PART A: FILE REVIEW
LANDSLIDE RISK ASSESSMENT
PEACE REGION (PEACE RIVER VALLEY/HIGH LEVEL)

SITE PH11: WHITEMUD RIVER CROSSING

LEGAL LOCATION:	88-21-W5M
Location along Highway:	Station 42+600 to 46+000, bridge is Station 44+300
AI FILE:	SH743:02
Date of Initial Observation:	1971
Date of Last Inspection:	not known
Instrument s Installed:	11 slope inclinometers, 2 piezometers
Instruments Operational:	none
Risk Assessment:	PF(9) * CF(2) = **18**
Last Updated:	AMEC Earth & Environmental Limited November 2000

INTRODUCTION

This section is a review of files made available by Alberta Infrastructure for the site. The file review was prepared prior to the site visit. The description of the sites is based on the information that was present in the file, topographical and geological information was added if it was not present in the file and if the site was familiar, previous observations were also included. A risk assessment, solely based on the file review is provided. The risk assessment may change once the observations made during the site visit are incorporated.

SH743:02 approaches the valley of the Whitemud River from the south, turning towards the west as it crosses the valley (see Figure 1). The length of road in the valley is approximately 3.5 km. The valley is approximately 150 m deep. The road follows the valleys of tributaries at each side of the crossing. The road crosses the tributaries at the south and north side of the Clearwater River twice at culvert crossings.

Since construction of the road in 1970, sliding has occurred at a number of locations on both sides of the crossing and two culverts have collapsed or sustained damage. In the past, re-aligning the crossing of the Whitemud River has been considered. No data is on file from 1993 to present and it is not clear whether the road was re-aligned.

Slope movements or other activity have been reported at the following sites (bridge is at Station 44+300):

- 42+600: slide of embankment at cut/fill interface; slide is 15 m wide and elevation difference between toe and scarp is 35 m;
- 42+650: sideslope slide, dates back to 1971 and 1983; failure may have been caused by overloading during construction;
- 43+200: slumping of sideslope due to scour by creek;
- 44+700 to 45+000: old slide, no active movement;
- 45+350: sinkhole due to collapse of culvert, culvert replaced;
- 45+800 to 46+000: slide, lime and flyash stabilization carried out in 1984

It is not clear from the files whether these sites are active. Between 1990 and 1993, significant shear movement was recorded in a number of slope inclinometers.

At the location of the crossing, the Whitemud River occupies a shallow pre-glacial valley (Pawlowicz and Fenton, 1995), which is not as deep as the valley of the Whitemud River, such that the lower part of the valley is eroded into bedrock. The valley walls slope between 8 and 12 degrees, with locally steeper sections.

GEOTECHNICAL CONDITIONS

The soil conditions generally consist of lacustrine clay and clay till overlying sand and gravel, which in turn overly shale. Fill (derived from till) may have been present in some of the boreholes, but it was not labelled as such. Lacustrine clay was not present in some of the boreholes. The sand and gravel varies from silty sand to gravel with cobbles. The shale is described as soft, possibly getting harder with depth. The shale belongs to the Shaftsbury formation, which typically contains weak zones. Shale was encountered at two of the three sites where boreholes were drilled at relatively shallow depth.

CHRONOLOGY

Table A1 provides the chronological background of the slides.

DESCRIPTION OF THE SITES

Descriptions in the file of the various sites is very brief. The most recent information in the file dates back to 1993.

Station 42+600, Embankment Slide

Description of Instability

At Station 42+600, the road crosses a tributary of the Whitemud River, which has been channelled in a culvert at the base of the embankment. The slide had occurred at the upstream slope of the embankment. The slide was 15 m wide and the elevation difference between the toe and the scarp was 35 m.

Past Investigation

The only reference to this slide is in a site visit by Karl Li in 1990. The slide is also visible on the 1987 air photos.

Remedial Measures

No remedial measures appear to have been implemented.

Monitoring Results

No monitoring appears to have been undertaken.

Assessment

This appears to be a small slide of the fill embankment. Probably, the slide occurred within the fill.

Station 42+650, Sideslope Slide

Description of Instability

At Station 42+650, the road was constructed along the side of the valley wall of the south tributary creek. It appears that a significant volume of fill was placed in this area. The slope below the road is approximately 15 m high. The dimensions of the slide are not provided.

The soil conditions consisted of clay fill (probably derived from till), overlying sand and gravel, in turn overlying shale. Shale was encountered at 8 m to 15 m depth. Slope inclinometer records indicated that the slide movement occurred in the shale. (Slope inclinometer records are not available, but a drawing in the file indicates at what depth they had sheared off).

At the downstream side of the embankment at Station 42+600, the culvert outlet was damaged, apparently as a consequence of this slide.

Past Investigation

It appears that three slope inclinometers (1-3) and one pneumatic piezometer were installed in the slide in 1990.

The slide is described in a note to file by Karl Li in 1990.

Remedial Measures

It appears that the road was shifted uphill at this location and that the slide was reshaped.

Monitoring Results

Monitoring of the slope inclinometers indicated that they sheared off in the shale (at depths ranging from 8.5 m to 9.8 m) by 1993.

Assessment

There is no data in the file that indicates that the slide is still active.

Station 43+200 Slumping Due to Scour

Description of Instability

At Station 43+200, the road was constructed along the side of the valley wall of a tributary. It appears that the slide occurred due to erosion at the toe by the tributary creek. The dimensions of the slide are not provided.

The road was shifted uphill into the backslope, which consisted of weathered shale.

Past Investigation

No boreholes were drilled at this location.

The slide is described in a note to file by Karl Li in 1990.

Remedial Measures

It appears that the road was shifted uphill at this location.

Monitoring Results

No monitoring was undertaken.

Assessment

There is no data in the file that indicates that the slide is still active.

Station 44+700 to 45+000, Old Slide North of the River

Description of Instability

Between Station 44+700 and 45+000, the road was constructed along the side of the valley wall of a tributary. The road appears to have been constructed on a thin fill. The dimensions of the slide are not provided.

The soil conditions appear to consist of topsoil overlying clay till, overlying sand and gravel, in turn overlying shale. In one of three boreholes, the sand and gravel did not appear to be present.

The surface of rupture appears to have been in shale or just above the shale.

In 1990, the road was shifted uphill around the slide area.

Past Investigation

Three slope inclinometers (5-7) were installed at this location in 1990. The boreholes were drilled using a wet rotary drill rig. It appears that samples were not taken.

The slide is described in a note to file by Karl Li in 1990.

Remedial Measures

It appears that the road was shifted uphill at this location.

Monitoring Results

The slope inclinometers appear to have been sheared off by 1993.

Assessment

There is no data in the file that indicates that the slide is still active.

Station 45+350, Sinkhole

In 1990, a sinkhole developed directly above a culvert at the crossing of the north tributary creek due to the collapse of the culvert. The culvert was replaced.

Station 45+800 to 46+000, Sideslope Failure

Description of Instability

Between Station 45+800 and 46+000, the road was constructed along the side of the valley wall of a tributary. The road appears to have been constructed on a thin fill. The dimensions of the slide are not provided.

The soil conditions consisted of a sequence of topsoil, clay till, lacustrine clay and sand and gravel. Clay till was both overlying and underlying the lacustrine clay. Shale was not encountered in the boreholes.

The surface of rupture appears to have been in the lacustrine clay.

Past Investigation

Two slope inclinometers (8, 9) were installed at this location in 1990.

The slide is described in a note to file by Karl Li in 1990.

Remedial Measures

Lime and flyash stabilization to 10 m depth was carried out in 1984, presumably to increase the strength of the clay in the rupture surface.

It appears that the road was shifted uphill at this location.

Monitoring Results

It appears that one slope inclinometers had sheared off by 1993 and one had registered 5 mm of movement over four years. Actual slope inclinometer data are not in the file.

Assessment

There is no data in the file that indicates that the slide is still active. This may indicate that the performance of the road has been good. If significant movement had occurred, this would have been reflected in the file.

TABLE A1: CHRONOLOGY

1970	Construction of road. Road was rerouted around two slope instabilities.
1983	Three boreholes drilled at south side of Whitemud Creek, 1500 m south of bridge.
1985	Photographs of lime-flyash stabilization at Whitemud Hill slide area. 130 m long stretch, right of centreline when moving towards the north. Lime-flyash was injected in boreholes 3 to 10 m deep. Repaired road and culvert. Active cracking occurring. Station 46+100 to 46+300.

1990, 04 Letter from R. Jurgens to J. Sawchuk. A number of alignment options were considered.

1990, 05 Note to file by K. Li. The note discusses a proposed re-alignment relative to slide activity.

- 42+600: slide at embankment at cut/fill interface; slide is 15 m wide and elevation difference between toe and scarp is 35 m;
- 42+650: sideslope slide, dates back to 1971 and 1983; failure may have been caused by overloading during construction;
- 43+200: slumping of sideslope due to scour by creek;
- 44+700 to 45+000: old slide, no active movement;
- 45+800 to 46+000: lime and flyash stabilization carried out in 1984.

Conclusion: proposed alignment P-3A is feasible.

1990, 06 Installed eight slope inclinometers and two piezometers in four areas: 42+620, 44+620, 45+000, and 46+200.

1990, 07 Note to file by K. Li. Collapse of road at centreline at 45+350 due to sinkhole above culvert at creek crossing. Sinkhole was approximately 3 m diameter and 4 m deep. Culvert needs replacement.

1990, 09 Note to file by K. Li. Site meeting review of proposed P-3A alignment. Active movement at Station 42+650 to 42+750. Site inspection revealed that the downstream outlet of culvert was squashed due to movement at old slide. New alignment would require 6 m of additional fill on old slide. Proposed to shift alignment. At Station 45+350 a toe berm was recommended at culvert crossing.

1991, 01 Note to file by K. Li. Alignment P-5B is preferred.

1992, 04 Letter by R. Callioux to R. Sawchuck. Request to consider shortening SH 743:02.

1992, 05 Letter by A. Humphries to T. Hazuka. Considerations of alternate alignments.

1992, 06 Letter by R. Jurgens to R. Callioux. Existing crossing is probably the best.

1993, 01 Photographs of squashed culvert at Station 42+560.

1993, Site plan with recorded movement depths. SI's 1, 2, 3, 5, 6 were sheared off (in shale) , others recorded movement.