
To:	Amy Driessen Alberta Transportation	From:	Leslie Cho and Carrie Murray Stantec Consulting Ltd.
File:	123315222	Date:	June 13, 2022

Reference: North Central Region, Edson, Site NC001 - Highway 43:16 Whitecourt East Hill Spring 2022 Instrumentation Monitoring Report

1.0 OBSERVATIONS

1.1 FIELD PROGRAM AND INSTRUMENTATION STATUS

The Spring 2022 reading cycle consisted of instrument readings of five slope inclinometers (SI5, SI31, SI06-1, SI06-2, and SI14-02), six pneumatic piezometers (PN01-2A, PN14-03A, PN14-03B, PN14-03C, PN14-04A and PN14-04B), and nine standpipes (SP06-1, SP06-2, SP06-3, SP06-5, SP06-6, SP06-7, SP06-8, SP14-02A and SP14-04). **Figure 1** attached provides a schematic of the site. The instruments were read by Mahendran Senthoran, M.Eng., EIT and Akintola Fakinlede, M.Sc., Engineering Technologist on May 5, 2022.

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 box. Standpipe piezometers (SP) were read with a Heron Instruments water tape.

SI12 was found blocked at 0.5 m below the top of casing during the Fall 2019 reading cycle, however this blockage was not encountered in subsequent reading cycles. SI06-3 was found blocked again (SI casing likely sheared) at 12.5 m below the top of casing during the current reading cycle. SI06-3 will be removed from future instrumentation monitoring cycles.

GPS coordinates of all instruments were obtained using a Garmin eTrex 10 handheld GPS unit.

2.0 INSTRUMENTATION READINGS

2.1 GENERAL

The slope inclinometer plots are attached and summarized in the following sections. Resultant plots in the X Direction (i.e. slope dip direction) along with rates of movement are provided for slope inclinometers where movement was observed. Where there was no skew between the slope direction and the 'A+' direction, the time-displacement plots for the A-direction are provided. **Table NC001-1** summarizes the slope inclinometer readings for the Spring 2022 reading cycle. Pneumatic and standpipe piezometer results are summarized in **Table NC001-2** and **Table NC001-3**, respectively and in the following sections with resulting plots attached.

2.2 ZONES OF MOVEMENT

No new zones of movement were observed.

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2.3 MONITORING RESULTS

2.3.1 Slope Inclinometers

SI5 recorded an incremental movement of about 2 mm corresponding to a current rate of movement is 2 mm/year. However, the overall trend appears to indicate negligible movement since 1996. The abrupt movement recorded between Fall 2015 and Spring 2016 is likely associated with the change of SI probe rather than actual movement.

SI31 is showing creep movement of less than 1 mm/year since 1997 at a shear zone between approximately 2.8 m and 4.8 m. The Spring 2022 readings showed less than 1 mm of incremental movement corresponding to a movement rate of less than 1 mm/year

SI06-1 has a distinct movement zone at about 3 m depth with 64 mm of cumulative movement. During the Spring 2022 reading cycle the rate of movement increased by less than 1 mm/yr compared to the previous reading, corresponding to a rate of movement of 1 mm/yr.

SI06-2 is showing creep at a rate of movement of less than 1 mm/yr since installation in the shear zone from 13.8 m to 15.3 m. A sudden spike recorded in Spring 2016 is likely a reading error.

SI06-3 was found to be blocked at 12.5 m during Spring 2021 reading cycle which coincides with the movement zone. Another attempt was made during Spring 2022 reading cycle which confirmed the blockage due to the excessive movement.

SI14-02 has an average rate of movement of about 5 mm/yr since initiation to Spring 2019 at a depth of about 2.8 m to 4.8 m. The rate of movement began increasing in Fall 2019 to a movement rate of about 24 mm/yr during the Fall 2020 reading cycle. The current movement rate slowed down to 2 mm/yr with less than 1 mm of incremental movement.

2.3.2 Piezometers

Generally, the PNs show an increase in water level up to 0.6 m since the Spring 2021 reading cycle except for PN14-03 which showed a decrease of 0.2. Most of the pneumatic piezometers have marginal changes since initialization except for PN14-03c which has decreased by about 4.9 m since initialization in 2014.

The current SP water level readings generally showed change in piezometric levels from 0.1 m decrease to 0.1 m increase since Spring 2021 except for SP06-1 which showed an increase in water level of 0.9 m. In addition, SP06-7 previously recorded water at 19.5 m below ground surface (bgs) and was found dry to standpipe bottom (20.8 mbgs) during the current reading. Most of the standpipes have marginal changes since about 2006.

SP14-04 (deep) SP was measured for the first time in Spring 2022 reading cycle and piezometric level observed to be 3.4 m bgs.

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Table NC001-2 and **Table NC001-3** summarize the pneumatic and standpipe piezometer readings for the current reading cycle.

3.0 RECOMMENDATIONS

3.1 FUTURE WORK

It is recommended that all instruments be read during the Spring 2023 reading cycle.

3.2 INSTRUMENTATION REPAIRS

SI16-04 was found blocked at 4.0 m below top of casing during the Spring 2019 reading cycle. In Spring 2017, SP06-4 and SP14-01 were found blocked at shallow depths of less than 0.5 m below top of casing. An attempt to remove these obstructions can be carried out upon approval from Alberta Transportation (AT).

SI12 was found damaged near ground surface during the Spring 2021 reading cycle. Stantec recommends repairing SI12 to continue monitoring the slope movement.

SI06-3 was found blocked at 12.5 m below the top of casing during the Spring 2021 reading cycle. This installation can be replaced upon approval by AT.

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Table NC001-1: Spring 2022 Slope Inclinometer Reading Summary

Instrument Name	Date Initialized	Coordinates ⁽¹⁾ (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							
SI5	June 14, 1996	5999354	586326	19 over 4.7m to 5.7 m depth in 23° direction	22 (May 2016)	Operational	July 5, 2021	2	2	<1
SI10	June 18, 1993	-	-	39 over 1.1m to 10.1m depth in 350° direction	30 (Nov 2014)	Non Operational	Sept. 25, 2019	Found blocked in Spring 2020 at 11.5 m below top of casing		
SI12	Repaired Mar 13, 2006	5999327	586391	2 over 2.8m to 5.8m depth in 140° direction	5 (Oct 2014)	Non Operational	September 23, 2020	Damaged near surface during Spring 2021		
				2 over 17.8m to 22.3m depth in 140° direction	9 (Oct 2013)					
SI31	Sept 26, 1995	5999497	585898	26 over 2.8m to 4.8m depth in 0° direction	14 (May 2016)	Operational	July 5, 2021	<1	< 1	<1
SI06-1	Mar 21, 2006	5999287	586403	64 over 1.3m to 3.8m depth in 3° direction	59 (Sept 2011)	Operational	July 5, 2021	1	1	<1
SI06-2	Mar 22, 2006	5999191	586406	5 over 0.3 m to 2.3m depth in 2° direction	6 (Oct 2008)	Operational	July 5, 2021	Negligible Movement (less than 1 mm /yr movement)		

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Instrument Name	Date Initialized	Coordinates ⁽¹⁾ (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							
SI06-2	Mar 22, 2006	5999191	586406	4 over 13.8 m to 15.3m depth in 2° direction	7 (Sept. 2017)	Operational	July 5, 2021	Negligible Movement (less than 1 mm /yr movement)		
SI06-3	Mar 19, 2006	5999237	586502	88 over 10.8m to 13.3m depth in 351° direction	72 (July 2021)	Non-Operational	September 23, 2020	Blocked at 12.5 m. Possibly sheared off.		
SI06-4	Mar 21, 2006	5999311	586457	65 over 0.8m to 3.3m depth in 357° direction	39 (Sept 2011)	Non-Operational	Sept. 6, 2018	Blocked 4.0 m below top of casing since Spring 2019		
SI14-02	Apr 1, 2014	5999308	586463	54 over 2.8m to 4.8m depth in 359° direction	34 (April 2014)	Operational	July 5, 2021	2	2	1
Note: (1) Updated May 5, 2022, with approximate accuracy of ± 3 m.										

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Table NC001-2: Spring 2022 Pneumatic Piezometer Reading Summary

Instrument Name	Date Initialized	Coordinates ⁽¹⁾ (UTM 11U, NAD1983) (m)		Ground Elevation (m)	Tip Elevation (m)	Current Status	Maximum Piezometric Level (m bgs)	Measured Piezometric Elevation (m)	Change in Piezometric Level Since Previous Reading (m)
		Northing	Easting						
PN01-2A (23177)	May 23, 2001	5999234	586400	720.3	711.3	Operational	8.8 (May 2019)	712.0 (10.1 m bgs)	<0.1
PN14-03A (35716)	Mar 23, 2014	5999247	586481	721.0	716.4	Operational	1.6 (May 2019)	718.4 (2.6 m bgs)	+ 0.5
PN14-03B (35715)	Mar 23, 2014				713.4	Operational	2.7 (May 2019)	717.9 (3.1 m bgs)	+ 0.6
PN14-03C (35714)	Mar 23, 2014				707.3	Operational	5.3 (Aug 2014)	709.8 (11.2 m bgs)	-0.2
PN14-04A (35086)	Apr 1, 2014	5999200	586420	723.7	713.7	Operational	2.0 (May 2019)	721.3 (2.5 m bgs)	<0.1
PN14-04B (35088)	Apr 1, 2014				717.6	Operational	1.2 (May 2019)	721.9 (1.9 m bgs)	<0.1
Note: (1) Updated May 5, 2022, with approximate accuracy of ± 3 m.									

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Table NC001-3: Spring 2022 Standpipe Piezometer Reading Summary

Instrument Name	Date Initialized	Coordinates ⁽¹⁾ (UTM 11U, NAD1983) (m)		Bottom Depth (mbgs), (Elevation)	Current Status	Maximum Water Level (mbgs)	Measured Water Level (mbgs), (Elevation)	Previous Water Level (Elevation), Spring 2021 (mbgs)	Change in Water Level (m)
		Northing	Easting						
SP06-1	March 15, 2006	5999348	586410	9.5 (694.2 m)	Operational	3.4 (May 2022)	3.4 (700.2 m)	4.3 (699.3 m)	0.9
SP06-2	March 15, 2006	5999302	586407	15.7 (694.6 m)	Operational	4.3 (Sept. 2019)	5.4 (704.9 m)	5.4 (704.9 m)	No Change
SP06-3	March 15, 2006	5999288	586429	15.2 (699.2 m)	Operational	9.1 (Sept. 2018)	9.3 (705.2 m)	9.3 (705.2 m)	<0.1
SP06-4	Sept 27, 1996	-	-	Unknown	Non-Operational	16.6 (Mar 2006)	Blocked at 0.5 m below casing since Spring 2017		
SP06-5	Sept 27, 1996	5999267	586423	20.6 (698.8 m)	Operational	15.6 (May 2006)	16.0 (703.4 m)	16.0 (703.4 m)	No Change
SP06-6	Sept 27, 1996	5999242	586453	20.9 (700.5 m)	Operational	20.5 (Oct 2007)	Dry	Dry	No Change
SP06-7	March 15, 2006	5999221	586390	20.8 (700.6 m)	Operational	16.6 (Mar 2006)	Dry	19.5 (701.9 m)	At least 1.3 m
SP06-8	March 15, 2006	5999193	586434	21.8 (702.8 m)	Operational	11.5 (Mar 2006)	20.2 (704.4 m)	20.1 (704.5 m)	-0.1
SP14-01	Mar 23, 2014	-	-	4.2 (695.7 m)	Non-Operational	1.4 (Sept 2015)	Blocked at 0.2 m below casing since Spring 2017		
SP14-02A	Apr 1, 2014	5999305	586464	5.4 (705.5 m)	Operational	5.3 (May 2018)	Dry	Dry	No Change
SP14-04 (Shallow)	Apr 1, 2014	5999203	586418	2.0 (721.7 m)	Operational	1.7 (Sept 2015)	Dry	Dry	No Change
SP14-04 (Deep)	Apr 1, 2014	5999203	586418	10.0 m (713.7 m)	Operational	3.4 (May 2022)	3.4 (720.3)	-	-
Note: (1) Updated May 5, 2022, with approximate accuracy of ± 3 m.									

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4.0 CLOSING

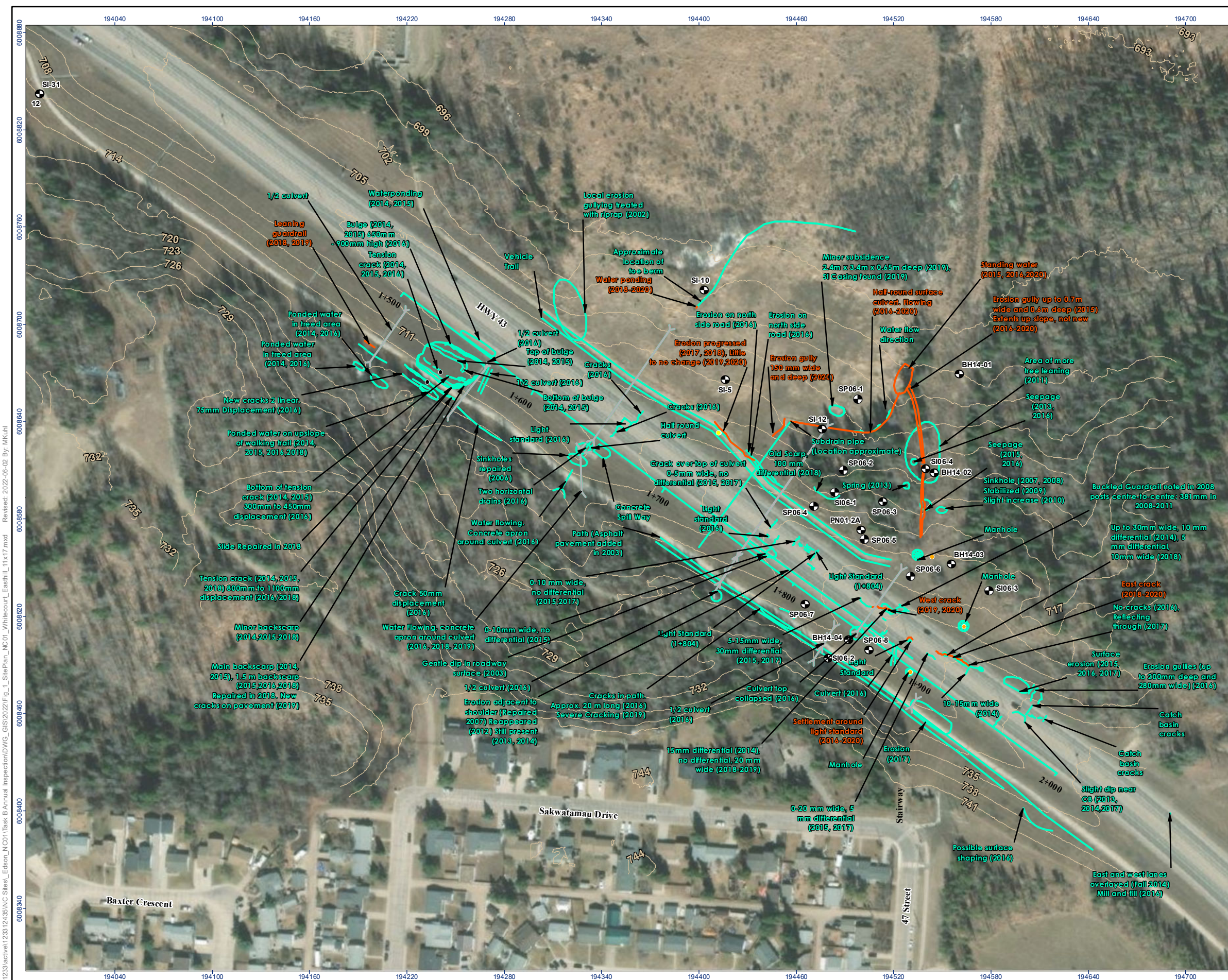
We trust this instrumentation report meets your requirements. If you have any questions, please do not hesitate to contact the undersigned.

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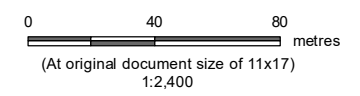
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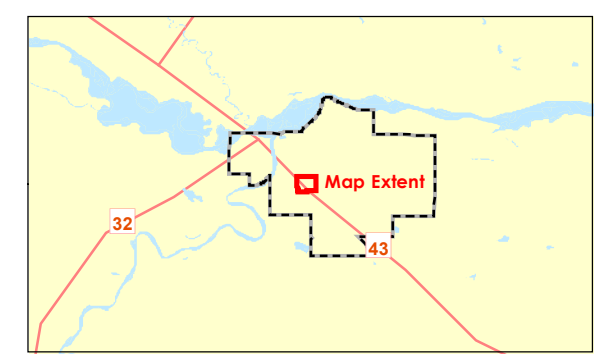
Attachment: Figure 1 – Site Plan
SI5 Slope Inclinator Plots
SI31 Slope Inclinator Plots
SI06-1 Slope Inclinator Plots
SI06-2 Slope Inclinator Plots
SI14-02 Slope Inclinator Plots
Pneumatic Piezometer Depth vs Time Plot
Pneumatic Piezometer Elevation vs. Time Plot
Standpipe Piezometer Depth vs Time Plot
Standpipe Piezometer Elevation vs. Time Plot



- Borehole
- Catch Basin
- Catch Basin Manhole
- Manhole
- Piezometer
- Culvert
- 2020 Observation
- Previous Observation
- Ground Elevation Contours (m AMSL, LiDAR Aug-Sept. 2013)



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 12N
 2. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Project Location
Town of Whitecourt,
Alberta

Prepared by MK on 2020-06-11
Quality Review by LC on 2020-06-19
Independent Review by XL on 2020-06-19

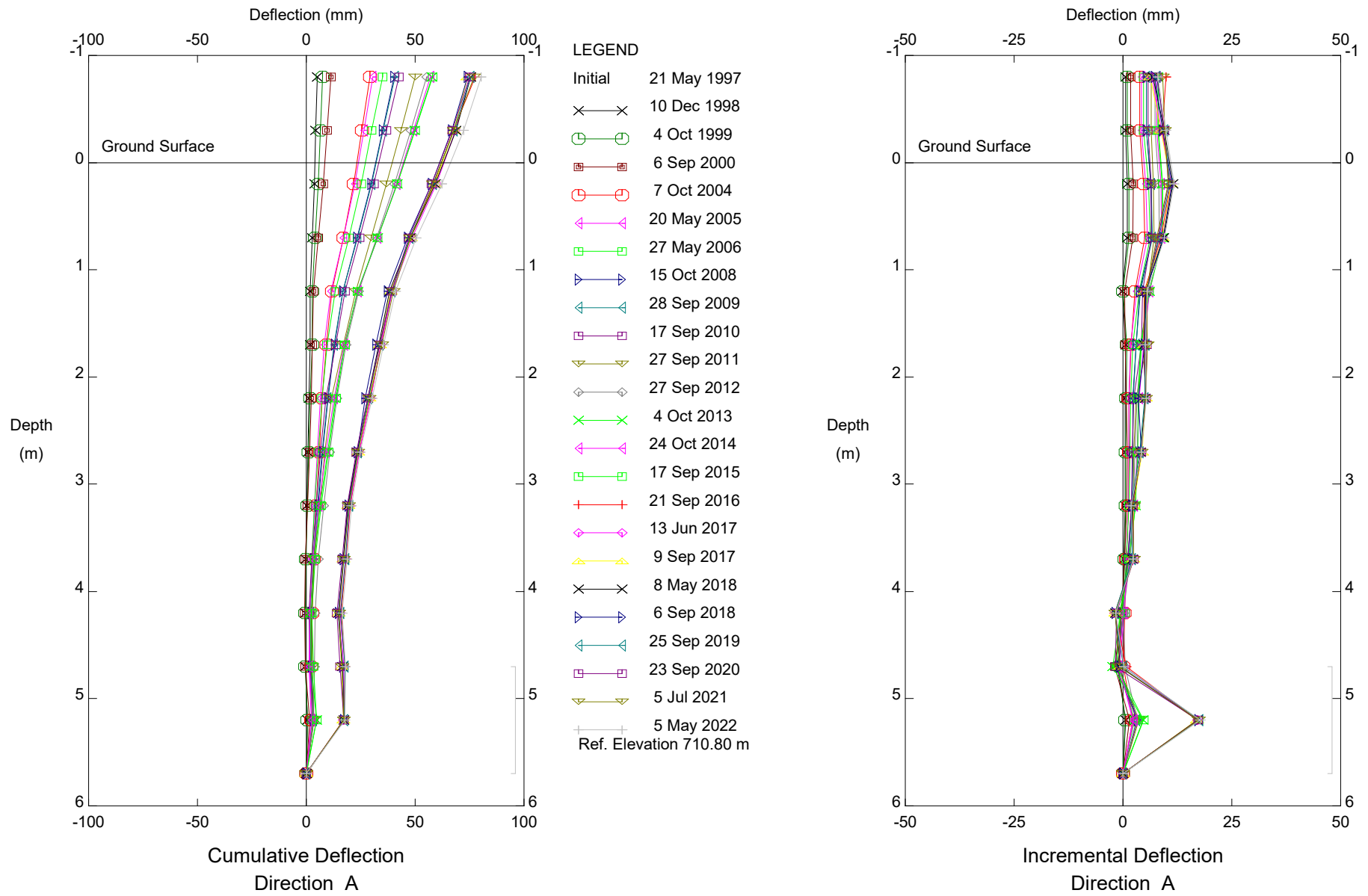
Client/Project
Alberta Transportation
Geohazard Monitoring Program
NC01 Whitecourt East Hill

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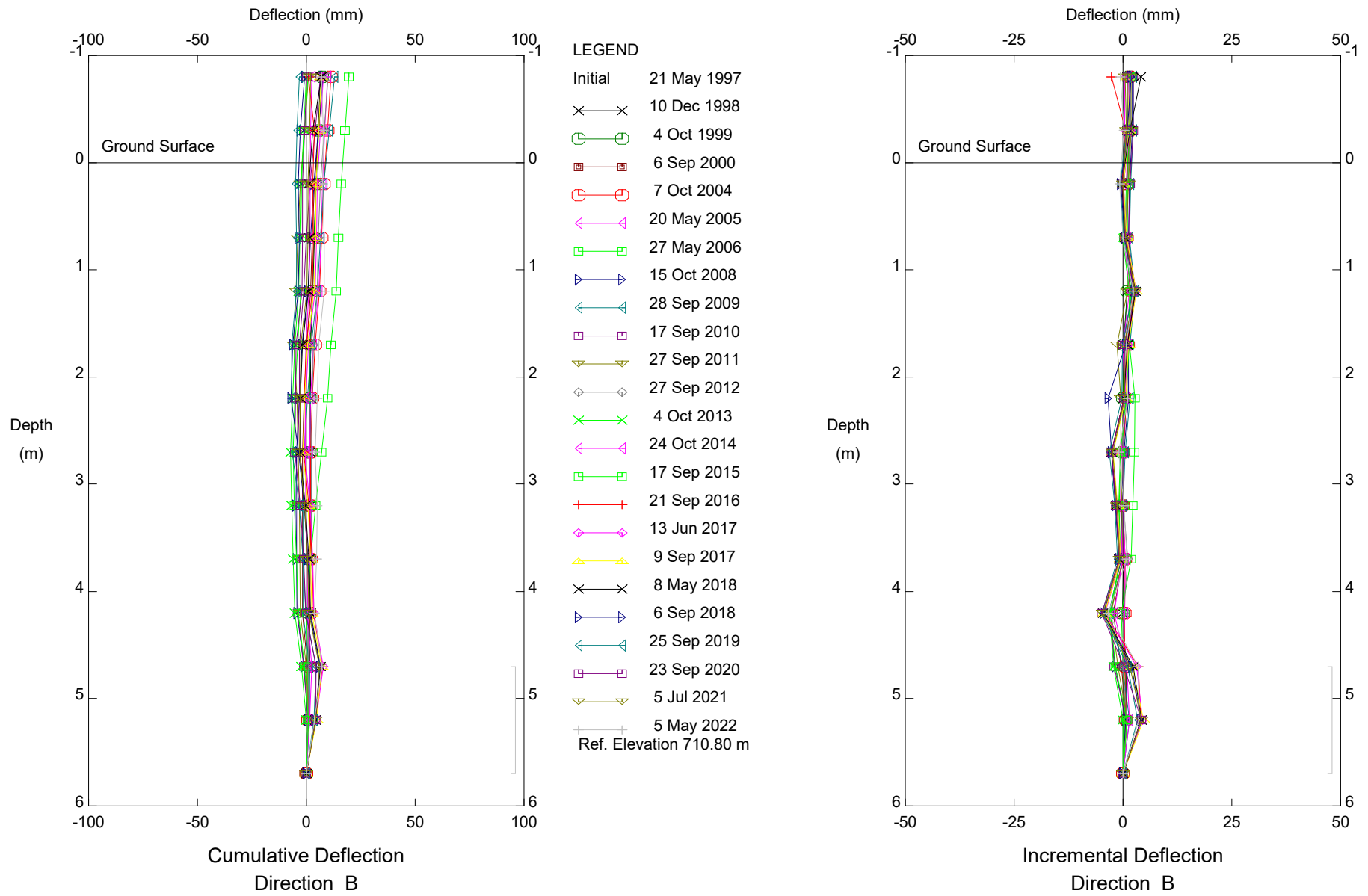
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Site Plan

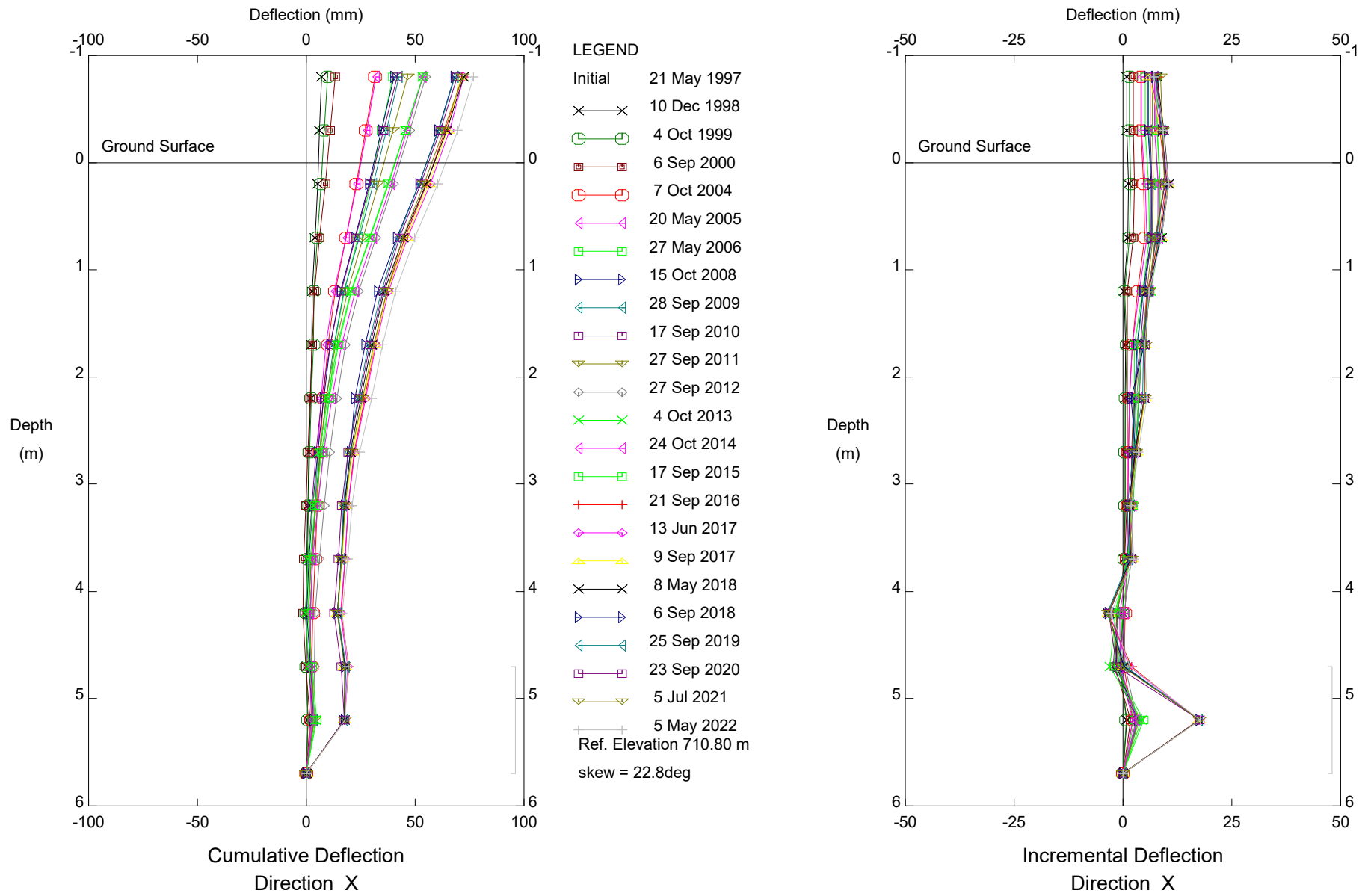
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 Alberta Transportation

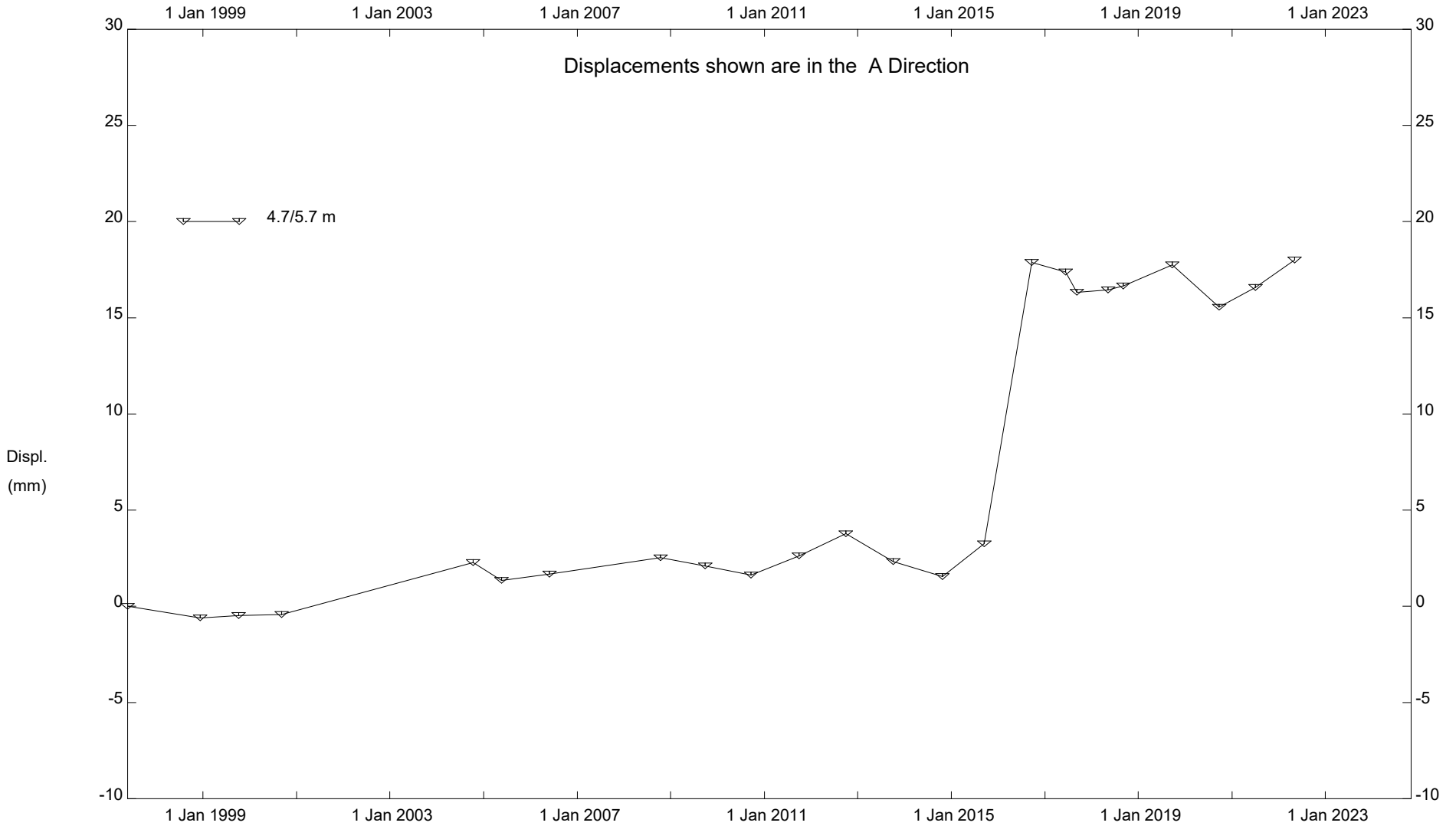


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HWY 43:16 Whitecourt East Hill (NC1), Inclinometer SI5
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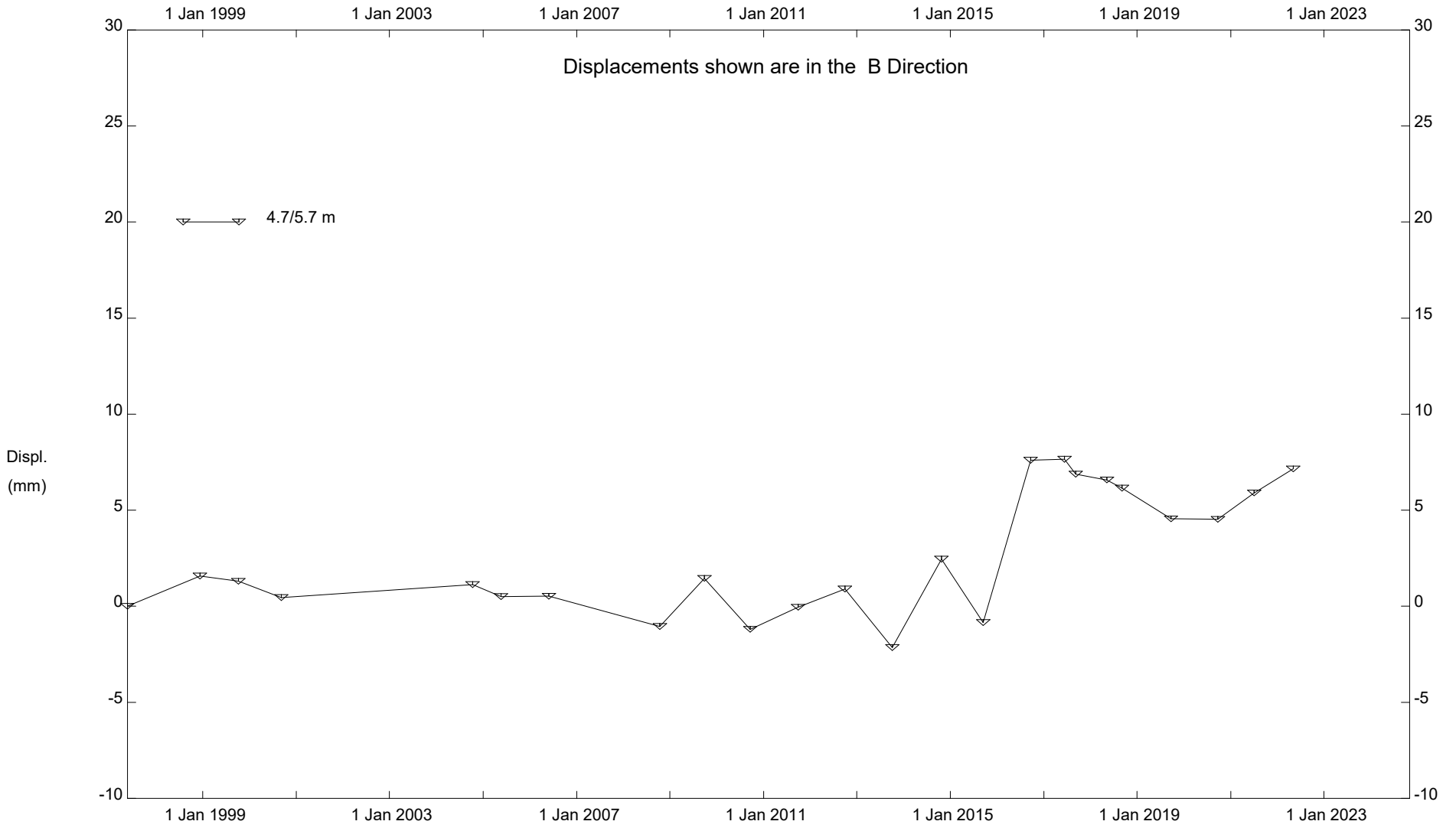
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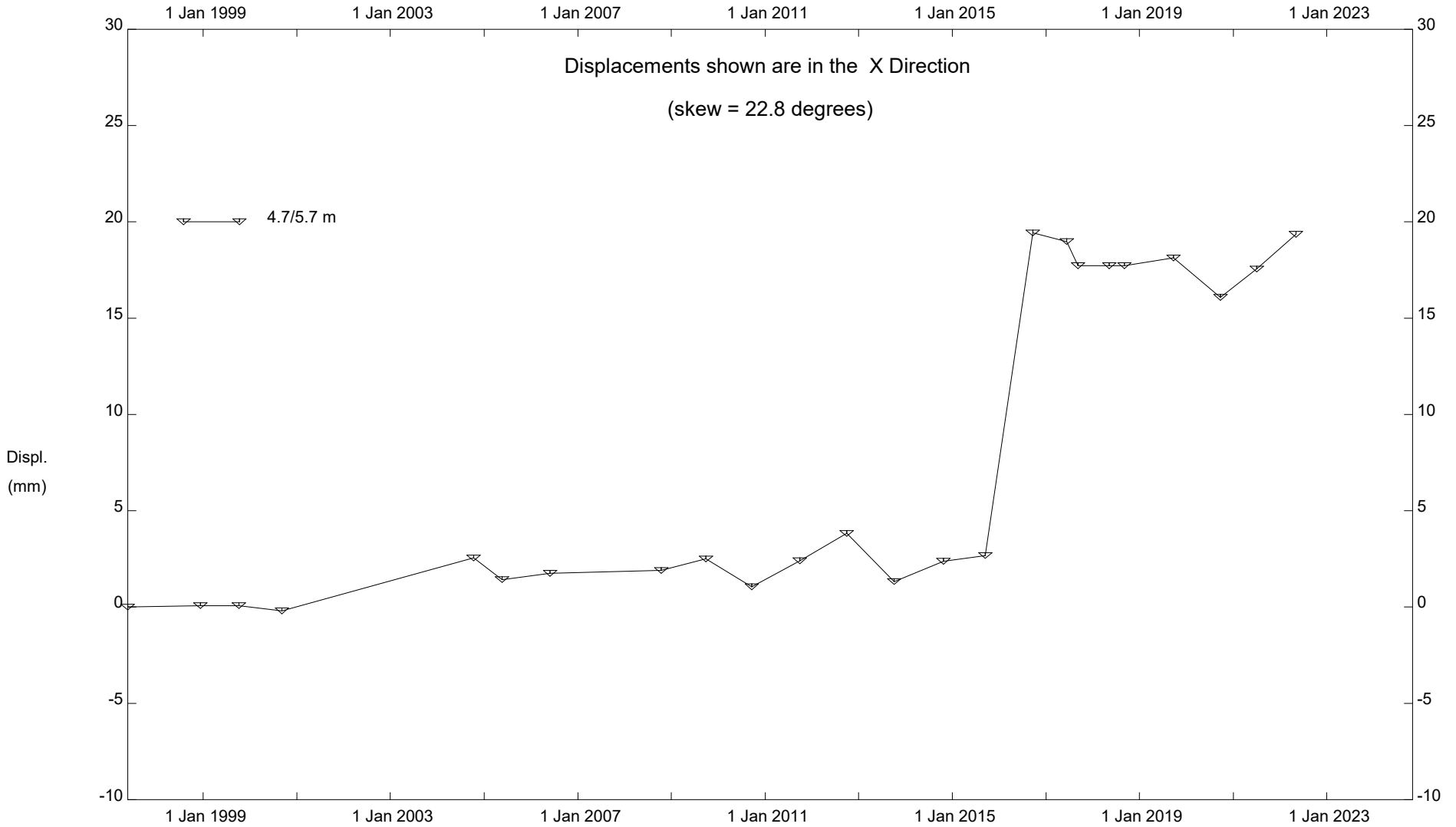
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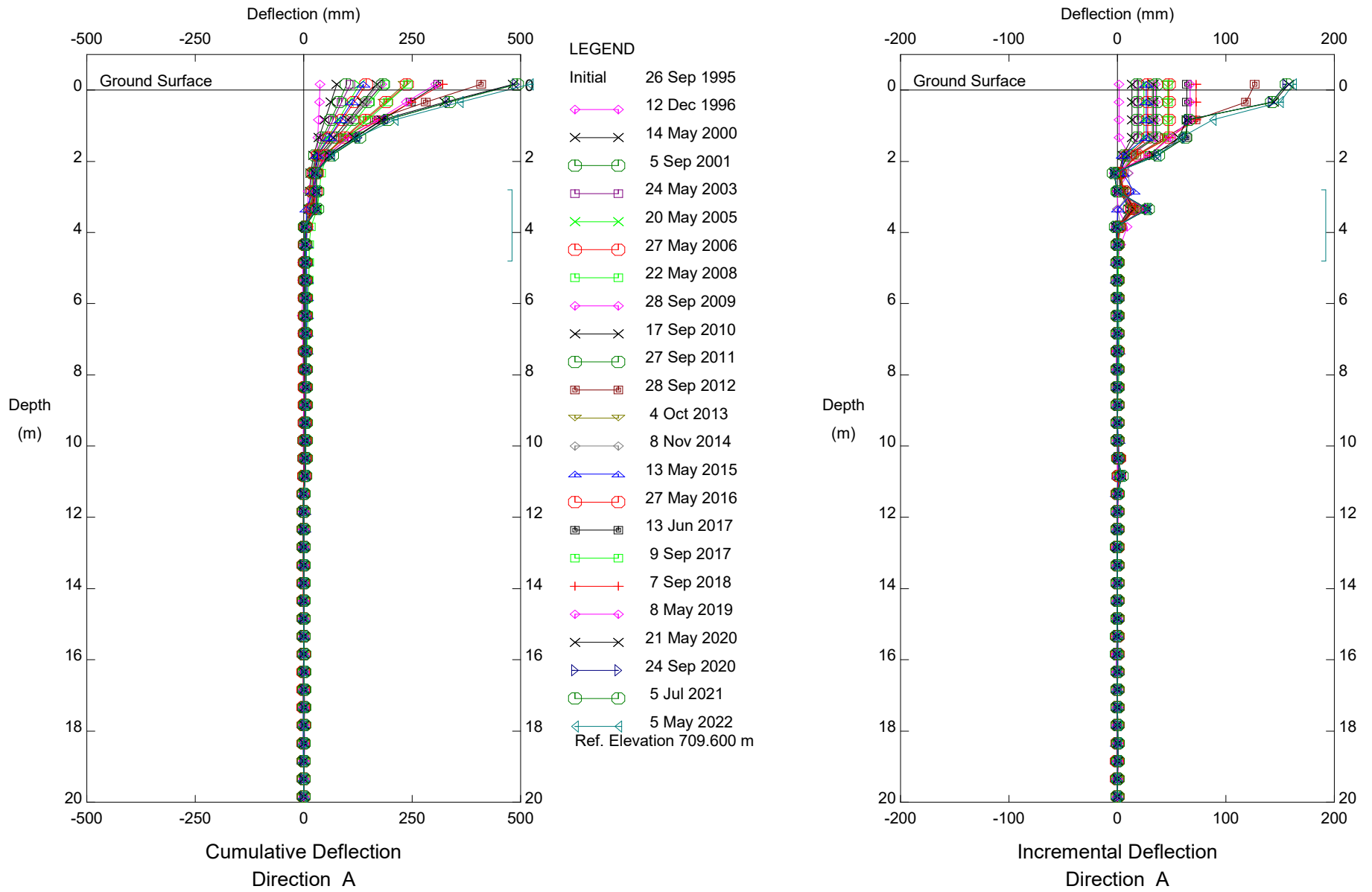
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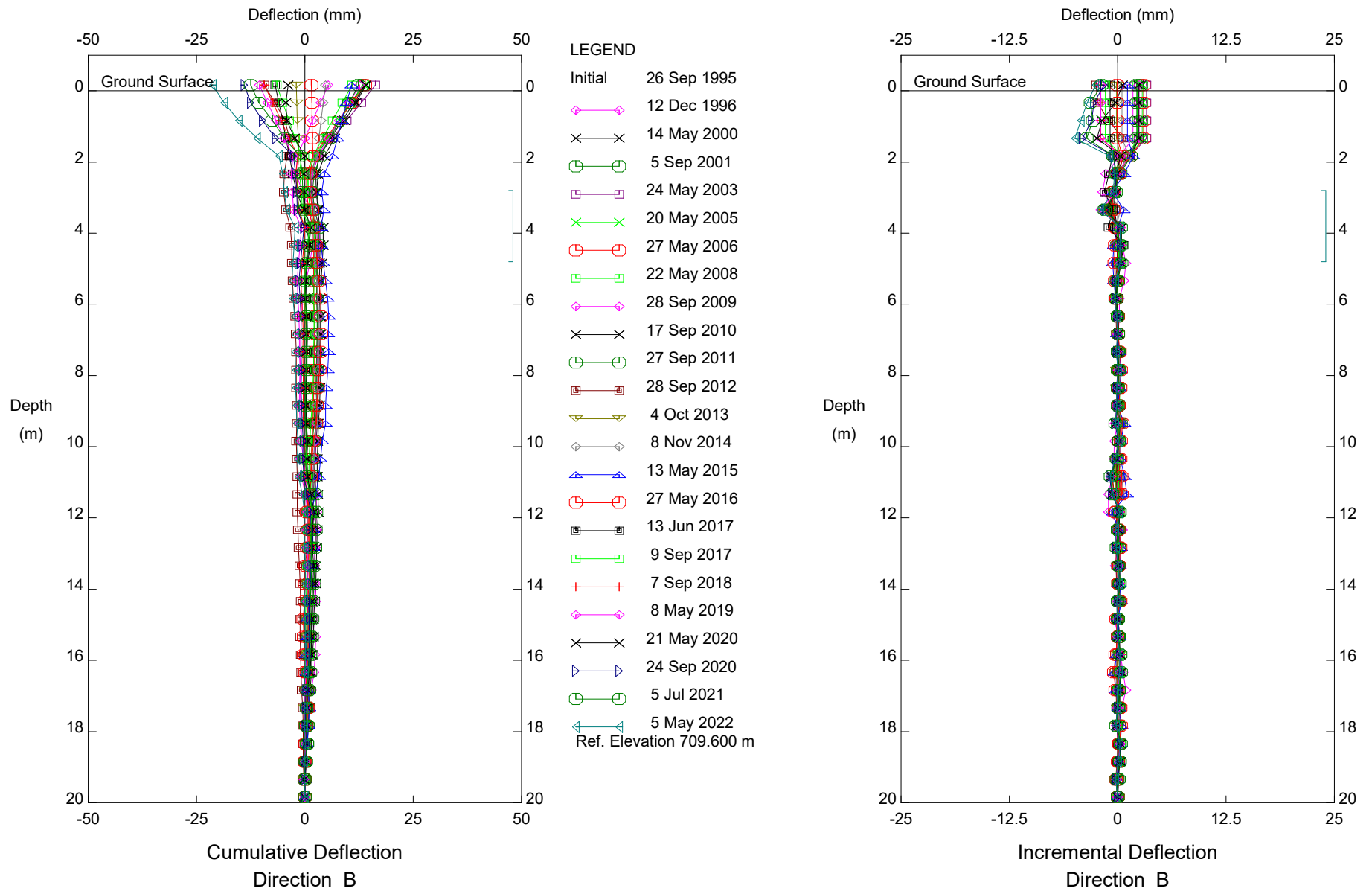
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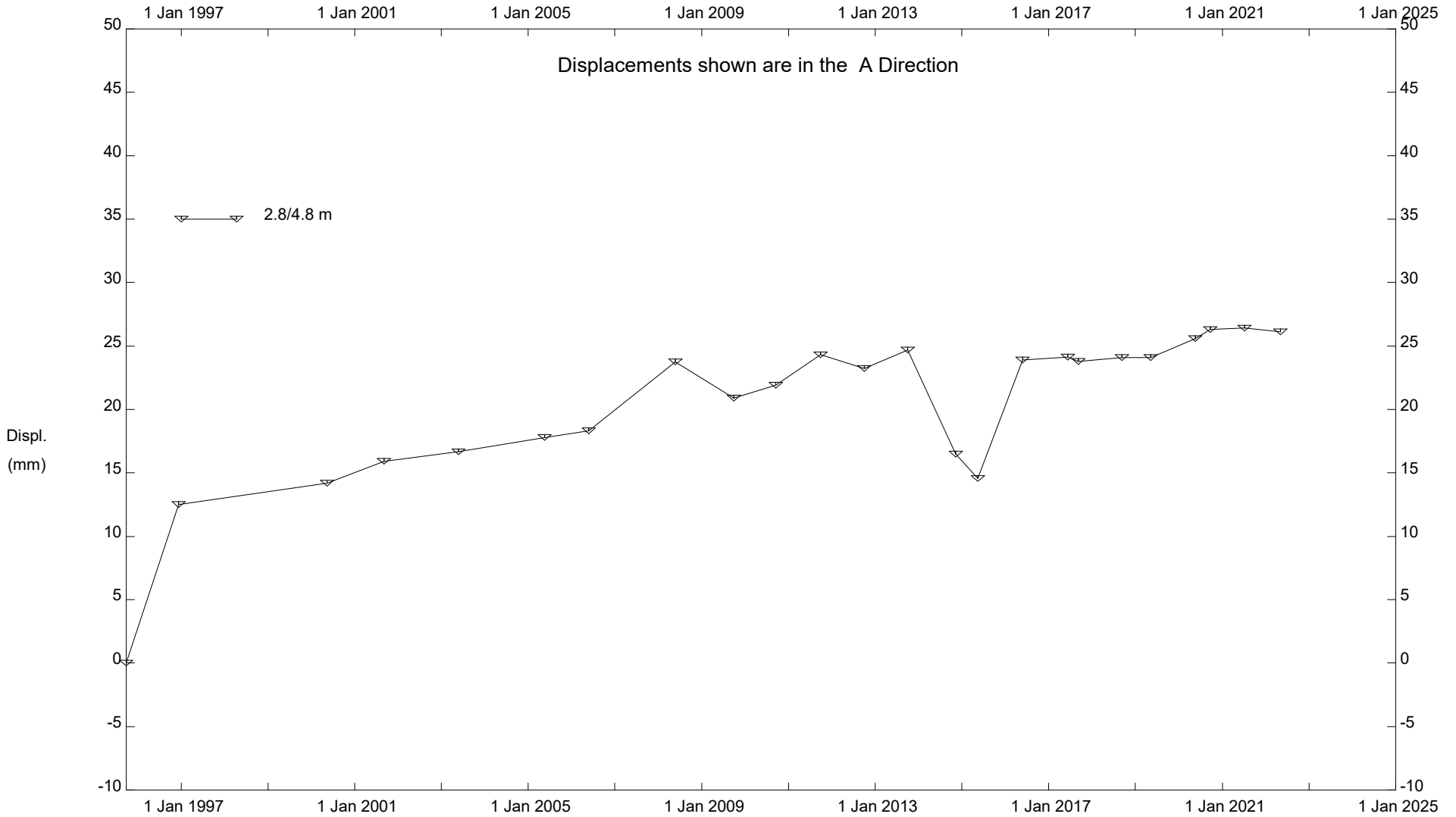
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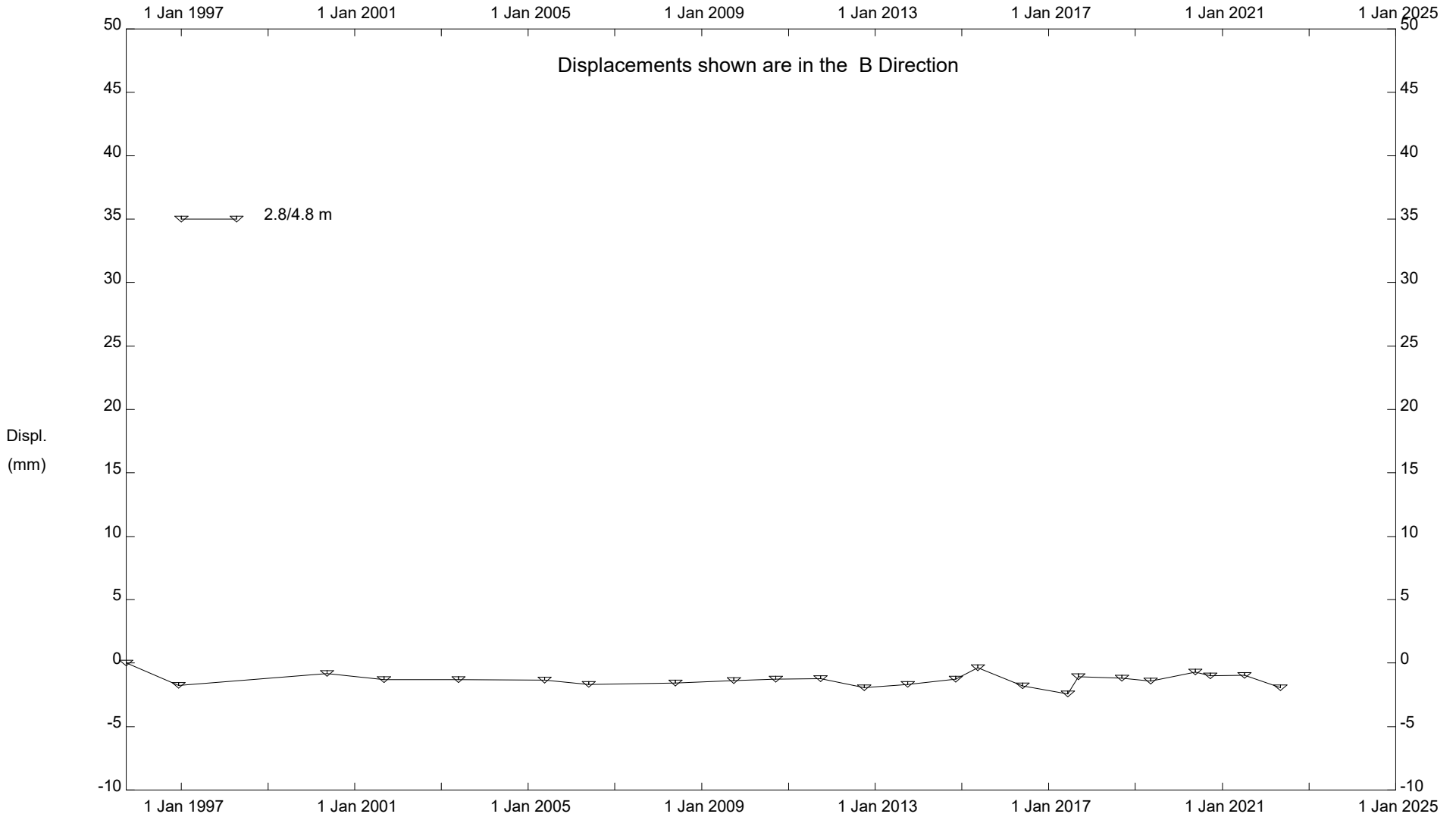
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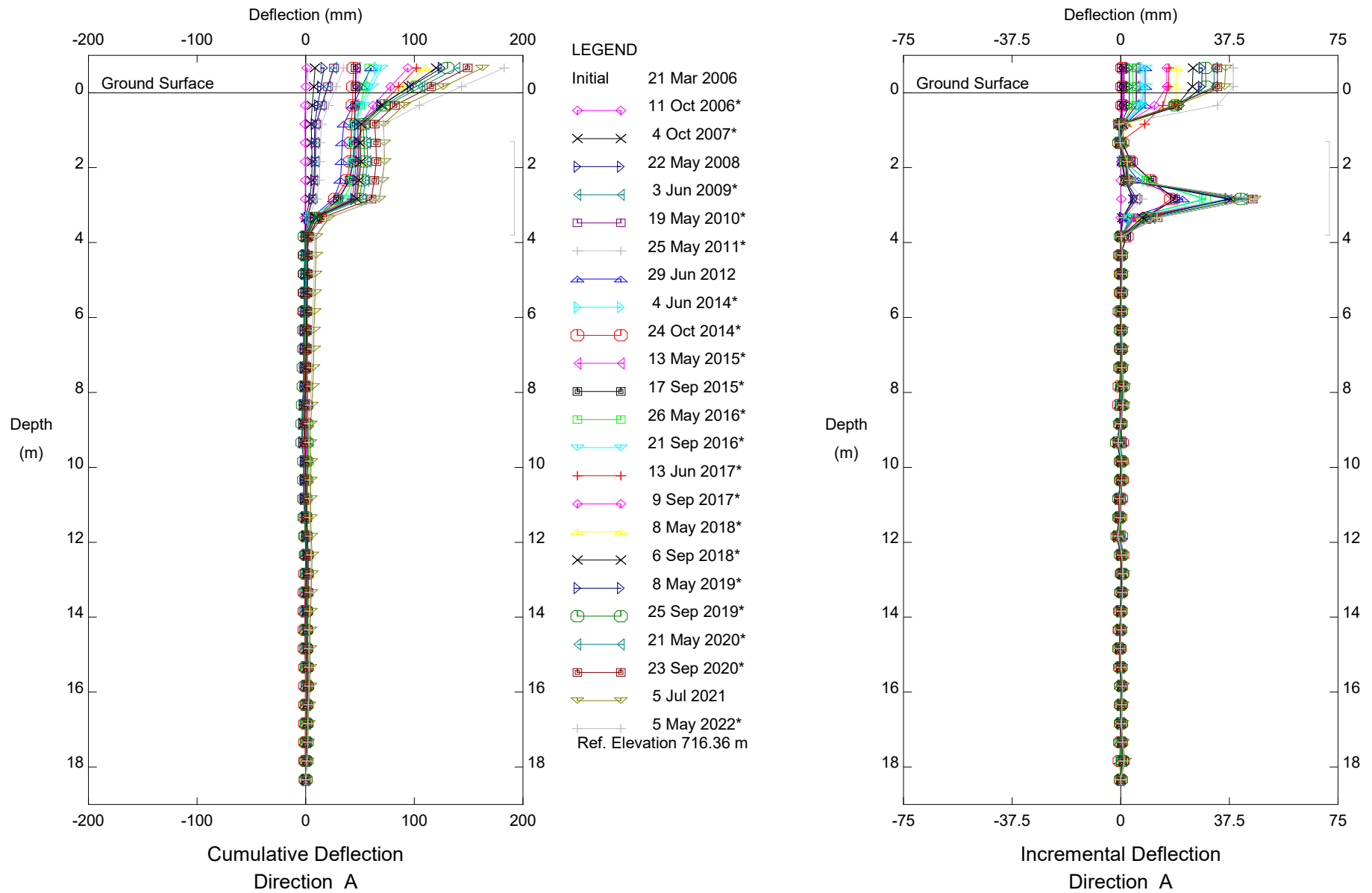
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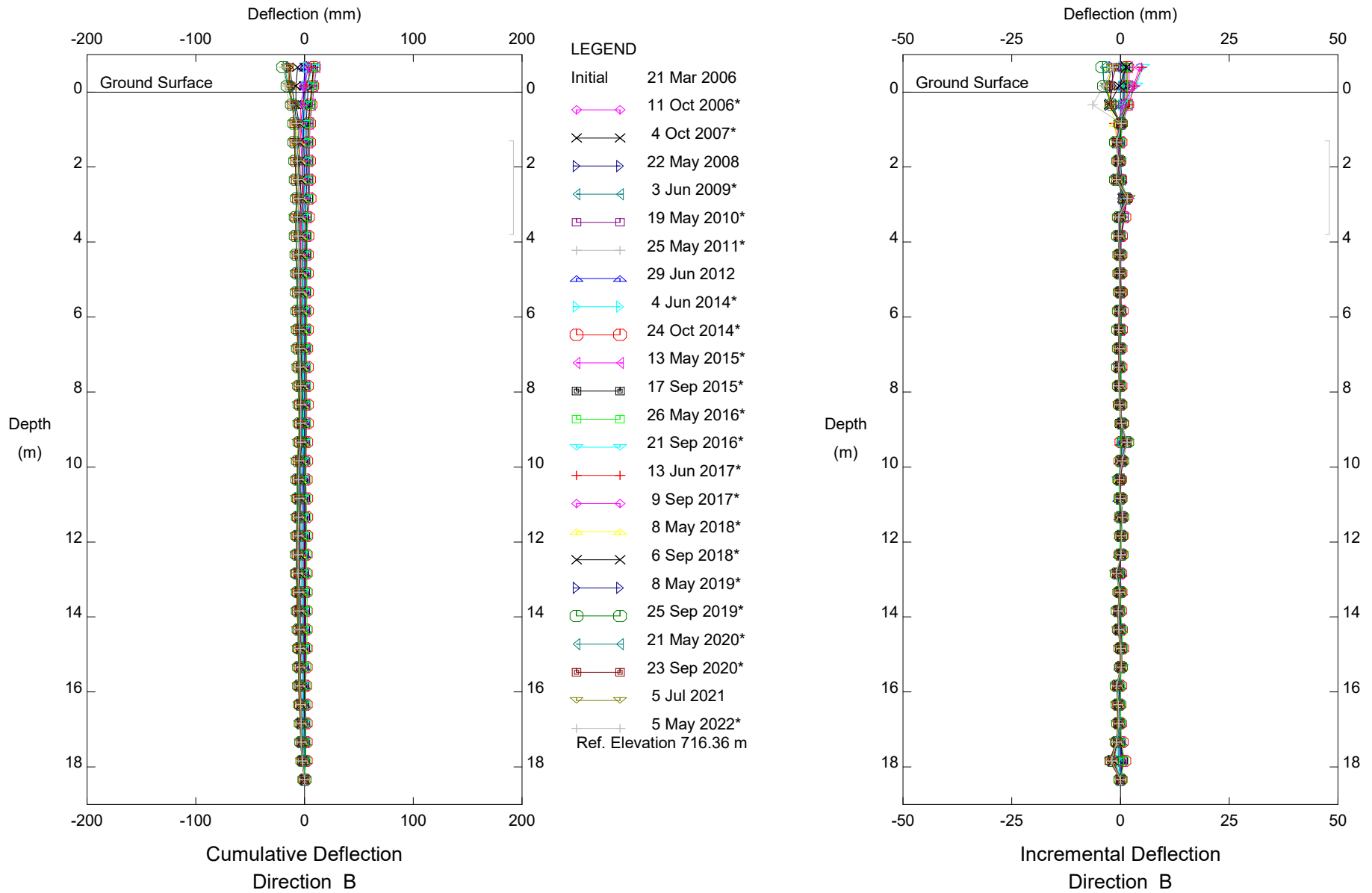
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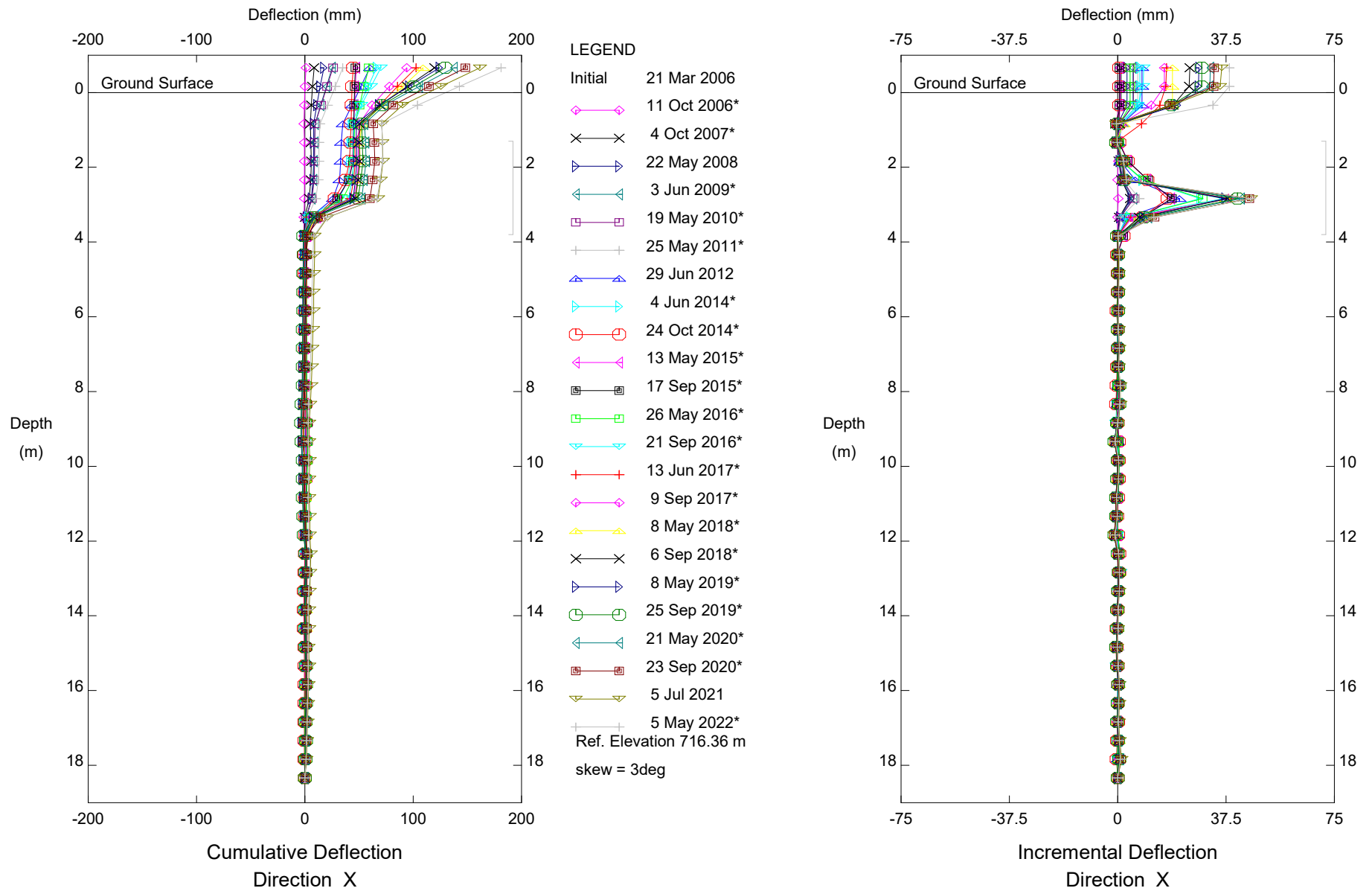
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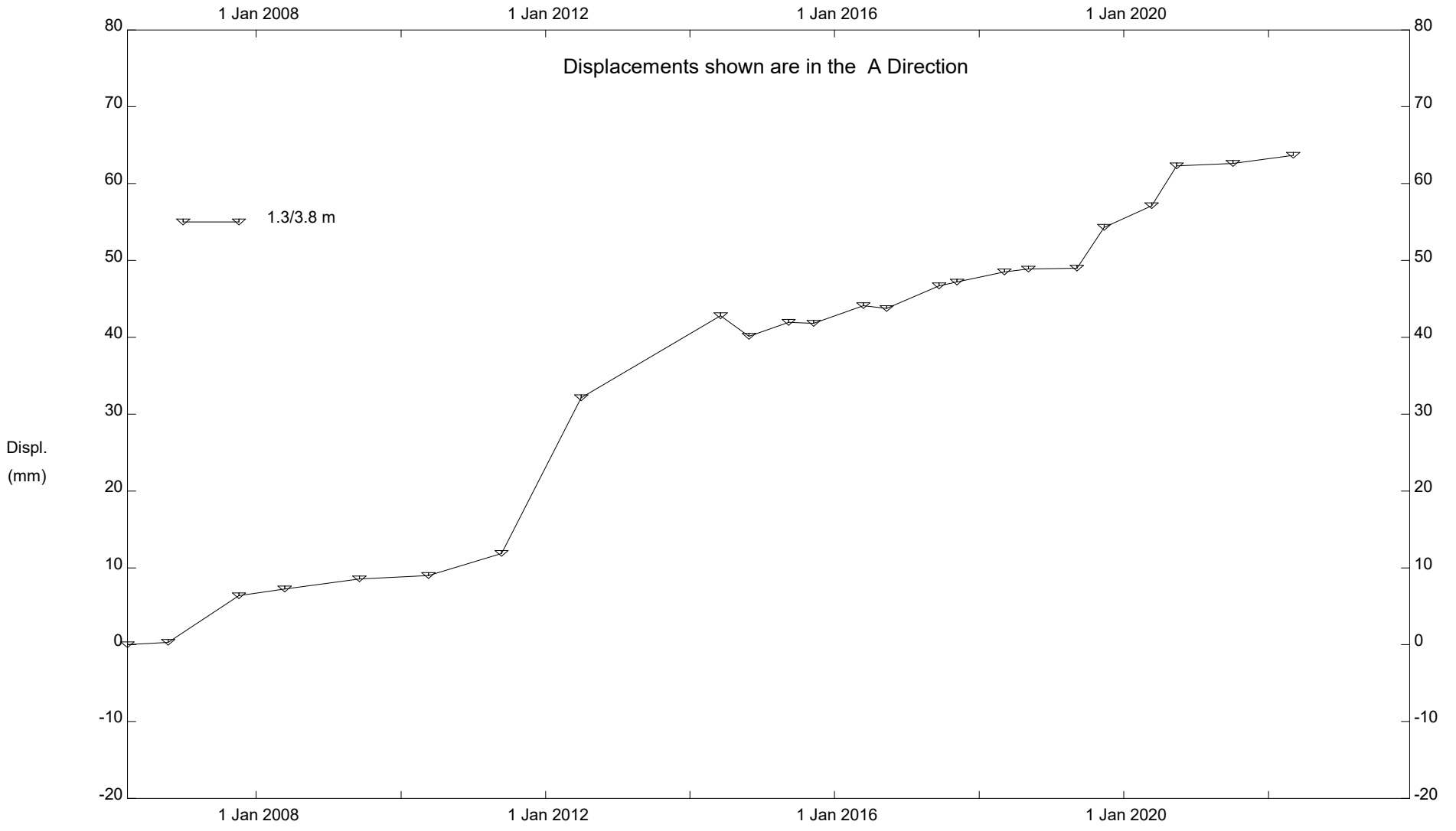


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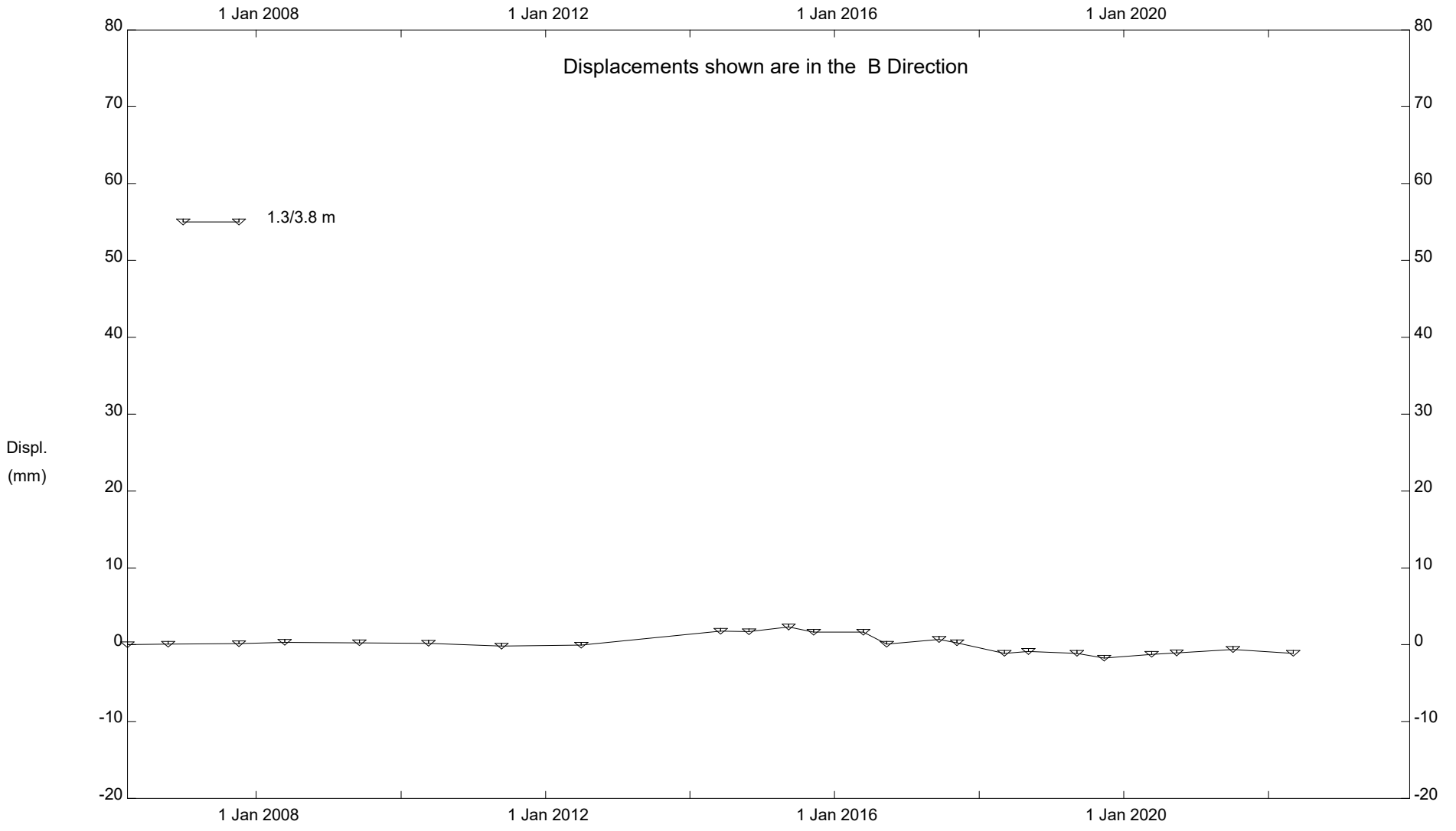
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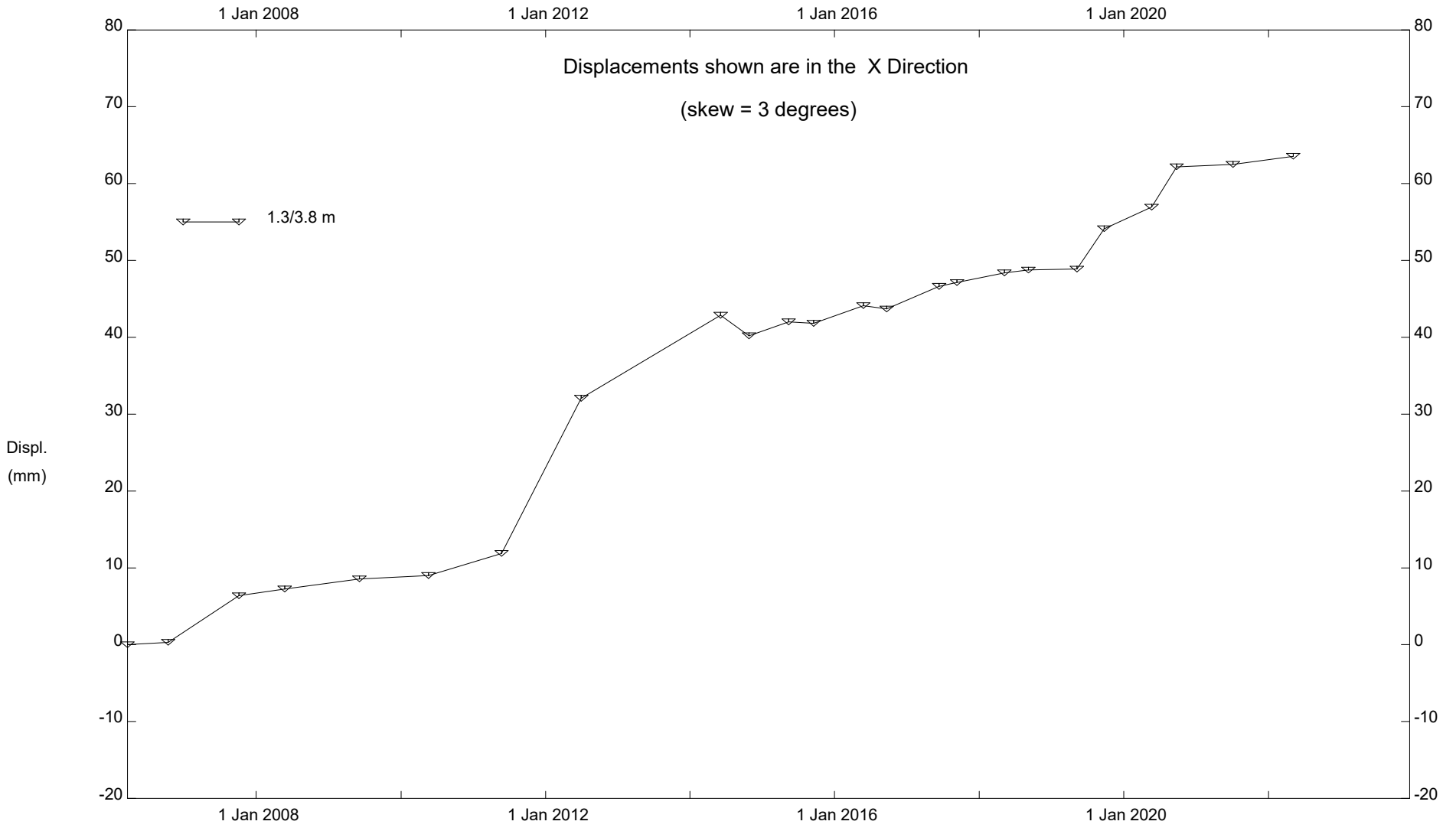
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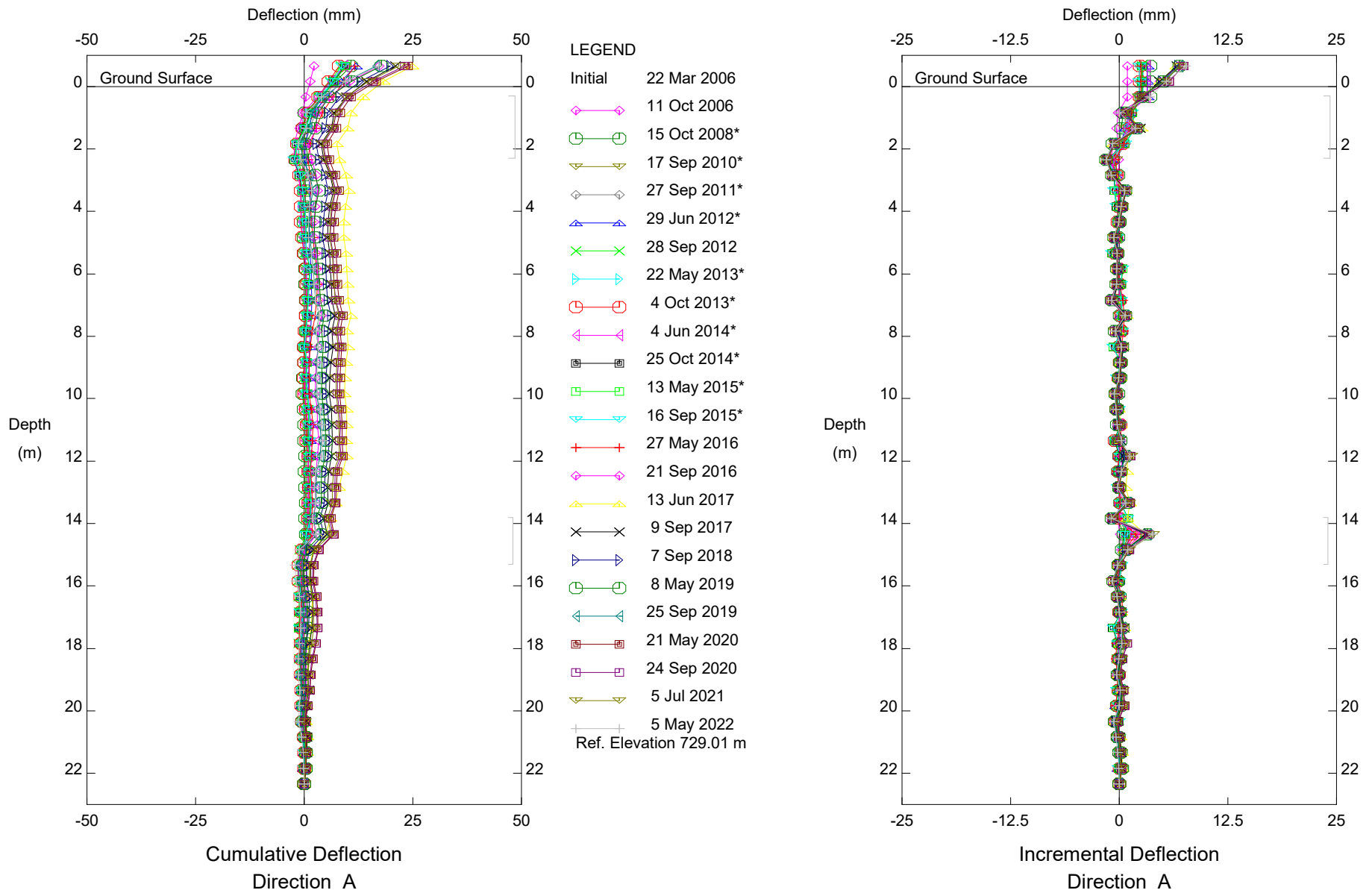
HWY 43:16 Whitecourt East Hill (NC001), Inclinometer SI06-1

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HWY 43:16 Whitecourt East Hill (NC001), Inclinator SI06-1

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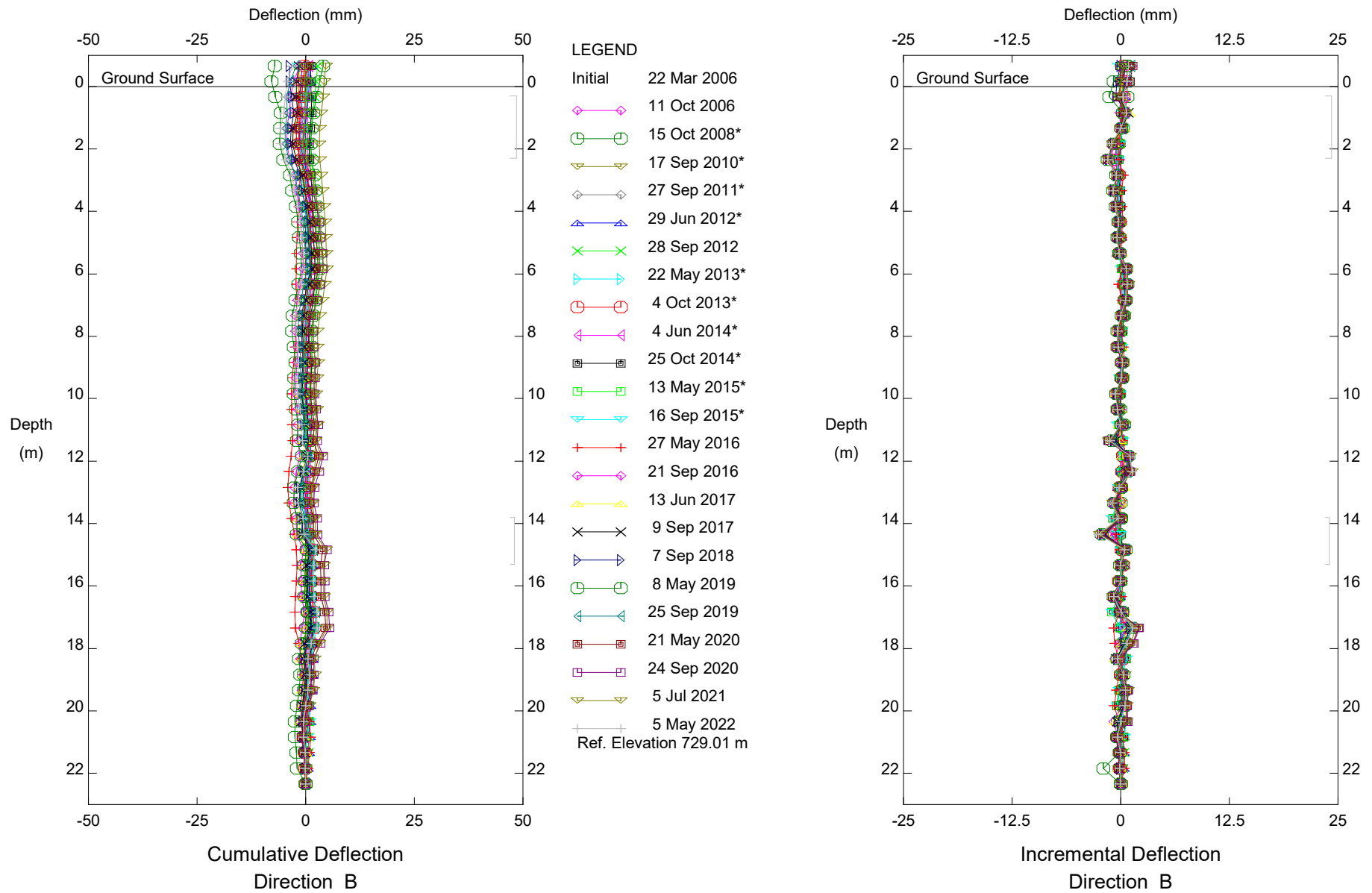


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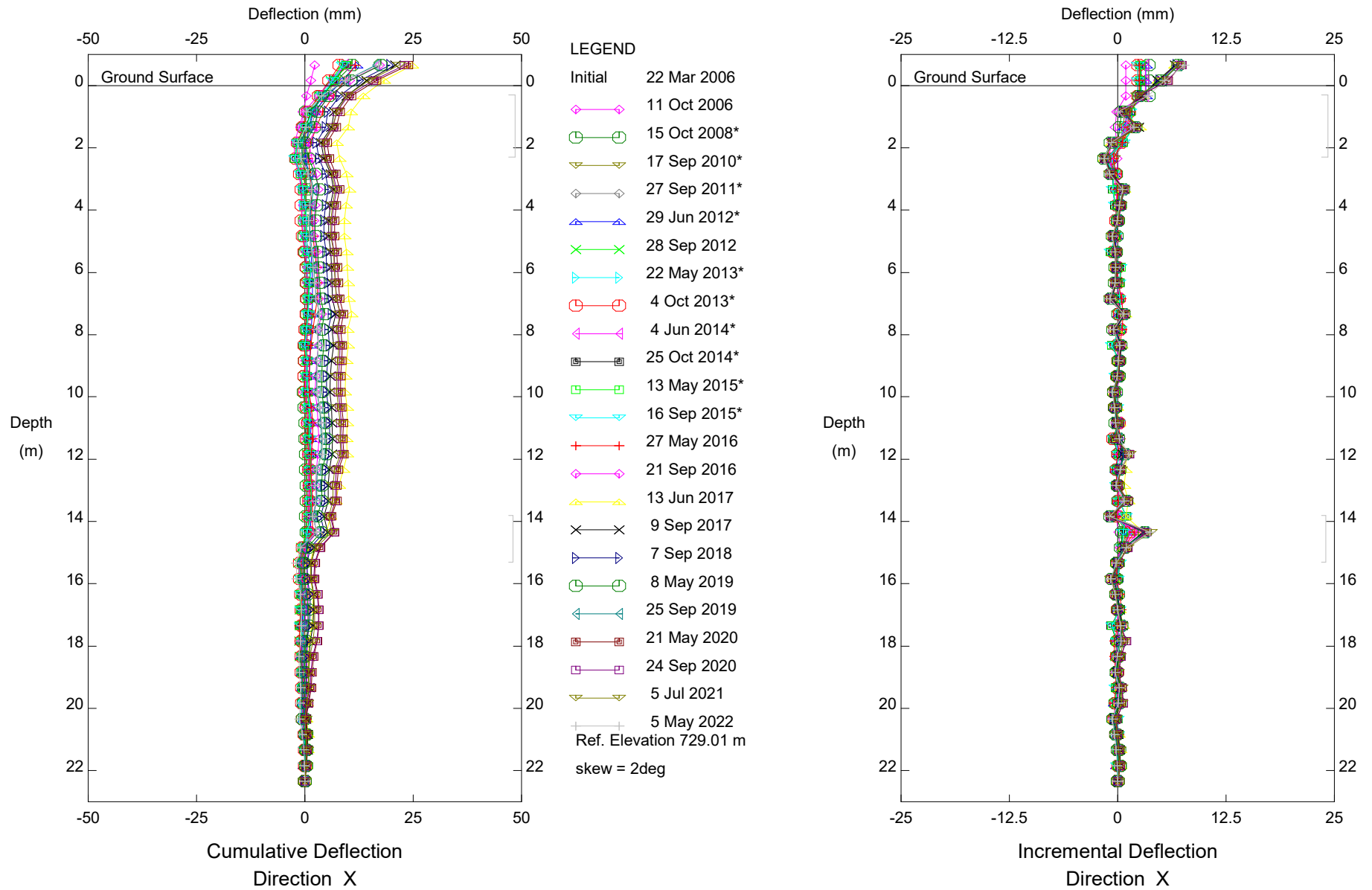


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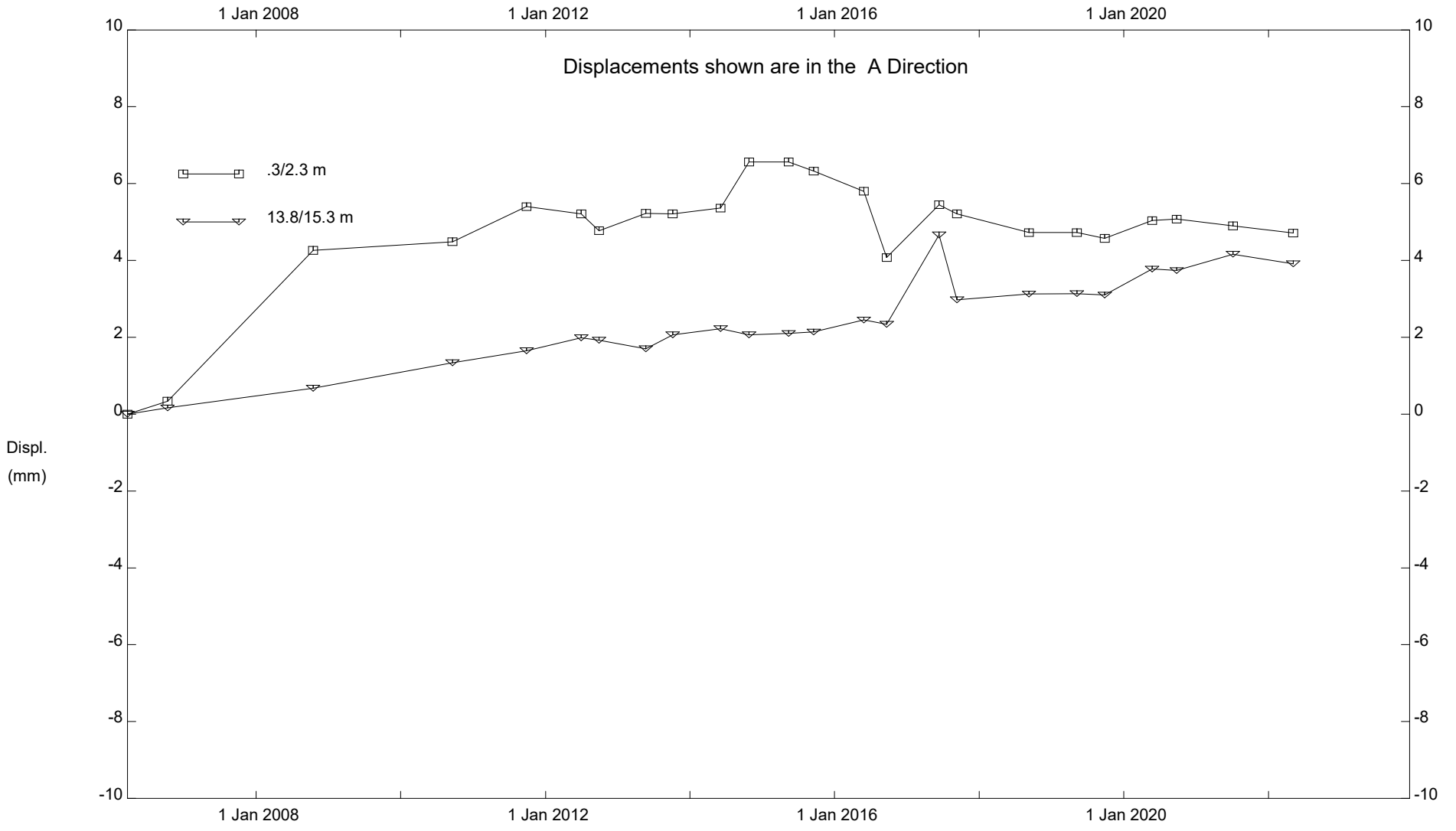
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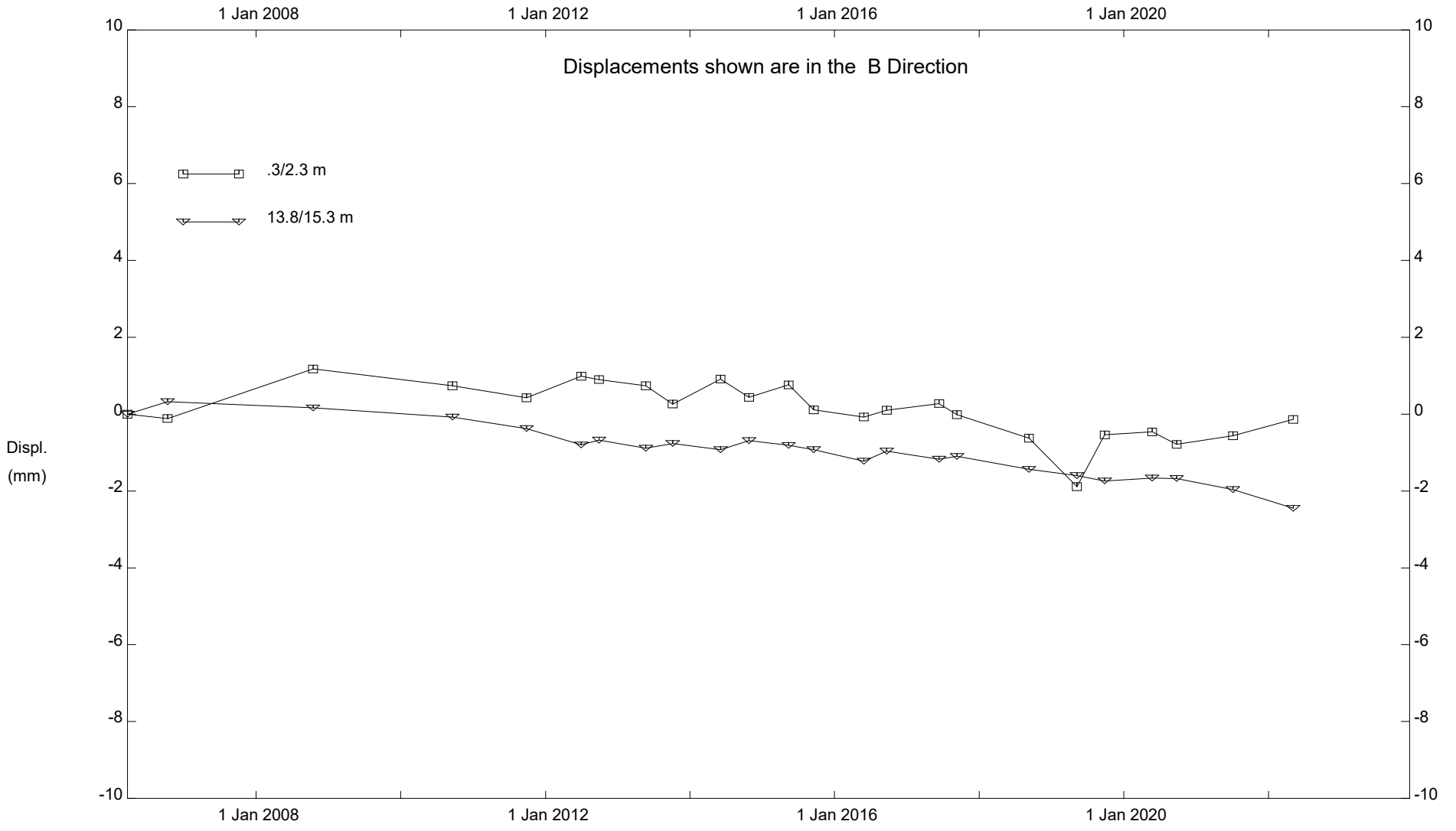
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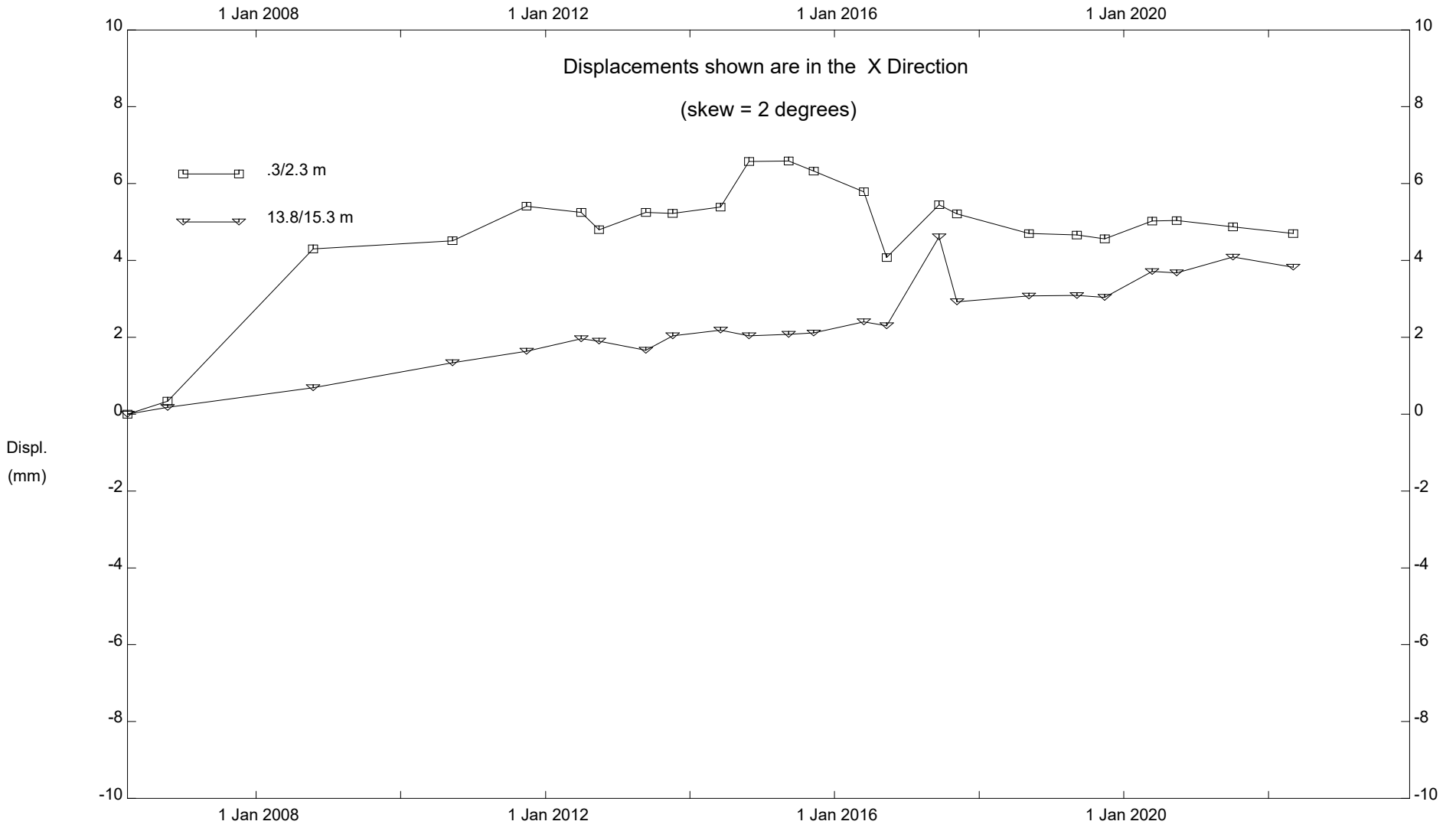
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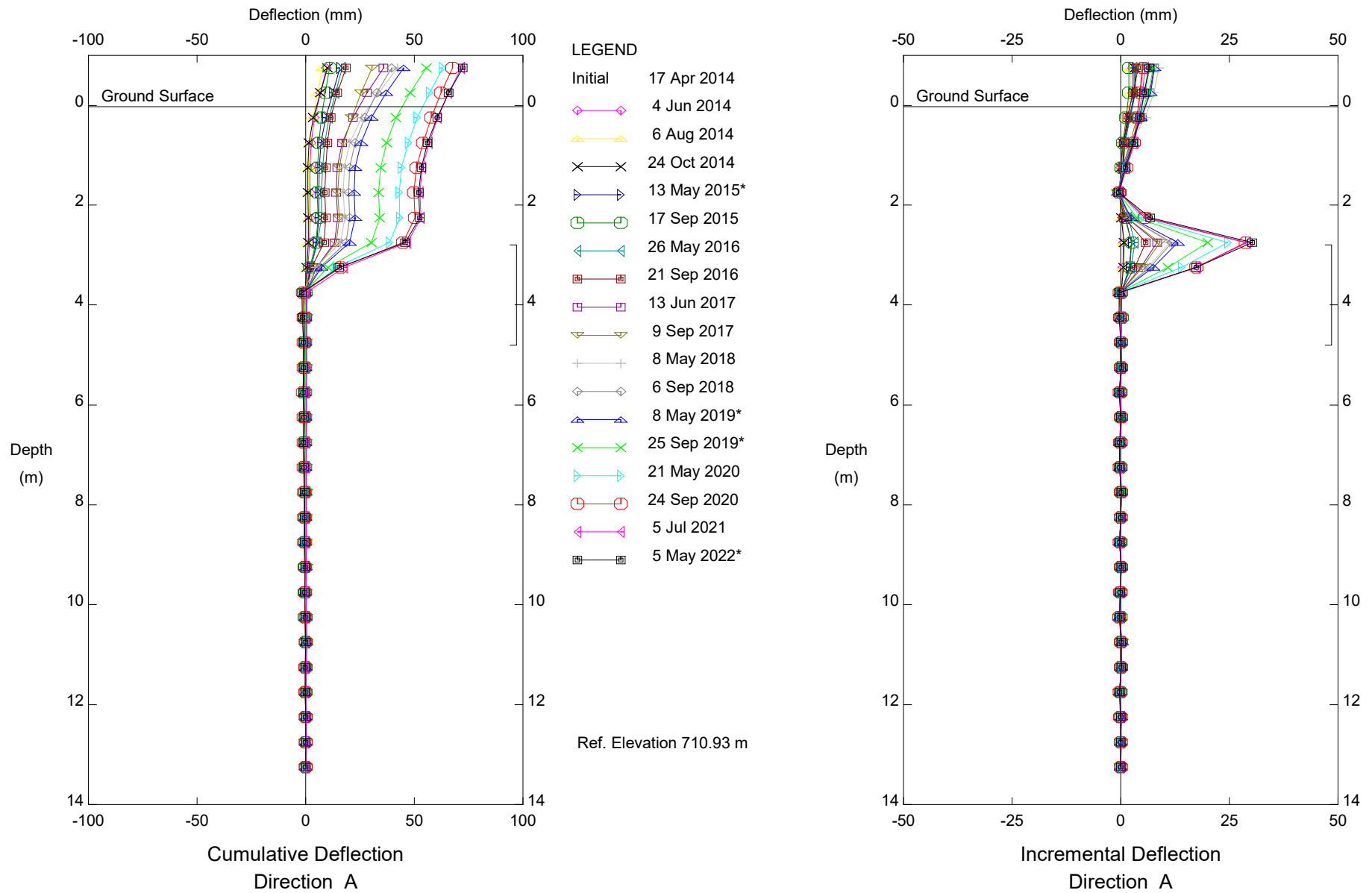
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HWY 43:16 Whitecourt East Hill (NC001), Inclinometer SI06-2

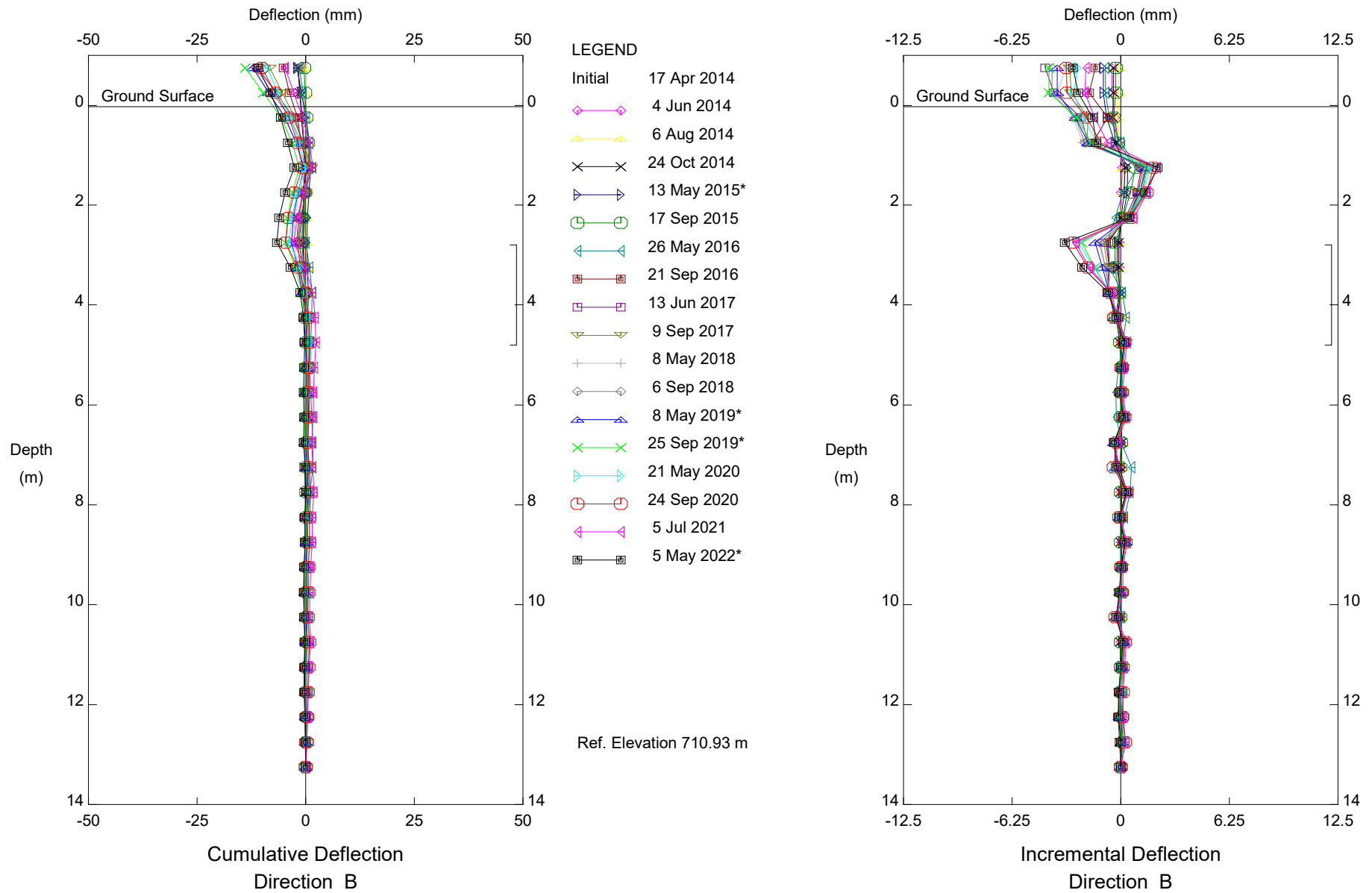
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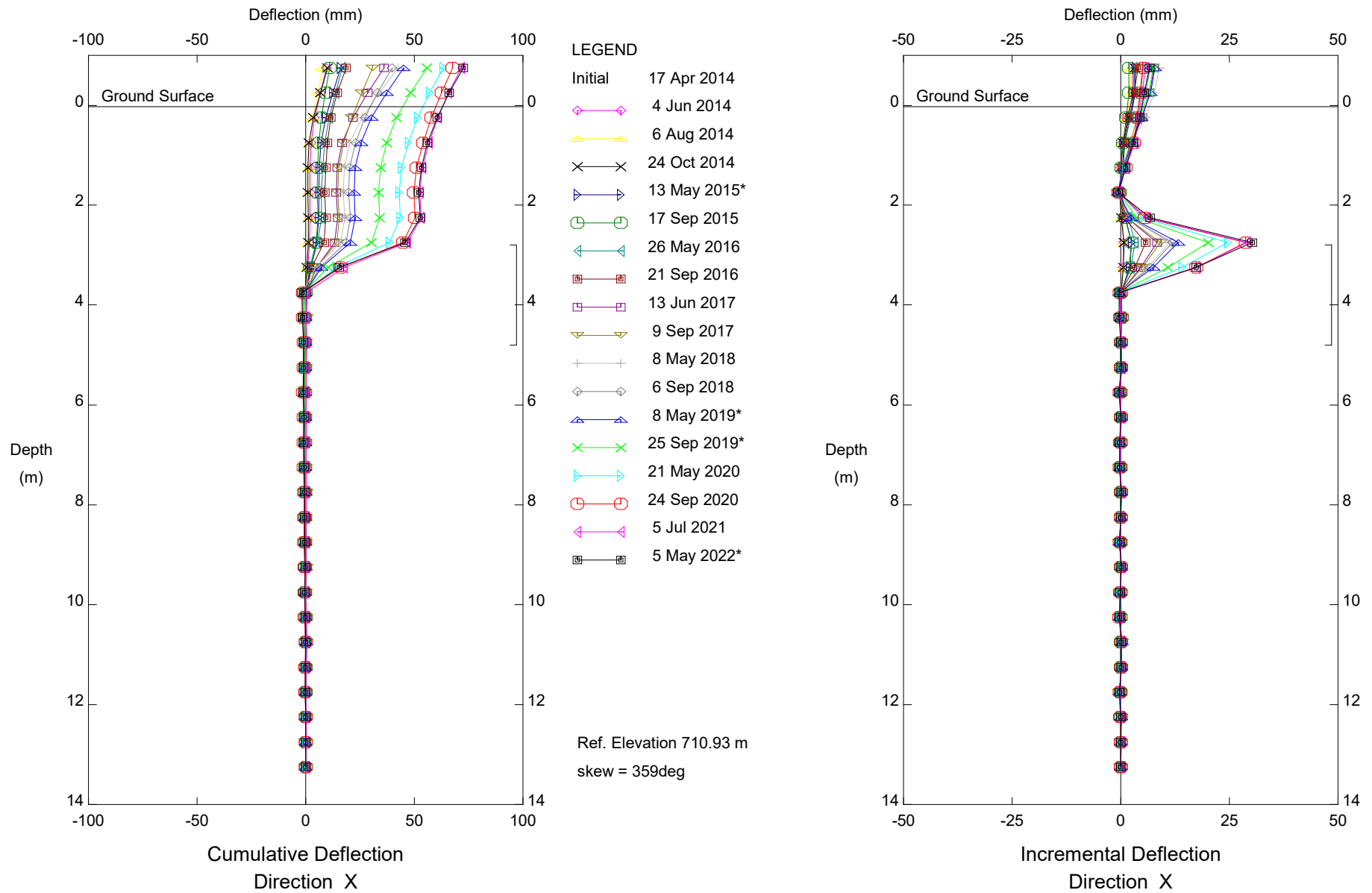
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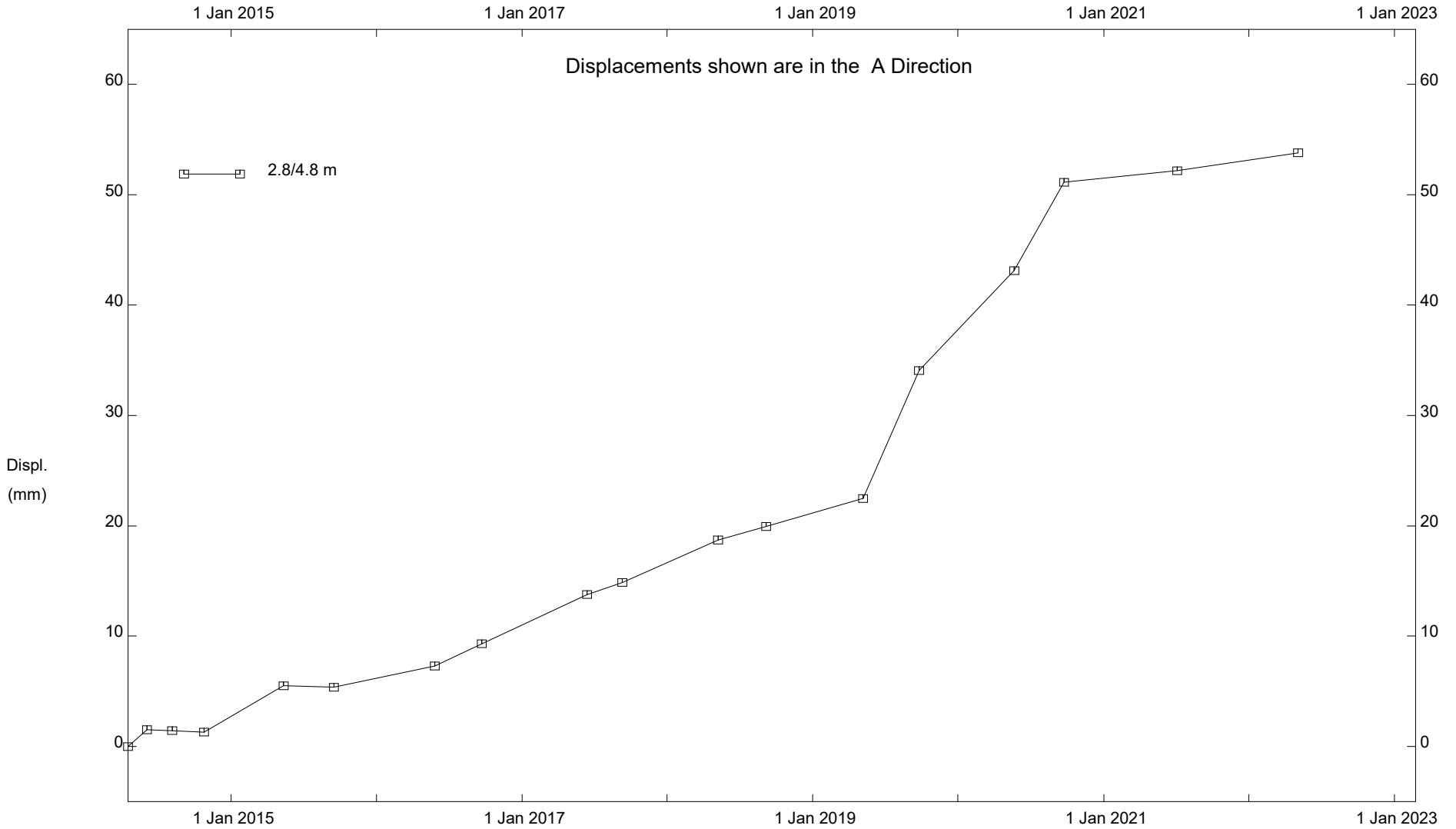


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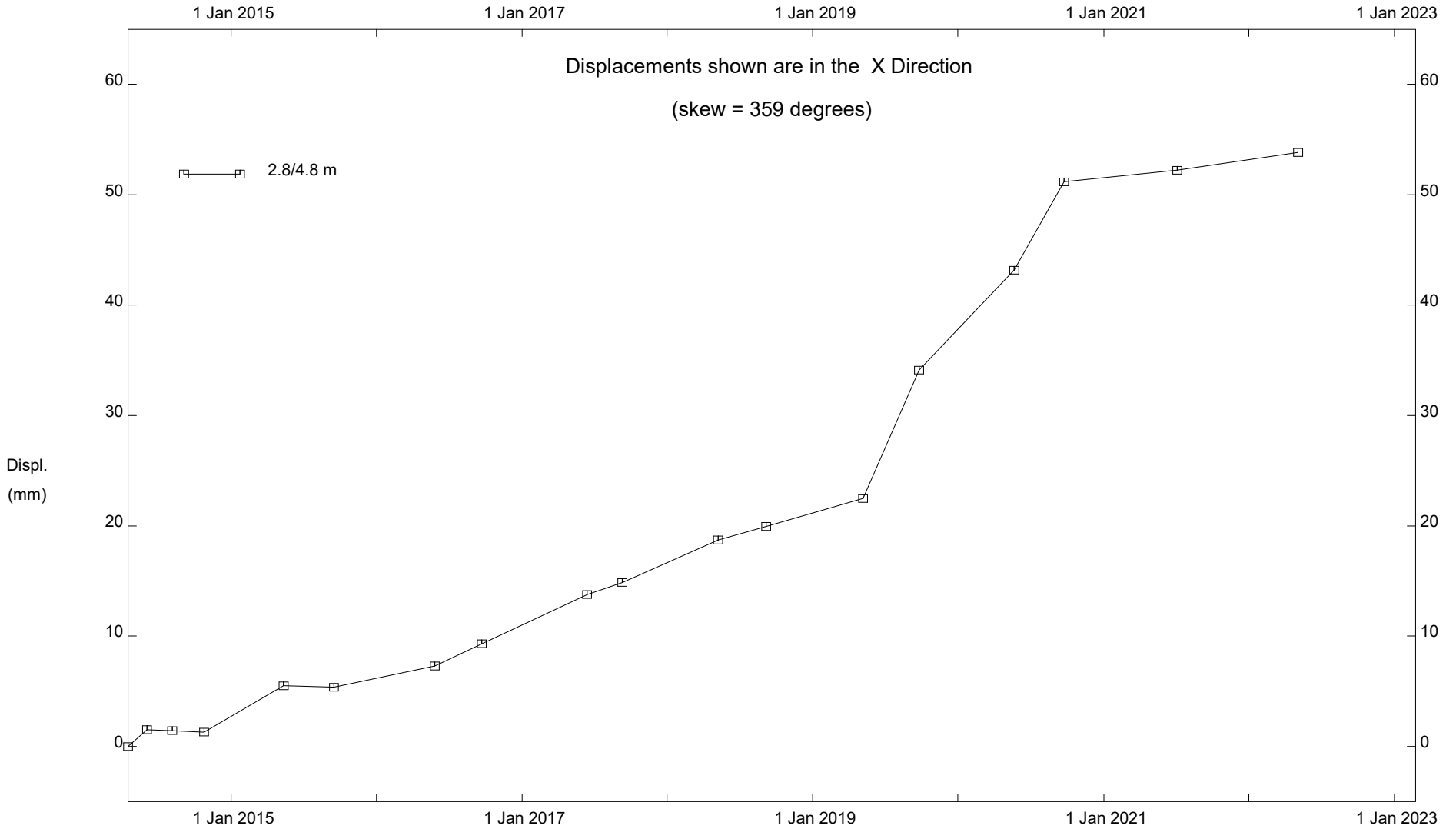
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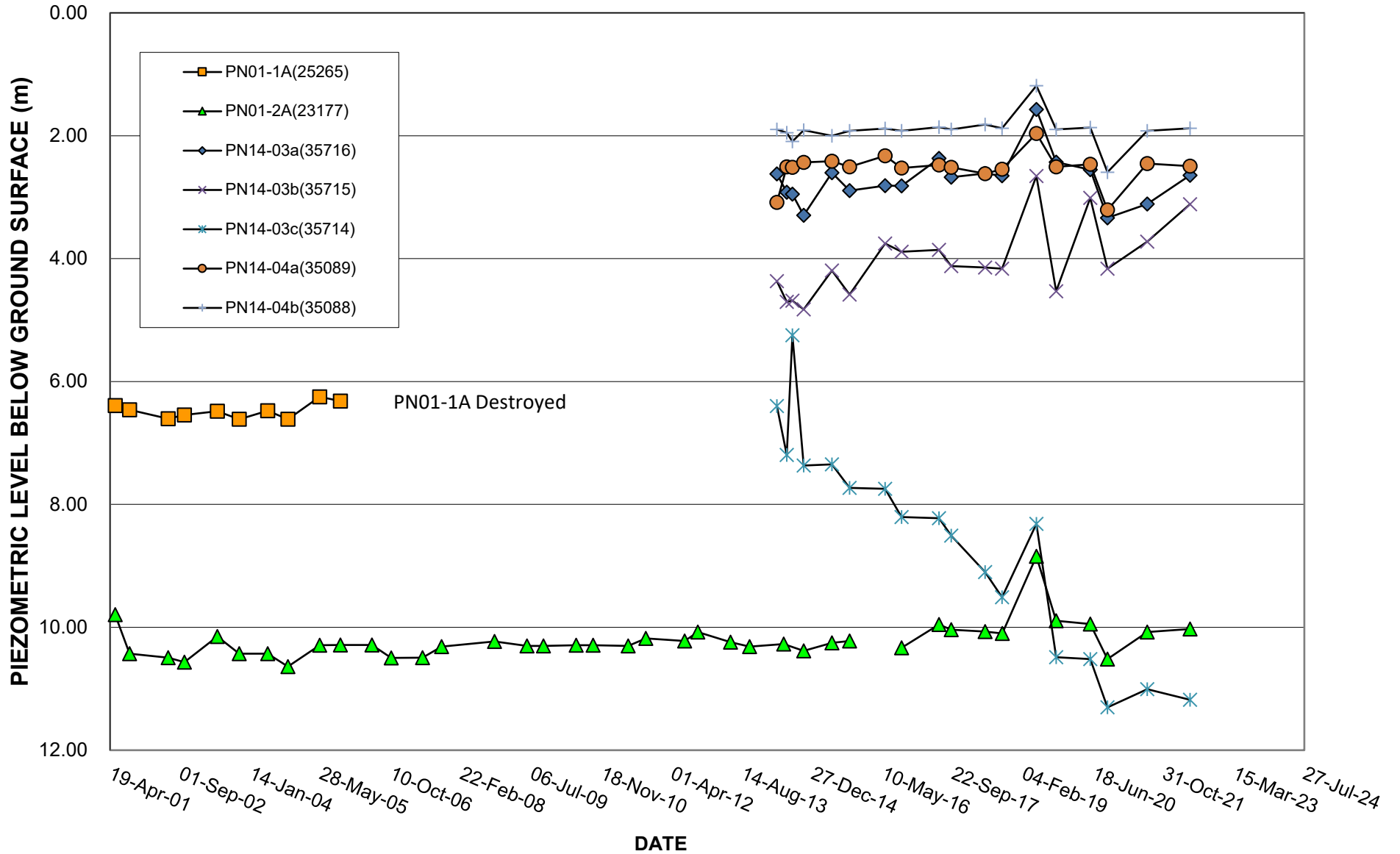
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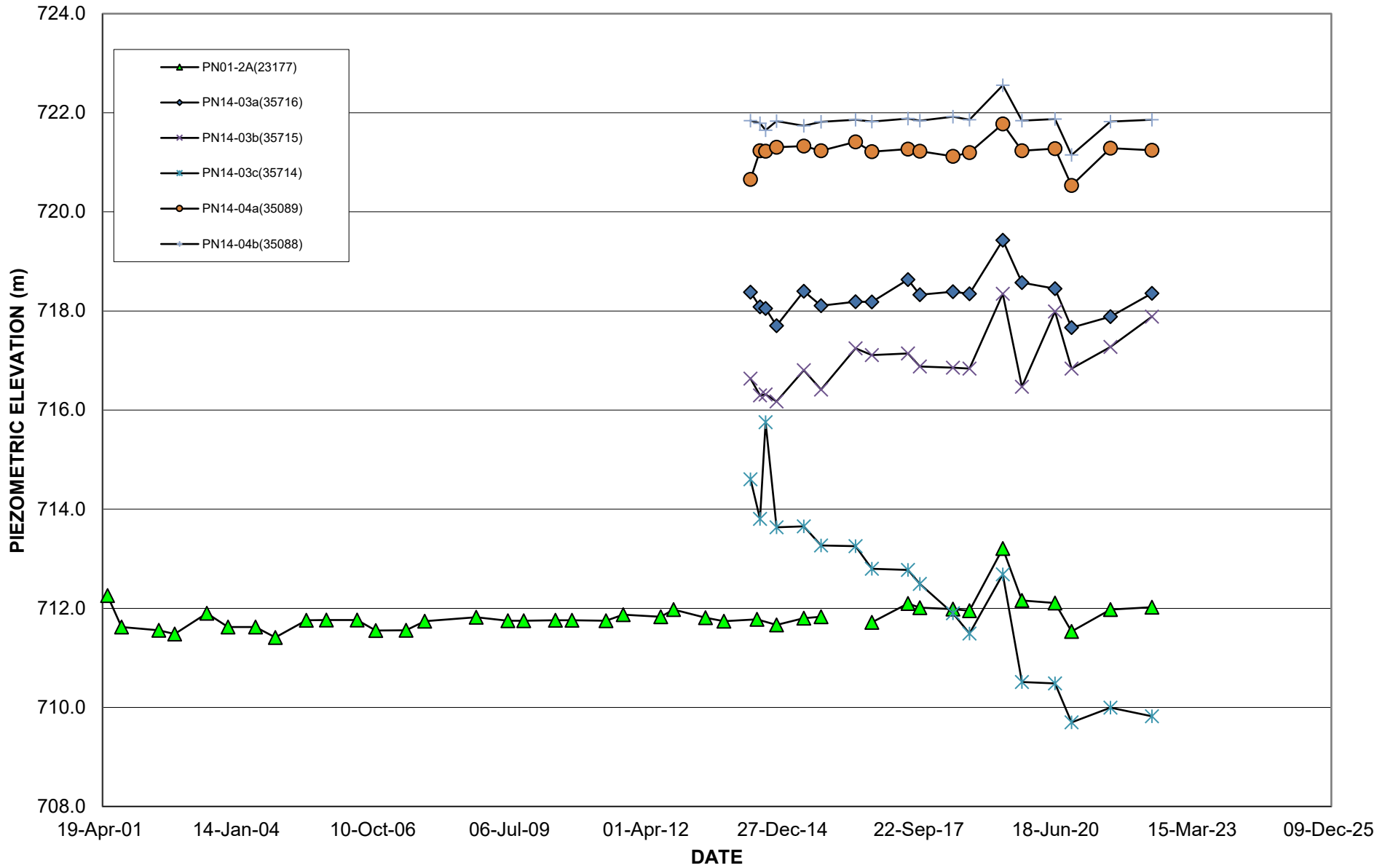


HWY 43:16 Whitecourt East Hill (NC001), Inclinometer SI14-02

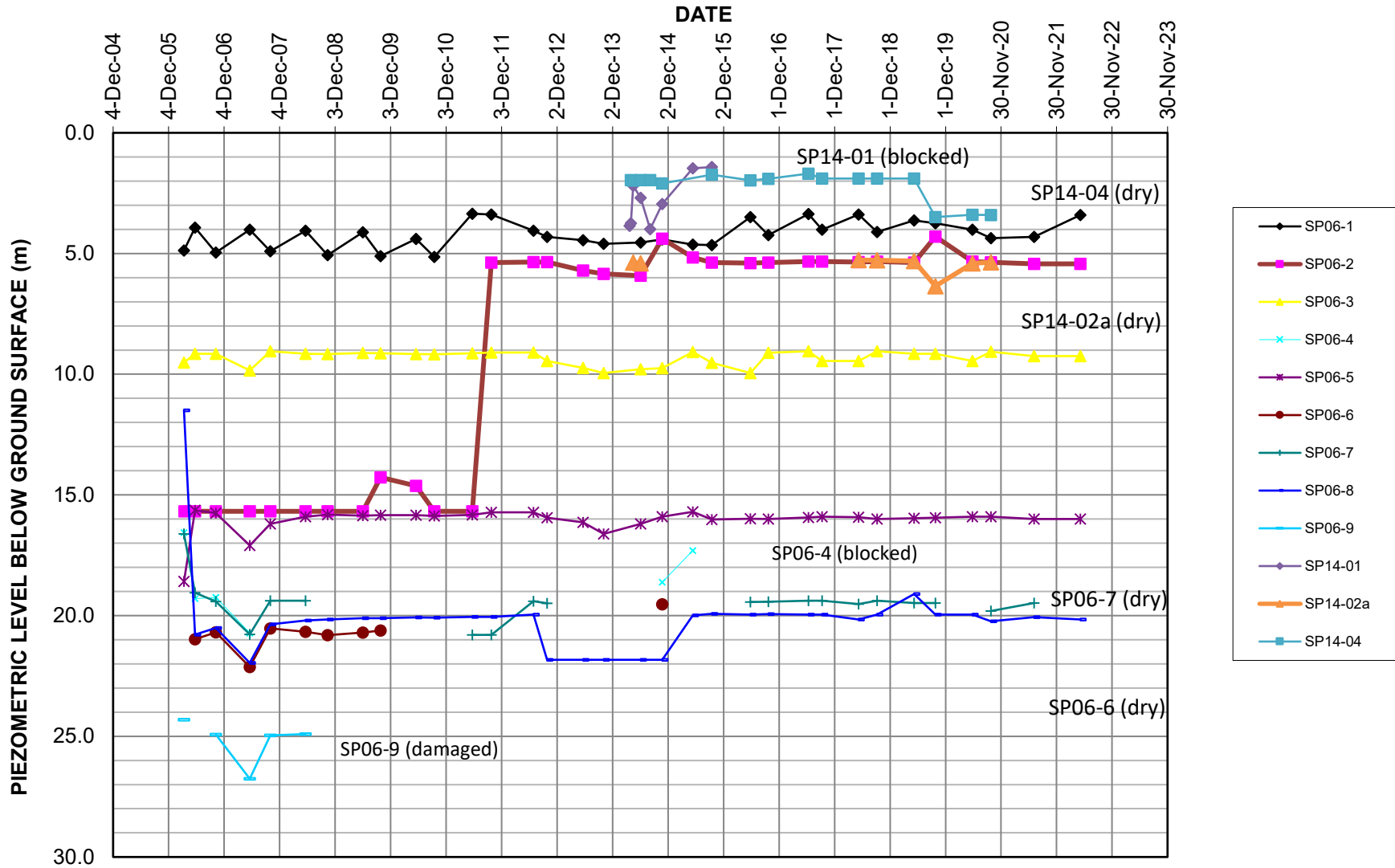
PNEUMATIC PIEZOMETER DATA



PNEUMATIC PIEZOMETER DATA



STANDPIPE PIEZOMETER DATA



STANDPIPE PIEZOMETER DATA

