THURBER ENGINEERING LTD.

ALBERTA TRANSPORTATION
LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

PEACE REGION (PEACE RIVER-HIGH LEVEL AREA)

SITE PH64: HWY 64:02 BF79554 SIDESLOPE INSTABILITIES (KM 52.7)

Highway Control Section:	**HWY 64:02**
Nearest Landmark	**Southwest of Worsley, AB**
Legal Location:	**SW17/NE8-85-8-W6M**
Date of Initial Observation:	**1981**
Date of Last Inspection:	**June 2014**
Last Inspected By:	**Thurber Engineering Ltd. (Thurber)**
Instruments Installed:	**3 Slope Inclinometers (1989)** **3 Slope Inclinometers and 5 Standpipe Piezometers (2009)**
Instruments Operational:	**3 Slope Inclinometers and 4 Standpipe Piezometers**
Risk Assessment:	PF(5) x CF(4) = **20** (South Side) PF(7) x CF(4) = **28** (North Side)
Last Updated:	**Thurber Engineering Ltd., March 2016**
Previous Update:	**N/A**

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thurber.ca

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1. LOCATION

The subject site is located along Highway 64:02 approximately 5 km west of the intersection with Highway 726. The site location is shown on Figure PH64-1, for insertion in Section G.

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

The site consists of a bridge culvert with a skew of 58° over a 9.2 m clear roadway with a 14 m height installed in 1983. The site was remediated in 1983 (new culvert), 1990 (north side instability), and 2011 (both north and south side slide repairs).

The slope instability at this site includes a slide in the south sideslope of the highway embankment fill surrounding the outlet of a CSP. The south embankment sideslope is 12 m to 14 m high with an approximate 3H:1V incline. The south embankment slide was about 70 m long and 40 wide with a scarp 2 m high. The slide was located as near as 12 m from the highway shoulder.

The north embankment of the highway varies from 6 m to 10 m high and is inclined at about 5H:1V. A slide was also present in the north embankment of the highway as outlined by cracking and rutting within the Westbound lane/shoulder of the highway surface. The north embankment slide was about 40 m long by 60 m wide, and was located about 170 m west of the south embankment slide.

The cause of the south slide was attributed to erosion and downcutting around the culvert outlet which subsequently created channel slumping at and downstream of the outlet, while the cause of the north slide was likely due to the soft foundation of the embankment.

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: Located in the Peace River Lowland (Atkinson, N. and Lyster, S., 2010).

Bedrock Geology: Consists of Upper Cretaceous age deposits: predominantly Dunvegan Formation consisting of light grey to yellow-grey sandstone interbedded with laminated siltstone and dark grey clay shale. (Bedrock Geology of Alberta, ERCB/AGS, 2013).

Surficial Geology: Surficial deposits in the area consist of glaciolacustrine deposits made up of laminated to massive fine sand, silt, and clay with local areas of pebbly sand and gravel. (Surficial Geology of Alberta, ERCB/AGS, 2013).

Hydrogeology: Local groundwater and surface water flow toward the local creeks. Regional groundwater flow is towards the Peace River, located approximately 6 km to the south of the site (Hydrogeological Map Clear Hills – Chinchaga River Alberta, ARC, 1972).

Stratigraphy: The five test holes drilled by Thurber in November 2009 show topsoil over clay and clay till fill over gravel and/or clay over clay till. Bedrock was not encountered in the test holes.

4. CHRONOLOGY

1981

An inspection of the site on May 13, 1981 indicated high water over top of the existing culvert. The culvert was noted to not carry flow. Scouring was observed at the culvert outlet. A 2.1 m high beaver dam approximately 100 m downstream ponded water to 0.6 m above the culvert outlet.

An authorization letter dated July 20, 1981 gives approval to order material and install a 171.9 m long 1800 mm SPCSP (thickness 3 and 4 mm) to replace a 1200 mm SPCSP. Work was completed in June of 1983.

1986

An inspection report dated June 10, 1986 indicated a long section of erosion up to 1.5 in depth in the north highway ditch and west of the newly installed pipe.

1989

A site inspection conducted by Karl Li and Pete van Deligt on November 3, 1989 indicated a slide on the north embankment which was 40 m wide and 15 m to 20 m high with a gradient of 3:1. The crown of the slide was noted as encroaching into the edge of the shoulder. A French drain water interceptor was noted as installed on the northwest cut/fill interface of the embankment. A beaver dam located 10 m upstream of the upstream toe of the embankment was ponding water to 3 m above the culvert bottom level. The steel culvert installed in 1983 appeared bent due to settlement.

1990

Testpitting of the site was completed on June 12, 1990 by Karl Li and Pete van Deligt and is described in a memo dated July 3, 1990. Three testpits were dug on the north highway

embankment east of the downdrain culvert. The testpits showed 0.5 to 0.6 m of sloughed material over dry to moist compacted silty clay fill. The test pits indicated a shallow slab slide failure limited to less than 1 m depth. Remedial recommendations included removing the sloughed material, rebuilding the top half of the slope, and adding a 0.5 m thick horizontal blanket of granular material 2 m below the gradeline.

The testpitting memo above indicated that the embankment gradeline was completed in 1984, the base course completed in 1987, and a slide occurring at the same location shortly after base course completion. The 1987 slide was subsequently repaired.

A memo dated August 20, 1990, from Karl Li of Geotechnical Services Section to Roy Callioux District Transportation Engineer in Peace River, indicated that once the beaver dam was removed, 1 m depth of dammed water drained away, revealing toe bulging approximately 15 m width. A vertical drop of approximately 0.3 m was observed shortly after completion of the remedial measures recommended in the July 3, 1990 memo. Three additional test pits were dug within the slide feature. Installation of 3 slope inclinometers was recommended to monitor the slide movement.

Three slope inclinometers were installed between August 15 and August 21, 1990.

A memo and drawing, dated November 15, 1990, from Karl Li to R. Callioux, indicates that a toe berm should be constructed on the upstream side of the highway to midslope height (~6 m high), extending 80 m wide from the west ditch downdrain pipe. Extensions of 25 m length onto the existing centerline culvert, and 30 m onto both the west ditch downdrain culvert and the west subdrain (100 mm diameter plastic pipe surrounded with 1m x 1m of free draining gravel in a trench), are required. This design was based on the monitoring results of 3 slope inclinometers which indicated slippage in the fill or native silty clay material at 6 to 10 m below surface (and soft foundation conditions).

Work completed by December 21, 1990, by ATU involved removing and salvaging the beveled end at the upstream inlet, removing the next three rings (11.0 m) which were damaged by the slide, and replacing nine new rings (32.9 m) to extend the culvert through the proposed toe berm, prior to reinstalling the beveled end and replacing the riprap.

1997

A bridge inspection on June 18, 1997, by Assenheimer Engineering Ltd., has photos showing: a previously repaired culvert outlet with ample but small riprap in the streambed, and a well defined ditch erosion gully east of the culvert inlet.

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2006

A bridge inspection on July 20, 2006, by MPA Engineering Ltd., has a photo showing significant debris (consisting of tree branches, large riprap, and soil) partially blocking the culvert outlet.

2008

A callout inspection conducted by Thurber in June 2008 indicated two slide areas; one on the south embankment and a second in the north embankment.

The south embankment slide was noted as 40 m long, 23 m wide near the top and 40 m wide at the bottom. The scarp was 2 m high. A large slump block was noted within the main slide body. No distinct toe roll was noted. The top scarp was within 12 m of the guardrail. The slide toe was within 10 m of the outlet of the 2100 mm diameter culvert. Eroded gabions, riprap and concrete was observed inside the lower portion of the slide.

The north embankment slide was noted to be 170 m west of the south embankment slide. Cracks in the highway surface were 40 m in length, beginning (from west to east) in the north shoulder, and then propagating into a double crack located primarily along the westbound lane. A 10 m long crack was also observed in the eastbound lane. Rutting up to 50 mm deep and a dip in the outer half of the westbound lane was also observed. A significant bulge in the north fenceline was observed below the highway cracking. An erosion gully about 70 m long, 2 m to 3 m deep and 2 m to 3 m wide was observed south of the fence running towards the 2100 mm diameter culvert inlet.

2009

Thurber's 2009 annual inspection indicated that the westbound lane had been patched in October 2008. Additional movement was observed at the south embankment slide. The erosion gullies at both slides have increased in size and depth. The north culvert inlet was exposed and possible separated as no taper was visible.

Three slope inclinometers and five standpipe piezometers were installed from November 5 to November 8, 2009 to monitor the slide in the sideslopes of the highway embankment fill. The locations of the instruments are shown on Drawing 15-16-305-PH64-1 attached.

2010

Thurber's 2010 annual inspection indicated the south embankment slide has increased in length from 40 m to 70 m. The culvert outlet was noted to be exposed and possibly separated. The

cracking zone was noted to have expanded west of the slide area into the bush. The erosion gully at the north embankment slide has worsened since the 2009 inspection.

A culvert rehabilitation design report was prepared by Thurber (#19-4841-2 dated March 18, 2010), and issued to MPA engineering Ltd.

2011

Thurber's 2011 annual inspection indicated that the erosion at the north embankment slide has not worsened since the 2010 inspection. Continued erosion and cracking was observed at the south embankment slide.

Remediation of the north and south embankment slides was completed in late 2011, under a contract administered by MPA Engineering Ltd. Remediation included extending the culvert outlet and inlet, flattening the slopes, installing an upstream granular drainage blanket, installation of upstream subdrain pipes, and re-establishment of the toe berms.

2012 to 2014

Thurber's annual inspections indicated fresh slumps in the channel immediately downslope of the new extended culvert outlet bowl on the south embankment slide repair. Erosion was also noted along the edge of and extending underneath the new downstream west ditch TRM liner, but which appeared to have abated in 2014.

The three slope inclinometers initially showed some slight movements subsequent to construction, but this abated in the single remaining inclinometer left in 2014, and it was attributed to post construction settlements. Erosion was also noted at the transition between the gabions and riprap on both sides leading to the culvert inlet.

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REFERENCES

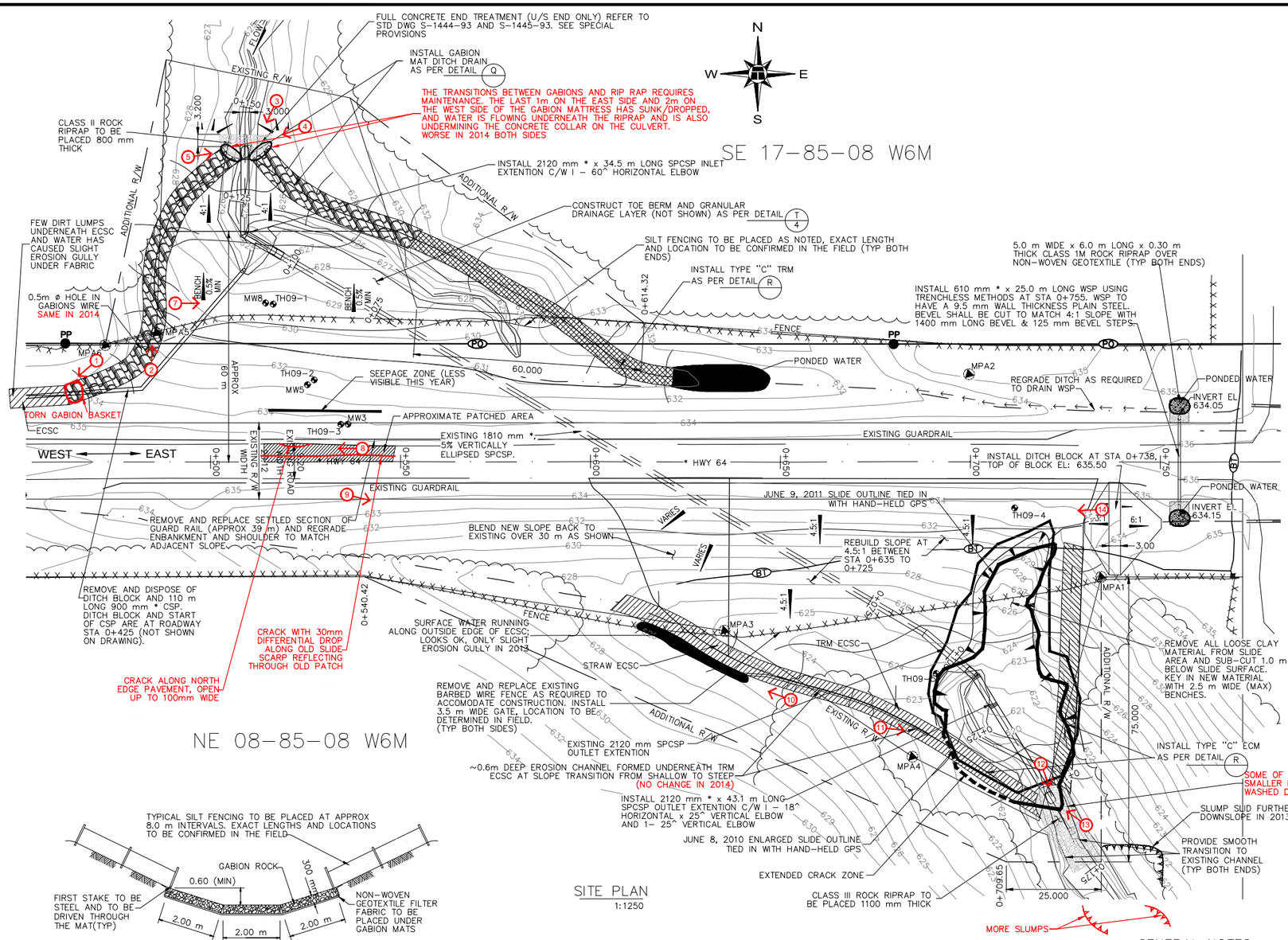
1. Atkinson, N. and Lyster, S., 2010. “Bedrock Topography of Alberta, Canada,” ERCB/AGS Map 50, scale 1:1,500,000.

2. Prior, G.J., Hathway, B., Glombick, P.M., Pana, D.I., Banks, C.J., Hay, D.C., Schneider, C.L., Grobe, M., Elgr, R. and Weiss, J.A., 2013. “Bedrock Geology of Alberta.” ERCB/AGS Map 600, scale 1:1,000,000.

3. Fenton, M.M., Waters, E.J., Pawley, S.M., Atkinson, N., Utting, D.J. and McKay, K., 2013. “Surficial Geology of Alberta.” ERCB/AGS Map 601, scale 1:1,000,000.

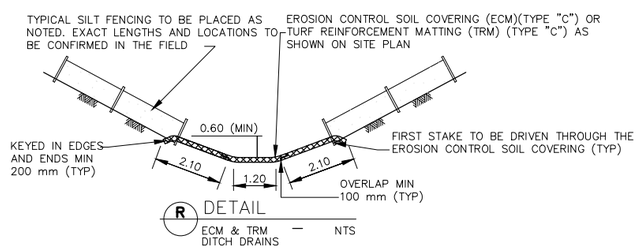
4. Alberta Research Council, 1972. “Hydrogeological Map Clear Hills – Chinchaga River Alberta.”

Z:\15\15-16-305\BDM\15-16-305_PH64-1.dwg - FIGURE 1 - Dec. 12, 2014



SITE PLAN
1:1250

Q DETAIL
GABION MAT DITCH DRAIN — NTS



R DETAIL
ECM & TRM DITCH DRAINS — NTS

LEGEND

1 PHOTO AND DIRECTION

TEST HOLE WITH SLOPE INCLINOMETER OR PIEZOMETER

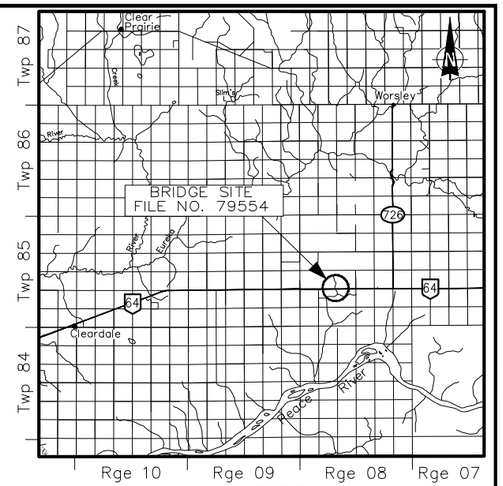
NOTES

1. BASE PLAN PROVIDED BY MPA ENGINEERING LTD.
2. JUNE 19, 2014 OBSERVATIONS SHOWN IN RED.
3. PHOTO 6 = PROPOSED REPAIR SCHEMATIC

0 10 20 30 40 50 60 70 m
SCALE 1:1250

GENERAL NOTES

- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE
- ROADWAY DESIGN STANDARD FOR CULVERT: RCU- 209-110
- CULVERT INSTALLATION TO BE IN ACCORDANCE WITH DRAWING No S-1418-03
- DESIGN SPECIFICATION CAN / CSA-S6-06
- DESIGN LIVE LOAD: CL 800 AB
- SCALES SHOWN ARE CORRECT FOR 11" x 17" SHEET SIZE



SITE MAP
1 : 500 000

LEGEND
- 2 HIGHWAY 1-216
- 51A HIGHWAY 500-986
- LOCAL ROAD

BENCH MARK

- MPA1- Fd.1P. LOCATED 30.24 m S OF * ROAD ALIGNMENT AT STATION 0+734.63, ELEVATION 633.29
- MPA2- Fd.1P. LOCATED 23.06 m N OF * ROAD ALIGNMENT AT STATION 0+699.65, ELEVATION 635.37
- MPA3- Fd.1P. LOCATED 44.37 m S OF * ROAD ALIGNMENT AT STATION 0+635.52, ELEVATION 625.11
- MPA4- Fd.1P. LOCATED 77.65 m N OF * ROAD ALIGNMENT AT STATION 0+685.09, ELEVATION 623.35
- MPA5- Fd.1P. LOCATED 34.03 m N OF * ROAD ALIGNMENT AT STATION 0+485.79, ELEVATION 631.67
- MPA6- Fd.1P. LOCATED 30.77 m N OF * ROAD ALIGNMENT AT STATION 0+472.35, ELEVATION 635.20

SURVEY BY

- MQT DATA, NOVEMBER 17, 2009

HYDROTECHNICAL SUMMARY

- DRAINAGE AREA = 13.0 km*
- DESIGN DISCHARGE = 7.10 m*/s
- MEAN OUTLET VELOCITY AT PROPOSED CULVERT FOR DESIGN DISCHARGE = 2.01 m/s
- AVERAGE SURVEYED SLOPE OF STREAMBED = 0.039 m/m

EXISTING STRUCTURE

- 5% VERTICALLY ELLIPSED 1810 mm * SPCSP x 203.0 m INVERT LENGTH, EXTENDED ON D/S END WITH A 2120 mm * SPCSP x 17.8 m INVERT LENGTH

PROPOSED STRUCTURE

- EXTEND EXISTING CULVERT WITH 2120 mm * SPCSP OUTLET EXTENSION x 43.10 m INVERT LENGTH C/W 1 - 25^ VERTICAL x 18^ HORIZONTAL ELBOW AND 1 - 25^ VERTICAL ELBOW
- EXTEND EXISTING CULVERT WITH 2120 mm * SPCSP INLET EXTENSION x 34.50 m INVERT LENGTH C/W 1 - 60^ HORIZONTAL ELBOW
- SPCSP WALL THICKNESS IS 3.0 mm (910 gm/m* GALVANIZED COATING)
- CORRUGATION PROFILE 152 x 51 mm

Alberta Transportation

PEACE REGION (PEACE RIVER/HIGH LEVEL)
PH 64 - WATERCOURSE CULVERT ON HWY 64, 22 KM SW OF WORSELY

2014 PH64 INSPECTION PLAN

FIGURE PH64-1

DRAWN BY	KLW
DESIGNED BY	BDM
APPROVED BY	DWP
SCALE	1:1250
DATE	JUNE 19, 2014
FILE No.	15-16-305

THURBER ENGINEERING LTD.

UTHORIZATION

File 79554

Date July 20, 1981

Job Y 743 B

Sub-Element B2260

Elect. Code 01

Work Class C

Struct. Type 2

Region 6

Transportation Engineer

River, Alberta

hereby authorized to: ~~Construct~~ ~~Reconstruct~~ Repair Install Culvert ~~Prel. Eng.~~

Located S/SE Sec. 17 Tp. 85 Rg. 8 Mer. 6

Location from nearest town 6.4Km west, 12.8Km north, 30.5Km west of Hines Creek

Stream Watercourse Highway 64 ~~M.D.~~ I.D. ~~No.~~ 21 District 14

Existing Structure 1 - 1200mm CSP

Proposed Structure 1 - 1800mm SPCSP, 171.9m invert

Roadway height above streambed 14m Clear Roadway 11.4m

Material on Order § (1) P668 (2) JY4467 (3) (4)

Trucking Orders (1) (2) (3) (4)

Instructions

Install 1-1800mm SPCSP, 171.9m invert length as per Drawing _____.

The culvert is to be placed at Station 52+694.5 with about 58° RHF skew. The culvert u/s invert is to be set at elevation 635.15, which is about 0.5m below the bottom of streambed diversion at that location. The d/s invert is to be set at elevation 631.55, which is 3.6m below the u/s invert. The distance from centerline to u/s end of the pipe is 75.11m and to d/s end is 96.80m. The u/s portion of the pipe is 45.11m long; thickness 3mm. The middle portion of the pipe is 63.40m long; thickness 4mm. The d/s portion of the pipe is 63.40m long; thickness 3mm. Excavate the streambed to a firm material and install the culvert on a compacted granular backfill with clay seals. Place rock rip-rap as per Drawing _____.

Costs Recoverable: Installation Grant: $150/m x 171.9m = $25,785.00
+ cost of 2000 m^3 of granular material.

Authorized by L. Mikkailousky
REGIONAL BRIDGE TECHNOLOGIST

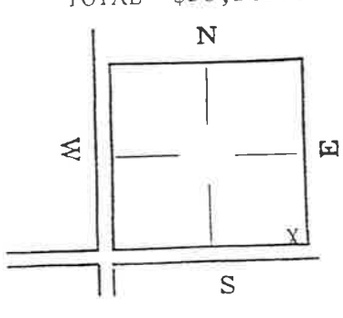
Telephone 624-6280

Approved

Title REGIONAL DIRECTOR

PIPE MATERIALS $54,500.00
GRANULAR FILL 10,000.00 Actual Cost
TOTAL $90,285.00

Hwy 64:02



Mark location with X

Bridge Started

Bridge Completed June/83

Foreman's Signature Peter Van Leeuwen
FOR GORDON DEWALD

SIGN AND RETURN THIS COPY
WHEN WORK COMPLETED

[illegible] No. [illegible]

[illegible] Transportation Culvert [illegible] Specifications

T001

[illegible] July 20, 1981

[illegible] September 15, 1981

[illegible] B 2760 Job No. — Y 743 B File No. — 79554

[illegible] to — Mr. C.R. Farr, District Transportation Engineer, Peace River, Alberta

[illegible] Location of Site — S/SE 17-55-8-6

[illegible] Location from [illegible] Town — 6.[illegible] km west, 12.5 km north, 50.[illegible] m west of [illegible] Creek

[illegible] of Pipe and Couplers to — Site

[illegible] to — Site

[illegible] Plans (SPCSP only) —

[illegible] of Pipe — SPCSP

— 7800 MM

[illegible] of Pipes — One

[illegible] Length of each Pipe — 171.9m

[illegible] Length — 171.9m

[illegible] — (a) SPCSP 3mm & 4 mm

[illegible] — (b) CSP, acceptable alternatives

1. 1 copy to Chief Bridge Engineer
2. 2 copies to the Road Authority

Mr. T.D. McGreer
[illegible] Bridge Engineer
Peace River, Alberta
Address

Corrugation, mm × mm	68 × 13	75 × 25	125 × 25
Thickness, mm			

NOTE: CSP corrugation not specified above will not be accepted.

[illegible] required

[illegible] 2:1 step levelled

[illegible] Instructions:

The u/s portion of the pipe is 45.11m long; thickness 7 m.

The middle portion of the pipe is 63.[illegible]m long; thickness [illegible]m.

The d/s portion of the pipe is 65.40m long; thickness 3 m.

[illegible] by [illegible]

Used Radius	Req'd Rise (600mm Chord)	Measured Rise (600mm Chord)
31½"	58mm	56 - 62mm
38"	48mm	43 - 44mm

O.K.

Pipe ok. KOPPERS [illegible]

[illegible]
[illegible]
[illegible] File
[illegible]
[illegible] Engineer

NOTE TO FILE Date: Jan 25, 90

From: Karl Li
G.D.E.

To: Vishnu Diyaljee
A.D.

Re: HWY 64:02 Embankment slide
Approx 3.5 mi West of Jct SH726

Karl and Pete van de ligt inspected the above slide on Nov 3, 89. after we had completed the test-pitting of the Clear River slide. Due to breaking-down of the backhoe, we could not test-pit the above site on the same day and had to re-schedule the test-pitting to my next visit to Peace River.

Site:

The slide is located on the north sideslope of the embankment across a creek connected by a 1m dia. culvert. The slide is approx. 40m wide and 15 to 20 m high and gradient is approx.3:1. The crown of slide has encroached to the edge of shoulder. There appears to be a french drain water-interceptor installed on the northwest cut/fill interface of the embankment.

On the upstream side (north) of the creek and approx. 10m from the toe of the north embankment sideslope, there is a beaver dam ponding up water to 2m above culvert bottom level. The steel culvert, that was installed in 82-83, appeared bent due to settlement of culvert foundation.

It is understood from Pete that
1) the subgrade was completed approx. 6 yrs ago;
2) the base course was completed approx. 3 yrs ago;
3) the slide has been fixed once already

OBSERVATION:

The cause of the slide might be:
-soft foundation of the embankment

-This cause, if confirmed, can be remedied by construction of a toe berm of approx. 1/3 of existing embankment height.

-The beaver dam might have to be relocated for berm construction and should be looked at also with perspective of environment concerns.

TESTING-PITTING has been scheduled in March 90.

Note written by
Karl Li

cc. Pete van de Ligt
Roy Callioux

Alberta MEMORANDUM

TRANSPORTATION
AND UTILITIES

FROM Assistant Director
Geotechnical Services Section
Materials Engineering Branch

OUR FILE REFERENCE

YOUR FILE REFERENCE

TO Roy Callioux
District Transportation Engineer
Peace River, Alberta
Attn: Pete Van Deligt

DATE July 3, 1990

TELEPHONE 427-3101

SUBJECT **HWY. 64:02 EMBANKMENT SLIDE**
APPROXIMATELY 3.5 MILES WEST OF JCT. SH 726

Karl Li and Pete van Deligt testpitted the above site on June 12, 1990. The observations were as follows.

SITE

Two slides were located on the north upstream sideslope of the embankment at a creek crossing with a 1 m dia. CSP culvert beneath. One slide was approximately 40 m wide, 10 m high and was on the western upper half of the 20 m high embankment slope; this slide is designated as the upper slide. The crown of this slide has encroached to the shoulder edge of the road. Another slide was located near the toe of the same slope at approximately 5 m west of culvert intake and is designated as the lower slide. The lower slide was approximately 10 m wide and 8 m high. A longitudinal CSP was located along the west cut/fill interface to channel water from ditch down to outfall to the creek. The toe of the slope appeared in good condition.

On the upstream side (north) of the creek and approximately 10 m from the toe of the north embankment sideslope, there was a beaver dam with water level at approximately 1 m above CSP culvert bottom level. The CSP culvert, that was installed in 1982-83, appeared bent due to settlement of foundation. The site is as shown on attached plan.

According to Pete's information, the embankment gradeline was completed in 1984, the base course was completed in 1987, and that a slide occurred at the same location shortly after base course completion and was subsequently repaired. We understood that this repaving of the road will be started shortly and that repairing the slope in conjunction with such repaving works is in order.

400PI004

SITE INVESTIGATION

Three testpits (TP 1-3) were dug at locations as shown on attached plan. Within the week of the time of testpitting, heavy precipitation was reported. TP 1 was dug close to top of slope at approximately 5 m below alignment level; TP 2 was dug at midslope level; TP 3 was dug at close to toe of slope at approximately 2 m above dammed water level. The results of testpitting are shown on attached table.

INFERENCE

For the upper slide, the above investigation tends to indicate shallow slab slide failure limited to less than 1 m depth and that breakage along the escarpment face of the previous slide was apparent. Such inference was based on the shallow sloughed material encountered in testpitting. The bottom half and the toe of the slope appeared in good condition.

For the lower slide, sloughing failure was evident.

Two horizontal granular layers, apparently installed during last repair operation, of approximately 0.5 m thick were located at approximately midslope and at toe of slope.

RECOMMENDATIONS

For the upper slide, the shallow sloughed material is to be removed and the exposed competent subgrade/fill be benched. The top half of the slope is be rebuilt with compacted competent material to key into the existing competent embankment fill. A 0.5 m thick horizontal blanket of granular material is to be installed at approximately 2 m below gradeline level for improving based friction to prevent further breakage/slippage of upper slope from the road. It is appropriate to start rebuilding from above the midslope granular layer. The GBC of the road is to be extended to daylight to the slope. Such repair works are shown in cross-section attached.

The lower slide is to be rebuilt with benched-in compacted material over a 0.5 m thick horizontal layer of granular material. It is understood from Pete that the beaver dam will be blown off prior to construction. Also, it is advisable to extend the longitudinal downdrain CSP closer to the creek to minimise gullying/erosion at the toe area. Approximately 20 m extension of the downdrain would be appropriate.

COSTS

The costs are estimated to be approximately $12,680 which breakdown is attached.

Should you require further information, please contact the undersigned.

Karl Li June 25, 90
for V. Diyaljee

KL/gc

cc: V. Diyaljee
M. Pariti M.P.
L.W. Nichols
R.D. Orrell
R. Callioux

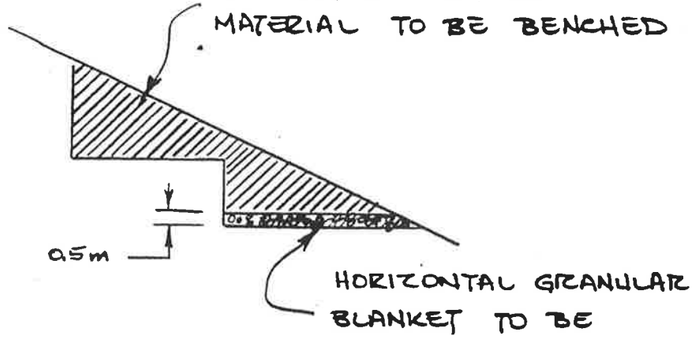
BREAKDOWN OF COST - HWY. 64:02

Material	Quantity	Rate		
Granular Material	200 m^3	@ \$6.50/m^3	\$1,300	
CSP Downdrain Extension	20 m	@ \$35/m	\$ 700	\$ 2,000
Equipment and Labour				
Packer (2 x 10 hrs)	20 hrs	@ \$45/hr	\$ 900	
Dozer (4 x 10 hrs)	40 hrs	@ \$60/hr	\$2,400	
Cat Scraper (3 x 10 hrs)	30 hrs	@ \$80/hr	\$2,400	
mo and demo (3 x 2 hrs)	6 hrs	@ \$70/hr	\$ 420	
Truck Hauling Waste			\$2,000	
Labourer (2) 1 x 40 hrs, 1 x 20 hrs	60 hrs	@ \$10/hr	\$ 600	
Foreman (1)	40 hrs	@ \$20/hr	\$ 800	\$ 9,520
			Subtotal	\$ 11,520
		+ approx. 10% contingency		\$ 1,160
				12,680

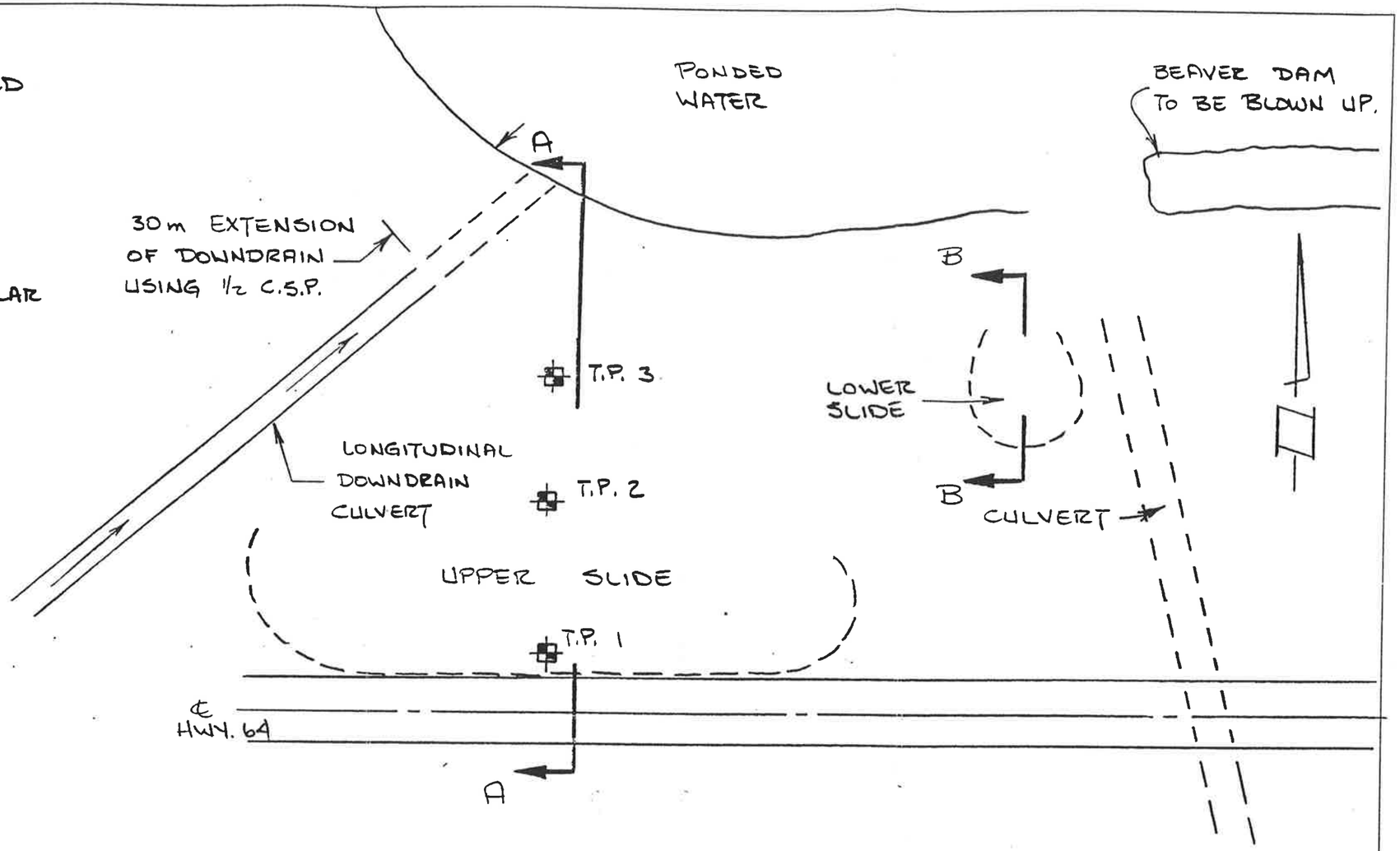
TESTPITS (TP)

TP 1		TP 2		TP 3	
Depth (m)		Depth (m)		Depth (m)	
0	Surface of top of slope	0	Surface of midslope	0	Surface of toe of slope
0-0.6	Sloughed material	0-0.6	Sloughed material	0-0.5	Moist to wet gravel
0.6-4.5	Dry to moist compacted silty clay fill	0.6-2.5	Moist compacted silty clay fill	0.5-4.0	Moist competent plastic clay fill
		2.5-3.0	Gravel Layer (wet at bottom)		
		3.0-5.0	Dry compacted silty clay fill		

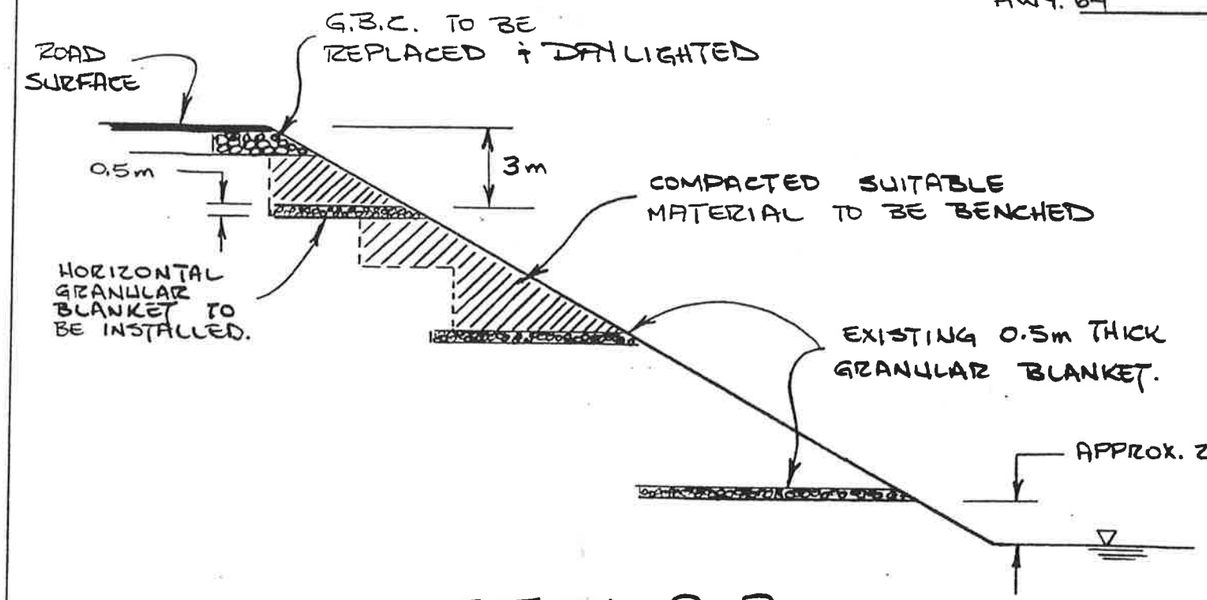
Table: Testpitting results for embankment slope at Hwy. 64:02 - 3.5 miles west of Jct. SH 726



SECTION B-B N.T.S.



PLAN N.T.S.



SECTION A-A N.T.S.

REV.	DATE	DESCRIPTION	BY
6			
5			
4			
3			
2			
1			

REVISIONS

APPROVED

ASSISTANT DIRECTOR GEOTECHNICAL SERVICES SECTION

DATE

Alberta TRANSPORTATION AND UTILITIES

MATERIALS ENGINEERING BRANCH
GEOTECHNICAL SERVICES SECTION

HWY. 64:02
PROPOSED REMEDIAL MEASURES FOR THE EMBANKMENT SLIDE
APPROX. 3.5 MILES W. OF JCT. SH 726

DESIGNED	LTA	DATE	PROJECT No.	DESCRIPTION	DISTRICT	A.T.E.	SHEET No.	DRAWING No.
DRAWN BY								

Alberta MEMORANDUM

TRANSPORTATION
AND UTILITIES

FROM Assistant Director
Geotechnical Services Section
Materials Engineering Branch
4th Floor, Twin Atria

OUR FILE REFERENCE

YOUR FILE REFERENCE

DATE August 20, 1990

TELEPHONE 427-3101

TO Roy Callioux
District Transportation Engineer
Peace River, Alberta
Attention: Pete van Deligt

SUBJECT **HWY. 64:02 EMBANKMENT SLIDE**
APPROX. 3.5 MILES WEST OF JCT. SH 726

This refers to our memo dated July 3, 1990 to R. Callioux, D.T.E., concerning recommendations for remedial works to the above slide.

Pete van Deligt, Project Manager, informed that upon destruction of the beaver dam and after draining away approximately 1 m depth of dammed water, a portion of toe bulging of approximately 15 m width was discerned. A major portion of the toe was still submerged to inhibit detailed observation. Also, shortly after implementation of the above remedial works, a vertical drop movement of approximately 0.3 m was observed at just below the alignment level.

Such occurrence was contrary to our expectation that a firmer toe bottom would be existent to our advantage. Such expectation was incurred in that during the last testpitting investigation, the height water at the apparent toe, caused by beaver dam, inhibit deeper exploring to find the true toe of the slope.

SITE INVESTIGATION

Further testpitting was carried out on July 18, 1990 by Karl Li and Pete van Deligt. Testpits (TP 4-6) were dug and is shown as per attached drawing. Such follow-up investigation revealed:

- Toe of slope to comprise of top 2 m of wet soft silty clay should be excavated and replaced with compacted competent clayey material for any toe foundation (TP-4). Firmer, less wet, clay to 2 m thickness was located beneath the top wet soft silty clay.

- Seepage at cut/fill interface, TP-5 revealed seepage at approximately 2.5 m below west ditch line (ie. 1.5 m below bottom of downdrain pipe) along side of northwestern embankment slope. At this testpit, seepage were recognized in native material beneath an 0.5 m thick organic layer beneath 1 m of silty clay fill followed by 0.5 m of granular material. Such seepage sources from the west backslope should be intercepted.

- Wet subbase material was located along line of breakage/edge of shoulder line and extending in depth to approximately 1 m below GBC. Along the roadway, such wet 1 m top fill should be subcut and replaced with competent compacted material. Such had been revealed at testpit (TP-6) that 1 m wet subbase of silty clay beneath GBC were followed by drier more competent fill material.

Visual inspection indicated that the culvert was bent upwards at both ends and the inside length beneath the embankment appeared straight. However, the upstream end appeared squashed to the east due to the last movement. Pete would be requesting Bridge Branch to appraise the integrity of the culvert and to participate in this culvert repair/extension operation.

INFERENCE

The last movement was apparently an adjustive movement as a result of the soft creek bottom of the creek foundation of the embankment as well as the seepage from the west backslopes. Such seepage flow served to saturate the fill and reactivate the old slip surface despite the proper weeping effect of the horizontal granular layers.

Vishnu/Karl reviewed the site on August 8, 1990 to concur on the undermentioned recommendations.

RECOMMENDATIONS

Further remedial works should be undertaken with a two stage approach:

Stage 1: is to intercept of any groundwater from the west backslopes and to define the slip plane by slope indicators for determination of the real toe movement location. The slope is to be monitored before consideration of stage 2 remedial measures.

Stage 2: is (option a) to construct a toe berm over the real toe location c/w culvert extension

or (option b) to retain the road by pile structures

or to implement a combination of both options. Such works is dependent on review of the results of stages 1.

Stage 1:

One subdrain should be installed along the full length of the northwestern ditch down the slope at 3.5 m depth (approx. 2.5 m below bottom of existing downdrain) and to outfall to the creek. This subdrain might be dug adjacent the existing downdrain to its desired depth and should be 0.6-1 m wide (bucket width) or the downdrain excavation might have to be considered prior to subdrain installation. The bottom of the subdrain should be below any organic layer encountered. The subsurface drains is to be lined with impermeable membrane at the embankment slope face as well as the bottom face and backfilled with free draining granular material c/w perforated pipe. The layout of the subdrain is shown on the attached drawing.

Based on review of the site (August 8, 1990), three slope indicators have been installed by us on August 13, 1990 down the slope and will be monitored regularly. The performance of the slope as well as the exact location of the toe movement location will be determined by the results of such slope indicator monitoring. Such results will be reviewed before Stage 2) toe berm construction is to be considered.

Stage 2:

This stage 2 includes either toe berm construction c/w culvert extension or retaining the road with piles is dependent on review of results from stage 1.

Option a: Toe Berm c/w Culvert Extension

A toe berm should be constructed over the location of the true toe of the slope as determined by slope indicator monitoring. The toe berm should be found on competent ground; any top thickness of wet/soft incompetent should be excavated before construction. Existing horizontal granular layers should be connected to daylight to the side of the toe berm. Length of toe berm is estimated to be approx. 40 m. Borrow material should be available from the north backslope area. Approx. 20 m extension of culvert towards upstream is estimated. Existing ditches down the sides of the embankment slope might have to be shifted to the backslope to accommodated the end of the toe berm.

To repair crack area along shoulder line, any wet subbase beneath the GBC should be subcut and replaced with compacted competent material so that later separation at old juncture can be avoided.

Option b: Retaining Piles

Retaining the road by piles might also be feasible. Such retaining piles were contemplated on the ground that only a shallow height of roadway is to be retained and that messy treatment of creek bottom for toe berm foundation can be avoided. A detailed design of the retaining piles will be provided after review of the results from stage 1.

COST & QUANTITIES

For Stage 1 subdrain, approx. 100 m perforated pipe and 500 sq. impermeable membrane is estimated. Total cost of 100 m subdrain installation are estimated to be $10,600 (breakdown is attached).

We hope that the above recommendations are satisfactory. Should you require further information, please contact the undersigned.

Aug 20.90

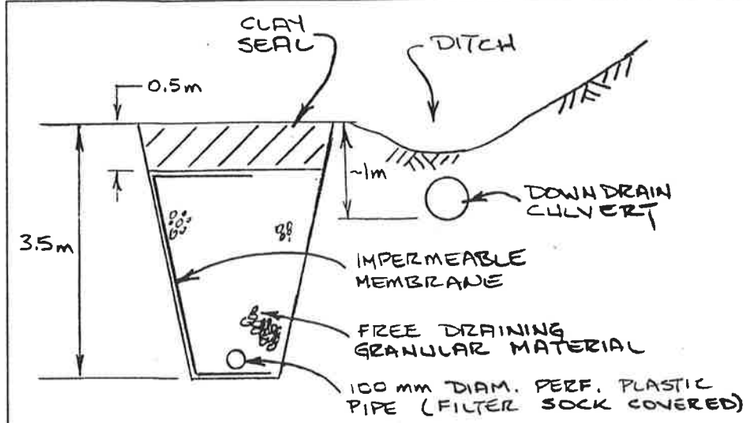
Karl Li
for V. Diyaljee

KL/tm

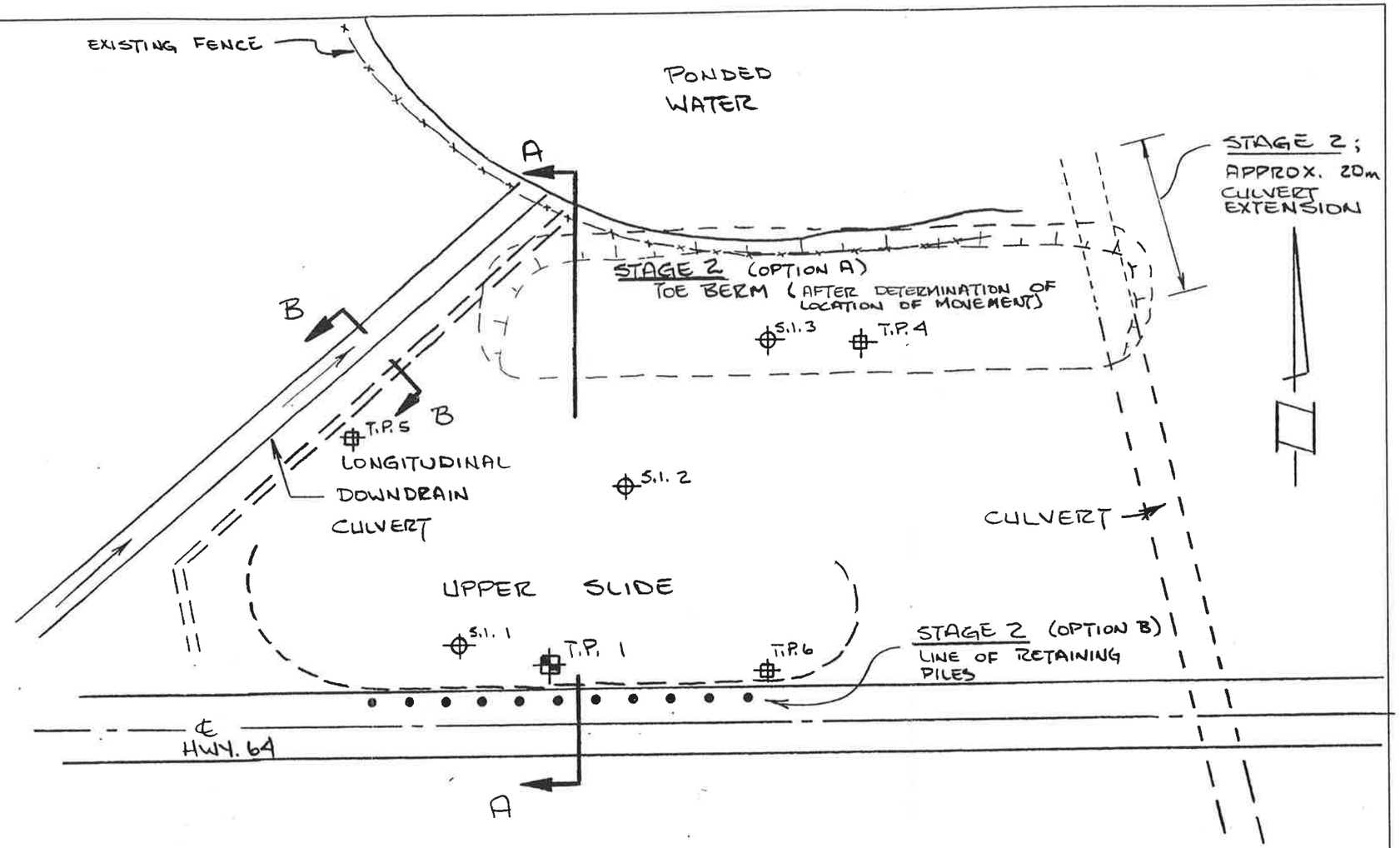
cc: V. Diyaljee August 21/90
M. Pariti
L. Nichols
R. Callioux
R. van Deligt
G. Newman

BREAKDOWN OF COSTS (STAGE 1)
(SUBDRAIN CONSTRUCTION HWY 64:02)

	QUANTITY	RATE	AMOUNT	TOTAL
EQUIPMENT				
Backhoe	40 hrs	$85/hr.	3400	
Dozer (D6)	10 hrs	$65/hr.	650	
Loader	20 hrs	$85/hr.	1700	
Mo & Dems	2 x 3 hrs	$70/hr.	420	6170
MATERIAL				
Impermeable membrane	500 sq. m	$1.25/$m^2$	625	
Perforated pipe	100 m	$1.8/m	180	
Granular material	300 m^3	$4/m	1200	2005
LABOUR				
1 Foreman	40 hrs	$20/hr.	800	
2 Labourers	2 X 40 hrs	$10/hr.	800	1600
SUBTOTAL				9775
+ 10% contingency on equipment and labour				825
TOTAL				10600

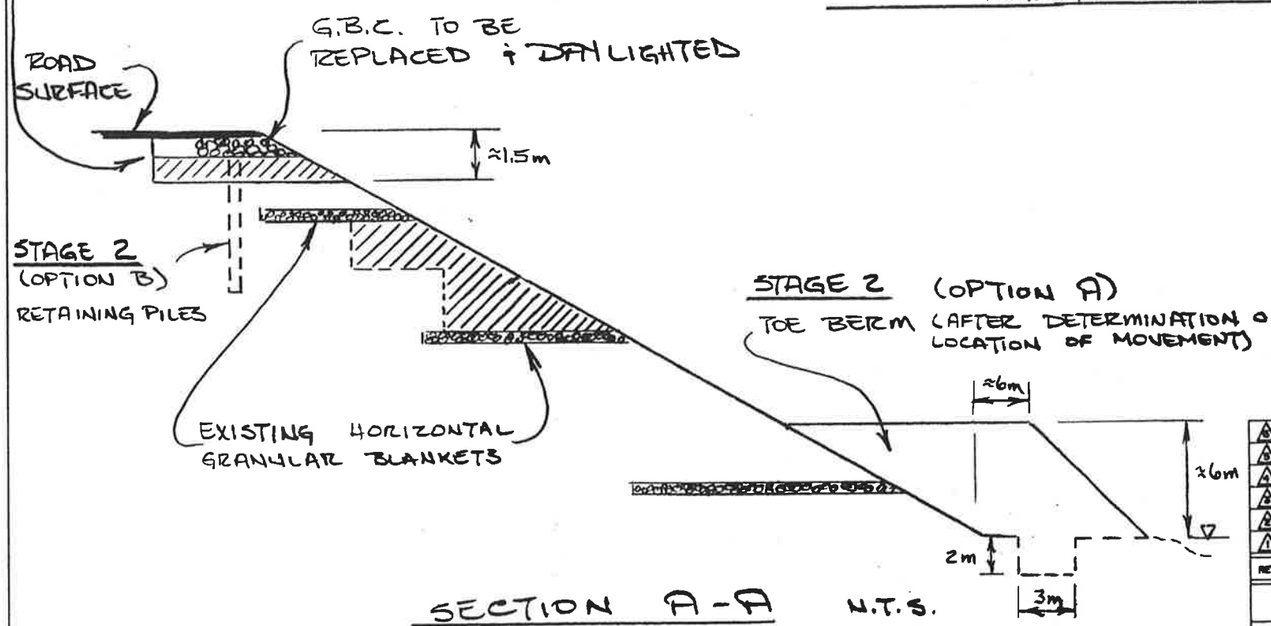


SECTION B-B N.T.S.



PLAN N.T.S.

STAGE 2; TO REPAIR CRACK AREA, SUBCUT WET MATERIAL INTO LANE WIDTH & BENCH TO COMPETENT MATERIAL; REPLACE WITH COMPACTED COMPETENT MATERIAL.



SECTION A-A N.T.S.

NOTE: S.I. – SLOPE INDICATOR
T.P. – TEST PIT
● – RETAINING PILES

REV.	DATE	DESCRIPTION	BY
A			
B			
C			
D			
E			
F			

REVISIONS

APPROVED
for ASSISTANT DIRECTOR GEOTECHNICAL SERVICES SECTION
DATE July 3/96

Alberta TRANSPORTATION AND UTILITIES
MATERIALS ENGINEERING BRANCH
GEOTECHNICAL SERVICES SECTION

HWY. 64:02 PROPOSED
REMEDIAL MEASURES (STAGES 1&2)
FOR THE EMBANKMENT SLIDE
APPROX. 3.5 MILES W. OF JCT. SH 726

DESIGNED / DRAWN BY / REVISED BY		DATE	PROJECT No.	DESCRIPTION	DISTRICT	D.T.S.	SHEET No.	DRAWING No.
	LTA							

GEOTECHNICAL SERVICES SECTION

MATERIALS ENGINEERING BRANCH

199-01-23
3004529

GEOTECHNICAL FIELD INVESTIGATION

INCLINOMETER INSTALLATION

HWY. 64:02 - SOUTH OF WORSLEY

3.5 km W. OF JCT. SH 726:02

REGION 614

Prepared by: E. Tislak
Technologist III

Reviewed by: G. Newman
Field Services Tech.

Geotechnical Section
September, 1990

NOTE TO FILE

SLIDE ON HWY 64:02 SOUTH OF WORSLEY

OR WEST OF S.H. 726

On August 13, 1990 a drill was sent to a slide area approx. 5 km west of SH 726. A cat made 3 pads on side slope at three different locations, 1 pad on top near pavement, 1 near the middle of the side slope and 1 at the bottom of the side slope. A total of 4 test holes were drilled including 1 on the pavement and 3 slope indicators were installed in the side slope. TH #64-4 was drilled on pavement to verify the material type and stability for possible installation of pile structures at a later date.

TH# 64-1 was drilled at Sta. 52+606 and 30m lt. centerline right at the bottom of the side slope and was drilled to a depth of 18.75m at which depth a hard material of +50 blows per foot on the SPT Test was encountered. The material in this area was predominately clay with a lot of gravel present which made sampling the material extremely difficult. The clay was +OPT and was very slippery to a depth of approx. 10m. Below 10m was hard and not quite as wet (near OPT) and seemed a lot more stable. The bottom of the SI is anchored at a depth of 17m.

TH #64-2 was drilled at Sta. 52+594 and 23m lt of centreline. There was a big crack in the vicinity which was difficult to seal as 8 bags of mud were used and 7 loads of water were used and it took approx. 10 hours to drill the test hole to 21.30m in depth. The circulation was being lost at between 1.40m to 4.00m. Water from drilling was coming out of the cracks up to 10m behind the drill. The material from 0m to 7.0m was a silty sandy, gravelly clay which was above OPT. The gravel in clay made sampling difficult. The clay from 7.0m to 13.0m was silty and layered with very little sand and gravel content. This clay was above OPT and very slippery when wet and also slip plans were evident. As it was very slippery when wet, it probably had some bentonite mixed in. But it appears the slide plane was between probably 3-4m deep. The clay from 13.00m to bottom of hole was silty, sandy and gravelly and was stiff to hard and is very stable. The bottom of the SI was anchored at 21.30m or 8.30m in the stiff clay.

TH #64-3 was drilled at Sta. 52+585 and 12m lt of centerline. This location was 3m left of crack near top of slide. There was no loss of circulation in this test hole. The material in this test hole was predominately clay. The fill was a silty, sandy, gravelly type of clay with a slightly above OPT. At approx. 6.0m, there was less gravel and sand content and slip planes became evident until 15.00m where the clay changed to silty sandy and gravelly type which was at OPT and was very stable. The bottom of SI was anchored at 21.30m or 6m into the clay.

TH #64-4 was drilled at Sta. 52+602 and 3m right of centerline on top of the pavement. The clay fill from 0.30m to 7.65m was silty, sandy and gravelly and slightly above OPT. The clay seemed stable even though the pavement was cracking. From 7.65m to 7.80m was an organic layer which indicated end of fill and beginning of natural ground. The clay from 7.80m to 16.75m was silty but with only traces of gravel. The clay was slightly above OPT and the slip planes were evident but it seemed stable. From 16.75 to 27.90m the clay was silty, sandy and gravelly and is near OPT and is very hard. There was no loss of circulation in this hole.

The whole area that slid was moving a little as fresh cracks appeared on the pavement as far as centerline. There was no evidence of free water on any of the samples that were retrieved or any evidence of springs in the area. There was evidence of cracks opening up on the side slopes in the slide area with the worst being in the vicinity of test hole #64-2. The slide on the whole is fairly shallow as the elevation from the top of the road to the bottom of the side slope is not more than 10m and the material under the road itself seems quite stable. The proposed piles would probably solve the problem as the whole area was dug out and rebuilt with more competent material once before.

E. Tislak
Tech. III

SLIDE SOUTH OF WORSLEY	STATION: 52-808, 30 M LT OF CENTERLINE	BOREHOLE No. 84-1
ALBERTA TRANSPORTATION & UTILITIES	MAYHEW 1000, NODWELL, TRACK	Project No: 84:02
PROJECT ENGINEER: K.L.	GARRITTY & BAKER DRILLING LTD.	ELEVATION 86.22 (m)

SAMPLE TYPE: SHELBY | CORE | SPT | GRAB SAMPLE

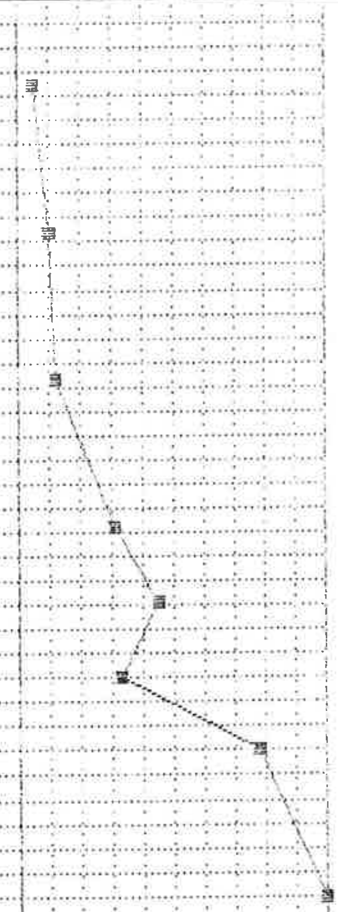
DEPTH (m)	SOIL PROFILE	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS PER 150 mm
2.0			SPT	nr	2-2-3
3.0		CLAY-silty, sandy, gravelly	SHELBY	24988	REC=75%
5.0			SPT	1	2-4-6
6.0			SHELBY	27488	REC=50%
7.0–8.0		-soft, +opt -very slippery, possible some bentonite present	SPT	2	3-6-6
9.0			SHELBY	nr	REC=0%
11.0			SPT	nr	7-14-17
12.0		-gravel in the clay mode	SPT	nr	12-19-28
13.0–14.0		samples difficult to get -very gravelly @ 13.00 m	SPT	3	10-13-20
15.0			SPT	nr	14-28-50
18.0			SPT	nr	50-60/3
19.0		TOAL DEPTH DRILLED 18.75 M			

-install 18.3 m S.I.casing
-2 bags cement
-250 lts of water
-N-groove 20 W of Mag North
-0.97 m stickup

PLASTIC — M.C. — LIQUID: 20 40 60 80

100 200 300 400
BLOW COUNT: 20 40 60 80
UNCONF. SHEAR STR. (kPa): 100 200 300 400
0.5 x POCKET PEN. (kPa): 1.0 2.0 3.0 4.0

OTHER DATA



Alberta Transportation Edmonton, Alberta	COMPLETION DEPTH 18.8 m	COMPLETE 90/08/15
	LOGGED BY E.T.	DWG NO..

SLIDE SOUTH OF WORSLEY	STATION: 62+594.23 M LT OF CENTERLINE	BOREHOLE No. 64-2
ALBERTA TRANSPORTATION & UTILITIES	MAYHEW 1999. NODWELL. TRACK	Project No: 64:02
PROJECT ENGINEER: K.L.	GARRITY & BAKER DRILLING LTD.	ELEVATION 99.86 (m)

SAMPLE TYPE: SHELBY | CORE | SPT | GRAB SAMPLE

DEPTH (m)	SOIL PROFILE	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS PER 150 mm	PLASTIC / M.C. / LIQUID (20 40 60 80)	BLOW COUNT (20 40 60 80) / UNCONF. SHEAR STR. (kPa) (100 200 300 400) / 0.5 x PICKET PEN. (kPa) (1.0 2.0 3.0 4.0)	OTHER DATA
0.0								
1.0		-0.2 m gravel layer @ 1.2 m		1&2&	REC=50%			
2.0		-losing circulation @ 1.2 m						
3.0				4	4-5-7			
4.0		CLAY-silty,sandy,gravelly						
5.0		-drilling on a crack		5	REC=0%			
6.0		-water coming out of crack 10 m away		6	10-7-8			
7.0		-gravel is making sampling very difficult						
8.0				8	3-4-7			
9.0		CLAY-silty,traces of sand & gravel, +cot		9	2-7-9			
10.0		-possibly bentonite						
11.0				11	4-10-11			
12.0		present as sample is very slippery		12	4-9-13			
13.0								
14.0				14	8-19-26			
15.0		CLAY-silty,sandy,gravelly		15	10-27-41			
16.0		-near opt						
17.0								
18.0				18	15-30-33			
19.0		-gets hard						
20.0								
21.0				21	26-30-33			
22.0		TOTAL DEPTH DRILLED 21.80 M						
23.0		-install 21.33 m of S.I.						
24.0		-2 bags cement						
25.0		-200 lbs of water						
26.0		-0.72 m stickup						
27.0		-N-groove 20 W of Mag North						
28.0								
29.0								

Alberta Transportation
Edmonton, Alberta

COMPLETION DEPTH 21.8 m		COMPLETE 90/08/16
LOGGED BY E.T.	DWG NO..	Page 1 of 1

SLIDE SOUTH OF WORSLEY	STATION: 62+695, 12 M LT OF CENTERLINE	BOREHOLE No. 64-2
ALBERTA TRANSPORTATION & UTILITIES	MAYHEW 1000, NODWELL, TRACK	Project No. 64:02
PROJECT ENGINEER: K.L.	GARRITTY & BAKER DRILLING LTD.	ELEVATION 101.45 (m)

SAMPLE TYPE: SHELBY | CORE | SPT | GRAB SAMPLE

DEPTH (m)	SOIL PROFILE	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	BLOWS PER 150 mm	PLASTIC / M.C. / LIQUID (20 40 60 80)	A A 100 200 300 400 — BLOW COUNT (20 40 60 80) — UNCONF. SHEAR STR. (kPa) (100 200 300 400) — 0.6 x POCKET PEN. (kPa) (1.0 2.0 3.0 4.0)	OTHER DATA
0.0								
1.0								
2.0		CLAY-silty,sandy,gravelly		10	7-10-20			
3.0		-near opt		10805	RED=40%			p.c.=1.60
4.0								
5.0		-softer and wetter		11	4-7-8			
6.0		-end of fill at 6.0 m						
7.0				64-1	RED=75%			p.c.=1.50
8.0		CLAY-silty,traces of sand & gravel, near opt		12	6-9-13			
9.0				66839	RED=90%			p.c.=2.00
10.0								
11.0				13	4-9-13			
12.0				14	5-9-12			
13.0		-very slippery, possibly some bentonite present						
14.0				15	6-10-16			
15.0								
16.0				16	12-20-29			
17.0		CLAY-silty,sandy,gravelly						
18.0		-opt						
19.0		-hard & quite dry		17	10-19-31			
20.0								
21.0								
22.0				19	19-38-42			
23.0		TOTAL DEPTH DRILLED 21.80 m						
24.0		-21.33 M of SI casing inst.						
25.0		-2 bags of cement						
26.0		-250 lbs of water						
27.0		-0.95 m stickup						
28.0		-N-groove 15 W Mag North						
29.0								
30.0								

Alberta Transportation
Edmonton, Alberta

COMPLETION DEPTH 21.8 m		COMPLETE 90/08/21
LOGGED BY E.T.	DWG NO..	Page 1 of 1

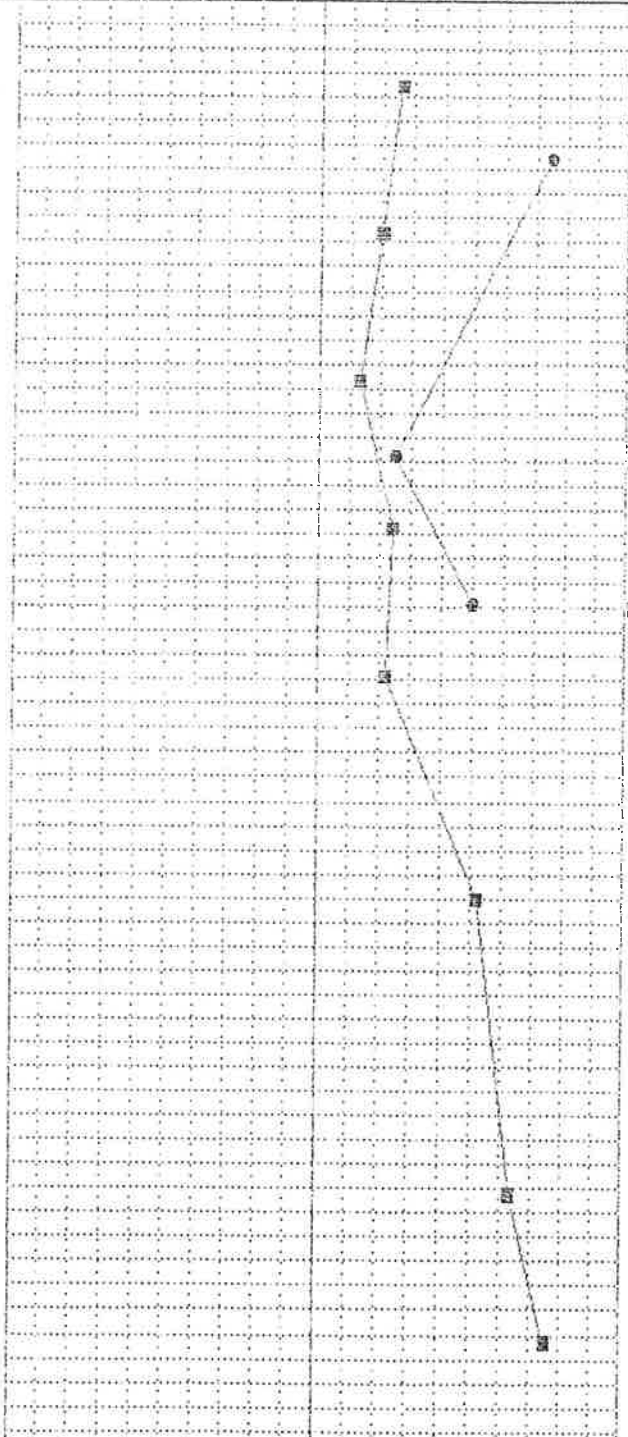
SLIDE SOUTH OF WORSLEY	STATION. 52-802. 3 M LT OF CENTERLINE	BOREHOLE No. 64-4
ALBERTA TRANSPORTATION & UTILITIES	MAYHEW 1000. NODWELL. TRACK	Project No: 64.02
PROJECT ENGINEER: K.L.	GARRITTY & BAKER DRILLING LTD.	ELEVATION 103.87 (m)

SAMPLE TYPE: SHELBY | CORE | SPT | GRAB SAMPLE

DEPTH (m)	SOIL DESCRIPTION	SAMPLE NO	BLOWS PER 150 mm	OTHER DATA
0.0	ASPHALT			
	CRUSH			
2.0		19	5-12-14	
3.5	CLAY—silty, sandy, gravelly —near topt —fill material	13986	REC=90%	p.p.=3.755
5.0		20	6-10-10	
6.5		nr	REC=0%	
8.0	ORGANIC LAYER —end of fill —natural ground	21	5-7-9	
9.5	CLAY—silty, traces of sand & gravel	84-2	REC=90%	p.p.=1.25
11.0	—slip planes are evident	22	6-11-13	
12.5		12089	REC=90%	p.p.=2.50
14.0		23	6-9-13	
15.5	—possibly some bentonite content	24	80/5	
17.0	CLAY—silty, sandy, gravelly			
18.5		25	12-24-28	
21.5	—more stable	nr	18-42-38	
24.5	—pebbles present	26	18-30-33	
27.5		27	18-31-44	
27.9	TOTAL DEPTH DRILLED 27.90 M			

PLASTIC — M.C. — LIQUID: 20 40 60 80

▲ 100 200 300 400 | ■ BLOW COUNT ■ 20 40 60 80 | ● UNCONF. SHEAR STR. (kPa) ● 100 200 300 400 | ● 0.5 x POCKET PEN. (kPa) ● 1.0 2.0 3.0 4.0



Alberta Transportation Edmonton, Alberta	COMPLETION DEPTH 27.9 m	COMPLETE 90/08/22
	LOGGED BY E.T.	DWG NO..

Alberta
TRANSPORTATION AND UTILITIES
MATERIALS ENGINEERING BRANCH
GEOTECHNICAL SECTION

SLOPE INDICATOR INSTALLATION RECORD

PROJECT : 64:02 LOCATION : SOUTH OF WORSLEY.

DATE INSTALLED : 90/08/15 TEST HOLE No.: 64-1

SLOPE INDICATOR CASING No.: 1 OFF SET : 30 M LT ℄

STATION : 52+606

ELEVATION (GRD. SURFACE) : 96.220 ELEVATION (TOP OF CASING) : 97.190

TOTAL LENGTH OF SLOPE INDICATOR CASING INSTALLED : 18.30 METRES 60 FEET

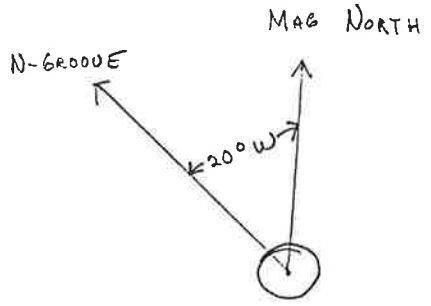
TECHNOLOGIST : E TISLAR CONSULTANT :

DRILL CONTRACTOR : G & B DRILLER : H. JOHNSON

GROUT MIXTURE & QUANTITY : 2 BAGS NORMAL CEMENT, 1 BAG MUD, 25 LT WATER

GROOVE ORIENTATION AT TOP OF CASING : N-GROOVE IS 20° WEST OF MAGNETIC NORTH

(DRAW DIAGRAM INDICATING GROOVE ORIENTATION & ORIENTATION RFEERENCE POINT FOR SLOPE INDICATOR SENSOR)



COMMENTS : (INSTALLATION PROCEDURES ETC.) S.I. CASING WAS SET IN HOLE AND CEMENT WAS PUMPED IN THROUGH 3/4" HOSE TAPED TO THE SI CASING. NO PROBLEMS WERE ENCOUNTERED DURING INSTALLATION

Alberta
TRANSPORTATION AND UTILITIES
MATERIALS ENGINEERING BRANCH
GEOTECHNICAL SECTION

SLOPE INDICATOR INSTALLATION RECORD

PROJECT : 64:02 LOCATION : SOUTH OF WORSLEY

DATE INSTALLED : 90/08/16 TEST HOLE No.: 64-2.

SLOPE INDICATOR CASING No.: 2 OFF SET : 23 M LT ℄

STATION : 52+594.

ELEVATION (GRD. SURFACE) : 99.680 ELEVATION (TOP OF CASING) : 100.400

TOTAL LENGTH OF SLOPE INDICATOR CASING INSTALLED : 21.33 METRES 70 FEET

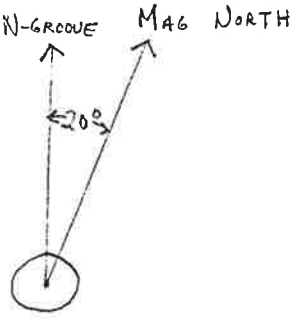
TECHNOLOGIST : E TISLAK CONSULTANT :

DRILL CONTRACTOR : G & B DRILLER : H JOHNSON

GROUT MIXTURE & QUANTITY : 2 BAGS NORMAL CEMENT, 1 BAG MUD, 250 LT WATER.

GROOVE ORIENTATION AT TOP OF CASING : N-GROOVE IS 20° WEST OF MAGNETIC NORTH

(DRAW DIAGRAM INDICATING GROOVE ORIENTATION & ORIENTATION RFEERENCE POINT FOR SLOPE INDICATOR SENSOR)



COMMENTS : (INSTALLATION PROCEDURES ETC.) SAME AS S.I. #1.
NO PROBLEMS INSTALLING SI CASING.

Alberta
TRANSPORTATION AND UTILITIES
MATERIALS ENGINEERING BRANCH
GEOTECHNICAL SECTION

SLOPE INDICATOR INSTALLATION RECORD

PROJECT : 64:02 LOCATION : SOUTH OF WOFSLEY

DATE INSTALLED : 90/08/21 TEST HOLE No. : 64-3

SLOPE INDICATOR CASING No. : 3 OFF SET : 12 M LT ℄

STATION : 52+585

ELEVATION (GRD. SURFACE) : 101.45 ELEVATION (TOP OF CASING) : 102.40

TOTAL LENGTH OF SLOPE INDICATOR CASING INSTALLED : 21.33 METRES 70 FEET

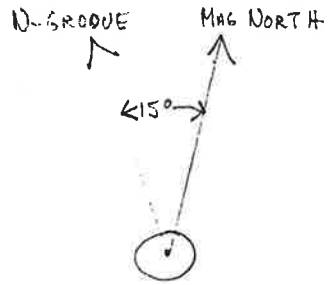
TECHNOLOGIST : E TISLAR CONSULTANT :

DRILL CONTRACTOR : C & B DRILLER : H JOHNSON

GROUT MIXTURE & QUANTITY : 2 BAGS NORMAL CEMENT, 1 BAG MUD, 250 LT WATER

GROOVE ORIENTATION AT TOP OF CASING : N-GROOVE IS 15° WEST OF MAG NORTH

(DRAW DIAGRAM INDICATING GROOVE ORIENTATION & ORIENTATION RFEERENCE POINT FOR SLOPE INDICATOR SENSOR)



COMMENTS : (INSTALLATION PROCEDURES ETC.) SAME PROCEDURE AS USED IN S.I. # 1 NO PROBLEMS WITH INSTALLATION.

Alberta

TRANSPORTATION
AND UTILITIES

MEMORANDUM

FROM Assistant Director
Geotechnical Services
Materials Engineering Branch
4th Floor, Twin Atria

OUR FILE REFERENCE ~~1470-64~~

YOUR FILE REFERENCE 79554

TO R. Callioux
District Transportation Engineer
Peace River, Alberta
ATTENTION: Pete van Deligt

DATE Nov. 15, 1990

TELEPHONE 427-3101

SUBJECT HWY 64:02 EMBANKMENT SLIDE
APPROXIMATELY 3.5 MILES WEST OF JCT 736

We refer to our memo to you dated August 20, 90 concerning our recommendation to implement remedial works in stages. After monitoring of the slope indicator results, we reckon that the mentioned stage 2) toe berm construction c/w culvert extension is required.

A toe berm should be constructed to midslope height to extend minimum 12m upstream from the lowest slope indicator at the existing toe of the slope. Such toe berm, approx. 80m in length, is to extend from the west downdrain location to approx. 15m east of embankment culvert. The bottom of such toe berm should be stripped off any incompetent soft material.

Approx. 25m extension of the existing embankment culvert is required. Proper culvert connection design for shear strength should be ensured such that any probable minor adjustive movement at berm/slope interface can be accommodated and that the probability of leakage as a result of any breakage can be minimized. Consultation with Bridge Branch in regard to the design of such culvert connection is recommended. Construction of appropriate designed culvert bedding as well as rip rap protection at headwater should also be carried out in conjunction with Bridge Branch.

Along the west side of the slope, approx. 30m of extensions of i) a downdrain pipe and ii) subdrain(installed in stage 1 in Sept 90) are required. As the outlet of the installed subdrain is at the toe elevation, extension of such subdrain with 1m x 1m granular material c/w perforated pipe with outfall to a safe distance away from the slope is reckoned as adequate. The above mentioned works are shown on attached drawing.

.../2

Tom

Tom.

Such design is based on survey data provided by you on Oct 19, 90 and upon slope indicator monitoring results which pointed to slippage around the fill or native silty clay material at 6-10m below surface. Triaxial tests on foundation soil were performed; however, slope stability analysis were performed using modified values of such test results. Due to soft foundation conditions, minor adjustive movement might be expected without adverse effect to the berm countermeasure and is not expected to encroach closer than 20m of road edge.

Upon completion of installation of the toe berm, minor escarpment adjacent the roadway should be shaped by dozer operations and any wet subgrade immediate beneath the roadway should be subcut and replaced by compacted competent material.

SUPPLIES & QUANTITIES

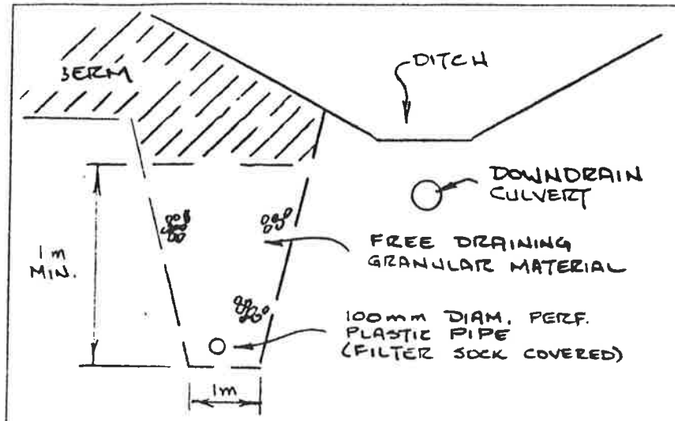
We expect that approx. 30m of perforated pipe and 120 cu. m. of free draining granular material is required for subdrain extension. The fill quantities for the toe berm, approx. 80m in length extending from the west downdrain location to approx. 15m east of embankment culvert, is estimated as approx. 10,000 cu. m.

We hope that the above report is satisfactory. Should you require further information, please contact the undersigned.

Karl Li Nov. 15, 90

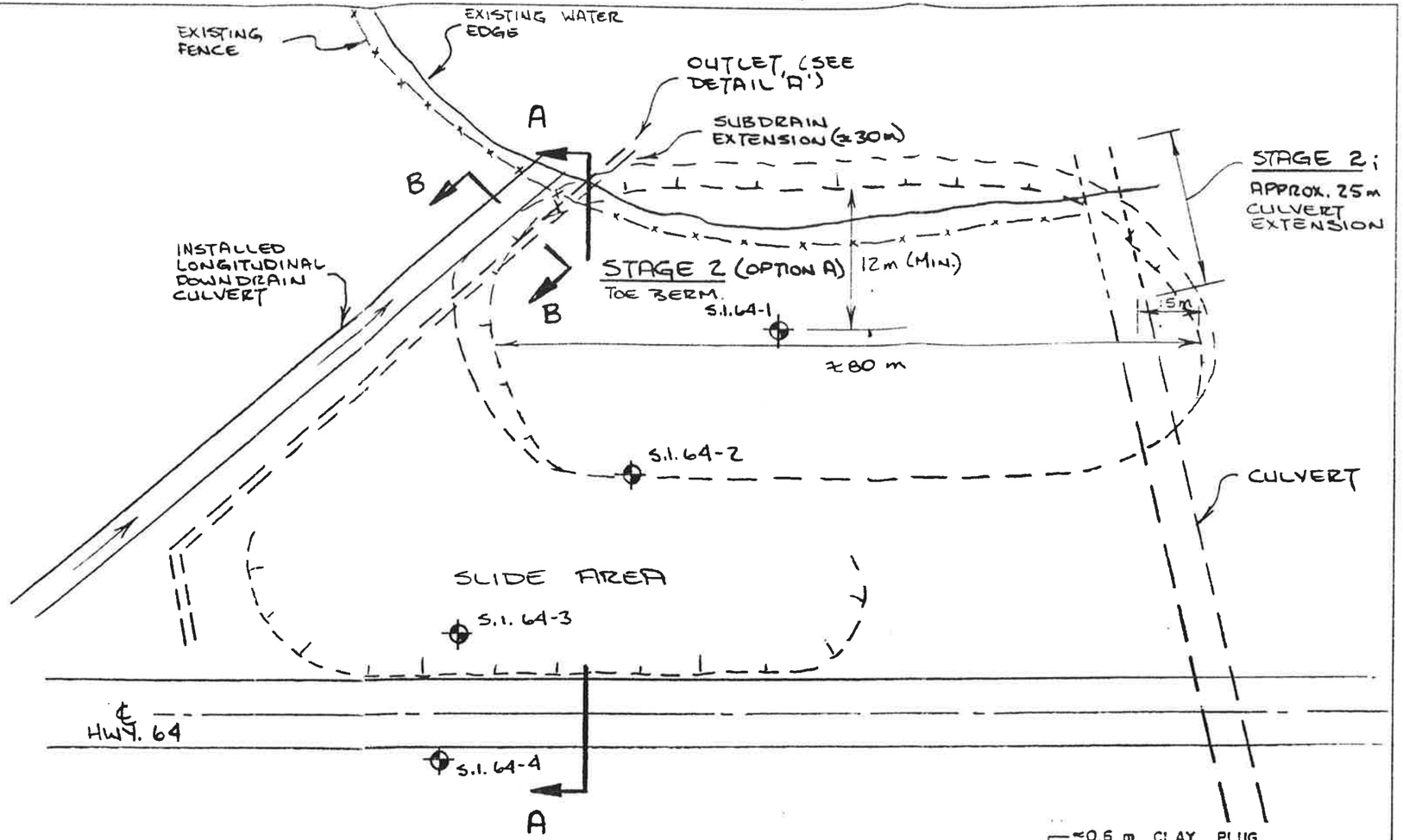
cc.
V. Diyaljee Nov 17/90
D. Palsat
[redacted]
T. Belke -

Note: please refer to para. 3 concerning the design of culvert connection

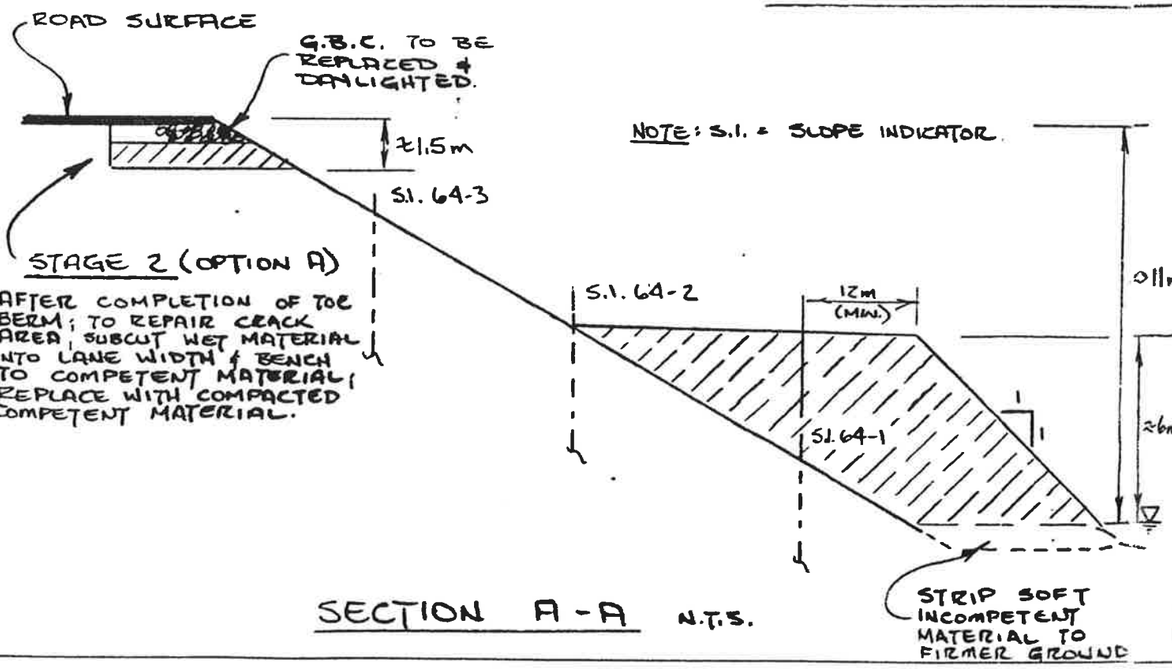


SECTION B-B, N.T.S.

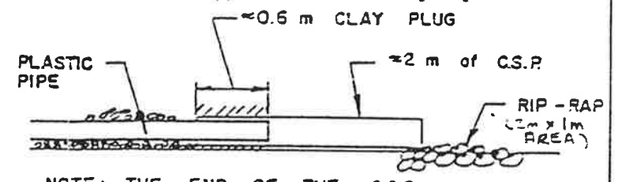
EXTENSION OF SUBDRAIN AT TOE OF SLOPE



PLAN N.T.S.



SECTION A-A N.T.S.



NOTE: THE END OF THE C.S.P. TO BE MARKED WITH A WHITE 4" x 4" POST. TYPE OF PIPE, SIZE, & YEAR INSTALLED TO BE MARKED.

DETAIL 'A'

N.T.S.

REV.	DATE	DESCRIPTION	BY
6			
5			
4			
3			
2			
1			

REVISIONS

APPROVED

ASSISTANT DIRECTOR GEOTECHNICAL SERVICES SECTION

DATE 12/17/92

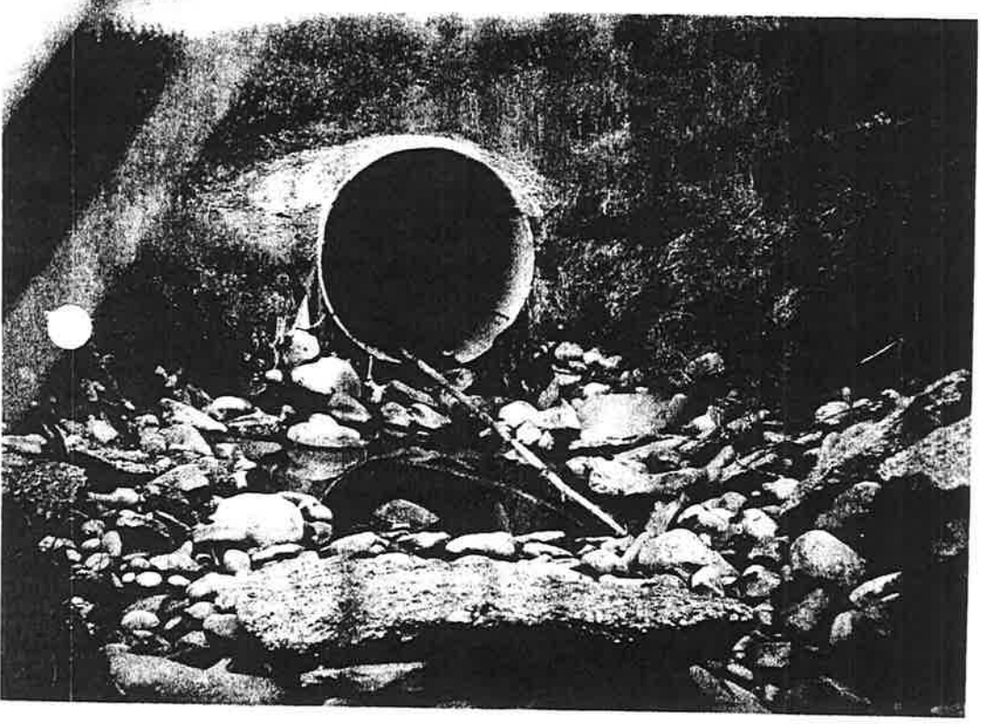
Alberta TRANSPORTATION AND UTILITIES

MATERIALS ENGINEERING BRANCH
GEOTECHNICAL SERVICES SECTION

HWY. 64:02 PROPOSED TOE BERM CONSTRUCTION (STAGE 2A) FOR THE EMBANKMENT SLIDE APPROX. 3.5 MILES W. of JCT. S.H. 726

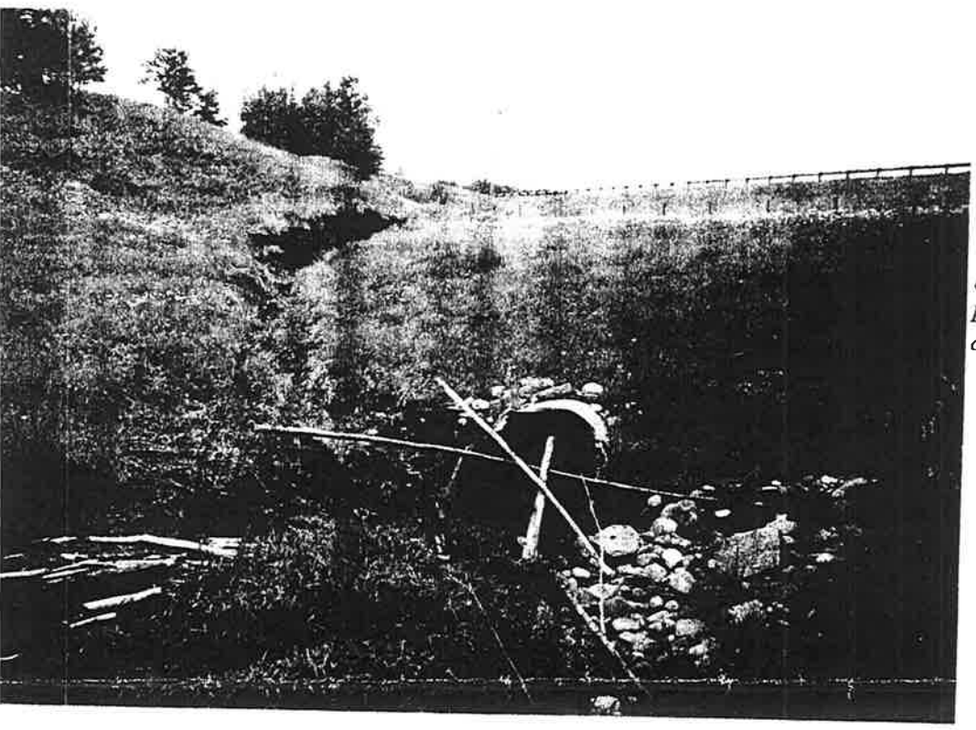
DESIGNED DRAWN BY REVIEWED BY	LTA	DATE	PROJECT No.	DESCRIPTION	DISTRICT	O.T.E.	SHEET No.	DRAWING No.

Assenheimer Engineering Ltd.	File: *79554*
	Date: *June 18, 1997*
Watercourse	By: *Randy Bredo*
Highway 64 - Worsley	Page: *1 of 2*



The outlet has been repaired in the past with ample rock (though small) in the streambed.

June 18/97



Ditch erosion gully at the NE corner all the way down.

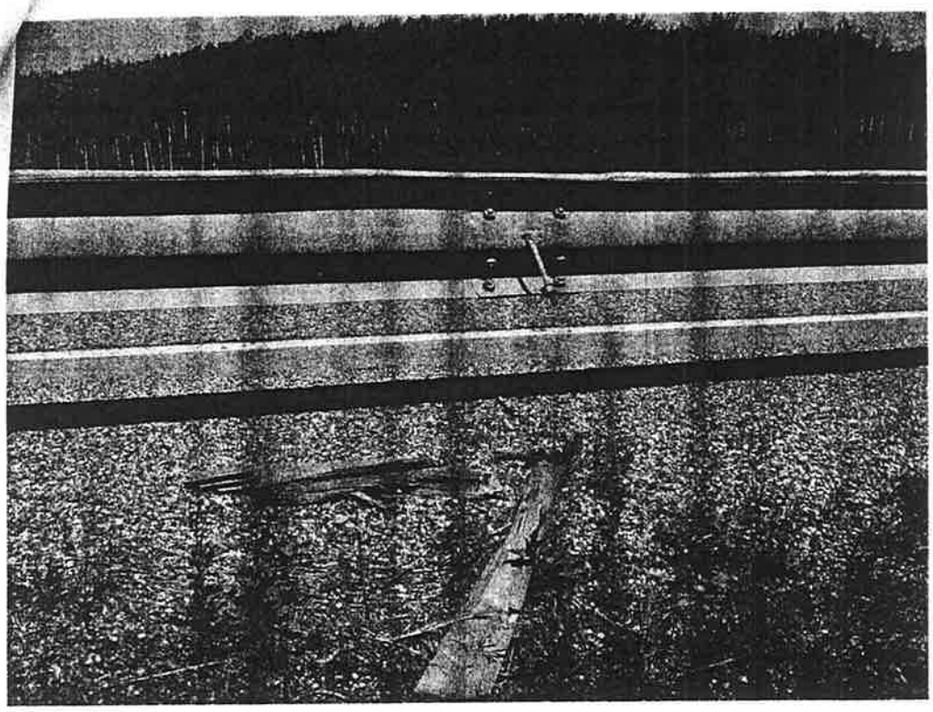
COMMONWEALTH SEAG

LEGEND:

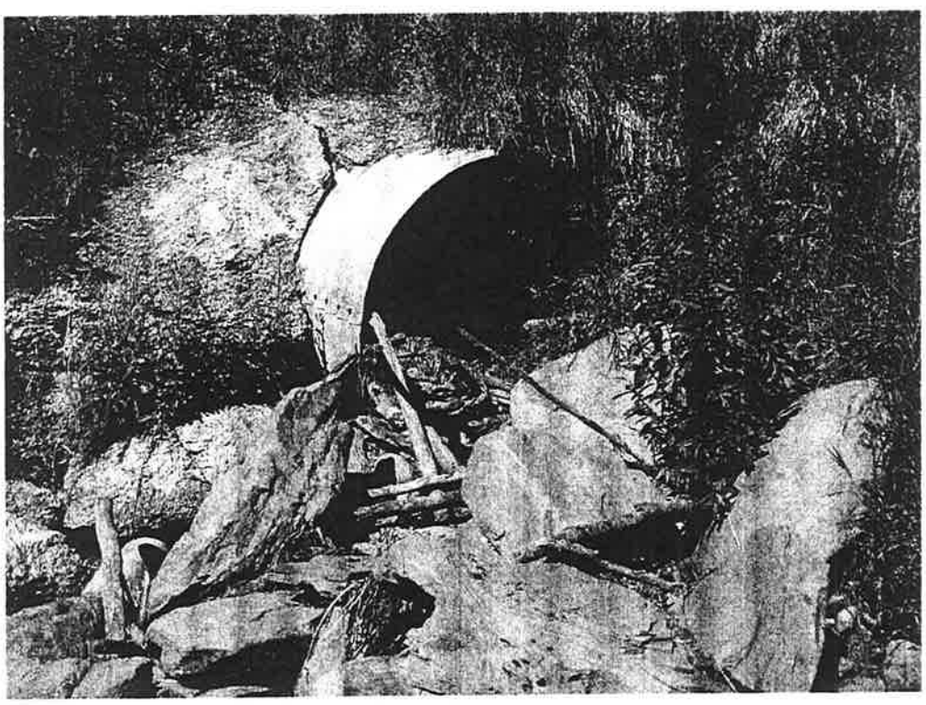
- Power Pole
- x Soil Resistivity Lo
- Foreign U/G Structu

Remarks:

ngineering Ltd.	File No.:	BF 79554
	Date:	July 20, 2006
Tributary to Peace River	By:	Tim Miskiman
Highway 64 near Worsley, SE 17 – 085 – 08 – 6	Page:	1 of 2



Viewing the missing post on the south side of the guardrail.



Viewing the debris blocking the outlet.

July / 2006
outlet

52	Detour Length (km)	
53	Road Classification	RAU 2 09 0 110
20,21,22,23	Sec.Span: Curb, Post, Rail, Sidewalk	
56,57,59,60	Sec. Span: Wearing Surface, Sub-Deck, Insp., Struct #, Struct Status.	
54	AADT (Type, Number, Year)	
55	Responsible Road Authority	
	DO NOT USE Card Columns 77,78,79,80	

nts: