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Edson, AB, T7E 1T2

North Central Region – Edson Area
NC1 – Hwy 43:16 Whitecourt East Hill
2012 Annual Inspection

Dear Mr. Lee

This report details the observations made during the annual inspection of the Whitecourt East Hill site on Hwy 43:16. The legal land description of this site is NW26-59-12-W5M. The inspection was conducted by Mr. Ian Darrach, P. Eng. and Mr. Eric Leishman, EIT of Golder Associates Ltd. on July 31, 2012. Also present onsite during the inspection were Mr. Roger Skirrow, P. Eng. and Mr. Jon Lee, EIT, of Alberta Transportation (AT).

1.0 BACKGROUND

The last site inspection was conducted in May 2011 by Thurber Engineering Ltd. Observed site conditions at that time are available in Section B of the site binder, with additional information regarding the history of the site available in Section A.

2.0 OBSERVATIONS

During the site visit, the highway surface, back and side slopes and culvert inlets and outlets were inspected. The slope and paved walking trail above the bin wall at the west end of the site was also inspected. Select photographs from the inspection are attached at the end of this report. Any observed changes in conditions since the previous inspection are documented on the site plan.

2.1 Highway Surface

The surface of the highway was inspected for new cracks and extensions of existing cracks. Three sets of cracks in the westbound lanes were observed. For consistency, these will be referred to as in previous inspection reports as ‘West Crack,’ ‘East Crack,’ and ‘Catch Basin Cracks.’ One set of cracks was reviewed in the eastbound lanes. Any new observations are indicated on the attached site plan.

As noted in the 2011 inspection report, cracking has been reflected through the patches completed in 2010. The west crack has extended into the median, which was first noted in 2006. This crack has remained mostly unchanged from the 2011 inspection. One difference noted was the differential height in a section of the median crack has grown from 10 mm to a maximum of 15 mm. At this location, the width of the crack ranged from 5 to

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10 mm. Within the travel lanes through the west crack, no height differential was observed due to recent patching. There was also no change of the width of the crack from 2011. A portion of the crack in the shoulder appeared to have been recently resealed. The cracking had not reflected through the seal at the time of inspection, and as such, no height differential or width was noted.

The east crack, shown in Photo 1, had been patched in 2010, with reflection of the cracks observed through the patch in 2011. The width of the crack has expanded from 5 mm in 2011 to 5 to 10 mm in 2012, with the crack extending from the outside lane to the inside lane up to 15 mm in width. No differential height was noted within the travel lanes due to the patching completed in 2010, however the shoulder of the highway was not patched and the differential in this area remained at 20 mm, unchanged from 2011. The transverse crack noted at the east end of the east crack also remained unchanged.

The catch basin cracks had reflected through the patch, as observed in the 2011 inspection, with one additional crack found within the outside lane in the 2012 inspection. Crack widths remained unchanged at 5 mm, and no differentials were observed. The transverse crack, observed to be 5 to 10 mm in width in 2011, had been patched prior to the 2012 inspection.

2.2 Back Slopes and Side Slopes

Signs of recent movement were observed in the slope south of Highway 43. A tension crack, potentially indicating the right flank of a backscarp, was visible approximately 3/4 of the way upslope from the bottom of the ditch. A corresponding toe bulge was also noted, approximately 1/4 of the way upslope. The backscarp and toe bulge, pictured in Photos 2 and 3, were approximately 30 m in length. This area of distress is located to the west of the concrete spillway, and appeared to be shallow in nature. It did not appear to be affecting the paved walking trail at the top of the slope. No other signs of instability were observed along the slope on the south side of the highway.

Also on the south side of Highway 43, significant erosion had taken place along the south shoulder of the eastbound lanes, shown in Photo 4. The erosion gullies have created a channel approximately 100 mm in depth and up to 300 mm in width. This channel begins between SP06-7 and SP06-8 and extends east up the slope approximately 50 m. This was also evident in previous inspections and had been repaired in 2007.

During the inspection, it was also noted that several sections of the paved walking trail near the top of the south slope had been recently repaved by the Town of Whitecourt. This was completed between the Spring 2012 instrumentation readings, done in June, and the site inspection in July.

Previous inspections document an area to the southeast of the toe berm, in the treed area to the west of the Town of Whitecourt right-of-way near SI06-4, where leaning trees were observed. There was a potential slight increase in the lean of these trees during the 2012 inspection. While some trees showed signs of recent movement, other trees in the area showed signs of historical movement. No other signs of distress, such as tension cracks or seepage, were observed at the time of inspection.

The sinkhole within the right-of-way, first observed in 2007, was found to be in the same condition as recorded in the 2011 site inspection report. It is believed that this may be either settlement of fill around the buried storm sewer line, or a rupture of the pipe at this location, resulting in the piping of soil into the sewer line. As noted in the previous inspection report, AT notified the Town of Whitecourt of this problem in 2009.

A summary of findings from the slope inclinometer and piezometer readings are presented in the table below. Instrument locations are shown on the attached site plan.

Table 1: Summary of Instrument Readings

Instrument Number	Summary
SI01-2A	Since the previous reading, the rate of movement has decreased and there was negligible incremental movement in the Spring 2012 readings. The pneumatic piezometer installed near this SI has shown a relatively constant water level since installation in 2001, with a piezometric elevation at or slightly above 966 m.
SI06-1, -3 and -4	These SI's showed significant decreases in rates of movement. SI06-3 showed an increased rate from the spring to fall readings in 2011, and this rate has decreased again with the Spring 2012 reading. Although the rate of movement has decreaed in SI06-4, it is still greater than the average rate from 2006 to 2011. All three SI's show trends of ongoing movement.
SI06-2	No significant movements observed since previous readings.
SI 5 and 11	The probe could not be lowered past 6.7 m in SI 5. The plot from the previous set of readings indicates a zone of movement from 5 to 6 m below ground surface. The probe became lodged at 1.8 m below ground surface while reading SI 11. Previous plots show that the majority of movement is concentrated near ground surface. It is possible that both of these SI's have sheared, and this will be confirmed in the Fall 2012 readings.
SI 10 and 12	No discernable movement observed.
SP06-1	Seasonal fluctuations have been observed in the past, with a substantial increase from Fall 2010 to Spring 2011. The water level has been steadily decreasing since then and has almost returned to levels prior to the spike.
SP06-2, -3, -5 and -8	Water levels have remained consistent in these standpipes over the last several years.
SP06-4, -6 and -7	These standpipes continue to remain dry.

2.3 Culverts

The culverts and drainage features were inspected on both sides of the highway, and all appeared to be in good working condition. The culverts were generally found to be clean of debris. No substantial change from the previous site inspection was observed.

Some minor surface erosion was observed on the subdrain pipe backfill, just above the outlet; however this does not appear to be impacting the operation of the subdrain. The half-round surface culvert at the outlet of the subdrain contained some minor debris consisting of domestic waste, seen in Photo 5. Although water was flowing through the culvert at the time of the inspection, mosses and other vegetation were lining the bottom of the pipe.

There was also some debris at the outlet of the culvert under Highway 43 at station 1+600. This debris again consisted of domestic waste as was scattered throughout the rip rap erosion protection and is shown in Photo 6. No substantial signs of erosion were observed in the area surrounding the culvert outlet. Sinkholes near the inlet of this culvert on the south side of the highway, repaired in 2006, have not reappeared.

2.4 Bin Wall

The bin wall near and paved walking trail at the west end of the site was inspected. Three sets of tension cracks in the paved trail above the bin wall were first observed in 2004, and these have not reopened since being sealed in 2009. During the 2011 site inspection, a new crack was observed east of the existing cracks. This

crack, shown in Photo 7, appears to have been sealed; however, the crack has reflected through this. There is no height differential across this crack, and the width is 5 to 10 mm.

The condition of the bin wall remains consistent with the previous site inspection in 2011.

3.0 ASSESSMENT

Observations from the site inspection and the Spring instrument readings indicate that slope movements are still occurring, but at reduced or similar rates compared with previous readings. Some instruments showed a spike in movement from 2010 to 2011, but results from the 2012 readings indicate that the rates have returned to levels comparable to pre-2010 readings. The observed spike may be related to heavy rainfall events.

The crack patterns in the east crack, west crack and catch basin crack have reflected through the patches, indicating that slope movement is ongoing, as evidenced by the instrument readings. Instability at this location may be due to an inadequately sized toe berm, combined with seasonal changes in groundwater levels. The toe berm, acting to stabilize part of the slope, may not have been extended far enough to the east to stabilize the entire zone of distress.

The patching has been effective in removing the height differential in the pavement cracks, improving trafficability; however, because the cracks have reflected, further movements may be expected, likely culminating in the reappearance of these differentials. Rates of movement may increase after severe or prolonged periods of rainfall due to infiltration of surface water into the cracks. Overall ride quality may be affected over time, possibly impacting safety and trafficability.

The tension cracking in the paved walking trail above the bin wall at the west end of the slope has reflected through the recent seal. Cumulative movement in the one operating SI between the path and the bin wall is 375 mm near ground surface, with an increased rate from the last set of readings; however this does not appear to be having any adverse effect on the bin wall based on visual observations of the wall.

Based on the nature of the fresh backscarp and toe bulge observed on the south slope of Highway 43, this failure appears to be active on a shallow shear surface, and isn't presumed to be affecting the overall stability of the embankment.

4.0 RISK LEVEL

The risk level at this site, based on AT's risk level system, has been determined to be:

PF(6) x CF(3) = 18

Due to the size of the site, the area that poses the highest consequence of failure was used to determine the appropriate risk level. This corresponds to the pavement distress areas, including the east, west and catch basin cracks. A probability factor of 6 was chosen because the slope is active with a slow rate of movement and an indeterminate movement pattern. A consequence factor of 3 is appropriate due to the height of the embankment and the potential for a partial road closure if slope movement occurs. This risk level is consistent with previous years.

5.0 RECOMMENDATIONS

5.1 Short Term

Short term measures should include:

- Sealing pavement cracks to reduce surface water infiltration into the slope. This should include the cracks in the westbound lanes of Highway 43 as well as in the paved walking trail near the top of the south slope along the entire site;
- Repairing the erosion along the shoulder of the eastbound lanes to limit further undermining of the asphalt and to enhance surface water drainage; and,
- Culverts and subdrains should be checked on a regular basis and cleaned when necessary to promote surface water drainage and prevent a buildup of groundwater pressures. This includes the half-round culverts both up and down slope of the highway and the concrete spillway on the south side of the highway.

5.2 Long Term

Additional investigation and instrumentation installation should be conducted to further assess slope stability near the pavement distress at the east and west cracks, as per Part F of the Terms-of-Reference. Installation of instrumentation comprising two piezometers and two slope inclinometers is recommended to monitor pore water pressures and target slope movements to facilitate understanding of the slide mechanism. Consideration should be given to the installation of horizontal drains to reduce pore water pressures and an extension of the toe berm, buttressing the slope.

5.3 Maintenance and Future Work

It is recommended that the pavement cracks be monitored regularly for ride quality and traffic safety by the MCI. Should significant changes occur, additional engineering assessment and/or analysis may be required. As mentioned above, culverts and subdrain outlets should be regularly monitored as well and any built up debris or sediment should be removed to promote surface water drainage. This includes the concrete spillway on the south side of Highway 43.

The shallow failure observed in the south slope to the west of the concrete spillway should continue to be observed by the MCI for further movement. Any worsening of the failure could potentially impact surface water flow in the ditch and may require additional engineering analysis to remediate this distress area.

It is recommended to continue reading the existing instrumentation at the site semi-annually, with site inspections conducted annually.

6.0 CLOSURE

We trust that the information presented in this report meets your present requirements. Should you require any additional information, or further clarification regarding any of the above, please do not hesitate to contact the undersigned.

Respectfully Submitted

GOLDER ASSOCIATES LTD.

Eric Leishman, EIT
Junior Geotechnical Engineer

Ian Darrach, M.Eng., P.Eng.
Senior Geotechnical Engineer

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Attachments:
1. Site Photographs
2. Site Plan

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Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report**. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report. During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.