Alberta Transportation

CENTRAL REGION
GEOHAZARD RISK ASSESMENT
SITE INSPECTION FORM

Klohn Crippen Berger

SITE NUMBER AND NAME / HIGHWAY & KM	PREVIOUS INSPECTION DATE	INSPECTION DATE
C7 H16:30 Kenilworth Lake	May 23, 2002	**May 19, 2010**

LEGAL DESCRIPTION	NAD 83 COORDINATES	RISK ASSESMENT
NE 28-50-4-4	N 5910800 E 532788	PF: 7 CF: 2 TOTAL: **14**

SUMMARY OF SITE INSTRUMENTATION:	INSPECTED BY:
4 Pneumatic piezometers and 1 standpipe operational as of 2002 (No instrument readings have been taken since 2002 when the slope was repaired.) LAST READING DATE: May 23, 2002	

PRIMARY SITE ISSUE:
Slope instability, fill settlement.

APPROXIMATE DIMENSIONS:

DATE OF ANY REMEDIAL ACTION: September 2001

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Cracking of the pavement and settlement was observed on the shoulder. Some cracking extended into the driving lane.	X	
Slope Movement	X				X
Erosion					
Seepage					
Culvert Distress					

COMMENTS

Refer to previous reports and attached letter and photographs.

Klohn Crippen Berger

May 25, 2010

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

Mr. Dennis Grace, P.Eng.
Project Engineer

Dear Mr. Grace:

Central Region GeoHazard Assessments
Site C07 H16:30 Kenilworth Lake Slide
May 2010 Site Assessment Report

Alberta Transportation has initiated a process of risk management at specific geohazard sites that includes a document control system. This annual site assessment report forms Section B of the document control system for the above site.

The site was inspected on May 19, 2010 by Mr. Darren Ratcliffe of Klohn Crippen Berger Ltd. Photographs from the inspection are attached.

This report was prepared by Klohn Crippen Berger Ltd. for Alberta Transportation Central Region under Contract No. CE101/2008.

1. BACKGROUND

1.1 Site History

The slide is located south of Highway 16 about 2 km East of Islay Junction along the north shore of Kenilworth Lake. The shoreline is located about 60 m from the highway and has a vertical elevation difference of about 15 m (approx. original slope of 4H:1V). The slide was first observed in 1977 and had no effect on the highway except for some cracks along the shoulder. The slide appeared to be a deep-seated rotational slide into the lake.

Remedial works constructed in 1980 included a dumped pit run gravel toe berm about 25 m wide and 50 m long.

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The slide was investigated in 1985/86 with the installation of slope inclinometers, pneumatic piezometers and standpipe piezometers. Horizontal drains up to 94 m long were also installed at this time. Twinning of the Yellowhead Highway past Kenilworth Lake was completed in 1990 or 1991 and followed the original highway alignment. In 1998, Highway 16 was re-paved, which included a nominal amount of additional fill at the crest of the slope to accommodate an increase in highway width. Patching on the shoulder was subsequently required in the fall of 1999, indicating that the slide was still active. It is understood that the addition of asphalt was required in the area from 1990 to 1999, with about one load of asphalt placed every 2 years over a 50 m long section of highway.

Patching on the shoulder at the slide location was regularly required in 1999, 2000 and 2001. Following the last patching work in August 2001, significant displacement was occurring in the driving lane adjacent to the lake. This lane was subsequently closed. Slide repair work at this site started on September 25, 2001. The selected remediation design included a granular berm at the toe of the slope keyed through the potential weak shear zone in combination with an overall flattening of the slope to about 6H:1V.

The base for the granular berm was excavated to elevation 604 m to 605 m, as shown on Figure 2. The berm was constructed with an external slope of 3H:1V, a crest width of 2 m, and a back slope of 1.5H:1V. Five of the six horizontal drains were extended through the granular fill as it was raised. Rip rap was collected from the lake bed and placed on the face of the berm to protect the toe from possible future erosion.

Using the granular toe berm as a starting point, the overall slope was flattened from 4H:1V to 6H:1V using compacted impervious fill. The slope was reclaimed with topsoil and seeded.

1.2 Instrumentation

Instrumentation at Kenilworth Lake was last read in May 2002. The slope inclinometers were last read in April 1988. A summary of the status of the instrumentation on site is provided in Table 1. Operational instruments in 2002 were limited to 4 pneumatic piezometers and 1 standpipe piezometer. It is not known if these instruments are still functional.

Table 1 Kenilworth Lake Slide Instrumentation (May 2002)

ID	Old ID	Ground Elevation (m)	Tip Depth/ Response Zone (m)	Stick-up (m)	Date Installed	May 2002 Piezometric Elevation (m)	Comments
Slope Inclinometers							
Ken01	1A	614.62	24 (?)	0.9	25-Apr-85	-	Sheared @ 4.9 m
Ken02	2	617.52	24.4	0.9	17-Oct-85	-	Destroyed
Ken03	3	611.88	20.7	1.0	18-Oct-85	-	Sheared @ 3.0 m
Ken04	1	607.40	15.2	0.8	24-Apr-86	-	Blocked @ 2.4 m
Ken05	2	609.18	15.2	0.8	25-Apr-86	-	Blocked @ 2.7 m
Ken06	3	612.61	21.3	1.0	28-Apr-86	-	Blocked @ 3.4 m
Pneumatic Piezometers							
P1		607.40	10.7	-	24-Apr-86	603.6	
P2		607.40	4.6	-	24-Apr-86	603.9	
P3		608.84	10.3	-	25-Apr-86	604.8	
P4		608.84	3.4	-	25-Apr-86	-	No return
P4A	P4	612.06	16.8	-	28-Apr-86	-	No return
P5		612.06	6.1	-	28-Apr-86	-	No return
P6		612.06	3.1	-	28-Apr-86	610.0	
Standpipe Piezometers							
SP 1A		614.65	19.8	1.13	26-Apr-85	610.8	
SP 2		617.59	1.5 - 21.6	0.31	17-Oct-85	-	Removed
SP 3		612.08	0.5 - 16.8	1.40	18-Oct-85	-	Blocked

1.3 Site Stratigraphy

The slope comprises of about 10 m to 20 m of medium to high plasticity silty clay till. Typically there is a 1.5 m thick layer of highly saturated organic material (peat) underlying the highway fill. This is underlain by a 3 m thick layer of soft saturated silty clay (till) followed by a 9 m thick layer of medium plasticity sandy clay (till). Some logs indicated the presence of clay fill overlying the native till, but the thickness is not well defined. The clay fill likely resembles the clay till in terms of material type and properties. An estimate of the fill thickness is about 5 m below the highway and about 3 m thick at the mid-slope. The clay deposits are underlain by a very dense uniform sand or sandstone of the Upper Cretaceous Belly River Group.

Moisture contents of the clay till ranged from 15% to 25% with an average of about 20%. Liquid limits ranged from 45% to 75% with corresponding plastic limits between 18% and 25%. The logs noted that the till contained low strength high plasticity bentonitic and reworked shale layers.

Laboratory testing was conducted in 1980 and 1985 to determine the strength properties of the clay till. The peak effective friction angles for the till varied from about 25° to 36°, with corresponding effective residual friction angles varying from about 15° to 20°. Due to the displacement that has occurred at the site, it is considered that the failure was occurring on a layer at which the residual friction angle has been attained.

2. SITE OBSERVATIONS

The site was last inspected in May 2002, the spring after construction was complete. Vegetation has established and the site appears to be performing relatively well. However, as shown in the photos below, cracking and settlement was observed on the shoulder above the slope. One crack extends into the driving lane. As shown in Photo 2, a semicircular area has dropped by a few centimetres.

Photo 1 Site Conditions May 19, 2010

Photo 2 Site Conditions May 19, 2010

3. RECOMMENDATIONS

It is considered that the observed distress in the pavement is due to residual slide movement and settlement of the fill. However, it is recommended that two inclinometers be installed in the slope to confirm the nature and rate of any movement. It is recommended that the instruments extend below the assumed weak zone at about elevation 597 m and about 5 m into bedrock.

The instruments should be installed near the alignment of the existing piezometers: one instrument should be located at the shoulder of the road, and the second instrument should be located further down the slope but above the fence line, as shown on Figure 1. The instrument drilled from the shoulder of the road, at about elevation 619 m, would be about 30 m deep and the second instrument would be slightly shorter at 25 m deep.

The drilling would comprise a combination of auger and air rotary drilling. The existing instruments would also be read during the investigation. The cost of the instrument installations is expected to be about $20,000, including KCB costs as shown in Table 2.

Table 2 Site Investigation Cost Estimate

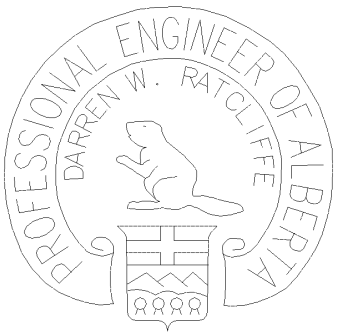
Item	Quantity	Unit	Rate	Total
Contractor Costs				
Mob / Demob	1	LS	1000	1000
Traffic Accomodation				
Drilling Time	24	hrs	250	6000
Air Compressor	2	days	450	900
SI Pipe	60	m	50	3000
Anchors, Caps, etc.	2	ea	200	400
Casing Protectors	2	ea	100	200
Grout Plant	2	days	135	270
Subsidence	2	days	450	900
Travel Time	2	hrs	95	190
Support Truck	2	days	225	450
Drilling Consumables	60	m	5	300
Constractor Subtotal				***$13,610***
KCB Costs				
Field Engineer	30	hrs	110	3300
Reporting	10	hrs	110	1100
Review	8	hrs	180	1440
Subsidence	2	days	250	500
Truck & Fuel	3	days		400
KCB Subtotal				***$6,740***
Total				**$20,350**

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

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Danelle Stutt, EIT
Geotechnical Engineer



Darren W. Ratcliffe, P.Eng.
Project Manager

APEGGA Permit to Practice No. 9196