ALBERTA INFRASTRUCTURE
LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

PEACE REGION
(SWAN HILLS)

SITE SH8: WATINO EAST HILL (SMOKY RIVER)

LEGAL LOCATION:	**NE26 and NW25-77-24-W5M**
NEAREST LANDMARK:	**2.1 KM EAST OF SMOKY RIVER**
Highway Control Section:	**HWY 49:08**
Date of Initial Observation:	**1997**
Date of Last Inspection:	**1999**
Last Inspected By:	**GAEA Engineering Ltd. (GAEA)**
Instruments Installed:	**4 Slope Inclinometers (1997)**
Instruments Operational:	**3 Slope Inclinometers (2000)**
Risk Assessment:	PF(7) * CF(2) = **14**

1. LOCATION

The site is located along Hwy 49:08 about 2.1 km east of the Smoky River Bridge as shown on Figure SH8-1, Section F.

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

The instability consists of 2 slumps located in the south backslope of a highway cut located about 1/3 of the distance down the east slope of the Smoky River valley. A plan sketch of the slumps (Figure SH8-2, Section F) indicates that the length of the affected area is about 130 m spanning from about Station 2+080 to 2+210. Station 0+000 appears to correspond to the east end of the bridge over the Smoky River. Design drawings (Figure SH8-3, Section F) taken from a 1999 GAEA report (Ref. 5) indicate that the backslope cut is in the order of 8 m in height and that the grade of the highway and ditches is about 8% at the affected section.

A NOVA Gas pipeline (273.1 mm dia. Natural Gas) parallels the highway a short distance back from the top of the backslope cut. An overhead power line is also present further back adjacent to the NOVA line. Figure SH8-3 shows an Alberta Transportation & Utilities Ltd. (AT&U) gas pipeline (168.3 mm dia.) and East Peace Gas Co-op pipeline located along the south side of the NOVA pipeline, however there is a note which indicates that these lines were to be re-located.

As described in Sections 3 and 4, the slumps in the backslope appear to be seated in clay and wet erodible silt and sand. High groundwater table resulting in springs in the slope appears to have contributed to the instability.

3. GEOLOGICAL\GEOTECHNICAL CONDITIONS

Physiographic Region: Peace River Lowland

Bedrock Geology: Dunvegan Formation is found at lower elevations in the valley and Shaftesbury Formation is found in the upper part of the valley. Dunvegan Formation of Upper Cretaceous age is composed of sandstone with hard calcareous beds, laminated siltstone and silty shale. Shaftesbury Formation of Upper and Lower Cretaceous age is composed of fish scale bearing shale with numerous nodules and thin beds of concretionary ironstone. The lower part of the formation contains thin silty and sandy intervals.

Surficial Geology: Glacial Lake Fahler deposits (clays)

Hydrogeology: Discharge area along valley slopes. Possible contact springs at junction of Dunvegan Formation sandstones and Shaftesbury shale; the road down the valley along the old alignment was heavily disturbed by slumps and landslides in 1978.

Stratigraphy:

Two previous test holes drilled by AI (WAT-104 and WAT-105) and 4 test holes advanced by GAEA (980301 through 980304) for installation of SI's provide information about the stratigraphic conditions at the site .The locations of the test holes are shown on Figures SH8-2 and SH8-3 and the test hole logs are provided in Section G. The test holes indicate the following stratigraphy at the backslope slump area:

- In the 7 to 8 m backslope cut, test holes WAT-104 and WAT-105 indicate 1.5 to 7 m of clay overlying 1 to 7 m of clayey to silty sand. The water level in WAT-104 was 1.75 m below ground surface.

- Test holes 980301 and 980304 indicate that the soil conditions below the south highway ditch consist of 14 to 15 m of gravelly, sandy, silty clay (Till?) overlying shale.

4. CHRONOLOGY

1988

The highway alignment down the east slope of the Smoky River Valley used to be located south of the existing alignment. The original alignment ultilized a side hill construction diagonally down the slope. Due to ongoing deep seated slide movements affecting1.5 km of the route, AT&U looked at potential alternate alignments, one of which was the current alignment.

Nine test holes, WAT-101 to WAT-109 were drilled by AT&U along the new alignment.

A note to file from Mr. Jit Umadat, P. Eng. summarized the results of a slope stability assessment carried out for a critical cut section located on the present alignment at Station 2+300 (approx. 100 m north of current backslope slump) where the backslope cut would be located in deep saturated silty sand. The results of the analyses indicated a minimum Factor of Safety (FOS) of 1.25 for a 3H:1V cut slope with the circular arc intersecting the ground surface at a distance of 11 m from edge of the pipeline right-of-way. It was concluded that the proposed cut would be safe and in the event that the backslope did fail, the pipeline still would not be affected. It was recommended that subdrains be installed at the time of construction to control groundwater in the sand and silt strata.

1992

AT&U requested an external review of the proposed new alignment as well as three other potential alignments. The review was carried out by Thurber Engineering Ltd. (Ref. 1) who recommended the present alignment which would be located through an area of the valley slope which appeared inactive.

1993

The highway was re-constructed along the current alignment.

There was an August 26 note to file from Mr. Karl Li, P. Eng. regarding wet cut areas between Station 2+100 to 2+500. Patches of scour were noted in the silty sand stratum present in the backslope due to seepage flow following a wet weather period (refer to photos in Section G). He recommended patching the scour holes with free draining well graded gravel and monitoring until the 1994 construction period.

A design drawing was prepared for subdrains (Figure SH8- 4, Section F). Photos dated Sept 93 of the subdrains being installed are included in Section G.

1994

There was a June 6 note to file from Mr. M. Pariti, P. Eng. regarding a site visit in May to assess springs in north backslope areas. The note suggests that groundwater flow used to be from north to south and that highway cut intercepted the flow resulting in seepage emitting from the north backslopes but none evident from the south backslopes. He notes that the subdrain installed in 1993 on the north side connects into a manhole half way down grade and then crosses the highway to connect into a second manhole with the subdrain from the south ditch. Both subdrains continue south side by side to daylight in the ditch at a flat area. Good flow was noted coming from the subdrains.

Springs in the north backslope are mostly located at the contact between the sand and clay layers. He recommends installing french drains down the slope at each spring location and connecting them into the existing main subdrains.

1998

Four slope indicators were installed by GAEA, 2 in the ditch area on each side of the highway. It appears that some of the SI's were installed through the subdrain gravel.

The plots for the slope indicators do not show any signs of any discernable movement which is not surprising since the SI's were installed outside the slump limits.

1999

A design was provided by GAEA for french drains through the slump areas on the south backslope but the drains were not installed.

REFERENCES

1. Thurber Engineering Ltd., March 3, 1992 (File 15-16-66). "Highway 49 Relocation Study, Smoky River East of Smoky River, Geotechnical Evaluation".

2. Alberta Transportation and Utilities, May 1993. "Geotechnical Field Report Inclinometer and Pneumatic Piezometer Installation, PH49:08 High Fill at Watino Hill, Region 6, District 12".

3. Alberta Infrastructure Instrumentation Binder 1993 -1996.

4. GAEA Engineering Ltd., May 1998. "Technologists Field Report - Geotechnical Investigation - Hwy 49:08 - Watino East Hill Slide and Others."

5. GAEA Engineering Ltd., March 1999. "Geotechnical Investigation Report - Pavement Distress and Backslope Erosion - Hwy 49:08 - Watino East Hill (2.1 km from east end of Smoky River Bridge)."

6. Alberta Infrastructure Slope Indicator Plots 1999.