Klohn Crippen Berger

September 12, 2022

Alberta Transportation
4th Floor, Provincial Building
4920 51 Street
Red Deer, Alberta
T4N 6K8

Tony Penney, P.Eng.
Construction Engineer

Dear Mr. Penney:

CON0022160 Central Region GRMP Instrumentation Monitoring
Site C074; H27:10, km 23.976 Red Deer River Bridge
Section C – 2022 Spring Readings

1 GENERAL

Four slope inclinometers (SIs) (SI18-01, SI-P01, SI-P06, and SI-P11), four vibrating wire piezometers (VWPs) (P1 through P4), and two vibrating-wire settlement plates (settlement plates) (P5 and P6) were read at the C074 by Mr. James Lyons, P.Eng. and Mr. Guerin White, E.I.T. Klohn Crippen Berger Ltd. (KCB) on June 27, 2022. These instruments were read as part of the Central Region Geohazard Risk Management Program (GRMP). As requested by Alberta Transportation (AT), these will be the last readings completed by KCB as part of the Central Region GRMP, unless AT requests additional readings. The site is located 11 km west of Morrin, Alberta, at the Red Deer River crossing. The approximate site coordinates are 5723858 N, 368302 E (UTM Zone 12, NAD 83) and the legal land description for the site is SW 15-31-21-W4M.

Between October 2017 and January 2018, a cast-in-place concrete pile wall approximately 24 m deep and 38 m long was installed at the site, consisting of fifteen (15) 1.8-m-diameter cast-in-place concrete piles, as depicted in Figure 1. The pile wall was constructed as part of the Red Deer River Bridge replacement project to stabilize the east abutment, where a weak-bentonite layer was identified at an approximate depth of 14 m below ground surface during construction of the new bridge. The new bridge was constructed prior to KCB taking over instrument readings at the site in May 2019 and the old bridge was removed between September 2019 and May 2020.

The original design report for the cast-in-place pile wall has not been provided to KCB. The designer should review the data in this report to assess if the pile wall is performing as expected.

Klohn Crippen Berger Ltd.
109, 4208 97 St NW ▪ Edmonton AB T6E 5Z9 ▪ Canada
t 780.444.0706 ▪ www.klohn.com

1.1 Instrumentation

Instrumentation installation details are tabulated in Table 1.1. Instrument locations are shown in Figure 1.

As part of the Red Deer River Bridge replacement project, the following instrumentation was installed:

- One SI (SI18-01) in the east abutment, northeast of the pile wall, to monitor lateral movement of the north side slope of the east abutment during construction;
- Three SIs (SI-P01, SI-P06, and SI-P11) in the pile wall to monitor movement at depth in the bentonite and clay-shale bedrock during construction; and
- Four VWPs (P1 through P4) and two settlement plates (P5 and P6) in the east abutment fill, east of the pile wall, to monitor groundwater conditions and settlement, respectively, during and after construction.

The SIs installed in the pile wall were secured to the inside of the rebar cages before the piles were filled with concrete, then raised through the fill placed above the pile wall. All the SIs are protected by above-ground casing protectors. Due to fill placement between September 2019 and September 2020 the top of the casing protectors are now near ground surface. The readout cables for the VWPs and settlement plates are trenched to a datalogger located on the east abutment, northwest of the pile wall.

At AT's request, KCB took over the SI readings at the site in May 2019 as part of the Central Region GRMP (Section C) instrument readings. KCB did not take over the VWP or settlement plate readings until June 2021.

The SIs were read using the same metric RST Digital MEMS Inclinometer System that has been used to the read the SIs since they were re-initialized in June 2019, when KCB took over the readings and the SI equipment was changed.

The VWPs and settlement plates were read manually using an RST VW2106 vibrating wire readout.

Table 1.1 Instrumentation Installation Details

Instrument ID	Instrument Type	Date Installed	UTM Coordinates[1] (m)		Ground Surface Elevation[2] (m)	Stick Up (m)	Depth (mbgs[2])	Casing Bottom/Tip Elevation (m)	Condition
			Easting	Northing					
SI18-1	SI	2018	368336	5724002	694.5	0.9	24.0	671.9	Operational
SI-P01	SI	2018	368348	5723956	691.5	0.1	25.5	665.5	Operational
SI-P06	SI	2018	368339	5723965	691.5	0.0	22.0	669.3	Operational
SI-P11	SI	2018	368339	5723962	691.5	0.1	24.0	666.5	Operational
P1	VWP	2018	Unknown	Unknown	692.0	N/A	10.0	682.0	Operational
P2	VWP	2018	Unknown	Unknown	692.0	N/A	15.8	676.2	Operational
P3	VWP	2018	Unknown	Unknown	692.3	N/A	13.2	679.1	Operational
P4	VWP	2018	Unknown	Unknown	692.3	N/A	8.2	684.1	Operational
P5	Settlement Plate	2018	Unknown	Unknown	691.4	N/A	N/A	N/A	Operational
P6	Settlement Plate	2018	Unknown	Unknown	691.8	N/A	N/A	N/A	Operational

Notes:
[1] Coordinates provided by previous consultant.
[2] Ground surface calculated based on depth of SI casing, bottom elevation (provided by the previous consultant), and the measured stick up. KCB estimated the ground surface elevations of the pile-wall SIs (SI-P01, SI-P06, and SI-P11) by refencing the elevation marking on the concrete bridge support. However, the instruments should be surveyed due to fill placement.
[3] Meters below ground surface (mbgs). Bottom reading depth and tip elevation.

2 INTERPRETATION

2.1 General

For the SIs, the cumulative displacement, incremental displacement, and displacement time data was plotted in the A-direction (i.e., the direction of the A0-grooves) and in the X-direction (i.e., the direction of maximum movement obtained at a skew angle from the A0-grooves). The SIs have skew angles varying between 310° and 350 measured clockwise from the direction of the A0-grooves. The A0-grooves in SI-P01, SI-P06, and SI-P11 are aligned approximately in the downslope direction, towards the Red Deer River. For SI18-01, the A0-grooves are aligned approximately parallel to the river to monitor lateral movement of the north side slope of the east abutment.

For the operational VWPs, the recorded porewater pressures were converted to an equivalent water/piezometric elevation and plotted relative to ground surface elevation and each instruments tip elevation.

For the operational settlement plates, the recorded pressures were converted to an amount of settlement and the differential settlement was plotted relative to ground surface elevation and each instruments installation elevation.

The SI, VWP, and settlement plate plots are included in Appendix I, and a summary of the SI data is provided in Table 2.1. Note that the reference elevations and stick-ups for the SI data plots need to

be confirmed by an as-built survey due to fill placement since KCB began reading the instruments in May 2019. KCB estimated the ground surface elevations of the pile-wall SIs (SI-P01, SI-P06, and SI-P11) by refencing the elevation marking on the concrete bridge support. However, the instruments should be surveyed. The SI data plots presented herein only include data for readings taken with KCB's equipment.

The data logger recording data for the VWPs and settlement plates stopped recording data in early-April 2019. An ice jam occurred in the Red Deer River near the bridge location, resulting in an increased water level that submerged the data logger damaging it (e-mail from the design consultant in May 2019). The contractor did not repair the data logger after the flood event and after construction was completed the solar panel powering the data logger was removed. Since September 2021, KCB has read these instruments manually.

2.2 Zones of Movement

East Abutment Fill

A description of the movement recorded in SI18-01 includes:

- distributed movement from ground surface to an approximate depth of 4 m below ground surface (mbgs) in the abutment fill;
- lateral spreading of the sand and gravel foundation at an approximate depth of 8 mbgs (which may be contributing to movement in the abutment fill); and
- discrete movement at an approximate depth of 21 mbgs below the contact between the bentonite layer and underlying clay-shale bedrock.

East Abutment Pile Wall

A description of the movement recorded in the SIs installed in the pile wall (SI-P01, SI-P06, and SI-P11) includes:

- distributed movement within the fill above the pile wall to an approximate depth of 2.0 mbgs to 4.5 mbgs; and
- distributed movement along the depth of the pile wall to an approximate depth of 21.0 mbgs.

Table 2.1 Slope Inclinometer Reading Summary

Instrument ID	Date				Ground Surface Elevation (m)	Depth of Movement (mbgs[1])	Direction of Movement, Skew Angle	Movement (mm)				Rate of Movement (mm/year)		
								Maximum Cumulative			Incremental Since Previous Maximum Cumulative			
	Initialized (Re-initialized)	Previous Maximum Cumulative Movement Recorded	Previous Reading	Most Recent Reading				Before Re-Initialization[4]	After Re-Initialization	Total		Previous Maximum	Most Recent Reading	Change from Previous Reading
SI18-01	May 29, 2018 (Jun. 17, 2019)[2]	Jun. 14, 2021	Jun. 14, 2021	Jun. 27, 2022	694.5	4.0	X-Direction, 310°	Unknown[5]	82.8	Unknown	14.3	136.5	13.9	4.7
						8.0		7.1	2.8	9.9	0.9	67.6	0.9	0.2
						21.0		9.6	2.3	11.9	0.4	150.7	0.4	0.2
SI-P01	May 30, 2018 (Jun. 17, 2019)[2]	Jun. 14, 2021	Jun. 14, 2021	Jun. 27, 2022	689.9	2.5 – 24.5	X-Direction, 335°	16.3	6.5	22.8	-0.5	138.4	-0.5	-2.8
SI-P06	Jun. 12, 2018 (Jun. 17, 2019)[2] (Sep. 1, 2020)[3]	Jun. 14, 2021	Jun. 14, 2021	Jun. 27, 2022	690.3	4.5 – 21.0	X-Direction, 335°	26.5 (1st re-initialization)[2] 0.0 (2nd re-initialization)[3]	2.8[3]	29.3	-0.5	128.3	-0.7	-2.0
SI-P11	May 30, 2018 (Jun. 17, 2019)[2]	Sep. 1, 2020	Jun. 14, 2021	Jun. 27, 2022	690.4	4.2 – 23.2	X-Direction	17.1	1.7	18.8	1.0	228.9	0.9	2.9

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 June 2019 when KCB took over the readings and the SI equipment was changed.
[3] SI-P06 was re-initialized for a second time in September 2020 because the instrument was damaged between the September 2019 and June 2020 readings, and the top of the casing was cut off (not by KCB) between the June and September 2020 readings.
[4] The total maximum cumulative movement recorded does not include any movement that occurred between January 2019 (the last reading obtained by the previous consultant) and June 2019 (the first reading obtained by the KCB).
[5] SI casing was raised during fill placement which resulted in 177 mm of negative displacement being recorded in SI18-01 before KCB took over readings. The actual displacement amount is unknown.

2.3 Interpretation of Monitoring Results

2.3.1 Vibrating Wire Piezometers in East Abutment Foundation

Between early-June 2018 to late-July 2018, the equivalent water levels recorded in three of the VWPs (P2 through P4) steadily increased approximately 2.0 m to 4.5 m in response to fill placement on the east abutment. Whereas water levels recorded in P1, which was installed in the clay shale unit beneath the north side slope of the east abutment, remained relatively steady. After fill placement was complete, water levels slowly decreased, except for slight increases (less than 1 m) recorded in late-2018 likely in response to pile wall installation and another increase recorded in late-March 2019 likely in response to the flood event caused by ice jamming in the Red Deer River. This flood event also damaged the data logger, so no further readings were taken of the VWPs until September 2021 when KCB started reading the instruments manually.

The first reading obtained by KCB in September 2021, indicated water levels recorded in P1, P3, and P4 had decreased 2.7 m to 5.9 m below peak water levels recorded during fill placement in 2018. Whereas the water level recorded in P2 was similar to the peak water level recorded during fill placement (approximately decrease of 0.5 m).

Data obtained in June 2022 reading, indicates water levels recorded in P1 and P4 (both installed in the shallow clay shale unit) increased approximately 1.6 m to 1.1 m since September 2021, respectively. Whereas water levels recorded in P2 and P3 (installed in the weak bentonite unit and deeper sandstone unit, respectively) increased approximately 0.6 m and 0.4 m, respectively. It is likely that the elevated water levels recorded in these instruments in June 2022 were due to recent wet weather (i.e., higher-than-average precipitation) in June 2022. The previous period of wet weather occurred in 2020 and no readings are available for this period for comparison.

2.3.2 Settlement Plates at Base of East Abutment Fill

Between early-June 2018 and late-October 2018, a steady rate of settlement was recorded in the settlement plates (P5 and P6) in response to fill placement on the east abutment. By late-October 2018, approximately 90 mm and 180 mm of settlement had been recorded in P5 and P6, respectively. P5 and P6 are located beneath the north side slope and crest of the east abutment, respectively.

Between late-October and December 2018 when the pile-wall was installed, slight heaving (approximately 20 mm) was recorded in P6 followed by 20 mm of settlement before the data logger became inoperable in April 2019. During this same period settlement recorded in P5 remained relatively steady.

Between September 2021 and June 2022 approximately 260 mm of settlement was recorded in P5 and P6, which is greater than the amount of settlement (90 mm and 180 mm, respectively) recorded during and immediately following fill placement on the east abutment. No additional fill has been placed on the east abutment since construction activities ceased in September 2020. Without further

readings it is difficult to assess if the latest reading is a result of instrument noise or the instruments malfunctioning.

2.3.3 Slope Inclinometers

East Abutment Fill

The maximum rate of movement recorded in SI18-01 was 67.6 mm/year and 150.7 mm/year at an approximate depth of 8 mbgs and 21 mbgs, respectively. These maximum rates of movement were recorded on July 18 and August 1, 2018 respectively, during fill placement on the east abutment. The rate of movement has since decreased and is now less than 1 mm/year.

Overall, the slow (attenuating) rate of movement recorded in SI18-01 indicates the east abutment is performing well. However, KCB does not have documentation of the expectations of the designers to compare to the abutment behavior. The design engineer for the abutment should review the data in this report to assess if the pile wall is performing adequately.

East Abutment Pile Wall

Prior to the pile-wall SIs being re-initialized in June 2019, movement recorded in these instruments was occurring in the fill above the pile wall. The movement was likely due to disturbance of the SI casing during construction, as advised by Thurber via e-mail:

> **May 5, 2019 e-mail:**
>
> *"Ignore the upper portions of the movements, the tops of the SI casings have been disturbed several times due to the fact that the top elevation of the piles are several meters (~3 m) below ground surface"*
>
> **June 6, 2019 e-mail:**
>
> *"The pile tops terminate about 3 m below grade, so there is SI casing extending through a mix of native and fill material from the cut off of the pile to surface. This is why you see the big movements in the upper portions of the SI. We had some disturbance to these zones and replaced the tops a few times between the completion of the piles and the general grading of the surface above. All 3 of these have their A+ azimuth pointing towards the river (i.e., downslope from the head slope)."*

Since the pile-walls SIs were re-initialized in June 2019, they continued to record movement in the fill above the pile wall. Since September 2020, the movement appears to have attenuated (currently less than 1 mm/year) . However, a higher rate of movement (up to approximately 12 mm/year) was recorded between June 2019 and September 2020 likely due to disturbance during ongoing construction, including:

- riprap placement around the pile-wall SIs in early to mid-2019;

- fill placement (approximately 1 m) around the pile-wall SIs and removal of the old bridge between the September 2019 and June 2020 readings; and
- fill placement (approximately 0.15 m to 0.30 m) around the pile-wall SIs between the June and September 2020 readings.

It also noted that the casing for SI-P11 was extended and then repaired by KCB in June 2019, and the casing for SI-P06 was damaged between the September 2019 and June 2020 readings, then cut off (not by KCB) between the June and September 2020 readings.

The data obtained from the pile-wall SIs indicates the top of the pile wall deflected approximately 16 mm to 26 mm between June 2018 (installation) and January 2019 (the last reading obtained by the previous consultant), and up to approximately 6 mm since June 2019 (the first reading obtained by the KCB). Most of the deflection occurred between June 2018 and August 2018 when (or just after) fill was being placed on the east abutment.

The maximum rate of movement recorded in the X-direction of the pile-wall SIs was between approximately 128 mm/year and 229 mm/year. This maximum rate of movement was recorded between July and August 2018 during fill placement on the east abutment. The rate of movement has since decreased and is now less than 1 mm/year. Additional displacement of the pile wall may occur in response to periods of heavy or prolonged rainfall, resulting in higher groundwater conditions or river levels.

Since distributed movement is being recorded in SI-P01, SI-P06, and SI-P11 to the bottom of the SI casing and the depth to the design failure surface is unknown, KCB cannot conclude if the pile wall has intercepted the failure surface and whether loads are being transferred to depths below the failure surface as the piles stabilize the sliding mass.

The design engineer for the pile wall should review the data in this report to assess if the pile wall is performing adequately.

3 RECOMMENDATIONS

3.1 Future Work

As requested by AT, these will be the last readings completed by KCB as part of the Central Region GRMP, unless AT requests additional readings.

3.2 Instrument Repairs and Maintenance

No instrument repairs or maintenance is required. However, the above-ground casing protector caps were damaged and removed between the June 2021 and June 2022 readings (KCB suspects they were damaged from vandalism) (Photo 1). The SI caps are still in place on the casing within the casing protectors. Since the casing protectors are damaged, this could lead to future damage of the SIs.

Photo 1 The casing protector cap at SI-P06 was completely removed between the June 2021 and June 2022 readings. Photo taken June 27, 2022.

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 (Client) for the specific application to the Central Region Geohazard Risk Management Program (Contract No. CON0022160), 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.

September 13 2022
I.D. # 58463

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

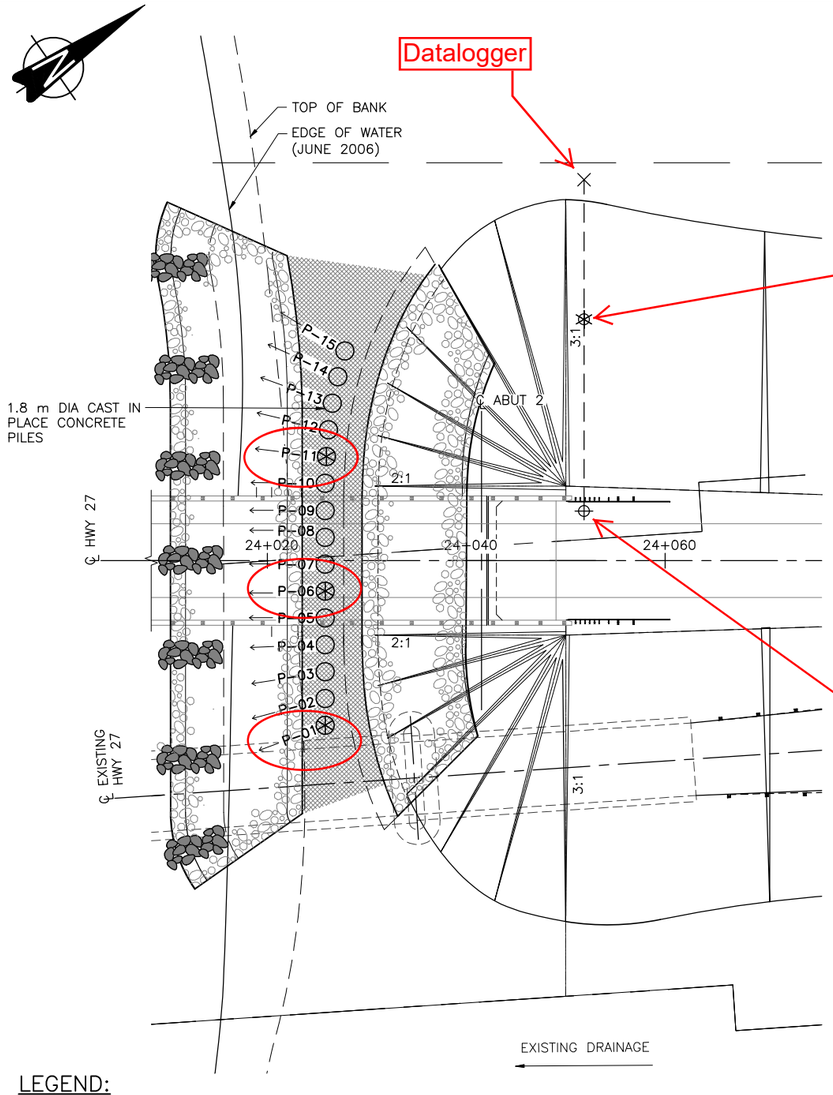
James Lyons, P.Eng.
Civil Engineer

JL:bb

PERMIT TO PRACTICE
KLOHN CRIPPEN BERGER LTD.
RM SIGNATURE:
RM APEGA ID #: 187607
DATE: 13 Sep. 2022
PERMIT NUMBER: P009196
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

ATTACHMENTS
Figure
Appendix I Instrumentation Plots

FIGURES



P5 - Settlement Plate
P1 - VWP in Clay Shale (Shallow)
P2 - VWP in Bentonite (Deep)
SI18-1

P6 - Settlement Plate
P3 - VWP in Sandstone (Deep)
P4 - VWP in Clay Shale (Shallow)

SHEAR PILE SCHEDULE – EAST EMBANKMENT

PILE MARK	NORTHING	EASTING	CUT–OFF ELEVATION	APPROXIMATE TIP ELEVATION	MIN PILE LENGTH
P–01	5723953.350	368353.078	687.8	664.0	23.8
P–02	5723954.930	368350.889	687.8	664.0	23.8
P–03	5723956.509	368348.699	687.8	664.0	23.8
P–04	5723958.088	368346.509	687.8	664.0	23.8
P–05	5723959.668	368344.319	687.8	664.0	23.8
P–06	5723961.249	368342.131	687.8	664.0	23.8
P–07	5723962.828	368339.941	687.8	664.0	23.8
P–08	5723964.406	368337.750	687.8	664.0	23.8
P–09	5723965.987	368335.561	687.8	664.0	23.8
P–10	5723967.591	368333.345	687.8	664.0	23.8
P–11	5723969.262	368331.225	687.8	664.0	23.8
P–12	5723971.013	368329.169	687.8	664.0	23.8
P–13	5723972.887	368327.226	687.8	664.0	23.8
P–14	5723974.883	368325.407	687.8	664.0	23.8
P–15	5723976.987	368323.715	687.8	664.0	23.8

GENERAL NOTES:

PILING CONTRACTOR SHALL HAVE EXPERIENCE ON DRILLING PILES IN BEDROCK FOR THE WORK.

- PILE WALL SHALL BE INSTALLED PRIOR TO PLACING ABUTMENT BACKFILL.
- ALL INSTRUMENTATION INSTALLED ON SITE SHALL BE PROTECTED FROM DAMAGE.
- PILE CONCRETE SHALL CONFORM TO "CLASS PILE" CONCRETE EXCEPT THAT THE 28 DAY CYLINDER COMPRESSIVE STRENGTH SHALL BE NOT LESS THAN 35 MPa. ALL PILE CONCRETE TO USE TYPE GU CEMENT
- CASING SHALL BE USED TO SEAL OFF THE WATER OR PREVENT THE SLOUGHING OF THE SIDES OF THE HOLE.
- EXCAVATION INTO BEDROCK MAY REQUIRE THE USE OF SPECIAL CUTTING/CORING TOOLS.
- ALL LOOSE MATERIAL SHOULD BE CLEANED FROM THE WALLS AND BOTTOMS OF THE PILE HOLES.
- REINFORCING STEEL AND CONCRETE SHALL BE PLACED IMMEDIATELY AFTER THE PILE HOLE HAS BEEN COMPLETED AND APPROVED TO MINIMIZE POSSIBILITY OF SOFTENING HOLE.
- WATER SHALL NOT BE LEFT PONDED ON THE PILE BASE AND SHALL BE REMOVED, OR DRIED BY THE USE OF DRY CEMENT WHEN PERMITTED BY THE CONSULTANT.
- ALTERNATIVELY, PILES MAY BE POURED BY TREMIE METHOD AFTER WATER HAS STABILIZED TO RIVER LEVEL, IF APPROVED BY THE CONSULTANT
- CSL TUBES SHALL BE INSTALLED IN EVERY SHEAR PILE WHETHER POURED AS A DRY HOLE OR BY TREMIE METHOD, AND CSL TESTING SHALL BE COMPLETED FOR EACH PILE
- DRILL AND PLACE CONCRETE EVERY SECOND HOLE. ADJACENT HOLES SHALL NOT BE DRILLED FOR A MINIMUM OF 48 HOURS AFTER CONCRETE IS PLACED OR BEFORE THE CONCRETE HAS REACHED ITS INITIAL SET.
- BACKFILL CLAY FILL OVER TOP OF PILE AFTER A MINIMUM OF 3–DAY PERIOD AFTER CONCRETE IS CAST. THE CLAY SHALL BE COMPACTED WITH A HOE–TAMP COMPACTOR IN LIFTS OF 1.0 m MAXIMUM THICKNESS, TO THE SATISFACTION OF THE CONSULTANT.

GEOTECHNICAL INSTRUMENTATION:

- SLOPE INCLINOMETERS TO BE INSTALLED IN 3 SHEAR PILES UNDER THE SUPERVISION OF THE CONSULTANT. EACH SLOPE INCLINOMETER SHALL EXTEND 0.75 m ABOVE GROUND SURFACE AND BE PROTECTED WITH AN OUTER STEEL PIPE PROTECTOR, AFFIXED TO THE PILE CONCRETE, PAINTED RED AND EQUIPPED WITH A LOCKABLE STEEL SLIP ON CAP.
- ADDITIONAL INSTRUMENTS ARE TO BE INSTALLED BY THE CONTRACTOR BELOW THE ABUTMENT FILL AT THE LOCATIONS SHOWN ON THIS DRAWING. THE SETTLEMENT SENSORS SHALL BE INSTALLED AT THE STRIPPED GROUND SURFACE AND THE VIBRATING WIRE PIEZOMETERS SHALL BE INSTALLED WITHIN THE WEATHERED SHALE (APPROX EL 682 m) AND BENTONITE LAYER (APPROX EL 677.5 m).
- THE TIP OF THE SLOPE INCLINOMETERS SHALL BE LOCATED AT ELEVATION 672 m OR AT LEAST 2.0 m INTO INTACT BEDROCK (N>100 BLOW/300 mm) WHICHEVER IS DEEPER. THE TOP SHALL BE EXTENDED UP THROUGH THE ABUTMENT FILL.
- FURTHER DETAILS FOR GEOTECHNICAL INSTRUMENTATION ARE PROVIDED IN THE SPECIAL PROVISIONS OF THE TENDER DOCUMENT.

LEGEND:

- ⟵ DIRECTION OF PILE MAJOR SHEAR FORCE (SEE DWG 41718 FOR PILE REBAR CAGE SHEAR TIE PLACEMENT DETAILS)
- ⊛ CONCRETE SHEAR PILE WITH SLOPE INCLINOMETER AND DATA LOGGER LOCATION
- ○ CAST–IN–PLACE CONCRETE SHEAR PILE
- ⌖ SETTLEMENT SENSOR WITH 2 VIBRATING WIRES
- ❄ SETTLEMENT SENSOR WITH 2 VIBRATING WIRES, SLOPE INCLINOMETER AND DATA LOGGER
- × READOUT AND DATA LOGGER STATION FOR INSTRUMENTS MOUNTED ON 8 m LONG STEEL POLE GROUTED 6 m INTO GROUND
- — — — TRENCH INSTRUMENT LEADS

PLAN – EAST EMBANKMENT CONCRETE SHEAR PILE WALL

1:300

ITEM		UNIT	TOTAL EST	AS CONST
CONCRETE – CLASS PILE		m^3	908	
REINFORCING STEEL	PLAIN – SHEAR PILE	kg	335562	
PILING – 1.8 m DIA CAST IN PLACE CONCRETE	DRILL	m	357	
	SETUP & INSTALL	PILE	15	

QUANTITY ESTIMATE: PILE WALL

CONSULTANT: ch2m:

SCALES ON THIS DRAWING ARE CORRECT WHEN PRINTED ON 22"x34" PAPER

JOB No. 467015

PERMIT TO PRACTICE
CH2M HILL Canada Limited
PERMIT NUMBER: P 2558
The Association of Professional Engineers and Geoscientists of Alberta

DESIGNER — PROFESSIONAL ENGINEER ALBERTA — DECEMBER 2016 — DATE

CHECKER — PROFESSIONAL ENGINEER ALBERTA — NOVEMBER 2016 — DATE

REV	DATE	REVISION	BY
5	·	·	·
4	·	·	·
3	·	·	·
2	·	·	·
1	·	·	·

DATE 2016–11–23 | LOCATION ISW15–31–21–4 | FILE 09551

Alberta Transportation

RED DEER RIVER BRIDGE
ON HWY 27, 12km SW OF MORRIN
STEEL GIRDER ALTERNATE
CONCRETE SHEAR PILE WALL – SHEET 1

CONTRACT	HIGHWAY	SHEET	DRAWING
14083	HWY 27	7 OF 48	41757–P

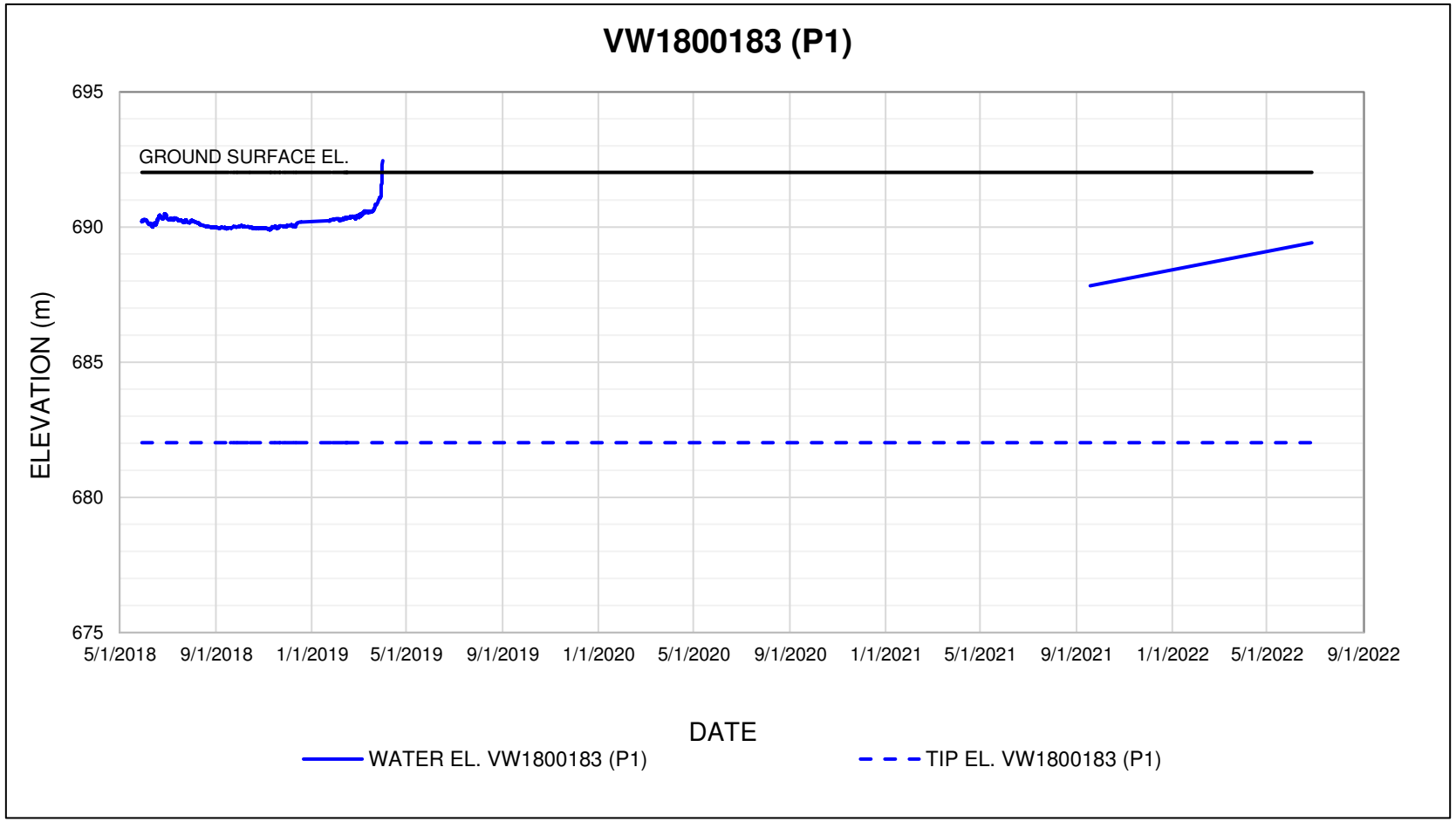
$FILES

DRAWING · HIGHWAY · CONTRACT · DESCRIPTION · PHOTO · DATE · BY · SURVEYED · DEPARTMENT BAR CODE

2015-12-03

APPENDIX I

Instrumentation Plots



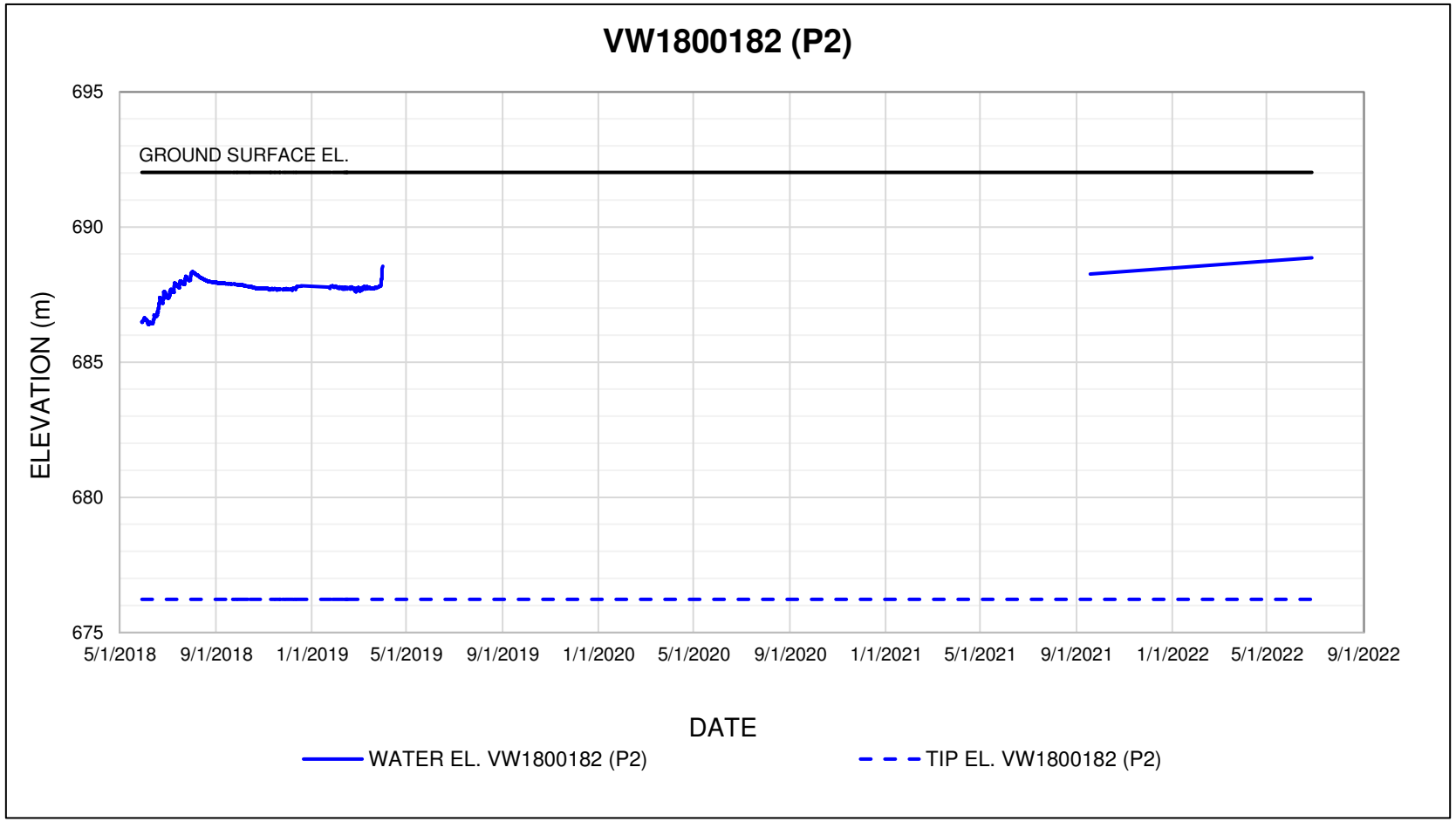
NOTES:
1. GROUND SURFACE ELEVATIONS OBTAINED FROM DATA PROVIDED BY THURBER ENGINEERING IN MAY 2019.
2. THE DATA LOGGER CONNECTED TO THE INSTRUMENTATION WAS INOPERABLE AFTER A FLOOD EVENT IN LATE-MARCH 2019.
3. MANUAL READINGS TAKEN SINCE SEPTEMBER 2021.

CLIENT
Alberta
Klohn Crippen Berger

PROJECT
CENTRAL REGION GEOHAZARD RISK MANAGEMENT PLAN

TITLE
Piezometer Data
C074 - Red Deer River Bridge
Hwy 27:10, km 23.976

SCALE	PROJECT No.	FIG No.
	A05116A02	



NOTES:
1. GROUND SURFACE ELEVATIONS OBTAINED FROM DATA PROVIDED BY THURBER ENGINEERING IN MAY 2019.
2. THE DATA LOGGER CONNECTED TO THE INSTRUMENTATION WAS INOPERABLE AFTER A FLOOD EVENT IN LATE-MARCH 2019.
3. MANUAL READINGS TAKEN SINCE SEPTEMBER 2021.

CLIENT
Alberta
Klohn Crippen Berger

PROJECT
CENTRAL REGION GEOHAZARD RISK MANAGEMENT PLAN

TITLE
Piezometer Data
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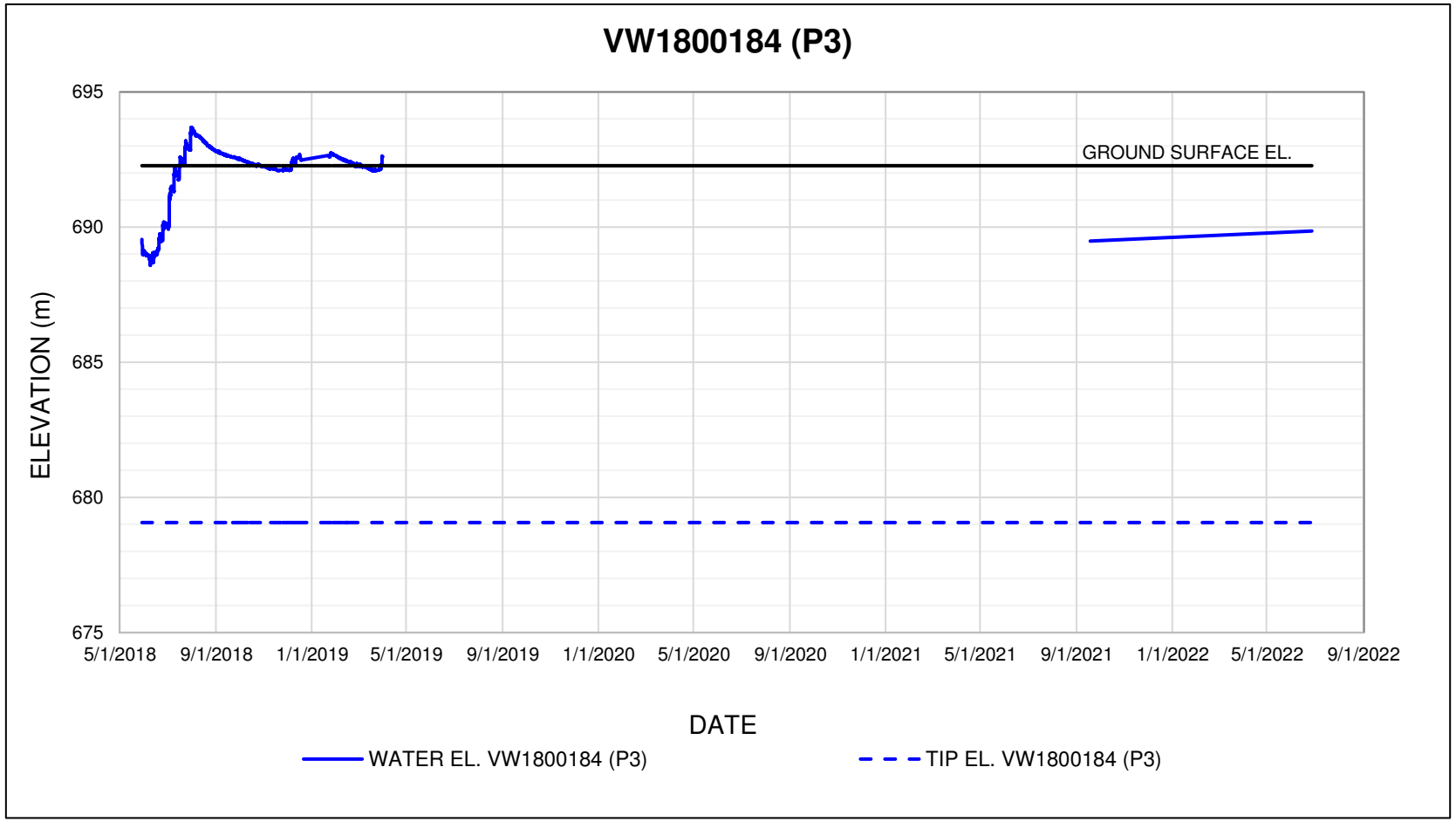

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CLIENT: Alberta

Klohn Crippen Berger

PROJECT: CENTRAL REGION GEOHAZARD RISK MANAGEMENT PLAN

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C074 - Red Deer River Bridge
Hwy 27:10, km 23.976

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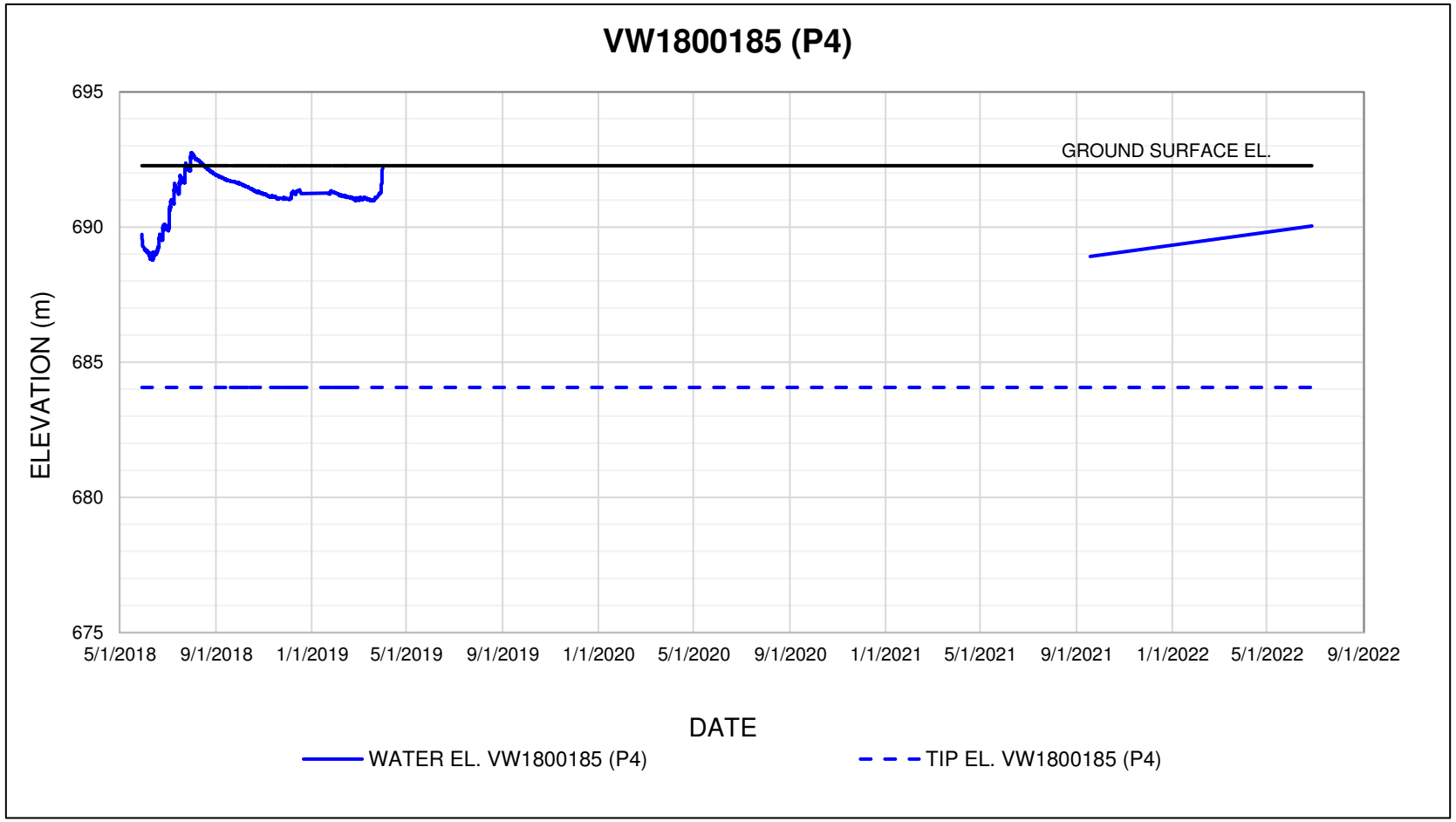
	A05116A02	



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CLIENT
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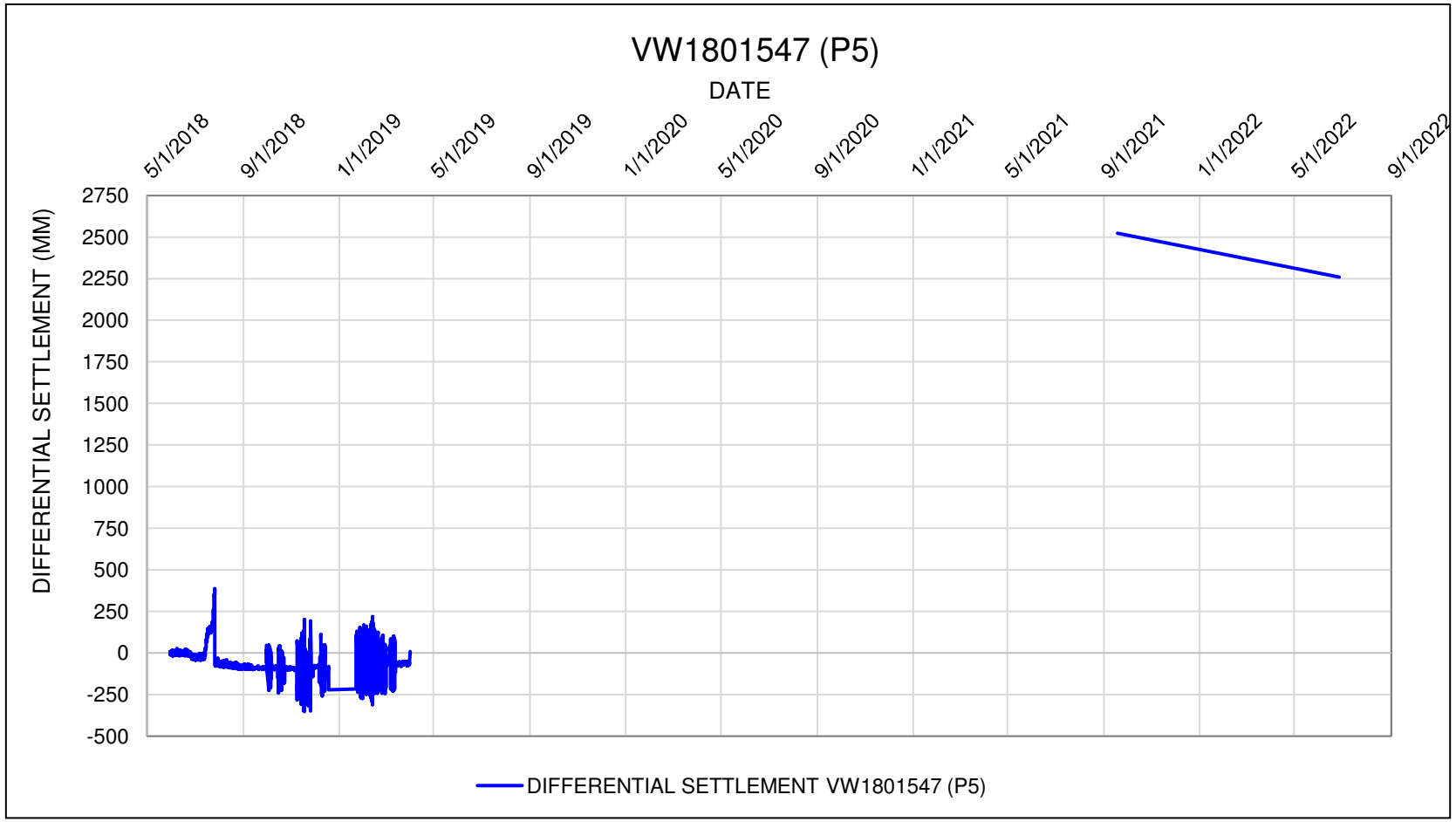

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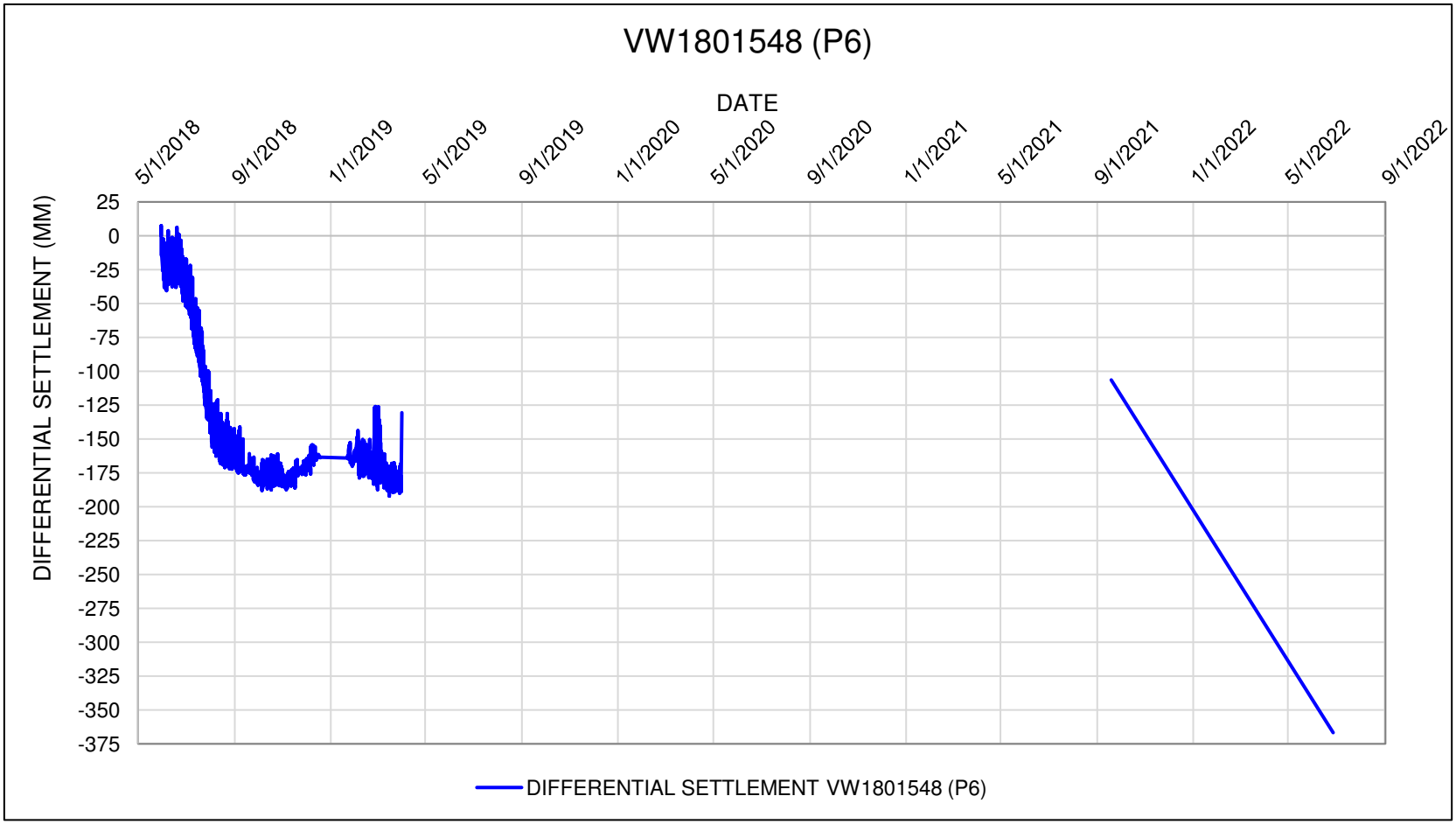
3. THE DIFFERENTIAL SETTLEMENT WAS CALCULATED BY USING MAY 30, 2021 AS THE "ZERO" READING.
4. MANUAL READINGS TAKEN SINCE SEPTEMBER 2021.

CLIENT
Alberta
Klohn Crippen Berger

PROJECT
CENTRAL REGION GEOHAZARD RISK MANAGEMENT PLAN

TITLE
Settlement Gauge Data
C074 - Red Deer River Bridge
Hwy 27:10, km 23.976

SCALE	PROJECT No.	FIG No.
	A05116A02	



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CLIENT
Alberta
Klohn Crippen Berger

PROJECT
CENTRAL REGION GEOHAZARD RISK MANAGEMENT PLAN

TITLE
Settlement Gauge Data
C074 - Red Deer River Bridge
Hwy 27:10, km 23.976

SCALE	PROJECT No.	FIG No.
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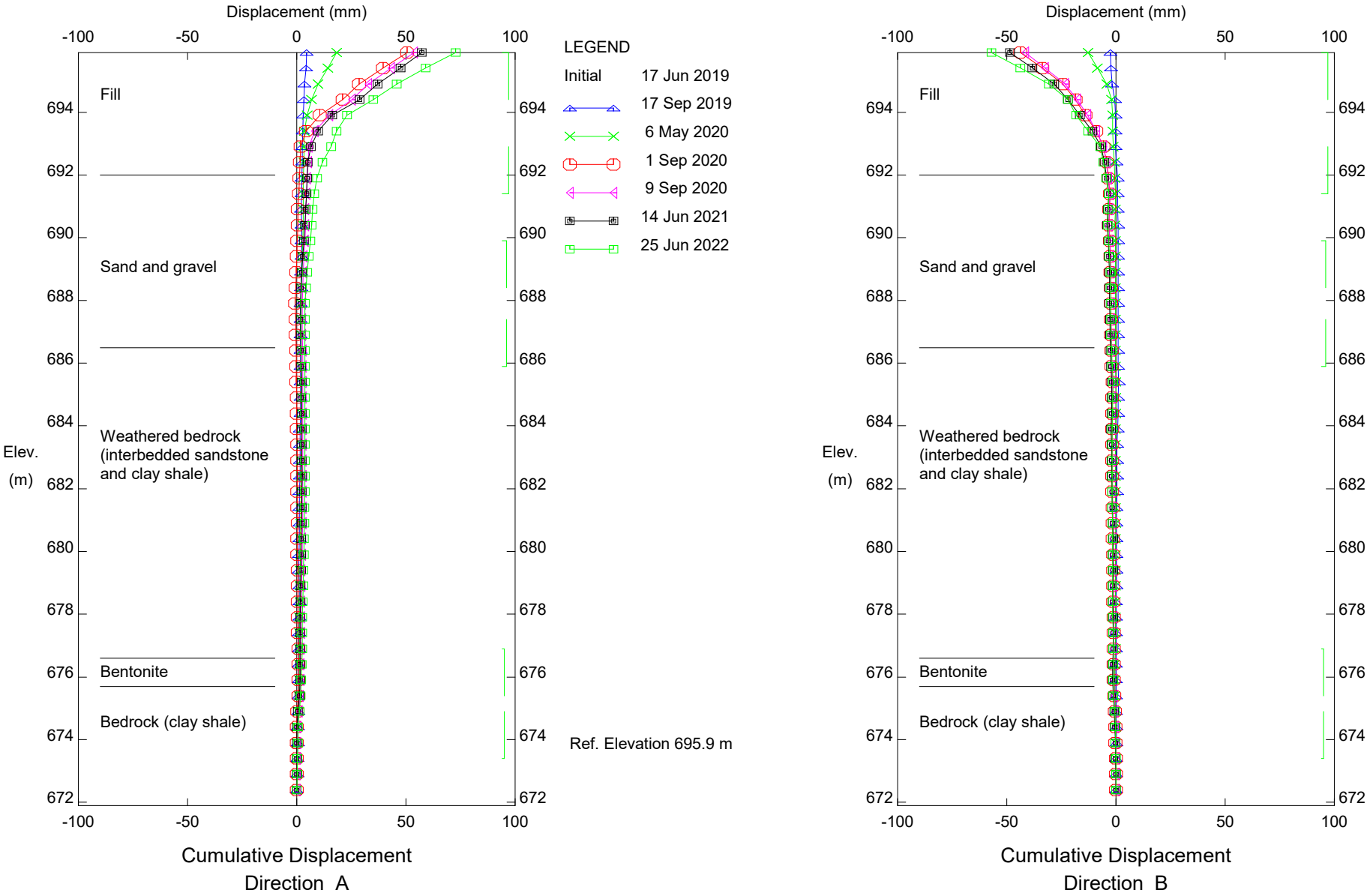
Klohn Crippen Berger - Vancouver

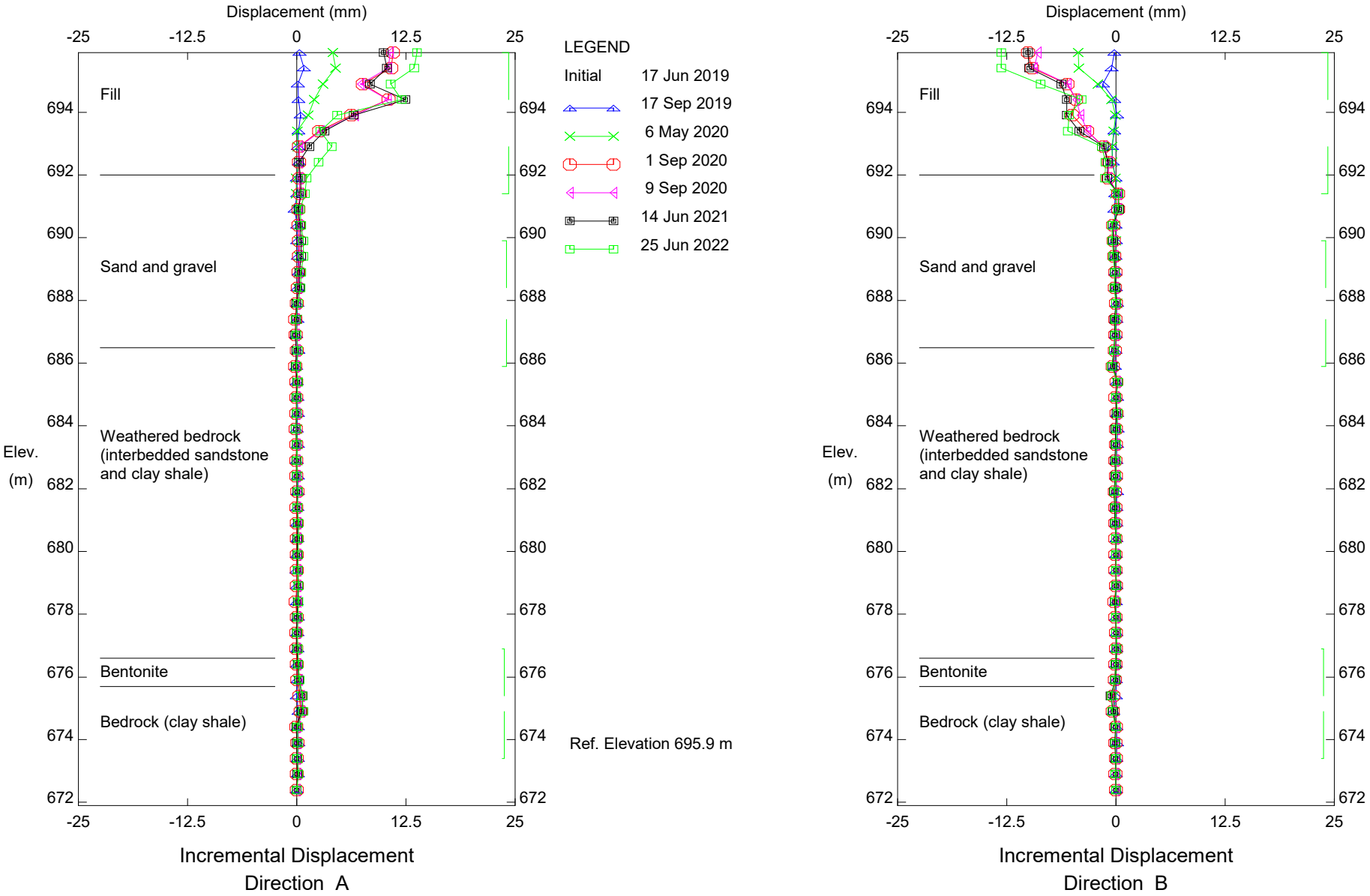


C074; H27:10, Morrin Bridge, Inclinometer SI18-1

Alberta Transportation

Embankment

Klohn Crippen Berger - Vancouver

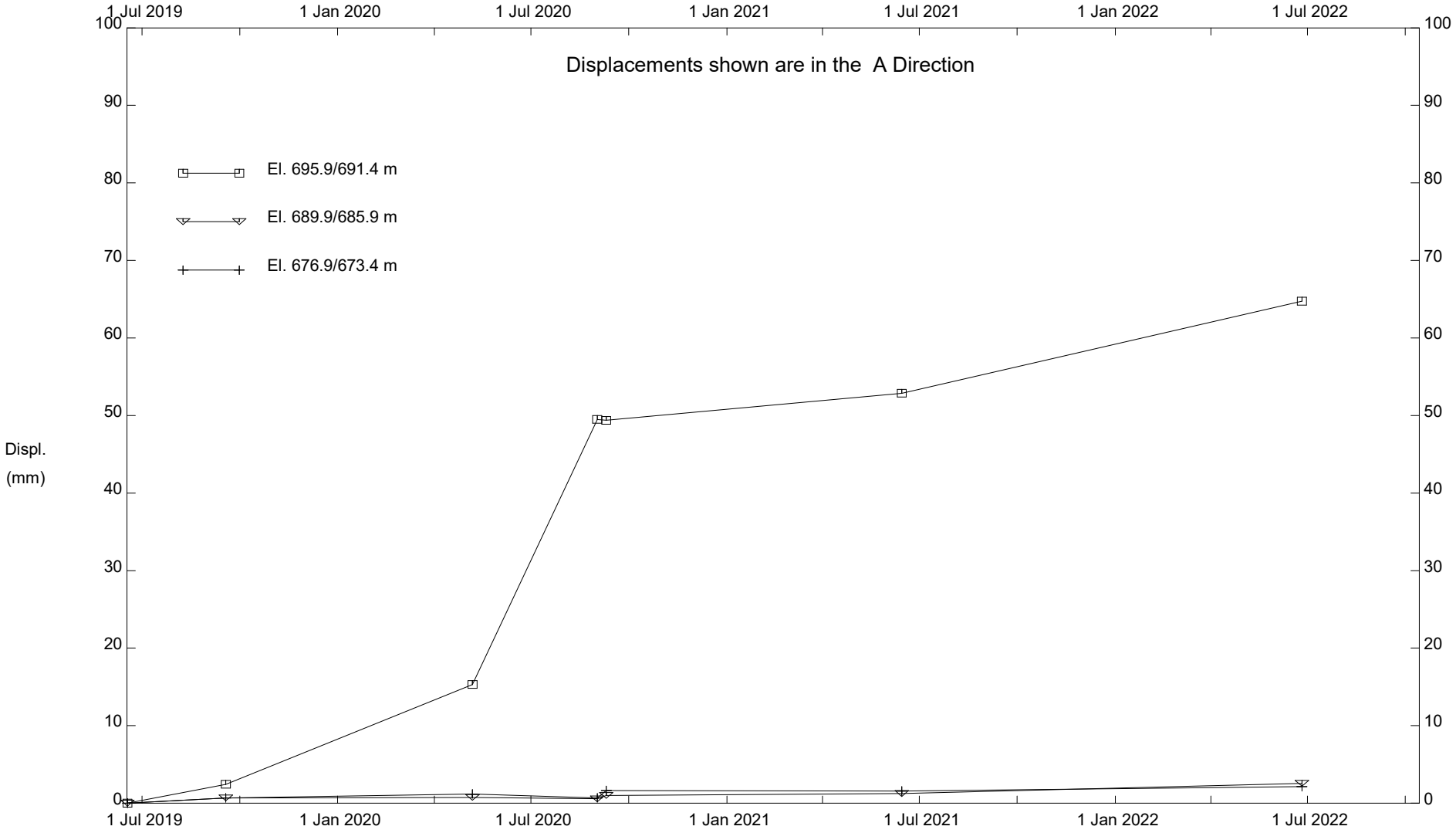


C074; H27:10, Morrin Bridge, Inclinometer SI18-1

Alberta Transportation

Embankment

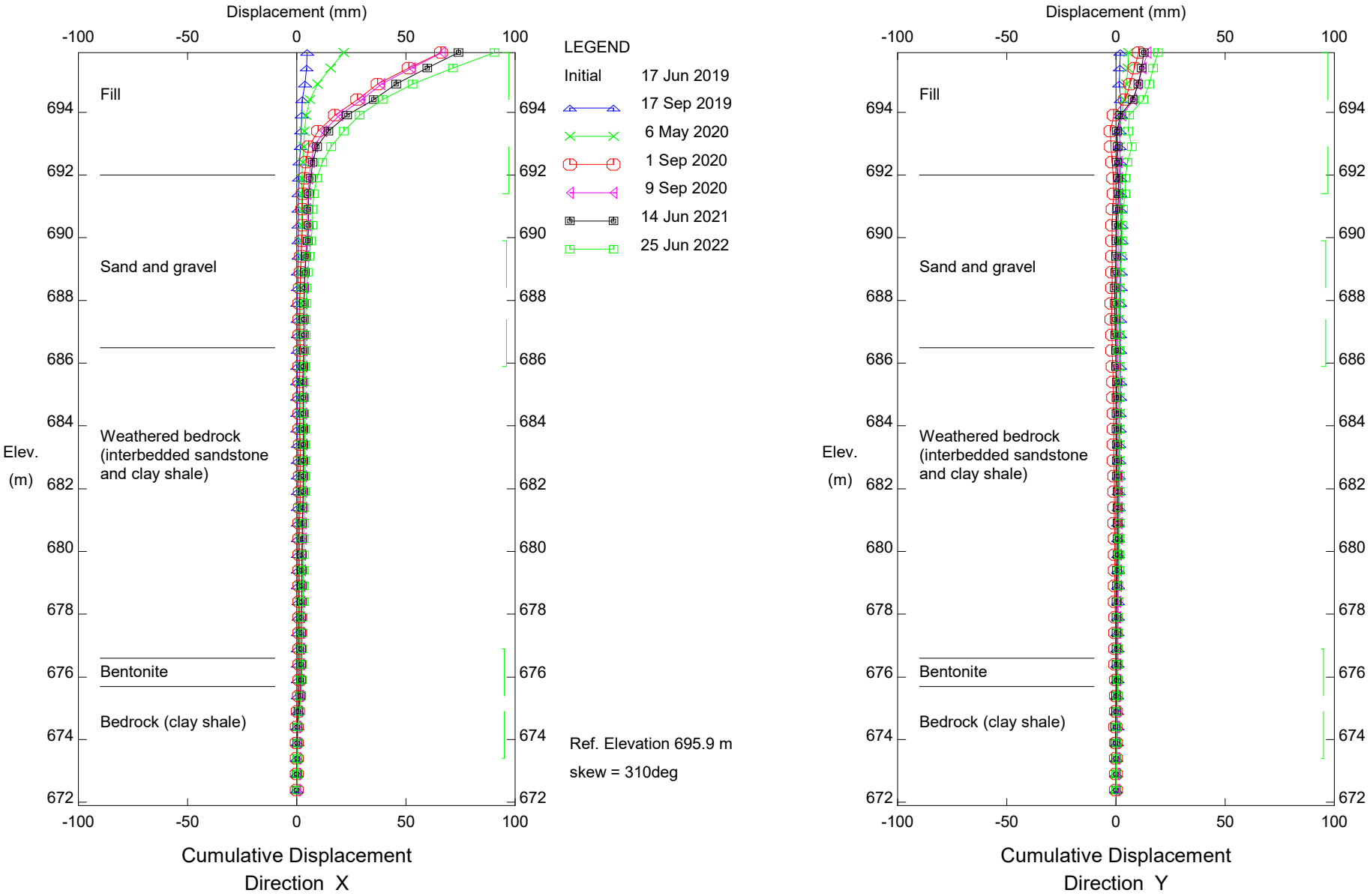
Klohn Crippen Berger - Vancouver



C074; H27:10, Morrin Bridge, Inclinometer SI18-1

Alberta Transportation

Klohn Crippen Berger - Vancouver

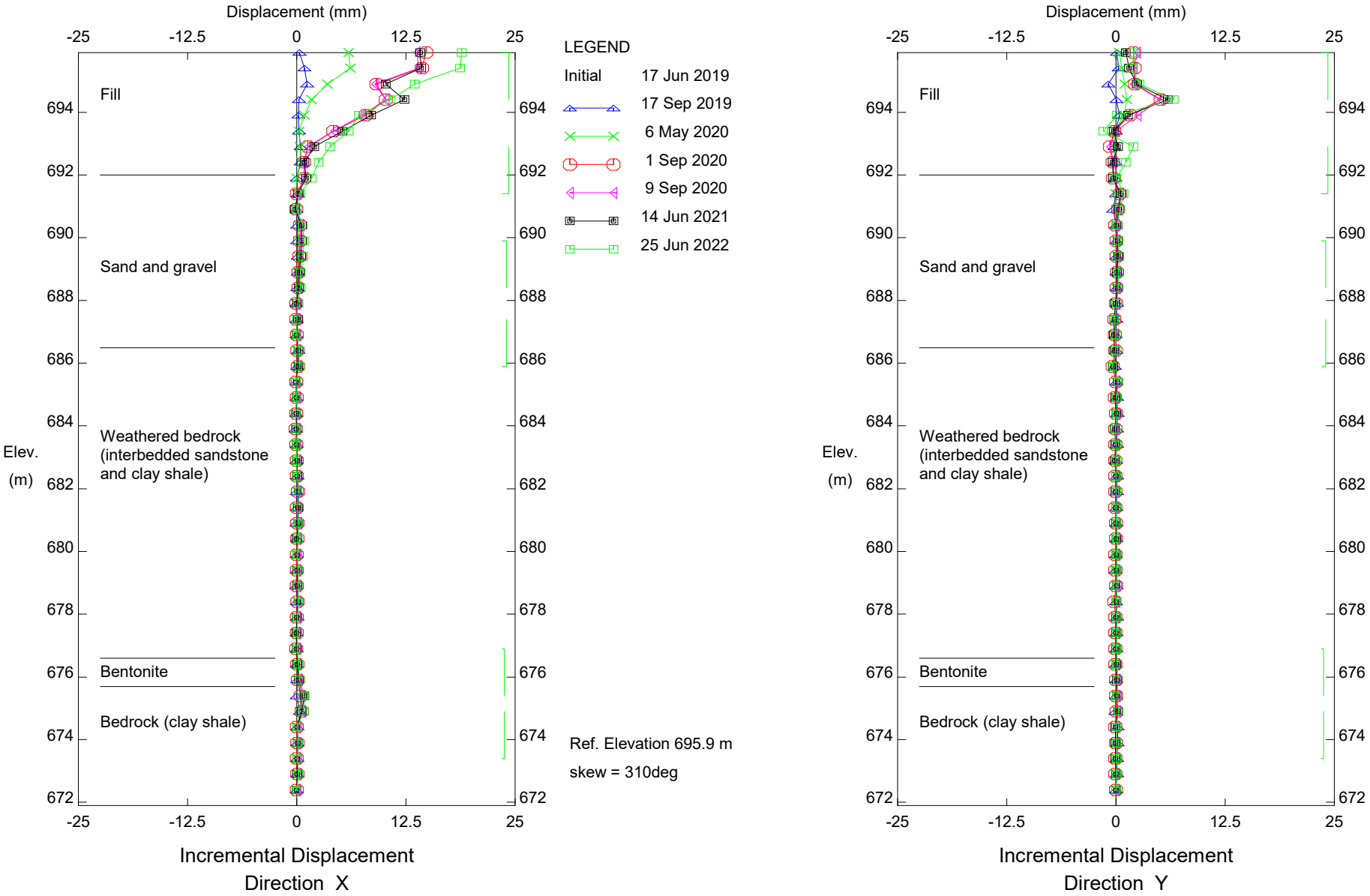


C074; H27:10, Morrin Bridge, Inclinometer SI18-1

Alberta Transportation

Embankment

Klohn Crippen Berger - Vancouver

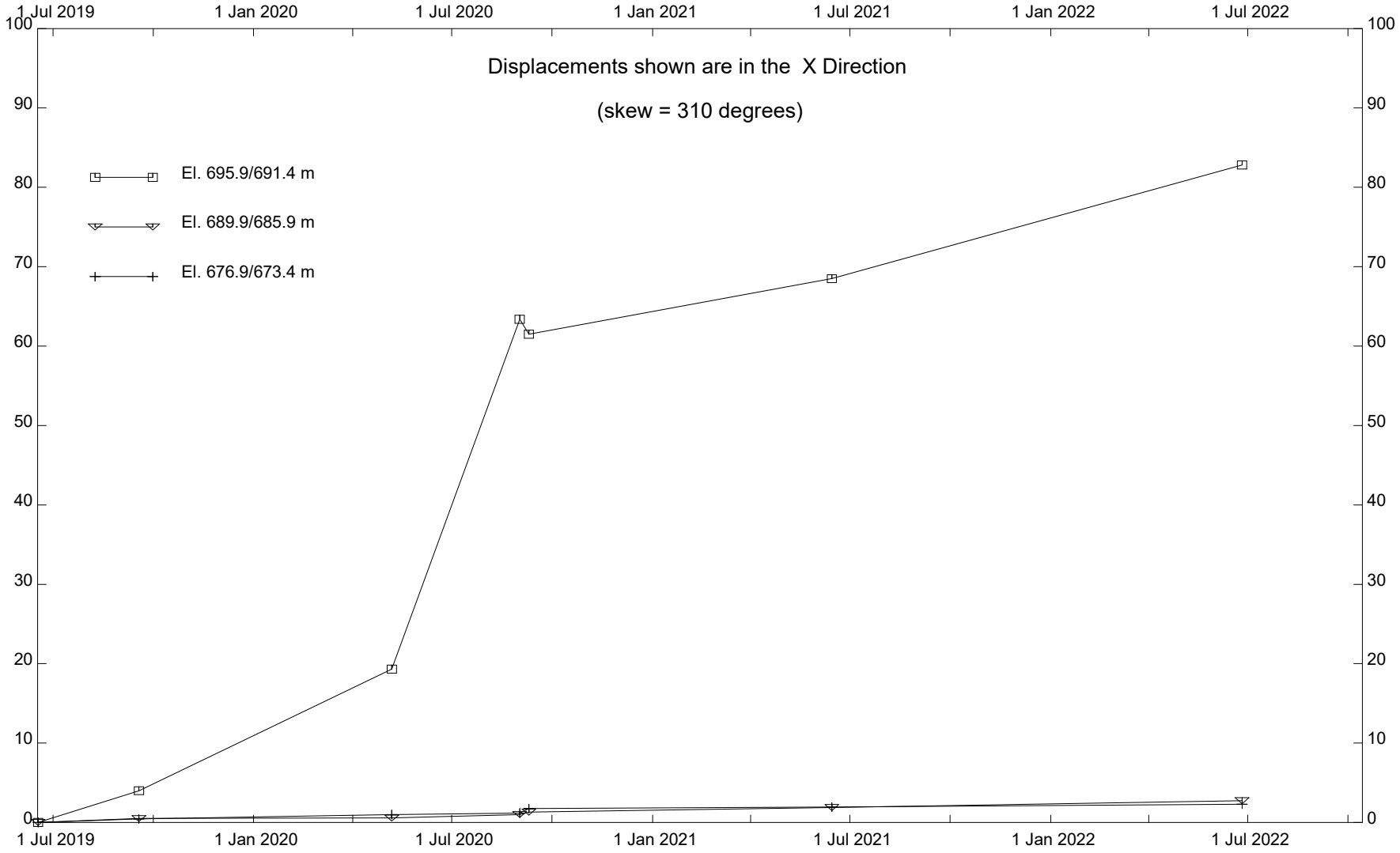


C074; H27:10, Morrin Bridge, Inclinometer SI18-1

Alberta Transportation

Embankment

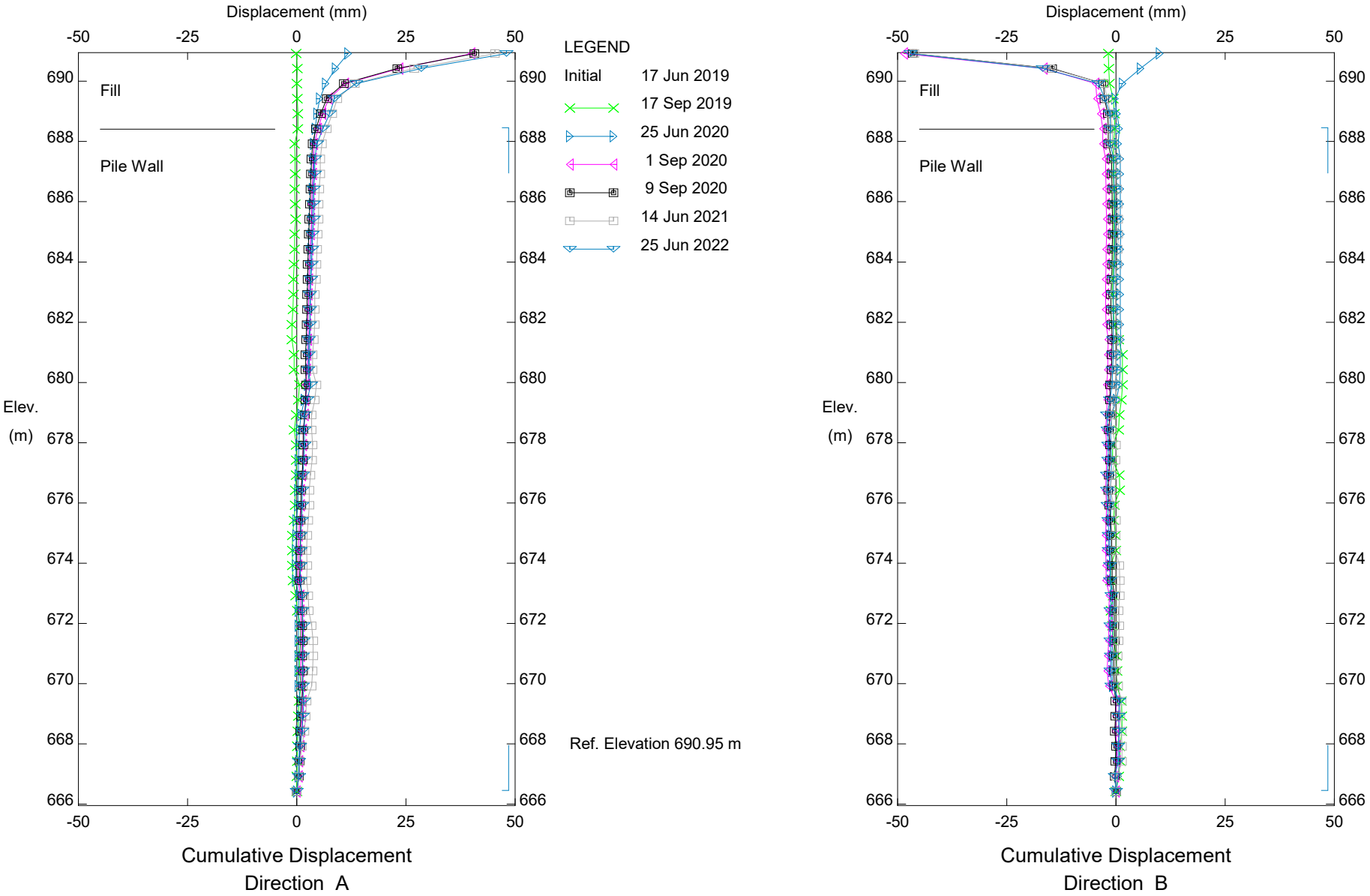
Klohn Crippen Berger - Vancouver



C074; H27:10, Morrin Bridge, Inclinometer SI18-1

Alberta Transportation

Klohn Crippen Berger - Vancouver

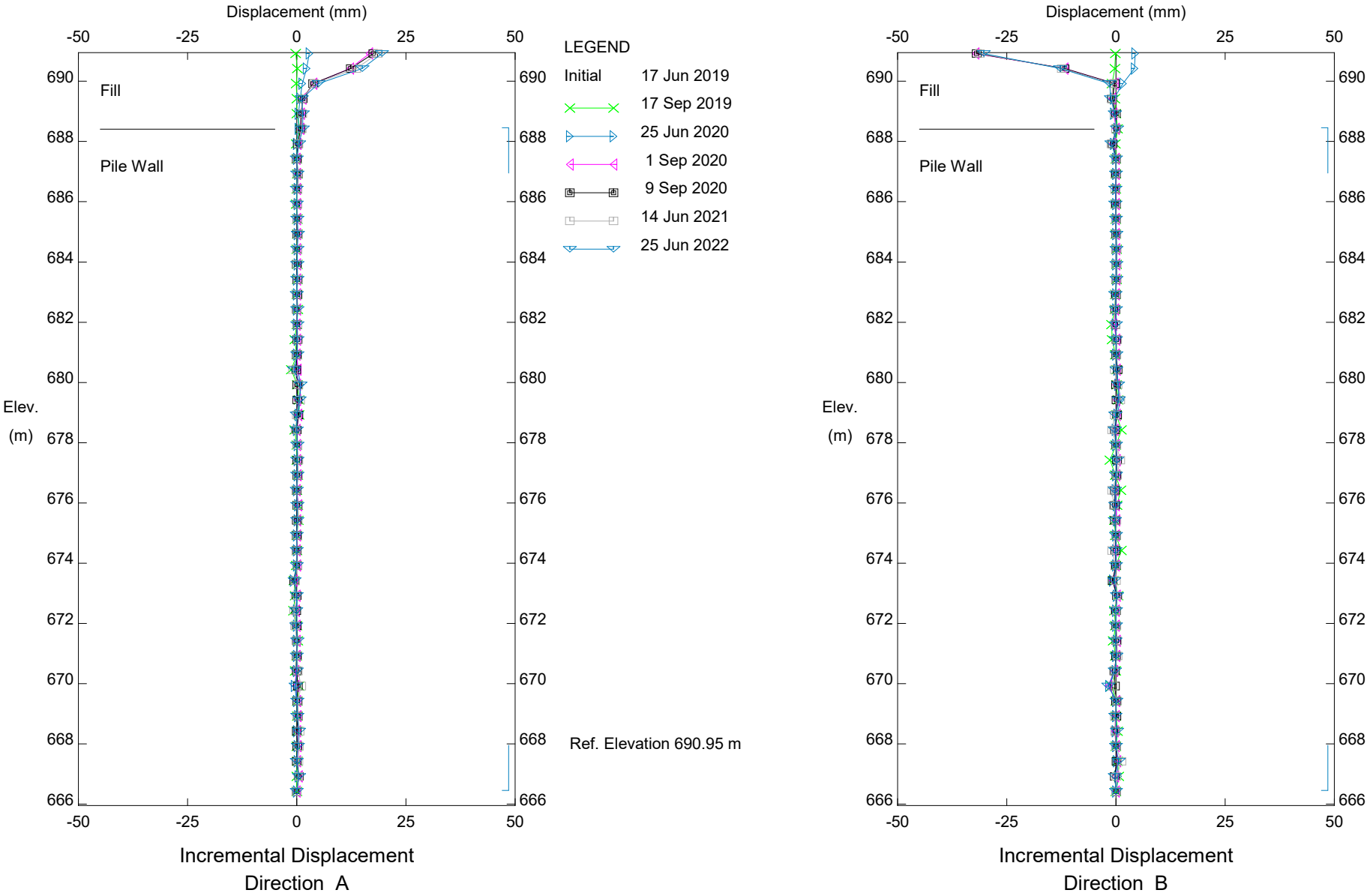


C074; H27:10, Morrin Bridge, Inclinometer SI-P01

Alberta Transportation

Pile Wall

Klohn Crippen Berger - Vancouver

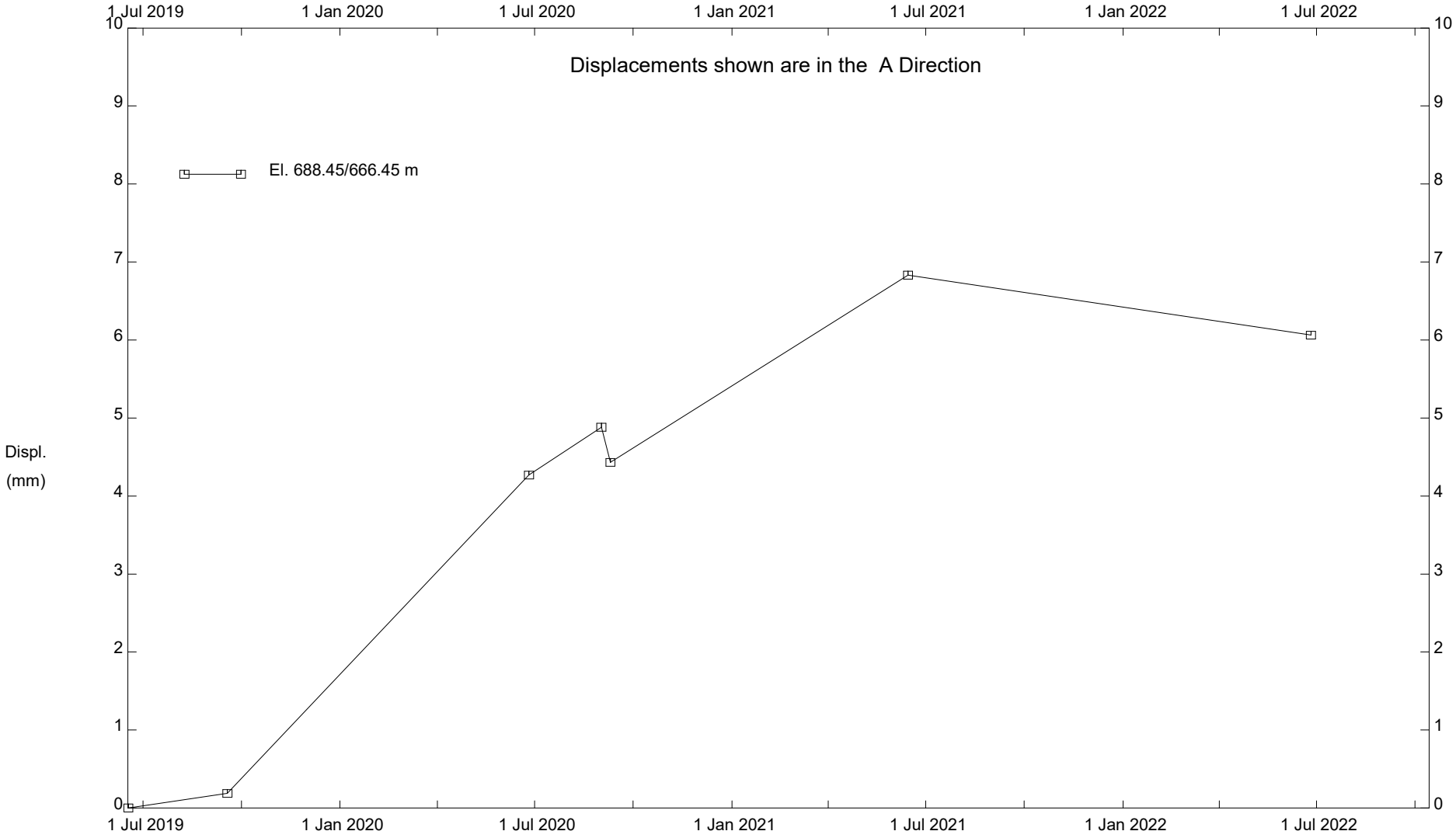


C074; H27:10, Morrin Bridge, Inclinometer SI-P01

Alberta Transportation

Pile Wall

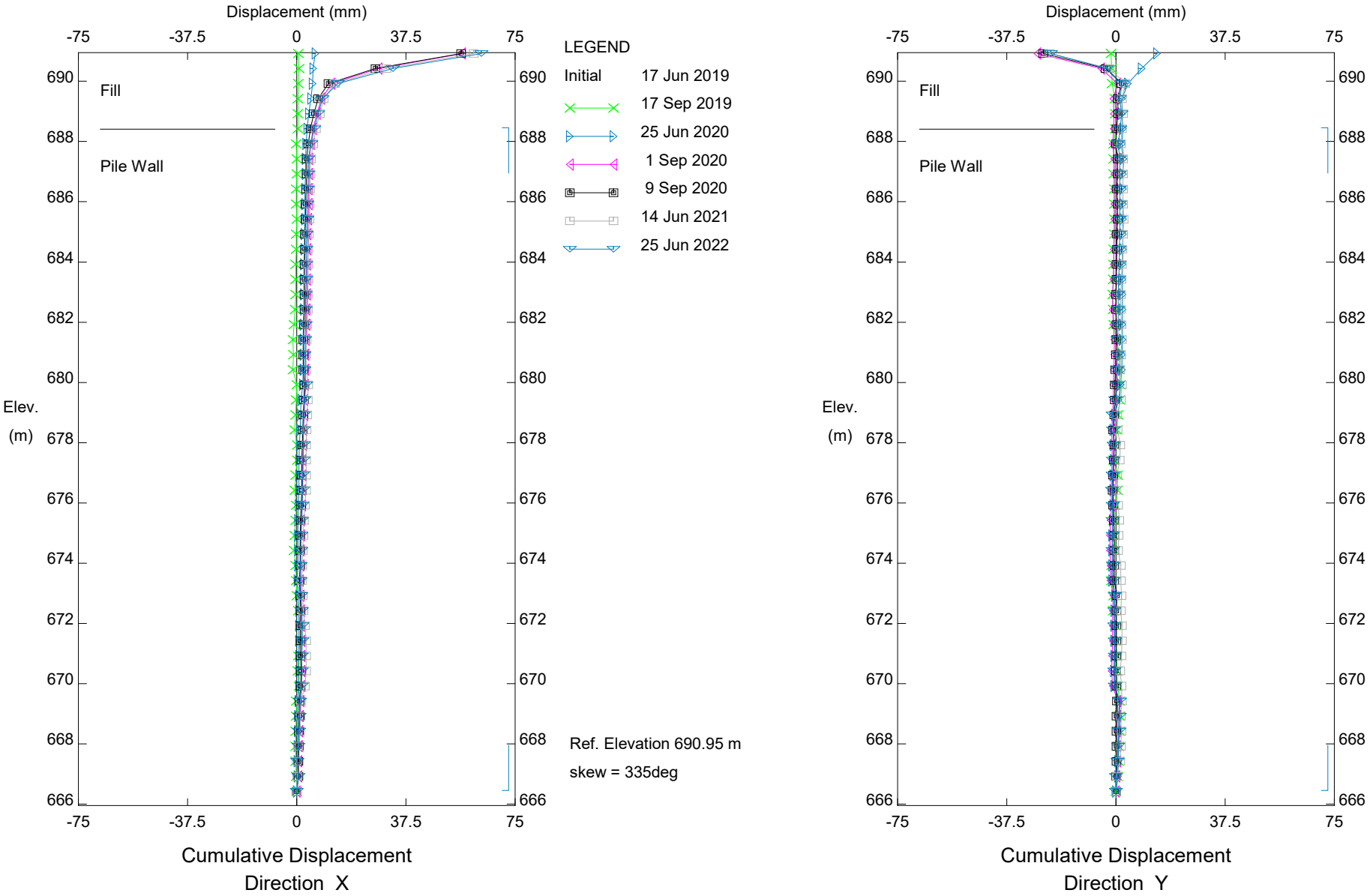
Klohn Crippen Berger - Vancouver



C074; H27:10, Morrin Bridge, Inclinometer SI-P01

Alberta Transportation

Klohn Crippen Berger - Vancouver

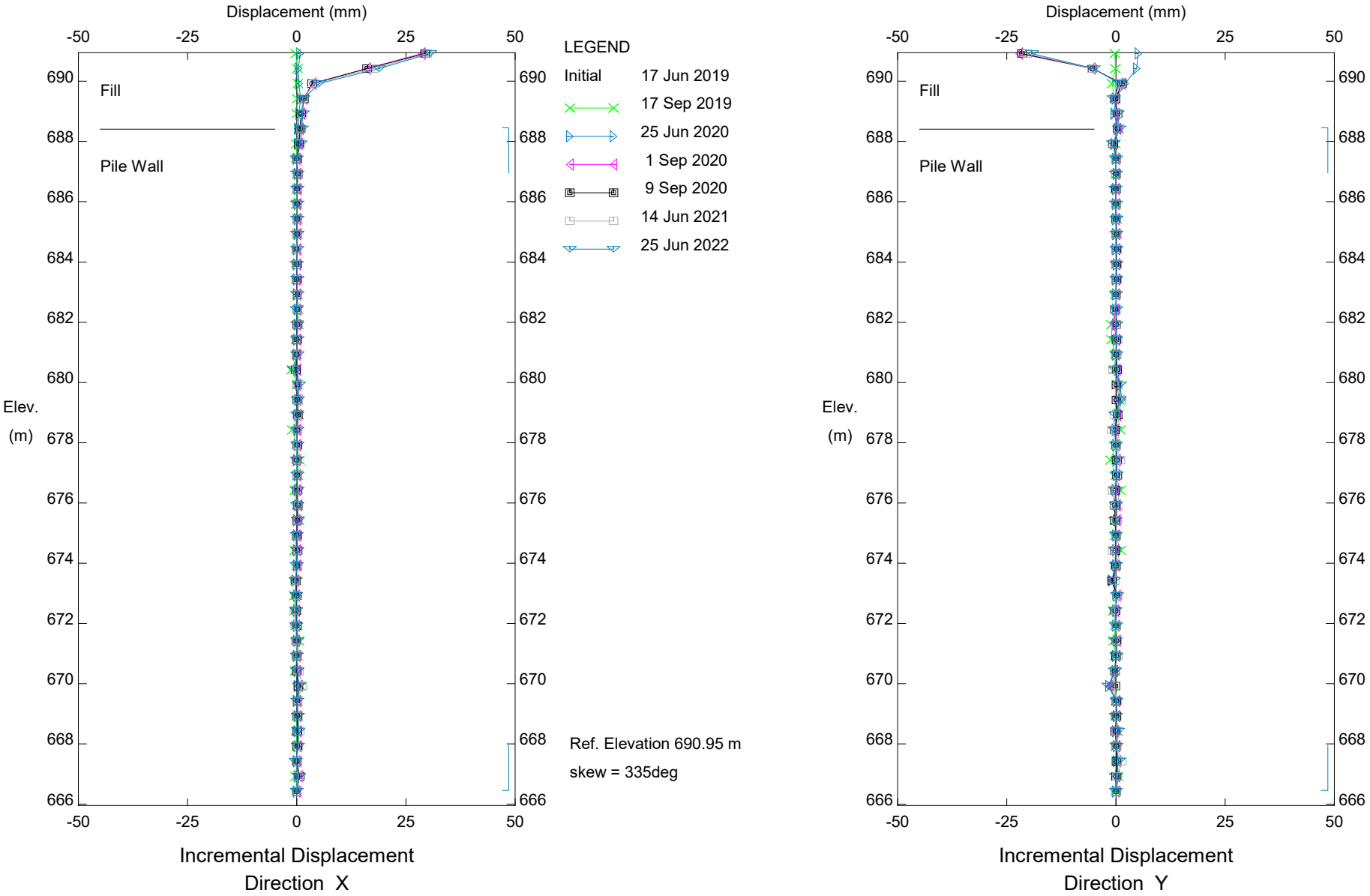


C074; H27:10, Morrin Bridge, Inclinometer SI-P01

Alberta Transportation

Pile Wall

Klohn Crippen Berger - Vancouver

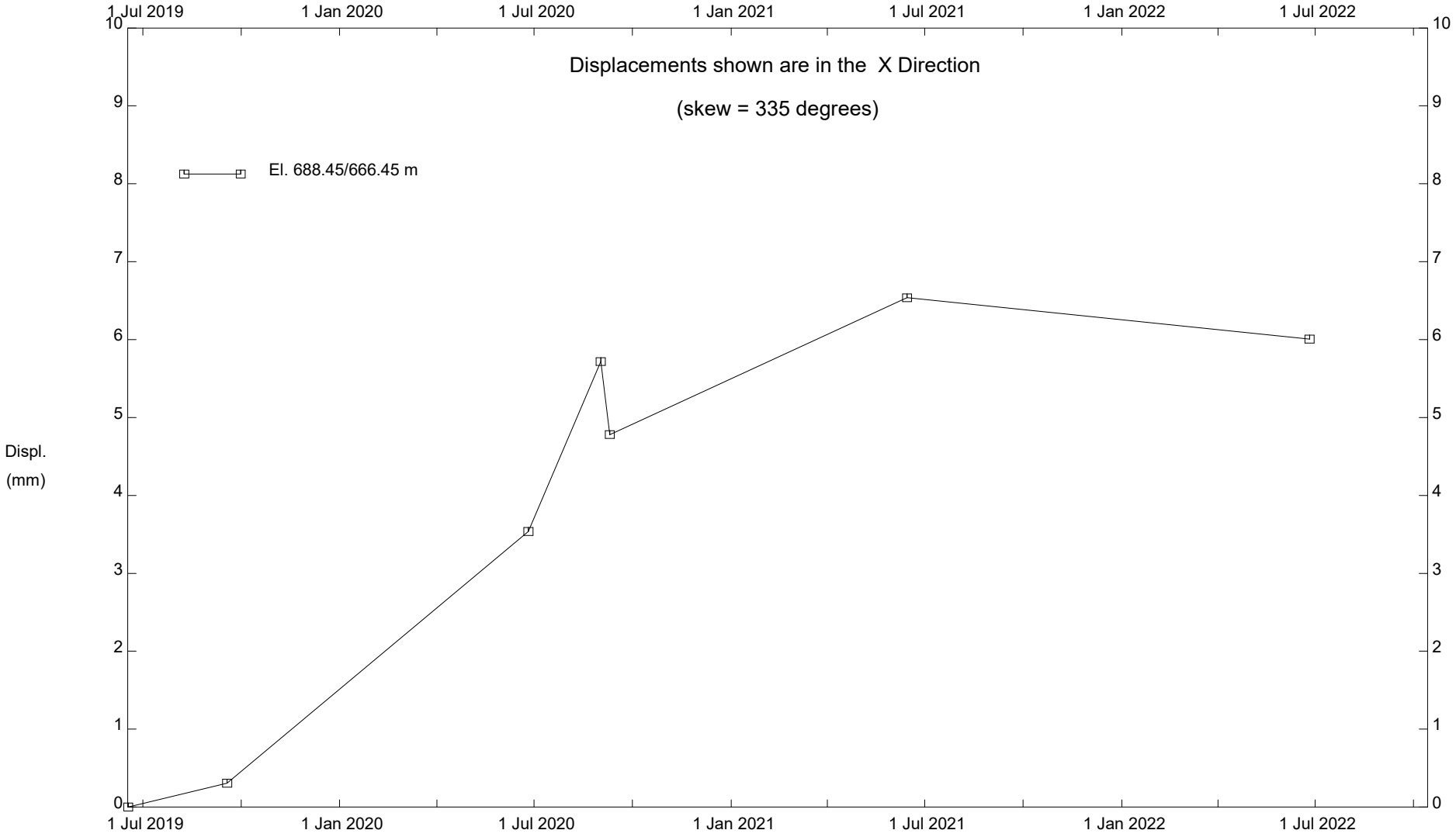


C074; H27:10, Morrin Bridge, Inclinometer SI-P01

Alberta Transportation

Pile Wall

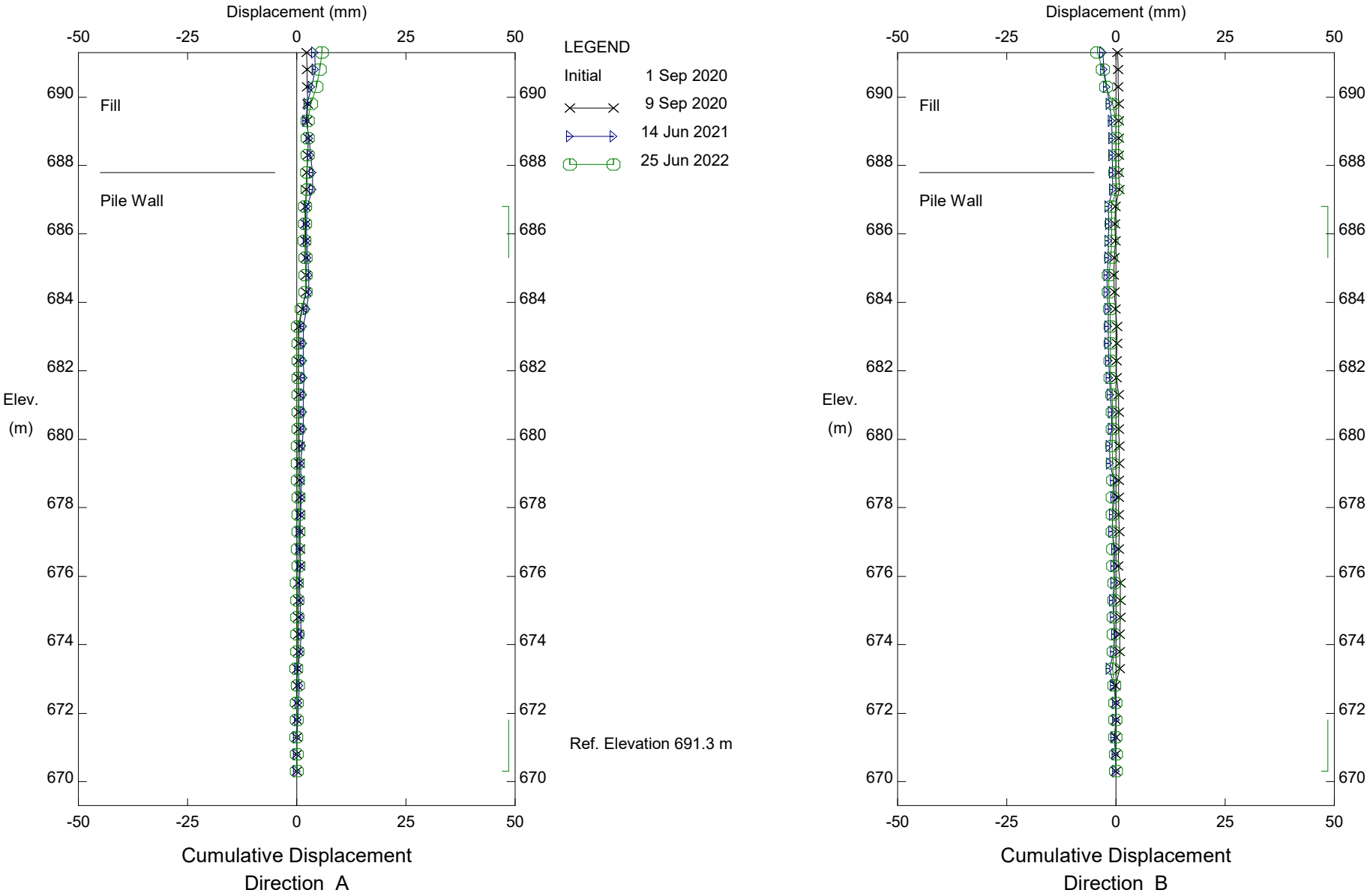
Klohn Crippen Berger - Vancouver



C074; H27:10, Morrin Bridge, Inclinometer SI-P01

Alberta Transportation

Klohn Crippen Berger - Vancouver

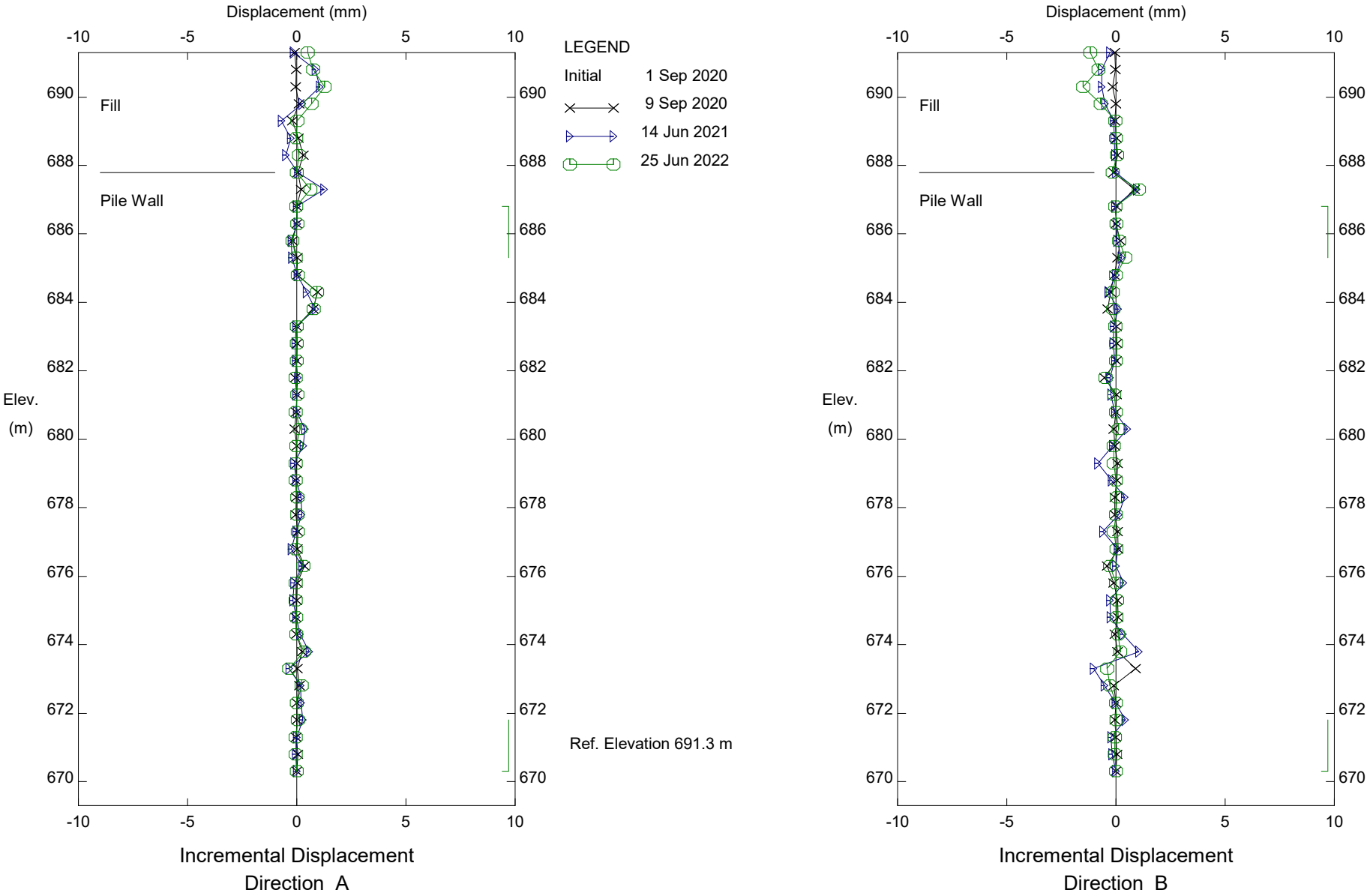


C0174; H27:10, Morrin Bridge, Inclinometer SI-P06

Alberta Transportation

Pile wall

Klohn Crippen Berger - Vancouver

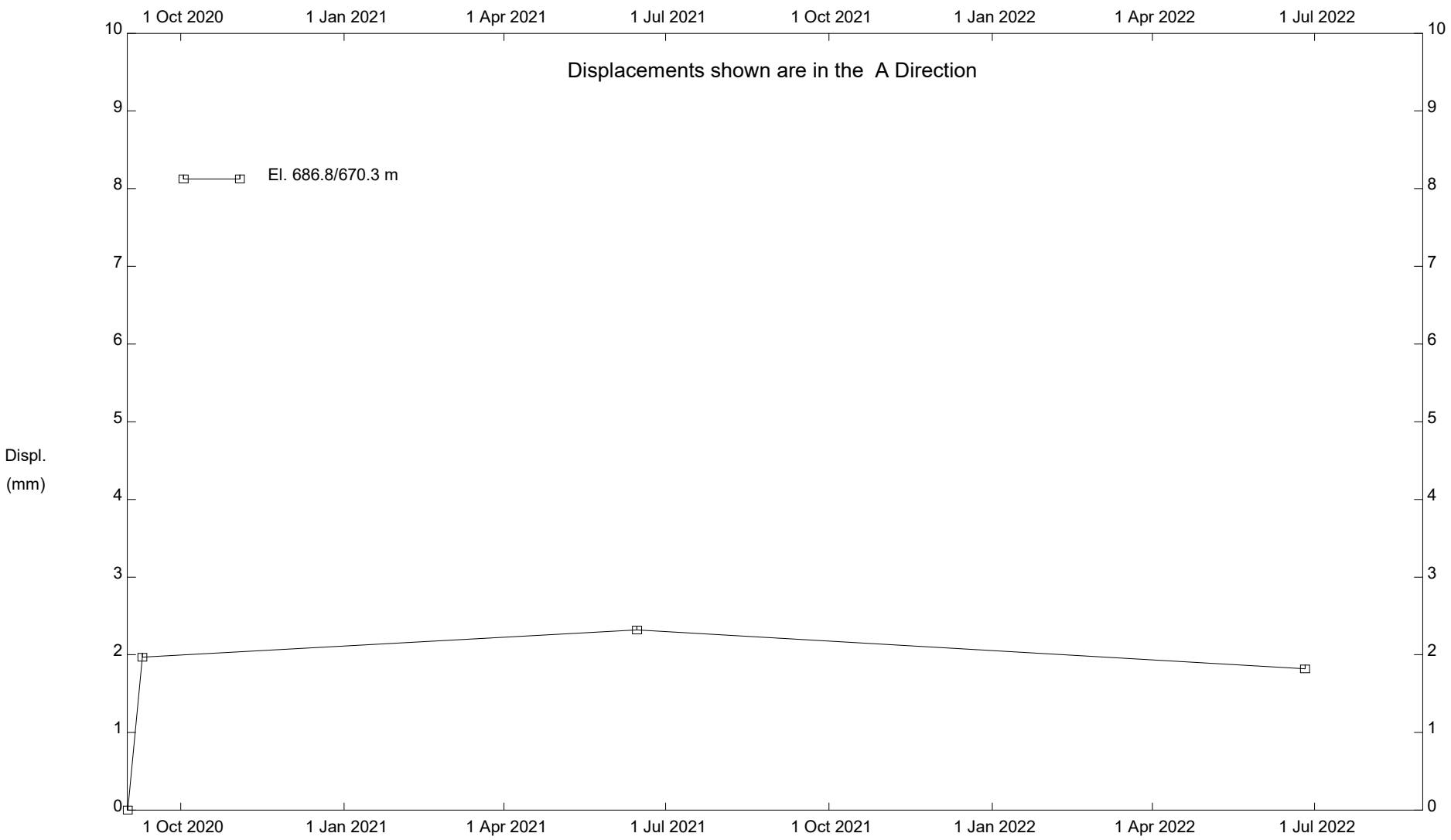


C0174; H27:10, Morrin Bridge, Inclinometer SI-P06

Alberta Transportation

Pile wall

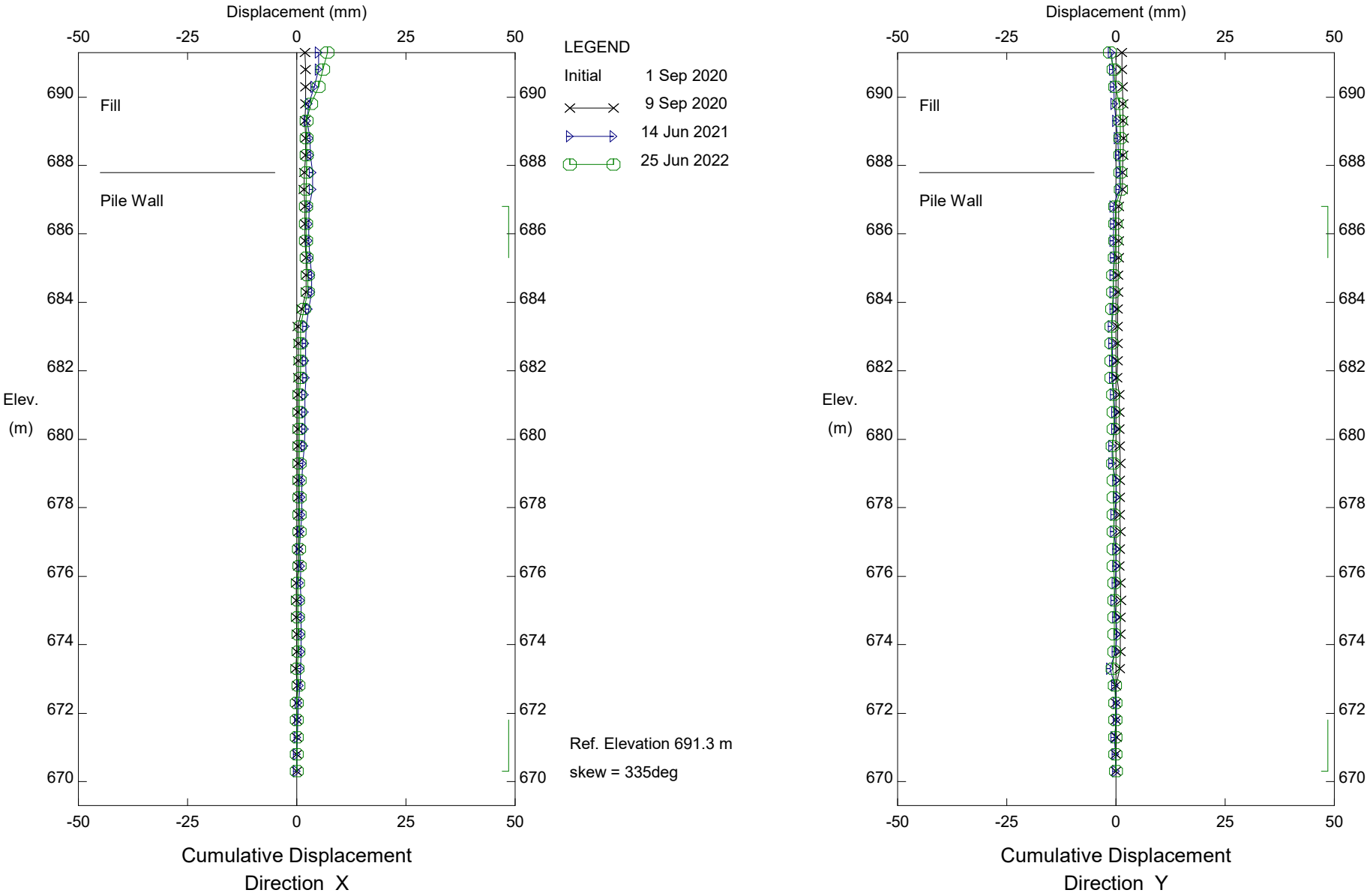
Klohn Crippen Berger - Vancouver



C0174; H27:10, Morrin Bridge, Inclinometer SI-P06

Alberta Transportation

Klohn Crippen Berger - Vancouver

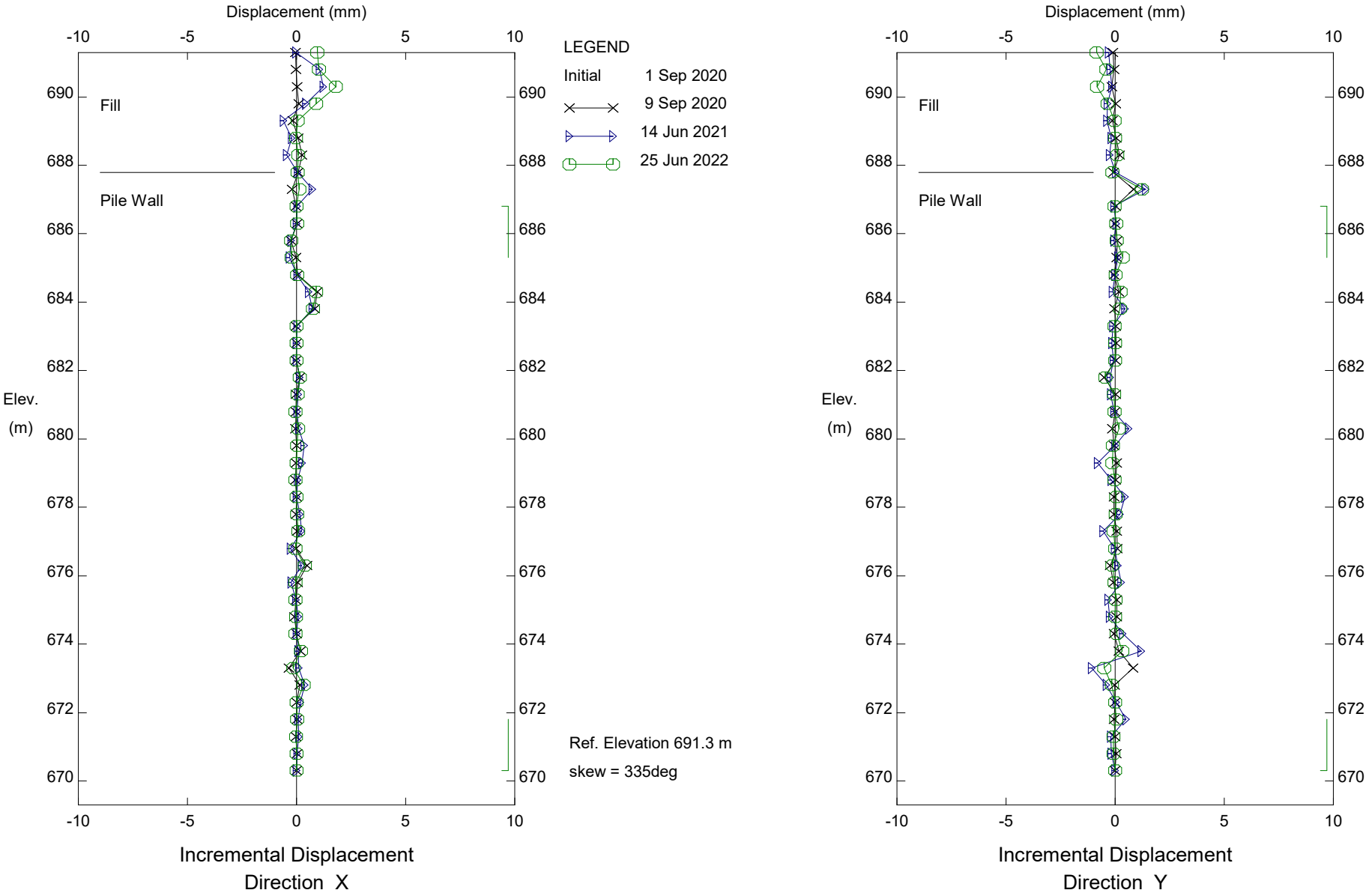


C0174; H27:10, Morrin Bridge, Inclinometer SI-P06

Alberta Transportation

Pile wall

Klohn Crippen Berger - Vancouver

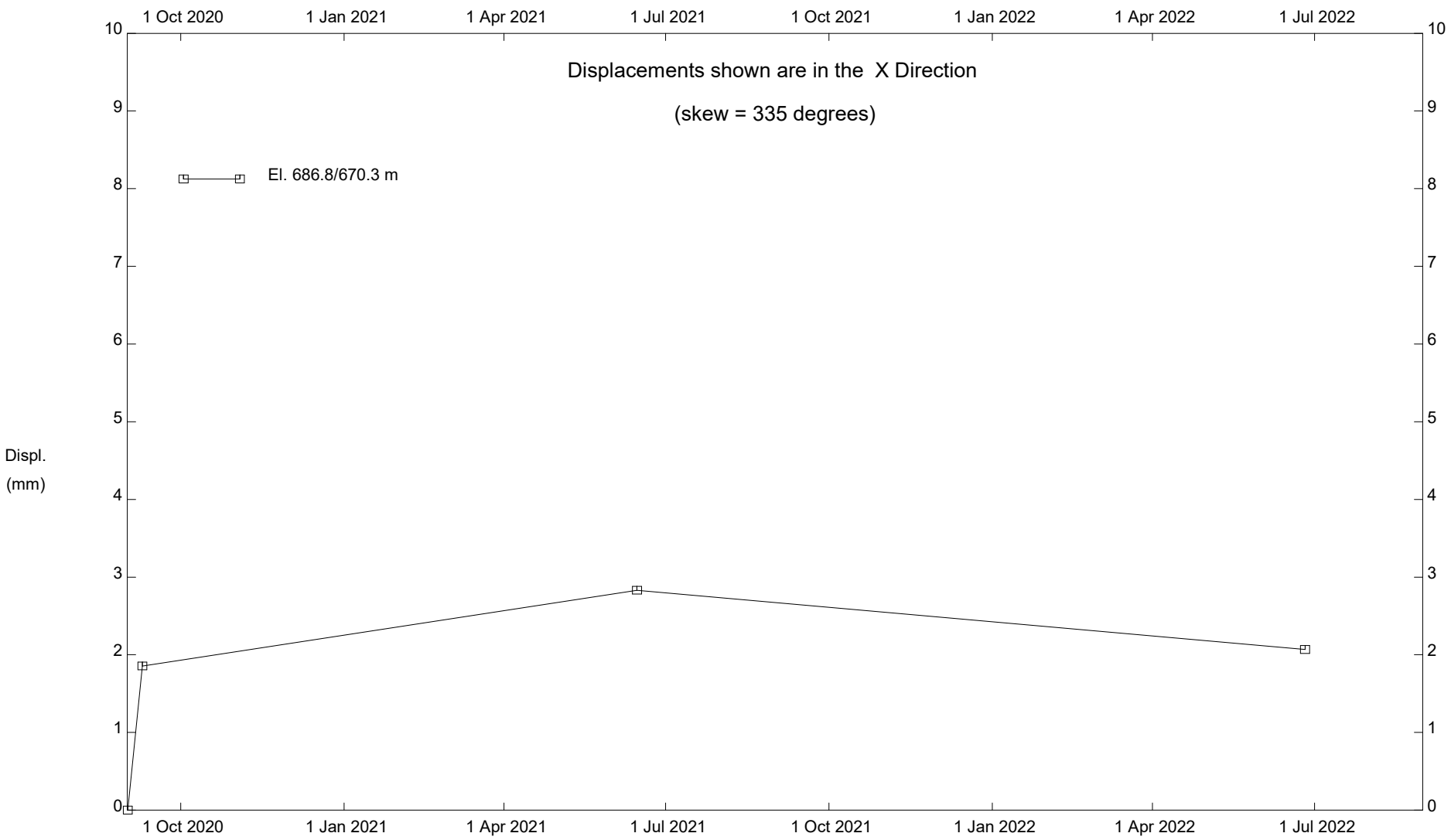


C0174; H27:10, Morrin Bridge, Inclinometer SI-P06

Alberta Transportation

Pile wall

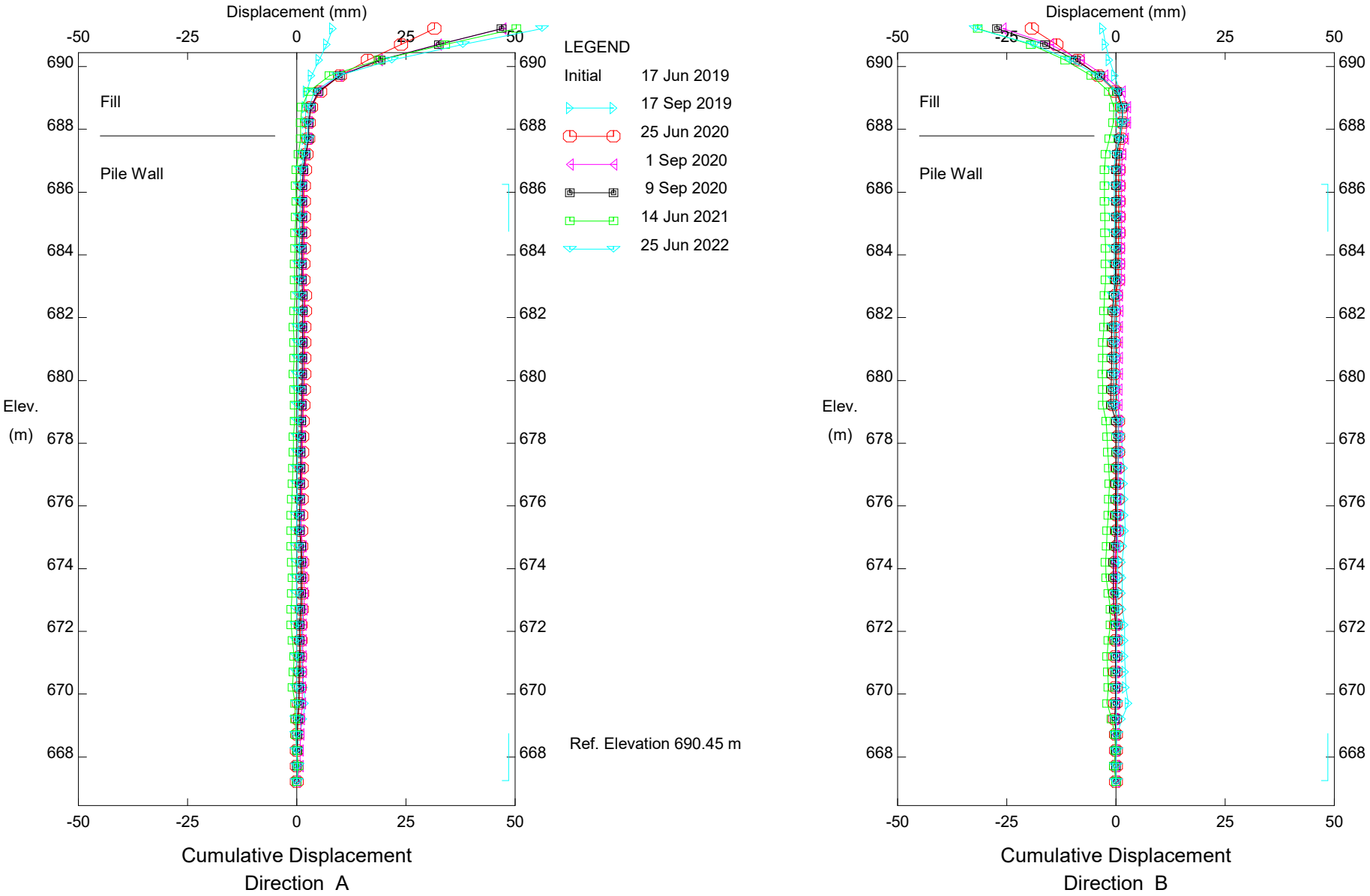
Klohn Crippen Berger - Vancouver



C0174; H27:10, Morrin Bridge, Inclinometer SI-P06

Alberta Transportation

Klohn Crippen Berger - Vancouver

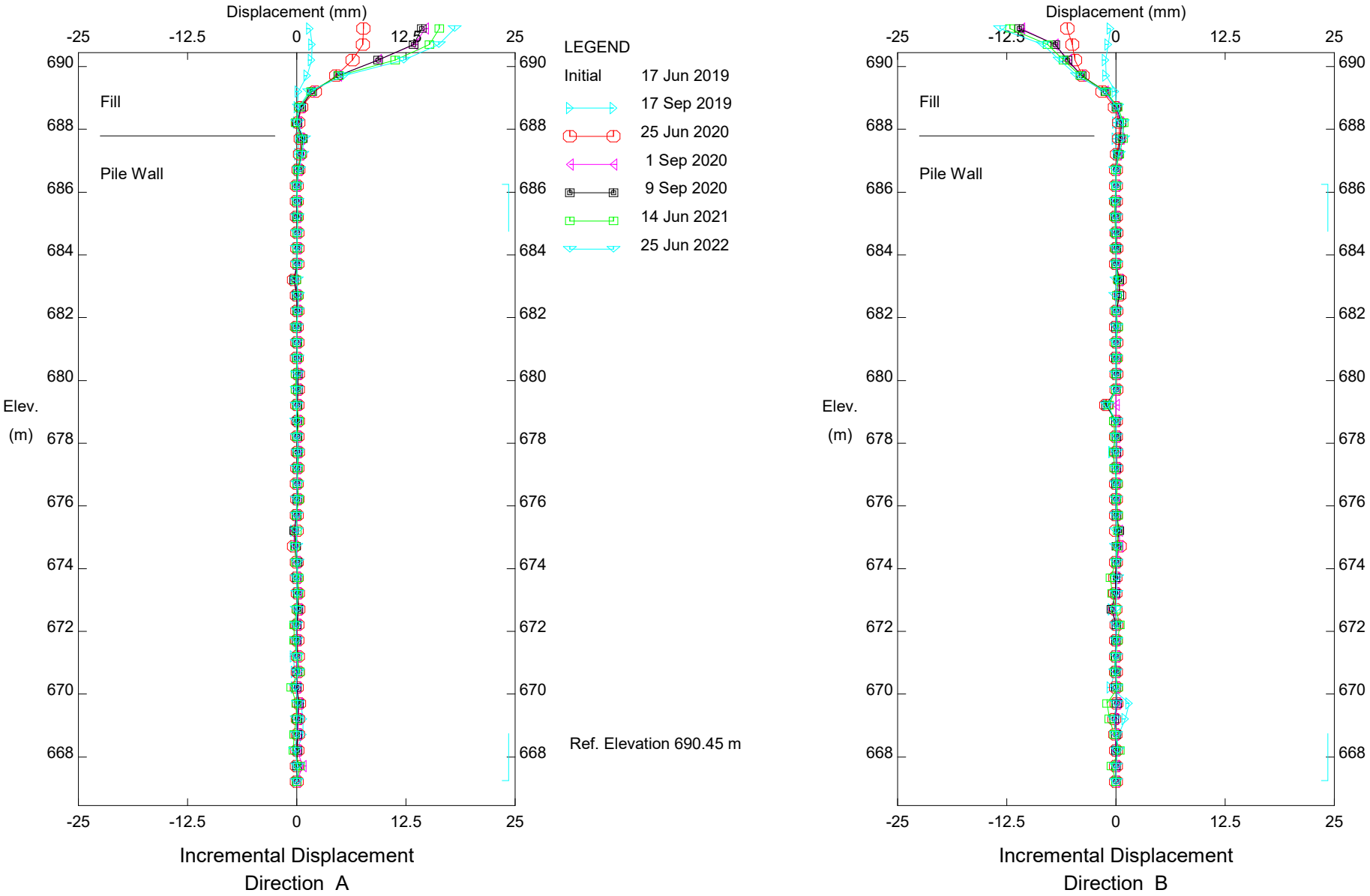


C074; H27:10, Morrin Bridge, Inclinometer SI-P11

Alberta Transportation

Pile wall

Klohn Crippen Berger - Vancouver

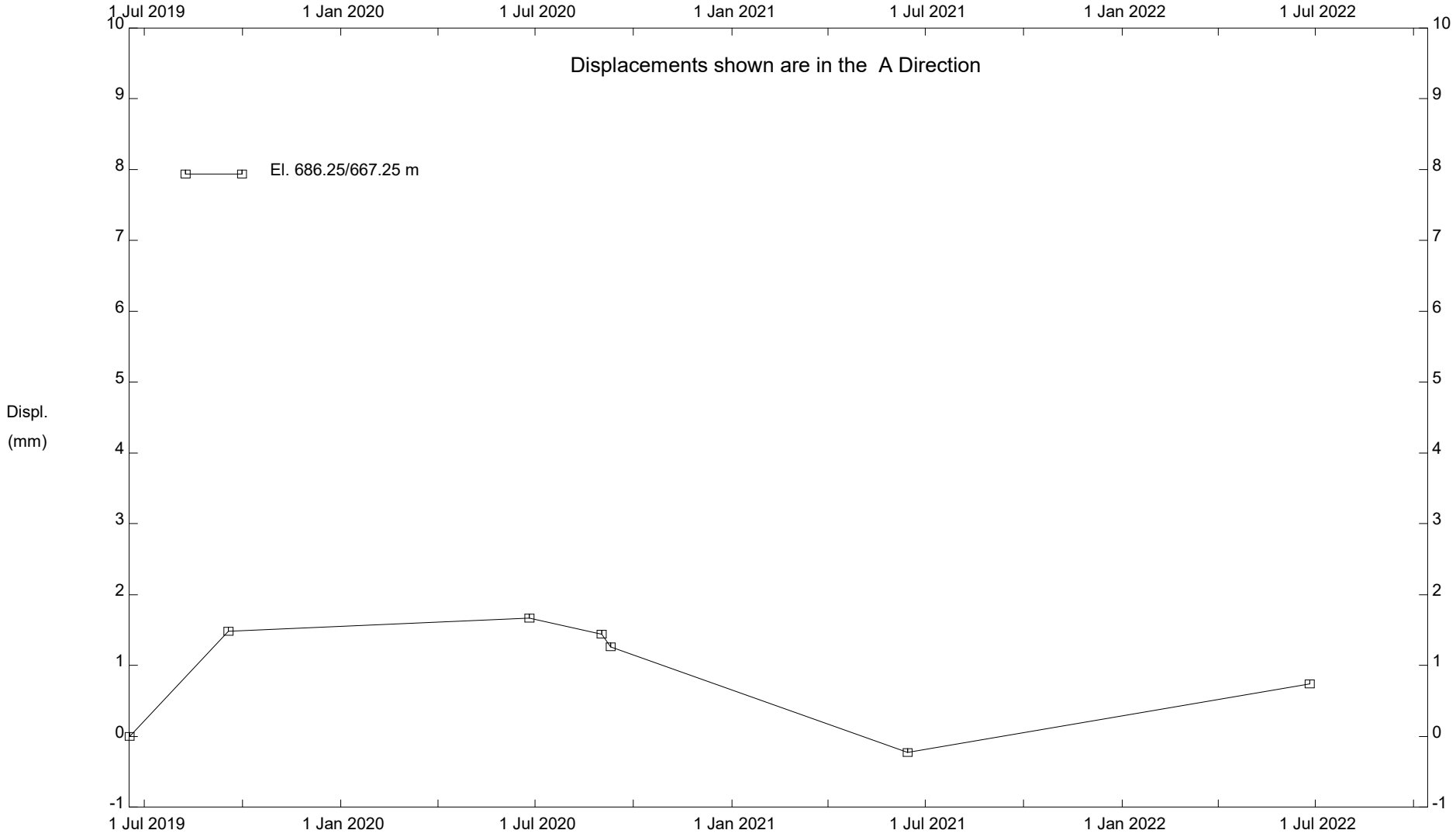


C074; H27:10, Morrin Bridge, Inclinometer SI-P11

Alberta Transportation

Pile wall

Klohn Crippen Berger - Vancouver



C074; H27:10, Morrin Bridge, Inclinometer SI-P11

Alberta Transportation