ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP GRANDE PRAIRIE REGION – (GRANDE PRAIRIE NORTH) INSTRUMENTATION MONITORING - SPRING 2024

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
GP029	HWY 2:70 km 11.88	Church Camp Slide	2:70	Km 11.9
Legal Description: 16-4-77-5 W6		**UTM Co-ordinates**		
		11U E 393096	N 6168377	

Current Monitoring:	29-May-2024	**Previous Monitoring**	15-Oct-2023
Instruments Read By:	Mr. Niraj Regmi, G.I.T and Mr. Nixson Mationg, of Thurber		

Instruments Read During This Site Visit			
Slope Inclinometers (SIs): SI-2, SI-3, and SI17-5	**Pneumatic Piezometers (PN):** PN-02, PN17 2A, PN17-2B, PN17-2C, PN17-3B, PN17-3C, PN17-4A, PN17-4B, PN17-4C, PN17-5A and PN17-5B	**Vibration Wire Piezometers (VW):** N/A	**Standpipe Piezometers (SP):** SP17-6
Load Cell (LC): N/A	**Strain Gauges:** N/A	**SAAs:** N/A	**Others:**

Readout Equipment Used			
Slope Inclinometers: RST Digital Inclinometer probe with a 2 ft. wheelbase and a RST Pocket PC readout	**Pneumatic Piezometers:** RST C108 pneumatic piezometer readout	**Vibration Wire Piezometers:**	**Standpipe Piezometers:** DGSI dipmeter
Load Cell:	**Strain Gauges:**	**SAAs:**	**Others:**
Notes:			

Discussion	
Zones of New Movement:	None
Interpretation of Monitoring Results:	Slope inclinometer SI-2 showed a rate of movement of 3.2 mm/yr over 7.0 m to 8.8 m depth and a rate of movement of 0.2 mm/yr over 33.8 m to 35.1 m depth since the fall of 2023 readings. Both zones of movement have small changes in movement rate compared to the previous readings cycle. SI-3 has four known zones of movement. The uppermost zone showed a rate of movement of 3.1 mm/yr over 5.2 m to 7.0 m depth. There were no discernible movements over 9.4 m to 10.6 m depth, 13.1 m to 14.3 m depth and 18.0 m to 19.2 m depth since the fall of 2023 readings. The zone of movement over 5.2 m to 7.0 m depth in SI-3 showed an acceleration in movement of 5.1 mm/yr compared to the fall of 2023 readings. The other zones of movement showed small changes in movement compared to the fall of 2023 readings. SI17-5 has shown no discernible movement since initialization as it is likely still located just outside of the landslide influence zone.

	Pneumatic piezometers PN-02, PN17-2A, PN17-2B, PN17-3B, PN17-3C, PN17-4A and PN17-4C showed increases in groundwater level of 0.43 m, 0.14 m, 0.28 m, 0.15 m, 2.39 m, 0.14 m, and 0.84 m, respectively, since the fall of 2023 readings. PN17-3C is currently showing the highest groundwater elevation recorded in the instrument since initialization of 641.20 m. PN17-3C and PN17-4C are currently showing above-ground (artesian) groundwater levels of 11.70 m and 9.93 m, respectively. PN17-2C, PN17-5A, and PN17-5B showed decreases in groundwater level of 0.56 m, 0.28 m, and 0.14 m, respectively, since the fall of 2023 readings. Standpipe piezometer SP17-6 showed a decrease in groundwater level of 1.29 m since the fall of 2023 readings. Overall, the piezometers are generally showing groundwater levels in line with historic groundwater level readings at the site, with the exception of PN17-3C.
Future Work:	The instruments should be read again in the fall of 2024.
Instrumentation Repairs:	No instrument repairs are required at this time.
Additional Comments:	Additional readings could be done during construction of the highway realignment; this would be advisable if cracks on the exiting highway begin to open as construction proceeds.

Attachments:	▪ Table GP029-1 Spring 2024 – HWY 2:70 Church Slide, Slope Inclinometer Instrumentation Reading Summary ▪ Table GP029-2 Spring 2024 – HWY 2:70 Church Slide, Pneumatic Piezometer Instrumentation Reading Summary ▪ Table GP029-3 Spring 2024 – HWY 2:70 Church Slide, Standpipe Piezometer Instrumentation Reading Summary ▪ Statement of Limitations and Conditions ▪ APPENDIX A – GP029-1 SPRING 2024 □ Field Inspector's report □ Site Plan Showing Approximate Instrument Locations (Drawing No. 32123-GP029) □ SI Reading Plots □ Figure GP029-1 (Piezometric Elevations) □ Figure GP029-2 (Piezometric Depths)

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

2024-07-15

Lucas Green, P.Eng.
Geotechnical Engineer

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: July 15, 2024
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

THURBER ENGINEERING LTD.

Table GP029-1: Spring 2024 – Hwy 2:70 Church Camp Slide Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 29, 2024

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)
SI-2	October 18, 2007	33.6 over 7.0 m to 8.8 m depth in 112° direction	8.1 in October 2016	Operational	October 15, 2023	2.0	3.2	2.0
		20.3 over 33.8 m to 35.1 m depth in 79° direction	6.9 in October 2020			0.1	0.2	>-0.1
SI-3	October 18, 2007	42.1 over 5.2 m to 7.0 m depth in 113° direction	7.6 in July 2021	Operational	October 15, 2023	2.0	3.1	5.1
		12.5 over 9.4 m to 10.6 m depth in 81° direction	6.7 in October 2016			No discernible movement	N/A	0.3
		2.9 over 13.1 m to 14.3 m depth in 81° direction	2.0 in October 2021			No discernible movement	N/A	>-0.1
		4.7 over 18.0 m to 19.2 m depth in 91° direction	2.3 in October 2018			No discernible movement	N/A	<0.1
SI17-1	*September 15, 2017*	*7.0 over 24.4 m to 26.3 m depth in 85° direction*	*8.1 in October 2018*	*Sheared at 33.2 m*	*June 26, 2023*	*N/A*	*N/A*	*N/A*
		22.4 over 31.8 m to 33.0 m depth in 120° direction	*22.6 in October 2018*			*N/A*	*N/A*	*N/A*

Table GP029-1 – Continued…Spring 2024 – Hwy 2:70 Church Camp Slide Slope Inclinometer Instrumentation Reading Summary

Date Monitored: May 29, 2024

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)
SI17-2	*September 15, 2017*	*25.7 m over 17.2 m to 19.7 m depth in 110° direction*	*42.7 in October 2017*	*Sheared at 50.6 m*	*October 7, 2019*	*N/A*	*N/A*	*N/A*
		6.9 m over 21.5 m to 23.3 m depth in 110° direction	*10.4 in October 2018*			*N/A*	*N/A*	*N/A*
		38.0 over 47.1 m to 50.8 m depth in 110° direction	*31.9 in October 2018*			*N/A*	*N/A*	*N/A*
SI17-3	*September 15, 2017*	*No discernible movement*	*N/A*	*Sheared at 43.6 m*	*October 5, 2018*	*N/A*	*N/A*	*N/A*
SI17-4	*September 15, 2017*	*11.8 over 37.4 m to 39.2 m depth in 118° direction*	*17.5 in July 2018*	*Sheared at 45.1 m*	*October 5, 2018*	*N/A*	*N/A*	*N/A*
SI17-5	September 16, 2017	No discernible movement	N/A	Operational	June 26, 2023	N/A	N/A	N/A

Drawing 32123-GP029 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

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Table GP029-2: Spring 2024 – Hwy 2:70 Church Camp Slide Pneumatic Piezometer Instrumentation Reading Summary

Date Monitored: May 29, 2024

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)
PN-02	May 9, 2008	629.66	635.76	Operational	635.82 in October 2016	57.9	635.57	635.14	0.43
PN-03	May 9, 2008	614.57	631.33	Damaged	628.23 in May 2014	N/A	N/A	628.13 (June 15, 2017)	N/A
PN17-1A	September 15, 2017	633.85	645.58	Malfunctioning	645.45 in July 2018	N/A	N/A	636.87 (July 5, 2019)	N/A
PN17-1B	September 15, 2017	610.53	645.58	Malfunctioning	645.75 in June 2020	N/A	N/A	645.75* (June 22, 2020)	N/A
PN17-2A	September 15, 2017	628.41	638.65	Operational	638.46 in June 2020	95.8	638.18	638.04	0.14
PN17-2B	September 15, 2017	598.54	638.65	Operational	637.77 in June 2022	384.7	637.77	637.49	0.28
PN17-2C	September 15, 2017	587.88	638.65	Operational	637.79 in October 2018	483.3	637.16	637.72	-0.56
PN17-3A	September 15, 2017	603.80	629.50	Malfunctioning	N/A	N/A	N/A	N/A	N/A

Drawing 32123-GP029 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.
* Indicates artesian groundwater level

Table GP029-2 – Continued…Spring 2024 – Hwy 2:70 Church Camp Slide Pneumatic Piezometer Instrumentation Reading Summary

Date Monitored: May 29, 2024

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)
PN17-3B	September 15, 2017	591.30	629.50	Operational	635.87 in September 2017	361.3	628.14	627.99	0.15
PN17-3C	September 15, 2017	581.45	629.50	Operational	641.20* in May 2024	586.1	641.20*	638.81*	2.39
PN17-4A	September 15, 2017	606.31	631.19	Operational	634.57* in September 2017	221.3	628.88	628.74	0.14
PN17-4B	September 15, 2017	590.92	631.19	Operational	636.27*in September 2017	386.8	630.36	630.36	0
PN17-4C	September 15, 2017	582.69	631.19	Operational	641.12* in June 2020	562.6	640.06*	639.22*	0.84
PN17-5A	September 15, 2017	633.17	647.40	Operational	649.97 in September 2017	117.9	645.19	645.47	-0.28
PN17-5B	September 15, 2018	611.99	647.40	Operational	653.19 in September 2017	284.1	640.95	641.09	-0.14

Drawing 32123-GP029 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.
* Indicates artesian groundwater level

Table GP029-3: Spring 2024 – Hwy 2:70 Church Camp Slide Standpipe Piezometer Instrumentation Reading Summary

Date Monitored: May 29, 2024

INSTRUMENT #	DATE INITIALIZED	TIP ELEV. (m)	GROUND ELEV. (m)	CURRENT STATUS	MAXIMUM MEASURED WATER ELEVATION (m)	MEASURED WATER ELEVATION (m)	PREVIOUS WATER ELEVATION (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
SP17-6	September 15, 2017	640.26	647.81	Operational	646.00 in October 2023	644.71	646.00	-1.29
SP17-7	September 15, 2017	*635.44*	*646.54*	*Destroyed*	*645.36 in January 2018*	*N/A*	*N/A*	*N/A*
SP17-8	September 15, 2017	*639.46*	*646.06*	*Destroyed*	*642.54 in January 2018*	*N/A*	*N/A*	*N/A*
SP17-9	September 15, 2017	*637.84*	*644.44*	*Destroyed*	*639.69 in January 2018*	*N/A*	*N/A*	*N/A*

Drawing 32123-GP029 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

THURBER

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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.

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ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP (CON0022165)
PEACE REGION (GRANDE PRAIRIE DISTRICT – NORTH)
INSTRUMENTATION MONITORING RESULTS

SPRING 2024

APPENDIX A
DATA PRESENTATION

SITE GP029: HWY 2:70, CHURCH CAMP SLIDE

ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
PEACE REGION (GRANDE PRAIRIE - NORTH DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (GP029)
SPRING 2024

Location:	Church Camp Slide (HWY 2:70 C1 11.881)	**Readout:**	RST PN C108 Unit 4
File Number:	32123	**Extension:**	2.75/3.34"
Probe:	RST SI Set 8R	**Temp:**	10
Cable:	RST SI Set 8R	**Read by:**	NKR/NRM

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 #	Size (")	Remarks
	Easting (m)	Northing (m)					A+	A-	B+	B-			
SI-2	393096	6168377	29-May-24	0.6	118 to 4	60	183	-169	24	-28	8R/8R	3.34	
SI-3	393155	6168341	29-May-24	0.64	108 to 4	120	69	-49	-94	86	8R/8R	3.34	
SI17-5	393014	6168383	29-May-24	0.72	128 to 2	70 °	-2	8	-4382	4376	8R/8R	2.75	

PNEUMATIC PIEZOMETER (PN) READINGS

PN#	GPS Location (UTM 11)		Date	Reading (Psi)	Identification Number
	Easting (m)	Northing (m)			
PN-02	393096	6168377	29-May-24	8.4	60675
PN17-2A	393112	6168505	29-May-24	13.9	37657
PN17-2B	393112	6168505	29-May-24	55.8	37651
PN17-2C	393112	6168505	29-May-24	70.1	37650
PN17-3B	393192	6168472	29-May-24	52.4	37652
PN17-3C	393192	6168472	29-May-24	85	37649
PN17-4A	393157	6168374	29-May-24	32.1	37655
PN17-4B	393157	6168374	29-May-24	56.1	37679
PN17-4C	393157	6168374	29-May-24	81.6(Water Return)	37678
PN17-5A	393014	6168383	29-May-24	17.1	37656
PN17-5B	393014	6168383	29-May-24	41.2	37654

STANDPIPE PIEZOMETER (SP) READINGS

SP	GPS Location (NAD83 UTM)		Date	Stick-up (m)	Water level below top of pipe (m)	Total length of pipe (m)
	Easting	Northing				
SP17-6	392931	6168288	29-May-24	0.86	3.96	7.55

INSPECTOR REPORT

- Call private landowner before reading SP17-6

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LEGEND

- APPROXIMATE INSTRUMENT LOCATION
- CRACK
- ACP PATCH
- SI SLOPE INCLINOMETER
- PN PNEUMATIC PIEZOMETER
- SP STANDPIPE PIEZOMETER

0 25 50 75 100 125 150m
SCALE 1:2500

Alberta

PEACE REGION
(GRANDE PRAIRIE DISTRICT - NORTH)

GP029: HWY 2:70 CHURCH CAMP SLIDE
INSTRUMENT LOCATIONS

DWG No. 32123-GP029

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	RVC
SCALE	1:2500
DATE	AUGUST 2021
FILE No.	32123

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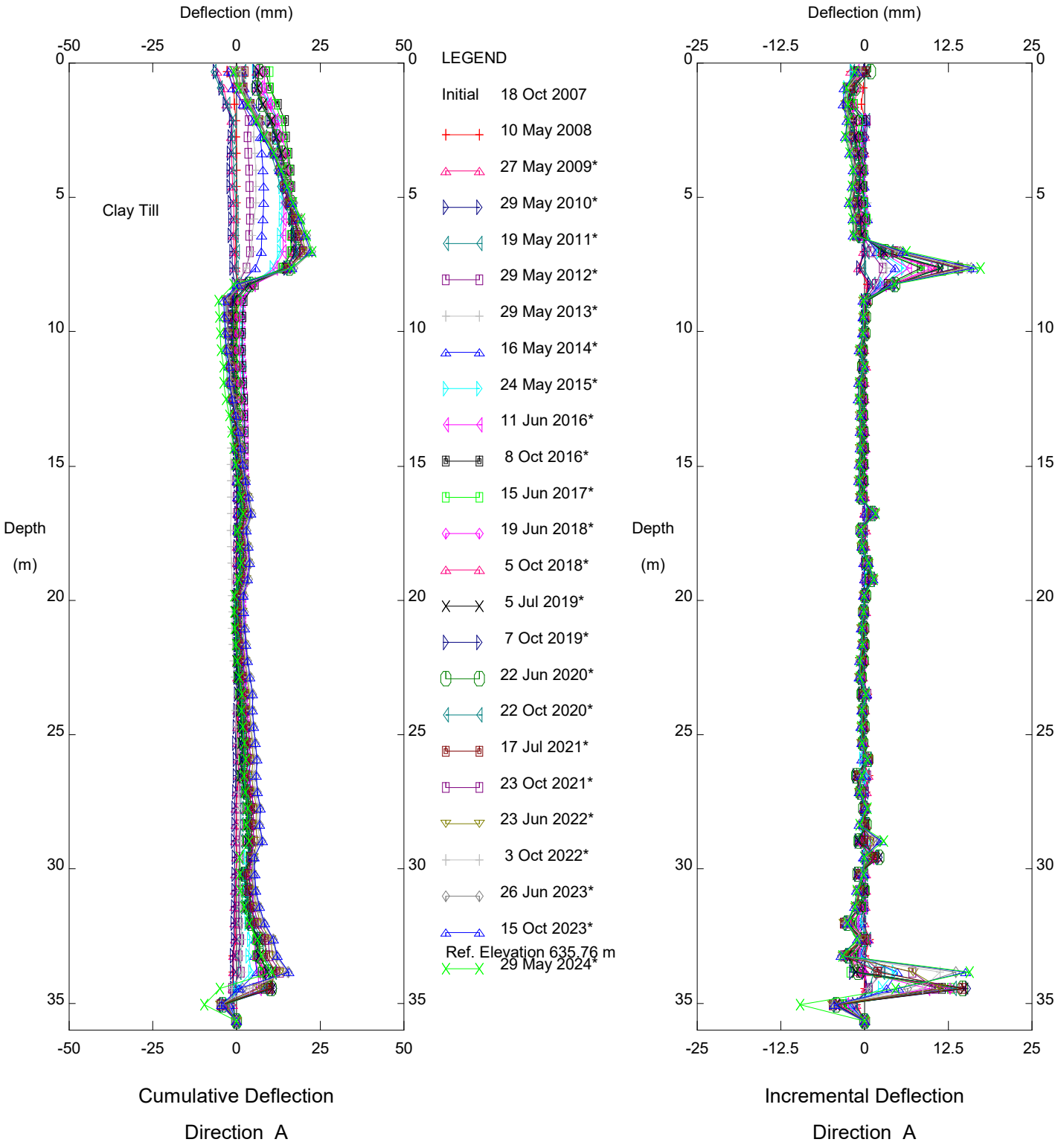

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

GP029 HWY 2:70 (Church Camp), Inclinometer SI-2

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

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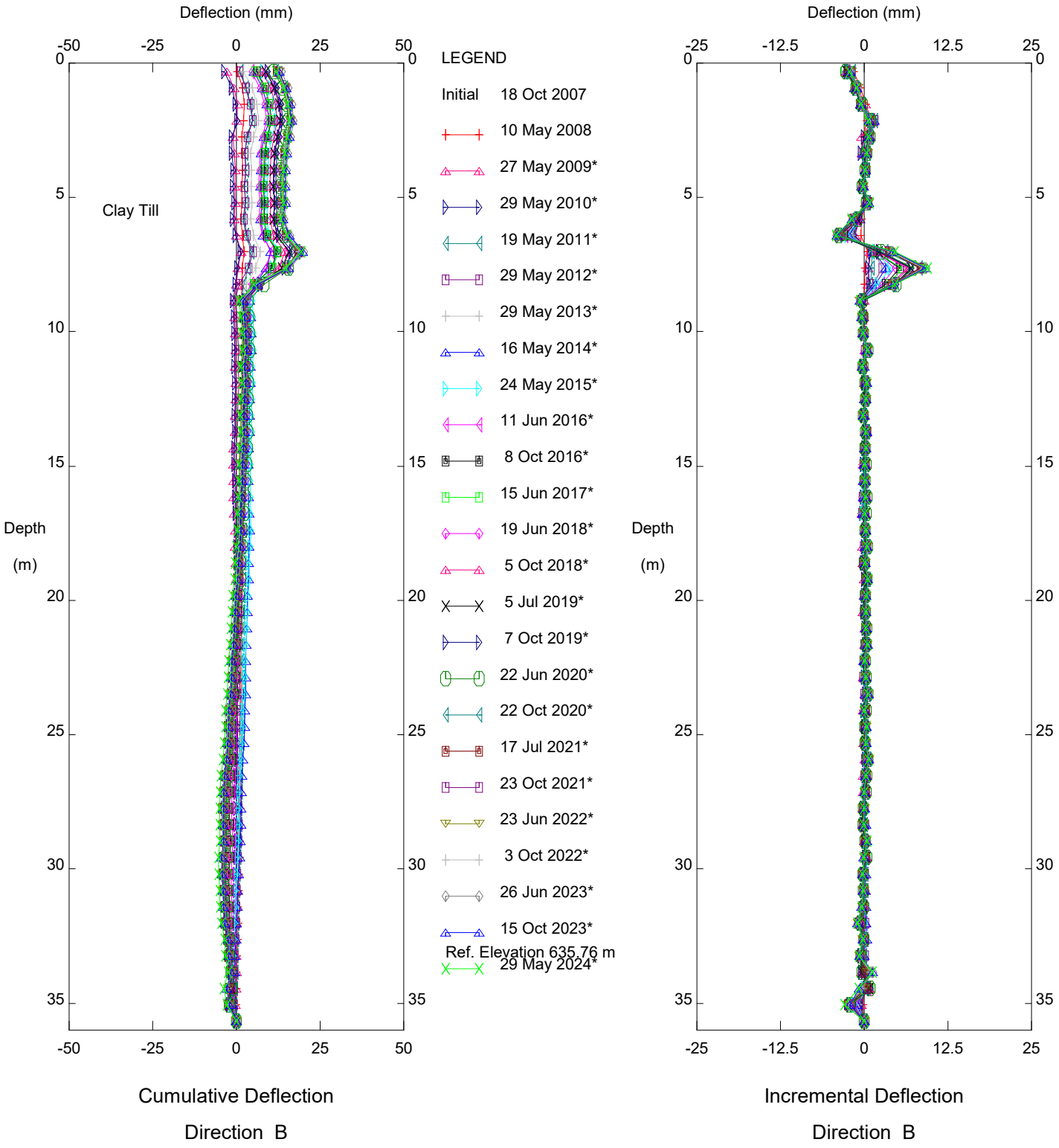

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

GP029 HWY 2:70 (Church Camp), Inclinometer SI-2

Alberta Transportation

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

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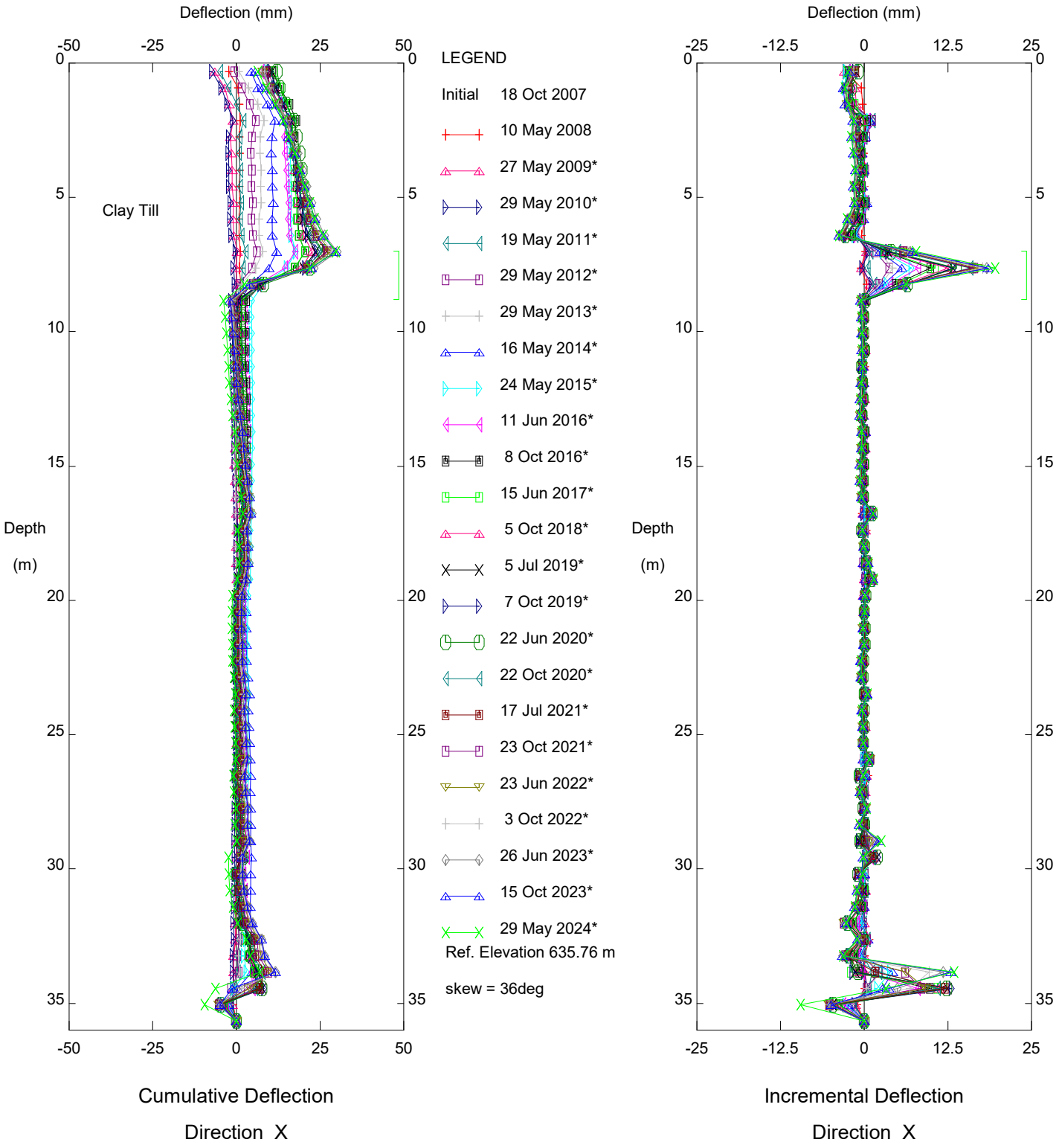

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

GP029 HWY 2:70 (Church Camp), Inclinometer SI-2

Alberta Transportation

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

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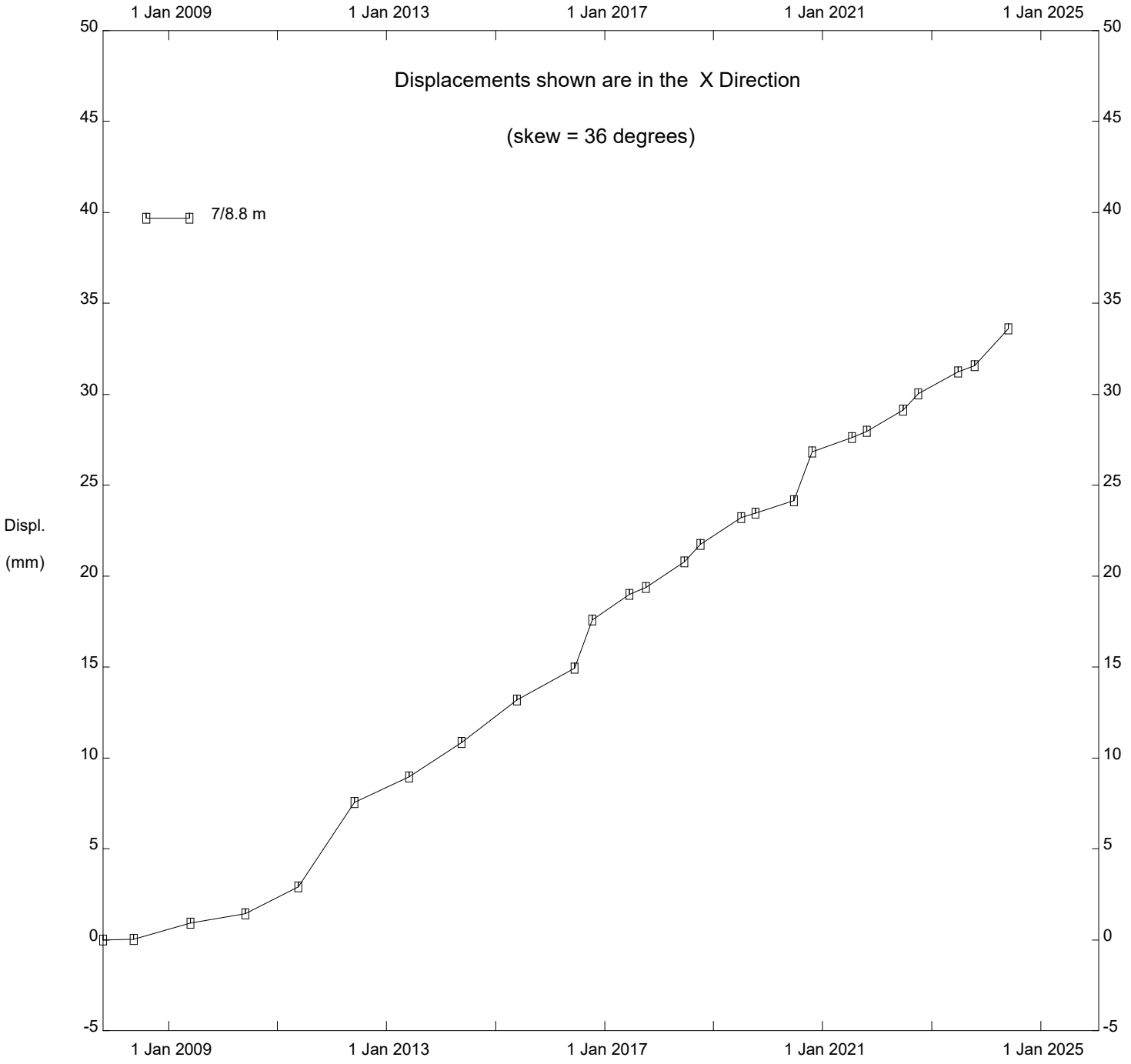

GP029 HWY 2:70 (Church Camp), Inclinometer SI-2

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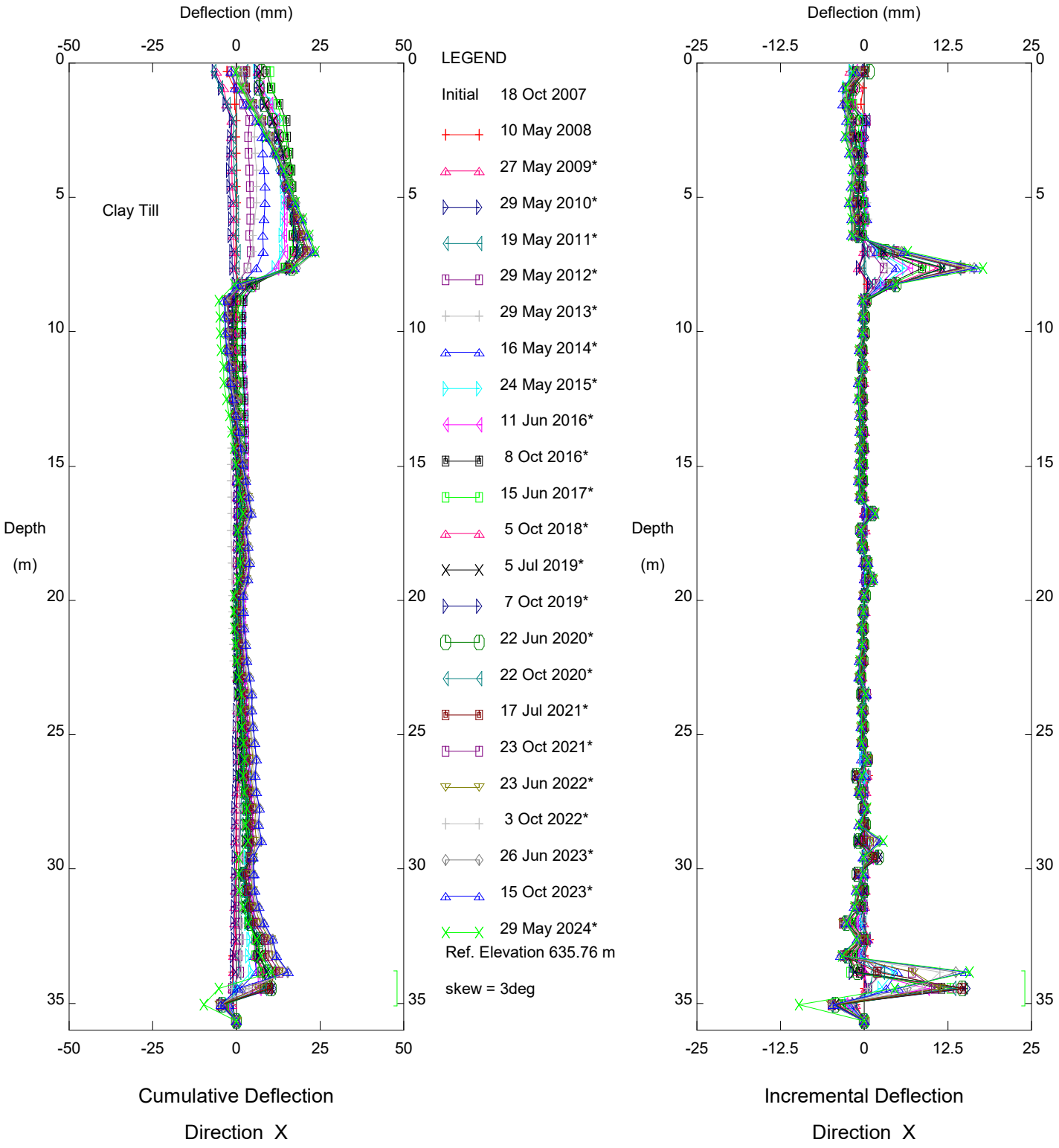

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

GP029 HWY 2:70 (Church Camp), Inclinometer SI-2

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

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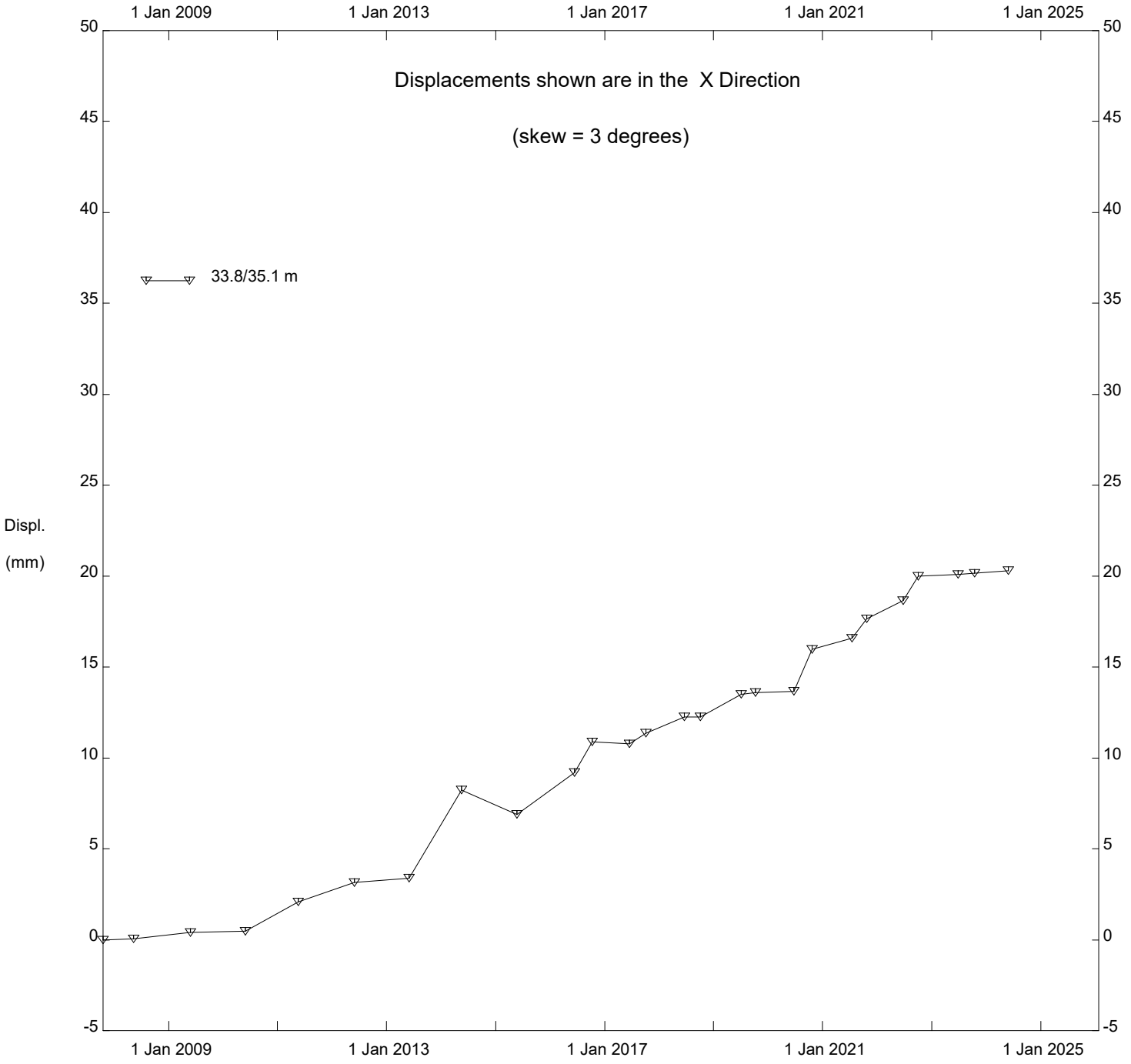

GP029 HWY 2:70 (Church Camp), Inclinometer SI-2

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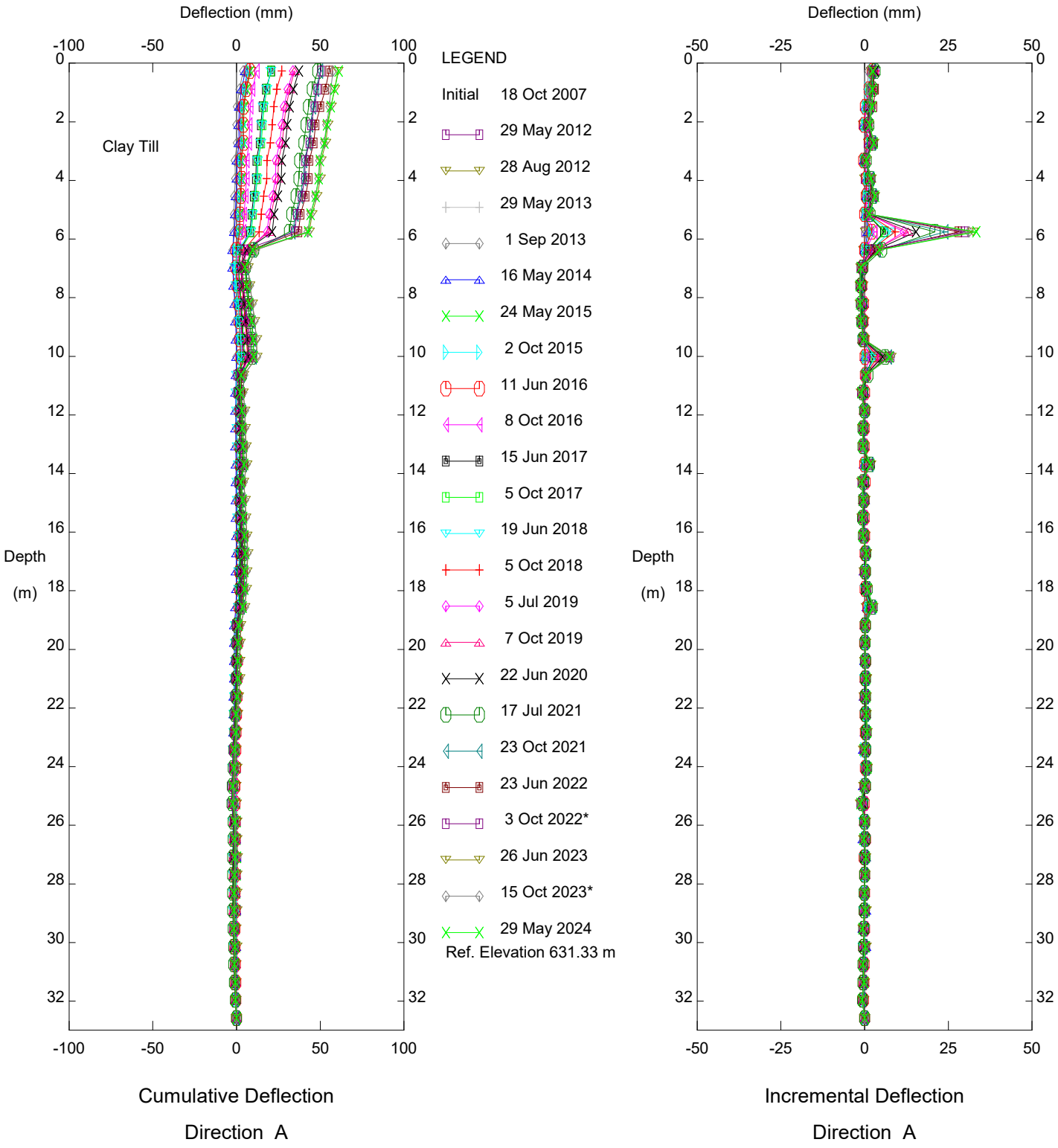

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

GP029 HWY 2:70 (Church Camp), Inclinometer SI-3

Alberta Transportation

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

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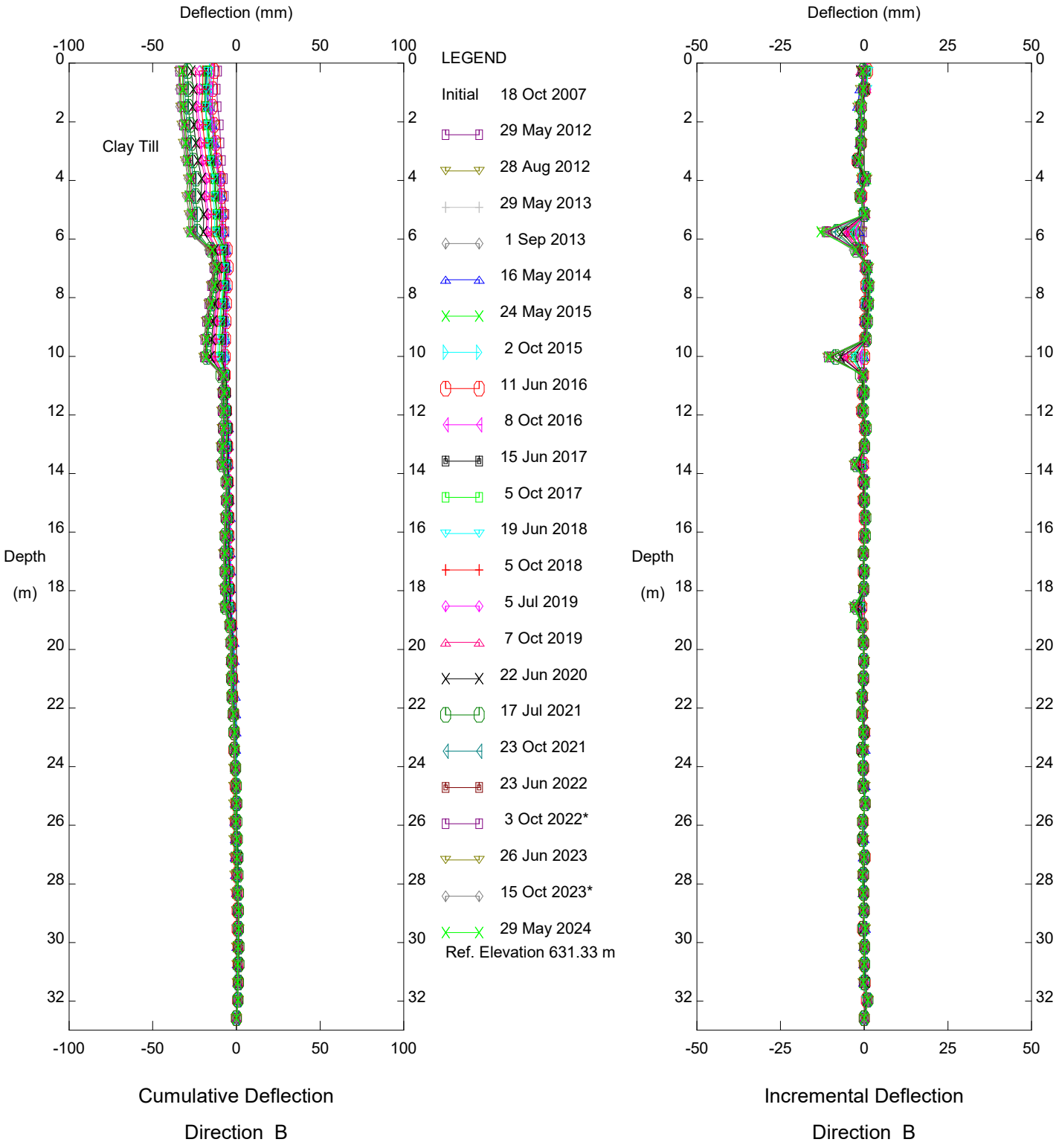
Thurber Engineering Ltd.



Cumulative Deflection

Direction B

Incremental Deflection

Direction B

GP029 HWY 2:70 (Church Camp), Inclinometer SI-3

Alberta Transportation

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

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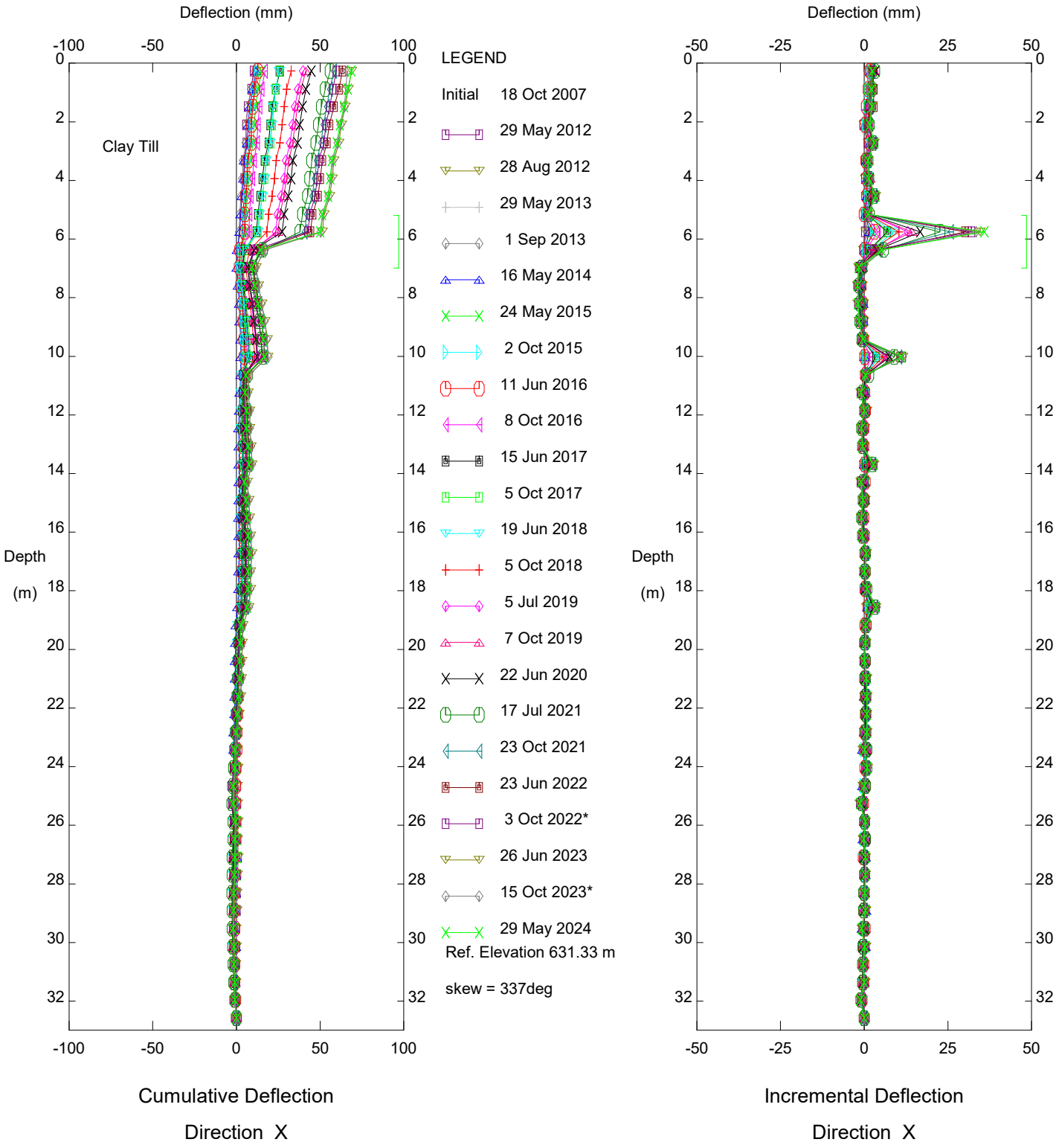

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

GP029 HWY 2:70 (Church Camp), Inclinometer SI-3

Alberta Transportation

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

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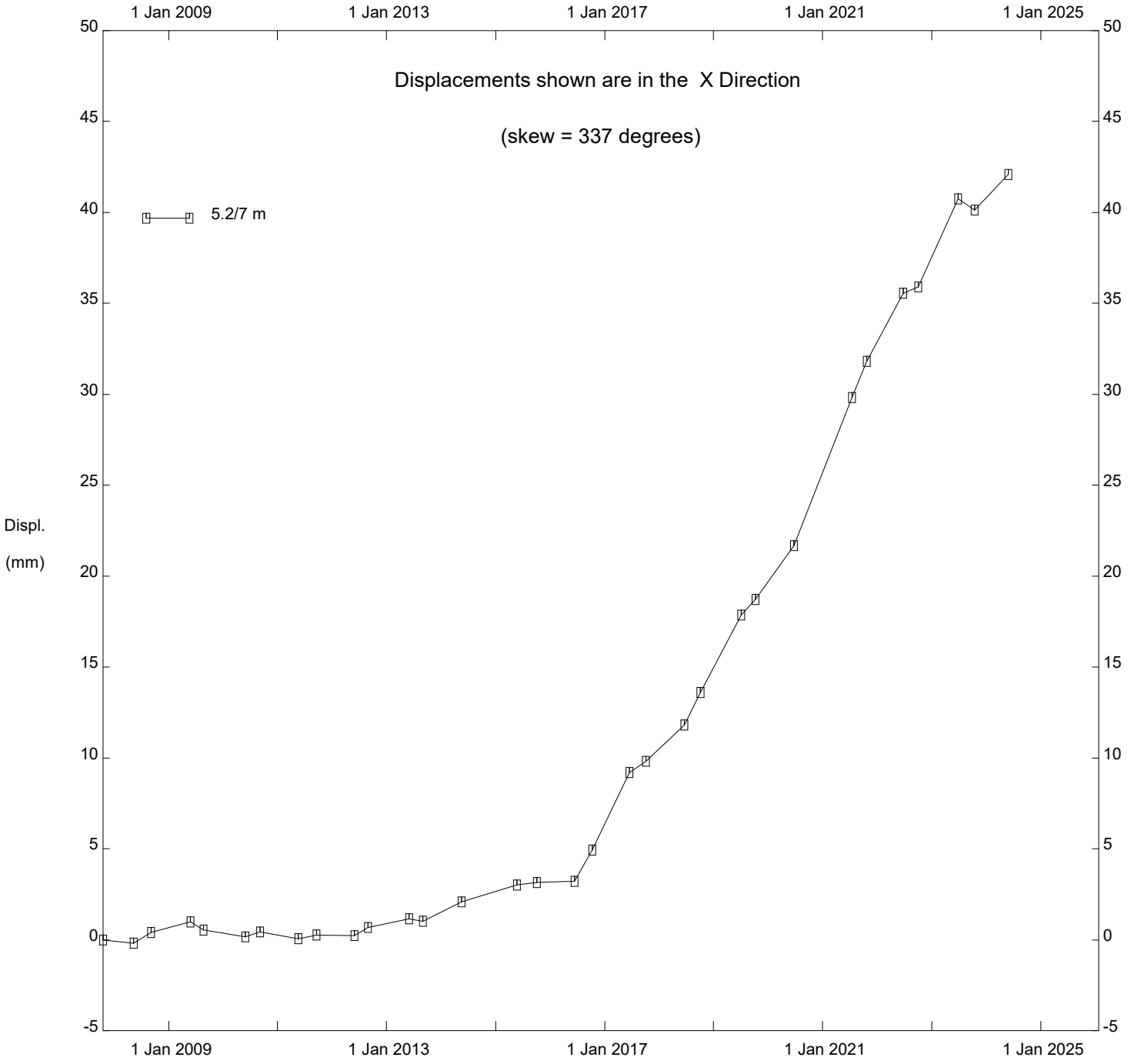

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Alberta Transportation

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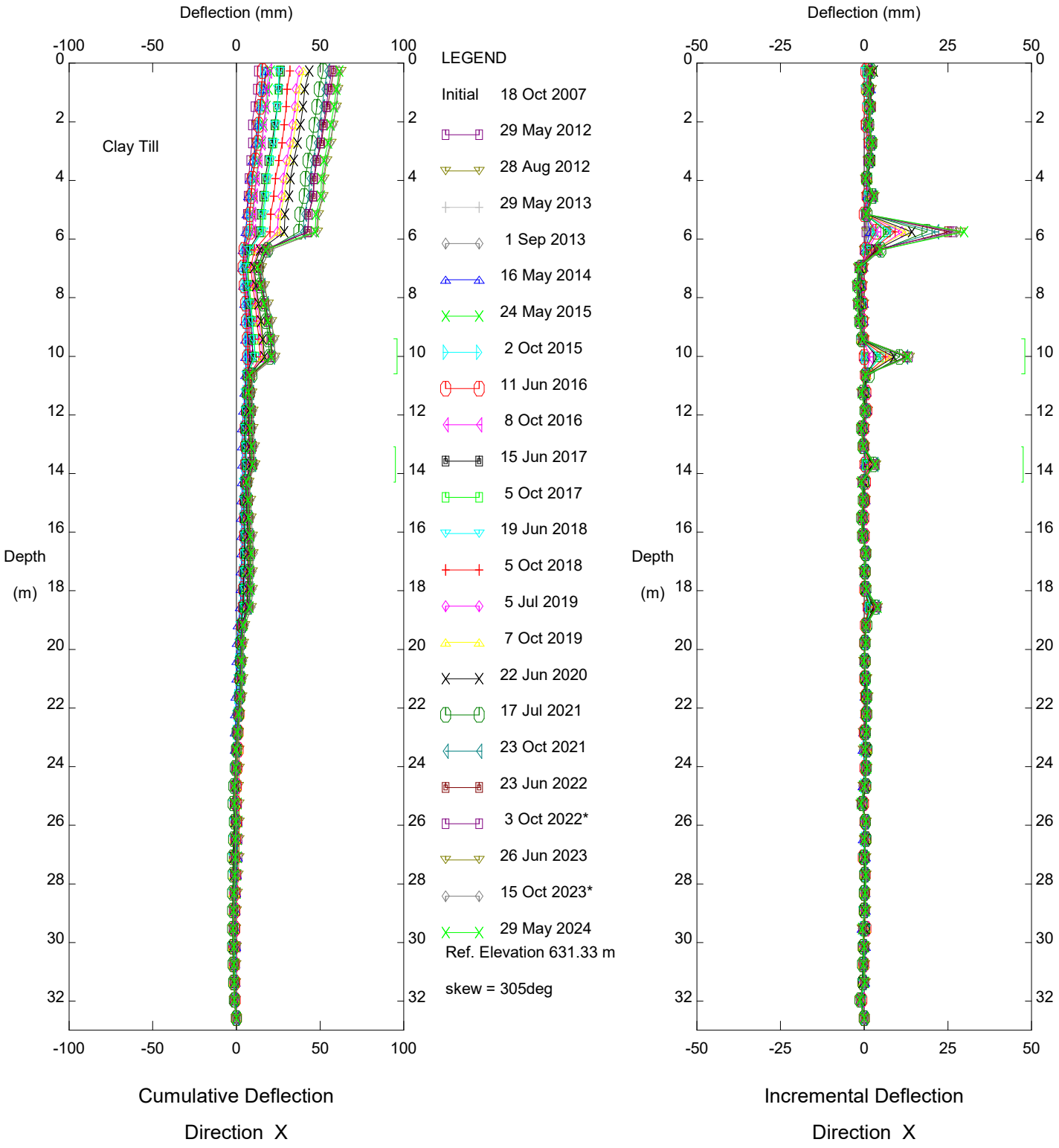

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

GP029 HWY 2:70 (Church Camp), Inclinometer SI-3

Alberta Transportation

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

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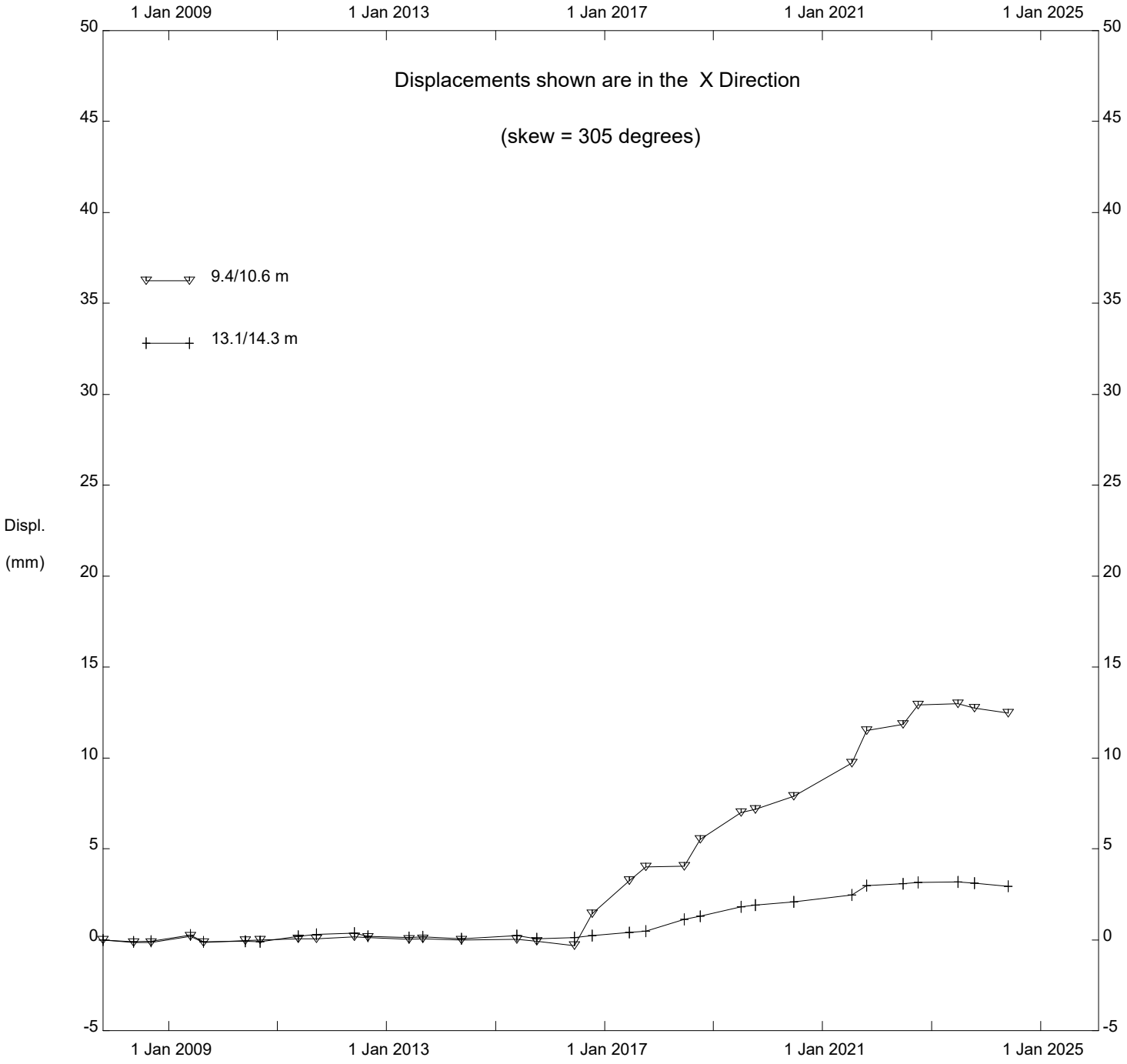

GP029 HWY 2:70 (Church Camp), Inclinometer SI-3

Alberta Transportation

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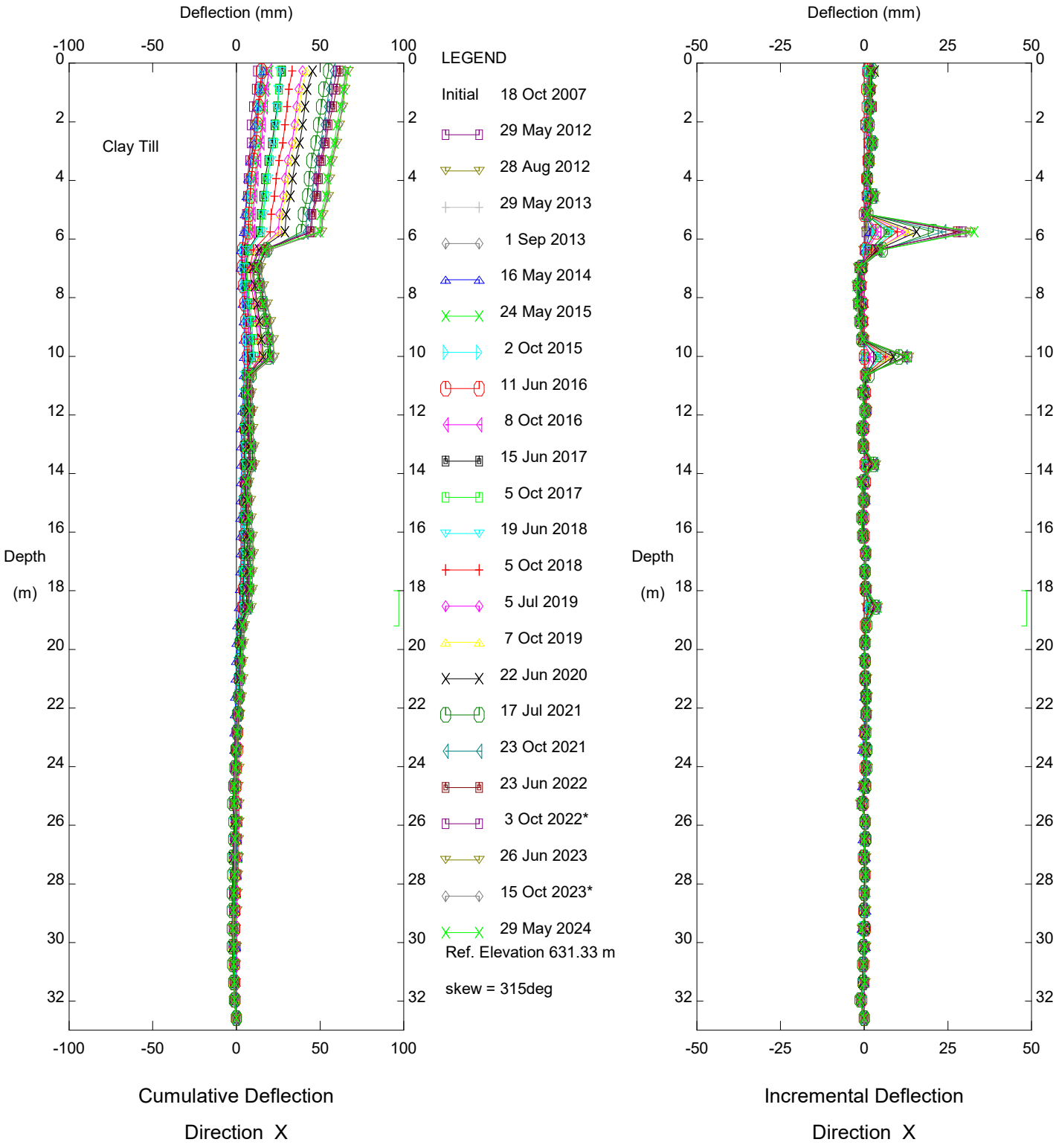

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

GP029 HWY 2:70 (Church Camp), Inclinometer SI-3

Alberta Transportation

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

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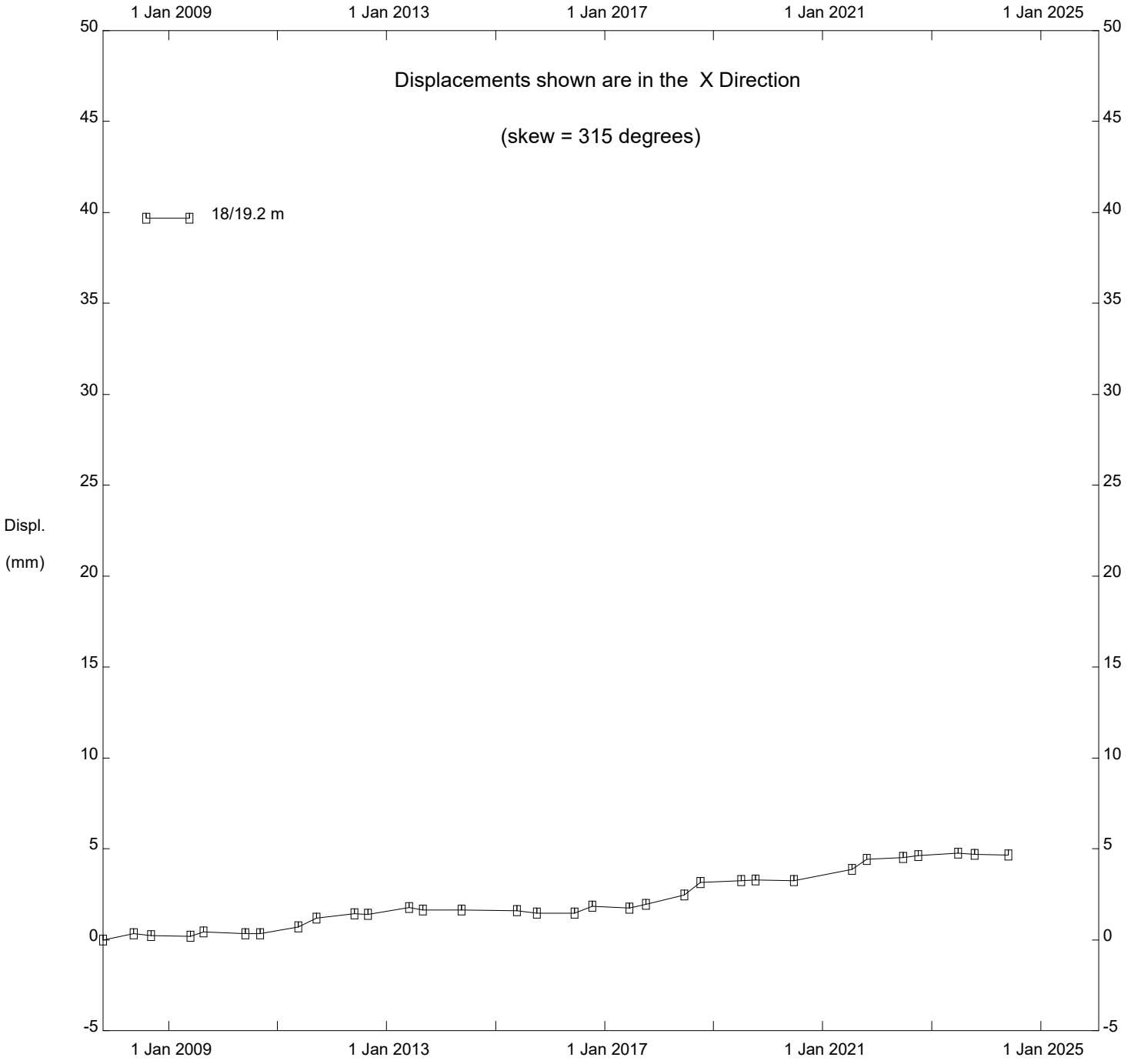

GP029 HWY 2:70 (Church Camp), Inclinometer SI-3

Alberta Transportation

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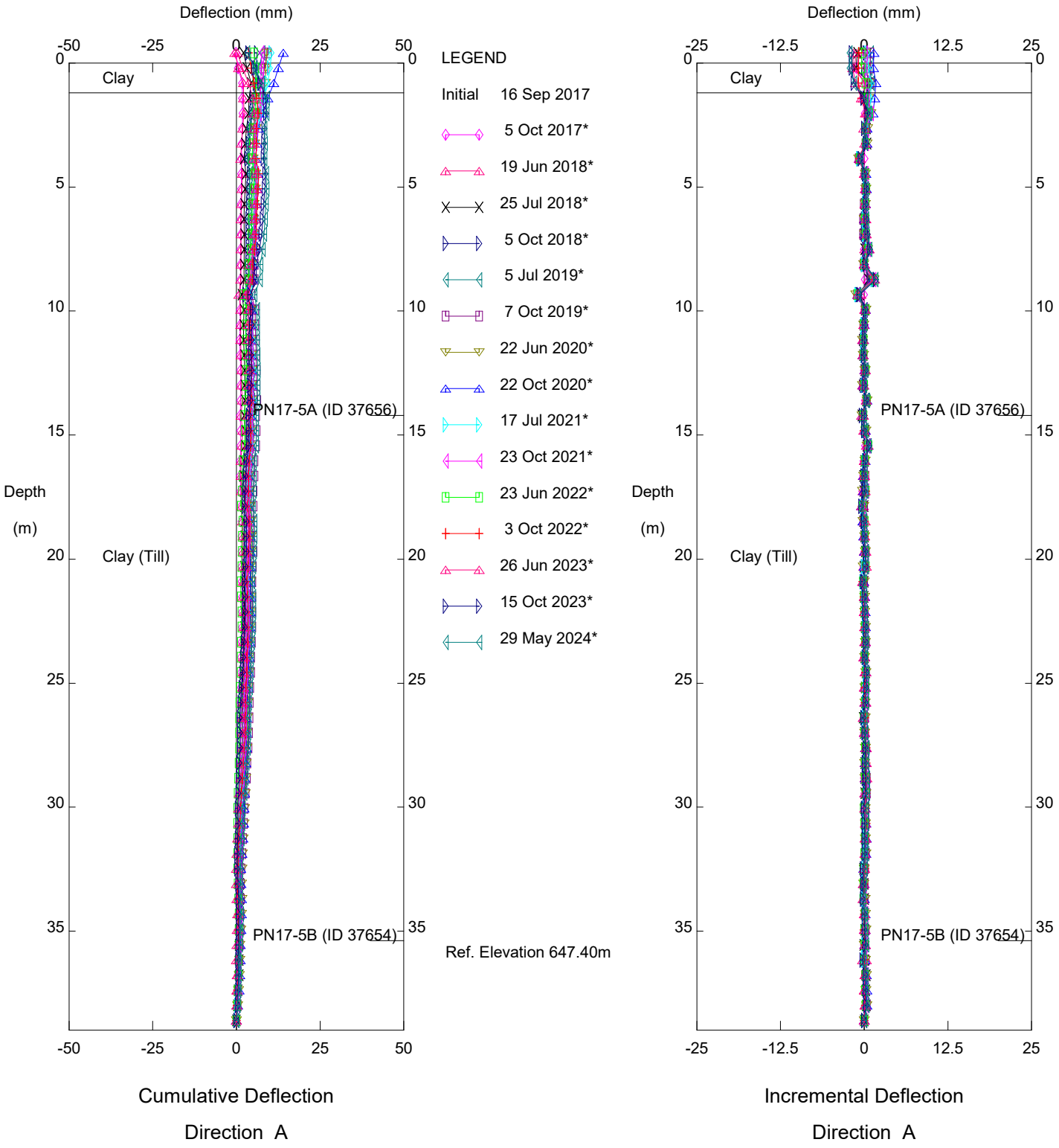

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

GP029 - Church Camp Slide, Inclinometer SI17-5

Alberta Transportation

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

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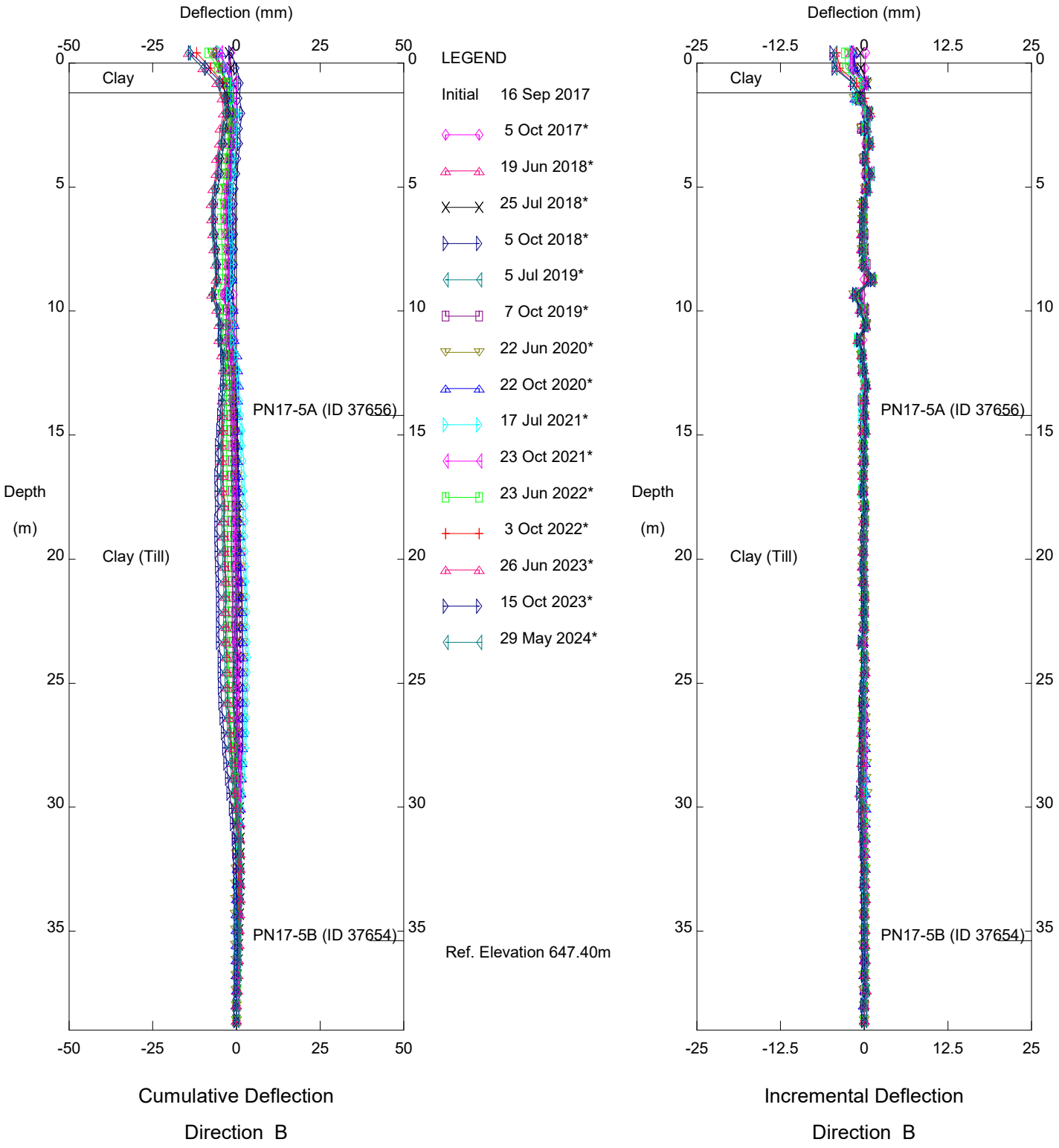

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

GP029 - Church Camp Slide, Inclinometer SI17-5

Alberta Transportation

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

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FIGURE GP029-1
PIEZOMETRIC ELEVATIONS FOR HWY 2:70 CHURCH CAMP SLIDE

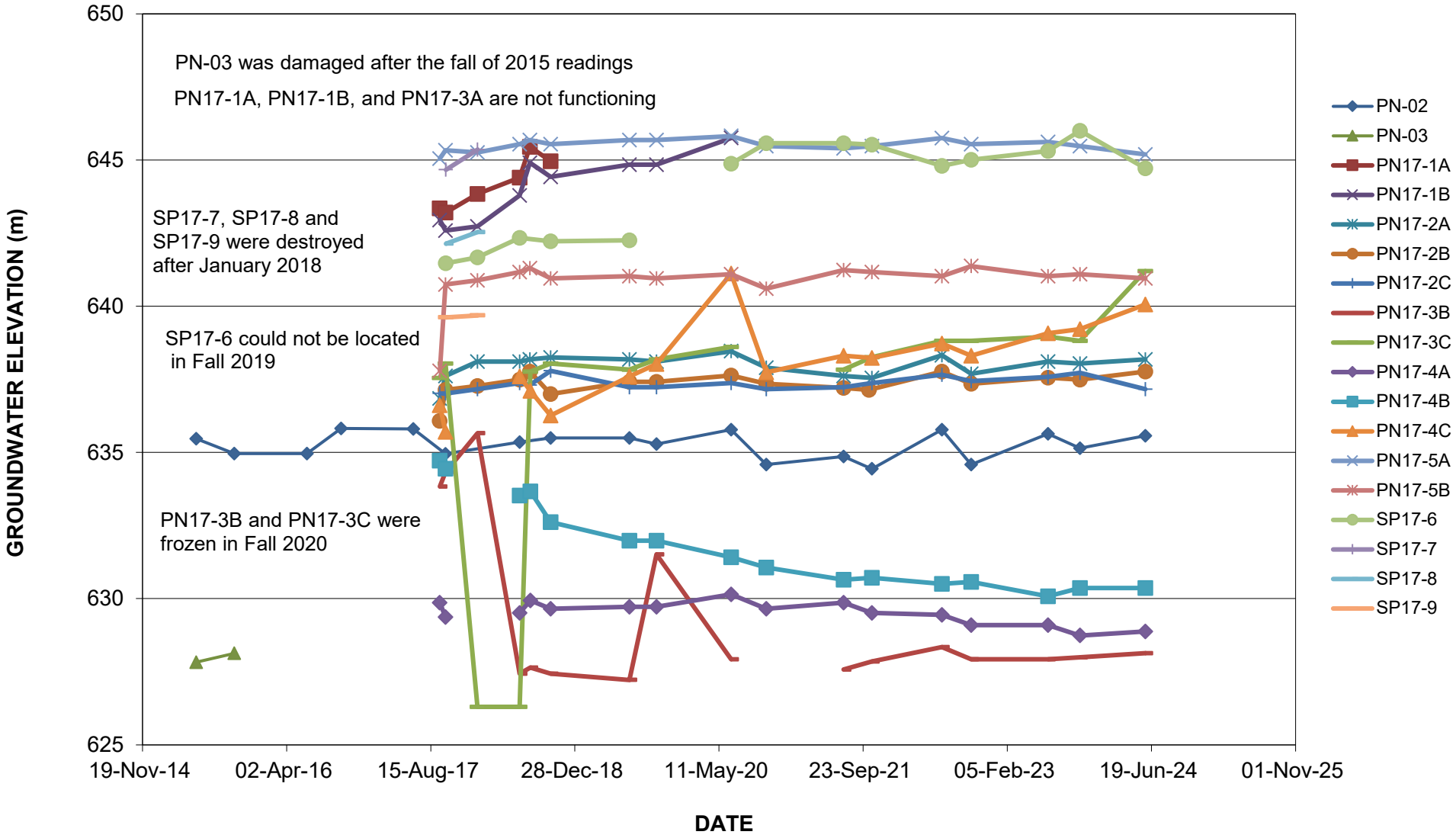

FIGURE GP029-2
PIEZOMETRIC DEPTHS FOR HWY 2:70 CHURCH CAMP SLIDE