ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA
2020 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
NC088	62 Km N of Wandering River	**Km 108 Settlement**	63:06	6.0
Legal Description		**UTM Co-ordinates (NAD 83)**		
S-30-77-14-W4M		12 6172629 E 426672		

	Date	PF	CF	Total
Previous Inspection:	May 8, 2018	13	6	78 (Highway 63 NBL)
	May 8, 2018	14	5	70 (Highway 63 SBL)
Current Inspection:	June 24, 2020	9	5	45 (Highway 63 NBL)
		7	4	28 (Highway 63 SBL)
Road AADT:	4,020		**Year:**	2019
Inspected By:	Tarek Abdelaziz and José Pineda (Thurber) Arthur Kavulok and Roger Skirrow (TRANS)			
Report Attachments:	☑ Photographs ☑ Plans ☐ Maintenance Items			

Primary Site Issue	**NBL:** A landslide above the original pipe causing a severe pavement distress on the highway north bound lanes and east embankment slope; localized slump above the inlet of the culvert **SBL:** A localized slump in the west embankment around and above the outlet of the smooth wall steel pipe installed in 2018, resulted in the formation of multiple tension cracks within the entire embankment and failure of a 12 m section of the pipe at the outlet location.
Dimensions:	**NBL:** The pavement distress section is about 25 to 30 m long. The landslide is about 30 m wide parallel to the highway and 40 m long perpendicular to the highway alignment. **SBL:** Local sinkhole at the toe of the embankment was approximately 5 m wide, 15 m long, and 3 to 4 m deep; cracking near the top of the embankment used to be 150 m long.
Site History:	The NBL embankment was constructed during the Hwy 63 twinning project. Up to 14 m of fill was placed to construct the NBL at the subject location to cross the valley of an existing creek. A 1,200 mm CSP pipe was connected to an existing 1,200 mm concrete pipe to convey the creek flow below the new embankment. It is understood that the highway was built in 2014 and paved in October 2016. In the fall of 2017, the CSP pipe collapsed at about 30 m from the inlet location (as per the information provided by AT). Slumping and erosion were also noted at the outlet of the concrete pipe (west side of SBL embankment). Recommendations were provided in the fall 2017 callout report to install a new pipe and to grout the old pipe. The proposed alignment of the new pipe was provided in the callout report. The recommended alignment of the replacement pipe was selected to avoid areas of potential instability on the east and west sides of the highway. ACP patch was placed in 2017 and the guardrail was severely distorted and had to be replaced in 2017. In the winter of 2018, a new 170 m long 1.2 m dia. SWSP culvert was installed through the embankment using the pilot tube micro-tunneling technology. The new pipe was installed immediately to the north of the existing culvert (installed from the outlet location on the

	west side towards the inlet location on the east side), and the old culvert was grouted and abandoned. As per the information provided by AT, the construction involved excavating a pit at the toe of the west embankment, where an old localized slump existed. During the May 2018 site inspection, a large cavity was noted at the toe of the west embankment and the flow bypassed the new pipe to wash out the old slump. A CCTV inspection conducted on the new pipe indicated a rupture at 12 m from the outlet location. Additional repairs were conducted between December 2018 and June 2019 consisting of (a) benched excavation of east and west slopes to replace damaged pipe section at culvert outlet location and repair localized slump around culvert inlet location, (b) backfilling excavations using compacted granular fill, (c) grading median ditch to promote surface drainage, (d) placement of Type C blanket, riprap and rock check dams for erosion protection, and (e) topsoil and seeding of all disturbed areas. A 62 m long ACP patch was placed on the NBLs in June 2020. The NBLs guardrail was also replaced in June 2020.	
Observations:	**Description**	**Worse?**
☑ Pavement Distress	**NBL:** No visible dip noted on the highway after recent ACP patch **SBL**: N/A	☐
☑ Slope Movement	**SBL:** 13 m long x 70 mm wide x 100 mm deep crack on the west side slope, approximately 1.5 m from the guardrail **NBL**: Minor slope dishing on the side slope	☐
☑ Erosion	**NBL:** Local erosion along the south facing riprap channel (north of the SWSP culvert inlet) **SBL:** Water ponding to the west of the SWSP culvert outlet location before it flows into the creek channel, resulting in slight bank erosion to the west of SWSP culvert outlet	☐
☐ Seepage		☐
☐ Bridge/Culvert Distress		☐
☑ Other	Vegetated slopes with the exception of a small area above the SWSP culvert inlet location; water is still ponding in the median ditch before it flows into the CSP culvert; water is flowing into the 1.2 m diameter SWSP culvert and in the 800 mm CSP median culvert	☐

Instrumentation (2SI and 4 PNs):

Slope inclinometer SI18-3, installed on the east highway embankment, showed a rate of movement of 6.3 mm/yr over 6.5 m to 11.3 m depth since Spring 2019, corresponding to a decrease in the rate of movement of 47.7 mm/yr over the same period. Movement plots for SI18-3 suggest that the embankment fill is settling and affecting the shape of the SI casing. SI18-4, installed in the west highway embankment, showed no discernible movement.

The groundwater levels ranged between 3.7 m to 8.2 m below ground surface. Since Spring 2019, the groundwater levels decreased in the pneumatic piezometers by up to 1.6 m.

Assessment (Refer to attached Figures and Photos)**:**

The repairs completed between 2018 and 2019 appear to have performed well to date.

There is still a concern regarding the stability of the east embankment. It is suspected that ongoing

movement will take place, resulting in re-appearance of a dip in the highway surface. Water ponding in the median ditch will continue to elevate groundwater levels in the east slope and this may result in future accelerated movement of the landslide.

There are no visible signs of instability in the west slope except for the observed crack near the top of the slope. However, it is suspected that this crack may been created by the mowing equipment. This will need to be confirmed during future site inspections.

Permanent erosion control measures installed during the 2018-2019 repairs have some deficiencies that need to be addressed to prevent further erosion and future slumping issues. The erosion control measures deficiencies include bare vegetation zone above the SWSP culvert inlet, and localized erosion gullies along the south facing riprap channel of the east slope.

Recommendations:

The site should also be inspected again in the Spring of 2021 to confirm the effectiveness of the remedial measures.

Short Term Measures

The MCI should periodically monitor the highway lanes and the slopes for signs of movement. If the dip re-appears on the highway NBLs, additional ACP patch should be placed to eliminate the dip and provide a smooth ride to motorists.

The median ditch should be slightly graded to prevent ponding of water in the ditch.

It is recommended to get the creek channel slightly realigned at the SWSP culvert outlet to prevent ponding of water at the toe of the slope. Additional riprap armoring of the creek channel (for at least 5 to 10 m beyond the outlet location) is also recommended to reduce the likelihood of future toe erosion issues.

Erosion gullies within the south facing channel of the east slope will need to be repaired. This will require salvaging existing riprap, excavating eroded areas, reshaping the channel to have well defined sides and bottom, placement of salvaged riprap and additional riprap (as needed) over non-woven geotextile fabric (to be keyed in at least 300 mm at the top of the channel) along the sides and the bottom of the channel.

Long Term Measures:

If the east slope continues to move in the future, the following provides potential long-term remedial options:

Option 1: Construct a toe berm to buttress the landslide. This option will require instream work to divert the creek flow, land acquisition, extending existing pipe, tree clearing, and the reconstruction of the riprap lined channels. Regularity authority approvals will be required to complete this option. The ballpark cost of this option is in the range of $600,000 to $700,000), excluding engineering.

Option 2: Excavate and replace the landslide mass with gravel or geogrid reinforced clay. This option will require temporary closure of the highway and the construction of a detour. The ballpark cost of this option is in the range of $1,000,000 (geogrid reinforced clay) to $1,600,000 (gravel), excluding engineering.

Option 3: Offload the top of the slope and backfill excavated mass using light weight fill (i.e. cellular concrete or EPS blocks). This option may require partial closure of the highway (i.e. alternating lane traffic). The ballpark cost of this option is in the range of $700,000 to $900,000 (excluding engineering), depending on the depth of replacement.

Option 4: Construct a 35 to 40 m long tied-back tangent pile wall along the east side of the highway along with slope flattening above the culvert location. This option does not require closure of the highway. The ballpark cost of this option is in the range of $1,000,000 to 1,400,000 (excluding engineering).

H:\13000\13357 Geohazard Assessment - Athabasca (CON0017605)\Drafting\2020\JGP\13357 NC088 FIGURE 1.dwg - 1NN - Oct. 09, 2020

NORTHBOUND LANE CENTER LINE

SLIGHT DEPRESSION
NOT VISIBLE IN 2020

SLIGHT HUMP IN NEW FILL
NOT VISIBLE IN 2020

100mm WIDE, 200mm DEEP
NOT VISIBLE IN 2020

40-90mm WIDE
100-250mm DEEP
CRACK ALONG EMBANKMENT SIDE SLOPE 13m LONG x 70mm WIDE x 100mm DEEP; 1.5m FROM GUARDRAIL (2020)

TENSION CRACK
NOT VISIBLE IN 2020

APPROXIMATE LIMIT OF LANDSLIDE (2017)
NOT VISIBLE IN 2020

NEW CULVERT OUTLET

SI/PN18-4A/B

WATER PONDING BEFORE FLOWING INTO CHANNEL

NORTH FACING RIPRAP CHANNEL

C1 (1200mm Ø CONCRETE) GROUTED AND ABANDONED IN 2018

NEW ROCK CHECK DAMS

REPLACEMENT CULVERT: 1.2m Ø SWSP CULVERT INSTALLED BY OTHERS IN 2018

NEW ROCK CHECK DAM

C3 (800mm Ø CSP)
WATER FLOWS INTO CULVERT

C3 OUTLET - WATER FLOWING; SILT FENCE REMOVED (2020)

EROSION GULLY 4m LONG X 1.5m WIDE X 0.8m DEEP

AREA BARE OF VEGETATION

EROSION GULLY
6m LONG x 3m WIDE x 1.1m DEEP

RIGHT OF WAY BOUNDARY

PONDING WATER IN MEDIAN DITCH

TENSION CRACK (2017)
NOT VISIBLE IN 2020

SI17-1
PN17-1A
PN17-1B

SI17-2
PN17-2A
PN17-2B

300mm DEEP x 200mm WIDE (2017)
NOT VISIBLE IN 2020

C2 (1200mm Ø CSP)
(GROUTED AND ABANDONED 2018)

SP17-3

SI/PN18-3A/B

- VISIBLE IN MAY 2017
- NOT VISIBLE IN OCTOBER 2017 DUE TO GRADING WORK TO INSTALL GEOTECHNICAL INSTRUMENTS
- NOT VISIBLE IN MAY 2018
- NOT VISIBLE IN 2020

200mm WIDE
200mm DEEP
NOT VISIBLE IN 2020

200-300mm DROP ON HIGHWAY

GUARDRAIL REPLACED IN 2017-
GUARDRAIL SHIFTED TOWARDS EAST BY 100-150mm (2018)
REPLACED AGAIN IN JUNE 2020

6+000

NEW ACP PATCH
JUNE 2020

SOUTHBOUND LANE CENTER LINE

BH6-1D

DUGOUT FULL OF WATER SAME IN 2018

NEW ROCK CHECK DAMS

N
W E
S

LEGEND

- APPROXIMATE THURBER TEST HOLE LOCATION
- SI — SLOPE INCLINOMETER
- PN — PNEUMATIC PIEZOMETER
- SP — STANDPIPE PIEZOMETER
- APPROXIMATE AMEC TEST HOLE LOCATION
- PAVED OVER INSTRUMENT
- CULVERT NUMBER AND DIAMETER (AS OF 2017)
- HIGHWAY CENTER LINE
- GUARD RAIL
- OLD CRACK / SCARP
- EXTENT OF DIP IN MAY 2018
- CREEK
- PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION

NOTES :

1. LIDAR FLOWN BEFORE NORTHBOUND LANE WAS CONSTRUCTED. CONTOURS ARE BASED ON 2007 LIDAR DATA.
2. FEATURE LOCATIONS ARE APPROXIMATE.
3. PREVIOUS OBSERVATIONS SHOWN IN BLACK.
4. JUNE 24, 2020 FEATURES SHOWN IN RED.

0 10 20 30 40 50 60m
SCALE 1:1000

Alberta

2020 GEOHAZARD ASSESSMENT
NORTH CENTRAL REGION (ATHABASCA AREA)

NC088: HWY 63:06 NBL (km 4.9) PAVEMENT DISTRESS SKETCH SHOWING SITE FEATURES

FIGURE 1

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:1000
DATE	AUGUST 2020
FILE No.	13357

THURBER ENGINEERING LTD.

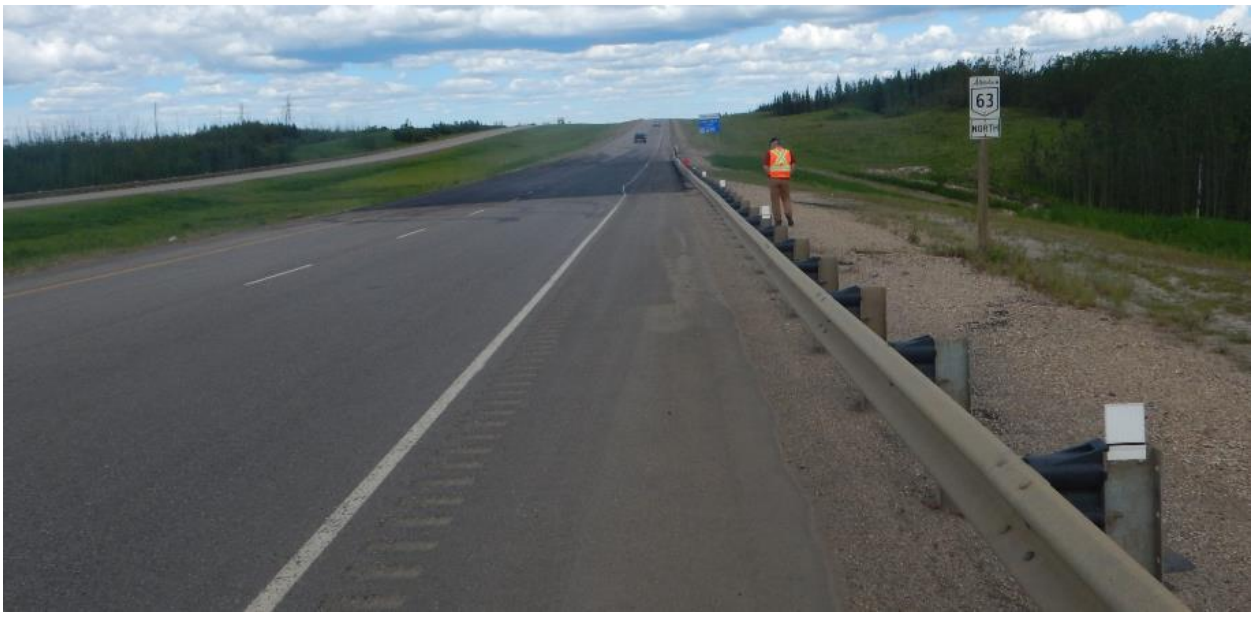

Photo No. 1 – Looking north at ACP patch recently placed along the north bound lanes (NBLs)

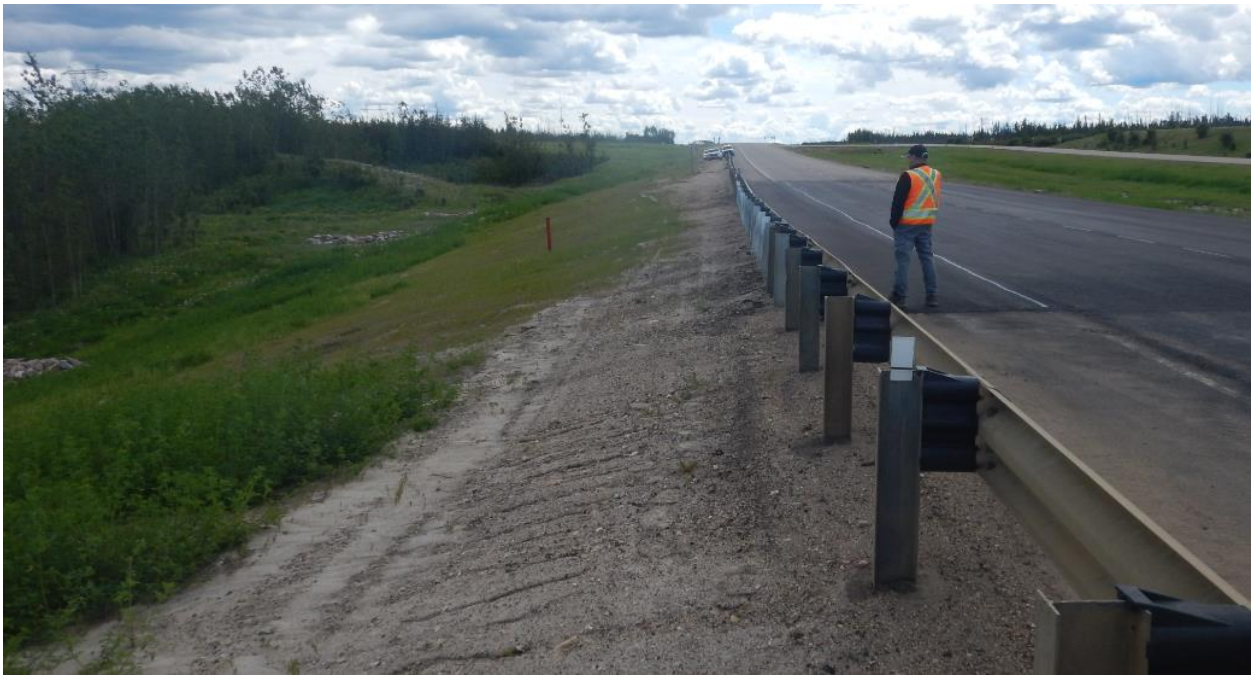

Photo No. 2 – Looking south at NBL embankment side slope; note minor rills near the guardrail

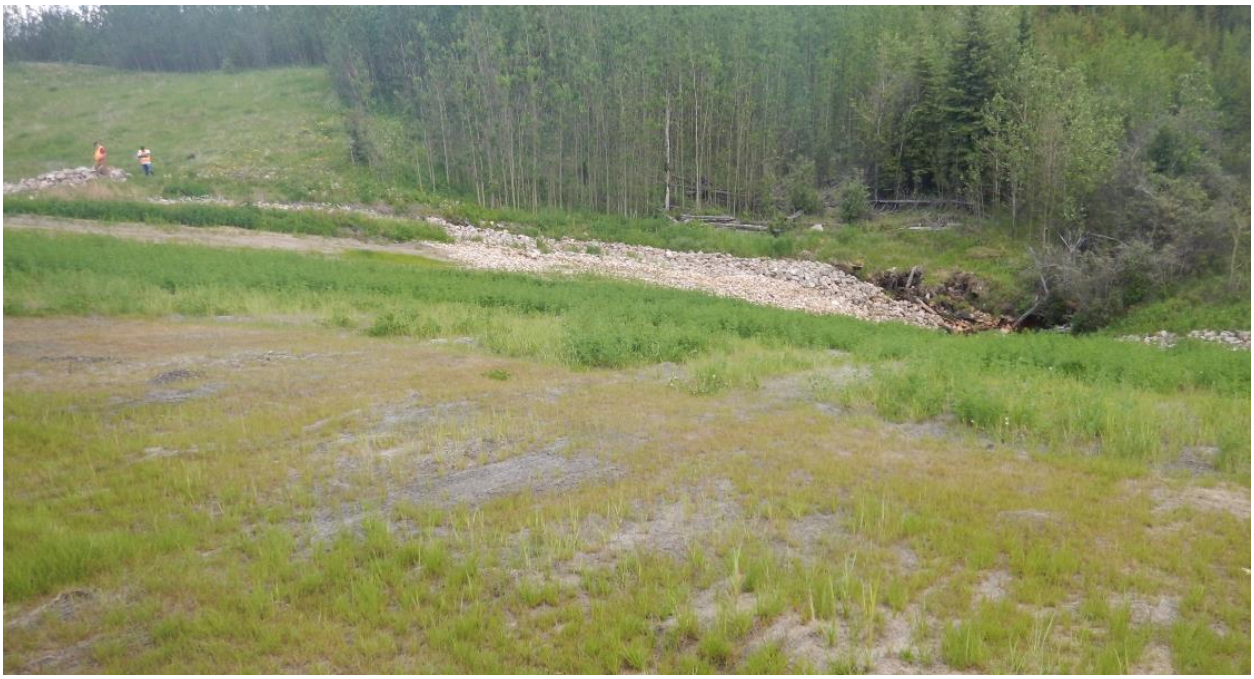

Photo No. 3 – NBL Embankment side slope; note vegetation growth and erosion of the creek bank at the toe of the slope

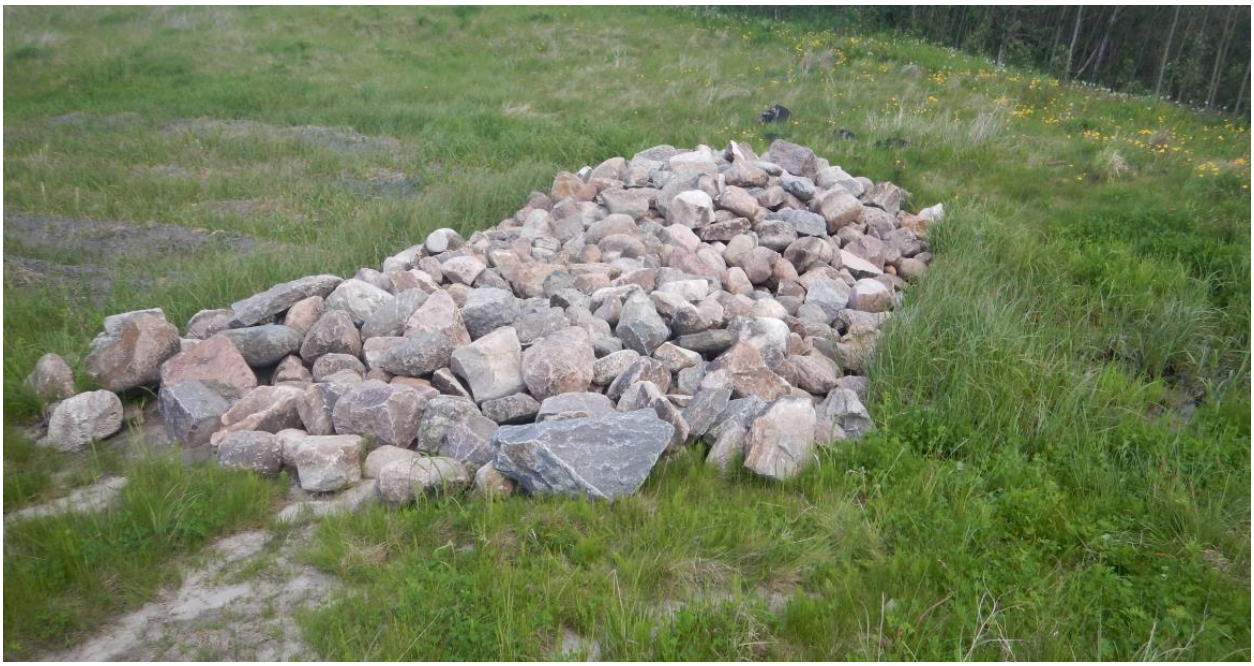

Photo No. 4 - New rock check dam located in the northeast ditch of the highway

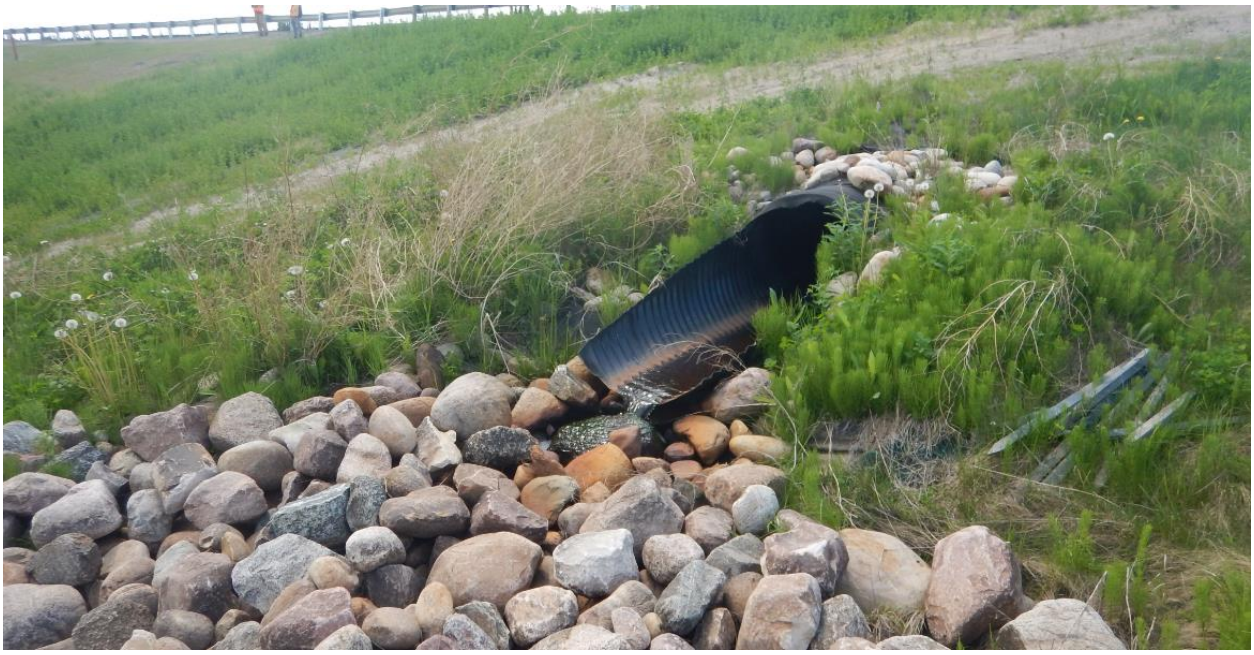

Photo No. 5 – CSP culvert C3 outlet

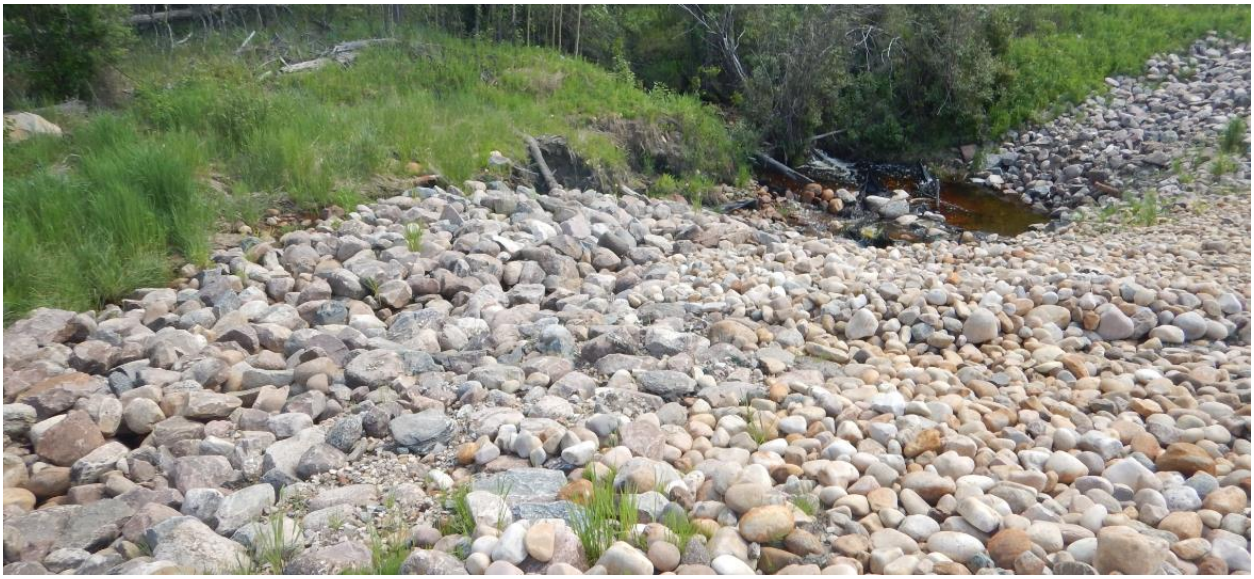

Photo No. 6 – Looking southeast toward the 1.2 m SWSP inlet; note erosion along the south facing riprap channel and deadfall accumulation near the inlet

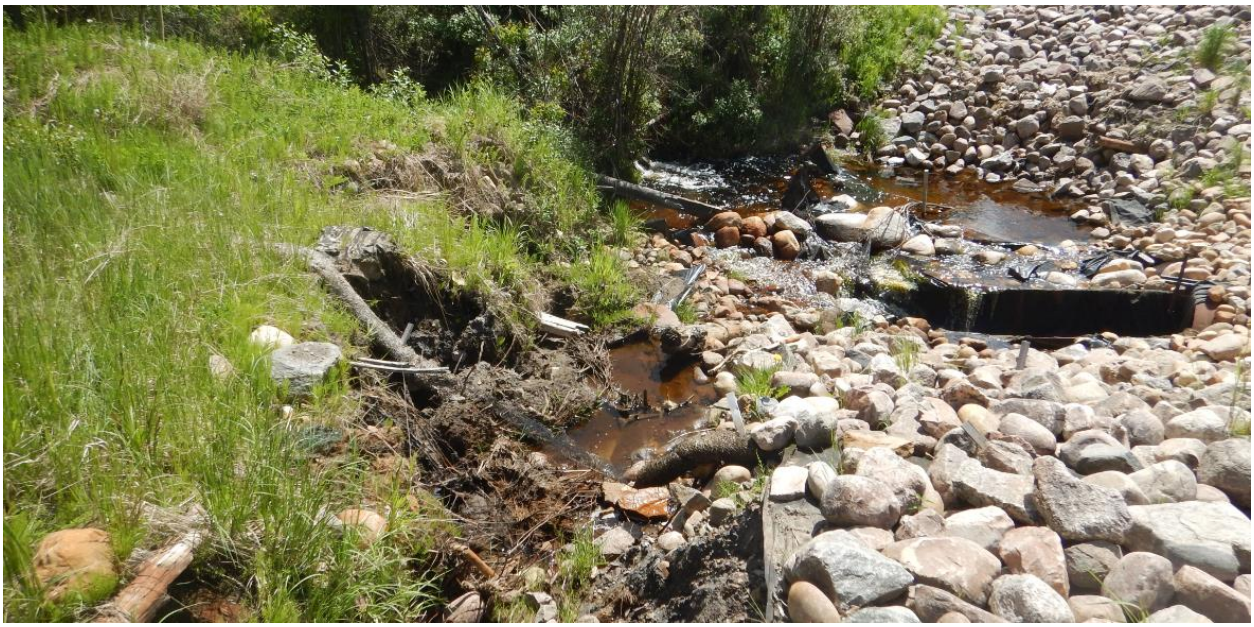

Photo No. 7 – Riprap channel erosion and debris accumulation near the 1.2 m SWSP culvert inlet

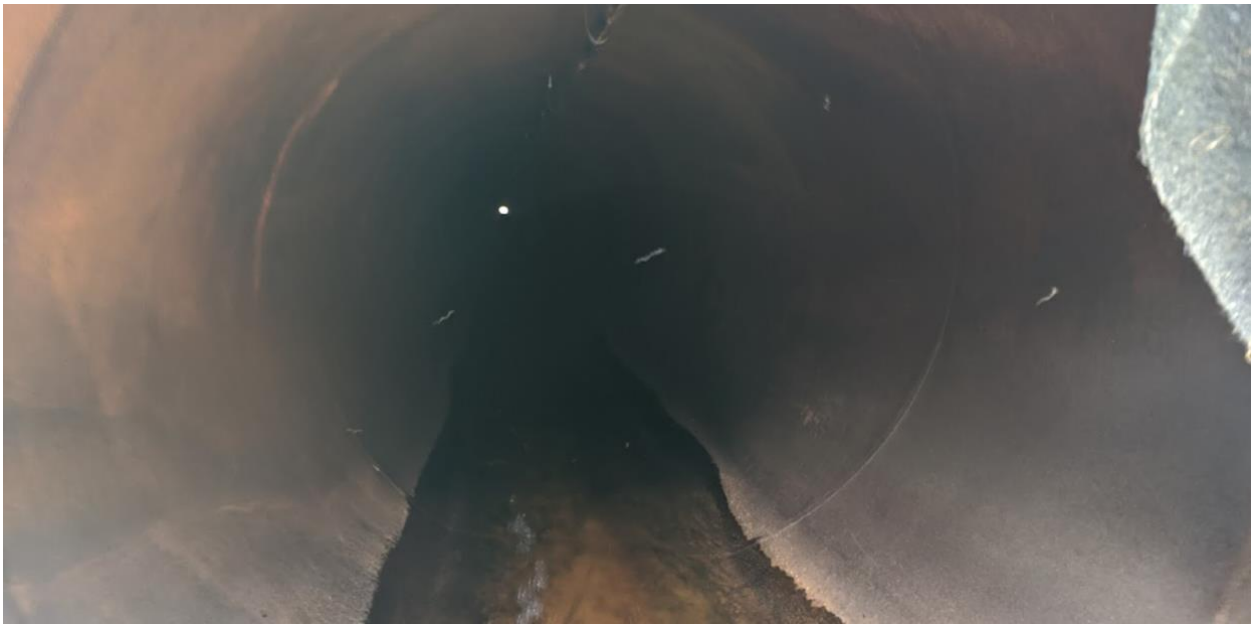

Photo No. 8 – Looking inside the SWSP culvert from inlet location

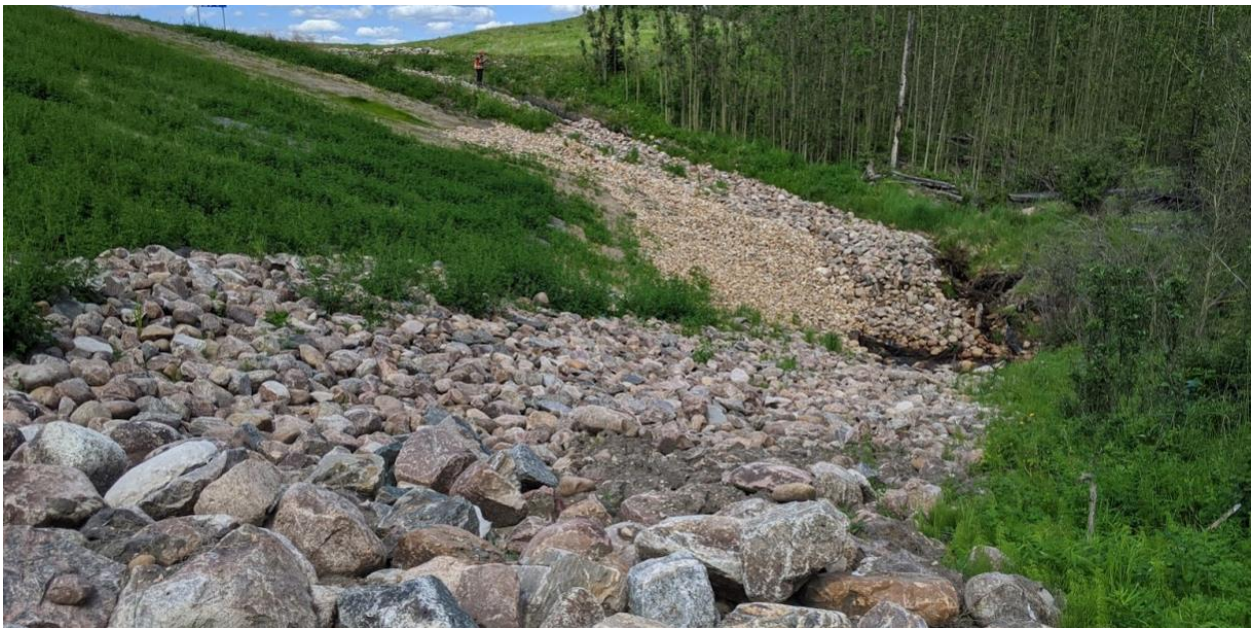

Photo No. 9 – NBL embankment east side slope; note poor vegetation growth upslope of the centre portion of the riprap

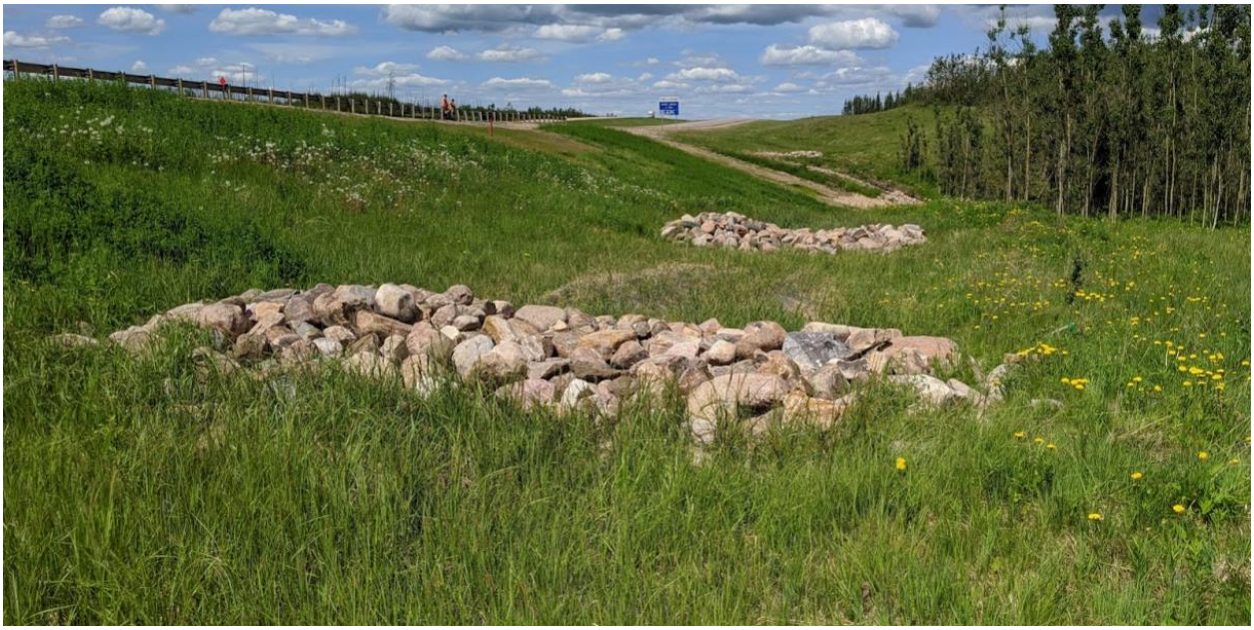

Photo No. 10 – Rock check dams located along NBL southeast ditch

Photo No. 11 – Median ponding water; note recently placed ACP patch on the NBL

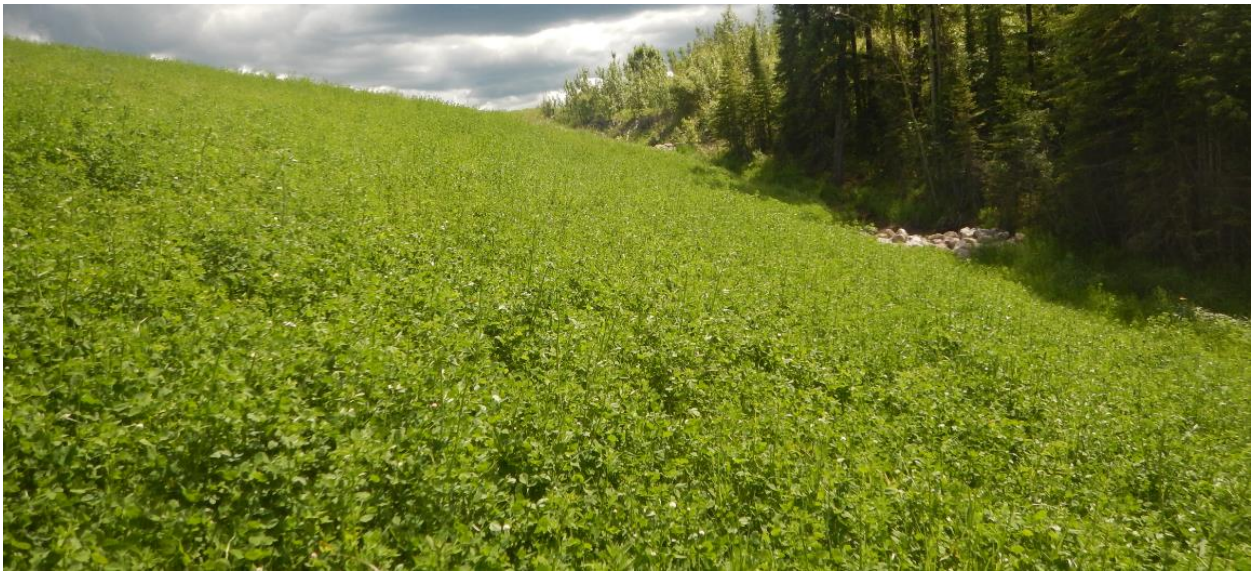

Photo No. 12 – Looking south at SBL west side slope; note good vegetation growth within recently repaired area

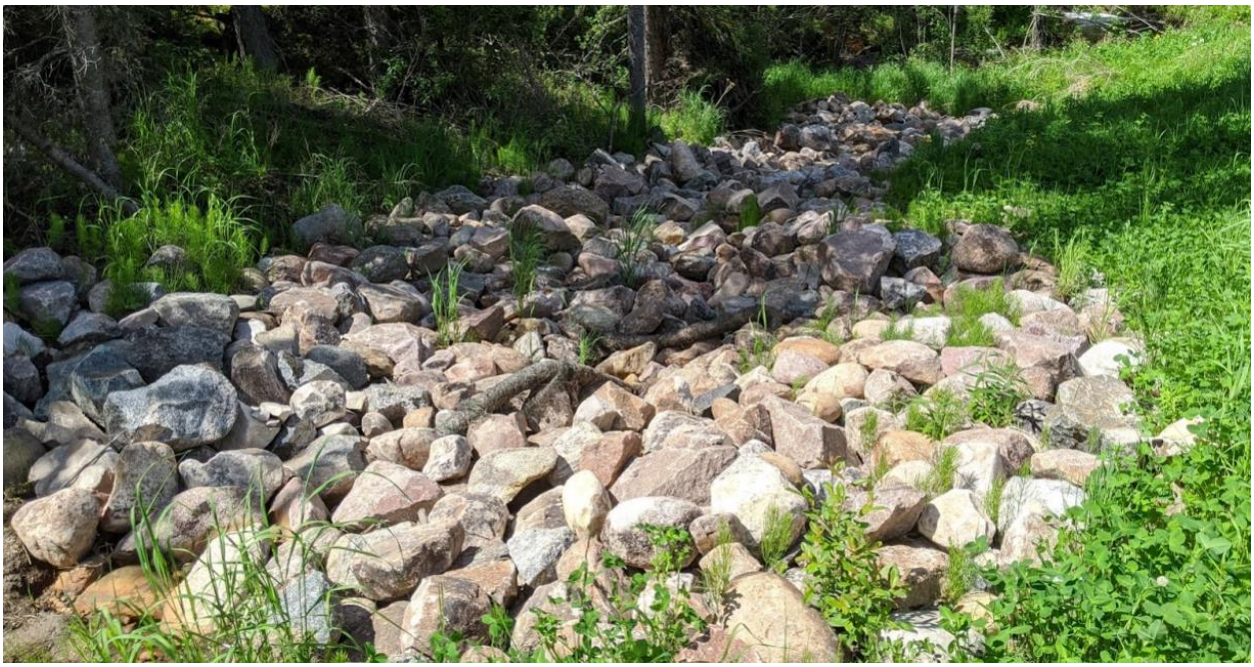

Photo No. 13 – New north facing riprap channel along the SBL west side slope

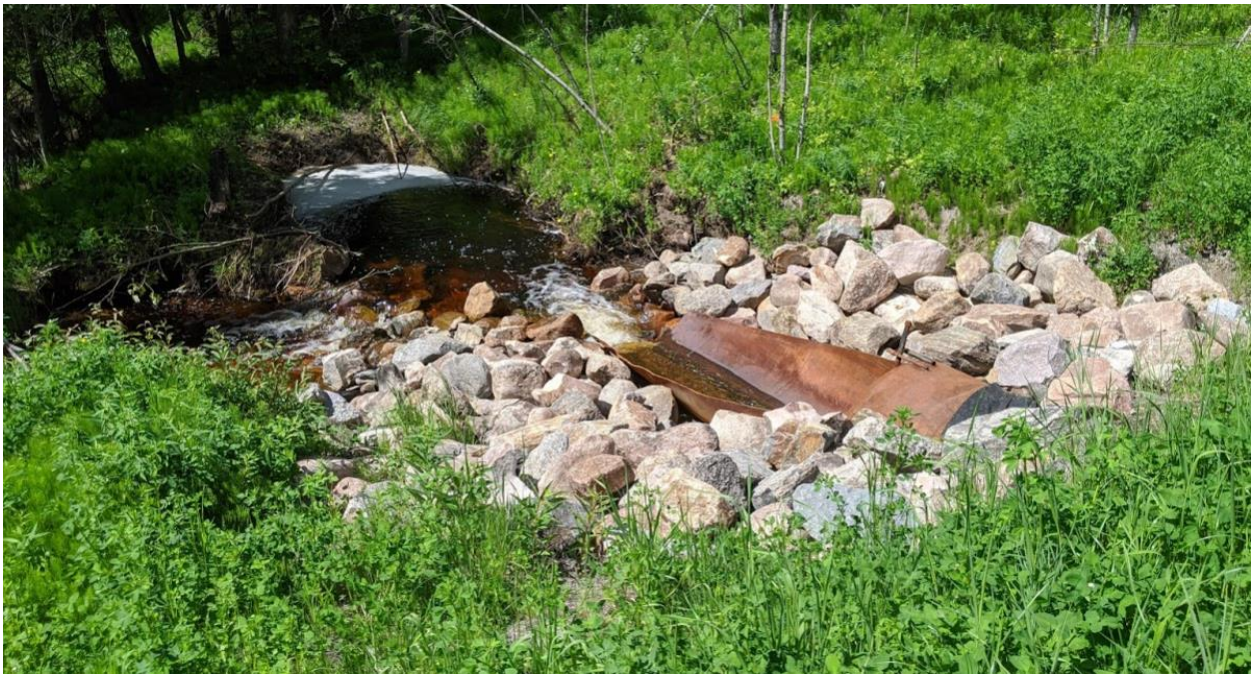

Photo No. 14 – New SWSP outlet; note water flow and minor erosion downstream of the outlet