THURBER ENGINEERING LTD.

ALBERTA TRANSPORTATION GEOHAZARD ASSESSMENT PROGRAM
PART A: FILE REVIEW

PEACE REGION – PEACE-HIGH LEVEL

PH34 JUDAH HILL – FENCE SLIDE

Legal Location:	SE¼ 29-083-21 W5M
Nearest Landmark:	400 m south of the CN Rail crossing on Hwy 744
Highway Control Section:	Hwy 744:04
Date of Initial Observation:	1984
Date of Last Inspection:	2008
Last Inspected By:	Thurber Engineering Ltd.
Instrumentation Installed:	8 Inclinometers 3 Piezometers
Instrumentation Operational:	1 Inclinometer
Risk Assessment:	PF = 12 CF = 5 Risk = 60

1. INTRODUCTION

The site is located 0.4 km south of the CN rail level crossing (km 59.6) on Hwy 744 near the town of Peace River. The site covers the road between km 59.1 and km 59.2 and the downslope stabilisation works as far as the CN Rail line.

Highway 744 runs south from Peace River through Marie-Reine to Highway 683 and on to Highway 49 near Girouxville. For the first 2 km south of the town of Peace River, it climbs roughly 200 m up the valley wall of the Peace River to prairie level at elevation 545 m. The CN Rail line is roughly 60 m slope distance downslope of the road, with houses a further 40 m beyond the rail line.

The site encompasses a roughly 50 m slide with its backscarp within the road, which was repaired in 2005. Repairs consisted of excavation of the slide mass and replacement with geogrid reinforced fill. However, since the repairs were completed, cracking and settlement of the reinforced fill has occurred, particularly at the southern end of the repair. Cracking and minor settlement has also been noted in the down slope (south-bound) lane both north and south of the main slide.

The location of the site is shown on Figure 1, while site details are shown on Figure 2, based on the last inspection.

This section is a review of files made available by Alberta Transportation regarding this site, and has been conducted to update the previous Part A review, which covered all the Judah Hill sites.

2. BACKGROUND

2.1 Bedrock Geology

Based on the AGS 1:1,000,000 bedrock geology map of Alberta, the following bedrock units occur in the valley slope down to the Peace River:

- Dunvegan Formation – fine sandstone with hard calcareous beds, laminated siltstone, silty shale.
- Shaftsbury Formation – silty shale and shale, ironstone beds, bentonite partings, thin silty and sandy intervals.

- Peace River Formation – silty shale, fine sandstone, silty interbeds.

No rock is exposed at the immediate site – cross-sections presented on the published hydrogeological maps suggest a considerable thickness of surficial materials overlie the rock.

2.2 Surficial Geology

AGS Map 291 (Surficial geology of the Grimshaw area) indicates a local veneer of eolian sand and silt overlying glaciolacustrine fine sand, silt and clay on the upland, with mixed colluvial materials on the slopes. Coarser sand and gravel deposits have been noted in road cuts locally along Hwy 744.

2.3 Hydrogeology

The ARC 1:250,000 Hydrogeological map of Peace River does not show springs or flowing wells (mainly completed within glacial deposits) in this area. Perched aquifers are expected locally, associated with local pockets of sand and gravel. Such pockets can become confined where covered by colluvium or fill on slopes.

2.4 Geomorphology

The site is below the crest of the east valley slope of the Peace River, on a ridge formed between the Peace River and Heart River valleys. Highway 744 runs down the west side of the ridge as it decreases in height and narrows northwards, towards the town of Peace River. The sides of the Peace River and Heart River valleys are characterised by extensive landslide activity. Common landslide mechanisms in this region include:

- Earthflows caused by sudden saturation of surficial material.
- Landslides with a base in the weak Shaftsbury Formation shales.
- Landslides within weak glaciolacustrine silts and clays.

At this site, other factors that might influence landslide occurrence include saturation of downslope road fill, and drainage off the impermeable road surface. There are concerns about slide activity extending to the base of the slope, based on the irregular slope topography and observation of slides at the toe of the slope,

including the 101 Street slide (see Barlow, McRoberts and Tenove 1990 “Stabilization of Urban Landslides in Peace River”).

The hillslope at this point is steep (41 degrees or 1.16H:1V), and the road has been constructed in cut and fill. Investigation in 2005 suggests failure occurred within a soft to firm clay layer at 4 m to 6.5 m depth on the downslope road shoulder. This clay layer may have become softened by water from surface runoff or penetrating along the stone columns.

3. HISTORIC INFORMATION

3.1 Summary

Slope problems have been noted at this location for some time, with inclinometers installed in 1986 and stone columns installed in 1988. Various efforts have been made to reduce infiltration of water from the ditch into the slope below the road, including a geomembrane liner in 1988, a seepage interceptor ditch in 1998, and a drain in 1999. Despite these measures, during a period of wet weather in April 2005, significant slide movement occurred. Repair work for this slide included excavation and replacement of failed material with geogrid-reinforced fill, and was completed in November 2005. Some cracking was noted around the margins of this repair shortly after the work was completed. This cracking has subsequently worsened. Some cracking along the downslope shoulder of the road has also been noted north and south of the slide for some time – at least since 2004.

Several phases of geotechnical investigation have been conducted through this area, the most recent being the 2005 investigation. The only remaining operational slope indicator is at the top of the hill above the slide.

3.2 Chronology

May 1984	Hwy 744 first paved.
1986	SI-1B and SI-2B installed.
1988	Stone columns installed on the downhill side of the road. Curb installed along downslope (west) road edge with drains running across the road to the upslope ditch. Geomembrane installed in ditch to reduce percolation of water into the slope.
July 1992	SI-11 and SI-12 installed.

August 1992	Tension cracks noted at stone columns.
November 1992	SI-21 to SI-24 installed.
September 1994	SI-31 and Si-40 installed.
Spring and Summer 1997	Cracking and settlement of the downslope portion of the road. SI-23 at the base of the slope registering movement at 16.7 m depth (later sheared off at 16.5 m depth). Other SIs not indicating shear movement, so connection between roadway settlement and deep movement not clear.
1998	Seepage interceptor ditch installed to 2.5 m depth in the upslope ditch, lined on the downslope side with geomembrane. French drain installed uphill of the road.
March 1998	SIs installed by AMEC.
February 1999	Report summarising findings of SIs installed in 1998. No significant movements detected (dry year).Report assumes that settlements are related to fill soils – recommend seepage interceptor drain in upslope ditch. Slump above road at km 59.475.
May 1999	Construction of seepage interceptor drain in Zone B1 (km 59.0 to km 59.2). Slump at km 59.475 removed.
October 1999	Hwy 744 re-paved
October 2002	Cracking and settlement at stone columns worsened.
May 2003	Significant settlement at the stone columns.
June 2004	Apparent worsening of settlement / loss of ground around columns. Longitudinal cracking along the downslope side of the road north and south of the stone columns.
March 2005	Test holes TH05-1 through TH05-7 drilled. SI installed in TH05-3 and piezometers installed in TH05-1 (x2) and TH05-3.
April 2005	Significant slide movement causing a drop in the pavement in the south-bound (west or downslope) lane. Guardrail shifted towards road centreline and ditch filled. Survey of slide area conducted. Continued creep in the downslope road shoulder. SI05-16 installed at the crest of the slope. TP05-1 to TP05-3 excavated into the toe of the slide. Results of investigation and subsequent monitoring suggest movement within a bowl-shaped soft to firm clay layer at 4 m to 6.5 m depth at the

	outside edge of the road. Clay layer may have become softened due to water from surface runoff or entering along stone columns.
November 2005	Slide repair work completed. Repair work consisted of excavation and replacement of failed material with geogrid reinforced fill.
June 2006	Crack noted running across road at the southern end of the repair, then running along road centreline and tapering out. Crack appears to run along the extent of the reinforced fill repair. Cracks initially though to be due to fill settlement. Some surface water erosion on the repaired slope.
May 2007	Worsening of cracking and settlement around the edge of the geogrid-reinforced fill repair. Cracking along the outer edge of the road to the north and south of the repaired area appears to be worsening.
June 2006	Worsening of cracking and settlement around the edge of the geogrid-reinforced fill repair. A distinct dip has developed in the guardrail. Surface ‘skin’ failure has occurred just below the downslope road shoulder. Cracking along the outer edge of the road to the north and south of the repaired area appears to be worsening.

NOTES:

1 LOCATION DATA RECORDED USING HAND HELD GPS RECEIVER. ALL LOCATIONS ARE APPROXIMATE AND ARE FOR ILLUSTRATIVE PURPOSES ONLY.

0 100 200 300 400 500 m

DRAWN BY ICB	DESIGNED BY	APPROVED BY
SCALE 1:10 000	DATE OCTOBER 29, 2008	FILE No. 15-16-213A-C1A

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PEACE REGION (PEACE RIVER/HIGH LEVEL)
JUDAH HILL

KEY PLAN

FIGURE 1

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LEGEND:

TEST HOLE LOCATION

SLOPE INDICATOR

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2 2008 OBSERVATIONS SHOWN IN RED

0 10 20 30 40 50 m

DRAWN BY	DESIGNED BY	APPROVED BY
ICB		
SCALE 1:750	DATE OCTOBER 31, 2008	FILE No. 15-16-213A-C0A

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PEACE REGION (PEACE RIVER/HIGH LEVEL)
PH34 FENCE SLIDE

SITE PLAN

FIGURE 2

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