THURBER ENGINEERING LTD.

ALBERTA TRANSPORTATION GEOHAZARD ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

PEACE RIVER/HIGH LEVEL REGION

SITE: PH42 DAISHOWA – PUMPING WELL SITE (STATION 13+300)

LEGAL LOCATION:	NE12-085-21 W5M and NW07-085-21 W5M
AT CONTROL SECTION:	HWY 968:01
NEAREST LANDMARK:	Peace River Bridge near Daishowa Pulp Mill (Station 11+00)
DATE OF INITIAL OBSERVATION:	1989
DATE OF LAST INSPECTION:	May 28, 2008
LAST INSPECTED BY:	Thurber Engineering Ltd.
INSTRUMENTS INSTALLED:	10, 11, 12, 14, 15, 16, and 03-7
INSTRUMENTS OPERATIONAL:	None
RISK ASSESSMENT:	PF(11) * CF(5) = 55
LAST UPDATED:	Thurber Engineering Ltd. October 2008

1. INTRODUCTION

This section is a review of files made available by Alberta Transportation specifically pertaining to conditions at the referenced geohazard site. This review is based on a compilation of a previous Part 'A' Review undertaken by AMEC for PH7 dated November 2000, annual Part 'B' Site Inspections undertaken since 2001, as well as relevant information from Part 'F' Plans and Part 'G' Site Documentation. Published geological and geotechnical information was also used to supplement the report.

Secondary Road 968 descends to the Peace River bridge just south of the Daishowa Pulp Mill from the east upland area by following a steeply incised unnamed creek valley/ravine. The Peace River Valley at this location is approximately 220 m deep. Widespread landsliding occurs naturally in this area but was exacerbated during construction of the highway in 1989/90, requiring some alignment changes and construction of berms and large upslope unloading. Erosion associated with the unnamed creek which flows along the north side of the roadway has also been an ongoing problem and continues to affect toe berms and road fills and has led to some major remediation projects to date.

Originally, all of the geohazards associated with the Daishowa East Hill approach were designated as being within PH7. In 2006, the site was subdivided into four separate areas as follows:

- PH7 (Site 7 & 8) - Extends from about Station 12+050 to Station 13+100 and includes the major riprap lined channel and gabion drop structures on the north side of the roadway and the recently installed (2007) erosion control measure test section in the upstream ditch.
- PH41 (Site 5) - Extends from about Station 11+600 to Station 12+050 and encompasses a previously unstable embankment slope and the lower of the major gabion erosion control structures on the east hill.
- PH42 (Pumping Well Site) - Extends from about Station 13+150 to Station 13+350 and includes an active landslide involving the roadway and its embankment slope. Several pumping wells were installed previously in an attempt to dewater a layer of gravel encountered at depth.
- PH43 (Site A and B) - Extends from about Station 13+350 to Station 14+100 and includes two large road fills with culverted toe berms

constructed across the unnamed creek. The western Site A is most active and a tangent pile wall was installed in 2004 to protect the roadway.

The location of PH 42 is shown in Figure 1.

2. DESCRIPTION OF GEOHAZARD

The geohazard at this location consists of a landslide on the downslope side of the roadway that is encompassing the fill embankment. In 1991, the slide was estimated to be about 100 m wide with a failure surface about 14 m below grade in the center, based on slope inclinometers. The rupture surface is below the fill (about 6 m thick on the slope) and is likely within glaciolacustrine clay and or the underlying clay shale. The height of the road above the creek is approximately 30 m.

Ongoing ground movements have been measured as far as the upslope side of the roadway, with the most active movement occurring across the westbound lane.

Layers of sand and gravel were encountered above the bedrock which have been targeted by several dewatering schemes in an attempt to stabilize the slide. It is believed pore pressures tend to build up in this layer as a result of being blocked by fill construction and/or landsliding.

3. GEOLOGICAL AND GEOTECHNICAL CONDITIONS

3.1 Physiographic Setting

The study area is located within the Peace River Lowland physiographic region.

3.2 Bedrock Geology

According to Hamilton et al. (1999), the Peace River Valley at this location cuts through several bedrock sequences and the following bedrock groups underlie portions of the general study area from the upland level to river level:

- Dunvegan Formation (Kd): grey, fine-grained, feldspathic sandstone with hard calcareous beds; laminated siltstone and grey silty shale; deltaic to marine.
- Shaftesbury Formation (Ksh): dark grey fish-scale bearing shale, silty in upper part; numerous nodules and thin beds of concretionary ironstone; bentonite partings; lower part with thin silty and sandy intervals; marine.

- Peace River Formation (Kp): dark grey silty shale; fine-grained glauconitic sandstone, silty interbeds in lower part (Harmon Member); fine-grained quartzose sandstone (Cadotte Member); shoreline complex.

Bedrock is locally exposed on the lower portion of the valley slope along the Peace River upstream and downstream of the bridge.

3.3 Surficial Geology

The east valley wall of the Peace River Valley and its tributaries are comprised of colluvium (i.e. landslide terrain) that is derived from the upland glaciolacustrine materials and the underlying soils and bedrock. The lacustrine deposits are complex and consist of layers of clay, silt and sand, and overlie clay till and, locally, sand and gravel above the bedrock.

These lacustrine deposits are believed to be pre-glacial in origin and have been only partially eroded by the present day Peace River leaving much of this material exposed in the valley walls.

A groundwater table near surface is common in the area and is exacerbated by the presence of sand and gravel layers, some of which became blocked during road construction by the placement of fill and subsequent landsliding.

3.4 Stratigraphy

Soil conditions at the site basically consist of about 6 m of medium to high plastic clay fill overlying glaciolacustrine clay and/or clay till. Layers of sand and gravel were encountered within the glaciolacustrine deposits and just above bedrock. Bedrock underlying the site is comprised predominantly of clay shale.

4. CHRONOLOGY

1989-1990 Construction of road. Horizontal drains (unknown number/length) installed at toe of fill slope.

1991 Drains reportedly dry.

1991 Note to file by Karl Li. Cracks in embankment extending to backslope ditch. Three slope inclinometers (10, 11 and 12) and three piezometers installed at site.

1994 Note to file by Karl Li. Two wells installed near headscarp of slide in sand/gravel layer overlying bedrock. Pump tests indicated permeabilities in the range of 7×10^{-6} m/s to 1×10^{-6} m/s.

1994 Note to file by Fred Cheng. Results of pump tests and stability calculations on the effect of groundwater table lowering.

1995 Series of 20 belled wells (connecting bases) installed on uphill side of highway ranging in depth from 10 m to 34 m. Pumps installed in 4 wells.

1997 Letter from V. Diyaljee to D. Kohut. Roadway was patched several times in past year indicating active sliding. Big 'O' drain outlet could not be located. Slope inclinometers 10 to 14 reported not functional. Submitted estimate for replacement slope inclinometers.

2003 Installation of slope inclinometer SI03-7.

2004 Slope inclinometer SI03-7 sheared off in 2004 at 13.4 m.

2001-2004 Pumping wells continue to draw power but outlet or evidence of discharging water could not be located in this time period.

2006	Last slope inclinometer at site (SI15 installed on edge of slide) sheared off at 3 m depth. Attempt to reinstate pumping wells failed; outlet pipe appears to have been sheared.
2001-2008	Visible signs of ongoing slope movement apparent. Road patched several times in this time period.

REFERENCES

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