November 22, 2004

Alberta Transportation,
Room 301, Provincial Building
9621 – 96 Avenue
Peace River, Alberta
T8S 1T4

Attention: Mr. Ed Szmata

PEACE REGION (PEACE RIVER) GEOHAZARD ASSESSMENT
SHAFTSBURY TRAIL (HWY 684:02) SITES (PH9)
2004 ANNUAL INSPECTION REPORT

Dear Sirs:

This letter report documents the 2004 annual site inspection of four landslide sites along Shaftsbury Trail (Hwy 64:02) grouped under PH9, on the west side of the Peace River, west and south of the town of Peace River, Alberta (refer to Figure 1). The work was undertaken by Thurber Engineering Ltd. (Thurber) in partial fulfilment of our Geotechnical Services for Geohazard Assessment, Instrumentation Monitoring and Related Work contract (CE047/2004) with Alberta Transportation (AT).

The inspections were undertaken on June 17 and 18, 2004 by Mr. Simon Cullum-Kenyon, P.Eng. and Mr. Don Proudfoot, P.Eng. of Thurber.

1. GENERAL

A general description of the geohazards, site geological and geotechnical conditions and history of previous events, investigations and remedial measures is given in the Geotechnical File Review included in Section A of the Project Binder.

2. SHAFTSBURY TRAIL OVERPASS

Background

The Shaftsbury Trail Overpass carries Highway 2 over a CNR line and Shaftsbury Trail on the approach to the bridge over the Peace River, and was constructed in 1982. Movement in the west abutment of the overpass was first noted in 1984. In 1986, the west abutment was moved back approximately 30 m and a portion of the intervening abutment fill was removed.

Continued...
Observations

Observations noted during our visit are shown on the attached Figure 2. Selected photos of the site are also attached for inclusion in section F of the binder. At the time of this inspection, there were a number of flowing springs around the overpass, including one in the north ditch, adjacent to the abutment, flowing at approximately 2 litres per minute (Photo 3). There is some surface water erosion at the north side of the abutment where drainage from the highway is flowing into the north ditch. At the south abutment, drainage is directed in a concrete channel into a gabion mattress-lined ditch.

On the highway surface, there is cracking up to 50 mm wide at the back edge of the abutment (Photo 1), and asphalt appears to have been pushed up against the approach road surface by the bridge deck and abutment. As a result, there are 50 mm high lumps at the edges of the highway and at the centre concrete no-post (jersey) barrier (Photo 2).

Under the extended portion of the bridge deck, damp sandy soil is exposed to the crest of the slope down to the rail line, which is concrete faced. The square section concrete piers which extend down through the concrete facing have moved upslope relative to the facing – a 250 mm to 265 mm wide gap has opened between the mastic seal around the base of the piers on the downslope side, and portions of the facing have been cut out on the upslope side to accommodate the movement (Photo 5).

On the south side of the bridge abutment there is a wide grassed area with a gabion-lined drainage ditch and gabion check structures (Photo 4). These appear in good repair. To the south of the drainage ditch, within a few metres of the edge of the trees is a 150 mm to 200 mm high scarp with minor horizontal offset.

Assessment

Field observations and instrumentation records indicate that there is continuing slide movement. Recent surface cracking and vertical offsets to the south of the bridge are of concern, and indicate extensive landslide movement. Springs noted on the north side of the abutment indicate very unfavourable groundwater conditions, at least during portions of the year.

It is not clear how much of the shallow movement observed in the inclinometers is real and how much is due to other factors. We suspect that the surface movements are due to loose backfill around the top of the casings. Ongoing deep movement observed at 29 m depth in SI-2 and SI4A is at a relatively low rate (<1mm/yr), though the consequences of ongoing movement for the bridge foundation could be significant. There appear to be opportunities to monitor
distortion and/or displacement of the bridge structure using survey control points and movement tell-tales. It will be necessary to identify what levels of movement might be safely tolerated in the foundations and bridge structure.

Risk Level

The risk level for this site has been assessed as follows:

PF(9) * CF(4) = 36

The rate of movement at depth appears low. However, the consequences of ongoing movement on the bridge structure are not well defined. The risk factor is unchanged from last year.

Recommendations

Deep slide movement might not be significant enough to warrant further stabilization measures at this point, though this needs to be confirmed with a bridge structural engineer. Additional movement monitoring on the bridge structure could be installed to indicate harmful levels of displacement. Installation of survey targets and tell-tales might be considered. We anticipate that continued displacement causing damage or unacceptable distress to the bridge will be the over-riding concern in this instance. Future inspections would most usefully be conducted in conjunction with a bridge structural engineer, in order to determine acceptable deformation criteria and landslide impacts on the structure as a whole. Monitoring of existing instrumentation should be continued.

Some minor improvements could be made to drainage from the Highway on the north side of the abutment into the drainage ditch to reduce erosion, though this is not considered particularly significant.

3. SHOP SLIDE

Background

The Shop Slide is located roughly 200 m south of the Highway 2 overpass, upslope of the CNR line, and affects the old highway that now serves as the south offramp for Highway 2 and access to residential and industrial development from Shaftsbury Trail. We understand that settlement associated with slope movement has become more severe over the last year.

Observations

The CNR line runs along the base of the valley slope at this point (Photo 6). There is significant seepage along the base of the slope, areas of bullrushes and horsetails (indicative of wet ground conditions) and several areas of standing...
water. There is a manhole on the east (downhill) side of the track, presumably associated with a drain system. Looking along the rail line, there don’t seem to be any signs that slide movement has distorted the line.

The slope up to the road from the rail line is inclined at around 16° to 17°, and has variable grass cover. In the middle of the slope, there is a subtle bulge, associated with sandier soil and sparse grass – the bulge may not be related to slide movement (Photo 8). At the far north end of the slide on the slope below the road, there are a few subtle cracks running across the slope, up to 25 mm wide.

At the road, the extent and severity of slide movement becomes more obvious. At the northern end of the road, there are several scarp segments that run across the northbound lane, meeting the main scarp at the southern end of the concrete divider. The main scarp runs across the entire width of the road and into the ditch, where it becomes hidden. At the southern extent of the slide, there are two zones of scarp movement, roughly 70 m apart. Vertical settlement across individual scarp segments in the road varies between 50 mm and 150 mm, with the largest settlement at the eastern edge of the pavement and the northern margin of the slide. A subtle bulge in the pavement characterizes the extreme southern margin of the slide. The width of the slide at the eastern (downslope) edge of the road is roughly 245 m.

The northern end of the upslope ditch is lined with gabion baskets. In places, these baskets have ripped open, and some of the cobbles have been displaced along the ditch. The cobble lining that remains in the ditch appears functional. Immediately upslope of the ditch there is a line of telegraph poles and a line of overhead electricity poles (Photo 9). The telegraph poles are tilted downslope through the area above the slide. At the time of the inspection, communications conduit was being installed along the base of the telegraph poles using a ‘ditch witch’ HDD trenchless system.

There is a disturbed area above the central portion of the lower slide, upslope of the road (Photo 11). At least a portion of the disturbance noted appears to be the result of landslide movement – there are irregular slump blocks with small trees back-tilted and a roughly 1 m high backscarp cutting across a track. The overall slope of this portion varies from 17° to 21°. There is a section of slope inclinometer pipe tilted out of the slope at a severe angle (Photo 12). This main scarp area does not show signs of very recent movement, but at the southern flank of this area, there are fresh cracks extending downslope to the ditch, with up to 75 mm vertical offset.
Assessment

Movement of the lower slide has become more obvious over the last year, though because there is no instrumentation in the slide to measure movement, it is not possible to quantify changes in movement rate.

There does not appear to be any geotechnical test hole information on file for this site, though given it’s proximity to the Overpass Slide, it is possible that there is a similar landslide mechanism and geology. It is possible that past investigations have occurred in the upper slide (hence the tilted inclinometer casing).

It is not clear whether movement in the upper slide is driving movement in the lower slide, though both do show signs of recent movement. Stabilization of the site will likely involve investigation and stabilization of both slides, though stabilization of the lower slide is probably more pressing as it is more directly affecting road safety, and could potentially affect the rail line.

Risk Level

The risk level for this site has been assessed as follows:

\[ PF(11) \times CF(6) = 66 \]

Although there is no objective measure of movement rate, AT’s observations suggest that movement may have increased. The lower slide now appears to affect both lanes over a considerable distance. Should movement accelerate, the road would likely have to be closed, and there is a possibility the rail line would be affected. The risk factor has increased from 54 due to an increase in PF (perceived increase in rate of movement).

Recommendations

Given the severity of movement on the lower slide backscarp as it crosses the road, consideration should be given to planning slide stabilization measures. This work will involve a geotechnical investigation to define and monitor movement on the slide plane, determine the likely slide mechanism and provide information on which to base a design. Four slope inclinometers are proposed at this site at the locations shown on Figure 3. The holes should be logged and piezometers should also be installed in adjacent holes at each location. A fourth test hole with a piezometer is recommended at the toe of the slope to complete the stratigraphic cross-section information. The drilling investigation should be followed by a topographic survey to provide slope geometry and to locate the test holes. Instrumentation should be monitored for a minimum of 1 year to provide parameters for design.
As an interim measure, we recommend that the upslope ditch be lined from the culvert outlet downslope to beyond the southern extent of the slide, to prevent water seeping into the slide plane and accelerating movement.

4. BRICK HILL WASHOUT

Background and Observations

The Brick Hill Washout occurred during a high stream flow event in McAllister Creek that washed out one lane of Hwy 684 in the Spring of 2003. The road has since been re-built and re-paved (Photo 13), and the channel has been restored, with rip rap armour on the outside of meander bends and erosion control mat on the inside of bends (Photo 14) and on other disturbed areas on or near the stream banks. Disturbed areas away from the banks have been hydro-seeded.

Assessment

The washout has been fixed and the road re-instated. Armour along the reconstructed channel is expected to protect against future similar events at this location. There is probably still a risk that similar high flow events might impact the road at other locations, and depending on the importance of the road, it might be useful to identify locations at risk through an air photo interpretation study.

The performance of sediment and erosion control measures should be monitored informally until full green-up. This information will likely provide useful feedback on the measures used at this site.

Risk Level

The risk level for this site has been assessed as follows:

$$PF(1) \times CF(2) = 2$$

Riprap armour minimizes the likelihood that a washout will occur again at this location, though it does not affect the likelihood of high flow events on the creek.

Recommendations

The site has recently been repaired. Further problems are not anticipated at this site, though depending on the importance of the road, some further work may be warranted to identify other areas of the road at risk.
5. **BRICK HILL SLIDE**

**Background and Observations**

Repairs at the Brick Hill slide were completed towards the end of May 2004. Road paving is scheduled for late in 2004. A site topo-plan showing a schematic of the site repairs is shown on the attached Figure 4. A reduced copy of the "as-built" drawings is also attached for inclusion in Section G of the binder.

Slide repairs consisted of placing a gravel drainage blanket and a toe berm against the slide mass, which was left in-place (Photo 16). One or more trench drains were dug through the slide mass – a section of 'multi-flow' type panel drain can be seen at the surface near the top of the slide repair. A drain exit appears to have been constructed at the toe of the repair, at an existing swale, and protected with riprap (Photo 19).

During repair work, as the contractor was removing the failed pavement surface, the slide mass started moving. As a consequence, the size of the repair was increased. The road was reconstructed using clay, pitrun gravel and granular base course. Both the upslope and downslope road ditches have been reconstructed / repaired and lined with riprap or erosion control mat (Photo 17). Both ditches are led into a CMP culvert, which extends downhill to near the base of the slide, discharging from a CPP culvert (Photo 18).

The repaired area is currently bare soil – there is no evidence of hydro-seeding on the surface. There are some longitudinal cracks in the pavement in the northbound lane (Photo 20).

**Assessment**

Stabilization measures have recently been completed at this location. There is no performance history to indicate how successful these measures have been. Once the road is re-paved, the surface should be checked occasionally for signs of further movement. Although located away from the main slide area, slope inclinometer SI-SB1 has shown some surficial movement. Further readings, combined with visual observations on the road surface and across the toe berm, should help to determine the significance of readings from this instrument and the success of the stabilization measures.

Sediment and erosion control measures implemented at this site should be monitored informally until full restoration to provide feedback. Particular attention should be paid to the appropriateness and performance of the ditch lining measures (check if flow and erosion are occurring under the erosion control mat).
Risk Level

The risk level for this site has been assessed as follows:

$$PF(5) \times CF(4) = 20$$

Slide stabilization measures were completed just prior to the field visit. The probability Factor of 5 has been selected since there is insufficient performance history to date to assess the effectiveness of the recent repairs.

Recommendations

The performance of the repair should be assessed over the next year. Particular attention should be paid to erosion of the currently bare soil slope and behaviour of the erosion control mat installed in the upslope ditch (check if flow and erosion is occurring under the mat).

6. CLOSURE

Should you have any questions, or if the slide conditions worsen please contact the undersigned.

Yours truly,
Thurber Engineering Ltd.
Don Proudfoot, P.Eng.
Review Principal

[Signature]

Simon Cullum-Kenyon, P.Eng.
Project Engineering Geologist

/slp