GEOHAZARD RISK ASSESSMENT
CENTRAL REGION

SITE C60: SLIDE EAST OF BLACKFALDS

LEGAL LOCATION:	**NE 9-39-26-W4**
REFERENCE LOCATION ALONG HIGHWAY:	**km 10.74**
UTM COORDINATES:	**N 5803030 E 317080 (NAD83)**
AT FILE:	**H597:02**
AT PLAN & PROFILE:	
Date of Initial Observation:	1976
Date of Previous Inspection:	October 25, 2011
Inspected By:	Klohn Crippen Berger Ltd.
Date of Current Inspection:	**June 15, 2012**
Inspected By:	Klohn Crippen Berger Ltd.
Instruments Installed:	1 Slope inclinometer, 2 standpipe piezometers
Instruments Operational:	2 standpipe piezometers
Date of Last Reading:	October 2012
Read By:	KCB
Risk Assessment:	PF(9) * CF(6) =**54**
Last Updated by:	Klohn-Crippen Berger Ltd.
Date:	October 2012

Location and General Description of Instability

The site is located on Highway 597:02 (km 10.74) about 500 m east of Site C8 (about 9 km east of Blackfalds, Alberta). The slide is located within an embankment fill about 25 m high. A small stream is located at the toe of the slope and is a tributary of the Red Deer River. The highway alignment in this area is a large side-hill fill where the road crosses a minor drainage bowl. It is apparent that problems developed shortly after the completion of construction in 1976. It is conjectured that the side-hill fill blocked groundwater seepage paths and it would appear from drilling information that the side-hill was not stripped of organics prior to the placement of the embankment fill.

On about July 24, 2010, a section of the road dropped significantly with cracks across the full width of the pavement defining the crest of the slide area. A patch was placed on the highway on July 28, 2010. Further cracking has occurred in the patched area following the repair.

Geotechnical Conditions

The 2010 KCB investigation indicated that the subsurface strata typically consists of about 10 m of medium plasticity clay fill over low to medium plasticity clay till. An organic topsoil zone about 1.6 m thick was encountered below the fill and comprised the original ground surface. Rafted bedrock was encountered within the till at approximately 17.5 m to 22.1 m (4.6 m thick) below the ground surface.

A description of the subsurface materials is provided below:

Clay Fill

The fill comprises medium plasticity silty clay with a trace of sand and gravel. SPT N values varied from 5 to 24 blows per 300 mm indicating firm to very stiff consistency. Moisture contents were typically about 25%. An Atterberg limit test indicated a liquid limit of about 40% with a corresponding plastic limit of about 20%.

Buried Topsoil

A relatively thick organic silt (topsoil) layer was encountered below the embankment fill. The organic layer was dark brown to black and contained rootlets and wood fragments. Some clay and a trace of gravel were also observed. The moisture content of the material was about 30% and was described as low plasticity and of stiff consistency.

Clay Till

The clay till comprises low to medium plasticity silty clay with a trace of sand and gravel. SPT N values varied from 20 to 40 blows per 300 mm indicating very stiff

to hard consistency. Moisture contents were typically about 20%. Atterberg limit tests indicated a liquid limit of about 35% to 40% with a corresponding plastic limit of about 15% to 20%.

Rafted Bedrock

Rafted claystone and siltstone was encountered within the till deposit. In the 1982 investigation, this was assumed to be the bedrock surface. The bedrock material was weathered, but was hard in consistency prior to drilling indicated by refusal of the SPT sampler. The raft appears to comprise an upper claystone layer about 1.4 m thick grading to a siltstone layer about 3.2 m thick. An Atterberg limit test on the claystone indicated a liquid limit of about 40% corresponding to medium plasticity. However, due to the process of shearing during placement in the till, the claystone is likely at a residual strength and so forms a weak plane in the embankment foundation. Due to the drilling method, it was not possible to determine if slickensides were present in the claystone

Chronology (Refer to Section G for Further Information)

1976

The highway was realigned to the present location.

1979

Photographs from March 1979 show the site with a patched pavement and a large erosion channel heading downhill from the outlet of the culvert below the highway.

1982

Photographs from November 1982 show a patch over a depression in the road, a dip in the guardrail and a half-pipe down-drain where the downslope erosion channel was repaired. A geotechnical investigation was undertaken in December 1982. The investigation indicated about 16 m of fill below the highway tapering to zero fill thickness at the creek level. The fill was underlain by about 4 m of silty clay overlying shale bedrock encountered at about 20 m below the road (about creek level). Based on instrumentation readings, the depth of the slide below the south side of the road was estimated at about 9 m.

1983

In November 1983, seven horizontal drains were installed connected to a 100 mm diameter “Big O” HDPE header drain that carried the water to the half pipe down-drain along the west edge of the site. The 1983 slide remediation design included the excavation of a 3 m wide key trench into the shale bedrock, about 10 m upslope of the creek. The key trench was backfilled with pit run gravel with the construction of a 17 m wide toe berm to an elevation about 10 m above the creek, including a 1.5H:1V slope.

1992
At some time after 1992, a rip rap toe berm was constructed by the M.D.; however, no information is available regarding the design or the construction.

2010
The highway surface was patched on July 28, 2010; however, reflective cracks were apparent in the surface extending over a highway length of about 50 m. The crack pattern extended across the highway extending into the uphill ditch by about 4 m beyond the edge of the pavement. The curved crack pattern in the highway suggests that the lateral extent of the slide is confined to the area below the highway and does not extend further east or west.

A slide scarp was apparent on the south side of the bench above a lower riprap toe berm at creek level. High creek flows have eroded the toe berm with contribution from the overland flow from the drains and runoff from the slope. A near vertical scarp is located on the downslope edge of the bench.

2011
A SI reading on January 5, 2011 indicated small movements above and below the rafted bedrock material. Inclinometer had sheared by October 2011.

2012
Additional horizontal drain installation was undertaken by CCD Energy Services of Edmonton, Alberta on February 18 to 21, 2012. Three drains were installed along the failure plane by directional drilling from the field north of the highway.

Throughout 2012 slide movements continued. A replacement SI was installed in September 2012 but this failed by October 2012.