MEMO

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From:

Kirk Lowery, P.E.

Date:

April 3, 2020

Arcadis Project No.:

LA003315.0000

Subject:
March 2020 Summary Report of Inclinometer Readings
Remediation Design of Levee Floodplain Failure within the Upper Brownsville Levee Reach Lower Rio Grande Flood Control Project – IBM15D0001 – IBM15T0015

1. Introduction

Arcadis U.S., Inc. (Arcadis), is pleased to submit this summary technical memorandum including data charts of the slope inclinometer readings at the IBWC site. The baseline readings for the new inclinometers, ARC-1, ARC-2, ARC-3 and ARC-4, were taken in June 2016 and the twelfth set of readings were measured on March 31, 2020. Under the current scope of work, this set of readings will be the second to last measurement to be taken for these inclinometers.

Readings for the United States Corps of Engineers' (USACE) inclinometers, I-32, I-33 and I-34, were not taken for fear of getting the inclinometer probe stuck in the already constricted areas of the pipe due to previous soil movement.

During the March 31, 2020 site visit, several pins that were installed June 14, 2017 have been removed. The removed pins were predominantly on top of the levee near inclinometer ARC-1 and south of the existing retaining wall. It is assumed that pins were removed by active traffic on the levee roadway and by grass mowing activities. In addition, vegetation at the top of the levee as covered the caliche base road. For these reasons, the longitudinal cracks noted in July 2017 could not be observed or measured during the March 2020 visit. Attachment C shows photos of the top of the levee where tension cracks were present in July 2017.

The readings for each inclinometer are reflected in the graphical displays provided in Attachment A. Attachment A includes both incremental and cumulative displacement plots. Attachment B shows the inclinometer locations on a Google Map.

The incremental displacement plot compares the mean deviation data to the baseline survey file. This plot reveals the exact depth where displacements are actually occurring. The cumulative displacement is the sum of the displacements from the base of the borehole. This plot shows the change in the position of the casing from the first set of readings.

The A-axis charts in the displacement plots show displacements in the plane perpendicular to the levee while the B-axis charts show displacements in the plane parallel with the levee. A positive reading in the A-axis chart indicates displacement to the west heading toward the Rio Grande, and a positive reading in the B-axis chart indicates displacement to the north heading toward the Gateway Bridge.

2. Digitilt AT Inclinometer

Digitilt AT system was used to survey the inclinometers. The system components include an inclinometer probe, control cable, a Bluetooth reel and the Digitilt Reader app for certified Android-based tablet computer. The equipment is shown in Figure 1.

Figure 1: Digitilt AT System Components.

3. March 2020 Inclinometers Assessment

Data collected on March 31, 2020 followed the same trend as the readings measured in July 2017. The incremental and cumulative displacement plots recorded between September 2016 through March 2020 are presented in Attachment A. The location Data comparisons for each inclinometer are described below:

Inclinometer ARC-1: The base readings for inclinometer ARC-1 were collected on June 22, 2016. The ARC-1 cumulative plot in the A-Axis direction shows a slight progressive movement starting at depths between

28 and 30 feet. This depth corresponds with the interpreted Alluvium/Pleistocene interface presented in Figure 2 of Arcadis' July 31, 2017 *Final Geotechnical Assessment Report*. After reviewing the cumulative displacement plots, there was a slight increase in displacement between the dates of September 2016 and March 2017. After March 2017, the displacement towards the Rio Grande (A-Axis) started to increase at a slow rate. Comparing the measurements taken in July 2017 to March 2020, the displacement is 0.17 inch towards the Rio Grande (A-Axis) at a depth of 28 feet. The overall displacement at a depth of 28 feet is 0.33 inch.

The displacement parallel to the levee does not show any sign of movement in this month's readings.

Inclinometer Arc-2: The base readings for inclinometer ARC-2 were collected on June 17, 2016. The ARC-2 cumulative displacement plot in the A-Axis direction shows displacement between the depths of 38 feet to 40 feet. This depth corresponds with the interpreted Alluvium/Pleistocene interface presented in Figure 2 of Arcadis' July 31, 2017 *Final Geotechnical Assessment Report*. The cumulative displacement plots show a slight increase in displacement in September 2016 and a decrease in movement in December 2016. After December 2016, the movement towards the Rio Grande (A-Axis) started to increase at a slow rate. Comparing the measurements taken in July 2017 to March 2020, the displacement is 0.08 inches towards the Rio Grande (A-Axis) at a depth of 40 feet. The overall displacement at a depth of 40 feet is 0.25 inch.

The displacement parallel to the levee does not show any sign of movement in this month's readings.

Inclinometer ARC-3: The base readings for inclinometer ARC-3 were collected on June 17, 2016. The ARC-3 cumulative displacement plot in the A-Axis direction shows displacement between the depths of 36 feet to 38 feet. This depth corresponds with the interpreted Alluvium/Pleistocene interface presented in Figure 2 of Arcadis' July 31, 2017 *Final Geotechnical Assessment Report*. Previous readings showed less than 0.1 inch movement at this depth that no shows an overall displacement of 0.15 inch.

Inclinometer ARC-4: The base readings for inclinometer ARC-4 were collected on June 22, 2016. The ARC-4 cumulative and incremental displacement does not show any sign of movement on the plane perpendicular to the levee nor on the plane parallel to the levee.

After reviewing the cumulative displacement plots, these figures in Attachment A show that each reading exhibits increasing displacement towards the Rio Grande (A-Axis direction) for inclinometers ARC-1 and ARC-2. The displacement for these inclinometers demonstrates a trend that will increase over time due to fluctuations of the water level in the Rio Grande. After critically reviewing the cumulative displacement plots, the graphical displays in Attachment A shows that there is an increase in movement towards the Rio Grande (A-Axis direction) for the inclinometers ARC-1, ARC-2, and ARC-3. The displacement for these inclinometers is progressive but moving at a very slow rate.

ATTACHMENTS:
A – Inclinometer Plots
B – Inclinometer Location Map
C – Site Photos

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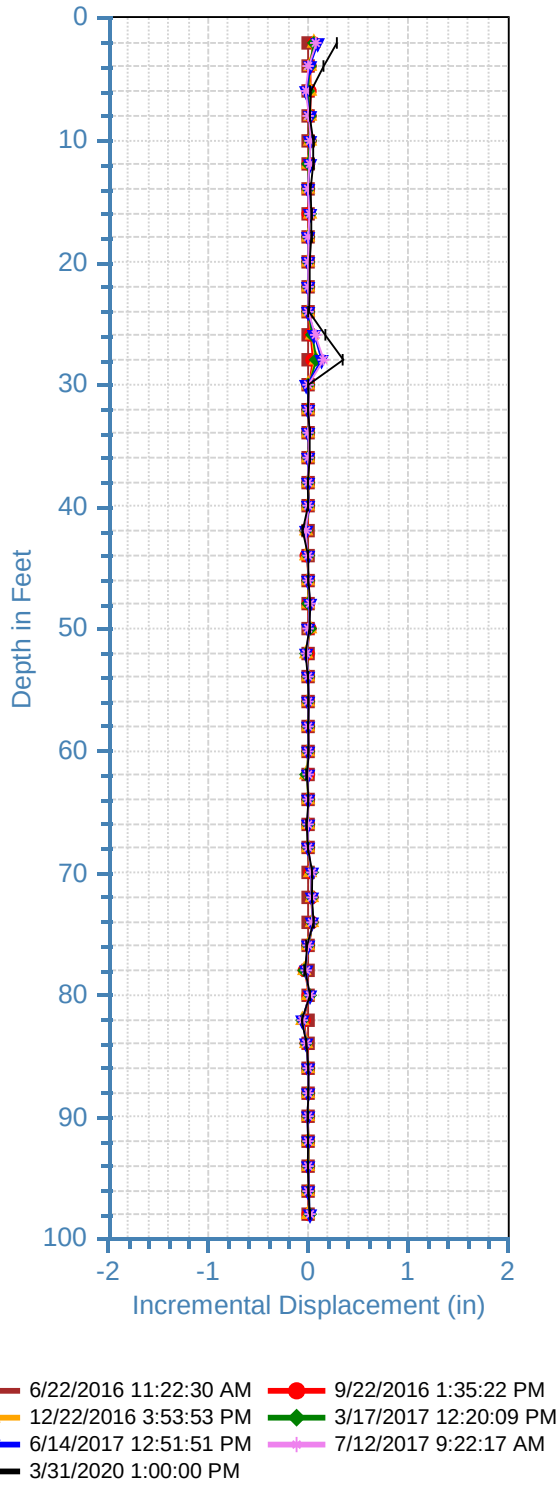
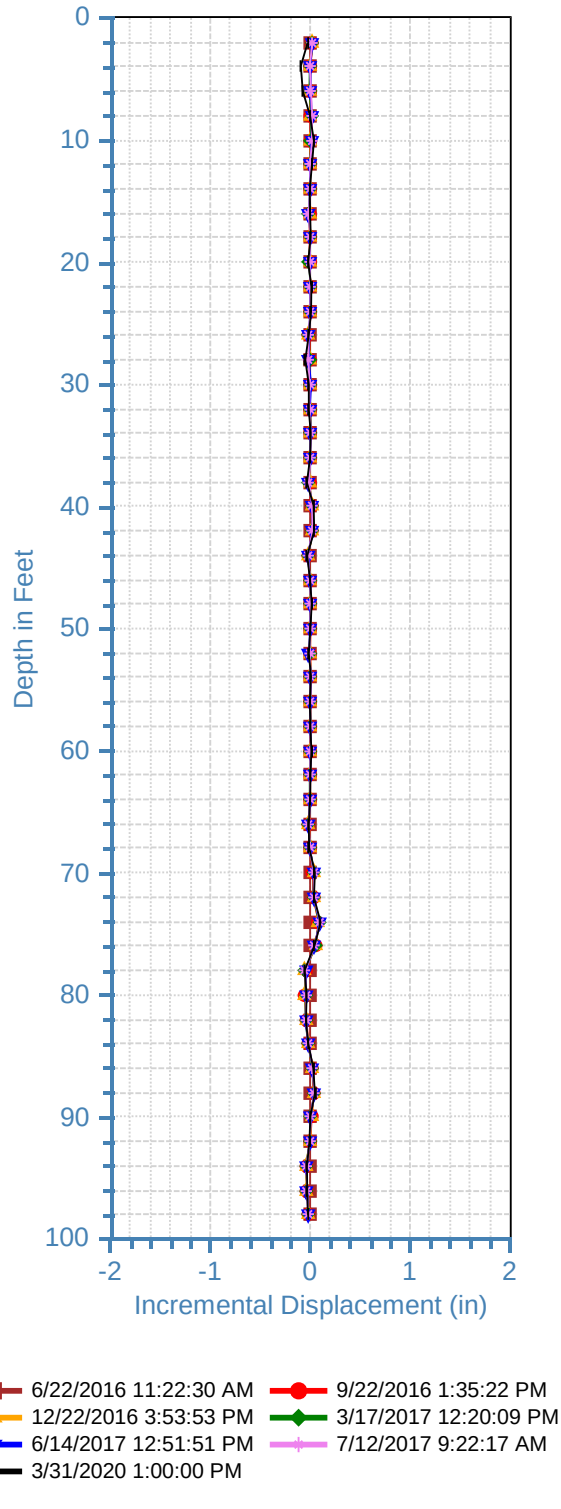
ATTACHMENT A

INCLINOMETER PLOTS

IBWC Arc-1 A - Axis



IBWC Arc-1 B - Axis



Base reading on 6/22/2016

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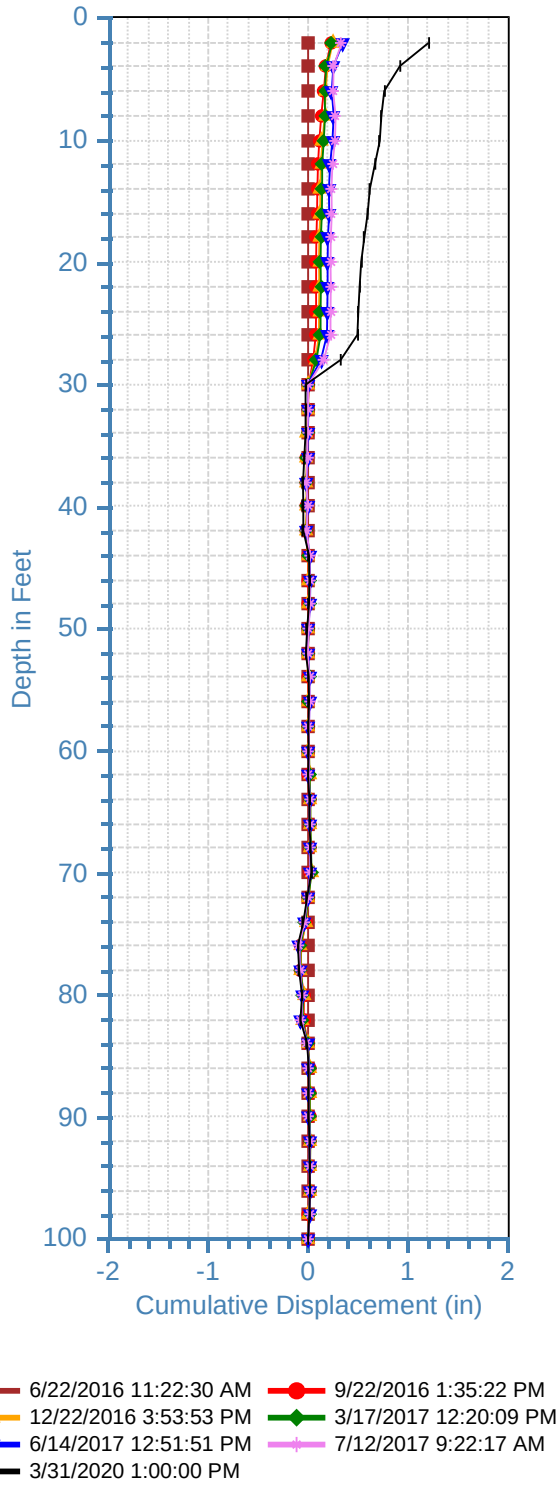
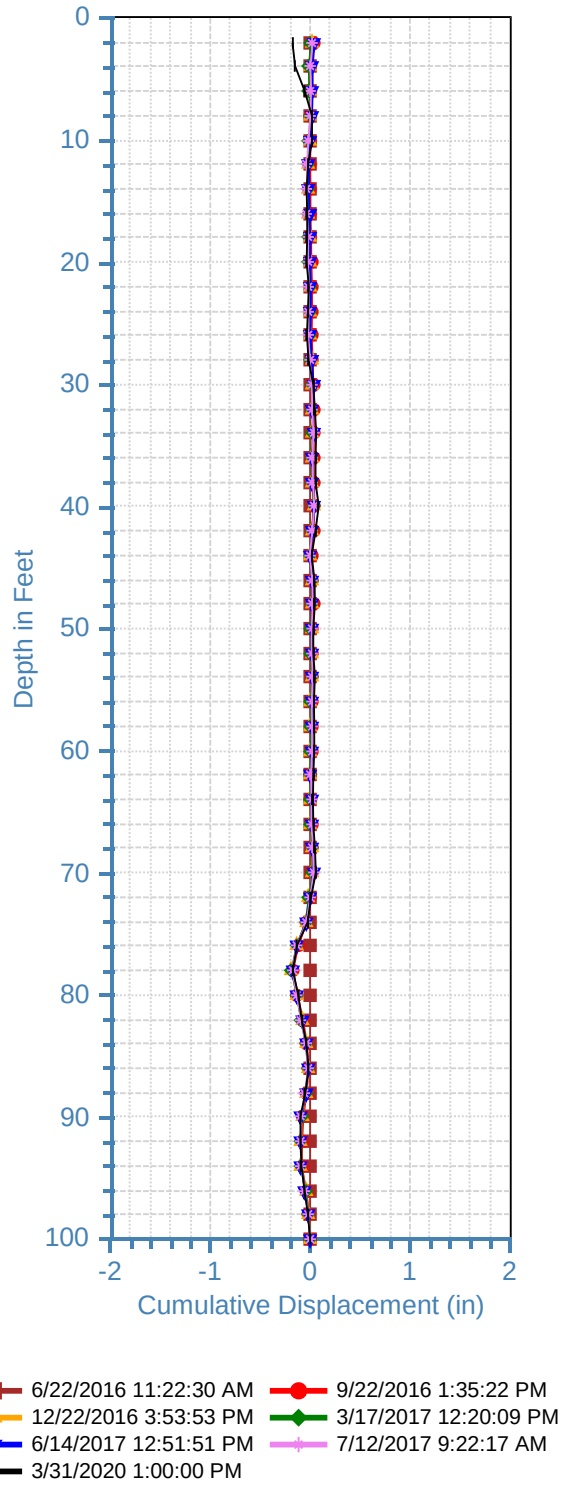
IBWC Arc-1 A - Axis



IBWC Arc-1 B - Axis



Base reading on 6/22/2016

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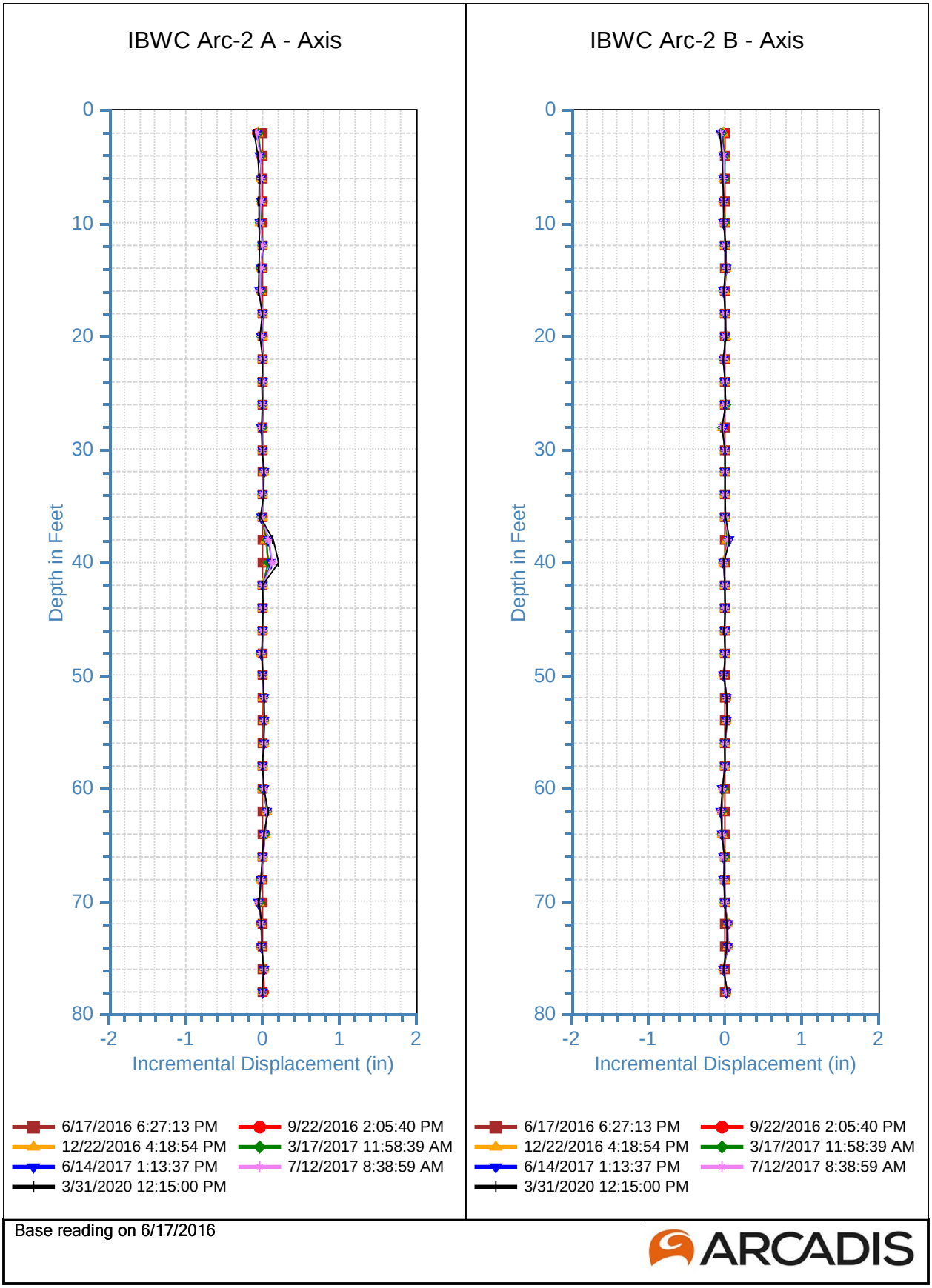

Base reading on 6/17/2016

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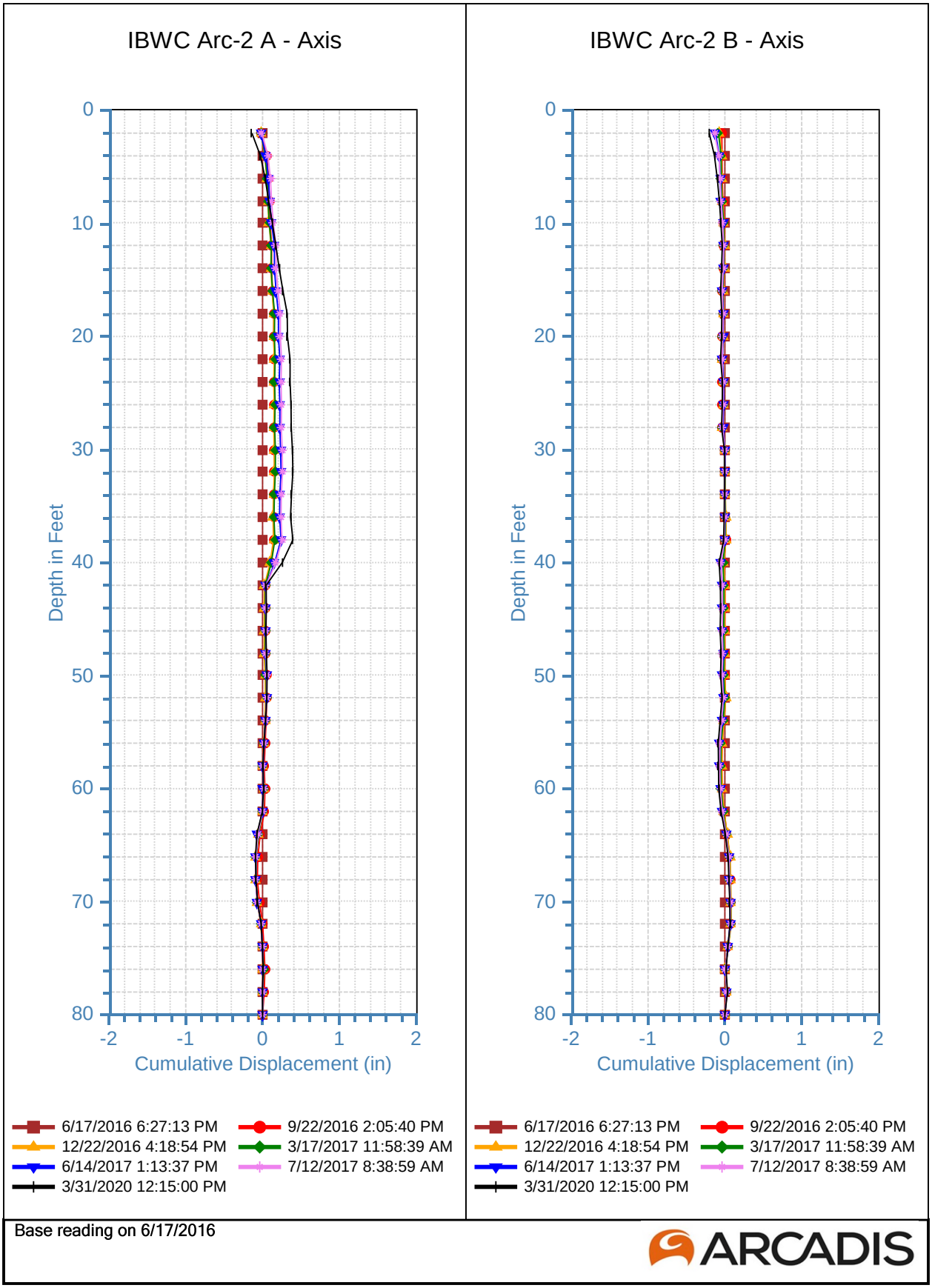

Base reading on 6/17/2016

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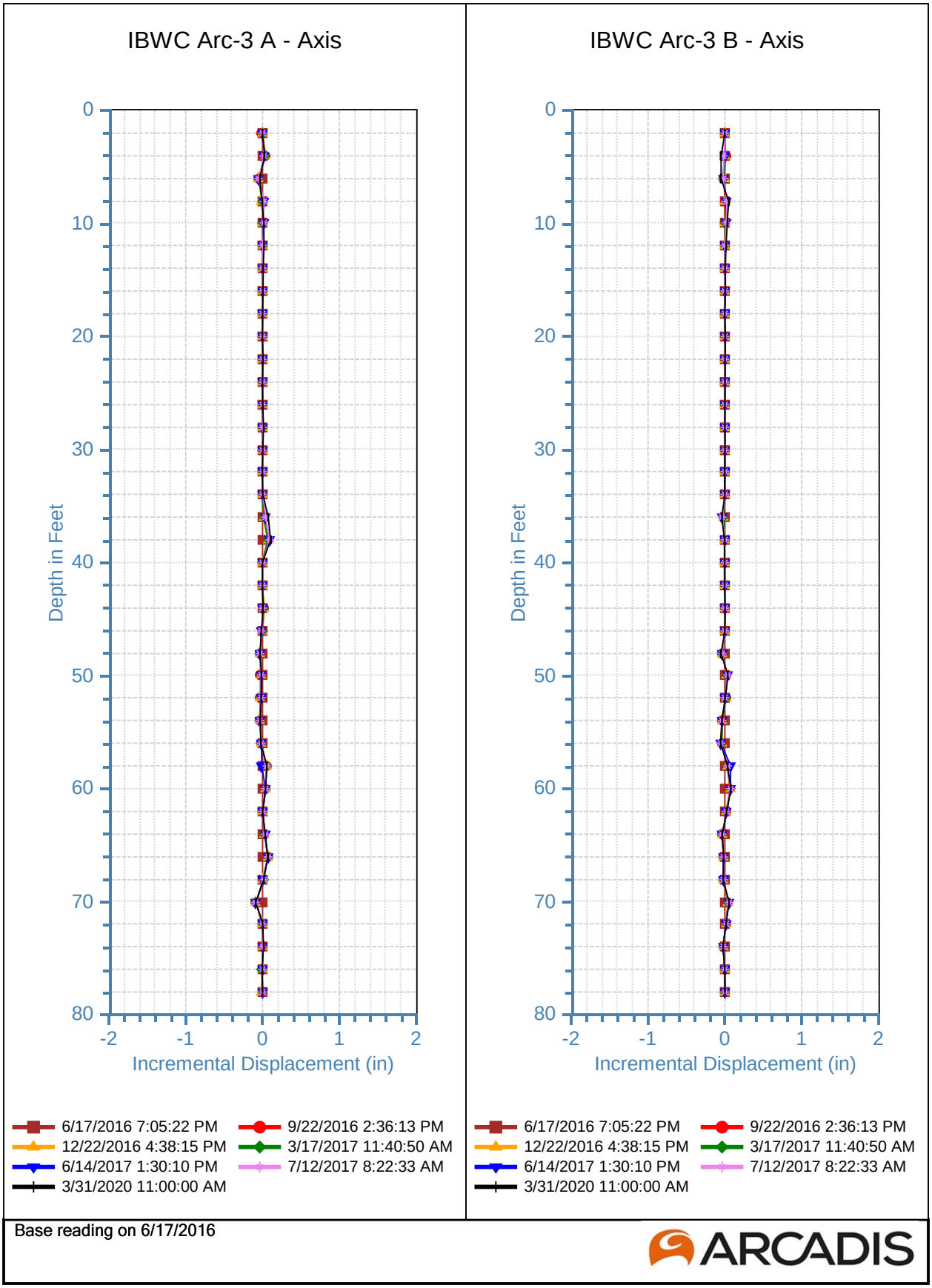

Base reading on 6/17/2016

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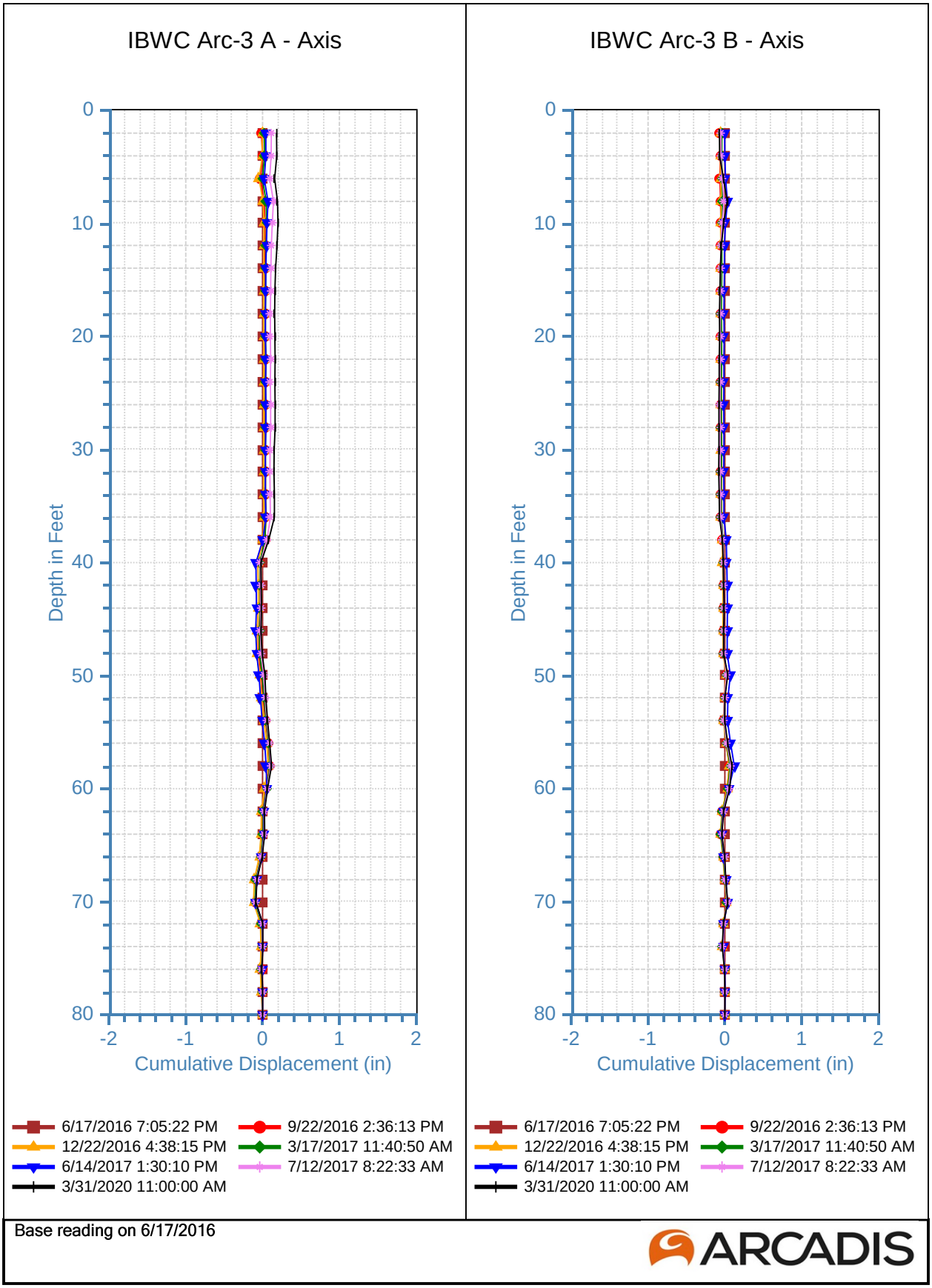

Base reading on 6/17/2016

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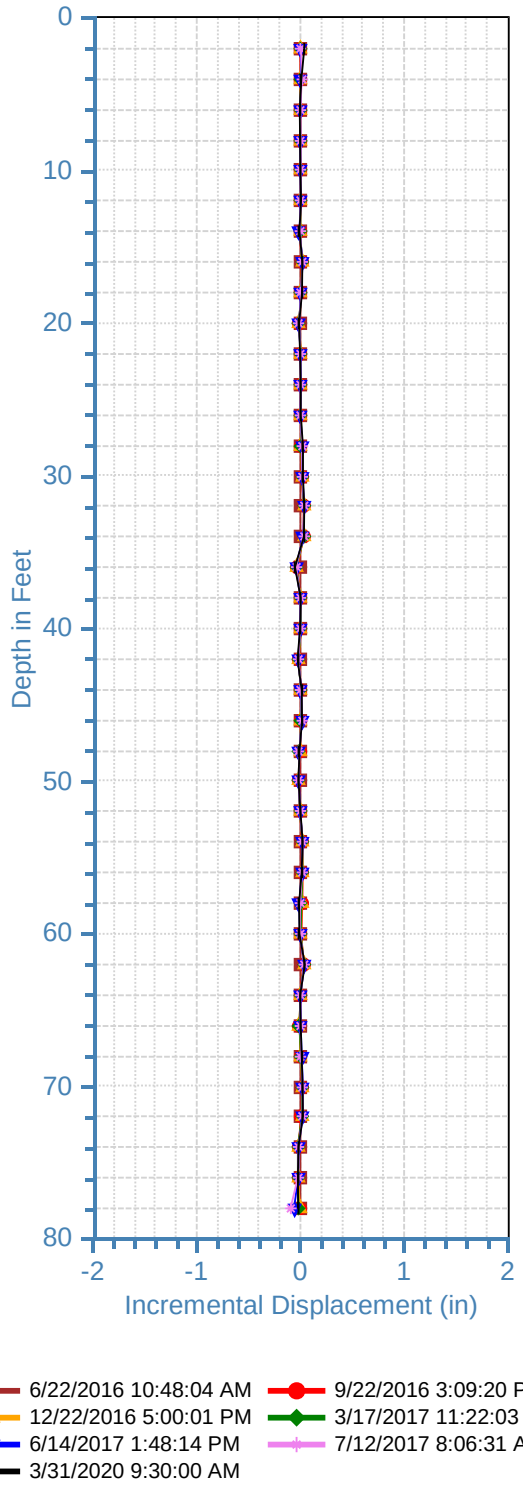
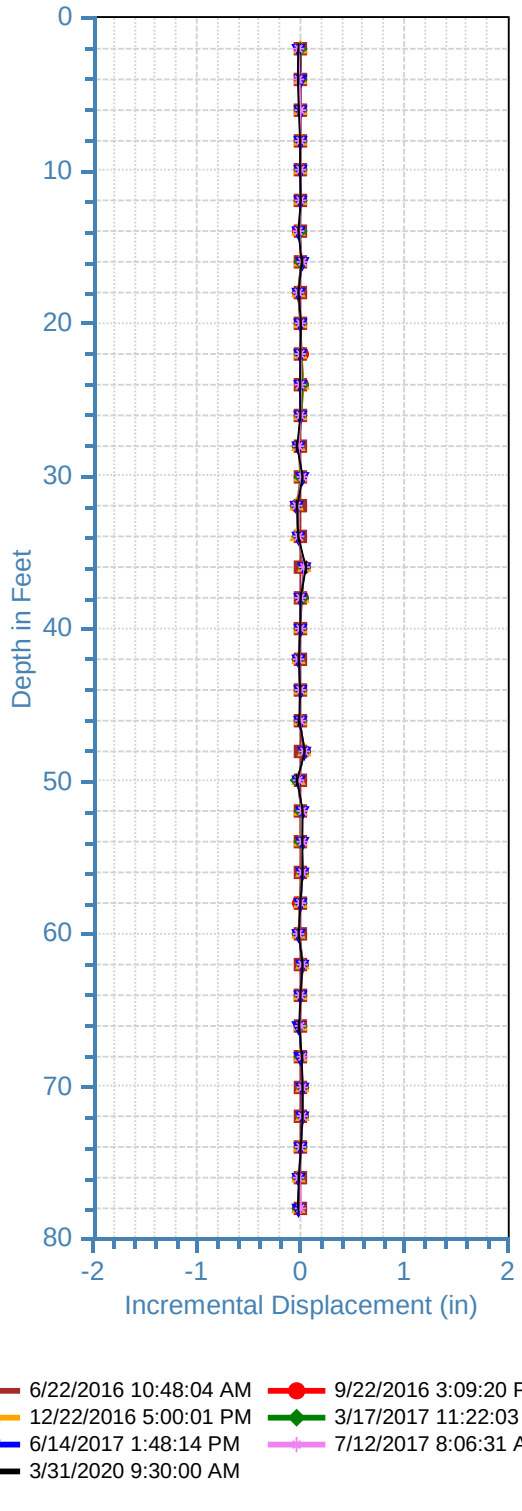
IBWC Arc-4 A - Axis



6/22/2016 10:48:04 AM
9/22/2016 3:09:20 PM
12/22/2016 5:00:01 PM
3/17/2017 11:22:03 AM
6/14/2017 1:48:14 PM
7/12/2017 8:06:31 AM
3/31/2020 9:30:00 AM

IBWC Arc-4 B - Axis



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3/31/2020 9:30:00 AM

Base reading on 6/22/2016

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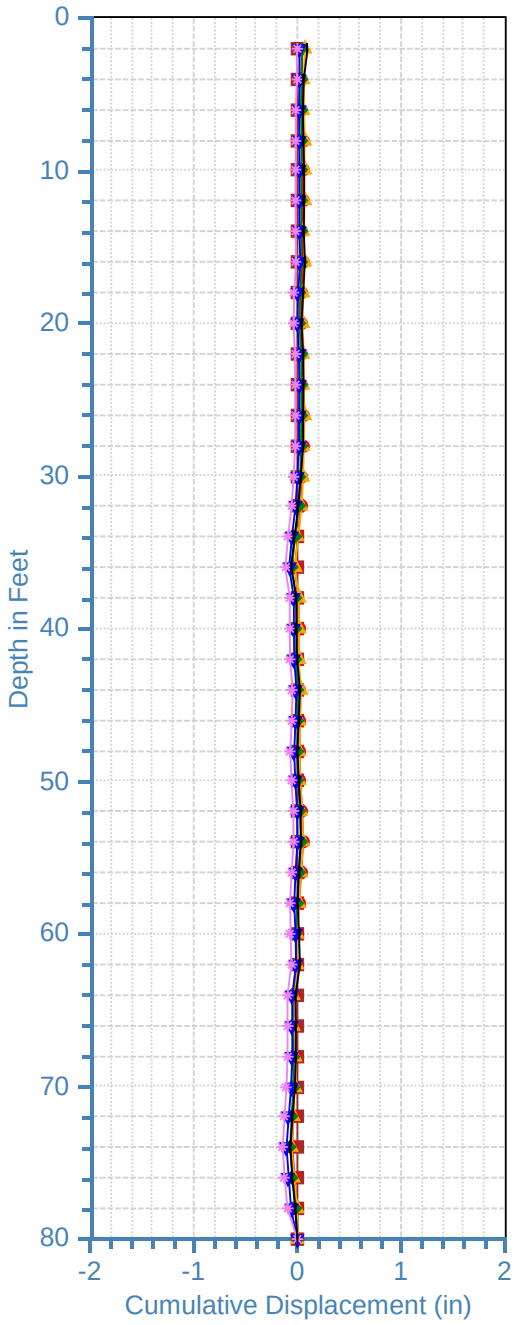
IBWC Arc-4 A - Axis



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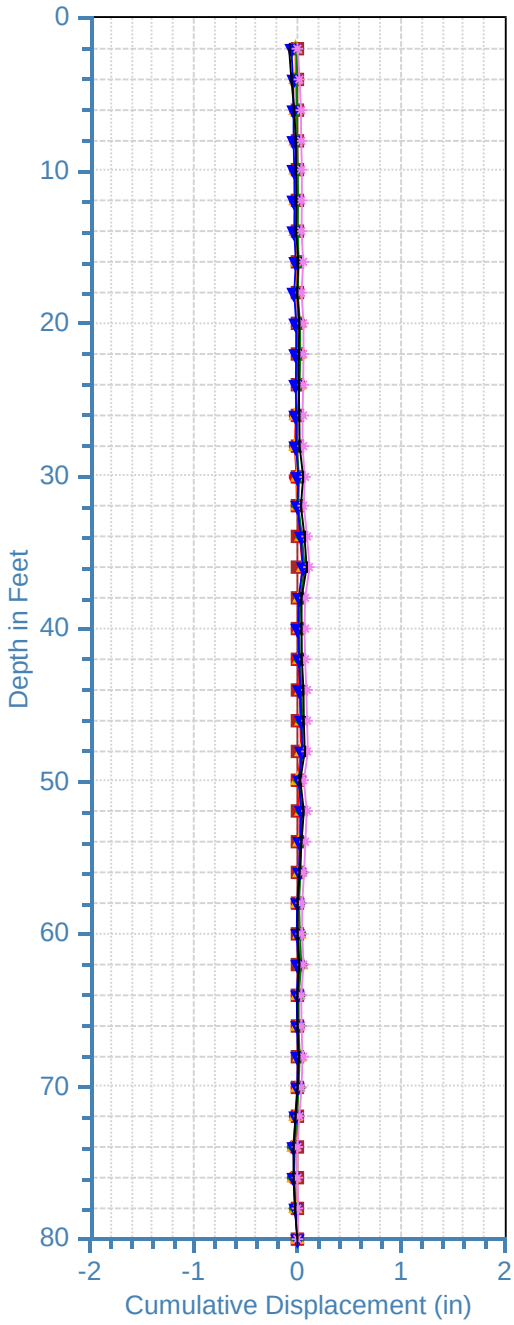
IBWC Arc-4 B - Axis



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Base reading on 6/22/2016

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ATTACHMENT B

INCLINOMETER LOCATION MAP

SCALE: 1/2" = 1'

LEGEND:

B-1: 100 FEET BOREHOLE DRILLED AT THE TOP OF THE LEVEE

ARC-1: 98 FEET INCLINOMETER CASING INSTALLED WITHIN BORING B-1

B-2: 80 FEET BOREHOLE DRILLED AT THE TOE OF THE LEVEE

ARC-2: 78 FEET INCLINOMETER CASING INSTALLED WITHIN BORING B-2

B-3: 80 FEET BOREHOLE DRILLED AT THE EDGE OF THE RIVERBANK

ARC-3: 78 FEET INCLINOMETER CASING INSTALLED WITHIN BORING B-3

B-4: 80 FEET BOREHOLE DRILLED NEAR THE NORTH ABUTMENT OF THE GATEWAY BRIDGE

ARC-4: 78 FEET INCLINOMETER CASING INSTALLED WITHIN BORING B-4

0 50' 100'

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SUMMARY REPORT OF INCLINOMETER READINGS

REMEDIATION DESIGN OF LEVEE FLOODPLAIN FAILURE WITHIN THE UPPER BROWNSVILLE LEVEE REACH LOWER RIO GRANDE FLOOD CONTROL PROJECT

INCLINOMETER LOCATION MAP

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ATTACHMENT **B**

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ATTACHMENT C

SITE PHOTOS

Photo 1 – Looking North – Top of the Levee.

Photo 2 – Looking South – Top of the Levee.

Photo 3 – Looking South – Top of the Levee.

Photo 4 – Looking South – Top of the Levee.

Photo 5 – Looking South – Top of the Levee.