THURBER ENGINEERING LTD.
Suite 200, 9636 - 51st Avenue
EDMONTON, Alberta T6E 6A5
Phone (780) 438-1460
Fax (780) 437-7125
www.thurber.ca

THURBER

ALBERTA TRANSPORTATION
LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

NORTH CENTRAL REGION

SITE NC6: MITSUE RECREATION AREA

LEGAL LOCATION:	**NW7-72-4-W5M**
NEAREST LANDMARK:	**8 KM EAST OF SLAVE LAKE**
Highway Control Section:	**HWY 2:46 km 50.24**
Date of Initial Observation:	**1977**
Date of Last Inspection:	**2003**
Last Inspected By:	**Thurber Engineering Ltd. (Thurber)**
Instruments Installed:	**3 Slope Inclinometers (1993), 3 Pneumatic Piezometers (1993)**
Instruments Operational:	**2 Slope Inclinometers, 1 Pneumatic Piezometer (2003)**
Risk Assessment:	PF(7) · CF(5) = **35**
Last Updated:	July 2004 – Thurber Engineering Ltd.

1. LOCATION

The site is located along Hwy 2:46 about 8 km east of the junction with Highway 88 and west of Mistue Recreation Area as shown on Figure NC6-0, Section F.

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

The site stretches over a 90 m long section of highway oriented approximately in a east to west direction. This section of the highway is located on a sidehill fill approximately 6 m high with a steep backslope on the south side. The lake is at least 100 m to the north and 15 m lower in elevation than the highway.

The site has had a long history of instability going back to 1977. Ongoing instability of the backslope and highway fill at this site was treated over the period from 1977 to 1983 by the installation of horizontal drains in the slippage zone. The drainage measures were last inspected in 1992 with seepage observed in some of the 1983 drains. No subsequent inspections of the horizontal drains have been recorded. As noted in Thurber's Spring 2003 inspection report, there is a catchwater ditch in the brush of the uphill side of the slide zone and a subdrain parallel to the highway in the upslope ditch area. Based on discussions with Mr. Fred Bickle, of AT, prior to 1989, the highway was cracked at the centreline and the north side was dropping up to 0.3 m/day. The highway was maintained using cold mix patching until the site stabilized.

In 1992, the site was inspected by AT personnel when cracking in the pavement surface was noticed from the shoulder edge to the centreline. Instrumentation (inclinometers and pneumatic piezometers) were installed in 1993 to provide additional information regarding the slide. Test pitting and surveying were also proposed for the backslope area, although it is not known if this was completed.

The locations of the instruments installed in 1993 are shown on Figure NC6-1, Section F, and the test hole logs and installation records are shown in Section G. Deflection plots for the destroyed SI and the last readings for the destroyed piezometers are included in Section G. Only 2 SI's and 1 pneumatic piezometer are still functional and the latest readings for these are provided in Sections C and D.

Movement has been observed at increasing depths down the slope north of the highway and has been estimated at between 2.8 and 8.0 mm/year. The maximum movement rate, since the instrumentation installation, was recorded between 1998 and 2000.

The presence of groundwater levels in the slide area has historically been a factor given the number of drainage measures implemented at the site. The most likely mechanism is that the downhill side of the highway embankment is steeper than the fill soils can support, given the groundwater levels, causing localized slumping and its weight acts as a driving force on the natural material causing deeper-seated movement.

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: The site is located on the boundary between the Swan Hills Upland to the south and Lesser Slave Lowland to the north. The site is located north of the Athabasca River and east of Lesser Slave Lake.

Bedrock Geology: The bedrock at the site is nonmarine clayey sandstone, bentonitic mudstone, and bentonite of the Cretaceous Wapiti Formation containing scattered coal beds. The bedrock is approximately 15 m below ground level with a northerly slope toward a bedrock low located approximately at the present-day Lesser Slave River. Immediately to the north of the site, the bedrock consists of Lea Park Formation marine shales with ironstone concretions.

Surficial Geology: no information available

Hydrogeology: Upper bedrock formations in the vicinity of the site may be able to provide up to 2 L/s of groundwater flow; however, near-surface glacial drift would have reduced flow. Further to the north adjacent to the Lesser Slave River, groundwater flows in the upper bedrock may be as high as 38 L/s. Groundwater flow directions are mostly downward with possible discharge areas and contact springs along slopes.

Stratigraphy: The test holes for the slope inclinometer installations were logged (refer to Section G) and indicate that the stratigraphy was clay and gravel fill overlying clay till overlying sand. Below the sand, the bedrock was very hard claystone with sandstone interbeds. The fill thickness ranged from 4.6 m of clay fill at a location 10 m north of the centreline to approximately 2 m of gravel fill 50 m north of the centreline. Organics were encountered at surface in the north-most two holes and below the gravel fill in the north-most hole (50 m north of centreline). No seepage was observed during the test hole drilling. Cross-sections of the site are shown on Figure NC6-3, Section F.

The operational pneumatic piezometer, PN#2 (PI#34443), indicates that groundwater levels at the site have stabilized from el. 92.0 m to below the tip elevation (91.38 m) since April 2001 (el. 100 m was assumed at the roadway surface). Prior to this time, the groundwater levels were typically at about elevation 92 m approximately 30 m from centreline. A peak value of 92.3 m was recorded in

May 1999.

4. CHRONOLOGY

A memo in the file from Karl Li, reproduced in Thurber's SI installation summary report of January 27, 1993, provided the following history from 1977 to 1992. The remaining information was taken from Thurber's SI installation summary report, ongoing monitoring reports, and conversations with AT personnel.

1977

Installation of 2 horizontal drains into the sideslope at the centre of the slippage zone approximately 5.5 m below the highway pavement surface elevation. The groundwater outflow was recorded to vary from 0.5 to 1 gallon/minute (1.9 to 3.8 litres/minute).

1979

Installation of 9 horizontal drains installed into the sideslope at the centre of the slippage zone and 12 m to either side approximately 8 m below highway pavement surface elevation. The groundwater outflow was 0.25 gal/min (0.9 L/min) at the centre and a trickle to the west.

1983

Installation of 8 horizontal drains at the centre of the slippage zone at two separate elevations: 15.5 m and 18 m below the existing highway pavement surface.

1989

Installation of a series of horizontal drains at the base of slope which eventually plugged and were replaced.

1992

Inspection in October by Karl Li and Vishnu Diyaljee of AT to observe cracking on the north half of the highway. Cracking was observed approximately 50 m in length from sideslope shoulder edge to near the centreline of the highway. Seepage was observed in the lower set of 1983 horizontal drains of 1 gal/min (3.8L/min) during a second site visit by B. Leicht.

1993

Installation of 3 SIs and 3 pneumatic piezometers by Thurber as requested by AT

following the October 1992 site visit.

1995/1996

Weeping tile was installed on the south side (upslope) of the highway. Cracks on the surface were routed and sealed.

1998

A forest fire destroyed a significant amount of trees and vegetation in the area.

2001/2002

New guardrail installed.

2000 – 2003

Ongoing instrumentation monitoring by Thurber. Only minor cracking on the highway and near SI#1 and creep movements were observed during this period. Vandalism to SI#1 was reported in Spring 2000 and was repaired prior to Spring 2001. Damage to SI#2 and PI#1 due to grass maintenance equipment occurred between the Fall and Spring 2000 monitoring events. Additional cracking of the pavement surface was observed during the Spring 2003 monitoring event. The 2003 annual inspection report suggested long-term stabilization measures and recommended that a file and historical aerial photograph review to provide further assessment of the slide.

REFERENCES

1. Thurber Engineering Ltd., September 12, 2003. "North Central Region Landslide Assessment – Hwy 2:46 (NC6, Mitsue Lake), 2003 Annual Inspection Report." File 15-16-167.

2. Thurber Engineering Ltd., January 27, 1993. "Highway 2:46 & 48 Canyon Creek, Widewater and Mitsue Embankment Slippage – Slope Indicator Installations." File 15-16-68.

3. Alberta Research Council, 1978. "Hydrogeological Map, Lesser Slave Lake, Alberta (83-O)."

4. Alberta Research Council, 1976. "Bedrock Topography of the Lesser Slave Lake Map Area, NTS 83 O, Alberta."

5. University and Government of Alberta, 1969. "Atlas of Alberta."