THURBER ENGINEERING LTD.

October 26, 2022 File No.: 32122

Alberta Transportation
Construction and Maintenance Division
North Central Region
Box 4596, 4513 – 62 Avenue
Barrhead, Alberta
T7N 1A5

Attention: Ms. Amy Driessen, P.Eng.

ALBERTA TRANSPORTATION GRMP (CON0022163)
NORTH CENTRAL (ATHABASCA AND FORT McMURRAY DISTRICTS)
INSTRUMENTATION MONITORING RESULTS – FALL 2022

SECTION C

SITE NC008: HWY 63:02 NORTH OF LA BICHE RIVER

Dear Ms. Driessen:

This report provides the results of the bi-annual geotechnical instrumentation monitoring for the above-mentioned site as part of Alberta Transportation's Geohazard Risk Management Program for North Central – Athabasca and Fort McMurray Districts (CON0022163).

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

Two slope inclinometers (SI1B and SI20-2), one standpipe piezometers (SP20-1), and two vibrating wire piezometers (VW20-2A and VW20-2B) were read at the Hwy 63:02 North of La Biche River site on September 21, 2022, by Mr. Niraj Regmi, G.I.T. and Mr. Kyle Crooymans, both of Thurber Engineering Ltd. Standpipe piezometer SP20-3 was damaged by a mower since the previous reading in the spring of 2022 and could not be read.

A site plan showing the approximate instrumentation locations is included in Appendix A.

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. The standpipe piezometer was read using a DGSI dipmeter. The vibrating wire piezometers were read using an RST VW 2106 digital readout.

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. Standpipe and vibrating wire piezometer plots are also provided in Appendix A.

Slope inclinometer and piezometer reading summary tables are provided below. These tables also include instruments deleted from the GRMP for future reference.

2.2 Zones of Movement

No zones of new movement were observed in the SIs since the previous readings in the spring of 2022.

Zones of movement are summarized in Table NC008-1 below. Table NC008-1 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 NC008-1
FALL 2022 – HWY 63:02 NORTH OF LA BICHE RIVER
SLOPE INCLINOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: September 21, 2022

INSTRUMENT #	DATE INITIALIZED	TOTAL CUMULATIVE RESULTANT MOVEMENT AND DEPTH OF MOVEMENT TO DATE (mm)	MAXIMUM RATE OF MOVEMENT (mm/yr)	CURRENT STATUS OF SI	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)
SI1A	*December 6, 1996*	*25.9 over 3.5 m to 5.4 m in 302° direction*	*13.1 in October 1997*	*Sheared or blocked at 3.2 m depth*	*May 22, 2003*	*N/A*	*N/A*	*N/A*
		16.1 over 6.0 m to 8.4 m in 302° direction	*6.3 in May 1997*			*N/A*	*N/A*	*N/A*
SI1B	December 6, 1996	86.2 over 4.8 m to 8.4 m depth in 246° direction	16.3 in October 1997	Operational	May 28, 2022	2.7	8.4	6.7
SI4A	*October 21, 1997*	*54.3 over 0.5 m to 2.4 m depth in 271° direction*	*17.7 in May 2003*	*Not read**	*Sep. 28, 2020*	*N/A*	*N/A*	*N/A*
SI4B	*October 21, 1997*	*27.8 over 1.1 m to 2.9 m depth in 308° direction*	*20.8 in June 1998*	*Presumed destroyed*	*May 22, 2003*	*N/A*	*N/A*	*N/A*
		16.5 over 5.9 m to 7.8 m depth in 308° direction	*10.3 in June 1998*			*N/A*	*N/A*	*N/A*
SI20-2	December 21, 2021	8.0 over 3.8 m to 7.4 m depth in 297° direction	15.8 in March 2021	Operational	May 28, 2022	2.9	9.1	6.2

Drawing 32122-NC008 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.
* SI4A was deleted from the current GRMP.

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TABLE NC008-2
FALL 2022 – HWY 63:02 NORTH OF LA BICHE RIVER
PNEUMATIC PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: Not monitored

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH** (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER LEVEL BGS (m)	MEASURED PORE PRESSURE (kPa)	CURRENT GROUNDWATER LEVEL BGS (m)	PREVIOUS GROUNDWATER LEVEL BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
PN1 (34455)	*November 20, 1996*	*17.06*	*-*	*Active*	*-0.77 m on September 28, 2020*	*N/A*	*N/A*	*-0.77**	*N/A*
PN2 (18199)	*November 20, 1996*	*7.60*	*-*	*Active*	*-1.03 on September 28, 2020*	*N/A*	*N/A*	*-1.03**	*N/A*

* Installed within the limits of the repaired site in 1997; negative values correspond to an above-ground (artesian) groundwater level.
** Reported tip depths, based on previous reports, may not account for fill placed during berm construction in 1997.
Note: pneumatic piezometers are not included in the current GRMP, and readings were therefore not included.

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TABLE NC008-3
FALL 2022 – HWY 63:02 NORTH OF LA BICHE RIVER
STANDPIPE PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: September 21, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER LEVEL BGS (m)	CURRENT GROUNDWATER DEPTH BGS (m)	PREVIOUS GROUNDWATER DEPTH BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
SP20-1	Nov. 28, 2020	20.70	-	Operational	1.46 on September 21, 2022	1.46	1.74	0.28
SP20-3	*Nov. 26, 2020*	*20.80*	-	*Damaged*	*2.45 on December 21, 2020*	*N/A*	*2.88*	*N/A*

Drawing 32122-NC008 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site

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TABLE NC008-4
FALL 2022 – HWY 63:02 NORTH OF LA BICHE RIVER
VIBRATING WIRE PIEZOMETER INSTRUMENTATION READING SUMMARY

Date Monitored: September 21, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	GROUND ELEV. (m)	CURRENT STATUS	HIGHEST MEASURED GROUNDWATER LEVEL BGS (m)	CURRENT GROUNDWATER DEPTH BGS (m)	PREVIOUS GROUNDWATER DEPTH BGS (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
VW20-2A (70909)	December 21, 2020	7.32	-	Operational	2.47 on September 21, 2022	2.47	3.01	0.54
VW20-2B (70910)	December 21, 2020	15.09	-	Operational	2.51 on September 21, 2022	2.51	2.99	0.48

Drawing 32122-NC008 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site

3. INTERPRETATION OF MONITORING RESULTS

SI1B showed a rate of movement of 8.4 mm/yr over 4.8 m to 8.4 m depth since the spring of 2022 readings. SI20-2 showed a rate of movement of 9.1 mm/yr over 3.8 m to 7.4 m depth since the spring of 2022 readings. The SIs showed accelerated movement rates compared to the past several readings cycles, which likely corresponds to the elevated groundwater levels observed in the piezometers. The movement zones in both SIs are within the native high plastic clay below the highway embankment fill.

Standpipe piezometer SP20-1 showed an increase in groundwater level of 0.28 m compared to the spring of 2022 readings and is currently showing the highest groundwater level measured in the instrument since initialization. The standpipe piezometer readings are summarized in Table NC008-3.

Vibrating wire piezometers VW20-2A and VW20-2B showed increases in groundwater level of 0.54 m and 0.48 m, respectively, since the spring of 2022 readings. Both piezometers are showing the highest groundwater levels measured in the respective instruments since initialization. The vibrating wire piezometer readings are summarized in Table NC008-4. The standpipe, pneumatic, and vibrating wire piezometer readings are plotted on Figure NC008-1 in Appendix A.

4. RECOMMENDATIONS

4.1 Future Work

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

4.2 Instrumentation Repairs

SP20-3 was damaged by a mower since the spring of 2022 readings. It was determined that the piezometer was damaged at 3 m below the top of the casing, so it is likely not economical to repair this instrument. It is recommended to delete this instrument from the readings program.

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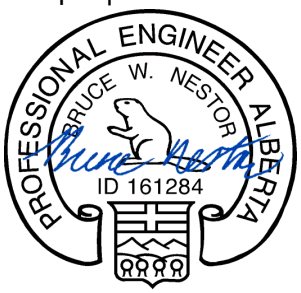
5. CLOSURE

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



November 10, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 91085
DATE: November 10, 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 (Drawing No. 32122-NC008)
  - SI Reading Plots
  - Figure NC008-1 (Piezometric Depths)

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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 (CON0022163)
NORTH CENTRAL (ATHABASCA AND FORT McMURRAY DISTRICTS)
INSTRUMENTATION MONITORING RESULTS

FALL 2022

APPENDIX A
DATA PRESENTATION

SITE NC008: HWY 63:02 NORTH OF LA BICHE RIVER

ALBERTA TRANSPORTATION
NORTH CENTRAL REGION - ATHABASCA AND FORT McMURRAY DISTRICTS
INSTRUMENTATION MONITORING FIELD SUMMARY (NC008)
FALL 2022

Location:	North of La Biche River (HWY 63:02 L1 15.635)	**Readout:**	RST VW 2106 Unit 2/DGSI Dipmeter
File Number:	32122	**Casing Diameter:**	3.34"/2.75"
Probe:	RST SI SET 8R	**Temp:**	6
Cable:	RST SI SET 8R	**Read by:**	NKR/KTC

SLOPE INCLINOMETER (SI) READINGS

SI#	GPS Location (UTM 12)		Date	Stickup m	Depth from top of casing (ft)	Azimuth of A+ Groove	Current Bottom Depth Readings				Probe/ Reel #	Remarks
	Easting (m)	Northing (m)					A+	A-	B+	B-		
SI1B	6089488	403478	21-Sep-22	1.02	66 to 4	225	1128	-1115	950	-936	8R/8R	
SI20-2	6089482	403494	21-Sep-22	0.82	70 to 2	293	-232	251	-919	930	8R/8R	

STANDPIPE PIEZOMETER (SP) READINGS

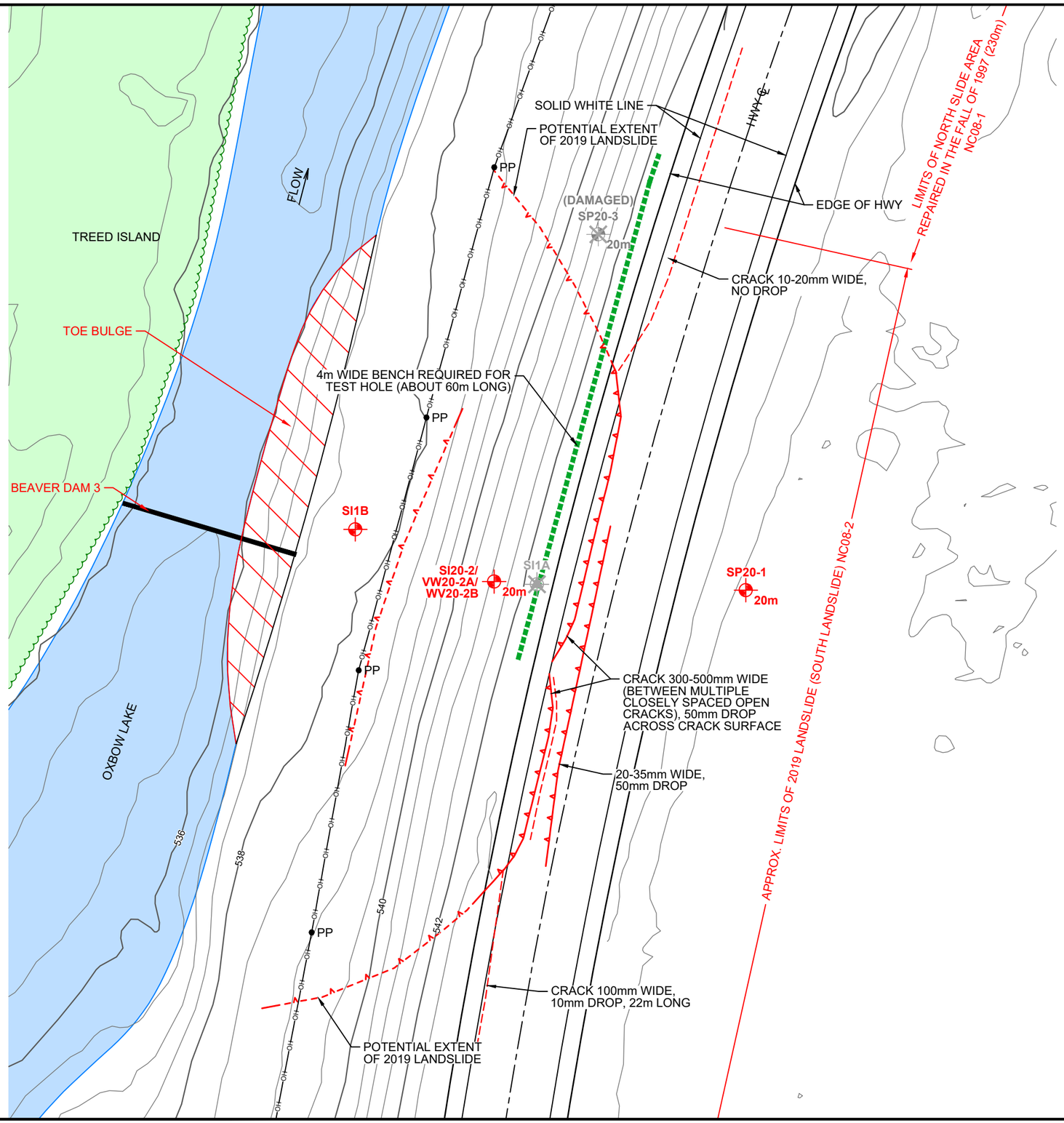
SP#	GPS Location (UTM 12)		Date	Stick-up (m)	Reading below top of casing (m)	Bottom Pipe Depth (below top of casing (m)
	Easting (m)	Northing (m)				
SP20-1	403523	6089481	21-Sep-22	0.84	2.3	20.24
SP20-3	403506	6089522	21-Sep-22	0.92	* See comments	21.87

VIBRATING WIRE READINGS

VW	Serial	GPS Location		Date	Reading B(units)	Temp degree C
		Latitude	Longitude			
VW20-2A	70909	6089482	403494	21-Sep-22	8678.7	5.5
VW20-2B	70910	6089482	403494	21-Sep-22	8358.2	5.3

INSPECTOR REPORT

SP20-3 is damaged by lawn mower, joint at 10 ft was not connected. Repair not possible. See photograph.



LEGEND

- APPROXIMATE TEST HOLE LOCATION (DEPTH (m))
- SI — SLOPE INCLINOMETER
- VW — VIBRATING WIRE PIEZOMETER
- SP — STANDPIPE PIEZOMETER
- DESTROYED INSTRUMENT
- ACTIVE LANDSLIDE SCARP CRACK
- LANDSLIDE TENSION CRACKS
- CRACK
- 540 — GROUND SURFACE CONTOUR
- OH — OVERHEAD POWERLINE
- PP — POWER POLE

NOTES:

1. SITE FEATURES ARE APPROXIMATE
2. TOPOGRAPHY IS BASED ON 2008 LIDAR DATA
3. JULY 3, 2019 OBSERVATIONS SHOWN IN RED
4. POTHOLES AND 10-20mm WIDE REFLECTIVE CRACKS ARE VISIBLE ON SOUTHBOUND LANES WITHIN THE LIMITS OF PREVIOUSLY REPAIRED AREA (NC08-1)
5. OVERHEAD POWERLINES WERE RELOCATED TO THE WEST SIDE OF THE OLD HIGHWAY 63 DURING HIGHWAY TWINNING PROJECT

0 5 10 15 20 25 30m
SCALE 1:500

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NORTH CENTRAL
(ATHABASCA AND FORT MCMURRAY DISTRICTS)

NC008 HWY 63:02 LA BICHE RIVER
SITE PLAN SHOWING APPROXIMATE INSTRUMENT LOCATIONS

DWG No. 32122-NC008

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	TSA
SCALE	1:500
DATE	OCTOBER 2022
FILE No.	32122

THURBER ENGINEERING LTD.

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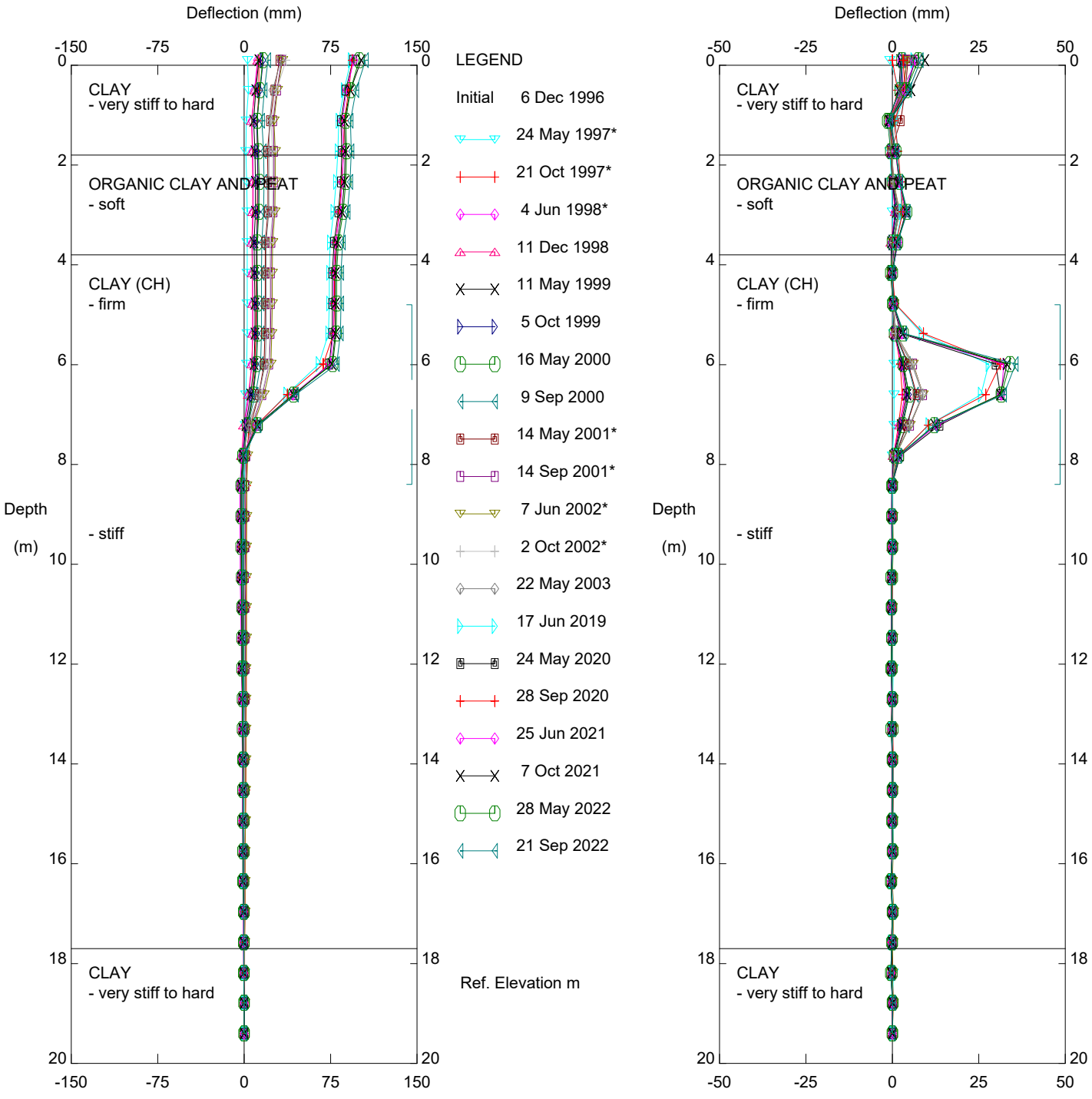

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

Labiche River, Inclinometer SI#1B

Alberta Transportation

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

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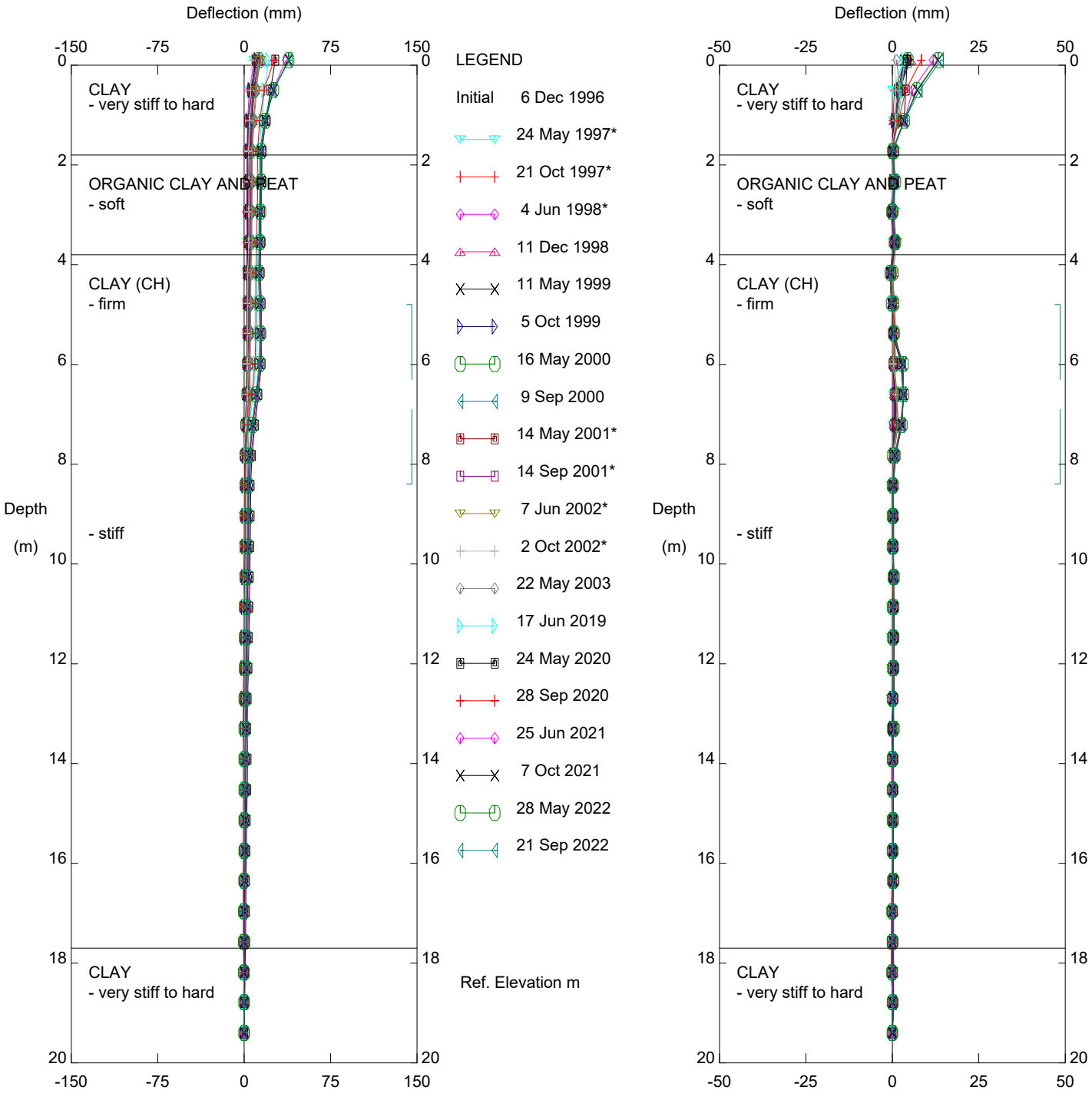

Cumulative Deflection

Direction B

Incremental Deflection

Direction B

Labiche River, Inclinometer SI#1B

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

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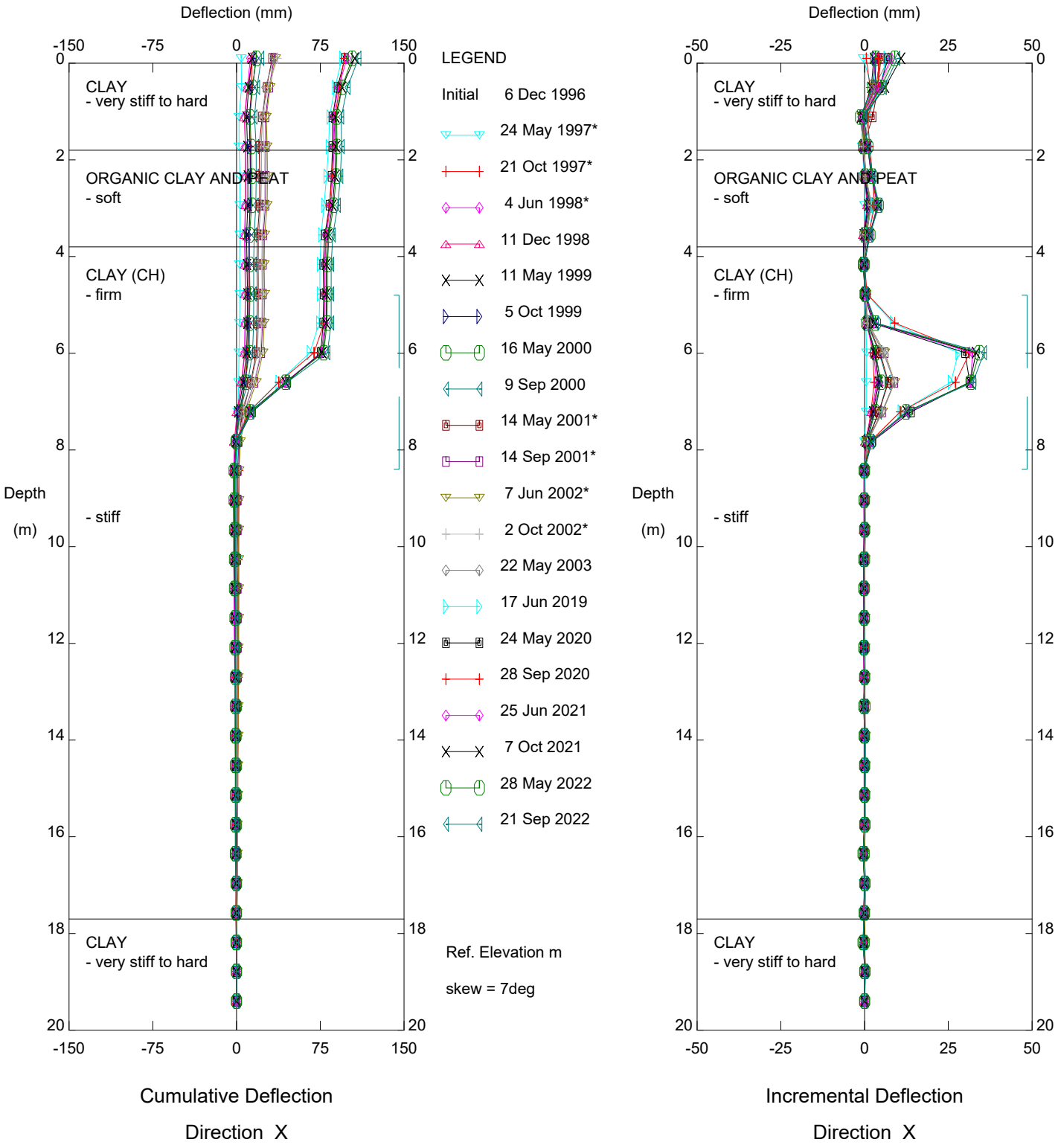

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

Labiche River, Inclinometer SI#1B

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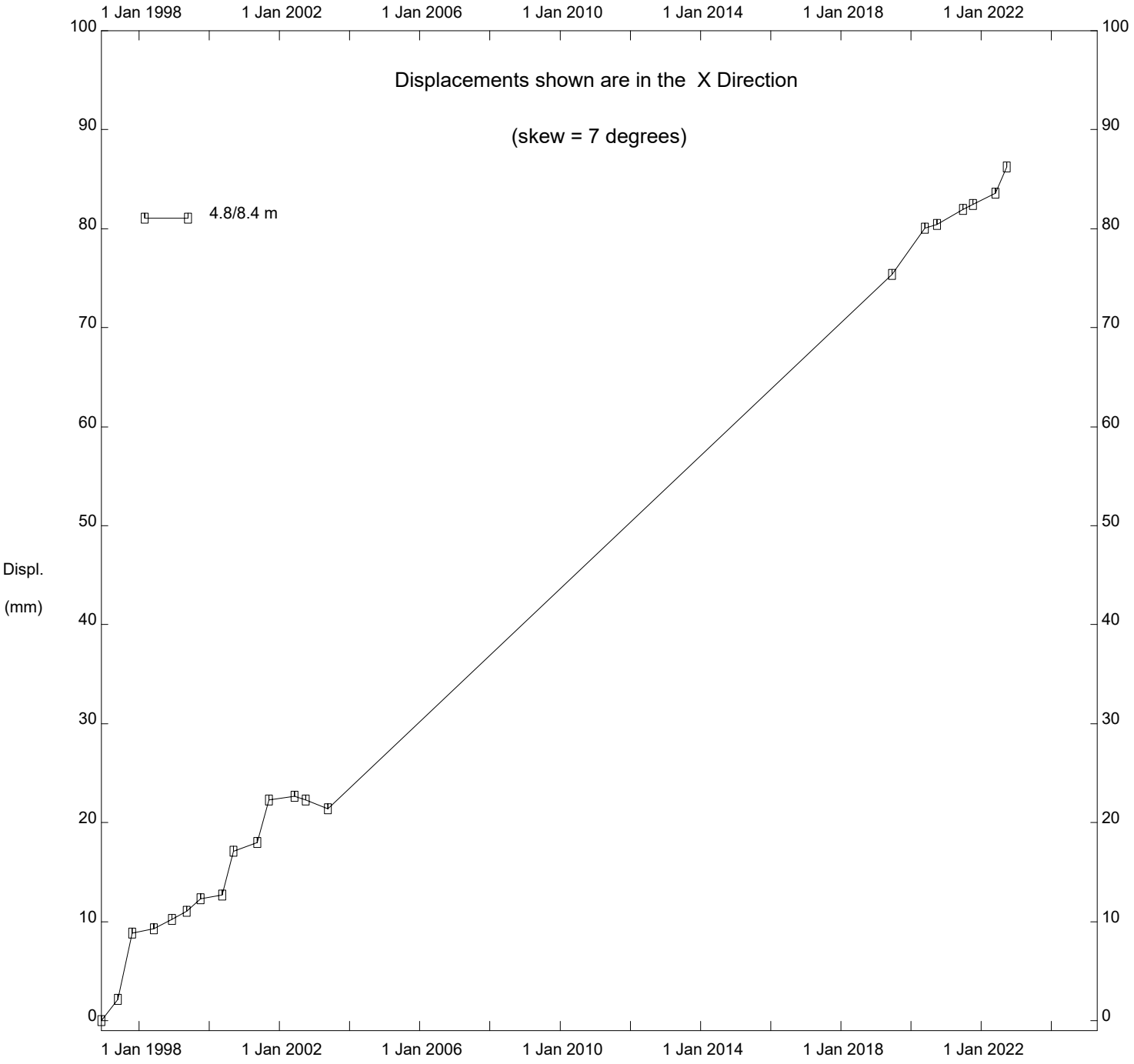

Labiche River, Inclinometer SI#1B

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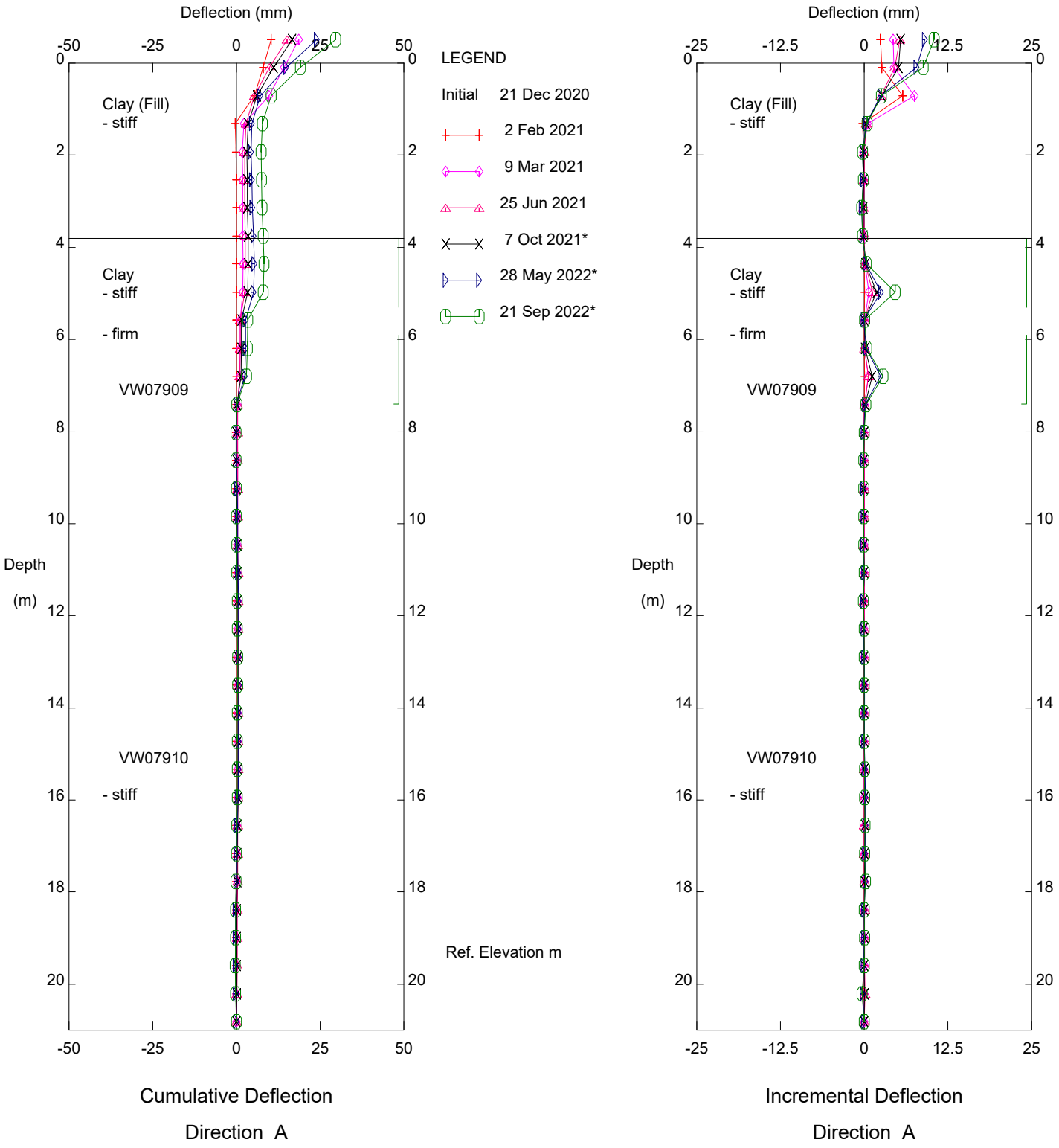

Cumulative Deflection

Direction A

Incremental Deflection

Direction A

Hwy 63:02 NC08-2 La Biche River, Inclinometer SI20-2

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

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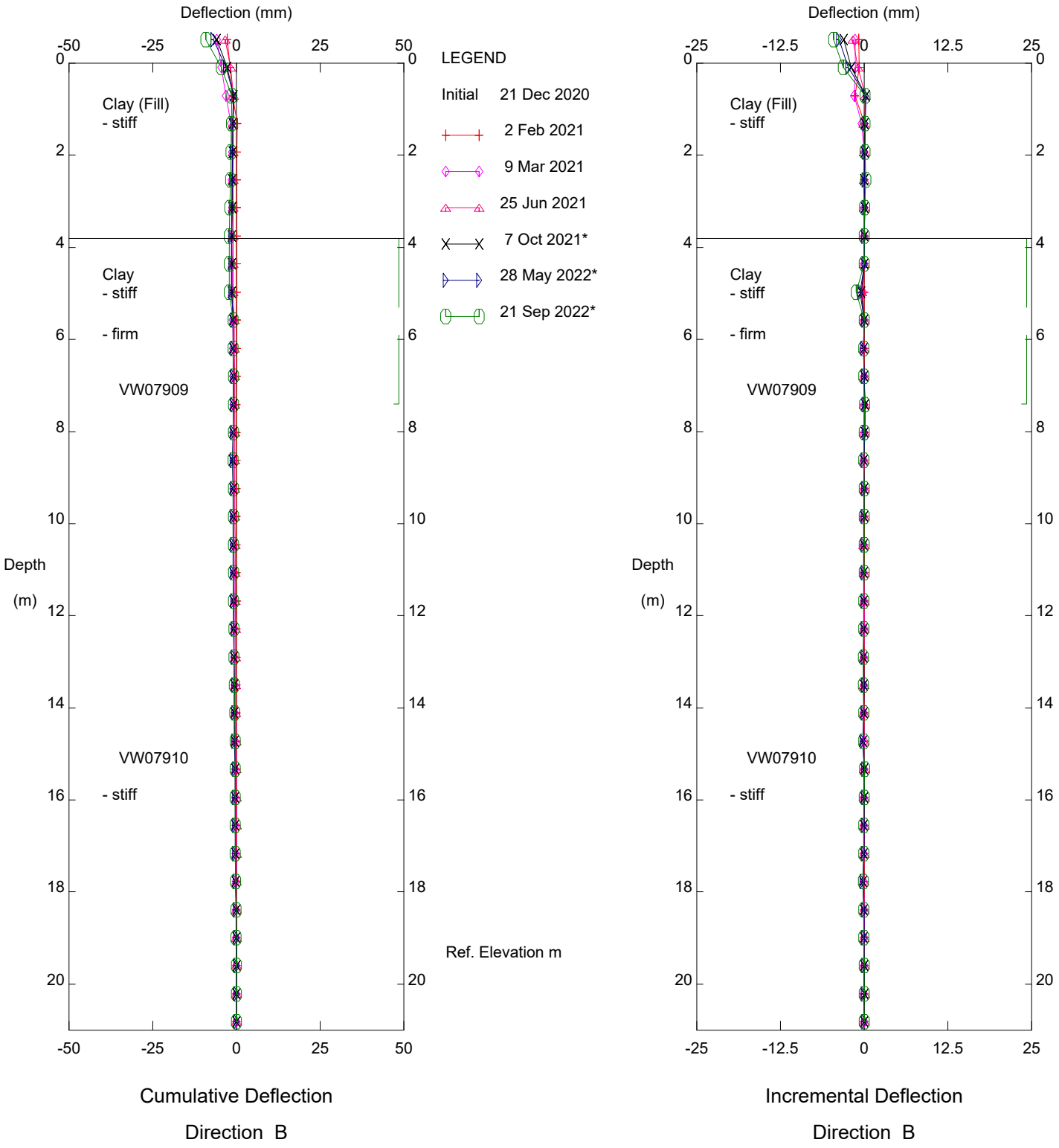

Hwy 63:02 NC08-2 La Biche River, Inclinometer SI20-2

Alberta Transportation

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

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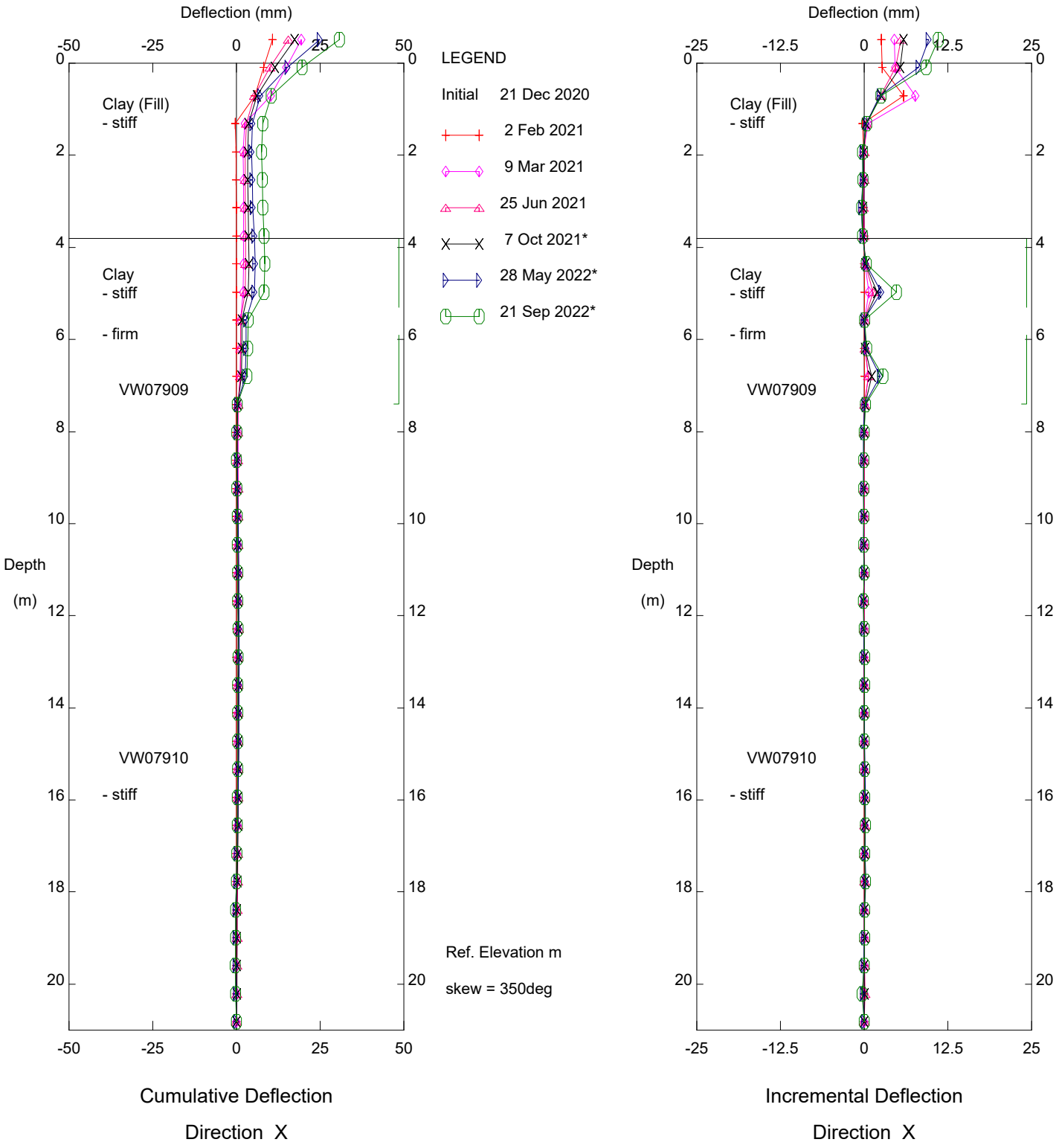

Cumulative Deflection

Direction X

Incremental Deflection

Direction X

Hwy 63:02 NC08-2 La Biche River, Inclinometer SI20-2

Alberta Transportation

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

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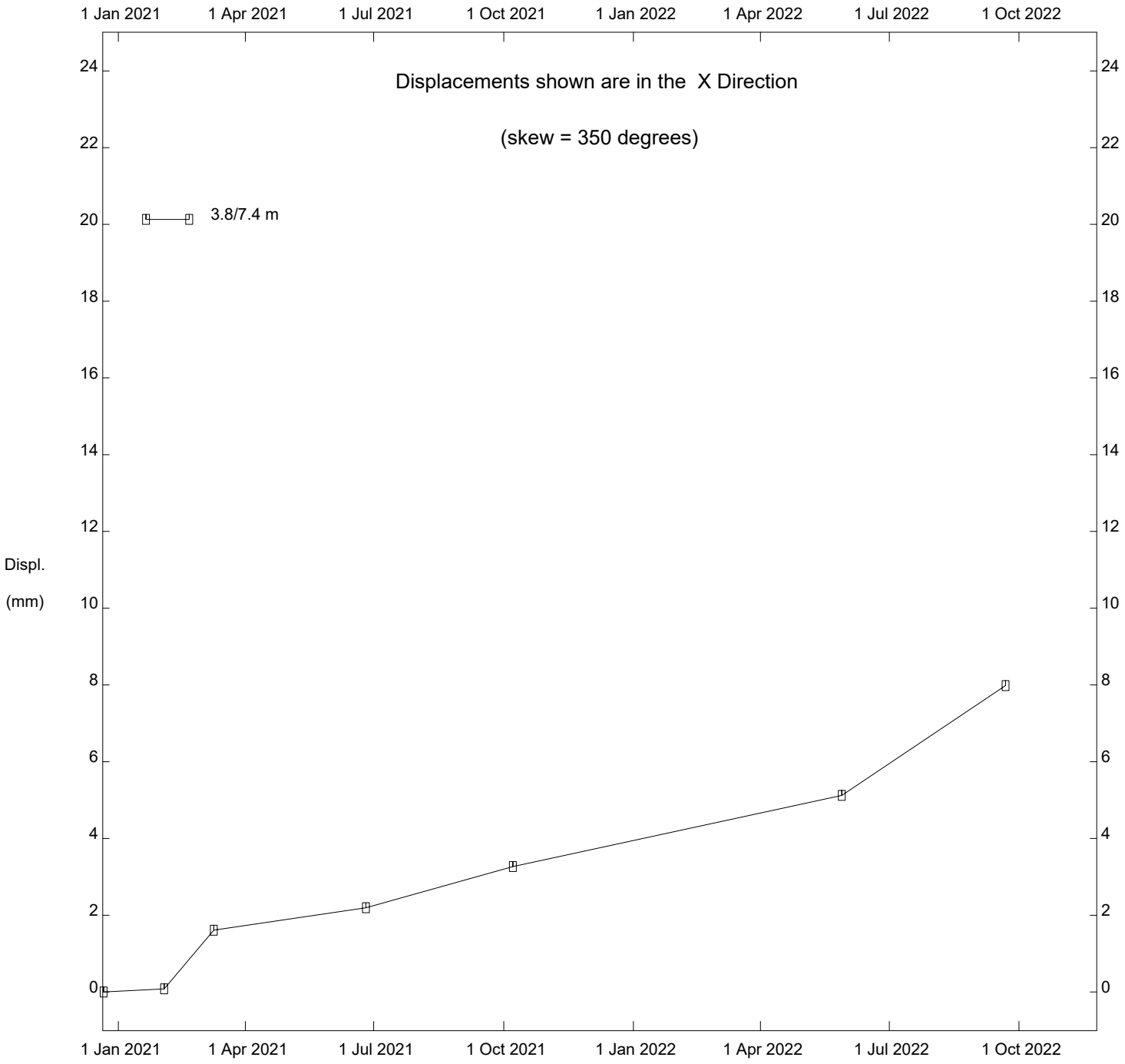
Thurber Engineering Ltd



Hwy 63:02 NC08-2 La Biche River, Inclinometer SI20-2

Alberta Transportation

FIGURE NC008-1
HWY 63:02 NORTH OF LA BICHE RIVER BRIDGE (KM 15.6)
VIBRATING WIRE AND STANDPIPE PIEZOMETER DATA