

#### 4.14 S17 – HIGHWAY 40 – MOUNT BALDY ROCK CUT

##### **Background**

This site consists of a rock cut slope along the east side of the highway and approximately 4.75 km south (as measured along the highway) of the junction between Highway 40 and Highway 68. Please refer to Figure S17-1 in Appendix S17 for an illustration of the site location.

There is a rockfall hazard at this site that was first documented during the geohazards review for the Highway 40 / 541 corridor. There is a warning sign (“Watch For Fallen Rock”) posted for northbound traffic at this site. The site characteristics are summarized as follows. Please refer to AMEC’s report on the Highway 40 / 541 corridor<sup>4</sup> for further details.

- The cut slope is near-vertical with a maximum height in the order of 8 to 10 m. There is also an oversteepened to near-vertical exposure of soil above the crest of the rock cut. The estimated thickness of the soil layer is 3 to 4 m and there are rocks of up to boulder sizes exposed in the soil layer. Photo S17-3 in Appendix S17 shows a typical view of the cut slope.
- The ditch along the toe of the rock cut is approximately 4 m wide and 0.75 m deep. Based on the “Ritchie ditch chart” rockfall catchment ditch design chart first developed by the Washington State Department of Highways (attached as Figure A1 in Appendix A), the ditch should be at least 4.3 to 4.7 m wide and at least 1.15 to 1.3 m deep for the height and inclination of cut slope at this site. Therefore, the existing ditch does not meet these criteria, at least for the segments of the cut slope near maximum height.
- At the time of the first site inspection in October 2005 the effective ditch depth had been significantly reduced by an accumulation of rockfall debris in the ditch. The rockfall debris included some boulder-sized rocks that had landed within 1 m of the edge of the pavement. There were no rocks on the pavement at the time of the inspection. There were some possible signs of damage to the pavement from previous rockfalls.

The June 2007 site inspection was the first annual site inspection under the Southern Region GRMP and the first site inspection since late 2005. This site was added to the annual site inspection tour because its recommended Risk Level was one of the highest in the geohazards review of the Highway 40 / Highway 541 corridor.

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<sup>4</sup> “Geohazards Review, Highway 40 / Highway 541 Corridor, Southwestern Alberta”, AMEC report submitted to AIT on April 10, 2006, AMEC project number CG25211.

### **Site Assessment**

The site assessment was performed on June 19, 2007. The weather at the time of the site assessment was clear and cool with a blustery wind.

The site assessment consisted of a visual inspection of the slope and ditch conditions from the highway.

### **Observations**

The following points summarize the observations made during the site assessment. Please also refer to Appendix S17 for photographs.

- There was an accumulation of rockfall debris in the east ditch, as shown in Photos S17-1, 2 and 3. The debris included rocks of up to 1 m maximum dimension within 0.5 m of the east edge of the pavement. There were no large rocks on the pavement at the time of the inspection.
- Groundwater seepage was coming out of the lower portion of the rock cut slope above where the largest accumulation of rockfall debris was located in the ditch. The approximate extent of the groundwater seepage is marked on Photos S17-1 and 3. This seepage was not observed during the October 2005 inspection, and is likely seasonal.
- Signs marking a buried Telus cable were noted in the west ditch, i.e. on the opposite side of the highway from the cut slope.

### **Assessment and Risk Level**

Overall, there have been no fundamental changes in the rockfall conditions since the October 2005 site inspection as part of the geohazard review for this highway corridor.

Based on a review of the Ritchie ditch chart (Figure A1 in Appendix A), the east ditch is undersized with respect to the rock cut slope. This becomes an even greater issue if the amount of rockfall debris that accumulates in the ditch reduces its effective depth and allows subsequent rockfalls to roll across the debris surface and onto the pavement. It does not appear that significant amounts of rockfall debris are being deposited on the pavement, however during the October 2005 inspection some possible rockfall damage was observed on the pavement along the east edge of the road. This suggests that at least some rocks have been deposited on the pavement.

The rate of rockfall debris accumulation is not known for this site. A comparison of the photos from the October 2005 and June 2007 site inspections suggests that the debris has been cleaned out at least once during that time, but this is not certain.

AMEC recommends the following Risk Level factors for this site using the rock fall frequency-severity matrix (Table A2 in Appendix A):

- Probability Factor of 15 based on the appearance of the cut slope (including the oversteepened rocky soil layer above the crest of the rock cut) and the volume of debris in the ditch that suggests that there are many rockfalls every year.
- Consequence Factor of 3. Although there were no rocks on the road at the time of the inspection, the volume of debris in the ditch and the presence of boulder-sized rocks within 1 m of the edge of the pavement raises the possibility of rockfall debris rolling onto the road and causing minor damage to vehicles if struck.

Therefore, the recommended Risk Level for this site is 45. These values are unchanged from those recommended in the geohazard review for this highway corridor.

### **Recommendations**

The following work is recommended in order to reduce the Risk Level at this site:

1. Scaling of the rock cut slope and the exposed soil face above the crest of the rock cut. This will be effective for removing rocks from the soil face that will otherwise erode out and fall into the ditch over the next few years and therefore would likely reduce the Probability Factor at least for the short term. The rock debris in the ditch should be cleaned upon completion of the scaling.
2. The ditch capacity should be increased by cleaning out the accumulated rockfall debris. This should be treated as an ongoing maintenance task with additional cleaning performed as required. If the ditch is kept clean and near its maximum capacity, it may be possible to reduce the Consequence Factor for this site. The signs showing a buried Telus line in the west ditch suggests that there are no buried utilities in the east ditch that would be of concern during cleaning of the east ditch, however this will need to be confirmed with a ground disturbance check prior to the work.