

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA &
FORT MCMURRAY DISTRICTS
2021 INSPECTION**



Site Number	Location	Name	km
NC084	To the south of the King Street Interchange in Fort McMurray	Hwy 63:11 Beacon Hill Erosion	9.1
Legal Description		UTM Co-ordinates	
5-10-089-09 W4M		12U E 478509	N 6284231

	Date	PF	CF	Total
Previous Inspection:	June 11, 2019	16	4	64 (Erosion)
Current Inspection:	June 24, 2021	16	4	64 (Erosion)
Road AADT:	29,050		Year:	2020
Inspected By:	José Pineda, Tarek Abdelaziz (Thurber) Kristen Tappenden, Bernard Ching (Alberta Transportation)			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue:	Erosion gullies and rills in the highway side slopes and west ditch
Dimensions:	Refer to attached drawings and notes below. The eroded area to the west side of Hwy 63 is about 1.0 km in length.
History/Maintenance:	<p>Available information from AT indicated the following:</p> <ul style="list-style-type: none"> - Underground utility work took place in the highway ditch in 2014. - The highway ditch has had progressive development of erosion in the highway side slope and ditch. - The erosion became severe in June 2016. - A temporary repair was completed in late 2016, and included filling in the erosion gullies, track packing rilled slopes, and minor ditch grading. Existing grass around DS1 to the north of the interchange ramp bin wall was also cleared in 2016. - Maintenance completed by AT between the spring and the fall of 2017 included: (a) sediment removal from DS1, the area north of the culvert C4 outlet extending to the storm water pond, the outlets of culvert C3 and C4; digging a small channel between the outlet of C4 and the pond; removal of sediment to expose two gabion weirs located between the C4 and the pond; construction of a small berm to the south of the bin wall to diver ditch flow away from the highway. - Sediment removal from the pond and the area located between the pond and C4 culvert as well as slight regrading was completed by AT in the winter of 2019 - Storm water pond and C3 and C4 culverts were cleaned, and an outflow discharge channel near the northern limit of the pond was dug between 2020 and 2021; willow stakes were planted between the pond and the top of bank of the river between 2019 and 2021.

Observations:	Description	Worsened?
<input type="checkbox"/> Pavement Distress		<input type="checkbox"/>

<input checked="" type="checkbox"/> Slope Movement	A slump occurred in 2016 within the backslope above the highway west ditch; this slump is currently being addressed under NC089. However, signs of potential slumping were noted between the 2016 slump and the potential old French drain around BH12-2 location	<input type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	Erosion rills (50 to 700 mm wide and 50 to 300 mm deep) were noted on the highway west side slopes; erosion gullies (0.4 to 0.6 m wide and 400 mm deep) in the ditch; severe erosion in the riprap channel near the inlet of the C6 culvert (13 m long, 3 m wide and 700 to 600 mm deep)	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Seepage from the backslope at multiple locations above the ditch alignment	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	CSP Culvert C5a was replaced with a new 900 mm diameter SWSP; old C5a pipe was grouted; two unsuccessful attempts by Inline Contracting to replace C5b with a new 900 mm diameter SWSP due to presence of rocks along the auger bore path; partially installed replacement pipes (1-900 mm diameter SWSP pipe on each side of the CSP culvert) will be grouted; C5b is in a very poor condition and will be lined by Inline Contracting; CSP Culvert C6 inlet is damaged; CSP culvert C4 outlet is almost free of sediment, and CSP C3 outlet is 10 percent full of sediment	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Other	Accumulated sediment between the bin wall and the highway shoulder buried manholes MH2 to MH5; minor vegetation/erosion along the riverbank section located to the north of the storm water pond; Free board was approximately 0.5m	<input type="checkbox"/>

Instrumentation:

There are several geotechnical instruments, consisting of slope inclinometers and piezometers, installed for other project in the ditch and within the hill. The instruments installed within the 2016 slump are being read under AT's GRMP. The remaining instruments within the ditch and the hill (outside the 2016 slump location) are not read under the current GRMP.

Assessment:

The site condition appears to have deteriorated since the last inspection event and in particular along the ditch alignment. The maintenance work completed within the highway ditch a few years ago helped reducing the severity of the current situation. The cleanup work completed by AT downstream of culverts C3 and C4 over the past few years appears to have improved the situation. It is anticipated that erosion and sedimentation issues will occur until an effective remedial measure is designed and implemented at this site.

The erosion that has been occurring on the west side of Hwy 63 is due to high runoff flowing over bare side slopes and a steep unprotected undefined "ditch". The side slopes and ditch bottom are generally bare of vegetation for the most part of the alignment, possibly due to excessive salting and sanding of this section of the highway during wintertime. Ground water seepage from the marginally stable backslopes above the ditch may have aggravated the situation.

The existing surface runoff management system at this site is not effective and continued to result in (a) development of erosion rills and gullies in the highway west ditch and side slope, (b) progressive accumulation of sediment downstream of the C4 pipe, within the pond, and blockage of the outlets of C3

and C4 culverts , and (c) progressive accumulation of sediment near the downstream end of the west ditch (to the south of the bin wall) to spill over the highway surface near MH#5.

Previous sediment noted downstream of the C4 pipe can also be attributed to (a) MH1 to MH5 (located on the highway shoulder) being partially filled with sediment (either from spreading sand and salt on the highway or from the transport of sediment in the underground piping system in response to ditch erosion), and (b) minor erosion of the bare median ditch upstream of the inlet of the C3 pipe.

Although the ongoing erosion does not appear to affect the highway surface, ongoing erosion along the side slopes could eventually undermine the integrity of the highway.

Further sediment accumulation to the north of C4 pipe and within the pond may result in further loss of the pond's storage capacity and backing up of water towards the C3 and C4 culverts and the king street embankment. Ponding of water, if occurs, at the King Street Interchange west ramp may impact the integrity of the ramp.

Recommendations:

Ditch Erosion Issue:

This site should be visited again in the spring of 2022.

Following are our recommendations and estimated ballpark prices:

**Estimated
Ballpark
Cost**

1. In the short-term, consideration should be given to blading and track packing rilled and bare side slopes of the highway and interchange ramp in a direction perpendicular to the flow direction (i.e., up and down the side slope surface to deal with side slope rills). Minor contouring should be undertaken to re-establish ditch grade and profile. The ditch should have at least 1 m wide flat bottom, 4H:1V side slopes and provided with a minimum height of 300 mm. Grading work should be carefully undertaken particularly where the toe of the valley is abutting the highway surface to avoid slope instability issues. The re-constructed ditch should be connected to the inlet drop structure located to the north of the interchange west ramp bin wall.

At locations where severe erosion gullies developed in the highway side slope or ditch, the gullies should be backfilled with well compacted crushed gravel.

Maint.

The temporary small berm and channel constructed by AT south of the bin wall to prevent sediment accumulation on the highway should be maintained. Consideration may be given to increasing the size of the berm to reduce surface water runoff from the ditch into the highway lanes.

Consideration should be given for clearing any accumulated sediment around the drop structure DS1; and placing a silt fence around the drop structure, near the edge of the pond, and at the inlets of the median culverts. Synthetic permeable ditch barriers should also be placed at key locations along the west and median ditches to trap sediments.

The pond areas should be inspected on a regular basis, particularly after spring breakup and after prolonged rainfall events. If water starts to back up from the pond area, it is recommended to use a hydrovac unit to drain this area so that the water will saturate the king street ramp embankment.

It should be noted that continuous maintenance and monitoring of this site will be required until it is permanently repaired. The maintenance should include, but not limited to, clearing the highway slopes and ditches of sand and salt accumulations each spring, cleaning the culverts, hydrovac the highway manholes, grading the ditch, and sediment removal from the pond as needed.

2. The long-term measure to deal with the ditch erosion consists of (a) shaping the highway ditch, (b) lining the ditch bottom with a gabion mattress, (c) exposure and/or replacement of the buried catch basin at the downstream end of the ditch to the south of the bin wall, (d) plugging inlets of C6 culvert and DS2, (e) tie in groundwater seepage areas in the backslope to the new ditch using riprap lined channels, (f) lining the highway side slopes with Flexamat.

\$3.5 Million
(Excluding
Engineering)

Although the above measures should eliminate ongoing erosion of the west ditch and reduce the amount of sediment entering the pond, a periodic maintenance program will likely still be required to clean the sedimentation pond, Manholes MH1 to 5, DS1, and the outlets of culverts C3 and C4. In the future, and when funds become available, consideration should be given to completing these additional measures (a) lining the median ditch and side slopes with a permanent erosion control product to prevent future ditch and side slope erosion and transport of sediment to the C2 and C3 culverts at the interchange location, and (b) designing a proper sedimentation pond, complete with an outflow pipe, armoring river bank to the north of the pond, and installing a permanent erosion control product in the area located between the C4 culvert and the pond. It should be noted that (a) a hydrotechnical assessment will need to be completed before implementing these additional long-term measures, and (b) Alberta Environment and Parks will need to be contacted if it is decided to undertake the design of a new sedimentation pond and the riverbank erosion protection work. The ballpark cost to implement these additional measures will likely be in the order of \$4 to \$5 Million (Excluding Engineering).

C5b Culvert Replacement Issues:

Failed attempts to replace C5b culvert by Inline Contracting resulted in pavement distress/settlement (about 6 to 8 m wide zone) of the walking trail and the highway northbound lanes (about 10 mm dip) above the alignment of the C5b pipe. Open transverse cracks were also noted on the highway NBLs near the ends of the dip zone. Based on onsite discussions with TetraTech (i.e., consultant overseeing the work), it is understood that: (a) the highway NBLs and the walking trail surfaces will be periodically monitored to assess whether further deterioration takes place, (b) the C5b culvert will be lined as soon as possible to reduce the likelihood of further deterioration of the highway condition, (c) the ditch block to the north of the inlet of C5b culvert will be removed so that the flow from the C5a pipe can be accommodated through the C5b liner and an existing 600 mm diameter culvert (below the NBLs) to the north of C5b pipe. The cracks developed in the highway NBLs should also be sealed and ACP patches should be placed as needed to repair the developed dip on the trail and the highway surfaces.

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.

Yours very truly,
Thurber Engineering Ltd.
Tarek Abdelaziz, Ph.D., P.Eng.
Principal | Senior Geotechnical Engineer

José Pineda, M.Eng., P.Eng.
Senior Geotechnical Engineer



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

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The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

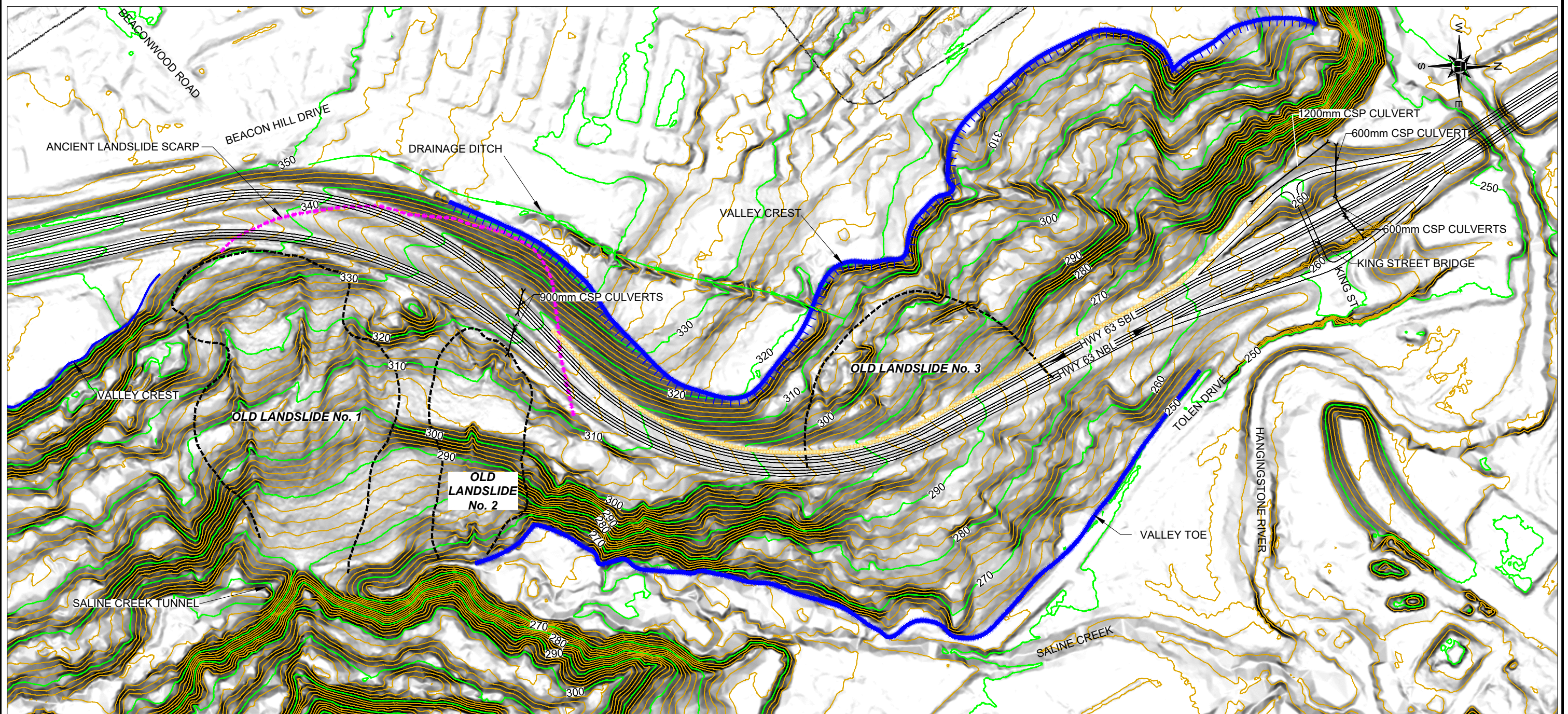
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification 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.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- 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.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

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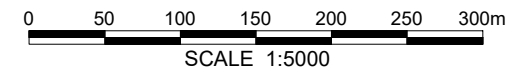


LEGEND

- APPROXIMATE HIGHWAY ALIGNMENT
- BARE GROUND
- VALLEY CREST
- VALLEY TOE
- OLD LANDSLIDE NO.1

NOTES:

1. OLD LANDSLIDES 1, 2, 3 WERE ACTIVE LOCAL LANDSLIDES THAT WERE REPAIRED IN THE PAST.
2. GROUND SURFACE CONTOURS HAVE BEEN ESTIMATED FROM THE 2008 LIDAR DATA.
3. SITE FEATURES ARE BASED ON SIMPLE MEASUREMENTS MADE DURING THE SITE VISIT AND THE ACTUAL EXTENT OF FEATURES MAY DEVIATE FROM WHAT IS PRESENTED ON THE DRAWINGS.
4. **JUNE 24, 2021 OBSERVATIONS SHOWN IN RED.**



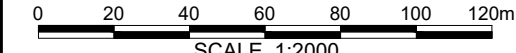
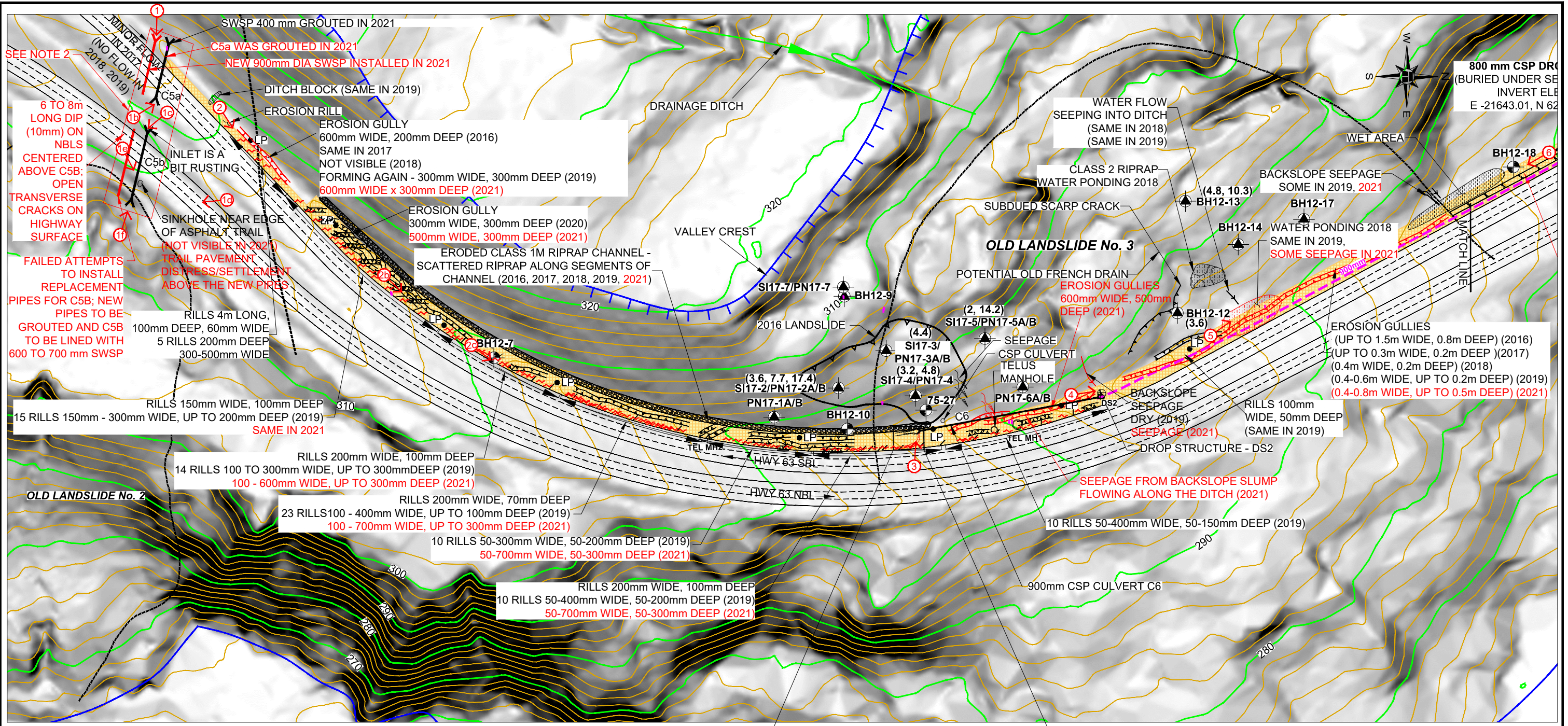
**NORTH CENTRAL REGION
 (ATHABASCA AND FORT MCMURRAY DISTRICTS)
 2021 GEOHAZARD ASSESSMENT
 NC084: HWY 63:11 BEACON HILL EROSION ISSUES
 (km 9.1)
 LIDAR IMAGE SHOWING SITE FEATURES**

FIGURE 1

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:5000
DATE	SEPTEMBER 2021
FILE No.	32122



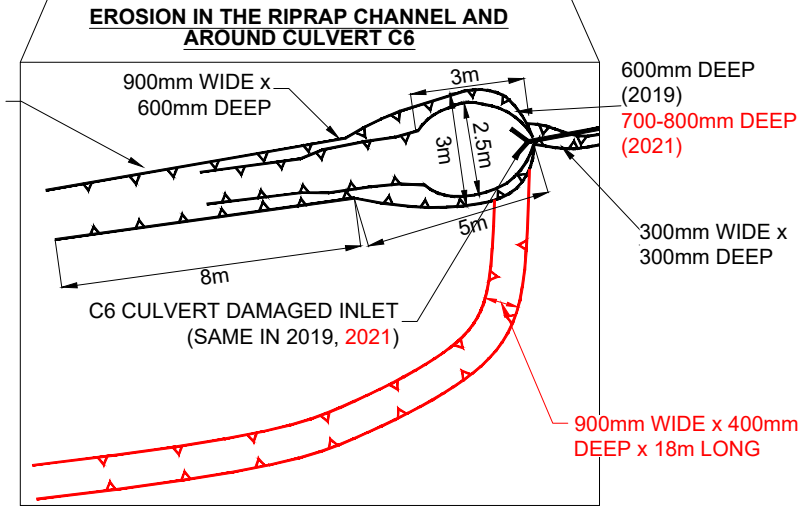
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LEGEND

- EROSION GULLY / RUTTING
- EROSION RILL
- LIGHT POLE
- GROUND SURFACE CONTOUR (CONTOUR INTERVAL = 2m)
- APPROXIMATE HIGHWAY ALIGNMENT
- PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION
- BARE GROUND
- VALLEY CREST
- VALLEY TOE
- OLD LANDSLIDE NO.1
- PREVIOUS SLOPE INCLINOMETER LOCATION
- PREVIOUS BOREHOLE LOCATION
- SLOPE INCLINOMETER
- PNEUMATIC PIEZOMETER
- BORE HOLE
- DEPTH OF MOVEMENT IN SLOPE INCLINOMETRE IN METERS

NOTES:
 1. JUNE 24, 2021 OBSERVATIONS SHOWN IN RED.
 2. INLINE CONTRACTING WAS WORKING ON THE REPLACEMENT OF CULVERT C5a AND C5b; TETRA TECH WAS THE CONSULTANT OVERSEEING THE CULVERT REPLACEMENT WORK. TETRA TECH INDICATED THAT THE CONTRACTOR HAD MULTIPLE UNSUCCESSFUL ATTEMPTS TO REPLACE THE C5b CULVERT.

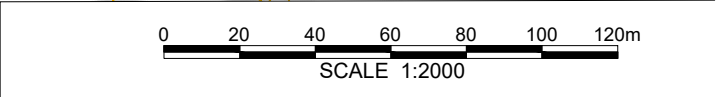
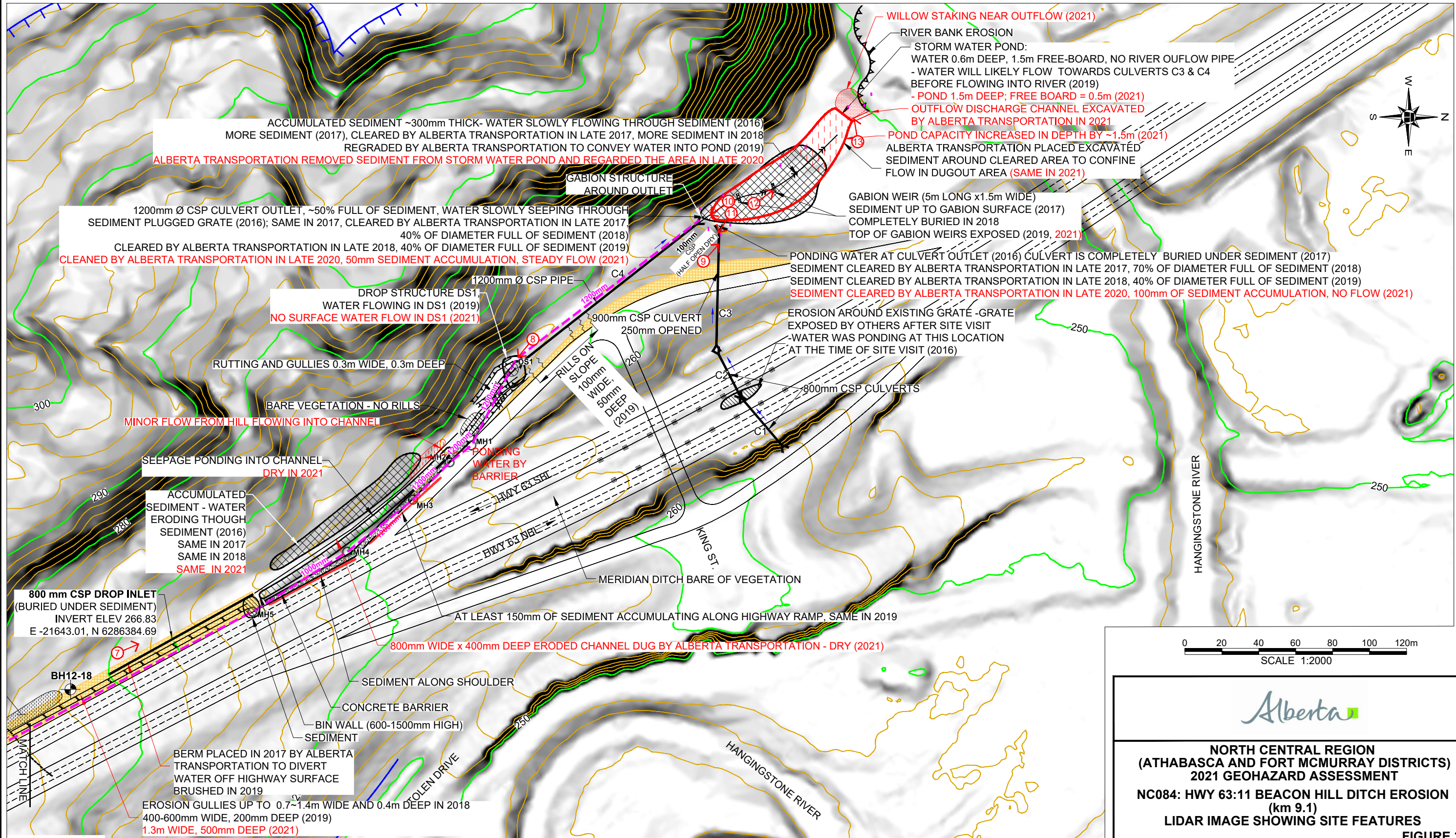


**NORTH CENTRAL REGION
 (ATHABASCA AND FORT McMURRAY DISTRICTS)
 2021 GEOHAZARD ASSESSMENT
 NC084: HWY 63:11 BEACON HILL DITCH EROSION
 (km 9.1)
 LIDAR IMAGE SHOWING SITE FEATURES**

FIGURE 2

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:2000
DATE	SEPTEMBER 2021
FILE No.	32122

THURBER ENGINEERING LTD.



**NORTH CENTRAL REGION
(ATHABASCA AND FORT McMURRAY DISTRICTS)
2021 GEOHAZARD ASSESSMENT**

**NC084: HWY 63:11 BEACON HILL DITCH EROSION
(km 9.1)**

LIDAR IMAGE SHOWING SITE FEATURES

FIGURE 3

LEGEND

- EROSION GULLY / RUTTING
- EROSION RILL
- GROUND SURFACE CONTOUR (CONTOUR INTERVAL = 2m)
- APPROXIMATE HIGHWAY ALIGNMENT
- PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION
- BARE SLOPE WITH EROSION GULLY / RILLS
- APPROXIMATE GUARDRAIL LOCATION

- VALLEY CREST
- VALLEY TOE
- WATER FLOW

- NOTES:**
1. MH2 TO MH5 ARE BURIED UNDER SEDIMENT.
 2. JUNE 24, 2021 OBSERVATIONS SHOWN IN RED.

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:2000
DATE	SEPTEMBER 2021
FILE No.	32122





Photo 1 – Looking at the inlet of a new 900 mm diameter SWSP culvert (C5a replacement)



Photo 1b – Looking at the outlet of a new 900 mm diameter SWSP culvert (C5a replacement)



Photo 1c - 900 mm diameter CSP culvert (C5b) inlet. This culvert will be lined in 2021



Photo 1d – 900 mm diameter CSP culvert (C5b) outlet. Inline Contracting had two unsuccessful attempts to replace the CSP culvert with a SWSP. The first attempt was to install the pipe 2m to the south of C5b, and the second attempt was to install the pipe 4 m to the north of C5b



Photo 1e –Asphalt walking trail settlement/distress in response to the failed attempts to replace C5b



Photo 1f –Looking inside the C5b culvert from the outlet location; the culvert floor is excessively damaged, and rocks/debris are present within the culvert floor; the integrity of this culvert is questionable, and it will be lined in 2021 by Inline Contracting



Photo 2 – Bare side slopes with erosion rills



Photo 2b – Bare side slopes and erosion rills



Photo 2c – Bare side slopes and erosion rills



Photo 3 – Severe sediment accumulation and excessive erosion developed on the highway side slope near culvert C6 inlet location



Photo 4 – Erosion , bare slopes, and debris near Drop structure DS2



Photo 5 – Some seepage from the colluvium backslope flowing into eroded ditch



Photo 6 – Sediment accumulation in the highway side slope



Photo 7 – Temporary berm and erosion gully along the back of bin and jersey walls



Photo 8 – Drop Structure DS1; note lush vegetation possible due to seepage and surface water flowing from the hill



Photo 9 – Substantial sediment was removed increasing pond capacity by approximately 1.5m



Photo 10 – Culvert C4 (1200 mm outlet); sediment removed from the culvert; steady flow from the outlet



Photo 11 – Culvert C4 and C3 outlets; note sediment accumulation was partially removed from the inside of C4 (small culvert on the LHS of the photo); no flow on C4



Photo 12 – Pond outflow discharge channel; approximately 0.5 m freeboard



Photo 13 – Willow staking within the vegetation buffer zone between the pond and the river