

**GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA
2020 INSPECTION**



Site Number	Location	Name	Hwy	km
NC 069-1	14 km south of Wandering River	S. of Wandering River- BF 76427	63:02	32
Legal Description		UTM Co-ordinates (NAD 83)		
SW-27-70-17-W4M		12 N 6105290	E 403588	

	Date	PF	CF	Total
Previous Inspection:	June 11, 2019	8	4	32
Current Inspection:	June 24, 2020	8	4	32
Road AADT:	3630		Year:	2019
Inspected By:	Tarek Abdelaziz, José Pineda (Thurber) Roger Skirrow, Arthur Kavulok (TRANS)			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue:	Creep movements of east and west side slopes of Hwy 63 SBL causing pavement distress
Dimensions:	Highway 63 Southbound Lanes Landslides: East Landslide affecting about 90 m of the highway and West Landslide affecting about 50 m of the highway
Date of any remediation:	<p>West side slope embankment failed in 2009 causing damage to the existing 1910 mm dia. SPCSP culvert and development of slide cracks along the highway. Emergency repairs were completed in May 2010 and consisted of building a toe berm along the bottom of the slope and extending the culvert outlet by about 28 m (using a 2000 mm CSP). The existing culvert failed during construction (approximately 28 m from the original culvert outlet location), and was strutted over a distance of about 12 m. An 1800 diameter SWSP was auger bored below the highway to temporarily replace the existing pipe.</p> <p>In 2013, the following was carried out during the construction of highway twinning project at this location: Grouting of old culverts, pipe jacking a 3630 mm diameter SWSP culvert below highway, diversion of stream channels at the inlet and outlet of the new pipe, increasing the size of the berm downslope of the highway SBL, and grading of future highway northbound lanes. The highway was patched in the vicinity of the southern flank of the east landslide near the pipe jacking pit.</p>
History/Maintenance:	The original highway was a two-lane undivided highway. The east and west landslides developed on the east and west side slopes of the original highway. The highway was upgraded between 2014 and 2016 to a four-lane divided highway. The two lanes of the former highway are currently the southbound lanes of the new highway.

	<p>West Landslide: ACP overlay on the SBL of the former highway in June 2010; ACP overlay on the former highway SBL in 2014 and 2015</p> <p>East Landslide: ACP overlay on the southern limits of the NBL of former highway in 2014</p> <p>Erosion issues identified in 2014 were addressed by others under existing contract: The erosion within the diversion channel at the inlet of the new pipe and along the south facing drainage channel to the north of the pipe were repaired; South facing drainage Channel: erosion control included extension of existing soil covering mat further north, armouring the southern segment of the channel using Class 1M riprap, inclusion of spring berms along the channel within the segment covered with the erosion mat; North facing Draining channel: erosion control included placement of a Class 1M riprap over existing soil covering mat, and installation of geo-ridge berms within the northern portion covered with the erosion blanket; fibre rolls installed along the crest of the east slope of the NBL above the inlet of the pipe.</p> <p>One of the erosion issues identified in 2015 was addressed by others under the contract for the highway twinning project. The erosion gully developed within the north facing drainage channel above the culvert inlet location was repaired through the extension of the riprap channel to the bottom of the slope towards the diversion channel.</p>	
Observations:	Description	Worse ?
<input checked="" type="checkbox"/> Pavement Distress	<p>West Landslide (western lane of highway SBLs): 15 to 20 mm dip for about 50 m</p> <p>East Landslide (eastern lane of highway SBLs): 10 to 20 mm dip for about 90 m</p> <p>Western Lane of highway SBLs: The existing patch on the western lane is 40 to 50 mm higher than surrounding pavement surfaces</p>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	<p>West Landslide (western lane of highway SBLs): 20 to 70 mm wide reflective landslide cracks with up to 15 mm drop across crack surfaces; existing shoulder crack to the north of the northern limits of the landslide is 40 mm wide and has 15-20 mm drop</p> <p>East Landslide (eastern lane of highway SBLs): 20 to 50 mm wide landslide cracks with up to 20 mm drop across crack surfaces</p>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	<p>Diversion channel at the inlet of the pipe: erosion/slump on the north facing slope exposed fabric and shifted riprap</p> <p>South facing drainage Channel to the east of the highway NBLs: Spring berms and synthetic ditch barrier failed; severe erosion gullies (up to 900 mm wide and 400 mm deep) to the north of the outlet of the NBL centerline culvert; localized erosion within the ditch to the south of the culvert outlet (4 m wide and 500 mm deep); severe erosion gully near the mouth of the channel within the western edge riprap (18 m long x 1.2 m wide x 1.3 m</p>	<input type="checkbox"/>

	<p>deep) was partially filled by adjacent riprap and water was flowing under this area</p> <p>Slump in the east back slope of the highway NBLs healed and was covered with vegetation; water is still ponding within the ditch at the slump location.</p> <p>Three sinkholes filled with water within the highway median ditch: 3m wide x 18 m long x 0.6 m deep 3m wide x 6 m long x 0.4 m deep 2 m wide x 3 m long x 0.4 m deep</p>	
<input checked="" type="checkbox"/> Seepage	New pipe is functioning as designed	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	The 600 mm diameter culvert below the highway NBLs has sagged and water is ponding inside the pipe	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Other	Vegetation continued to grow within the highway median, side slopes of the highway NBLs, and within south facing drainage channel to the east of the NBLs	<input type="checkbox"/>

Instrumentation: (4SIs, 3 PNs, 3 VWs)

West Landslide: SI13-14 showed a rate of movement of 0.4 mm/yr. SI09-4 showed a rate of movement of 0.3 mm/yr. PN09-3: Ground water levels increased by about 0.4 m. VW13-13 has been dry since 2013.

East Landslide: SI09-1 showed creep a rate of 0.8 mm/yr; and SI10-1 showed a rate of movement of 0.6 mm/yr; PN09-1: Ground water levels decreased by about 0.3 m, PN10-1: showed a groundwater level increase of approximately 0.1 m, VW 13-11 and 13-12: Groundwater levels decreased between 0.03 m and 0.14 m since the fall of 2019.

Assessment (Refer to attached Figure):

The instrument readings and the site observations indicate that remedial measures have been effective in reducing the landslide movement rates of the east and west landslides of the SBLs. The reflective cracks on the highway reflect the creep movements of the landslides and it is anticipated that the cracks will continue to widen until the berms mobilize the full stabilizing forces.

The existing shoulder crack to the north of the northern limit of the west lane of the old highway may reflect a new movement to the west of the highway; however, there is no visible evidence downslope of the highway to confirm this hypothesis and this should be confirmed through future inspections.

The top surface elevation of the patch placed in 2015 along the most western lane of the old highway is about 40 to 50 mm higher than the top surface elevation of the pavement surface outside the boundaries of the patched area. This has resulted in an uncomfortable ride on the highway surface and constitutes a safety hazard to the motorists. The existing dip on the highway lanes has also aggravated the situation.

The sink holes developed near the bottom of the new lanes west side slope are near the inlets of the old culverts and channels. It is likely that the sinkholes reflect poor subgrade preparation and backfill construction practice at these locations.

The south facing ditch to the east of the highway NBLs continued to erode significantly over the last few years. It appears that the ditch was not designed appropriately to handle the flow, resulting in severe erosion in this area. The erosion is anticipated to get worse over time until remedial measures are implemented.

The highway east back slope slump is completely covered with vegetation and does not seem to be as active as observed in 2017.

Recommendations:

It is recommended that the site be inspected every second year.

In the short term, all open cracks on the highway SBLs surface should be sealed to prevent surface water infiltration into the landslide masses. Consideration should be given for placing ACP patch on the highway SBLs to provide a smooth ride to motorists. The difference in elevation between the east and west lanes of the old highway should be considered when undertaking the patching to eliminate existing lip.

The sinkholes should be backfilled with compacted gravel or clay. Prior to backfilling the sinkholes, it is recommended that the bottom and the sides of the sink holes be cleaned of loose materials and debris.

A CCTV inspection should be undertaken for the existing 600 mm diameter culvert below the highway NBL. Based on the inspection results, it may be required to either replace or line the pipe to enhance surface drainage in the highway median.

Erosion issues to the east of Hwy NBLs:

Within the south facing drainage channel, consideration should be given for repairing existing erosion issues. This will require removing all loose material within the ditch footprint and reshaping and re-compacting the eroded surfaces, followed by topsoil placement and seeding along with placing TRM Type C covering in flat sections near the top of the channel and placement of non-woven geotextile and additional heavy rock riprap in steep sections near the bottom of the channel.