



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  
Kelley Shaw, CEG (CA 2760)

Date: March 2, 2022

Project Number: 19-009

Subject: 301 Mission Retrofit Monitoring Report 043: Results as of February 28, 2022

---

## **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 February 28, 2022. Figure 03B presents settlement data since January 11, 2021, through February 28, 2022. Figure 04 presents current settlement contours (in inches) on February 28, 2022.

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 February 28, 2022. 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 February 28, 2022.

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 February 28, 2022.



Figure 10 presents extensometer data from within the Tower basement since the start of production pile installation (May 12, 2021) through February 28, 2022. Figure 11 presents extensometer data from Fremont Street since the start of production pile installation (May 12, 2021) through February 28, 2022. Figure 12 presents extensometer data from Mission Street since the start of production pile installation (May 12, 2021) through February 28, 2022.

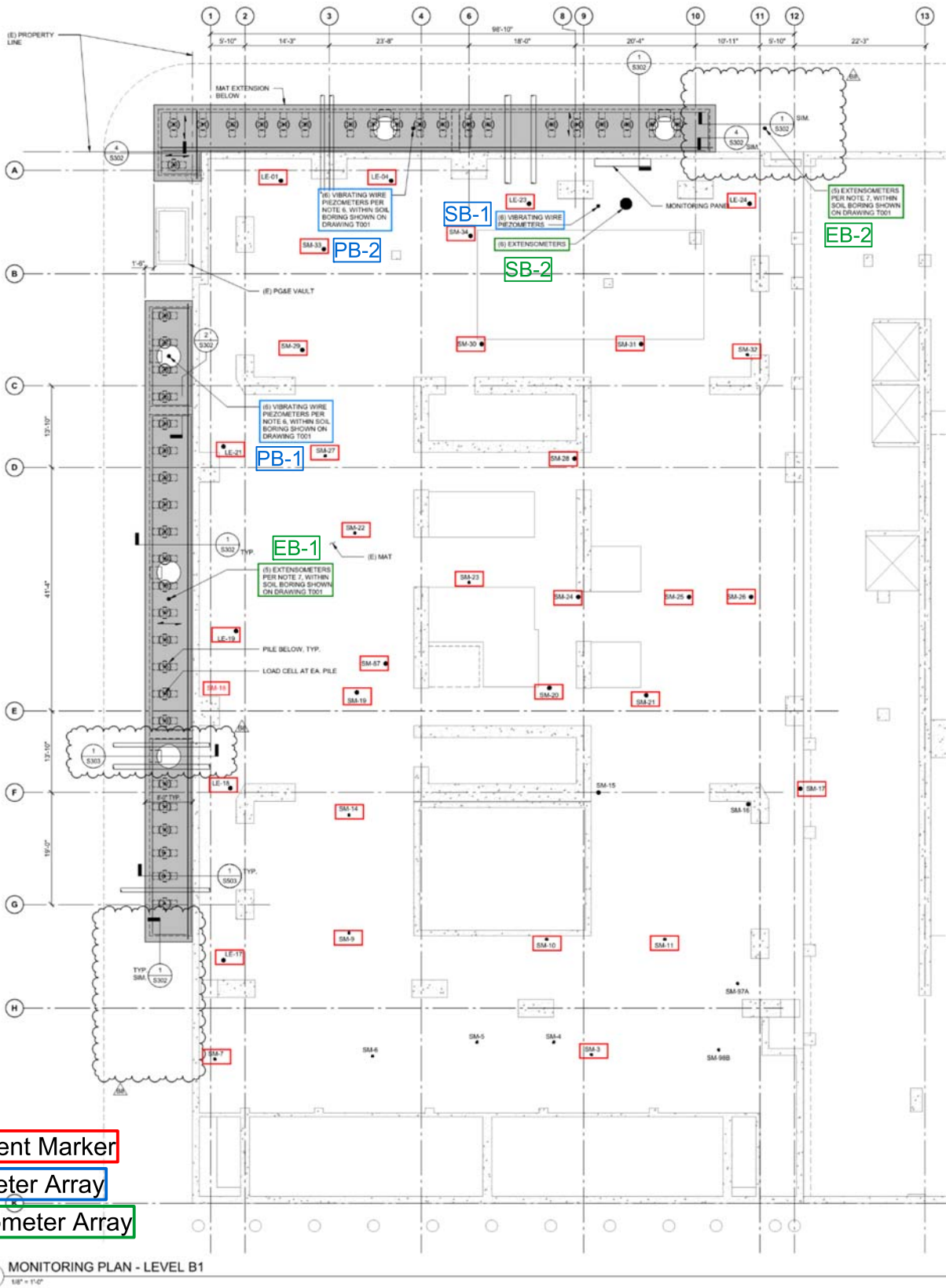
## **CLOSING**

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 02/28/2022
- Figure 03B – Settlement Marker Data since 01/11/2021 through 02/28/2022
- Figure 04 – Settlement Contours since 05/10/2021 through 02/28/2022
- Figure 05 – Historical Lateral Roof Deflection Data
- Figure 06A – Lateral Roof Deflection Data since 05/10/2021 through 02/28/2022
- Figure 06B – Lateral Roof Deflection Data since 01/11/2021 through 02/28/2022
- 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 02/28/2022
- Figure 08B – Groundwater Elevation Measurements in Marine and Colma Sand since 05/10/2021 through 02/28/2022
- Figure 09A – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 02/28/2022
- Figure 09B – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 02/28/2022
- Figure 10A – Extensometer Data from within Tower Basement since 01/01/2021 through 02/28/2022
- Figure 10B – Extensometer Data from within Tower Basement since 05/10/2021 through 02/28/2022
- Figure 11A – Extensometer Data from Fremont Street since 01/01/2021 through 02/28/2022
- Figure 11B – Extensometer Data from Fremont Street since 05/10/2021 through 02/28/2022
- Figure 12A – Extensometer Data from Mission Street since 01/01/2021 through 02/28/2022
- Figure 12B – Extensometer Data from Mission Street since 05/10/2021 through 02/28/2022

Filepath: S:\StateDrive - Documents\Projects\_2019\19-009.00\_Millennium Tower Retrofit\10\_Construction\01\_Monitoring Reports\TowerSoilWater\00\_Figures\Fig\_043-01A\_Instrument\_Map.grf



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: KAS

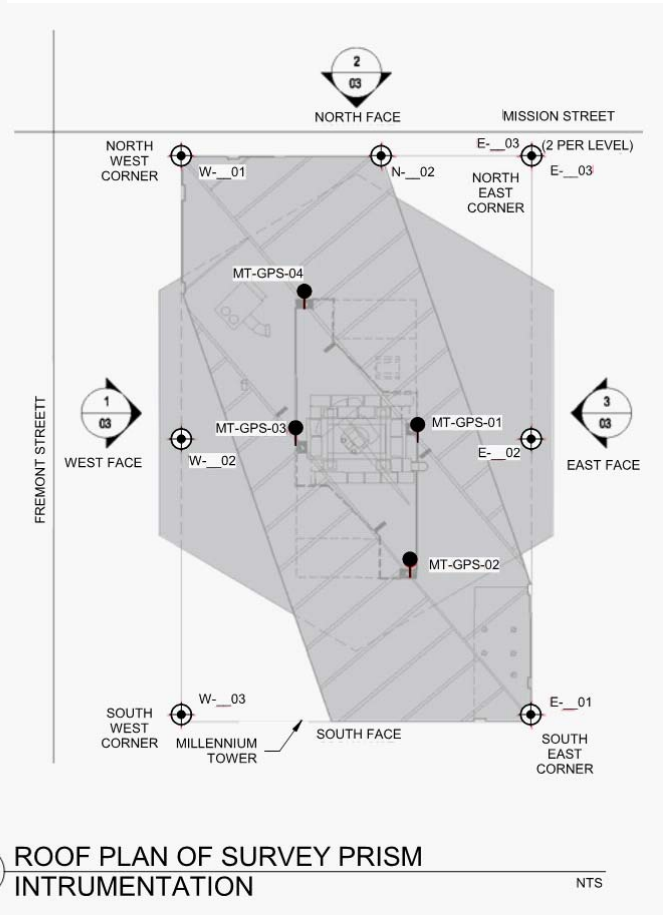
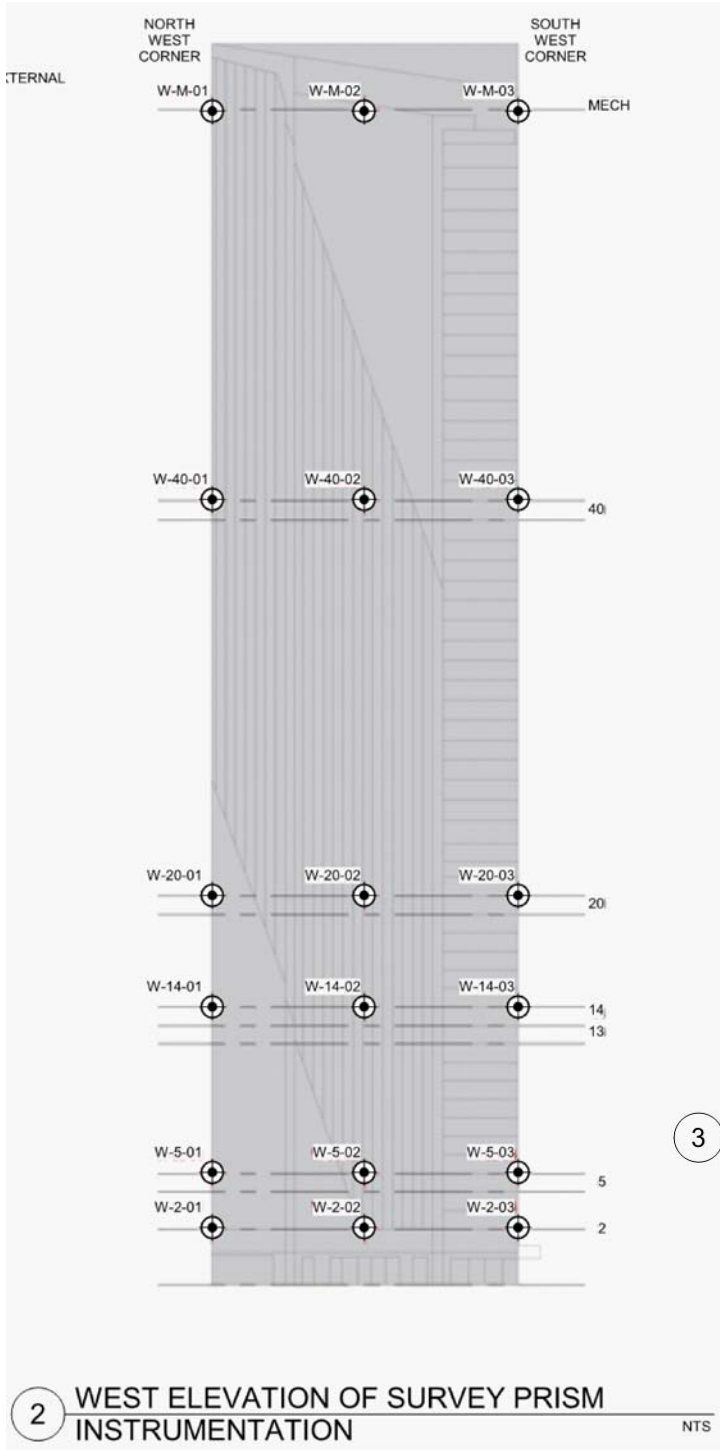
Checked By: DGM

Figure No: 043-01A



INSTRUMENT LOCATION MAP  
SETTLEMENT MARKERS, PIEZOMETERS, EXTENSOMETERS

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



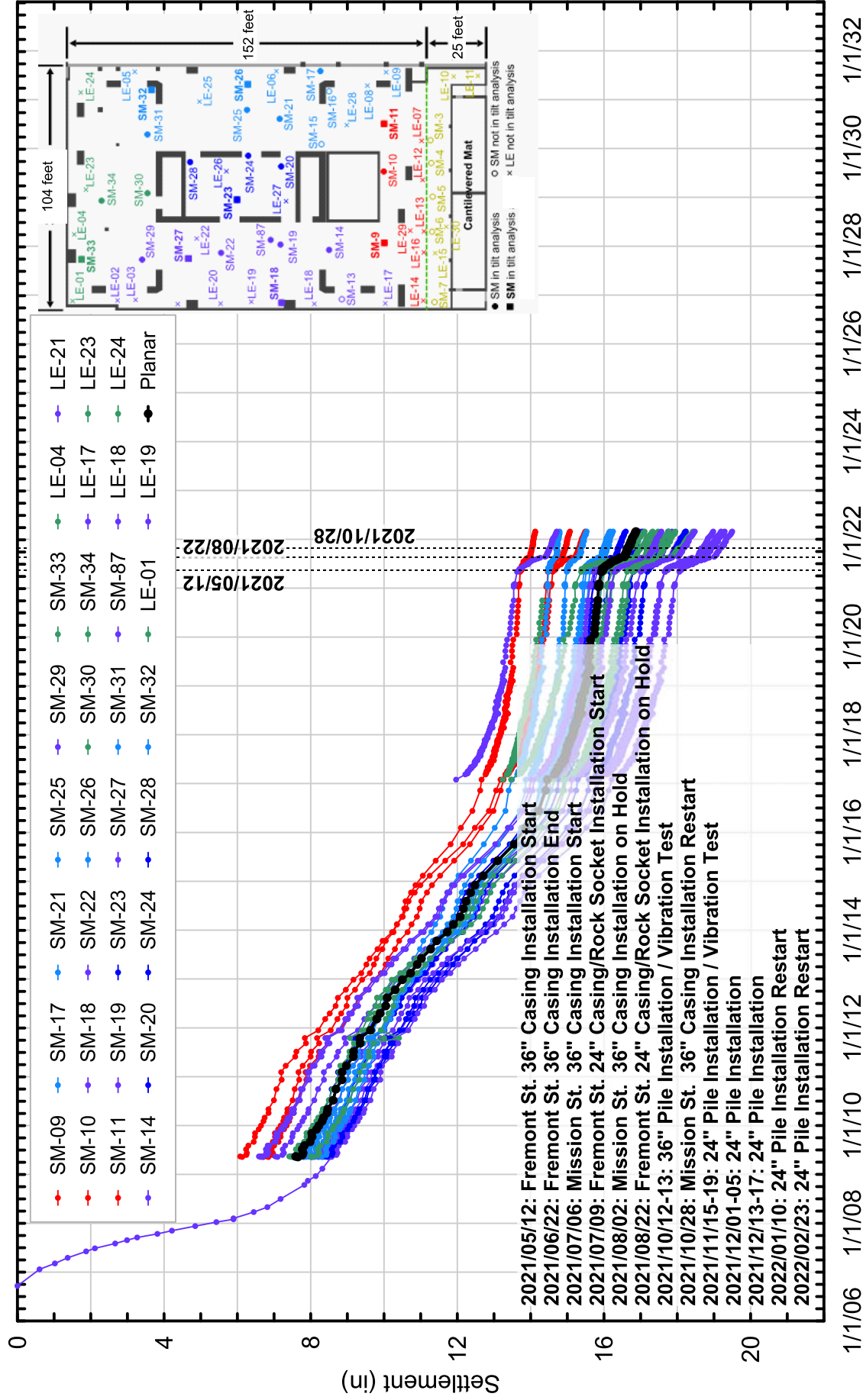
From 301 Mission Perimeter Pile Upgrade Bulletin 8 Set S 207 2021-06-15

|                       |                 |                 |                 |                           |
|-----------------------|-----------------|-----------------|-----------------|---------------------------|
| Project No: 19-009.00 | Date: 7/26/2021 | Created By: KAS | Checked By: DGM | Figure No: <b>043-01B</b> |
|-----------------------|-----------------|-----------------|-----------------|---------------------------|



TOWER SURVEY PRISM LOCATION SCHEMATIC

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

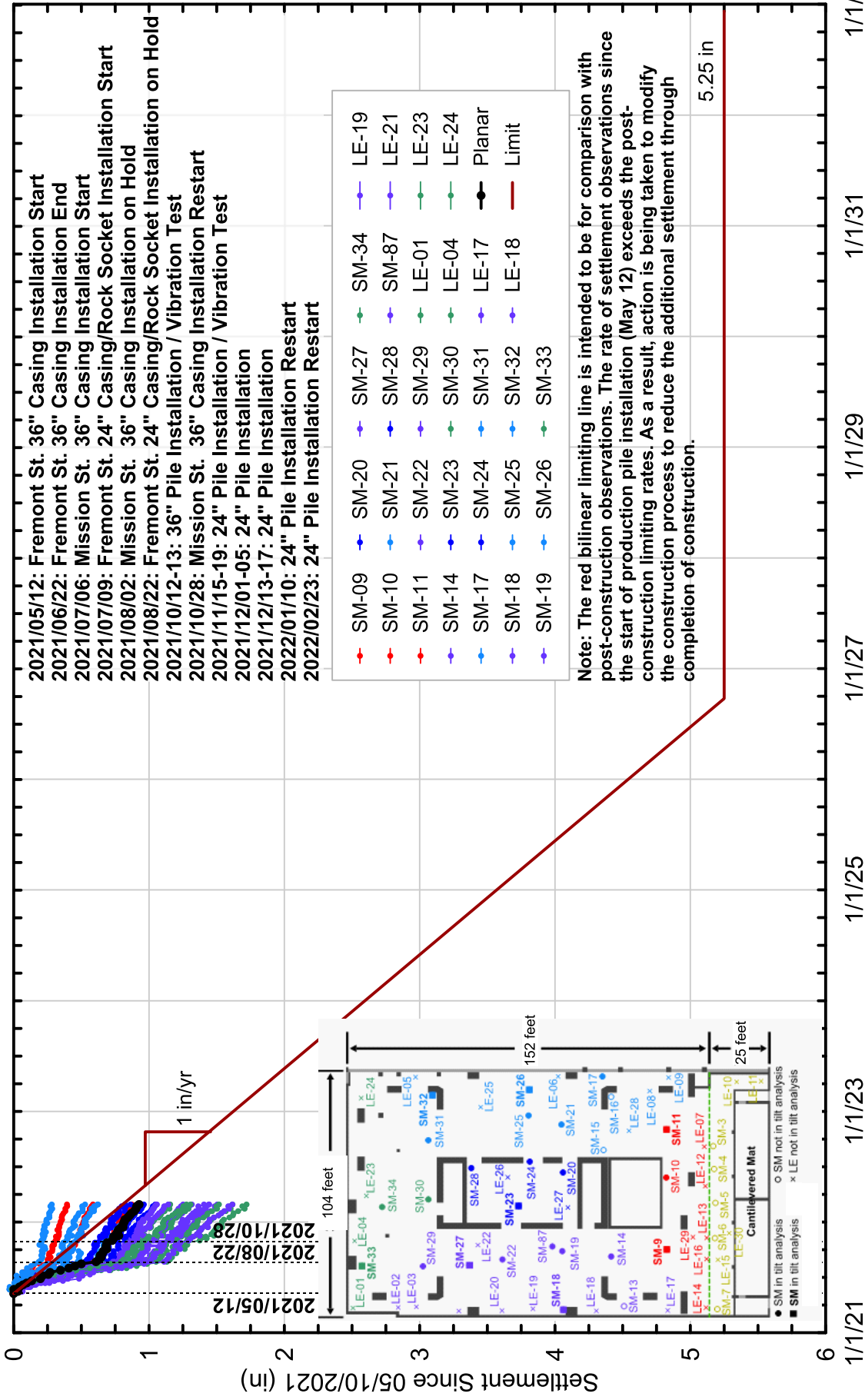


Project No: 19-009.00    Date: 3/2/2022    Created By: KAS    Checked By: DGM    Figure No: 043-02

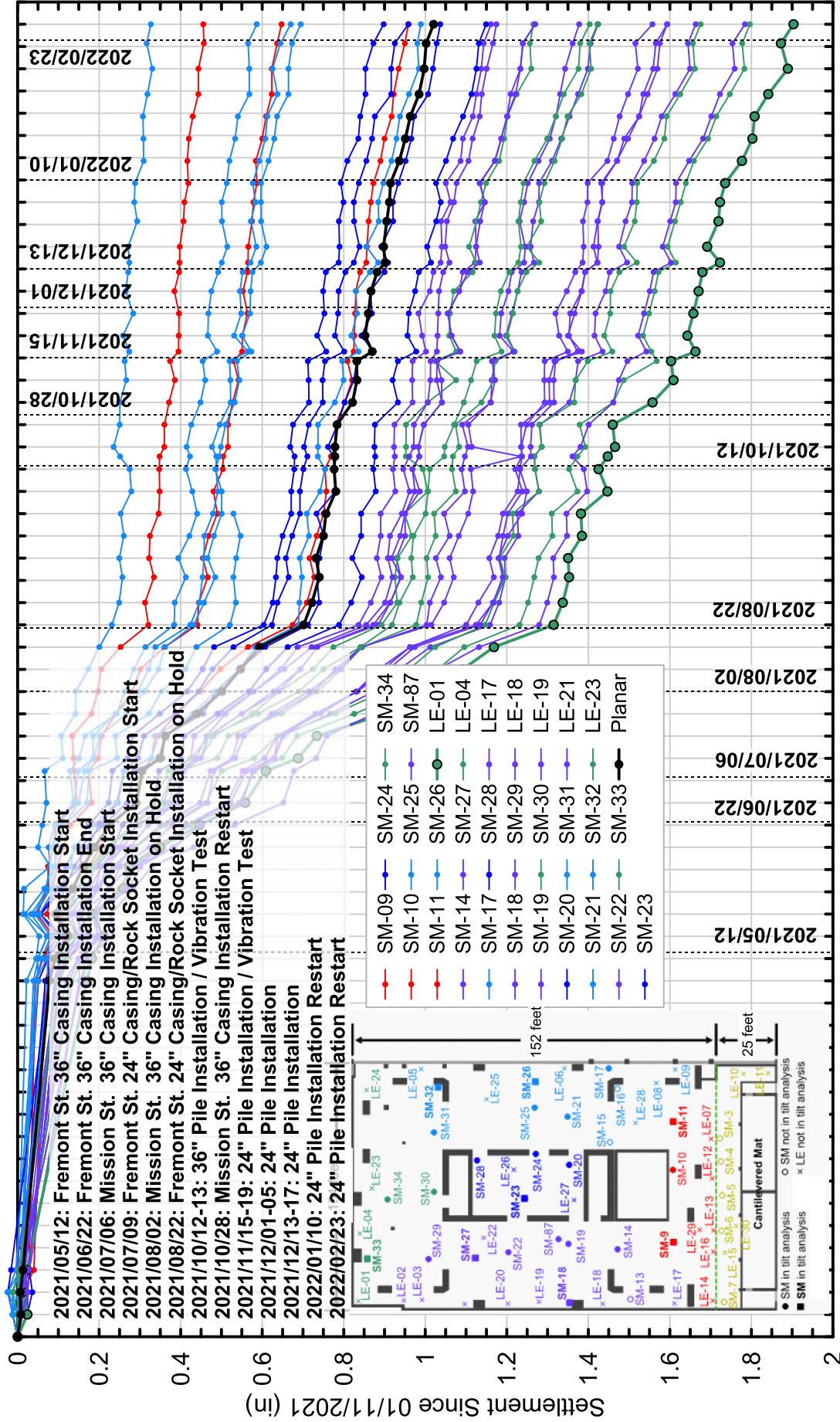
**SLATE**  
GEOTECHNICAL CONSULTANTS

HISTORICAL SETTLEMENT MARKER DATA


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

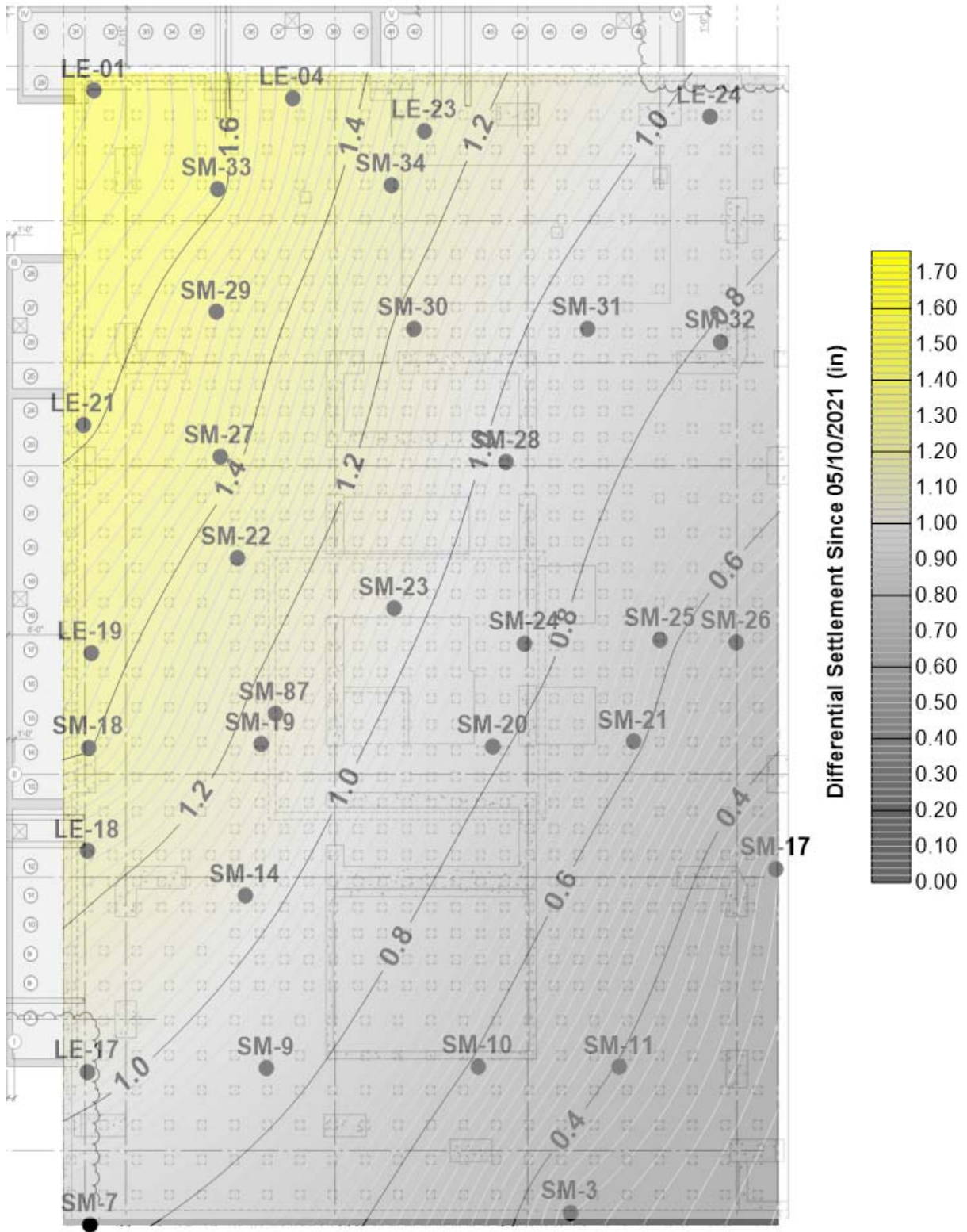


|  |                |                 |                 |                    |
|--|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00  | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-03A |
|  |                |                 |                 |                    |
| SETTLEMENT MARKER DATA<br>SINCE 05/10/2021 THROUGH 02/28/2022  |                |                 |                 |                    |
| Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data<br>City and County of San Francisco, California |                |                 |                 |                    |



1/11/21 2/8/21 3/8/21 4/5/21 5/3/21 5/31/21 6/28/21 7/26/21 8/23/21 9/20/21 10/18/21 11/15/21 12/13/21 1/10/22 2/7/22 3/7/22

|  |                |                 |                 |                    |
|--|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00  | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-03B |
|                                     |                |                 |                 |                    |
| SETTLEMENT MARKER DATA<br>SINCE 01/11/2021 THROUGH 02/28/2022  |                |                 |                 |                    |
| Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data<br>City and County of San Francisco, California |                |                 |                 |                    |



Project No: 19-009.00

Date: 3/2/2022

Created By: KAS

Checked By: DGM

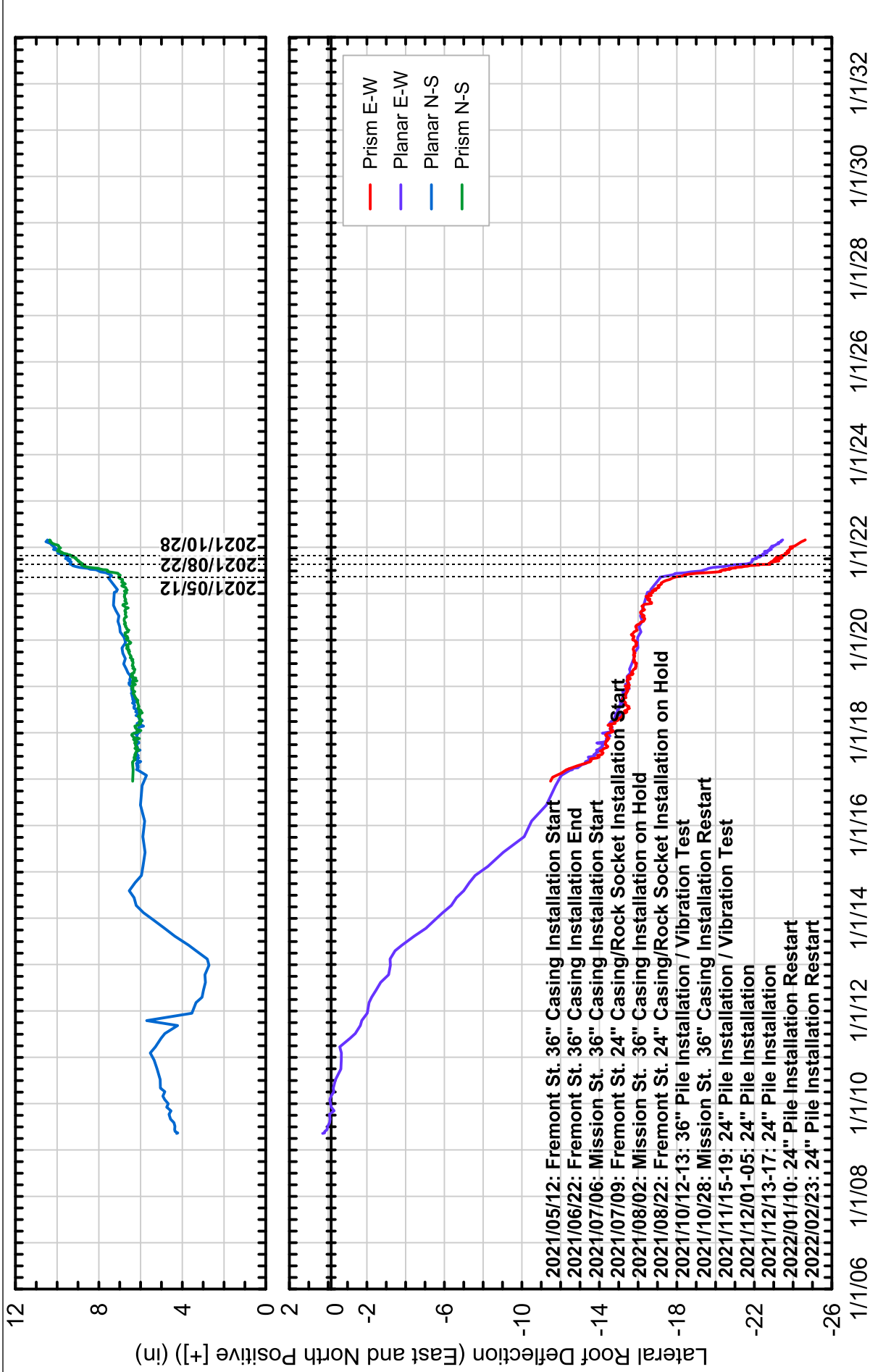
Figure No: **043-04**



SETTLEMENT CONTOURS  
SINCE 05/10/2021 THROUGH 02/28/2022

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




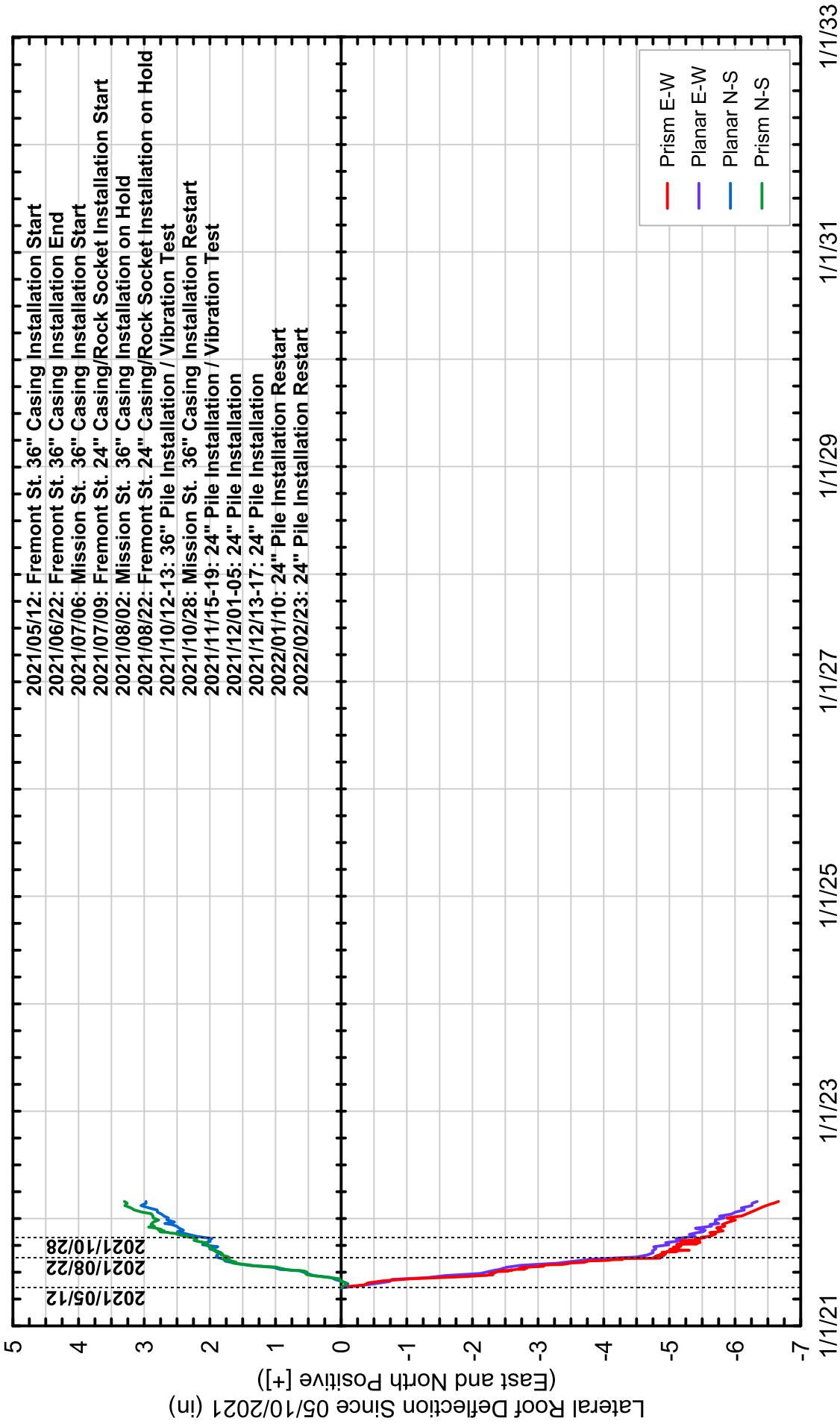


|                       |                |                 |                 |                   |
|-----------------------|----------------|-----------------|-----------------|-------------------|
| Project No: 19-009.00 | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-05 |
|-----------------------|----------------|-----------------|-----------------|-------------------|

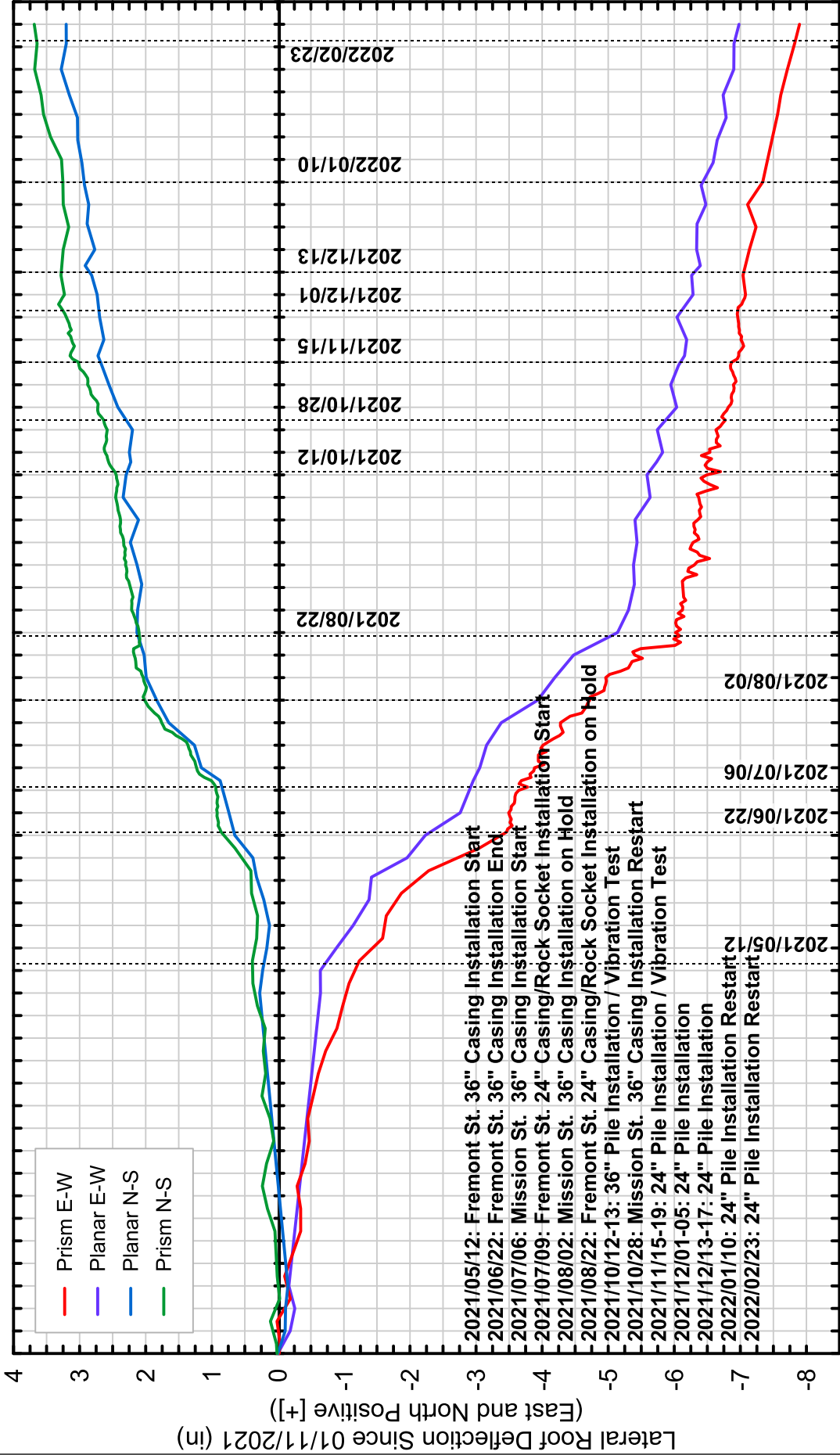
**HISTORICAL LATERAL ROOF DEFLECTION DATA**

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





|  |                |                 |                 |                    |
|--|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00  | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-06A |
|                                     |                |                 |                 |                    |
| LATERAL ROOF DEFLECTION DATA<br>SINCE 05/10/2021 THROUGH 02/28/2022  |                |                 |                 |                    |
| Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data<br>City and County of San Francisco, California |                |                 |                 |                    |



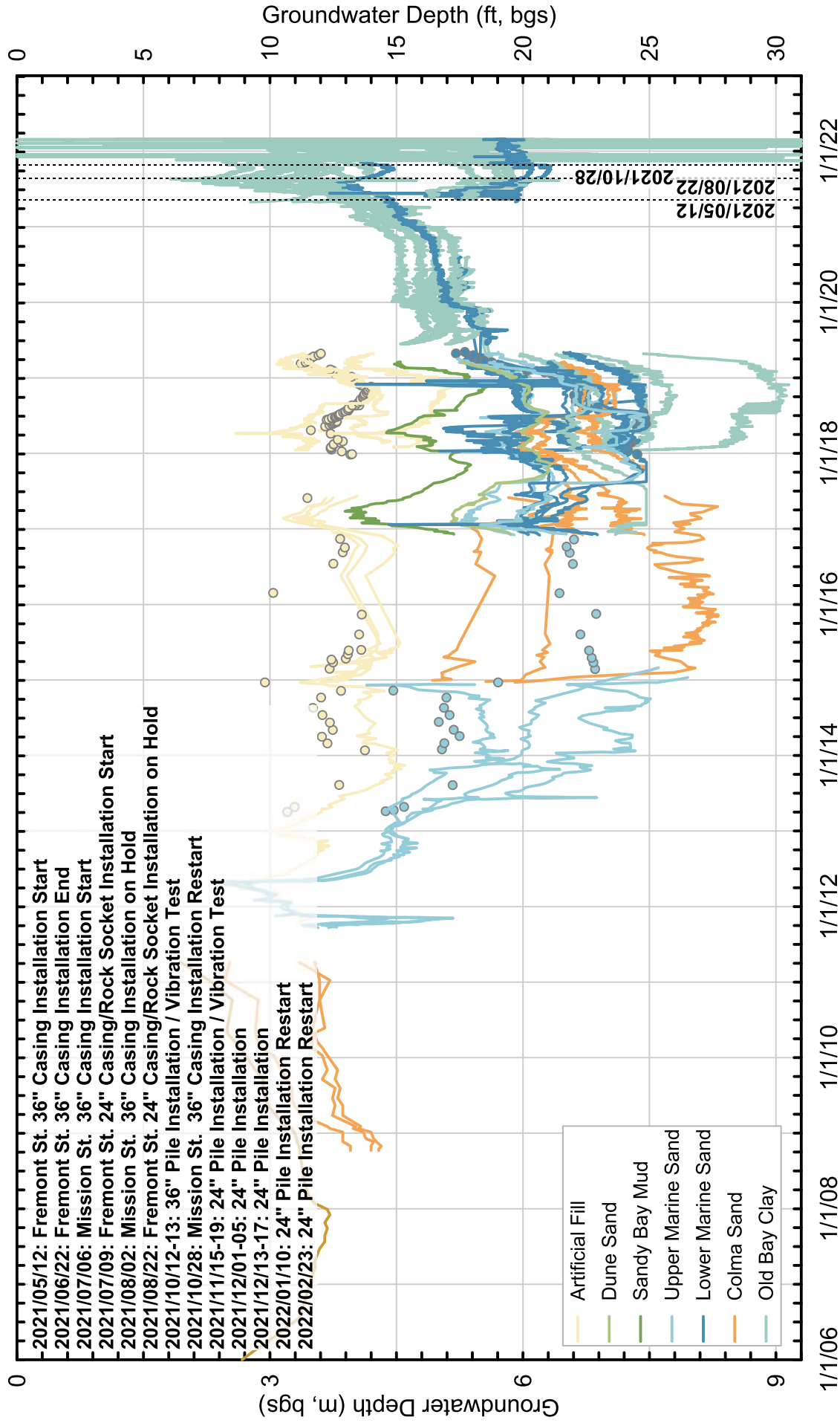
1/11/21 2/8/21 3/8/21 4/5/21 5/31/21 6/28/21 7/26/21 8/23/21 9/20/21 10/18/21 11/15/21 12/13/21 11/10/22 2/7/22 3/7/22

Project No: 19-009.00 Date: 3/2/2022 Created By: KAS Checked By: DGM Figure No: 043-06B



LATERAL ROOF DEFLECTION DATA  
SINCE 01/11/2021 THROUGH 02/28/2022

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



Project No: 19-009.00 Date: 3/2/2022

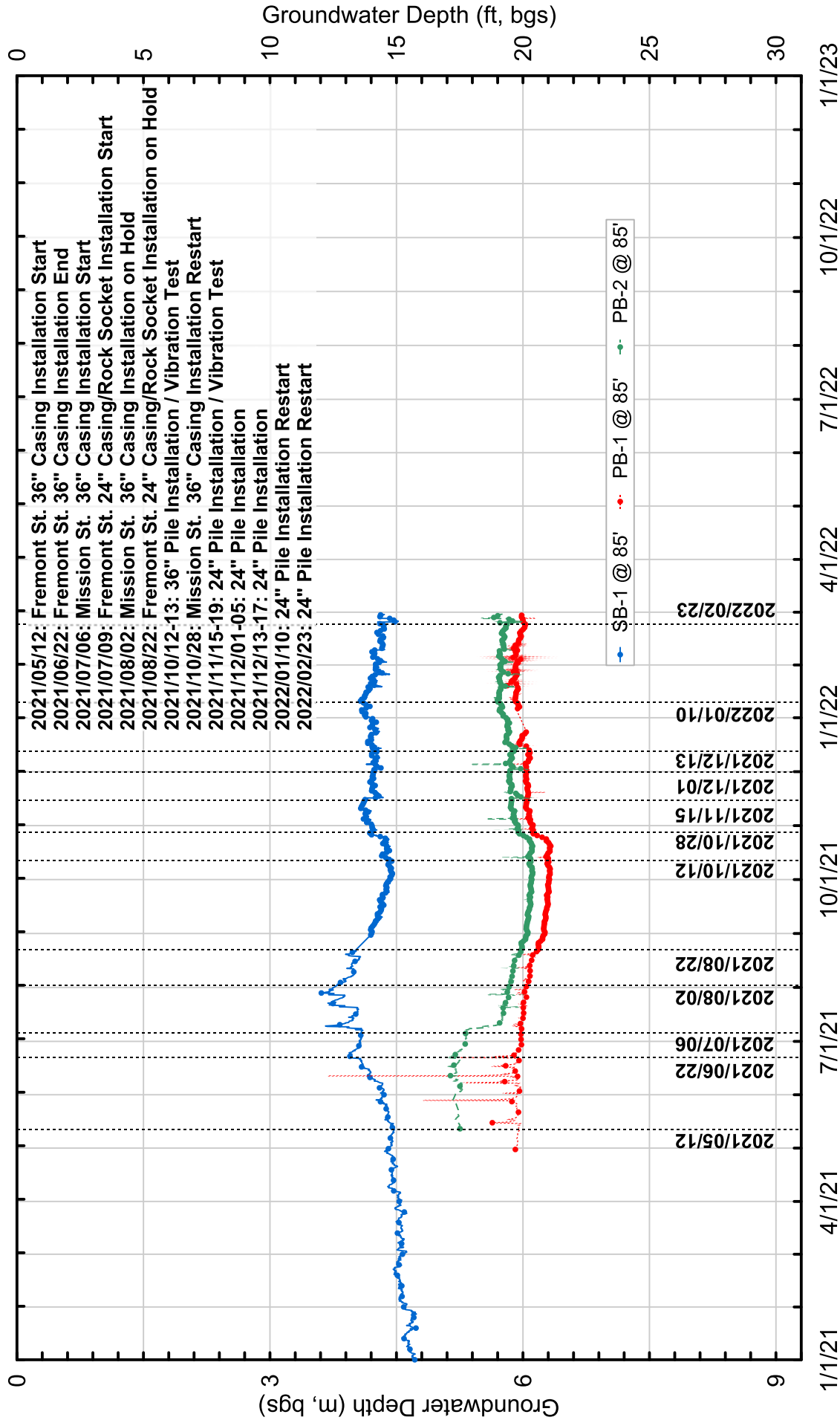
Created By: KAS Checked By: DGM


Figure No: 043-07

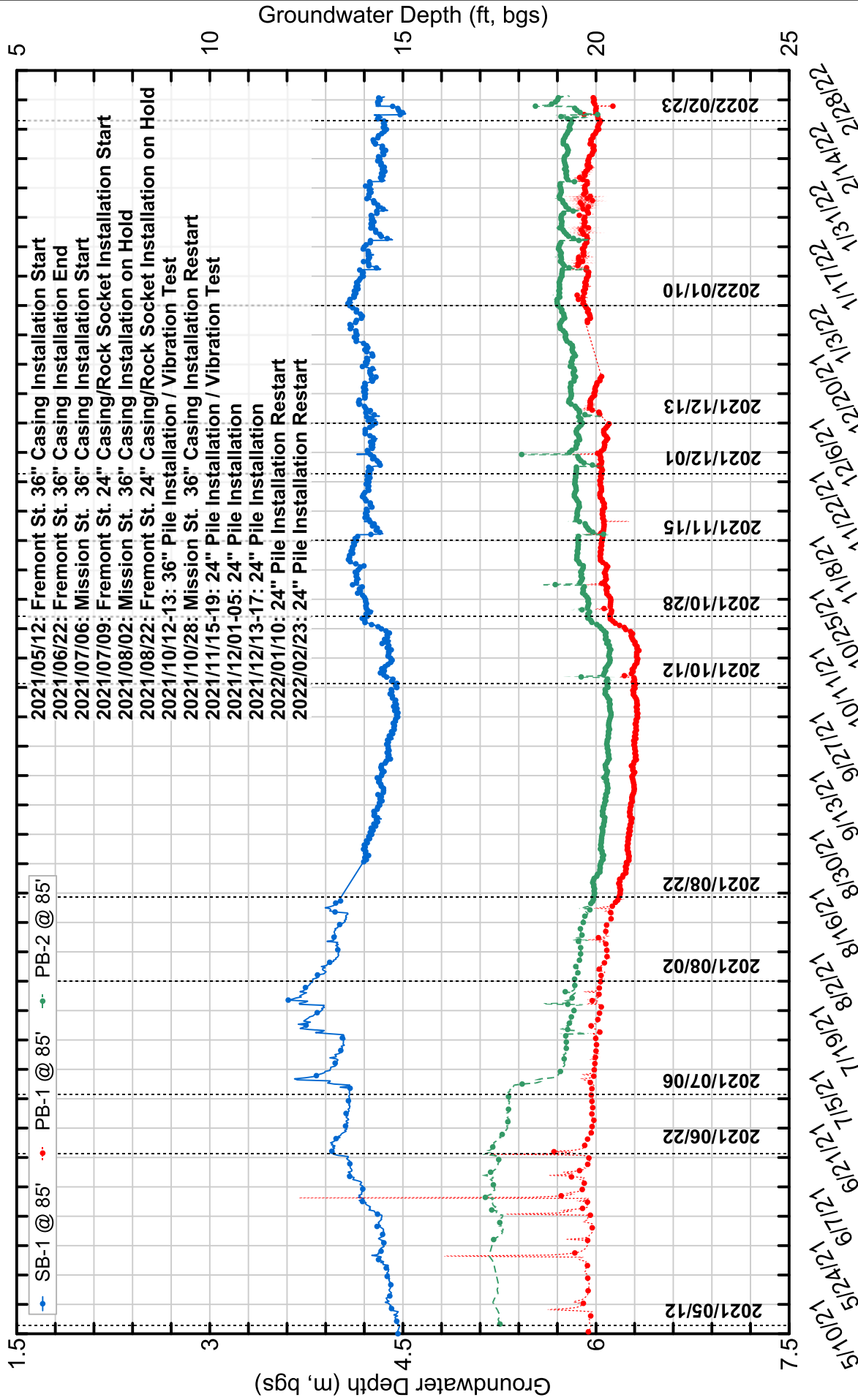


**HISTORICAL GROUNDWATER ELEVATION MEASUREMENTS  
 AT LOCATIONS NEAR 301 MISSION**

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



|  |                |                 |                 |                    |
|--|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00  | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-08A |
|                                     |                |                 |                 |                    |
| GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND<br>SINCE 01/01/2021 THROUGH 02/28/2022                       |                |                 |                 |                    |
| Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data<br>City and County of San Francisco, California |                |                 |                 |                    |

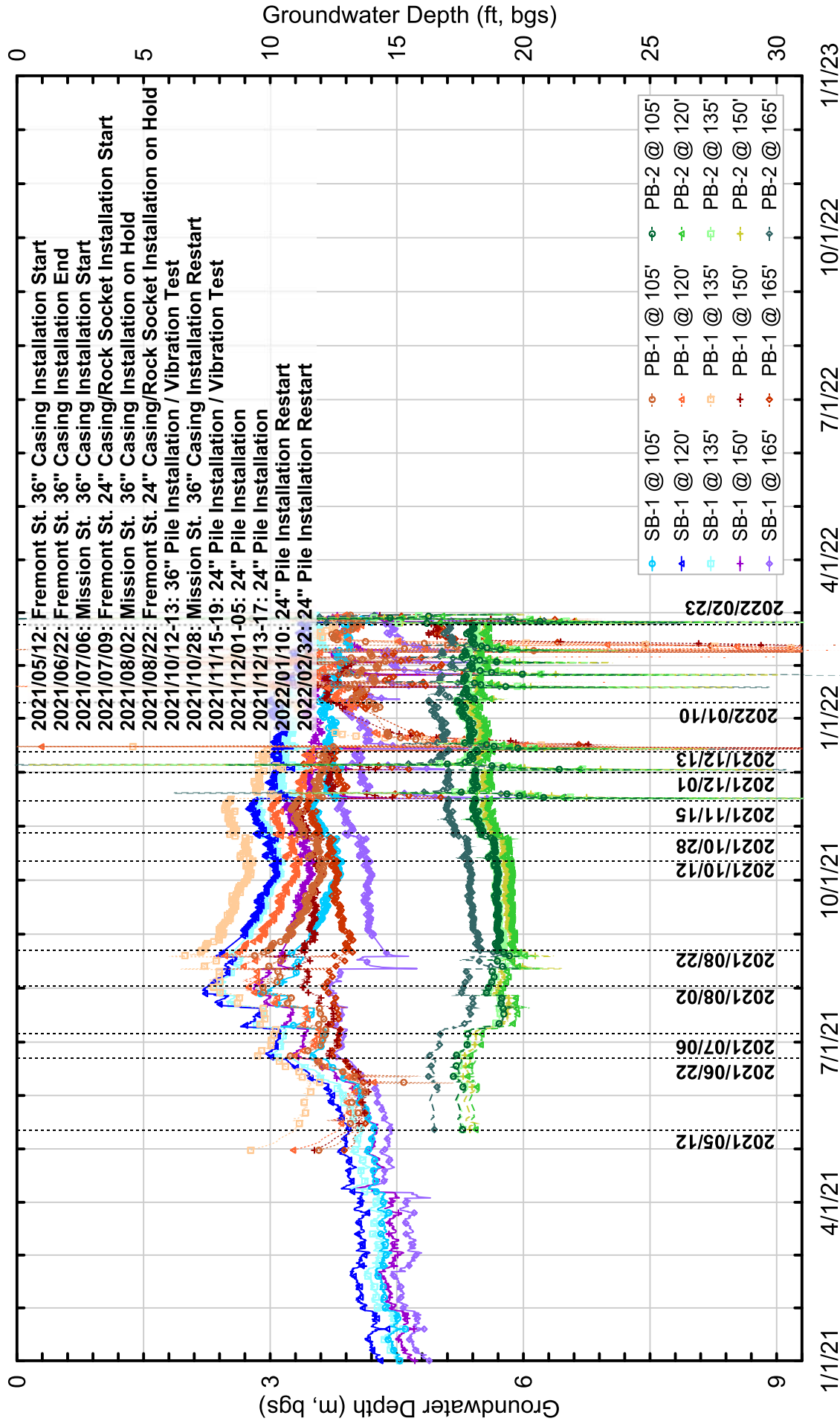


|                       |                |                 |                 |                    |
|-----------------------|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00 | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-08B |
|-----------------------|----------------|-----------------|-----------------|--------------------|

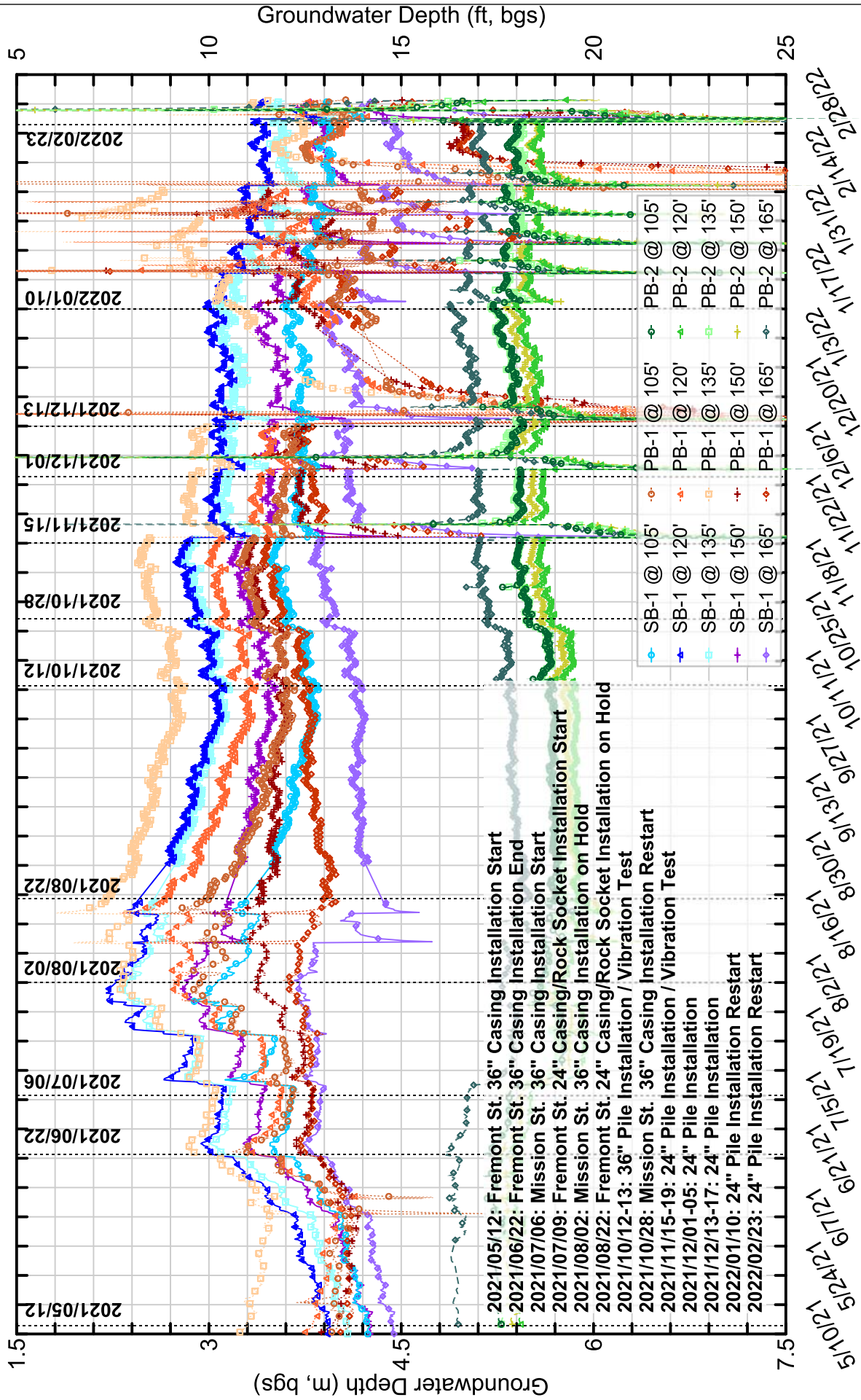
**SLATE**  
 GEOTECHNICAL CONSULTANTS

GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND  
 SINCE 05/10/2021 THROUGH 02/28/2022


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



|  |                |                 |                 |                    |
|--|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00  | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-09A |
| <b>SLATE</b><br>GEOTECHNICAL CONSULTANTS   |                |                 |                 |                    |
| GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY<br>SINCE 01/01/2021 THROUGH 02/28/2022                                |                |                 |                 |                    |
| Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data<br>City and County of San Francisco, California |                |                 |                 |                    |



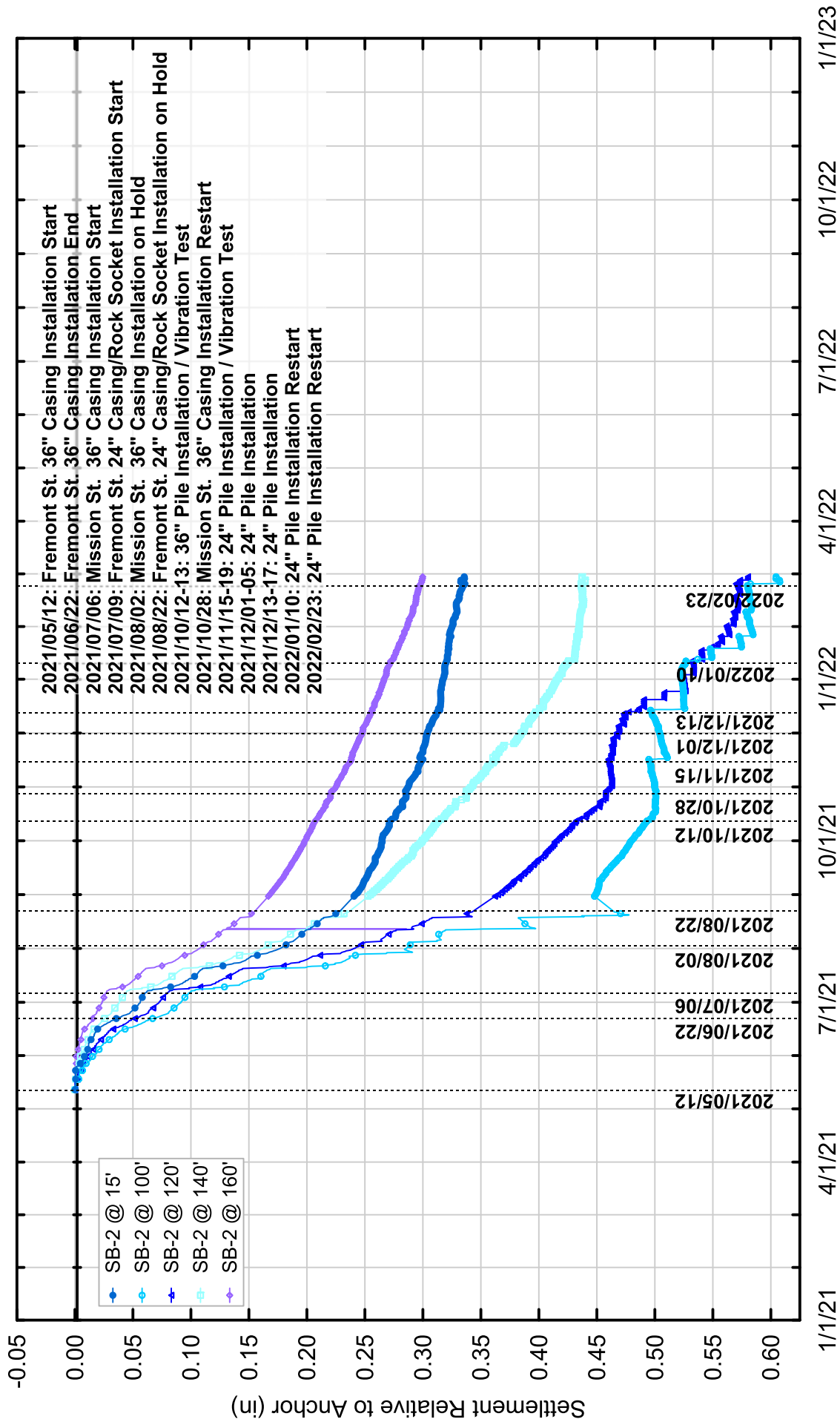
|                       |                |                 |                 |                    |
|-----------------------|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00 | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-09B |
|-----------------------|----------------|-----------------|-----------------|--------------------|




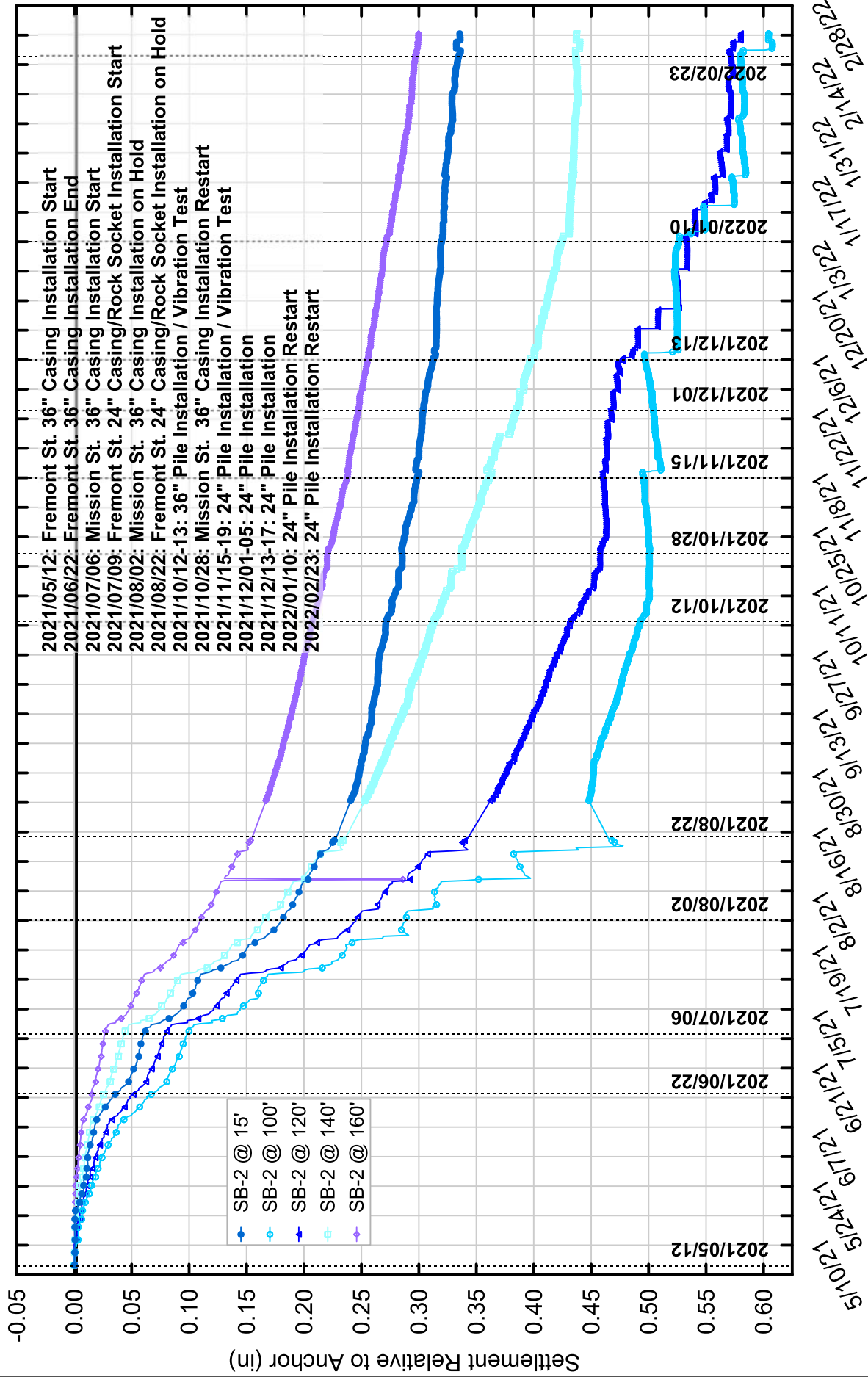
**GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY**  
SINCE 05/10/2021 THROUGH 02/28/2022

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





|  |                |                 |                 |                    |
|--|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00  | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-10A |
|                                     |                |                 |                 |                    |
| EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT<br>SINCE 01/01/2021 THROUGH 02/28/2022                                      |                |                 |                 |                    |
| Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data<br>City and County of San Francisco, California |                |                 |                 |                    |

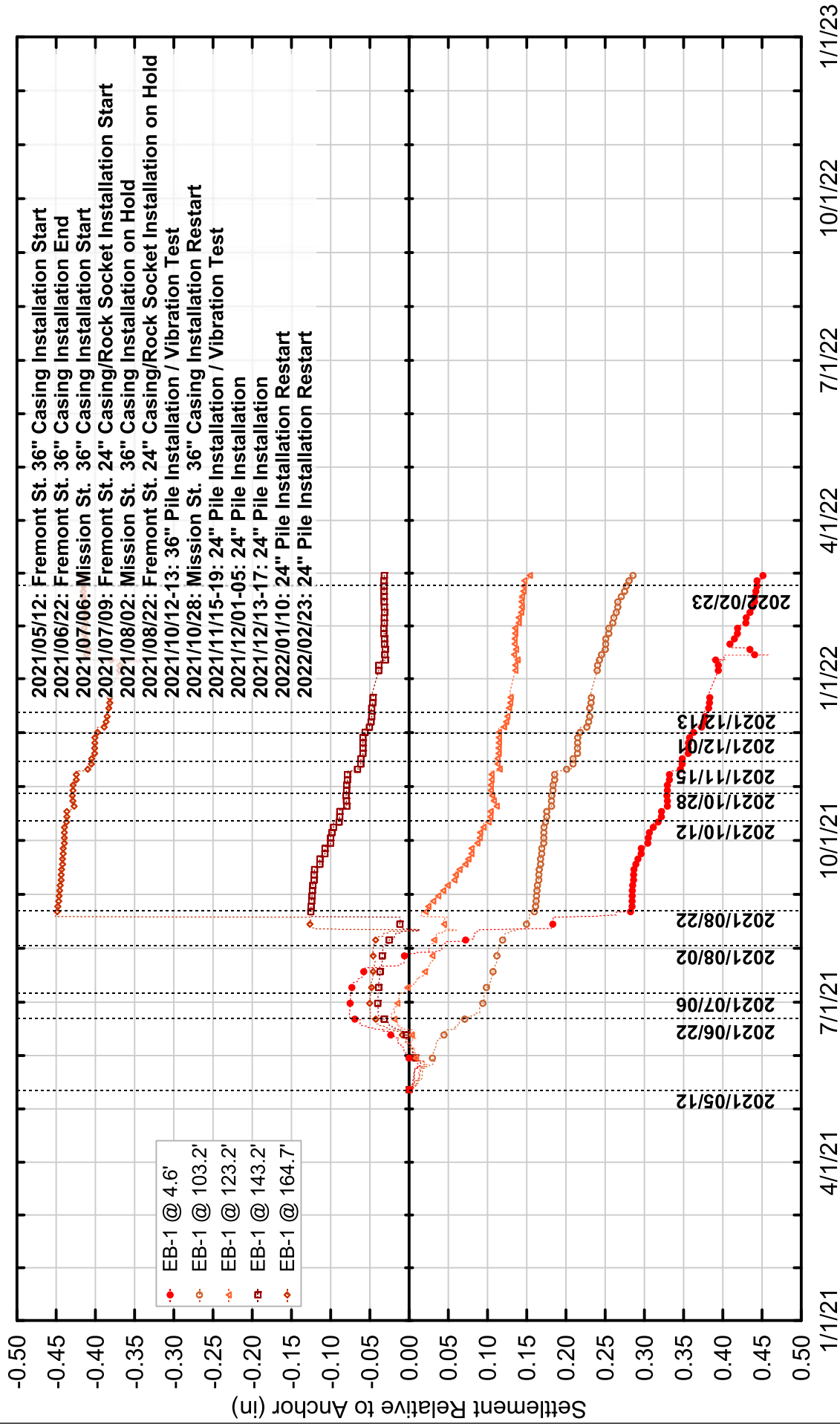


|                       |                |                 |                 |                    |
|-----------------------|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00 | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-10B |
|-----------------------|----------------|-----------------|-----------------|--------------------|

**EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT**  
SINCE 05/10/2021 THROUGH 02/28/2022

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





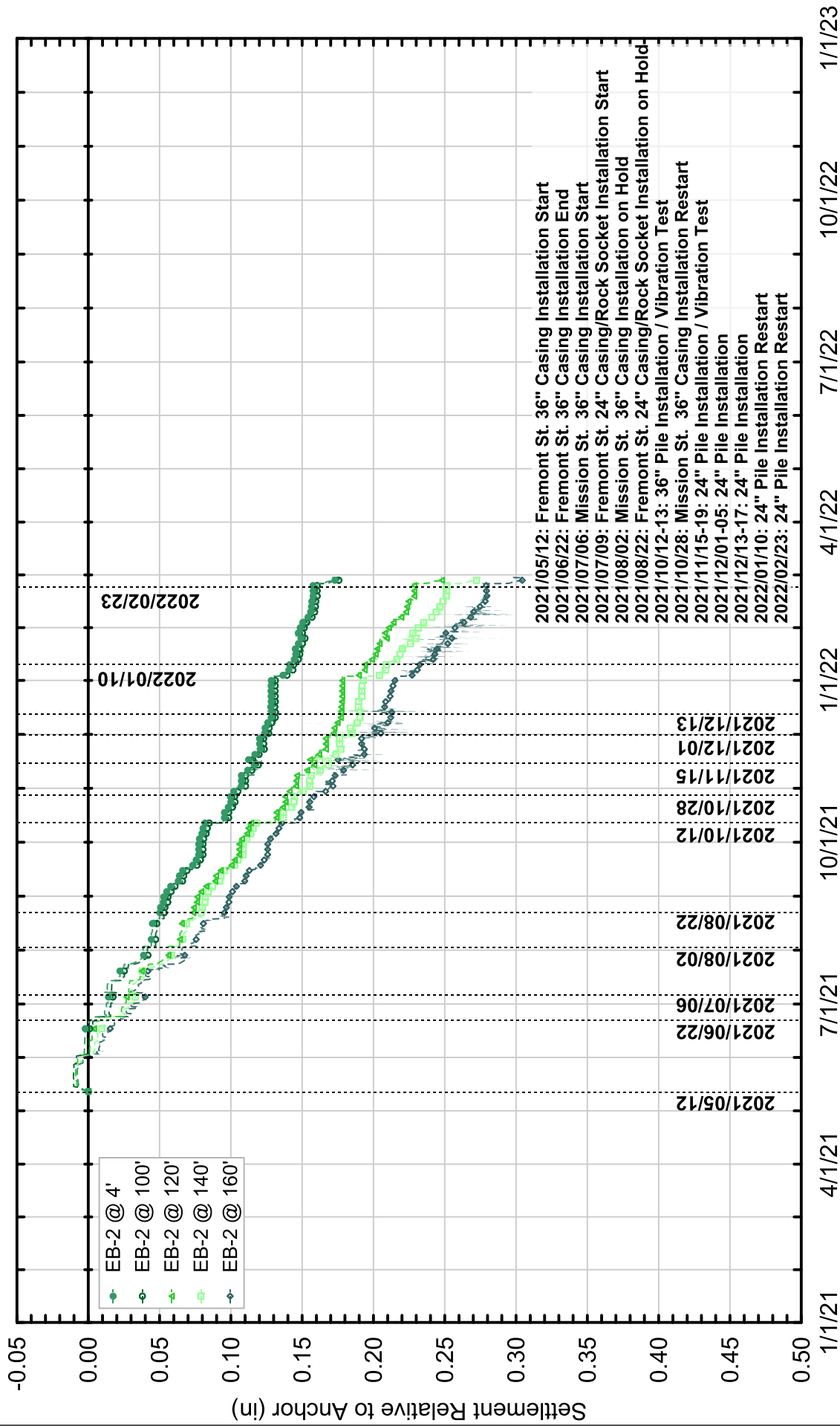
|                       |                |                 |                 |                    |
|-----------------------|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00 | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-11A |
|-----------------------|----------------|-----------------|-----------------|--------------------|


**SLATE**  
GEOTECHNICAL CONSULTANTS

EXTENSOMETER DATA FROM FREMONT STREET  
SINCE 01/01/2021 THROUGH 02/28/2022

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





|  |                |                 |                 |                    |
|--|----------------|-----------------|-----------------|--------------------|
| Project No: 19-009.00  | Date: 3/2/2022 | Created By: KAS | Checked By: DGM | Figure No: 043-12A |
|                                     |                |                 |                 |                    |
| EXTENSOMETER DATA FROM MISSION STREET<br>SINCE 01/01/2021 THROUGH 02/28/2022   |                |                 |                 |                    |
| Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data<br>City and County of San Francisco, California |                |                 |                 |                    |

