SITE C18: H837:02 Riverbank Slide

LEGAL LOCATION:	**28-29-21-W4**
REFERENCE LOCATION ALONG HIGHWAY:	km 1.9
UTM COORDINATES (NAD 83):	**N 5,708,370 E 369,940**
AT FILE:	H837:02
AT PLAN & PROFILE:	
Date of Initial Observation:	Summer 2000
Dates of Previous Inspections: (Inspected by)	July 14, 2000 (AT) July 18, 2000 November 10, 2000 May 22, 2001 July 24, 2001 October 3, 2001 May 16, 2002 May 9, 2003 May 21, 2003 May 18, 2004
Instruments Installed:	None
Instruments Operational:	None
Reading Dates: (Read by)	
Risk Assessment:	PF(9) * CF(4) = **36**
Last Updated by:	Klohn Crippen Consultants Ltd.
Date:	June 2004

Location

During the summer of 2000, Alberta Transportation noted an instability at about km 1.9 of Highway 837:02 in the section adjacent to the riverbank of the Red Deer River. The width of the slide at this point was about 4 m, however, cracking and evidence of slide/slumping activity extended for about 14 m. The road surface is about 7 m above river level. The existing riverbank slopes are typically very steep (about 1H:1V or steeper) and slow erosion of the toe of the riverbank by the river is ongoing.

General Description of Site Conditions

The primary trigger for the observed instability is considered to be the change in road camber at the top of the slide. It would appear that the highway grade concentrates the sheet runoff flow moving down the road over the bank in the area of the slide. It is also observed that the native material becomes very soft when wet. The combination of the very steep slope, the close proximity to the Red Deer River, and the runoff flow softening the slope material is creating the slide conditions.

Geotechnical Conditions

The highway is located at the toe of a steep valley slope (about 1.5H:1V) and for a length of about 860 m is directly adjacent to the Red Deer River. It is believed that the road was constructed on an original trail along a narrow terrace in the area and the surfacing was placed on native material. Drilling was performed in 1981 and indicated about 0.5 m to 5.5 m of medium to high plasticity clay (weathered bedrock) over sandstones and shales. For this 860 m long section of the highway, the surfacing consisted of gravel and an oil-bound surface.

Chronology (Refer to Section G for Further Information)

1980-2000
Over the last twenty years numerous proposals have been put forward to improve this highway to a minimum RCU 209 design standard. Due to the narrow terrace, various types of reinforced earth retaining walls or riprap protected granular fills pushed out into the river have been proposed. In 1988, it was agreed that it was unreasonable to spend the $1.0M to $1.5M required to carry out these measures and protect this section of highway. Instead, a 2.5 m deep ditch was proposed beside the road at the base of the hill, with a target for the riverside fill slopes towards the river set at 2H:1V. Guardrails were also proposed to be installed adjacent to the river. Although a nominal ditch was constructed at the toe of the valley slopes, no other improvement works were undertaken.

A study in 1992 recommended providing a 0.5 m minimum freeboard above the 1:100 year flood level (highwater elevation 688.6 m). The recommended bank protection

measures using Class II rock riprap would cost about $700,000 for the 860 m long section. This section of road has washed away at least twice, most recently in either 1948 or 1951. No additional erosion protection measures were installed at the toe of the slope, so additional repair work was anticipated in the future along this section of highway.

Summer 2000

During the summer of 2000, Alberta Transportation noted an instability in the riverbank at about km 1.9 in the 860 m section adjacent to the river. The slide was observed for at least the first two weeks of July while highway patching work in the area was carried out. Deterioration in the condition of the slope following a period of rain was reported on July 14, 2000. A joint site inspection was undertaken on July 18, 2000 by Mr. Darren Ratcliffe, P.Eng., of Klohn Crippen Consultants Ltd. and by Mr. Lyle Newman and Mr. Frank Vidmar of Alberta Transportation to determine the nature and condition of the slide. Further deterioration of the slide area was subsequently reported to Klohn Crippen on July 25, 2000.

The slide material at the edge of the river appeared to consist of fine-grained, clay-rich soil-like material, most likely consisting of weathered bedrock material. The material becomes very soft when wet and is erodible. At about 0.9 m below the road level, a saturated sandy seam was observed in the scarp.

At this location, the highway pavement is 6.7 m wide and the scarp of the slip was about 0.8 m from the edge of the paved surface. By July 25, 2000 the scarp had further advanced towards the road and was 0.7 m from the edge of the pavement. The width of the slide at this point was about 4 m, however, cracking and evidence of slide/slumping activity extended for about 14 m. The road surface was about 7 m above river level. The existing riverbank slopes are typically very steep (about 1H:1V or steeper) and slow erosion of the toe of the riverbank by the river was ongoing.

Sloughing of the steep backslopes above the road was highly apparent. The road ditch on the west side of the road, at the toe of the backslope, had completely silted up at this location. It appeared that storm runoff was flowing across the road and down the slide area towards the river. The flow of water was causing both erosion and softening/slumping of slope material. It appeared that a substantial portion of the material that would have comprised the original slope between the road and the river had been eroded away and thereby reduced the stability of the slope.

Fall 2000

In the fall of 2000, the ditch on the west side of the road was excavated to a depth of about 0.5 m. Pit run gravel was placed in the scour zone by dumping over the edge of the scarp. No riprap was placed at the toe. Despite significant movement of the gravel out into the river, a shoulder of about 2 m wide was formed at the road edge.

May 2001

In May 2001, the area was largely unchanged from the previous fall, but precipitation levels had been low. However, in July higher precipitation levels were experienced in the

area. The resulting runoff caused the gravel to slide and create a scarp at the road edge. To alleviate the hazard to traffic, native fill was placed at the top of the slide area to create a shoulder. In a matter of days, the new fill had also slid down towards the river.

The slide area appeared to be extending both upstream and downstream. Beyond the slide itself, cracks were appearing at the crest of the riverbank. The location of the cracks tended to suggest that the near vertical banks located immediately to the north and south are becoming unstable. The overall extent of the unstable riverbank now measured approximately 40 m.

From a review of the riverbank along the highway section, it is believed that river erosion is a contributing factor in the observed instability. However, areas along the river, on the outside of the same river bend, are well vegetated and are showing less signs of erosion. The primary trigger for the observed instability at this site is the change in road camber at the top of the slide. It would appear that the highway grade concentrates the sheet runoff flow moving down the road over the bank in the area of the slide.

July/August 2001
Options for the repair of this section of riverbank and slide remediation drawings were prepared by Klohn Crippen. These were sent to the Department of Fisheries and Oceans (DFO), and approval was received to proceed with the project in November 2001. It was proposed that the most efficient and economical remedial action was to make use of a protection/retention riprap toe berm in conjunction with compacted pit run gravel to reinstate the overall slope to about 2H:1V.

October 2002
The repair work was awarded to the local highway maintenance contractor, Ledcor Industries in September 2002. Construction started on October 1, 2002 and was substantially complete by October 10, 2002. Further details are provided in the report, "H837:02 Red Deer Riverbank Slide, Slide Remediation As-Built Report", dated October 2002.

Reports and Documents

July 2000 (KCCL) Emergency Inspection Report (July 25, 2000)
November 2000 Follow-up Inspection (November 14, 2000)
May 2001 (KCCL) Inspection Report (May 24, 2001)
July 2001 (KCCL) Inspection Report and Recommendations (July 25, 2001)
May 2002 (KCCL) Inspection Report (June 11, 2002)
May 2003 (KCCL) Emergency Inspection Report May 9, 2003 (revised July 2003)
May 2004 (KCCL) Inspection Form
Miscellaneous File Material 1979-1991
Alignment Report November 1992
Approval to proceed from DFO, November 7, 2001