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: May 4, 2022
Project Number: 19-009
Subject: 301 Mission Retrofit Monitoring Report 052: Results as of May 3, 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 May 2, 2022. Figure 03B presents settlement data since January 11, 2021, through May 2, 2022. Figure 04 presents current settlement contours (in inches) on May 2, 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 May 2, 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 May 2, 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 May 3, 2022.

Figure 10 presents extensometer data from within the Tower basement since the start of production pile installation (May 12, 2021) through May 3, 2022. Figure 11 presents extensometer data from Fremont Street since the start of production pile installation (May 12, 2021) through May 3, 2022. Note that two of the Fremont Street extensometers have been offline since about April 11, 2022. Figure 12 presents extensometer data from Mission Street since the start of production pile installation (May 12, 2021) through April 23, 2022. Note that the Mission Street instruments have been offline since about April 23, 2022; work to correct this is underway.

CLOSING

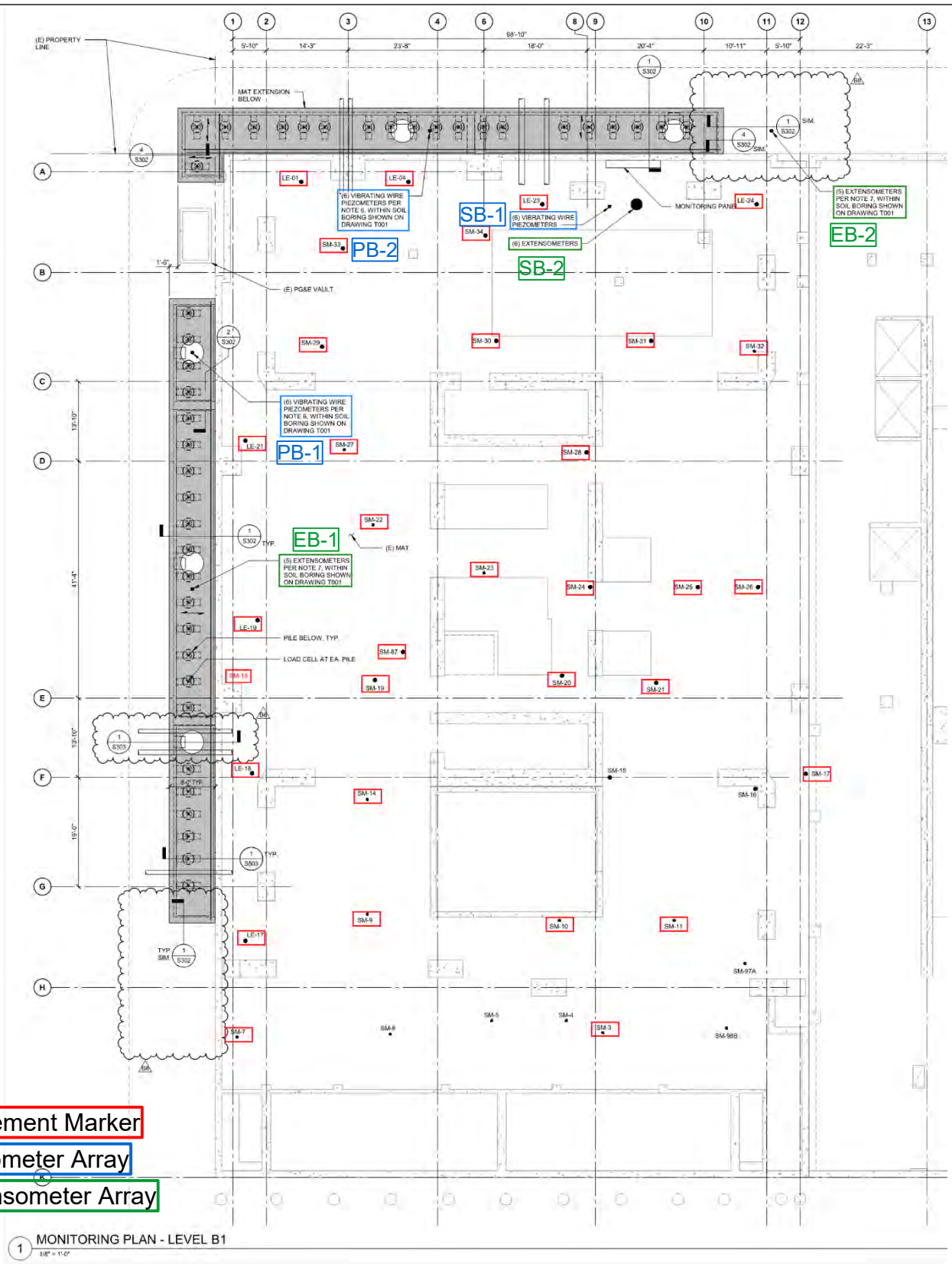
Please contact us if you have any comments or questions, or if you would like to discuss the results presented in this memorandum.

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 05/02/2022
Figure 03B – Settlement Marker Data since 01/11/2021 through 05/02/2022
Figure 04 – Settlement Contours since 05/10/2021 through 05/02/2022
Figure 05 – Historical Lateral Roof Deflection Data
Figure 06A – Lateral Roof Deflection Data since 05/10/2021 through 05/02/2022
Figure 06B – Lateral Roof Deflection Data since 01/11/2021 through 05/02/2022
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 05/03/2022
Figure 08B – Groundwater Elevation Measurements in Marine and Colma Sand since 05/10/2021 through 05/03/2022
Figure 09A – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 05/03/2022
Figure 09B – Groundwater Elevation Measurements in Old Bay Clay since 01/01/2021 through 05/03/2022
Figure 10A – Extensometer Data from within Tower Basement since 01/01/2021 through 05/03/2022
Figure 10B – Extensometer Data from within Tower Basement since 05/10/2021 through 05/03/2022
Figure 11A – Extensometer Data from Fremont Street since 01/01/2021 through 05/03/2022
Figure 11B – Extensometer Data from Fremont Street since 05/10/2021 through 05/03/2022
Figure 12A – Extensometer Data from Mission Street since 01/01/2021 through 04/23/2022
Figure 12B – Extensometer Data from Mission Street since 05/10/2021 through 04/23/2022

ATTACHMENTS

Attachment 01 – Crack Gauge Report since 01/06/2021 through 05/02/2022



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

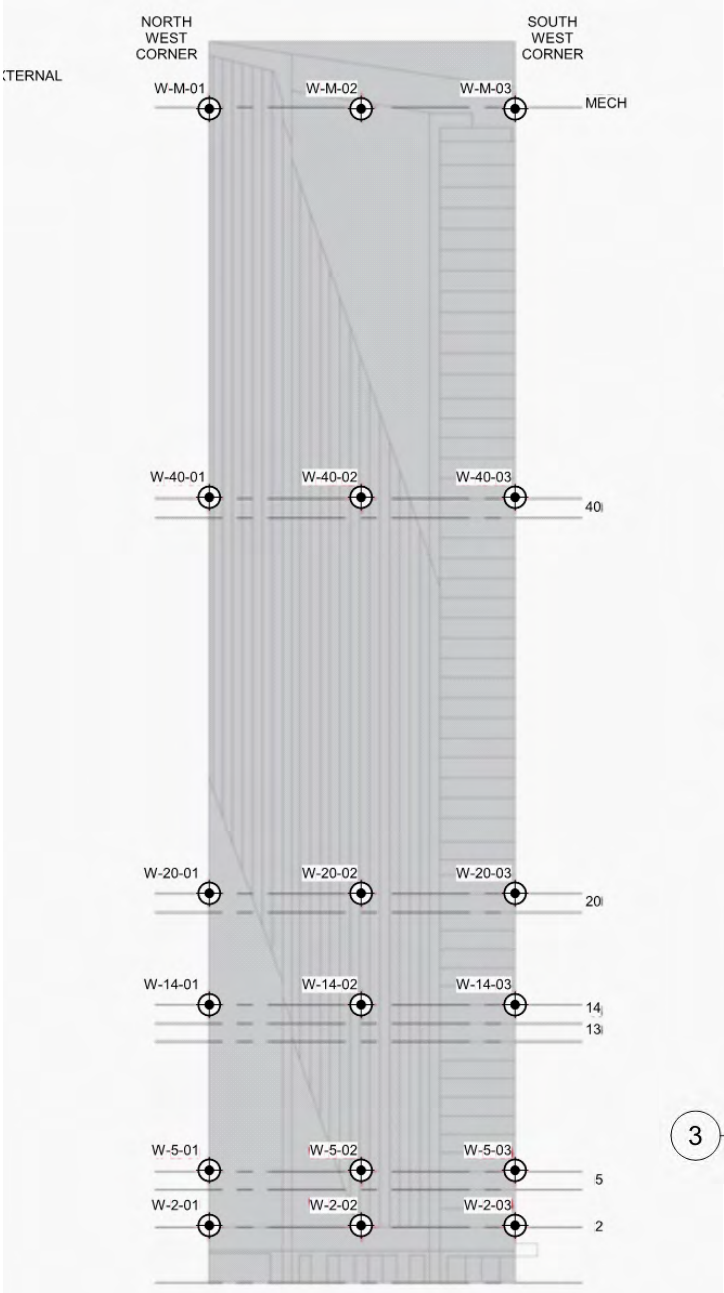
Project No: 19-009.00	Date: 7/26/2021	Created By: NBW	Checked By: DGM	Figure No: **052-01A**

SLATE GEOTECHNICAL CONSULTANTS

INSTRUMENT LOCATION MAP
SETTLEMENT MARKERS, PIEZOMETERS, EXTENSOMETERS

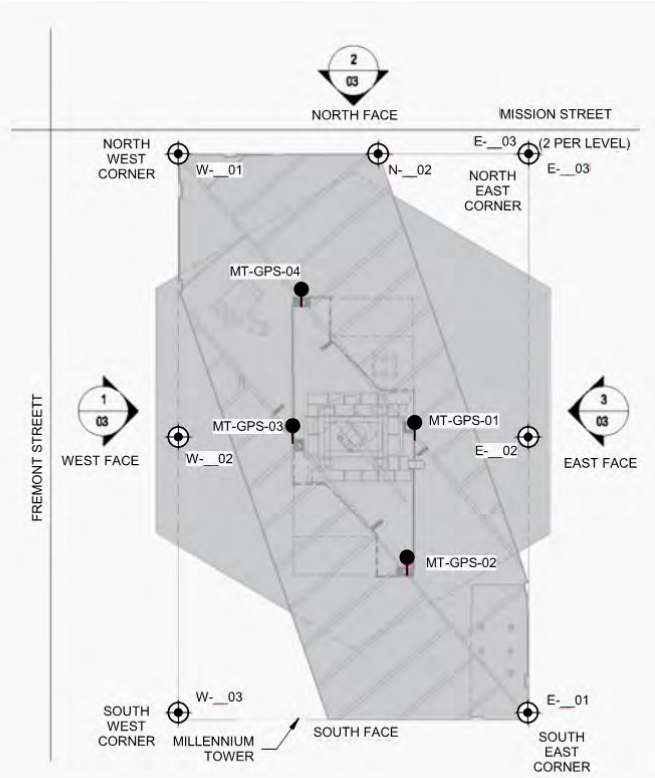
Millennium Tower Perimeter Pile Upgrade: Instrumentation Monitoring Data
City and County of San Francisco, California

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-01A_Instrument_Map.grf



2 WEST ELEVATION OF SURVEY PRISM INSTRUMENTATION

NTS



3 ROOF PLAN OF SURVEY PRISM INTRUMENTATION

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: **052-01B**

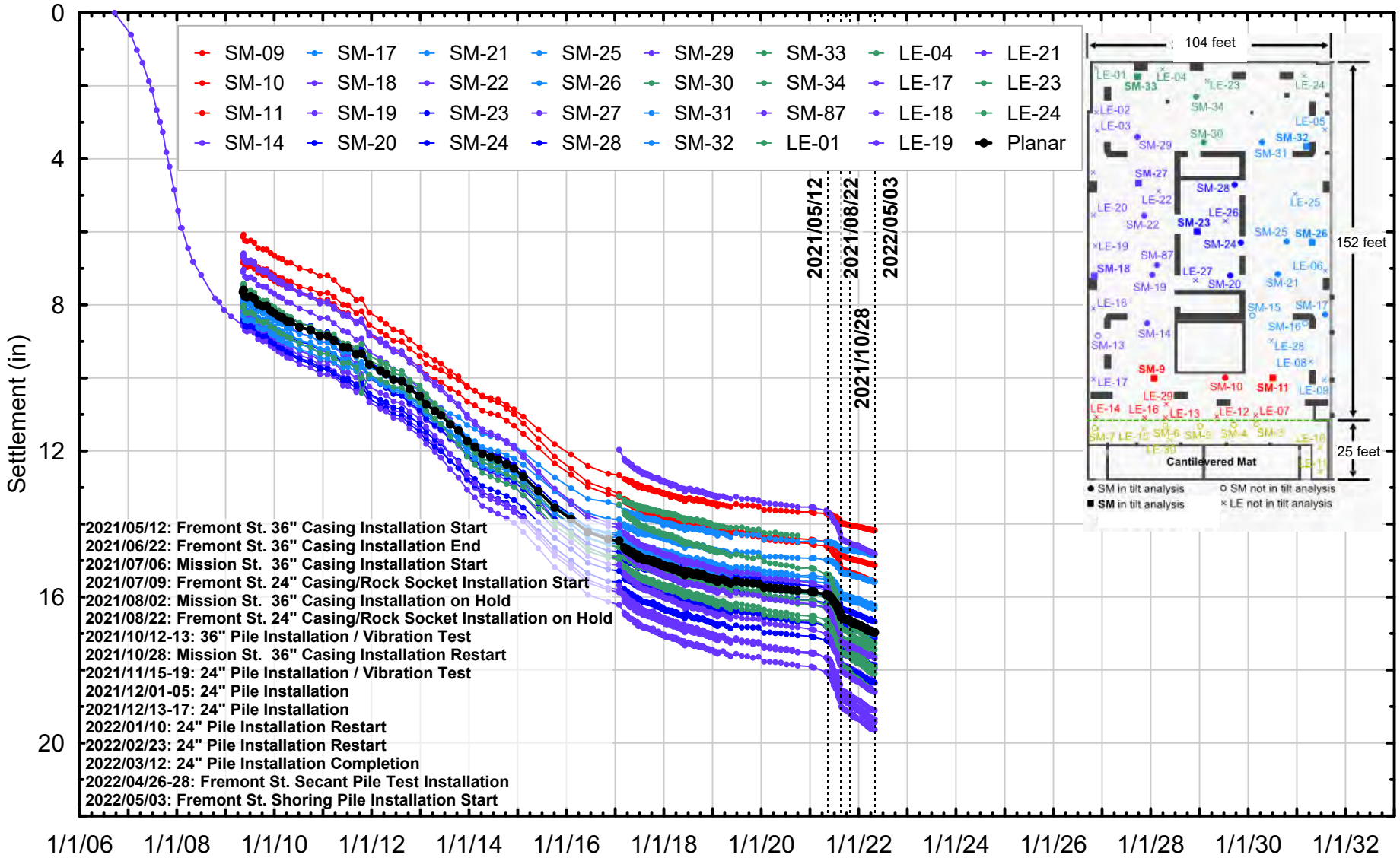
SLATE GEOTECHNICAL CONSULTANTS

TOWER SURVEY PRISM LOCATION SCHEMATIC

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-01B_Prism_Map.grf

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-02_SM_Data.grf



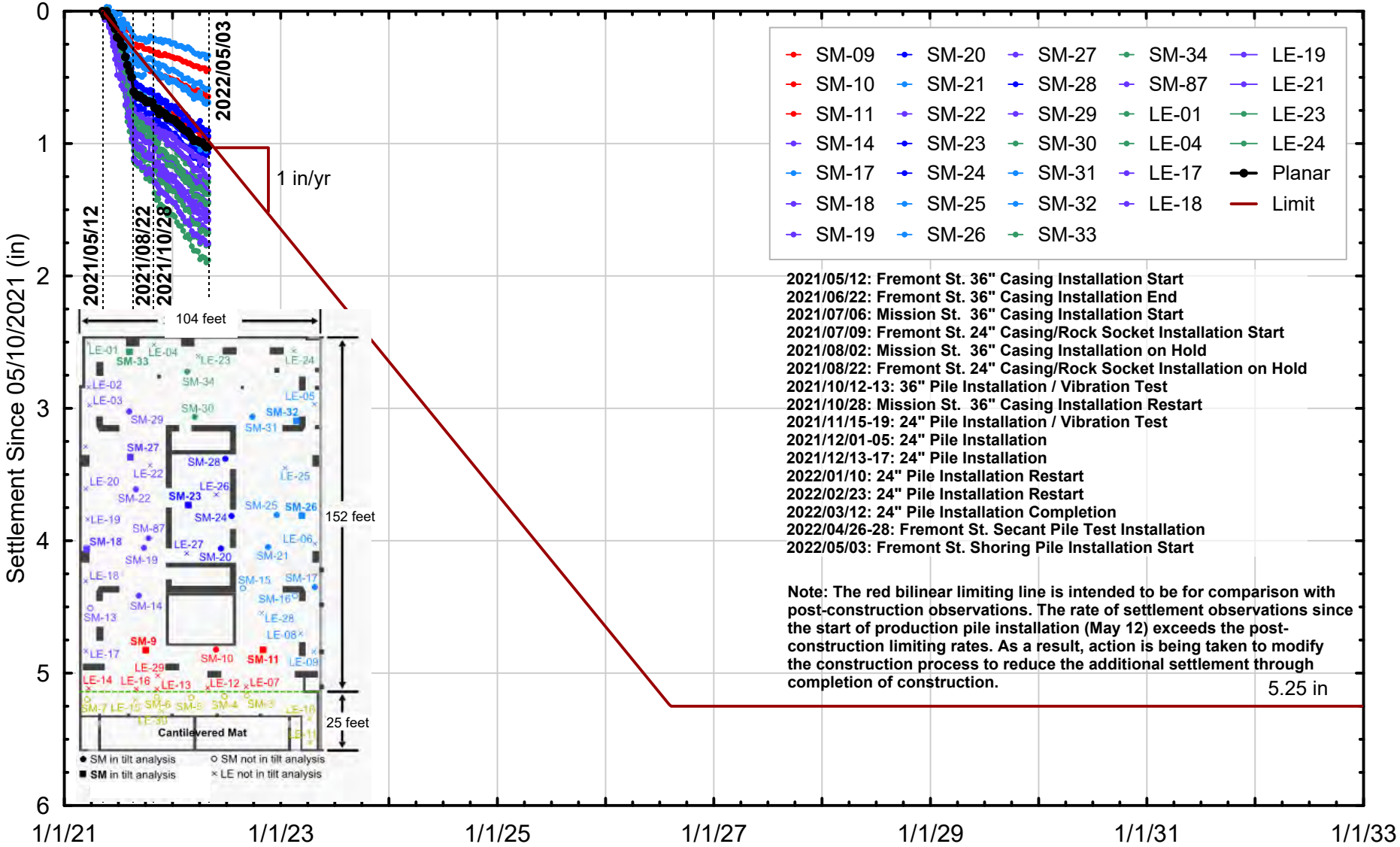
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-02**

SLATE GEOTECHNICAL CONSULTANTS

HISTORICAL SETTLEMENT MARKER DATA

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-03A_SM_Data_Diff.grf



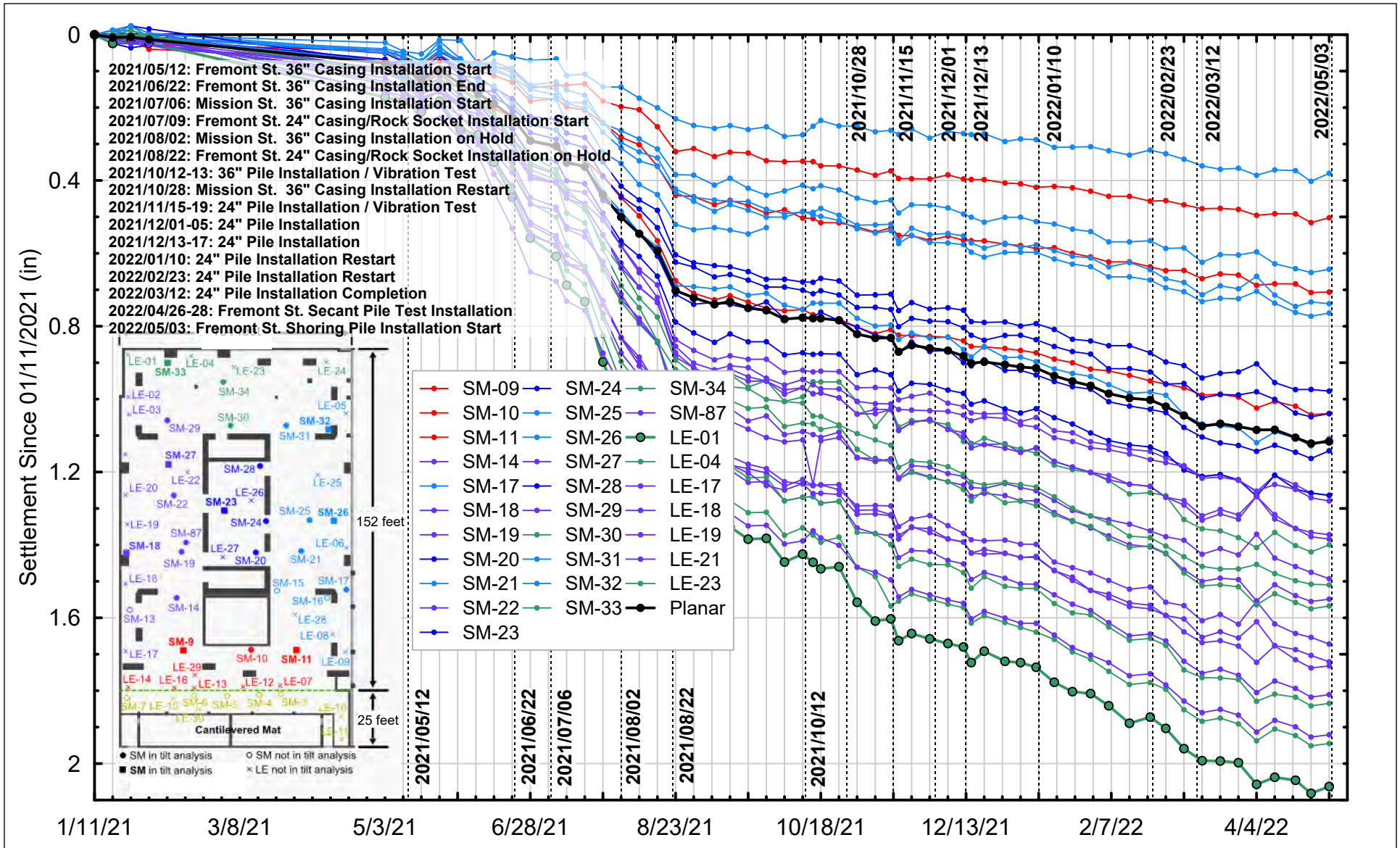
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-03A**

SLATE GEOTECHNICAL CONSULTANTS

SETTLEMENT MARKER DATA
SINCE 05/10/2021 THROUGH 05/02/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-03B_SM_Data_Diff.grf

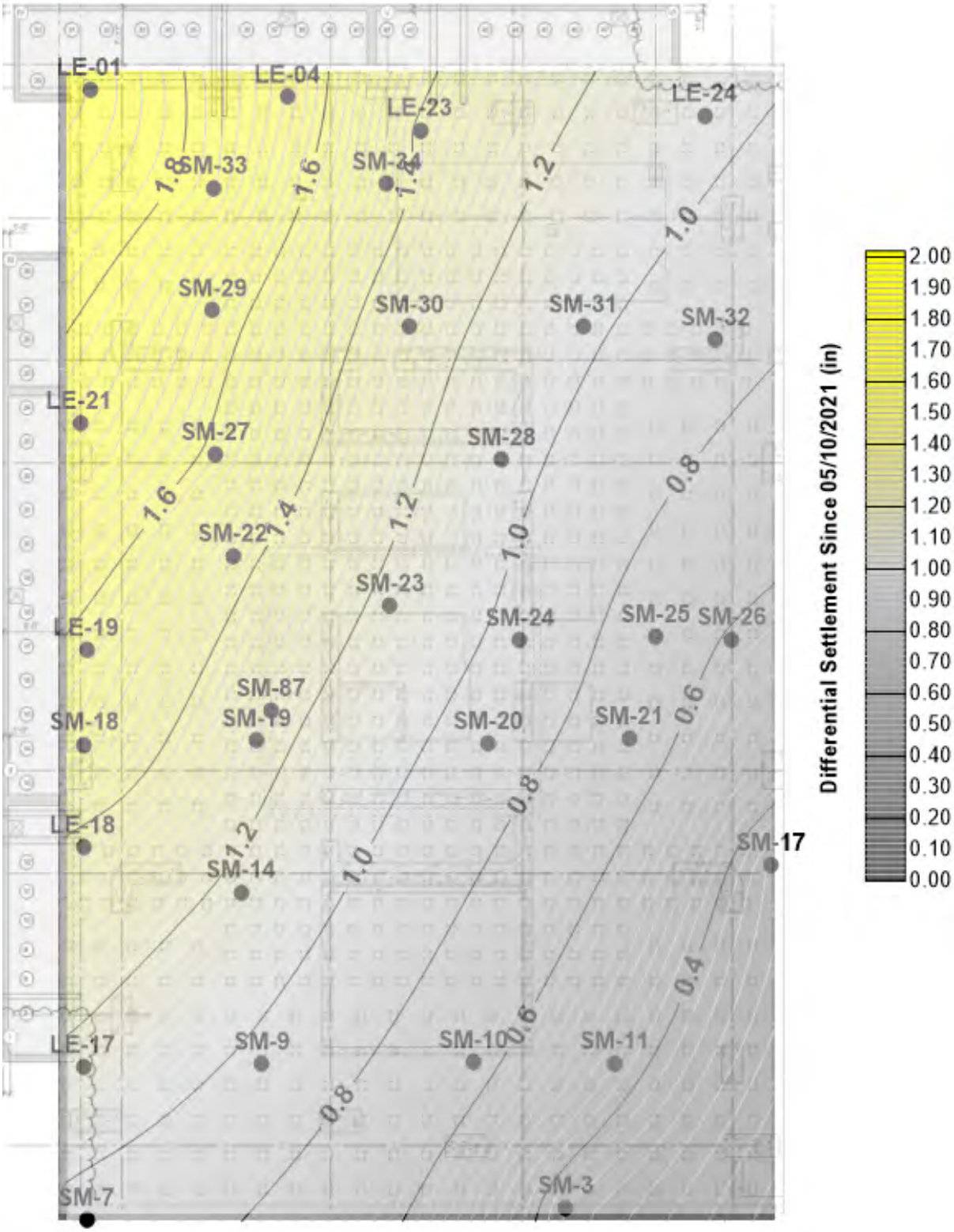


Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-03B**

SLATE GEOTECHNICAL CONSULTANTS

SETTLEMENT MARKER DATA
SINCE 01/11/2021 THROUGH 05/02/2022

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



Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-04**

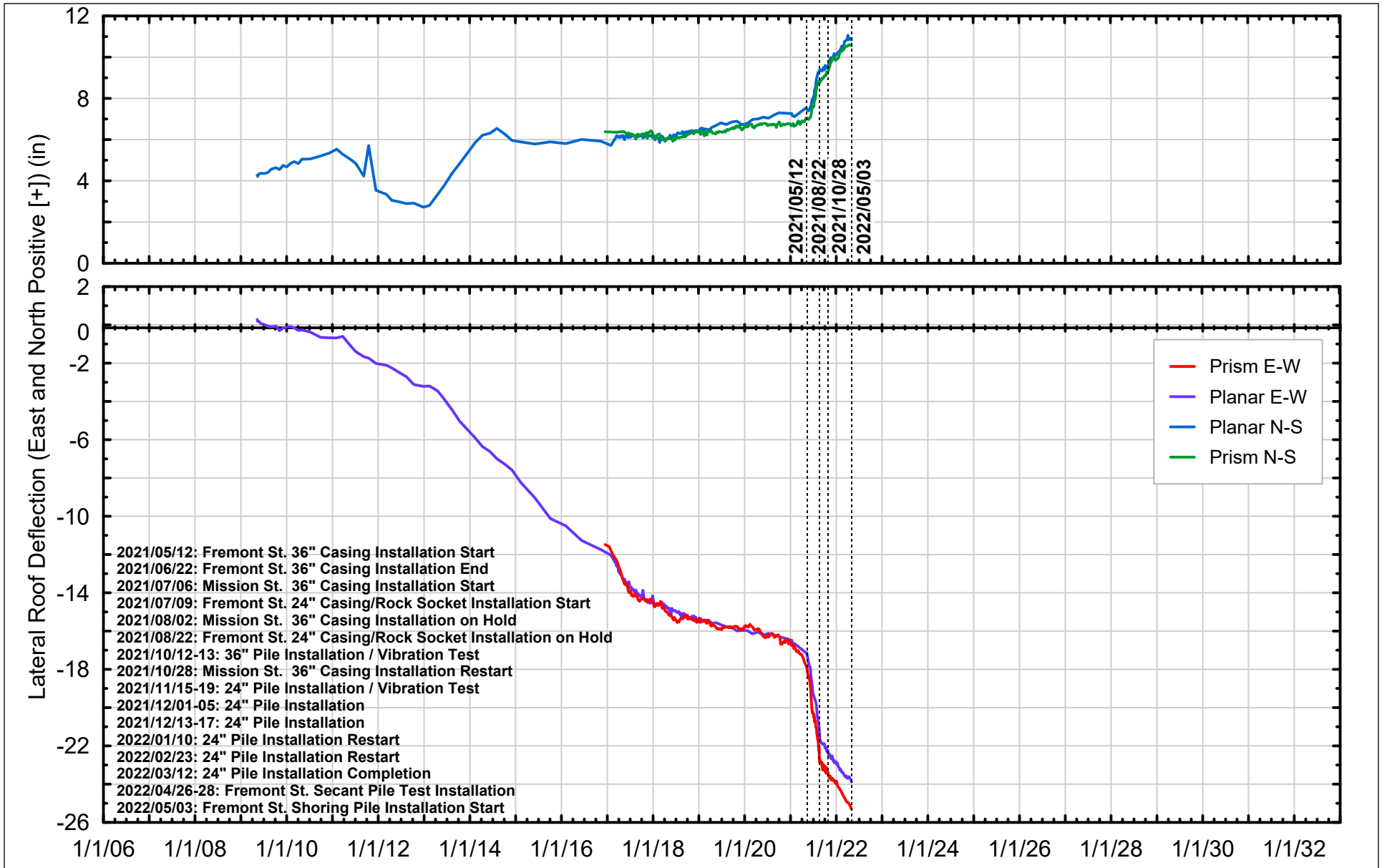
SLATE GEOTECHNICAL CONSULTANTS

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

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-04_SM_Data_Diff_Contours.grf

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-05_LatDef_Data.grf



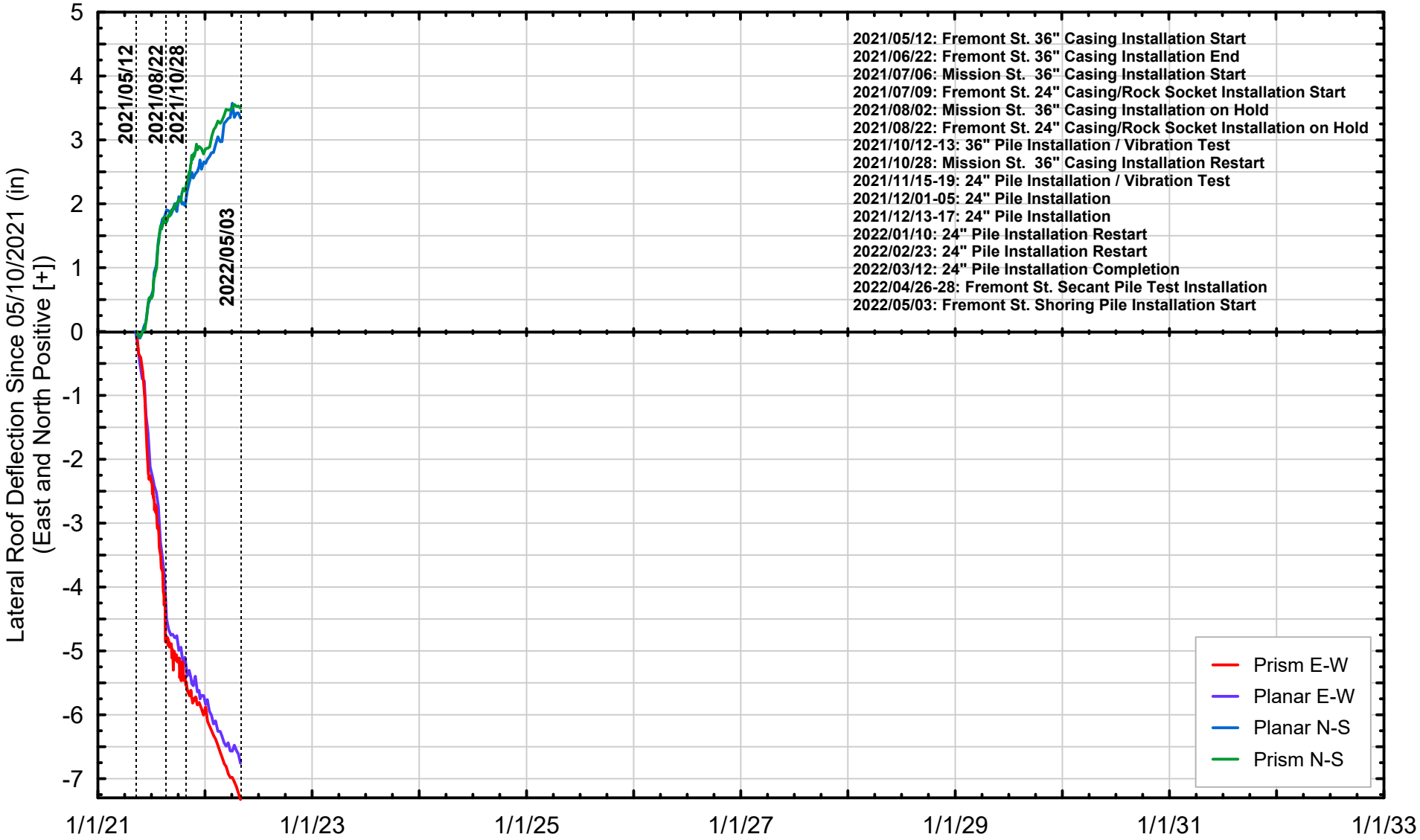
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-05**

SLATE GEOTECHNICAL CONSULTANTS

HISTORICAL LATERAL ROOF DEFLECTION DATA

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-06A_LatDef_Data_Diff.grf



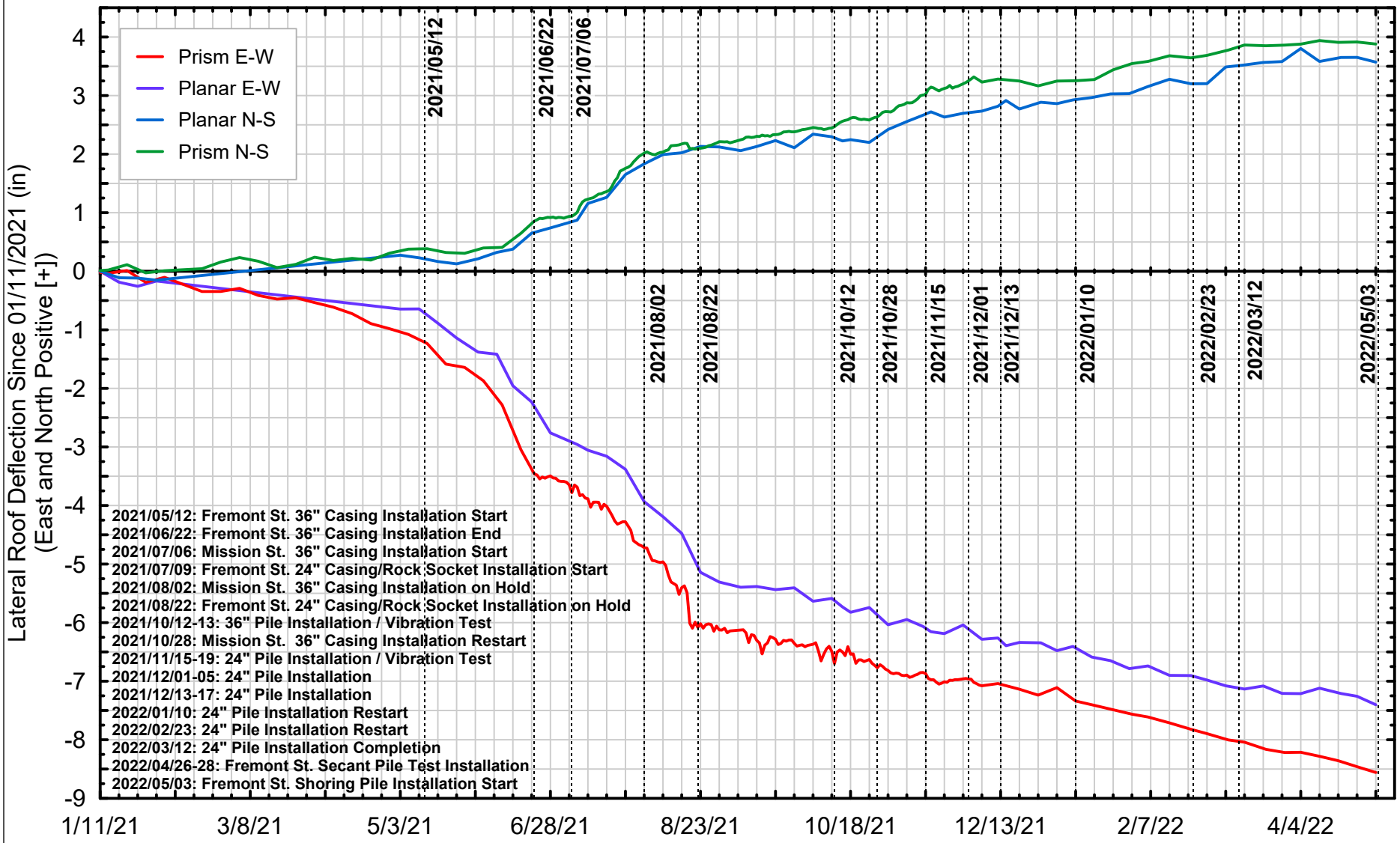
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-06A**

SLATE GEOTECHNICAL CONSULTANTS

LATERAL ROOF DEFLECTION DATA
SINCE 05/10/2021 THROUGH 05/02/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-06B_LatDef_Data_Diff.grf



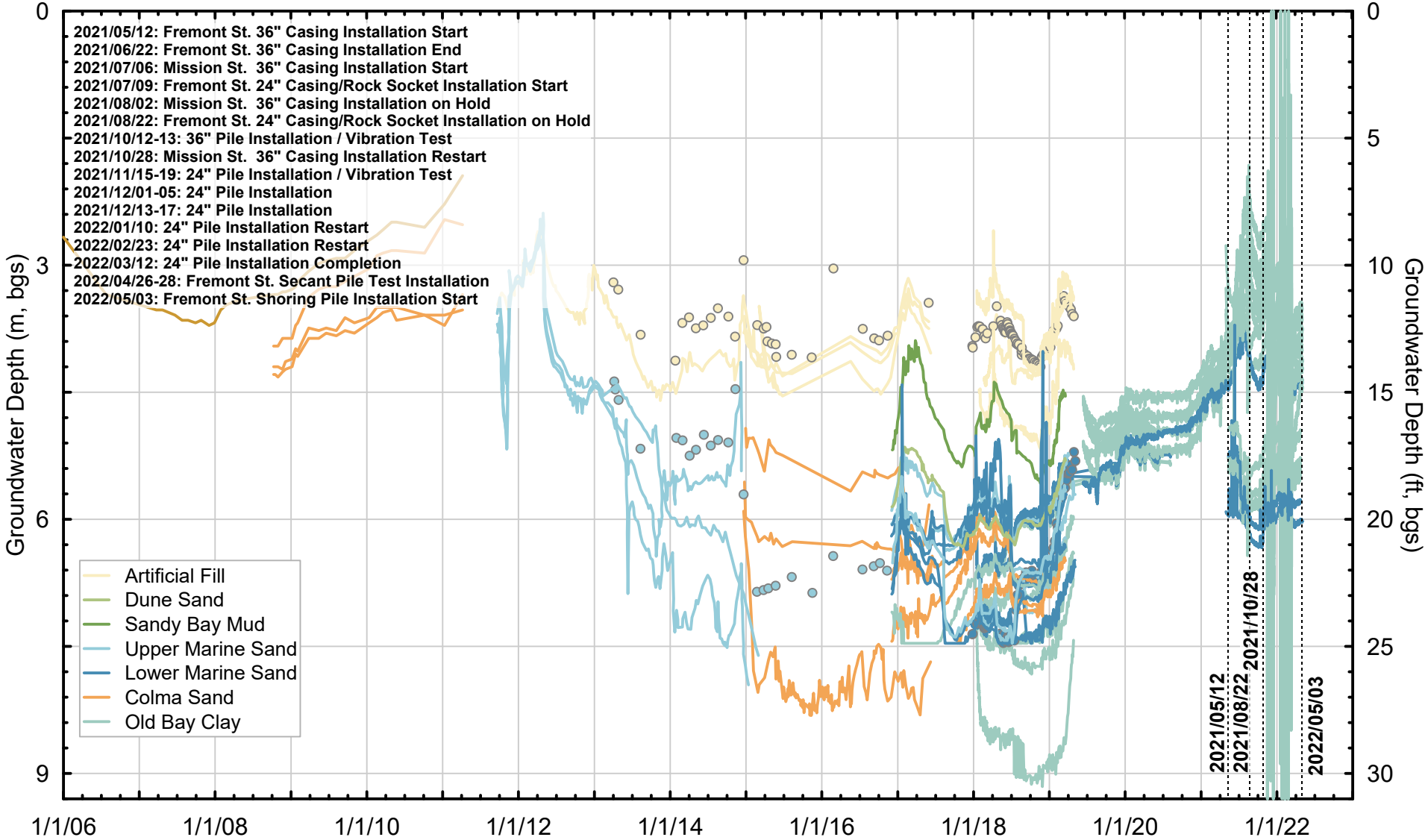
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-06B**

SLATE GEOTECHNICAL CONSULTANTS

LATERAL ROOF DEFLECTION DATA
SINCE 01/11/2021 THROUGH 05/02/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-07_GWT_Data.grf



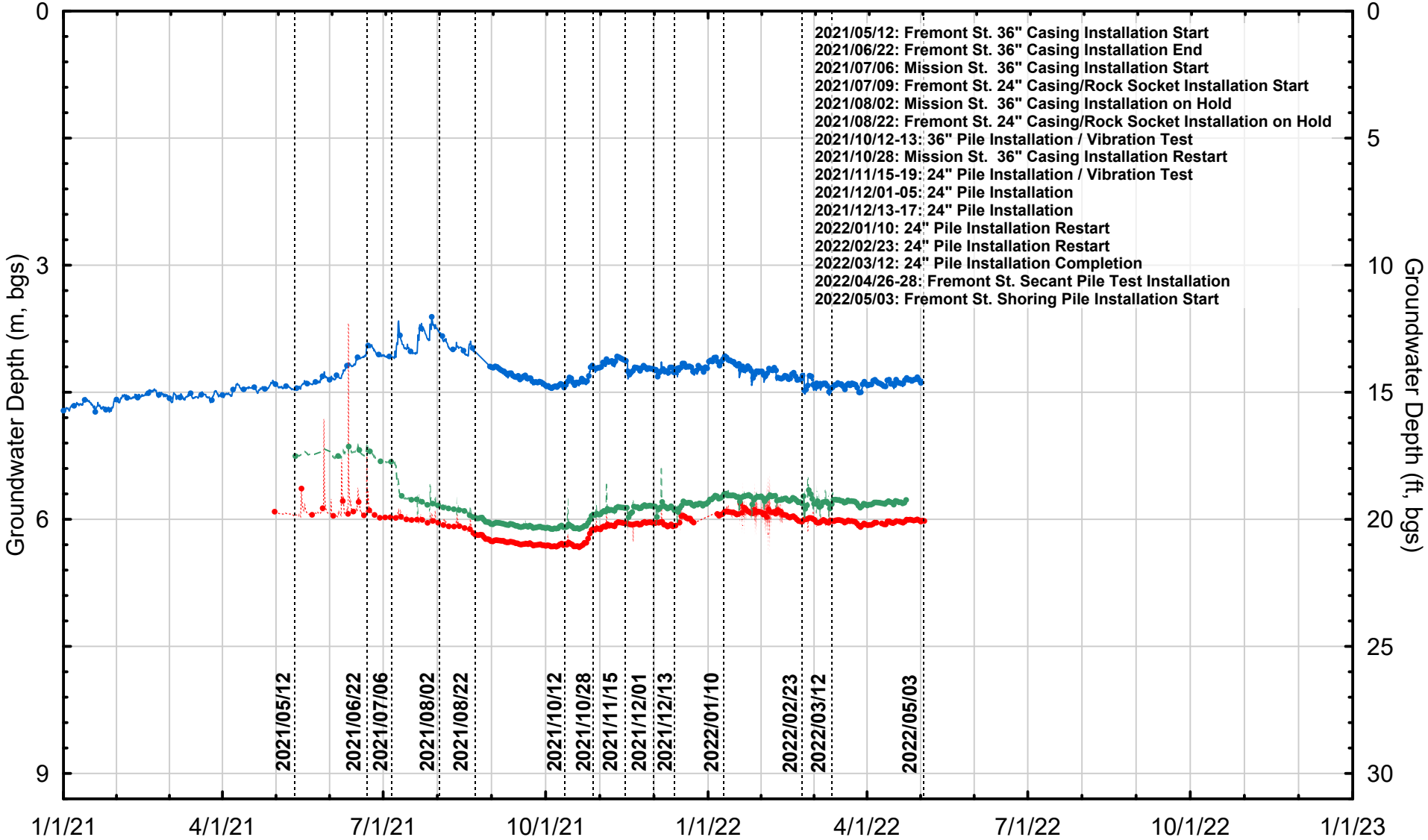
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-07**

SLATE GEOTECHNICAL CONSULTANTS

HISTORICAL GROUNDWATER ELEVATION MEASUREMENTS
AT LOCATIONS NEAR 301 MISSION

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-08A_GWT_Data_Sand.grf



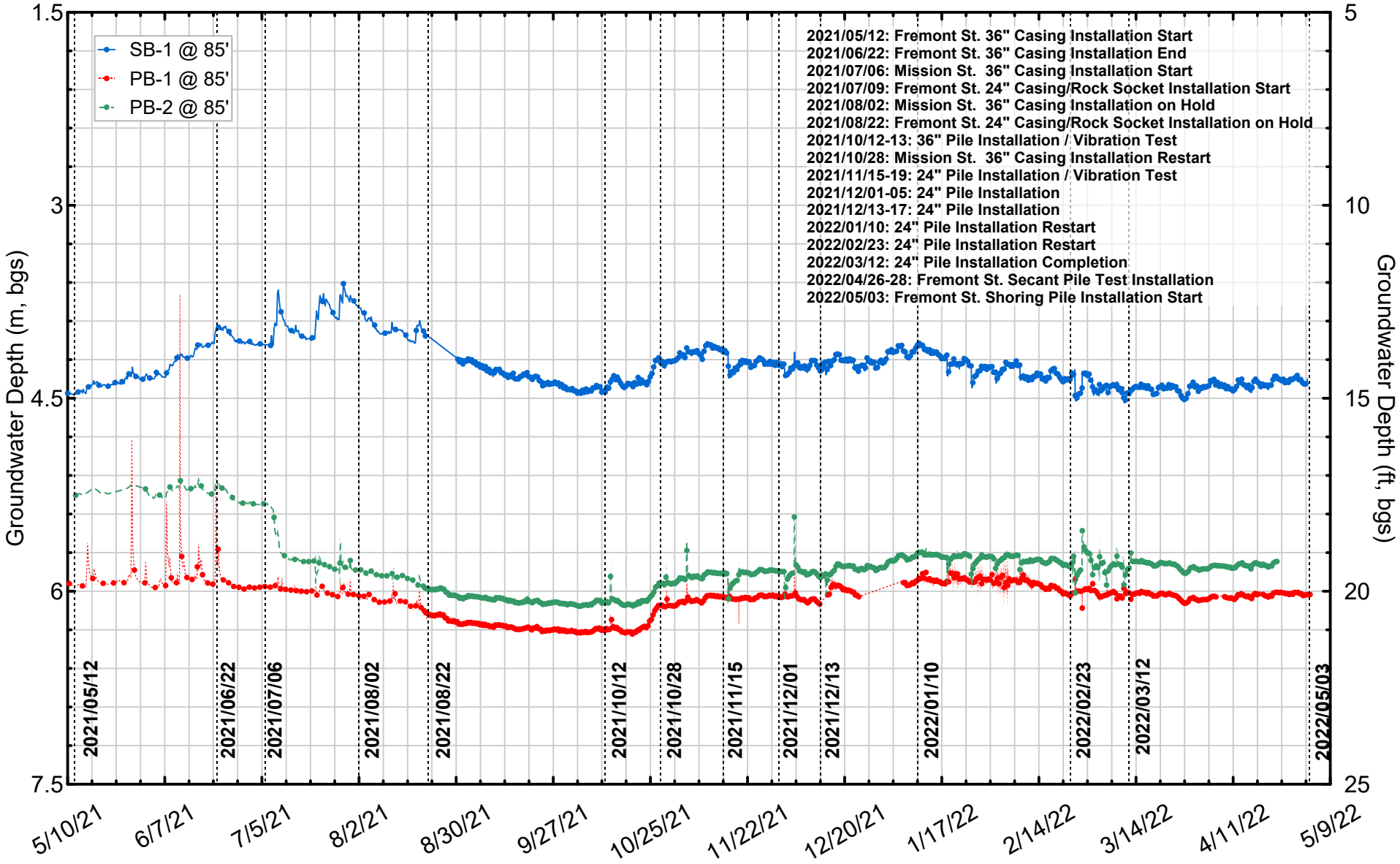
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-08A**

SLATE GEOTECHNICAL CONSULTANTS

GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND
SINCE 01/01/2021 THROUGH 05/03/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-08B_GWT_Data_Sand.grf



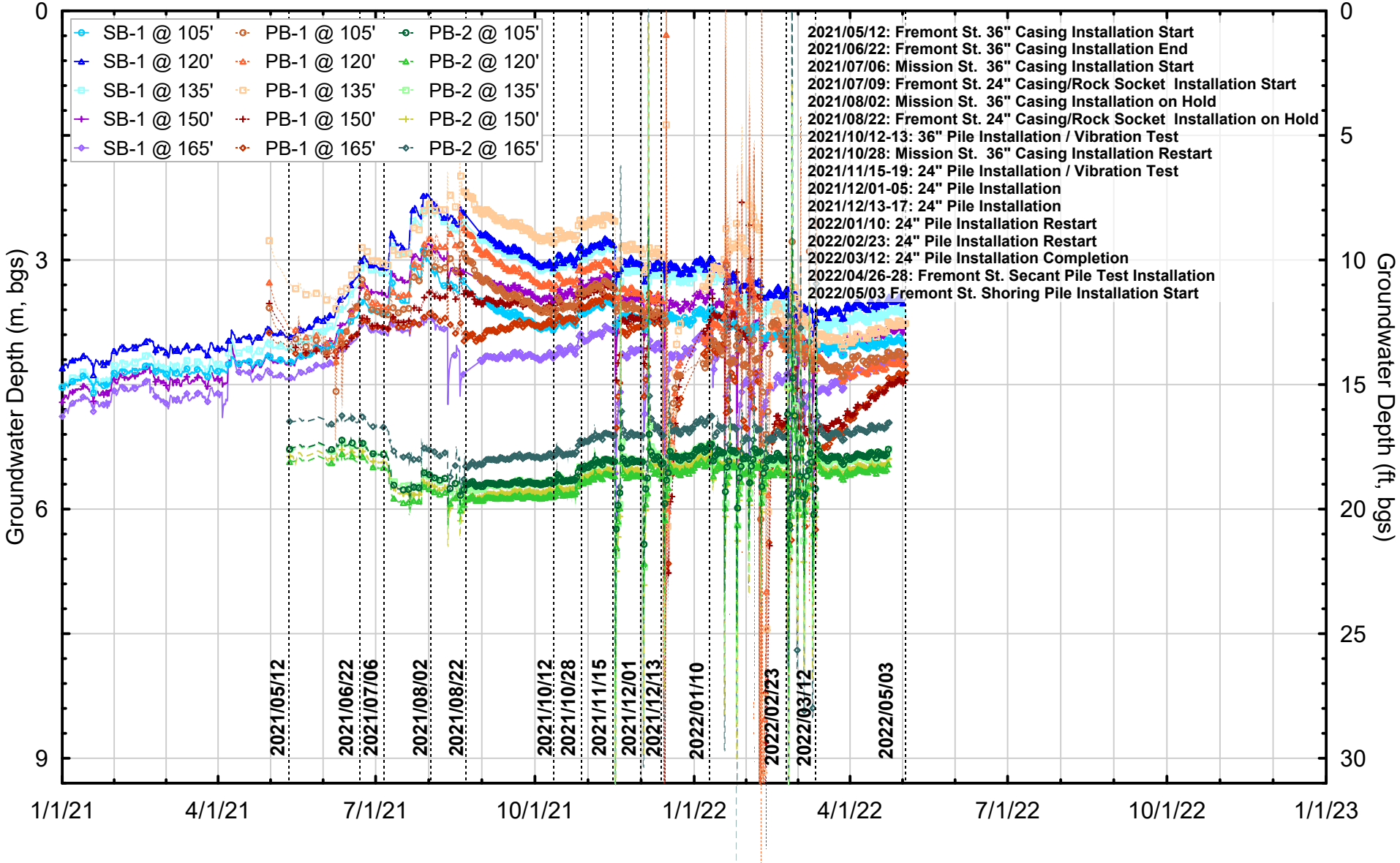
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-08B**

SLATE GEOTECHNICAL CONSULTANTS

GROUNDWATER ELEVATION MEASUREMENTS IN MARINE AND COLMA SAND
SINCE 05/10/2021 THROUGH 05/03/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-09A_GWT_Data_OBC.grf



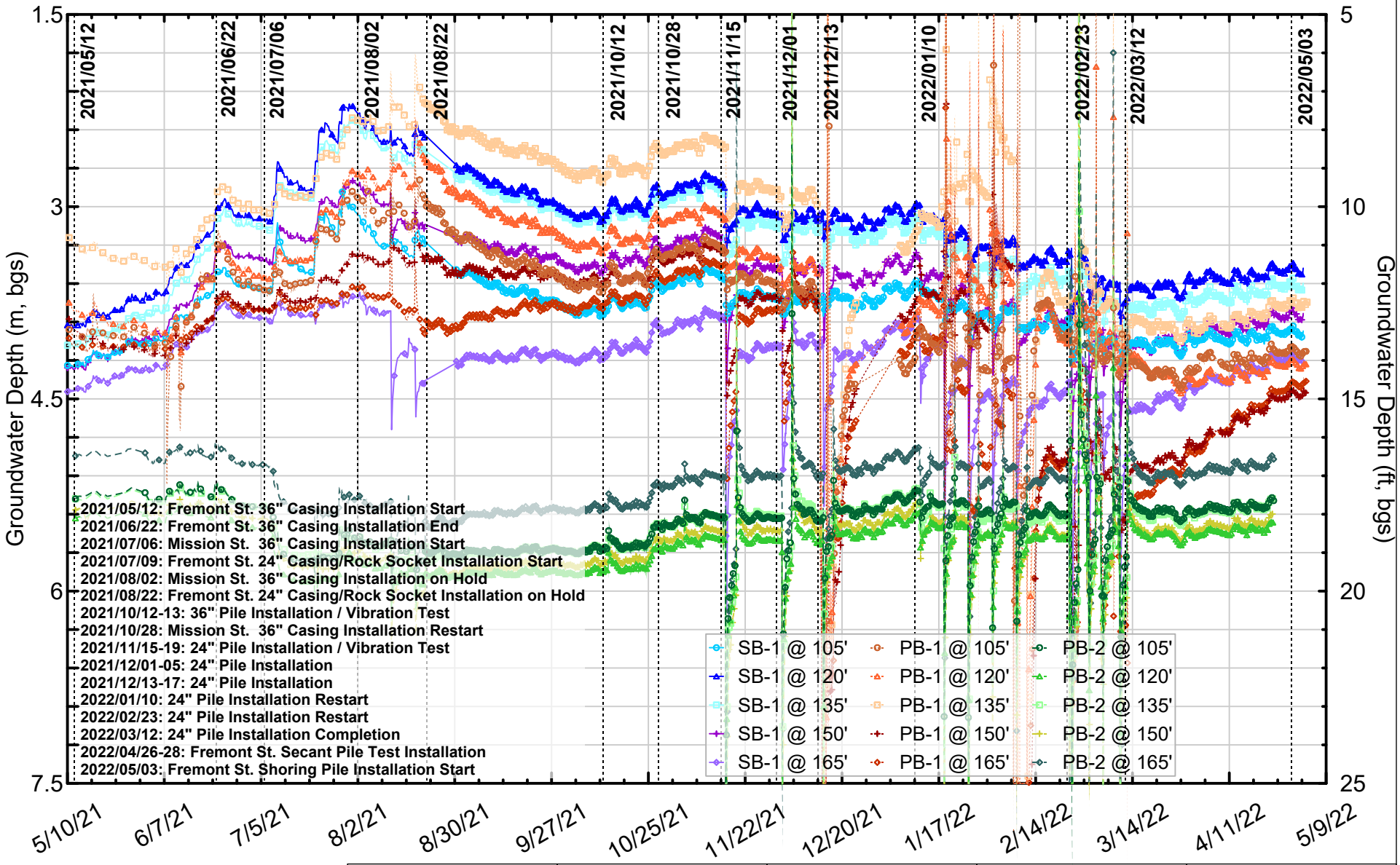
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-09A**

SLATE GEOTECHNICAL CONSULTANTS

GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY
SINCE 01/01/2021 THROUGH 05/03/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-09B_GWT_Data_OBC.grf



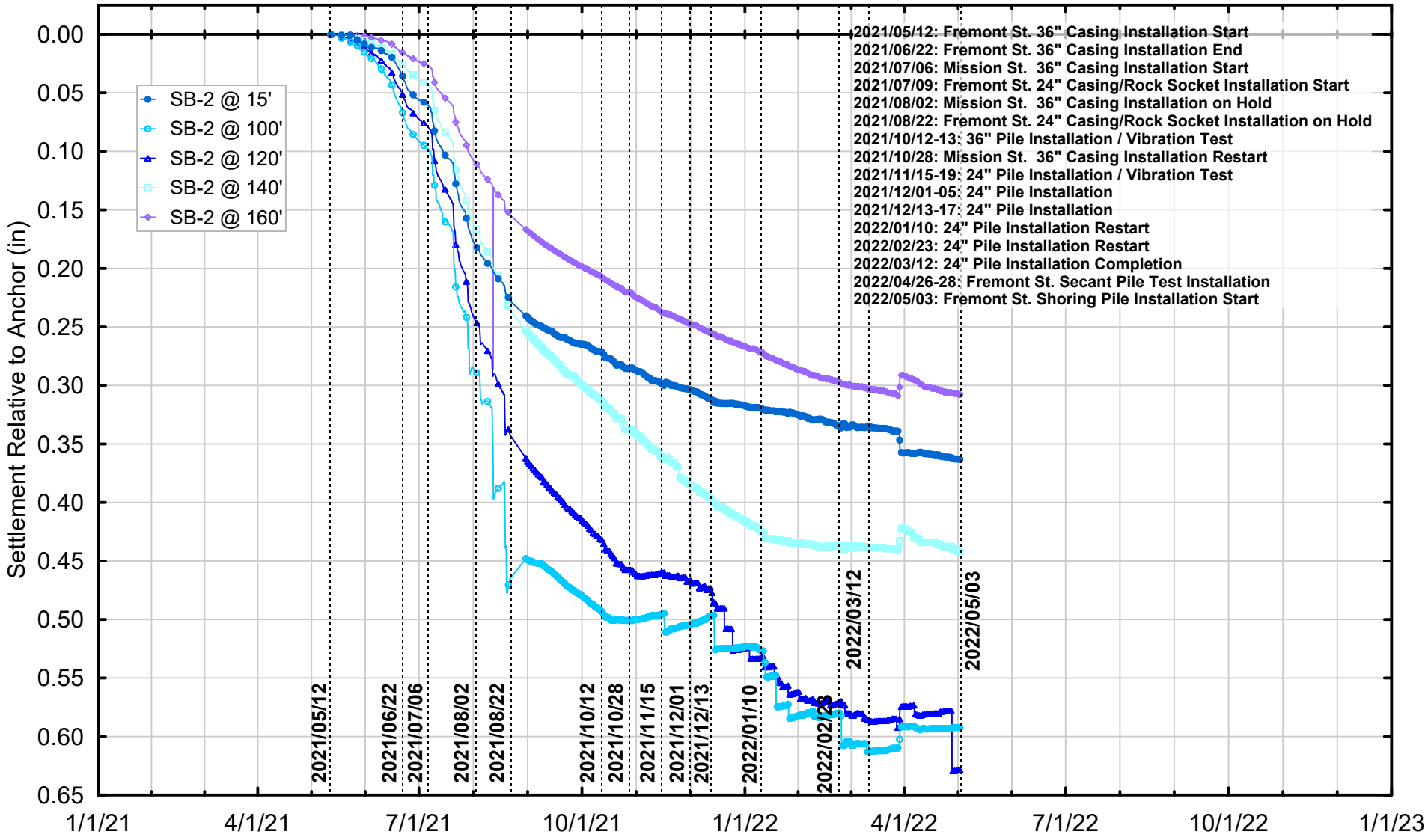
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-09B**

SLATE GEOTECHNICAL CONSULTANTS

GROUNDWATER ELEVATION MEASUREMENTS IN OLD BAY CLAY
SINCE 05/10/2021 THROUGH 05/03/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-10A_Ext_Data_Basement.grf



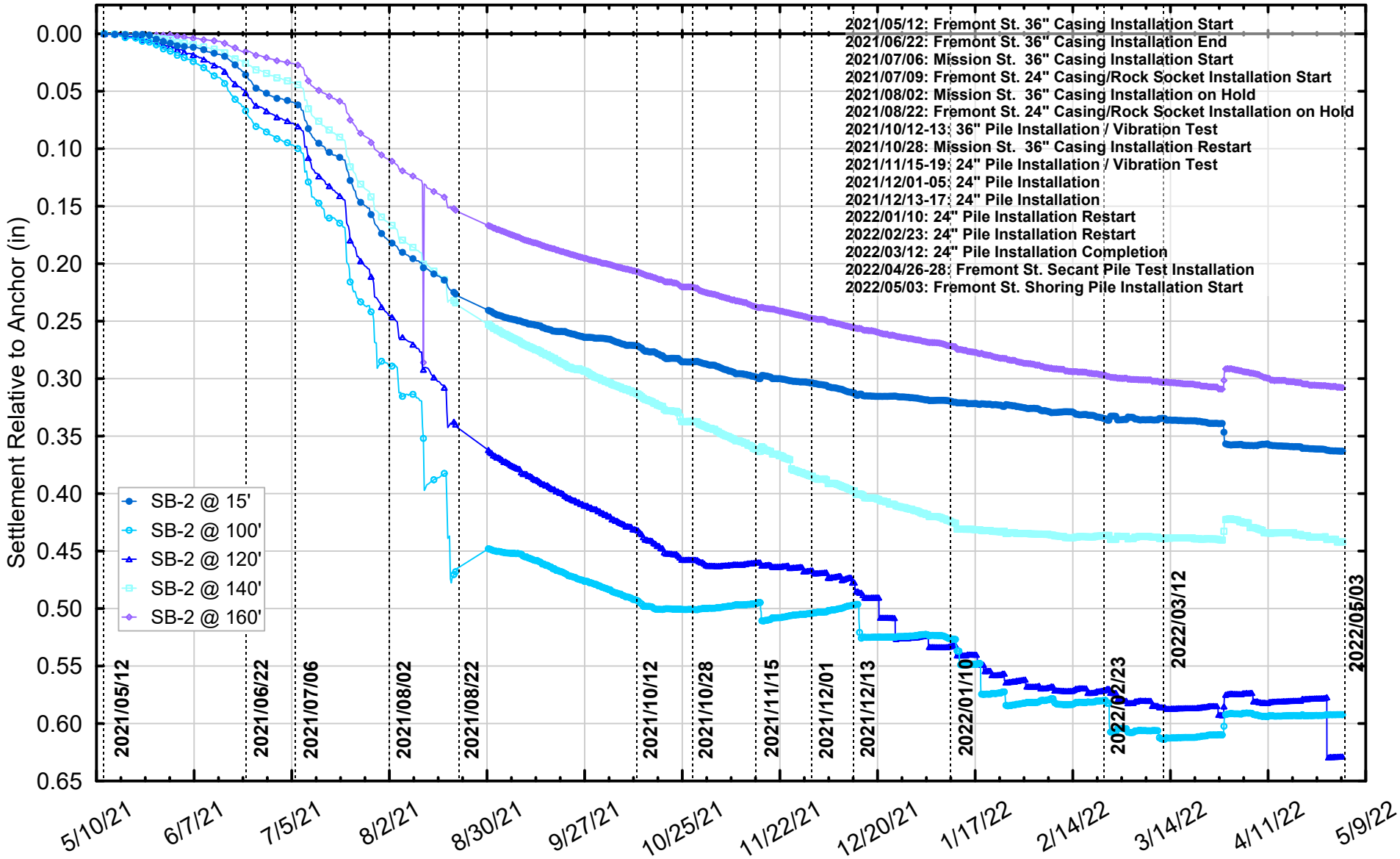
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-10A**

SLATE GEOTECHNICAL CONSULTANTS

EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT
SINCE 01/01/2021 THROUGH 05/03/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-10B_Ext_Data_Basement.grf



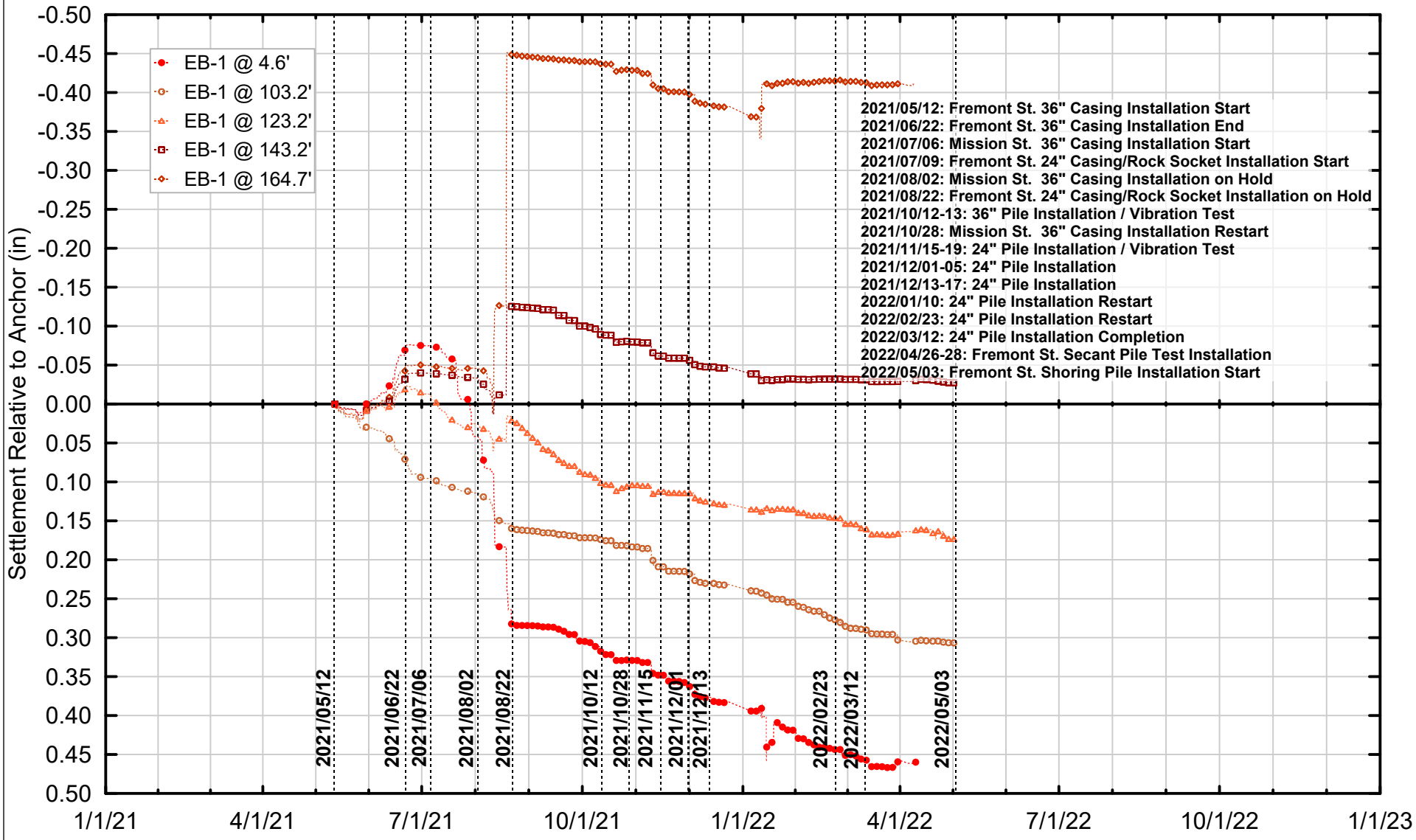
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-10B**

SLATE GEOTECHNICAL CONSULTANTS

EXTENSOMETER DATA FROM WITHIN TOWER BASEMENT
SINCE 05/10/2021 THROUGH 05/03/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-11A_Ext_Data_Fremont.grf



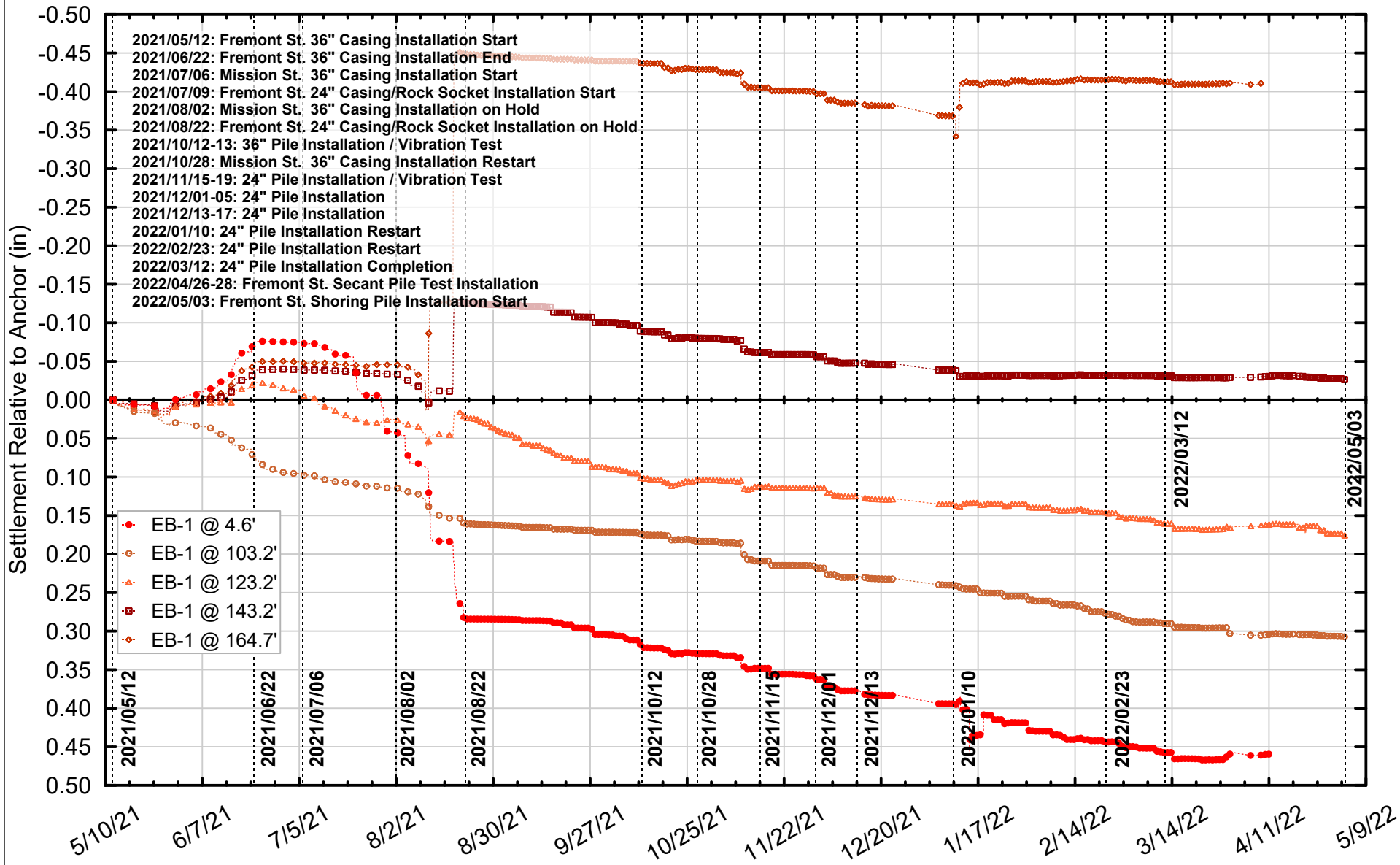
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-11A**

SLATE GEOTECHNICAL CONSULTANTS

EXTENSOMETER DATA FROM FREMONT STREET
SINCE 01/01/2021 THROUGH 05/03/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-11B_Ext_Data_Fremont.grf



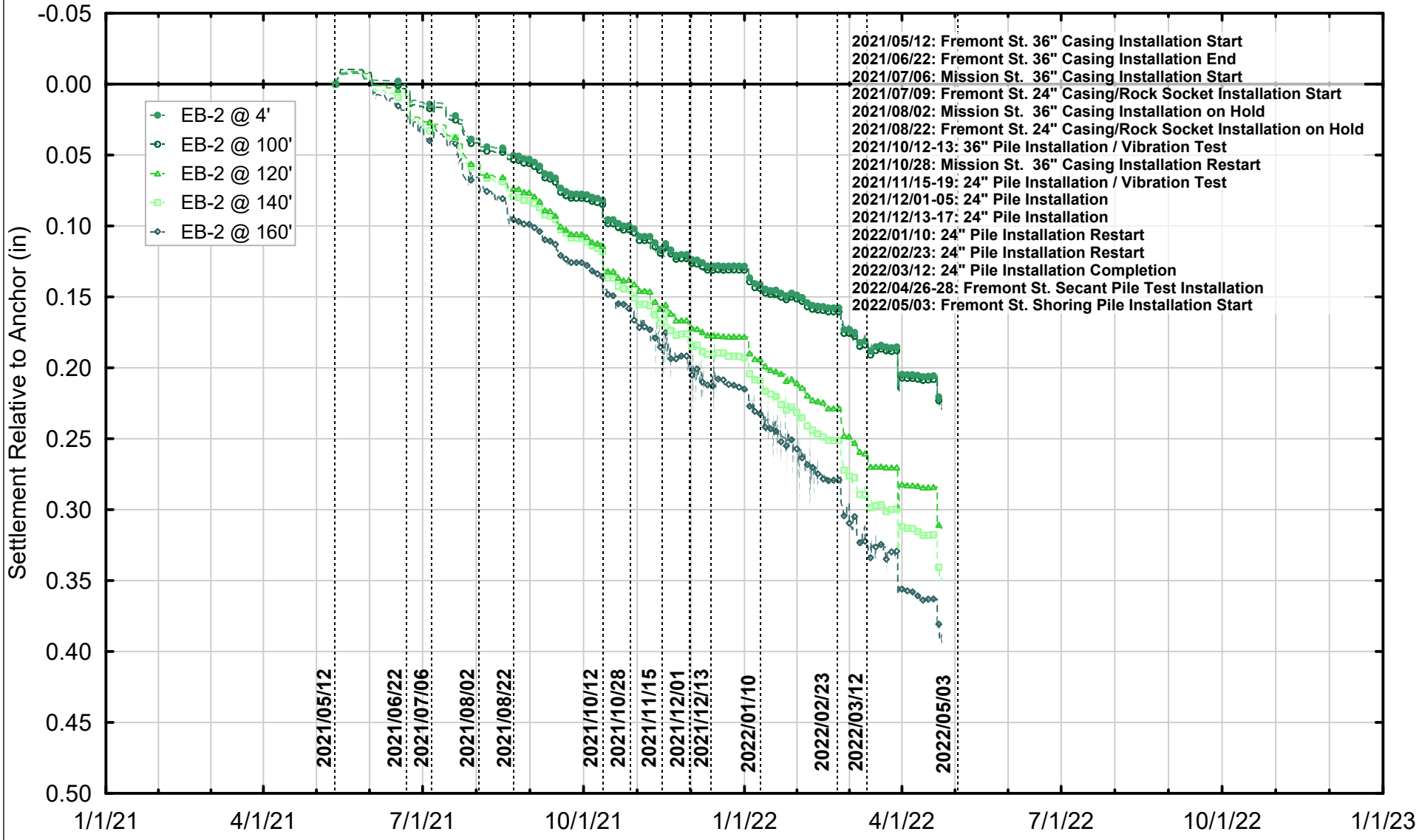
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-11B**

SLATE GEOTECHNICAL CONSULTANTS

EXTENSOMETER DATA FROM FREMONT STREET
SINCE 05/10/2021 THROUGH 04/23/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-12A_Ext_Data_Mission.grf



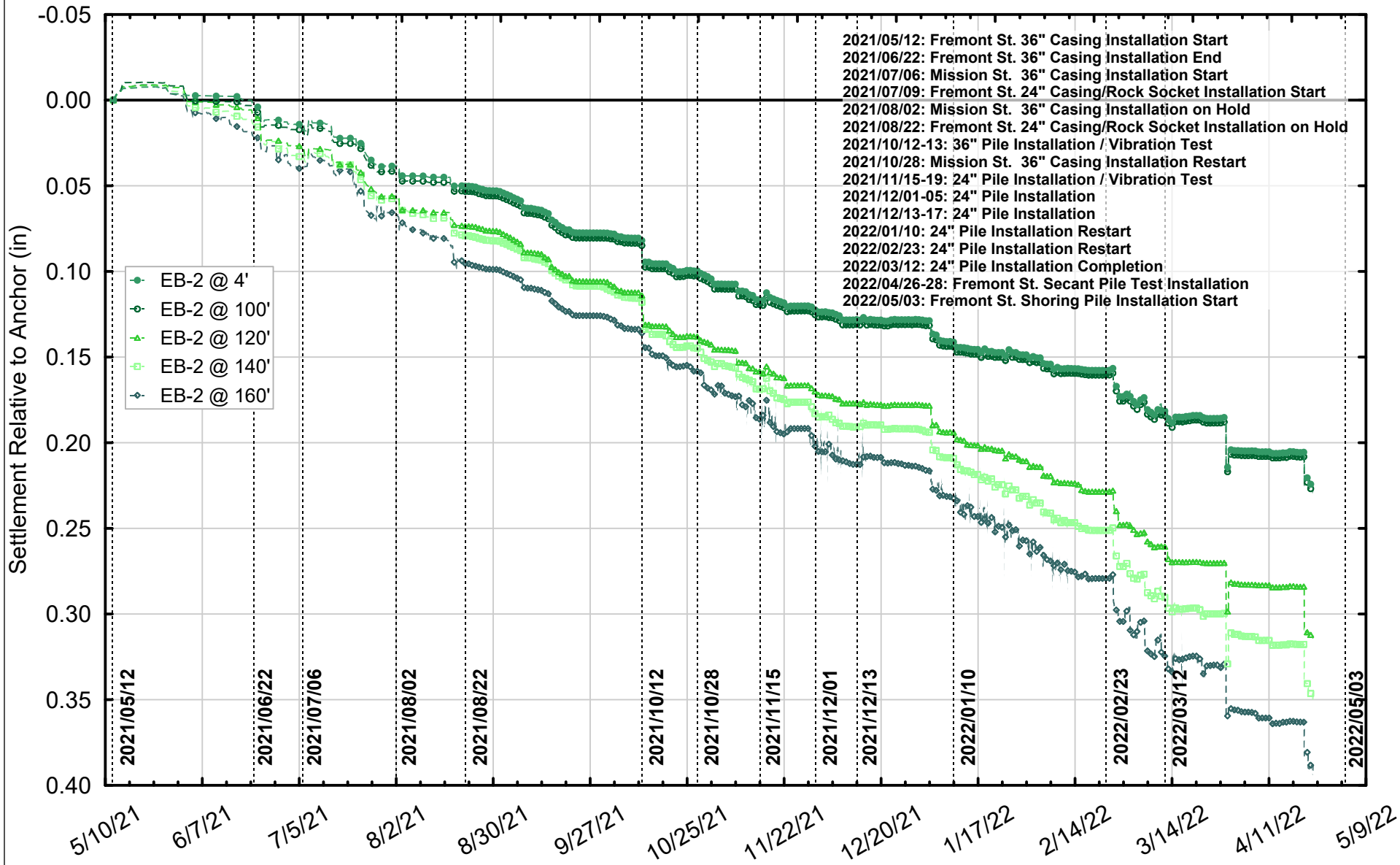
Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-12A**

SLATE GEOTECHNICAL CONSULTANTS

EXTENSOMETER DATA FROM MISSION STREET
SINCE 01/01/2021 THROUGH 05/03/2022

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

Filepath: S:\SlateDrive - Documents_Projects_2019\19-009.00_Millennium Tower Retrofit\10_Construction\01_Monitoring Reports\TowerSoilWater\00_Figures\Fig_052-12B_Ext_Data_Mission.grf



Project No: 19-009.00	Date: 5/4/2022	Created By: NBW	Checked By: DGM	Figure No: **052-12B**

SLATE GEOTECHNICAL CONSULTANTS

EXTENSOMETER DATA FROM MISSION STREET
SINCE 05/10/2021 THROUGH 04/23/2022

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