THURBER ENGINEERING LTD.

July 26, 2022 File No.: 32121

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

Attention: Mr. Max Shannon

ALBERTA TRANSPORTATION GRMP (CON0022164)
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING RESULTS – SPRING 2022

SECTION C

SITE PH072: HWY 744:04, JUDAH HILL (SUNSHINE SLIDE)

Dear Mr. Shannon:

This report provides the results of the annual geotechnical instrumentation monitoring for the above-mentioned site as part of Alberta Transportation's Geohazard Risk Management Program for Peace Region – Peace River District (CON0022164).

It is a condition of this letter report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

1. FIELD PROGRAM AND INSTRUMENTATION STATUS

In 2014, an anchored tangent pile wall was installed at the Hwy 744:04 Sunshine Slide site to repair a landslide that had closed the road the previous year. Three slope inclinometers (Pile 34, Pile 59 and Pile 82) were installed in the pile wall to monitor future slope movements. Six load cells (VC1805, VC1806, VC1801, VC1802, VC1803 and VC1804) were installed on the tie-back anchors as they were locked off and connected to a RST DT2040 datalogger. The SIs and load cell datalogger were read on June 14, 2022, by Mr. Niraj Regmi, G.I.T. and Mr. Jayden Del Cid, both of Thurber Engineering Ltd.

The SIs were read using a RST Digital Inclinometer probe with a 2 ft wheelbase and a RST Pocket PC readout. Inclinometer reading depths were defined as per cable markings with respect to the top of the inclinometer casings.

2. DATA PRESENTATION

2.1 General

SI plots for A and B directions are included in in Appendix A. Where movement has been recorded the resultant plot (X direction, if applicable) and rate of movement have also been provided. SI and load cell summary tables are also provided below.

2.2 Zones of Movement

Zones of new movement were not observed in the SIs since the previous readings in the spring of 2021.

Zones of movements are summarized in Table PH072-1 below. Table PH072-1 also provides a historical account of the total movement, the depth of movement and the maximum rate of movement that has occurred in the SIs since initialization.

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TABLE PH072-1
SPRING 2022 – HWY 744:04 JUDAH HILL (SUNSHINE SLIDE)
SLOPE INCLINOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: June 14, 2022

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/y)
Pile 34	July 4, 2015	0.4 over 2.5 m to 19.5 m depth in 221° direction (pile only)	5.4 in September 2019	Operational	July 10, 2021	No discernible movement	N//A	-0.7
		-0.9 over 0.0 m to 19.5 m depth in 221° direction (pile and waler)	8.4 in September 2019			No discernible movement	N//A	-1.9
Pile 59	July 4, 2015	4.3 over 2.4 m to 19.5 m depth in 241° direction (pile only)	12.8 in July 2015	Operational	July 10, 2021	0.2	0.2	0.9
		5.1 over 0.0 to 19.5 m depth in 241° direction (pile and waler)	25.8 in July 2015			0.7	0.7	2.3
Pile 82	July 4, 2015	5.7 over 2.4 m to 19.5 m depth in 238° direction (pile only)	16.3 in July 2015	Operational	July 10, 2021	<0.1	<0.1	-1.8
		4.7 over 0.0 m to 19.5 m depth in 238° direction (pile and waler)	18.5 in July 2015			No discernible movement	N/A	-0.8

Drawings 32121-PH072-1 and 32121-PH072-2 in Appendix A provide a sketch of the approximate location of the monitoring instrumentation for this site.

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TABLE PH072-2
SPRING 2022 – HWY 744:04 JUDAH HILL (SUNSHINE SLIDE)
LOAD CELL INSTRUMENTATION READING SUMMARY

Date Monitored: June 14, 2022

ANCHOR NUMBER	SERIAL #	DESIGN SERVICE LOAD / LOCK-OFF LOAD (kN)	MAXIMUM RECORDED LOAD (kN)	RECORDED LOAD (JUNE 14, 2022) (1) (kN)	PREVIOUS RECORDED LOAD (JULY 11, 2021) (1) (kN)	CHANGE IN LOAD SINCE PREVIOUS READING (kN)
34U	VC1805	192/162	178.28 on April 4, 2015	160.43	162.89	-2.46
34L	VC1806	192/162	164.65 on November 13, 2014	136.16	138.55	-2.39
60U	VC1801	192/162	229.43 on January 6, 2022	213.05	210.13	2.92
60L	VC1802	192/162	225.51 on January 16, 2022	213.75	210.76	2.99
82U	VC1803	192/162	190.54 on January 13, 2022	177.75	176.73	1.02
82L	VC1804	192/162	188.94 on January 16, 2022	180.97	178.55	2.42

Drawings 32121-PH072-1 and 32121-PH072-2 in Appendix A provide a sketch of the approximate location of the monitoring instrumentation for this site.

1. Load cell data is recorded twice daily with datalogger on site. Dataloggers are uploaded twice annually during instrumentation readings. See Figure PH072-1 in Appendix A for combined historical instrument readings. Datalogger battery was dead between November 14, 2018 to July 25, 2019, October 27, 2019 to June 11, 2020, and between June 27, 2020 to July 10, 2021.

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3. INTERPRETATION OF MONITORING RESULTS

Pile 34 showed no discernible movement over either the length of the pile or the combined length of the pile and waler since the spring of 2021 readings. Pile 34 has shown a total cumulative pile head movement of 0.4 mm in the downslope direction since completion of construction and a total cumulative movement of 0.9 mm in the upslope direction over the combined length of the pile and waler.

Pile 59 showed a rate of movement of 0.2 mm/yr over the length of the pile and a rate of movement of 0.7 mm/yr over the combined length of the pile and waler since the spring of 2021 readings. Pile 59 has shown a total cumulative pile head movement of 4.3 mm in the downslope direction since completion of construction with a total cumulative movement of 5.1 mm in the downslope direction over the combined length of the pile and waler.

Pile 82 showed a rate of movement of less than 0.1 mm/yr over the length of the pile and no discernible movement over the combined length of the pile and waler since the spring of 2021 readings. Pile 82 has shown a total cumulative pile head movement of 5.7 mm in the downslope direction since completion of construction and a total cumulative movement of 4.7 mm in the downslope direction over the combined length of the pile and waler.

The six load cells (VC1805, VC1806, VC1801, VC1802, VC1803 and VC1804) are connected to an RST DT2040 datalogger which was initially programmed to take readings once per day. Starting in the spring of 2015, the datalogger was reprogrammed to take readings twice per day. The latest load cell readings, as of June 14, 2022, show minor changes compared to the previous readings taken in on July 11, 2021. The changes range from a decrease of 2.46 kN in load cell VC1805 (anchor 34U) to an increase of 2.99 kN in VC1802 (anchor 60L). Load cells VC1801 (anchor 60U), VC1802 (anchor 60L), VC1803 (anchor 82U) and VC1804 (anchor 82L) measured all-time high loads during a period from January 6-16, 2022. These high anchor loads appear to correspond to a period of extreme cold weather from late December 2021 to early January 2022. It should also be noted that load cells C1801 (anchor 60U), VC1802 (anchor 60L) are showing loads that are slightly higher than the design loads.

The load cell readings are summarized in Table PH072-2 above and are plotted in Figure PH072-1 in Appendix A. Overall, the load cells show a trend of stable loads over the past several readings cycles.

Overall, the SI and load cell readings show that the pile wall has been effective in stabilizing the landslide movement at this site.

4. RECOMMENDATIONS

4.1 Future Work

The instruments should be read again in the spring of 2023.

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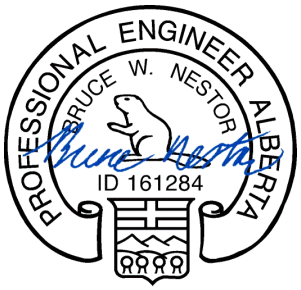
4.2 Instrumentation Repairs

No instrument repairs are required at this time.

5. CLOSURE

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.
Tarek Abdelaziz, Ph.D., P. Eng.
Principal | Senior Geotechnical Engineer



July 29, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 91085
DATE: July 29, 2022
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Bruce Nestor, P.Eng.
Geotechnical Engineer
/jf

Attachments:

- Statement of Limitations and Conditions
- Appendix A
  - Field Inspector's report
  - Site Plan Showing Approximate Instrument Locations (Drawings No. 32121-PH072-1 and 32121-PH072-2)
  - SI Reading Plots
  - Figure PH072-1(Load Cell Readings)

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STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

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.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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ALBERTA TRANSPORTATION GRMP (CON0022164)
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING RESULTS

SPRING 2022

APPENDIX A
DATA PRESENTATION

SITE PH072: HWY 744:04, JUDAH HILL (SUNSHINE SLIDE)

ALBERTA TRANSPORTATION
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (PH072)
SPRING 2022

Location:	Sunshine Slide - Judah Hill (HWY 744:04 C1 58.154)	**Readout:**	
File Number:	32121	**Extension:**	2.75
Probe:	RST set 8R	**Temp:**	21
Cable:	RST set 8R	**Read by:**	NKR/JD

SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location (UTM 11)		Date	Stickup (m)	Depth from top of casing (ft)	Magn. North A+ Groove	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Northing (m)	Easting (m)					A+	A-	B+	B-		
Pile 34	6230075	483111	14-Jun-22	0.88	66 to 2	215	-522	530	572	-566	8R/8R	
Pile 59	6230103	483098	14-Jun-22	0.91	66 to 2	210	16	-6	-556	562	8R/8R	
Pile 82	6230124	483082	14-Jun-22	0.93	66 to 2	170	229	-18	140	-133	8R/8R	

VIBRATING WIRE LOAD CELL (VC) READINGS

VC#	GPS Location (UTM 11)		Datalogger Serial #	Date	Remarks
	Easting (m)	Northing (m)			
VC1801-VC1806			RST 0	14-Jun-22	Downloaded

INSPECTOR REPORT

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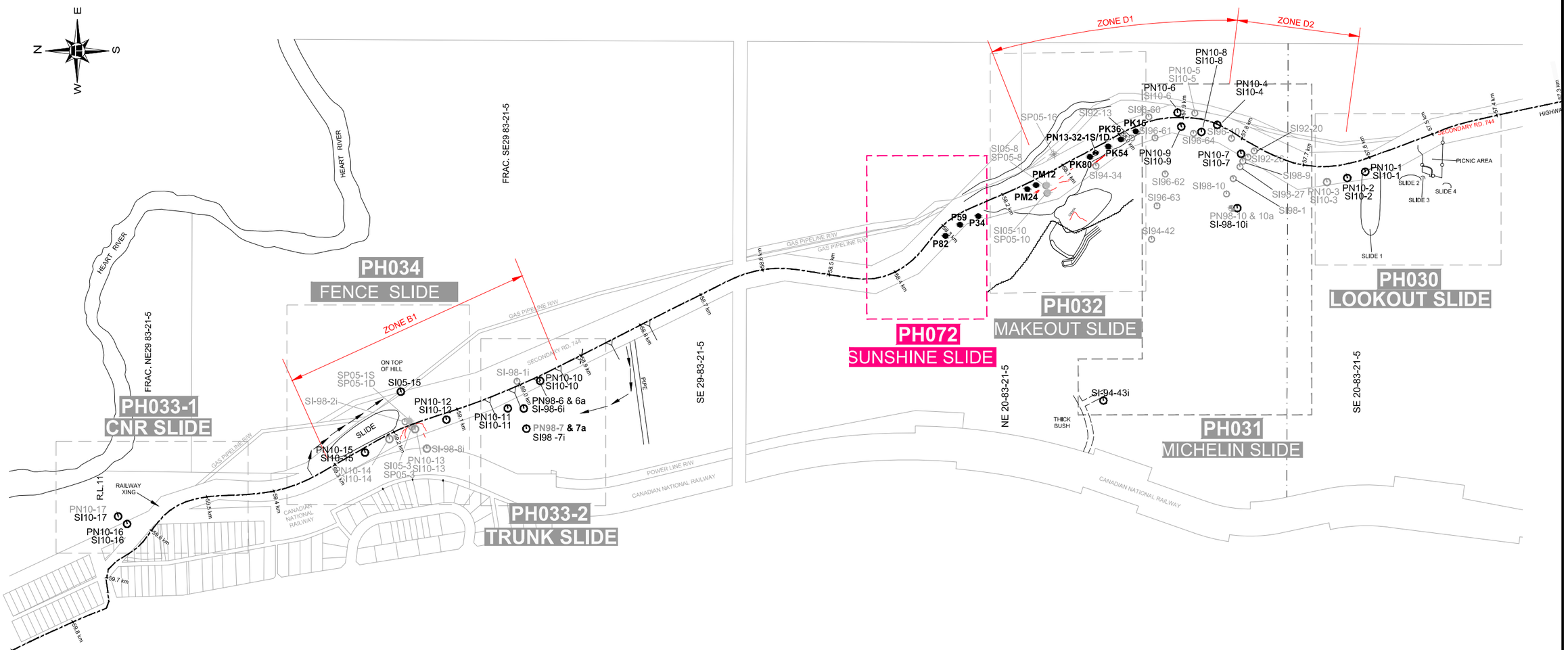

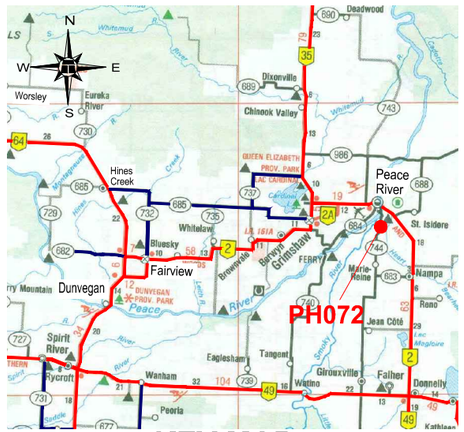

KEY MAP
NOT TO SCALE

LEGEND

- PN — APPROX. PNEUMATIC PIEZOMETER LOCATION
- SP — APPROX. STANDPIPE PIEZOMETER LOCATION
- SI — APPROX. SLOPE INCLINOMETER LOCATION
- SP — APPROX. STANDPIPE PIEZOMETER LOCATION *(CURRENTLY NOT IN USE)*
- SI — APPROX. SLOPE INCLINOMETER LOCATION *(CURRENTLY NOT IN USE)*
- APPROXIMATE PILE LOCATION

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PEACE REGION (PEACE RIVER DISTRICT)

PH072: HWY 744:02 - JUDAH HILL(SUNSHINE SLIDE) INSTRUMENT LOCATIONS

DWG No. 32121-PH072-1

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	DWP
SCALE	APPROX. 1:6000
DATE	SEPTEMBER 2021
FILE No.	32121

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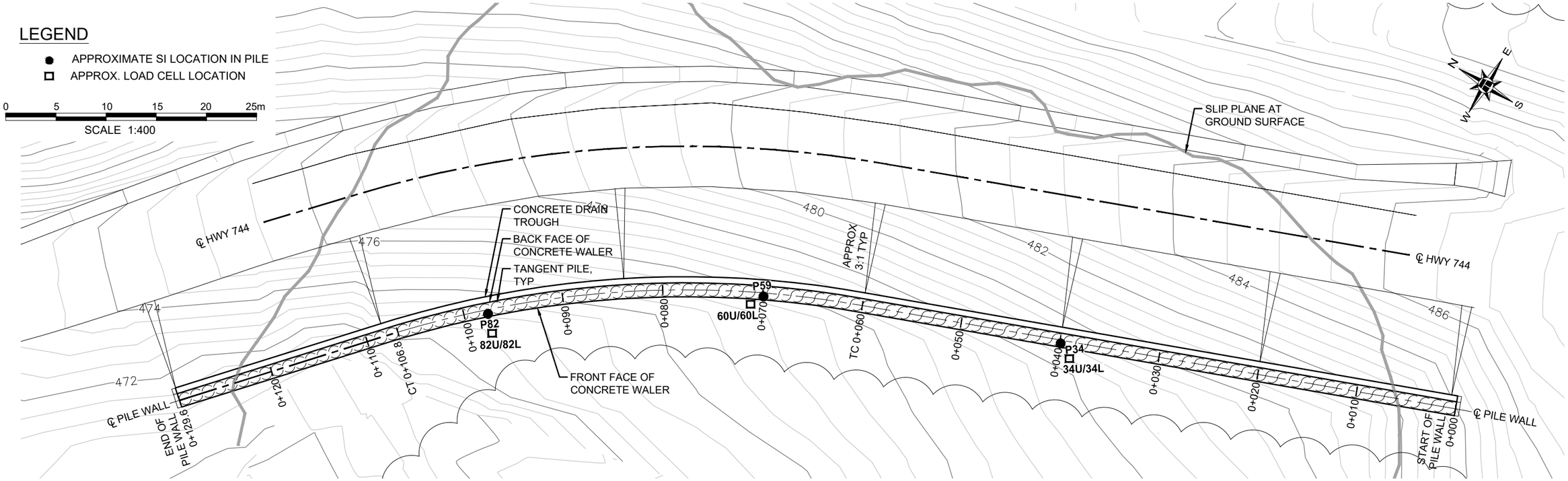
LEGEND

- APPROXIMATE SI LOCATION IN PILE
- APPROX. LOAD CELL LOCATION

0 5 10 15 20 25m

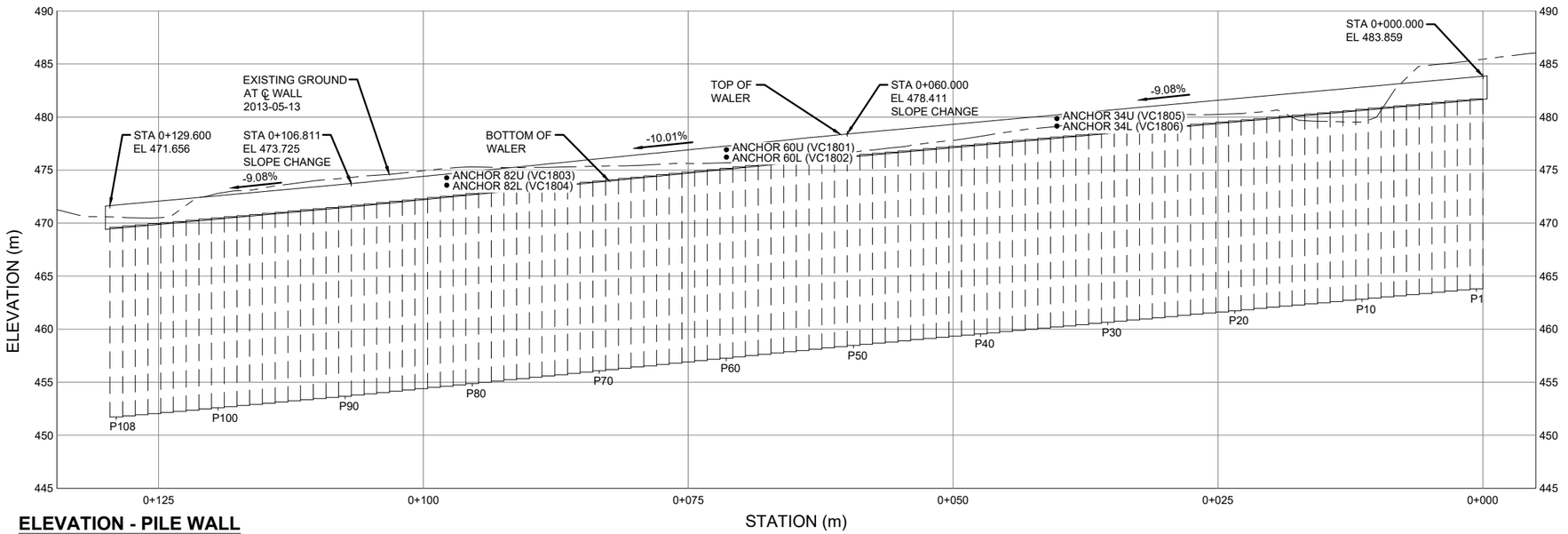
SCALE 1:400



SITE PLAN

SCALE 1:400

PILE NO.	NORTHING (m)	EASTING (m)
P34	6230075.448	483111.042
P59	6230102.621	483098.357
P82	6230124.419	483081.571



ELEVATION - PILE WALL

SCALE 1:500

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

PH072: HWY 744:02 - JUDAH HILL(SUNSHINE SLIDE) INSTRUMENT LOCATIONS

DWG No. 32121-PH072-2

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	SEPTEMBER 2021
FILE No.	32121

THURBER ENGINEERING LTD.

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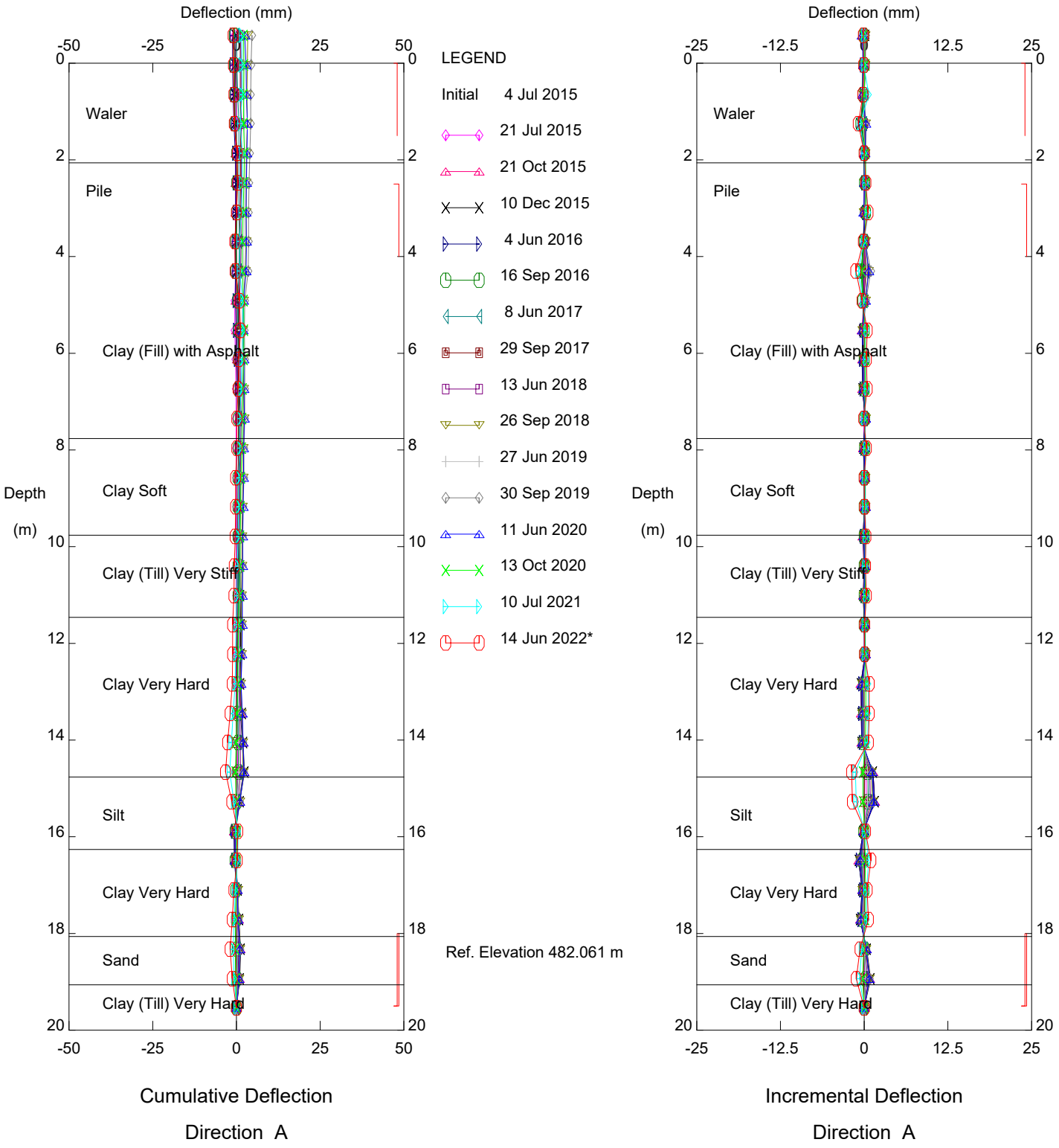

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

PH072 Sunshine (Post Construction), Inclinometer Pile 34

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

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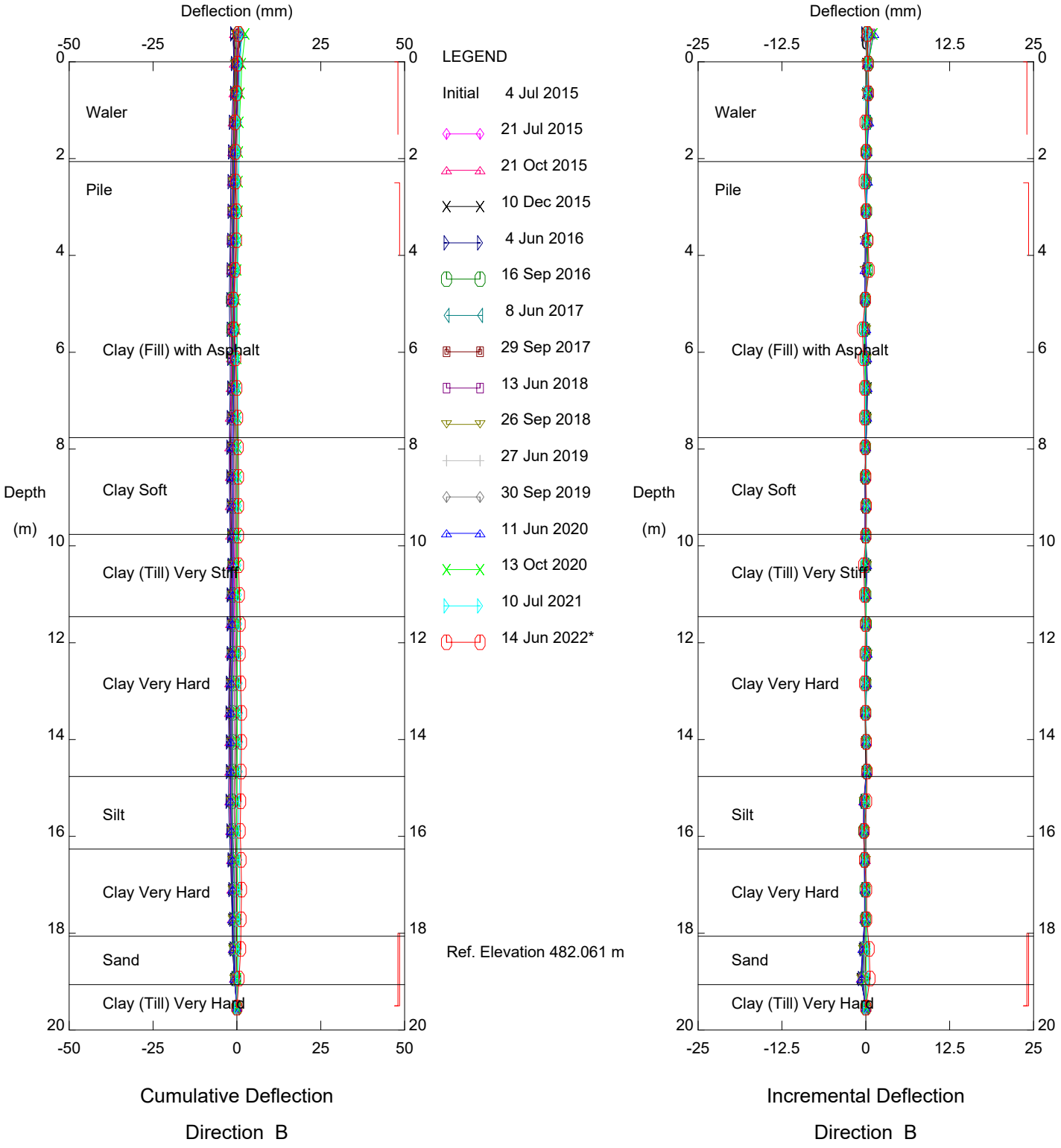

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

PH072 Sunshine (Post Construction), Inclinometer Pile 34

Alberta Transportation

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

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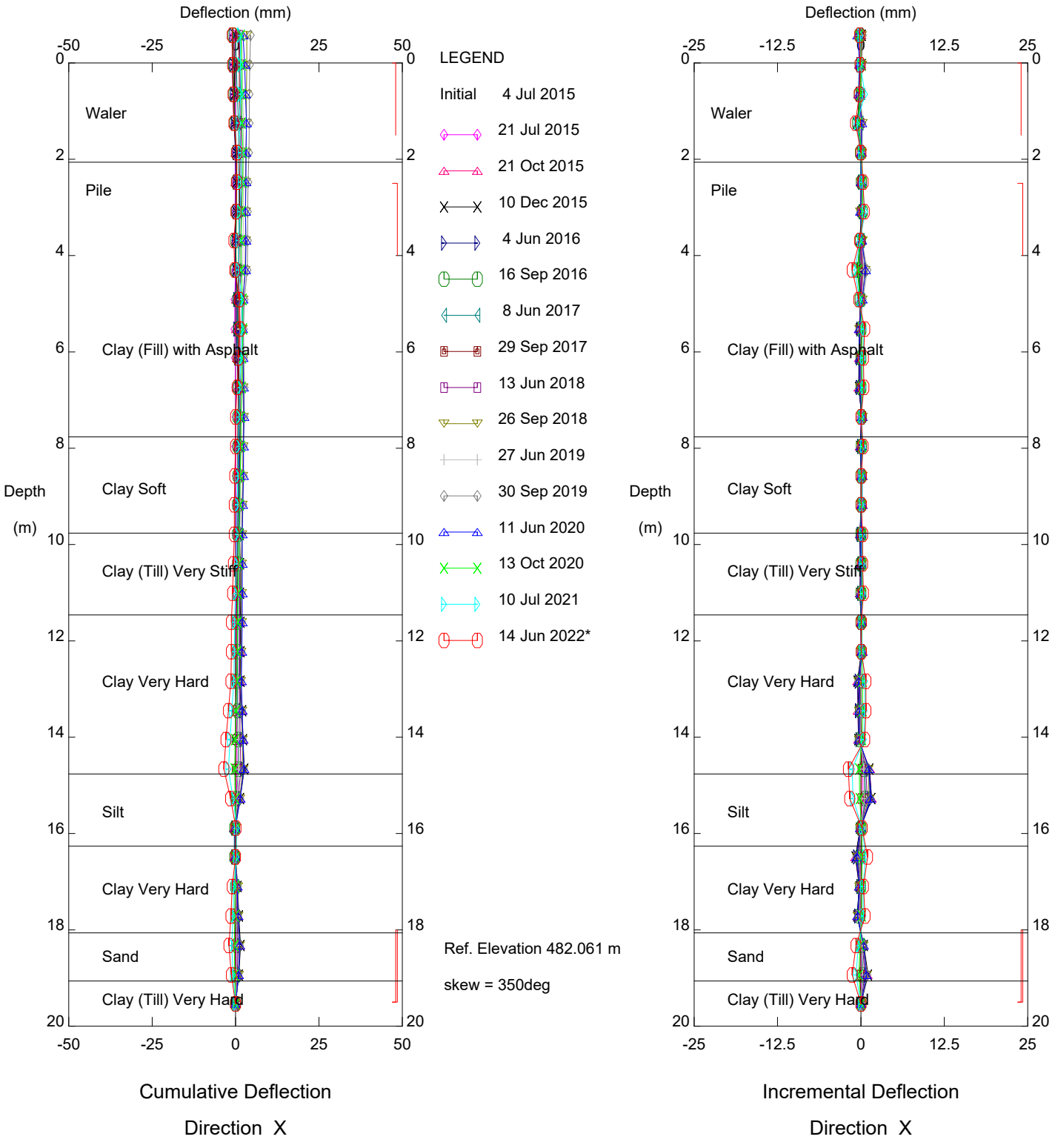

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

PH072 Sunshine (Post Construction), Inclinometer Pile 34

Alberta Transportation

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

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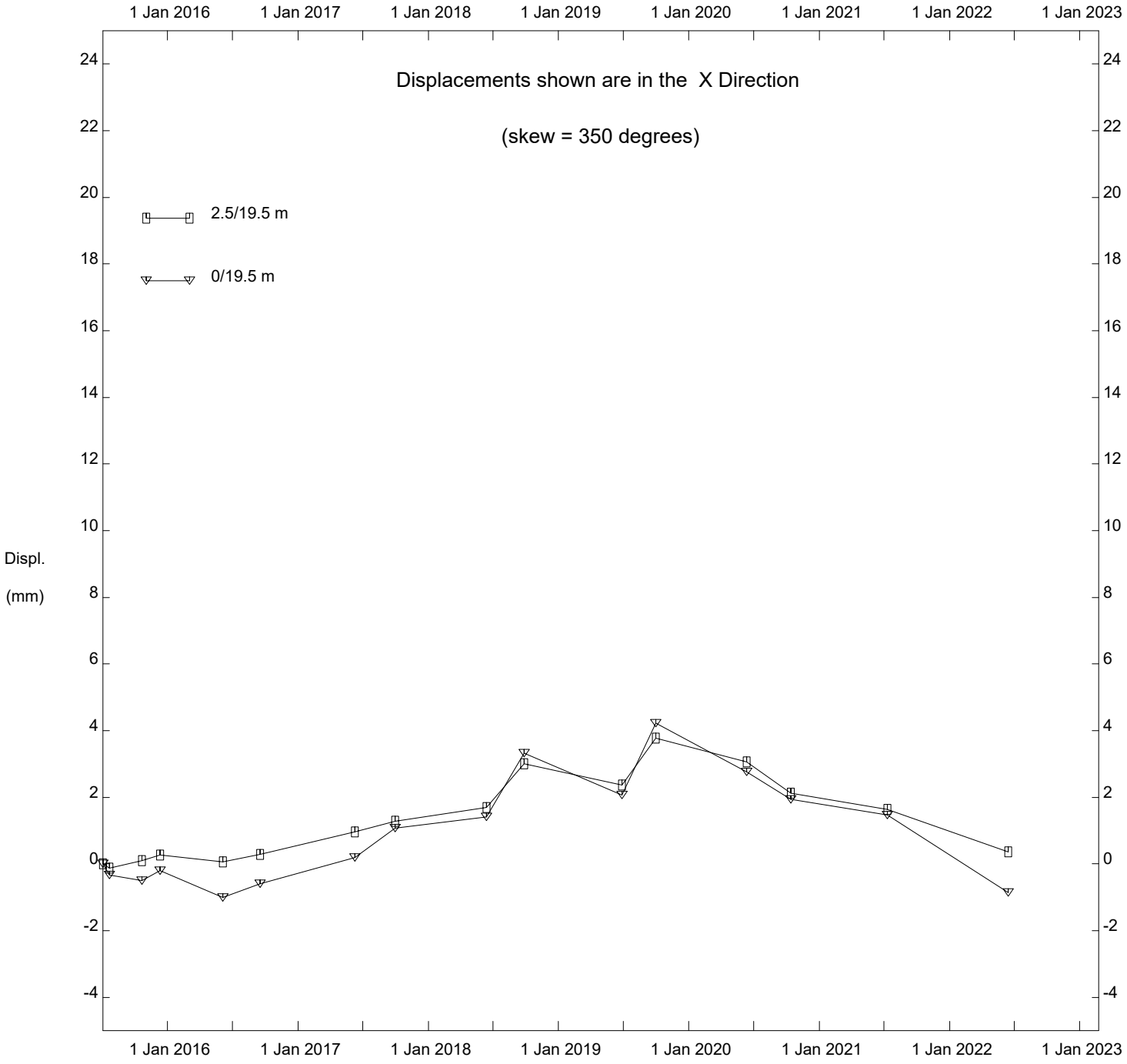

PH072 Sunshine (Post Construction), Inclinometer Pile 34

Alberta Transportation

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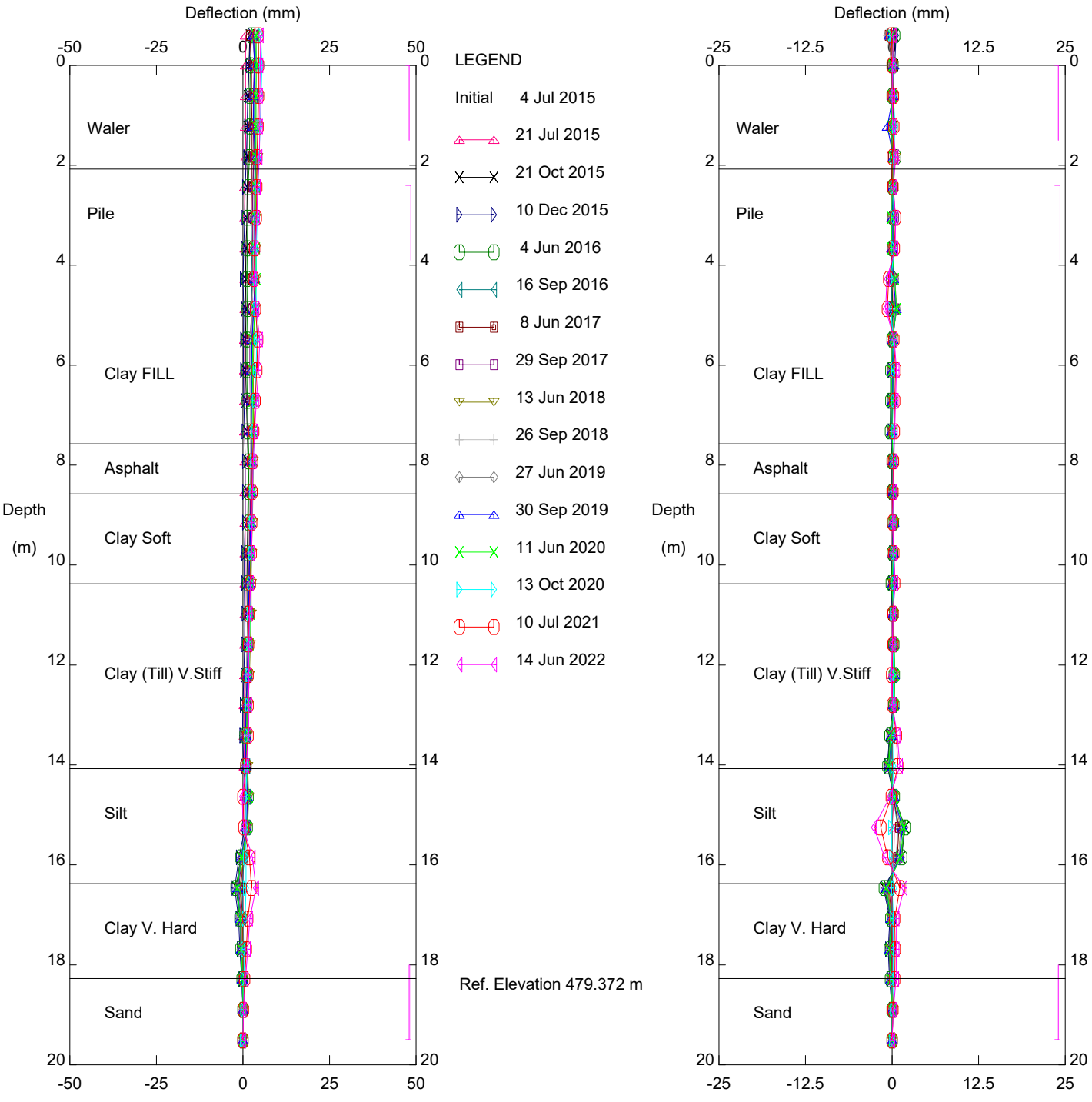

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

PH072 Sunshine (Post Construction), Inclinometer Pile 59

Alberta Transportation

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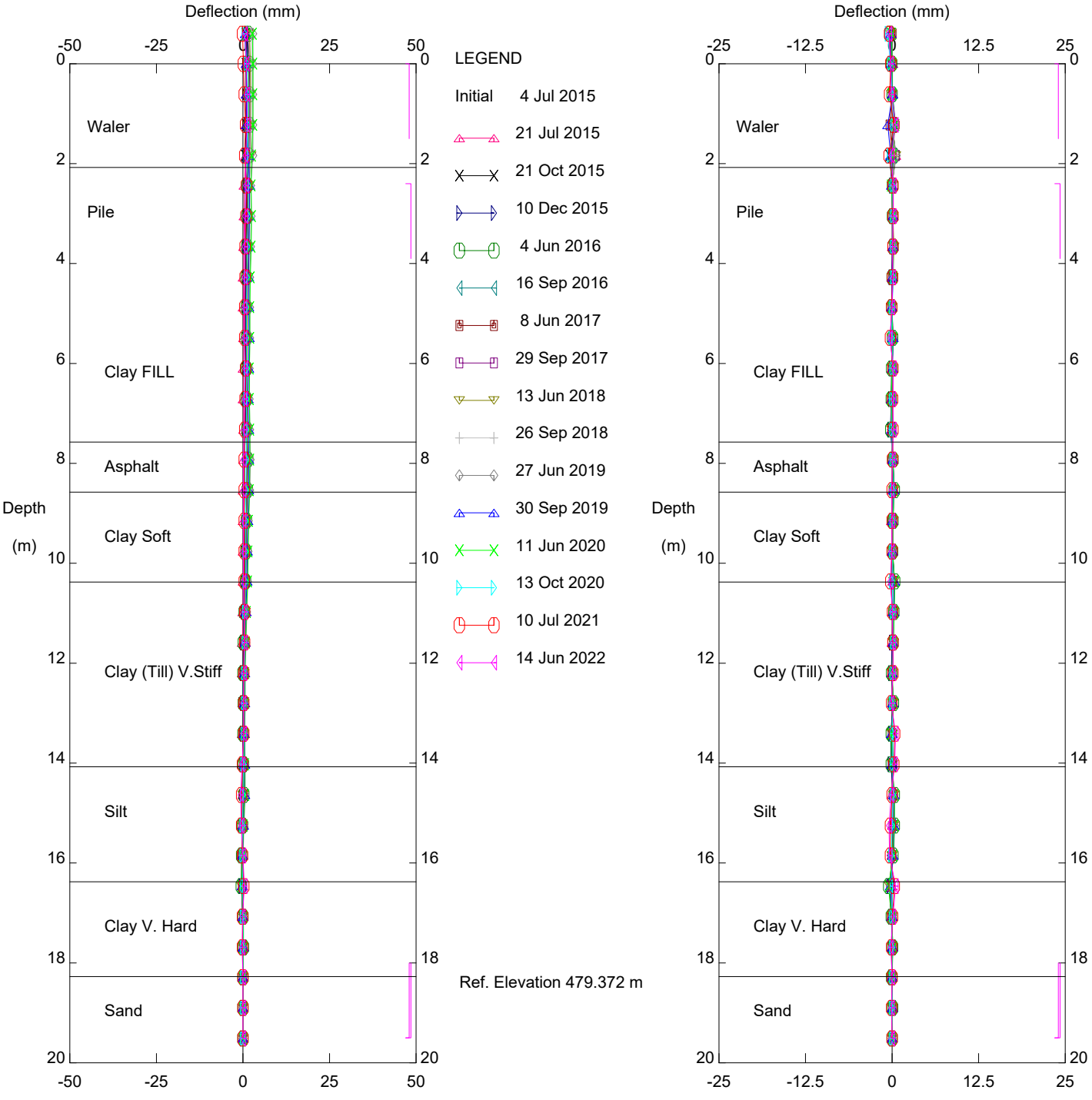

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

PH072 Sunshine (Post Construction), Inclinometer Pile 59

Alberta Transportation

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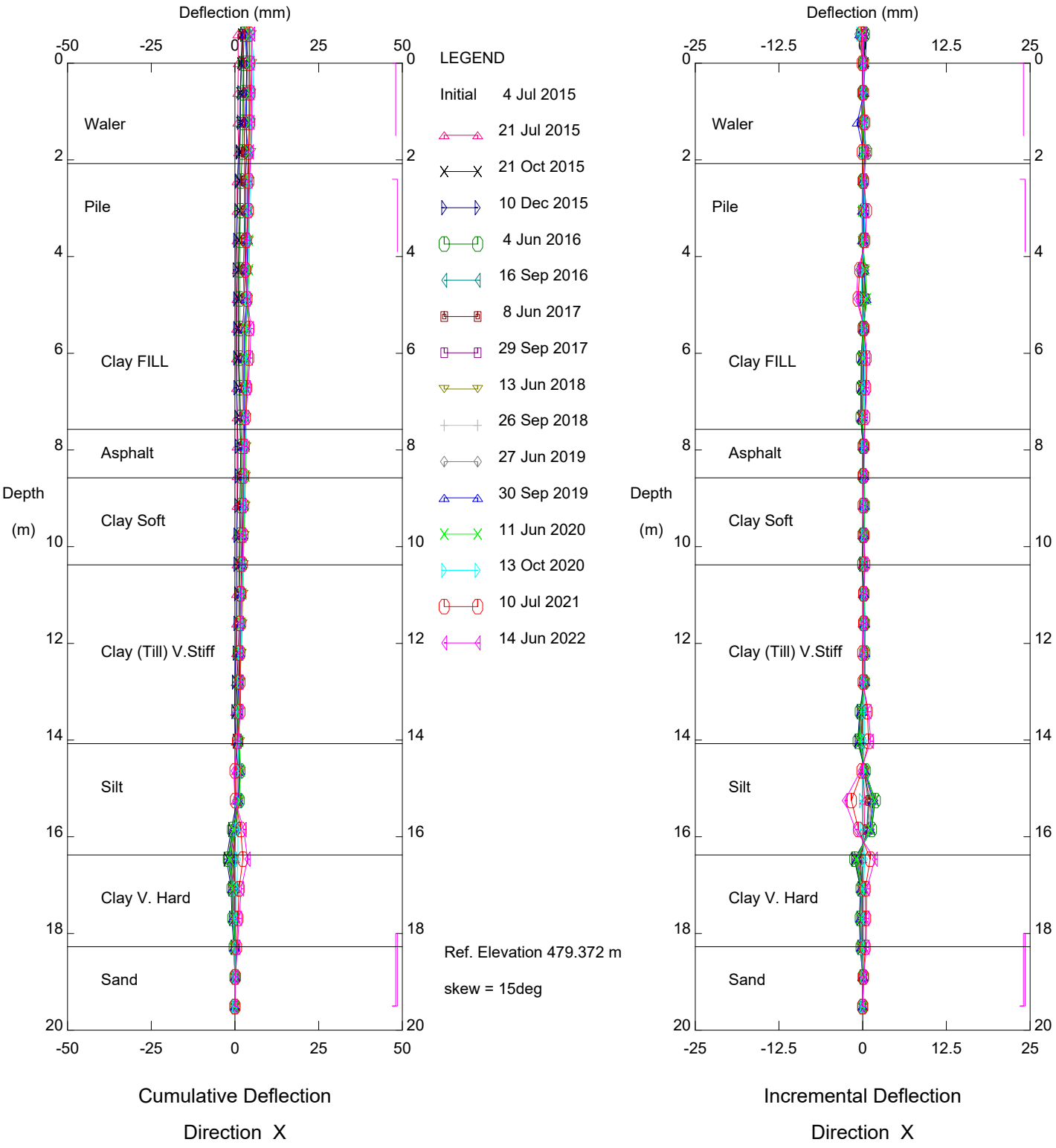

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

PH072 Sunshine (Post Construction), Inclinometer Pile 59

Alberta Transportation

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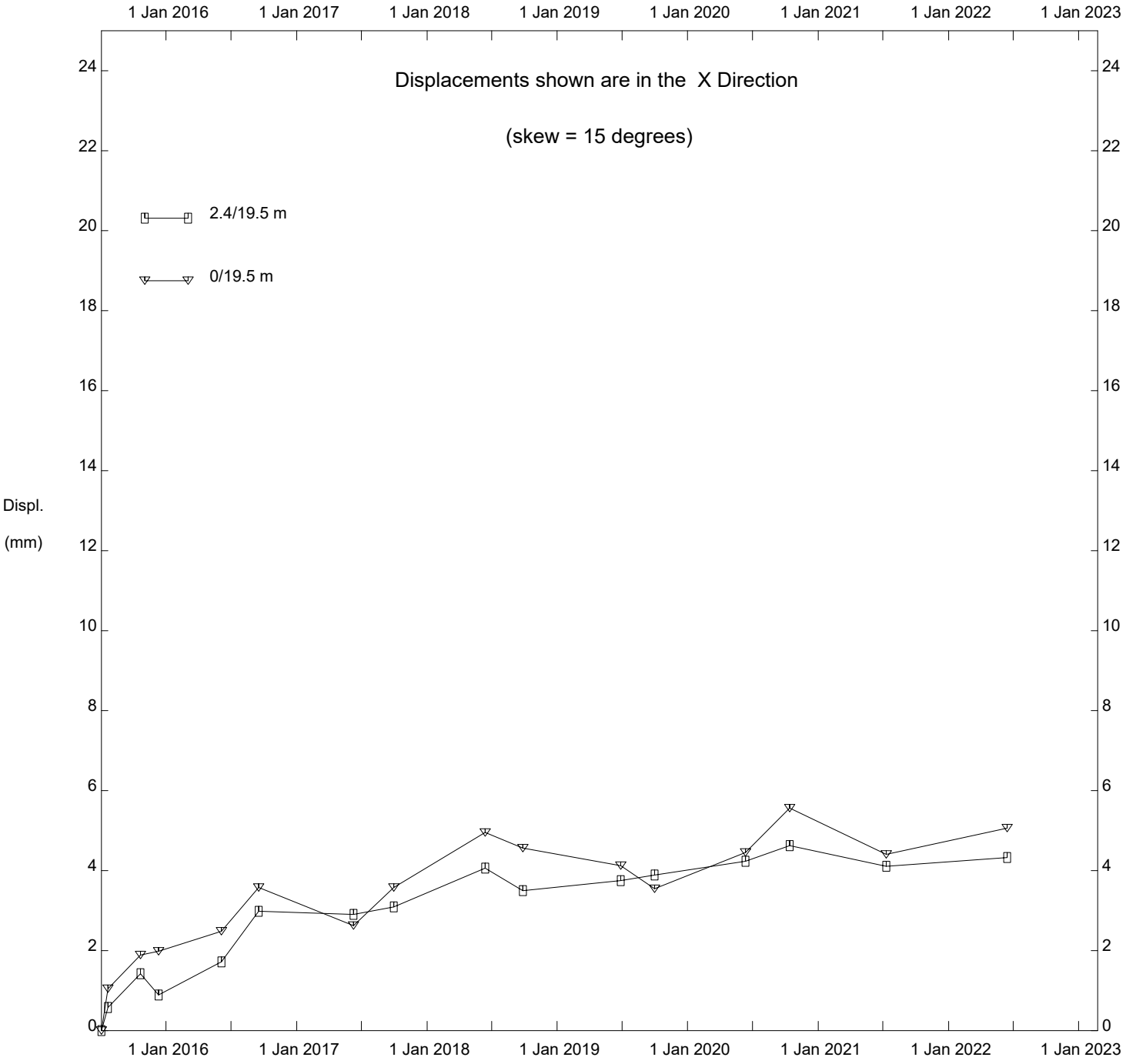
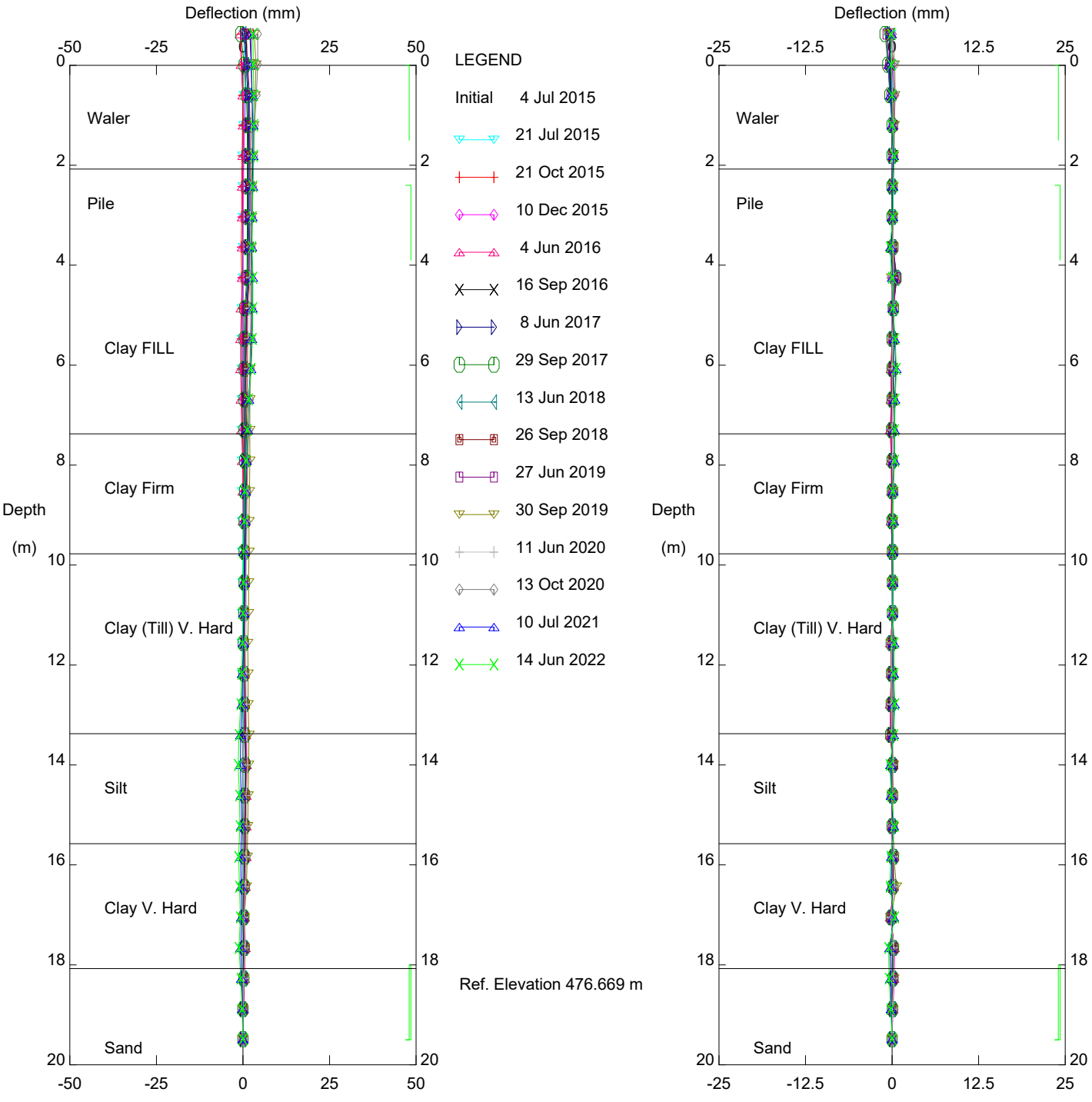


PH072 Sunshine (Post Construction), Inclinometer Pile 59

Alberta Transportation

Thurber Engineering Ltd



Cumulative Deflection

Direction A

Incremental Deflection

Direction A

PH072 Sunshine (Post Construction), Inclinometer Pile 82

Alberta Transportation

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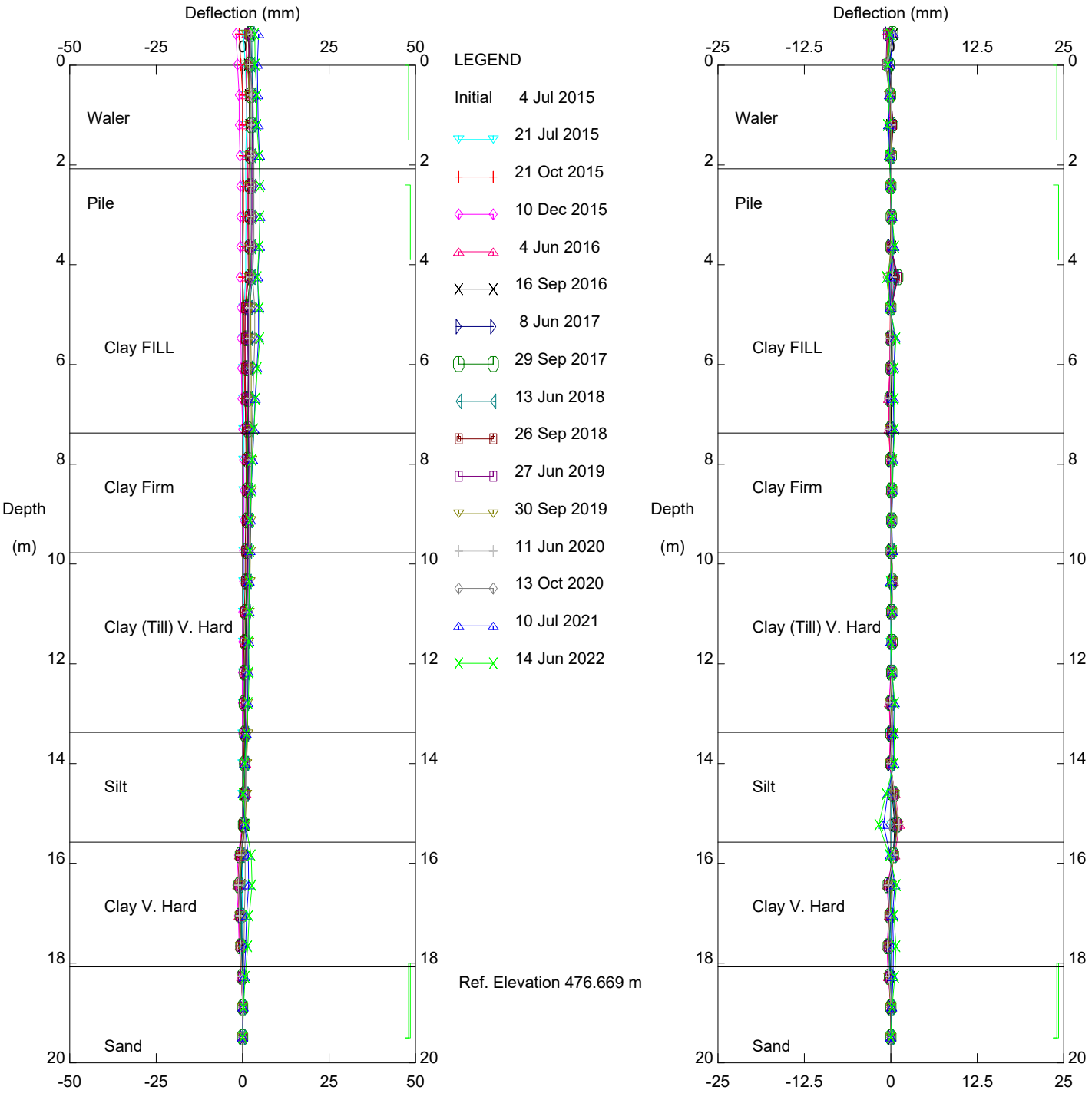

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

PH072 Sunshine (Post Construction), Inclinometer Pile 82

Alberta Transportation

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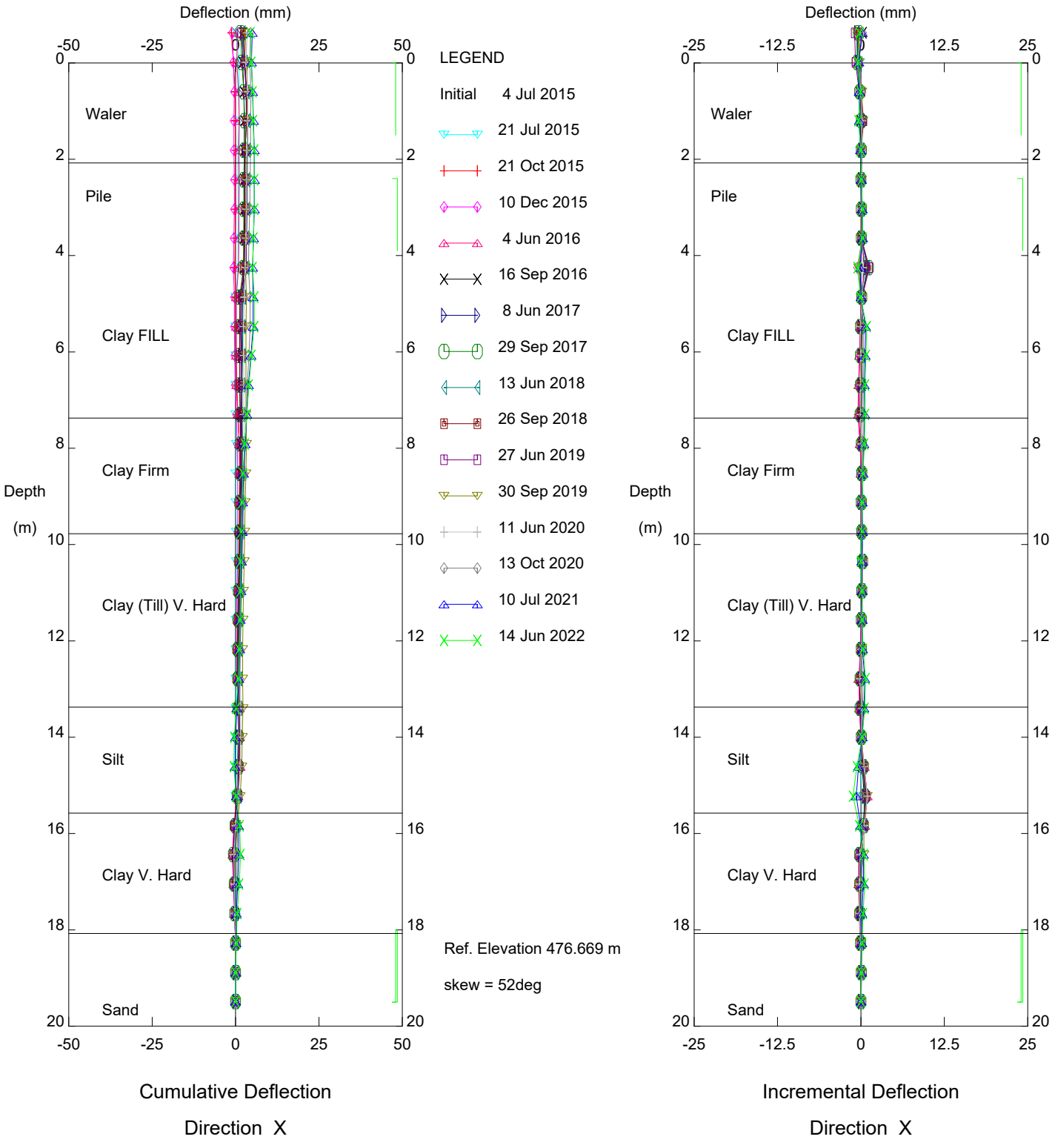

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

PH072 Sunshine (Post Construction), Inclinometer Pile 82

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Thurber Engineering Ltd

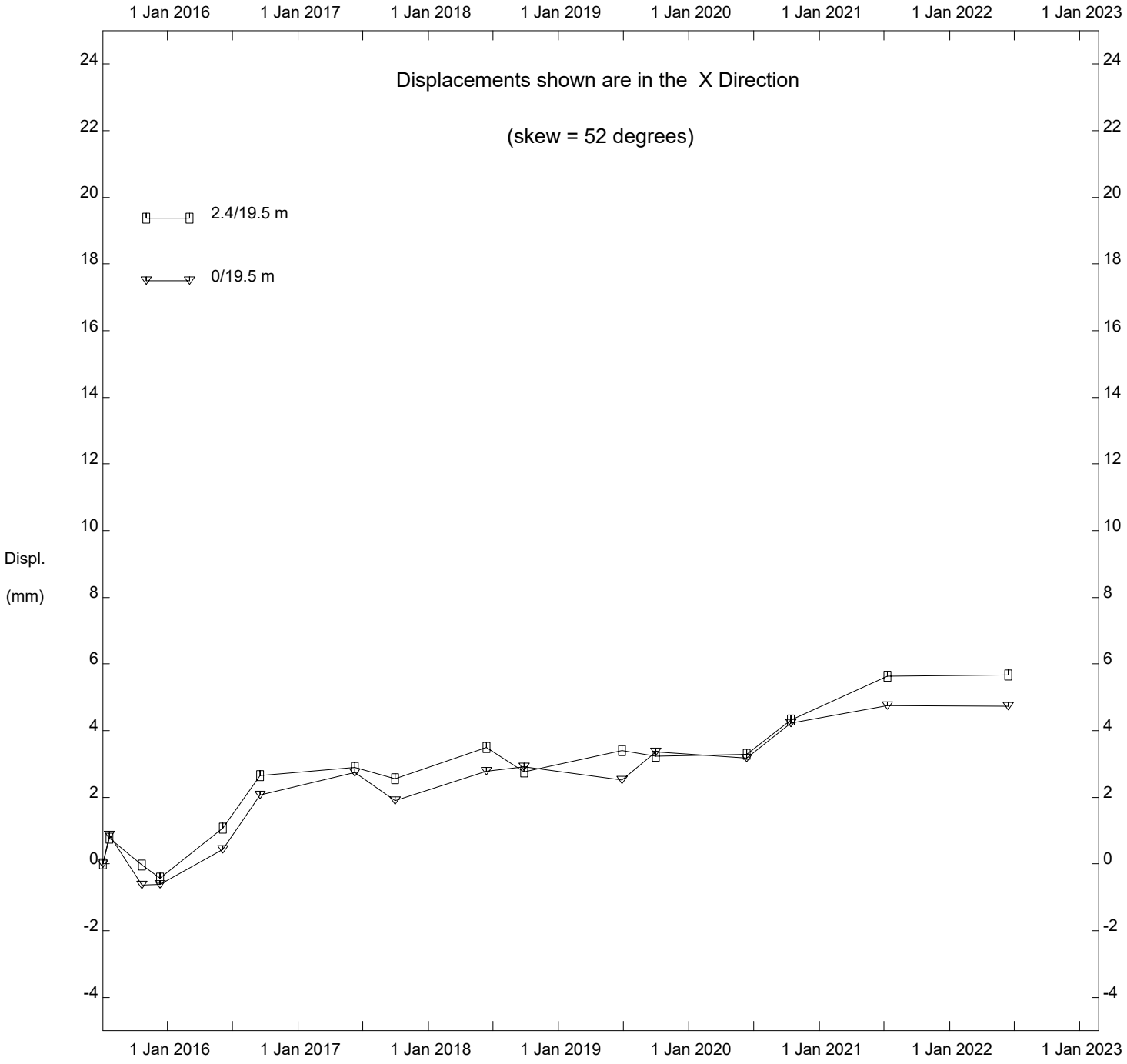

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FIGURE PH072-1
SUNSHINE PILE WALL - LOAD CELLS