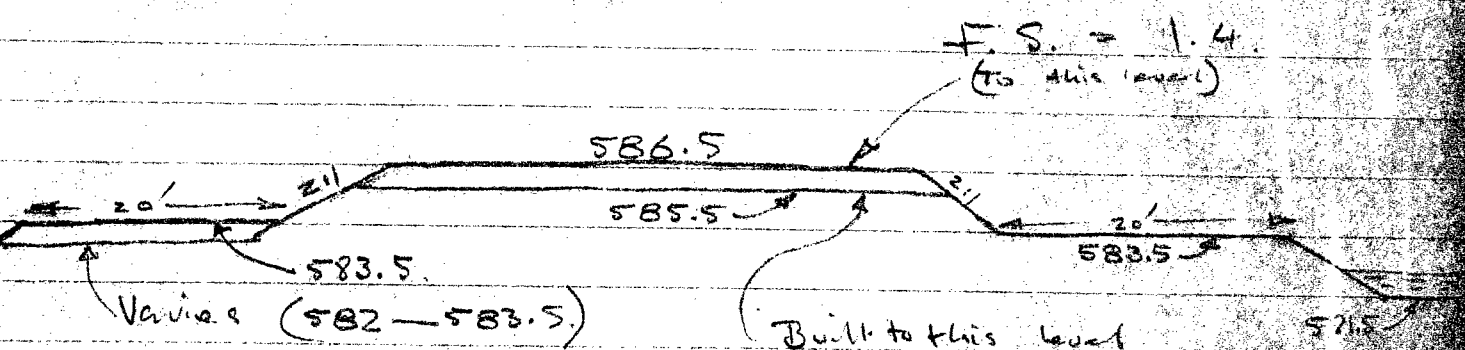
END OF BOREHOLE

72-11121

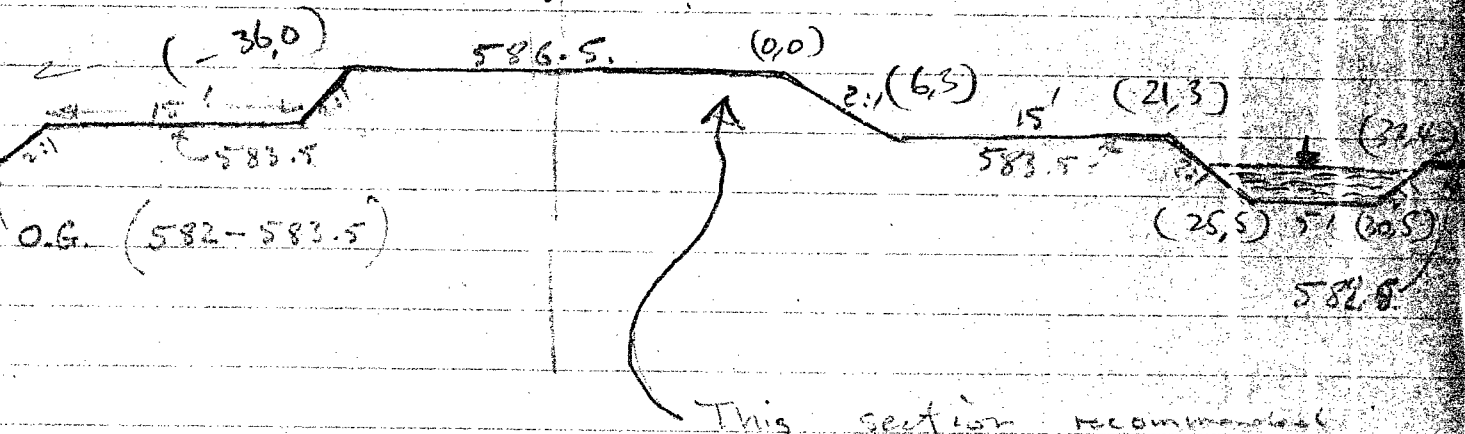

B.H. #1
GR. L
0.0
8.4
11.0
CLAYEY SILT
41.0
SAND
46.5
585
580
570
560
550
540
0
200
400
(C = 180 TO 400 PSF)

REMEDIAL MEASURES HWY. 638 72-111-1

STA. 49+00 – 53+00



Kupsch



This section recommended to Mr. C. McClure Constr. Sup. by K. G. Selby May 1973

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. K. G. Selby,
Supervising Foundations Eng.,
Design Services Branch,
Downsview, Ontario.

FROM: Mr. F. Fancy,
District Construction Supvr.,
18-Sault Ste. Marie, Ontario.

ATTENTION:

DATE: December 11, 1972.

OUR FILE REF.

IN REPLY TO

SUBJECT: Fill Failure, Contract 71-164
Secondary Highway 638, District 18

As requested, please find attached our records re the fill failure in the area of the settlement.

As you will note in the table of elevations, there was virtually no movement in the test section Station 50+50 to Station 51+50, which was the area that we lowered to elevation 585, until our readings on December 7, 1972, when a further settlement on the extreme right is indicated. This, however, may be nothing more than a sloughing of the shoulder or the results of snowplowing.

However, further records will be kept, including records either side of this test section and you will be kept advised.

Please contact this office if we can be of further help.

F. Fancy,
District Construction Supervisor,

for G. R. Browning,
District Engineer.

Attach:

ELEVATIONS ON TEST AREA Contract 71-164
50+50 - 51+50 Hwy 638 Dist 18

DATE	STATION	18	13	4	13	18	BOOK AND PAGE
NOV 14/72	50+50	584.8	585.1	585.4	585.1	584.9	BK 80 PAGE 53
NOV 15/72	" "	585.0	585.2	585.5	585.3	585.1	BK 80 " 55
NOV 16/72	" "	584.9	585.3	585.5	585.2	585.0	BK 80 " 57
NOV 17/72	" "	584.9	585.2	585.5	585.3	585.0	BK. 81 " 9
NOV 20/72	50+50	584.8	585.2	585.4	585.2	584.9	BK. 81 " 11
NOV 21/72	" "	584.8	585.2	585.4	585.2	584.9	BK 81 " 13
NOV 22/72	" "	584.9	585.2	585.5	585.2	585.0	BK 81 " 15
NOV 23/72	" "	585.0	585.3	585.5	585.2	585.0	BK 81 " 18
NOV 27/72	" "	584.9	585.2	585.4	585.1	584.8	BK 81 " 25
NOV 28/72	" "	584.9	585.3	585.4	585.3	584.9	BK 81 " 27
NOV 30/72	50+50	584.9	585.2	585.4	585.3	585.0	BK 81 " 29
DEC 7/72	" "	584.9	585.3	585.5	585.3	584.6	BK 81 " 32

DATE	STATION					18	BOOK AND PAGE
NOV 14/72	51+00	584.8	585.1	585.4	585.1	584.8	BK 80 PAGE 53
NOV 15/72	" "	585.0	585.2	585.5	585.2	584.9	BK 80 " 55
NOV 16/72	" "	584.9	585.2	585.5	585.2	584.9	BK 80 " 57
NOV 17/72	" "	584.9	585.2	585.5	585.1	584.9	BK 81 " 9
NOV 20/72	51+00	584.8	585.2	585.4	585.2	584.8	BK 81 " 11
NOV 21/72	" "	584.8	585.1	585.4	585.1	584.8	BK 81 " 13
NOV 22/72	" "	584.9	585.2	585.5	585.2	584.8	BK 81 " 15
NOV 23/72	" "	584.9	585.2	585.5	585.1	584.9	BK 81 " 18
NOV 27/72	" "	584.8	585.1	585.4	585.1	584.7	BK 81 " 25
NOV 28/72	" "	584.8	585.2	585.4	585.2	584.7	BK 81 " 27
NOV 30/72	51+00	584.9	585.1	585.4	585.1	584.8	BK 81 " 29
DEC 7/72	" "	585.0	585.3	585.4	585.2	584.4	BK 81 " 32

DATE	STATION	17				16	BOOK AND PAGE
NOV 14/72	51+50	584.8	585.1	585.4	585.1	584.8	BK 80 PAGE 54
NOV 15/72	" "	585.1	585.3	585.4	585.3	585.0	BK 80 " 56
NOV 16/72	" "	585.0	585.2	585.5	585.2	584.7	BK 80 " 58
NOV 17/72	" "	585.0	585.2	585.5	585.2	584.8	BK 81 " 10
NOV 20/72	51+50	584.9	585.2	585.5	585.1	584.7	BK 81 " 12
NOV 21/72	" "	584.9	585.2	585.4	585.0	584.8	BK 81 " 14
NOV 22/72	" "	585.0	585.2	585.5	585.2	584.8	BK 81 " 16
NOV 23	" "	585.0	585.3	585.5	585.2	584.8	BK 81 " 19
NOV 27	" "	584.7	585.1	585.4	585.2	584.7	BK 81 " 26
NOV 28/72	" "	584.9	585.2	585.5	585.2	584.7	BK 81 " 28
NOV 30/72	51+50	585.1	585.2	585.5	585.2	584.7	BK 81 " 30
DEC 7/72	" "	585.0	585.3	585.5	585.3	584.4	BK 81 " 33

MINISTRY OF TRANSPORTATION AND COMMUNICATIONS, ONTARIO

MEMORANDUM

TO: Mr. K. G. Selby,
Supervising Foundations Engineer,
Design Services Branch,
Downsview, Ontario.

FROM: Mr. C. D. McLure,
District Construction Supvr.,
18-Sault Ste. Marie, Ontario.

ATTENTION:

DATE: April 12, 1973.

OUR FILE REF.

IN REPLY TO

SUBJECT: Contract 71-164 - Secondary Highway 638
District 18 - Fill Failure

As a follow up to the report dated December 11, 1972, from Mr. F. Fancy, (now retired) regarding the above-noted, we are submitting the attached information on the fill failure area.

As I am in some doubt as to what elevations you have previously received, I am attaching a complete table of elevations for the area of settlement, up to date, from information received from our field party.

As you will note, very little change in elevations has taken place since December of 1972 and it would appear that the failure area has perhaps reached some stage of stability.

During the peak of the spring runoff, the water was up to and onto the shoulders of the road for a short period of time. This year's spring runoff was, perhaps, the most minimal we have had in that area in recent years, and for this reason, it is felt that the grade, as originally designed, cannot be lowered to any great degree without the possibility of future washouts.

The Contractor has visited the site and we are informed he intends to move back to commence operations in the very near future.

We would be pleased to receive your recommendations regarding this settlement area and will continue to keep a check on elevations and advise you if any appreciable change occurs. If further information is required, please advise.

C. D. McLure

CDMcL:my
Attach:

C. D. McLure,
Construction Supervisor,

for D. Aspinwall,
District Construction Engineer.

ELEVATION FOR TEST AREA

Sta. 48+00 to Sta. 49+00

Date	Station	13	13	cl	13	18	Book and Page
Nov. 14/72	48+00	587.1	587.7	588.0	587.4	586.0	Bk. 80, Page. 50
Dec. 15/72	48+00	587.0	587.5	587.8	587.4	586.2	Bk. 81, Page 34
Dec. 21/72	48+00	587.1	587.5	587.8	587.6	586.9	Bk. 81, Page 39
Apr. 2/73	48+00			587.4			Bk. 81, Page 51
Dec. 15/72	48+50	586.3	587.1	587.5	587.0	586.4	Bk. 81, Page 34
Dec. 21/72	48+50	586.5	587.1	587.5	587.1	586.4	Bk. 81, Page 39
Nov. 14/72	49+00	586.2	586.6	587.2	586.8	586.0	Bk. 80, Page 50
Dec. 15/72	49+00	586.2	586.9	587.2	586.9	586.0	Bk. 81, Page 35
Dec. 21/72	49+00	586.3	586.9	587.1	587.0	586.1	Bk. 81, Page 40
Apr. 2/73	49+00			586.9			Bk. 81, Page 51

ELEVATION FOR TEST AREA
Sta. 49+50 to 50+00

Date	Station	18	13	C/L	13	18	Book and Page
Dec. 15/72	49+50	585.5	586.4	586.6	586.3	585.3	Bk. 81, Page 35
Dec. 21/72	49+50	585.4	586.4	586.5	586.4	585.3	Bk. 81, Page 40
Apr. 2/73	49+50	585.5	586.0	586.3	586.0	585.6	Bk. 81, Page 51
Nov. 14/72	50+00	585.2	585.5	585.8	585.5	585.3	Bk. 80, Page 51
Dec. 15/72	50+00	585.1	585.6	586.0	585.7	585.5	Bk. 81, Page 35
Dec. 21/72	50+00	585.1	585.7	585.9	585.7	585.3	Bk. 81, Page 40
Apr. 2/73	50+00	584.8	585.4	585.7	585.4	585.1	Bk. 81, Page 51

Elevation on Test Area - Station 50+50 to 51+50

Date	Station	18	13	CL	13	18	Book	Page
Nov. 14/72	50+50	584.8	585.1	585.4	585.1	584.9	80	53
15/72	50+50	585.0	585.2	585.5	585.3	585.1	80	55
16/72	50+50	584.9	585.3	585.5	585.2	585.0	80	57
17/72	50+50	584.9	585.2	585.5	585.3	585.0	81	9
20/72	50+50	584.8	585.2	585.4	585.2	584.9	81	11
21/72	50+50	584.8	585.2	585.4	585.2	584.9	81	13
22/72	50+50	584.9	585.2	585.5	585.2	585.0	81	15
23/72	50+50	585.0	585.3	585.5	585.2	585.0	81	18
27/72	50+50	584.9	585.2	585.4	585.1	584.8	81	25
28/72	50+50	584.9	585.3	585.4	585.3	584.9	81	27
30/72	50+50	584.9	585.2	585.4	585.3	585.0	81	29
Dec. 7/72	50+50	584.9	585.3	585.5	585.3	584.6	81	32
15/72	50+50	584.8	585.2	585.5	585.3	585.0	81	36
21/72	50+50	585.1	585.3	585.5	585.3	584.6	81	41
Jan. 12/73			585.2	585.5	585.2	584.9	81	44
Nov. 14/72	51+00	584.8	585.1	585.4	585.1	584.8	80	53
15/72	"	585.0	585.2	585.5	585.2	584.9	80	55
16/72	"	584.9	585.2	585.5	585.2	584.9	80	57
17/72	"	584.9	585.2	585.5	585.1	584.9	81	9
20/72	"	584.8	585.2	585.4	585.2	584.8	81	11
21/72	"	584.8	585.1	585.4	585.1	584.8	81	13
22/72	"	584.9	585.2	585.5	585.2	584.8	81	15
23/72	"	584.9	585.2	585.5	585.1	584.9	81	18
27/72	"	584.8	585.1	585.4	585.1	584.7	81	25
28/72	"	584.8	585.2	585.4	585.2	584.7	81	27
30/72	"	584.9	585.1	585.4	585.1	584.8	81	29
Dec. 7/72	"	585.0	585.3	585.4	585.2	584.4	81	32
15/72	"	584.9	585.2	585.5	585.2	584.8	81	36
21/72	"	585.1	585.3	585.5	585.2	584.0	81	41
Jan. 12/73	"		585.2	585.4	585.2	584.8	81	44
Nov. 14/72	51+50	584.8	585.1	585.4	585.1	584.8	80	54
15/72	"	585.1	585.3	585.4	585.3	585.0	80	56
16/72	"	585.0	585.2	585.5	585.2	584.7	80	58
17/72	"	585.0	585.2	585.5	585.2	584.8	81	10
20/72	"	584.9	585.2	585.5	585.1	584.7	81	12
21/72	"	584.9	585.2	585.4	585.0	584.8	81	14
22/72	"	585.0	585.2	585.5	585.2	584.8	81	16
23/72	"	585.0	585.3	585.5	585.2	584.8	81	19
27/72	"	584.9	585.2	585.4	585.2	584.7	81	26
28/72	"	584.9	585.2	585.5	585.2	584.7	81	28
30/72	"	585.1	585.2	585.5	585.2	584.7	81	30
Dec. 7/72	"	585.0	585.3	585.5	585.3	584.4	81	33
15/72	"	584.9	585.2	585.5	585.2	584.2	81	36
21/72	"	585.0	585.3	585.4	585.0	584.1	81	41
Jan. 12/73	"		585.2	585.4	585.1	584.6	81	45

ELEVATIONS FOR TEST AREA
Sta. 50+00 to Sta. 51+50

Date	Station	18	13	C/L	13	18	Book and Page
Mar. 21/73	50+50	84.9	85.2	85.5	85.2	84.5	
Apr. 2/73	50+50	584.7	585.1	585.3	585.0	584.5	Bk. 81, Page 52
Mar. 21/73	51+00	85.0	85.2	85.5	85.1	84.5	
Apr. 2/73	51+00	584.7	584.9	585.3	584.8	584.5	Bk. 81, Page 52
Mar. 21/73	51+50	84.9	85.2	85.5	85.2	84.3	
Apr. 2/73	51+50	584.7	585.1	585.3	585.1	584.3	Bk. 81, Page 52

ELEVATIONS FOR TEST AREA
Sta. 52+00 to Sta. 53+00

Date	Station	18	13	C/L	13	18	Book and Page
Nov. 14/72	52+00	585.2	585.5	585.9	585.2	584.9	Bk. 80, Page 51
Dec. 15/72	52+00	585.4	585.9	586.0	585.5	585.1	Bk. 81, Page 37
Dec. 21/72	52+00	585.7	586.0	585.9	585.4	584.6	Bk. 81, Page 42
Apr. 2/73	52+00	585.5	585.6	585.8	585.3	584.4	Bk. 81, Page 53
Dec. 15/72	52+50	585.7	586.5	586.7	586.1	584.6	Bk. 81, Page 37
Dec. 21/72	52+50	586.1	586.6	586.6	586.1	584.6	Bk. 81, Page 42
Apr. 2/73	52+50	585.5	586.1	586.3	585.9	584.8	Bk. 81, Page 52
Nov. 14/72	53+00	586.6	587.0	587.2	586.4	586.0	Bk. 80, Page 52
Dec. 15/72	53+00	586.5	587.1	587.3	586.9	585.2	Bk. 81, Page 37
Dec. 21/72	53+00	586.7	587.2	587.3	586.9	585.4	Bk. 81, Page 42
Apr. 2/73	53+00			587.0			Bk. 81, Page 53

Elevations for Test Area - Station 53+50 to Station 54+00 (6)

Date	Station	18'	13'	CL	13'	18'	Book	Page
Dec. 15/72	53+50	587.7	587.8	587.9	587.6	587.3	81	38
21/72	53+50	587.7	587.8	588.0	587.7	587.2	81	43
Nov. 14/72	54+00	587.7	587.9	588.2	588.0	587.7	80	52
Dec. 15/72	54+00	587.6	587.8	588.2	588.0	587.7	81	38
21/72	54+00	587.7	587.9	588.2	587.9	587.7	81	43
April 2/73	54+00			587.8			81	53