

January 10, 2022

Alberta Transportation
Main Floor, Provincial Building
9621 96 Avenue
Peace River, Alberta
T8S 1T4

Ed Szmata
Construction Technologist

Dear Mr. Szmata:

CON0022166 Peace Region (Grande Prairie District – South) GRMP Instrumentation Monitoring Site GP001; H40:42; km 25.393 Slide 5 km South of Wapiti Road Bridge (Wapiti Hill)

Section C – 2021 Spring Readings

1 GENERAL

Two slope inclinometers (SIs) (SI-06 and SI-09) and three pneumatic piezometers (PNs) (PN-9A, PN-9B, and PN-11) were read at the GP001 site in the Peace Region (Grande Prairie District – South) (GP South) on June 27, 2021 by Mr. James Lyons, E.I.T. and Ms. Amy Miller, E.I.T. of Klohn Crippen Berger Ltd. (KCB). A large, active wasp nest was adjacent to SI-08 during the spring 2021 readings and therefore this instrument was not read. These instruments were read as part of the GP South geohazard-risk-management program (GRMP). The site is located on Hwy 40:42, km 25.393, approximately 5 km south of Wapiti River Bridge. The site coordinates are 6103635 N, 388701 E (UTM zone 11, NAD 83). A site plan is presented in Figure 1.

The geohazard at the GP001 site consists of a large landslide backscarp on the south valley slope of the Wapiti River.

1.1 Instrumentation

Instrumentation installation details are tabulated in Table 1.1. Locations of operable instruments are shown in Figure 1.

Three SIs (SI-06, SI-08, and SI-09) and seven PNs (PN-4, PN-9A, PN-9B, PN-11, PN-21, AND PN-23) were installed between 1991 and 2004 to monitor depth of movement and groundwater conditions, respectively. PN-4, PN-21, and PN-23 are all inoperable. SI-06, SI-08, and SI-09 were installed approximately 100 m, 75 m, and 50 m downslope of the highway shoulder, respectively. PN-9A and PN-9B were installed 50 m downslope of the highway shoulder and PN-11 was installed 25 m downslope of the highway shoulder, respectively. All instruments are protected with above-ground casing protectors.

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The SIs were read using an RST Digitilt MEMS Inclinometer System with a metric inclinometer probe with a 0.5 m wheelbase. Prior to the spring 2021 monitoring program, the readings were obtained using an imperial RST Digital Inclinometer probe with a 2 ft wheelbase and an RST Pocket PC readout.

The operational PNs were read using an RST C109 pneumatic piezometer readout.

Table 1.1 Instrumentation Installation Details

Instrument ID	Instrument Type	Date Installed	Coordinates ¹ (m)		Ground Surface Elevation (m)	Stick Up (m)	Depth Below Ground Surface (m)	Condition
			Northing	Easting				
SI-06	SI	Oct. 9, 1991	6103850	388643	619	0.8	21.5	Operational
SI-08	SI	Oct. 9, 1991	6103800	388665	618	0.7	21.5	Operational
SI-09	SI	Jun. 16, 1992	6103836	388590	620	0.8	23.5	Operational
PN-4	PN	Jun. 13, 1997	Unknown	Unknown	619	N/A	12.8	Inoperable
PN-9A	PN	Jun. 13, 1997	6103836	388590	619	N/A	9.0	Operational
PN-9B	PN	Jun. 13, 1997	6103836	388590	619	N/A	19.5	Operational
PN-11	PN	May 21, 1998	6103792	388597	624	N/A	15.2	Operational
PN-21	PN	Oct. 20, 2004	Unknown	Unknown	615	N/A	33.5	Inoperable
PN-23	PN	Oct. 20, 2004	Unknown	Unknown	617	N/A	38.1	Inoperable

Notes:

¹ Installation details were provided by AT and the previous consultant. Ground surface elevations were not provided for the SIs, so the ground surface elevation from adjacent instruments/piezometer tips if provided.

2 INTERPRETATION

2.1 General

For SI-06, the cumulative displacement, incremental displacement, and displacement-time data was plotted in the A-direction (i.e., the direction of the A0-grooves). For SI-08 and SI-09, the cumulative displacement, incremental displacement, and displacement-time data was plotted in the A-direction and the X-direction (i.e., the direction of maximum movement obtained at a skew angle from the A0-grooves). SI-08 and SI-09 have skew angles of 175° and 150°, respectively, measured clockwise from the direction of the A0-grooves.

For the operational PNs, the equivalent water level data was plotted relative to ground surface elevation and each instrument’s tip elevation.

The SI and piezometer plots are included in Appendix I, and a summary of the SI and piezometer data is provided in Table 2.1 and Table 2.2, respectively.

Table 2.1 Slope Inclinometer Reading Summary

Instrument ID	Date Initialized	Date of Previous Reading	Date Previous Maximum Cumulative Movement Recorded	Date of Most Recent Reading	Ground Surface Elevation (m)	Depth of Movement (mbgs ¹)	Maximum Cumulative Movement Recorded (mm)	Incremental Movement Recorded Since Previous Maximum Cumulative Movement Recorded (mm)	Rate of Movement (mm/year)		
									Previous Maximum	Current	Change from Previous Reading
SI-06	Oct. 9, 1991	Oct. 8, 2020	Oct. 1, 2009	Jun. 27, 2021	618.6	0.0 – 19.0	44.4	-6.5	43.7	10.5	-3.6
SI-08	Oct. 9, 1991	Oct. 8, 2020	N/A – no discernible movement has been recorded								
SI-09 ²	Jun. 16, 1992	Oct. 8, 2020	Oct. 8, 2020	Jun. 27, 2021	619.8	5.5	23.2	-0.6	8.6	-0.8	-2.6

Notes:

¹ Meters below ground surface (mbgs).

² There was a small data shift between the fall 2020 and spring 2021 readings when the SI probe was changed.

Table 2.2 Pneumatic Piezometer Reading Summary

Instrument ID	Date Installed	Date of Previous reading	Date of Most Recent Reading	Ground Surface Elevation (m)	Tip Depth (mbgs ¹)	Previous Water Level (mbgs ¹)	Current Water Level (mbgs ¹)	Change from Previous Reading (m)
PN-9A	Jun. 13, 1997	Oct. 8, 2020	Jun. 27, 2021	619.0	9.0	6.3	5.8	0.5
PN-9B	Jun. 13, 1997	Oct. 8, 2020	Jun. 27, 2021	619.0	19.5	10.4	10.9	-0.5
PN-11	May. 21, 1998	Oct. 8, 2020	Jun. 27, 2021	624.0	15.2	9.3	9.5	-0.2

Notes:

¹ Meters below ground surface (mbgs).

KCB reviewed the instrumentation data provided by the previous consultant and removed corrections applied to the historical SI data based on our experience. The instrumentation data obtained by KCB is generally consistent with the data obtained by the previous consultant.

The SI data plots presented herein include data for readings taken with both the previous consultants' and KCB's equipment.

2.2 Zones of Movement

For SI-08, there appears to be a slight “kick-out” near the base of the instrument, which could indicate the instrument were not installed in competent material or that the base of the SI is above a zone of movement. Generally, SI-08 has recorded noisy data since installation.

For SI-06, there has been distributed movement from approximately El. 600.0 m to El. 618.5 m (i.e., near the base of the instrument to ground surface). There has been approximately 40 mm of distributed movement recorded since the instrument was installed.

For SI-09, there is a zone of distributed movement from approximately El. 614.0 m to El. 619.0 m (i.e., 5.7 mbgs to ground surface). There has been approximately 15.4 mm of distributed movement in this zone since the instrument was installed.

2.3 Interpretation of Monitoring Results

PN-9B and PN-11 recorded decreases of 0.5 m and 0.2 m since October 2020, respectively. The decreases may be attributed to a drier-than-normal spring and early-summer.

The 0.5 m increase recorded by PN-9A does not appear to have resulted in an increased rate of movement in SI-09.

3 RECOMMENDATIONS

3.1 Future Work

All operational instruments should continue to be read once per year (spring).

In the spring of 2022, KCB will confirm the instrument coordinates and ground surface elevations with a handheld GPS (accuracy of ± 5 m), and where applicable, sticks up and reading depths with a tape measure, and azimuths of the SI A0-grooves with a compass.

The site should continue to be inspected by the Maintenance Contract Inspector (MCI) and as part of the GP South GRMP Section B inspections.

3.2 Instrument Repairs

No instrument repairs are required. However, prior to the spring 2022 GP South instrumentation tour the wasp nest adjacent to SI-08 should be removed.

4 CLOSING

This report is an instrument of service of Klohn Crippen Berger Ltd. (KCB). The report has been prepared for the exclusive use of Alberta Transportation (Client) for the specific application to the Peace Region Geohazard Risk Management Program (Contract No. CON0022166) and it may not be relied upon by any other party without KCB's written consent.

KCB has prepared this report in a manner consistent with the level of care, skill, and diligence ordinarily provided by members of the same profession for projects of a similar nature at the time and place the services were rendered. KCB makes no warranty, express or implied.

Use of or reliance upon this instrument of service by the Client is subject to the following conditions:

1. The report is to be read in full, with sections or parts of the report relied upon in the context of the whole report.
2. The observations, findings, and conclusions in this report are based on observed factual data and conditions that existed at the time of the work and should not be relied upon to precisely represent conditions at any other time.
3. KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.

Please contact the undersigned if you have any questions or comments regarding this report.

Yours truly,

KLOHN CRIPPEN BERGER LTD.



James Lyons, E.I.T.
Civil Engineer

Chris Gräpel, M.Eng., P.Eng.
Senior Civil Engineer, Associate

JL:bb

ATTACHMENTS

Figure
Appendix I Instrumentation Plots

FIGURE

Time: 14:04:46 PM
 Date: September 21, 2021
 File: Z:\AEDM\A05116A01\ABT - Grande Prairie South GRMP\400 Drawings\GIS\MXD\2021\Section C\GP001_210921.mxd



Legend

- ◆ Pneumatic Piezometer (PN)
- Slope Inclinometer (SI)



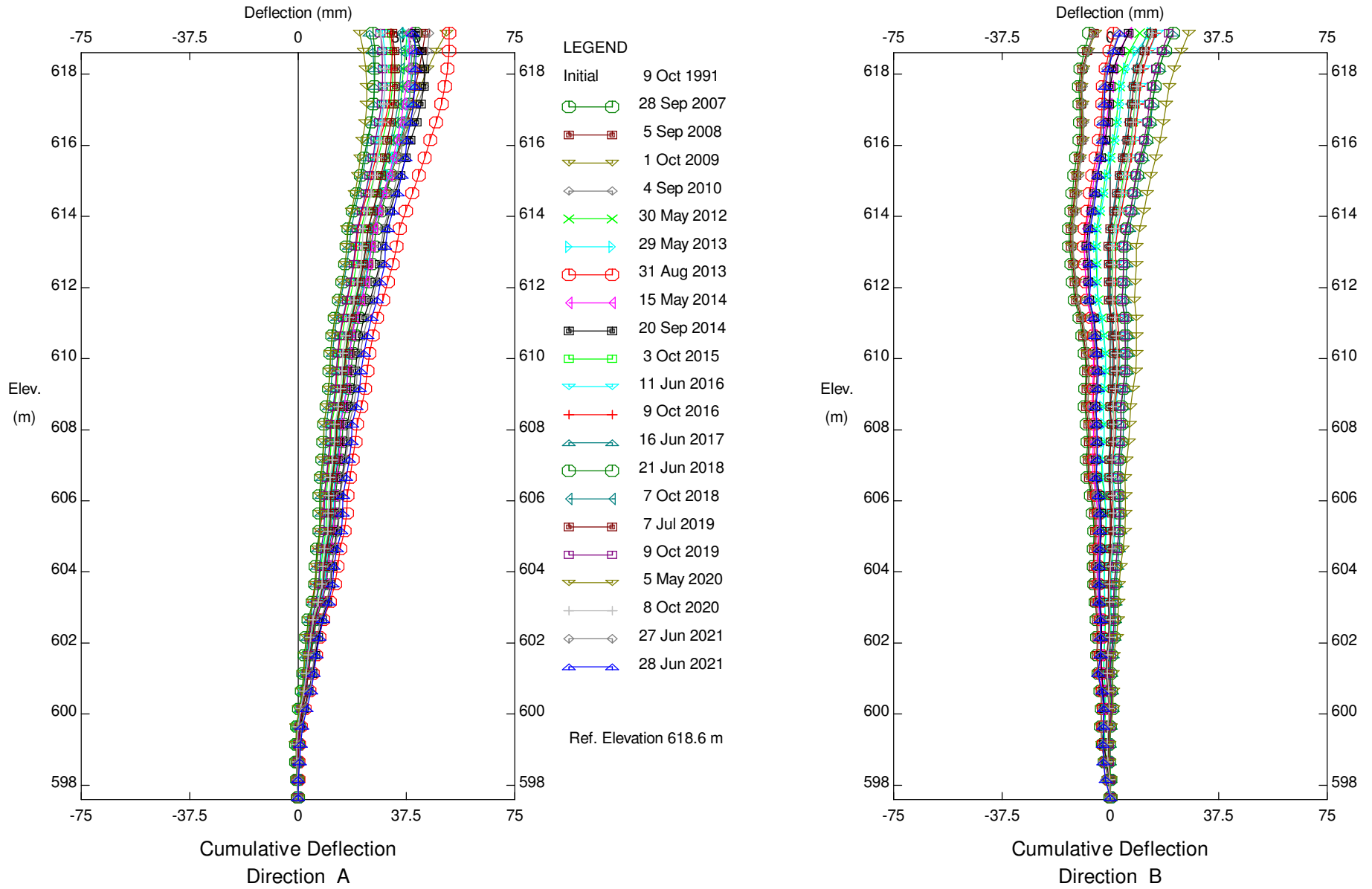
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		TITLE Site Plan GP001 - Wapiti Hill Hwy 40:42, km 25.393
SCALE 1:1,250	PROJECT No. A05116A01	FIG No. 1

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APPENDIX I

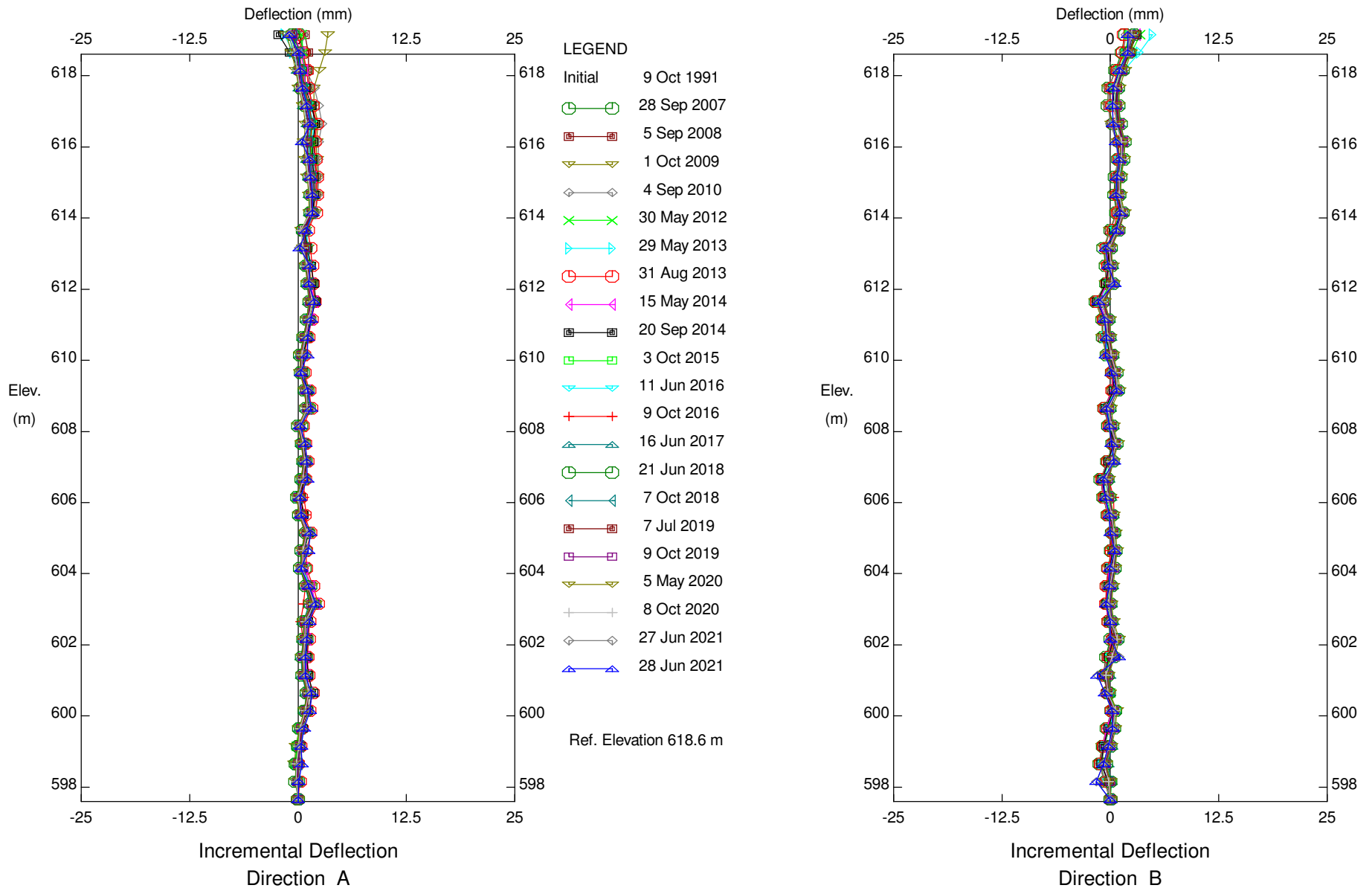
Instrumentation Plots

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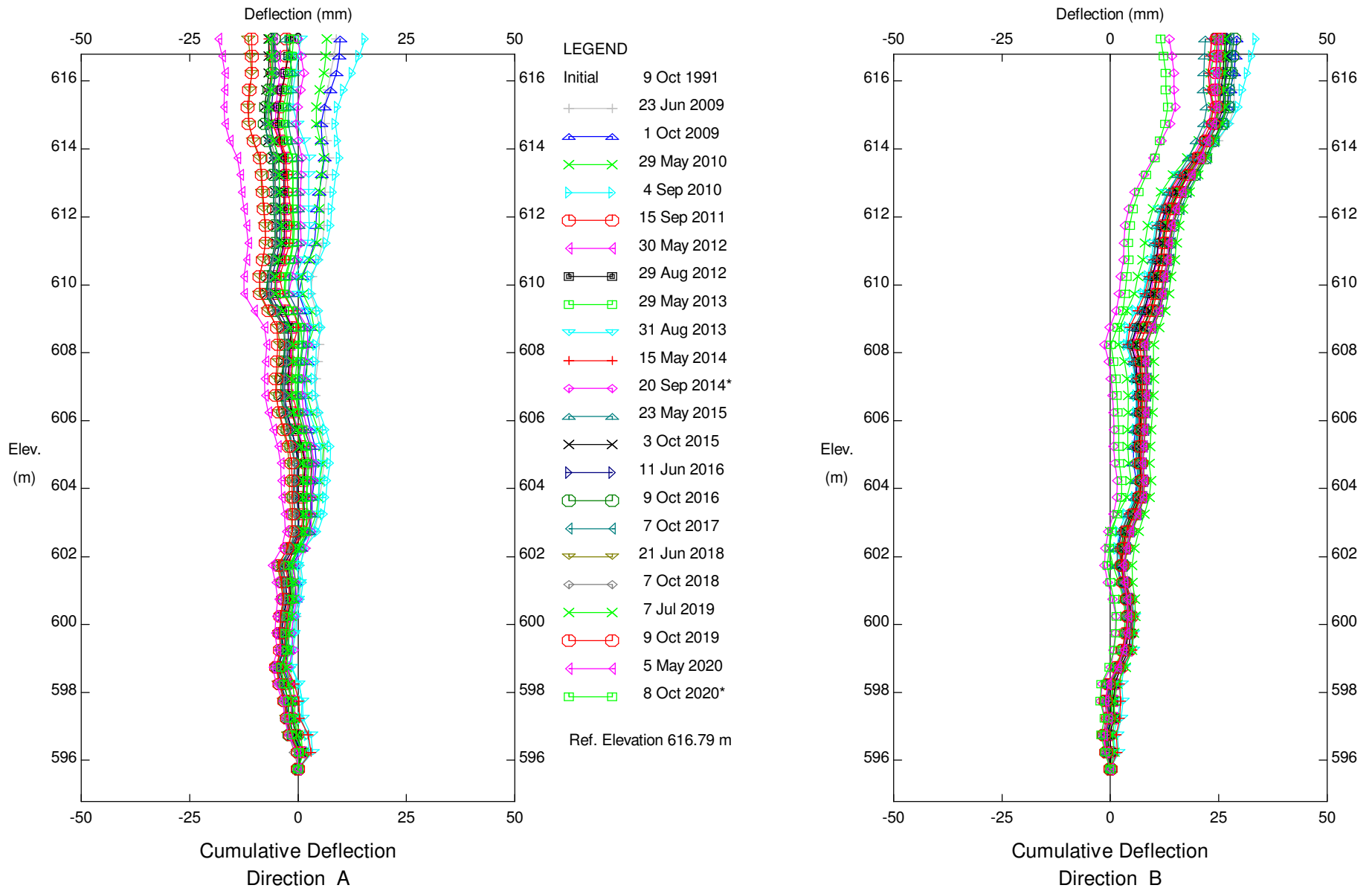
GP001; H40:42, Wapiti Hill, Inclinometer SI-06
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GP001; H40:42, Wapiti Hill, Inclinator SI-06
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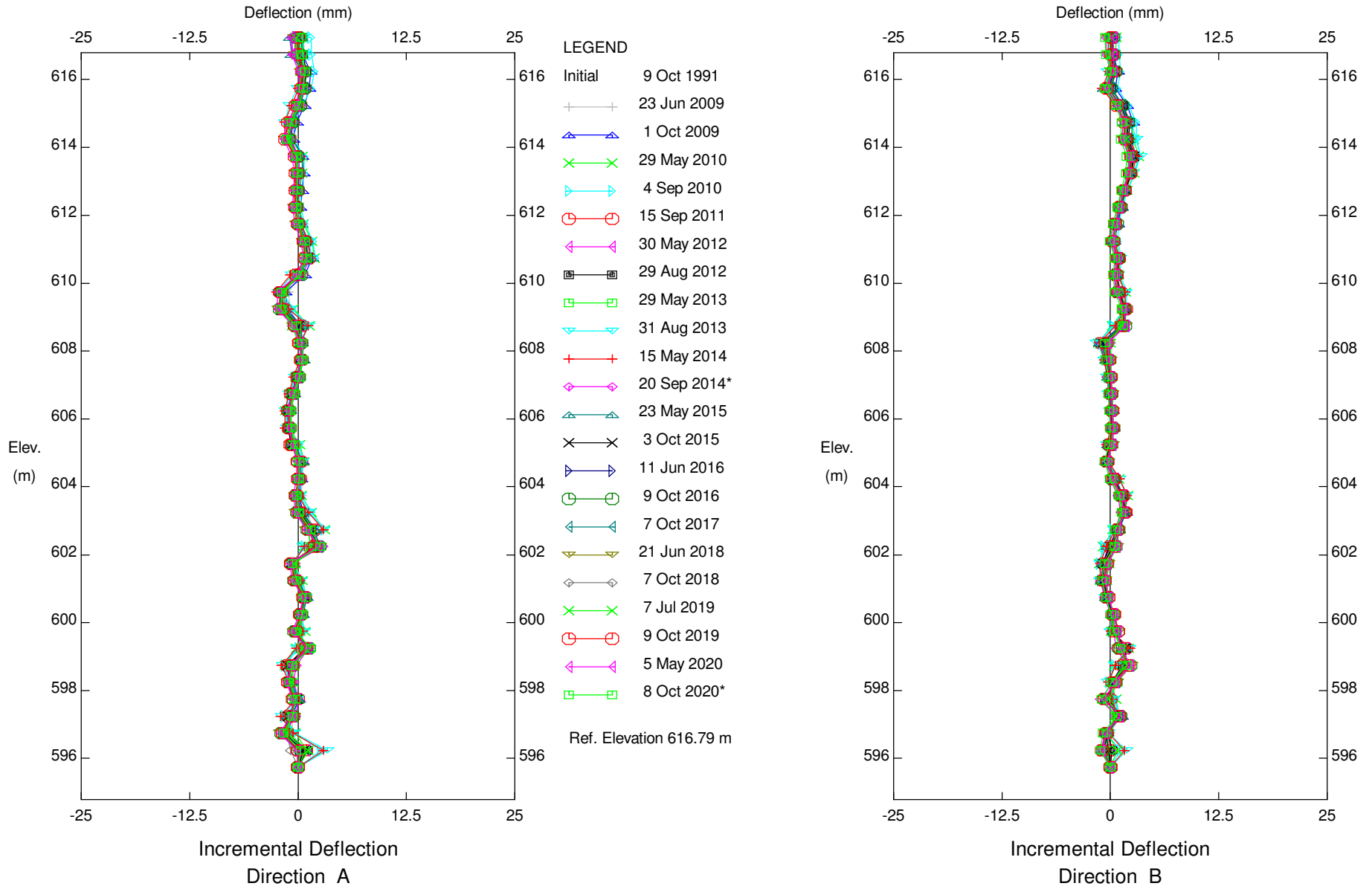
Klohn Crippen Berger - Calgary



GP001; H40:42, Wapiti Hill, Inclinometer SI-08
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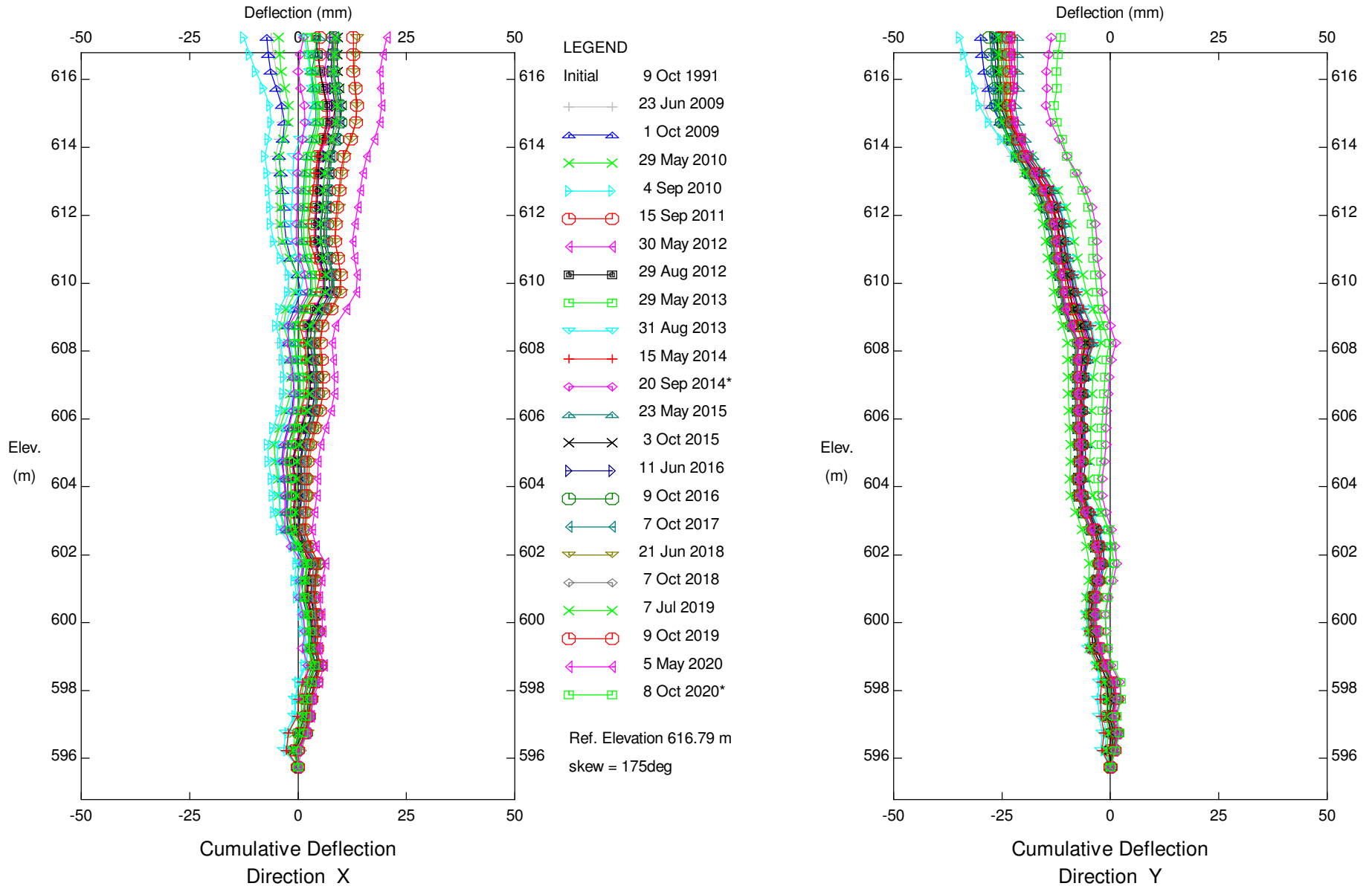
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GP001; H40:42, Wapiti Hill, Inclinator SI-08
Alberta Transportation

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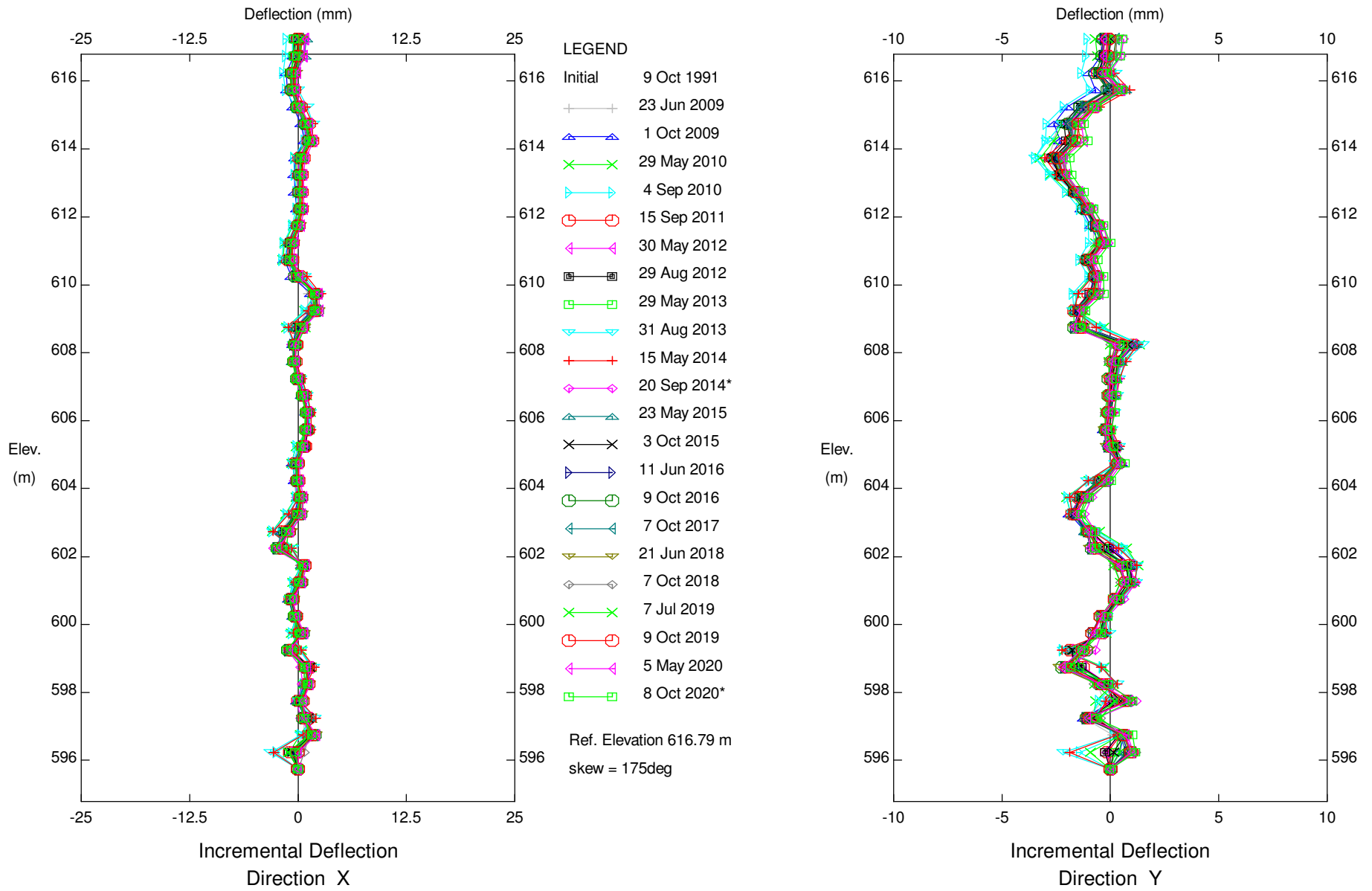
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GP001; H40:42, Wapiti Hill, Inclinometer SI-08
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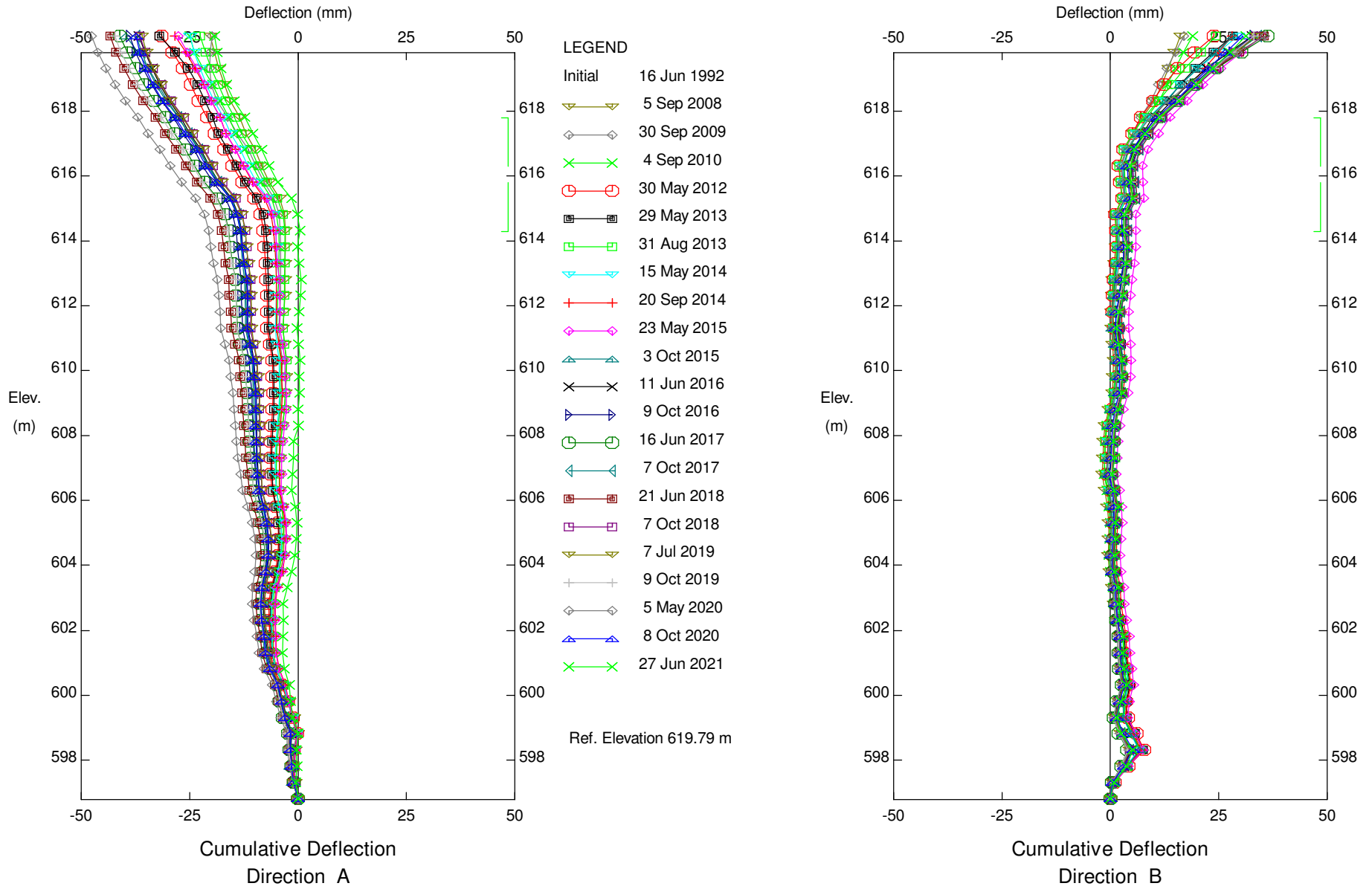
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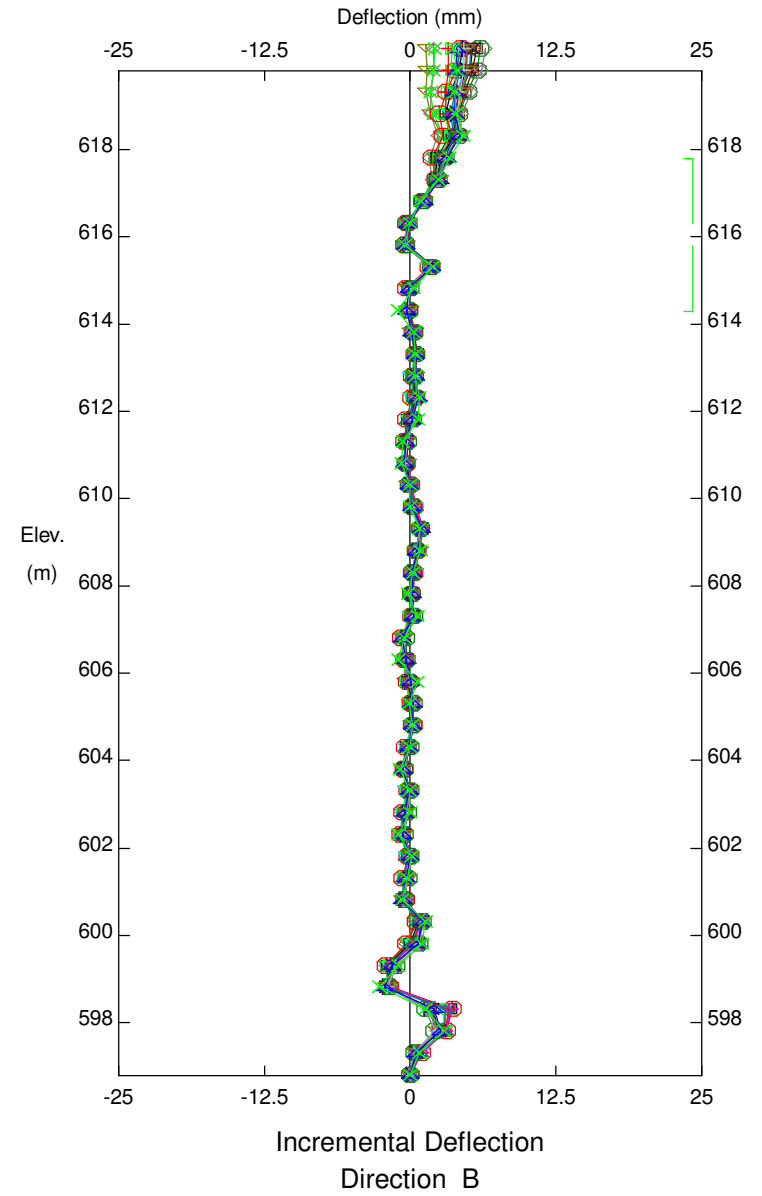
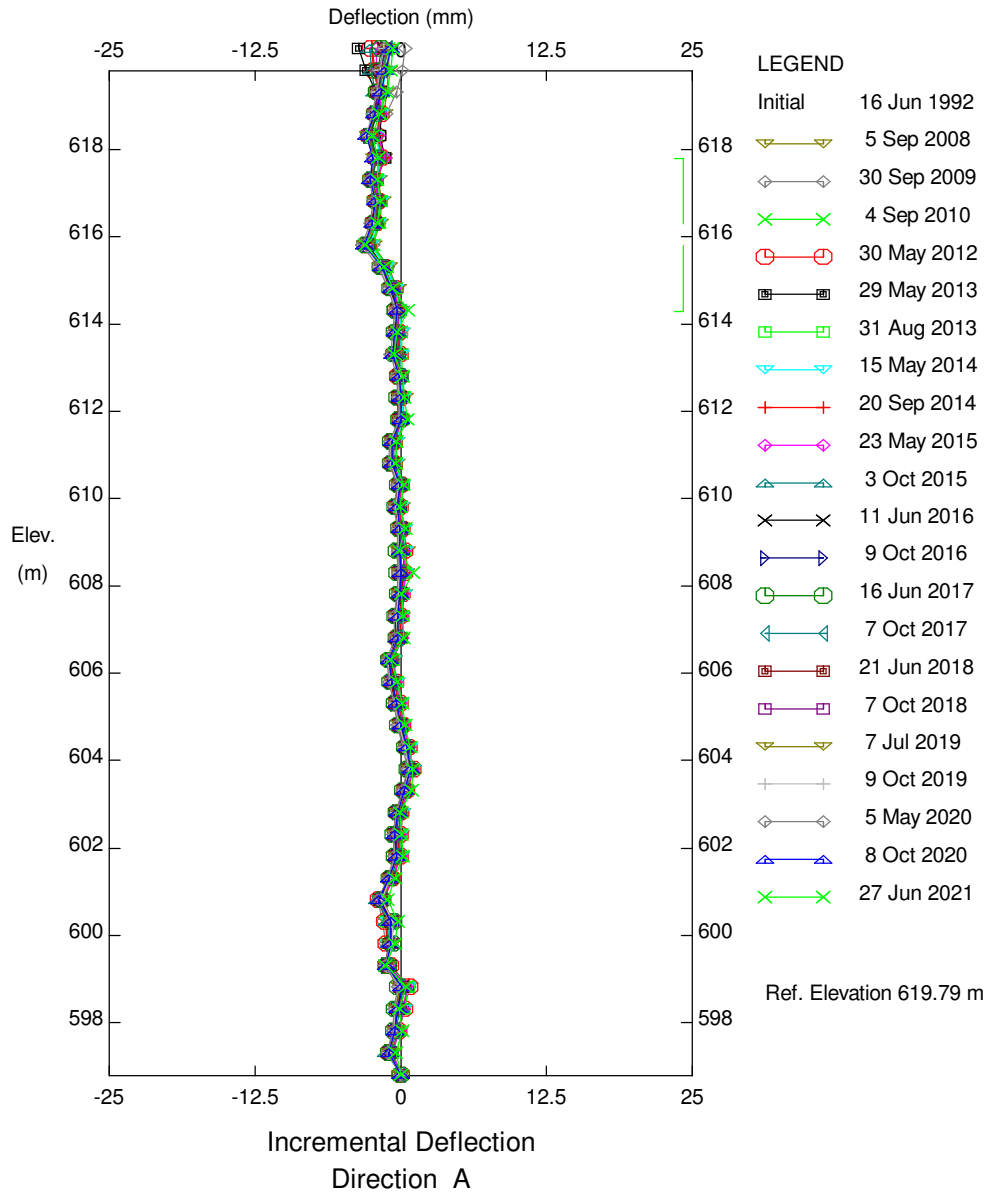
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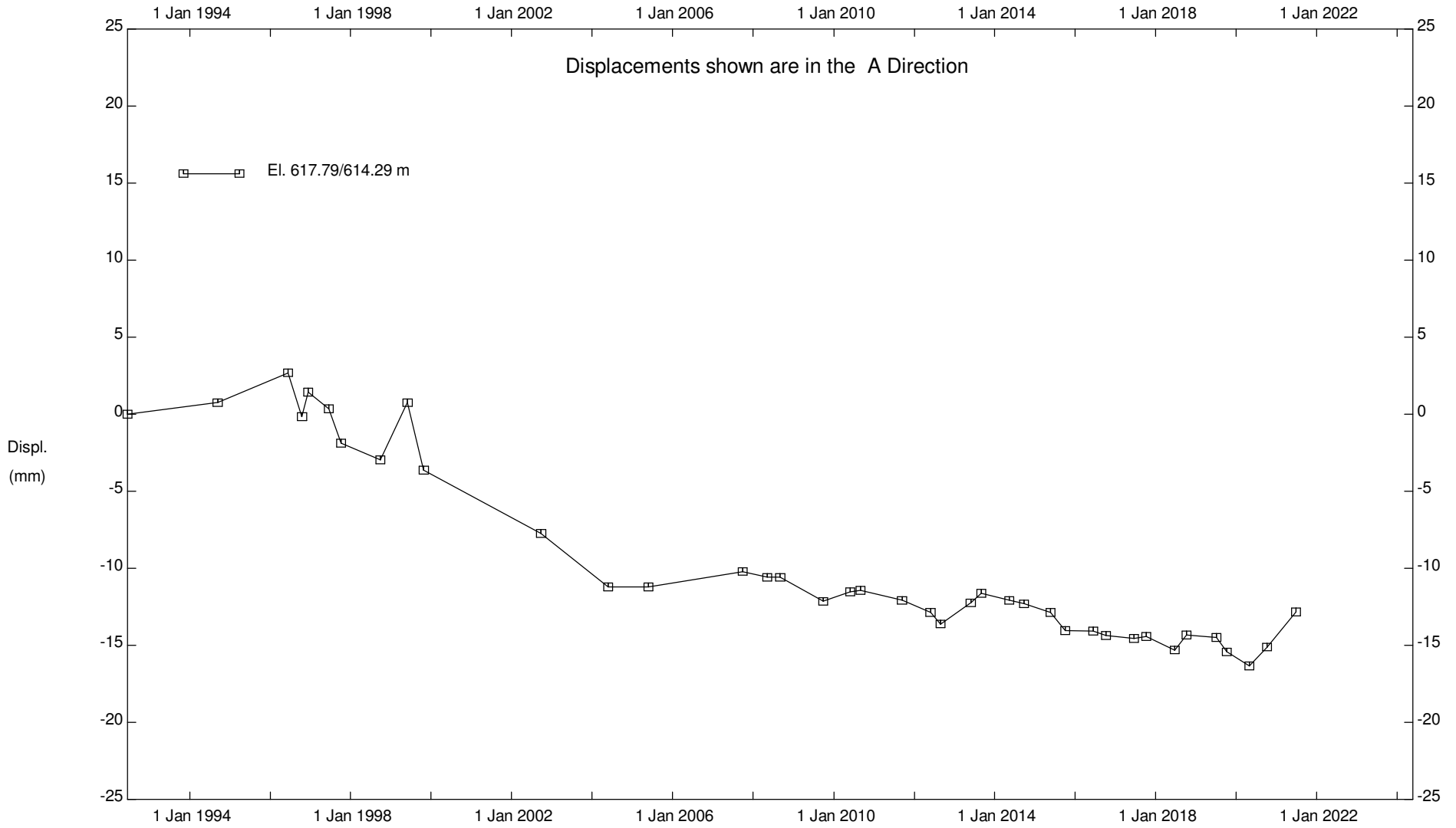
GP001; H40:42, Wapiti Hill, Inclinometer SI-09
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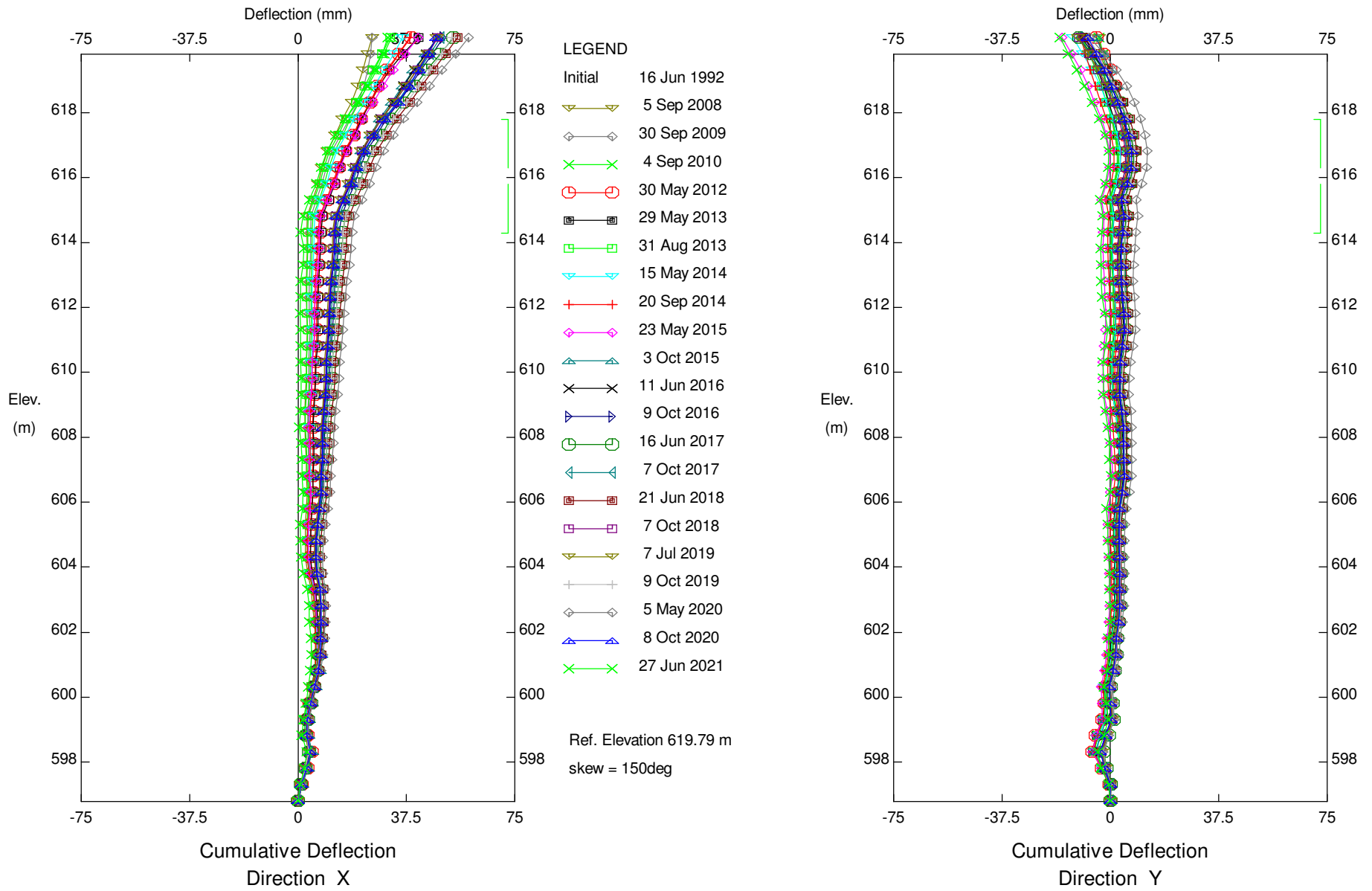
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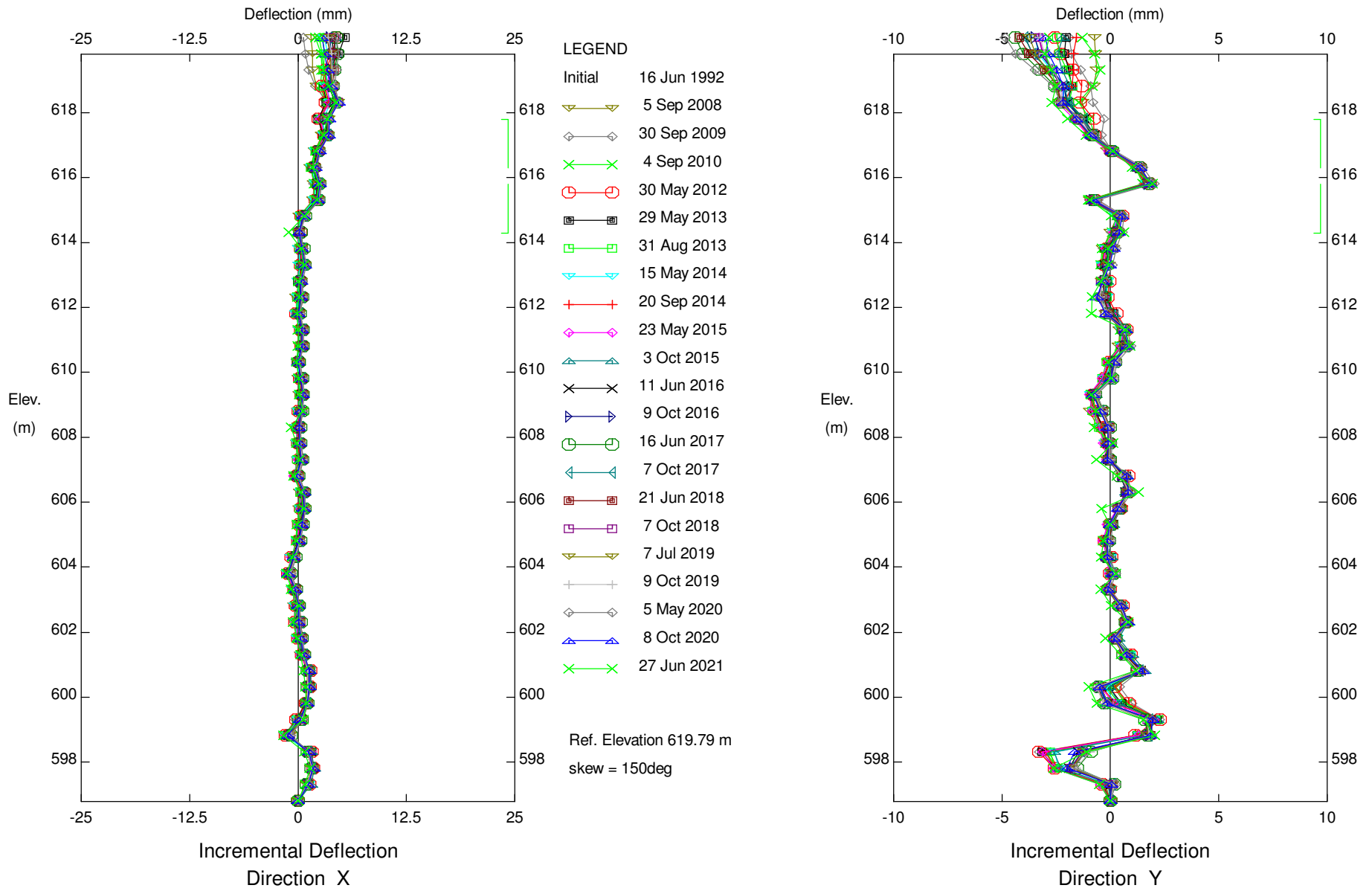
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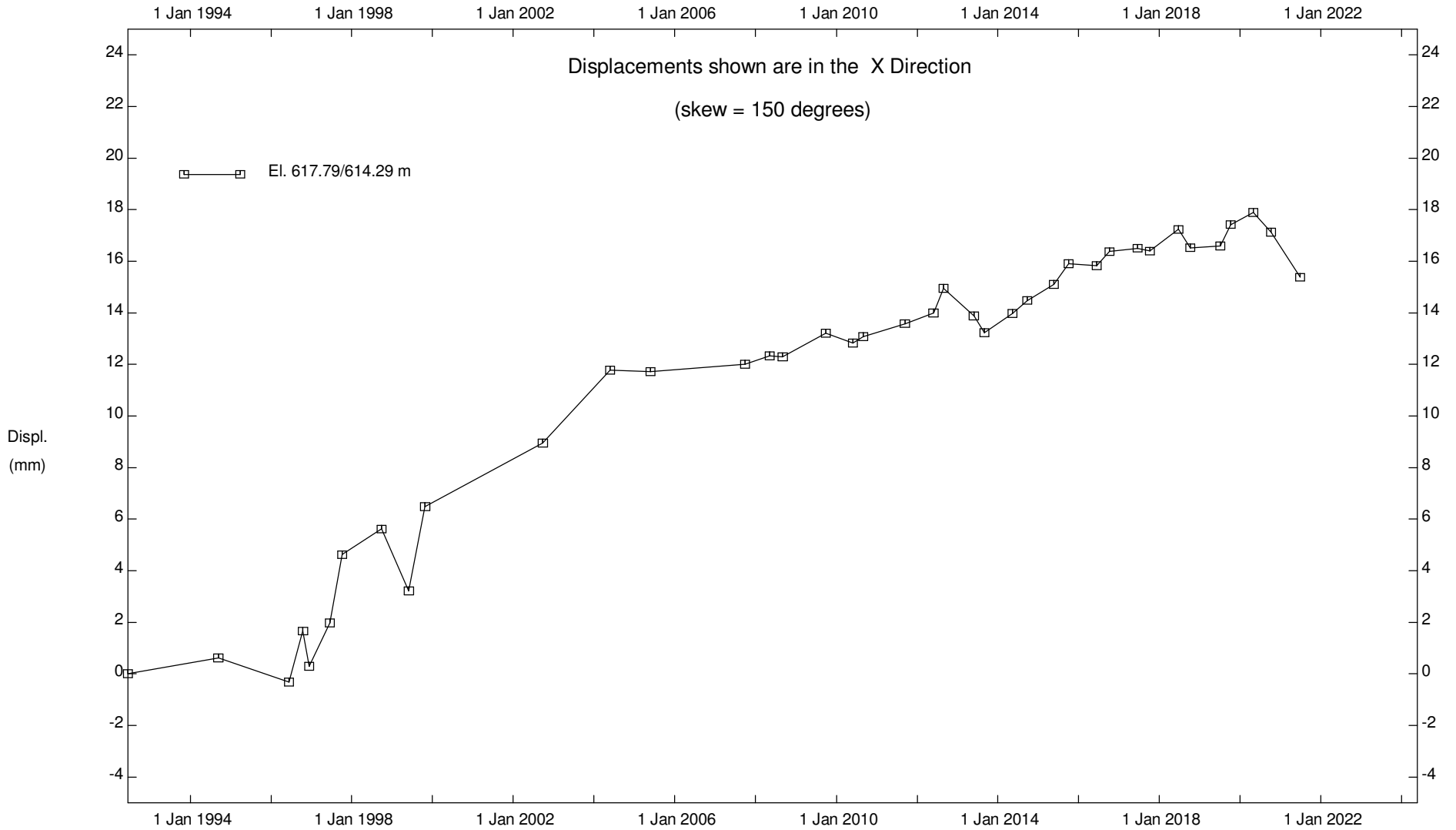
GP001; H40:42, Wapiti Hill, Inclinometer SI-09
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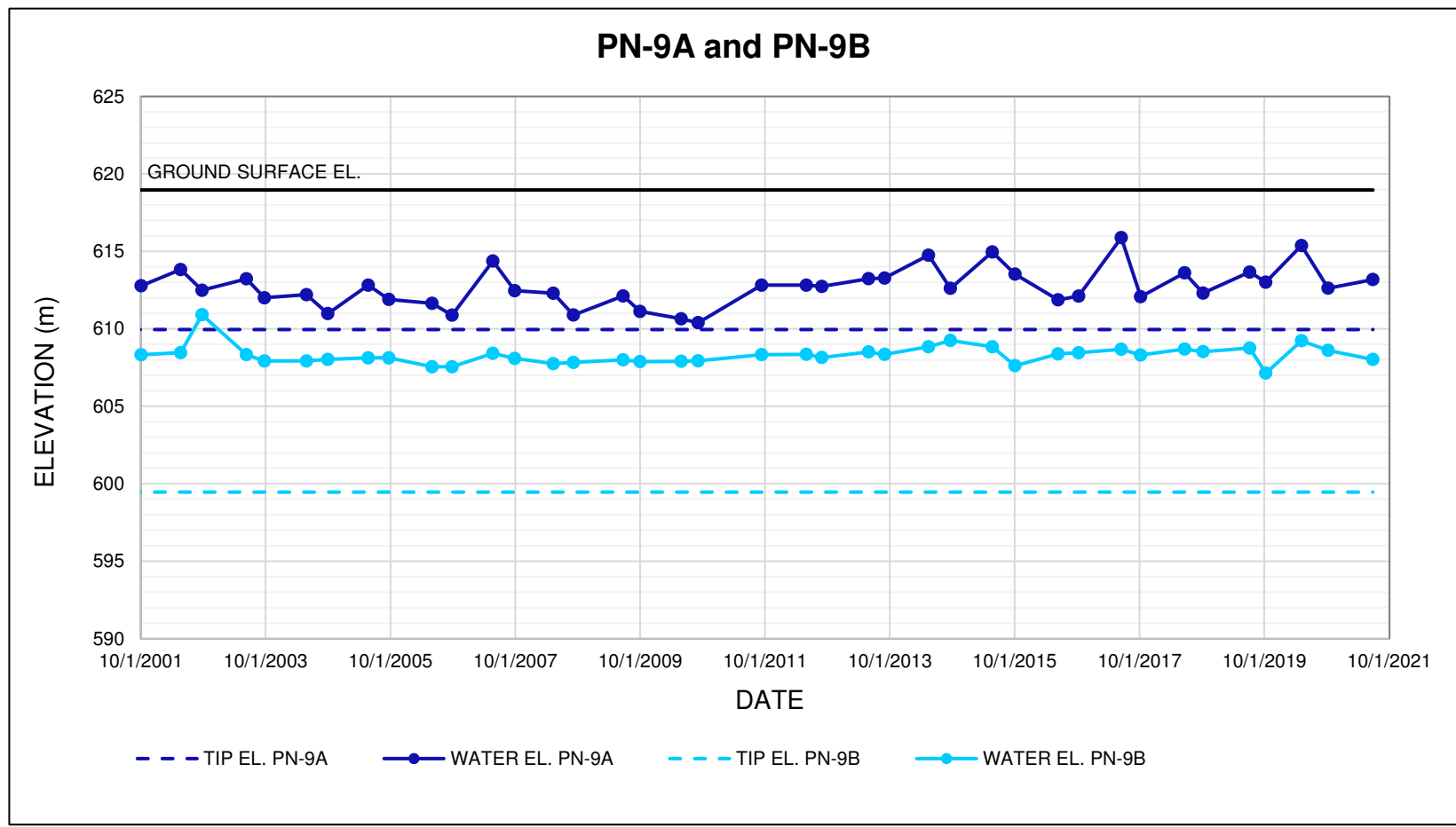
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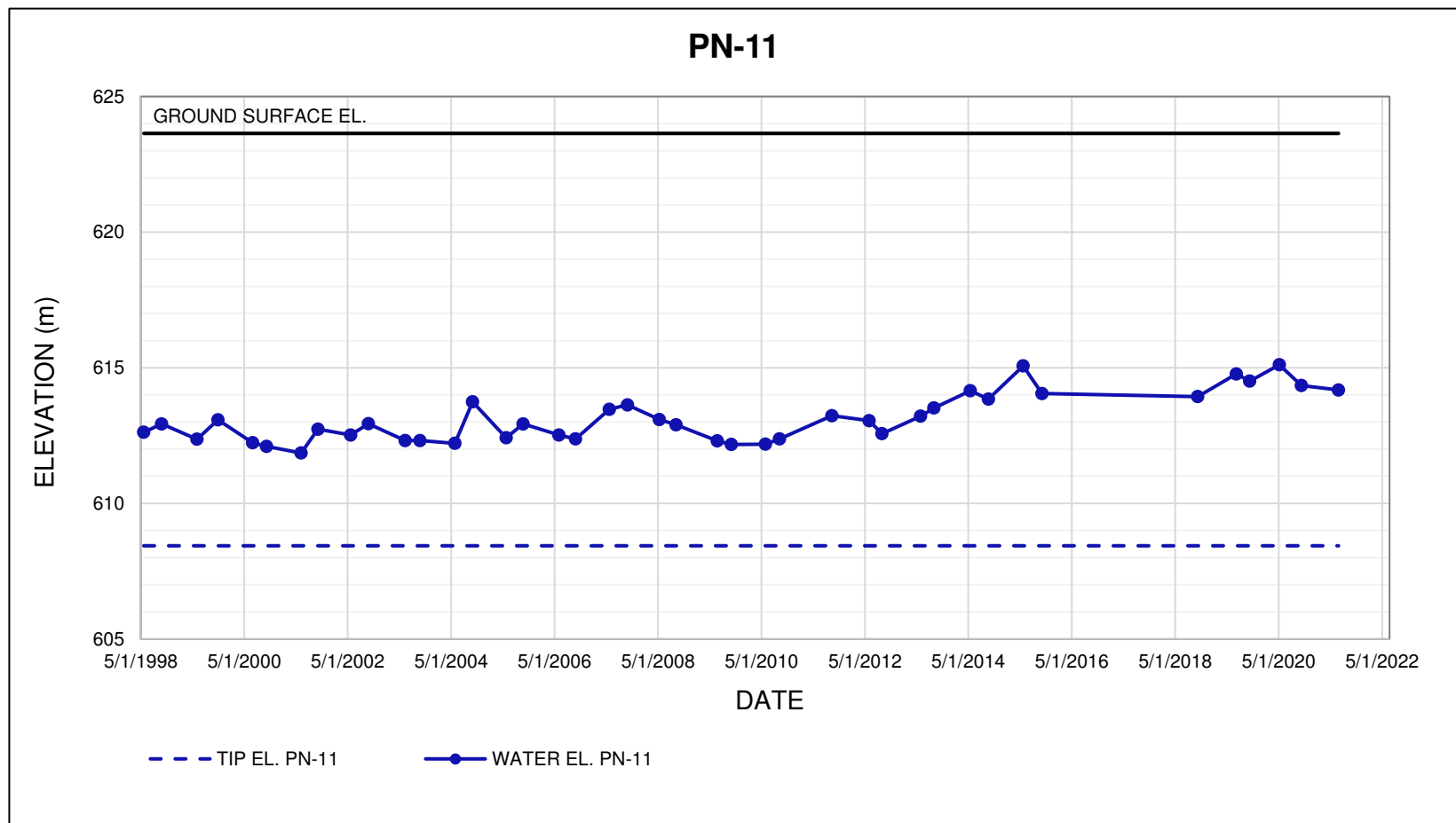
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Notes:



1. Piezometer data before the spring 2021 readings was provided to KCB by Alberta Transportation (AT) on June 25, 2021.

CLIENT 	PROJECT PEACE REGION - GRANDE PRAIRIE SOUTH GEOHAZARD RISK MANAGEMENT PROGRAM	
	TITLE Piezometer Data GP001 - Wapiti Hill Hwy 40:42 km 25.393	
	SCALE	PROJECT No. A05116A01
		FIG No.



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		FIG No.