SITE C2: NACMINE SLIDE

LEGAL LOCATION:	**SE 8-29-20-4**
REFERENCE LOCATION ALONG HIGHWAY:	**Sta. 33+600 - Sta. 34+000**
UTM COORDINATES (NAD83):	**N 5,703,253 E 376,177**
AT FILE:	**SH575:04**
AT PLAN & PROFILE:	W. Kirkpatrick – Drumheller, Sheet 2 of 3
Date of Initial Observation:	Fall 1991
Dates of Previous Inspections: (Inspected By)	May 12, 2000 (KCCL) May 22, 2001 (KCCL) May 16, 2002 (KCCL) May 21, 2003 (KCCL) May 18, 2004 (KCCL)
Instruments Installed:	8 Slope Inclinometers (1993), 4 Slope Inclinometers (1994)
Instruments Operational:	3 Slope Inclinometers (2002)
Reading Dates: (Read by)	May 12, 2000 (KCCL) November 7, 2000 (KCCL) May 29, 2001 (KCCL) November 16, 2001 (KCCL) June 4, 2002 (KCCL) November 18, 2002 (KCCL) May 15, 2003 (KCCL) October 31, 2003 (KCCL) May ??, 2004 (KCCL)
Risk Assessment:	PF(7) * CF(4) = **28**
Last Updated by:	Klohn Crippen Consultants Ltd. (KCCL)
Date:	May 2004

Location

The town of Nacmine is situated in the flood plain of the Red Deer River and has been the site of intense coal mining activity. Based on information provided by Alberta Transportation and EUB, a mine known as #1473 exists directly under the slide area. The mine plans indicate that some rooms were depillared, which is the removal of roof support to collapse the room, while some were not. The main shafts were also heavily timbered and likely remain open today. Secondary shafts and rooms that were not depillared are subject to collapse at any time. Based on a review of the coal seam records, it is inferred that the mine rooms are about 60 m below the road elevation or about elevation 630 m.

SH575 is located between the town and the valley slopes to the south. The slide area is located on the south side of SH575 and extends for a length of about 400 m (Sta. 33+600 – Sta. 34+000). The slide was first observed in 1991 and has required periodic removal of material from the south highway ditch. An estimated 1 m thickness of material per year was removed from the ditch in the early years, but this has steadily reduced to periodic cleaning only.

Conjectured reasons for the slope failure include the build up of water in and the collapse of underground mine workings resulting in settlement and lateral movement of the slope. This could have been initiated due to the side slope cut (about 6 m) in 1985 for construction of the new highway alignment.

General Description of Instability

The landslide has the following observed features:

1. Cracking and heaving pattern in the backslope ditch indicating that the toe of the slide is in the highway ditch. The angle of the stratigraphy at the toe is about 60° from the horizontal indicating rotational movement.
2. Visible cracking and backscarps in the valley slopes suggesting a complex slide with multiple slip surfaces.
3. No apparent distress in road pavement.

Possible reasons for the failure include:

1. There could be a build up of water in and the collapse of underground mine workings resulting in settlement and lateral movement of the slope.
2. Problem could have started due to the side slope cut (about 6 m) in 1985 for construction of the new highway alignment.

Geotechnical Conditions

The bedrock in the area consists of interbedded sedimentary strata of the Upper Cretaceous Horseshoe Canyon Formation. The hillside stratigraphy consists of interbedded sands, silts, clays and clayshales with occasional coal seams overlying shale bedrock. The bedrock was located at depths varying from 15 m to 30 m and was observed to contain slickensided surfaces. Clays and clayshales were typically of medium to high plasticity.

Test hole logs and additional information are provided in Section G.

Chronology (Refer to Section G for Further Information)

1985-86
The highway was reconstructed along a new alignment slightly shifted into the valley slope.

Summer 1992
The slide activity became apparent when heaving was observed in the backslope ditch. Approximate limits of the slide area were from 33+600 to 34+000. Cracking was also observed in the valley slope.

March 1993
An inspection at this time noted that from the cracking and heaving pattern in the backslope ditch, it appeared that the toe of the slide was within the backslope ditch. There was no distress in the road at this time. Longitudinal cracking was visible in the two benches in the slope above the road.

July-August 1993
The Stage 1 site investigation consisted of 19 test pits dug to a average depth of 4.8 m. Typically, the test pits showed no water except a trickle through minor coal seams in the heaved ditches. Stage 2 consisted of drilling and sampling 8 holes and the installation of slope inclinometers to form two lines down the slope about 50 to 80 m apart. The holes ranged in depth from 23 m to 41 m. All the hillside inclinometers are non-operational and have typically sheared between elevations 688 m to 698 m.

November 1994
Four additional slope inclinometers were installed at the toe of the slide, two on either side of the highway to monitor if the slide was affecting the highway. Typically holes were drilled to about 12 m deep. The drilling indicated silts and clays overlying claystones/siltstones at about 5 m to 8 m below ground surface.

July 1996
The four inclinometers beside the road were last read in July 1996. The inclinometers on the north side of the highway indicated only very small movements of less than 10 mm.

The inclinometers on the south side of the highway in the toe of the side indicated total cumulative movements at the surface of less than 20 mm at the surface in SI #12. However, a shear plane was apparent in SI #11 between 3 m to 4 m depth with a displacement of 30 mm. By May 2000, the inclinometer had sheared at this depth.

Reports and Documents

May 2000 (KCCL) Inspection and Instrumentation Monitoring Report
November 2000 (KCCL) Instrumentation Monitoring Report
May 2001 (KCCL) Inspection and Instrumentation Monitoring Report
November 2001(KCCL) Instrumentation Monitoring Report
May 2002 (KCCL) Inspection and Instrumentation Monitoring Report
November 2002 (KCCL) Instrumentation Monitoring Report
May 2003 (KCCL) Inspection and Instrumentation Monitoring Report
October 2003 (KCCL) Instrumentation Monitoring Report
May 2004 (KCCL) Inspection and Instrumentation Monitoring Report

Geotechnical Field Report (AT), September 1993
Installation of Inclinometers Report (Golder), December 2, 1994
Site Survey Report (KCCL), January 31, 2002
AT Memo to File – Mining History around Nacmine Landslide, March 1, 2002
Air Photos (1999)