

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2024 INSPECTION**



Site Number	Location	Name	Hwy	km
PH093-1	Brick's Hill/Shaftesbury Trail	The Big Eddie	684:02	8.86-8.98
Legal Description		UTM Co-ordinates		
NW24/SW25-91-23-W5M		11 E 467,076	N	6,219,660

	Date	PF	CF	Total
Previous Inspection:	9-Jun-2023	14	8	112
Current Inspection:	29-May-2024	13	6	58
Road AADT:	390		Year:	2024
Inspected By:	Rocky Wang, TEC Robert Senior, TEC		Ken Froese, Thurber Tyler Clay, Thurber	
Report Attachments:	<input checked="" type="checkbox"/> Photographs	<input checked="" type="checkbox"/> Plans	<input type="checkbox"/> Maintenance	

Primary Site Issue:	Massive flow slide through existing fill located downslope of the highway with retrogressive cracks in the sideslope within 3.5 m of highway shoulder. The slide is located where a similar slide occurred in 1986. The current slide has overwhelmed the mitigation work done to repair the 1986 slide.	
Dimensions:	Main landslide is 340 m long, and 43 m from the highway. The main head scarp is about 120 m wide and 6.3 m high while the main earth flow slide body is about 50 m wide.	
Date of Remediation:	1986: Translational landslide repaired using subdrains and toe berm to pinch off the movement flow at the narrow part of the flow path. 2023: Temporary detour constructed to north of site, accepting that the slide retrogression could affect the highway with little warning.	
Maintenance:	2023: Jersey barriers and warning signs installed.	
Observations:	Description	Worsened?
<input type="checkbox"/> Pavement Distress	None yet observed.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Tension crack arcs along south highway sideslope and continues to drop and widen. The headscarp is slowly retrogressing and may rapidly retrogress as water infiltrates the cracks.	<input checked="" type="checkbox"/>
<input type="checkbox"/> Erosion		<input type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	There are damp areas on the west flank. The location of previously installed subdrains is not known.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert	Outlet of 900 mm CSP on west side is mostly obstructed. Temporary detour has diverted ditch flow to the east along the north side of the highway.	<input type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>

Instrumentation (as of Fall 2024):	
Inclinometers	SI23-1 (between the main scarp and highway): sheared off after Spring 2024 reading at 11.5 m depth after 56 mm of deformation; the rate had slowed slightly to 73 mm/yr compared to the overall rate of 97 mm/yr.

	SI23-4 (upslope of detour): No clear pattern has developed within the depth of instrument installation (26 m).
Standpipe Piezometers	SP23-2 (West): Slight increasing trend since March 2024; at 455.8 m El. (3.5 m depth BGS) SP23-3 (East): Increasing trend overall but only slightly since March 2024; at 446.9 m El. (4.3 m depth BGS)
Vibrating Wire Piezometers	VW23-1 (datalogged): tip at about 18 m below ground and about 7 m below slip surface and dry since installation. VW23-4A/B: 4A tip is about 15 m below ground and dry since Dec. 2023; 4B tip is about 25 m below ground with slight decreasing trend and at 436.8 m El. (19.9 m depth) VW23-5: tip is about 8 m below ground and dry since installation.

Assessment:

A call-out inspection was completed on June 8, 2023. The site background and review of available site information was provided in the July 16, 2023, Call-Out Report. Based on a comparison between the pre-disturbance LiDAR ground surface captured in 2007 and the post-disturbance UAV photogrammetry-derived elevation model, the transition between depletion and accumulation occurs coincident with the downslope end of the toe berm constructed following the 1986 slide. That would suggest that the failure occurred near the base of the fill. Since the failure took 37 years to occur, it may be due to gradually strain softening of the relatively weak native clay soils under the load of the fill that was placed to reconstruct the slope and build the toe berm. This softening, in combination with a gradual loss of cohesion, could have resulted in the observed failure. It is possible that there was also some oversteepening by erosion at the toe of the embankment. The likely source of erosion would be from the gabion mattress lined channel on the west side of the fill. Above-average rainfall may also have been a contributing factor in triggering erosion or raising the local groundwater table. Environment Canada data (from Peace River about 13 km distant) indicates that there was 50 mm of rainfall between May 22 and 24, 2023, which is greater than the long-term 1981 to 2010 Climate Normal of 40 mm for the entire month of May. However, the Google Earth imagery indicated that failure had already initiated earlier in May (assuming their dates are correct) so the heavy rainfall later in the month was not the cause although it most likely contributed to the rate and size of movement. It is possible small slope deformations and minor cracks may have initiated prior to May 2023 and had gone unnoticed.

Given the long run out of the slide and the appearance of flow slide-type behaviour, an advancing zone of water and mud could have been anticipated but the dried leaves on the gully floor did not show evidence of such. It is possible that there was some wetter material in the initial phase of movement which was subsequently buried by drier material. Thurber's hydrogeologist speculates that flow-type behaviour did occur but only on thin clay layers where excess pore pressures could have initiated slope failure with relatively small amounts of water.

Due to the presence of the large tension crack in the sideslope of the highway at the time of the call-out (3.96 m from the fog line at the closest point), it was agreed to keep the road open but reduce the speed limit to 30 kph, place jersey barriers along the downslope side of the highway, and increase the frequency of inspection. McIntosh Perry (now Egis) was contracted to develop a low-speed temporary detour and supervise the construction. The Maintenance Contractor completed the gravel detour construction in September 2023 and the detour can now be used to re-route traffic if/when the landslide retrogresses further and compromises the main highway. For this reason, the Consequence Factor has been lowered from that applied at the time of the call-out and the Probability Factor has also been reduced slightly as the retrogression has not advanced as quickly as had been initially anticipated.

Comparison between UAV imagery taken in 2023 and 2024 shows that there has been some regression of the main headscarp (up to about 5 m) as noted on the Drawing 32121-PH093-1) in the upper central portion of the slide area; the west and east flanks appeared relatively stable other than some dissociation and toppling of blocks that had already slumped. There are additional intermediate tension cracks between the main scarp and the highway mostly on the west portion of the site. All the cracks were wider and deeper than in 2023. It is expected that the slow movements will continue until there is a sudden, brittle failure and this next block slides or topples out. This may be triggered by high rainfall raising the groundwater table and lubricating the slip surfaces or by steady erosion of the slide material below the headscarp leading to further destabilization of the overall slope.

Recommendations:**Short-Term:**

- Routine monitoring to determine if tension cracking has started within the pavement. If this occurs, then the next step is to shift traffic onto the temporary detour.

Long-Term remediation options:

- a) Realignment of the highway appears to be the most-economical solution. The realignment would similar the temporary detour already in place but with improve geometry starting with a cut into the backslope to the east of the site where the highway is protected by the PH040 pile wall and returning to the existing highway alignment on the west side beyond the original 1985 failure extents. There will be significant volumes of cut material that will need to be hauled off the site for disposal.
- b) A pile wall could also be considered, either as a standalone repair or in conjunction with the realignment noted in a), but is expected to be quite expensive and difficult to justify for the low traffic volumes. If installed adjacent to the highway the pile wall could be about 150 m long and consist of drilled concrete piles up to 25 m deep with two or more rows of tie-back anchors.

Ongoing Investigation:

- The geotechnical drilling investigation has been completed. The preliminary engineering assessment is underway to consider the potential long-term remediation options.
- Ongoing monitoring of the instrumentation should be continued under the GRMP program.
- It is recommended that this site be inspected annually under the GRMP program.

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.

Roger Skirrow, M.Sc., P.Eng.
Senior Geotechnical Engineer

Ken Froese, P.Eng.
Associate | 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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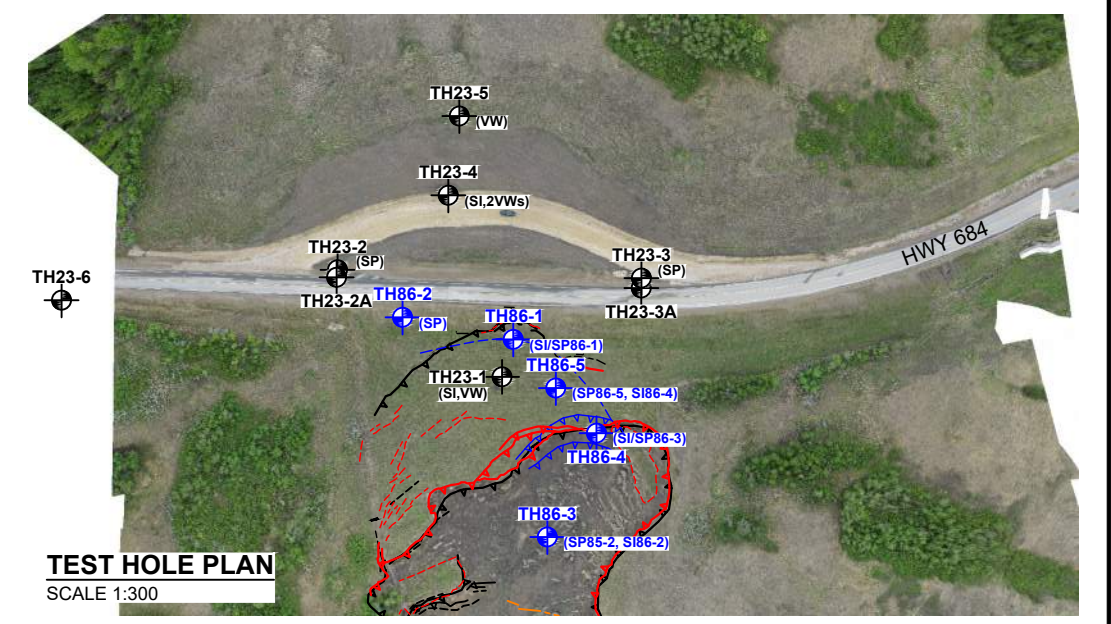
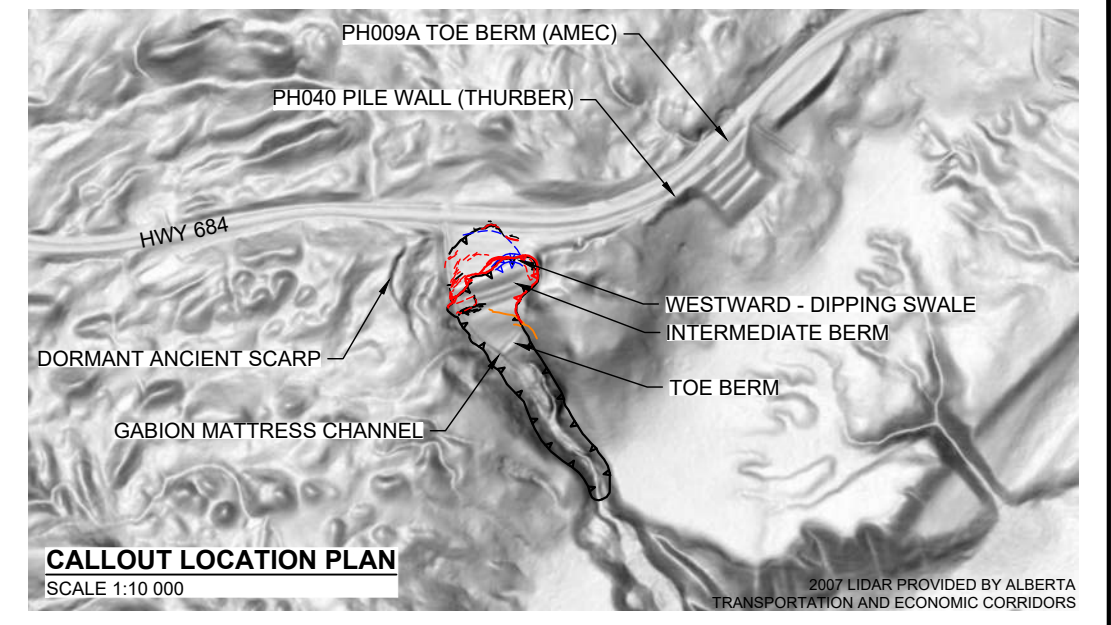
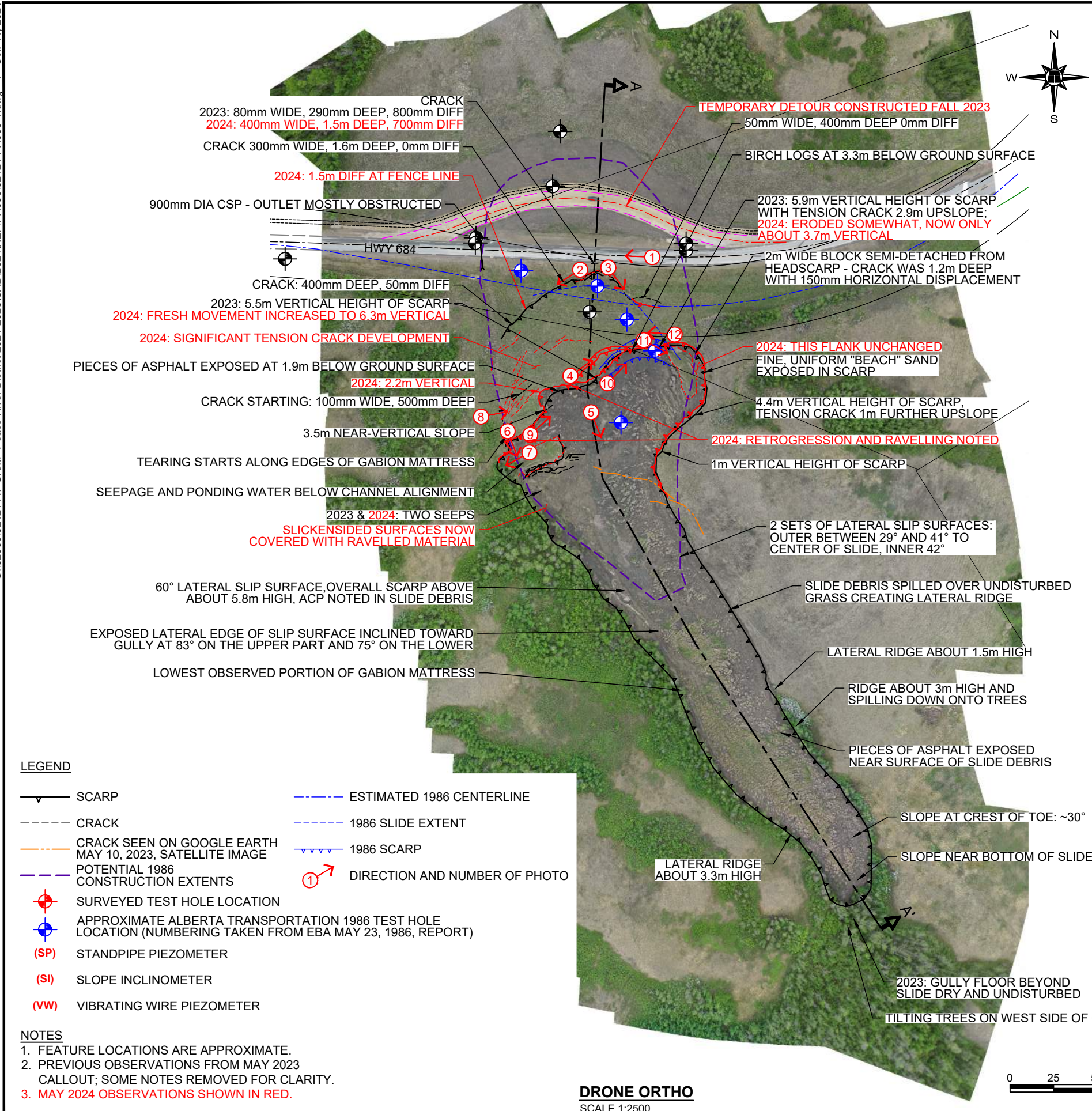
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- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has 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.

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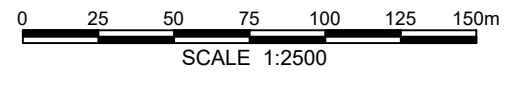
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- LEGEND**
- SCARP
 - CRACK
 - CRACK SEEN ON GOOGLE EARTH MAY 10, 2023, SATELLITE IMAGE
 - POTENTIAL 1986 CONSTRUCTION EXTENTS
 - SURVEYED TEST HOLE LOCATION
 - APPROXIMATE ALBERTA TRANSPORTATION 1986 TEST HOLE LOCATION (NUMBERING TAKEN FROM EBA MAY 23, 1986, REPORT)
 - (SP) STANDPIPE PIEZOMETER
 - (SI) SLOPE INCLINOMETER
 - (VW) VIBRATING WIRE PIEZOMETER
 - ESTIMATED 1986 CENTERLINE
 - 1986 SLIDE EXTENT
 - 1986 SCARP
 - ① DIRECTION AND NUMBER OF PHOTO

- NOTES**
1. FEATURE LOCATIONS ARE APPROXIMATE.
 2. PREVIOUS OBSERVATIONS FROM MAY 2023 CALLOUT; SOME NOTES REMOVED FOR CLARITY.
 3. MAY 2024 OBSERVATIONS SHOWN IN RED.
- DRONE ORTHO**
 SCALE 1:2500



ORTHOMOSAIC FLOWN BY THURBER MAY 2024;
 BASE MAPPING BY McINTOSH PERRY / EGIS 2023

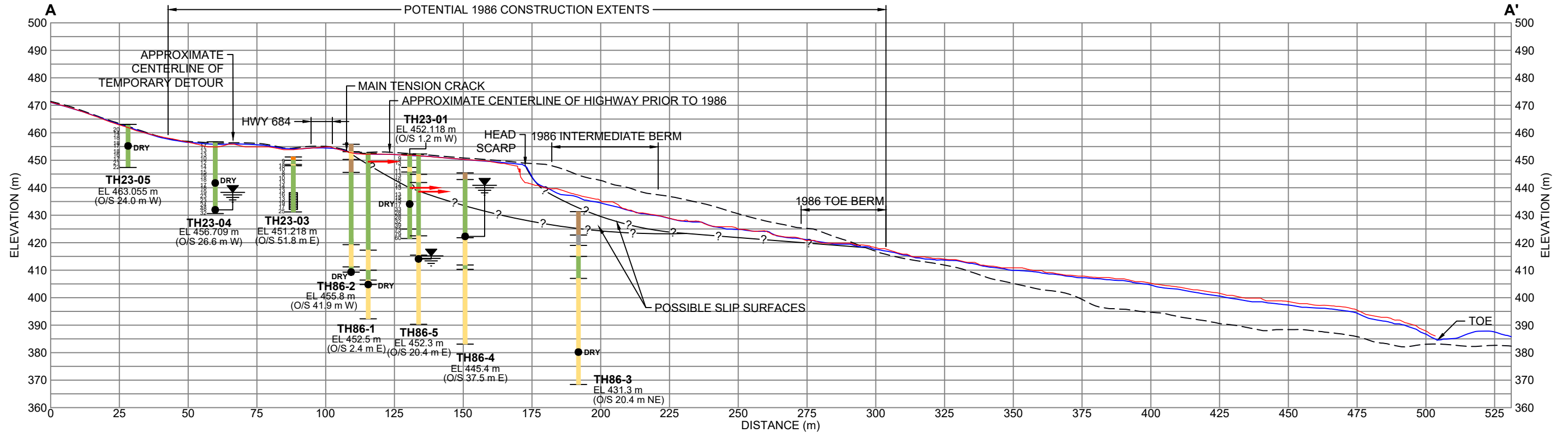
PEACE REGION (PEACE RIVER DISTRICT)

**PH093: BIG EDDIE: HWY 684:02 KM 8.86 TO KM 8.98
 2024 SITE INSPECTION PLAN**

DWG No. 32121-PH093-1

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	OCTOBER 2024
FILE No.	32121

THURBER ENGINEERING LTD.




LEGEND

- | | | | |
|--------------------------|---|---------------|--------------|
| 15 I | SPT N VALUE | Orange square | FILL |
| Water level symbol | WATER LEVEL IN PIEZOMETER (NOVEMBER 16, 2023) | Green square | CLAY |
| Dot with line | VIBRATING WIRE PIEZOMETER TIP LOCATION | Brown square | CLAY TILL |
| Screened interval symbol | STANDPIPE PIEZOMETER SCREENED INTERVAL | Yellow square | SAND, GRAVEL |
| Arrow | ZONE OF MOVEMENT IN SLOPE INCLINOMETER | Grey square | SILT |
| Dashed line | 2007 LIDAR PROFILE | | |
| Blue line | 2023 LIDAR PROFILE | | |
| Red line | 2024 DSM PROFILE (APPROX) | | |

NOTES:

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.
2. ELEVATIONS FOR THE 1986 TEST HOLES WERE RELATIVE AND HAVE BEEN ADJUSTED TO FIT ESTIMATED PRE-SLIDE TOPOGRAPHY.
3. 2007 LIDAR PROVIDED BY TEC, 2023 LIDAR FLOWN BY MCINTOSH PERRY/EGIS USING RTK CONTROL, 2024 DIGITAL SURFACE MODEL DERIVED USING SfM TECHNIQUES FROM UAV FLOWN BY THURBER




PEACE REGION (PEACE RIVER DISTRICT)

**PH093: BIG EDDIE: HWY 684:02 KM 8.86 TO KM 8.98
CROSS-SECTION A-A'**

DWG No. 32121-PH093-2

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:1500
DATE	OCTOBER 2024
FILE No.	32121



THURBER ENGINEERING LTD.



Photo 1: Looking west along as-yet uncracked highway surface.



Photo 2: Looking southwest along main tension crack at the highway sideslope with measuring transect stakes in foreground.



Photo 3: Looking southeast along the rest of the main tension crack at the highway sideslope.



Photo 4: Looking east along the main headscarp where the portion is regressing towards the highway.



Photo 5: Looking south down the axis of the landslide mass.



Photo 6: Stretching gabion mattress along the west flank of the landslide.



Photo 7: Additional scarps just beyond the west flank of the landslide.



Photo 8: Looking east across the main landslide scarp.



Photo 9: Toppling blocks at the face of the main headscarp.



Photo 10: Looking east along face of the main headscarp.



Photo 11: Looking southeast at the east flank of the main landslide.



Photo 12: Looking west at the main landslide headscarp.