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December 16, 2013

Mr. Jason Wise, P.E.
ODOT District 12 Geotechnical Engineer
Ohio Department of Transportation
5500 Transportation Boulevard
Garfield Heights, Ohio 44125-5396

Re: October 2013 Annual Report
CUY-90-15.24 Slope Monitoring
PID 76117
EDP Project No. 062943.00

Dear Mr. Wise:

Quarterly instrument readings for the CUY-90-15.24 Slope Monitoring project are presented in the attached report. Both "hard" and electronic copies are being sent. An additional hard copy is being sent to Chris Merklin in ODOT's Central Office.

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

Very truly yours,

SOIL AND MATERIALS ENGINEERS, INC.

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

Attachments

Copy to: Chris Merklin, P.E., ODOT Central Office

OCTOBER 2013 ANNUAL REPORT

CUY-90-15.24 SLOPE MONITORING
PID 76117
CLEVELAND, OHIO
SME PROJECT NO. 062943.00

DECEMBER 16, 2013

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INTRODUCTION

Instrument readings and interpretations for October 2013 are presented in this report. Readings and data reduction for this report were obtained between October 16 and November 5, 2013. Plots of the quarterly readings are included in the appendices with piezometer plots in Appendix A, inclinometer plots in Appendix B, and plots for the tiltmeters and stabilization structure, including the inclinometers in the piers, in Appendix C.

PIEZOMETERS, APPENDIX A

We saw little or no change in total head for most piezometers this past quarter. The few exceptions are discussed in the following paragraphs.

P-001. Total head in the shallow piezometer has decreased by about one-half foot since June of this year. Total head in the deep piezometer remained constant. From November 2012 through June 2013 pore pressures in both piezometers dropped with the rate of drop in the shallow piezometer being greater than it has since June.

P-002. Pore pressures in the shallow piezometer have been increasing since the piezometers were installed and the grout fully set in about October 2011, except for a short time when the pressures dropped in early part of 2012. There have been three periods of increasing pore pressures all with slightly different rates. Since November 2012 the rate of increase has been slower but has remained steady. Pore pressures in the deep piezometer generally followed the same pattern as the shallow piezometer through April 2012 although the rates of increase were significantly greater. Since that time, while pore pressures in the shallow piezometer were increasing, pore pressures in the deep piezometer were decreasing. This continued until the end of 2012. Since then, pore pressures in the deep piezometer have remained virtually constant, although we may currently be seeing a slight increase in pore pressures that started in July of this year.

P-003. Sometime after the July readings this installation was covered to create a crane pad for erection of the new bridge and is not accessible. Therefore, we have no new quarterly data for this installation. The plot in the appendix shows pore pressures since the seven piezometers were installed at this location. Piezometers installed at elevation 600 and above recorded no pore pressure change since October 2012. Pore pressures in piezometers at 550 and 580 feet have continued to increase since the beginning of June 2012, although the rates of increase have slowed this year. Total head changes have been 1 foot at elevation 580 feet and 3 feet at elevation 550 feet. Pore pressures have decreased continuously since June 2012 in the deepest piezometer (elevation 458 feet). The rate of decrease slowed through about November 2012 and has remained virtually constant since. The decrease this year has been just 0.5 feet.

P-004. Protective covers have not been replaced for these instruments and the data loggers have not been reinstalled. Manual readings since May 2012 have shown that total heads in both piezometers are increasing. The rate of increase had been gradually decreasing, but has

remained nearly constant since October 2012. Changes this year have been 1 foot in the shallow, and 2.5 feet in the deep piezometers.

P-008. Pore pressure changes at this location have been negligible since May 2012.

B-05-02. The original piezometers at this location were replaced in January 2012. Two plots are included in the appendix; one includes data for both the original and the replacement piezometers; the other includes data only for the replacement piezometers.

Pore pressures in both piezometers at this location have been increasing since April 2012. The rate of increase in the shallow piezometer slowed after October 2012. The average rate of increase has remained nearly constant since then, although there has been some significant variation about the average rate with three short periods when pore pressures dropped. During this year, the total head increased about 2 feet. Pore pressures in the deep piezometer have continued to increase at a decreasing average rate since April 2012. Since June 2013, the rate of increase has been constant at about 1.5 feet per year.

B-05-03. Pore pressures in both piezometers at this location have been trending downward since March 2011. This quarter the total head in both piezometers dropped about 1 foot. Total head change in the shallow piezometer was only about 0.3 feet during the prior three quarters resulting in a net decrease for the year of about 1.3 feet. Total head in the deep piezometer increased during the prior three quarters so that the net change since October 2012 has been a drop of about 0.5 feet.

B-05-04. Ignoring the few extreme data spikes, average total head in the shallow piezometer remained constant for the year. Total head in the deep piezometer has been slowly increasing since April 2012. The total head increase this year was about 0.5 foot.

B-05-07. Miniloggers at this location were damaged by construction activities on October 9, 2013. Although both miniloggers were damaged beyond repair, we were able to retrieve data for the shallow piezometer through the date when the miniloggers were damaged and the cables were torn off. No quarterly date was retrieved for the deep piezometer. We saw a slight drop in pore pressures in both piezometers during the summer months of 2012 with a low reached in late June. The net pore pressure change in the shallow piezometer was negligible for the year.

B-05-11. Because of the ongoing construction activity, no protective covers are installed at this location and we have not reinstalled the miniloggers. Manual readings have been taken.

Total head in both piezometers has been increasing since May 2012 following a 10 month period when total heads dropped as much as 11 feet. The rate of pore pressure increase continues to slow. Total head increase since October 2012 has been 1.7 feet in the shallow piezometer, and 3 feet in the deep piezometer. Increases this quarter were 0.2 and 0.4 feet in the shallow and deep piezometers, respectively.

B-05-13. We have not been able to read piezometers at B-05-13 since July 2012 when soil was placed over the installation for work on Pier 5.

B-101. Plots show that total head was at the piezometer tips for both piezometers from July to October 2012. Thus, the actual groundwater elevation was at or below the elevation of the piezometer tips. This occurred again from April to July this year for the shallow piezometer. Total head also dropped in the deep piezometer but did not drop below the elevation of the piezometer tip. This past quarter pore pressures increased in both piezometers. Total heads this October were 1.2 and 0.7 feet higher than a year ago in the shallow and deep piezometers, respectively.

B-105. Total head dropped in the shallow piezometer and increased in the deep piezometer by the same amount (0.4 feet) this quarter. Total heads in October 2013 were the same and 0.4 feet higher in the shallow and deep piezometers, respectively, as they were at the time of the October 2012 readings. Total head (pore pressure) continues to trend downward in both piezometers.

B-303. Only one piezometer is functioning at this location. This quarter's pore pressure reading indicates no change in total head at the elevation of the piezometer since last quarter. For the year, the total head decreased 0.4 feet. Pore pressures have been decreasing since July 2007, and readings since July 2009 indicate a downward trend in the pore pressure of 0.6 feet/year.

INCLINOMETERS, APPENDIX B

Inclinometer surveys for I-001, I-002, I-004, I-010, B-05-04 and B-05-11 show no change or negligible change in displacement this year. Zone plots associated with some of the inclinometers are included with the attachments. Some of these plots indicate significant variation from reading to reading. This is caused by slight differences in the readings due to instrument accuracy and changes to the bias corrections. The remaining inclinometer surveys are discussed below.

I-003. The area around this installation was covered some time after the July readings and we were not able to obtain readings this quarter. Displacement of the top approximately 8 to 10 feet of the slope tube was caused by excavation around the tube. This occurred on two occasions, the latest on July 23, 2013. Aside from that, our readings show no movement since October 2012.

I-008. Inclinometer readings this quarter indicate a slight increase in A-axis displacement in the depth interval from 48 to 52 feet. Movement at this depth began to show in the inclinometer readings in the last half of 2012. The first significant increase in displacement was seen in the January 2013 readings. During 2013 the movement continued to increase at a very slow rate. For this year we estimate that the displacement increased by about 20%. A second zone of movement is occurring from 88 to 90 feet. Most of the displacement in this depth zone occurred during 2012. The displacement, which is very small, approximately doubled in January 2013, but has not changed since.

B-05-02. We continue to see an increase in A-axis displacement from 37 to 41 feet at this location. The zone plot of resultant displacements for this depth interval indicates an increase in displacement larger than we have seen since August 2012. Much of this may be due to the less accurate B-axis reading. Prior to this reading, displacement had been increasing but the rate of movement appeared to be slowing. Displacement this quarter was more than double the total displacement for the prior three quarters. Two deeper zones are also monitored at this location. There has been no movement in either zone since at least April 2011.

B-05-03. Zone plots are included for three depth zones for this location. Since about April 2011 there has been no displacement in the shallow zone. The plot simply mirrors the displacement that is occurring in the zone from 32 to 42 feet. The rate of displacement in this zone increased from October 2012 through April 2013 and slowed after that. The October 2012-January 2013 plot for the 121 to 123 foot depth zone indicates an increase in displacement. Plots for the remaining quarters of 2013 show no displacement. For both zones that are showing an increase in displacement, the average rate of displacement has remained constant since January 2010.

B-05-07. This location was damaged by construction on October 9, 2013. The top of the slope tube was broken off and the tube was filled at least partially with soil. This location will be uncovered and the inclinometer tube will be extended. We will attempt to flush the tube and resume readings.

The July plot shows an apparent rotation of the inclinometer tube above 120 feet. This does not show in the incremental plot which is also included with the attachments. However, an interesting pattern appears in the incremental plots where we see a spike at each 10 foot interval in the A-axis readings. We believe this may indicate that there is a slight gap in the casing joints and one of the inclinometer probe wheels may stop at the joints causing this spike. This would not affect the B-axis readings, and we do not see the same pattern occurring in those readings. Even the slightest change in the stop points for the readings could affect the cumulative plots. It is likely that there was no slope movement at this location from October 2012 through July 2013.

B-05-13. We were unable to obtain readings at B-05-13 this year because the instruments were covered by fill for a crane pad.

B-101. April 2013 readings indicated rotation of the tube in both axis directions. This may have been due to an erroneous data point(s) in the bottom part of the tube. The July and October 2013 readings are nearly identical. It seems likely that there has been no movement at this location and the apparent displacement in the bottom 30 to 40 feet of the slope tube is due to insufficient embedment to provide full fixity.

B-102. Displacements for two depth zones are plotted for this location. Readings for the October 2012-January 2013 quarter indicated reverse displacement in the 65 to 67 foot depth zone; this quarter's readings indicate no change in this zone. Similar reversals of less magnitude have occurred each year. This is likely due to adjustments in the bias corrections that try to align the plots for each set of readings within the depths where the slope tube should be fixed.

Matching is extremely difficult due to the small magnitude of the displacements. It is unlikely that any actual movement has occurred at this location since at least June 2012.

B-105A. The zone plot for the 105 to 109 foot depth interval indicates a decrease of about 0.07 inches of resultant displacement. The inclinometer plots indicate that this displacement is virtually all B-axis displacement. It is likely that the apparent displacement is due to the lower B-axis instrument accuracy. The most significant displacement at this location is occurring in the upper approximately 30 feet of the profile as indicated by the Zone 1 plot. About 0.5 inches of displacement has occurred since July 2012 with the majority of that occurring between July and January 2013. The zone plot indicates no increase in displacement since January.

B-203. The only significant displacement at this location is occurring in Zone 2 between 54 and 58 feet where about 0.1 inches of displacement has occurred since June 2012. Most of this displacement occurred between June 2012 and January 2013. Movement has continued at a constant but slower rate since January. The Zone 5 plot combines the displacements in Zones 1 and 2 and indicates that the average rate of movement is continuing along the long term historical trend.

TILTMETERS, APPENDIX C

Changes in Tiltmeters 3, 4, 5, and 6 were negligible again this quarter. Readings at these four locations have remained virtually constant since July 2011.

Tilt 1 saw a relatively large negative change last quarter, which at the time, we thought might be an errant reading. However, this quarter's reading is about the same as last quarter. From July 2011 through April 2013 we had seen some variation but little net change in readings at this location. In earlier years the readings had been positive by an amount nearly identical to the recent negative readings.

Readings at Tilt 2 have continued to decrease following a trend that has continued since the tiltmeters were installed.

Tilt 7 has been gradually increasing since July 2012 and that trend continued this quarter.

This quarter's reading at Tilt 8 was slightly positive and nearly the same as last quarter. Prior to last quarter, and since July 2012, tilt readings at this location showed little variation and were trending along the neutral axis.

Figure 1 shows the location and direction of positive rotation for each of the tiltmeters.

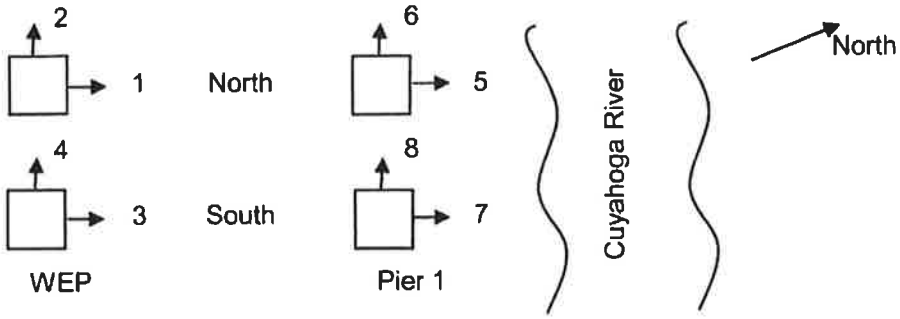


Figure 1. Tiltmeter locations with arrows showing the direction of positive tilt.

STABILIZATION STRUCTURE, APPENDIX C

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

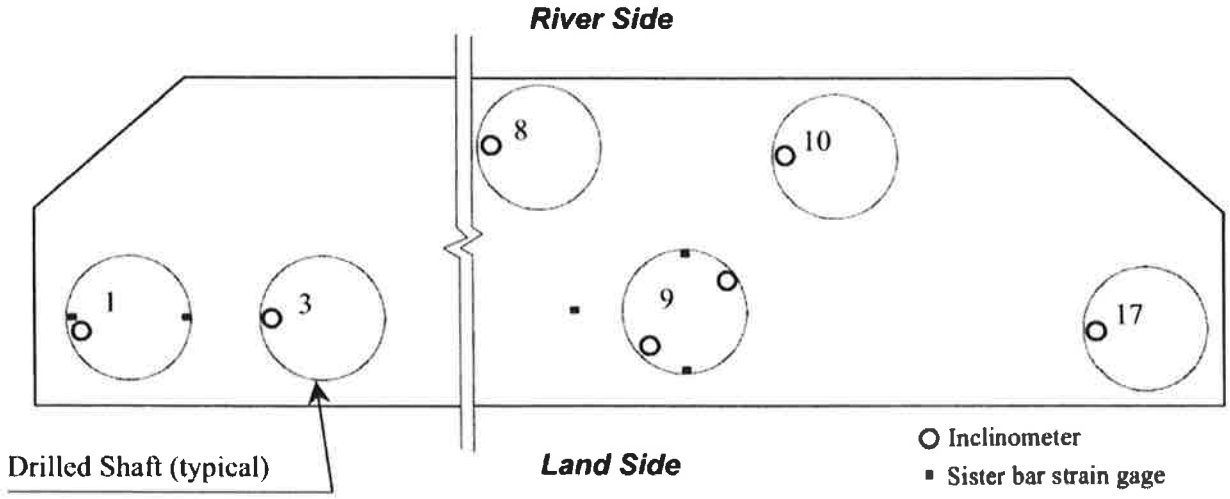


Figure 2. Pier cap with the location of inclinometers and strain gauges.

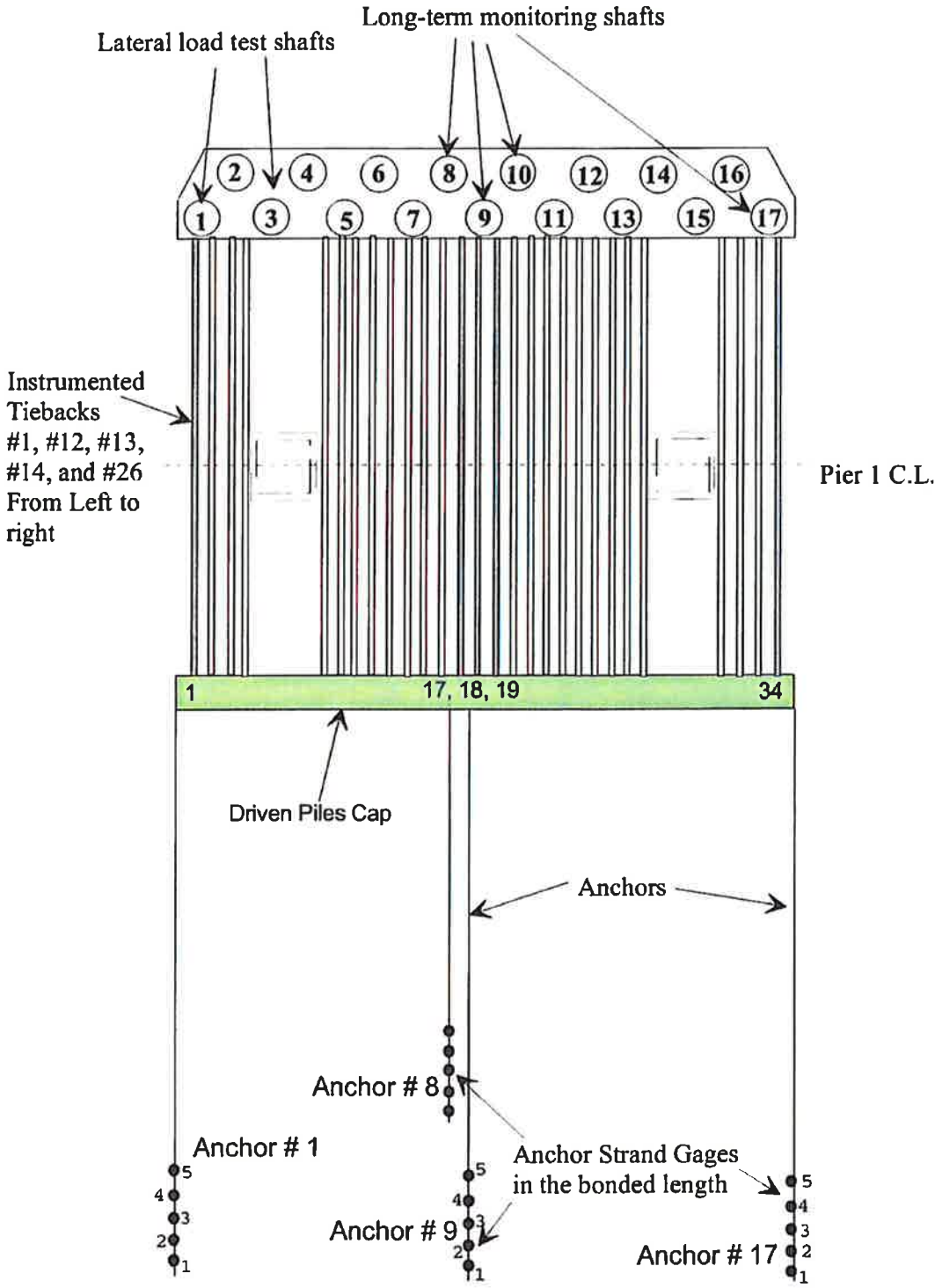


Figure 3. Plan of the stabilization system showing the locations of the instrumented foundation elements.

Load Cells

Loads in Load Cells 1, 9, and 17 have remained constant except for seasonal variations. A number of erroneous data points (large drops) were recorded for Load Cell 1 this quarter. These were caused by erroneous and intermittent data points recorded for Gauges 1 and 4. Gauges 2 and 3 on Load Cell 8 recorded data for short periods this quarter. About 40% of the possible data points were recorded. This causes the jump in the plot of the load for this load cell. Table 1 shows which gauges were active in each of the load cells this quarter.

Table 1. Active gauges (indicated by check mark) in load cells on the four instrumented anchors.

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

Anchors

With the exception of an occasional errant data point, loads recorded for all strandmeters on all anchors remained nearly constant for the quarter and for the year. The plots indicate slight seasonal variations in the loads on some strandmeters. These variations correspond to the variations in the loads on the load cells which are also included with the strandmeter plots.

Average loads this quarter for the load cells and the strandmeters that are still functioning are listed in Table 2. Strandmeter gauges that have failed are indicated by an "×" in the table.

Data indicates that the load in Strandmeter 5 on Anchor 1 has been increasing since February 2011. This apparent increase continued through this year. Although the load indicated by this strandmeter may be increasing, the magnitude of the load is clearly incorrect since it exceeds the load in the anchor. The large negative (compression) load indicated for Strandmeter 3 on Anchor 8 is also incorrect since negative loads are impossible. Other loads that are clearly incorrect include Strandmeter 5 on Anchor 9, which exceeds the anchor load, and Strandmeters 1 and 3 on Anchor 17 which are both negative.

Table 2. Average strandmeter loads for the four instrumented anchors, tension is positive.

Anchor	Load Cell (kips)	Strandmeter (kips)				
		1	2	3	4	5
1	468	-10.1	×	+/- 0	×	1937
8	325	26.7	65.2	-175.8	×	×
9	473	-19.0	8.2	2.8	194.3	771.2
17	363	-35.6	×	-25.0	×	231.7

Driven piles

Axial loads in Piles 17, 18, and 19 decreased by 8 kips on March 16, 2013. The load in Pile 1 decreased by 17 kips from March 16 to 20. That change did not occur in Pile 34. The loads in Piles 1 and 34 continued to trend slightly down (Pile 1) or up (Pile 34) throughout the year.

With the exception of Pile 1, both strong axis and weak axis bending moments remained virtually constant this quarter. Some seasonal variation is apparent in the bending moment plots. After the change that occurred in mid-March of this year, the strong axis bending moment in Pile 1 gradually decreased changing from positive to negative in mid-July. This is caused almost entirely by changing data in Gauge 3, which since March has gone from -80 to +10 micro strains. The change has not significantly affected the weak axis bending moments.

Tiebeams

Data for the tiebeams was erratic and meaningless from August 2012 through July 2013. Some data was lost due to a shutdown of the datalogger in Enclosure 2. The long straight-line parts of the tiebeam graphs are for this period. In our last report we concluded that the gauges had been damaged and were unlikely to recover. With this quarter's readings, however, we can see that since July the readings have stabilized and have virtually returned to normal.

Plots for axial loads on the anchor side show similar seasonal variations but somewhat higher loads than for the same period in 2012. Strong axis, anchor side, bending moments show less season variation than the axial loads and are similar in magnitude to the loads recorded for the same period a year ago. The single exception is Tiebeam 1 where the plot shows a decrease of about 3 kip-feet of moment this current quarter with moments being about 2 to 5 kip-feet lower than a year ago. Weak axis, anchor side, bending moments also show little seasonal variation, and are similar in magnitude to the moments recorded a year ago. Here again, the single exception is Tiebeam 1, which shows an increase during the quarter and moments -1 to -2 kip-feet greater than a year ago.

Plots for axial loads on the drilled pier side show similar load magnitudes but significantly less seasonal affects that for the same period in 2012. Strong axis, drilled pier side, bending moments show similar seasonal variation to a year ago but bending moments are slightly higher. Weak axis, drilled pier side, bending moments show little seasonal variation and loads are similar to a year ago. Data for Tiebeam 1 has continued to be somewhat more erratic than for the other tiebeams.

Drilled Piers

The attached plots compare the current quarter average readings to the one-year average for Drilled Piers 1 and 9. Plots of axial load and bending moment vs. time are also included for selected depths. For Pier 1, the plots are for gauges at 16 and 58 feet; for Pier 9, the plots are for gauges at 17 and 50 feet. These plots show the seasonal variation in axial load and bending moment that occurs at all depths along the drilled shafts, although the seasonal effects become less with increasing depth. The straight line section of the plots is due to the shutdown of the datalogger in Enclose 2 that occurred during the second quarter of this year.

This quarter, the axial load in Pier 1 changed the most in the bottom part of the shaft, and the bending moment changed the most in the upper part of the shaft. Percent change varies along the shaft with the magnitude of the load or moment. For the most highly stressed parts of the shaft, the differences were less than 2% in the axial load and 3.5% in the bending moment. Maximum and minimum loads and moments for the year were within the range of prior years.

This quarter for Pier 9, changes in axial load vs. the annual average were between 1.5 and 3.5% along the entire length of the shaft. The largest change in bending moment occurred at the top of the shaft where the moment increased 8.8%. For the most highly stressed parts of the shaft, the changes in bending moment were less than 2.5%. The depth plots show that axial load has been trending upward in this shaft. Bending moment has been trending upward at 17 feet and downward at 50 feet.

Drilled Pier Inclinometer Surveys P-1, 3, 8, 9N, 10 and 17

The lateral displacement, or bulge, between about 110 and 150 feet in Pier 1 increased throughout the year with the largest increase occurring from January to April. The inclinometer plot for Pier 8 indicates B-axis lateral rotation below about 118 feet. The only change this year occurred from January to April. Changes in the inclinometer surveys for the remaining piers were negligible this year.

EXPANSION JOINTS AND TRUSS OPENINGS

Location of Measurements

The general location of the bridge deck and truss expansion joint measurements is shown in Figures 4 and 5. Measurements and temperatures at the time of the measurements are plotted in Figures 6 and 7. Truss and deck measurements were taken on October 18, 2013.

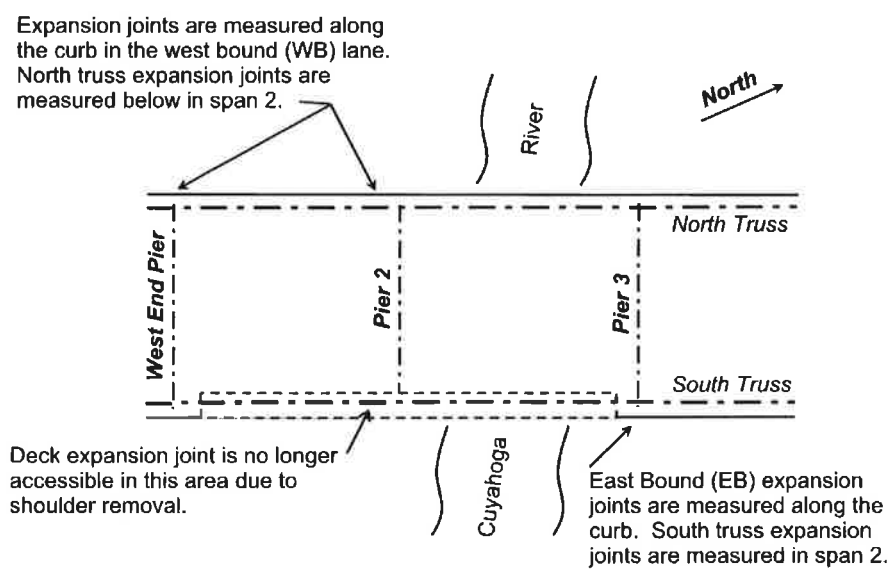


Figure 4. General location of the expansion joint measurements.

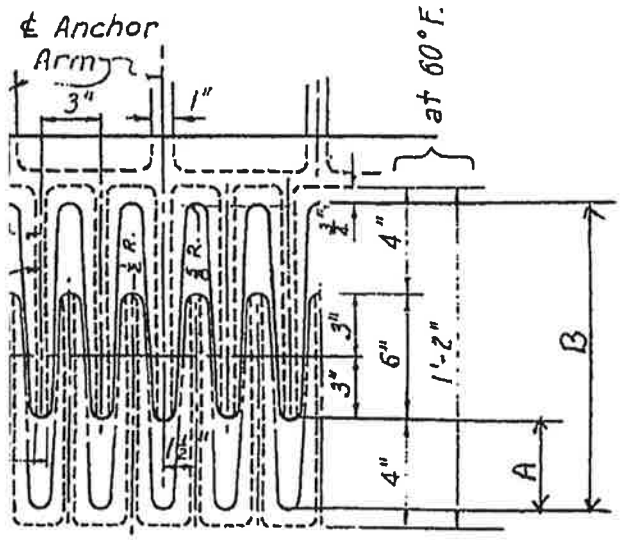


Figure 5. Locations of measurements for the bridge deck expansion joints.

Bridge Deck Expansion Joints

Expansion joint measurements on the bridge deck are taken near the west end pier and Piers 2 and 4. The plots in Figure 6 are labeled 1WB for the expansion joint at the west end pier in the westbound traffic lane, 2WB for the expansion joint near Pier 2 in the westbound traffic lane, and so forth. Measurements of the expansion joints in the eastbound traffic lanes are similarly labeled with EB substituted for WB in the label.

Temperature at the time of this quarter's expansion joint measurements was about 17 degrees lower than last quarter. All gap measurements increased this quarter with the drop in temperature. Changes this year were proportionately smaller than in past years due to the smaller temperature difference between the September and October reading dates vs. prior years when we saw differences of about 30 degrees.

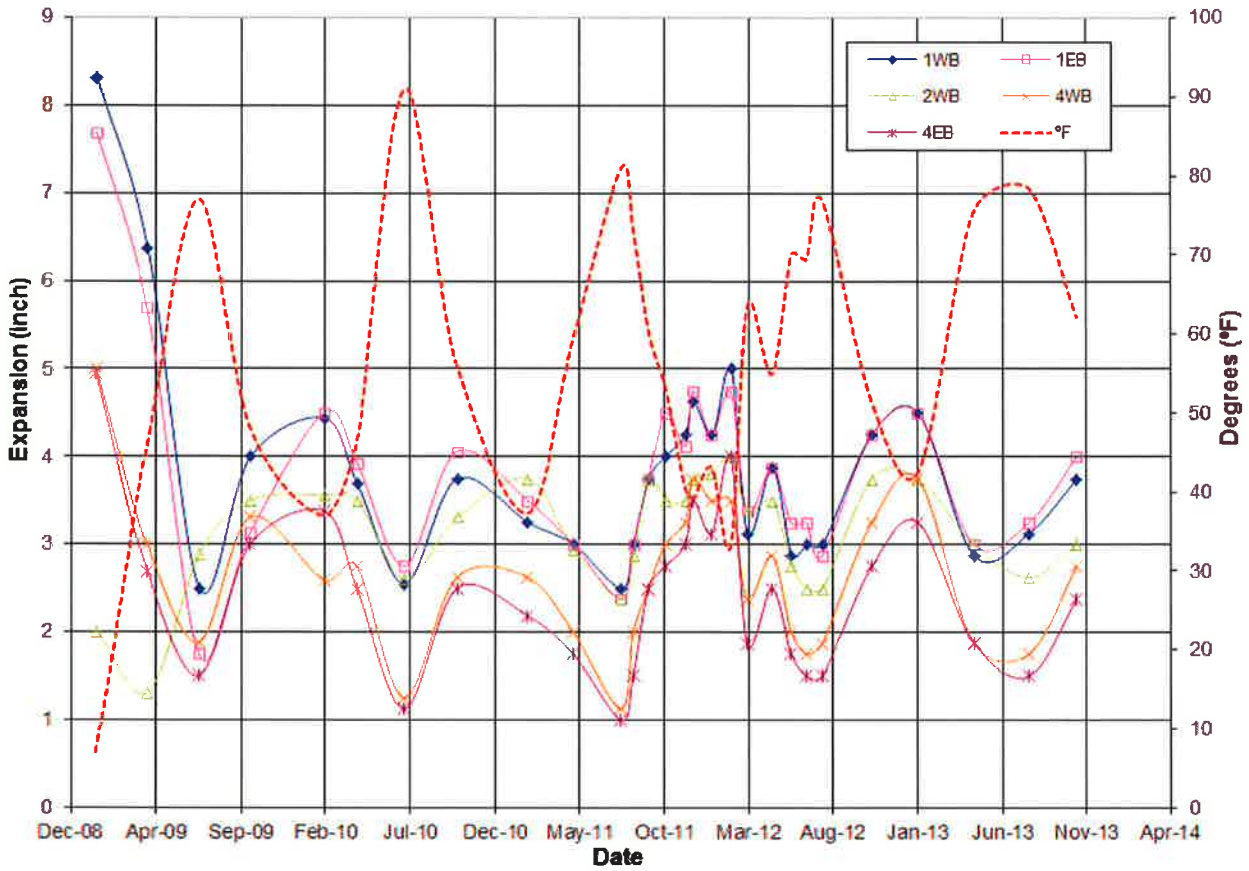


Figure 6. Bridge deck expansion joint and temperature measurements October 18, 2013.

Bridge Truss Openings

Four locations, A, B, C, and D, are measured on the north and south trusses at span 2, floor beam 12. The plots in Figure 7 are labeled NA, NB, etc., for the north truss and SA, SB, etc., for the south truss.

All truss measurements increased this quarter with the drop in temperature with the exception of the measurement at NA. The measurement at NA decreased slightly which is unusual for this location since this measurement had increased with falling temperatures in prior years shown in Figure 7. Neglecting the seasonal variations, for the past four years there has been a gradual decrease in opening size at six of the eight locations that are measured. Only the NA and SA measurements have tended to remain constant during this period.

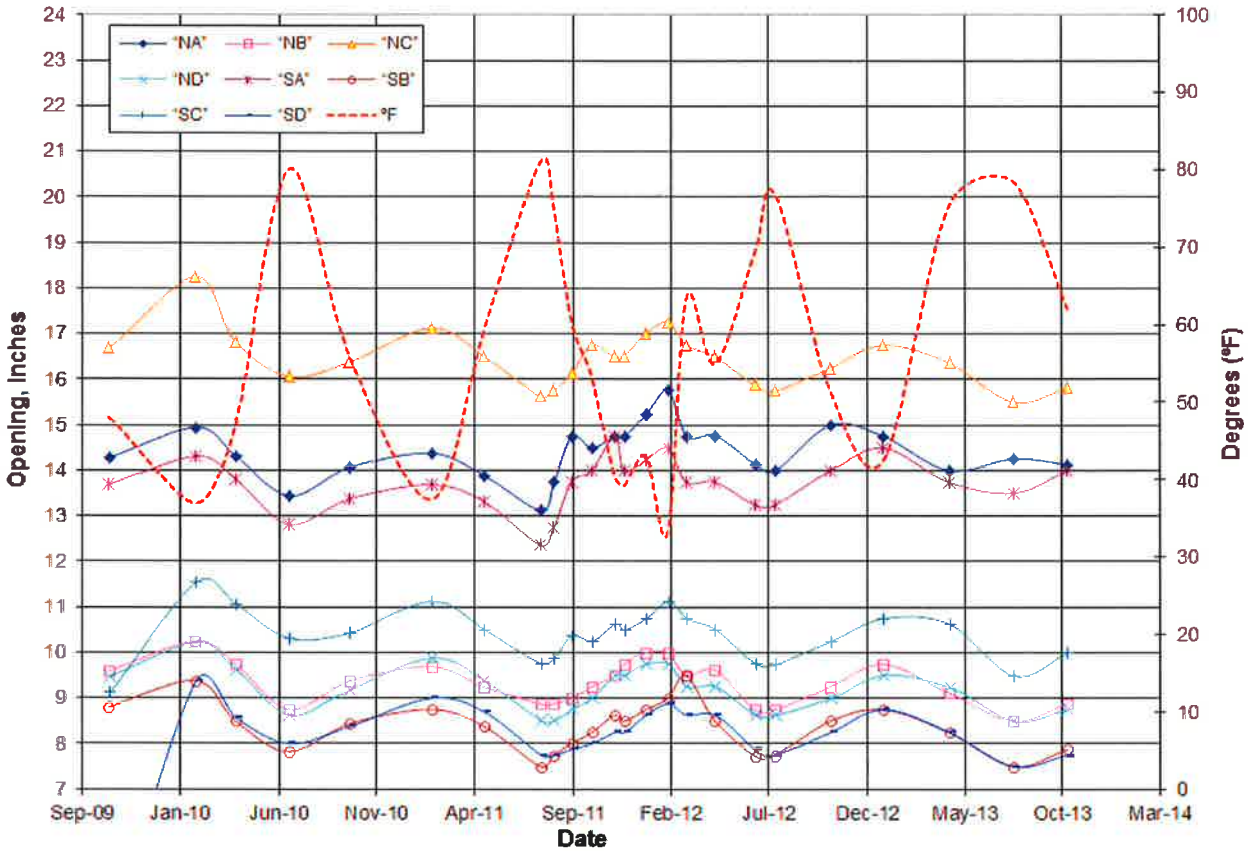


Figure 7. Bridge truss joint spacing and temperature measurements October 18, 2013.

AGGREGATE STOCKPILES

We observed and photographed the aggregate stockpiles on October 14, 2013 from vantage points consistent with prior reports as depicted in Figures 8 and 9. At that time, we estimated that the two larger piles near the east fence were approximately 5 to 8 feet high covering about 25% of the property. The toe of the closest pile was about 5 feet from the east fence line. The amount of material stockpiled decreased significantly since last quarter, but the distance from the fence line is about the same.

Figure 8. Aggregate stockpile east of the ODOT right-of-way (October 14, 2013).

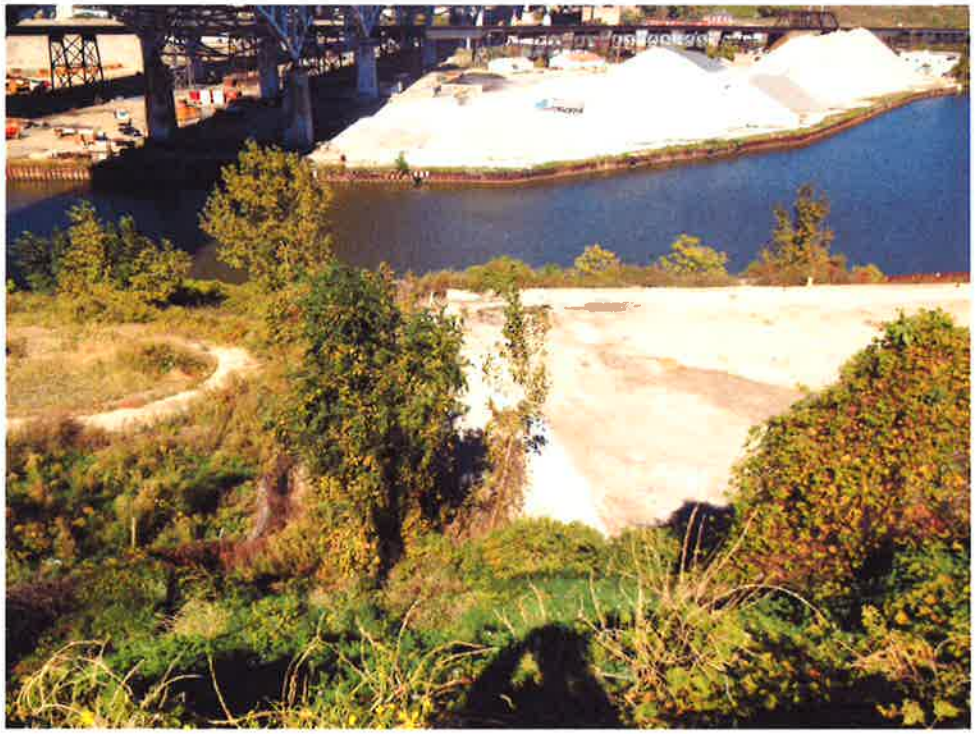
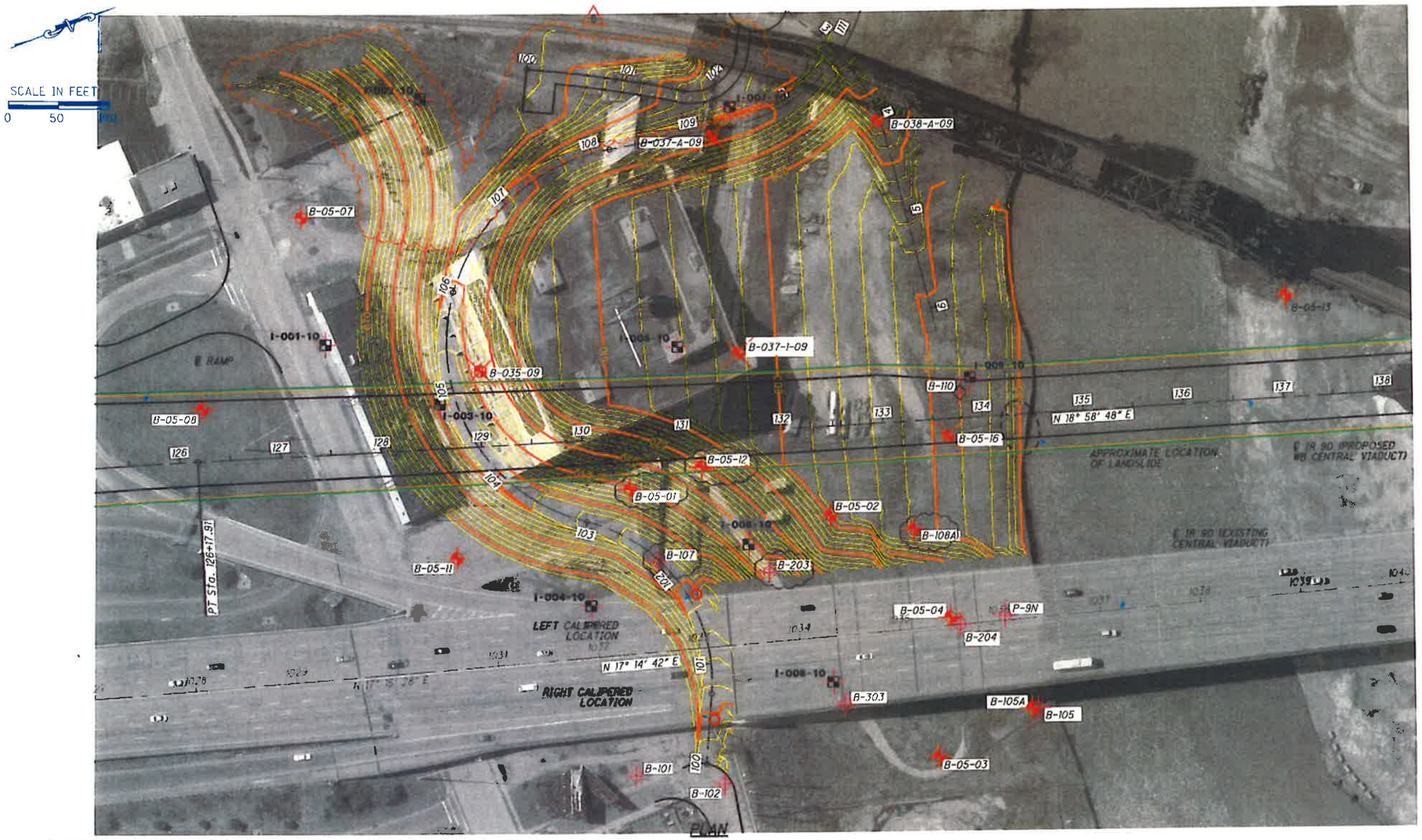


Figure 9. Aggregate stockpile near ODOT's east right-of-way fence (October 14, 2013).



PLAN

LEGEND

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

LOCATION OF PROPOSED INCLINOMETER AND/OR PIEZOMETER (I-001-10 THROUGH I-009-10 AND P-001-10 THROUGH P-009-10). THE LOCATION OF EACH PIEZOMETER IS WITHIN 5 FEET FROM THE LOCATIONS OF THE INCLINOMETER. ODOT IS RESPONSIBLE FOR THE PLACEMENT AND REPLACEMENT INSTRUMENTATION.

LOCATION OF ABANDONED INCLINOMETER AND/OR PIEZOMETER (B-035-09, B-037-A-09 B-037-1-09 AND B-05-16)

INCLINOMETER AND/OR PIEZOMETER TO BE REPLACED. THE FUTURE INSTALLATION WILL HAVE THE SAME DESIGNATION PRECEDED BY LETTER A (B-05-01, B-107, B-05-112, B-203 B-108A)

NOTE:
THE DESIGN BUILD TEAM NEEDS TO PROTECT ALL THE INSTRUMENTS AND REPLACE ANY IF DAMAGED, PER SECTION 9.3.3.1 OF THE SCOPE.

E.L. ROBINSON
The Challenger The Choice
1801 Watermark Dr. Suite 310
Columbus, OH 43215

DESIGNED	DRAWN	REVIEWED	DATE
CHECKED	REVISED	STRUCTURE FILE NUMBER	

INSTRUMENTATION PLAN
CUYAHOGA RIVER WEST BANK

CUY-90-14.92
PID No. 77332

1/4

31/34

P:\77332\admin\contracts\Innerbell Construction Contract Group 1\Instrumentation\Existing Instrumentation Sheet.dgn 4/28/2011 12:59:46 PM cstack

This completes the 2013 annual report for the CUY-90-15.24 Slope Monitoring Project, ODOT PID 76117.

Report prepared by:

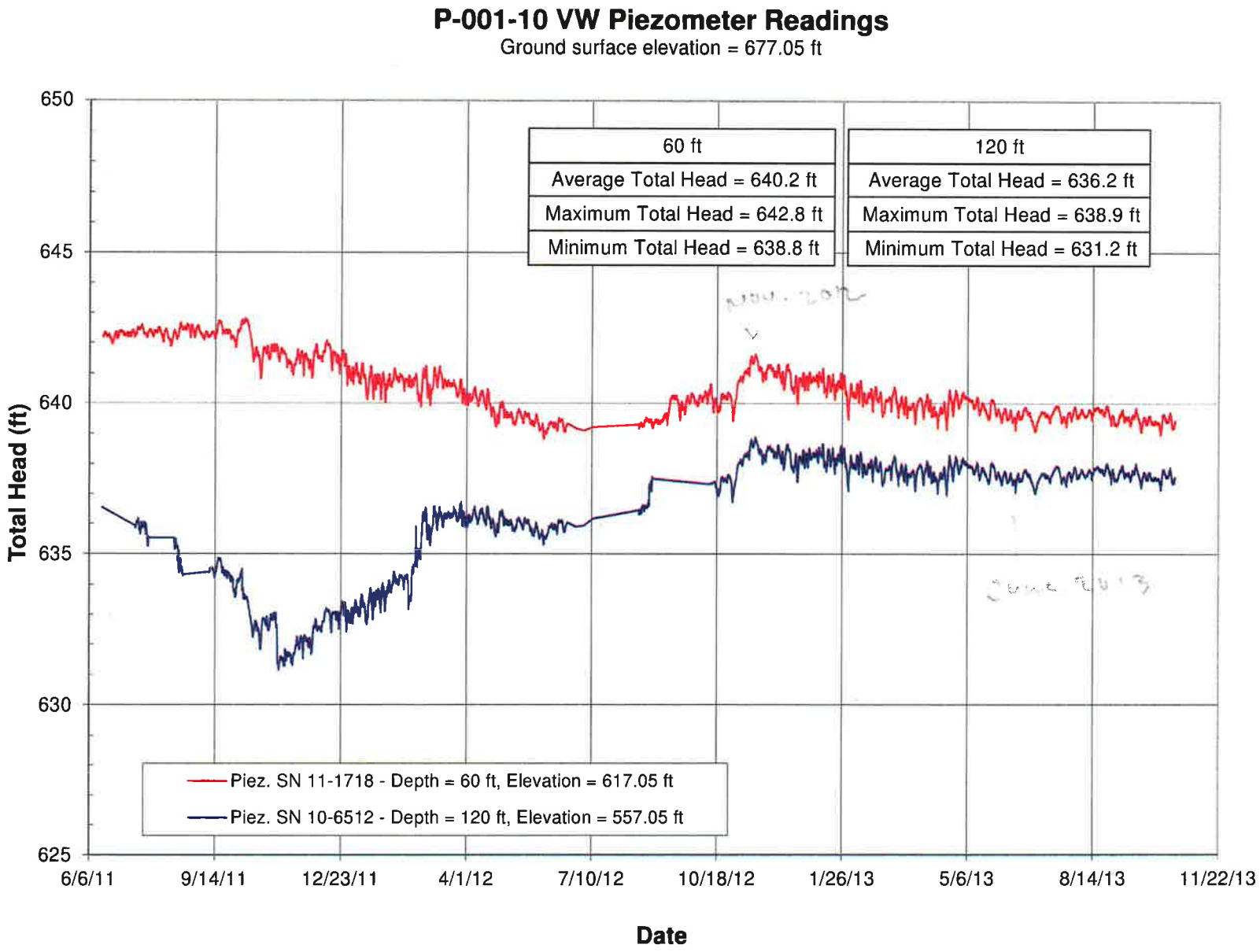
Alan J. Esser, P.E., D.GE
Principal Consultant

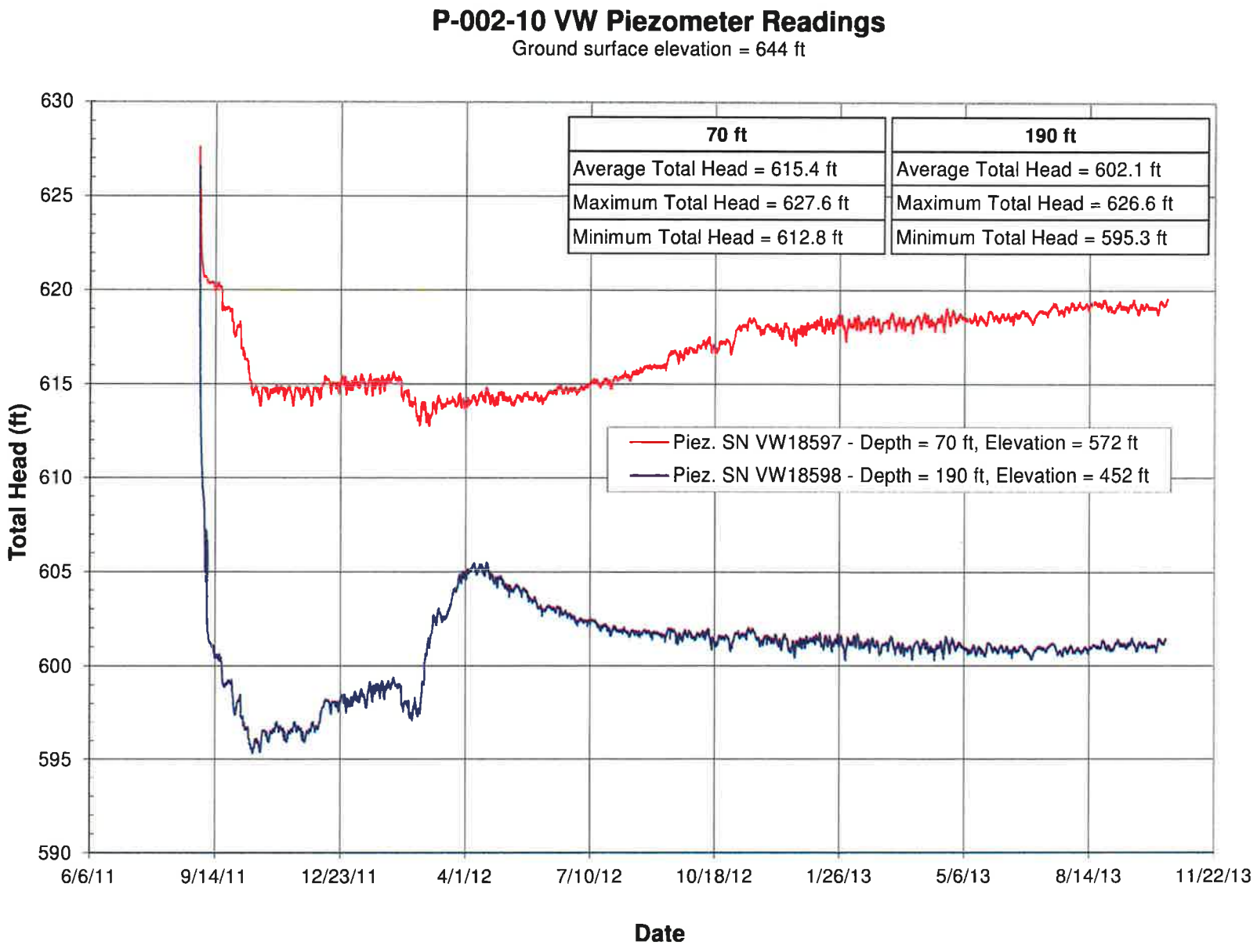
STATE OF OHIO
ALAN JAMES
ESSER
E-40092
REGISTERED
PROFESSIONAL ENGINEER

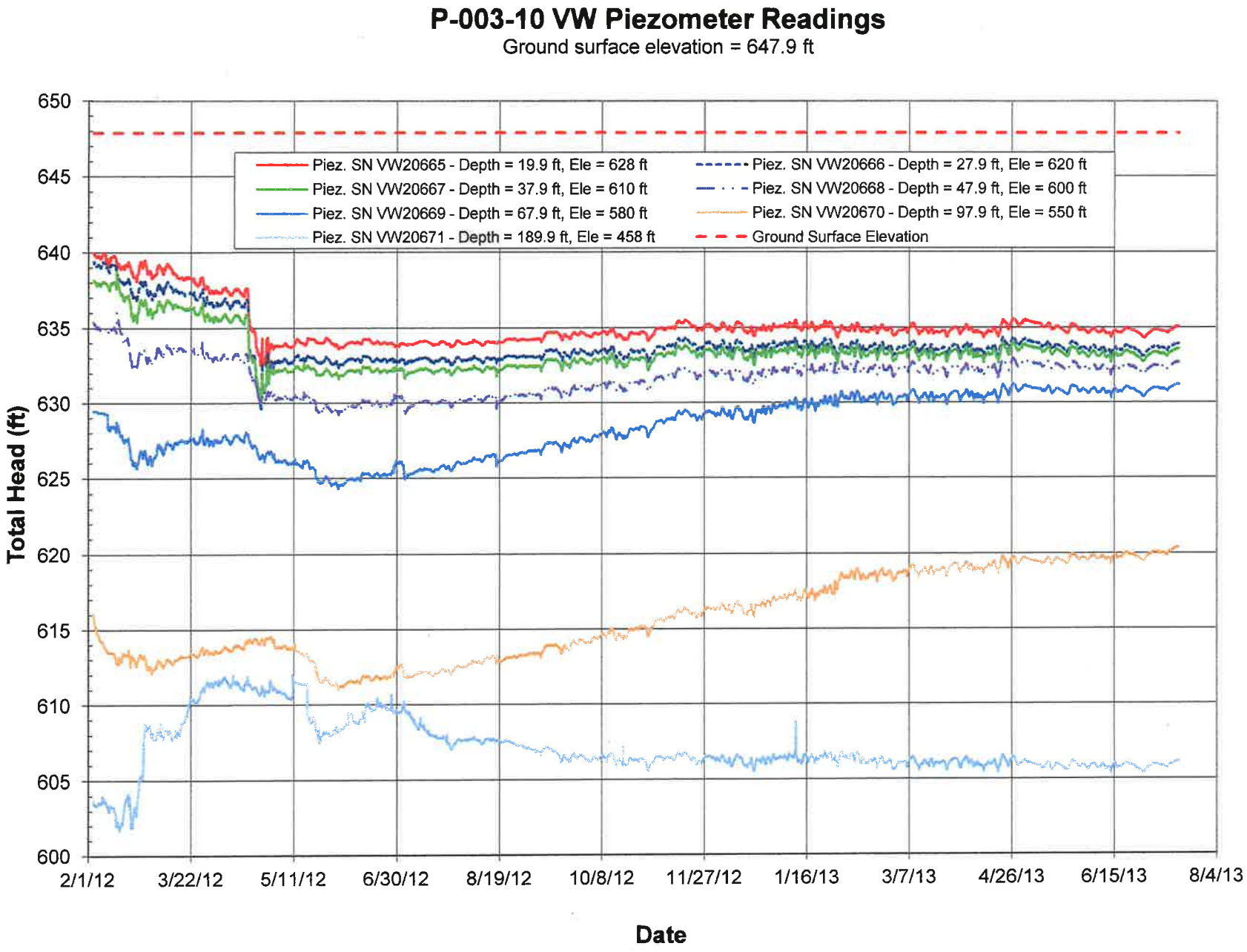
Report reviewed by:

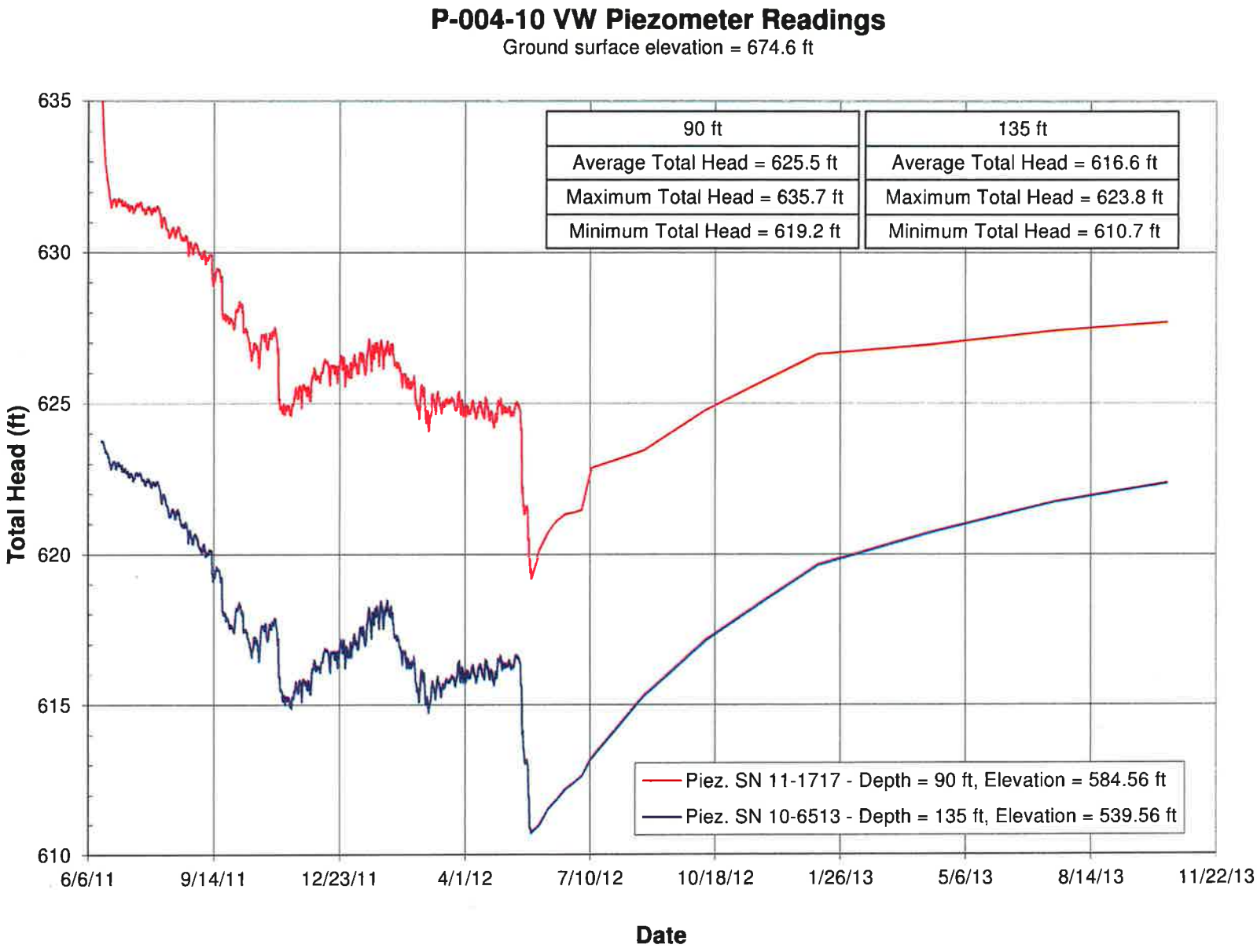
Seth Molenaar
Material Specialist

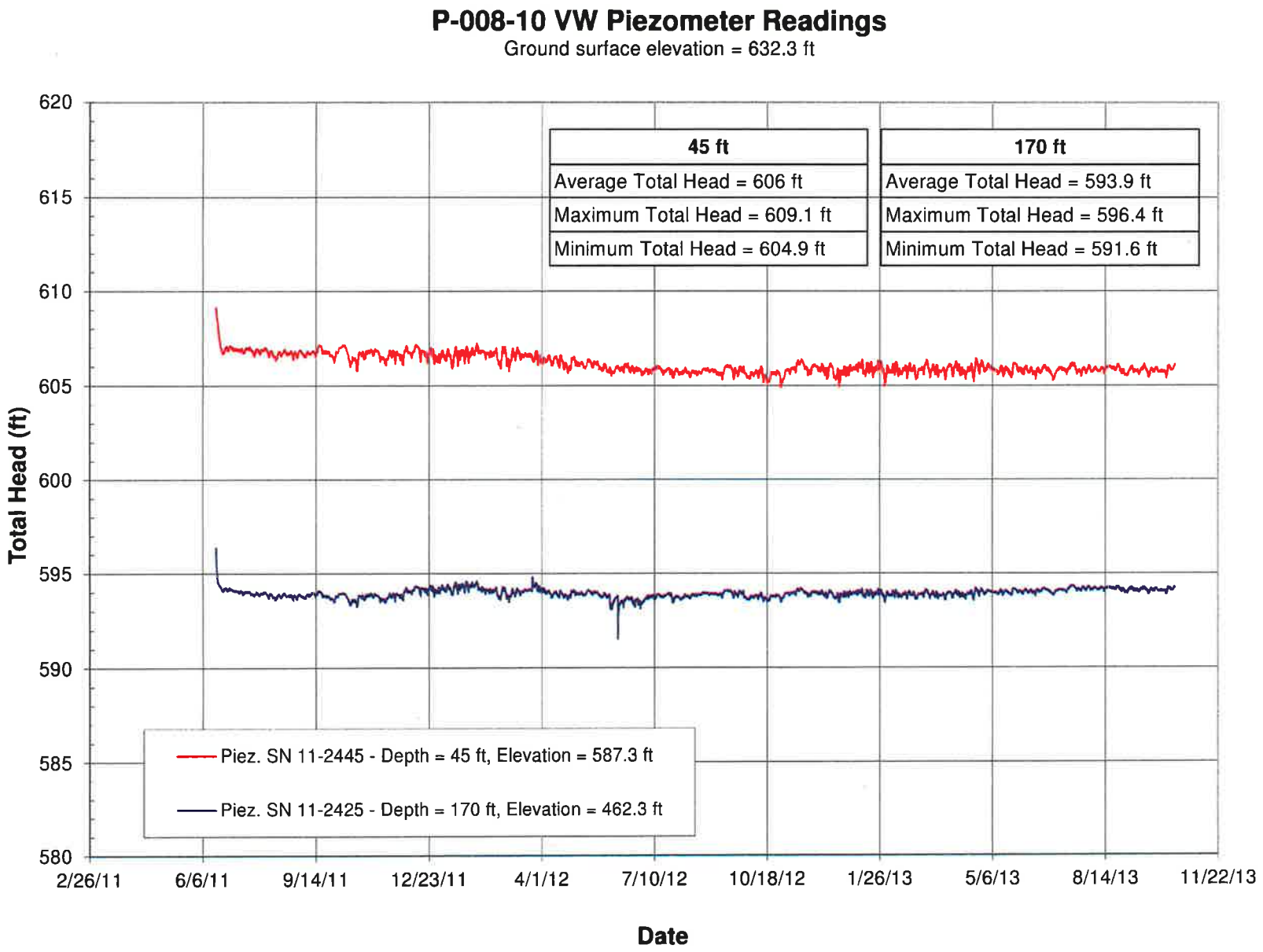
APPENDIX A
PIEZOMETERS

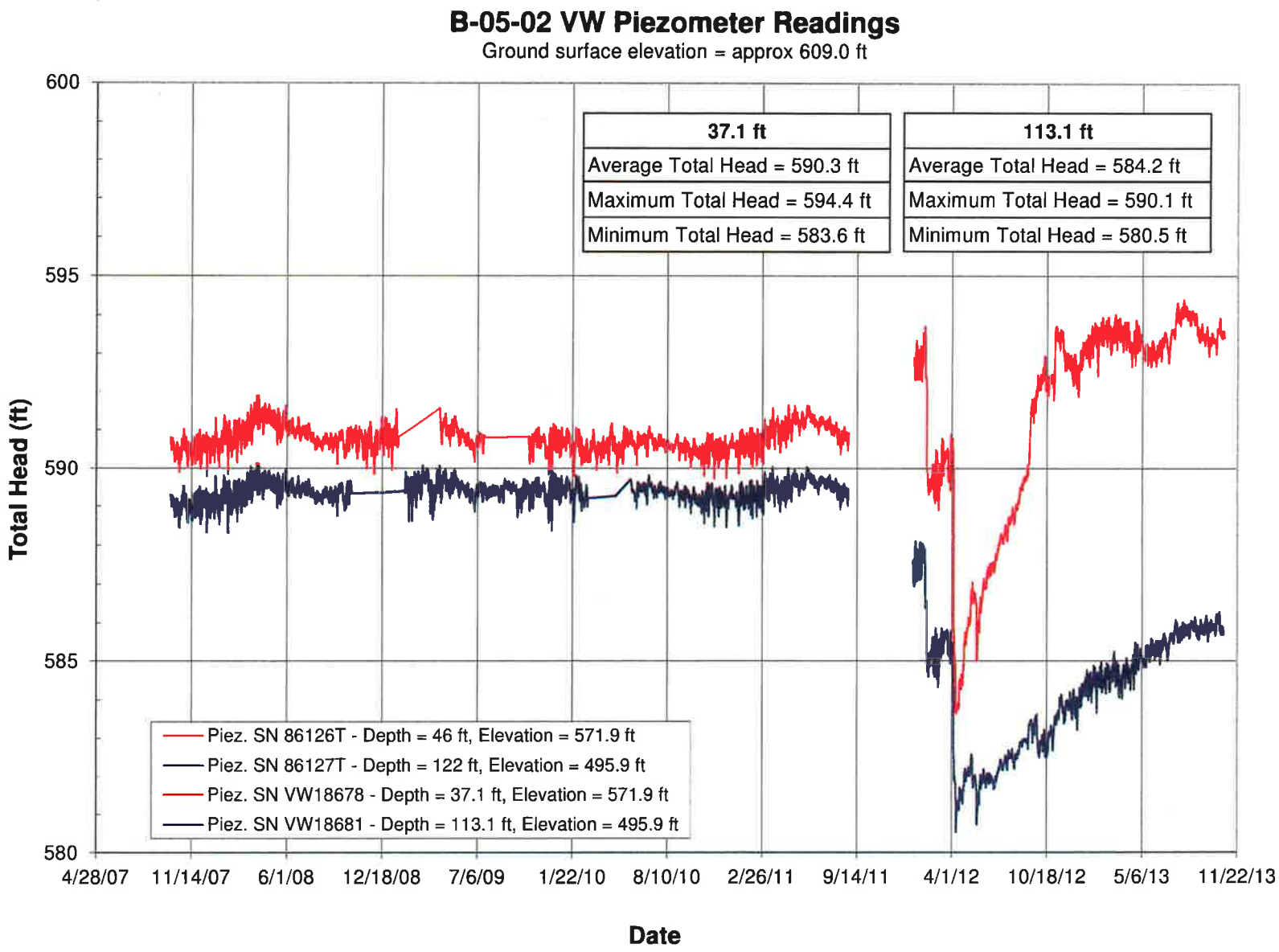

P-001-10 VW Piezometer Readings
Ground surface elevation = 677.05 ft
60 ft
Average Total Head = 640.2 ft
Maximum Total Head = 642.8 ft
Minimum Total Head = 638.8 ft
120 ft
Average Total Head = 636.2 ft
Maximum Total Head = 638.9 ft
Minimum Total Head = 631.2 ft
Piez. SN 11-1718 - Depth = 60 ft, Elevation = 617.05 ft
Piez. SN 10-6512 - Depth = 120 ft, Elevation = 557.05 ft
Total Head (ft)
650
645
640
635
630
625
6/6/11
9/14/11
12/23/11
4/1/12
7/10/12
10/18/12
1/26/13
5/6/13
8/14/13
11/22/13
Date

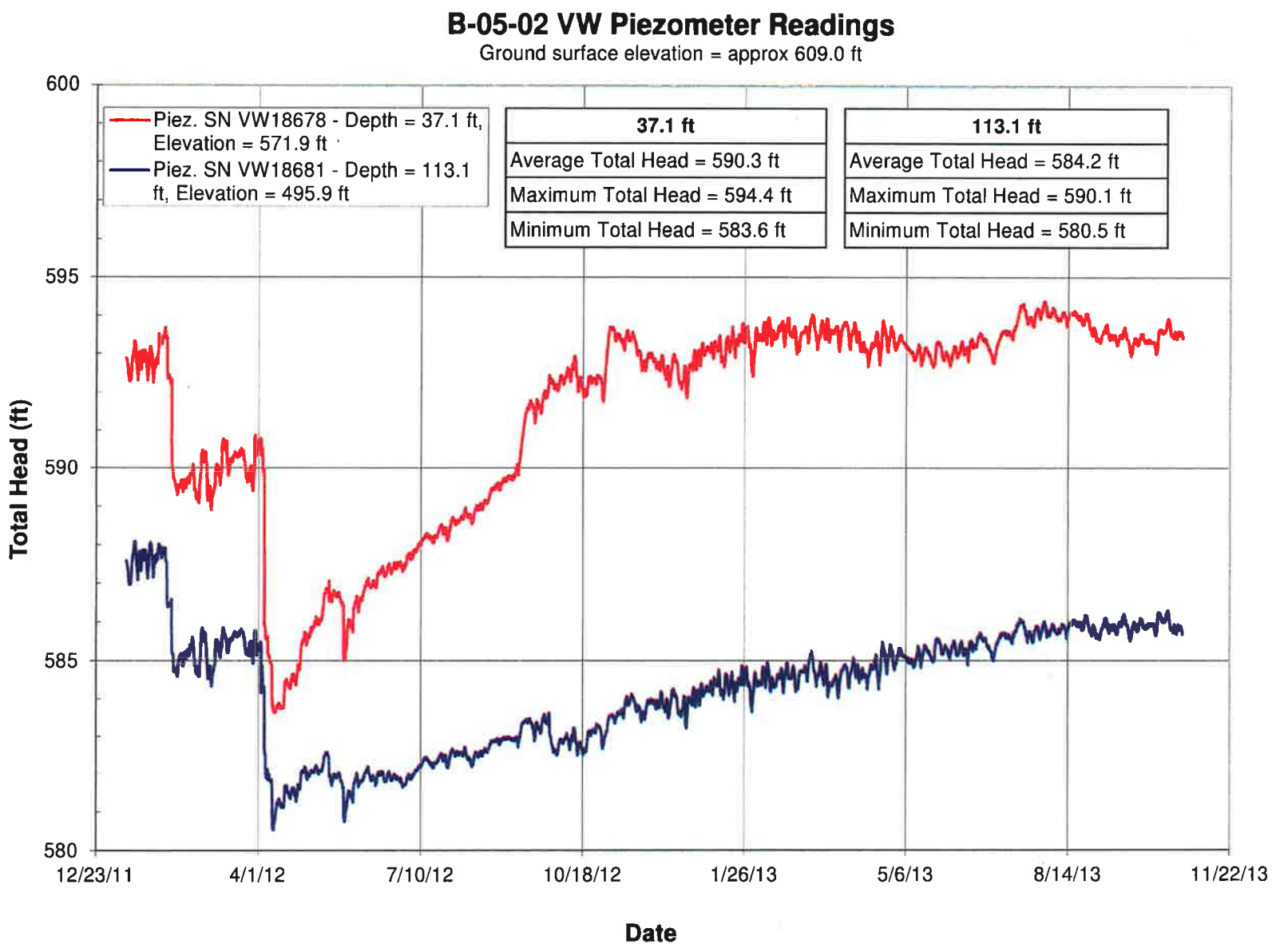

P-002-10 VW Piezometer Readings
Ground surface elevation = 644 ft
70 ft
Average Total Head = 615.4 ft
Maximum Total Head = 627.6 ft
Minimum Total Head = 612.8 ft
190 ft
Average Total Head = 602.1 ft
Maximum Total Head = 626.6 ft
Minimum Total Head = 595.3 ft
Piez. SN VW18597 - Depth = 70 ft, Elevation = 572 ft
Piez. SN VW18598 - Depth = 190 ft, Elevation = 452 ft
Total Head (ft)
630
625
620
615
610
605
600
595
590
6/6/11
9/14/11
12/23/11
4/1/12
7/10/12
10/18/12
1/26/13
5/6/13
8/14/13
11/22/13
Date

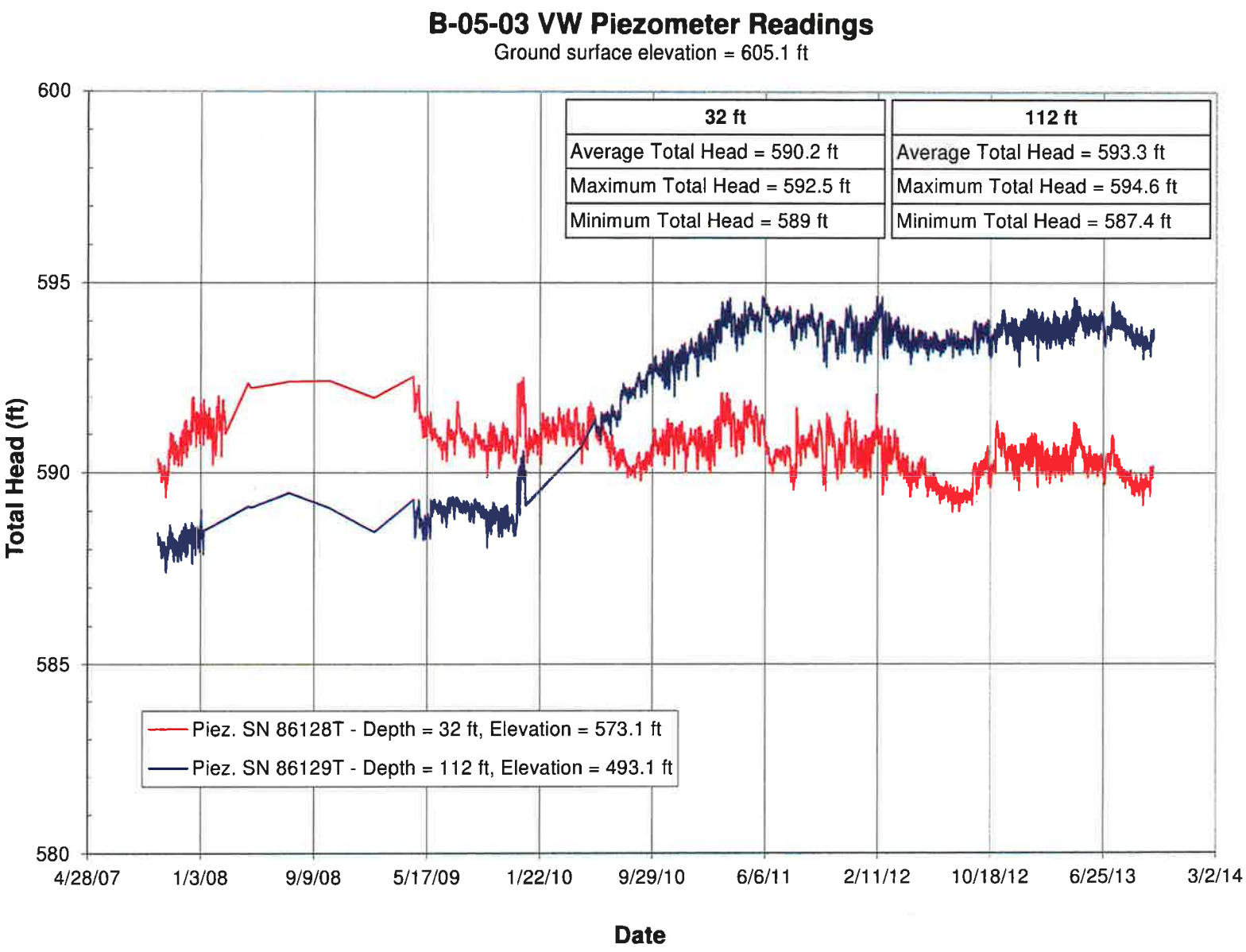

P-003-10 VW Piezometer Readings
Ground surface elevation = 647.9 ft
Piez. SN VW20665 - Depth = 19.9 ft, Ele = 628 ft
Piez. SN VW20666 - Depth = 27.9 ft, Ele = 620 ft
Piez. SN VW20667 - Depth = 37.9 ft, Ele = 610 ft
Piez. SN VW20668 - Depth = 47.9 ft, Ele = 600 ft
Piez. SN VW20669 - Depth = 67.9 ft, Ele = 580 ft
Piez. SN VW20670 - Depth = 97.9 ft, Ele = 550 ft
Piez. SN VW20671 - Depth = 189.9 ft, Ele = 458 ft
Ground Surface Elevation
Total Head (ft)
650
645
640
635
630
625
620
615
610
605
600
2/1/12
3/22/12
5/11/12
6/30/12
8/19/12
10/8/12
11/27/12
1/16/13
3/7/13
4/26/13
6/15/13
8/4/13
Date

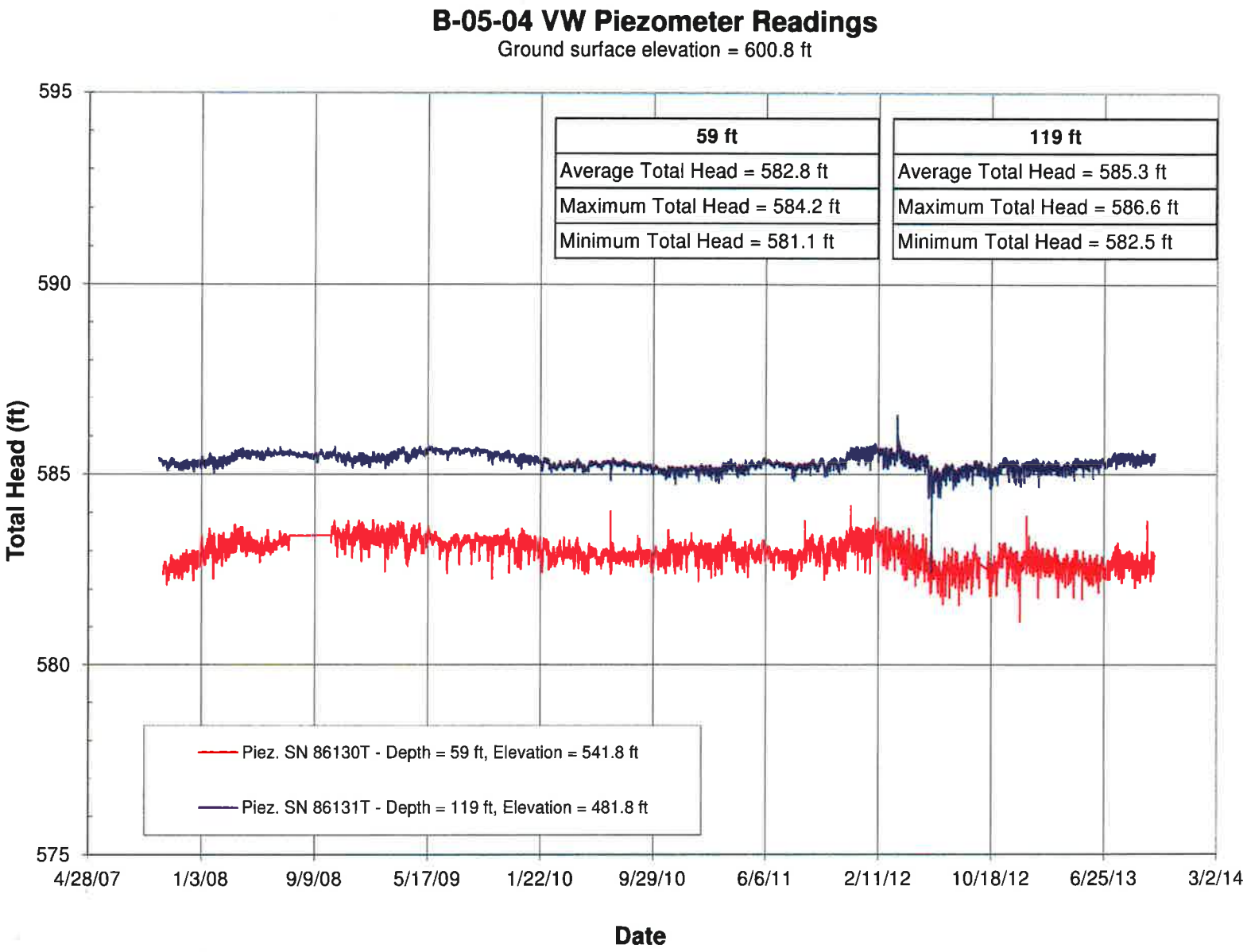

P-004-10 VW Piezometer Readings
Ground surface elevation = 674.6 ft
90 ft
Average Total Head = 625.5 ft
Maximum Total Head = 635.7 ft
Minimum Total Head = 619.2 ft
135 ft
Average Total Head = 616.6 ft
Maximum Total Head = 623.8 ft
Minimum Total Head = 610.7 ft
Piez. SN 11-1717 - Depth = 90 ft, Elevation = 584.56 ft
Piez. SN 10-6513 - Depth = 135 ft, Elevation = 539.56 ft
Total Head (ft)
635
630
625
620
615
610
6/6/11
9/14/11
12/23/11
4/1/12
7/10/12
10/18/12
1/26/13
5/6/13
8/14/13
11/22/13
Date

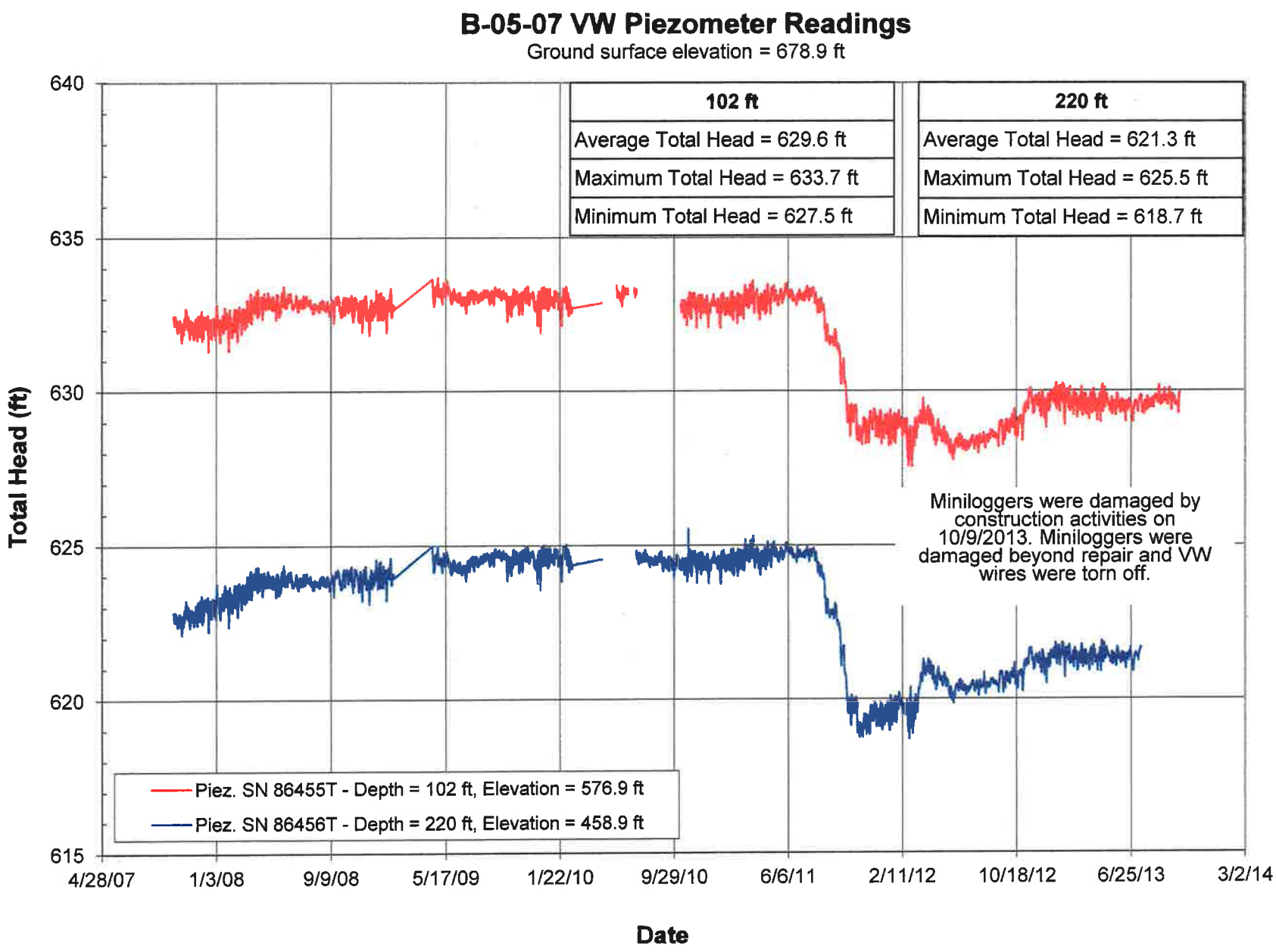

P-008-10 VW Piezometer Readings
Ground surface elevation = 632.3 ft
45 ft
Average Total Head = 606 ft
Maximum Total Head = 609.1 ft
Minimum Total Head = 604.9 ft
170 ft
Average Total Head = 593.9 ft
Maximum Total Head = 596.4 ft
Minimum Total Head = 591.6 ft
Piez. SN 11-2445 - Depth = 45 ft, Elevation = 587.3 ft
Piez. SN 11-2425 - Depth = 170 ft, Elevation = 462.3 ft
Total Head (ft)
620
615
610
605
600
595
590
585
580
2/26/11
6/6/11
9/14/11
12/23/11
4/1/12
7/10/12
10/18/12
1/26/13
5/6/13
8/14/13
11/22/13
Date

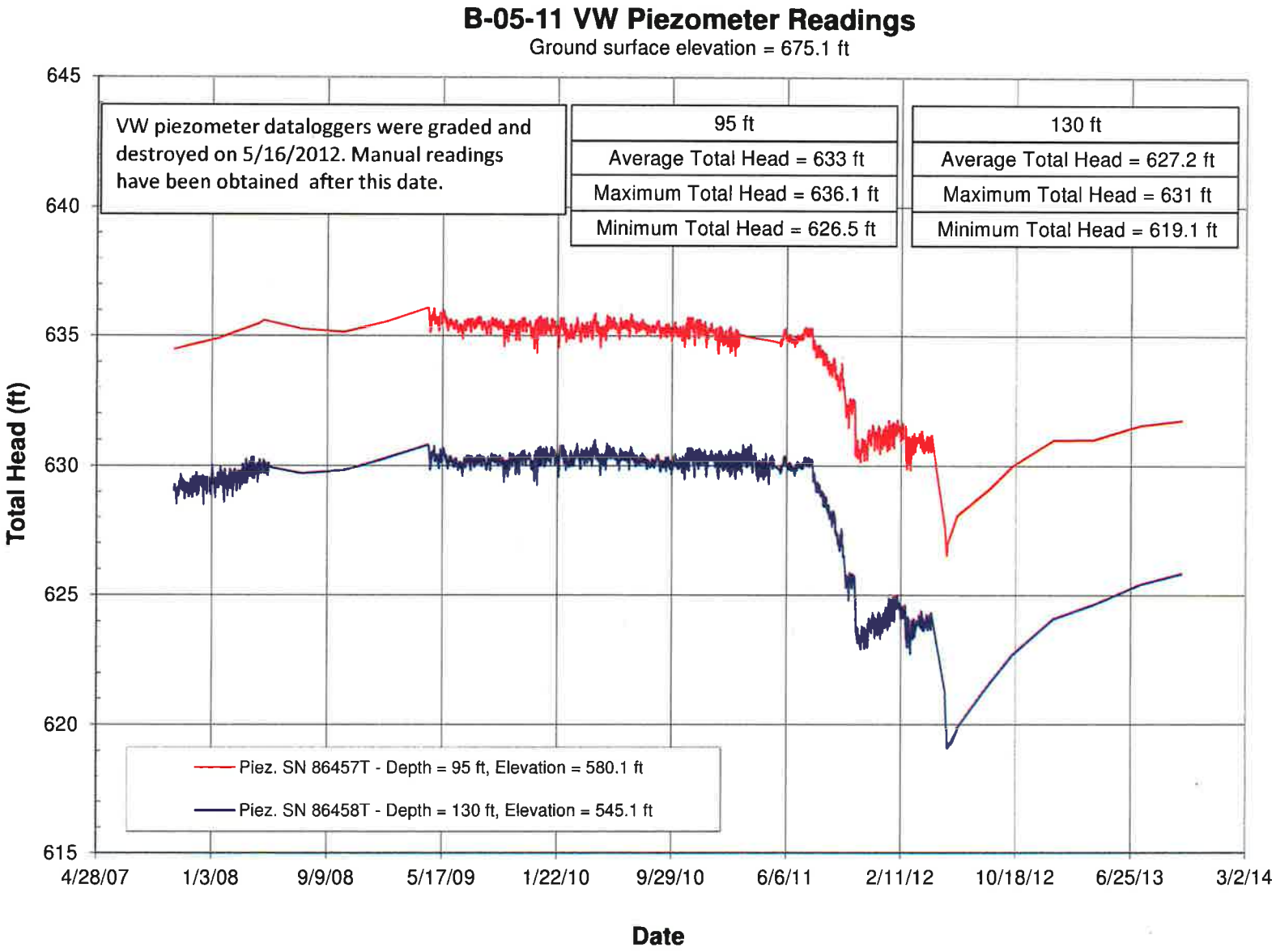

B-05-02 VW Piezometer Readings
Ground surface elevation = approx 609.0 ft
37.1 ft
Average Total Head = 590.3 ft
Maximum Total Head = 594.4 ft
Minimum Total Head = 583.6 ft
113.1 ft
Average Total Head = 584.2 ft
Maximum Total Head = 590.1 ft
Minimum Total Head = 580.5 ft
Piez. SN 86126T - Depth = 46 ft, Elevation = 571.9 ft
Piez. SN 86127T - Depth = 122 ft, Elevation = 495.9 ft
Piez. SN VW18678 - Depth = 37.1 ft, Elevation = 571.9 ft
Piez. SN VW18681 - Depth = 113.1 ft, Elevation = 495.9 ft
Total Head (ft)
600
595
590
585
580
4/28/07
11/14/07
6/1/08
12/18/08
7/6/09
1/22/10
8/10/10
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
Date

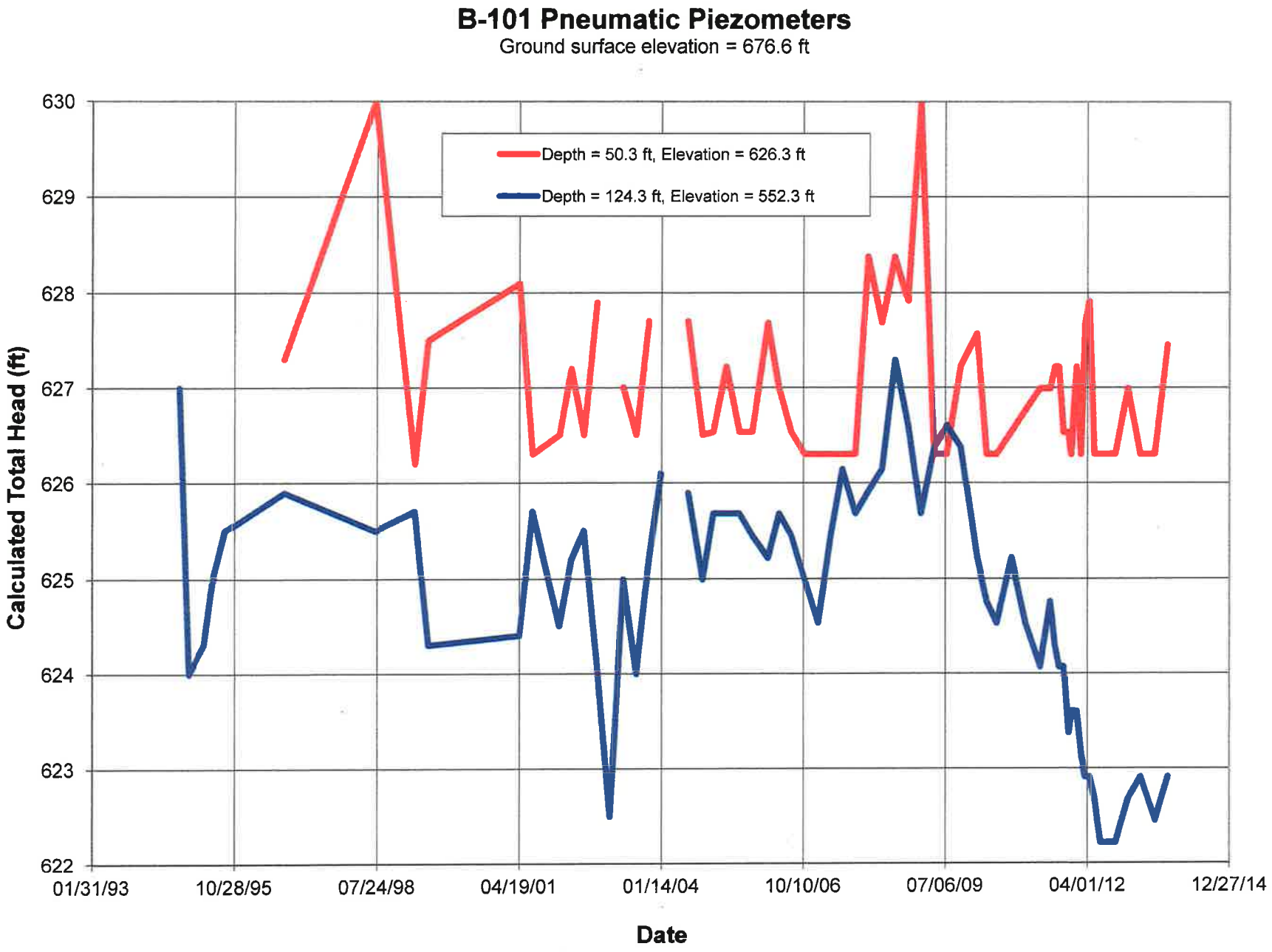

B-05-02 VW Piezometer Readings
Ground surface elevation = approx 609.0 ft
Piez. SN VW18678 - Depth = 37.1 ft, Elevation = 571.9 ft
Piez. SN VW18681 - Depth = 113.1 ft, Elevation = 495.9 ft
37.1 ft
Average Total Head = 590.3 ft
Maximum Total Head = 594.4 ft
Minimum Total Head = 583.6 ft
113.1 ft
Average Total Head = 584.2 ft
Maximum Total Head = 590.1 ft
Minimum Total Head = 580.5 ft
Total Head (ft)
600
595
590
585
580
12/23/11
4/1/12
7/10/12
10/18/12
1/26/13
5/6/13
8/14/13
11/22/13
Date

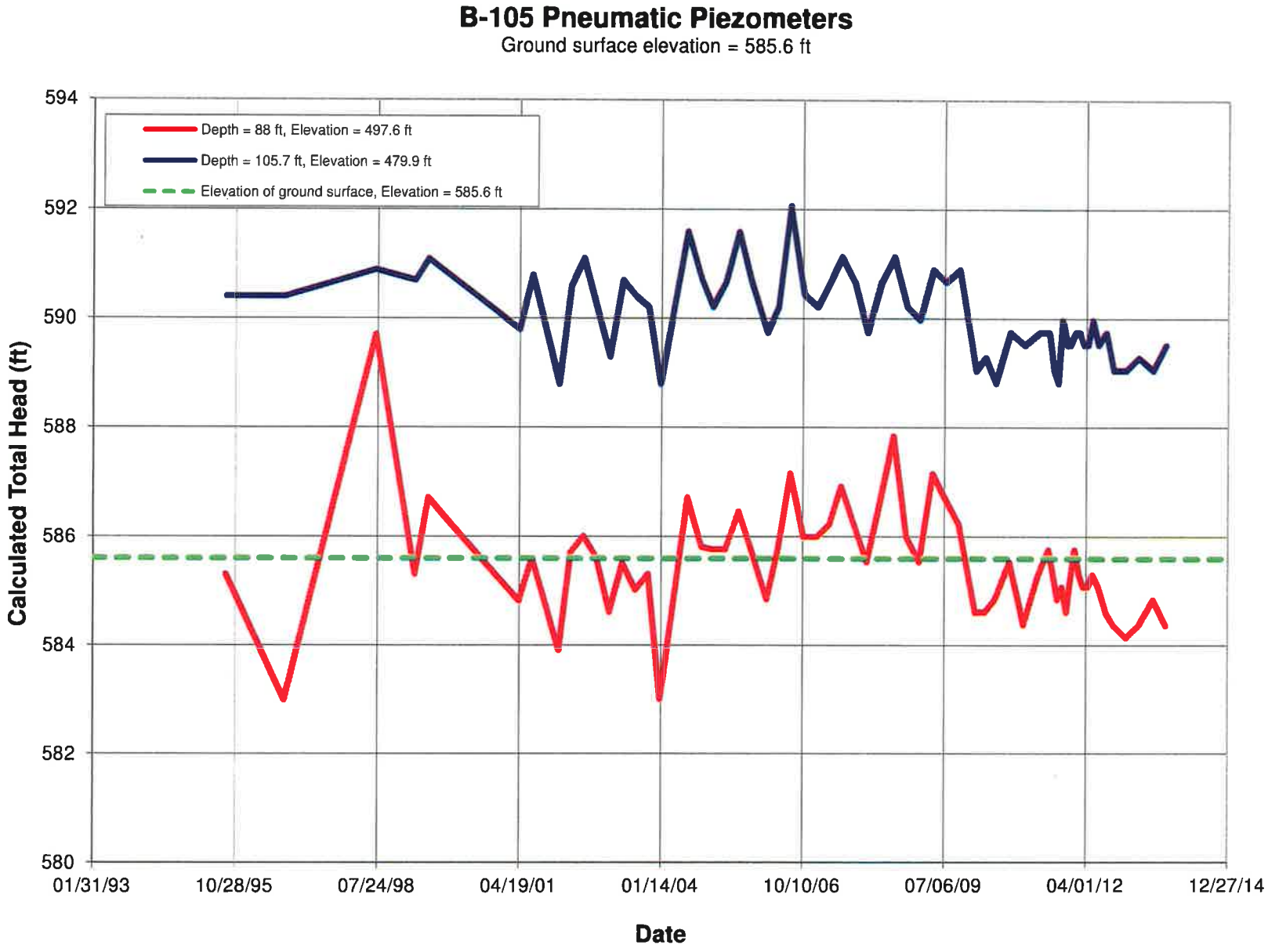

B-05-03 VW Piezometer Readings
Ground surface elevation = 605.1 ft
32 ft
Average Total Head = 590.2 ft
Maximum Total Head = 592.5 ft
Minimum Total Head = 589 ft
112 ft
Average Total Head = 593.3 ft
Maximum Total Head = 594.6 ft
Minimum Total Head = 587.4 ft
Piez. SN 86128T - Depth = 32 ft, Elevation = 573.1 ft
Piez. SN 86129T - Depth = 112 ft, Elevation = 493.1 ft
Total Head (ft)
600
595
590
585
580
4/28/07
1/3/08
9/9/08
5/17/09
1/22/10
9/29/10
6/6/11
2/11/12
10/18/12
6/25/13
3/2/14
Date


B-05-04 VW Piezometer Readings
Ground surface elevation = 600.8 ft
59 ft
Average Total Head = 582.8 ft
Maximum Total Head = 584.2 ft
Minimum Total Head = 581.1 ft
119 ft
Average Total Head = 585.3 ft
Maximum Total Head = 586.6 ft
Minimum Total Head = 582.5 ft
Piez. SN 86130T - Depth = 59 ft, Elevation = 541.8 ft
Piez. SN 86131T - Depth = 119 ft, Elevation = 481.8 ft
Total Head (ft)
595
590
585
580
575
4/28/07
1/3/08
9/9/08
5/17/09
1/22/10
9/29/10
6/6/11
2/11/12
10/18/12
6/25/13
3/2/14
Date


B-05-07 VW Piezometer Readings
Ground surface elevation = 678.9 ft
102 ft
Average Total Head = 629.6 ft
Maximum Total Head = 633.7 ft
Minimum Total Head = 627.5 ft
220 ft
Average Total Head = 621.3 ft
Maximum Total Head = 625.5 ft
Minimum Total Head = 618.7 ft
Miniloggers were damaged by construction activities on 10/9/2013. Miniloggers were damaged beyond repair and VW wires were torn off.
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
4/28/07
1/3/08
9/9/08
5/17/09
1/22/10
9/29/10
6/6/11
2/11/12
10/18/12
6/25/13
3/2/14
Date


B-05-11 VW Piezometer Readings
Ground surface elevation = 675.1 ft
VW piezometer dataloggers were graded and destroyed on 5/16/2012. Manual readings have been obtained after this date.
95 ft
Average Total Head = 633 ft
Maximum Total Head = 636.1 ft
Minimum Total Head = 626.5 ft
130 ft
Average Total Head = 627.2 ft
Maximum Total Head = 631 ft
Minimum Total Head = 619.1 ft
Piez. SN 86457T - Depth = 95 ft, Elevation = 580.1 ft
Piez. SN 86458T - Depth = 130 ft, Elevation = 545.1 ft
Total Head (ft)
645
640
635
630
625
620
615
4/28/07
1/3/08
9/9/08
5/17/09
1/22/10
9/29/10
6/6/11
2/11/12
10/18/12
6/25/13
3/2/14
Date


B-101 Pneumatic Piezometers
Ground surface elevation = 676.6 ft
Depth = 50.3 ft, Elevation = 626.3 ft
Depth = 124.3 ft, Elevation = 552.3 ft
Calculated Total Head (ft)
630
629
628
627
626
625
624
623
622
01/31/93
10/28/95
07/24/98
04/19/01
01/14/04
10/10/06
07/06/09
04/01/12
12/27/14
Date


B-105 Pneumatic Piezometers
Ground surface elevation = 585.6 ft
Depth = 88 ft, Elevation = 497.6 ft
Depth = 105.7 ft, Elevation = 479.9 ft
Elevation of ground surface, Elevation = 585.6 ft
Calculated Total Head (ft)
594
592
590
588
586
584
582
580
01/31/93
10/28/95
07/24/98
04/19/01
01/14/04
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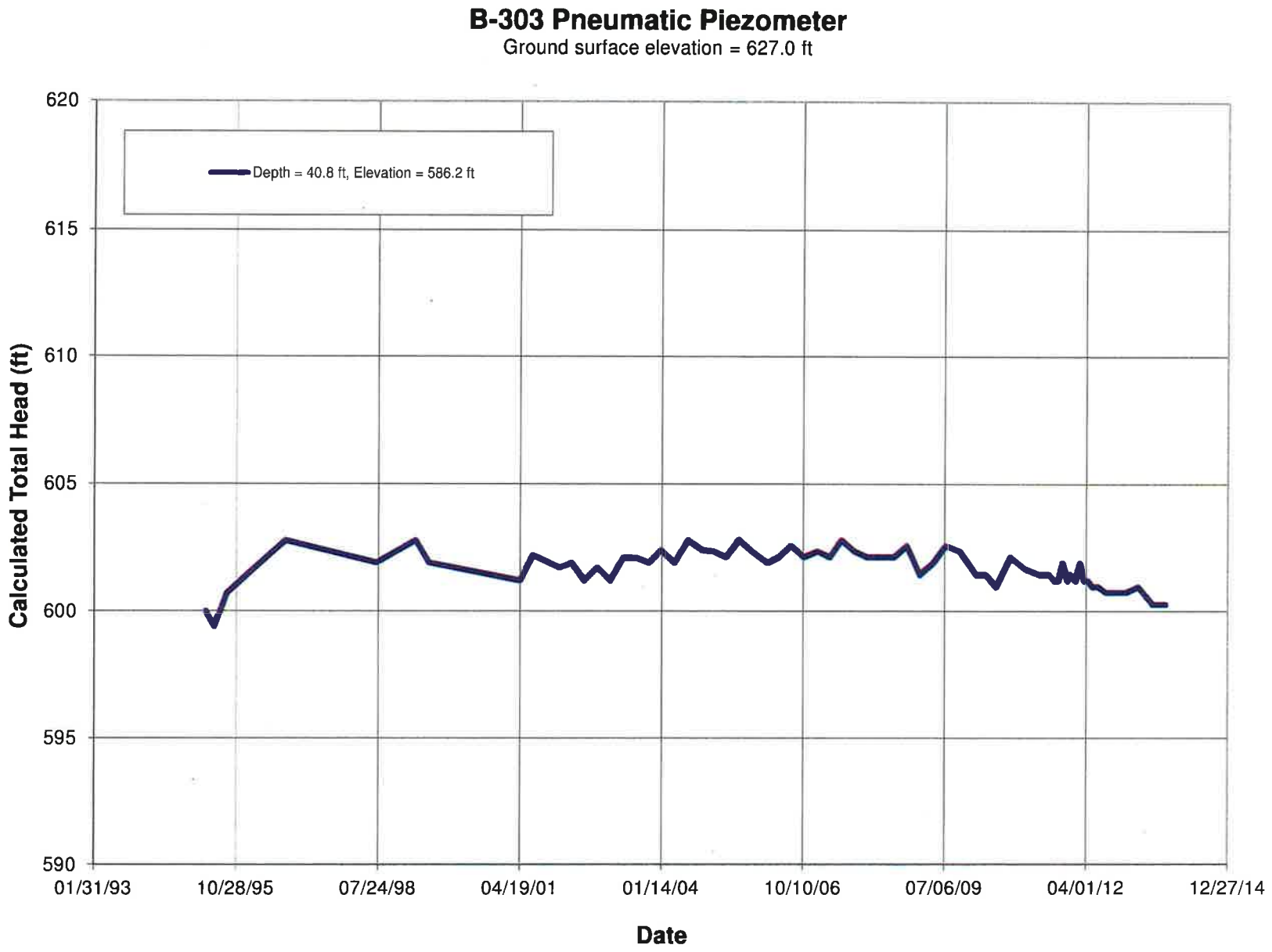
07/06/09
04/01/12
12/27/14
Date


B-303 Pneumatic Piezometer
Ground surface elevation = 627.0 ft
Depth = 40.8 ft, Elevation = 586.2 ft
Calculated Total Head (ft)
620
615
610
605
600
595
590
01/31/93
10/28/95
07/24/98
04/19/01
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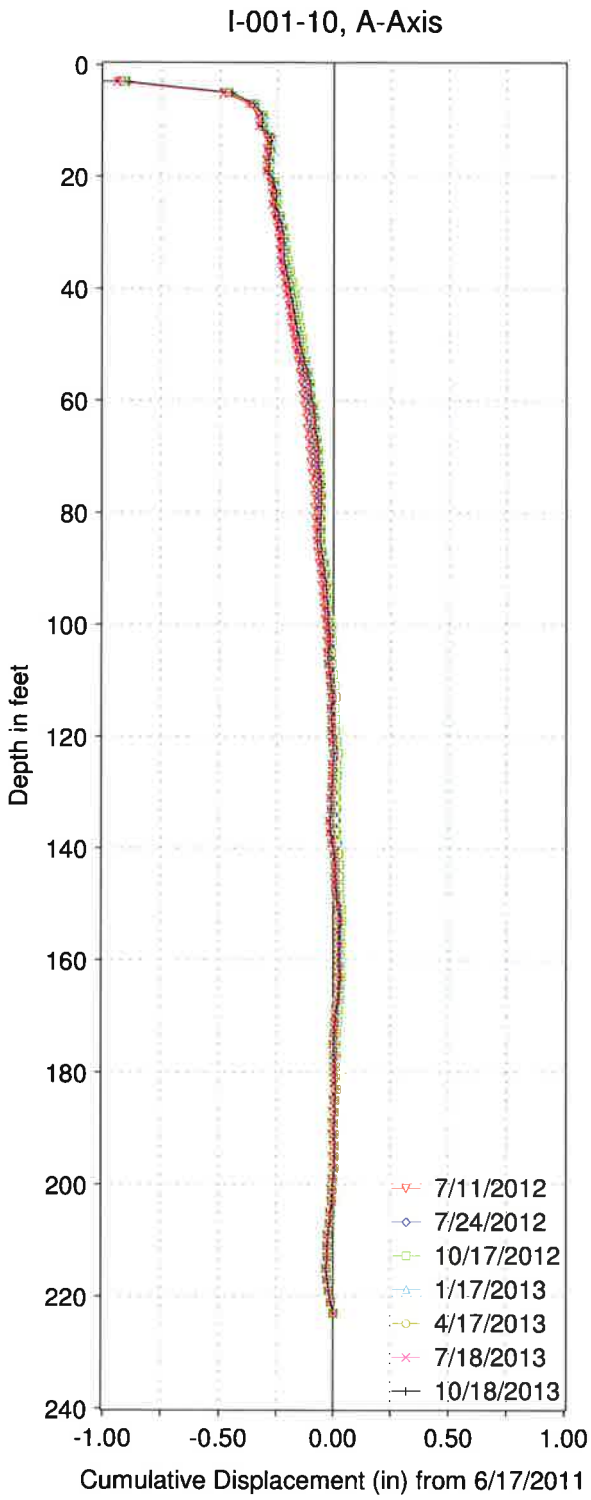
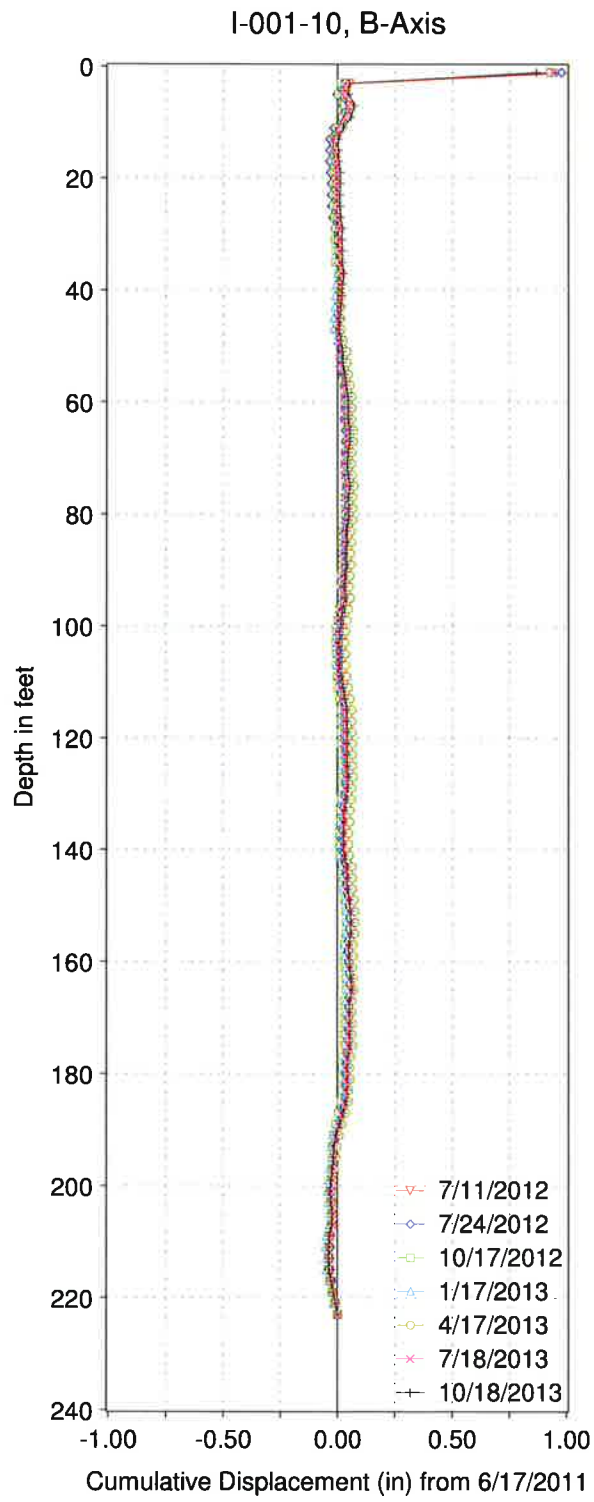
10/10/06
07/06/09
04/01/12
12/27/14
Date

APPENDIX B
INCLINOMETERS





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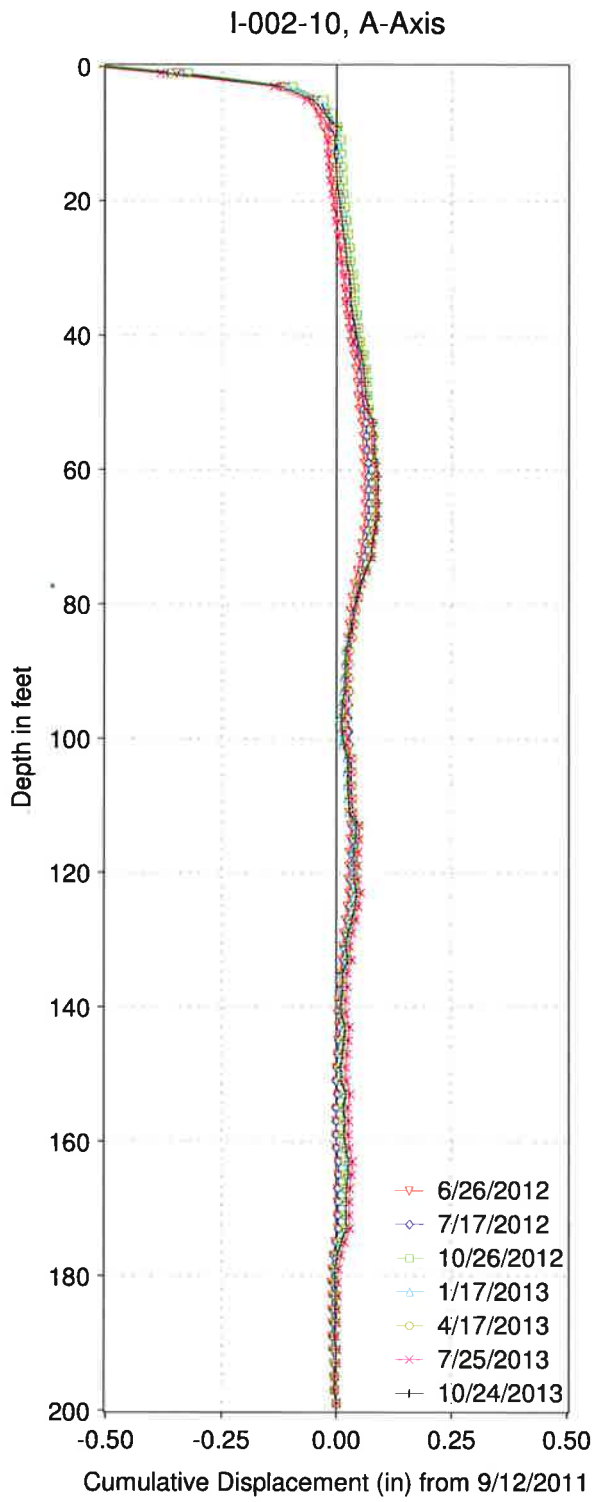
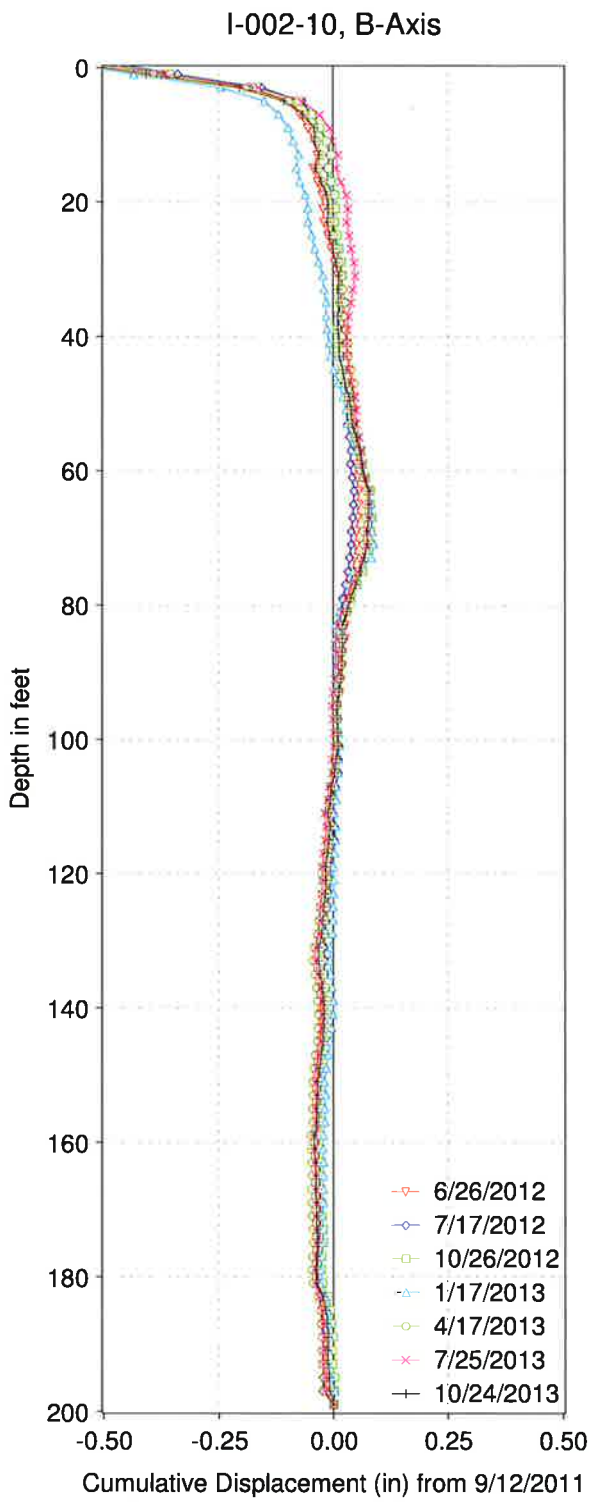
SME Project# 062943.00
Reading Date: 10/18/2013

Soil and Materials Engineers, Inc.





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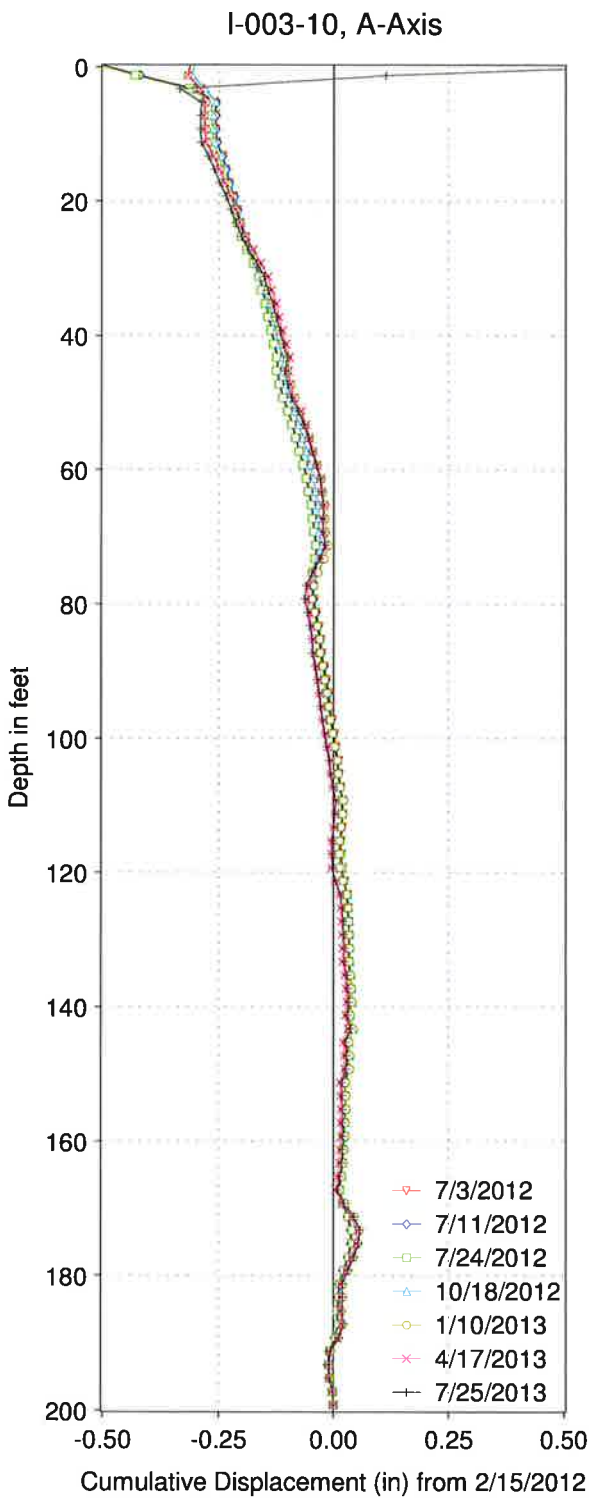

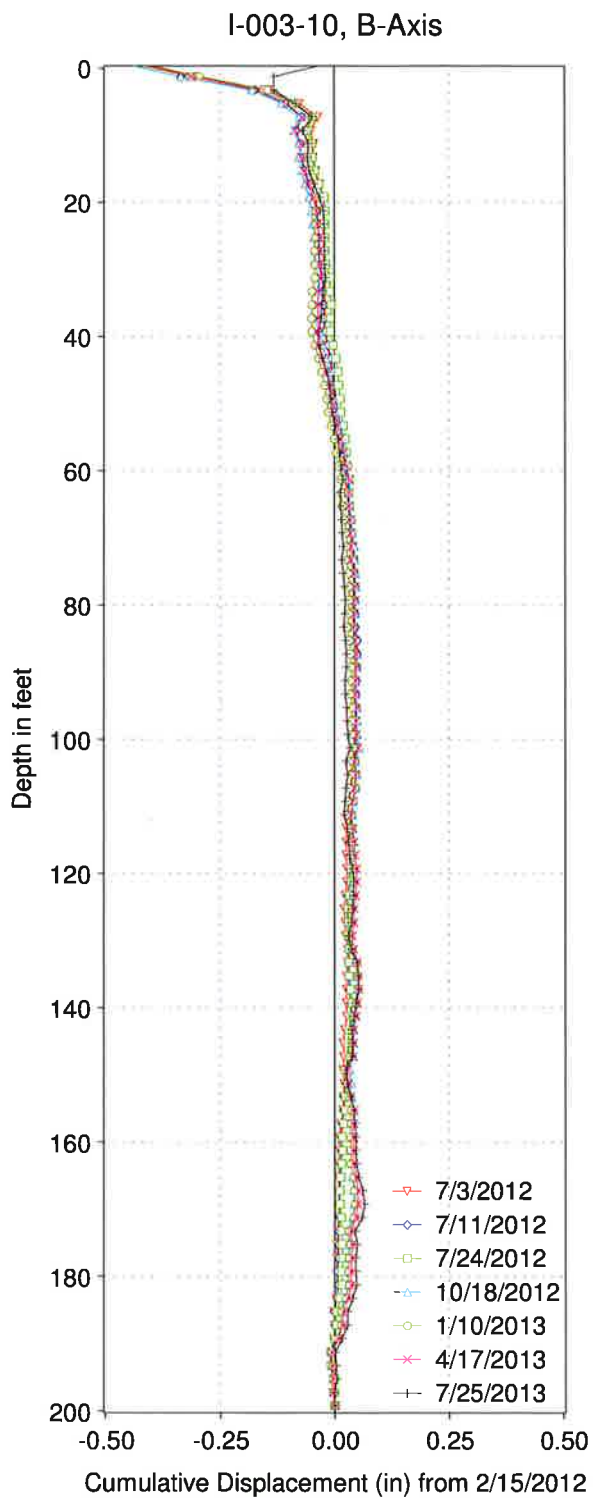

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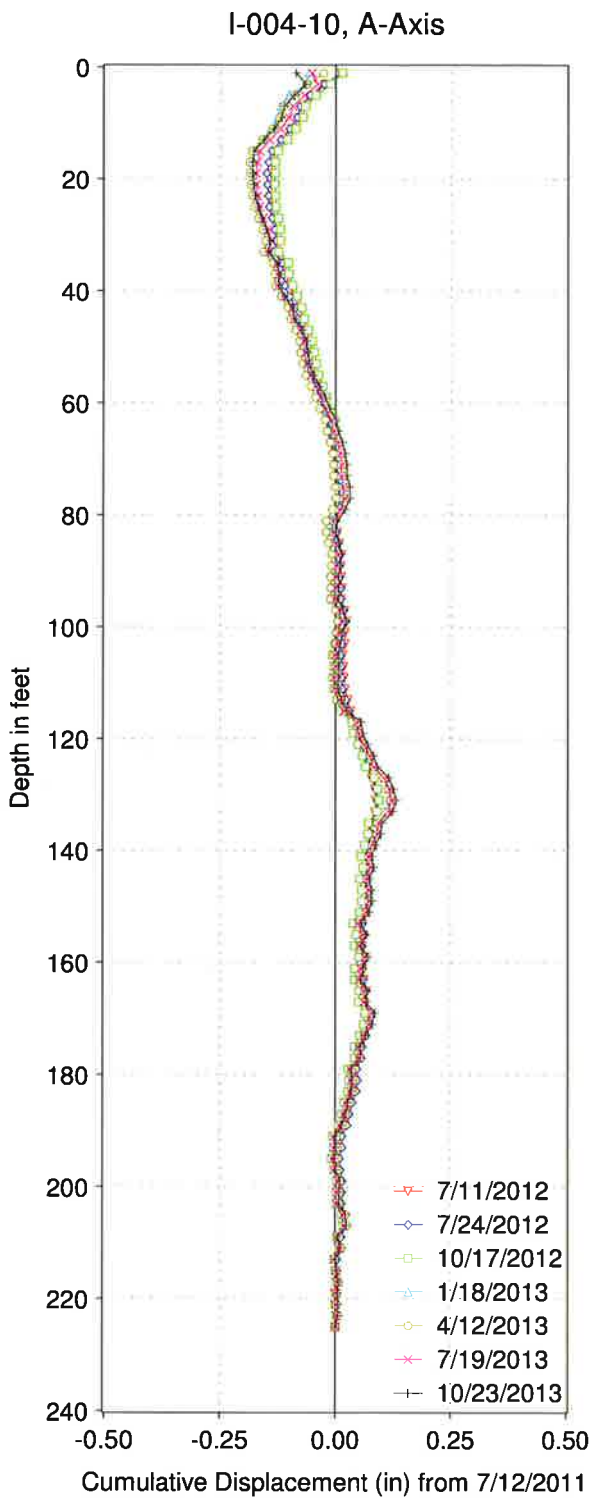
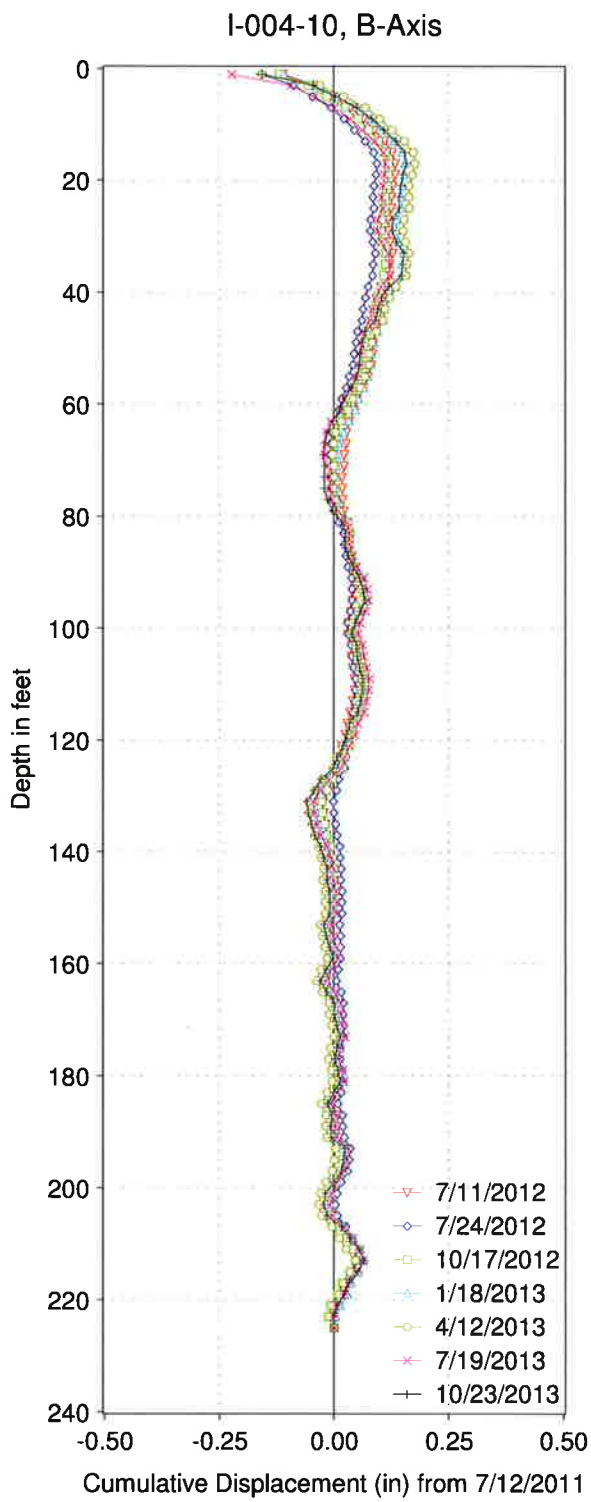
Soil and Materials Engineers, Inc.





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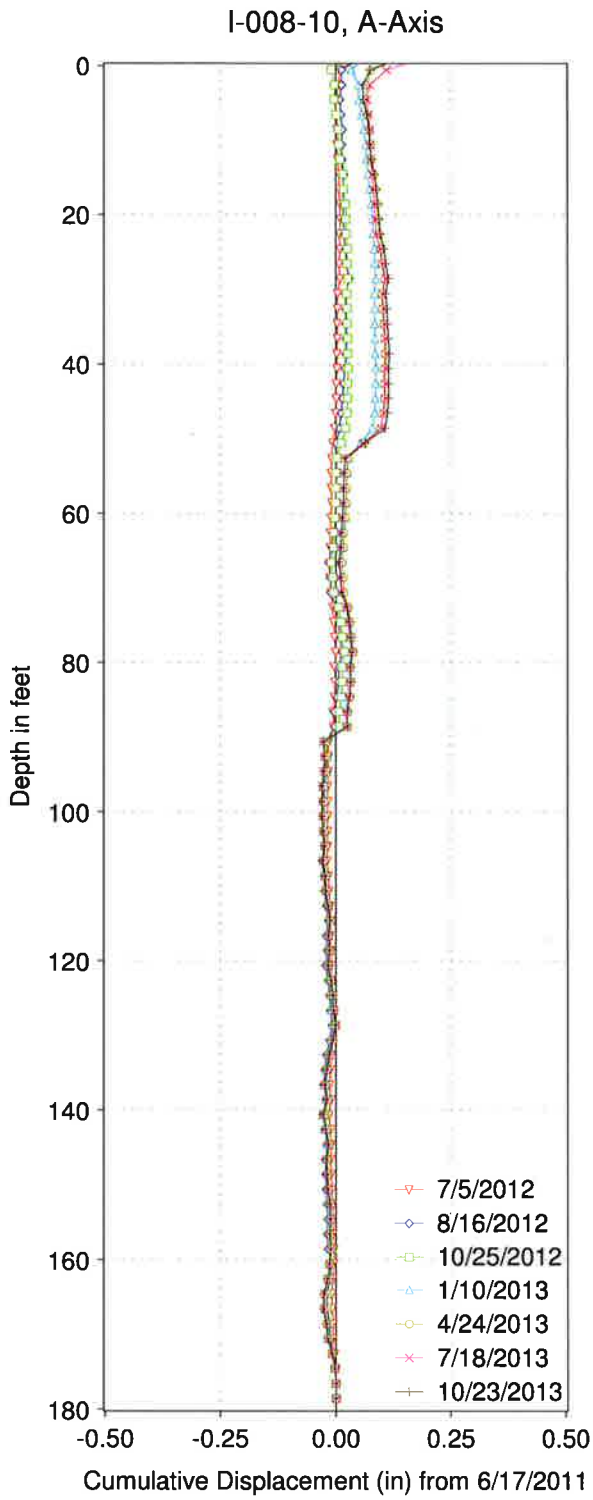
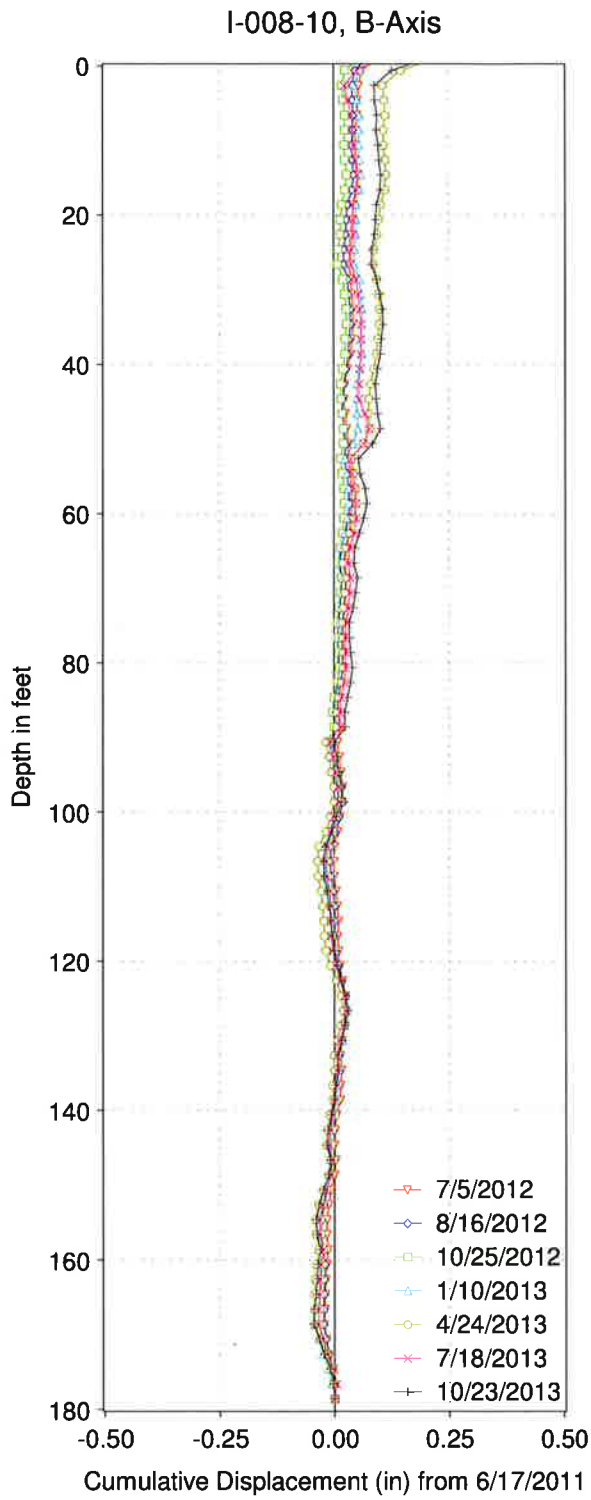
Soil and Materials Engineers, Inc.





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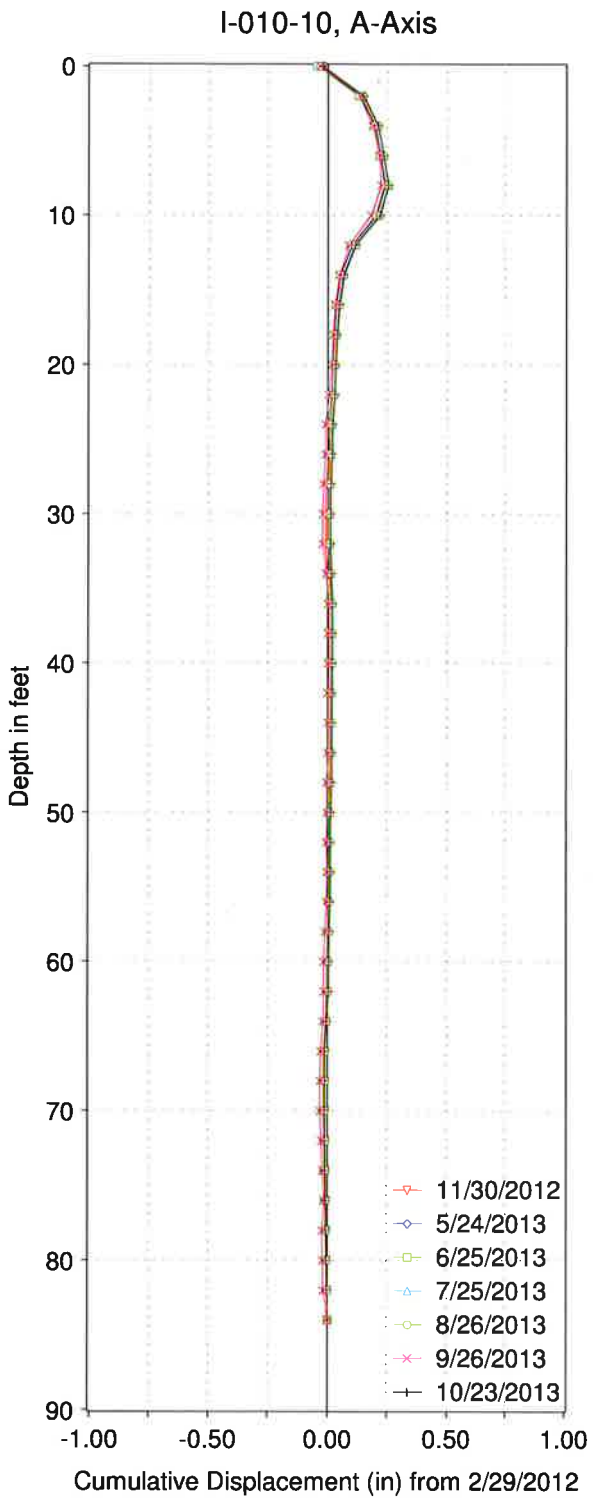
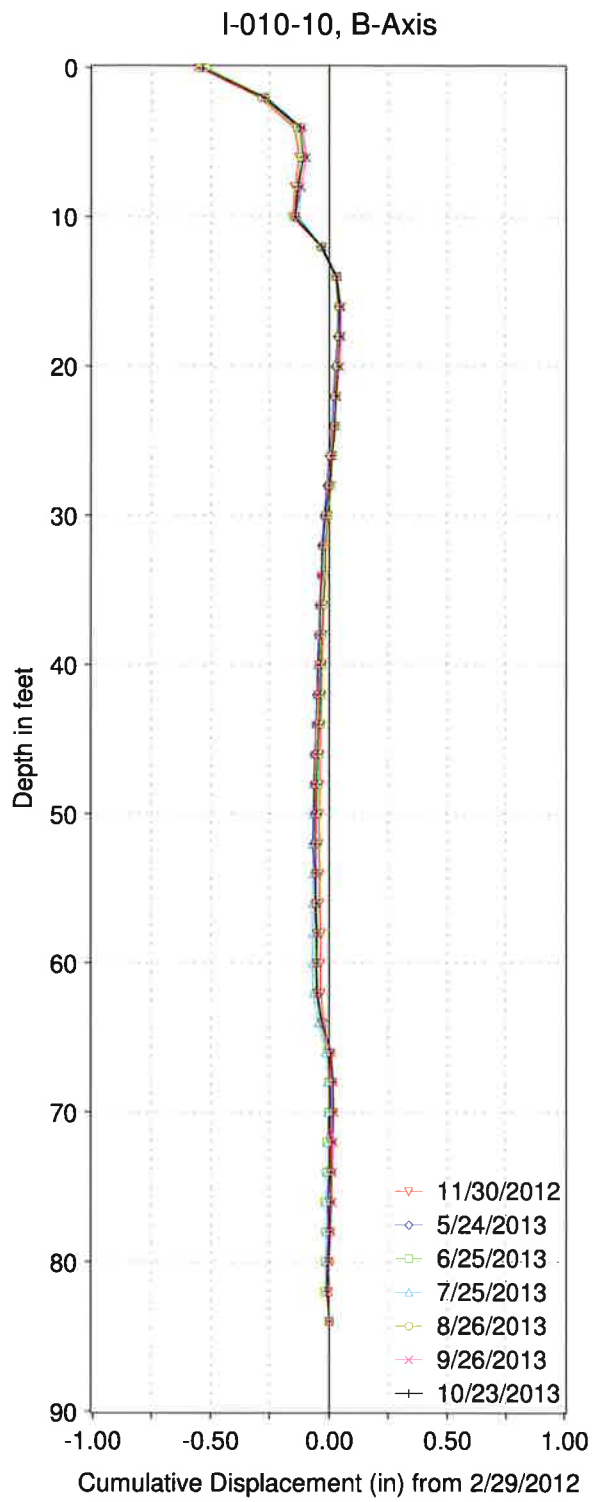
Readin Date: 10/23/2013

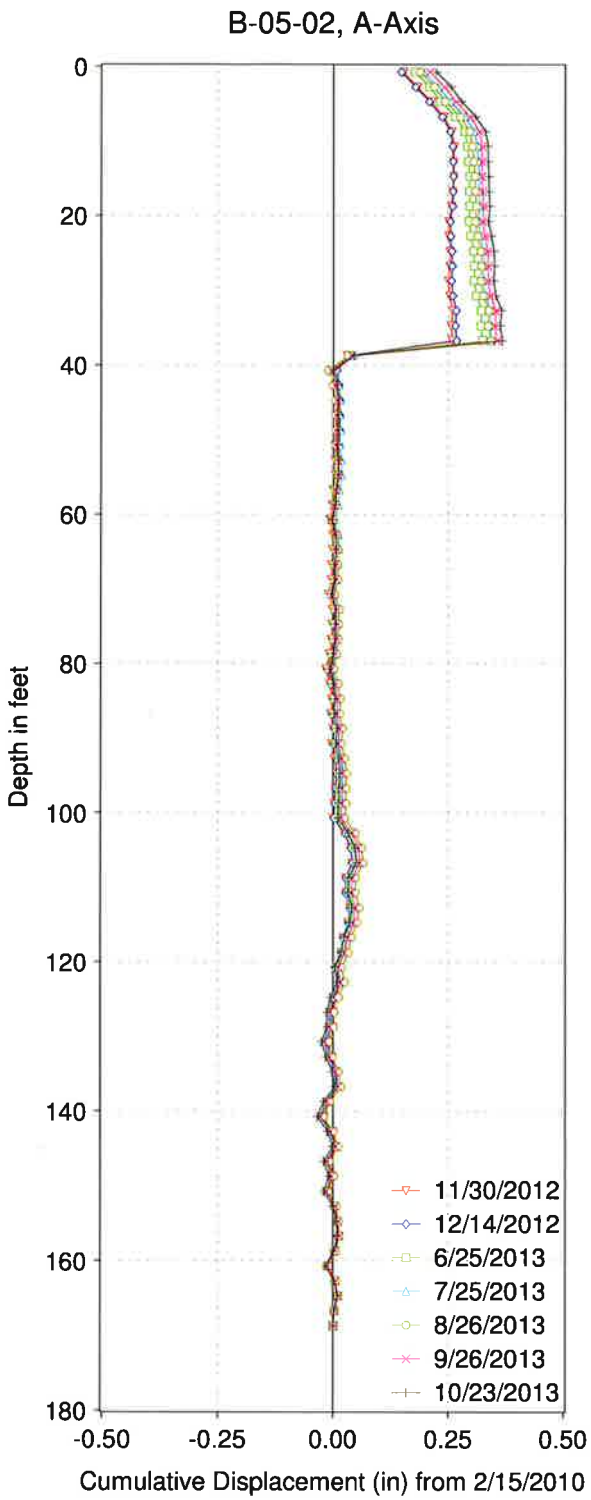
Soil and Materials Engineers, Inc.

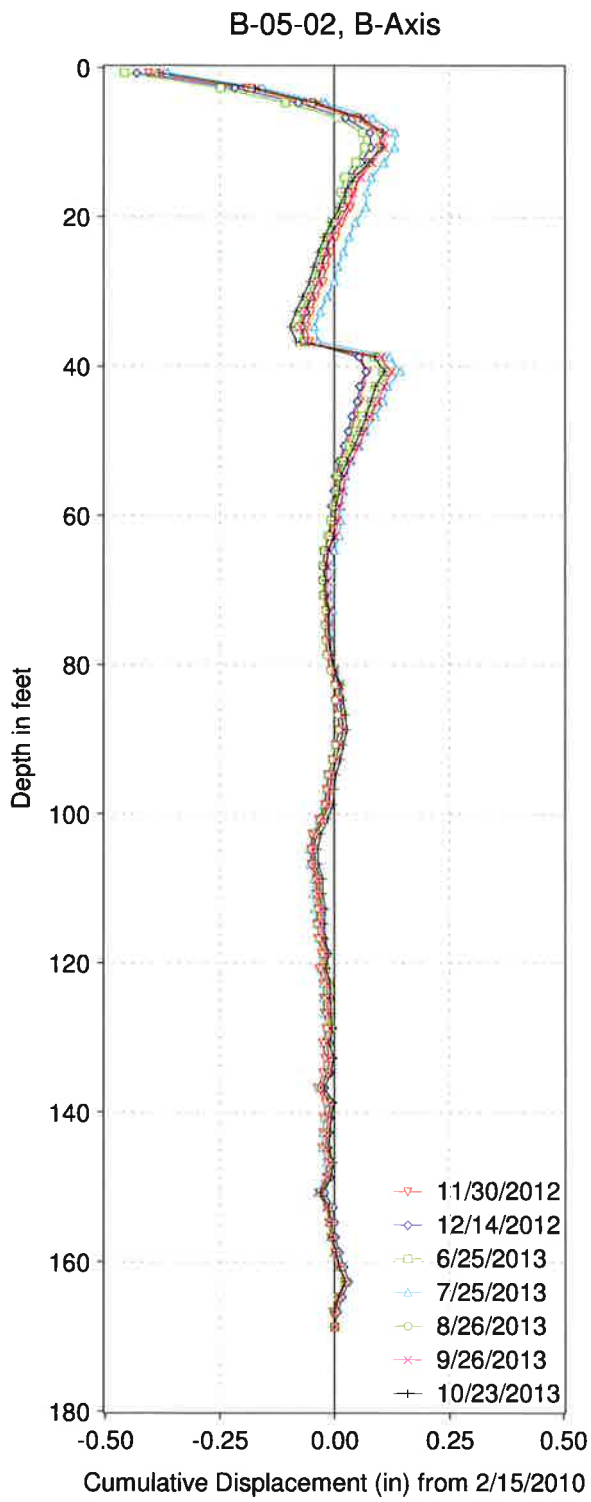




CUY-90-15.24
PID 76117
SME Project# 062943.00
Reading Date: 10/23/2013

Soil and Materials Engineers, Inc.





CUY-90-14.92
PID 76117
SME Project#: 062943.00
Reading Date: 10/23/2013

Soil and Materials Engineers, Inc.

CUY-90-15.24
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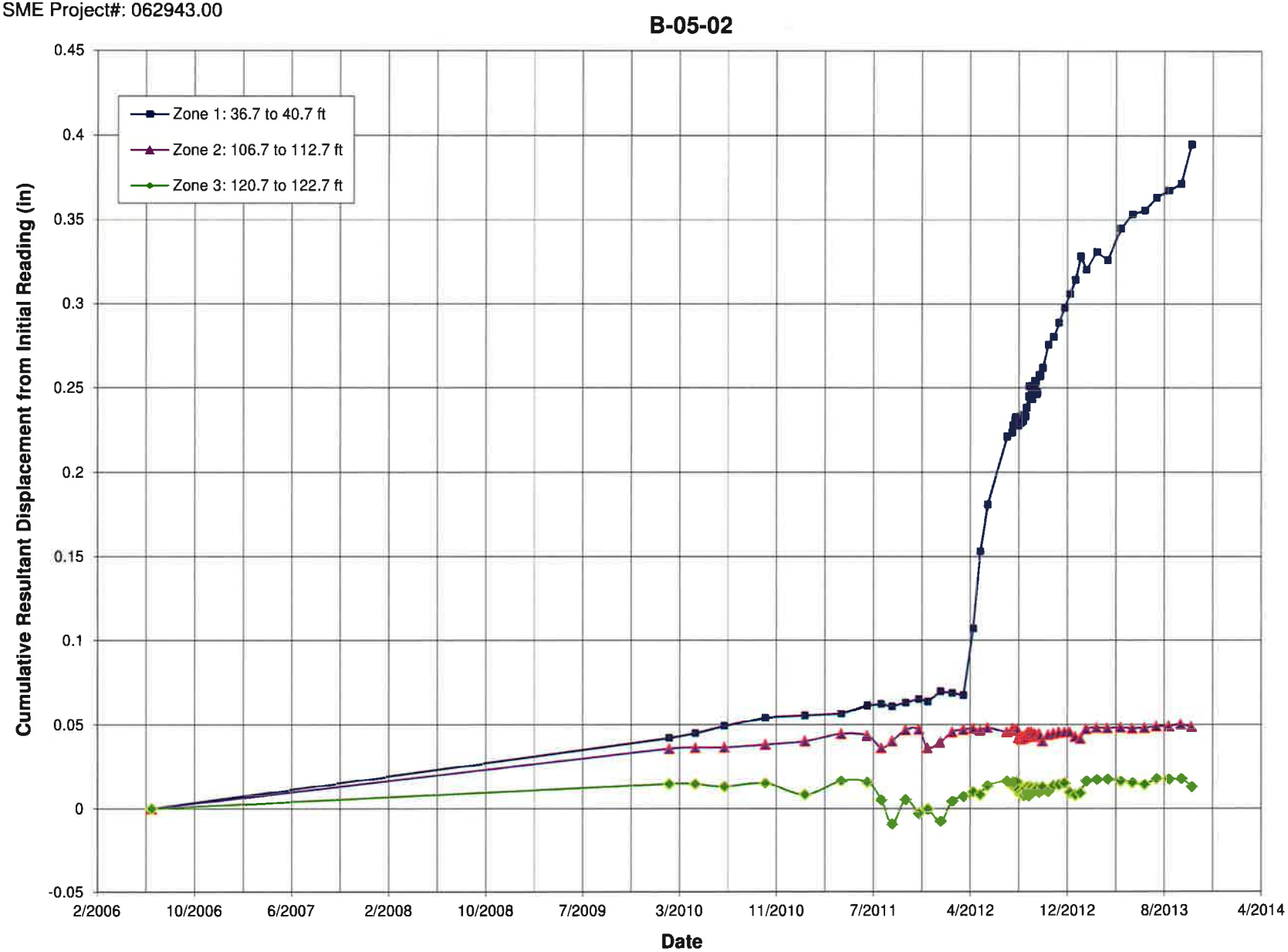
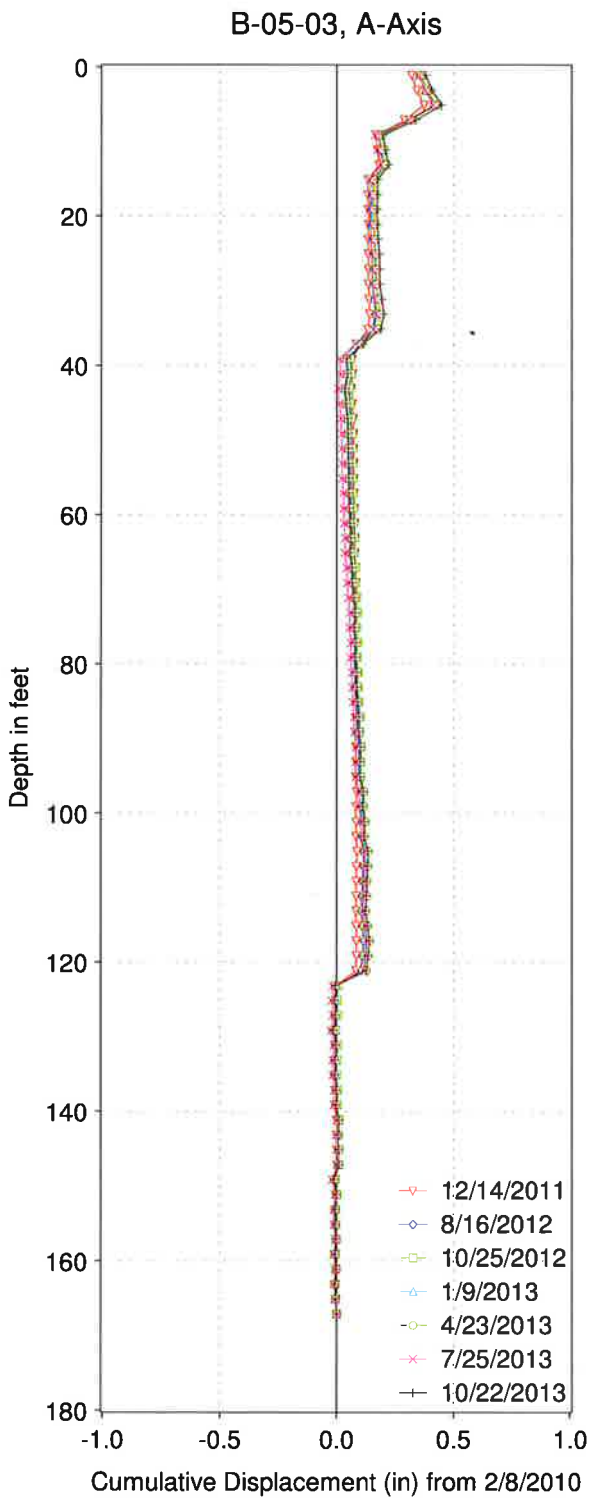
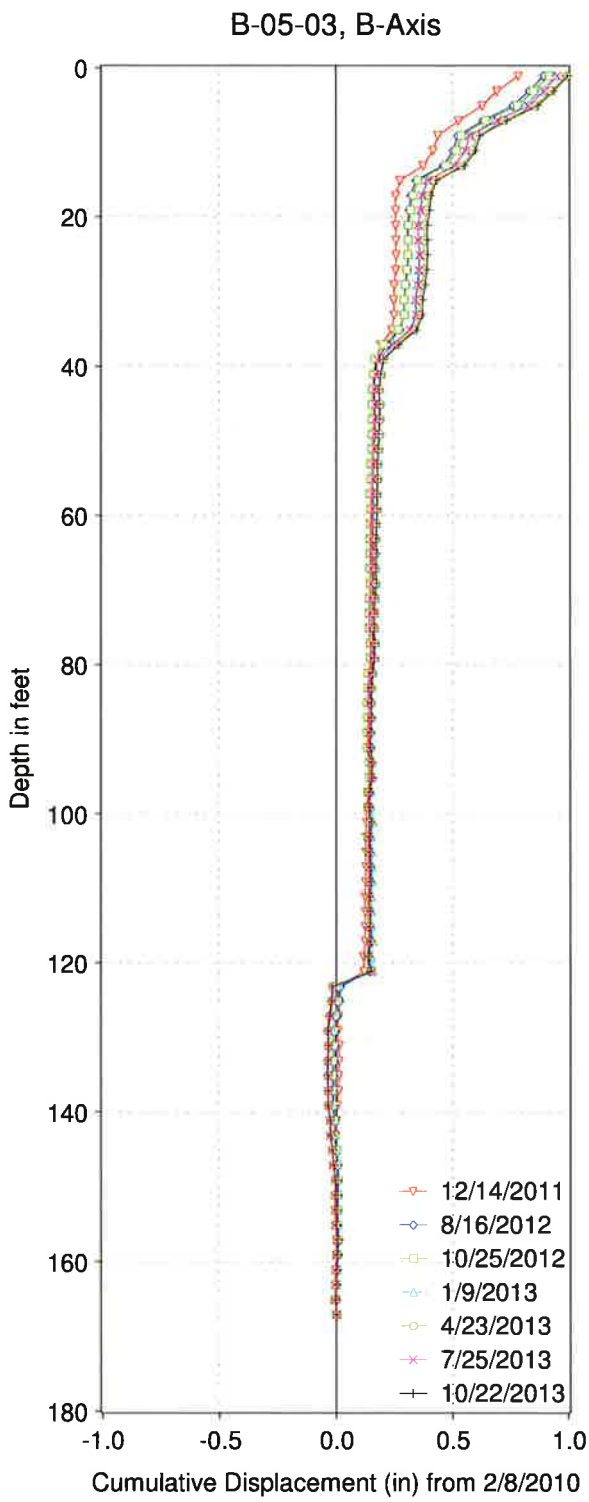




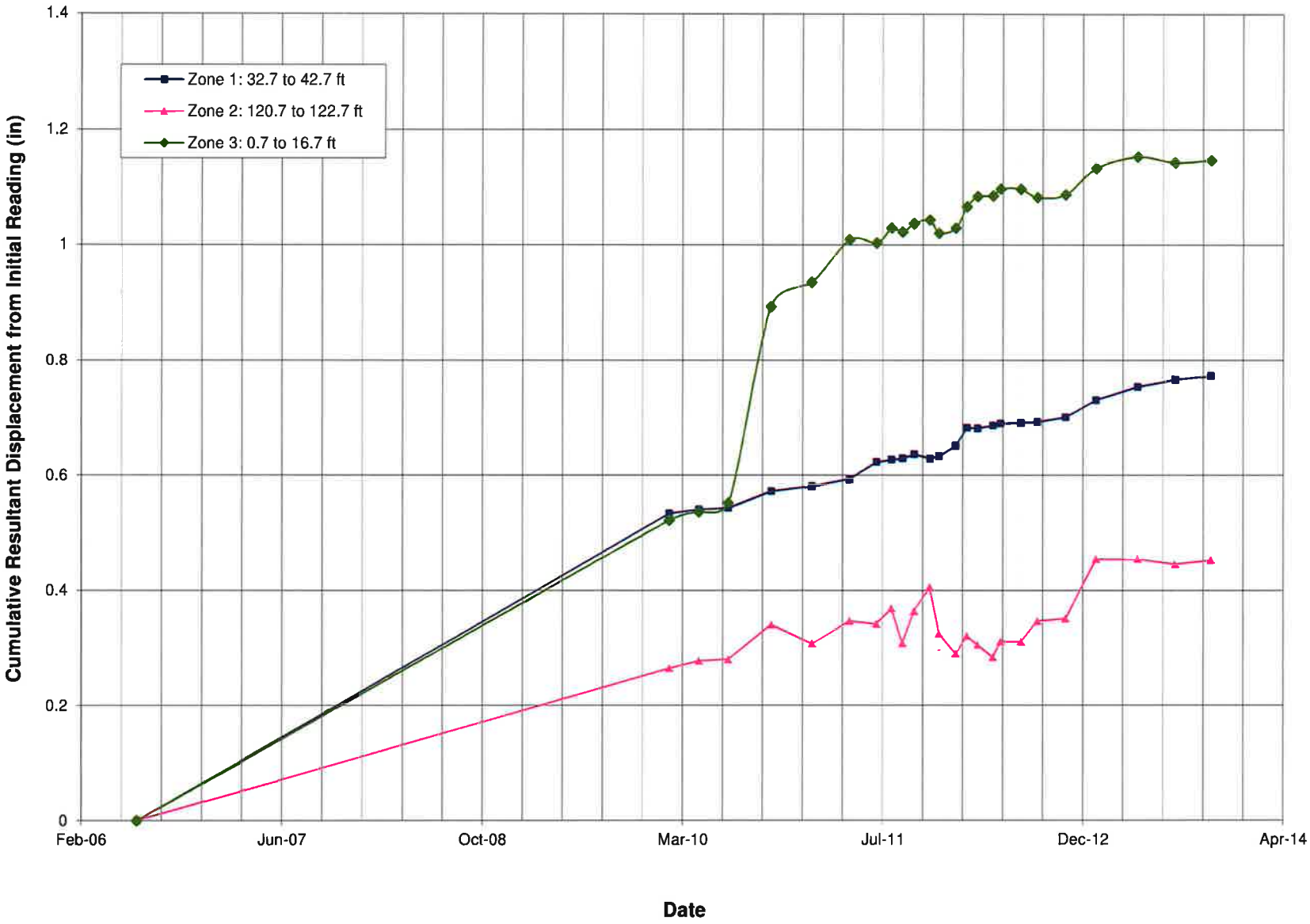


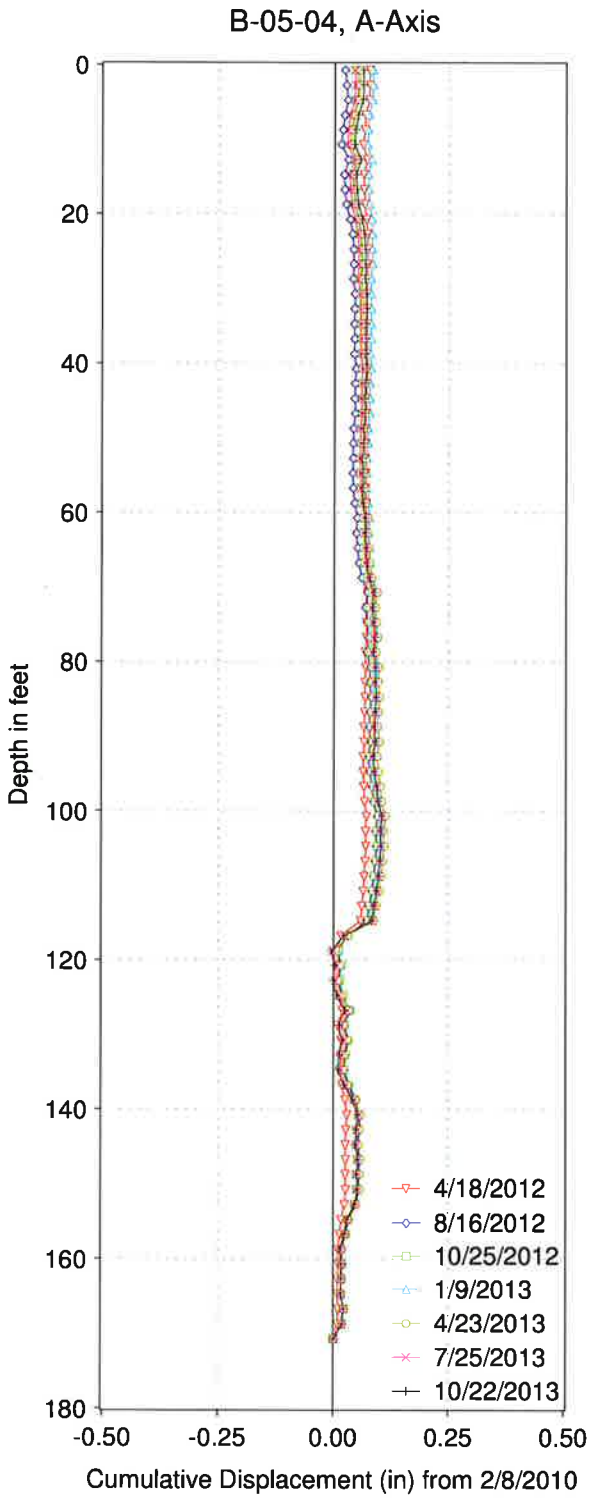
CUY-90-15.24
PID 76117
SME Project#: 062943.00
Reading Date: 10/22/2013

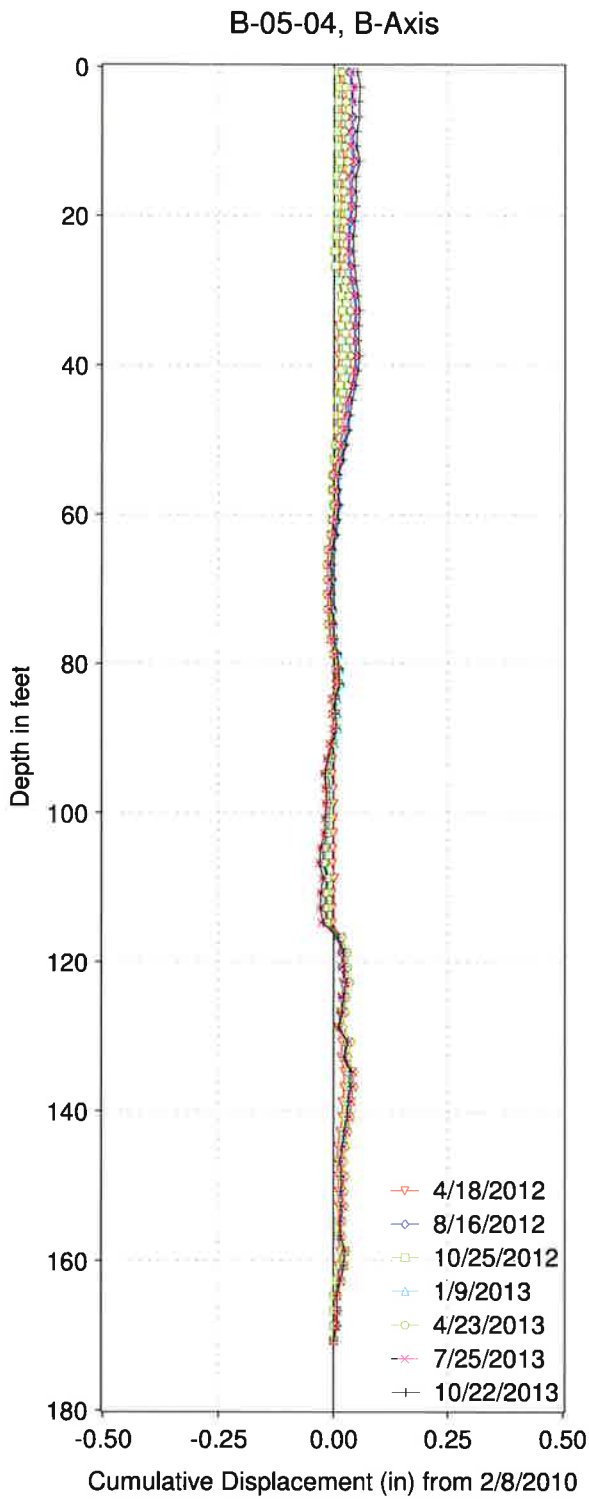
Soil and Materials Engineers, Inc.

CUY-90-15.24
PID 76117
SME Project#: 062943.00

B-05-03







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PID 76117
SME Project#: 062943.00
Reading date: 10/22/2013

Soil and Materials Engineers, Inc.

CUY-90-15.24
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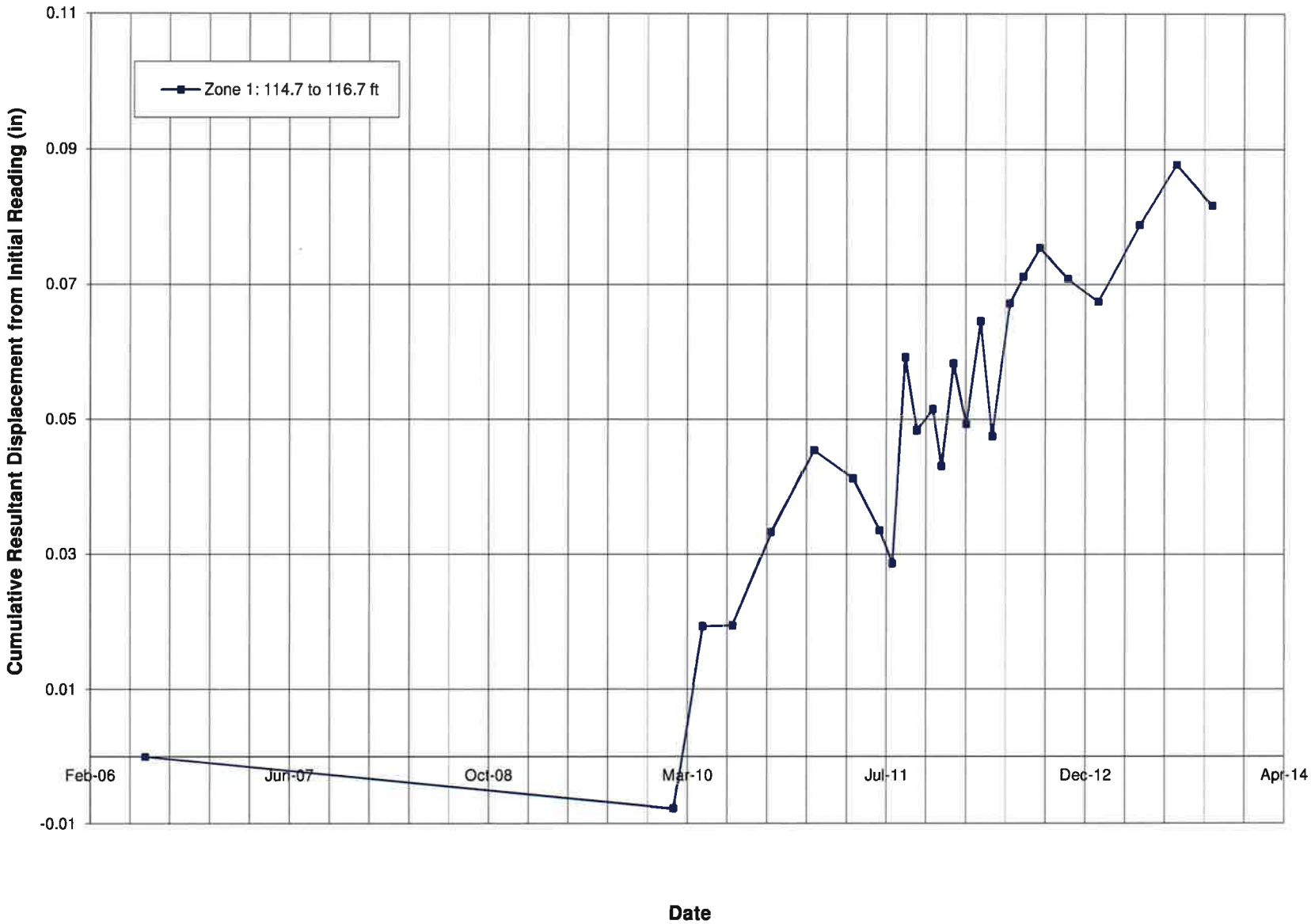
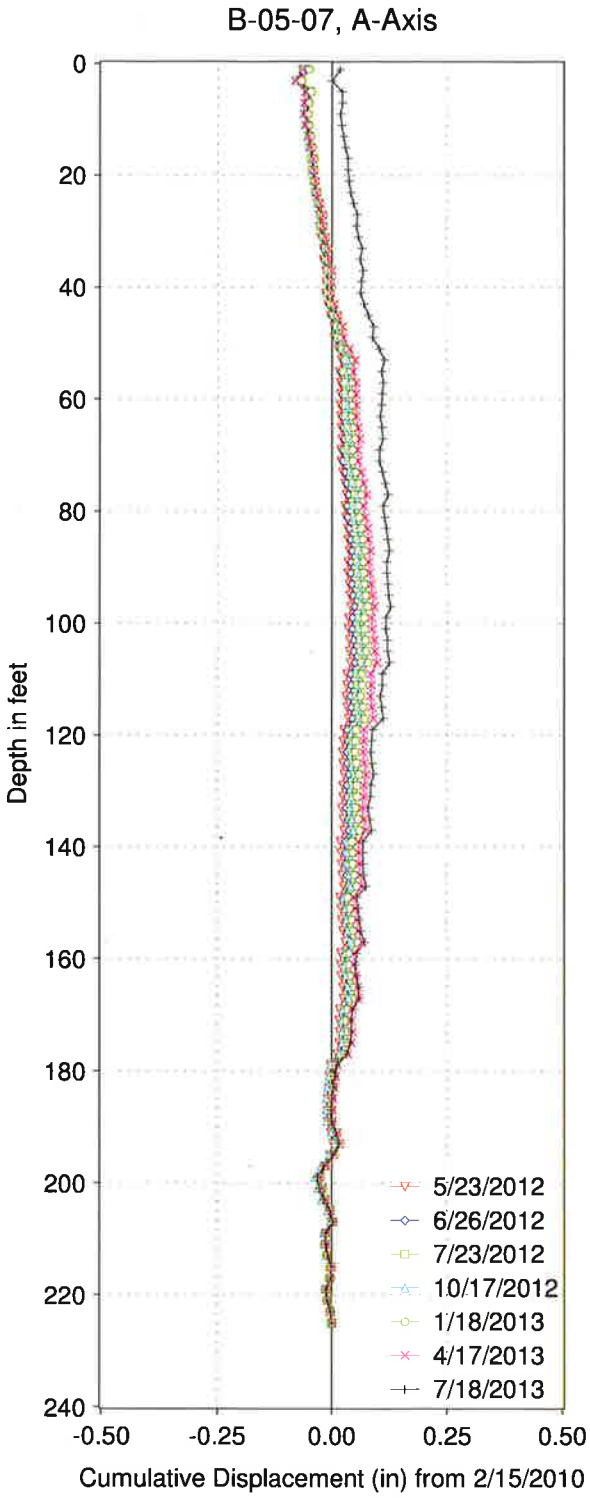
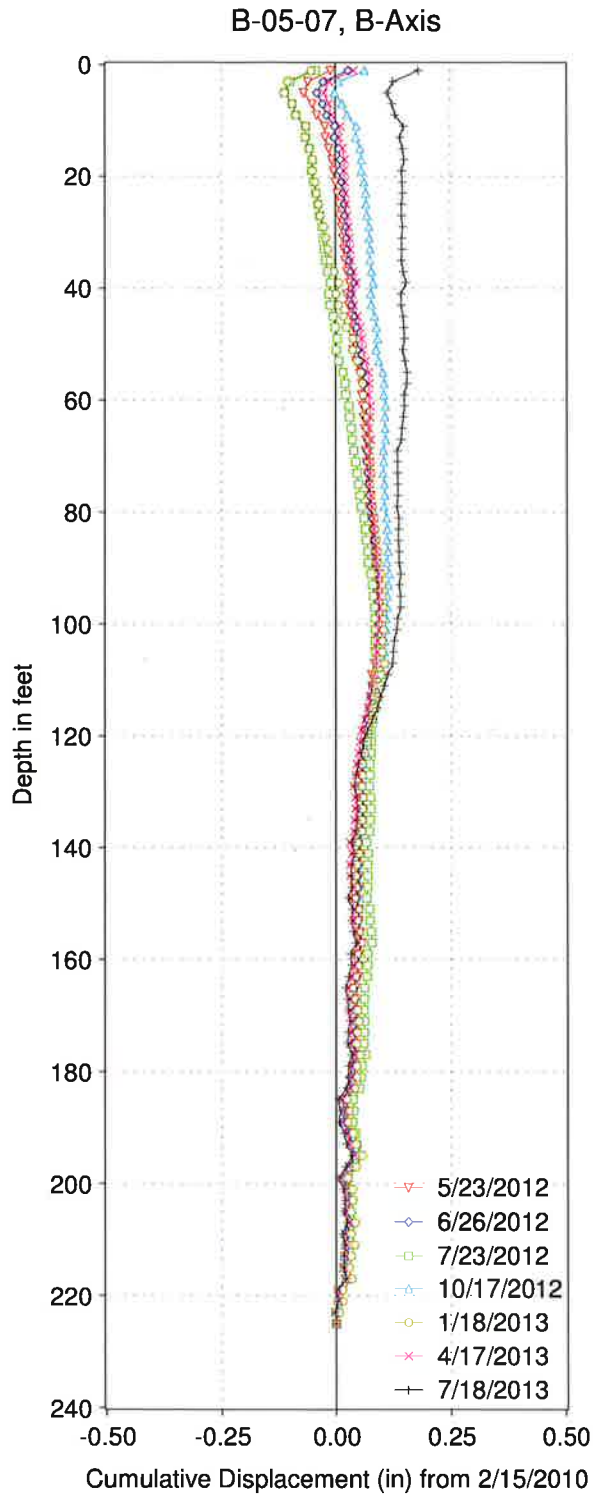
B-05-04







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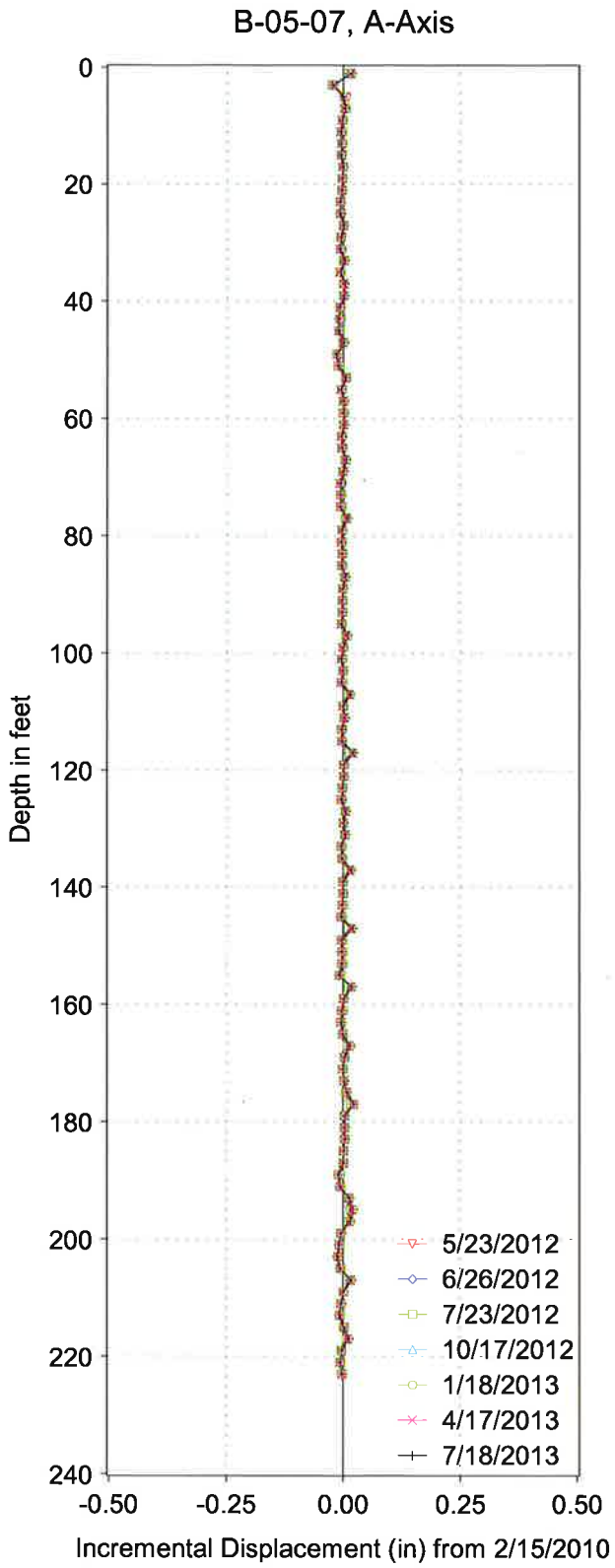
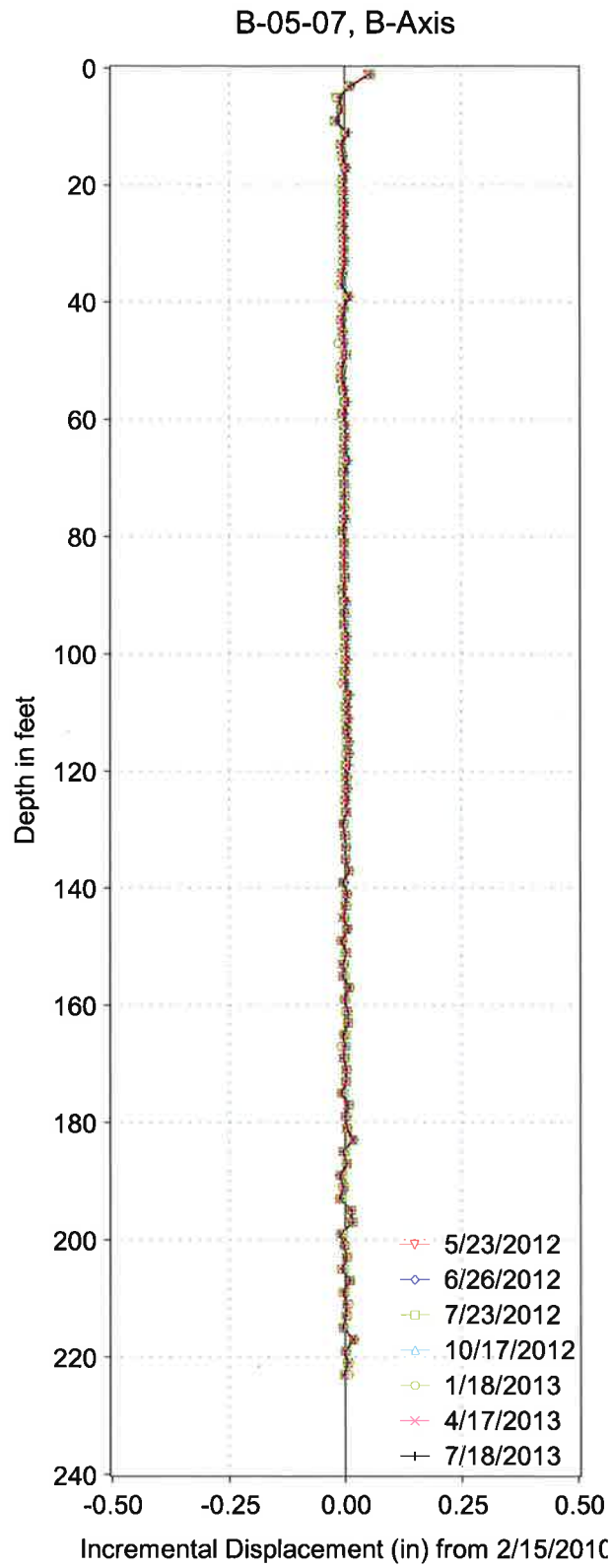
PID 76117
SME Project#: 062943.00
Reading Date: 7/18/2013

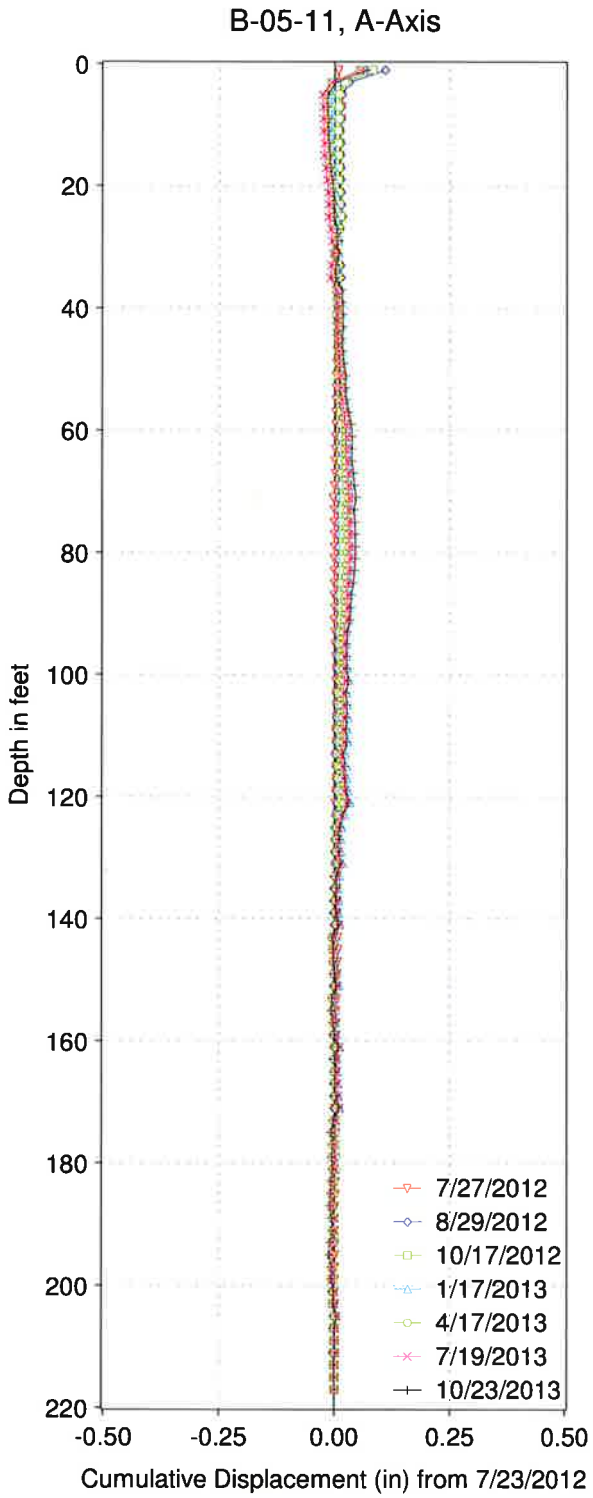
Soil and Materials Engineers, Inc.

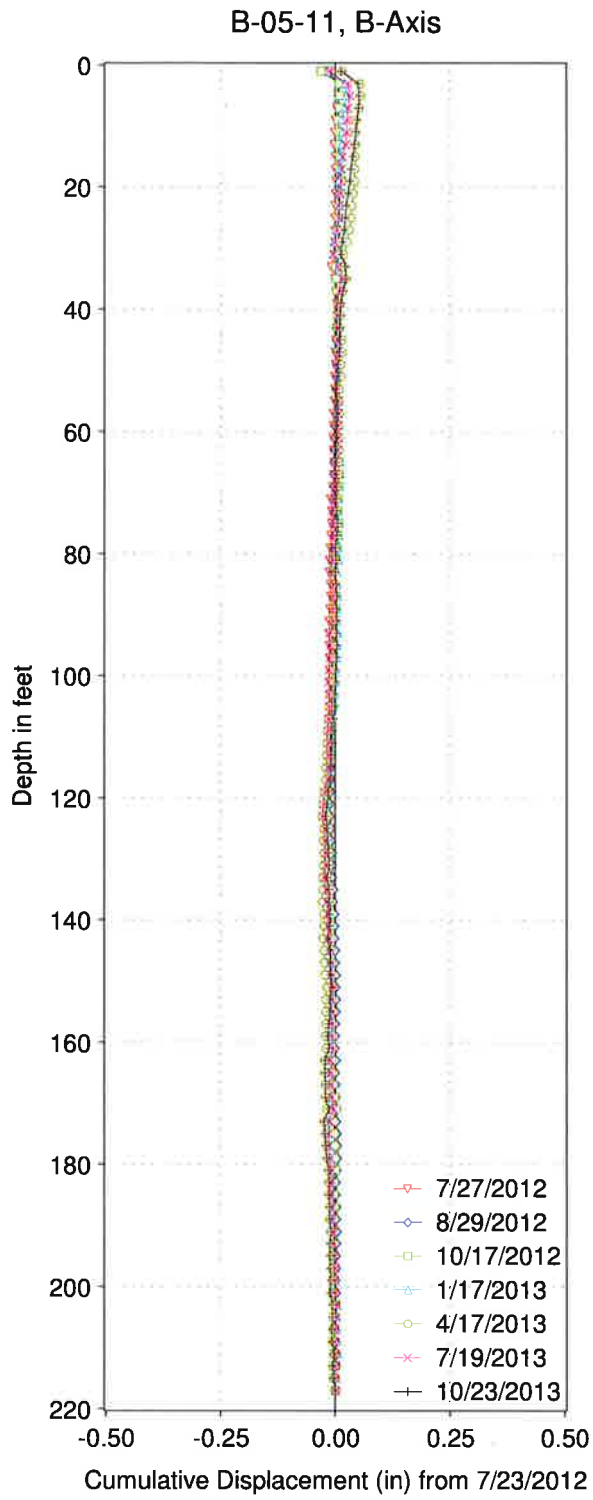




CUY-90-15.24 Slope Monitoring
EDP# 09305G
B-05-07
Reading Date: 7/18/2013

Soil and Materials Engineers, Inc.





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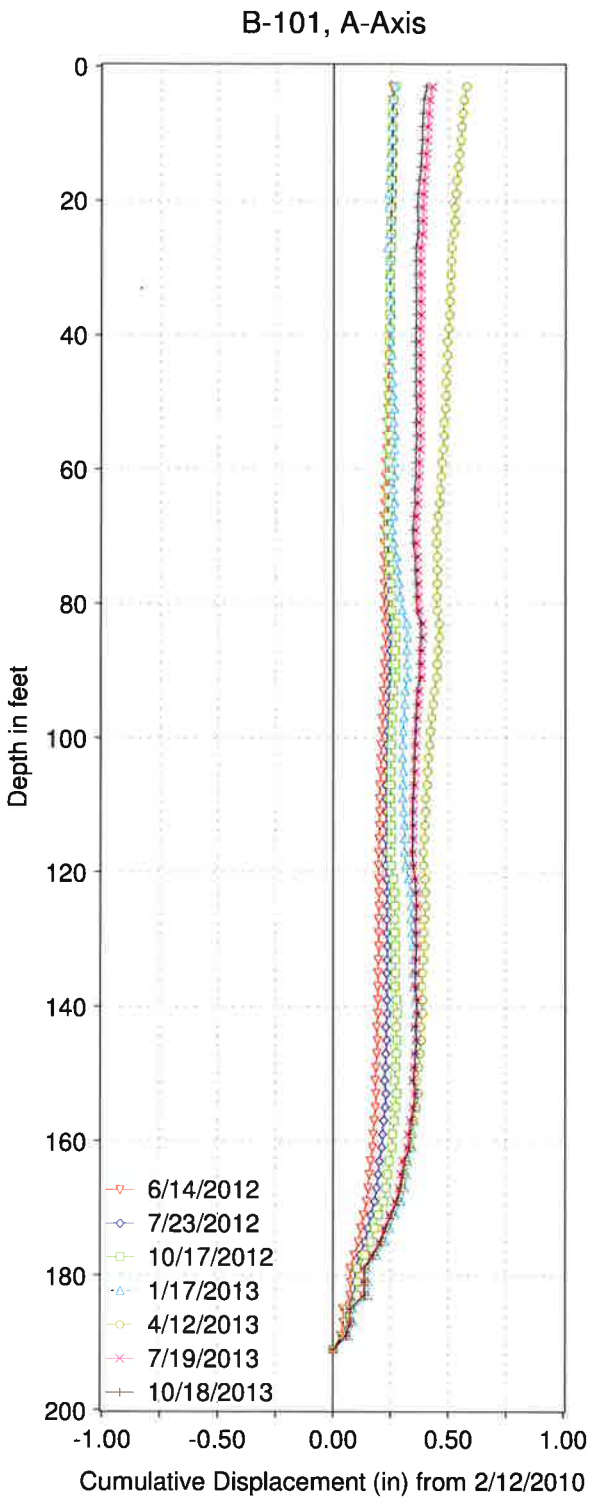
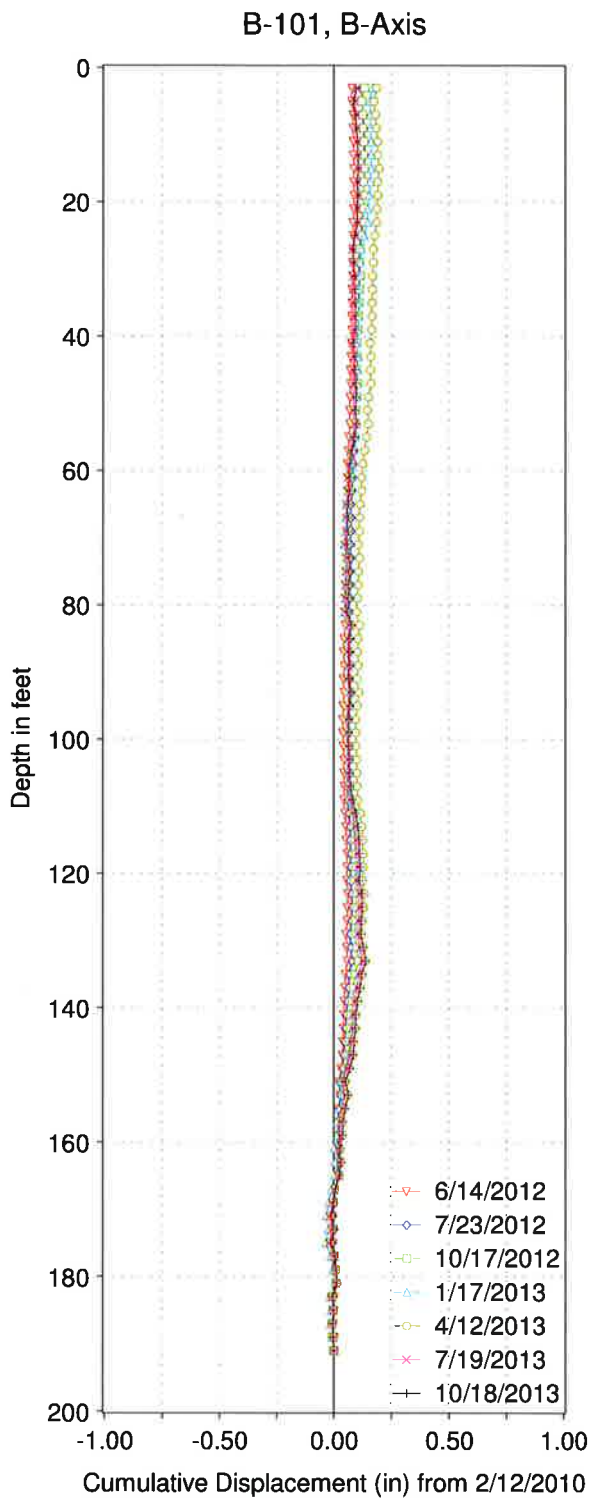
PID 76117
SME Project#: 062943.00
Reading Date: 10/23/2013

Soil and Materials Engineers, Inc.





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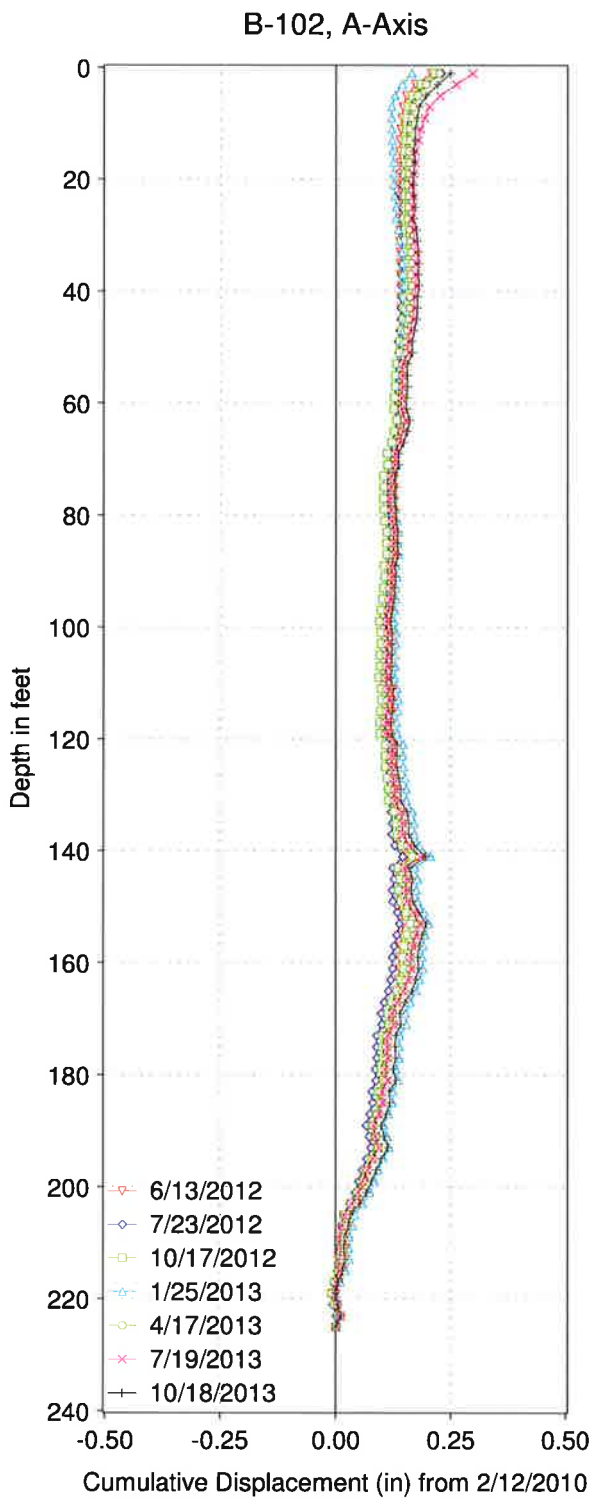
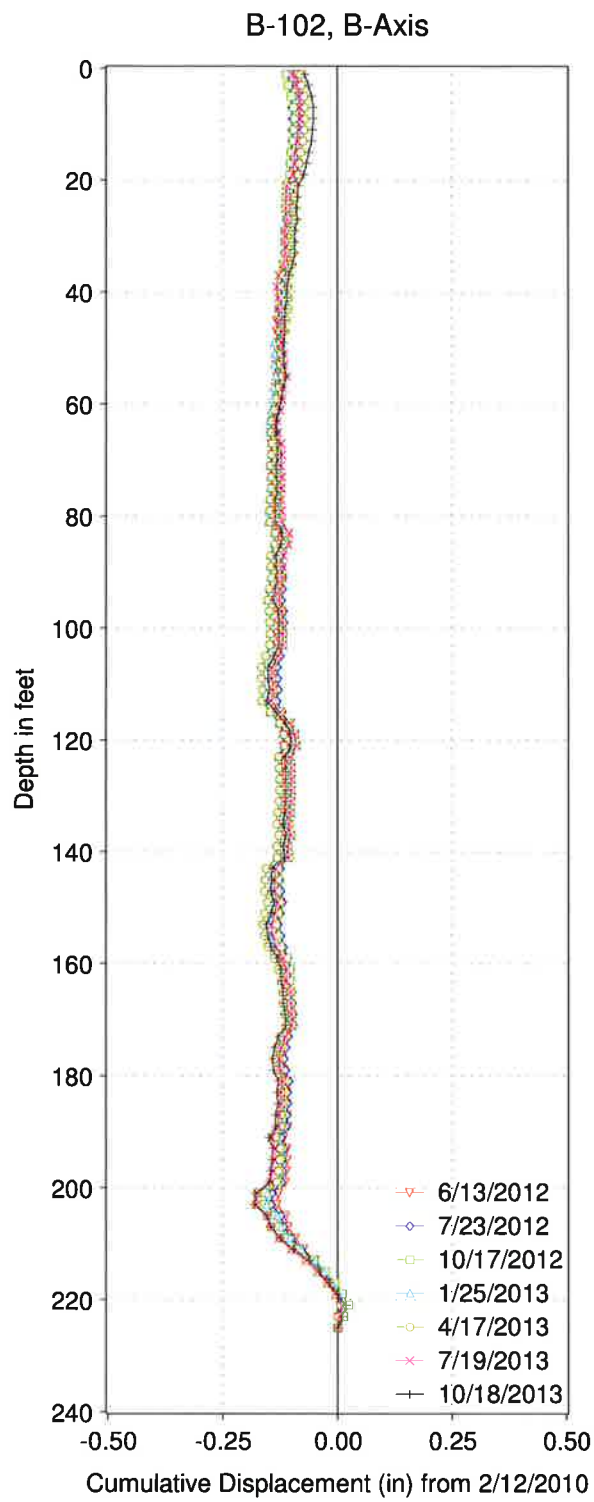
PID 76117
SME Project#: 062943.00
Reading Date: 10/18/2013

Soil and Materials Engineers, Inc.





CUY-90-15.24
PID 76117
SME Project#: 062943.00
Reading Date: 10/18/2013

Soil and Materials Engineers, Inc.

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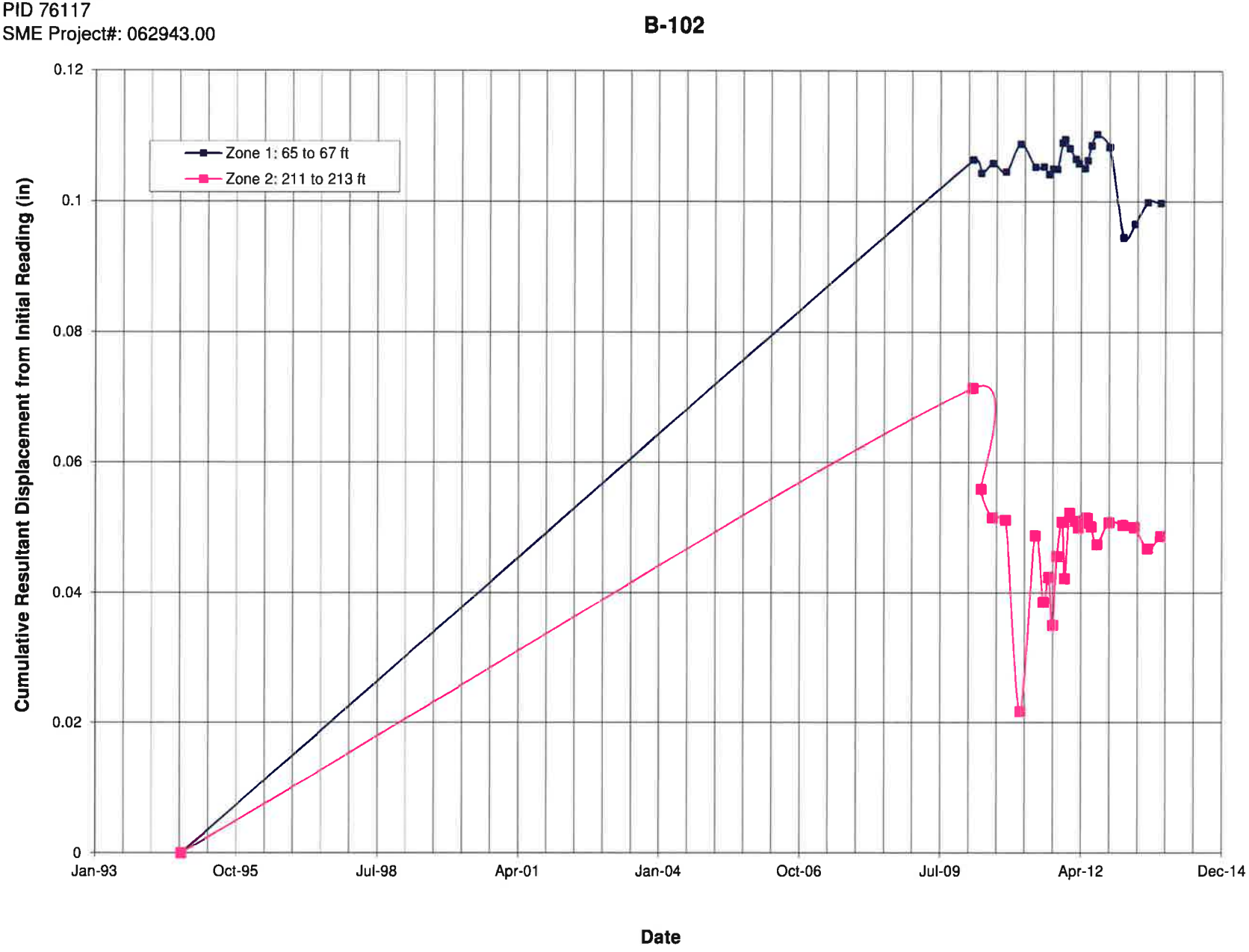

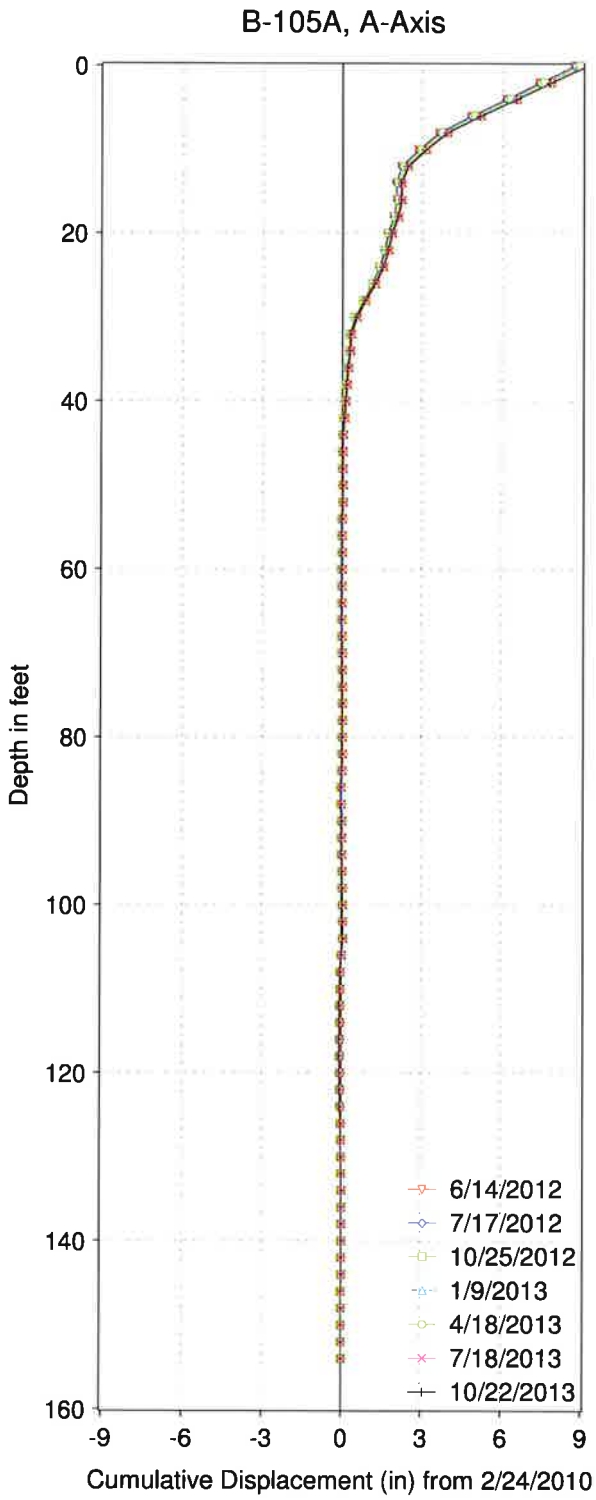

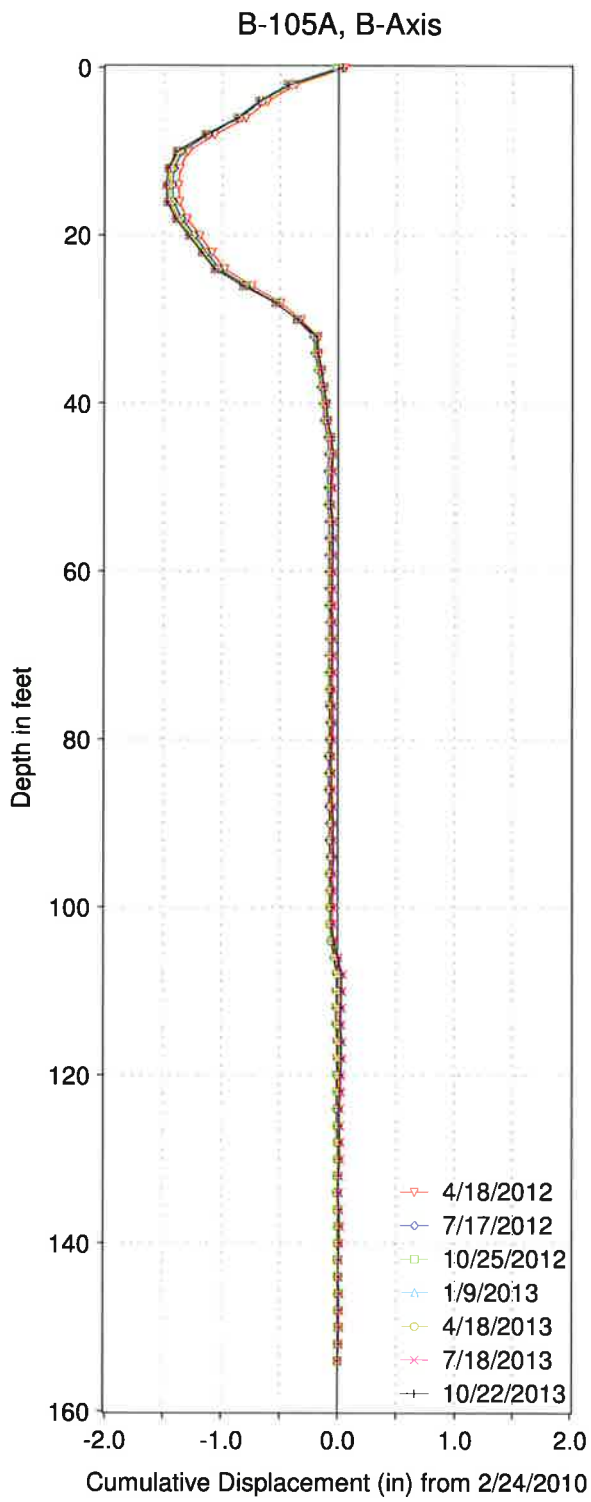

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PID 76117
SME Project#: 062943.00
Reading Date: 10/22/2013

Soil and Materials Engineers, Inc.

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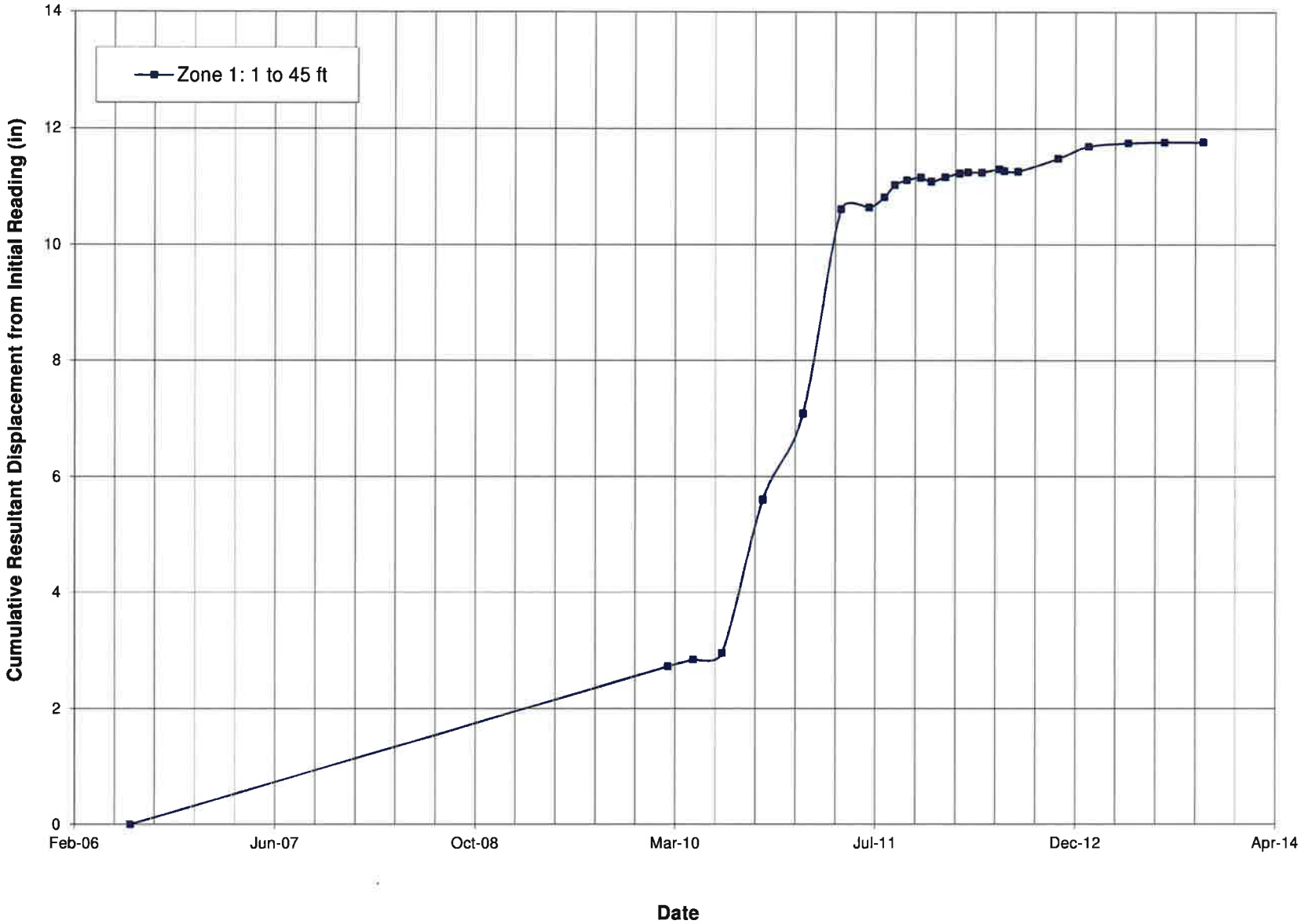
PID 76117
SME Project#: 062943.00

B-105A



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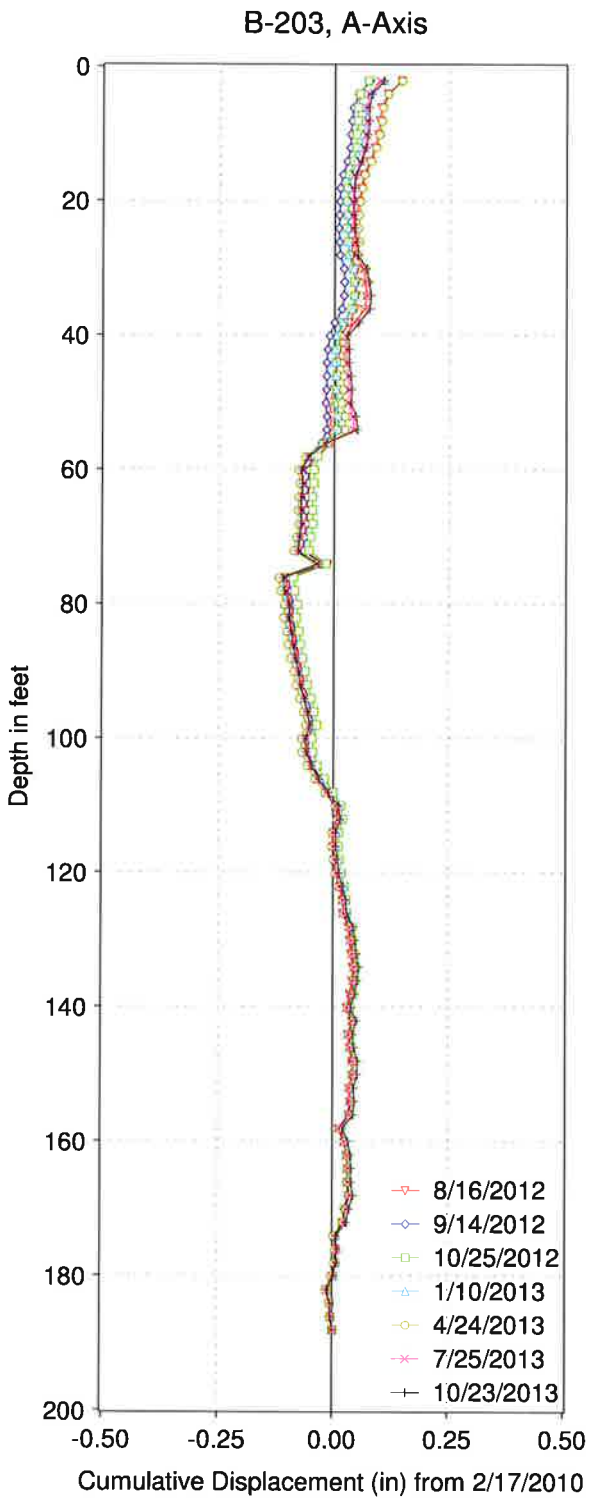
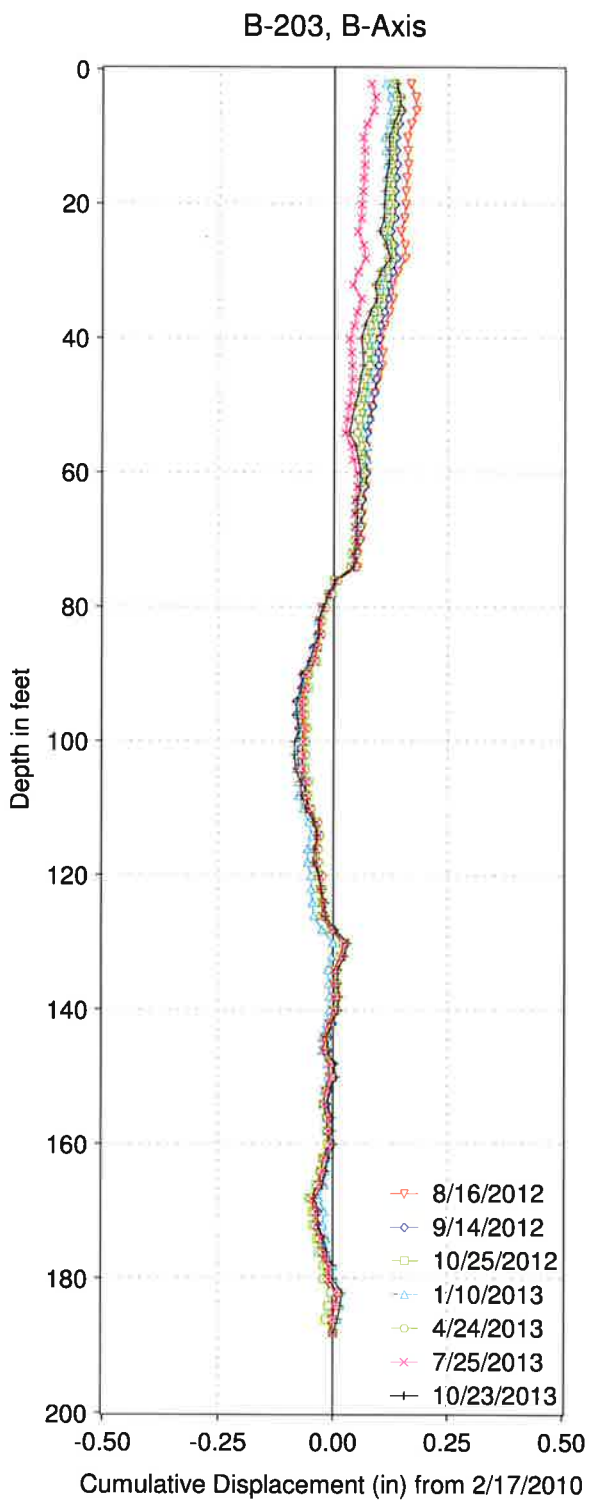


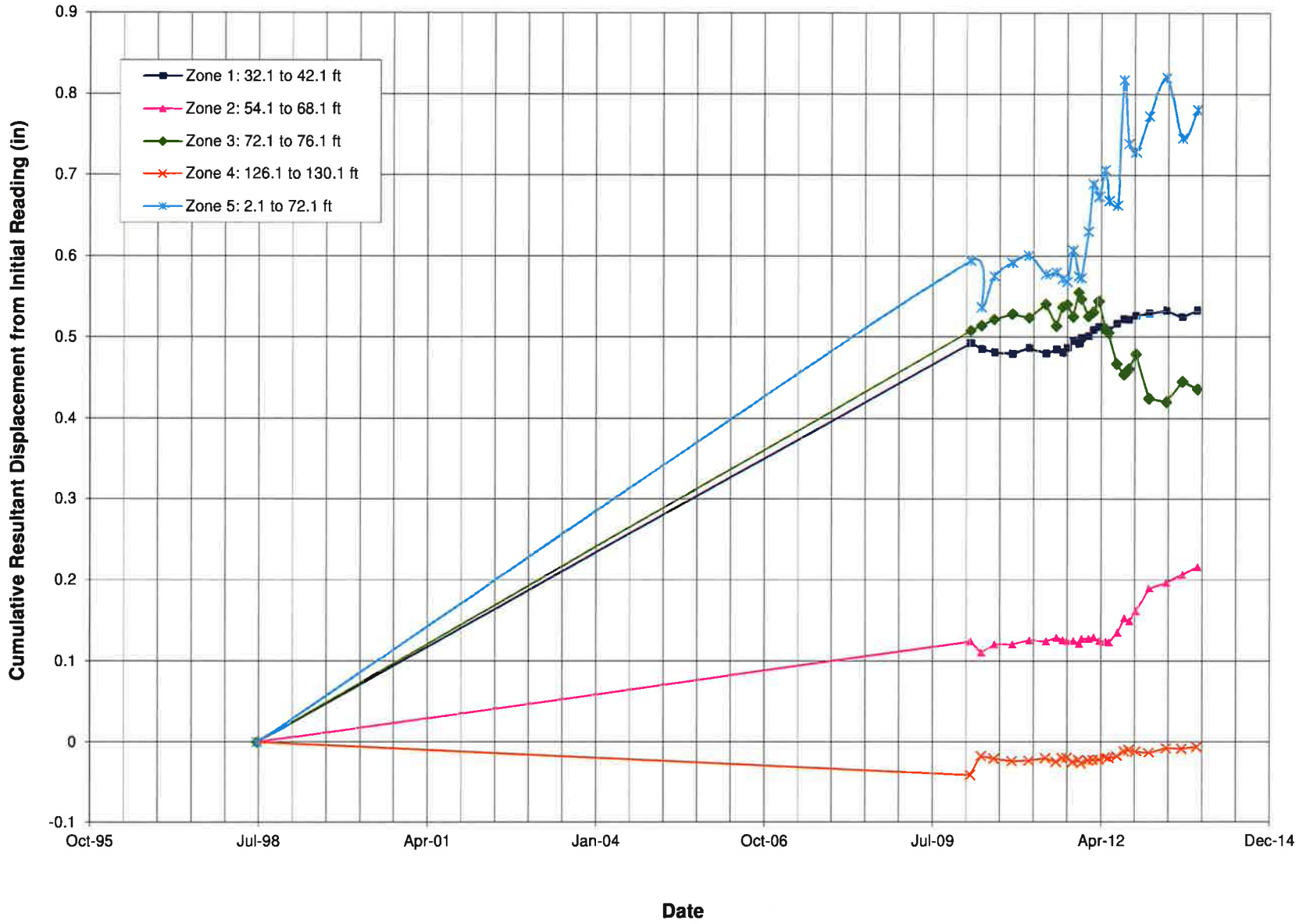


CUY-90-15.24
PID 76117
SME Project#: 062943.00
Reading Date: 10/23/2013

Soil and Materials Engineers, Inc.

CUY-90-15.24
PID 76117
SME Project#: 062943.00

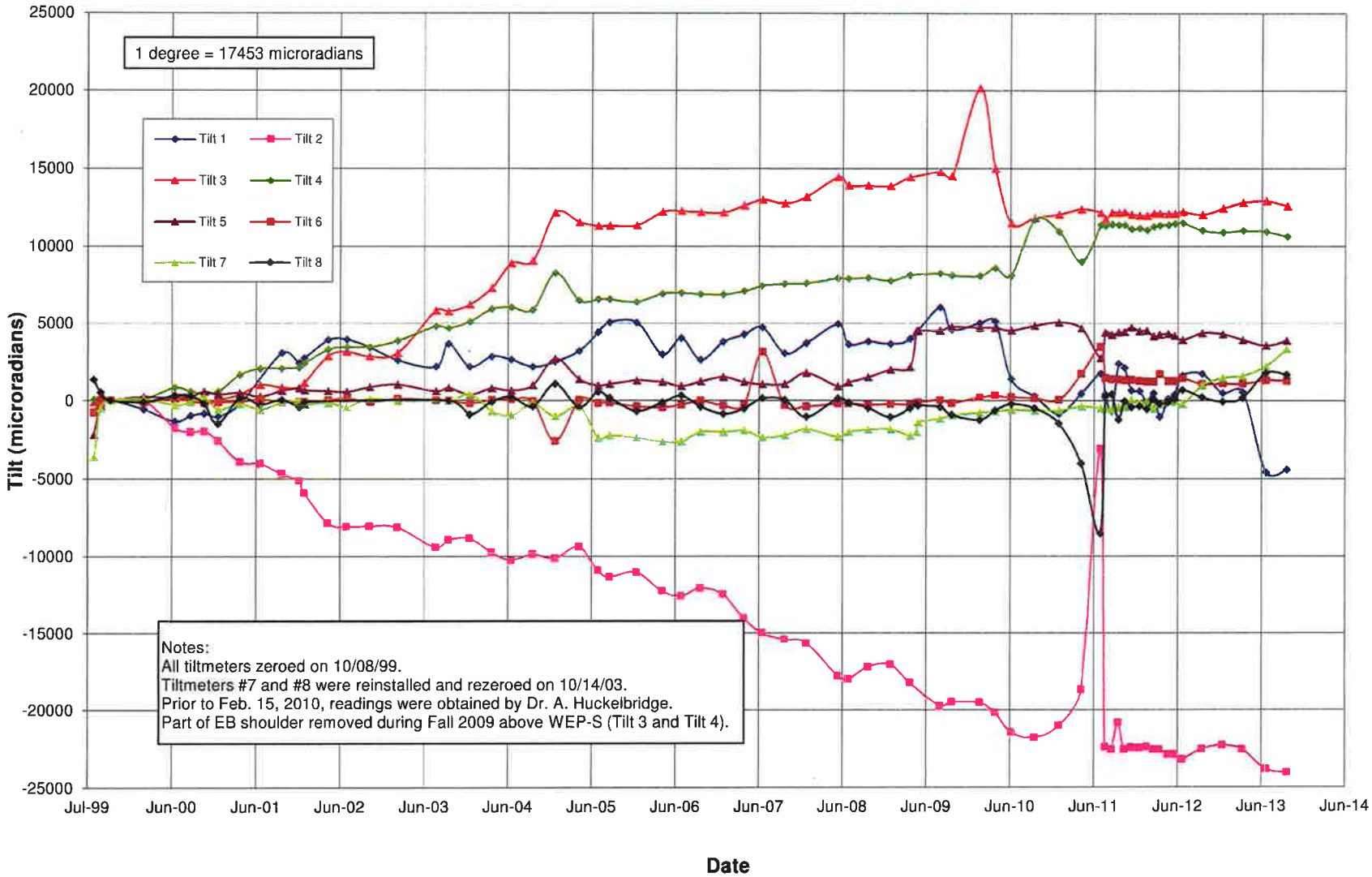
B-203



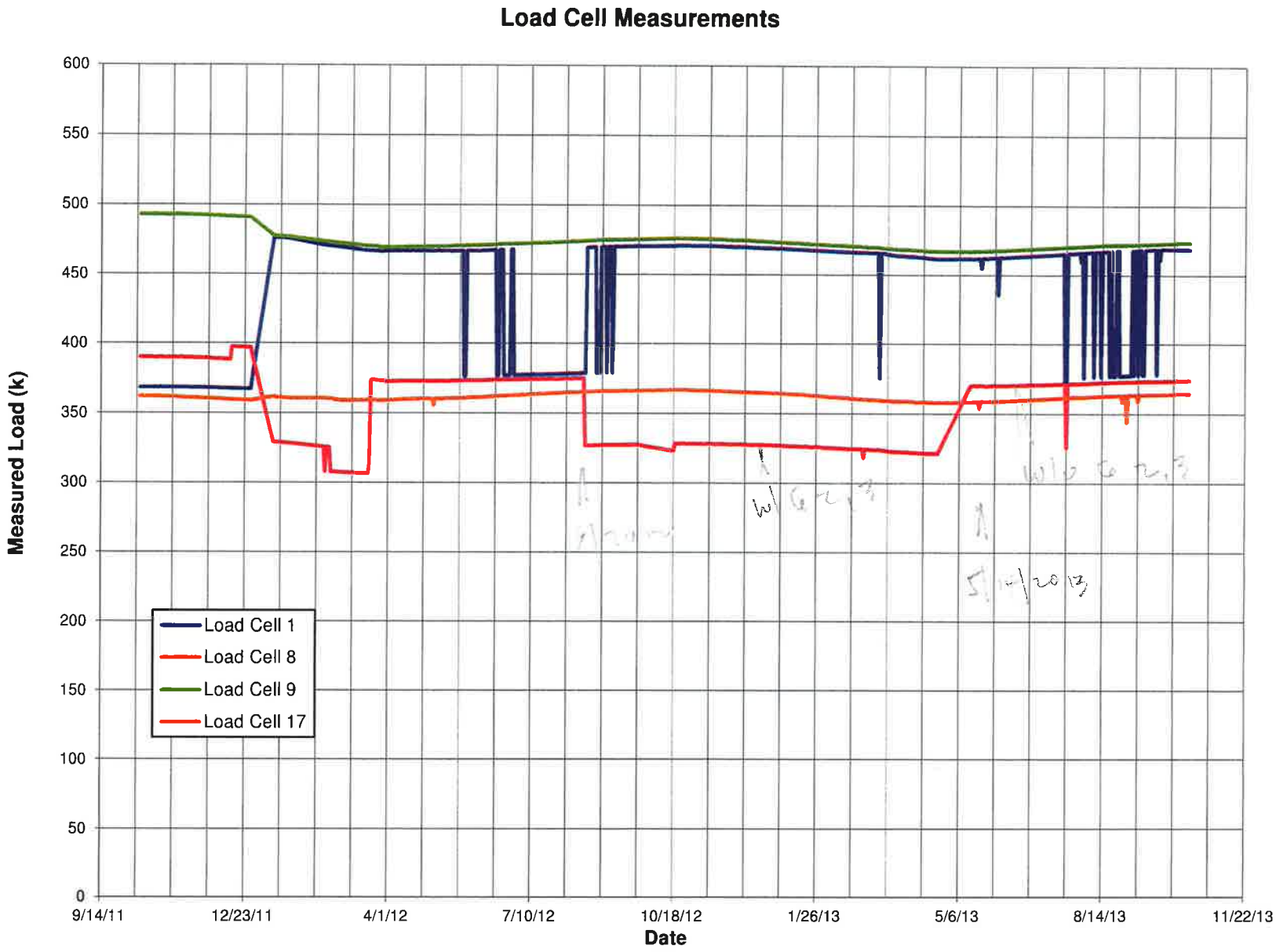
APPENDIX C
TILTMETERS AND STABILIZATION STRUCTURE

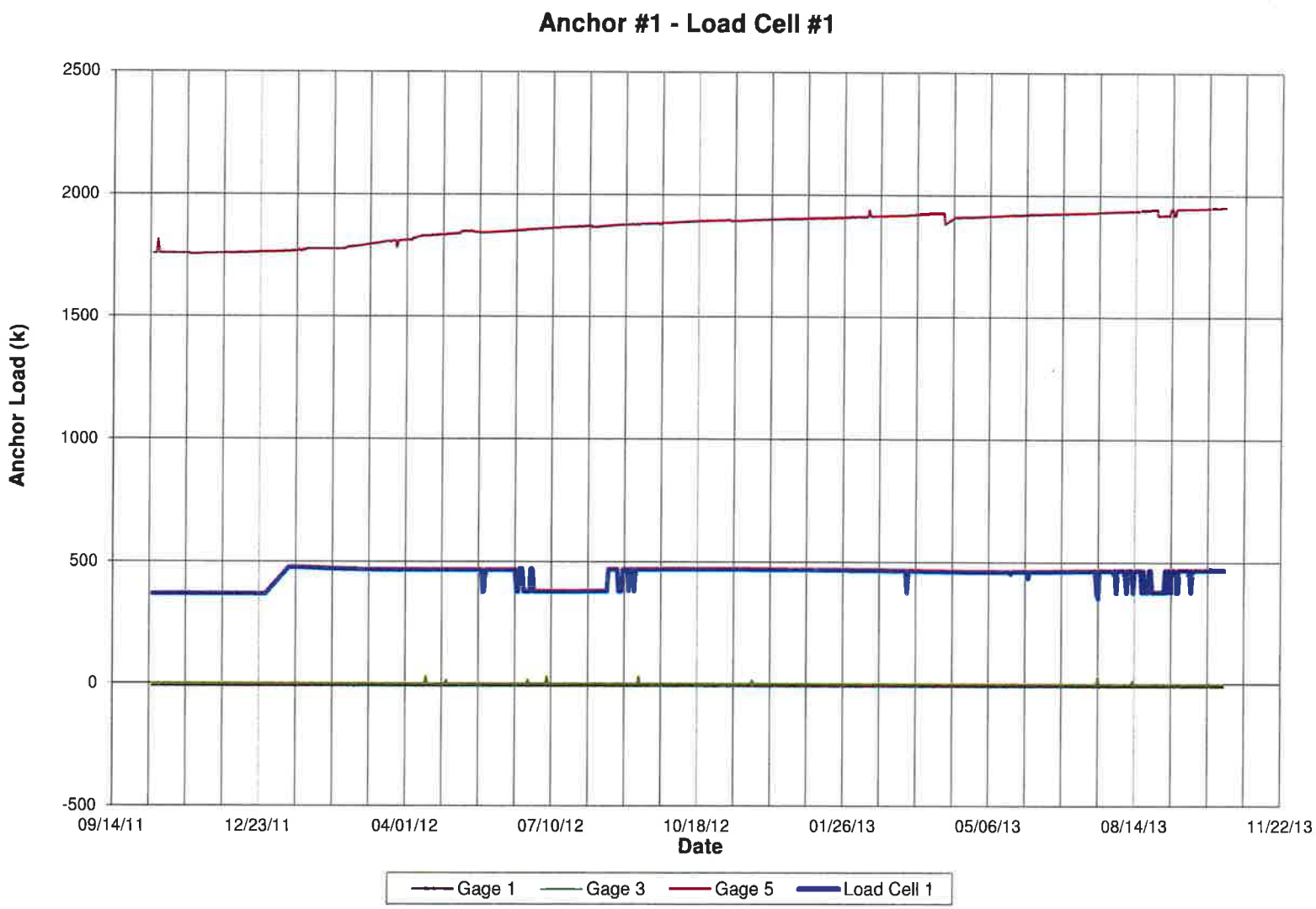
CUY-90-15.24 Slope Monitoring
PID 76117
Cleveland, Ohio
SME Project#: 062943.00

Tiltmeter Readings



CUY-90-15.24 Slope Monitoring
PID #76177
EDP #09305G

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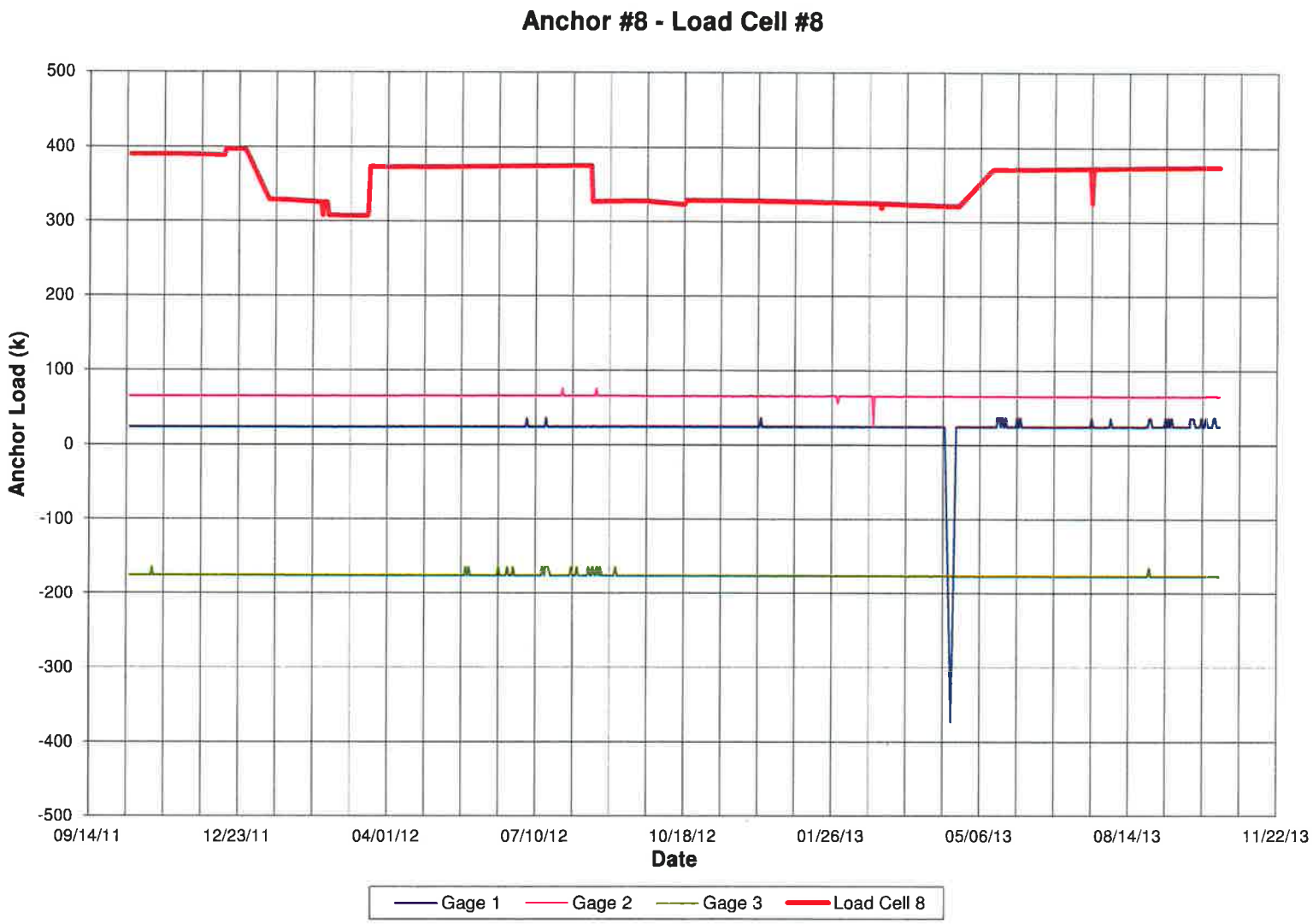
1500
1000
500
0
-500
09/14/11
12/23/11
04/01/12
07/10/12
10/18/12
01/26/13
05/06/13
08/14/13
11/22/13
Date
Gage 1
Gage 3
Gage 5
Load Cell 1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300
200
100
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-300
-400
-500
09/14/11
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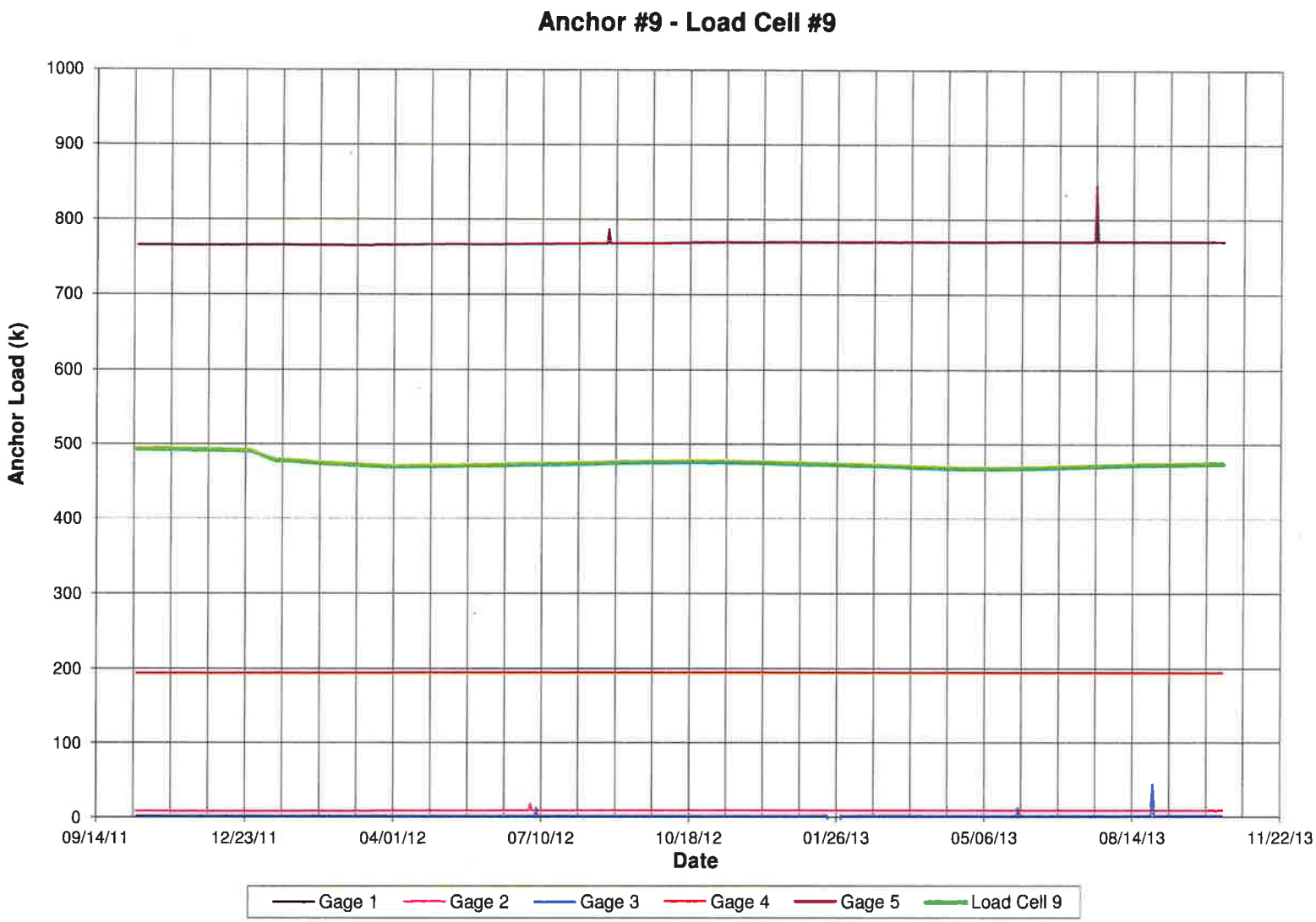
04/01/12
07/10/12
10/18/12
01/26/13
05/06/13
08/14/13
11/22/13
Date
Gage 1
Gage 2
Gage 3
Load Cell 8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800
700
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200
100
0
09/14/11
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10/18/12
01/26/13
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08/14/13
11/22/13
Date
Gage 1
Gage 2
Gage 3
Gage 4
Gage 5
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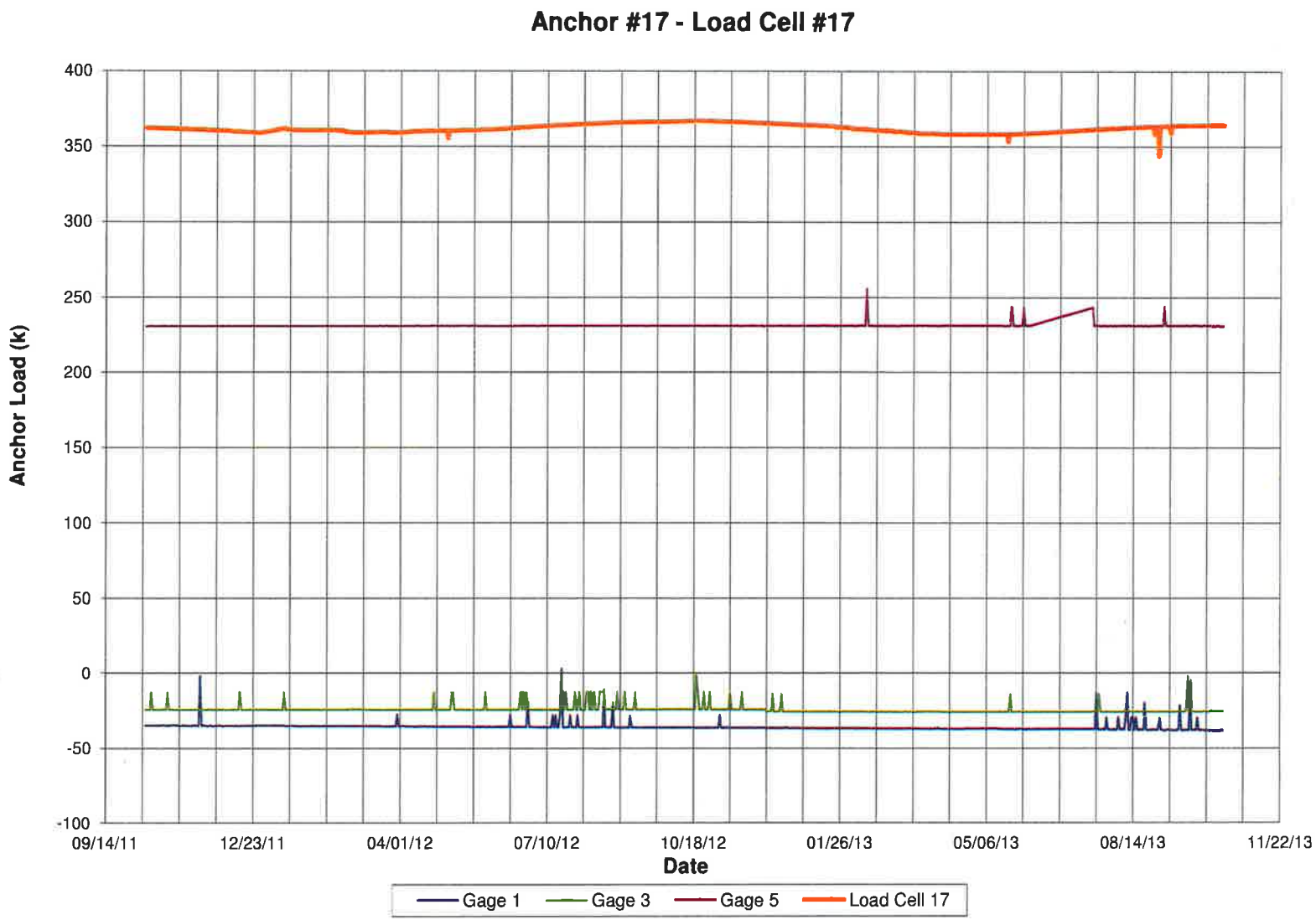
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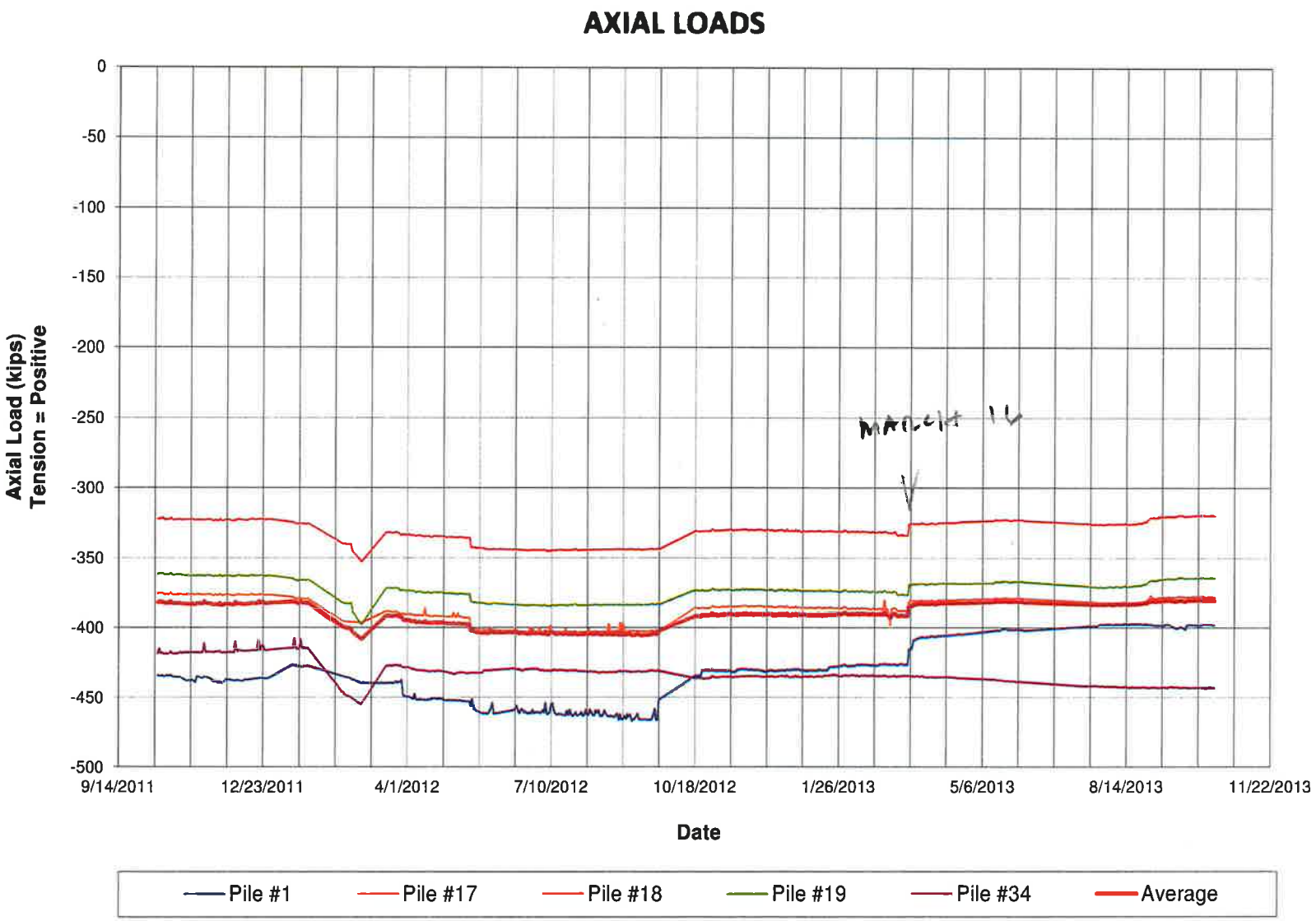
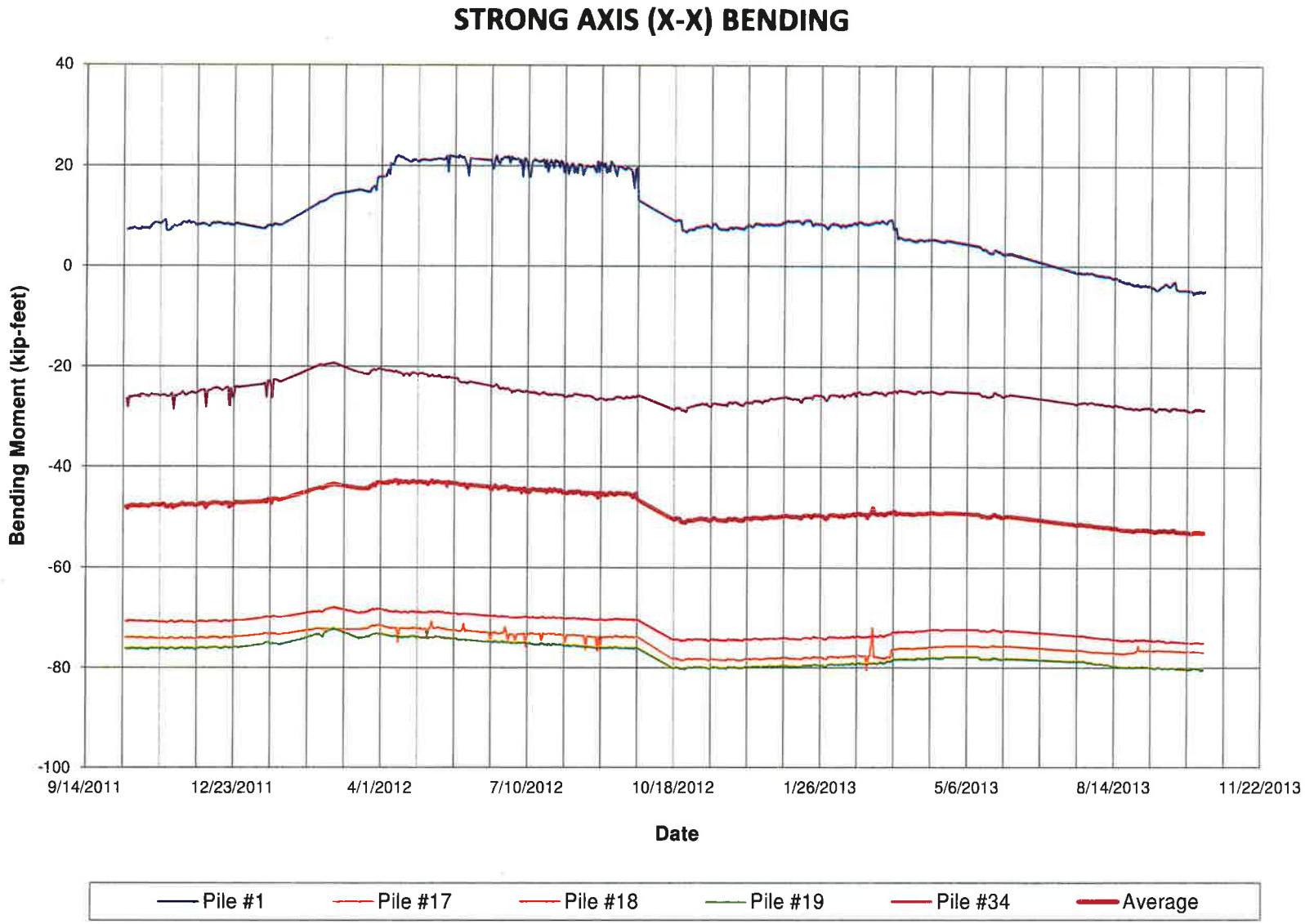
01/26/13
05/06/13
08/14/13
11/22/13
Date
Gage 1
Gage 3
Gage 5
Load Cell 17

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



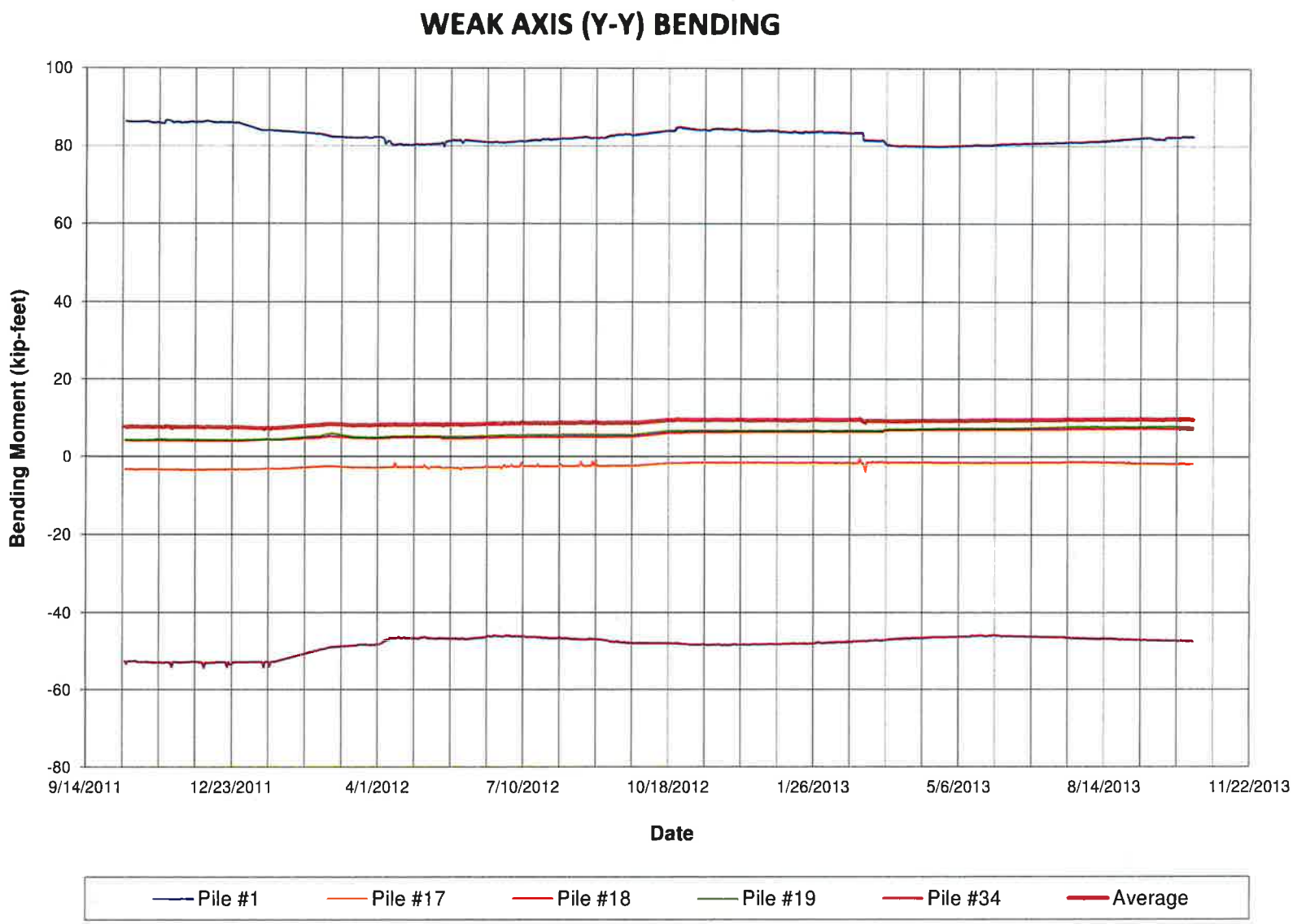
Driven Piles

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



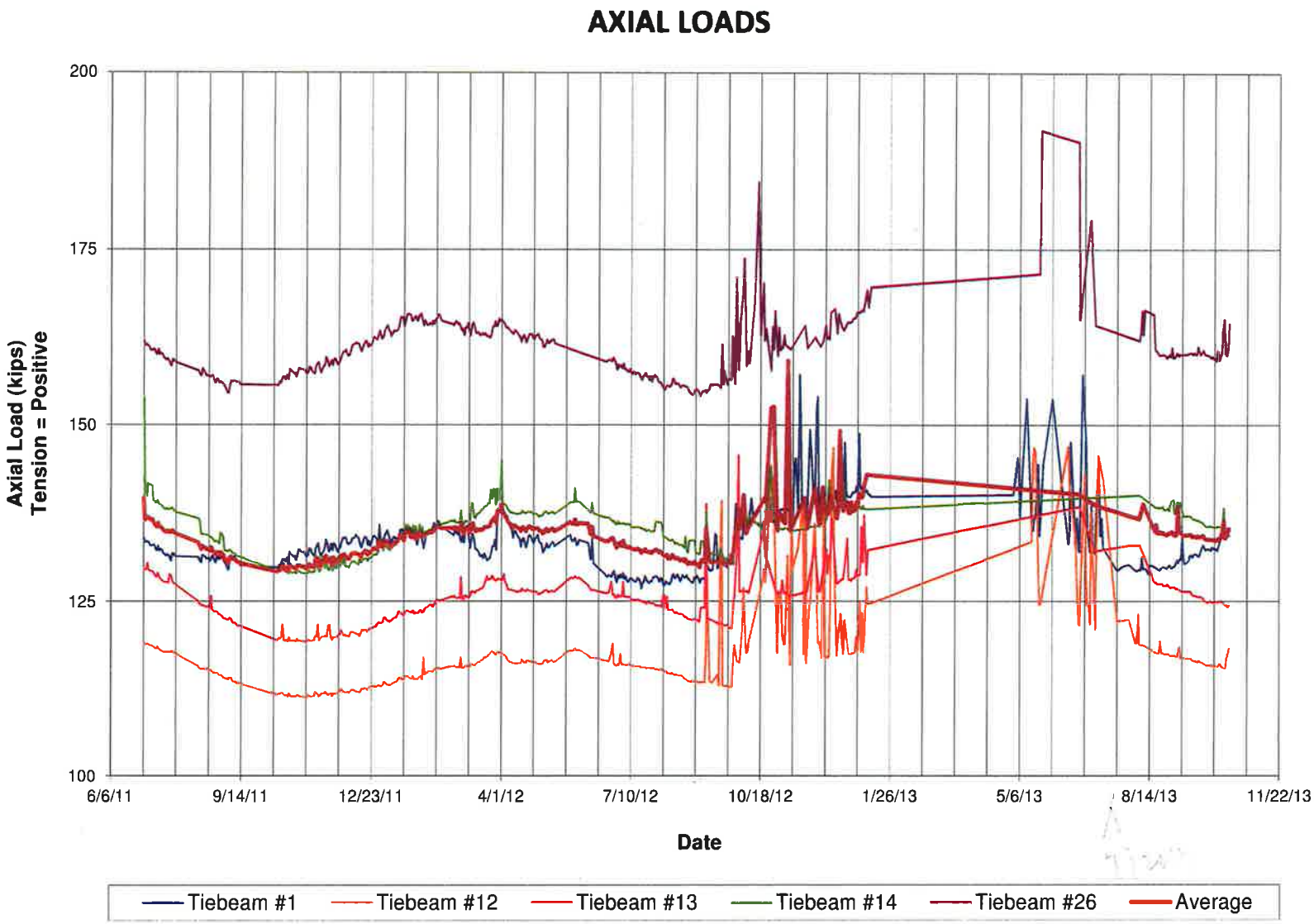
Driven Piles

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



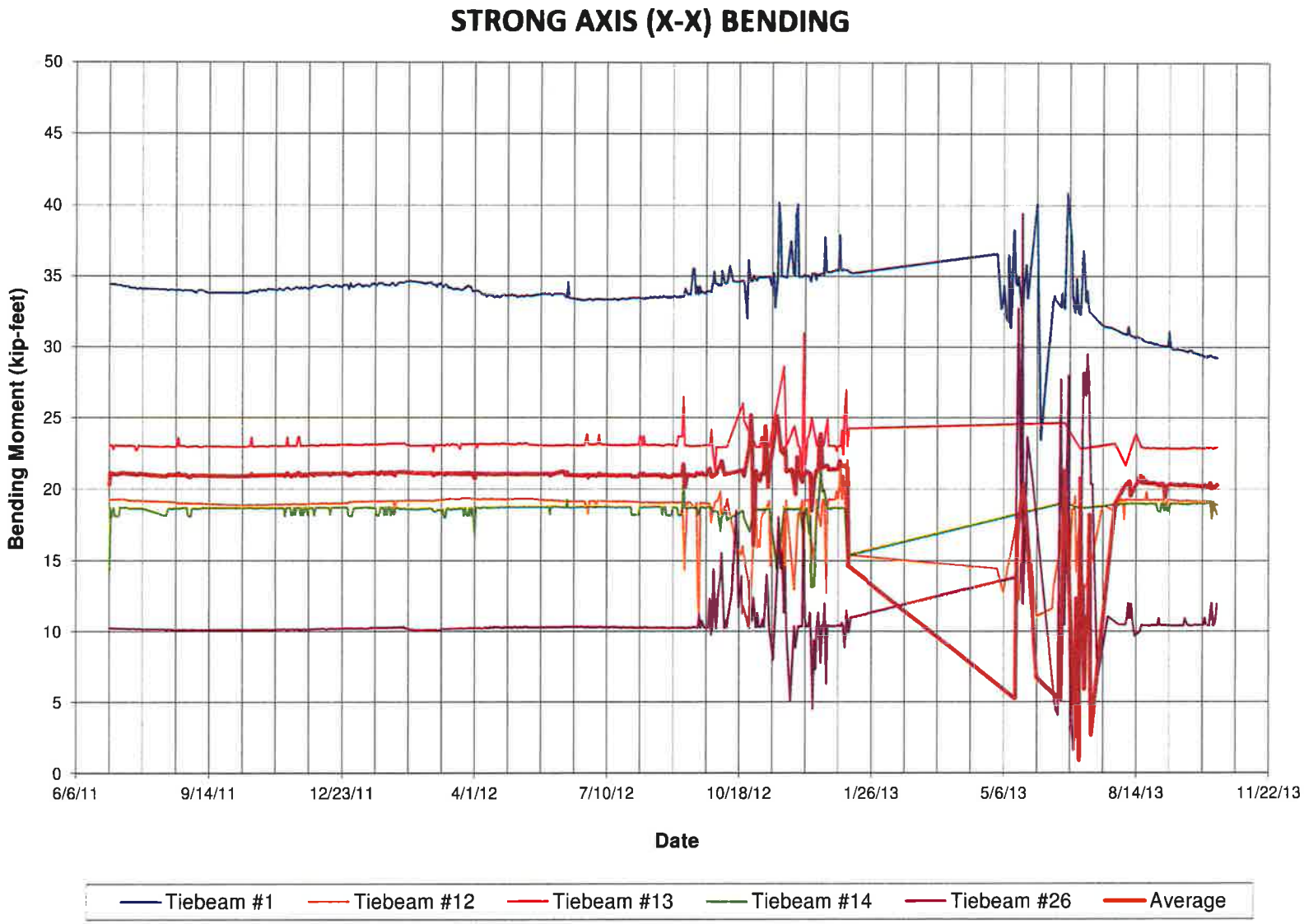
Driven Piles

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



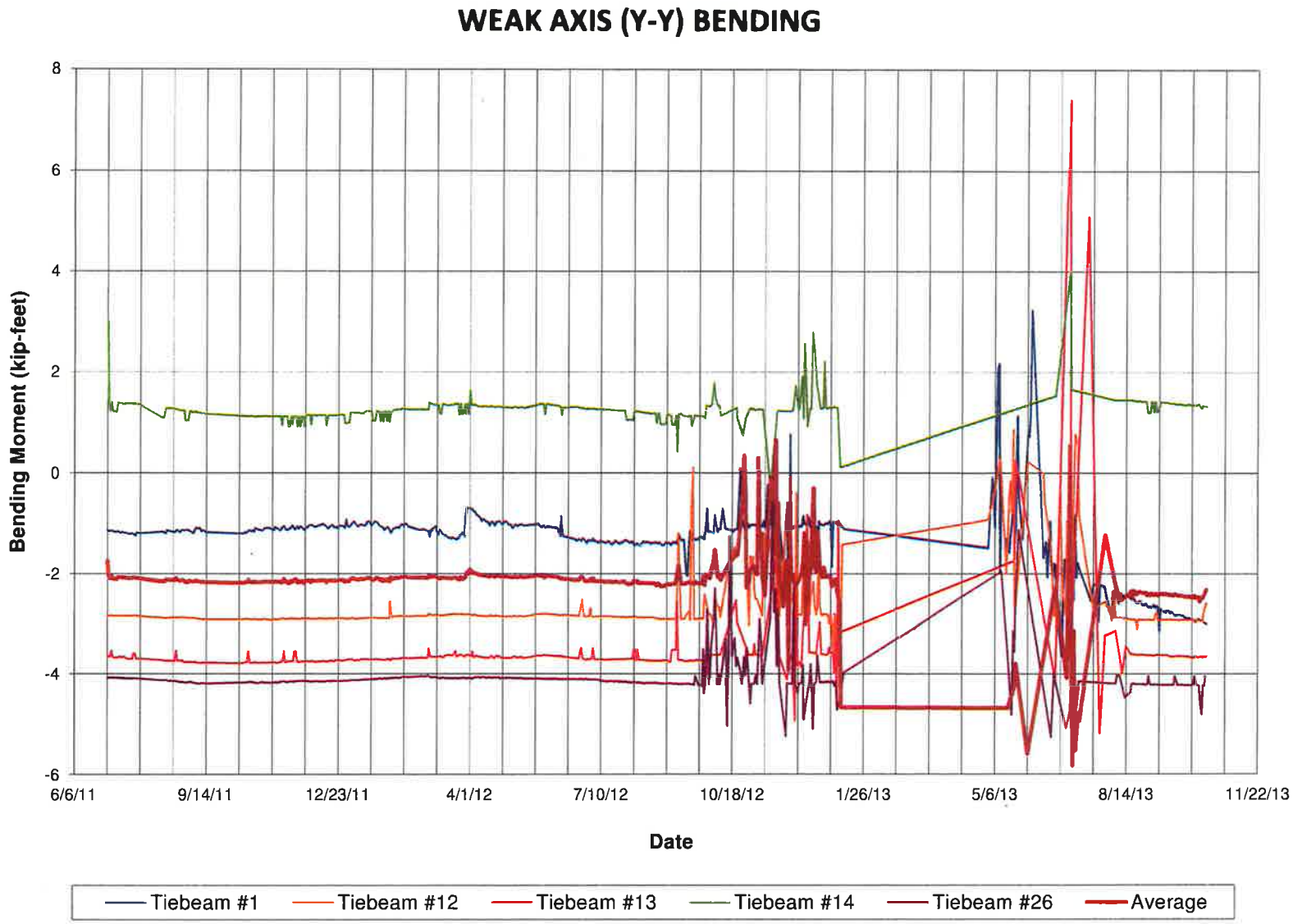
Tiebeams - Anchor Side

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



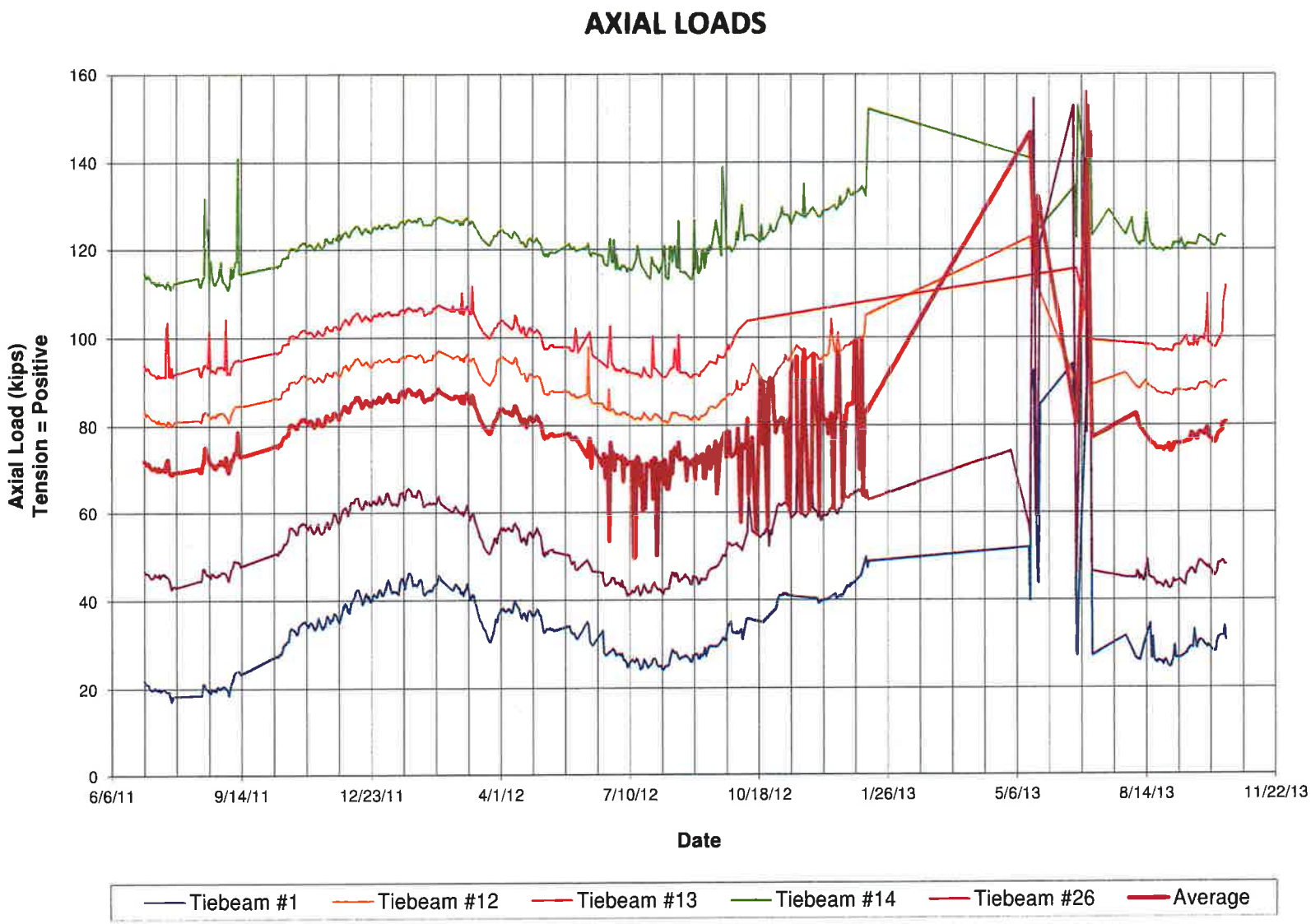
Tiebeams - Anchor Side

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



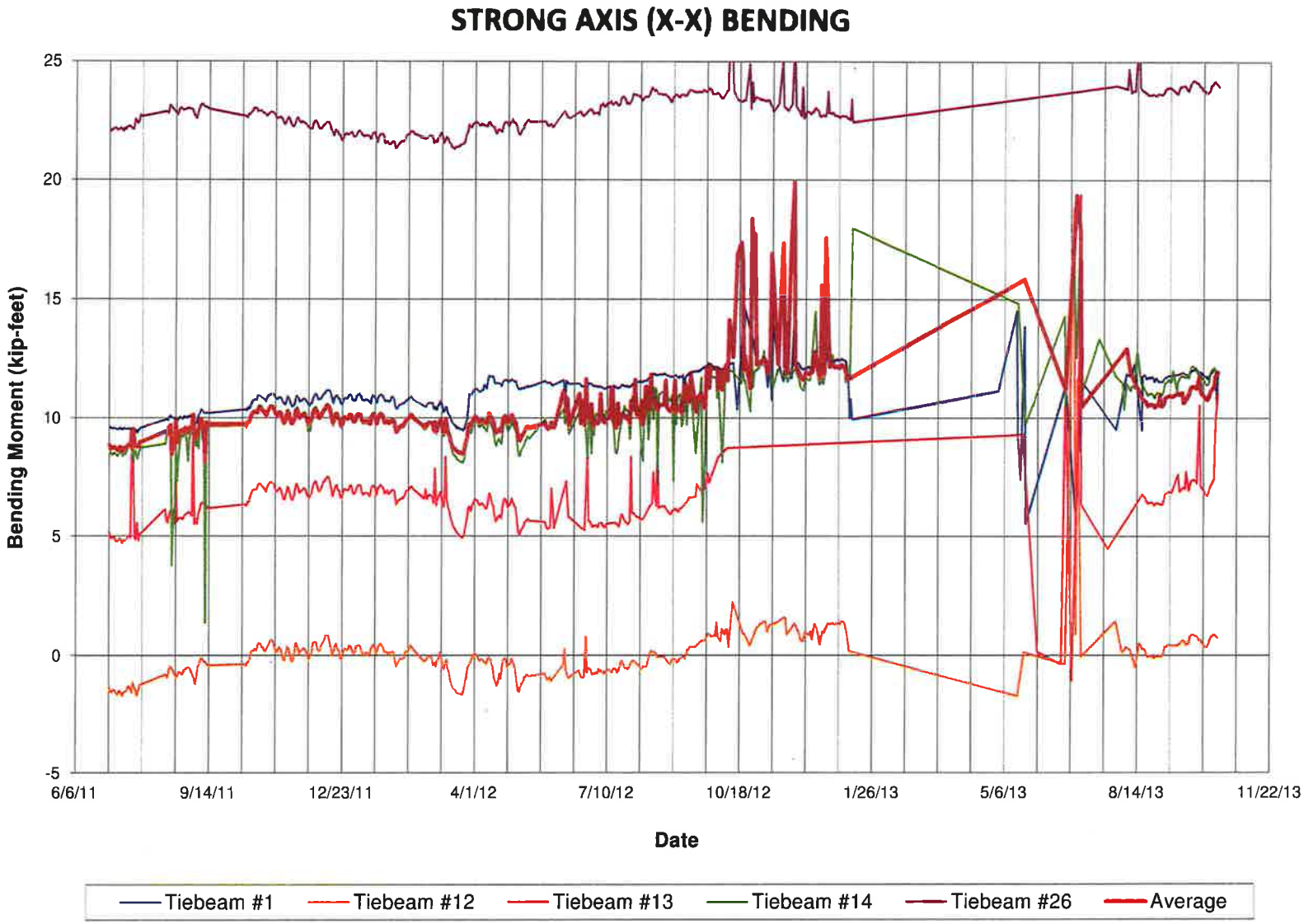
Tiebeams - Anchor Side

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



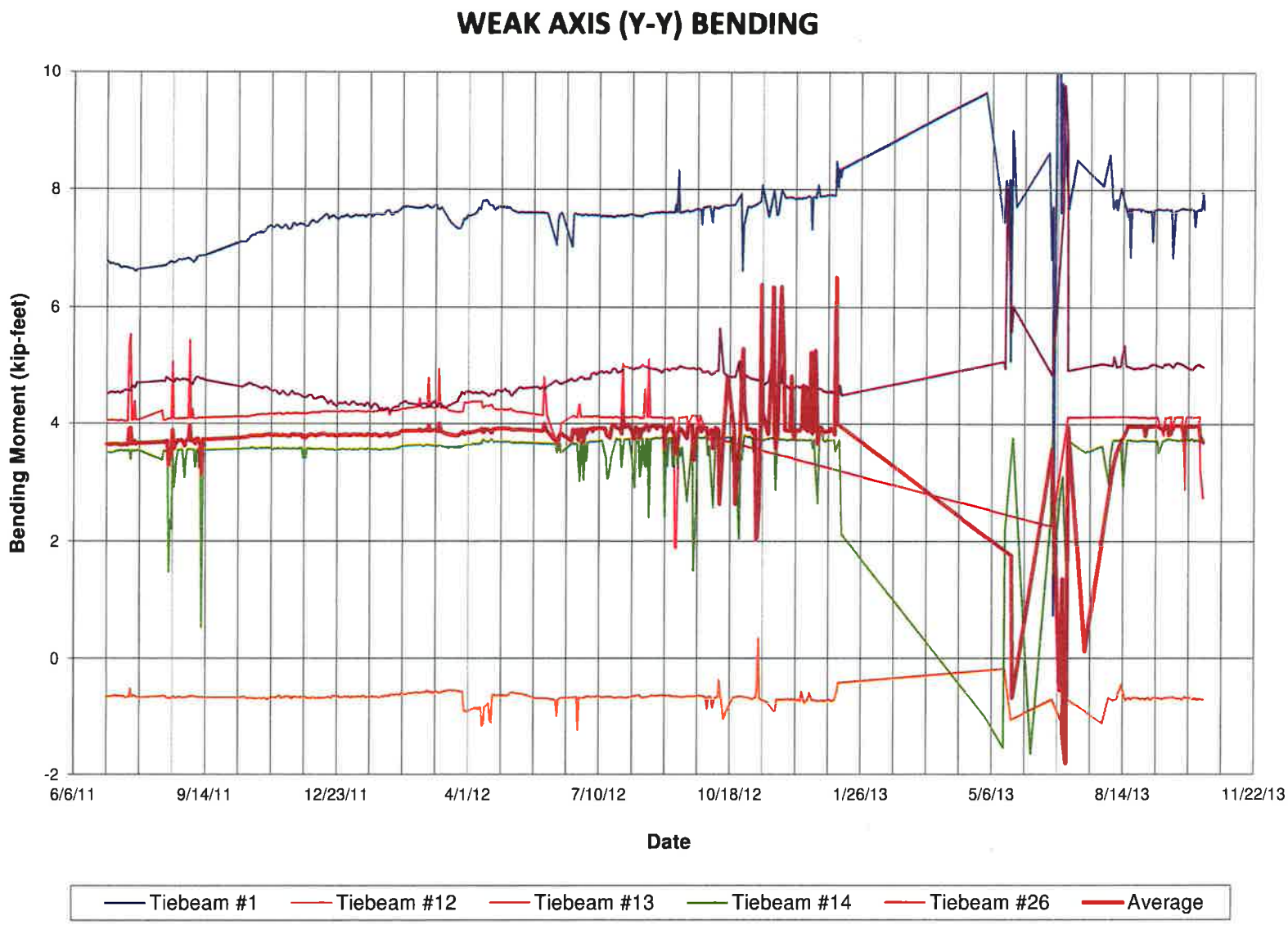
Tiebeams - Drilled Pier Side

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



Tiebeams - Drilled Pier Side

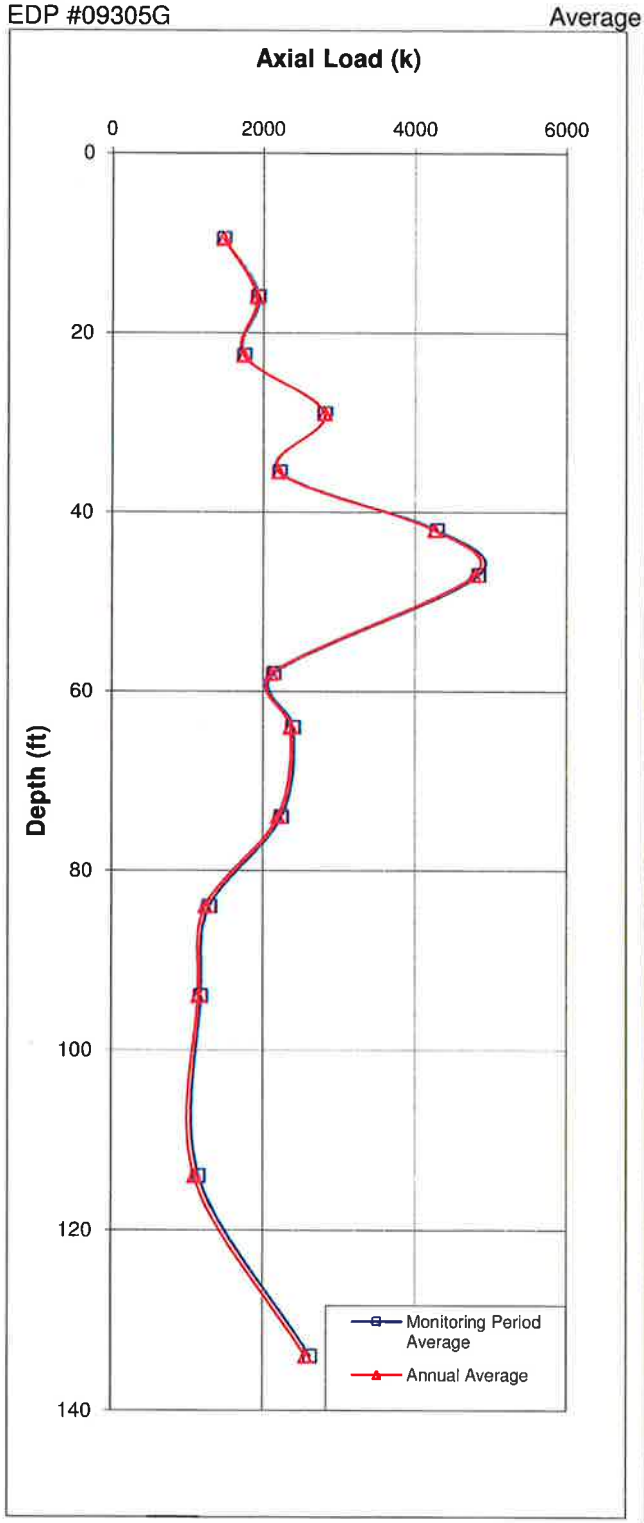
CUY-90-15.24 Slope Monitoring
Cleveland, Ohio
PID 76117
EDP #09305G

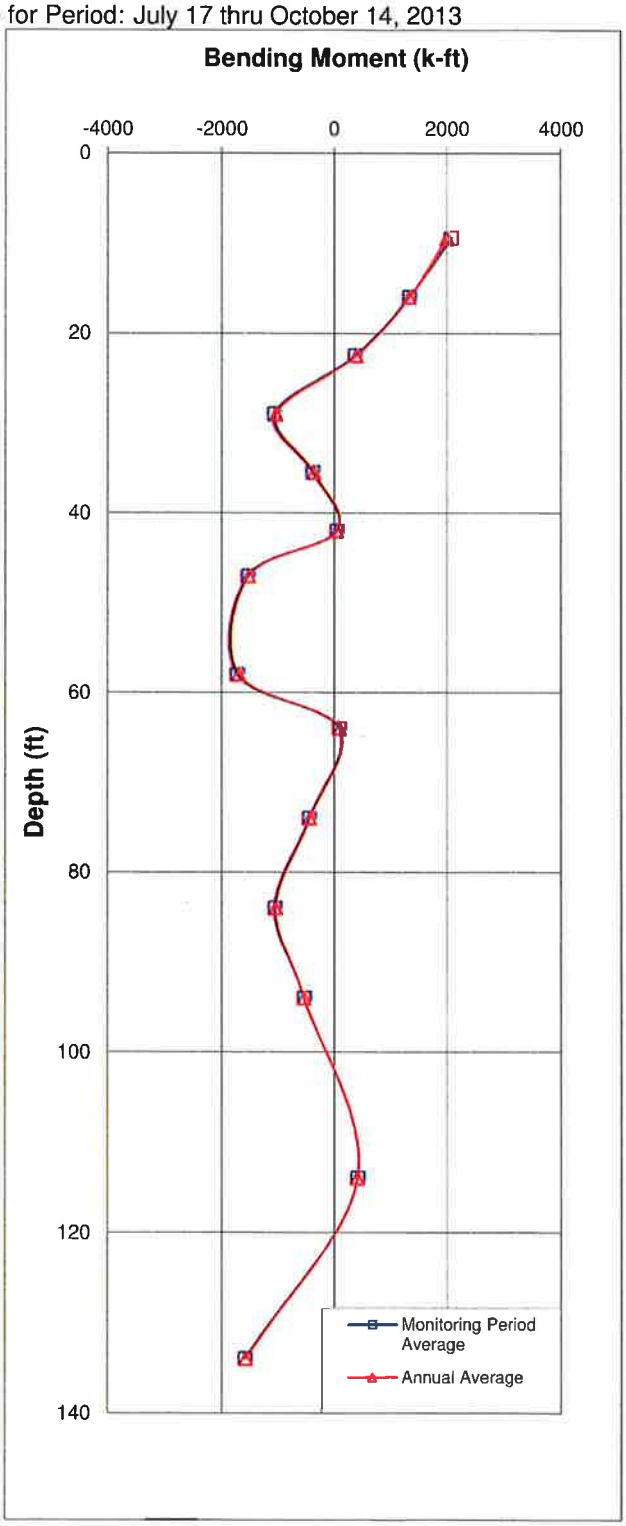


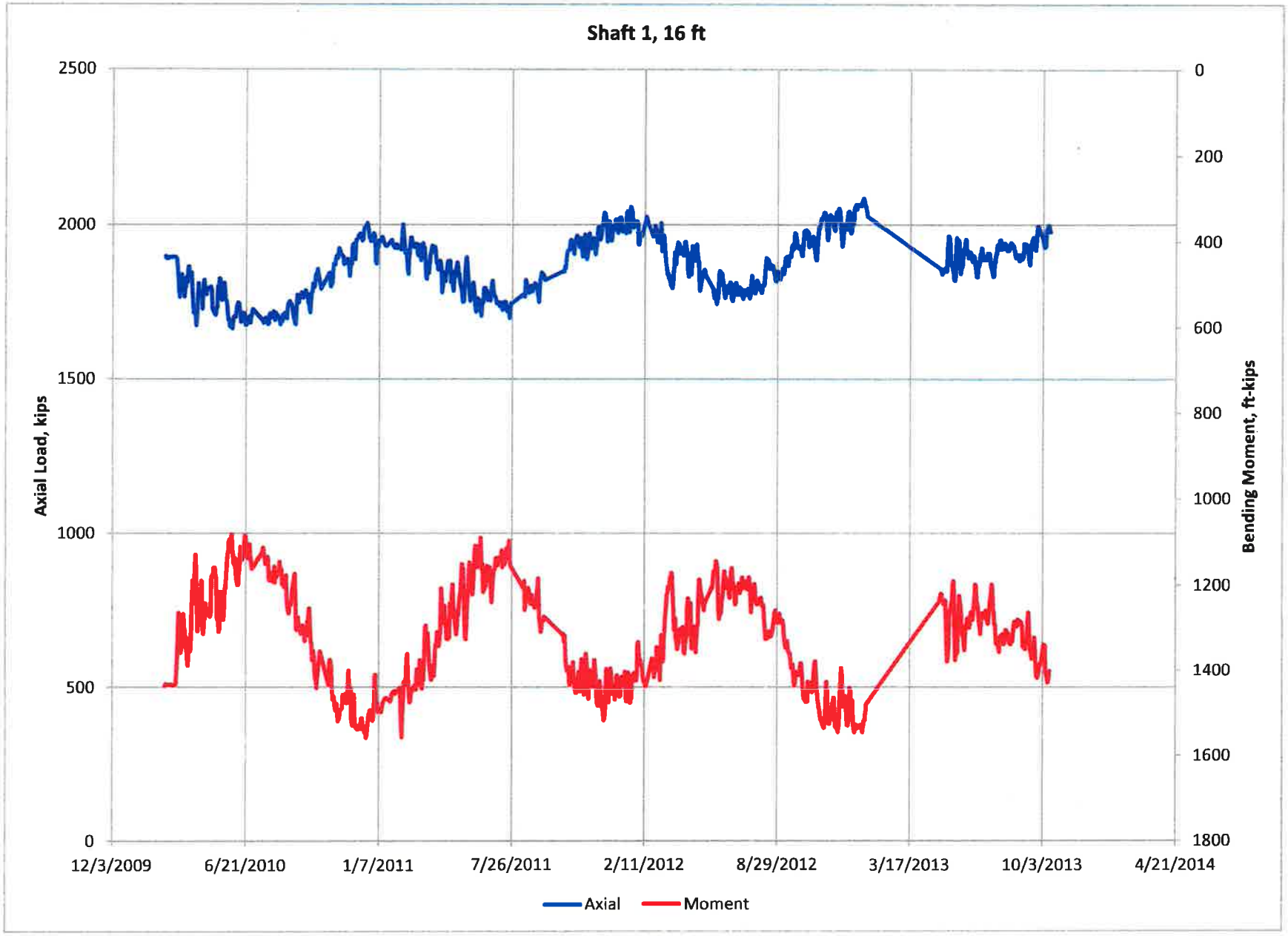
Tiebeams - Drilled Pier Side

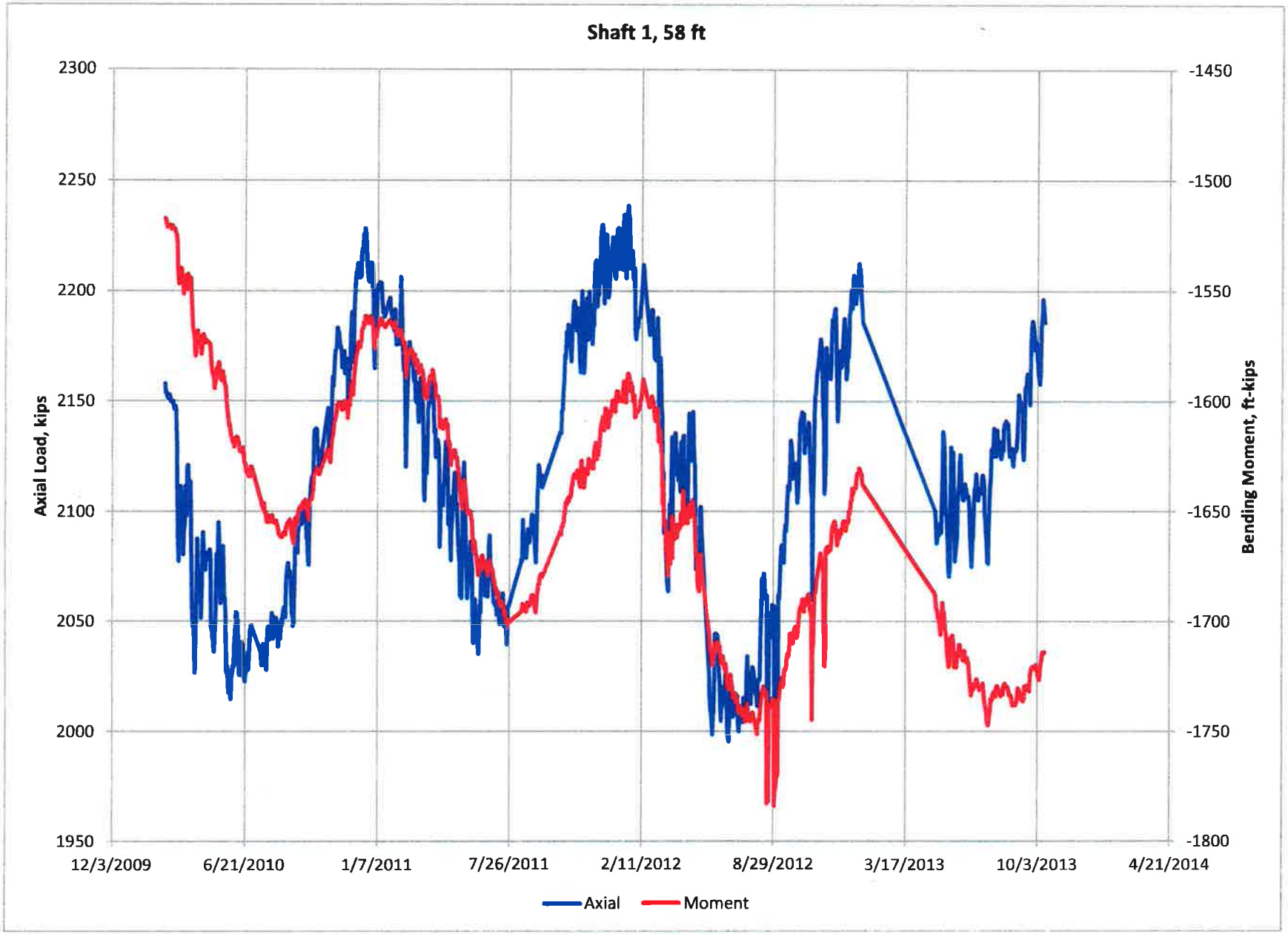
CUY-90-15.24 Slope Monitoring
PID 76117
Cleveland, Ohio
EDP #09305G

Drilled Shaft #1
(Weak Axis Bending)
Average for Period: July 17 thru October 14, 2013






Shaft 1, 16 ft
Axial Load, kips
Bending Moment, ft-kips
2500
2000
1500
1000
500
0
0
200
400
600
800
1000
1200
1400
1600
1800
12/3/2009
6/21/2010
1/7/2011
7/26/2011
2/11/2012
8/29/2012
3/17/2013
10/3/2013
4/21/2014
Axial
Moment


Shaft 1, 58 ft
Axial Load, kips
Bending Moment, ft-kips
2300
2250
2200
2150
2100
2050
2000
1950
-1450
-1500
-1550
-1600
-1650
-1700
-1750
-1800
12/3/2009
6/21/2010
1/7/2011
7/26/2011
2/11/2012
8/29/2012
3/17/2013
10/3/2013
4/21/2014
Axial
Moment

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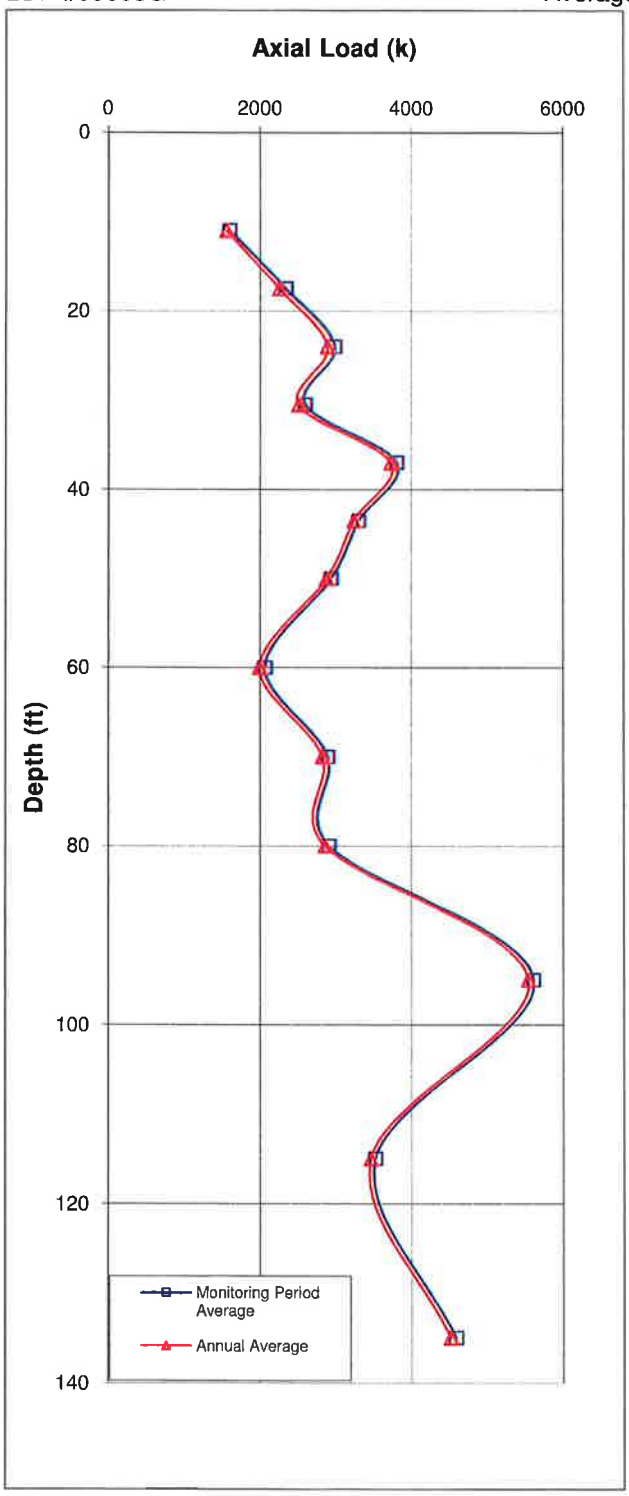
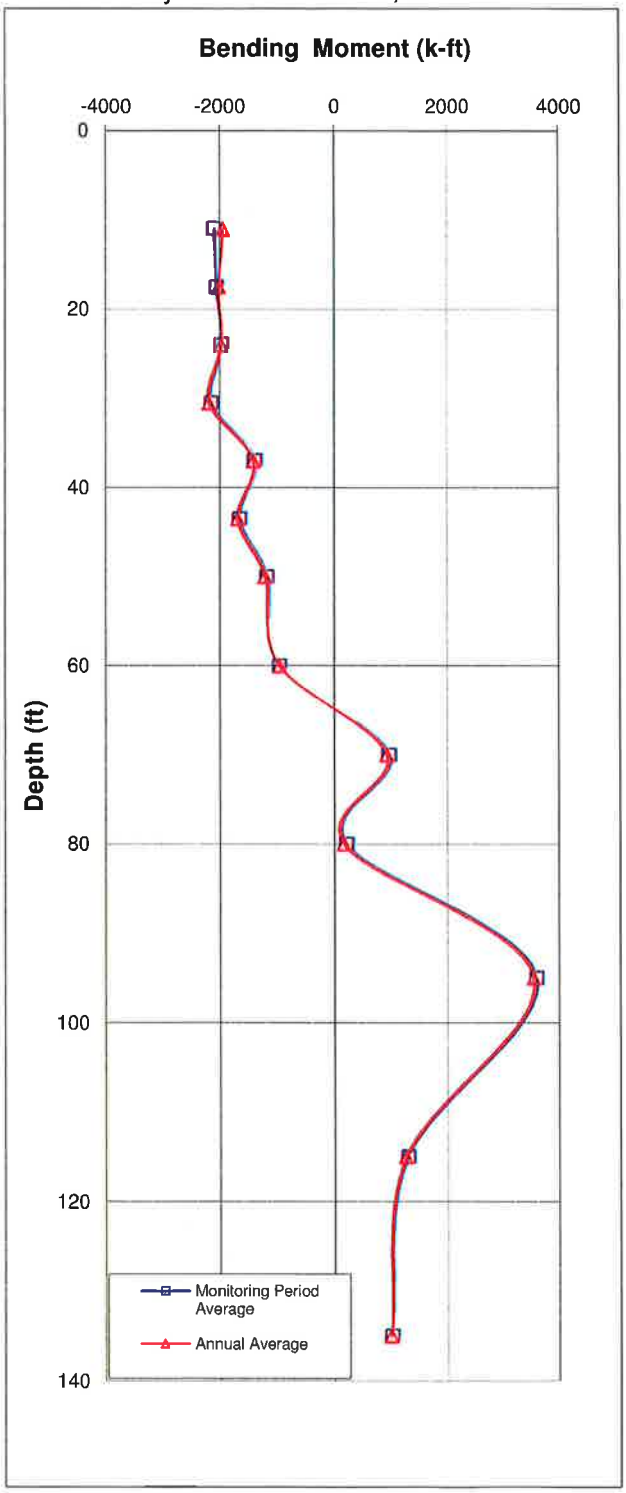
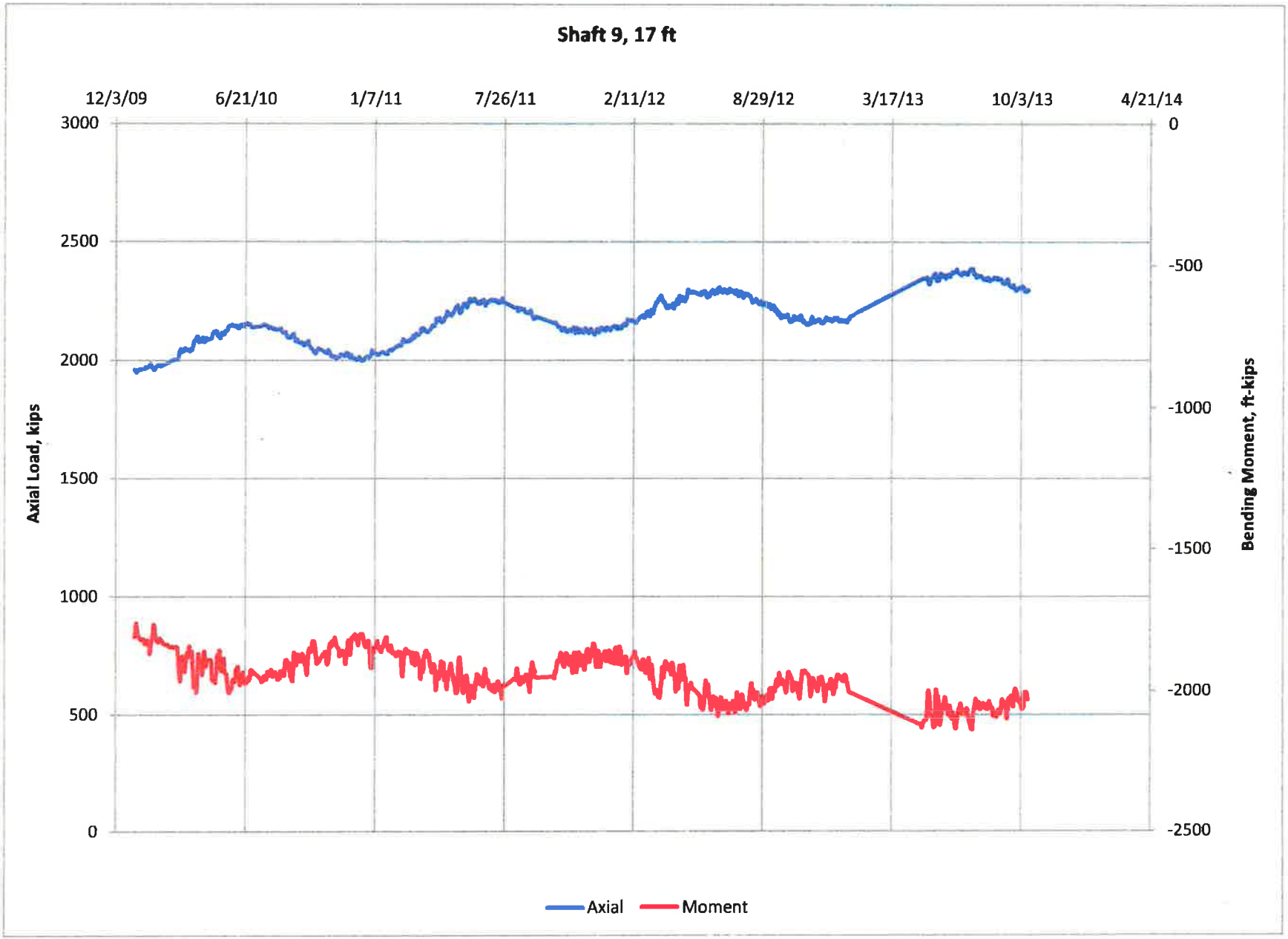
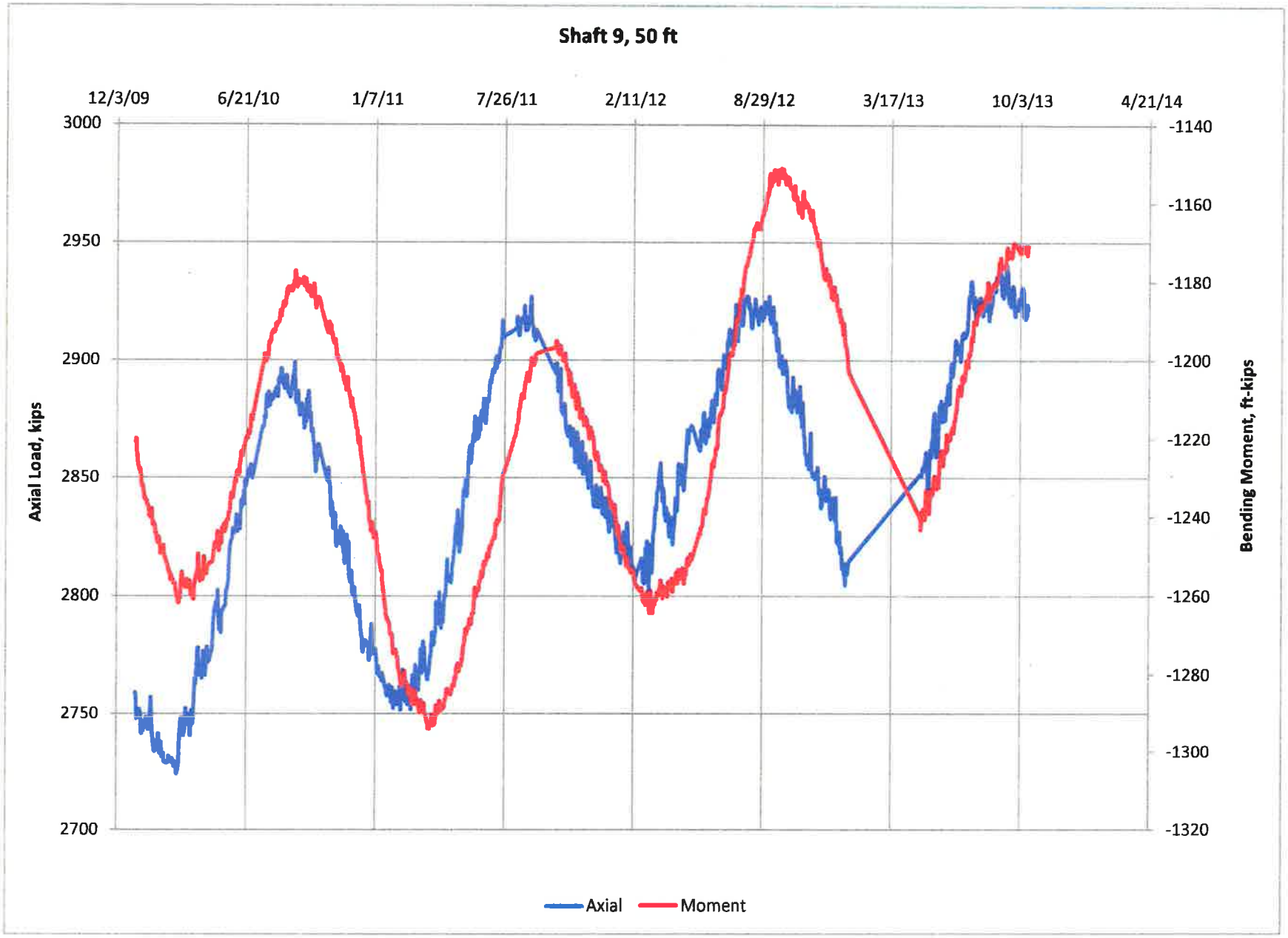
Cleveland, Ohio
EDP #09305G

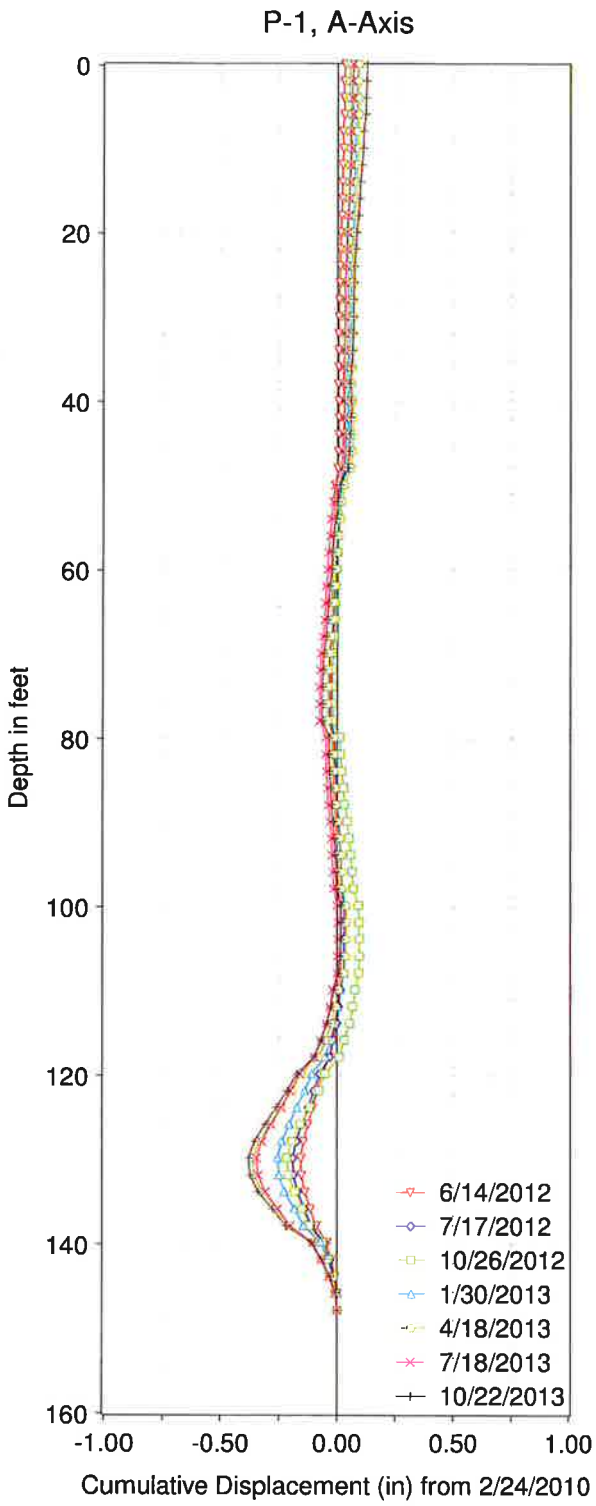
Drilled Shaft #9
Strong Axis Bending
Average for Period: July 17 thru October 14, 2013

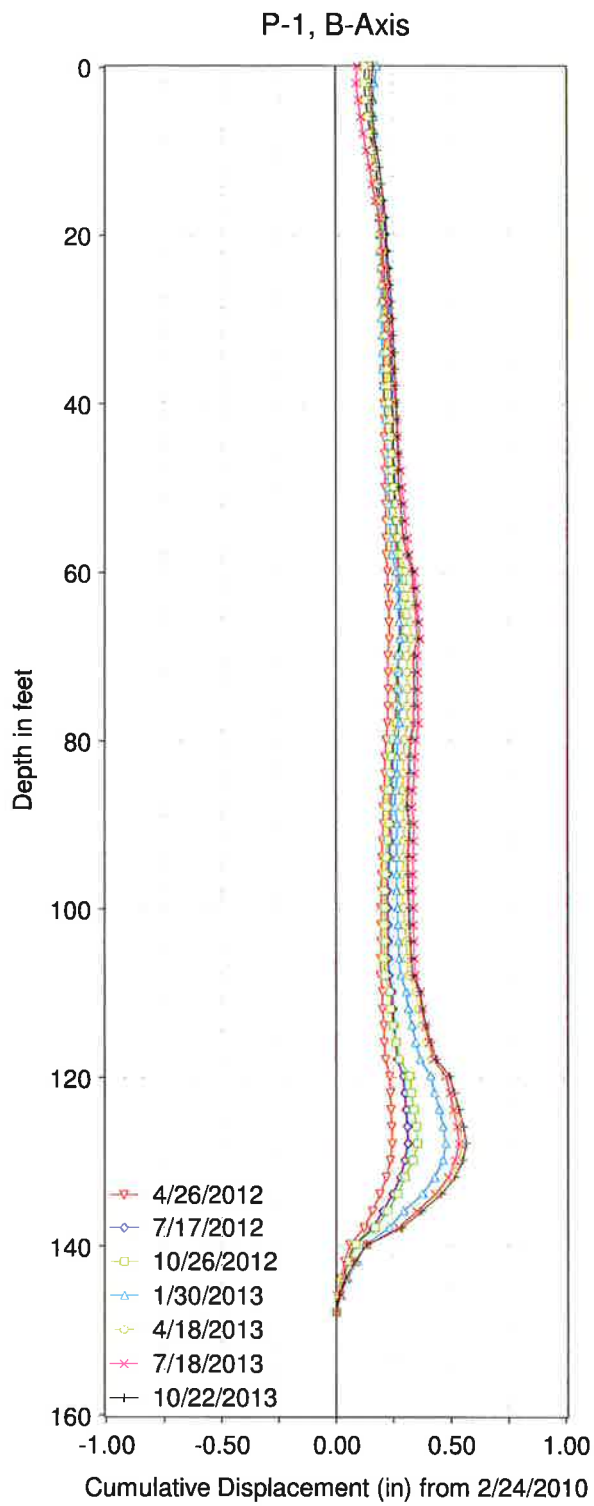





Shaft 9, 17 ft
12/3/09
6/21/10
1/7/11
7/26/11
2/11/12
8/29/12
3/17/13
10/3/13
4/21/14
3000
2500
2000
1500
1000
500
0
0
-500
-1000
-1500
-2000
-2500
Axial Load, kips
Bending Moment, ft-kips
Axial
Moment

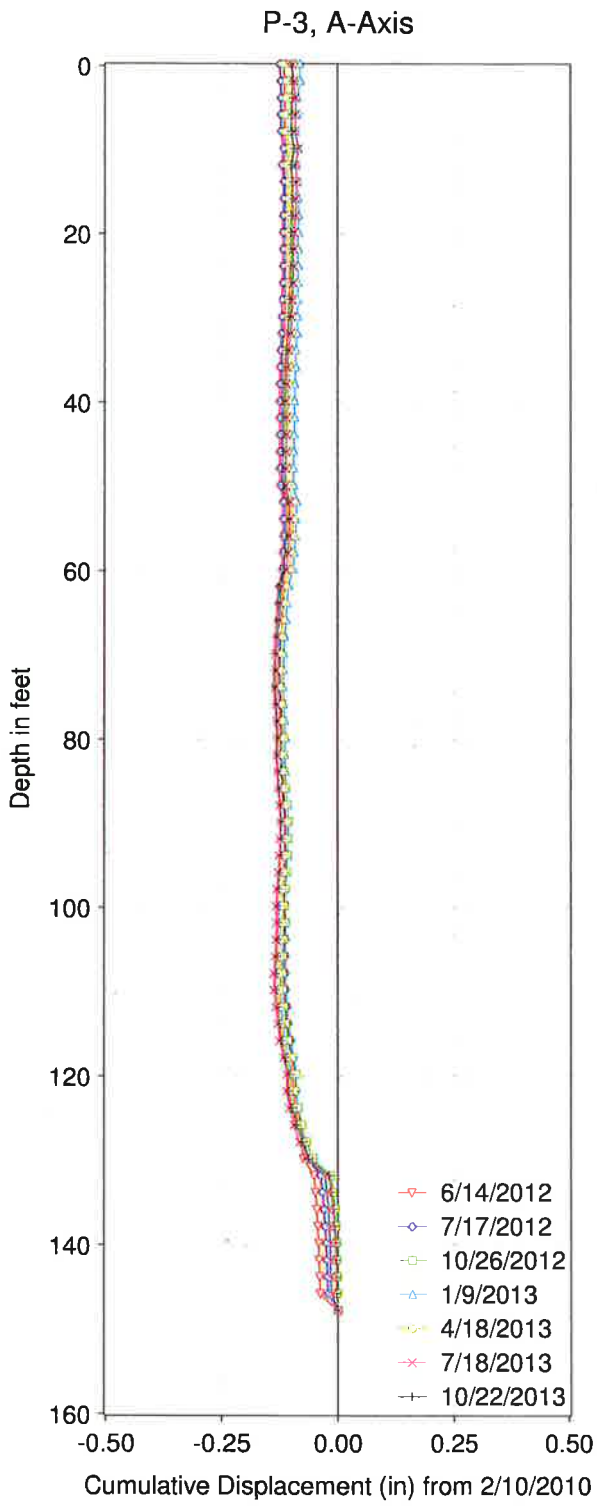

Shaft 9, 50 ft
12/3/09
6/21/10
1/7/11
7/26/11
2/11/12
8/29/12
3/17/13
10/3/13
4/21/14
3000
2950
2900
2850
2800
2750
2700
Axial Load, kips
-1140
-1160
-1180
-1200
-1220
-1240
-1260
-1280
-1300
-1320
Bending Moment, ft-kips
Axial
Moment

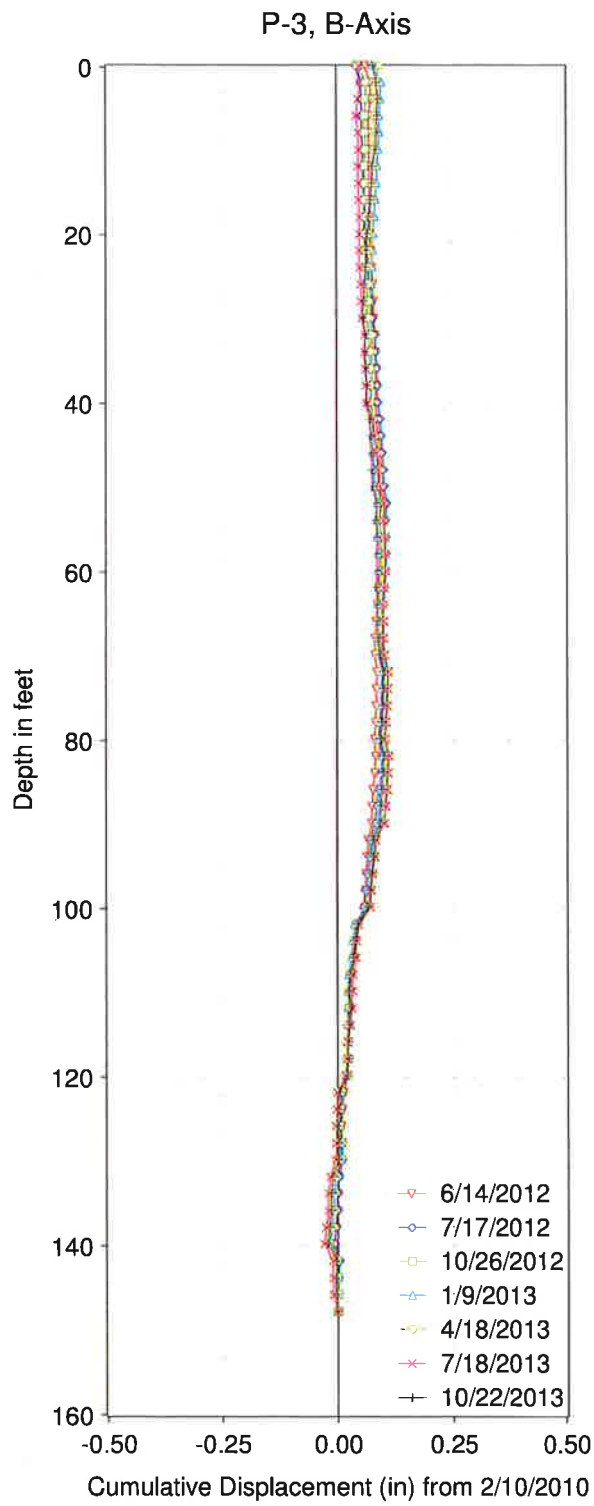




CUY-90-15.24
PID 76117
SME Project#: 062943.00
Reading Date: 10/22/2013

Soil and Materials Engineers, Inc.





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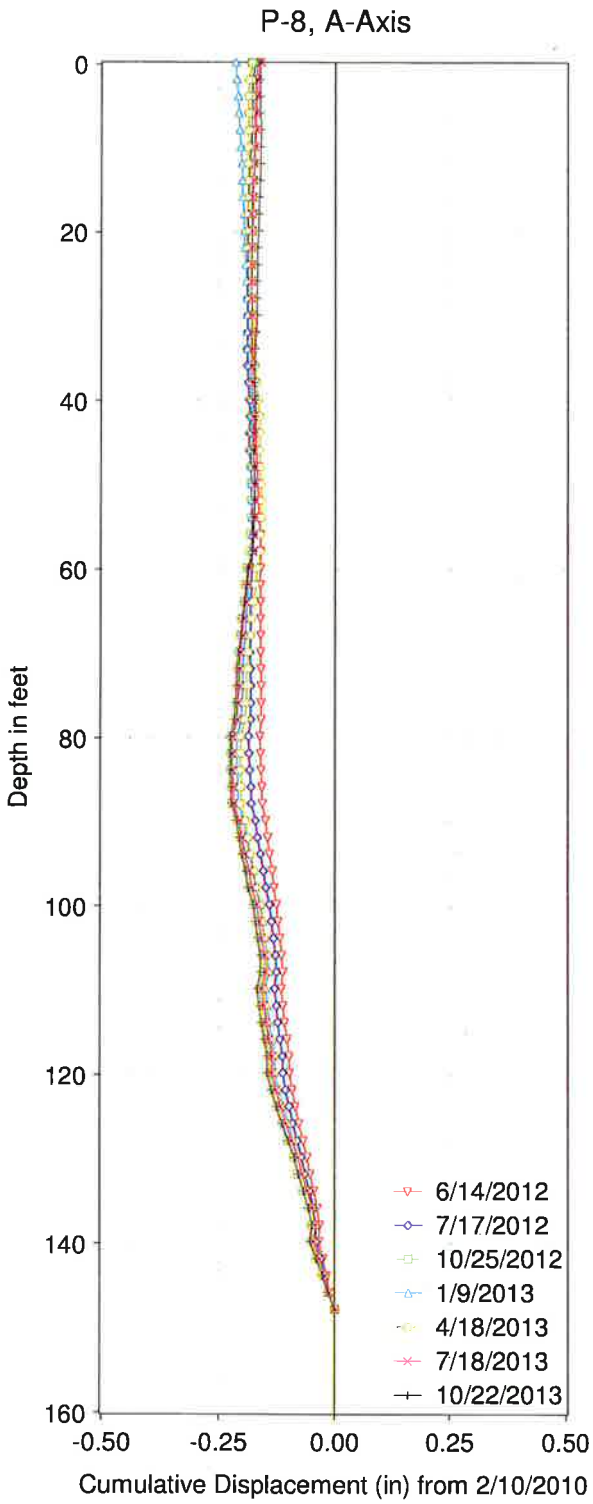

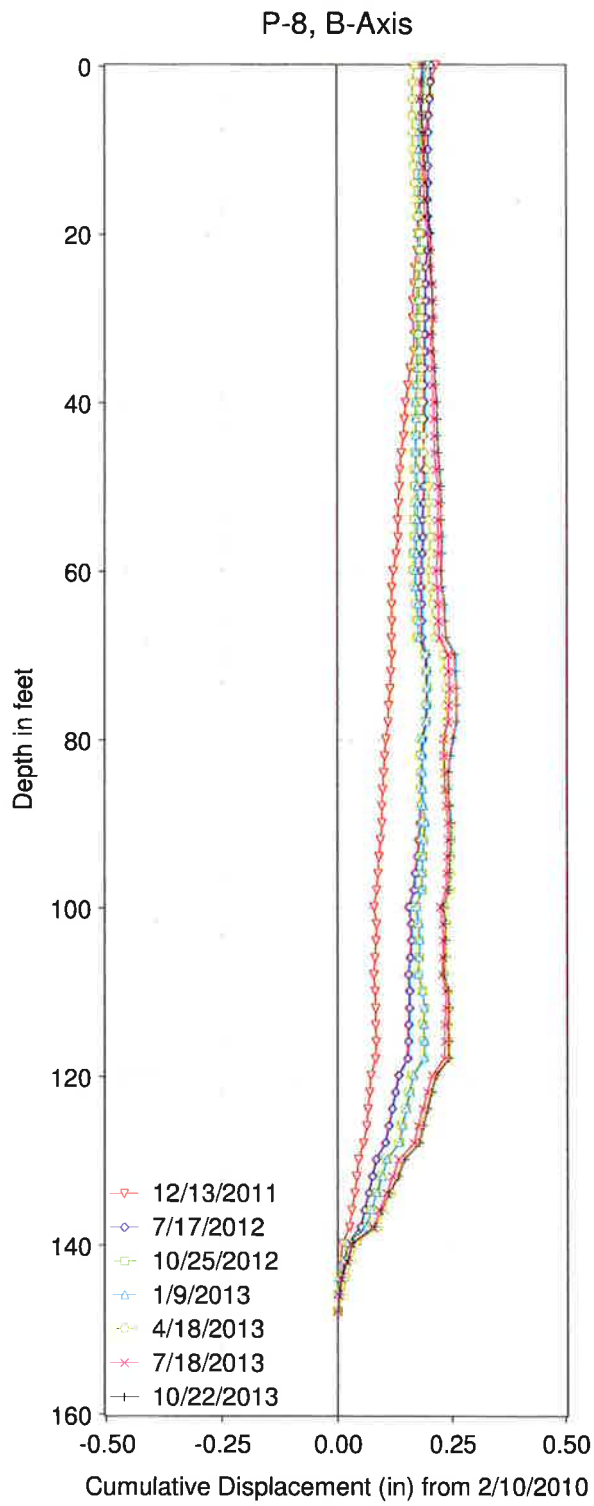

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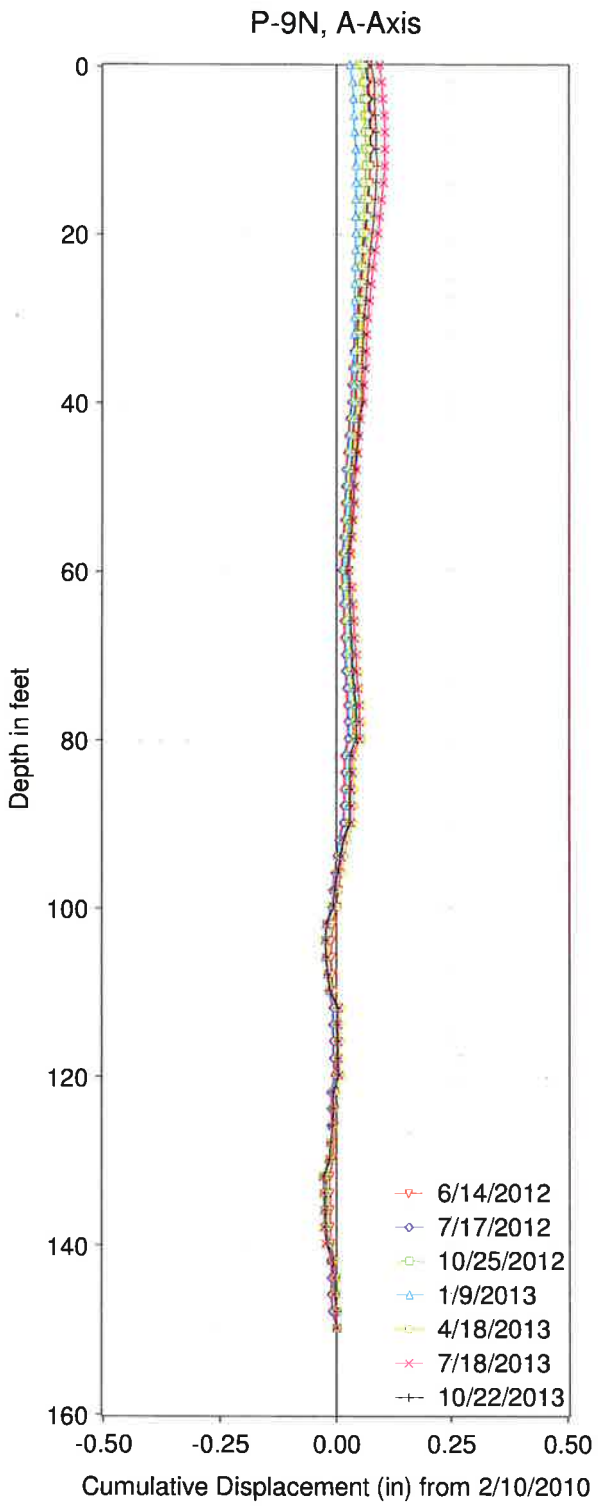

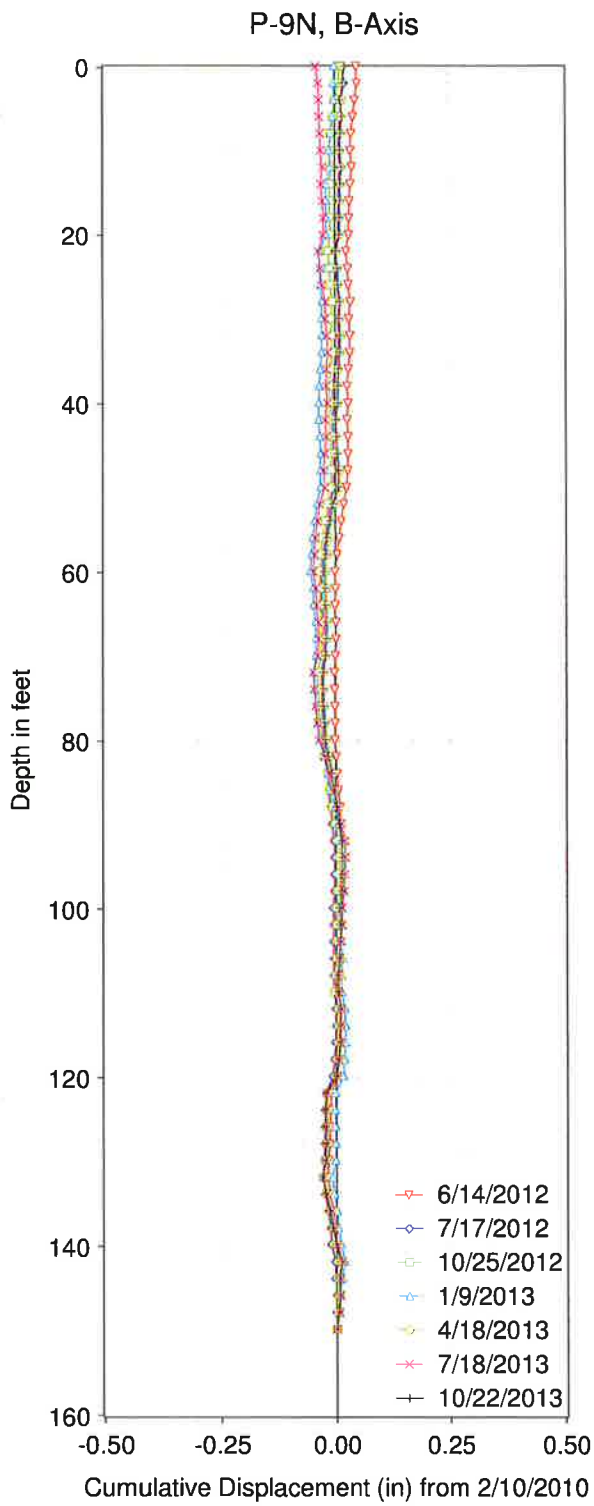

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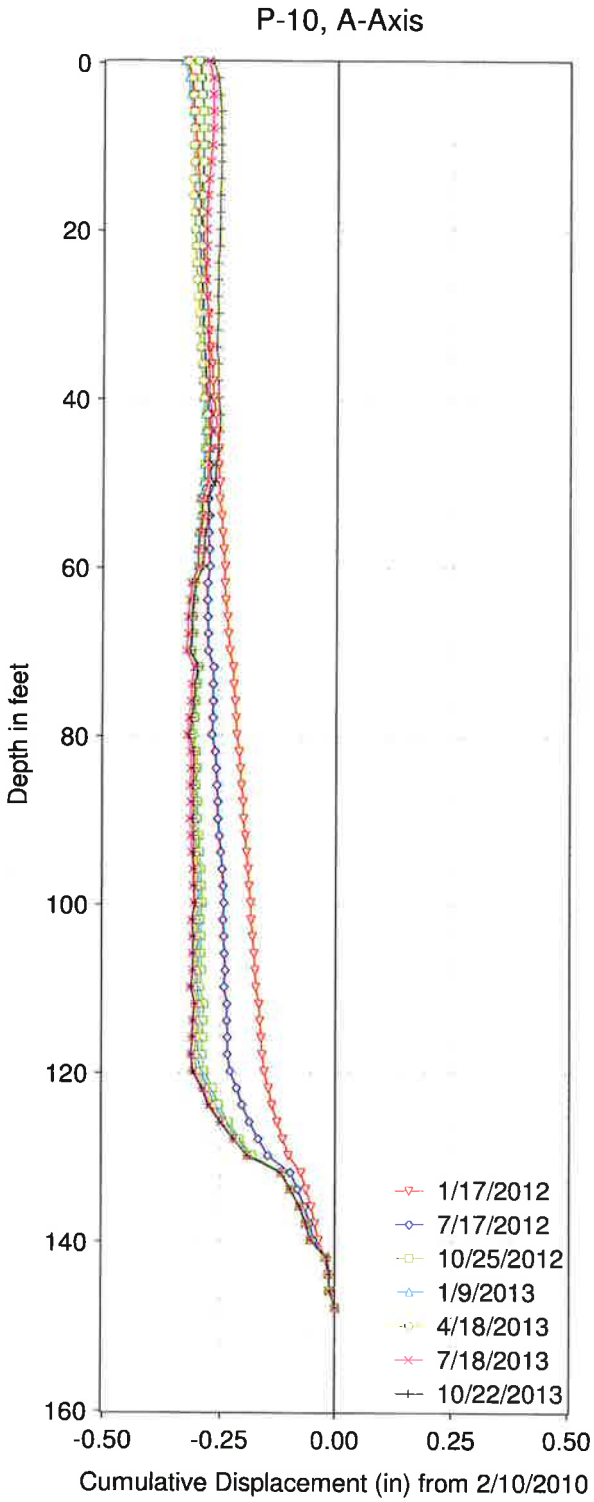

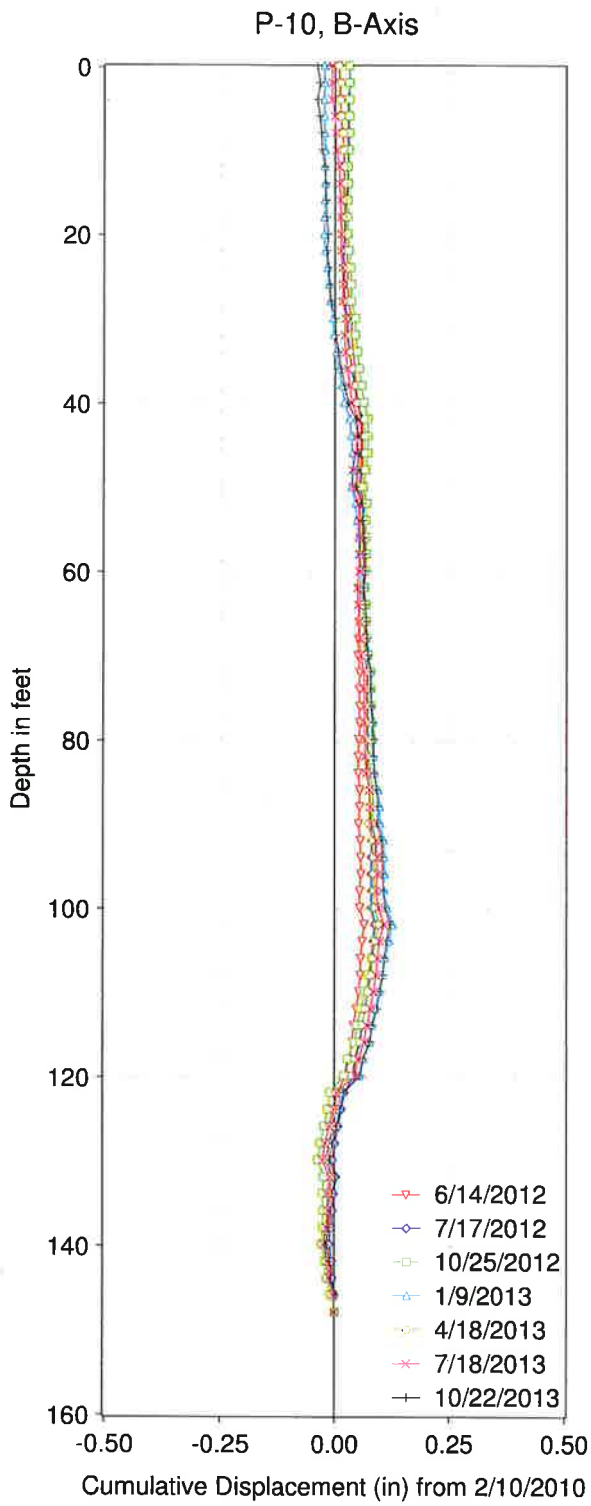

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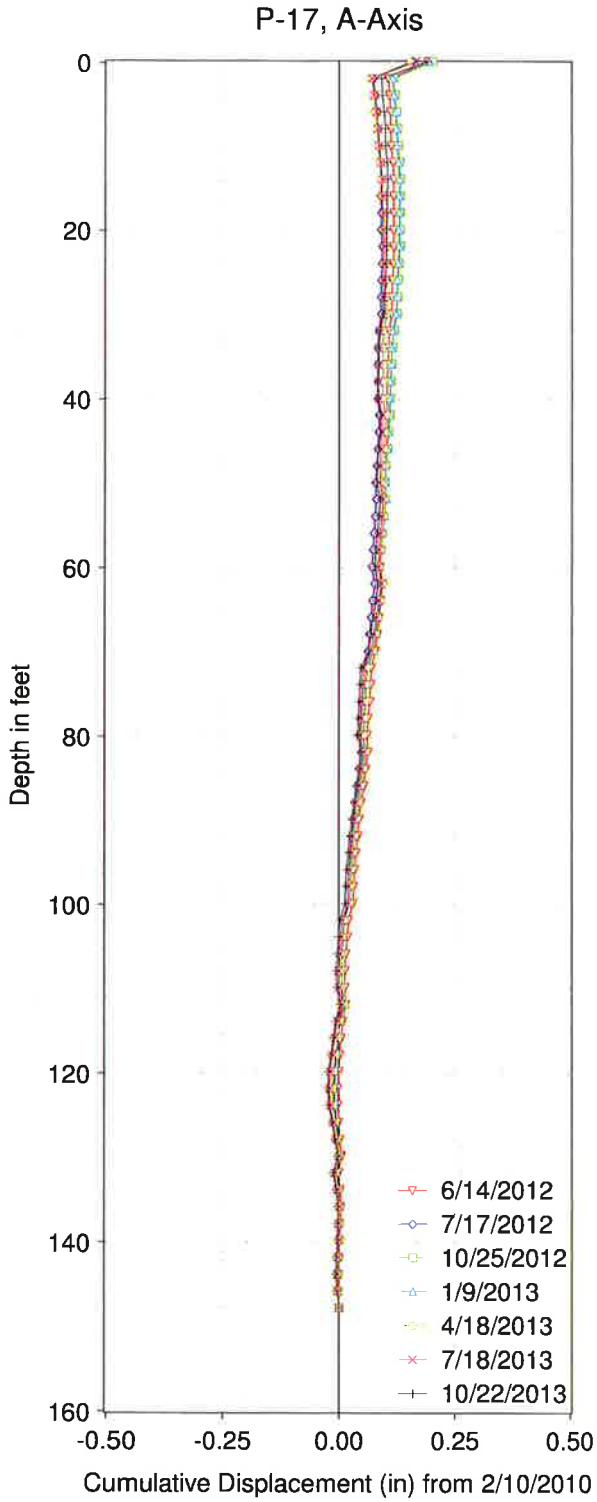

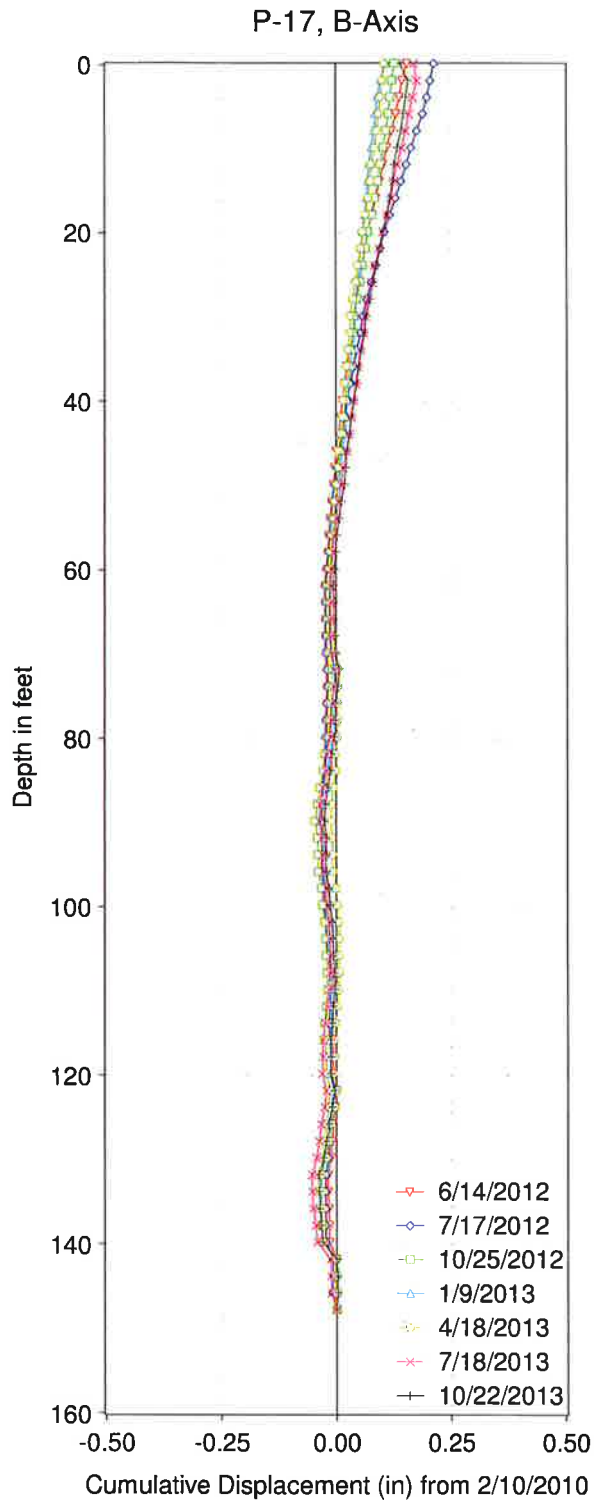

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