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January 16, 2017

David R. Lastovka, P.E.
ODOT District 12 Transportation Engineer
Ohio Department of Transportation
5500 Transportation Boulevard
Garfield Heights, Ohio 44125-5396

Re: October 2016 Quarterly Report
CUY-90-15.24 Slope Monitoring
PID 96504
EDP Project No. 069032.00

Dear Mr. Lastovka:

October annual instrument readings for the CUY-90-15.24 Slope Monitoring project are presented in the attached report.

If you have any questions or comments regarding this report, please call.

Very truly yours,

SME

Alan J. Esser, P.E., D.GE
Chief Consultant

Attachments

Distribution via e-mail

OCTOBER 2016 ANNUAL REPORT

CUY-90-15.24 SLOPE MONITORING
PID 96504
CLEVELAND, OHIO
SME PROJECT NO. 069032.00

NOVEMBER 30, 2016

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INTRODUCTION

Instrument readings and interpretations for October 2016 are presented in this report. Figures showing the arrangement of instrumentation are found in Appendix A. Plots of the data are included in Appendix B. Labels like P-001-13 for the piezometers and I-001-13 for the inclinometer at that same location are used for all recently installed instruments. For earlier instruments, a label like B-101 is used for both the piezometers and inclinometers at the same location.

CRITICAL INSTRUMENTS READ BI-WEEKLY

Critical instruments are those that are judged to provide a clearer picture of slope performance. The following critical instruments are currently read and reported on a bi-weekly schedule.

Piezometers: P-001-13, P-002-13, P-003-10, P-004-13, P-009-13, B-05-02, B-05-A-03, B-05-04, B-05-A-11, and B-105-A.

Inclinometers: I-001-13, I-002-13, I-003-10, I-004-13, I-009-13, B-05-02, B-05-A-03, B-05-04, B-05-A-11, B-101, B-102, B-105-A, Pier 1, Pier 9N, and TGR I-4.

Refer to the bi-weekly reports for details and comments on those instruments. This report will only cover those instruments that are not included in the bi-weekly reading schedule.

STATUS OF INSTRUMENTS

B-303 and I/P-008-10. Fill was placed over these instruments during the CCG1 contract. The inclinometer casing at I-008-10 was recently uncovered. During excavation or grading operations, the casing was bent and then ripped off just below the surface. With the top of the casing open and unprotected, grading and/or surface runoff caused the casing to fill with soil. We repaired the casing first by flushing soil from the casing with a high pressure water stream, and then splicing on a new section of casing to extend above grade. The inclinometer casing at this location has now been restored to service. New baseline readings were taken and included with the next scheduled bi-weekly report. Cables for the piezometers at P-008-10 were also damaged and are no longer in service. The tubing for the pneumatic piezometers at B-303 were never located. Due to the coverage available from other piezometers in the area, ODOT has opted to abandon the piezometers at both of these locations.

RECENTLY INSTALLED INSTRUMENTS

P-003-13. We installed four vibrating wire piezometers at this location between November 8 and 10, 2016. After the grout was set, we took initial readings from these instruments and included the results in the following bi-weekly report.

PIEZOMETERS

P-001-10. Total head in both piezometers at P-001-10 decreased by about 2 feet between July 2015 and April 2016. A temporary rise of about 1 foot of total head occurred in November 2015. Since April 2016, variations in total head have stayed within a range or about 1 foot and are similar to the total heads recorded from April 2013 through April 2015. The datalogger for the shallow piezometer failed to record between April 29 and July 20, 2016, but pore pressure readings on either side of this gap in data indicated no net change in total head.

P-002-10. Total head in the deep piezometer at P-002-10 decreased by 8.5 feet between June 9 and June 12, 2016, and then began to gradually increase. At the time of these quarterly readings, the increase had reached about 5.6 feet. Total head in the shallow piezometer at this location has fluctuated by about 1 foot throughout this past year, but has shown no significant change since January 2014.

P-007-13. Total head in the deep piezometer at P-007-13 decreased by 3.7 feet between June 9 and June 16, 2016, then gradually increased through the third week of August 2016, and has remained nearly constant since that time. The total increase was about 2.8 feet leaving a net decrease of about 0.9 feet since the first week of June 2016. Total head in the shallow piezometer at this location has been trending downward since July 2015. The total decrease during this time has been about 1.8 feet.

B-05-07. Three piezometers are installed at this location. Pore pressures in the shallow and middle piezometers have been trending downward since July 2015. The majority of the decrease, about 1 to 1.5 feet of total head, occurred between July 2015 and the third week of April 2016. Since then, the change has been more gradual with only a slight decrease for the 6 months through October 2016. Total head in the deep piezometer at this location has trended upward very slightly this past year with a net change of less than four inches of total head.

TGR P-3. Three piezometers are installed at this location. Total head in all three piezometers have generally trended downward between short periods where large changes occurred. On December 23, 2015, total head increases of 2.5 to 5 feet occurred in all three piezometers. This increase was caused by the placement of fill in the area immediately adjacent to the instruments. Pore pressures decreased rapidly in the shallow and middle piezometers over the next 3 to 5 weeks. Pore pressures then stabilized in the shallow piezometer remaining about one foot higher than they had been prior to the sudden increase. Pore pressures in the middle piezometer continued to decrease at a gradual rate. Pore pressures decreased gradually in the deep piezometer after the sudden December increase. Then, between September 25 and October 17, 2016, total head decreased by 6.2 feet in the deep piezometer, 2.7 feet in the middle piezometer, and 0.7 feet in the shallow piezometer. This was likely due to the final grading operations in the area of these instruments.

INCLINOMETERS

I-001-10, I-002-10. Inclinometer readings at these locations indicate no movement since April 2015.
I-007-13. Inclinometer readings at this location indicate no movement since July 2016. The July and October 2016 readings appear as a mirror image of the October 2015 reading. We think this may be an issue with the data reduction program. We have discussed this with the manufacturer but have not been able to find the cause or correct the issue.

B-05-07. Inclinometer readings at this location indicate slight movement in the positive A-axis direction from the surface to about 100 feet between April and July 2016. Throughout this year, slight movement is indicated in the negative B-axis direction from 40 to 120 feet. These changes are likely due to slight changes in the readings and are not considered to be significant.

P-3, P-8, P-10, P-17. Inclinometer readings at these locations indicate movement between October 2015 and January 2016, which are a reversal in the direction of past displacements, i.e., displacement toward the baseline. The maximum displacement was about 0.2 inches at any point. At P-3, P-8, and P-10, this movement occurred in the positive A-axis and negative B-axis directions. At P-17, this movement occurred in the positive A-axis and positive B-axis directions. Since January 2016, the readings have indicated some slight but negligible displacement in both the positive and negative directions at various points along the slope tubes. This movement has generally been back toward the baseline.

STABILIZATION STRUCTURE

The general arrangement of the stabilization structure and its instrumentation is shown in Figures 2 and 3 in Appendix A.

Load Cells

Seasonal variations are apparent in the plots for all the load cells with the usual increase in load during the summer months. The plots for all load cells indicate a slight upward trend this year. This is the first such increase we have seen since October 2009. The many spikes shown in the plot for Load Cell 8 occur when one or more of the gages in the load cell fail to record. These spikes are occurring in all load cells with the exception of Load Cell 9. Table 2 shows which gages were active in each of the load cells this quarter. A plot of the load cell data is included in Appendix B.

Table 2. Active gages (indicated by check mark) in load cells on the four instrumented anchors.

Load Cell	Gage					
	1	2	3	4	5	6
1	✓			✓	✓	✓
8	✓	✓	✓		✓	✓
9	✓	✓	✓	✓	✓	✓
17	✓	✓	✓	✓	✓	✓

Anchors

Loads recorded for most active strandmeters on the instrumented anchors remained virtually constant this quarter with the exception of an occasional gap or spike caused by gages failing to record. The gaps are data points that were omitted from the plot to "clean up" the graph. The plot for Gage 5 on Anchor 1 indicates the continuing upward trend that has been ongoing since 2010. The magnitude of the load is obviously incorrect since it is unrealistically high and is more than four times the load indicated by the load cell. The plot for Gage 5 on Anchor 9 shows a slight increase between January and April 2016, with almost no change at other times. Average loads this quarter for the load cells and active strandmeters are listed in Table 3. We are also reporting the percent change in load from last quarter. Strandmeter gages that have failed are indicated by an "×" in the table. Note that negative (compression) loads and loads in the individual gages that exceed the load indicated by the load cell are not possible. Assuming uniform load transfer from the anchor to the rock over the bond length, we should expect the load indicated by the strandmeters to increase progressively from Gage 1 to Gage 5 which is closest to the top end of the bond zone. Only a few of the data points listed in Table 3 seem to be valid.

Table 3. Average strandmeter loads and % change from last quarter, tension loads are positive.

Anchor	Load Cell (kips)	Strandmeter (kips)				
		1	2	3	4	5
1	451.8	-9.8	×	+/- 0	×	2092.6
% change		0.2	×	0	×	0.3
8	318.4	29.1	65.9	-176.7	×	×
% change		1.6	0.3	-0.1	×	×
9	461.4	-19.26	8.47	2.69	194.04	785.76
% change		0.1	-0.4	4.4	-0.1	0.1
17	376.3	-40.2	×	-24.7	×	232.7
% change		5.7	×	2.5	×	0.1

Driven piles

Axial loads in all driven piles except Pile 1 increased by 3 to 9 kips between January and February 2016 then gradually decreased between March and September 2016 by 10 to 15 kips. All of the gages in Pile 34 failed to record between May 5 and July 21, 2016, after which only gages 2, 3, and 4 started working again. Thus, it is difficult to interpret the changes that may have been occurring in this pile. Prior to this gap in the data, the axial load followed trends similar to the other gages except Pile 1. The axial load in Pile 1 decreased by about 6 kips between December 2015 and February 2016, then gradually increased through August 2016 when the total increase was about 20 kips. Between September 18 and October 31, 2016, the axial load in all driven piles increased by 5 to 20 kips. The largest, and apparently anomalous, increase was in Pile 34.

Strong axis bending moments in all of the driven piles decreased between September 2015 and April 2016. The greatest decrease, 22 kip-feet, occurred in Pile 1. We should note that this decrease is probably exaggerated as the data indicates that a significant and probably erroneous increase occurred in July 2015 and the data hadn't returned to "normal" until April 2016. Decreases in the remaining piles (and probably Pile 1) ranged from 1.5 to 6 kip-feet. Between May 2016 and September 2016, the strong axis bending moments in all of the driven piles increased. The greatest increase of 6 kip-feet occurred in Pile 1. Increases in the remaining piles were about 2 kip-feet. Between September 21 and 23, 2016, the strong axis bending moments in all of the driven piles except Pile 17 decreased by about 2 kip-feet. Strong axis bending moments have generally been trending upward since July 2012. Seasonal variations are apparent in the data.

Average weak axis bending moments in Piles 1 and 34, which are at the ends of the stabilization structure, appear to have been relatively constant this past year. From 2010 through 2015 the weak axis bending moments in these piles had been trending downward. Changes in weak axis bending moments in the remaining piles were negligible. Gaps in a large part of the Pile 34 bending moment plot are due to the gage failures.

Tiebeams General

Data for the tiebeams was more stable this year than in the previous year. A relatively small amount of erratic data had to be deleted to “clean up” the plots in the attachments. The following interpretations refer to the trends that are visible after the data was “cleaned”.

Tiebeams Anchor Side

Seasonal changes are apparent in the data for the axial loads at the anchor end of the tiebeams. A seasonal peak was reached in early May 2016. Between September 20 and 25, the axial load in all of the tiebeams, except Tiebeam 1, decreased by 9 to 15 kips. Then, including Tiebeam 1, the axial load in all of the tiebeams began to increase. Axial loads are trending downward in the end tiebeams, and trending upward interior tiebeams. The spread in the axial loads between tiebeams is also narrowing. It is difficult to interpret the data for 2014-15, but it appears the difference between the maximum and minimum seasonal loads is greater this year than in past years.

With the exception of Tiebeam 1, strong axis bending moments were constant this year. The strong axis bending moment in Tiebeam 1 increased by about 10 kip-feet between July and December 2015, decreased by about 1 kip-foot between April and July 2016, then increased by about 1 kip-foot between July and October 2016. Changes in weak axis bending moments were negligible for all tiebeams.

Tiebeams Drilled Pier Side

Seasonal changes are also seen in the axial loads in the tiebeams on the drilled pier side, reaching peak loads between February and March, and seasonal lows in August. Axial loads in Tiebeams 1 and 26 show larger changes than we have seen in previous years, decreasing by 39 kips and 44 kips, and increasing by 25 kips and 15 kips, respectively. Axial loads in the other tiebeams show seasonal changes similar to past years.

Strong axis bending moments exhibited seasonal changes, decreasing between October and April and then increasing. In July 2016, the strong axis bending moment in Tiebeam 26 decreased suddenly by about 8 kip-feet, then continued to decrease gradually. This corresponds to a similar decrease in the axial load in this tiebeam. No bending moment data is presented for Tiebeam 12 due to gage failures. Changes in weak axis bending moments were negligible except for Tiebeam 26, which decreased by about 1 kip-foot in July 2016.

Drilled Piers

Plots of axial load vs. time show the usual seasonal changes in both Piers. The load vs. time plots continue to show a gradual increase in axial load over time in both shafts at all depths except 84 to 114 feet in Shaft 1 where the axial load has remained relatively constant except for seasonal changes.

Bending moments in Pier 1 show the largest seasonal changes at the top end of the pier. Moments are decreasing from 29 and 35.5 feet, and are increasing above 22.5 feet and below 58 feet. A similar trend occurs in Pier 9 where the seasonal changes in bending moments show the greatest variation at 50 feet and above.

AGGREGATE STOCKPILES

We observed and photographed the aggregate stockpiles on October 29, 2016. The photos are included in Appendix A as Figures 4 and 5. Only a small pile of aggregate remains closest to the right-of-way fence. This pile has not unchanged since January 2014. The pile is about 8 feet high and covers only a small area of the property.

This completes the October 2016 annual report for the CUY-90-15.24 Slope Monitoring Project, ODOT PID 96504.

Report prepared by:	Report reviewed by:
STATE OF OHIO BRENDAN PATRICK LIESKE E-81254 REGISTERED PROFESSIONAL ENGINEER cosign	cosign
Brendan P. Lieske, P.E.	Alan J. Esser, P.E., D.GE
Senior Staff Engineer	Chief Consultant

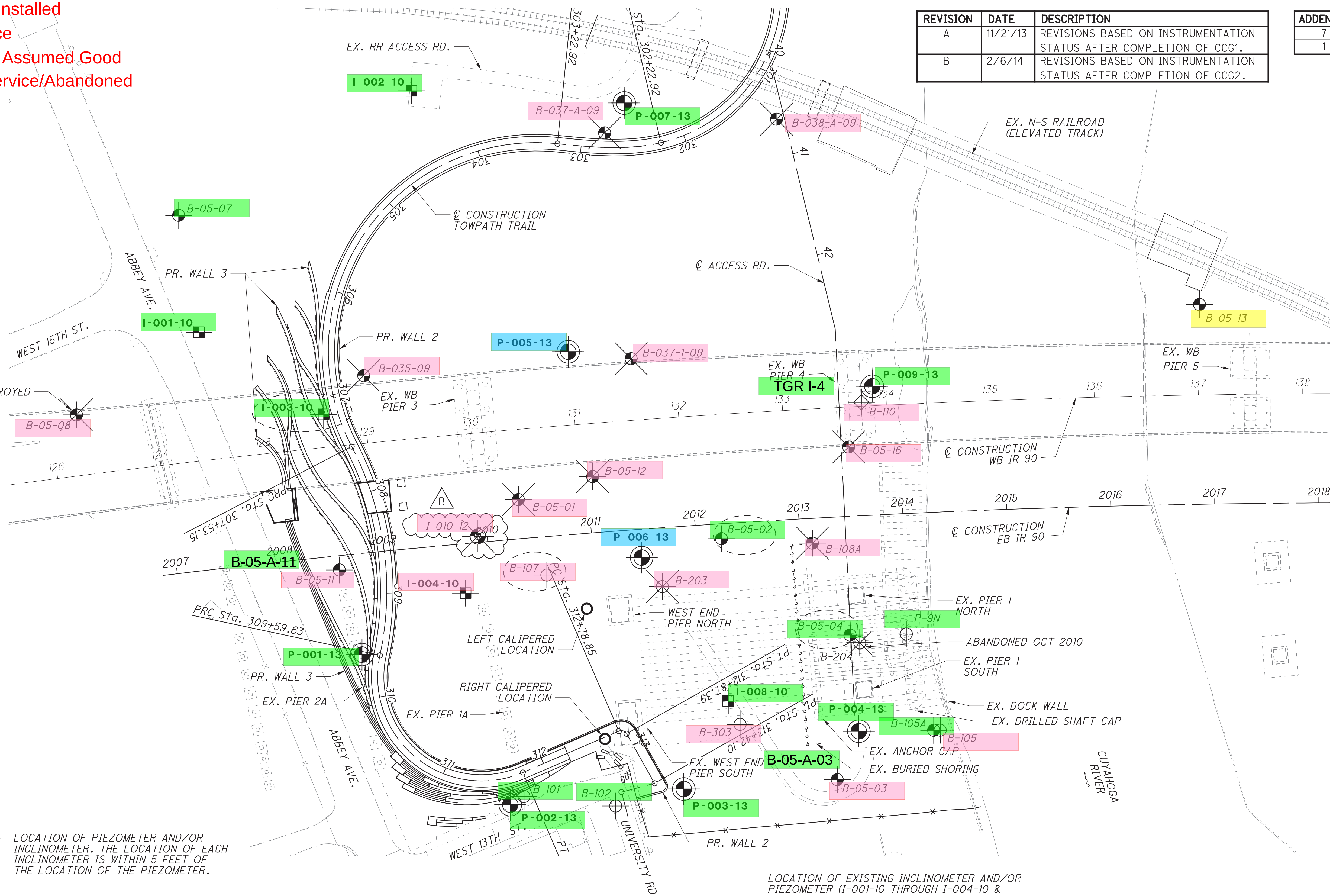
APPENDIX A

ARRANGEMENT OF INSTRUMENTATION

Not Yet Installed
In Service
Inactive, Assumed Good
Out of Service/Abandoned

REVISION	DATE	DESCRIPTION
A	11/21/13	REVISIONS BASED ON INSTRUMENTATION STATUS AFTER COMPLETION OF CCG1.
B	2/6/14	REVISIONS BASED ON INSTRUMENTATION STATUS AFTER COMPLETION OF CCG2.

ADDENDUM	DATE
7	8/2/13
1	4/16/13



LEGEND

P-001-13 — LOCATION OF PIEZOMETER AND/OR INCLINOMETER. THE LOCATION OF EACH INCLINOMETER IS WITHIN 5 FEET OF THE LOCATION OF THE PIEZOMETER.

B-05-01 — LOCATION OF INCLINOMETER/PIEZOMETER INSTALLED BY BBCM IN 2006 (B-05-01 THROUGH B-05-04, B-05-07, B-05-08, B-05-11 THROUGH B-05-13, AND B-05-16). THESE INSTRUMENTS ARE NOT AFFECTED BY THE GRADING AND REMAIN IN SERVICE.

B-105A — LOCATION OF REPLACEMENT INCLINOMETER INSTALLED BY BBCM IN 2006 (B-105A AND B-108A).

B-101 — LOCATION OF INCLINOMETER AND/OR PIEZOMETER INSTALLED BY BBCM BETWEEN 1994 AND 1999 (B-101, B-102, B-105, B-107, B-203, B-204, B-303, AND P-9N).

B-110 — LOCATION OF INCLINOMETER AT B-110, WHICH WAS DESTROYED BY EXCAVATION ACTIVITIES IN MARCH, 2006

I-010-12 — LOCATION OF INCLINOMETER INSTALLED DURING PIER 3 CONSTRUCTION, 2012

I-001-10 — LOCATION OF EXISTING INCLINOMETER AND/OR PIEZOMETER (I-001-10 THROUGH I-004-10 & I-008-10 AND P-001-10 THROUGH P-004-10 & P-008-10 INSTALLED AS PART OF THE CCG1 CONTRACT). THE LOCATION OF EACH PIEZOMETER IS WITHIN 5 FEET OF THE LOCATION OF THE INCLINOMETER. DEVELOPER IS RESPONSIBLE FOR THE REPLACEMENT INSTRUMENTATION, IF DAMAGED. (NOT USED: I-005-10 THROUGH I-007-10 & I-009-10 AND P-005-10 THROUGH P-007-10 & P-009-10).

B — LOCATION OF ABANDONED/DESTROYED INCLINOMETER AND/OR PIEZOMETER (B-05-01, B-05-12, B-05-16, B-035-0-09, B-037-1-09, AND B-037-A-09, B-038-A-09, B-107, B-108A, B-203, B-204, B-05-08), I-010-12

INCLINOMETER AND/OR PIEZOMETER TO BE REPLACED. THE FUTURE INSTALLATION WILL HAVE THE SAME DESIGNATION PRECEDED BY LETTER 'A' (B-05-02, B-05-04, B-107, I-003-10)

NOTE:
THE DEVELOPER NEEDS TO PROTECT ALL THE INSTRUMENTS AND REPLACE ANY IF DAMAGED, PER SCOPE REQUIREMENTS.

HORIZONTAL SCALE IN FEET 0 25 50 100

DRAWN CDS CHECKED JN

INSTRUMENTATION PLAN
CUYAHOGA RIVER WEST BANK

CUY-90-14.90

1/4

61/93

P:\82119\geotechnical\sheets\82119ZP410 Revision B.dgn 2/7/2014 8:43:29 AM csteck

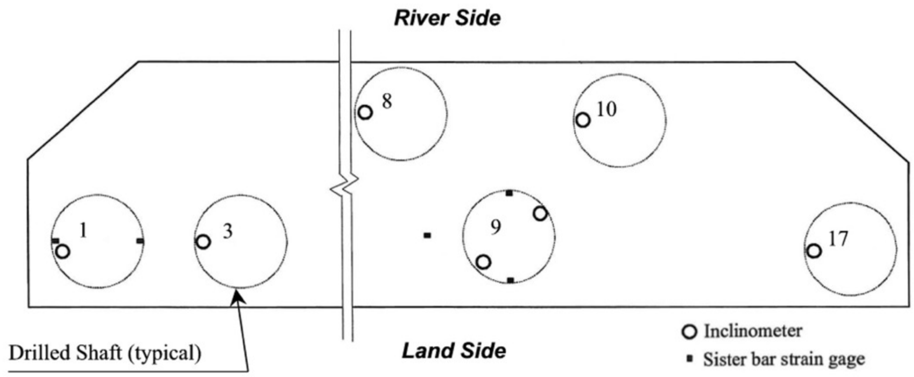


Figure 2. Pier cap with the location of inclinometers and strain gauges.

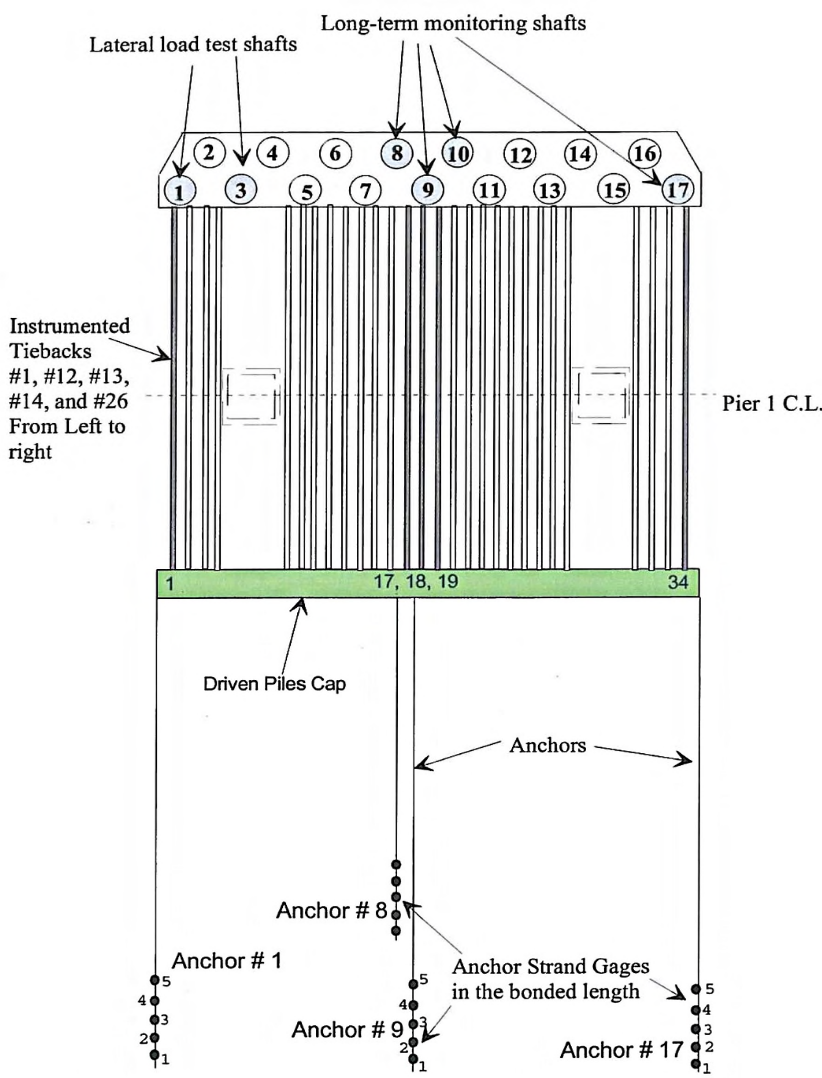


Figure 3. Plan of the stabilization system showing the locations of the instrumented foundation elements.

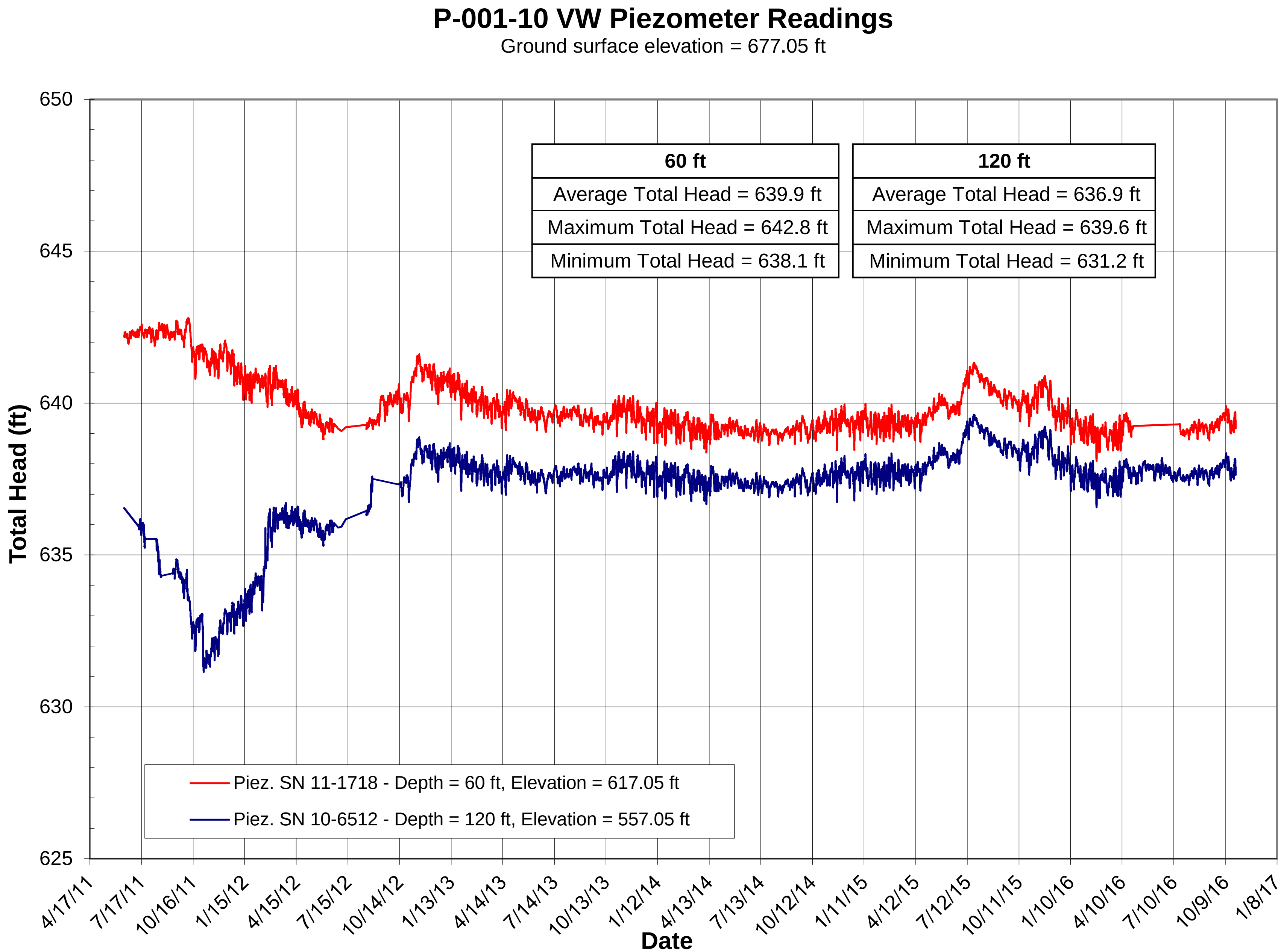
Figure 4. Aggregate stockpile east of the ODOT right-of-way (October 29, 2016).

Figure 5. Aggregate stockpile near ODOT's east right-of-way fence (October 29, 2016).

APPENDIX B

PLOTS OF INSTRUMENT READINGS

DISCUSSED IN THE REPORT



P-001-10 VW Piezometer Readings
Ground surface elevation = 677.05 ft
60 ft
Average Total Head = 639.9 ft
Maximum Total Head = 642.8 ft
Minimum Total Head = 638.1 ft
120 ft
Average Total Head = 636.9 ft
Maximum Total Head = 639.6 ft
Minimum Total Head = 631.2 ft
Piez. SN 11-1718 - Depth = 60 ft, Elevation = 617.05 ft
Piez. SN 10-6512 - Depth = 120 ft, Elevation = 557.05 ft
Total Head (ft)
650
645
640
635
630
625
Date
4/17/11
7/17/11
10/16/11
1/15/12
4/15/12
7/15/12
10/14/12
1/13/13
4/14/13
7/14/13
10/13/13
1/12/14
4/13/14
7/13/14
10/12/14
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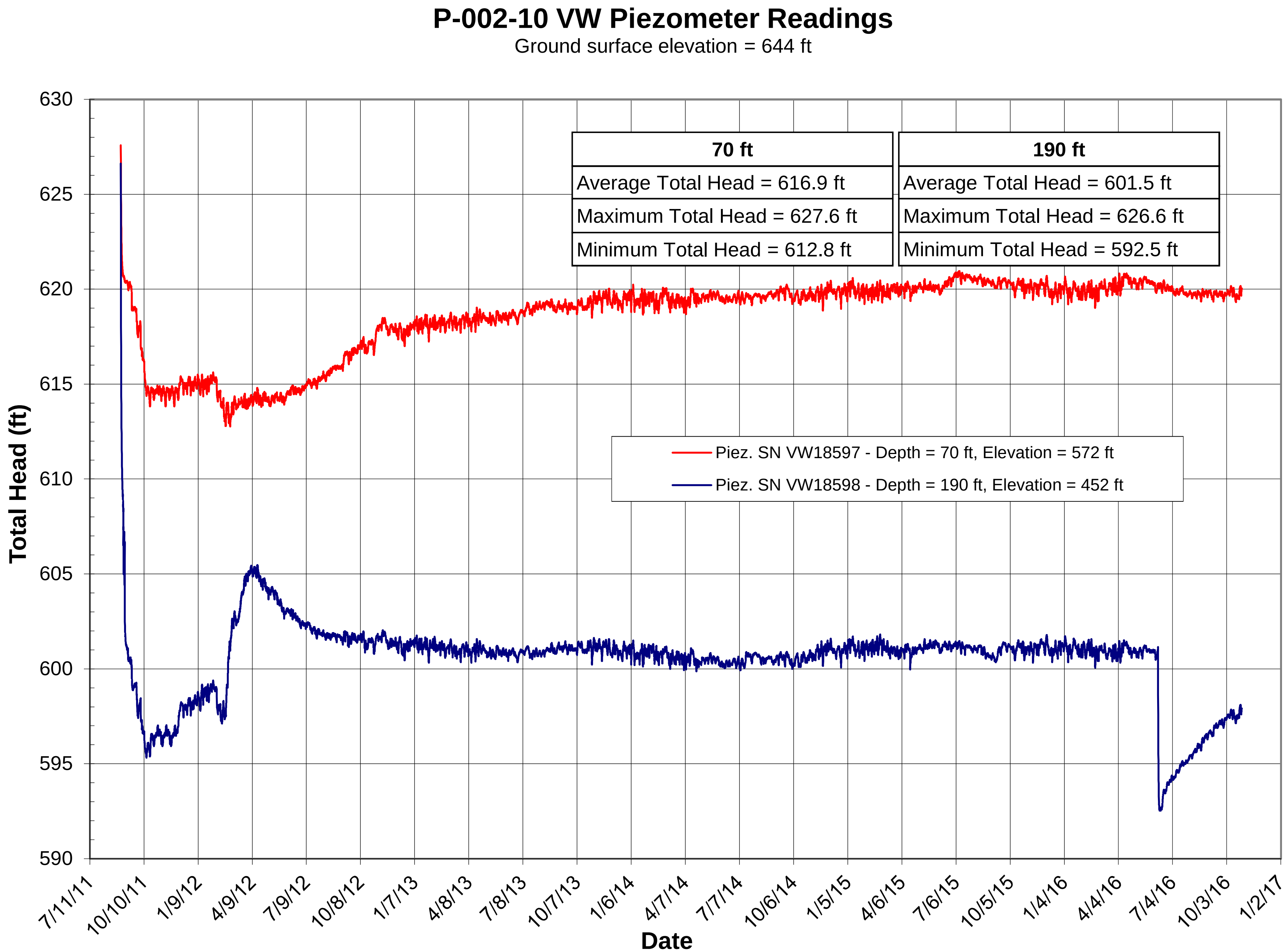
10/9/16
1/8/17


P-002-10 VW Piezometer Readings
Ground surface elevation = 644 ft
70 ft
Average Total Head = 616.9 ft
Maximum Total Head = 627.6 ft
Minimum Total Head = 612.8 ft
190 ft
Average Total Head = 601.5 ft
Maximum Total Head = 626.6 ft
Minimum Total Head = 592.5 ft
Piez. SN VW18597 - Depth = 70 ft, Elevation = 572 ft
Piez. SN VW18598 - Depth = 190 ft, Elevation = 452 ft
Total Head (ft)
630
625
620
615
610
605
600
595
590
7/11/11
10/10/11
1/9/12
4/9/12
7/9/12
10/8/12
1/7/13
4/8/13
7/8/13
10/7/13
1/6/14
4/7/14
7/7/14
10/6/14
1/5/15
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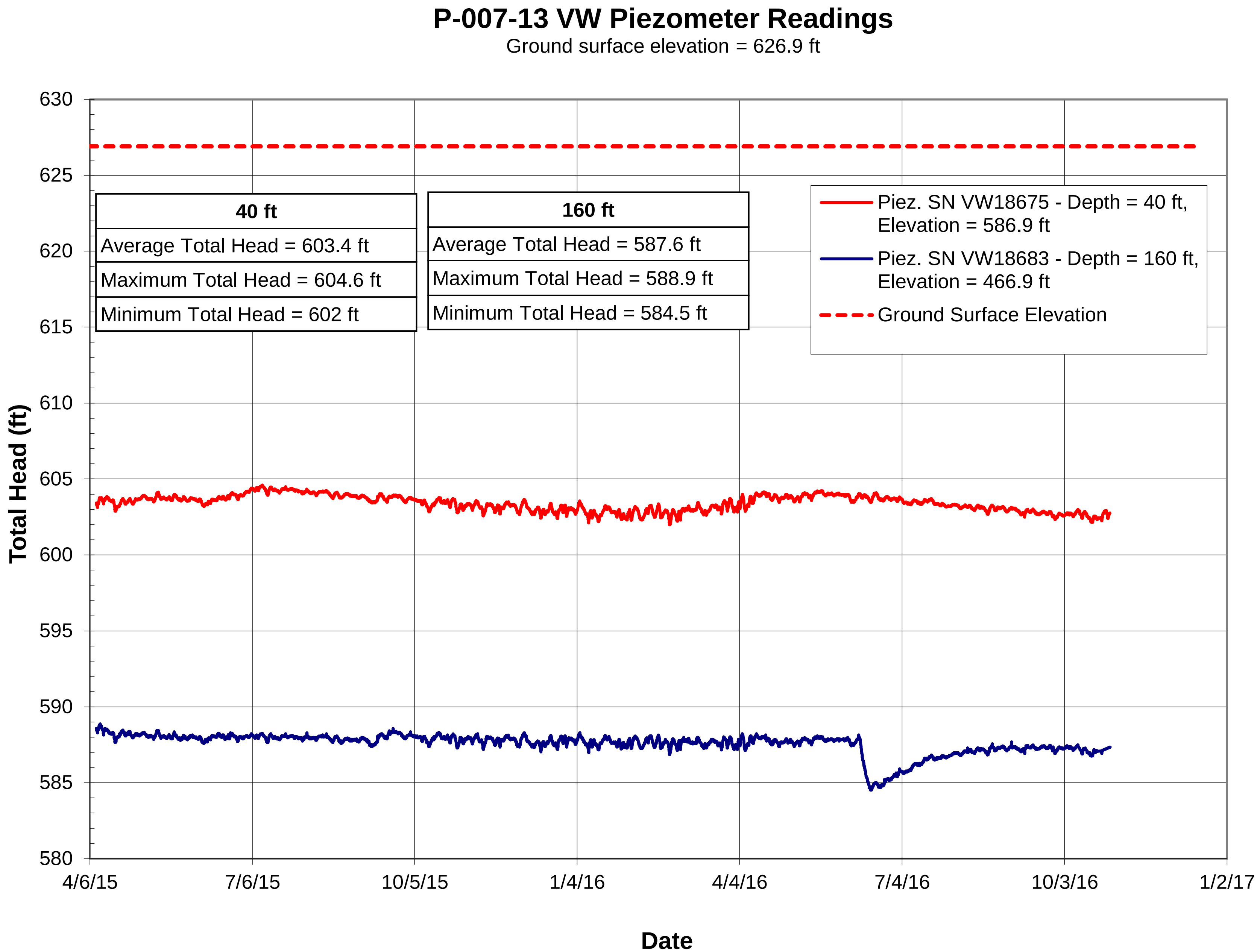
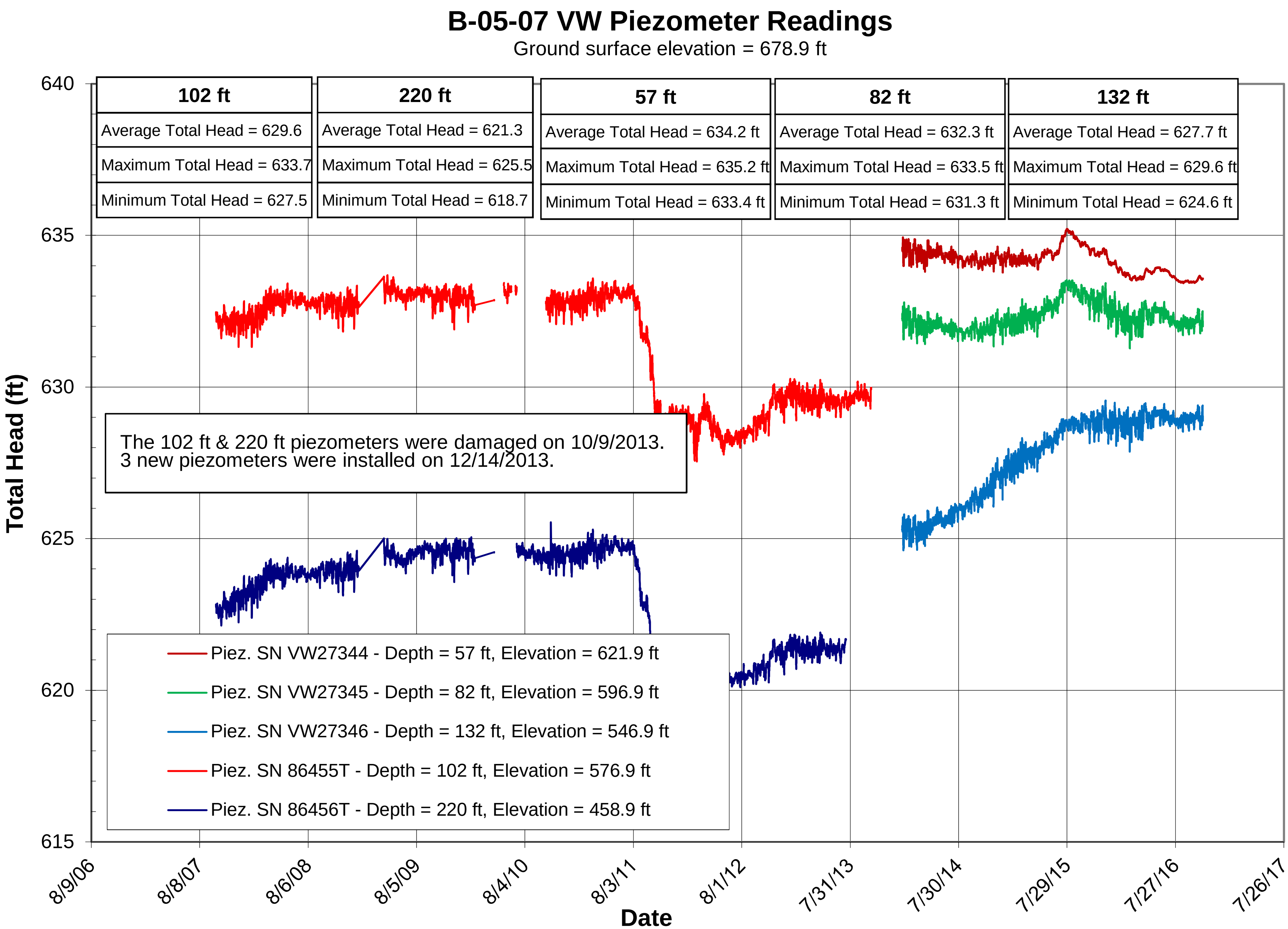
10/3/16
1/2/17
Date



P-007-13 VW Piezometer Readings
Ground surface elevation = 626.9 ft
Total Head (ft)
630
625
620
615
610
605
600
595
590
585
580
40 ft
Average Total Head = 603.4 ft
Maximum Total Head = 604.6 ft
Minimum Total Head = 602 ft
160 ft
Average Total Head = 587.6 ft
Maximum Total Head = 588.9 ft
Minimum Total Head = 584.5 ft
Piez. SN VW18675 - Depth = 40 ft, Elevation = 586.9 ft
Piez. SN VW18683 - Depth = 160 ft, Elevation = 466.9 ft
Ground Surface Elevation
4/6/15
7/6/15
10/5/15
1/4/16
4/4/16
7/4/16
10/3/16
1/2/17
Date


B-05-07 VW Piezometer Readings
Ground surface elevation = 678.9 ft
102 ft
Average Total Head = 629.6
Maximum Total Head = 633.7
Minimum Total Head = 627.5
220 ft
Average Total Head = 621.3
Maximum Total Head = 625.5
Minimum Total Head = 618.7
57 ft
Average Total Head = 634.2 ft
Maximum Total Head = 635.2 ft
Minimum Total Head = 633.4 ft
82 ft
Average Total Head = 632.3 ft
Maximum Total Head = 633.5 ft
Minimum Total Head = 631.3 ft
132 ft
Average Total Head = 627.7 ft
Maximum Total Head = 629.6 ft
Minimum Total Head = 624.6 ft
The 102 ft & 220 ft piezometers were damaged on 10/9/2013.
3 new piezometers were installed on 12/14/2013.
Piez. SN VW27344 - Depth = 57 ft, Elevation = 621.9 ft
Piez. SN VW27345 - Depth = 82 ft, Elevation = 596.9 ft
Piez. SN VW27346 - Depth = 132 ft, Elevation = 546.9 ft
Piez. SN 86455T - Depth = 102 ft, Elevation = 576.9 ft
Piez. SN 86456T - Depth = 220 ft, Elevation = 458.9 ft
Total Head (ft)
640
635
630
625
620
615
Date
8/9/06
8/8/07
8/6/08
8/5/09
8/4/10
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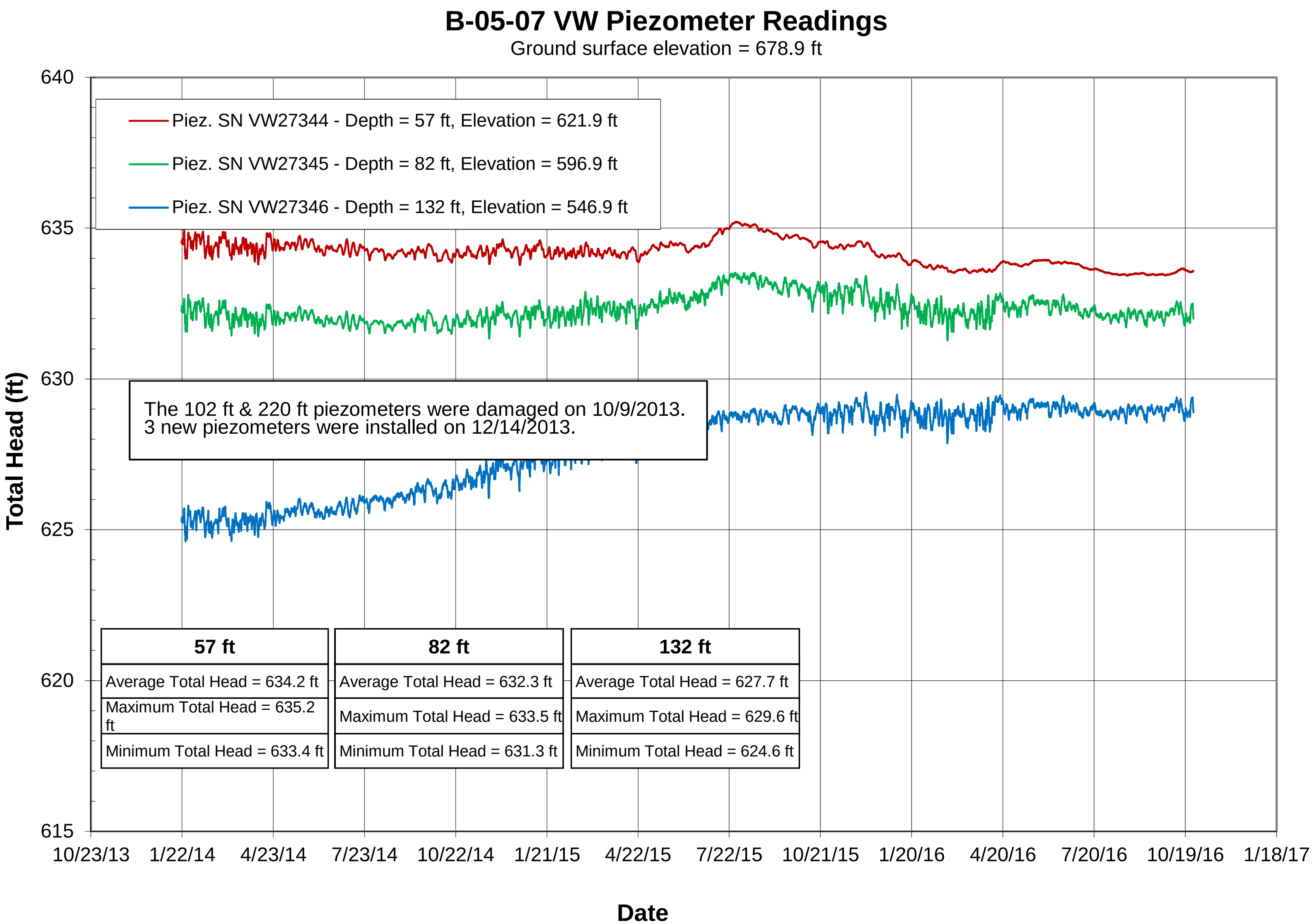
7/27/16
7/26/17



B-05-07 VW Piezometer Readings
Ground surface elevation = 678.9 ft
Piez. SN VW27344 - Depth = 57 ft, Elevation = 621.9 ft
Piez. SN VW27345 - Depth = 82 ft, Elevation = 596.9 ft
Piez. SN VW27346 - Depth = 132 ft, Elevation = 546.9 ft
The 102 ft & 220 ft piezometers were damaged on 10/9/2013.
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57 ft
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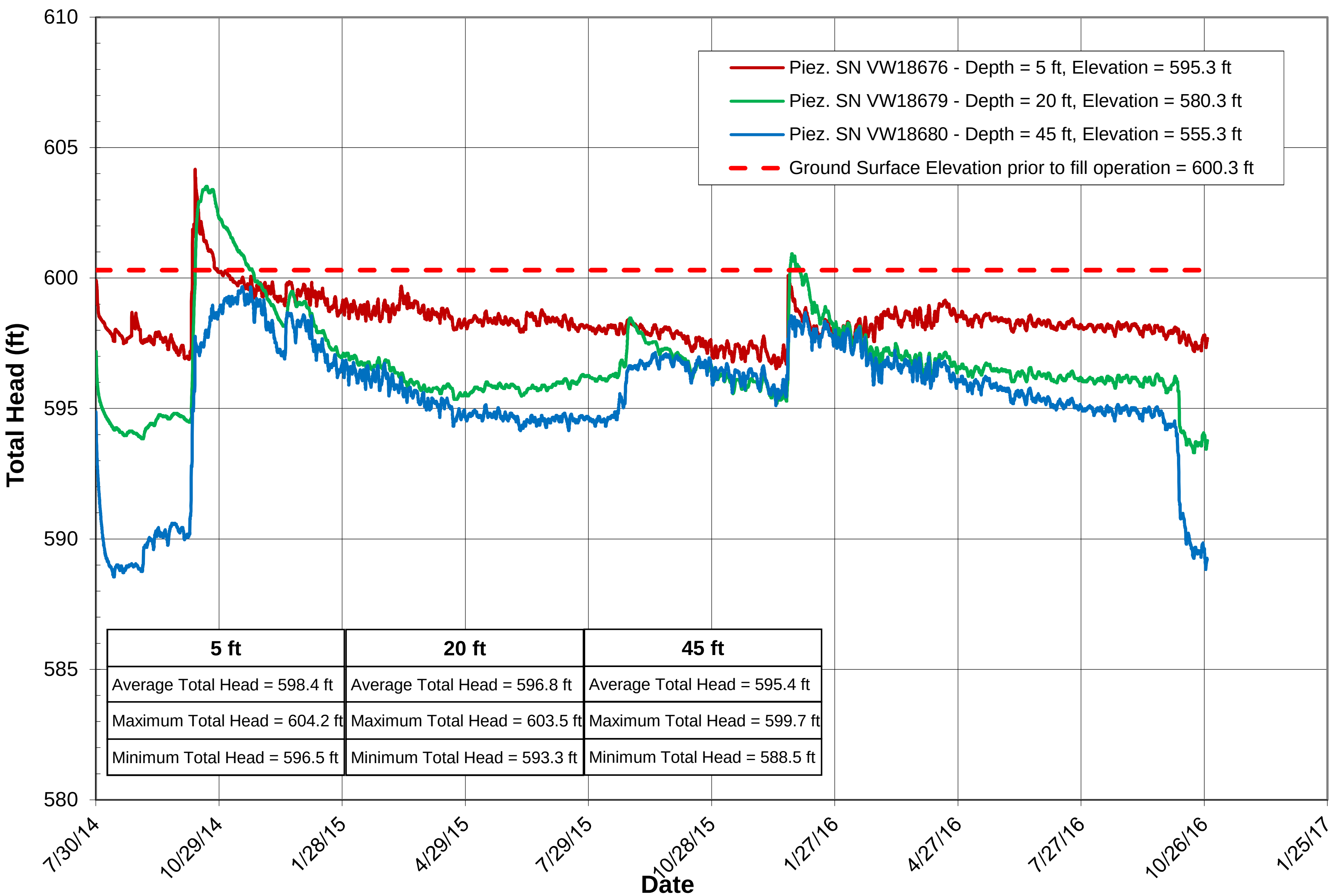
Minimum Total Head = 633.4 ft
82 ft
Average Total Head = 632.3 ft
Maximum Total Head = 633.5 ft
Minimum Total Head = 631.3 ft
132 ft
Average Total Head = 627.7 ft
Maximum Total Head = 629.6 ft
Minimum Total Head = 624.6 ft
Total Head (ft)
640
635
630
625
620
615
10/23/13
1/22/14
4/23/14
7/23/14
10/22/14
1/21/15
4/22/15
7/22/15
10/21/15
1/20/16
4/20/16
7/20/16
10/19/16
1/18/17
Date

TGR P-3 VW Piezometer Readings



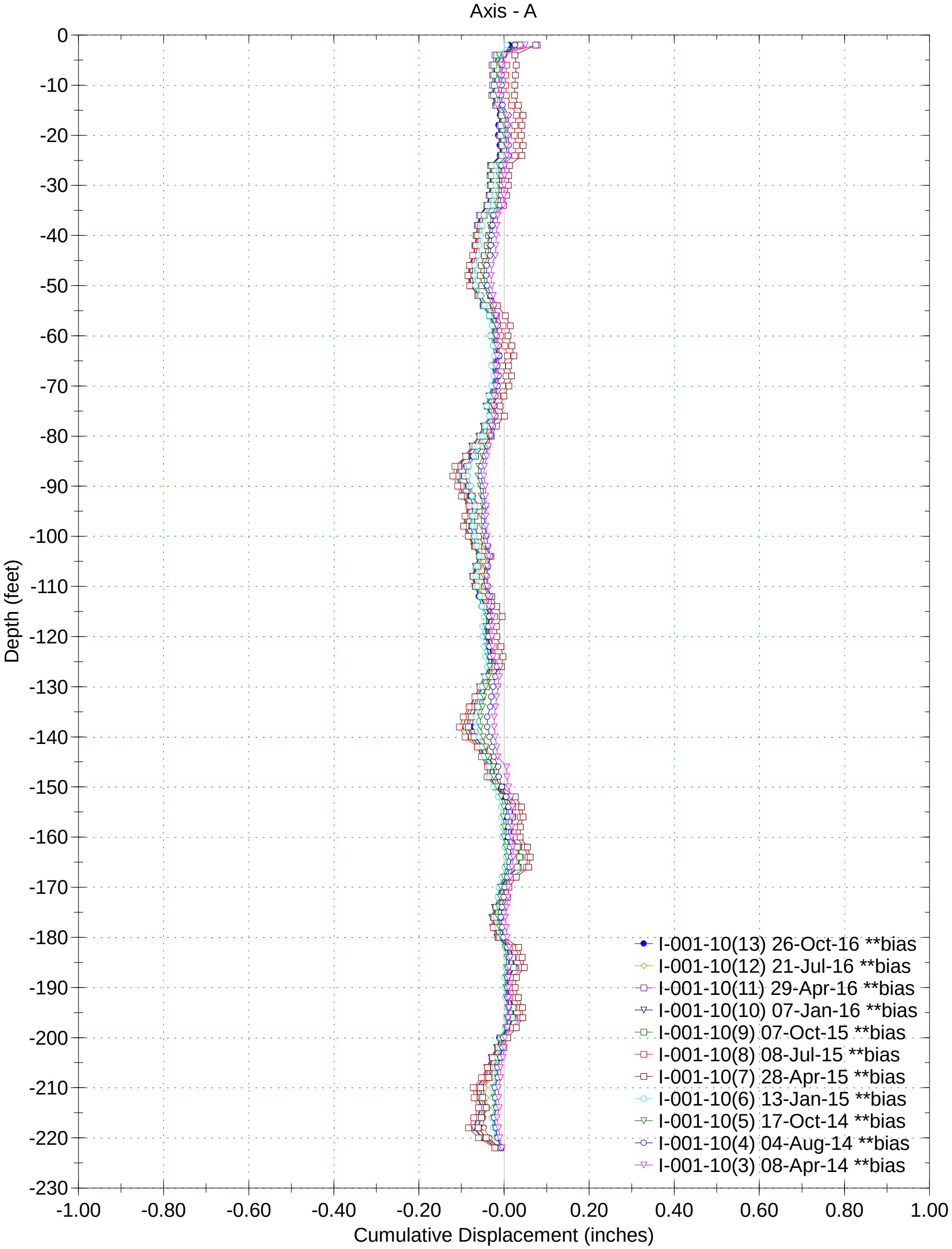
RST Instruments Ltd.

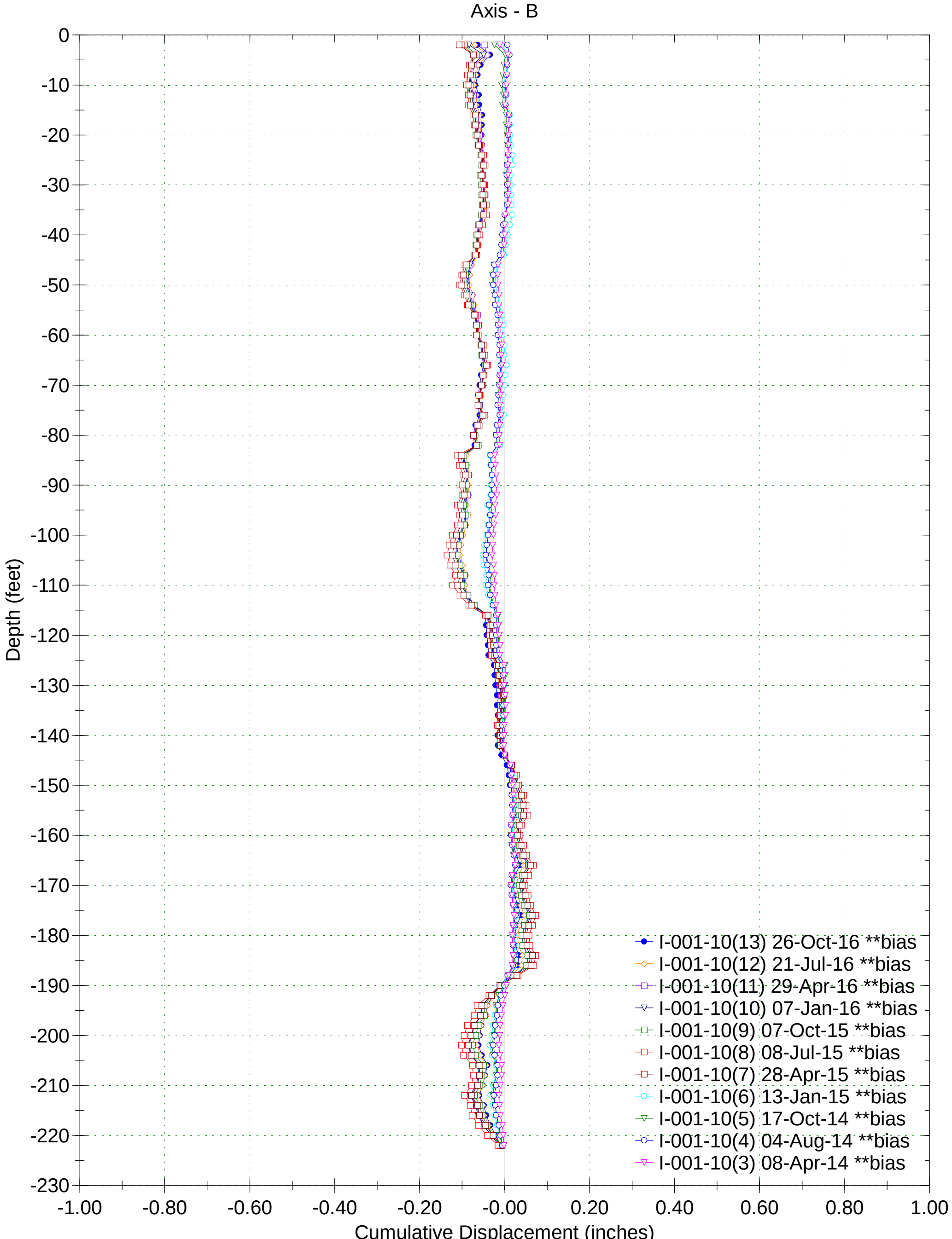
CUMULATIVE DISPLACEMENT

Inclinalysis v. 2.47.5

Borehole : I-001-10
Project : CUY-90-15-24
Location : Cleveland, Ohio
Northing : 663346.19
Easting : 2189917.266
Collar :

Spiral Correction : N/A
Collar Elevation : 0.0 feet
Borehole Total Depth : 222.0 feet
A+ Groove Azimuth :
Base Reading : 2014 Jan 10 07:36
Applied Azimuth : 0.0 degrees





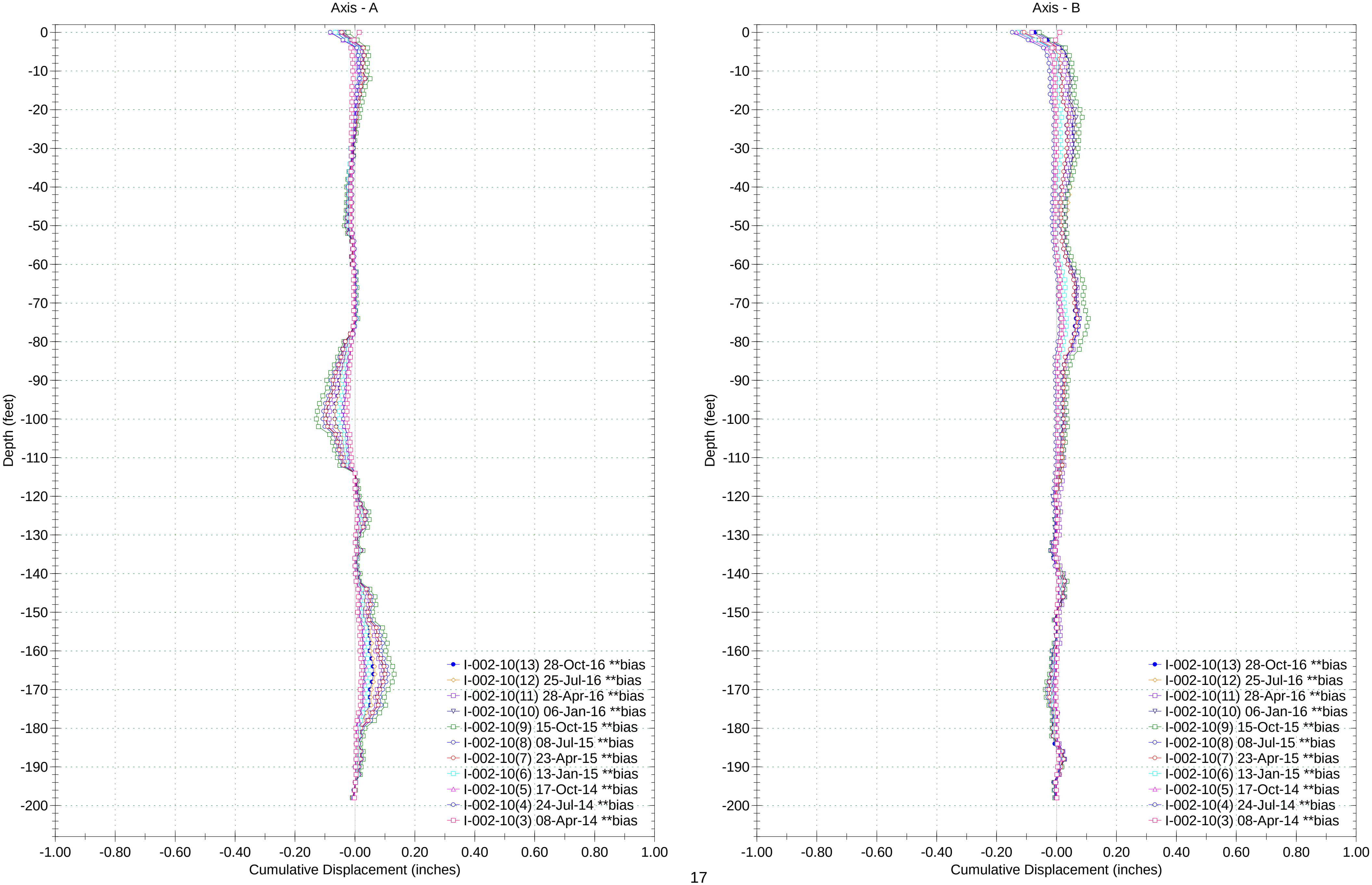
RST Instruments Ltd.

CUMULATIVE DISPLACEMENT

Inclinalysis v. 2.47.5

Borehole : I-002-10
Project : CUY-90-15-24
Location : Cleveland, Ohio
Northing : 663622.262
Easting : 2189778.413
Collar :

Spiral Correction : N/A
Collar Elevation : 2.0 feet
Borehole Total Depth : 200.0 feet
A+ Groove Azimuth :
Base Reading : 2014 Jan 09 09:59
Applied Azimuth : 0.0 degrees



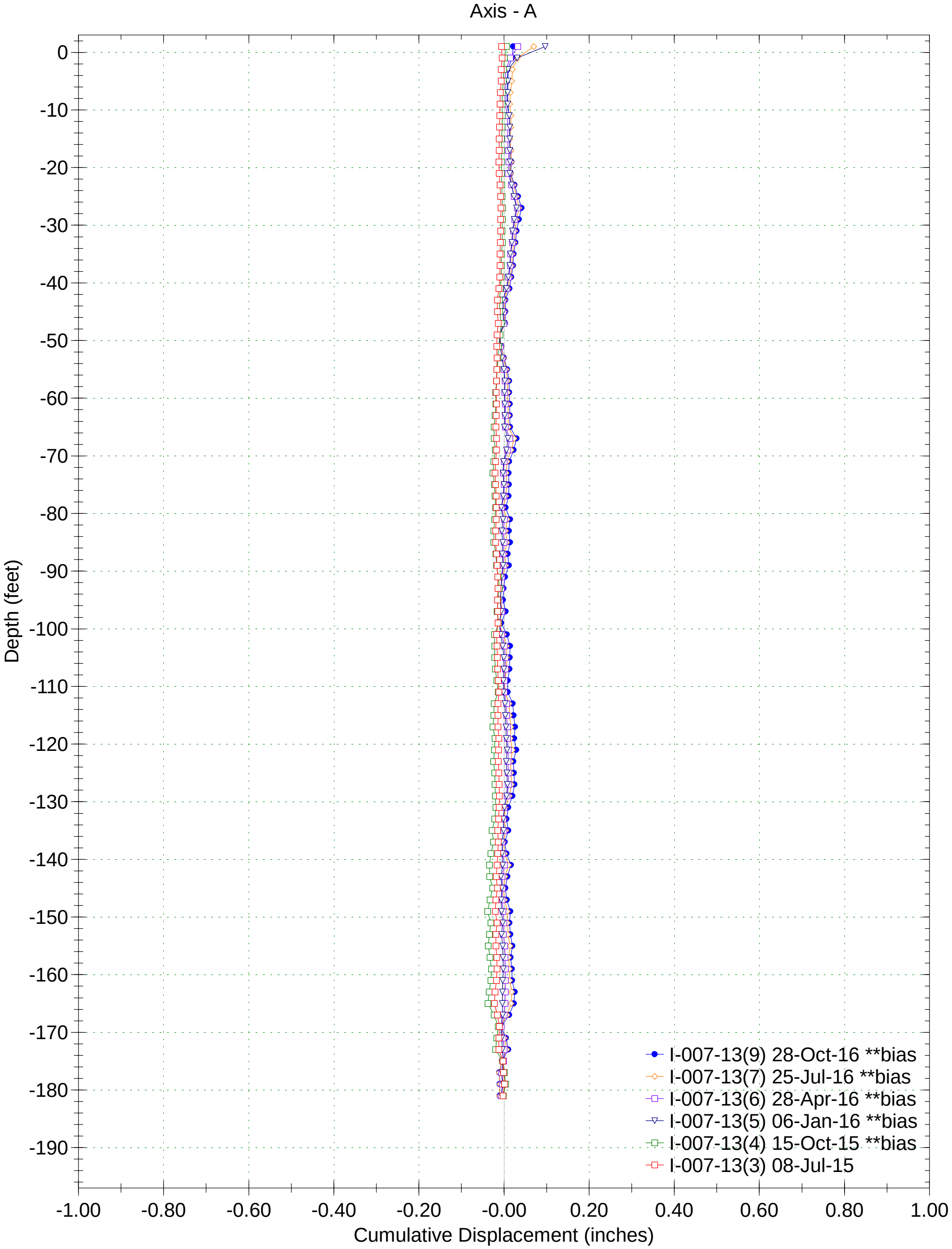
RST Instruments Ltd.

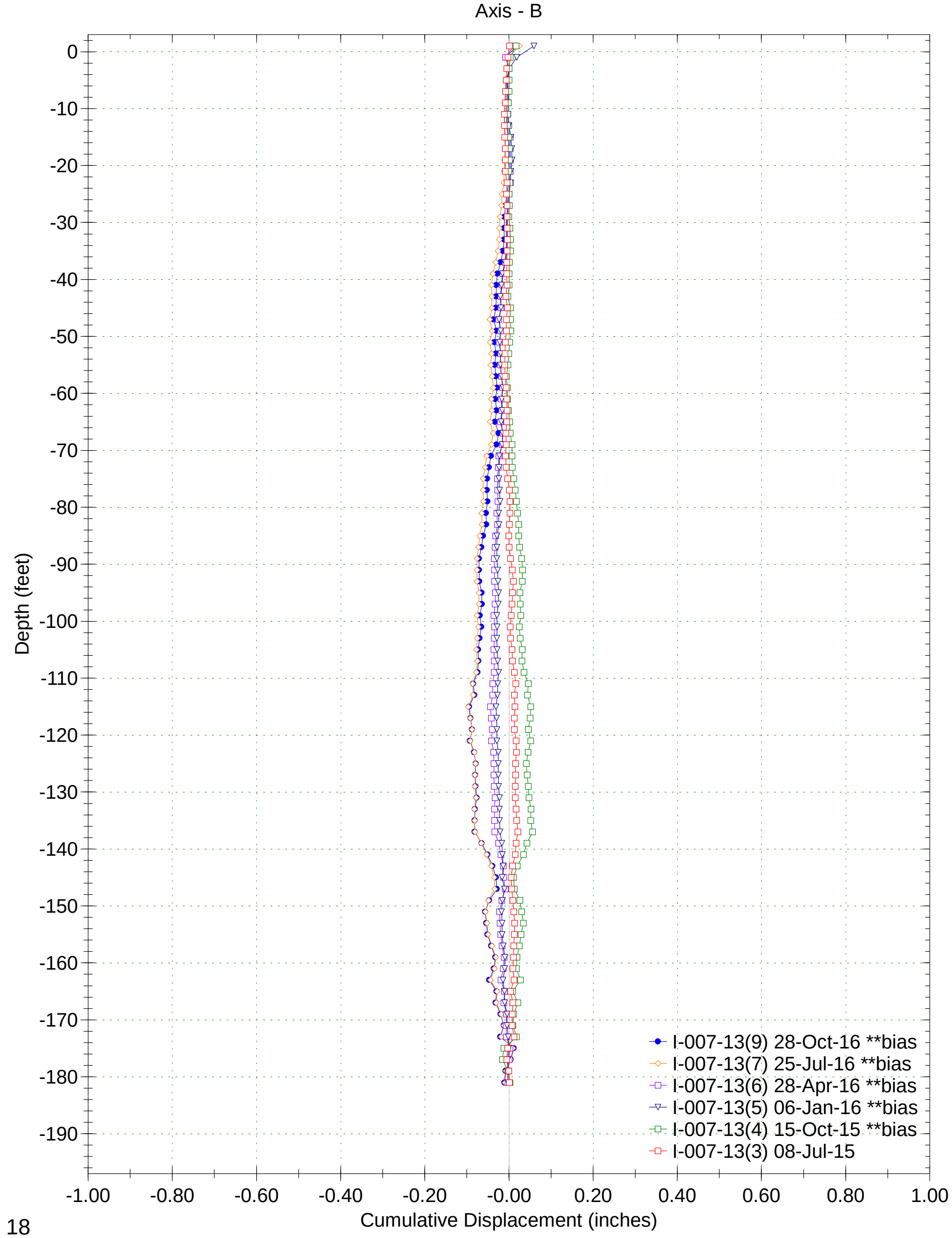
CUMULATIVE DISPLACEMENT

Inclinalysis v. 2.47.5

Borehole : I-007-13
Project : CUY-90-15-24
Location :
Northing :
Easting :
Collar :

Spiral Correction : N/A
Collar Elevation : 3.0 feet
Borehole Total Depth : 184.0 feet
A+ Groove Azimuth :
Base Reading : 2015 Apr 28 15:31
Applied Azimuth : 0.0 degrees

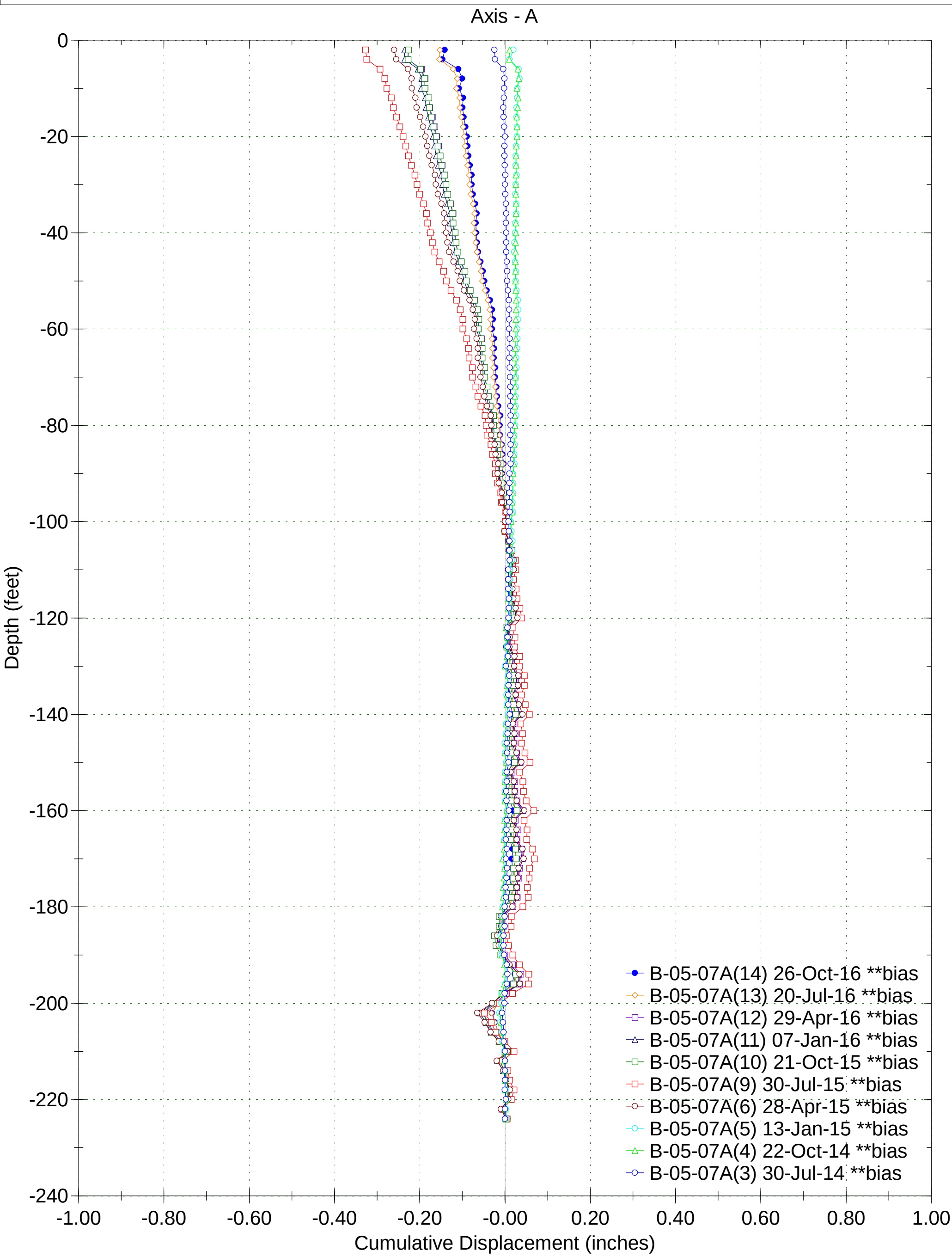


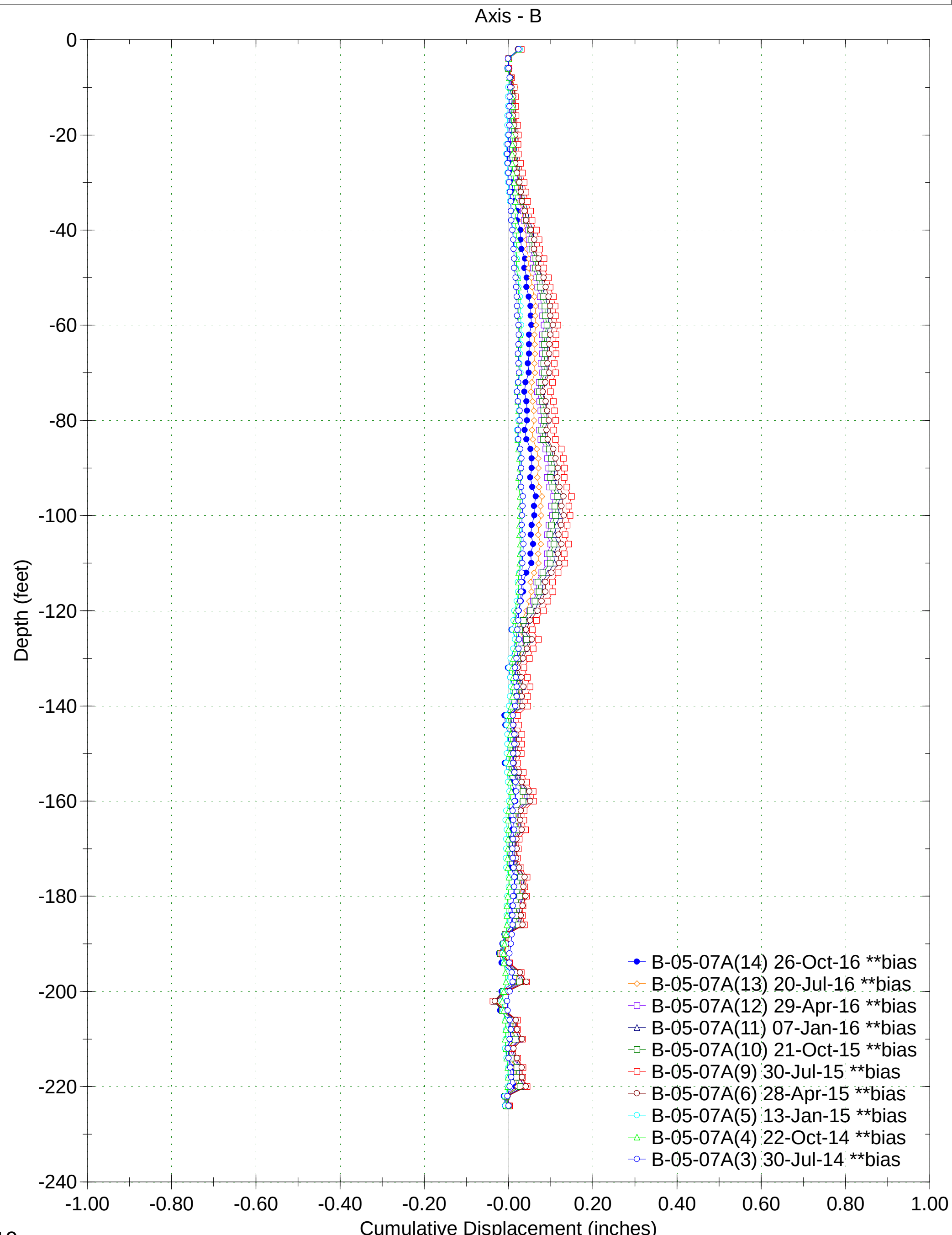


RST Instruments Ltd. | CUMULATIVE DISPLACEMENT | Inclinalysis v. 2.47.5

Borehole : B-05-07A
Project : CUY-90-15-24
Location : Cleveland, Ohio
Northing : 663369.991
Easting : 2189805.799
Collar :

Spiral Correction : N/A
Collar Elevation : 0.0 feet
Borehole Total Depth : 224.0 feet
A+ Groove Azimuth :
Base Reading : 2014 Apr 11 09:50
Applied Azimuth : 0.0 degrees





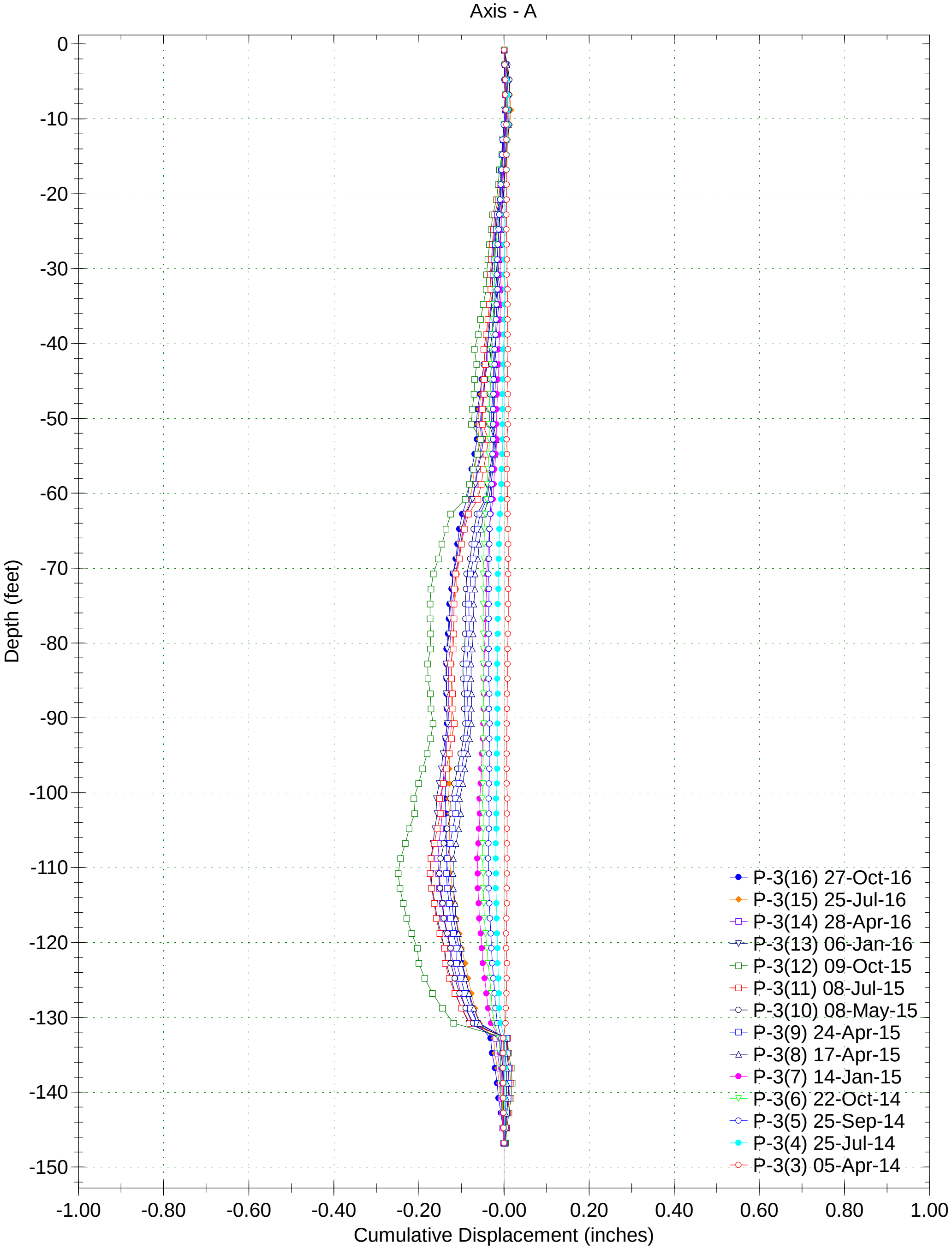
RST Instruments Ltd.

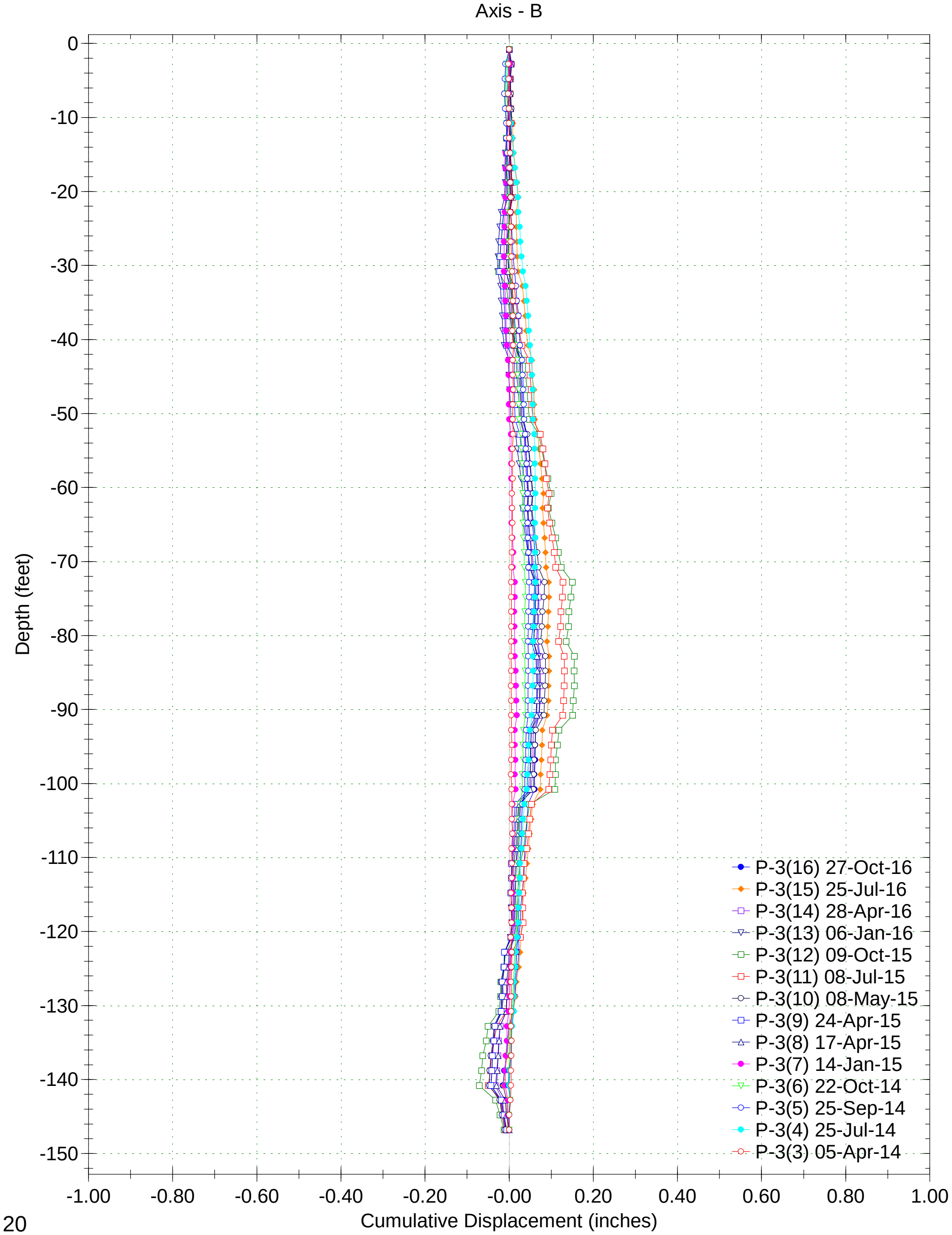
CUMULATIVE DISPLACEMENT

Inclinalysis v. 2.47.5

Borehole : P-3
Project : CUY-90-15-24
Location : Cleveland, Ohio
Northing :
Easting :
Collar :

Spiral Correction : N/A
Collar Elevation : 1.2 feet
Borehole Total Depth : 148.0 feet
A+ Groove Azimuth :
Base Reading : 2014 Jan 21 10:48
Applied Azimuth : 0.0 degrees

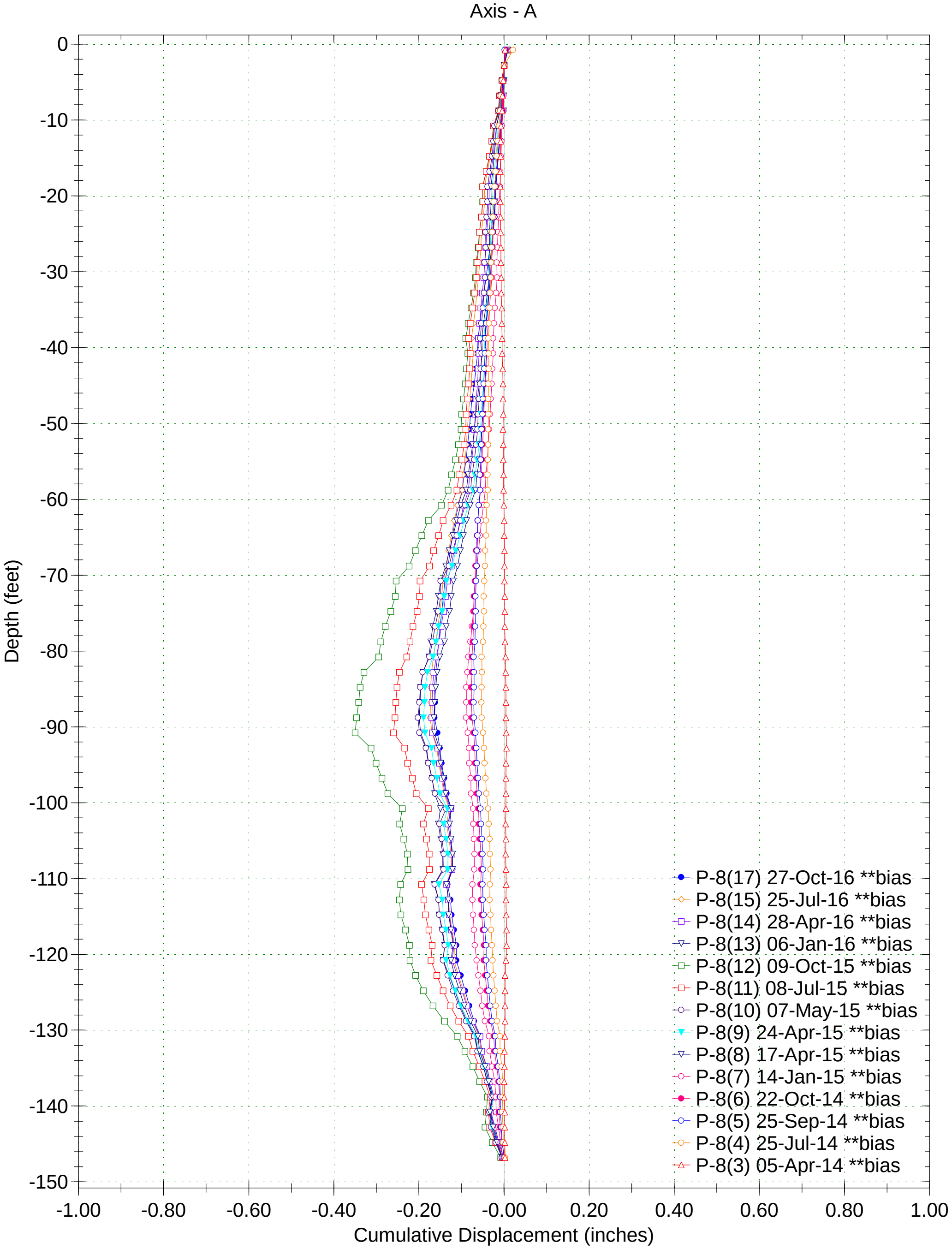


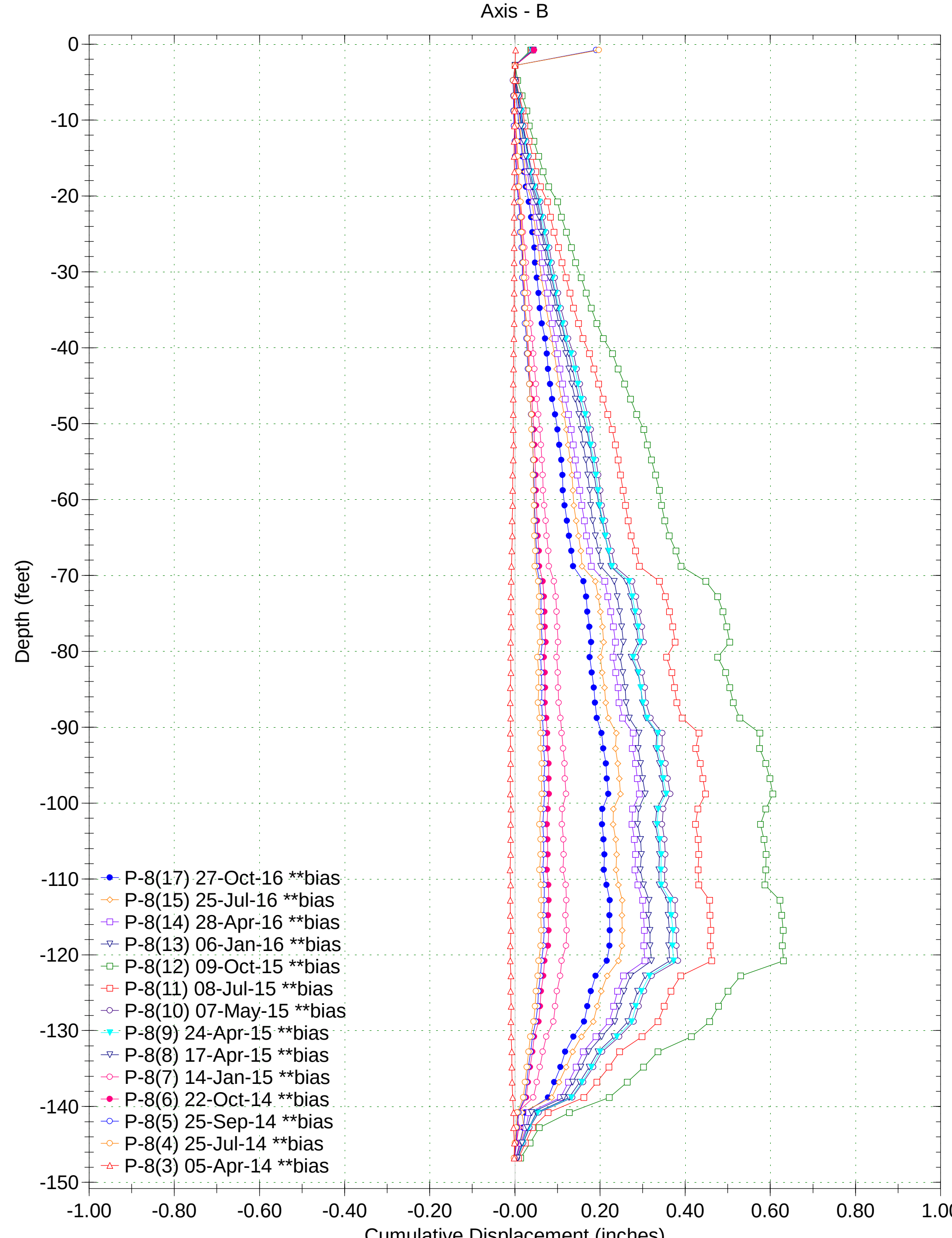


RST Instruments Ltd. | CUMULATIVE DISPLACEMENT | Inclinalysis v. 2.47.5

Borehole : P-8
Project : CUY-90-15-24
Location : Cleveland, Ohio
Northing :
Easting :
Collar :

Spiral Correction : N/A
Collar Elevation : 1.2 feet
Borehole Total Depth : 148.0 feet
A+ Groove Azimuth :
Base Reading : 2014 Jan 16 10:23
Applied Azimuth : 0.0 degrees

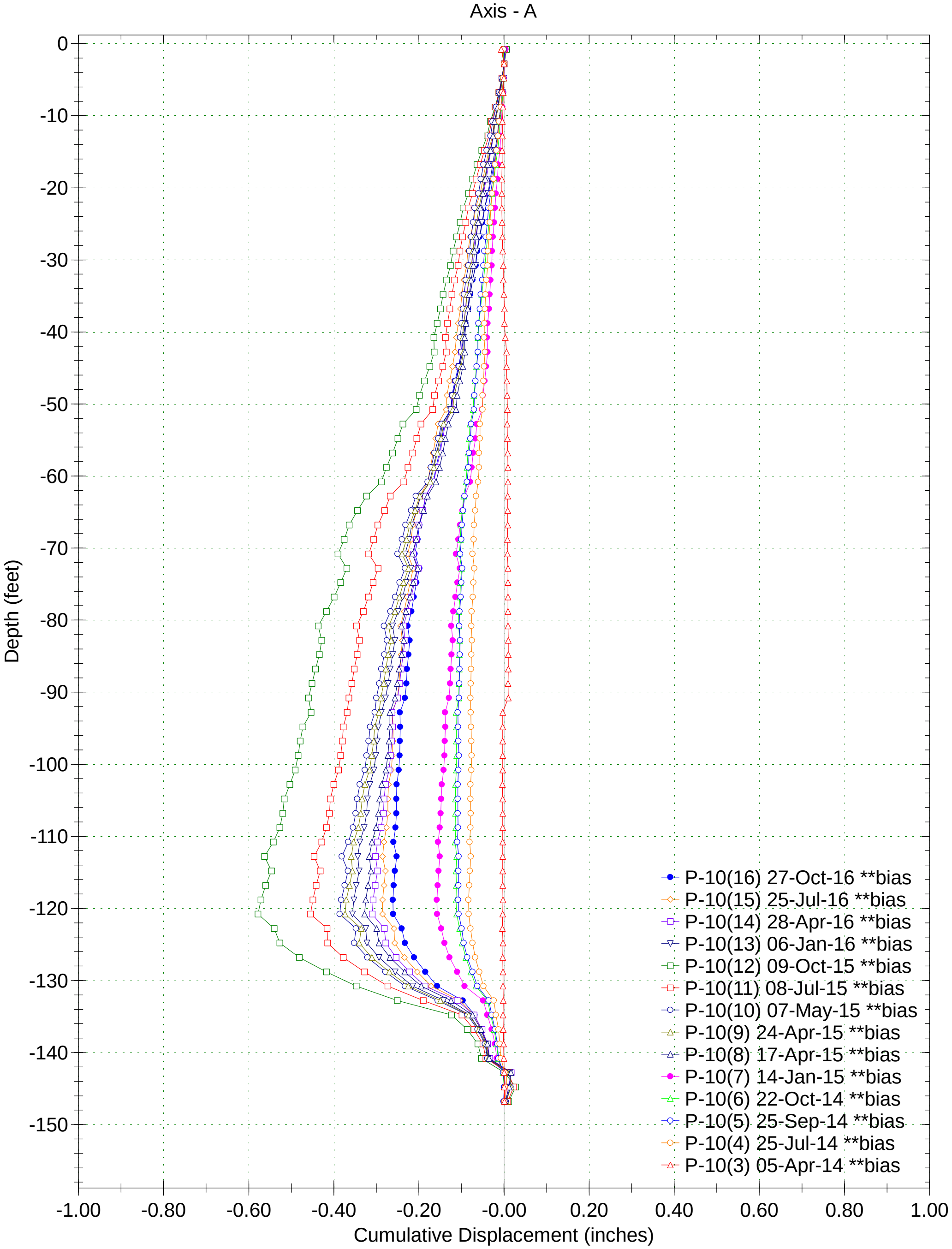


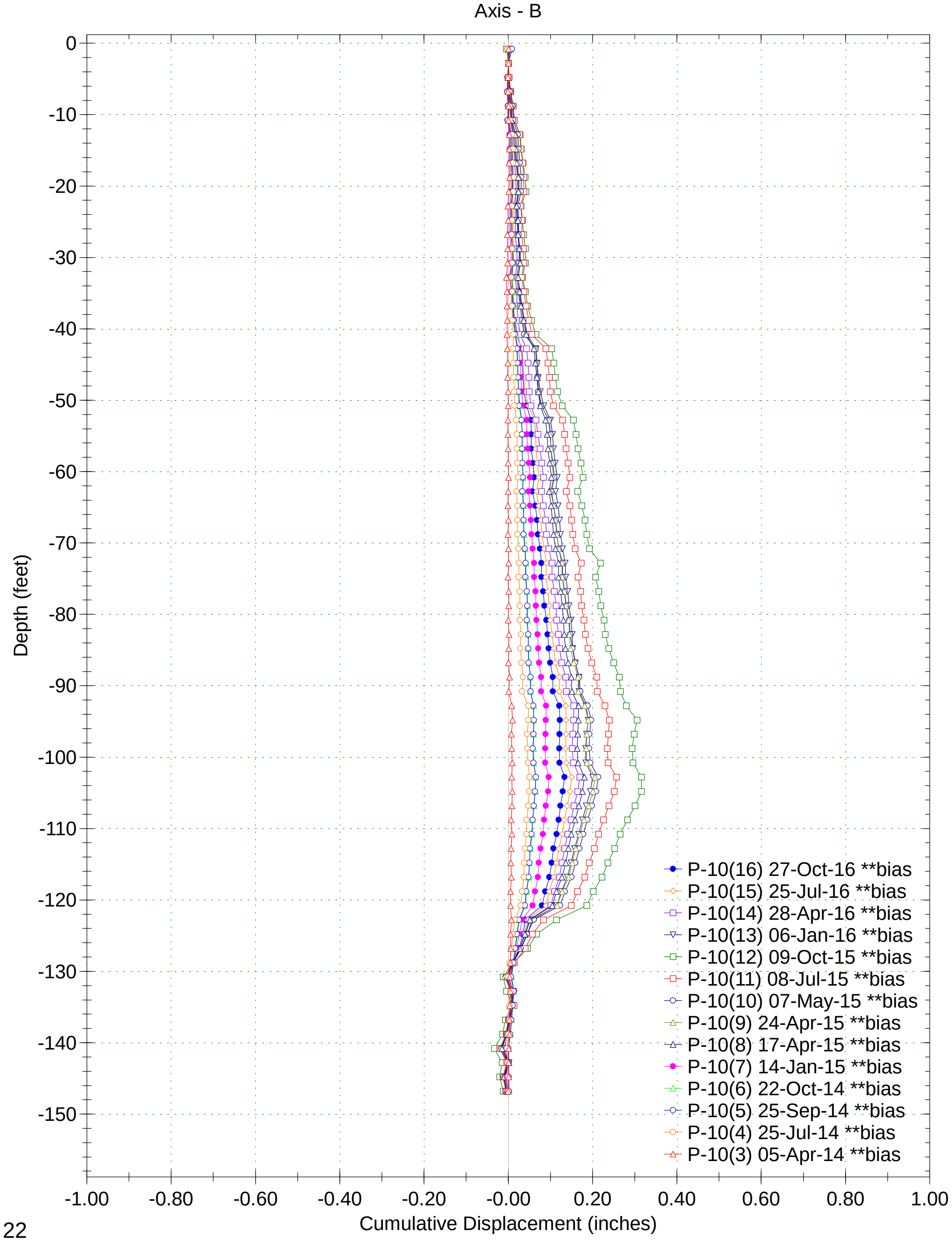


RST Instruments Ltd. CUMULATIVE DISPLACEMENT Inclinalysis v. 2.47.5

Borehole : P-10
Project : CUY-90-15-24
Location : Cleveland, Ohio
Northing :
Easting :
Collar :

Spiral Correction : N/A
Collar Elevation : 1.2 feet
Borehole Total Depth : 148.0 feet
A+ Groove Azimuth :
Base Reading : 2014 Jan 16 06:45
Applied Azimuth : 0.0 degrees





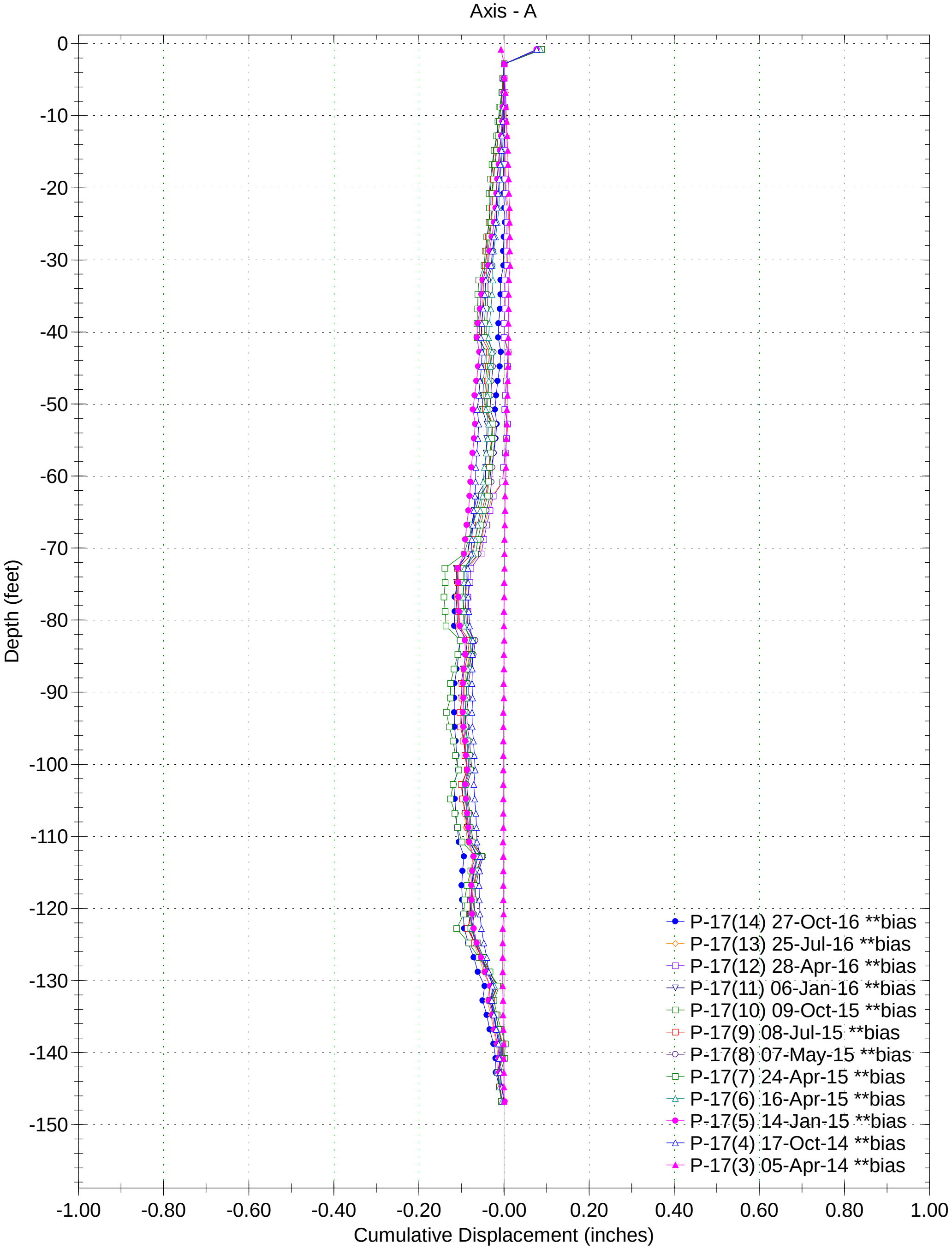
RST Instruments Ltd.

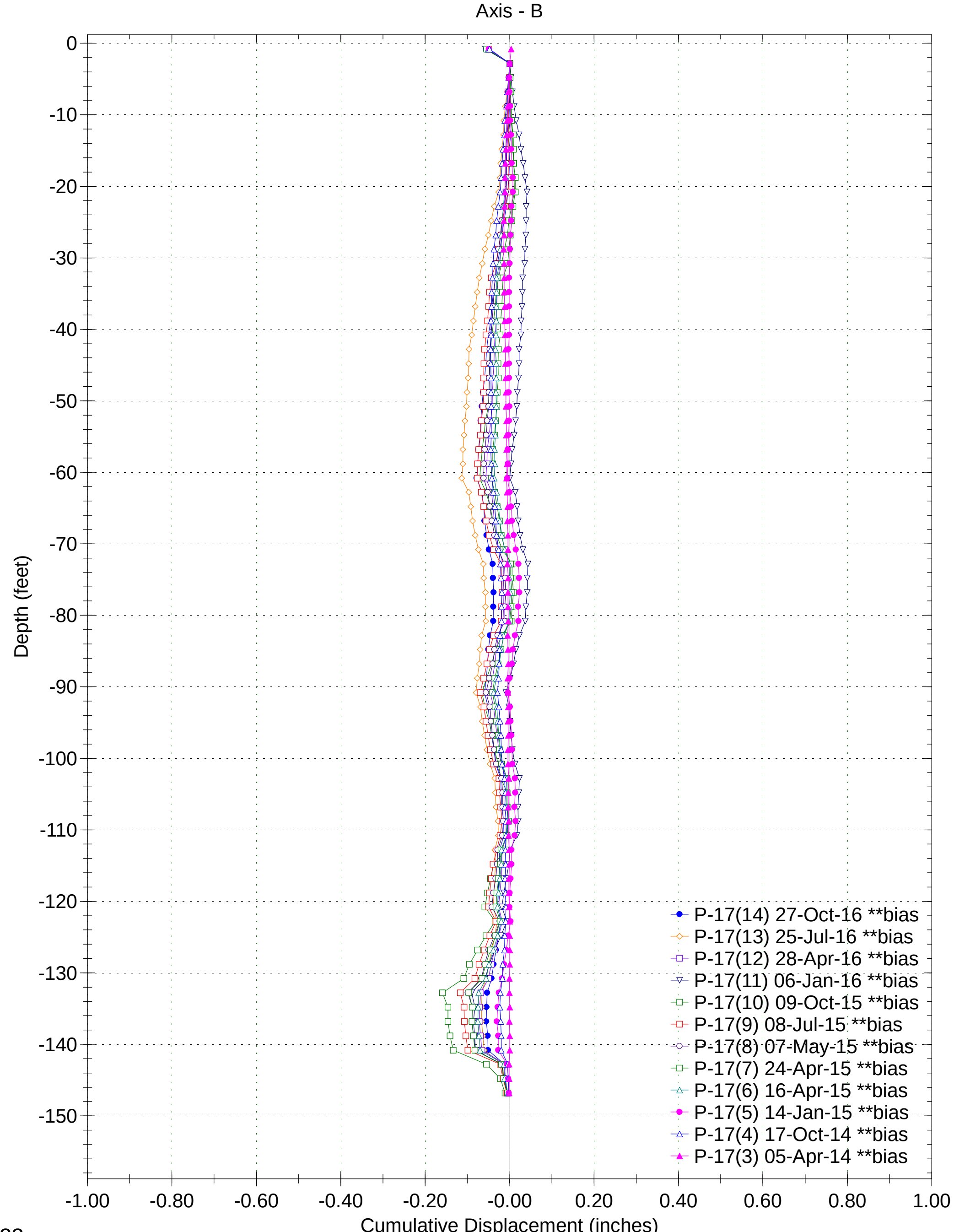
CUMULATIVE DISPLACEMENT

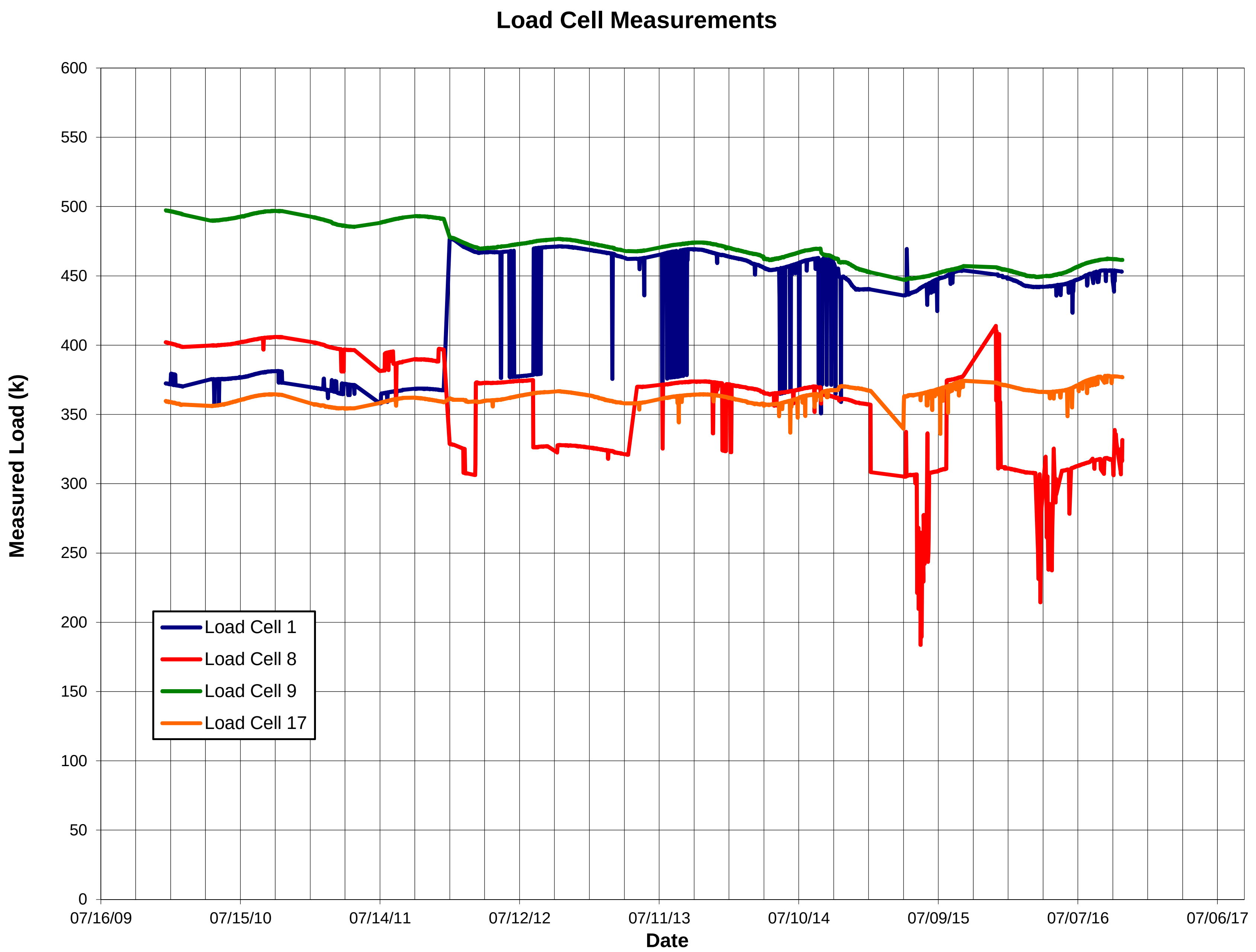
Inclinalysis v. 2.47.5

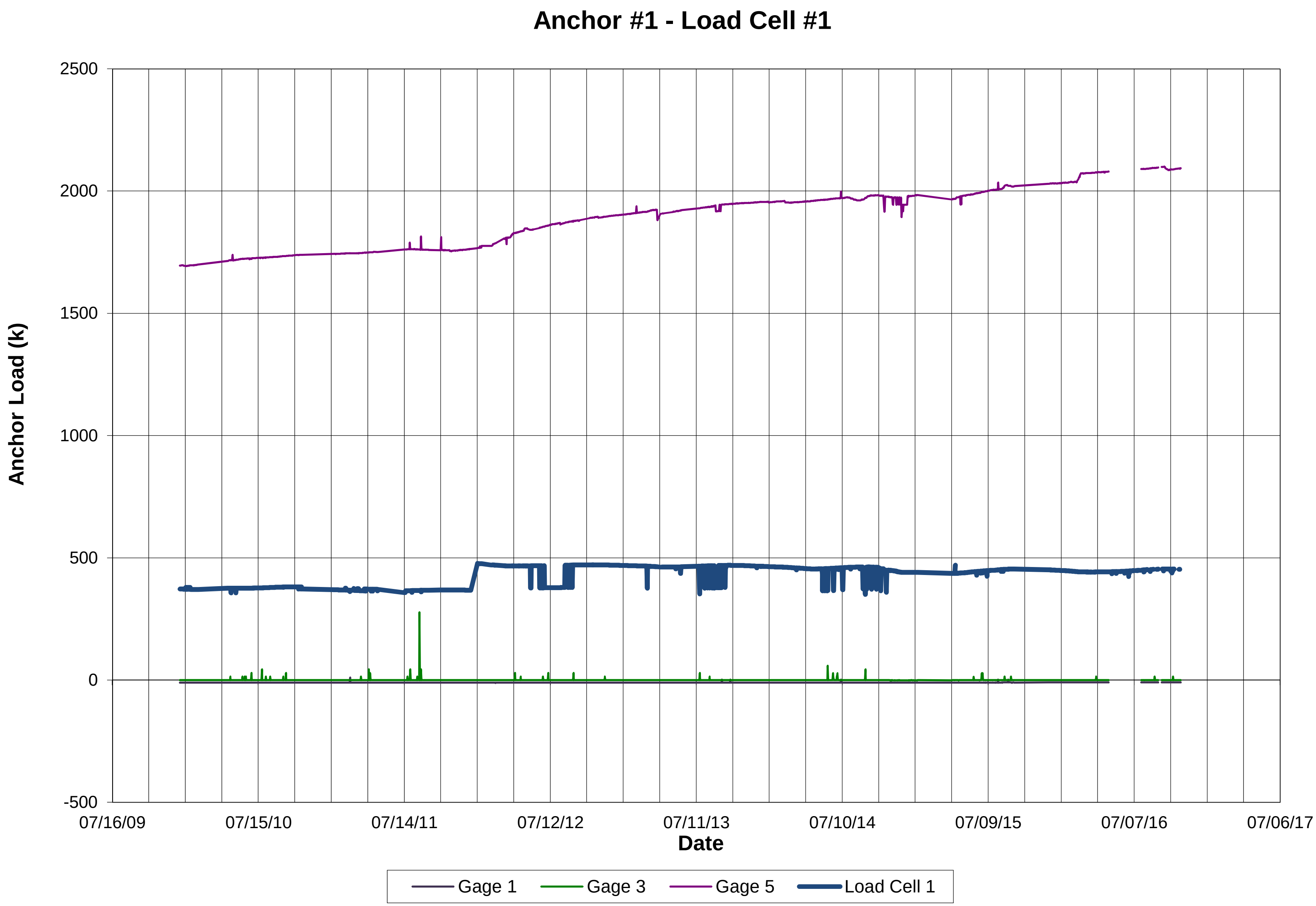
Borehole : P-17
Project : CUY-90-15-24
Location : Cleveland, Ohio
Northing :
Easting :
Collar :

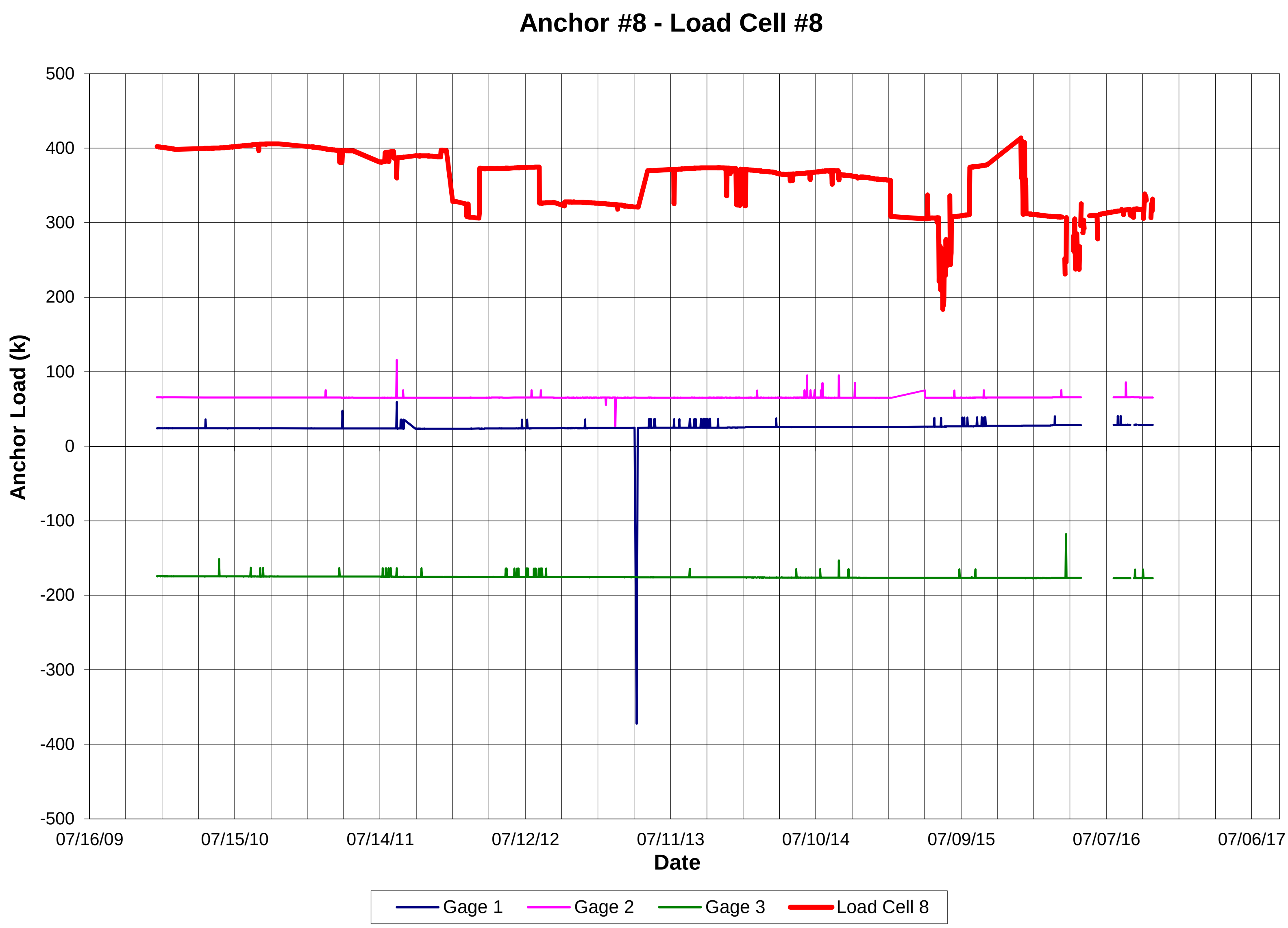
Spiral Correction : N/A
Collar Elevation : 1.2 feet
Borehole Total Depth : 148.0 feet
A+ Groove Azimuth :
Base Reading : 2014 Jan 15 12:02
Applied Azimuth : 0.0 degrees

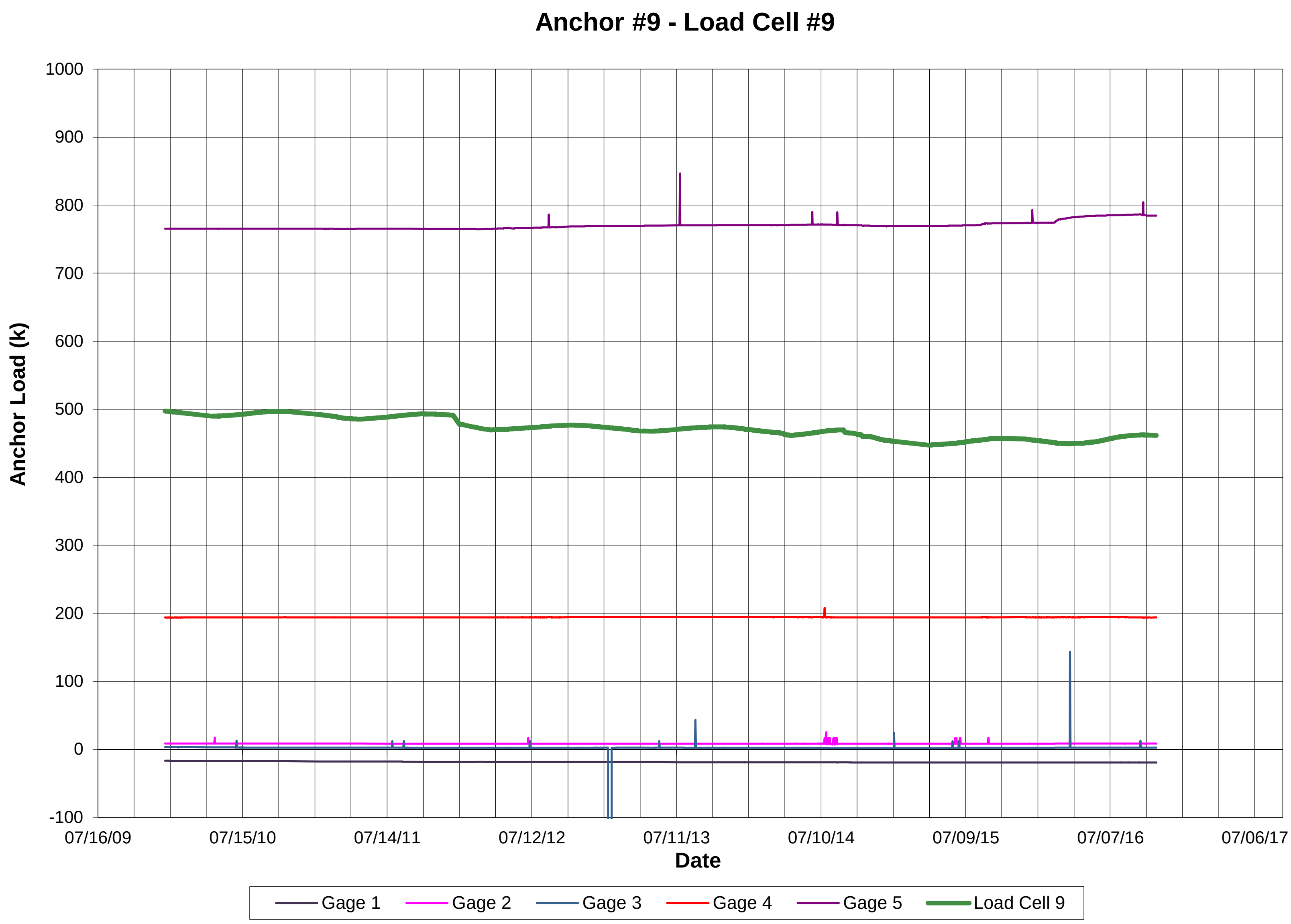


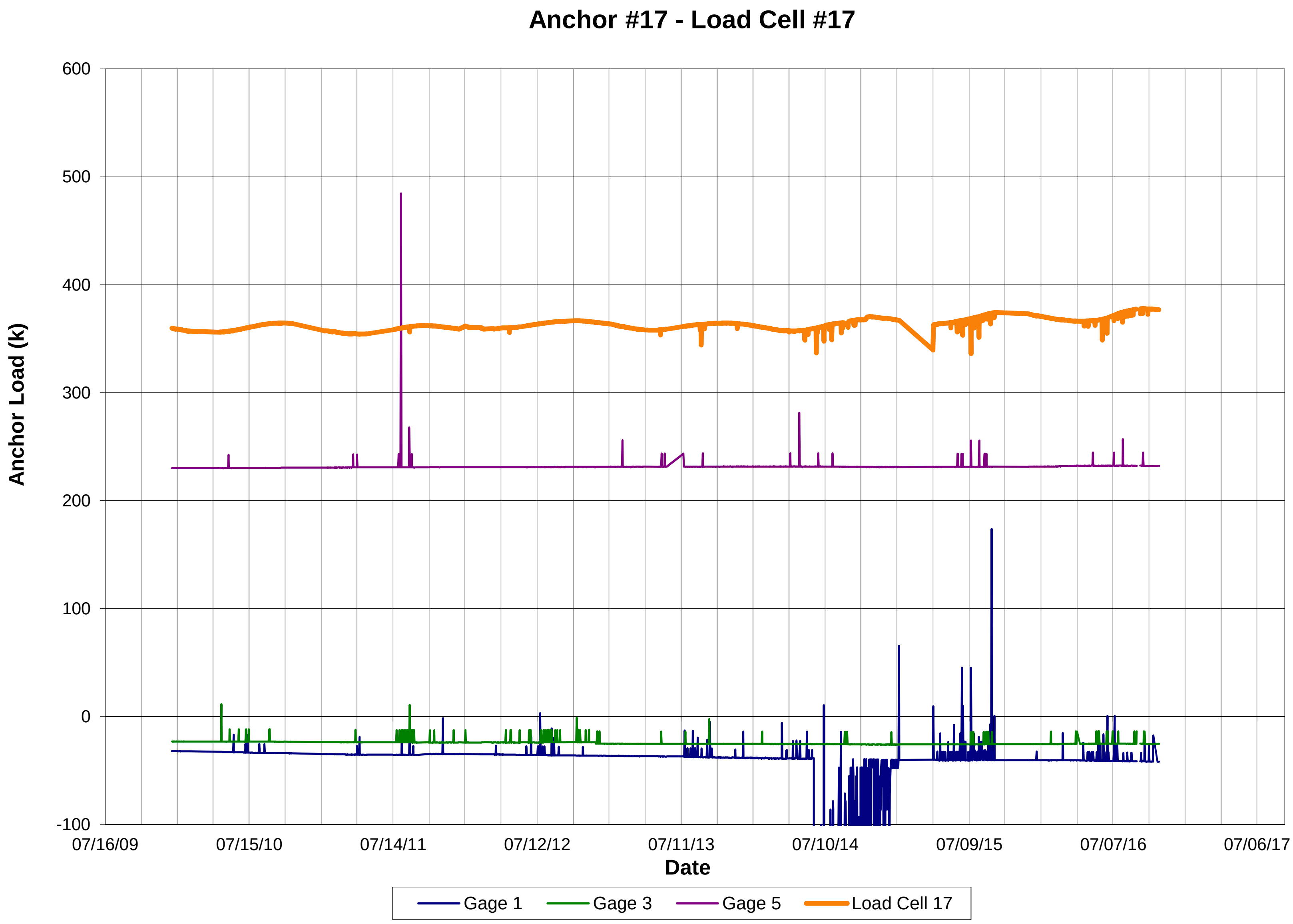



Load Cell Measurements
Measured Load (k)
600
550
500
450
400
350
300
250
200
150
100
50
0
07/16/09
07/15/10
07/14/11
07/12/12
07/11/13
07/10/14
07/09/15
07/07/16
07/06/17
Date
Load Cell 1
Load Cell 8
Load Cell 9
Load Cell 17


Anchor #1 - Load Cell #1
Anchor Load (k)
2500
2000
1500
1000
500
0
-500
07/16/09
07/15/10
07/14/11
07/12/12
07/11/13
07/10/14
07/09/15
07/07/16
07/06/17
Date
Gage 1
Gage 3
Gage 5
Load Cell 1

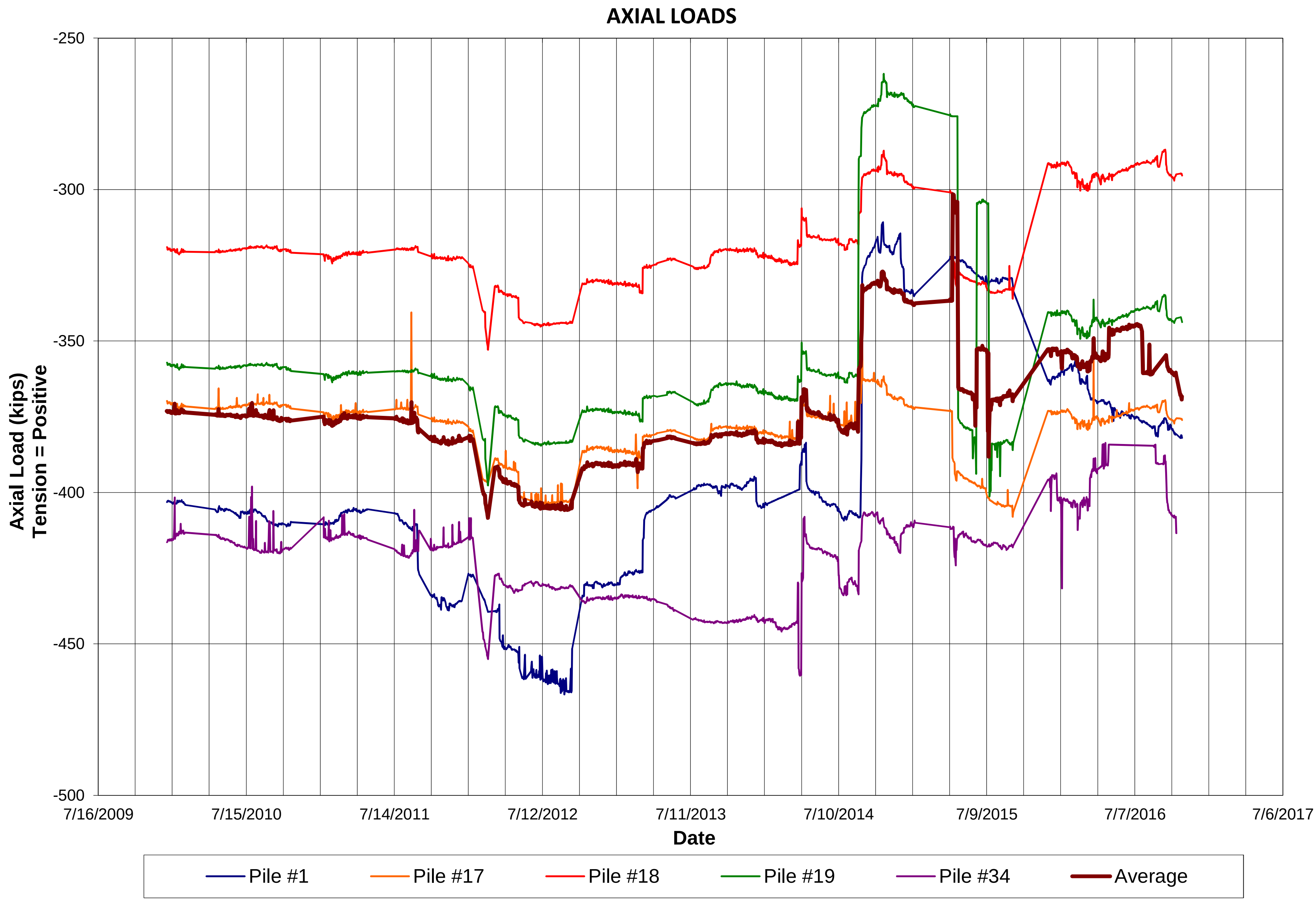

Anchor #8 - Load Cell #8
Anchor Load (k)
500
400
300
200
100
0
-100
-200
-300
-400
-500
07/16/09
07/15/10
07/14/11
07/12/12
07/11/13
07/10/14
07/09/15
07/07/16
07/06/17
Date
Gage 1
Gage 2
Gage 3
Load Cell 8


Anchor #9 - Load Cell #9
Anchor Load (k)
1000
900
800
700
600
500
400
300
200
100
0
-100
07/16/09
07/15/10
07/14/11
07/12/12
07/11/13
07/10/14
07/09/15
07/07/16
07/06/17
Date
Gage 1
Gage 2
Gage 3
Gage 4
Gage 5
Load Cell 9



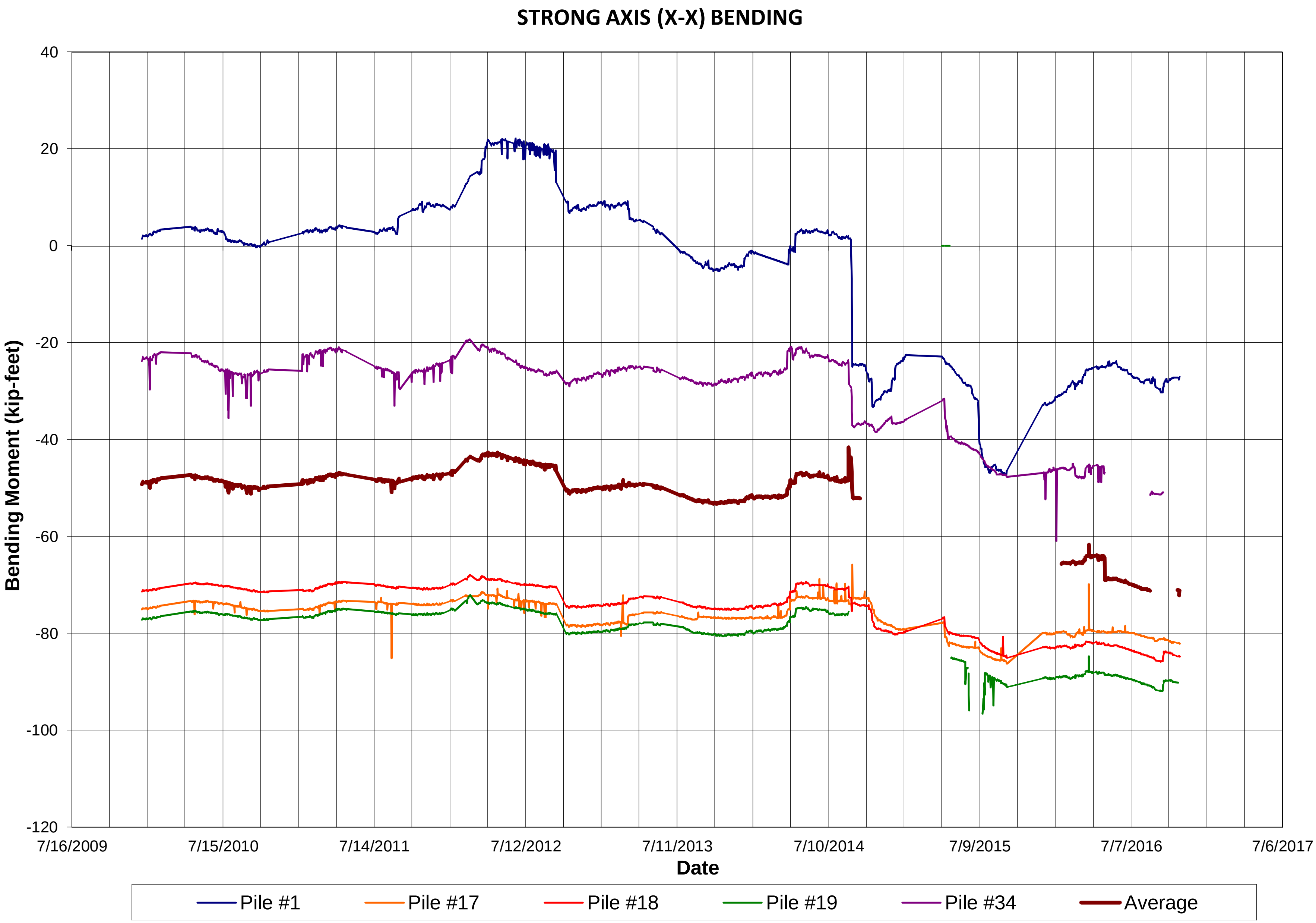
Anchor #17 - Load Cell #17
Anchor Load (k)
600
500
400
300
200
100
0
-100
07/16/09
07/15/10
07/14/11
07/12/12
07/11/13
07/10/14
07/09/15
07/07/16
07/06/17
Date
Gage 1
Gage 3
Gage 5
Load Cell 17

CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00



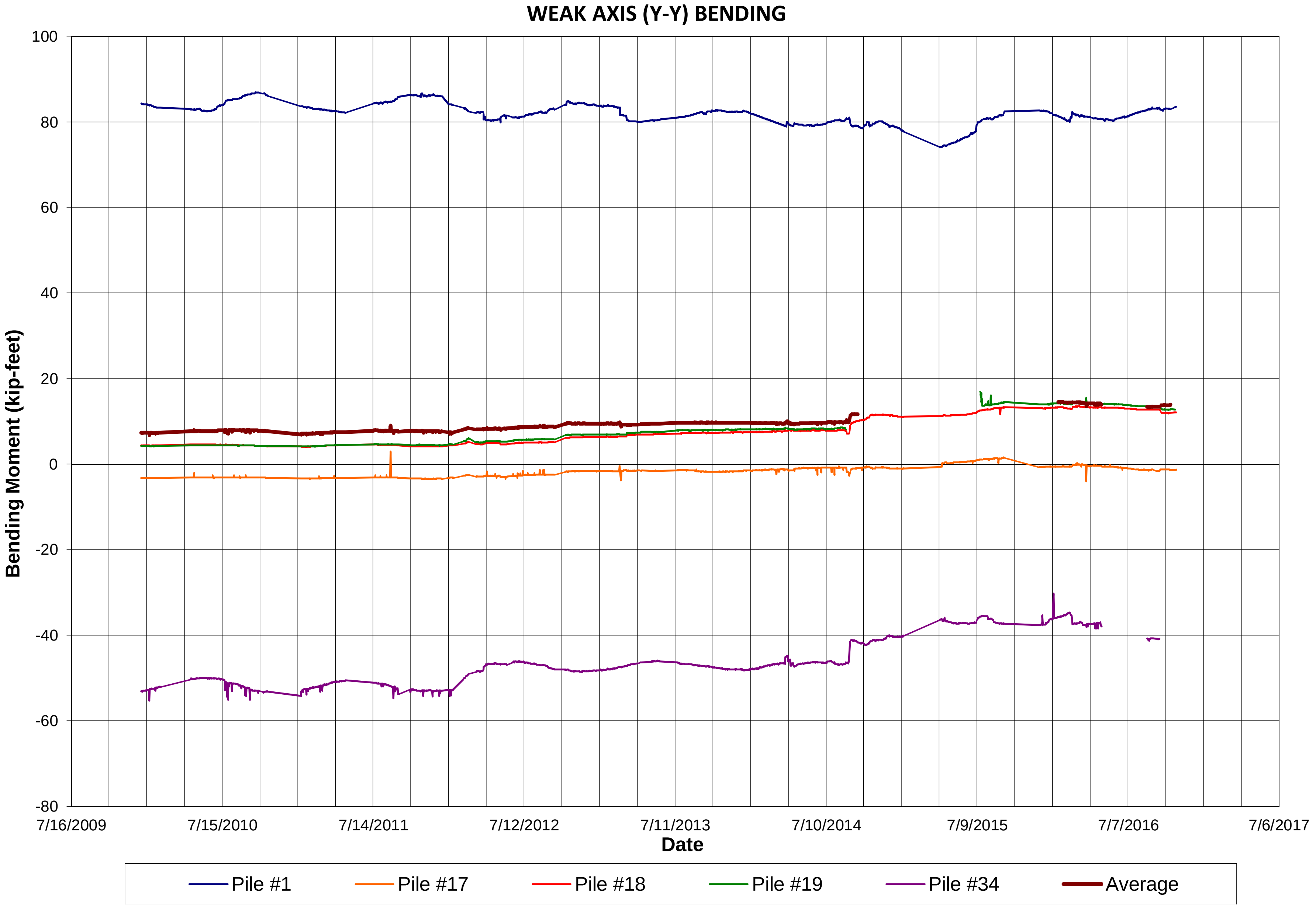
Driven Piles

CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00



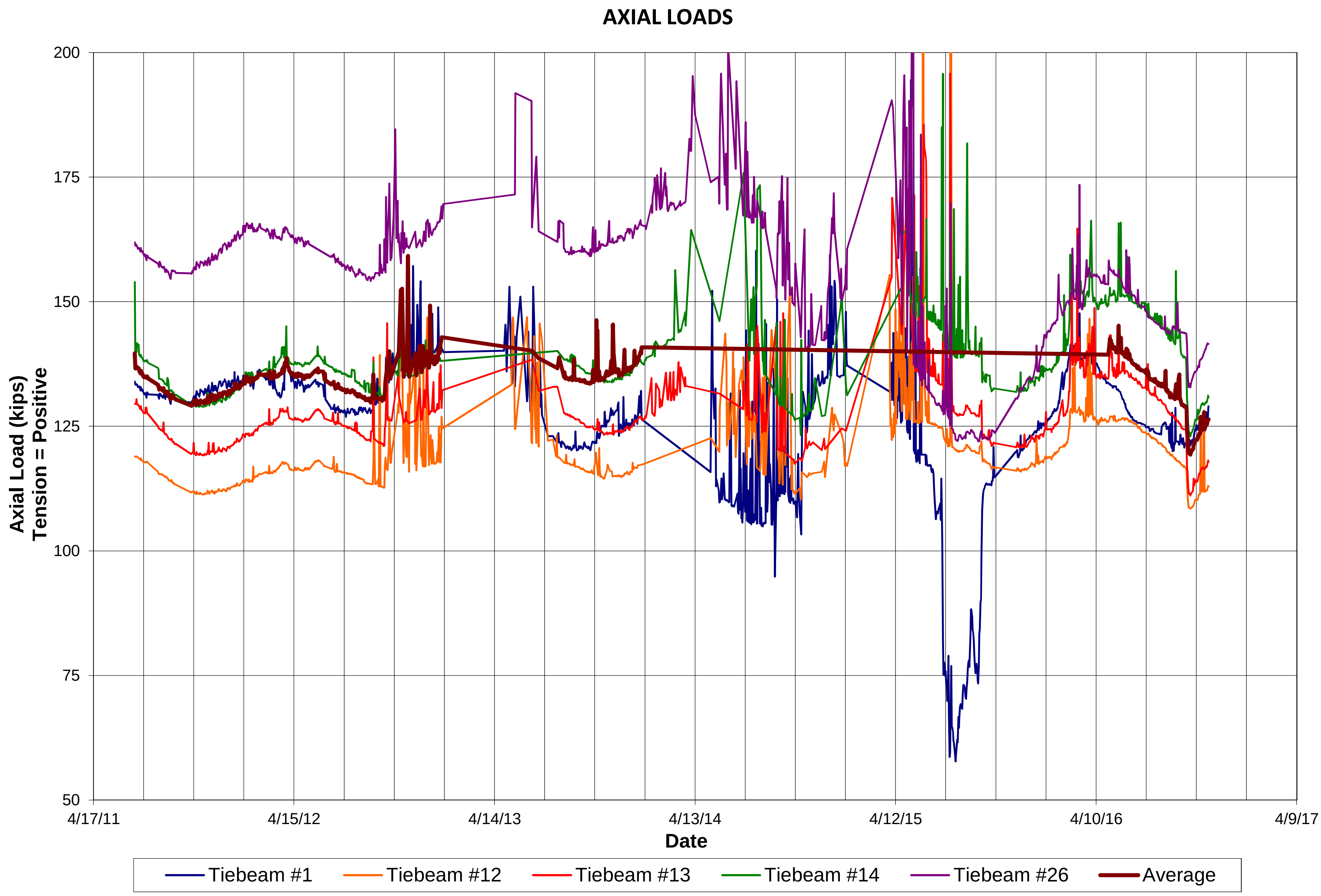
Driven Piles

CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00



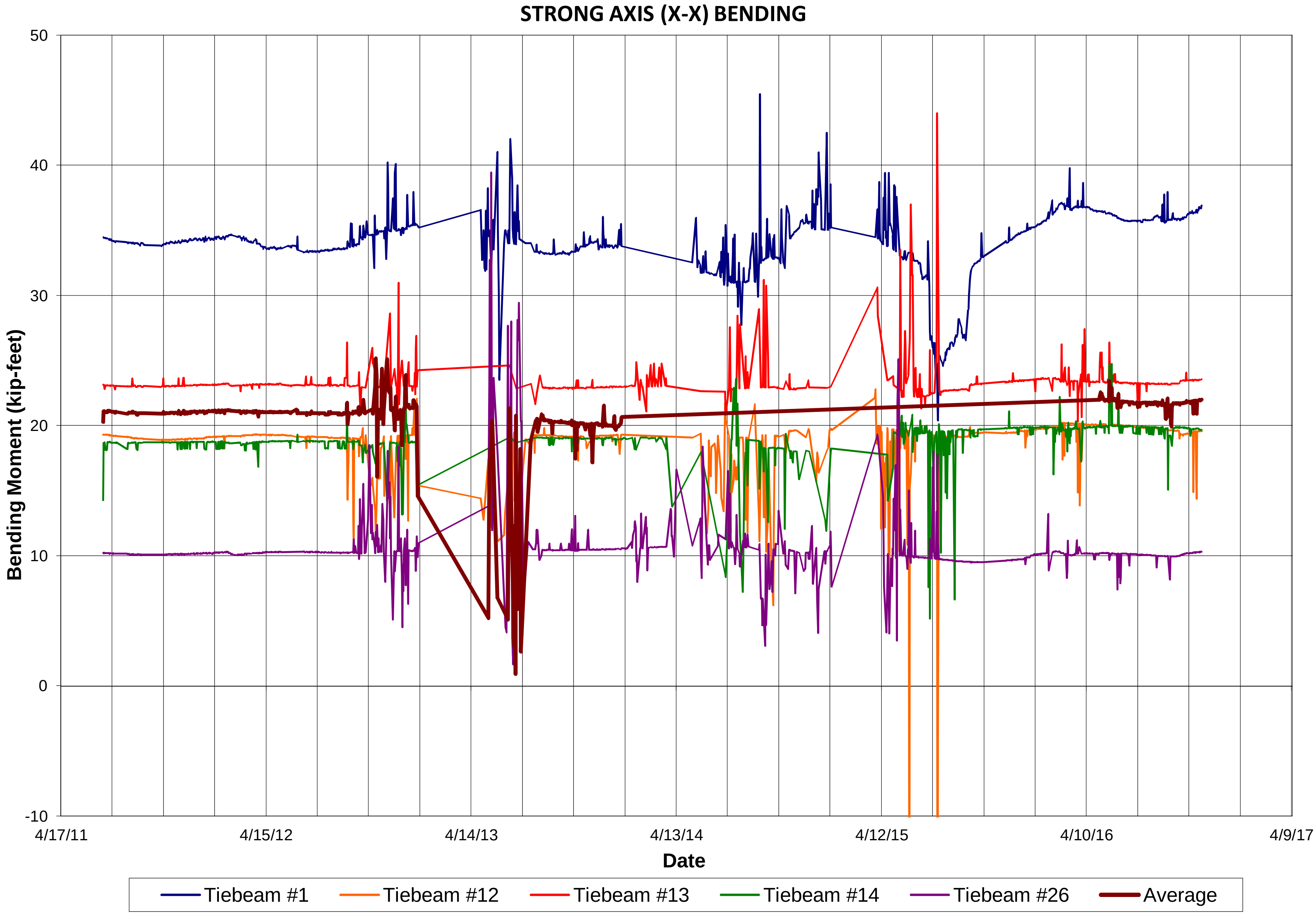
Driven Piles

CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00



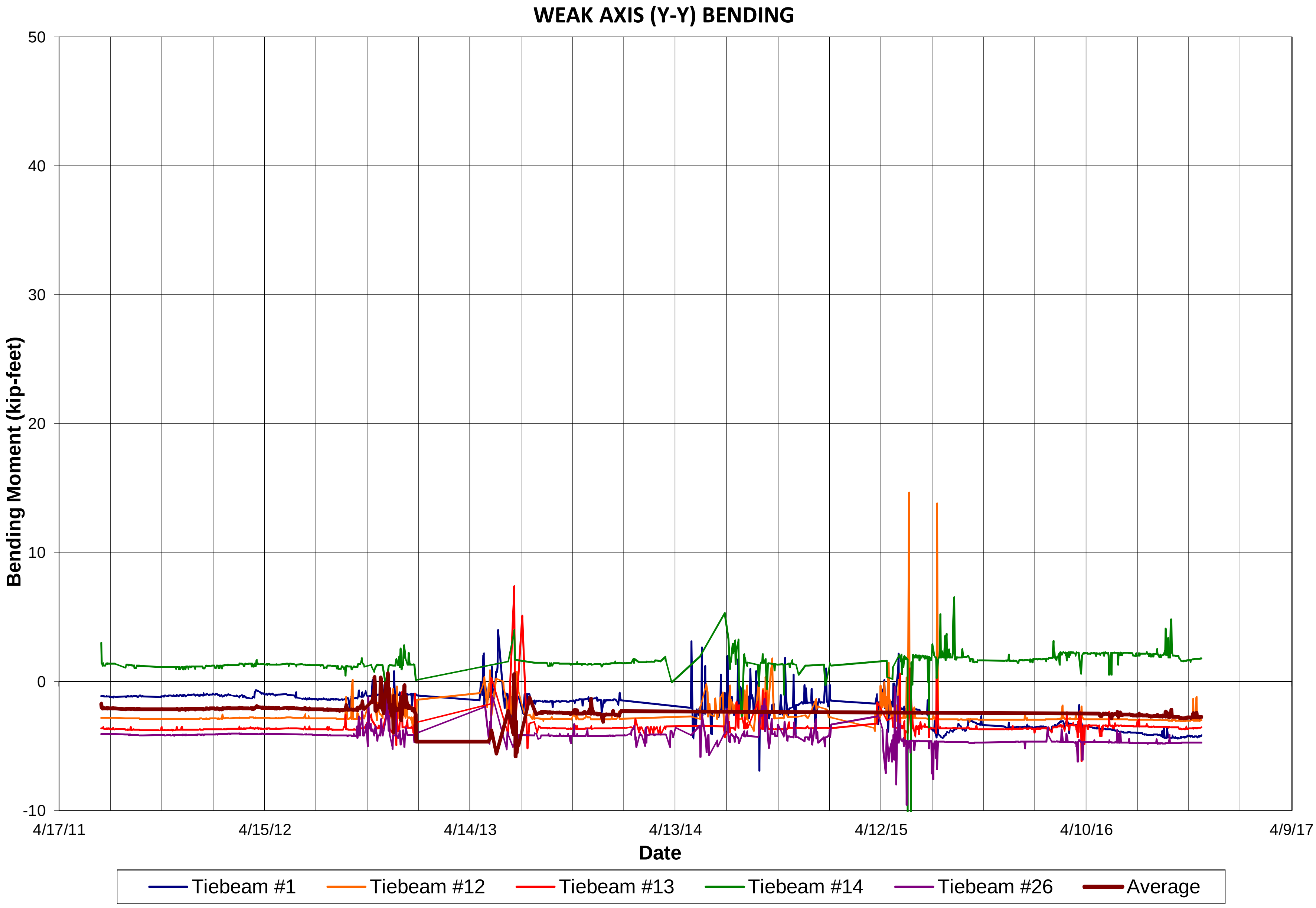
Tiebeams - Anchor Side

CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00



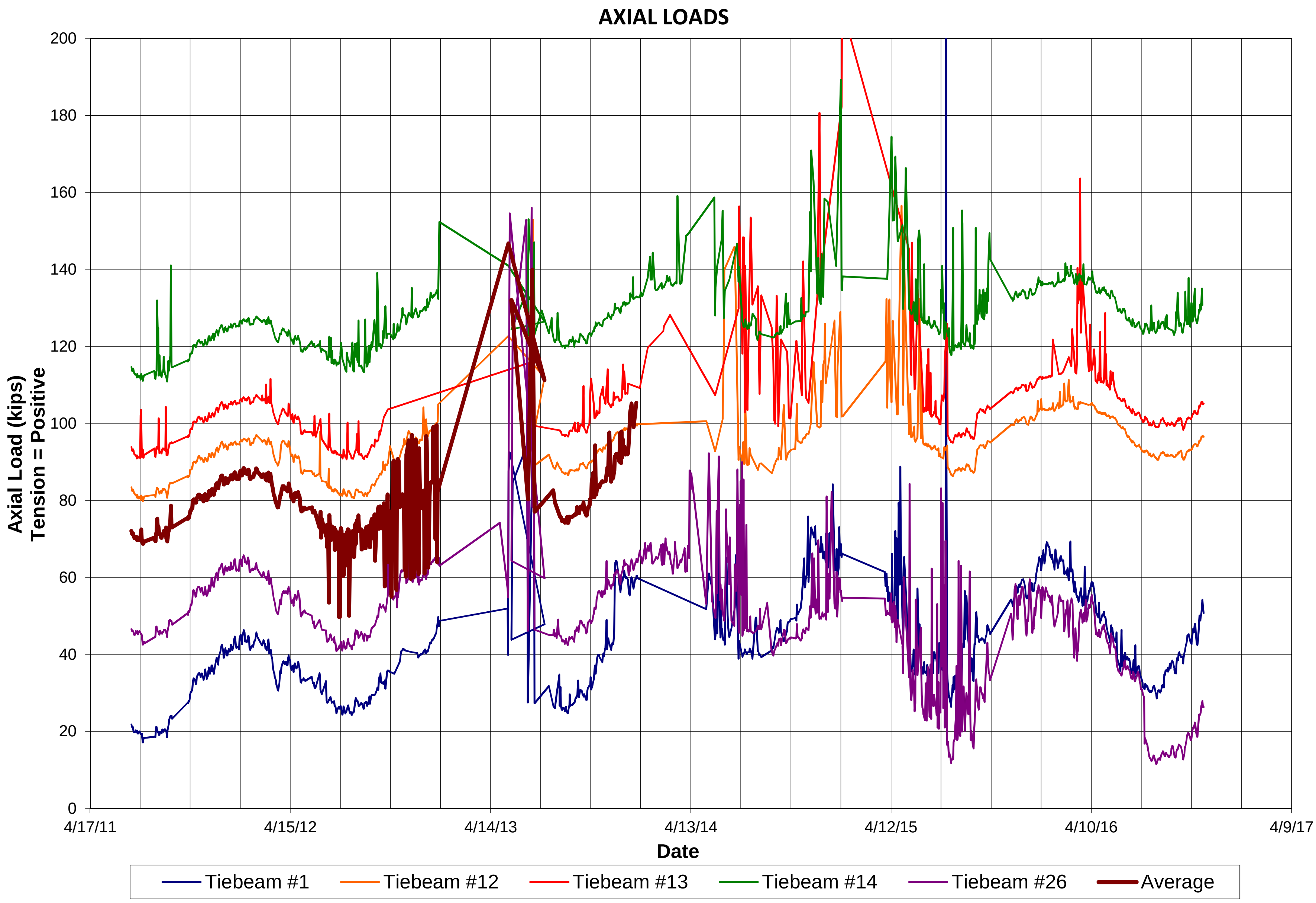
Tiebeams - Anchor Side

CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00



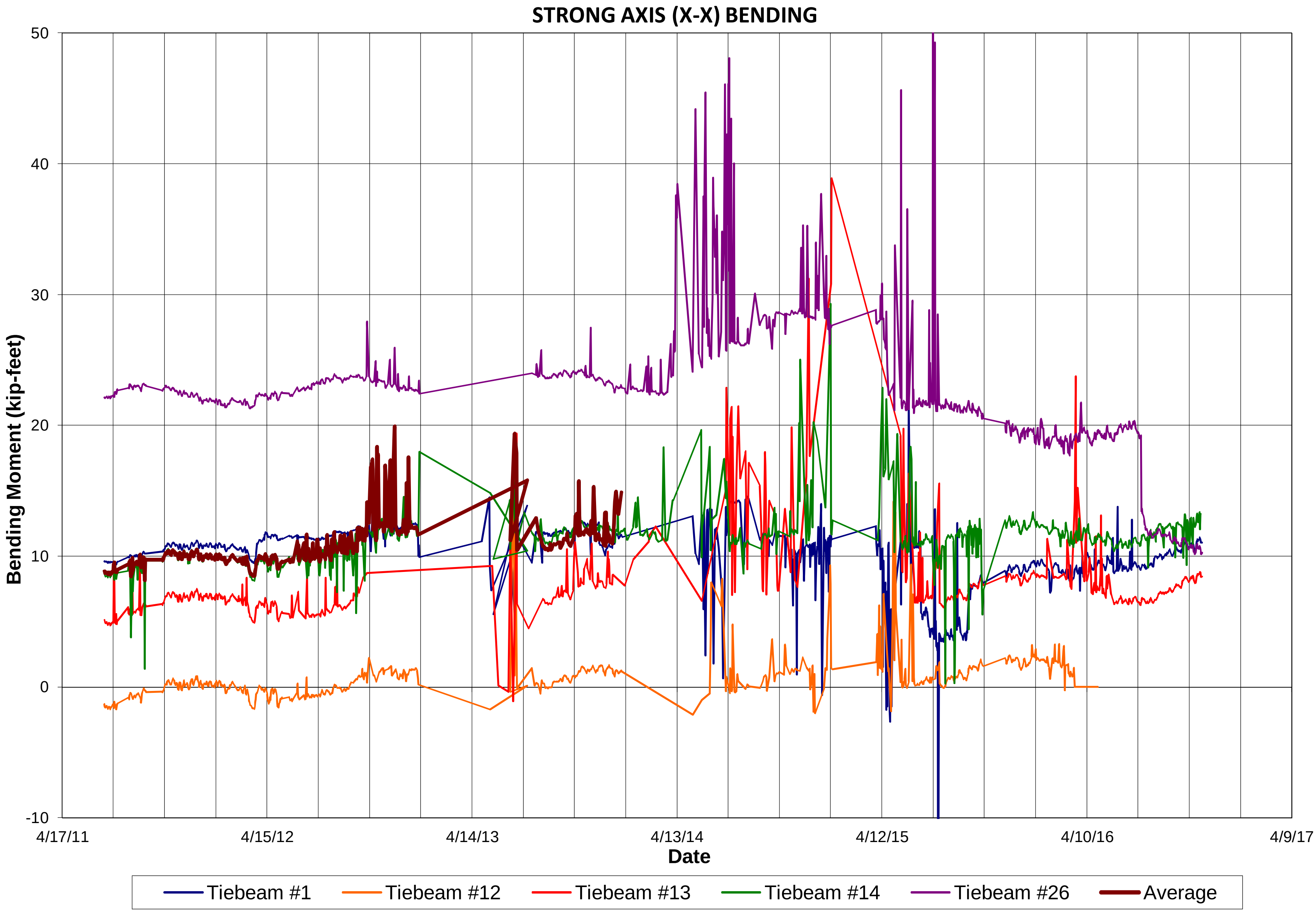
Tiebeams - Anchor Side

CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00



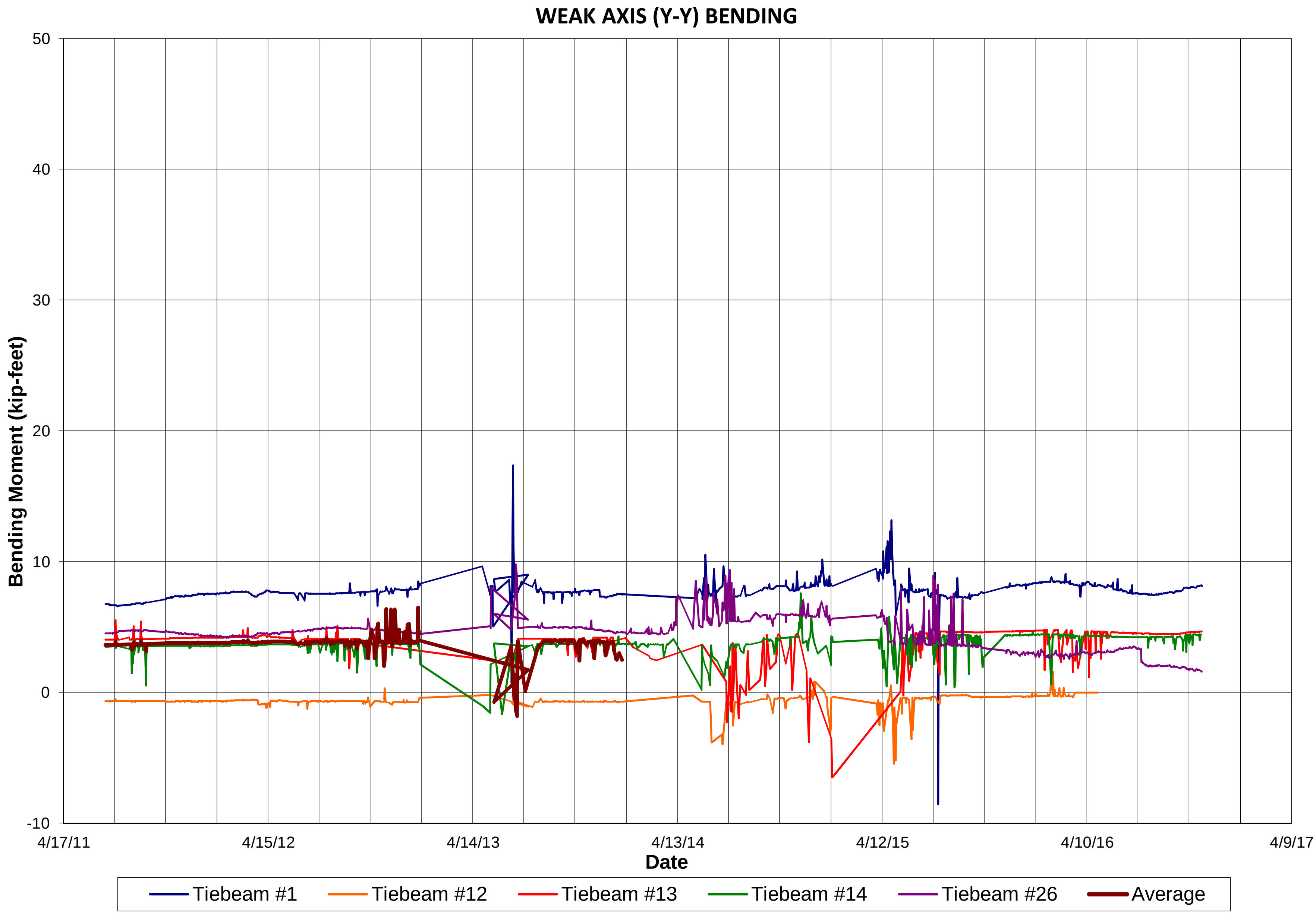
Tiebeams - Drilled Pier Side

CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00



Tiebeams - Drilled Pier Side

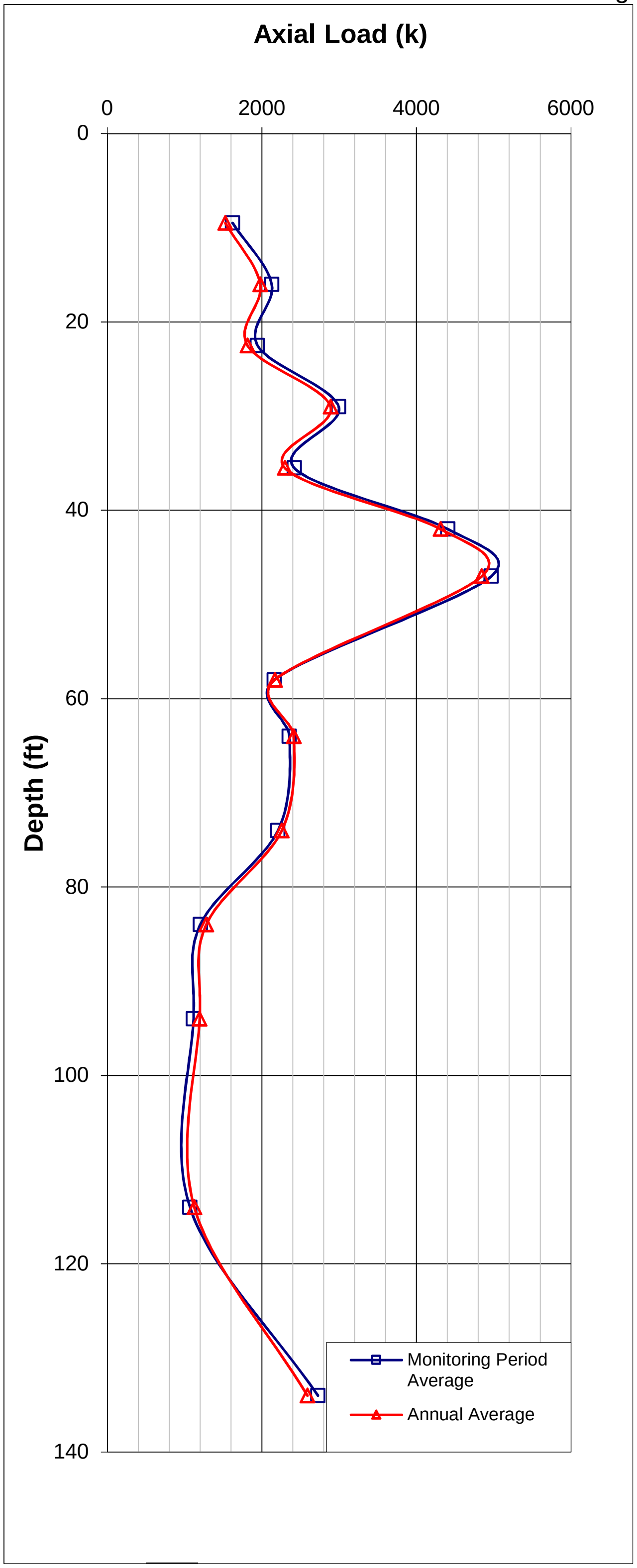
CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 96504
SME#: 069032.00

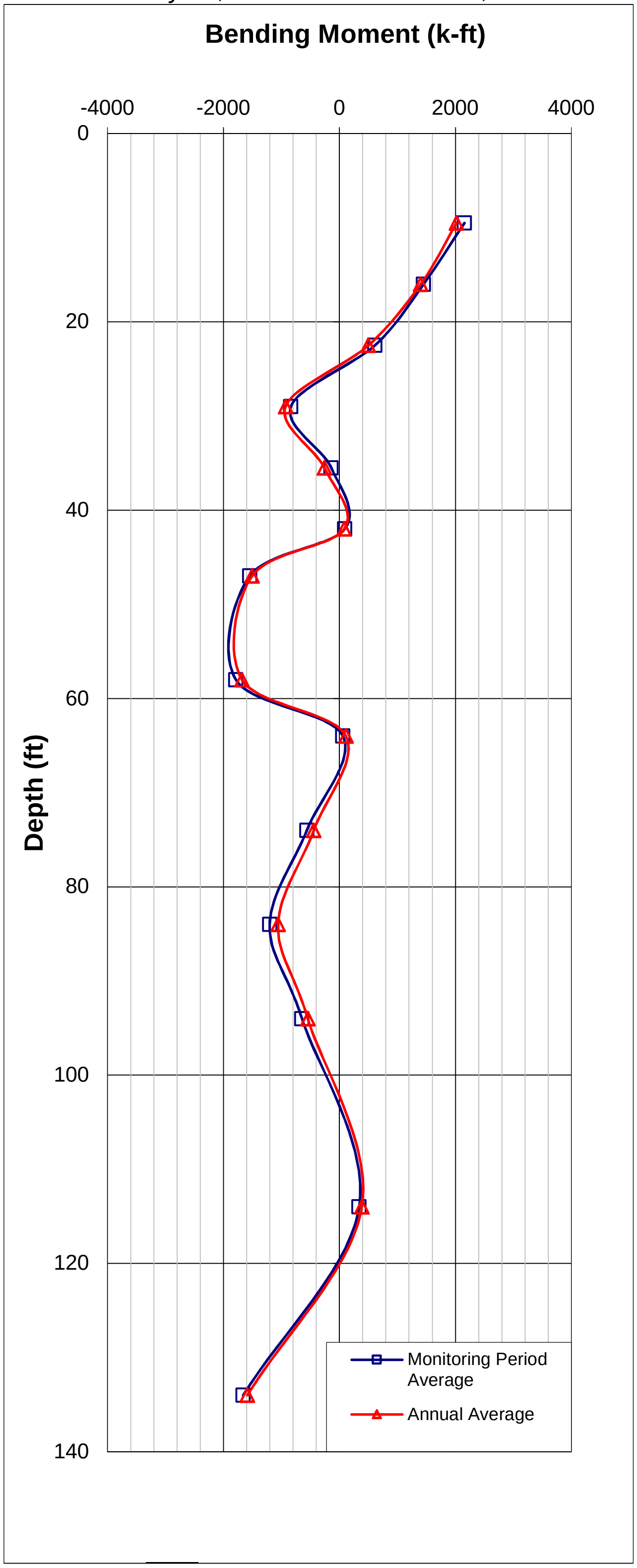


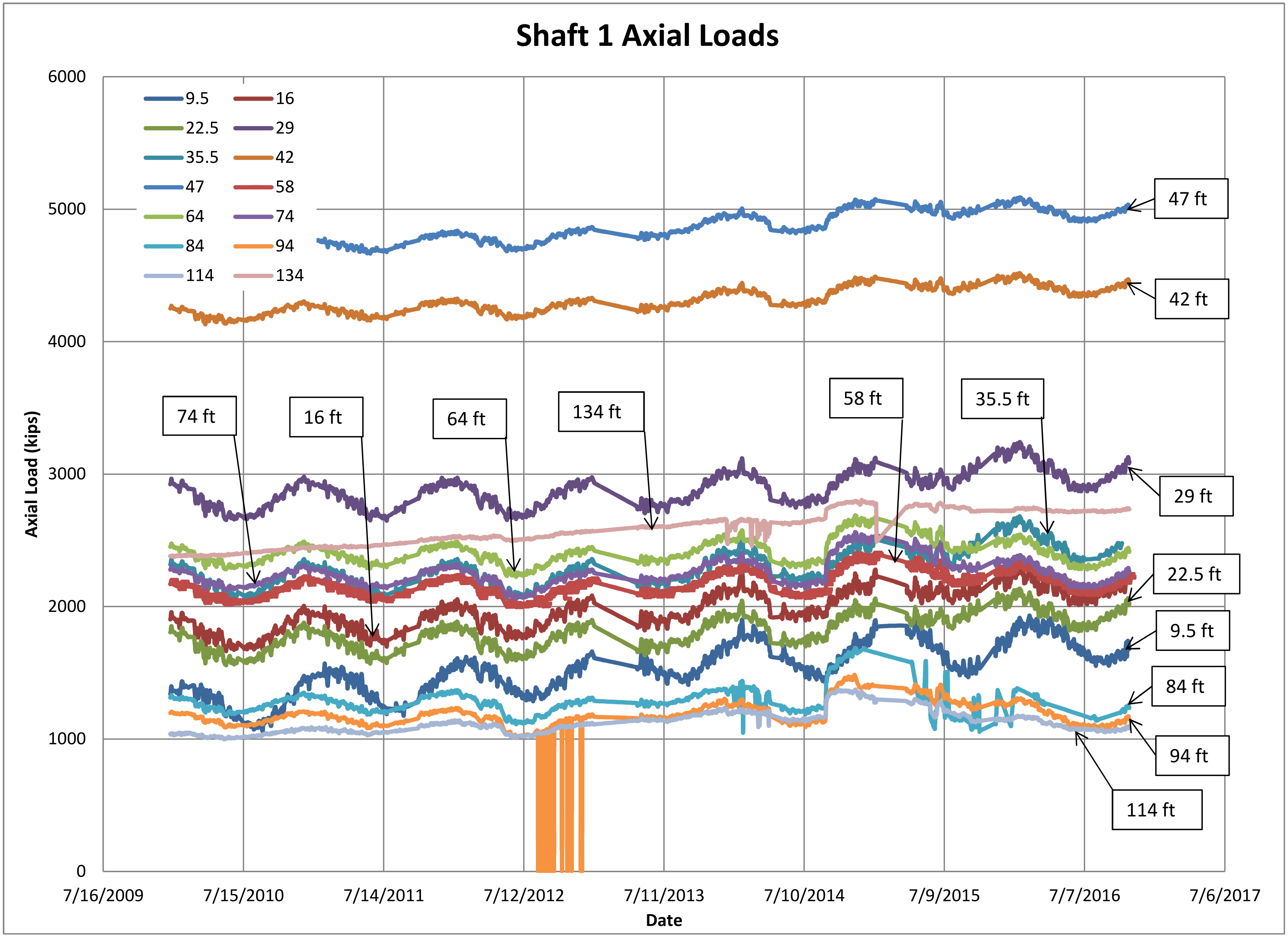
Tiebeams - Drilled Pier Side

CUY-90-15.24 Slope Monitoring
PID 96504
Cleveland, Ohio
SME#: 069032.00

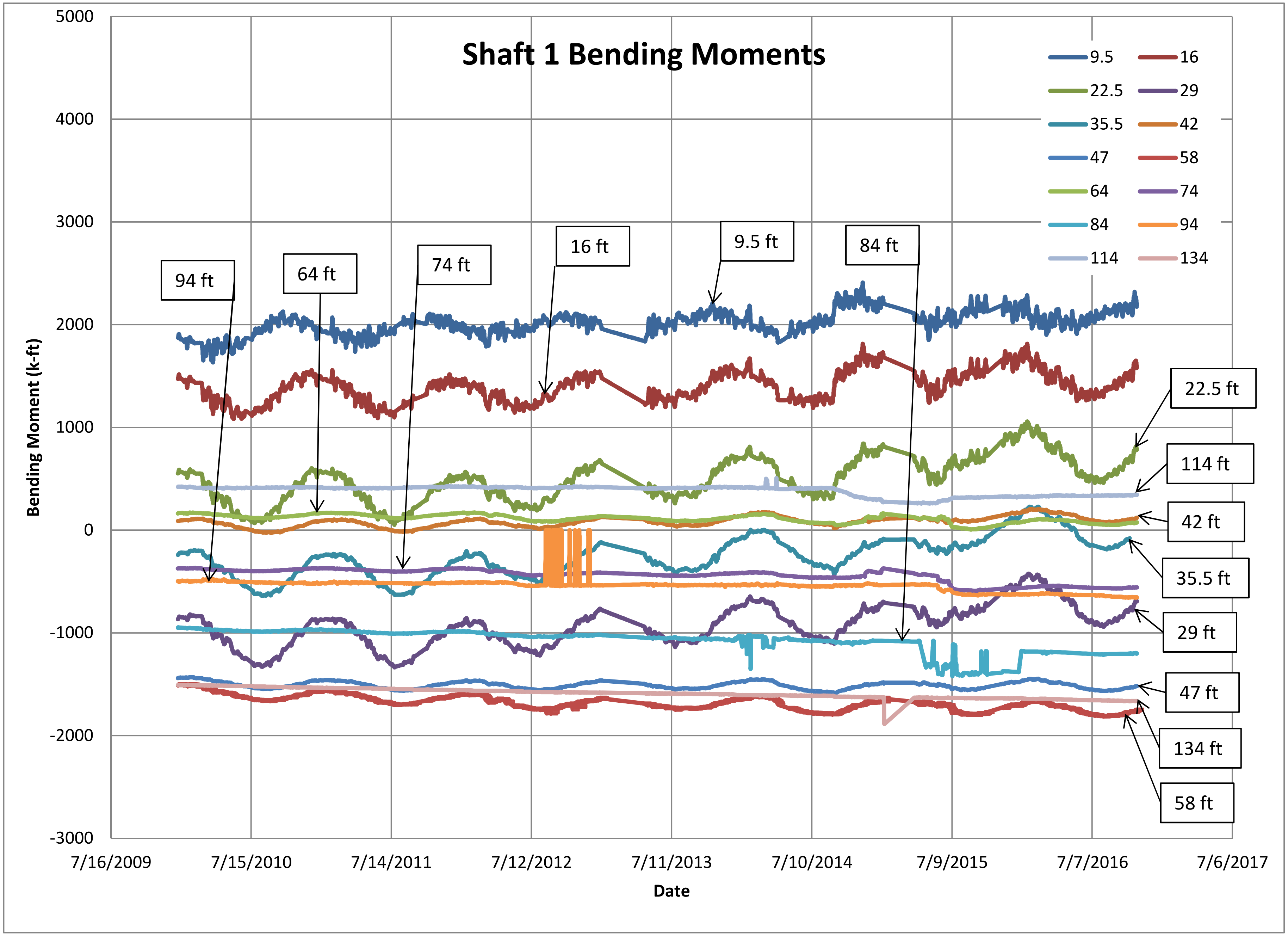
Drilled Shaft #1
(Weak Axis Bending)
Average for Period: July 31, 2016 thru October 31, 2016







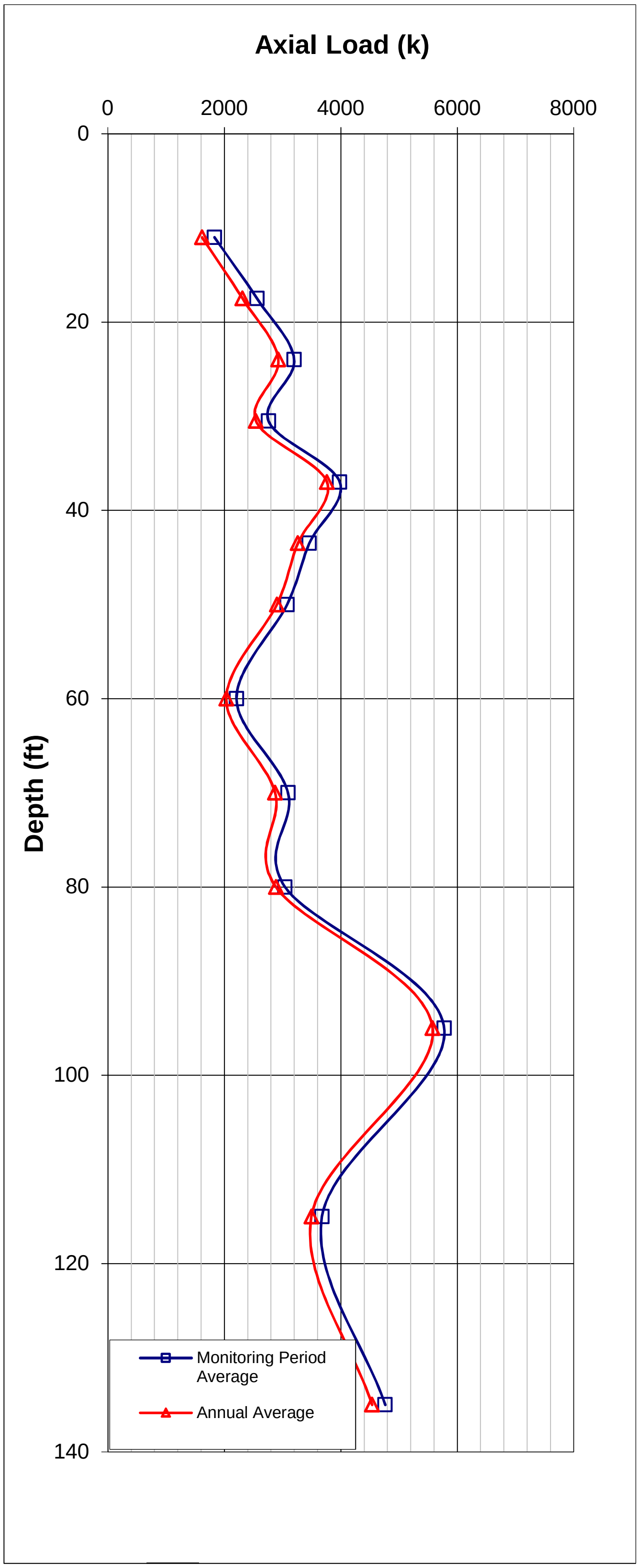
Shaft 1 Axial Loads
6000
5000
4000
3000
2000
1000
0
Axial Load (kips)
9.5
16
22.5
29
35.5
42
47
58
64
74
84
94
114
134
47 ft
42 ft
74 ft
16 ft
64 ft
134 ft
58 ft
35.5 ft
29 ft
22.5 ft
9.5 ft
84 ft
94 ft
114 ft
7/16/2009
7/15/2010
7/14/2011
7/12/2012
7/11/2013
7/10/2014
7/9/2015
7/7/2016
7/6/2017
Date

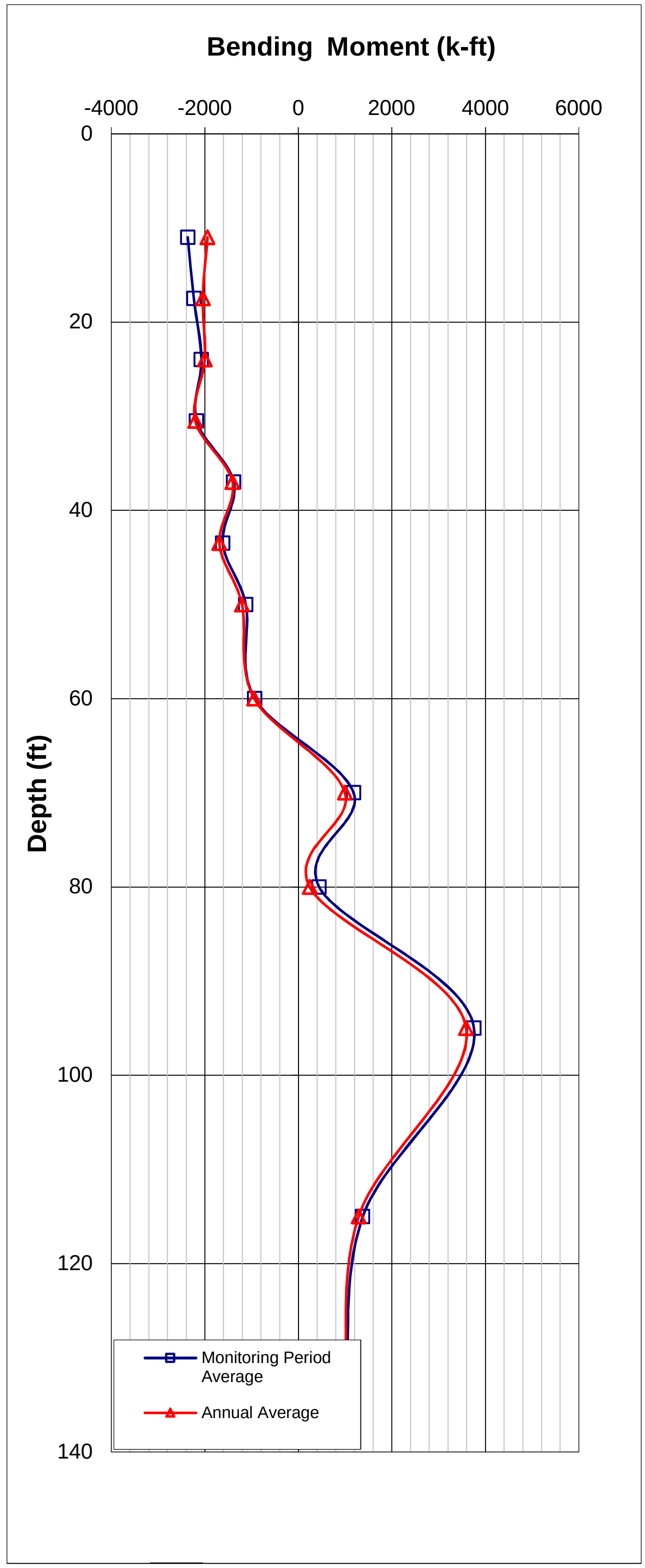


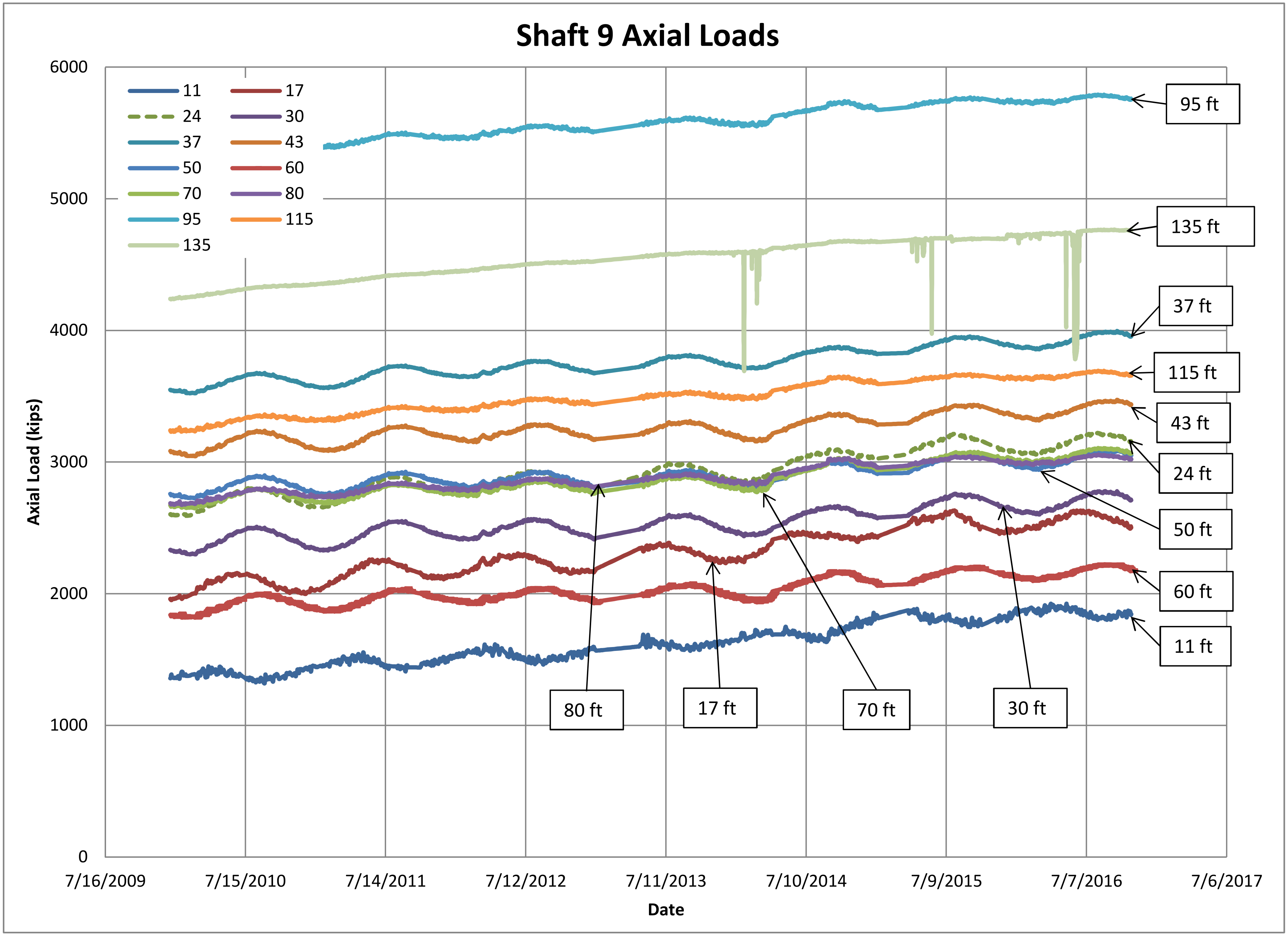
Shaft 1 Bending Moments
Bending Moment (k-ft)
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
7/16/2009
7/15/2010
7/14/2011
7/12/2012
7/11/2013
7/10/2014
7/9/2015
7/7/2016
7/6/2017
Date
9.5
16
22.5
29
35.5
42
47
58
64
74
84
94
114
134
94 ft
64 ft
74 ft
16 ft
9.5 ft
84 ft
22.5 ft
114 ft
42 ft
35.5 ft
29 ft
47 ft
134 ft
58 ft

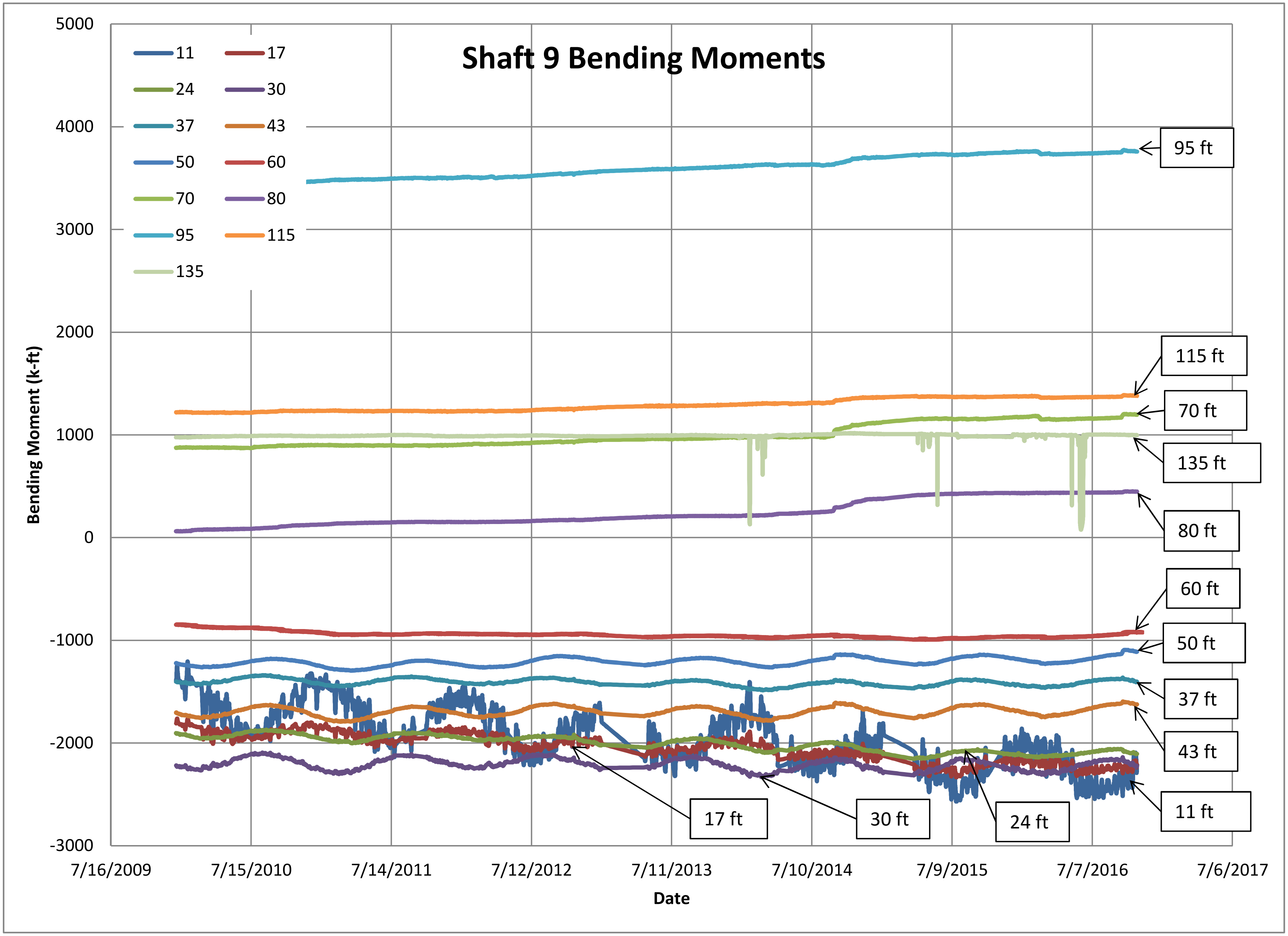
CUY-90-15.24 Slope Monitoring
PID 76117
Cleveland, Ohio
EDP #09305G

Drilled Shaft #9
Strong Axis Bending
Average for Period: July 31, 2016 thru October 31, 2016






Shaft 9 Axial Loads
Axial Load (kips)
Date
6000
5000
4000
3000
2000
1000
0
7/16/2009
7/15/2010
7/14/2011
7/12/2012
7/11/2013
7/10/2014
7/9/2015
7/7/2016
7/6/2017
11
17
24
30
37
43
50
60
70
80
95
115
135
95 ft
135 ft
37 ft
115 ft
43 ft
24 ft
50 ft
60 ft
11 ft
80 ft
17 ft
70 ft
30 ft


Shaft 9 Bending Moments
11
17
24
30
37
43
50
60
70
80
95
115
135
95 ft
115 ft
70 ft
135 ft
80 ft
60 ft
50 ft
37 ft
43 ft
11 ft
17 ft
30 ft
24 ft
Bending Moment (k-ft)
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
7/16/2009
7/15/2010
7/14/2011
7/12/2012
7/11/2013
7/10/2014
7/9/2015
7/7/2016
7/6/2017
Date