



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 NC090: HWY 2:42 BAPTISTE CREEK BRIDGE
NW APPROACH FILL LANDSLIDE (BF7055)**

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

In 2019, remedial measures were undertaken to repair a landslide that was affecting the approach fill of the north abutment of the Hwy 2:42 Baptiste Creek Bridge (NC090). The repairs included installation of cantilever and tied-back sheet pile walls, slope flattening of the northwest slope, instream work to restore the creek channel and structural work to repair the landslide-induced damages to the north bridge abutment. As part of the construction, a series of new geotechnical instrumentation was installed, including a new slope inclinometer (SI19-1) and two vibrating wire piezometers (VW19-1A and VW19-1B) installed in the same borehole above the cantilever sheet pile wall, seven vibrating wire load cells (VC2130 to VC2136) to measure changes in anchor loads of the tie-back wall grouted anchors, and three vibrating wire strain gauges welded to the outer face of the tied-back sheet pile wall to monitor the performance of the sheet piles. The vibrating wire piezometers, load cells and strain gauges were all wired to a Campbell Scientific CR6 datalogger which was programmed to take readings once per day.

The above instruments were read on September 25, 2022, by Mr. Niraj Regmi, G.I.T. and Mr. Kyle Crooymans, both of Thurber Engineering Ltd.



Selected drawings showing approximate instrumentation locations are included in Appendix A.

The SI was 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 piezometer, load cell and strain gauge data were downloaded to a field laptop using Campbell Scientific Loggernet software.

2. DATA PRESENTATION

2.1 General

SI plots for A and B directions are presented in Appendix A. Where movement has been recorded the resultant plot (X direction, if applicable) and rate of movement have also been provided. The slope inclinometer, piezometer, load cell and strain gauge reading summary tables are provided below. These tables also include instruments deleted from the GRMP program or not read during this monitoring event for future reference.

2.2 Zones of Movement

Zones of new movement were not observed in SI19-1 since the previous readings in the spring of 2022.

Zones of movement are summarized in Table NC090-1 below. Table NC090-1 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.



**TABLE NC090-1
FALL 2022 – HWY 2:42 BAPTISTE CREEK BRIDGE NW APPROACH FILL LANDSLIDE (BF7055)
SLOPE INCLINOMETER INSTRUMENTATION READING SUMMARY**

Date Monitored: September 25, 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)
SI18-1	February 20, 2018	5.6 mm over 4.3 to 6.7 m depth in 130° direction	56.8 on March 28, 2018	Sheared at 5.2 m BGS	March 28, 2018	N/A	N/A	N/A
SI18-2	February 20, 2018	4.5 mm over 4.4 to 6.2 m depth in 130° direction	45.1 on March 28, 2018	Sheared at 5.3 m BGS	March 28, 2018	N/A	N/A	N/A
SI18-3	February 20, 2018	4.2 mm over 3.9 to 6.3 m depth in 107° direction	42.7 on March 28, 2018	Sheared at 4.8 m BGS	March 28, 2018	N/A	N/A	N/A
SI19-1	August 21, 2019	25.2 mm over 0.4 to 1.7 m depth in 126° direction	365 on Sep. 14, 2019	Operational	June 5, 2022	0.7	2.2	0.7

Drawings 32122-NC090-1 and NC090-2 in Appendix A show approximate locations of the monitoring instrumentation at this site.



**TABLE NC090-2
FALL 2022 – HWY 2:42 BAPTISTE CREEK BRIDGE NW APPROACH FILL LANDSLIDE (BF7055)
VIBRATING WIRE AND STANDPIPE PIEZOMETER INSTRUMENTATION READING SUMMARY**

Date Monitored: September 25, 2022

INSTRUMENT #	DATE INITIALIZED	TIP DEPTH (m)	CURRENT STATUS	MAXIMUM GROUNDWATER DEPTH (m)	CURRENT GROUNDWATER DEPTH (m)	PREVIOUS GROUNDWATER DEPTH (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
VW18-1A (48139)	February 3, 2018	4.0	Not Operational ⁽¹⁾	3.26 on March 13, 2019	N/A	3.50 (March 14, 2019)	N/A
VW18-1B (48143)	February 3, 2018	12.8	Not Operational ⁽¹⁾	3.61 on March 28, 2018	N/A	3.80 (June 2, 2018)	N/A
VW18-2A (48140)	February 2, 2018	4.6	Not Operational ⁽¹⁾	2.68 on June 2, 2018	N/A	2.70 (Sep. 18, 2018)	N/A
VW18-2B (48144)	February 2, 2018	11.3	Not Operational ⁽¹⁾	9.45 on February 20, 2018	N/A	1.60 (March 28, 2018)	N/A
VW18-3A (48141)	February 1, 2018	7.0	Not Operational ⁽¹⁾	4.04 on June 2, 2018	N/A	4.04 (June 2, 2018)	N/A
VW18-3B (48142)	February 1, 2018	13.7	Not Operational ⁽¹⁾	6.49 on March 28, 2018	N/A	6.72 (June 2, 2018)	N/A
VW19-1A ⁽²⁾ (4060)	August 21, 2019	5.0	Operational	1.98 on September 10, 2019	3.54	2.87	-0.67
VW19-1B ⁽²⁾ (4061)	August 21, 2019	10.0	Operational	1.00 on June 18, 2020	2.32	2.04	-0.28
SP18-4	January 30, 2018	15.5	Not Operational ⁽¹⁾	8.29 on March 28, 2018	N/A	8.60 (Sep. 18, 2018)	N/A

Drawings 32122-NC090-1 and NC090-2 in Appendix A show approximate locations of the monitoring instrumentation at this site.

Notes:

- 1) Instruments were damaged during construction,
- 2) Vibrating wire piezometer data is recorded daily through on-site datalogger and is downloaded twice annually during the instrumentation readings.



**TABLE NC090-3
FALL 2022 – HWY 2:42 BAPTISTE CREEK BRIDGE NW APPROACH FILL LANDSLIDE (BF7055)
VIBRATING WIRE LOAD CELL INSTRUMENTATION READING SUMMARY**

Date Monitored: September 25, 2022

LOAD CELL SERIAL #	ANCHOR NUMBER	DESIGN LOAD / LOCK-OFF LOAD (kN)	MAXIMUM RECORDED LOAD (kN)	RECORDED LOAD ⁽¹⁾ (SEPTEMBER 25, 2022) (kN)	PREVIOUS RECORDED LOAD ⁽¹⁾ (JUNE 5, 2022) (kN)	CHANGE IN LOAD SINCE PREVIOUS READING (kN)
VC2135	8	140/140	169.00 on January 30, 2022	135.70	138.23	-2.53
VC2132	12	210/210	221.59 on January 31, 2022	186.85	188.11	-1.26
VC2131	13	140/140	158.37 on January 30, 2022	142.47	143.56	-1.09
VC2136	19	140/140	151.31 on January 29, 2022	138.76	139.05	-0.29
VC2134	24	210/210	231.05 on February 02, 2022	185.49	182.12	3.37
VC2133	29	140/140	129.34 on February 18, 2021	114.59	114.81	-0.22
VC2130	34	210/210	189.38 on February 22, 2022	173.97	174.94	-0.97

Drawings 32122-NC090-1 and NC090-2 in Appendix A show approximate locations of the monitoring instrumentation at this site.

Notes:

- 1) Load cell data is recorded daily through existing datalogger on site. Datalogger data is downloaded twice annually during instrumentation readings.



TABLE-NC090-4
FALL 2022 – HWY 2:42 BAPTISTE CREEK BRIDGE NW APPROACH FILL LANDSLIDE (BF7055)
VIBRATING WIRE STRAIN GAUGE INSTRUMENTATION READING SUMMARY

Date Monitored: September 25, 2022

GAUGE	ELEVATION	GAUGE	TOTAL MICROSTRAIN ⁽¹⁾ (SEPTEMBER 25, 2022) ($\mu\epsilon$)	PREVIOUS TOTAL MICROSTRAIN ⁽¹⁾ (JUNE 5, 2022) ($\mu\epsilon$)	CHANGE IN MICROSTRAIN SINCE PREVIOUS READING ($\mu\epsilon$)
Upper	585.5	Upper	28.16	12.13	16.03
Middle	584.0	Middle	40.74	37.73	3.01
Lower	582.5	Lower	25.49	23.34	2.15

Drawings 32122-NC090-1 and NC090-2 in Appendix A show approximate locations of the monitoring instrumentation at this site.



3. INTERPRETATION OF MONITORING RESULTS

Slope inclinometer SI19-1, installed upslope of the cantilever sheet pile wall, showed a rate of movement of 2.2 mm/yr over 0.4 m to 1.7 m depth since the spring of 2022 readings. SI19-1 has appeared to show movement over this zone since the end of construction, however this may only reflect surficial movement of backfill material around SI, or poor grouting condition within the upper section of the SI casing.

Vibrating wire piezometers VW19-1A and VW19-1B showed decreases in groundwater level of 0.67 m and 0.28 m, respectively, since the spring of 2022 readings. Both vibrating wire piezometers have shown a pattern of seasonable variation in groundwater level, with the highest groundwater levels typically recorded between the months of April and June. The seasonal variation is more pronounced in VW19-1A, which is installed closer to the ground surface at 5 m depth. The vibrating wire piezometer readings are summarized in Table NC090-1-2 above, and are plotted on Figure NC090-1 (by depth) in Appendix A.

Load cells VC2135, VC2132, VC2131, VC2136, VC21333, and VC2130 showed decreases in measured load of 2.53 kN, 1.26 kN, 1.09 kN, 0.29 kN, 0.22 kN, and 0.97 kN, respectively, since the spring of 2022 readings. Load cell VC2134 showed an increase in measured load of 3.37 kN since the spring of 2022 readings. The measured loads in the load cells have remained relatively stable since the spring of 2022 readings. The load cells have generally shown a pattern of seasonable variation in loads, with the highest loads typically recorded within the periods of extreme cold weather between the months of December and March. Although anchor loads appear to fluctuate seasonally, they are still within the acceptable range of design loads. The load cell readings are summarized in Table NC090-3 above, and are plotted on Figure NC090-2 in Appendix A.

The upper, middle, and lower strain gauges showed increases in total micro-strain of 16.03 $\mu\epsilon$, 3.01 $\mu\epsilon$ and 2.15 $\mu\epsilon$, respectively, since the spring of 2022 readings. In general, the strain gauge readings continue to show minimal bending stresses in the tied-back sheet pile wall. The strain gauge readings are summarized in Table NC090-4 above, and are plotted on Figure NC090-3 in Appendix A.

The instrumentation readings indicate that the pile walls have performed well since construction completion.

4. RECOMMENDATIONS

4.1 Future Work

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

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

Bruce Nestor, P.Eng.
Geotechnical Engineer
/jf

Attachments:

- Statement of Limitations and Conditions
- Appendix A
 - Field Inspector's report
 - Site Plan and Cross Section Showing Approximate Instrument Locations (Drawings No. 32122-NC090-1 and 32122-NC090-2)
 - SI Reading Plots
 - Figure NC090-1 (Piezometric Data Plot)
 - Figure NC090-2 (Load Cell Data Plot)
 - Figure NC090-3 (Strain Gauge Data Plot)



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

FALL 2022

**APPENDIX A
DATA PRESENTATION AND DRAWINGS**

**SITE NC090: HWY 2:42 BAPTISTE CREEK BRIDGE
NW APPROACH FILL LANDSLIDE (BF7055)**

**ALBERTA TRANSPORTATION
NORTH CENTRAL REGION - ATHABASCA AND FORT McMURRAY DISTRICTS
INSTRUMENTATION MONITORING FIELD SUMMARY (NC090)
FALL 2022**

Location: Baptiste Creek (HWY 2:42 C1 17.723) File Number: 32122 Probe: RST SI SET 8R Cable: RST SI SET 8R	Readout: Casing Diameter: 2.75" Temp: 10 Read by: NKR/KTC
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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-		
SI19-1	338297	6071816	25-Sep-22	1.09	52 to 2	107	-2	16	84	-71	8R/8R	

VIBRATING WIRE LOAD CELL (VC) READINGS

VC#	Datalogger GPS Location (UTM 12)		Datalogger Serial #	Date	Comment
	Easting (m)	Northing (m)			
VC2130 to VC2136	338298	6071815	Campbell Scientific 10671	25-Sep-22	Downloaded

VIBRATING WIRE STRAIN GAUGE (SG) READINGS

SG #	Datalogger GPS Location (UTM 12)		Datalogger Serial #	Date	Comment
	Easting (m)	Northing (m)			
3 RST strain gauges	338298	6071815	Campbell Scientific 10671	25-Sep-22	Downloaded

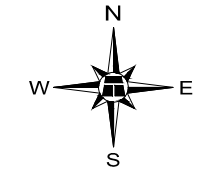
VIBRATING WIRE PIEZOMETER (VW) READINGS

VW #	Serial #	GPS Location (UTM 12)		Datalogger Serial #	Date	Comment
		Easting (m)	Northing (m)			
VW19-1A	4060	338298	6071815	CS 10671	25-Sep-22	Downloaded
VW19-1B	4061				25-Sep-22	Downloaded

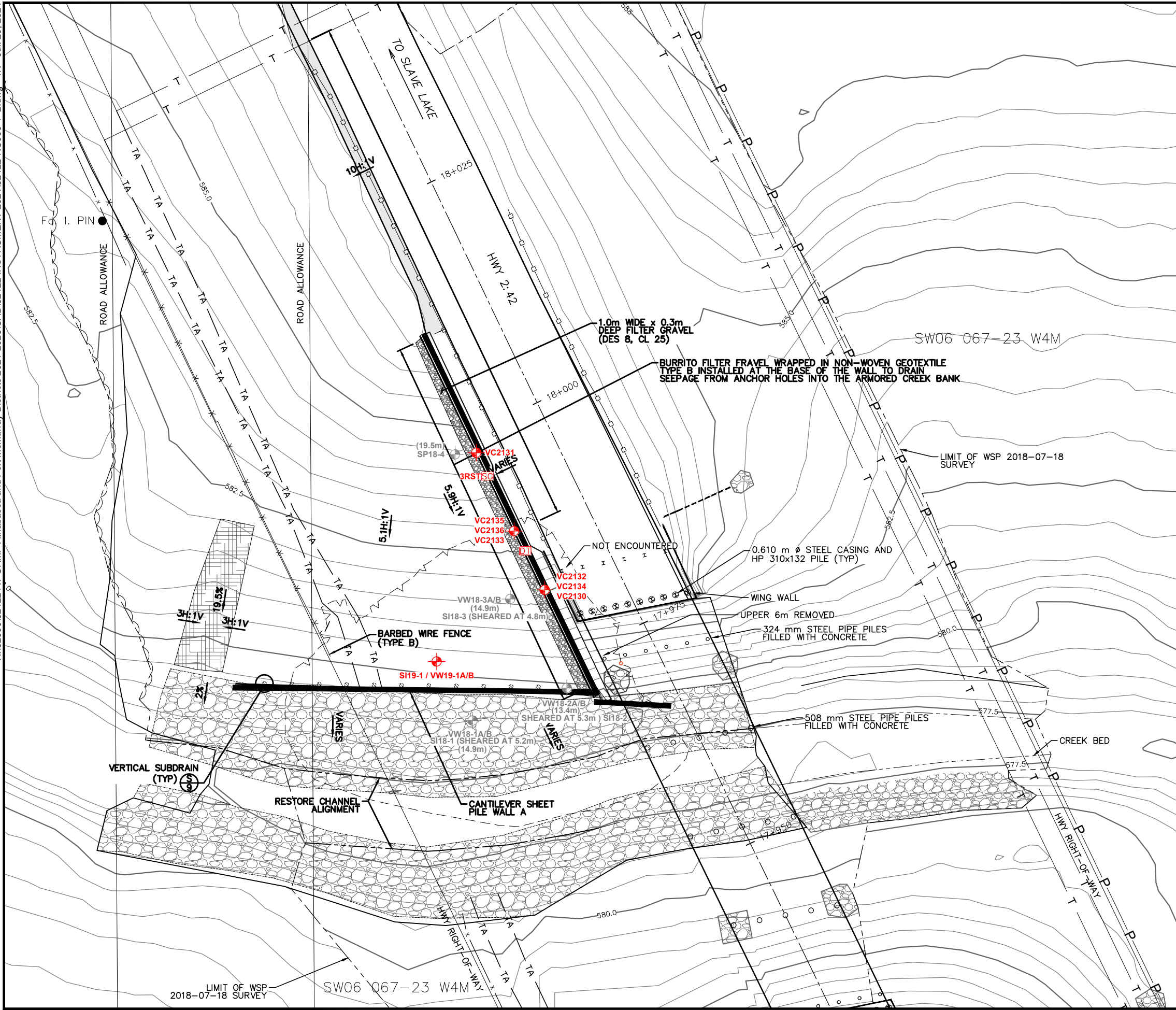
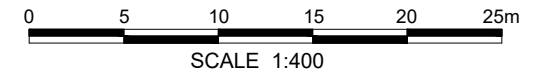
INSPECTOR REPORT


7 load cells, 3 VW strain gauges and 2 VW strain gagues are wired to a Campbell Scientific CR6 datalogger mounted on the west face of the sheet pile wall

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- LEGEND**
- NEW INSTRUMENT LOCATION
 - INSTRUMENT LOCATION (SHEARED OFF/DAMAGED DURING CONSTRUCTION)
 - CONTROL POINT
 - VERTICAL DRAIN
 - DATA LOGGER
 - STRAIN GAUGE
 - STABILIZED LANDSLIDE AREA
 - EXISTING CLASS 1M RIPRAP
 - DESIGN GRADING LIMITS
 - CLASS 1 RIPRAP
 - TRM TYPE C
 - TELUS LINE (APPROXIMATE)
 - ABANDONED TELUS LINE
 - BARBED WIRE FENCE
 - NEW TYPE B FENCE
 - OVERHEAD POWER LINE (APPROXIMATE)
 - TREELINE
 - GUARD RAIL
 - GROUND SURFACE CONTOUR
 - Fd. I. PIN ● FOUND IRON PIN






**NORTH CENTRAL
(ATHABASCA AND FORT McMURRAY DISTRICTS)**

**NC090: HWY 2:42 BAPTISTE CREEK BRIDGE (BF7055)
SITE PLAN SHOWING APPROXIMATE
INSTRUMENT LOCATIONS**

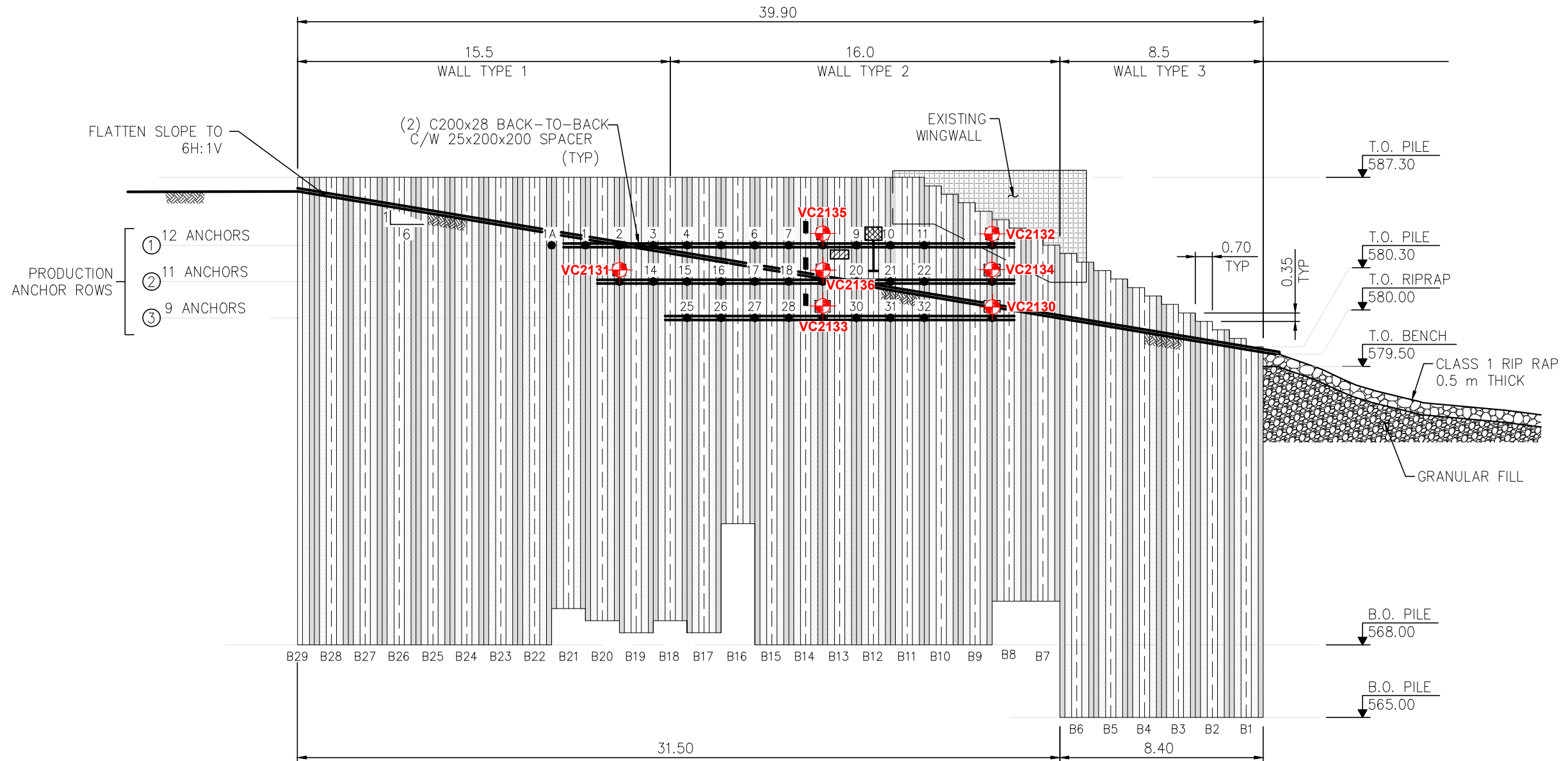
DWG No. 32122-NC090-1

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	TSA
SCALE	1:400
DATE	JULY 2021
FILE No.	32122



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TIEBACK SHEET PILE WALL 'B' ELEVATION

LEGEND

- LOCATION OF ANCHOR
- 1 PRODUCTION ANCHOR NUMBER
- 1A PRE-PRODUCTION ANCHOR NUMBER
- ▨ DATA LOGGER ENCLOSURE (BOLTED TO SHEET PILE)
- ▣ SOLAR PANEL AND SUPPORT FRAME (BOLTED TO SHEET PILE)
- STRAIN GAUGE LOCATION (C/W LOCKABLE PROTECTIVE COVER)
- ⊕ LOAD CELL LOCATION

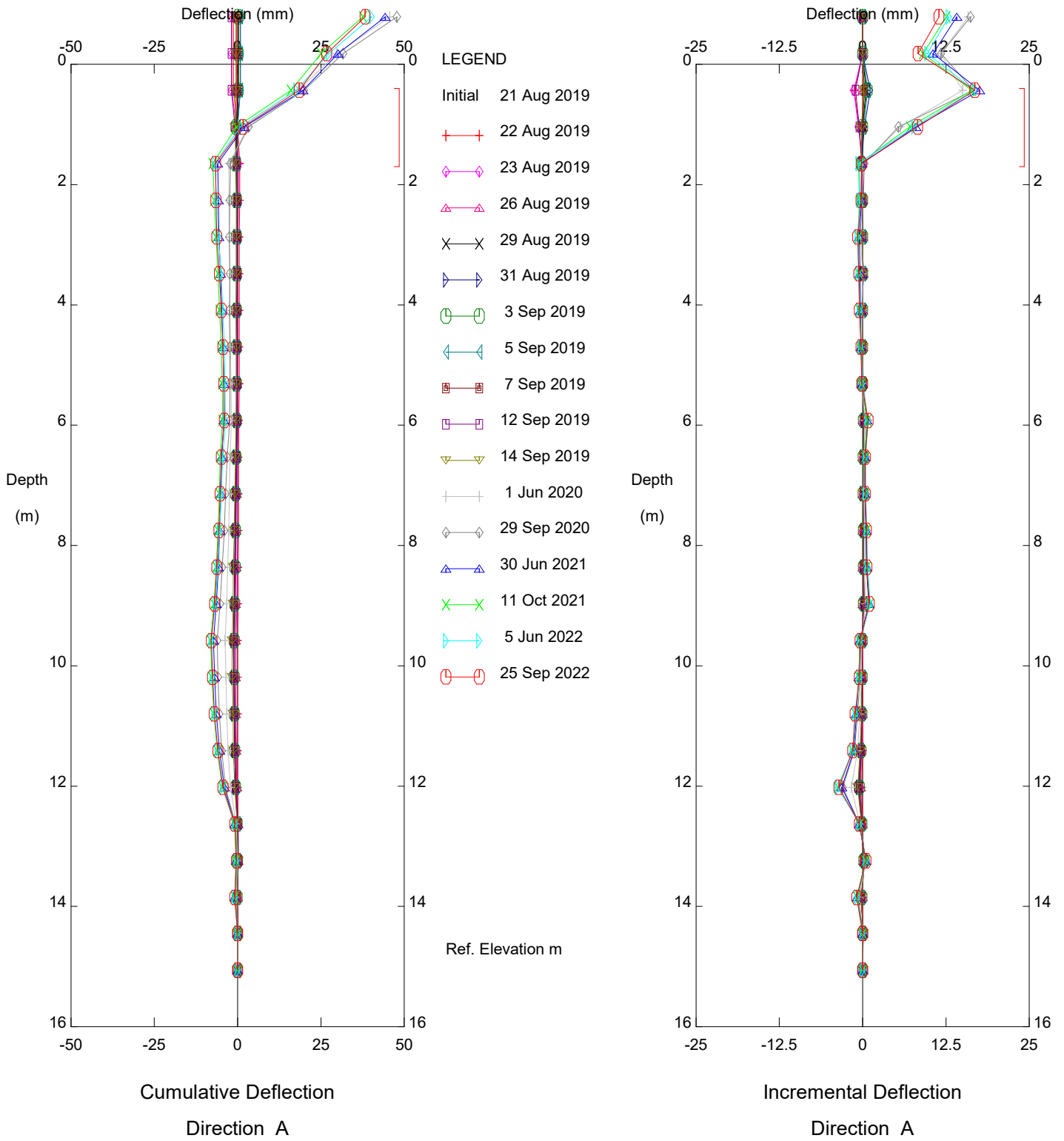


**NORTH CENTRAL
(ATHABASCA AND FORT MCMURRAY DISTRICTS)**
**NC090: HWY 2:42 BAPTISTE CREEK BRIDGE (BF7055)
TIEBACK SHEET PILE WALL 'B' ELEVATION**

DWG No. 32122-NC090-2

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	TSA
SCALE	1:200
DATE	JULY 2021
FILE No.	32122

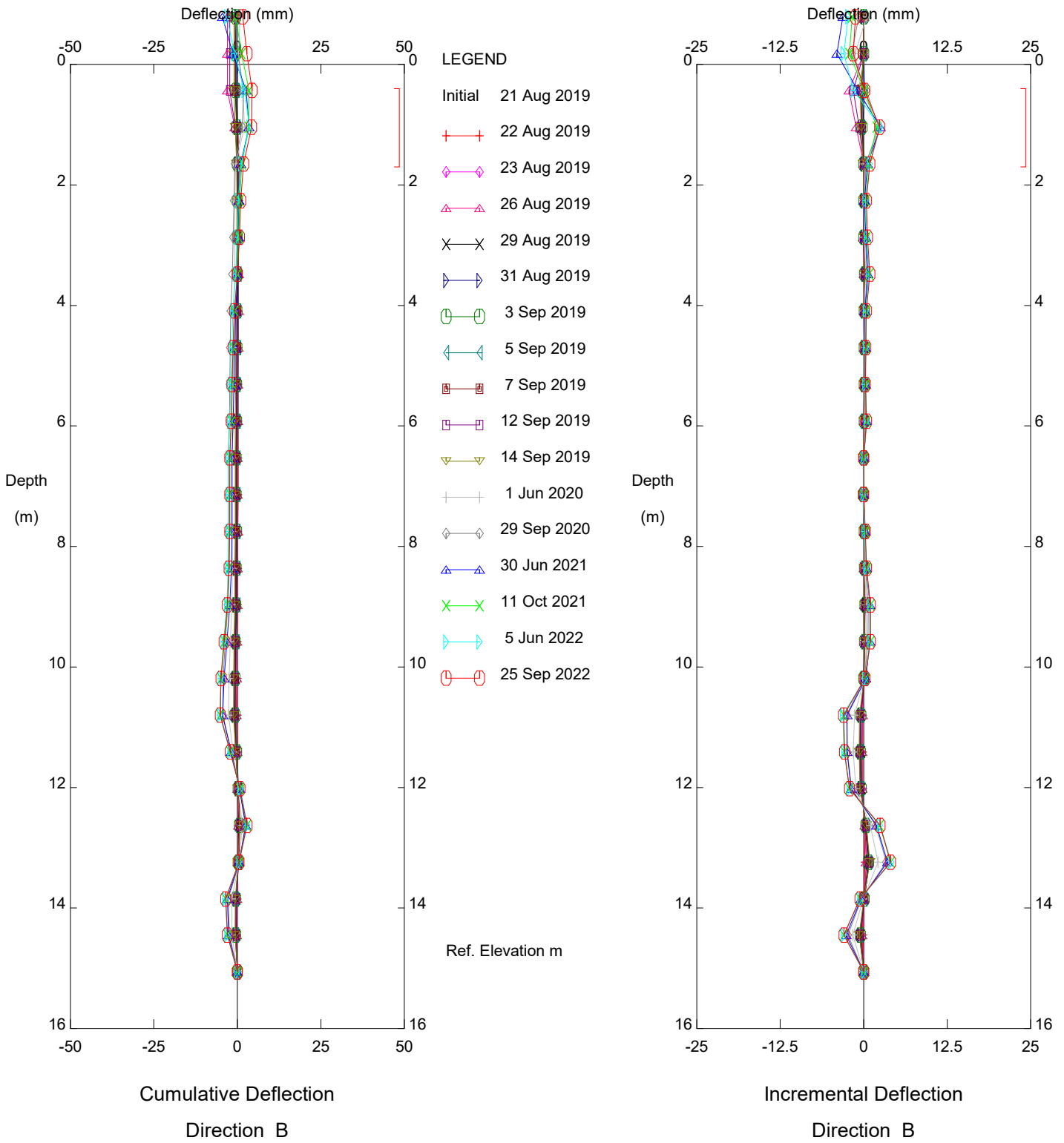




Hwy 2:42 Baptiste Creek Bridge, Inclinator SI19-1

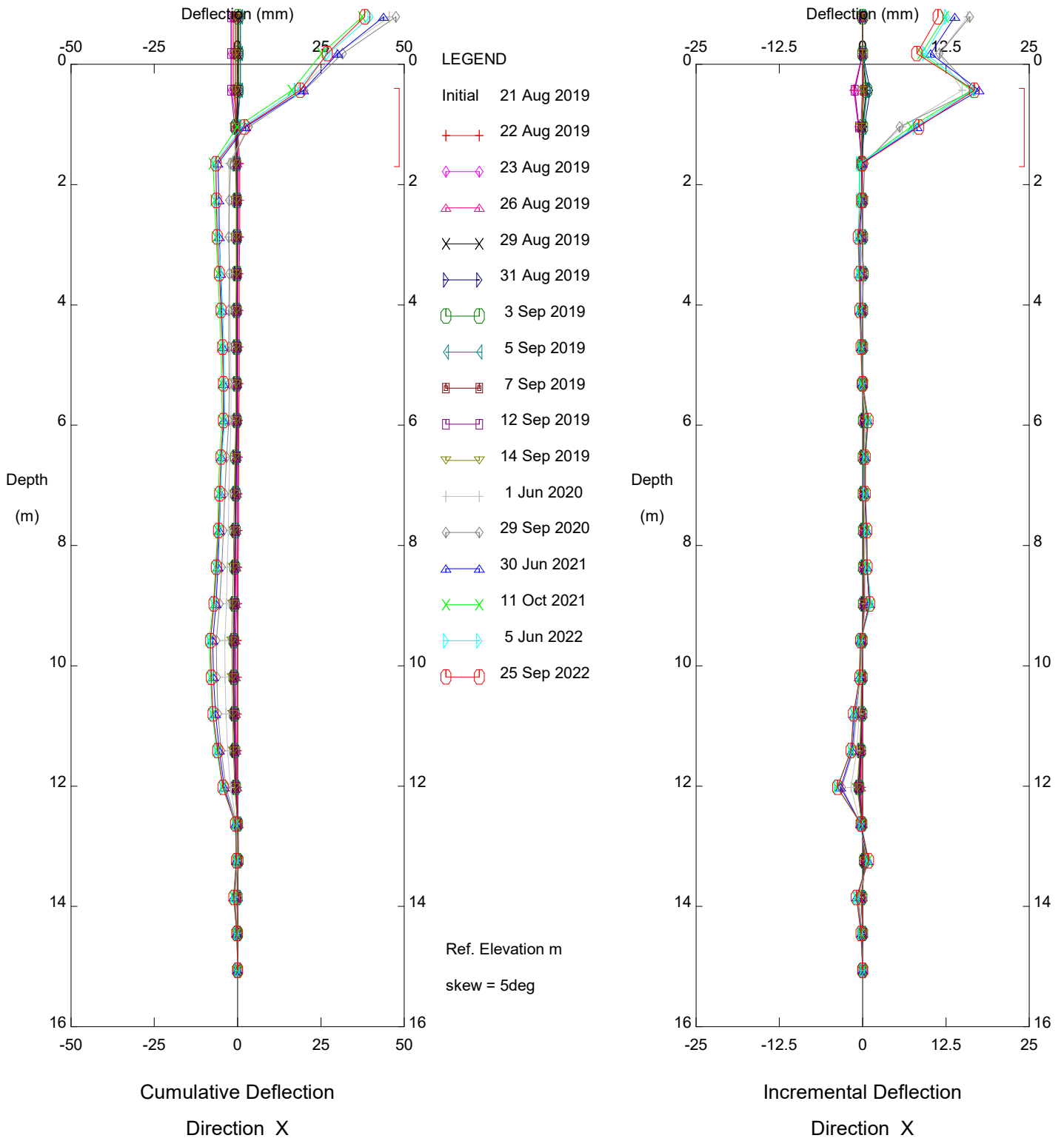
Alberta Transportation

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Hwy 2:42 Baptiste Creek Bridge, Inclinator SI19-1

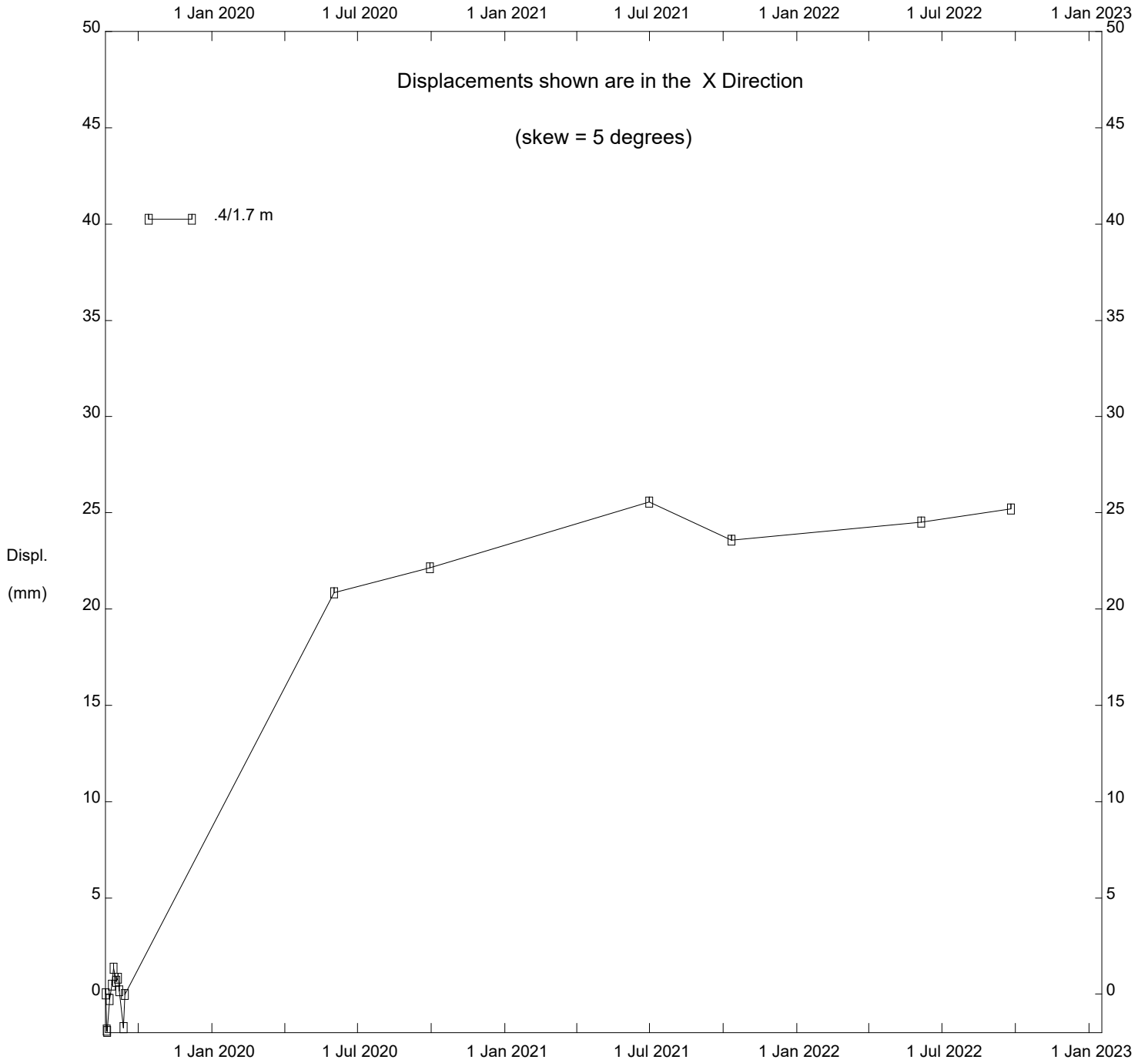
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Hwy 2:42 Baptiste Creek Bridge, Inclinator SI19-1

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Hwy 2:42 Baptiste Creek Bridge, Inclinometer SI19-1

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**FIGURE NC090-1
PIEZOMETER DATA FOR HWY 2:42 BAPTISTE CREEK**

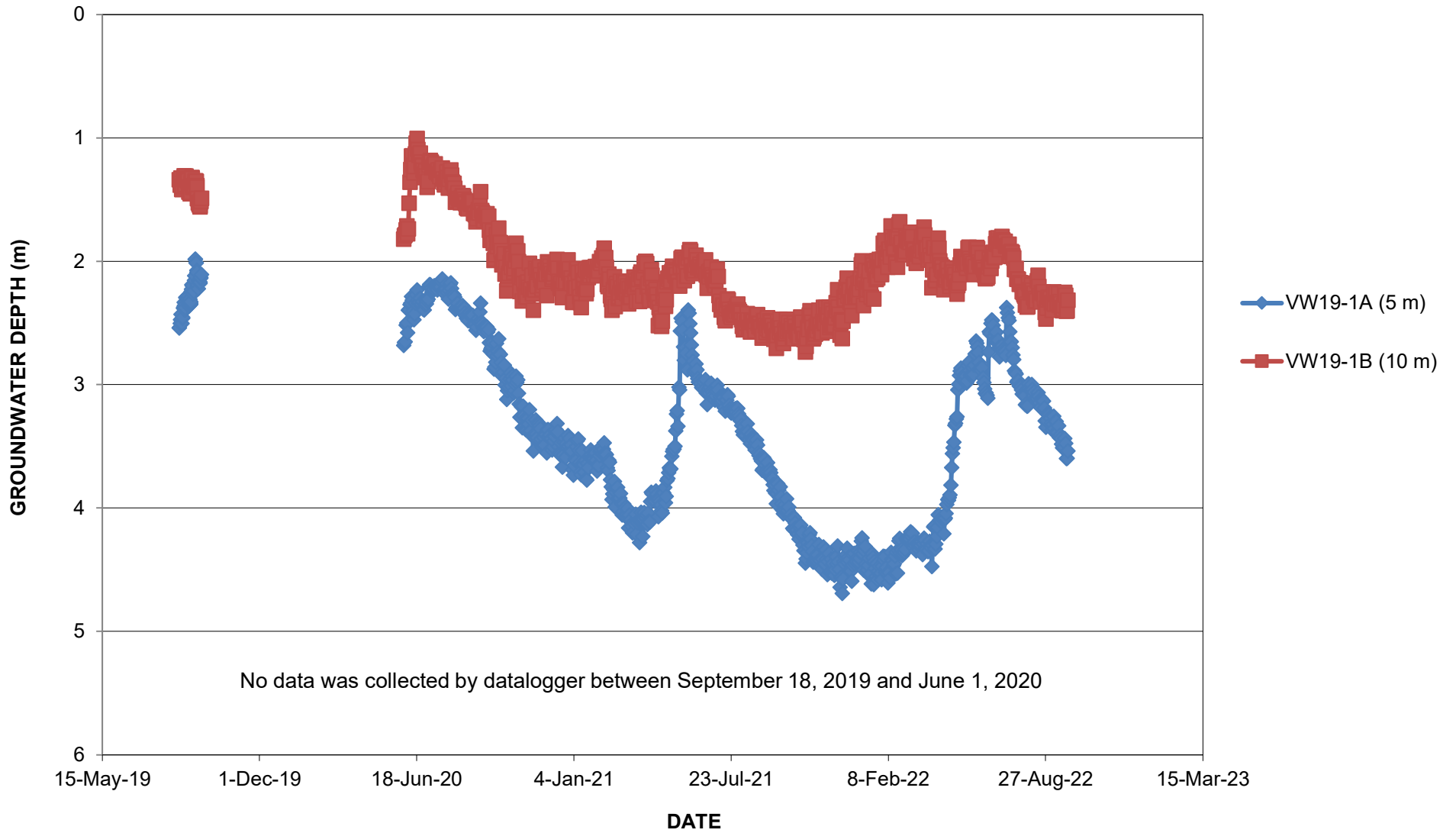


FIGURE NC090-2
LOAD CELL DATA FOR HWY 2:42 BAPTISTE CREEK

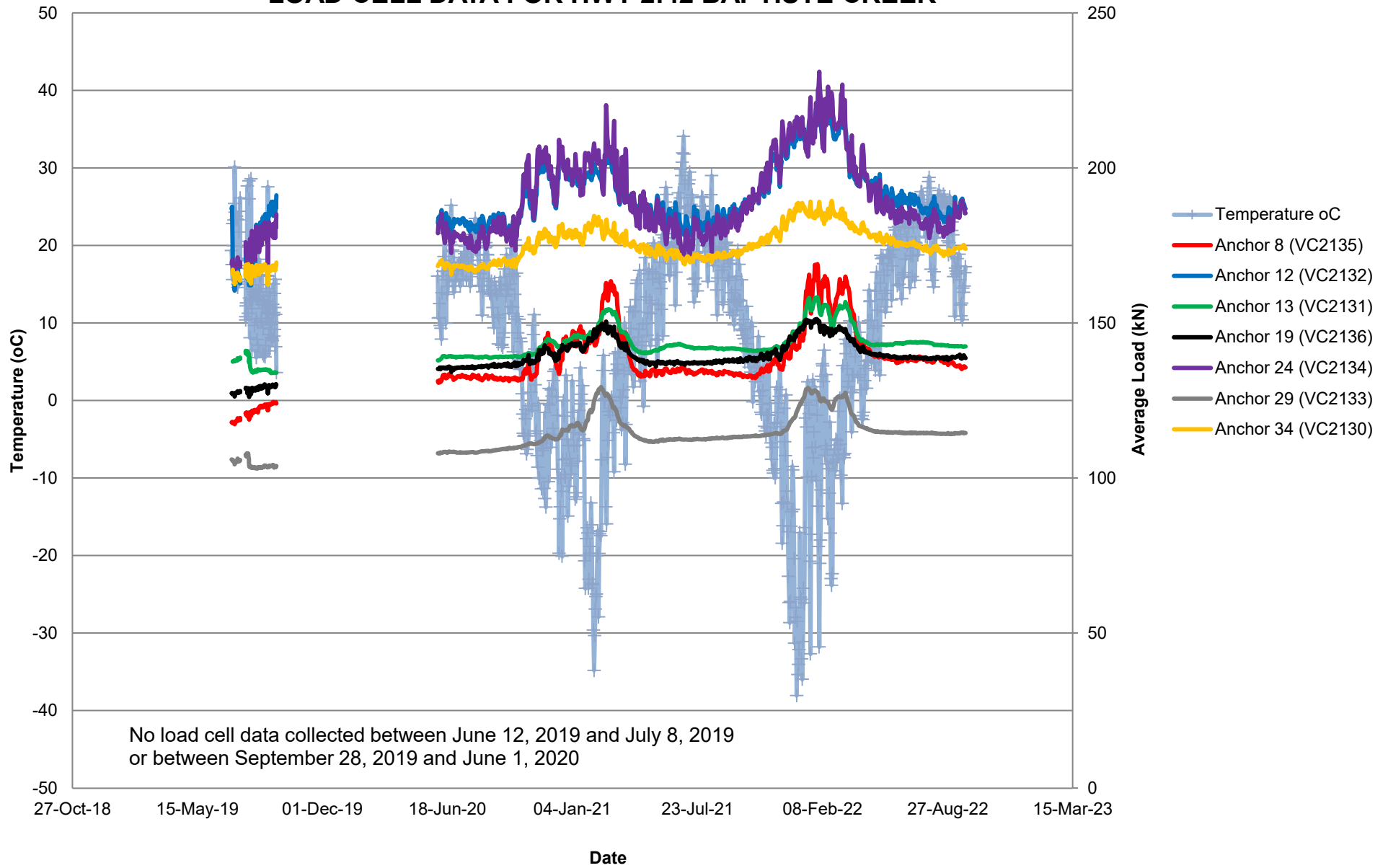


FIGURE NC090-3
STRAIN GAUGE DATA FOR HWY 2:42 BAPTISTE CREEK

