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

SITE PH5: MEIKLE RIVER (NEW SLIDE BY BRIDGE)

LEGAL LOCATION:	SW 7 94-22-5
Location along Highway:	Station 0+100 (centreline of Meikle River Bridge is Station 0+000)
AI FILE:	35:08
Date of Initial Observation:	May 1997
Date of Last Inspection:	June 1999
Instruments Installed:	4 SIs at Station 0+100 30 SIs installed in total
Instruments Operational:	18 slope inclinometers, 2 piezometers
Risk Assessment:	PF(9) * CF(4) = **36**
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.

The Meikle River site is on Highway 35:08, it is located at Station 0+100, north of the centreline of the Meikle River Bridge. Two other sites north of the river have been active in the past, but stabilization measures have been installed, they are located at Stations 0+500 and between 0+700 and 0+870. Information on these sites has been included as background for the assessment.

At this location, Highway 35 climbs out of the valley of the Meikle River. The valley is approximately 65 m deep. The road was constructed along the sideslope of the valley of a tributary of the Meikle River. The road was constructed in cut and fill. Some of the fills are in the order of 10 m high.

The site is located at the edge of an infilled pre-glacial valley located to the east (Notikewin). The valley of the Meikle River was eroded in post-glacial times. Landslides are common along the valley (Nasmith, 1964, Can. Geotech. J.). Typically, the slides occur in the glacial till. The slope profile generally consists of a lower slope of clay till slump blocks at an inclination of 4H:1V and an upper slope composed of undisturbed clay till at an inclination of 1.5H:1V.

GEOTECHNICAL CONDITIONS

The soil conditions consist of, from the crest of the valley down, lacustrine clay overlying a thick sequence of clay till, overlying clay shale bedrock. The lacustrine clay is medium to high plastic. The clay till contains stones and is medium plastic. Between the till and the bedrock, a 5 m thick sand and gravel layer was encountered in a number of boreholes.

According to Nasmith (1964), the lower part of the valley consists of slump blocks in the till. The till would be pre-sheared in these slump blocks and would be weak.

CHRONOLOGY

Table A1 provides the chronological background of the slides.

DESCRIPTION OF INDIVIDUAL SITES

In the following, the individual sites are described.

Station 0+100, near Bridge

Description of Instability

At this location, the road is approximately 15 m above the river terrace located to the west. The slope is inclined at 3H:1V. The road is constructed on fill, the thickness of fill is approximately 6 m.

In 1997, cracks and settlement of the road were noted at Station 0+100. A toe bulge or cracks in the slope have not been reported. The slope inclinometers installed in the failure registered distinct shear movement. The rupture surface is primarily in fill, extending into lacustrine clay at the toe.

At the location of the instability, based on borehole logs for the slope inclinometer installations, the soil profile consists of the following sequence:

- lacustrine clay; slickensides were noted in one of the boreholes.
- clay till, with sand layers;
- a thick layer of sand and gravel;
- shale bedrock.

Past Investigation

In 1998, five slope inclinometers were installed at Station 0+100. The slope inclinometers were installed to a depth of 30.5 m. Borehole logs are in the file.

Remedial Measures

In 1999, GAEA proposed to install a pile wall at this location. The estimated cost of the pile wall was $ 126,000. GAEA recommended that the wall be constructed based on the observation that movement was accelerating. No remedial measures have been implemented.

Monitoring Results

Slope inclinometer 63 registered surficial creep and distinct shear movement at 5 m depth (at a rate of 6 mm per year).

Slope inclinometer 64 registered distinct shear movement at 6 m depth (at a rate of 10 mm per year).

None of the other slope inclinometers installed on the terrace registered significant movement.

Assessment

The instability appears to be a failure of the fill slope. The borehole logs indicate that the fill is 7 m thick at slope inclinometer 64, but there was uncertainty regarding the change from fill to in situ material. Sliding in slope inclinometer 64 was recorded at a depth of 6 m. It appears more likely that the rupture surface is in the native lacustrine clay than in the fill, which was derived

from clay till. Thus, it is expected that the failure is a consequence of weak lacustrine clay underlying the fill slope (slickensides were noted in the lacustrine clay between 7 and 9 m depth). Adverse piezometric pressures may have contributed also. Sand and silt layers were noted in the lacustrine clay underlying the fill. Such layers often result in adverse pore water pressures.

GAEA recommended construction of a pile wall at this location based on the observation that the slope inclinometers were showing an increasing rate of slide movement. A review of the data did not indicate an increasing rate of movement, in fact the rate of movement is the order of 6 mm per year, which is considered relatively slow. Thus, in our opinion, implementation of remedial measures is not urgent, but it is recommended that monitoring be continued.

Risk Assessment:
The probability factor is 9, settlement of the road has occurred, but it appears that movement is small. The consequence factor is 4, this is a fill close to a bridge. Thus, the risk level is estimated at 36.

TABLE A1: CHRONOLOGY

Station 0+100

1997, 05	GAEA drawing indicates cracks in the road.
1998,	Cracks and settlement of pavement at location 110 m North of the centreline of Meikle River bridge.
1998, 11	Installed slope inclinometers numbers 60 through 64 at the location of the cracks.
1999, 06	Inspection by GAEA and AI personnel.
1999, 07	Letter by V. Diyaljee to D. Kohut. The letter states that the slope inclinometers indicate deep-seated movement. Proposed a pile wall and provided cost estimate ($ 126,000).
1999, 09	SI monitoring report states that slope inclinometers indicate increasing rate of movement, especially those close to the highway. The installation of a pile wall is strongly recommended.

Station 0+500

1992, 07	Letter by V. Diyaljee to R. Callioux (the date on this letter is shown as 1991, 07, but it incorporates observations dated May 1992). A slide has occurred at the interface between cut and fill over a draw. Slide is approximately 100 m long and 30 m wide with an elevation difference between toe and head of 30 m. Slide has developed in five slumped terraces. Airphoto analysis indicates that the slide was adjacent to a slide in native material at a lower elevation.

1993, 06	Note to file by K. Li. No deterioration of slumping. The inferred cause of slumping is erosion by ditch flow. An effort to divert surface flow has minimized outflow into the slumping area.
1993, 10	Letter by V. Diyaljee to R. Callioux. Proposed construction of pile wall, reconstruction of the slope is prohibitively expensive, because granular material is not available in the area. Pile wall to be 30 m long, 16 piles to 12 m depth 24" diameter, 9 pieces of M25 rebar.
1996	Installed pile wall, installed slope inclinometers 40 to 48

Station 0+700 to 0+870

1992, 07	Letter by V. Diyaljee to R. Callioux (the date on this letter is shown as 1991, 07, but it incorporates observations dated May 1992). A number of sags in the road were observed. The height of the embankment is approximately 20-25 m above the toe of 3H:1V sideslope. The culvert located at the slide area appeared in good condition.
1993, 10	Letter by V. Diyaljee to R. Callioux. Proposed construction of 5 m deep subdrain in ditch.
1993	A culvert located at the slide was repaired by installing an inner culvert and grouting.
1993, 06	Note to file by K.Li. Observed seepage from backslope and suspected seepage into cut/fill interface.
1994, 08	Letter by V. Diyaljee to R. Callioux, stating that cracking and settlement are worse than in 1991. SI-1 indicated movements at 13 m. At the toe of the slope, there are old slump blocks; the toe of the slide is not well defined. Culvert may be under stress from the impending slide. Installed additional slope inclinometers (21, 22, 23).
1996,	Installed anchors as a temporary measure to stabilize slope.
1997,	Installed pile wall at 0.7 to 0.87 North of Meikle River bridge. 77 piles installed. After installation of the pile wall, significant movement was detected in slope inclinometers embedded in the wall.
1998,	Installed capping beam, gabion wall and drainage measures at 0.7 to 0.87 km North of Meikle River bridge.