



To: John Egan, PE, GE  
Ron Hamburger, PE, SE  
Phil Lovett  
Kristin Gonsar  
Kelly McCormick  
Andrew Weichert

From: Debra Murphy, PE (CA 77748)  
Nathaniel Wagner, PE (CA 88778), PhD

Date: November 10, 2021  
Project Number: 19-009

Subject: 301 Mission Retrofit Monitoring Report 028: Results as of November 9, 2021

---

## **CONTEXT**

This memorandum summarizes results from the monitoring plan implemented at the 301 Mission property. Instrumentation to monitor the structure prior to, during and after the retrofit was installed in January 2021, including piezometers and extensometers. Settlement markers installed in April 2009 and January 2017, survey prisms mounted on the exterior of the structure in December 2016, and crack gauges installed in April 2009 have also been monitored. This memorandum is for review only. It only contains ongoing monitoring information. This memorandum does not contain recommendations based upon the ongoing monitoring information.

## **PRESENTATION OF DATA**

Figure 01 presents the instrument locations as referenced in later figures.

Figure 02 presents the historical settlement data interpreted from settlement markers installed on the B-1 Level of 301 Mission Tower. In addition, data from surveys performed during the retrofit are included. Figure 03A presents settlement data since the start of production pile installation (May 12, 2021; baseline readings on May 10, 2021) through November 8, 2021. Figure 03B presents settlement data since January 11, 2021, through November 8, 2021. Figure 04 presents current settlement contours (in inches) on November 8, 2021.

Figure 05 presents historical lateral roof deflections in the project north-south and project east-west directions interpreted from survey prisms mounted on the exterior of the Tower, from InSAR data, and from a planar fit of the settlement marker data. In addition, data from surveys performed during the retrofit are included. Figure 06A presents lateral roof deflection data from a planar fit of the settlement marker data and from survey prisms mounted on the exterior of the Tower since the start of production pile installation (May 12, 2021; baseline readings on May 10 and 13, 2021, respectively) through November 8, 2021. Figure 06B presents lateral roof deflection data from a planar fit of the settlement marker data and from survey prisms mounted on the exterior of the Tower since January 11, 2021, through November 8, 2021.

Figure 07 presents the historical groundwater elevation interpreted from piezometer readings at locations near 301 Mission. In addition, data from piezometers installed to monitor groundwater elevation during the retrofit are included. Figures 08 and 09 present groundwater elevation interpreted from piezometer readings in the Marine/Colma Sand and the Old Bay Clay, respectively, for the time period prior to the start of production pile installation (January 1, 2021) through November 9, 2021.



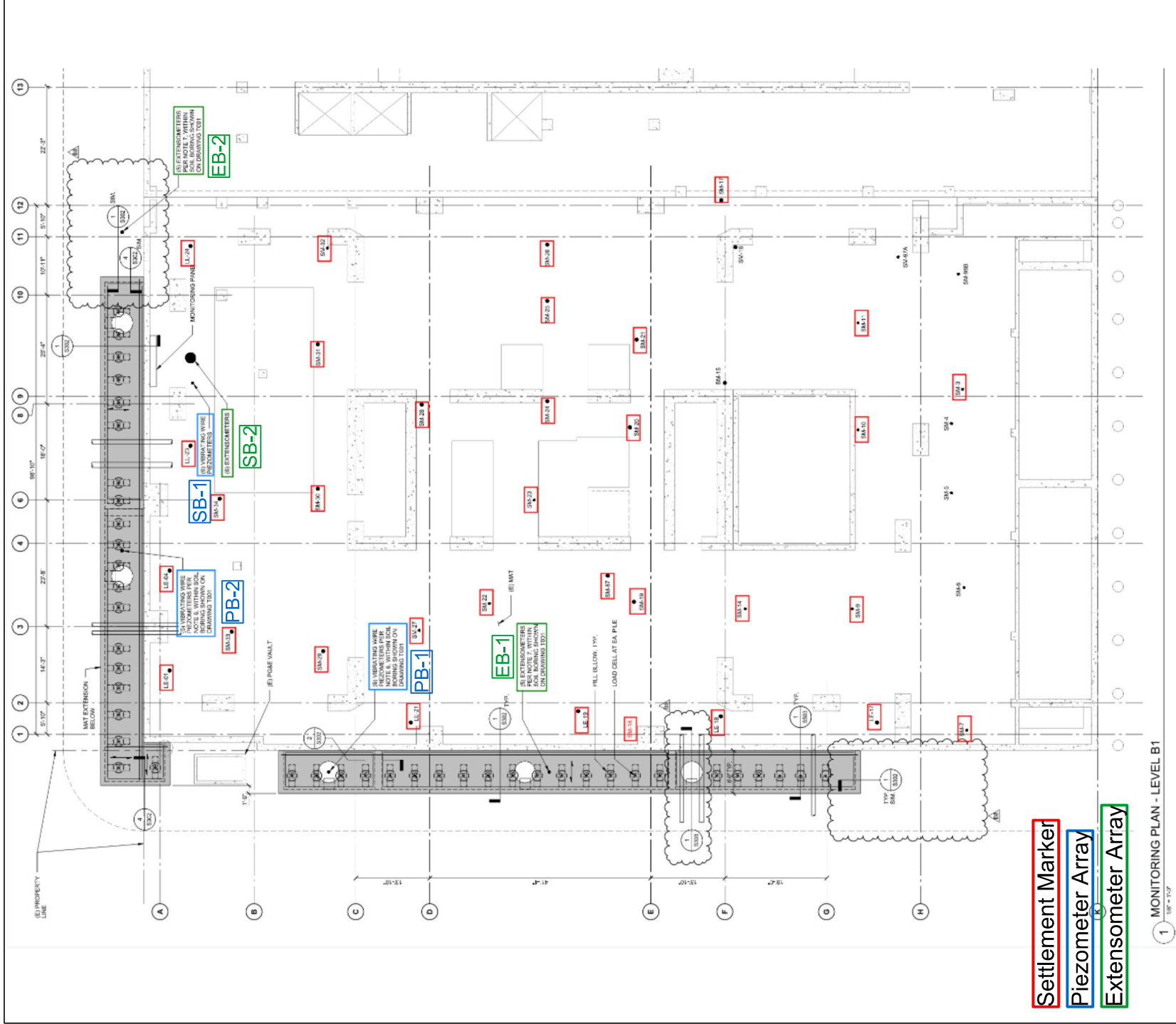
Figure 10 presents extensometer data from within the Tower basement since the start of production pile installation (May 12, 2021) through November 9, 2021. Figure 11 presents extensometer data from Fremont Street since the start of production pile installation (May 12, 2021) through November 9, 2021. Figure 12 presents extensometer data from Mission Street since the start of production pile installation (May 12, 2021) through November 9, 2021.

## **CLOSING**

Please contact us if you have any comments or questions, or if you would like to discuss the results presented in this memorandum.

## **FIGURES**

- Figure 01A – Instrument Location Map: Settlement Markers, Piezometers, Extensometers
- Figure 01B – Tower Survey Prism Location Schematic
- Figure 02 – Historical Settlement Marker Data
- Figure 03A – Settlement Marker Data since 05/10/2021 through 11/08/2021
- Figure 03B – Settlement Marker Data since 01/11/2021 through 11/08/2021
- Figure 04 – Settlement Contours since 05/10/2021 through 11/08/2021
- Figure 05 – Historical Lateral Roof Deflection Data
- Figure 06A – Lateral Roof Deflection Data since 05/10/2021 through 11/08/2021
- Figure 06B – Lateral Roof Deflection Data since 01/11/2021 through 11/08/2021
- Figure 07 – Historical Groundwater Elevation Measurements at Locations Near 301 Mission
- Figure 08A – Groundwater Elevation Measurements in Marine and Colma Sand since 01/01/2021 through 11/09/2021
- Figure 08B – Groundwater Elevation Measurements in Marine and Colma Sand since 05/10/2021 through 11/09/2021
- Figure 09A – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 11/09/2021
- Figure 09B – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 11/09/2021
- Figure 10A – Extensometer Data from within Tower Basement since 01/01/2021 through 11/09/2021
- Figure 10B – Extensometer Data from within Tower Basement since 05/10/2021 through 11/09/2021
- Figure 11A – Extensometer Data from Fremont Street since 01/01/2021 through 11/09/2021
- Figure 11B – Extensometer Data from Fremont Street since 05/10/2021 through 11/09/2021
- Figure 12A – Extensometer Data from Mission Street since 01/01/2021 through 11/09/2021
- Figure 12B – Extensometer Data from Mission Street since 05/10/2021 through 11/09/2021



**Settlement Marker**  
**Piezometer Array**  
**Extensometer Array**

1 MONITORING PLAN - LEVEL B1  
1/8" = 1'-0"

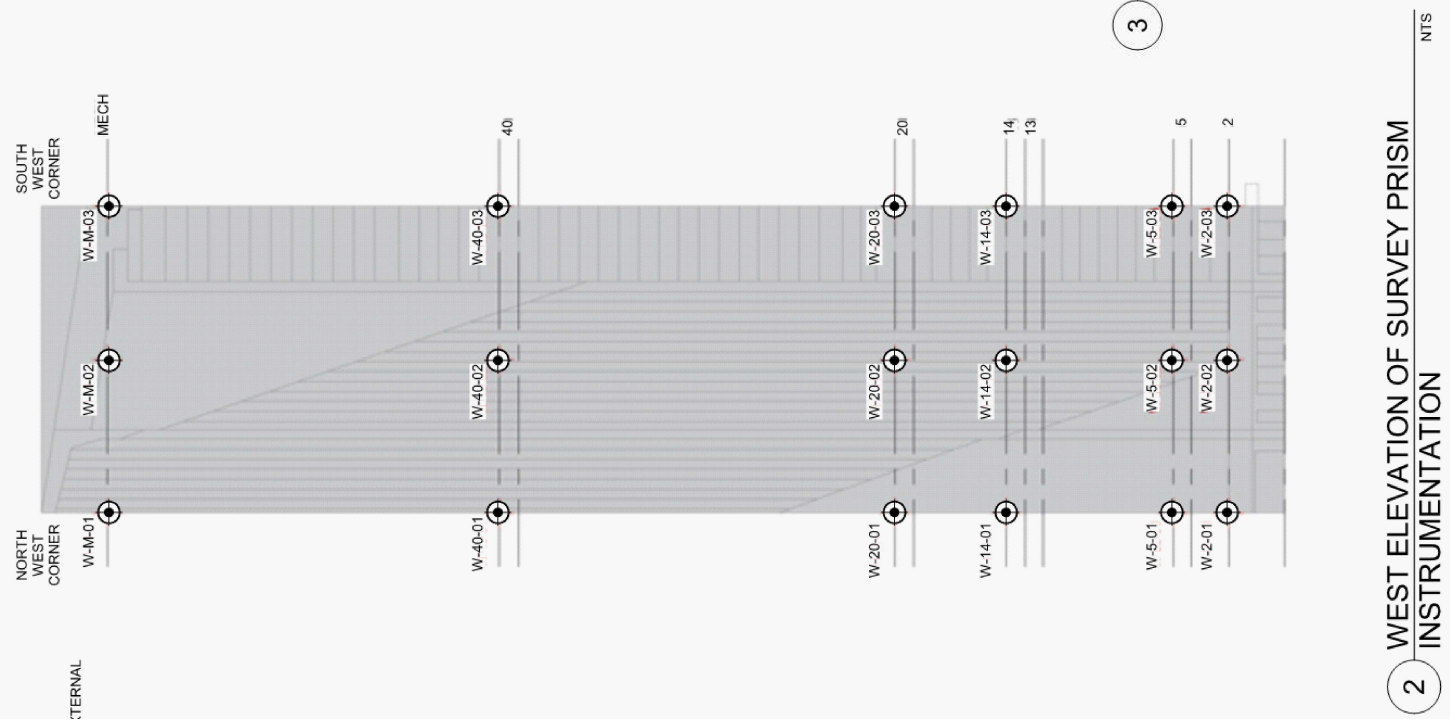
From 301 Mission Perimeter Pile Upgrade Bulletin 8 Set S 207 2021-06-15

Project No: 19-009.00	Date: 7/26/2021	Created By: NBW	Checked By: DGM	Figure No: 028-01A
-----------------------	-----------------	-----------------	-----------------	--------------------

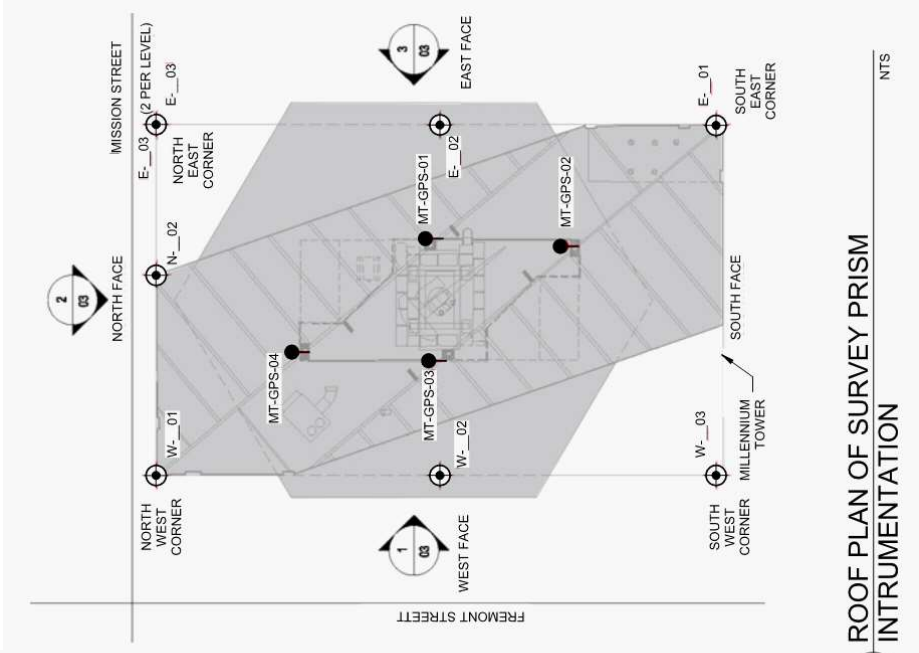


**INSTRUMENT LOCATION MAP**  
**SETTLEMENT MARKERS, PIEZOMETERS, EXTENSOMETERS**

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California



2 WEST ELEVATION OF SURVEY PRISM INSTRUMENTATION  
NTS



3 ROOF PLAN OF SURVEY PRISM INSTRUMENTATION  
NTS

From 301 Mission Perimeter Pile Upgrade Bulletin 8 Set S 207 2021-06-15

Project No: 19-009.00

Date: 7/26/2021

Created By: NBW

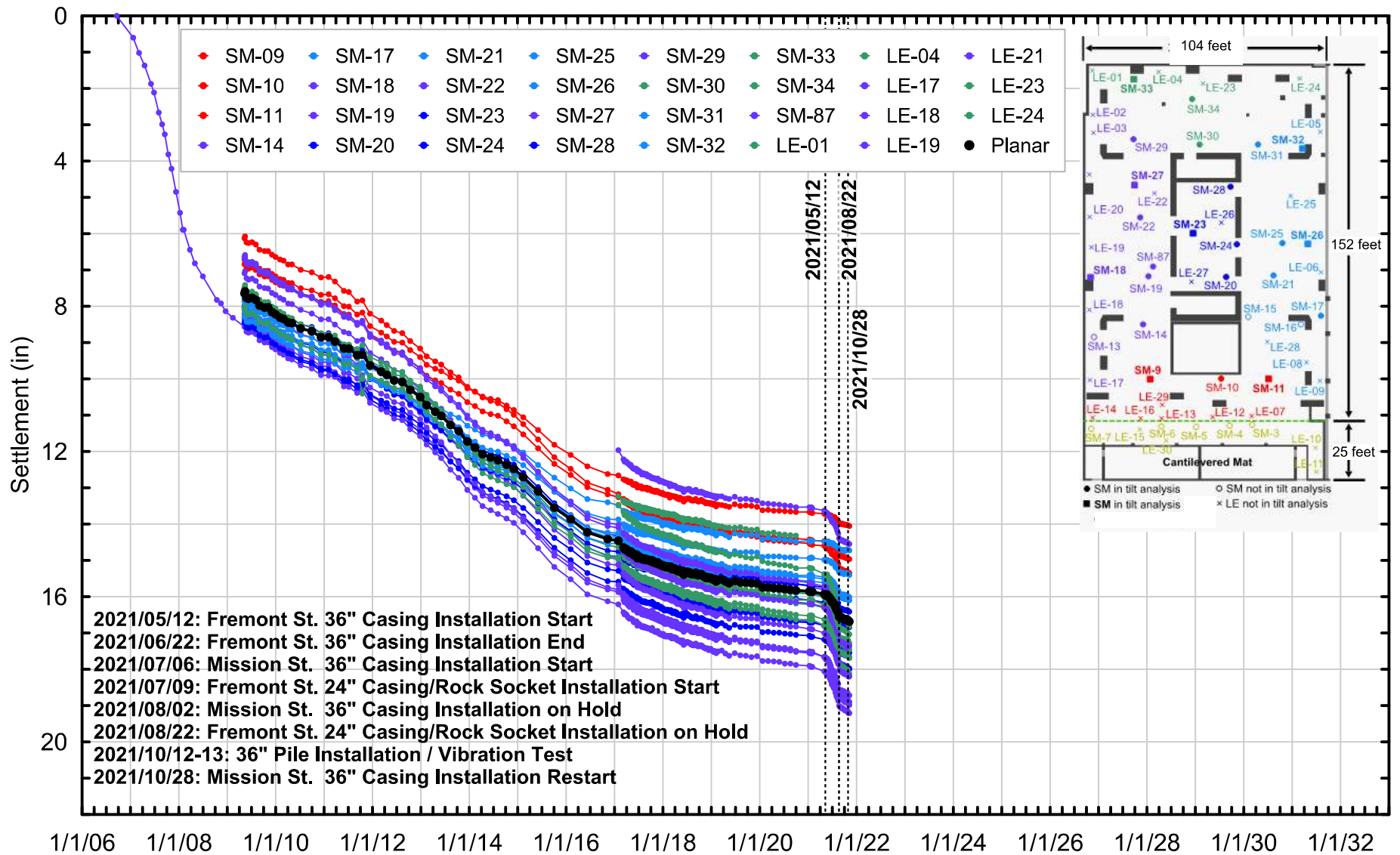
Checked By: DGM

Figure No: 028-01B



TOWER SURVEY PRISM LOCATION SCHEMATIC

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California

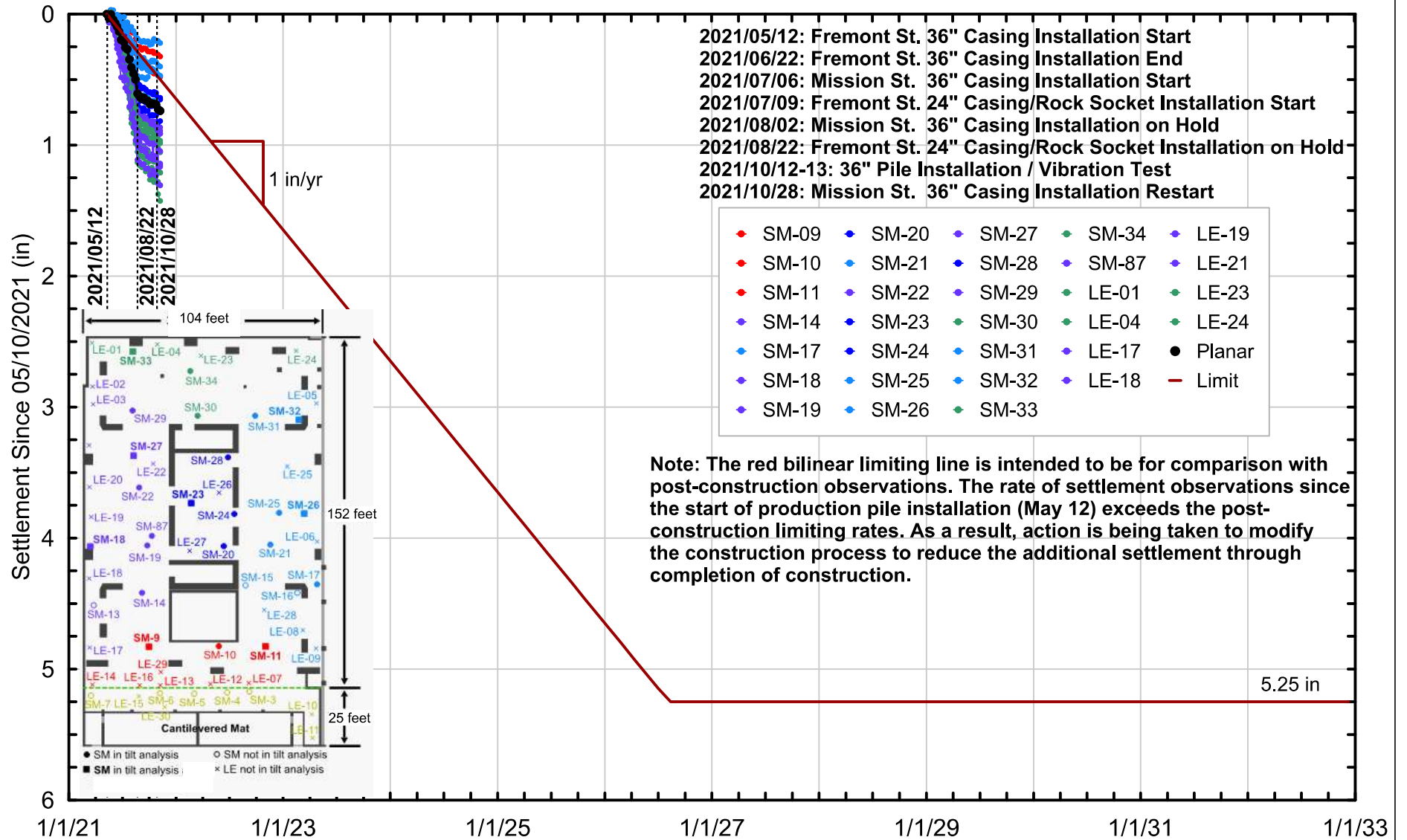


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: 028-02
-----------------------	------------------	-----------------	-----------------	-------------------



HISTORICAL SETTLEMENT MARKER DATA

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California

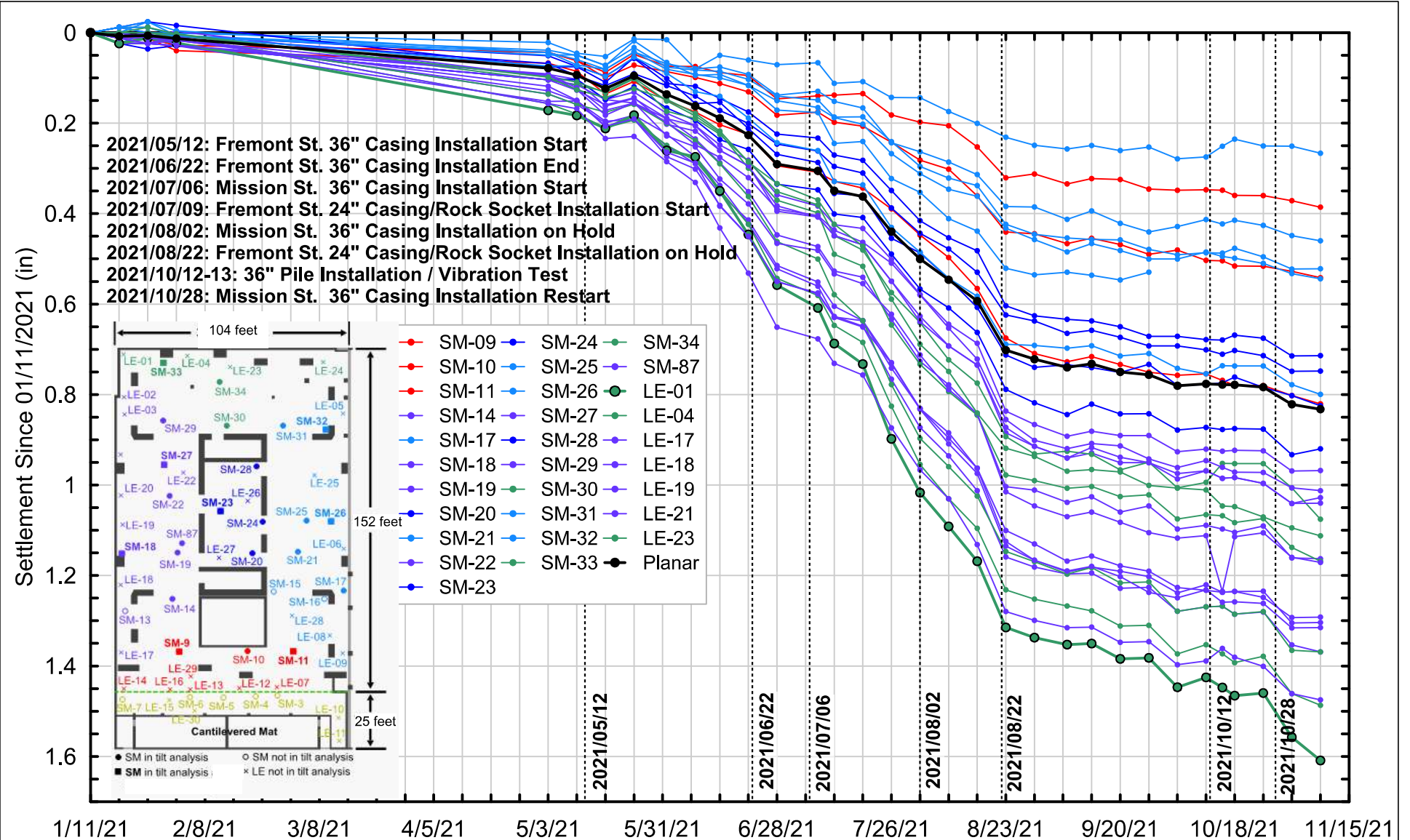


Project No: 19-009.00    Date: 11/10/2021    Created By: NBW    Checked By: DGM    Figure No: **028-03A**



SETTLEMENT MARKER DATA  
 SINCE 05/10/2021 THROUGH 11/08/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California

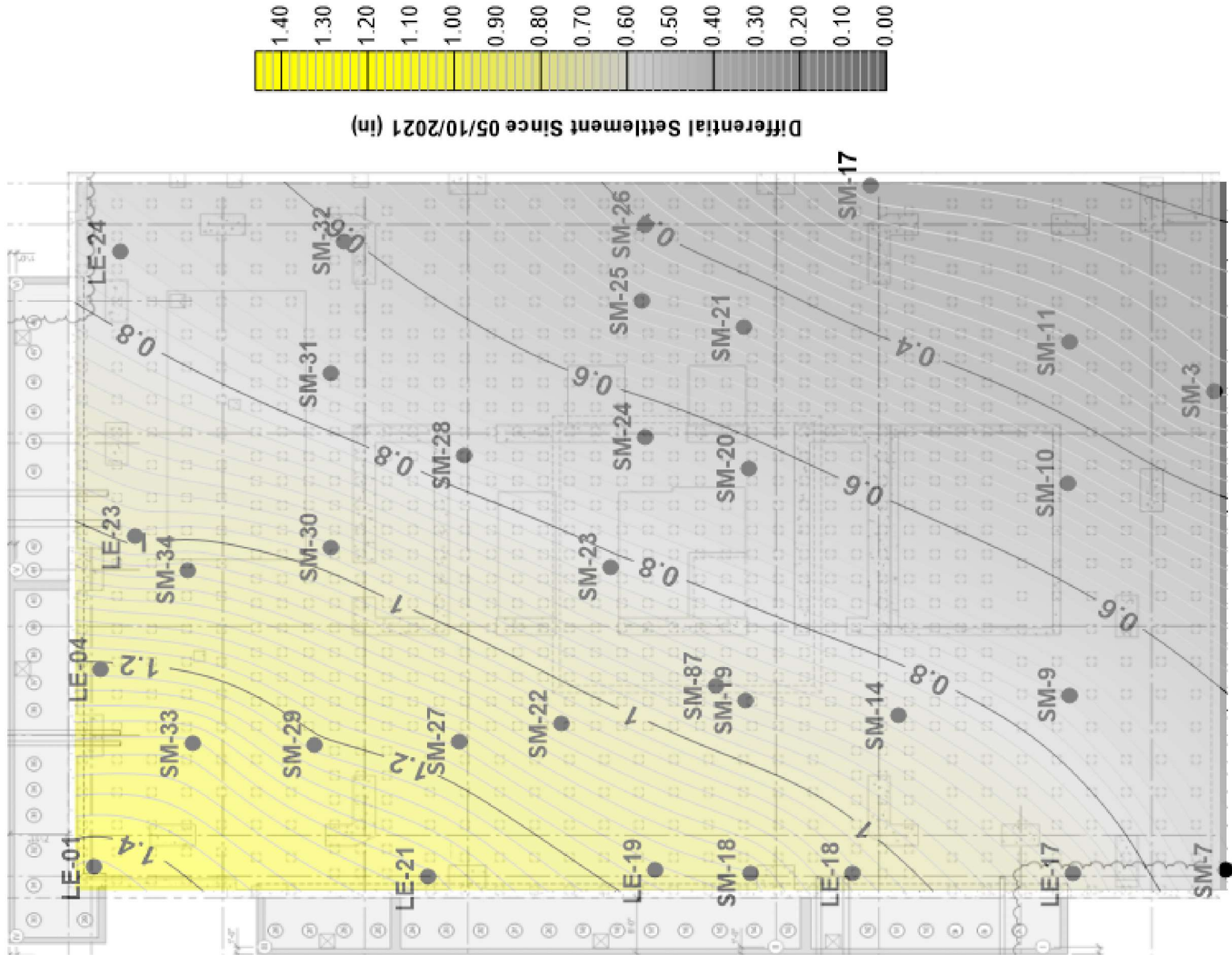


Project No: 19-009.00    Date: 11/10/2021    Created By: NBW    Checked By: DGM    Figure No: **028-03B**



SETTLEMENT MARKER DATA  
 SINCE 01/11/2021 THROUGH 11/08/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California



Project No: 19-009.00

Date: 11/10/2021

Created By: NBW

Checked By: DGM

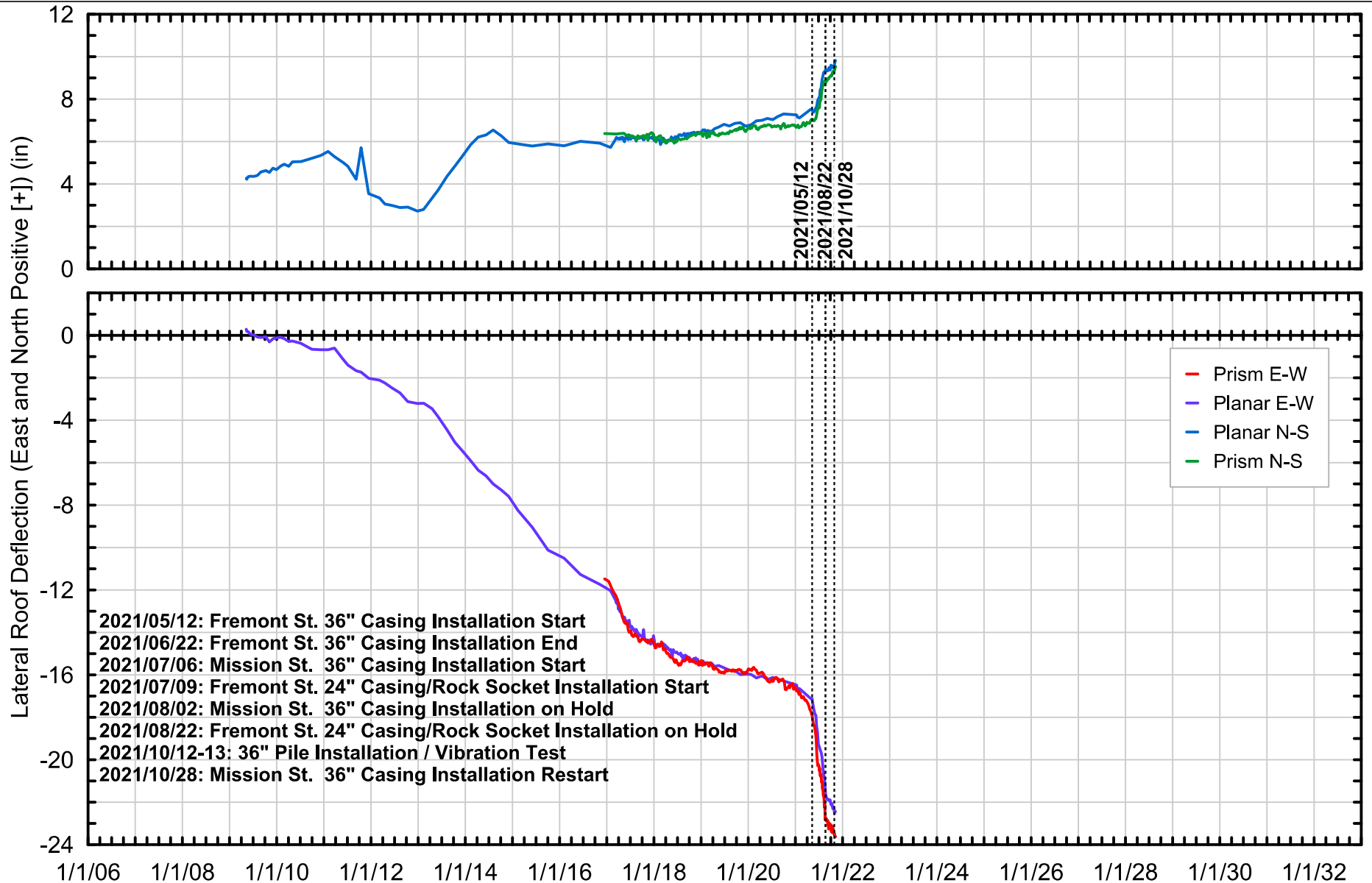
Figure No: 028-04



SETTLEMENT CONTOURS  
SINCE 05/10/2021 THROUGH 11/08/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California



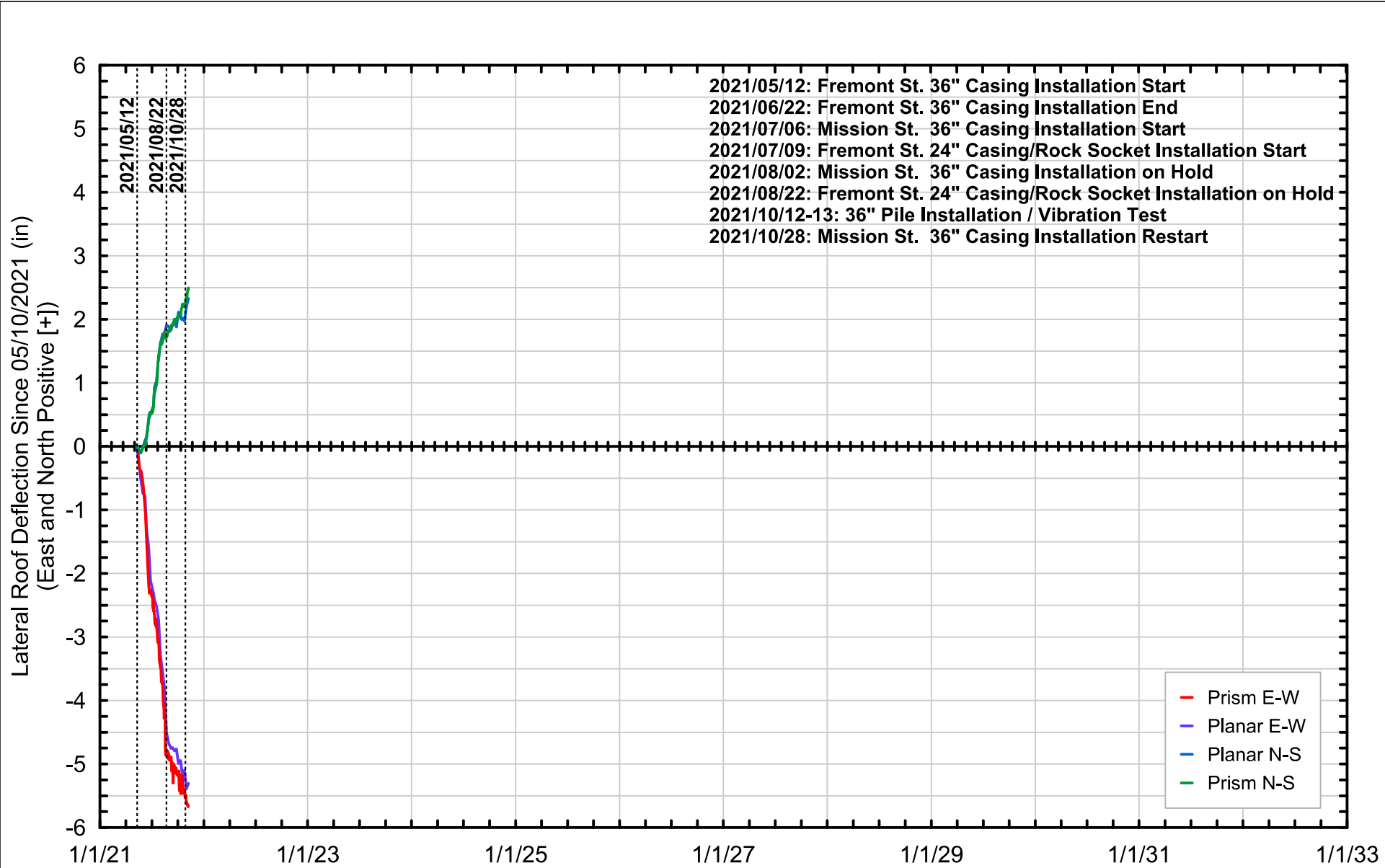


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: <b>028-05</b>
-----------------------	------------------	-----------------	-----------------	--------------------------



HISTORICAL LATERAL ROOF DEFLECTION DATA

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California

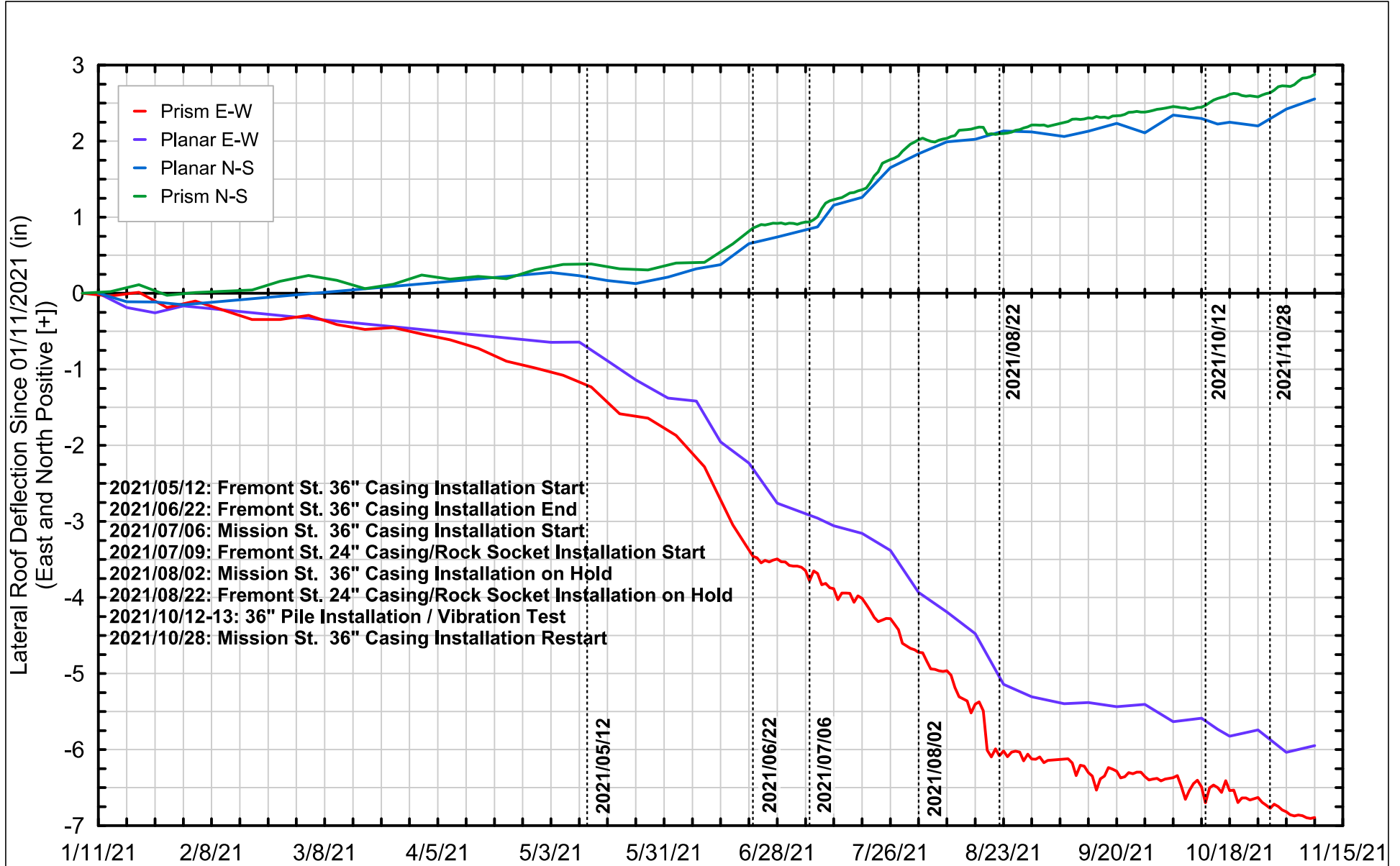


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: <b>028-06A</b>
-----------------------	------------------	-----------------	-----------------	---------------------------



LATERAL ROOF DEFLECTION DATA  
 SINCE 05/10/2021 THROUGH 11/08/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California

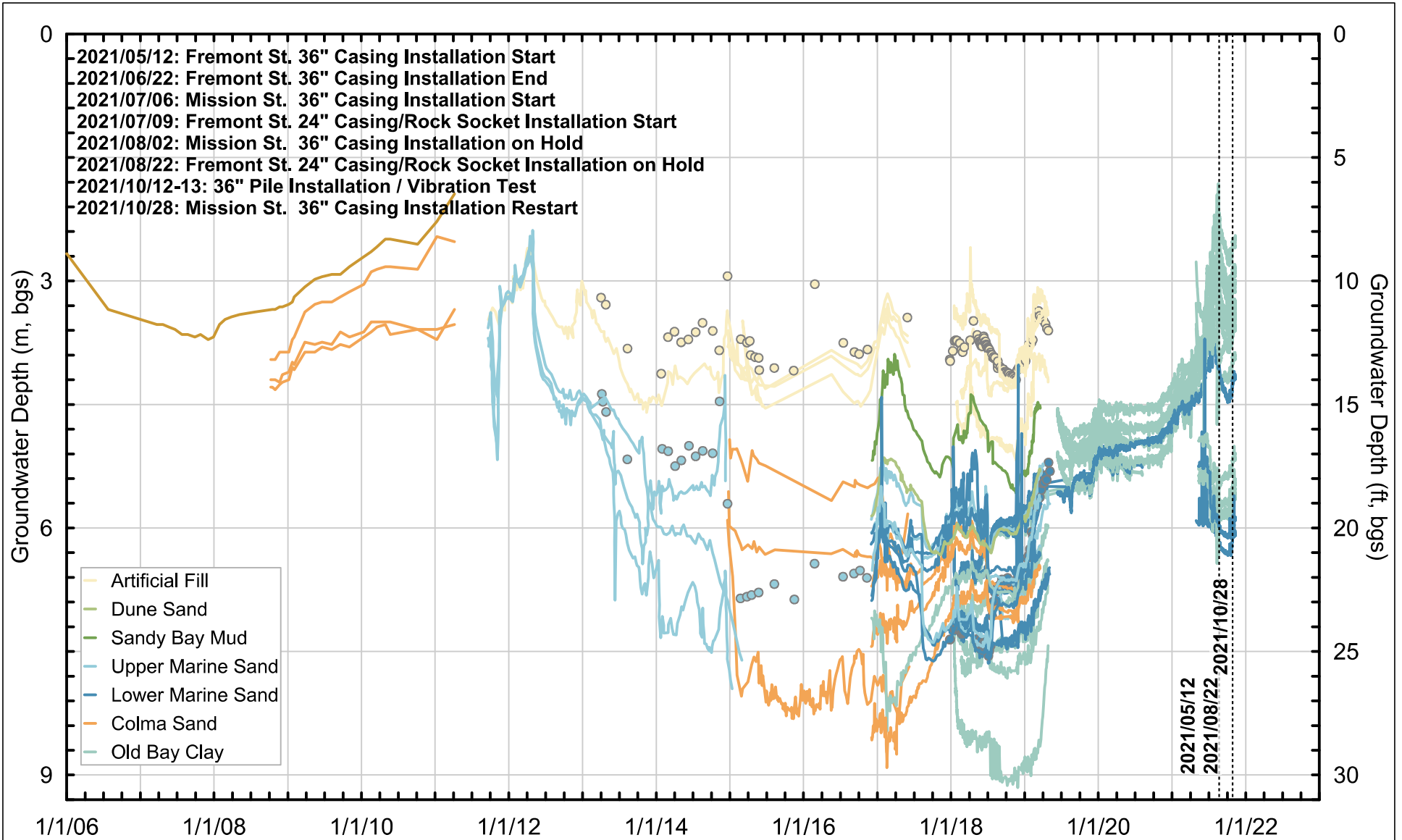



Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: 028-06B
-----------------------	------------------	-----------------	-----------------	--------------------

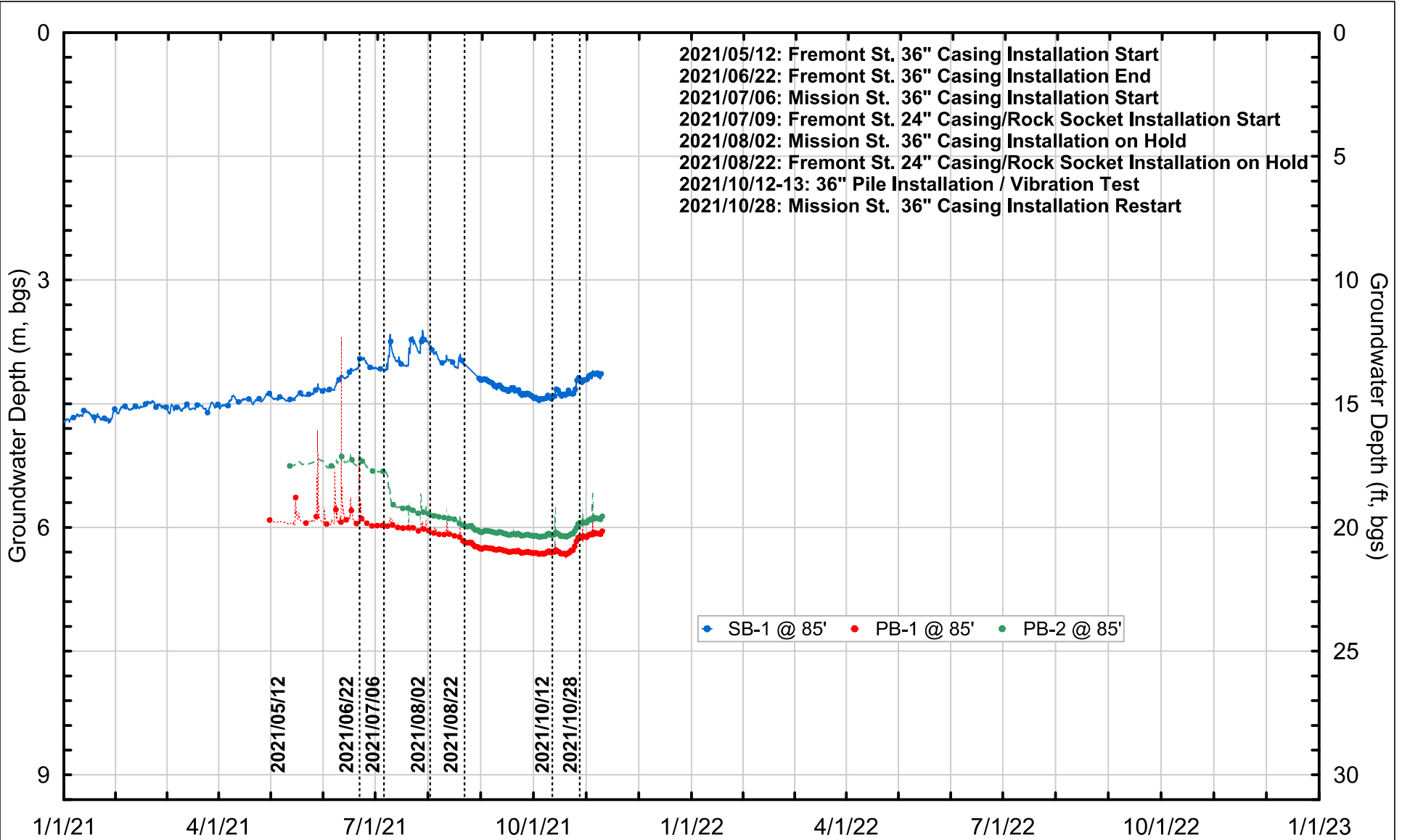


LATERAL ROOF DEFLECTION DATA  
SINCE 01/11/2021 THROUGH 11/08/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California



Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: <b>028-07</b>
		HISTORICAL GROUNDWATER ELEVATION MEASUREMENTS AT LOCATIONS NEAR 301 MISSION		
		Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data City and County of San Francisco, California		

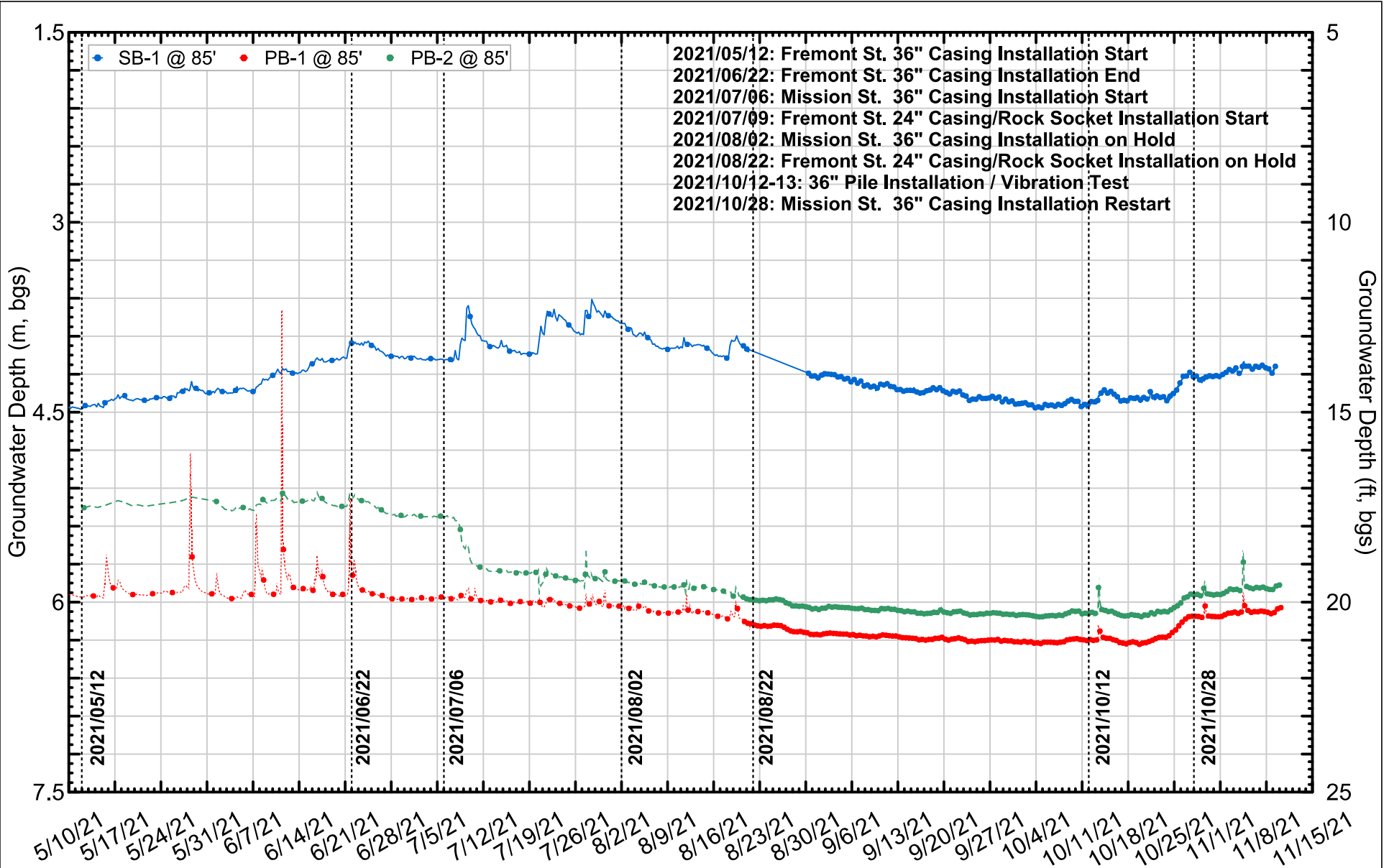


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: <b>028-08A</b>
-----------------------	------------------	-----------------	-----------------	---------------------------



GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND  
 SINCE 01/01/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California

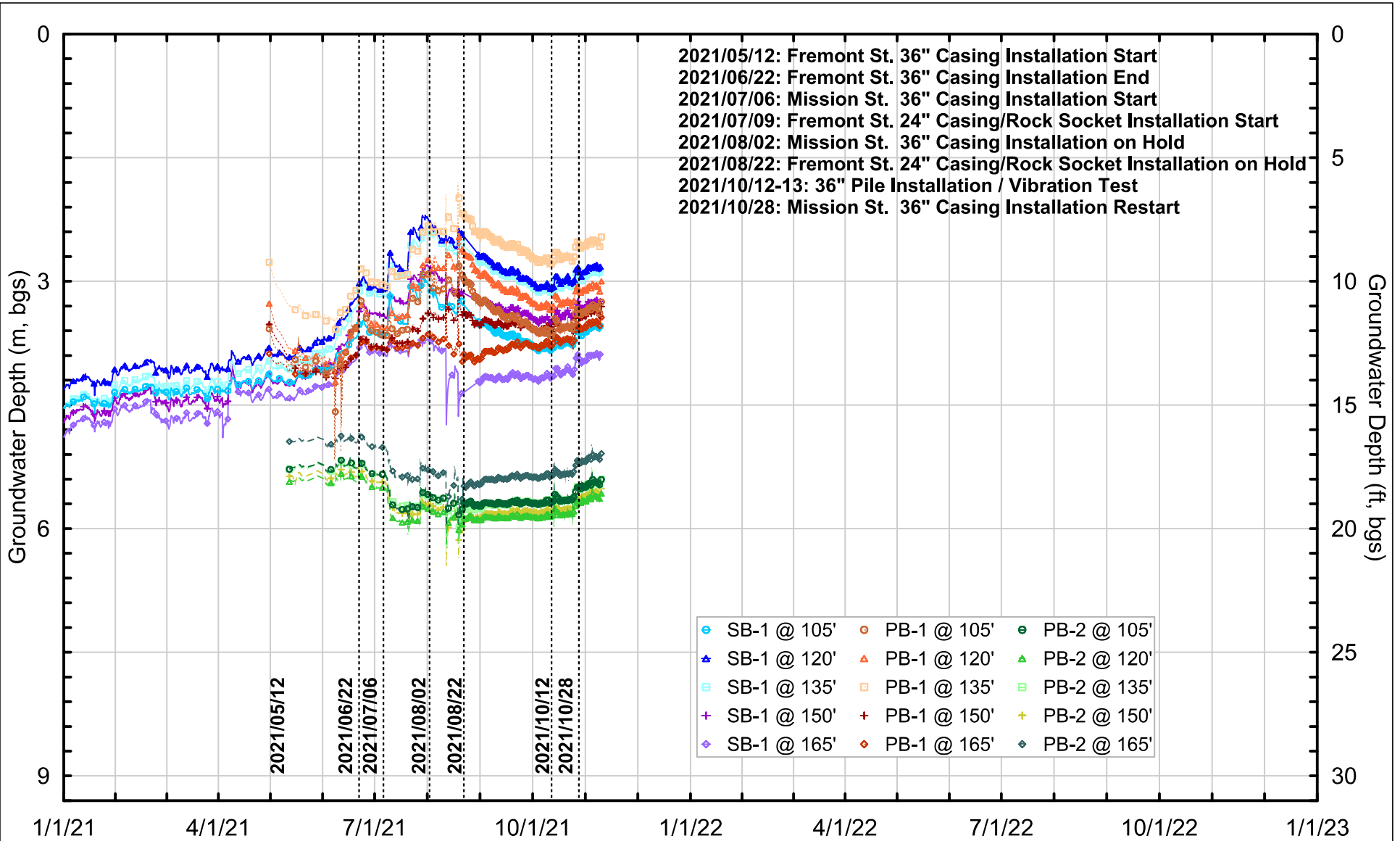


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: 028-08B
-----------------------	------------------	-----------------	-----------------	--------------------



GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND  
 SINCE 05/10/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California

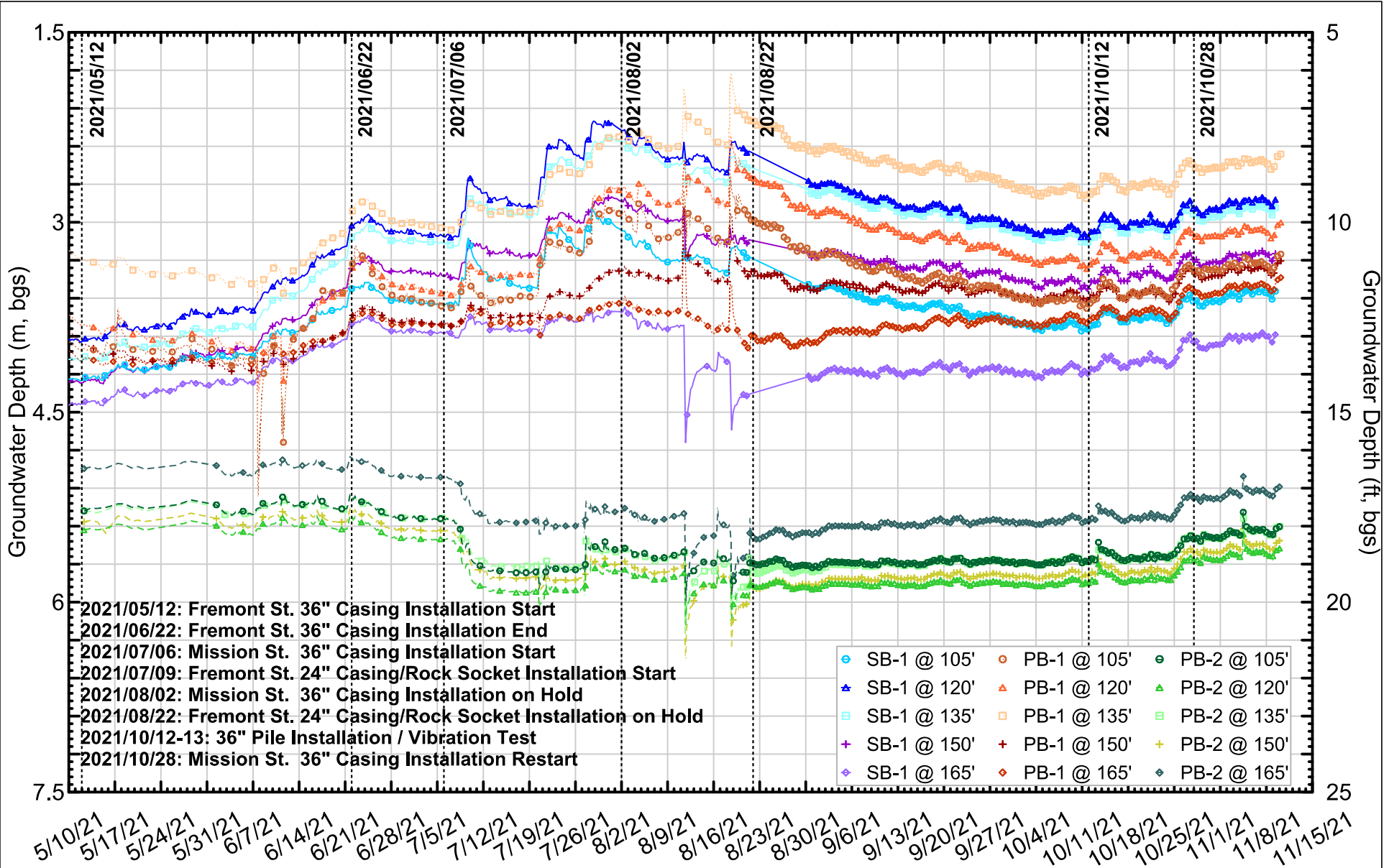


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: <b>028-09A</b>
-----------------------	------------------	-----------------	-----------------	---------------------------



GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY  
 SINCE 01/01/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California



2021/05/12: Fremont St. 36" Casing Installation Start  
 2021/06/22: Fremont St. 36" Casing Installation End  
 2021/07/06: Mission St. 36" Casing Installation Start  
 2021/07/09: Fremont St. 24" Casing/Rock Socket Installation Start  
 2021/08/02: Mission St. 36" Casing Installation on Hold  
 2021/08/22: Fremont St. 24" Casing/Rock Socket Installation on Hold  
 2021/10/12-13: 36" Pile Installation / Vibration Test  
 2021/10/28: Mission St. 36" Casing Installation Restart

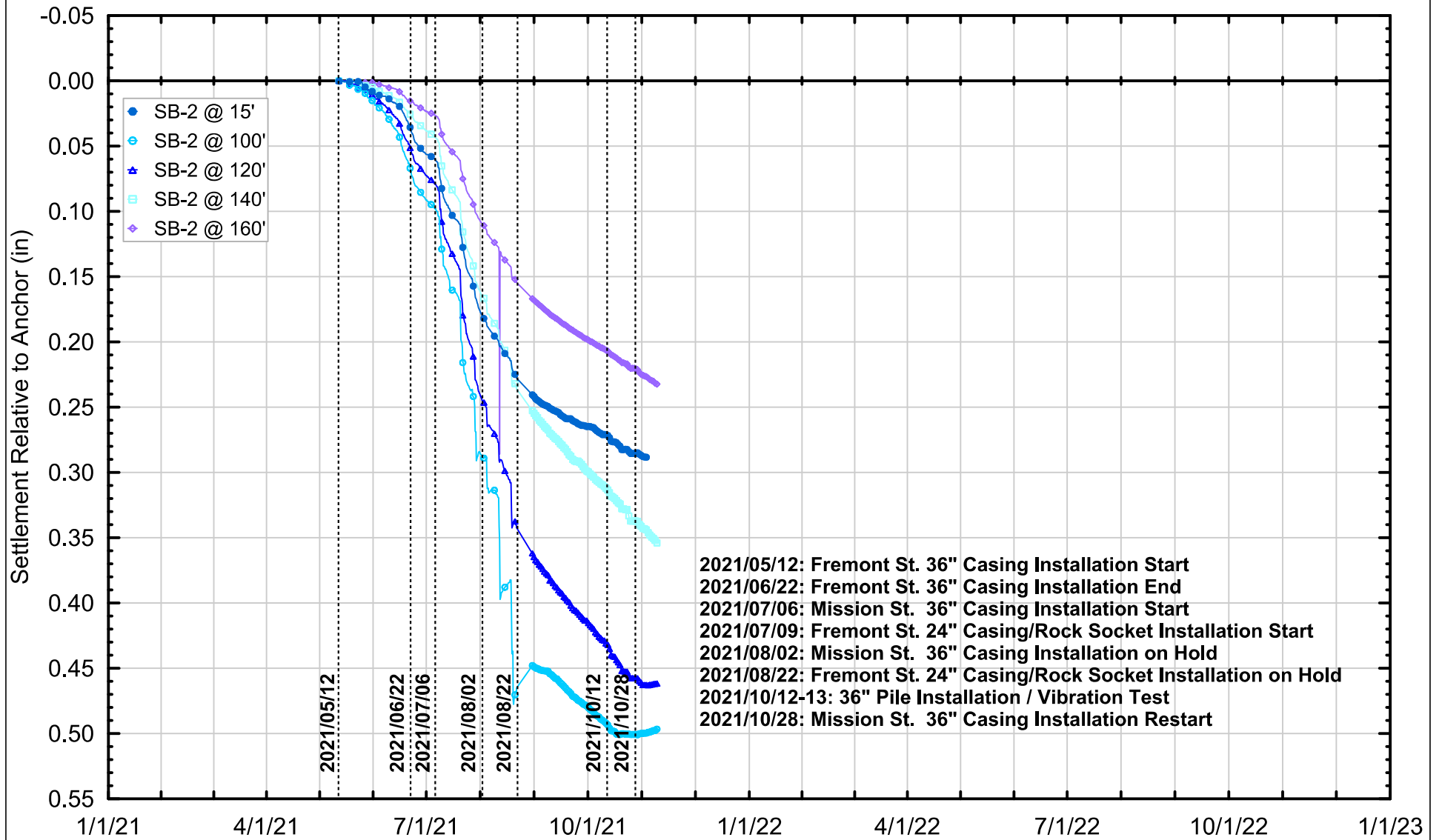
- SB-1 @ 105'
- PB-1 @ 105'
- PB-2 @ 105'
- ★ SB-1 @ 120'
- ▲ PB-1 @ 120'
- ▲ PB-2 @ 120'
- SB-1 @ 135'
- PB-1 @ 135'
- PB-2 @ 135'
- + SB-1 @ 150'
- + PB-1 @ 150'
- + PB-2 @ 150'
- ◇ SB-1 @ 165'
- ◇ PB-1 @ 165'
- ◇ PB-2 @ 165'

Project No: 19-009.00 | Date: 11/10/2021 | Created By: NBW | Checked By: DGM | Figure No: 028-09B



GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY  
 SINCE 05/10/2021 THROUGH 11/09/2021  
 Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California



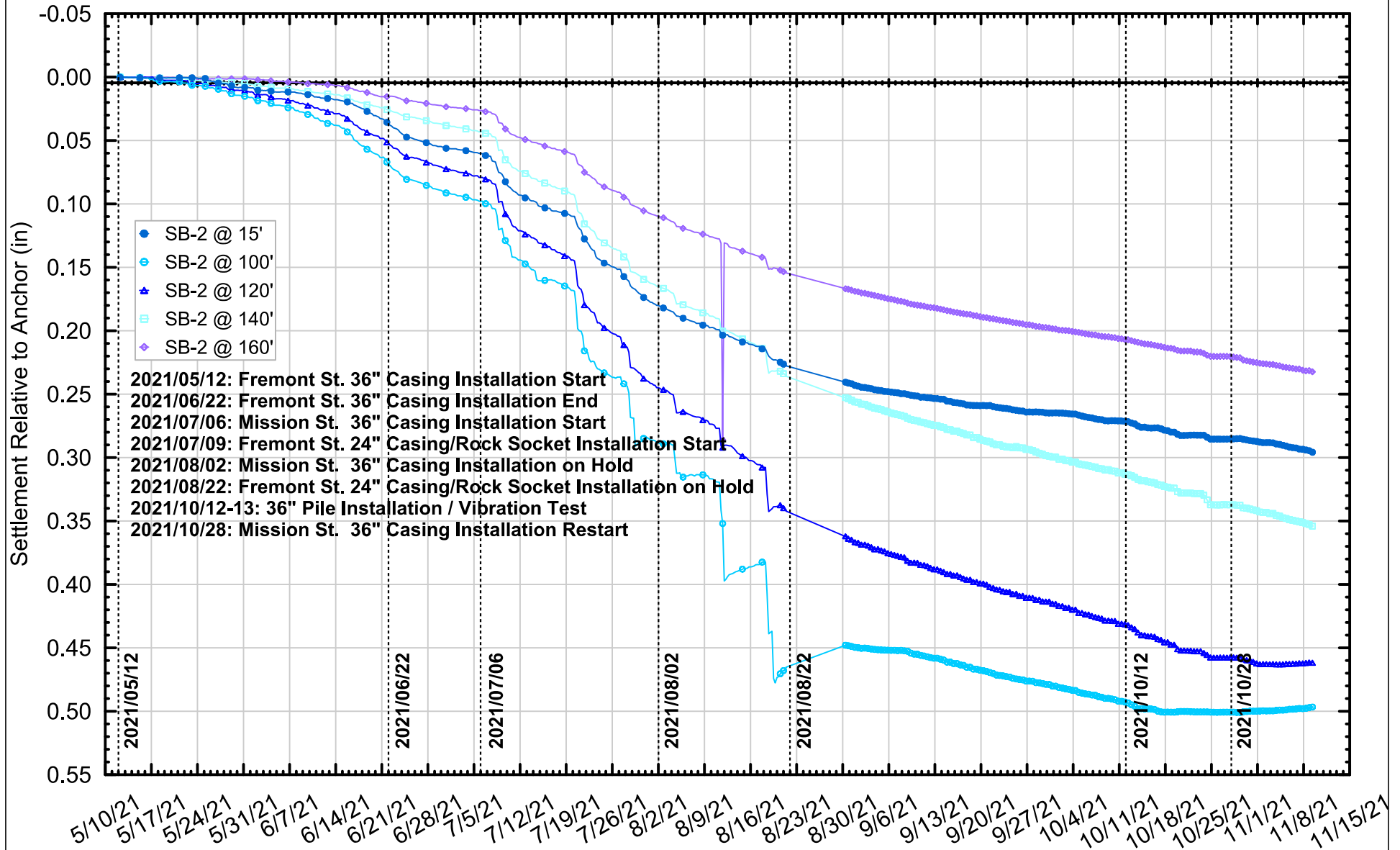


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: <b>028-10A</b>
-----------------------	------------------	-----------------	-----------------	---------------------------



EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT  
SINCE 01/01/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California

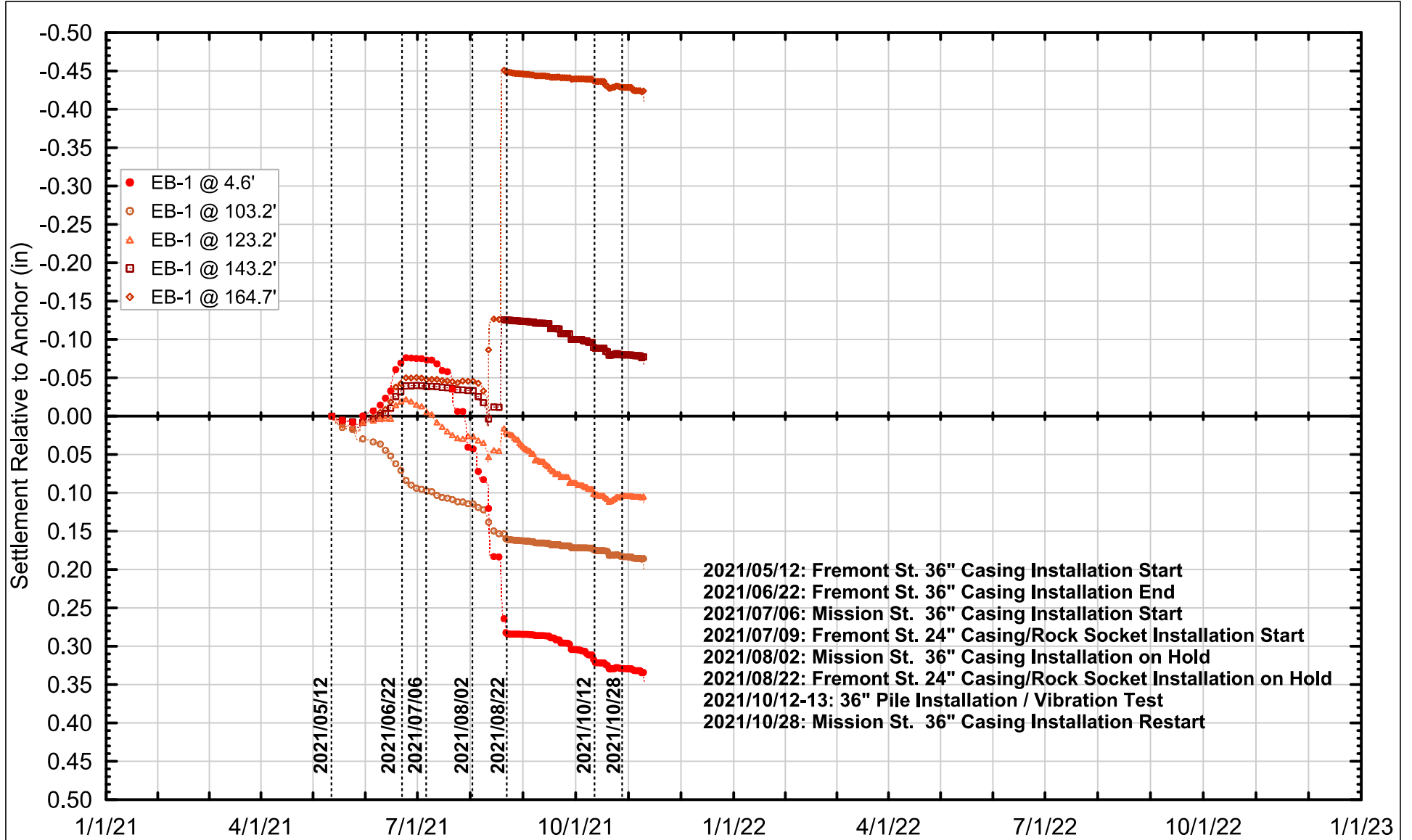


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: <b>028-10B</b>
-----------------------	------------------	-----------------	-----------------	---------------------------



EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT  
SINCE 05/10/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California

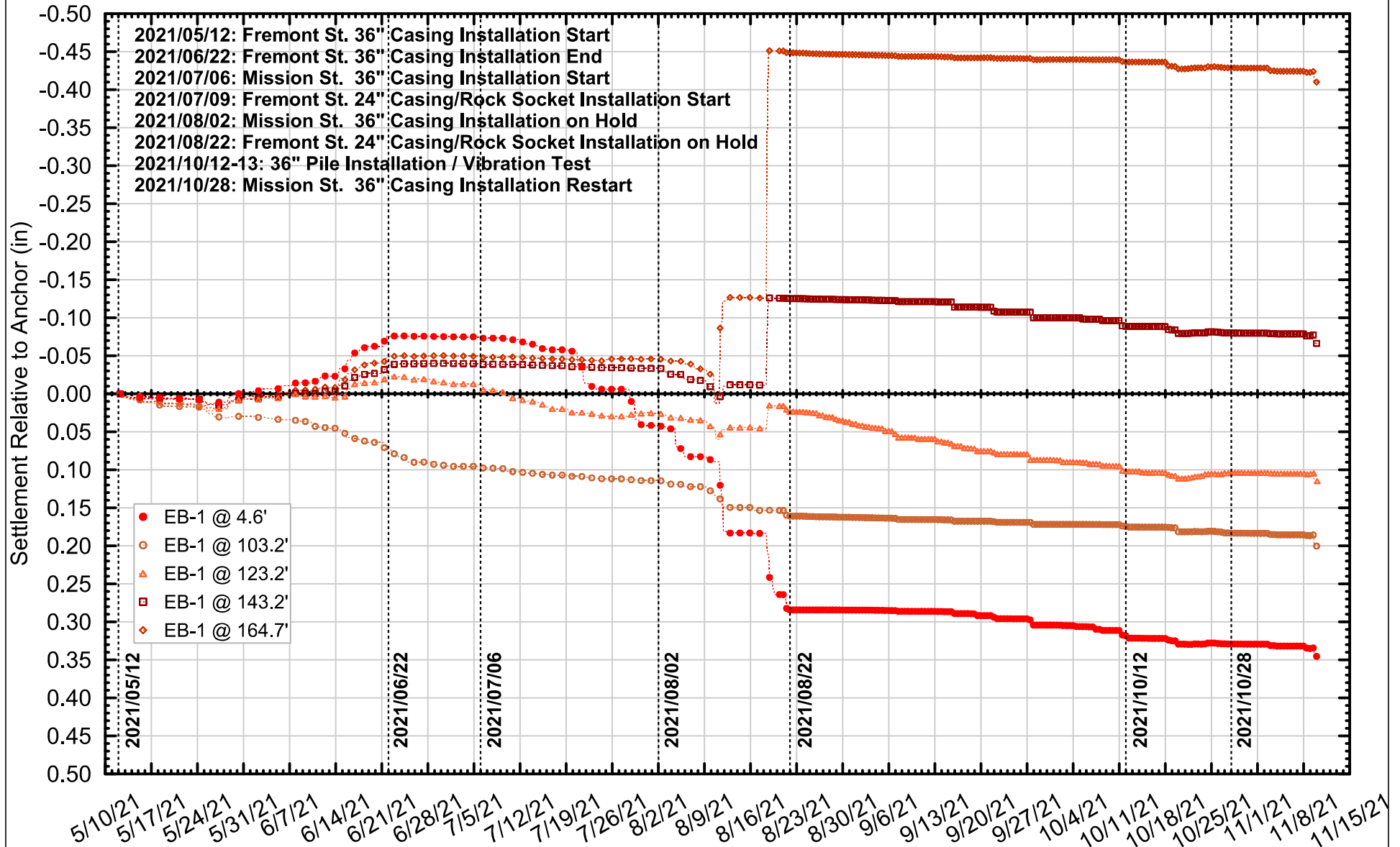


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: 028-11A
-----------------------	------------------	-----------------	-----------------	--------------------



EXTENSOMETER DATA FROM FREMONT STREET  
SINCE 01/01/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California

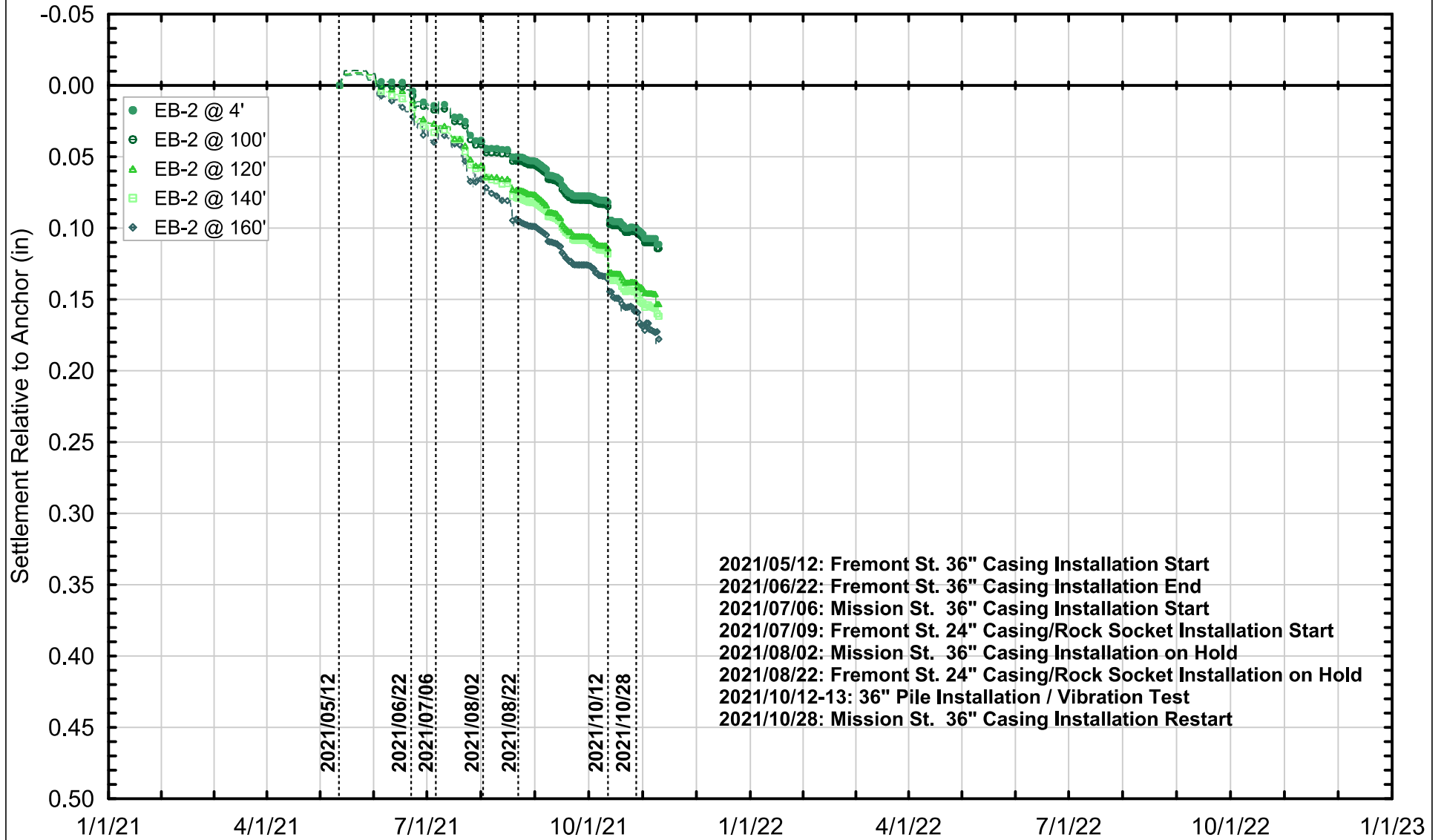


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: <b>028-11B</b>
-----------------------	------------------	-----------------	-----------------	---------------------------



EXTENSOMETER DATA FROM FREMONT STREET  
 SINCE 05/10/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
 City and County of San Francisco, California

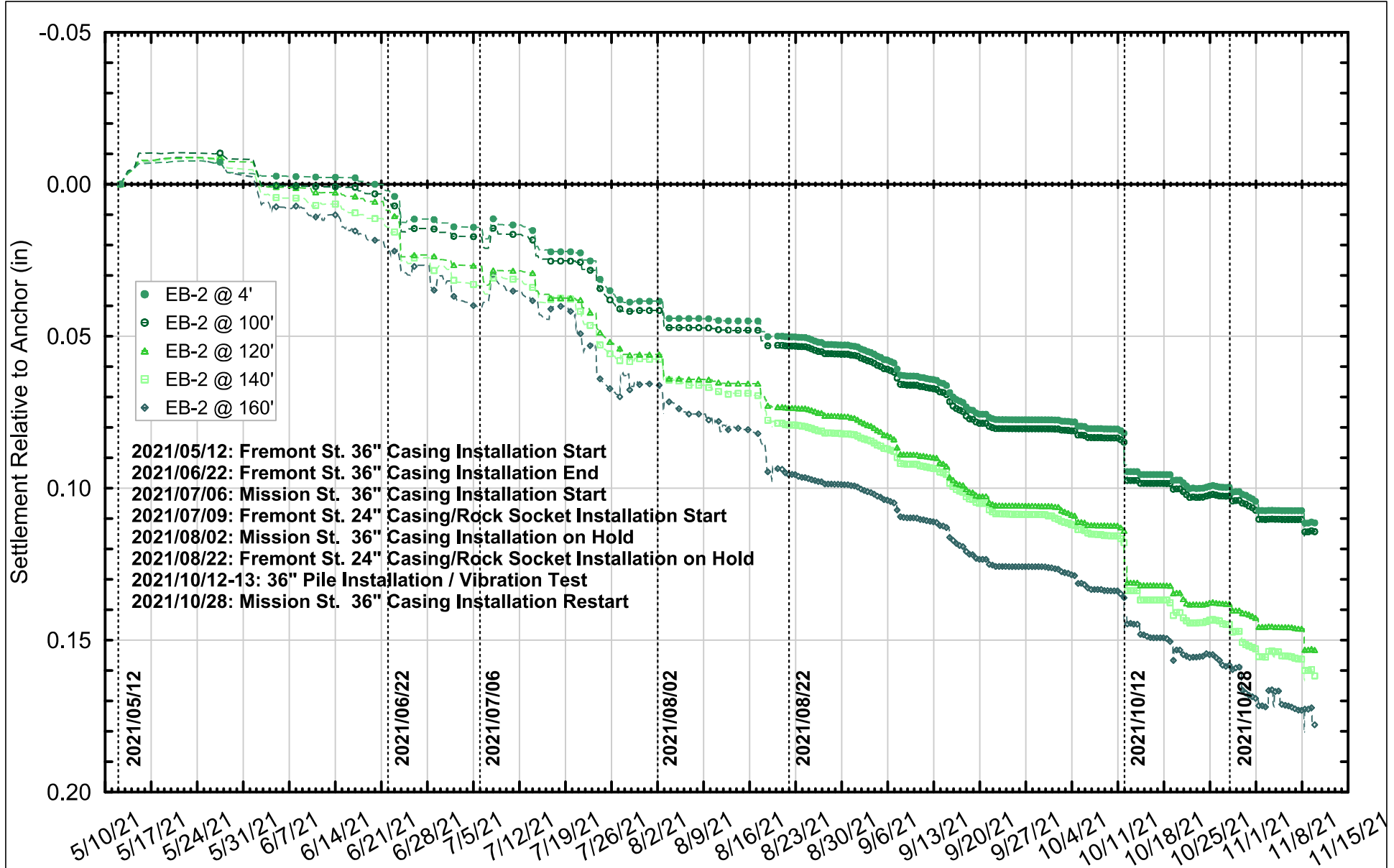


Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: 028-12A
-----------------------	------------------	-----------------	-----------------	--------------------



EXTENSOMETER DATA FROM MISSION STREET  
SINCE 01/01/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California



Project No: 19-009.00	Date: 11/10/2021	Created By: NBW	Checked By: DGM	Figure No: 028-12B
-----------------------	------------------	-----------------	-----------------	--------------------



EXTENSOMETER DATA FROM MISSION STREET  
SINCE 05/10/2021 THROUGH 11/09/2021

Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data  
City and County of San Francisco, California