

69-F-69

CONTRACT 68-123

H.W.Y. #516 (FAILURE)

UTTERSON LAKE

MEMORANDUM

TO: Mr. W. S. Aitken,
District Engineer,
District #11 (Huntsville).

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

ATTENTION:

DATE: September 18, 1969

OUR FILE REF.

IN REPLY TO

SUBJECT:

Failure of Hwy. 516 at Utterson Lake
Contract 68-123 -- W.J. 69-F-69

As requested by you, we have carried out a foundation investigation at the above mentioned site to determine the causes of the failures which occurred between Stations 123+00 and 127+00 on the above mentioned contract. The results of our investigation and our recommendations have already been given to you verbally: this memo contains essentially the same information and has been prepared mainly for record purposes.

History:

At this location the existing road was being widened by cutting into the rock on the south side and filling into the lake on the north side. During and after blasting operations for the rock cut, failures occurred and approximately half of the road slid northwards into the lake. About 400 feet of road was affected between Stations 123+00 and 127+00. Initial attempts to rebuild were unsuccessful in that failures recurred. These events took place between July 29 and August 9, 1969.

The site was visited by Mr. K.C. Selby on August 12, 1969 at which time it was agreed to carry out a soil boring program to determine the nature of the soil under and adjacent to the portion of the road which had failed. On the same day, drilling commenced and was completed on August 18. Four borings were carried out along a section roughly perpendicular to centre-line at Station 123+50.

Subsoil was found to consist of from 7 to 15 feet of very soft to soft clayey silt followed by 20 to about 40 feet of loose to very dense silt followed by granite bedrock. The thicknesses of the subsoil layers increase with increasing distance into the lake from the edge. Along the boundary of the failed zone a rock ledge was observed to extend from the east end of the zone to about Station 123+15. At this point B.H. #1 revealed that the rock was about 10 ft. deep, indicating that the projecting ledge was sloping steeply downwards from a point just east of Station 123+15.

Mr. W. S. Aitken,
District Engineer,
District #11 (Huntsville).

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September 18, 1969

Re: Failure of Hwy. 516 at Utterson Lake - Cont. 68-123

Copies of the borelogs and soil stratigraphy are attached to this memo.

Our assessment of the situation is as follows:

Failures have occurred by displacement of the soft clayey silt subsoil referred to on the foregoing page. Shock waves from blasting, and the impact loads of large quantities of blasted rock have been the cause of the failures. This type of failure is likely to reoccur in the future until all blasting work is completed, or until all of the soft material is displaced.

With regard to the future construction and subsequent performance of the section of highway involved, it is our opinion that a satisfactory road can be built along the line as originally designed, though of course it would be preferable to move the line as far south into the rock as is possible. In any event, all future fills which overlie the soft material should be built initially several feet higher than the final grade. The object here is to ensure that the embankment portion will be subjected to greater loads during construction than after construction, in which case, it can be assumed that a reasonable safety factor will have been achieved. The method of placing fill, therefore, should be designed so as to achieve this objective.

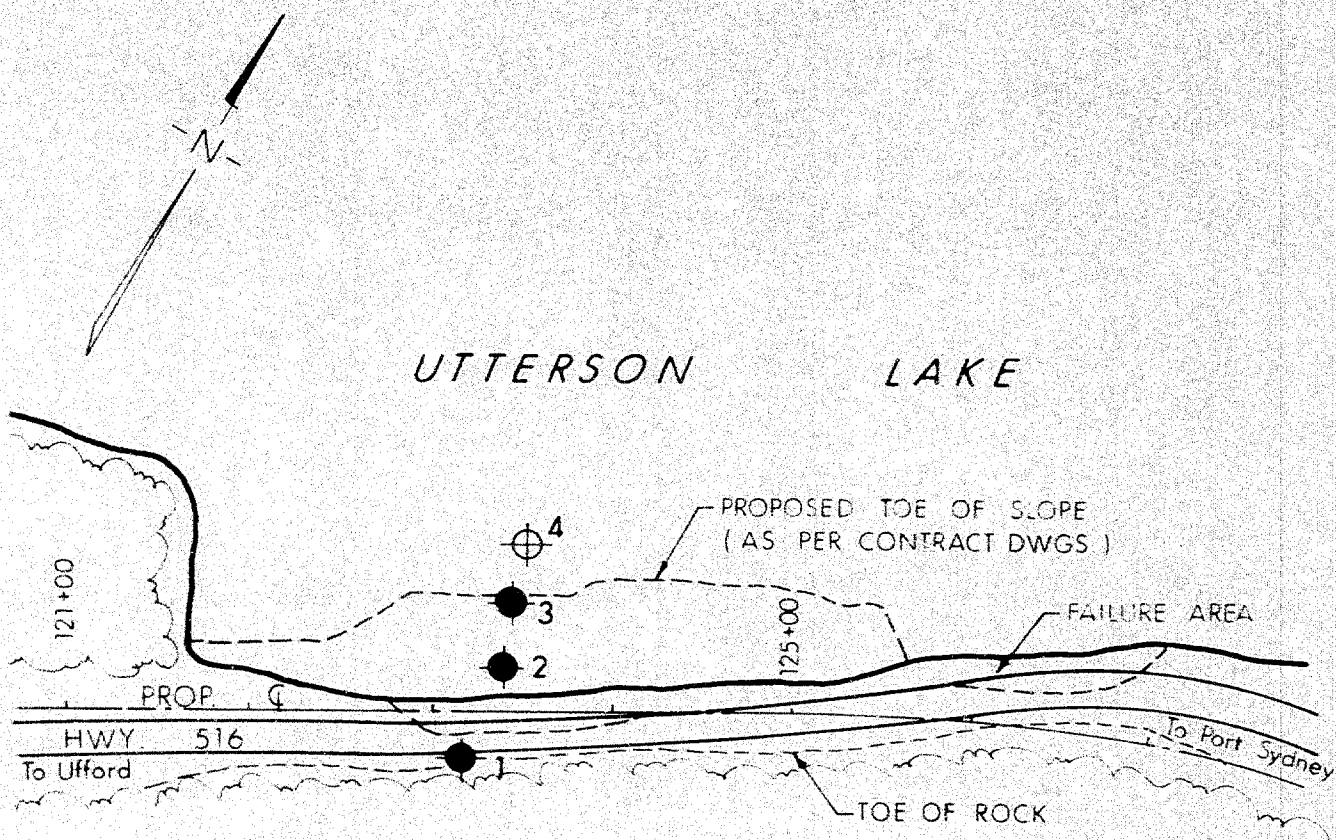
With regard to the future performance of the road, it is likely that cracking will occur over the boundary between the above mentioned rock ledge and the embankment fill. It is difficult to see how this eventuality can be avoided, however, and it must be accepted as a continuing maintenance problem which may decrease with time.

AGS/udeF
Attech.

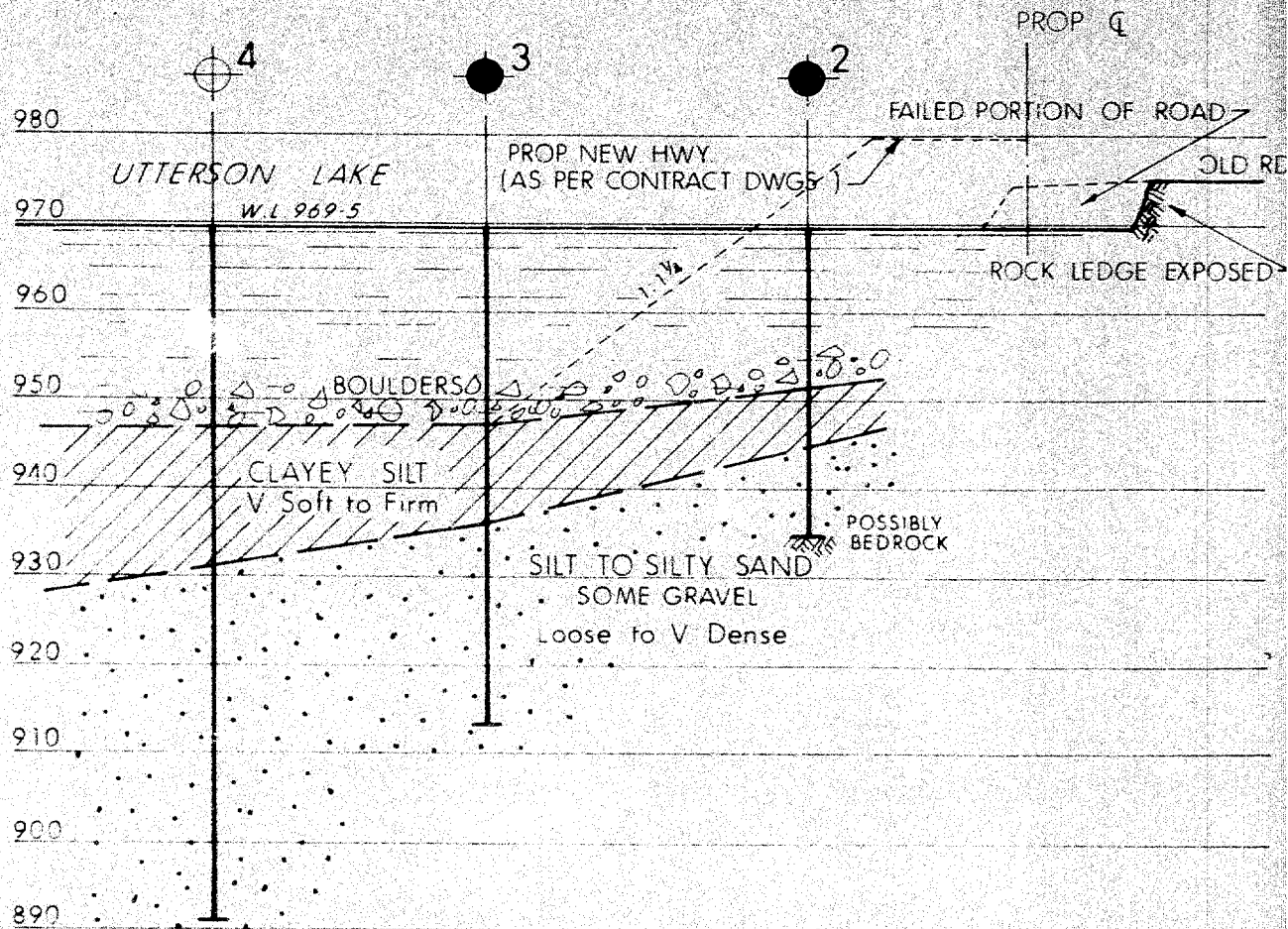
A. G. Stermac
A. G. Stermac
PRINCIPAL FOUNDATION ENGINEER

cc: Mr. H. A. Tregaskes

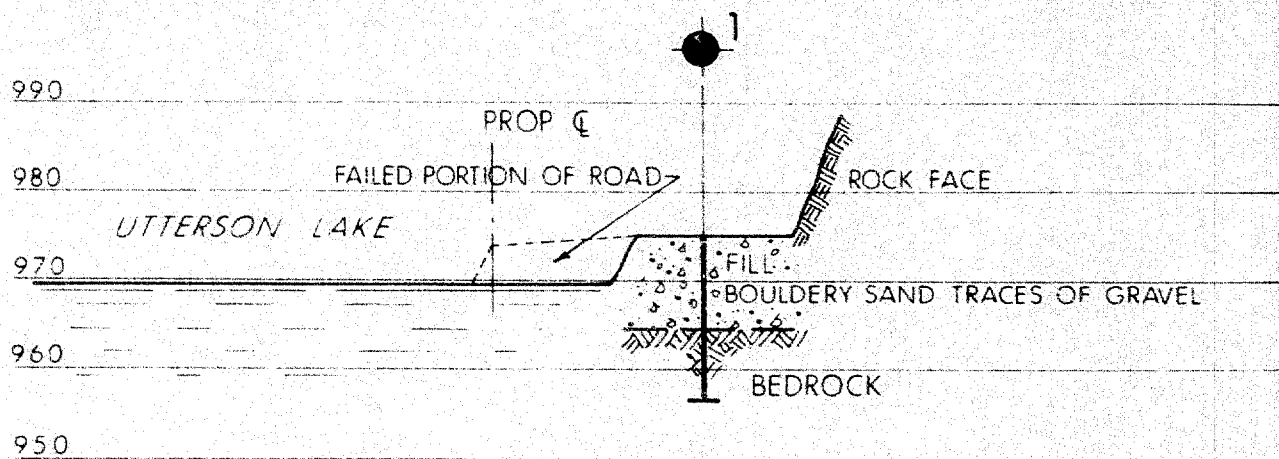
Foundations Files ✓
Gen. Files



PLAN
SCALE 1" = 100'



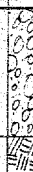
STA. 123 + 50



STA. 123 + 15

SCALE 1" = 20'

JOB 69-F-69 LOCATION Sta. 123 + 15 o/s 23' Rt. E ORIGINATED BY GA
W.P. BORING DATE August 13, 1969 COMPILED BY GA
DATUM Geodetic BOREHOLE TYPE Washboring, NX, BX Casing CHECKED BY GA

SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT			LIQUID LIMIT, PLASTIC LIMIT, WATER CONTENT			BULK DENSITY Y P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT	ELEV. SCALE	SHEAR STRENGTH P.S.F. ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE			WATER CONTENT % 10 20 30				
974.9	Ground Level		1	SS	4"	970								
964.9	Bouldery sand with traces of gravel		2	RC	10"									
10.0			3	SS	10"									
956.4	Bedrock		4	RC	100% Rec	960								
18.5	End of Borehole					977								

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 2

FOUNDATION SECTION

JOB 69-F-69 LOCATION Sta. 123 + 38 o/s 25' Lt. 2 ORIGINATED BY GA
 W.P. _____ BORING DATE August 14, 1969 COMPILED BY GA
 DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing CHECKED BY LL

SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT				LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w			BULK DENSITY γ P.C.F.	REMARKS
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.				w_p — w — w_L WATER CONTENT %				
969.5	Water Level						○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE				15 30 45				GR SA SI CL
0.0															
	Utterson Lake					960									
952.0	Lake Bottom														
17.5	Grey clayey silt					950									
945.0	Very soft to firm		1	SS	5										
24.5			2	SS	14										18 3 73 6
	Silt to silty sand		3	SS	54	940									
	with some gravel		4	SS	44										22 68 (10)
	Compact to very dense		5	SS	91	930									10 60 (30)
924.5			6	SS	38										
			7	SS	bouncing										
45.0	End of Borehole Probable Bedrock														

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 3

FOUNDATION SECTION

JOB 69-F-69 LOCATION Sta. 123 + 44 o/s 61' Lt. Ø ORIGINATED BY GA
 W.P. BORING DATE August 16, 17, 1969 COMPILED BY GA
 DATUM Geodetic BOREHOLE TYPE Washboring, BX Casing CHECKED BY AK

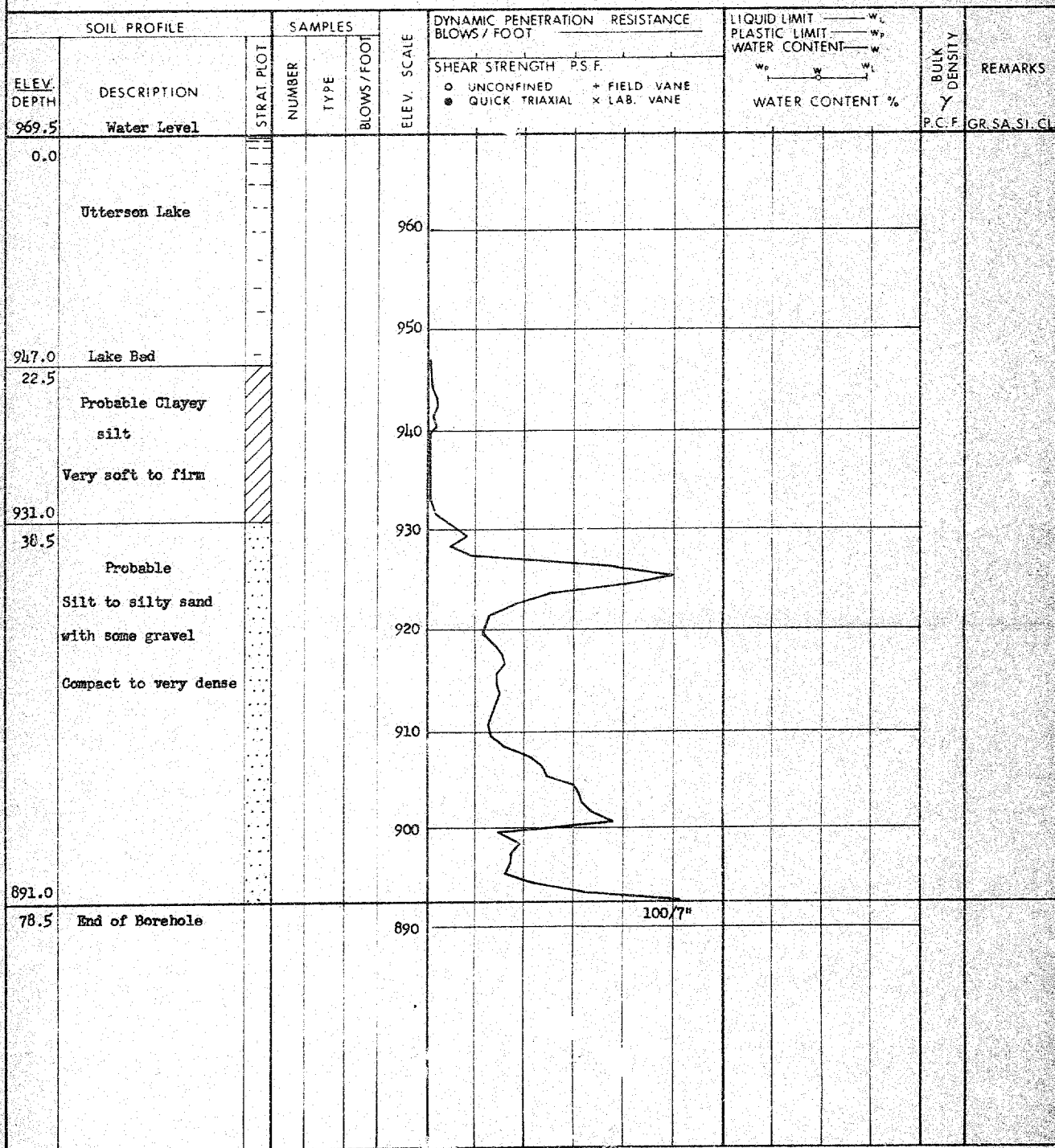
SOIL PROFILE			SAMPLES			ELEV. SCALE	DYNAMIC PENETRATION RESISTANCE BLOWS / FOOT					LIQUID LIMIT — w_L PLASTIC LIMIT — w_p WATER CONTENT — w w_p — w — w_L			BULK DENSITY γ P.C.F.	REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE	BLOWS / FOOT		SHEAR STRENGTH P.S.F.					WATER CONTENT %					
							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL x LAB. VANE					15 30 45					
969.5	Water Level						200	400	600	800	1000		15	30	45		
0.0	Utterson Lake																
947.5	Lake Bed																
22.0	Grey clayey silt Very soft		1	SS	1												
936.5																	
33.0	Silt to silty sand with some gravel		2	SS	12												
			3	SS	43												
			4	SS	6												
			5	SS	30												
	Loose to very dense		6	SS	28												
913.1			7	SS	>100												
56.4	End of Borehole																

DEPARTMENT OF HIGHWAYS- ONTARIO
MATERIALS & TESTING OFFICE

RECORD OF BOREHOLE No. 4

FOUNDATION SECTION

JOB 69-P-69 LOCATION Sta. 123 + 50 o/s 92' Lt. 6 ORIGINATED BY GA
 W.P. BORING DATE August 15, 1969 COMPILED BY GA
 DATUM Geodetic BOREHOLE TYPE Dynamic Cone Penetration CHECKED BY AK



1969 SEP 25 AM 9:42

00085

file copy
~~W.P. 98-64-1, 2, 3, 4~~
183-67-1

69-F-69

DOWN HUNT 4 SEPT 25/69 9:15 AM

H A TREGASKES CONSTRUCTION ENG

ATTN: R A PANTER

COPY TO: A G STERNAC

RE: CONTRACT 68-123, SEC HWY 516, FAILURE AT LONG'S LAKE.

THIS TELETYPE WILL CONFIRM DISCUSSIONS WHICH I HAVE HAD WITH YOURSELF AND MR K SELBY WHEN IT WAS AGREED THAT SAND CUSHION MATERIAL WILL BE DUMPED OVER THE AREA OF THE SEC HWY 516 EMBANKMENT SITUATED ON THE LONG'S LAKE SIDE OF THE FAILURE SLOPE. THE LOADS WILL BE DUMPED AS CLOSELY TOGETHER AS POSSIBLE AND PERIODICALLY SATURATED WITH WATER TO PRODUCE A GREATER SURCHARGE EFFECT. WE WILL AIM FOR A MINIMUM OF 3' SURCHARGE ABOVE THE FINAL ROADWAY GRADE AND THE SURCHARGE WILL BE LEFT IN PLACE FOR 5 DAYS. THIS WILL BE IN ACCORDANCE WITH THE SECOND LAST PARAGRAPH IN MR A G STERNAC'S MEMO TO ME OF SEPT 18/69.

IT IS OUR INTENTION TO PAY FOR THIS MATERIAL AT THE CONTRACT SAND CUSHION PRICE AND TO PAY BY FORCE ACCOUNT FOR THE LOADING AND HAULING AWAY OF ANY SURPLUS MATERIAL WHICH CAN BE USED AS SAND CUSHION ELSEWHERE ON THE CONTRACT. I UNDERSTAND THAT YOU ARE IN AGREEMENT WITH THIS IF ALL GOES ACCORDING TO PLAN AND WE HAVE NO FURTHER FAILURES WE SHOULD HAVE THE HIGHWAY OPEN TO TRAFFIC BY OCT. 3/69.

W S AITKEN DIST ENG

JH





GEORGE WIMPEY CANADA LIMITED

BUILDING AND CIVIL ENGINEERING CONTRACTORS

BOX 10, POSTAL STATION 'U'
TORONTO 18, ONTARIO,

CANADA

OFFICES AND DEPOT
80 NORTH QUEEN ST. EAST
TORONTO 18, ONTARIO

DIRECTOR:

S. I. GOLDFREY W. MITCHELL
W. BARN
R. H. G. HE
A. R. GRANT, F.I.C.E., M.ASCE, P.ENG.
A. D. McDONELL

YOUR REF. _____

OUR REF. FKWS/1b

August 13, 1969

Department of Highways,
Huntsville,
Ontario.

Attention Mr. W.S. Aitken

Dear Sirs,

D.H.O. CONTRACT 68-23, HWY. 516
FAILURE OF HIGHWAY

69-F-69

CONST.	FOR YOUR INFORMATION
MAINT.	DISCUSS WITH ME
MUNICIP.	PLEASE ANSWER
SERVICES	NOTE & RETURN TO ME
ACCOUNTS	INVESTIGATE & REPORT
EQUIP.	TAKE APPROPRIATE ACTION
SIGNS & PAINT	SHOW ME REPLY BEFORE MAILING

This is to confirm our understanding of the events which have occurred in the past few days leading up to the failure of Highway 516 at approximately Sta 126 + 00.

On July 29, 1969, Pat McNulty Limited blasted his first shot at 10.30 a.m. and again on July 31, 1969 at 10.30 a.m. and 3 p.m. Slight shear failure of the existing fill section of the highway occurred on the initial blast in the adjacent area of the shot, which consisted of 12 holes. On the second blast, consisting of 5 holes, approximately 200 feet of road fill failed and slid into the lake and on the third blast, also 5 holes, another 100 feet failed. The situation then became critical and the highway was placed into a one-lane operation. On the 31st July, W.D. Ham notified our office, after the first blast of the day, of the Department's concern that further blasting would

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ASSOCIATED OFFICES: GREAT BRITAIN - AFRICA - ASIA - AUSTRALIA - EUROPE - FAR EAST - MIDDLE EAST - SOUTH AMERICA



completely close the road to which we agreed. A meeting was arranged for Tuesday a.m. to discuss all alternatives.

In the meantime, Pat McNulty Limited was given instructions to continue drilling but not to blast. The Department at this time instructed us to blast the number of holes at our choice, but only if traffic was maintained with a minimum delay. On Tuesday, August 5, 1969 a meeting was held on site with W.S. Aitken, M. Rogers, C. Goldthorpe, J.C. Flockhart and K.W. Sparks. It was suggested by us that drilling be completed and the balance of the rock be let off in one shot. The road would have to be closed for three days while the rock was moved to fill. We also expressed our concern of the unsafe conditions present, the inconvenience to the motoring public and the ultimate closing of the road through complete failure. It appeared evident at that time that a shortage of rock would occur and it was agreed that the existing rock cut be drilled, blasted and mucked to existing road grade, which is approximately 5 feet below profile and payment would be made accordingly. No decision was made at the meeting, but H. Tregaskas later in the day instructed the District who in turn instructed us to carry out operations as is and keep traffic open through the one-lane situation.

On Wednesday, August 6, 1969, 25 holes were fired at 10 a.m. and traffic was operative at 11.30 a.m. Drilling was carried through August 7th and at 10.15 a.m. on August 8th 25 holes were fired and traffic resumed through the area at noon. At 2.45 p.m., 75% of the highway failed at 123 + 50 and 200 feet of the previously placed fill settled 6 feet in the lake to Sta 125 + 50. These areas of failure, were approximately 200 feet away from the blasting area. Immediately the Department, on instructions from W.S. Aitken, closed the highway to through traffic, which condition still exists.

On the same day W.S. Aitken, on site, instructed J.C. Flockhart to continue operations as is while decisions were made. By August 12th, the D.H.O. Design, Soil and Foundations Personnel were on site and a soils drilling

investigation was under way. Instructions as to re-alignment or rock borrow are forthcoming.

It is our understanding that this situation is strictly the responsibility of the Department as a design problem existed in the failure of the road. We would also like to point out that the situation seriously affects our contract. This contract is now split in half, with our granular "A" pit at the east end and our sand cushion pit at the west. Consequently considerable grade is prepared with no sand cushion available and at the west end sand cushion is being placed with no available crushed gravel. Increased costs are occurring because of the long detour affecting certain operations and equipment is standing due to unavailability of work. It is also understood that present and future delays will not be held against the contract completion date.

Please understand that it is our fullest intention to help in any way possible to have this situation resolved and if you would think that an immediate meeting would help to alleviate the problem, we would be only too glad to voice our opinion.

With regard to the contract completion date, we would be pleased to receive instructions from you as to how we will be compensated for the extra costs we have referred to. In the meantime we are keeping as accurate records as possible of the work affected by the road failure and we would suggest that your field staff be instructed to approve these records daily.

Yours very truly,

GEORGE WIMPEY CANADA LIMITED



K.W. Sparks, P.Eng.
Contracts Manager

c.c. Mr. H. Tregaskas, Construction Engineer
Department of Highways,
Downsview, Ontario.

MEMORANDUM

To: Mr. W. S. Aitken,
District Engineer,
District #11,
HUNTSVILLE, Ont.

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

ATTENTION:

DATE: August 8, 1969

OUR FILE REF.

IN REPLY TO

SUBJECT:

Re: Contract 68-123, Wimpey -
Side Hill Cut at Long's Lake 69-F-69

With respect to the above mentioned subject, and in connection with your memorandum of August 6, 1969, to Mr. H. A. Tregaskes, we would like to make the following comment:

It would be very useful if the slope of the line A-A would be known. It is realized that, because of the water, it may not be easy to establish that. However, the knowledge of the slope at the "worst" locations would enable us to decide whether the building of a berm is necessary and feasible. The berm could be built by just dumping and pushing the material over the slope, or by overbuilding and thus inducing a failure.

The recent failure seems to indicate that some parts of the road are susceptible to shock action. The blasting has triggered the sliding of the rock fill mass along the rock face. We feel that the failed areas should be built up again by bringing the rock fill back to grade. Whenever possible, the grade should not be raised since additional weight can only deteriorate the existing equilibrium.

AGG/adeF

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

cc: Messrs. H. A. Tregaskes
R. A. Panter

Foundations Files
Gen. Files

Copy for the information of Mr. A.G. Stermac.

Mr. H.A. Tregaskes,
Construction Engineer,
Downsview.

W.S. Aitken,
District Engineer,
#11, Huntsville.

Mr. H.A. Panter,
Asst. Construction Engineer.

August 6, 1969.

Contract 68-123, Wimper Side
Hill Rock Cut at Long Lake.

Confirming our telephone conversation of yesterday afternoon, we shall proceed as follows at the side hill rock cut immediately adjacent to Long's Lake (see also attached sketch):-

1. Rock grade for the length of side hill cut from approximately station 124+50 to 127+50, will be lowered by some 4' so that final rock grade will be at the elevation of the existing highway. This will give us a more uniform roadbed and will make available rock which is badly needed for widening on the lake side.
2. Should still more rock be required for widening, we will establish a rock borrow item.
3. We will investigate the possibility of lowering profile grade through this section of the project, however, if that is not feasible, we will build up from the existing highway elevation with borrow.

Some further comments are:-

- a) I have discussed with Tony Stermac the possibility of a future failure of fill material along rock face A-A. Mr. Stermac's opinion is that this is impossible to predict, and his advice is that we proceed in accordance with our plans and keep a watch on the situation. I agree with his recommendation.
- b) We have requested the Contractor to blast several short sections of the cut rather than take out all of the rock in one or two blasts. Our reasons are twofold, namely:
 - (i) One or two large blasts could, we feel, result in a large amount of rock kicking into, and being lost in, Long's Lake, beyond the proposed fill slope B-B.
 - (ii) We are not at all certain that mucking could be completed in 48 hours. Detouring would be complex, and

Mr. H.A. Tregaskes.

August 6, 1969.

Attn: Mr. R.A. Panter.

this is the worst time of the year for detouring
traffic on this particular highway. Four hour
highway closings are now contemplated.

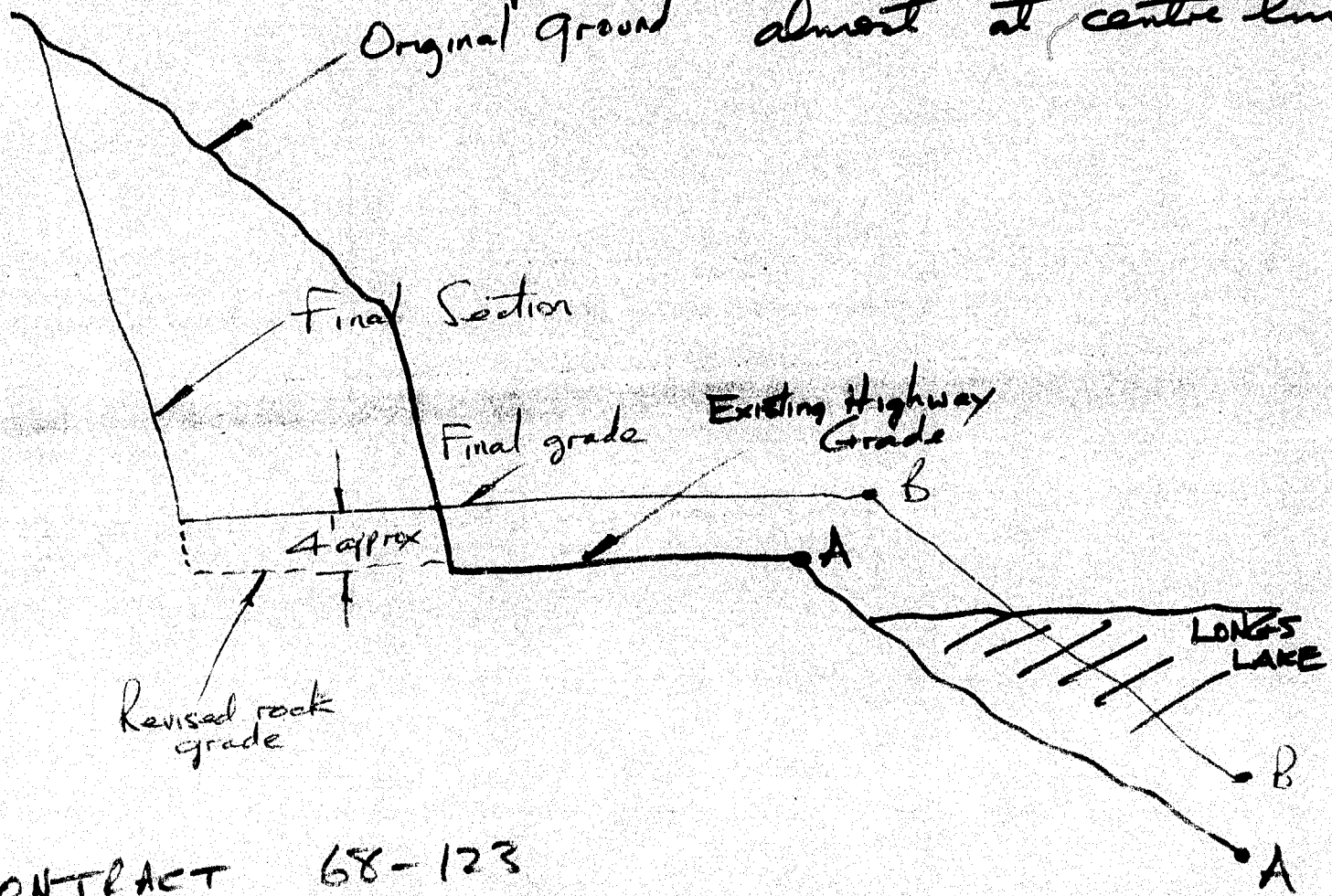


W.S. Aitken,
District Engineer.

WSA/bjm
Attach.

c.c. Mr. A.G. Stermac,
Mr. C. Goldthorp.

NOTE At the "worst" location the line A-A produced intersects the new grade almost at centre line.



CONTRACT 68-123
SIDE HILL CUT AT
LONGS LAKE

69-F-69 088

1000 AUG 19 PM 3:07

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HUNT DOWN 4 AUG 19/69 255P VR

W S AITKEN DIST ENGR

COPY TO H A TREGASKES CONSTRUCTION EGR LA BLDG

RE HWY 516 CONTRACT 68-23 M

REAGRDING TRAFFIC SAFETY ALONG FAILED PORTION OF HWY 516 WE FEEL
THAT ONLY AROUND STATION 123 PLUS OR MINUS CERTAIN DANGER PERSISTS

THIS IS BECAUSE FAILURE HERE OCCURRED WITHIN THE FILL ITSELF

WHILE IN OTHER PLACES FILL SLID AWAY ALONG THE BEDROCK FACE.

WE WOULD THEREFORE SUGGEST THAT REMEDIAL MEASURES BE STARTED AT

STATION 123 PLUS OR MINUS. AS MUCH SURCHARGING DURING CONSTRUCTION

AS POSSIBLE SHOULD BE ATTEMPTED. THIS WILL INDUCE LOCAL INSTABILITIES

DUE TO THE DISPLACEMENT OF THE CLAY LAYER ON THE LAKE BOTTOM.

WE ARE SOMEWHAT APPREHENSIVE REGARDING BLASTING BECAUSE PIECES OF
ROCK ON THE LAKE BOTTOM PRECLUDE THE PLACING OF CHARGES WITHIN THE
CLAY LAYER. HOWEVER, POSSIBLY AN ATTEMPT SHOULD BE MADE IN ORDER
TO ASSESS THE MERITS OF THIS METHOD

A G STERMAC PRINCIPAL FOUNDATION ENGR MAT AND TESTING DIV

BB

69-F-69

1969 AUG 19 PM 1:31

DOWN HUNT 3 AUGUST 19/69 1:15 PM

MR A G STERMAC PRINCIPAL FOUNDATION ENGR

RE: CONTRACT 68-123, SEC HWY 516, FAILURE AT LONG'S LAKE

IT IS MY UNDERSTANDING FROM OUR TELEPHONE CONVERSATION OF THIS MORNING THAT YOU CONSIDER THAT:

1. IT WILL NOT BE NECESSARY TO COMPLETE THE NEW SEC HWY 516 EMBANKMENT BEFORE PUTTING TRAFFIC BACK OVER IT AND THAT EVEN NOW, WITH SOME EXTRA ROADWAY WIDTH, TRAFFIC COULD USE THE HIGHWAY IN SAFETY. THIS IS CONDITIONAL UPON TRAFFIC PROCEEDING AT REDUCED SPEED AND A CLOSE WATCH BEING KEPT ON THE ROADWAY FOR ANY SIGNS OF FURTHER MOVEMENT.
2. THE EMBANKMENT WIDENING SHOULD BE CONSTRUCTED USING THE MAXIMUM SURCHARGE POSSIBLE. IN OTHER WORDS NORMAL ROCK EMBANKMENT CONSTRUCTION PROCEDURES WILL APPLY WHEREBY ROCK IS NOT DUMPED DIRECTLY OVER THE EDGE OF THE EMBANKMENT BUT RATHER PLACED AT THE EDGE OF THE EMBANKMENT AND BULLDOZED OVER.
3. SHOULD THERE BE SURPLUS ROCK FROM OUR ROCK EXCAVATION OPERATION WHICH CANNOT BE PLACED ELSEWHERE ON THE CONTRACT, IT WILL BE IN ORDER TO USE IT TO WIDEN OUT THE NEW EMBANKMENT.

W S AITKEN DISTRICT ENGINEER

MBS



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