ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS GRMP
PEACE REGION – (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING - FALL 2024

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy
SH016	HWY 49:12	Little Smoky River, West Bank Instability	49:12
Legal Description:		**UTM Co-ordinates**	
10-33-74-21 W5		11U E 489600	N 6145512

Current Monitoring:	18-Sep-2024	**Previous Monitoring**	17-May-2024
Instruments Read By:	Mr. Niraj Regmi, G.I.T., and Mr. Nixson Mationg, Thurber		

Instruments Read During This Site Visit			
Slope Inclinometers (SIs):	**Pneumatic Piezometers (PN):**	**Vibration Wire Piezometers (VW):** VW21-7A, VW21-7B, VW21-8A, VW21-8B, VW21-9A, VW21-9B,	**Standpipe Piezometers (SP):**
Load Cell (LC):	**Strain Gauges:**	**SAAs:**	**Others:** Fibre optic strain gauges (read by others)

Readout Equipment Used			
Slope Inclinometers:	**Pneumatic Piezometers:**	**Vibration Wire Piezometers:** Three RST DT2055 dataloggers	**Standpipe Piezometers:**
Load Cell:	**Strain Gauges:**	**SAAs:**	**Others:**
Note: Dataloggers were installed in January 2023 to obtain a better understanding of seasonal or cyclical trends tied to longer term climatic triggers.			

Discussion	
Zones of New Movement:	N/A
Interpretation of Monitoring Results:	Vibrating wire piezometers VW21-7A and VW21-7B showed increases in groundwater level of 0.07 m and 0.05 m since the spring of 2024 readings. Vibrating wires VW21-8A and VW21-8B showed increases in groundwater levels of 0.11 m and 0.30 m, respectively, since the spring of 2024 readings. VW21-8B registered an all-time high groundwater level of 482.87 m on August 31, 2024. VW21-8B had shown a increasing water level trend since July 2021 (shortly after installation). VW21-9A and VW21-9B showed increases in groundwater level of 0.10 m and 0.13 m, respectively, since the spring of 2024 readings. VW21-9B registered an all-time high groundwater level of 492.37 m on September 4, 2024. There appears to be a seasonal trend to the piezometer readings. Additional readings will be required to understand the annual cycle of the

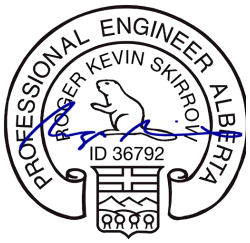
	piezometers. The annual variation in groundwater level (based on one year's data) was relatively minimal.
Future Work:	The instruments should be read again in the spring of 2025.
Instrumentation Repairs:	No instrument repairs are required at this time.
Additional Comments:	The University of Alberta assessed the fibre optic cables continuity in Fall 2023, and determined the cables were still intact. At this time, TEC is not planning to undertake another reading of the cables. A program involving precise surveying of monitoring points installed at various locations on the bridge and bridge foundations was proposed to TEC's bridge group to assist in tracking bridge movements and timing for adjustments to the foundations. If this program is conducted, the tops of the three sheared SI's could also be monitored to gauge ground movements at those locations.

Attachments:	• Table SH016-1 Fall 2024 – HWY 49:12 Little Smoky River Bridge, Slope Inclinometer Instrumentation Reading Summary • Table SH016-2 Fall 2024 – HWY 49:12 Little Smoky River Bridge, Vibrating Wire Piezometer Instrumentation Reading Summary • Statement of Limitations and Conditions • APPENDIX A – SH016 FALL 2024 o Field Inspector's report o Site Plan Showing Approximate Instrument Locations (Drawing No. 32121 SH016-1) o Figure SH016-1 (Vibrating Wire Piezometer Elevations) o Figure SH016-2 (Vibrating Wire Piezometer Depths)

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.
Roger Skirrow, M.Sc., P. Eng.
Senior Geotechnical Engineer

2024-11-21



2024-11-21

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: _____
RM APEGA ID #: 91085
DATE: November 21, 2024
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Lucas Green, P.Eng.
Geotechnical Engineer

Table SH016-1 Fall 2024 – Hwy 49:12, Little Smoky River Bridge Slope Inclinometer Instrumentation Reading Summary

Date Monitored: Not Monitored

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)	AVERAGE RATE OF MOVEMENT OVER MONITORING PERIOD (mm/yr)	CHANGE IN RATE OF MOVEMENT SINCE PREVIOUS READING (mm/yr)
SI21-7	*June 14, 2021*	*7.2 mm over 11.6 m to 13.5 m in 91° direction*	*25.7 in July 2021*	*Sheared at 13.4 m below top of casing*	*October 12, 2021*	*N/A*	*N/A*	*N/A*
Si21-8	*June 14, 2021*	*7.5 mm over 9.3 m to 11.1 m in 86° direction*	*35.6 in July 2021*	*Sheared at 11.0 m below top of casing*	*October 12, 2021*	*N/A*	*N/A*	*N/A*
SI21-9	*June 14, 2021*	*9.3 mm over 15.3 m to 16.5 m in 61° direction*	*32.0 in July 2021*	*Sheared at 16.5 m below top of casing*	*October 12, 2021*	*N/A*	*N/A*	*N/A*

Drawing 32121-SH016 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site.

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Table SH016-2 Fall 2024 – Hwy 49:12, Little Smoky River Bridge Vibrating Wire Piezometer Instrumentation Reading Summary

Date Monitored: September 18, 2024

INSTRUMENT	DATE INITIALIZED	GROUND ELEVATION (m)	TIP DEPTH (m)	CURRENT STATUS	MAXIMUM GROUNDWATER ELEVATION (m)	CURRENT GROUNDWATER ELEVATION (m)	PREVIOUS GROUNDWATER ELEVATION* (m)	CHANGE IN WATER LEVEL SINCE PREVIOUS READING (m)
VW21-7A	June 10, 2021	492.42	5.00	Operational	490.23 on April 17, 2024	489.72	489.65	0.07
VW21-7B	June 20, 2021	492.42	12.00	Operational	489.67 on April 17, 2024	489.18	489.13	0.05
VW21-8A	June 16, 2021	493.89	5.00	Operational	492.46 on July 11, 2023	491.82	491.71	0.11
VW21-8B	June 16, 2021	493.89	14.00	Operational	482.87 on August 31, 2024	482.69	482.39	0.30
VW21-9A	June 16, 2021	500.36	9.80	Operational	494.13 on August 25, 2023	493.56	493.46	0.10
VW21-9B	June 16, 2021	500.36	19.04	Operational	492.37 on September 4, 2024	492.19	492.06	0.13

Drawing 32121-SH016 in Appendix A provides a sketch of the approximate location of the monitoring instrumentation for this site

* Previous groundwater elevation on May 17, 2024

THURBER

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.

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

FALL 2024

APPENDIX A
DATA PRESENTATION

SITE SH016: HWY 49:12, LITTLE SMOKY RIVER BRIDGE

ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
PEACE REGION (PEACE RIVER DISTRICT)
INSTRUMENTATION MONITORING FIELD SUMMARY (SH016)
FALL 2024

Location: HWY 49:12 LITTLE SMOKY RIVER WEST BANK INSTABILITY
File Number: 32121

Read Out: Downloaded
Temp: 10
Read by: NKR/NRM

VIBRATING WIRE PIEZOMETER (VW) READINGS

Location	Serial	GPS Location (UTM 11)		Location	Date	Reading		Comments
		Easting (m)	Northing (m)			B Units	Temp °C	
VW21-7A	133742	489600	6145512	Stand Alone Location	18-Sep-24	Downloaded	Downloaded	
VW21-7A	133747	489600	6145512	Stand Alone Location	18-Sep-24	Downloaded	Downloaded	
VW21-8A	133715	489593	6145503	Attached to SI21-08	18-Sep-24	Downloaded	Downloaded	
VW21-8B	133476	489593	6145503	Attached to SI21-08	18-Sep-24	Downloaded	Downloaded	
VW21-9A	133478	489570	6145510	Attached to SI21-09	18-Sep-24	Downloaded	Downloaded	
VW21-9B	133492	489570	6145510	Attached to SI21-09	18-Sep-24	Downloaded	Downloaded	

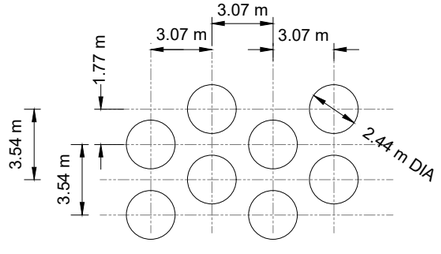
INSPECTOR REPORT

- Dataloggers are connected to RST DT2055 dataloggers at their respective locations - download data at each station

H:\32000\32121 AT GRMP Peace River District 2021-2025\CAD\2022 Instrument\32121 SH016-1.dwg - 1 - Nov. 30, 2022

INFERRED SCARP (FROM LIDAR 09/2008 AND VISUAL RECONNAISSANCE)
TREE LINE
STONE COLUMNS BACKFILLED WITH 40 mm AGGREGATE IN 2 LIFTS WITH VIBRATORY PROBE COMPACTION
DIAGONAL CRACKING ON SIDE OF FOUNDATION - WIDER CRACKS 20-30° - NARROWER 30-35°
100 mm DIA PERFORATED HDPE PIPE
SHALLOW VOID 0.75m LONG x 0.15m WIDE x 0.25m DEEP
PIER 1
SOIL ACCUMULATION
SI21-07 (SHEARED), VW21-07A/B
FOC V/H,SI,2VWs
20mm/yr@13.5m
PILE SUPPORTED
SLAB-ON-GRADE
0.7m (2022)
TH21-07A
TH21-11
TH21-10
SI21-09 (SHEARED), VW21-09A/B
FOC V/H,SI,2VWs
29mm/yr@16.5m
EROSION UNDERMINING OLD PORTION OF ABUTMENT #1
WEST ABUTMENT
ABUTMENT 1
SPLASH PAD
SI21-08 (SHEARED), VW21-08A/B
FOC V/H,SI,2VWs
23mm/yr@11.1m
TH99-4 SI,PN *20mm/yr @17.5m*
TH99-5 SI,PN,SP *15mm/yr @19.5m*
TH99-6 PN,SP
TH99-3 - SI,PN,SP *20mm/yr@14.0m*
SMALL EROSION GULLY
GULLY 0.4m DEEP
SOUTH GIRDER RIDING ON OLD WEST ABUTMENT FOUNDATION ELEMENT (REPAIRED 2022)
ROAD PLAN 4832 PX
TO VALLEYVIEW
HWY 49:12
RUTS
GULLY 0.2m WIDE x 0.3m DEEP
GULLY 0.5m WIDE x 0.2m DEEP (2022)
OUTLET OF GROUND WATER WEEPING TILE (IN THE WEST-EAST DIRECTION); SLIGHTLY CRACKED, SLOW TRICKLE
SWALE; 0.6 m DEEP, ECSC TYPE B OVER SEEDED TOPSOIL
2019-2021:WET ZONE
100 mm DIA PERFORATED HDPE PIPE
TREE LINE
3 ROWS STONE COLUMNS 5.2-5.6 m DEEP
1 ROW STONE COLUMNS 3.8 m DEEP
TH99-2 - SI,PN,SP *35mm/yr@12.0m*
TH99-1 SI,PN,SP *35mm/yr @15.5m*
100 mm DIA NON-PERFORATED HDPE PIPE
200 mm DIA CORRUGATED STEEL OUTLET PIPE (NO FLOW) 2019-2020
ORDINARY HIGH WATER LEVEL (1:2 YEAR) EL 480.9 m (LIMIT OF WORKING AREA)
APPROXIMATE LOCATION OF STONE COLUMNS AND RIP RAP INSTALLED AS PER WOOD DESIGN 2016
DISPLACED RIPRAP
2018-2022:TREE DEBRIS
TO GUY
B'
A
PIER 2
200 mm DIA CORRUGATED STEEL OUTLET PIPE
100 mm DIA NON-PERFORATED HDPE PIPE (INSIDE 200mm DIA STEEL PIPE)
200 mm DIA CORRUGATED STEEL OUTLET PIPE; NO SIGN IT EVER HAD FLOW
100 mm DIA NON-PERFORATED HDPE PIPE
RIVER EROSION HAS OVERSTEEPENED TO 40°, ABOUT 2m HIGH
HIGH WATER LEVEL (1:100 YEAR) EL 483.4 m
POTTED WILLOW; ALL DEAD
RIPRAP A BIT STEEPER
HEAVY ROCK RIPRAP CLASS 2
SCARPS CONTINUE DOWN BANK - ALL HAD FRESH MOVEMENT
LITTLE SMOKY RIVER
N
W
E
S
505 504 503 502 501 500 499 498 497 496 495 494 493 492 491 490 489 488 487 486 485 484 483 482 481 480

BASE PLAN PROVIDED BY MOST ENGINEERING (SURVEYED 2021)



TYPICAL DETAIL OF STONE COLUMN SPACING
SCALE 1:300

LEGEND

- APPROXIMATE INSTRUMENTATION LOCATION
- APPROXIMATE TEST HOLE LOCATION (THURBER, 2021)
- APPROXIMATE TEST HOLE LOCATION (THURBER, 1999)
- SI — SLOPE INCLINOMETER
- FOC V/H — FIBRE OPTIC CABLE: VERTICAL / HELICAL ORIENTATION
- PN — PNEUMATIC PIEZOMETER
- SP — STANDPIPE PIEZOMETER
- VW — VIBRATING WIRE PIEZOMETER
- GROUND SURFACE CONTOUR (CONTOUR INTERVAL = 0.5m)
- *13mm/yr @15m* — MOVEMENT VECTOR AND DEPTH (SCALED BY OVERALL MOVEMENT RATE)

NOTES

1. MAY 2022 OBSERVATIONS SHOWN IN RED.
2. DETAILS OF REPAIR BELOW PIER 1 PROVIDED BY AMEC FOSTER WHEELER.
3. HIGHWAY RIGHT OF WAY BOUNDARY IS 91 m FROM THE HIGHWAY CENTERLINE (OUTSIDE OF DRAWING LIMITS)

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

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

SH016: HWY 49:12 LITTLE SMOKY RIVER APPROXIMATE INSTRUMENT LOCATIONS

DWG No. 32121-SH016-1

DRAWN BY	ML
DESIGNED BY	BWN
APPROVED BY	RVC
SCALE	1:500
DATE	NOVEMBER 2022
FILE No.	32121

THURBER ENGINEERING LTD.

FIGURE SH016-1
HWY 49:12 LITTLE SMOKY RIVER PIEZOMETRIC ELEVATIONS

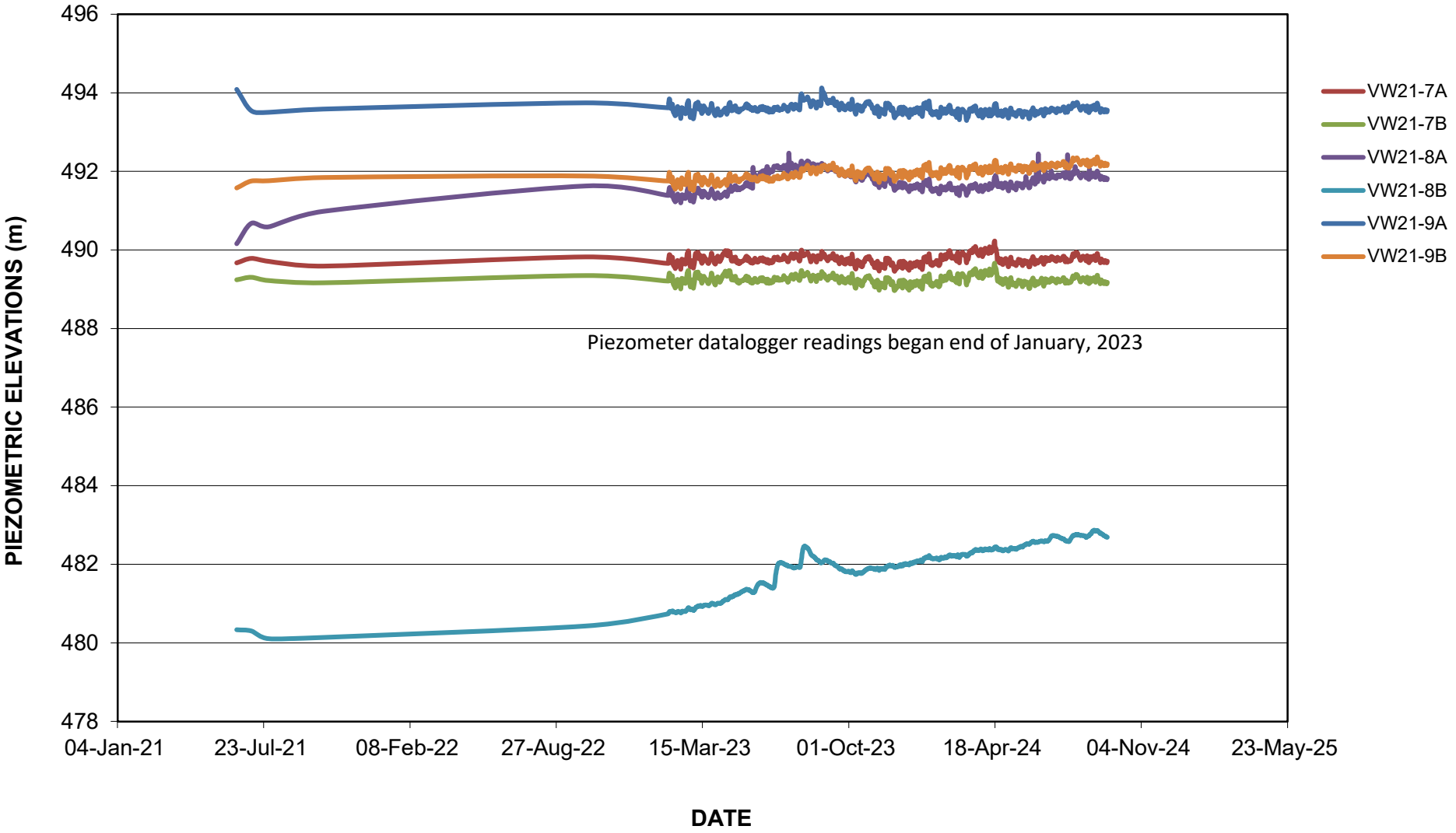


FIGURE SH016-2
HWY 49:12 LITTLE SMOKY RIVER PIEZOMETRIC DEPTHS