FUGRO

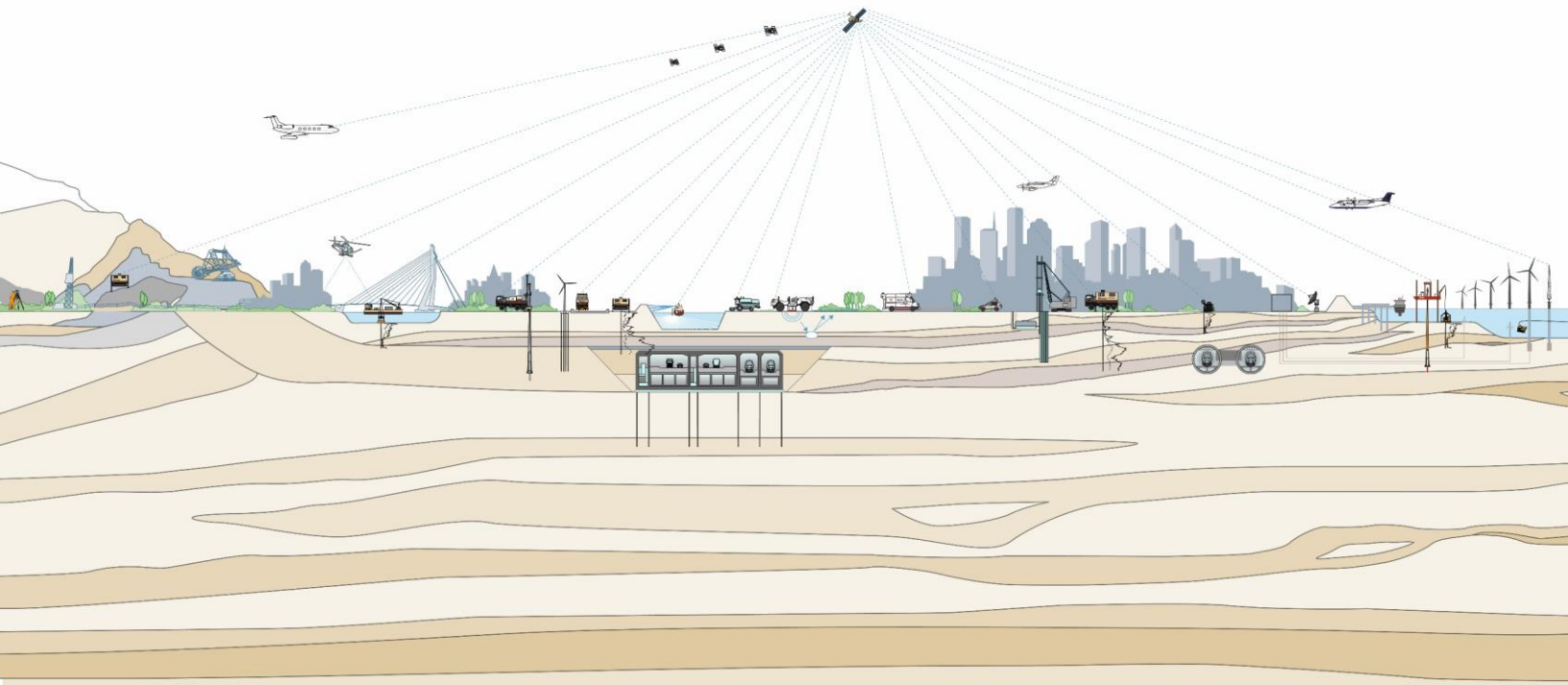
ANNUAL REPORT
JULY 2018 THROUGH JUNE 2019
BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT

City of Malibu, California

November 2019
Fugro Project No. 04.62160606
Document No. 04.62160606-PR-006(Rev.00)

Big Rock Mesa Landslide Assessment District

Final



FUGRO

ANNUAL REPORT
JULY 2018 THROUGH JUNE 2019
BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT

City of Malibu, California

November 2019
Fugro Project No. 04.62160606
Document No. 04.62160606-PR-006(Rev.00)

Prepared for:

City of Malibu
Big Rock Mesa Landslide Assessment District
23825 Stuart Ranch Road
Malibu, California 90265

00	Final	DMT	MP	MP	November 20, 2019
A	Draft for Review	DMT	MP	MP	October 24, 2019
Rev.	**Status**	**Prepared**	**Reviewed**	**Approved**	**Date**

FUGRO
4820 McGrath Street, Suite 100
Ventura, California 93003
T +1 805 650 7000
F +1 805 650 7010
www.fugro.com

Fugro Project No. 04.62160606
Document No. 04.62160606-PR-006(Rev.00)
November 20, 2019

Big Rock Mesa Landslide Assessment District
23825 Stuart Ranch Road
Malibu, California 90265

Attention: Mr. Rob DuBoux, Esq., P.E.

Annual Report of Maintenance and Monitoring, July 2018 through June 2019,
Big Rock Mesa Landslide Assessment District, City of Malibu, California

Dear Mr. DuBoux,

Fugro is pleased to present the annual report of maintenance and monitoring for the Big Rock Mesa Landslide Assessment District. This report summarizes the monitoring and maintenance activities completed during the period of July 2018 through June 2019.

Fugro appreciates this opportunity to serve the City of Malibu and the District homeowners. Please contact David Thornhill or Matt Pollard at (805) 650-7000 if you have any questions regarding this report.

Sincerely,
Fugro USA Land, Inc.

David M. Thornhill, P.E.
Project Engineer/Lead Technician

LICENSED PROFESSIONAL ENGINEER
DAVID M. THORNHILL
C 87169
exp 9/30/21
CIVIL
STATE OF CALIFORNIA

Matthew Q. Pollard, P.E.
Principal Engineer/Project Manager

REGISTERED PROFESSIONAL ENGINEER
MATTHEW Q. POLLARD
No. 2987
Exp. 06-30-20
GEOTECHNICAL
STATE OF CALIFORNIA

Distribution: One electronic copy to Mr. Rob DuBoux, Esq., P.E.
One electronic copy to City of Malibu Geotechnical Staff

CONTENTS

1. INTRODUCTION 1
1.1 Authorization 1
1.2 Background 1
1.3 Scope of Work 1
1.4 Report Organization 2
1.5 Report Availability 2

2. MONITORING 3
2.1 Rainfall Data 3
2.2 Master Water Meter 3
2.3 Groundwater Level Monitoring 3
2.3.1 Pacific Coast Highway (PCH) Region 5
2.3.2 Bluff Region 6
2.3.3 Eastern Mesa Region 6
2.3.4 Central Mesa Region 7
2.3.5 Western Extension Region 7
2.3.6 Headscarp Region 8
2.4 Dewatering Well Production 8
2.5 Hydrauger Production 8
2.6 Slope Inclinometers 8
2.6.1 Pacific Coast Highway Region 9
2.6.2 Bluff Region 9
2.6.3 Eastern Mesa Region 10
2.6.4 Central Mesa Region 10
2.6.5 Western Extension Region 10
2.6.6 Headscarp Region 10
2.7 Water Quality Monitoring 10
2.7.1 Regional Board Requirements 10
2.7.2 Water-Quality Results 11

3. DEWATERING FACILITY MAINTENANCE 13
3.1 Capital Improvements 13
3.2 Facility Maintenance 13

4. SUMMARY AND CONCLUSIONS 14
4.1 Annual Summary 14
4.2 Concluding Comments 15

5. REFERENCES 16

TABLES IN THE MAIN TEXT

Page
Table 1. Summary of Average Groundwater Elevations by Area 5
Table 2. Summary of Completed Facility Maintenance 13

PLATES

Site Location Map 1
Dewatering Facilities Map 2
Rainfall Graph 3
Summary of Groundwater Levels, Dewatering, & Rainfall 4
Total Dewatering Production and Total Water Consumption 5
Groundwater Elevation Map May 1995 and May 2019 ..... 6a
Change in Groundwater Elevation Map May 1995 to May 2019 ..... 6b
Change in Groundwater Elevation Map May 2016 to May 2019 ..... 6c

APPENDICES

APPENDIX A GROUNDWATER LEVEL DATA
Piezometer Information – Standpipe Piezometers ..... Plate A-1a
Piezometer Information – Pneumatic Piezometers ..... Plate A-1b
Groundwater Elevation Data Analysis ..... Plate A-2a
Groundwater Elevation Data Analysis ..... Plate A-2b
Groundwater Elevation Data - PCH Region (Western Half) ..... Plate A-3a
Groundwater Elevation Data - PCH Region (Eastern Half) ..... Plate A-3b
Groundwater Elevation Data - Bluff Region ..... Plate A-4
Groundwater Elevation Data - Eastern Mesa Region ..... Plate A-5
Groundwater Elevation Data - Central Mesa Region ..... Plate A-6a
Groundwater Elevation Data - Central Mesa Region ..... Plate A-6b
Groundwater Elevation Data - Western Extension ..... Plate A-7
Groundwater Elevation Data - Headscarp Area ..... Plate A-8

APPENDIX B DEWATERING WELL DATA
Dewatering Well Information ..... Plate B-1
Discharge Rate for Dewatering Wells - Eastern Mesa Region ..... Plate B-2a
Discharge Rate for Dewatering Wells - Eastern Mesa Region ..... Plate B-2b
Discharge Rate for Dewatering Wells - Central Mesa Region ..... Plate B-3a
Discharge Rate for Dewatering Wells - Central Mesa Region ..... Plate B-3b
Discharge Rate for Dewatering Wells - Central Mesa Region ..... Plate B-3c

Discharge Rate for Dewatering Wells - Western Extension ..... Plate B-4

APPENDIX C **HYDRAUGER DATA**

Summary of Hydrauger Information ..... Plate C-1
Discharge Rate for Hydraugers - Eastern Mesa Region ..... Plate C-2a
Discharge Rate for Hydraugers - Eastern Mesa Region ..... Plate C-2b
Discharge Rate for Hydraugers - Central Mesa Region ..... Plate C-3a
Discharge Rate for Hydraugers - Central Mesa Region ..... Plate C-3b
Discharge Rate for Hydraugers - Western Extension ..... Plate C-4

APPENDIX D **SLOPE INCLINOMETER PLOT / DATA**

Slope Inclinometer Information ..... Plate D1
Cumulative and Incremental Deflection A Direction Plot SP-11 ..... Plate D2-1
Cumulative and Incremental Deflection B Direction Plot SP-11 ..... Plate D2-2
Displacement vs. Time A Direction Plot SP-11 ..... Plate D2-3
Displacement vs. Time B Direction Plot SP-11 ..... Plate D2-4
Cumulative and Incremental Deflection A Direction Plot SP-12 ..... Plate D3-1
Cumulative and Incremental Deflection B Direction Plot SP-12 ..... Plate D3-2
Displacement vs. Time A Direction Plot SP-12… ..... Plate D3-3
Displacement vs. Time B Direction Plot SP-12 ..... Plate D3-4
Cumulative and Incremental Deflection A Direction Plot SP-14 ..... Plate D4-1
Cumulative and Incremental Deflection B Direction Plot SP-14 ..... Plate D4-2
Displacement vs. Time A Direction Plot SP-14 ..... Plate D4-3
Displacement vs. Time B Direction Plot SP-14 ..... Plate D4-4
Cumulative and Incremental Deflection A Direction Plot SP-15 ..... Plate D5-1
Cumulative and Incremental Deflection B Direction Plot SP-15 ..... Plate D5-2
Displacement vs. Time A Direction Plot SP-15 ..... Plate D5-3
Displacement vs. Time B Direction Plot SP-15 ..... Plate D5-4
Cumulative and Incremental Deflection A Direction Plot SP-19 ..... Plate D6-1
Cumulative and Incremental Deflection B Direction Plot SP-19 ..... Plate D6-2
Displacement vs. Time A Direction Plot SP-19 ..... Plate D6-3
Displacement vs. Time B Direction Plot SP-19 ..... Plate D6-4
Cumulative and Incremental Deflection A Direction Plot SP-27A ..... Plate D7-1
Cumulative and Incremental Deflection B Direction Plot SP-27A ..... Plate D7-2
Displacement vs. Time A Direction Plot SP-27A ..... Plate D7-3
Displacement vs. Time B Direction Plot SP-27A ..... Plate D7-4
Cumulative and Incremental Deflection A Direction Plot SP-29 ..... Plate D8-1
Cumulative and Incremental Deflection B Direction Plot SP-29 ..... Plate D8-2
Displacement vs. Time A Direction Plot SP-29 ..... Plate D8-3
Displacement vs. Time B Direction Plot SP-29 ..... Plate D8-4
Cumulative and Incremental Deflection A Direction Plot SP-30 ..... Plate D9-1
Cumulative and Incremental Deflection B Direction Plot SP-30 ..... Plate D9-2
Displacement vs. Time A Direction Plot SP-30 ..... Plate D9-3

Displacement vs. Time B Direction Plot SP-30.....Plate D9-4
Cumulative and Incremental Deflection A Direction Plot SP-10.....Plate D10-1
Cumulative and Incremental Deflection B Direction Plot SP-10.....Plate D10-2
Displacement vs. Time A Direction Plot SP-10.....Plate D10-3
Displacement vs. Time B Direction Plot SP-10.....Plate D10-4
Cumulative and Incremental Deflection A Direction Plot SP-28.....Plate D11-1
Cumulative and Incremental Deflection B Direction Plot SP-28.....Plate D11-2
Displacement vs. Time A Direction Plot SP-28.....Plate D11-3
Displacement vs. Time B Direction Plot SP-28.....Plate D11-4
Cumulative and Incremental Deflection A Direction Plot SP-32.....Plate D12-1
Cumulative and Incremental Deflection B Direction Plot SP-32.....Plate D12-2
Displacement vs. Time A Direction Plot SP-32.....Plate D12-3
Displacement vs. Time B Direction Plot SP-32.....Plate D12-4
Cumulative and Incremental Deflection A Direction Plot PC-1.....Plate D13-1
Cumulative and Incremental Deflection B Direction Plot PC-1.....Plate D13-2
Displacement vs. Time A Direction Plot PC-1.....Plate D13-3
Displacement vs. Time B Direction Plot PC-1.....Plate D13-4
Cumulative and Incremental Deflection A Direction Plot SP-3.....Plate D14-1
Cumulative and Incremental Deflection B Direction Plot SP-3.....Plate D14-2
Displacement vs. Time A Direction Plot SP-3.....Plate D14-3
Displacement vs. Time B Direction Plot SP-3.....Plate D14-4
Cumulative and Incremental Deflection A Direction Plot SP-3A.....Plate D15-1
Cumulative and Incremental Deflection B Direction Plot SP-3A.....Plate D15-2
Displacement vs. Time A Direction Plot SP-3A.....Plate D15-3
Displacement vs. Time B Direction Plot SP-3A.....Plate D15-4
Cumulative and Incremental Deflection A Direction Plot SP-33.....Plate D16-1
Cumulative and Incremental Deflection B Direction Plot SP-33.....Plate D16-2
Displacement vs. Time A Direction Plot SP-33.....Plate D16-3
Displacement vs. Time B Direction Plot SP-33.....Plate D16-4
Cumulative and Incremental Deflection A Direction Plot SP-9A.....Plate D17-1
Cumulative and Incremental Deflection B Direction Plot SP-9A.....Plate D17-2
Displacement vs. Time A Direction Plot SP-9A.....Plate D17-3
Displacement vs. Time B Direction Plot SP-9A.....Plate D17-4
Cumulative and Incremental Deflection A Direction Plot SP-16A.....Plate D18-1
Cumulative and Incremental Deflection B Direction Plot SP-16A.....Plate D18-2
Displacement vs. Time A Direction Plot SP-16A.....Plate D18-3
Displacement vs. Time B Direction Plot SP-16A.....Plate D18-4
Cumulative and Incremental Deflection A Direction Plot SP-17B.....Plate D19-1
Cumulative and Incremental Deflection B Direction Plot SP-17B.....Plate D19-2
Displacement vs. Time A Direction Plot SP-17B.....Plate D19-3
Displacement vs. Time B Direction Plot SP-17B.....Plate D19-4
Cumulative and Incremental Deflection A Direction Plot SP-24.....Plate D20-1

Cumulative and Incremental Deflection B Direction Plot SP-24 .....Plate D20-2
Displacement vs. Time A Direction Plot SP-24.....Plate D20-3
Displacement vs. Time B Direction Plot SP-24.....Plate D20-4
Cumulative and Incremental Deflection A Direction Plot SP-34 .....Plate D21-1
Cumulative and Incremental Deflection B Direction Plot SP-34 .....Plate D21-2
Displacement vs. Time A Direction Plot SP-34.....Plate D21-3
Displacement vs. Time B Direction Plot SP-34.....Plate D21-4
Cumulative and Incremental Deflection A Direction Plot SP-35 .....Plate D22-1
Cumulative and Incremental Deflection B Direction Plot SP-35 .....Plate D22-2
Displacement vs. Time A Direction Plot SP-35.....Plate D22-3
Displacement vs. Time B Direction Plot SP-35.....Plate D22-4
Cumulative and Incremental Deflection A Direction Plot SP-36 .....Plate D23-1
Cumulative and Incremental Deflection B Direction Plot SP-36 .....Plate D23-2
Displacement vs. Time A Direction Plot SP-36.....Plate D23-3
Displacement vs. Time B Direction Plot SP-36.....Plate D23-4
Cumulative and Incremental Deflection A Direction Plot SP-20 .....Plate D24-1
Cumulative and Incremental Deflection B Direction Plot SP-20 .....Plate D24-2
Displacement vs. Time A Direction Plot SP-20.....Plate D24-3
Displacement vs. Time B Direction Plot SP-20.....Plate D24-4
Cumulative and Incremental Deflection A Direction Plot SP-21 .....Plate D25-1
Cumulative and Incremental Deflection B Direction Plot SP-21 .....Plate D25-2
Displacement vs. Time A Direction Plot SP-21.....Plate D25-3
Displacement vs. Time B Direction Plot SP-21.....Plate D25-4
Cumulative and Incremental Deflection A Direction Plot SP-22 .....Plate D26-1
Cumulative and Incremental Deflection B Direction Plot SP-22 .....Plate D26-2
Displacement vs. Time A Direction Plot SP-22.....Plate D26-3
Displacement vs. Time B Direction Plot SP-22.....Plate D26-4
Cumulative and Incremental Deflection A Direction Plot SP-23 .....Plate D27-1
Cumulative and Incremental Deflection B Direction Plot SP-23 .....Plate D27-2
Displacement vs. Time A Direction Plot SP-23.....Plate D27-3
Displacement vs. Time B Direction Plot SP-23.....Plate D27-4
Cumulative and Incremental Deflection A Direction Plot SP-26 .....Plate D28-1
Cumulative and Incremental Deflection B Direction Plot SP-26 .....Plate D28-2
Displacement vs. Time A Direction Plot SP-26.....Plate D28-3
Displacement vs. Time B Direction Plot SP-26.....Plate D28-4

APPENDIX E WATER QUALITY TESTING

Summary of Water Quality Monitoring Data – Third Quarter (Jul.-Sep.) 2018 .....Plate E-1
Summary of Water Quality Monitoring Data – Fourth Quarter (Oct.-Dec.) 2018 .....Plate E-2
Summary of Water Quality Monitoring Data – First Quarter (Jan.-Mar.) 2019 .....Plate E-3
Summary of Water Quality Monitoring Data – Second Quarter (Apr.-Jun.) 2019 .....Plate E-4

1. INTRODUCTION

1.1 Authorization

Fugro USA Land, Inc. (Fugro) performed the work summarized in this report in accordance with our contract with the City of Malibu (City) and consistent with the cost estimate document "Exhibit A - FY 2018 - 2019 Maintenance Cost Estimate" presented in the Annual Assessment Report (Taussig, 2018).

1.2 Background

Following the activation of the Big Rock Mesa landslide in 1983, the County of Los Angeles (County) established the Big Rock Mesa Landslide Assessment District (Assessment District) in 1989. The Assessment District provides permanent funding to maintain and monitor dewatering facilities with the purpose of reducing landslide movements. The County administered the Assessment District until 1991 when the City of Malibu (City) incorporated. The Assessment District was re-authorized in May 1998 under City of Malibu Resolution No. 98-030. The City has since administered the Assessment District, utilizing consultants to maintain and monitor the district facilities.

1.3 Scope of Work

This annual report summarizes the current monitoring and maintenance of the geotechnical instrumentation and dewatering facilities for the period between July 1, 2018, and June 30, 2019 (hereinafter, the "monitoring period"). Data collected during this monitoring period included the following:

- Annual Rainfall data from Big Rock Mesa rain gauge number 1239, operated by the County of Los Angeles, Department of Public Works – Water Resources Division;
- Monthly groundwater level measurements from 29 standpipes;
- Periodic groundwater measurements from 4 pneumatic piezometers;
- Semi-Monthly to Monthly dewatering production readings from 24 dewatering wells;
- Monthly to Bi-Monthly dewatering production readings from 32 horizontal drains (hydraugers);
- Quarterly, semi-annual, or annual ground deformation readings from 26 slope inclinometers (geotechnical instrumentation);
- Monthly readings of water usage data from the Mesa's master flow meter; and
- Water-quality sampling and analysis for National Pollution Discharge Elimination System (NPDES) compliance.

The operating condition of the instrumentation and dewatering facilities was checked during each field monitoring/observation event and by evaluating preliminary data in the office as they were received. Maintenance was performed as needed based on field observations, preliminary data evaluation, and correspondence from concerned homeowners and tenants.

The scope of our services is limited to monitoring and maintaining the Assessment District facilities. The services that are provided on an annual basis for the Assessment District do not include geologic or engineering evaluations of the stability of the landslide.

1.4 Report Organization

Monitoring data collected during the July 1, 2018 to June 30, 2019, monitoring period are provided herein. The boundary of the Assessment District is illustrated on Plate 1 – Site Location Map. Plate 2 – Dewatering Facilities Map presents the approximate locations of the geotechnical instrumentation and dewatering facilities. Monitoring data are presented in both tabular and graphical form in Appendices A through E, respectively, and as indicated in the table of contents.

1.5 Report Availability

The annual Assessment District reports are available for review at Malibu City Hall. Reports may also be viewed on the City's website at http://www.malibucity.org.

2. MONITORING

2.1 Rainfall Data

Plate 3 – Rainfall Graph presents the historical monthly rainfall and average annual rainfall data from October 1968 through June 30, 2019. Data between 1968 and 2004 were obtained from County of Los Angeles Department of Public Works (LADPW) Carbon Canyon Rain Station 447C. Monthly rainfall totals from 2004 to the present were obtained from LADPW Big Rock Mesa Rain Gauge 1239.

Rainfall data indicate that approximately 22.20 inches of precipitation fell during the monitoring period from July 1, 2018, through June 30, 2019. The average annual rainfall from 1968 to 2019 in the “Malibu area” for the same months is approximately 15.55 inches.

However, rainfall data are usually analyzed in terms of the annual "rain season" that covers the time period between October 1 through September 30. Rainfall between October 1, 2018, through September 30, 2019, was approximately 22.24 inches. That is approximately 27 percent higher than the average annual rainfall of 15.88 inches for the “rain seasons” between 1968 and 2019.

Plate 4 – Summary of Groundwater Levels, Dewatering, and Rainfall shows the yearly magnitude of deviation of each years’ rainfall relative to the mean annual rainfall. The graphic also shows the average annual dewatering output (gallons per day, gpd). The data illustrates that the average annual dewatering output decreased with above average rainfall for the 2018 - 2019 monitoring period.

2.2 Master Water Meter

Water usage data are collected by performing monthly readings at the master water meter near the intersection of Rockport Way and Big Rock Drive. The master water meter measures all imported water supplied to the Big Rock Mesa area by Los Angeles County Waterworks District 29. Processed readings are shown as a plot of flow rate versus time on Plate 5. An evaluation of the data indicates the following.

- The recorded water usage rates are cyclic throughout the monitoring year reflecting higher levels of usage during the summer months.
- Periods of higher than average rainfall, such as the springs of 2005 and 2006 and the winters of 2011 and 2017 tend to lead to lower water consumption as landscaping water needs decline.
- There had been a general trend of increasing water consumption from about 1995 to 2008. Water consumption has generally trended downwards since 2008.
- Average monthly water usage for this monitoring year decreased slightly from the previous year. Average water usage during the 2018 through 2019 monitoring year was approximately 145,800 gallons per day (gpd), which is approximately 6.7 percent less than the 2017 through 2018 monitoring year average of 156,200 gpd.

2.3 Groundwater Level Monitoring

The groundwater monitoring data collected during the 2018 - 2019 monitoring period are summarized in Appendix A. Groundwater levels fluctuate throughout the year, and from year to year, in response to

natural and man-made influences. The primary natural influence is varying precipitation. Man-made influences include:

- Infiltration from onsite wastewater treatment systems;
- Infiltration from irrigation;
- Alterations to surface drainage by grading, landscaping, storm drains, and rain gutters;
- Inadvertent water discharges from leaking utilities such as water, irrigation, sewer, storm drain lines as well as from swimming pools; and
- Dewatering activities from pumping dewatering wells and gravity-draining hydraugers.

Standpipe piezometers are constructed from a length of pipe, usually PVC, inserted into a borehole and then backfilled in place with grout, sand or other approved backfill materials. The pipe contains perforations along selected depth intervals that allow groundwater to enter from the formation and fill the pipe to a height equivalent to the water head at the perforated interval. Some of the standpipes in Big Rock Mesa may be perforated along most of their length and are therefore effective at measuring the average water head at their location, which is typically the equivalent of the water table. Other standpipes are perforated only at the bottom five feet of the casing and measure water head specific to that depth interval. The water level inside piezometers is measured directly by lowering an electric sounder down the standpipe into contact with the water surface.

Inclinometer casings installed within the Assessment District after 1998 were typically outfitted with one or more pneumatic piezometer sensors, also referred to as ‘Tips’, nested at varying depths along the length of the inclinometer casing. Each sensor records saturated soil pore water pressure by measuring differential air pressure between the instrument sensor and groundwater surface across a flexible bladder. Differential pressure is converted into water head, which is translated to a relative groundwater elevation. Measuring pore pressures at specific elevations along a vertical profile can be used to measure flow gradients for groundwater migrating through the formation above and within the water table and to infer the presence of perched or confined groundwater zones

Our staff typically measures groundwater levels in standpipe piezometers on a monthly basis and in pneumatic piezometers on a semi-annual basis. Monitoring data and graphs illustrating groundwater levels recorded in monitoring wells and pneumatic piezometers for the six physiographic regions of the Big Rock Mesa landslide are presented in Appendix A. Groundwater elevation maps from May 8, 1995, and May 14, 2019, are shown on Plate 6a. A map of the changes in ground water elevation between May 1995 and May 2019 is shown on Plate 6b. A map of the changes in ground water elevation between May 2018 and May 2019 is shown on Plate 6c.

As observed from the available data, groundwater levels rise relatively quickly following significant rainfall and gradually lower after a wet season ends. Groundwater levels recorded in the Assessment District typically peak around late-March to mid-April and have gradually declined through late September to November.

We reviewed groundwater data by evaluating changes that occurred during the monitoring period as well as changes in groundwater levels compared to historical averages (1984 through 2019). To analyze trends in seasonal groundwater fluctuations, the average (mean) annual and highest annual recorded groundwater elevation for each piezometer were calculated (Appendix A) and are summarized in Table 1. Average groundwater elevations presented in Table 1 incorporate measurements from all monitored standpipes. It is important to note that historical reports (prior to 2012) do not include SP-17B, which was installed in February 2012, but the water levels reported since 2012 include measurements from SP-17B in the area average for the Central Mesa Area. Similarly, measured tip pressures from the pneumatic piezometers located throughout the Assessment District have been excluded from the area averages due to the inconsistency and potential error with their readings.

Table 1. Summary of Average Groundwater Elevations by Area

	Total No. of Wells	2018-2019 Average Groundwater Elevation (ft)	Change in Average Groundwater from Prior Monitoring Period (ft)	2018-2019 Average Peak Groundwater Elevation (ft)	Change in Average Peak Groundwater Elevation from Prior Monitoring Period (ft)
PCH Region	8	9.1	+0.3	11.3	+1.6
Bluff Region	4	31.5	-2.7	34.5	-5.3
Eastern Mesa	4[1]	41.5	-1.4	42.9	-2.3
Central Mesa	9	227.5	+8.7	232.6	+3.3
Western Extension	4	375.7	-4.9	391.4	+4.1
Headscarp Region	1	553.2	+0.9	558.6	+4.8
1. Since SP-3 remains dry, the Eastern Mesa area average is based on 3 wells					

A summary graph presenting the deviation of peak groundwater elevations for each of the six regions in Big Rock Mesa as compared to the average peak groundwater elevations for each region is presented on the top graph of Plate 4. The bottom graph on Plate 4 compares the average dewatering output (gpd) to the annual deviation from the mean annual rainfall over the same time period.

2.3.1 Pacific Coast Highway (PCH) Region

The PCH Region parallels the coastal highway at the base of the bluff, including the area between the bluff and the Pacific Ocean. The PCH Region includes the southern boundary of the 1983 landslide. The Shoreline fault and landslide rupture surface define both a zone of weakness and a groundwater barrier, extending approximately along the same alignment as the highway.

Groundwater data for the PCH Region are presented as hydrographs on Plate A-3a and A-3b. Groundwater levels in this area are monitored using standpipe piezometers SP-11, 12, 14, 15, 19, 27A, 29, and 30. In general, groundwater elevations in the PCH Region for the 2018 - 2019 monitoring year increased slightly. The calculated area average groundwater elevation increased by 0.3 feet when compared to the 2017 - 2018 monitoring period and is 0.5 feet above the mean groundwater elevation for the area for the period of record (1987 to 2019). Calculated average water elevations for individual

standpipes during the 2018 - 2019 monitoring period varied by 1 foot or less when compared to average water elevations for the 2017 - 2018 monitoring year in all standpipes except SP-15 and SP-30, which showed an annual average increase of 2.6 feet and 1.6 feet, respectively.

While taking standpipe measurements on March 6, 2019, Fugro observed that the casing and vault for SP-19 was filled with water. In addition, we noticed that a nearby storm drain manhole had been dislodged. It is possible that storm water from recent rainfall exceeded the capacity of the nearby storm drain and filled the standpipe and vault with water. The abnormal reading taken in February 2019 is also assumed to be a result of water entering the casing from the surface. As a result, the February and March 2019 readings were not included in the average groundwater elevation as a result. Water level readings taken after March 2019 were consistent with readings prior to February.

2.3.2 Bluff Region

The Bluff Region extends along the top of the slope immediately the north of the PCH Region, and is an area where intense ground cracking was observed during the 1983 landslide. The subsurface materials within the Bluff Region generally have a relatively high secondary permeability due to the level of fracturing that had occurred.

Groundwater data for the Bluff Region are presented as hydrographs on Plate A-4. Groundwater levels in this area are monitored using standpipe piezometers SP-10, 28, 32, and 34, and the pneumatic piezometers installed with SP-34. In general, groundwater elevations for the Bluff Region for the 2018 - 2019 monitoring year decreased slightly. The calculated area average groundwater elevation decreased 2.7 feet when compared to the 2017 - 2018 monitoring period and is 22.9 feet below the mean water level elevation for the area for the period of record.

Calculated average water elevations for individual standpipes during the 2018 - 2019 monitoring year varied by 1 foot or less when compared to average water elevations for the 2017 - 2018 monitoring year, with the exception of SP-32, which declined by 9.3 feet. Water levels in SP-32 reached an all-time low elevation of 20.8 feet in December 2018.

Pore pressures measured in SP-34 pneumatic piezometer tips 1 and 2 continue to rise and fall in approximate correlation with the standpipe water levels. Standpipe SP-34 pneumatic tip 3 continues to measure 0 PSI and tip 4 is non-functional; therefore, no data for those tips are reported.

2.3.3 Eastern Mesa Region

The Eastern Mesa Region lies between the Bluff Region and Big Rock Mesa Drive east of the Piedra Chica cul-de-sac. Groundwater in this area occurs within low permeability deposits of the Sespe Formation.

Groundwater data for the Eastern Mesa Region are presented as hydrographs on Plate A-5. Groundwater levels in this area are monitored using standpipe piezometers SP-3, -3A, -33, PC-1, and the pneumatic piezometers installed with PC-1. Overall groundwater elevations for the Eastern Mesa for the 2018-2019

monitoring year decreased. The calculated area average groundwater elevation decreased 1.4 feet when compared to the 2017 - 2018 monitoring period and is 26.6 feet below the mean water level elevation for the area for the period of record.

Calculated average water elevations during the 2018 - 2019 monitoring year for standpipes PC-1 and SP-3A varied by 1 foot or less when compared to average water elevations for the 2017 - 2018 monitoring year. Average groundwater elevations in SP-33 decreased by 4.1 feet when compared to the previous monitoring year.

Pore pressures measured in PC-1 pneumatic tips 1 and 3 remained steady throughout the 2018 - 2019 monitoring year. PC-1 Tip 2 has been reading a pore pressure of 0 PSI since 2011. Tips 4 and 5 are not functional and no data are reported.

2.3.4 Central Mesa Region

The Central Mesa Region lies between the Bluff Region and Big Rock Mesa Drive, west of the Piedra Chica cul-de-sac. Groundwater within this area generally occurs within moderately permeable landslide deposits derived from the Topanga Formation.

Groundwater data for the Central Mesa Region are presented as hydrographs on Plate A-6a and A-6b. Groundwater levels in this area are monitored using standpipe piezometers SP-9A, 16, 16A, 17, 17A, 17B, 24, 35, 36, and the pneumatic piezometers tips installed with SP-35 and 36. In general, groundwater elevations in the Central Mesa Region for the 2018 - 2019 monitoring year increased. The calculated area average groundwater elevation increased 8.7 feet when compared to the 2017 - 2018 monitoring period.

Calculated average water elevations for standpipes during the 2018 - 2019 monitoring year in standpipes SP-9A, SP-17, SP-17A, SP-17B, SP-24, and SP-36 varied by 2 feet or less when compared to average water elevations for the 2017 - 2018 monitoring year.

Groundwater elevations in standpipes SP-16 and -16A experienced a steep increase in March 2019, likely in response to increased rainfall. SP-16 and -16A typically display a higher sensitivity to rainfall. The average groundwater elevation in SP-16 during the 2018-2019 monitoring year was 56.9 feet above the mean water level elevation for the area for the period of record, but 100.3 feet lower than the highest water level recorded in 1984. The average groundwater elevation in SP-16A during the 2018-2019 monitoring year was 1.2 feet above the mean water level elevation for the area for the period of record.

2.3.5 Western Extension Region

The Western Extension Region encompasses approximately 79 acres, from PCH on the south to the upper ridgeline on the north. The region is located immediately west of the active 1983 Big Rock Mesa Landslide area.

Groundwater data for the Western Extension Region are presented as hydrographs on Plate A-7. Groundwater levels in this area are monitored using standpipe piezometers SP-20, -21, -22, and -23. In

general, groundwater elevations for the Western Extension Region for the 2018 - 2019 monitoring year decreased. The calculated area average groundwater elevation decreased by 4.9 feet when compared to the 2017 - 2018 monitoring period and was 7.7 feet below the mean groundwater elevation for the area for the period of record.

2.3.6 Headscarp Region

The Headscarp Region borders the Central Mesa Region to the north. The ground surface elevation in the Headscarp Region is higher than other regions in Big Rock Mesa, and groundwater is relatively deep.

Groundwater data for the Headscarp Region is presented as a hydrograph on Plate A-8. Groundwater levels in this area are monitored using standpipe piezometer SP-26. In general, groundwater elevations for the Headscarp Region for the 2018 - 2019 monitoring year increased slightly. The calculated area average groundwater elevation increased by 0.9 feet when compared to the 2017 - 2018 monitoring period and was 3.9 feet above the mean groundwater elevation for the area for the period of record.

2.4 Dewatering Well Production

The total production rate for all dewatering wells from 1993 through June 2019 is depicted on Plate 5. Dewatering well information, status and production rates for individual wells are presented on Plates B-1 through B-4 (Appendix B).

The average total well production rate for the monitoring period was approximately 41,799 gpd. This is approximately 6 percent less than the previous year's monitoring period value of 44,445 gpd, and below the historical average production of 52,012 gpd measured from 1993 to the present. Total dewatering well production was affected during the year as mechanical, electrical, or other issues caused wells to intermittently stop or reduce production. Over the course of the 2018 - 2019 monitoring year, dewatering wells BYA-12, -9, -11, and W-18 had periods without production.

2.5 Hydrauger Production

The total production rate for all hydraugers from 1993 through June 2019 is depicted on Plate 5. Additional data regarding hydraugers and production rates are presented in Appendix C, Plates C-1 through C-4.

The average total hydrauger production rate over the monitoring period was approximately 14,084 gpd. That represents a less than 1 percent decrease in production relative to the previous monitoring period (14,184 gpd).

2.6 Slope Inclinometers

Fugro monitored 26 slope inclinometers on a quarterly to annual basis to check for subsurface ground deformation through June 2019.

Slope inclinometer measurement plots are presented in Appendix D. Four slope inclinometer plots are prepared for each inclinometer installation:

- The first plot shows the cumulative deflection and incremental deflection for the A-direction.
- The second plot shows the cumulative deflection and incremental deflection for the B-direction.
- The third and fourth plots show displacement versus time for the same period as the first two plots (one for each direction) and the displacement time plots include intermediate readings for each of the years presented.

When reviewing and interpreting the slope inclinometer data plots, instrument limitations and movement history should be considered. Individual plots have been reviewed and interpreted with regard to movement along identified slide planes. Interpreted movement along the identified slide planes is summarized on Plate D1 in Appendix D.

Several inclinometers show some inconsistent changes (typically <0.1 to 0.2 inch), but the potential movement magnitude and orientation is not clear and is not within the reliable accuracy of the instrument. Some of the irregular shapes observed in the deep inclinometers can be attributed to depth position and rotation errors caused by cable length changes, local curvatures within the casings, and significant deviation from vertical during initial installation, which is common to deep inclinometers.

A brief summary of each region is presented below and is summarized on Plate D1. It is important to keep in mind the high sensitivity of the inclinometer probes and the magnitude of the interpreted movements when reviewing the inclinometer data presented in this report. Plate D1 notes the depths at which movement has been interpreted in the past, as well as whether the inclinometer penetrates the basal rupture surface. Shallower depths of historically interpreted movement above the base of the Big Rock Mesa Landslide have also been noted.

2.6.1 Pacific Coast Highway Region

The PCH Region extends along PCH in proximity of the southern boundary of the 1983 Big Rock Mesa landslide. SP-11 displayed movement of less than 0.1 inches between a depth of approximately 12 to 20 feet depth. No other quantifiable offsets within the inclinometers of the PCH Region were measured during this monitoring period.

2.6.2 Bluff Region

The Bluff Region extends along the top of the slope immediately north of the PCH Region, where intense ground cracking was observed during the 1983 landslide. The inclinometers in that area are deep and show evidence of depth position and rotation errors, associated with cable stretch, casing curvature, and casing deviation from vertical. No quantifiable offsets within the inclinometers of the Bluff Region were measured during this monitoring period.

2.6.3 Eastern Mesa Region

The Eastern Mesa Region extends west to the ends of Inland Lane and the Piedra Chica cul-de-sac. This area is bordered to the north by Big Rock Drive and to the south by the Bluff Region. The inclinometers in the Eastern Mesa Region are deep and show evidence of depth position errors, as well as localized casing curvature, and casing deviation from vertical. PC-1 displayed movement of less than 0.1 inches at a depth of approximately 142 feet depth. No other quantifiable offsets along identified shear planes were detected within the inclinometers of the Eastern Mesa Region during the current monitoring year.

2.6.4 Central Mesa Region

The Central Mesa Region is located between the Bluff and Big Rock Mesa Drive and to the west of the Piedra Chica cul-de-sac. The inclinometers in that region are deep and show evidence of depth position errors, probably associated with ground settlement and/or cable stretch. SP-17B displayed movement of less than 0.1 inches at a depth of approximately 200 feet depth No other quantifiable offsets were measured within the inclinometers in the Central Mesa Region during the current monitoring year.

2.6.5 Western Extension Region

The Western Extension Region encompasses approximately 79 acres, from PCH on the south end to the upper ridgeline on the north, immediately west of the 1983 Big Rock Mesa landslide area. The inclinometers in that area are deep and show evidence of depth position errors, probably associated with local casing curvature and casing deviation from vertical. No quantifiable offsets within the inclinometers in the Western Extension Region were measured during the current monitoring year.

2.6.6 Headscarp Region

The Headscarp Region borders the Central Mesa Region to the north. SP-26 is the only inclinometer being measured in this region and, historically, has been the first to move and the last to cease movement in response to heavy rainfall within the assessment district. Inclinometer SP-26 is deep and shows evidence of depth position errors, probably associated with local casing curvatures and casing deviation from vertical. No quantifiable offsets within SP-26 were measured during the current monitoring year.

2.7 Water Quality Monitoring

2.7.1 Regional Board Requirements

Water quality monitoring was completed in general compliance with the NPDES permit, as required by the California Regional Water Quality Control Board (RWQCB).

On March 2, 2004, the RWQCB issued General NPDES permit CAG994004, Order No. R4-2003-011. On October 3, 2008, Order No. R4-2003-0111 was superseded by Order No. R4-2008-0032, providing revised requirements for sampling and analysis. Total chlorine was not a required element of the sampling and testing plan until the end of the second quarter 2010. A revised permit was issued to the City in October 2010 requiring all discharge points to be sampled monthly for all constituents, except for Acute Toxicity, which is to be tested annually. On June 5, 2015, order No. R4-2003-0032 was superseded by general order number R4-2013-0095 (current permit). Fugro conducted water quality monitoring during

the 2018 - 2019 monitoring year consistent with the requirements of the RWQCB NPDES permit, No. R4-2013-0095.

Water produced by assessment district dewatering wells is pumped into the public storm drain system and water flow from the hydraugers is collected though a conveyance line system. Both the storm drain system and the conveyance line system empty into ten culverts on the north side of Pacific Coast Highway. Usually, effluent from several wells and hydraugers drain into a common culvert where they co-mingle with effluent from other sources and then flow under the PCH to a Discharge Point on the beach. The ten beach Discharge Points referred to in the permit are named M-001 through M-010. Other sources of surface water are collected by the storm-drain system including storm water runoff (during and following precipitation), irrigation runoff, domestic use surface runoff from car washing and hosing-off of driveways, illicit discharges, groundwater seepage, and other possible unidentified sources.

The City of Malibu continues to contend that the current monitoring and reporting program sources effluent from comingled sources, and as such does not accurately represent the Big Rock Mesa Landslide Assessment District discharge. In June and July 2018, City representatives participated in conference calls with members of the RWQCB to discuss continuing exceedances as measured at the ocean-side discharge monitoring points. A revised sampling and testing program was submitted to the RWQCB for their review and comment in August 2018. In the interim, and with the approval of the RWQCB, the August 2018 event included monitoring select ocean-side discharge points along with hillside discharge flow facility monitoring to allow further evaluation of the difference in water quality based on where samples are collected. The September 2018 and following sampling events consisted of monitoring select hillside discharge sample points to better understand the water quality being discharged from the hillside dewatering facilities.

Representative samples from each discharge point were collected and analyzed for the entire suite of constituents listed in the permit once per month. Discharge points with analytes that were detected in concentrations exceeding permitted limits were subsequently sampled and tested for that analyte on a weekly basis. After at least three consecutive weekly follow-up samples are measured within permit limits, sampling for that analyte may return to once monthly.

All samples were collected in clean laboratory provided jars, placed in a cooler on ice and delivered to the analytic laboratory under proper chain of custody protocol within method specific holding times, with the exception of total chlorine, pH, and temperature, which were measured in the field during sample collection. One quality control duplicate sample was collected for every monthly sampling event.

2.7.2 Water-Quality Results

Water quality data summary sheets for each quarter of the 2018 - 2019 monitoring period are provided as Plate E-1 through E-4 in Appendix E.

During the 2018 - 2019 monitoring year, samples collected from the ten ocean discharge points exceeded permitted concentration limits for Biochemical Oxygen Demand, Bis(2-Ethylhexyl) Phthalate, Oil and Grease, TPH, Zinc, and Total Chlorine.

In accordance with the permit, bacteriological testing for Total Coliform, Fecal Coliform and Enterococcus was performed once monthly at each discharge point. With the exception of M-010, results of bacteriological sampling through the 2018 - 2019 monitoring year at ocean discharge points consistently or intermittently detected Total Coliform and Enterococcus in concentrations exceeding NPDES general permit limits at each of the Discharge Points. Fecal Coliform was intermittently detected in concentrations exceeding NPDES general permit limits from all ocean-side discharge points except M-008 and M-008.

During the 2018 - 2019 monitoring year, samples collected from hillside facility discharge points exceeded permitted concentration limits for Biochemical Oxygen Demand, Settleable Solids, Total Suspended Solids, Turbidity, Sulfides, TPH, and Zinc.

In accordance with the permit, bacteriological testing for Total Coliform, Fecal Coliform and Enterococcus was performed monthly at select representative hillside facility discharge points. Results of bacteriological sampling through the 2018 - 2019 monitoring year at hillside facility discharge points did not exceed concentrations exceeding NPDES general permit limits.

Acute toxicity testing is required once per year under the permit. Acute toxicity was performed during Quarter 4 of 2018. Those results indicate 96 to 100 percent survival rate from all facilities with the exception of dewatering wells BYA-4 and BYA-11. Subsequent exceedance sampling for acute toxicity was performed on BYA-4 and BYA-11 until February 2019, when the results of three successive testing resulted in 96 to 100 percent survival rate.

The current permit requires quarterly and annual compliance reporting to the Regional Board. Those water quality reports are more comprehensive and provide details for each sampling event and exceedance. Quarterly and annual permit compliance reports may be downloaded and viewed from the RWQCB website.

3. DEWATERING FACILITY MAINTENANCE

3.1 Capital Improvements

Capital improvement projects are those of larger scale that are budgeted for during the previous year and that in most cases involve subcontracted services and/or extensive coordination with the City or other agencies to complete. During the 2018 - 2019 monitoring year, Fugro contracted with Tri-County Drilling to perform well rehabilitation on dewatering wells BYA-4, BYA-10, BYA-11, BYA-13 and BYA-14. Well rehabilitation consisted of brushing screened intervals, bailing out particulates dislodged during brushing, flushing the well with hydrochloric acid to clear well of iron bacteria and deposits of resultant by-products, replacing pumps and PVC column pipes, and replacing any electrical components as necessary. Well rehabilitation is planned for additional wells during the 2019 - 2020 monitoring year.

3.2 Facility Maintenance

The operating status of each dewatering well and hydrauger was checked during each monitoring event. When necessary, repair work was scheduled and undertaken as expeditiously as reasonable. Generally, repairs and maintenance consisted of brush clearance, cleaning, and well pump and electrical repairs. Table 2 presents a summary of facility maintenance/repairs that were completed during the 2018 - 2019 monitoring year.

Table 2. Summary of Completed Facility Maintenance

Facility	Date of Repair	Repair
Various wells	8/13/18-8/17/18	Add discharge spigots to facilitate easier sampling
BYA-4	9/10/18	Replace pump/motor/control box and discharge pipe
BYA-11	9/10/18	Replace pump/motor/control box and discharge pipe
BYA-2	9/10/18	Replace control box
BYA-9	12/27/18	Replace pump/motor/control box and discharge pipe
BYA-13	1/21/19	Replace stuck meter
Hydraugers	1/28/19	Brush removal around hydraugers
HD-24, HD-28, HD-29, HD-39	2/5/19	Repair broken hydraugers
HD-12	2/12/19	Repair broken hydrauger
Hydraugers	2/22/19	Brush removal around hydraugers
HD-30, HD-33	5/8/19	Repair broken hydraugers after Caltrans debris clearing activities
HD-42, HD-43, H-1	5/9/19	Repair broken hydraugers after Caltrans debris clearing activities
BYA-12	5/14/19	Replace pump/motor/control box and discharge pipe
BYA-11	5/14/19	Replace main breaker in electrical panel
HD-9	5/17/19	Repair broken hydrauger after Caltrans debris clearing activities
HD-24	5/23/19	Repair broken hydrauger after Caltrans debris clearing activities
W-1	6/4/19	Repair broken discharge pipe.

4. SUMMARY AND CONCLUSIONS

4.1 Annual Summary

The general status of the Big Rock Mesa Landslide Assessment District can be summarized as follows:

- The groundwater level in the Big Rock Mesa landslide is the primary factor controlling the stability of the landslide mass. Rises in groundwater level tend to de-stabilize the landslide. Previous episodes of movement of the landslide have been directly related to high groundwater levels. Therefore, controlling the long-term average and peak groundwater levels in the landslide mass is the primary means being used to reduce future movements of the landslide. The primary factors influencing recharge of groundwater to the landslide are: 1) onsite wastewater treatment system discharge, 2) rainfall, 3) irrigation, and 4) water-line and pool leakage.
- Monitoring data related to rainfall and imported water usage indicate the following:
  - Rainfall during the 2018 - 2019 rain-season period (October to September) was 22.24 inches of precipitation, which is above the historical average annual rainfall during the “rain season” of 15.88 inches. Rainfall during the Malibu “monitoring period” (July 2018 to June 2019) was 22.20 inches of precipitation which is higher than the historical annual average of 15.55 inches per year measured between July and June from 1968 through June 2019.
  - Use of imported water decreased approximately 6.7 percent from the previous monitoring year (145,800 gpd versus 156,200 gpd) and is 24 percent above the average usage in 1984 (117,400 gpd).
- Groundwater levels in 29 standpipe piezometers were measured on a monthly basis during the monitoring period. Average groundwater levels measured during the monitoring period were more than 1 foot above long-term average groundwater levels for 9 of the 29 standpipe piezometers. The remaining 20 piezometers indicated a relatively static or lowered groundwater level.
- The average total well production rate for the 2018 - 2019 monitoring period was approximately 41,799 gpd. This is a 6 percent decrease when compared to the previous year’s monitoring period rate of 44,445 gpd and is below the historical average production rate of 52,012 gpd measured between 1993 and the present.
- The average total hydrauger production rate over the 2018 - 2019 monitoring period was approximately 14,084 gpd. That represents a less than one-percent decrease in production relative to the previous monitoring period (14,184 gpd).
- Interpretation of inclinometer data shows minimal (less than 0.1 inch) of movement in inclinometers SP-11, SP-17B, and PC-1. No other quantifiable ground movement was detected in the inclinometers monitored during the 2018 through 2019 monitoring period.
- Water quality monitoring, conducted in general conformance with the requirements of the RWQCB NPDES Permit No. R4-2013-0095, which became effective June 5, 2015, indicate occasional to consistent exceedances for zinc at many of the dewatering wells. An ongoing well-rehabilitation program has been set up to reduce the levels of zinc in the dewatering well discharge.
- Routine and minor maintenance was conducted throughout the 2018 - 2019 monitoring year on the dewatering wells, hydraugers, and conveyance systems. Ongoing maintenance and repair work are essential to maintaining the capacity of the dewatering system.

4.2 Concluding Comments

It is important to recognize that the dewatering facilities installed over the preceding decades are aging and require increasing maintenance and regular replacement. The anticipated lifespan of an average hydrauger is measured in years, not decades. Dewatering wells may last from a few years to several decades.

Dewatering wells should be reviewed on an individual basis and redeveloped, repaired, or replaced as necessary.

The geology throughout the Assessment District is not uniform and varies from one location to another. Areas of low permeability, such as in the Eastern Mesa Region, can limit the dewatering production of individual facilities.

Water conservation throughout the Big Rock Mesa area is essential to reduce groundwater recharge. As previously stated, rainfall and imported (household) water usage are the primary sources of groundwater recharge and are the primary factors controlling the movement of the landslide. Seasonal rainfall is beyond the control of homeowners and the City; therefore, water conservation is the most critical remaining means of controlling groundwater recharge on the Mesa.

5. REFERENCES

Bing Yen and Associates, Inc. (BYA) (1992), "A Geotechnical Engineering Evaluation - Big Rock Mesa, Malibu, California," dated February.

_____ (1993), "Semi-Annual Observation & Maintenance Report for the Period July to December 1992, Big Rock Mesa, Malibu, California," dated February.

_____ (1993), "Semi-Annual Observation & Maintenance Report for the Period January to July 1993, Big Rock Mesa, Malibu, California," dated September.

_____ (1994), "Annual Observation & Maintenance Report for the Period July 1993 to July 1994, Big Rock Mesa, Malibu, California," dated September.

_____ (1995), "Annual Observation & Maintenance Report for the Period July 1994 to July 1995, Big Rock Mesa, Malibu, California," dated September.

_____ (1996), "Slope Stability Evaluation - South Facing Slope Region," dated November.

_____ (1996), "Annual Observation & Maintenance Report for the Period July 1995 to July 1996, Big Rock Mesa, Malibu, California," dated September.

_____ (1997), "Annual Observation & Maintenance Report for the Period July 1996 to July 1997, Big Rock Mesa, Malibu, California," dated June.

_____ (1998), "Annual Observation & Maintenance Report for the Period July 1997 to April 1998, Big Rock Mesa, Malibu, California," dated April.

_____ (1999), "Annual Observation & Maintenance Report for the Period July 1998 to April 1999, Big Rock Mesa, Malibu, California," dated April.

_____ (2000), "Annual Observation & Maintenance Report for the Period April 1999 to June 2000, Big Rock Mesa, Malibu, California," dated August.

_____ (2001), "Annual Observation & Maintenance Report for the Period July 2000 to June 2001, Big Rock Mesa, Malibu, California," dated October.

_____ (2002), "Annual Observation & Maintenance Report for the Period July 2001 to June 2002, Big Rock Mesa, Malibu, California," dated March.

_____ (2003), "Annual Observation & Maintenance Report for the Period July 2002 to June 2003, Big Rock Mesa, Malibu, California," dated December.

Donald B. Kowalewsky (1994), "Engineering Geologic Report and Geotechnical Report for Proposed New Residence and Guest House, to Replace Previous Residence Destroyed by Fire at 20790 Rockpoint Road, Malibu, California," dated May 27.

David Taussig & Associates, Inc. (2017), "Annual Assessment District No. 98-1 (Big Rock Mesa) FY 2017-2018," dated June 26.

Fugro USA Land, Inc. (Fugro) (2018), "Annual Report, July 2016 through June 2017, Big Rock Mesa Landslide Assessment District, Malibu, California," dated March 2018.

Fugro Consultants, Inc. (Fugro) (2011), "Annual Report, July 2010 through June 2011, Big Rock Mesa Landslide Assessment District, Malibu, California," dated August 2011.

_____ (2012), "Annual Report, July 2011 through June 2012, Big Rock Mesa Landslide Assessment District, Malibu, California," dated September 2012.

_____ (2014), "Annual Report, July 2012 through June 2013, Big Rock Mesa Landslide Assessment District, Malibu, California," dated March 2014.

_____ (2015a), "Annual Report, July 2013 through June 2014, Big Rock Mesa Landslide Assessment District, Malibu, California," dated April.

_____ (2015b), "Annual Report, July 2014 through June 2015, Big Rock Mesa Landslide Assessment District, Malibu, California," dated November.

_____ (2016), "Annual Report, July 2015 through June 2016, Big Rock Mesa Landslide Assessment District, Malibu, California," dated November.

Fugro West, Inc. (Fugro) (2004), "Annual Report, July 2003 through June 2004 Malibu Road Landslide Assessment District, Malibu, California," dated November 2004.

_____ (2005), "Annual Report, July 2004 through June 2005, Big Rock Mesa Landslide Assessment District, Malibu, California," dated October 2005.

_____ (2006), "Annual Report, July 2005 through June 2006 Malibu Road Landslide Assessment District, Malibu, California," dated August 2006.

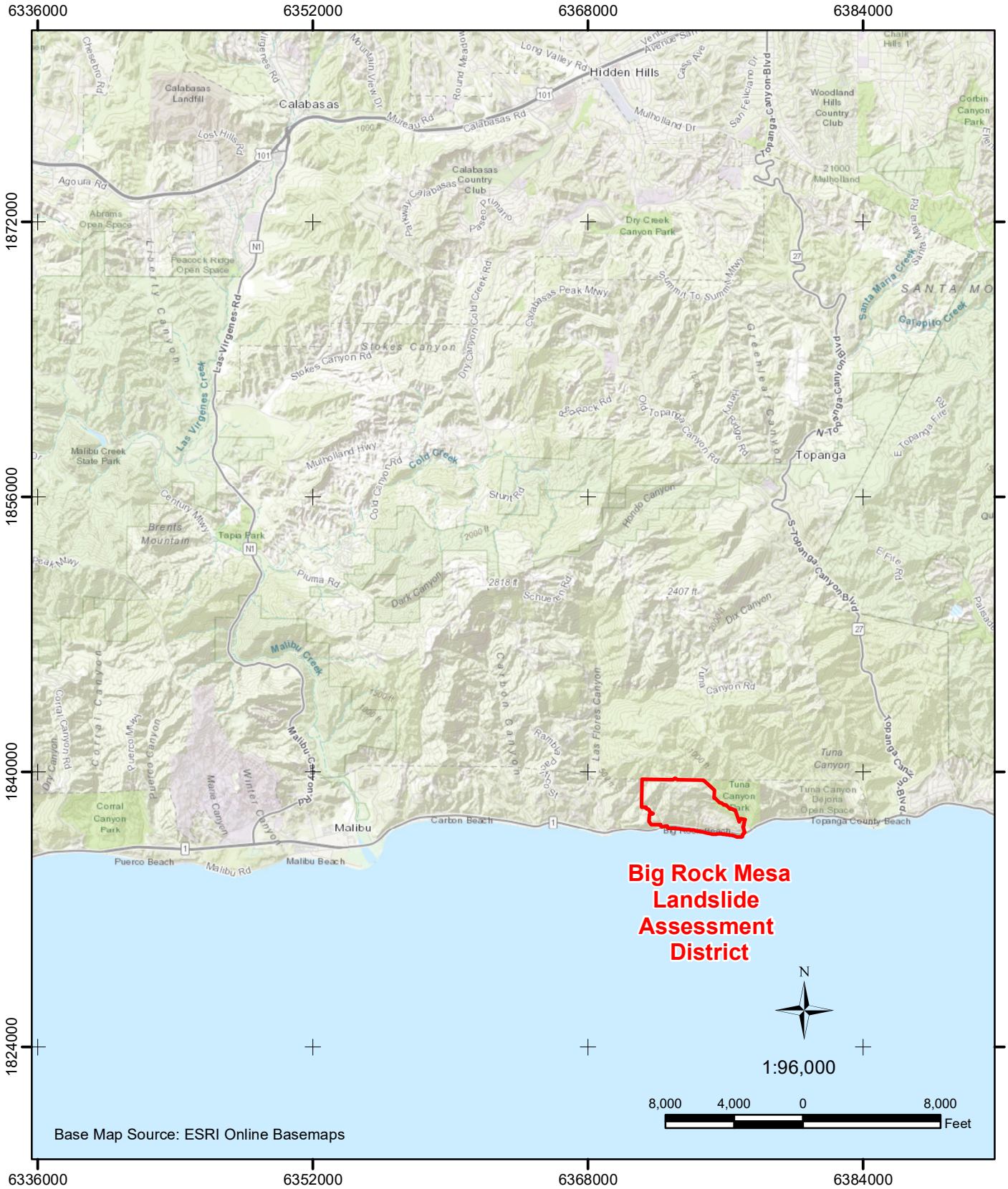
_____ (2007), "Annual Report, July 2006 through June 2007 Malibu Road Landslide Assessment District, Malibu, California," dated September 2007.

_____ (2008), "Annual Report, July 2007 through June 2008 Malibu Road Landslide Assessment District, Malibu, California," dated August 2008.

_____ (2009), "Annual Report, July 2008 through June 2009 Malibu Road Landslide Assessment District, Malibu, California," dated October 2009.

_____ (2010), "Annual Report, July 2009 through June 2010 Malibu Road Landslide Assessment District, Malibu, California," dated May 2011.

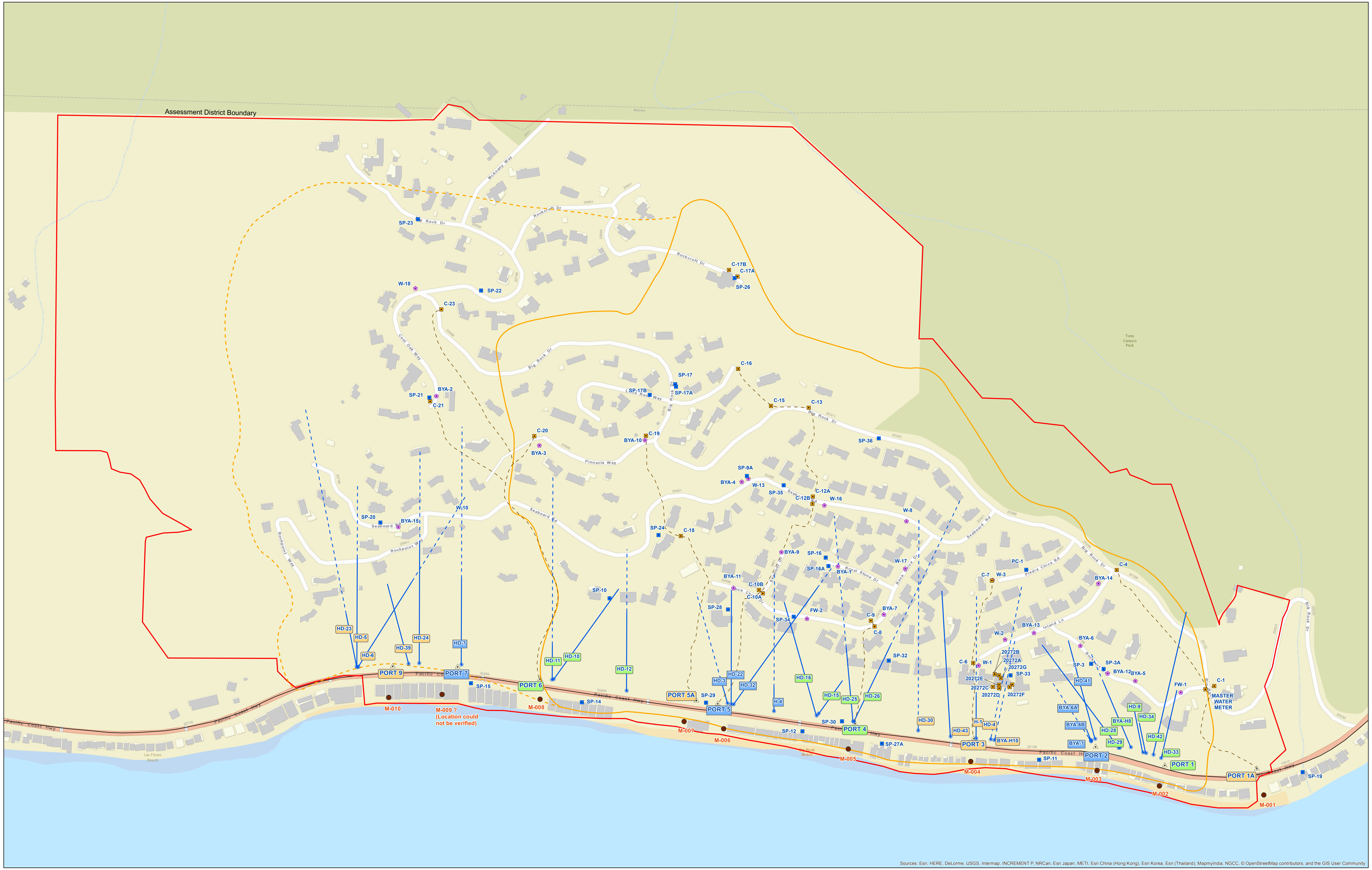
PLATES



SITE LOCATION MAP
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE 1

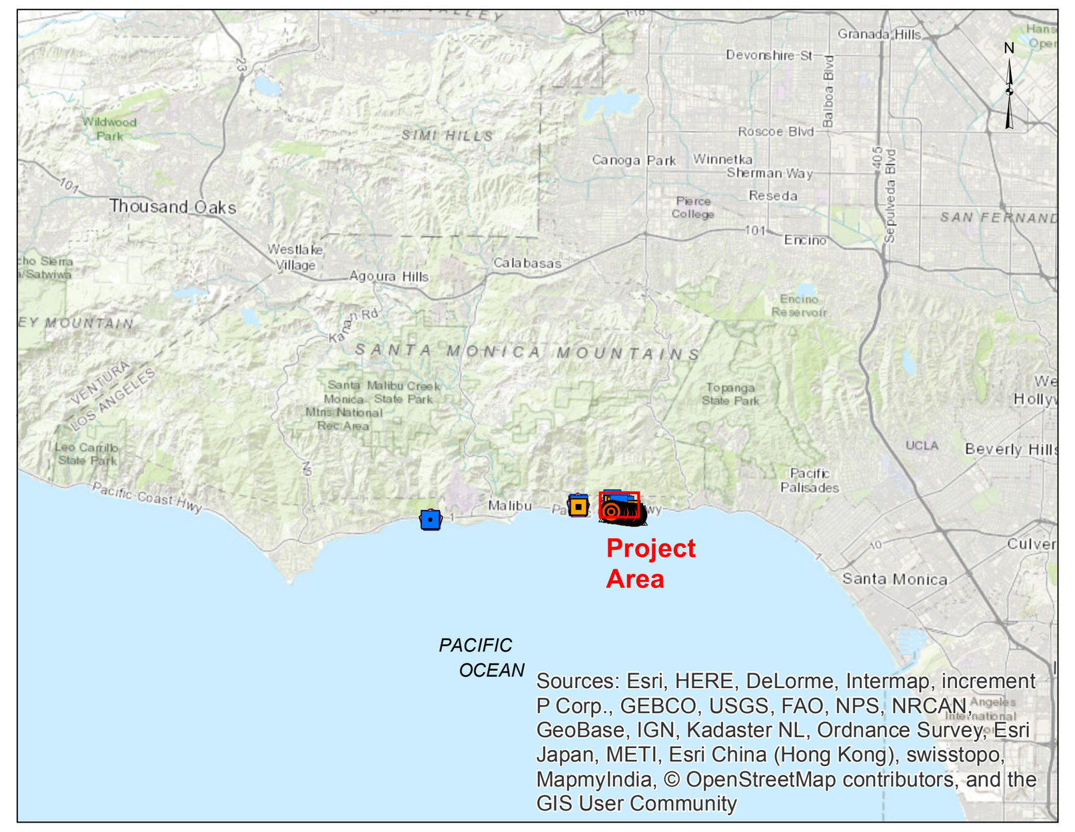
N:\Projects\04_2014\04_6214_0606_City_of_Malibu_BigRockMesa\Outputs\2014_01_02_AnnualReport\MXD\Plate-01_SiteLocation.mxd, 10/22/2019, d.thornhill



BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
MALIBU, CALIFORNIA

DEWATERING FACILITIES MAP

FUGRO USA LAND, INC.
4820 McGrath St., Suite 100, Ventura, California 93003
Tel: (805) 650-7000, Fax: (805) 650-7010



LEGEND

- Standpipe
- Dewatering Well (In Service)
- Hydrauger (In Service) Color Referenced to Inferred Storm Drain Outfall
- Storm Drain Outfall
- Catch Basin
- Discharge Point
- Hydrauger
- Approximate Limits of Primary Land Movement
- Western Extension Boundary
- Big Rock Mesa Landslide Assessment District Boundary
- Storm Drain
- Trees/Brush
- Streams
- Building
- Coordinate Grid: California State Plane, Zone 7, NAD 27, Feet; Vertical Datum: NAVD88 Feet

N

SCALE: 1:2,400

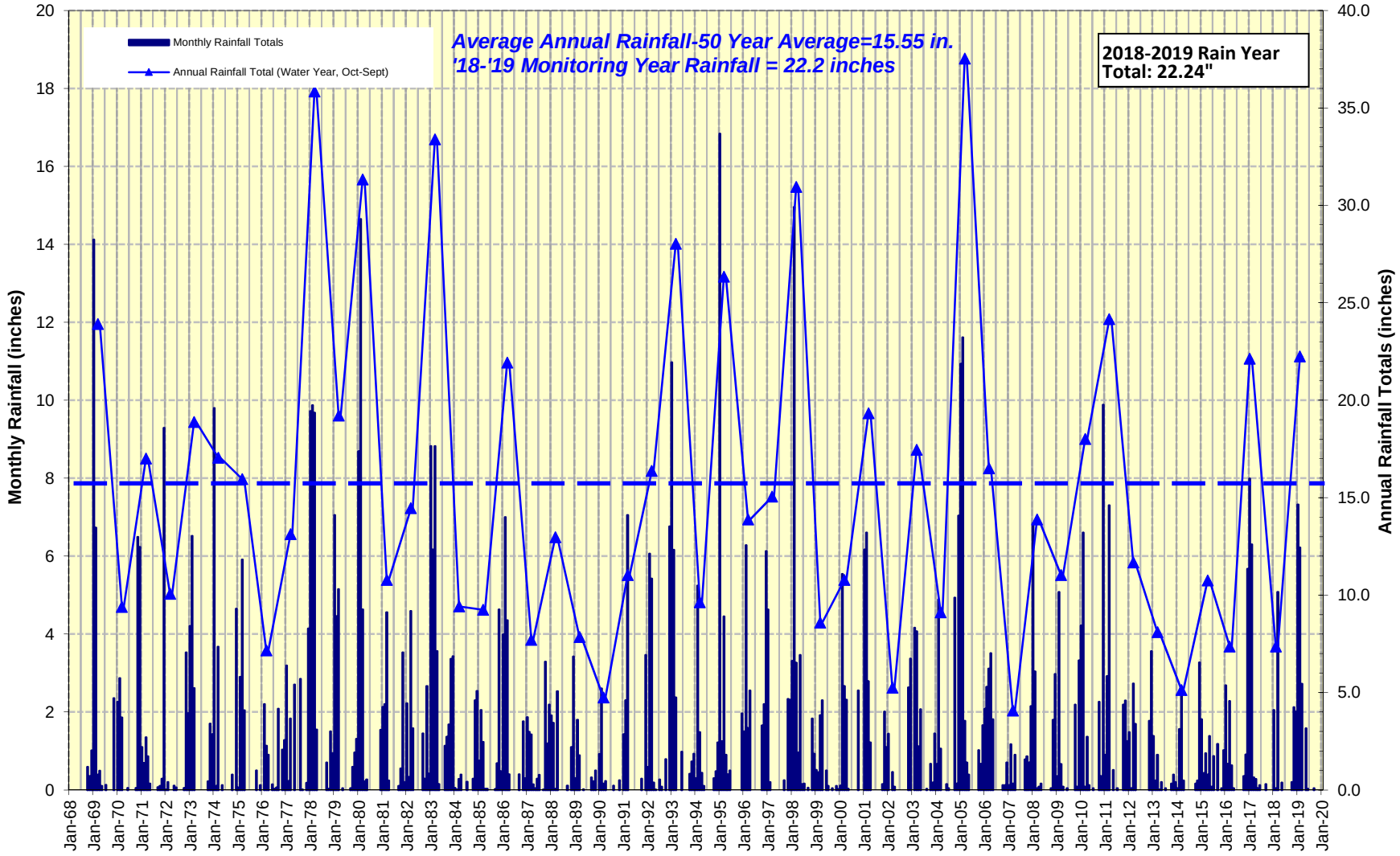
200 100 0 200 Feet

REVISIONS

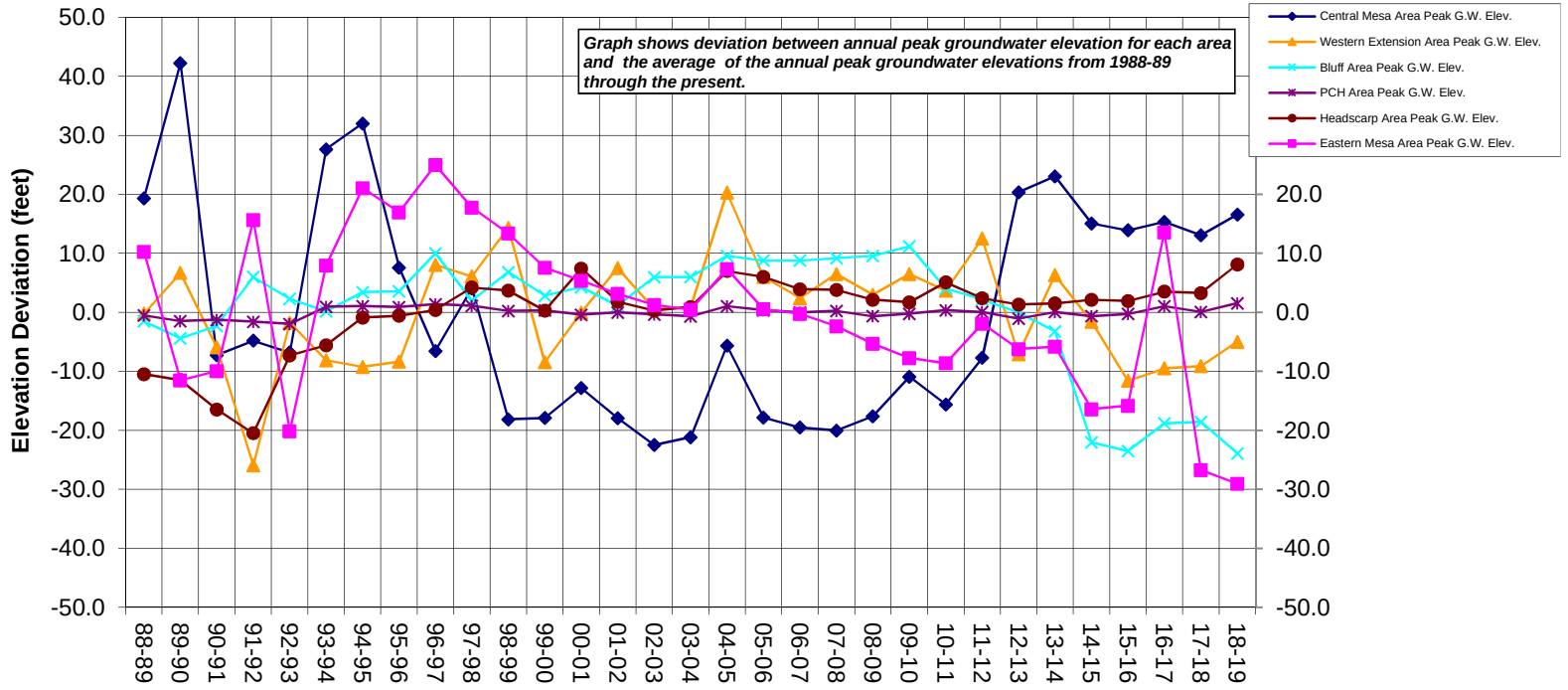
No.	DATE	DESCRIPTION	BY	No.	DATE	DESCRIPTION	BY
1	5/04/15	Discharge Pts.	TN				
2	9/24/18	Standpipes	DT				

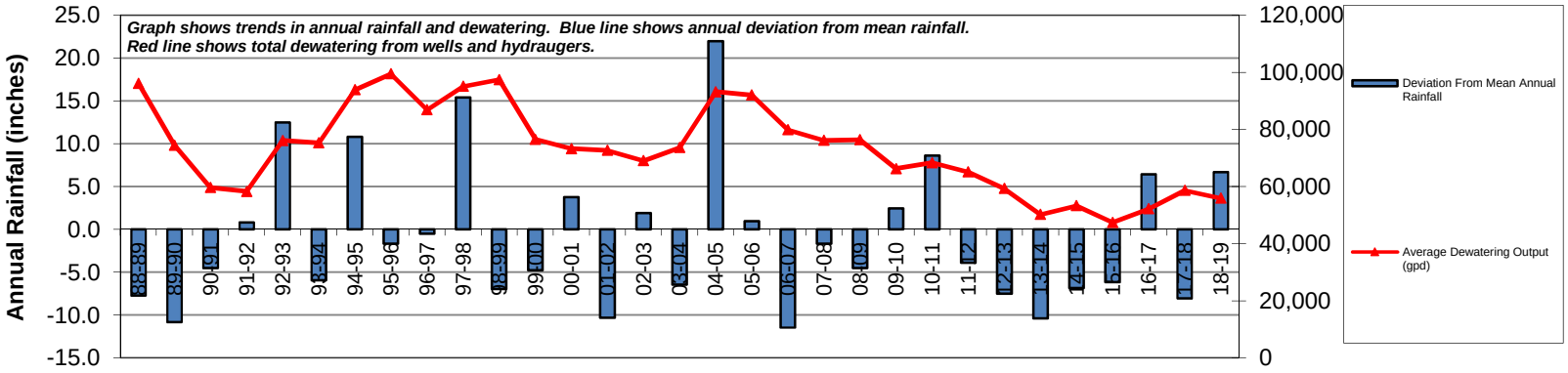
DATE:	WORK ORDER:	PLATE NO.:
September 24, 2015	04.62160606	2

DRAWN BY:	CHECKED BY:	APPROVED BY:
TN	TC	TN

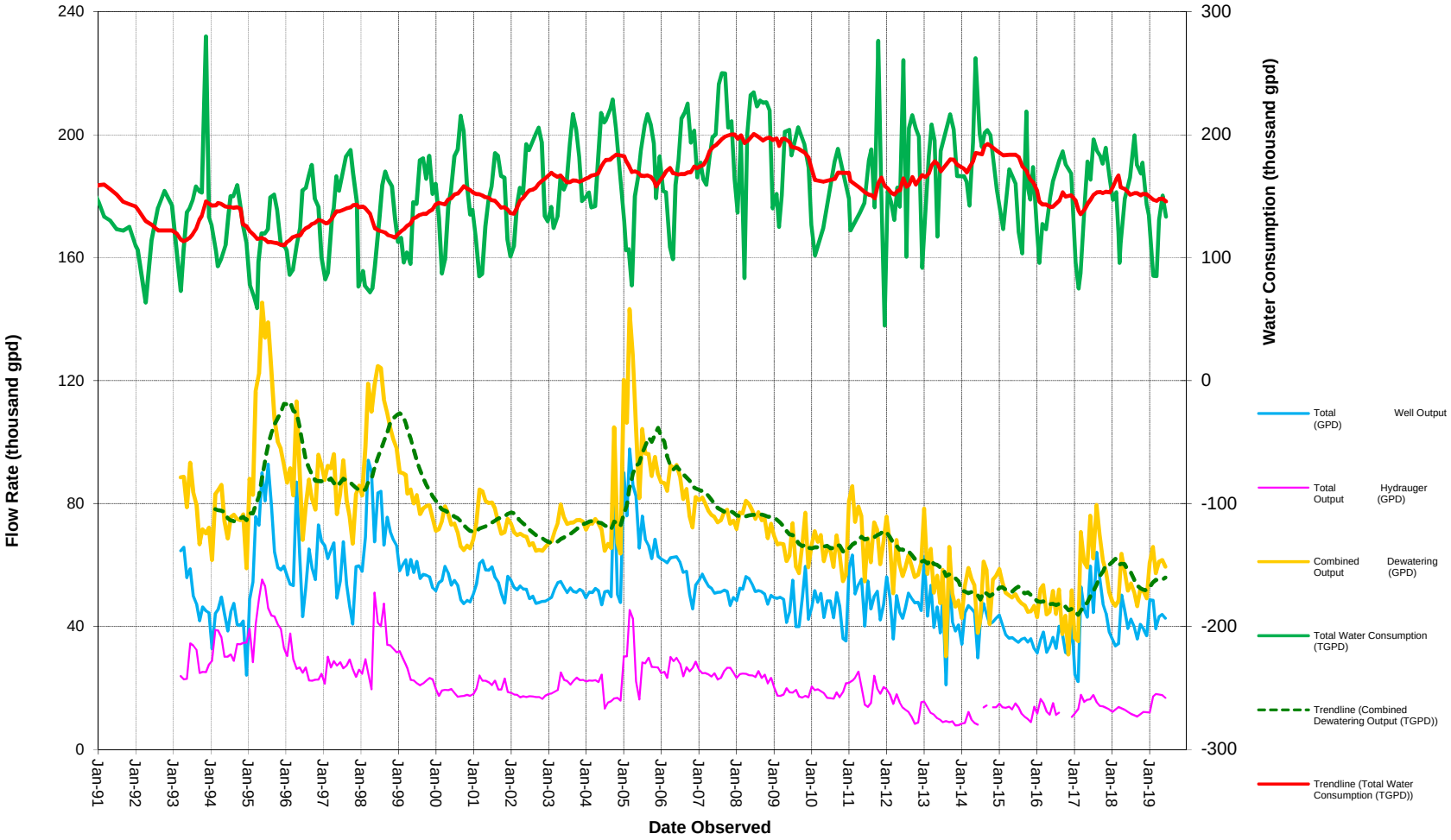


RAINFALL GRAPH
Big Rock Mesa Landslide Assessment District
Malibu, California



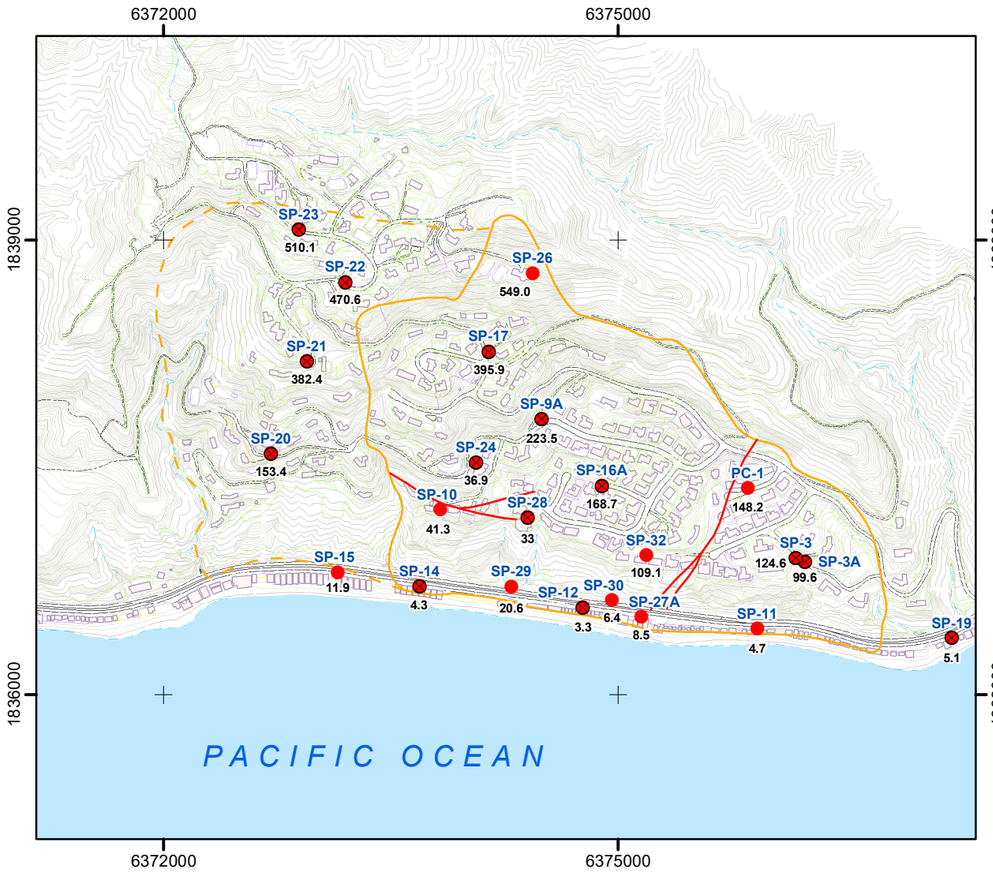


SUMMARY OF GROUNDWATER LEVELS, DEWATERING, AND RAINFALL
Big Rock Mesa Landslide Assessment District
Malibu, California

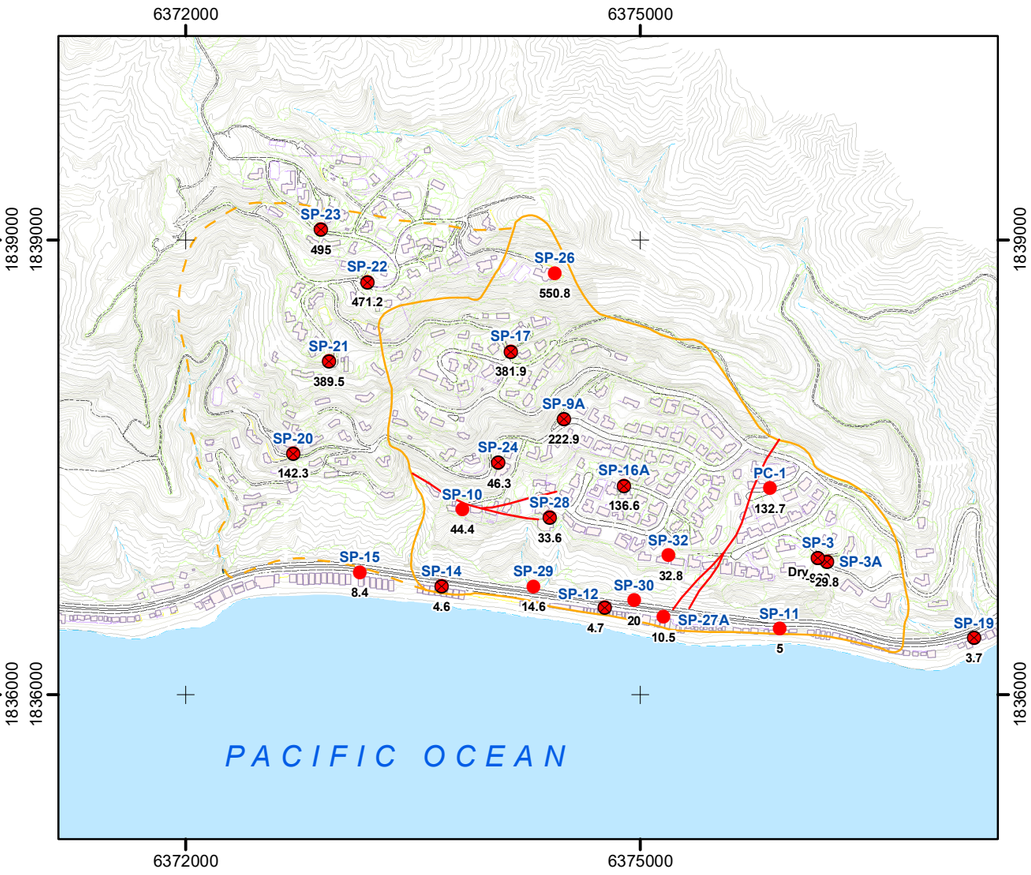


TOTAL DEWATERING PRODUCTION AND TOTAL WATER CONSUMPTION
Wells & Hydraugers (Combined) / Total Water Consumption
Big Rock Mesa Landslide Assessment District
Malibu, California

Groundwater Elevation (May 8, 1995)



Groundwater Elevation (May 20, 2019)



Legend

Instrumentation

- Slope Inclinometer, does not Penetrate Rupture Surface
- Slope Inclinometer, does Penetrate Rupture Surface
- SP-16 / 400 — Instrument Label and Ground Water Elevation in feet

Site Map Features

- Faults
- Approximate Landslide Limits
- Approximate Western Extension Limits
- Buildings

N

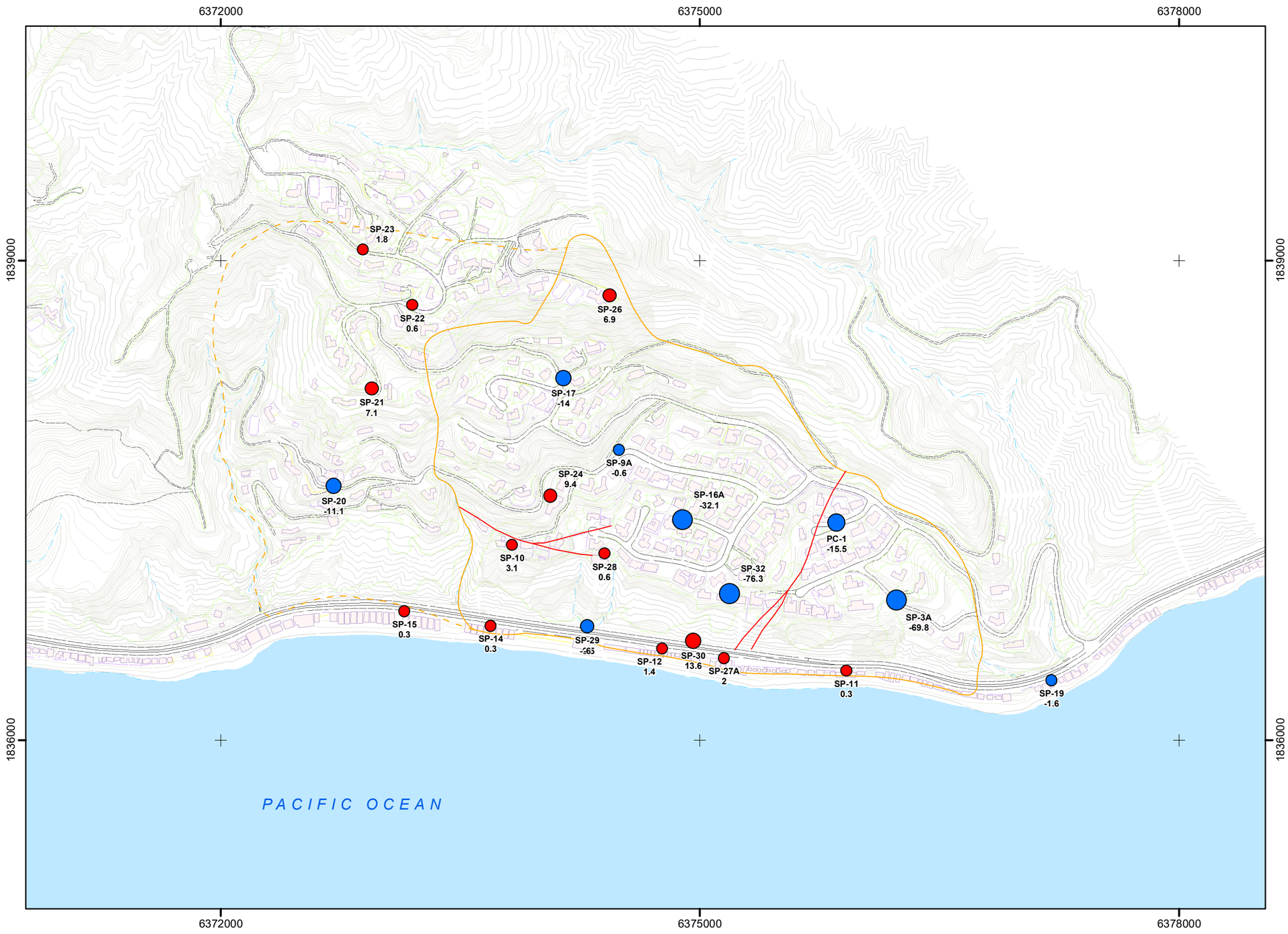
1:12,000

1,000 500 0 1,000 Feet

GROUNDWATER ELEVATION MAP
MAY 1995 AND MAY 2019
Big Rock Mesa Landslide
Assessment District
Malibu, California

PLATE 6a

N:\Projects\04_2014\04_6214_0606_City_of_Malibu_BigRockMesa\Outputs\2017_8_22_AnnualReport2017\mxd\Plate-05a_WaterLevel_95_17.mxd, 10/22/2019, d.thornhill



Legend

Groundwater Elevation Change (Feet)

- < -20
- -15 to -20
- -10 to -15
- -5 to -10
- -5 to 0
- 0 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- > 20

SP-16 -3.1 — Instrument Label and Ground Water Elevation Change in feet

Site Map Features

- Faults
- Approximate Landslide Limits
- Approximate Western Extension Limits
- Buildings

N

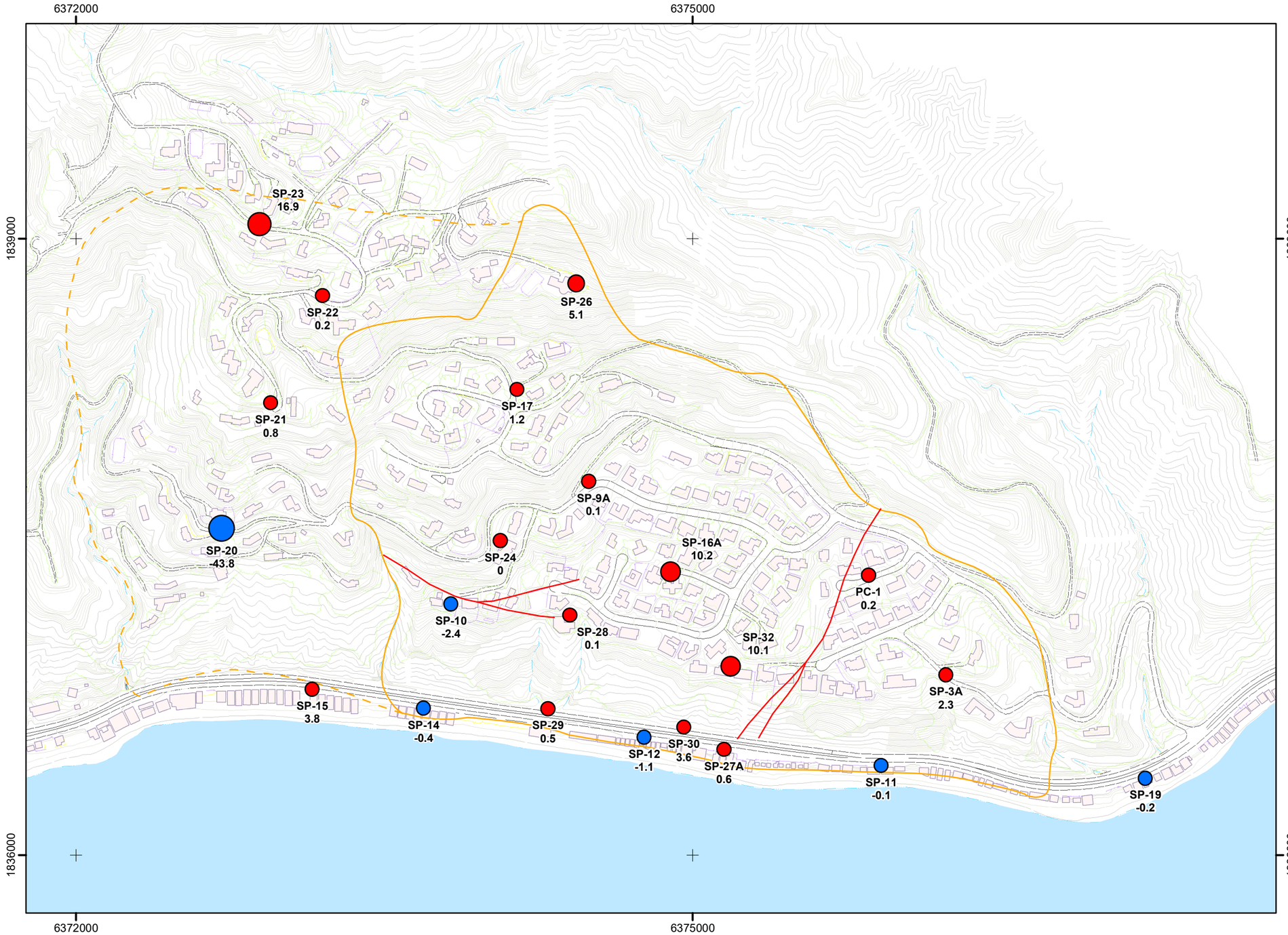
1:7,657

0 125250 500 750 1,000 Feet

CHANGE IN GROUNDWATER ELEVATION MAY 1995 TO MAY 2019
Big Rock Mesa Landslide
Assessment District
Malibu, California

PLATE 6b

N:\Projects\04_2014\04_6214_0606_City_of_Malibu_BigRockMesa\Outputs\2017_8_22_AnnualReport2017\mxd\Plate-05b_WaterLevelChange_95_17.mxd, 10/23/2019, d.thornhill



Legend

Instrumentation

SP-16
3.6 — Instrument Label and Ground Water Elevation Change in feet

Site Map Features

- Faults
- Approximate Landslide Limits
- Approximate Western Extension Limits
- Buildings

Groundwater Elevation Change (Feet)

- < -20
- -20 to -15
- -15 to -10
- -10 to -5
- -5 to 0
- 0 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- > 20

N

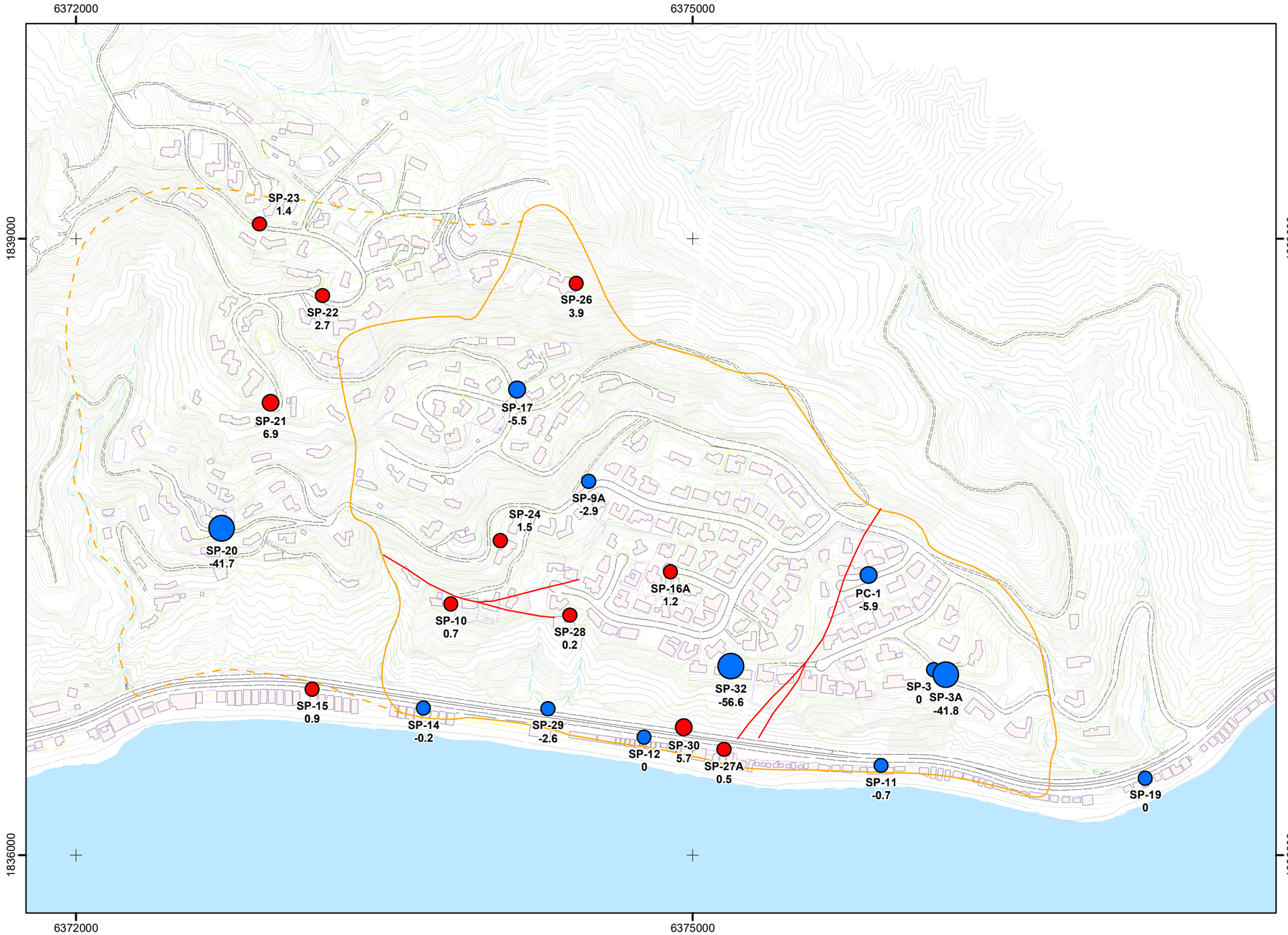
1:6,000

0 125 250 500 750 1,000 Feet

CHANGE IN GROUNDWATER ELEVATION MAY 2018 TO MAY 2019
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE 6c

N:\Projects\04_2014\04_6214_0606_City_of_Malibu_BigRockMesa\Outputs\2017_8_22_AnnualReport2017\mxd\Plate-05c_WaterLevelChange_15_17.mxd, 10/24/2019, d.thornhill



Legend

Instrumentation

SP-16
3.6 — Instrument Label and Ground Water Elevation Change in feet

Site Map Features

- Faults
- Approximate Landslide Limits
- Approximate Western Extension Limits
- Buildings

Groundwater Elevation Change (Feet)

- < -20
- -20 to -15
- -15 to -10
- -10 to -5
- -5 to 0
- 0 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- > 20

N

1:6,000

0 125 250 500 750 1,000 Feet

2018-2019 AVERAGE VS 1991-2019 AVERAGE GROUNDWATER ELEVATION
Big Rock Mesa Landslide
Assessment District
Malibu, California

PLATE 6d

N:\Projects\04_2014\04_6214_0606_City_of_Malibu_BigRockMesa\Outputs\2017_8_22_AnnualReport2017\mxd\Plate-05c_WaterLevelChange_15_17.mxd, 10/23/2019, d.thornhill

APPENDIX A
GROUNDWATER LEVEL DATA

Big Rock Mesa: Standpipe Piezometer Information				
Piezometer ID	**Surface Elev. (ft)**	**Depth (ft)**	**Perforation Interval Elevation (ft)**	**Installer**
PCH Standpipe Piezometers				
SP-11	27	58	Unknown	Evans
SP-12	26	40	Unknown	Evans
SP-14	25	30	Unknown	Evans
SP-15	20	82	Unknown	Evans
SP-19	25	82	Unknown	Evans
SP-27A	29	94	Unknown	Evans
SP-29	27	138	Unknown	Evans
SP-30	29	128	Unknown	Evans
Bluff Standpipe Piezometers				
SP-10	295	332	Unknown	Evans
SP-28	270	358	Unknown	Evans
SP-32	233	354	Unknown	Evans
SP-34	270	382	-112 to -107	BYA
Headscarp Piezometers				
SP-26	745	346	Unknown	Conv
Central Standpipe Piezometers				
SP-9A	365	300	Unknown	Evans
SP-16	285	240	Unknown	Evans
SP-16A	285	392	Unknown	Evans
SP-17	540	192	Unknown	Evans
SP-17A	540	238	Unknown	BYA
SP-24	370	382	Unknown	Conv
SP-35	345	396	-51 to -46	BYA
SP-36	380	254	120 to 125	BYA
Western Standpipe Piezometers				
SP-20	430	326	Unknown	Conv
SP-21	660	280	Unknown	Evans
SP-22	780	332	Unknown	Conv
SP-23	860	398	Unknown	Conv
Eastern Standpipe Piezometers				
PC-1	250	160	87.5 to 90	BYA
SP-3	212	132	Unknown	Evans
SP-3A	203	246	Unknown	Evans
SP-33	208	374	Unknown	Evans

Evans - D.A. Evans
Converse - Converse Consultants
BYA - Bing Yen and Associates

STANDPIPE PIEZOMETER INFORMATION
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-1a

PNEUMATIC PIEZOMETER INFORMATION					
Piezometer ID	**Surface Elev. (ft)**	**Tip No.**	**TIP DEPTH (ft.)**	**INSTALL BY**	**STATUS**
W-10**	432	230	230	BYA	No air-line, has sounder acess, no data reported
W-11**	507	214	214	BYA	Air-line present, no sounder access, no data reported
W-15**	295	164	164	BYA	Air-line present, no sounder access, no data reported
PC-1	250	TIP-1	120	BYA	Functioning, reported
		TIP-2	90		0 PSI since November 2011
		TIP-3	70		Functioning, reported
		TIP-4	40		Non-Functioning, no return air flow, not reported
		TIP-5	20		Non-Functioning, no return air flow, not reported
SP-5A*	NA	TIP-1		BYA	Non-functioning - Covered by asphalt pavement
		TIP-2	NA		
		TIP-3			
SP-8A*	NA	TIP-1		BYA	Non-functioning - Covered by landslide
		TIP-2	NA		
		TIP-3			
SP-17A*	540	TIP-1	Unknown	BYA	Non-functioning, no return air flow
		TIP-2	Unknown		
		TIP-3	Unknown		
		TIP-4	Unknown		
		TIP-5	Unknown		
SP-34	270	TIP-1	381	BYA	Non-Functioning, no return air flow, not reported
		TIP-2	282		Functioning, reported
		TIP-3	182		Low PSI since installation, not reported
		TIP-4	82		Non-Functioning, no return air flow, not reported
SP-35	345	TIP-1	393	BYA	Functioning, reported
		TIP-2	293		Functioning, reported
		TIP-3	193		Non-Functioning, no return air flow, not reported
		TIP-4	98		Non-Functioning, no return air flow, not reported
SP-36	380	TIP-1	255	BYA	Functioning, reported
		TIP-2	195		Functioning, reported
		TIP-3	95		0 PSI since installation, not reported
BYA-2*	665	TIP-1	Unknown	BYA	Non-functioning, no return air flow
		TIP-2	Unknown		
		TIP-3	Unknown		
BYA-3A*	NA	TIP-1		BYA	Non-Functioning
		TIP-2			
		TIP-3	NA		
		TIP-4			
BYA-4A*	NA	TIP-1		BYA	Non-functioning, no return air flow
		TIP-2			
		TIP-3	NA		
		TIP-4			
		TIP-5			
		TIP-6			
BYA-5A*	NA	TIP-1		BYA	Non-Functioning, Paved over
		TIP-2	NA		
		TIP-3			
		TIP-4			
GEO-2 (OB-2)*	305	TIP-1		GS	Non-Functioning
		TIP-2	NA		
		TIP-3			
GEO-1*	NA	TIP-1		GS	Restricted Access (possibly malfunctioning)
		TIP-2	NA		
		TIP-3			

NOTE: * Not functioning or no longer monitored pneumatic peizometer
** Inactive dewatering well air-line

PNEUMATIC PIEZOMETER INFORMATION
Big Rock Mesa Landslide Assessment District
Malibu, California

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Piezometer I.D.		1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	**2018-2019**	Highest Recorded	Mean '91 - '19	Stand Dev.	'18-'19 vs '97-'98	'18-'19 vs '17-'18	'18-'19 vs mean
PCH REGION																																											
SP-11	Mean El.						5.7	5.3	4.7	4.5	5.7	5.7	5.5	5.8	5.5	5.8	6.3	5.5	4.8	5.4	5.4	5.2	5.3	5.1	5.4	4.9	4.6	5.1	8.4	7.8	4.7	4.8	5.0	5.3	5.7	5.9	4.8	Jul-16	*5.5*	*0.9*	*-1.0*	*-1.1*	*-0.7*
	Highest El.						6.4	5.8	5.5	5.0	6.0	7.4	6.9	7.5	6.7	7.3	8.1	6.5	5.5	8.3	7.0	5.7	5.8	5.9	7.6	5.9	5.2	5.6	11.8	8.8	5.0	5.1	5.9	6.1	7.2	7.2	5.2	11.8	*6.7*	*1.5*	*-2.1*	*-2.0*	*-1.4*
SP-12	Mean El.						4.6	5.4	5.5	5.4	5.2	4.8	4.9	5.1	4.8	5.0	5.3	5.3	4.7	4.5	4.8	4.6	5.5	5.2	4.9	4.8	4.7	4.0	4.7	4.2	5.2	5.2	5.2	6.0	6.4	5.9	5.0	Feb-17	*5.0*	*0.5*	*0.0*	*-0.8*	*0.0*
	Highest El.						4.6	5.4	6.0	6.0	6.0	7.2	6.1	6.3	7.4	7.0	6.4	6.5	7.4	6.4	6.4	6.4	8.3	7.2	6.4	5.8	5.7	5.1	5.3	5.2	5.5	5.8	6.2	8.8	8.8	7.8	6.9	8.81	*6.6*	*1.0*	*-0.1*	*-0.9*	*0.3*
SP-14	Mean El.					4.5	4.7	4.4	4.8	4.3	4.8	4.9	4.9	4.9	5.0	5.9	5.8	5.6	4.7	4.5	4.6	4.6	4.7	4.8	4.7	4.7	4.3	4.3	4.3	4.1	5.2	5.6	4.5	5.1	4.9	4.9	4.7	Feb-98	*4.8*	*0.5*	*-1.2*	*-0.2*	*-0.2*
	Highest El.					4.5	4.7	4.4	5.2	5.4	7.1	6.1	5.3	5.9	5.7	8.7	6.9	7.4	5.4	5.7	5.1	5.4	5.4	5.7	5.5	6.0	5.1	5.0	4.6	4.9	5.5	5.5	5.7	6.0	6.2	5.8	5.9	8.7	*5.8*	*0.8*	*-2.8*	*0.1*	*0.1*
SP-15	Mean El.					11.3	8.8	10.5	9.1	7.5	10.7	13.4	12.6	15.1	14.5	12.2	12.0	11.7	11.6	11.5	11.7	10.0	11.9	11.6	11.6	11.4	8.9	8.4	7.2	7.6	5.5	5.7	8.6	10.6	10.6	8.8	11.4	Jan-97	*10.5*	*2.4*	*-0.8*	*2.6*	*0.9*
	Highest El.					11.3	12.2	10.5	11.4	9.1	12.4	19.4	19.5	19.9	20.0	16.3	13.5	12.7	12.4	12.5	12.4	12.2	12.8	12.4	12.2	12.2	11.1	12.2	10.1	10.2	5.9	6.2	12.0	12.2	12.4	10.6	12.5	20.0	*12.8*	*3.5*	*-3.8*	*1.9*	*-0.3*
SP-19	Mean El.							3.6	3.6	3.1	4.5	4.4	4.7	4.6	4.3	4.4	4.5	3.8	3.4	3.7	3.5	3.4	3.9	3.6	3.6	3.5	3.1	3.6	3.7	3.6	3.0	3.6	3.4	3.4	3.5	3.7	3.8	Mar-95	*3.7*	*0.5*	*-0.6*	*0.0*	*0.0*
	Highest El.							4.1	4.0	3.4	5.0	5.0	5.9	5.4	4.9	5.2	5.0	4.5	3.9	4.3	4.1	4.0	4.2	4.5	4.4	4.1	3.6	4.6	4.0	4.3	3.3	4.2	4.1	3.6	4.1	4.2	5.5	5.9	*4.4*	*0.6*	*0.3*	*1.3*	*1.1*
SP-27A	Mean El.						7.1	9.1	8.8	8.7	9.3	9.4	9.7	9.5	9.5	9.7	9.6	10.1	9.2	9.0	9.5	9.3	10.2	9.7	9.5	10.0	9.5	10.0	10.0	9.7	10.5	17.1	9.7	9.1	10.0	9.9	10.4	Jun-15	*9.9*	*1.5*	*0.6*	*0.5*	*0.5*
	Highest El.						7.1	10.1	9.2	10.2	10.0	10.2	10.8	10.3	10.4	10.7	10.4	13.7	9.6	9.7	9.9	9.8	13.5	12.5	10.2	13.7	10.1	10.6	10.5	10.5	10.8	17.8	10.0	10.1	12.8	10.3	15.5	17.8	*11.2*	*2.0*	*4.8*	*5.2*	*4.2*
SP-29	Mean El.					19.7	20.4	19.4	18.7	18.0		19.7	20.0	19.2	19.2	19.7	18.8	18.0	18.1	17.0	16.2	16.0	18.0	17.7	16.7	16.3	15.8	15.9	16.2	15.8	16.7	15.7	14.4	13.9	14.5	14.3	14.3	Feb-05	*16.9*	*1.8*	*-5.5*	*-0.1*	*-2.6*
	Highest El.					19.7	21.7	19.4	18.7	18.0		20.9	22.1	20.2	20.5	21.3	19.9	19.1	19.6	18.1	16.7	16.4	22.2	18.7	17.4	16.9	16.1	16.6	16.9	17.1	16.9	16.8	14.7	14.3	16.7	14.8	18.0	22.2	*18.0*	*2.2*	*-3.3*	*3.2*	*-0.1*
SP-30	Mean El.					7.4	7.1	6.4	7.2	6.9	7.7	7.3	7.9	8.1	9.6	8.0	8.5	9.0	9.7	11.3	12.6	12.9	13.0	13.4	13.4	14.4	15.1	15.7	16.2	15.8	16.5	16.8	13.6	13.8	16.0	16.5	18.1	Feb-19	*12.4*	*3.5*	*10.1*	*1.7*	*5.7*
	Highest El.					7.4	8.0	6.4	8.0	8.0	8.0	9.3	9.6	9.4	13.3	10.2	9.6	10.1	10.8	12.6	14.3	13.4	14.3	14.1	14.2	15.3	15.5	16.4	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	20.9	20.9	*13.8*	*3.5*	*10.7*	*3.7*	*7.1*
Area Average	Mean El.					10.7	8.3	8.0	7.8	7.3	6.8	8.7	8.8	9.1	9.1	8.8	8.8	8.6	8.3	8.4	8.5	8.2	9.1	8.9	8.7	8.7	8.2	8.4	8.8	8.6	8.4	9.3	8.1	8.4	9.0	8.7	9.1		*8.6*	*0.5*	*0.2*	*0.3*	*0.5*
	Highest El.					10.7	9.2	8.3	8.5	8.1	7.8	10.7	10.8	10.6	11.1	10.8	10.0	10.1	9.3	9.7	9.5	9.2	10.8	10.1	9.7	10.0	9.1	9.5	10.1	9.8	8.8	9.8	9.5	9.8	10.7	9.7	11.3		*9.9*	*0.8*	*0.5*	*1.6*	*1.4*
Change vs Prior	Mean El.						-2.4	-0.3	-0.2	-0.5	-0.4	1.8	0.1	0.3	0.0	-0.2	0.0	-0.2	-0.3	0.1	0.2	-0.3	0.8	-0.2	-0.2	0.0	-0.5	0.2	0.4	-0.3	-0.1	0.9	-1.3	0.3	0.6	-0.2	0.3						
	Highest El.						-1.5	-1.0	0.2	-0.4	-0.4	2.9	0.1	-0.2	0.5	-0.3	-0.9	0.1	-0.7	0.4	-0.2	-0.3	1.7	-0.7	-0.4	0.3	-0.9	0.5	0.5	-0.3	-1.0	1.1	-0.3	0.3	0.9	-0.9	1.6						
BLUFF REGION																																											
SP-10	Mean El.	144.7	76.0	50.0	50.5	49.2	47.4	45.9	48.8	55.3	44.6	42.9	41.6	42.0	41.6	41.3	42.4	42.8	42.9	43.3	43.7	44.3	45.5	45.2	45.2	44.8	43.7	44.0	43.9	42.6	43.7	43.5	43.9	45.8	44.8	45.8	44.8	Dec-83	*44.1*	*2.5*	*3.6*	*-1.0*	*0.7*
	Highest El.	174.2	130.0	50.0	50.5	50.0	52.0	46.0	55.5	74.0	45.9	44.4	42.2	42.6	41.9	41.6	44.8	43.4	43.3	43.6	44.1	44.4	47.2	45.4	45.4	45.2	44.9	44.6	46.0	44.7	44.1	44.0	44.3	48.7	47.3	55.4	47.3	174.2	*46.1*	*6.1*	*5.7*	*-8.1*	*1.2*
SP-28	Mean El.						36.4	33.7	37.5	33.7	33.6	33.7	33.0	32.7	32.2	31.9	32.6	33.2	33.1	33.0	32.9	32.9	34.9	34.7	33.3	33.1	32.8	33.1	32.8	35.2	32.8	32.8	33.4	33.4	33.3	33.4	33.4	Jan-12	*33.2*	*0.7*	*1.5*	*0.0*	*0.2*
	Highest El.						40.5	33.8	40.0	36.0	35.2	35.2	33.1	33.1	32.4	32.2	34.9	33.6	33.2	33.3	33.0	32.9	36.1	36.0	33.6	33.1	33.1	33.4	33.8	42.0	33.7	33.6	33.4	33.5	33.6	33.6	33.6	42.0	*34.1*	*1.9*	*1.4*	*0.0*	*-0.5*
SP-32	Mean El.						75.3	79.1	72.6	76.1	90.1	85.9	92.5	92.5	94.9	76.5	84.2	79.7	88.2	70.1	89.9	91.1	99.9	100.2	102.3	102.4	104.4	105.1	102.3	104.8	106.4	105.6	35.0	24.0	34.3	34.8	25.5	Apr-96	*82.1*	*26.3*	*-51.0*	*-9.3*	*-56.6*
	Highest El.						78.2	82.3	72.8	83.2	101.0	96.2	110.2	110.2	130.9	107.4	95.3	88.4	97.0	83.6	106.0	105.8	106.7	105.9	105.9	105.8	105.8	105.8	105.9	106.9	106.9	107.1	41.3	30.3	55.0	47.1	33.7	130.9	*92.3*	*26.0*	*-73.7*	*-13.3*	*-58.6*
SP-34	Mean El.																74.4	77.6	76.2	76.4	73.5	73.8	80.0	79.7	82.8	84.5	86.0	88.6	53.2	44.7	37.1	35.9	24.7	24.2	20.6	22.8	22.2	Nov-09	*59.0*	*25.6*	*22.2*	*-0.6*	*-36.8*
	Highest El.																85.9	79.5	77.3	77.7	74.4	74.5	82.1	81.4	83.8	86.1	88.0	94.5	64.5	48.8	48.7	36.2	26.7	27.1	22.7	23.3	23.6	94.5	*62.2*	*25.7*	*23.6*	*0.3*	*-38.6*
Area Average	Mean El.	144.7	76.0	50.0	50.5	49.2	53.0	52.9	53.0	55.0	56.1	54.2	55.7	55.7	56.2	49.9	58.4	58.3	60.1	55.7	60.0	60.5	65.1	64.9	65.9	66.2	66.7	67.7	58.0	56.8	55.0	54.5	34.2	31.9	33.2	34.2	31.5		*54.3*	*11.1*	*-18.4*	*-2.7*	*-22.9*
	Highest El.	174.2	130.0	50.0	50.5	50.0	56.9	54.0	56.1	64.4	60.7	58.6	61.8	62.0	68.4	60.4	65.2	61.2	62.7	59.6	64.4	64.4	68.0	67.2	67.2	67.6	68.0	69.6	62.5	60.6	58.4	55.2	36.4	34.9	39.6	39.8	34.5		*58.7*	*10.9*	*-25.9*	*-5.3*	*-24.2*
Change vs Prior	Mean El.		-68.7	-26.0	0.5	-1.3	3.8	-0.2	0.1	2.0	1.1	-1.9	1.5	0.1	0.5	-6.3	8.5	-0.1	1.8	-4.4	4.3	0.5	4.6	-0.1	0.9	0.3	0.5	0.9	-9.6	-1.2	-1.8	-0.5	-20.2	-2.4	1.4	0.9	-2.7						
	Highest El.		-44.2	-80.0	0.5	-0.5	6.9	-2.9	2.1	8.3	-3.7	-2.1	3.2	0.1	6.4	-8.0	4.8	-4.0	1.5	-3.2	4.8	0.0	3.6	-0.8	0.0	0.4	0.4	1.6	-7.0	-2.0	-2.2	-3.1	-18.8	-1.5	4.8	0.2	-5.3						
HEADSCARP REGION																																											
SP-26	Mean El.				541.9	540.2	538.9	535.8	532.4	527.0	532.6	543.6	543.3	547.8	547.1	549.9	551.9	549.8	550.7	550.6	549.1	550.7	553.1	554.7	553.8	552.9	551.4	551.2	552.5	551.9	551.0	551.4	552.1	551.9	552.0	552.3	553.2	May-19	*549.3*	*6.1*	*3.3*	*0.9*	*3.9*
	Highest El.				542.0	540.2	540.0	539.0	534.0	530.0	543.2	544.9	549.6	549.9	550.9	554.7	554.2	550.8	557.9	552.3	550.8	551.4	557.5	556.5	554.4	554.3	552.6	552.2	555.6	552.9	551.8	552.0	552.6	552.4	554.0	553.8	558.6	558.6	*551.8*	*5.4*	*3.8*	*4.8*	*6.7*
Change vs Prior	Mean El.		0.0	0.0	541.9	-1.6	-1.4	-3.1	-3.3	-5.4	5.6	11.0	-0.3	4.4	-0.7	2.8	2.1	-2.1	0.9	-0.1	-1.5	1.6	2.5	1.5	-0.9	-0.9	-1.5	-0.2	1.4	-0.6	-0.9	0.4	0.6	-0.1	0.1	0.3	0.9						
	Highest El.		0.0	0.0	542.0	-1.8	-0.2	-1.0	-5.0	-4.0	13.2	1.7	4.7	0.3	1.0	3.8	-0.5	-3.4	7.1	-5.6	-1.5	0.6	6.1	-1.0	-2.1	-0.1	-1.7	-0.4	3.4	-2.8	-1.1	0.2	0.6	-0.1	1.5	-0.2	4.8						

Piezometer Not Installed

No Data Recorded

GROUNDWATER ELEVATION DATA ANALYSIS
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-2a

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

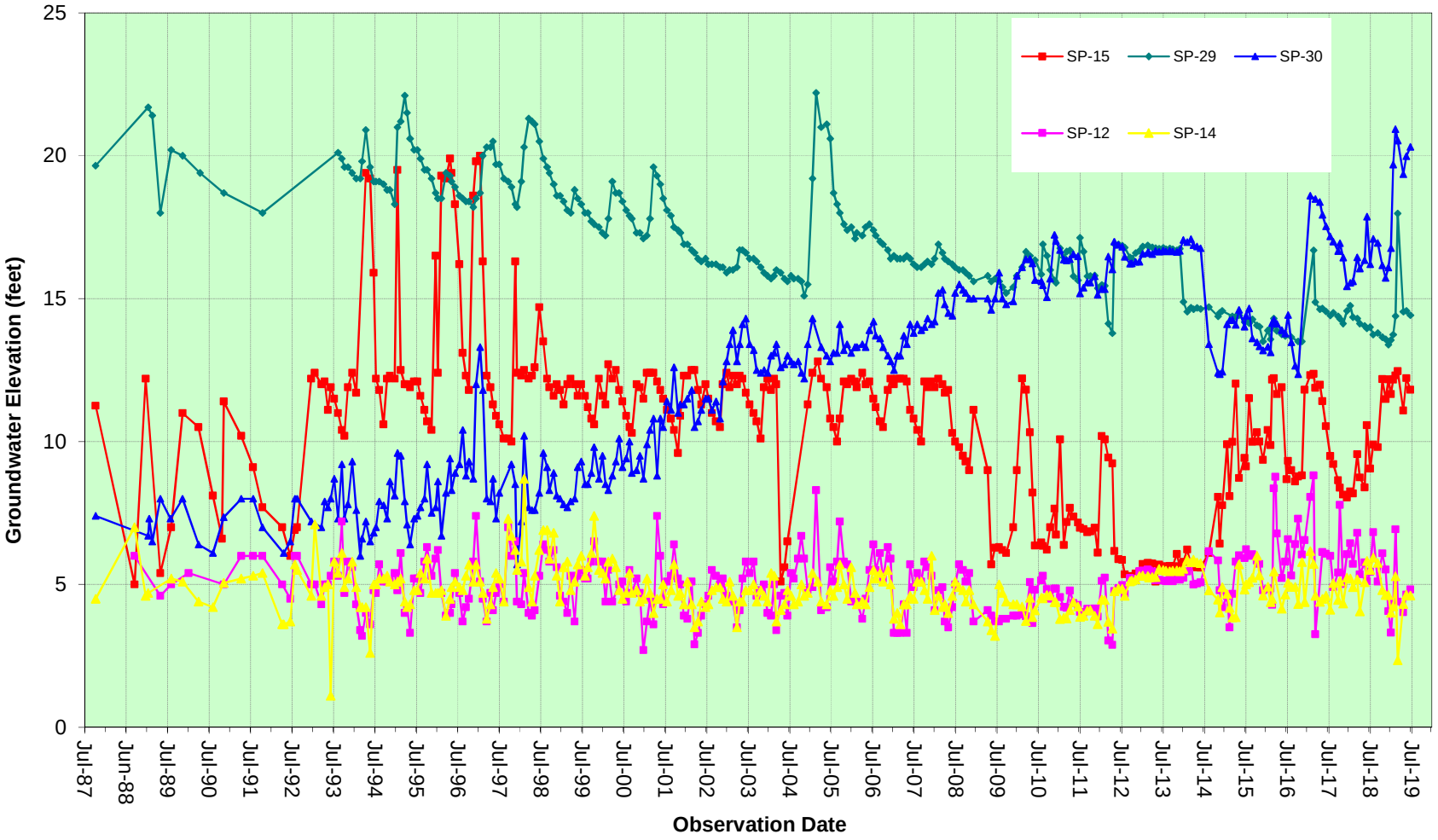
Piezometer I.D.		1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	**2018-2019**	Highest Recorded	Mean '91 - '19	Stand Dev.	'18-'19 vs '97-'98	'18-'19 vs '17-'18	'18-'19 vs mean
CENTRAL MESA																																										
SP-9A	Mean El.	254.7	232.0	232.0	227.5	236.3	222.2	220.0	233.3	215.1	221.9	226.8	220.8	222.0	222.0	224.6	226.8	226.4	228.0	229.3	229.5	230.0	229.7	229.9	228.3	227.5	227.1	227.7	226.6	230.6	230.6	238.6	224.9	223.5	222.7	223.7	223.5	Dec-83	*226.4*	*4.3*	*-1.1*	*-0.3*	*-2.9*
	Highest El.	270.0	232.0	232.0	232.0	236.3	224.0	222.2	235.2	222.9	228.5	228.5	225.5	223.8	223.7	231.1	229.0	226.9	231.0	230.6	232.3	231.5	232.5	231.9	229.7	229.7	228.4	229.2	227.5	238.6	238.6	238.9	225.7	224.2	227.7	227.6	226.8	270.0	*229.4*	*4.2*	*-4.3*	*-0.9*	*-2.6*
SP-16	Mean El.	226.5	195.4	174.3	171.9	171.5	161.8	113.0	86.5	95.7				68.2	47.9	48.0	46.5	48.4	53.1	47.9	46.0	46.6	87.0	51.6	50.1	50.1	53.7	107.8	117.4	81.8	63.3	56.9	92.6	92.0	72.9	80.6	126.2	Mar-84	*69.3*	*24.6*	*78.2*	*45.6*	*56.9*
	Highest El.	226.5	214.7	180.3	174.2	177.1	182.5	147.8	89.5	121.0				117.8	61.3	66.5	53.5	78.7	89.7	64.4	46.6	49.2	124.0	57.7	50.9	61.8	79.4	121.3	121.1	120.5	75.4	58.2	117.5	113.6	121.0	131.3	138.3	226.5	*89.6*	*31.5*	*71.8*	*7.1*	*48.7*
SP-16A	Mean El.					181.2	153.3	122.0	108.4	108.3	122.2	125.7	147.9	127.6	113.4	126.0	126.8	149.2	180.8	146.0	105.0	133.0	185.1	182.1	180.1	165.8	173.7	166.3	136.0	106.3	149.4	130.0	128.9	111.4	110.3	112.9	140.2	Jan-05	*138.9*	*25.6*	*14.2*	*27.3*	*1.2*
	Highest El.					181.2	180.3	148.8	124.5	124.5	184.5	169.1	186.3	182.3	154.9	185.5	182.4	189.4	184.5	183.9	170.0	183.0	196.2	183.8	182.8	184.4	181.8	183.1	153.7	131.9	149.7	149.6	169.8	150.3	158.1	145.2	156.2	196.2	*169.9*	*19.0*	*-29.4*	*11.0*	*-13.7*
SP-17	Mean El.	406.0	401.8	395.3	399.1	398.3	393.3	392.0	385.1	382.7		385.5	390.1	389.3	388.3	393.6	390.0	385.6	389.1	386.9	387.9	388.6	393.8	393.6	391.9	388.4	386.8	386.1	387.5	385.4	386.0	385.9	381.1	379.4	382.5	381.3	381.5	Jan-84	*387.0*	*3.9*	*-12.1*	*0.2*	*-5.5*
	Highest El.	410.0	403.0	395.3	400.1	400.0	401.0	394.1	386.0	383.2		389.8	404.3	396.5	396.5	408.8	395.5	386.9	399.2	389.1	396.4	392.0	406.5	398.1	401.5	392.5	394.8	397.0	393.0	388.0	386.1	386.8	382.0	380.0	390.3	381.8	384.3	410.0	*392.6*	*7.7*	*-24.5*	*2.5*	*-8.4*
SP-17A	Mean El.						360.1	377.4	376.6	374.5	379.2	379.8	377.8	379.3	377.2	379.1	379.1	375.3	376.6	375.6	374.9	376.0	378.0	379.4	378.4	375.3	374.2	372.8	373.4	374.6	376.5	375.2	369.7	367.8	368.4	369.1	369.0	Feb-94	*375.2*	*3.6*	*-10.1*	*-0.1*	*-6.2*
	Highest El.						372.4	378.5	377.7	375.7	385.0	389.8	384.4	381.6	380.5	386.7	382.9	376.4	381.1	377.3	376.5	377.2	385.2	383.4	380.7	376.3	376.3	373.7	375.0	376.2	377.0	376.8	370.6	368.7	369.8	369.8	369.7	389.8	*378.0*	*5.6*	*-17.0*	*-0.1*	*-8.3*
SP-17B	Mean El.																														511.9	510.9	463.3	463.5	468.2	467.3	467.1	Feb-13	*478.9*	*22.3*		*-0.2*	*-11.8*
	Highest El.																														511.9	511.9	463.6	464.7	468.2	468.4	467.7	511.9	*479.5*	*22.2*		*-0.7*	*-11.8*
SP-24	Mean El.	195.3	102.1	49.0	49.2		49.0		35.1	38.6	38.5	38.9	37.2	39.0	39.1	40.0	41.6	41.4	41.7	42.3	41.4	43.3	46.3	47.6	46.1	45.3	45.6	47.0	46.7	43.0	36.8	87.9	47.8	49.0	46.7	46.6	46.2	Mar-84	*44.7*	*9.2*	*6.2*	*-0.5*	*1.5*
	Highest El.	220.6	170.0	50.0	52.0		52.0		39.6	40.0	38.9	41.0	39.6	39.6	39.8	42.0	43.3	42.2	43.0	43.7	41.8	44.0	51.0	50.2	48.2	46.0	46.0	49.0	47.5	45.1	38.9	142.6	50.0	49.8	49.6	46.9	46.8	220.6	*48.1*	*18.9*	*4.8*	*-0.1*	*-1.3*
SP-35	Mean El.																92.2	88.3	93.6	97.4	90.5	89.4	90.8	88.2	86.8	85.9	86.0	89.4	88.1	104.1	94.8	94.1	100.1	119.2	100.6	96.9	103.7	Feb-16	*94.3*	*8.0*		*6.8*	*9.4*
	Highest El.																101.3	91.0	104.0	102.9	92.7	90.6	95.2	89.0	87.2	86.4	90.2	95.8	94.1	112.9	96.9	94.7	109.7	127.2	106.0	100.7	112.6	127.2	*99.1*	*10.3*		*11.9*	*13.5*
SP-36	Mean El.																193.3	193.0	192.8	192.3	191.4	191.0	191.4	191.3	191.0	190.7	190.1	190.4	190.6	201.3	196.5	191.2	190.7	190.6	191.2	190.6	190.1	Jun-12	*192.0*	*2.6*		*-0.5*	*-1.9*
	Highest El.																195.2	193.4	193.0	192.7	191.9	191.2	192.2	191.8	191.3	190.9	190.5	191.4	191.3	253.0	253.1	192.2	190.8	191.0	191.8	191.4	190.7	253.1	*197.7*	*18.5*		*-0.7*	*-7.0*
Area Average	Mean El.	270.6	232.8	212.6	211.9	246.8	223.3	244.9	204.1	202.5	190.4	231.3	234.7	204.2	198.0	201.9	187.0	188.4	194.5	189.7	183.3	187.2	200.3	195.4	194.1	191.1	192.1	198.4	195.8	190.9	227.3	230.1	222.1	221.8	218.2	218.8	227.5		*204.2*	*16.2*	*25.6*	*8.7*	*23.3*
	Highest El.	281.8	254.9	214.4	214.6	248.7	235.4	258.3	208.8	211.2	209.2	243.6	248.0	223.6	209.5	220.1	197.9	198.1	203.2	198.1	193.5	194.8	210.4	198.2	196.5	196.0	198.4	205.1	200.4	208.3	236.4	239.1	231.1	229.9	231.4	229.2	232.6		*214.1*	*17.1*	*12.5*	*3.3*	*18.5*
Change vs Prior	Mean El.		-37.8	-20.2	-0.7	34.9	-23.5	21.6	-40.8	-1.7	-12.0	40.9	3.4	-30.5	-6.2	3.9	-14.8	1.4	6.0	-4.7	-6.4	3.9	13.0	-4.8	-1.4	-3.0	1.0	6.3	-2.7	-4.9	36.4	2.8	-7.9	-0.3	-3.7	0.6	8.7						
	Highest El.		-26.9	-40.5	0.2	34.1	-13.3	22.9	-49.5	2.5	-2.0	34.4	4.4	-24.4	-14.2	10.7	-22.2	0.2	5.1	-5.1	-4.6	1.3	15.5	-12.1	-1.7	-0.5	2.4	6.6	-4.7	7.9	28.1	2.7	-8.0	-1.1	1.4	-2.2	3.3						
WESTERN EXTENSION																																										
SP-20	Mean El.	317.0	254.6	220.5	213.3	194.5	217.5	186.2	198.8	160.3	184.9	175.1	149.8	155.0	162.1	165.5	231.8	196.9	204.6	195.8	186.4	183.1	219.7	228.8	230.9	237.6	221.0	215.9	214.3	202.2	151.2	177.1	198.3	187.1	165.4	176.2	148.5	Feb-84	*190.2*	*27.5*	*-17.0*	*-27.7*	*-41.7*
	Highest El.	350.0	277.0	224.0	216.7	194.5	231.0	214.5	202.4	165.5	233.0	223.3	159.4	158.6	211.6	224.7	290.1	202.4	221.4	247.1	187.6	196.3	248.2	234.7	235.8	245.6	237.3	234.4	226.0	219.0	151.4	203.7	219.4	205.7	185.2	193.0	172.4	350.0	*211.9*	*32.4*	*-52.3*	*-20.6*	*-39.5*
SP-21	Mean El.		436.7	407.0		404.0	403.1	402.2	390.5	351.1	353.5	356.0	369.8	368.9	368.7	372.4	374.6	379.5	388.5	387.7	379.4	378.6	390.4	394.0	391.2	388.1	383.9	385.8	386.3	392.3	389.7	389.2	381.8	382.3	387.3	388.6	387.2	Apr-94	*380.2*	*11.8*	*14.8*	*-1.4*	*6.9*
	Highest El.		450.9	407.0		405.0	407.0	410.4	399.1	358.9	361.2	358.0	393.9	374.3	377.1	396.4	379.3	389.6	401.2	393.0	385.5	381.9	408.9	403.3	396.4	393.2	387.5	392.5	394.7	395.0	389.9	389.9	383.6	383.2	396.5	390.1	398.4	450.9	*387.6*	*12.6*	*2.0*	*8.2*	*10.7*
SP-22	Mean El.		461.1	450.5	451.9	447.5	450.5	451.4	451.0	454.3	457.5	455.3	463.9	462.1	468.9	466.0	468.6	468.8	469.2	470.8	473.0	471.2	471.9	470.2	469.9	469.1	467.9	470.0	470.7	466.9	464.8	465.1	473.1	469.6	470.4	469.2	470.1	Dec-96	*467.4*	*4.9*	*4.2*	*0.9*	*2.7*
	Highest El.		493.5	450.5	454.1	450.9	455.7	451.4	451.3	468.0	471.3	464.5	477.0	469.6	501.5	470.4	470.7	471.0	474.2	471.1	476.6	475.1	475.1	471.0	470.9	470.9	469.7	470.9	472.8	470.6	465.1	466.8	477.5	471.2	472.6	471.0	477.9	501.5	*472.7*	*6.6*	*7.5*	*6.8*	*5.2*
SP-23	Mean El.					514.2	491.0	499.2	495.6	486.0	496.6	500.8	508.6	511.6	501.5	500.4	486.7	478.0	473.9	476.2	488.9	486.1	496.1	490.7	489.8	494.1	499.8	503.6	495.4	511.1	550.8	519.2	479.0	478.4	482.1	488.2	496.8	May-12	*495.4*	*15.8*	*-3.6*	*8.6*	*1.4*
	Highest El.					514.2	491.0	536.0	509.1	489.4	513.1	507.3	518.2	549.6	527.6	518.4	502.7	488.7	488.6	504.5	538.1	535.7	534.6	500.5	492.0	502.0	503.1	514.0	506.7	551.1	551.0	550.4	498.7	479.2	493.2	495.0	517.0	551.1	*513.2*	*21.4*	*-1.4*	*22.0*	*3.7*
Area Average	Mean El.	317.0	384.2	359.3	332.6	390.0	390.5	384.7	384.0	362.9	373.1	371.8	373.0	374.4	375.3	376.1	390.4	380.8	384.0	382.6	381.9	379.8	394.5	395.9	395.5	397.2	393.1	393.9	391.7	393.1	389.1	387.7	383.0	379.3	376.3	380.6	375.7		*383.3*	*9.0*	*-0.4*	*-4.9*	*-7.7*
	Highest El.	350.0	407.1	360.5	335.4	391.2	396.2	403.1	390.5	370.5	394.7	388.3	387.1	388.0	404.5	402.5	410.7	387.9	396.4	403.9	397.0	397.3	416.7	402.4	398.8	402.9	399.4	402.9	400.1	408.9	389.3	402.7	394.8	384.8	386.9	387.3	391.4		*396.4*	*9.6*	*-11.1*	*4.1*	*-5.0*
Change vs Prior	Mean El.		67.2	-24.8	-26.7	57.4	0.5	-5.8	-0.8	-21.0	10.2	-1.4	1.2	1.4	0.9	0.8	14.4	-9.6	3.2	-1.4	-0.7	-2.2	14.8	1.4	-0.5	1.7	-4.1	0.7	-2.2	1.4	-4.0	-1.5	-4.6	-3.7	-3.0	4.3	-4.9						
	Highest El.		57.1	-46.6	-25.1	55.8	5.0	6.9	-12.6	-20.0	24.2	-6.4	-1.1	0.9	16.4	-2.0	8.2	-22.8	8.4	7.6	-7.0	0.3	19.4	-14.3	-3.6	4.1	-3.5	3.5	-2.9	8.9	-19.6	13.3	-7.9	-10.0	2.1	0.4	4.1						
EASTERN MESA																																										
PC-1	Mean El.												148.0	142.4	148.1	139.4	138.4	136.6	137.6	138.4	138.3	139.1	140.2	141.9	139.8	136.2	136.7	138.9	139.1	137.4	134.8	134.8	134.7	133.7	150.4	132.1	132.9	Jan-17	*138.8*	*4.6*	*-6.5*	*0.8*	*-5.9*
	Highest El.												148.2	145.2	190.0	153.5	138.9	137.5	138.8	138.9	139.2	139.6	142.4	142.5	141.5	137.2	138.1	140.4	140.0	140.2	135.2	135.1	135.4	134.6	219.7	132.7	134.7	219.7	*144.8*	*19.1*	*-18.8*	*1.9*	*-10.1*
SP-3	Mean El.	125.5	119.8	118.5	121.3	122.0	118.3			117.7		119.7	120.6	121.6	118.7	119.2	119.1	117.9	118.0	117.1	111.4	111.7	109.0	116.2	115.4	110.3	94.0	87.0	87.7	108.6	103.6	104.6	DRY	DRY	DRY	DRY	DRY	Nov-83			*10.3*		
	Highest El.	126.1	120.0	118.5	121.5	125.9	120.0			118.4		120.7	124.6	123.7	120.7	120.6	120.2	118.4	118.4	118.5	114.8	114.9	117.9	117.1	116.9	115.5	100.6	91.7	91.0	113.2	103.8	105.9	DRY	DRY	DRY	DRY	DRY	126.1			*9.4*		
SP-3A	Mean El.		105.0	74.0	79.5	75.7	79.2	80.5	82.5	89.5	86.3	88.6	87.6	99.1	94.1	96.1	96.8	79.2	77.0	75.1	72.3	62.5	67.8	68.7	68.5	67.1	65.7	64.7	64.1	67.0	64.7	66.5	57.6	56.1	44.6	30.0	29.1	Apr-85	*71.0*	*18.0*	*-66.9*	*-0.9*	*-41.8*
	Highest El.		105.0	74.0	81.4	78.4	80.0	81.0	85.4	99.0	90.5	94.0	100.3	101.2	95.6	103.6	101.4	83.0	82.2	76.1	74.1	72.0	93.5	70.2	69.7	68.2	66.7	66.8	65.1	69.8	66.9	66.9	65.5	57.9	49.6	32.1	30.2	105.0	*75.4*	*19.5*	*-73.4*	*-1.9*	*-45.2*
SP-33	Mean El.						41.6	39.0	38.3	34.4	8.7	16.5	-9.8	-16.3	-20.8	-21.3	-22.9	-25.6	-31.8	-34.3	-36.3	-37.9	-38.8	-40.5	-41.9	-43.2	-42.1	-42.6	-43.1	-45.1	-43.3	-43.7	-39.4	-28.8	-21.3	-33.5	-37.6	May-92	*-27.9*	*19.7*	*-16.3*	*-4.1*	*-9.7*
	Highest El.						46.7	39.8	38.5	45.5	13.1	24.9	-1.0	-14.6	-18.7	-19.1	-19.3	-20.8	-30.1	-33.0	-35.5	-37.1	-36.5	-39.9	-41.3	-42.5	-39.1	-42.1	-42.9	-43.0	-43.1	-43.4	-34.3	-24.2	-12.7	-29.1	-36.1	46.7	*-24.9*	*22.1*	*-17.0*	*-6.9*	*-11.2*
Area Average	Mean El.	125.5	112.4	96.3	100.4	98.8	79.7	59.8	60.4	80.5	47.5	74.9	86.6	86.7	85.1	83.3	82.8	77.1	75.2	74.1	71.4	68.9	69.6	71.6	70.5	67.6	63.6	62.0	61.9	67.0	65.0	65.6	51.0	53.7	57.9	42.9	41.5		*68.0*	*12.6*	*-41.9*	*-1.4*	*-26.6*
	Highest El.	126.1	112.5	96.3	101.5	102.2	82.2	60.4	62.0	87.6	51.8	79.9	93.0	88.9	96.9	89.7	85.3	79.5	77.3	75.1	73.2	72.4	79.3	72.5	71.7	69.6	66.6	64.2	63.3	70.0	65.7	66.1	55.5	56.1	85.5	45.2	42.9		*72.3*	*13.9*	*-46.7*	*-2.3*	*-29.4*
Change vs Prior	Mean El.		-13.1	-16.1	4.1	-1.6	-19.2	-19.9	0.6	20.1	-33.0	27.4	11.7	0.1	-1.6	-1.7	-0.5	-5.8	-1.8	-1.2	-2.6	-2.6	0.7	2.0	-1.1	-2.9	-4.0	-1.6	-0.1	5.0	-2.0	0.6	-14.6	2.7	4.2	-15.0	-1.4						
	Highest El.		-13.6	-16.3	5.2	0.7	-19.9	-21.9	1.6	25.7	-35.8	28.1	13.2	-4.1	8.0	-7.2	-4.4	-5.8	-2.2	-2.2	-2.0	-0.8	7.0	-6.9	-0.8	-2.1	-3.0	-2.4	-0.9	6.7	-4.3	0.4	-10.6	0.6	29.4	-40.3	-2.3						

Piezometer Not Installed

No Data Recorded

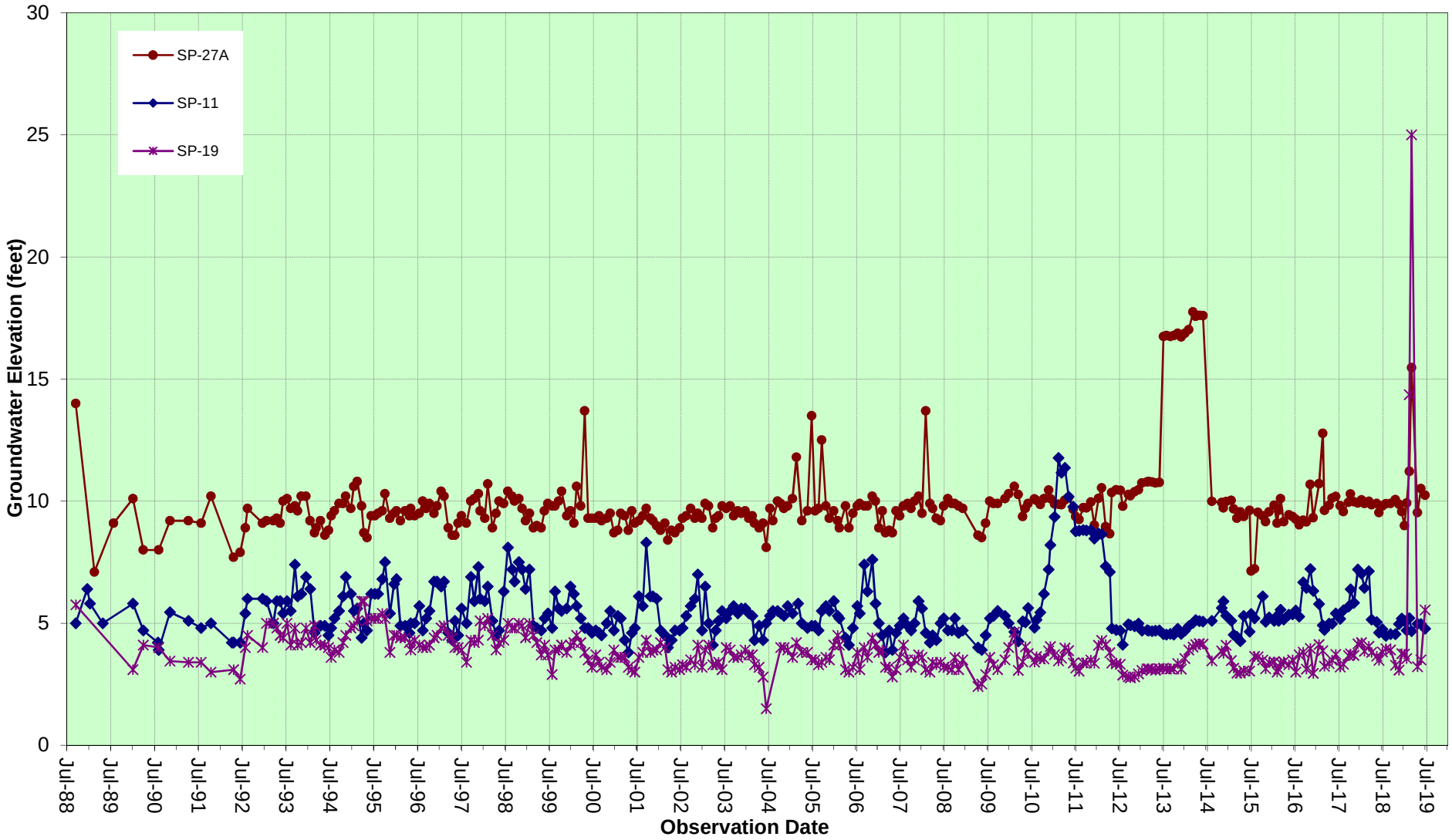
GROUNDWATER ELEVATION DATA ANALYSIS
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-2b



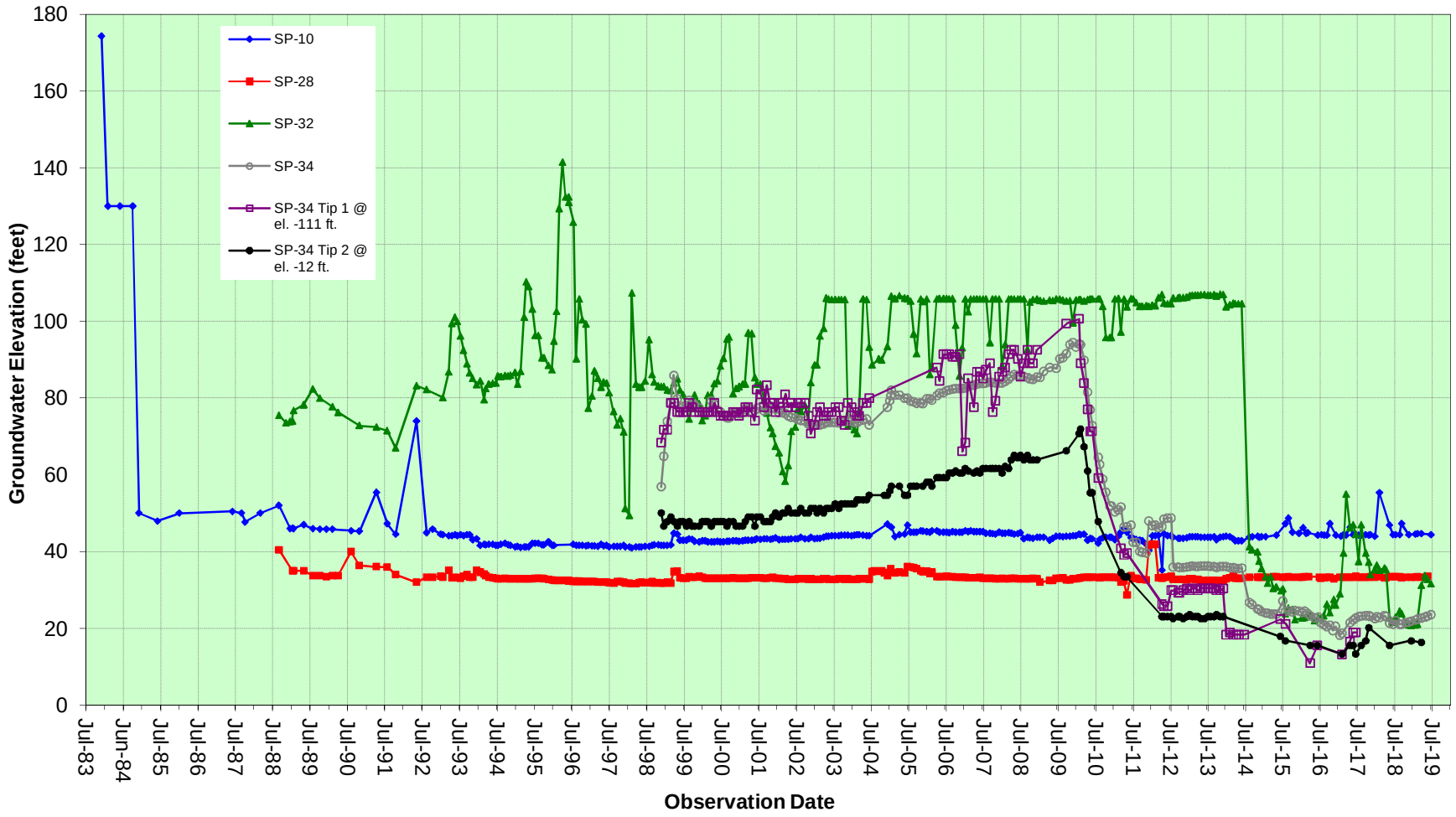
GROUNDWATER ELEVATION DATA
Pacifc Coast Highway (Western Half)
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-3a

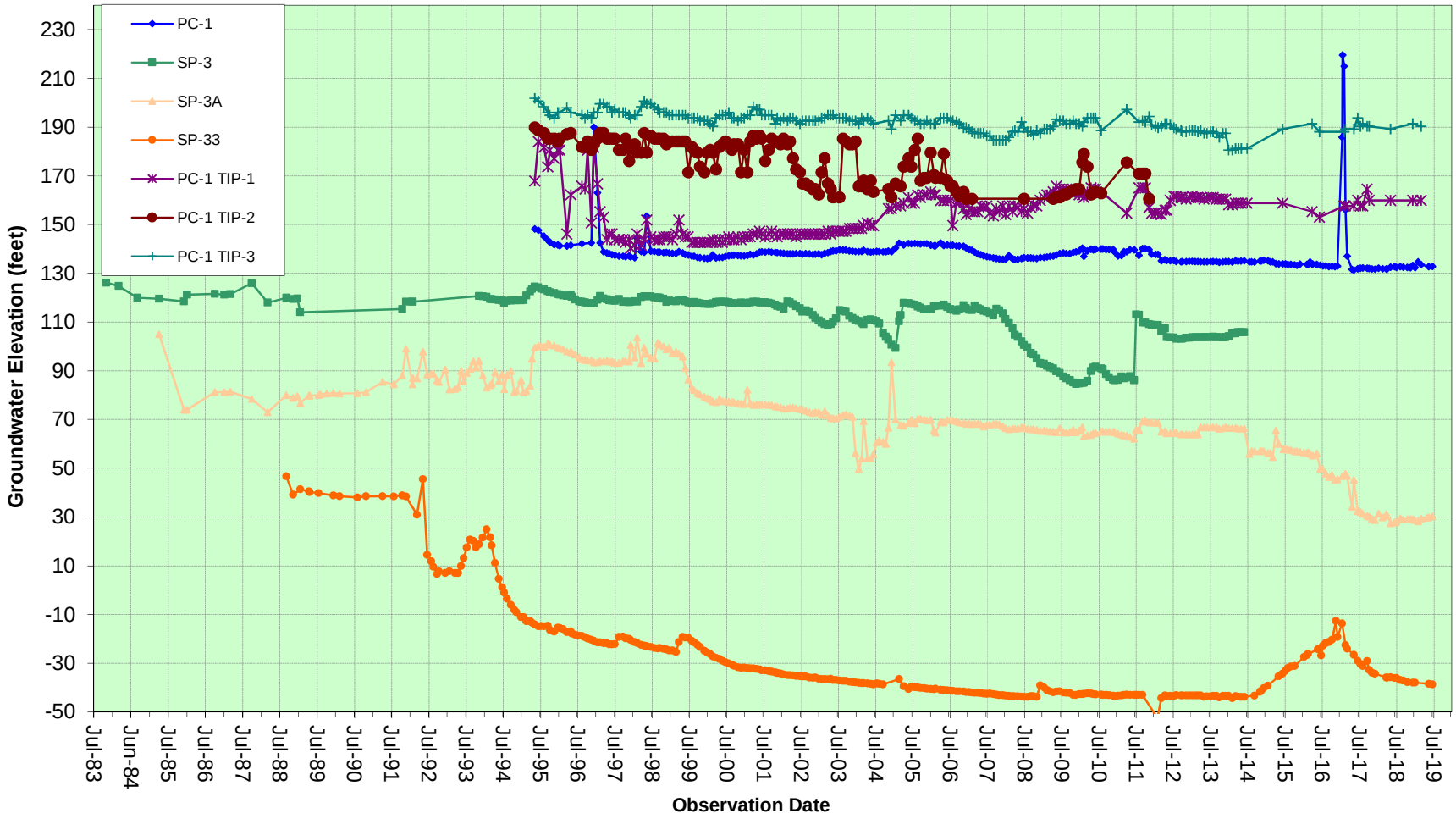


GROUNDWATER ELEVATION DATA
Pacific Coast Highway (Eastern Half)
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-3b

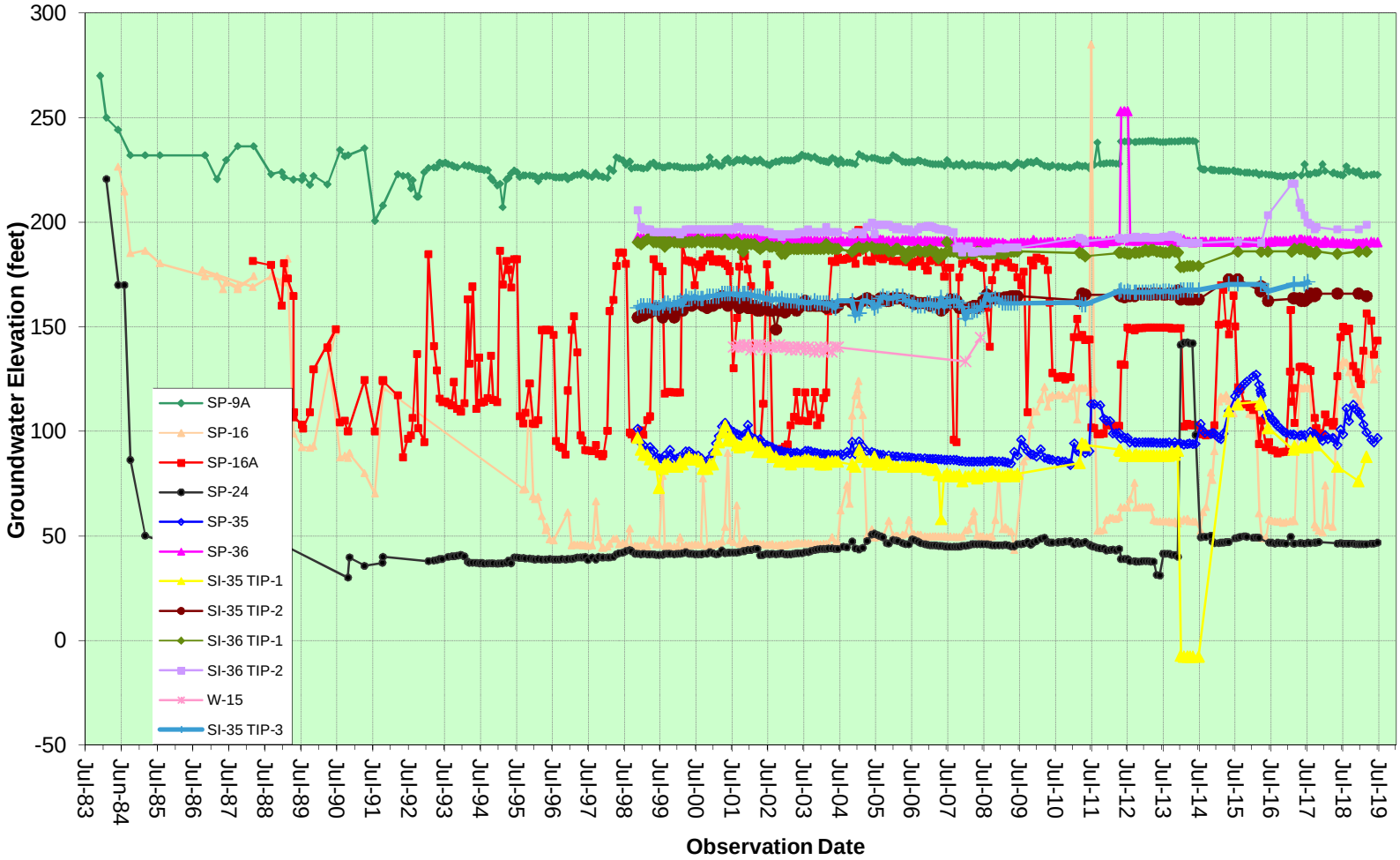


GROUNDWATER ELEVATION DATA
Bluff Region
Big Rock Mesa Landslide Assessment District
Malibu, California



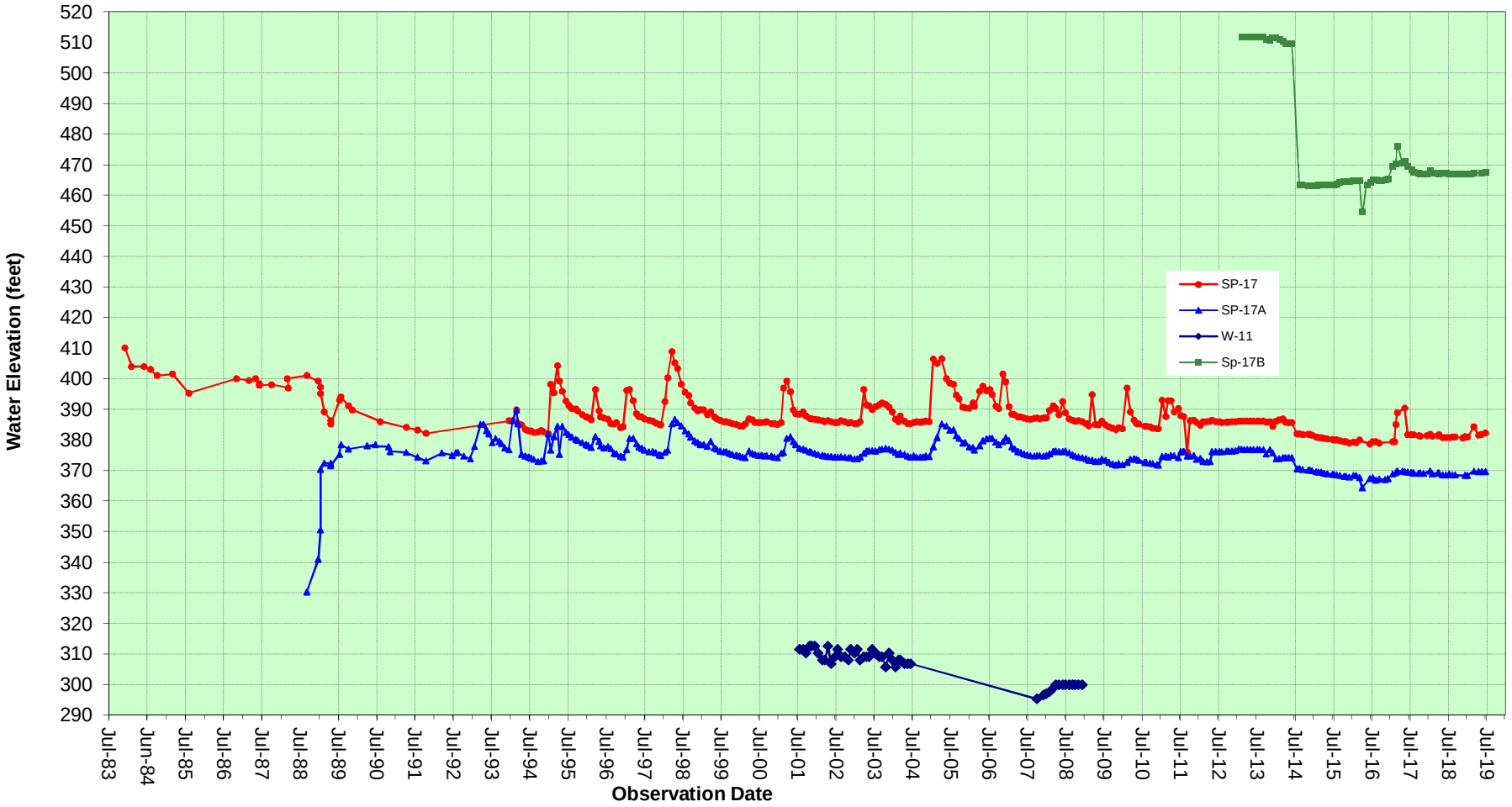
GROUNDWATER ELEVATION DATA
Eastern Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-5



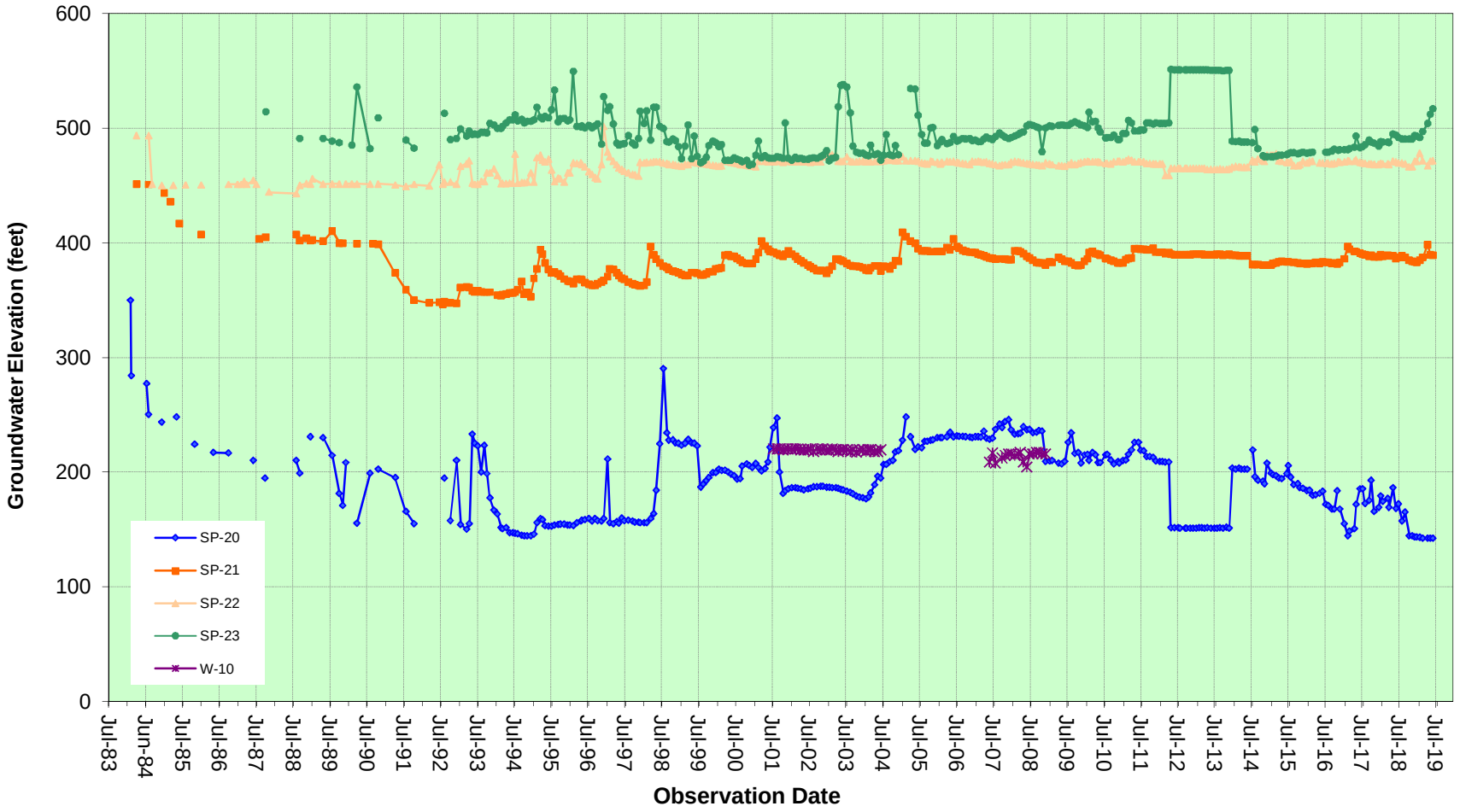
GROUNDWATER ELEVATION DATA
Central Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-6a



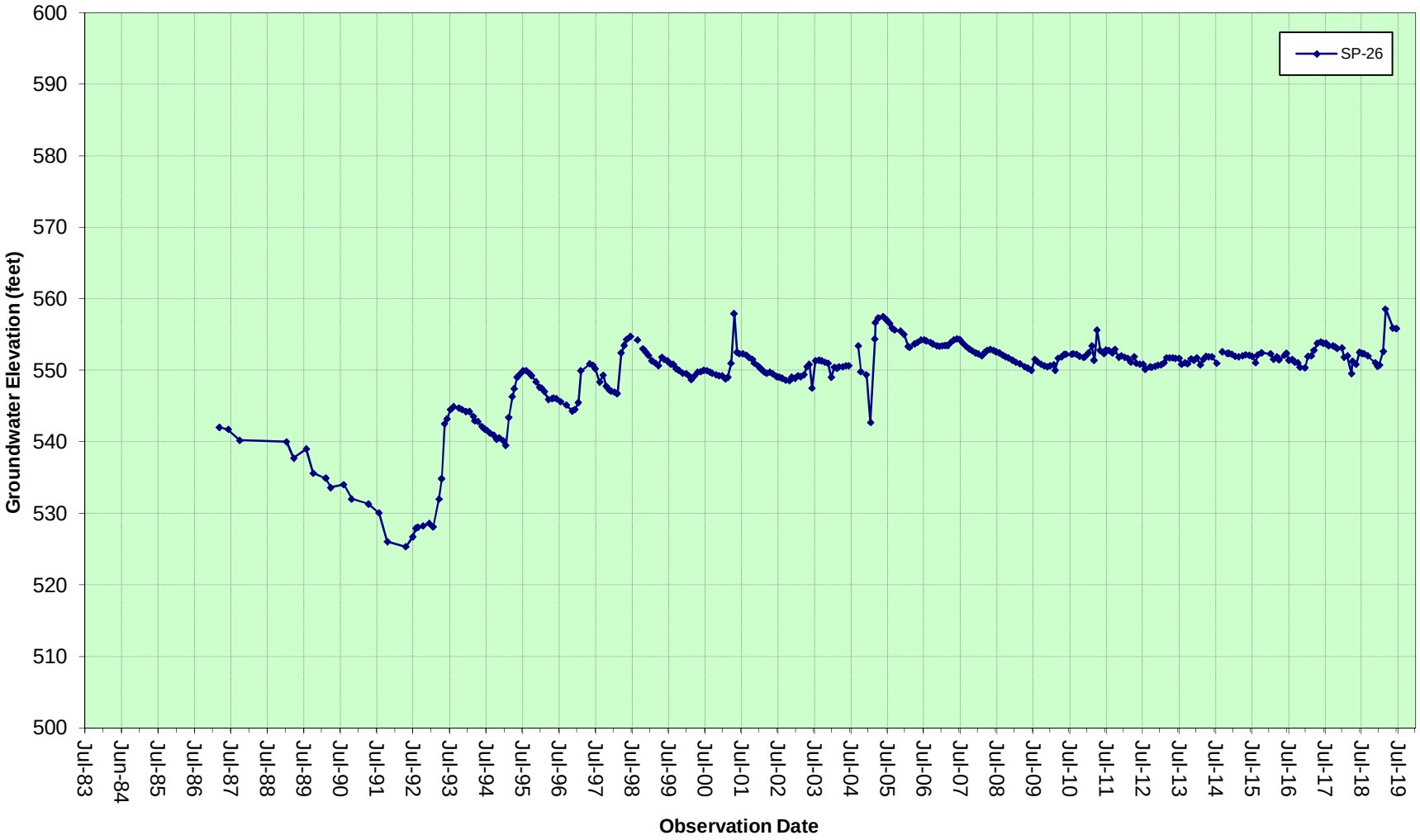
GROUNDWATER ELEVATION DATA
Central Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-6b



GROUNDWATER ELEVATION DATA
Western Extension
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-7



GROUNDWATER ELEVATION DATA
Headscarp Area
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE A-8

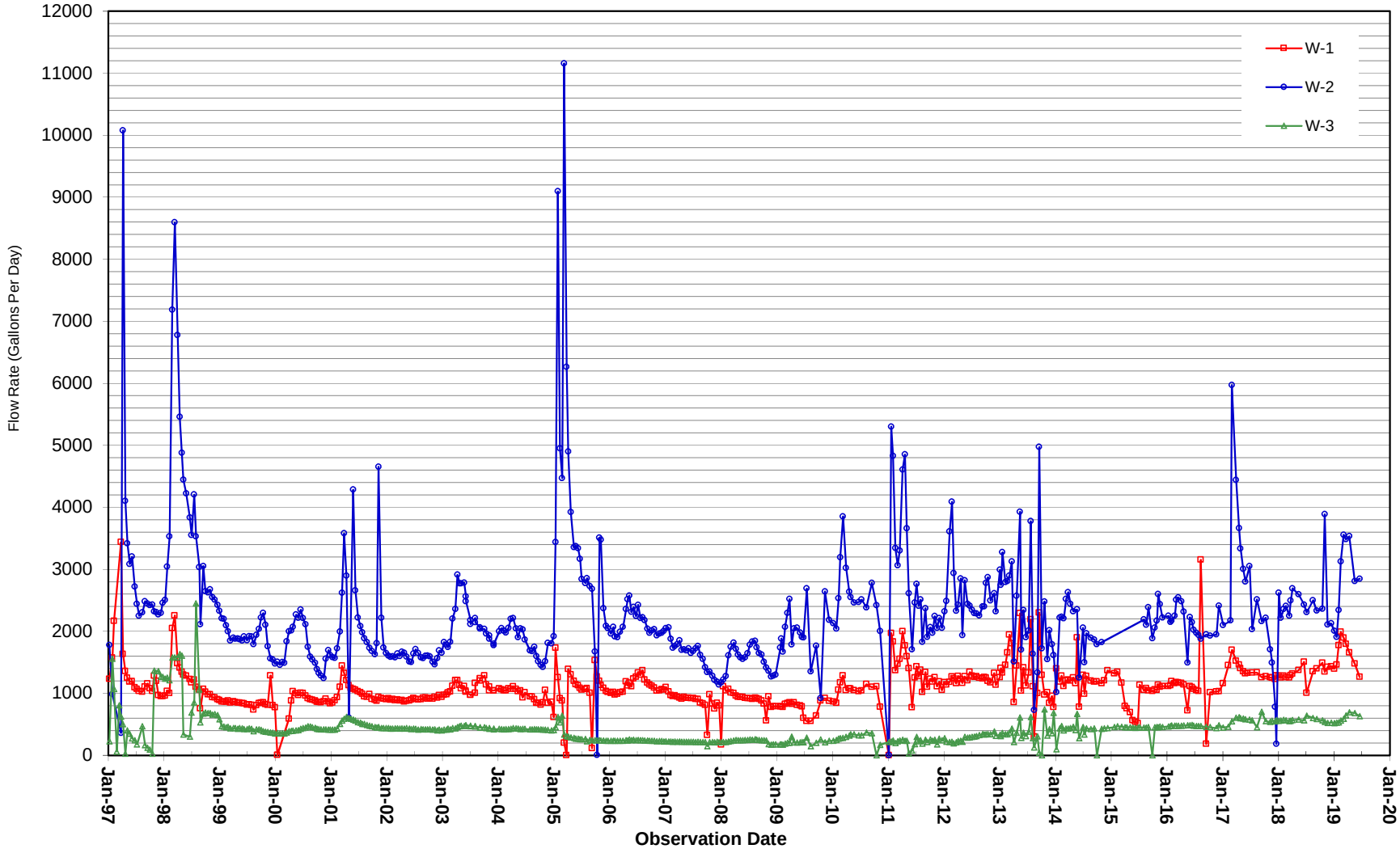
APPENDIX B
DEWATERING WELL DATA

SUMMARY OF DEWATERING WELL INFORMATION										
Well I.D.	DATE COMPLETED (DA Evans 1986)	TOP ELEV. (ft.)	BOTTOM ELEV. (ft.)	PUMP ELEV. (ft.)	PUMP SIZE (HP)	2018-19 PUMPING RATE (GPD)	% of TOTAL PRODUCTION	Rank	Drainage Port	COMMENT
W-1	1977	210.5	-30	14.5	1.5	1,510	4%	9	3	Producing
W-2	1955	219	41	44	1.5	2,703	6%	6	3	Producing
W-3	1973	243.5	65.5	70.5	3/4	585	1%	18	3	Producing
W-4	1973	248	-10	N/A	N/A	0	0%	25	N/A	Non-producing, casing perforations closed due to siltation (BYA 1991)
W-5	1984	280	252	N/A	N/A	0	0%	25	N/A	Capped 4/4/84 (DA Evans 1986)
W-6	1983	174	80	N/A	N/A	0	0%	25	N/A	Non-producing, static water level at bottom of casing (BYA 1991)
W-7	1983	257	171	N/A	N/A	0	0%	25	N/A	Non-producing, static water level at bottom of casing (BYA 1991)
W-8	1983	287	93	98	1	5,112	12%	3	4	Producing
W-9	1983	282	87	N/A	N/A	0	0%	25	N/A	Non-producing, static water level at bottom of casing (BYA 1991), replaced with BYA-11
W-10	1983	432	192	194	3/4	0	0%	25	N/A	Inactive, no pump
W-11	1983	507	285	292	3/4	0	0%	25	N/A	Inactive, diconnected from electrical, replaced with BYA-10
W-12	1983	375	195	N/A	N/A	0	0%	25	N/A	Non-producing, casing sheared at 185 ft.elevation (BYA 1991)
W-13	1983	361	184	193	1	911	2%	12	5	Producing
W-14	1984	283	131	N/A	N/A	0	0%	25	N/A	Non-producing, static water level at bottom of casing (BYA 1991)
W-15	1984	295	121	130	3/4	0	0%	25	N/A	Inactive, replaced with BYA-9
W-16	1984	325	107	113	3/4	5,575	13%	2	5	Producing
W-17	1984	270	41	50	3/4	2,649	6%	7	4	Producing
W-18	1984	750	179	225	3	4,309	10%	4	6	Producing
BYA-1	1990	281	-162	-128	3	1,178	3%	10	4	Producing
BYA-2	1990	665	215	242	1.5	465	1%	20	6	Producing
BYA-3	1990	510	-40	29	3	1,771	4%	8	6	Producing
BYA-4	1990	372	-68	-28	1.5	3,676	9%	5	5	Producing
BYA-5	1990	189	-231	-211	1.5	601	1%	17	1	Producing
BYA-6	1996	220	-280	-275	0.75	283	1%	22	1	Producing
BYA-7	1996	240	-120	-115	0.75	802	2%	13	2	Producing
BYA-9	1996	295	-105	-100	7.5(5)	6,540	15%	1	5	Producing
BYA-10	1996	510	210	215	1	647	2%	16	5A	Producing
BYA-11	1996	275	-125	-120	0.75	701	2%	15	5	Producing
BYA-12	1998	207	-140	-137	0.5	45	0%	23	1	Producing
BYA-13	1998	329	-14	-18	0.5	1,035	2%	11	3	Producing
BYA-14	1998	265	38	40	0.5	578	1%	19	1A	Producing
BYA-15	2002	429	340	300	1	5	0%	24	6	Producing <10 GPD
FW-1	2008	170			1	346	1%	21	1A	Producing
FW-2	2009	270	-130	-115	1.5	778	2%	14	4	Producing

Note:
- Not functioning or no longer monitored dewatering well

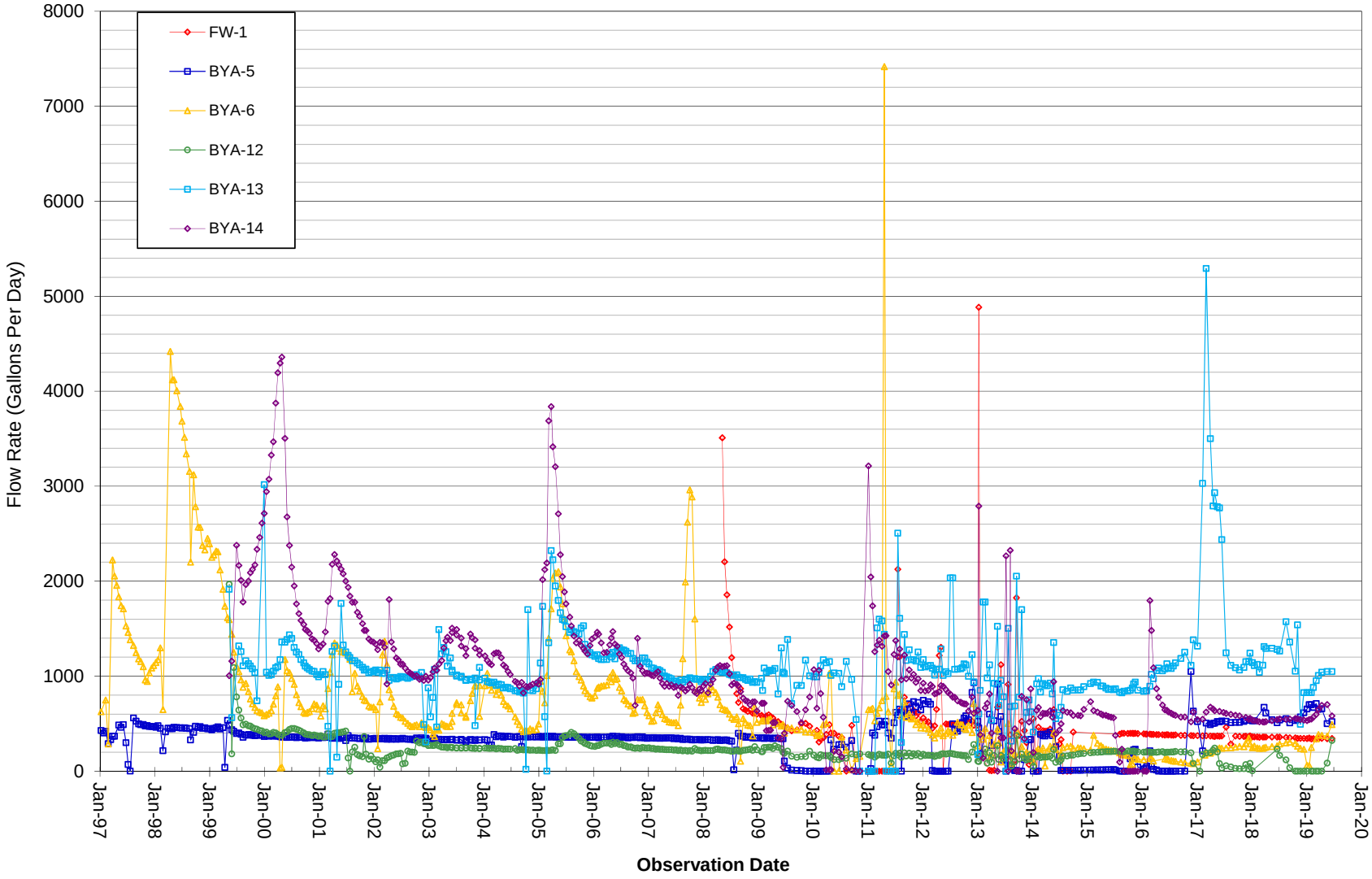
DEWATERING WELL INFORMATION
Big Rock Mesa Landslide Assessement District
Malibu, California

PLATE B-1



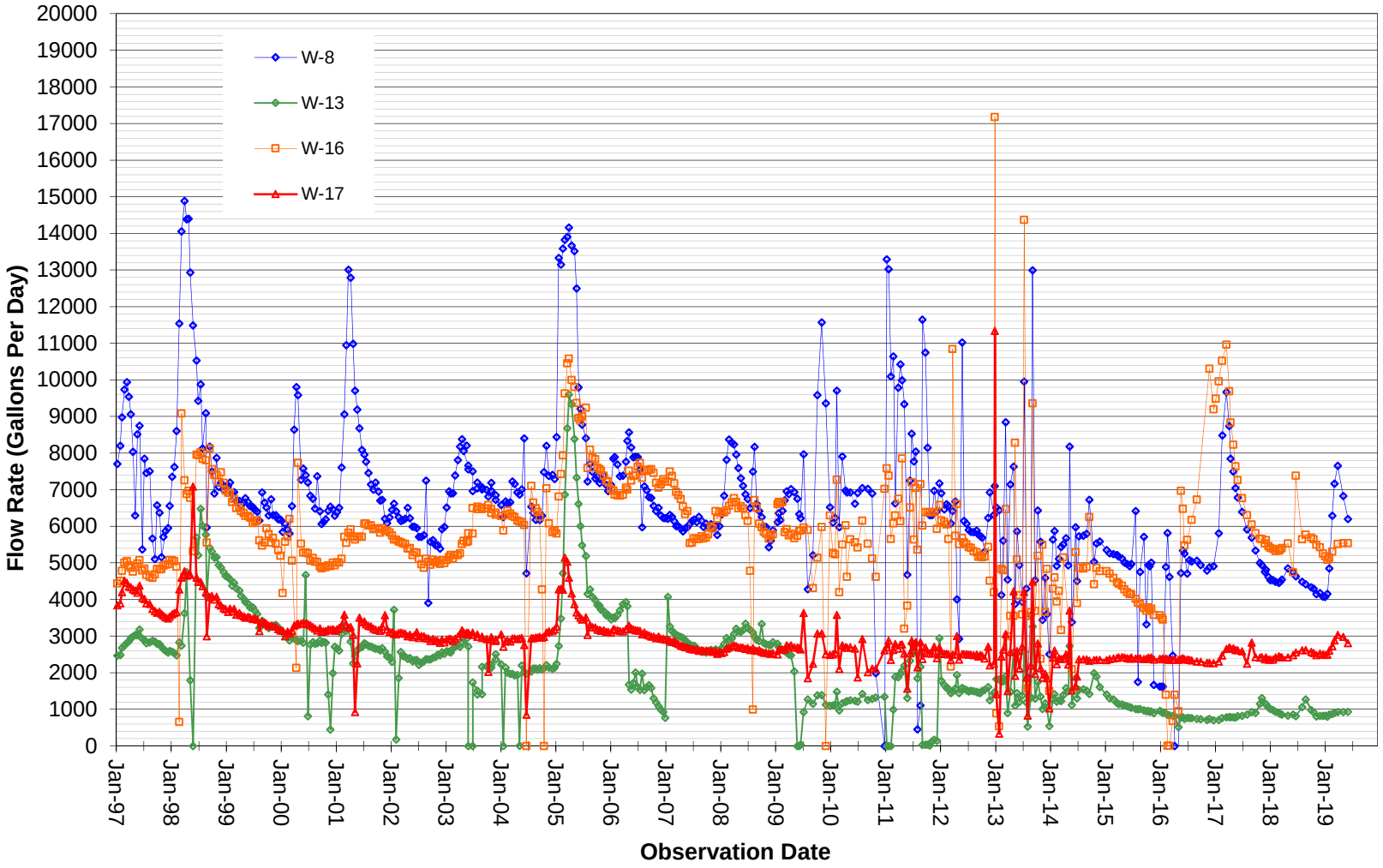
DEWATERING WELL HYDROGRAPHS
Eastern Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE B-2a



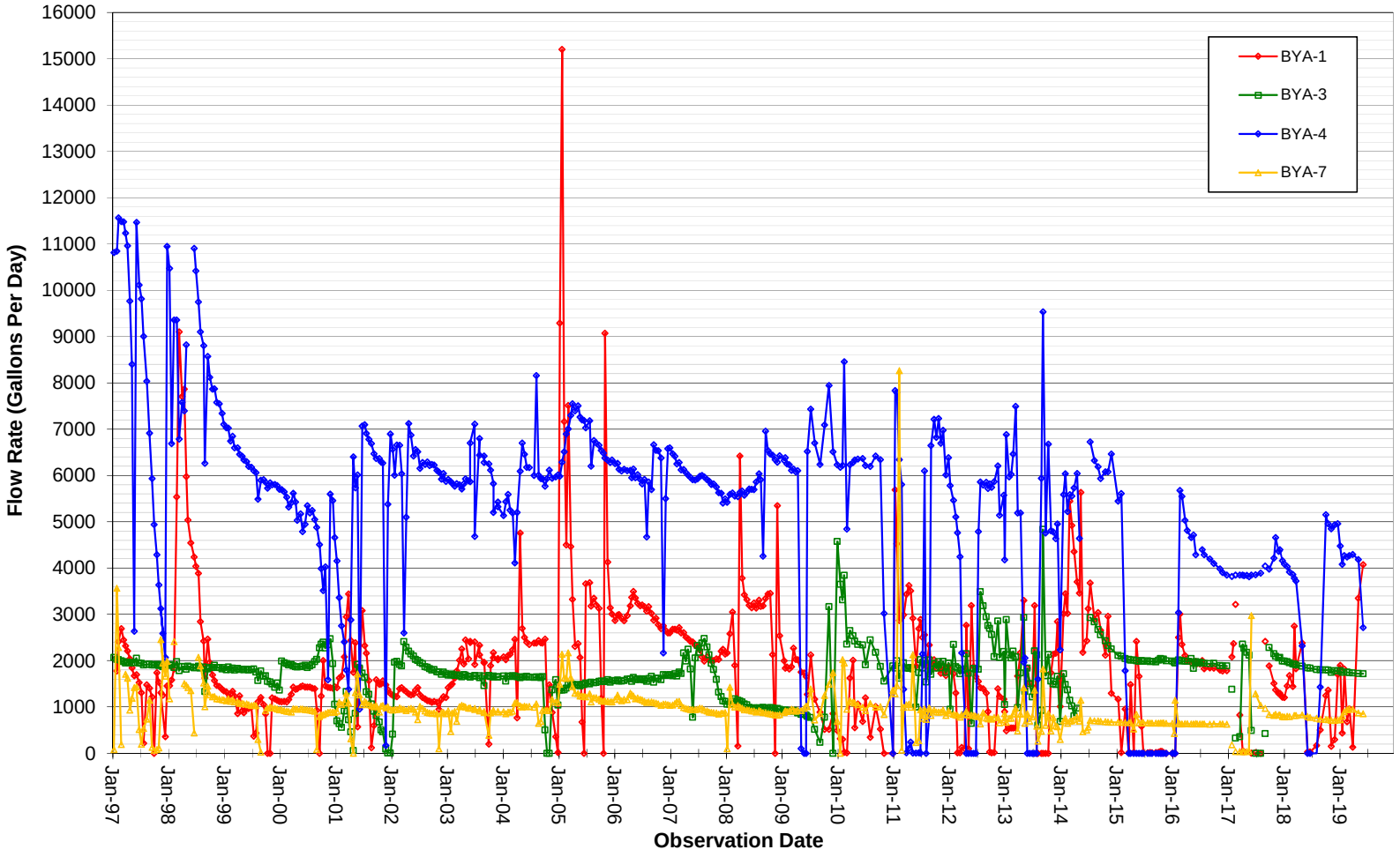
DEWATERING WELL HYDROGRAPHS
Eastern Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE B-2b

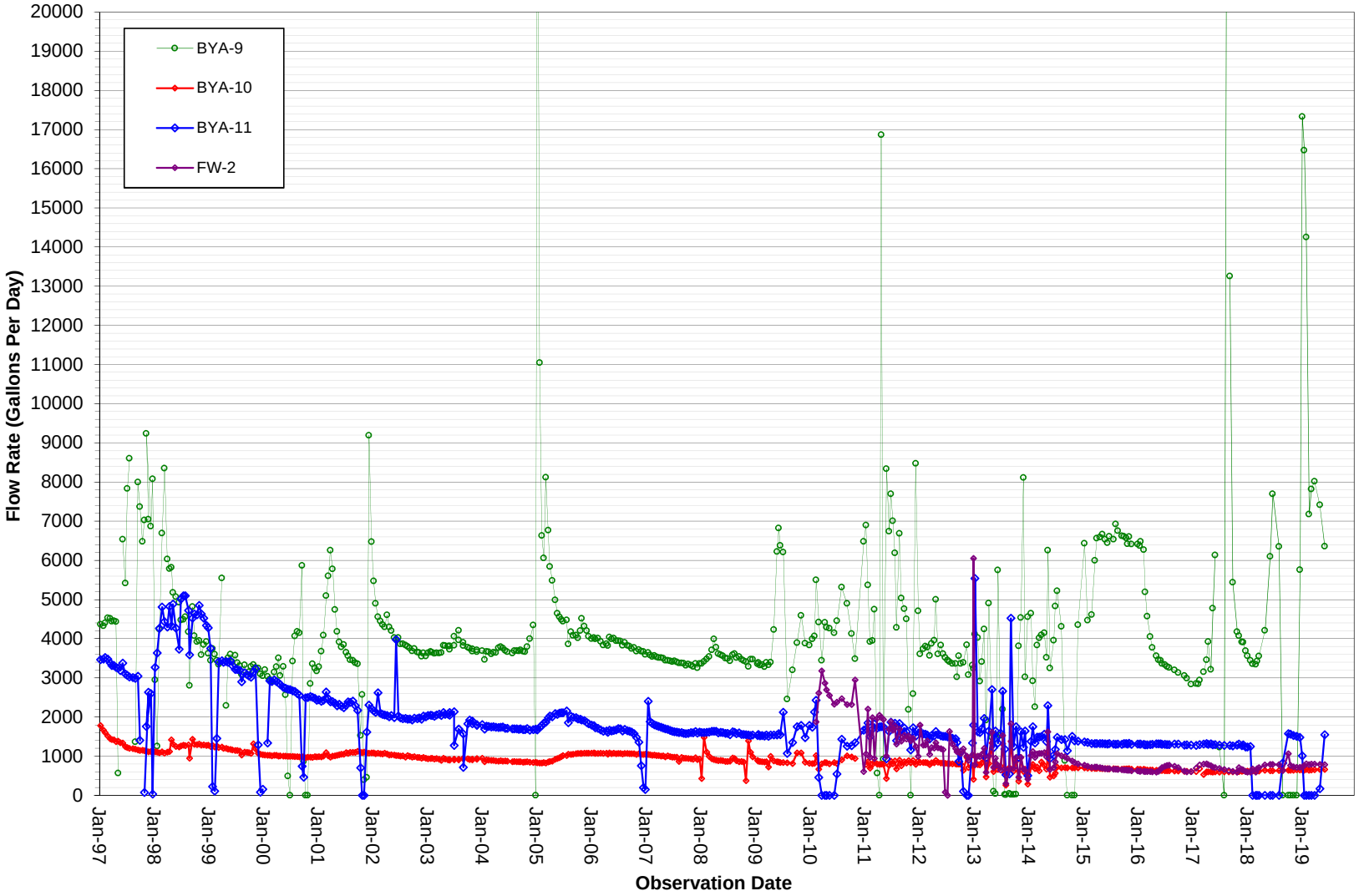


DEWATERING WELL HYDROGRAPHS
Eastern Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE B-3b

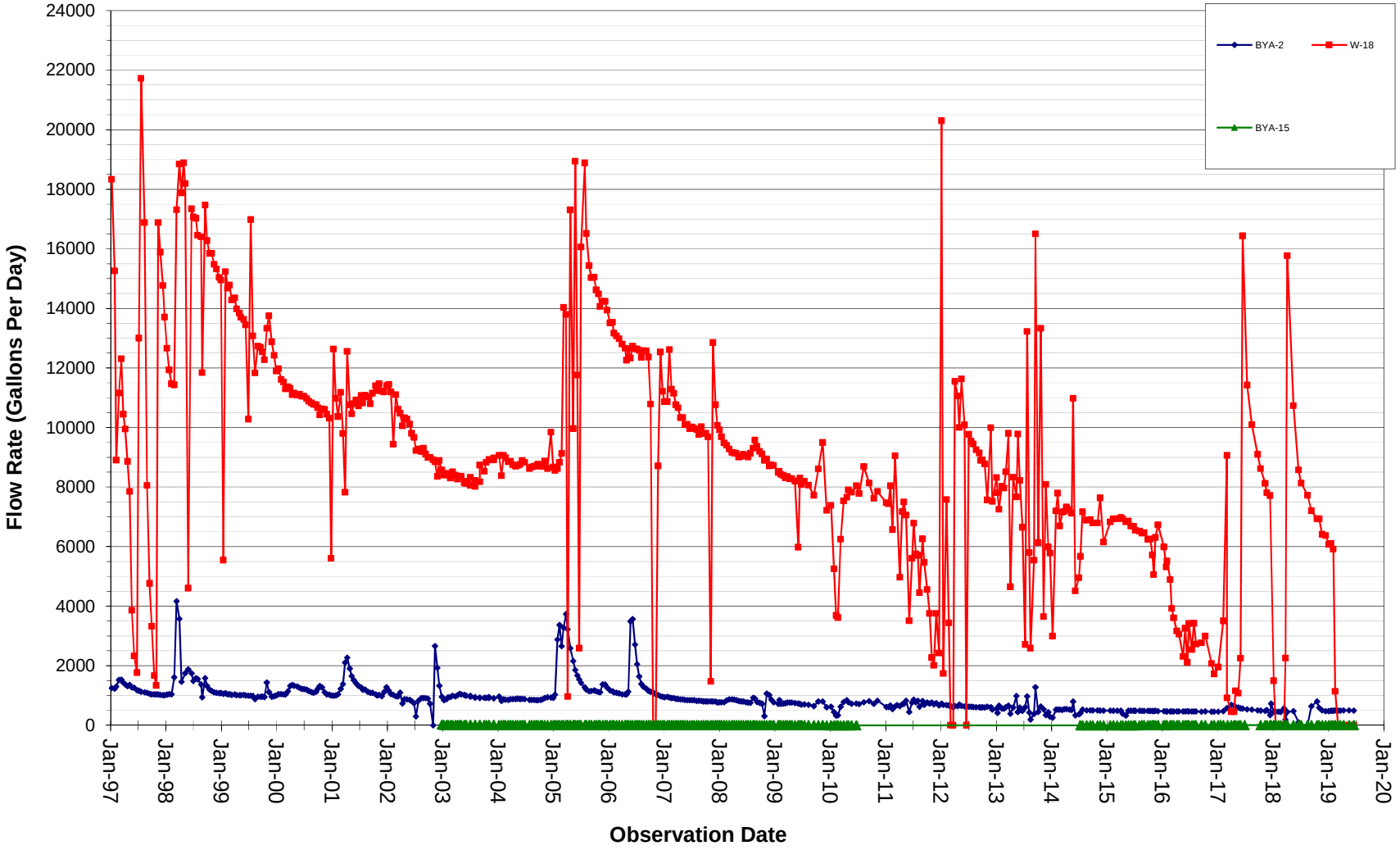


DEWATERING WELL HYDROGRAPHS
Central Mesa Region
Big Rock Landslide Assessment District
Malibu, California



DEWATERING WELL HYDROGRAPHS
Central Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE B-3c



DEWATERING WELL HYDROGRAPHS
Western Extension
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE B-4

APPENDIX C
HYDRAUGER DATA

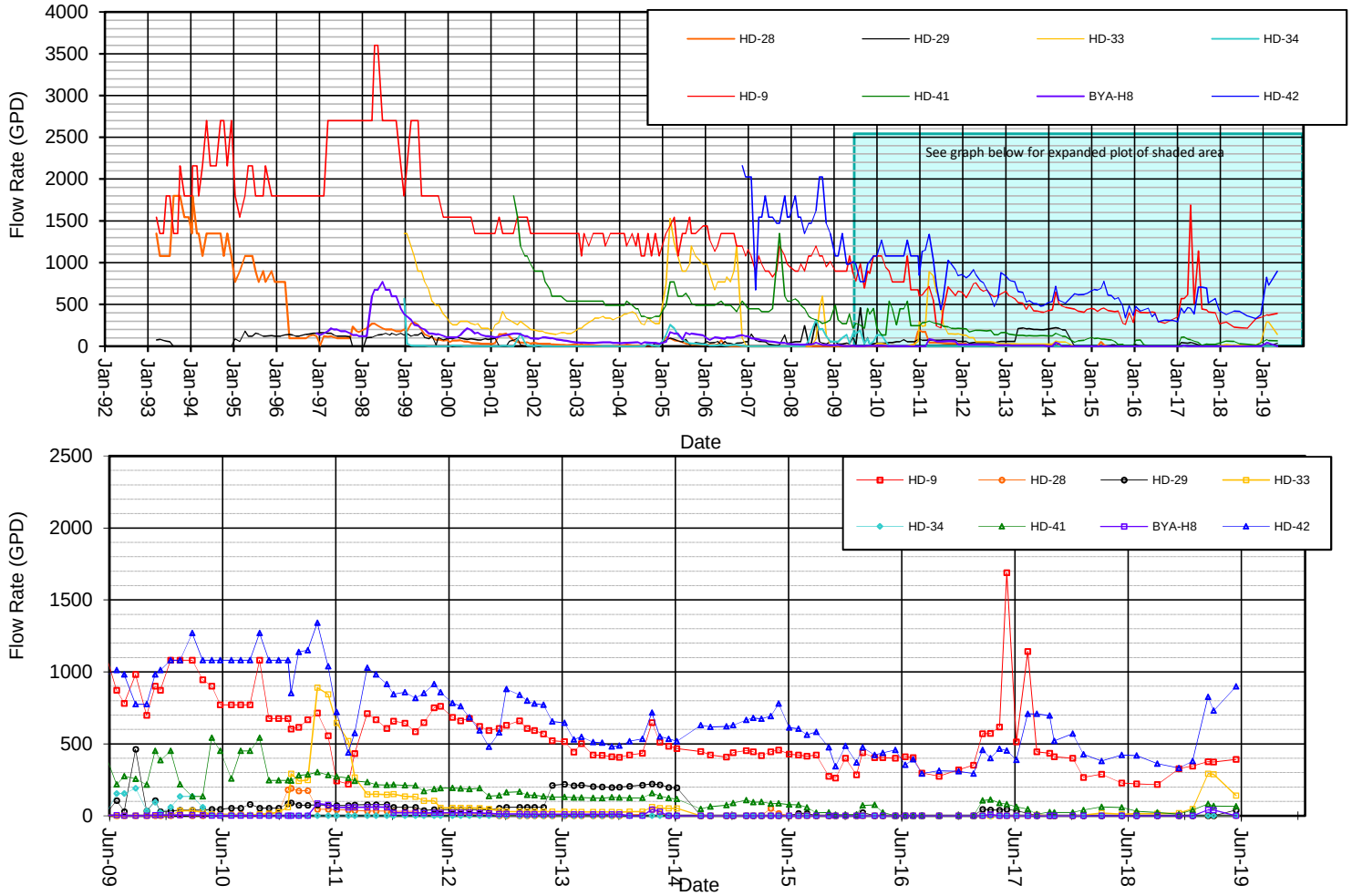
SUMMARY OF HYDRAUGER INFORMATION							
HYDRAUGER ID	**INSTALLED LENGTH (ft.)**	**OPEN LENGTH (ft.)****	**Orientation/ Slope**	**2018-2019 Average Flow (GPD)**	**% OF TOTAL PRODUCTION**	**Rank**	**INSTALLED BY**
H-1	700	210**	S115W / 3	7	0.0%	23	MT
HD-4	760	10	-	277	1.9%	11	D.E.
HD-5	890	530**	-	721	5.1%	6	D.E.
HD-6	980	490**	-	66	0.5%	16	D.E.
HD-7	1160	420**	-	66	0.5%	16	D.E.
HD-9	205	205**	-	322	2.3%	9	D.E.
HD-10	990	170**	-	303	2.1%	10	D.E.
HD-11	540	540**	-	115	0.8%	15	D.E.
HD-12	690	385**	-	2020	14.2%	3	D.E.
HD-15	200	200**	-	240	1.7%	12	D.E.
HD-22	568	540**	-	1441	10.1%	5	D.E.
HD-23	1280	260**	-	1607	11.3%	4	D.E.
HD-24	1030	580**	-	42	0.3%	20	D.E.
HD-25	1005	360**	-	49	0.3%	18	D.E.
HD-26	1200	410**	S37W / 1	2468	17.3%	2	D.E.
HD-28	1420	595**	-	0	--	--	D.E.
HD-29	1150	450**	-	5	0.0%	24	D.E.
HD-30	1040	10**	S13W / 7	3211	22.6%	1	D.E.
HD-33	340	340	S23W / 5	117	0.8%	14	BYA
HD-41	500	500	S18E / 3	45	0.3%	19	BYA
BYA-H8	500	345**	-	11	0.1%	22	BYA
BYA-H10	500	10**	-	119	0.8%	13	BYA
HD-42	700	700	-	563	4.0%	7	Fugro
HD-43	700	700	-	389	2.7%	8	Fugro
H-2*	Unknown	0	-	0	--	--	MT
H-3a*	Unknown	0	-	0	--	--	MT
H-3b*	Unknown	0	-	0	--	--	MT
H-3c*	Unknown	0	-	0	--	--	MT
H-4	680	115**	-	0	--	--	MT
H-5a*	Unknown	0	-	0	--	--	MT
H-5b*	Unknown	0	-	0	--	--	MT
H-6a*	100	96	-	0	--	--	CT
H-6b*	100	96	-	0	--	--	CT
H-7a*	100	100	-	0	--	--	CT
H-7b*	100	96	-	0	--	--	CT
H-7c*	50	0	-	0	--	--	CT
H-8*	Unknown	0	-	0	--	--	CT
HD-1*	350	340**	-	0	--	--	D.E.
HD-2a*	70	33	-	0	--	--	D.E.
HD-2b*	Unknown	0	-	0	--	--	D.E.
HD-2c*	460	0	-	0	--	--	D.E.
HD-3	560	90**	-	0	--	--	D.E.
HD-8*	530	170**	-	0	--	--	D.E.
HD-13*	650	14	-	0	--	--	D.E.
HD-14*	130	130**	-	0	--	--	D.E.
HD-16	575	575**	-	0	--	--	D.E.
HD-17*	750	176	-	0	--	--	D.E.
HD-18*	870	285	-	0	--	--	D.E.
HD-19*	1000	182	-	0	--	--	D.E.
HD-20*	1000	446	-	0	--	--	D.E.
HD-21*	1560	147	-	0	--	--	D.E.
HD-27*	700	327	-	0	--	--	D.E.
HD-31*	140	113	-	0	--	--	D.E.
HD-32	835	700**	-	23	0.2%	21	D.E.
HD-34	150	150	S40W / 10	0	--	--	BYA
HD-35*	40	40	-	0	--	--	BYA
HD-36*	150	150	-	0	--	--	BYA
HD-37*	430	50	-	0	--	--	BYA
HD-38A*	140	140	S23W / 5	0	--	--	BYA
HD-38B*	140	140	S18W / 6	0	--	--	BYA
HD-39	400	400	S15E / 5	0	--	--	BYA
HD-40*	595	595	S25W / 6	0	--	--	BYA
BYA-6a	350	20**	-	0	--	--	BYA
BYA-6b	60	60	-	0	--	--	BYA
BYA-7	400	375**	-	0	--	--	BYA
BYA-H9*	550	550**	-	0	--	--	BYA
BYA-H11*	450	400**	S7E / 3	0	--	--	BYA

** Not functioning or no longer monitored hydrauger*

*** Open Length is Measured on 10-1997 by BYA*

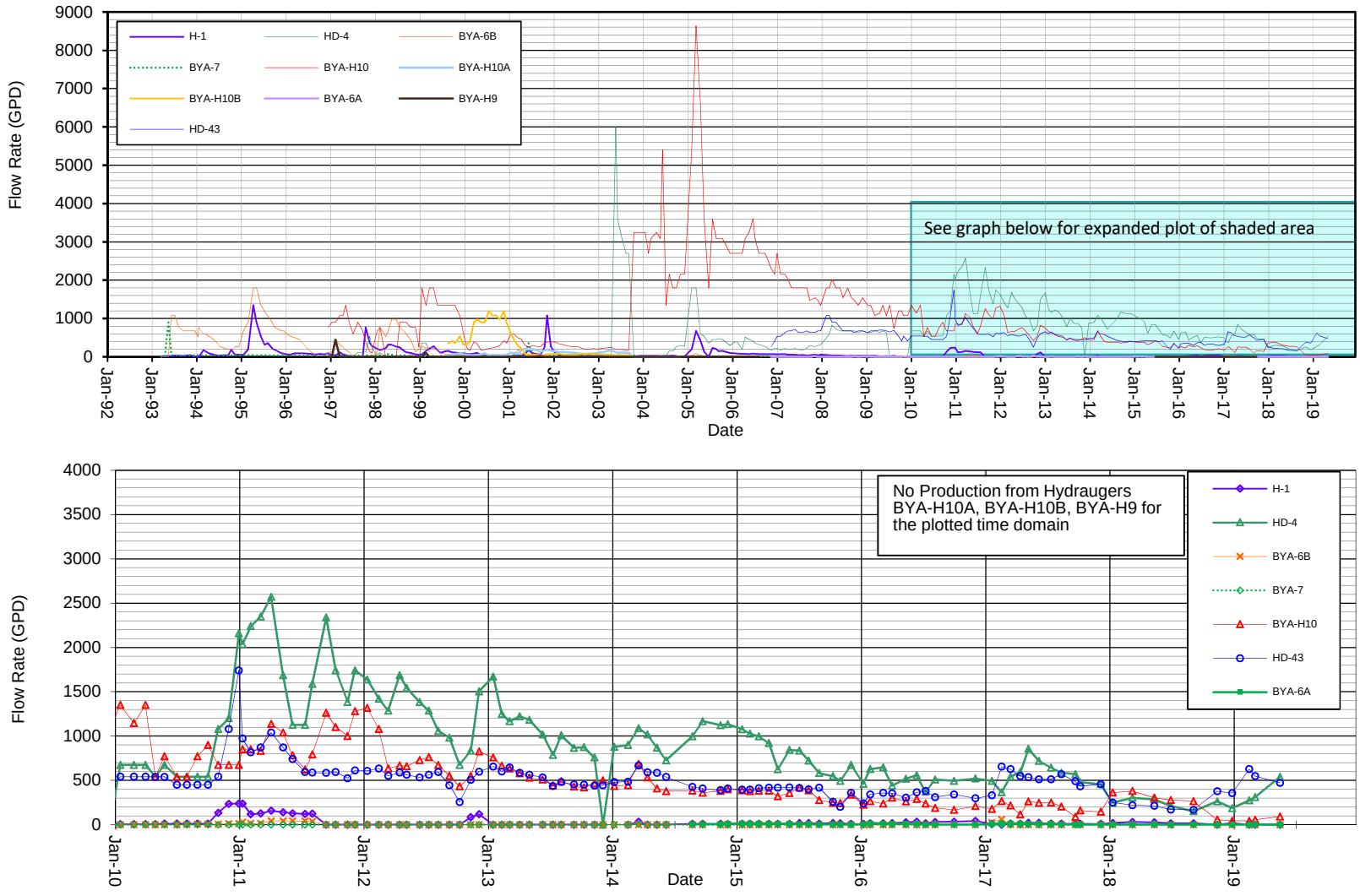
Installed by: MT = Moore & Taber; CT = Caltrans; D.E. = D.A. Evans; BYA = Bing Yen & Associates

SUMMARY OF HYDRAUGER INFORMATION
Big Rock Mesa Landlside Assessment District
Malibu, California

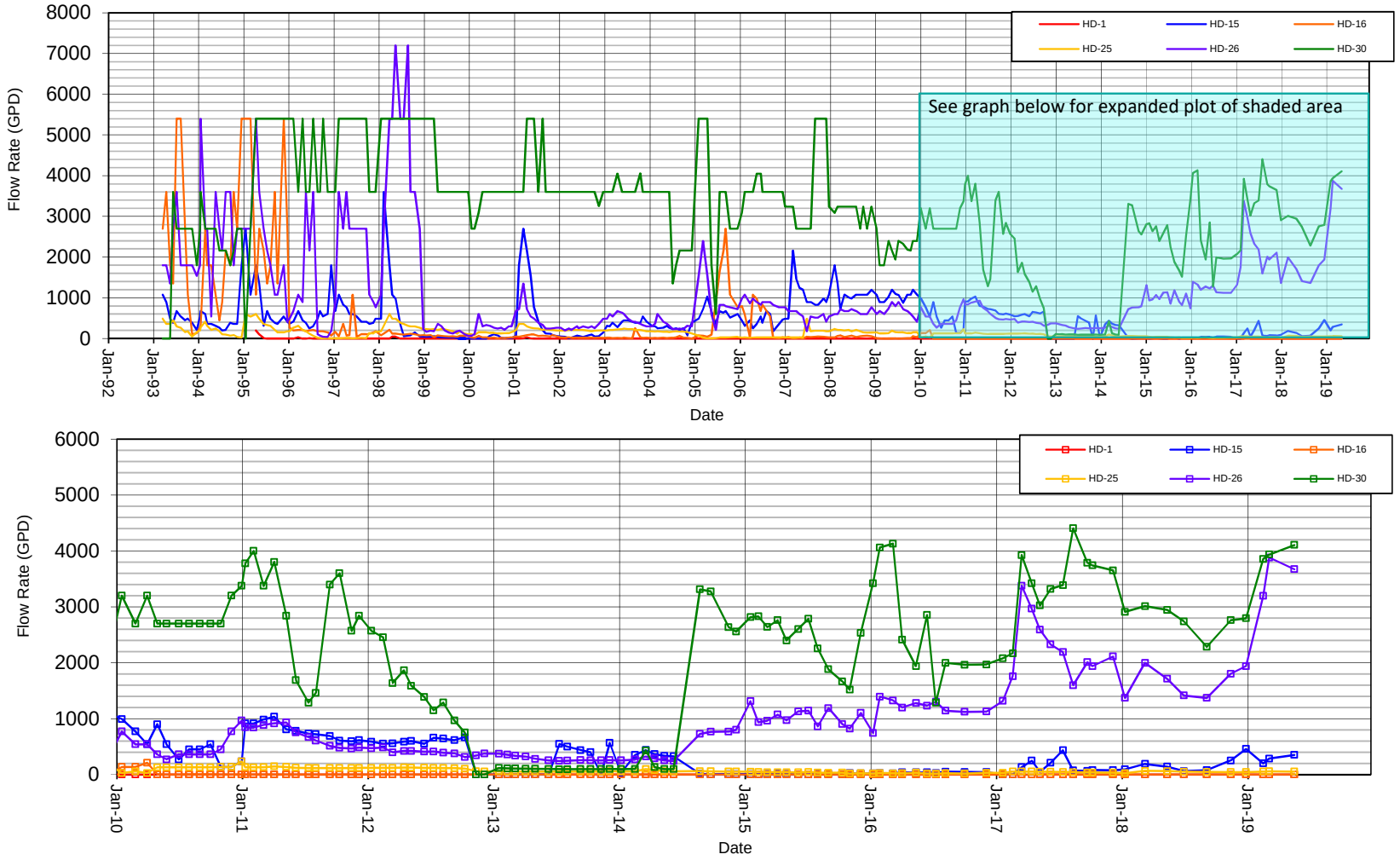


DISCHARGE RATE FOR HYDRAUGERS
Eastern Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE C-2a

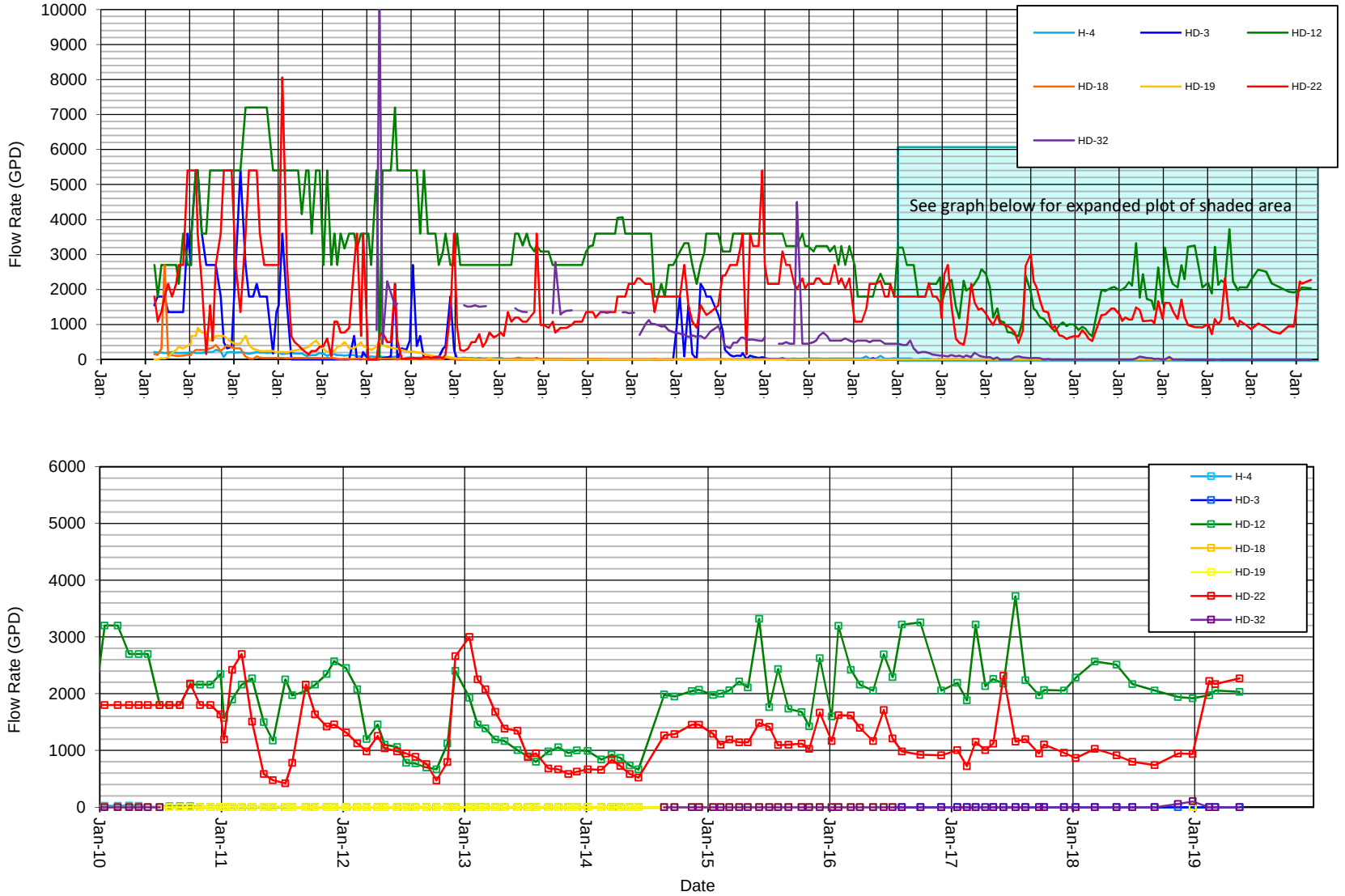


DISCHARGE RATE FOR HYDRAUGERS
Eastern Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California



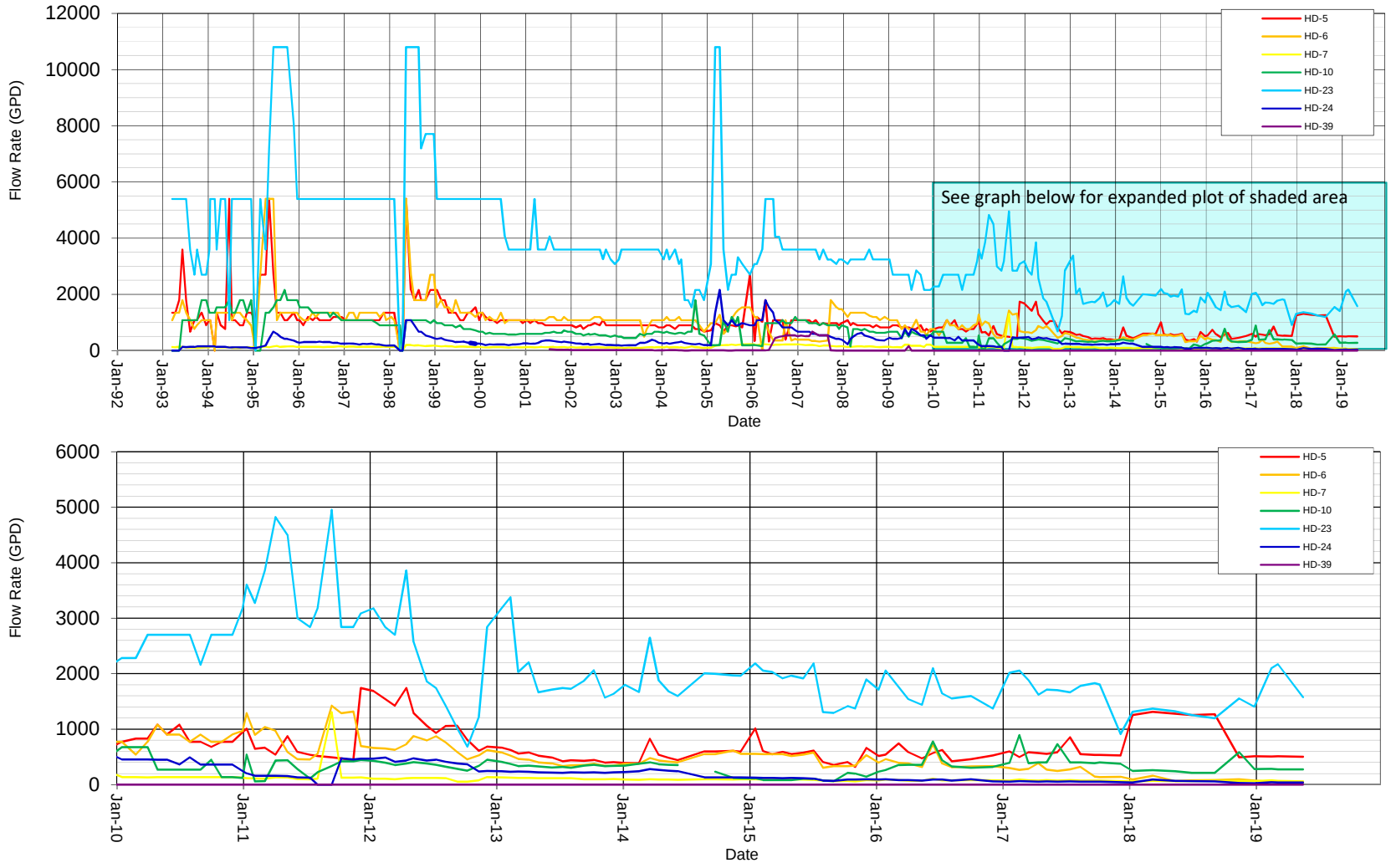
DISCHARGE RATE FOR HYDRAUGERS
Central Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE C-3a



DISCHARGE RATE FOR HYDRAUGERS
Central Mesa Region
Big Rock Mesa Landslide Assessment District
Malibu, California

PLATE C-3b



DISCHARGE RATE FOR HYDROGRAPHS
Western Extension
Big Rock Mesa Landslide Assessment District
Malibu, California

APPENDIX D
SLOPE INCLINOMETER PLOT/DATA

SLOPE INCLINOMETER INTERPRETATION SUMMARY

REGION	PACIFIC COAST HIGHWAY																		BLUFF			EAST						CENTRAL												WESTERN				HEAD	
	SP-1	SP-11	SP-12	SP-14	SP-15	SP-19	SP-27A	SP-29	SP-30	SP-2	SP-5	SP-5A	SP-6	SP-7	SP-8	SP-8A	SP-31	SP-37	SP-10	SP-28	SP-32	PC-1	SP-3	SP-3A	SP-33	BYA-5A	SP-18	SP-9A	SP-16A	SP-17	SP-17A	SP-17B	SP-24	SP-34	SP-35	SP-36	SP-4	SP-16	SP-20	SP-21	SP-22	SP-23	SP-26	SP-38
Installation Details																																											
Surface Elev.	NI	27	26	25	20	25	29	27	29	NI	NI	NI	NI	NI	NI	NI	NI	NI	295	270	233	250	212	203	318	NI	NI	365	285	540	540	540	370	270	345	380	NI	285	430	660	780	860	745	NI
Original Depth (ft)	43	59	95	32	88	95	100	140	155	32	98	146	102	Unknown	Unknown	106	140	336	330	365	360	160	240	295	375	300	78	378	390	192	325	250	390	360	360	200	245	380	330	380	335	390	350	Unknown
Measured Depth (ft)	NI	56	38	30	80	82	92	138	126	NI	NI	146	NI	NI	NI	106	NI	NI	332	250	350	158	132	244	374	186	NI	298	392	190	238	250	384	380	394	254	96	240	322	280	330	396	342	NI
Casing Diameter	NI	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	NI	NI	2.75	NI	NI	NI	2.75	NI	NI	2.75	2.75	2.75	2.75	2.75	2.75	2.75	NI	NI	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	NI	NI	3.5	2.75	2.75	3.5	3.5	NI
Casing Type	NI	SI/cc	Alum/cc	SI/cc	Alum/cc	Alum/cc	Alum/cc	SI	SI	NI	NI	NI	NI	NI	NI	NI	NI	NI	Alum/cc	Alum	Alum/cc/ mod	SI/1.5"	Alum/cc	Alum/cc	Alum/cc/ mod	NI	NI	Alum	Alum/cc	SI/cc	SI	SI	Alum	SI	SI	SI	NI	NI	Alum/3.5"/ cc	Alum/cc	Alum	Alum/3. 5"	Alum/3.5"	NI
Perforated interval	NI	-31 to -26	-14 to -9	-5 to 0	-62 to -57	-57 to -52	-65 to -60	-111 to - 106	-99 to -94	NI	NI	bottom	NI	NI	NI	bottom	NI	NI	-37 to - 32	-88 to - 83	-121 to - 116	92 to 97	80 to 85	-43 to - 38	-56 to - 51	NI	NI	65 to 70	-107 to - 102	348 to 353	302 to 307	None	NI	-112 to - 107	-51 to -46	126 to 131	NI	45 to 50	104 to 204	380 to 385	448 to 453	462 to 562	NI	NI
Backfill	NI	Sand	NI	NI	NI	NI	NI	NI	NI	NI	NI	Grout	NI	NI	NI	Grout	NI	NI	NI	NI	NI	Grout	Sand	Sand	NI	NI	NI	NI	NI	NI	Grout	Grout	NI	Grout	Grout	Grout	NI	NI	Filter	NI	NI	NI	Sand	NI
Installed By	KB	EVANS	EVANS	EVANS	EVANS	EVANS	EVANS	EVANS	EVANS	KB	CT	BYA	CT	CT	CT	BYA	EVANS	CT	EVANS	EVANS	EVANS	BYA	EVANS	EVANS	EVANS	BYA	LS	EVANS	EVANS	EVANS	BYA	Fugro	CONV	BYA	BYA	BYA	EVANS	EVANS	CONV	EVANS	CONV	CONV	CONV	EVANS
Reading Interval	NR	Quart	Quart	Quart	Semi.	Semi.	Quart	Quart	Quart	NR	NR	NR	NR	NR	NR	NR	NR	NR	Quart	Quart	Quart	Quart	Semi.	Quart	Quart	NR	NR	Semi.	Semi.	NR	NR	Quart	Semi.	Quart	Quart	Quart	NR	NR	Semi.	Semi.	Semi.	Semi.	Quart	NR
Status	D	F	F	F	F	F	F	F	F	D	D	D	D	D	D	D	D	D	F	F	F	F	F	F	F	D	D	F	F	F	F	F	F	F	F	D	D	F	F	F	F	F	D
Date 1st Base Reading	10/31/83	9/13/88	9/13/88	9/13/88	3/10/88	9/3/89	12/10/87	10/19/88	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	11/5/87	9/8/88	9/7/88	6/8/95	9/7/88	NI	6/3/87	NI	NI	3/10/88	3/10/88	NI	2/10/89	11/13/12	9/8/88	2/19/99	11/24/98	11/20/98	11/18/83	NI	11/5/87	7/2/87	7/2/87	9/8/88	9/13/88	NI
Displacement Depth		0 to 25	23, 43		58	60	25-30	48-54	39	NI	NI	NI	NI	NI	NI	NI	NI	NI	140	245	110,250	143, 50	132, 170, 220	247, 200	210, 50	NI	NI	305	380	140,184	196	NI	366			78	NI	251	142	NI	NI	NI	45,130	NI
A+ axis direction	NI	34	44	35	20	30	350	64	10	NI	NI	NI	NI	NI	NI	NI	NI	NI	39	204	18	190	32	60	20	NI	NI	340	330	10	60	NI	326	210	184	164	NI	NI	1	300	345	5	45	NI
Region	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	PCH	BLUFF	BLUFF	BLUFF	EAST	EAST	EAST	EAST	EAST	EAST	CENT.	CENT.	CENT.	CENT.	CENT	CENT.	CENT.	CENT.	CENT.	CENT.	CENT.	WEST.	WEST.	WEST.	WEST.	HEAD	HEAD
Basal Surf. Penetrated		YES	NO	NO	NO	NO	YES	YES	YES										NO	NO	YES	YES	NO	NO	YES			NO	NO	NO	YES	YES	YES	YES	YES	YES	NI	NI	NO	NO	NO	NO	YES	NI
Interpretation Movement (inches)																																											
2018-2019	NA	<0.1	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	NA	--	<0.1	--	--	--	NA	NA	--	--	NA	NA	<0.1	--	--	--	--	NA	NA	--	--	--	--	--	NA
2017-2018	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	NA	--	--	--	--	--	NA	NA	--	--	NA	NA	--	--	--	--	--	NA	NA	--	--	--	--	--	NA
2016-2017	NA	--	--	--	--	--	0.1	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	NA	--	--	--	--	--	NA	NA	--	0.15	NA	NA	--	--	--	--	--	NA	NA	--	--	--	--	--	NA
2015-2016	NA	--	--	--	--	--	--	0.1	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	NA	--	--	--	--	<0.2	NA	NA	--	--	NA	NA	--	--	--	--	--	NA	NA	--	--	--	--	0.15	NA
2014-2015	NA	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	<0.2	<0.1	<0.1	<0.1	0.2	NA	NA	<0.2	<0.1	NA	NA	<0.2	<0.2	<0.1	<0.2	<0.2	NA	NA	<0.1	<0.1	<0.1	<0.2	<0.2	NA
2013-2014	NA	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	<0.1	<0.1	<0.1	<0.2	<0.1	0.2	NA	NA	<0.1	<0.1	NA	NA	<0.1	<0.2	<0.1	<0.2	<0.1	NA	NA	<0.1	<0.1	<0.2	<0.2	<0.2	NA
2012-2013	NA	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	NA	NA	<0.1	<0.1	NA	NA	<0.1	<0.1	<0.1	<0.2	<0.1	NA	NA	<0.1	<0.1	<0.1	0.1	<0.1	NA
2011-2012	NA	<0.1	--	--	--	--	<0.1	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.5	<0.1	0.2	0.05	--	0.2	0.2	NA	NA	--	--	0.25	0.1		--	--	--	0.3	NA	NA	0.2	0.2	0.4	0.1	0.1	NA
2010-2011	NA	<0.1	--	--	--	--	<0.1	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	<0.1	<0.1	--	--	0.2	<0.1	NA	NA	--	--	0.5	--		--	--	--	--	NA	NA	--	--	--	<0.1	--	NA
2009-2010	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	0.1	--	--	--	--	<0.1	NA	NA	--	--	--	--		--	--	--	--	NA	NA	--	--	--	0.1	<0.05	NA
2008-2009	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	0.10	--	0.1	NA	NA	--	--	--	--		--	--	--	--	NA	NA	--	--	--	--	--	NA
2007-2008	NA	--	--	--	--	--	0.05	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	0.1	NA	NA	--	--	--	--		--	--	--	--	NA	NA	--	--	--	--	--	NA
2006-2007	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	0.1	NA	NA	--	--	--	--		--	--	--	--	NA	NA	--	--	--	--	--	NA
2005-2006	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	NA	--	--	--	--	--	NA	NA	--	--	--	0.1		--	--	--	--	NA	NA	--	--	--	--	0.22	NA
2004-2005	NA	0.09	0.03	--	0.03	0.01	0.04	0.04	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	0.05	0.02	--	--	0.10	0.06	NA	NA	?	0.06	0.09	0.09		0.15	--	--	--	NA	NA	--	--	--	--	0.35	NA
2003-2004	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	NA	NA	--	--	--	--		--	--	--	--	NA	NA	--	--	--	--	--	NA
2002-2003	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	NA	NA	--	--	--	--		--	--	--	--	NA	NA	--	--	--	--	--	NA
2001-2002	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	--	--	--	NA	NA	--	--	--	--		--	--	--	--	NA	NA	--	--	--	--	--	NA
2000-2001	NA	--	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	-0.02-0.04*	--	--	--	--	~0.05*	NA	NA	--	--	--	0.02-0.04*		--	--	--	--	NA	NA	--	--	--	--	0.2	NA
1999-2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	--	--	--	--	NA	NA
1998-1999	NA	~0.1	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	<0.5	--	--	--	NA	NA	--	--	--	--		--	--	--	--	NA	NA	--	--	--	--	1.9	NA
1997-1998	NA	0.3	--	--	--	--	0.08	0.04	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	0.08	--	0.02	0.08	NA	NA	--	--	--	0.03		--				NA	NA	--	--	--	--	1	NA
1996-1997	NA	<0.1	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	<0.1	--	0.5	--	NA	NA	--	--	--	--		--				NA	NA	--	--	--	--	0.7	NA
1995-1996	NA	0.08	<0.1	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	0.07	--	--	--	NA	NA	--	--	--	0.04		--				NA	NA	--	--	--	--	3.5	NA
1994-1995	NA	0.1	0.08	--	--	--	0.15	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--	0.04, 0.05	--	--	0.1, 0.2	NA	NA	--	--	--	--		--				NA	NA	--	--	--	--	5	NA
1993-1994	NA									NA	NA	NA	NA	NA	NA	NA	NA	NA								NA	NA										NA	NA					NA
1/1993-7/1993	NA	0.08	--	--	--	--	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--		--	0.2	--	NA	NA	--	--	--	--		--				NA	NA	--	--	--	--	1.1	NA
7/1992-12/1992	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA		NA				NA	NA	NA	NA	NA	NA	NA	NA
1988-1991	NA	0.2	0.05	--	0.08	--	0.15	0.1	0.14	NA	NA	NA	NA	NA	NA	NA	NA	NA	--	--	--		--	0.3	0.05	NA	NA	--	--	--	--		0.1				NA	NA	--	--	--	--	0.3	NA
1983-1984	2.28	3.4					1.4																8.4							4.8	--					4.7						

NI	No Information	--	No quanitifiable movement	Installation Designations:	KB	Kovacs-Byer, Inc.	GS	GeoSoils
Semi	Semi-Annually	NA	Data not available		EVANS	D.A. Evans	BYA	Bing Yen & Associates
Quart	Quarterly	NR	No Reading		CT	Caltrans	LS	Lockwood-Singh
F	Functioning				CONV	Converse Consultants		
D	Destroyed							

-- Shaded Blue to indicate inclinometer does NOT penetrate the basal rupture

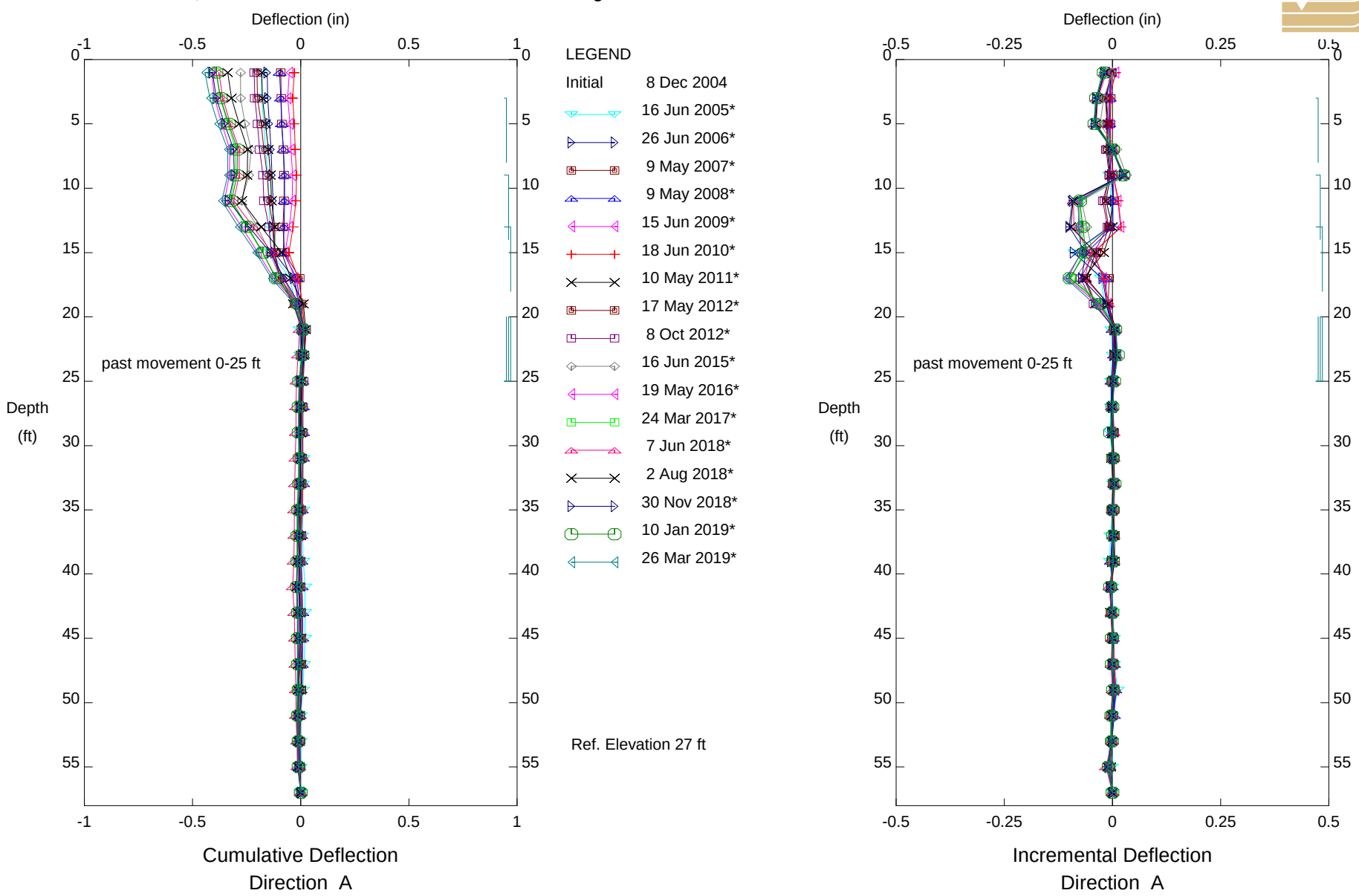
-- Shaded yellow to indicated inclinometer does penetrate basal rupture

-- Shaded gray to indicated inclinometer is no longer monitored

SLOPE INCLINOMETER INFORMATION
Big Rock Mesa Landslide Assessment District
Malibu, California

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-11

PCH REGION

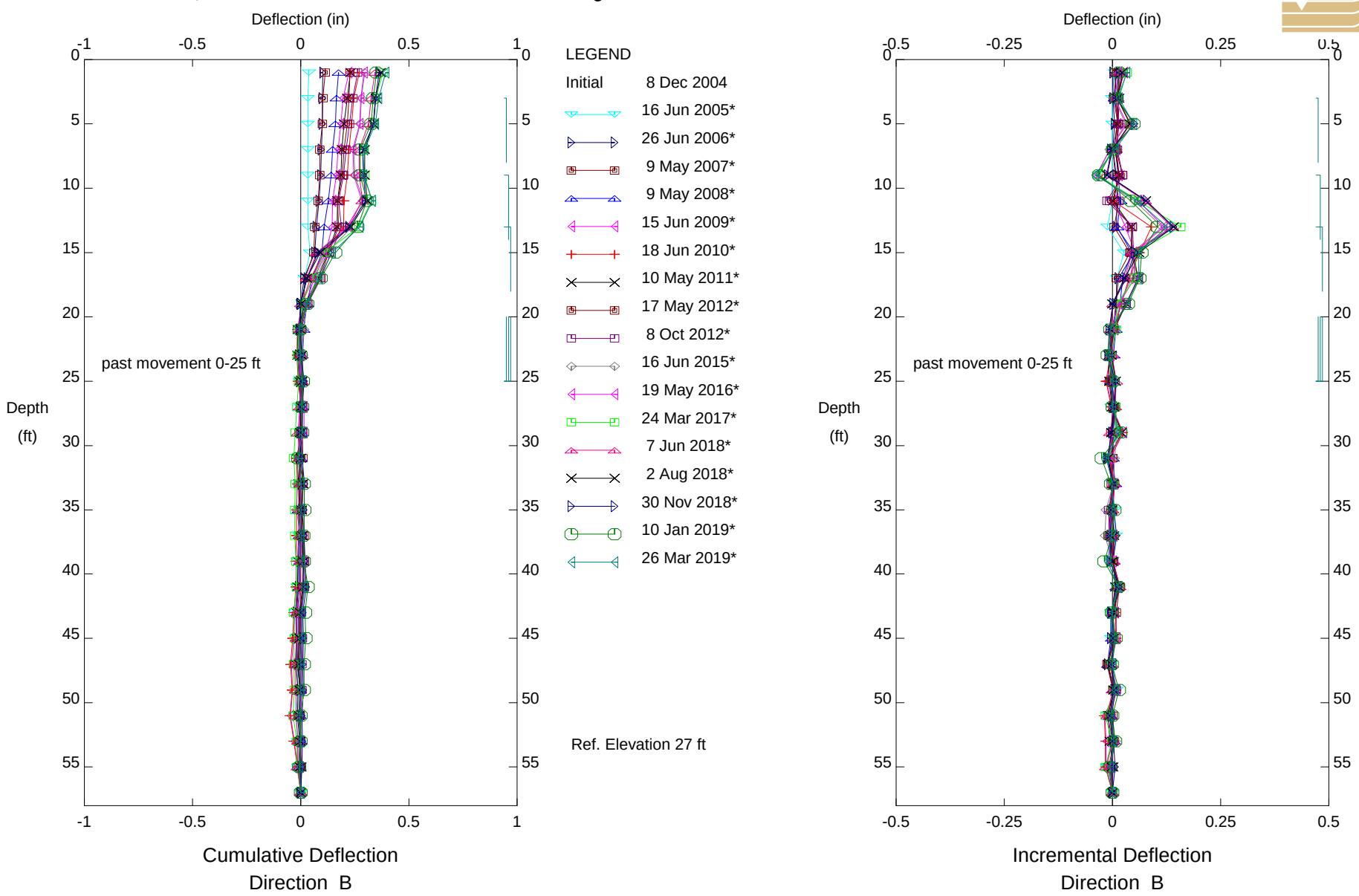
Sets marked * include zero shift and/or rotation corrections.

PLATE D2-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP11.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-11

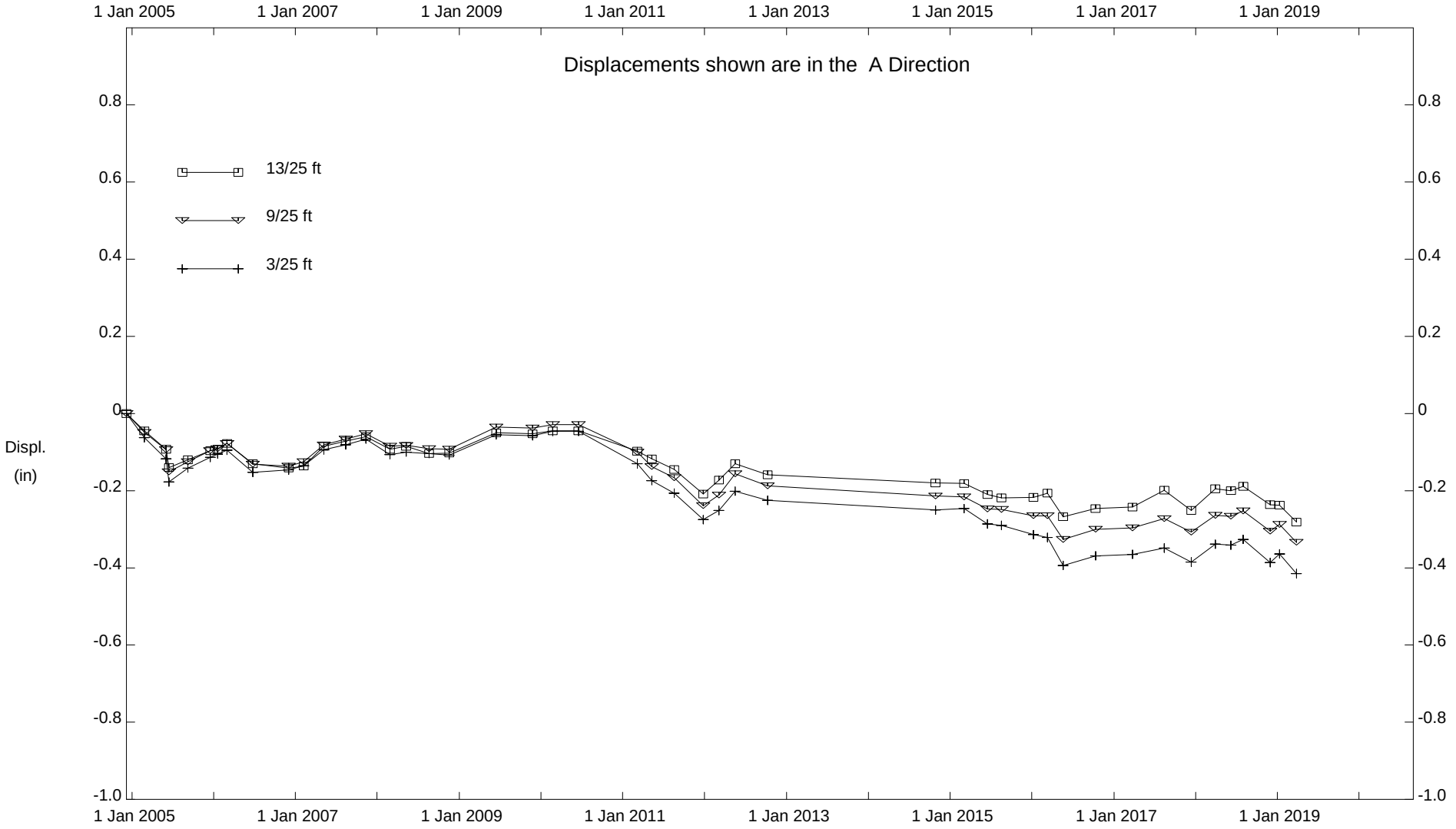
PCH REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D2-2

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

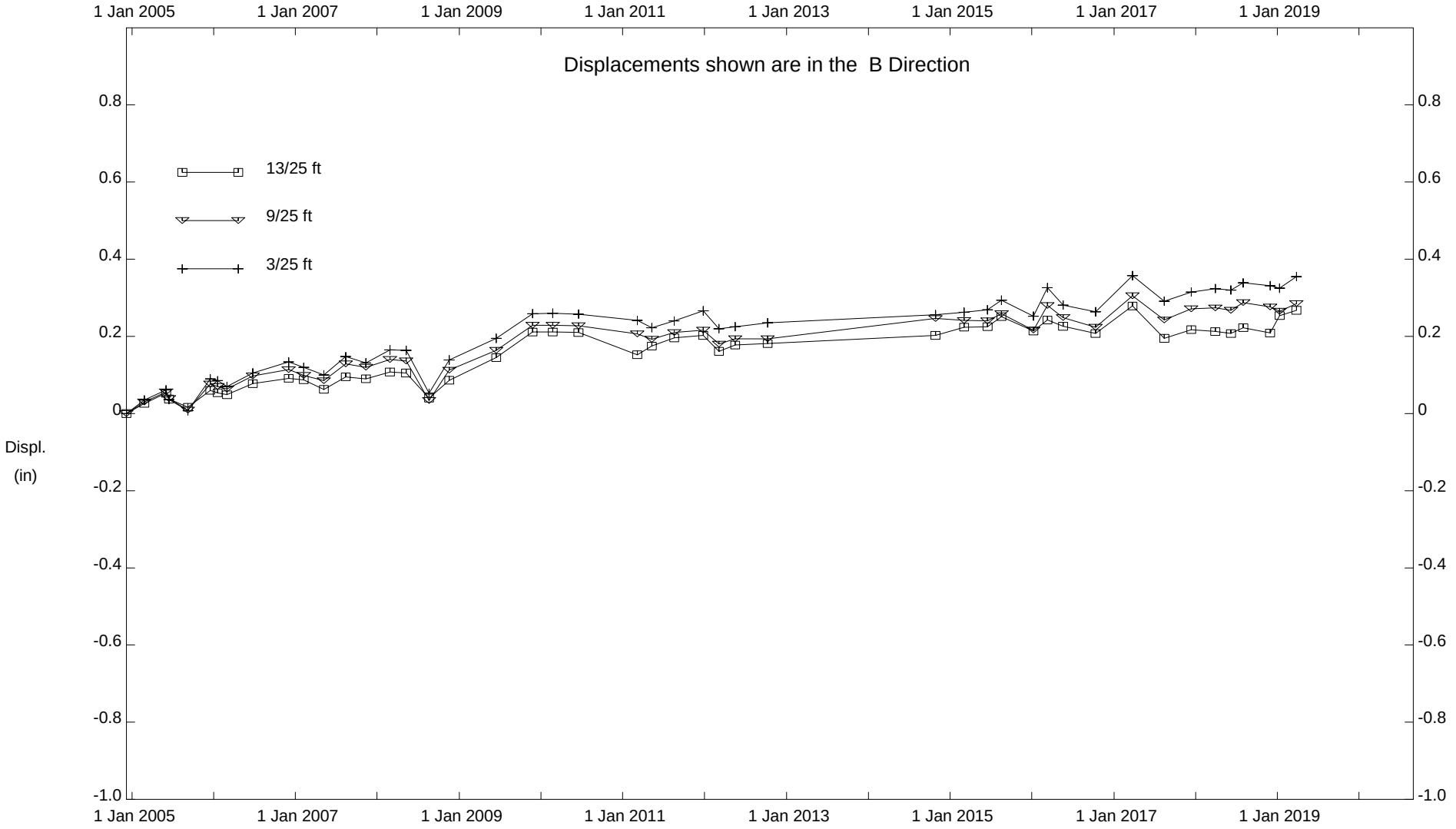
Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-11

PCH REGION

PLATE D2-3



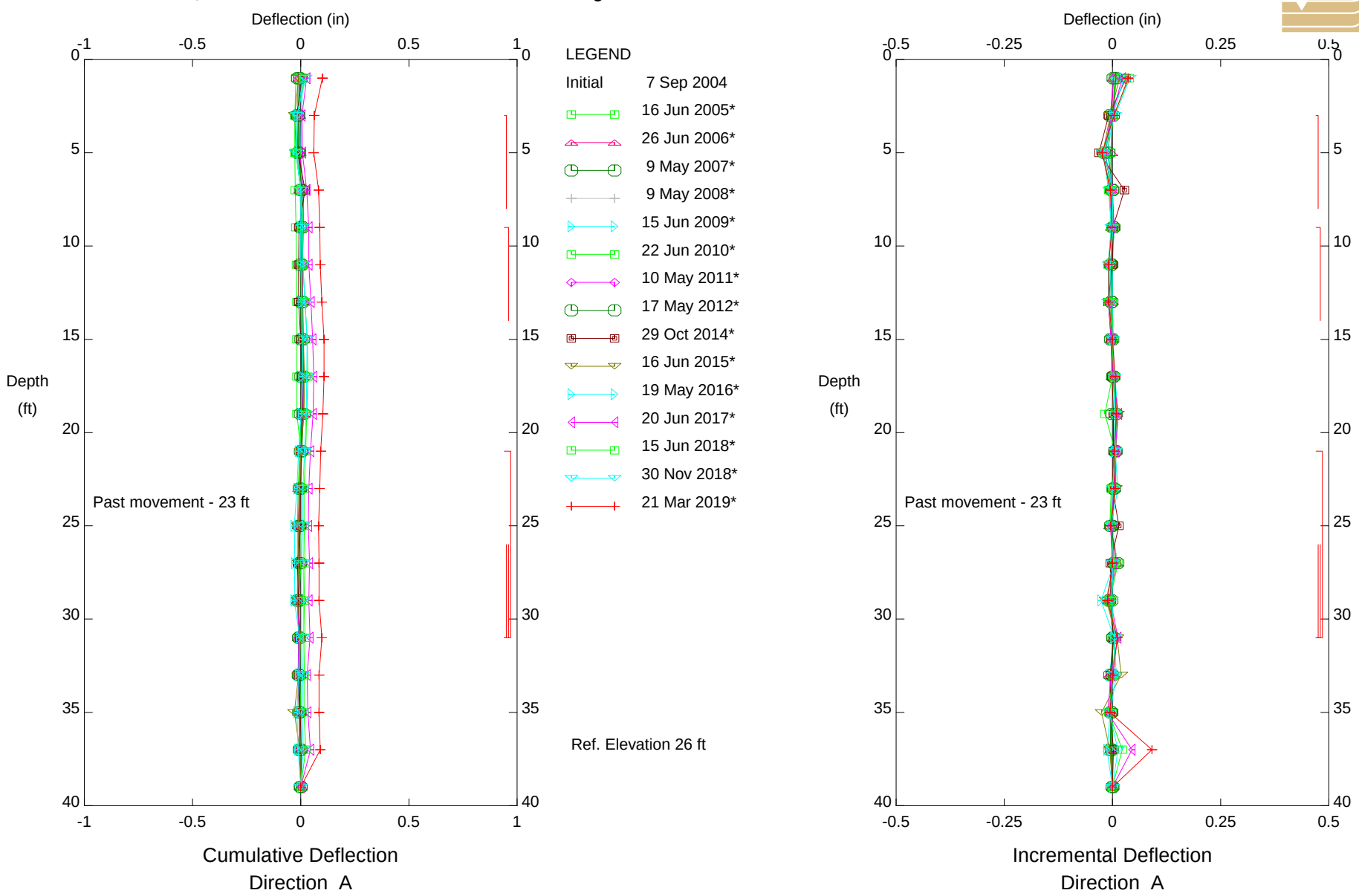
BIG ROCK MESA, Inclinometer SP-11

PCH REGION

PLATE D2-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-12

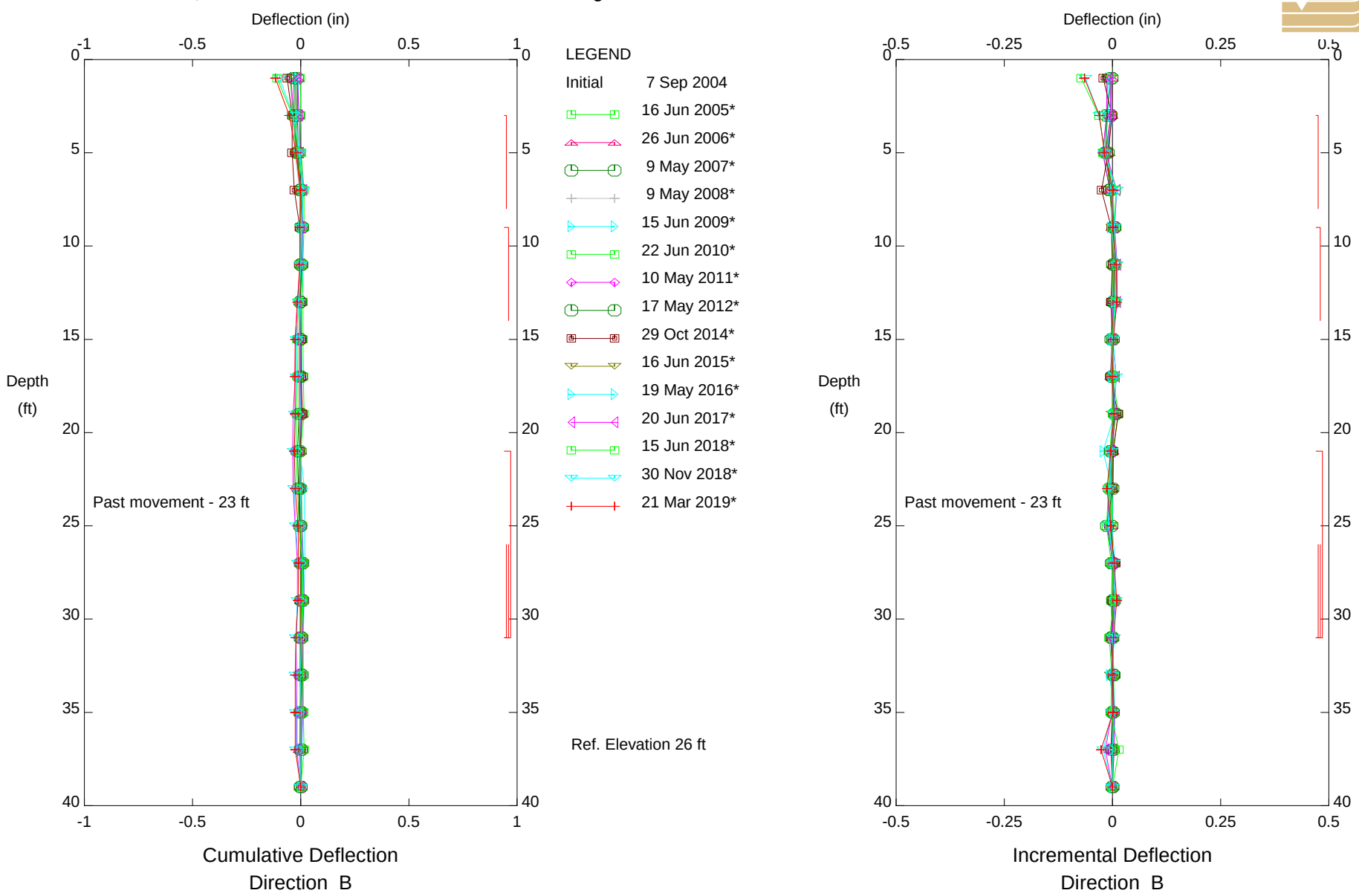
PCH REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D3-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

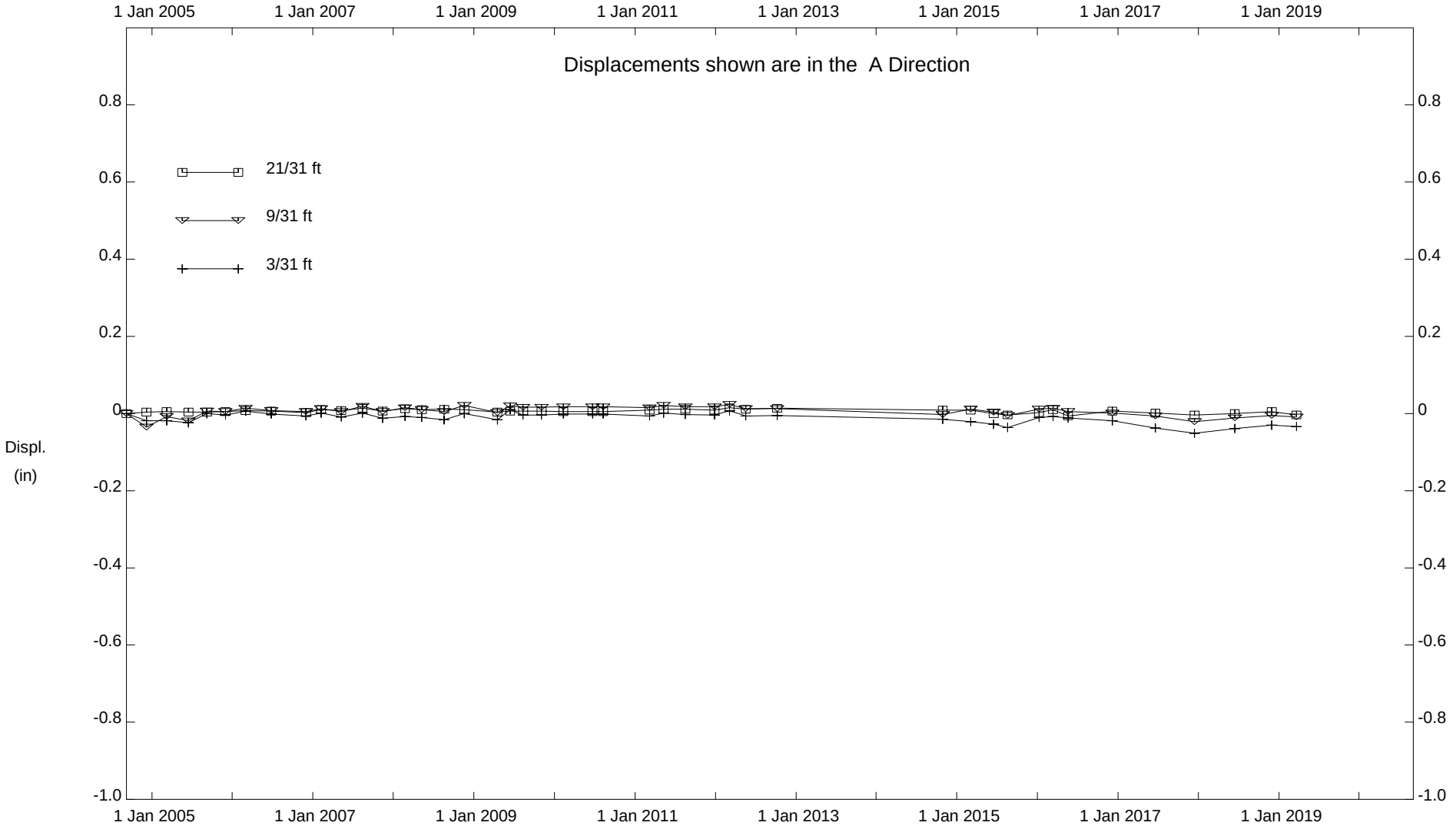


BIG ROCK MESA, Inclinometer SP-12

PCH REGION

Sets marked * include zero shift and/or rotation corrections.

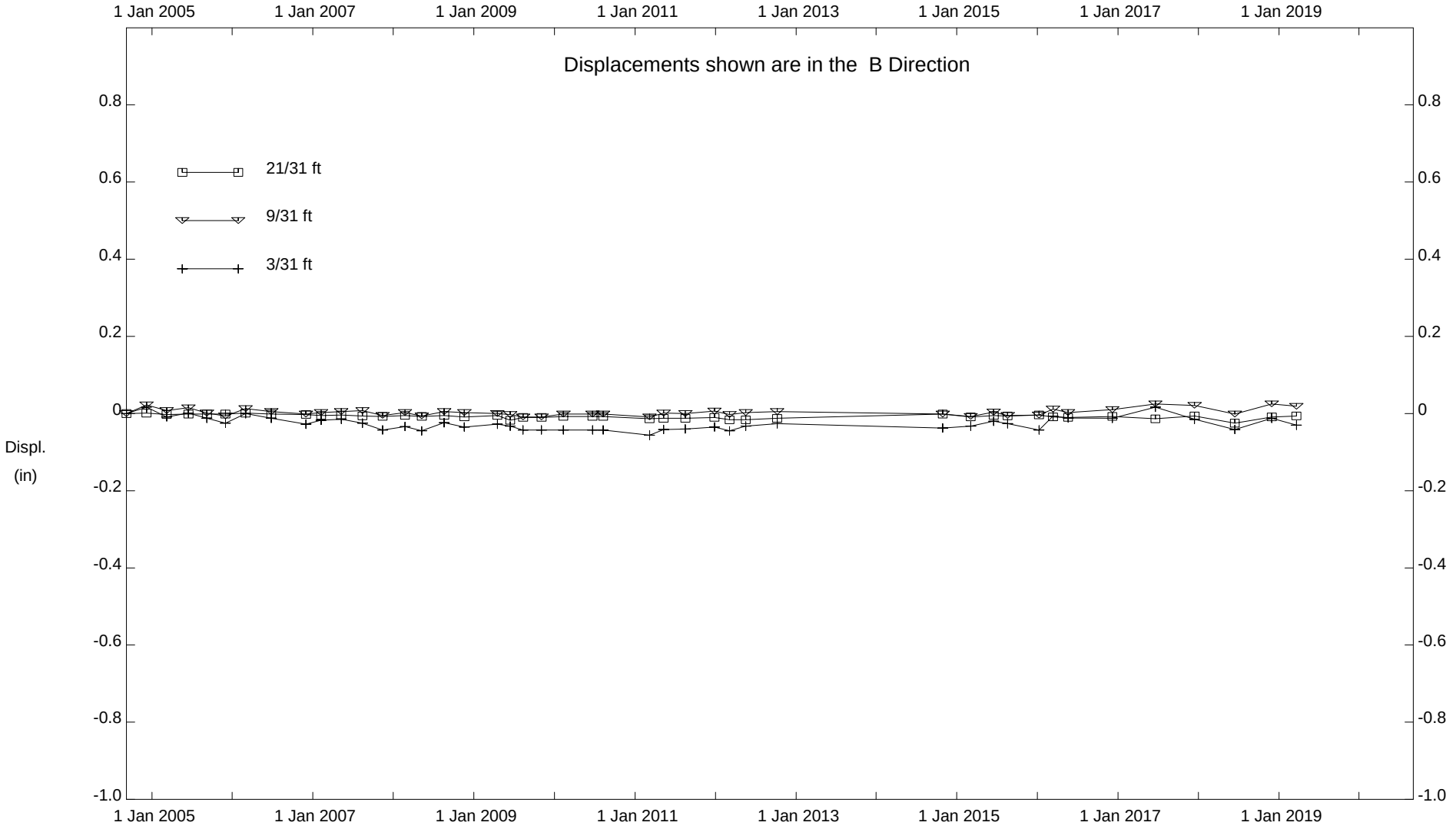
PLATE D3-2



BIG ROCK MESA, Inclinometer SP-12

PCH REGION

PLATE D3-3



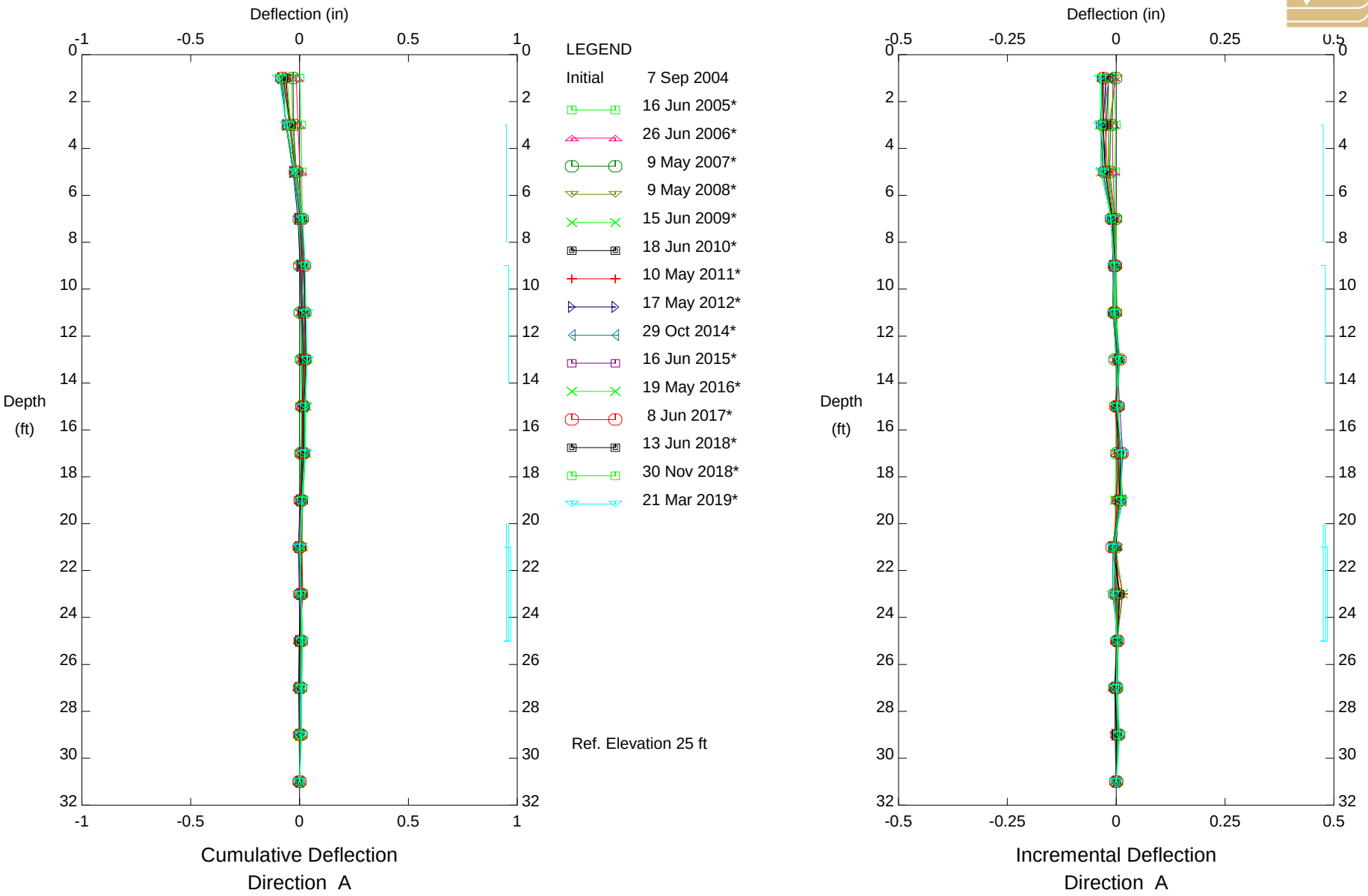
BIG ROCK MESA, Inclinometer SP-12

PCH REGION

PLATE D3-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-14

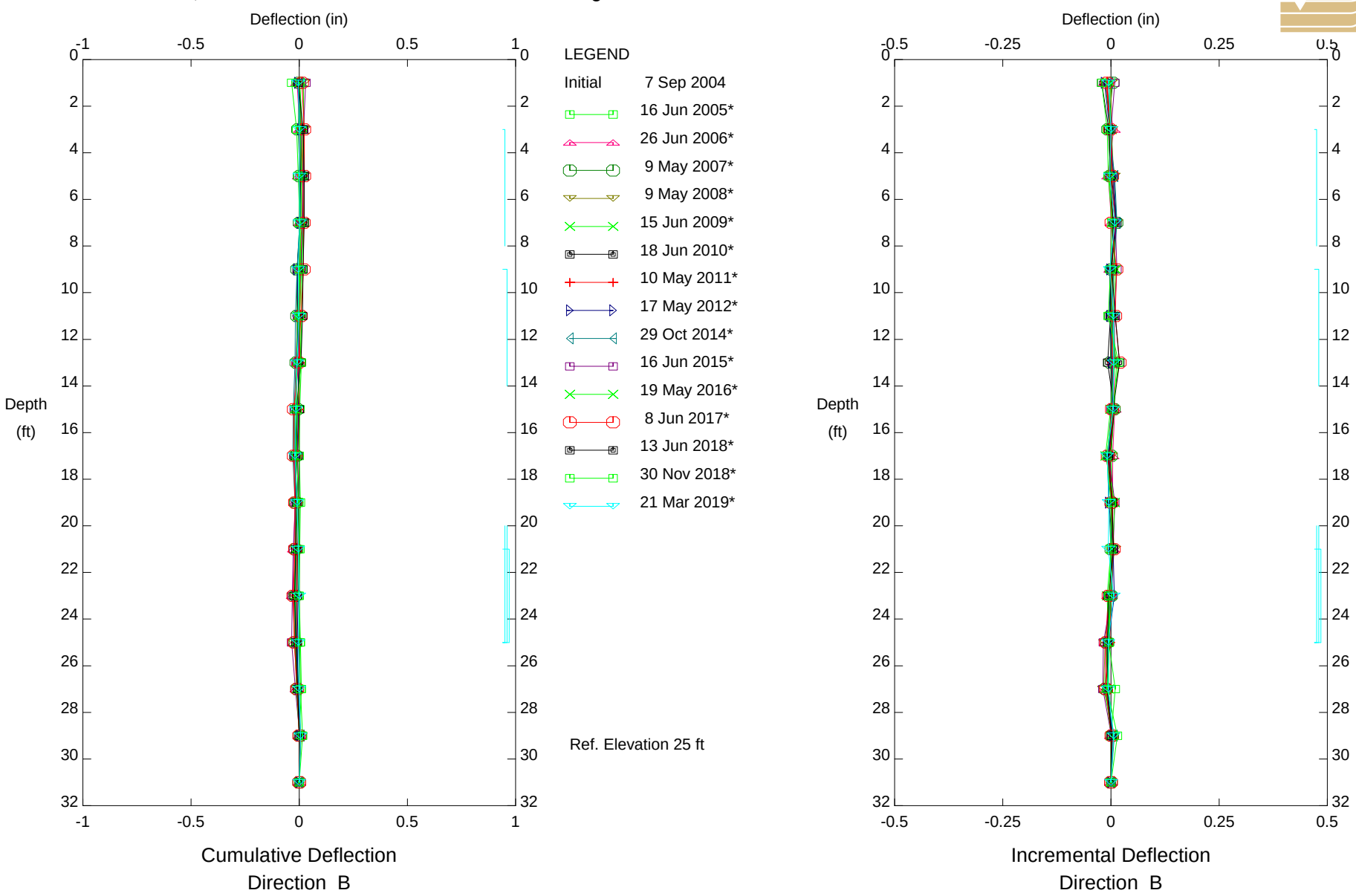
PCH REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D4-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

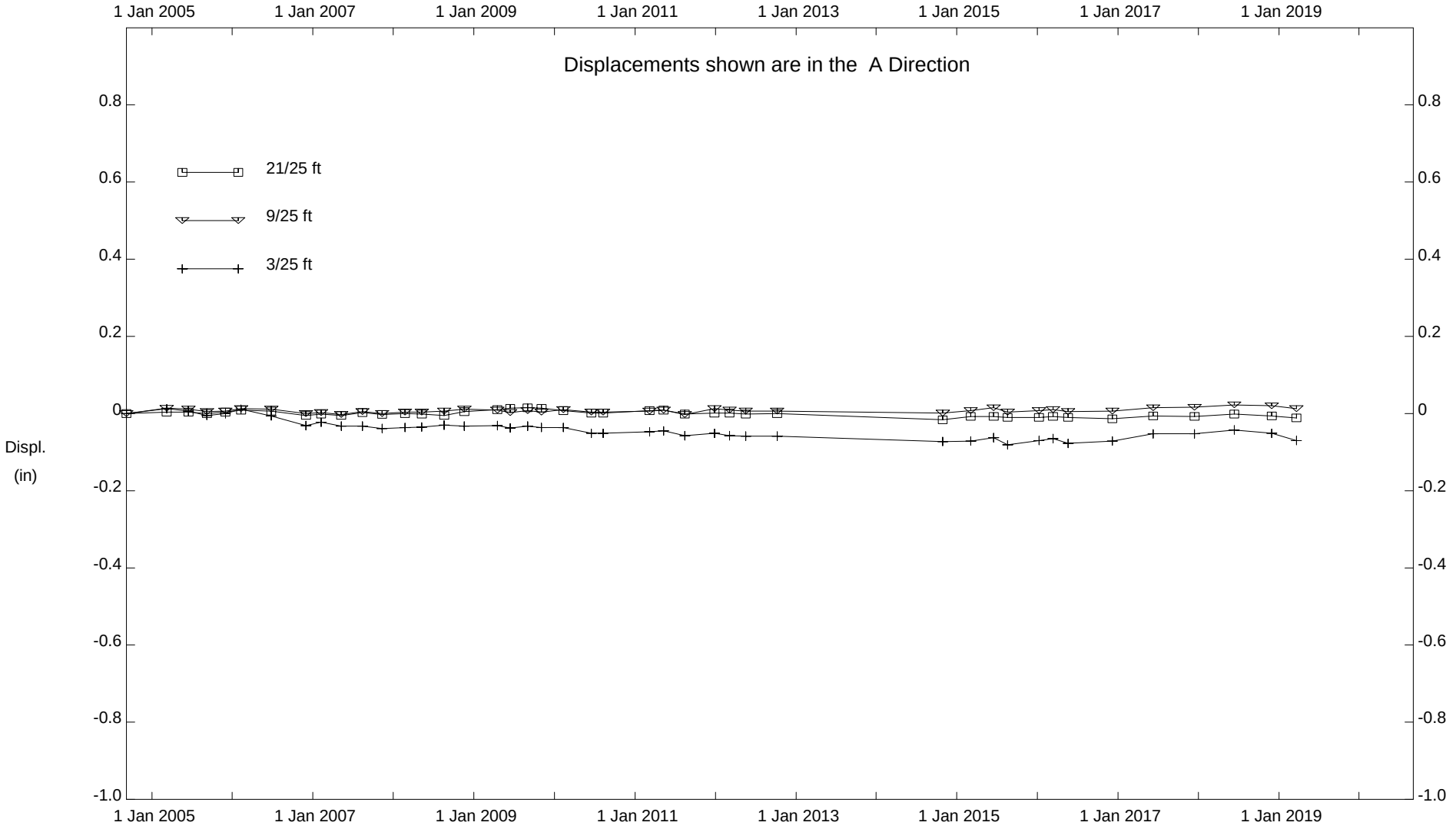


BIG ROCK MESA, Inclinometer SP-14

PCH REGION

Sets marked * include zero shift and/or rotation corrections.

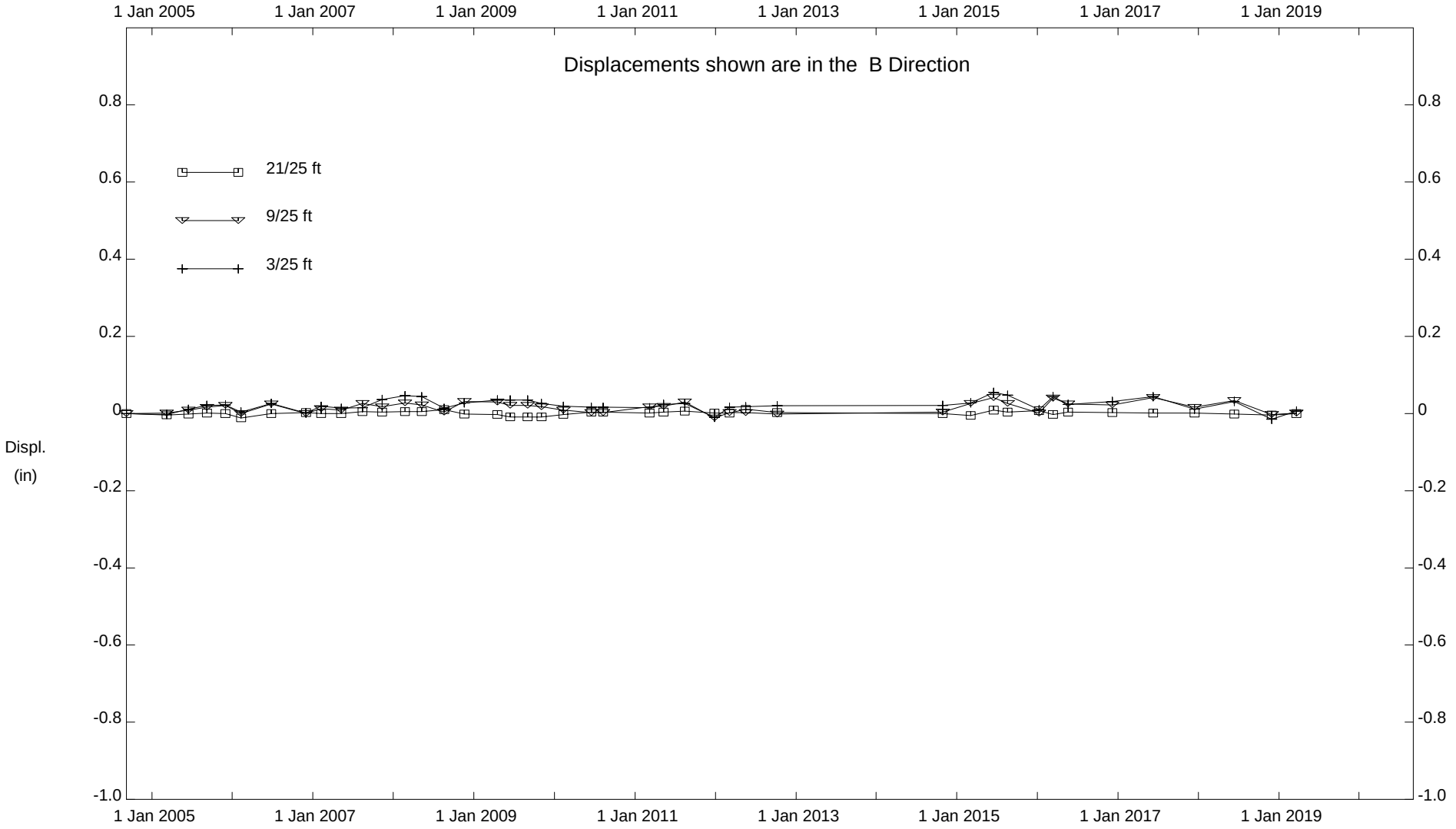
PLATE D4-2



BIG ROCK MESA, Inclinometer SP-14

PCH REGION

PLATE D4-3



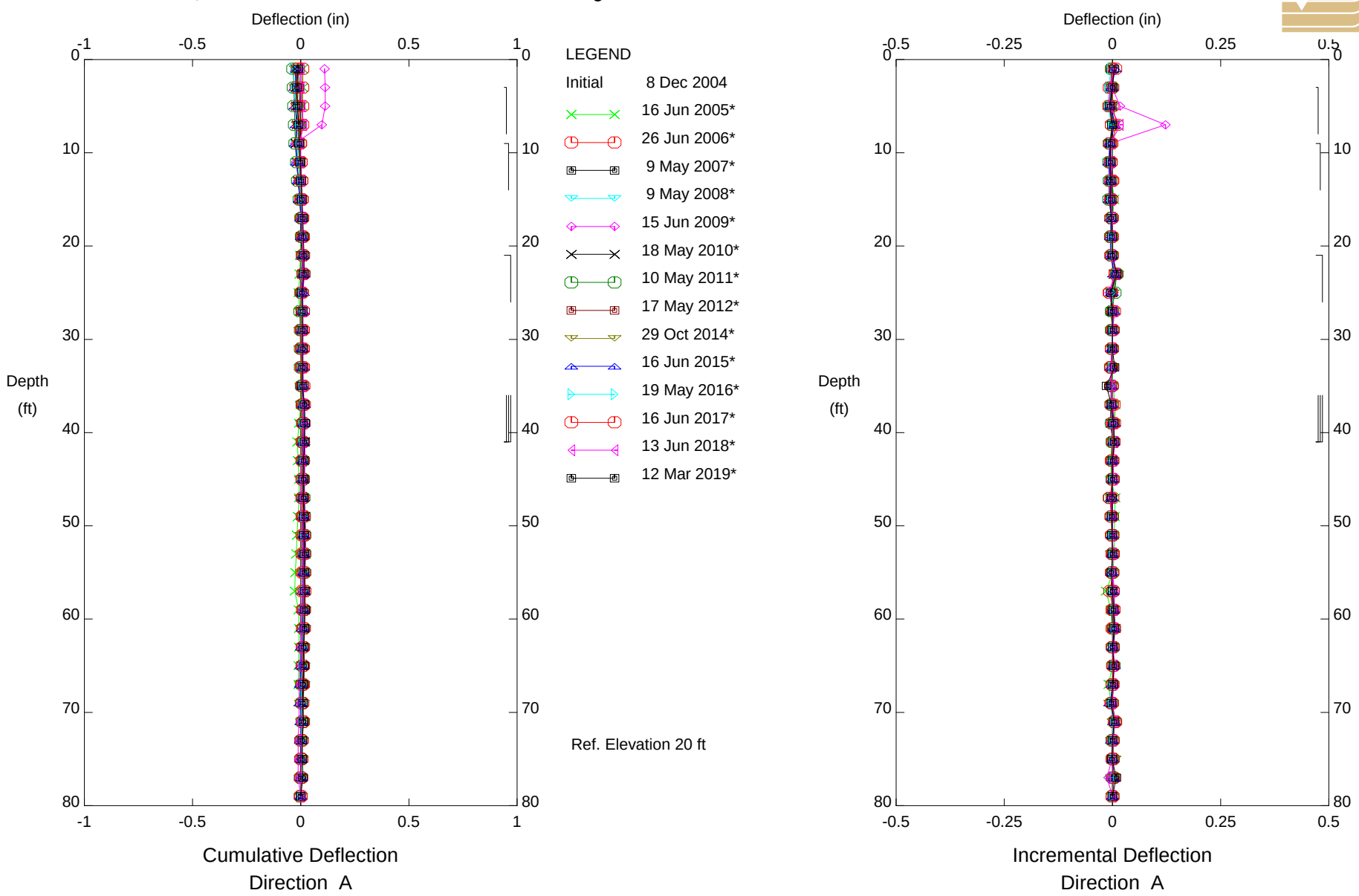
BIG ROCK MESA, Inclinometer SP-14

PCH REGION

PLATE D4-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-15

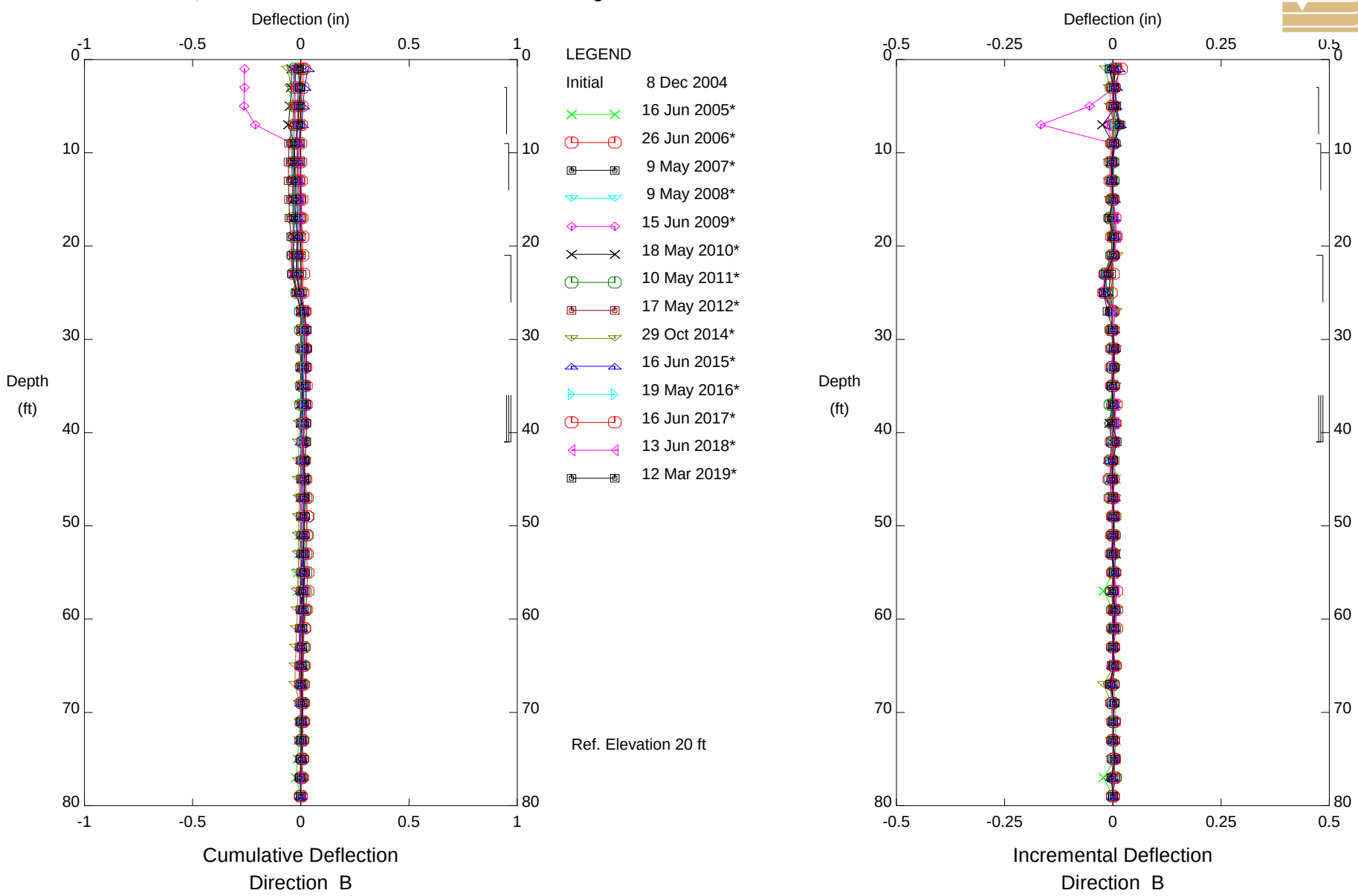
PCH REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D5-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

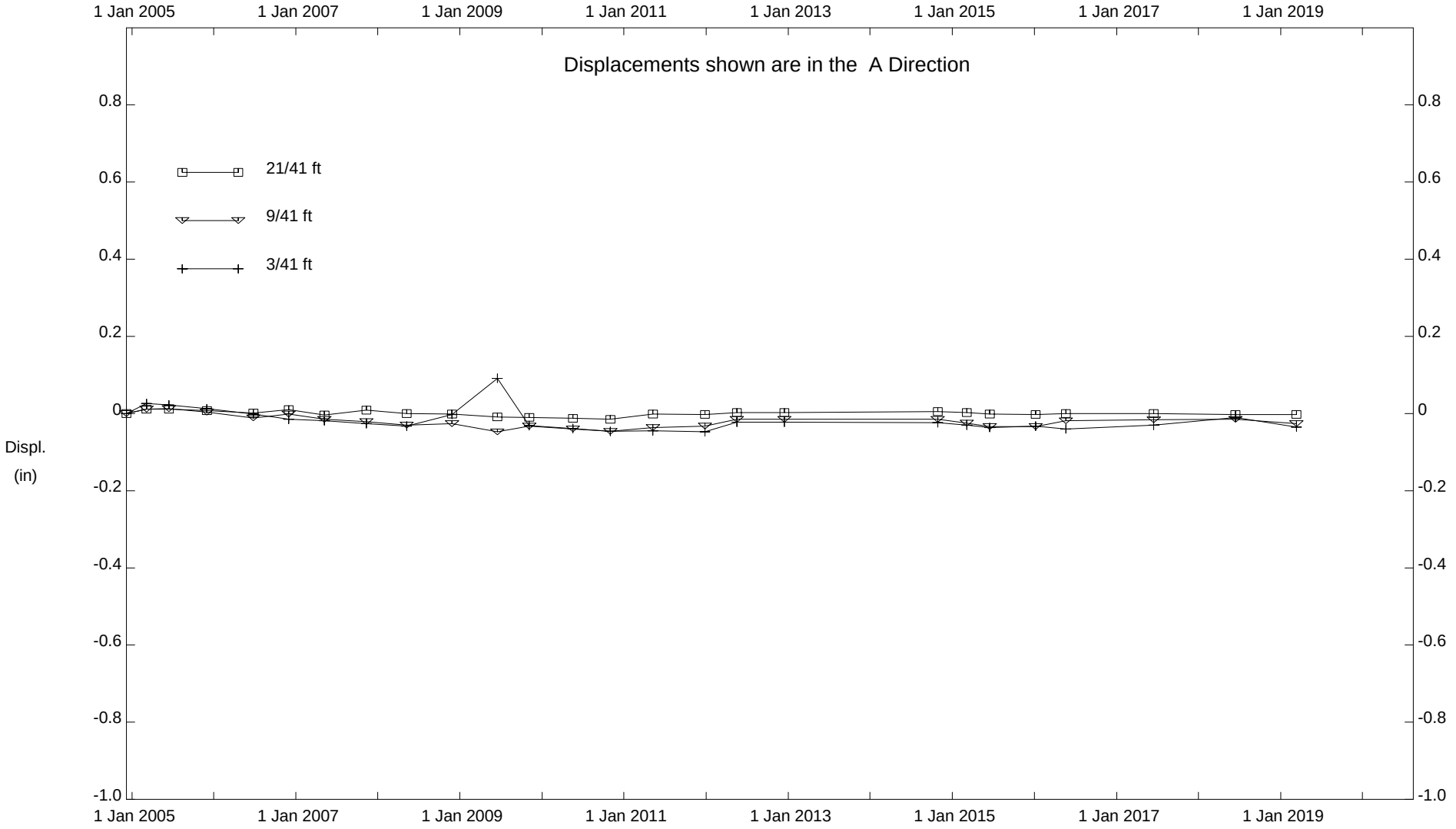


BIG ROCK MESA, Inclinometer SP-15

PCH REGION

Sets marked * include zero shift and/or rotation corrections.

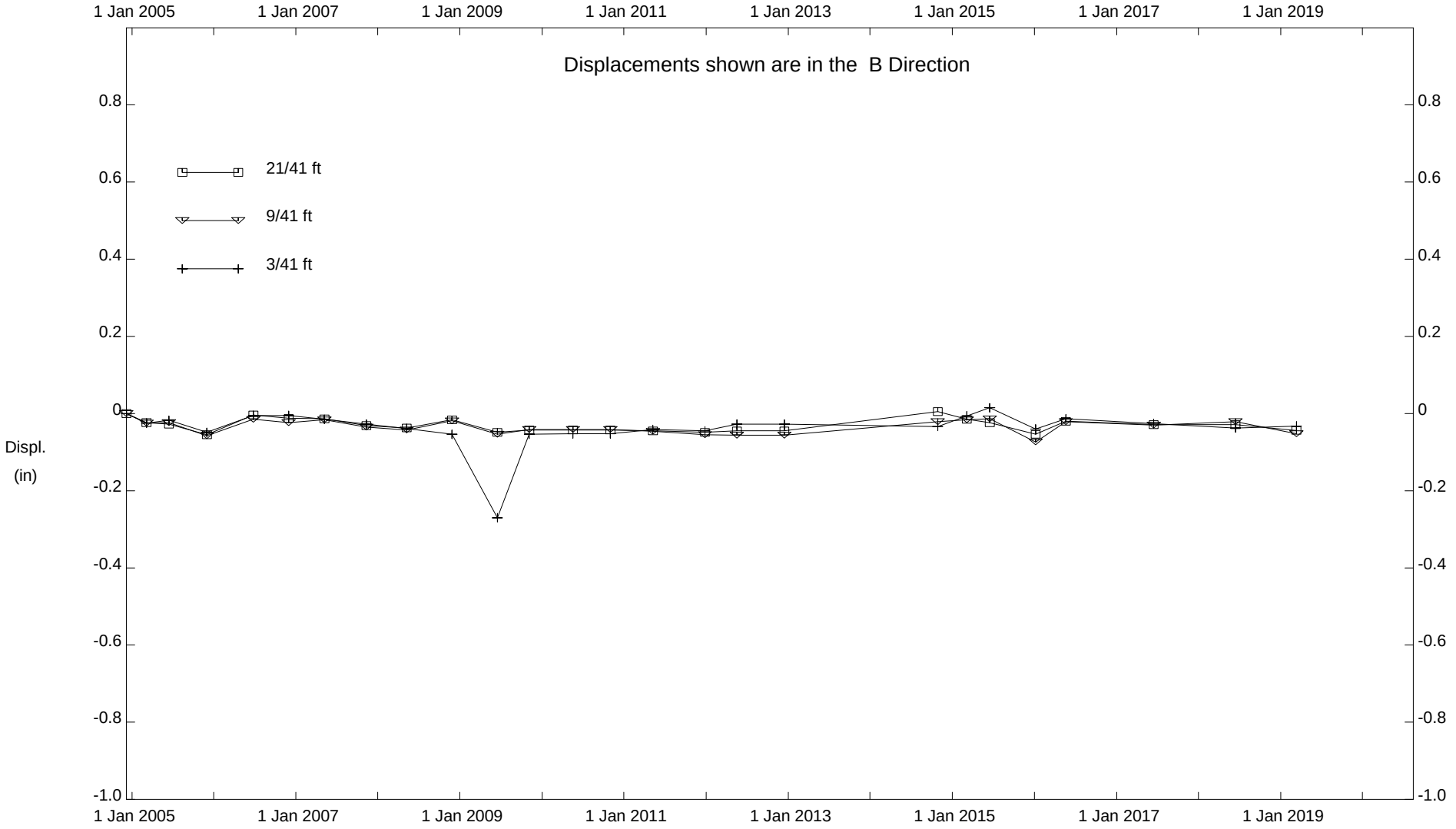
PLATE D5-2



BIG ROCK MESA, Inclinometer SP-15

PCH REGION

PLATE D5-3



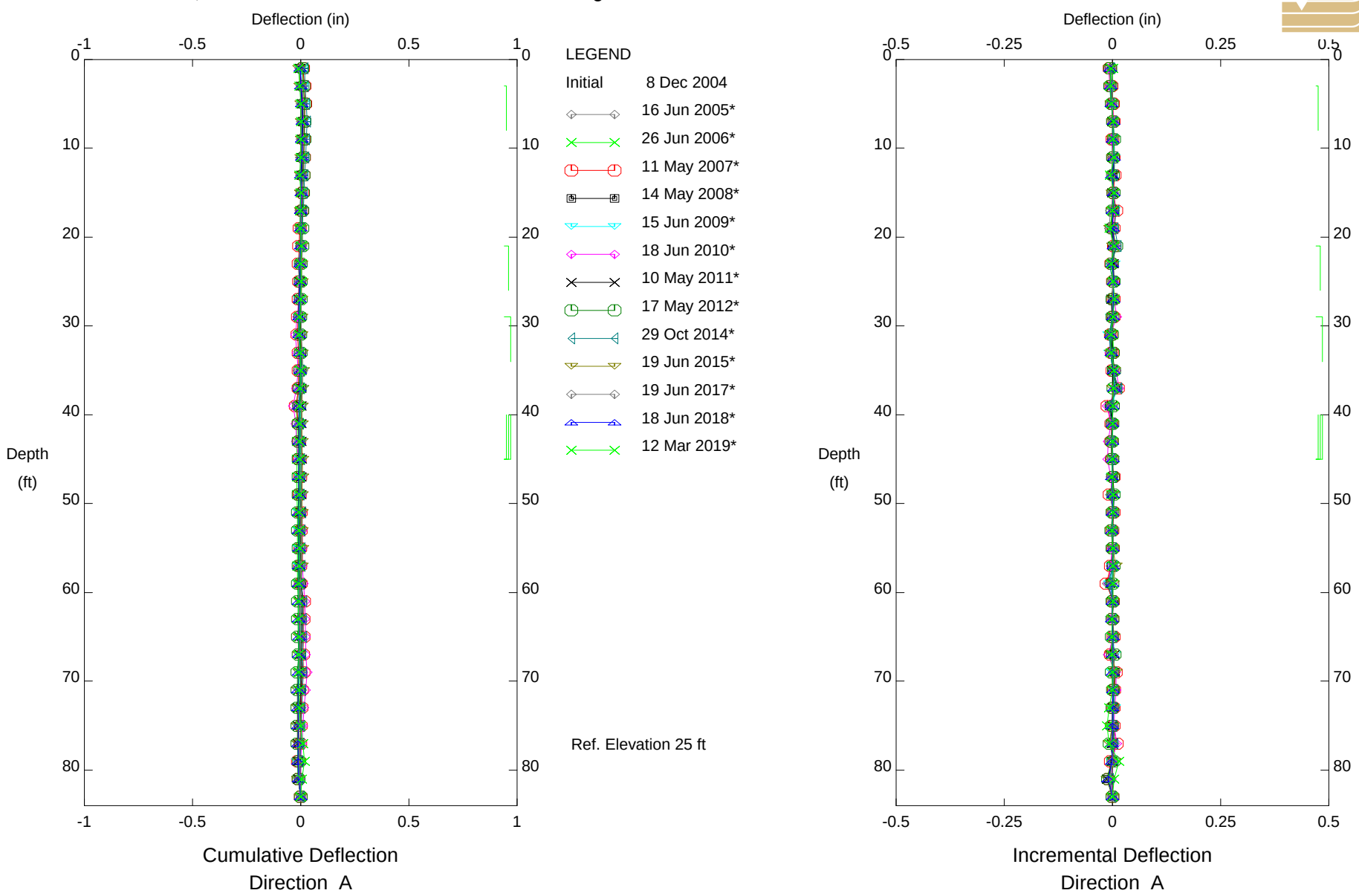
BIG ROCK MESA, Inclinometer SP-15

PCH REGION

PLATE D5-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-19

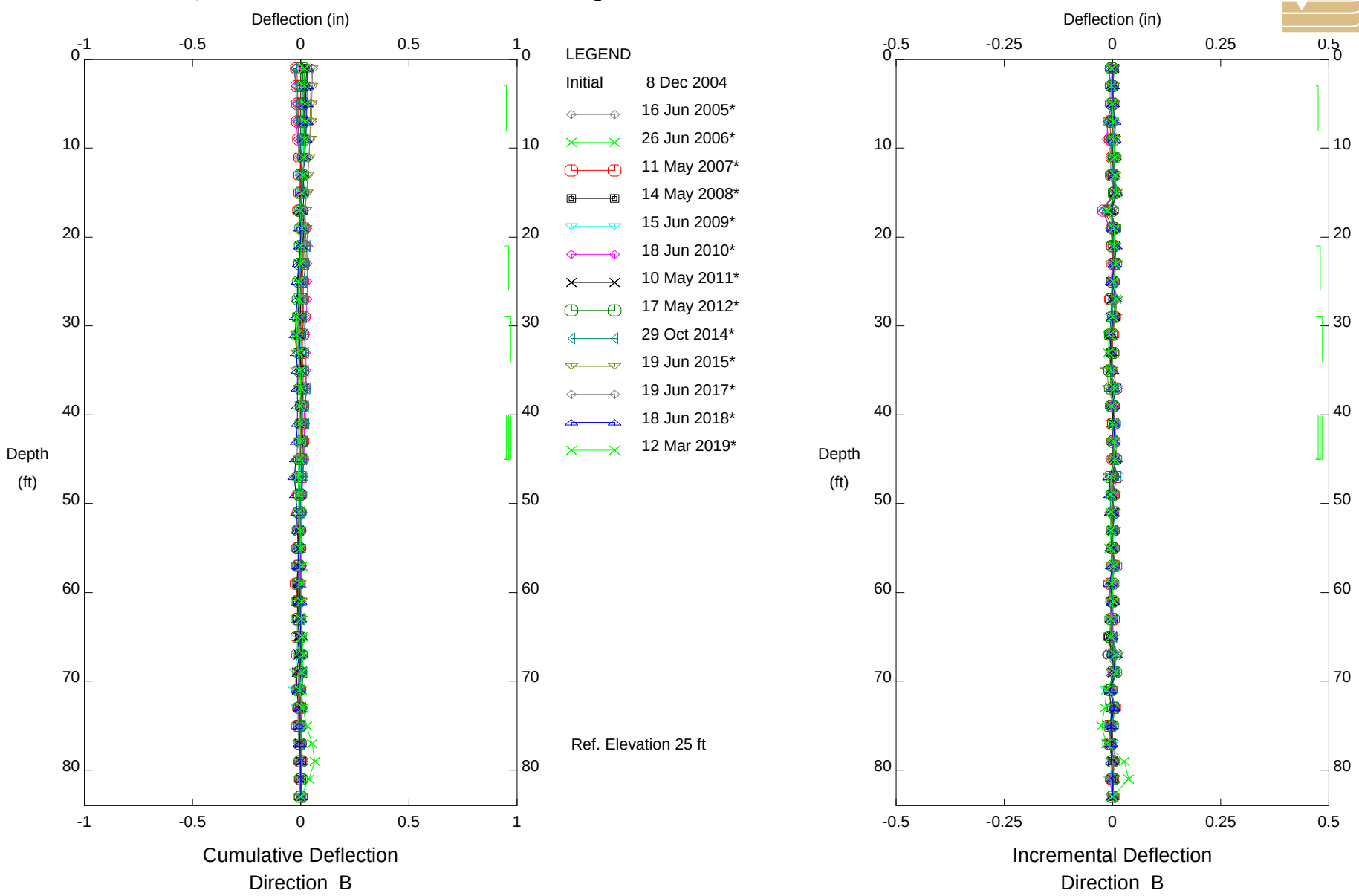
PCH REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D6-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

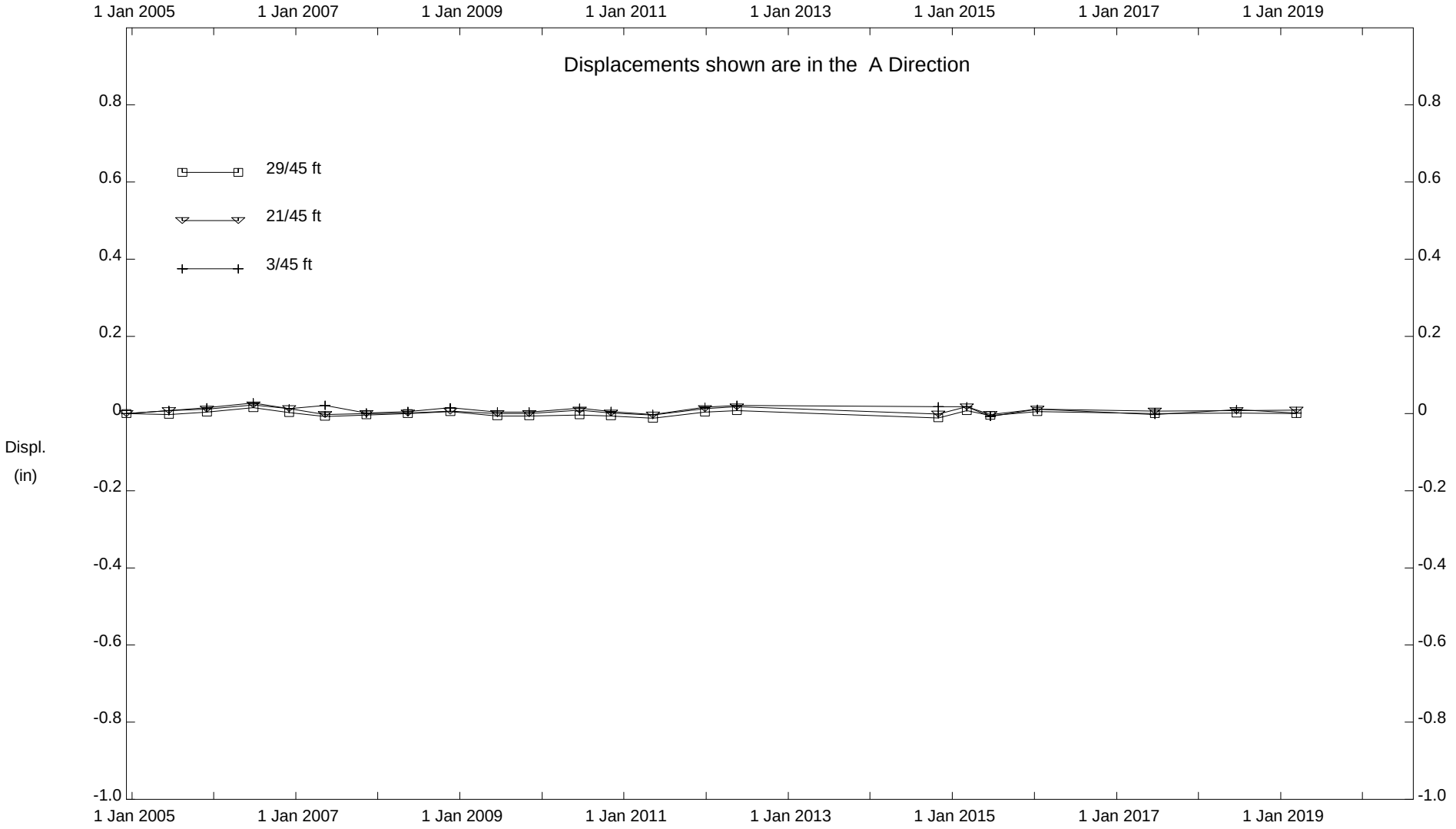


BIG ROCK MESA, Inclinometer SP-19

PCH REGION

Sets marked * include zero shift and/or rotation corrections.

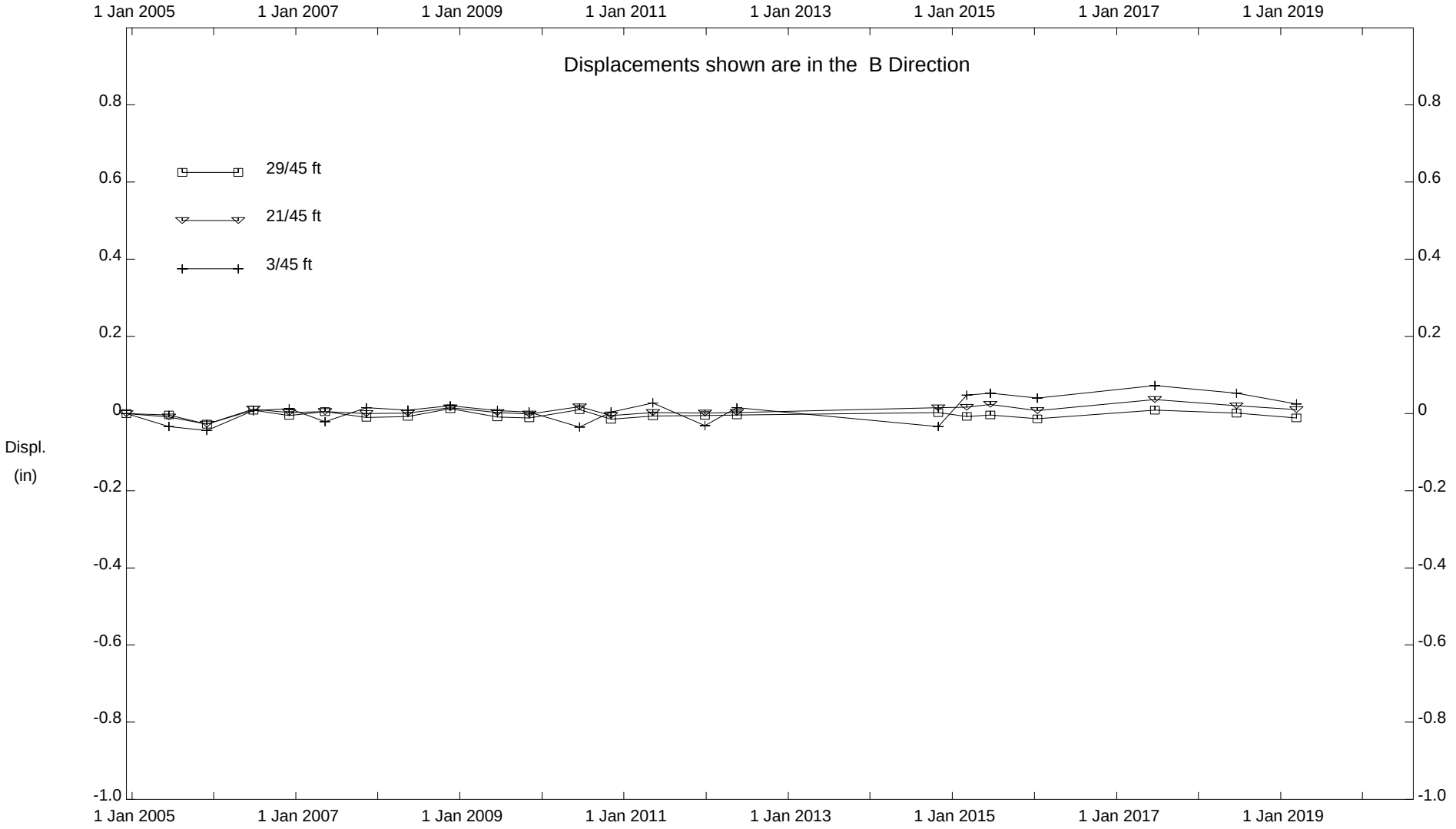
PLATE D6-2



BIG ROCK MESA, Inclinometer SP-19

PCH REGION

PLATE D6-3



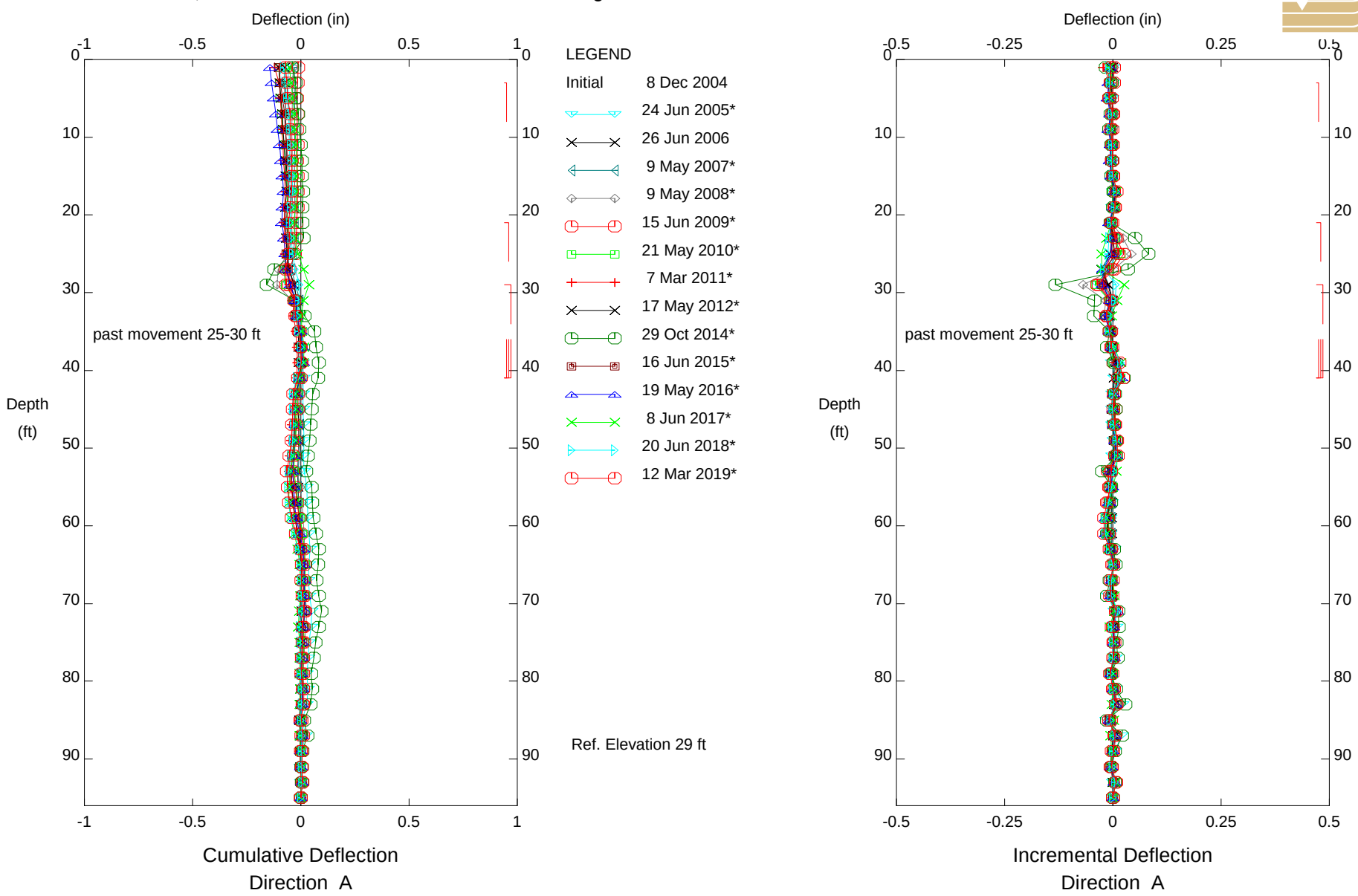
BIG ROCK MESA, Inclinometer SP-19

PCH REGION

PLATE D6-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-27A

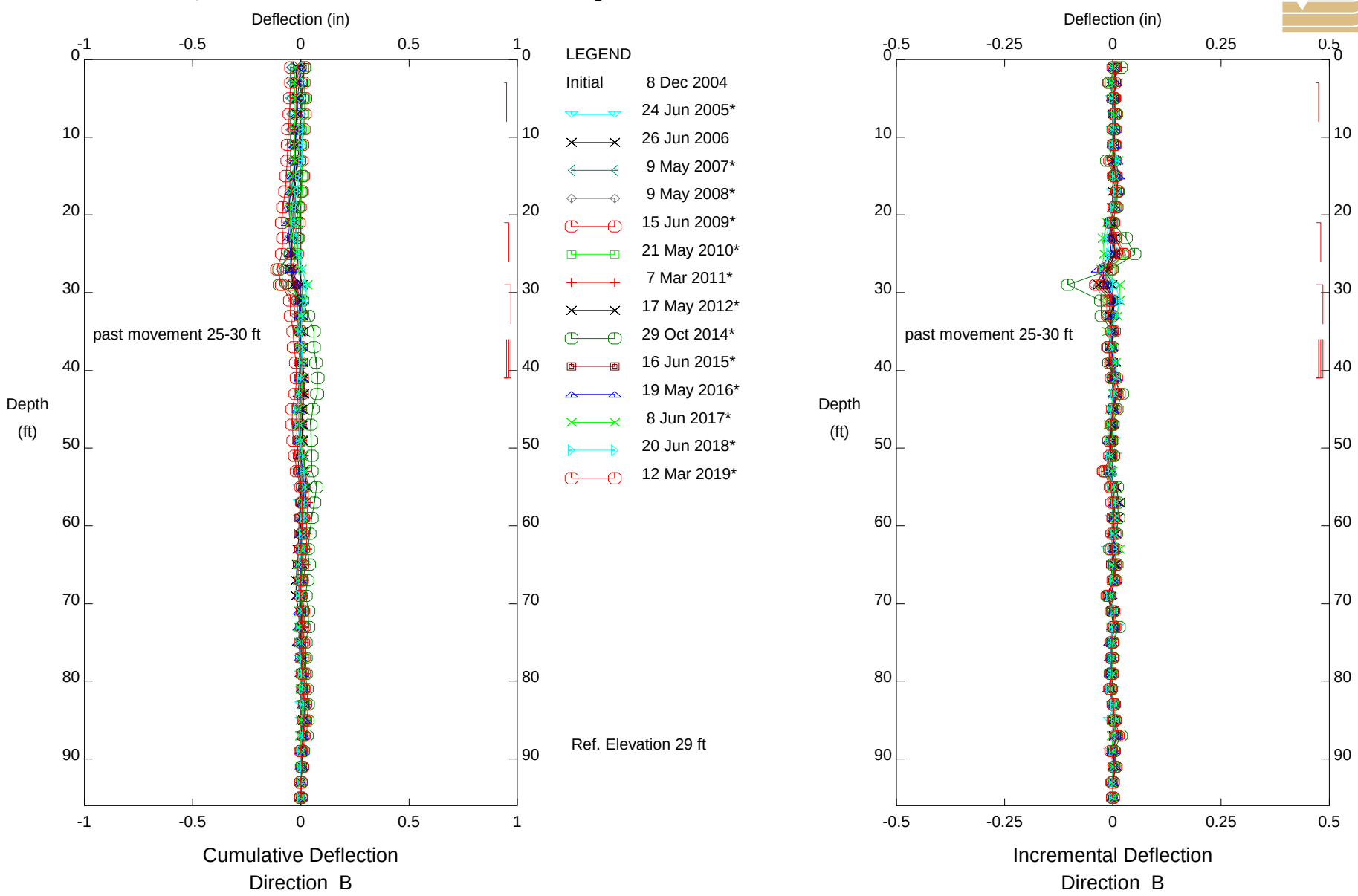
PCH REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D7-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

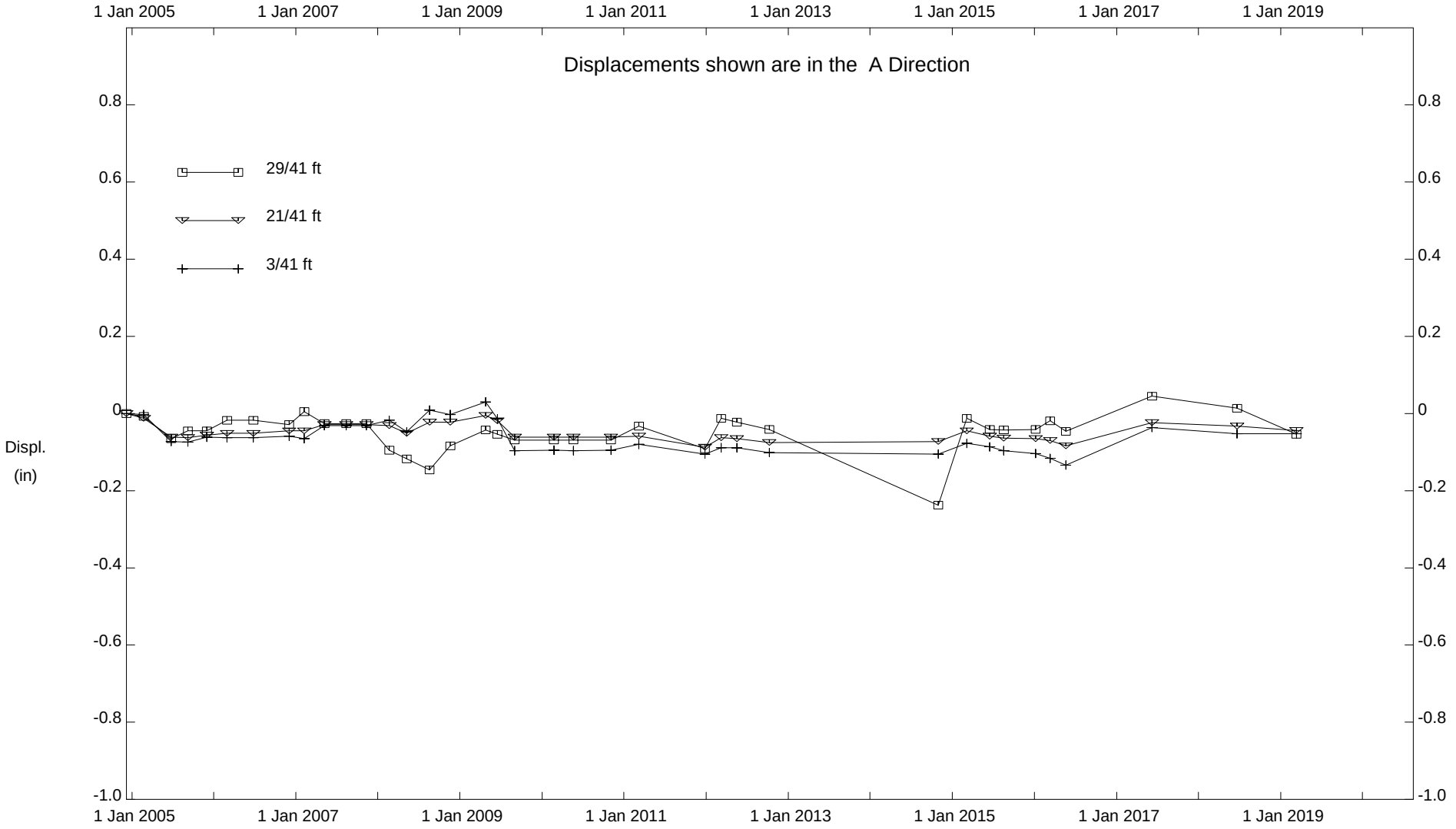


BIG ROCK MESA, Inclinometer SP-27A

PCH REGION

Sets marked * include zero shift and/or rotation corrections.

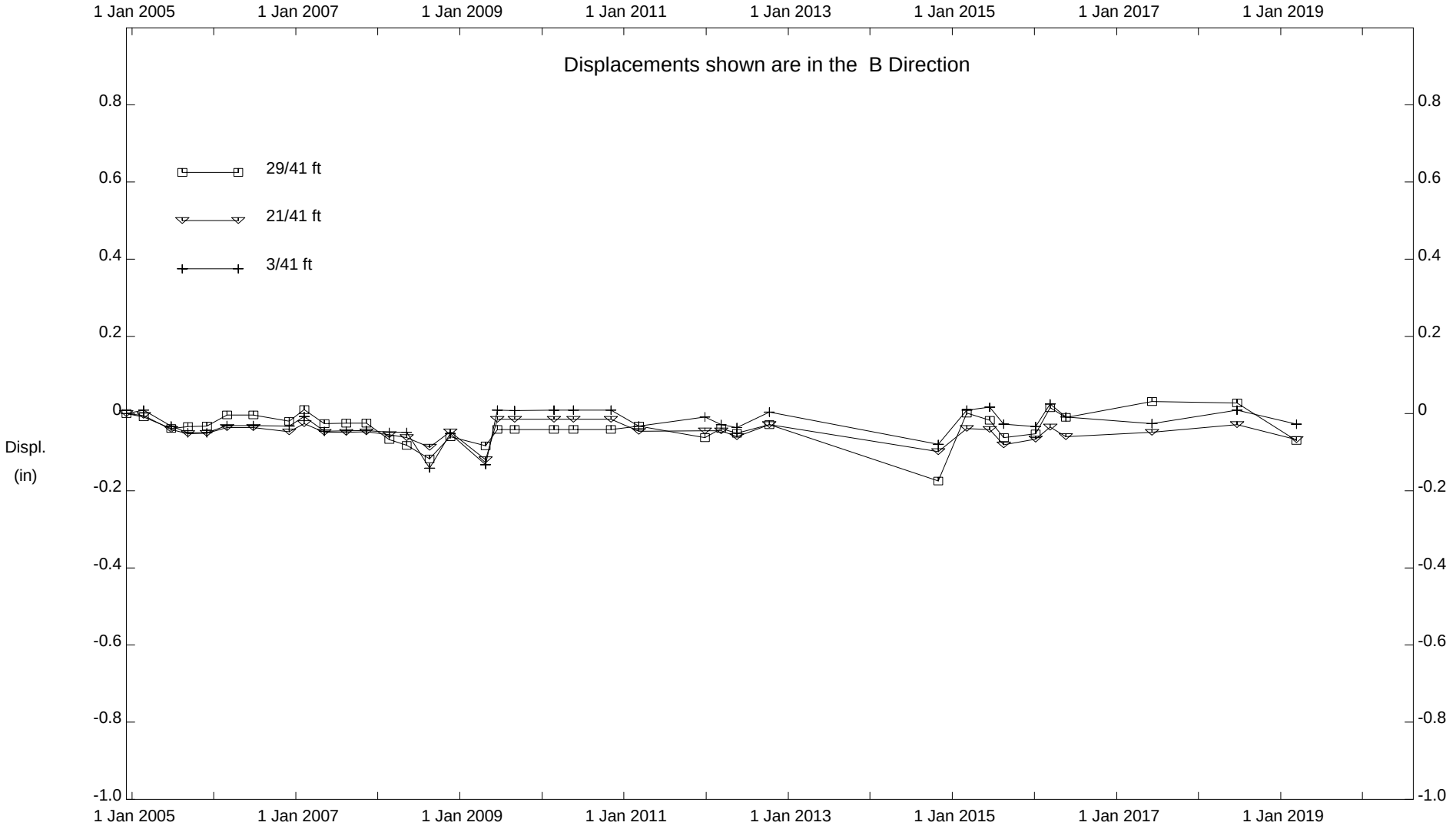
PLATE D7-2



BIG ROCK MESA, Inclinometer SP-27A

PCH REGION

PLATE D7-3



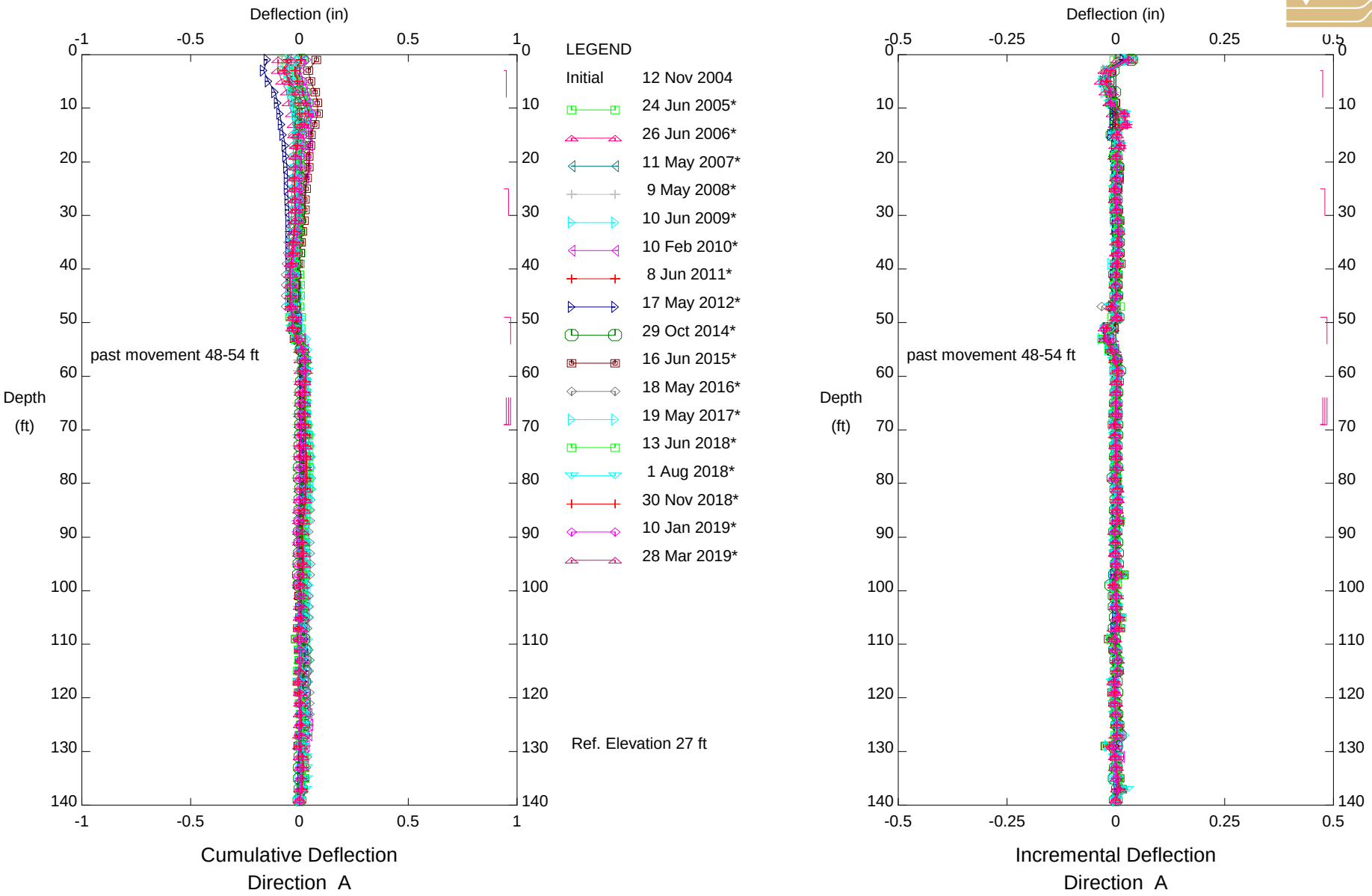
BIG ROCK MESA, Inclinometer SP-27A

PCH REGION

PLATE D7-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-29

PCH REGION

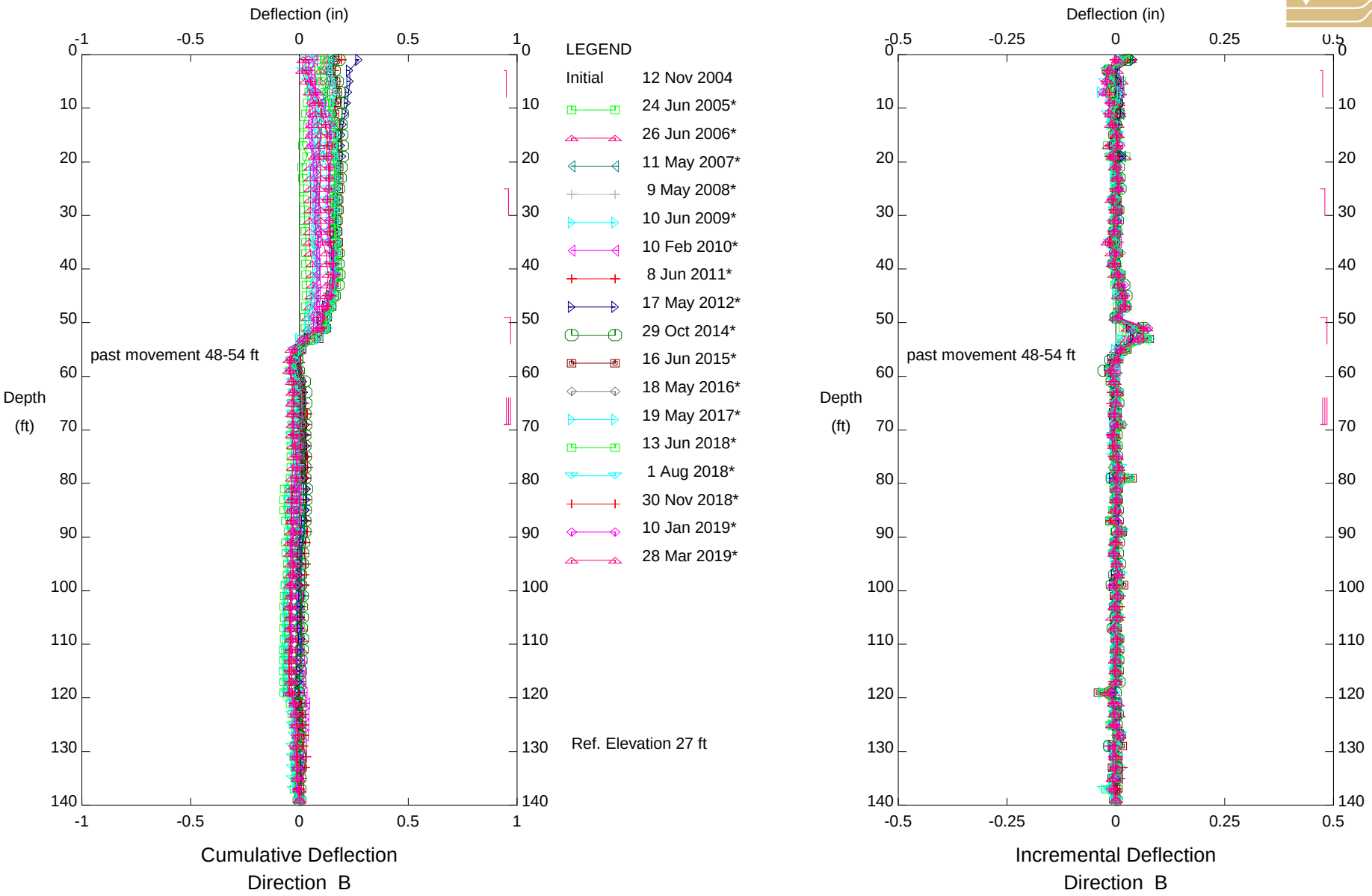
Sets marked * include zero shift and/or rotation corrections.

PLATE D8-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP29.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



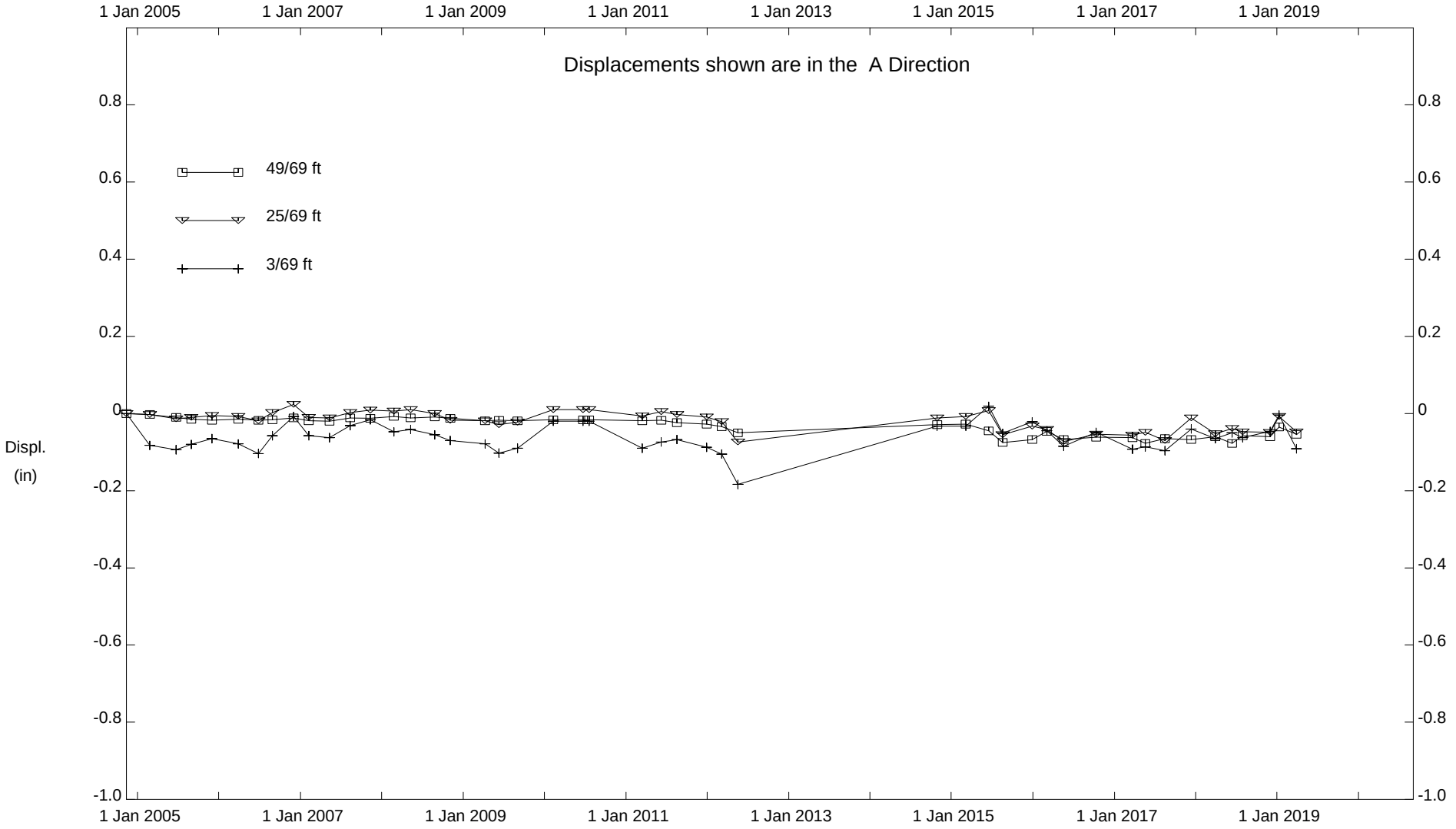
BIG ROCK MESA, Inclinometer SP-29

PCH REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D8-2

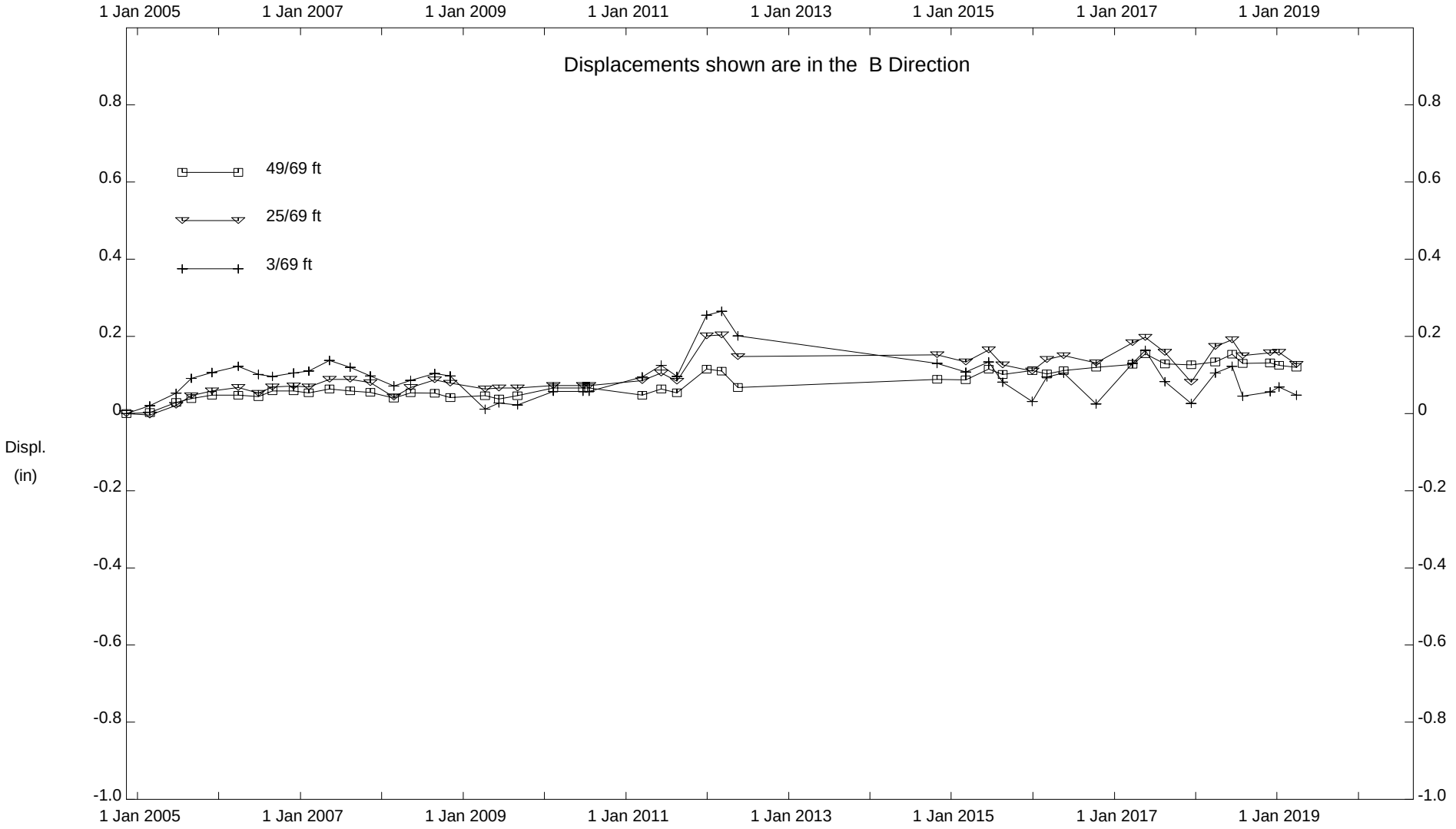
O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP29.gtl



BIG ROCK MESA, Inclinometer SP-29

PCH REGION

PLATE D8-3



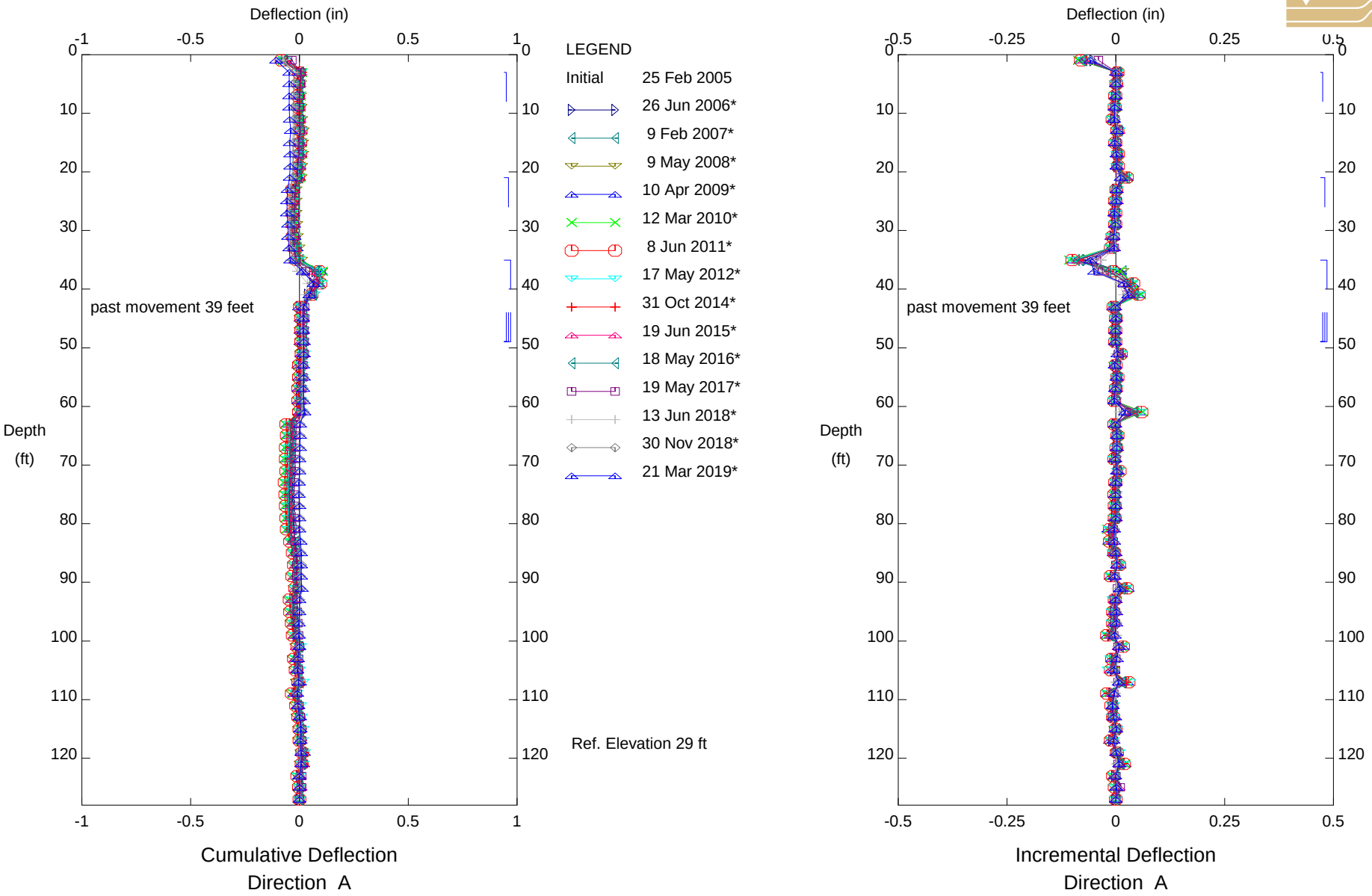
BIG ROCK MESA, Inclinometer SP-29

PCH REGION

PLATE D8-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-30

PCH REGION

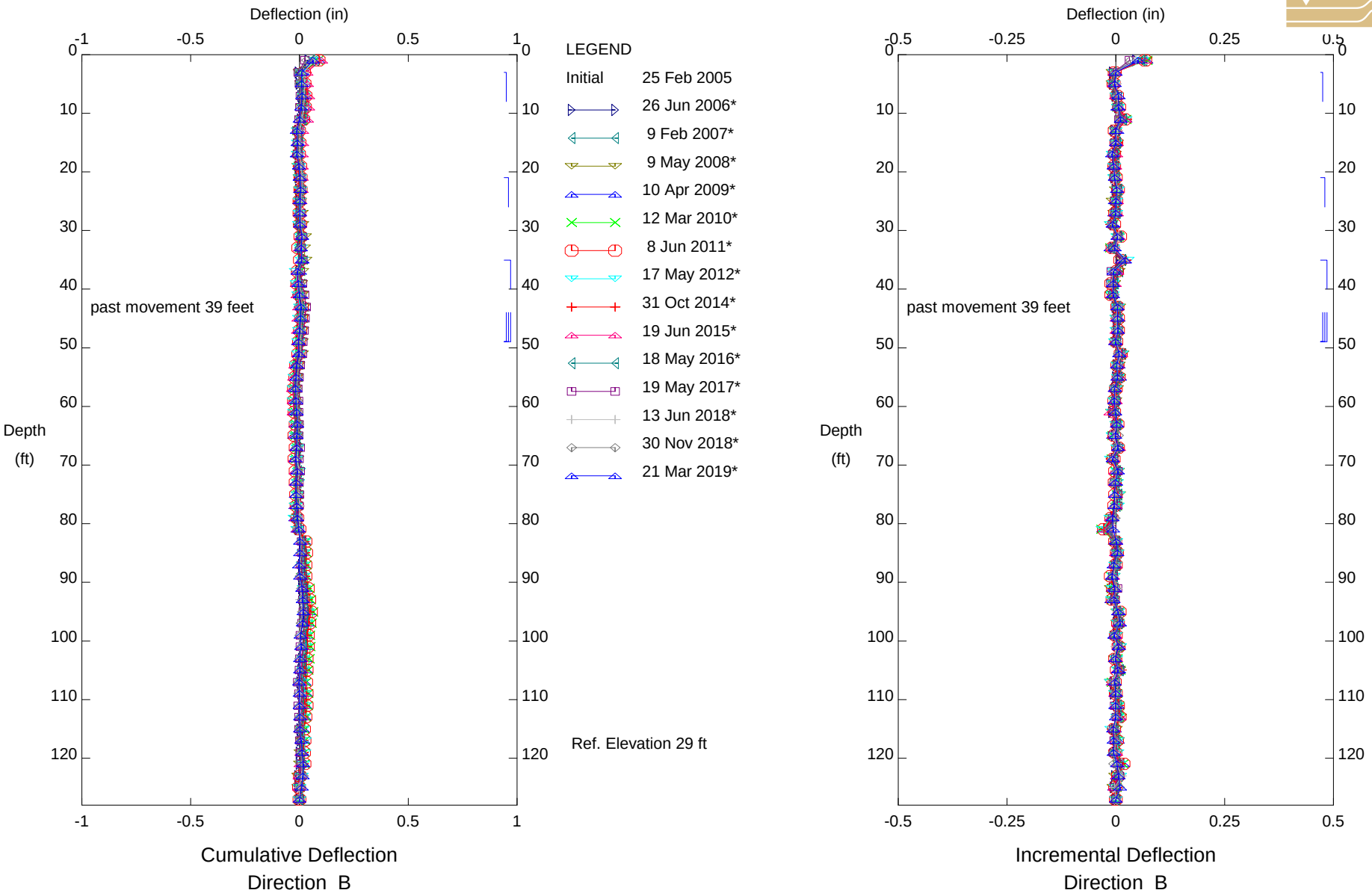
Sets marked * include zero shift and/or rotation corrections.

PLATE D9-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2019-2020\SP30.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



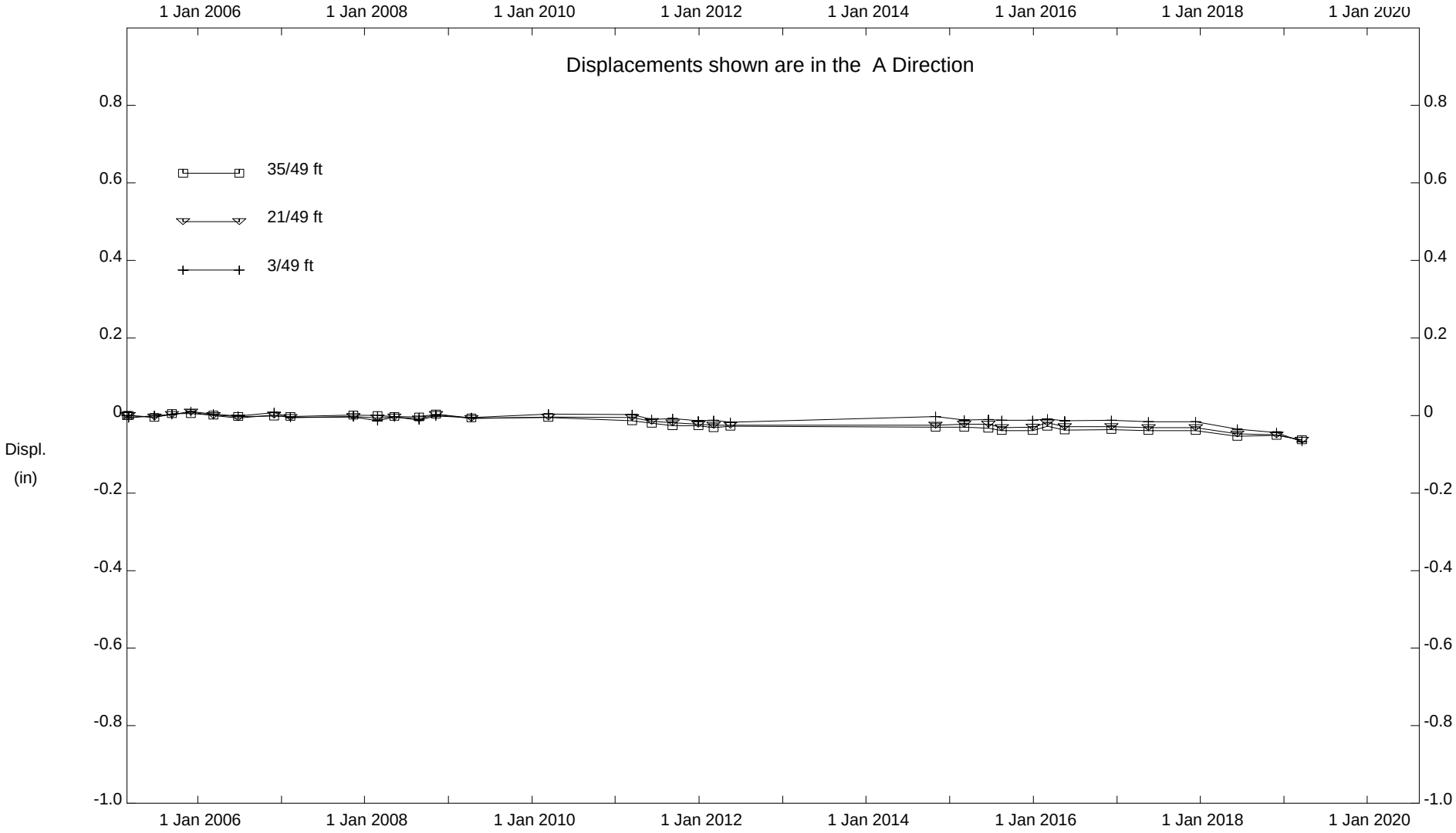
BIG ROCK MESA, Inclinometer SP-30

PCH REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D9-2

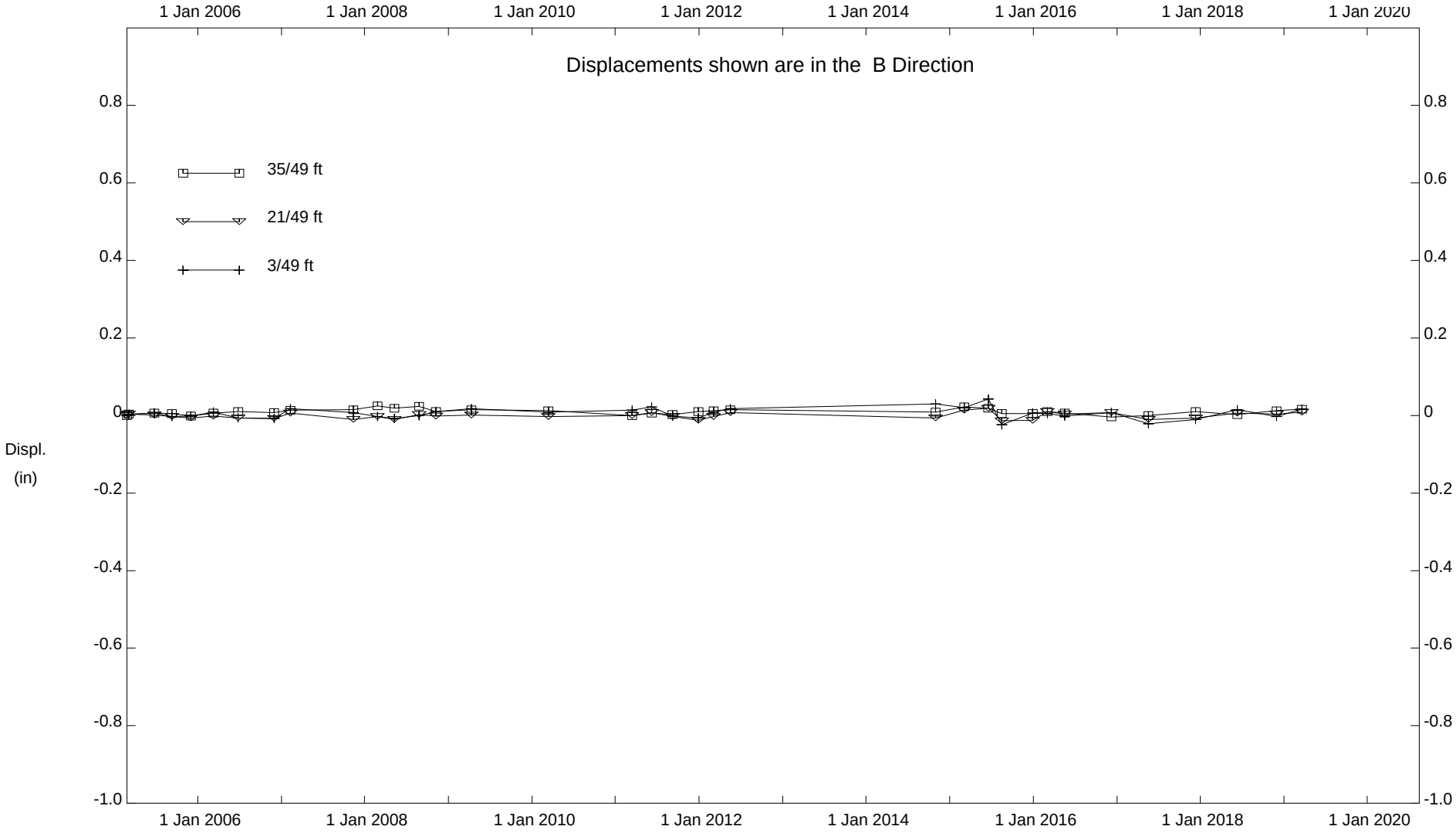
O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2019-2020\SP30.gtl



BIG ROCK MESA, Inclinometer SP-30

PCH REGION

PLATE D9-3



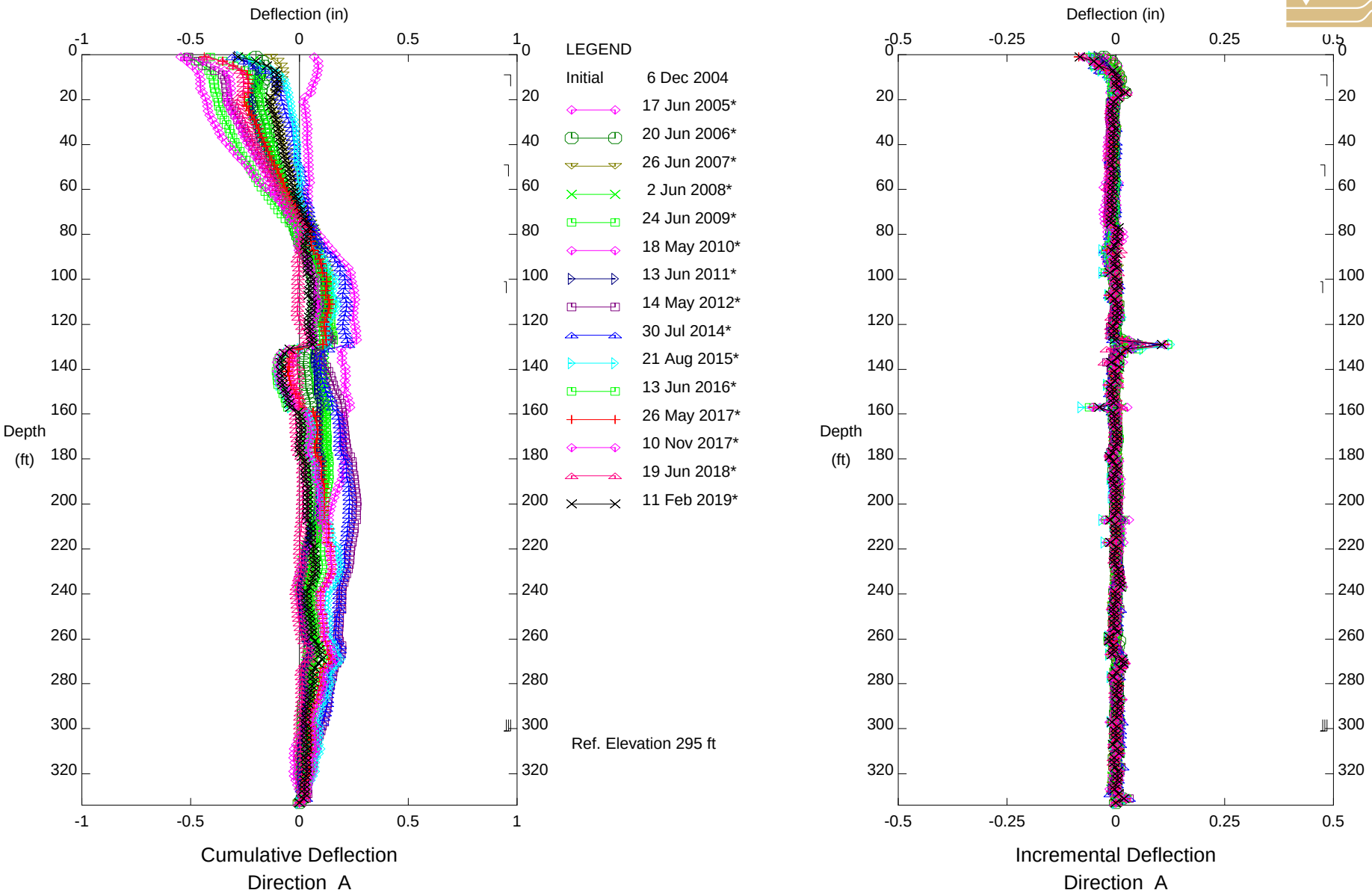
BIG ROCK MESA, Inclinometer SP-30

PCH REGION

PLATE D9-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-10

BLUFF REGION

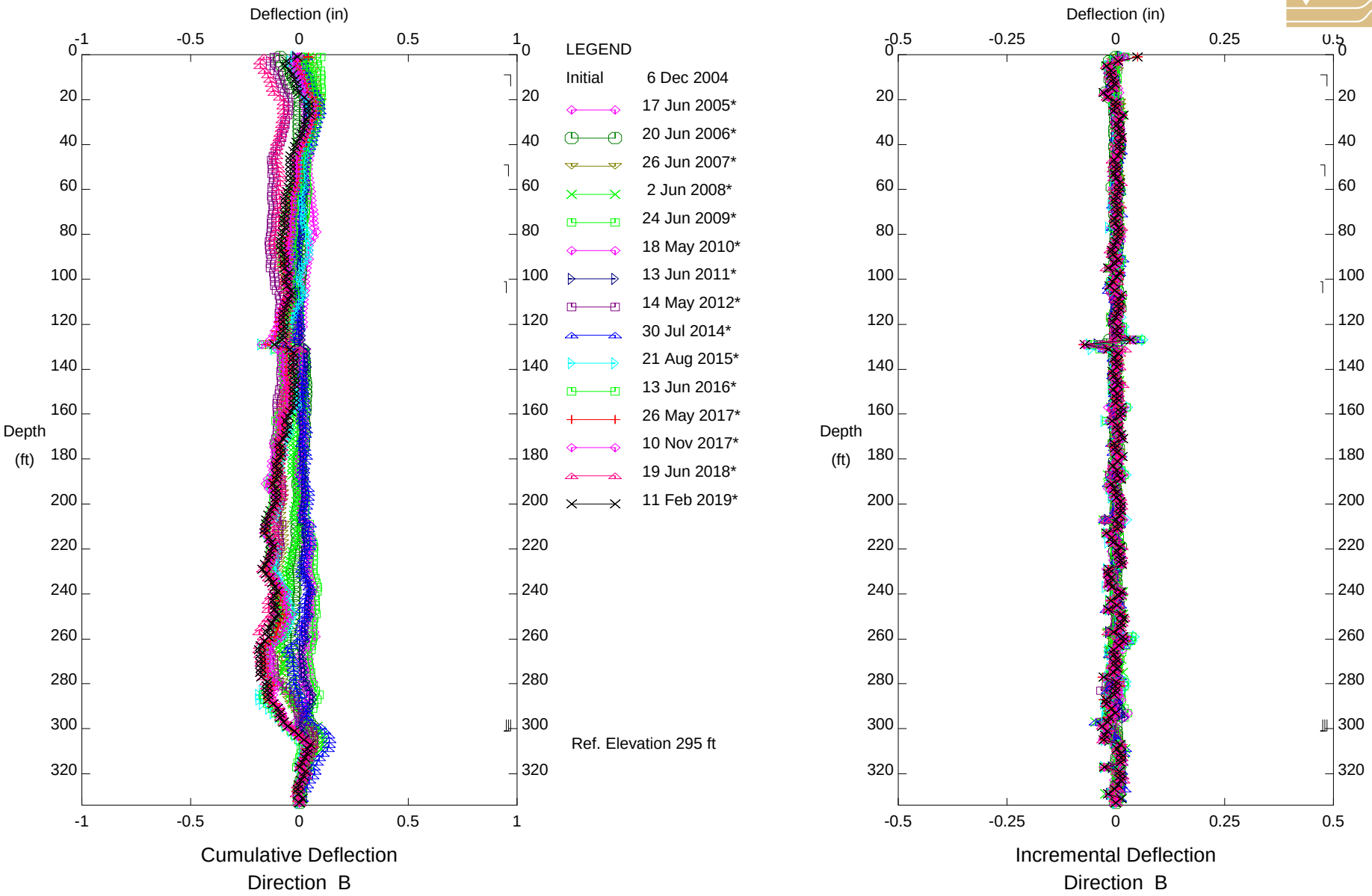
Sets marked * include zero shift and/or rotation corrections.

PLATE D10-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP10.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



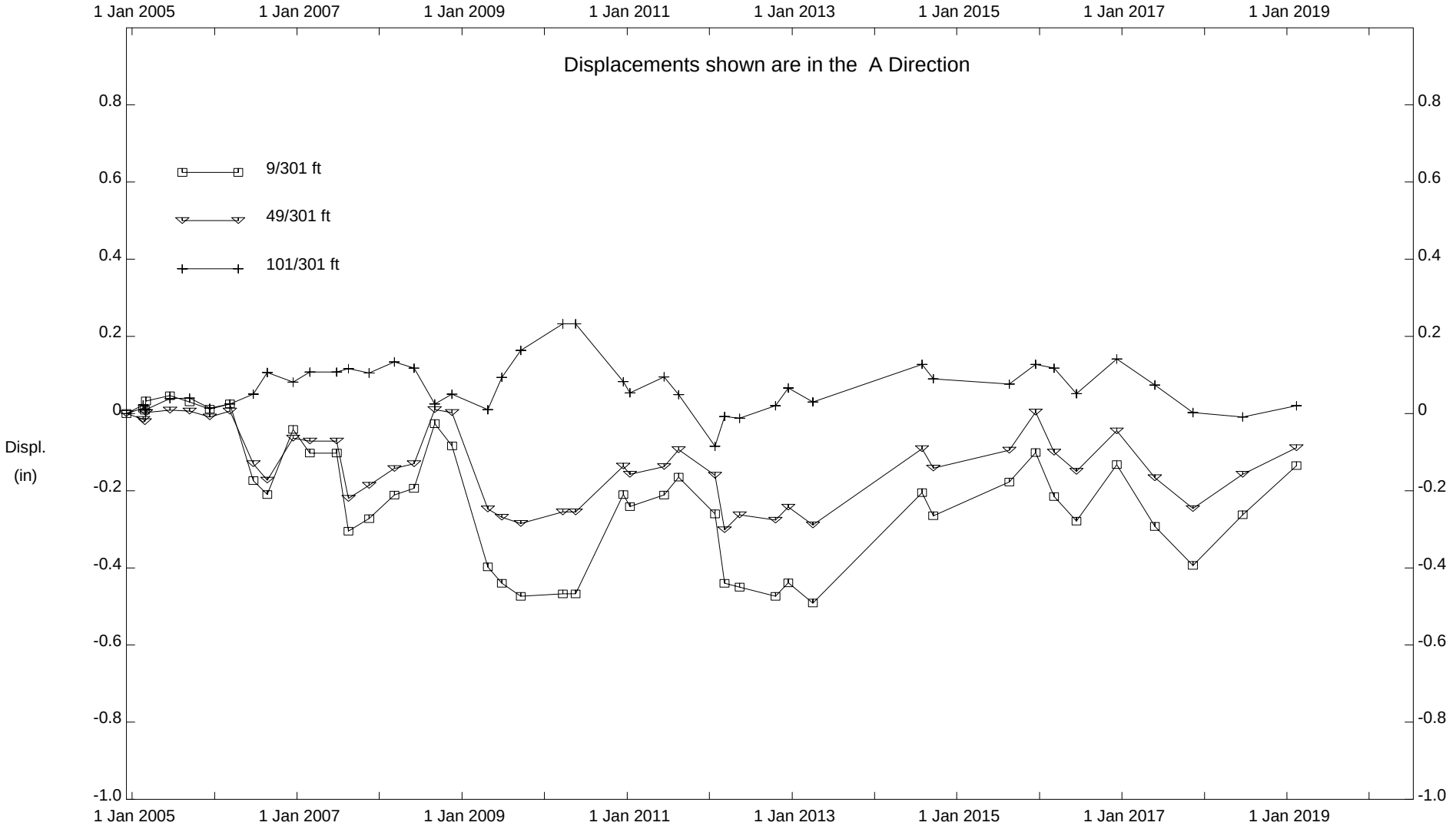
BIG ROCK MESA, Inclinometer SP-10

BLUFF REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D10-2

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP10.gtl



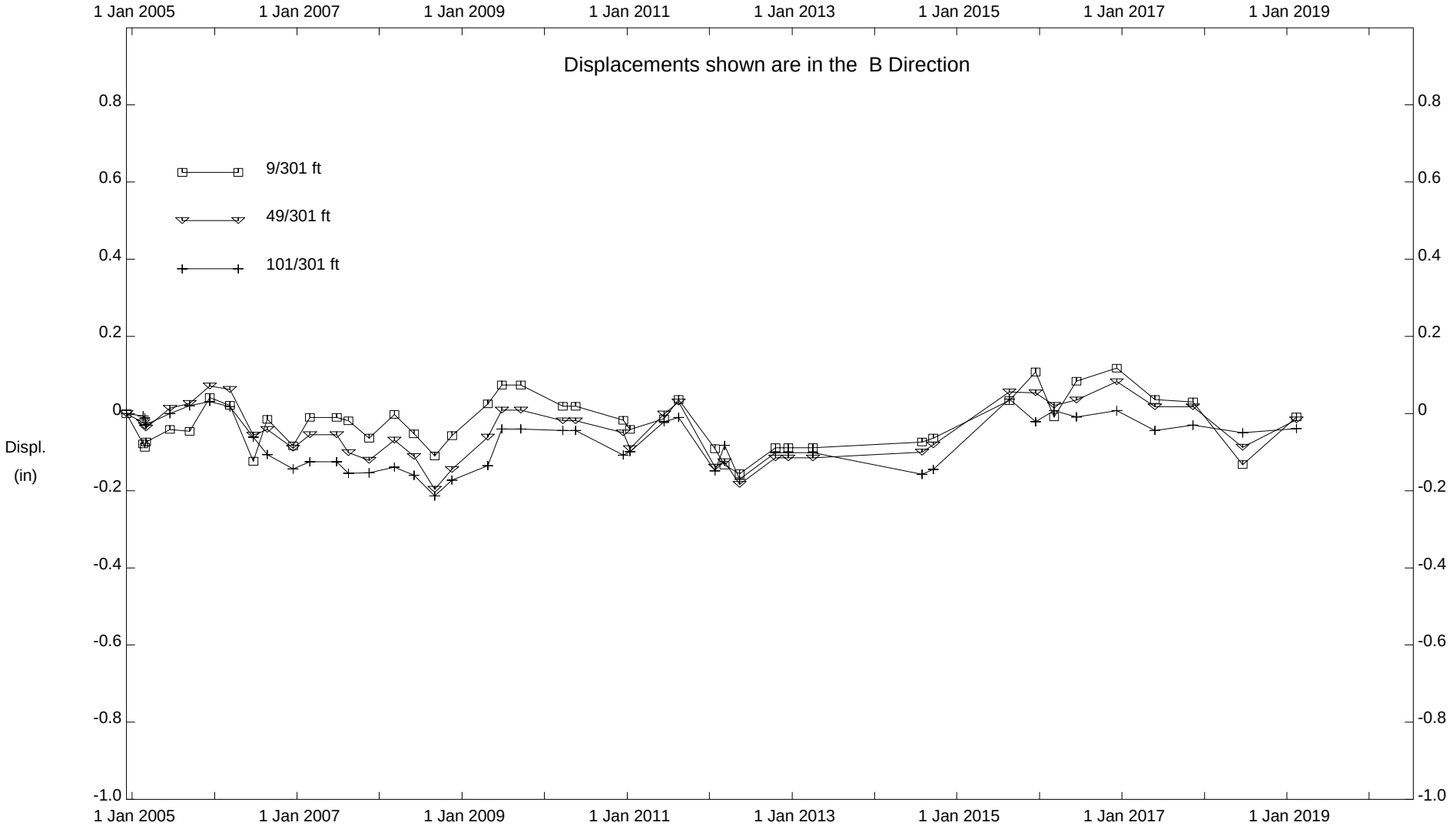
BIG ROCK MESA, Inclinometer SP-10

BLUFF REGION

PLATE D10-3

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



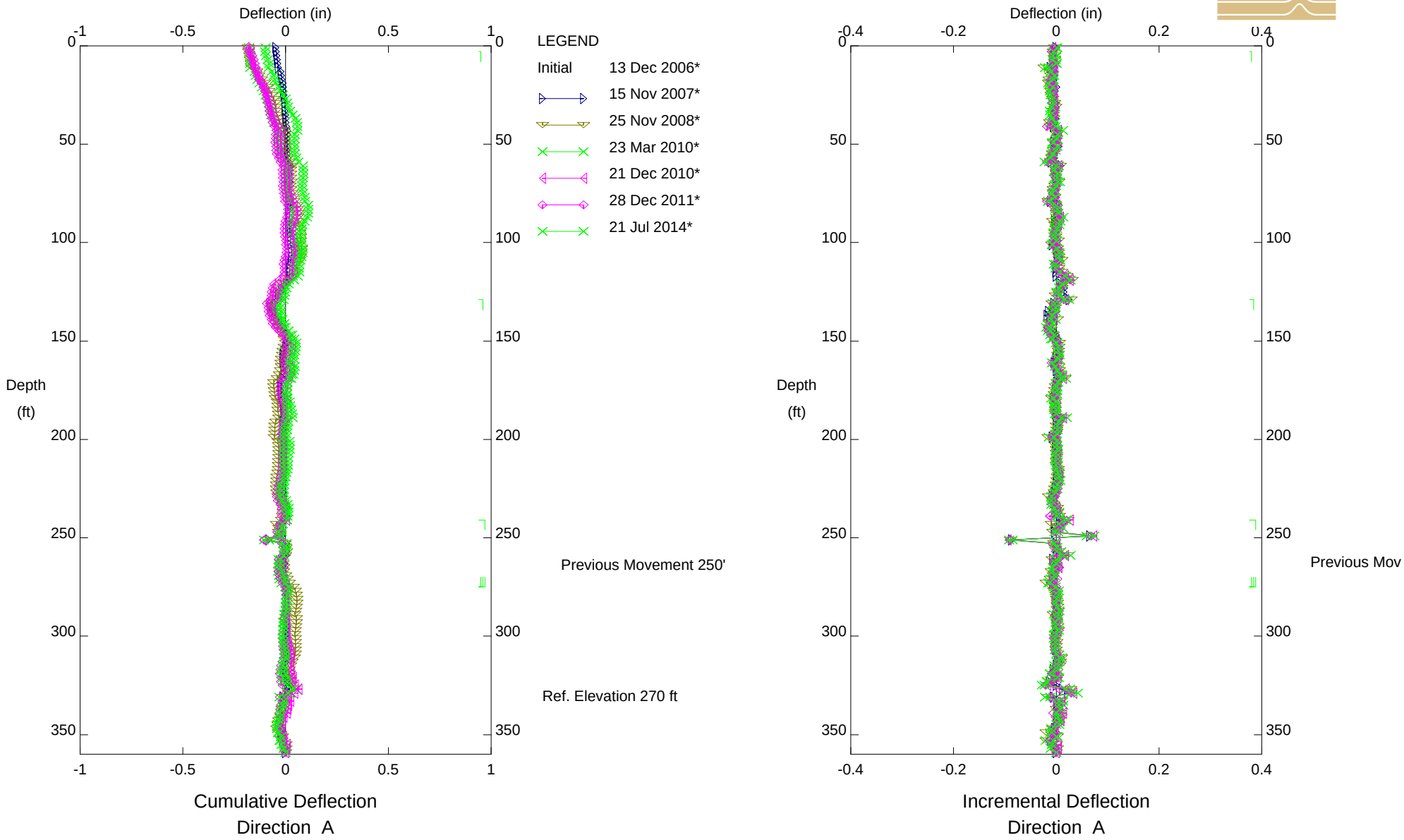
BIG ROCK MESA, Inclinometer SP-10

BLUFF REGION

PLATE D10-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-28

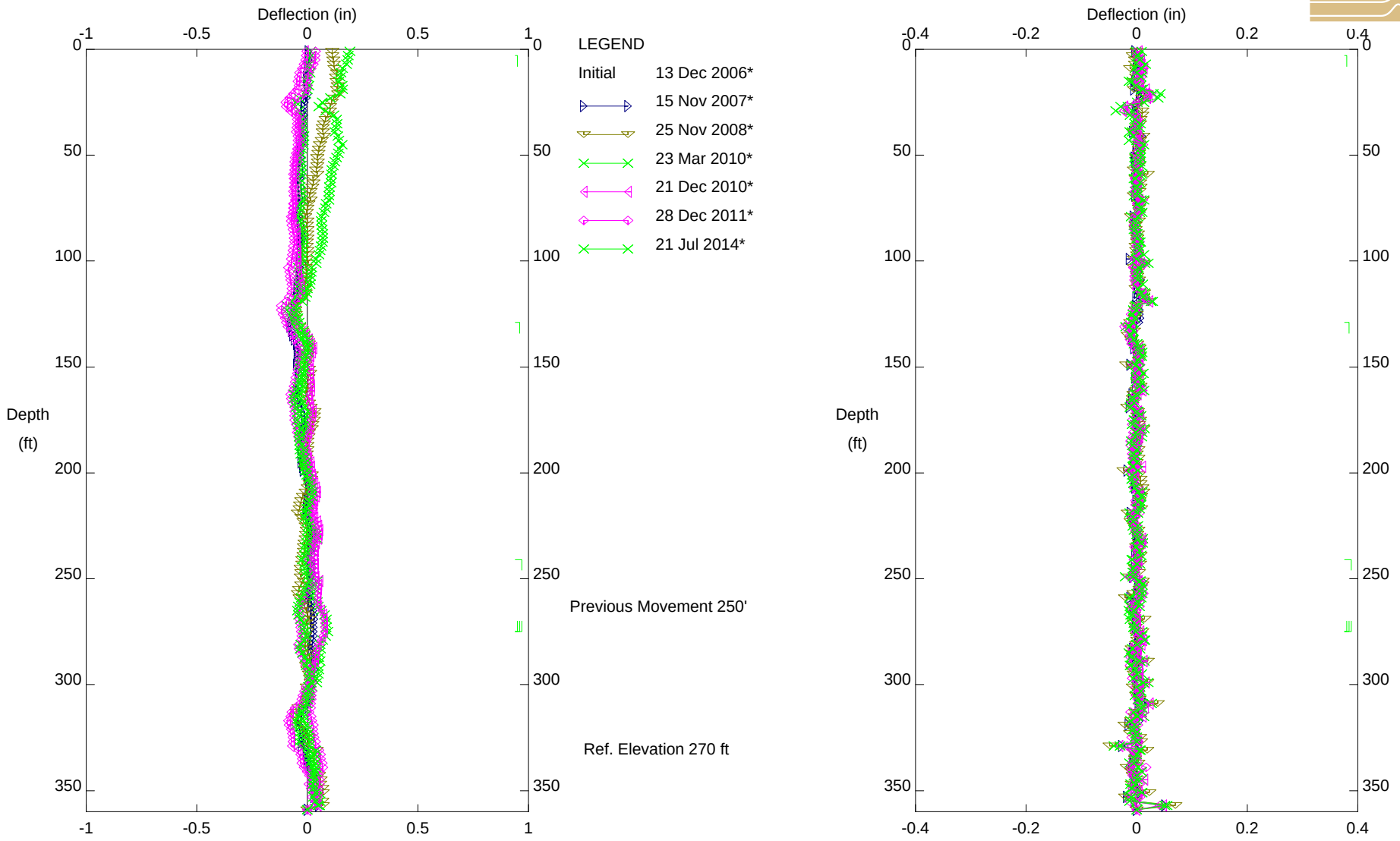
BLUFF REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D11-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA

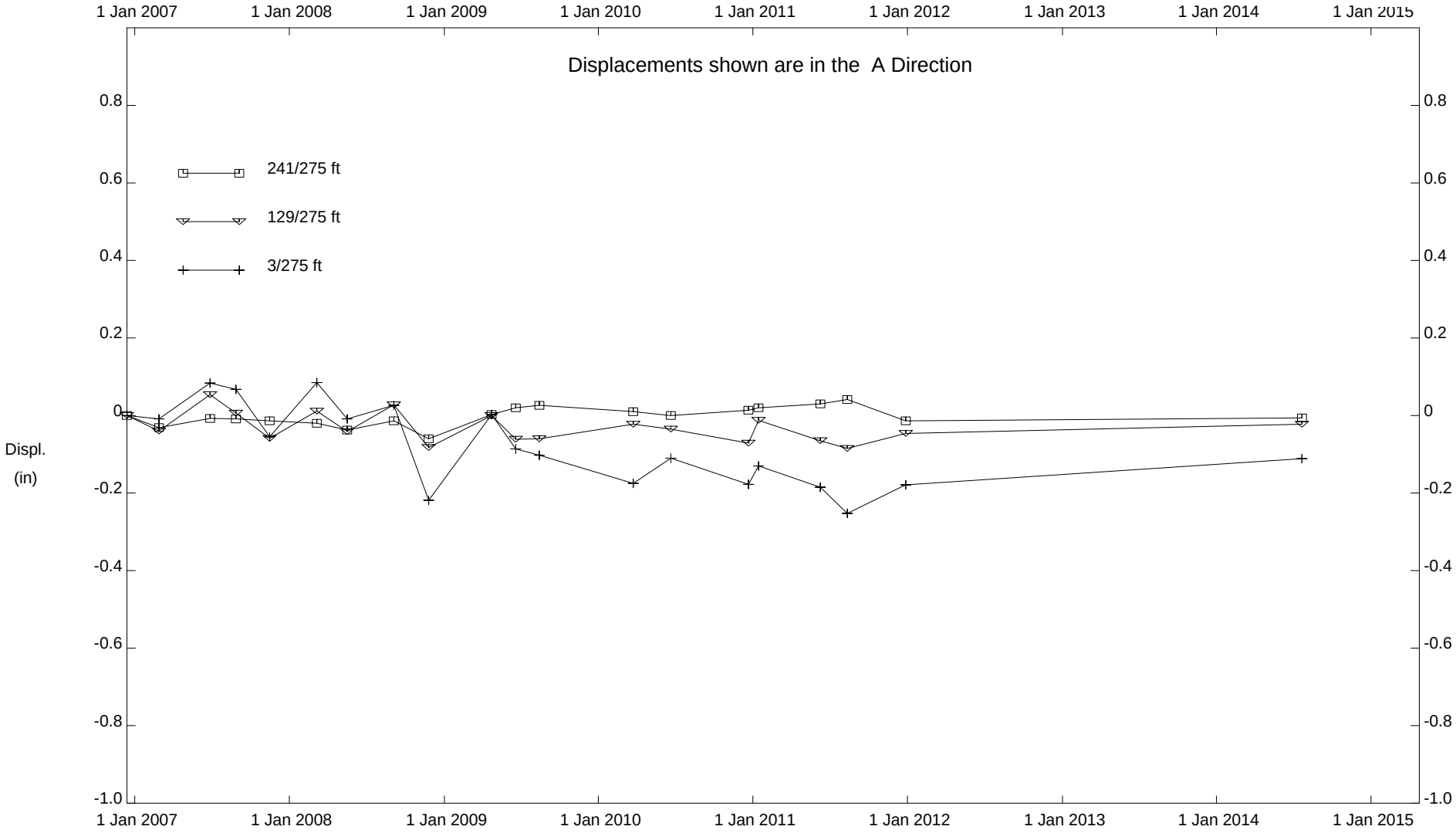


BIG ROCK MESA, Inclinometer SP-28

BLUFF REGION

Sets marked * include zero shift and/or rotation corrections.

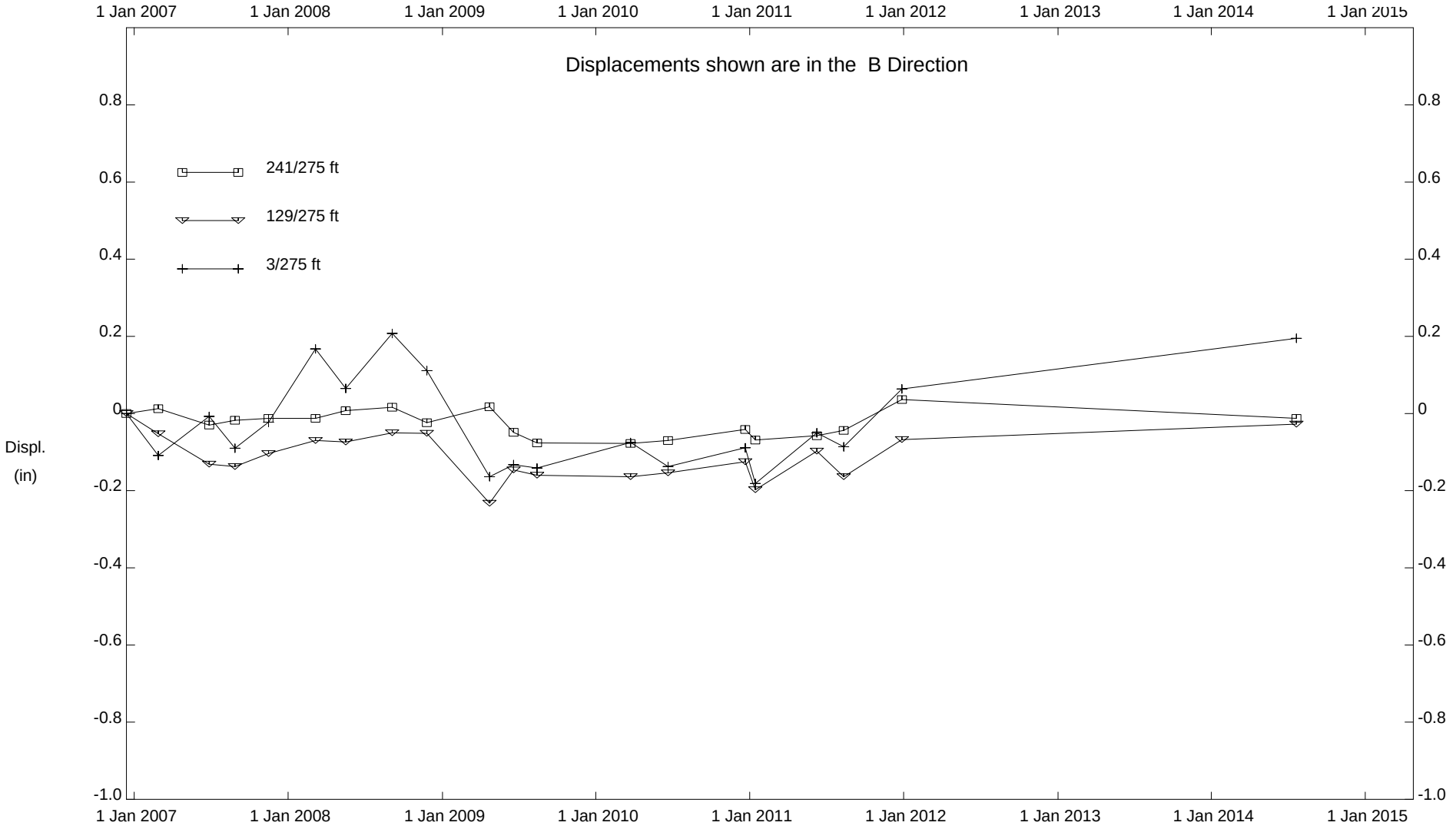
PLATE D11-2



BIG ROCK MESA, Inclinometer SP-28

BLUFF REGION

PLATE D11-3



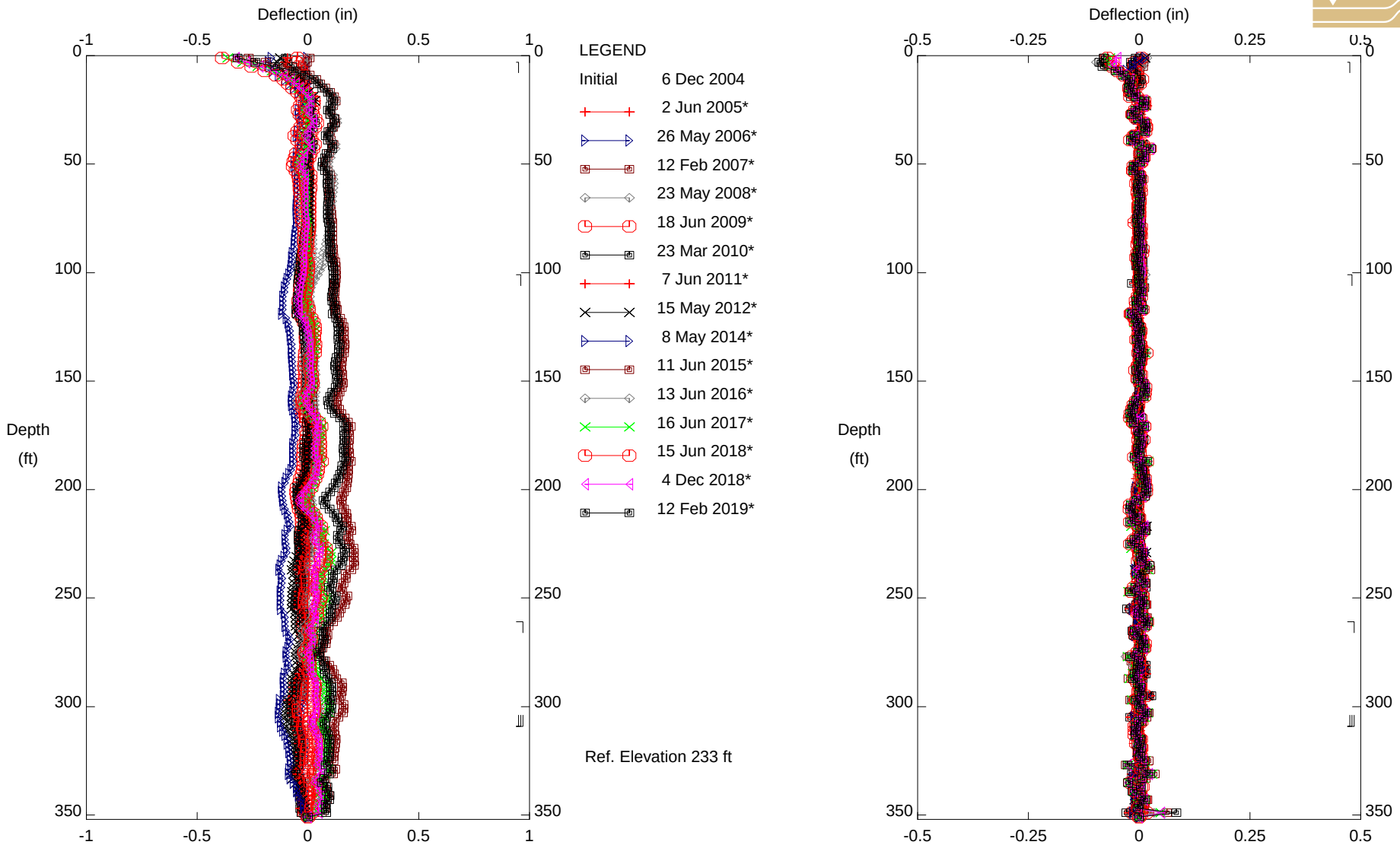
BIG ROCK MESA, Inclinometer SP-28

BLUFF REGION

PLATE D11-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Cumulative Deflection
Direction A

past movement 250 feet

Incremental Deflection
Direction A

past movement 250 feet

BIG ROCK MESA, Inclinometer SP-32

BLUFF REGION

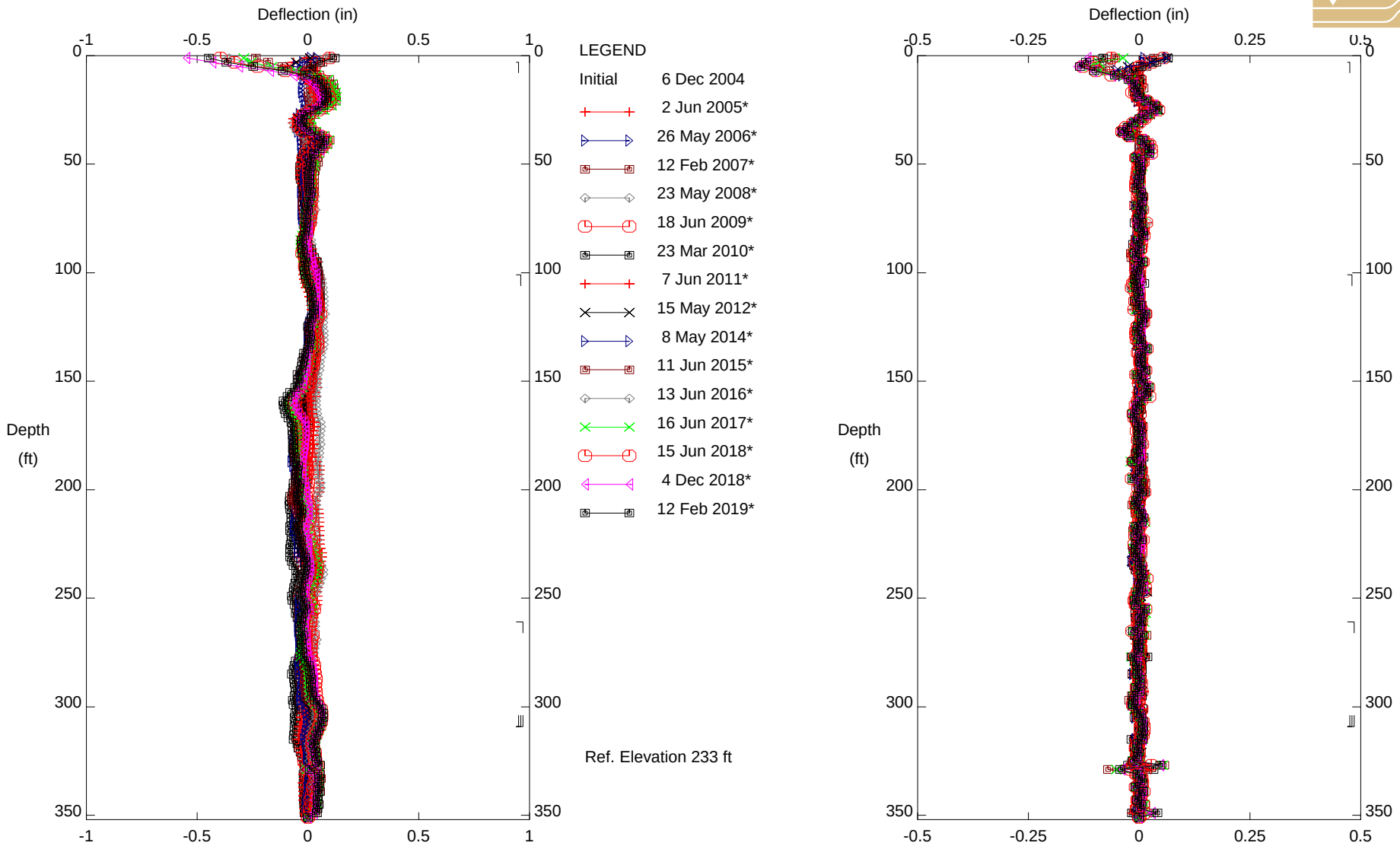
Sets marked * include zero shift and/or rotation corrections.

PLATE D12-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2019-2020\SP32.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Cumulative Deflection
Direction B

past movement 250 feet

Incremental Deflection
Direction B

past movement 250 feet

BIG ROCK MESA, Inclinometer SP-32

BLUFF REGION

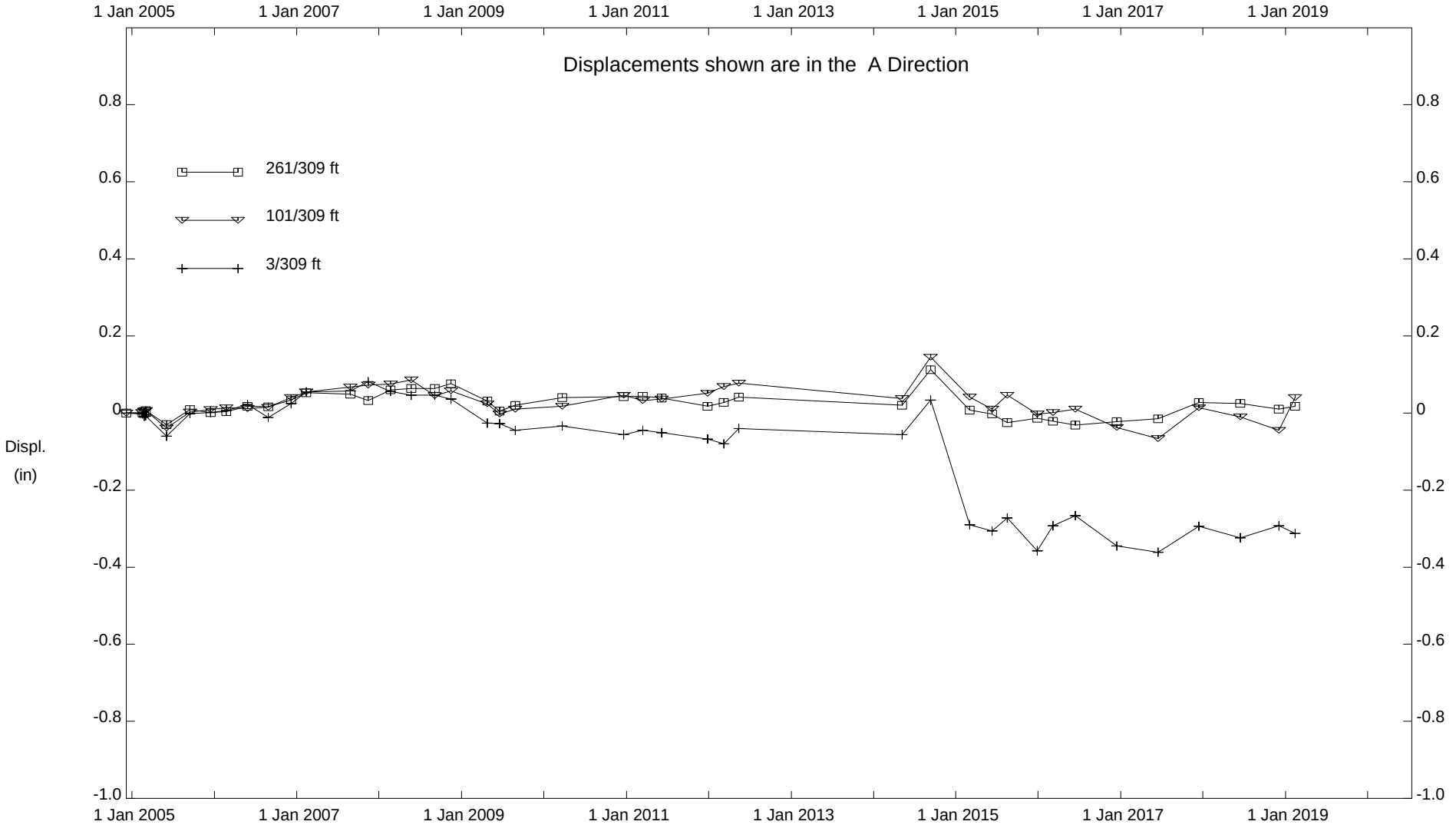
Sets marked * include zero shift and/or rotation corrections.

PLATE D12-2

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2019-2020\SP32.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

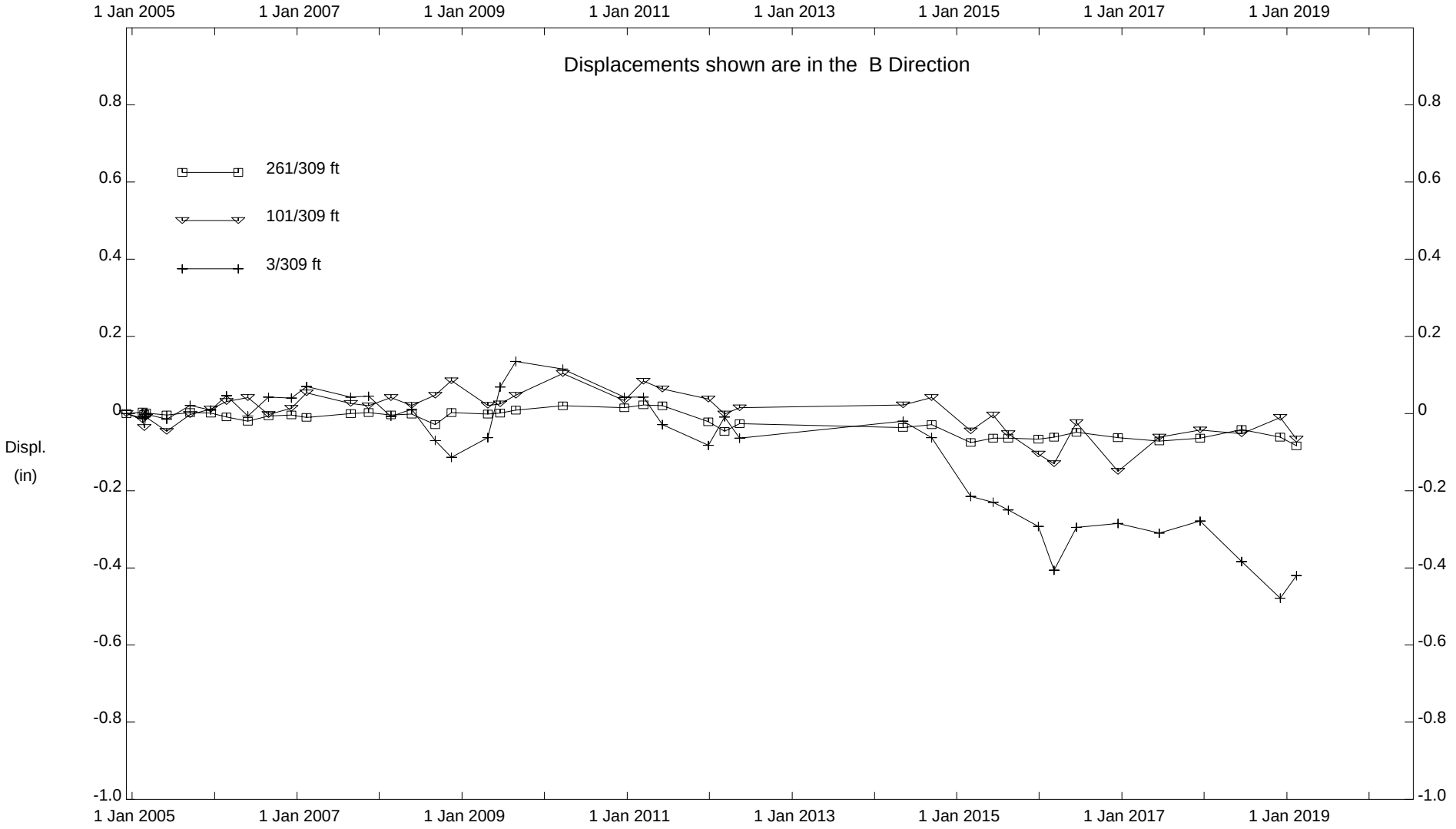
Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-32

BLUFF REGION

PLATE D12-3



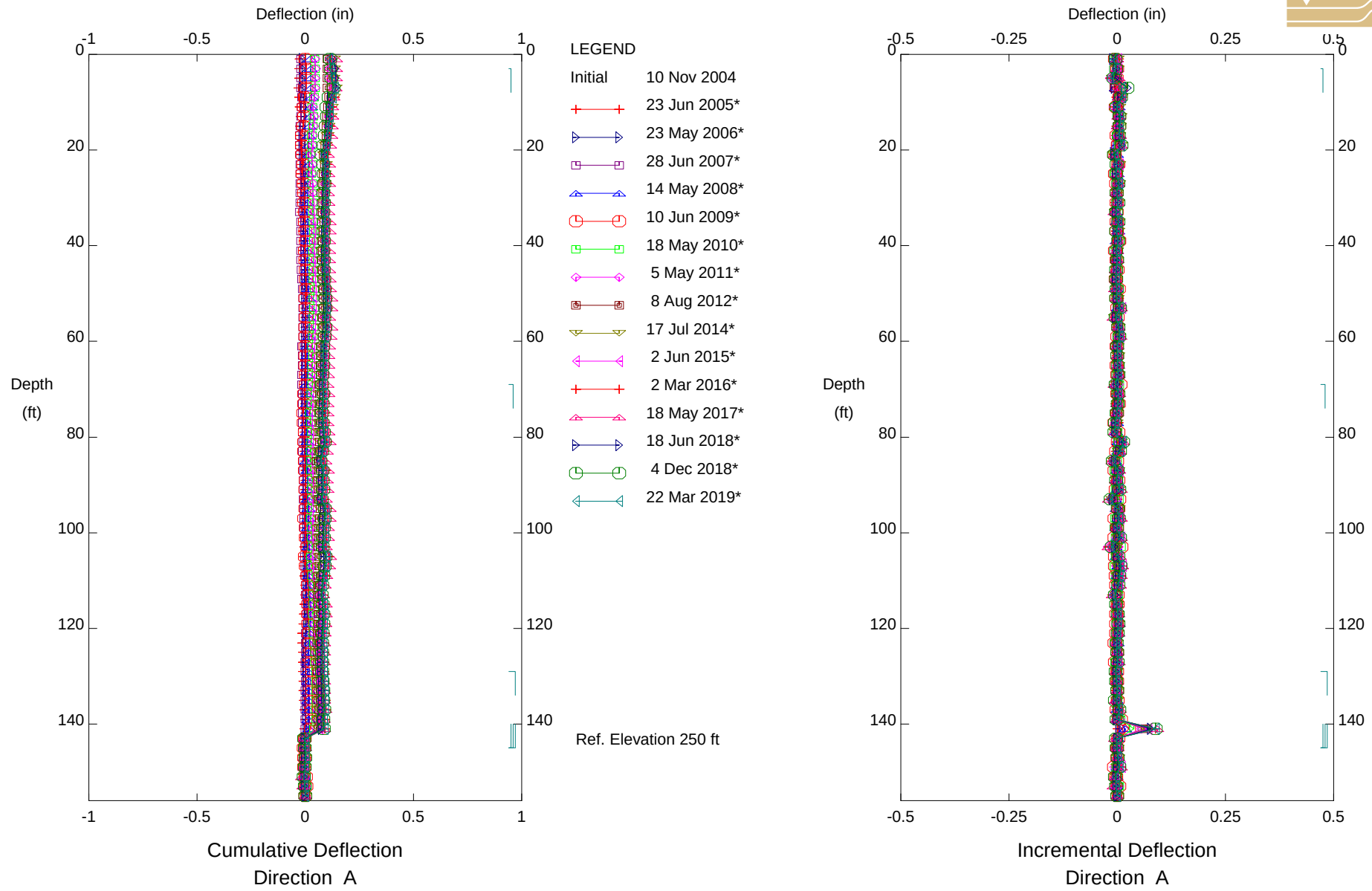
BIG ROCK MESA, Inclinometer SP-32

BLUFF REGION

PLATE D12-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer PC-1

EASTERN REGION

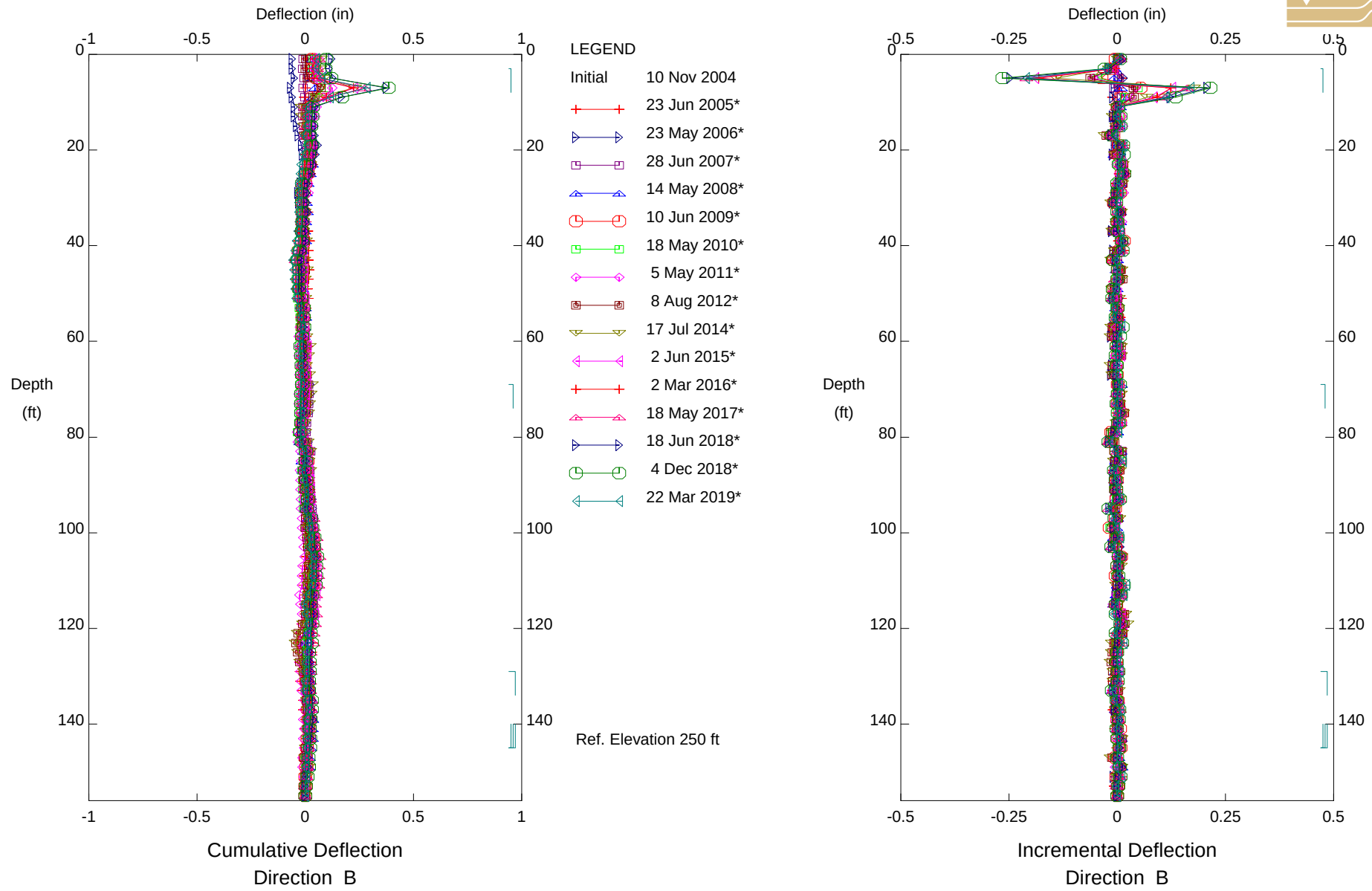
Sets marked * include zero shift and/or rotation corrections.

PLATE D13-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\PC-1.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer PC-1

EASTERN REGION

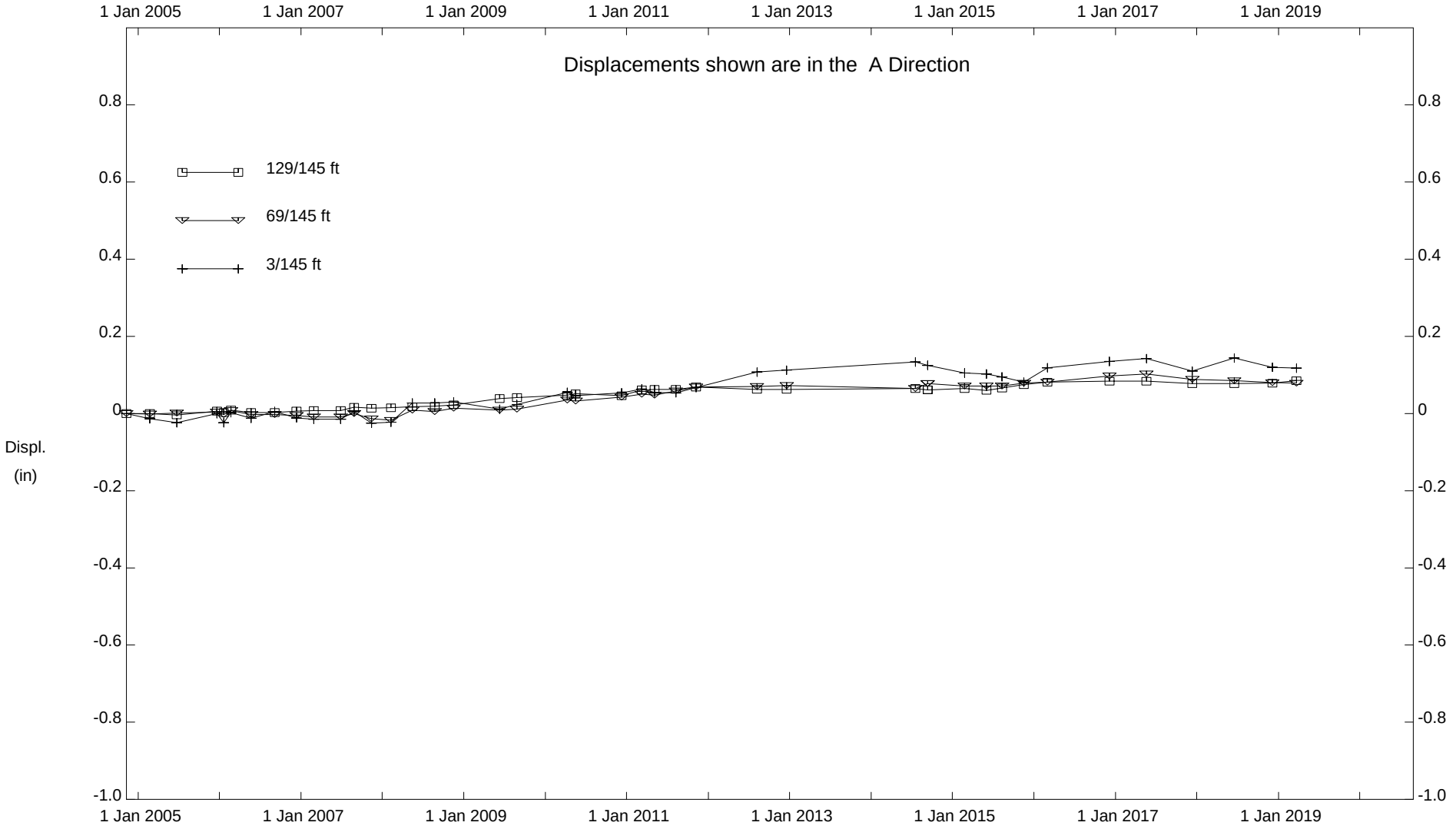
Sets marked * include zero shift and/or rotation corrections.

PLATE D13-2

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\PC-1.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

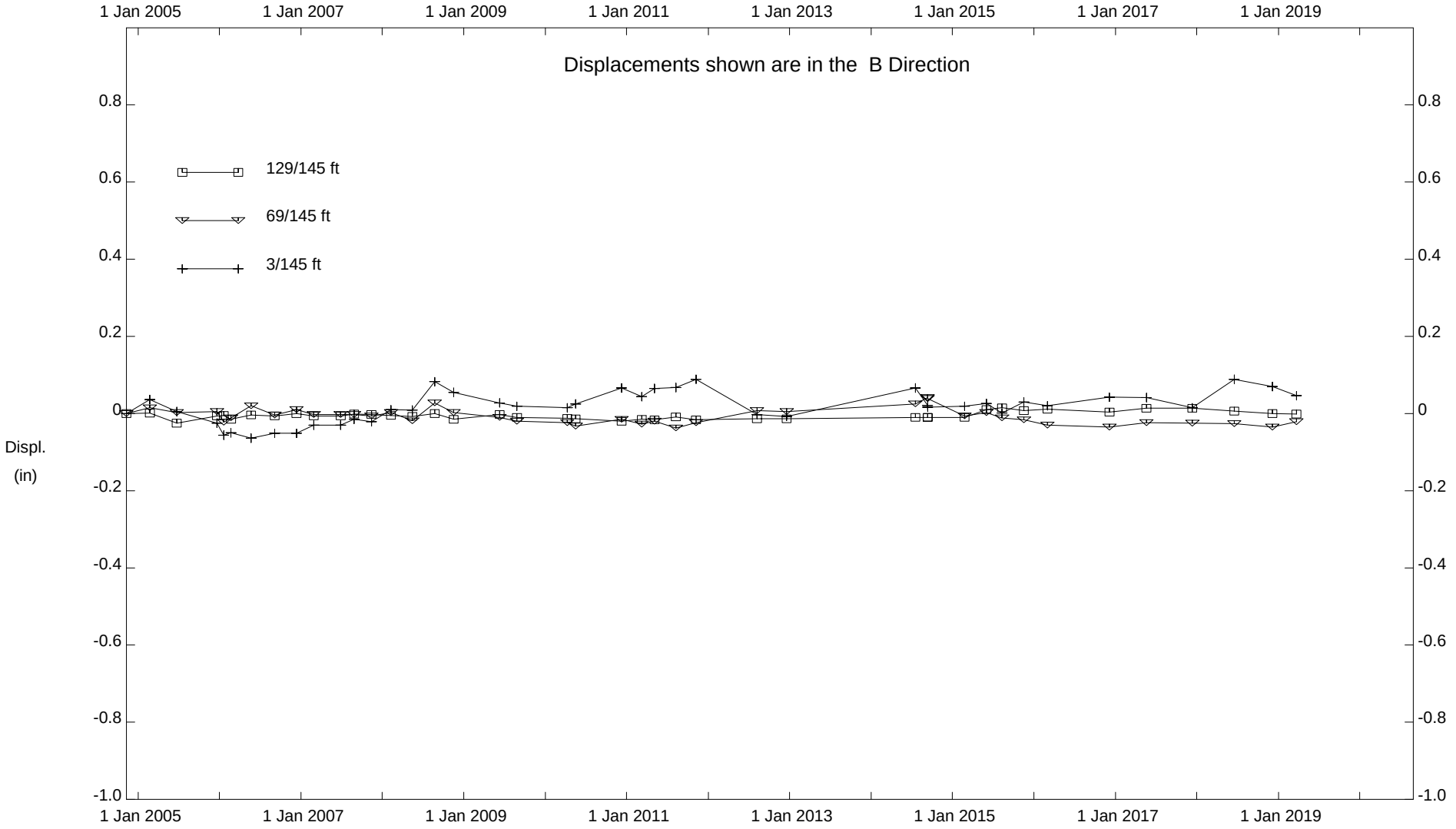
Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer PC-1

EASTERN REGION

PLATE D13-3



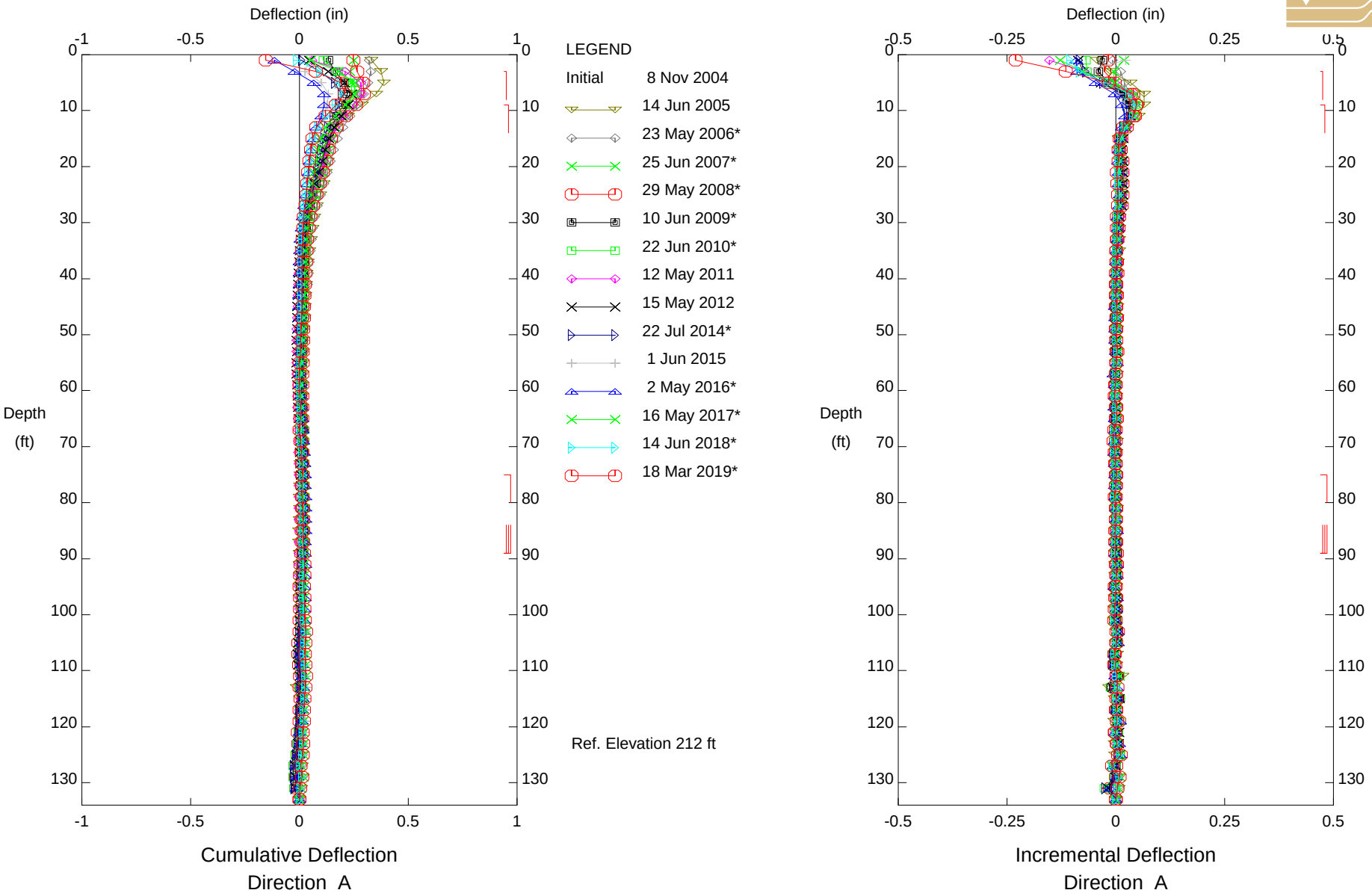
BIG ROCK MESA, Inclinometer PC-1

EASTERN REGION

PLATE D13-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-3

EASTERN REGION

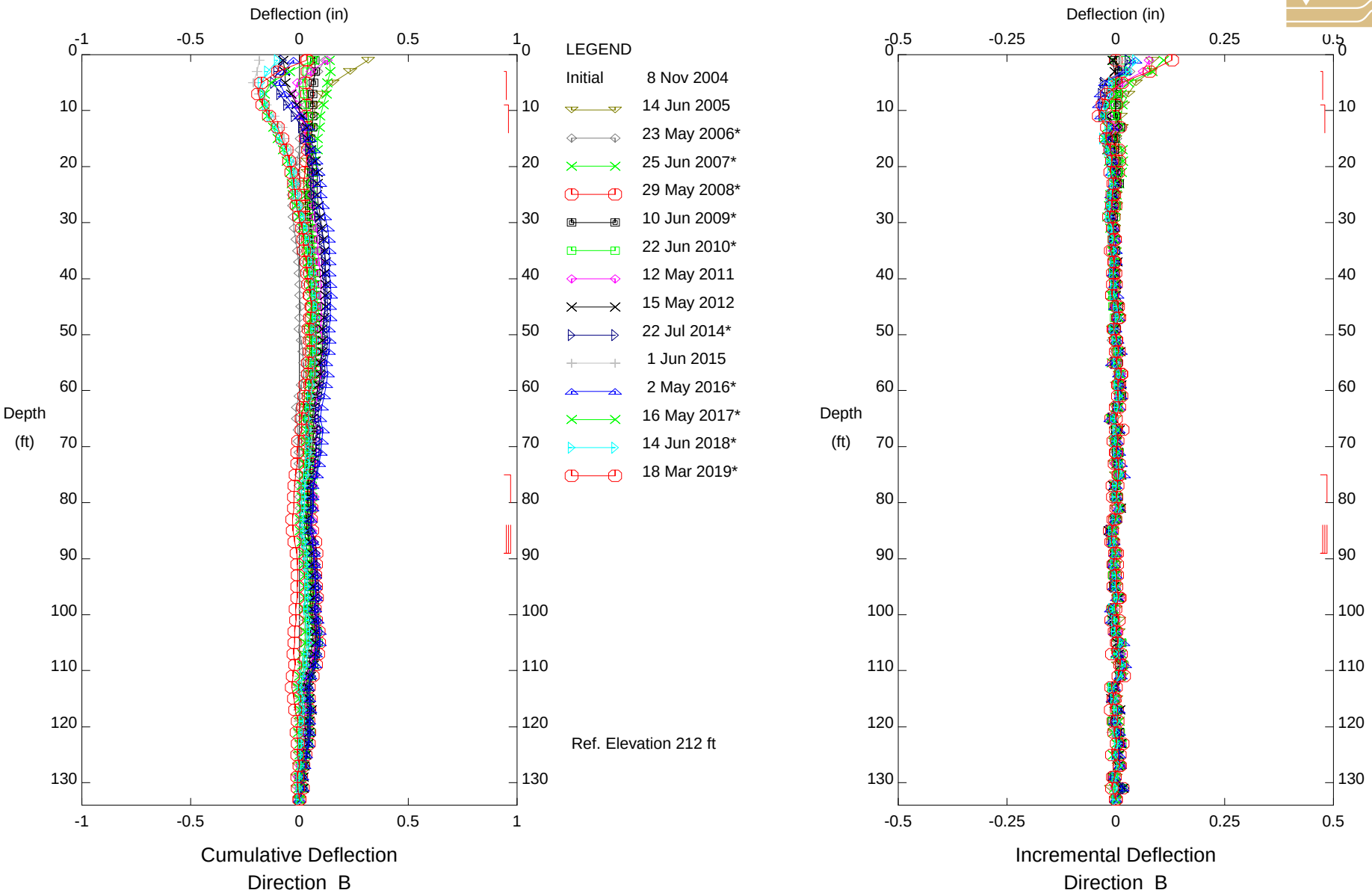
Sets marked * include zero shift and/or rotation corrections.

PLATE D14-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP3.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



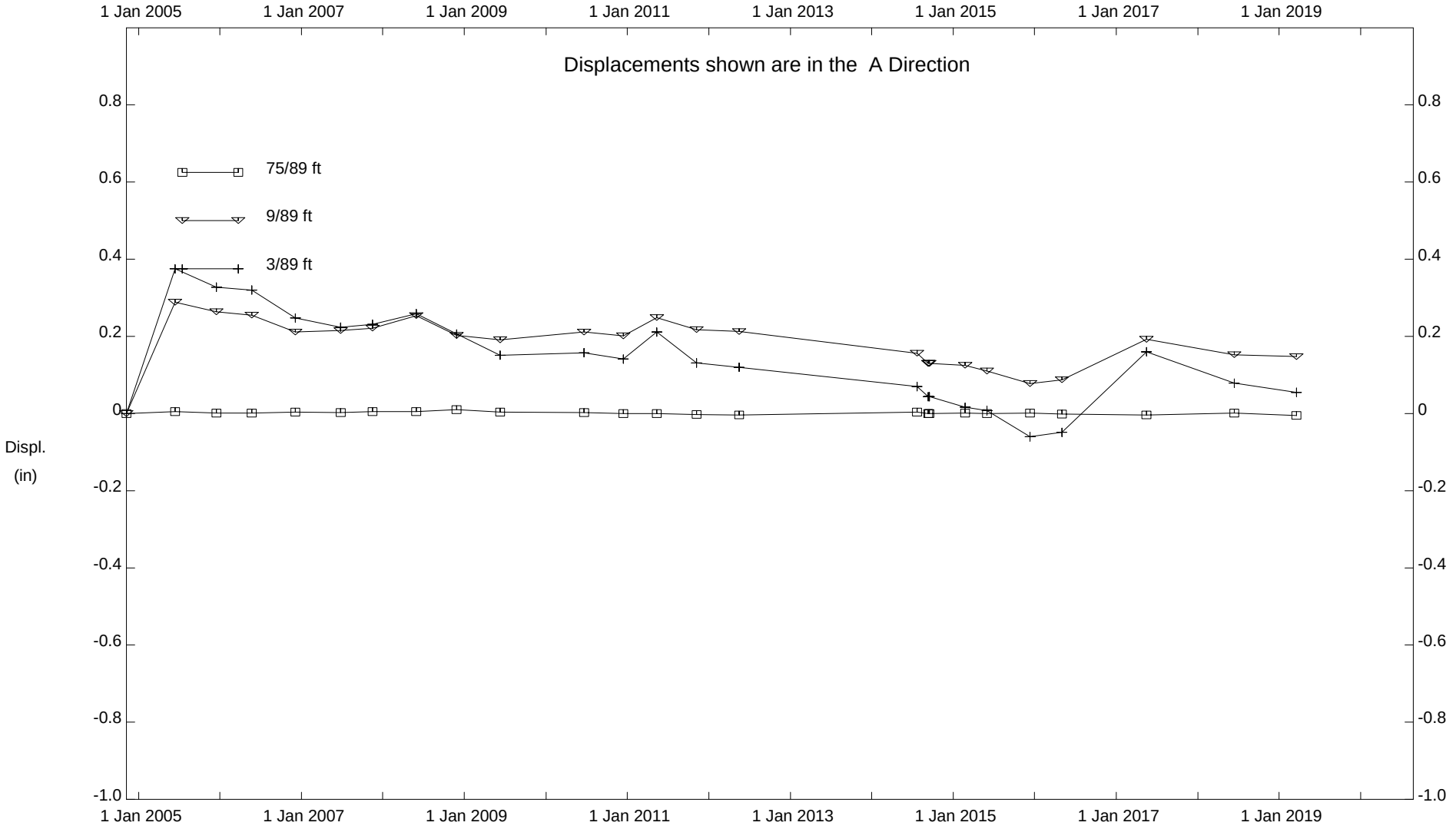
BIG ROCK MESA, Inclinometer SP-3

EASTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D14-2

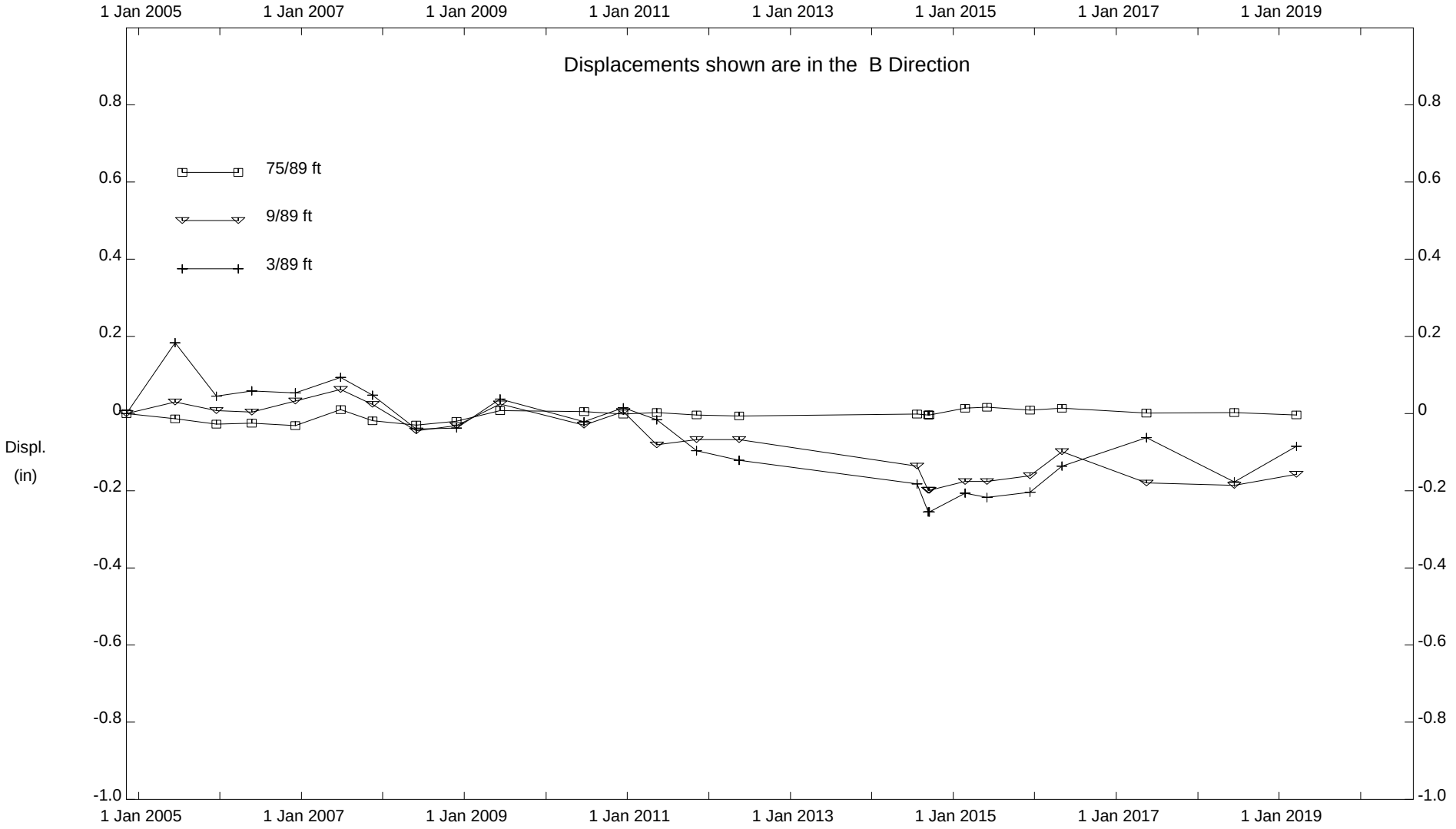
O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP3.gtl



BIG ROCK MESA, Inclinometer SP-3

EASTERN REGION

PLATE D14-3



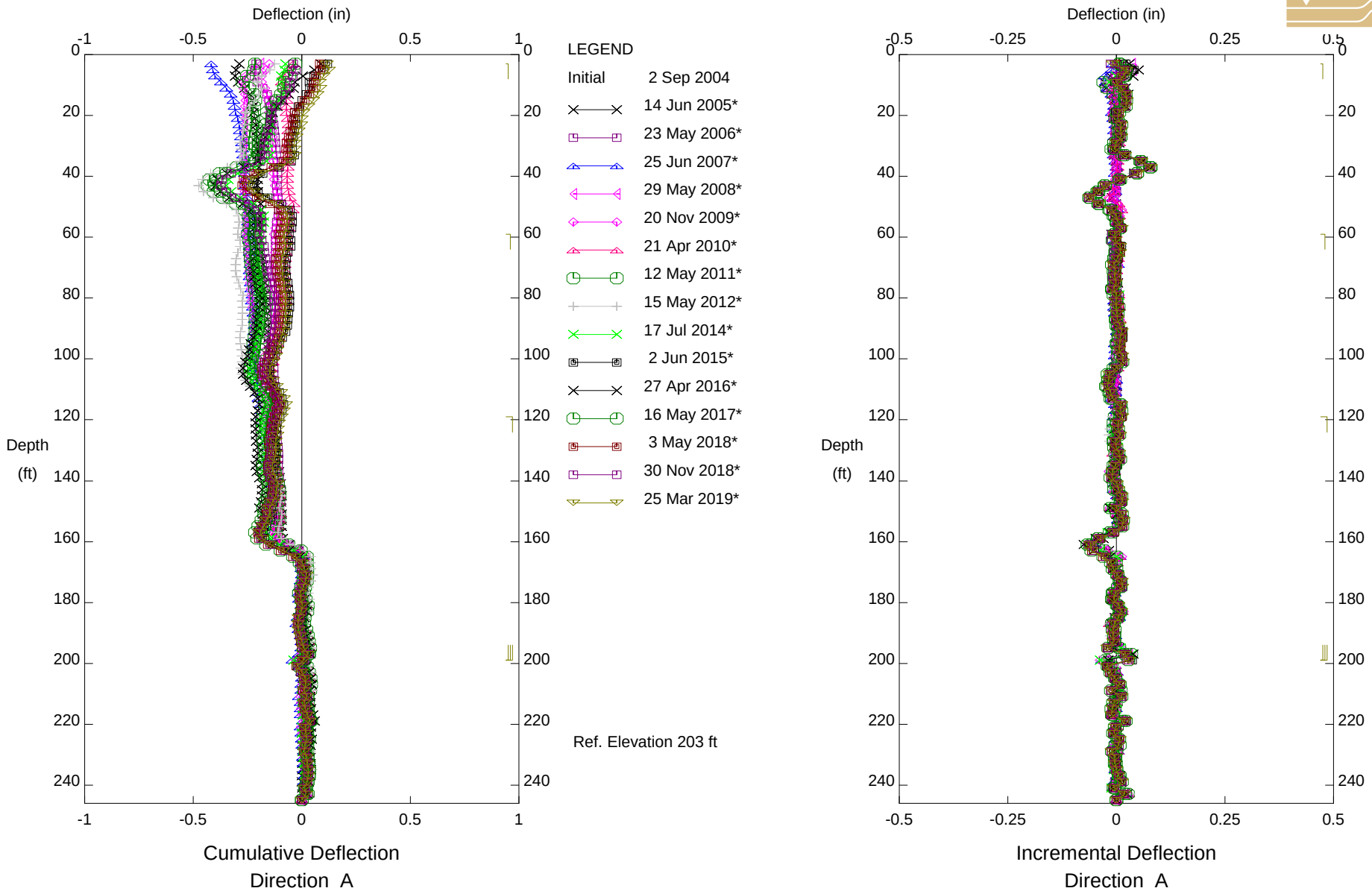
BIG ROCK MESA, Inclinometer SP-3

EASTERN REGION

PLATE D14-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-3A

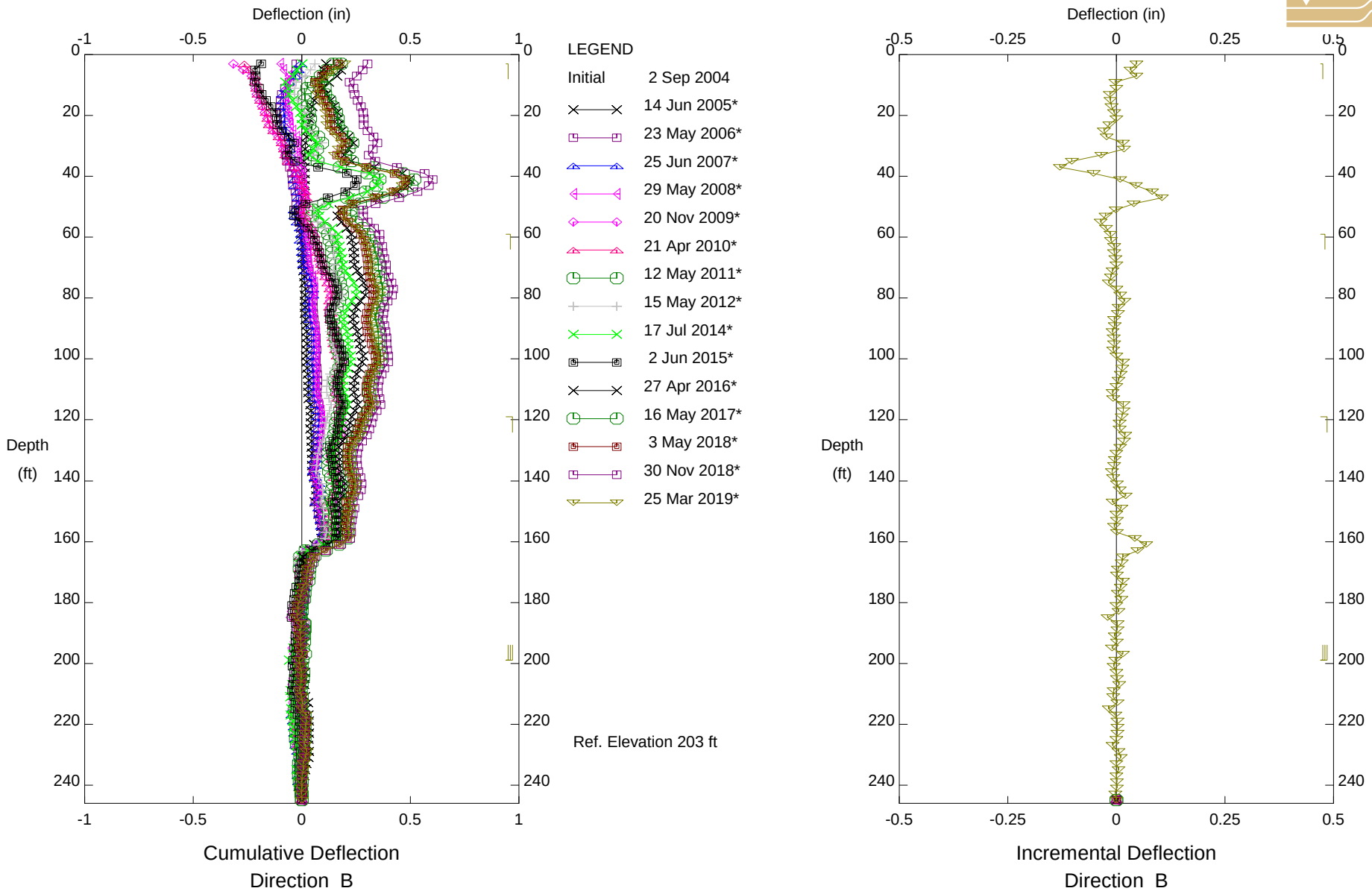
EASTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D15-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



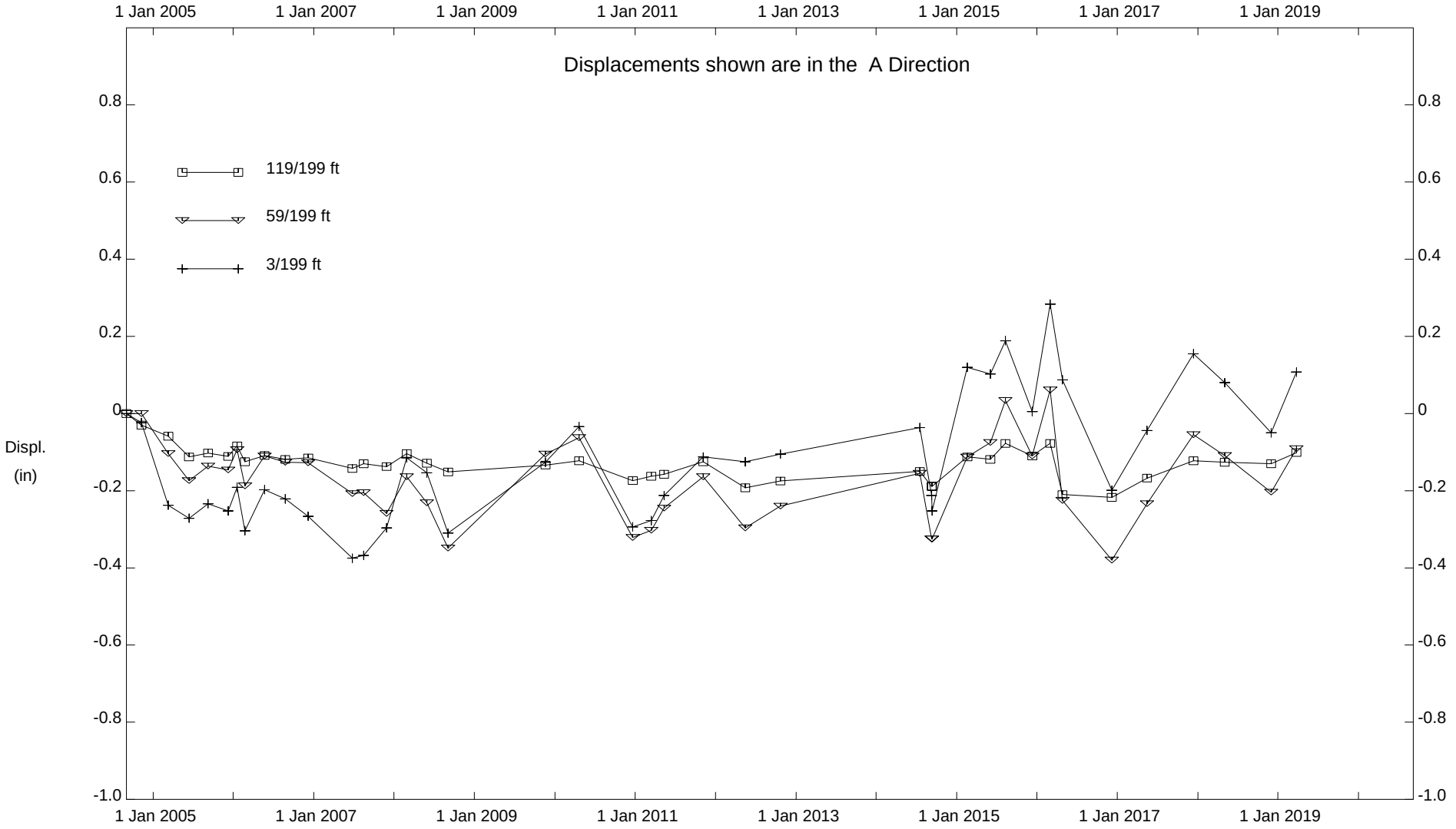
BIG ROCK MESA, Inclinometer SP-3A

EASTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D15-2

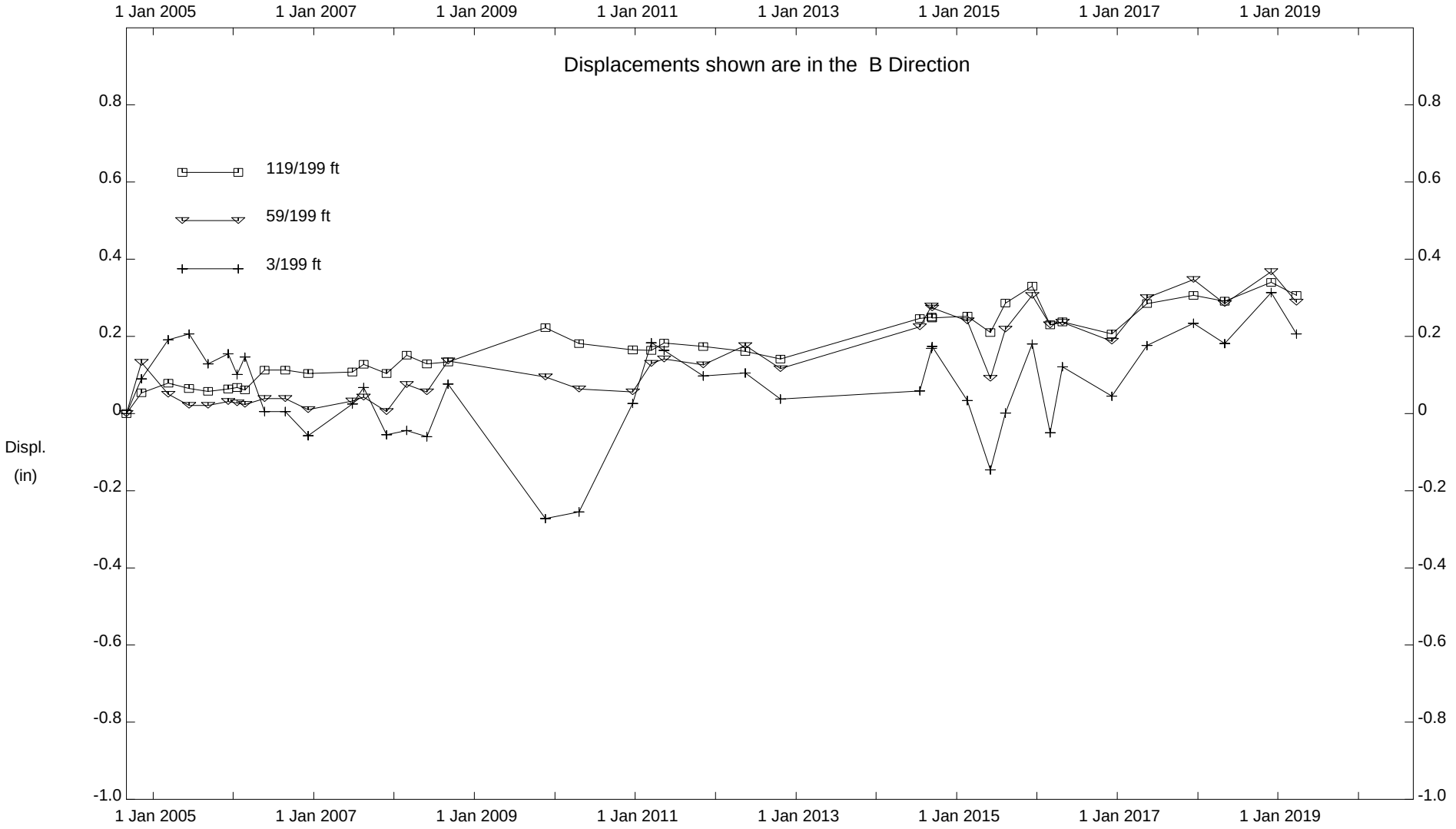
O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP3A.gtl



BIG ROCK MESA, Inclinometer SP-3A

EASTERN REGION

PLATE D15-3



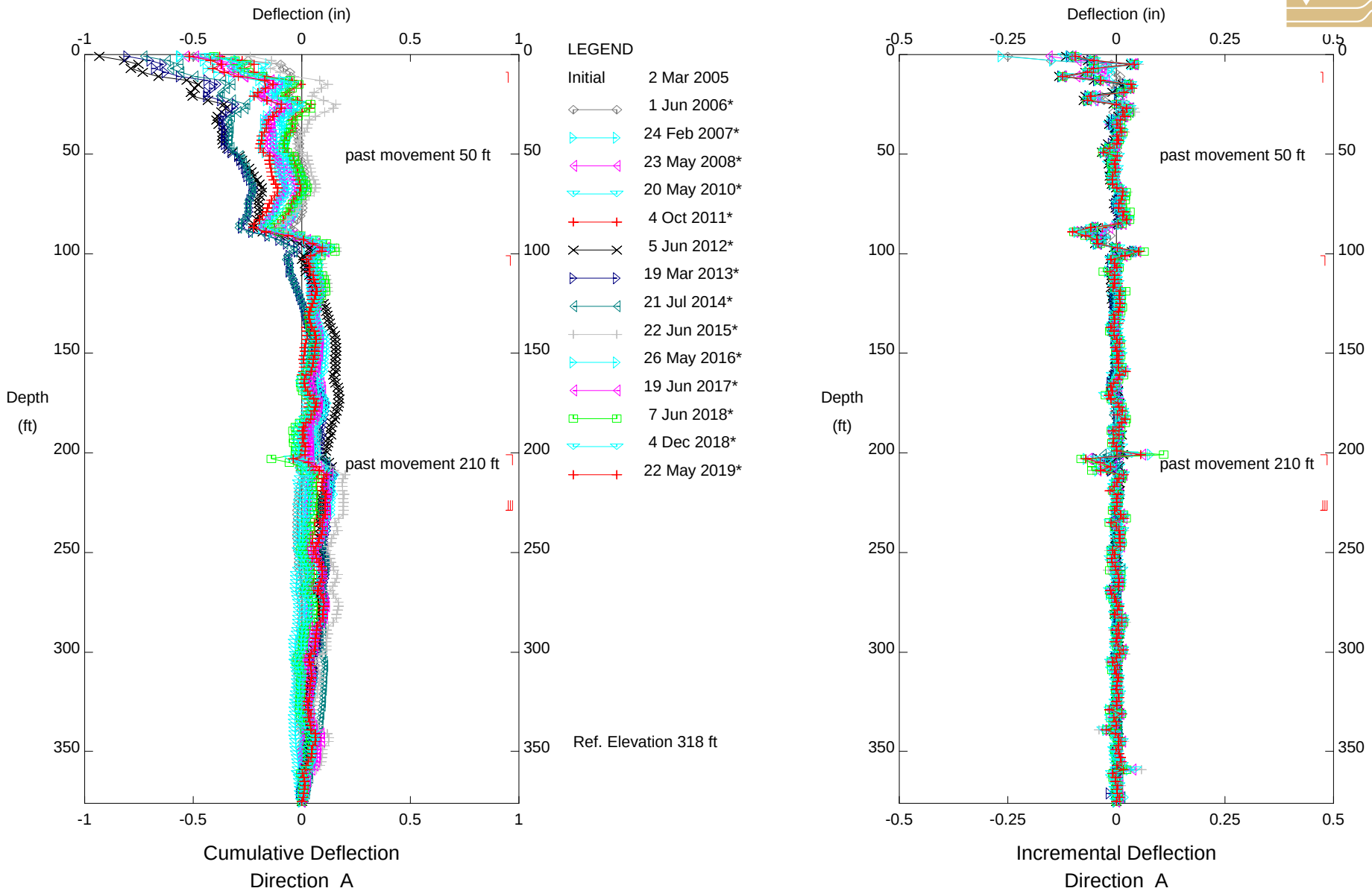
BIG ROCK MESA, Inclinometer SP-3A

EASTERN REGION

PLATE D15-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-33

EASTERN REGION

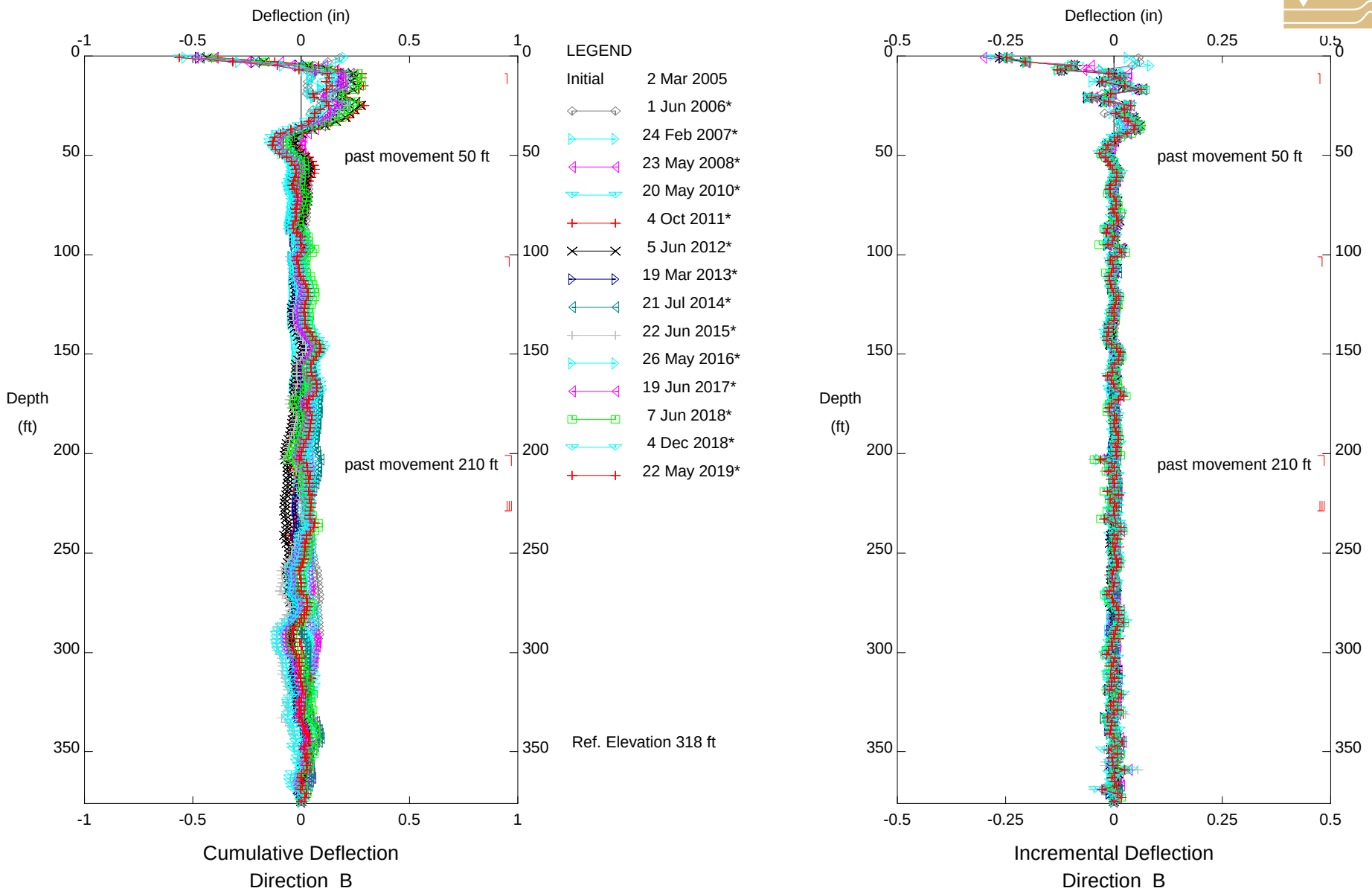
Sets marked * include zero shift and/or rotation corrections.

PLATE D16-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2019-2020\SP33.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



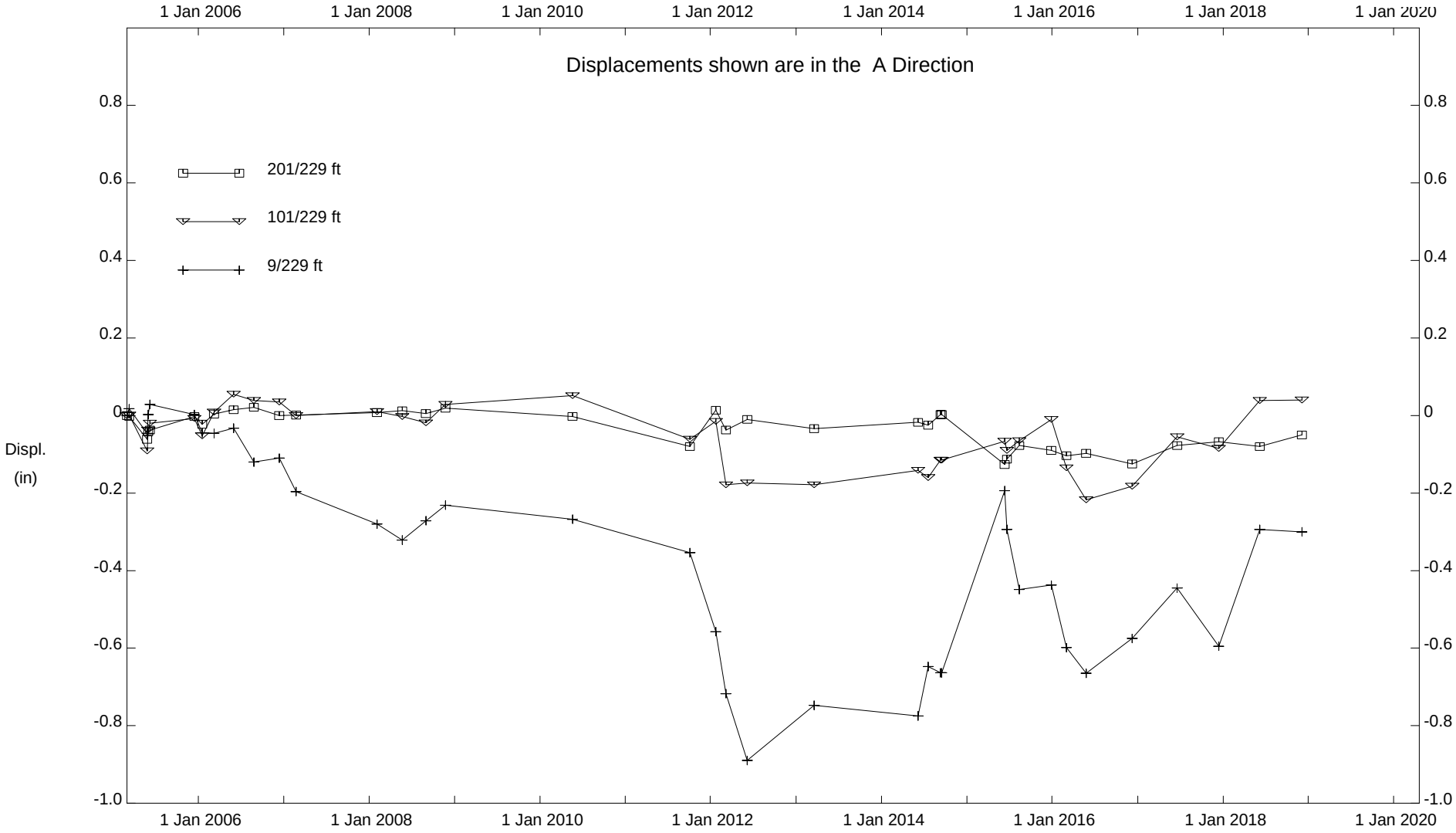
BIG ROCK MESA, Inclinometer SP-33

EASTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D16-2

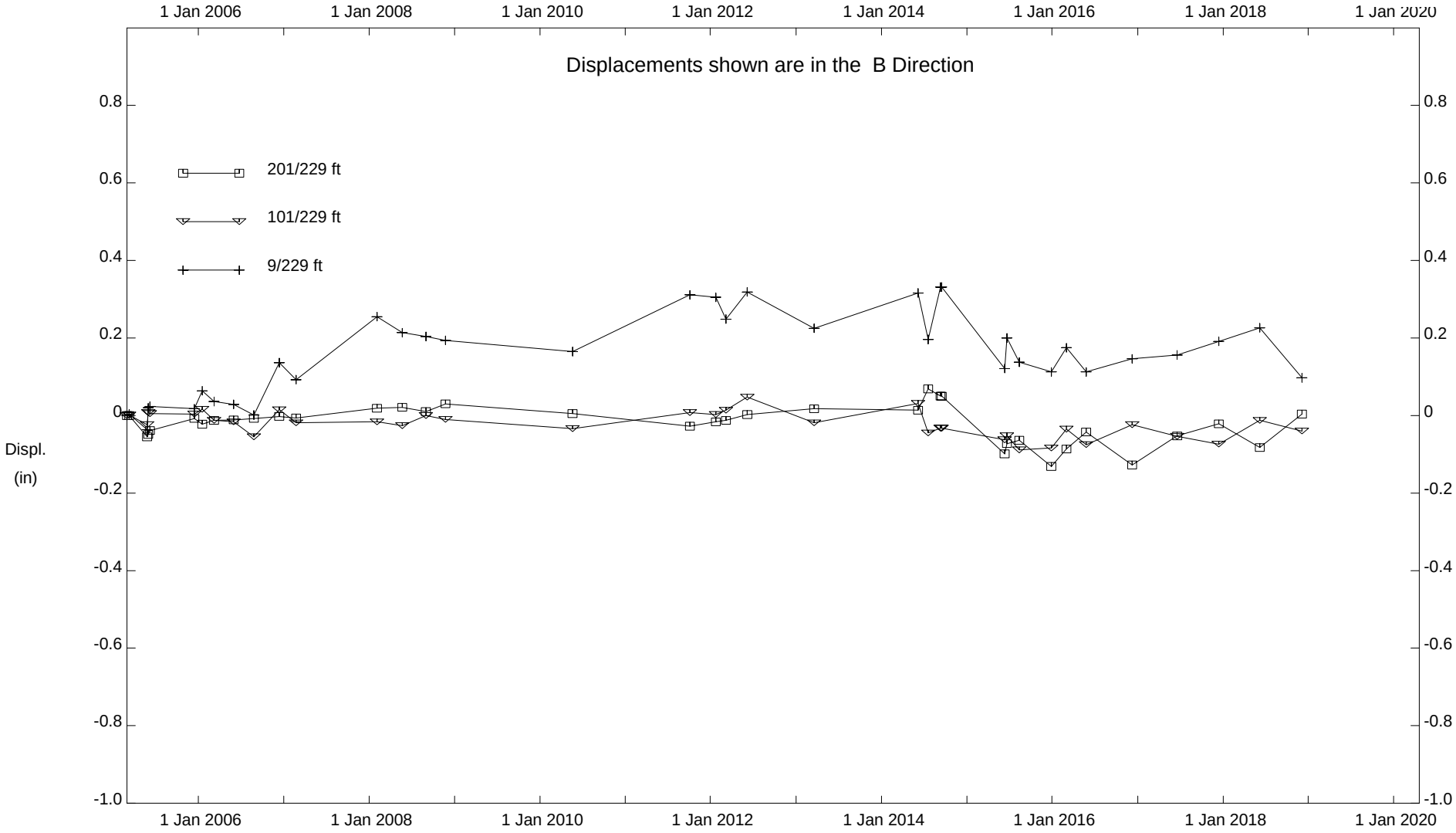
O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2019-2020\SP33.gtl



BIG ROCK MESA, Inclinometer SP-33

EASTERN REGION

PLATE D16-3



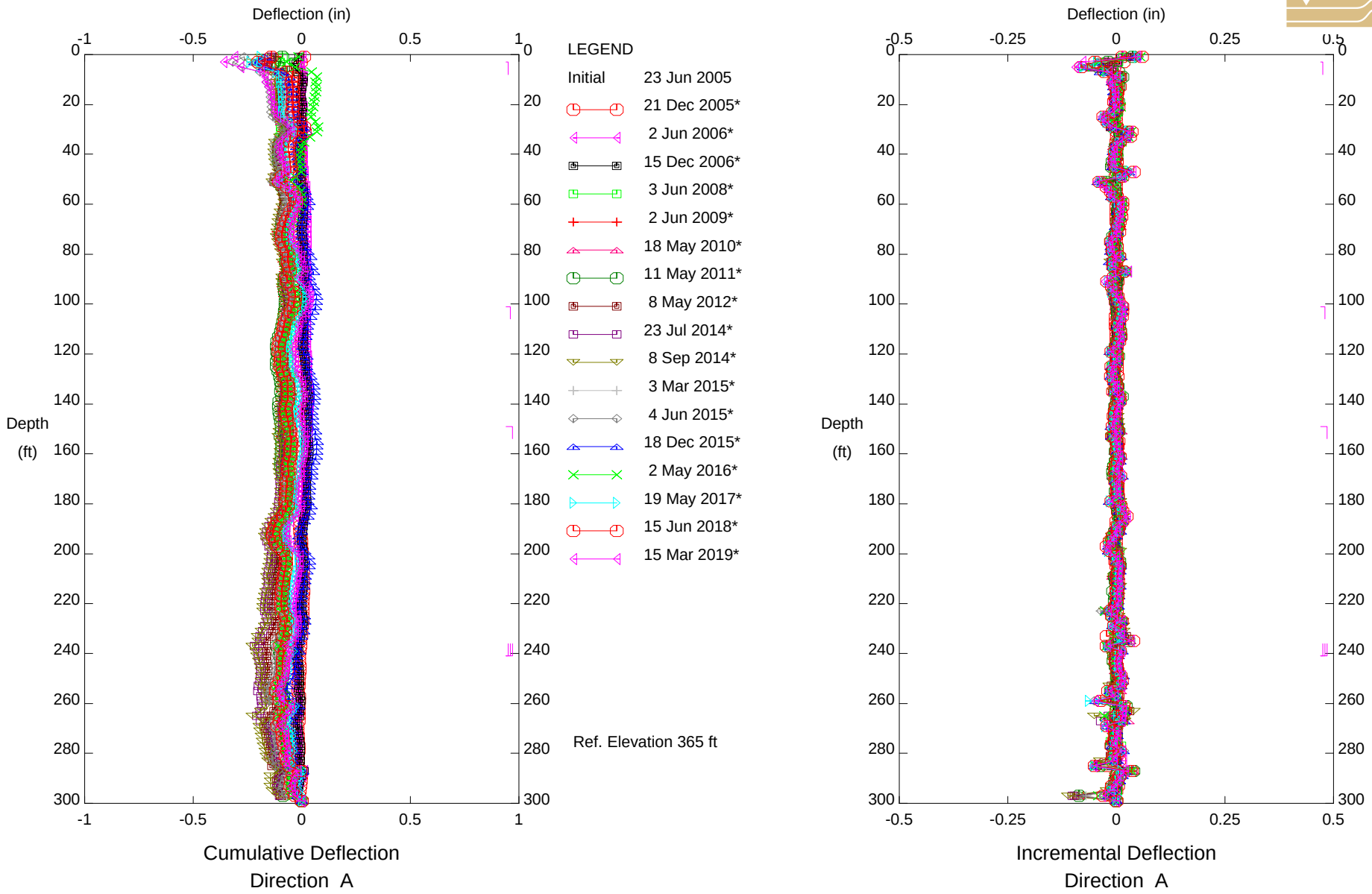
BIG ROCK MESA, Inclinometer SP-33

EASTERN REGION

PLATE D16-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-9A

CENTRAL REGION

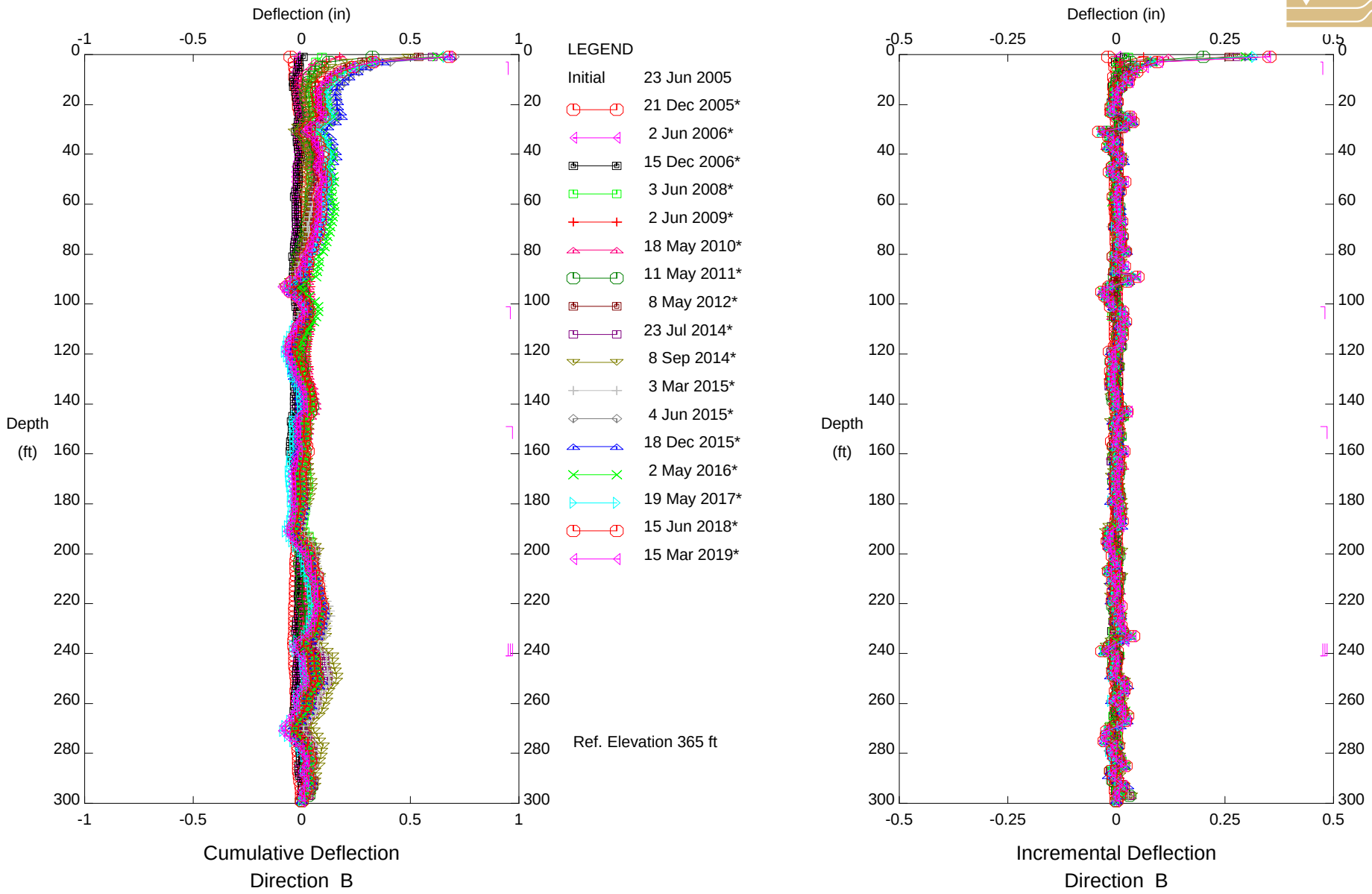
Sets marked * include zero shift and/or rotation corrections.

PLATE D17-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP9A.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



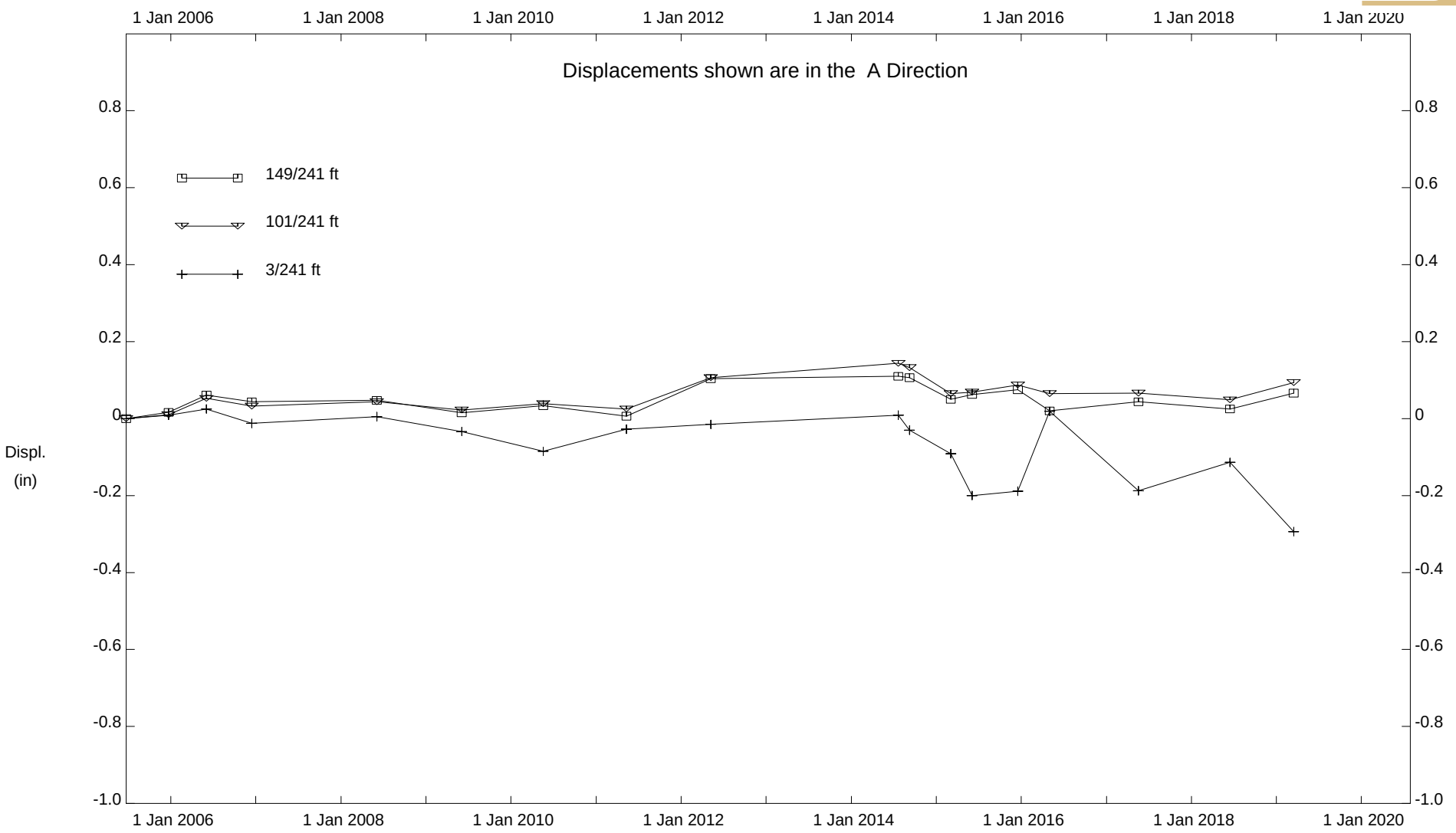
BIG ROCK MESA, Inclinometer SP-9A

CENTRAL REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D17-2

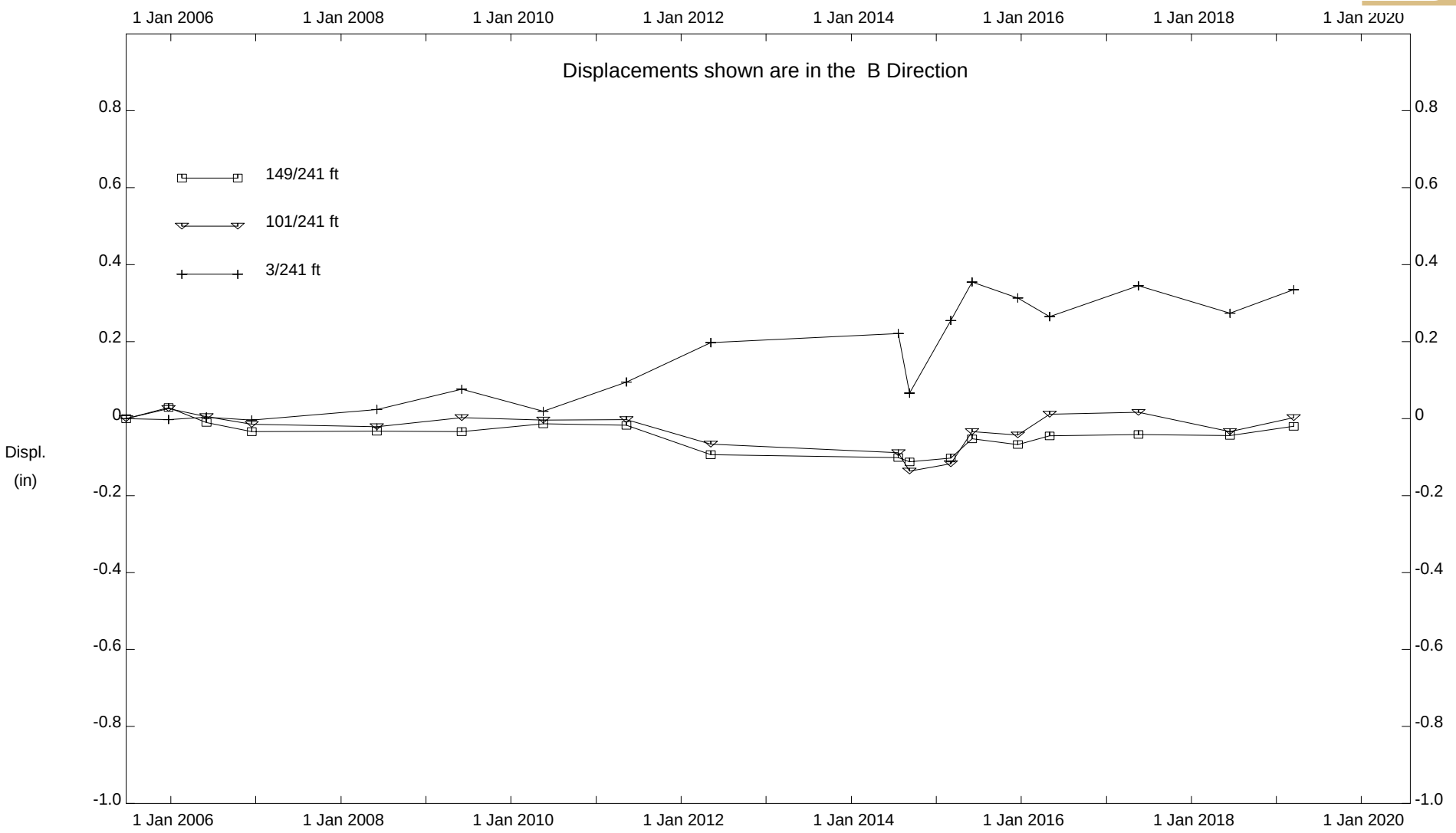
O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP9A.gtl



BIG ROCK MESA, Inclinometer SP-9A

CENTRAL REGION

PLATE D17-3



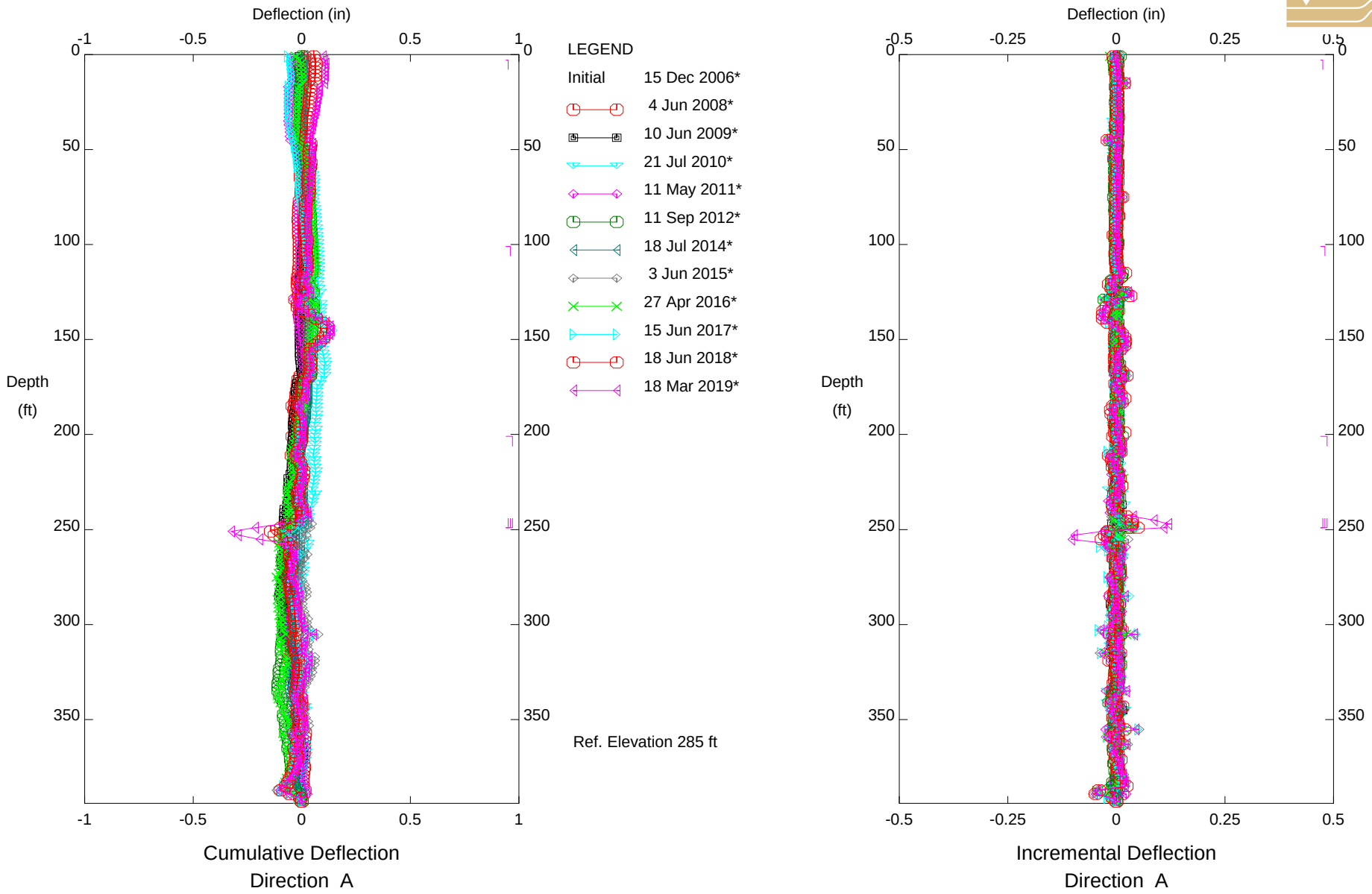
BIG ROCK MESA, Inclinometer SP-9A

CENTRAL REGION

PLATE D17-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-16A

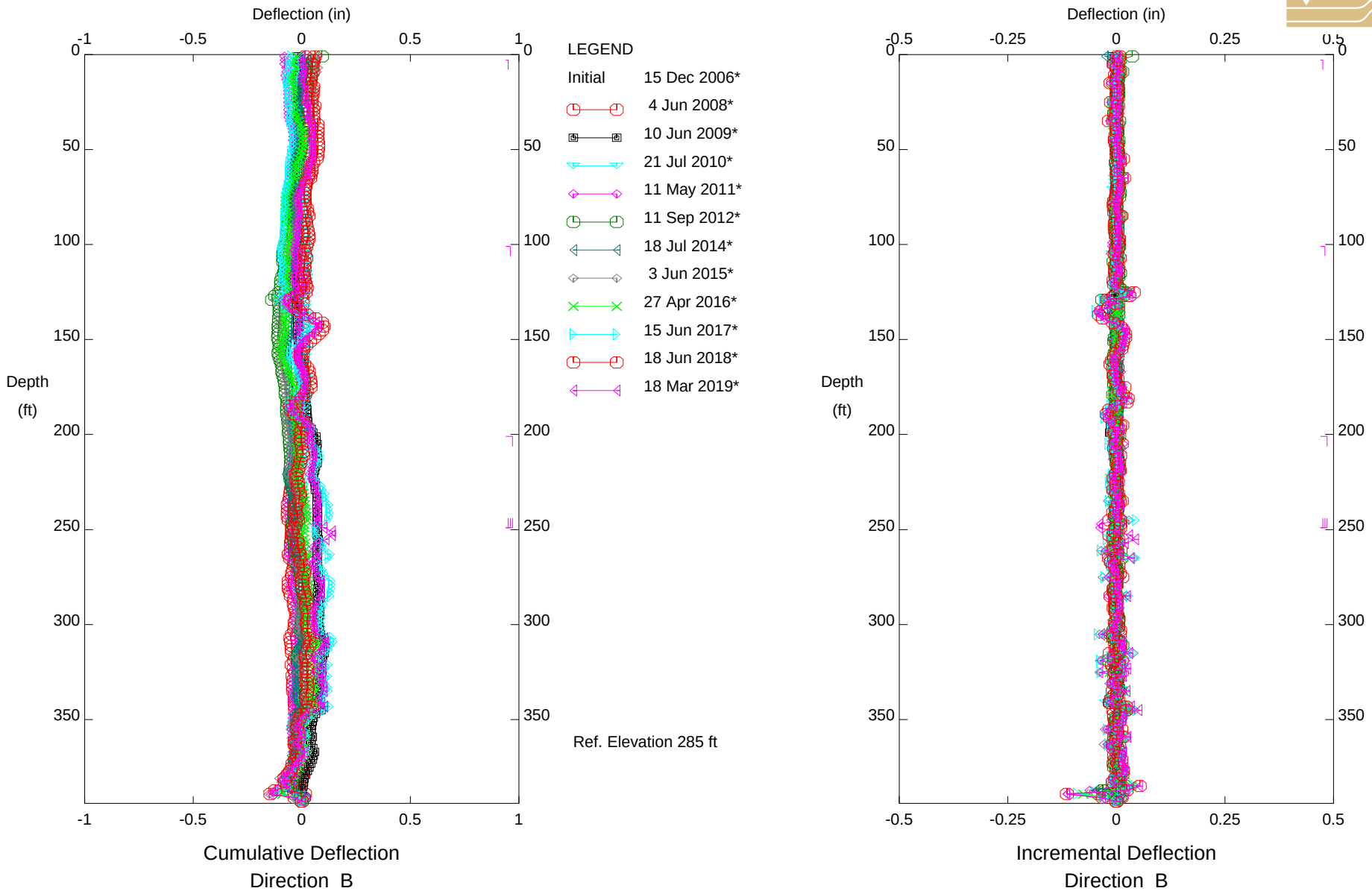
CENTRAL REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D18-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-16A

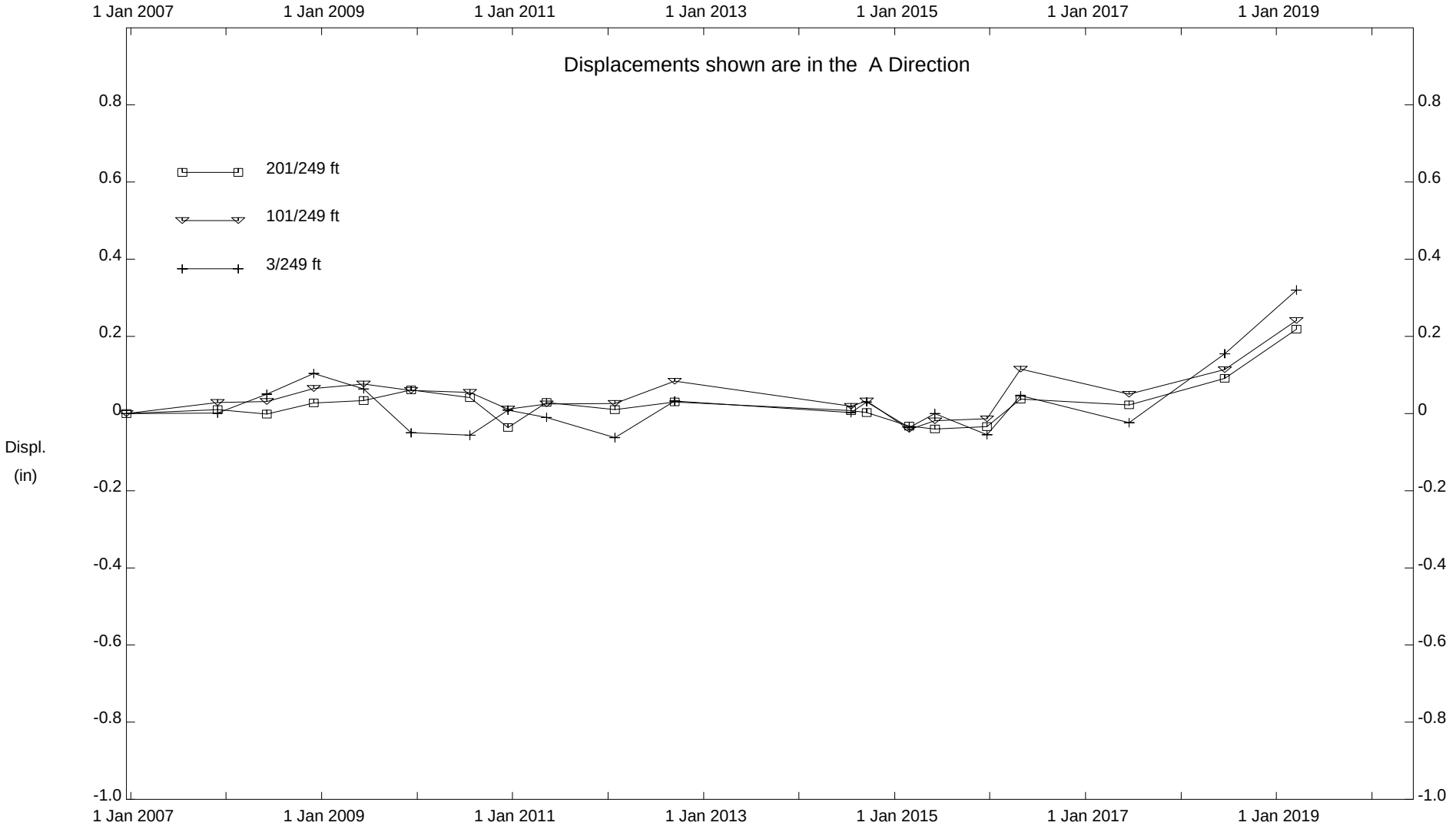
CENTRAL REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D18-2

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



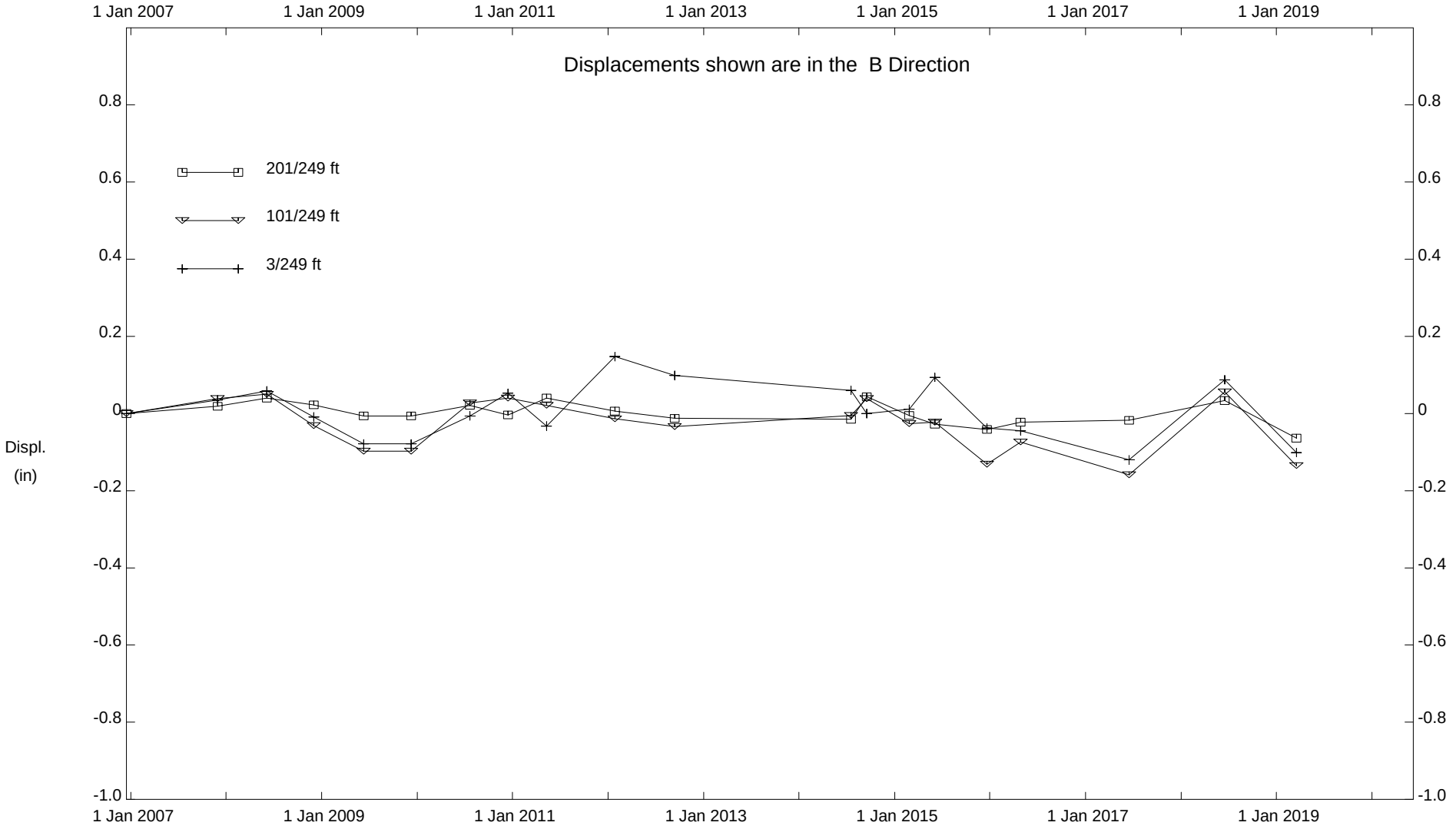
BIG ROCK MESA, Inclinometer SP-16A

CENTRAL REGION

PLATE D18-3

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



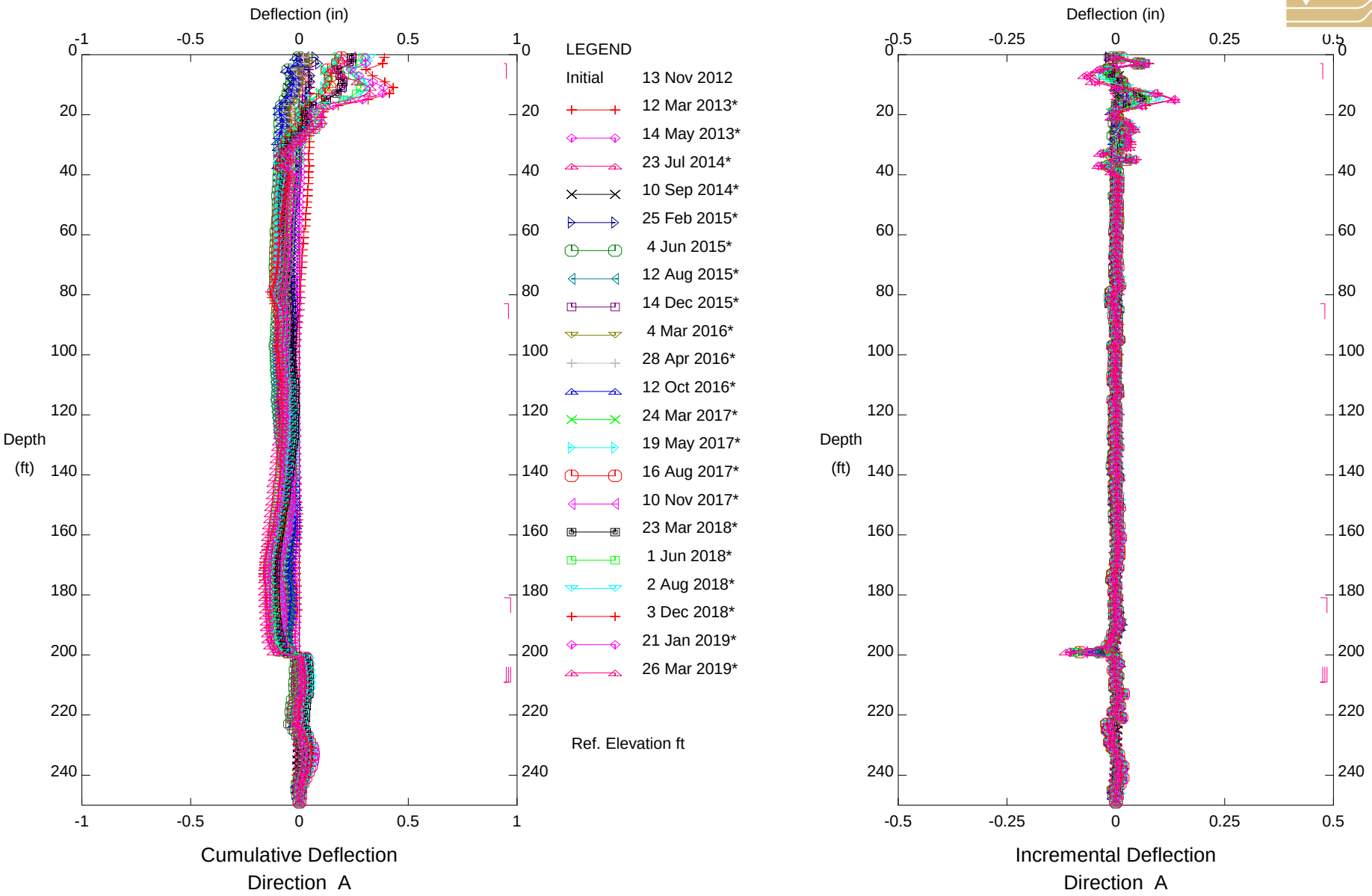
BIG ROCK MESA, Inclinometer SP-16A

CENTRAL REGION

PLATE D18-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BRM, Inclinometer SP-17B

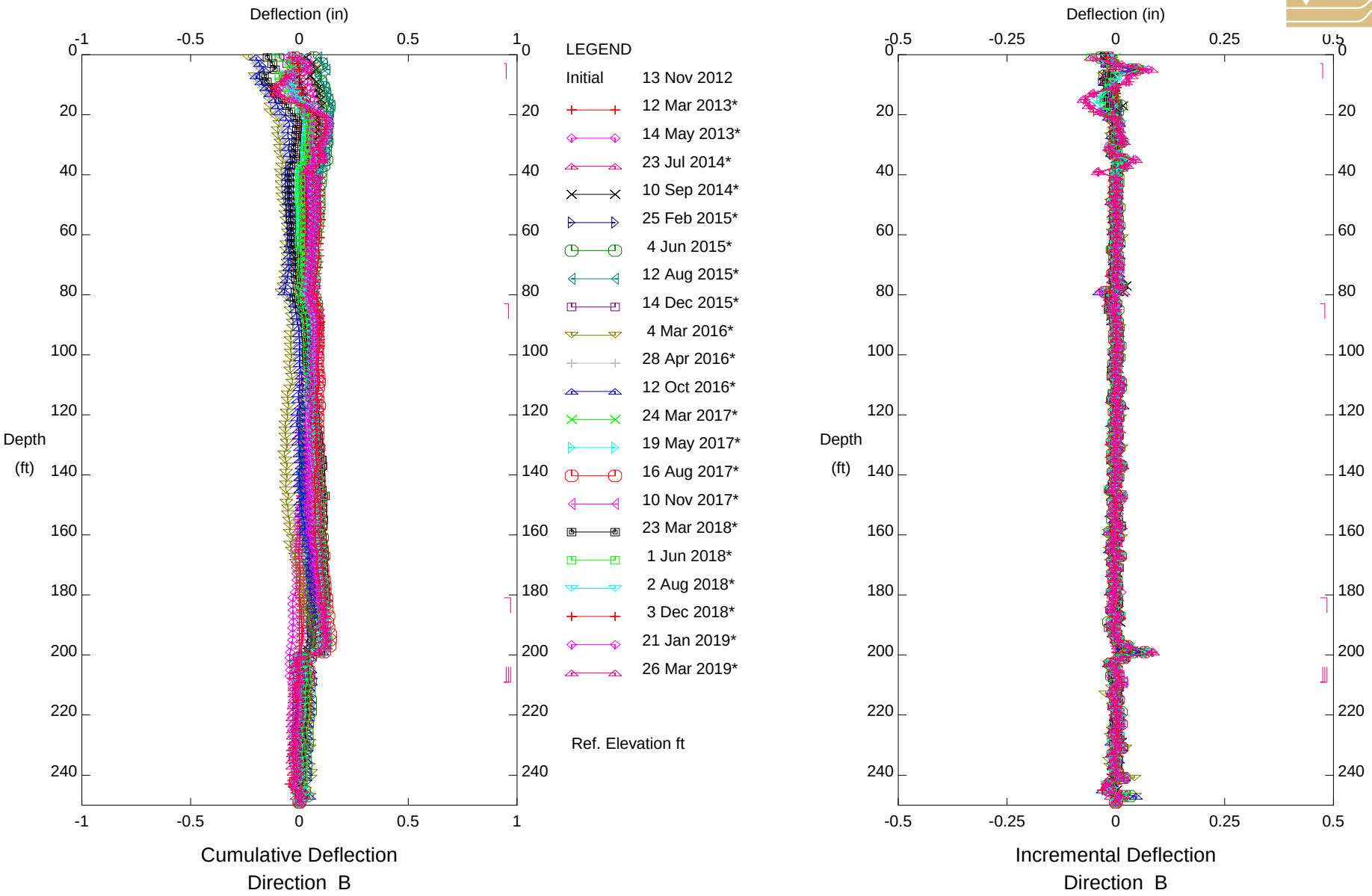
Sets marked * include zero shift and/or rotation corrections.

PLATE D19-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP-17B.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

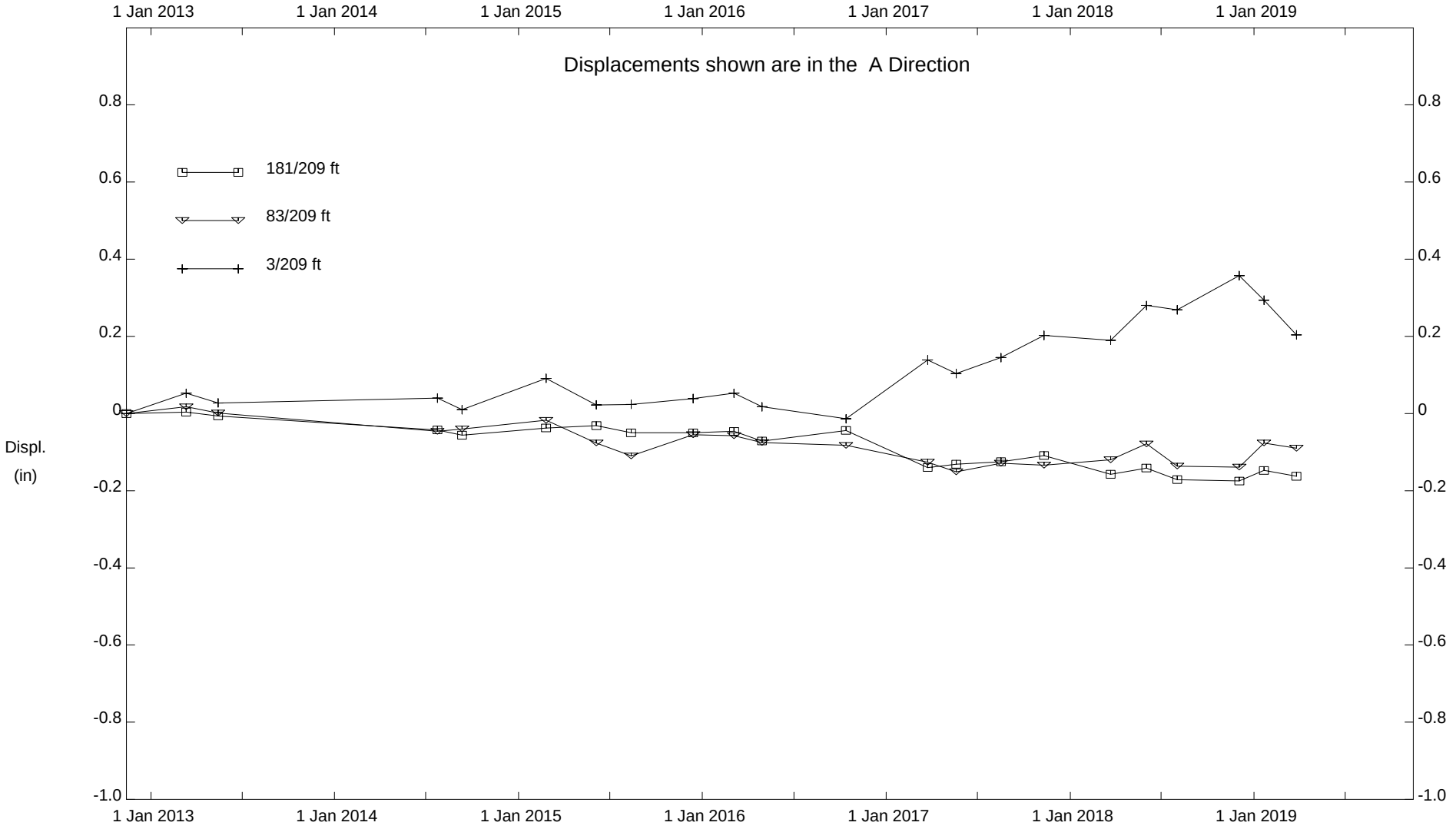
Fugro USA Land, Inc. - Ventura, CA



BRM, Inclinometer SP-17B

Sets marked * include zero shift and/or rotation corrections.

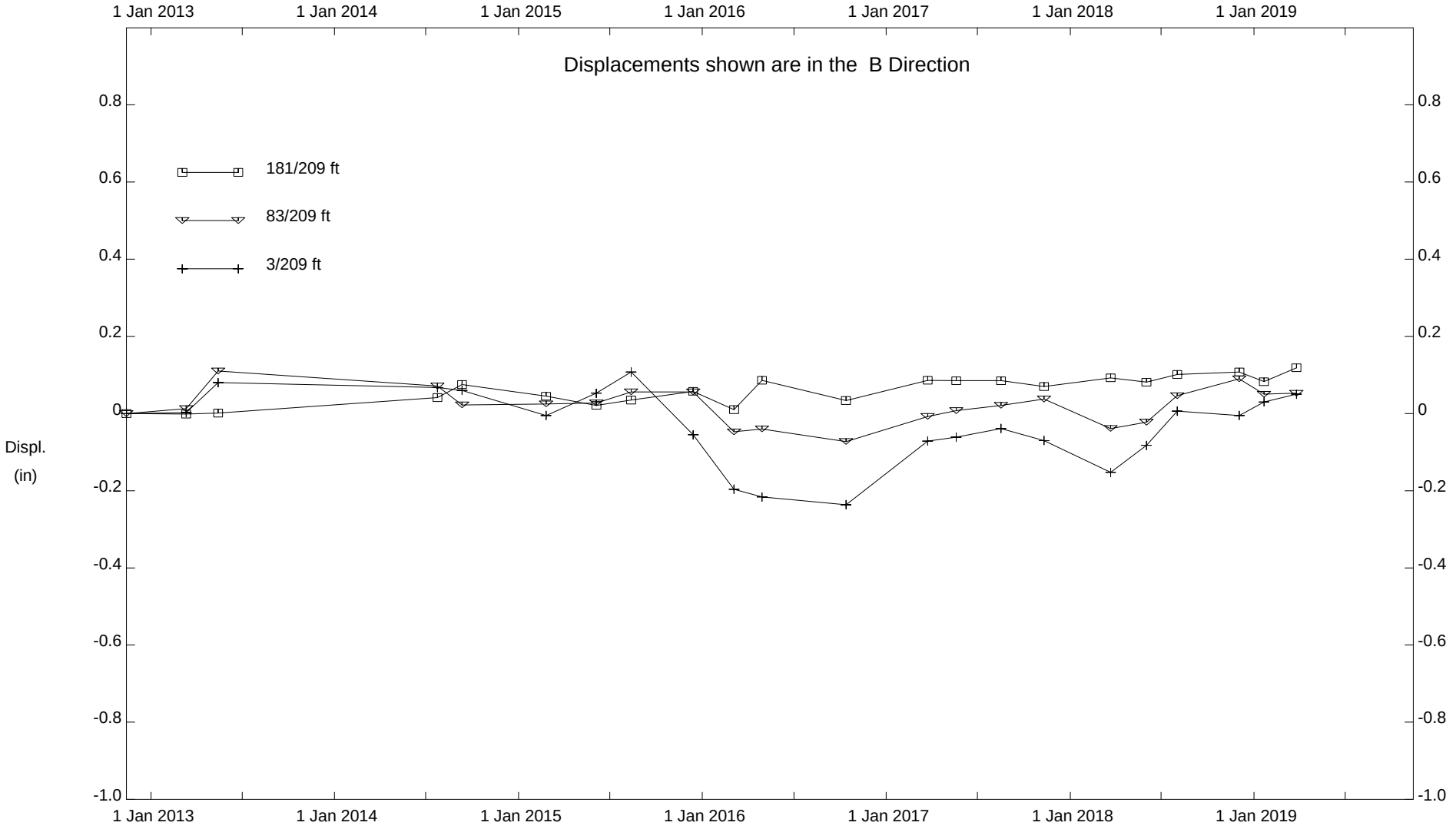
PLATE D19-2



BRM, Inclinometer SP-17B

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

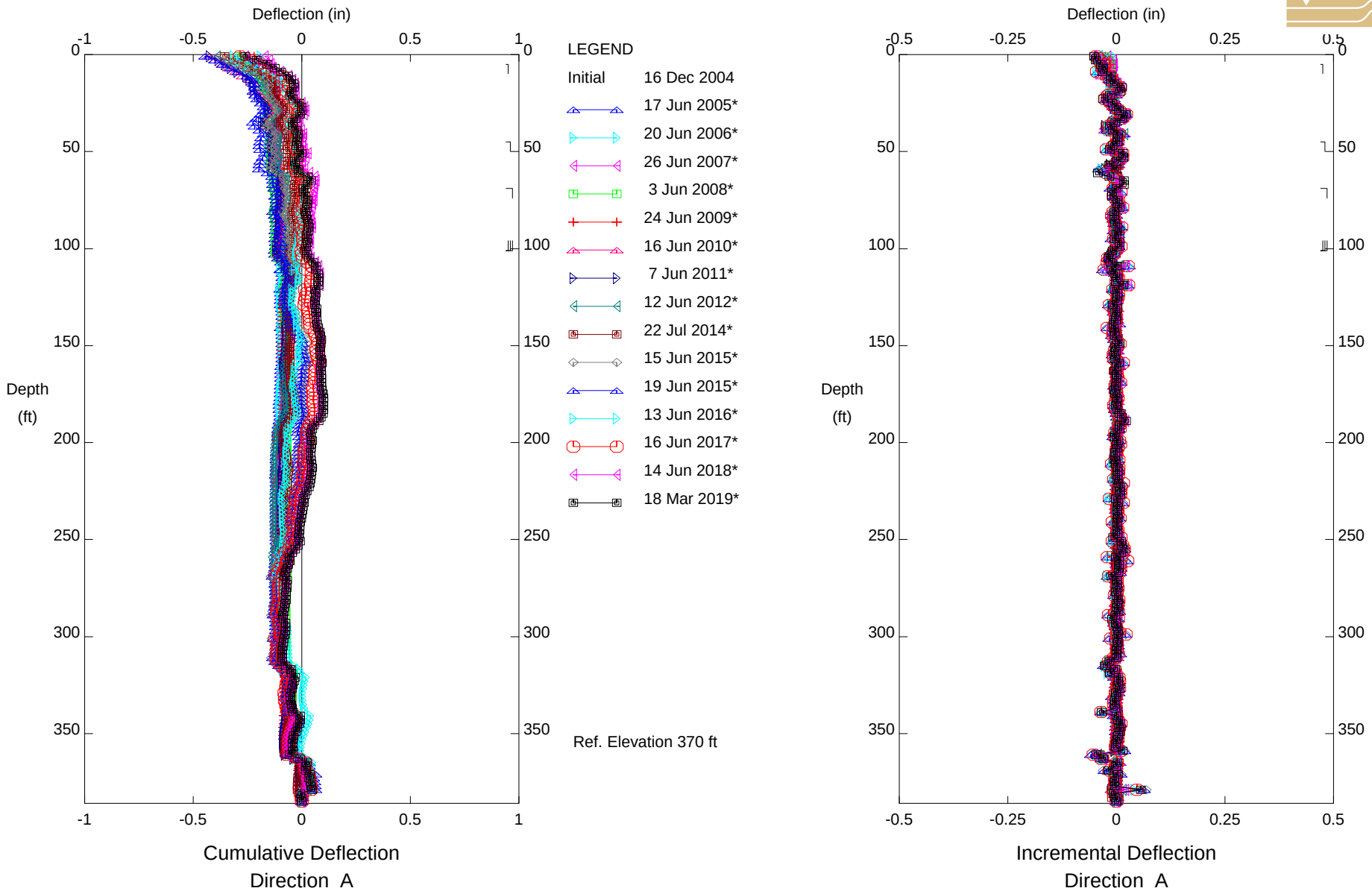


BRM, Inclinometer SP-17B

PLATE D19-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-24

CENTRAL REGION

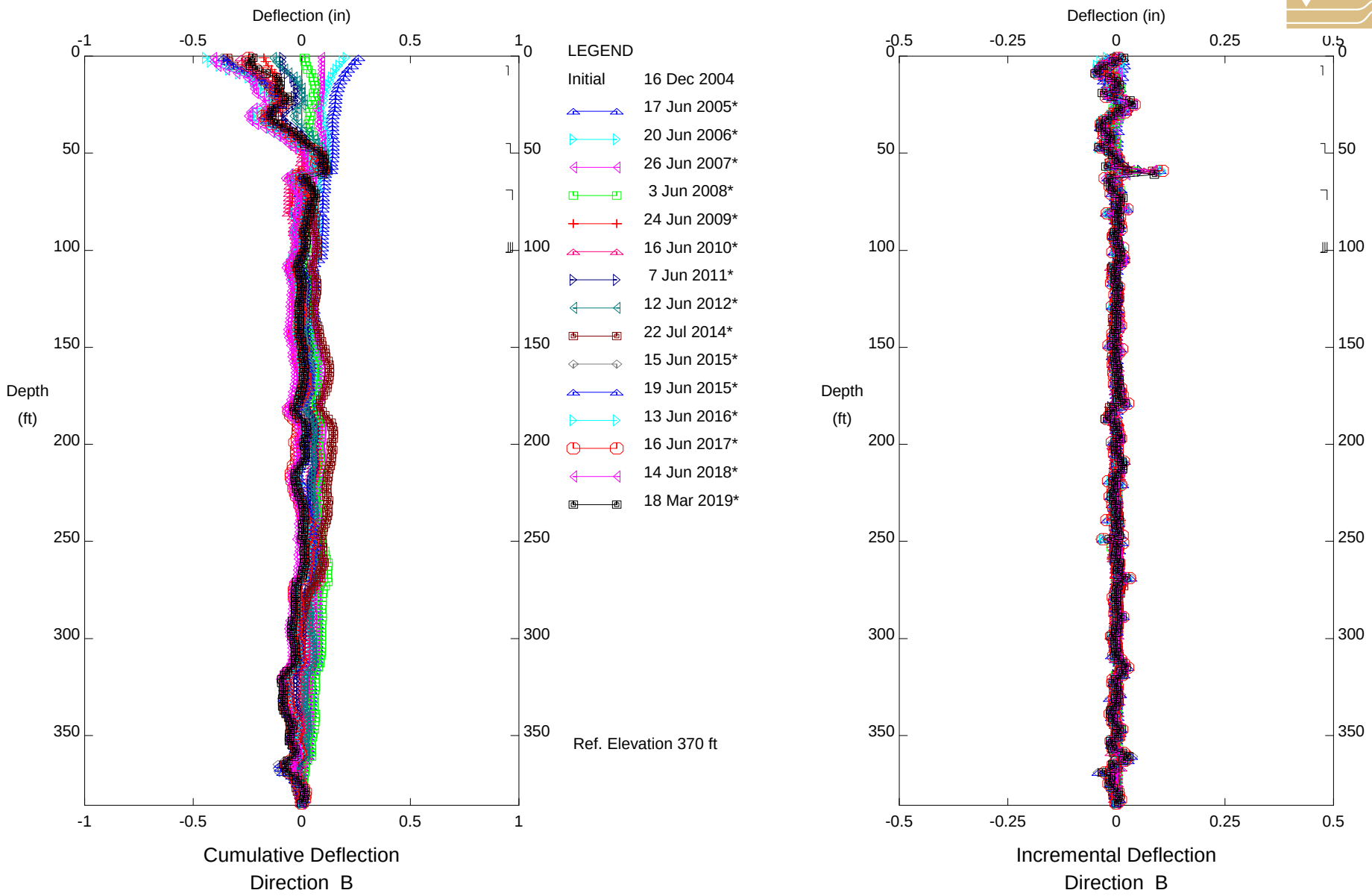
Sets marked * include zero shift and/or rotation corrections.

PLATE D20-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP24.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-24

CENTRAL REGION

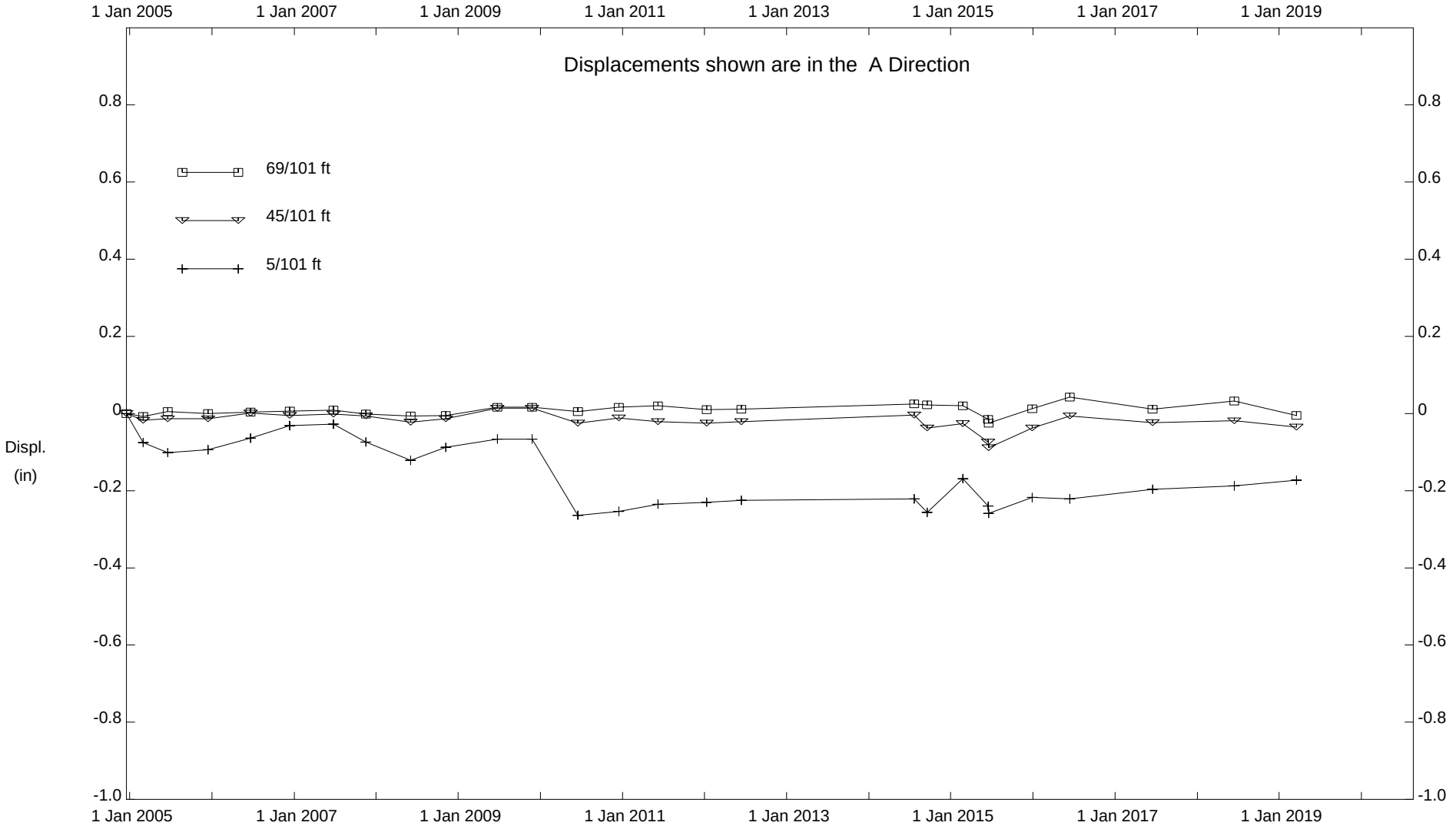
Sets marked * include zero shift and/or rotation corrections.

PLATE D20-2

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP24.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



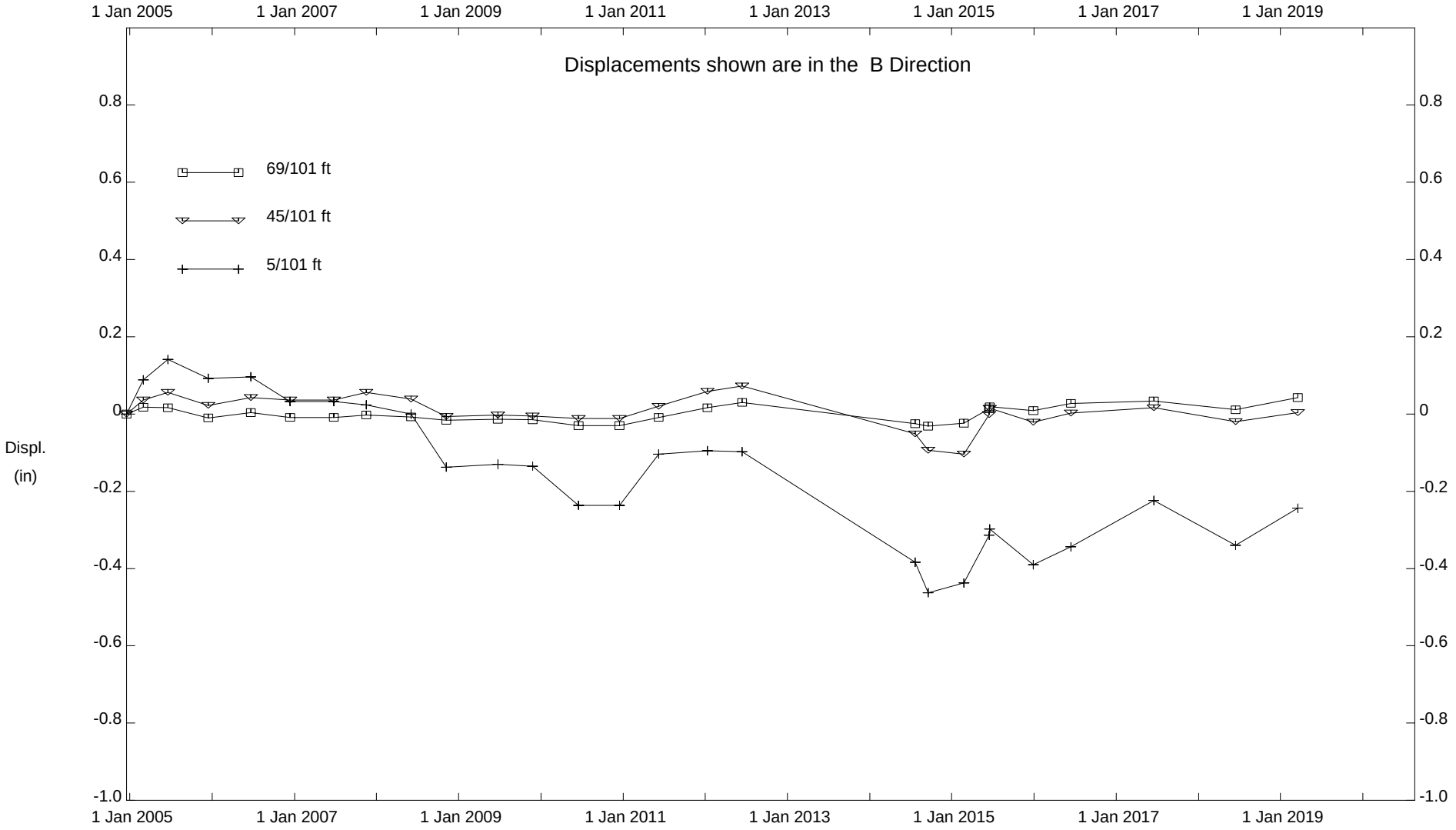
BIG ROCK MESA, Inclinometer SP-24

CENTRAL REGION

PLATE D20-3

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



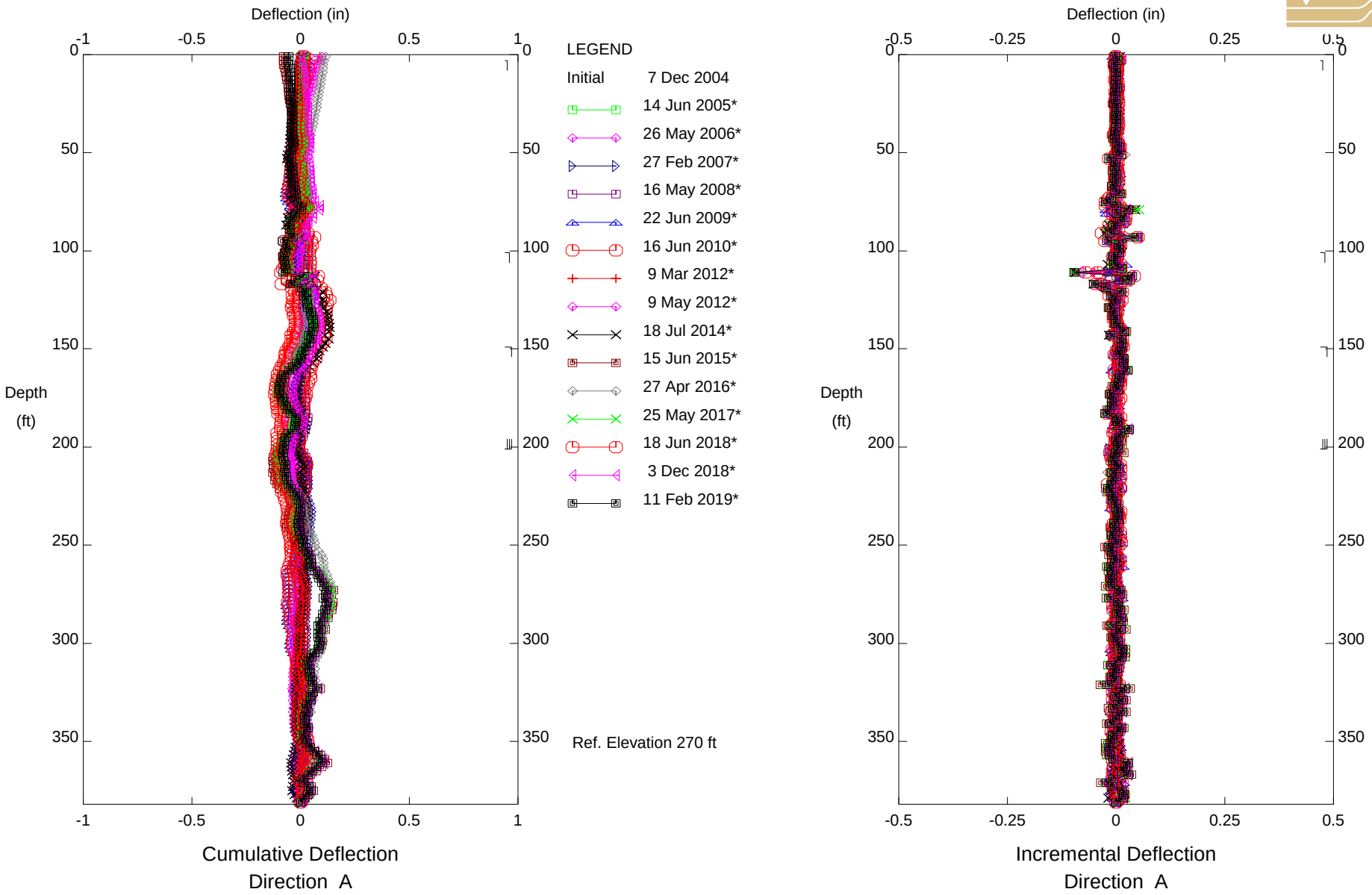
BIG ROCK MESA, Inclinometer SP-24

CENTRAL REGION

PLATE D20-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-34

CENTRAL REGION

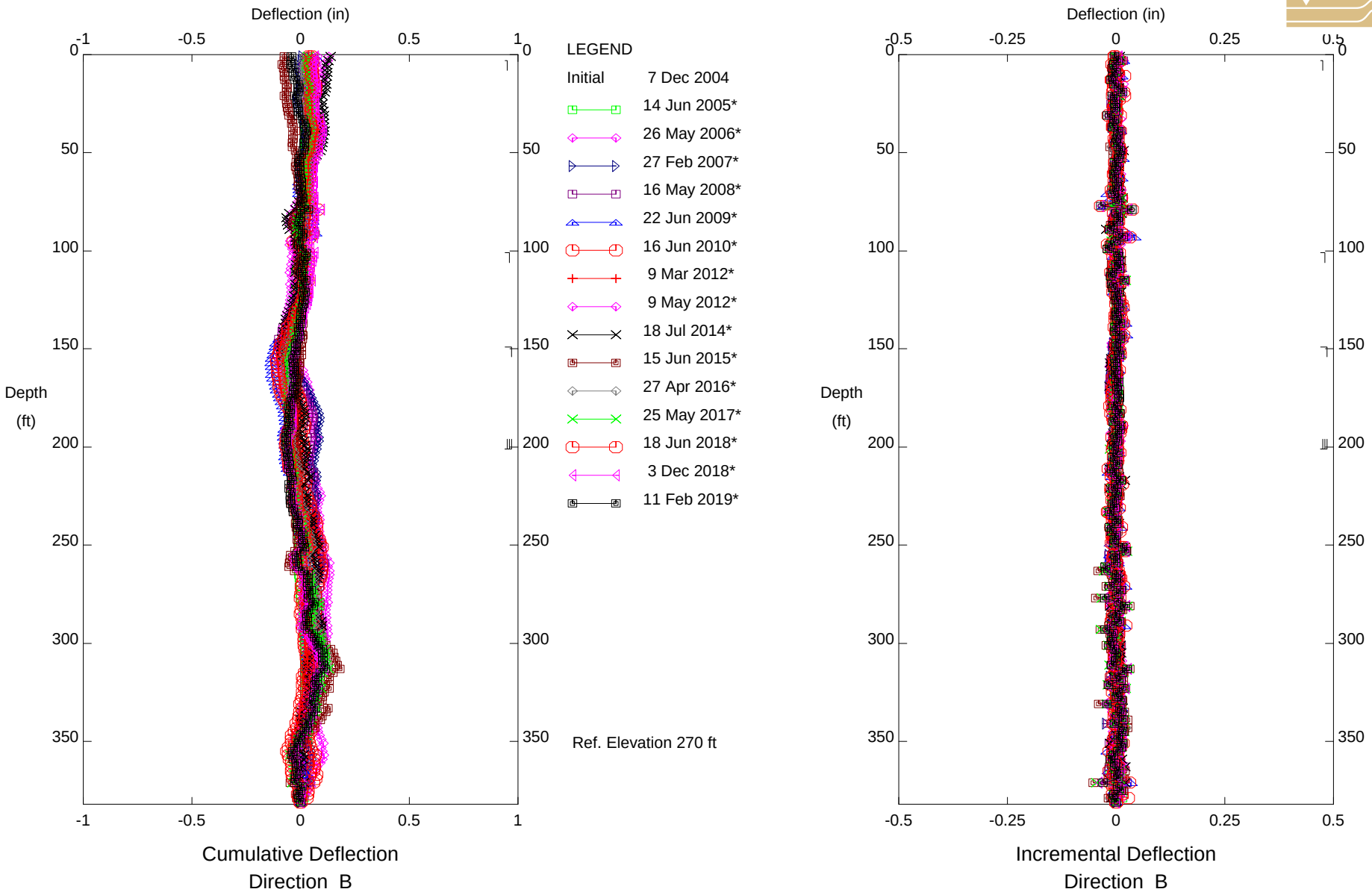
Sets marked * include zero shift and/or rotation corrections.

PLATE D21-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP34.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-34

CENTRAL REGION

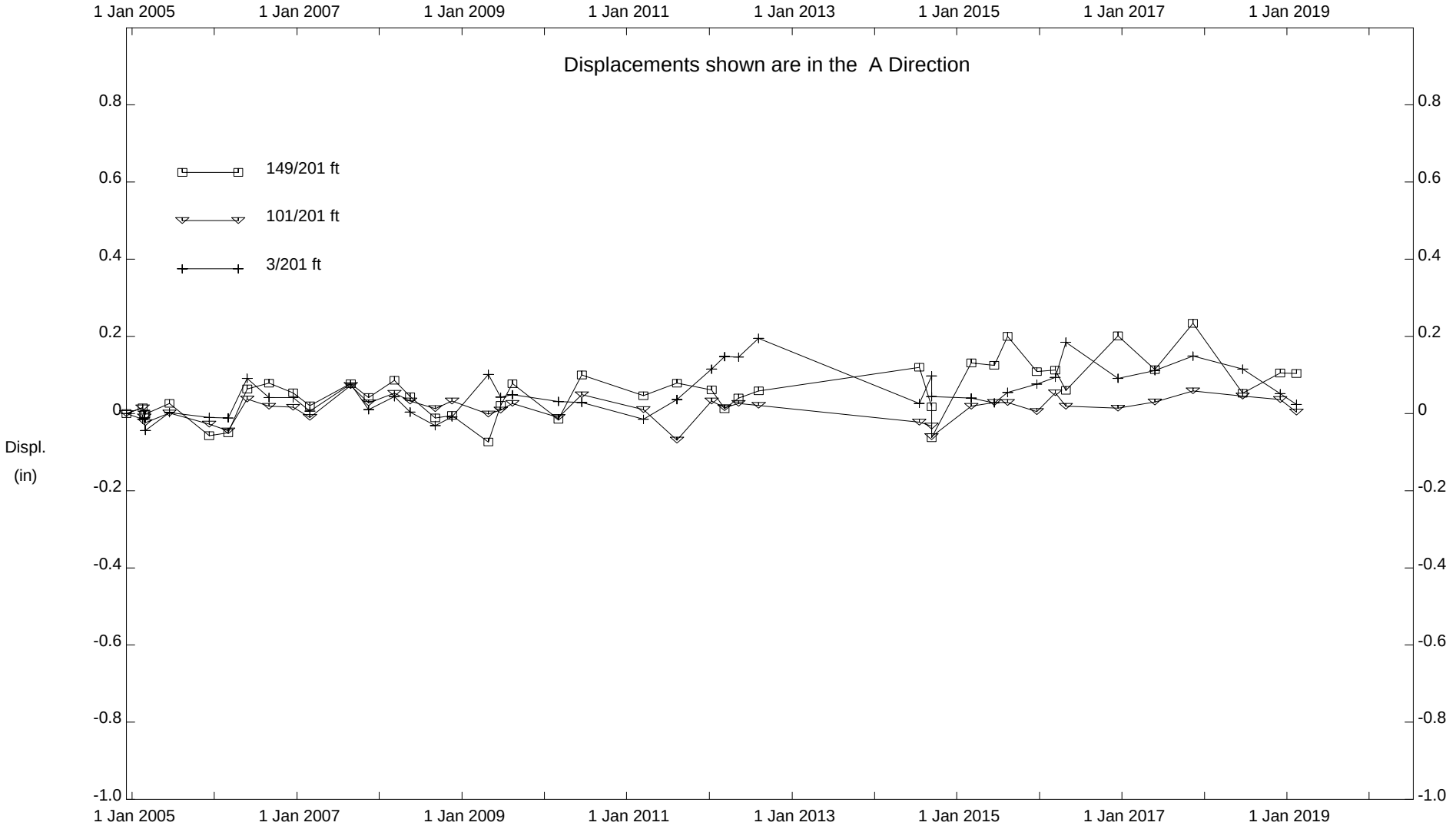
Sets marked * include zero shift and/or rotation corrections.

PLATE D21-2

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP34.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

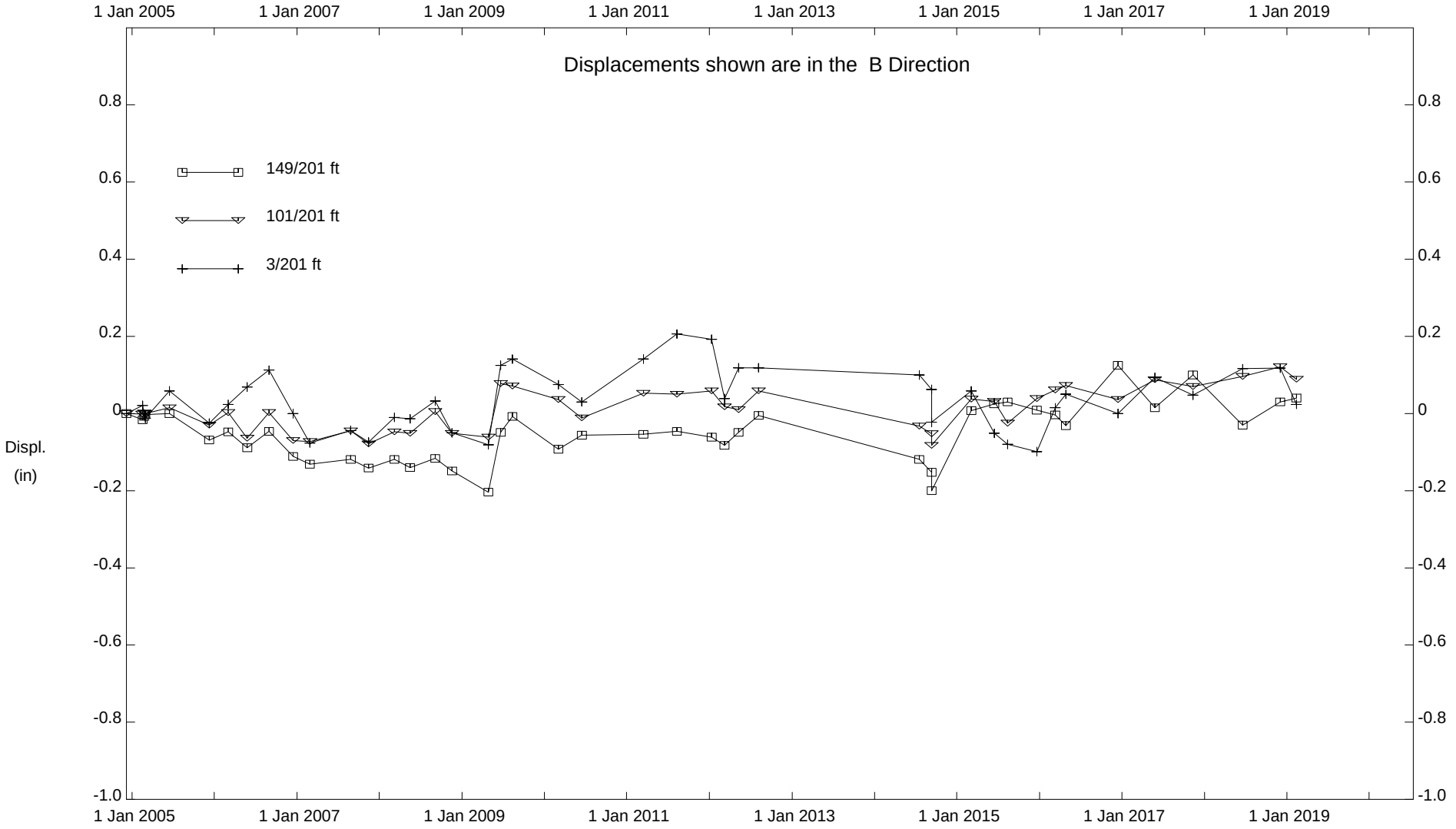
Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-34

CENTRAL REGION

PLATE D21-3



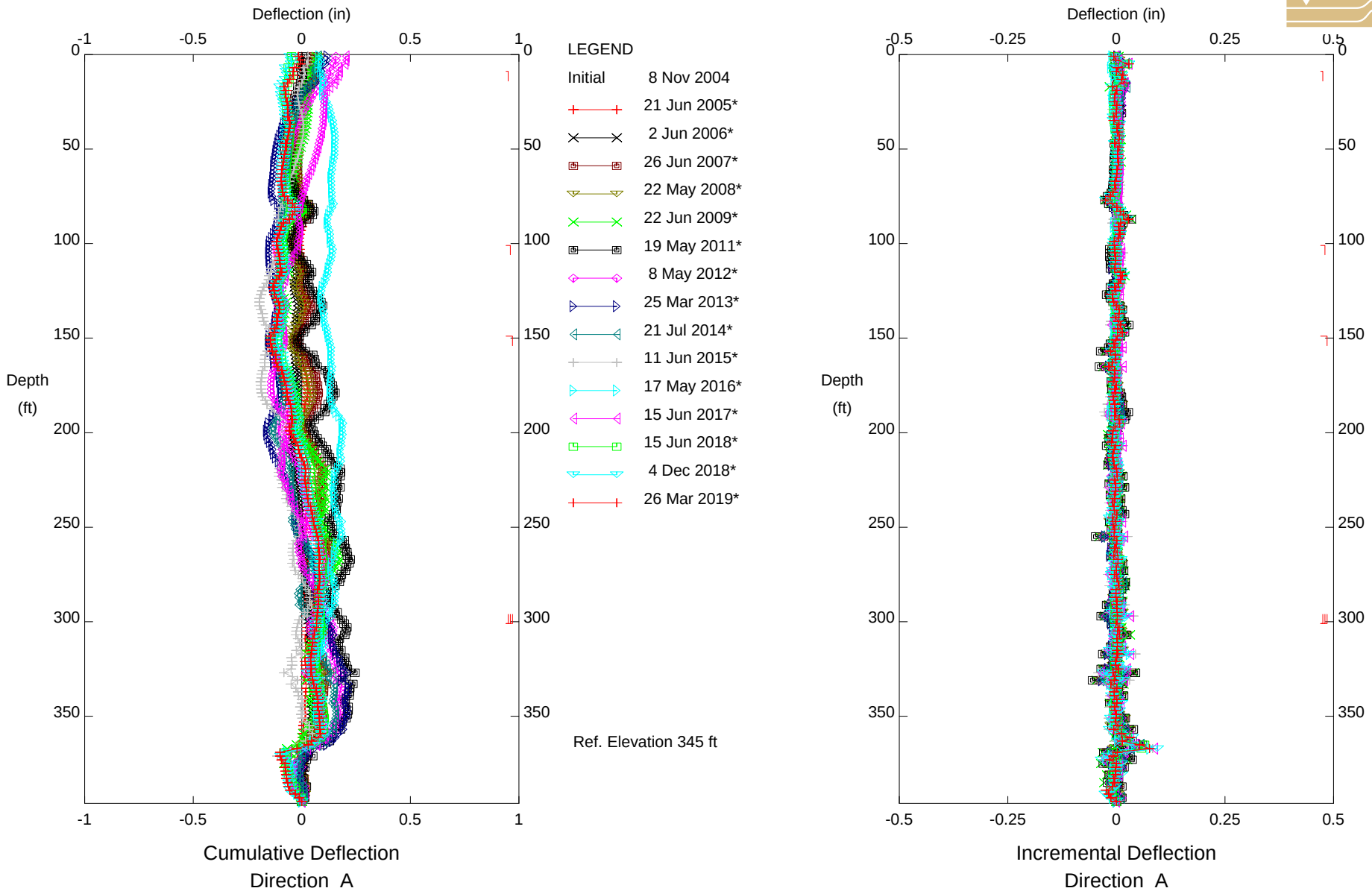
BIG ROCK MESA, Inclinometer SP-34

CENTRAL REGION

PLATE D21-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-35

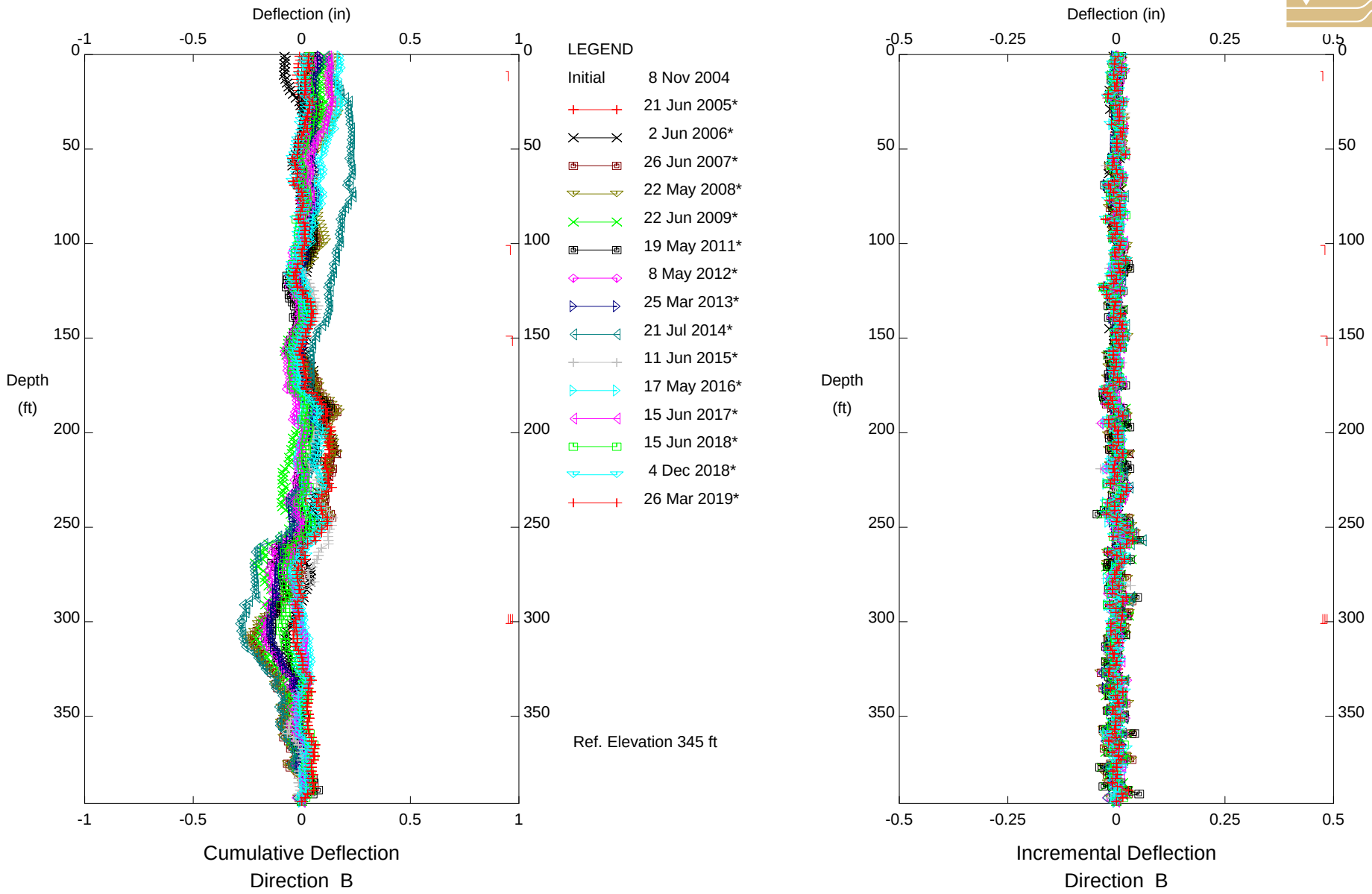
CENTRAL REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D22-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



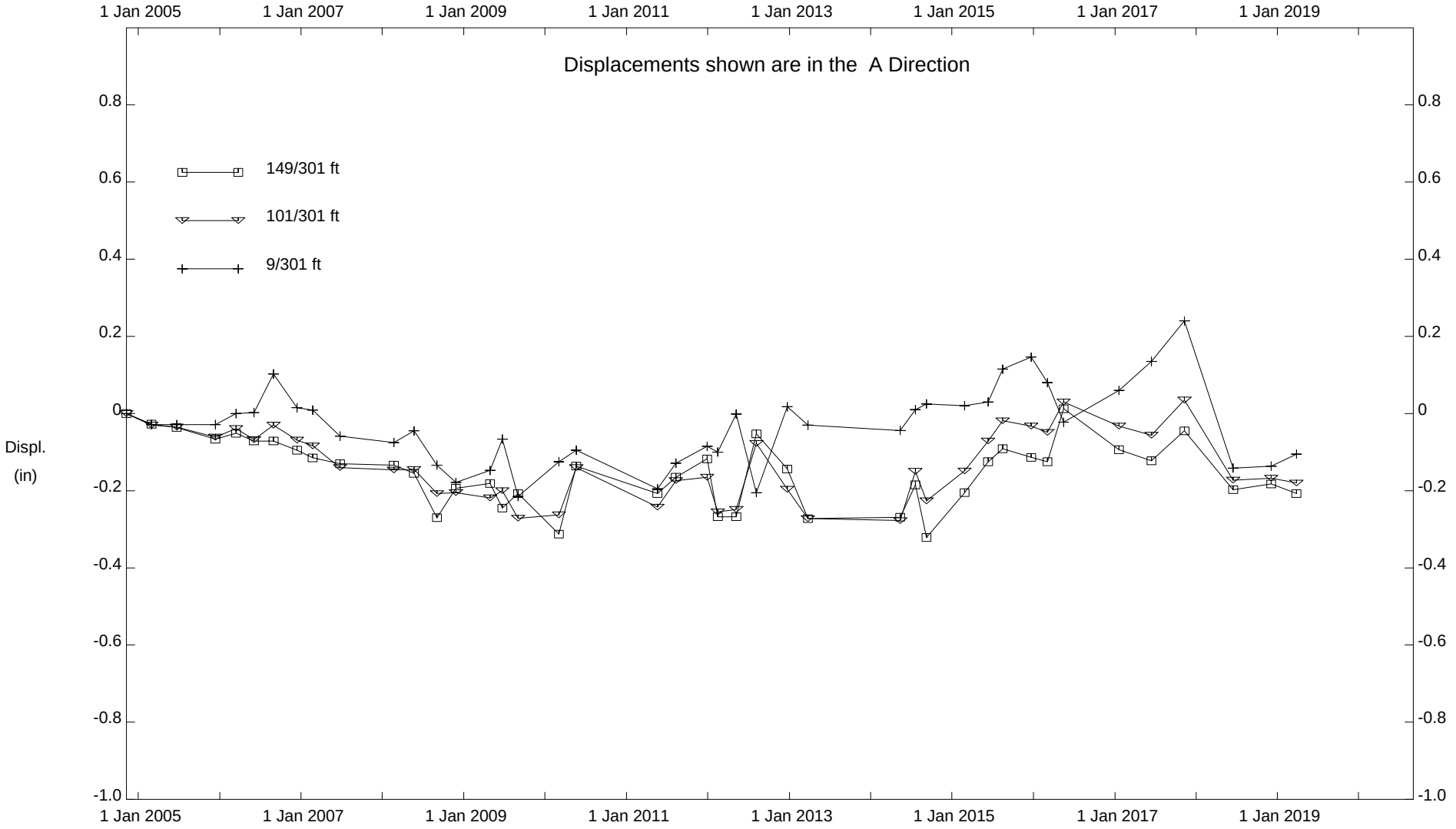
BIG ROCK MESA, Inclinometer SP-35

CENTRAL REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D22-2

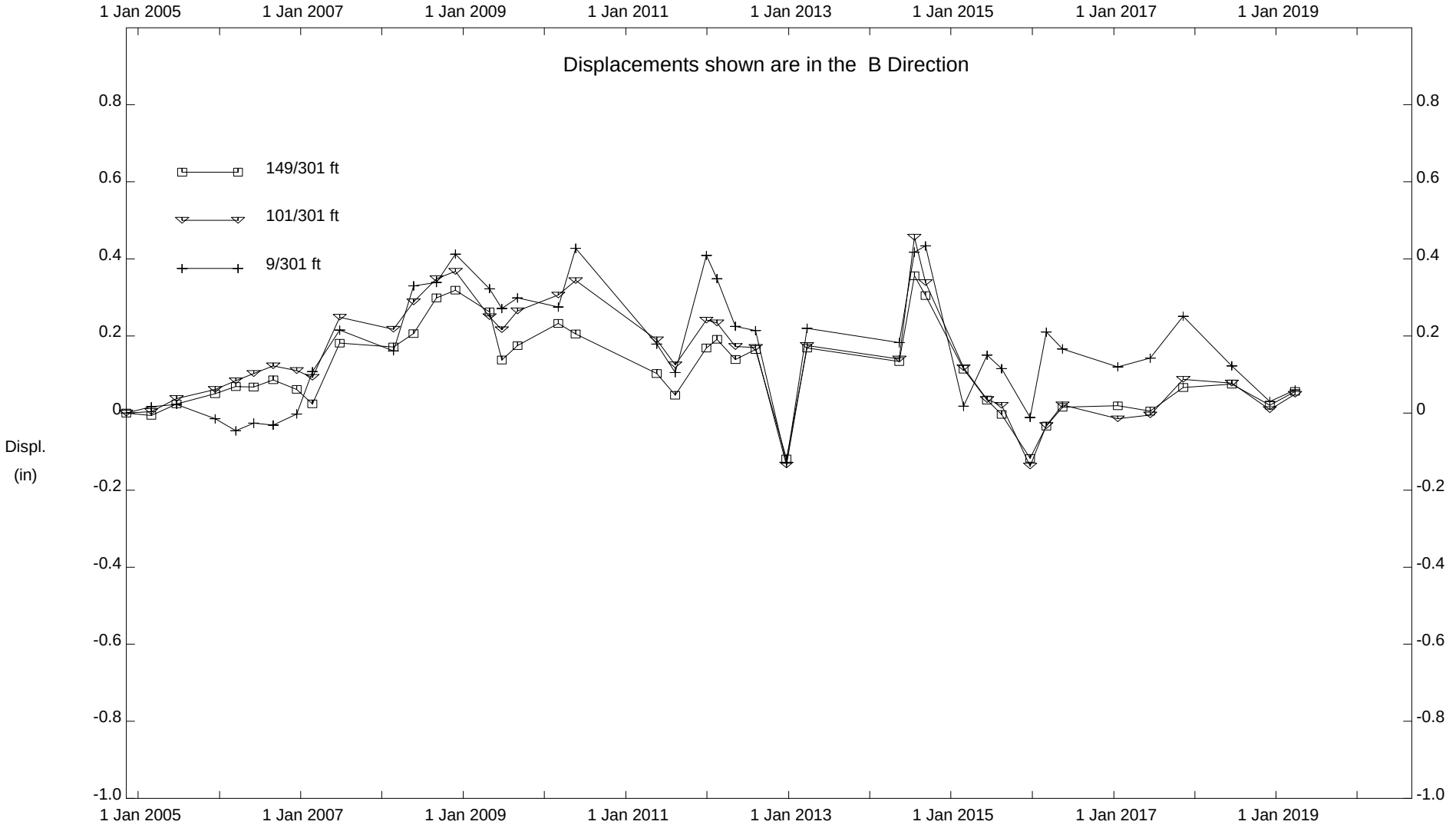
O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP35.gtl



BIG ROCK MESA, Inclinometer SP-35

CENTRAL REGION

PLATE D22-3



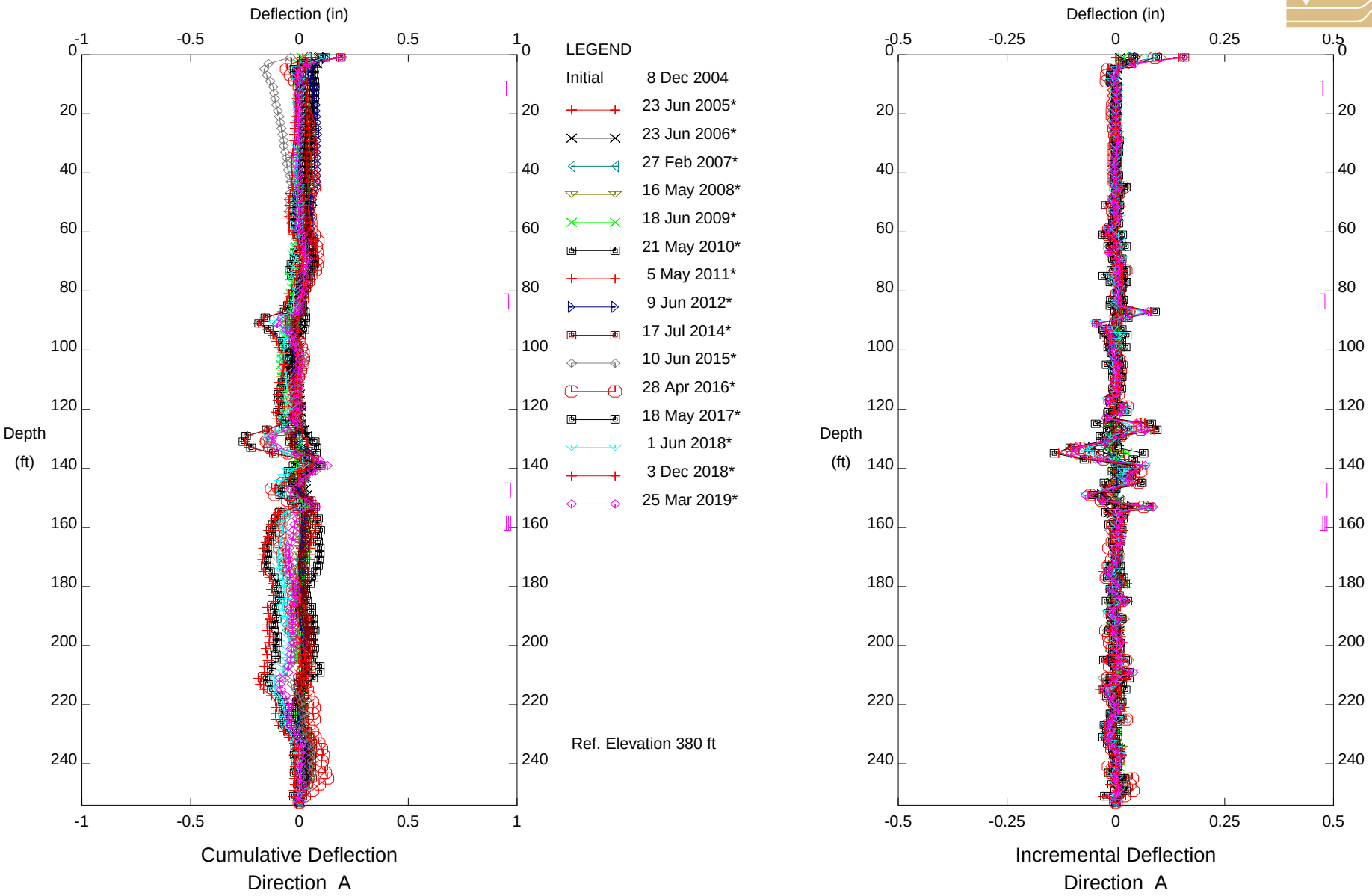
BIG ROCK MESA, Inclinometer SP-35

CENTRAL REGION

PLATE D22-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-36

CENTRAL REGION

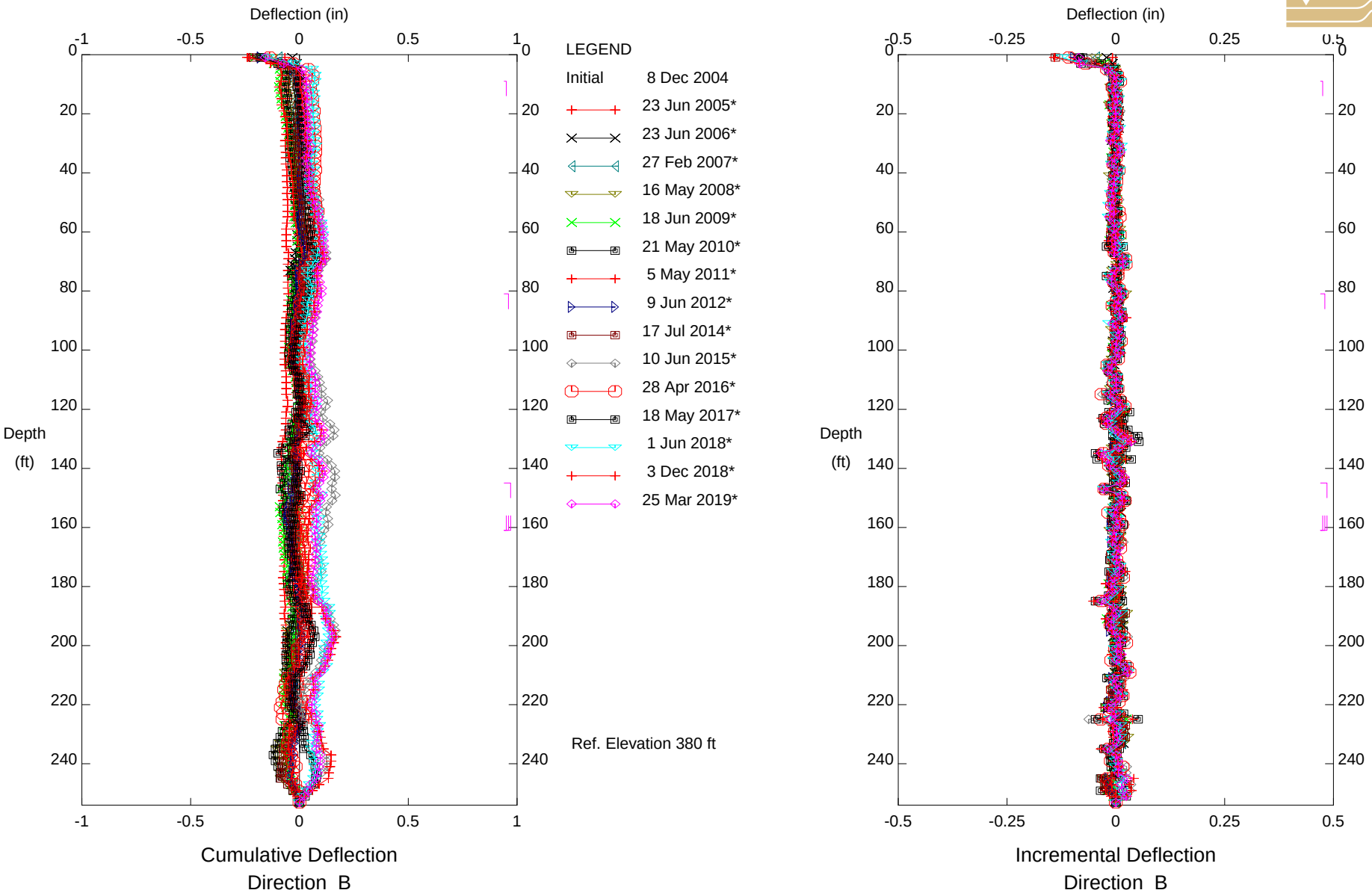
Sets marked * include zero shift and/or rotation corrections.

PLATE D23-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP36.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



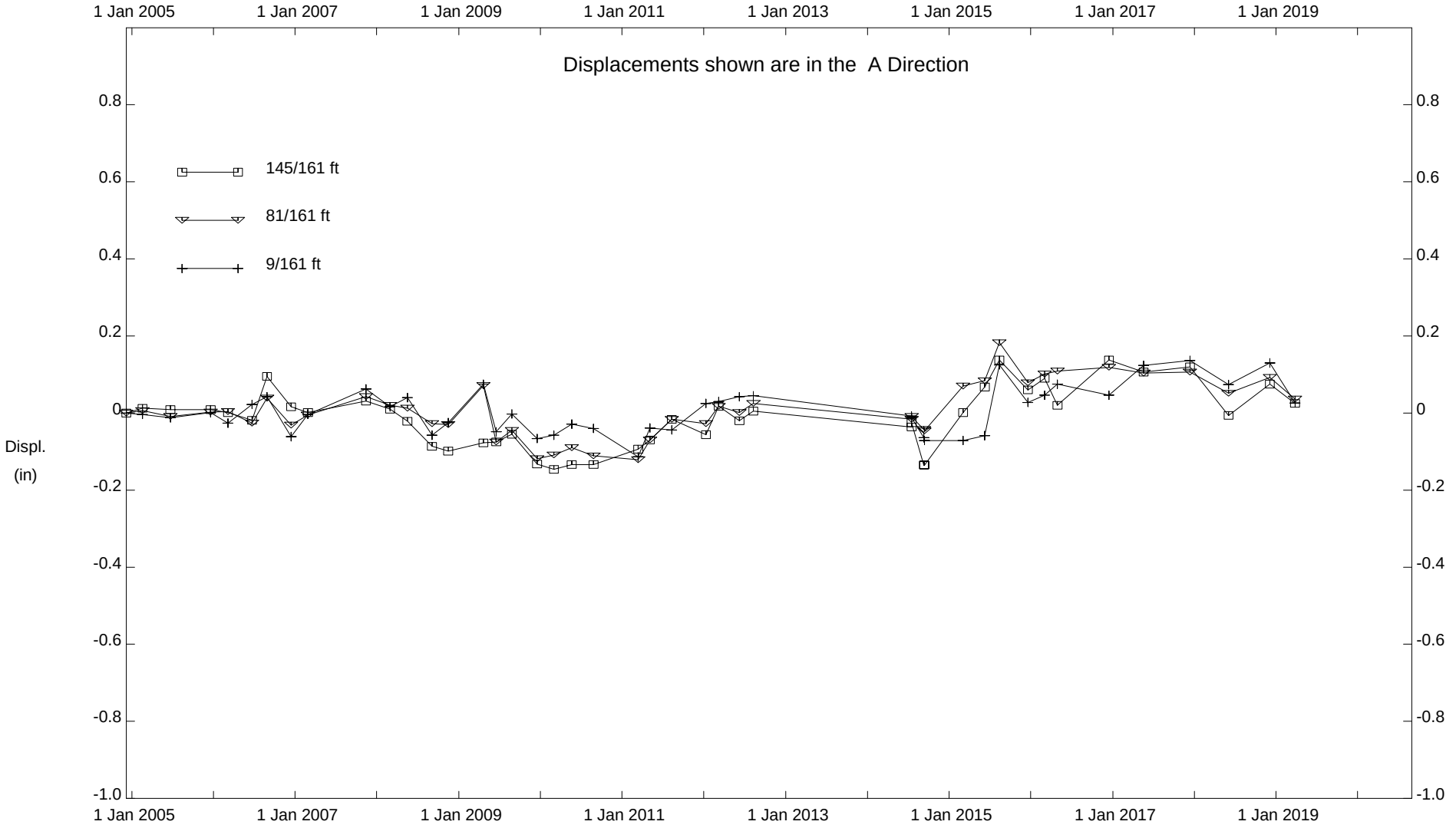
BIG ROCK MESA, Inclinometer SP-36

CENTRAL REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D23-2

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP36.gtl



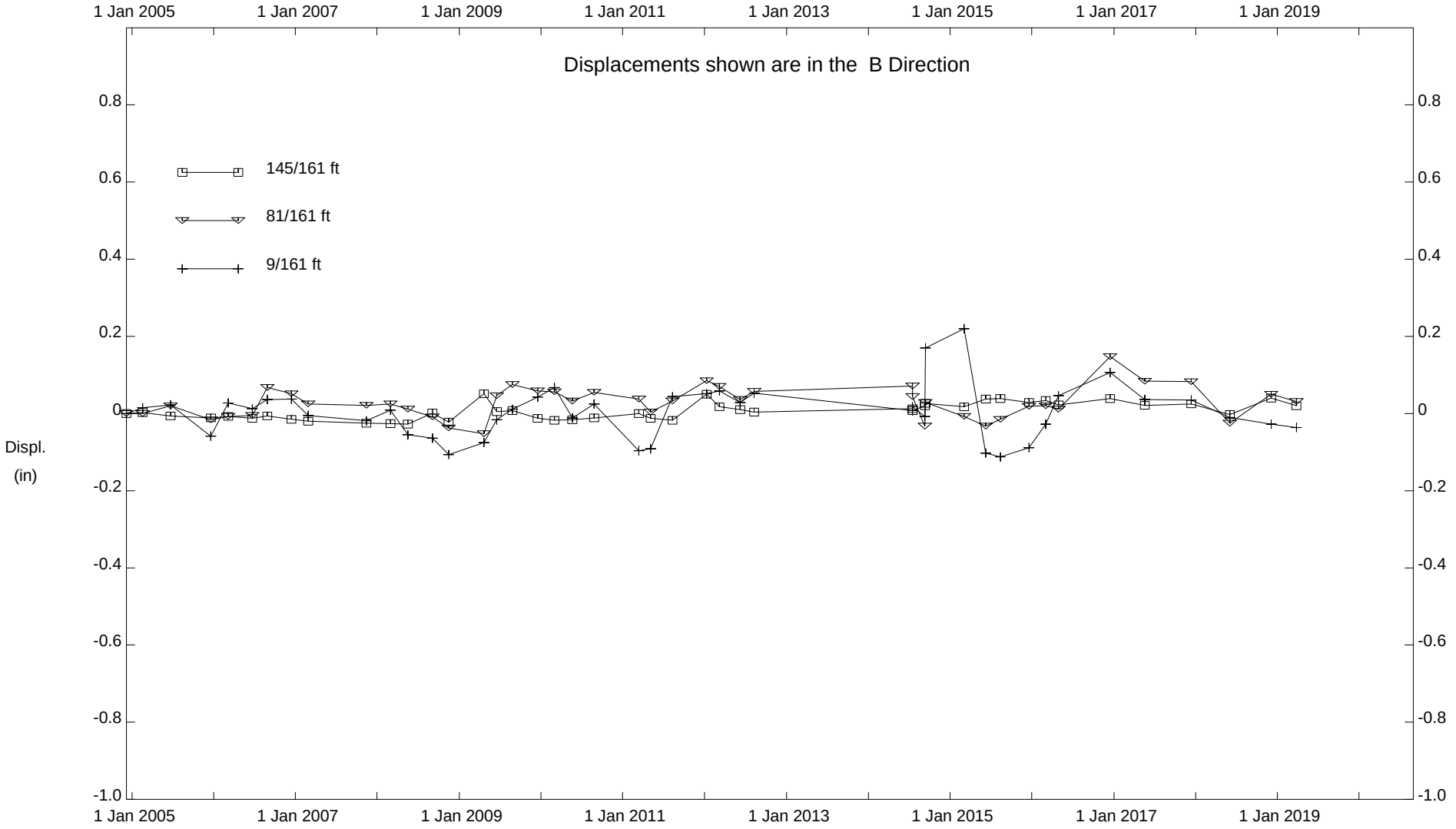
BIG ROCK MESA, Inclinometer SP-36

CENTRAL REGION

PLATE D23-3

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



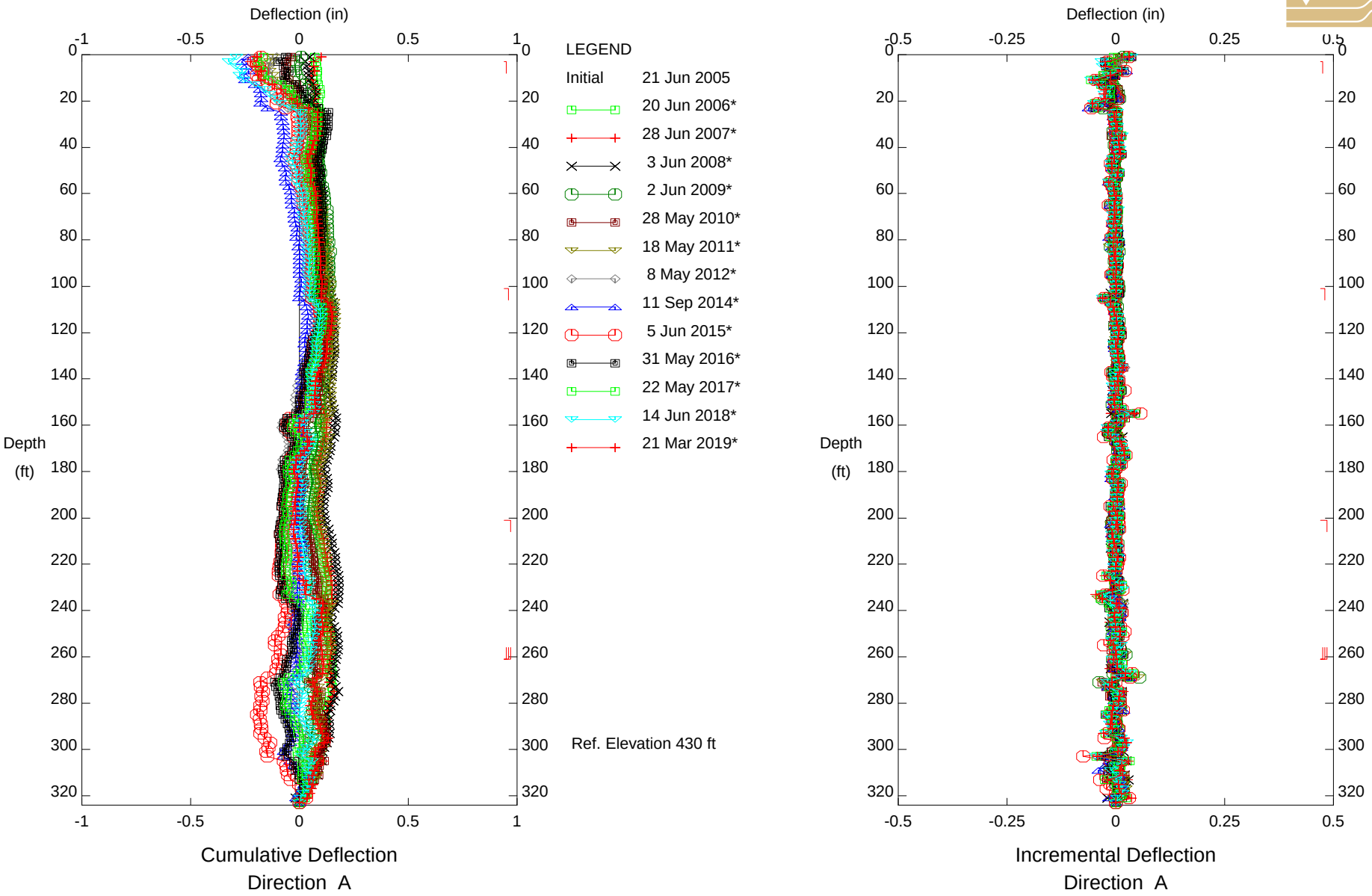
BIG ROCK MESA, Inclinometer SP-36

CENTRAL REGION

PLATE D23-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-20

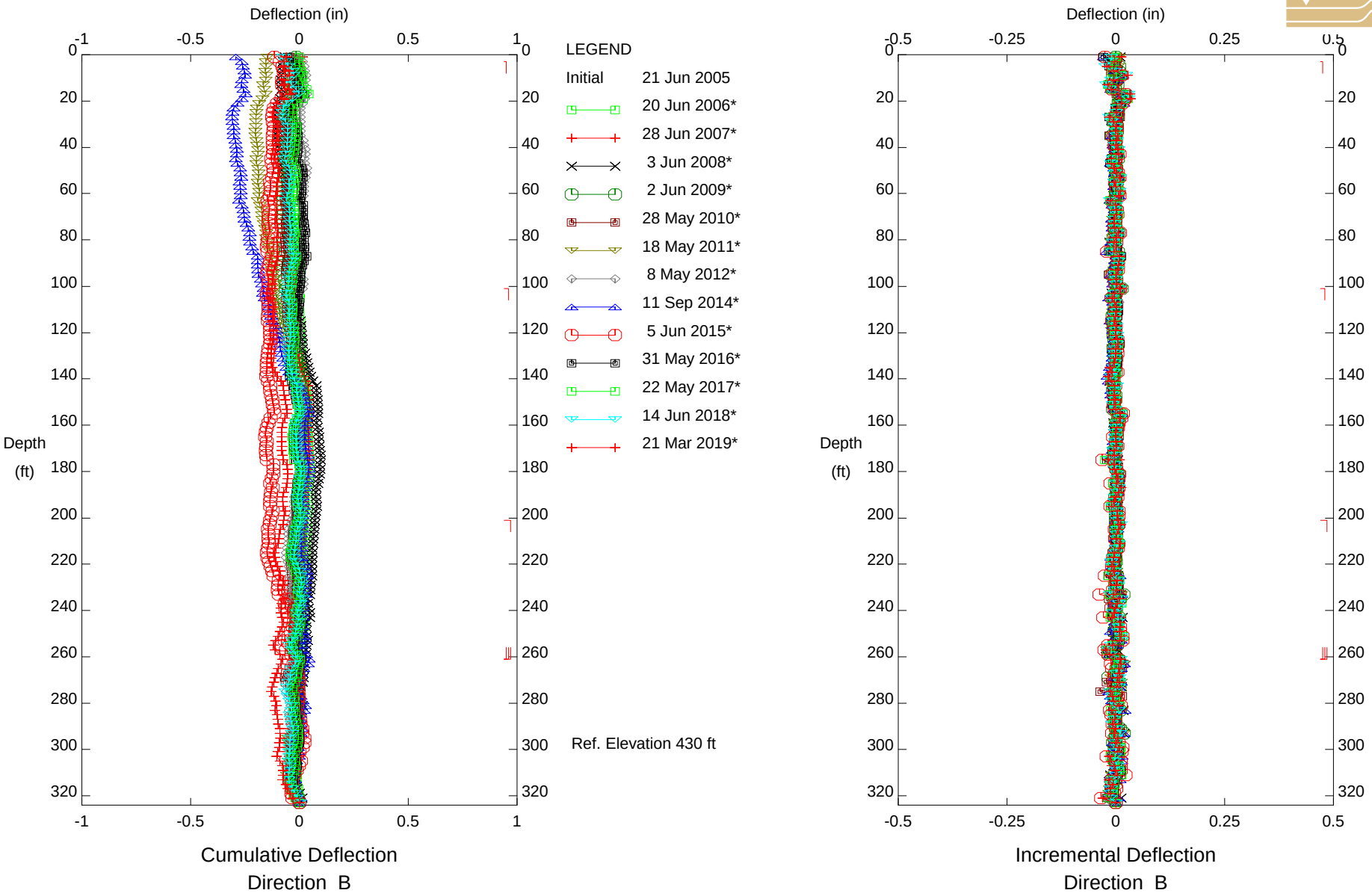
WESTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D24-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

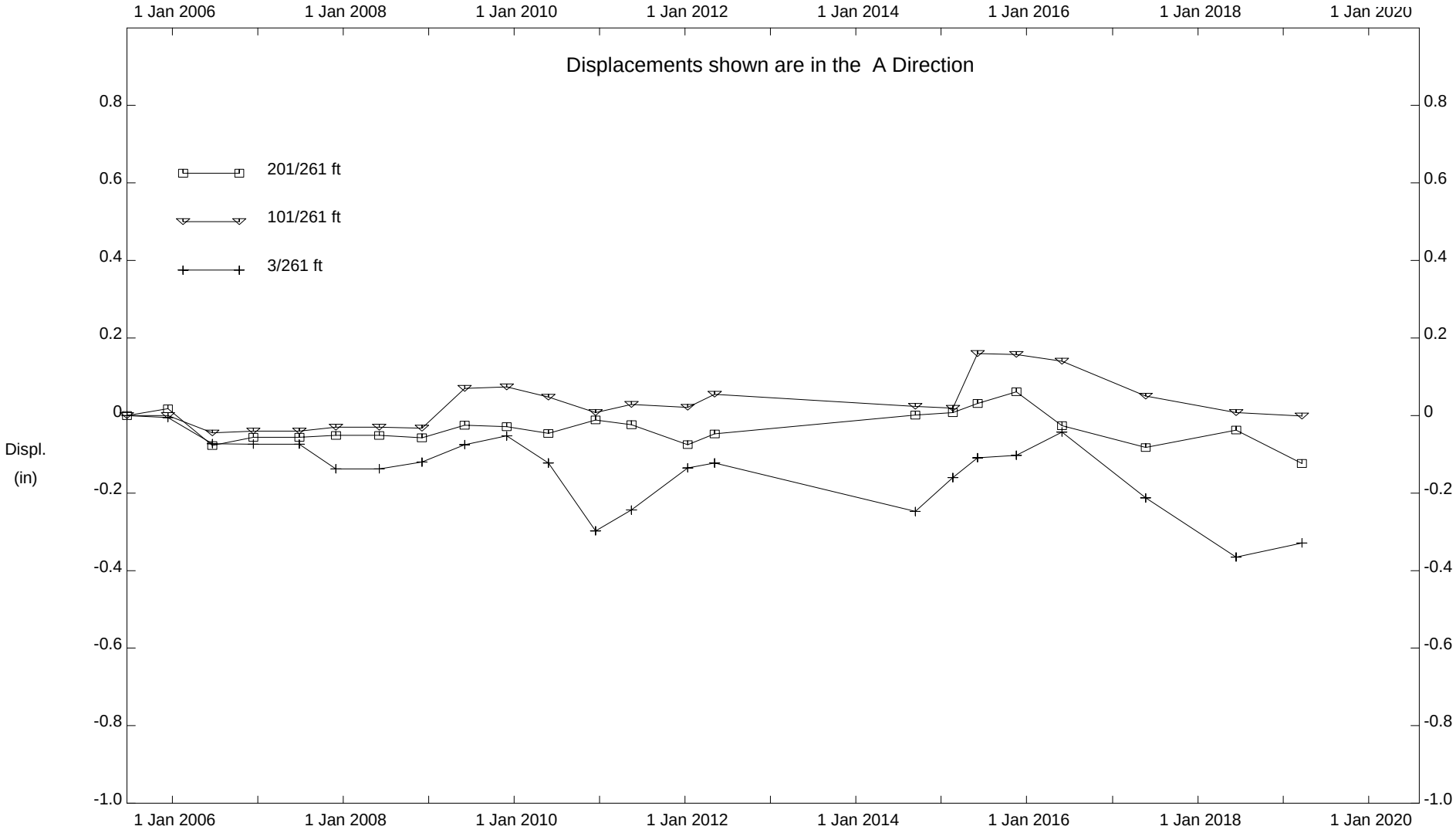


BIG ROCK MESA, Inclinometer SP-20

WESTERN REGION

Sets marked * include zero shift and/or rotation corrections.

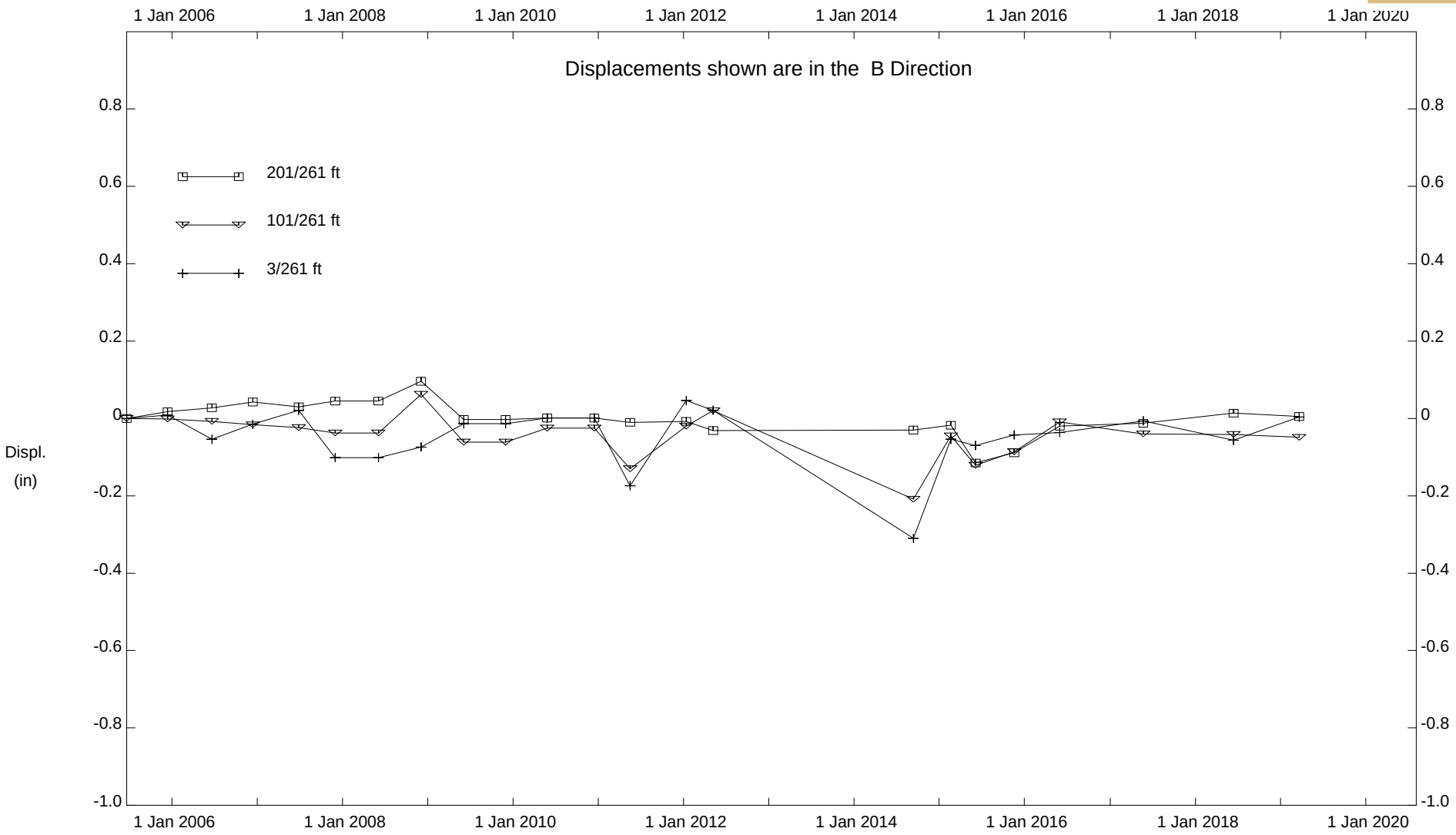
PLATE D24-2



BIG ROCK MESA, Inclinometer SP-20

WESTERN REGION

PLATE D24-3



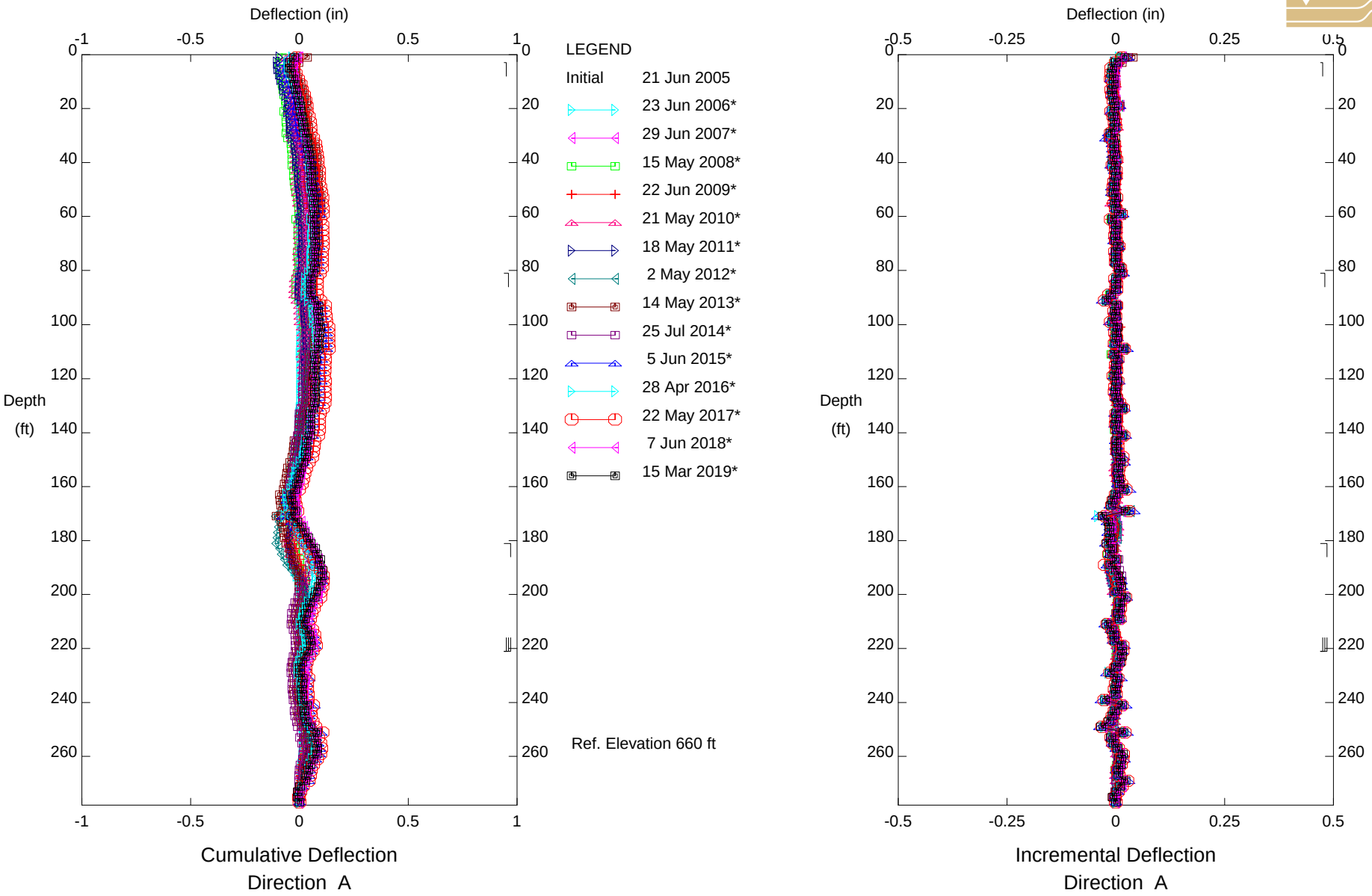
BIG ROCK MESA, Inclinometer SP-20

WESTERN REGION

PLATE D24-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-21

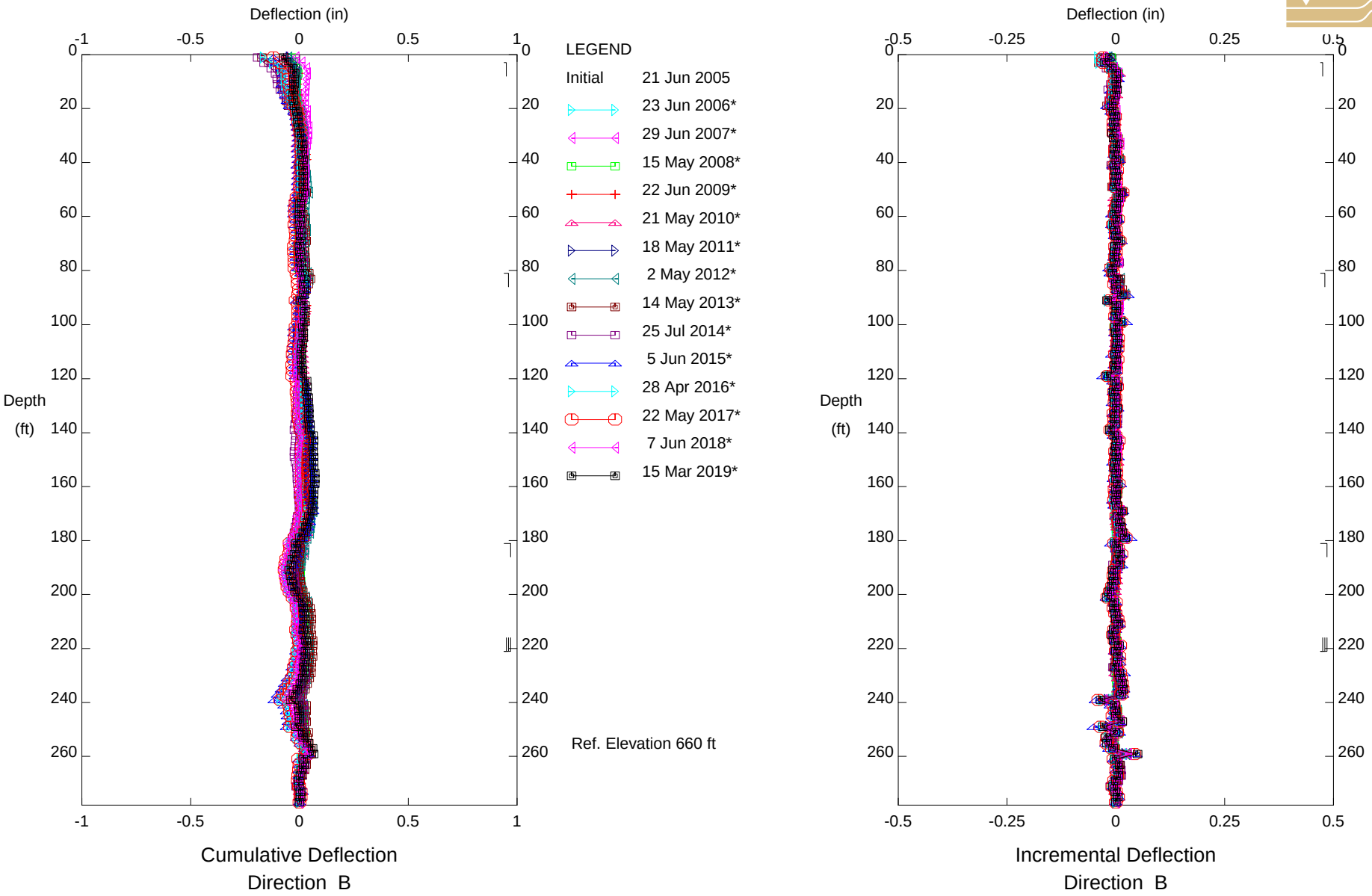
WESTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D25-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-21

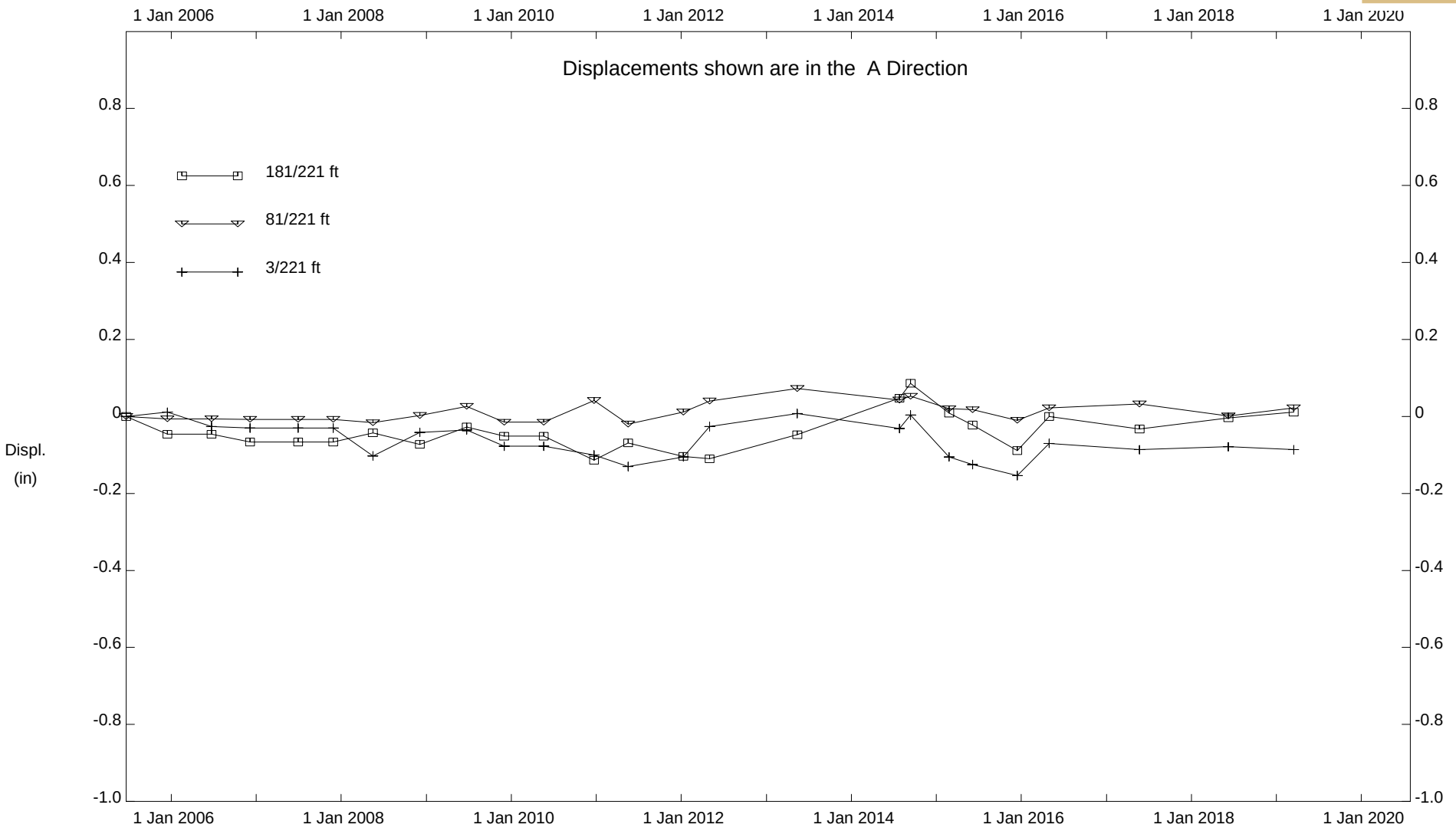
WESTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D25-2

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

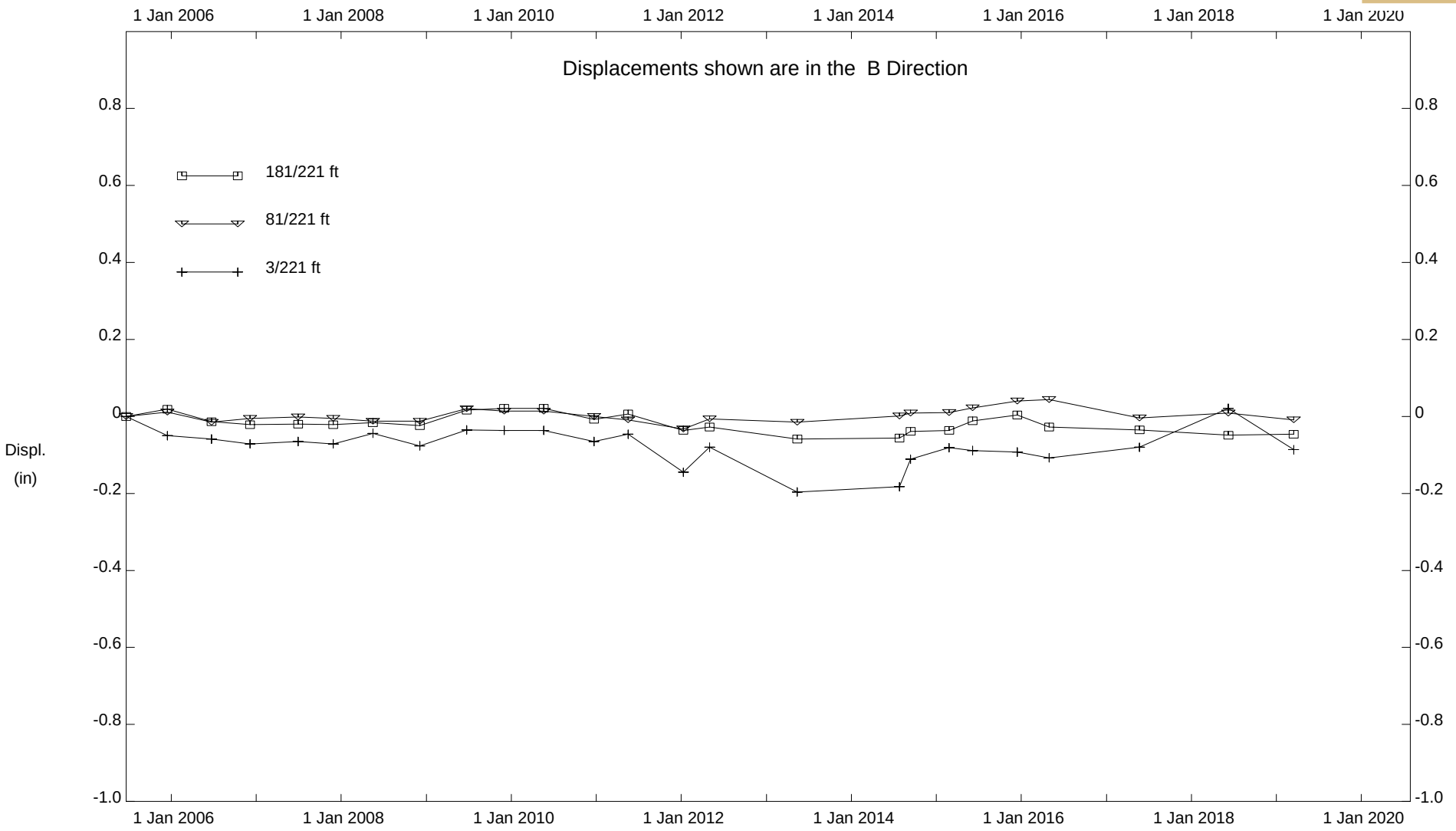
Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-21

WESTERN REGION

PLATE D25-3



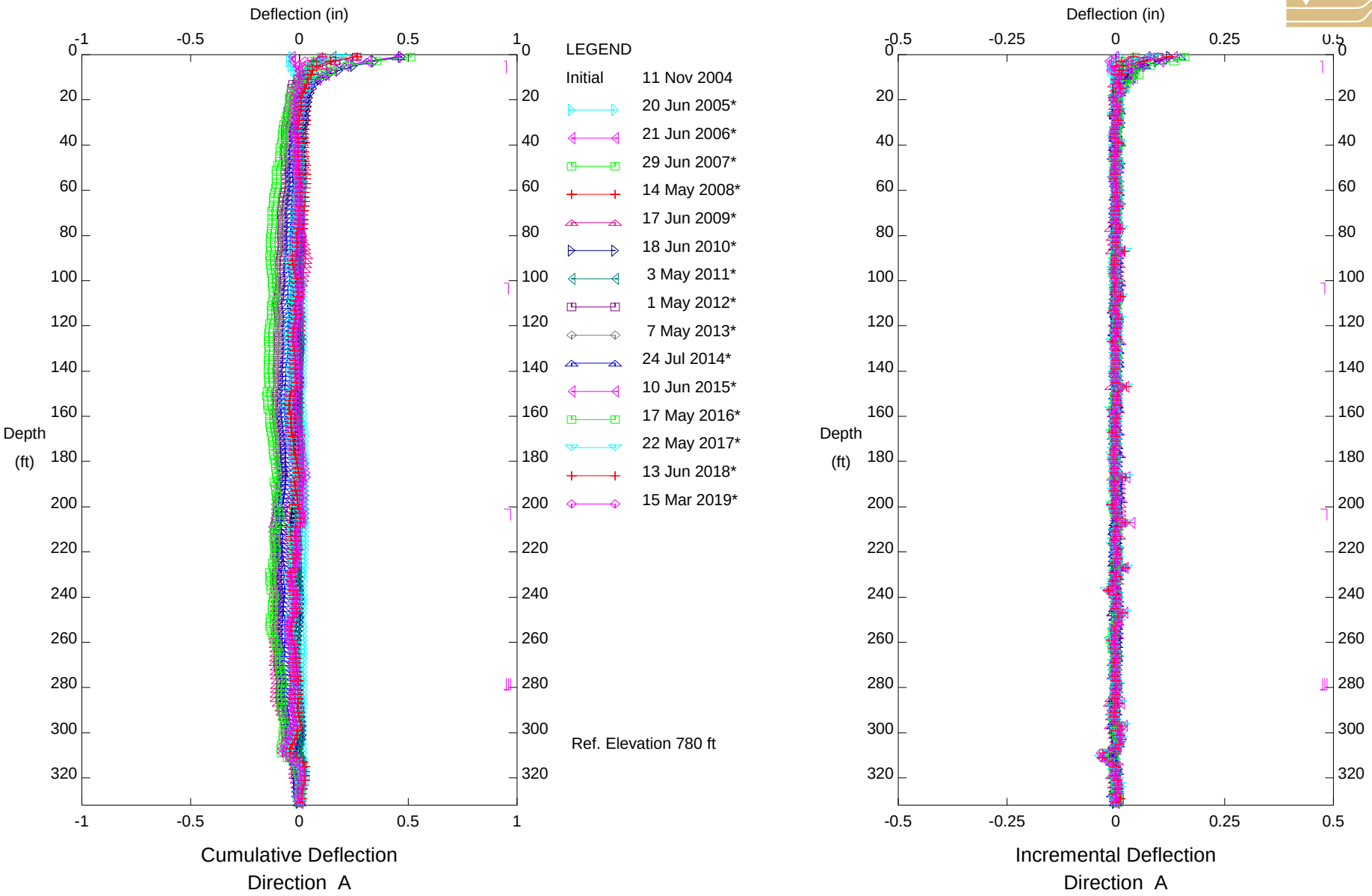
BIG ROCK MESA, Inclinometer SP-21

WESTERN REGION

PLATE D25-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-22

WESTERN REGION

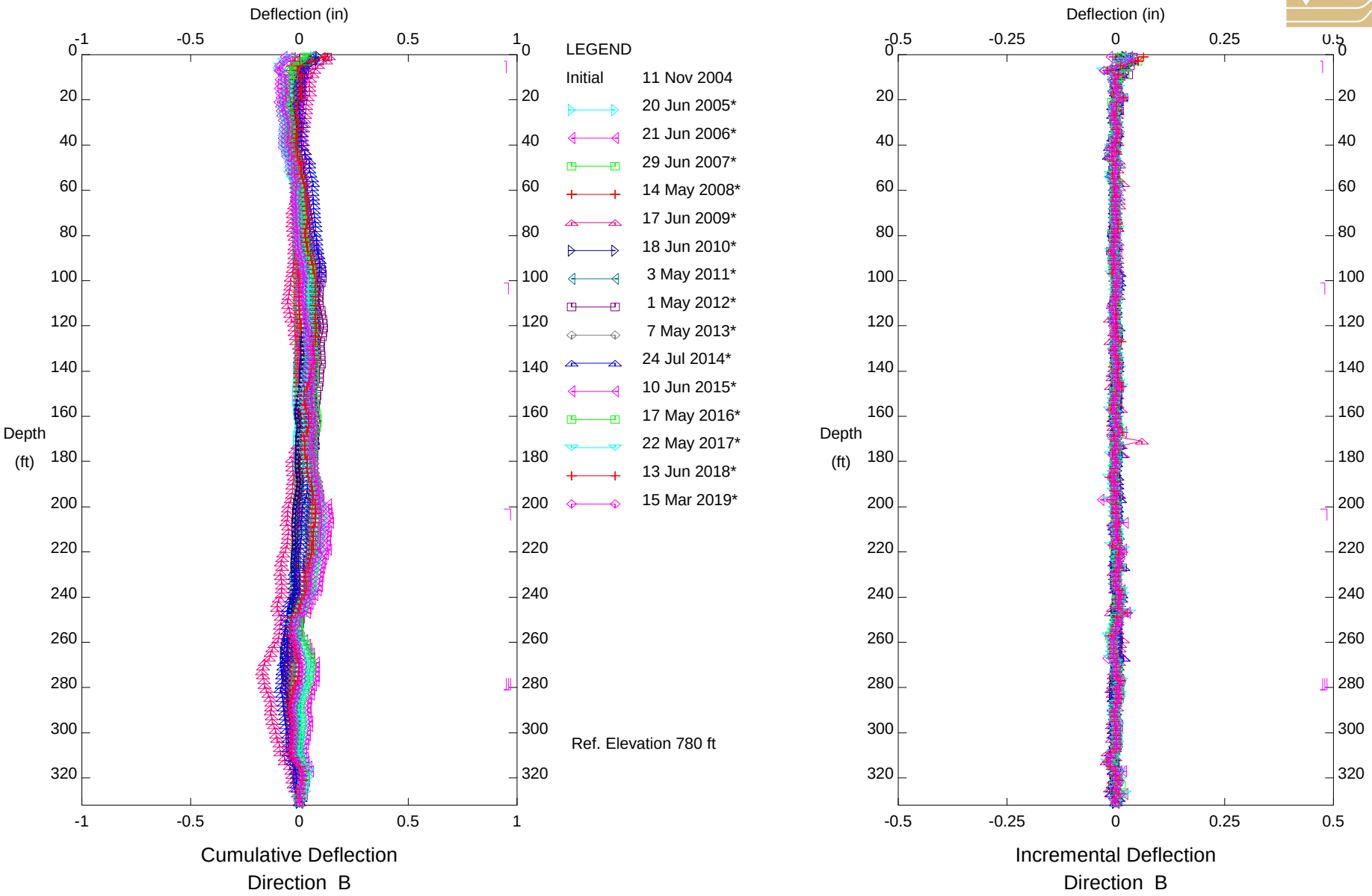
Sets marked * include zero shift and/or rotation corrections.

PLATE D26-1

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP22.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

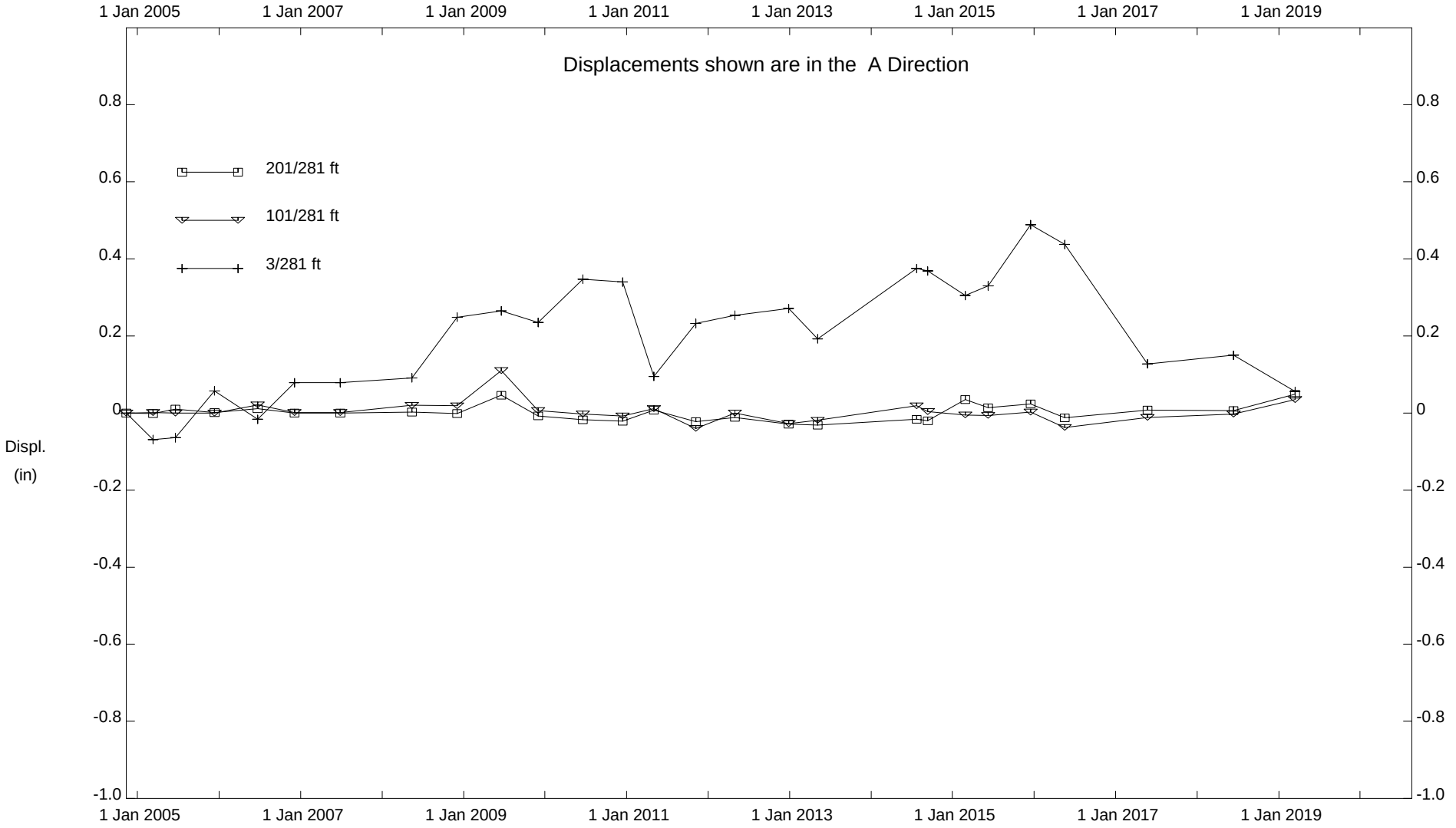


BIG ROCK MESA, Inclinometer SP-22

WESTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D26-2



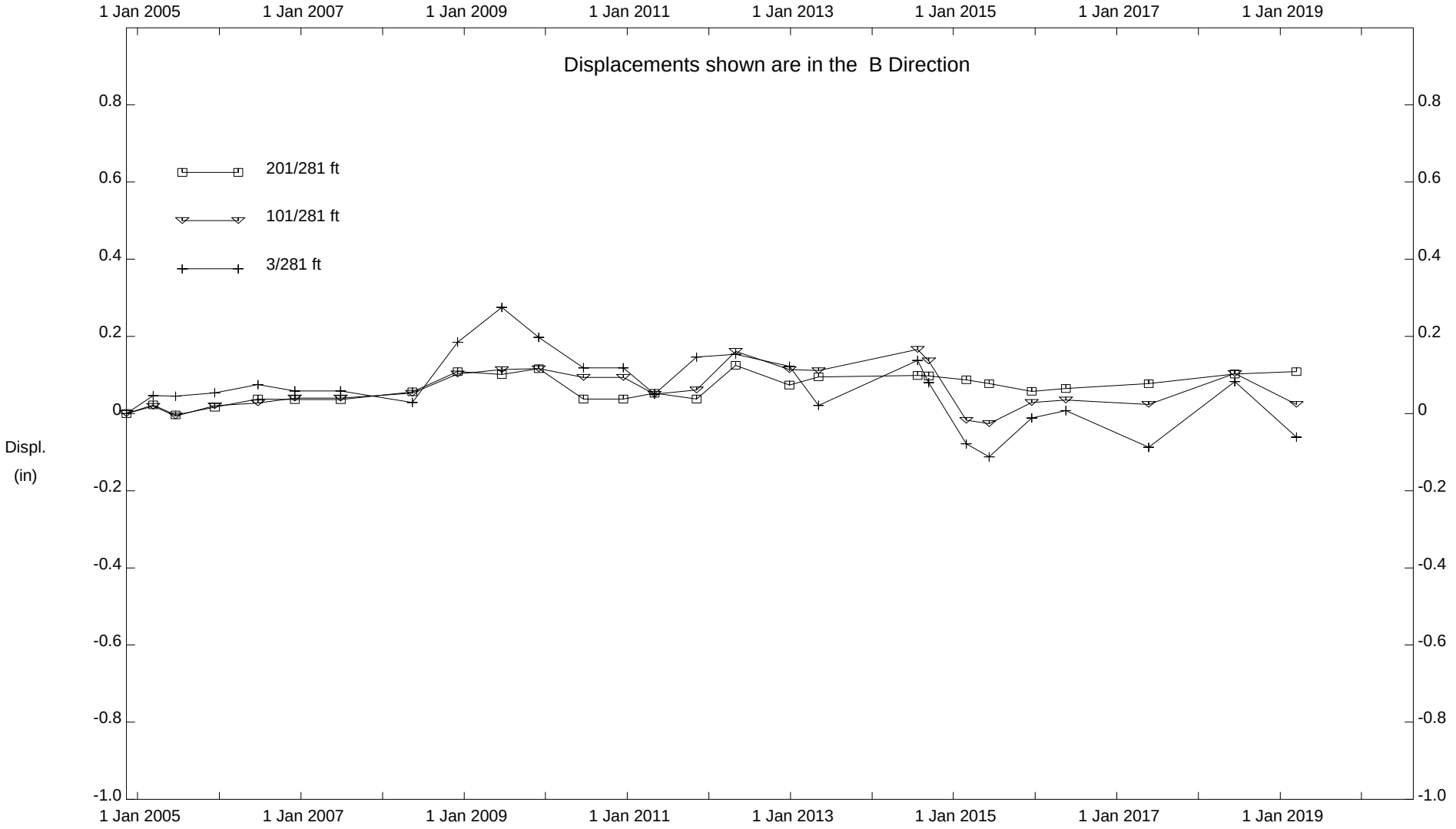
BIG ROCK MESA, Inclinometer SP-22

WESTERN REGION

PLATE D26-3

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



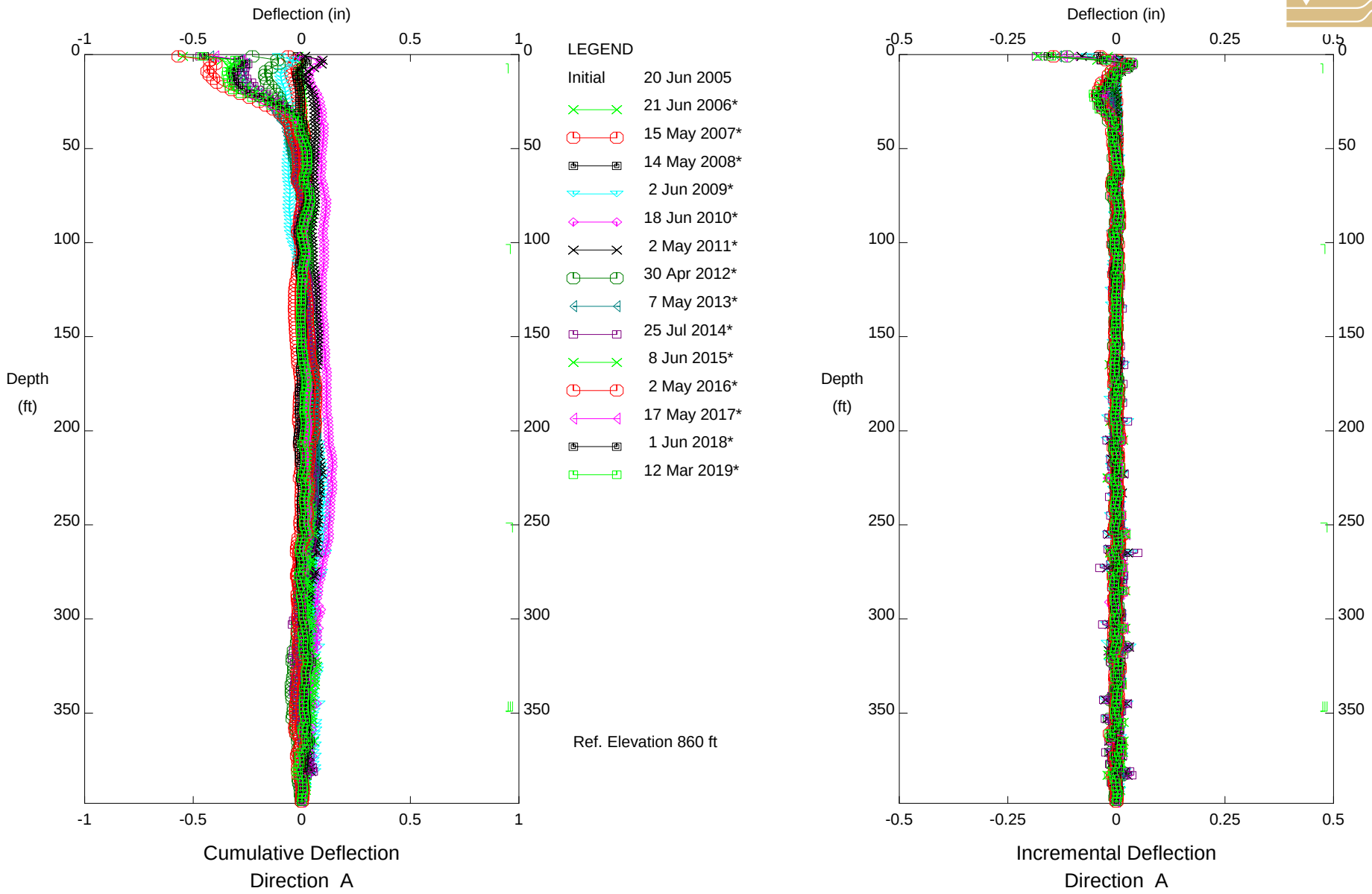
BIG ROCK MESA, Inclinometer SP-22

WESTERN REGION

PLATE D26-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-23

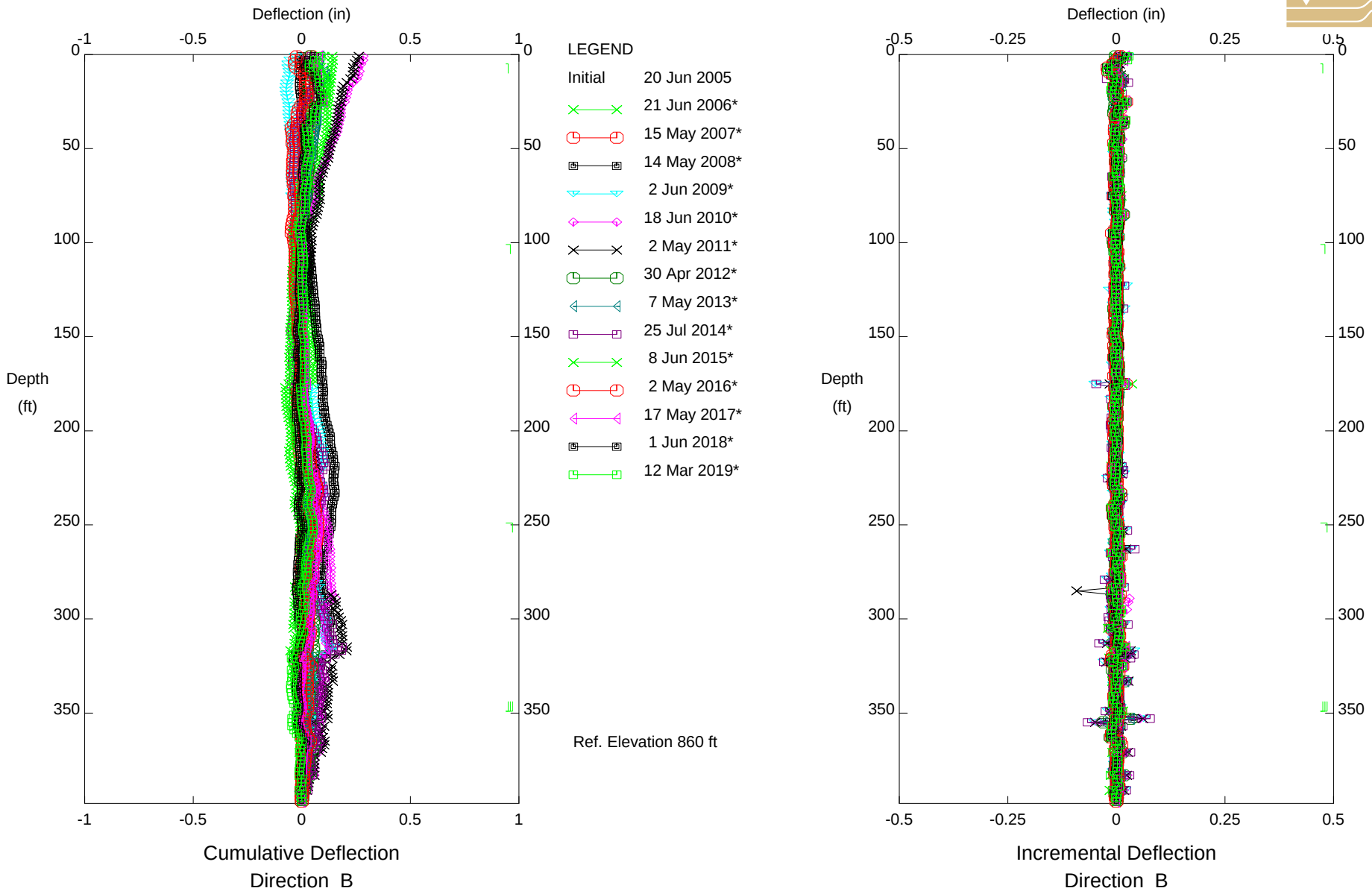
WESTERN REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D27-1

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA

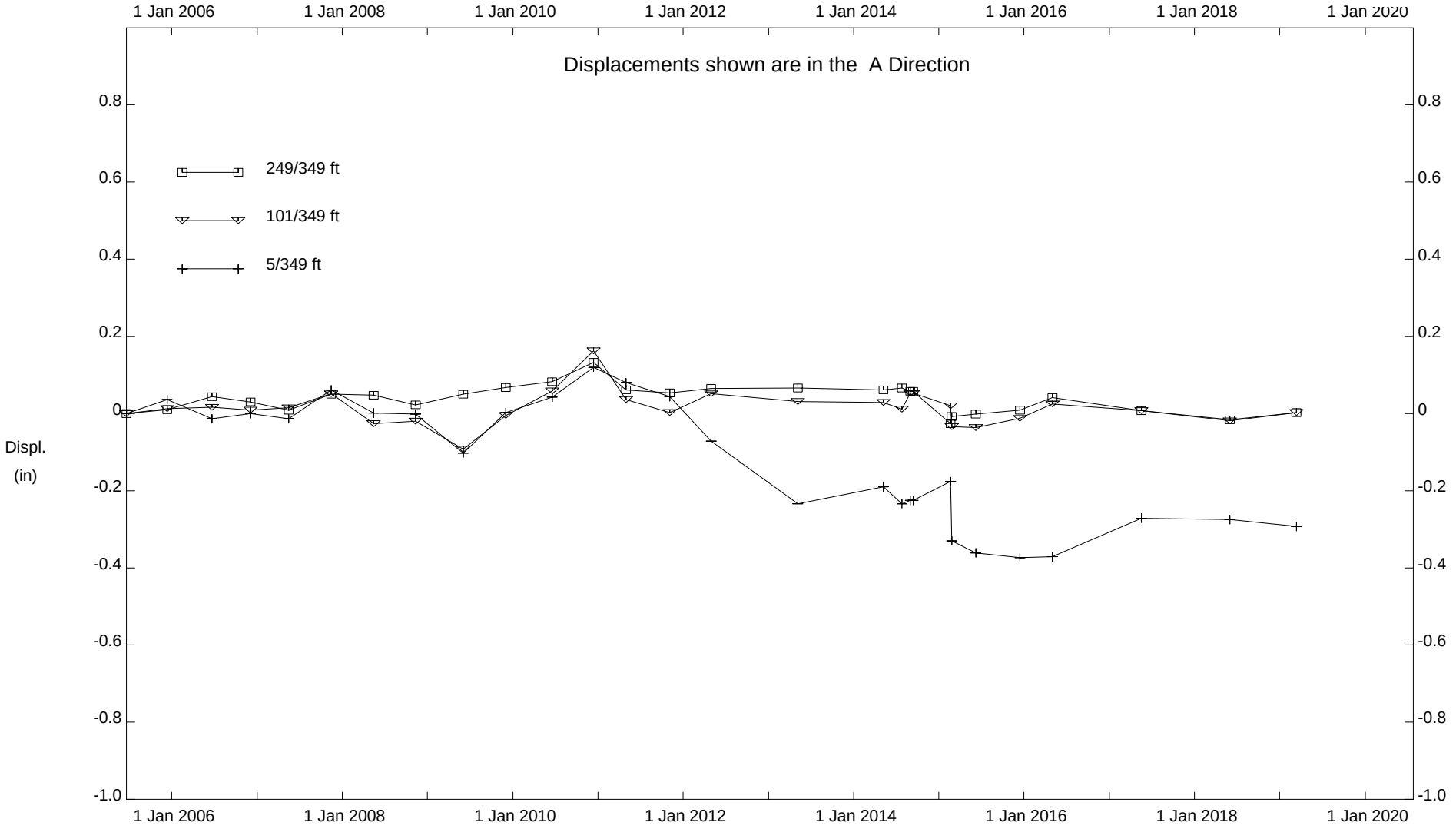


BIG ROCK MESA, Inclinometer SP-23

WESTERN REGION

Sets marked * include zero shift and/or rotation corrections.

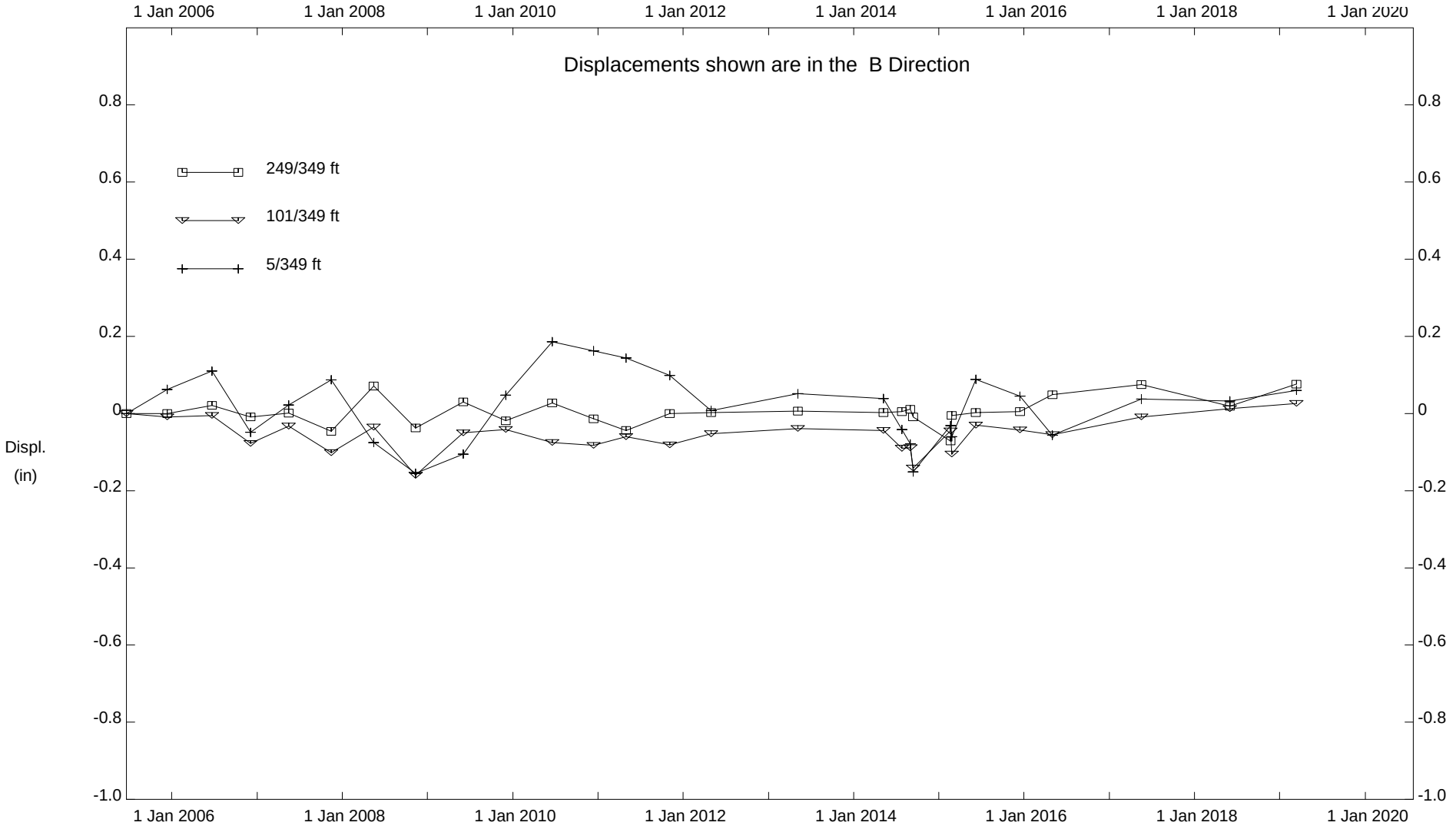
PLATE D27-2



BIG ROCK MESA, Inclinometer SP-23

WESTERN REGION

PLATE D27-3



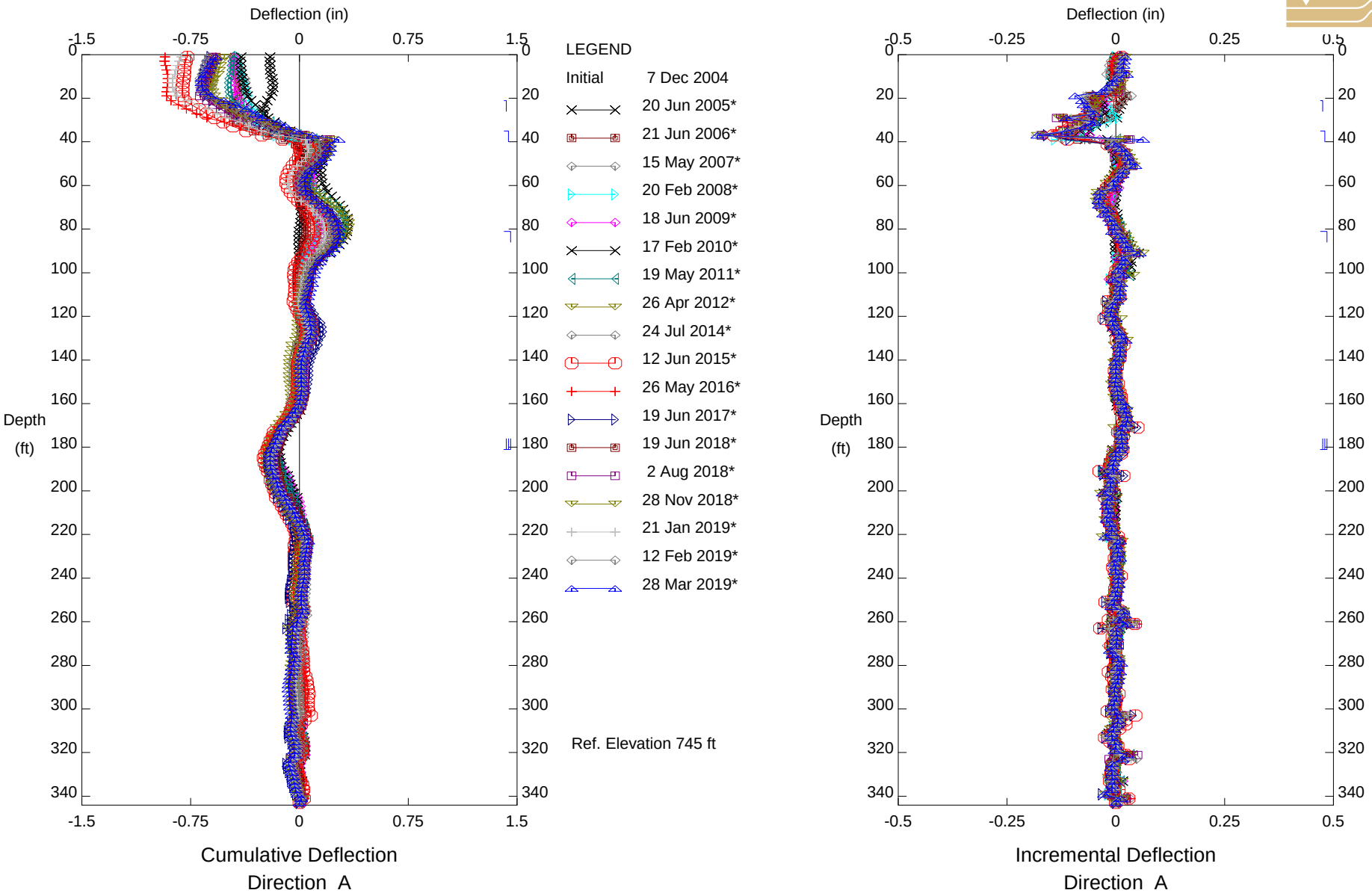
BIG ROCK MESA, Inclinometer SP-23

WESTERN REGION

PLATE D27-4

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-26

HEADSCARP REGION

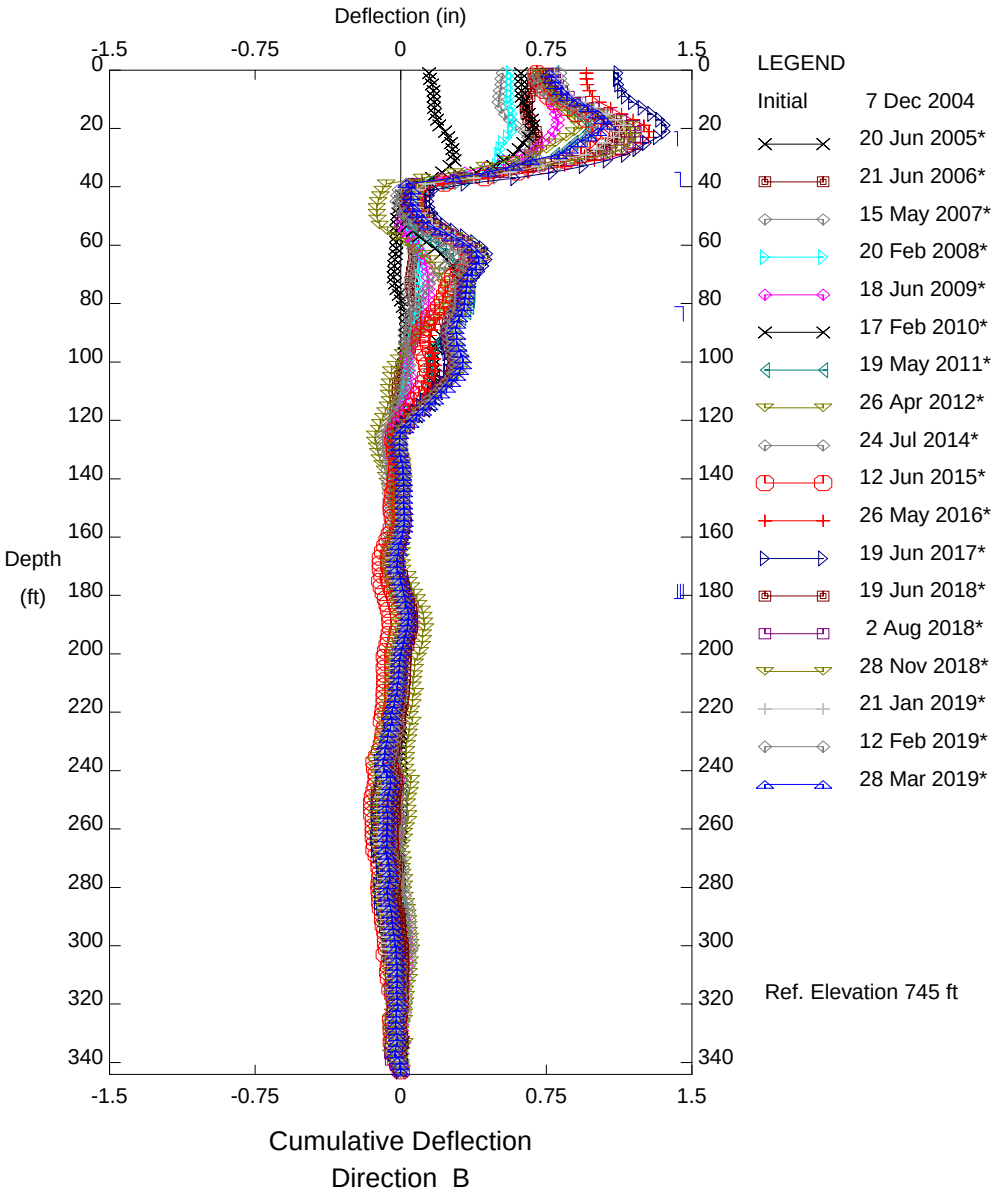
Sets marked * include zero shift and/or rotation corrections.

PLATE D28-1

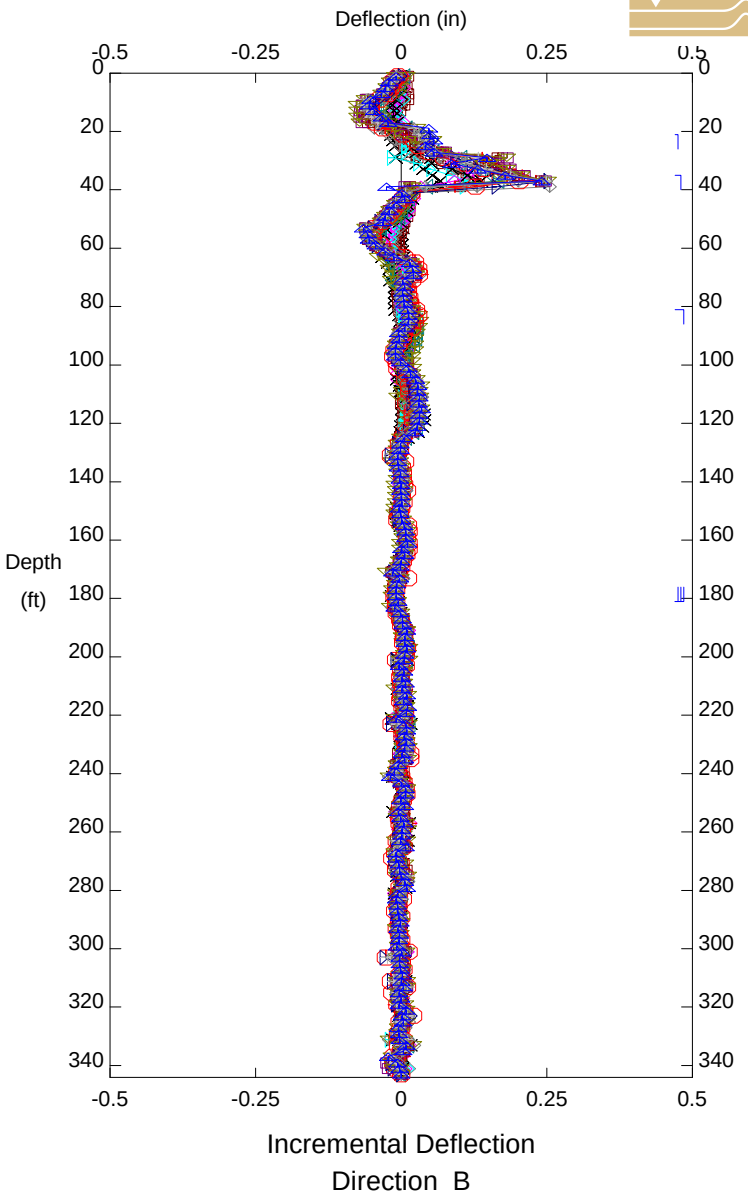
O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP26.gtl

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Cumulative Deflection
Direction B



Incremental Deflection
Direction B

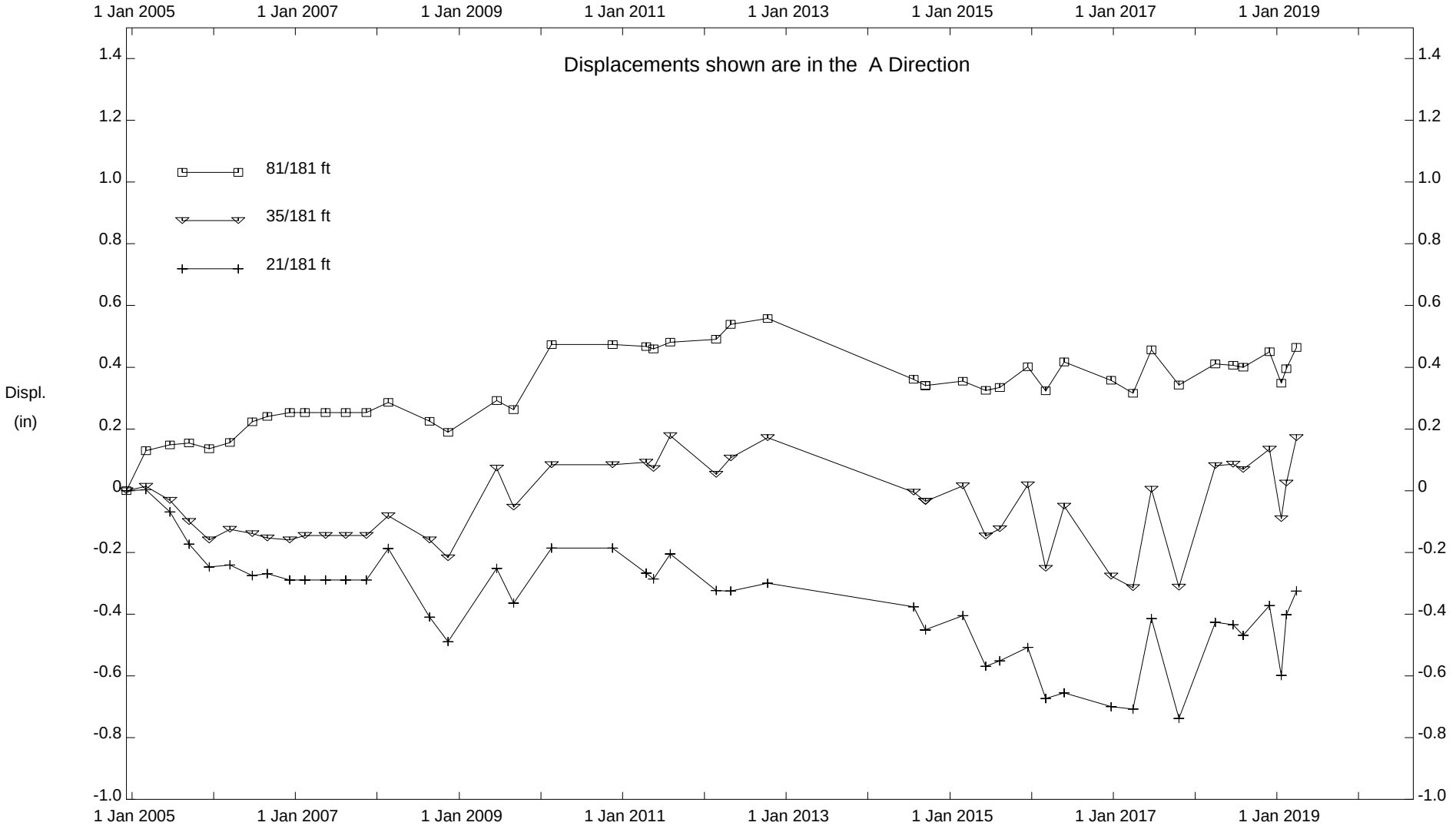
BIG ROCK MESA, Inclinometer SP-26

HEADSCARP REGION

Sets marked * include zero shift and/or rotation corrections.

PLATE D28-2

O:\Management\04_2016\04_6216_0606_Big Rock Mesa AD\01_FIELD DATA\Inclinometer\GTL\2018-2019 adjusted\SP26.gtl



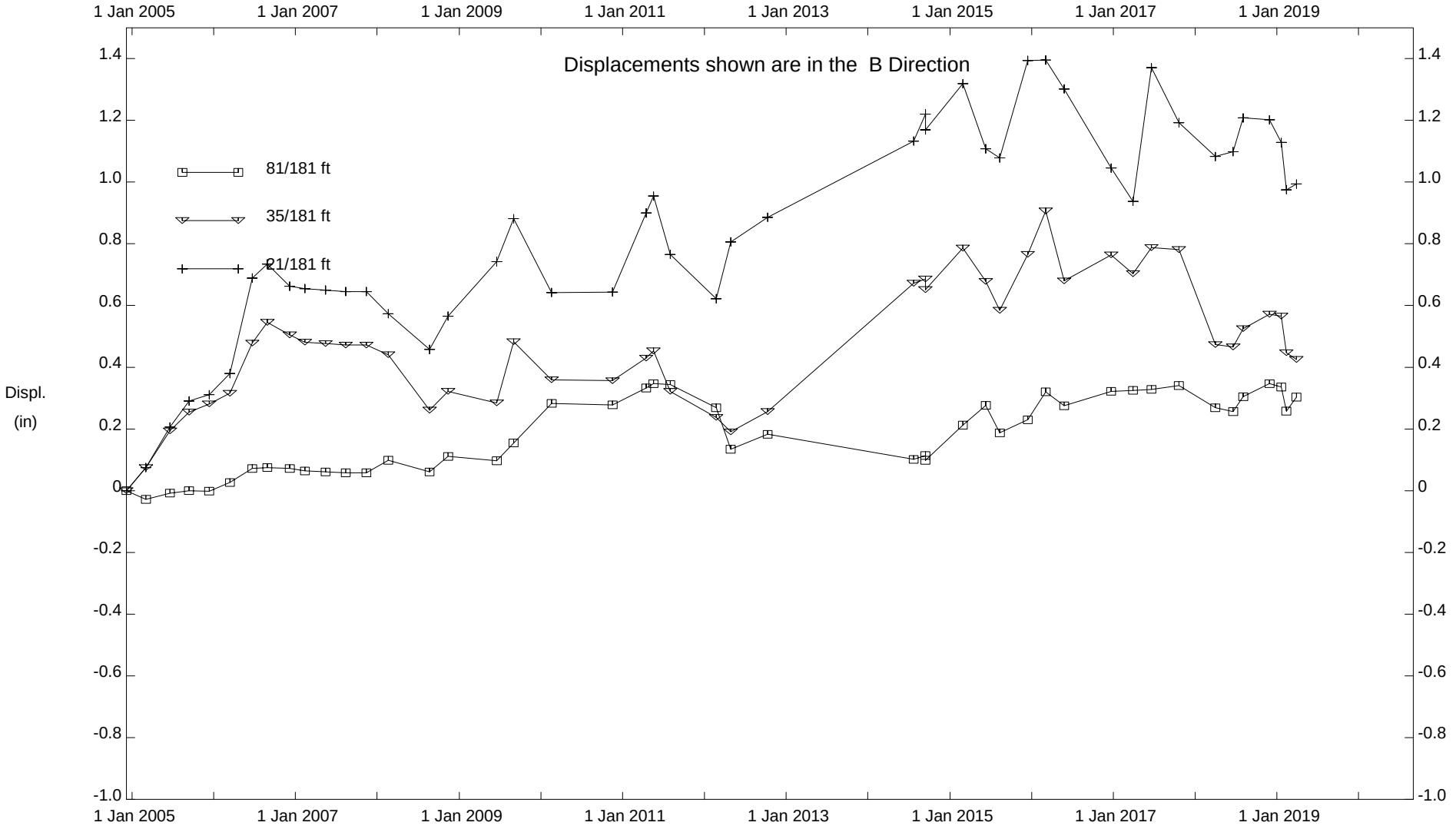
BIG ROCK MESA, Inclinometer SP-26

HEADSCARP REGION

PLATE D28-3

BIG ROCK MESA LANDSLIDE ASSESSMENT DISTRICT
FY 2018-2019 ANNUAL REPORT
CITY OF MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



BIG ROCK MESA, Inclinometer SP-26

HEADSCARP REGION

PLATE D28-4

APPENDIX E
WATER QUALITY TESTING

INORGANIC NON-METALS (Aqueous Matrix)

Date Sampled	Sample Point	pH (Field Measured)	Temperature	Biochemical Oxygen Demand	Surfactants (MBAS)	Oil & Grease	Settleable Solids	Sulfides	Phenols	Residual Chlorine (Field Measured)	Total Suspended Solids	Turbidity	TPH Diesel	TPH Motor Oil	Bis(2-Ethylhexyl) Phthalate	Zinc	Total Coliform	Fecal Coliform	Fecal/Total Coliform >0.1?	Enterococcus	Acute Toxicity**
Units:			*°F*	*mg/L*	*mg/L*	*mg/L*	*mL/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*NTU*	µg/L	µg/L	µg/L	µg/L	MPN/100ml	MPN/100ml		MPN/100ml	% Survival
Discharges to M-001 (Outfall/Port #1a)																					
7/2/2018	M-001	8.45	68.2	ND	ND A07	ND	ND	ND	ND	0.00	1.7	0.48	ND	ND	ND	26 J	**>160000**	**>160000**	N/A	**>2420**	--
7/12/2018	M-001	8.55	74.5	--	--	--	--	--	--	--	--	--	--	--	--	12 J	--	--	--	--	--
Jul Avg	M-001	8.50	71.3	ND	ND	ND	ND	ND	ND	0.00	1.70	0.48	ND	ND	ND	19	**>160000**	**>160000**	N/A	**>2420**	--
Discharges to M-002 (Outfall/Port #1)																					
7/2/2018	M-002	8.23	69.1	ND	0.021 J	ND	ND	ND	ND	0.00	ND	0.16	ND	ND	0.29 J	ND	**1700**	<1.8	No	28.5	--
Discharges to M-004 (Outfall/Port #3)																					
7/2/2018	M-004	8.06	70.9	ND	0.018 J	ND	ND	ND	ND	0.00	ND	0.17	ND	ND	0.31 J	ND	**2300**	**2300**	Yes	**172**	--
8/6/2018	M-004	8.13	74.7	ND	0.020 J	ND	ND	ND	ND	0.00	ND	0.16	ND	ND	0.28 J	ND	**1300**	**230**	Yes	**387.3**	--
8/6/2018	HD-30	7.38	72.3	ND	ND	ND	ND	ND	ND	0.08	1.1	0.79	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
8/6/2018	W-1	7.26	76.3	2.2	0.017 J	ND	ND	ND	ND	0.00	1.7	2.5	ND	ND	ND	45 J	13	<1.8	No	<1	--
Aug Avg	Fac. Avg	7.34	73.6	1.2	0.01	ND	ND	ND	ND	0.05	1.3	1.4	ND	ND	ND	18	<6.0	<1.8	N/A	<1	--
9/12/2018	HD-30	7.29	71.4	ND	ND	ND	ND	ND	ND	0.00	ND	0.13	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
9/12/2018	W-1	7.08	75.0	3.2	ND	ND	ND	ND	ND	0.05	0.78	0.56	ND	ND	ND	29 J	<1.8	<1.8	N/A	<1	--
9/12/2018	W-2	7.42	75.4	1.8	ND	ND	ND	ND	ND	0.00	1.8	0.80	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
9/12/2018	BYA-13	7.34	74.1	ND	ND	ND	ND	ND	ND	0.00	0.89	0.11	ND	ND	ND	190	49	<1.8	No	4.1	--
9/20/2018	BYA-13	7.16	73.9	--	--	--	--	--	--	--	--	--	--	--	--	210	--	--	--	--	--
9/27/2018	BYA-13	7.03	70.9	--	--	--	--	--	--	--	--	--	--	--	--	180	--	--	--	--	--
Sep Avg	BYA-13	7.18	73.0	ND	ND	ND	ND	ND	ND	0.00	0.89	0.11	ND	ND	ND	193	49	<1.8	No	4.1	--
Sep Avg	Fac Avg	7.28	73.6	1.49	ND	ND	ND	ND	ND	0.01	0.96	0.41	ND	ND	ND	44	<11	<1.8	N/A	<1.6	--
Discharges to M-005 (Outfall/Port #4)																					
7/2/2018	M-005	8.24	71.4	2.4	0.22	ND	ND	ND	ND	0.00	0.78	0.72	**110 A52**	**230 A57**	ND	12 J	**160000**	**3500**	No	**>2420**	--
7/12/2018	M-005	8.19	75.4	--	--	--	--	--	--	--	--	--	ND	ND	--	--	--	--	--	--	--
Jul Avg	M-005	8.22	73.4	2.4	0.22	ND	ND	ND	ND	0.00	0.78	0.72	59	**143**	ND	12	**160000**	**3500**	N0	**>2420**	--
8/6/2018	M-005	8.25	72.7	**44**	0.15 A07	**14**	ND	ND	ND	**0.87**	9.6	14	**1600 A01, A52**	**1800 A01, A57**	**8.5**	**82**	**35000**	**17000**	Yes	**275.5**	--
8/6/2018	HD-26	7.41	75.6	ND	0.040 J,A07	ND	ND	ND	ND	0.04	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
8/6/2018	W-8	7.01	75.0	ND	0.054 J	ND	ND	ND	ND	0.00	ND	0.31	ND	ND	ND	21 J	49	<1.8	No	<1	--
8/6/2018	W-17	7.47	76.5	ND	ND	ND	ND	ND	ND	0.00	ND	0.12	ND	ND	ND	ND	<1.8	<1.8	N/A	5.2	--
Aug Avg	Fac Avg	7.22	75.5	ND	0.04	ND	ND	ND	ND	0.01	ND	0.21	ND	ND	ND	13	<29	<1.8	N/A	<2.0	--
9/12/2018	HD-26	7.36	72.1	2.1	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
9/12/2018	W-8	6.92	73.2	2.4	ND	ND	ND	ND	ND	0.02	ND	ND	ND	ND	ND	20 J	<1.8	<1.8	N/A	<1	--
9/12/2018	W-17	7.45	74.8	ND	ND	ND	ND	ND	0.027 J	0.00	0.56	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	2.0	--
Sep Avg	Fac Avg	7.15	73.5	1.8	ND	ND	ND	ND	0.01	0.01	0.37	ND	ND	ND	ND	13	<1.8	<1.8	N/A	**<1.2**	--
Discharges to M-006 (Outfall/Port #5)																					
7/2/2018	M-006	8.36	72.7	ND	0.024 J	ND	ND	ND	ND	0.00	0.91	0.60	ND	ND	ND	ND	**54000**	**54000**	Yes	**>2420**	--
Discharges to M-007 (Outfall/Port #5a)																					
7/2/2018	M-007	8.15	71.8	5.4	0.047 J	ND	ND	ND	ND	0.00	0.56	0.64	**110 A52**	**200 A57**	ND	ND	**4900**	**700**	Yes	**122.3**	--
Duplicate	M-007	8.15	71.8	4.1	0.050 J	ND	ND	ND	0.086	0.00	ND	0.62	82 A52	**210 A57**	ND	ND	**13000**	**2800**	Yes	**124.6**	--
7/12/2018	M-007	8.08	75.4	--	--	--	--	--	--	--	--	--	ND	ND	--	--	--	--	--	--	--
Jul Avg.	M-007	8.12	73.6	4.8	0.05	ND	ND	ND	0.05	0.00	0.42	0.63	67	**155**	ND	ND	**8950**	**1750**	Yes	**123**	--
Discharges to M-008 (Outfall/Port #6)																					
7/2/2018	M-008	8.41	73.2	ND	0.021 J	ND	ND	ND	ND	0.00	ND	0.18	ND	ND	ND	ND	130	23	Yes	20.1	--
8/6/2018	M-008	8.02	71.2	ND	ND	ND	ND	ND	ND	0.00	ND	0.21	ND	ND	ND	ND	**24000**	230	No	**>2420**	--
Duplicate	M-008	8.02	71.2	ND	0.053 J, A07	ND	ND	ND	ND	0.00	ND	0.12	ND	**210 A57**	ND	ND	**2300**	79	No	**>2420**	--
Aug Avg	M-008	8.02	71.2	ND	0.03	ND	ND	ND	ND	0.00	ND	0.17	ND	**133.00**	ND	ND	**13150**	155	No	**>2420**	--
8/6/2018	HD-12	7.40	73.8	3.5	ND	ND	ND	ND	ND	0.00	30	4.0	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
8/6/2018	W-18	7.26	75.7	2.2	0.030 J	ND	ND	ND	ND	0.00	3.0	6.5	ND	ND	0.28 J	66	2	<1.8	N/A	<1	--
8/17/2018	W-18a	6.82	73.0	--	--	--	--	--	--	--	--	--	--	--	--	47 J	--	--	--	--	--
8/17/2018	W-18b	6.89	73.9	--	--	--	--	--	--	--	--	--	--	--	--	35 J	--	--	--	--	--
8/23/2018	W-18a	6.82	74.5	--	--	--	--	--	--	--	--	--	--	--	--	51	--	--	--	--	--
8/23/2018	W-18b	6.94	74.3	--	--	--	--	--	--	--	--	--	--	--	--	67	--	--	--	--	--
8/28/2018	W-18b	6.89	78.4	--	--	--	--	--	--	--	--	--	--	--	--	49 J	--	--	--	--	--
Aug Avg	W-18	6.946	74.3	2.2	0.03	ND	ND	ND	ND	0.00	3.0	6.5	ND	ND	0.28	53	2	<1.8	N/A	<1	--
Aug Avg	Fac Avg	7.04	74.2	2.5	0.03	ND	ND	ND	ND	0.00	8.8	6.0	ND	ND	0.24	42	<1.9	<1.8	N/A	<1	--
9/12/2018	HD-12	7.42	73.8	2.7	0.019 J	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	**ND**	<1.8	<1.8	N/A	<1	--
9/12/2018	W-18	7.31	79.2	2.0	0.019 J	ND	ND	ND	ND	0.00	4.3	7.8	ND	ND	ND	**48 J**	<1.8	<1.8	N/A	<1	--
Duplicate	W-18	7.31	79.2	2.1	ND	ND	ND	ND	ND	0.00	1.0	1.6	ND	ND	ND	**66**	<1.8	<1.8	N/A	<1	--
9/12/2018	BYA-3	7.56	79.0	2.2	ND A07	ND	ND	ND	ND	0.00	ND	0.10	ND	ND	ND	**180**	<1.8	<1.8	N/A	<1	--
9/20/2018	W-18	7.13	78.1	--	--	--	--	--	--	--	--	--	--	--	--	**49 J**	--	--	--	--	--
9/20/2018	BYA-3	7.37	75.7	--	--	--	--	--	--	--	--	--	--	--	--	**180**	--	--	--	--	--
9/27/2018	W-18	6.99	73.0	--	--	--	--	--	--	--	--	--	--	--	--	**46 J**	--	--	--	--	--
9/27/2018	BYA-3	7.57	72.5	--	--	--	--	--	--	--	--	--	--	--	--	**170**	--	--	--	--	--
Sep Avg	W-18	7.14	76.8	2.1	0.013	ND	ND	ND	ND	0.00	2.7	4.7	ND	ND	ND	**52**	<1.8	<1.8	N/A	<1	--
Sep Avg	BYA-3	7.50	75.7	2.2	ND	ND	ND	ND	ND	0.00	ND	0.10	ND	ND	ND	**177**	<1.8	<1.8	N/A	<1	--
Sep Avg	Fac Avg	7.25	76.0	1.8	0.01	ND	ND	ND	ND	0.00	1.8	3.1	ND	ND	ND	**63**	<1.8	<1.8	N/A	<1	--
Discharges to M-010 (Outfall/Port #9)																					
7/2/2018	M-010	8.35	72.5	5.0	ND	ND	ND	ND	0.042 J	0.00	ND	0.18	ND	ND	ND	ND	46	<1.8	No	1	--
Standpipes																					
9/12/2018	SP-21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	ND	--	--	--	--	--
9/27/2018	SP-3A	7.84	71.6	--	--	--	--	--	--	--	--	--	--	--	--	ND	--	--	--	--	--
9/27/2018	SP-9A	6.88	70.5	--	--	--	--	--	--	--	--	--	--	--	--	17 J	--	--	--	--	--
Effluent Limit (Daily Max.)			---	30	0.5	15	0.3	1.0	1.0	0.1	75	150	100	100	11	95	10000	400		104	90
Effluent Limit (Daily Max. if Fecal/Total Coliform > 0.1))																				1000	
Effluent Limit (Monthly Avg.)			---	20	---	10	0.1	---	---	---	50	50	---	---	5.9	47	1000	200		35	--

-- = Not tested for
--- = No established limit.
** = Acute Toxicity samples were collected in Q1.
ND = none detected above laboratory
NR = No reading taken
J = Laboratory estimated value, below PQL and above the MDL.
A = Laboratory PQLs were raised due to sample dilution caused by high analyte concentration or matrix interference.
B = Indicates laboratory measurement.
A01= Detection and quantitation limits were raised due to sample dilution
A52 = Chromatogram not typical of diesel
A57= Chromatogram not typical of motor oil
A07= Detection and quantitation limits were raised due to sample dilution caused by high analyte concentration or matrix interference.
D = Chromatogram not typical of motor oil
1 = Chlorine test repeated after flow appeared to increase
2= Area of coalesence that discharges through M-007

0.12 Exceedance of effluent limit.
Waiting for data
Exceedance Sampling Needed

INORGANIC NON-METALS (Aqueous Matrix)

Date Sampled	Sample Point	pH (Field Measured)	Temperature	Biochemical Oxygen Demand	Surfactants (MBAS)	Oil & Grease	Settleable Solids	Sulfides	Phenols	Residual Chlorine (Field Measured)	Total Suspended Solids	Turbidity	TPH Diesel	TPH Motor Oil	Bis(2-Ethylhexyl) Phthalate	Zinc	Total Coliform	Fecal Coliform	Fecal/Total Coliform >0.1?	Enterococcus	Acute Toxicity***
Units:			*°F*	*mg/L*	*mg/L*	*mg/L*	*mL/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*NTU*	*µg/L*	*µg/L*	*µg/L*	*µg/L*	MPN/100ml	MPN/100ml		MPN/100ml	*% Survival*
Discharges to M-001 (Outfall/Port #1a)																					
10/15/2018	FW-1	7.78	70.5	**25**	ND	ND	ND	**31 A07**	ND	0.00	6.8	4.1	ND	ND	ND A01	17	4.0	<1.8	N/A	<1	--
10/15/2018	BYA-14	7.49	76.5	ND	ND	ND	ND	ND	ND	0.04	ND	0.46	ND	ND	ND	**450**	<1.8	<1.8	N/A	<1	--
Duplicate	BYA-14	--	--	ND	ND	ND	ND	ND	ND	--	1.8	1.6	--	--	ND	**500**	11	<1.8	N/A	<1	100
11/26/2018	BYA-14	7.73	74.3	1.7	0.032 J	ND	ND	ND	ND	0.00	ND	0.37	ND	ND	ND	**1300**	<1.8	--	--	<1	--
11/26/2018	FW-1	8.18	71.4	--	--	--	--	**35 A07**	--	0.00	--	--	--	--	--	--	--	--	--	--	--
12/18/2018	BYA-14	7.87	71.6	2.7	ND	ND	ND	ND	ND	0.00	ND	0.49	ND	ND	ND	**680**	17	<1.8	N/A	<1	--
Duplicate	BYA-14	--	--	ND	ND	ND	ND	ND	ND	--	ND	0.34	ND	ND	ND	**690**	39	<1.8	No	<1	--
Discharges to M-002 (Outfall/Port #1)																					
10/15/2018	BYA-5	7.97	72.9	7.7	ND	ND	**0.80**	0.56	ND	0.00	37	**190 A07**	ND	ND	ND	**4600**	<1.8	<1.8	N/A	<1	--
10/15/2018	BYA-6	6.88	74.3	ND	ND	ND	ND	ND	ND	0.00	ND	0.46	ND	ND	ND	**200**	<1.8	<1.8	N/A	<1	--
11/26/2018	BYA-5	8.18	73.2	2.6	ND	ND	ND	ND A07	0.029 J	0.00	ND	1.00	ND	ND	0.20 J	**270**	<1.8	--	--	<1	100
12/18/2018	BYA-5,BYA-6	8.17	72.9	1.8	0.025 J	ND	ND	ND	ND	0.00	ND	0.48	ND	ND	ND	**230**	4.0	<1.8	Yes	<1	--
Discharges to M-003 (Outfall/Port #2)																					
12/18/2018	HD-41	7.67	75.6	ND	0.031 J	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	14 J	2.0	<1.8	N/A	<1	--
Discharges to M-004 (Outfall/Port #3)																					
10/15/2018	BYA-13	6.94	72.3	ND	ND A07	ND	**0.30**	ND	ND	0.00	**110**	**150 A07**	ND	ND	ND	**68000**	<1.8	<1.8	N/A	<1	--
10/15/2018	BYA-13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**79000**	--	--	--	--	--
11/26/2018	BYA-13	--	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	**260**					
11/26/2018	W-3	7.38	73.6	ND	0.043 J	ND	ND	ND	ND	0.00	ND	0.34	ND	ND	ND	ND	<1.8	--	--	<1	100
12/18/2018	HD-30, HD-43	7.33	71.2	ND	ND	ND	ND	ND	ND	0.00	ND	0.10	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Discharges to M-005 (Outfall/Port #4)																					
11/26/2018	BYA-7	7.96	76.1	ND	ND	ND	ND	ND	ND	0.05	20	1.4	ND	ND	ND	**290**	<1.8	--	--	<1	100
11/26/2018	FW-2	7.87	76.5	2.2	ND	ND	ND	ND	ND	0.00	2.9	3.5	ND	ND	ND	**90**	<1.8	--	--	<1	100
Duplicate	FW-2	7.87	76.5	2.0	ND	ND	ND	ND	ND	0.00	3.4	2.6	ND	ND	ND	**65**	<1.8	--	--	<1	100
12/18/2018	HD-26	7.14	70.7	ND	ND	ND	ND	ND	0.034 J	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Discharges to M-006 (Outfall/Port #5)																					
10/17/2018	W-16	6.77	71.4	2.0	ND	ND	ND	ND	ND	0.00	1.7	0.19	ND	ND	ND	9.7 J	4.0	<1.8	N/A	<1	--
10/17/2018	BYA-4	6.99	75.9	1.5	ND	ND	ND	ND	ND	0.00	ND	0.32	ND	ND	ND	**1300**	<1.8	<1.8	N/A	<1	--
11/26/2018	BYA-11	7.83	73.4	2.7	ND	ND	ND	ND	ND	0.00	1.4	0.25	ND	ND	ND	**1000**	<1.8	--	--	<1	**55**
11/26/2018	BYA-4	7.48	75.6	1.5	ND	ND	ND	ND	ND	0.00	1.1	3.8	ND	ND	ND	**1400**	<1.8	--	--	<1	**85**
11/26/2018	W-13	7.28	73.9	ND	0.018 J	ND	ND	ND	ND	0.00	ND	0.23	ND	ND	ND	36 J	220	--	--	2	100
12/18/2018	BYA-11	8.18	70.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	**57.5**
12/18/2018	BYA-4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100
12/18/2018	BYA-4, W-13	8.31	71.6	ND	ND	ND	ND	ND	ND A07	0.00	ND	1.4	ND	ND	ND	**1800**	2.0	<1.8	N/A	<1	--
Discharges to M-007 (Outfall/Port #5a)																					
10/17/2018	BYA-10	7.35	75.4	2.1	ND	ND	ND	ND	ND	0.00	ND	1.0	ND	ND	ND	**51**	<1.8	<1.8	N/A	<1	--
12/18/2018	BYA-10	7.26	77.0	2.7	ND	ND	ND	ND	ND	0.00	ND	0.38	ND	ND	ND	**100**	<1.8	<1.8	N/A	<1	--
Discharges to M-008 (Outfall/Port #5)																					
10/17/2018	W-18	7.17	78.3	4.5	ND	ND	ND	ND	ND	0.00	3.7	39	ND	ND	ND	**73**	9	<1.8	N/A	<1	--
10/17/2018	BYA-3	7.58	77.7	1.9	ND	ND	ND	ND	ND	0.00	ND	0.24	ND	ND	ND	**180**	<1.8	<1.8	N/A	<1	--
11/26/2018	BYA-3	7.89	74.7	ND	ND	ND	ND	ND	ND	0.00	ND	0.24	ND	ND	ND	**180**	<1.8	--	--	<1	100
11/26/2018	BYA-2	7.32	75.9	2.0	ND	ND	ND	ND	ND	0.00	1.8	2.6	ND	ND	ND	30 J	<1.8	--	--	<1	100
12/18/2018	W-18, BYA-3, BYA-2	8.44	73.6	2.4	0.031 J,A07	ND	ND	ND	0.026 J	0.00	4.3	3.8	ND	ND	ND	**130**	2.0	<1.8	N/A	<1	--
Discharges to M-009 (Outfall/Port #5)																					
12/18/2018	HD-7	8.00	74.5	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Discharges to M-010 (Outfall/Port #9)																					
12/18/2018	HD-5, HD-6, HD-23	7.45	73.2	ND	ND	ND	ND	ND	ND	0.00	ND	0.17	**140**	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Effluent Limit (Daily Max.)			---	30	0.5	15	0.3	1.0	1.0	0.1	75	150	100	100	11	95	10000	400		104	90
Effluent Limit (Daily Max. if Fecal/Total Coliform > 0.1))																				1000	
Effluent Limit (Monthly Avg.)			---	20	---	10	0.1	---	---	---	50	50	---	---	5.9	47	1000	200		35	--

-- = Not tested for
--- = No established limit.
** = Acute Toxicity samples were collected on 1/21/15
ND = none detected above laboratory
NR = No reading taken
J = Laboratory estimated value, below PQL and above the MDL.
A = Laboratory PQLs were raised due to sample dilution caused by high analyte concentration or matrix interference.
B = Indicates laboratory measurement.
A01= Detection and quantitation limits were raised due to sample dilution
A52 = Chromatogram not typical of diesel
A57= Chromatogram not typical of motor oil
A07= Detection and quantitation limits were raised due to sample dilution caused by high analyte concentration or matrix interference.
D = Chromatogram not typical of motor oil
1 = Chlorine test repeated after flow appeared to increase
2= Area of coalesence that discharges through M-007

0.12 Exceedance of effluent limit.
Waiting for data
Exceedance Sampling Needed

2019 Q1 INORGANIC NON-METALS (Aqueous Matrix)

Date Sampled	Sample Point	Percentage of Composite Sample	pH (Field Measured)	Temperature	Biochemical Oxygen Demand	Surfactants (MBAS)	Oil & Grease	Settleable Solids	Sulfides	Phenols	Residual Chlorine (Field Measured)	Total Suspended Solids	Turbidity	TPH Diesel	TPH Motor Oil	Bis(2-Ethylhexyl) Phthalate	Zinc	Total Coliform	Fecal Coliform	Fecal/Total Coliform >0.1?	Enterococcus	Acute Toxicity**
Units:				*° F*	*mg/L*	*mg/L*	*mg/L*	*mL/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*NTU*	*µg/L*	*µg/L*	*µg/L*	*µg/L*	MPN/100ml	MPN/100ml		MPN/100ml	*% Survival*
Discharges to M-001 (Outfall/Port #1a)																						
1/8/2019	BYA-14	100%	7.10	73.2	ND	ND	ND	ND	ND	ND	0.00	ND	0.43	ND	ND	3.5 J	530	17	<1.8	No	<1	--
2/7/2019	FW-1	100%	7.87	67.8	21	ND	ND	ND	24 A07	0.018 J	0.00	ND	0.36	ND	ND	ND	15 J	33	33	Yes	<1	--
3/13/2019	BYA-14	100%	7.61	73.8	ND	0.039 J	ND	ND	ND	0.025 J	0.00	ND	0.84	ND	ND	ND	450	<1.8	<1.8	N/A	1.0	--
Duplicate	BYA-14	100%	7.61	73.8	ND	0.025 J	ND	ND	ND	ND	0.00	ND	0.55	ND	ND	ND	410	170	<1.8	No	1.0	--
Discharges to M-002 (Outfall/Port #1)																						
1/8/2019	HD-9	55%	8.27	69.6	ND	ND	ND	ND	ND	ND	0.00	ND	0.50	ND	ND	ND	ND	33	<1.8	No	<1	--
	HD-42	45%																				
2/7/2019	BYA-5	68%	7.48	68.2	1.7	0.027 J	ND	ND	ND	ND	0.01	ND	0.37	ND	ND	ND	210	<1.8	<1.8	N/A	<1	--
	BYA-6	32%																				
3/14/2019	HD-9	55%	7.34	70.3	ND	0.035 J	ND	ND	ND	ND	0.00	ND	0.14	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	HD-42	45%																				
Discharges to M-003 (Outfall/Port #2)																						
1/8/2019	HD-41	100%	8.49	70.3	ND	ND	ND	ND	ND	0.021 J	0.00	ND	0.11	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
2/6/2019	HD-41	100%	7.02	69.6	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	5	<1.8	No	<1	--
3/14/2019	HD-41	100%	7.44	72.7	1.7	0.015 J	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	
Discharges to M-004 (Outfall/Port #3)																						
1/8/2019	W-1	45%	7.14	73.2	ND	ND	ND	ND	ND	ND	0.00	ND	2.3	ND	ND	ND	12 J	<1.8	<1.8	N/A	<1	--
	W-2	55%																				
2/6/2019	HD-4	14%	7.48	70.3	ND	ND	ND	ND	ND	ND	0.03	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	HD-30	86%																				
3/13/2019	W-2	56%	7.32	73.9	ND	ND	ND	ND	ND	ND	0.00	1.4	0.74	ND	ND	ND	73	920	<1.8	No	2.0	--
	BYA-13	44%																				
Discharges to M-005 (Outfall/Port #4)																						
1/8/2019	W-8	71%	6.84	71.8	ND	ND	ND	ND	ND	ND	0.00	ND	0.29	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	W-17	29%																				
2/6/2019	HD-26	100%	6.94	69.8	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	36 J	<1.8	<1.8	N/A	<1	--
3/13/2019	W-8	71%	6.98	85.8	ND	0.021 J	ND	ND	ND	ND	0.01	ND	0.13	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	W-17	29%																				
Discharges to M-006 (Outfall/Port #5)																						
1/8/2019	HD-22	100%	8.25	69.1	1.6	ND	ND	ND	ND	ND	0.00	1.6	0.50	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
1/8/2019	BYA-4	--	8.08	70.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100
1/8/2019	BYA-11	--	8.32	70.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100
2/7/2019	BYA-4	22%	7.31	73.8	ND	ND	ND	ND	ND	ND	0.00	1.1	2.2	ND	ND	ND	390	<1.8	<1.8	N/A	<1	--
	BYA-9	35%																				
	W-16	43%																				
Duplicate	BYA-4	22%	7.31	73.8	ND	ND	ND	ND	ND	ND	0.00	1.1	2.1	ND	ND	ND	400	<1.8	<1.8	N/A	<1	--
	BYA-9	35%																				
	W-16	43%																				
2/21/2019	BYA-4	--	6.95	73.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100
3/13/2019	BYA-4	21%	7.14	69.8	ND	ND	ND	ND	ND	ND	0.00	ND	0.70	ND	ND	ND	370	<1.8	<1.8	N/A	<1	--
	BYA-9	33%																				
	W-13	5%																				
	W-16	41%																				
Discharges to M-007 (Outfall/Port #5a)																						
1/8/2019	BYA-10	100%	7.39	71.6	1.8	ND	ND	ND	ND	ND	0.00	0.67	0.41	ND	ND	ND	39 J	<1.8	<1.8	N/A	<1	--
Duplicate	BYA-10	100%	7.39	71.6	1.7	ND	ND	ND	ND	ND	0.00	ND	0.50	ND	ND	ND	38 J	<1.8	<1.8	N/A	<1	--
2/7/2019	BYA-10	100%	7.47	72.9	ND	ND	ND	ND	ND	ND	0.00	ND	0.39	ND	ND	0.25 J	51	<1.8	<1.8	N/A	<1	--
3/13/2019	BYA-10	100%	7.16	73.2	ND	ND	ND	ND	ND	ND	0.00	ND	0.76	ND	ND	ND	56	<1.8	<1.8	N/A	<1	--
Discharges to M-008 (Outfall/Port #5)																						
1/8/2019	HD-12	100%	8.37	70.0	3.3	0.028 J	ND	ND	ND	ND	0.00	ND	0.16	44 J	280 A57	ND	ND	<1.8	<1.8	N/A	<1	--
1/18/2019	HD-12	100%	7.55	72.1	--	--	--	--	--	--	--	--	--	ND	ND	--	--	--	--	--	--	--
1/21/2019	HD-12	100%	7.45	72.3	--	--	--	--	--	--	--	--	--	ND	ND	--	--	--	--	--	--	--
2/1/2019	HD-12	100%	7.18	70.3	--	--	--	--	--	--	--	--	--	ND	ND	--	--	--	--	--	--	--
2/7/2019	BYA-3	100%	7.61	67.6	ND	ND	ND	ND	ND	ND	0.00	ND	0.20	ND	ND	ND	230	<1.8	<1.8	N/A	<1	--
3/14/2019	HD-10	17%	7.58	75.4	ND	0.018 J	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	HD-12	83%																				
Discharges to M-009 (Outfall/Port #5)																						
1/8/2019	HD-7	100%	8.64	72.5	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
2/6/2019	HD-7	100%	8.02	72.0	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
3/14/2019	HD-7	100%	8.11	76.3	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Discharges to M-010 (Outfall/Port #9)																						
1/3/2019	HD-5	23%	7.66	70.2	--	--	--	--	--	--	--	--	--	ND	ND	--	--	--	--	--	--	--
	HD-6	10%																				
	HD-23	67%																				
1/8/2019	HD-5	23%	8.45	70.0	ND	0.022 J	ND	ND	ND	ND	0.00	0.56	0.73	ND	ND	0.22 J	ND	<1.8	<1.8	N/A	<1	--
	HD-6	10%																				
	HD-23	67%																				
1/18/2019	HD-5	23%	7.78	71.8	--	--	--	--	--	--	--	--	--	ND	ND	--	--	--	--	--	--	--
	HD-6	10%																				
	HD-23	67%																				
2/6/2019	HD-5	23%	7.71	69.1	ND	ND	ND	ND	ND	ND	0.00	ND	0.13	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	HD-6	10%																				
	HD-23	67%																				
3/14/2019	HD-5	23%	7.83	74.3	2.2	0.024 J	ND	ND	ND	ND	0.00	0.56	0.14	ND	ND	ND	ND	2.0	<1.8	No	<1	--
	HD-6	10%																				
	HD-23	67%																				
Effluent Limit (Daily Max.)				---	30	0.5	15	0.3	1.0	1.0	0.1	75	150	100	100	11	95	10000	400		104	90
Effluent Limit (Daily Max. if Fecal/Total Coliform > 0.1))																					1000	
Effluent Limit (Monthly Avg.)				---	20	---	10	0.1	---	---	---	50	50	---	---	5.9	47	1000	200		35	--

-- = Not tested for
--- = No established limit.
** = Acute Toxicity samples were collected on 1/21/15
ND = none detected above laboratory
NR = No reading taken
J = Laboratory estimated value, below PQL and above the MDL.
A = Laboratory PQLs were raised due to sample dilution caused by high analyte concentration or matrix interference.
B = Indicates laboratory measurement.
A01= Detection and quantitation limits were raised due to sample dilution
A52 = Chromatogram not typical of diesel
A57= Chromatogram not typical of motor oil
A07= Detection and quantitation limits were raised due to sample dilution caused by high analyte concentration or matrix interference.
D = Chromatogram not typical of motor oil
1 = Chlorine test repeated after flow appeared to increase
2= Area of coalesence that discharges through M-007

0.12 Exceedance of effluent limit.
Waiting for data
Exceedance Sampling Needed

2019 Q1 INORGANIC NON-METALS (Aqueous Matrix)

Date Sampled	Sample Point	Percentage of Composite Sample	pH (Field Measured)	Temperature	Biochemical Oxygen Demand	Surfactants (MBAS)	Oil & Grease	Settleable Solids	Sulfides	Phenols	Residual Chlorine (Field Measured)	Total Suspended Solids	Turbidity	TPH Diesel	TPH Motor Oil	Bis(2-Ethylhexyl) Phthalate	Zinc	Total Coliform	Fecal Coliform	Fecal/Total Coliform >0.1?	Enterococcus	Acute Toxicity***
Units:				*°F*	*mg/L*	*mg/L*	*mg/L*	*mL/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*NTU*	*µg/L*	*µg/L*	*µg/L*	*µg/L*	MPN/100ml	MPN/100ml		MPN/100ml	*% Survival*
Discharges to M-001 (Outfall/Port #1a)																						
4/2/2019	BYA-14	100%	7.52	75.0	ND	0.033 J,A07	ND	ND	ND	ND	0.00	ND	1.0	ND	ND	ND	**330**	<1.8	<1.8	N/A	<1	--
5/7/2019	FW-1	100%	7.91	73.6	5.0	ND	3.0 J	ND	**32 A07**	0.090	0.00	ND	**96 A07**	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
5/17/2019	FW-1	100%	7.85	70.7	--	--	--	--	--	--	--	--	30	--	--	--	--	--	--	--	--	--
5/21/2019	FW-1	100%	7.92	71.2	--	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--
5/30/2019	FW-1	100%	6.46	72.5	--	--	--	--	--	--	--	--	**66**	--	--	--	--	--	--	--	--	--
6/6/2019	FW-1	100%	7.26	72.5	6.6	ND	ND	ND	**23 A07**	ND	0.00	ND	32	ND	ND	ND	ND	20	<1.8	No	<1	--
6/13/2019	FW-1	100%	7.72	71.4	--	--	--	--	--	--	--	--	**82**	--	--	--	--	--	--	--	--	--
6/20/2019	FW-1	100%	7.17	70.9	--	--	--	--	--	--	--	--	26	--	--	--	--	--	--	--	--	--
6/24/2019	FW-1	100%	7.57	70.7	--	--	--	--	--	--	--	--	**92, A07**	--	--	--	--	--	--	--	--	--
Discharges to M-002 (Outfall/Port #1)																						
4/2/2019	BYA-5	68%	7.20	75.4	2.0	ND	ND	ND	ND	ND	0.00	7.1	1.5	ND	ND	ND	**310**	<1.8	<1.8	N/A	2.0	--
	BYA-6	32%																				
Duplicate	BYA-5	68%	7.20	75.4	ND	ND A07	--	ND	ND	--	0.00	6.9	1.2	ND	ND	ND	**280**	<1.8	<1.8	N/A	1.0	--
	BYA-6	32%																				
5/7/2019	HD-9	55%	7.60	69.6	2.1	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	120	<1.8	No	<1	--
	HD-42	45%																				
6/6/2019	BYA-5	68%	6.83	72.7	3.0	ND	ND	ND	ND	ND	0.00	1.1	0.80	ND	ND	ND	**240**	<1.8	<1.8	N/A	<1	--
	BYA-6	32%																				
Discharges to M-003 (Outfall/Port #2)																						
4/2/2019	HD-41	100%	6.98	72.5	ND	0.11	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
5/7/2019	HD-41	100%	7.40	70.0	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
6/6/2019	HD-41	100%	7.61	72.0	ND	ND	ND	ND	ND	ND	0.00	ND	0.14	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Discharges to M-004 (Outfall/Port #3)																						
4/2/2019	HD-30	86%	6.55	68.5	ND	ND	ND	ND	ND	ND	0.00	ND	0.14	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	HD-4	14%																				
5/7/2019	W-1	45%	7.43	71.6	2.4	ND	ND	ND	ND	ND	0.00	ND	0.62	ND	ND	ND	13 J	4.0	<1.8	N/A	<1	--
	W-2	55%																				
Duplicate	W-1	45%	7.43	71.6	2.1	ND	ND	ND	ND	ND	0.00	0.89	1.0	ND	ND	ND	14 J	4.5	<1.8	N/A	<1	--
	W-2	55%																				
6/6/2019	HD-30	86%	7.89	71.8	4.3	ND	ND	ND	ND	ND	0.00	0.56	0.33	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	HD-4	14%																				
Discharges to M-005 (Outfall/Port #4)																						
4/2/2019	HD-26	100%	6.74	70.0	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
5/7/2019	BYA-7	11%	7.21	72.9	ND	ND	ND	ND	ND	0.170	0.00	ND	0.38	ND	ND	ND	**52**	14	<1.8	N/A	<1	--
	W-8	89%																				
6/6/2019	HD-26	100%	7.73	71.8	ND	ND	ND	ND	ND	ND	0.00	ND	0.13	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Duplicate	HD-26	100%	7.73	71.8	ND	ND	ND	ND	ND	ND	0.00	ND	0.13	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Discharges to M-006 (Outfall/Port #5)																						
4/2/2019	HD-22	100%	6.9	71.4	ND	0.055 J	ND	ND	ND	ND	0.00	0.56	5.60	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
5/7/2019	BYA-4	39%	7.62	71.8	1.90	ND	ND	ND	ND	ND	0.00	1.3	2.4	ND	ND	ND	**390**	<1.8	<1.8	N/A	<1	--
	BYA-9	61%																				
5/17/2019	BYA-11	100%	7.64	72.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100
6/6/2019	BYA-4	100%	6.96	72.5	2.3	ND	ND	ND	ND	ND	0.00	14	9.8	ND	**160 J,A57**	0.40 J	**54**	<1.8	<1.8	N/A	<1	--
6/13/2019	BYA-11	100%	7.69	72.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	100
Discharges to M-007 (Outfall/Port #5a)																						
4/2/2019	BYA-10	100%	7.51	74.3	ND	ND	ND	ND	ND	ND	0.00	ND	0.63	ND	ND	ND	42 J	<1.8	<1.8	N/A	<1	--
5/7/2019	BYA-10	100%	7.49	73.4	2.3	ND	ND	ND	ND	ND	0.00	ND	0.28	ND	ND	0.23 J	39 J	<1.8	<1.8	N/A	<1	--
6/6/2019	BYA-10	100%	6.99	72.0	2.2	ND	ND	ND	ND	ND	0.00	0.67	0.61	ND	ND	0.36 J	ND	46	<1.8	No	<1	--
Discharges to M-008 (Outfall/Port #5)																						
4/2/2019	BYA-2	29%	7.51	74.1	ND	ND	ND	ND	ND	ND	0.00	ND	0.26	ND	ND	ND	**140**	<1.8	<1.8	N/A	<1	--
	BYA-3	71%																				
5/7/2019	HD-12	100%	7.54	70.5	4.5	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
6/6/2019	BYA-3	100%	8.00	73.4	2.9	ND	ND	ND	ND	0.08	0.00	1.9	1.3	ND	ND	ND	**180**	<1.8	<1.8	N/A	<1	--
Discharges to M-009 (Outfall/Port #5)																						
4/2/2019	HD-7	100%	7.59	78.4	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
5/7/2019	HD-7	100%	7.89	72.1	1.50	ND	ND	ND	ND	ND	0.00	0.56	0.10	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
6/6/2019	HD-7	100%	7.96	72.7	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
Discharges to M-010 (Outfall/Port #9)																						
4/2/2019	HD-23	67%	7.20	70.7	1.5	ND	ND	ND	ND	ND	0.00	0.56	0.53	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	HD-5	23%																				
	HD-6	10%																				
5/7/2019	HD-23	67%	7.59	69.4	ND	ND	ND	ND	ND	ND	0.00	0.78	0.57	ND	ND	ND	ND	<1.8	<1.8	N/A	<1	--
	HD-5	23%																				
	HD-6	10%																				
6/6/2019	HD-23	67%	8.04	73.0	ND	ND	ND	ND	ND	ND	0.00	ND	0.47	ND	ND	ND	ND	14	<1.8	N/A	<1	--
	HD-5	23%																				
	HD-6	10%																				
Effluent Limit (Daily Max.)				---	30	0.5	15	0.3	1.0	1.0	0.1	75	150	100	100	11	95	10000	400		104	90
Effluent Limit (Daily Max. if Fecal/Total Coliform > 0.1))																					1000	
Effluent Limit (Monthly Avg.)				---	20	---	10	0.1	---	---	---	50	50	---	---	5.9	47	1000	200		35	--

-- = Not tested for
--- = No established limit.
** = Acute Toxicity samples were collected on 1/21/15
ND = none detected above laboratory
NR = No reading taken
J = Laboratory estimated value, below PQL and above the MDL.
A = Laboratory PQLs were raised due to sample dilution caused by high analyte concentration or matrix interference.
B = Indicates laboratory measurement.
A01= Detection and quantitation limits were raised due to sample dilution
A52 = Chromatogram not typical of diesel
A57= Chromatogram not typical of motor oil
A07= Detection and quantitation limits were raised due to sample dilution caused by high analyte concentration or matrix interference.
D = Chromatogram not typical of motor oil
1 = Chlorine test repeated after flow appeared to increase
2= Area of coalesence that discharges through M-007

0.12 Exceedance of effluent limit.
Waiting for data
Exceedance Sampling Needed