November 26, 2025

Alberta Transportation and Economic Corridors
2nd Floor, 803 Manning Road N.E.
Calgary, Alberta
T2E 7M8

Alex Frotten, P.Eng.
Construction Engineer – Delivery Services Division (Southern Region)

Dear Mr. Frotten:

CON0022161 Southern Region GRMP Instrumentation Monitoring
Site S026; H41:03, km 35.169 Elkwater Slides
Section C – 2025 Fall Readings

1 GENERAL

Three slope inclinometers (SIs) (SI08-1, SI08-3, and SI12-1) and two standpipe piezometers (SPs) (SP08-01A and SP08-01B) were read at the S026 site in the Southern Region on October 10, 2025, by Mr. Shawn Keegan, E.I.T. of Klohn Crippen Berger Ltd. (KCB). These instruments were read as part of the Southern Region Geohazard Risk Management Plan (GRMP). The site is located at Hwy 41:03 km 35.2, approximately 4 km south of the turnoff from Hwy 41:03 to the Town of Elkwater, Alberta. The approximate site coordinates are 5499046 N, 553536 E (UTM Zone 12, NAD 83). A site plan is presented in Figure 1.

The highway is constructed across the lower portion of the east valley slope of a north-draining, unnamed creek valley that is incised into the north slope bordering the Cypress Hills Plateau to the south.

There are two segments of the highway that are being impacted by landslide movement at this site:

- Area A – located at the south extent of the site where there is a failure in a cut and fill section of the highway embankment. Previous remedial actions in Area A include shallow drainage installed near the south end in the 1970s or 1980s (records unavailable). In the fall of 2016, both lanes of the highway in Area A were resurfaced and the east slope was regraded. A new overlay was placed in the fall of 2017.
- Area B – located at the north extent of the site near the crest of a hill, where a landslide was repaired with a driven-steel H-pile wall in 2012. The H-pile wall was installed after an earlier temporary repair (date unknown) using air-launched soil nails was unsuccessful and deformations of the highway surface continued. Design and construction details for the soil nail and H-pile wall repairs have not been provided to KCB for review.

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1.1 Instrumentation

KCB has been reading the instruments at this site since 2016. Instrumentation installation details are tabulated in Table 1.1. Instrument locations are shown in Figure 1. Any instruments not included in Table 1.1 or shown in Figure 1 are assumed to be inoperable and are not presented or discussed in this report.

Several instruments have been installed at the site by previous consultants during various geotechnical site investigations. Some of these instruments are now inoperable, including:

- Numerous slope inclinometers and piezometers which have either been destroyed, sheared, or lost (e.g., buried due to ongoing roadway maintenance and construction activities);
- A rainfall gauge with remote access installed in 2008, which became inoperable and was removed in 2019 and relocated to the Central Region C018 site; and
- A SAA readout and remote connectivity system, which was removed from the casing before June 2016. At the request of AT, KCB dismantled and removed the SAA datalogger box, battery pack, and solar panel in May 2019. The equipment is in temporary storage at KCB's Calgary Office.

The operable instruments in Area A (SI08-1, SI08-3, SP08-01A, and SP08-01B) are located on or near the shoulder of the east (northbound) lane of Hwy 41:03 and are protected by a flush-mounted headbox. The operable instrument in Area B (SI12-01) is located along the west (southbound) lane of Hwy 41:03 between the highway and the pile wall, and it is protected by a 100 mm diameter black PVC pipe.

Table 1.1 Instrument Installation Details

Instrument ID	Instrument Type	Date Installed[1]	UTM Coordinates[1] (m)		Ground Surface Elevation (m)[1,2]	Stick Up (m)	Depth[1] (mbgs[3])	Condition
			Northing	Easting				
SI08-1	SI	Jun. 2008	5498860	553696	1398	0.0	25.0	Operable
SI08-3	SI	Jun. 2008	5498915	553651	1397	-0.1	26.0	Operable
SP08-1A	SP	Jun. 2008	5498854	553697	1394	-0.1	24.1	Operable
SP08-1B	SP	Jun. 2008	5498854	553697	1394	-0.1	8.9	Operable
SI12-01	SI	2012	5499335	553370	1366	1.0	21.0	Operable

Notes:
[1] Instrument installation details taken from reports and data files prepared or provided by the previous consultant(s) or TEC. Coordinates reported by the previous consultants were confirmed by KCB with a handheld GPS with NAD83/UTM 11N Datum. The ground surface elevation reported by the previous consultants is referenced to a local benchmark.
[2] Ground surface elevation on operable instruments updated by KCB with a handheld GPS with GRS80 reference system. The handheld GPS has an accuracy of ±5 m.
[3] Meters below ground surface (mbgs).
[4] SI08-2 has sheared at an approximate depth of 2.0 m below ground surface.
[5] SP08-04A is blocked at an approximate depth of 4.6 m below ground surface.

KCB changed the SI reading equipment in 2016 when KCB took over the readings from the previous consultant, and again in October 2021, after the previous equipment became inoperable. Currently,

KCB is reading the SIs with a metric RST Digital MEMS Inclinometer System. The operable standpipes were read using an RST Water Level Meter.

2 INTERPRETATION

2.1 General

The SI plots presented in the report include cumulative displacement, incremental displacement, and displacement-time data (Appendix I). The displacement-time data is plotted in the A-direction (i.e., the direction of the A0-groove) and, where applicable, the X-direction (i.e., the direction of maximum movement obtained at a skew angle from the A0-grooves). SI12-01 has a skew angle of 15° measured clockwise from the direction of the A0-grooves. Since October 2021, KCB has been using a new inclinometer probe and reel, which might lead to slight differences in data compared to earlier readings. However, during the review of the SI data for this report, all prior data corrections were removed to facilitate better interpretation of displacement trends.

For the operable SPs, the recorded water levels were converted to an equivalent water/piezometric elevation and plotted relative to ground surface elevation.

Monthly precipitation data is also plotted with the piezometer data. The data was obtained from the Alberta Climate Information Service (ACIS) database, referencing the Medicine Lodge Station.

The SI and piezometer data plots are included in Appendix I.

2.2 Zones of Movement

2.2.1 Area A

No discernible movement has been recorded in SI08-01 or SI08-03.

2.2.2 Area B

Discrete movement has been recorded in SI12-01 between an approximate depth of 4.5 m and 6.5 m below ground surface.

2.3 Interpretation of Monitoring Results

2.3.1 Area A

Water levels recorded in SP08-01A and SP08-01B appear to fluctuate seasonally (with the spring readings being higher than fall readings) from an approximate depth of 14.4 m to 17.5 m below ground surface and 4.8 m to 6.8 m below ground surface, respectively. The October 2025 readings were consistent with historical trends observed in these instruments, with decreases of 1.5 m and 0.5 m recorded in SP08-01A and SP-01B, respectively. The spring 2024 report noted the water levels recorded were the highest recorded since installation, which based on the precipitation data,

corresponds with a large amount of precipitation (191 mm) in May 2024. The water levels have since returned to normal.

2.3.2 Area B

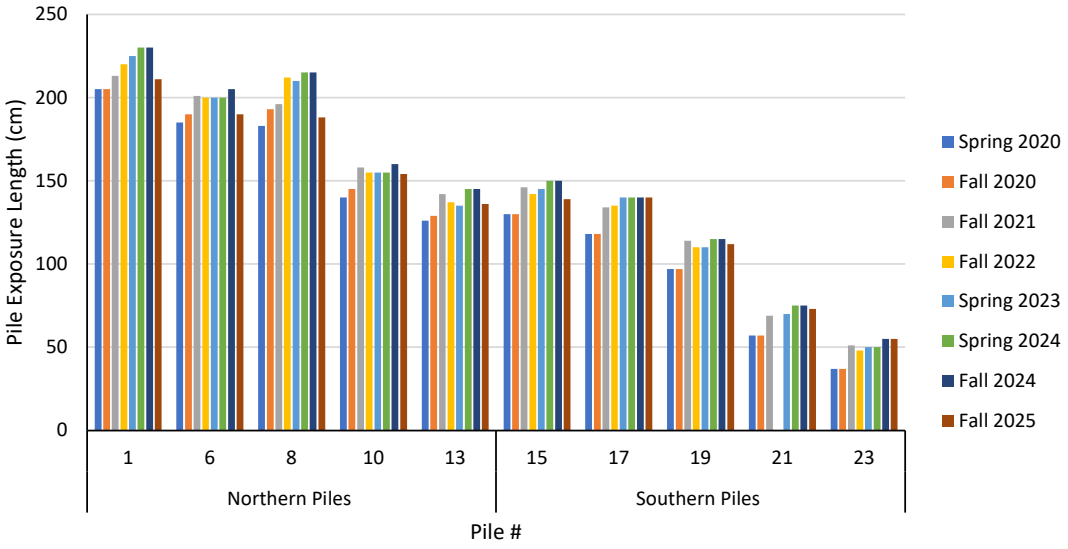
The zone of movement recorded in SI12-01 is occurring at a similar depth to the original slide plane reported by the previous consultant prior to construction of the H-pile wall.

Since KCB took over the instrument readings in 2016, the rate of movement recorded in SI12-01 has been relatively steady (approximately 5 mm/year), except for an increased rate of movement recorded in the fall of 2017 and fall of 2021 (approximately 13.7 mm/year and 16.1 mm/year, respectively). The increased rate of movement recorded in the fall of 2021 could be due to a small data shift caused by KCB changing the SI reading equipment when the old equipment became inoperable. However, the increased rate of movement recorded in 2017 reflected site observations made by KCB and TEC during the 2017 Section B inspection.

Soil sliding observed downslope of the H-pile wall has exposed the H-piles and reduced the passive support of the H-pile wall on the downslope side. The movement recorded in SI12-01 reflects the movement of the H-pile occurring as the passive support is reduced.

In May 2020, KCB began measuring the exposed lengths (i.e., steel above ground surface) of the H-piles as a baseline for subsequent measurements. The pile exposure measurements at ten (10) locations decrease towards the southern part of the H-pile wall. Some piles show slight decreases in exposed pile length, associated with erosion of the surrounding material that accumulates at the bottom and covers the extended exposure. As of October 2025, the exposed height of the H-pile (Piles 1 through 23) varied from approximately 0.55 m to 2.31 m, a negligible increase since May 2025.

Figure 2.1 Change in pile exposure length between 2020 and 2025



2.4 Summary

A summary of the SI and piezometer data is provided in Table 2.1 and Table 2.2, respectively. The SI data plots only include data obtained by KCB. In Spring 2024, SI18-03 was not read due to the presence of a wasp nest at the instrument at the time of the site visit. No wasp nest was observed during subsequent readings

Table 2.1 Slope Inclinometer Reading Summary

Instrument ID	Area	Date				Ground Surface Elevation (m)	Depth of Movement (mbgs[1])	Direction of Movement, Skew Angle[2]	Movement (mm)					Rate of Movement (mm/year)		
		Initialized (Re-initialized)	Previous Maximum Cumulative Movement Recorded	Previous Reading	Most Recent Reading				Maximum Cumulative			Incremental Since Previous Reading	Total	Previous Maximum	Current	Change from Previous Reading
									Before First Re-Initialization[3]	Before Second Re-Initialization[4]	Most Recent Reading					
SI08-1	A	Jun. 2008 (May 28, 2016)[3] (October, 2021)[4]	N/A – no discernible movement recorded since re-initialized	May 22, 2025	October 10, 2025	1398	N/A – no discernible movement recorded since re-initialized[3]		2.0	N/A – no discernible movement recorded since re-initialized[3]			2.0	N/A – no discernible movement recorded since re-initialized		
SI08-3[4]	A	Jun. 2008 (May 28, 2016)[3] (October, 2021)[4]		May 22, 2025	October 10, 2025	1397			2.0				2.0	N/A – no discernible movement recorded since re-initialized		
SI12-01	B	2012 (May 28, 2016)[3] (October, 2021)[4]	May 22, 2025	May 22, 2025	October 10, 2025	1366	4.8 – 6.3	X-Direction, 15°	12.0	27.1	16.2	0.8	55.3	9.4	2.2	-1.1

Notes:
[1] Meters below ground surface (mbgs).
[2] Skew angle of X-direction measured clockwise from the A-direction.
[3] All SIs were re-initialized in May 2016 when KCB took over the readings from the previous consultant and changed the SI reading equipment. Movement recorded before 2016 was taken from reports prepared by the previous consultant.
[4] Re-initialized in October 2021 when the SI reading equipment was changed.

Table 2.2 Standpipe Piezometer Reading Summary

Instrument ID	Area	Date			Ground Surface Elevation (m)	Screen Depth (mbgs[1])	Water Level		
		Installed	Previous Reading	Most Recent Reading			Previous Reading (mbgs[1])	Most Recent Reading (mbgs[1])	Change from Previous Reading (m)
SP08-1A	A	Jun. 2008	May 22, 2025	May 22, 2025	1394	21.3 – 24.7	15.5	17.0	1.5
SP08-1B	A	Jun. 2008	May 22, 2025	May 22, 2025	1394	6.0 – 9.1	5.3	5.8	0.5

Notes:
[1] Meters below ground surface (mbgs).

3 RECOMMENDATIONS

3.1 Future Work

All operable instruments should continue to be read twice per year (spring and fall). Spring readings should be completed after late-May or early-June, due to the risk of water inside the instrument casings being frozen earlier in the year.

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

Instrument readings should include measurements and photographs of the length of the H-pile exposed on the downslope side of the H-pile wall to monitor ongoing slope movements and erosion downslope of the H-pile wall.

Adding to the recommendation of the 2025 Section B reports, additional future work should include:

- Installing a data logger in one or more of the SPs to assess for short-term fluctuations (e.g., increases and decreases) in groundwater level that could be occurring in response to periods of heavy or prolonged rainfall or freshet infiltration between readings.
- A geotechnical site investigation (drilling and instrument installations) to assess the depth of movement in recently active slide areas to support a repair design. Two additional SIs should be installed in Area B, one upslope of the H-pile wall near its south end and one adjacent to the highway north of the H-pile wall, to monitor for movement.

3.2 Instrument Repairs and Maintenance

No instrument repairs are required.

4 CLOSING

This report is an instrument of service of Klohn Crippen Berger (KCB). The report has been prepared for the exclusive use of Alberta Transportation and Economic Corridors (Client) for the specific application to the Southern Region Geohazard Risk Management Program (Contract No. CON0022161), 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.

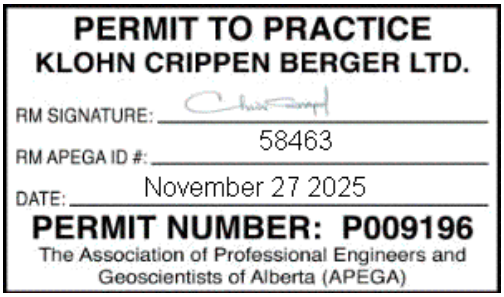
Use of or reliance upon this instrument of service by the Client is subject to the following conditions:

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. The report is based on information provided to KCB by the Client or by other parties on behalf of the client (Client-supplied information). KCB has not verified the correctness or accuracy of such information and makes no representations regarding its correctness or accuracy. KCB shall not be responsible to the Client for the consequences of any error or omission contained in Client-supplied information.
4. KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.
5. This report is electronically signed and sealed, and its electronic form is considered the original. A printed version of the original can be relied upon as a true copy when supplied by the author or when printed from its original electronic file.

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

Yours truly,

KLOHN CRIPPEN BERGER LTD.

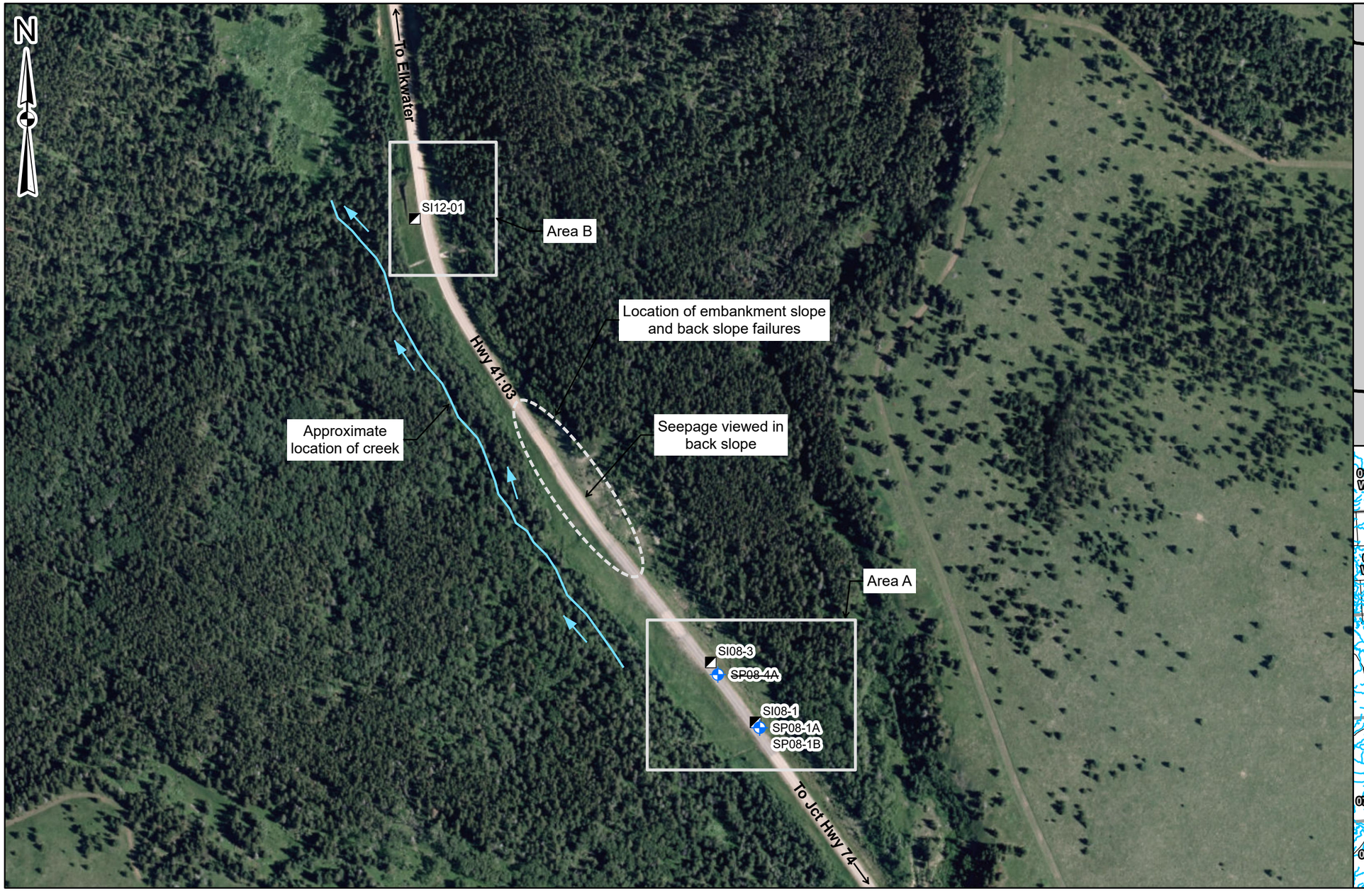


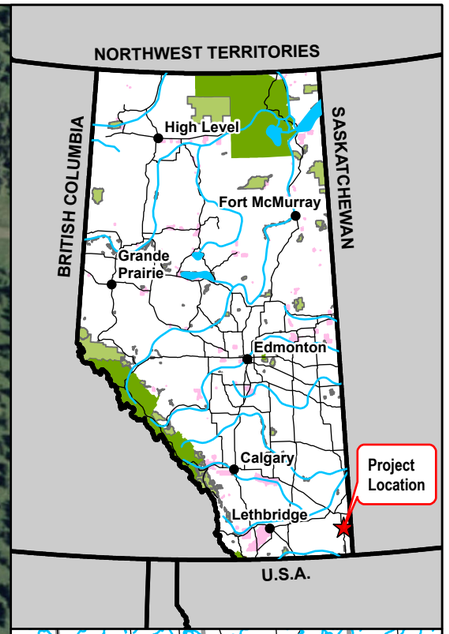
Jorge Rodriguez., Ph.D, M.Sc., P.Eng.
Geotechnical Engineer

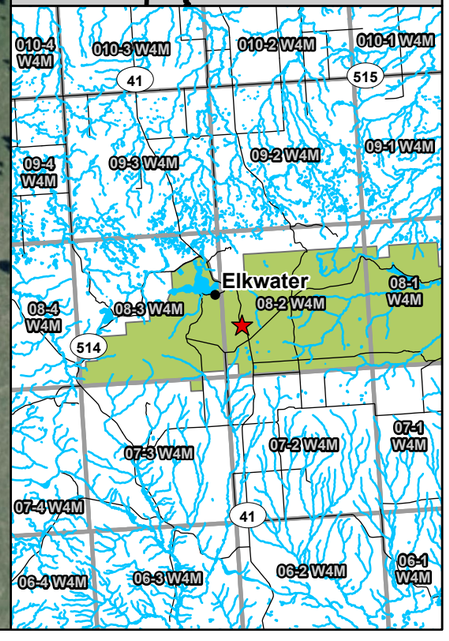
JT&JR:bb

ATTACHMENTS
Figure
Appendix I Instrumentation Plots

FIGURE







Legend

- Slope Inclinometer (SI)
- Standpipe Piezometer (SP)
- Flow Direction
- Watercourse
- Slope Failure

0 200 Metres

NOTES:
1. HORIZONTAL DATUM: NAD83
2. GRID ZONE: UTM ZONE 12N
3. IMAGE SOURCE: CYPRESS COUNTY, MAXAR
4. STRIKETHROUGH INDICATES INSTRUMENT IS INACTIVE

CLIENT: Alberta

Klohn Crippen Berger

PROJECT: SOUTHERN REGION GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE: Site Plan
S026 - Elkwater Slides
Hwy 41:03, km 35.169

SCALE	PROJECT No.	FIG No.
1:4,000	A05116A03	1

File: Z:\AC\CGY\Alberta\A05116A03 ABT Southern Region GRMP\400 Drawings\2022\Section C\Section C - Spring 2022\Section C - Spring 2022.aprx Date: Time: Creator: : aharrison

APPENDIX I

Instrumentation Plots

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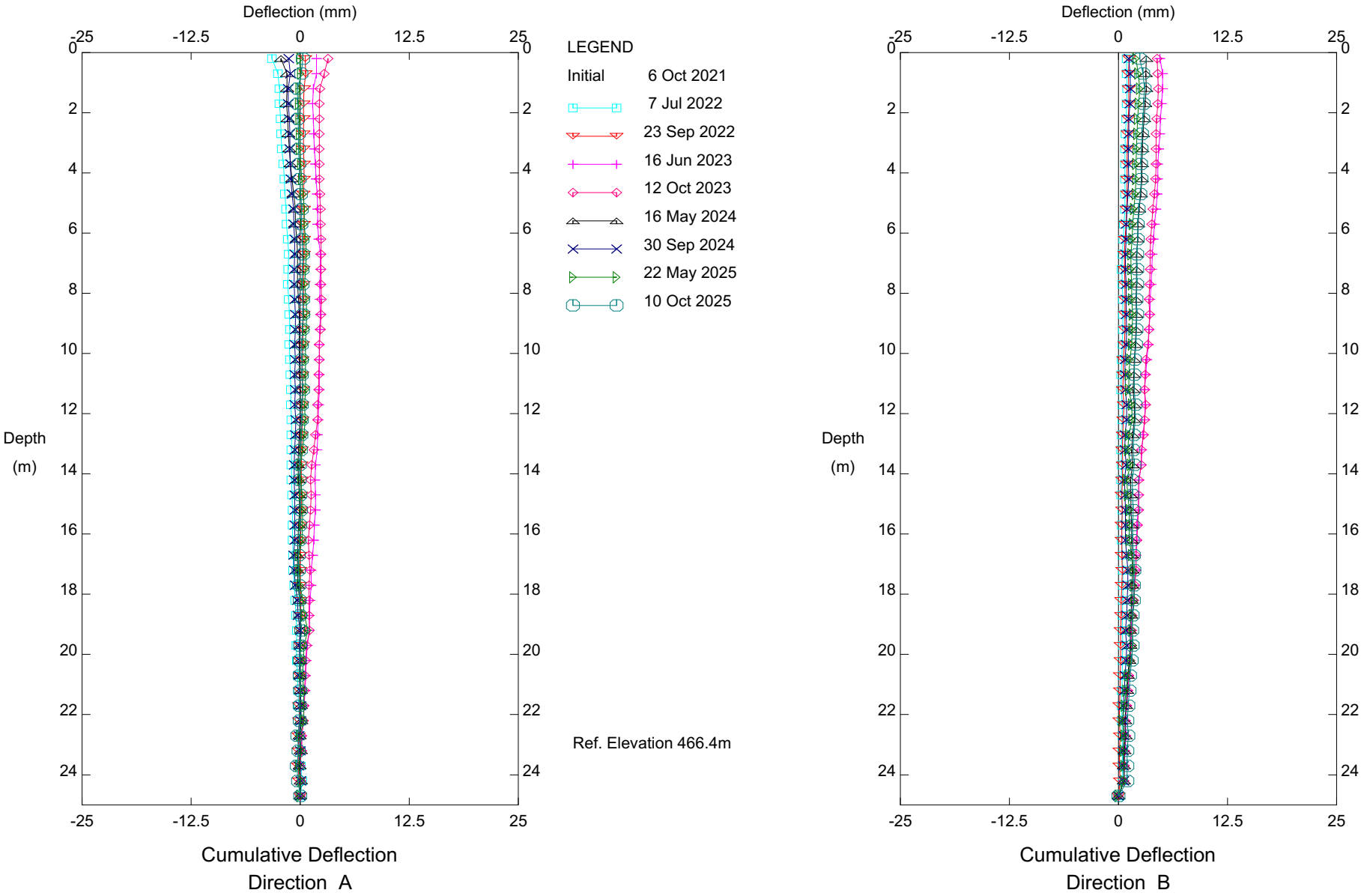

S026; H41:03, Elkwater Slides, Area A, Inclinometer SI08-1

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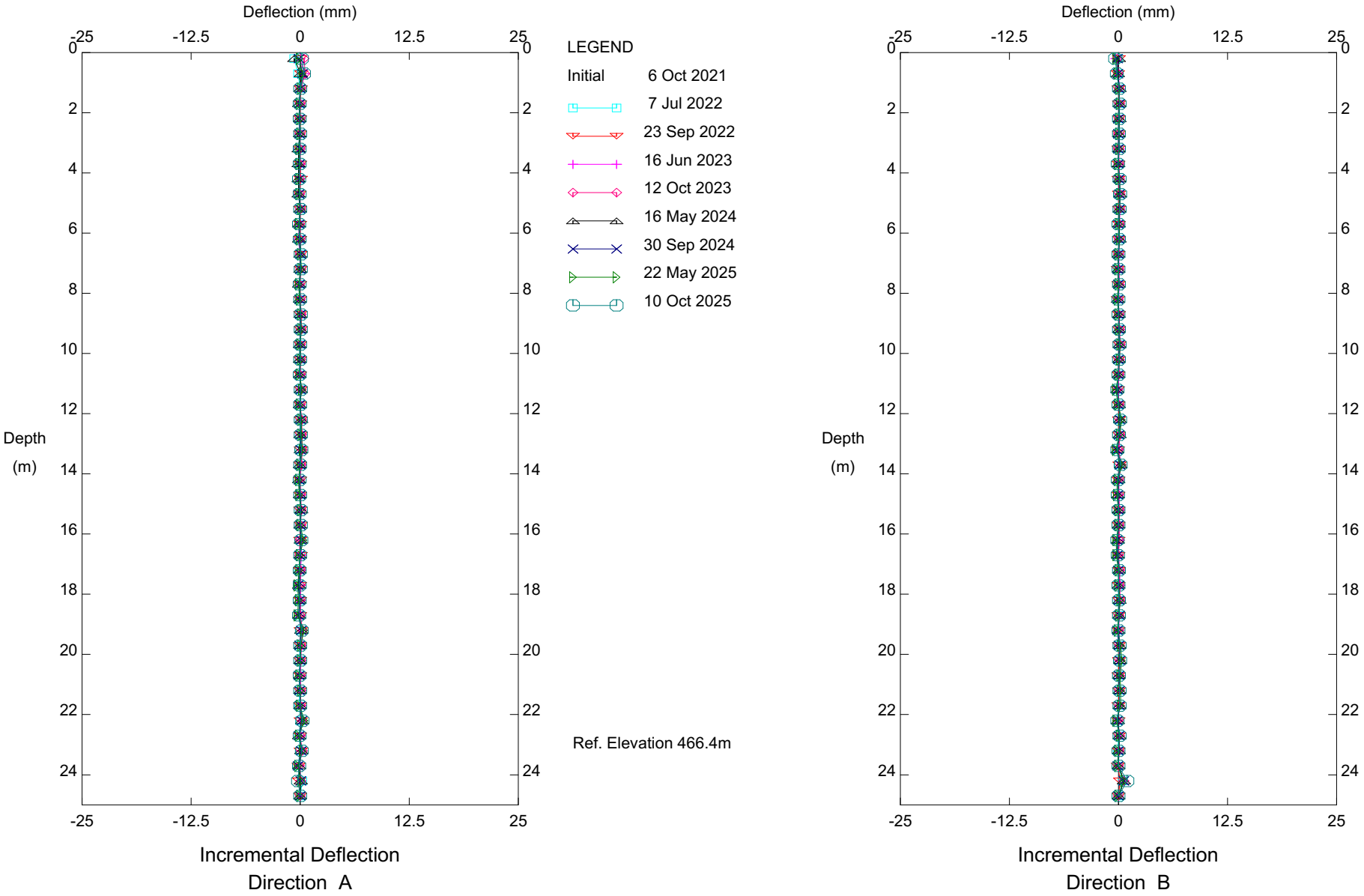

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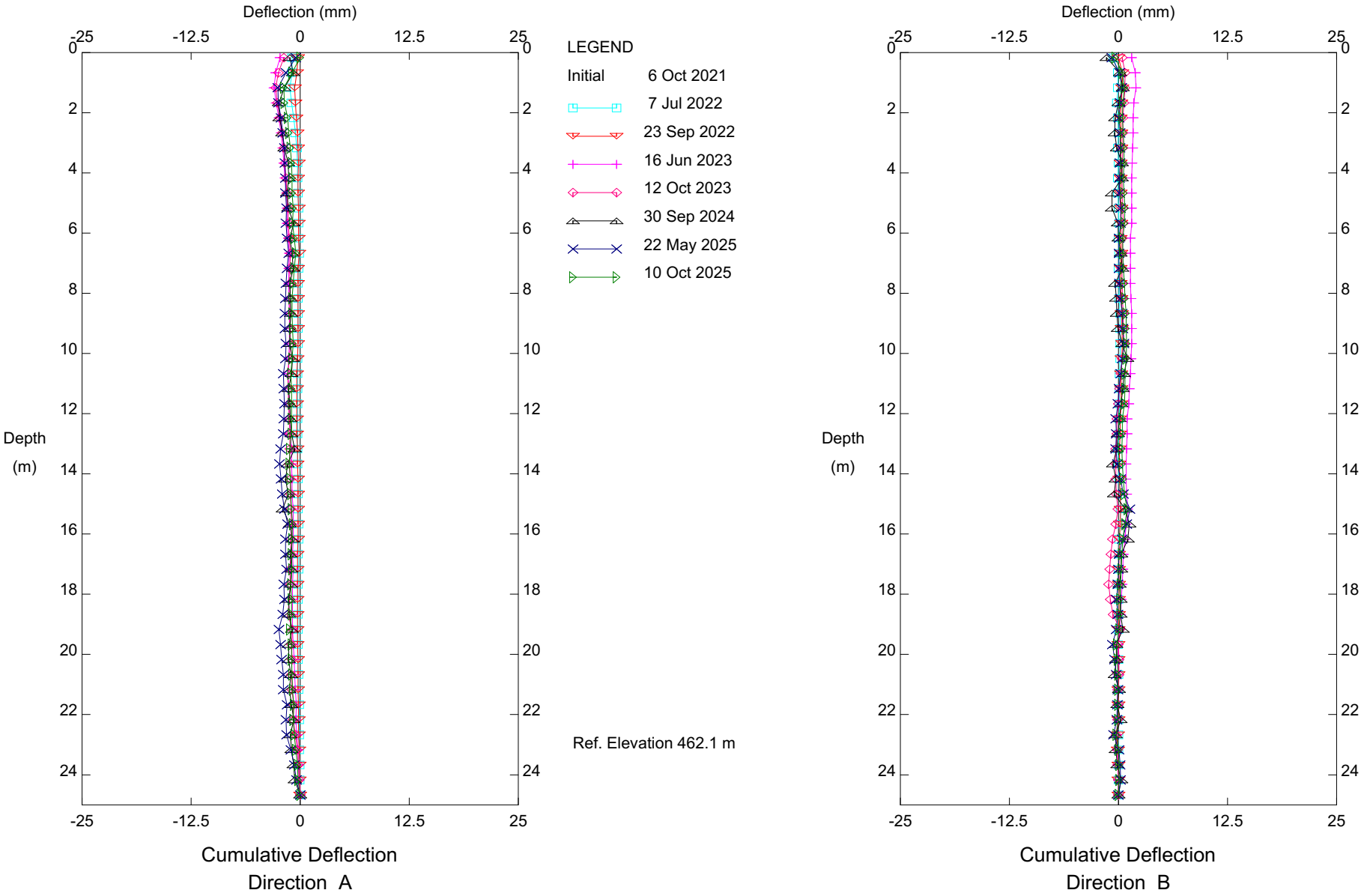

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Alberta Transportation

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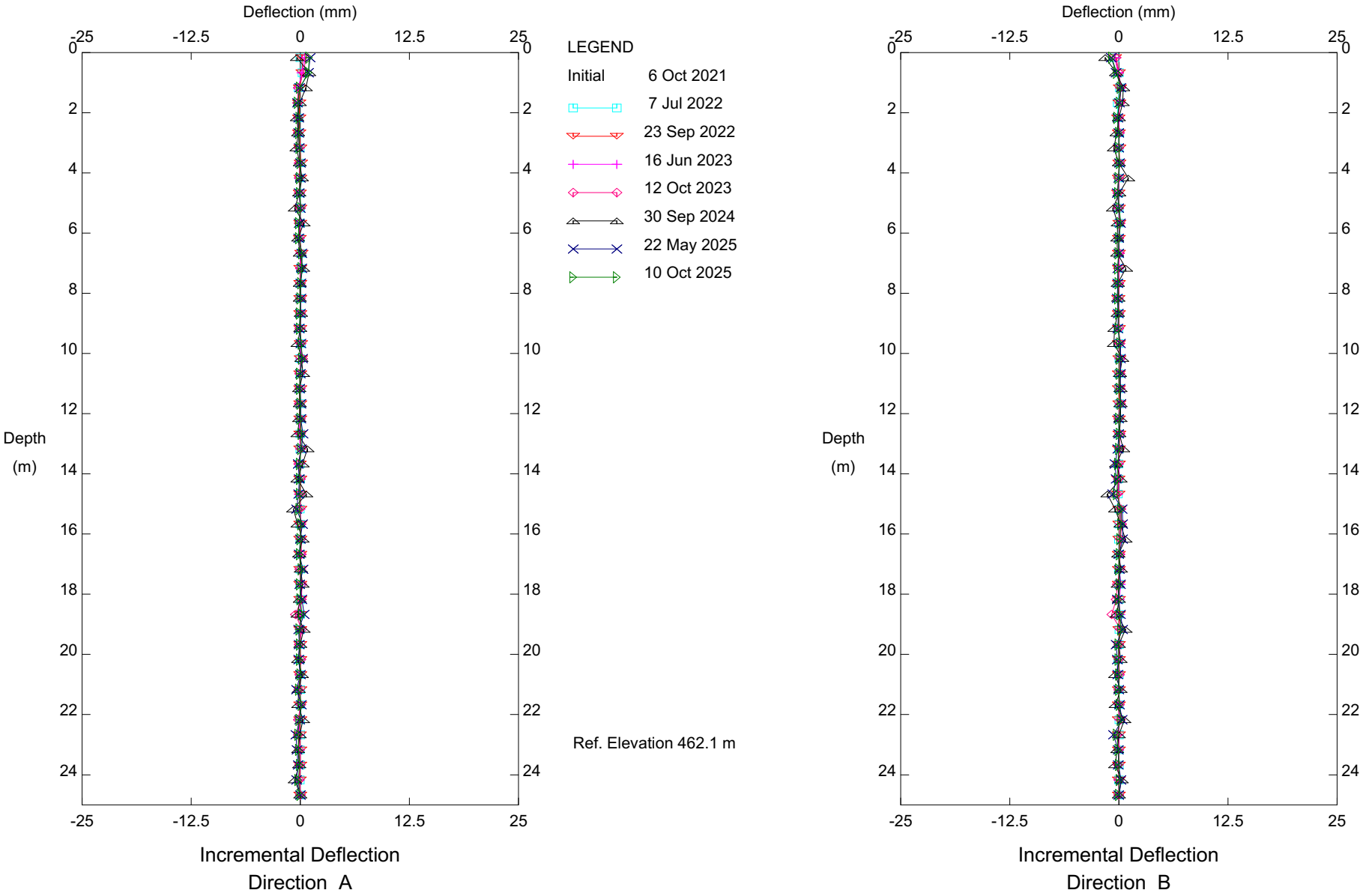

S026; H41:03, Elkwater Slides, Area A, Inclinometer SI08-3

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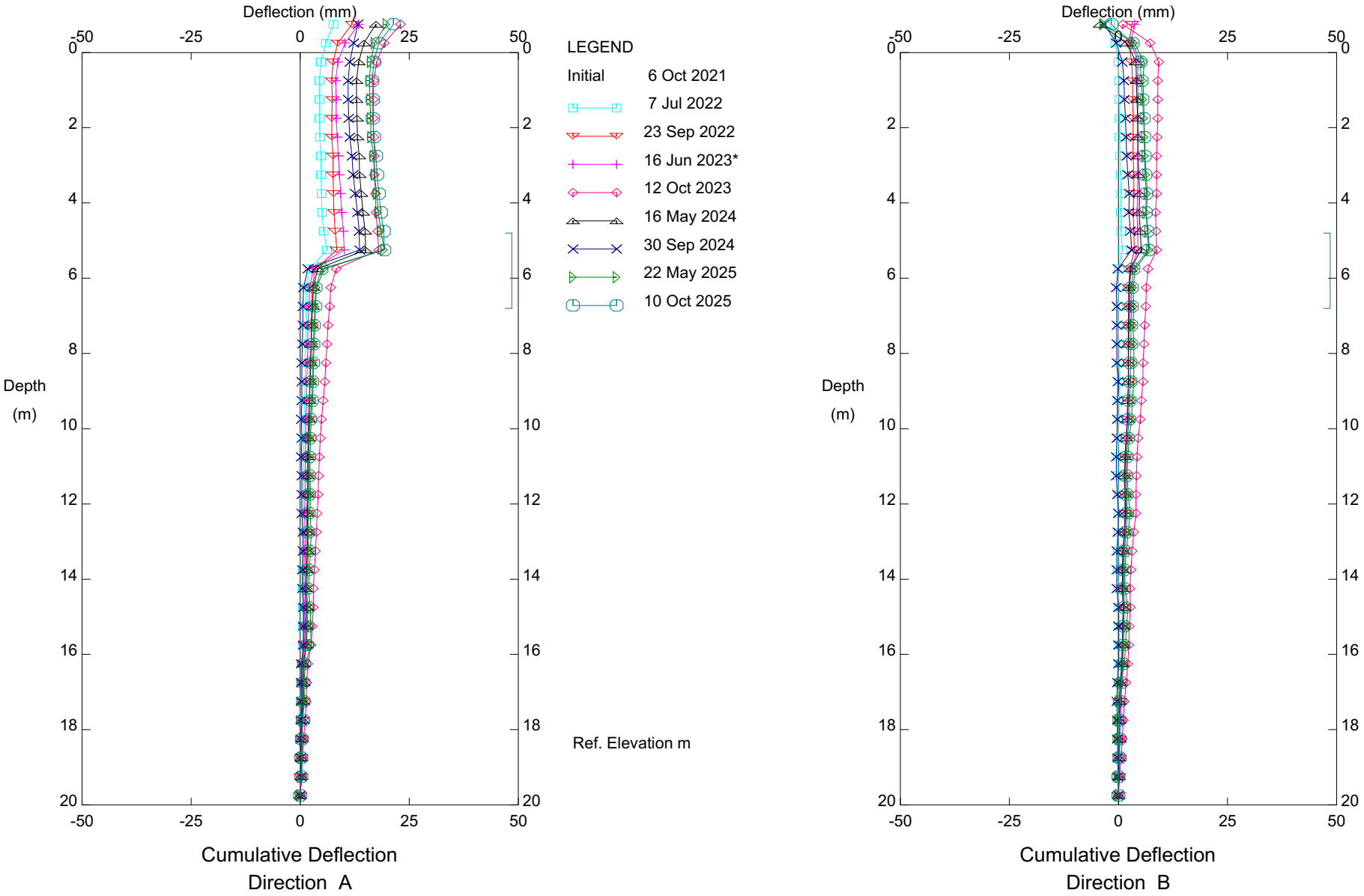

S026; H41:03, Elkwater Slides, Area B, Inclinometer SI12-01

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

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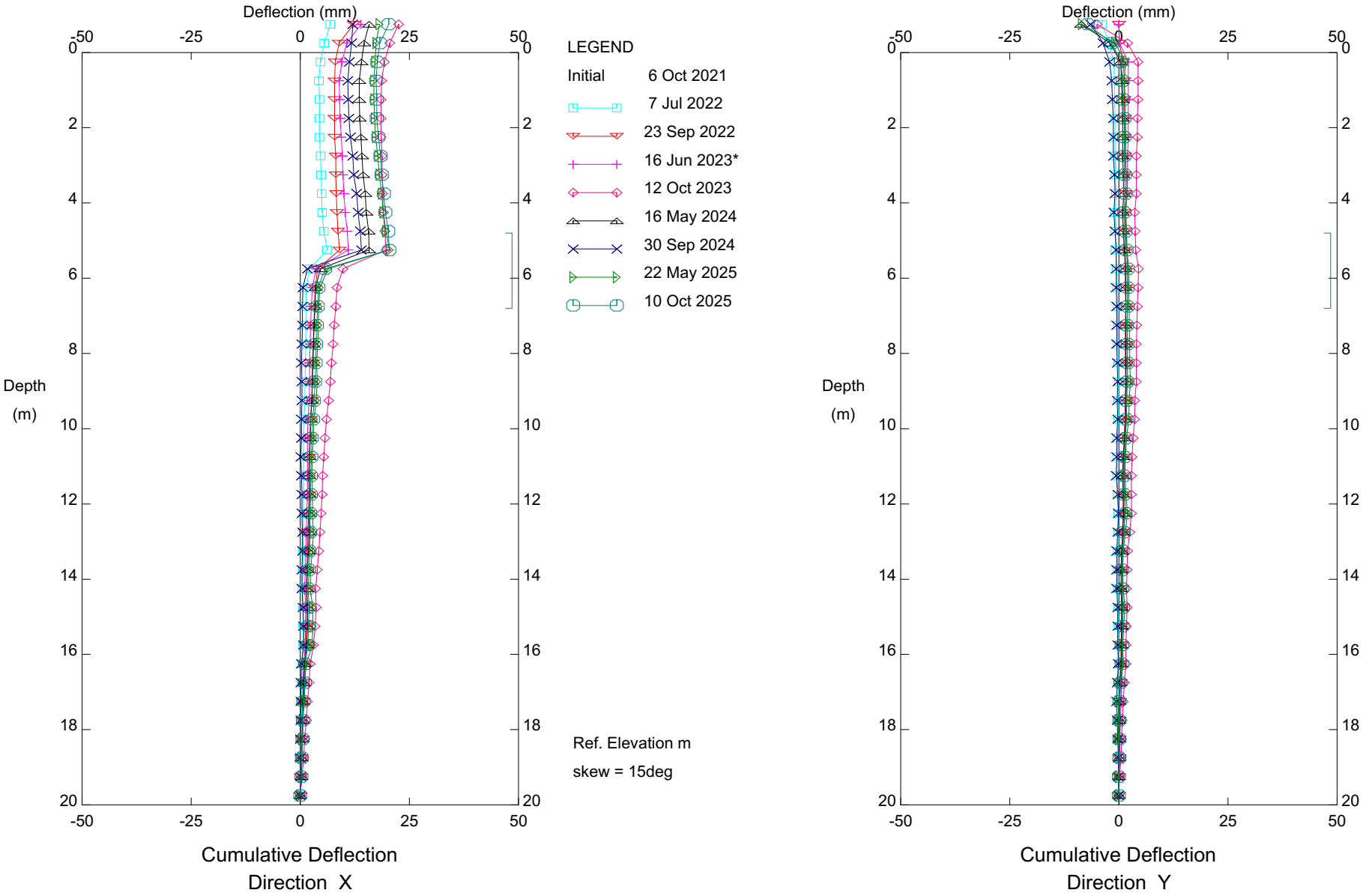

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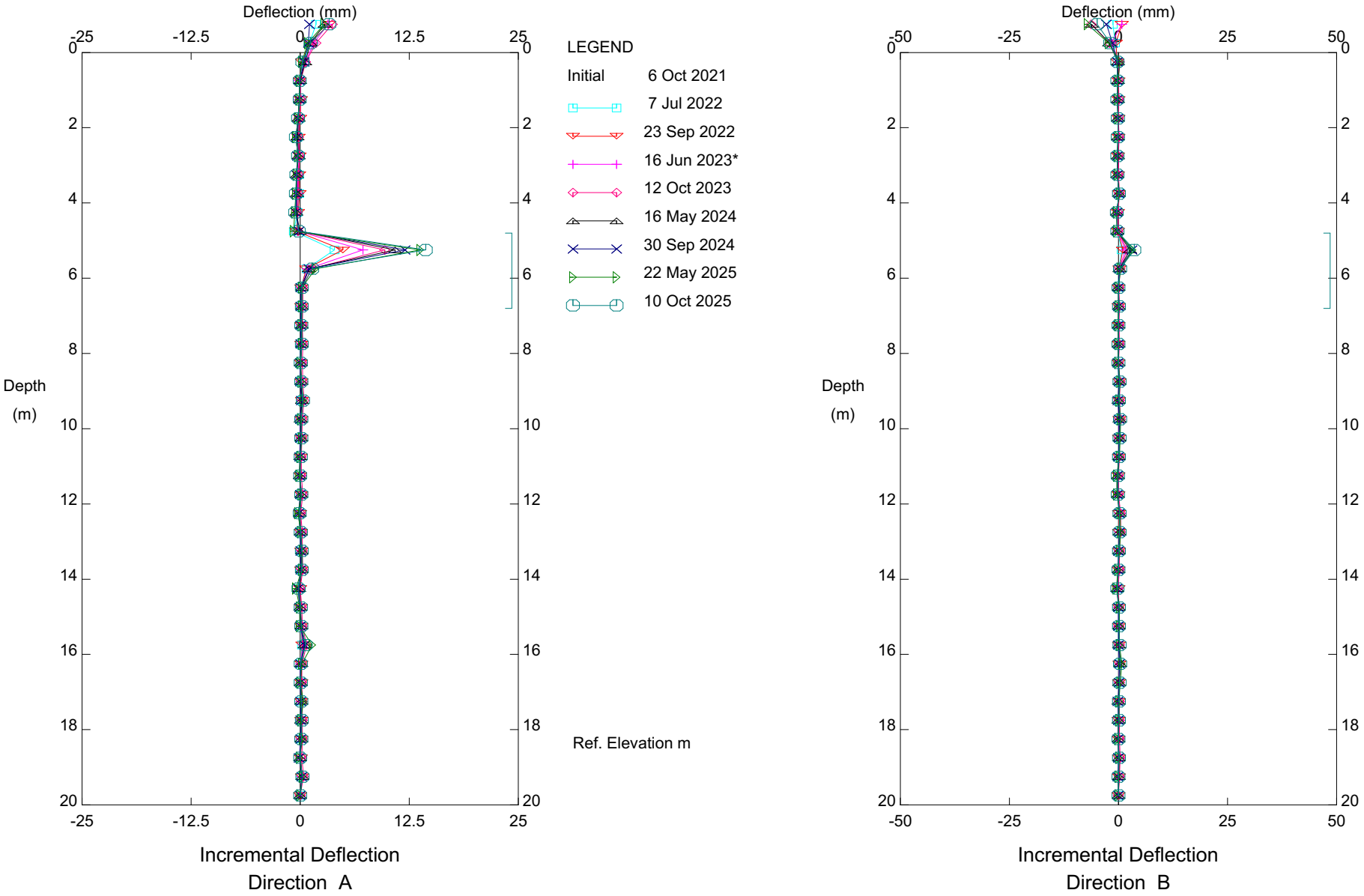

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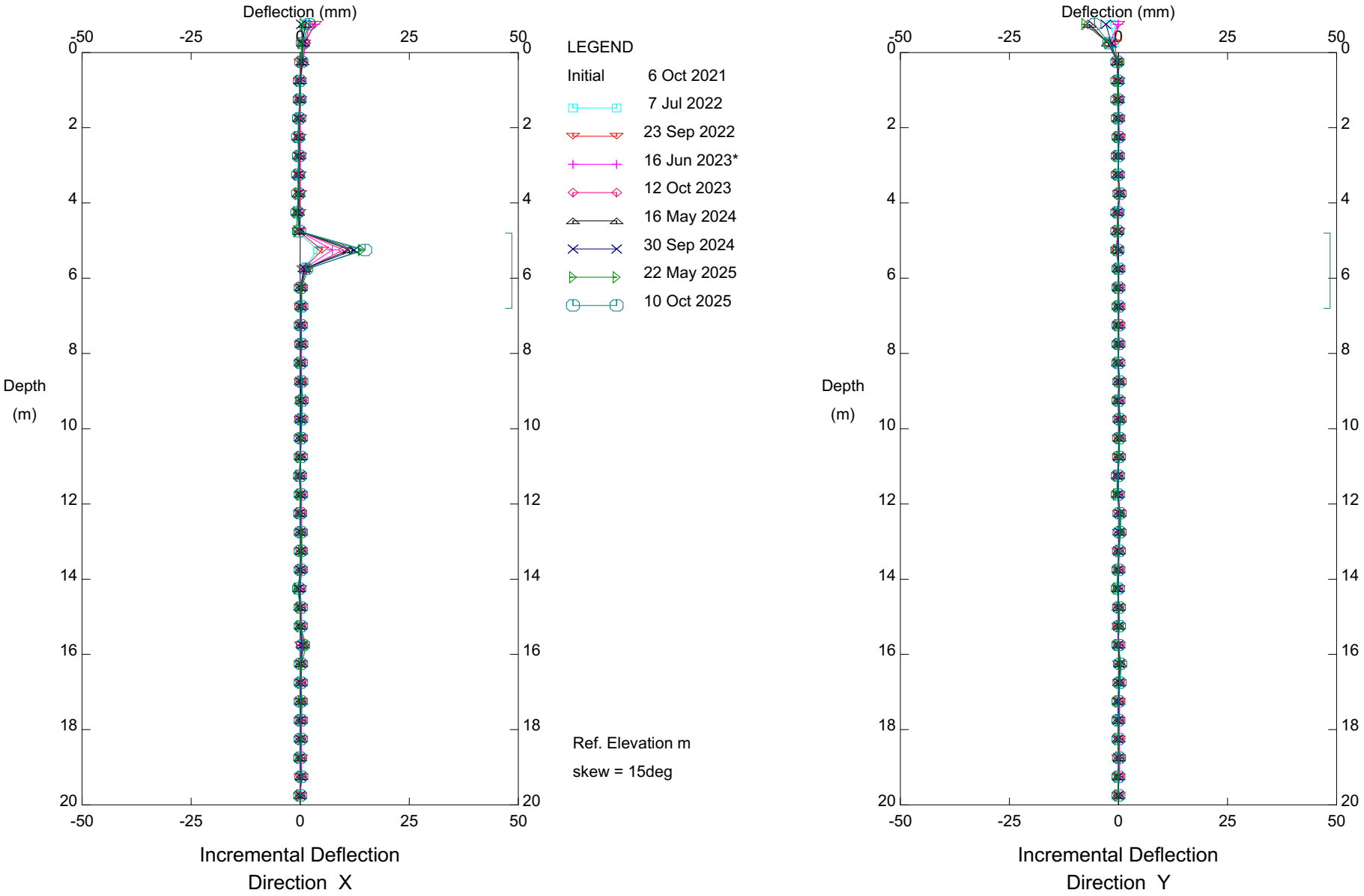

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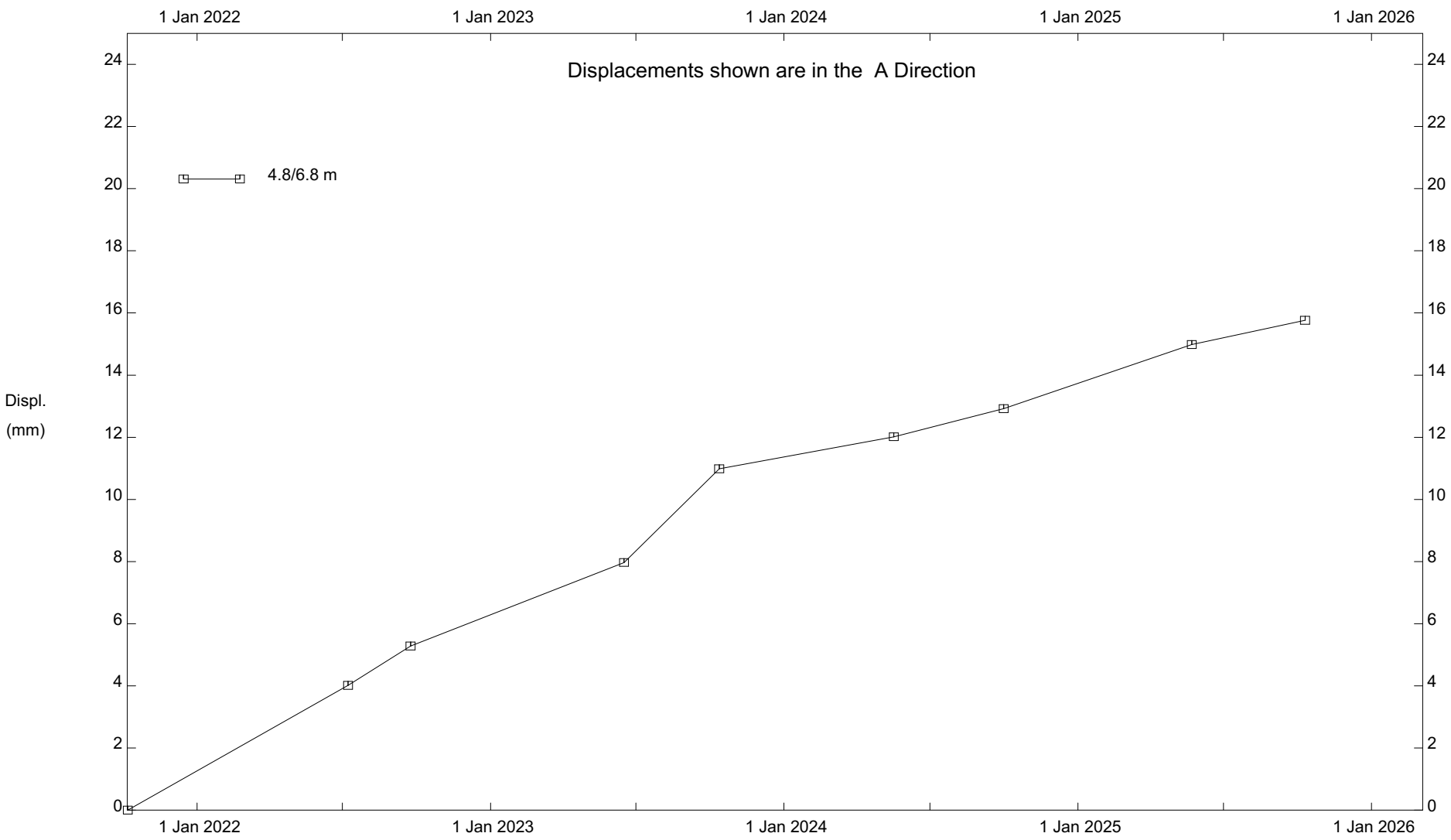

S026; H41:03, Elkwater Slides, Area B, Inclinometer SI12-01

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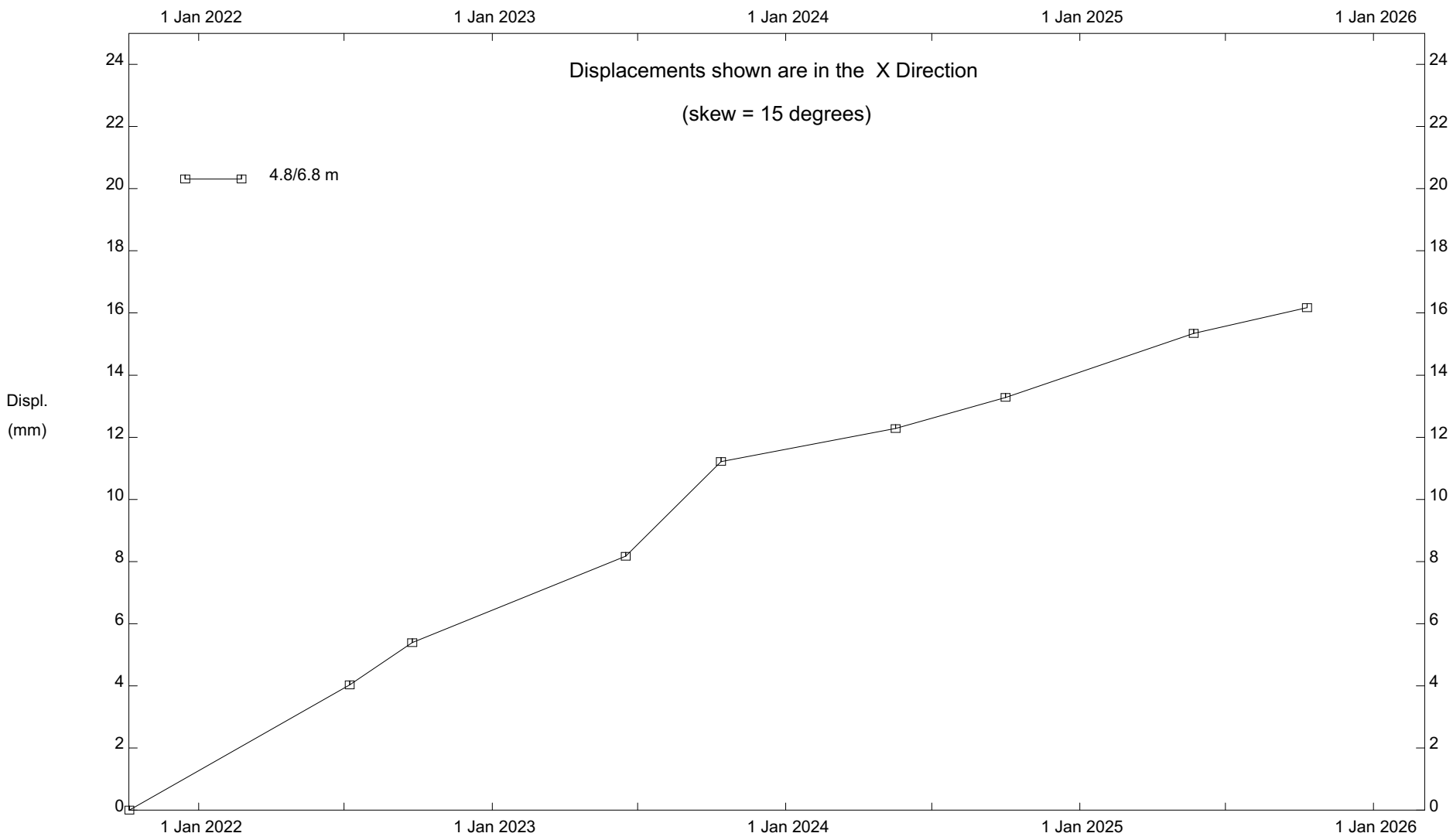
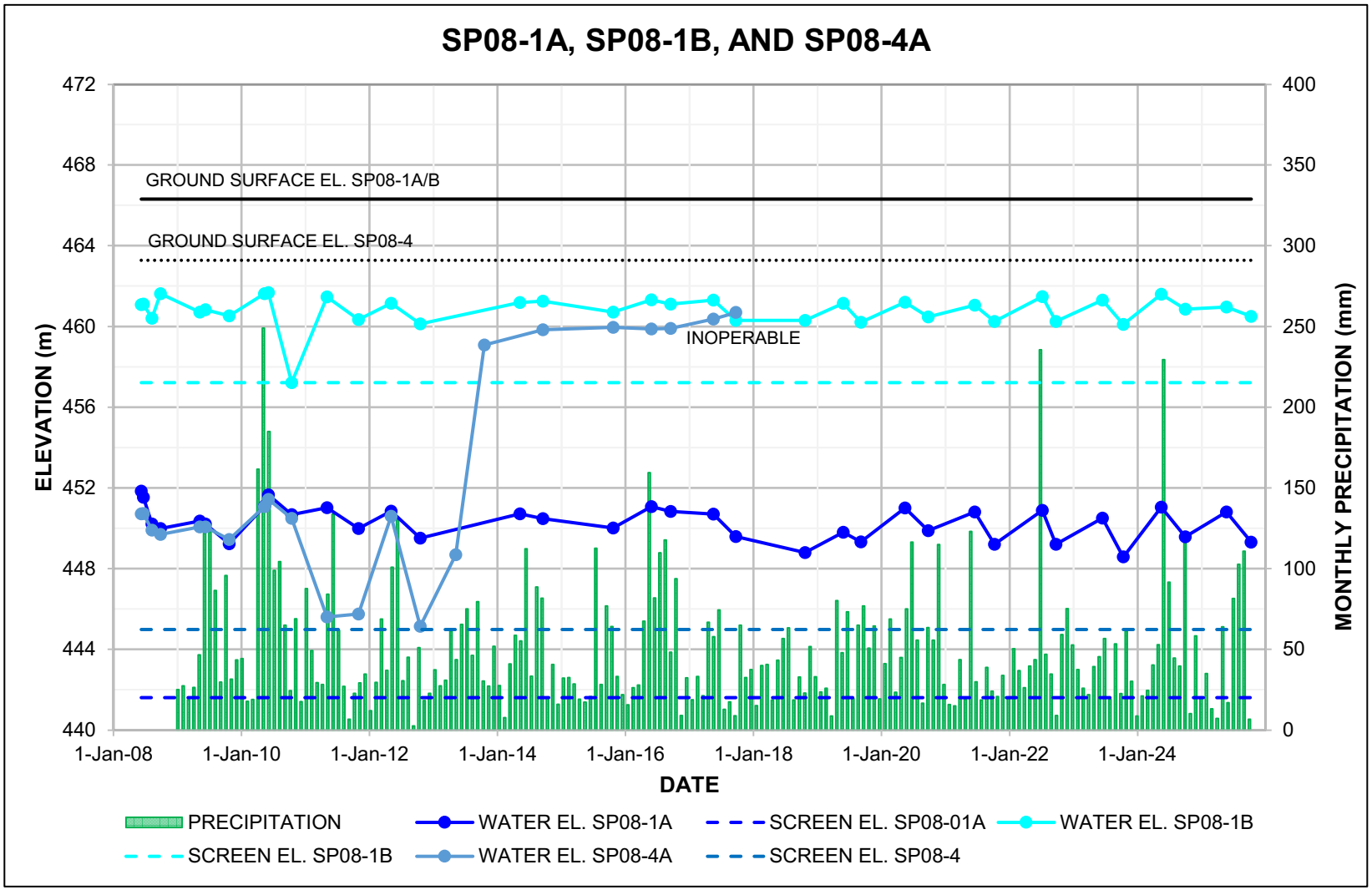


S026; H41:03, Elkwater Slides, Area B, Inclinometer SI12-01

Alberta Transportation



NOTES:
1. MONTHLY PRECIPITATION DATA OBTAINED FROM THE ALBERTA CLIMATE INFORMATION SERVICE (ACIS) DATABASE, REFERENCING MEDICINE LODGE STATION.

CLIENT: Alberta

Klohn Crippen Berger

PROJECT: SOUTHERN REGION GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE: Piezometer Data
S026 - Elkwater Slide Area A
Hwy 41:03, km 35.169

SCALE	PROJECT No.	FIG No.
	A05116A03	