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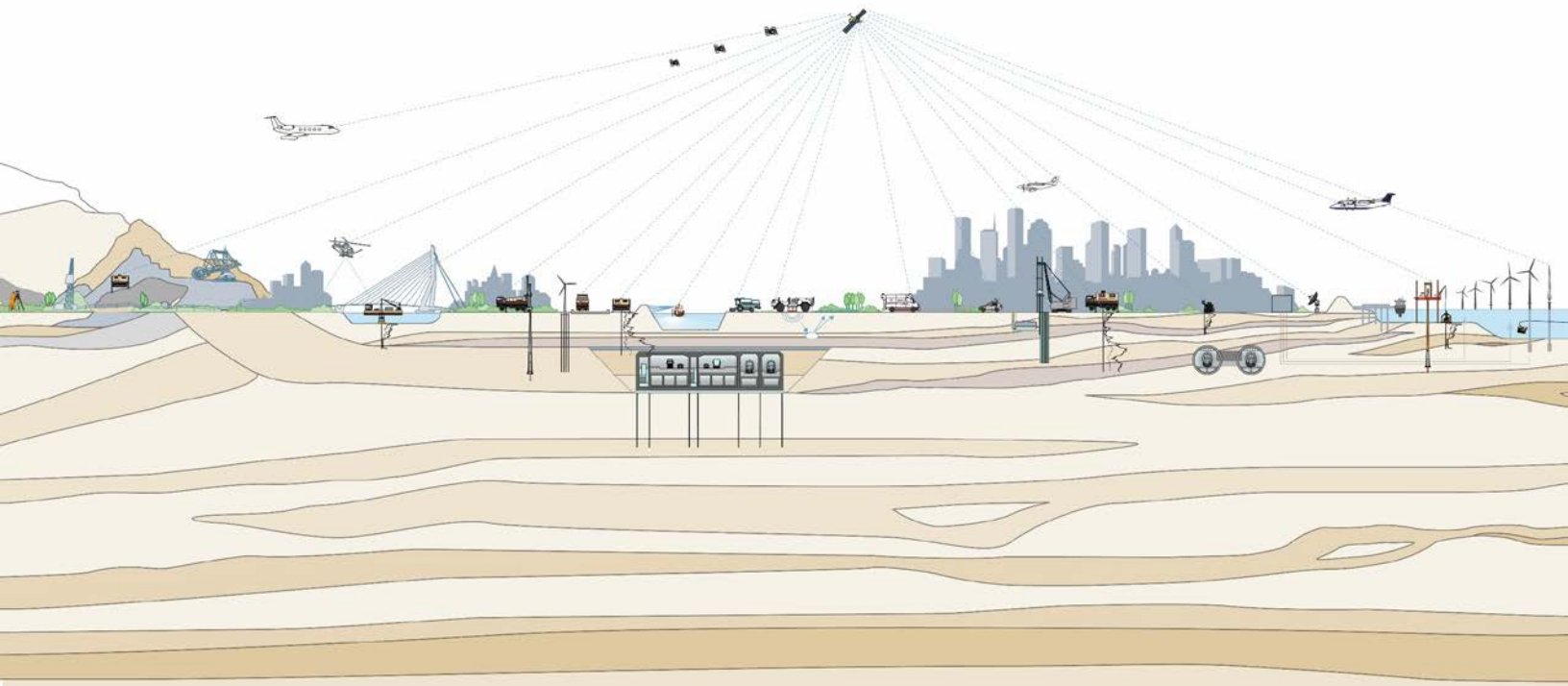
Annual Report, July 2016 Through June 2017 Calle Del Barco Landslide Assessment District

Malibu, California

January 2018
Fugro Project No. 04.62160605
Document No. 04.62160605-PR-001(Rev.00)

City of Malibu

Final



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Prepared for: City of Malibu
23825 Stuart Ranch Road
Malibu, California 90265

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

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City of Malibu
23825 Stuart Ranch Road
Malibu, California 90265

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

Annual Report, July 2016 Through June 2017,
Calle Del Barco Landslide Assessment District,
Malibu, California

Dear Mr. DuBoux,

Fugro is pleased to present this annual report for the Calle del Barco Landslide Assessment District. This report summarizes the monitoring and maintenance activities completed during the period of July 2016 through June 2017.

Fugro appreciates the opportunity to be of service to the City of Malibu and the District homeowners. Please contact Loree Berry at (805) 289-3830 if you have any questions regarding this report.

Sincerely,
Fugro USA Land, Inc.

David Thornhill, P.E.
Senior Staff Engineer

LICENSED PROFESSIONAL ENGINEER
DAVID M. THORNHILL
C 87168
exp 09-19
CIVIL
STATE OF CALIFORNIA

Loree A. Berry, P.E.
Associate Engineer/ Senior Project Manager

REGISTERED PROFESSIONAL ENGINEER
LOREE A. BERRY
No. 73221
Exp. 12-31-18
CIVIL
STATE OF CALIFORNIA

Distribution: (1) Addressee and PDF
(1) City of Malibu - Geotechnical staff and PDF

CONTENTS

TABLES

PLATES

APPENDICES

1. INTRODUCTION

1.1 Authorization

Fugro prepared this data report in accordance with our contract with the City of Malibu (City) and consistent with the cost estimate document "Exhibit A - FY 2016-2017 Maintenance Cost Estimate" presented in the Annual Assessment Report (Taussig, 2016).

1.2 Background

The Calle del Barco Landslide Assessment District (Assessment District) was established in 1986 by the County of Los Angeles (County) following the activation of a landslide between Rambla Orienta and Calle del Barco in 1978. The Assessment District provides permanent funding to maintain and monitor dewatering facilities with the purpose of stabilizing the landslide. The County administered the Assessment District until 1991 when the City of Malibu incorporated. The Assessment District was reauthorized in May 1998 under Resolution No. 98-033. 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 monitoring and maintenance of the geotechnical instrumentation and dewatering facilities for the period between July 1, 2016, and June 30, 2017 (herein after, the 'monitoring period').

Data collected during this monitoring period included the following:

- Annual rainfall data from a local rain gauge operated by the County of Los Angeles, Department of Public Works - Water Resources Division;
- Monthly groundwater level measurements from 9 standpipes;
- Periodic groundwater level measurements from 19 pneumatic piezometers;
- Monthly dewatering production readings from 11 dewatering wells;
- Monthly dewatering production readings from 11 horizontal drains;
- Quarterly to Semi-Annual ground deformation measurements from 12 slope inclinometers; and
- Periodic maintenance of dewatering and monitoring facilities.

Fugro staff checked the operating condition of the instrumentation and dewatering facilities at each field monitoring/observation location and by evaluating preliminary data in the office as information was 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

This report summarizes the monitoring data collected during the July 1, 2016 to June 30, 2017 monitoring period and presents conclusions regarding the annual monitoring results. The location of the Assessment District is illustrated on Plate 1 - Site Location Map. Locations of the geotechnical instrumentation facilities are shown on Plate 2 - Assessment District Map. Tabulated and graphic summaries of monitoring data are presented in Appendices A through C 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

A graph of historical monthly rainfall and average annual rainfall from October 1968 through September 30, 2017, is shown on Plate 3 - Rainfall Graph. Monthly rainfall totals from 1968 through 2004 were obtained from County of Los Angeles Department of Public Works (LADPW) Carbon Canyon Rain Station 447C and monthly rainfall totals from 2004 to the present were obtained from LADPW Big Rock Mesa Rain Gauge 1239.

Rainfall data indicate that approximately 21.98 inches of precipitation fell during the monitoring period from July 1, 2016, through June 30, 2017. The average annual rainfall from 1968 to 2017 in the “Malibu Area” for the same months is approximately 15.6 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 for October 1, 2016 through September 30, 2017, was approximately 22.13 inches. That is approximately 138 percent of the average annual rainfall of 16.0 inches for the “rain seasons” between 1968 and 2017.

Plate 5 – 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 has been decreasing with continued below average rainfall between 2011 and 2016. Despite above average rainfall in early 2017, measured groundwater levels within the District remained low. Subsequently, the total dewatering discharge continued to show a decreasing trend through June 2017.

2.2 Groundwater Monitoring

The groundwater level data collected during the current monitoring period are summarized in Appendix A and a summary graph of annual mean high groundwater elevations for the Assessment District is included as part of Plate 5. 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 septic systems;
- Infiltration from irrigation;
- Alterations to surface drainage by grading, landscaping, storm drains and rain gutters;
- Accidental water discharges from leaking utilities such as water, irrigation, sewer, and storm drain lines as well as swimming pools; and
- Dewatering activities from pumping dewatering wells and hydraugers.

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

2.2.1 Standpipe Piezometers

Nine standpipe piezometers (SI-4, SI-5, SI-7, SI-8, SI-9, SI-13, SI-14, SI-15 and SI-16) were measured over the monitoring period. 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 Calle del Barco 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. The locations of the standpipe piezometers are depicted on Plate 2 - Assessment District Map, and groundwater elevation data are presented in Appendix A.

2.2.2 Pneumatic Piezometers

Inclinometer casings installed within the Assessment District after 1996 were outfitted with two-to-four pneumatic piezometer sensors, referred to as ‘Tips’, nested at varying depths along the length of the inclinometer casing. Each sensor records the saturated pore water pressure at its nested depth by measuring differential air pressure between the instrument sensor and the 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.

With the exception of SI-16 which was installed in 2003, of the District’s pneumatic sensors were installed in 1998 or prior. Over time, some of the sensors and their air-line tubing have developed leaks or become occluded, resulting in inconsistent results especially when reading low pore pressures. Due to the inconsistent data and generally historical low groundwater levels, the pneumatic piezometers were monitored only intermittently during the 2016-2017 monitoring period.

The locations of the piezometers are shown on Plate 2 and groundwater elevation data are presented in Appendix A. The results of the pneumatic piezometer readings are presented along with standpipe measurements Appendix A.

2.2.3 Groundwater Level Discussion

General. Groundwater data were reviewed by evaluating changes that occurred within each of three geographic areas delineated within the Calle del Barco Landslide limits. Groundwater elevations within each of the three areas were compared to the previous and current monitoring period as well as to levels over extended periods. To analyze trends in seasonal groundwater fluctuations, the average (mean) annual and highest annual recorded groundwater elevation for each piezometer were calculated and compared with those of previous years (Appendix A, Plate A-2).

Rambla Vista. Groundwater elevation data for the Rambla Vista Area are presented in Plate A-3. Groundwater levels for this area are monitored using standpipes SI-7 and SI-4 and the pneumatic piezometers attached to Inclinometer SI-10. In general, groundwater elevations in the Rambla Vista Area continued to decline during the 2016-2017 monitoring period. The calculated area average declined 2.6 feet when compared to the area average for the 2015-2016 monitoring period and is about 7.8 feet lower than the mean water level elevation for this area for the period of record (1991-2017).

Groundwater levels measured in standpipe SI-4 fell from July to November 2016 before rising through March 2017, likely as a result of increased rainfall. Groundwater elevations remained relatively stable from March to June 2017. Groundwater elevations in SI-7 have continued to decline and recorded all-time lows for the period of record on January 13, 2017, before slightly rising. Pore pressure readings in pneumatic piezometer SI-10 Tip 3 and Tip 4 measured 0 PSI. Pneumatic piezometer SI-10 Tip 3 has read 0 PSI since September 2006 and Tip 4 has read 0 PSI since installation. It is believed that Tip 3 and Tip 4 are functioning, but are reading zero due to the groundwater elevation being lower than the piezometer tip elevation. SI-10 Tip 2 is clogged and non-functional and was last readable in January 2010. SI-10 Tip 1 had been clogged from March 2014 to March 2017, but was discovered to be functioning again in April 2017.

Calle Del Barco. Groundwater data for the Calle del Barco Area are presented on Plate A-4. Groundwater levels for this area are monitored using standpipe piezometers SI-5, SI-8, SI-9, SI-15, and SI-16 and pneumatic piezometers attached to inclinometers SI-9, SI-11, SI-12, SI-15, and SI-16. In general, groundwater elevations in the Calle del Barco Area for the 2016-2017 monitoring period decreased approximately 1.9 feet from the 2015-2016 monitoring period. The Calle del Barco area remains approximately 13.8 feet below the mean water level elevation for this area over the period of record.

Water levels in all of the individual standpipe piezometers trended lower or remained unchanged throughout the monitoring year except for some temporary rises following the rainfall events of December 2016 through February 2017. Pneumatic piezometers generally trended in a manner similar to the standpipes.

Rambla Pacifico. Groundwater data for the Rambla Pacifico Area are presented on Plate A-5. Groundwater levels for this area are monitored using standpipe piezometers SI-13 and SI-14 along with two pneumatic piezometers installed within each of those standpipes. In general, groundwater elevations in the Rambla Pacifico Area for the 2016-2017 monitoring period continued to decline. The calculated area average declined by 0.5 feet when compared to the 2015-2016 monitoring period and is 5.1 feet below the mean water level elevation for the area for the period of record.

Water levels in the individual standpipe piezometers continued to decline throughout the monitoring period and are at all-time lows for the period of record. SI-13 experienced a temporary jump in water elevation during the January reading, likely due to increased rainfall. Pneumatic Piezometers SI-13 Tip 1 and SI-14 Tip 1 continue to decline with trends that approximately correlate with their respective standpipe water levels. The shallow pneumatic piezometers (Tip 2) in both standpipes have been dry since installation and no data are reported. Dewatering well W-K, located within the Rambla Pacifico Area near SI-13 has a reported bottom elevation of 370 feet and has also been completely dry since December 2015.

Summary. Groundwater levels in individual piezometers were generally lower relative to the previous year. The annual average groundwater elevations were lower than the prior year averages in all three areas. The peak groundwater elevations were lower than the prior year's peak in the Rambla Vista and Calle del Barco areas and unchanged in the Rambla Pacifico area. Table 1 presents the average and highest annual groundwater levels by area. The shallow pneumatic piezometers located above the water table reflect unsaturated conditions, which indicates that there has not been sufficient recharge to maintain significant shallow perched water.

Table 1. Summary of Average Groundwater Elevations by Area

Location	Average Groundwater Elevation 2016-2017	Change from Prior Year Average	Peak Groundwater Elevation 2016-2017	Change from Prior Year Peak
Rambla Vista	160.2	-2.6	161.6	-2.9
Calle Del Barco	248.4	-1.9	249.7	-2.2
Rambla Pacifico	345.7	-0.5	346.5	+0.1
Note: All Units are in feet.				

2.3 Dewatering Production

Dewatering production data are provided in Appendix B, with dewatering well and hydrauger information presented on Plate B-1. A summary of the dewatering output compared to groundwater levels and rainfall is depicted on Plate 5.

2.3.1 Total Dewatering Production

A combined graph of the total dewatering rate for the monitored dewatering wells and hydraugers is presented on Plate 4. Total dewatering production data for the measured hydraugers and wells indicates the following:

- The average total dewatering rate during the monitoring period was approximately 489 gallons per day (gpd). This represents a 13 percent decrease in the average dewatering rate relative to the 561 gpd average recorded during the previous monitoring period

2.3.2 Dewatering Well Production

Graphs showing production rates for individual dewatering wells are provided in Appendix B. Production data for the dewatering wells indicates the following:

- The average total dewatering well production rate for this monitoring period was approximately 219 gpd. That represents a decrease of about 24 percent from the average production rate of 288 gpd for the previous monitoring period.
- The decline in dewatering well production correlates with continued decline in average groundwater levels.
- Dewatering well W-K has remained dry since December 2015.

2.3.3 Hydrauger Production

Graphs of production rates for individual hydraugers are included in Appendix B. Data for the hydraugers indicate the following:

- The average production rate for all hydraugers over the monitoring period is approximately 270 gpd. That represents a decrease of approximately 1 percent from the average production rate of 272 gpd for the previous monitoring period.
- Hydrauger H-2A recorded flow in February 2017, the first time since May 2015.
- From November 2016 to February 2017, Hydraugers HD-13 and Row H-1 recorded their highest production rates since May 2011 and April 2005, respectively, before declining through the spring and summer.

2.4 Slope Inclinometer Measurements

Fugro monitored 10 slope inclinometers on a semi-annual basis and 2 slope inclinometers on a quarterly basis to evaluate changes in subsurface ground deformation. Plots of slope inclinometer measurements (four plots for each monitored slope inclinometer) are presented in Appendix C. The first plot shows the cumulative deflection and incremental deflection for the A-direction and the second plot shows the cumulative deflection and incremental deflection for the B-direction. Those two plots show approximately one measurement per year from about 2006 through the current monitoring year. The third and fourth plots show displacement versus time for the same period for all of the measurements plotted on the A and B direction plates the during that period.

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 C-1 in Appendix C. Some slope inclinometer plots show minor amounts of cumulative displacement measured at the ground surface during the 2016 through 2017 monitoring period. Measurements along identified slide planes during the 2016 through 2017 monitoring period are negligible with the exception of SI-16 which showed minor displacement of less than 0.1 inch.

Inclinometer SI-9 exhibits a pattern of movement measured at the ground surface at a rate of about 0.06 inch/year since 2005, resulting in approximately 0.7 inch of cumulative displacement since the 2004-2005 monitoring period. Movement of the inclinometer appears to be both translational at specific depths between 30 and 55 feet and rotational about a hinge point at about 55 feet below the ground surface. However, no detectable movement occurred at SI-16 over the 2016-2017 monitoring period.

Historically, inclinometer SI-16 has exhibited a pattern of movement measured at the ground surface at an average rate of up about 0.08 inches/year since 2005, resulting in approximately 0.5 inches of cumulative displacement at the ground surface since the 2004-2005 monitoring period. Movement of that inclinometer appears to be both translational at specific depths between 0 to 10 feet and rotational between 40 and 50 feet about a hinge point at about 50 feet below the ground surface. Minor displacement of less than 0.1 inches was detected in SI-16 during the 2016 to 2017 monitoring period.

Although the movement observed in inclinometers SI-9 and SI-16 has not produced new, observed distress in pavements or other development of which Fugro is aware, the movement is nevertheless quantifiable and can be defined by a clear trend.

3. FACILITY MAINTENANCE

3.1 Maintenance Summary

The operating status of each dewatering well and hydrauger was checked monthly. When necessary, repair work was scheduled and undertaken as expeditiously as possible, typically within a matter of a few hours or days. Table 2 - Summary of Facility Maintenance provides a description of significant maintenance activities that were completed during the current monitoring period.

Table 2. Summary of Facility Maintenance

Repair Date	Facility	Description
November 17, 2016	Dewatering Well W-J	Replaced pump, motor, control box, and associated piping. Significant rooting was scrubbed and bailed from the well.

3.2 Capital Improvement Projects

No capital improvements were performed during the current monitoring period.

4. SUMMARY AND CONCLUSIONS

The status of monitoring facilities within the Calle del Barco Landslide Assessment District can be summarized as follows:

- Measured rainfall during the 2016 - 2017 monitoring year (July 1 through June 30) was 21.98 inches of precipitation. Rainfall during that monitoring period was above the “Malibu Area” historical average of 15.6 inches per monitoring year measured from 1968 through 2017.
- Average groundwater levels for all areas within the District were lower relative to the previous year. Groundwater levels are generally continuing to decrease from the levels observed in the record winter of 2004 through 2005.
- In the standpipe piezometers, measured groundwater levels were generally lower than groundwater levels in monitoring year 1997-1998 when major slope failure occurred.
- Total dewatering production decreased about 24 percent when compared to last year’s total production. Decreased production is thought to be attributed to generally static to declining groundwater levels within the District.
- Groundwater production from existing dewatering wells and hydraugers should be expected to continually decline regardless of rainfall amounts as the efficiency of the wells and hydraugers decrease due to mineralization and aging. This may contribute to reduced rates of groundwater lowering or localized increases in groundwater levels. Periodic maintenance of the existing facilities and replacement of older, worn-out pumps should improve the efficiency of the dewatering systems throughout the year, especially during and immediately following the rainy months.
- Slope inclinometer readings indicate a maximum cumulative (since the 2004-2005 Monitoring Year) localized displacement at the ground surface of about 0.7 inch (SI-9) and 0.5 inch (SI-16) located on Calle del Barco with the majority of inclinometers indicating no significant ground movement since the 2004-2005 Monitoring Year.
- Water conservation is encouraged throughout the Calle Del Barco District to reduce the infiltration of domestic water and the potential for future groundwater level increases. Control of groundwater levels within the landslide area is a critical to maintaining the stability of the landslides.

5. REFERENCES

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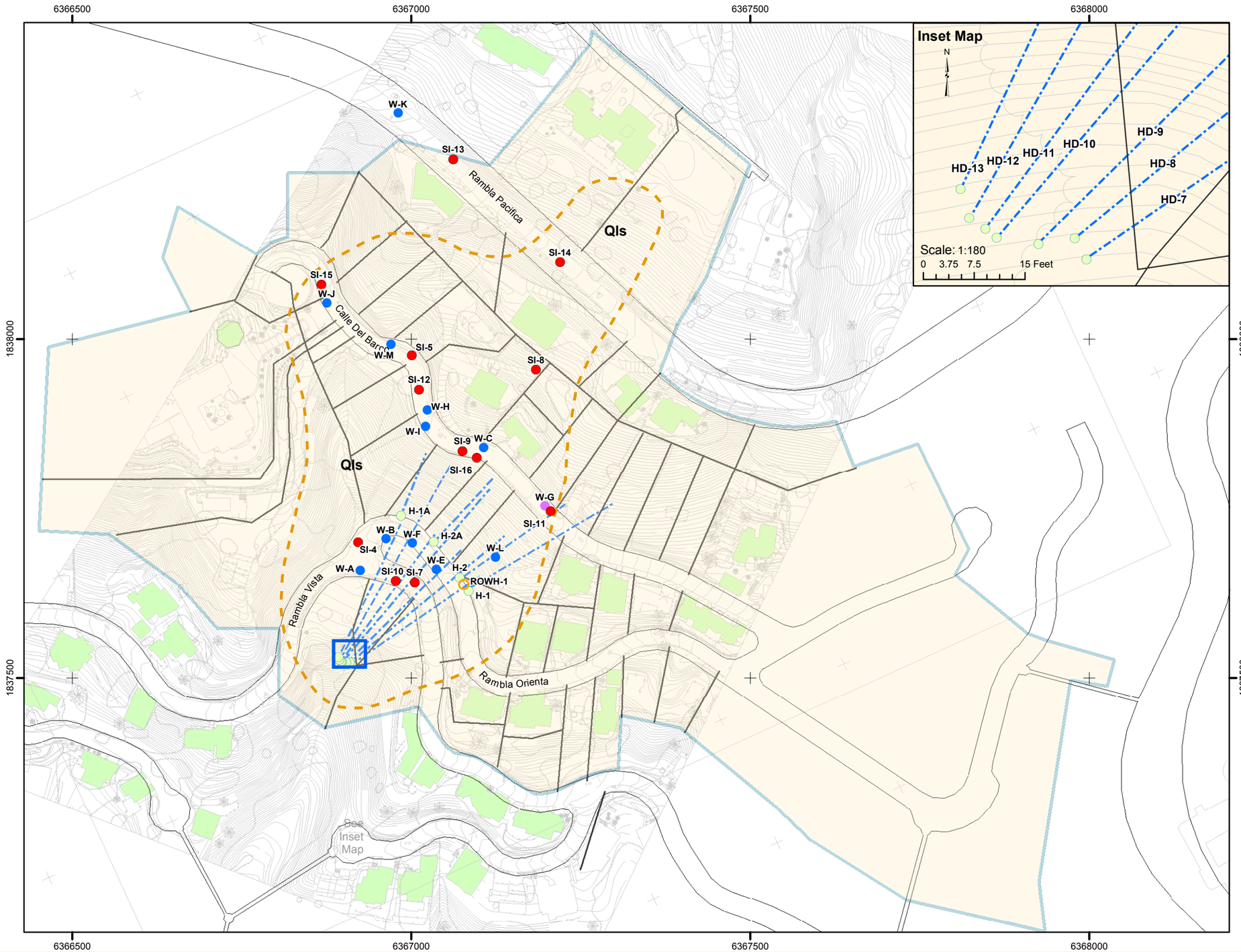
PLATES

SITE LOCATION MAP
Calle del Barco Landslide Assessment District
Malibu, California

PLATE 1



LEGEND

- Active Dewatering Well
- Inactive Dewatering Well
- Slope Inclinometer/Standpipe
- ROWH-1 -Conveyance Line for H-2
- Horizontal Drain (Hydrauger)
- Qls — Approximate Limits of Landslide
- Assessment District Boundary
- Extent of Horizontal Drain (Hydrauger) Inset
- Coordinate Grid: California State Plane, Zone 5, NAD 83, Feet

N

Scale: 1:1,800

150 75 0 150 Feet

ASSESSMENT DISTRICT MAP
Calle del Barco Landslide Assessment District
Malibu, California

PLATE 2

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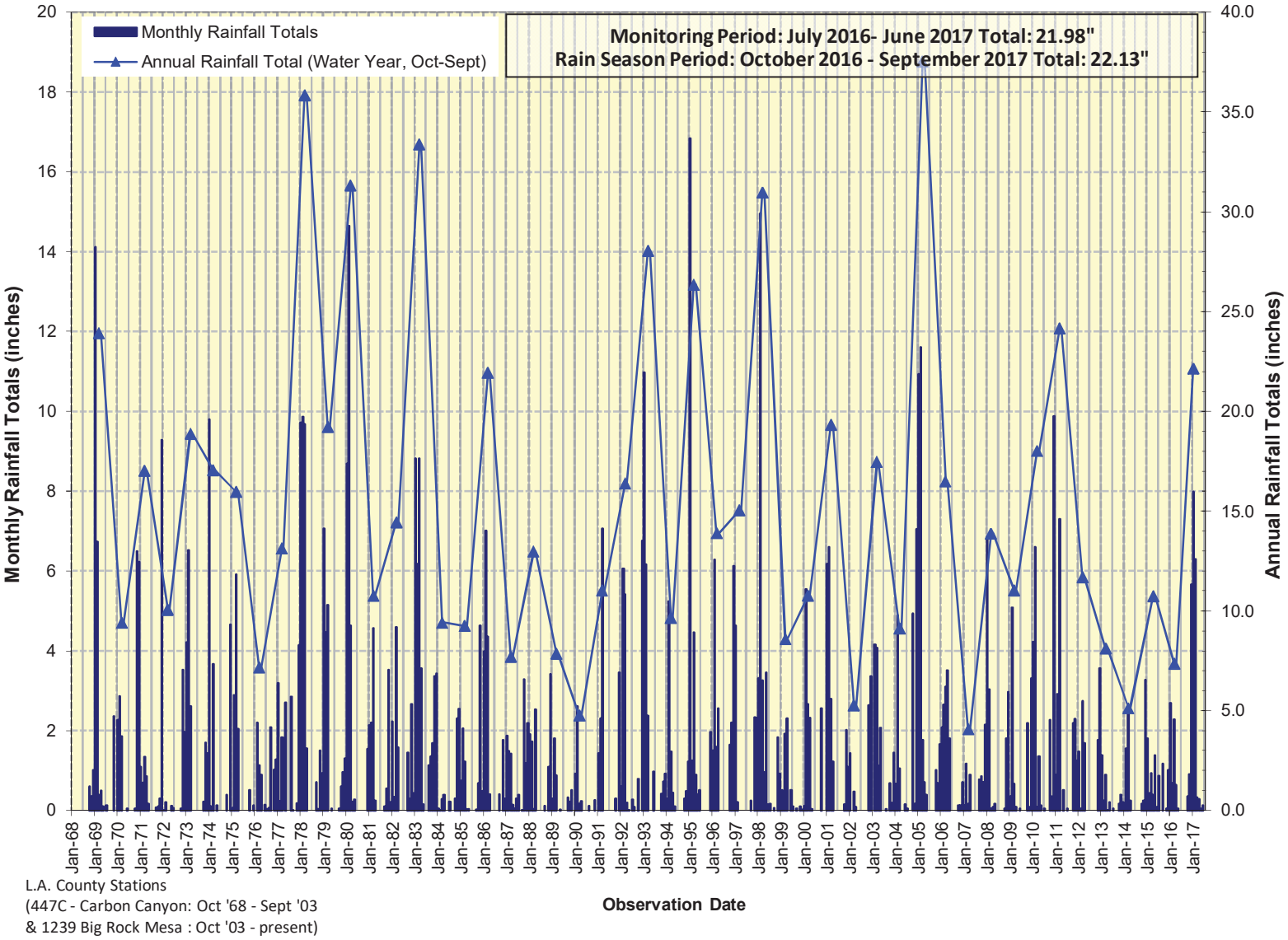
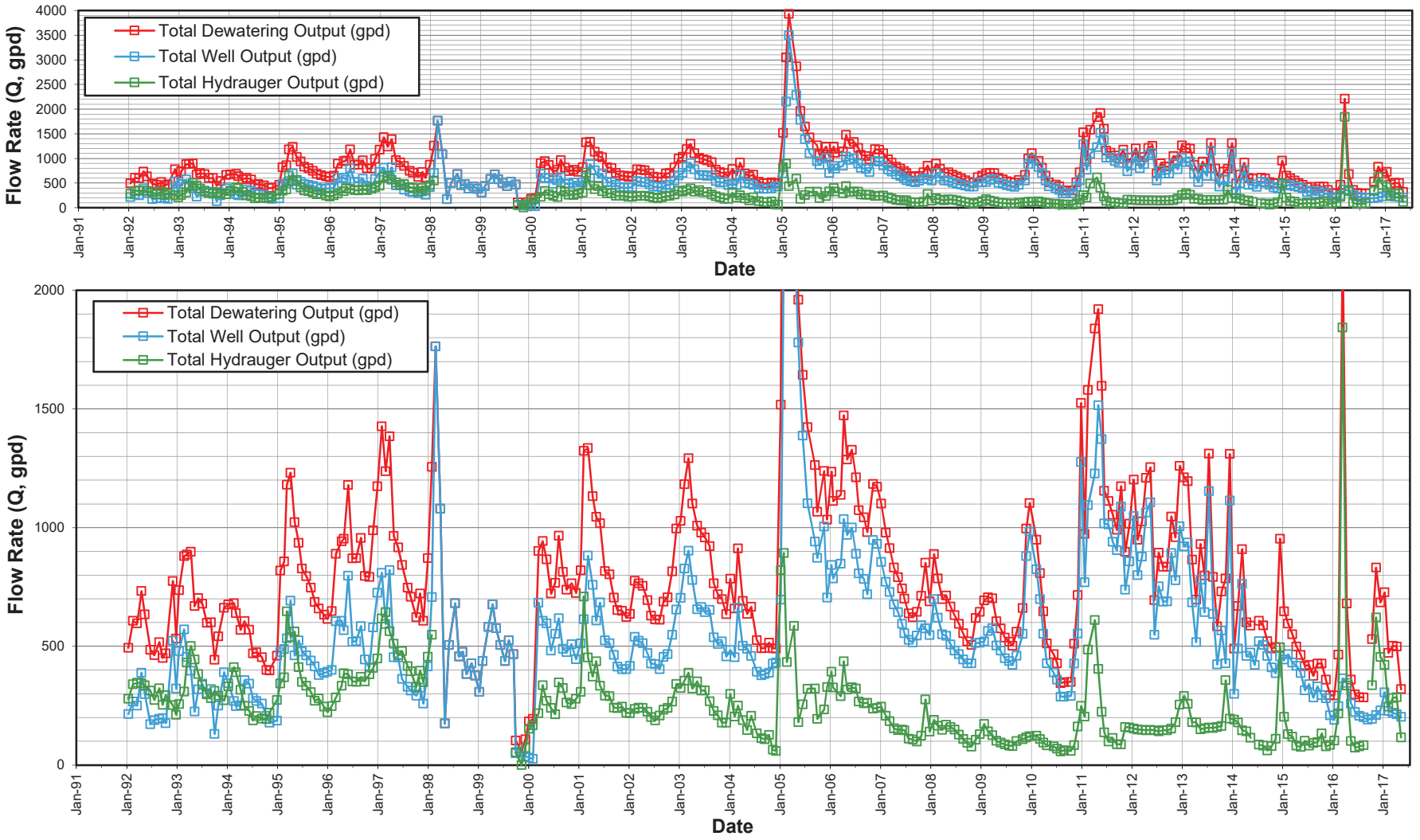


RAINFALL GRAPH

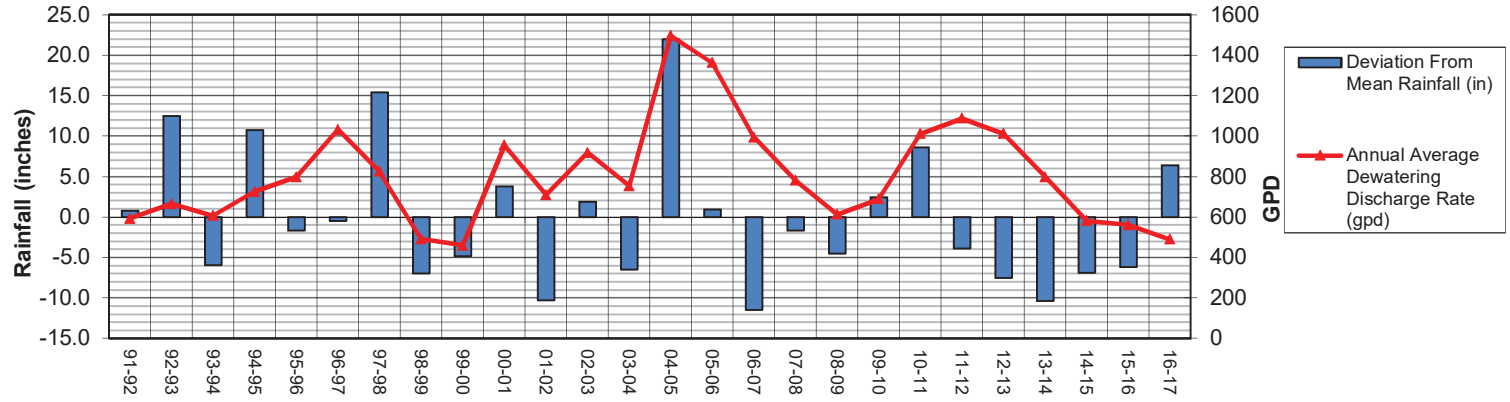
Calle del Barco Landslide Assessment District
Malibu, California

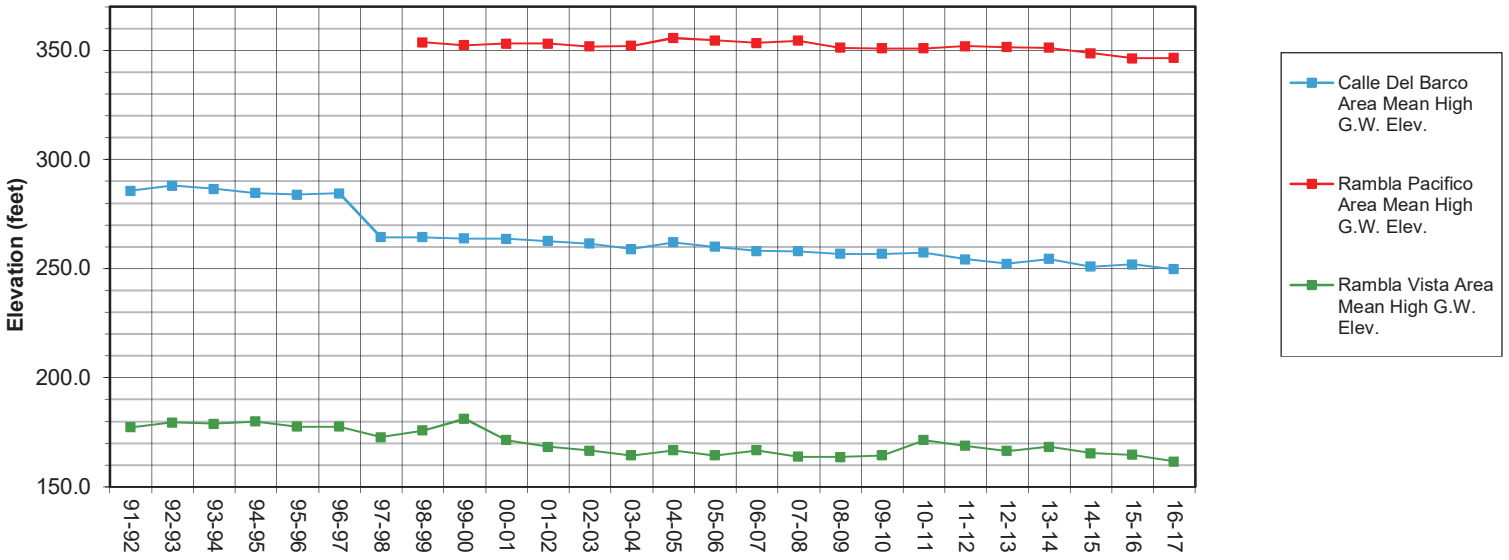
PLATE 3



TOTAL DISCHARGE - WELLS AND HYDRAUGERS
Calle del Barco Landslide Assessment District
Malibu, California

PLATE 4





** Graph shows the average of the highest groundwater elevations recorded in each well/piezometer during the monitoring period.*

GROUNDWATER LEVELS, DEWATERING AND RAINFALL

Calle del Barco Landslide Assessment District
Malibu, California

PLATE 5

APPENDIX A
GROUNDWATER DATA

CALLE DEL BARCO LAD - Standpipe Piezometer Information

Standpipe ID	Reference Elevation (ft)	Casing Depth (ft)	Perforation Interval (ft)	Installed By	Notes
SI-4	207.0	81.0	Unknown	Unknown	
SI-5	302.0	100.0	Unknown	Unknown	
SI-7	201.0	106.0	Unknown	Unknown	
SI-8	352.0	131.0	Unknown	Unknown	
SI-9	298.0	100.0	Unknown	Unknown	
SI-13	424.0	82.0	75-80	BYA	
SI-14	408.0	80.0	73-78	BYA	
SI-15	301.0	78.0	71-76	BYA	
SI-16	297.0	90.0	Unknown	Unknown	

CALLE DEL BARCO LAD - Pneumatic Piezometer Information

Piezomenter ID	Tip No.	Reference Elev. (ft)	Tip Depth (ft)	Tip Elev. (ft)	Installed By	Notes
SI-9	1	298	68	230	BYA	functioning
	2		38	260	BYA	0 PSI
SI-10	1	202	60	142	BYA	functioning
	2*		50	152	BYA	blocked air line
	3		40	162	BYA	0 PSI
	4		20	182	BYA	0 PSI
SI-11	1	291.5	60	231.5	BYA	functioning
	2[a]		50	241.5	BYA	readings <0.5 PSI
	3*		40	251.5	BYA	air line leak
	4[a]		20	271.5	BYA	blocked air line
SI-12	1	301	60	241	BYA	functioning
	2		50	251	BYA	functioning
	3*		40	261	BYA	functioning
	4'		20	281	BYA	0 PSI
SI-13	1[a]	424	70	354	BYA	readings <0.3PSI
	2[a]		50	374	BYA	readings <0.3PSI
SI-14	1	408	68	340	BYA	functioning
	2		48	360	BYA	functioning
SI-15	1	301	66	235	BYA	functioning
	2*		36	265	BYA	non functioning
SI-16	1	297	70	227	BYA	functioning
	2		40	257	BYA	functioning

* - Piezometer not functioning
[a] - functionality not certain, readings not included in calculation of area averages

PIEZOMETER INFORMATION
Calle del Barco Landslide Aseessment District
Malibu, California

PLATE A-1

CALLE DEL BARCO - SUMMARY OF GROUNDWATER DATA

Piezometer I.D.		91-92*	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00**	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	Highest Ever Recorded	Mean '91 - '17	Stand. Dev.	16-17 vs 97-98	16-17 vs 15-16	16-17 vs Mean
Rambla Vista																																	
SI-4	Mean El.	180.9	184.9	187.3	188.9	188.6	188.8	190.1	187.9	182.0	180.4	180.1	181.8	176.1	180.5	179.6	179.5	180.4	178.7	179.8	182.0	181.1	179.6	181.3	175.2	174.2	169.0	Mar-98	181.5	5.0	-21.1	-5.2	-12.5
	Max El.	185.7	189.4	189.3	193.0	190.1	192.0	193.6	190.7	183.5	185.0	181.7	182.7	180.6	188.2	181.2	183.0	182.1	180.7	184.7	185.7	185.2	180.7	182.9	177.5	177.5	171.3	193.6	184.5	5.3	-22.3	-6.2	-13.2
SI-7	Mean El.	167.8	168.5	167.3	165.8	163.9	162.7	162.8	162.7	173.9	160.3	156.5	154.5	153.6	153.8	154.3	153.9	153.6	153.2	153.1	158.2	153.7	155.7	158.2	152.4	151.3	151.3	Aug-99	158.6	6.3	-11.5	0.0	-7.3
	Max El.	169.0	169.6	168.6	166.7	165.1	163.0	164.3	164.6	185.0	161.7	158.6	155.0	154.2	154.9	154.6	154.2	153.8	153.6	153.6	161.8	154.5	157.7	160.2	153.4	151.7	151.9	185.0	160.0	7.7	-12.4	**0.3**	-8.1
SI-10 TIP-1	Mean El.							167.3	167.7	170.6	169.3	168.1	166.0	165.2	164.5	161.2	158.2	158.5	162.4	163.0	165.5	163.9	159.3	159.3		--	168.8	Apr-07		3.9			
	Max El.							167.3	168.5	170.8	170.8	168.5	167.3	166.2	169.6	165.0	171.2	163.9	163.9	166.8	166.7	166.7	161.0	162.1		--	174.2	174.2		3.4			
SI-10 TIP-2	Mean El.							164.7	168.7	177.0	166.2	162.4	158.8	155.9	154.3	155.5	156.0	154.9	154.8	152.6	--	--	--	--		--	--	Jan-99		7.2			
	Max El.							165.8	179.6	185.4	168.1	164.7	161.2	156.6	154.3	156.6	158.7	155.5	156.6	152.6	--	--	--	--		--	--	185.4		10.0			
Area Average	Mean El.	174.4	176.7	177.3	177.4	176.3	175.7	171.2	171.7	175.9	169.0	166.8	165.3	162.7	163.3	162.6	161.9	161.8	162.3	162.1	168.6	166.2	164.9	166.3	163.8	162.8	160.2		168.0	5.9	-11.0	-2.6	-7.8
	Max El	177.4	179.5	179.0	179.9	177.6	177.5	172.8	175.8	181.2	171.4	168.4	166.6	164.4	166.8	164.4	166.8	163.8	163.7	164.4	171.4	168.8	166.5	168.4	165.4	164.6	161.6		170.3	6.2	-11.1	-2.9	-8.7
Change vs Prior	Mean El.		2.3	0.6	0.0	-1.1	-0.5	-4.5	0.5	4.1	-6.8	-2.2	-1.5	-2.6	0.6	-0.7	-0.7	-0.1	0.4	-0.1	6.4	-2.3	-1.4	1.4	-2.5	-1.0	-2.6						
	Max El.		2.2	-0.6	0.9	-2.3	-0.1	-4.8	3.1	5.3	-9.8	-3.0	-1.8	-2.2	2.4	-2.4	2.4	-3.0	-0.1	0.7	7.0	-2.6	-2.3	1.9	-3.0	-0.9	-2.9						
Calle Del Barco																																	
SI-5	Mean El.	271.9	273.5	278.9	280.1	279.9	278.8	282.6	282.6	278.9	279.1	279.9	278.8	278.8	281.2	283.9	280.6	278.7	277.2	276.5	278.1	277.1	273.3	273.1	256.1	255.7	254.9	Mar-98	275.8	8.0	-27.7	-0.8	-20.9
	Max El.	275.9	283.5	280.9	285.1	282.6	280.2	287.5	285.1	279.9	281.1	280.6	279.7	279.6	287.0	285.1	283.7	280.8	278.7	279.2	279.4	277.8	276.6	274.2	256.4	257.7	255.3	287.5	278.2	8.7	-32.2	-2.3	-22.9
SI-8	Mean El.	288.6	290.0	287.5	279.8	283.8	286.0	290.7	293.0	291.9	292.2	290.5	289.8	289.6	293.2	293.7	290.7	287.2	286.9	286.8	286.9	--	--	285.5	285.0	283.4	281.4	Apr-05	288.1	3.8	-9.2	-2.0	-6.7
	Max El.	295.4	292.6	292.1	284.0	285.3	288.7	296.6	294.2	295.2	295.2	292.7	291.8	291.6	297.7	294.7	293.6	288.8	287.5	286.8	286.9	--	--	286.1	286.8	289.4	284.0	297.7	290.7	4.2	-12.6	-5.4	-6.8
SI-9	Mean El.							228.2	225.6	228.2	228.7	226.8	225.8	225.6	226.1	227.7	226.1	224.7	224.2	224.2	224.0	224.6	223.4	223.5	221.6	221.5	221.9	Apr-98	225.1	2.2	-6.3	**0.4**	-3.3
	Max El.							230.5	226.7	229.7	229.0	228.3	226.6	226.7	229.2	228.8	227.2	225.1	224.8	224.6	224.5	225.4	224.1	224.2	221.8	221.7	225.1	230.5	226.2	2.5	-5.4	**3.4**	-1.1
SI-15	Mean El.								261.0	263.1	263.3	264.2	264.3	264.9	265.5	266.9	266.3	265.5	264.9	264.6	265.4	265.9	265.4	265.3	264.5	263.8	262.3	Jul-05 & Aug-05	264.6	1.4		-1.5	-2.3
	Max El.								263.7	263.3	264.2	265.2	265.2	265.3	267.7	267.8	267.3	265.8	265.5	265.8	265.9	266.4	265.9	266.0	264.8	264.3	262.9	267.8	265.4	1.4		-1.4	-2.5
SI-16	Mean El.													229.8	231.6	232.7	230.1	228.5	227.9	227.9	227.7	228.8	227.6	227.6	224.6	224.3	224.4	Apr-05	228.1	2.5		**0.1**	-3.7
	Max El.													230.9	236.1	234.5	231.7	228.8	228.5	228.3	228.7	229.9	228.5	228.8	224.8	224.5	224.9	236.1	229.2	3.4		**0.4**	-4.3
SI-9 TIP-1	Mean El.							244.1	246.7	248.7	245.9	243.5	242.1	242.3	245.2	244.1	242.0	236.8	235.7	237.6	240.2	239.0	235.5	235.4		238.1	238.3	Jan-Feb-00		4.1			
	Max El.							249.6	247.3	254.2	247.3	245.0	243.8	243.8	248.4	245.0	243.8	239.2	239.8	240.8	240.9	240.9	236.3	236.3		238.1	242.7	254.2		4.7			
SI-9 TIP-2	Mean El.							267.8	263.8	261.2	262.9				266.5	261.2										--	--	Mar-98		2.8			
	Max El.							274.3	266.9	261.2	263.5				270.4	261.2										--	--	274.3		5.3			
SI-11 TIP-1	Mean El.							235.0	234.4	237.5	236.8	236.3	235.3	235.2	240.0	235.7	235.3	235.0	234.7	234.5	235.0	234.3	240.3	240.9		234.7	235.0	Apr-05		2.1			
	Max El.							236.1	239.6	238.4	237.3	237.3	236.1	236.1	245.3	239.6	238.2	235.5	235.5	235.0	239.0	235.5	242.4	241.9		235.0	236.1	245.3		2.8			
SI-11 TIP-2	Mean El.							242.7	243.7	243.8	242.8	242.8	242.7		242.9	242.7	242.7	242.8	242.9	242.5	242.1	242.1	242.1	242.3		--	--	Jan-00		0.5			
	Max El.							242.7	245.0	246.1	243.8	243.8	242.7		245.0	243.2	243.2	243.2	243.8	242.7	242.1	242.1	242.1	243.2		--	--	246.1		1.1			
SI-12 TIP-1	Mean El.							273.2	269.1	268.0	266.9	266.4	264.6	264.4	264.6	268.5	268.1	266.9	265.9	265.5	264.7	263.6	260.1	260.7		265.2	257.6	May-98		3.5	-15.6		
	Max El.							275.5	269.8	268.6	267.5	267.5	265.2	265.2	268.6	269.8	269.8	268.6	267.5	266.3	265.7	265.7	261.1	262.9		268.6	258.3	275.5		3.7	-17.3		
SI-12 TIP-2	Mean El.							275.2	273.9	272.5	270.9	268.7	266.9	267.1	267.1	269.2	266.7	266.7	265.2	264.8	264.6	263.0	258.9	259.0		268.3	257.4	Jun-98		4.8	-17.7		
	Max El.							276.3	275.2	272.9	271.7	270.6	267.1	267.1	271.7	270.6	268.3	270.6	268.8	266.5	266.5	265.4	260.2	260.8		272.9	257.9	276.3		4.9	-18.4		
SI-12 TIP-3	Mean El.							274.2	270.8	269.8	269.7	268.3	266.4	266.1	268.8	270.7	267.9	269.9	268.9	267.9	266.6	265.6	263.9	264.4		--	263.6	Oct-07		2.7			
	Max El.							274.8	272.5	272.5	273.7	270.2	267.9	267.9	273.7	273.7	269.1	274.8	271.9	269.1	268.5	267.3	264.5	265.0		--	264.5	274.8		3.5			
SI-15 TIP-1	Mean El.								271.2	270.4	270.6	271.1	271.0	271.6	274.0	273.0	271.6	271.6	270.1	270.2	271.3	269.0	264.0	263.9		266.6	267.2	Mar-05 & Apr-05		2.8			
	Max El.								271.8	271.8	274.1	273.0	274.1	273.0	276.4	274.1	273.5	273.5	270.7	271.2	274.7	271.2	267.2	264.9		267.2	267.2	276.4		3.1			
SI-15 TIP-2	Mean El.								277.7	276.1	276.4	276.8	274.8	268.9	267.1	266.8	266.0	270.8	273.1	275.2	279.1	277.7	273.0	273.0		--	--	May-11		4.2			
	Max El.								278.8	276.5	280.0	277.7	276.5	276.5	267.3	273.1	266.2	277.1	274.2	278.8	282.8	279.4	277.1	275.9		--	--	282.8		4.3			
SI-16 TIP-1	Mean El.													238.3	239.3	238.5	238.5	237.7	236.2	236.1	233.7	233.7	232.4	232.5		231.9	232.5	Jan-05		2.8			
	Max El.													239.7	244.3	239.7	239.1	238.5	236.8	239.7	235.6	235.6	232.8	233.9		232.2	232.8	244.3		3.6			
SI-16 TIP-2	Mean El.													259.9	262.9	259.4	257.6	257.6	257.6	257.6	258.2	257.6				--	259.2	Mar-05		1.7			
	Max El.													261.6	265.1	260.5	257.6	257.6	257.6	257.6	258.2	257.6				--	259.3	265.1		2.5			
Area Average	Mean El.	280.3	281.8	283.2	279.9	281.8	282.4	261.4	262.6	262.3	262.0	261.3	260.2	257.3	258.5	258.4	256.7	256.0	255.4	255.5	255.8	253.0	250.8	253.4	250.3	250.3	248.4		262.3	11.5	-12.9	-1.9	-13.8
	Max El	285.7	288.1	286.5	284.6	284.0	284.5	264.4	264.3	263.9	263.7	262.6	261.4	258.9	262.1	260.1	258.1	257.9	256.8	256.8	257.3	254.3	252.2	254.6	250.9	251.9	249.7		264.4	12.5	-14.6	-2.2	-14.7
Change vs Prior	Mean El.		1.5	1.4	-3.3	1.9	0.6	-21.0	1.2	-0.3	-0.3	-0.7	-1.1	-2.9	1.2	-0.1	-1.7	-0.7	-0.6	0.0	0.4	-2.8	-2.2	2.6	-3.0	0.0	-1.9						
	Max El.		2.4	-1.6	-1.9	-0.6	0.5	-20.1	0.0	-0.5	-0.2	-1.1	-1.2	-2.5	3.2	-2.0	-1.9	-0.3	-1.1	0.0	0.5	-3.0	-2.1	2.4	-3.6	1.0	-2.2						

SUMMARY OF GROUNDWATER DATA
Calle del Barco Landslide Assessment District
Malibu, California

PLATE A-2

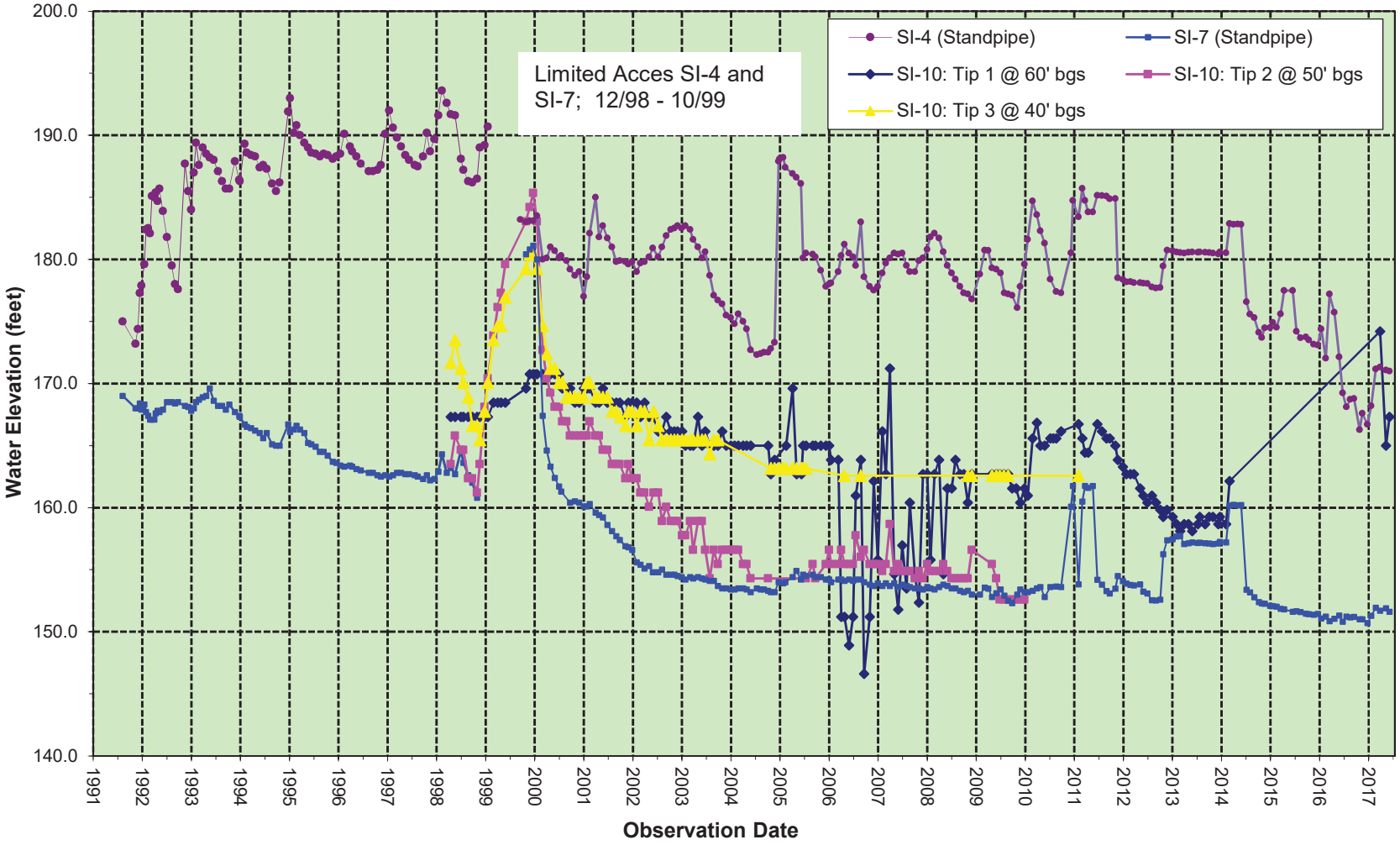
CALLE DEL BARCO - SUMMARY OF GROUNDWATER DATA

Piezometer I.D.		91-92*	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00**	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	Highest Ever Recorded	Mean '91 - '17	Stand. Dev.	16-17 vs 97-98	16-17 vs 15-16	16-17 vs Mean
Rambla Pacifico																																	
SI-13	Mean El.								361.3	359.3	360.3	360.2	360.0	360.5	361.7	363.4	362.4	360.4	360.0	359.1	359.0	359.9	358.6	358.5	356.2	355.5	354.6	Apr-05	359.5	2.2		-0.8	-4.9
	Max El.								362.4	359.9	361.2	360.8	361.1	361.1	365.1	364.5	363.4	361.1	360.5	359.5	359.3	360.5	359.4	359.5	356.3	355.9	356.4	365.1	360.4	2.5		**0.5**	-4.0
SI-13 TIP-1	Mean El.								362.9	361.1	362.5	362.5	361.4	361.5	361.9	363.3	362.3	361.2	359.0	358.6	359.3	359.5	357.5	357.1		--	--	Nov-07		2.0			
	Max El.								363.2	362.1	363.2	363.2	363.2	362.1	365.5	364.4	364.4	367.8	360.3	359.8	359.8	360.3	359.2	359.2		--	--	367.8		2.5			
SI-14	Mean El.								342.0	341.6	341.7	342.2	341.7	341.8	342.8	344.1	343.6	342.8	342.8	342.1	342.4	342.5	342.1	342.3	341.0	340.8	340.4	May-05	342.1	0.9		-0.4	-1.8
	Max El.								342.2	341.7	342.3	342.5	341.9	341.9	346.3	345.8	344.3	343.1	343.0	342.5	342.9	342.8	343.2	342.8	341.1	340.9	340.7	346.3	342.7	1.5		-0.3	-2.1
SI-14 TIP-1	Mean El.								345.9	345.7	345.0	344.0	341.2	342.5	343.2	342.5	340.7	342.3	340.8	340.8	341.5	343.4	343.3	343.3		342.3	342.1	Nov-98		1.6			
	Max El.								346.9	345.8	345.8	345.8	341.2	343.5	345.8	343.5	341.7	345.8	341.2	341.7	341.7	344.0	344.0	343.5		342.3	342.3	346.9		1.9			
Area Average	Mean El.								353.0	351.9	352.4	352.2	351.1	351.6	352.4	353.3	352.3	351.7	350.6	350.2	350.6	351.3	350.4	350.3	348.6	346.2	345.7		350.8	2.1		-0.5	-5.1
	Max El								353.7	352.4	353.1	353.1	351.8	352.1	355.7	354.5	353.4	354.4	351.2	350.9	350.9	351.9	351.5	351.2	348.7	346.4	346.5		351.8	2.5		**0.1**	-5.3
Change vs Prior	Mean El.									-1.1	0.5	-0.2	-1.1	0.5	0.9	0.9	-1.1	-0.6	-1.0	-0.5	0.4	0.8	-1.0	-0.1	-1.7	-2.4	-0.5						
	Max El.									-1.3	0.8	-0.1	-1.2	0.3	3.5	-1.1	-1.1	1.0	-3.2	-0.4	0.0	1.0	-0.5	-0.2	-2.5	-2.3	0.1						

Piezometer Not Installed | No Data Recorded | -- Piezometer Not Functioning, Reading 0 PSI or Data Uncertain

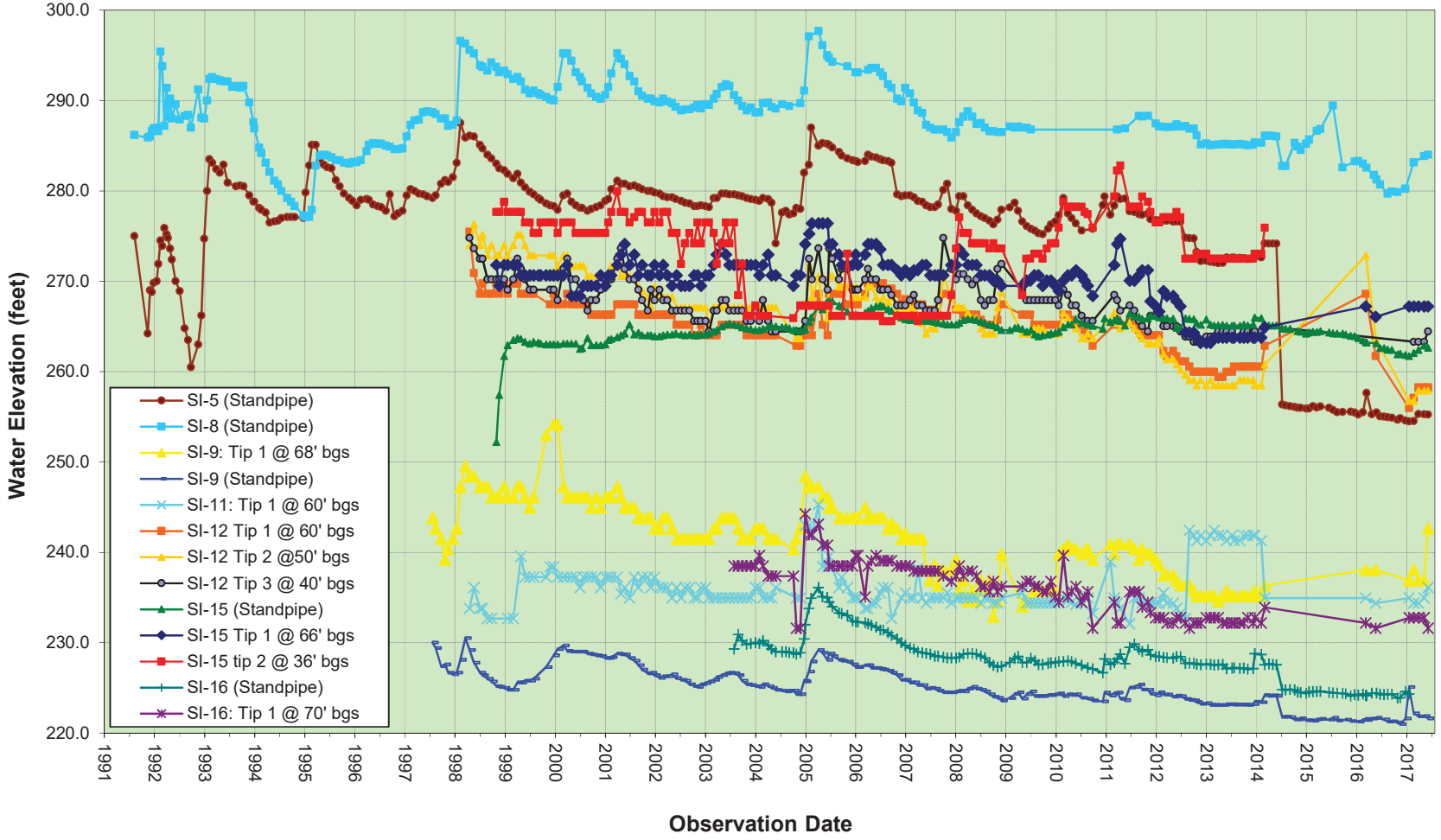
SUMMARY OF GROUNDWATER DATA
Calle del Barco Landslide Assessment District
Malibu, California

PLATE A-2



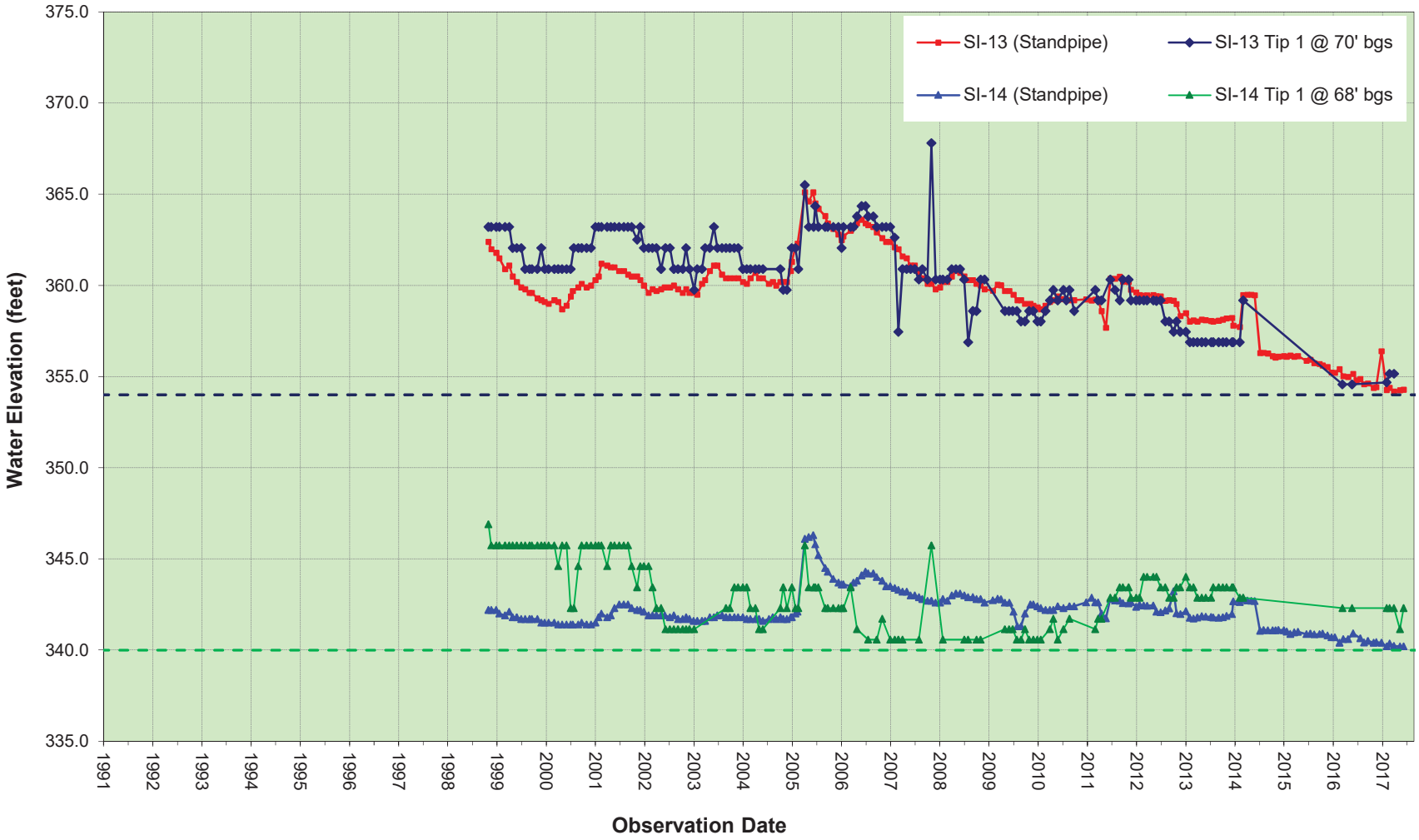
GROUNDWATER HYDROGRAPH
Rambla Vista
Calle del Barco Landslide Assessment District
Malibu, California

PLATE A-3



GROUNDWATER HYDROGRAPH
Calle del Barco
Calle del Barco Landslide Assessment District
Malibu, California

PLATE A-4



GROUNDWATER HYDROGRAPH
Rambla Pacifico
Calle del Barco Landslide Assessment District
Malibu, California

PLATE A-5

APPENDIX B
DEWATERING DATA

Dewatering Well Information							
Well ID	Vault Elevation (ft.)	Bottom Elevation (ft.)	Pump Elevation (ft.)	Pump Size (hp)	2016-2017 Pumping Rate (gpd)	% of Total Well Production	Comment
W-A	196.0	Unknown	45.0	1/2	10.9	5%	
W-B	204.0	Unknown	54.0	1/2	9.8	4%	
W-C	295.0	Unknown	233.0	1/2	25.2	11%	
W-D*	297.0	Unknown	Unknown	none	0.0	0%	Destroyed '98
W-E	215.0	Unknown	116.5	1/2	27.2	12%	
W-F	210.0	109.0	112.0	1/2	71.0	32%	
W-G*	292.0	222.0	223.0	1/3	0.0	0%	No Pump
W-H	299.5	234.5	242.5	1/3	1.3	1%	
W-I	298.0	238.0	248.0	1/3	13.3	6%	
W-J	304.0	244.0	254.0	1/3	12.0	5%	
W-K	430.0	370.0	380.0	1/3	0.0	0%	Dry
W-L	258.0	189.0	192.5	1/2	11.0	5%	
W-M	302.0	237.0	Unknown	Unknown	40.5	18%	

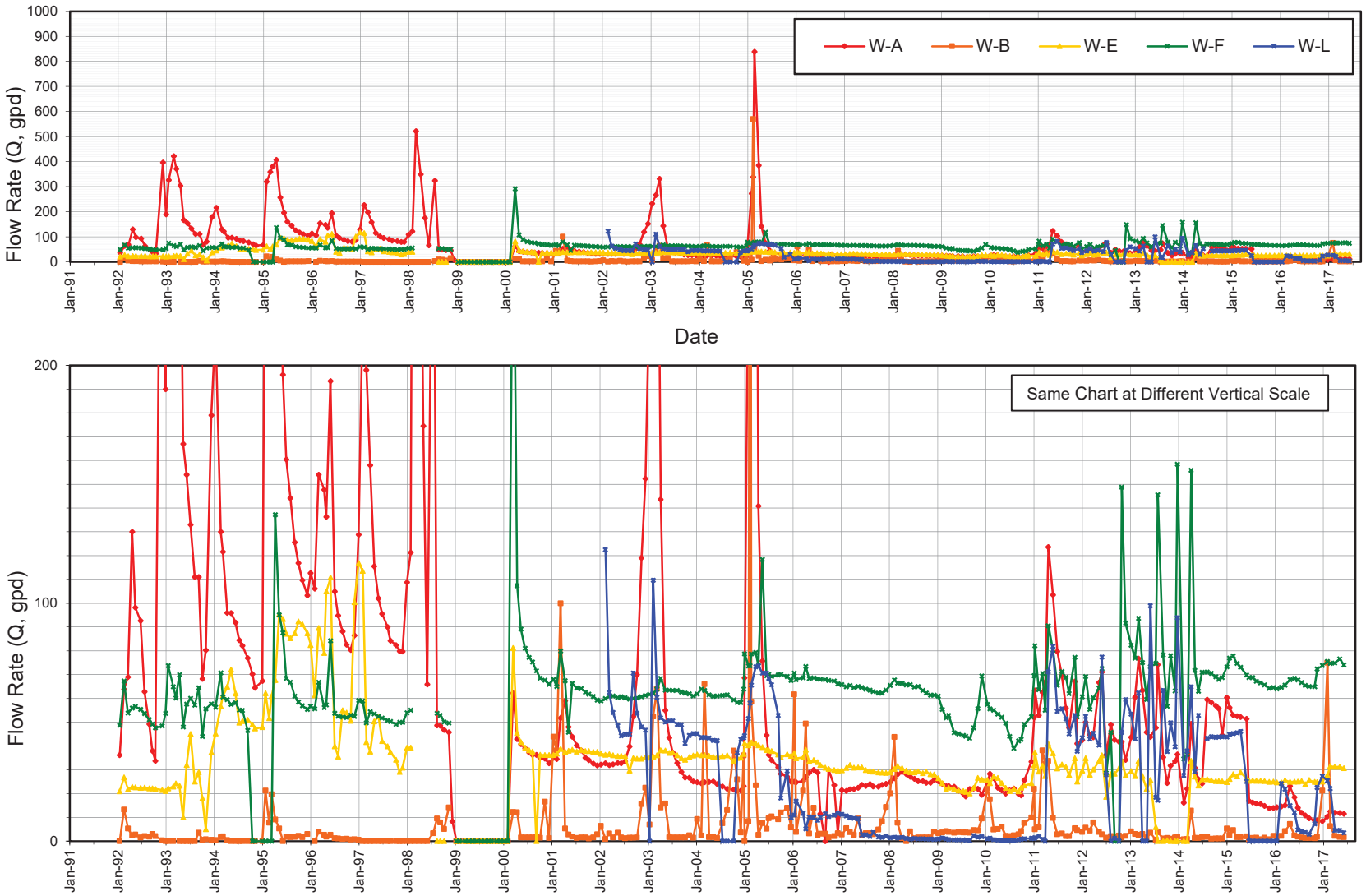
*Note: * Non-functioning Dewatering Wells*

Hydrauger Information						
Hydrauger ID	Installed Length (ft)	Functional Length (ft)	2016-2017 Flow Rate (gpd)	% of Total Production	Installed By	Comment
HD-1[2]	93	unknown	0	0%	BYA	Destroyed per BYA (2000)
HD-2[2]	127	unknown	0	0%	BYA	Destroyed per BYA (2000)
HD-3[2]	155	unknown	0	0%	BYA	Destroyed per BYA (2000)
HD-4[2]	80	unknown	0	0%	BYA	Destroyed per BYA (2000)
HD-5[2]	65	unknown	0	0%	BYA	Destroyed per BYA (2000)
HD-6[2]	97	unknown	0	0%	BYA	Destroyed per BYA (2000)
HD-7[3]	227	unknown	0	0%	BYA	no production '16-'17
HD-8[3]	290	unknown	0	0%	BYA	no production '16-'17
HD-9[3]	230	unknown	0	0%	BYA	no production '16-'17
HD-10[3]	330	unknown	0	0%	BYA	no production '16-'17
HD-11[3]	230	unknown	0	0%	BYA	no production '16-'17
HD-12[3]	330	unknown	0	0%	BYA	no production '16-'17
HD-13	210	unknown	53	21%	BYA	
H-1	240	unknown	143	56%	LA County	
H-2	180	unknown	0	0%	LA County	No outlet to monitor
ROWH-1	--	unknown	53	21%	BYA	discharge diverted from H-2
H-3[1]	235	unknown	0	0%	LA County	Destroyed 1998
H-4[1]	140	unknown	0	0%	LA County	Destroyed 1998
H-5[1]	260	unknown	0	0%	LA County	Destroyed 1998
H-6[1]	140	unknown	0	0%	LA County	Destroyed 1998
H-7[1]	205	unknown	0	0%	LA County	Destroyed 1998
H-1A	100	92	4	1%	Fugro	
H-2A	130	125	1	1%	Fugro	

Note: 1 - Destroyed in 1998 Landslide
2 - Destroyed per BYA (2000)
3 - Non-producing Hydraugers

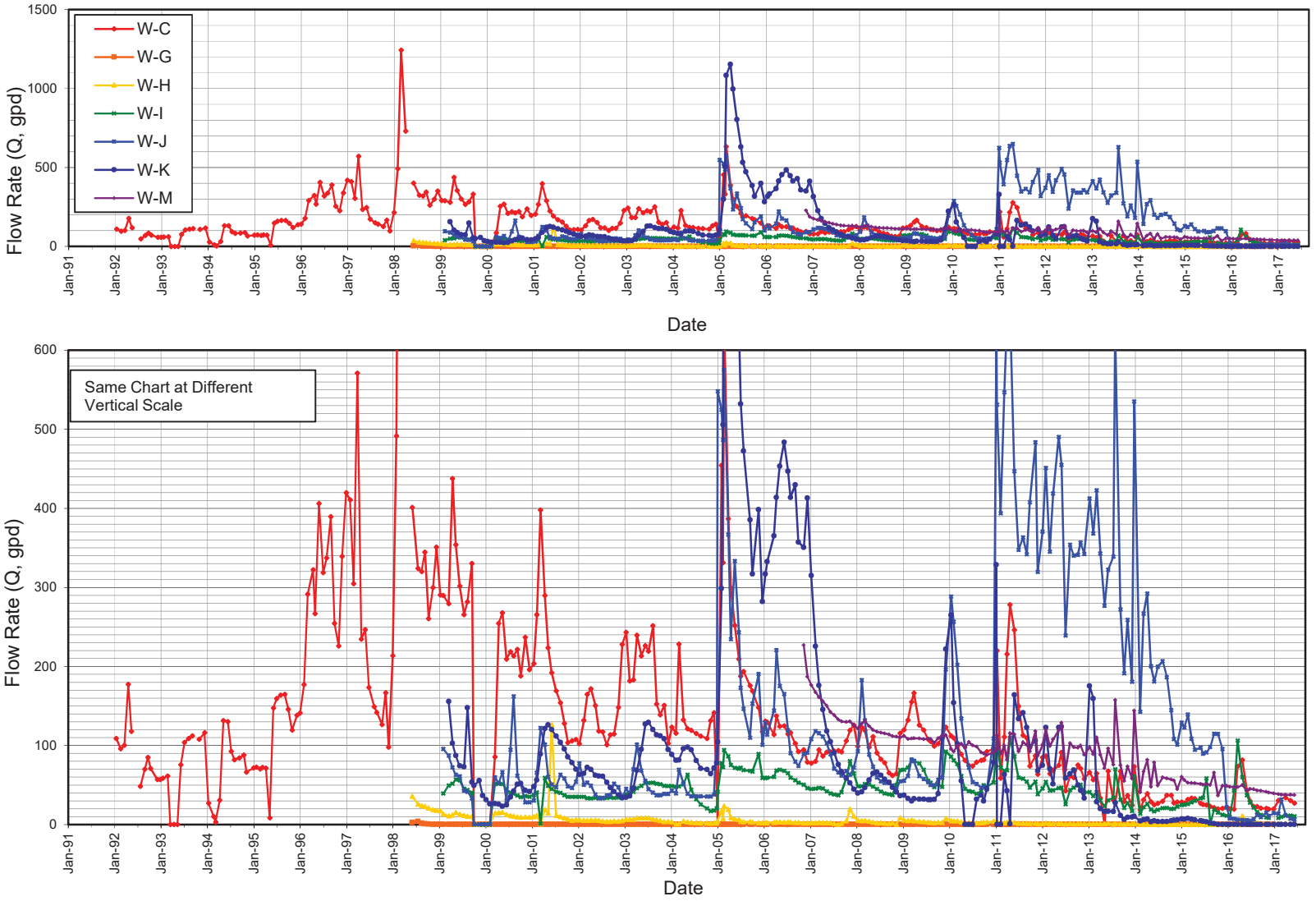
DEWATERING WELL / HYDRAUGER INFORMATION
Calle del Barco Landslide Assessment District
Malibu, California

PLATE B-1



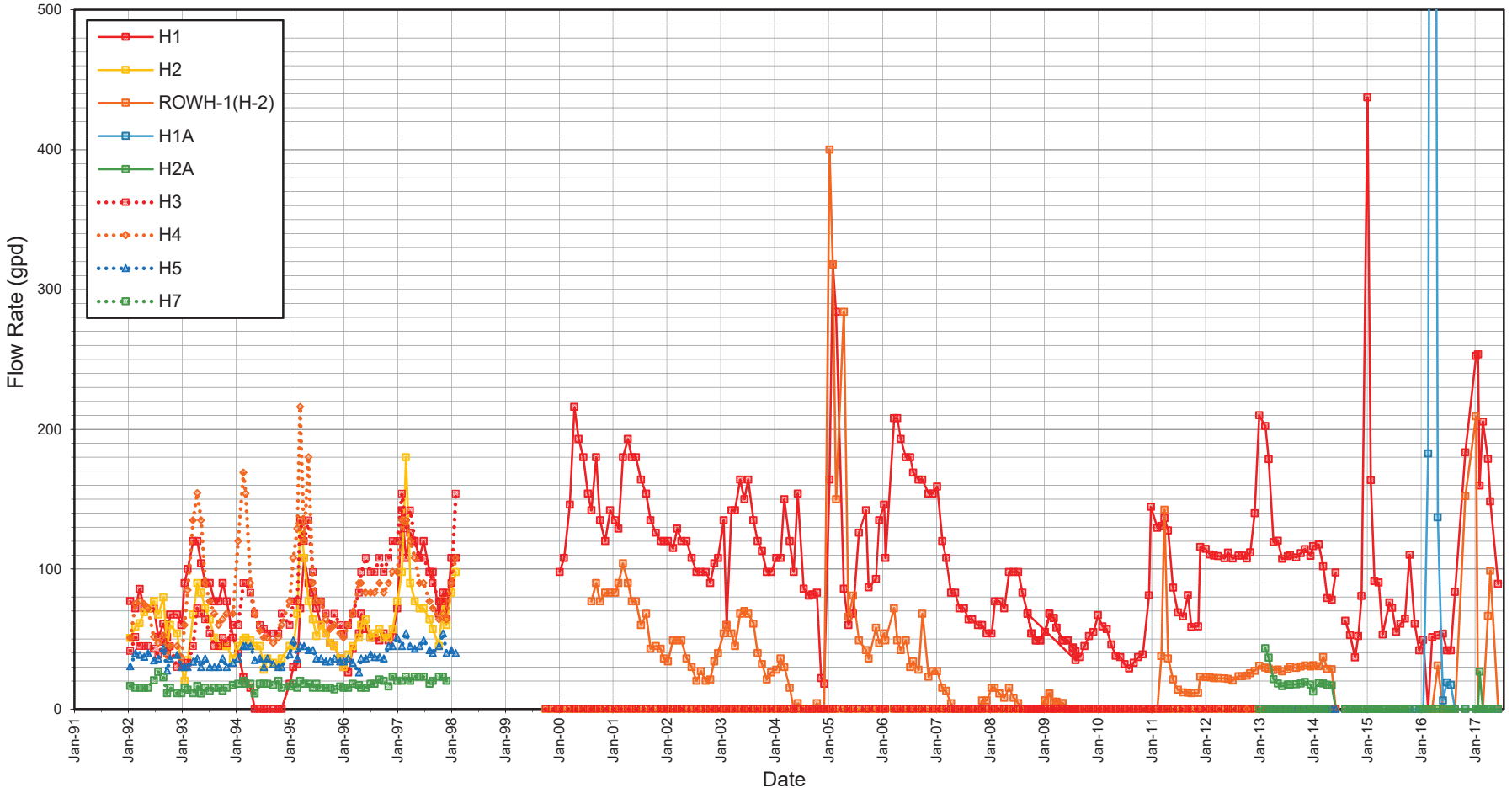
DEWATERING WELL DISCHARGE RATE GRAPH
Rambla Orienta and Slope
Calle del Barco Landslide Assessment District
Malibu, California

PLATE B-2



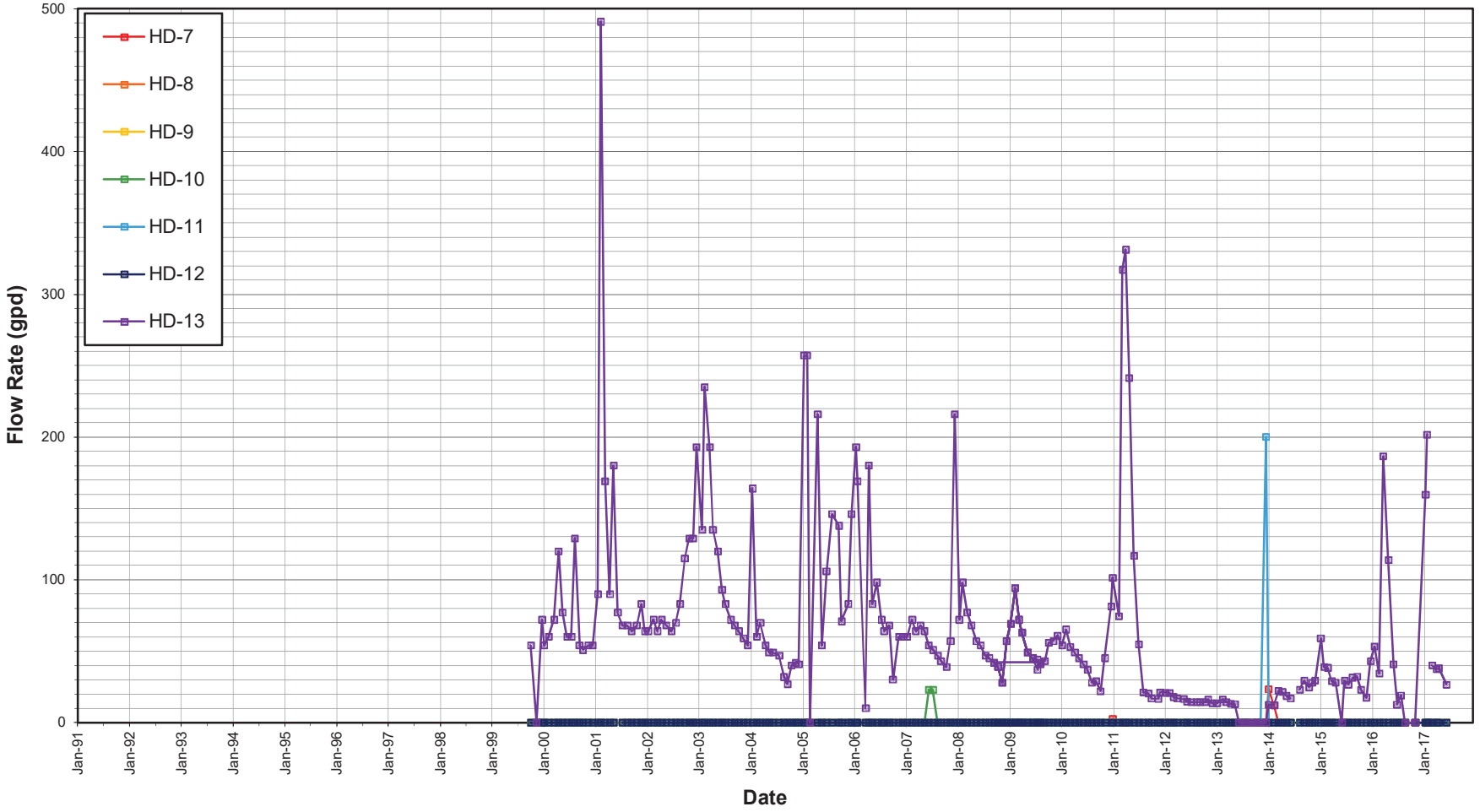
DEWATERING WELL DISCHARGE RATE GRAPH
Calle del Barco and Rambla Pacifico
Calle del Barco Landslide Assessment District
Malibu, California

PLATE B-3



HYDRAUGER DISCHARGE RATE GRAPH
Rambla Orienta
Calle del Barco Landslide Assessment District
Malibu, CAlifornia

PLATE B-4



HYDRAUGER DISCHARGE RATE GRAPH
Landslide Toe
Calle del Barco Landslide Assessment District
Malibu, California

PLATE B-5

APPENDIX C
SLOPE INCLINOMETER DATA

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Slope Inclinometer Interpretation Summary																	
	SI-1*	SI-1A	SI-2**	SI-3	SI-4	SI-5	SI-6	SI-7	SI-8	SI-9	SI-10	SI-11	SI-12	SI-13	SI-14	SI-15	SI-16
Installation Details																	
Surface Elev. (ft) 4/00	295.0	297.0	298.0	207.0	206.0	302.0	295.0	200.0	335.0	298.0	202.0	291.5	301.0	405.0	398.0	304.0	295.0
Original DEPTH (ft.)	64.0	NI	NI	NI	76.0	100.0	NI	100.0	130.0	100.0	60.0	60.0	60.0	80.0	78.0	76.0	88.0
Current DEPTH (ft.)	64.0	NI	NI	NI	78.0	96.0	NI	102.0	130.0	96.0	62.0	57.0	56.0	78.0	76.0	72.0	86.0
STATUS	D	D	D	D	F	F	D	F	F	F	F	F	F	F	F	F	F
READING INTERVAL	N/A	N/A	N/A	N/A	Semi	Semi	N/A	Semi	Semi	Qrtly	Semi	Semi	Semi	Semi	Semi	Semi	Qrtly
DATE OF INSTALLATION	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	3/13/98	3/12/98	3/12/98	9/1998	9/1998	9/1998	8/8/03
DATE FIRST BASE READING	NI	NI	NI	NI	NI	NI	NI	NI	NI	12/22/97	3/16/98	3/13/98	3/16/98	10/12/98	10/12/98	10/23/98	8/13/03
*DEPTH of MOVEMENT (ft)****	NI	NI	NI	NI	17-22	0-10, 36-38	15.0	40.0	15-17	53, 44	35-38	0-55	54	0-30	8.0	0-25, 77	46, 87
A+ Axis orientation	NI	NI	NI	NI	0	38.0	NI	28.0	22.0	212.0	244.0	258.0	238.0	210.0	224.0	190.0	210 est.
Interpretation Movement (inches)																	
2016-2017	NR	NR	NR	NR	--	--	NR	--	--	--	--	--	--	--	--	--	<0.1
2015-2016	NR	NR	NR	NR	--	<0.05	NR	--	--	0.2	--	--	--	--	--	--	--
2014-2015	NR	NR	NR	NR	--	0.1	NR	--	--	--	--	--	--	--	--	--	<0.1
2013-2014	NR	NR	NR	NR	--	0.1	NR	--	--	--	--	--	--	--	--	--	<0.1
2012-2013	NR	NR	NR	NR	--	0.1	NR	--	--	0.15	0.1	--	0.1	--	--	--	0.2
2011-2012	NR	NR	NR	NR	--	--	NR	<0.05	0.1	0.15	--	0.2	--	--	--	0.1	0.35
2010-2011	NR	NR	NR	NR	--	--	NR	<0.05	0.05	<0.05	--	--	--	--	--	--	--
2009-2010	NR	NR	NR	NR	--	--	NR	--	--	0.2	--	0.1	--	--	--	--	0.1
2008-2009	NR	NR	NR	NR	--	--	NR	NA	--	0.1	--	--	--	--	--	--	--
2007-2008	NR	NR	NR	NR	--	--	NR	--	--	0.1	--	--	--	--	--	--	--
2006-2007	NR	NR	NR	NR	--	<0.1	NR	--	--	0.2	--	--	--	--	0.2	--	0.2
2005-2006	NR	NR	NR	NR	--	--	NR	--	--	0.1	--	--	<0.1	--	0.15	--	0.1
2004-2005	NR	NR	NR	NR	--	0.45	NR	<0.1	0.1	0.5	--	<0.1	0.11	--	--	--	0.35
2003-2004	NR	NR	NR	NR	--	--	NR	--	--	--	--	--	--	--	--	--	--
2002-2003	NR	NR	NR	NR	--	--	NR	--	--	--	--	--	--	--	--	--	--
2001-2002	NR	NR	NR	NR	--	--	NR	--	--	--	--	--	--	--	--	--	--
2000-2001	NR	NR	NR	NR	--	--	NR	--	--	--	--	--	--	--	--	--	--
1999-2000	NR	NR	NR	NR	--	--	NR	--	--	--	--	--	--	--	--	--	--
1998-1999	NR	NR	NR	NR	--	0.16	NR	0.11	--	2.19	--	--	--	--	--	--	--
1997-1998	NR	NR	NR	NR	0.22	0.4	NR	0.66	0.32	13	0.22	--	--	NR	NR	NR	NR
1996-1997	NR	NR	NR	NR	NA	NA	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR
1995-1996	NR	NR	NR	NR	NA	NA	NR	NA	NA	NR	NR	NR	NR	NR	NR	NR	NR

KEY:

D	Destroyed
F	Functioning
B	New baseline in 1999
NI	No information
--	Shaded yellow to indicate inclinometer does penetrate basal rupture.
--	Shaded blue to indicate inclinometer does NOT penetrate basal rupture.
--	Shaded gray to indicate inclinometer is no longer monitored.

--	No clearly defined interpreted movement
NR	No reading
NA	Data not available

NOTES:

* Original SI-1 installed in 1978, and was destroyed. SI-65 (installed in 1979) was renamed to SI-1

** Original SI-2 installed in 1978, and was destroyed. SI-90 (installed in 1979) was renamed to SI-2

*** Referenced to current depth of SI (see note below)

**** SI-4, SI-7, and SI-10 were extended 6 feet upwards during reconstruction of the road in 1999 and interpretations are referenced to their current depth.

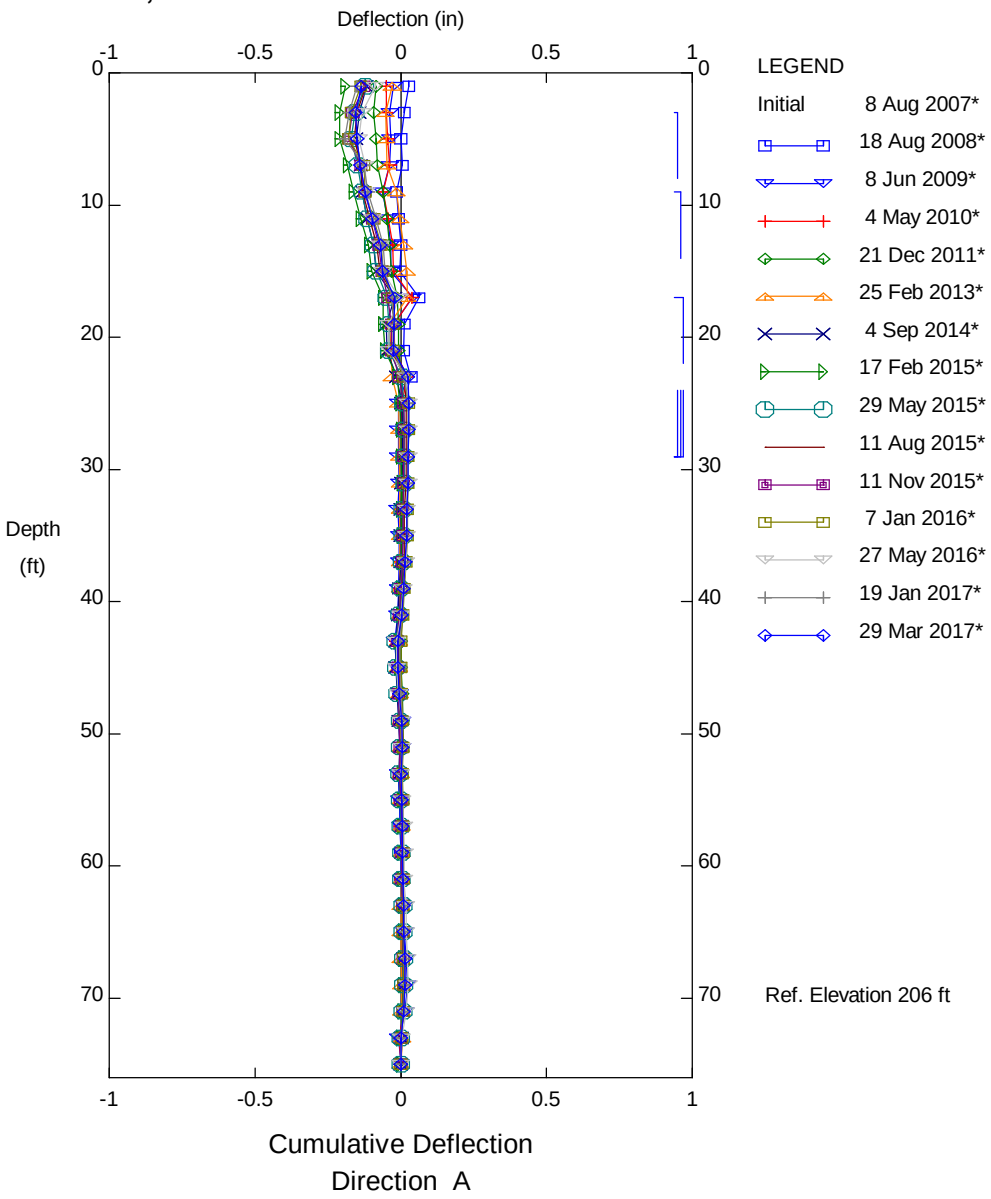
SUMMARY OF SLOPE INCLINOMETERS

Calle del Barco Landslide Assessement District
Malibu, California

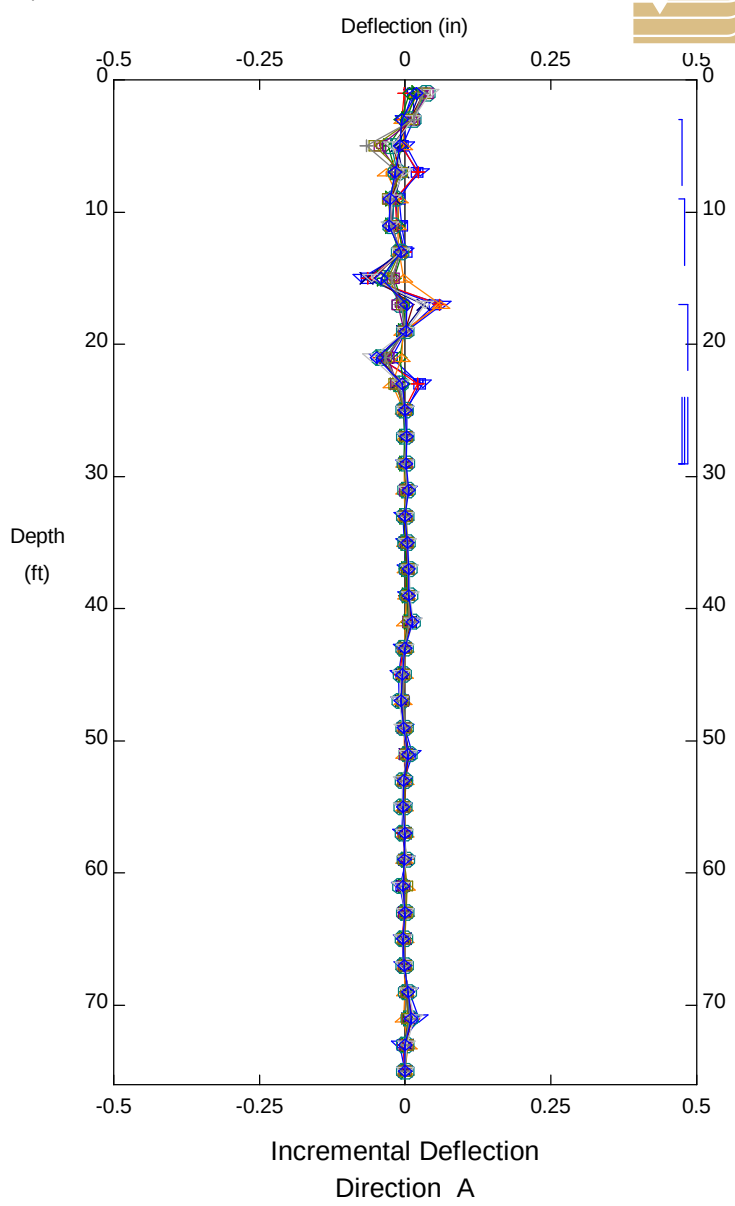
PLATE C-1

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction A



Incremental Deflection
Direction A

Assessment District 98-2, Inclinometer SI-4

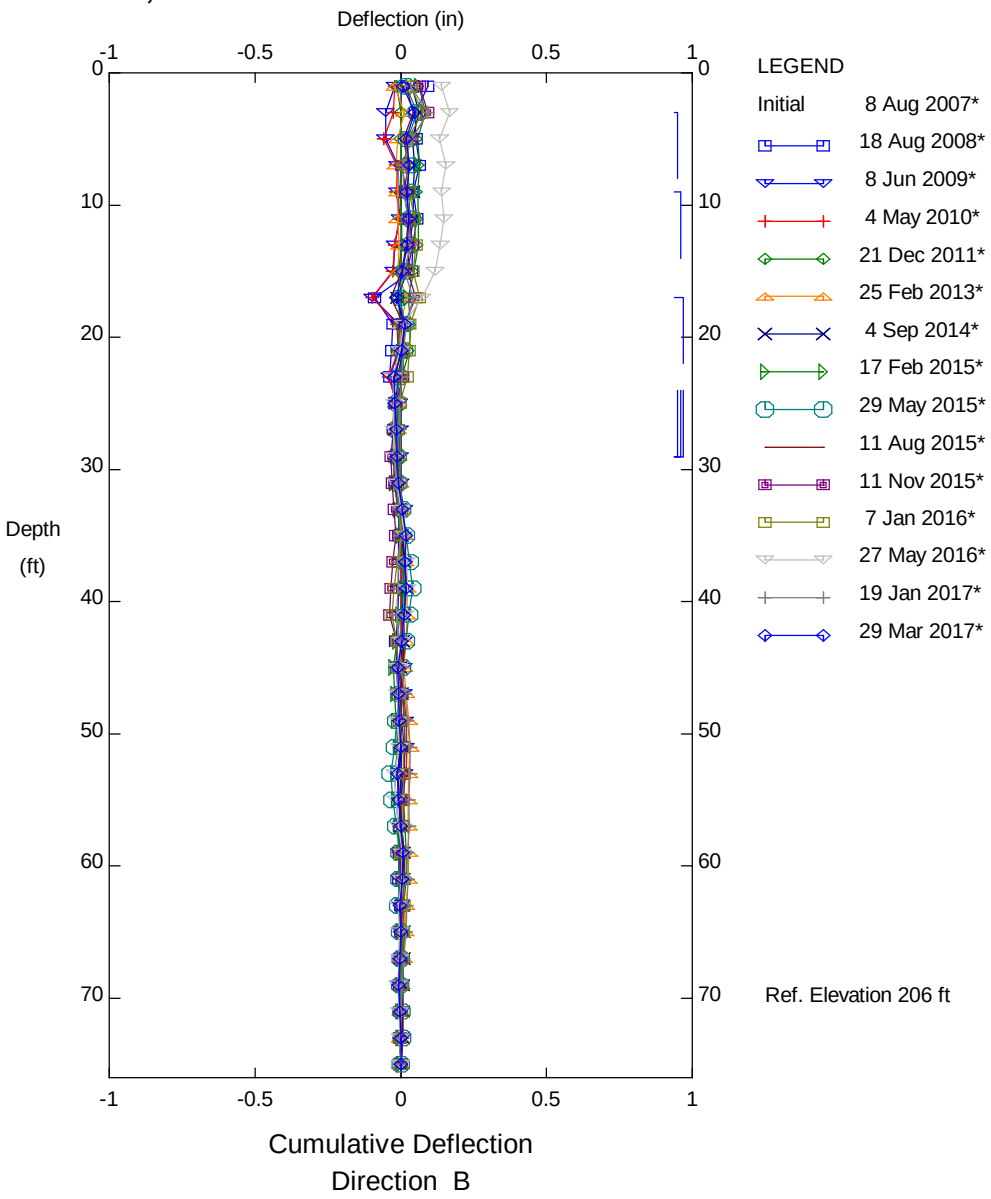
City of Malibu

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

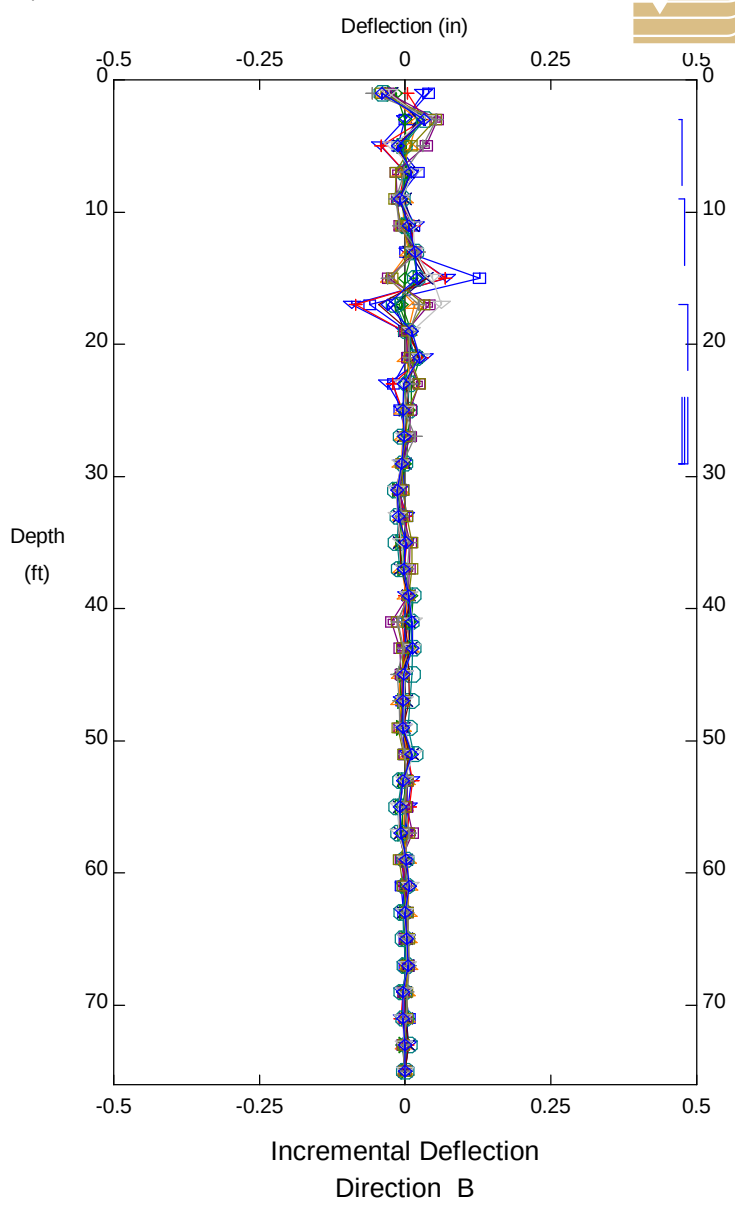
PLATE C-2a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction B



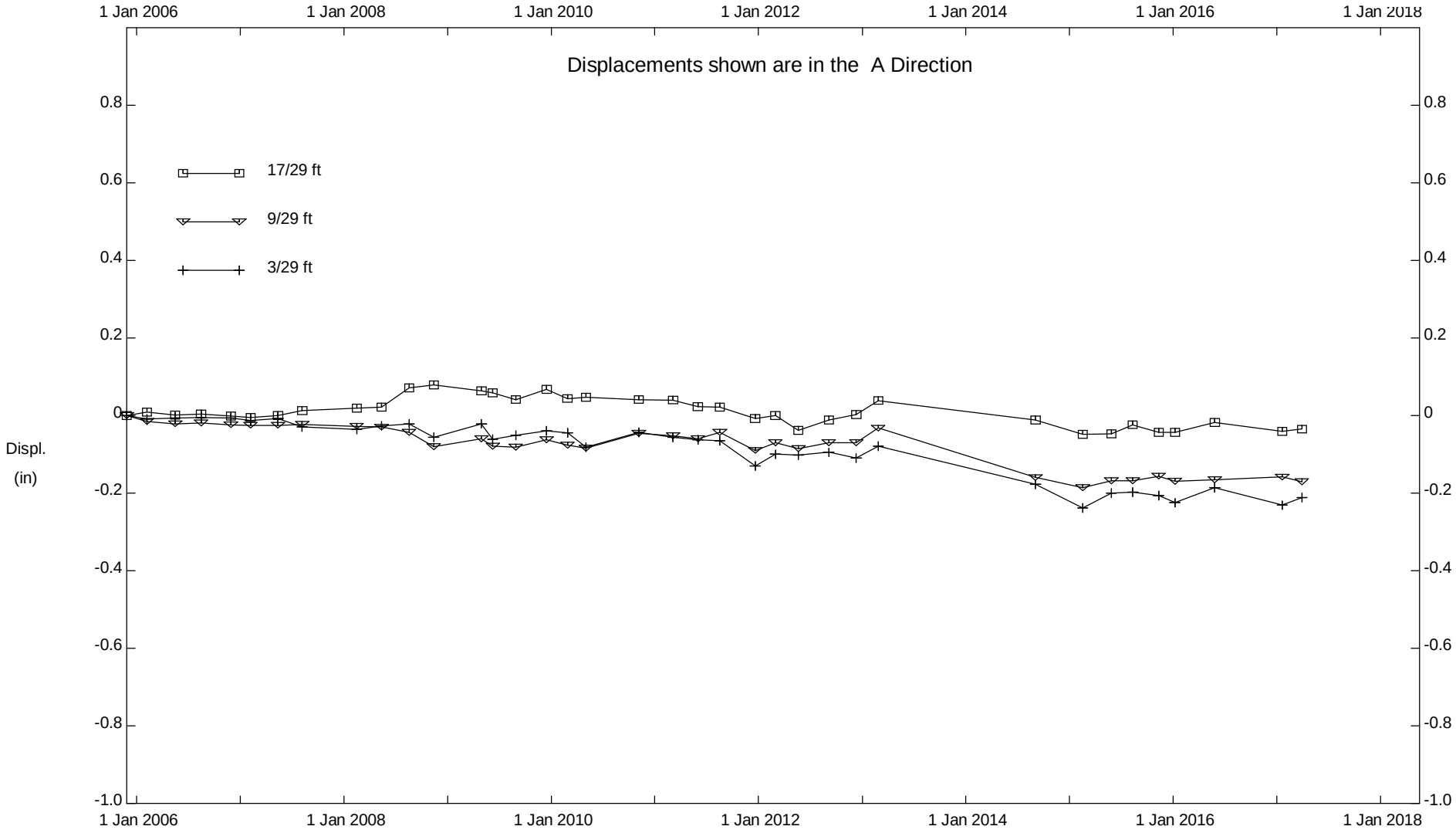
Incremental Deflection
Direction B

Assessment District 98-2, Inclinometer SI-4

City of Malibu

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

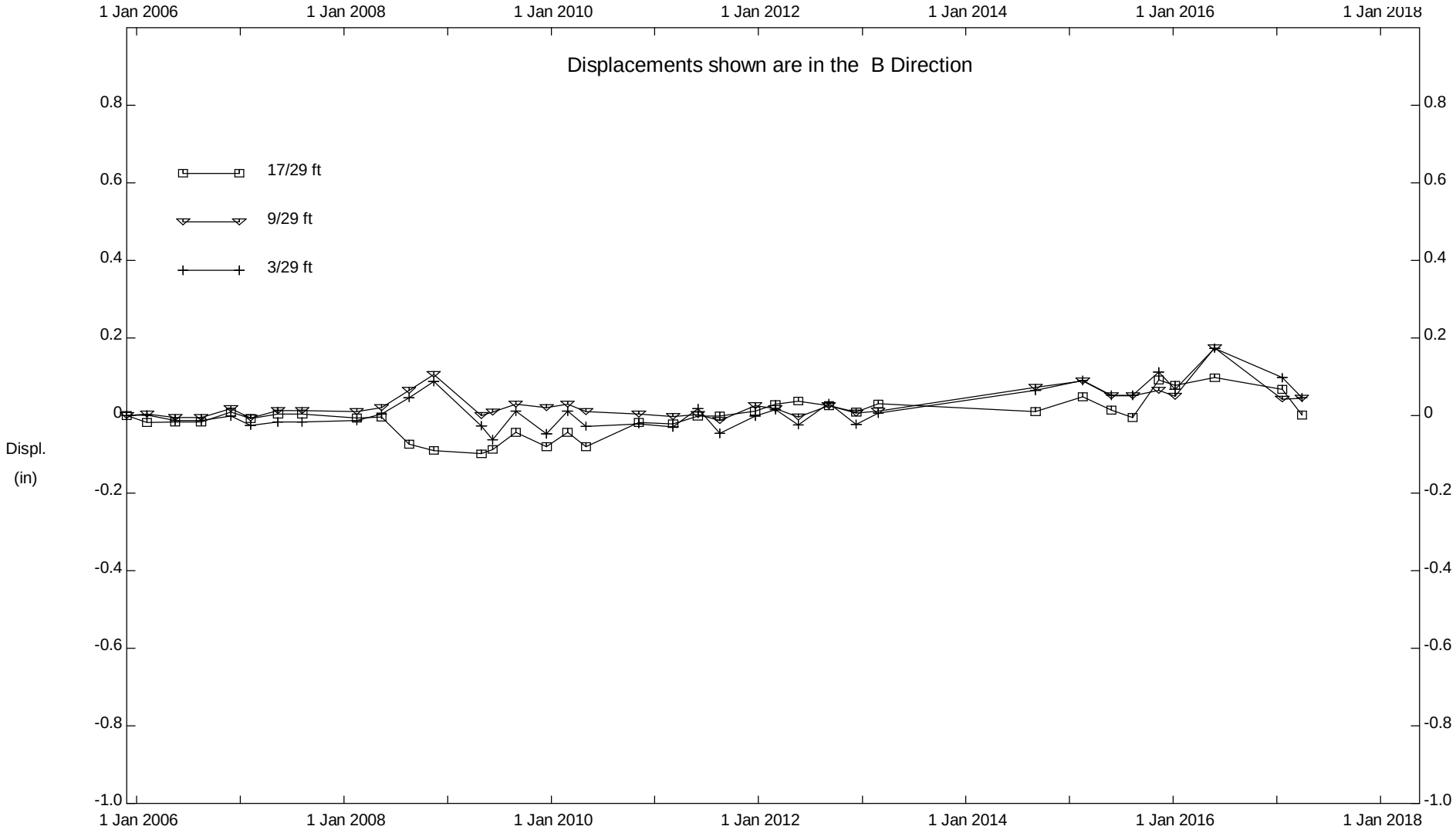
PLATE C-2b



Assessment District 98-2, Inclinometer SI-4

City of Malibu

PLATE C-2c



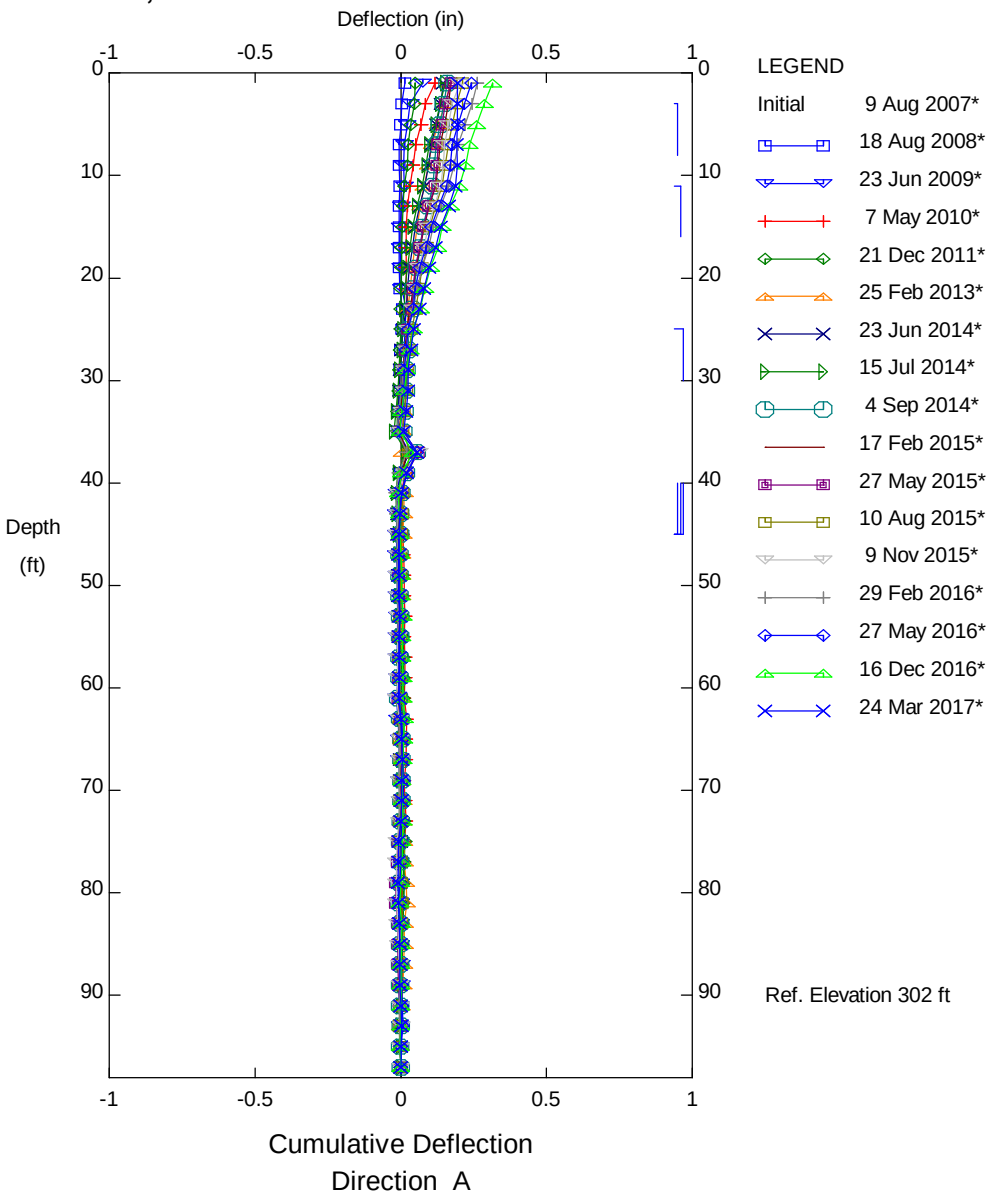
Assessment District 98-2, Inclinometer SI-4

City of Malibu

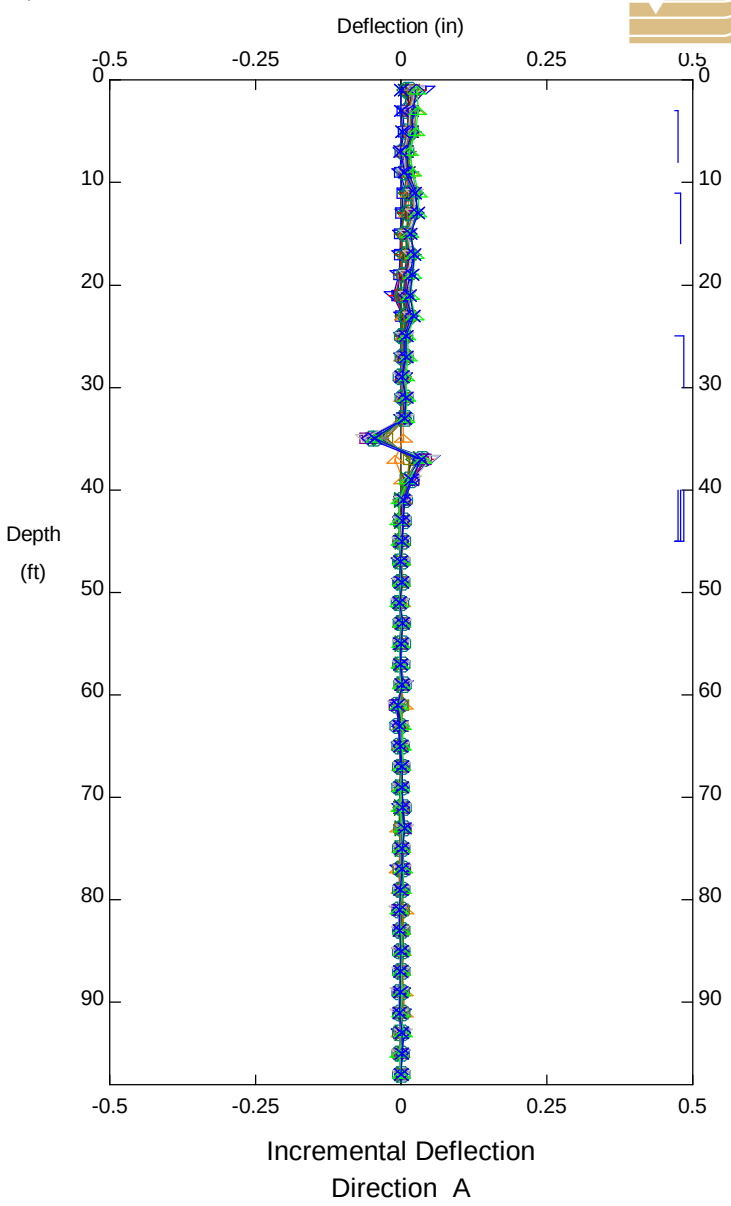
PLATE C-2d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction A



Incremental Deflection
Direction A

Assessment District 98-2, Inclinometer SI-5

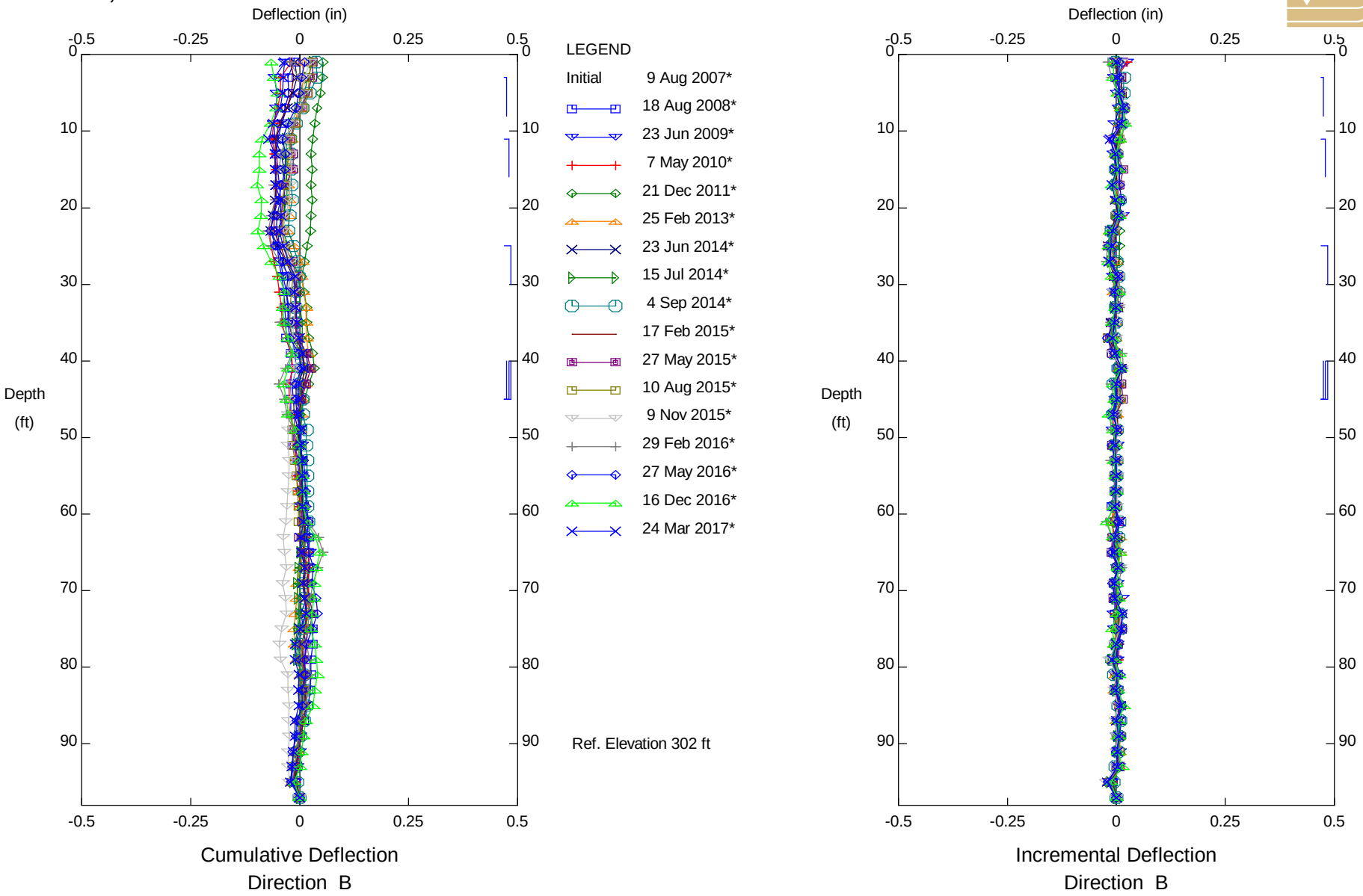
City of Malibu

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

PLATE C-3a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



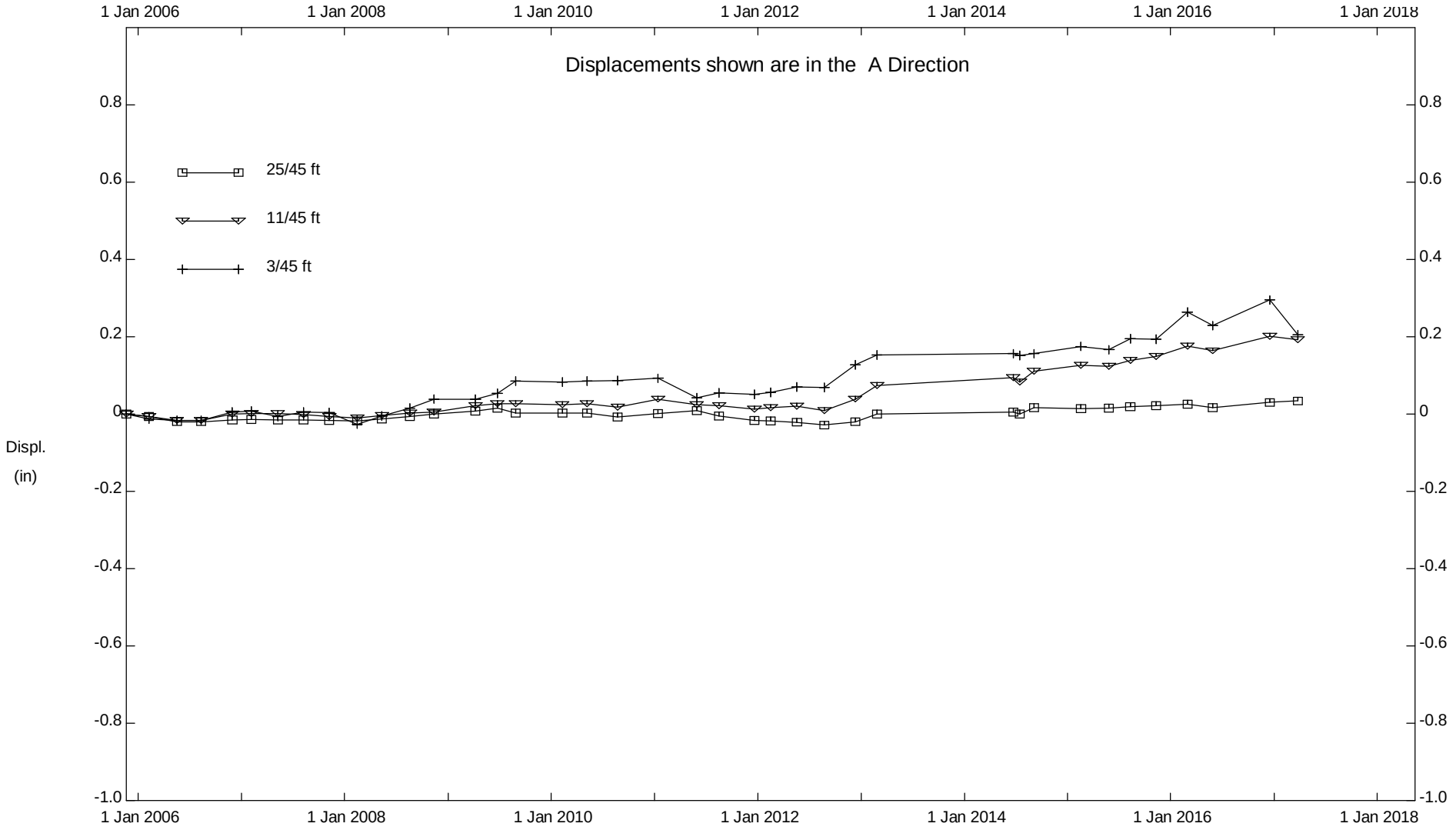
Assessment District 98-2, Inclinometer SI-5

City of Malibu

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

PLATE C-3b

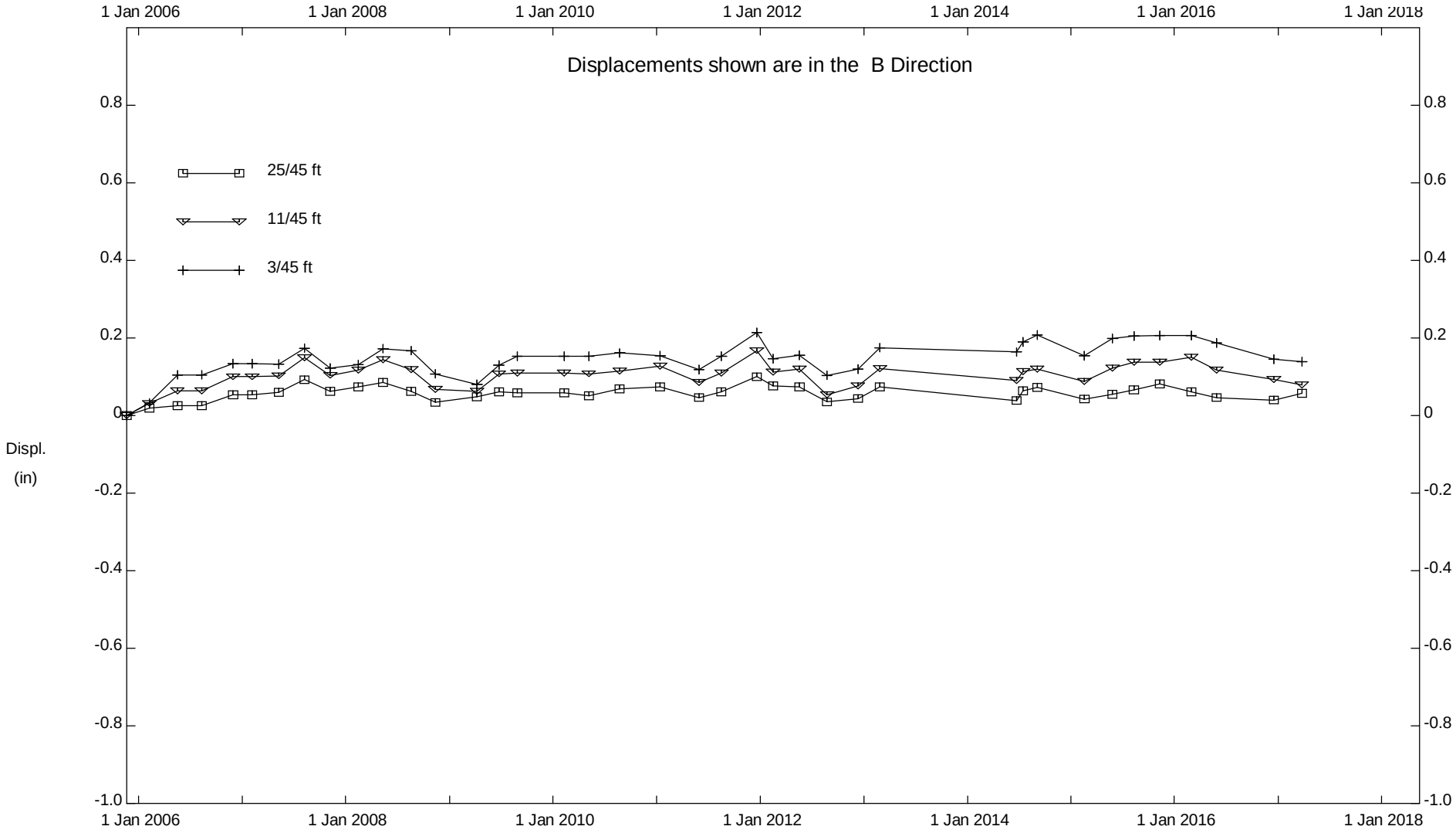
Fugro Consultants, Inc. - Ventura, CA



Assessment District 98-2, Inclinometer SI-5

City of Malibu

PLATE C-3c



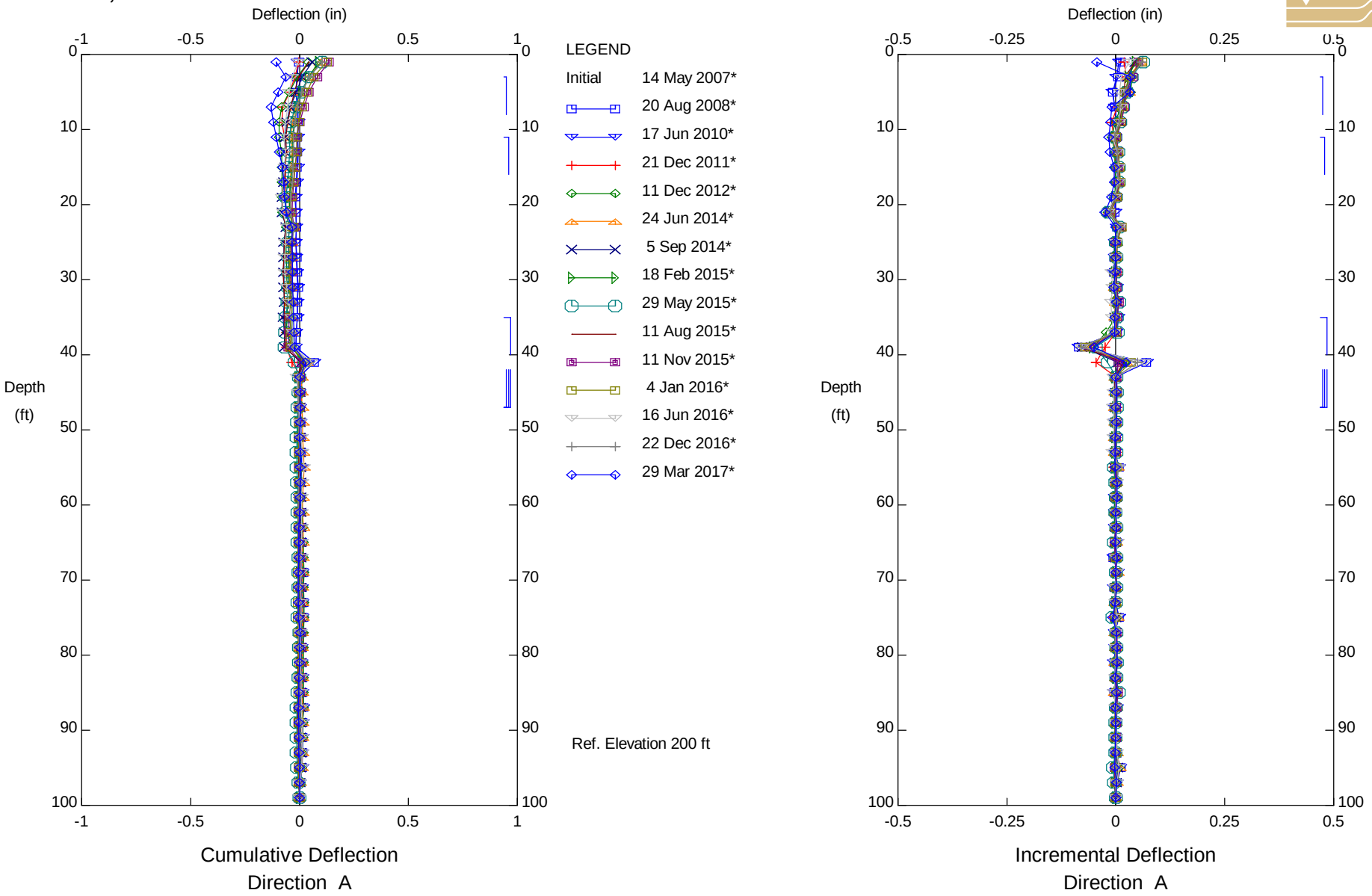
Assessment District 98-2, Inclinometer SI-5

City of Malibu

PLATE C-3d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Calle del Barco, Inclinometer SI-7

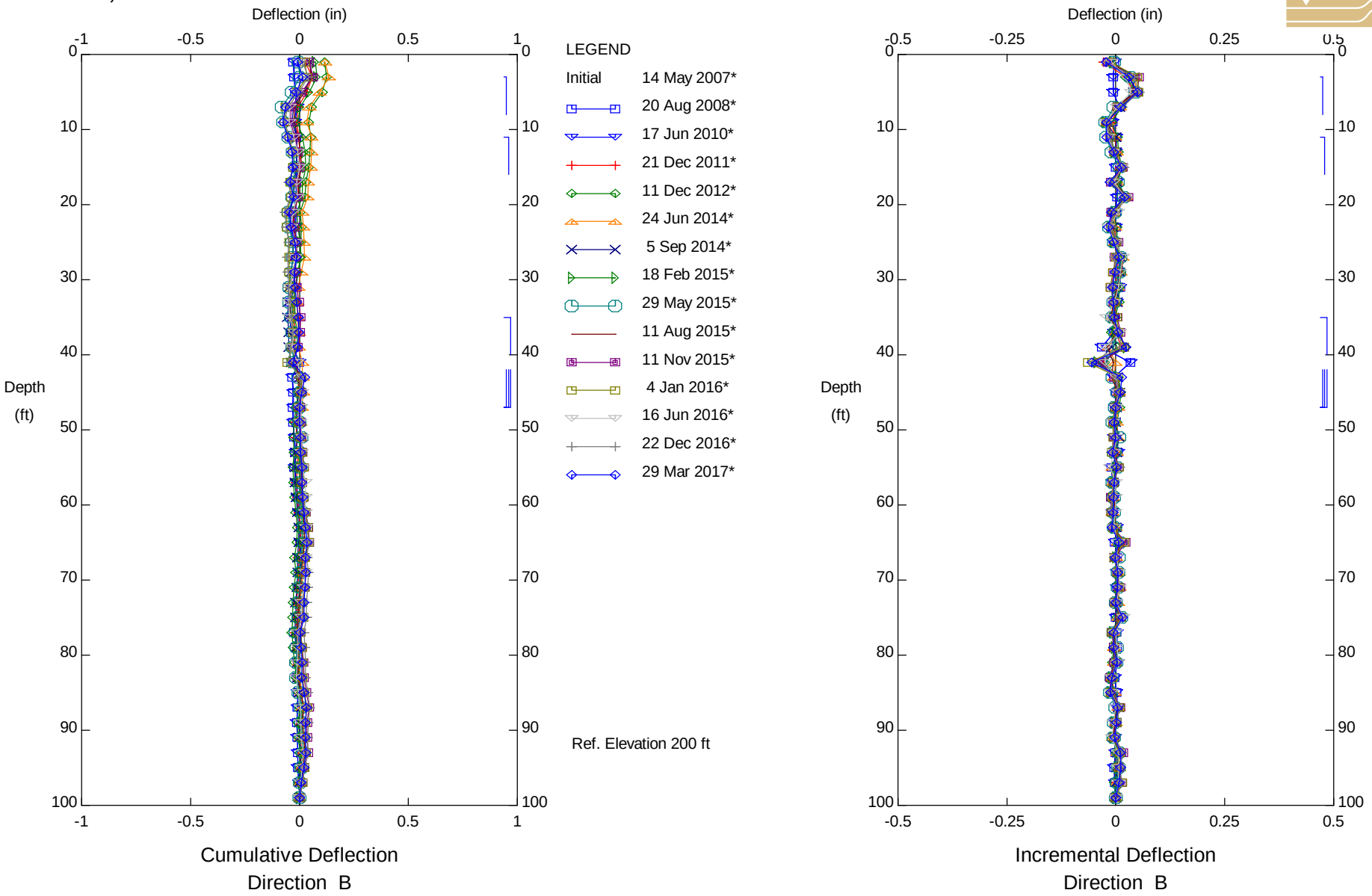
City of Malibu

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

PLATE C-4a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA

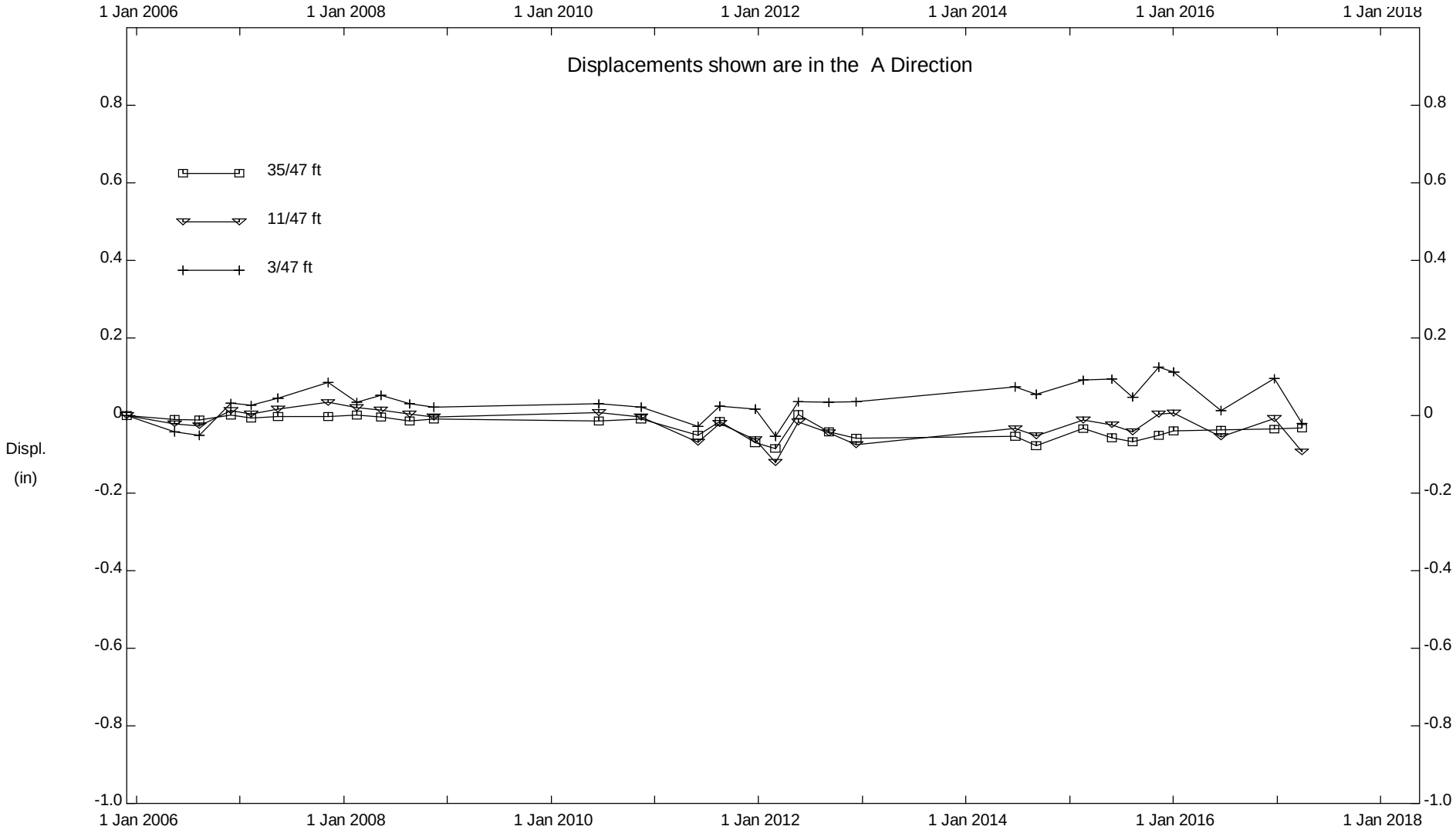


Calle del Barco, Inclinometer SI-7

City of Malibu

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

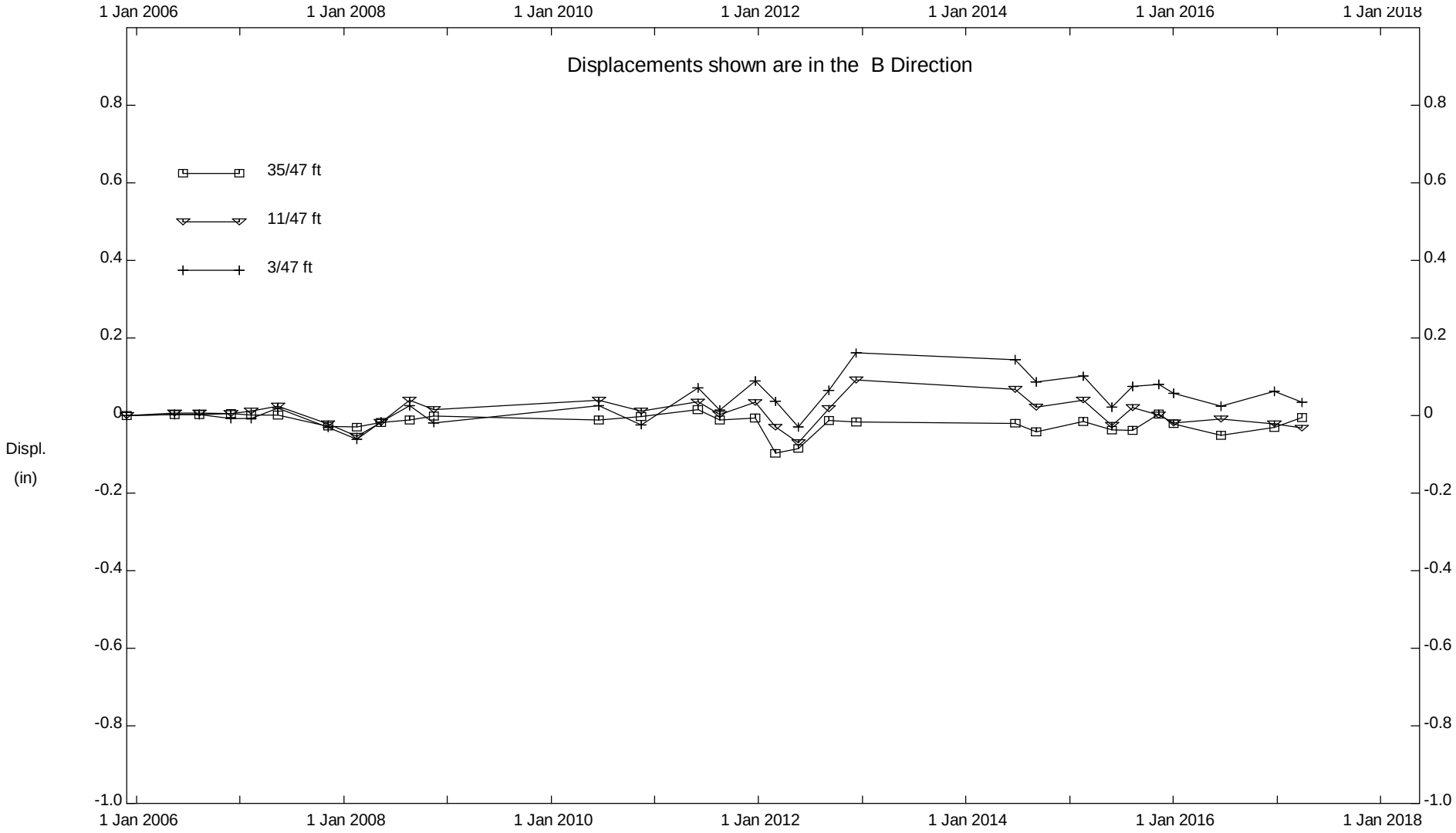
PLATE C-4b



Calle del Barco, Inclinometer SI-7

City of Malibu

PLATE C-4c



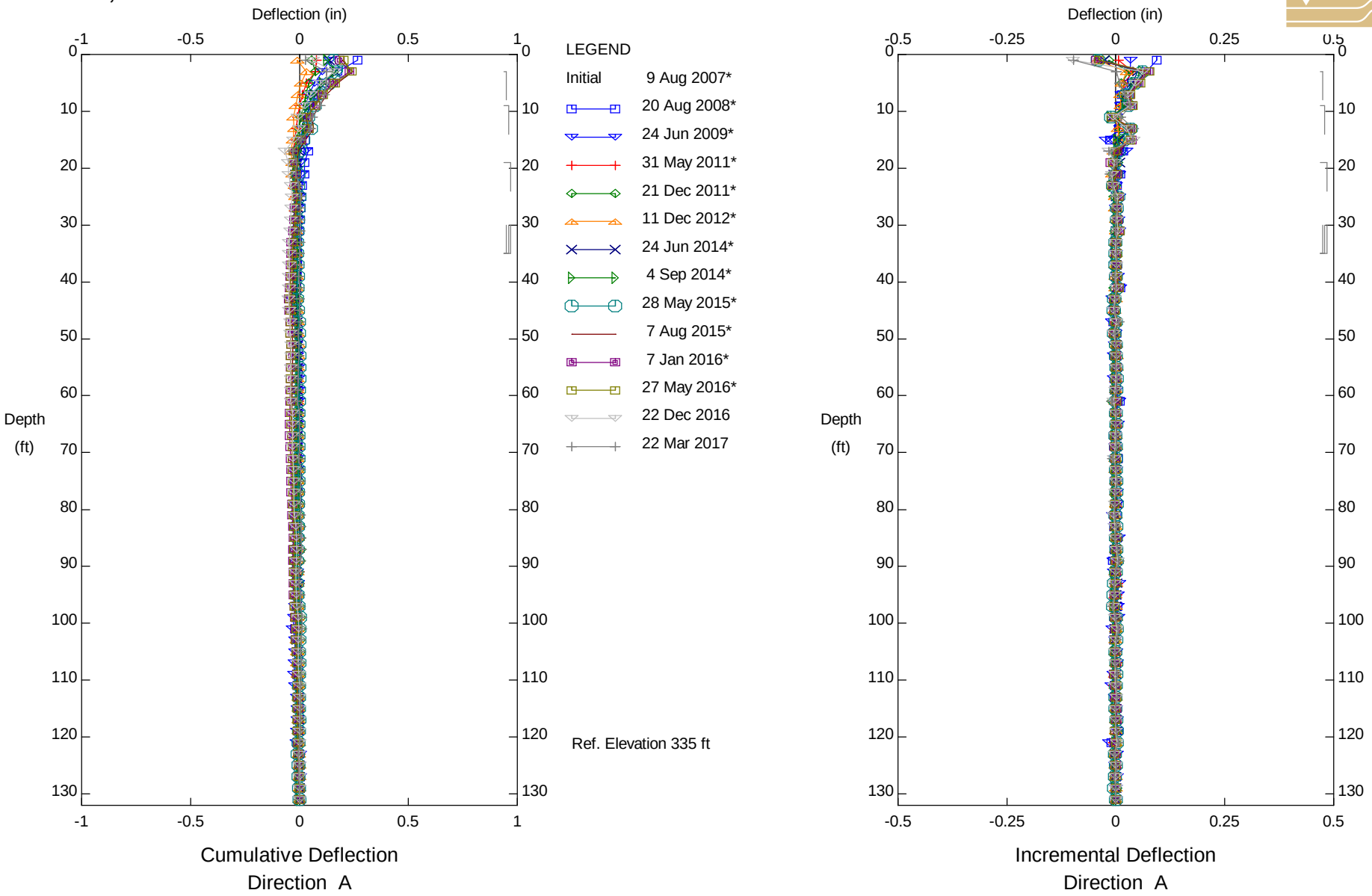
Calle del Barco, Inclinometer SI-7

City of Malibu

PLATE C-4d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Assessment District 98-2, Inclinometer SI-8

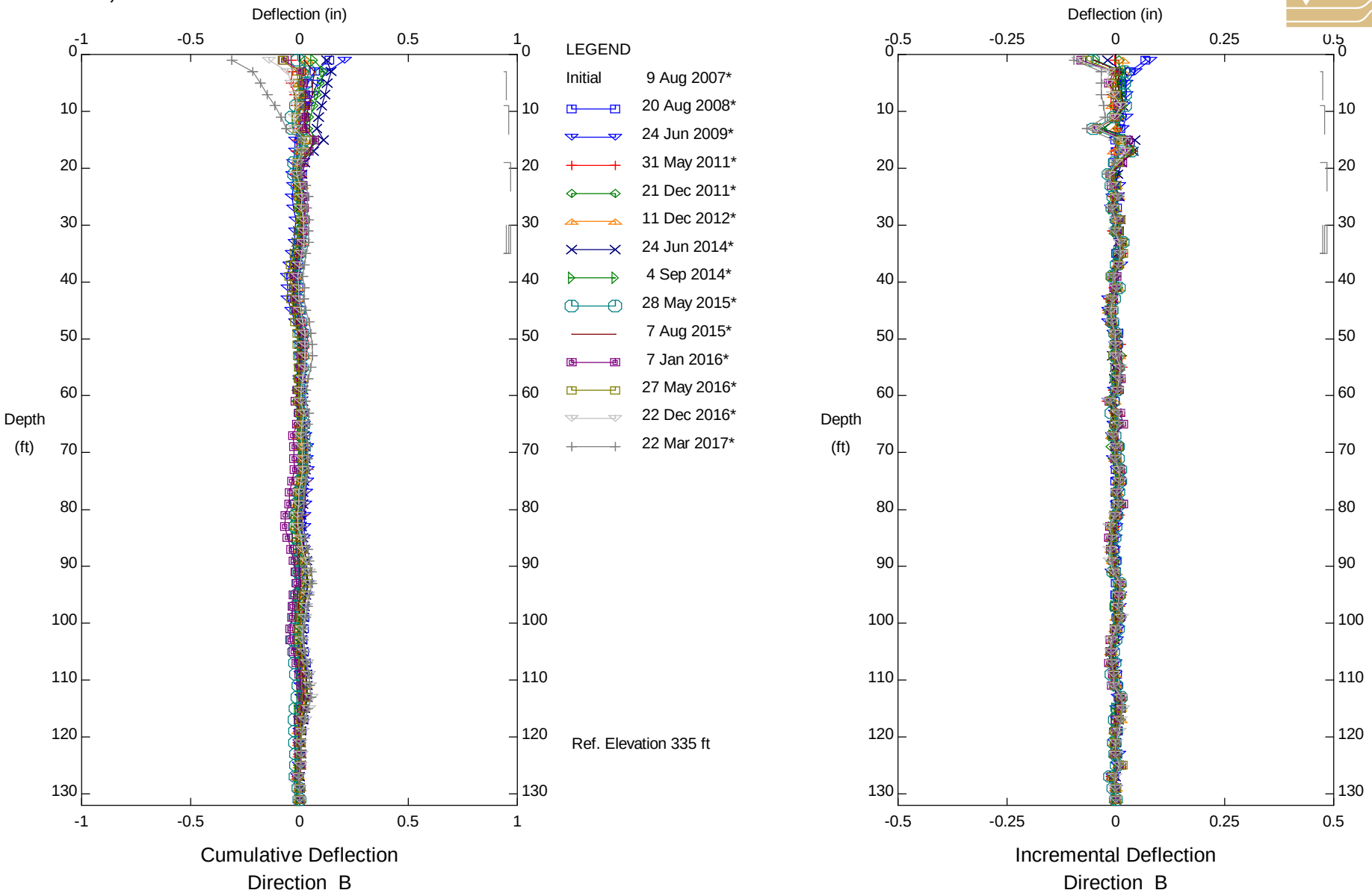
City of Malibu

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

PLATE C-5a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA

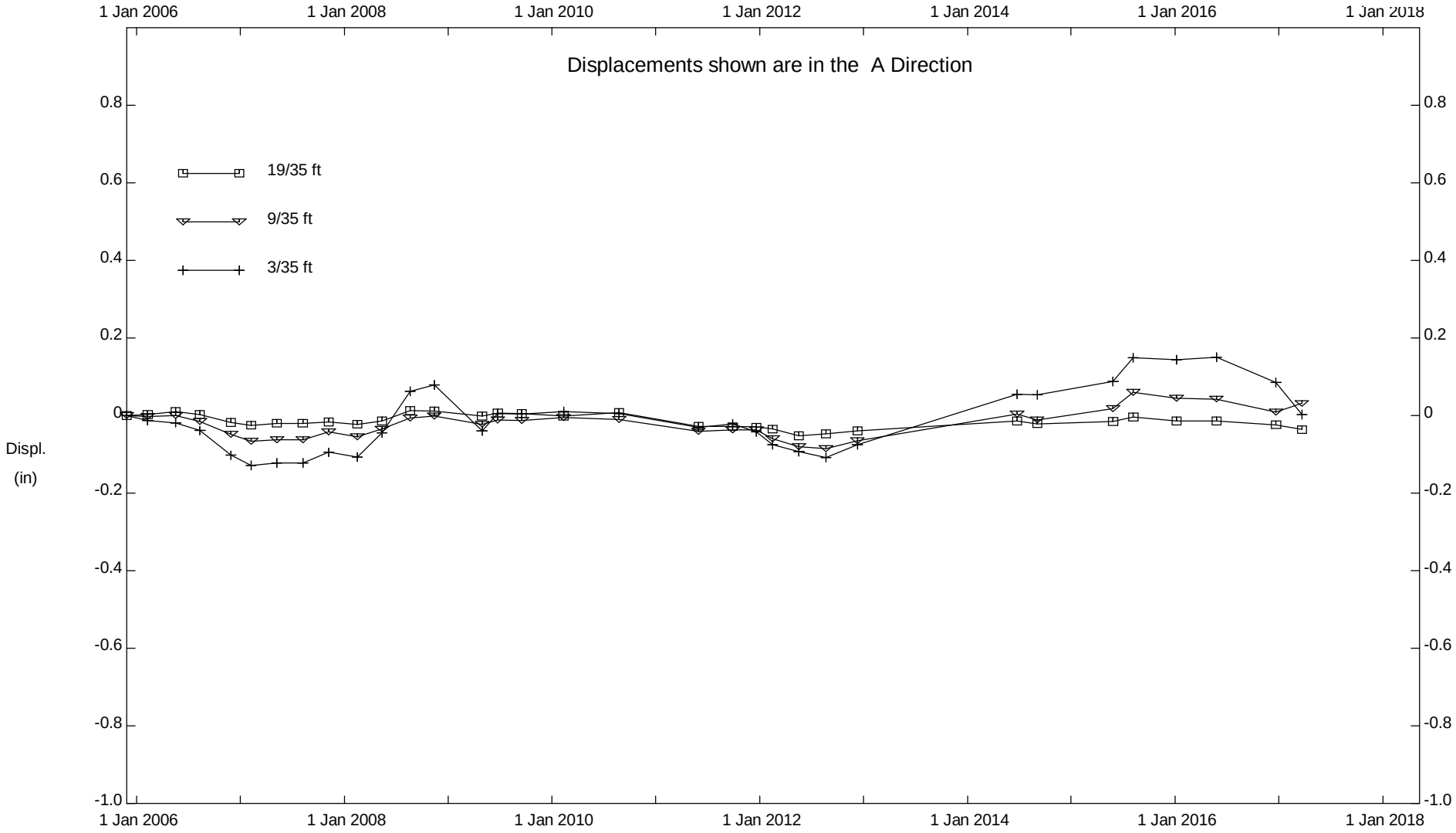


Assessment District 98-2, Inclinometer SI-8

City of Malibu

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

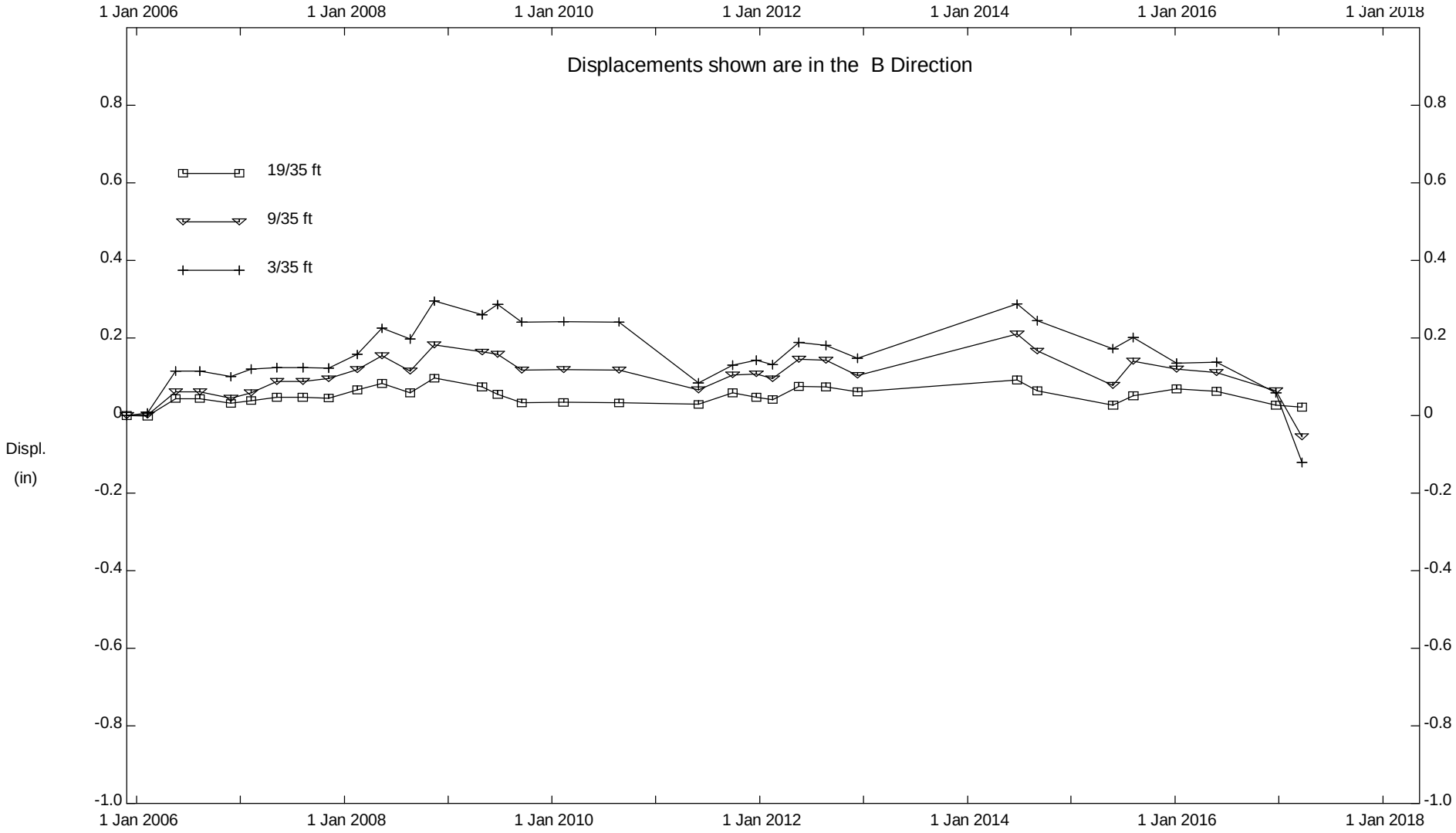
PLATE C-5b



Assessment District 98-2, Inclinometer SI-8

City of Malibu

PLATE C-5c



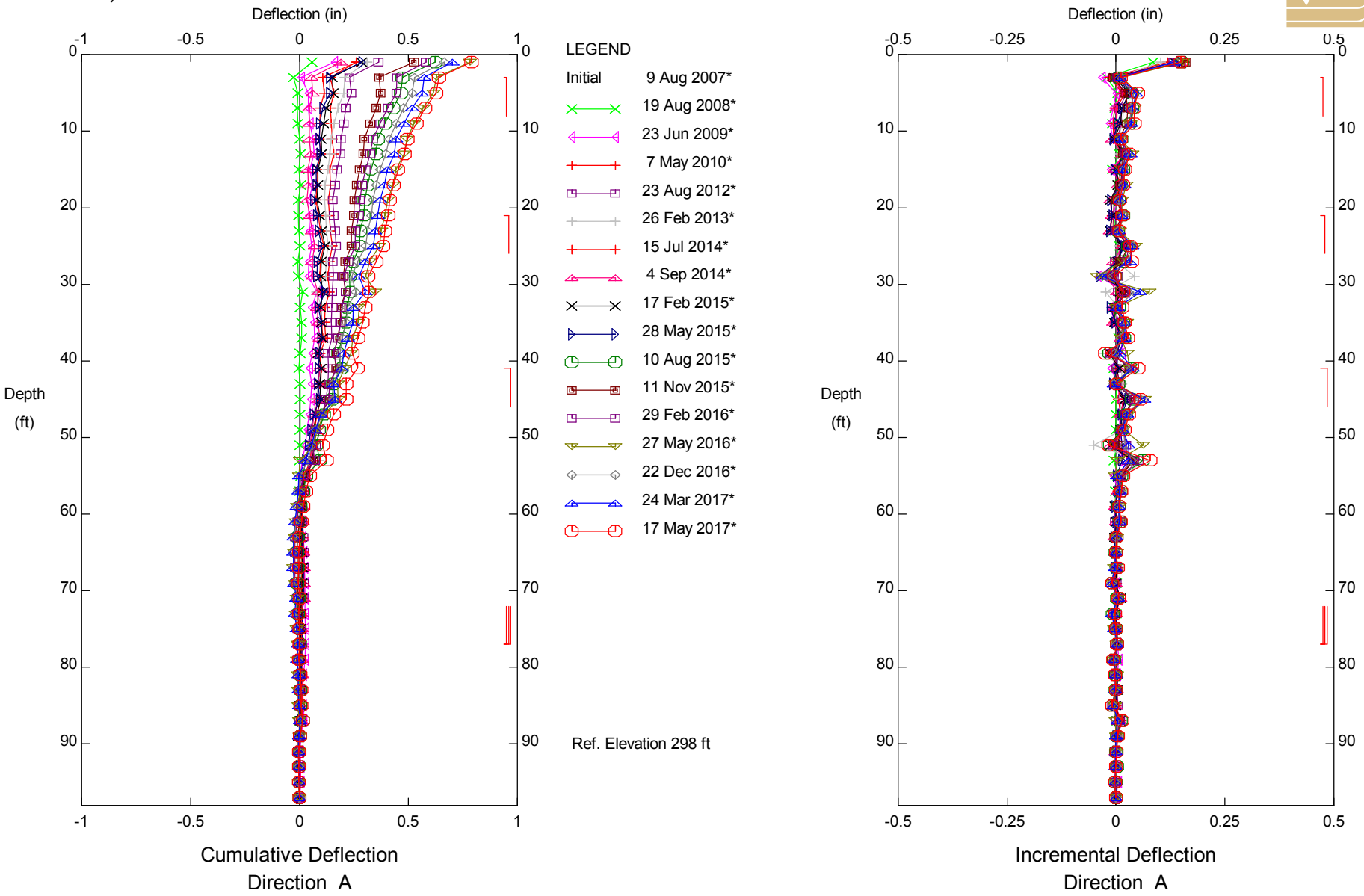
Assessment District 98-2, Inclinometer SI-8

City of Malibu

PLATE C-5d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Calle del Barco, Inclinometer SI-9

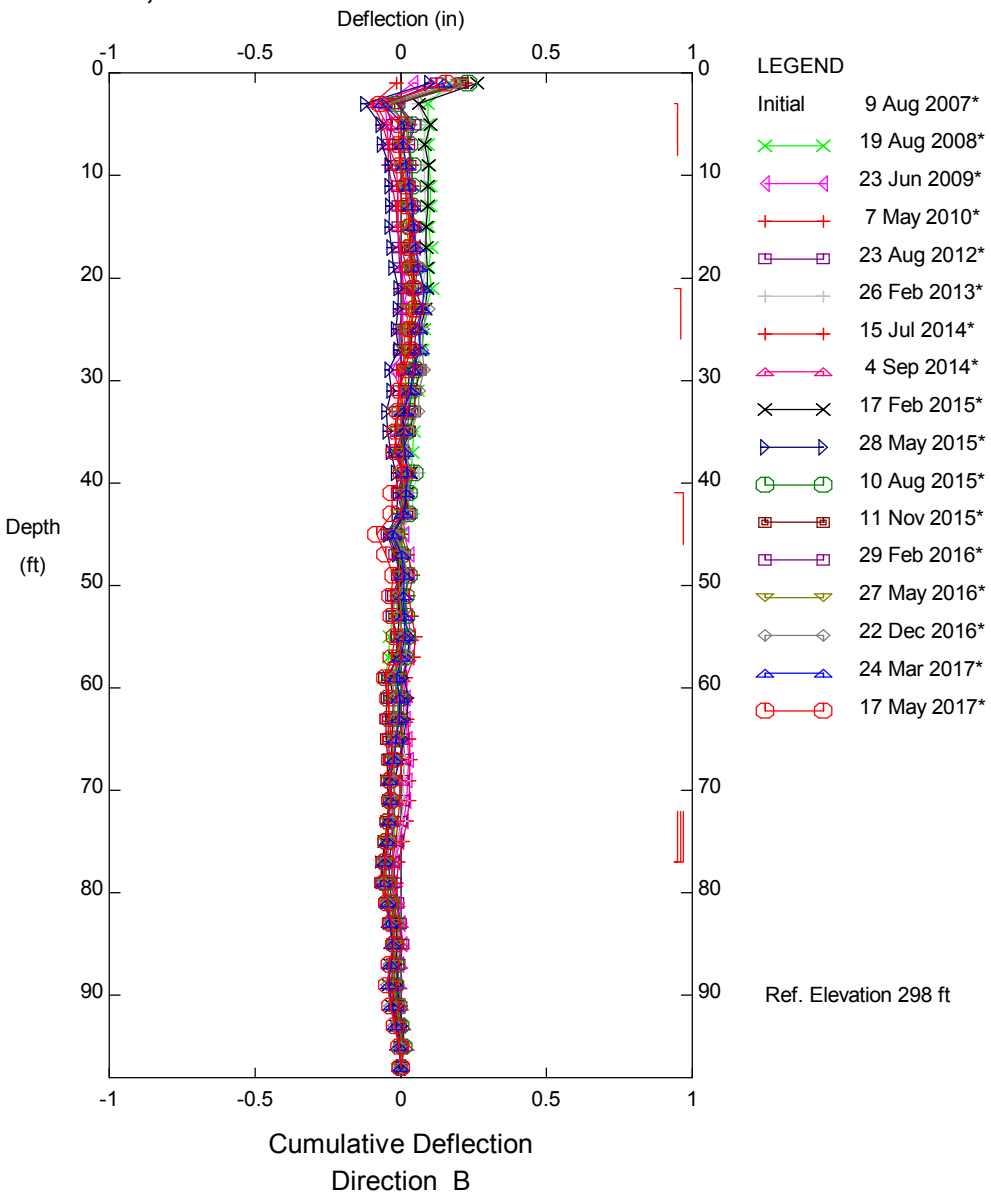
City of Malibu

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

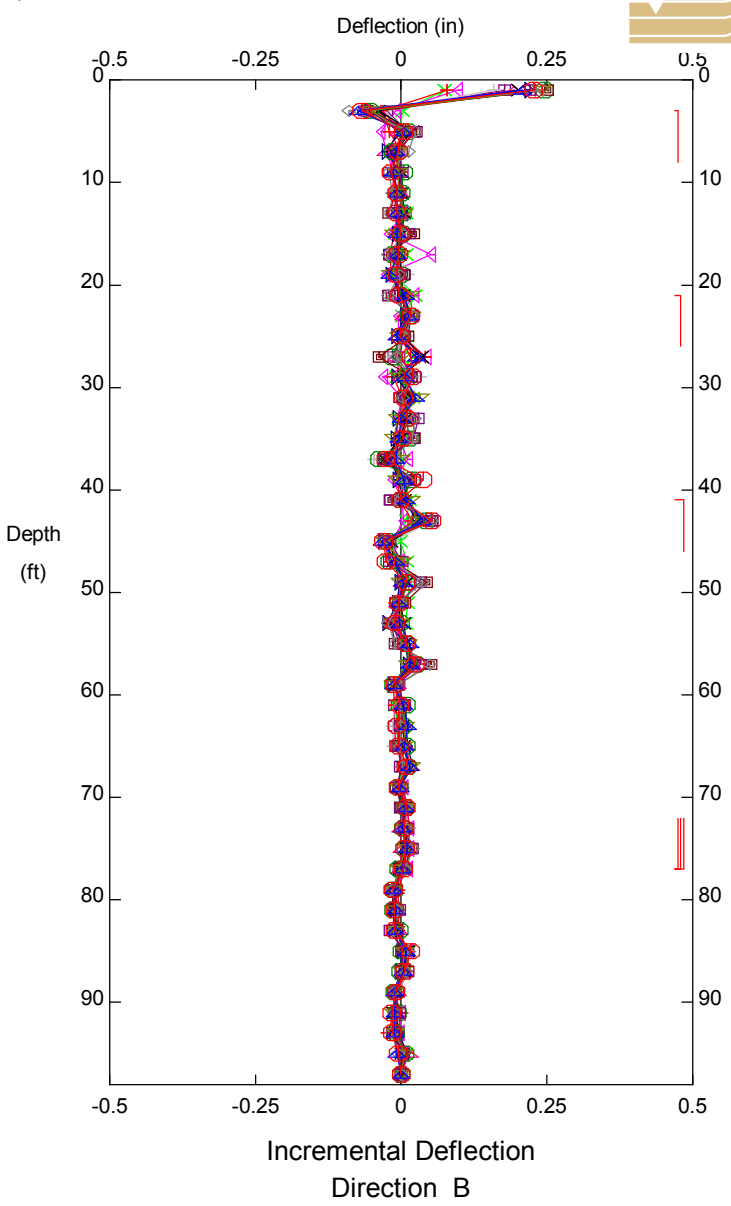
PLATE C-6a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Cumulative Deflection
Direction B



Incremental Deflection
Direction B

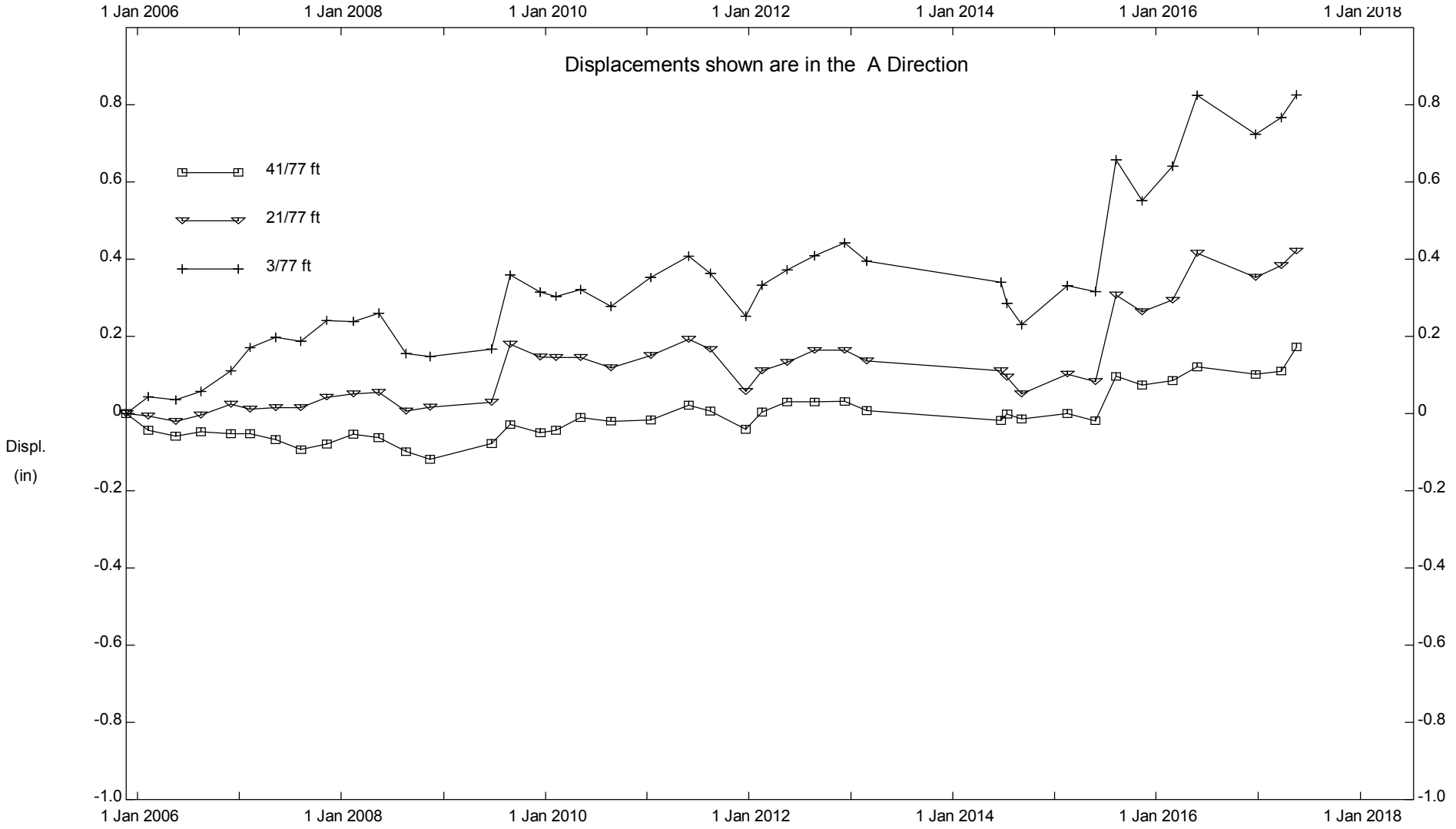
Calle del Barco, Inclinometer SI-9
City of Malibu

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

PLATE C-6b

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



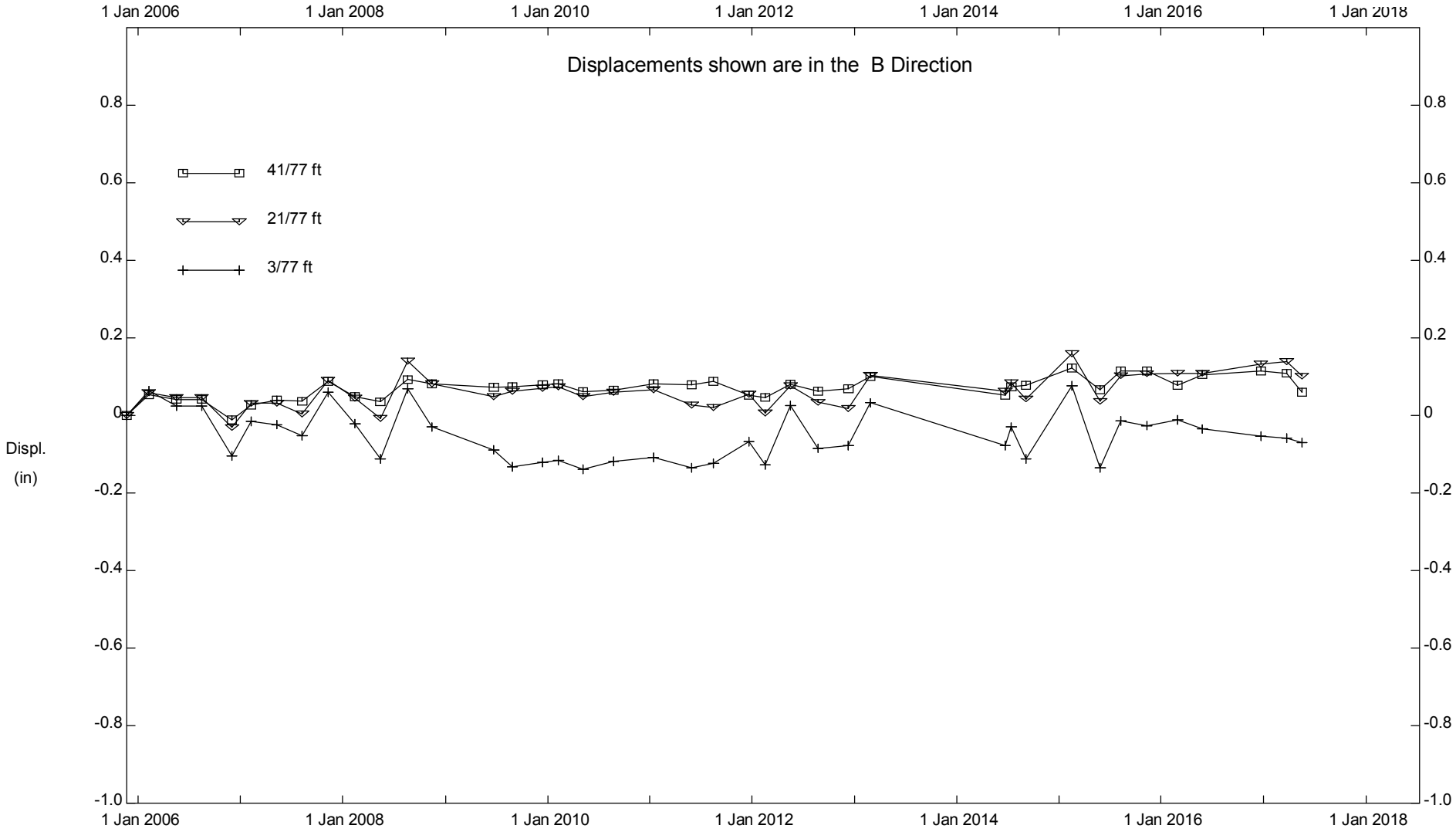
Calle del Barco, Inclinometer SI-9

City of Malibu

PLATE C-6c

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



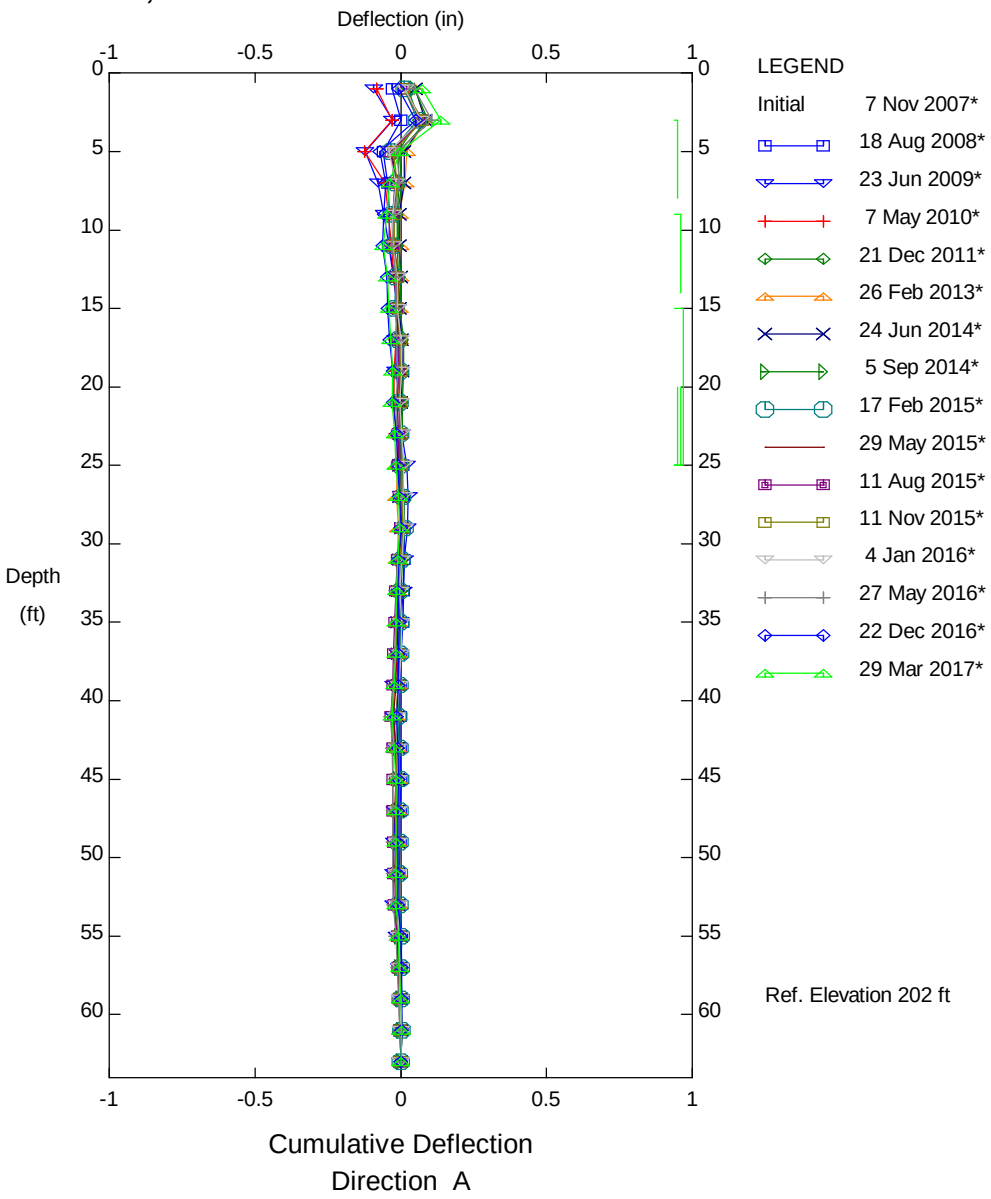
Calle del Barco, Inclinometer SI-9

City of Malibu

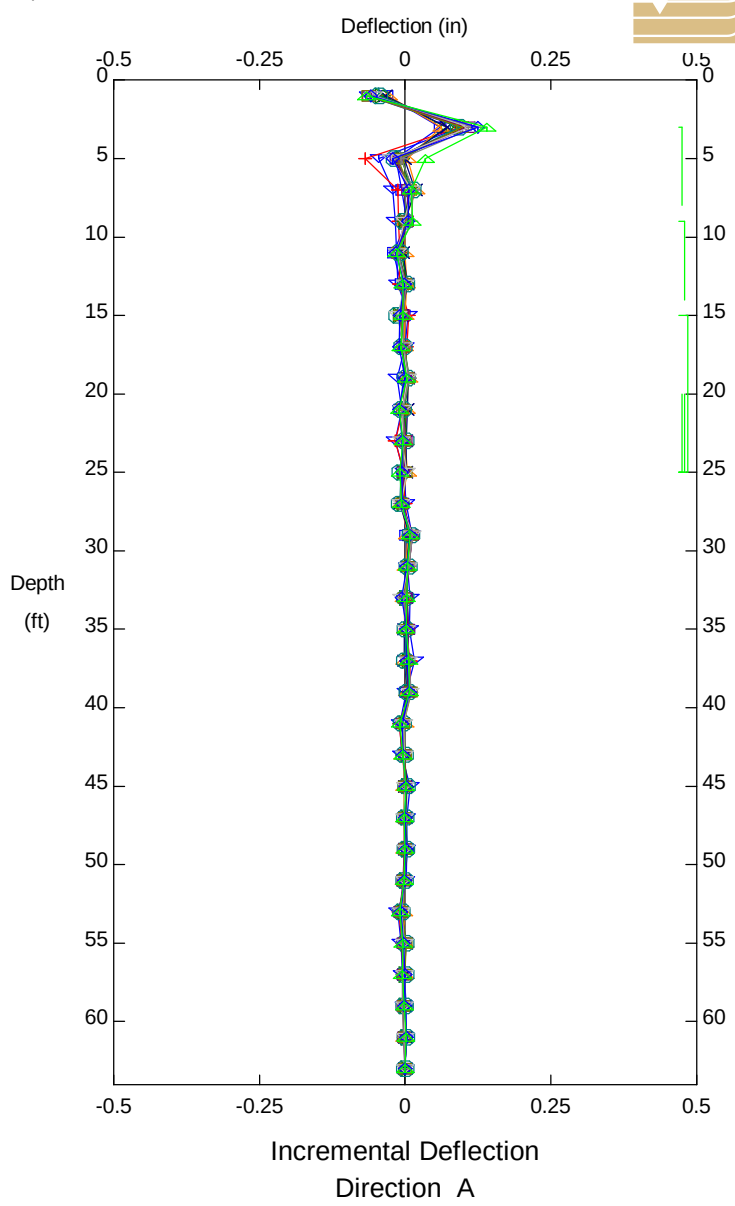
PLATE C-6d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction A



Incremental Deflection
Direction A

Calle del Barco, Inclinometer SI-10

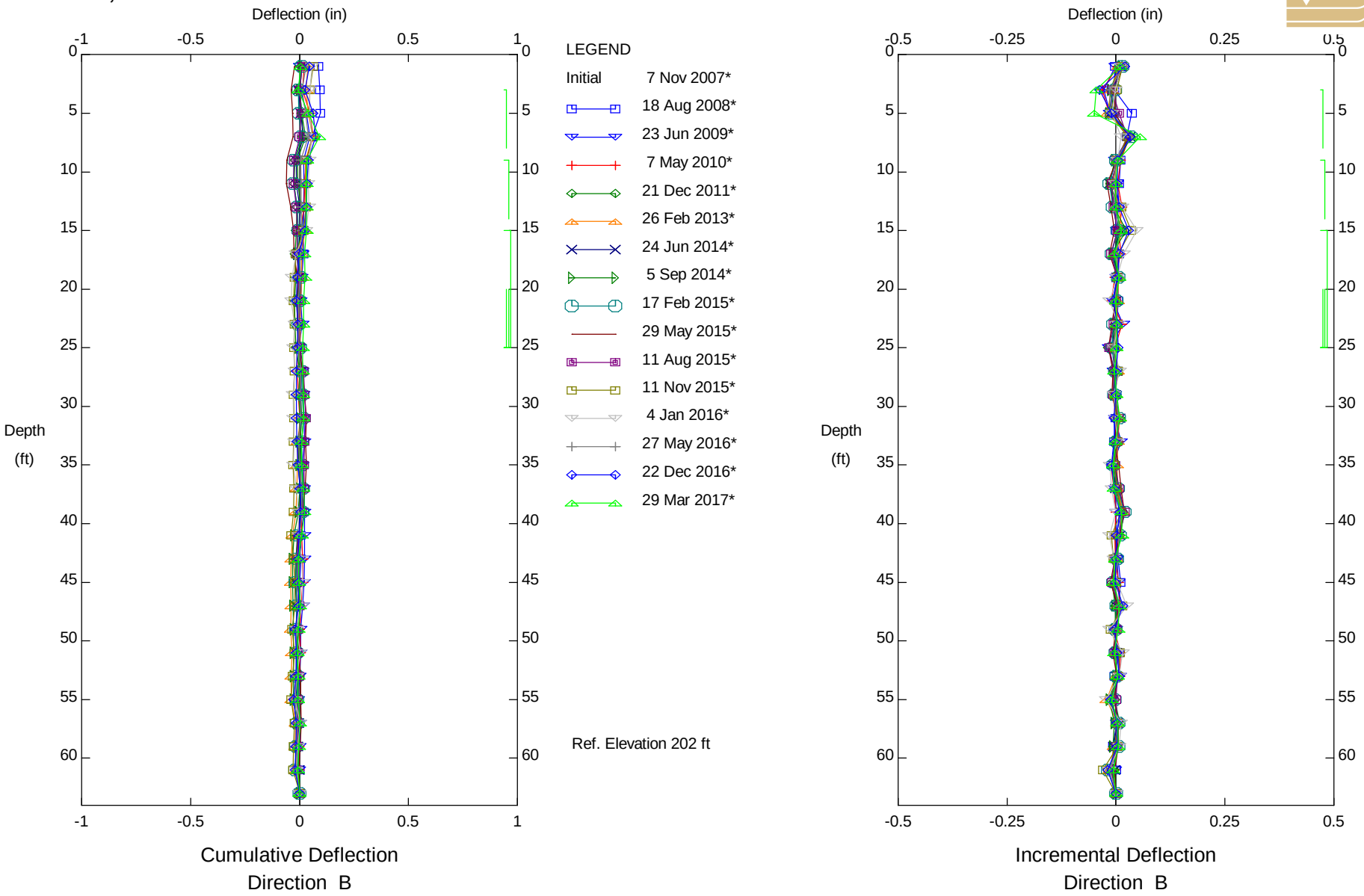
City of Malibu

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

PLATE C-7a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



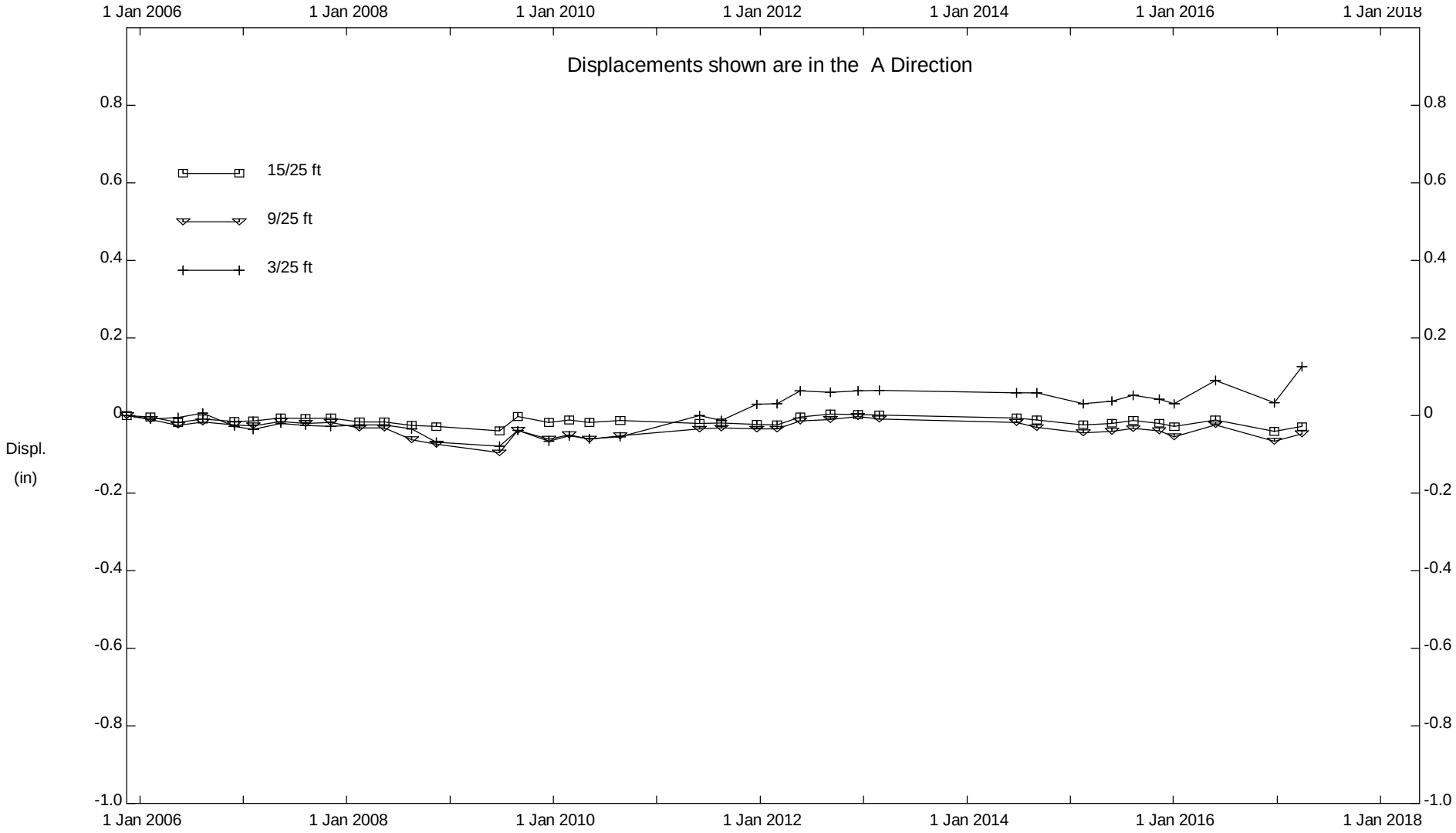
Calle del Barco, Inclinometer SI-10

City of Malibu

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

PLATE C-7b

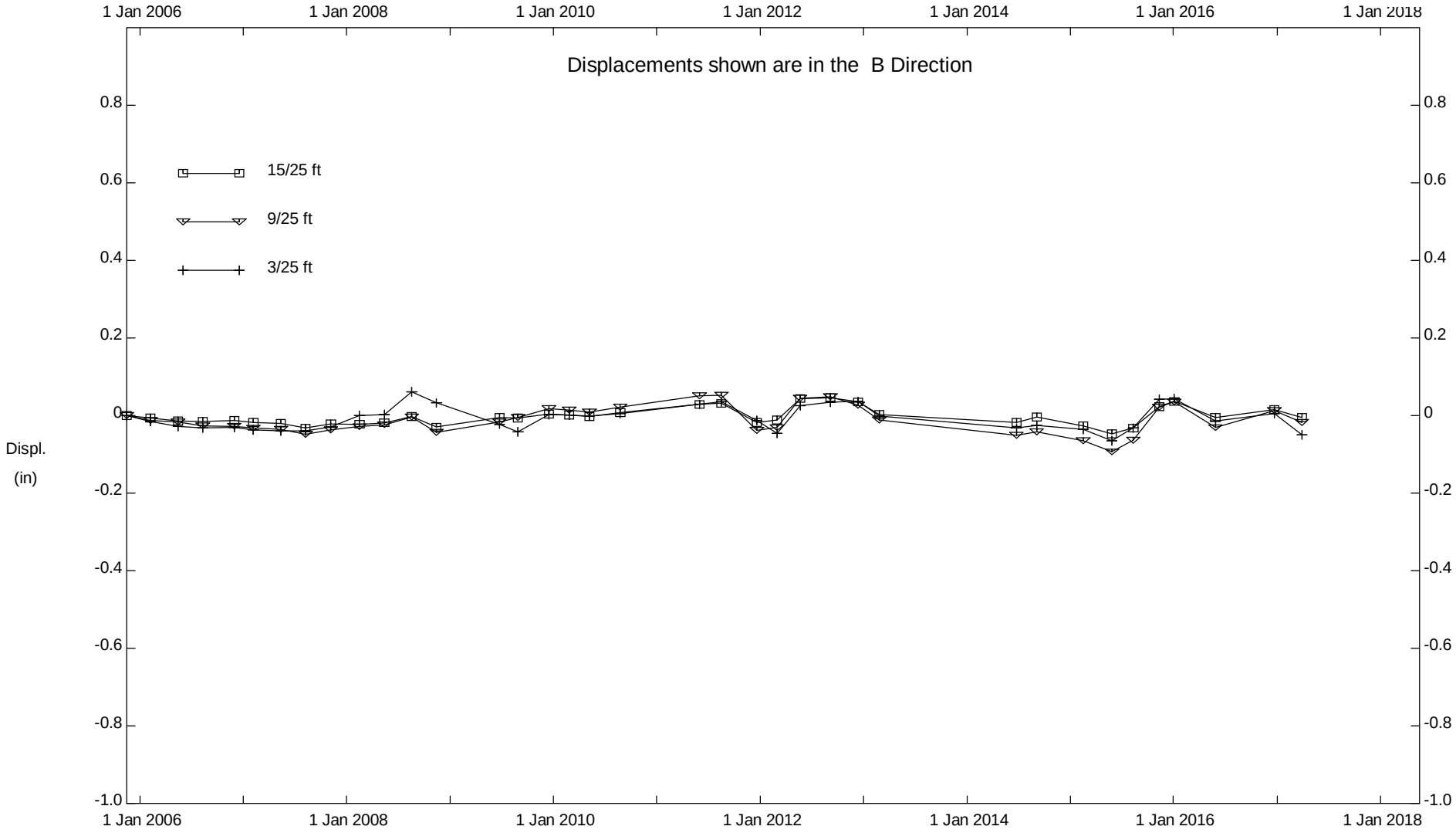
Fugro Consultants, Inc. - Ventura, CA



Calle del Barco, Inclinometer SI-10

City of Malibu

PLATE C-7c



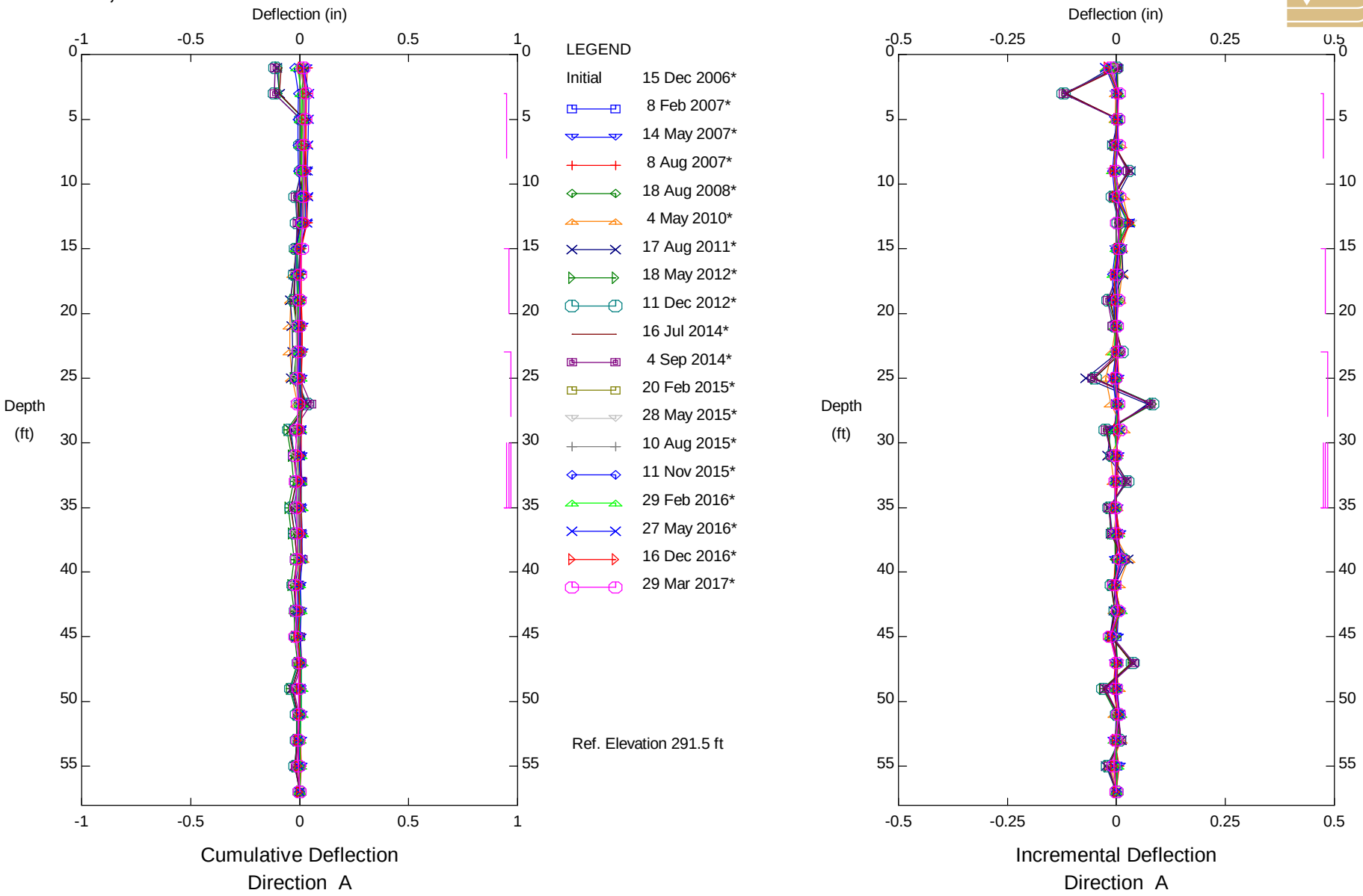
Calle del Barco, Inclinometer SI-10

City of Malibu

PLATE C-7d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Assessment District 98-2, Inclinometer SI-11

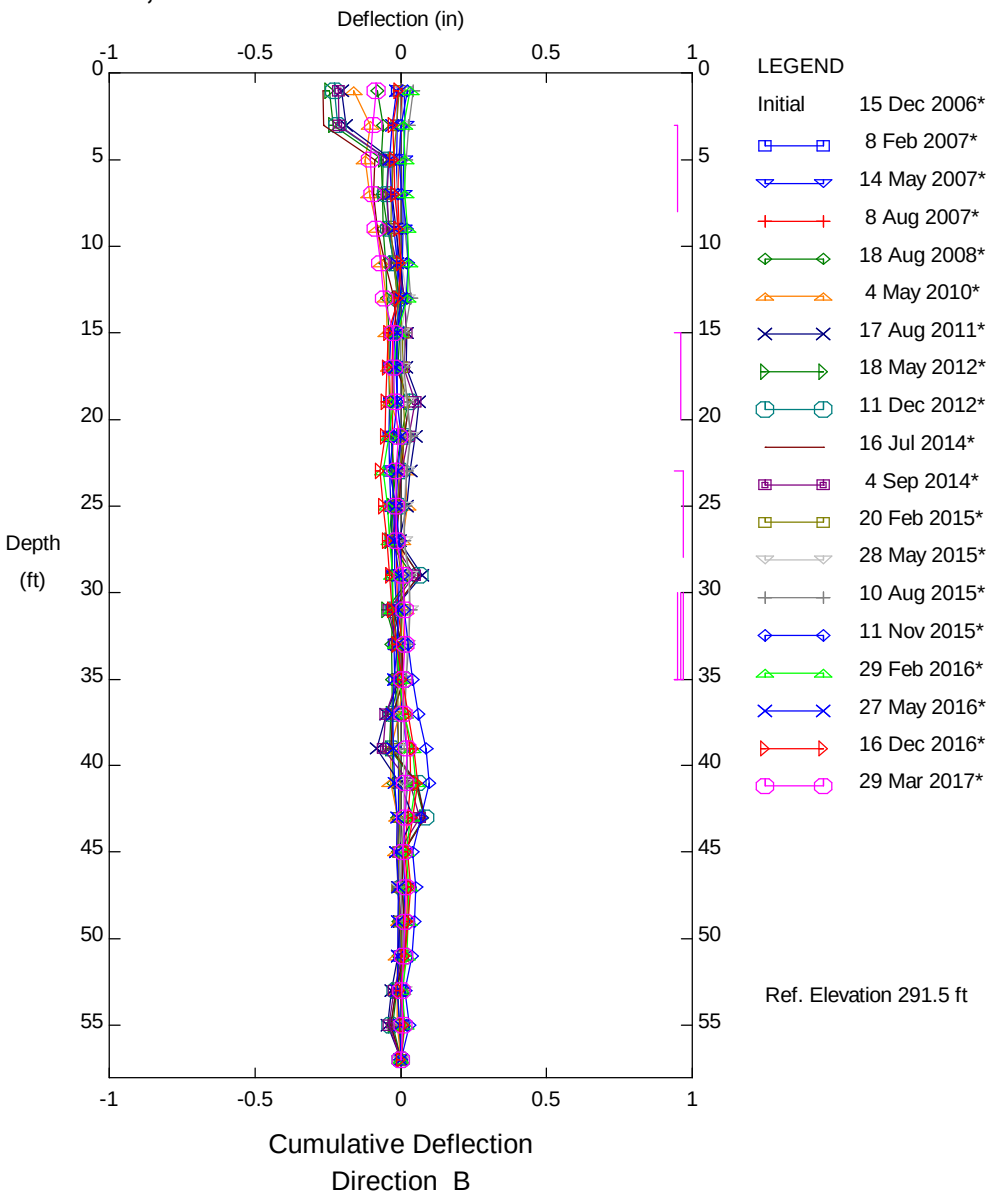
City of Malibu

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

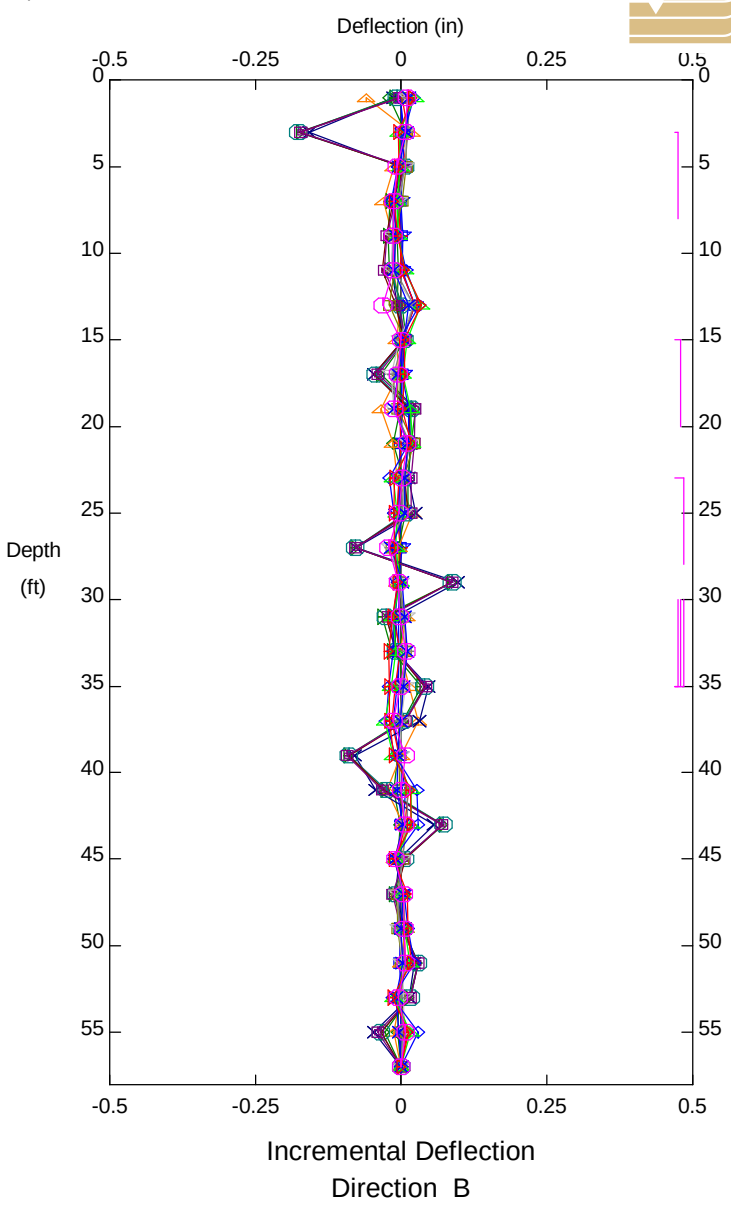
PLATE C-8a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction B



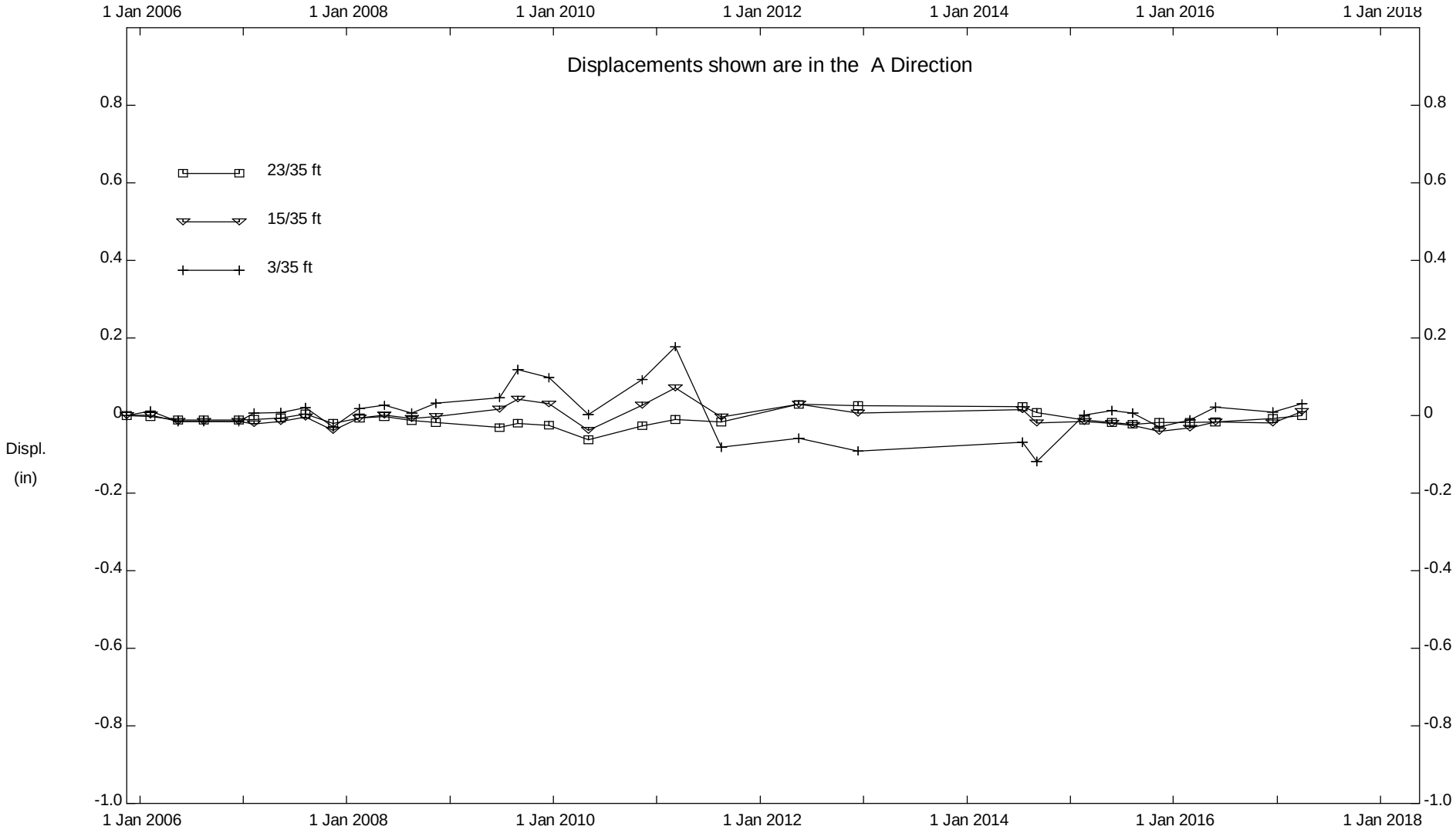
Incremental Deflection
Direction B

Assessment District 98-2, Inclinometer SI-11

City of Malibu

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

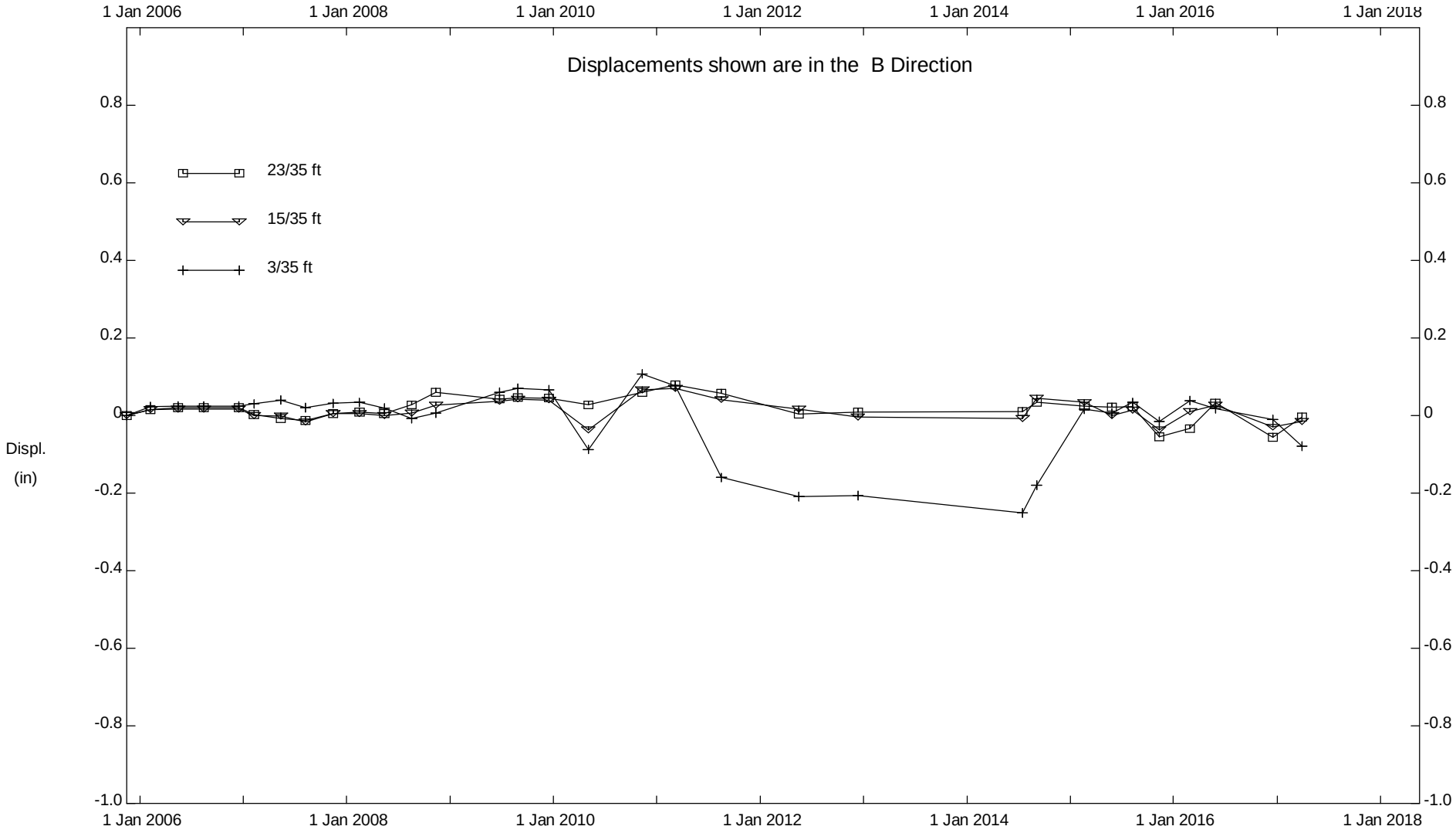
PLATE C-8b



Assessment District 98-2, Inclinometer SI-11

City of Malibu

PLATE C-8c



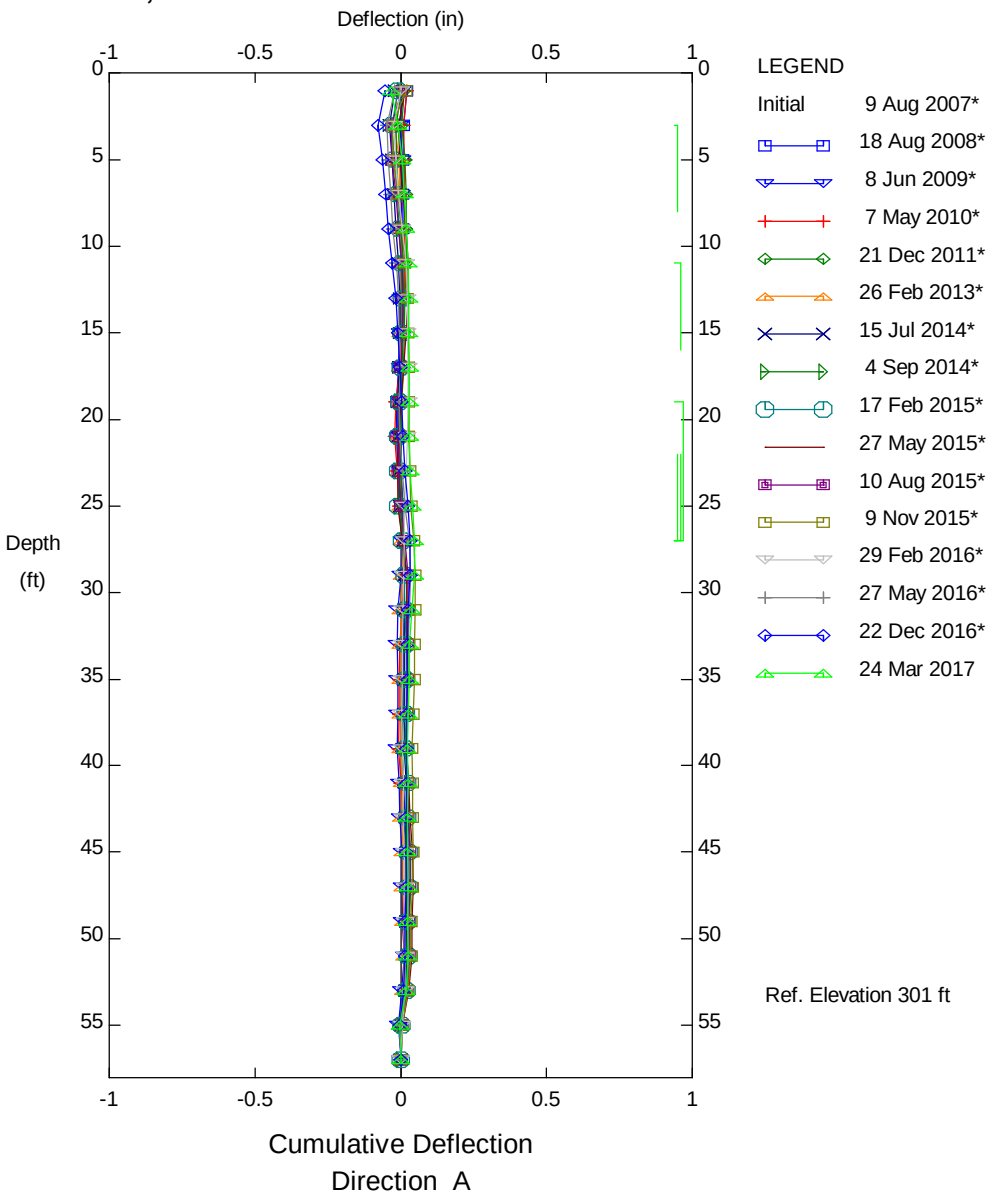
Assessment District 98-2, Inclinometer SI-11

City of Malibu

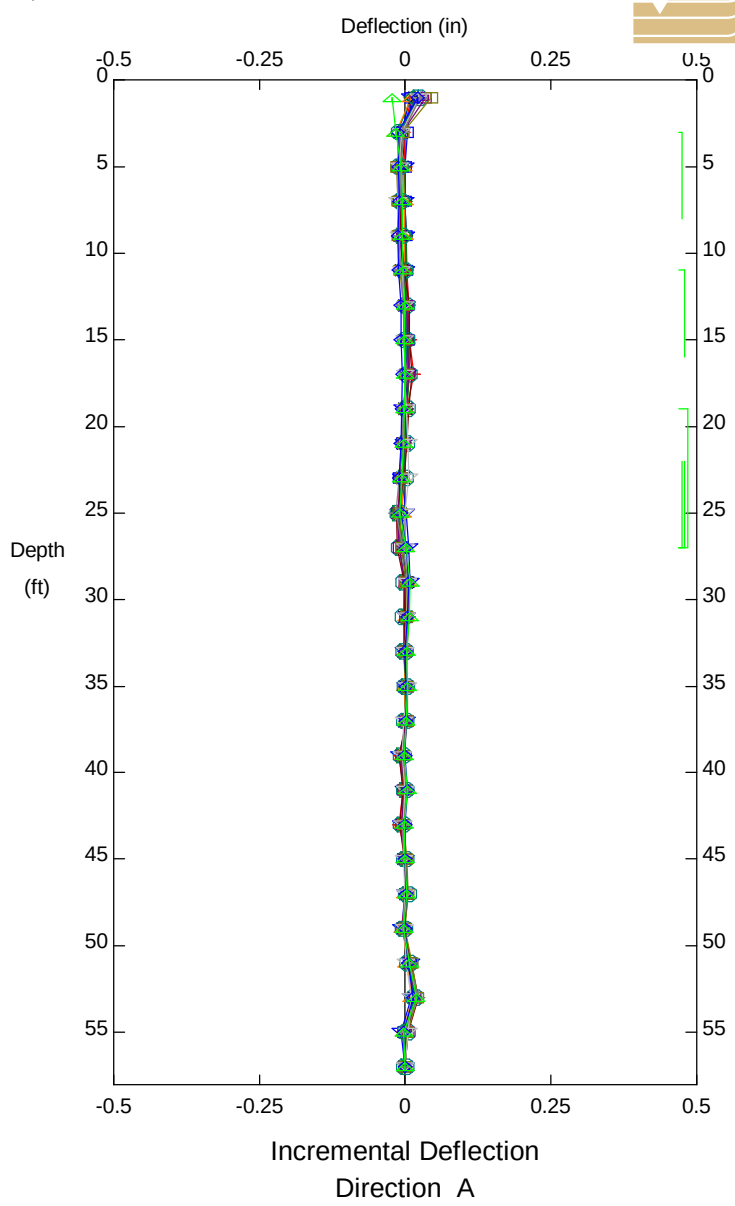
PLATE C-8d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction A



Incremental Deflection
Direction A

Assessment District 98-2, Inclinometer SI-12

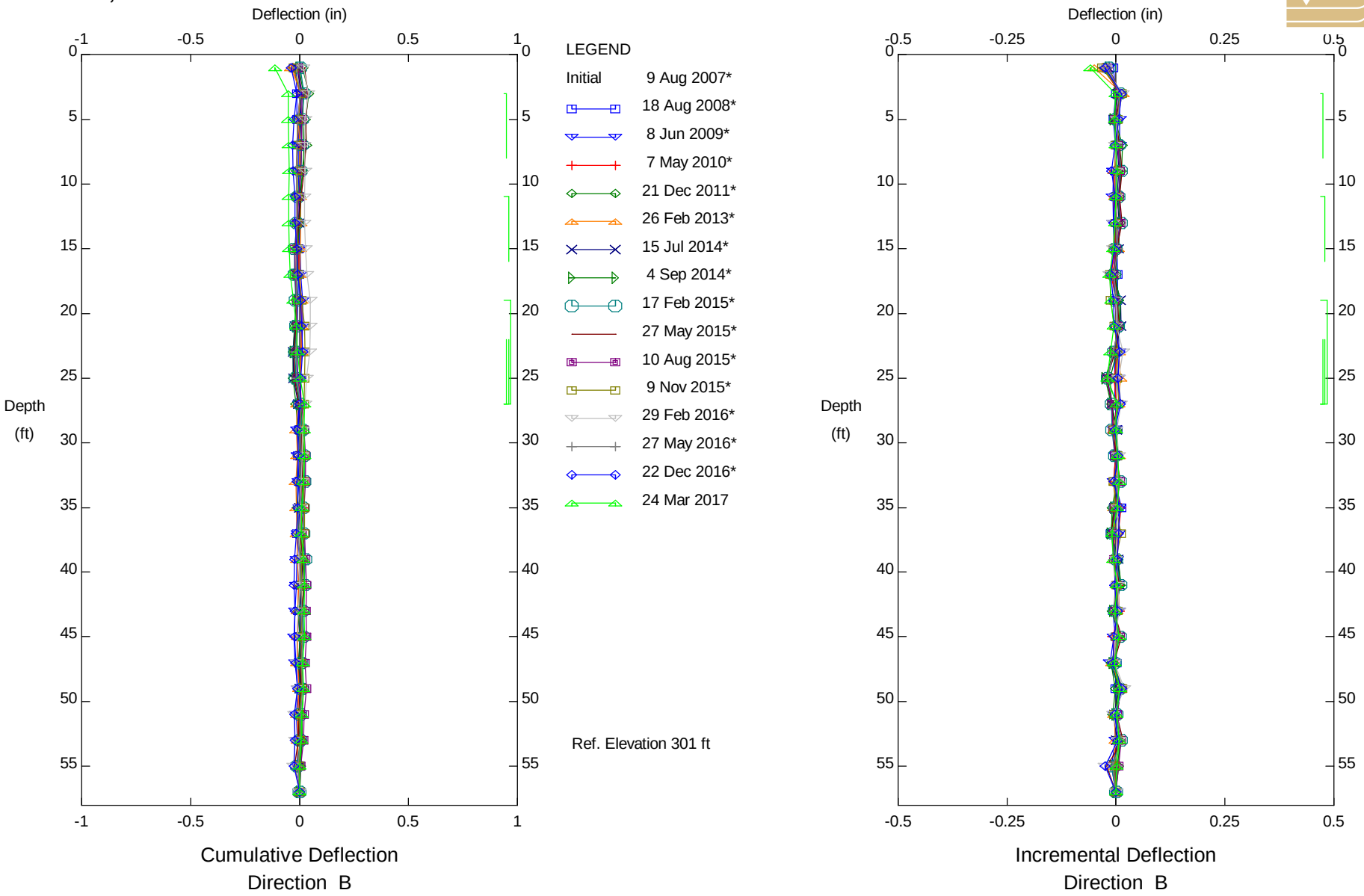
City of Malibu

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

PLATE C-9a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



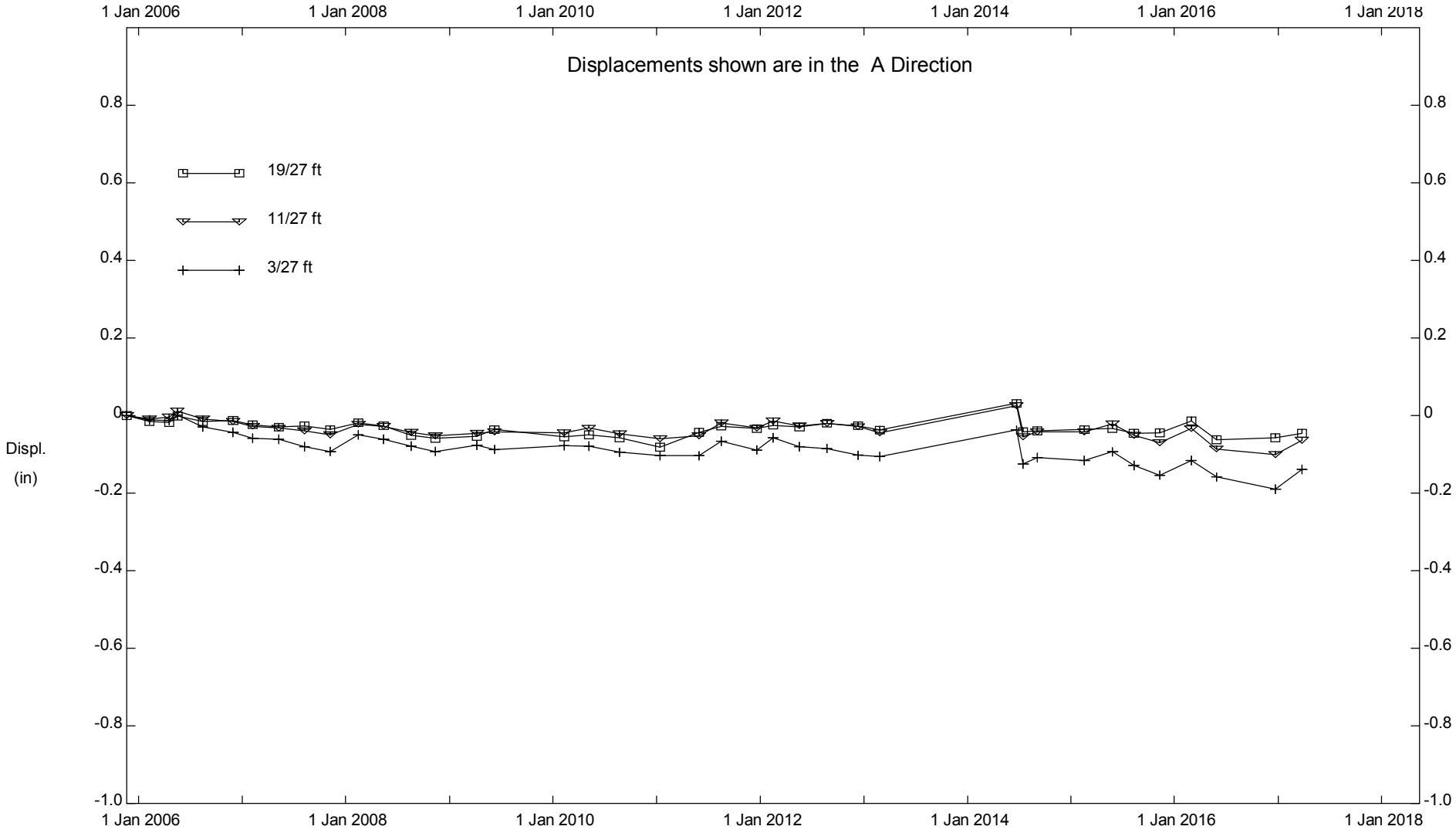
Assessment District 98-2, Inclinometer SI-12

City of Malibu

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

PLATE C-9b

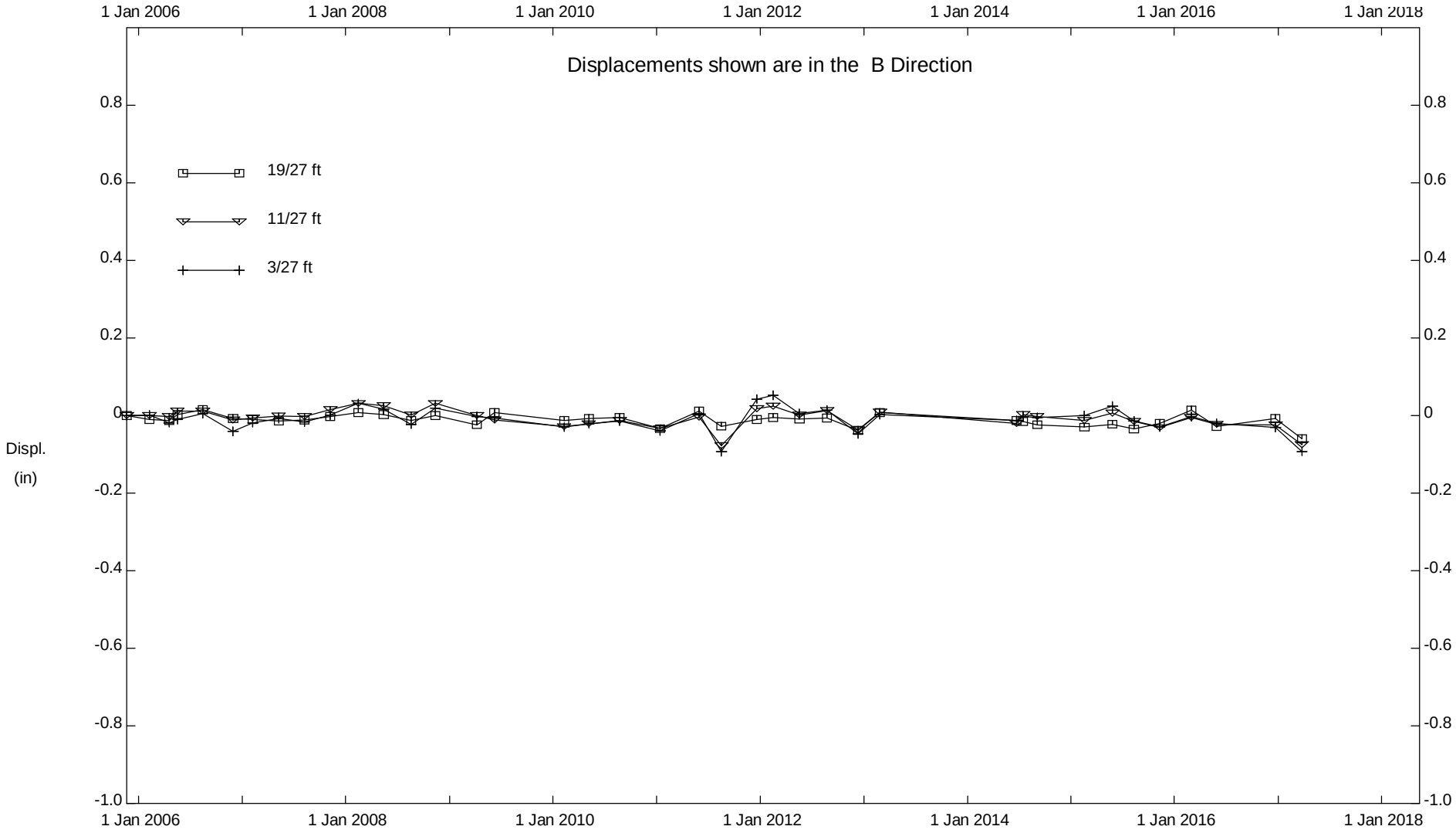
Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-2, Inclinometer SI-12

City of Malibu

PLATE C-9c



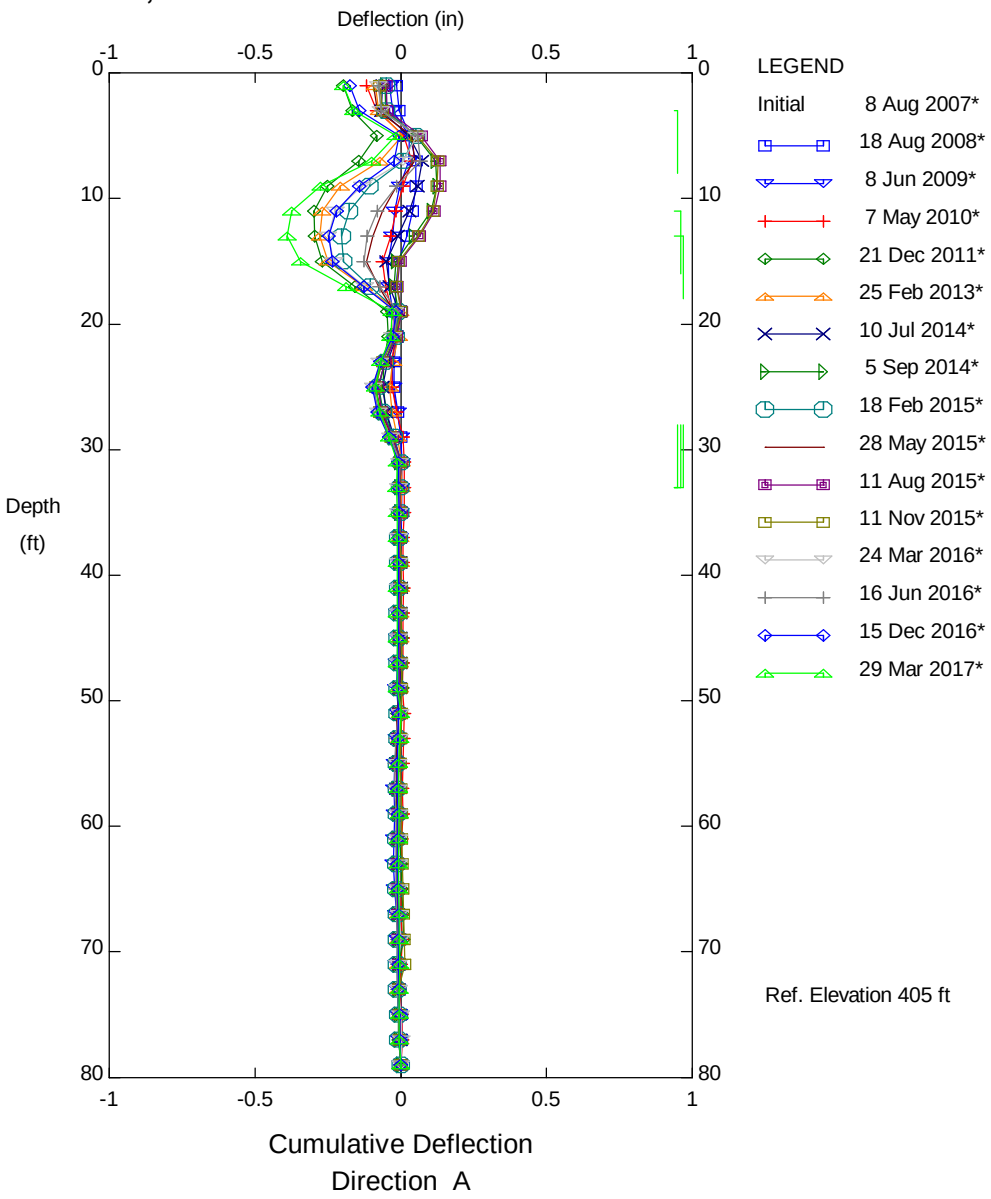
Assessment District 98-2, Inclinometer SI-12

City of Malibu

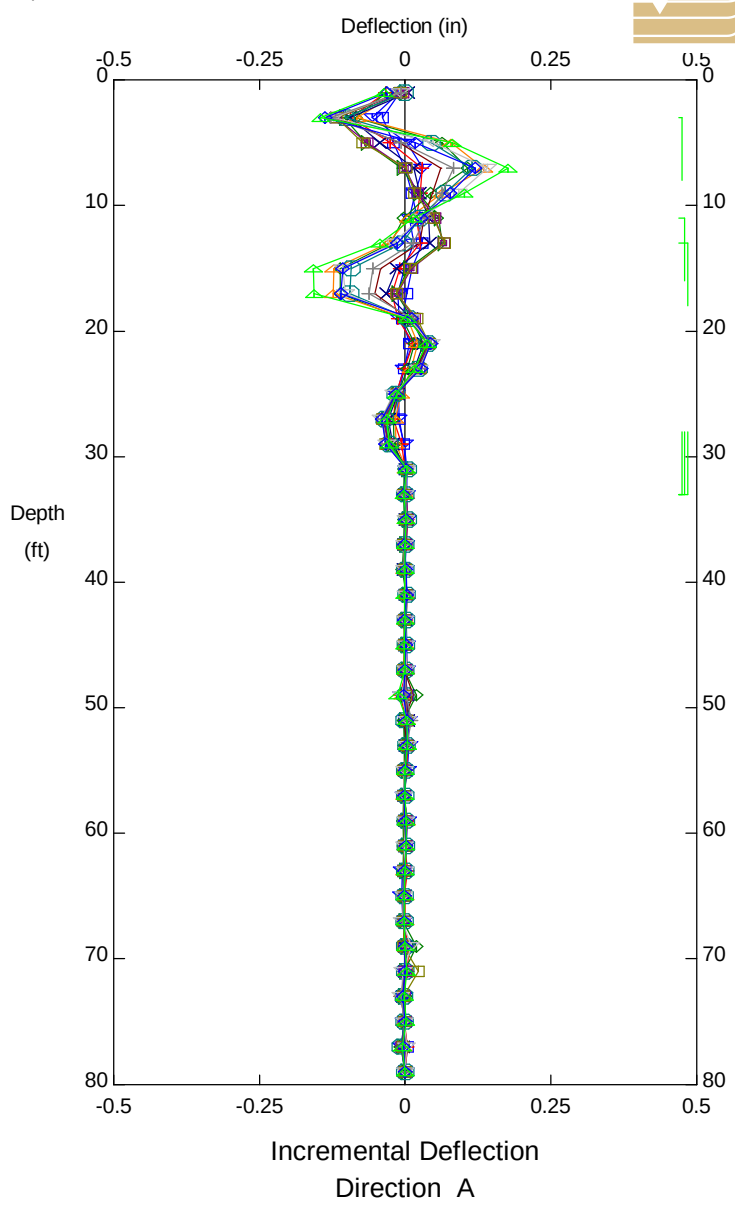
PLATE C-9d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction A



Incremental Deflection
Direction A

Assessment District 98-2, Inclinometer SI-13

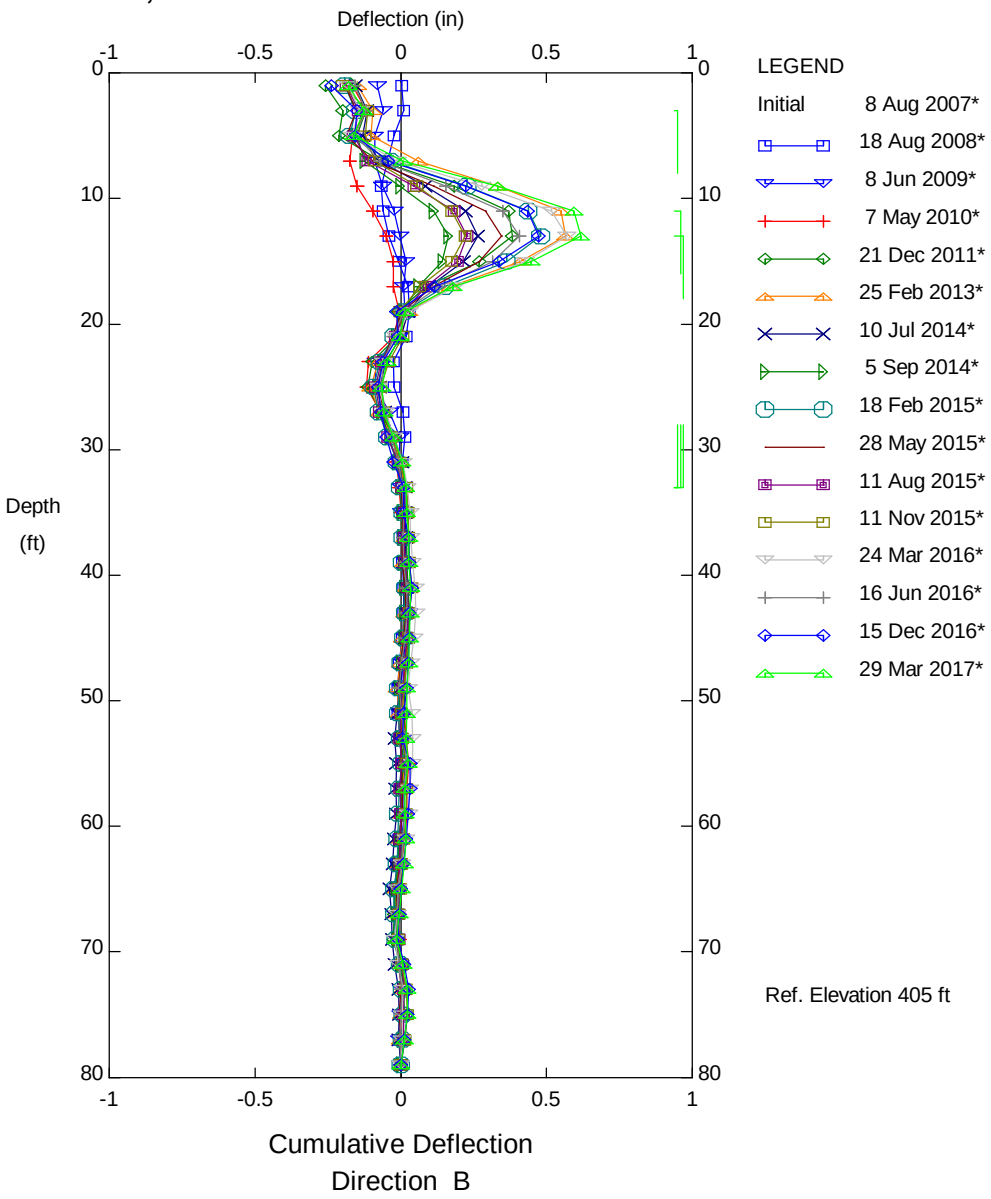
City of Malibu

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

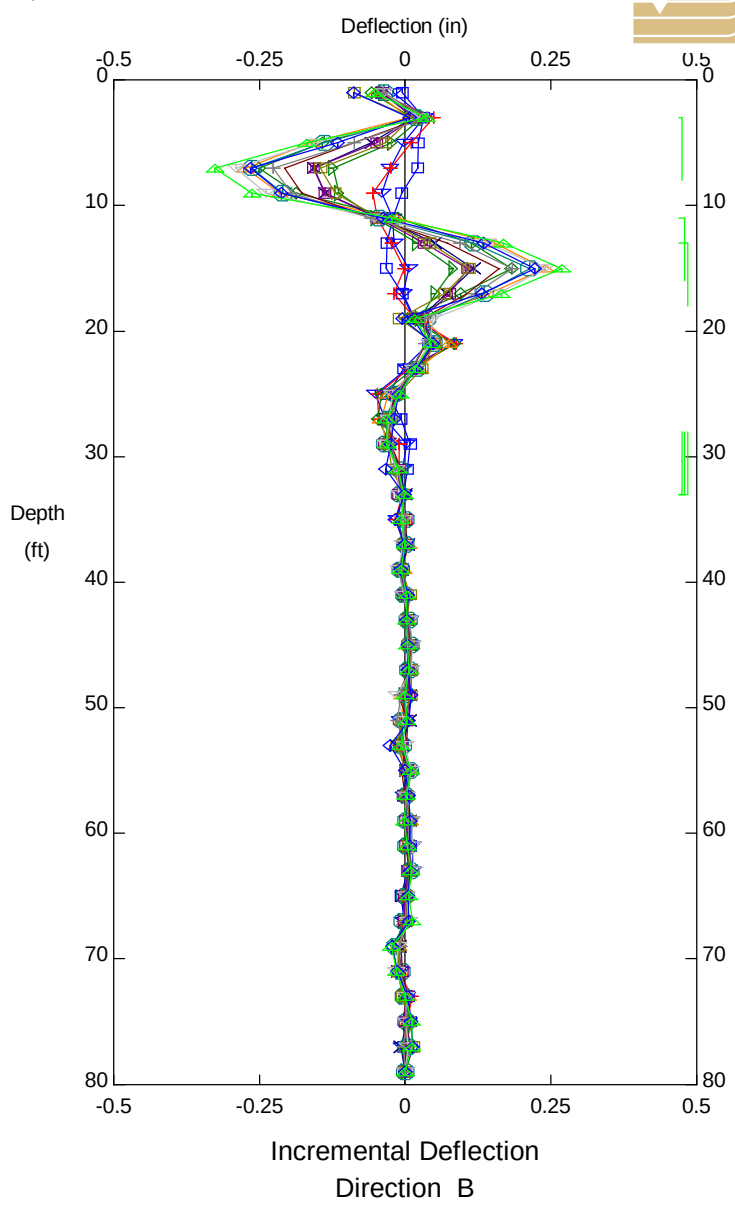
PLATE C-10a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction B



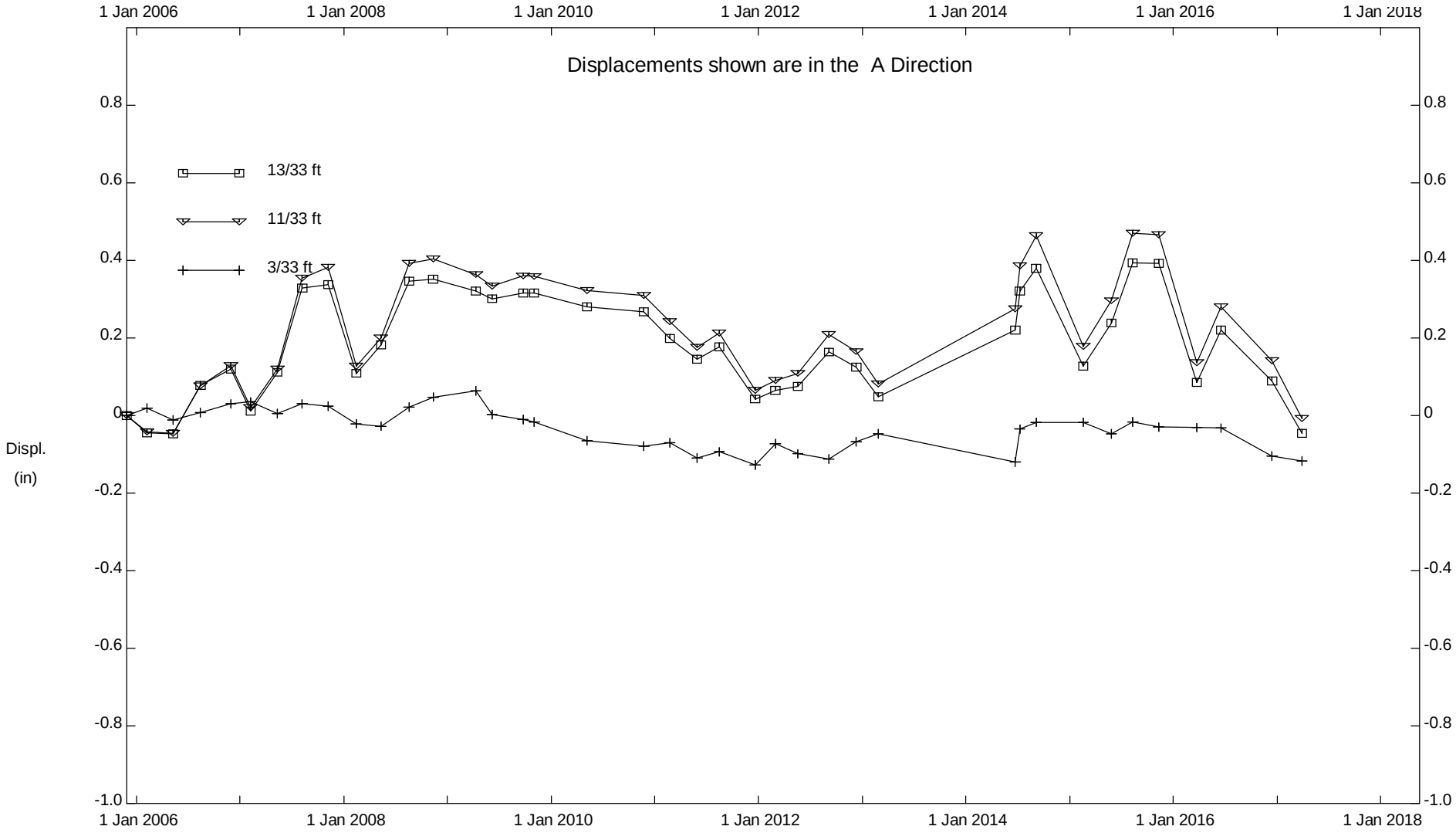
Incremental Deflection
Direction B

Assessment District 98-2, Inclinometer SI-13

City of Malibu

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

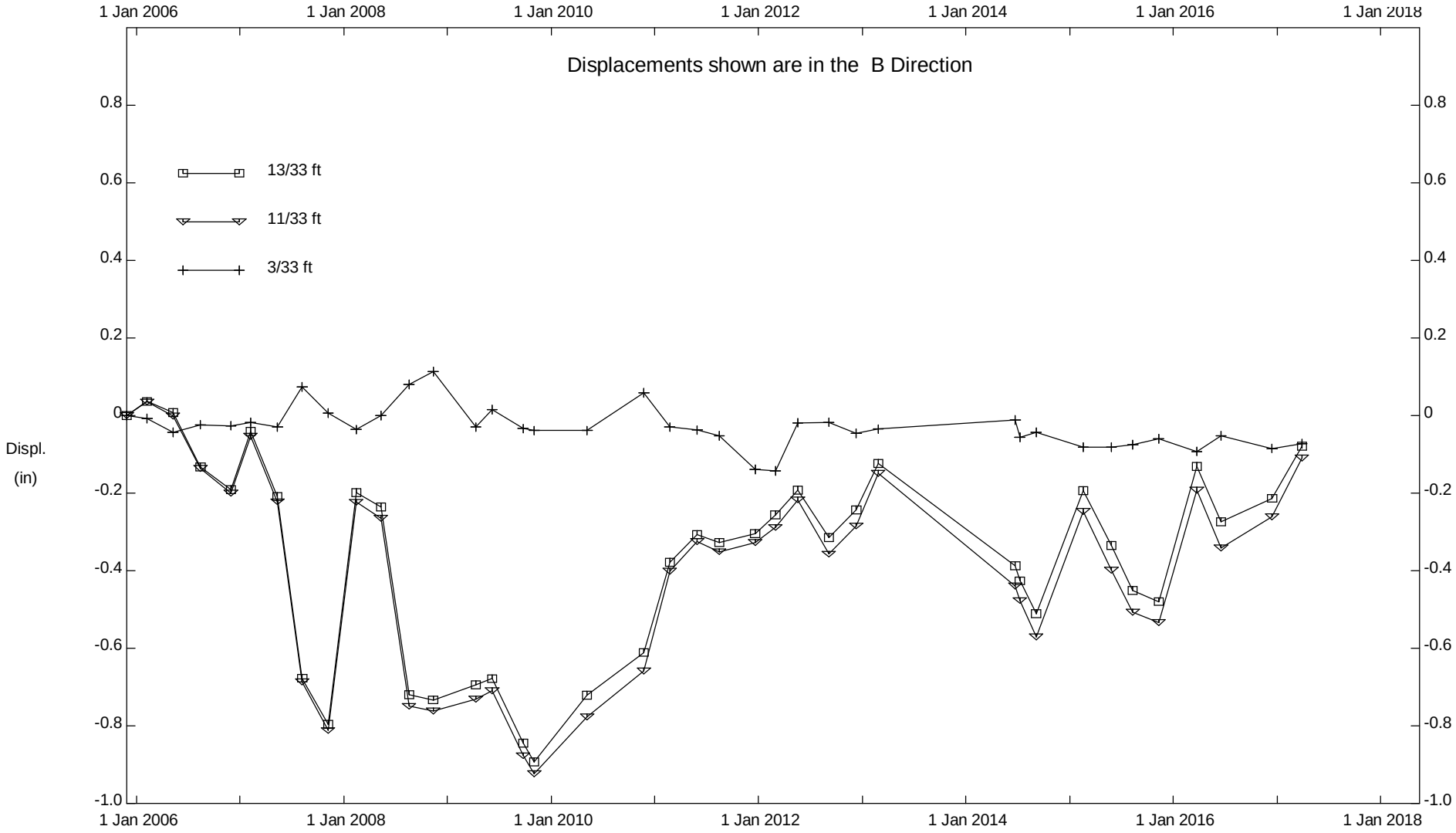
PLATE C-10b



Assessment District 98-2, Inclinometer SI-13

City of Malibu

PLATE C-10c



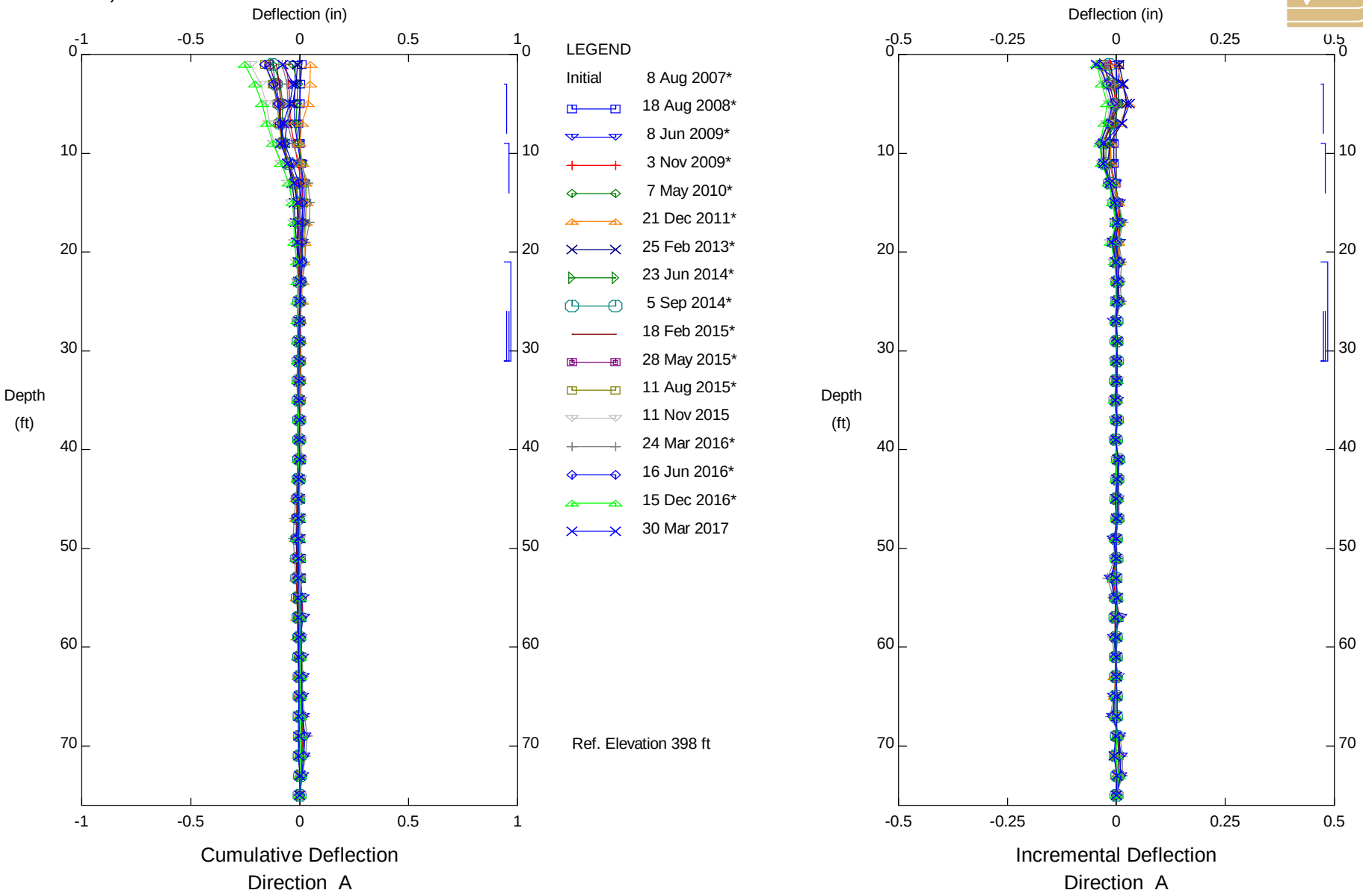
Assessment District 98-2, Inclinometer SI-13

City of Malibu

PLATE C-10d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Assessment District 98-2, Inclinometer SI-14

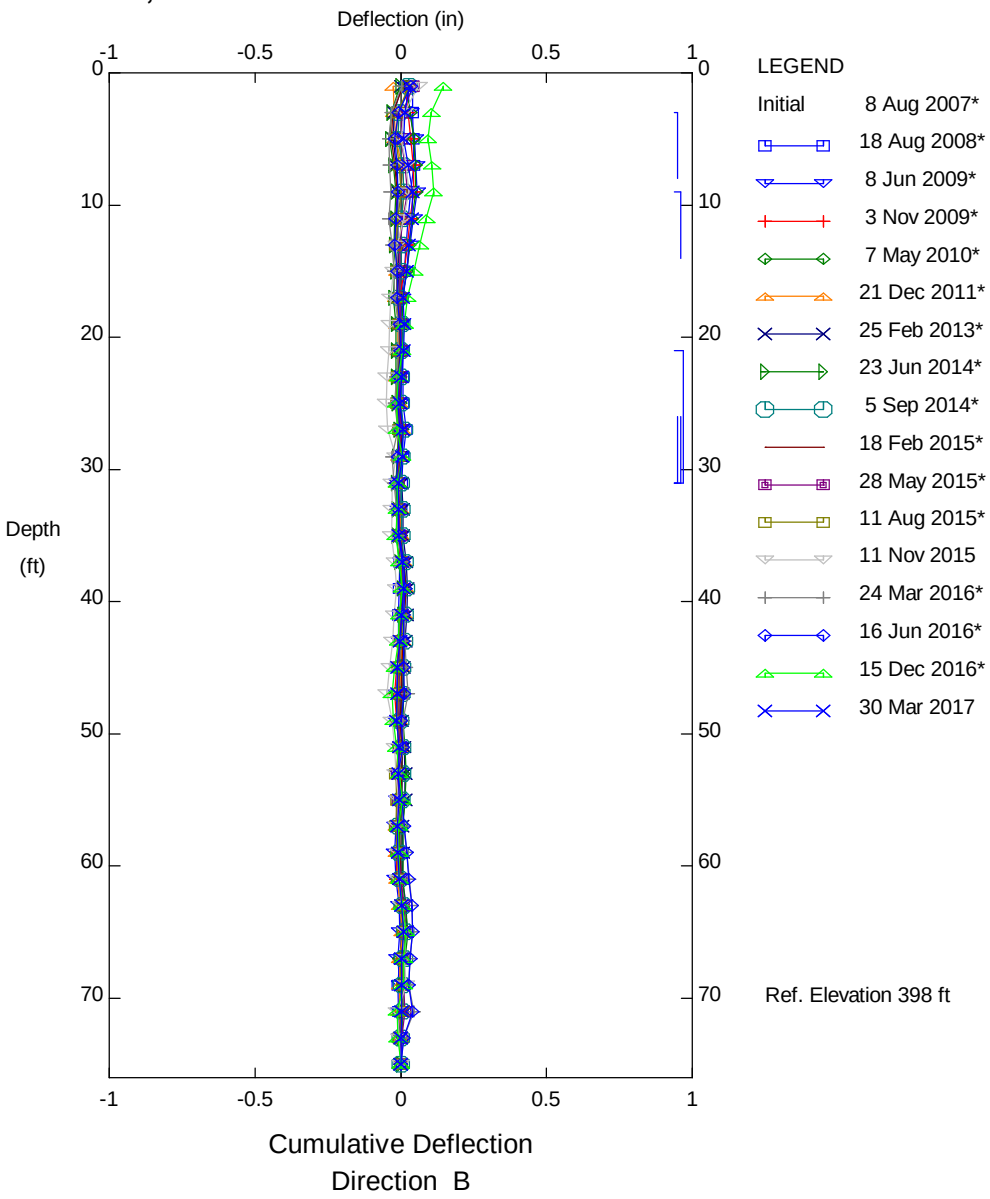
City of Malibu

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

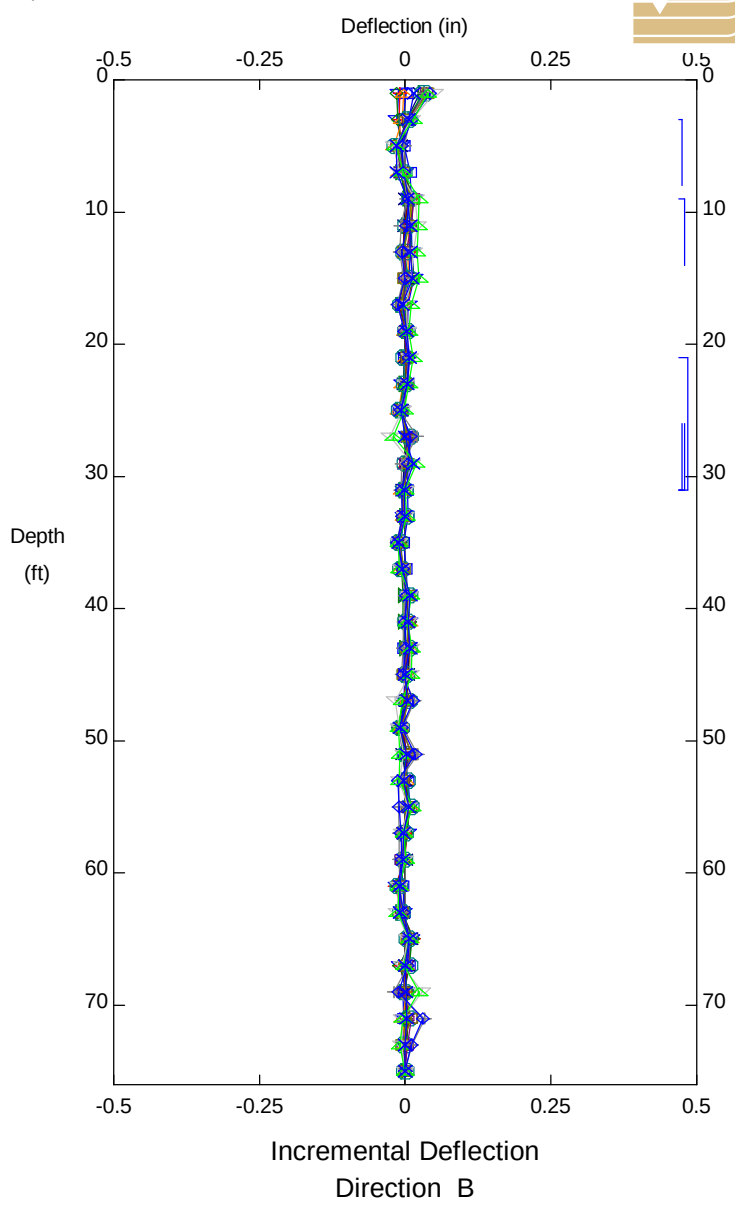
PLATE C-11a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction B

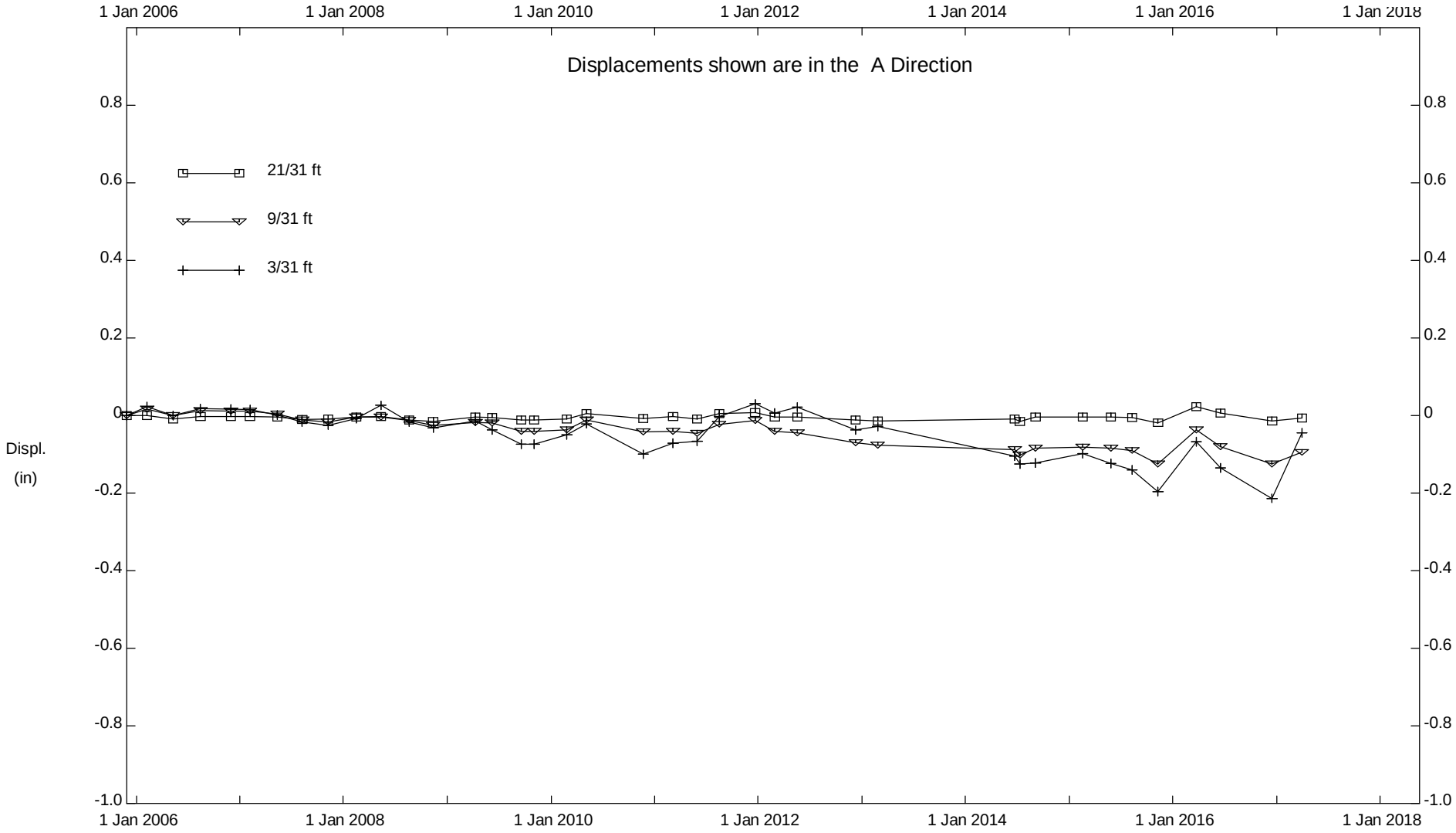


Incremental Deflection
Direction B

Assessment District 98-2, Inclinometer SI-14
City of Malibu

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

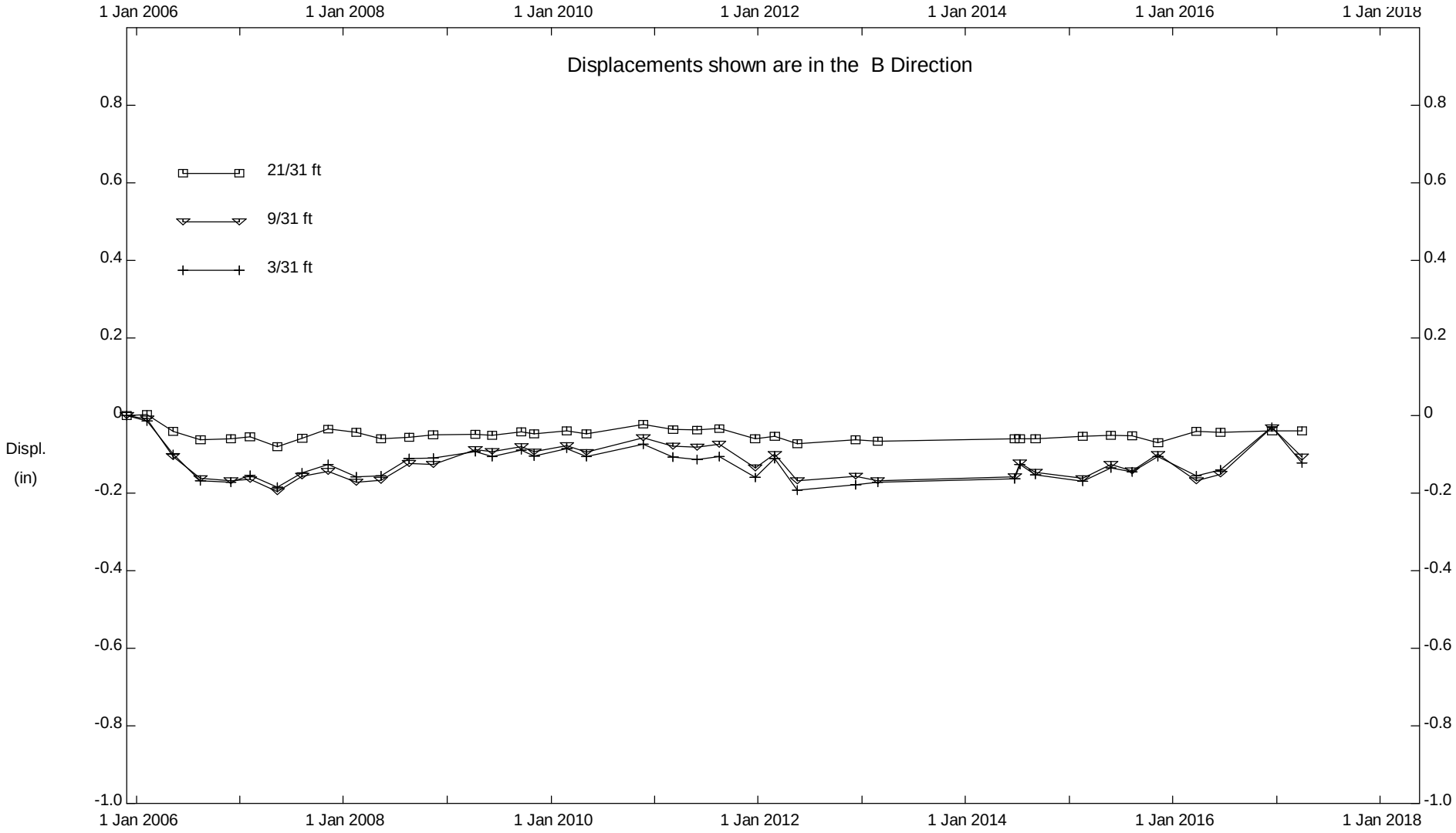
PLATE C-11b



Assessment District 98-2, Inclinometer SI-14

City of Malibu

PLATE C-11c



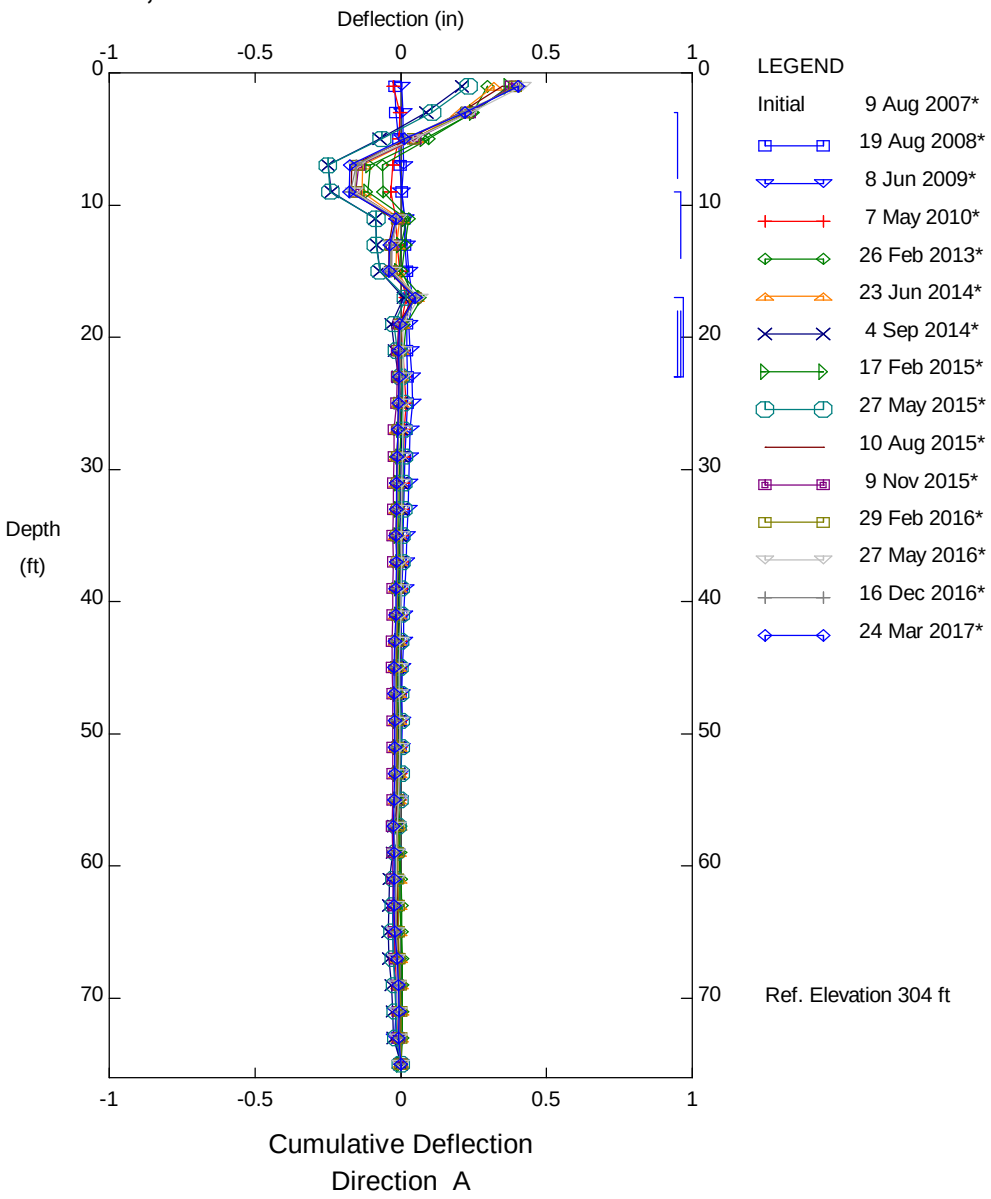
Assessment District 98-2, Inclinometer SI-14

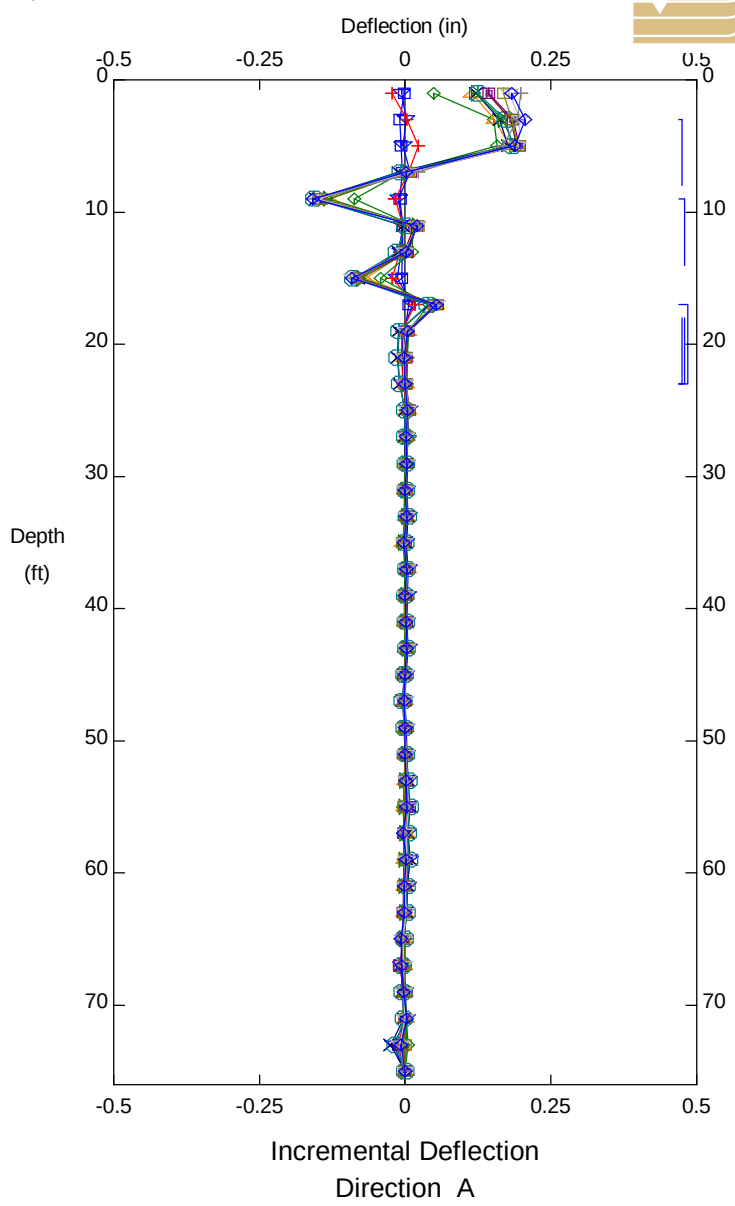
City of Malibu

PLATE C-11d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA





CALLE DEL BARCO, Inclinometer SI-15

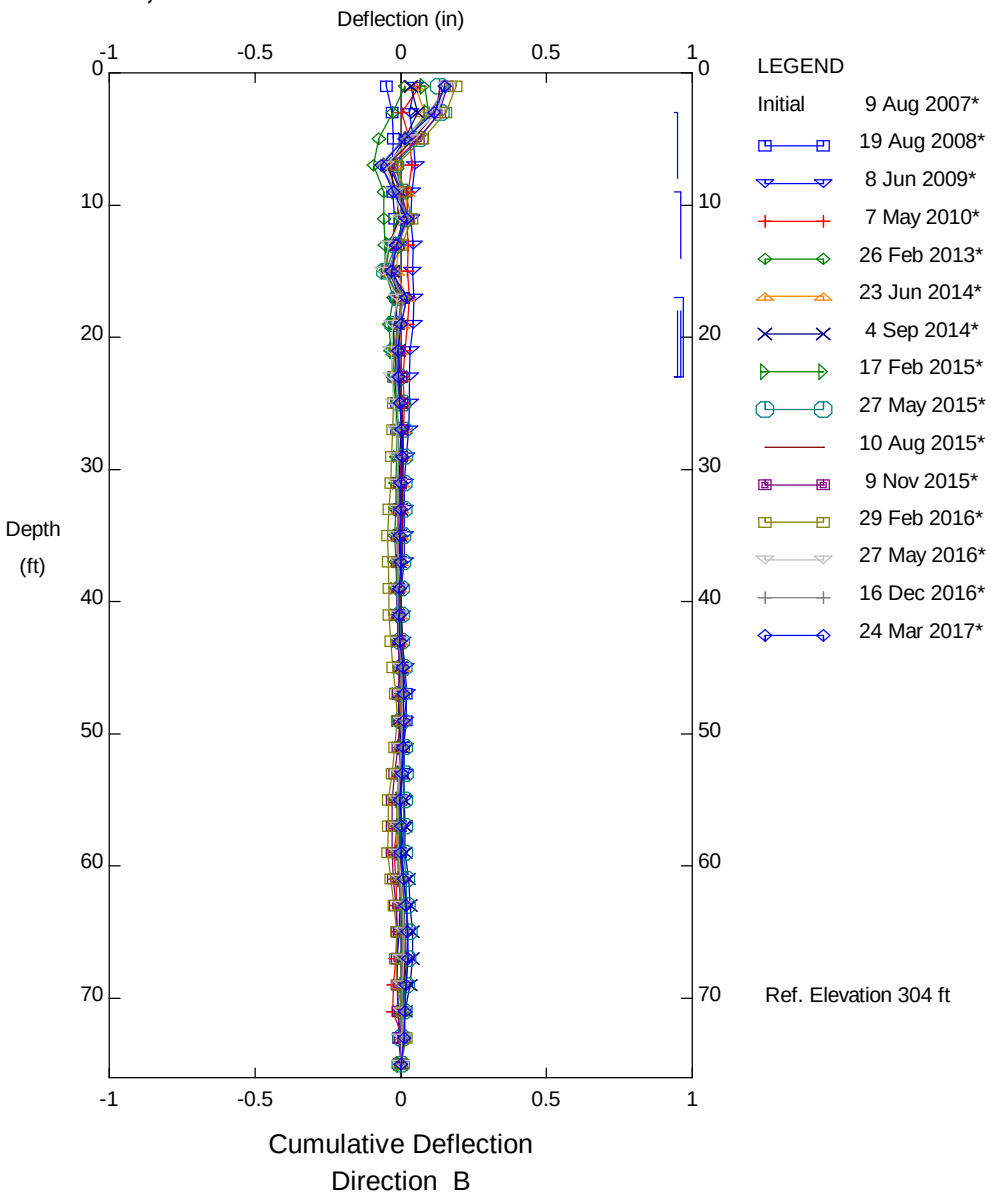
Depth of readings = 72 ft

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

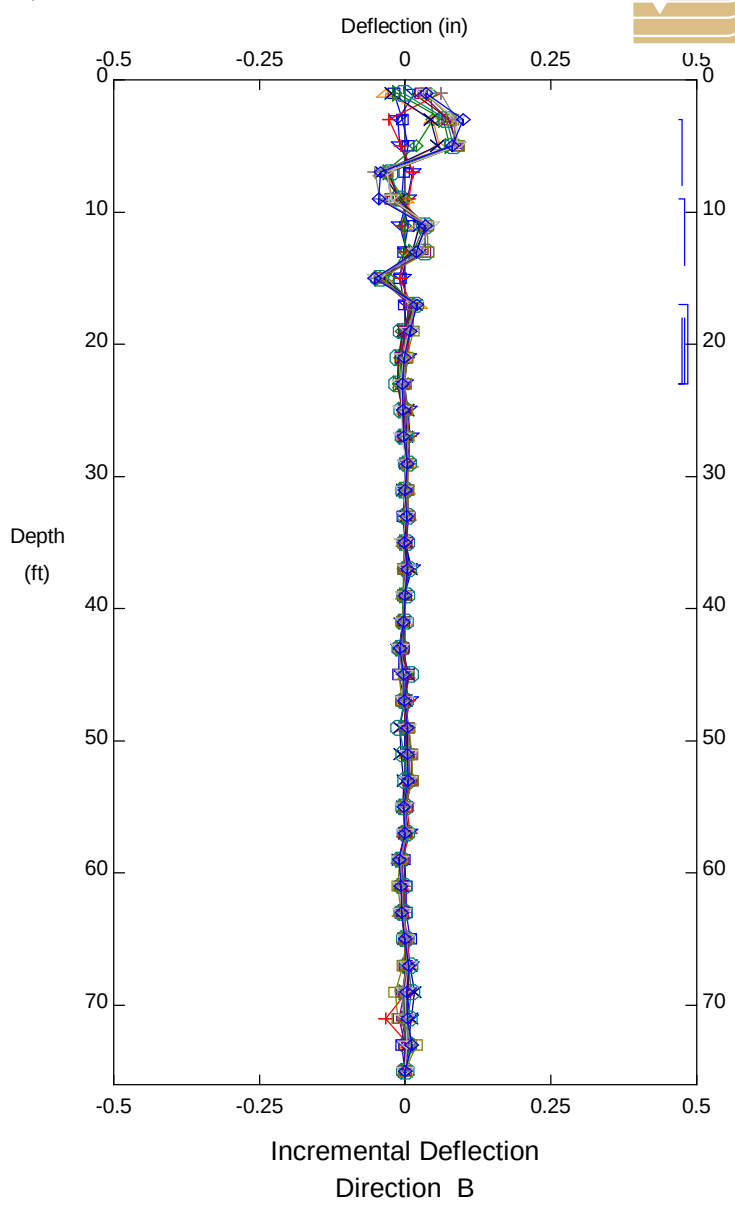
PLATE C-12a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro Consultants, Inc. - Ventura, CA



Cumulative Deflection
Direction B



Incremental Deflection
Direction B

CALLE DEL BARCO, Inclinometer SI-15

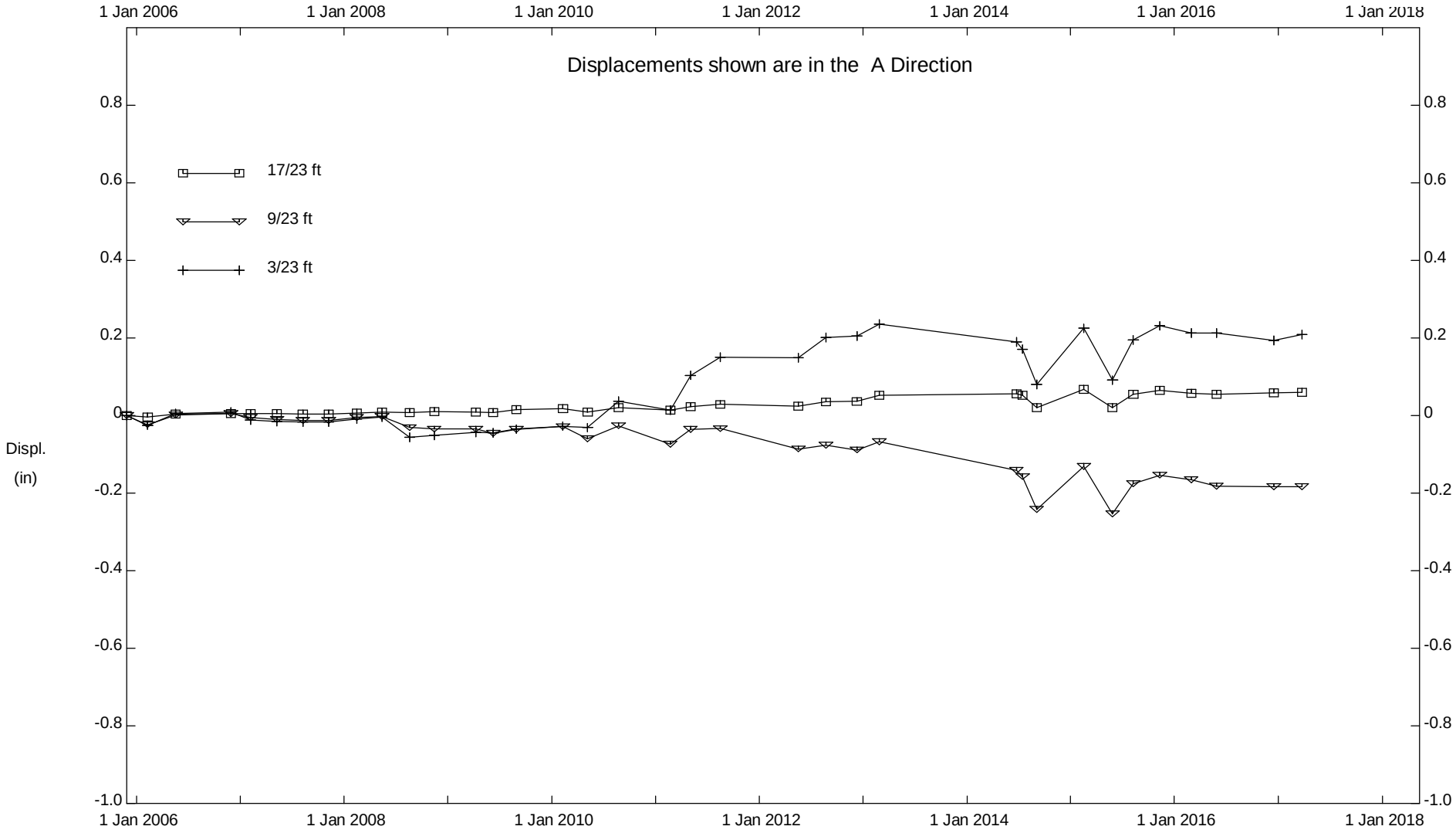
Depth of readings = 72 ft

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

PLATE C-12b

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

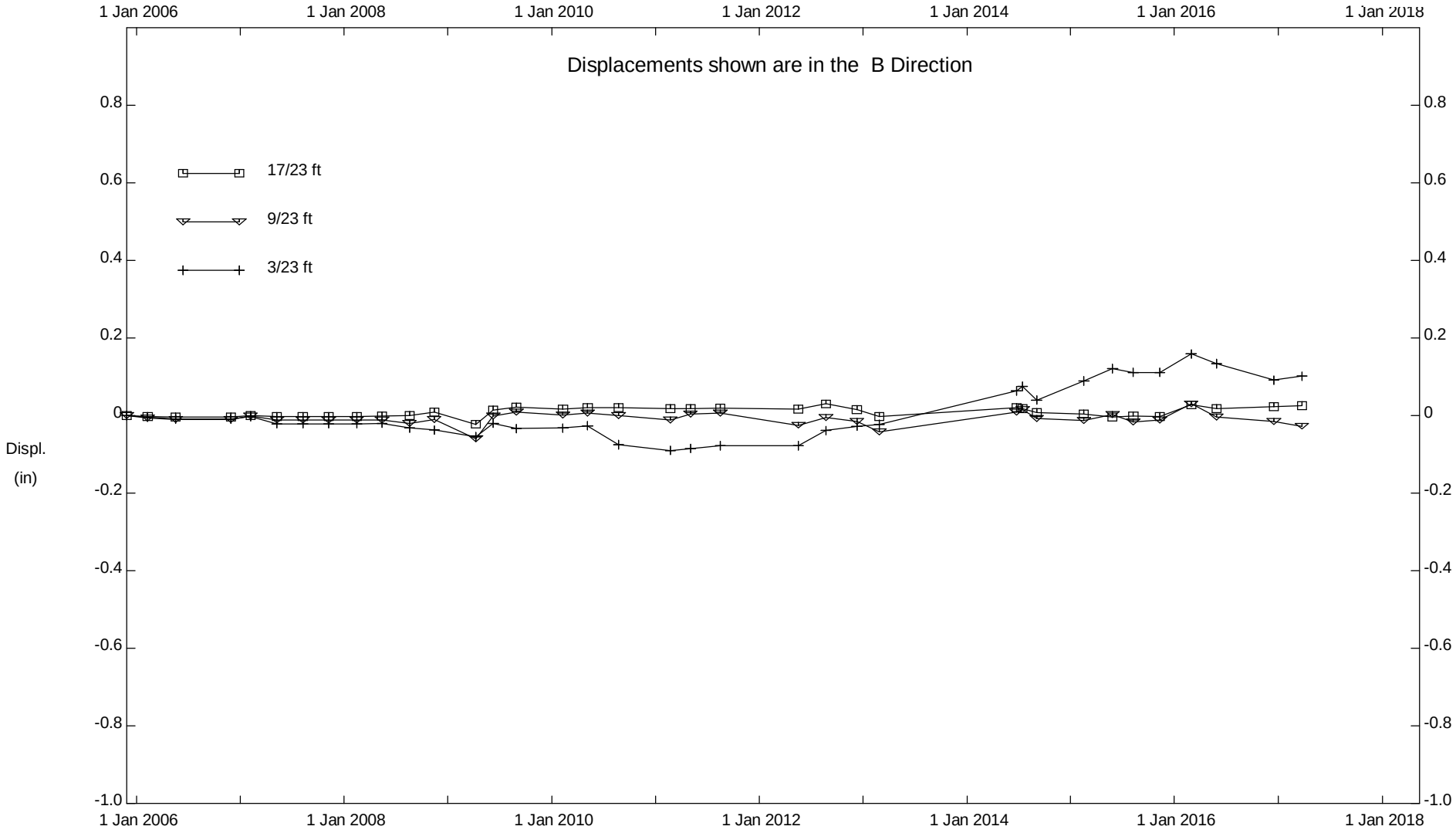
Fugro Consultants, Inc. - Ventura, CA



CALLE DEL BARCO, Inclinometer SI-15

Depth of readings = 72 ft

PLATE C-12c



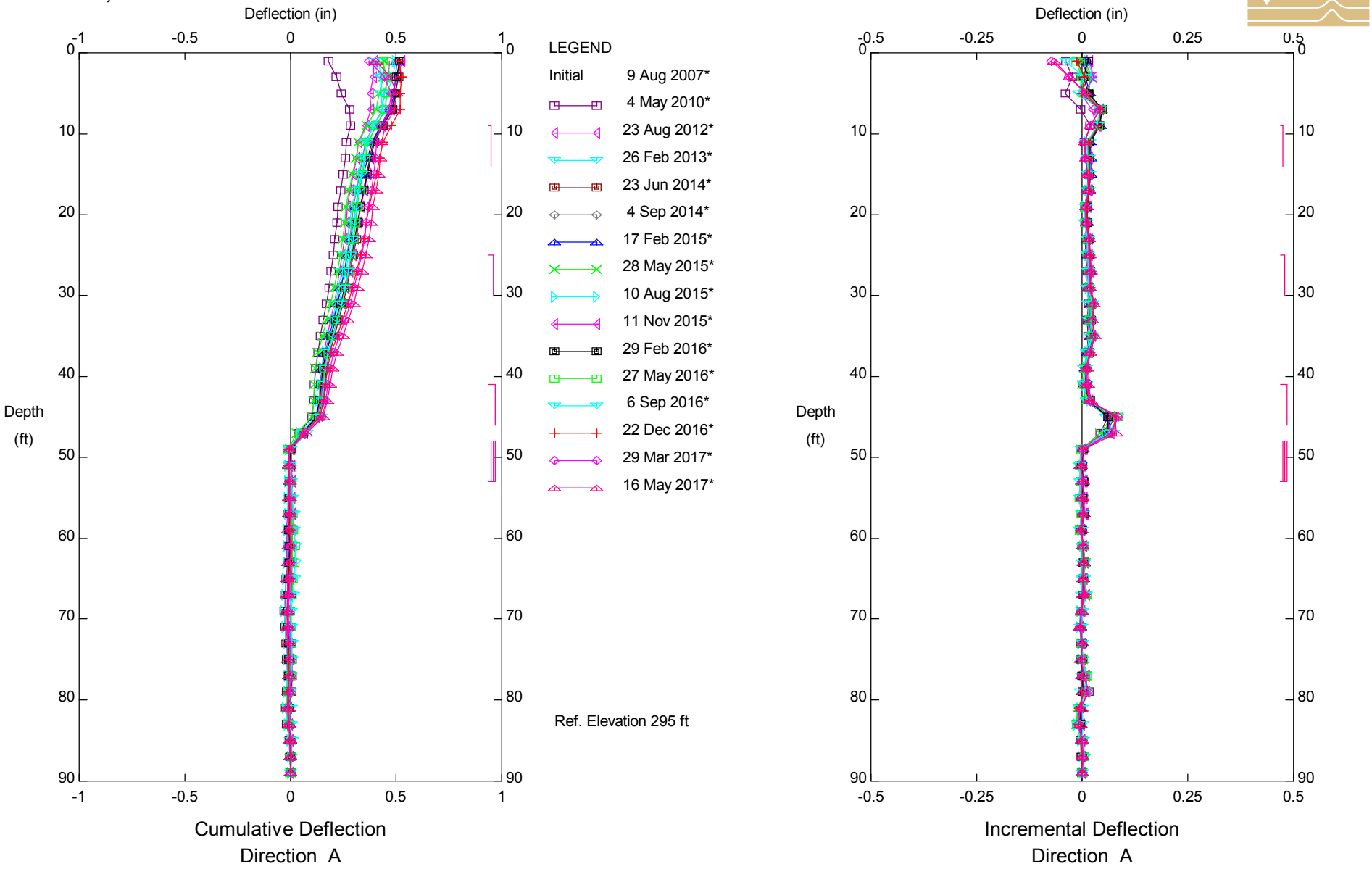
CALLE DEL BARCO, Inclinometer SI-15

Depth of readings = 72 ft

PLATE C-12d

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-2, Inclinometer SI-16

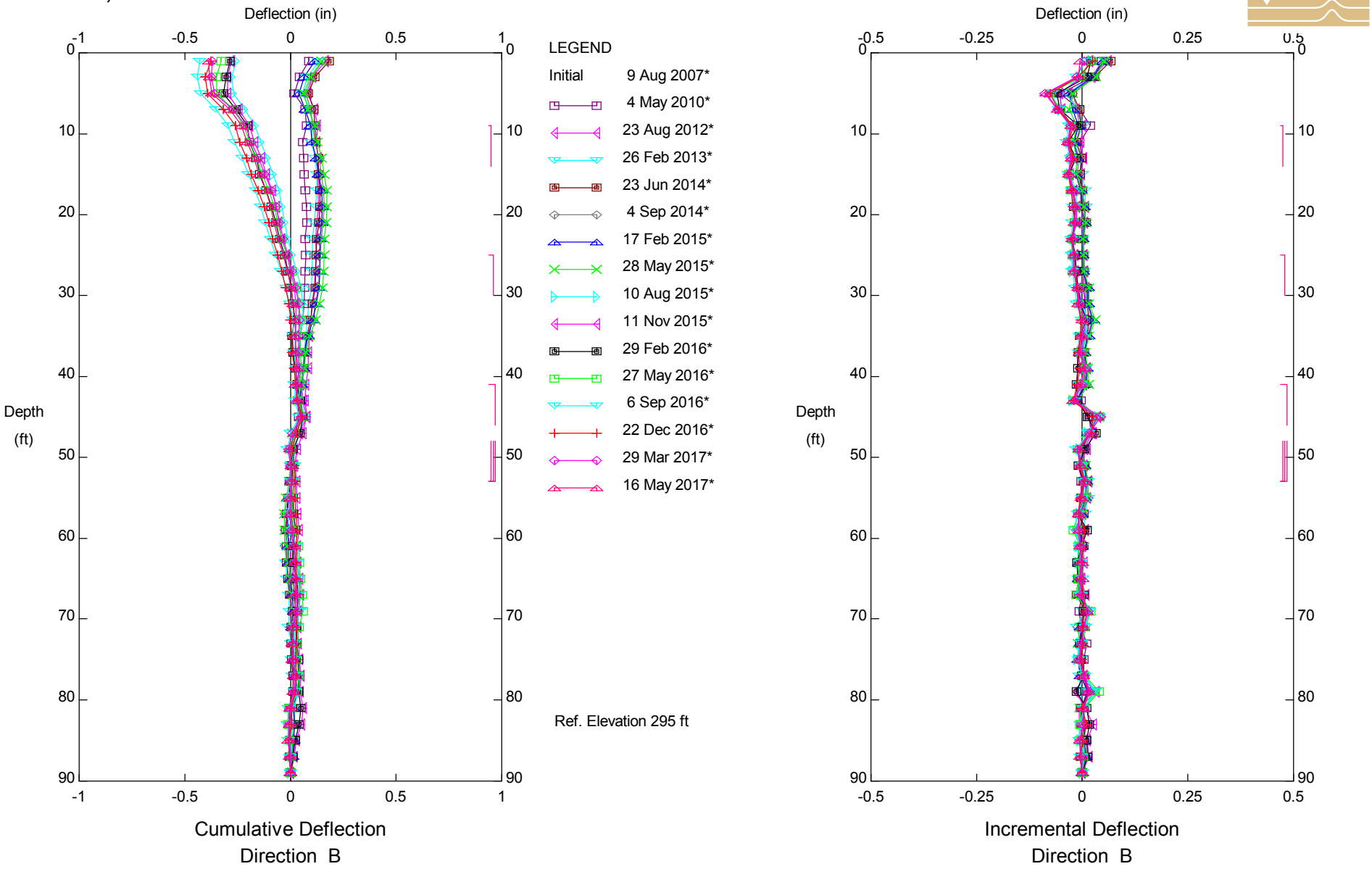
City of Malibu

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

PLATE C-13a

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-2, Inclinometer SI-16

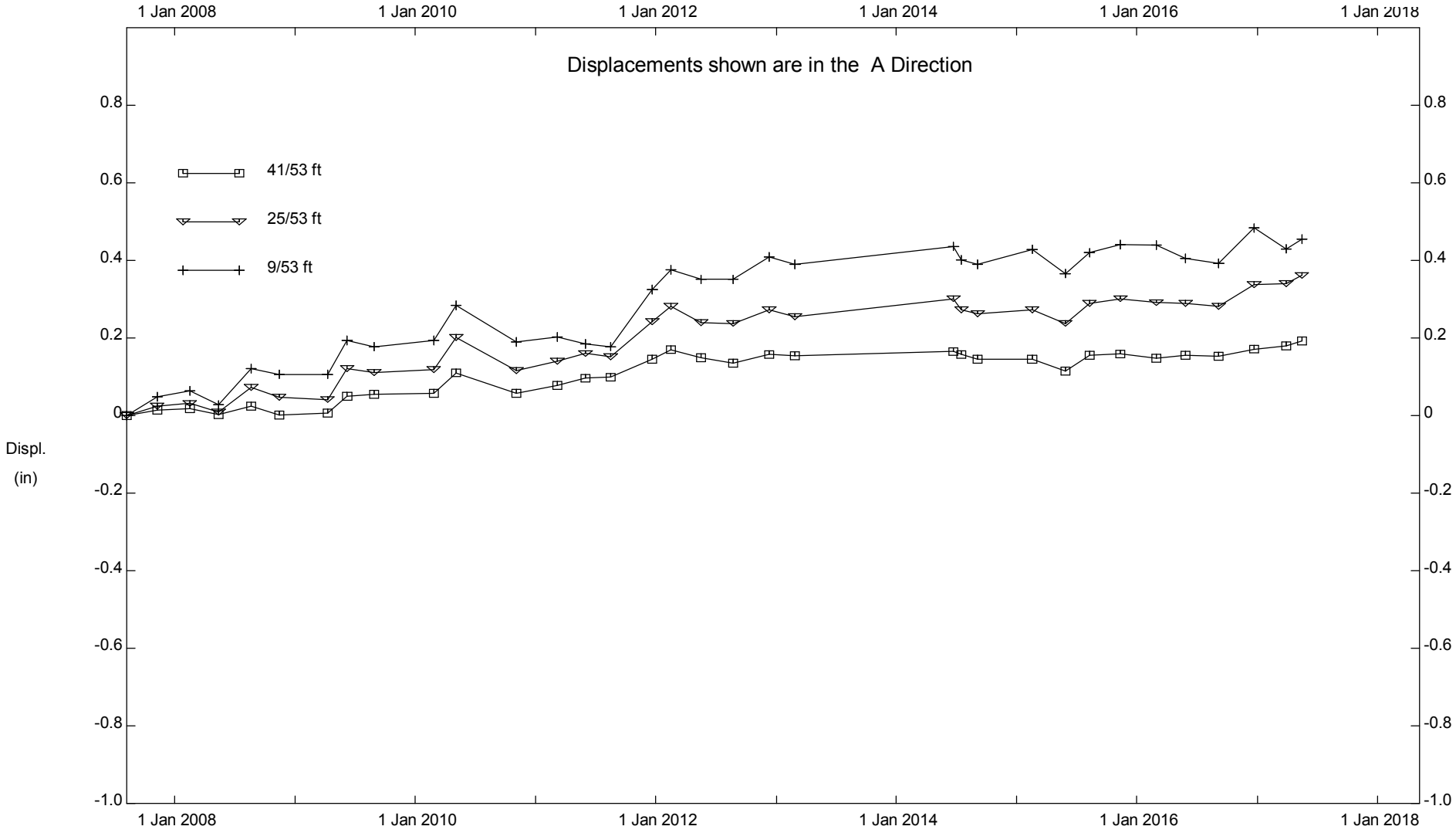
City of Malibu

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

PLATE C-13b

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



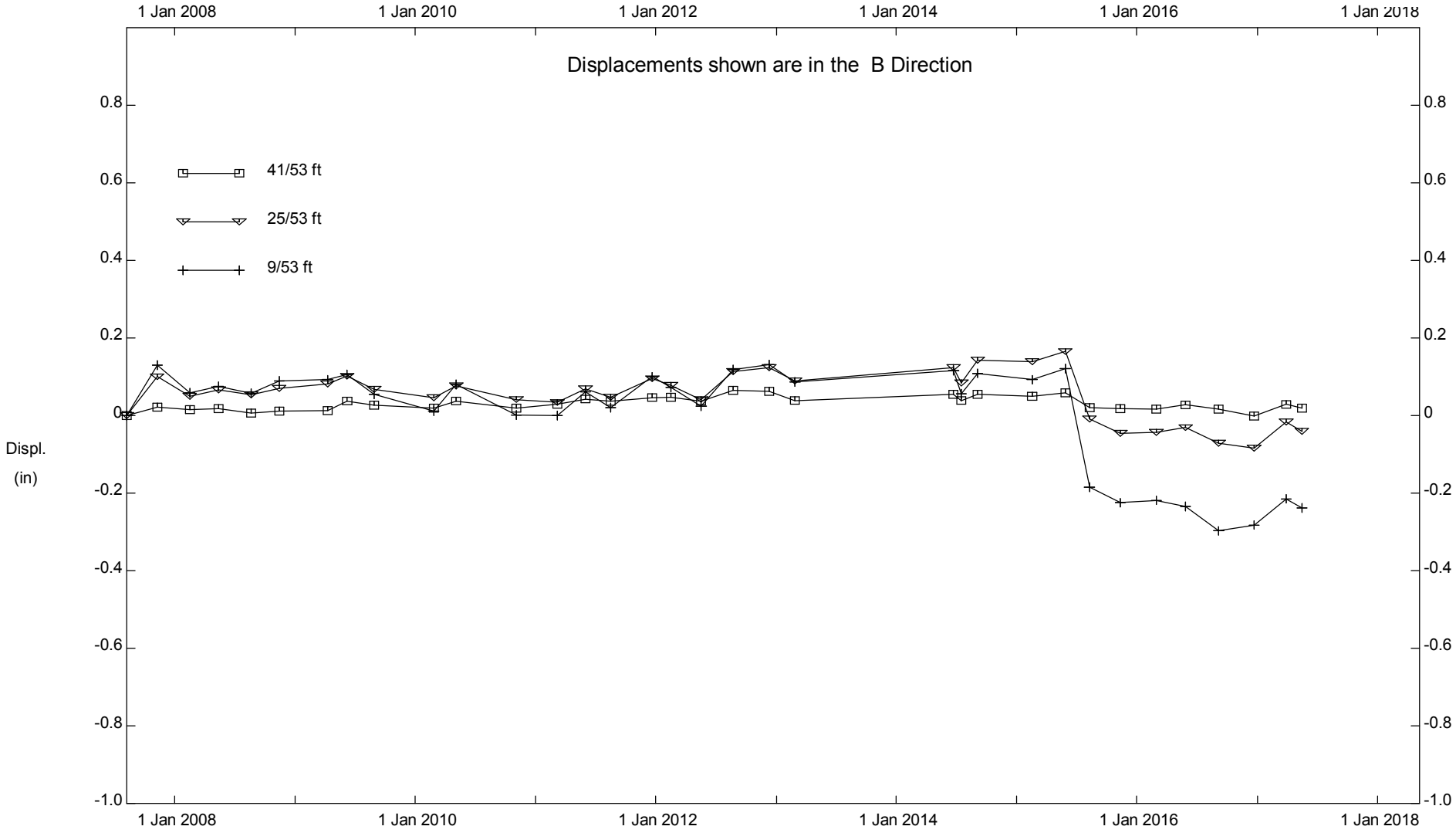
Assessment District 98-2, Inclinometer SI-16

City of Malibu

PLATE C-13c

CITY OF MALIBU
ANNUAL REPORT, JULY 2016 THROUGH JUNE 2017
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-2, Inclinometer SI-16

City of Malibu

PLATE C-13d