

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2022 INSPECTION**



Site Number	Location	Name	Hwy	km
SH013-13	Little Smoky River	Little Smoky River Valley, North Hill – Site #13	744:02	21.36-21.49
Legal Description		UTM Co-ordinates		
SE28/SW27-76-22-W5M		11U E 478,608	N	6,162,922

	Date	PF	CF	Total
Previous Inspection:	3-Jun-2020	11	4	44
Current Inspection:	1-Jun-2022	11	4	44
Road AADT:	230		Year:	2022
Inspected By:	Rishi Adhikari, TRANS Max Shannon, TRANS		Ken Froese, Thurber Mark Gallego, Thurber	
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue:	Highway traverses deep-seated, retrogressive landslides with ongoing creep movements due partly to erosion at toe by the Little Smoky River and Peavine Creek resulting in cracking and sagging of the pavement surface at numerous locations. Approx. 4 km of the highway crosses this unstable north valley slope. An active slump developed in Fall 2018 in the east embankment slope near the location of the previously repaired 2002 slide. Erosion from the culvert outlet has contributed to the width of the slide. Site #13 is 55 m above and 310 m away from the Peavine Creek and 35 m above and 115 m away from the tributary gully.	
Dimensions:	20 m wide active slide on east side of embankment.	
Date of Remediation:	<u>1997:</u> Investigation and construction of gabion wall and surface pipe to direct culvert outflow. <u>2002:</u> Downslope slump excavated, subdrain installed, and backfilled with imported clay. <u>2014:</u> Repair of upslope side of embankment <u>2017:</u> Installed new 760mm SWSP culvert, placed fill on upslope side, new riprap apron on downslope, and grouted old culvert.	
Maintenance:	Routine ACP crack sealing, milling, and patching, when required. <u>2017 (post-inspection):</u> Overlay through Sites 13, 15, and 14 2020: Line painting 2021: Overlay, new guardrail and line painting, ditch improvements	
Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	Crack pattern predominantly in the SBL – cracks have reflected through recent overlay.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Ongoing creep movement toward Peavine Creek. North portion of embankment slid in September 2019 removing part of the gabion wall	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	Loss of vegetation and change in flow patterns due to Sept. 2018 slide is causing erosion at several locations including loss of material into the valley below. Gully forming in NW quadrant from ditch flow.	<input checked="" type="checkbox"/>

<input checked="" type="checkbox"/> Seepage	Some seepage noted at location where old culvert was cut off.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	Riprap apron deteriorating due to erosion and lower portion lost or covered due to slide.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Other	Gabion basket wall north half lost due to Sept. 2018 slide and south half deformed by erosion and scarps.	<input checked="" type="checkbox"/>
Instrumentation:		
None.		

Assessment:

The overall valley slope is moving as several separate slide blocks in response to the toe erosion and downcutting of two different rivers resulting in numerous scarps, sag ponds, and differential movement zones going in slightly different directions. The highway intersects the scarps of these blocks at several locations resulting in an uneven highway surface and cracking. At this site, the driving force is downcutting of a tributary gully (starts at SH013-14) to the Peavine Creek.

This site may be affected by deep-seated valley movements; however, localized movements are the primary concern. The formation of an erosion gully below the culvert outlet led to the requirement for the initial repair in 1997. Subsequent replacement of a slumped portion of the downslope embankment was required in 2002. In 2008, a failure developed on the west side of the embankment (upslope) which continued to retrogress toward the road. A temporary repair undertaken in 2014 had not slowed movements which obstructed the culvert inlet resulting in ponding of water in the upslope ditch. In spring of 2017, the Maintenance Contractor pushed a 760 mm smooth-wall steel pipe (SWSP) through the embankment. The inlet is approximately 1.2 m higher than the old culvert and some of the softened material was left in place. Approximately 300 m³ of pitrun was placed on the embankment sideslope. The riprap apron at the outlet was extended about 10 m past the gabion wall. The old culvert was grouted (approximately 35 m³ of grout required) and the damaged surface pipe removed. The soils immediately above the new culvert and in the ditch, bottom were soft and wet with standing water. Settlement cracks are present in the sideslope and highway surface which may continue to worsen until settlement is complete. The ditch bottom was improved during the summer of 2017. All of Highway 744 along the north valley slope was overlaid in 2021 including replacement of culverts (although not at this site), installation of new guardrail, and regrading of the ditches. Erosion control blankets with GeoRidge were installed along the bottom of some portions of the upslope ditch (including between this site and SH013-15, further up the valley).

Heavy spring runoff in 2018 has led to erosion and undermining of the riprap apron below the culvert outlet particularly immediately below the outlet where the discharge flow impacted the top of the apron. There was also erosion, displacement of riprap, and damage to the gabion basket wall further down-channel. In Fall 2018, the north portion of the east embankment slope failed at the approximate location of the 2002 slump. By 2019, the scarp was approximately 20 m in width up to the north tree line and extended through the gabion wall removing the north half of it. The scarp was approximately 12 m from the highway at the closest point. In 2020, the scarp had widened to 22 m and about 11 m from the highway. Three of the five stakes placed in 2019 had to be relocated away from the encroaching scarp and may need to be relocated again in 2023. There was a slower rate of deterioration of the north side between the 2020 and 2022 inspections; nonetheless, this slump is now about 5.1 m from the back of the new guardrail. The remaining south half of the gabion wall has displaced further and the retrogressive slumping below it is affecting the riprap apron including the erosion bowl forming below the culvert outlet. The inspection in 2022 observed deeper and wider slumps at and downstream of the culvert outlet. UAV flights taken over the site in 2020 and 2022 were used to refine the site drawing.

There is significant risk of undermining of the east embankment due to the continued erosion of the slide mass and retrogression of the gully.

Recommendations:

Short-Term:

- Road maintenance should continue as necessary to maintain a safe roadway surface and may consist of milling, patching, and crack sealing of the ACP.
- Routine observation of the site, particularly following periods of heavy precipitation, to ensure that the slide mass has not retrogressed closer to the highway.
- Preliminary engineering design should be undertaken so that there are developed options available for implementation should there be rapid deterioration of the site.

Medium-Term:

- A pile wall could be constructed across the narrower downslope end of the sideslope near the outlet of the old culvert to buttress the slope. The slump in the east embankment could then be reconstructed with geogrid-reinforced fill after over-excavating the slide material.
- A surface pipe should be installed from the new culvert extending further down the gully to where it meets the tributary coming down from Site #14.
- Although the upslope ditches were regraded and protected from erosion during the 2021 overlay, the gully from the ditch down toward the culvert inlet should also be shaped and protected from erosion to minimize eventual downcutting of the ditch and sediment accumulating at the culvert inlet.

Long-Term:

It is understood that, at this time, the only long-term remediation option under consideration is realignment of the entire north hill section of Highway 744. However, given the high cost of this option and as it is a low volume highway, it is unlikely that realignment will be undertaken in the near future. Partial backfilling and hard armouring of the tributary creek to re-establish a toe buttress for this site so that the embankment slope could be rebuilt at a flatter inclination would also be another option but is also of a larger scale than might be financially feasible at this time.

Ongoing Investigation:

- It is recommended that the annual Geohazard inspection should continue as scheduled.
- At least one deep slope inclinometer installed on the downslope side between the highway and the gabion basket should be installed to confirm the stratigraphy at the site and provide an indication of the depth and rate of movement. Additional test holes should be drilled if a pile wall is to be designed.

Closure

It is a condition of this letter report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

Don Proudfoot, P.Eng.
Principal | Senior Geotechnical Engineer

Ken Froese, P.Eng.
Senior Geotechnical Engineer



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This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

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- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
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- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

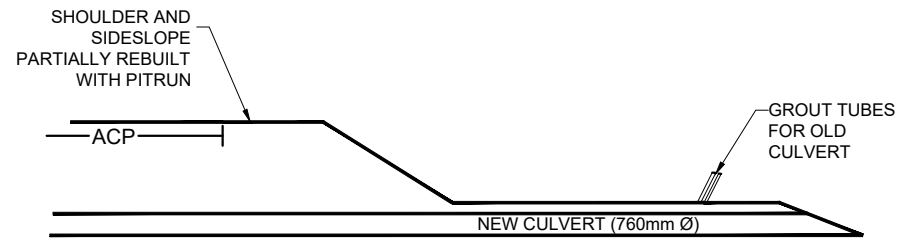
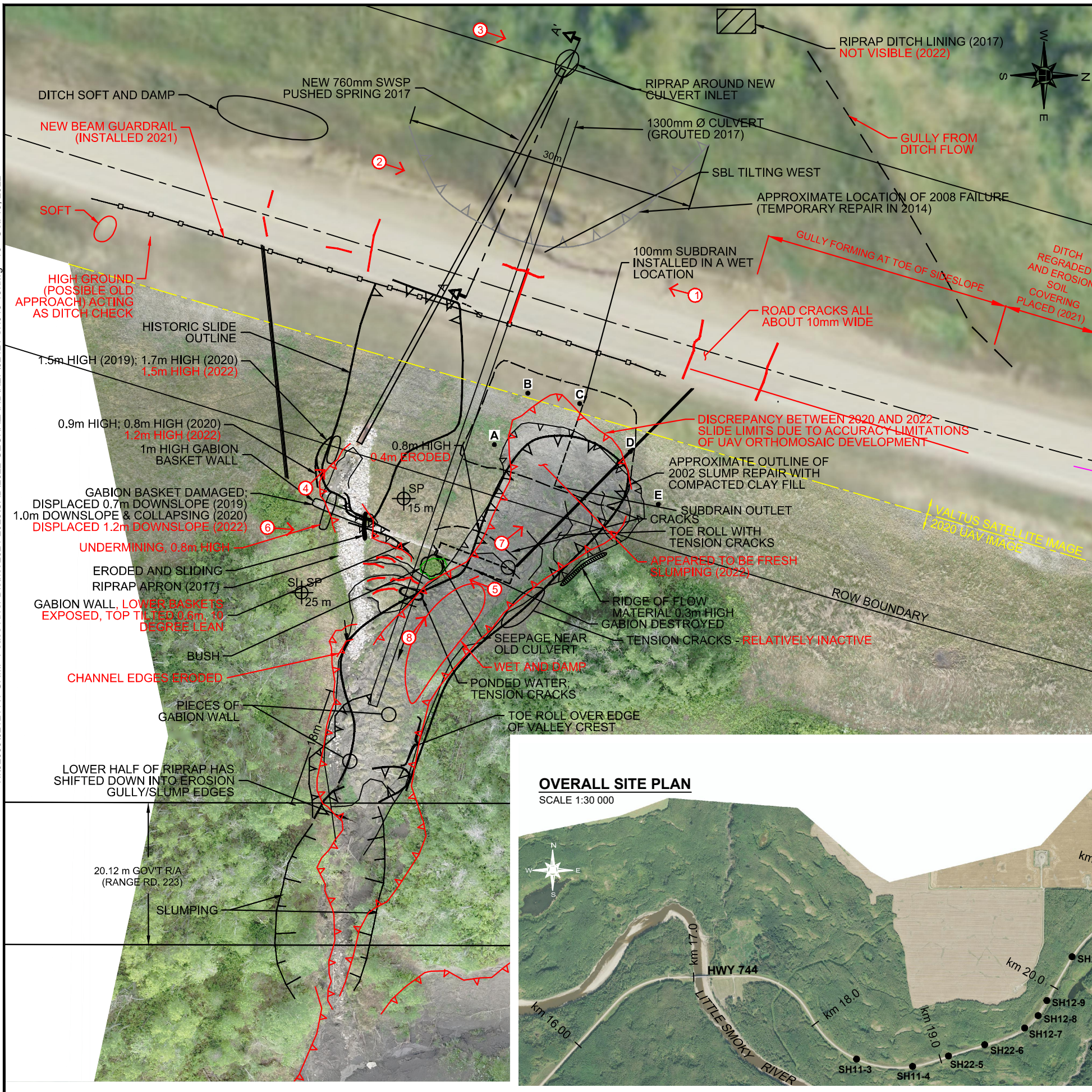
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CROSS - SECTION A - A'
APPROX. SCALE: 1:300 (HAND MEASURED)

STAKE	SCARP (HEIGHT)		
	2019	2020	2022
A	3.1m (1.5m HIGH)	? (1.8m HIGH)*	1.8m (0.6m HIGH)
B	1.5m DOWNSLOPE 1.7m LATERAL	0.3m / 2.0m** (0.5m HIGH)	2.0m (0.2m HIGH)
C	1.3m	0m / 2.0m**	2.0m (0.6m HIGH) 5.1m TO BACK SIDE OF W-BEAM GUARDRAIL AND 5.7m TO EGG LINE
D	11.6m TO GUARDRAIL	FELL / 2.0m**	1.3m (0.6m HIGH)
E	0.6m TO CRACK 1.9m TO SCARP (0.5m HIGH)	0.6m TO CRACK 1.9m TO SCARP (0.5m HIGH)	0.6m TO CRACK 1.9m TO SCARP (0.5m HIGH)

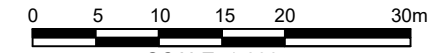
* STAKE MISSING; SCARP HEIGHT MEASURED AT APPROXIMATE LOCATION
** OFFSET FROM SCARP BEFORE/AFTER STAKE RELOCATED

NOTES

- PREVIOUS OBSERVATIONS SHOWN IN BLACK
- THIS DRAWING TAKEN FROM EXH ENGINEERING SERVICES LTD. PROJ. NO. 1202177 WITH 2013-2015 OBSERVATIONS FROM AMEC FIGURE 1, PROJECT EG10030 (PROVIDED BY AT)
- DUE TO SIGNIFICANT CHANGES OBSERVED IN 2019, NUMEROUS HISTORICAL FEATURES AND OBSERVATIONS WERE REMOVED FROM THIS DRAWING
- JUNE 2022 OBSERVATIONS SHOWN IN RED.
- CRACK AND PATCH PATTERNS RESET USING 2022 UAV IMAGERY AS HWY 744 WAS OVERLAID IN SUMMER 2021.
- GUARDRAIL AND CULVERT LOCATIONS TAKEN FROM MCINTOSH PERRY AS-BUILT DRONE SURVEY (JULY 2021).

LEGEND

DIRECTION AND NUMBER OF PHOTO

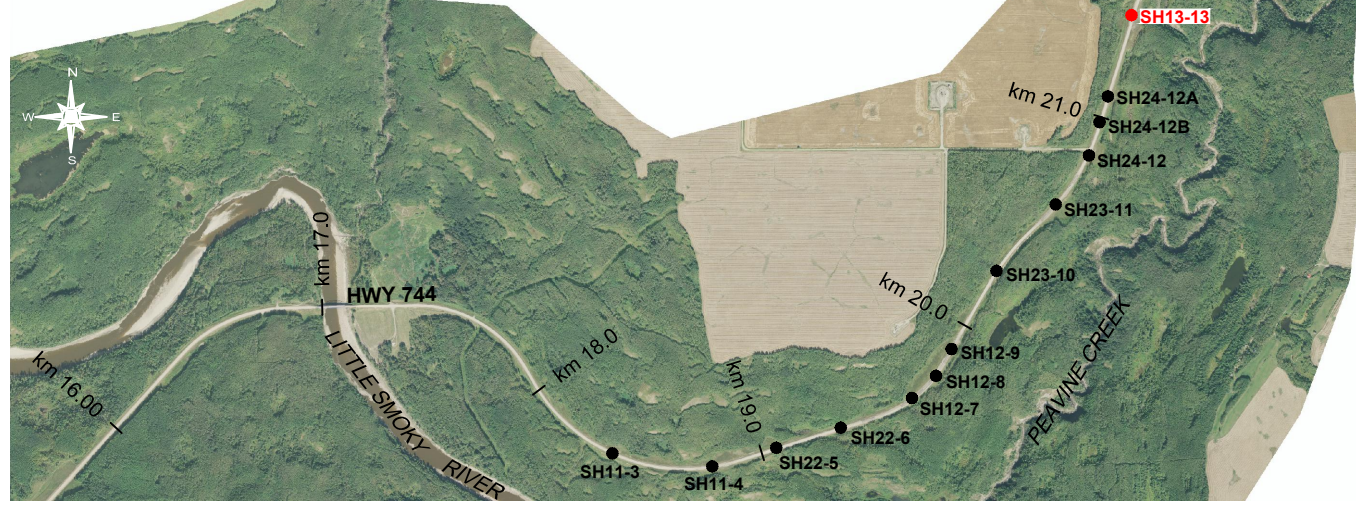


SCALE 1:600

SATELLITE IMAGE FROM VALTUS IMAGERY (DATED 2014)
UAV IMAGE ACQUIRED BY THURBER (2020)

OVERALL SITE PLAN

SCALE 1:30 000



PEACE REGION (SWAN HILLS)

**SH013-13: HWY 744:02 LITTLE SMOKY RIVER VALLEY
2022 SITE INSPECTION PLAN**

DWG No. 32121-SH013-13

DRAWN BY	ML
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:600
DATE	OCTOBER 2022
FILE No.	32121





Photo 1 – Looking south at upslope shoulder – the highway was overlaid the previous year and the crack pattern is not yet fully re-established.



Photo 2 – Looking north at sideslope above culvert inlet.



Photo 3: Looking north at new culvert inlet.



Photo 4: Looking northwest at new culvert outlet. Erosion on left-hand side (south) is significantly worse and may be part of a retrogressive tension crack from the slide further down the slope.



Photo 5 – Looking south at gabion wall on downslope side of embankment. Note eroded south face of new riprap apron from culvert outlet. September 2018 slide has removed about half of the gabion wall.



Photo 6 – Looking north at scarps above and below the gabion wall at the riprap apron.



Photo 7 – Looking northwest at top of September 2019 slide block.



Photo 8 – Looking northwest at slide in the north half of the embankment with tension cracks extending into the south half at and below the gabion wall.



UAV Photo 2 (May 2022): Overall site including tributary gully on the right (south).



UAV Photo 2 (May 2022): Closer view of the east slump encroaching towards the highway (5.1 m from back of W-Beam guardrail).