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 NC102 (NC024-2): HWY 41:23 KEHIWIN LAKE (km 8.8)

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

In 2011, a 113-m long cantilever pile wall was constructed to stabilize the landslide movement at Hwy 41:23, km 8.8 (previously known as site NC24-2, NC24B prior to 2016). Three slope inclinometers (SI11-1 to SI11-3) were installed in selected piles to monitor the lateral deflection of the pile wall. In 2014, a pronounced dip occurred on the highway surface to the south of the existing pile wall. Additional instruments consisting of four SIs (SI15-1 to SI15-4) and four pneumatic piezometers (PN15-1 to PN15-14) were installed in 2015 to the south of the existing pile wall to determine the depth of movement and groundwater levels.

In the fall of 2016, a second cantilever pile wall, 40 m in length, was built immediately to the south of the 2011 pile wall, at the site previously known as NC24D. Two new SIs (SI16-1 and SI16-2) were installed in piles P04 and P08, respectively.

Eleven slope inclinometers (SI10-1, SI10-3, SI11-1 to SI11-3, SI15-1 to SI15-4, SI16-1 and SI16-2), eight pneumatic piezometers (PN10-1, PN10-3, PN10-5, PN10-6 and PN15-1 to PN15-4), and four standpipe piezometers (PB10-1 to PB10-4) were read at the Kehiwin Lake km 8.8 (NC102) site on May 25 and May 27, 2022, by Mr. Niraj Regmi, G.I.T. and

Mr. Jayden Del Cid, both of Thurber Engineering Ltd. PB10-2 was found to be blocked at 2.7 m below the top of the pipe and no reading could be obtained.

A site plan showing approximate instrumentation locations is included in Appendix A.

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 casings. The standpipe piezometers were read using a Heron dipmeter. 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 and standpipe 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 new zones of movement were observed in the SIs since the spring of 2021 readings.

Zones of old movements and the zone of new movement are summarized in Table NC102-1 at the end of this report. Table NC102-1 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.

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TABLE NC102-1
SPRING 2022– HWY 41:23 KEHIWIN LAKE (km 8.8)
SLOPE INCLINOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: May 25 & 27, 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)
SI10-1	October 13, 2010	No discernible movement	No discernible movement	Operational	June 22, 2021	N/A	N/A	N/A
SI10-3	October 13, 2010	126.8 over 0.0 m to 2.4 m depth in 323° direction	30.3 in May 2011	Operational	June 22, 2021	0.6	0.6	-0.6
SI11-1 (P7)	June 21, 2011	1.6 over 0.1 m to 9.3 m depth in 275° direction	5.1 in August 2011	Operational	June 22, 2021	No discernible movement	N/A	-1.4
SI11-2 (P16)	June 21, 2011	2.9 over 0.1 m to 9.9 m depth in 346° direction	11.0 in August 2011	Operational	June 22, 2021	No discernible movement	N/A	-3.5
SI11-3 (P24)	June 21, 2011	0.0 over 0.4 m to 9.6 m depth in 358° direction	4.5 in September 2018	Operational	June 22, 2021	No discernible movement	N/A	1.5
SI15-1	August 20, 2015	No discernible movement	No discernible movement	Operational	June 22, 2021	N/A	N/A	N/A
SI15-2	August 20, 2015	14.1 over 3.0 m to 4.8 m depth in 328° direction	15.4 in September 2020	Operational	June 22, 2021	No discernible movement	N/A	-1.3
SI15-3	August 20, 2015	87.3 over 1.7 to 3.5 m depth in 337° direction	233.8 in September 2020	Operational	June 22, 2021	0.3	0.3	-2.2

Figure 32122-NC102 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site

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TABLE NC102-1 – CONTINUED…
SPRING 2022 – HWY 41:23 KEHIWIN LAKE (km 8.8)
SLOPE INCLINOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: May 25 & 27, 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)
SI15-4	August 20, 2015	9.8 over 1.6 to 3.4 m depth in 328° direction	19.6 in September 2020	Operational	June 22, 2021	1.6	1.8	0.6
		10.1 over 3.4 to 4.7 m depth in 328° direction	9.3 in September 2020			0.6	0.7	-1.3
SI16-1 (P04)	October 19, 2016	4.3 over 0.0 to 12.2 m depth in 308° direction	9.2 in March 2017	Operational	June 22, 2021	<0.1	<0.1	-0.4
SI16-2 (P08)	October 19, 2016	5.6 over 0.0 to 12.2 m depth in 323° direction	8.9 in November 2016	Operational	June 22, 2021	0.2	0.2	-1.0

Figure 32122-NC102 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

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TABLE NC102-2
SPRING 2022 – HWY 41:23 KEHIWIN LAKE (km 8.8)
PNEUMATIC PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: May 25 & 27, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER LEVEL BGS (m)	MEASURED PORE PRESSURE (kPa)	CURRENT GROUNDWATER LEVEL BGS (m)	PREVIOUS GROUNDWATER LEVEL BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN10-1	October 7, 2010	5.9	-	Active	2.76 on October 8, 2010	26.5	3.22	3.13	-0.09
PN10-2A	*October 8, 2010*	*3.9*	-	*Non-Operational*	*0.90 on May 31, 2012*	*N/A*	*N/A*	*N/A*	*N/A*
PN10-2B	*October 8, 2010*	*11.9*	-	*Not Functioning*	*1.39 on May 31, 2012*	*N/A*	*N/A*	*N/A*	*N/A*
PN10-3	October 10, 2010	10.0	-	Active	2.48 on September 24, 2012	53.1	4.59	4.58	-0.01
PN10-5	October 9, 2010	4.8	-	Active	0.41 on May 26, 2016	30.6	1.64	1.13	-0.51
PN10-6	October 9, 2010	9.9	-	Active	1.48 on September 12, 2013	63.0	3.48	3.21	-0.27

Figure 32122-NC102 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

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TABLE NC102-2 – CONTINUED…
SPRING 2022 – HWY 41:23 KEHIWIN LAKE (km 8.8)
PNEUMATIC PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: May 25& 27, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER LEVEL BGS (m)	MEASURED PORE PRESSURE (kPa)	CURRENT GROUNDWATER LEVEL BGS (m)	PREVIOUS GROUNDWATER LEVEL BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN15-1	August 20, 2015	8.4	-	Active	1.14 on May 25, 2017	65.3	1.73	1.63	-0.10
PN15-2	August 20, 2015	9.1	-	Active	0.96 on May 25, 2017	75.7	1.43	1.13	-0.30
PN15-3	August 20, 2015	3.8	-	Active	1.07 on May 27, 2022	26.9	1.07	1.09	0.02
PN15-4	August 20, 2015	6.1	-	Active	1.23 on May 25, 2017	37.4	2.29	1.96	-0.03

Figure 32122-NC102 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

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TABLE NC102-3
SPRING 2022 – HWY 41:23 KEHIWIN LAKE (km 8.8)
STANDPIPE PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: May 25 & 27, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	MAXIMUM GROUNDWATER LEVEL BGS (m)	MEASURED GROUNDWATER DEPTH BGS (m)	PREVIOUS READING BGS (m)	CHANGE IN GROUNDWATER LEVEL SINCE PREVIOUS READING (m)
PB10-1	October 7, 2010	19.7	-	Operational	0.63 on May 25, 2017	2.08	1.28	-0.80
PB10-2	*October 7, 2010*	*20.0*	-	*Blocked*	*3.03 on May 12, 2011*	*N/A*	*3.60 (June 22, 2021)*	*N/A*
PB10-3	October 10, 2010	20.0	-	Operational	0.62 on May 25, 2017	1.53	1.24	-0.29
PB10-4	October 10, 2010	19.6	-	Operational (blocked at 1.59 m BGS)	0.98 on June 22, 2021	1.37	0.98	-0.39

Drawing 32122-NC102 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

3. INTERPRETATION OF MONITORING RESULTS

Slope inclinometer SI10-1, installed in the highway east ditch upslope of the NC24B pile wall, continued to show no discernible movement. SI10-3 installed downslope of the NC24B pile wall, showed a rate of movement of 0.6 mm/yr over 0.0 m to 2.4 m of depth since the spring of 2021 readings.

SI11-1 through SI11-3 were installed in piles P7, P16 and P24, respectively, of the 2011 pile wall. Slope inclinometers SI11-1 to SI11-3 all showed no discernible movement since the spring of 2021 readings. SI11-1, SI11-2 and SI11-3 have shown total pile head movements of 1.6 mm, 2.9 mm, and 0.0 mm, respectively, since installation.

Slope inclinometer SI15-1, installed in the highway east ditch upslope of the NC24D pile wall, has shown no discernible movement since initialization. SI15-2, installed immediately downslope of the NC24D pile wall, showed a no discernible movement over 3.0 m to 4.8 m depth since the spring of 2021. SI15-3, installed near the bottom of the slope downslope of the NC24D pile wall, showed a rate of movement of 0.3 mm/yr over 1.7 m to 3.5 m depth since the spring of 2021. SI15-4, installed near the west edge of the highway to the south of the NC24D pile wall, showed a rate of movement of 1.8 mm/yr over 1.6 m to 3.4 m depth and a rate of movement of 0.7 mm/yr over 3.4 m to 4.7 m depth since the spring of 2021.

SI16-1, installed in the 2016 pile wall, showed a rate of movement of less than 0.1 mm/yr over the length of the pile from 0.0 m to 12.2 m depth since the spring of 2021 readings. SI16-1 has shown a total pile head movement of 4.3 mm to date. SI16-2, also installed in the 2016 pile wall, showed a rate of movement of 0.2 mm/yr over the length of the pile from 0.0 m to 12.2 m depth since the spring of 2021 readings. SI16-2 has shown a total pile head movement of 5.6 mm to date.

In general, the pile wall appears to have performed well since the completion of construction.

Most of the Pneumatic piezometers showed decreases in water levels, ranging from a decrease of 0.01 m in PN10-3, to a decrease of 0.51 m in PN10-5, since the spring of 2021 readings. The water level in PN15-3 increased by 0.02 m and was the highest recorded since initialization. The pneumatic piezometer readings are summarized in Table NC102-2.

Standpipe piezometers PB10-1, PB10-3, and PB10-4 showed decreases in groundwater level of 0.80 m, 0.29 m, and 0.39 m, respectively, since the spring of 2021 readings. The standpipe piezometer readings are summarized in Table NC102-3 .

The pneumatic and standpipe piezometers are plotted on Figures NC102-1 (2010 instruments) and NC102-2 (2015 instruments) in Appendix A.

4. RECOMMENDATIONS

4.1 Future Work

The instruments should be read again in the spring of 2023. PB10-2 is blocked at 2.7 m below the top of pipe. When the instrument was read during the spring of 2021 readings, the dipmeter became stuck inside the pipe. It should therefore be removed from the readings program going forward.

4.2 Instrumentation Repairs

No 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

PROFESSIONAL ENGINEER ALBERTA
BRUCE W. NESTOR
ID 161284

July 6, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 91085
DATE: July 7, 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. 32122-NC102)
  - SI Reading Plots
  - Figure NC102-1 (Piezometer Depths, 2010 Instruments)
  - Figure NC102-2 (Piezometer Depths, 2015 Instruments)

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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.

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

SPRING 2022

APPENDIX A
DATA PRESENTATION AND SITE PLANS

SITE NC102 (NC024-2): HWY 41:23 KEHIWIN LAKE (km 8.8)

ALBERTA TRANSPORTATION
NORTH CENTRAL REGION - ATHABASCA AND FORT McMURRAY DISTRICTS
INSTRUMENTATION MONITORING FIELD SUMMARY (NC102)
SPRING 2022

Location: Kehiwin Lake (HWY 41:23 C1 8.888)	**Readout:** RST C108 PN unit 4
File Number: 32122	**Casing Diameter:** 2.75"
Probe: RST set 5R and 8R	**Temp:** 18
Cable: RST set 5R and 8R	**Read by:** NKR/JD

SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location (UTM 12)		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	507287.34	5989236.19	27-May-22	0.89	66 to 4	275	-674	683	355	-366	5R/5R	
SI10-3	507262.45	5989246.17	25-May-22	0.95	64 to 4	305	73	-61	334	-329	8R/8R	
SI11-1	507254.65	5989210.55	25-May-22	0.77	32 to 2	282	-385	402	-7	11	8R/8R	Pile Wall NC24B
SI11-2	507268.34	5989246.18	25-May-22	0.81	34 to 2	308	243	-224	-684	687	8R/8R	Pile Wall NC24B
SI11-3	507279.42	5989276.23	25-May-22	1.10	34 to 2	315	-528	538	611	-606	8R/8R	Pile Wall NC24B
SI15-1	507254.71	5989170.50	27-May-22	0.93	32 to 2	297	421	-411	404	-422	5R/5R	
SI15-2	507236.37	5989178.26	27-May-22	1.00	48 to 2	300	409	-386	687	-682	8R/8R	
SI15-3	507232.44	5989179.36	27-May-22	1.08	28 to 2	300	-399	416	79	-74	8R/8R	
SI15-4	507242.28	5989168.25	27-May-22	1.13	48 to 2	310	421	-407	543	-561	5R/5R	
SI16-1	507238.05	5990972.19	27-May-22	0.95	42 to 2	290	296	-272	142	-138	8R/8R	Pile Wall NC24D (SIP04)
SI16-2	507238.82	5990957.80	27-May-22	0.97	42 to 2	285	-40	61	118	-115	8R/8R	Pile Wall NC24D (SIP08)

PNEUMATIC PIEZOMETER (PN) READINGS

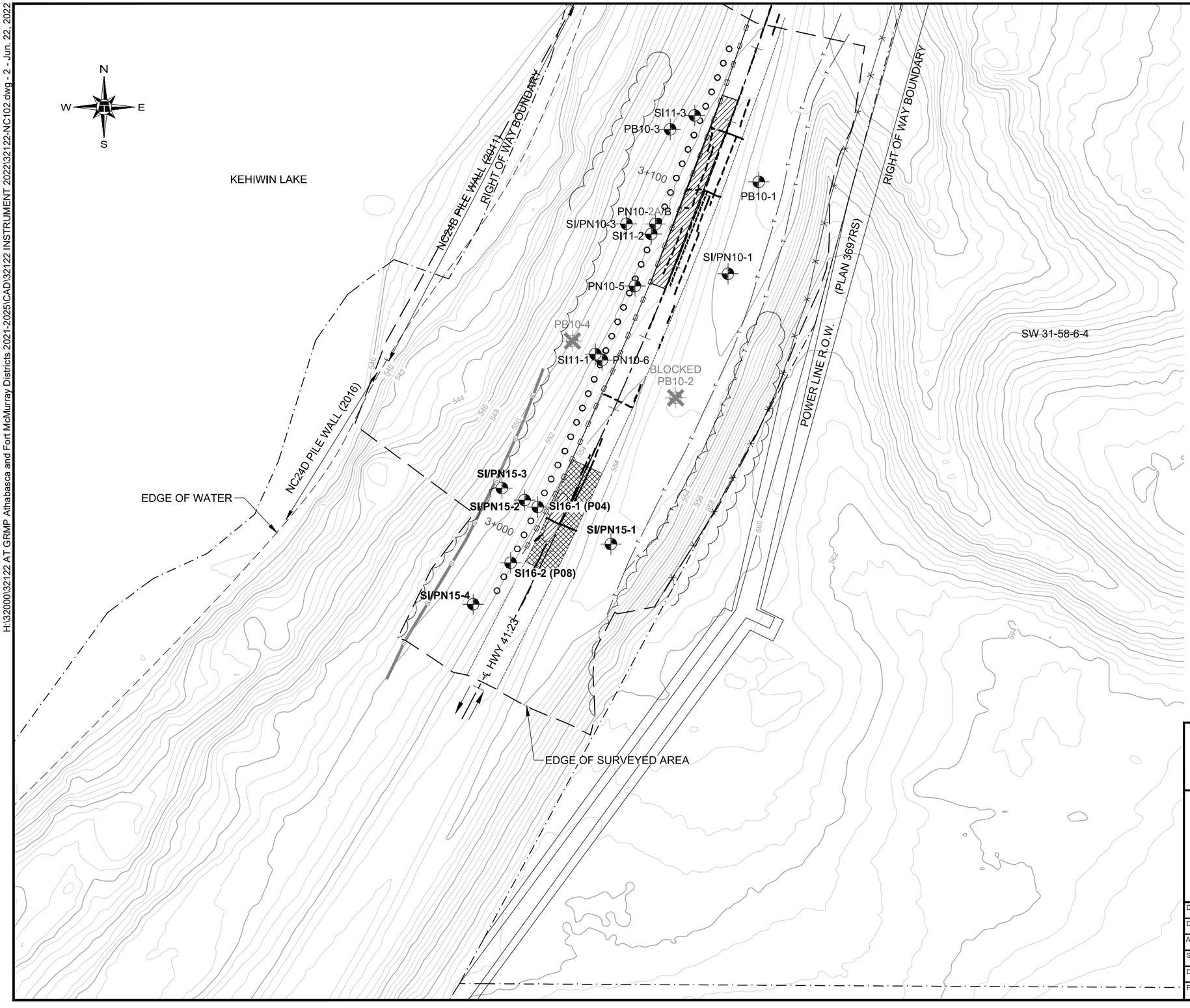
PN #	GPS Location (UTM 12)		Date	Reading (kPa)	Identification Number
	Easting (m)	Northing (m)			
PN10-1	Attached to SI10-1		27-May-22	26.5	33669
PN10-3	Attached to SI10-3		25-May-22	53.1	33666
PN10-5	Attached to SI10-5		25-May-22	30.6	32863
PN10-6	Attached to SI10-6		25-May-22	63	33664
PN15-1	Attached to SI15-1		27-May-22	65.3	36682
PN15-2	Attached to SI15-2		27-May-22	75.7	36689
PN15-3	Attached to SI15-3		27-May-22	26.9	36688
PN15-4	Attached to SI15-4		27-May-22	37.4	36685

STANDPIPE PIEZOMETER (SP) READINGS

PB#	GPS Location (UTM 12)		Date	Stick-up (m)	Water level below top of pipe (m)	Total length of pipe (m)	Poor Boy Probe Depth below top of pipe to bottom of probe (m)			
	Easting (m)	Northing (m)					4'	3'	2'	1'
PB10-1	507293.20	5989259.57	25-May-22	0.76	2.84	20.46	-	-	-	-
PB10-2	507271.68	5989205.01	27-May-22	0.76	4.36	20.72	-	-	-	-
PB10-3	507270.27	5989271.77	27-May-22	0.76	2.29	21.04	-	-	-	-
PB10-4	507247.00	5989219.00	27-May-22	0.76	2.13	2.35**	-	-	-	-

INSPECTOR REPORT

Only water levels recorded in the poor boys.
** Blocked at 2.35m, Original pipe depth was 6.19m
PB 10-2 blocked at 2.7m. Dip meter probe got stuck. Tried pulling out, but probe was stuck - had to cut cable at 2.7m below ground.
SI 15- 3, very stiff 10-12 ft. use dummy for fall readings.



LEGEND

- km 8.8 PILE WALL
- FENCE LINE
- BUSH LINE
- ACTIVE SLIDE CRACKS ON HIGHWAY
- INACTIVE SLIDE CRACKS ON HIGHWAY
- TEST HOLE LOCATION
- SI — SLOPE INCLINOMETER
- PN — PNEUMATIC PIEZOMETER
- PB — POORBOY / STANDPIPE
- DAMAGED/BLOCKED INSTRUMENT
- 550 — GROUND SURFACE CONTOUR
- P — OVERHEAD POWER LINE (APPROXIMATE)
- T — TELUS LINE (APPROXIMATE)
- S — SILT FENCE
- GUARD RAIL
- HIGHWAY DIP AREA
- ACP PATCH
- (P04) — PILE NUMBER

NOTES:

1. CONTOUR INTERVAL IS 0.5m.
2. CONTOURS INSIDE SURVEYED AREA WERE SURVEYED BY WSP. ELEVATION CONTOURS OUTSIDE SURVEYED AREA WERE DERIVED FROM LiDAR DATA.
3. NC24D PILE WALL IS AN EXTENSION TO THE ORIGINAL NC24B PILE WALL CONSTRUCTED IN 2011.

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

Alberta

NORTH CENTRAL
(ATHABASCA AND FORT MCMURRAY DISTRICTS)

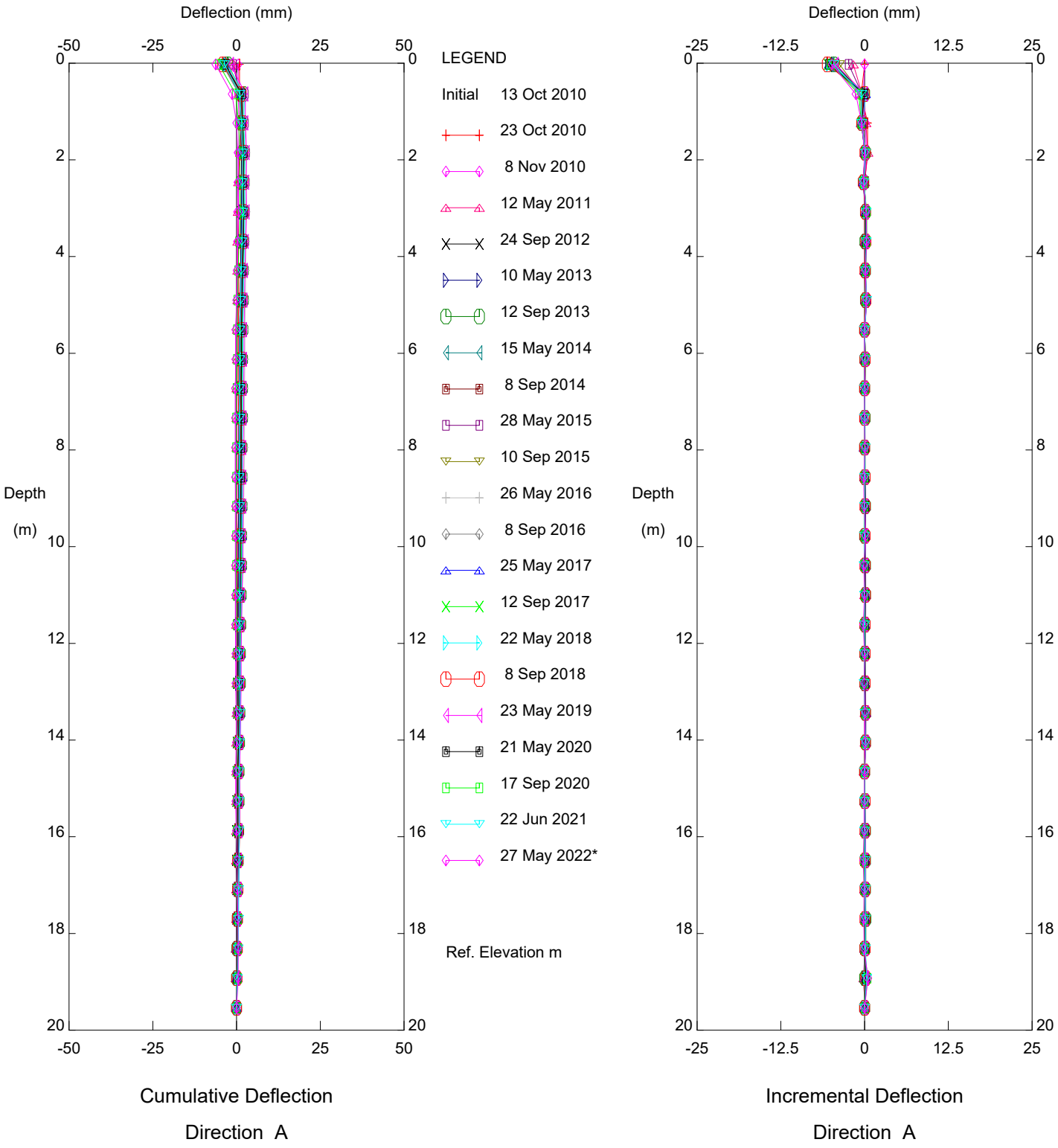
NC102: HWY 41:23 SLIDE (km8.8)
SITE PLAN SHOWING APPROXIMATE INSTRUMENT LOCATIONS

DWG NO. 32122-NC102

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	TSA
SCALE	1:1000
DATE	JUNE 2022
FILE No.	32122

THURBER ENGINEERING LTD.

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

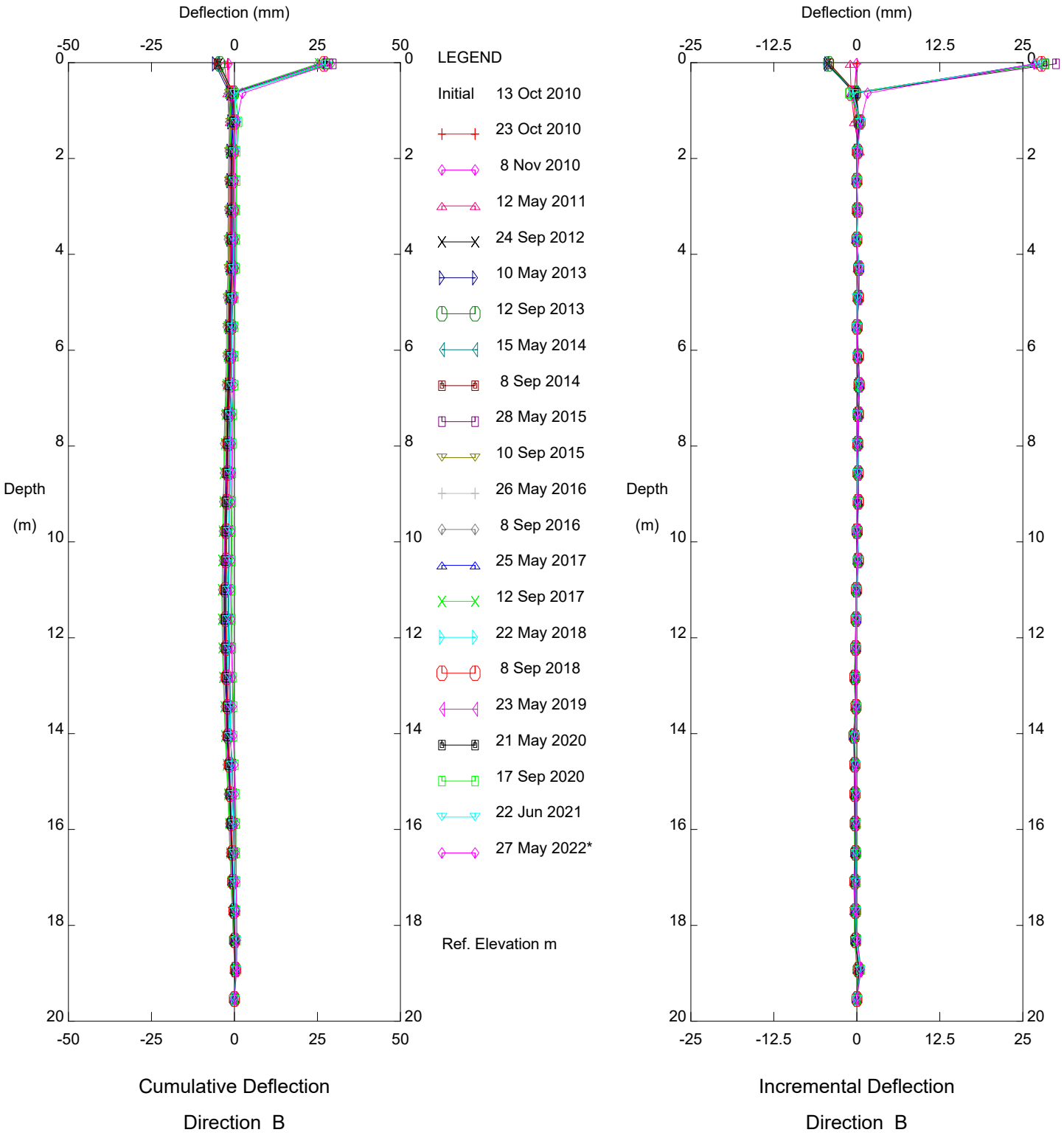
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI10-1

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI10-1.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

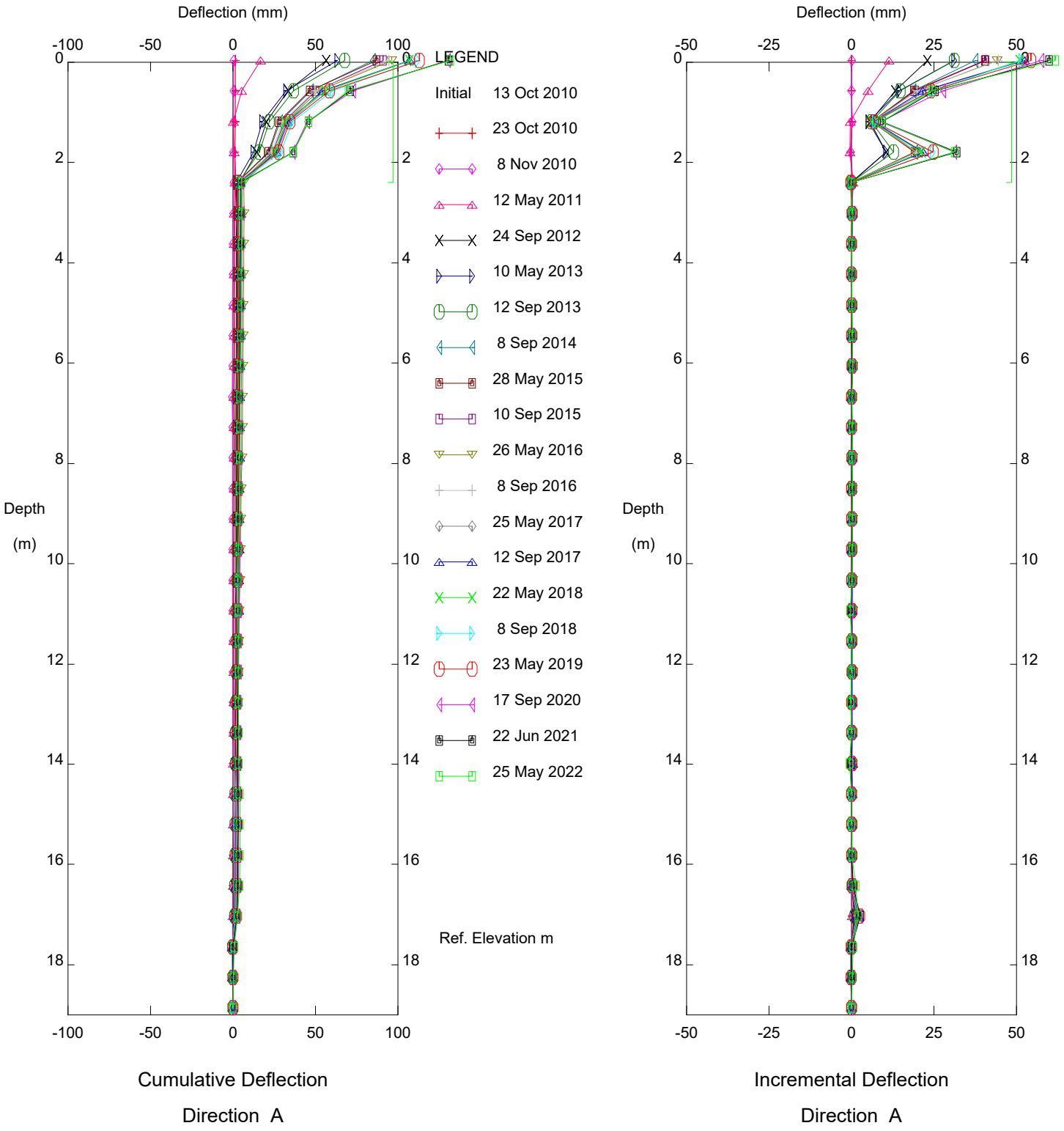
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI10-1

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI10-1.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

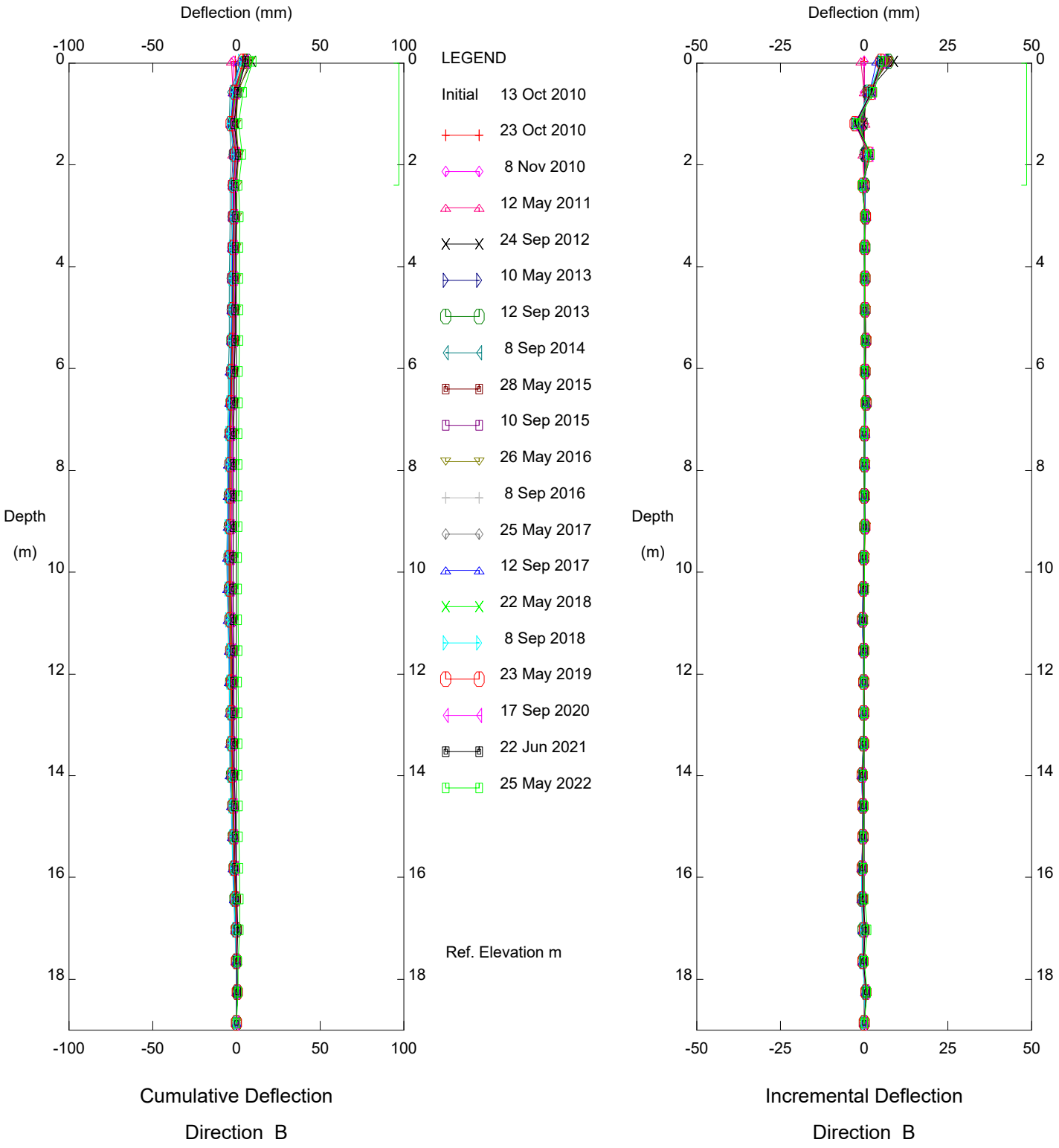
Direction A

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI10-3

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI10-3.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

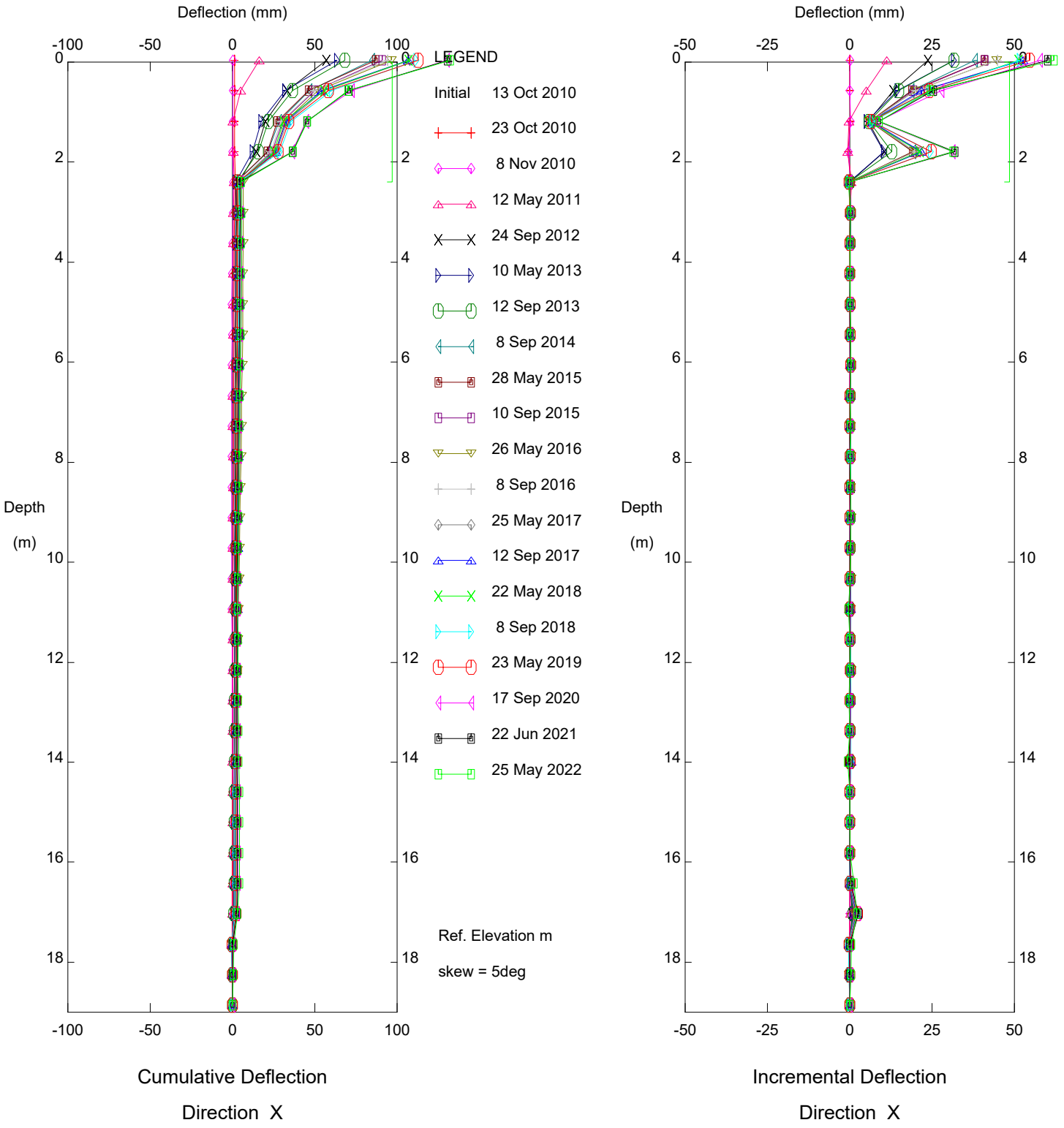
Direction B

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI10-3

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI10-3.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

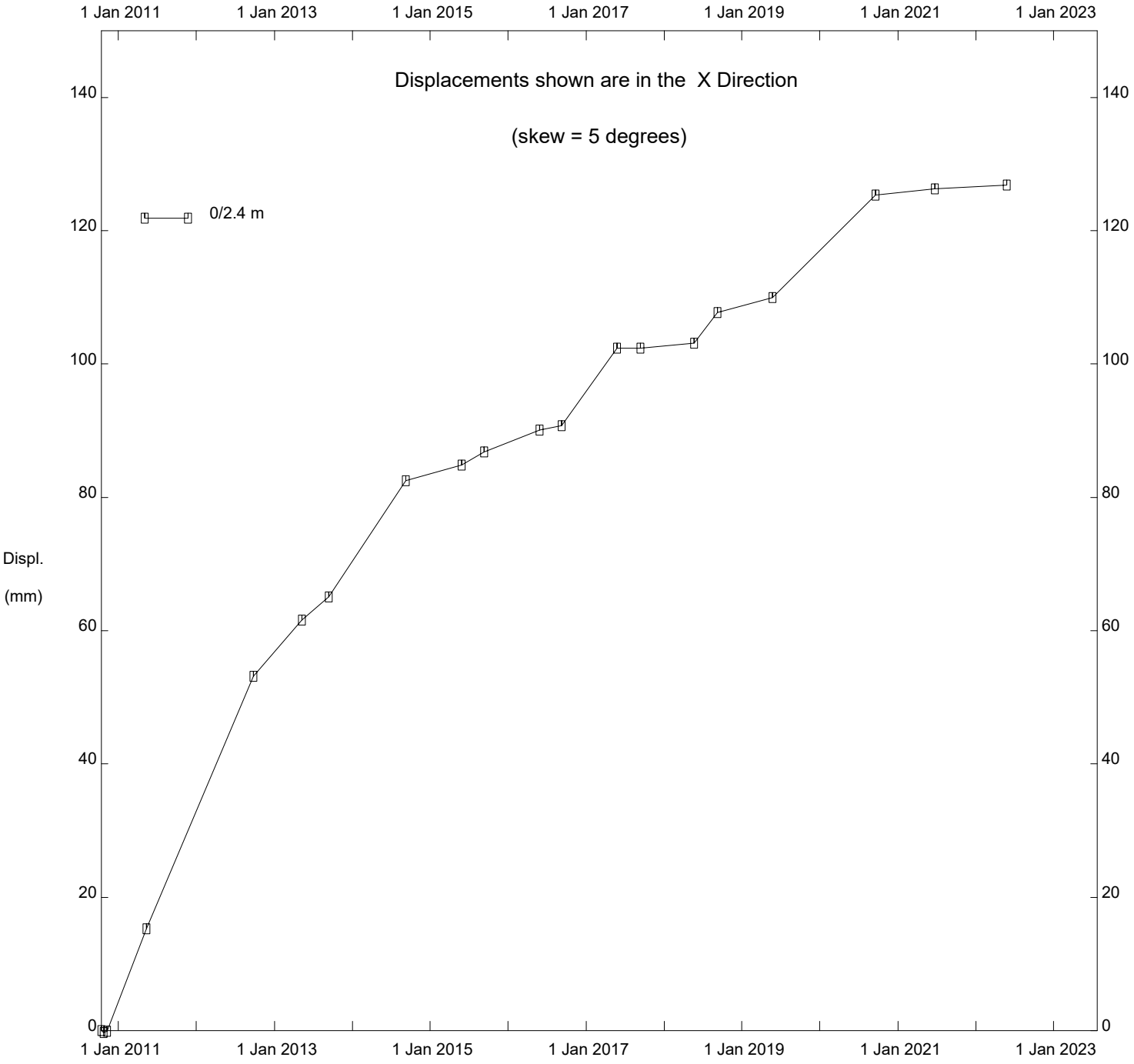
Direction X

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI10-3

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI10-3.gtl

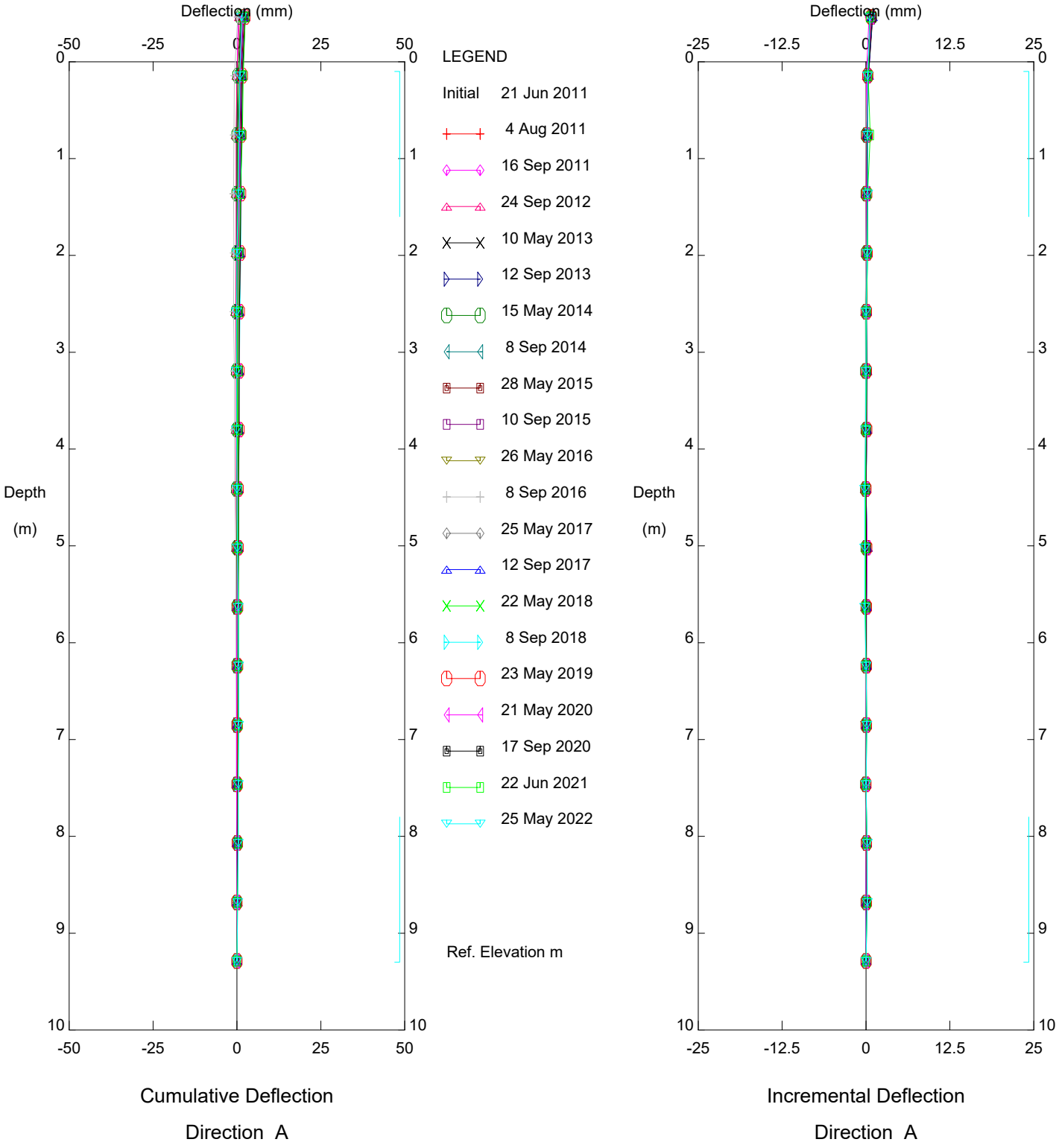
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI10-3

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

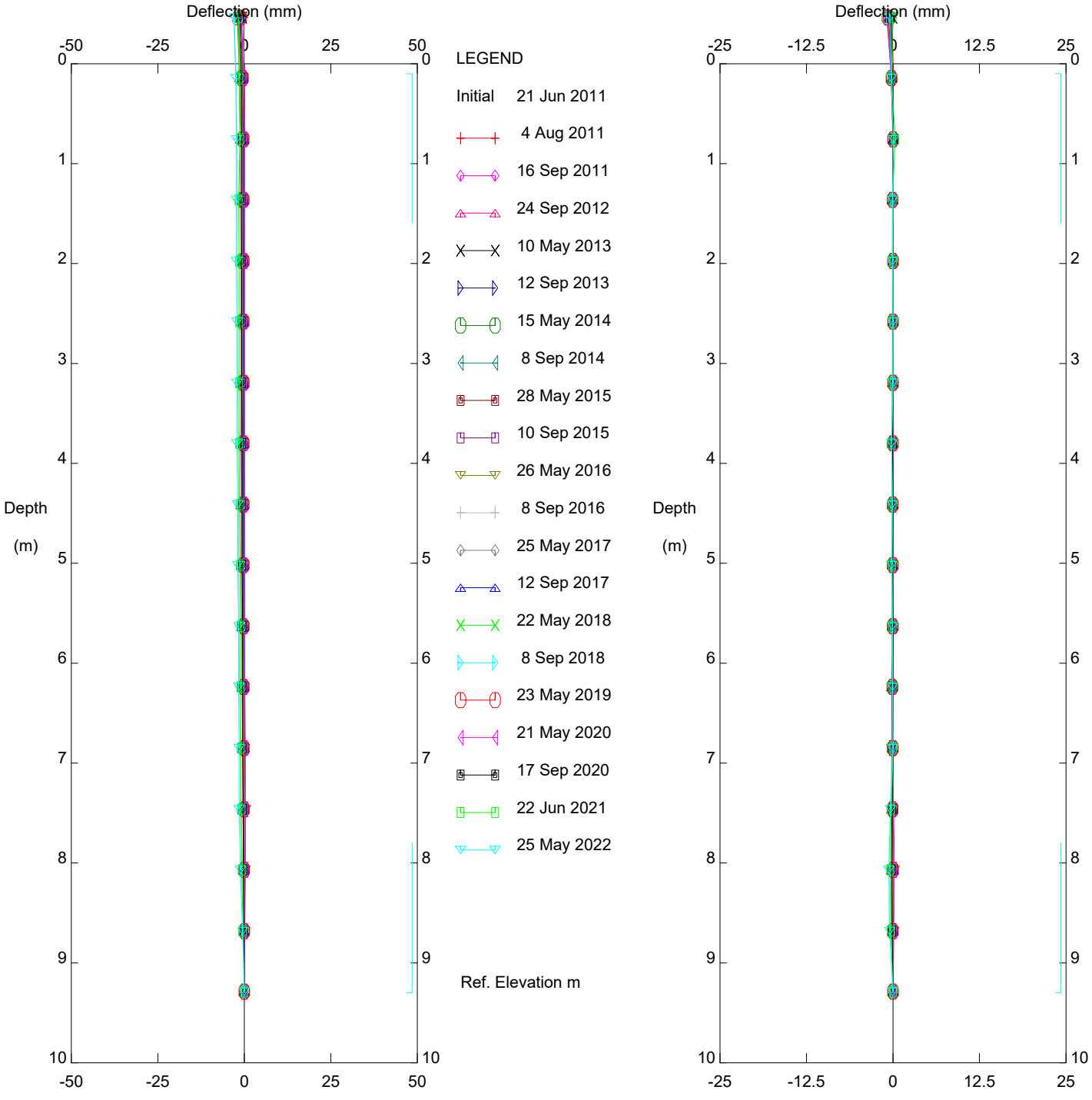
Direction A

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-1 (P7)

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-1(km 8.8).gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

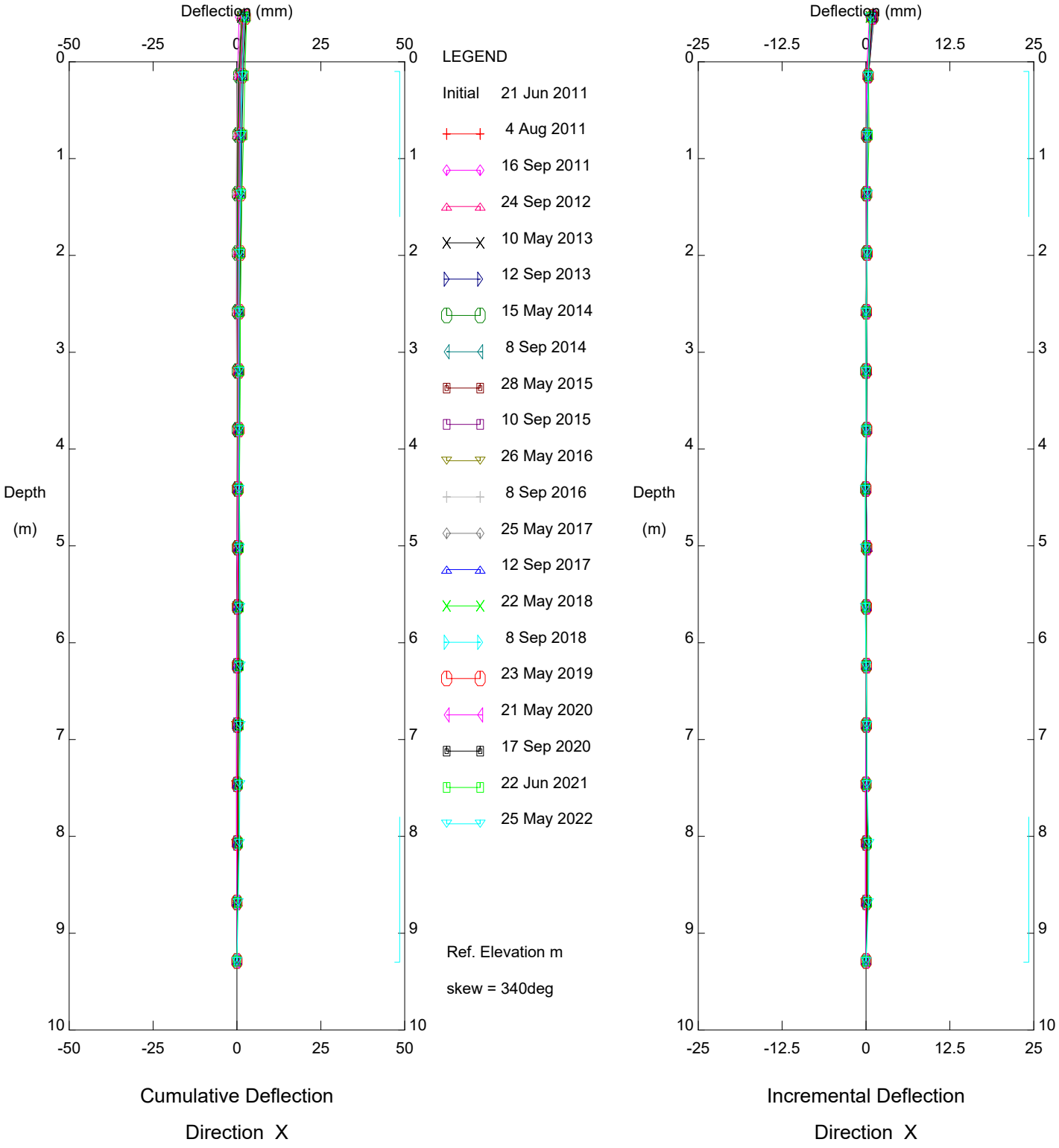
Direction B

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-1 (P7)

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-1(km 8.8).gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

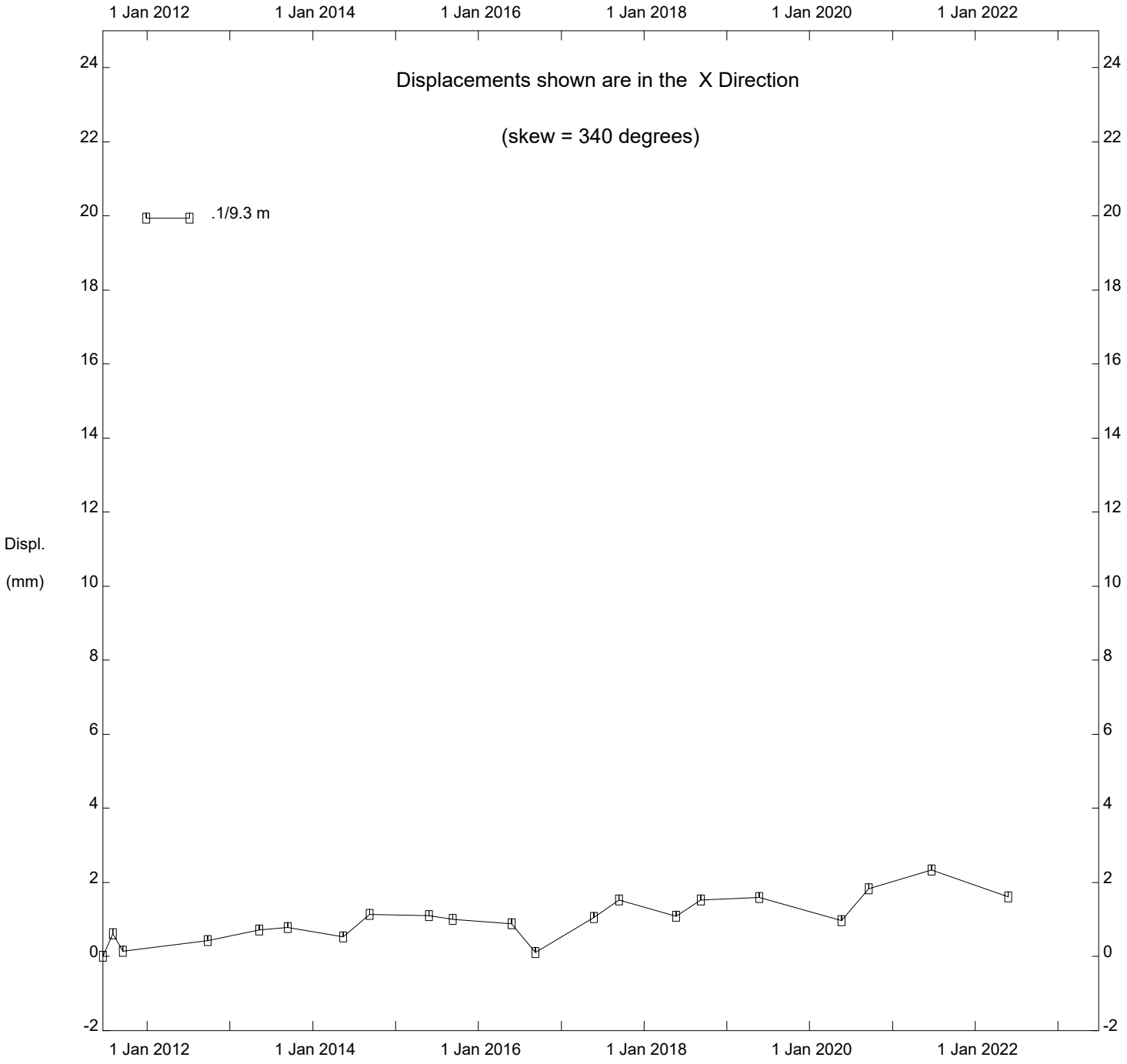
Direction X

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-1 (P7)

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-1(km 8.8).gtl

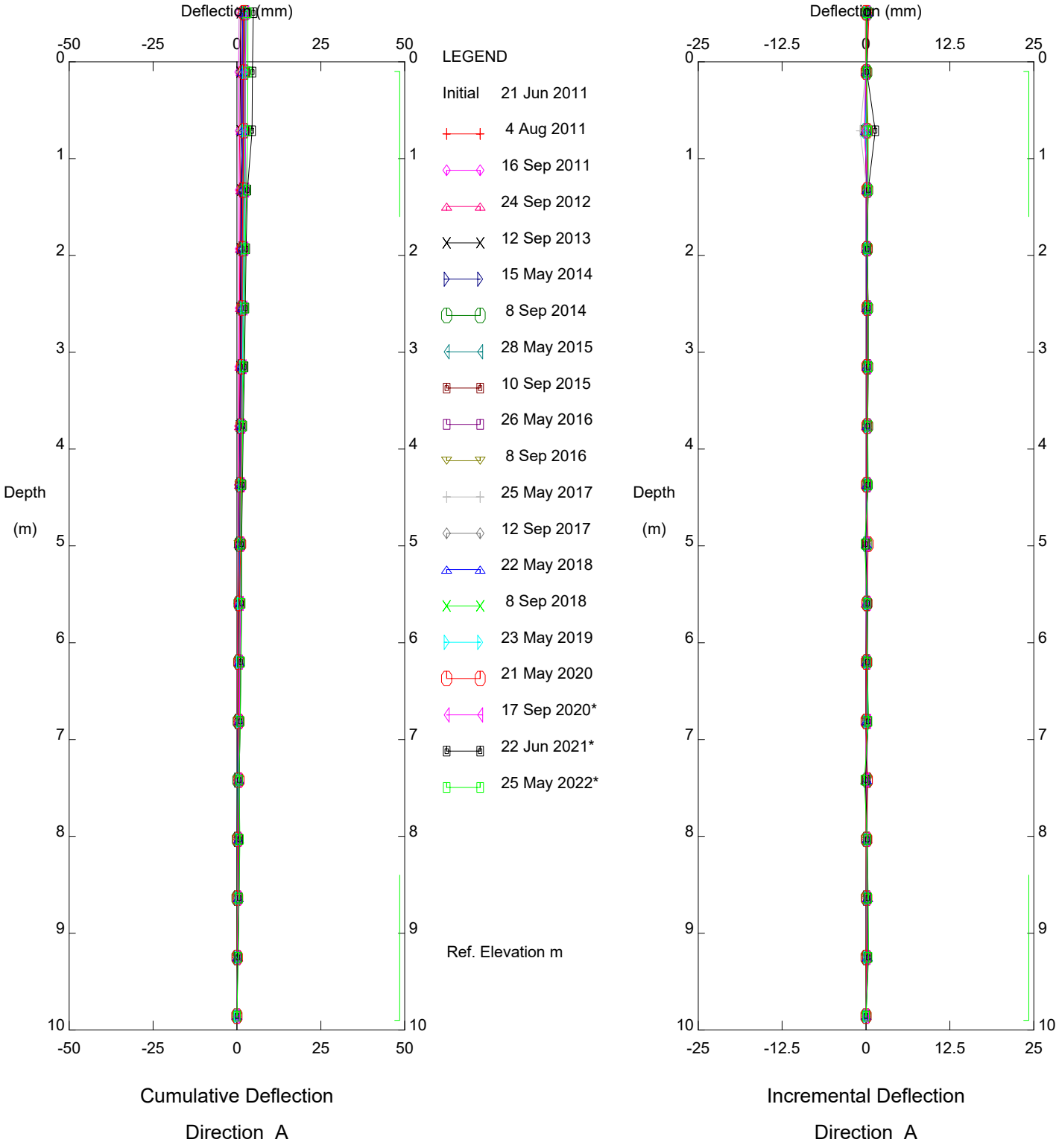
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-1 (P7)

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

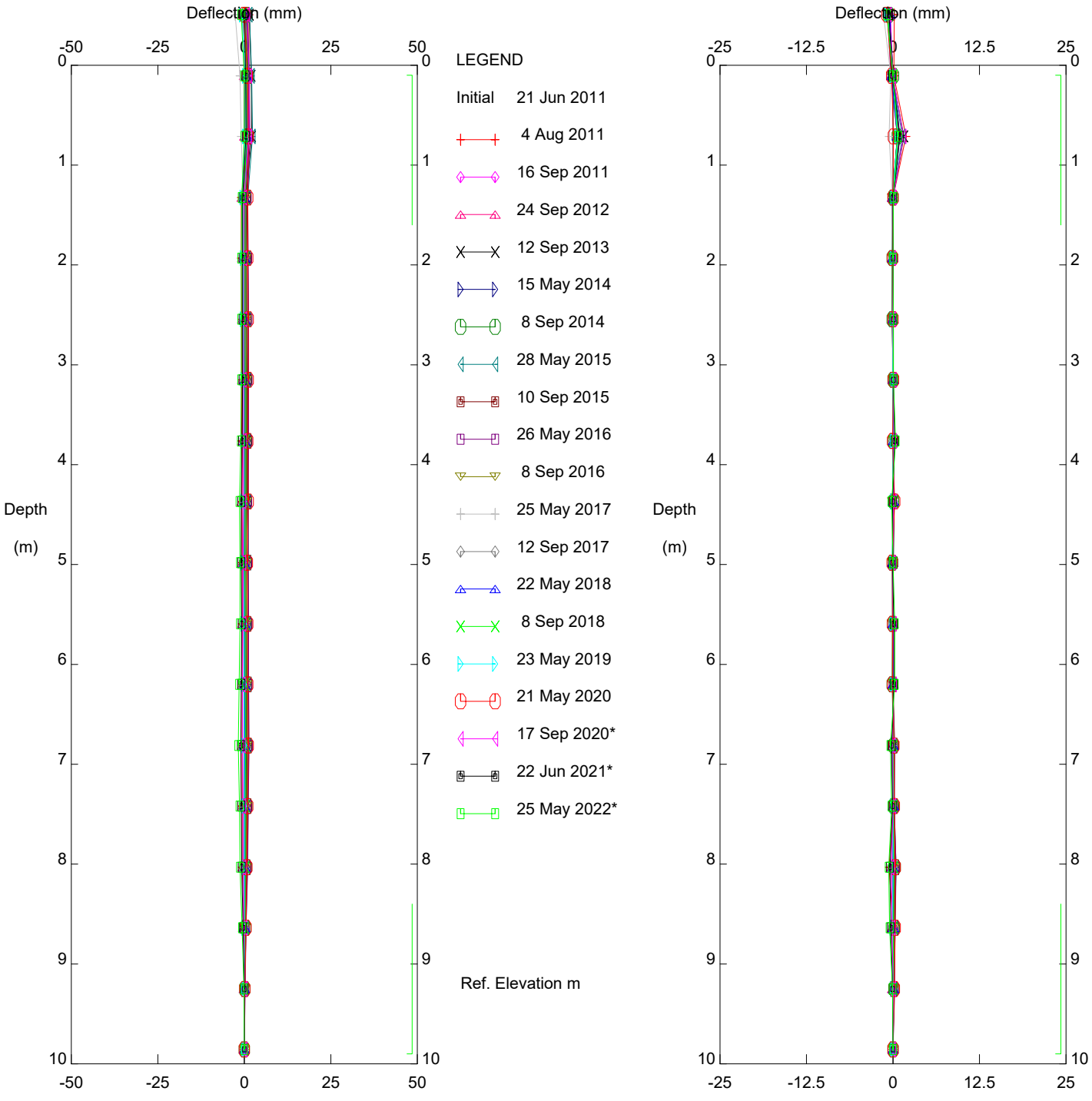
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-2 (P16)

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-2(km 8.8).gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

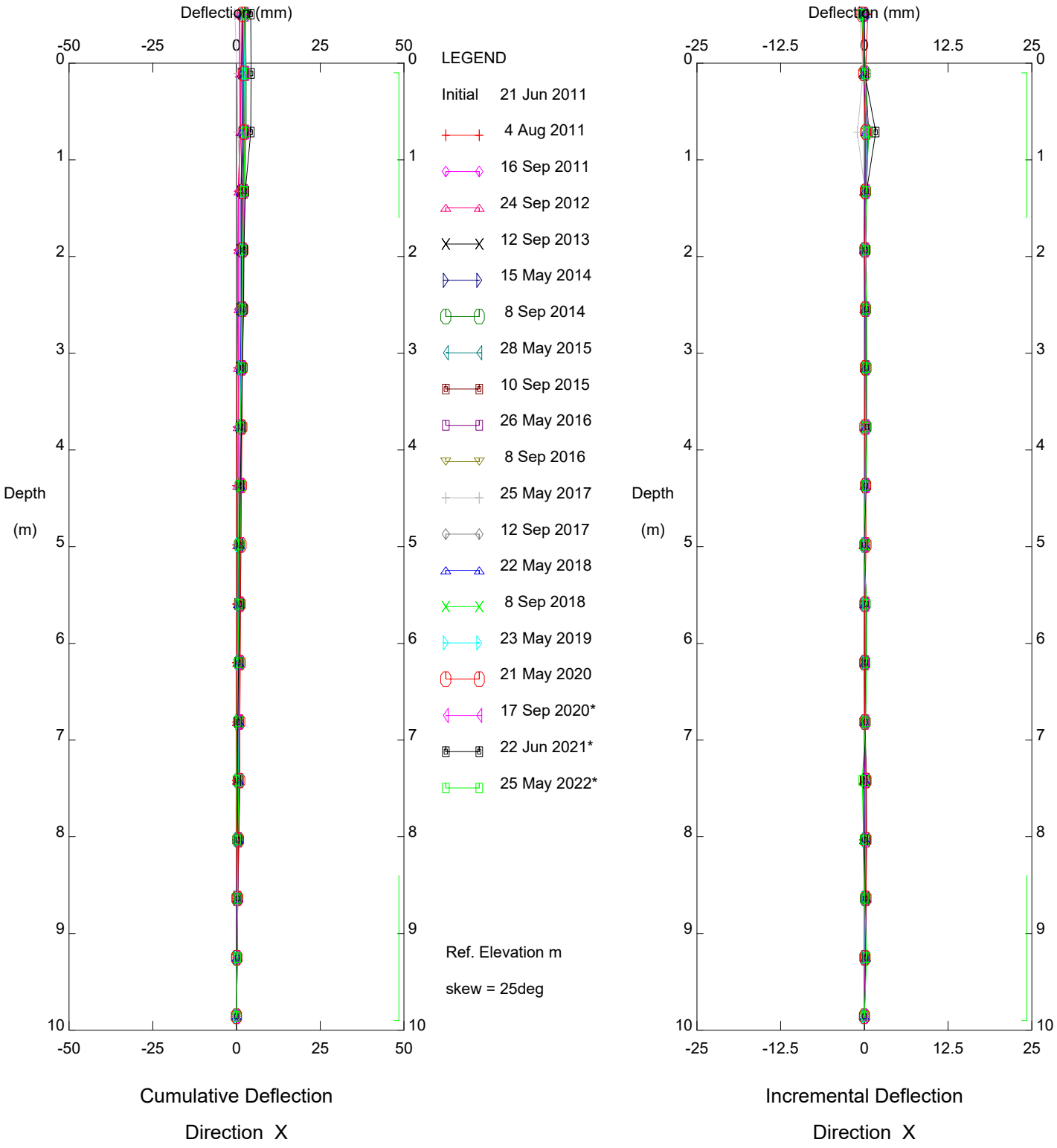
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-2 (P16)

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-2(km 8.8).gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

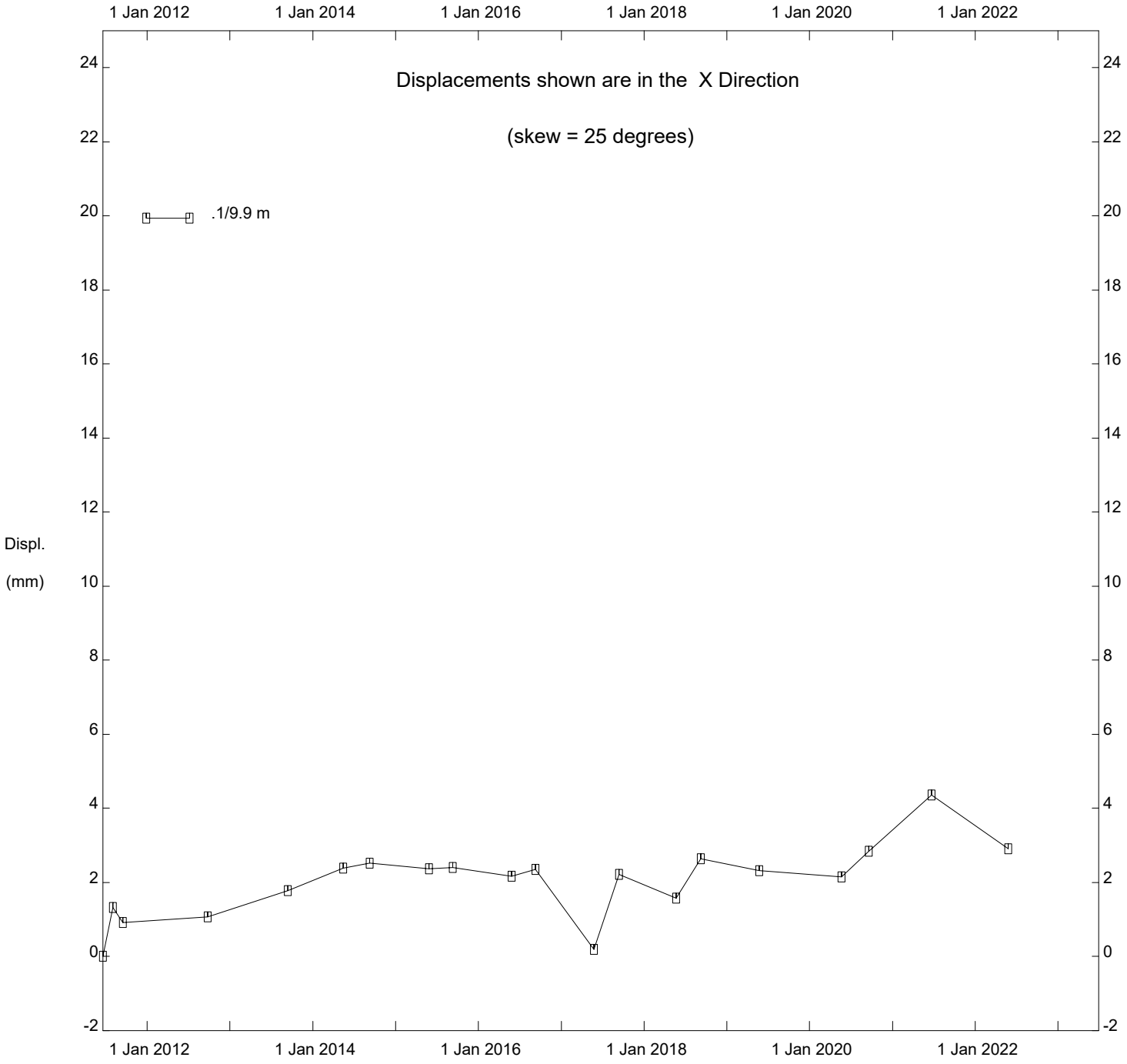
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-2 (P16)

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-2(km 8.8).gtl

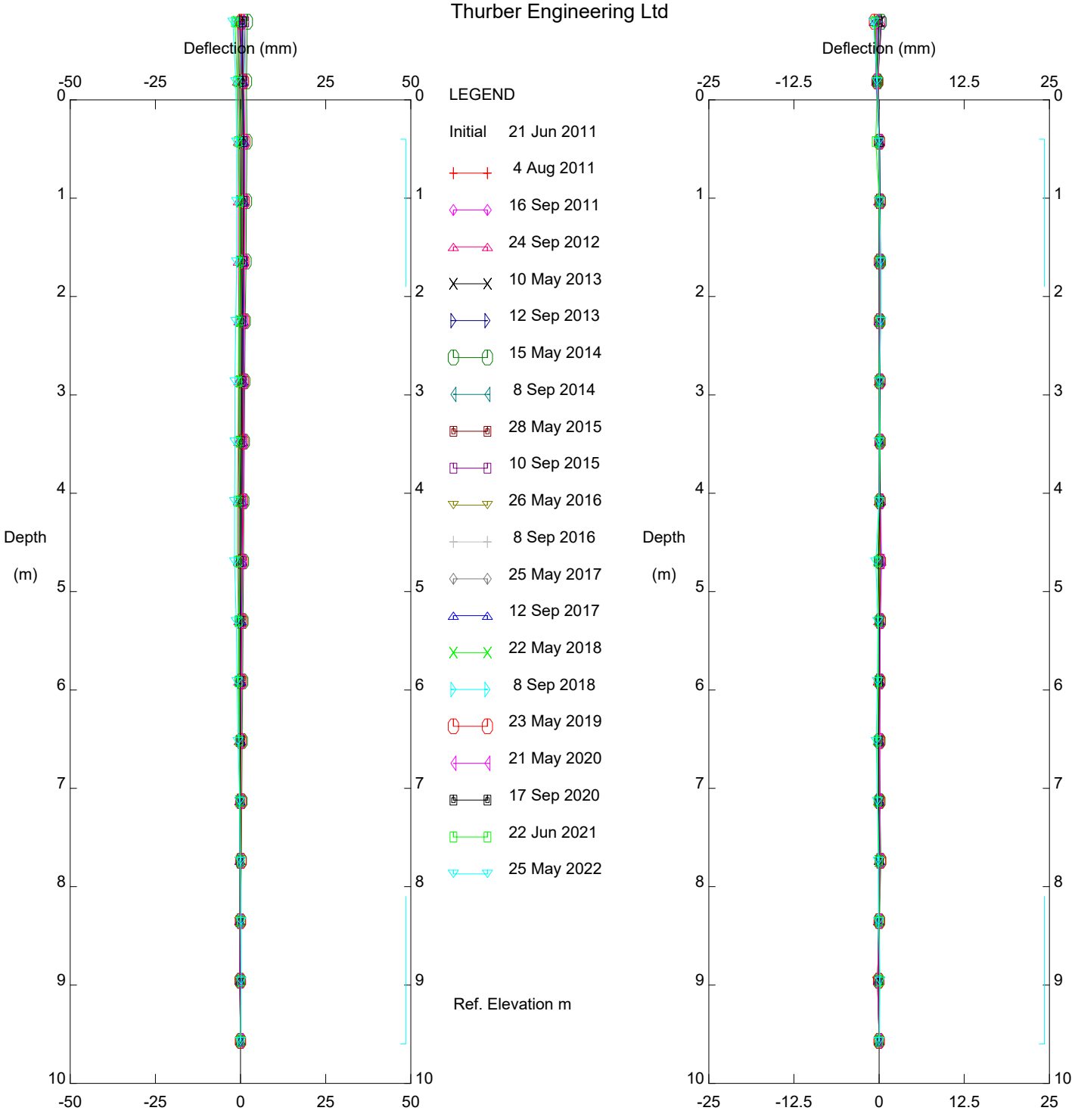
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-2 (P16)

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

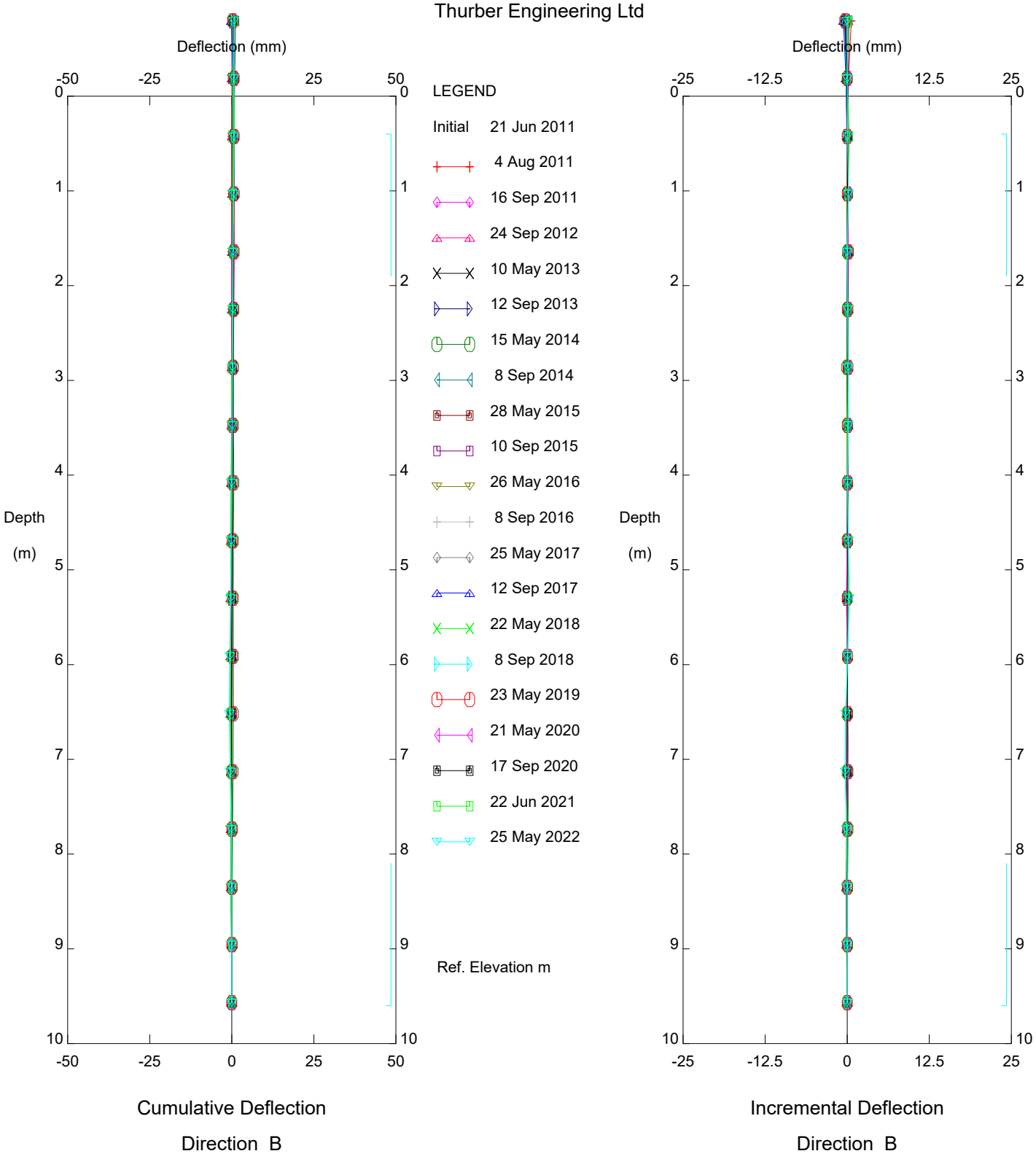
Direction A

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-3 (P24)

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-3(km 8.8).gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

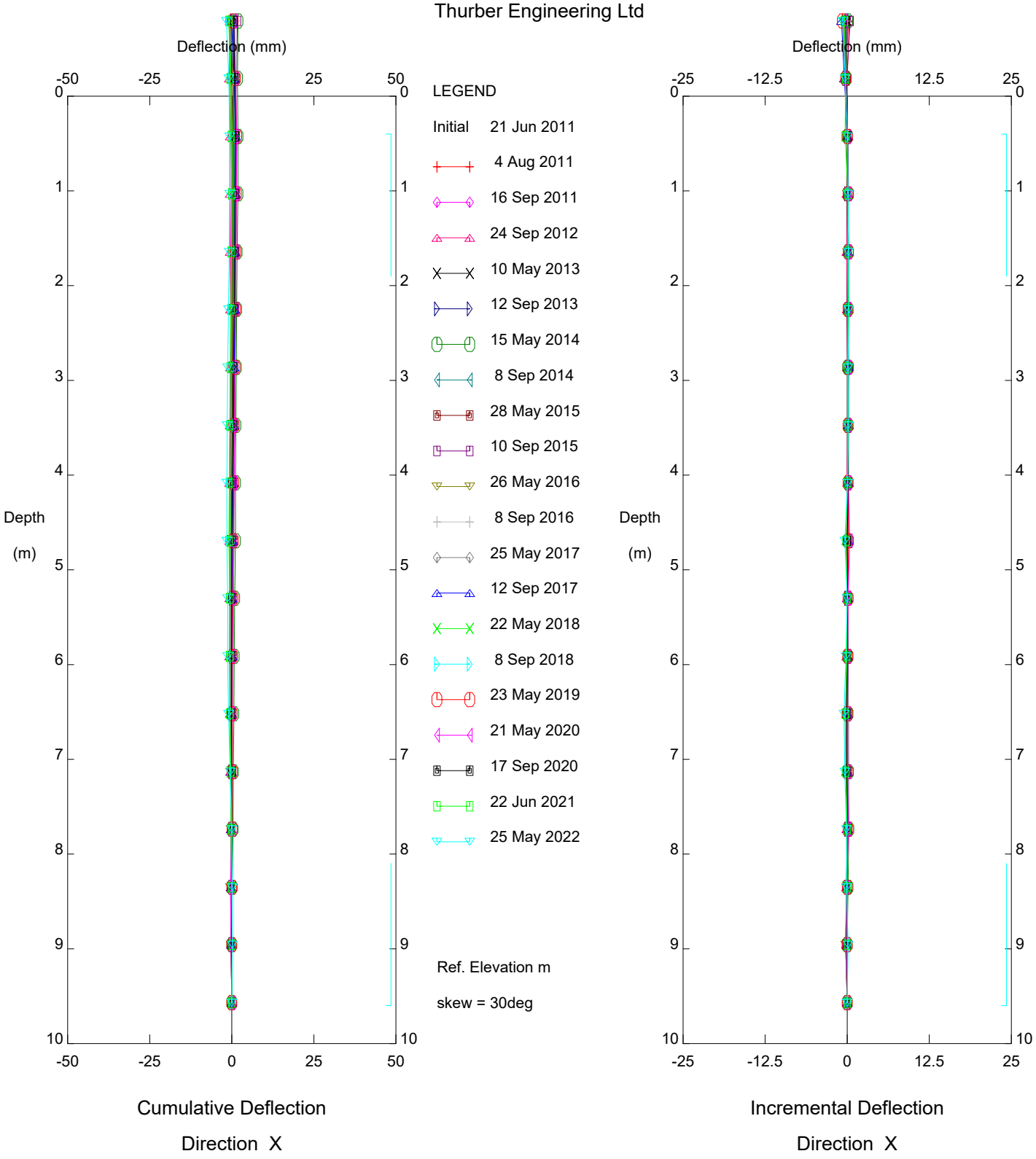
Direction B

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-3 (P24)

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-3(km 8.8).gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

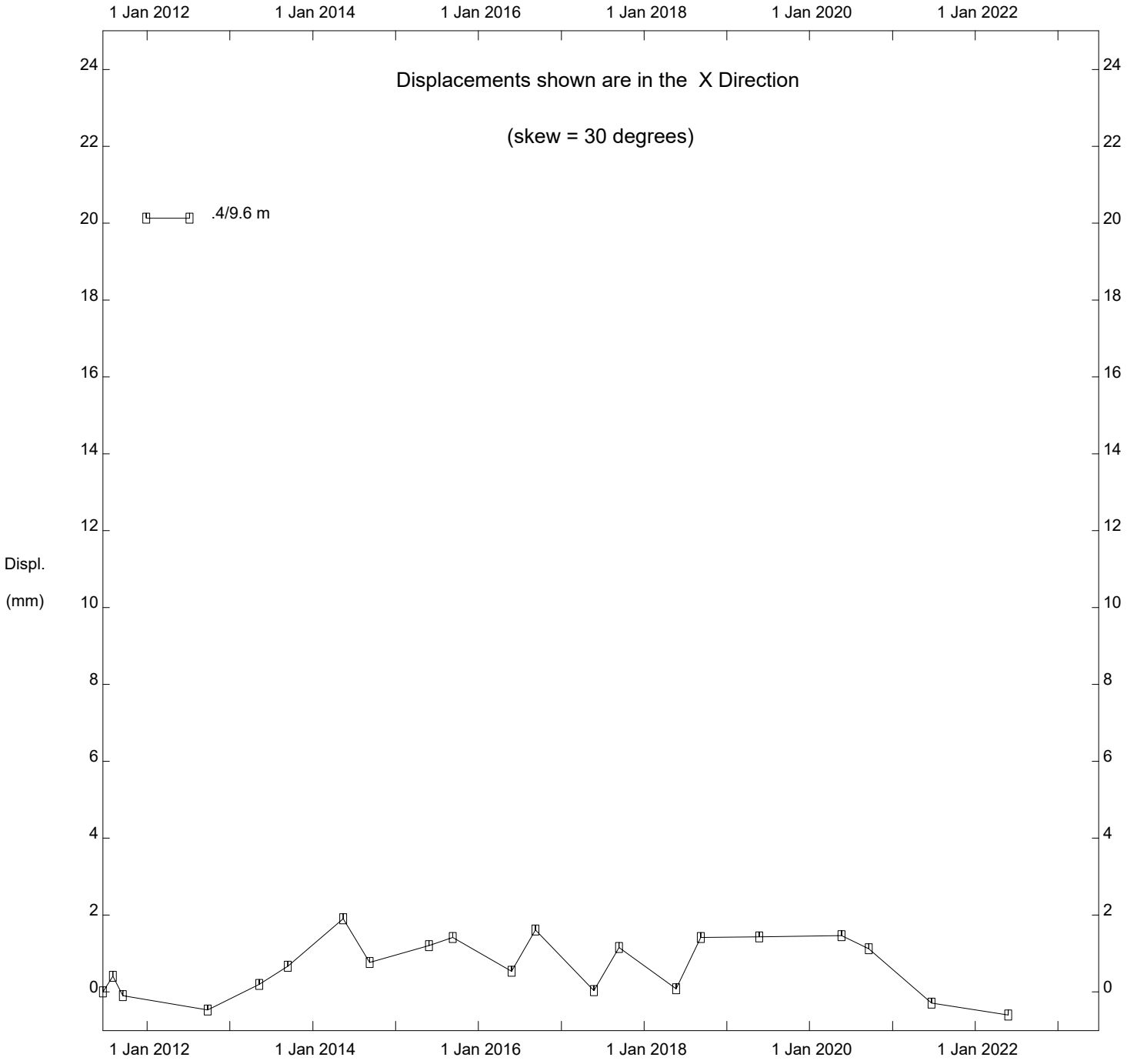
Direction X

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-3 (P24)

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI11-3(km 8.8).gtl

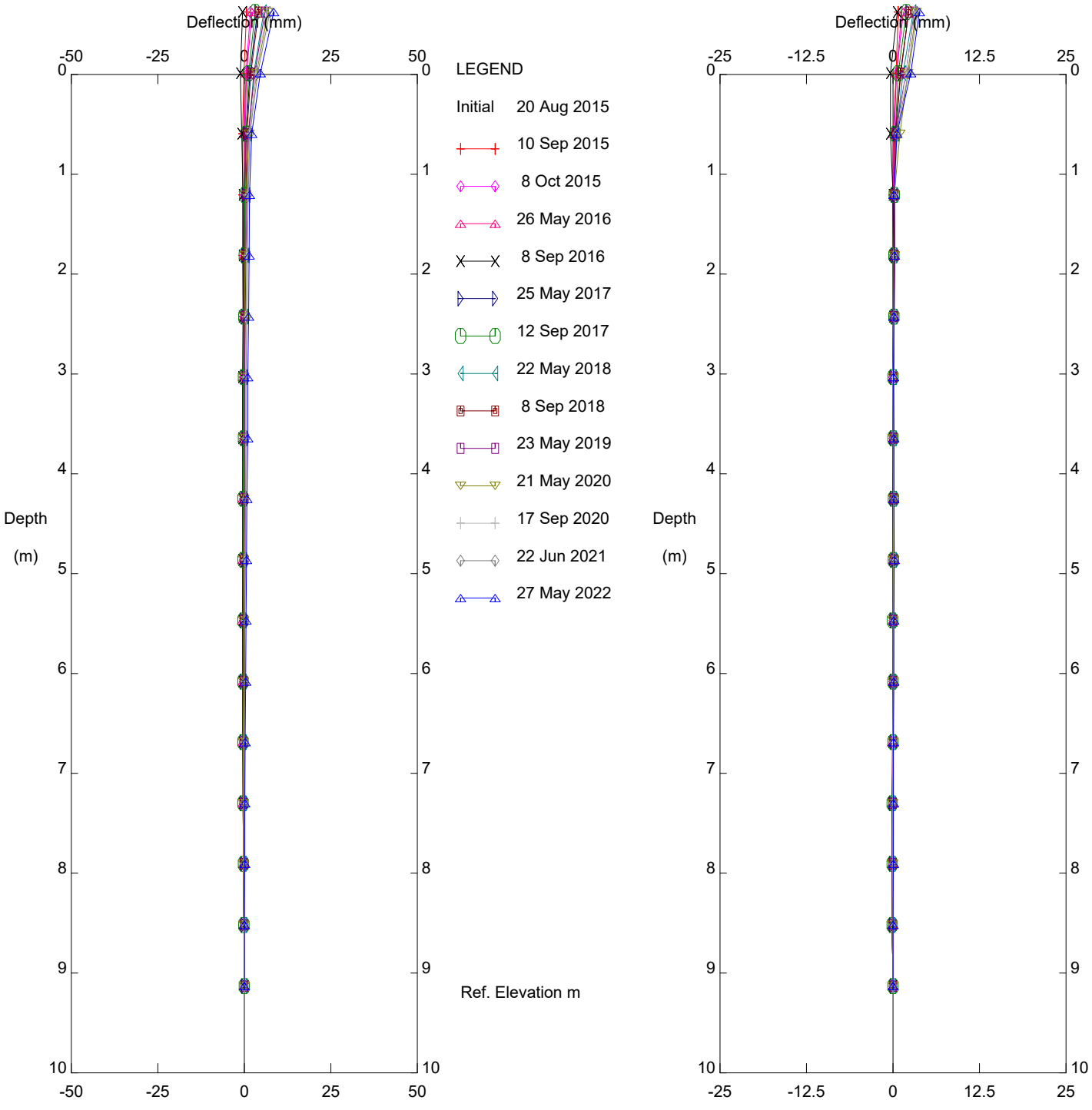
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI11-3 (P24)

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

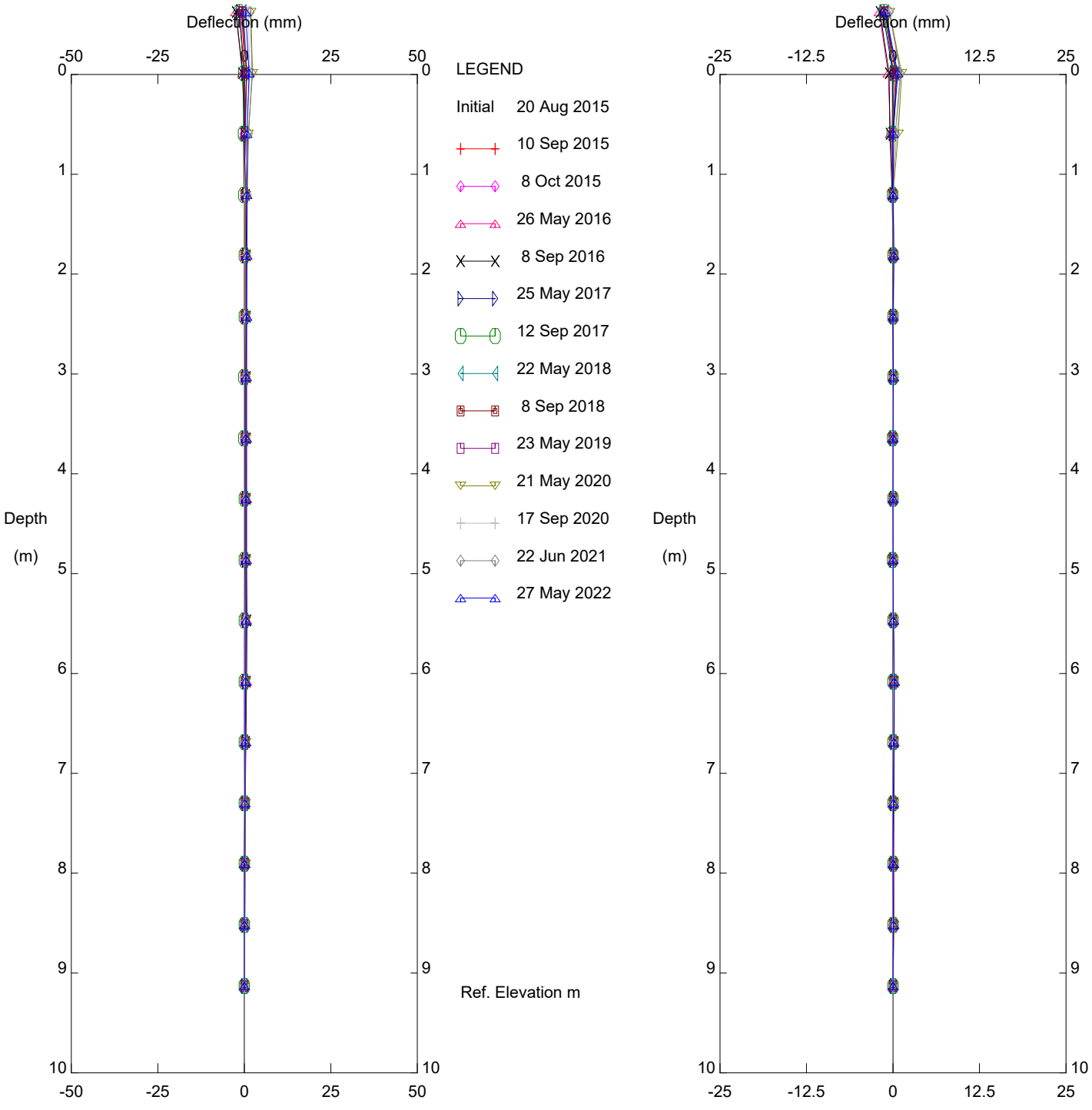
Direction A

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-1

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI15-1.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-1

Alberta Transportation

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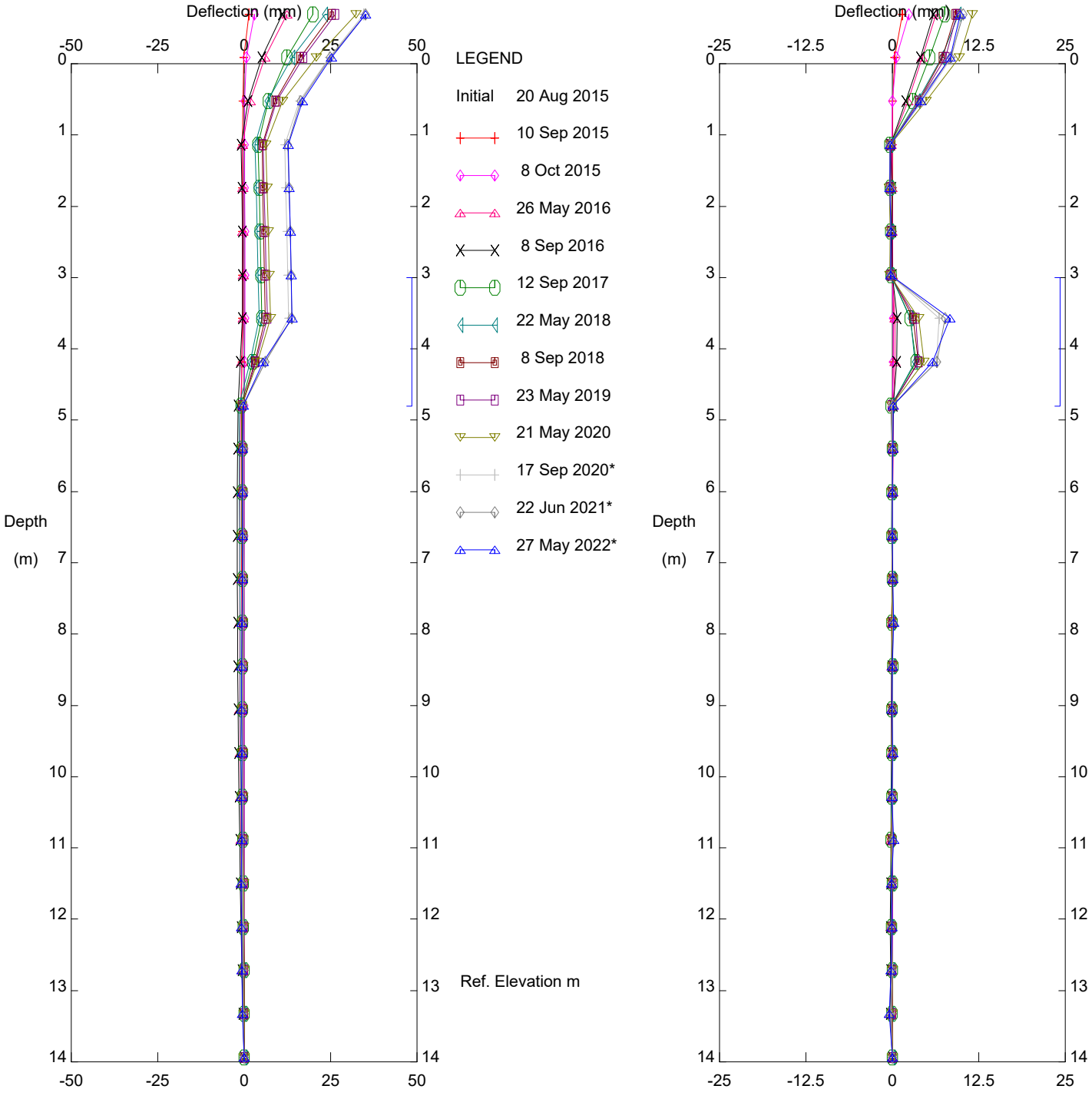
Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-2

Alberta Transportation

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

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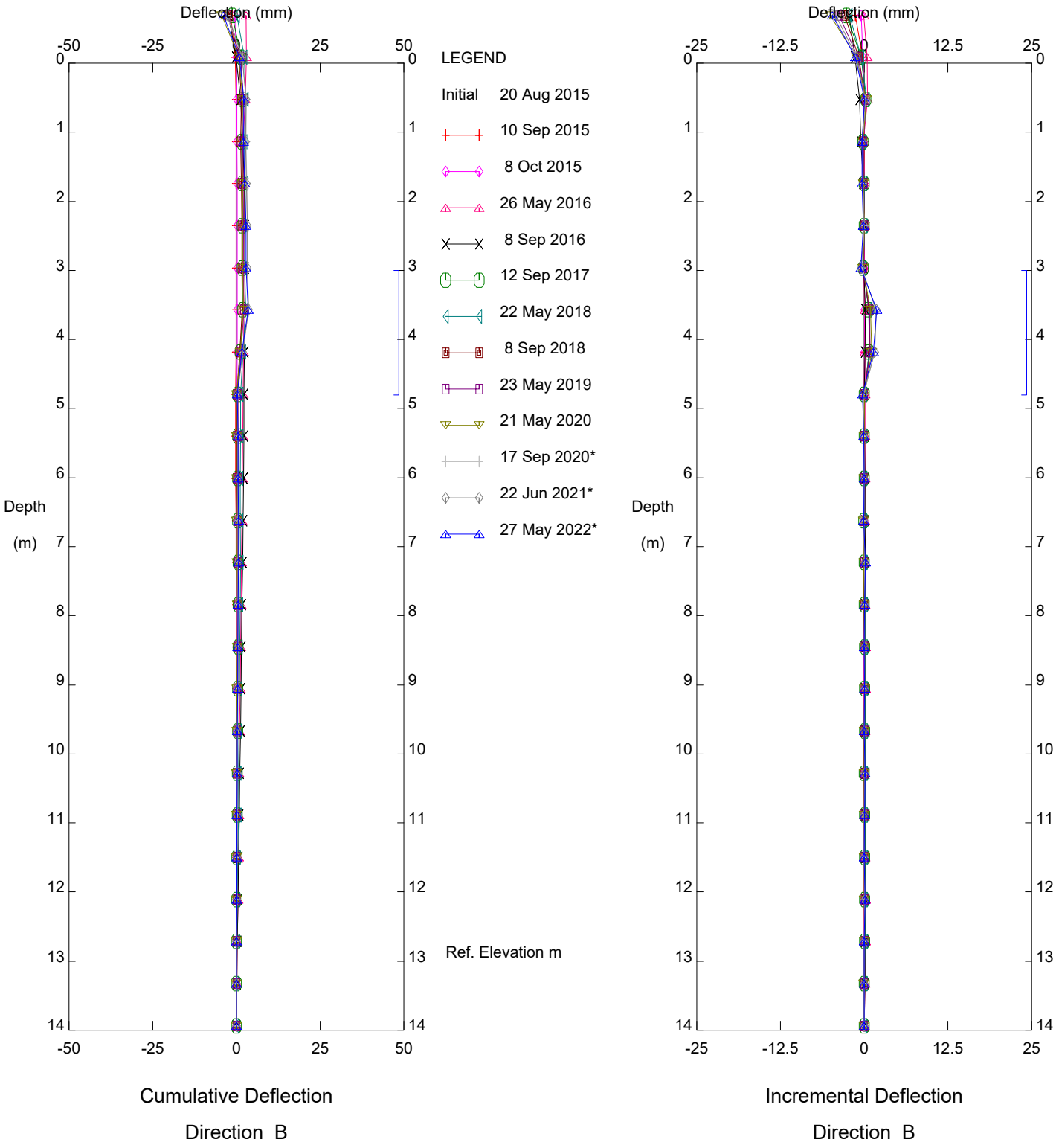
Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-2

Alberta Transportation

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

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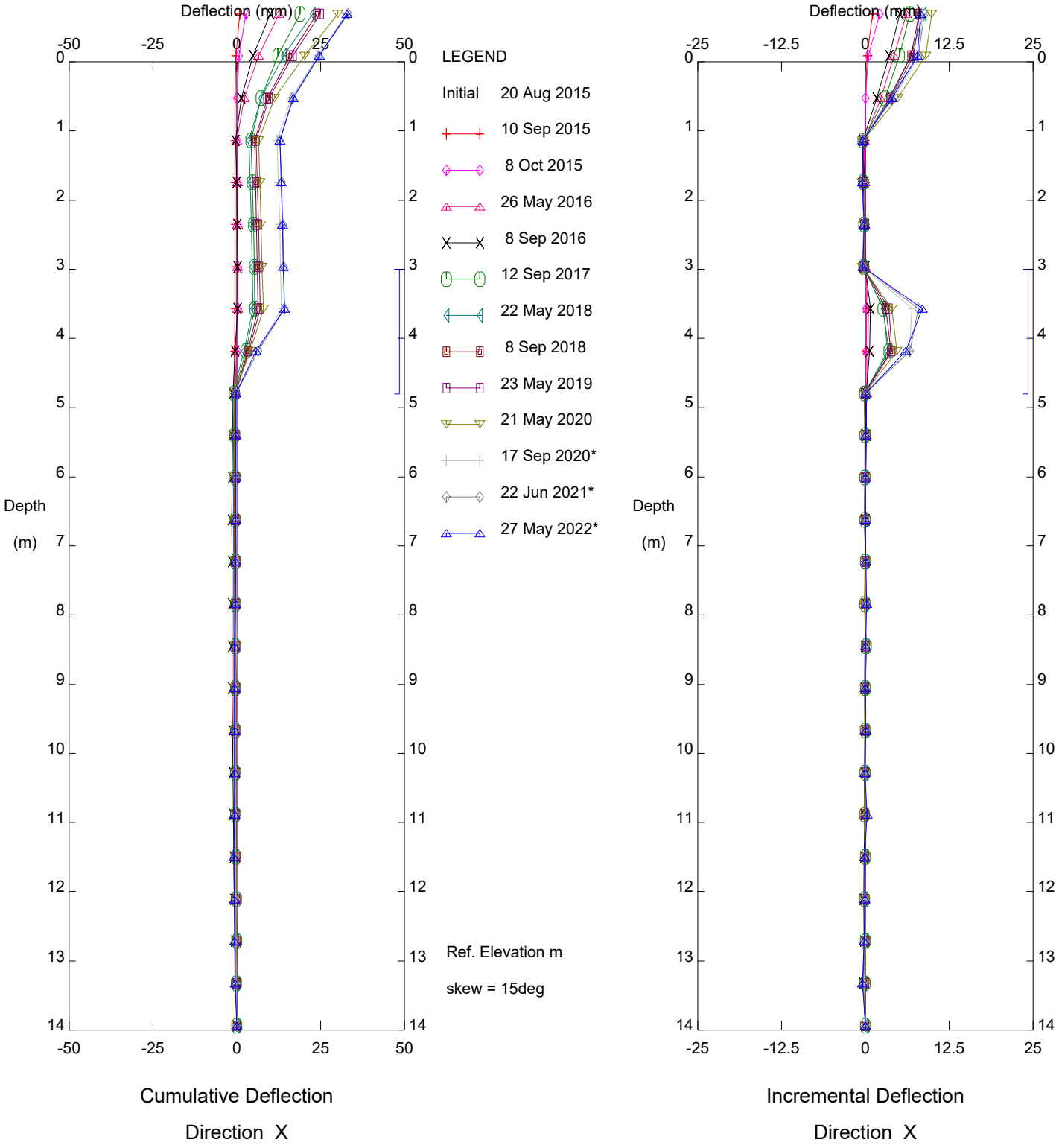
Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

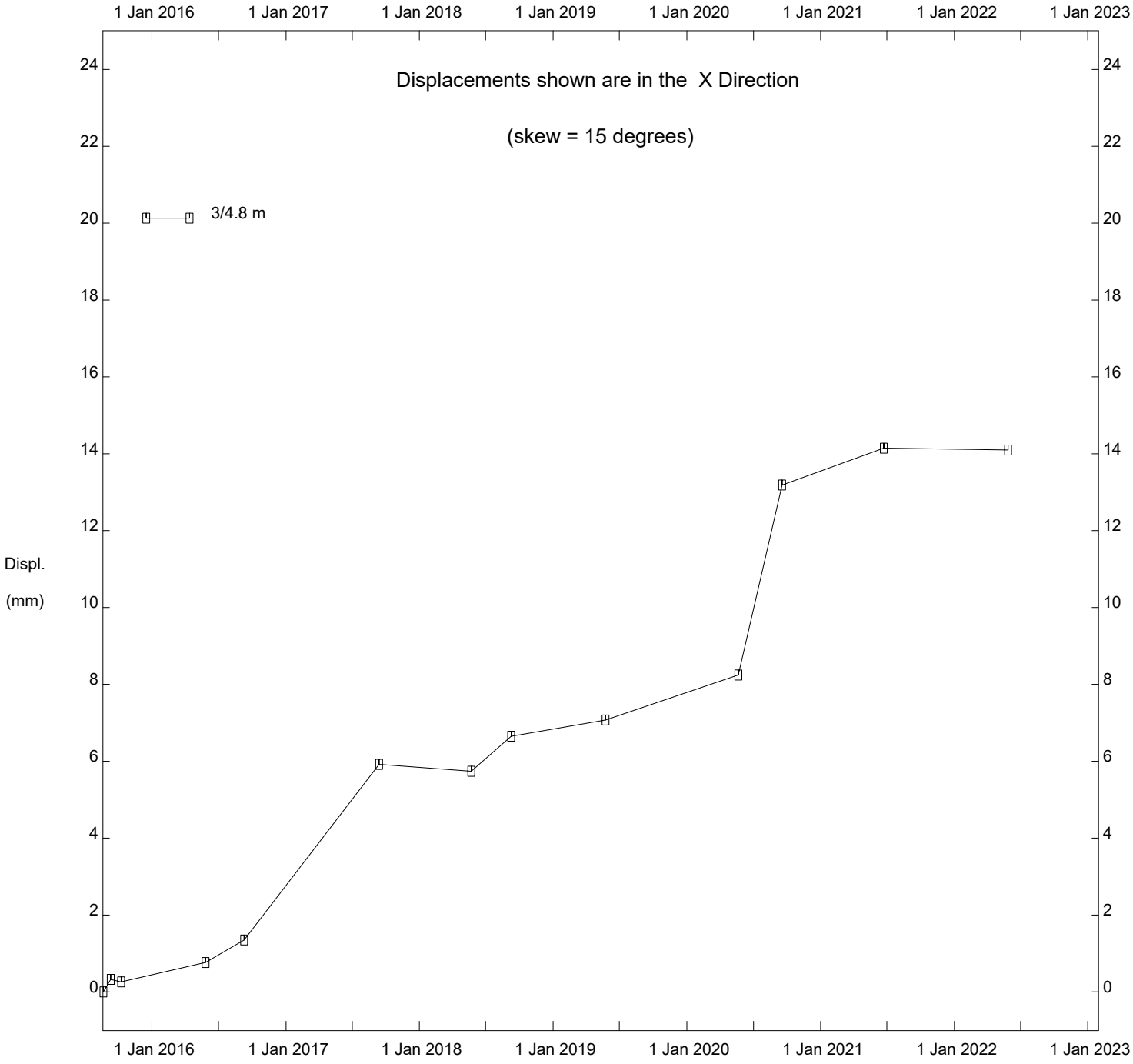
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-2

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI15-2.gtl

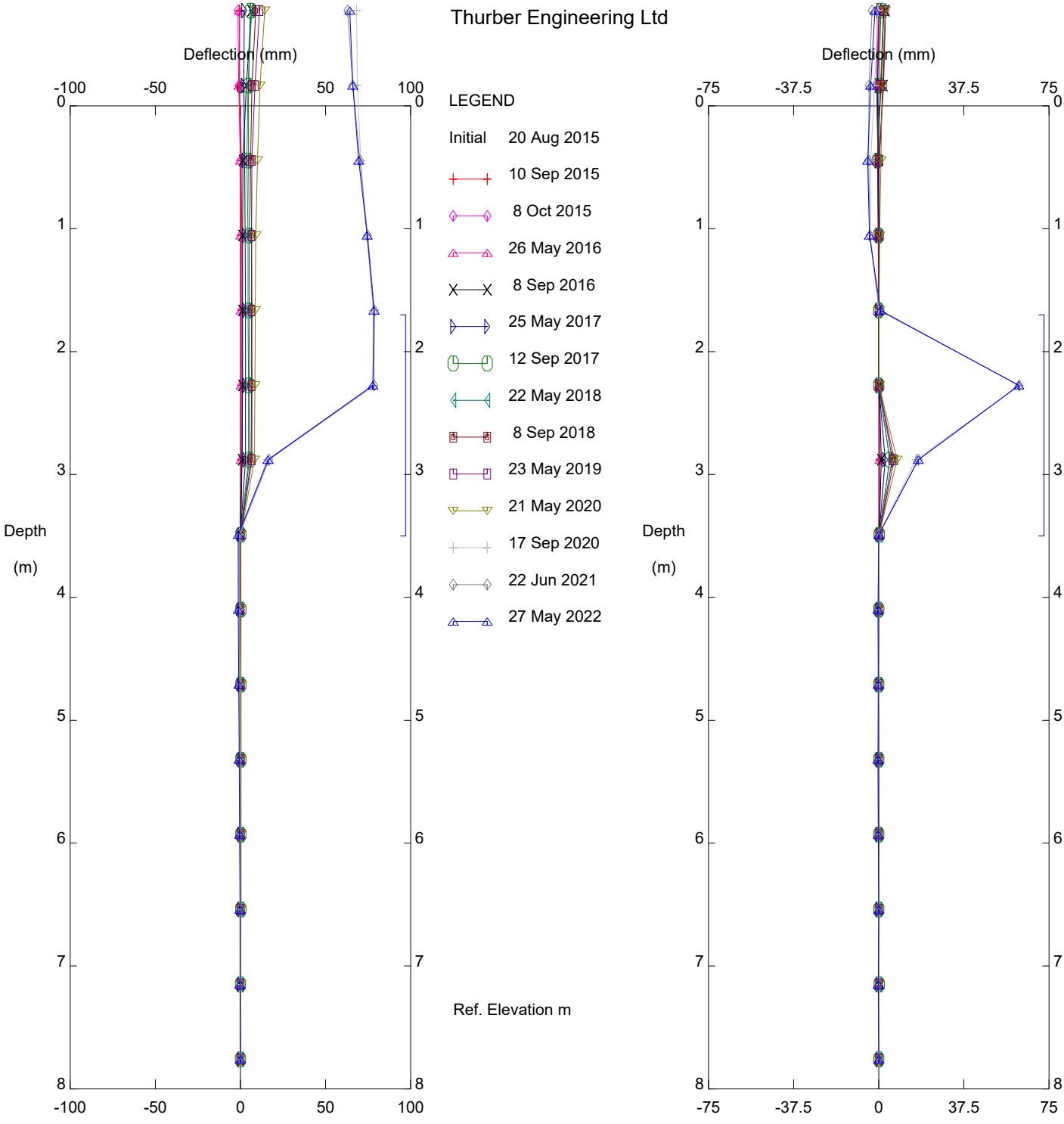
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-2

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

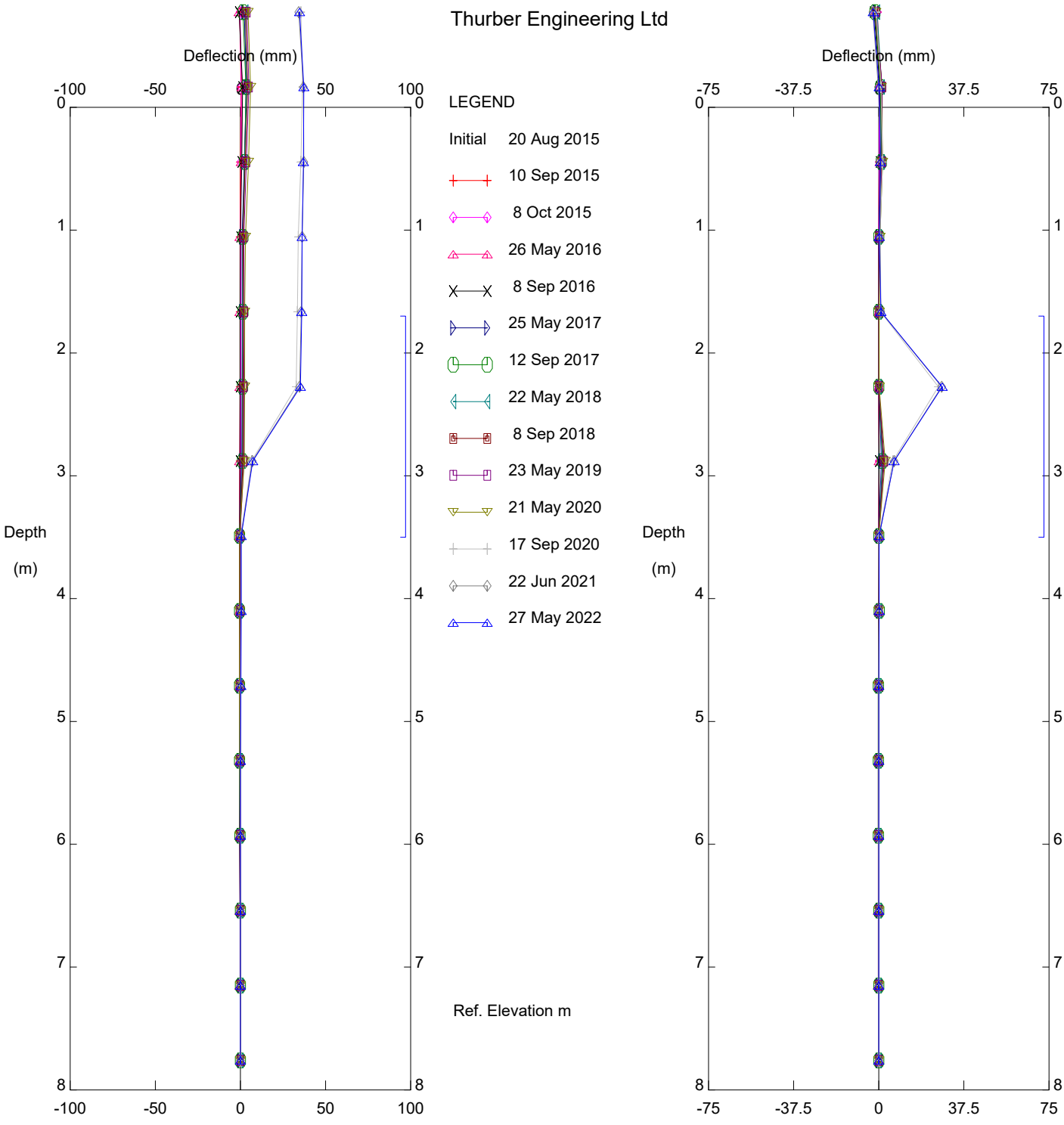
Direction A

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-3

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI15-3.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

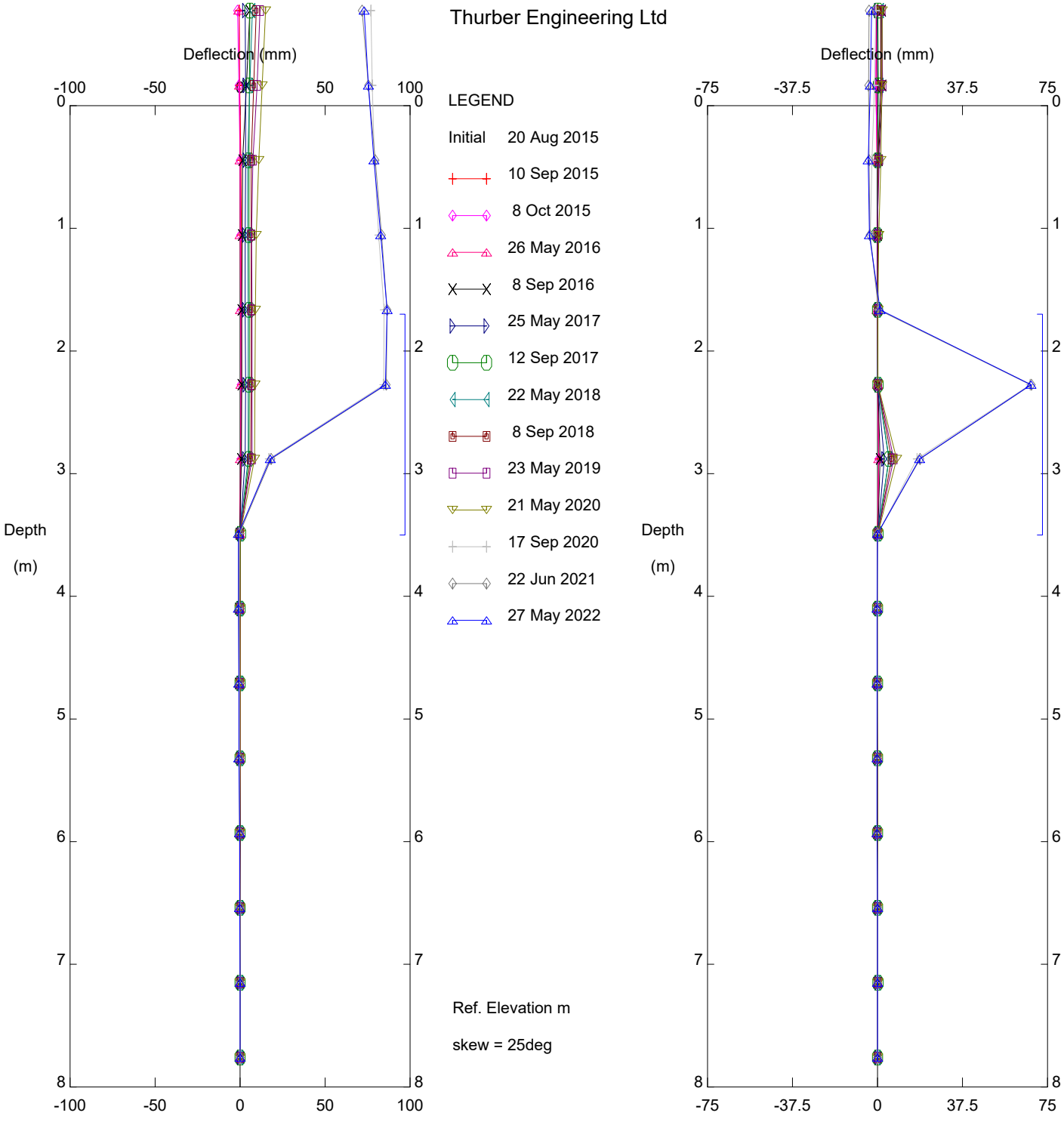
Incremental Deflection

Direction B

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-3

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

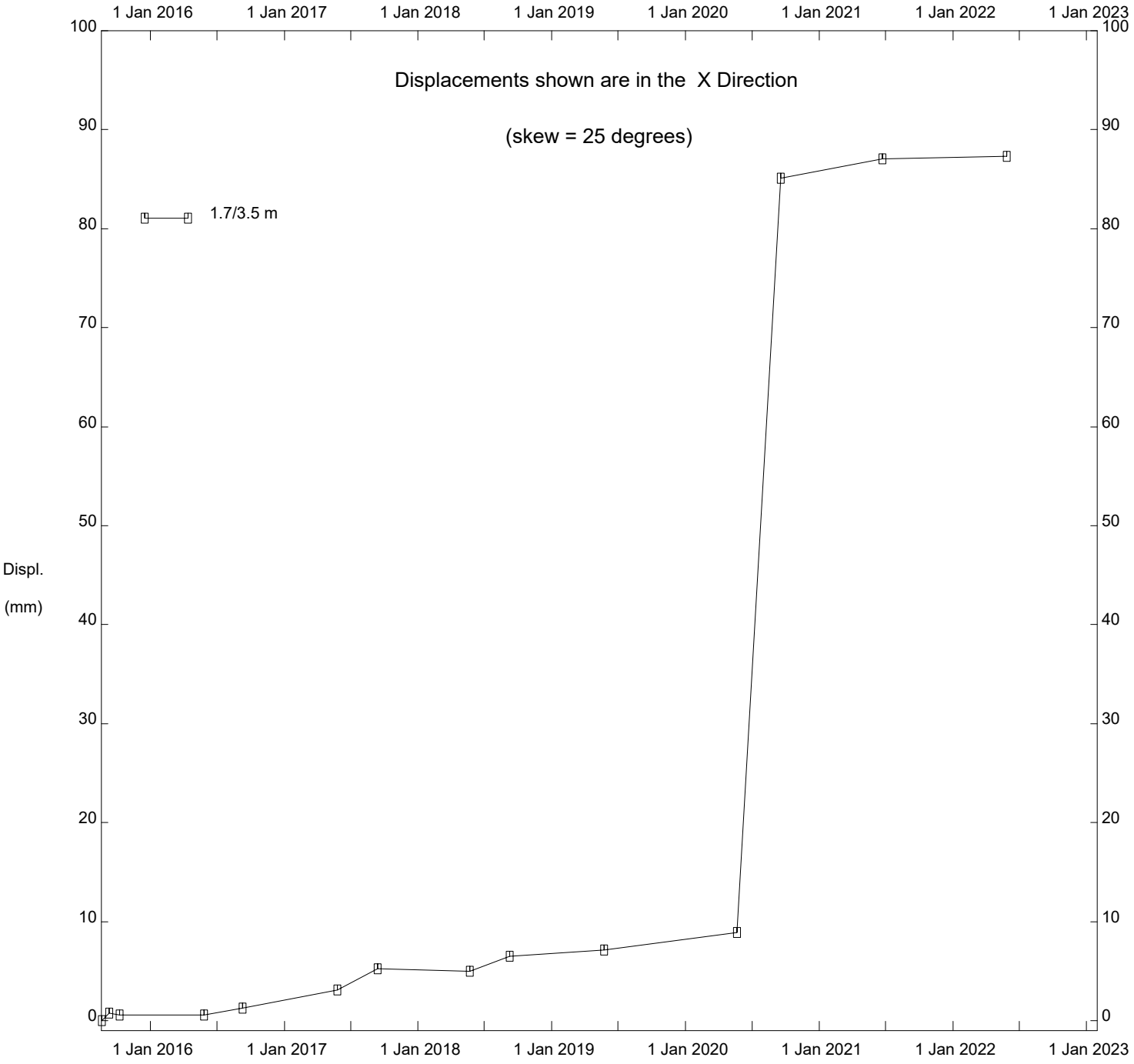
Direction X

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-3

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI15-3.gtl

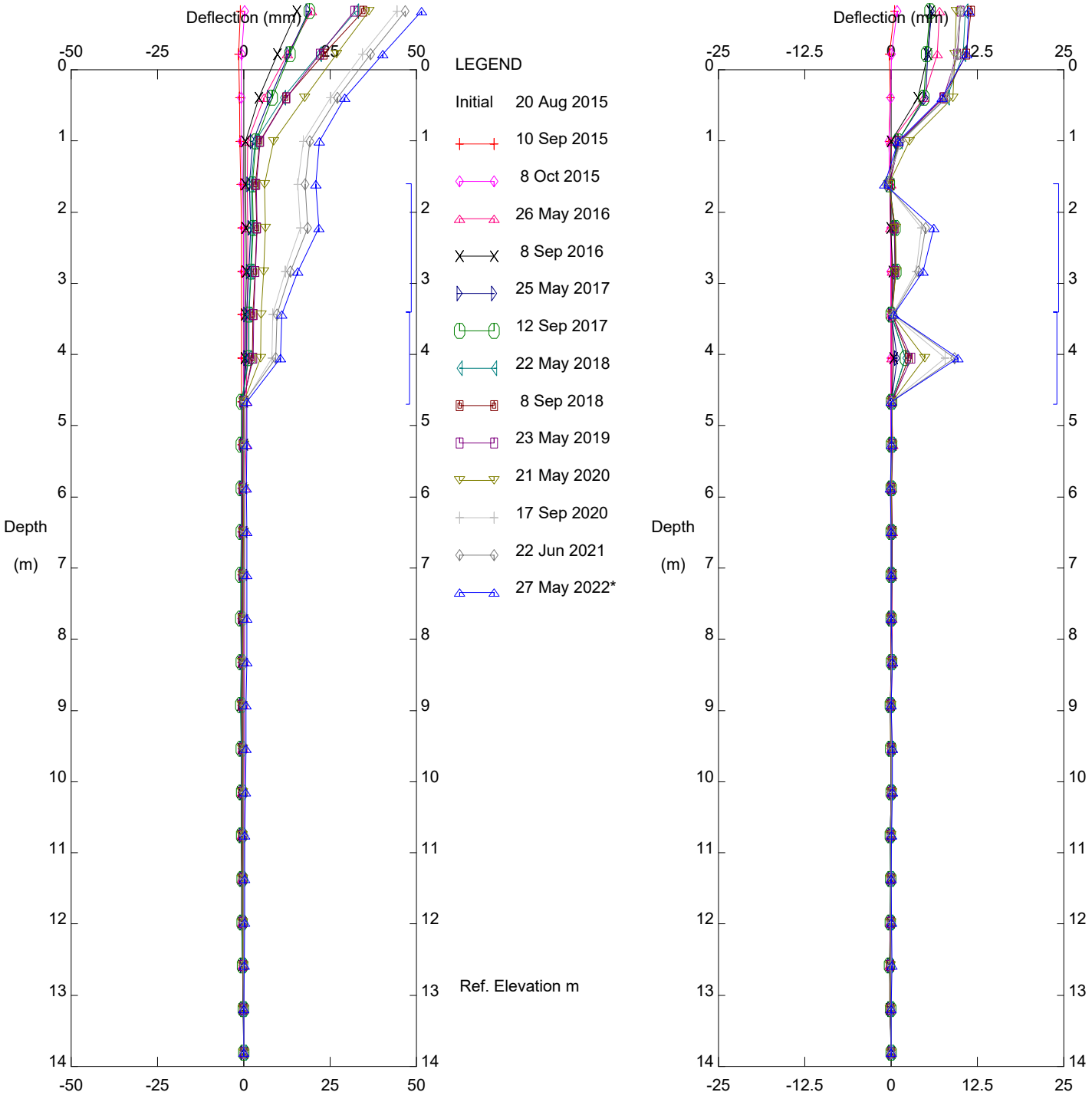
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-3

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

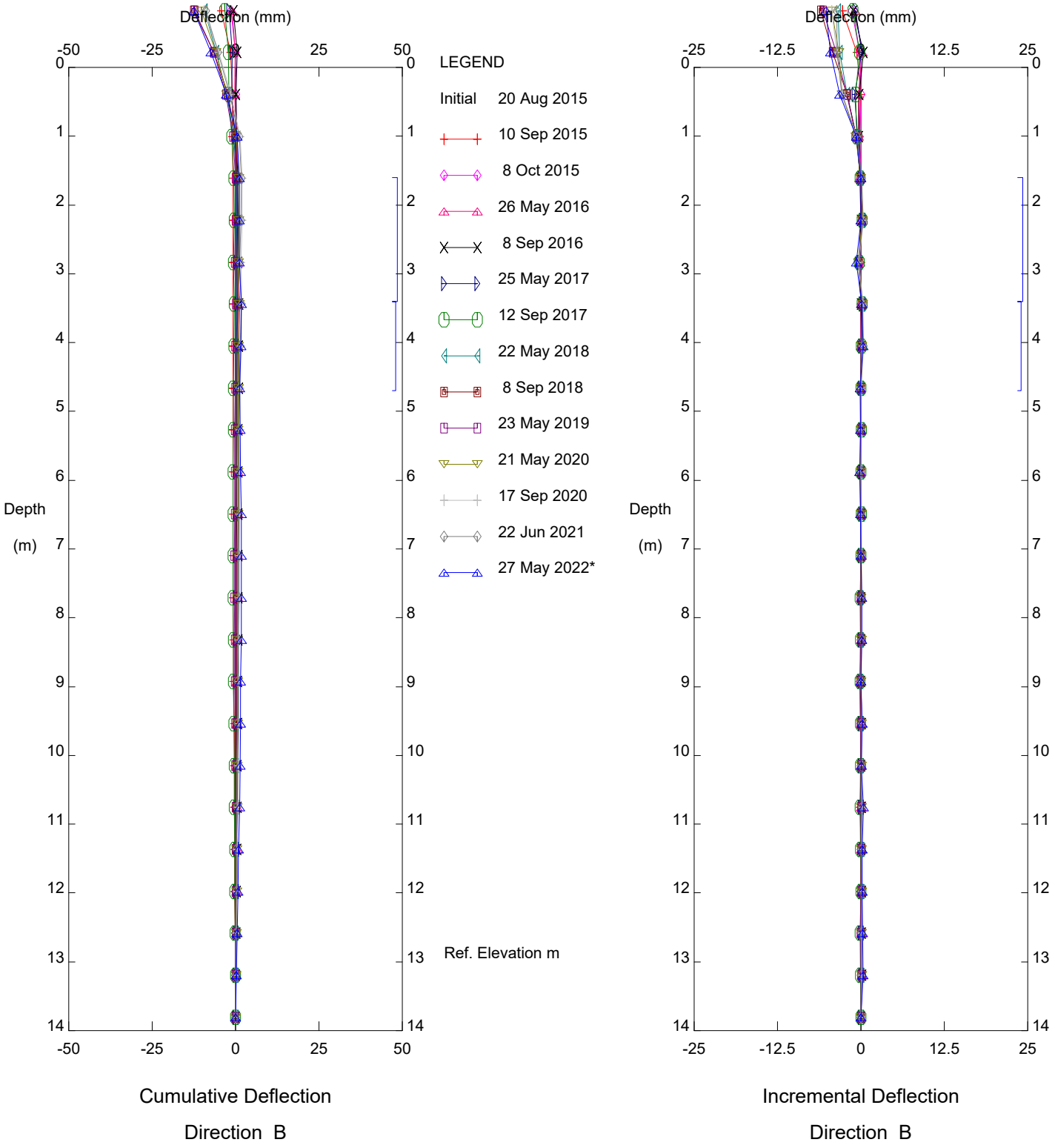
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-4

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI15-4.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

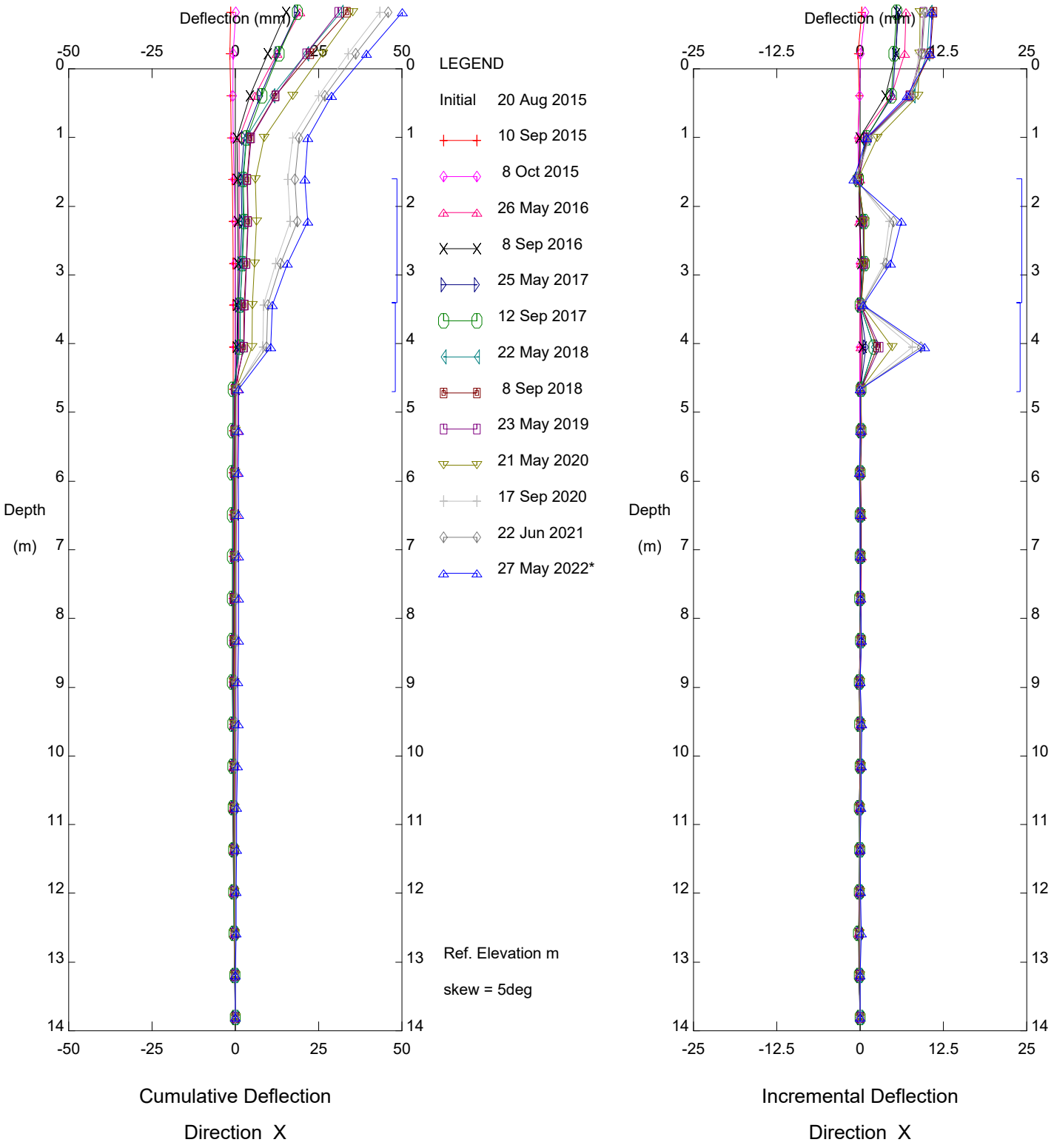
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-4

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI15-4.gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

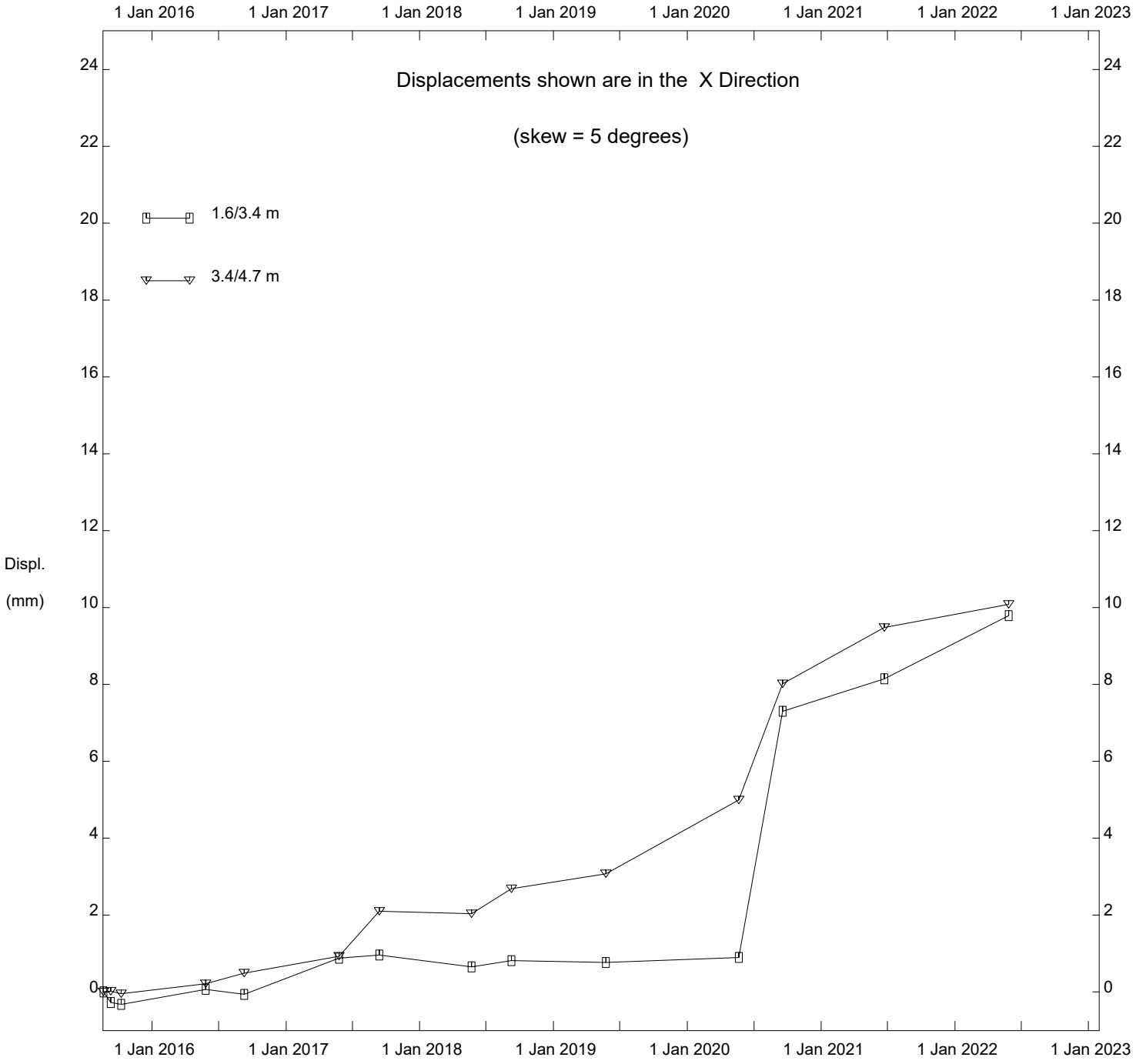
Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-4

Alberta Transportation

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

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI15-4.gtl

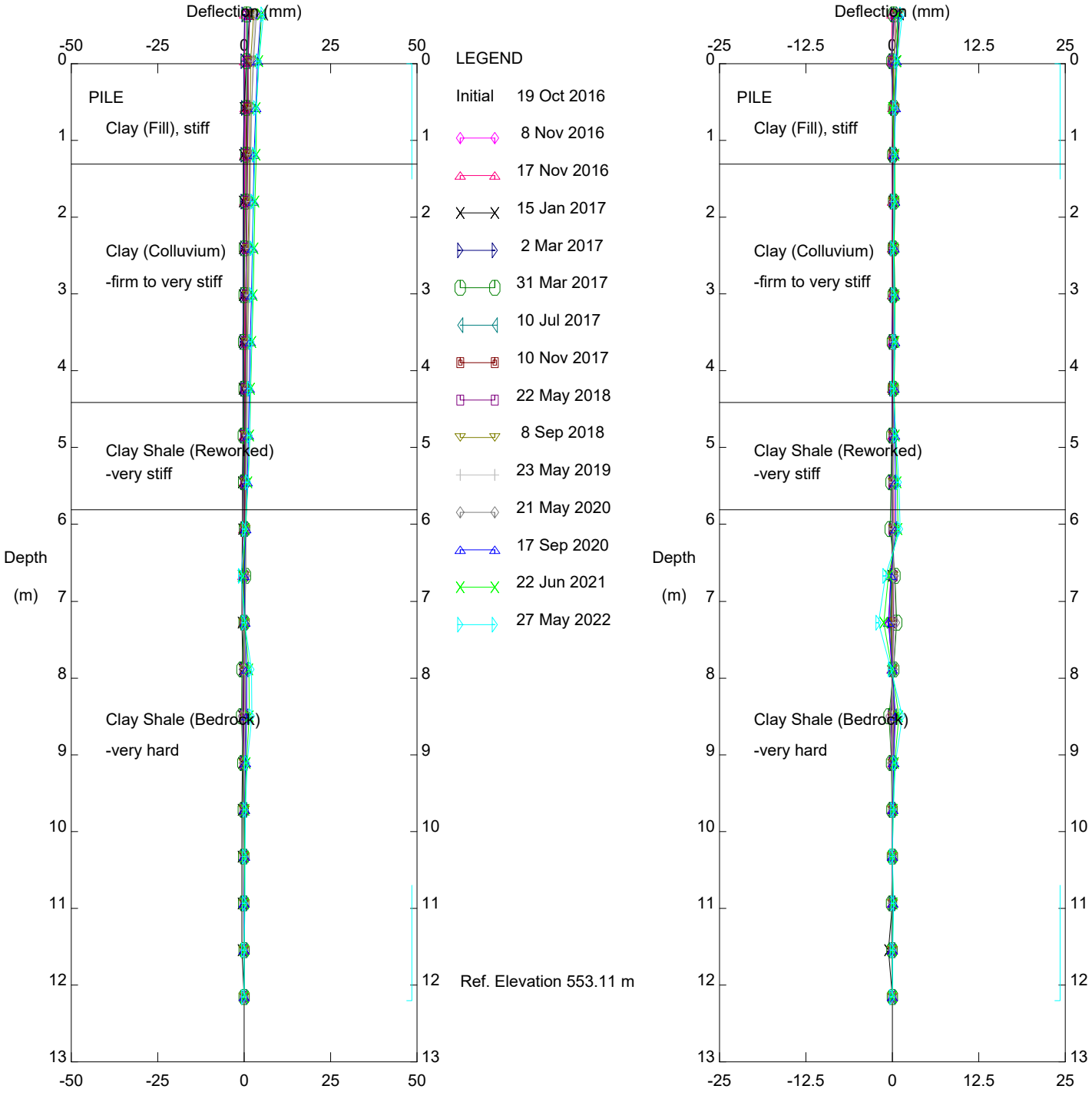
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI15-4

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

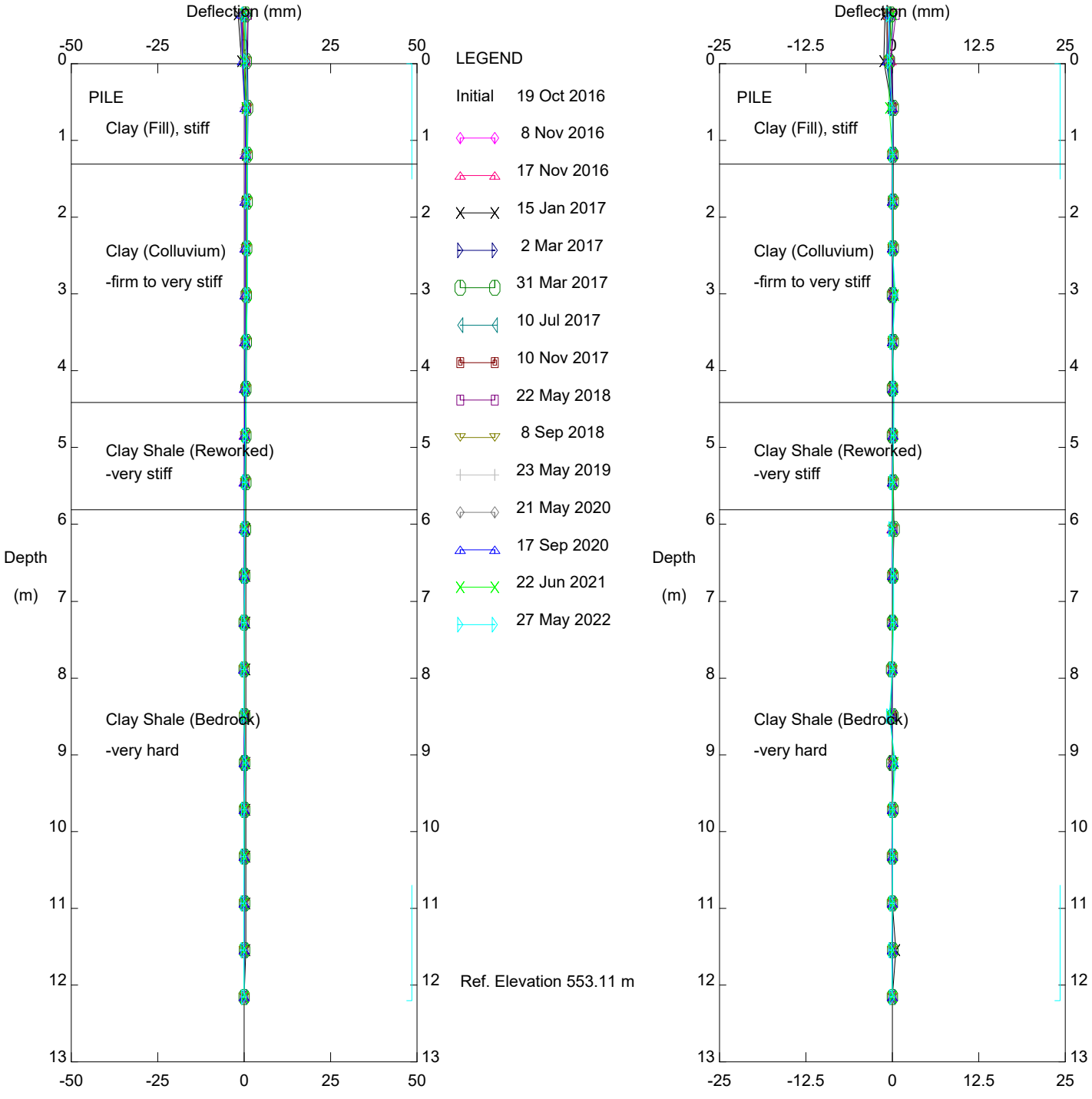
Direction A

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI16-1 (P04)

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI16-1 (P04).gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

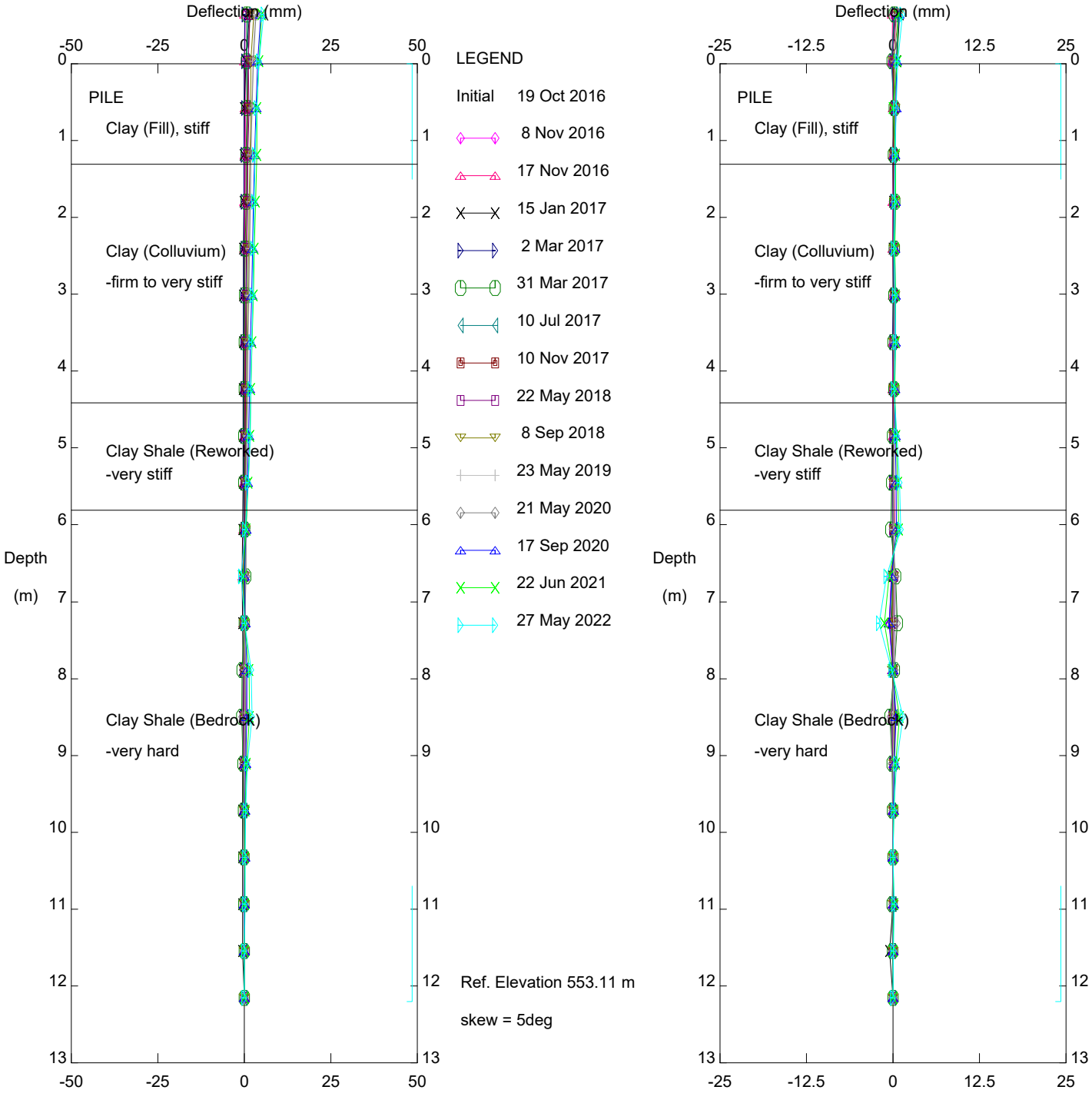
Direction B

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI16-1 (P04)

Alberta Transportation

H:\32000\32122 AT GRMP Athabasca and Fort McMurray Districts 2021-2025\Section C\2022A-Spring\SI Readings\NC102 (NC024-2)\SI16-1 (P04).gtl

Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI16-1 (P04)

Alberta Transportation

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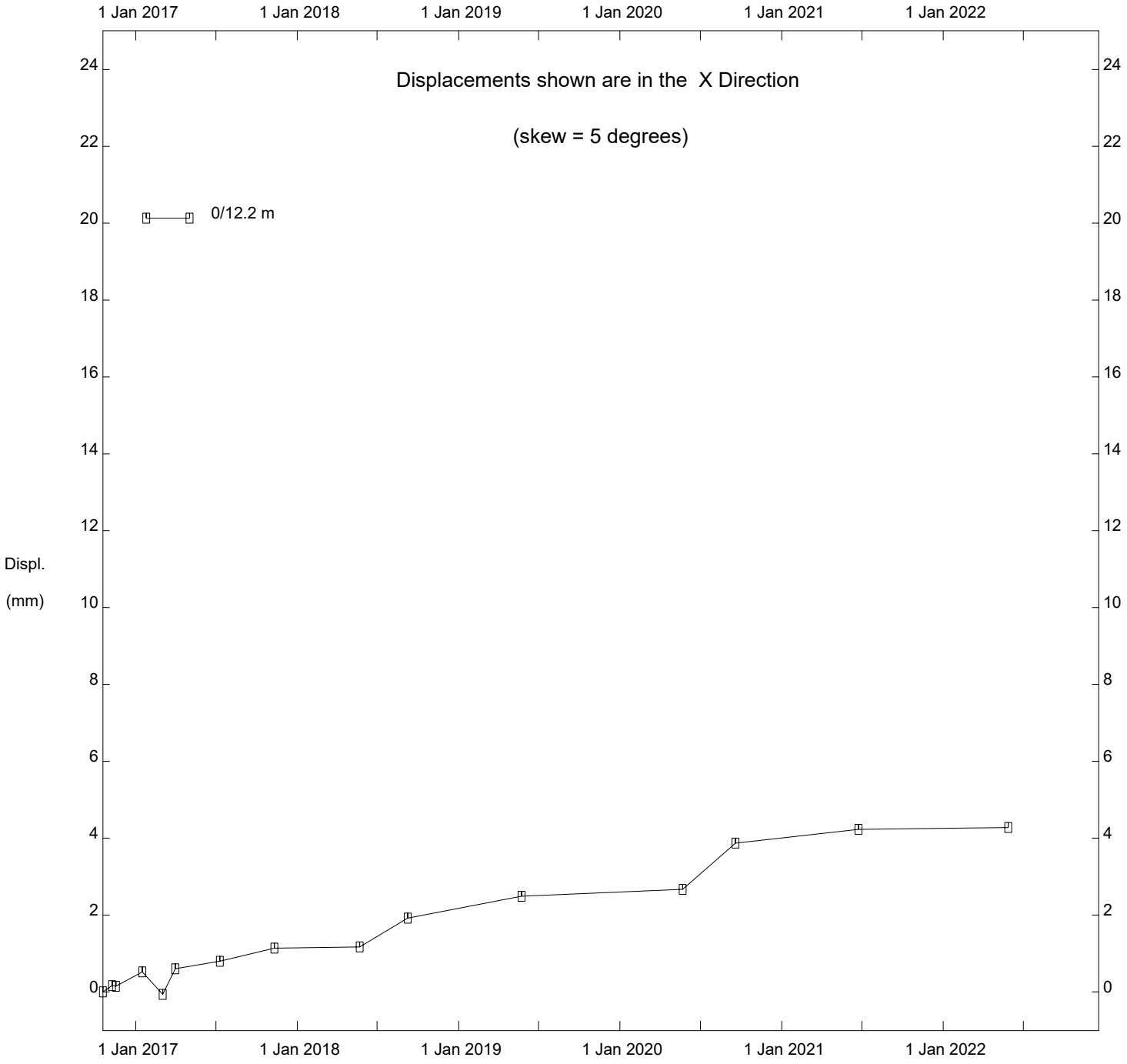
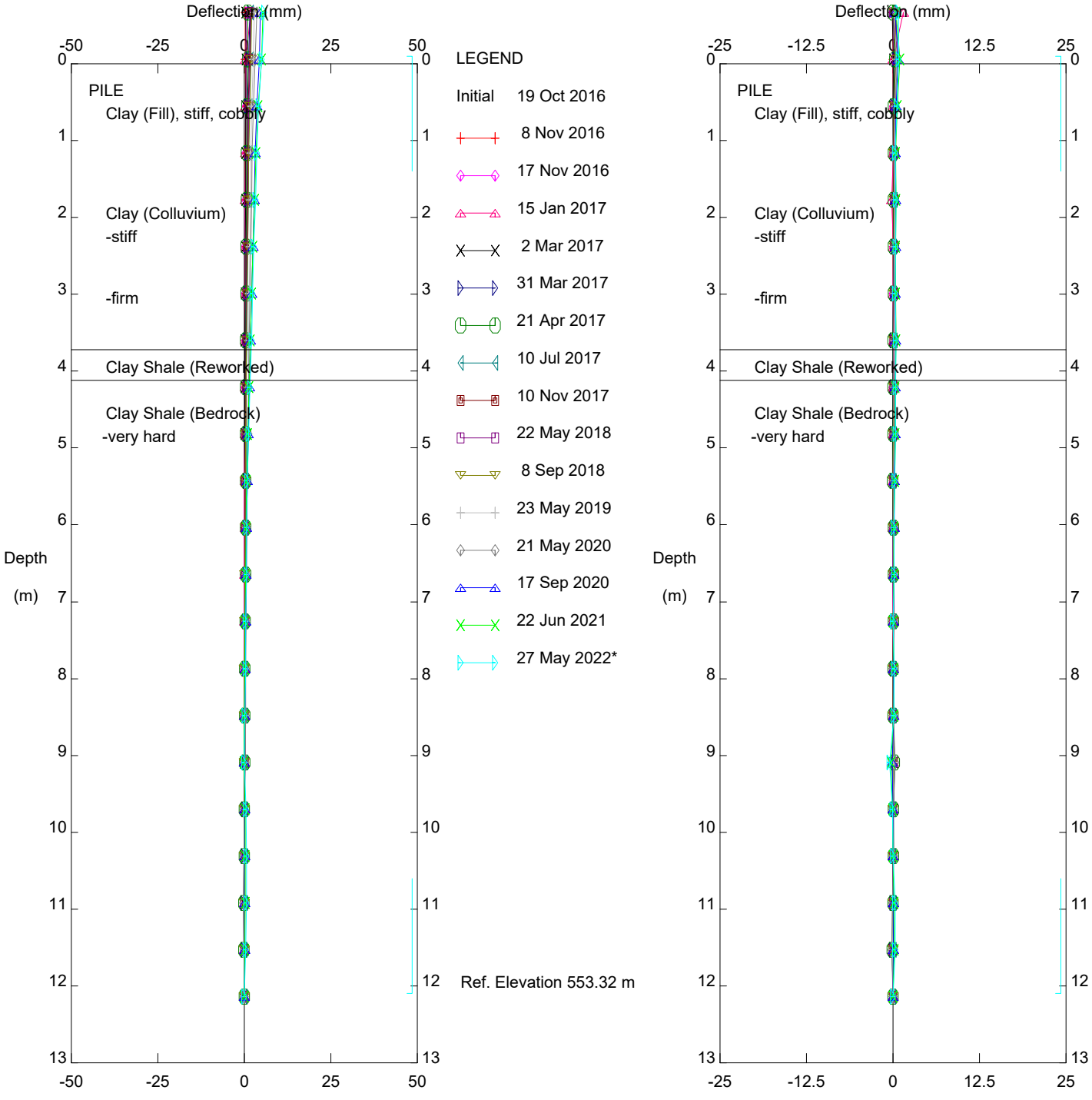
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI16-1 (P04)

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI16-2 (P08)

Alberta Transportation

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

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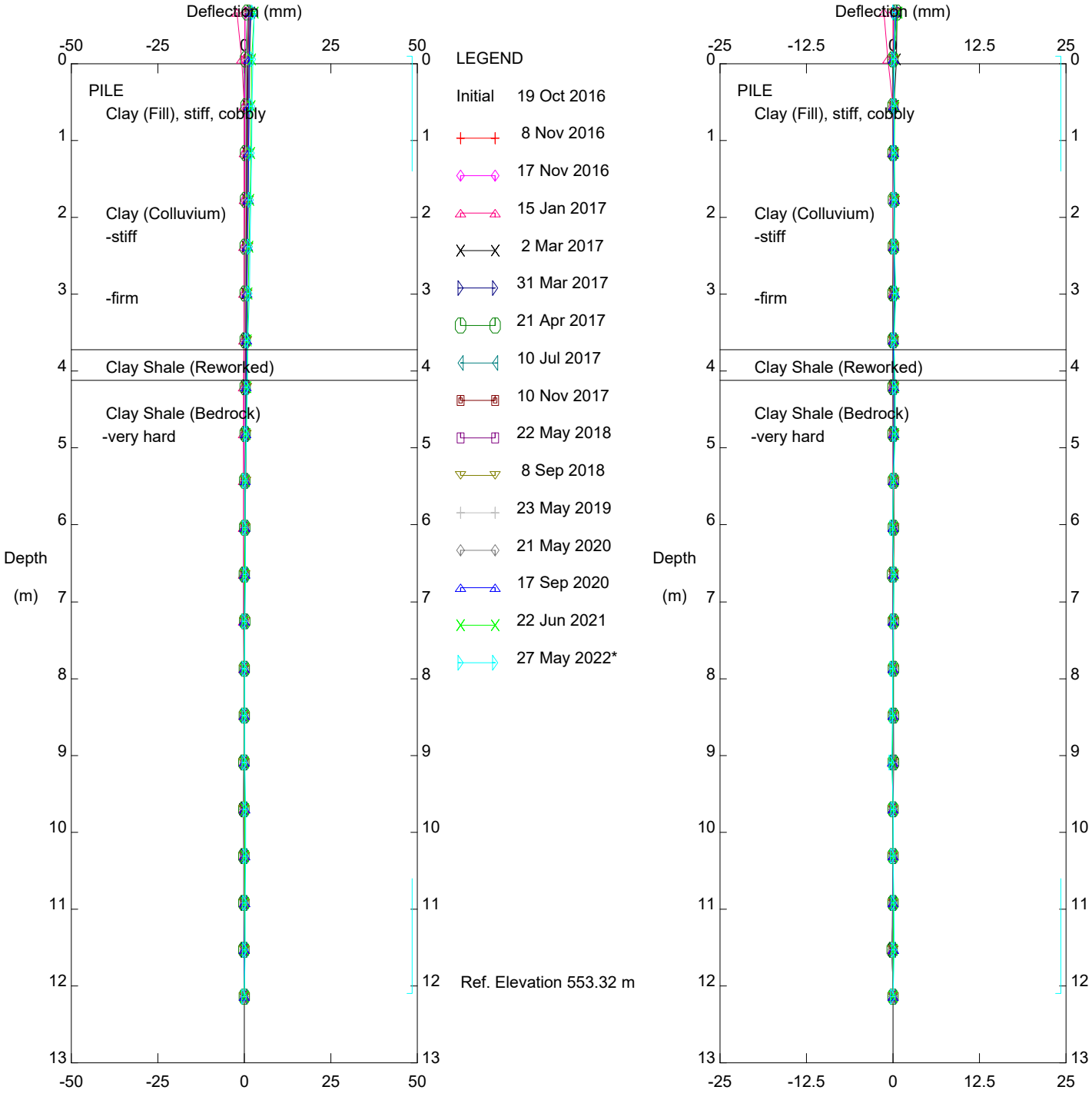
Thurber Engineering Ltd



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI16-2 (P08)

Alberta Transportation

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

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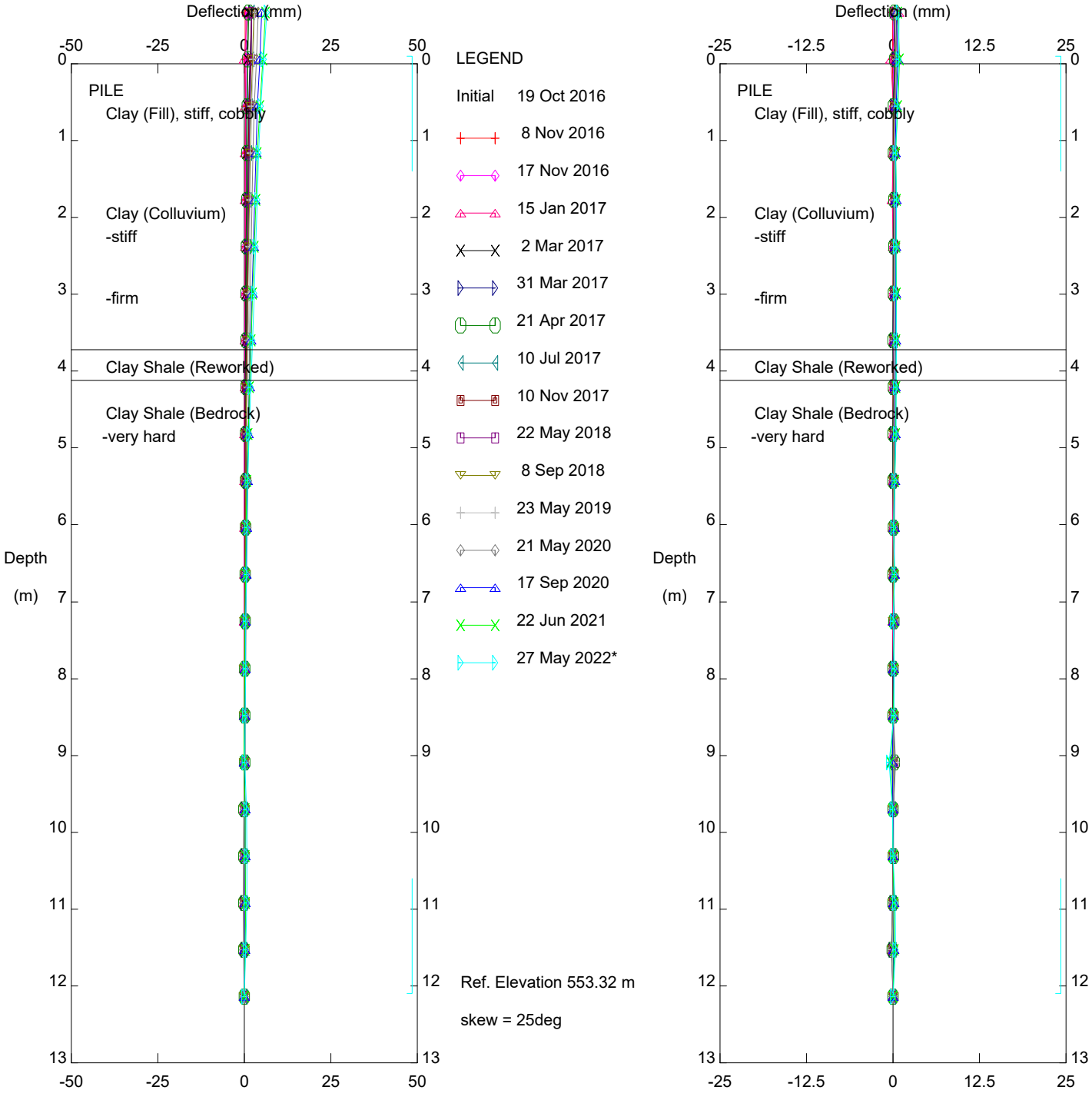
Thurber Engineering Ltd



Cumulative Deflection

Direction X

Incremental Deflection

Direction X

Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI16-2 (P08)

Alberta Transportation

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

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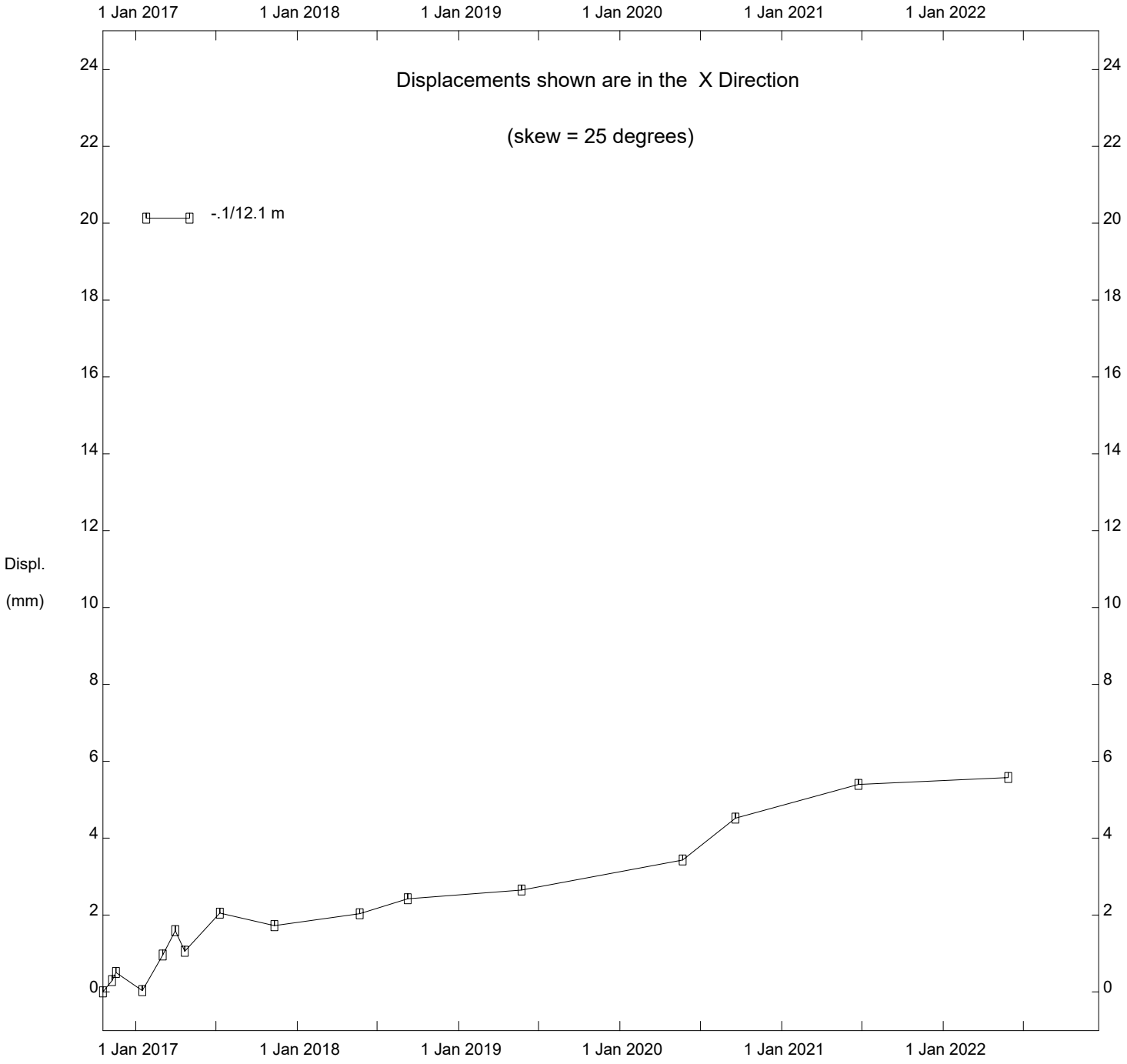
Thurber Engineering Ltd



Hwy 41:23 Kehiwin Lake (NC102), Inclinometer SI16-2 (P08)

Alberta Transportation

FIGURE NC102-1
PIEZOMETER DATA (2010 INSTRUMENTS) FOR NC024-2, KEHIWIN LAKE, km 8.89

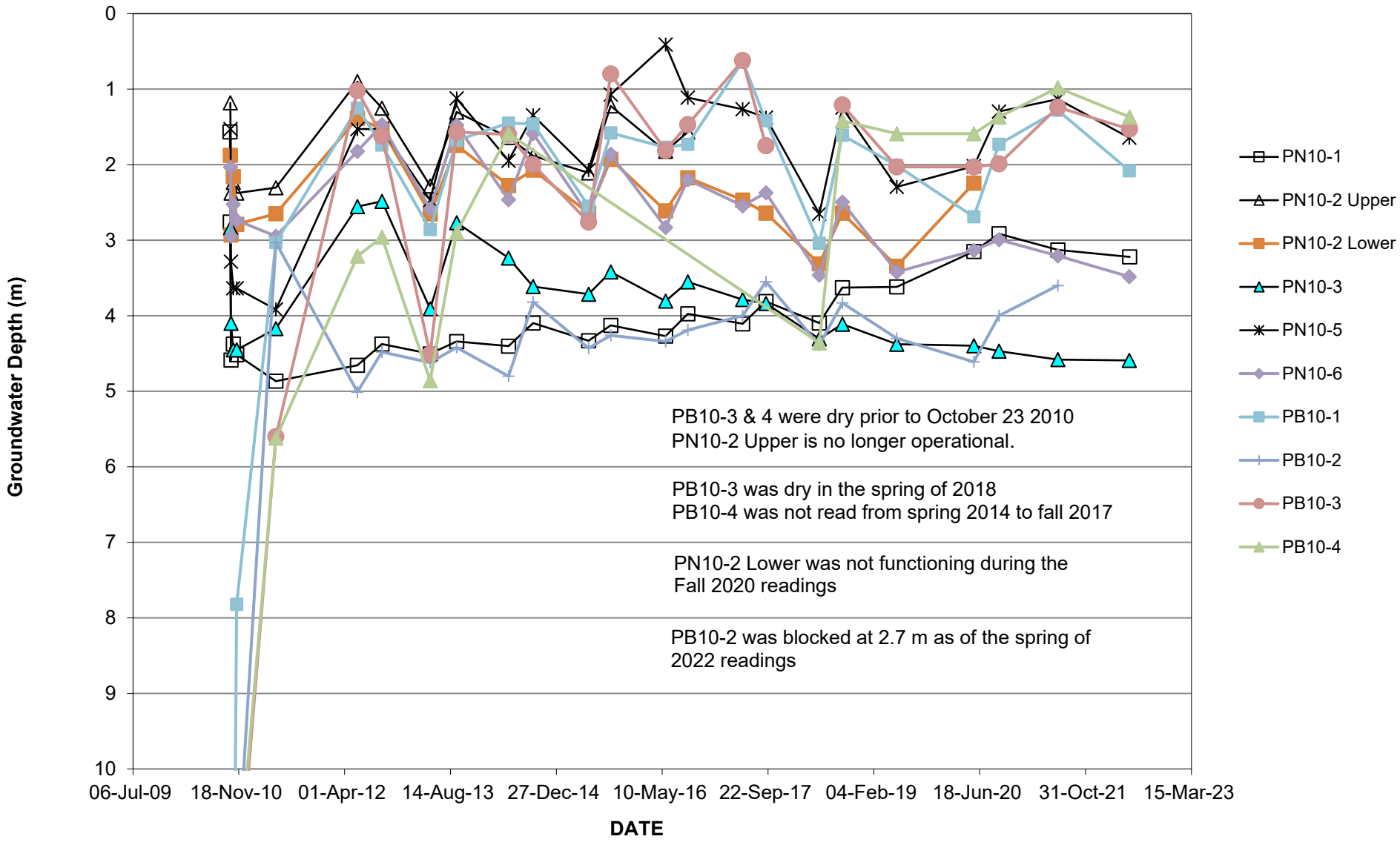


FIGURE NC102-2
PIEZOMETER DATA (2015 INSTRUMENTS) FOR NC024-2, KEHIWIN LAKE, km 8.89