ALBERTA TRANSPORTATION
LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

NORTH CENTRAL REGION - ATHABASCA

SITE NC62: HWY 881:16 (km 29), SOUTH OF BEAVER RIVER

Legal Location:	S.E. 12-63-9-W4M
Nearest Landmark:	3.3 KM SOUTH OF JCT HWY 881:16 AND 55
Highway Control Section:	HWY 881:16
Date of Initial Observation:	2007
Date of Last Inspection:	June 2009
Last Inspected By:	Thurber Engineering Ltd. (Thurber)
Instruments Installed:	N/A
Instruments Operational:	N/A
Risk Assessment:	PF(7).CF(4) = 28
Last Updated:	January 2010 – Thurber Engineering Ltd.

1. LOCATION

The site is located along Hwy 888:16 approximately 3.3 km south of the junction with Highway 55.

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

Highway 881 (south) is a two-lane undivided paved highway. At the site location, the highway descends the sidehill of a tributary valley of the Beaver River. The centre of the site is located about 350 m south of the Beaver River. The highway embankment fill is about 28 m deep with an overall slope angle of 18.4 degrees to the horizontal. The back slope is about 24 m high with a 6 m wide bench at 4 m height and sloped at 26 degrees and 18 degrees to the horizontal above and below the bench, respectively.

In 2001, a major landslide took place along the west side of the highway and took out half of the roadway over an approximately 80 m long section. The MD of Bonneyville No. 87 retained AMEC Earth and Environmental (AMEC) to conduct a geotechnical investigation and design remedial measures. The remedial measures consisted of excavating the failed west side slope in a benched configuration and reconstructing it using a combination of common and granular fill layers. Geogrid reinforcement was incorporated in the fill at key elevations and a gravel shear key was constructed at the base of the fill extending below the creek level. A sand drainage layer was placed along the lower part of the back of the slope excavation and drain pipes were extended to drain seepage from the drainage layer to the creek. Riprap was placed along the toe of the slope to guard against creek erosion. The highway was then rebuilt and paved at the slide location after construction completion in 2004. The design plans and cross sections prepared by AMEC for implementation of the remedial measure along with the drilled test holes for preliminary assessments are included in Section G of the binder.

In 2007, longitudinal and arch-shaped open cracks were noted on the highway surface inside and outside the remediated section of the highway. In general, no signs of slope instability were noted on either of the highway backslope or sideslope. The cracks inside the remediated section appeared to be reflective cracks. However, the cracks located outside the remediated section of the highway and particularly those located to the south of the remediated section of the highway have continued to open and widen since 2007. The site observations and crack patterns indicated potential slide movement outside the south limits of the repaired area.

Based on the site observations, a possible long term solution was to extend the remedial measures implemented by AMEC to the south of the remediated section or to realign the highway further to the east to circumvent the slide area subject to carrying out a geotechnical investigation and Instrumentation Monitoring Program.

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

Physiographic Region: Eastern Alberta Plains (Atlas of Alberta, University and Government of Alberta, 1969).

Bedrock Geology: The bedrock at the site is an Upper Cretaceous bedrock of the Lea Park Formation from the Mesazoic era; dark grey marine shale, pale grey, glauconitic, silty with ironstone concretions (Geological Map of Alberta, AGS, 1999). The bedrock elevation is about 450 meters (Bedrock Topography of Alberta, AGS, 1995).

Surficial Geology: The surficial geology consists of undivided Colluvial deposits. The deposits are massive to moderately well stratified, non-sorted to poorly sorted with clay to boulder size sediments that have been transported by gravity-induced movement and confined to the sides and floors of the valley (Surficial Geology Sand River Area, AGS, 1983).

Hydrogeology: The available hydrogeological map was poor in quality to provide full interpretation. According to the available hydrogeological map, the groundwater flow from the Lea Park Formation bedrock would be limited to less than 0.1 L/s. However, higher flow (about 0.4 to 2 L/s) would be expected in the surficial sand layers overlying the bedrock shale. Groundwater flow is anticipated to be in a northern direction towards the Beaver River (Hydrogeological Map Sand River Alberta, Alberta Research Council, 1979).

Stratigraphy: AMEC drilled six (6) test holes in 2001 to depths varied between 7.8 m and 16.7 m below ground surface. The main subsurface soil units typically consisted of 4.0 m to 7.0 m of clay fill and sand fill underlain by clay till, extending to the end of exploration depth. Sand layers were noted within the clay till layer in the test holes drilled along the west shoulder of the highway at a depth of about 9.0 m and extended to a depth of about 15.0 m below ground surface. Approximately 0.7 m thick high plastic clay layer was present within the clay till layer. The test holes drilled by AMEC are presented in Section G of the binder.

4. CHRONOLOGY

2001

A major landslide occurred and took out half of the roadway.

2001 - 2004

AMEC was retained by the MD of Bonneyville No. 87 to design and implement remedial measures. Remedial measures were completed in 2004.

2007 - Present

In 2007, longitudinal and arch-shaped cracks first appeared on the highway paved surface inside and outside the remediated portion of the highway.

Thurber first visited the site based on a call-out request made by TRANS in May, 2008 to inspect the highway conditions and record any pertinent features. The site was then added to the 2008's North Central Geo-hazard Assessment Program.

A geotechnical investigation and Instrumentation Monitoring Program Proposal was prepared by Thurber and sent to TRANS for approval in December, 2008. Due to lack of funds at the time the proposal was submitted, the work was postponed for indeterminate period of time.

The south hill section of the highway was overlaid in fall 2008 and a stepped gabion drainage structure was constructed to replace the damaged above ground half culvert structure to carry flow from the highway ditch down to the tributary creek.

The site was last visited in June, 2009 during the annual inspection event. After June 2009 site visit, and because the site conditions remained relatively unchanged since 2007 and was not affecting the highway surface conditions, it was decided to temporarily discontinue the annual inspections. However, it was recommended that Thurber should be contacted again if the highway conditions start to deteriorate significantly and affect the safety of travelers.

REFERENCES

1. University and Government of Alberta, 1969. "Atlas of Alberta."

2. Alberta Geological Survey, Alberta Energy and Utilities Board, 1999. "Geological Map of Alberta," Map No. 236.

3. Alberta Geological Survey, Alberta Energy and Utilities Board, 1995. "Bedrock Topography of Alberta," Map No. 226.

4. Alberta Research Council, Alberta Geological Survey, 1983. "Surficial Geology of Sand River Area, Alberta," NTS 73L.

5. Alberta Research Council, 1979. "Hydrogeological Map of Sand River, Alberta," Report No. 79-1, taken from Ozoray et al., 1979, Hydrogeology.