BRIEF FILE REVIEW
(LANDSLIDE RISK ASSESSMENT)

1)	**Site (GP7)**	Hwy 40:36 Waniyandie Road Slide
2)	**Reference Location along Highway:**	Hwy 40:36 at Waniyandie Road Jct. at 9 km north of Sheep Creek
3)	**Legal Description:**	NW Section 2, Twp 59, Rge 7, W6M
4)	**UTM Coordinate:**	Northing 5996937.591 Easting -257808.001
5)	**AI File:**	New File

6) **Alberta Infrastructure Plan and Profile (attached)**

- Site plan (aerial photo) showing SI and Piezometer locations
- 1998 Survey Slope Profile

7) **General Description of Instability**

Sliding movement was noted at the Waniyandie Road area with the cracking and settlement of pavement. Cracking and settlement of the pavement was noted along a 500 m stretch of highway from Waniyandie Road (at the south end) to a deep gully crossing (at the north end). From Waniyandie Road northward for 200 m, the highway was constructed with 10 to 20 m thick fill across a draw (possibly an old landslide scarp); at the deep gully at the north end, deep fill (+ 30 m) was placed with a toe berm crossing this gully. In fall 1997, the headscarp cracking of the pavement transgressed the highway centreline from Waniyandie Road junction (from the south towards the north) and in May 1998, further pavement cracking transgressing highway centreline from the gully (at the north end towards the south) was noted. The joining of the north and south cracks to complete a headscarp crack pattern at the centre 200 m stretch has not yet been noted (June 2000 inspections). It is possible that 2 slide systems exist at this site: (i) the south end - Waniyandie Road slide, (ii) the north end - Deep Gully slide.

THE SOUTH END - WANIYANDIE SLIDE

High fill was placed across a gully and/or old slide scarp to form the Waniyandie Road access. Instability of valley slope of the Smoky River at the Waniyandie Road location should be coupled to the 10 to 20 m high fill construction as it acts as surcharge along this portion of the river valley slope.

THE NORTH END - DEEP GULLY SLIDE

Instability at the deep gully (north) location can be related to the high fill across the gully despite the use of berming during the original construction.

The Smoky River Valley is of high relief at the fringe of the Rocky Mountains and a 70 to 100 m high elevation difference of the valley slope can be estimated from highway elevation to river elevation. The roadway location was estimated to be at mid height of the total mountain valley slope. From site and aerial photo review, old steps and slump terraces down the valley slope face were observed as indicative of past slide movements of this valley slope. Aerial photos indicated that a channel restriction formed at the river flat at the slope toe may be a previous slide "tongue" of run-out material. A railway line was located along the riverbank between the toe of the slope and the apparent slide run-out "tongue" of a previous slide.

It is uncertain whether the sliding is limited to the upper portion of the valley slope above the railway and beneath the highway elevation; or the whole valley slope from the highway down to the railway at the toe area. It is uncertain whether the total slide area at this site has the potential of joining of 2 slide areas at the south end (Waniyandie Road) and the north end (Deep Gully) to form a major slide site. These possibilities will be monitored in the long-term.

Lateral degradation and scour of the river bank by the Little Smoky River caused vertical scarp along the railway line at the toe area of the slope. The railway line along the river bank is heavily armored with rip rap and evidence of past erosion of the bank was obvious. EBA

communicated (letter of July 17, 1999) with CN to inquire on any previous movements at the toe area along the railway. CN (Tom Edwards and Tim Keegan) verbally responded that no movement was recorded since construction of the railway.

8) **Date of Initial Observation**

- May 1997 (1997 Slide Tour) - Cracking of pavement and settlement of fill at cut/fill interface noticed since 1995 pavement construction.

9) **Date of Last Inspection**

- June 1999 (1999 Slide Tour)

10) **Instrument Installed**

8 Slope Indicators
SI #1
SI #2
SI #3
SI #4
SI #5
SI #6
SI #7
SI #8
6 Piezometers

11) **Instrument Operational**

- 8 slope indicators
- 6 piezometers

8 Slope Indicators	Movement Depth (m)
SI #1	6 to 8
SI #2	23
SI #3	not apparent
SI #4	not apparent
SI #5	23 to 24; 7 to 13 m (probable movement and leakage "void" zones can be interpreted due to circulation loss during drilling)
SI #6	12 to 16 m ("wavy" movement pattern; need further monitoring)
SI #7	obvious movement zone not clear; can be at interface of different materials
SI #8	Movement "wavy" at 4 to 8 m; needs further monitoring.

6 Piezometers

- Four piezometers (SI 3, 4, 5, 6) show no piezometric pressure; high fluid loss encountered during drilling installation of instrumentation; past movement and leakage "void" zones can be interpreted from circulation loss during drilling.
- SI #1 piezometer at 16.7 m depth registered 20 to 31 kPa (2 to 3 m of H_20)
- SI #7 piezometer at 4.6 m depth registered 1.4 kPa (0.15 m of H_2O)

12) **Risk Assessment**

PF (10) * CF (7) = 70

PF = 10

- Active with moderate steady but increasing rate of movement.
- High fill construction at Waniyandie Road acts as a surcharge on the original valley slope.
- Propagation of crack since first observed at this slide in 1997; however, this movement might have been occurring since operation of this roadway as a gravel road in mid 1980's.
- At the Waniyandie Road area, one to two sinkholes (150 mm diameter) develop per year along cracks observed in 1998 and 1999; the sinkholes were sub-excavated and infilled

with granular backfill.

- The lithology forming this slope should be more tolerant to movement strain. The materials included native granular overburden, till, bedrock shale and sandstone. Seepage flow may be occurring at the interface of different material layers or at "void" zones formed from past movements.
- Existing steps/benches along valley slope face down to the Smoky River are indicative of old slide movements.
- Movement zones can be deep (20+ m) along the roadway corridor and will require further monitoring to define the movement regime.

CF = 7

- Slide occurrence will require closure of road and reconstruction of roadway.
- No detour route available in the event of catastrophic failure of roadway.
- Remediation will be very difficult due to vastness of this slide.
- Slide occurrence can affect railway line at the toe of the slope in the case of the total movement of whole slope. In the case of slide daylighting at midslope, the railway line might probably not be affected but the highway will be affected.

Note:
This Risk Assessment rating is based on the Scheme proposed by AI in the Request for Proposal (2000).

Probability Factor (PF) : 1 to 20 scale
Consequence Factor (CF) : 1 to 10 scale

13) **Geotechnical Conditions**

- This site is a sidehill cut/fill embankment located along the midslope of the Smoky River Valley. The Smoky River Valley is located in steeply sloping and mountainous topography at the foothills and eastern flank of the Rocky Mountains. The surficial (overburden) deposits in the general area include glacial till, gravel, and in place, weathered sandstone. The glacial till can comprise sandy clay which is stoney; at close to river areas, glacial outwash material of silt/sand and gravel can be located. Part of the surficial deposits in the general mountain area can be of colluvial nature, especially along the sideslope of this site which was observed to comprise slumped terraces from the road elevation down to the Smoky River. To date, the failure areas are located at the fill sections at the north end (gully) and at the south end (road access).
- The bedrock generally consists of Cretaceous bedrock of Brazeau Formation of sandstone; shale; conglomerate; minor coal and ash beds.
- The bedrock stratigraphy could be affected by faulting and folding due to past tectonic activities in the Rocky Mountain area.
- Groundwater flow can be along the interface between soil overburden types and/or along permeable bedrock zones toward the Smoky River along the river valley topography.

14) **Chronology**

Historical setting: past site problem (including construction problem)

- not available

Past investigations

- 1997, 3 slope indicators (SI #1 to 3) + piezometers
- 1998, 5 slope indicators (SI #4 to 8) + piezometers
- 1998, survey of slope

Mitigative Measures

- not available

15) **Action**

- Further study required as the slide area is vast and remediation will be very difficult.
- Continue visual and instrumentation monitoring.
- Additional instrumentation will be required to identify the toe and other areas of possible movement.
- Continue existing pavement maintenance with patching when required. Any further development of sinkholes should be reported and investigated by an experienced geotechnical engineer.

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