



THURBER ENGINEERING LTD.

July 5, 2022

File No.: 32122

Alberta Transportation
Construction and Maintenance Division
North Central Region
Box 4596, 4513 – 62 Avenue
Barrhead, Alberta
T7N 1A5

Attention: Ms. Amy Driessen, P.Eng.

**ALBERTA TRANSPORTATION GRMP (CON0022163)
NORTH CENTRAL (ATHABASCA AND FORT McMURRAY DISTRICTS)
INSTRUMENTATION MONITORING RESULTS – SPRING 2022**

SECTION C

SITE NC089: HWY 63:12 BEACON HILL BACKSLOPE SLIDE (km 8.7)

Dear Ms. Driessen:

This report provides the results of the annual geotechnical instrumentation monitoring for the above-mentioned site as part of Alberta Transportation's Geohazard Risk Management Program for North Central – Athabasca and Fort McMurray Districts (CON0022163).

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.

1. FIELD PROGRAM AND INSTRUMENTATION STATUS

Two slope inclinometers (SI17-2, and SI17-7), and 14 pneumatic piezometers (PN17-1A, PN17-1B, PN17-2A, PN17-2B, PN17-3A, PN17-3B, PN17-4, PN17-5A, PN17-5B, PN17-6A, PN17-6B, PN17-7A, PN17-7B, and PN17-7C) were read at the Hwy 63:12 Beacon Hill Backslope Slide site on June 3, 2022, by Mr. Niraj Regmi, G.I.T. and Mr. Jayden Del Cid, both of Thurber Engineering Ltd.

SI17-3, SI17-4, and SI17-5, which had all previously been found to be blocked or sheared off, were not read during the current readings cycle.

The SIs were read using an RST Digital Inclinometer probe with a 2 ft. wheelbase and a RST Pocket PC readout. Inclinometer reading depths were defined as per cable markings with respect to the top of the inclinometer casings. The pneumatic piezometers were read using a RST C108 pneumatic piezometer reader.



2. DATA PRESENTATION

2.1 General

SI plots for A and B directions are presented in Appendix A. Where movement has been recorded the resultant plot (X direction, if applicable) and rate of movement have also been provided. Pneumatic piezometer results are also provided in Appendix A. The slope inclinometer and piezometer reading summary tables are provided below. These tables also include instruments deleted from the GRMP program or not read during this monitoring event for future reference.

2.2 Zones of Movement

No zones of new movement were observed in the SIs since the spring of 2021 readings.

Zones of movement are summarized in Table NC089-1 below. Table NC089-1 also provides a historical account of the total movement, the depth of movement and the maximum rate of movement that has occurred in the SIs since initialization.



**TABLE NC089-1
 SPRING 2022 – HWY 63:12 BEACON HILL BACKSLOPE SLIDE (km 8.7)
 SLOPE INCLINOMETER INSTRUMENTATION READING SUMMARY**

Date Monitored: June 3, 2022

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI17-2	September 18, 2017	35.7 mm over 1.8 to 3.6 m depth in 54° direction	58.9 on September 25, 2020	Operational	June 28, 2021	4.1	4.4	-7.9
		6.7 mm over 4.8 to 7.3 m of depth in 81° direction	5.8 on September 25, 2020			0.3	0.4	-2.6
		2.5 mm over 16.4 to 17.6 m depth in 54° direction	3.6 on October 18, 2017			0.1	<0.1	-1.1
SI17-3	September 18, 2017	94.7 mm over 1.4 to 3.8 m depth in 20° direction	183.1 on September 25, 2020	Blocked at 1.2 m	September 25, 2020	N/A	N/A	N/A
SI17-4	September 18, 2017	1.0 mm over 2.0 to 3.2 m depth in 118° direction	2.9 on February 21, 2018	Blocked at 1.2 m	September 25, 2020	N/A	N/A	N/A
		1.0 mm over 13.0 to 14.8 m depth in 78° direction	3.5 on October 18, 2017			N/A	N/A	N/A
SI17-5	September 18, 2017	36.4 mm over 0.1 to 2.0 m depth in 56° direction	43.9 on September 17, 2018	Blocked at 1.2 m	May 28, 2020	N/A	N/A	N/A
		1.2 mm over 12.3 to 14.2 m depth in 56° direction	2.0 on September 17, 2018			N/A	N/A	N/A

Figure 32122-NC089 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.



**TABLE NC089-1 – CONTINUED...
 SPRING 2022 – HWY 63:12 BEACON HILL BACKSLOPE SLIDE (km 8.7)
 SLOPE INCLINOMETER INSTRUMENTATION READING SUMMARY**

Date Monitored: June 3, 2022

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI17-7 (Replacement for SI12-09)	September 18, 2017	24.1 mm over 1.6 to 3.4 m depth in 29° direction	60.8 in September 2020	Operational	June 28, 2021	1.2	1.3	-0.9
		2.5 mm over 22.9 to 24.1 m depth in 29° direction	2.3 in September 2020			0.7	0.7	0.3

Figure 32122-NC089 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.



**TABLE NC089-2
 SPRING 2022 – HWY 63:12 BEACON HILL BACKSLOPE SLIDE (km 8.7)
 PNEUMATIC PIEZOMETER INSTRUMENTATION READING SUMMARY**

Date Monitored: June 3, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER DEPTH (m)	MEASURED PORE PRESSURE (kPa)	CURRENT GROUNDWATER DEPTH (m)	PREVIOUS GROUNDWATER DEPTH (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN17-1A (37677)	September 18, 2017	8.0	Operational	5.42 on February 21, 2018	23.8	5.57	6.35	0.78
PN17-1B (37659)	September 18, 2017	15.5	Operational	10.43 on October 18, 2017	33.9	12.04	11.82	-0.22
PN17-2A (37666)	September 18, 2017	13.0	Operational	7.05 on October 18, 2017	66.2	6.25	7.51	1.26
PN17-2B (37494)	September 18, 2017	21.6	Operational	21.20 on February 21, 2018	1.5	21.45	21.46	0.01
PN17-3A (37665)	September 18, 2017	4.7	Operational	2.38 on September 25, 2020	22.6	2.40	2.59	0.19
PN17-3B (37495)	September 18, 2017	14.6	Operational	9.33 on September 25, 2020	48.4	9.67	9.55	-0.12
PN17-4 (37674)	September 18, 2017	8.0	Operational	3.86 on September 25, 2020	46.4	3.25	4.25	1.00

Figure 32122-NC089-1 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.



TABLE NC089-2 – CONTINUED...
SPRING 2022 – HWY 63:12 BEACON HILL BACKSLOPE SLIDE (km 8.7)
PNEUMATIC PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: June 3, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER DEPTH (m)	MEASURED PORE PRESSURE (kPa)	CURRENT GROUNDWATER DEPTH (m)	PREVIOUS GROUNDWATER DEPTH (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN17-5A (37667)	September 18, 2017	8.9	Operational	8.83 on September 25, 2020	0.2	8.88	8.82	-0.06
PN17-5B (37660)	September 18, 2017	14.8	Operational	9.95 on September 25, 2020	48.4	9.87	9.81	-0.06
PN17-6A (37664)	September 18, 2017	9.7	Operational	5.35 on October 18, 2017	32.5	6.39	6.63	0.24
PN17-6B (37493)	September 18, 2017	18.5	Operational	18.11 on February 21, 2018	0.6	18.44	18.41	-0.03
PN17-7A (37675)	September 18, 2017	8.0	Operational	6.13 on October 18, 2017	20.5	5.91	6.14	0.23
PN17-7B (37477)	September 18, 2017	18.0	Operational	17.59 on February 21, 2018	1.1	17.89	17.87	-0.02
PN17-7C (37661)	September 18, 2017	28.0	Operational	21.77 on May 29, 2018	50.9	22.81	23.18	0.37

Figure 32122-NC089-1 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.



3. INTERPRETATION OF MONITORING RESULTS

SI17-2 showed rates of movement of 4.4 mm/yr over 1.8 m to 3.6 m depth, 0.4 mm/yr over 4.8 m to 7.3 m depth, and less than 0.1 mm/yr over 16.4 to 17.6 m of depth. The rate of movement decreased in SI17-2 by 7.9 mm/yr over 1.8 m to 3.6 m depth since the spring of 2021 reading event. SI17-7 showed rates of movement of 1.3 mm/yr and 0.7 mm/yr, over 1.6 m to 3.4 m depth and 22.9 m to 24.1 m depth, respectively. The rate of movement decreased in SI17-7 by 0.9 mm/yr over 1.6 m to 3.4 m since the spring of 2021 reading event.

Pneumatic piezometers PN17-1A, PN 17-2A, PN17-2B, PN17-3A, PN17-4, PN17-6A, PN17-7A, and PN17-7C showed increases in groundwater levels of 0.78 m, 1.26 m, 0.01 m, 0.19 m, 1.00 m, 0.24 m, 0.23 m, and 0.37 m, respectively, since the spring of 2021. Pneumatic piezometers PN17-1B, PN17-3B, PN17-5A, PN17-5B, PN17-6B, and PN17-7B showed decreases in groundwater of 0.22 m, 0.12 m, 0.06 m, 0.06 m, 0.03 m, and 0.02 m, respectively since the spring of 2021. The pneumatic piezometer readings are summarized in Table NC089-2 and are plotted in Figure NC089-1 in Appendix A.

4. RECOMMENDATIONS

4.1 Future Work

The instruments should be read again in the spring of 2023.

4.2 Instrumentation Repairs

SI17-3, SI17-4 and SI17-5 were inspected during the fall of 2021 readings using a downhole camera. The SIs were found to be obstructed between 1.2 m – 1.5 m below the ground surface. After an internal review, it was determined that these SIs would be uneconomical to repair since they would require additional work such as hydrovac excavation in order to repair.

No other instrument repairs are required at this time.



5. CLOSURE

We trust this report meets your requirements at present. If you have any questions, please contact the undersigned at your convenience.

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

Bruce Nestor, P.Eng.
Geotechnical Engineer
/jf

Attachments:

- Statement of Limitations and Conditions
- Appendix A
 - Field Inspector's report
 - Site Plan Showing Approximate Instrument Locations (Drawing No. 32122-NC089)
 - SI Reading Plots
 - Figure NC089-1 (Piezometric Depths)



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.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

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.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



**ALBERTA TRANSPORTATION GRMP (CON0022163)
NORTH CENTRAL (ATHABASCA AND FORT McMURRAY DISTRICTS)
INSTRUMENTATION MONITORING RESULTS**

SPRING 2022

**APPENDIX A
DATA PRESENTATION AND SITE PLANS**

SITE NC089: HWY 63:12 BEACON HILL BACKSLOPE SLIDE (km 8.7)

**ALBERTA TRANSPORTATION
NORTH CENTRAL REGION - ATHABASCA AND FORT McMURRAY DISTRICTS
INSTRUMENTATION MONITORING FIELD SUMMARY (NC089)
SPRING 2022**

Location: HWY 63:12 Beacon Hill Backslope Slide File Number: 32122 Probe: RST set 5R Cable: RST set 5R	Readout: RST PN C108 Unit 4 Casing Diameter: 2.75" Temp: 20 Read by: NKR/JD
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SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location (UTM 12)		Date	Stickup (m)	Leadings Depth from top of casing (ft)	Azimuth of A+ Groove degree	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Northing	Easting					A+	A-	B+	B-		
SI17-2	6284103	478503	03-Jun-22	0.95	82 to 2	60	-563	573	-211	199	5R/5R	
SI17-7	6284102	478453	03-Jun-22	0.55	98 to 2	40	1762	-1749	317	-337	5R/5R	

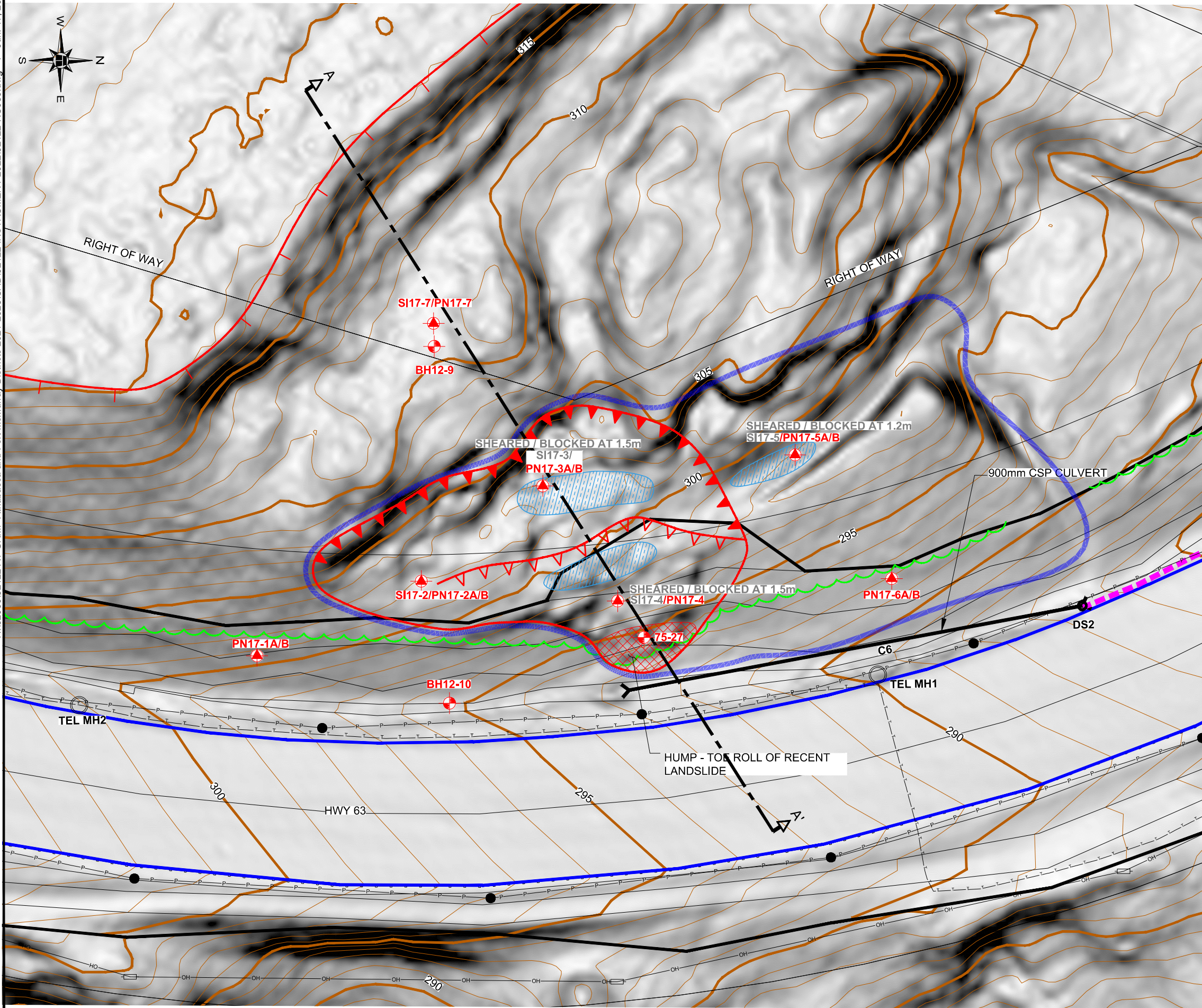
PNEUMATIC PIEZOMETER (PN) READINGS

PN #	Serial	GPS Location (UTM 12)		Location	Date	Reading (kPa)	Comments
		Northing	Easting				
PN17-1A	37677	6284070	478515		03-Jun-22	23.8	
PN17-1B	37659	6284070	478515		03-Jun-22	33.9	
PN17-2A	37666	6284103	478503	Attached to SI17-2	03-Jun-22	62.2	
PN17-2B	37494	6284103	478503	Attached to SI17-2	03-Jun-22	1.5	
PN17-3A	37665	6284125	478484	Attached to SI17-3	03-Jun-22	22.6	**
PN17-3B	37495	6284125	478484	Attached to SI17-3	03-Jun-22	48.4	**
PN17-4	37674	6284139	478507	Attached to SI17-4	03-Jun-22	46.6	*
PN17-5A	37667	6284177	478476	Attached to SI17-5	03-Jun-22	0.2	
PN17-5B	37660	6284177	478476	Attached to SI17-5	03-Jun-22	48.4	
PN17-6A	37664	6284194	478502		03-Jun-22	32.5	
PN17-6B	37493	6284194	478502		03-Jun-22	0.6	
PN17-7A	37675	6284102	478453	Attached to SI17-7	03-Jun-22	20.5	
PN17-7B	37477	6284102	478453	Attached to SI17-7	03-Jun-22	1.1	
PN17-7C	37661	6284102	478453	Attached to SI12-7	03-Jun-22	50.9	

INSPECTOR REPORT

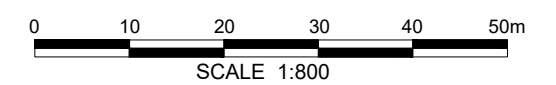
* Clear SI17-4, Water seepage and running down the slope.

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- LEGEND**
- APPROXIMATE LOCATION OF SLOPE INCLINOMETER (SI) / PNEUMATIC PIEZOMETER (PN)
 - APPROXIMATE LOCATION OF PREVIOUS TEST HOLE
 - HEADSCARP CRACK
 - TENSION CRACK
 - APPROXIMATE BOUNDARY OF ANCIENT LANDSLIDE BLOCK
 - APPROXIMATE BOUNDARY OF RECENT ACTIVE LANDSLIDE
 - APPROXIMATE VALLEY CREST
 - TREE LINE
 - GUARDRAIL
 - OVERHEAD POWER LINE
 - UNDERGROUND POWER LINE
 - UNDERGROUND TELUS CABLE
 - LIGHT STAND
 - TELUS MANHOLE
 - POWER POLE
 - DROP STRUCTURE (DS#)
 - STANDING WATER

- NOTES:**
1. LIMITED SURVEY IN THE VICINITY OF THE HIGHWAY WAS CONDUCTED ON AUGUST 30, 2017 BY WSP.
 2. LIDAR, AS RECENT AS 2016, USED TO AUGMENT WSP SURVEY DATA.



Alberta

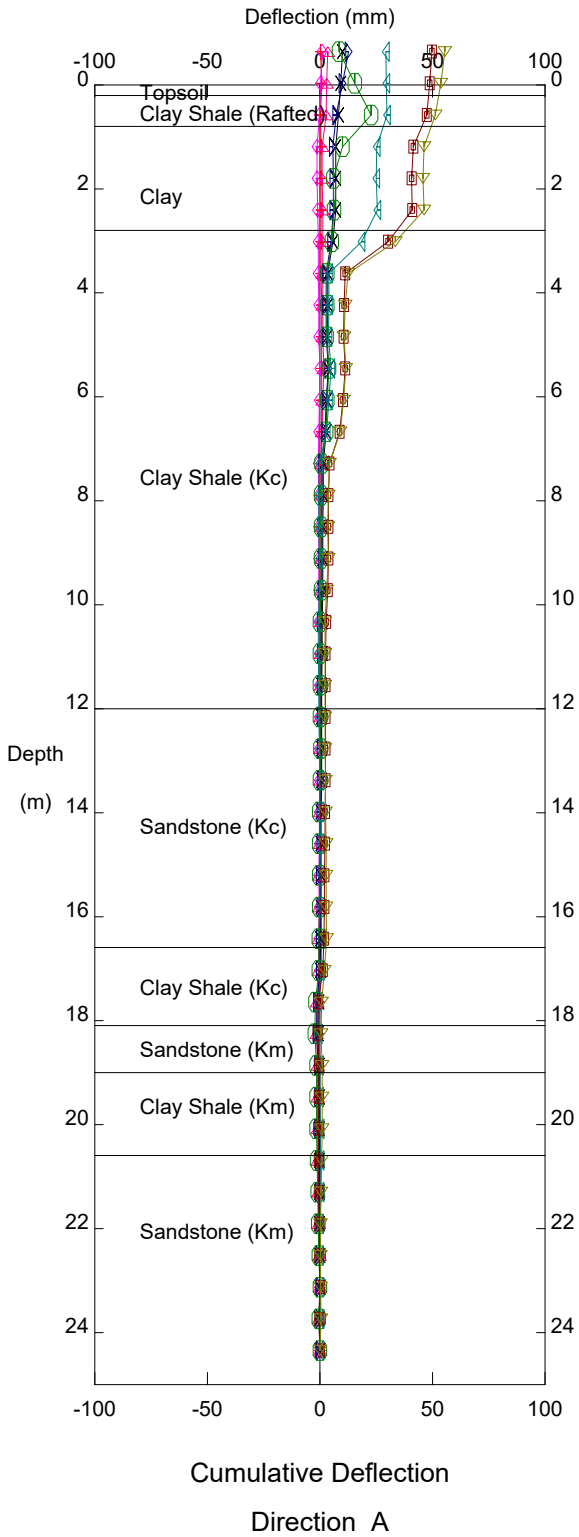
**NORTH CENTRAL
(ATHABASCA AND FORT McMURRAY DISTRICTS)
NC089: HWY 63:11 BEACON HILL
BACKSLOPE SLIDE (km 8.7)
SITE PLAN SHOWING INSTRUMENT LOCATIONS**

DWG No. 32122-NC089

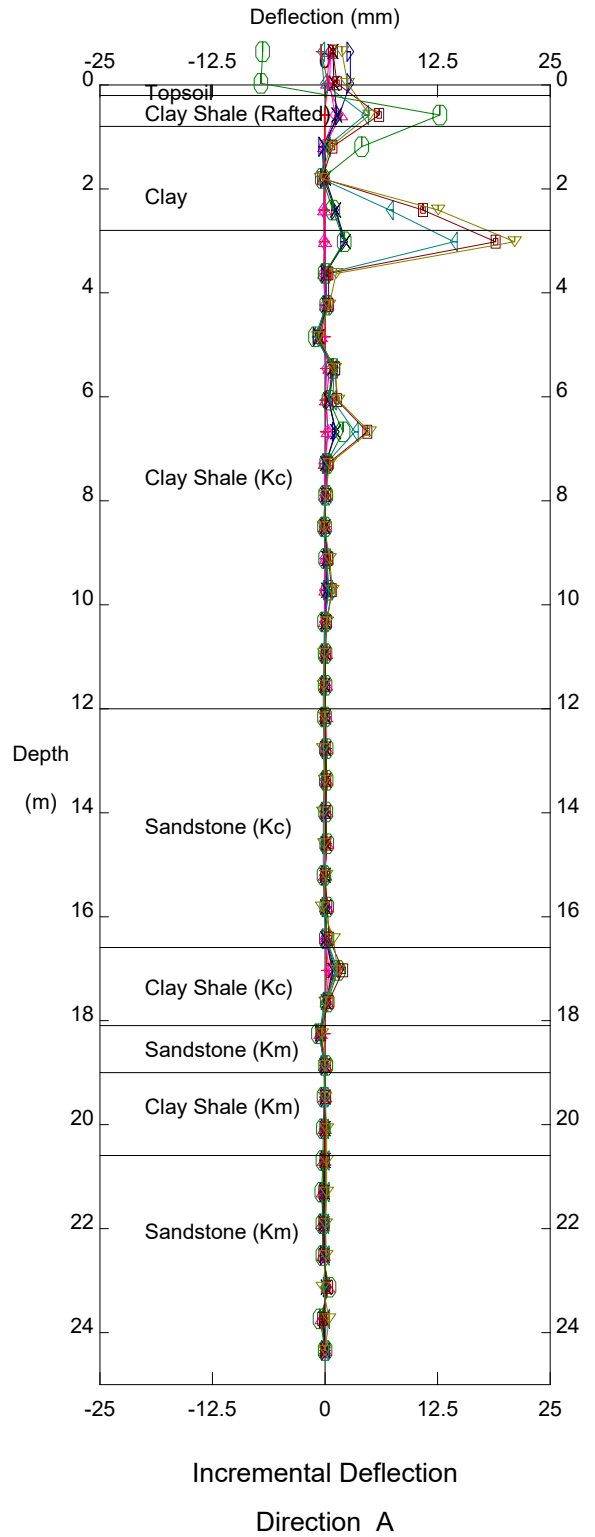
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DESIGNED BY	BWN
APPROVED BY	TSA
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DATE	JUNE 2022
FILE No.	32122

THURBER ENGINEERING LTD.

Thurber Engineering Ltd



Ref. Elevation 301.70 m

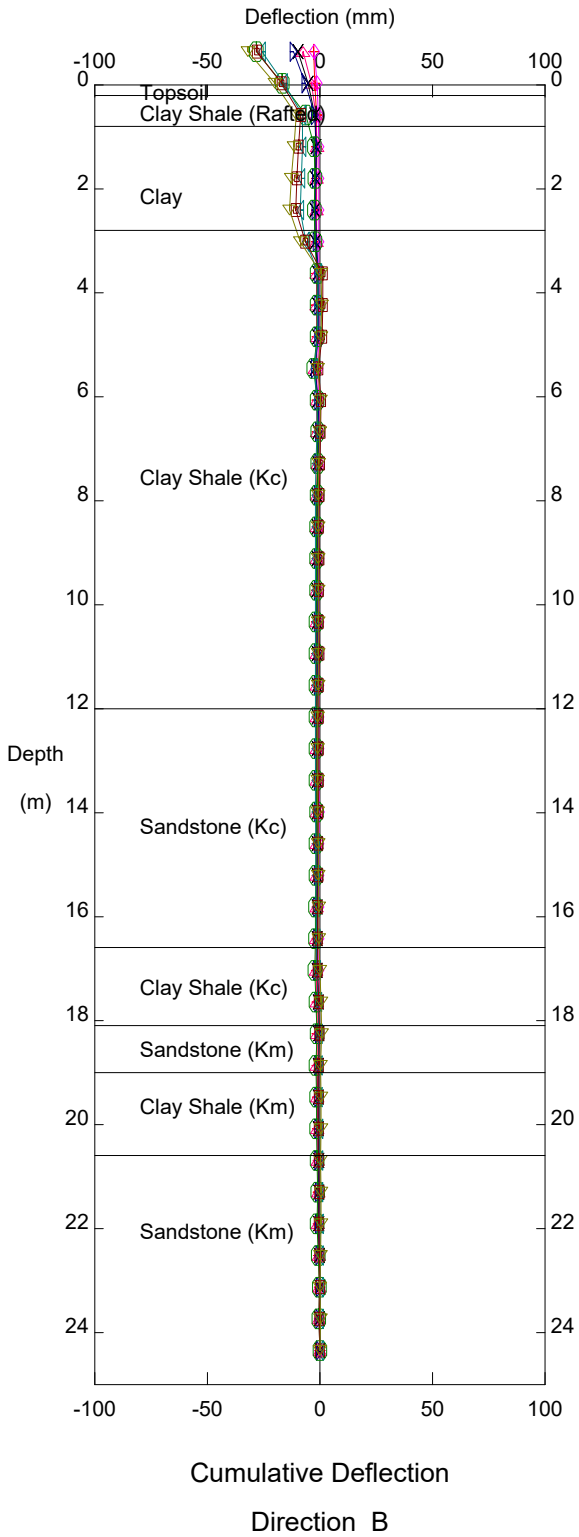


NC089 - Beacon Hill Backslope Slide, Inclinometer SI17-2

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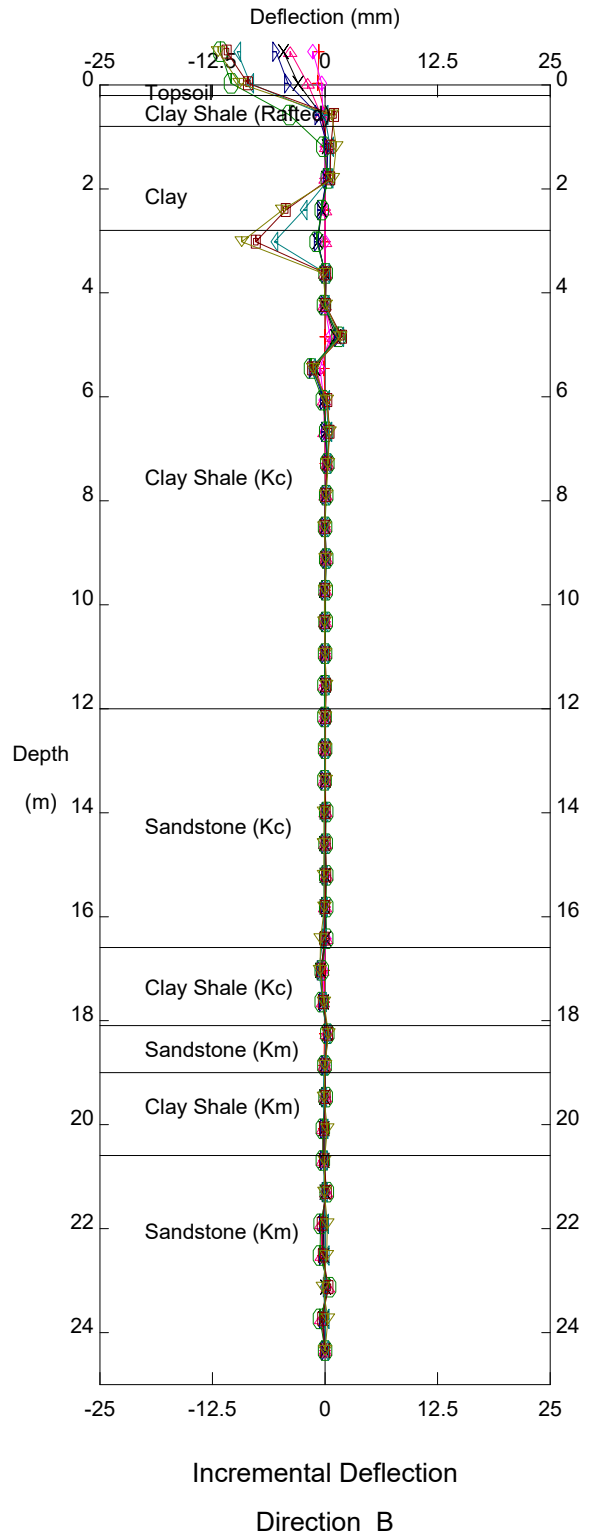
Sets marked * include zero shift and/or rotation corrections.

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- LEGEND
- Initial 18 Sep 2017
 - 18 Oct 2017
 - 21 Feb 2018
 - 29 May 2018
 - 17 Sep 2018
 - 16 Jun 2019
 - 28 May 2020*
 - 25 Sep 2020*
 - 28 Jun 2021*
 - 3 Jun 2022*

Ref. Elevation 301.70 m

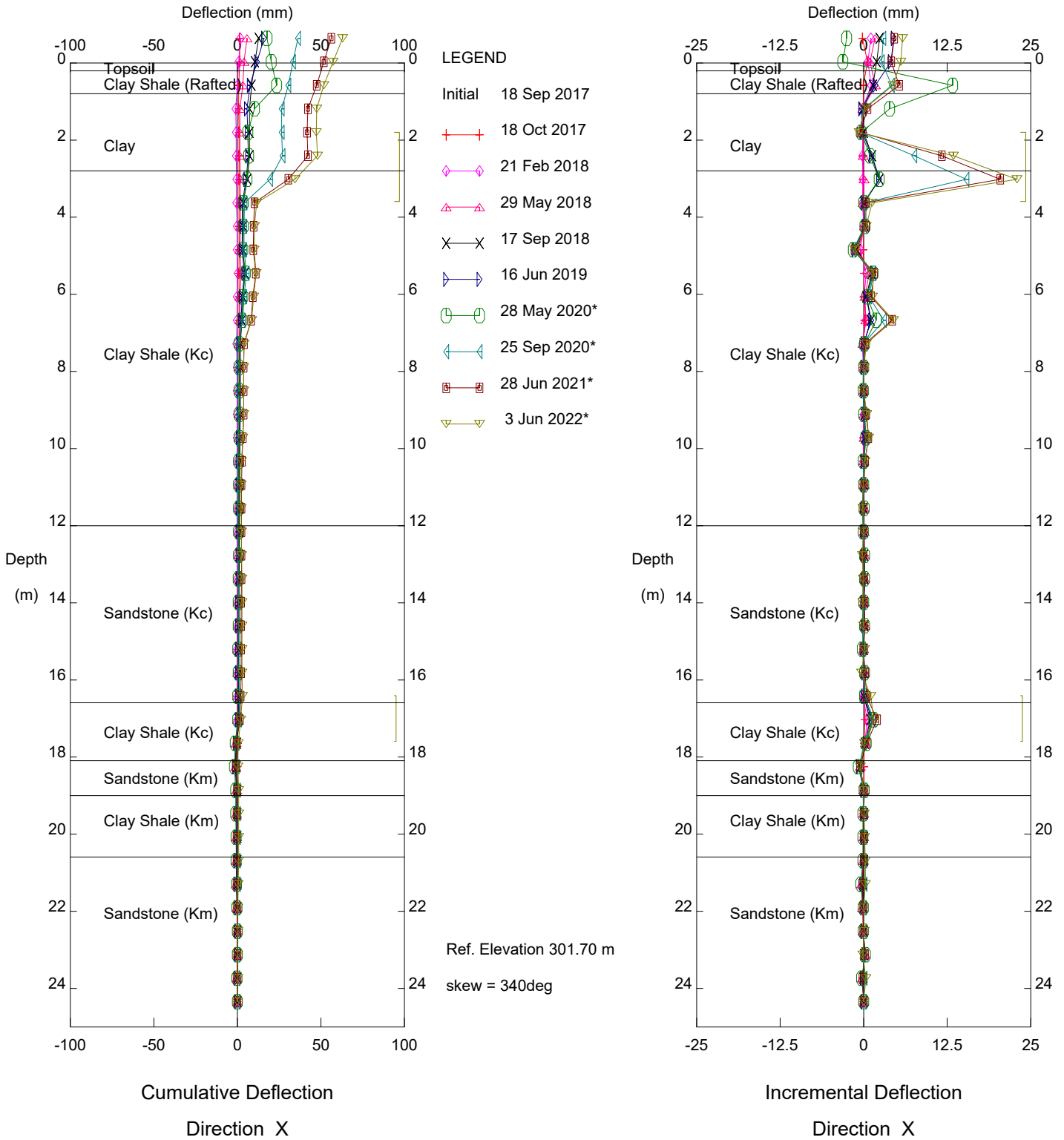


NC089 - Beacon Hill Backslope Slide, Inclinometer SI17-2

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Sets marked * include zero shift and/or rotation corrections.

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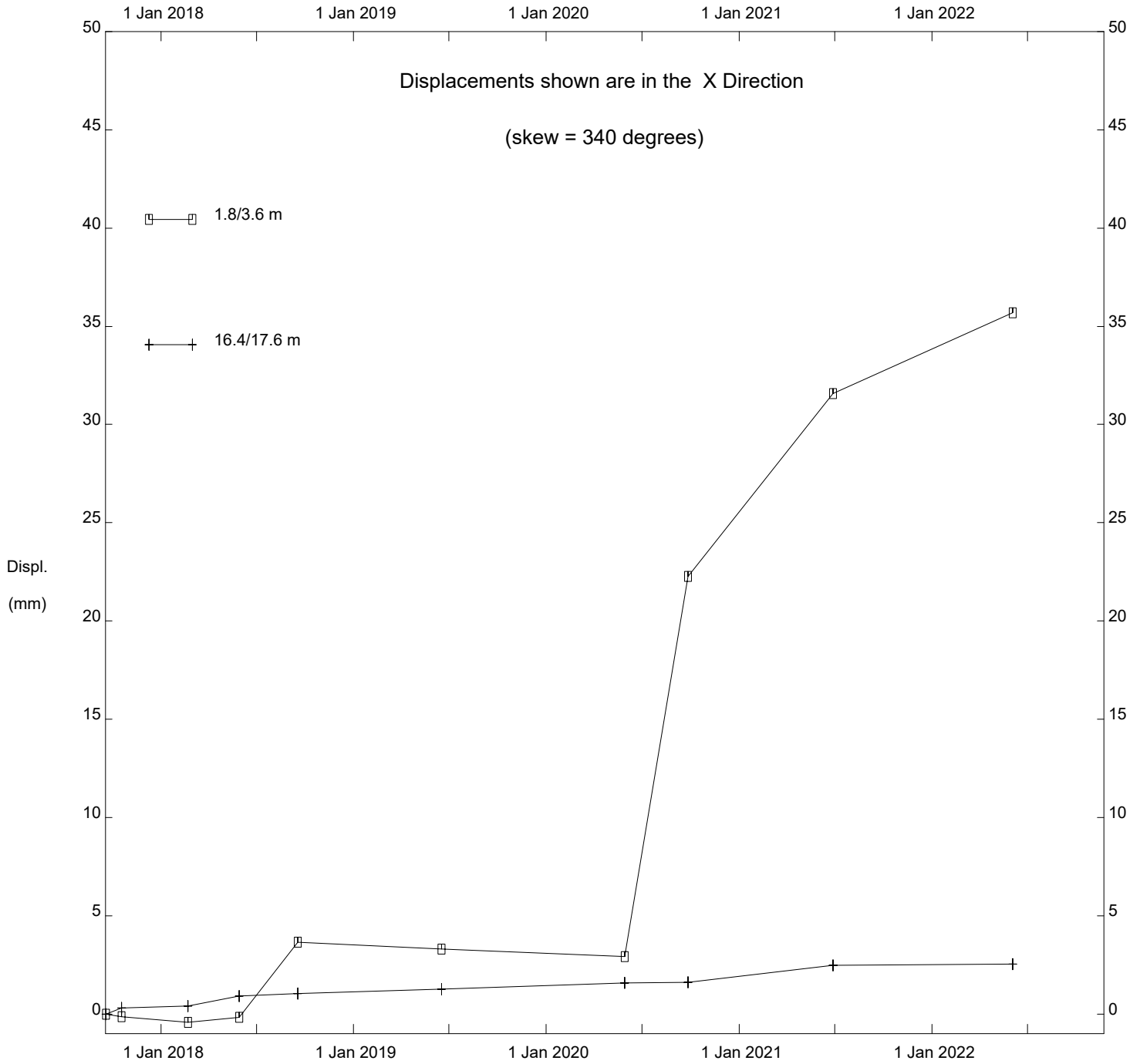


NC089 - Beacon Hill Backslope Slide, Inclinometer SI17-2

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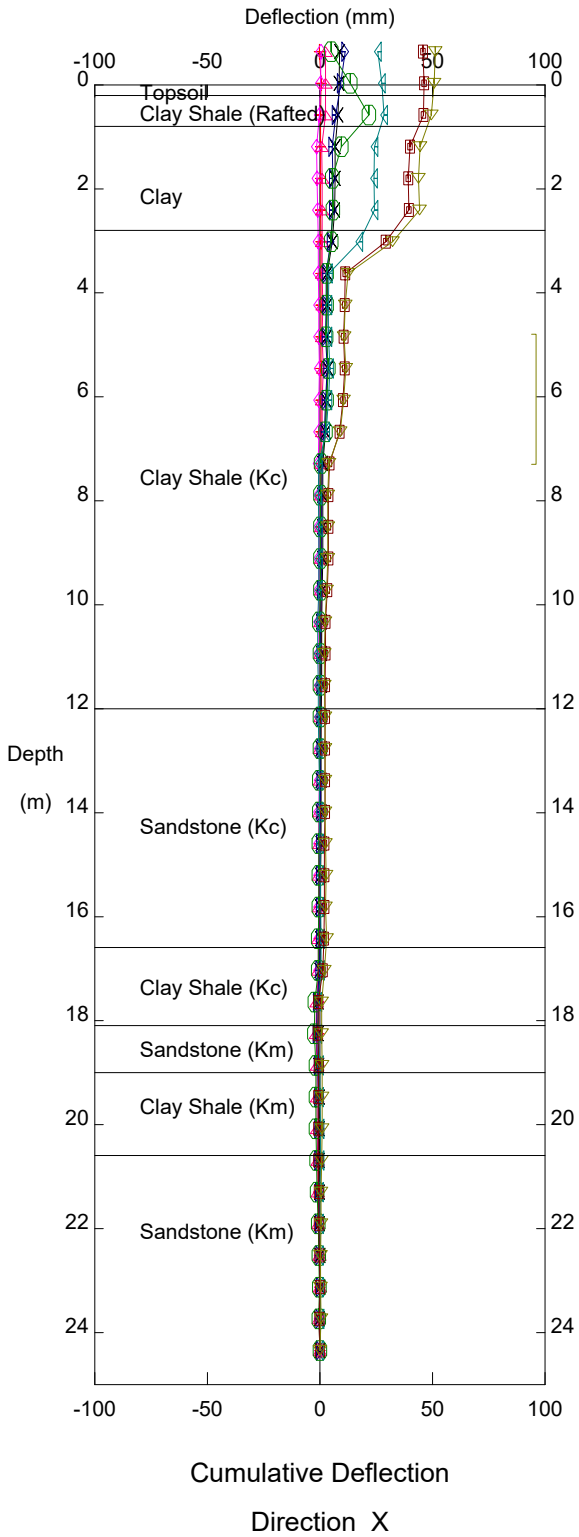
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NC089 - Beacon Hill Backslope Slide, Inclinator SI17-2

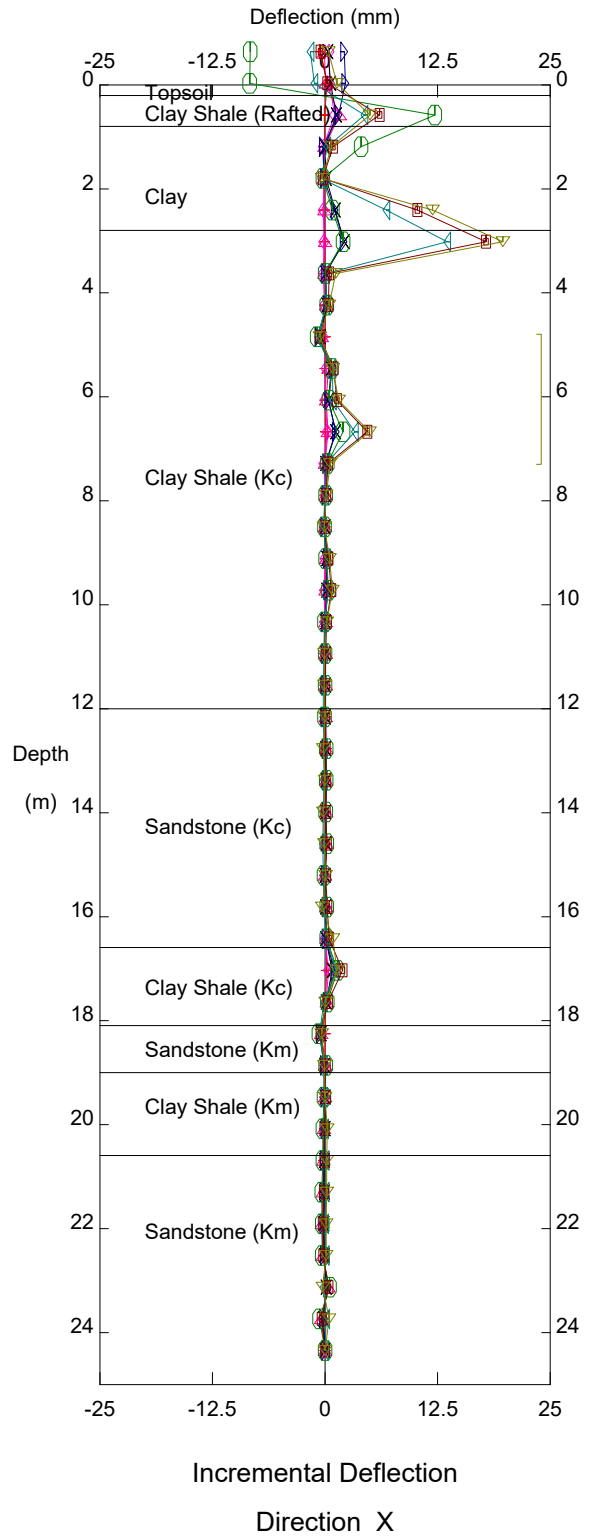
Alberta Transportation

Thurber Engineering Ltd



- LEGEND
- Initial 18 Sep 2017
 - 18 Oct 2017
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 - 28 May 2020*
 - 25 Sep 2020*
 - 28 Jun 2021*
 - 3 Jun 2022*

Ref. Elevation 301.70 m
skew = 7deg

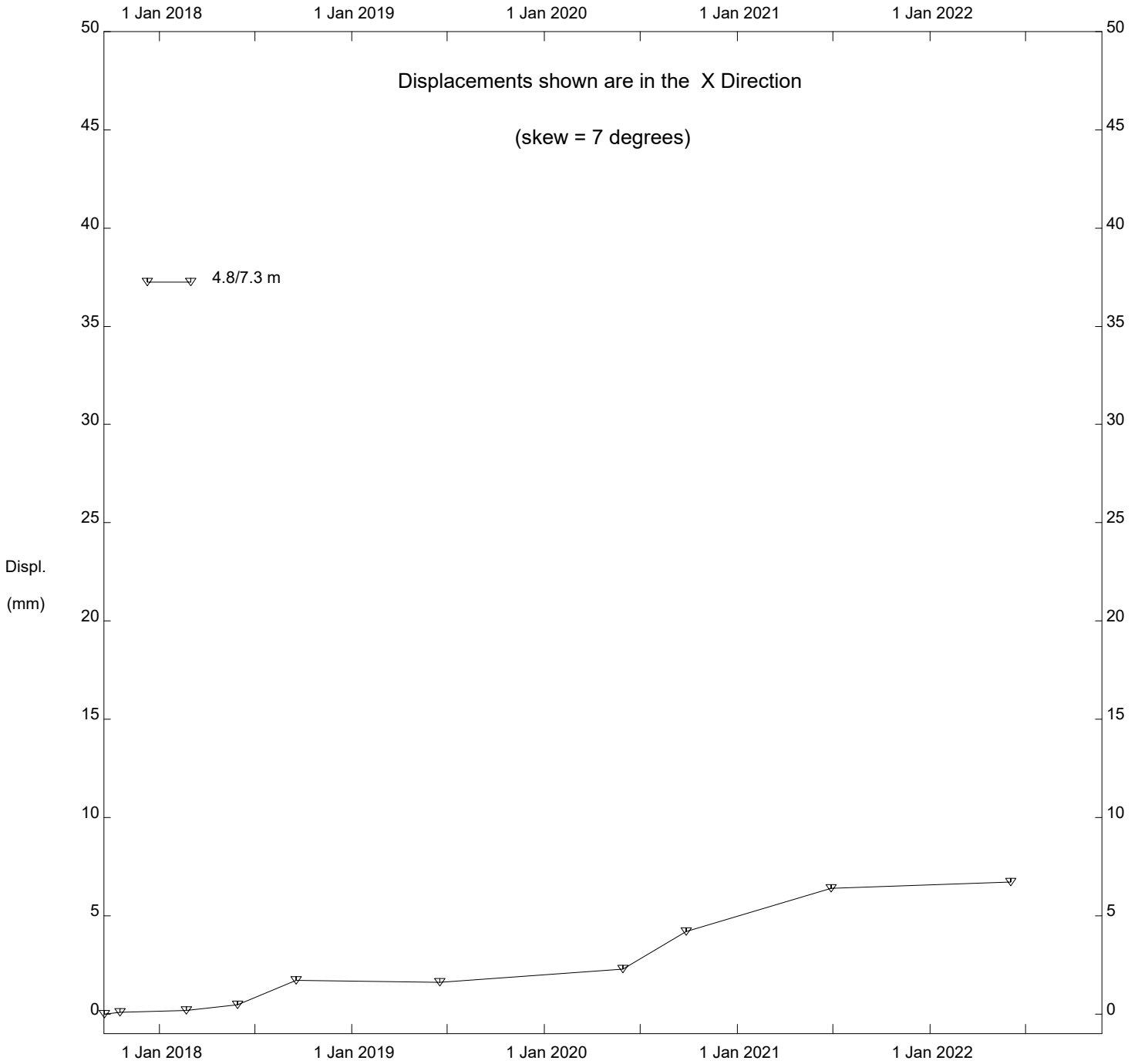


NC089 - Beacon Hill Backslope Slide, Inclinometer SI17-2

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Sets marked * include zero shift and/or rotation corrections.

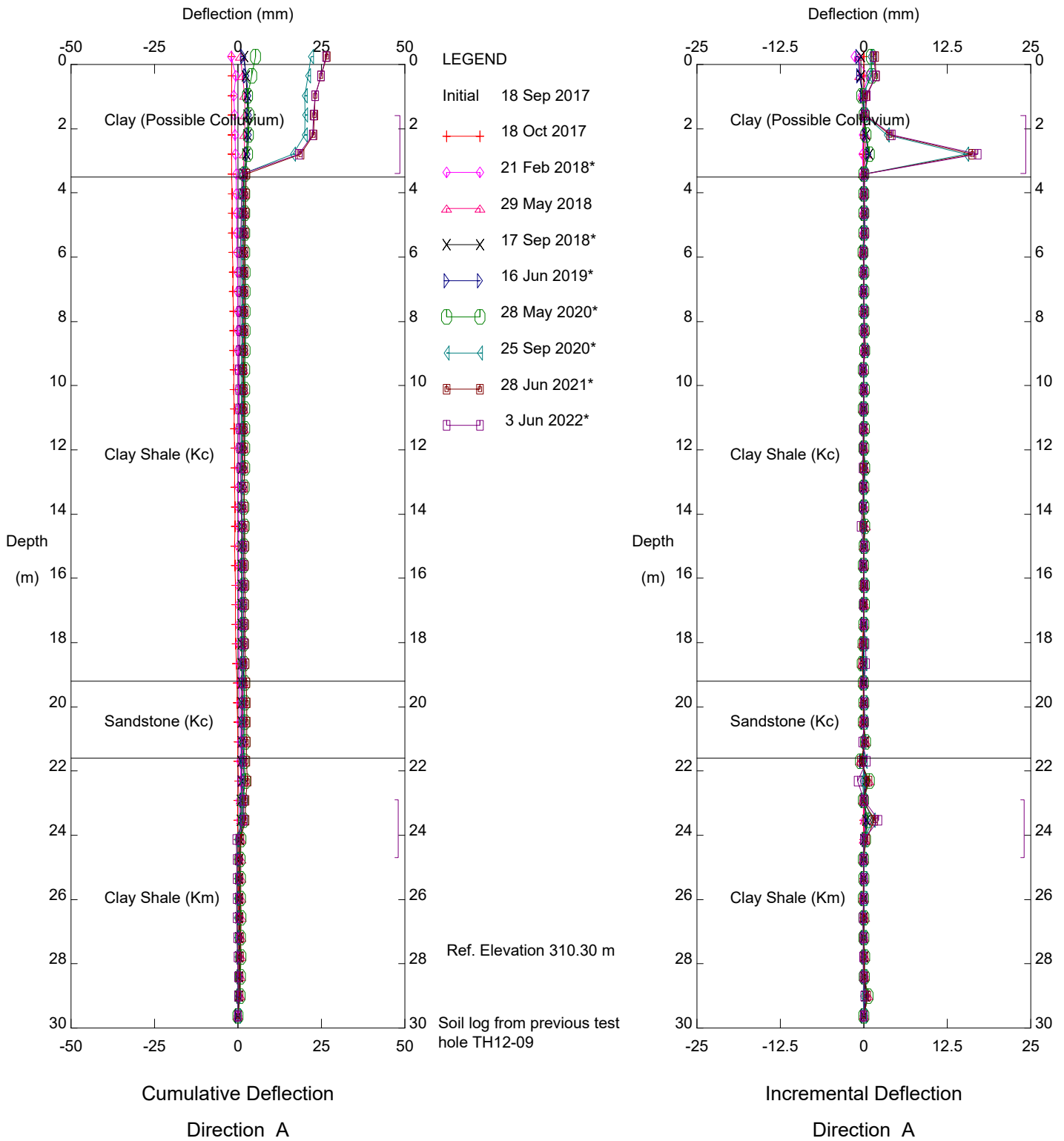
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NC089 - Beacon Hill Backslope Slide, Inclinometer SI17-2

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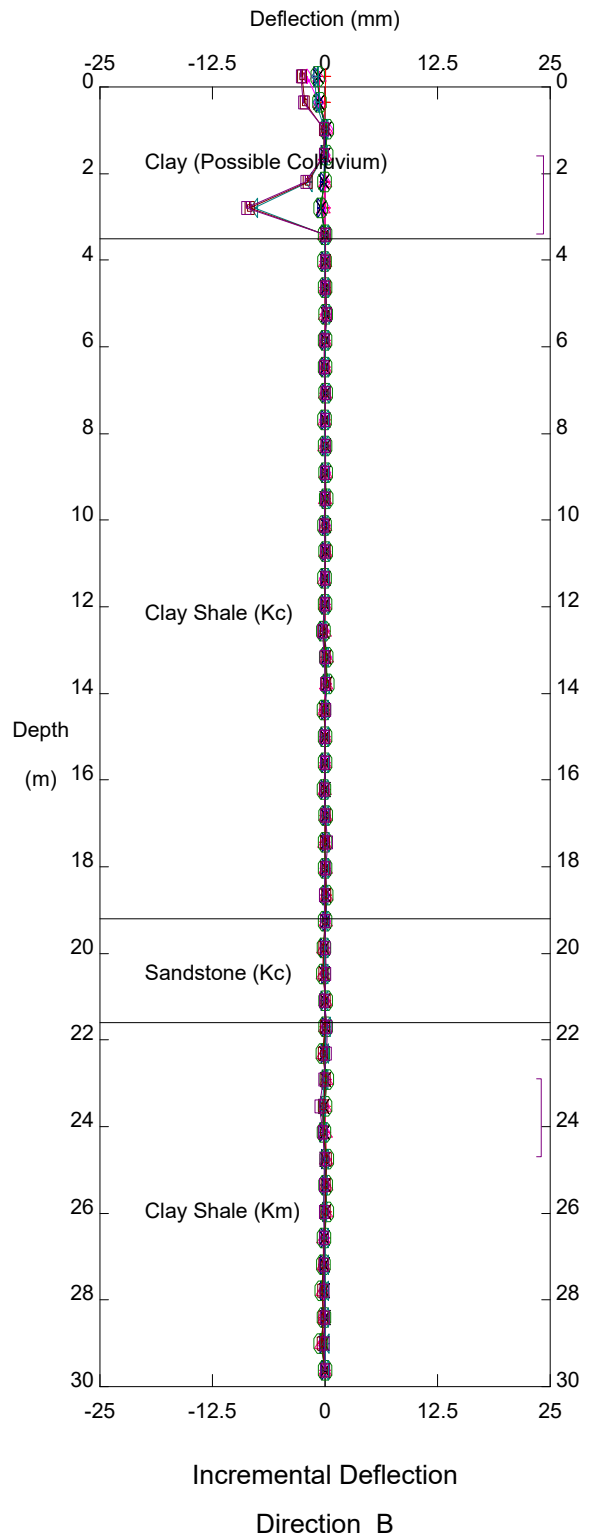
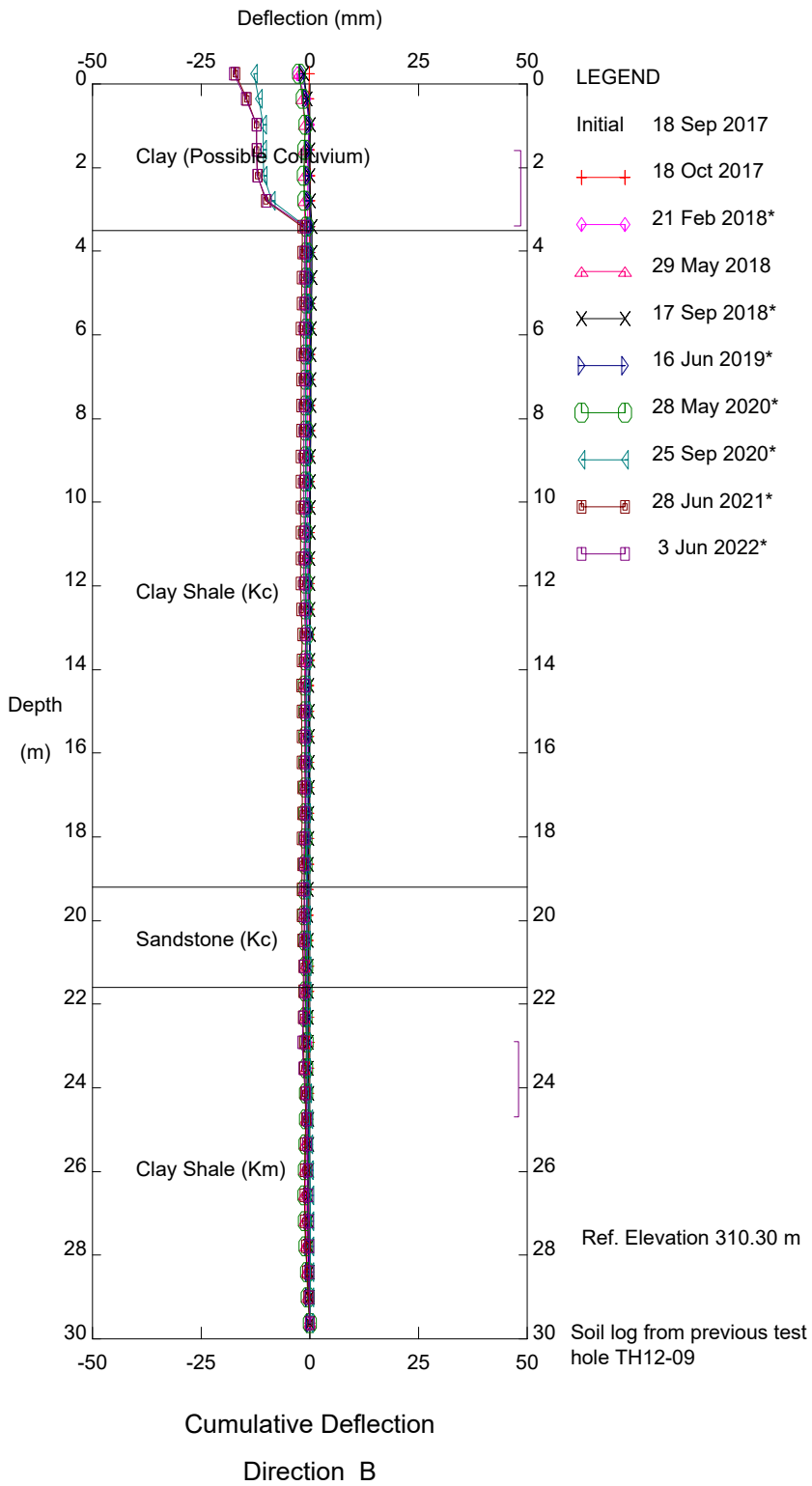


NC089 - Beacon Hill Backslope Slide, Inclinometer SI17-7

Alberta Transportation

Sets marked * include zero shift and/or rotation corrections.

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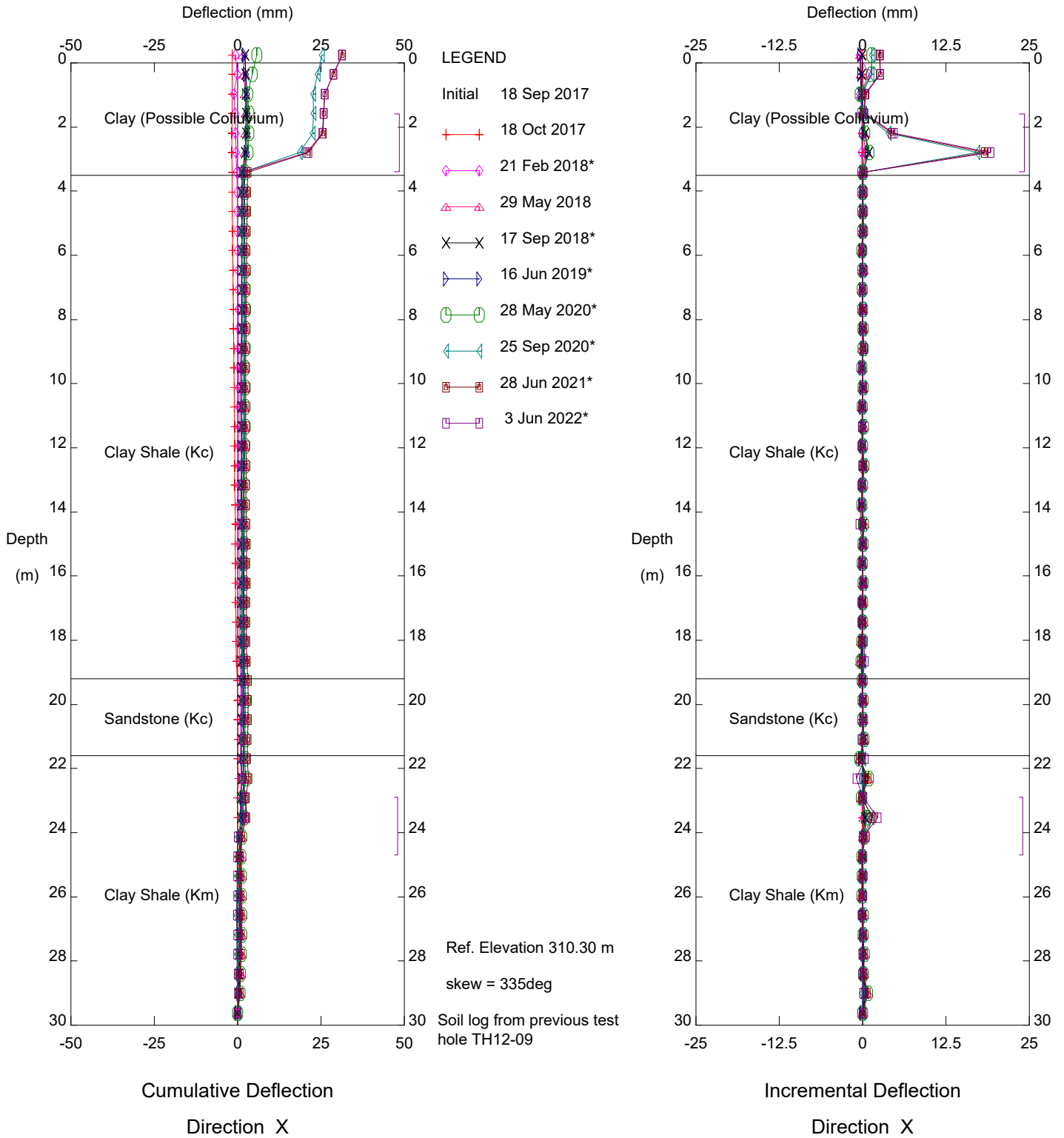


NC089 - Beacon Hill Backslope Slide, Inclinometer SI17-7

Alberta Transportation

Sets marked * include zero shift and/or rotation corrections.

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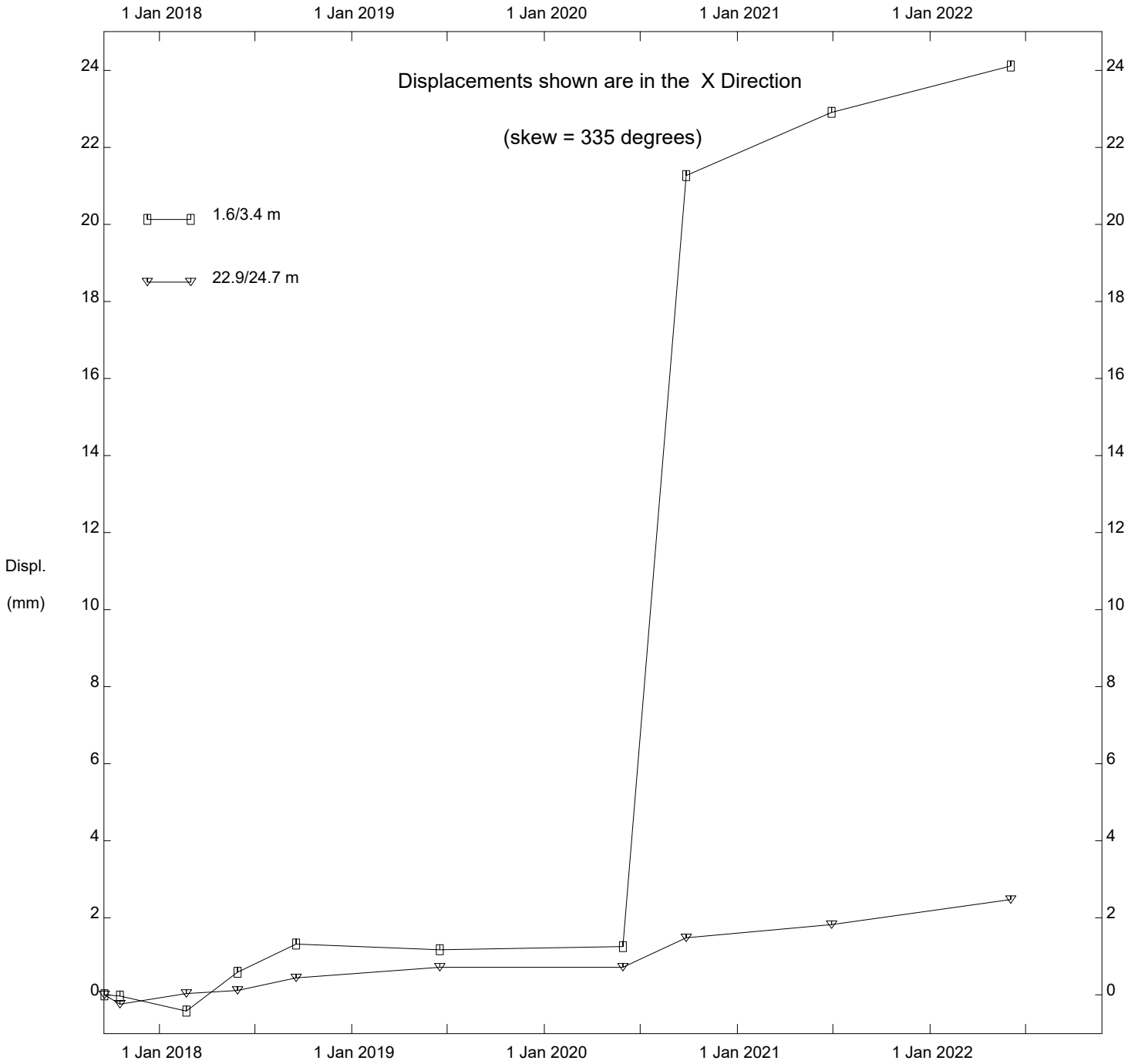


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**FIGURE NC089-1
PIEZOMETER DATA FOR HWY 63:12 BEACON HILL**

