September 12, 2003

Alberta Transportation
Central Region
#401, 4902 – 51 Street
Red Deer, Alberta
T4N 6K8

Mr. Melvin Mayfield, P.Eng.
Project Engineer

Dear Mr. Mayfield:

Central Region Landslide Assessment
H734:12 Slide
Emergency Geotechnical Inspection Report

This emergency geotechnical inspection report was prepared by Klohn Crippen Consultants Ltd. for Alberta Transportation Central Region under the Landslide Assessment Agreement CE053/2000. The site inspection was undertaken on September 12, 2003 by Mr. Darren Ratcliffe, P.Eng., of Klohn Crippen Consultants Ltd. Authorization to proceed with the inspection was provided on September 11, 2003 from Mr. Melvin Mayfield, P.Eng. of Alberta Transportation.

1. PROJECT BACKGROUND

The project site is located on Highway 734:12 about 3 km south of the junction with Highway 584, approximately 45 km west of Sundre, Alberta. At this location, the highway is located at the crest of the James River valley orientated in a north-south alignment. The legal description of the site is NE 19-33-08-W5 with approximate NAD83 coordinates of E629,740 and N5,745,805.

The highway is a gravel road and would appear to service logging and oil field operations and a number of recreational campsites in the area. Very little traffic was observed during the inspection (less than 2 vehicles per hour). No details were provided on the construction history of the road.

The site is illustrated on the attached photographs and on Figures 1 and 2.

2. SITE OBSERVATIONS

At the time of the site inspection on September 12, 2003, the following observations were noted:

- Two (2) slides about 20 m apart are present on the east side along this stretch of highway. For descriptive purposes the north slide is termed "Slide 1" and the south slide is termed "Slide 2. A ditch is present on the west side of the road.
- "Slide 1" has a total width of about 30 m and extends back into the edge of the highway surface. The slide has two semi-circular components in plan with backscarps of about 0.5 m. In general, the slide area was soft and wet and comprised a gravelly clay.

  A 600 mm diameter CSP culvert is located under the road at this location and the downstream end has been displaced downwards by the slope movement. Despite the culvert break, water is still flowing from the outlet. However, the source of the water is from within the slope as the upstream end of the culvert and ditch was dry. The flow of water from the culvert flows initially northwards along tension cracks and then eastwards down the slope towards the James River located about 100 m away with a vertical drop of about 20 m. Due to the vegetation, it was difficult to determine the steepness of the valley slope below the slide area.

  A second culvert is located about 25 m north of the broken culvert. This was observed to be a 400 mm diameter CSP and was dry at the time of the inspection.
- "Slide 2" is located about 20 m south of the first slide and is about 20 m wide. The slide is semi-circular in plan with a 1.5 m high scarp about 3 m from the edge of the road. The slide extends for a length of about 10 m down the valley side and a seepage flow was also observed exiting from the slide area. Similarly, the ditch on the west side of the road was dry.
- The extent of the vegetation in the slide areas was generally poor in terms of both grass and trees. In contrast, the vegetation was much thicker outside the slide areas. This would tend to imply that these areas have been active for a significant length of time and are associated with the observed springs in the slope.

3. SITE ASSESSMENT

It is considered that this length of highway was constructed very close to the edge of the river valley and was built over natural springs in the area. The spring flows have softened the clayey soil and this has resulted in a slope movement towards the river. At this time, one slide has progressed back into the highway surface. This slide has also displaced the downstream end of a culvert. Although groundwater is flowing from the culvert outlet, it is uncertain if ditch flows can still pass through the culvert without entering the fill.

The rate of slide progression is uncertain, however, it is considered that movements are generally of a slow nature, however, more rapid movements could be initiated during periods of high groundwater levels. Groundwater is exiting the slide area and so pore pressures are not considered to be building up within the slope at this time.

It would appear that the road does not carry large volumes of traffic and the slide would have to progress a considerable distance to block the highway.

Based on the risk level criteria provided by Alberta Transportation relating to safety, a risk rating of 18 was assigned to this site. This is based on a probability factor of 9 for an active slide, and a consequence factor of 2 due to the low traffic volume and the unlikely closure of the full width of the road.

4. RECOMMENDATIONS

Due to the infrequent use of the road and the potential slow nature of the slope movement, an observational approach may be acceptable in this location to monitor the rate of progression of the slide (say, to spring/summer 2004). Improvements to the warning signage may be required to highlight the edge of the road (additional posts or barricades etc.).

If it appears that the slide is encroaching too far into the road and warrants remedial action, it is considered that two approaches could be taken: (1) control groundwater flows and rebuild the upper slope, or (2) control groundwater flows and move the highway away from the valley edge for a length of about 50 m.

Option 1 – Groundwater Control and Shoulder Reconstruction

For this approach, the concept is to excavate into the slide area and at least 2 m into the road embankment to expose the broken culvert and identify the seepage zones. The soft wet soil is unsuitable for re-use and will have to be wasted. The CSP culvert would be repaired and about four (4) 150 mm diameter perforated PVC pipes with filter socks would be appropriately placed to carry groundwater out of the

slope. To create a new 3 m wide shoulder on the edge of the road, it will be necessary to place and compact pit run gravel. However, in order to prevent the gravel from sliding off the top of the slope, it is proposed to anchor and reinforce the new fill with geo-grid material extending the grid as far back under the road as possible. Geo-grid sheets would be placed at about 0.5 m vertical spacing as the gravel fill was raised. At the outlets of the groundwater drains some erosion protection would also be placed.

At this time, it is proposed to repair the north slide that is encroaching onto the road. If the slide to the south begins to regress then similar measures will likely be required. A cost estimate for the work is presented in the table below and indicates that the cost of the work is about $10,000.

Item	Quantity	Unit Rate	Total
Excavation	50 m^3	$15	$750
Fill	100 m^3	$25	$2,500
Geo-Grid	400 m^2	$10	$4,000
PVC Pipes	40 m	$20	$800
Culvert Repair	1	LS	$1,000
Total			$9,050

Option 2 – Groundwater Control and Highway Realignment

It is considered that the present road alignment is very close to the edge of the valley slope. Space does exist to the west of the highway to permit local realignment of the road by a distance of about 3 m to 5 m over a length of about 50 m. The simplest approach would be to excavate a new ditch at the tree line and place fill in the existing ditch. The downstream end of the 600 culvert would still need to be repaired and groundwater drains should also be provided. The road gravel surfacing would be reused. This would also require an extension of the upstream end of the existing culverts.

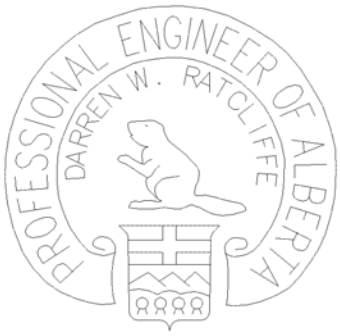
The benefit of this approach is that there is no new fill placed at the top of the unstable slope. Similarly to Option 1, this realignment covers the north slide only. A cost estimate for the work is presented in the table below and indicates that the cost of the work is about $12,000.

Item	Quantity	Unit Rate	Total
Excavation	250 m³	$15	$3,750
Fill	200 m³	$25	$5,000
Culvert	10 m	$100	$1,000
PVC Pipes	40 m	$20	$800
Culvert Repair	1	LS	$1,000
Total			$11,550

Please contact the undersigned if you have any questions regarding this report.

Yours truly,

KLOHN CRIPPEN CONSULTANTS LTD.



Darren Ratcliffe, P.Eng.
Project Manager

Reviewed by Tom Murray, P.Eng.
Manager, Geotechnical

APEGGA Permit to Practice No. 433

cc. Roger Skirrow, Alberta Transportation

FIGURES