THURBER ENGINEERING LTD.

November 16, 2022 File No.: 32121

Alberta Transportation
Provincial Building
9621-96 Avenue
Peace River, Alberta
T8S 1T4

Attention: Mr. Max Shannon

ALBERTA TRANSPORTATION GRMP (CON0022164)
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING RESULTS – FALL 2022

SECTION C

SITE PH030: HWY 744:04, JUDAH HILL (LOOKOUT SLIDE)

Dear Mr. Shannon:

This report provides the results of the bi-annual geotechnical instrumentation monitoring for the above-mentioned site as part of Alberta Transportation's Geohazard Risk Management Program for Peace Region – Peace River District (CON0022164).

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 (SI10-1 and SI10-2) and two pneumatic piezometers (PN10-1 and PN10-2) were read at the Hwy 744:04 Judah Hill Lookout Slide site on September 28, 2022 by Mr. Niraj Regmi, G.I.T. and Mr. Kyle Crooymans, both of Thurber Engineering Ltd.

The SIs were read using two RST Digital Inclinometer probes with 2 ft. wheelbases and RST Pocket PC readouts. Inclinometer reading depths were defined as per cable markings with respect to the top of the inclinometer casing. The pneumatic piezometers were read using a RST C108 pneumatic piezometer readout.

2. DATA PRESENTATION

2.1 General

SI plots for A and B directions are presented in Appendix A and are summarized below. Where movement has been recorded, the resultant plot (X direction, if applicable) and rate of movement have also been provided. SI and piezometer readings summary tables are presented below. These tables also include instruments deleted from the current GRMP program, for future reference.

2.2 Zones of Movement

No zones of new movement were observed in the SIs since the last set of readings in the spring of 2022.

Zones of movement are summarized in Table PH030-1 below. This table also provides a historical account of the total movement, the depth of movement and the maximum rate of movement that has occurred at this site since the initialization of the slope inclinometers.

THURBER

TABLE PH030-1
FALL 2022 – HWY 744:04 JUDAH HILL (LOOKOUT SLIDE)
SLOPE INCLINOMTER INSTRUMENTATION READING SUMMARY

Date Monitored: September 28, 2022

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AT NOTED DEPTH SINCE INITIAL READING (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS	DATE OF PREVIOUS READING	INCREMENTAL MOVEMENT SINCE PREVIOUS READING (mm)	RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI10-1	March 26, 2010	12.2 mm over 1.4 m to 6.3 m depth in 271° direction	5.8 mm/yr in September 2018	Operational	June 11, 2022	0.6	2.0	-0.4
		1.4 mm over 14.2 m to 15.4 m depth in 251° direction	0.9 mm/yr in September 2013			No discernible movement	N/A	-0.3
SI10-2	March 26, 2010	17.0 mm over 0.4 m to 4.1 m depth in 291° direction	11.1 mm/yr in June 2017	Operational	June 11, 2022	No discernible movement	N/A	-2.3
		26.2 mm over 4.1 m to 8.3 m depth in 291° direction	4.5 mm/yr In May 2010			1.3	4.4	0.7
SI10-3	*March 26, 2010*	*147.9 mm over 2.5 m to 5.6 m depth in 241° direction*	*264 mm/yr in June 2015*	*Sheared at 2.8 mBGS in August 2015*	*August 13, 2015*	*N/A*	*N/A*	*N/A*
		13.7 mm over 5.6 m to 8.0 m depth in 241° direction	*59.9 mm/yr in July 2015*			*N/A*	*N/A*	*N/A*
		5.8 mm over 8.0 m to 10.5 m depth in 241° direction	*32.2 mm/yr in July 2015*			*N/A*	*N/A*	*N/A*
		167.4 mm over 2.5 m to 10.5 m depth in 241° direction	*250.1 mm/yr in August 2015*			*N/A*	*N/A*	*N/A*

Drawing 32121-PH030 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

THURBER

TABLE PH030-2
FALL 2022 – HWY 744:04 JUDAH HILL (LOOKOUT SLIDE)
PNEUMATIC PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: September 28, 2022

INSTRUMENT #	DATE INITIALIZED	TIP ELEV. (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED WATER ELEVATION (m)	MEASURED PORE PRESSURE (kPa)	CURRENT WATER ELEVATION (m)	PREVIOUS WATER ELEVATION (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN10-1 (33093)	March 26, 2010	523.72	N/A	Operational	525.62 on June 3, 2016	3.1	524.04	524.09	-0.05
PN10-2 (33095)	March 26, 2010	520.71	N/A	Operational	520.88 on June 13, 2018	0.4	520.75	520.76	-0.01
PN10-3 (33096)	*March 26, 2010*	*516.82*	*N/A*	*Destroyed*	*518.37 on July 4, 2015*	*N/A*	*N/A*	*N/A*	*N/A*

Drawing 32121-PH030 in Appendix A provides a sketch of the approximate locations of the monitoring instrumentation for this site.

Notes:
PN - pneumatic piezometer.
BGS - below ground surface.

3. INTERPRETATION OF MONITORING RESULTS

The highway at the Lookout Slide location was realigned after the fall of 2015 readings due to a landslide near SI10-13 affecting the southbound lane. As a result of the work, slope inclinometers SI10-1 and SI10-2 were each shortened by 1.2 m. Zones of movement in Table PH030-1 were adjusted to reflect the change in length of the SIs.

SI10-1 showed a rate of movement of 2.0 mm/yr over 1.4 m to 6.3 m depth and no discernible movement over 14.2 m to 15.4 m depth since the spring of 2022 readings. SI10-2 showed no discernible movement over 0.4 m to 4.1 m depth and a rate of movement of 4.4 mm/yr over 4.1 m to 8.3 m depth since the spring of 2022 readings.

Pneumatic piezometers PN10-1 and PN10-2 showed decreases in groundwater levels of 0.05 m and 0.01 m, respectively, compared to the spring of 2022 readings. The groundwater level measured in PN10-1 during the spring of 2022 reading is the lowest measured in the instrument since September 2011. Table PH030-2 summarizes the pneumatic piezometer readings. Pneumatic piezometer readings are also plotted in Figures PH030-1 (by elevation) and PH030-2 (by depth) in Appendix A.

4. RECOMMENDATIONS

4.1 Future Work

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

4.2 Instrumentation Repairs

No instrument repairs are required at this time.

THURBER

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

PROFESSIONAL ENGINEER ALBERTA
BRUCE W. NESTOR
ID 161284

November 21, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 51674
DATE: November 21, 2022
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

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.32121-PH030)
  - SI Reading Plots
  - Figure PH030-1 (Piezometric Elevations)
  - Figure PH030-2 (Piezometric Depths)

THURBER

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.

THURBER

ALBERTA TRANSPORTATION GRMP (CON0022164)
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING RESULTS

FALL 2022

APPENDIX A
DATA PRESENTATION

SITE PH030: HWY 744:04, JUDAH HILL (LOOKOUT SLIDE)

ALBERTA TRANSPORTATION
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (PH030)
FALL 2022

Location:	Lookout Slide - Judah Hill (HWY 744:04 C1 57.430)	**Readout:**	RST PN C208 Unit 1
File Number:	32121	**Casing:**	2.75
Probe:	RST SI SET 8R	**Temp:**	7
Cable:	RST SI SET 8R	**Read by:**	NKR/KTC

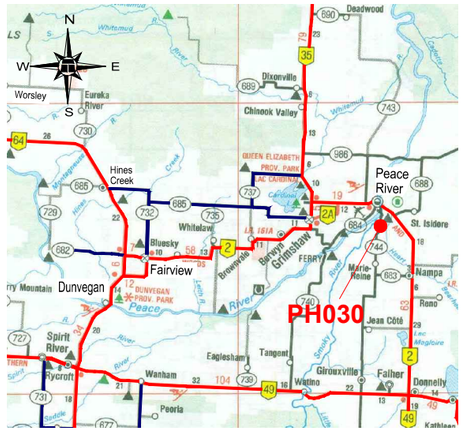
SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location (UTM 11)		Date	Stickup (m)	Depth from top of casing (ft)	Azimuth of A+ Groove	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Easting (m)	Northing (m)					A+	A-	B+	B-		
SI10-1	483185.00	6229488.00	28-Sep-22	0.75	100 to 4	260	-500	513	-298	310	8R/8R	
SI10-2	483176.58	6229515.56	28-Sep-22	1.1	102 to 4	260	-232	243	-1361	1343	5R/5R	

PNEUMATIC PIEZOMETER READINGS

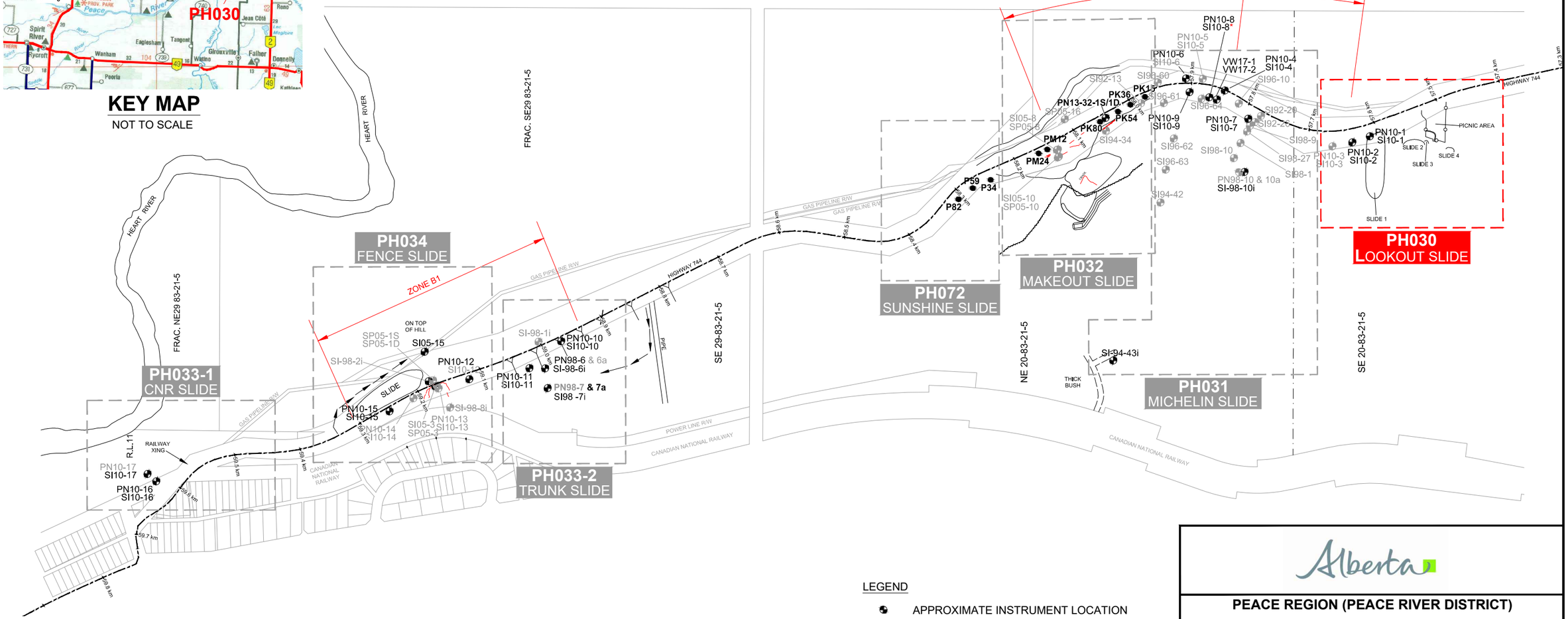
PN#	GPS Location (UTM 11)		Date	Reading (kPa)	Identification Number
	Easting (m)	Northing (m)			
10-1	483185.00	6229488.00	28-Sep-22	3.1	33093
10-2	483176.58	6229515.56	28-Sep-22	0.4	33095

INSPECTOR REPORT



KEY MAP

NOT TO SCALE



LEGEND

- APPROXIMATE INSTRUMENT LOCATION
- INSTRUMENT NOT IN USE
- PN PNEUMATIC PIEZOMETER
- SP STANDPIPE PIEZOMETER
- SI SLOPE INCLINOMETER
- VW VIBRATING WIRE PIEZOMETER
- APPROXIMATE PILE LOCATION

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

PH030: HWY 744:04 - JUDAH HILL
(LOOKOUT SLIDE)
INSTRUMENT LOCATIONS

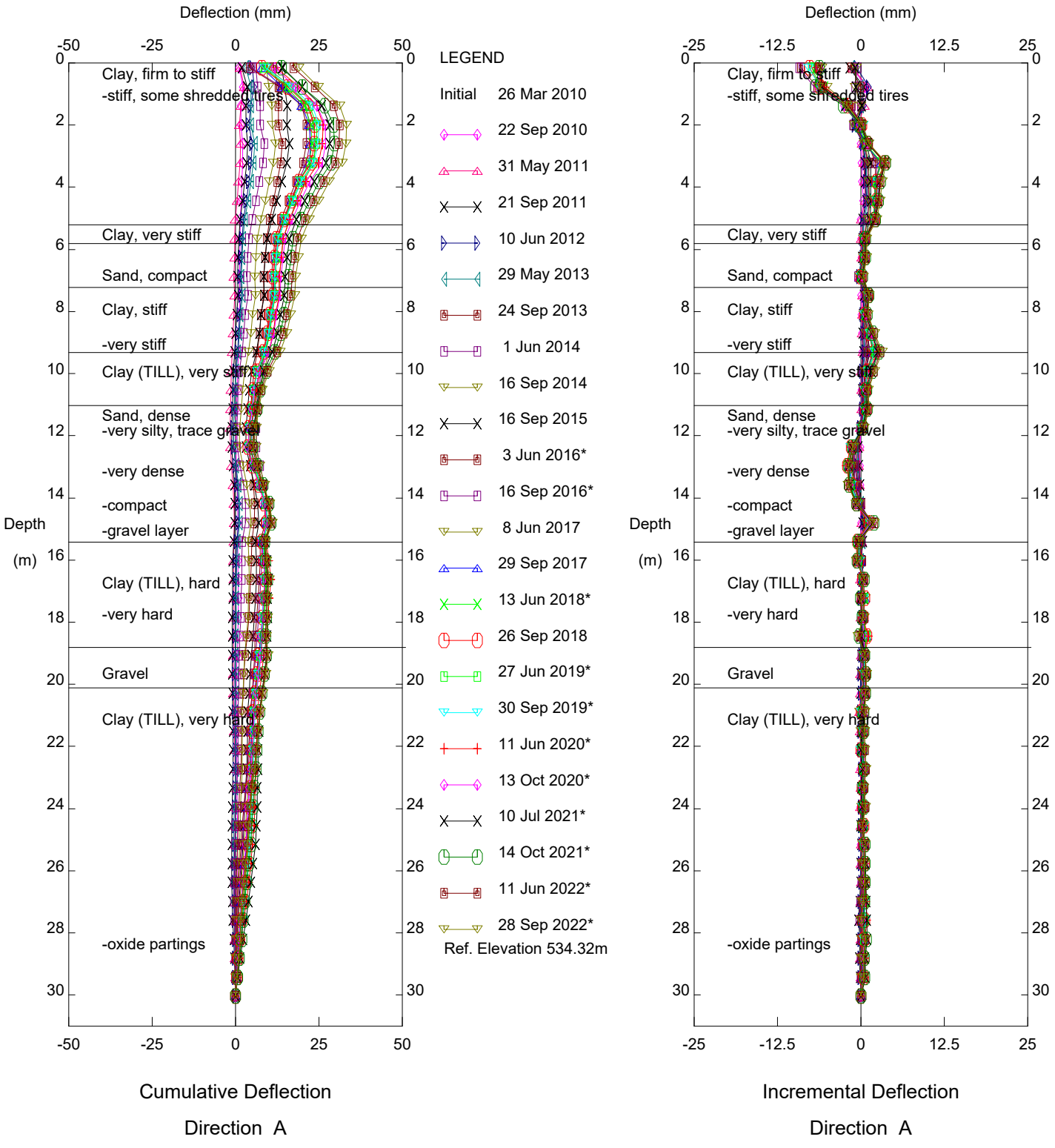
DWG No. 32121-PH030-1

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	DWP
SCALE	APPROX. 1:6000
DATE	SEPTEMBER 2021
FILE No.	32121

THURBER ENGINEERING LTD.

H:\32000\32121 AT GRMP Peace River District 2021-2025\CAD\2021 INSTRUMENT\32121-PH030, PH031, PH032, PH033, PH034, PH072.dwg - 30 - Sep. 08, 2021

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

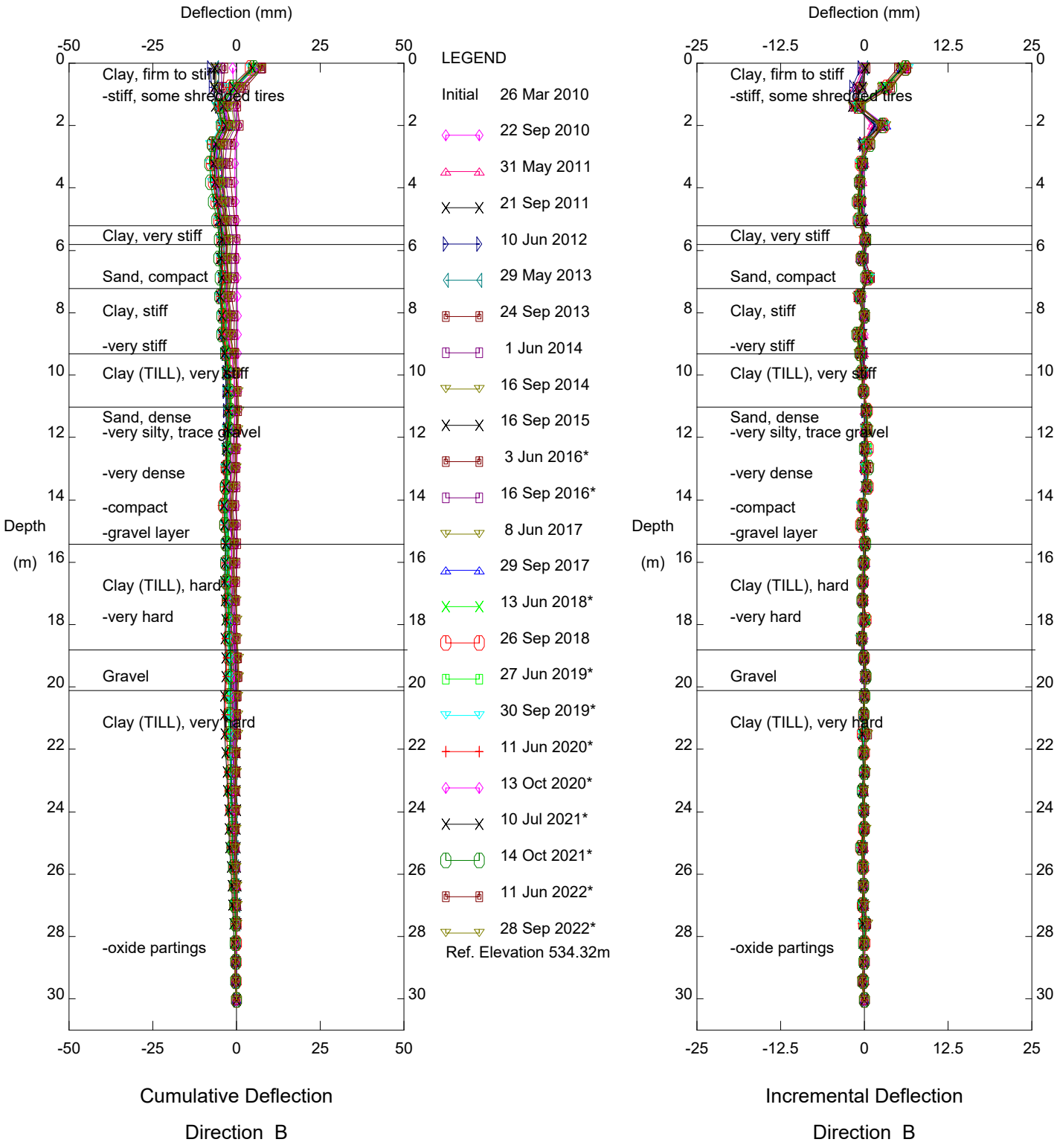
Judah Hill PH030, Inclinometer SI10-1

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022B-Fall\SI Readings\PH030\SI10-1.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

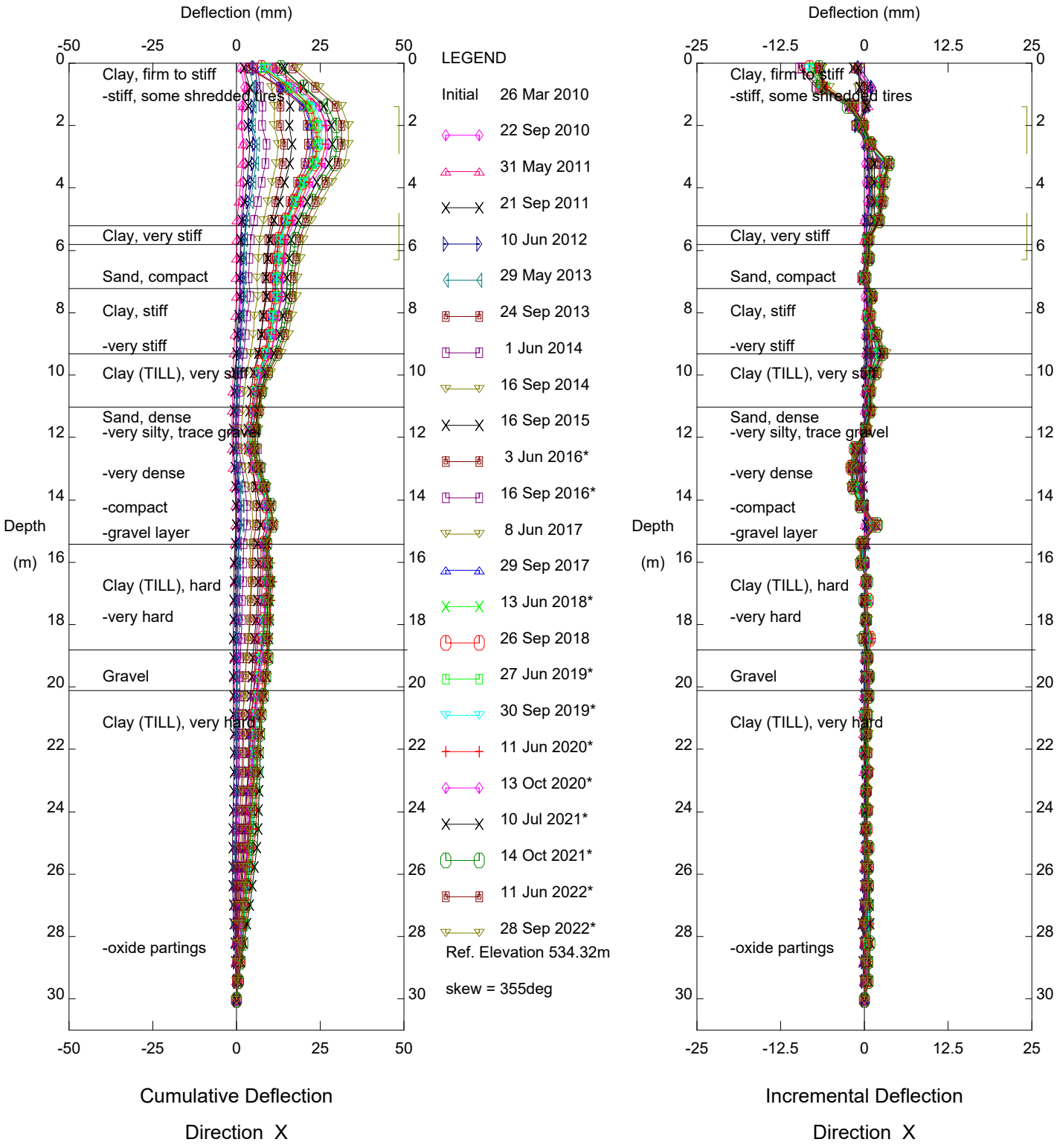
Judah Hill PH030, Inclinometer SI10-1

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022B-Fall\SI Readings\PH030\SI10-1.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

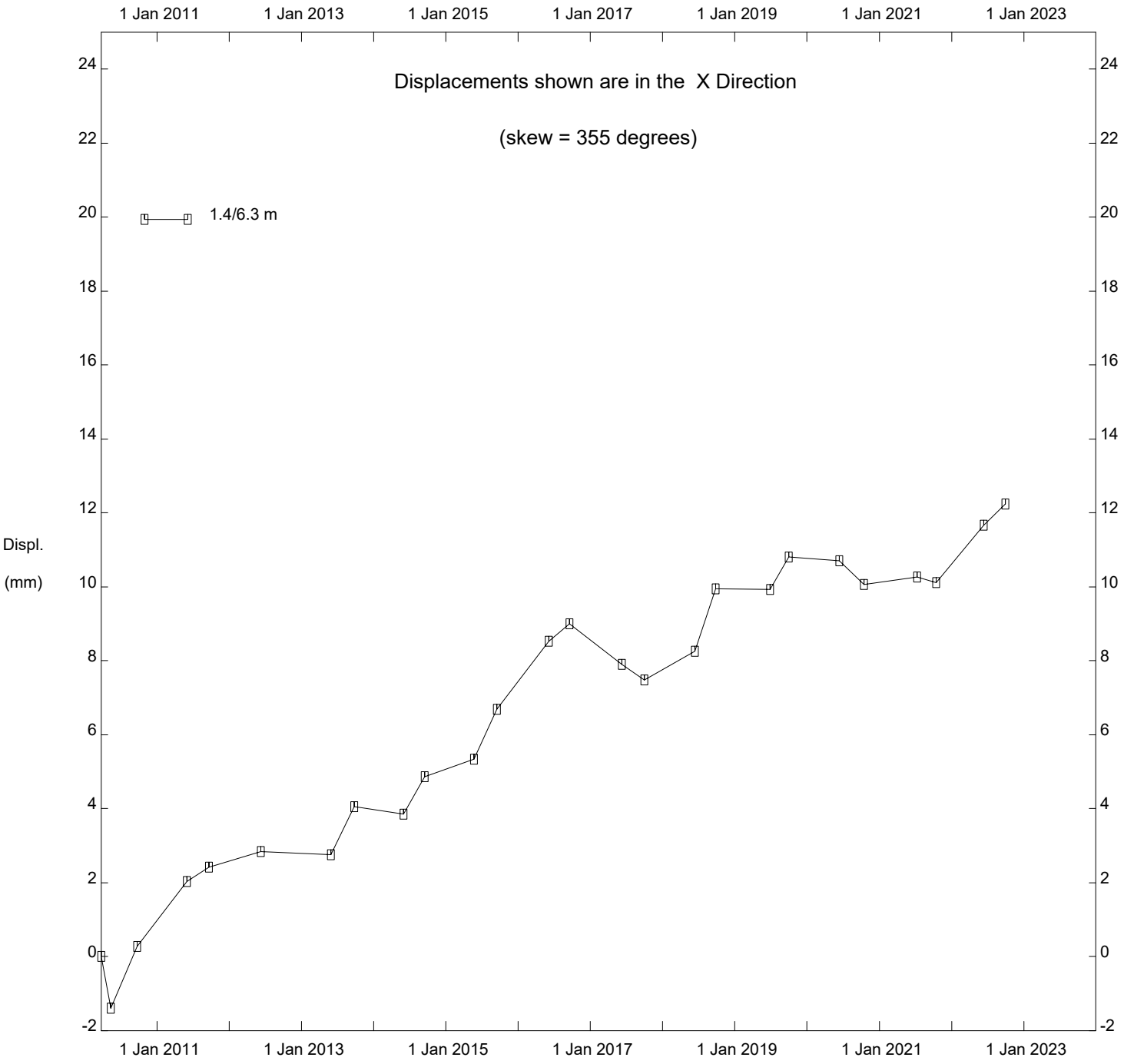
Judah Hill PH030, Inclinometer SI10-1

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022B-Fall\SI Readings\PH030\SI10-1.gtl

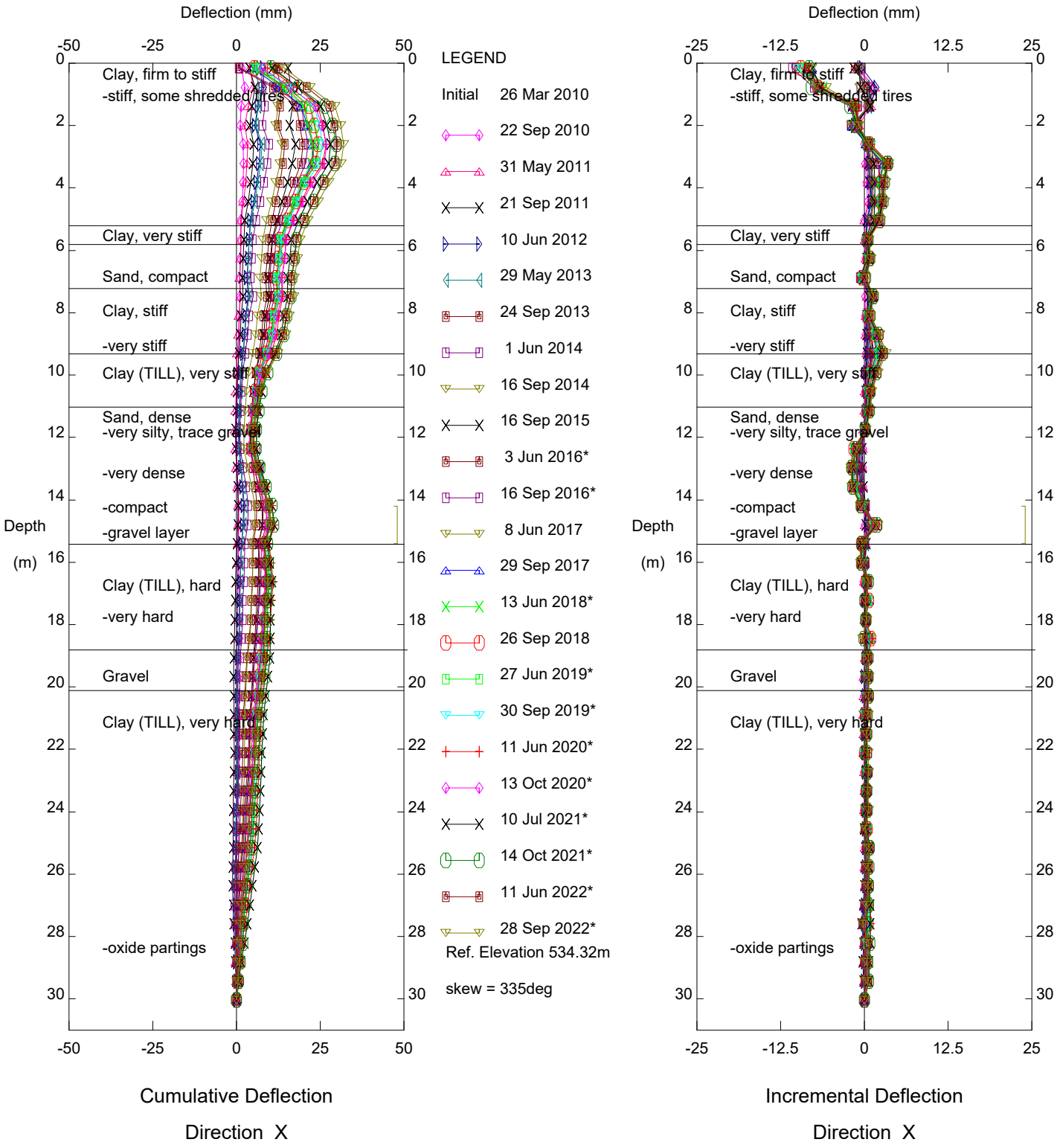
Thurber Engineering Ltd



Judah Hill PH030, Inclinometer SI10-1

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

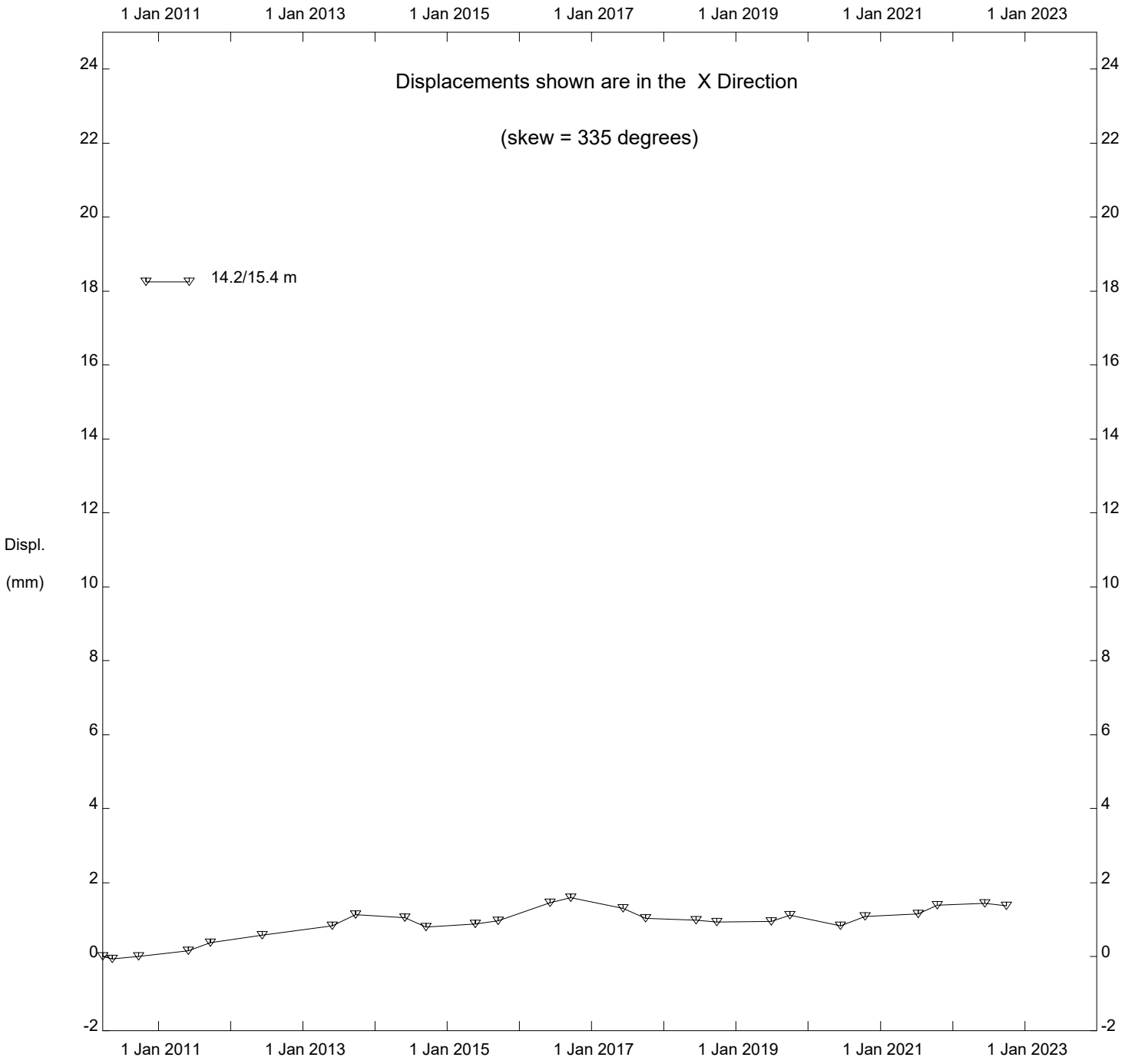
Judah Hill PH030, Inclinometer SI10-1

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022B-Fall\SI Readings\PH030\SI10-1.gtl

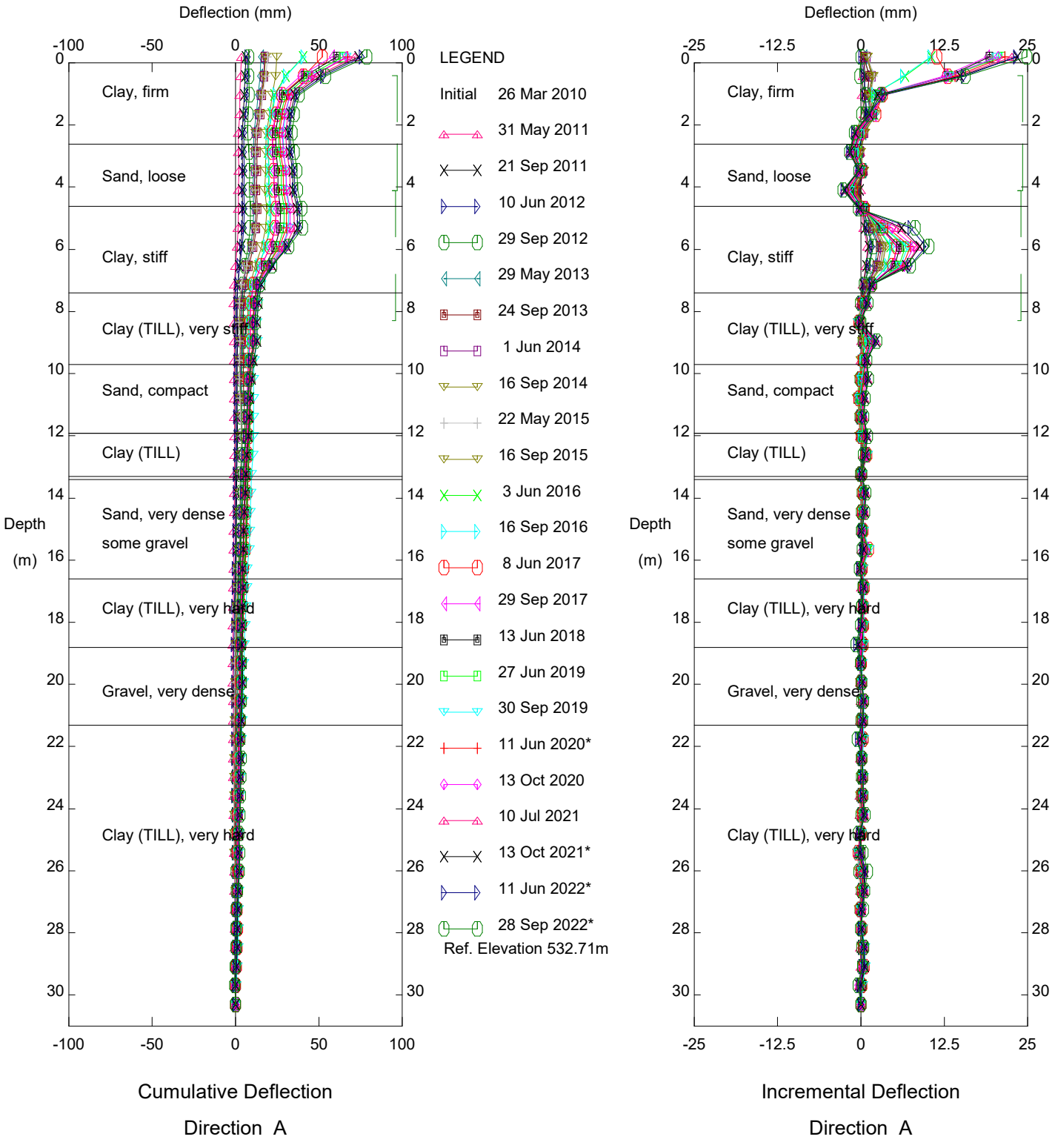
Thurber Engineering Ltd



Judah Hill PH030, Inclinometer SI10-1

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

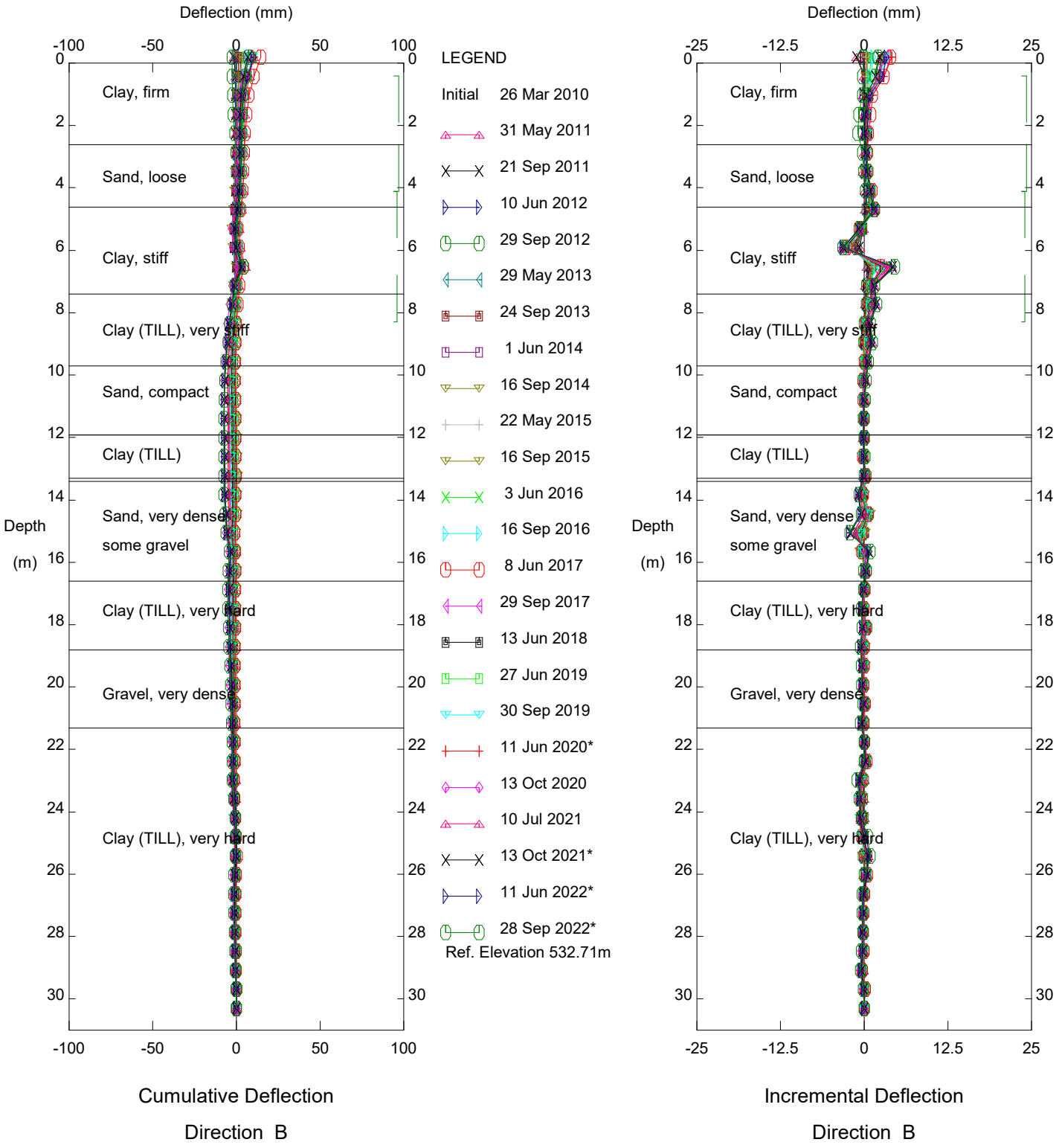
Judah Hill PH030, Inclinometer SI10-2

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022B-Fall\SI Readings\PH030\SI10-2.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

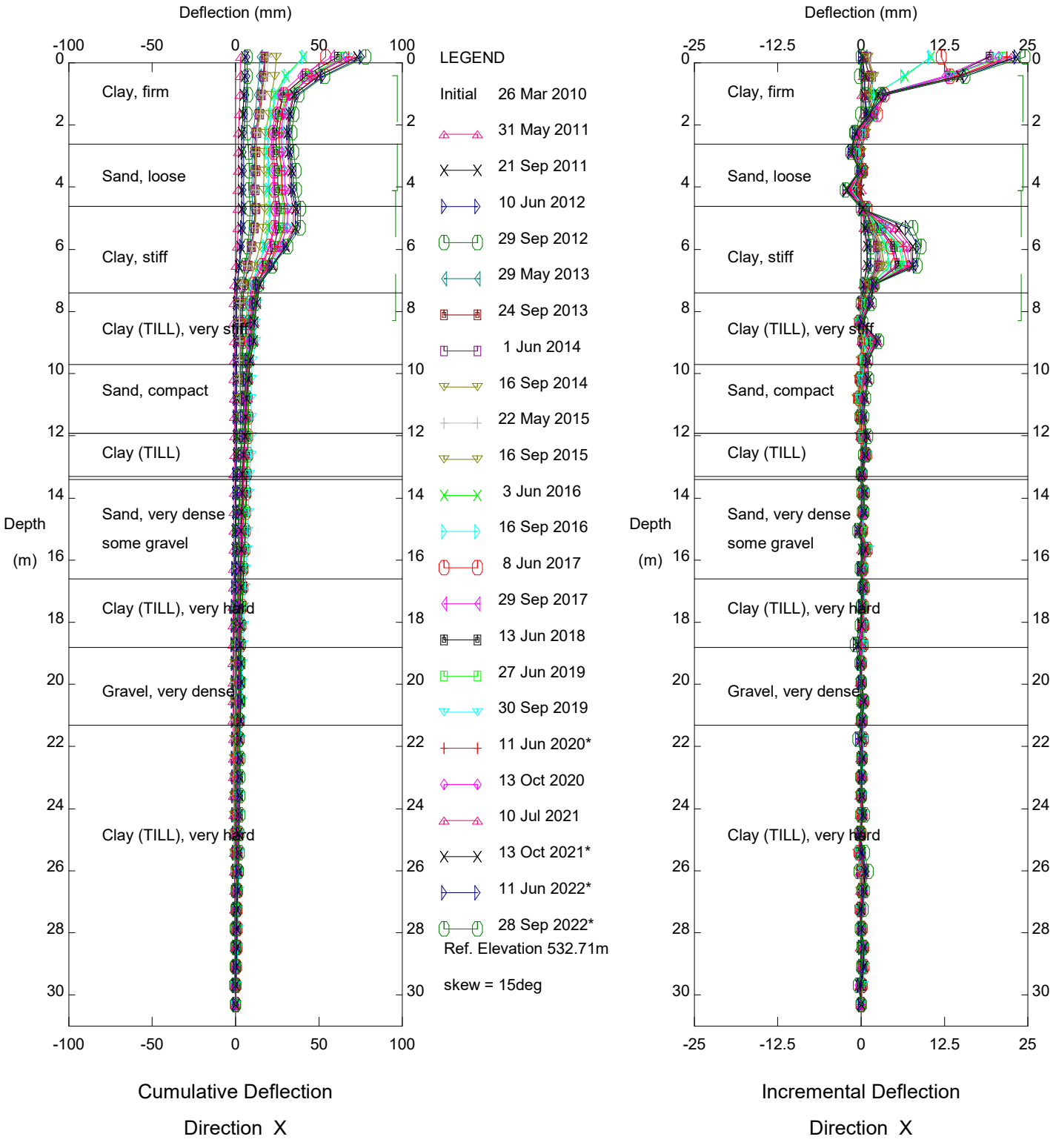
Judah Hill PH030, Inclinometer SI10-2

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022B-Fall\SI Readings\PH030\SI10-2.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

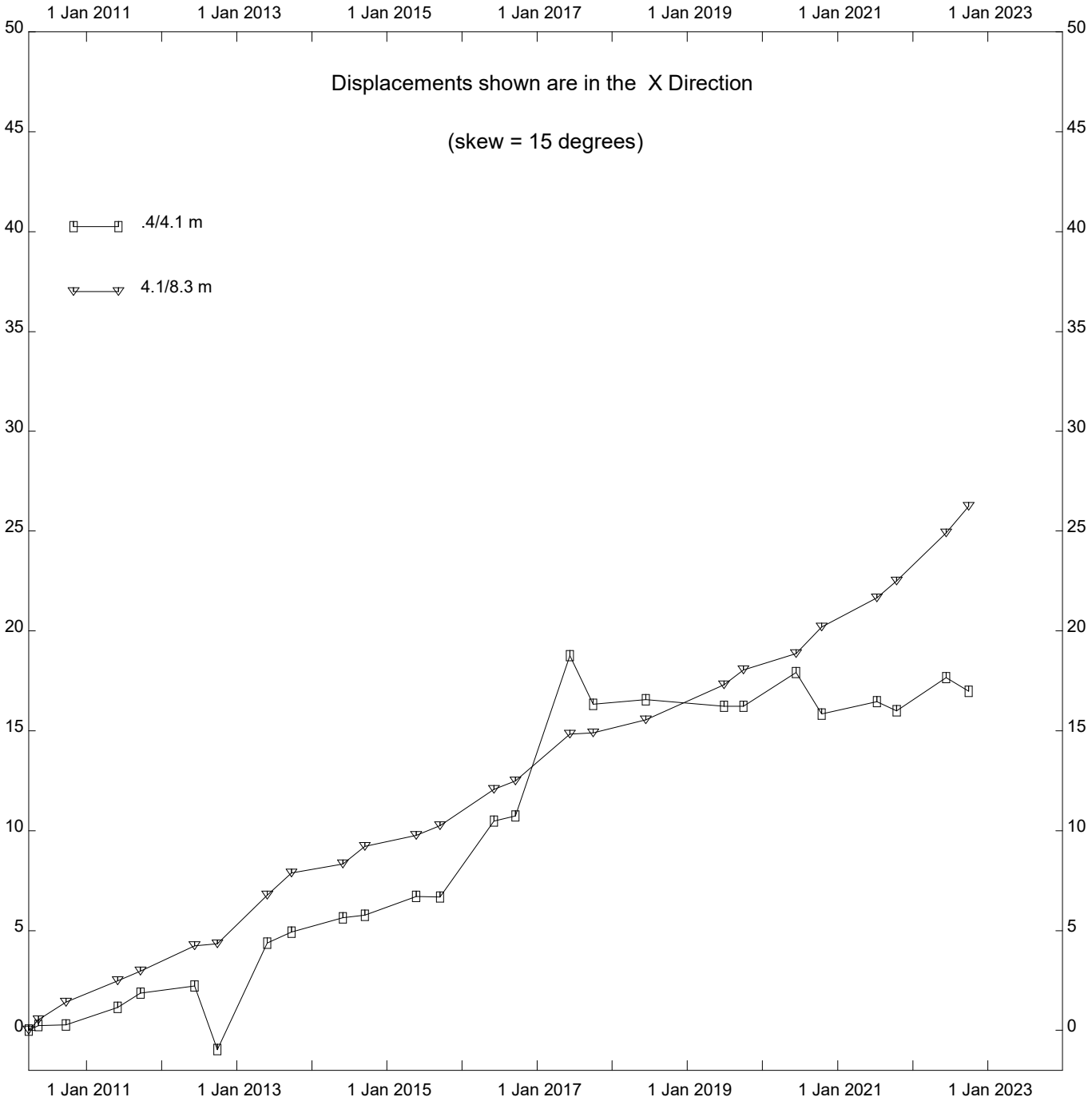
Judah Hill PH030, Inclinometer SI10-2

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022B-Fall\SI Readings\PH030\SI10-2.gtl

Thurber Engineering Ltd.



Judah Hill PH030, Inclinometer SI10-2

Alberta Transportation

FIGURE PH030-1
PIEZOMETRIC ELEVATIONS FOR HWY 744:04: JUDAH HILL (LOOKOUT SLIDES)

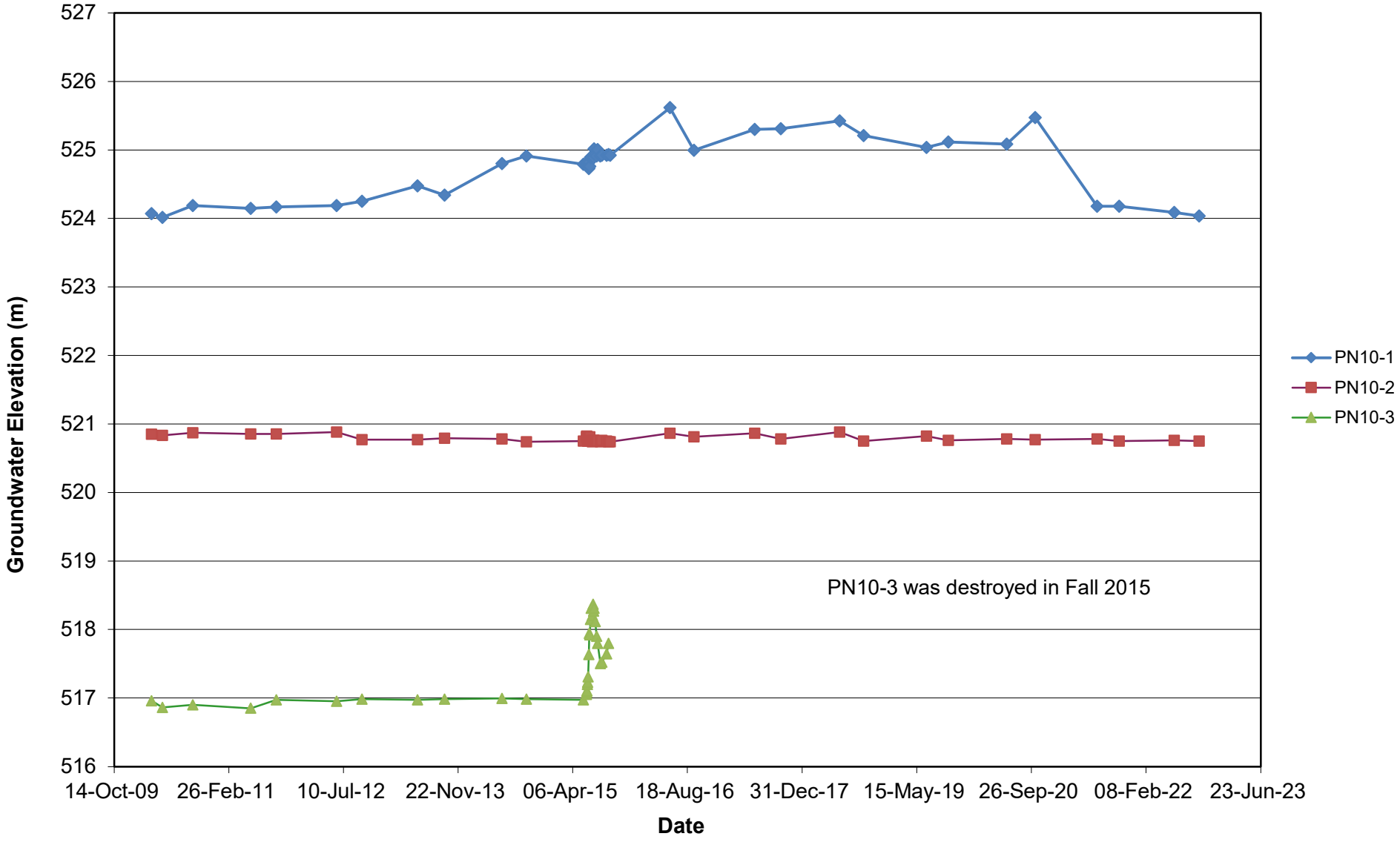


FIGURE PH030-2
PIEZOMETERIC DEPTHS FOR HWY 744:04: JUDAH HILL (LOOKOUT SLIDES)