

To: Amy Driessen  
Transportation and Economic Corridors  
File: 123315222

From: Leslie Cho and Xiteng Liu  
Stantec Consulting Ltd.  
Date: June 18, 2024

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**Reference: North Central Region, Edson, Site NC037 - Highway 32:10 South of Whitecourt, Spring 2024 Instrumentation Monitoring Report**

## 1.0 OBSERVATIONS

### 1.1 FIELD PROGRAM AND INSTRUMENTATION STATUS

The Spring 2024 reading cycle consisted of instrument readings of eight slope inclinometers (SI10-5, SI10-6, SI10-7, SI10-8, SI10-9, SI18-03, SI18-04, and SI18-05), four pneumatic piezometers (PN10-5, PN10-6, PN10-7 and PN10-8), seven standpipes (SP05-1, SP05-2, SP05-4, SP10-8, SP20-1, SP20-2, and SP20-3), and four vibrating wire piezometers (VW18-02, VW18-03, VW18-04, and VW18-05). Figure 1 attached provides a schematic of the site. The instruments were read by Andres Padros, Technologist and Olawale Odusi, Geotechnical Technologist on May 14, 2024.

The slope inclinometers (SI) were measured using an RST MEMS digital inclinometer probe with 0.5 m increments and handheld PC. Readings were taken based on cable markings in relation to the top of SI casing. The pneumatic piezometers (PN) were read with an RST Instruments C-109 Pneumatic Readout. Standpipe piezometers (SP) were read with a Heron Instruments water tape. The vibrating wire piezometers (VW) were read with an RST VW2106 readout box.

GPS coordinates of all instruments were obtained using a Garmin eTrex 22x handheld GPS unit.

PN10-6 was observed to be damaged during the Spring 2022 instrumentation cycle. In the current cycle, it was found that although the casing was damaged, the pneumatic cable itself was accessible and hence a reading was taken.

Slide remediation was completed in December 2020 and consisted of installing six finger drains along the highway backslope. The finger drains were connected to an interceptor drain along the south ditch. Three standpipes (SP20-1, SP20-2, and SP20-3) were installed as part of construction to monitor groundwater levels along the roadway. The interceptor drain was inspected during Spring 2023 monitoring cycle. Water level was observed to be at the invert level of the drainpipe and slight water flow was observed at the interceptor pipe daylight location.

## 2.0 INTERPRETATION

### 2.1 GENERAL

SI plots are provided in the attachments and summarized in the following sections. Resultant plots in the x-direction (i.e., slope dip direction) along with movement rates, total cumulative movement, maximum movement rates, and incremental movements are provided in **Table NC037-1**.

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The groundwater levels from piezometer readings are plotted in the attachments and summarized in **Tables NC037-2, NC037-3, and NC037-4.**

## **2.2 ZONES OF MOVEMENT**

No new zones of movement were observed in any of the operational slope inclinometers.

## **2.3 MONITORING RESULTS**

### **2.3.1 Slope Inclinometers**

SI10-5 shows a zone of movement from about 8.8 m to 12.3 m depth. The movement zone appears to be creeping at an overall rate of less than 1 mm/yr since berm construction in 2011. The current movement rate is 8 mm/yr, and the cumulative movement increased by 8 mm to 43 mm.

SI10-6 has a movement zone between 6.4 m and 8.9 m depth and appears to be creeping at a rate of less than 1 mm/yr since berm construction in 2011. An increase to 3 mm/yr rate of movement was observed during Fall 2017. Since then, the rate has returned to less than 1 mm/yr.

SI10-7 shows movement between 1.2 m to 4.7 m with an average rate of movement of 2 mm/yr from 2013 to 2019. The Spring 2024 reading cycle shows a current rate of movement of 5 mm/yr and total cumulative movement of 110 mm. The direction of movement observed in the current instrumentation cycle was opposite to that observed in Spring 2023, and the cumulative movement returned to values similar to the ones prior to that cycle.

The absolute position plot for SI10-7 suggests there is disturbance of about 40 mm in the soil surrounding the inclinometer casing between 6 m to 15 m depth. This disturbance may be causing the erratic movement observed in the incremental and cumulative movement plots.

SI10-8 has two zones of movement at approximately 2.5 m and 8.0 m depth. The deeper movement zone has recorded less than 1 mm of movement since 2016 while the upper zone has cumulative movement up to about 5 mm. The current movement rate in the upper zone is less than 1 mm/yr and appears to be creeping.

Note that during the work transfer to Stantec in 2016, a slight depth discrepancy was observed in SI10-8 due to different units of measurement used during data collection. To present more accurate information, data prior to 2016 was excluded from the SI plots and the cumulative movement since initialization included on Table NC037-1.

SI10-9 has a zone of movement at approximately 4.6 m to 6.1 m depth. The movement zone shows creep movement since 2011 with a movement rate of about 1 mm/yr.

SI18-04 has a potential movement zone (creeping) between 2 m and 4 m. The current rate of movement is less than 1 mm/yr with total cumulative movement of about 3 mm since 2018.

No discernable movement was observed in SI18-03 and SI18-05.

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### **2.3.2 Piezometers**

Most of the PNs have remained consistent since Spring 2011 showing very little to no change (<0.1 m) in piezometric level. Piezometric levels in PN10-5, PN10-6, PN10-7, and PN-10-8 did not change when compared with the data from previous reading cycle.

SP10-8 and SP20-3 were observed to be dry again and have been since 2020 and initialization, respectively. SP05-01 showed no change in water level since the previous monitoring cycle in Spring 2023. SP05-4 and SP20-1 showed an increase in water level of 0.2 m and 0.4 m, respectively. SP20-2 showed a slight decrease in water level of less than 0.1 m. SP05-2 was found dry during this Spring 2024 cycle. Overall, all ground water elevations resembled those read in the previous cycle.

The VWP's showed no change in piezometric level since the previous reading cycle.

## **3.0 RECOMMENDATIONS**

### **3.1 FUTURE WORK**

It is recommended that all instruments be read during the Spring 2025 reading cycle.

### **3.2 INSTRUMENTATION REPAIRS**

No instrument repairs are required at this time.

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**Table NC037-1: Spring 2024 Slope Inclinometer Reading Summary**

Instrument Name	Date Initialized	Coordinates <sup>(1)</sup> (UTM 11U, NAD1983) (m)		Total Cumulative Resultant Movement and Depth of Movement to Date (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)
		Northing	Easting							
SI10-4	Jan. 16, 2010	-	-	5 over 7.4m to 9.9m depth in the 0° direction	11 in June 2017	Non - Operational	June 12, 2017	Knocked over in Fall 2017		
SI10-5	Jan. 16, 2010	5999425	583333	43 over 8.8 m to 12.3 m depth in 355° direction	42 in Sept. 2011	Operational	May 11, 2023	8	8	5
SI10-6	Jan. 16, 2010	5999420	583294	22 over 6.4 m to 8.9 m depth in 313° direction	6 in Sept. 2011	Operational	May 11, 2023	<1	<1	<1
SI10-7	Jan. 16, 2010	5999468	583291	110 over 1.2 m to 4.7 m depth in 337° direction	728 in Oct. 2011 during construction	Operational	May 11, 2023	5	5	-21
SI10-8	Jan. 16, 2010	5999469	583662	5.4 over 1.4 m to 3.3 m depth in 20° direction since 2016 and 0 mm prior to 2016	2 in April 2018	Operational	May 11, 2023	Negligible Movement (less than 1 mm/yr)		
				< 1 over 7.3 m to 8.4 m depth in 20° direction since 2016 and 2 mm prior to 2016	1 in Sept. 2016			Negligible Movement (less than 1 mm/yr)		

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SI10-9	Jan. 16, 2010	5999477	583665	10 over 4.6 m to 6.1m depth in 26° direction	2 in Sept. 2011	Operational	May 11, 2023	1	1	1
SI18-01	Mar 28, 2018	-	-	66 over 1.2m to 2.2m depth in 340° direction	98 in June 2018	Non - Operational	September 25, 2019	Sheared off @ 2.5 m in Fall 2019		
SI18-03	Mar 28, 2018	5999460	583601	No Discernable Movement		Operational	May 11, 2023	No Discernable Movement		
SI18-04	Mar 28, 2018	5999453	583541	3 over 2.2 m to 4.2 m depth in 0° direction	1 in July 2021	Operational	May 11, 2023	<1	<1	<1
SI18-05	Mar 28, 2018	5999487	583594	No Discernable Movement Zone		Operational	May 11, 2023	No Discernable Movement		
<p>Note:            (1) Updated May 14, 2024, with approximate accuracy of ± 3 m.</p>										

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**Table NC037-2: Spring 2024 Pneumatic Piezometer Reading Summary**

Instrument Name	Date Initialized	Coordinates <sup>(1)</sup> (UTM 11U, NAD1983) (m)		Tip Elevation (mbgs)	Ground Elevation (m) (aMSL) <sup>(2)</sup>	Current Status	Maximum Piezometric Elevation (m bgs)	Measured Piezometric Elevation (m) (Groundwater Level)	Previous Piezometric Elevation (m) (Groundwater Level)	Change in Piezometric Level Since Previous Reading (m)
		Northing	Easting							
PN10-4 (33010)	Jan. 16, 2010	-	-	708.8	719.3	Non-operational	719.2 Sept. 2010	Found Damaged in Fall 2017		
PN10-5 (32890)	Jan. 16, 2010	5999425	583333	708.6	719.8	Operational	719.4 Jan 2010	708.6 (11.3 m bgs)	708.6 (11.3 m bgs)	No Change
PN10-6 (32889)	Jan. 16, 2010	5999420	583294	711.8	719.9	Operational	712.1 Oct 2012 & May 2016	711.8 (8.1 m bgs)	711.8 (8.1 m bgs)	No Change
PN10-7 (32891)	Jan. 16, 2010	5999468	583291	701.8	707.1	Operational	702.2 May 2016	702.0 (5.1 m bgs)	702.0 (5.1 m bgs)	No Change
PN10-8 (32892)	Jan. 16, 2010	5999469	583662	710.4	713.6	Operational	713.6 June 2017	710.0 (3.5 m bgs)	710.0 (3.5 m bgs)	No Change
<p>Note:</p> <p>(1) Updated May 14, 2024, with approximate accuracy of ± 3 m.</p> <p>(2) aMSL = Above Mean Sea Level</p>										

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**Table NC037-3: Spring 2024 Standpipe Piezometer Summary**

Instrument Name	Date Initialized	Coordinates <sup>(1)</sup> (UTM 11U, NAD1983) (m)		Ground Elevation (m)	Current Status	Maximum Groundwater Elevation (m)	Measured Water Level Elevation (m) (Groundwater Level)	Previous Water Level Elevation (m) (Groundwater Level)	Change in Groundwater Level Since Previous Reading (m)
		Northing	Easting						
SP05-1	May 9, 2005	5999398	583378	718.7	Operational	719.11 Oct 2014	718.3 (0.4 m bgs)	718.3 (0.4 m bgs)	No change
SP05-2	May 19, 2005	5999430	583370	719.1	Operational	715.78 May 2015	Dry	709.8 (9.3 m bgs)	N/A
SP05-4	May 9, 2005	5999482	583369	706.8	Operational	704.87 May 2011	703.5 (3.3 m bgs)	703.2 (3.5 m bgs)	0.2
SP10-8	Jan. 16, 2012	5999469	583662	713.6	Operational	704.44 Oct 2014	Dry	Dry	No change
SP20-1	December 4, 2020	5999419	583492	719	Operational	717.7 May 2024	717.7 (1.4 m bgs)	717.2 (1.8 m bgs)	0.4
SP20-2	December 4, 2020	5999429	583590	717.3	Operational	715.7 May 2023	715.6 (1.7 m bgs)	715.7 (1.6 m bgs)	-<0.1
SP20-3	December 4, 2020	5999439	583676	-	Operational	-	Dry	Dry	No change
Note: (1) Updated May 14, 2024, with approximate accuracy of ± 3 m.									

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**Table NC037-4: Spring 2024 Vibrating Wire Piezometer Summary**

Instrument Name	Date Initialized	Coordinates <sup>(1)</sup> (UTM 11U, NAD1983) (m)		Ground Elevation (m)	Tip Elevation (m)	Current Status	Maximum Piezometric Level (mbgs)	Measured Piezometric Elevation (m) (Piezometric Level)	Previous Piezometric Elevation (m) (Piezometric Level)	Change in Piezometric Level Since Previous Reading (m)
		Northing	Easting							
VW18-01	Mar. 28, 2018	-	-	-	714.7	Non – Operational	1.1 Sept. 2018	Found sheared off in Fall 2019.		
VW18-02	Mar. 28, 2018	5999415	583539	718.4	715.4	Operational	1.0 March 2018	716.7 (1.7 m bgs)	716.7 (1.6 m bgs)	No Change
VW18-03	Mar. 28, 2018	5999460	583601	715.9	711.9	Operational	3.7 May 2018	Dry	Dry	No change
VW18-04	Mar. 28, 2018	5999453	583541	716.6	712.0	Operational	4.1 May 2020	Dry	Dry	No change
VW18-05	Mar. 28, 2018	5999487	583594	709.8	702.2	Operational	7.5 Sept. 2018	Dry	Dry	No change
Note: (1) Updated May 14, 2024, with approximate accuracy of ± 3 m.										



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## 4.0 CLOSING

We trust this instrumentation report meets your requirements. If you have any questions, please do not hesitate to contact the undersigned.

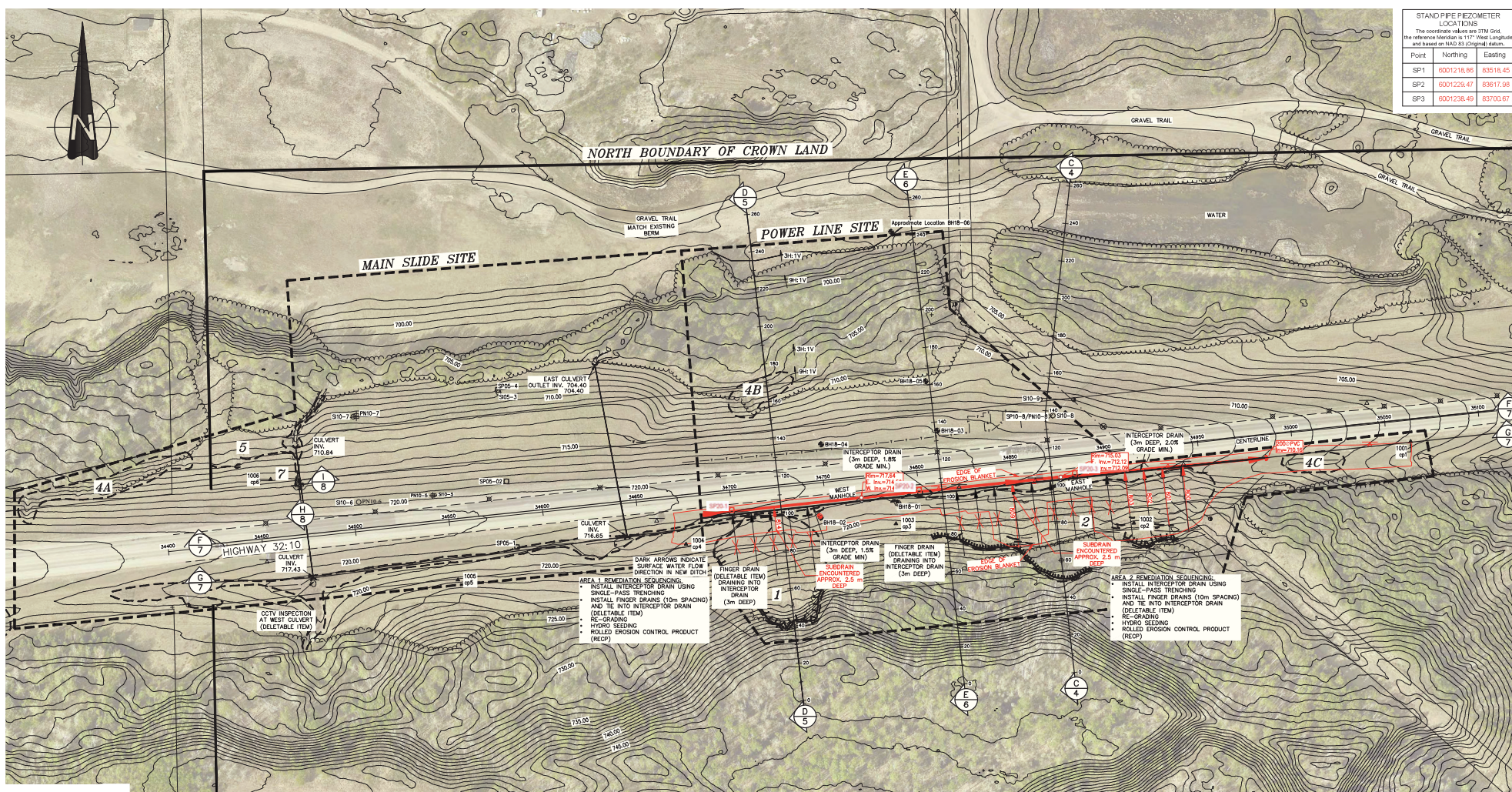
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Attachment: Figure 1 – Proposed Remediation Plan  
SI10-5 Slope Inclinator Plots  
SI10-6 Slope Inclinator Plots  
SI10-7 Slope Inclinator Plots  
SI10-8 Slope Inclinator Plots  
SI10-9 Slope Inclinator Plots  
SI18-03 Slope Inclinator Plots  
SI18-04 Slope Inclinator Plots  
SI18-05 Slope Inclinator Plots  
Pneumatic Piezometer Elevation vs. Time Plot  
Pneumatic Piezometer Depth vs Time Plot  
Standpipe Piezometer Elevation vs. Time Plot  
Standpipe Piezometer Depth vs Time Plot  
Vibrating Wire Piezometer Depth vs Time Plot

DEPARTMENT BAR CODE: 21302-202005-RD-0003  
 DRAWING: 32.10  
 CONTRACT: 21302  
 DESCRIPTION: SLOPE FAILURE - NC37 WHITECOURT, AB REMEDIATION PLAN  
 PHOTO  
 DATE: 2018-05-28  
 BY: DM  
 SURVEYED



STAND PIPE PIEZOMETER LOCATIONS  
 The coordinate values are 27M Grid. The reference Meridian is 117 West Longitude and based on NAD 83 (Original datum).

Point	Northing	Easting
SP1	6001216.96	635116.45
SP2	6001226.47	636117.98
SP3	6001236.49	637003.67

- LEGEND**
- BH BOREHOLE
  - SP STANDPIPE PIEZOMETER
  - PNP PNEUMATIC PIEZOMETER
  - SI SLOPE INCLINOMETER
  - POWERPOLE
  - DELINEATOR
  - SIGN
  - PEDESTAL
  - GUYWIRE
  - CULVERT
  - OVERHEAD POWERLINES
  - BURIED TELEPHONE LINES
  - FENCE LINES
  - TREE LINES
  - SCARP
  - CONTROL POINT
- PHASE 1 REMEDIATION**
- 1 WEST LANDSLIDE
  - 2 EAST LANDSLIDE
  - 4 GULLY / EROSION AREA
  - 5 TENSION CRACKS
  - 7 CULVERT / SINKHOLE & EROSION
- NOTES**
- ALL DIMENSIONS AND ELEVATIONS ARE EXPRESSED IN METRES AND DECIMALS THEREOF  
 STATIONING DISTANCES ARE GRID DISTANCES.
- PROJECT LIMIT**
- CROSS SECTION LOCATION**
- DRAIN NOT CONSTRUCTED**

**PLAN**  
1:1000

**LEGEND**

- BH BOREHOLE
- SP STANDPIPE PIEZOMETER
- PNP PNEUMATIC PIEZOMETER
- SI SLOPE INCLINOMETER
- POWERPOLE
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**PHASE 1 REMEDIATION**

- 1 WEST LANDSLIDE
- 2 EAST LANDSLIDE
- 4 GULLY / EROSION AREA
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**NOTES**

ALL DIMENSIONS AND ELEVATIONS ARE EXPRESSED IN METRES AND DECIMALS THEREOF  
 STATIONING DISTANCES ARE GRID DISTANCES.

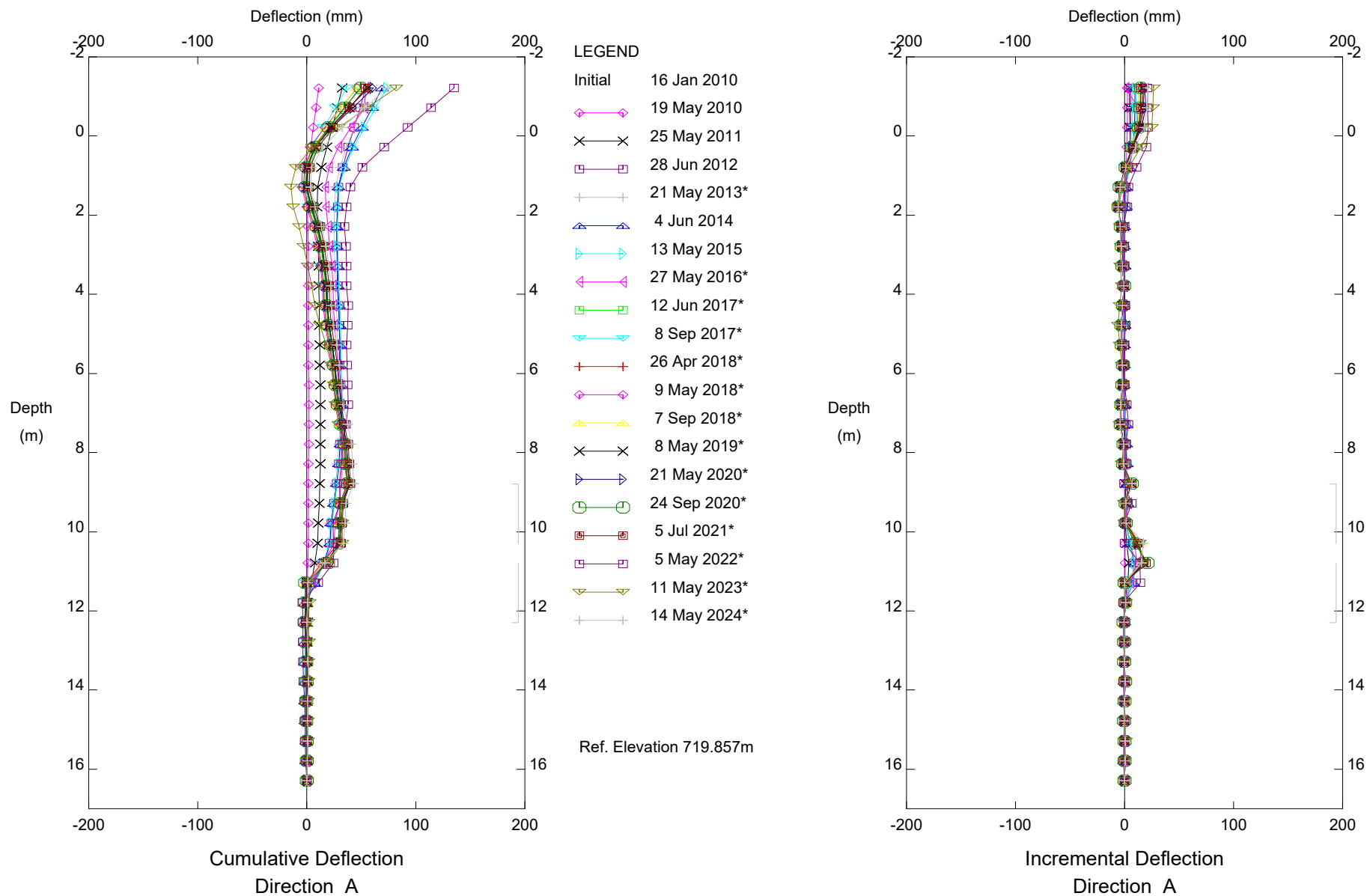
**PROJECT LIMIT**

**CROSS SECTION LOCATION**

**DRAIN NOT CONSTRUCTED**

CONSULTANT	DESIGNER	CHECKER	REVISION	DATE	LOCATION	SITE	CONTRACT	HIGHWAY	SHEET	DRAWING	
<b>Stantec</b>	<b>PERMIT TO PRACTICE STANTEC CONSULTING LTD.</b> Signature: [Signature] 16 March 2021 <b>PERMIT NUMBER: P 0258</b> The Association of Professional Engineers and Geoscientists of Alberta	<b>ENGINEER</b> [Stamp]	<b>ENGINEER</b> [Stamp]	2021-02-26 2020-10-27 2020-06-08 2020-05-12	RECORD DRAWINGS ISSUED FOR CONSTRUCTION ISSUED FOR TENDER ISSUED FOR REVIEW	WHITECOURT, AB	NC37	21302	32.10	3 of 8	21302-202005-RD-0003

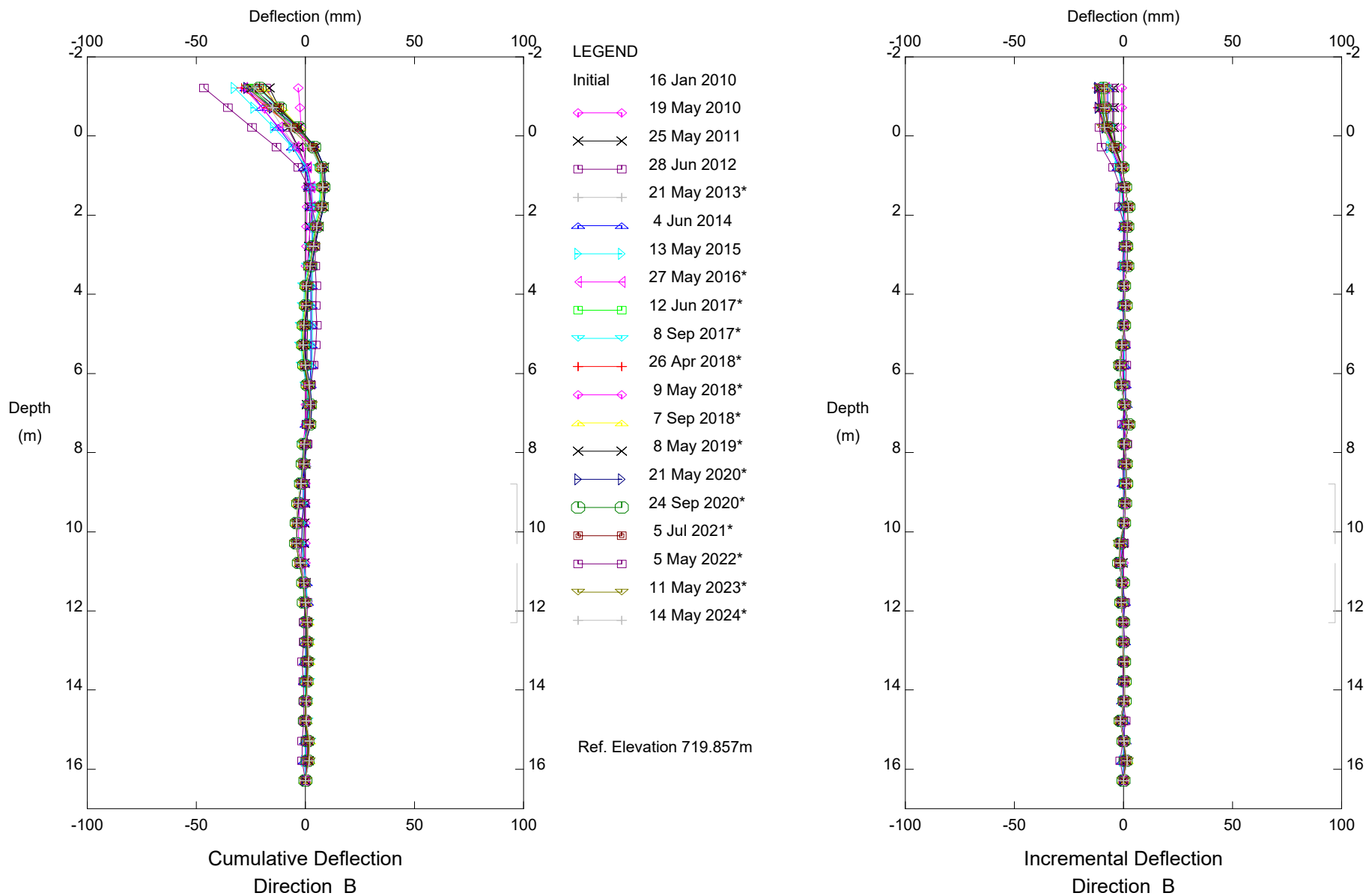
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HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-5

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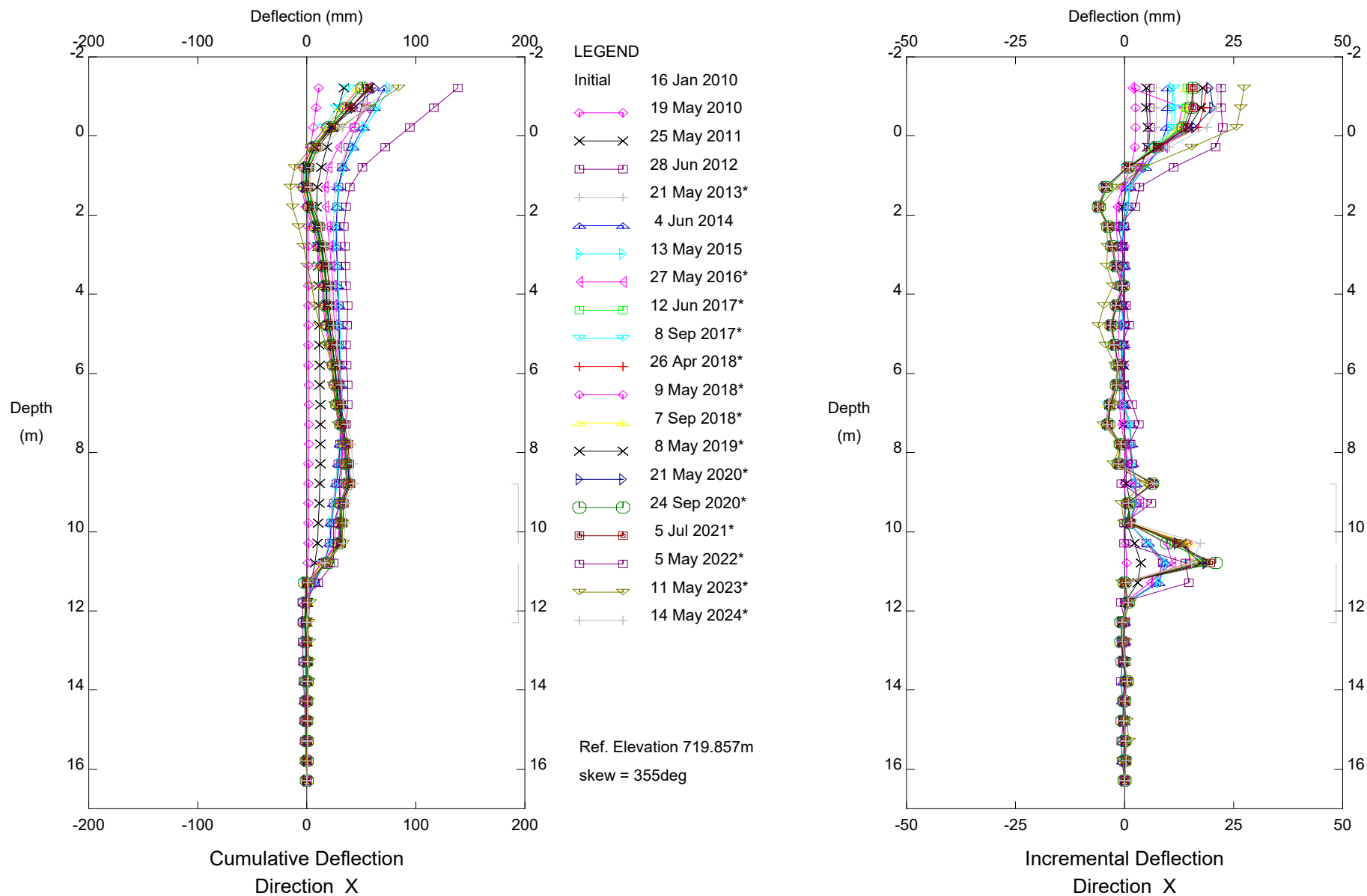
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HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-5

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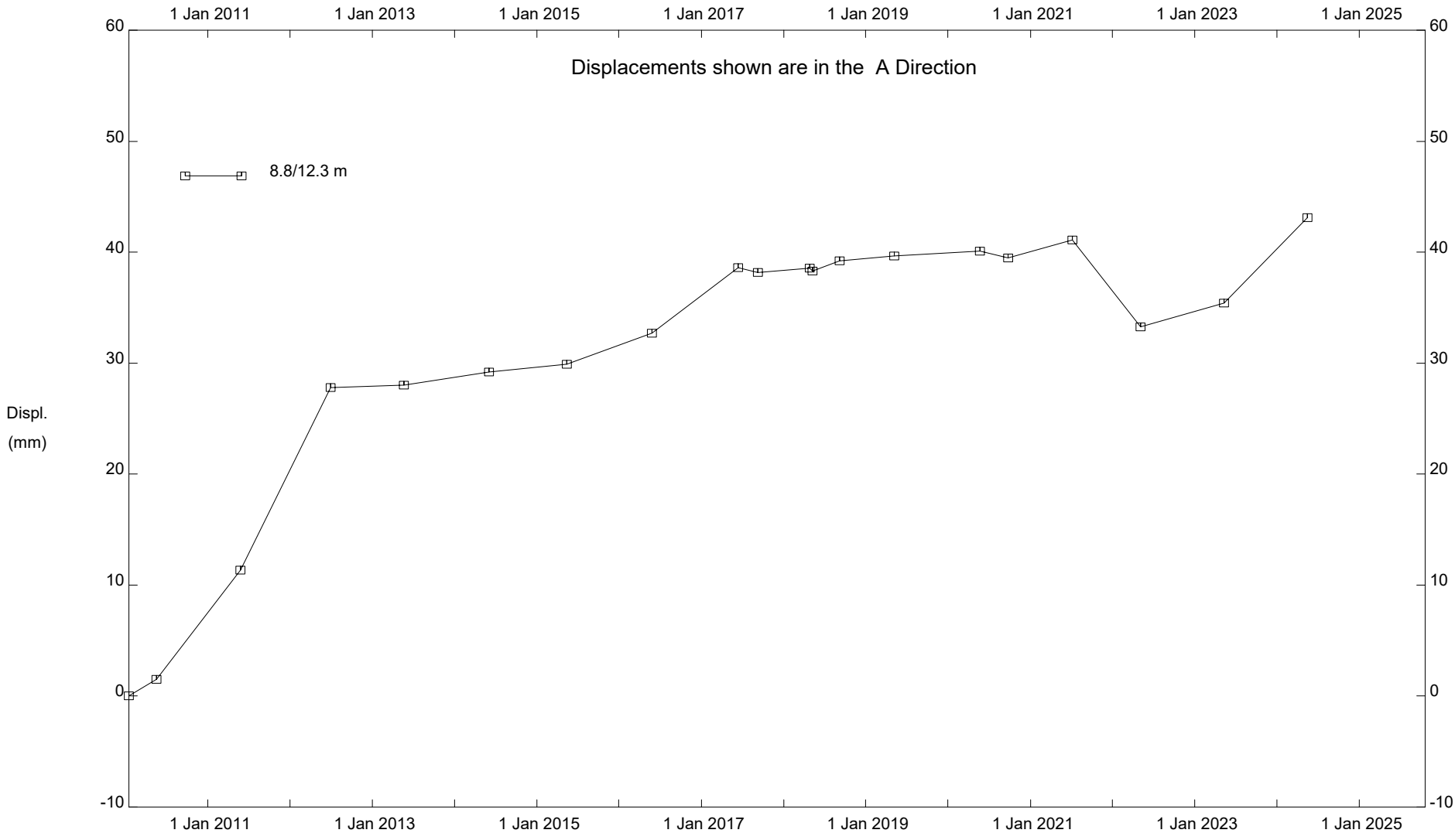
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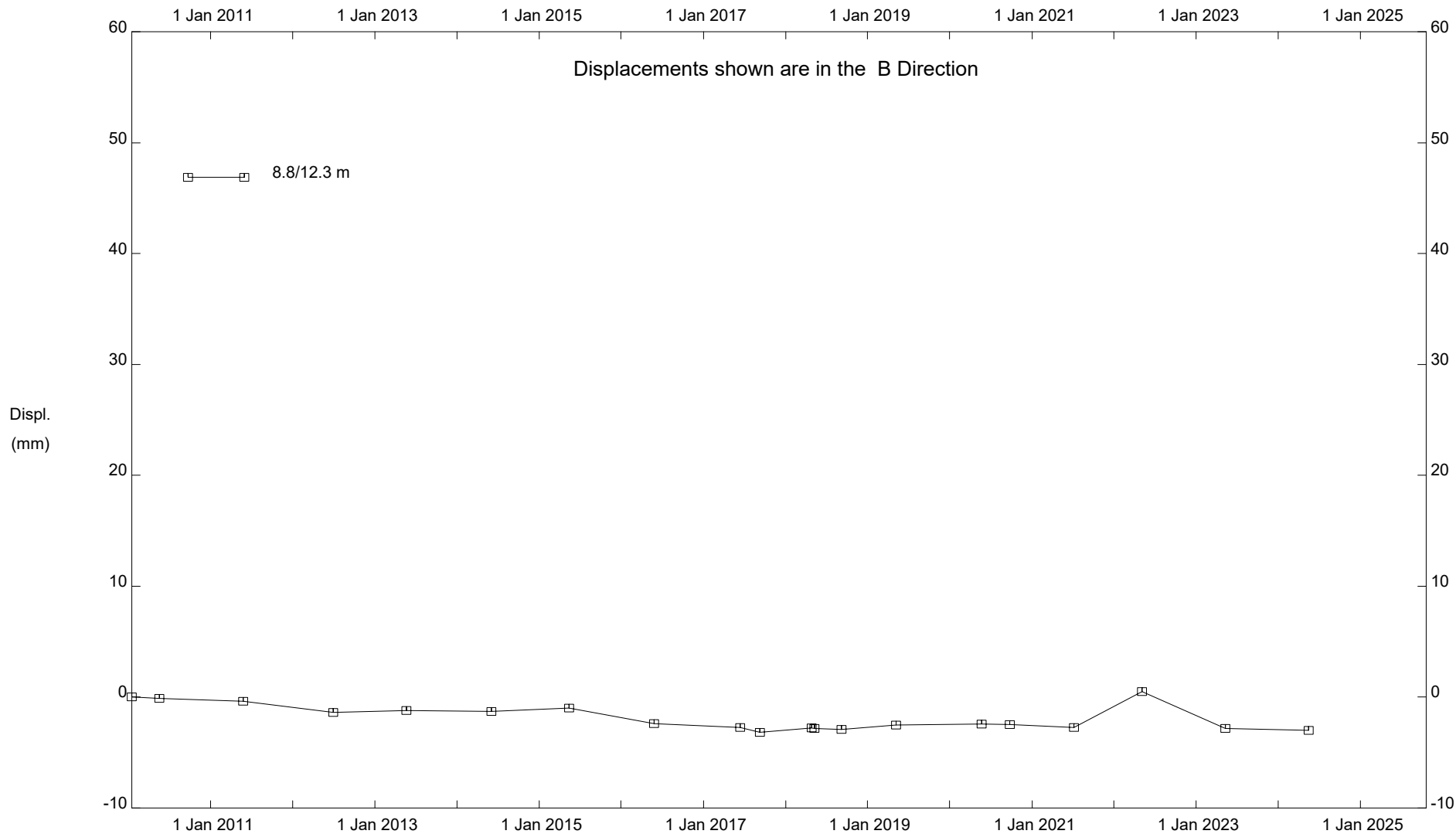
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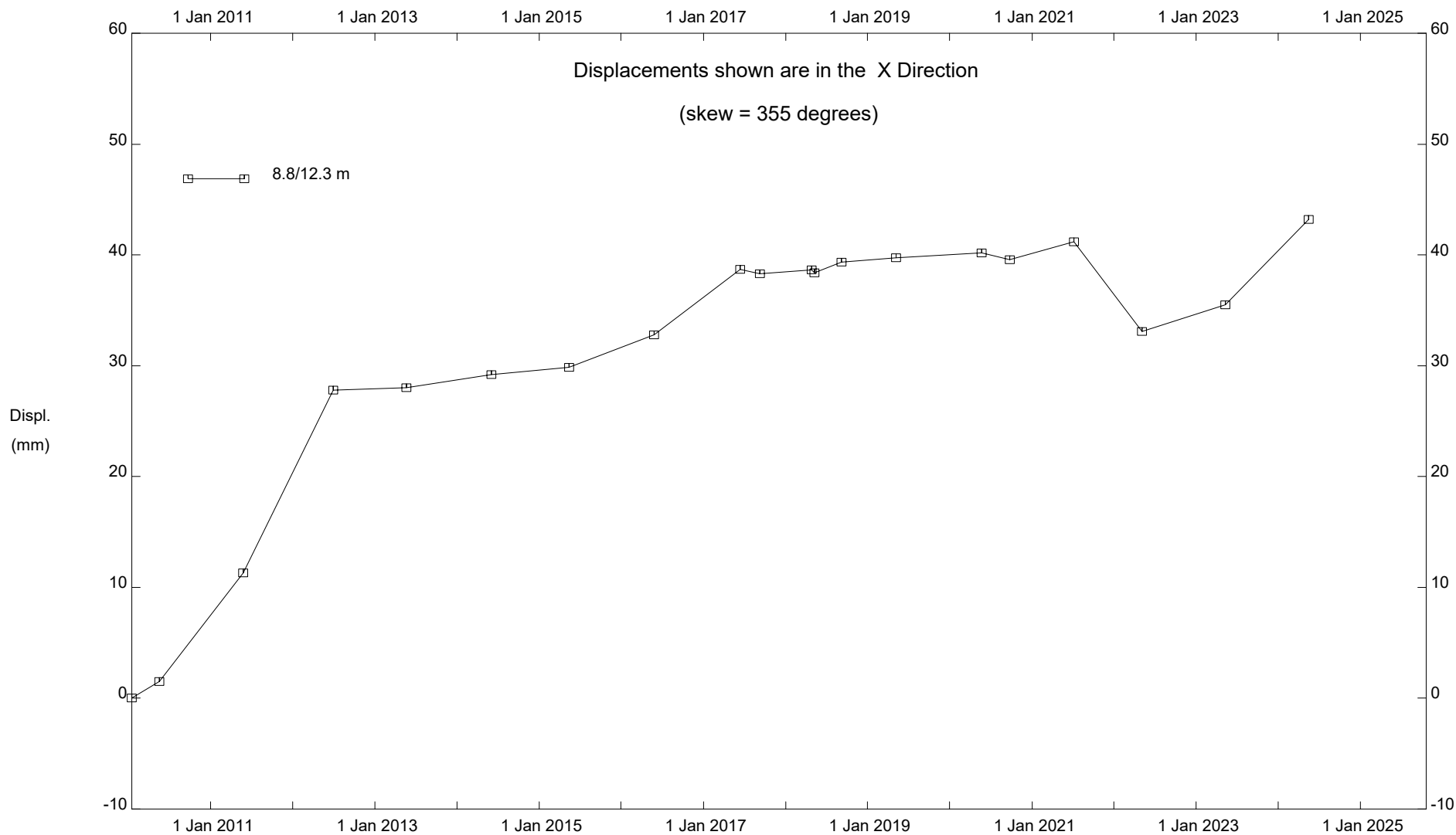
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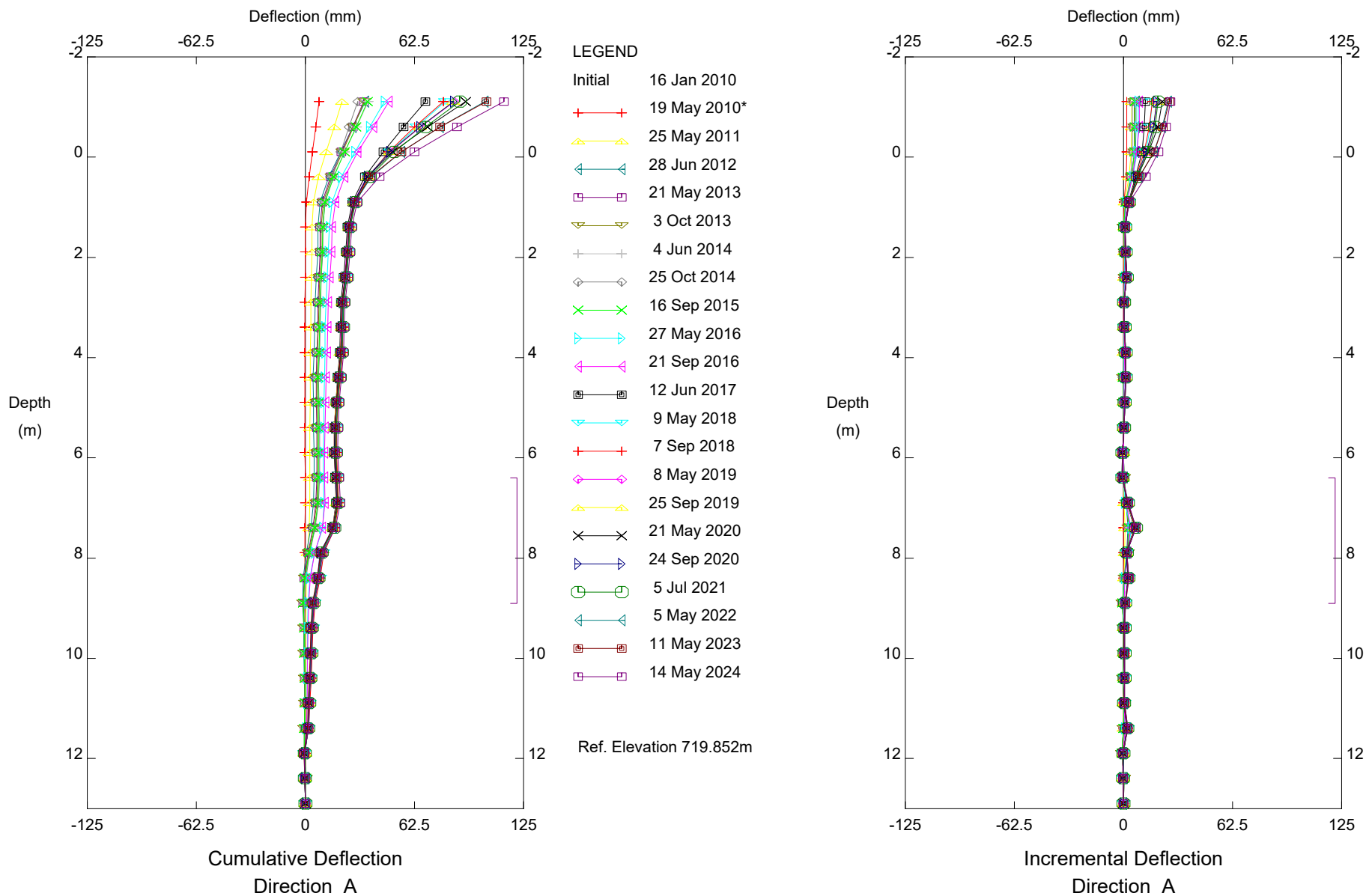
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HWY32:10 South of Whitecourt (NC37), Inclinator SI10-5

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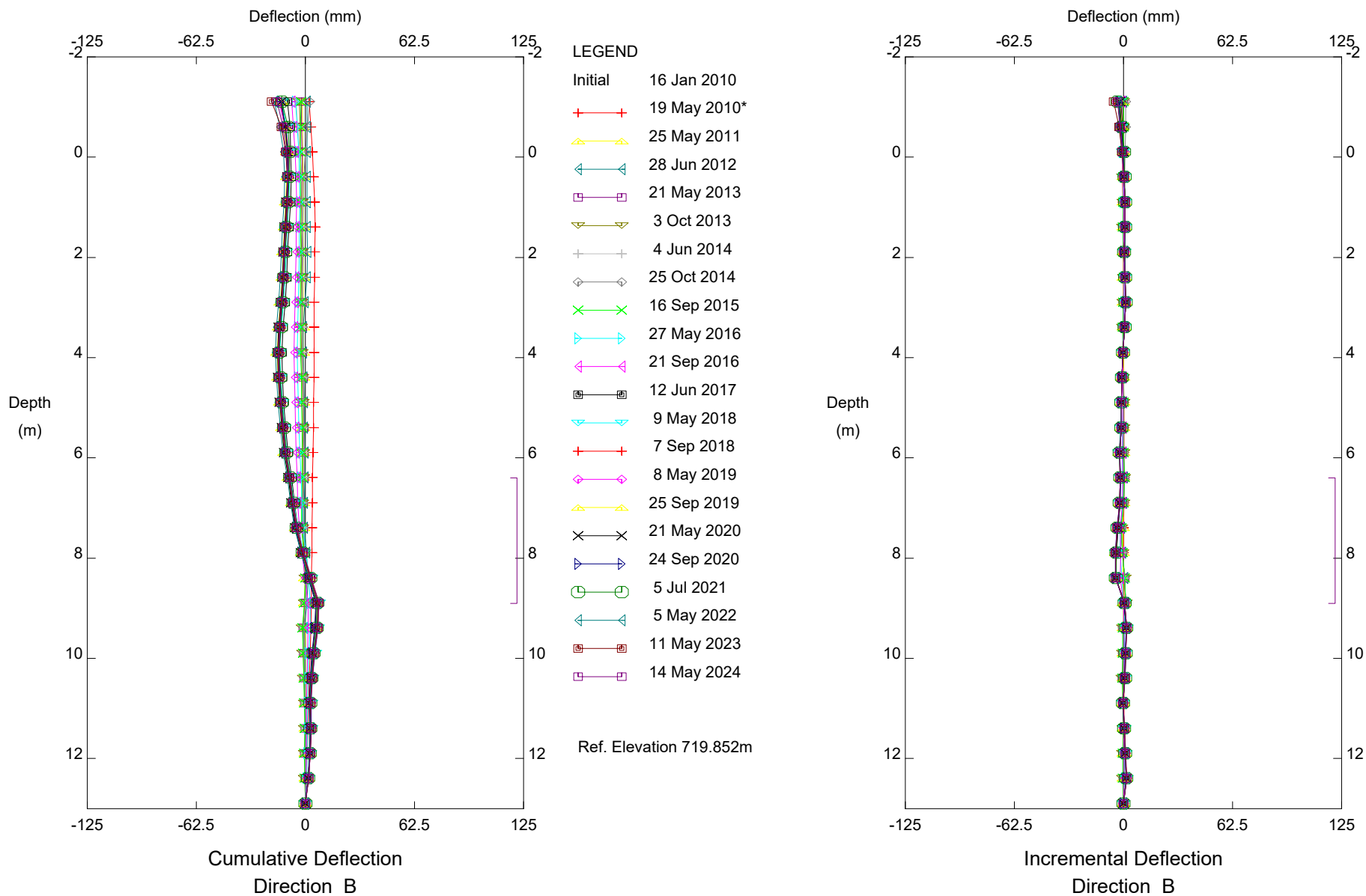


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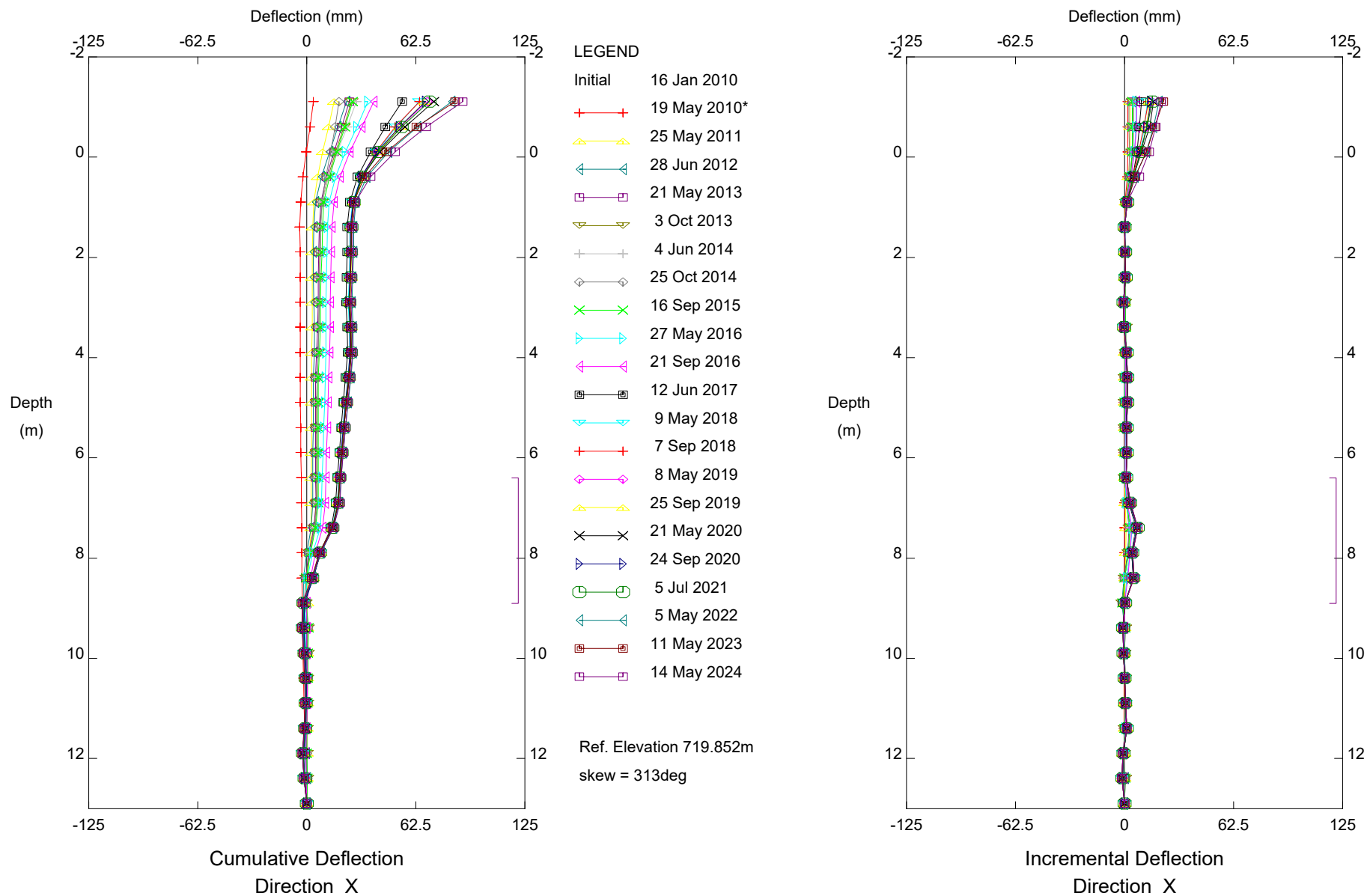


HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-6

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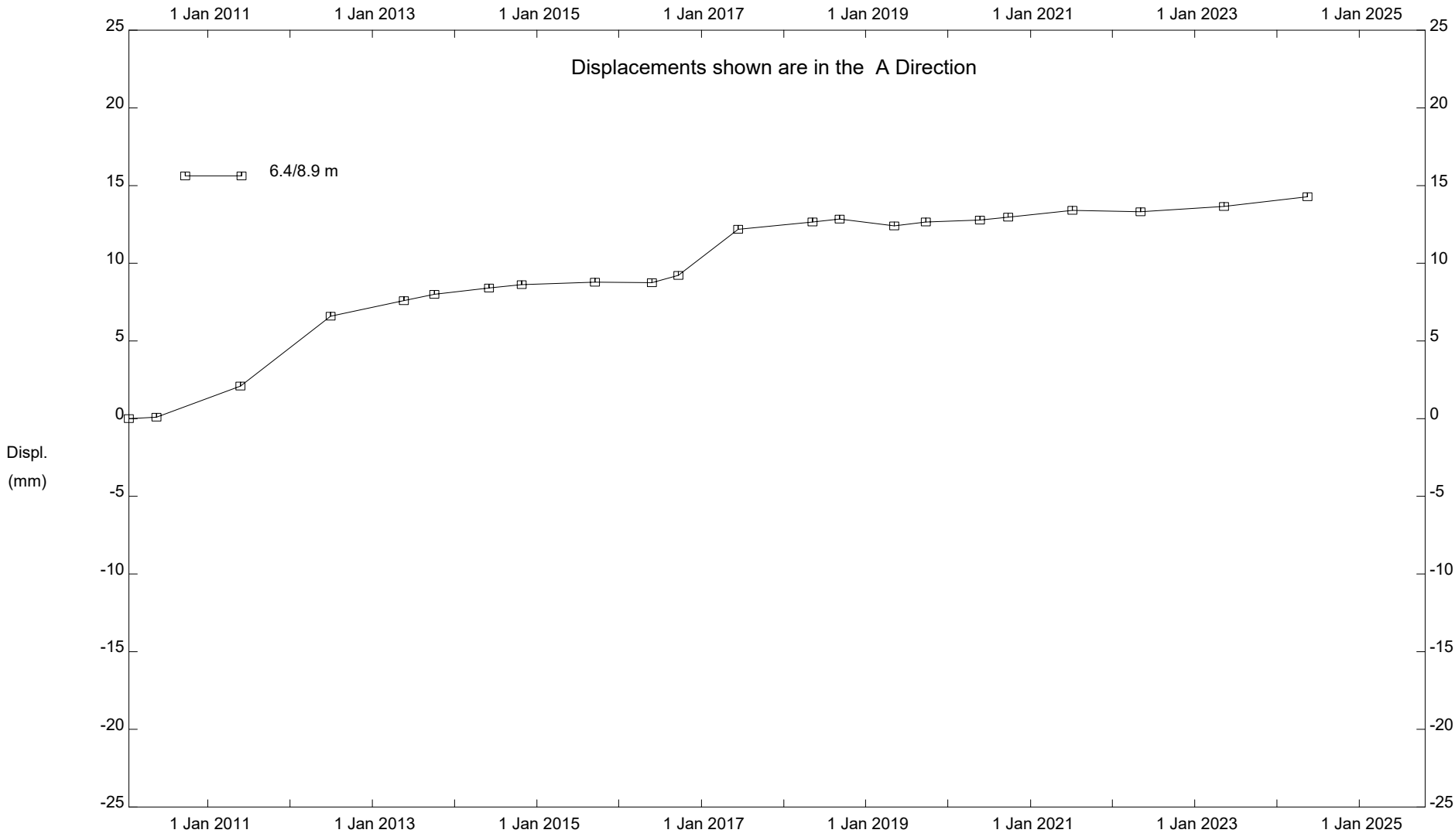


HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-6

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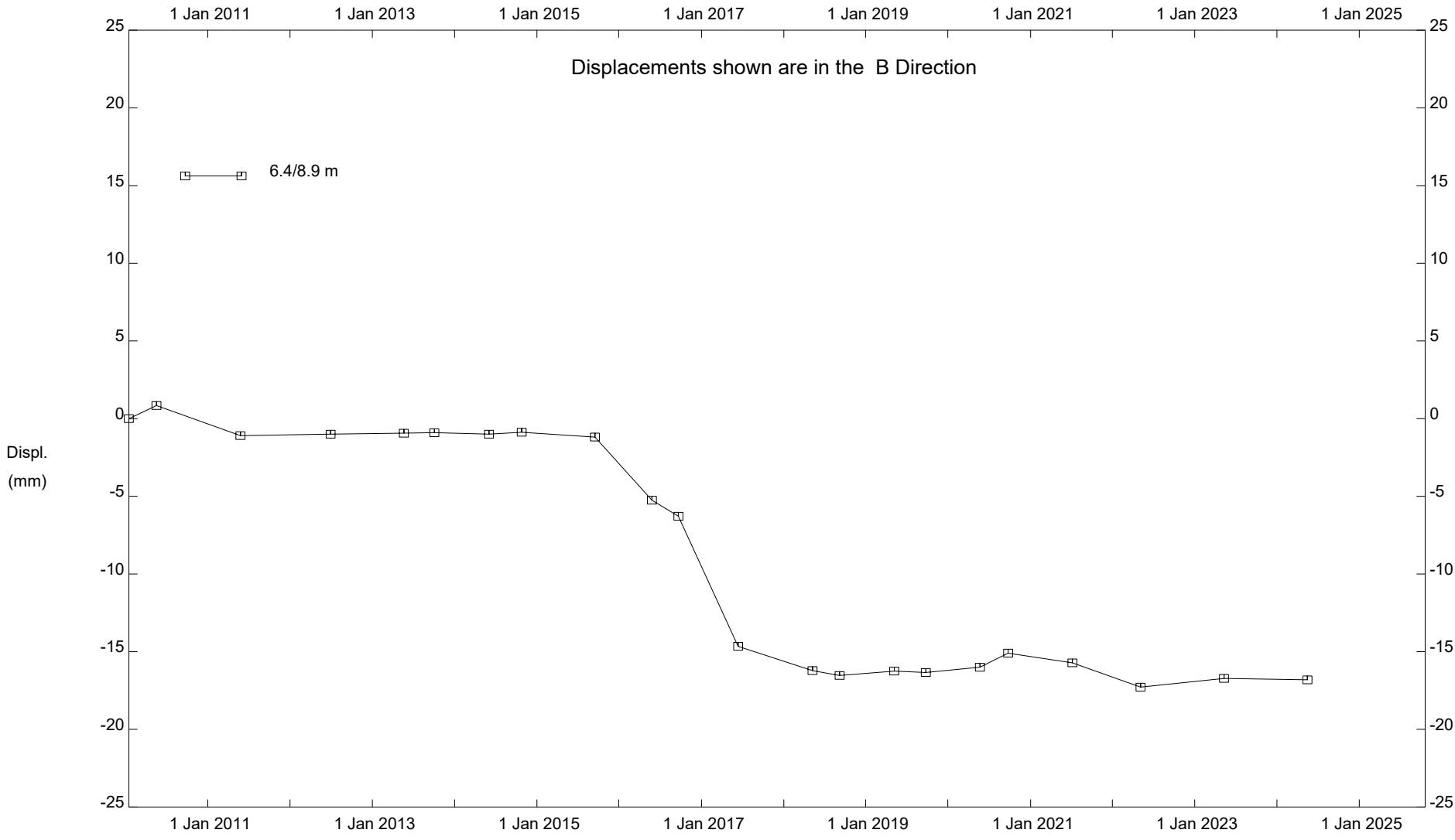
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HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-6

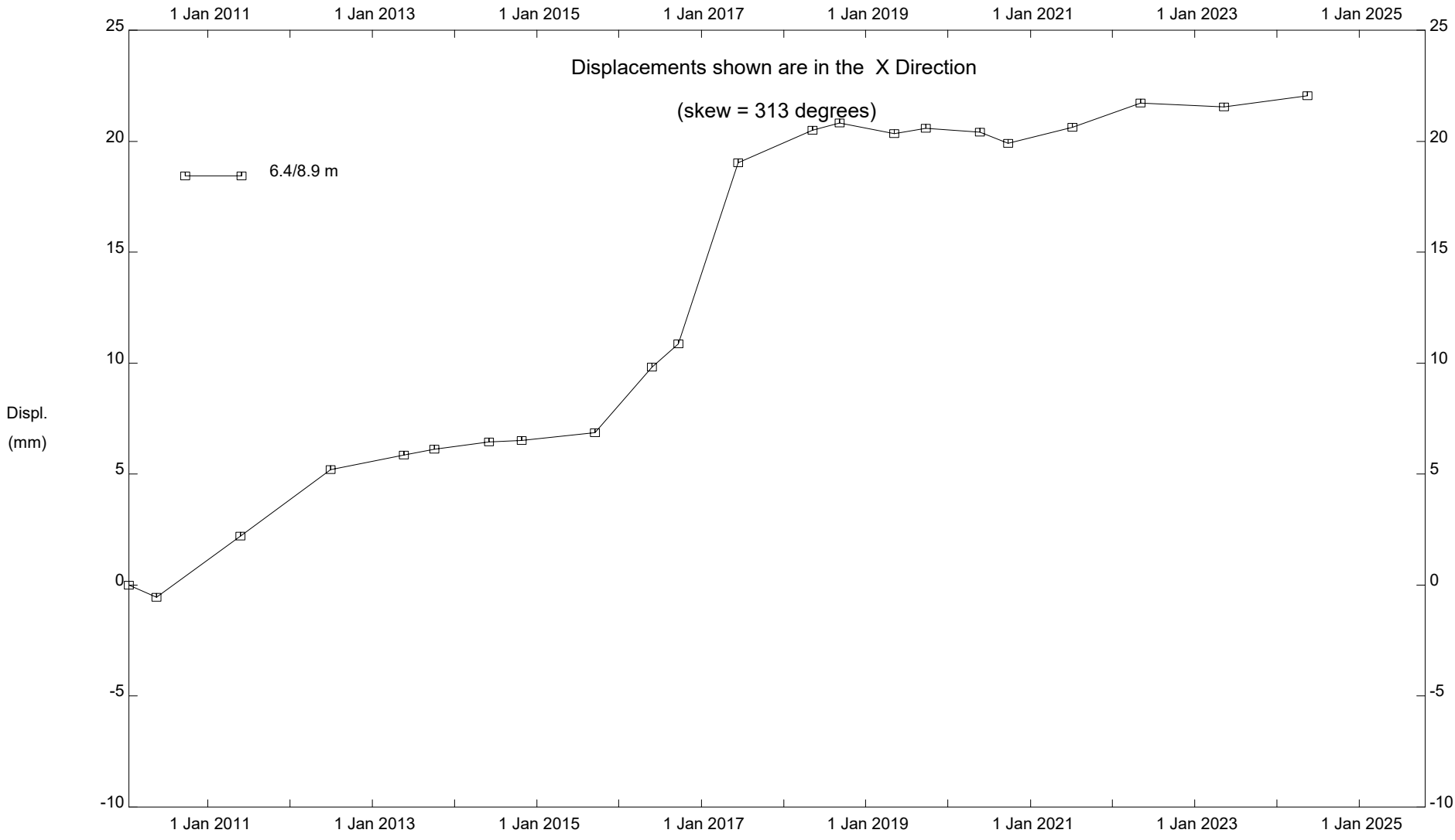
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HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-6

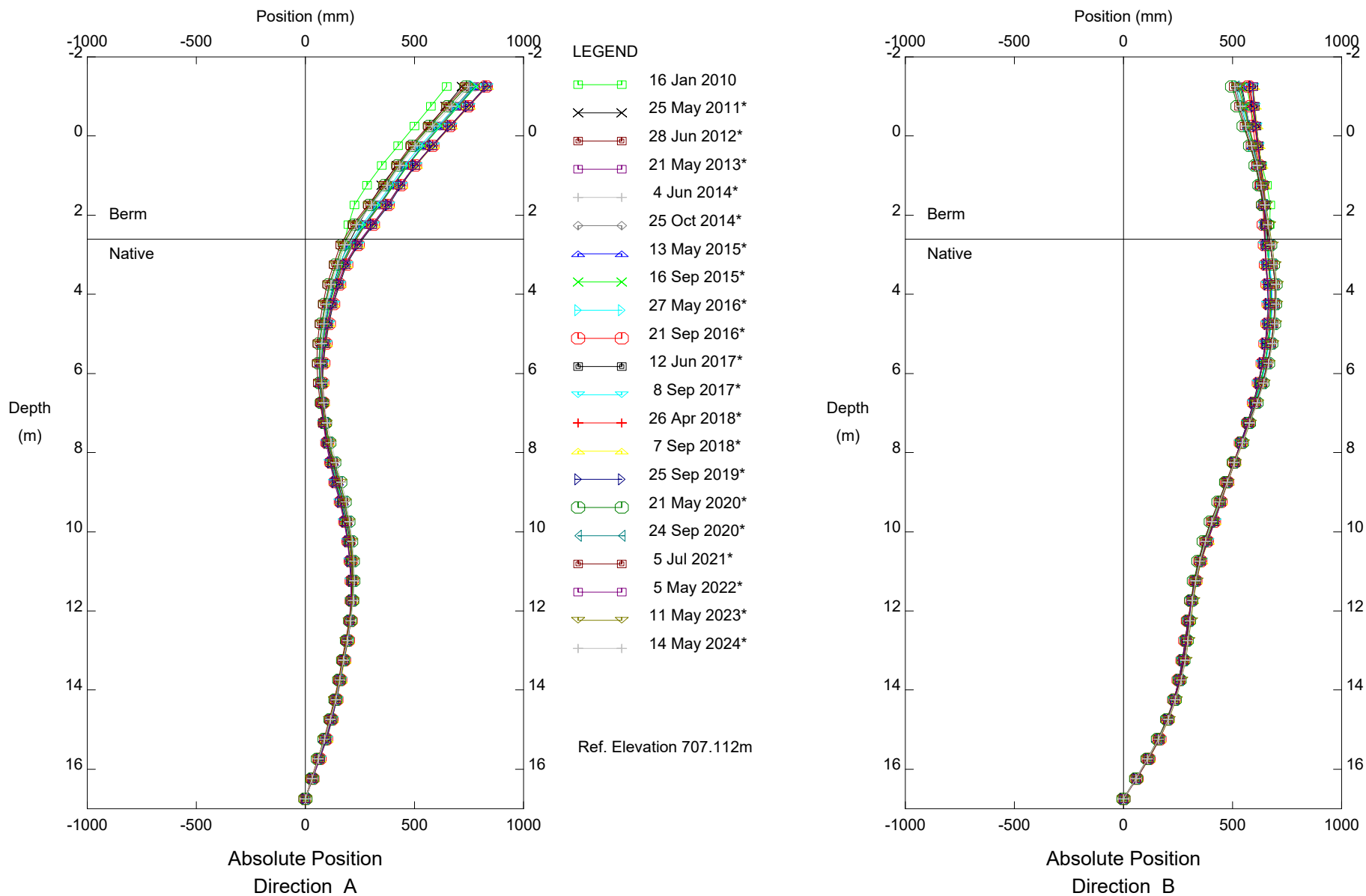
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HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-6

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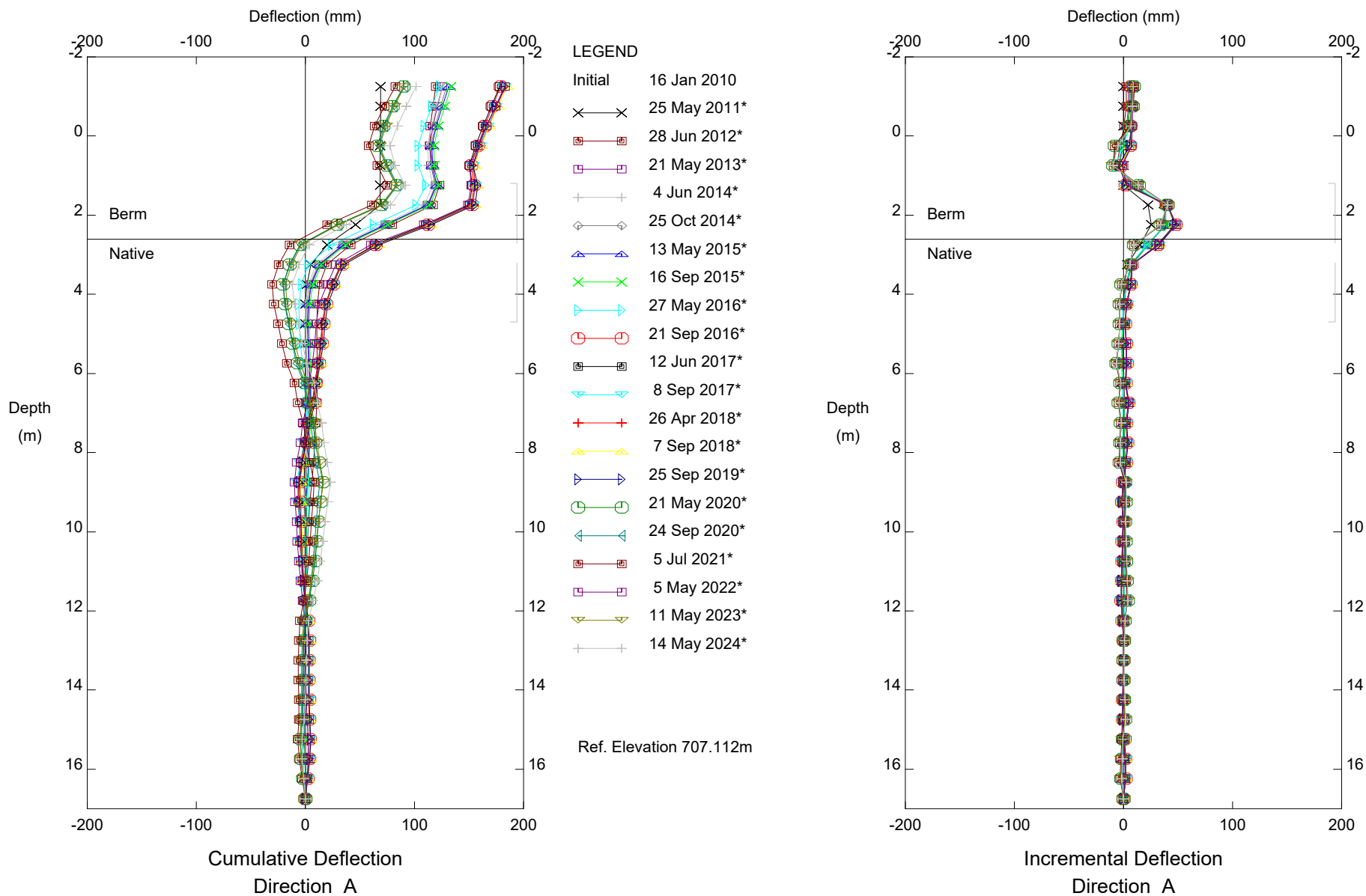
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HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-7

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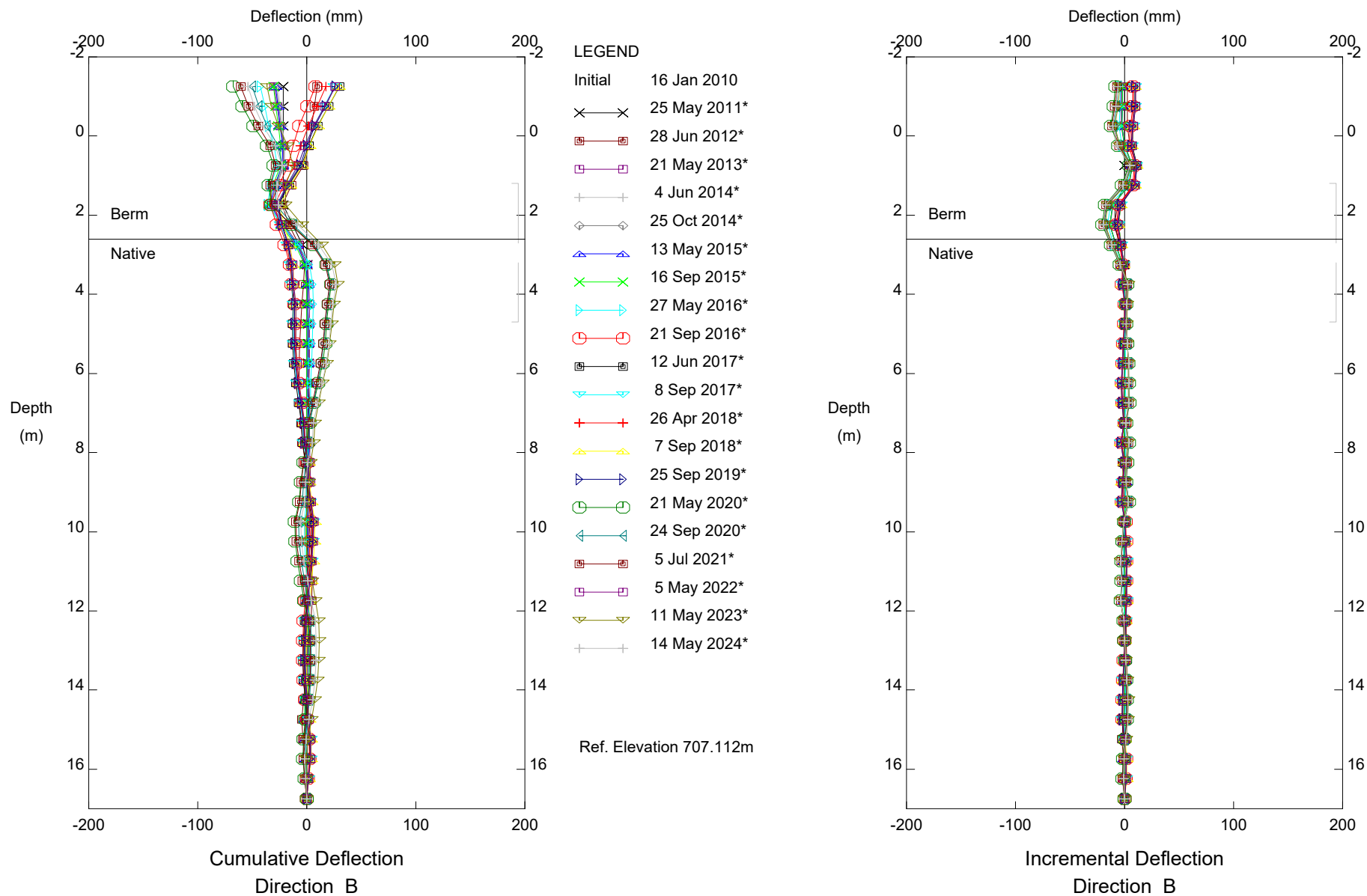


HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-7

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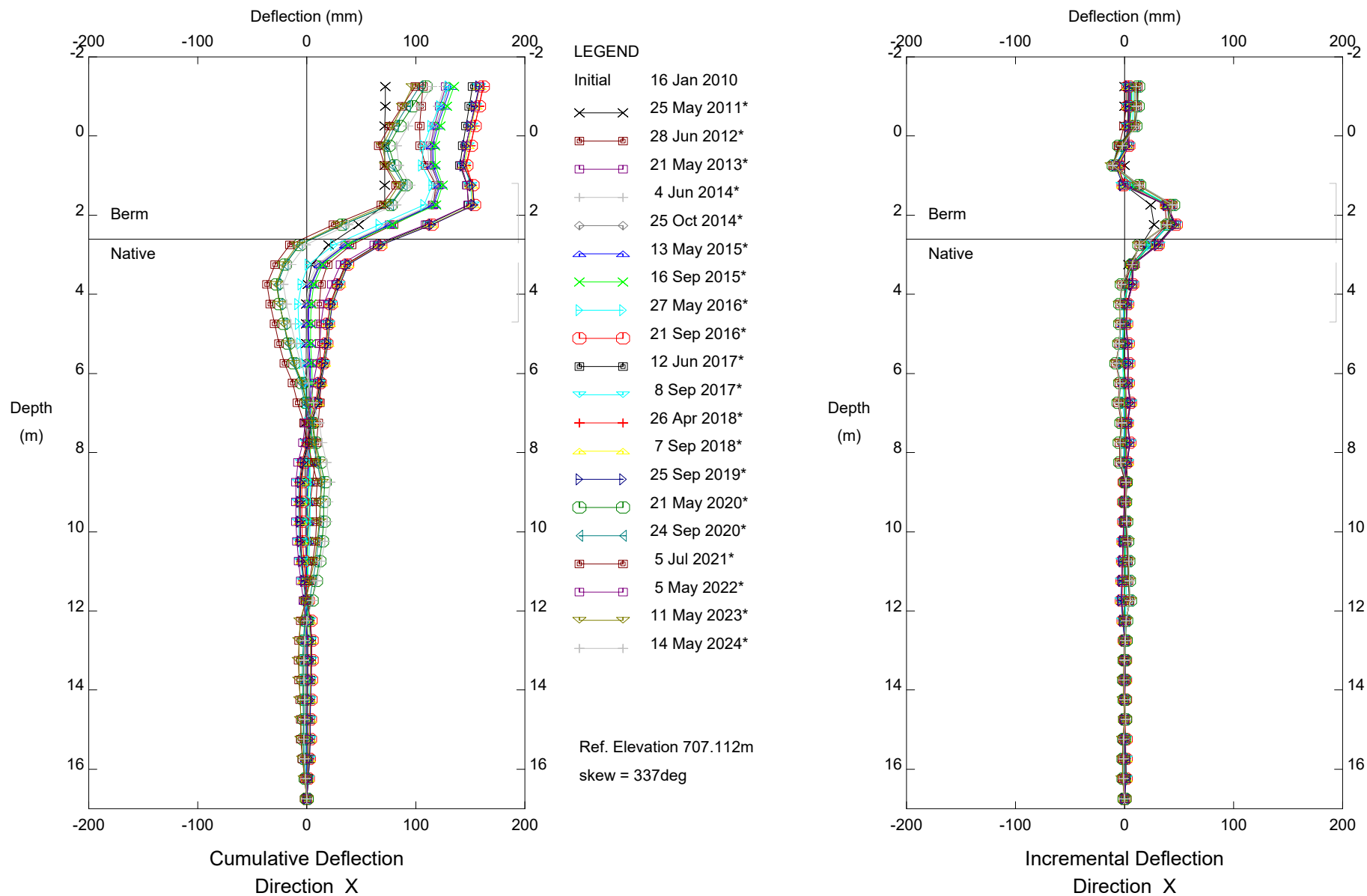




HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-7

Transportation & Economic Corridors

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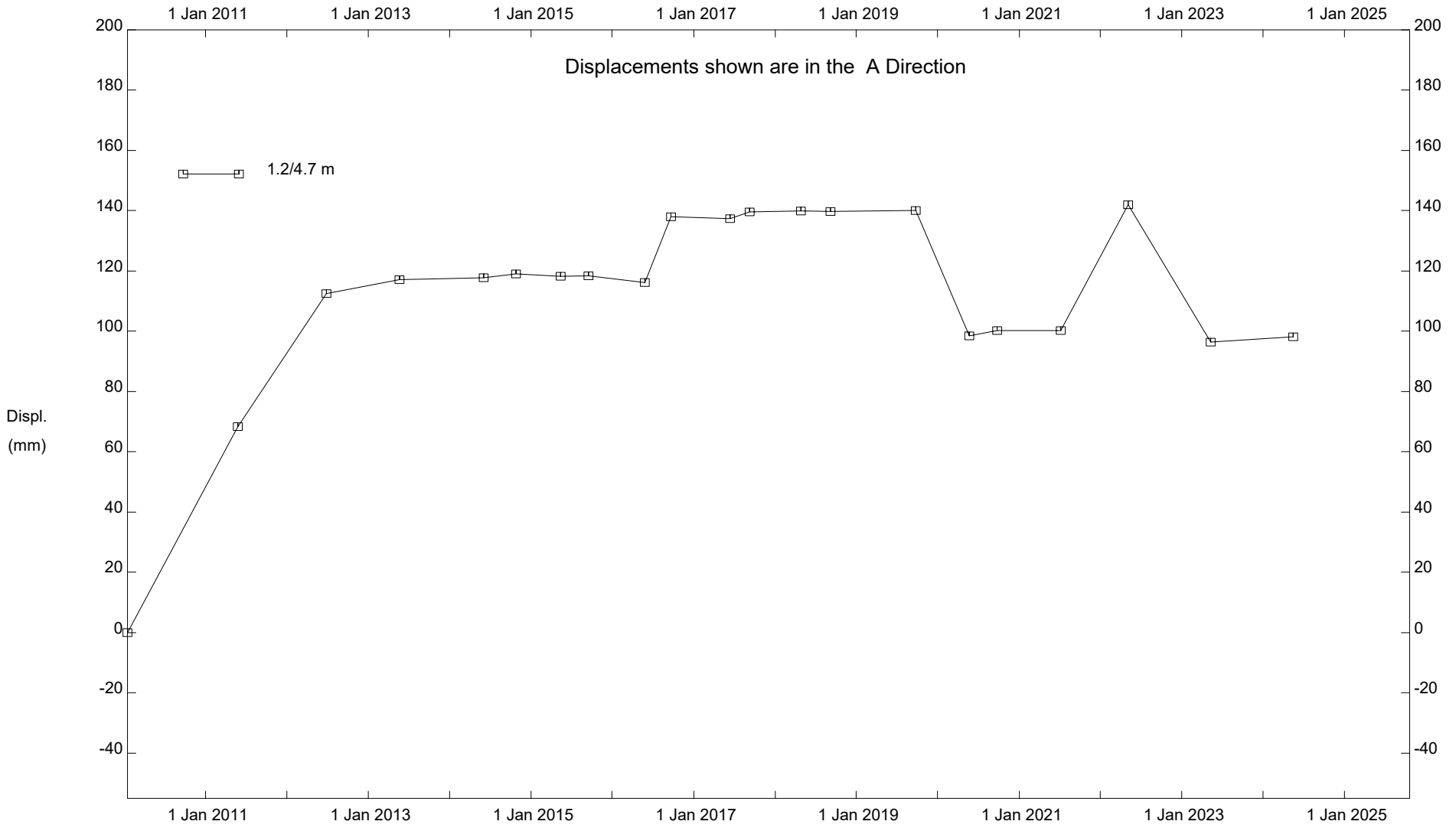


HWY32:10 South of Whitecourt (NC37), Inclinator SI10-7

Transportation & Economic Corridors

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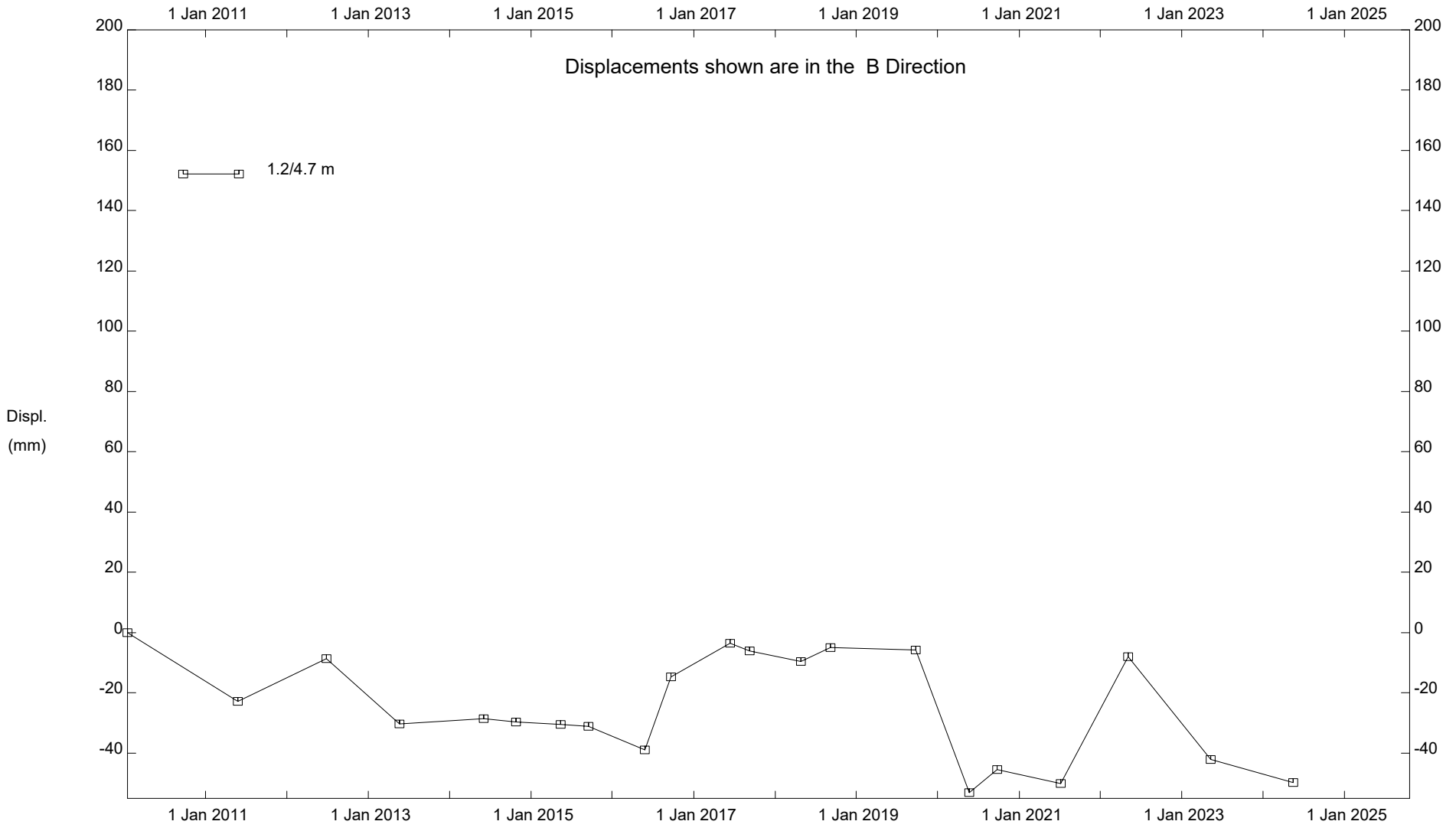
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HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-7

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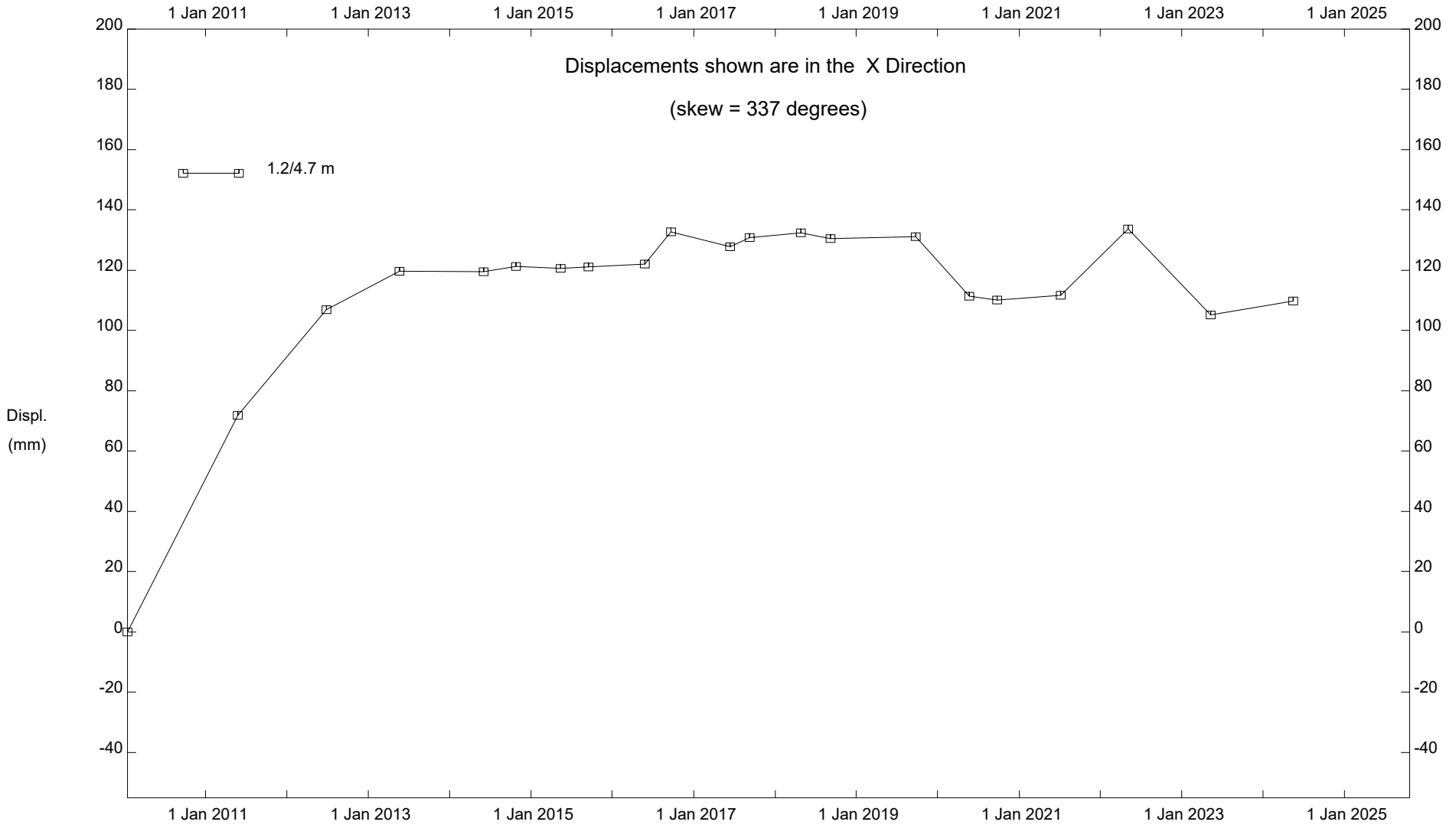
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HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-7

Transportation & Economic Corridors

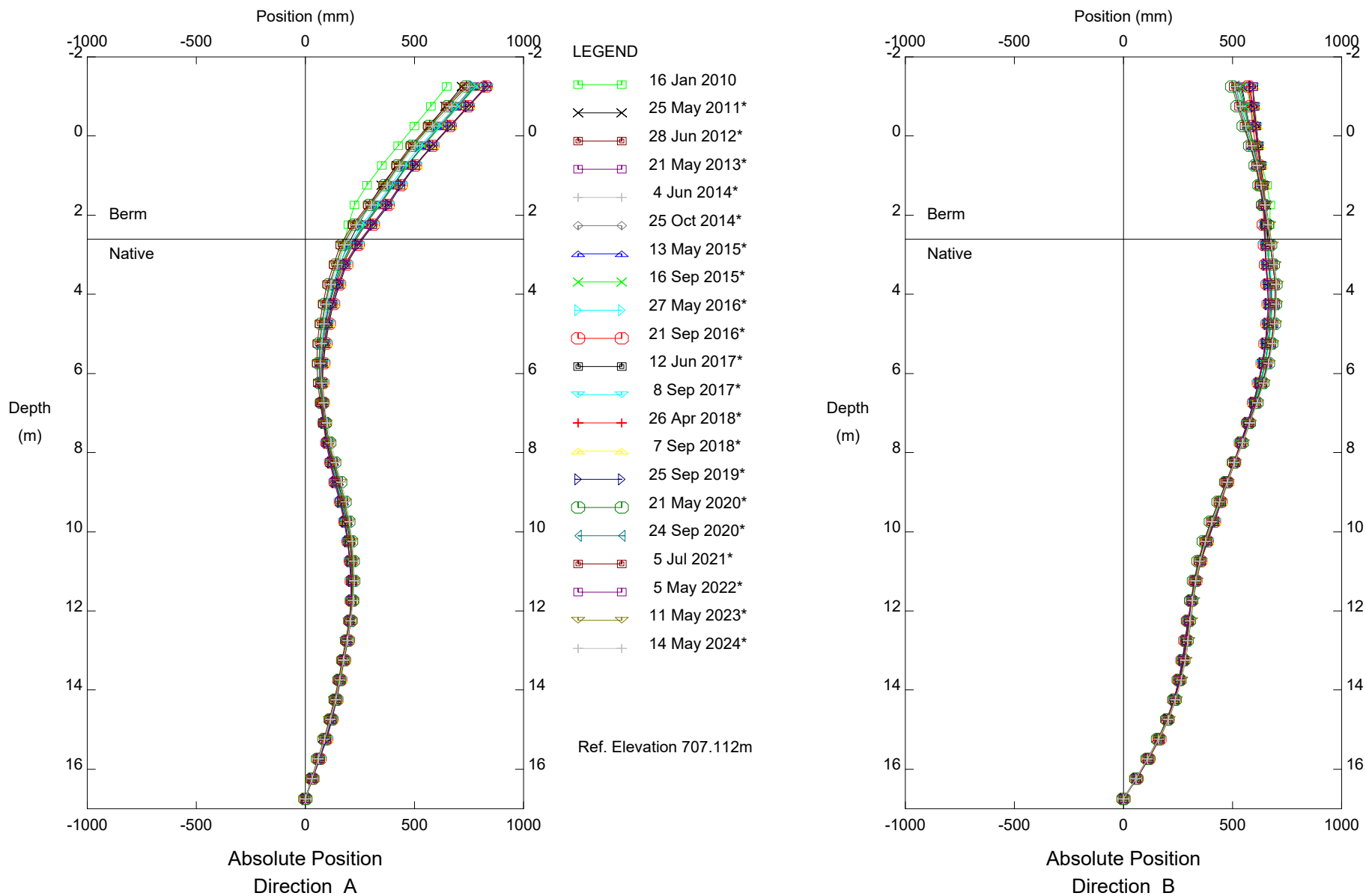
Stantec Consulting Ltd - Edmonton



HWY32:10 South of Whitecourt (NC37), Inclinator SI10-7

Transportation & Economic Corridors

Stantec Consulting Ltd - Edmonton

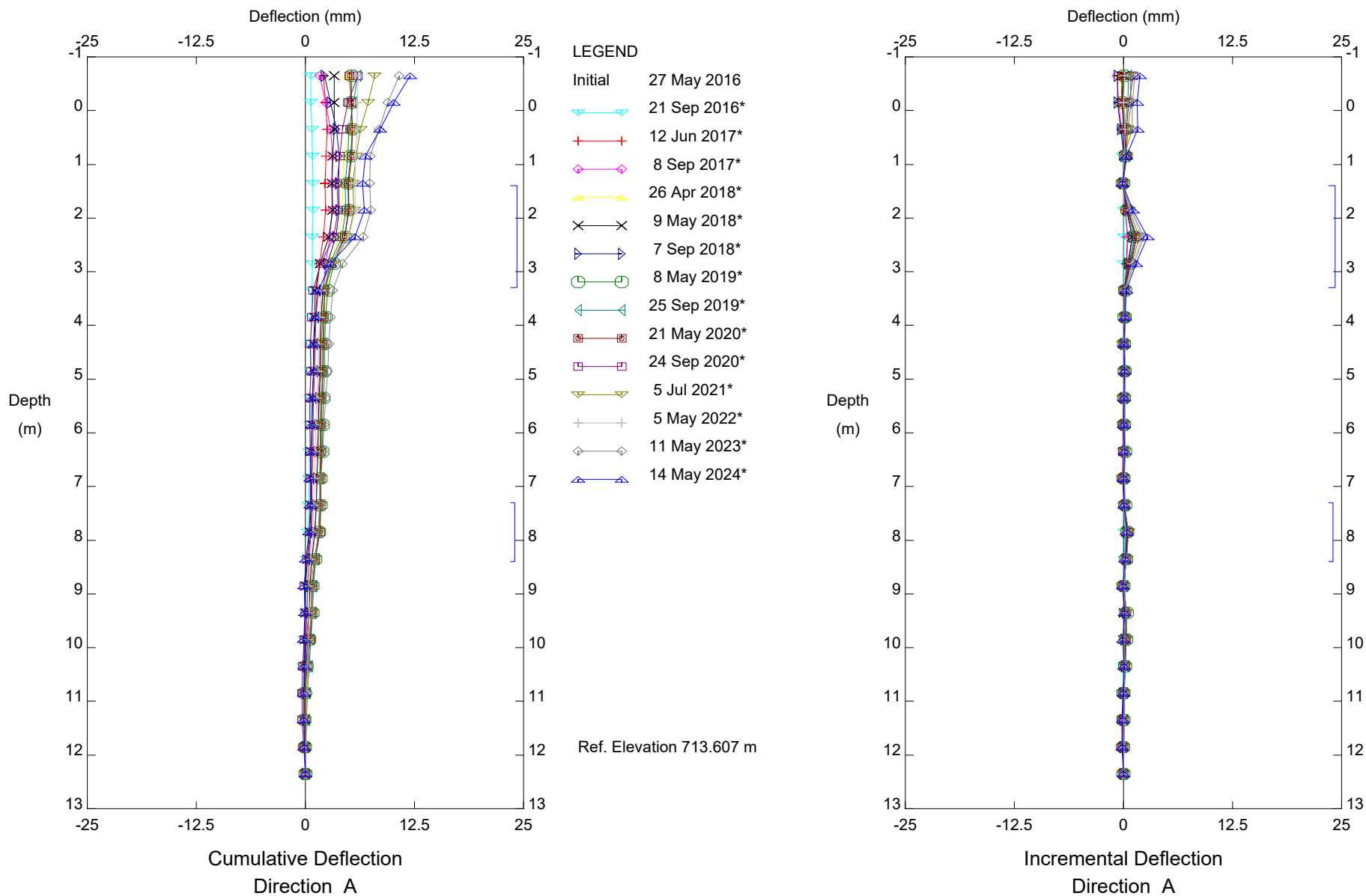


HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-7

Transportation & Economic Corridors

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

Stantec Consulting Ltd - Edmonton

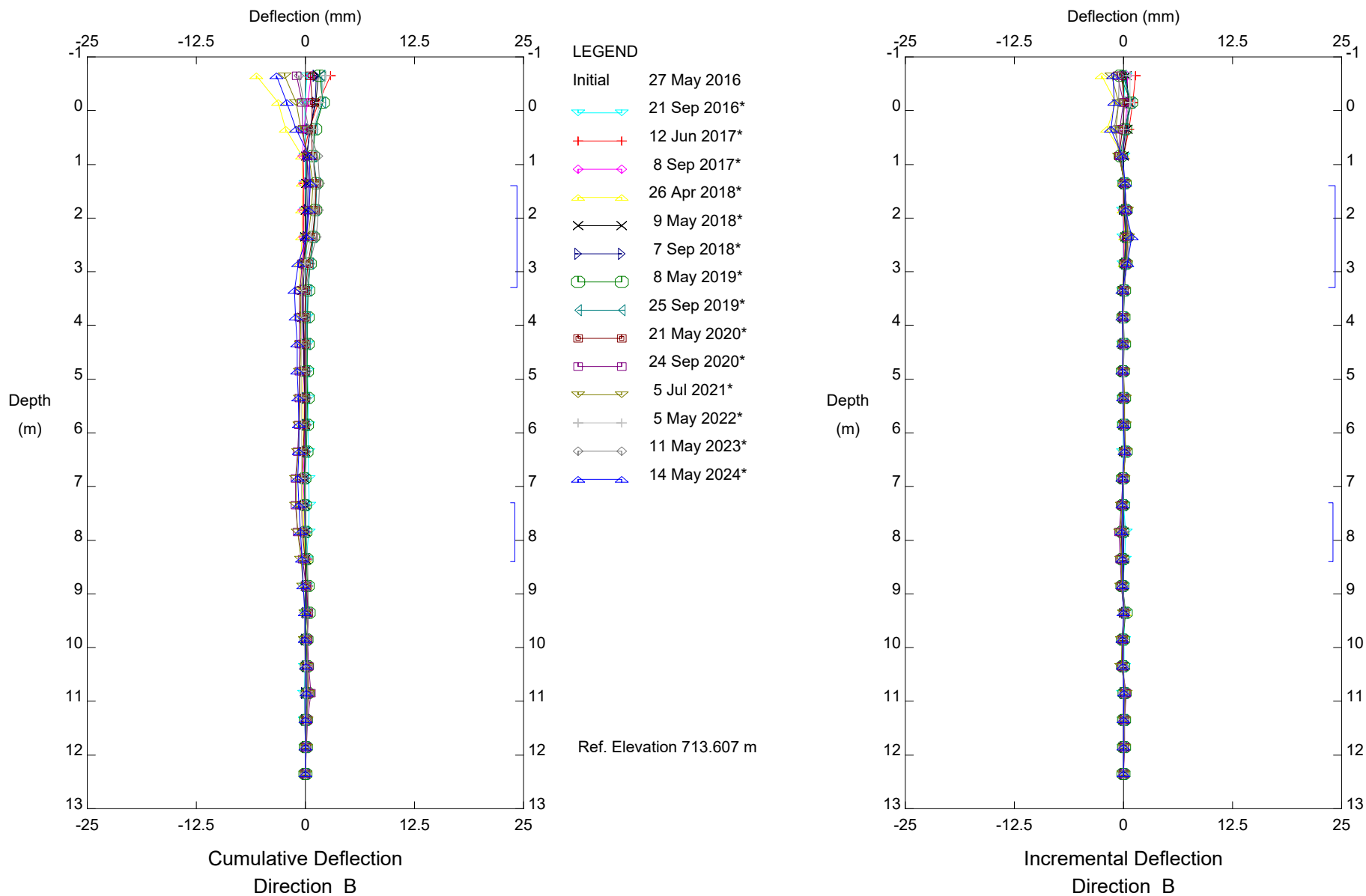


HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-8

Transportation & Economic Corridors

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

Stantec Consulting Ltd - Edmonton

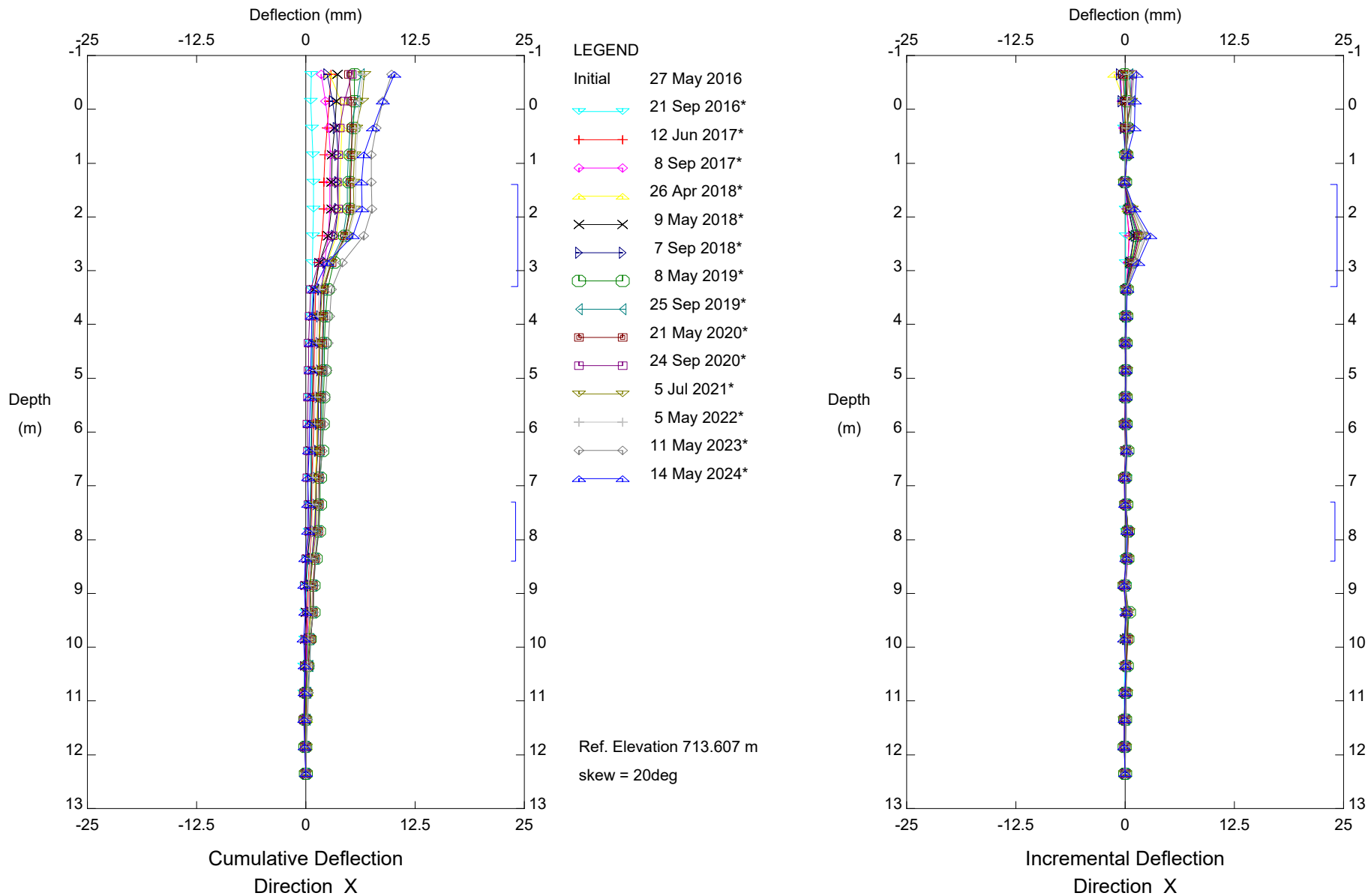


HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-8

Transportation & Economic Corridors

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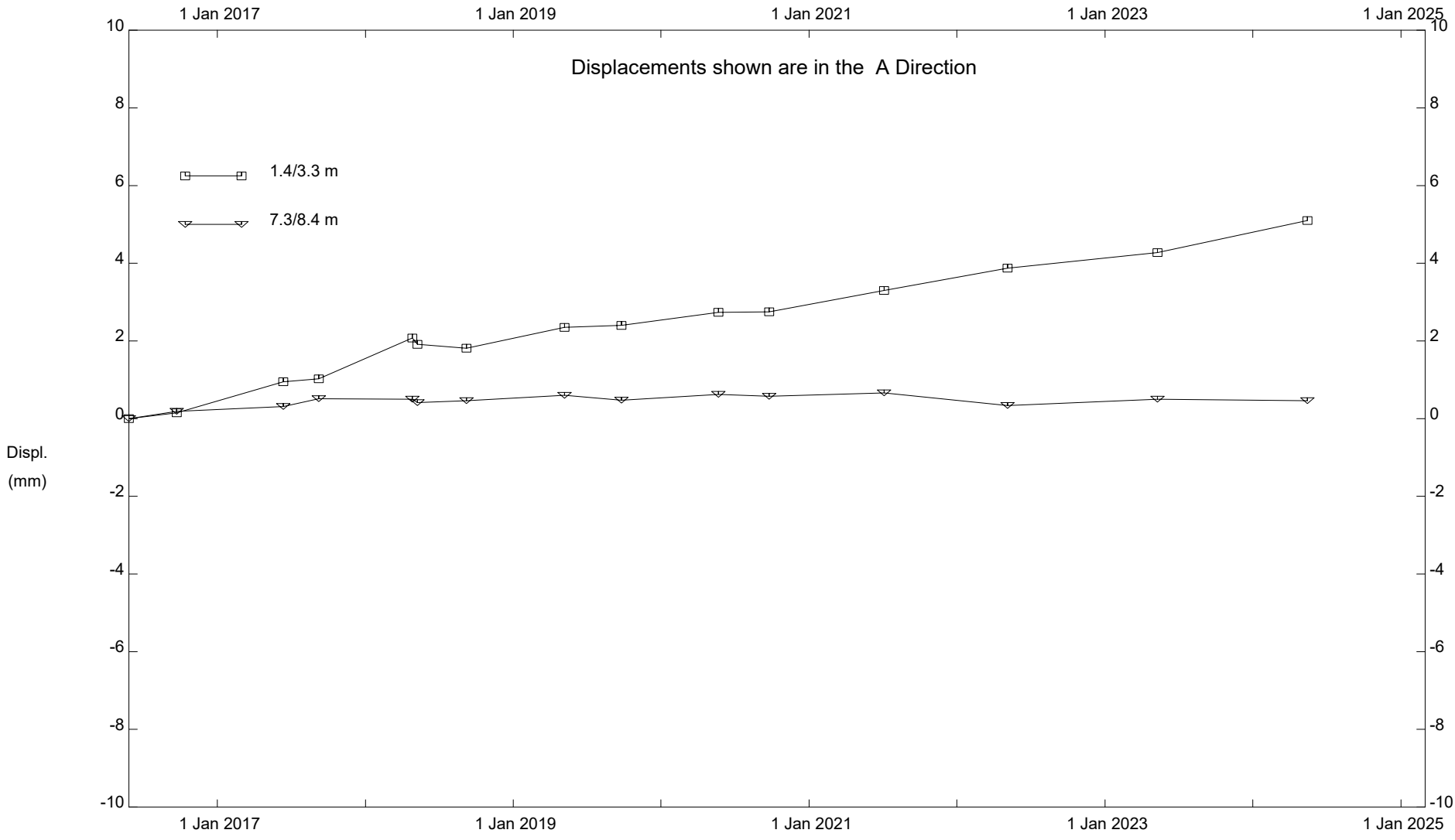




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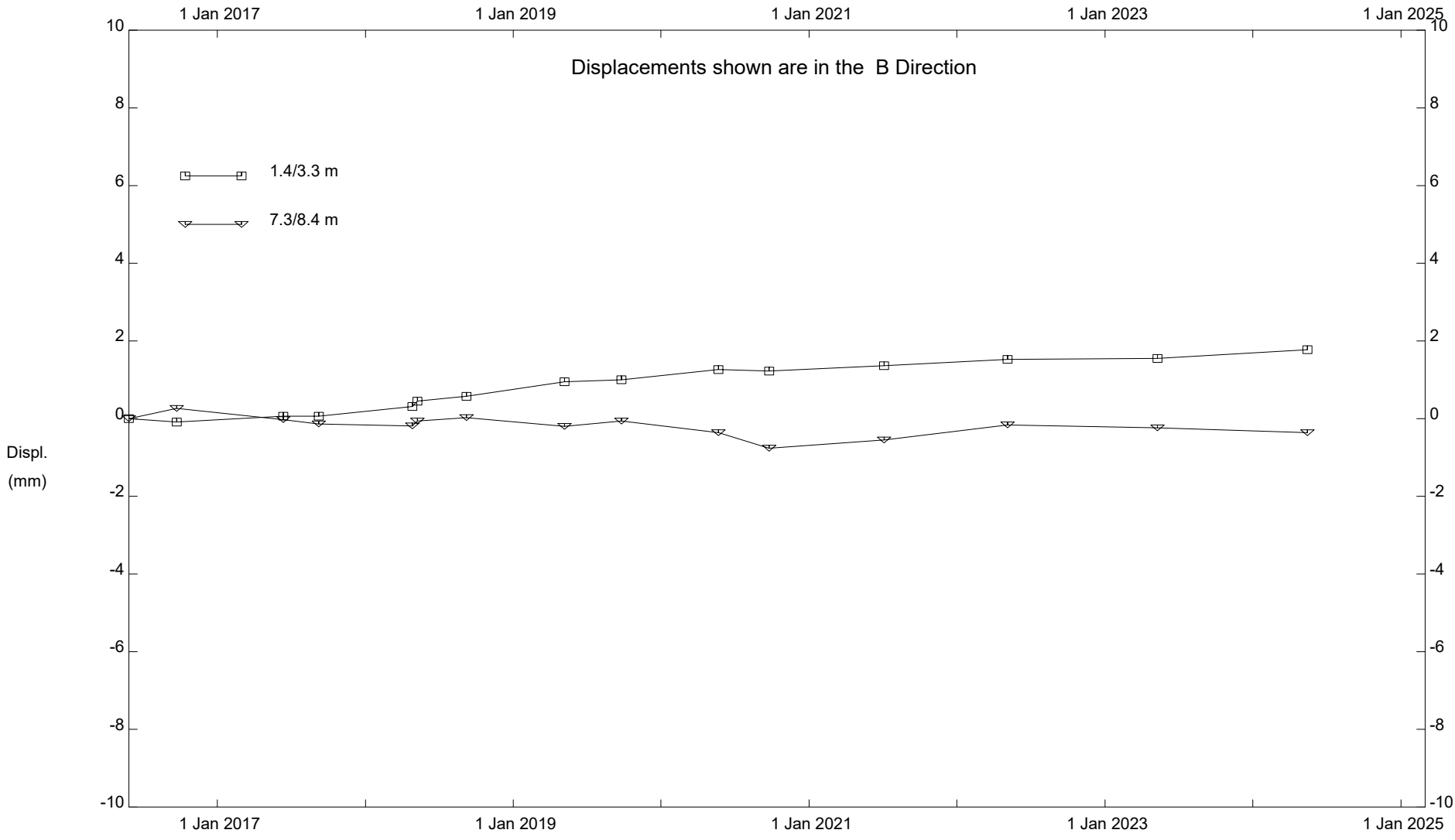
Transportation & Economic Corridors

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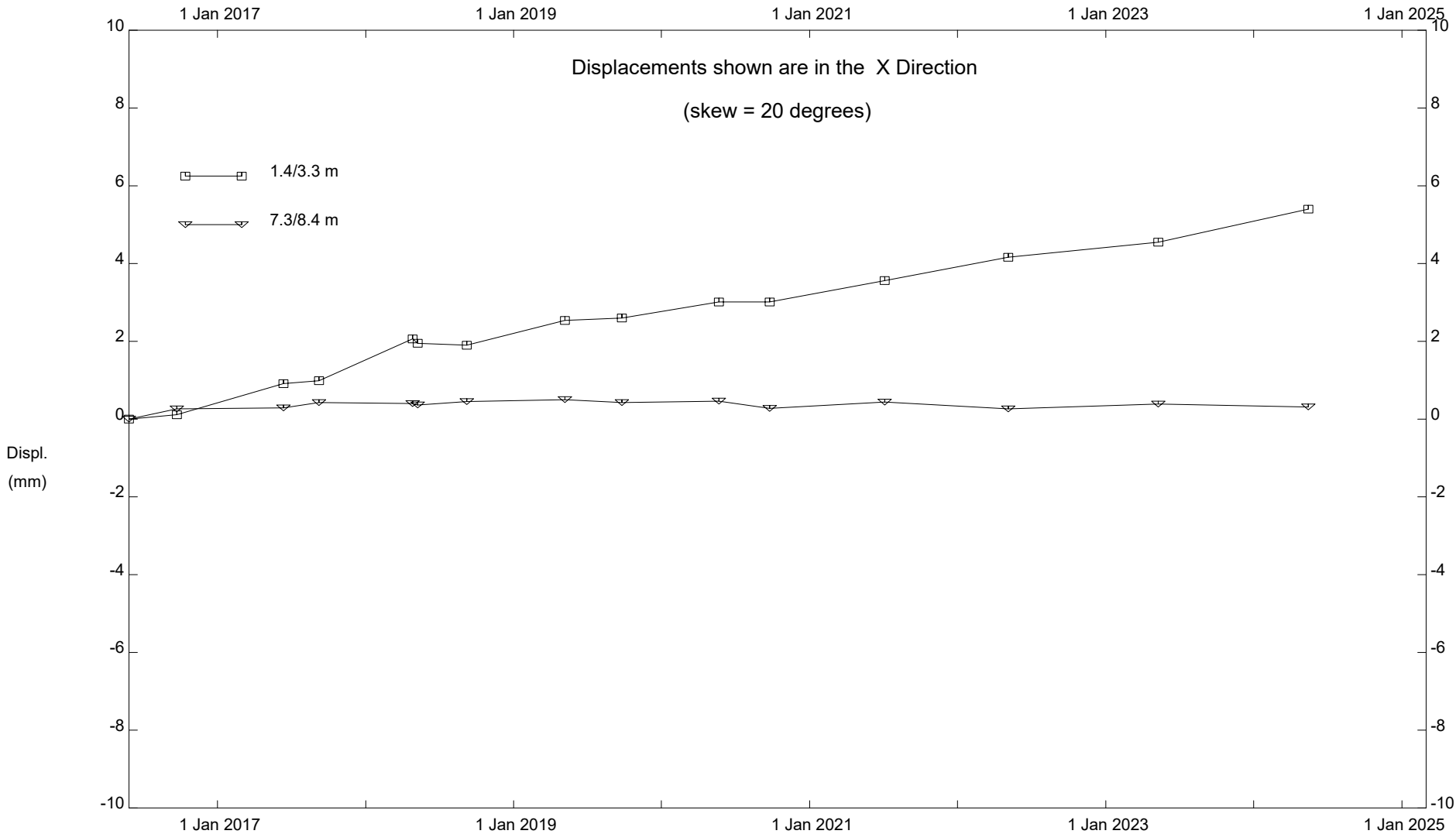
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Transportation & Economic Corridors



HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-8

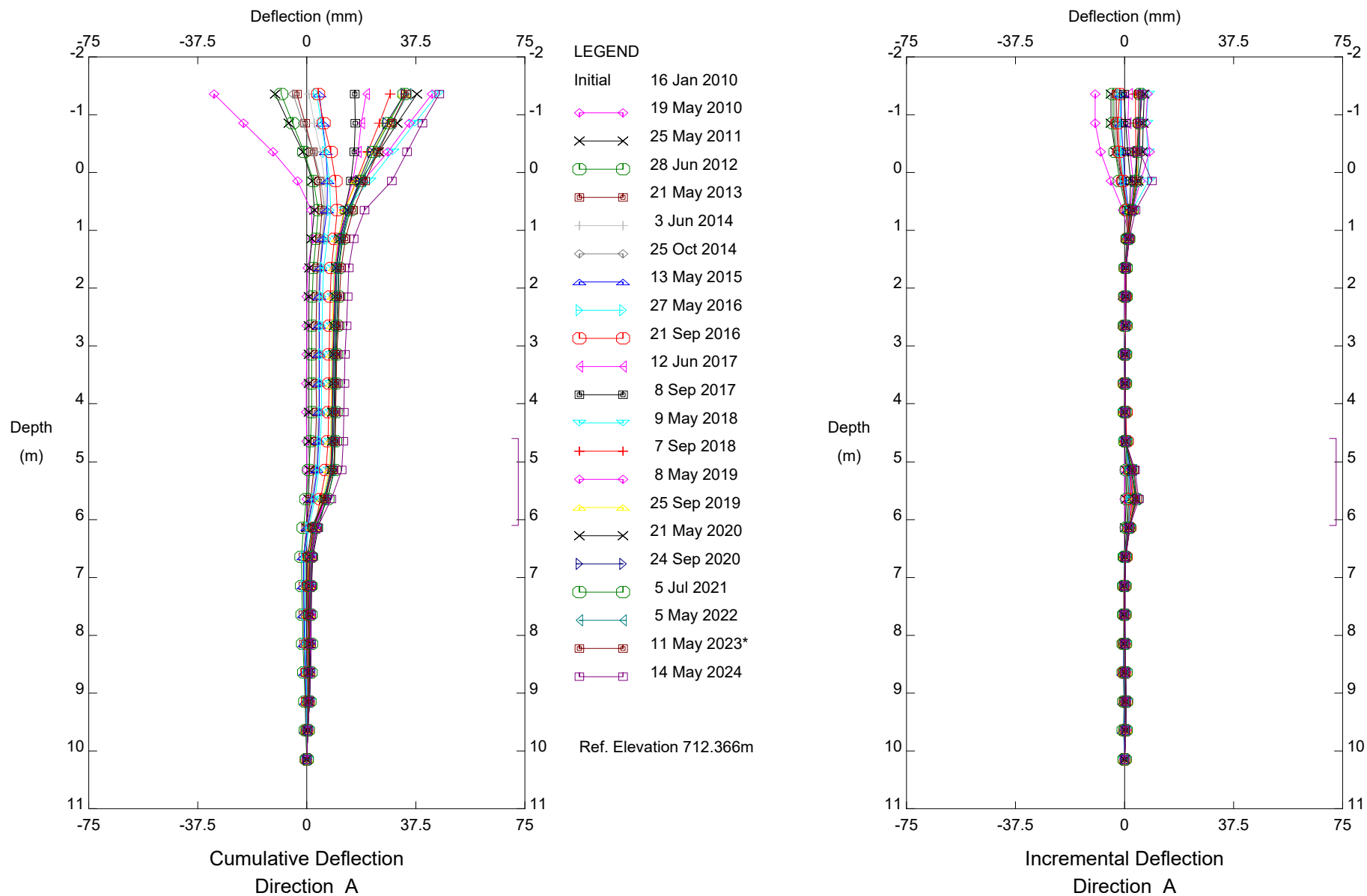
Transportation & Economic Corridors



HWY32:10 South of Whitecourt (NC37), Inclinator SI10-8

Transportation & Economic Corridors

Stantec Consulting Ltd - Edmonton

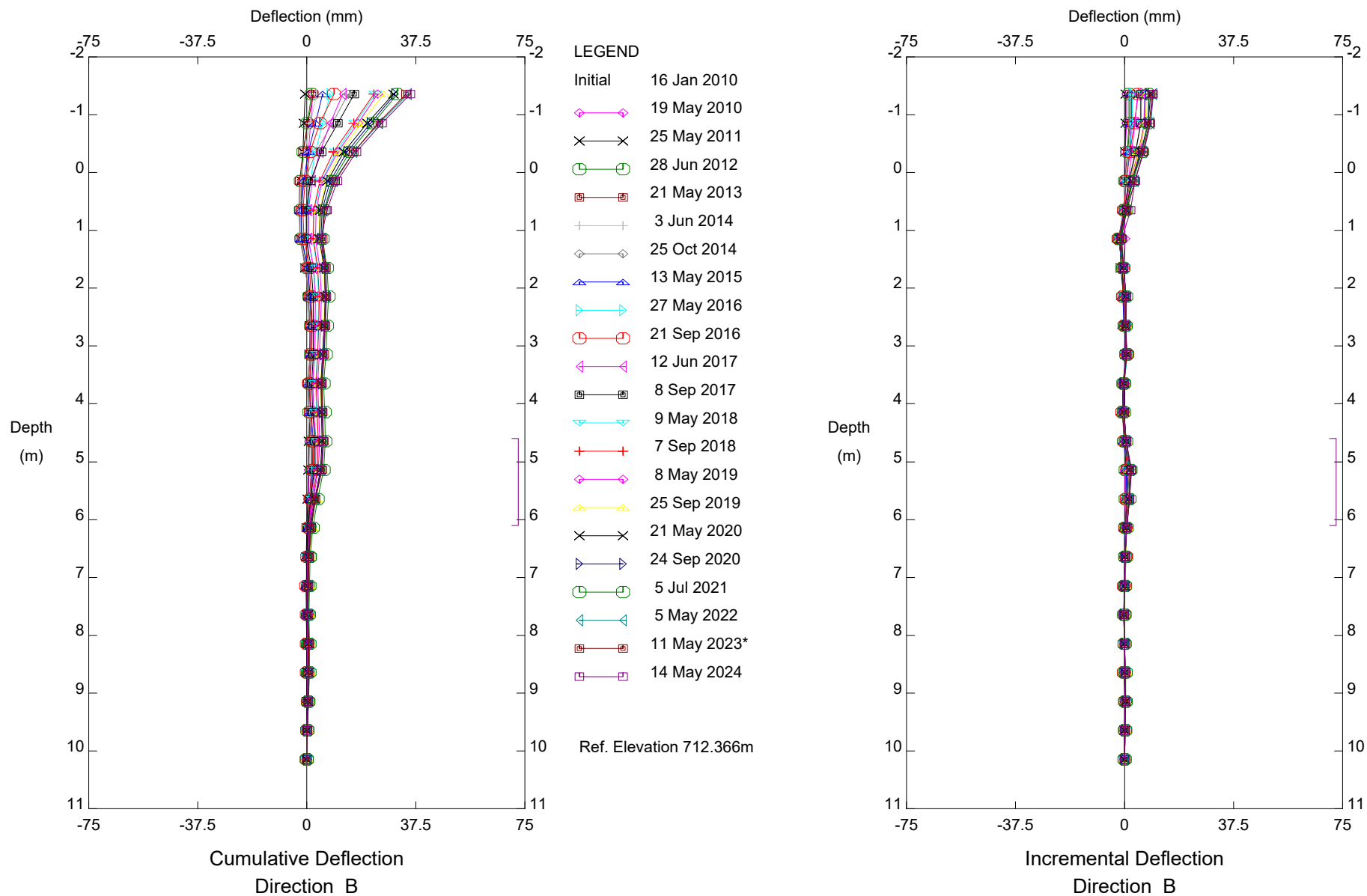


HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-9

Transportation & Economic Corridors

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

Stantec Consulting Ltd - Edmonton

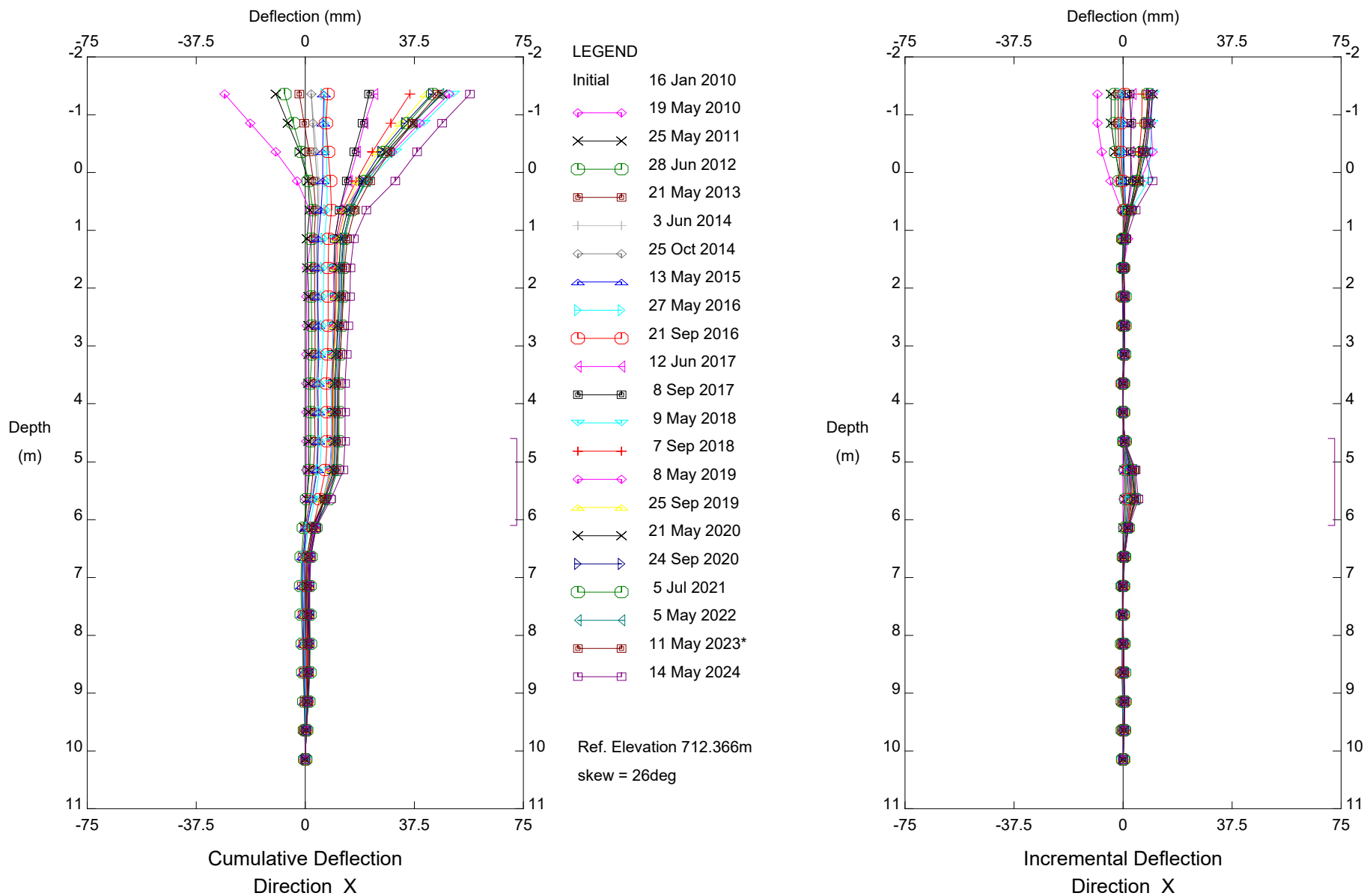


HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-9

Transportation & Economic Corridors

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

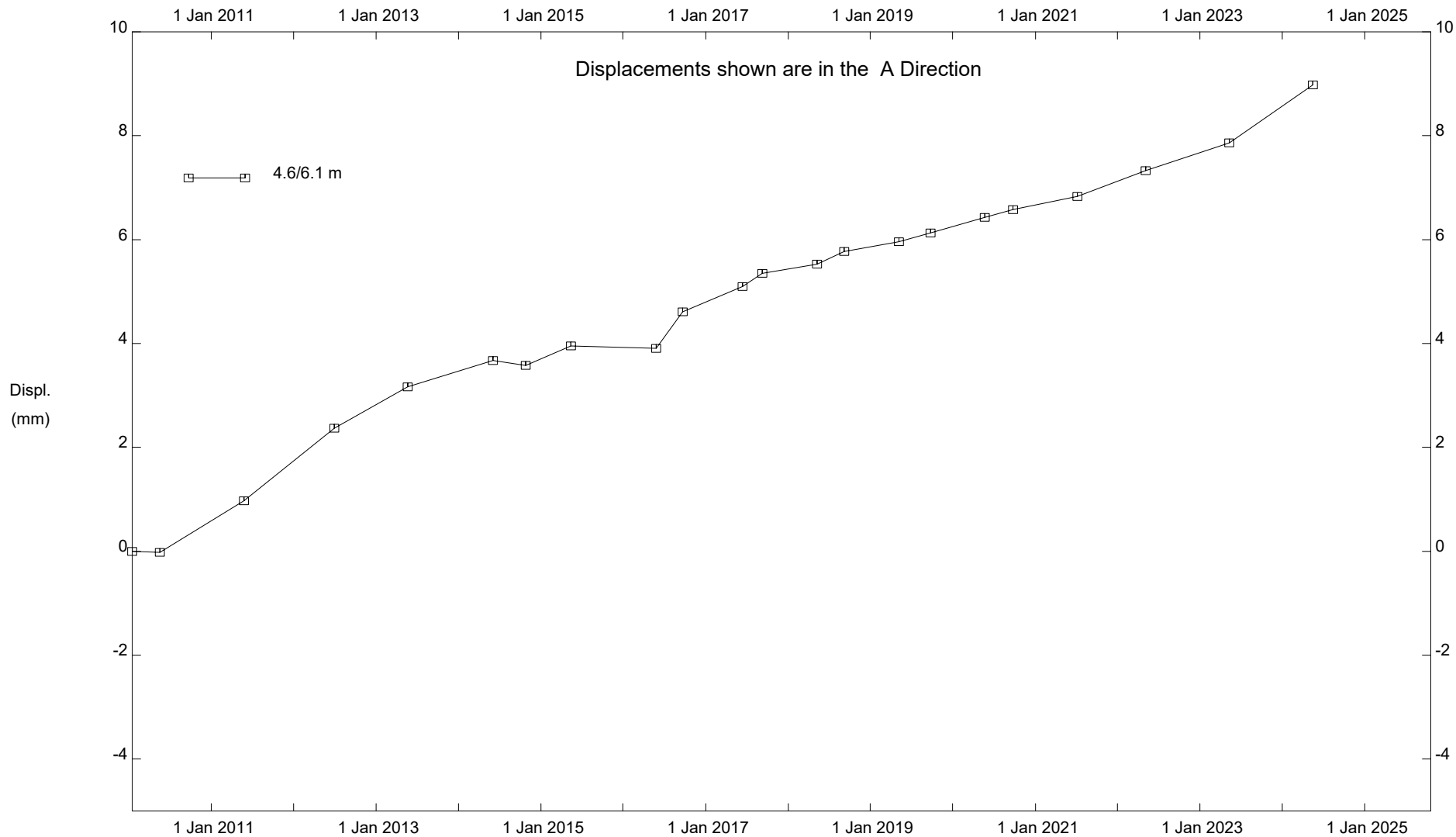
Stantec Consulting Ltd - Edmonton



HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-9

Transportation & Economic Corridors

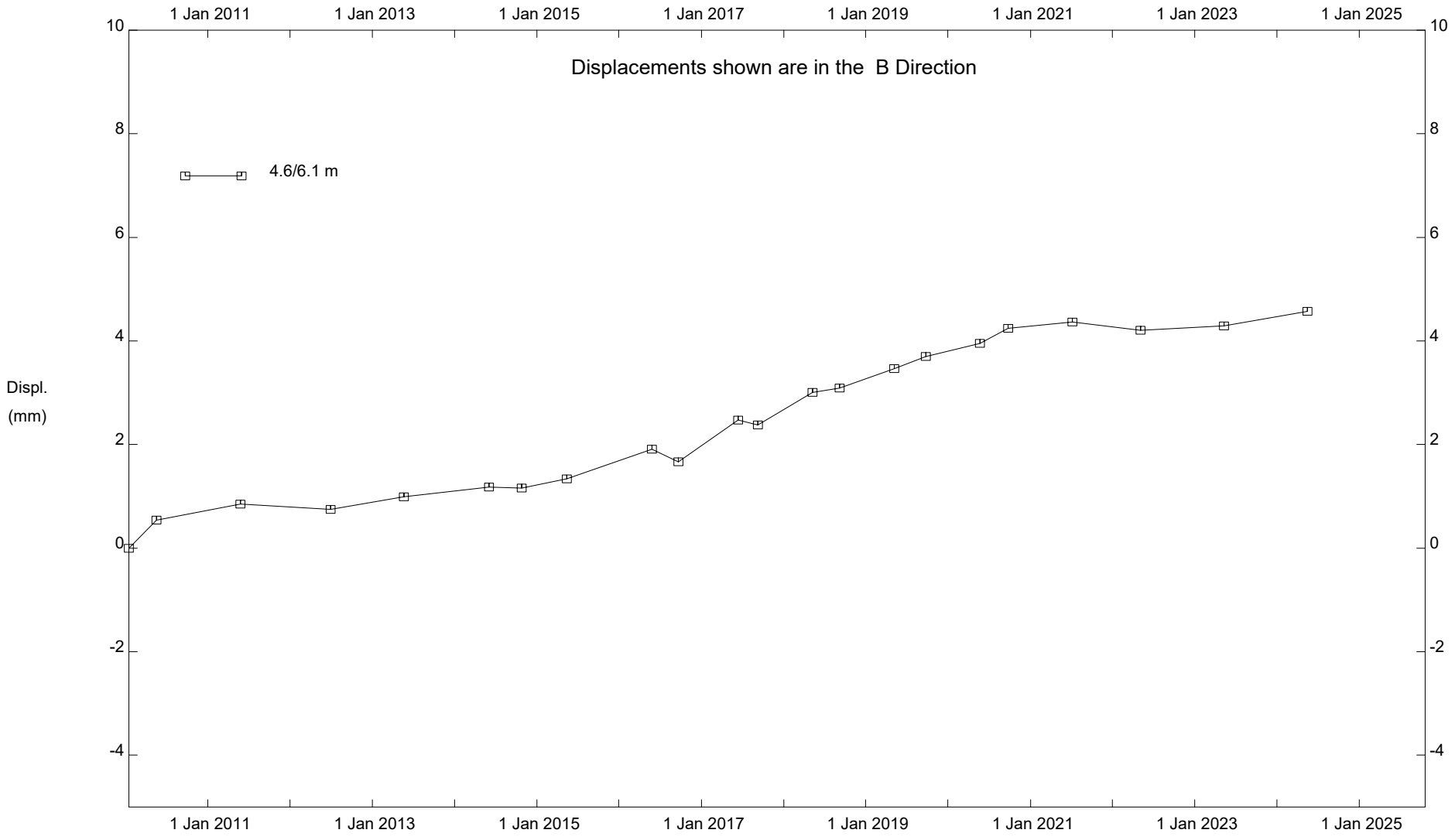
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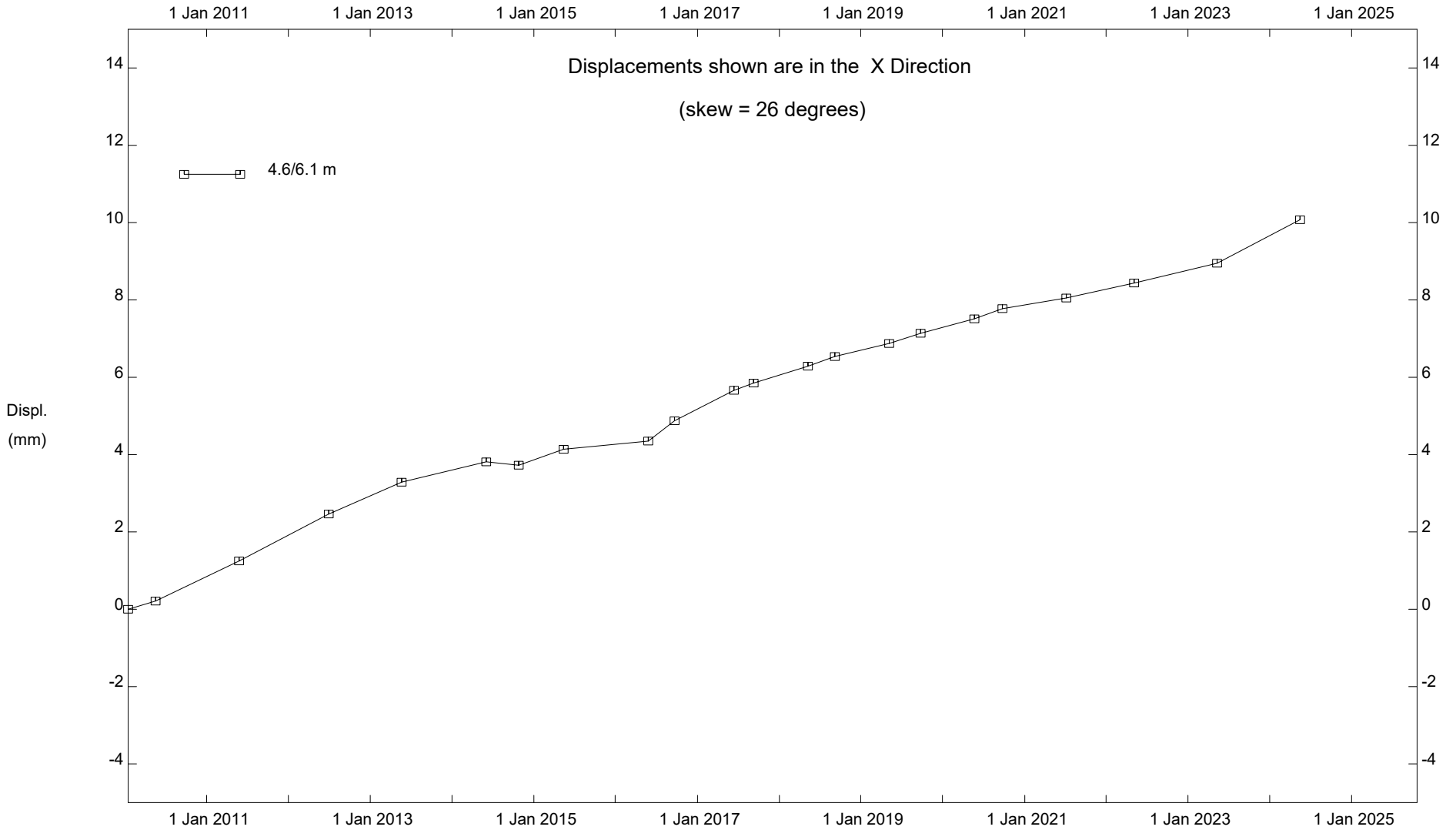
Transportation & Economic Corridors





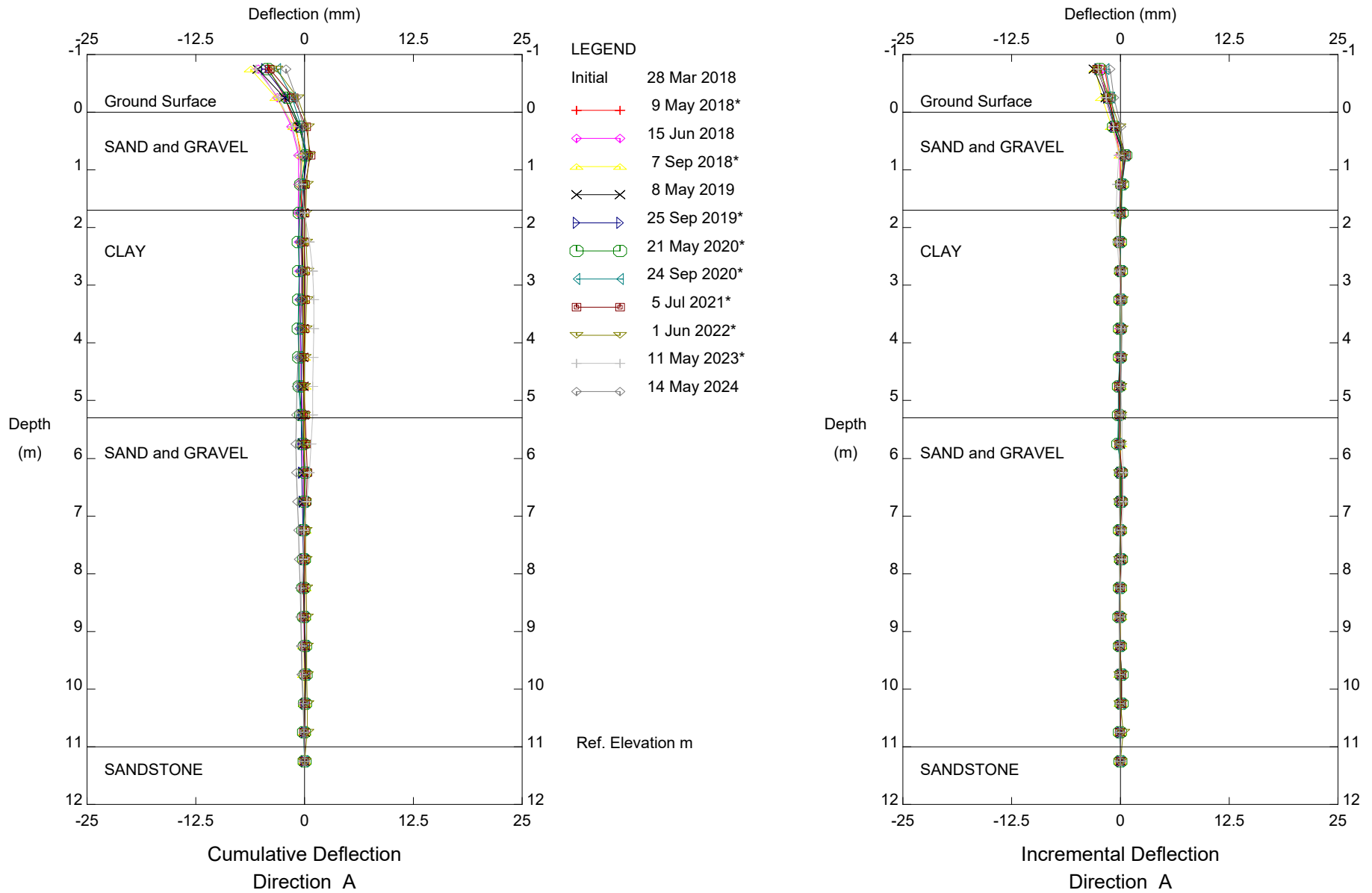
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Transportation & Economic Corridors



HWY32:10 South of Whitecourt (NC37), Inclinometer SI10-9

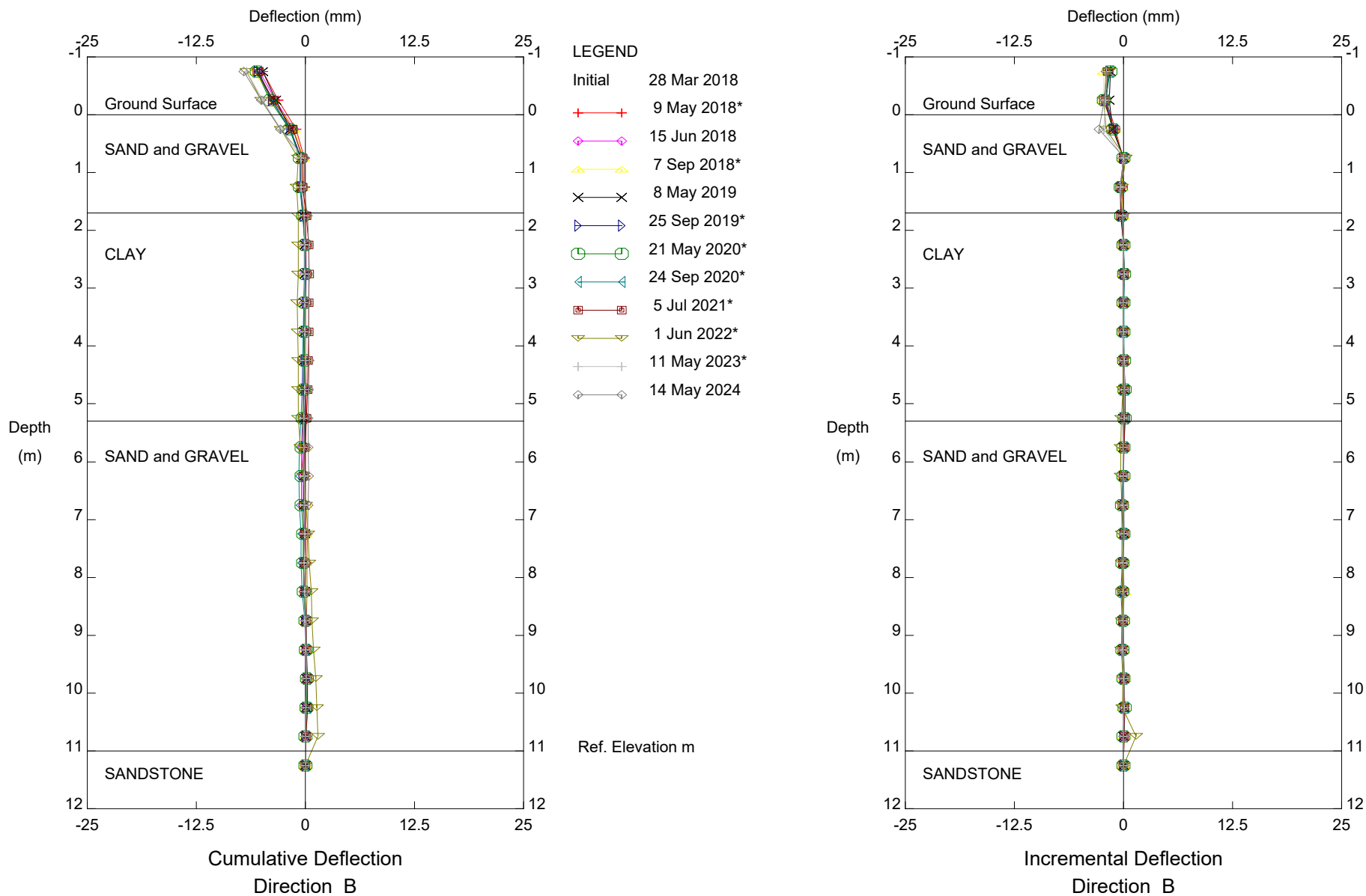
Transportation & Economic Corridors



Hwy 32:10 South of Whitecourt (NC37), Inclinometer SI18-03

Transportation & Economic Corridors

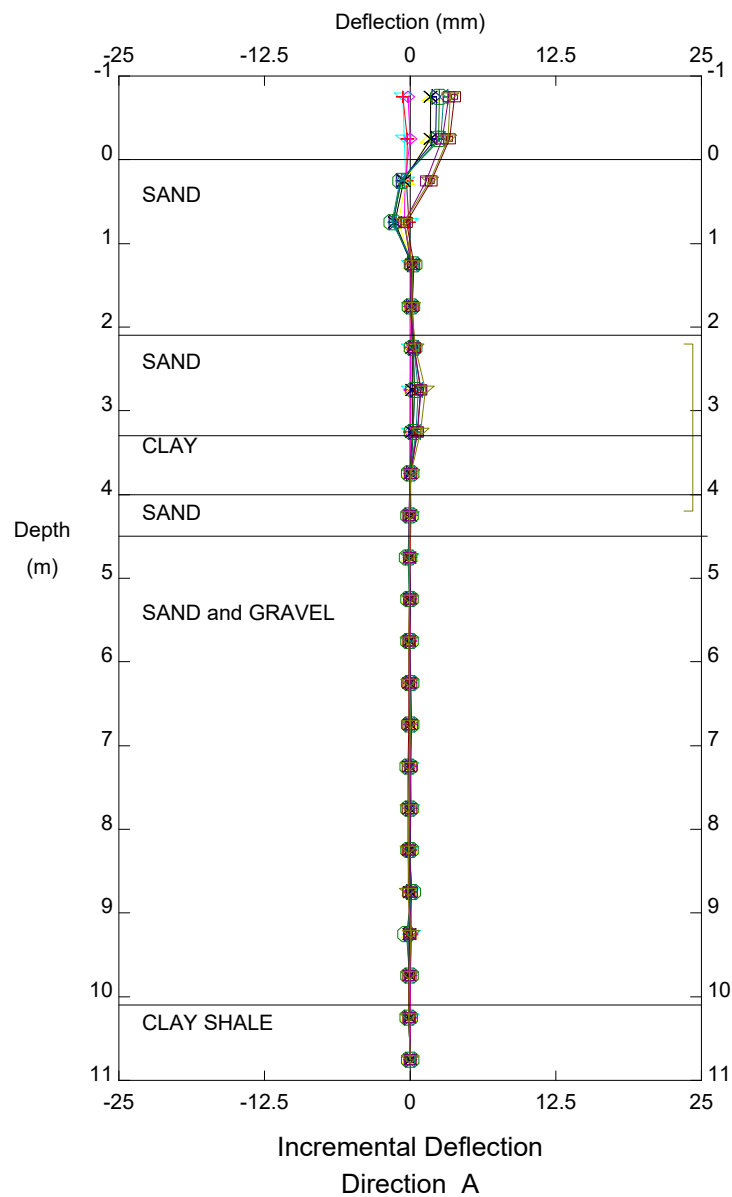
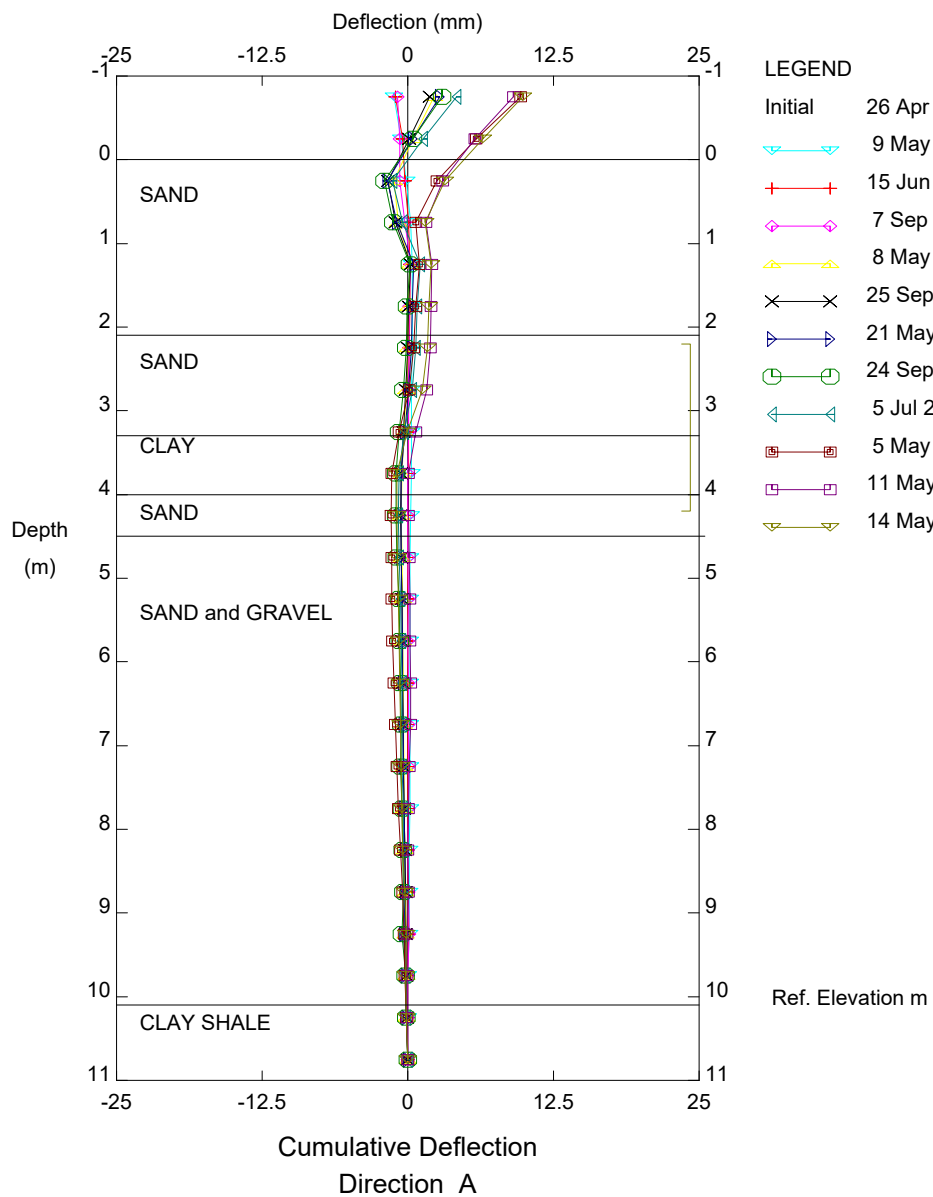
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Hwy 32:10 South of Whitecourt (NC37), Inclinometer SI18-03

Transportation & Economic Corridors

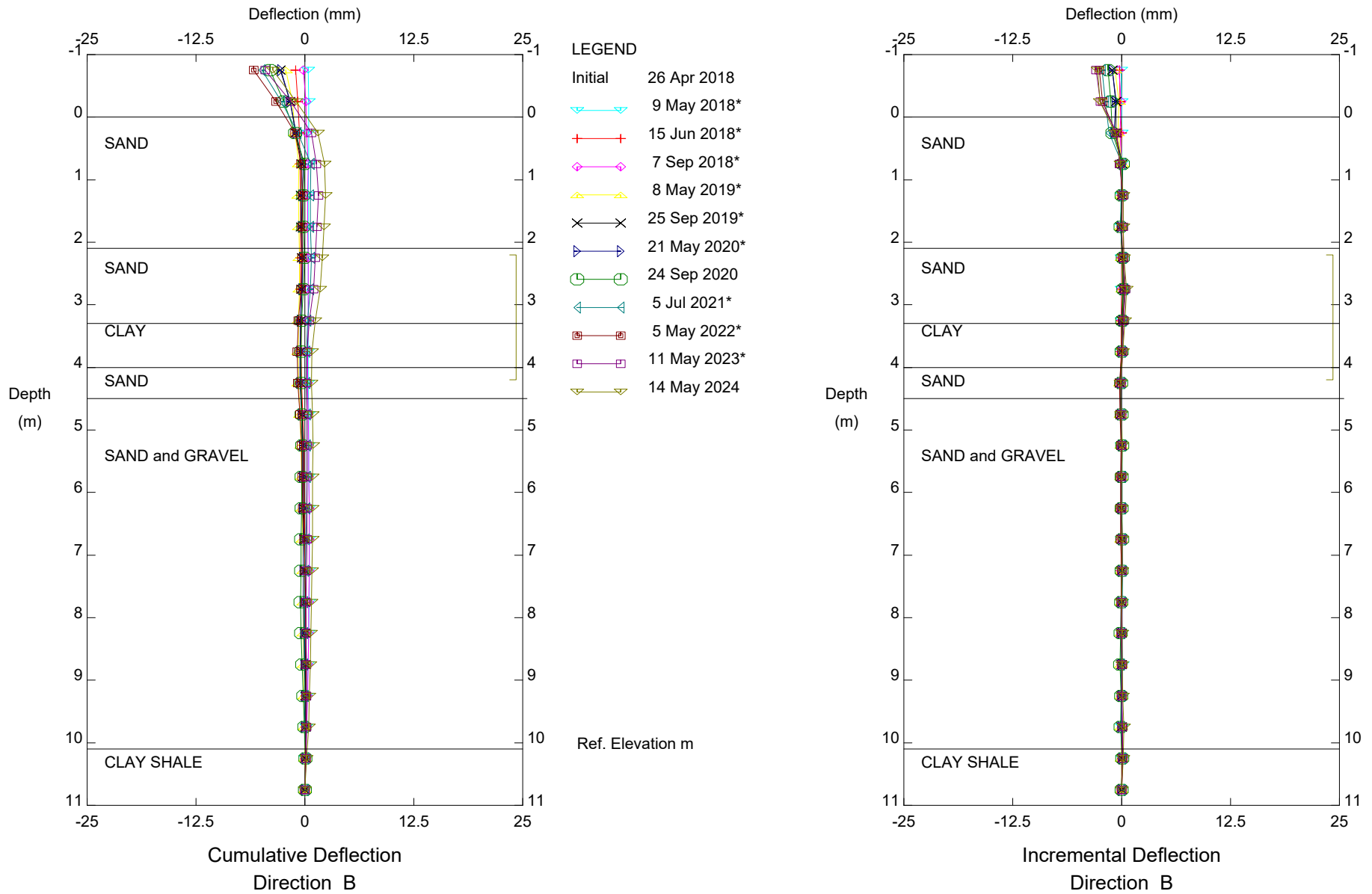
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Hwy 32:10 South of Whitecourt (NC37), Inclinator SI18-04

Transportation & Economic Corridors

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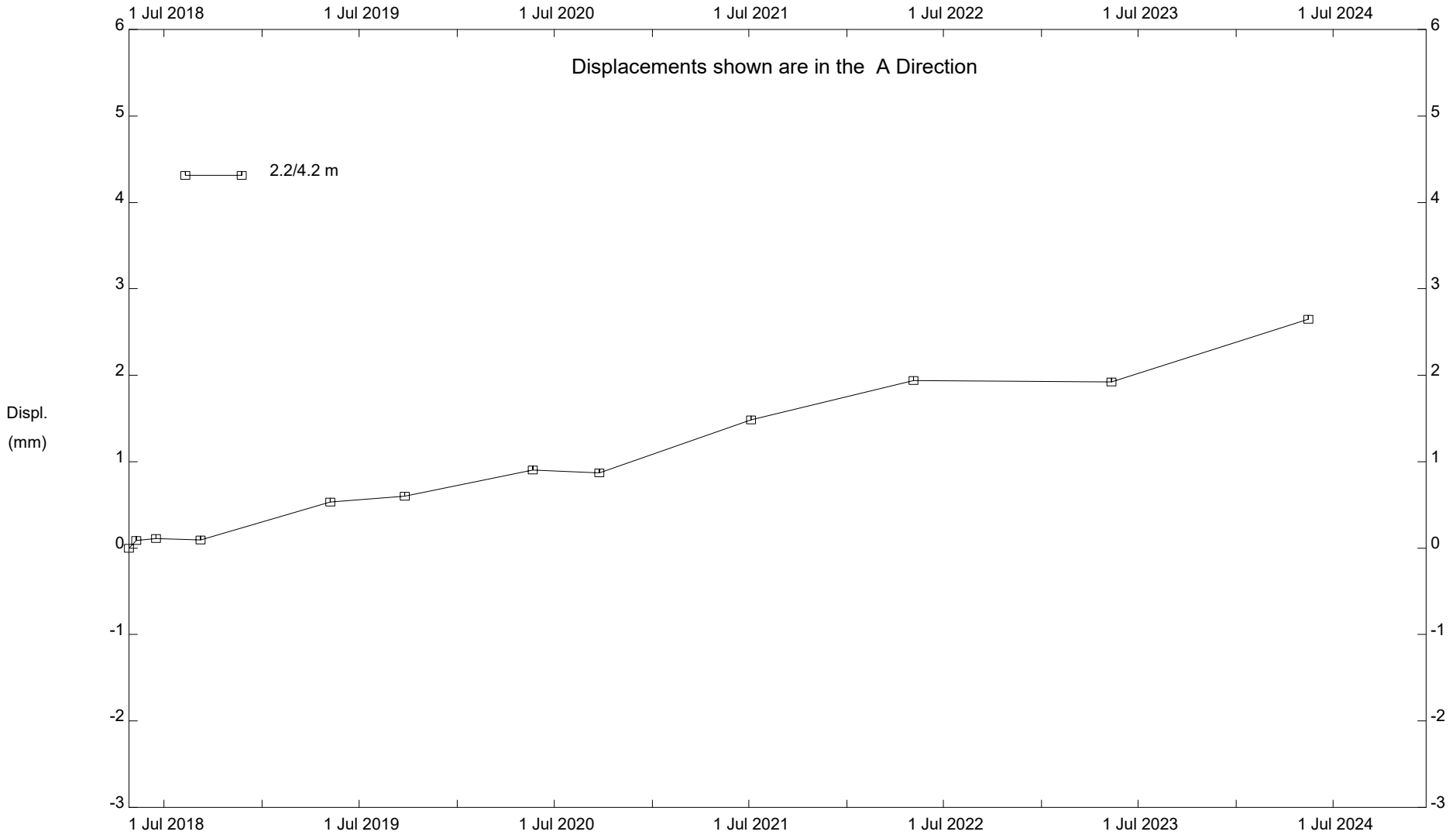


Hwy 32:10 South of Whitecourt (NC37), Inclinometer SI18-04

Transportation & Economic Corridors

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

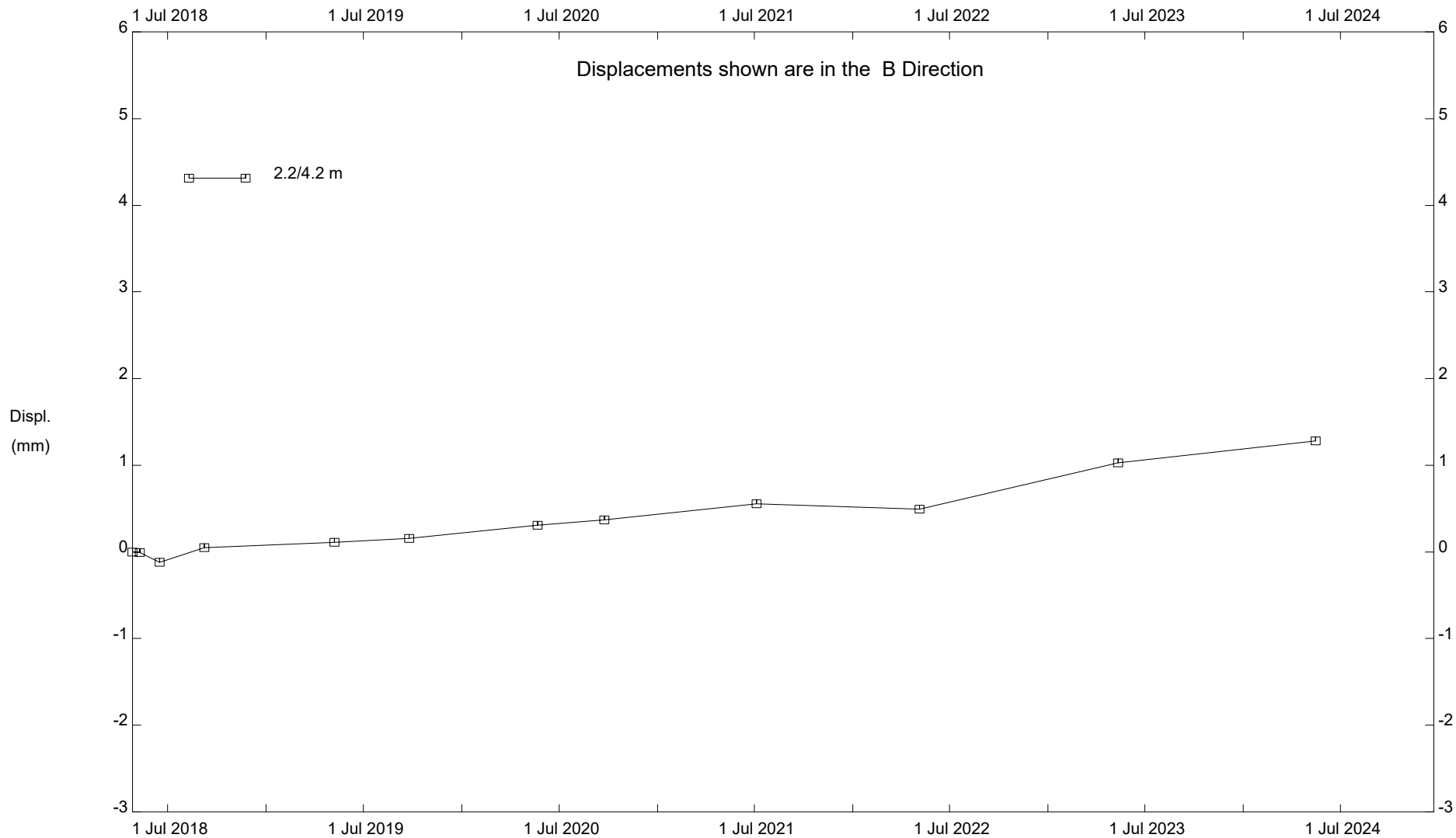
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Hwy 32:10 South of Whitecourt (NC37), Inclinator SI18-04

Transportation & Economic Corridors

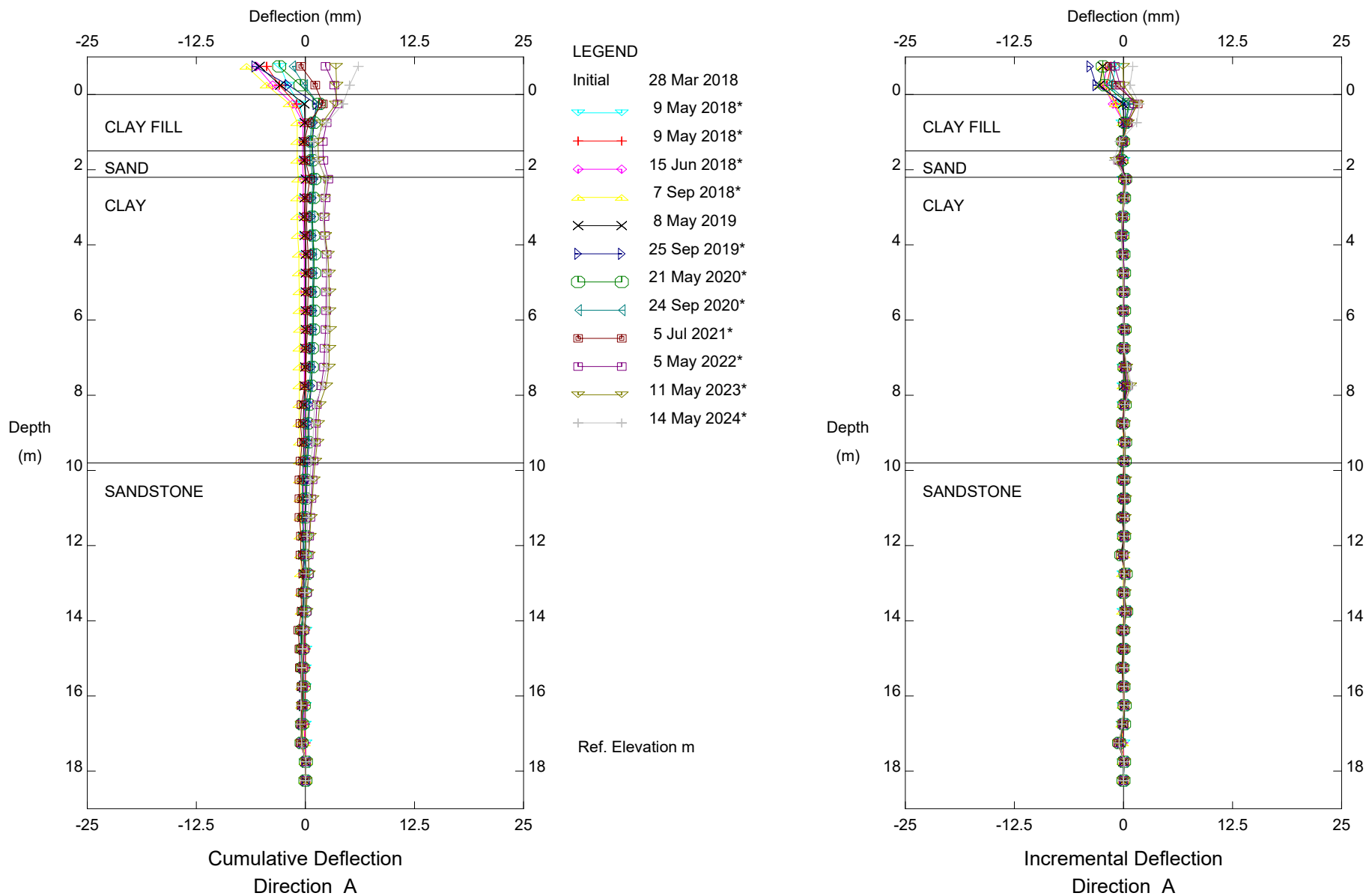
Stantec Consulting Ltd - Edmonton



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Transportation & Economic Corridors

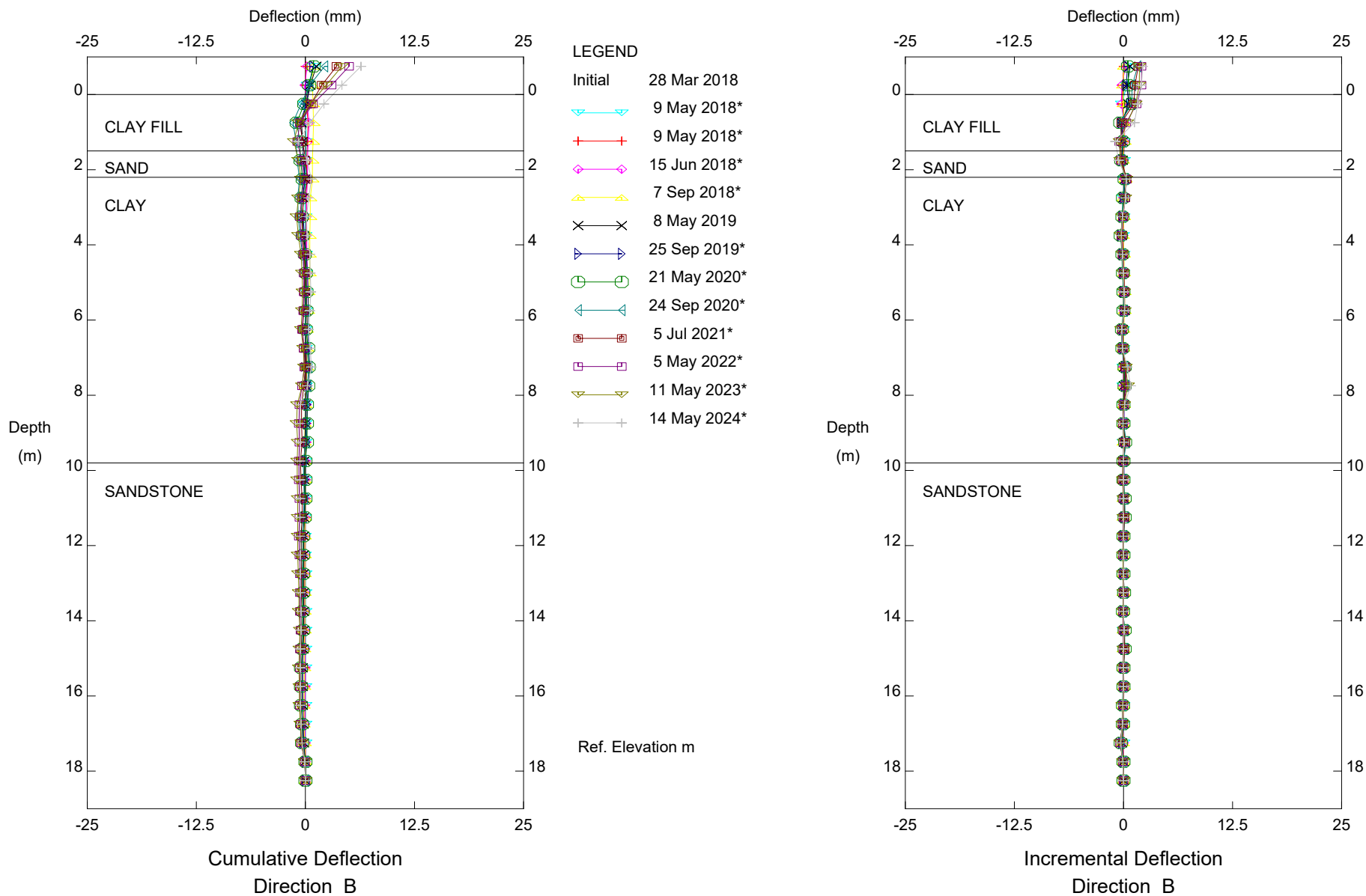




Hwy 32:10 South of Whitecourt (NC37), Inclinometer SI18-05

Transportation & Economic Corridors

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



Hwy 32:10 South of Whitecourt (NC37), Inclinometer SI18-05

Transportation & Economic Corridors

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

