THURBER ENGINEERING LTD.

July 28, 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 – SPRING 2022

SECTION C

SITE PH009A: HWY 684:02, BRICKS HILL

Dear Mr. Shannon:

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 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

In 2018, a tangent cantilever pile wall was installed at the Hwy 684:02 Bricks Hill site to mitigate a landslide that had affected the eastbound highway lane. Three slope inclinometers (SI18-P6, SI18-P23 and SI18-P40) were installed in select piles during construction. In addition, there were two standpipe piezometers (SP17-2 and SP17-6) installed during a geotechnical investigation prior to construction that are still active at the site. The SIs and standpipe piezometers were read on June 11, 2022 by Mr. Niraj Regmi, G.I.T. and Mr. Jayden Del Cid, both of Thurber Engineering Ltd.

The SIs were read using a 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 casing. The standpipe piezometers were read using a DGSI dipmeter.

2. DATA PRESENTATION

2.1 General

SI plots with 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 a rate of movement have also been provided. SI and piezometer summary tables are included below.

2.2 Zones of Movement

No new zones of movement were observed since the spring of 2021 readings. Zones of movement have been defined in each of the SIs over the length of the pile and over the combined length of the pile and waler cap beam.

Zones of movement are summarized in Tables PH009A-1 below. These tables also provide 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 PH009A-1
SPRING 2022 – HWY 684:02 BRICKS HILL
SLOPE INCLINOMETER READING SUMMARY

Date Monitored: June 11, 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)	CURRENT RATE OF MOVEMENT (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI18-P6	September 26, 2018	7.7 mm over 2.5 m to 17.1 m depth in 157° direction	3.7 mm/yr in October 2020	Operational	July 7, 2021	1.9	2.0	<0.1
		11.8 mm over 0.1 m to 17.1 m depth in 157° direction	5.2 mm/yr in June 2019			2.8	3.0	0.7
SI18-P23	September 26, 2018	12.2 mm over 2.5 m to 17.2 m depth in 155° direction	6.3 mm/yr in June 2019	Operational	July 7, 2021	1.6	1.7	-2.2
		17.7 mm over 0.1 m to 17.2 m depth in 155° direction	16.6 mm/yr in October 2020			2.8	3.0	0.2
SI18-P40	September 26, 2018	18.2 mm over 2.3 m to 16.9 m depth in 130° direction	9.9 mm/yr in June 2019	Operational	July 7, 2021	2.4	2.6	-1.6
		23.7 mm over 0.4 m to 16.9 m depth in 130° direction	13.5 mm/yr in June 2019			3.4	3.7	-1.6

Drawing 32121-PH009A in Appendix A provides a sketch of the approximate locations of the monitoring instrumentation for this site.

THURBER

TABLE PH009A-2
SPRING 2022 – HWY 684:02 BRICKS HILL
PNEUMATIC PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: June 11, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED WATER LEVEL BGS (m)	MEASURED PORE PRESSURE (kPa)	CURRENT WATER LEVEL BGS (m)	PREVIOUS WATER LEVEL BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN17-1-1 (37482)	*June 9, 2017*	*9.14*	*433.03*	*Destroyed*	*426.07 on June 11, 2019*	*N/A*	*N/A*	*424.34 (June 2018)*	*N/A*
PN17-1-2 ((37422)	*June 9, 2017*	*19.35*	*433.03*	*Destroyed*	*414.38 on September 28, 2017*	*N/A*	*N/A*	*414.02 (June 2018)*	*N/A*

Drawing 32121-PH009A 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.

THURBER

TABLE PH009A-3
SPRING 2022 – HWY 684:02 BRICKS HILL
STANDPIPE PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: June 11, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	MAXIMUM MEASURED WATER LEVEL BGS (m)	MEASURED WATER LEVEL BGS (m)	PREVIOUS READING BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
SP17-2	June 6, 2017	14.79	433.03	Active	8.45 on June 9, 2020	8.60	9.40	0.80
SP17-6	June 6, 2017	9.73	444.08	Active	9.69 on October 10, 2020	Dry	Dry	N/A
SP17-7	*June 6, 2017*	*11.60*	*440.30*	*Destroyed*	*428.73 on June 15, 2018*	*N/A*	*428.73 (June 2018)*	*N/A*
SP17-8	*June 6, 2017*	*8.67*	*436.10*	*Destroyed*	*428.84 on June 15, 2018*	*N/A*	*428.84 (June 2018)*	*N/A*
SP17-9	*June 6, 2017*	*9.85*	*428.48*	*Blocked/ sheared*	*DRY*	*N/A*	*DRY (June 2018)*	*N/A*

Drawing 32121-PH009A in Appendix A provides a sketch of the approximate locations of the monitoring instrumentation for this site.

3. INTERPRETATION OF MONITORING RESULTS

SI18-P6 showed a rate of movement of 2.0 mm/yr over the length of the pile from 2.5 m to 17.1 m depth and a rate of movement of 3.0 mm/yr over the combined length of the pile and waler from 0.1 m to 17.1 m depth. SI18-P6 has shown a total pile head deflection of 7.7 mm to date. SI18-P23 showed a rate of movement of 1.7 mm/yr over the length of the pile from 2.5 m to 17.2 m depth and a rate of movement of 3.0 mm/yr over the combined length of the pile and waler from 0.1 m to 17.2 m depth. SI18-P23 has shown a total pile head deflection of 12.2 mm to date. SI18-P40 showed a rate of movement of 2.6 mm/yr over the length of the pile from 2.3 m to 16.9 m depth and a rate of movement of 3.7 mm/yr over the combined length of the pile and waler from 0.4 m to 16.9 m depth. SI18-P40 has shown a total pile head deflection of 18.2 mm to date.

There are no pneumatic piezometers currently active at the site. Historical pneumatic piezometers (prior to construction) are summarized in Table PH009A-2 above.

The groundwater level increased in standpipe piezometer SP17-2 by 0.8 m since the previous reading in the spring of 2021. SP17-6 was dry. The standpipe piezometer readings are summarized in Table PH009A-3. The pneumatic and standpipe piezometer readings are plotted on Figure PH009A-1 (by elevation) and PH009A-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

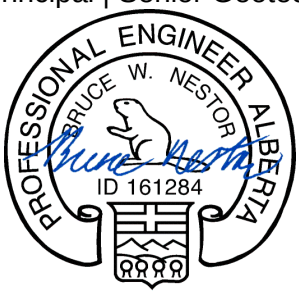
No instruments need repair at this site.

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.
Tarek Abdelaziz, Ph.D., P. Eng.
Principal | Senior Geotechnical Engineer



July 29, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 91085
DATE: July 29, 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-PH009A)
  - SI Reading Plots
  - Figure PH009A-1 (Piezometric Elevations)
  - Figure PH009A-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 (PEAE RIVER DISTRICT)
INSTRUMENTATION MONITORING RESULTS

SPRING 2022

APPENDIX A
DATA PRESENTATION

SITE PH009A: HWY 684:02, BRICKS HILL

ALBERTA TRANSPORTATION
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (PH009A)
SPRING 2022

Location:	Hwy 684:02 Bricks Hill (km 8.89 to km 9.45)	**Readout:**	DGSI Dipmeter
File Number:	32121	**Casing:**	2.75
Probe:	RST SI SET 8R	**Temp:**	13
Cable:	RST SI SET 8R	**Read by:**	NKR/JD

SLOPE INCLINOMETER (SI) READINGS

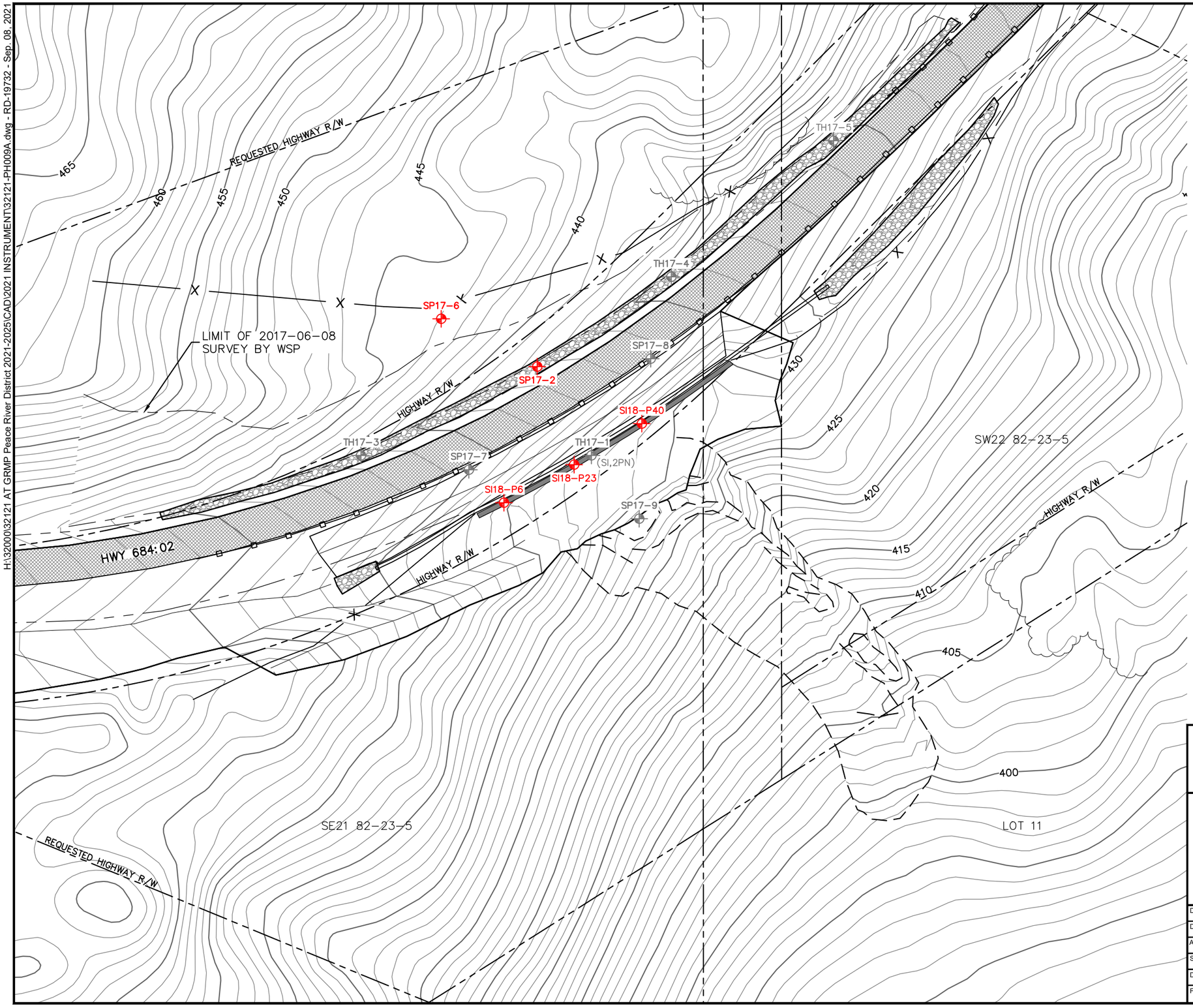
SI#	GPS Location (UTM 11)		Date	Stickup (m)	Depth from top of casing (ft)	Magn. North A+ Groove	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Easting (m)	Northing (m)					A+	A-	B+	B-		
SI18-P6	467291.00	6219675.00	11-Jun-22	0.84	58 to 2	126°	210	-201	23	-16	8R	
SI18-P23	467309.00	6219684.00	11-Jun-22	0.83	58 to 2	141°	472	-460	-522	529	8R	
SI18-P40	467326.00	6219694.00	11-Jun-22	1.10	58 to 2	102°	-92	102	244	-238	8R	

STANDPIPE PIEZOMETER READINGS

SP#	GPS Location (UTM 11)		Date	Stick-up (m)	Reading below top of casing (m)	Bottom Pipe Depth (below top of casing (m)
	Easting (m)	Northing (m)				
SP17-2	467330.1	6219711	11-Jun-22	1	9.6	15.79
SP17-6	467276.1	6219721	11-Jun-22	0.95	Dry	10.68

INSPECTOR REPORT

H:\32000\32121 AT GRMP Peace River District 2021-2025\CAD\2021 INSTRUMENT\32121-PH009A.dwg - RD-19732 - Sep. 08, 2021



LEGEND

- APPROXIMATE INSTRUMENT LOCATION
- INSTRUMENT DAMAGED / NOT IN USE
- (SP) STANDPIPE PIEZOMETER
- (SI) SLOPE INCLINOMETER
- (PN) PNEUMATIC PIEZOMETER
- RIP RAP IN DITCH
- SCARP CRACK
- GUARD RAIL
- BARBED WIRE FENCE
- TREE LINE
- CULVERT

0 10 20 30 40 50 60m
SCALE 1:1000

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

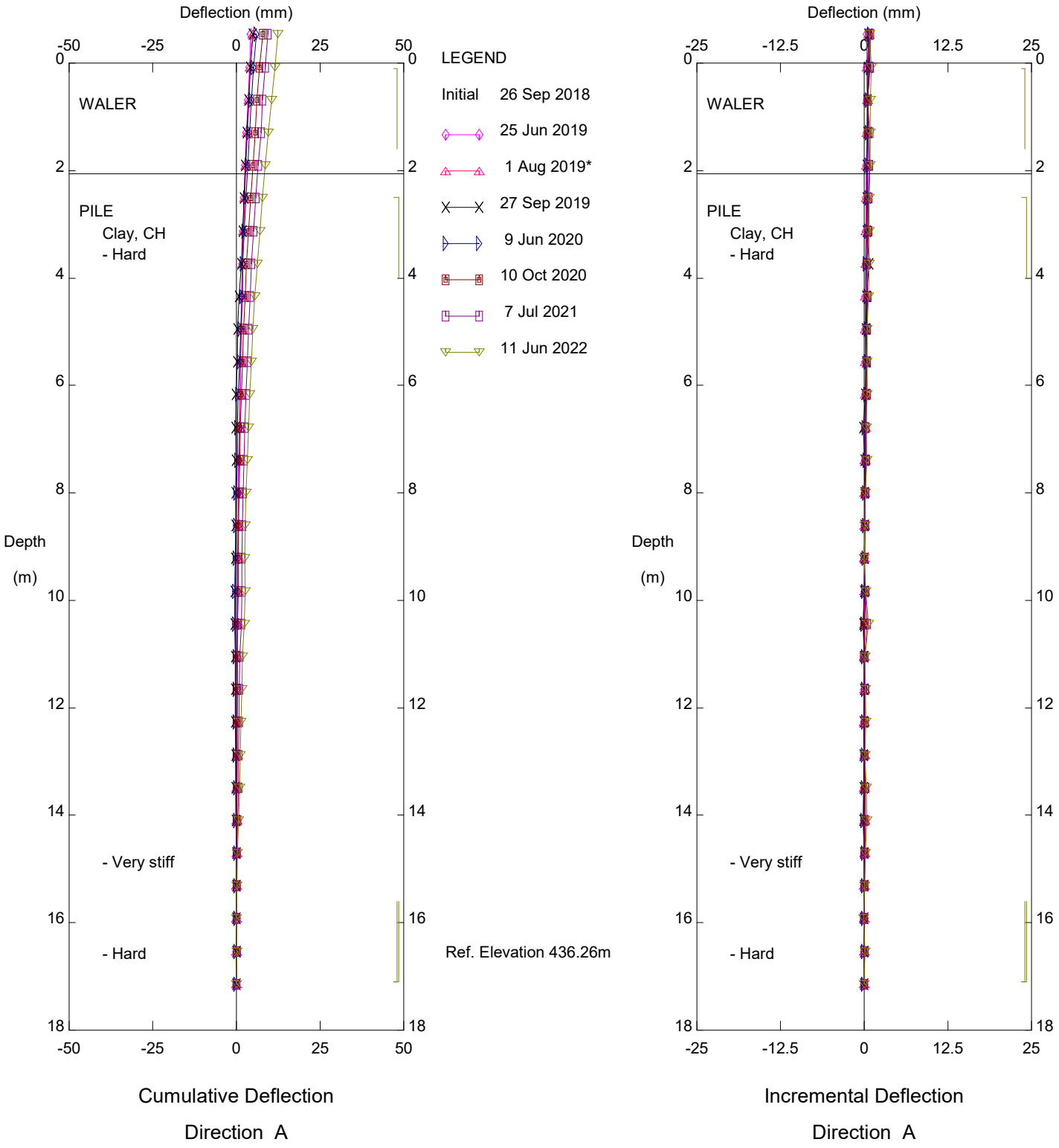
PH009A: HWY 684:02 BRICKS HILL
SITE PLAN SHOWING INSTRUMENTATION LOCATIONS

DWG No. 32121-PH009A

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	DWP
SCALE	1:1000
DATE	SEPTEMBER 2021
FILE No.	32121

THURBER ENGINEERING LTD.

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

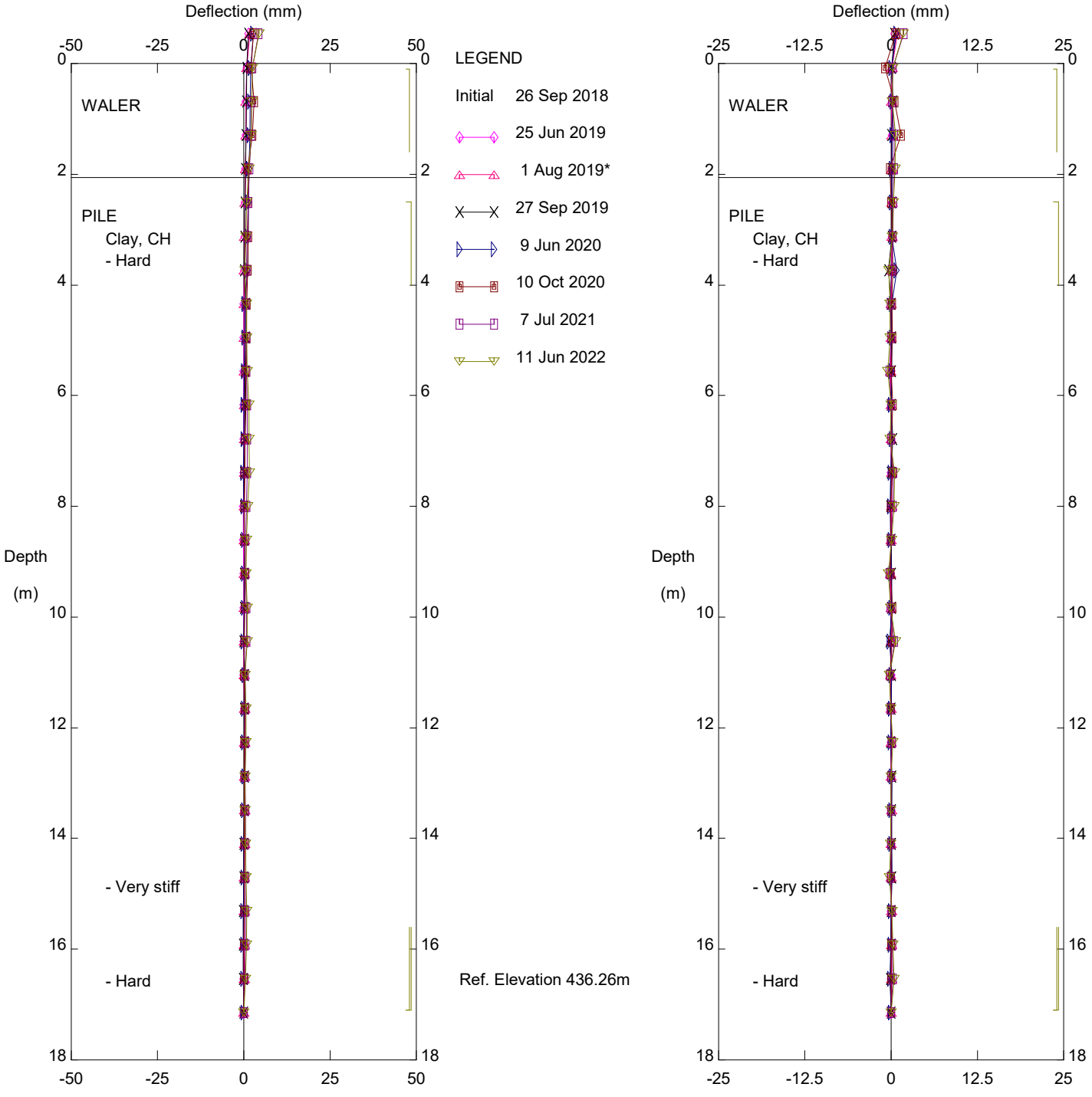
Hwy 684:02 km 9 Bricks Hill, Inclinometer SI18-P6

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P6.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

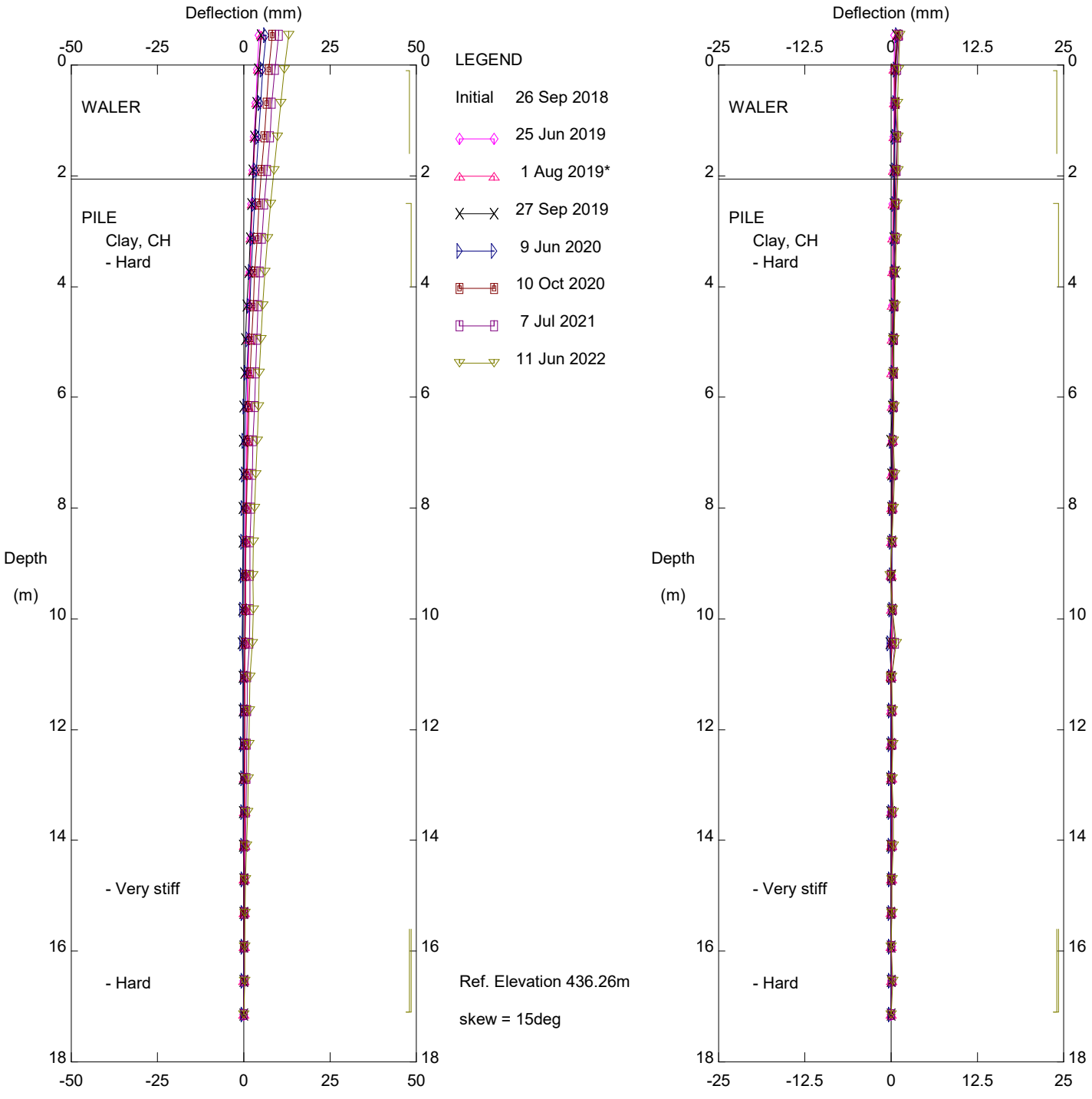
Hwy 684:02 km 9 Bricks Hill, Inclinometer SI18-P6

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P6.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

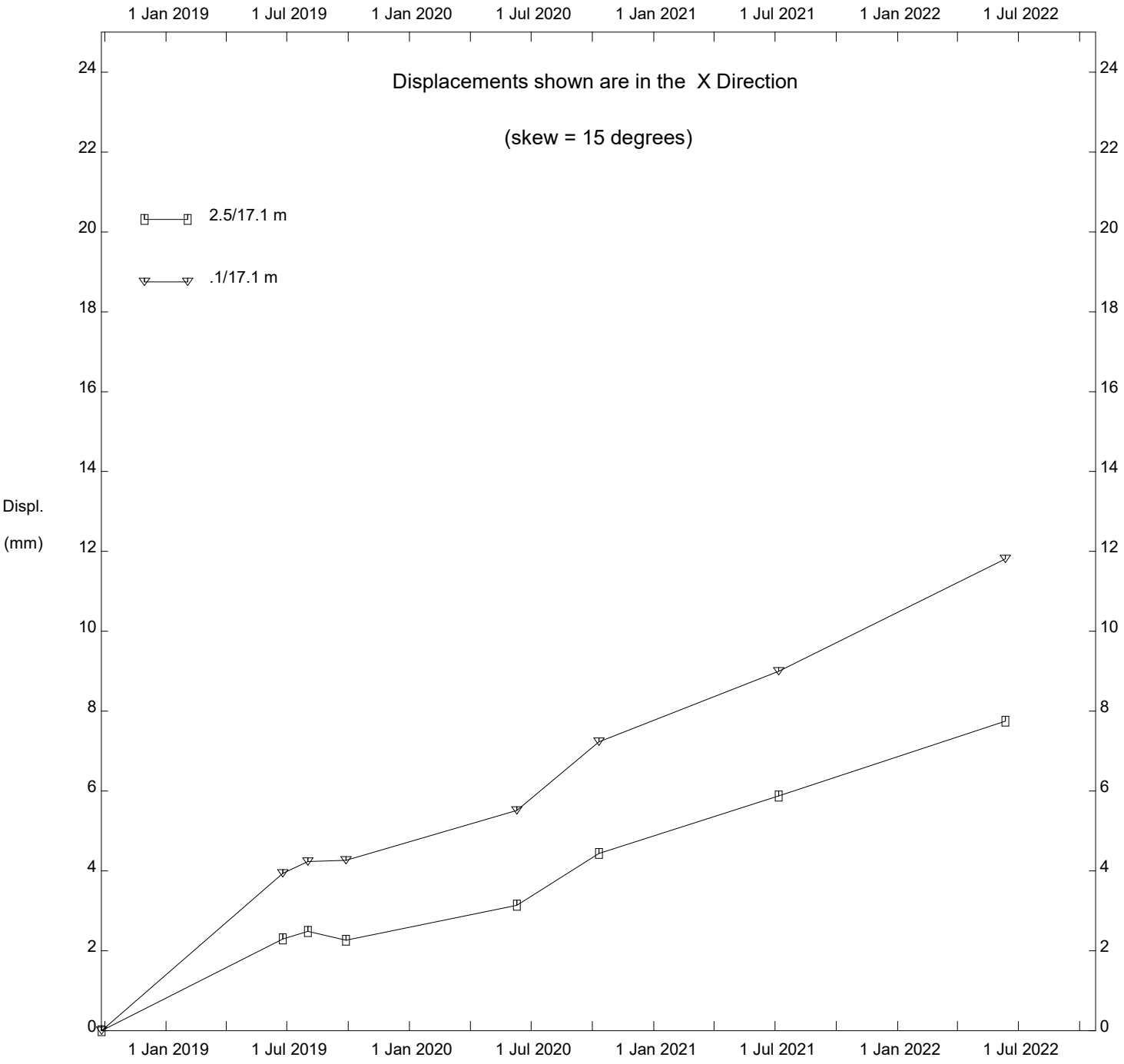
Hwy 684:02 km 9 Bricks Hill, Inclinometer SI18-P6

Alberta Transportation

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

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P6.gtl

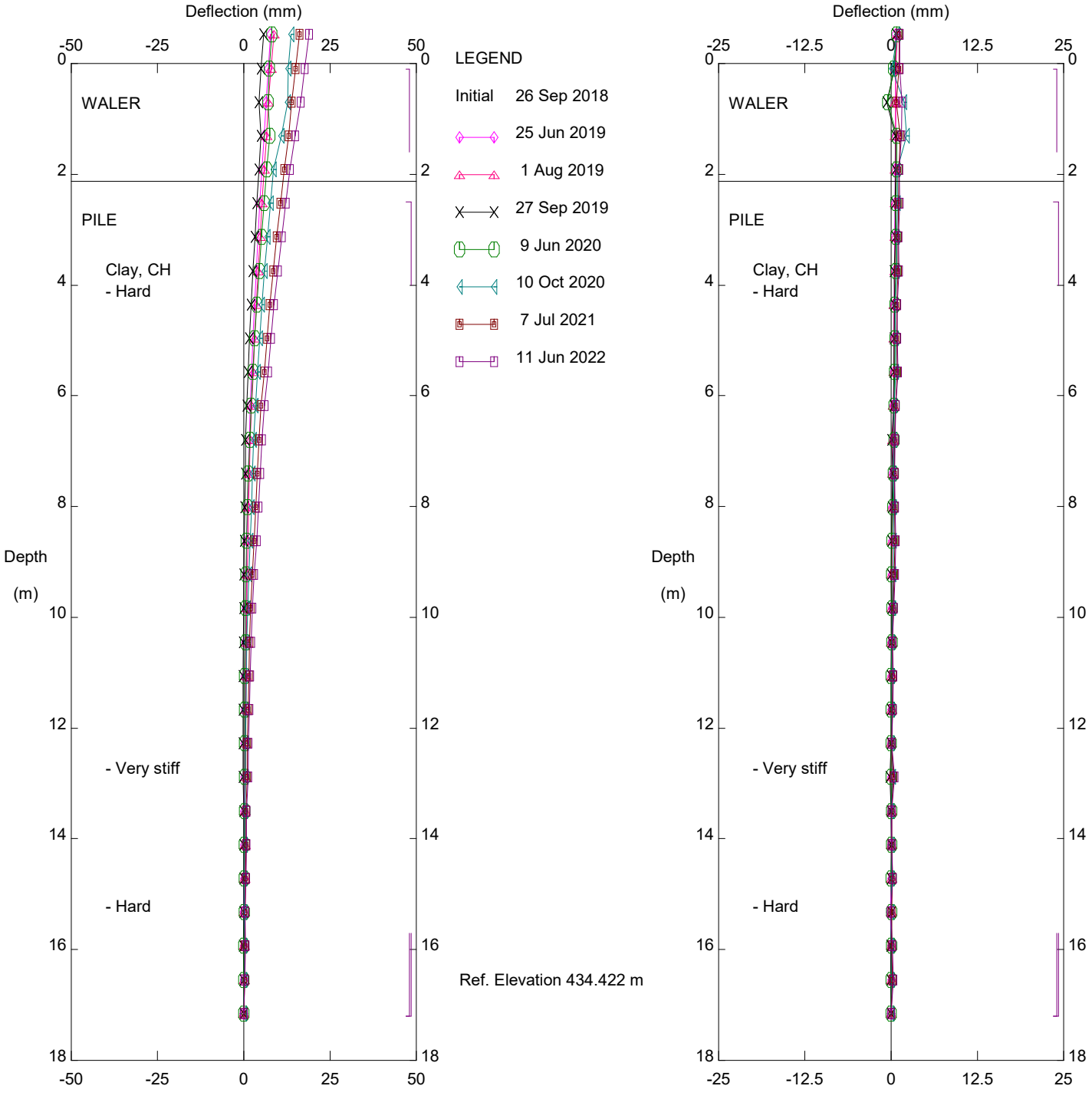
Thurber Engineering Ltd.



Hwy 684:02 km 9 Bricks Hill, Inclinometer SI18-P6

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

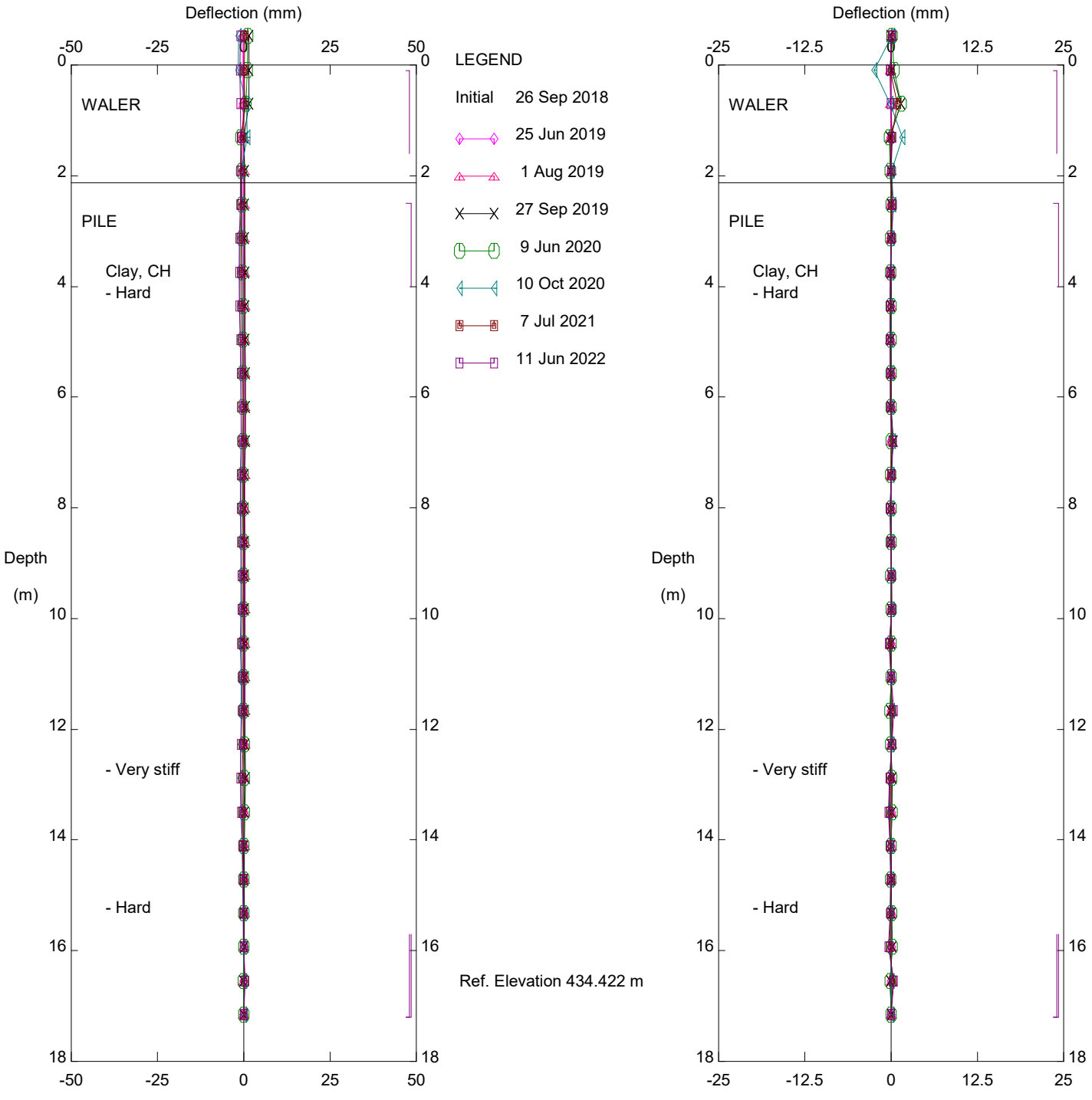
Direction A

Hwy 684:02 km 9 Bricks Hill, Inclinometer SI18-P23

Alberta Transportation

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P23.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

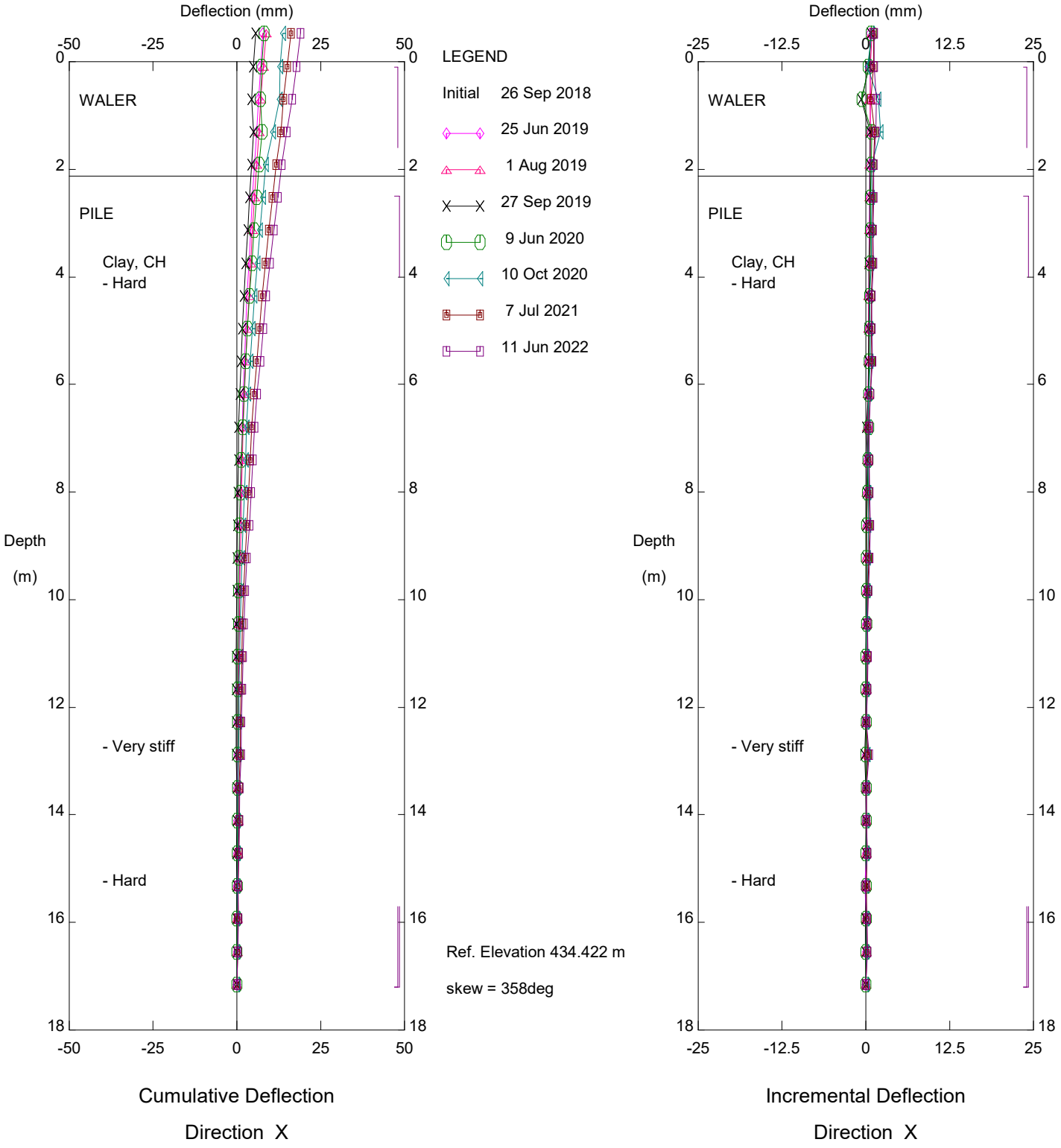
Direction B

Hwy 684:02 km 9 Bricks Hill, Inclinometer SI18-P23

Alberta Transportation

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P23.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

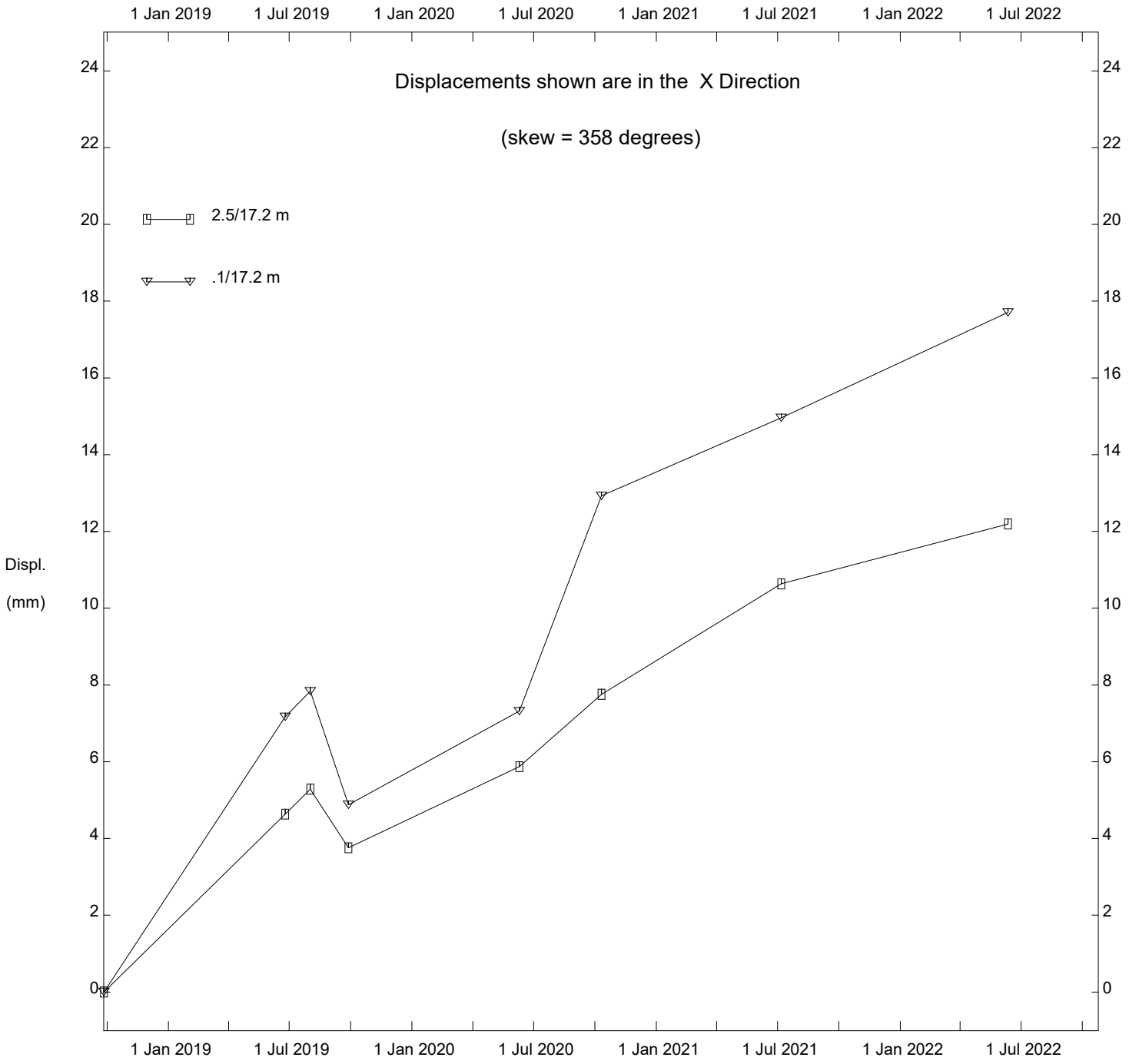
Direction X

Hwy 684:02 km 9 Bricks Hill, Inclinometer SI18-P23

Alberta Transportation

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P23.gtl

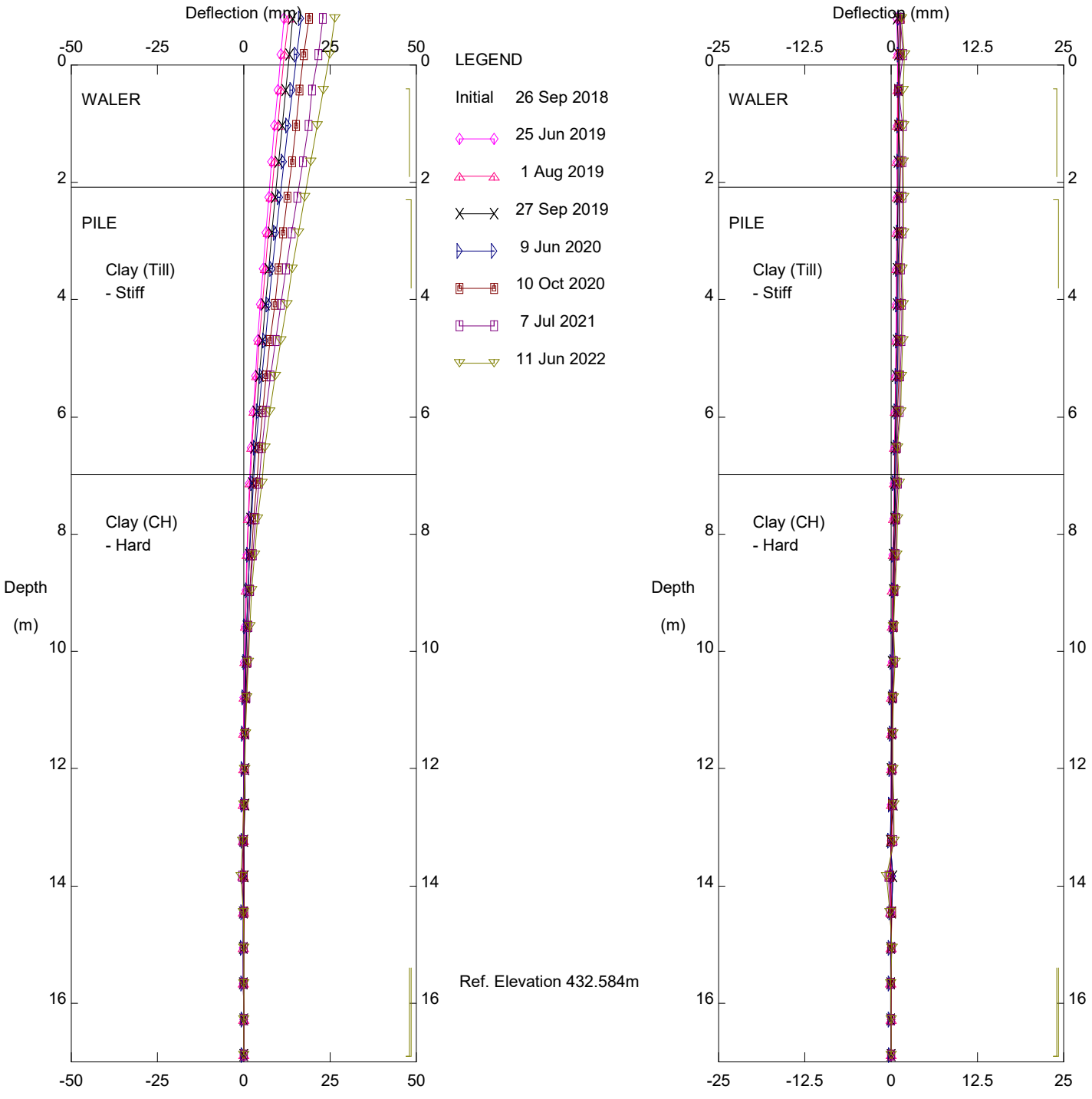
Thurber Engineering Ltd.



Hwy 684:02 km 9 Bricks Hill, Inclinometer SI18-P23

Alberta Transportation

Thurber Engineering Ltd.



Cumulative Deflection

Direction A

Incremental Deflection

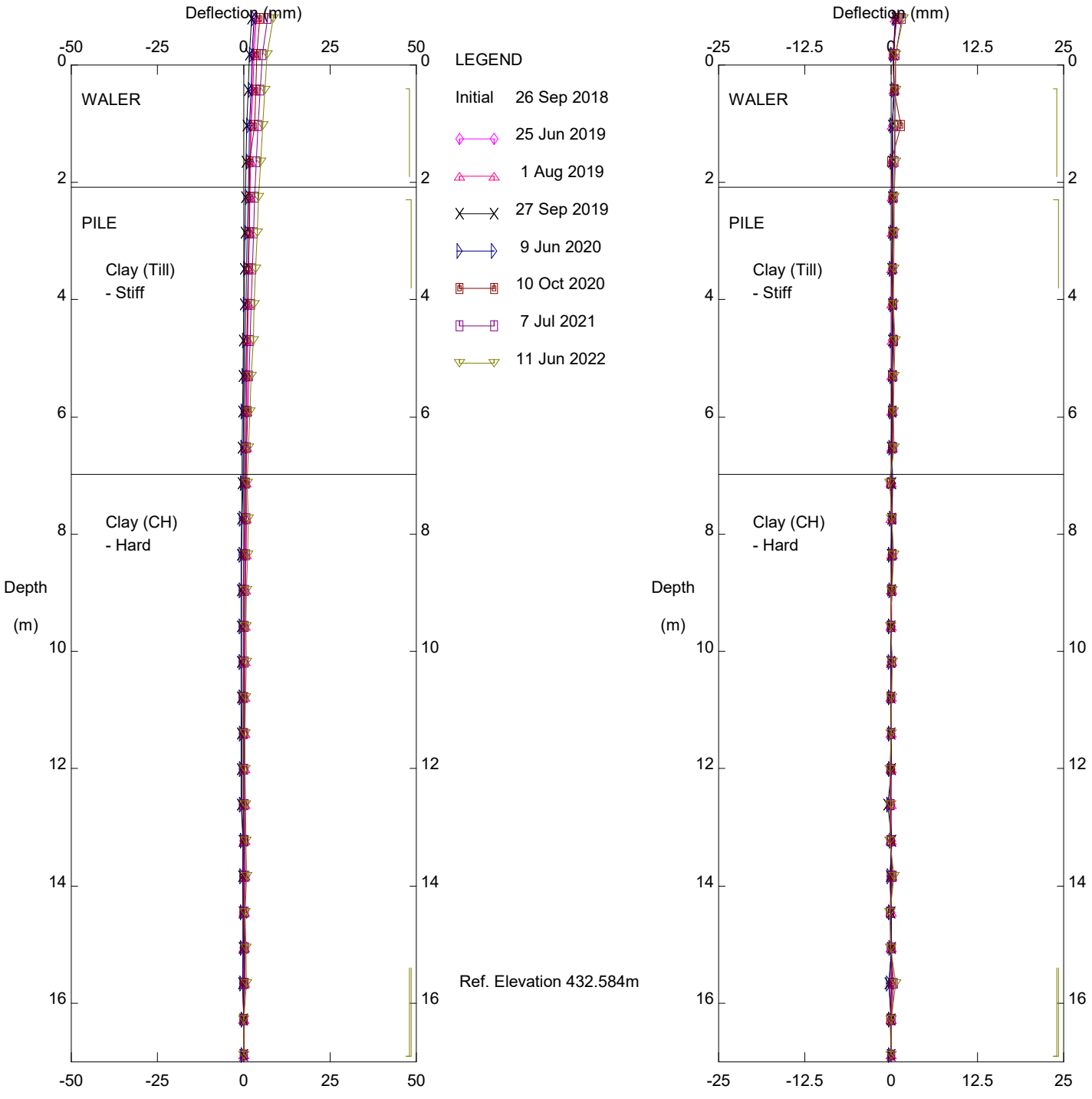
Direction A

Alberta Transportation, Inclinometer SI18-P40

Hwy 684:02 km 9 Bricks Hill

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P40.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

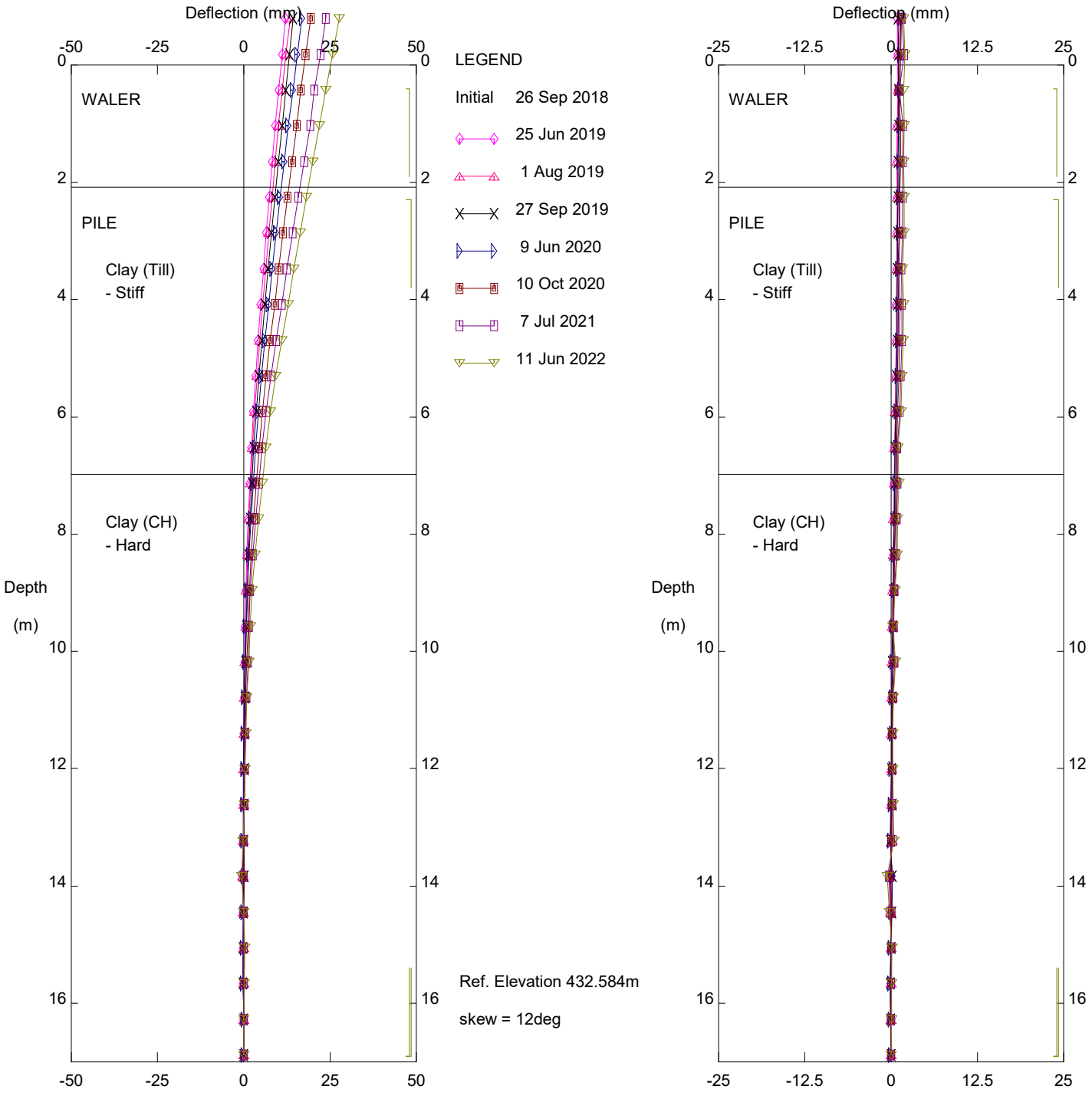
Direction B

Alberta Transportation, Inclinometer SI18-P40

Hwy 684:02 km 9 Bricks Hill

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P40.gtl

Thurber Engineering Ltd.



Cumulative Deflection

Direction X

Incremental Deflection

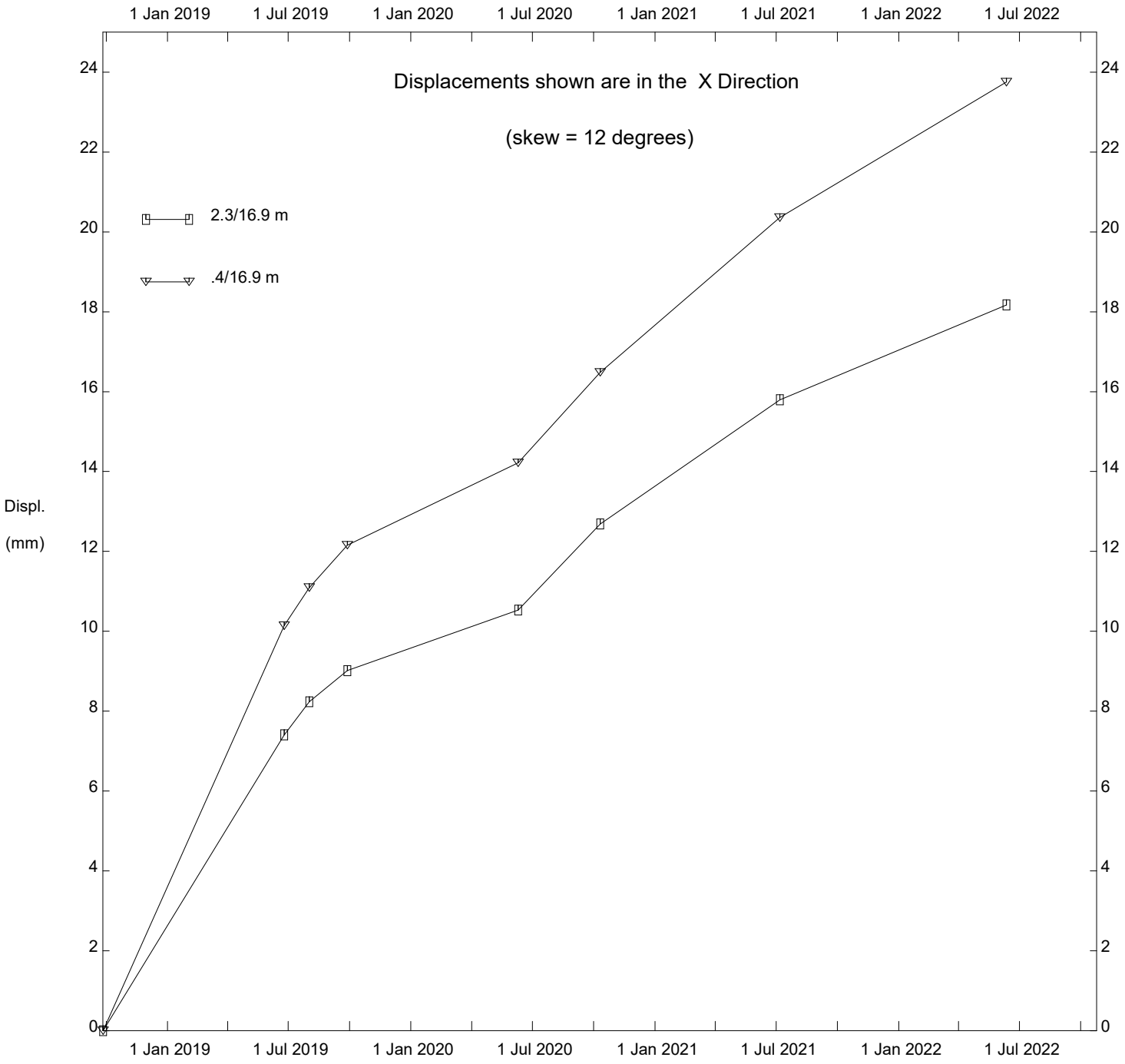
Direction X

Alberta Transportation, Inclinometer SI18-P40

Hwy 684:02 km 9 Bricks Hill

H:\32000\32121 AT GRMP Peace River District 2021-2025\Section C\2022A-Spring\SI Readings\PH009A\SI18-P40.gtl

Thurber Engineering Ltd.



Alberta Transportation, Inclinometer SI18-P40

Hwy 684:02 km 9 Bricks Hill

FIGURE PH009A-1
PIEZOMETERIC ELEVATIONS FOR HWY 684:02 BRICKS HILL

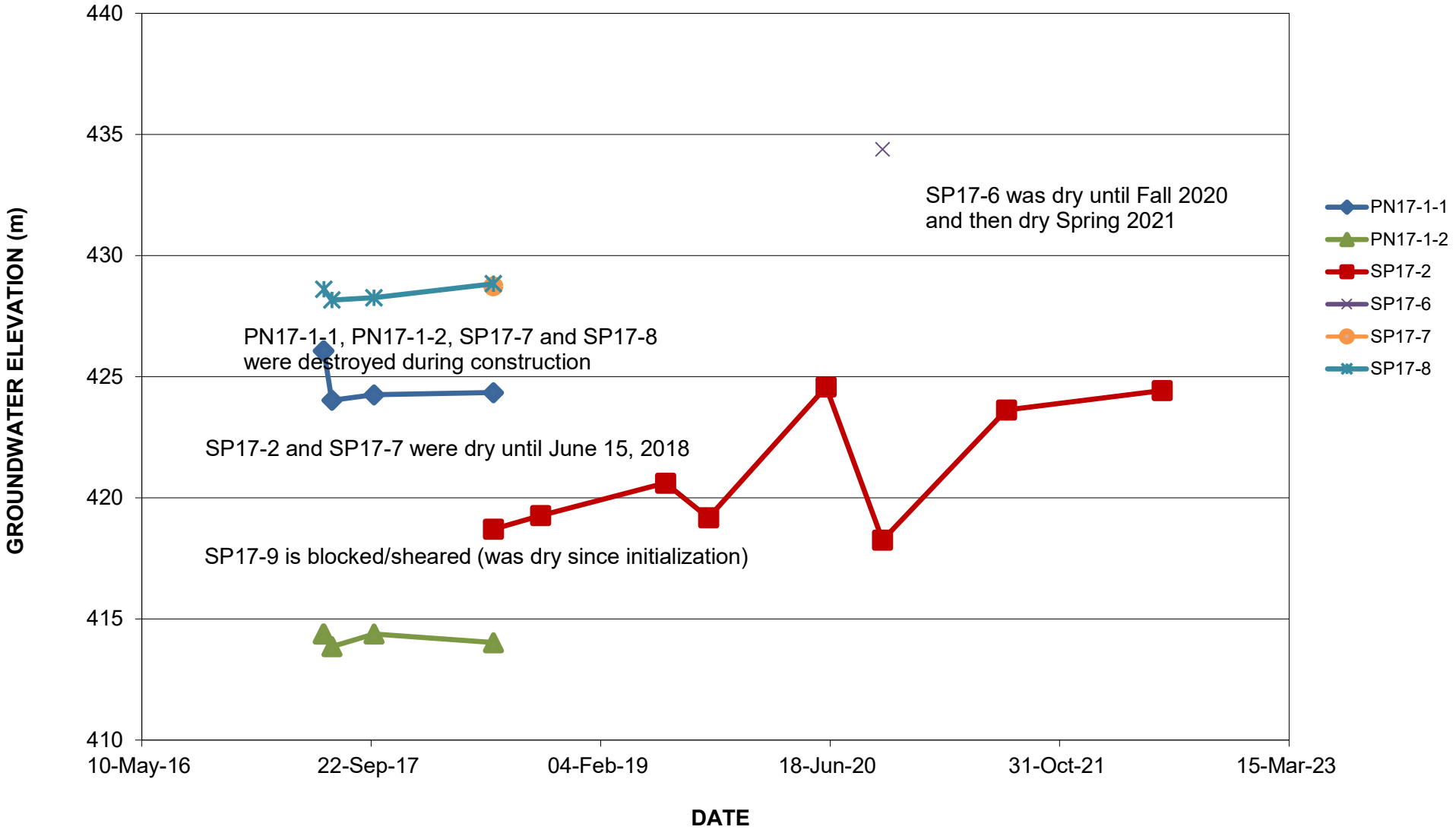


FIGURE PH009A-2
PIEZOMETERIC DEPTHS FOR HWY 684:02 BRICKS HILL