FUGRO

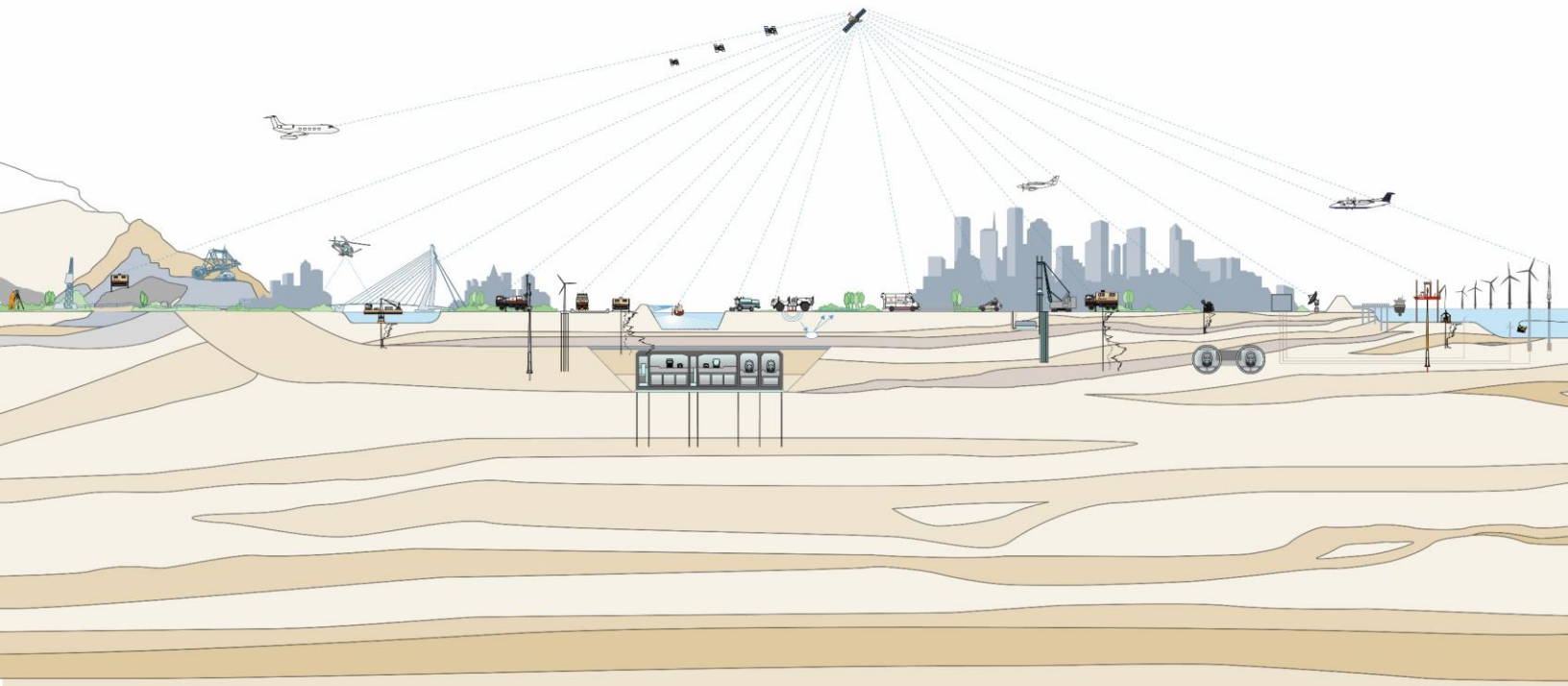
Annual Report
July 2018 Through June 2019
Malibu Road Landslide Assessment District

Malibu, California

November 2019
Fugro Project No. 04.62160604
Document No. 04.62160604-PR-003(Rev.00)

City of Malibu

Final



FUGRO

Annual Report
July 2018 Through June 2019
Malibu Road Landslide Assessment District
Malibu, California

November 2019
Fugro Project No. 04.62160604
Document No. 04.62160604-PR-003(Rev.00)

Final

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

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

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. 04.62160604
Document No. 04.62160604-PR-003(Rev.00)
November 20, 2019

City of Malibu
23825 Stuart Ranch Road
Malibu, California 90265

Attention: Mr. Rob DuBoux

Annual Report, July 2018 Through June 2019, Malibu Road Landslide Assessment District, Malibu, California

Dear Mr. Duboux,

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

Fugro appreciates the opportunity to be of service to 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 Thornhill, PE
Project Engineer/Lead Technician

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

Matthew Q. Pollard, PE
Principal Engineer/Project Manager

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

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

CONTENTS

TABLES IN THE MAIN TEXT

PLATES

APPENDICES

1. INTRODUCTION

1.1 Authorization

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

The Malibu Road Landslide Assessment District (Assessment District) was established in 1981 by the County of Los Angeles (County) following the activation of a landslide on the west end of Malibu Road in 1978 (Plates 1 and 2). The assessment district provides permanent funding to maintain and monitor dewatering facilities with the purpose of stabilizing the landslide to the extent feasible using dewatering methods only. The County administered the assessment district until 1991 when the City incorporated. The Assessment District was reauthorized in May 1998 under Resolution No. 98-036. The City has 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 within the Malibu Road Assessment District for the period between July 1, 2018, and June 30, 2019 (hereafter, the "monitoring period").

Routine monitoring data collected during the current monitoring period included the following:

- Review of 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 eight standpipes;
- Periodic groundwater measurements from nine pneumatic piezometers;
- Monthly dewatering production readings from ten dewatering wells owned by the Assessment District and three wells owned by a private homeowner on Bayshore Drive;
- Monthly to Bi-Monthly dewatering production readings from 23 horizontal drains (hydraugers);
- Monthly, quarterly, and semi-annual ground deformation measurements from 5 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 by visual observation and by evaluating preliminary data in the office as information was received. Maintenance was performed as needed based upon the field observations and preliminary data evaluation, and correspondence from concerned homeowners and tenants.

The scope of services includes monitoring and maintenance of the assessment district facilities. The services provided on an annual basis for the assessment district do not include an engineering evaluation of the stability of the landslide.

1.4 Report Organization

This report summarizes the monitoring data collected during the July 1, 2018 to June 30, 2019, 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 are shown on Plate 2 - Assessment District Map. Tabulated and graphic summaries of monitoring data are presented in Appendix A through Appendix 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 June 30, 2019, 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 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 15.58 inches.

However, rainfall data is usually analysed in terms of the annual "rain season" that covers the time period between October 1 through September 30. Rainfall for October 1, 2018, through September 30, 2019, was approximately 22.24 inches. That is approximately 130 percent of the average annual rainfall of approximately 15.55 inches for the “rain seasons” between 1968 and 2019.

Plate 5 – Groundwater Levels, Dewatering, and Rainfall shows the yearly magnitude of deviation of each year’s rainfall relative to the mean annual rainfall. The graphic also shows the average annual dewatering output in gallons per day (gpd). The data illustrates that the average annual dewatering output is generally consistent with average rainfall.

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 elevation 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, for example, 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 including pumping dewatering wells and hydraugers.

Typically, groundwater levels rise relatively quickly following significant rainfall events and gradually lower after the wet season ends. Groundwater levels at Malibu Road typically peak around late-March to mid-April and gradually decline through late September to November.

2.2.1 Standpipe Piezometers

Eight standpipe piezometers (W-2A, PZ-A, PZ-B, PZ-C, PZ-D, PZ-E, SI-5, and SI-6) were measured regularly over the monitoring period. Standpipe W-3A cannot be located and is presumed to be buried under soil creeping down the slope on the northern side of Malibu Road. Slope inclinometers/piezometers SI-5 and SI-6 were installed in 1998 along Bayshore Drive. Los Angeles County installed the other piezometers at earlier dates. 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 Malibu Road 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 1998 were typically outfitted with one or two 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. Pneumatic water levels were monitored intermittently during the 2018 - 2019 monitoring year. The locations of the piezometers are depicted on Plate 2, and groundwater elevation data are presented in Appendix A.

2.2.3 Groundwater Level Discussion

General. The groundwater data were reviewed by evaluating changes that occurred during the current monitoring period as well as changes in groundwater levels over extended periods. To analyze trends in seasonal groundwater fluctuations, the average (mean) annual and highest annual recorded groundwater elevation for each standpipe piezometer were calculated and compared with those of previous years (Appendix A, Plate A-2).

Malibu Road. Groundwater elevation data for the area along Malibu Road are presented on Plates A-3 and A-4. Groundwater levels for that area are monitored using standpipes PZ-A, -B, -C, -D, -E, W-2A, and W-3A along with pneumatic piezometers installed in inclinometers SI-1, -1A, -2, -3, and -4. Groundwater levels decreased slightly during the 2018 - 2019 monitoring period. The calculated area average water level decreased by 0.2 feet when compared to the area average for the 2017-18 monitoring period and is 2.0 feet below the mean area average for this area for the period of record. Except for PZ-E, water levels in individual

standpipes declined over the monitoring year. Water levels in PZ-E increased by 0.5 feet over the monitoring year.

No new data are presented for standpipes W-2A or W-3A because W-2A has been dry since July 2014 and W-3A is buried beneath soil creep from the bluff face.

Pneumatic piezometers in inclinometer SI-1A showed increased pore pressure readings, whereas pneumatic piezometers in SI-2 and SI-4 showed decreased pore pressure readings. Pneumatic piezometers in inclinometers SI-1 (replaced by SI-1A) and SI-3 are no longer functioning and no new data are presented.

Bayshore Drive. Groundwater elevation data for the area along Bayshore Drive are presented on Plate A-5. Groundwater levels for that area are monitored using standpipes SI-5 and SI-6 along with the two pneumatic piezometers installed with each standpipe. In general, groundwater levels declined during the 2018 - 2019 monitoring period. The calculated area average water-level declined by 0.2 feet when compared to the area average for the 2017 - 2018 monitoring year and is 7.4 feet below the mean area average for this area for the period of record (1991 - 2019). Water levels in standpipe SI-5 declined steadily reached an all-time low for the period of record in March 2019, before rising slightly. Water levels in standpipe SI-6 remained approximately static over the course of the monitoring year, with fluctuations of less than 1 foot. Readings from both the shallow and deep pneumatic piezometers in standpipes SI-5 and SI-6 continue to record water elevation above the standpipe water levels.

The average and highest annual groundwater levels are provided on Plate A-2 and are summarized in Table 1, below.

Table 1. Summary of Average Groundwater Elevations by Area

Location	Average Groundwater El. 2018-2019	Change from Prior Year Average	Peak Groundwater El. 2018-2019	Change from Prior Year Peak
Malibu Road	6.0	-0.2	7.3	-0.4
Bay Shore Drive	17.8	-0.2	20.2	+2.0
Note: All units are in feet				

2.3 Dewatering Production

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 that the average total dewatering rate during the monitoring period was approximately 1553 gpd. This represents a 17 percent decrease in the average rate relative to the 1871 gpd average recorded during the previous monitoring period.

2.3.2 Dewatering Well Production

Graphs showing production rates of individual wells are provided in Appendix B. Production data for the dewatering wells indicate that the average total dewatering well production rate for this monitoring period was approximately 1352 gallons per day (gpd). That represents an increase of approximately 10 percent from the previous monitoring period production rate of 1225 gpd.

2.3.3 Hydrauger Production

Graphs of individual production rates for individual hydraugers are included in Appendix B. Data for the hydraugers indicate that the average production rate for all hydraugers over the monitoring period is approximately 201 gpd. This represents a decrease of approximately 69 percent from the average production rate of 646 gpd for the previous monitoring period.

2.4 Slope Inclinometer Measurements

Fugro monitored five slope inclinometers on a quarterly to semi-annual basis to evaluate 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 recorded measurements during that period.

The original 6 inclinometers SI-1 through SI-6 were installed in 1998. SI-1A was installed in August 2006 to replace SI-1 and has a baseline reading from September 2006. SI-2A was installed in September of the 2010 - 2011 monitoring year as a replacement for SI-2 with a baseline reading in November 2010. SI-4A was installed in August 2012 as a replacement for SI-4 and has a baseline reading from September 2012.

Inclinometer SI-3 was installed in April 1998 and is no longer being monitored due to being sheared off in January 2005.

No significant detectable movement was observed during this monitoring year in any inclinometers within the Malibu Road Assessment District.

3. DEWATERING FACILITY MAINTENANCE

3.1 Facility Maintenance

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. Generally, repairs and maintenance performed during the current monitoring period consisted of fixing broken hydraugers and conveyance lines. 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
9/11/18	W-10	Add check valve to prevent water from conveyance line entering the well
12/14/18	HD-21	Repair broken hydrauger
1/4/19	HD-12	Repair broken hydrauger
2/1/19	HD-11	Repair broken hydrauger
2/27/19, 3/4/19, 5/24/19, 5/28/19	Hydraugers	Brush clearing to improve hydrauger access
5/22/19	HD-22, HD-23	Hydrauger conveyance line repaired
6/24/19	W-10, W-14	Replace well vault lids

3.2 Capital Improvement Projects

No capital improvements were performed during the current monitoring period.

4. SUMMARY AND CONCLUSIONS

The status of the Malibu Road Landslide Assessment District can be summarized as follows:

- Measured rainfall during the 2018 - 2019 monitoring year (July 1 through June 30) was 22.20 inches of precipitation. Rainfall during that monitoring period was above the “Malibu Area” historical average of 15.58 inches per monitoring year measured from 1968 through 2019.
- Groundwater levels on Bayshore Drive on average increased slightly during the 2018-2019 monitoring period. Groundwater levels on Malibu Road on average decreased slightly over the 2018 - 2019 monitoring period.
- Average daily dewatering production decreased 17 percent from the previous monitoring year with dewatering well production increasing by 10 percent and hydrauger production decreasing 69 percent.
- No detectable movement was recorded in inclinometers during the 2018 - 2019 monitoring year.
- Water conservation is encouraged throughout the Malibu Road area to reduce the infiltration of domestic water and the potential for future groundwater level increases. Control of groundwater levels within the landslide area is critical to maintaining the stability of the landslides.
- Groundwater production from existing dewatering wells and hydraugers should be expected to gradually decline over time as the efficiency of the wells and hydraugers decrease due to mineralization and aging of the facilities. 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.

5. REFERENCES

Bing Yen and Associates, Inc. (2003), "Annual Observation & Maintenance Report for the Period July 2002 to June 2003, Malibu Road, Malibu, California," dated October.

_____ (2003), "Annual Observation & Maintenance Report for the Period July 2001 to June 2002, Malibu Road, Malibu, California" dated February.

_____ (2002), "Annual Observation & Maintenance Report for the Period July 2000 to June 2001, Malibu Road, Malibu, California," dated January.

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

_____ (1999), "Annual Observation & Maintenance Report for the Period April 1998 to March 1999, Malibu Road, Malibu, California," dated May.

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

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

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

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

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

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

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

_____ (1992), "Second Quarter Observation Report: Instrumentation and Dewatering Facilities at Calle del Barco, Puerco Beach, and Latigo Canyon Landslide Sites," dated July 9.

_____ (1992), "First Quarter Observation Report: Instrumentation and Dewatering Facilities at Calle Del Barco, Puerco Beach, and Latigo Canyon Landslide Sites," dated April 7.

_____ (1991), "Monitoring, Instrumentation, and Dewatering Facilities at Calle del Barco, Puerco Beach, Latigo Canyon, and Rambla Pacifico (2 wells) Landslide Sites," dated October 4.

David Taussig & Associates, Inc. (2016), "Annual Assessment District No. 98-3 (Malibu Road) FY 2017-2018," dated June 26.

Fugro USA Land, Inc. (2019), "Annual Report, July 2017 through June 2018 Malibu Road Landslide Assessment District, Malibu, California," dated March 2019.

_____ (2018), "Annual Report, July 2016 through June 2017 Malibu Road Landslide Assessment District, Malibu, California," dated January 2018.

Fugro Consultants, Inc. (2016), "Annual Report, July 2015 through June 2016 Malibu Road Landslide Assessment District, Malibu, California," dated November 2016.

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

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

_____ (2014), "Annual Report, July 2012 through June 2013 Malibu Road Landslide Assessment District, Malibu, California," dated January 2014.

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

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

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

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

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

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

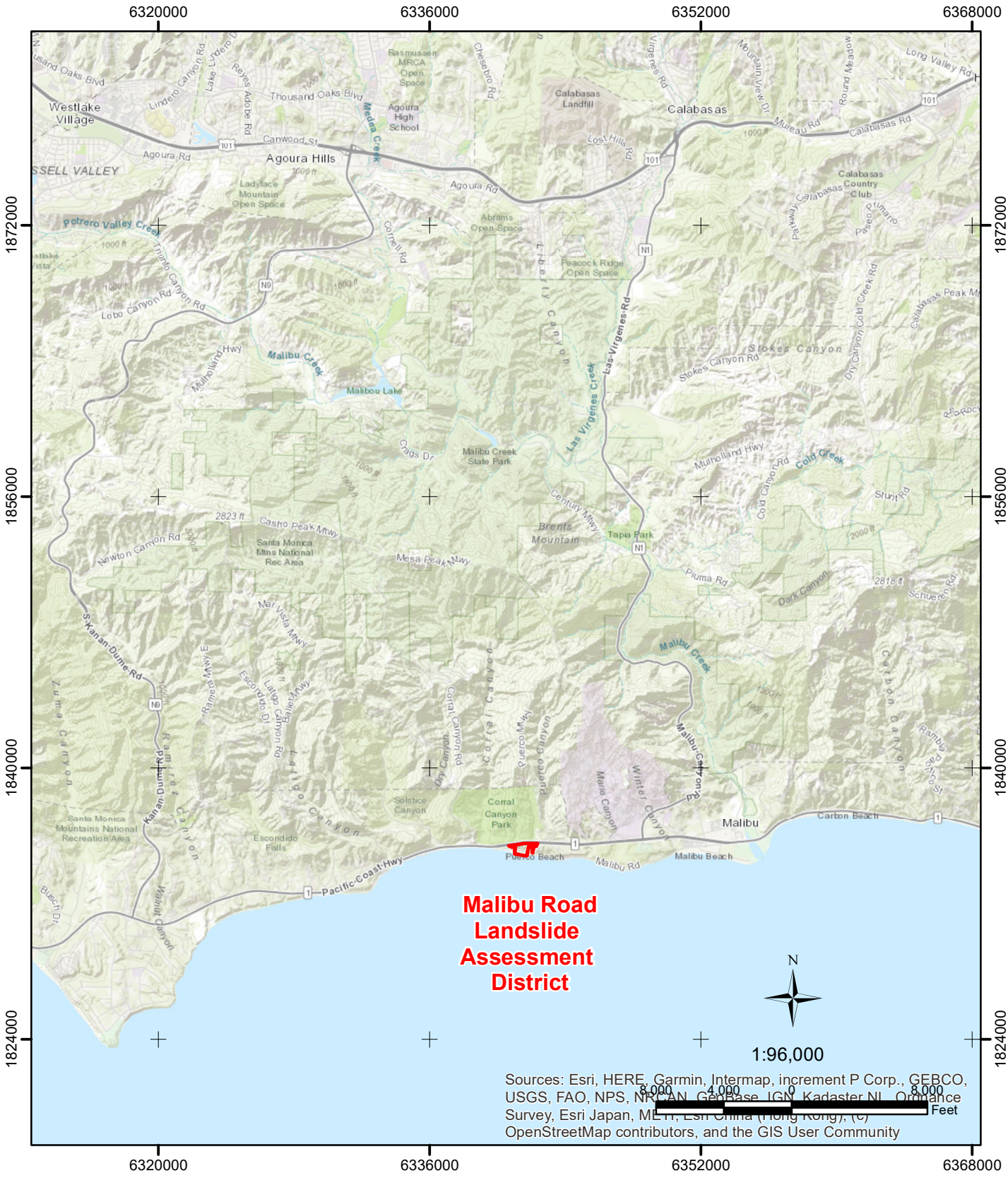
_____ (2006), "Annual Report, July 2005 through June 2006 Malibu Road Landslide Assessment District, Malibu, California," dated August 2006.

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

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

Leighton and Associates, Inc. (1979), "Final Report, Geotechnical Investigation of Landslide Conditions Affecting Puerco West Area, Malibu, California," dated September 4.

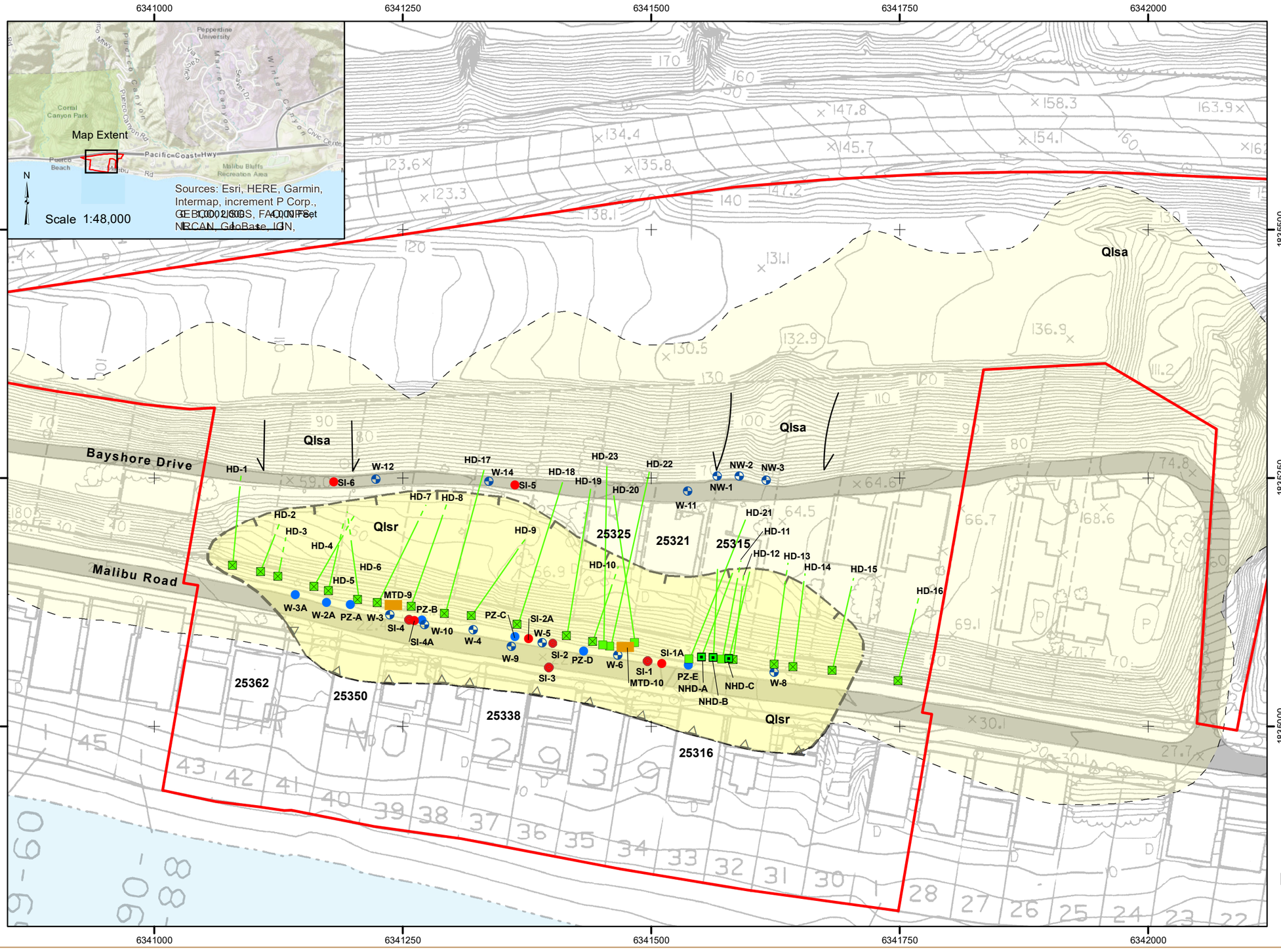
PLATES



SITE LOCATION MAP
Malibu Road Landslide Assessment District
Malibu, California

PLATE 1

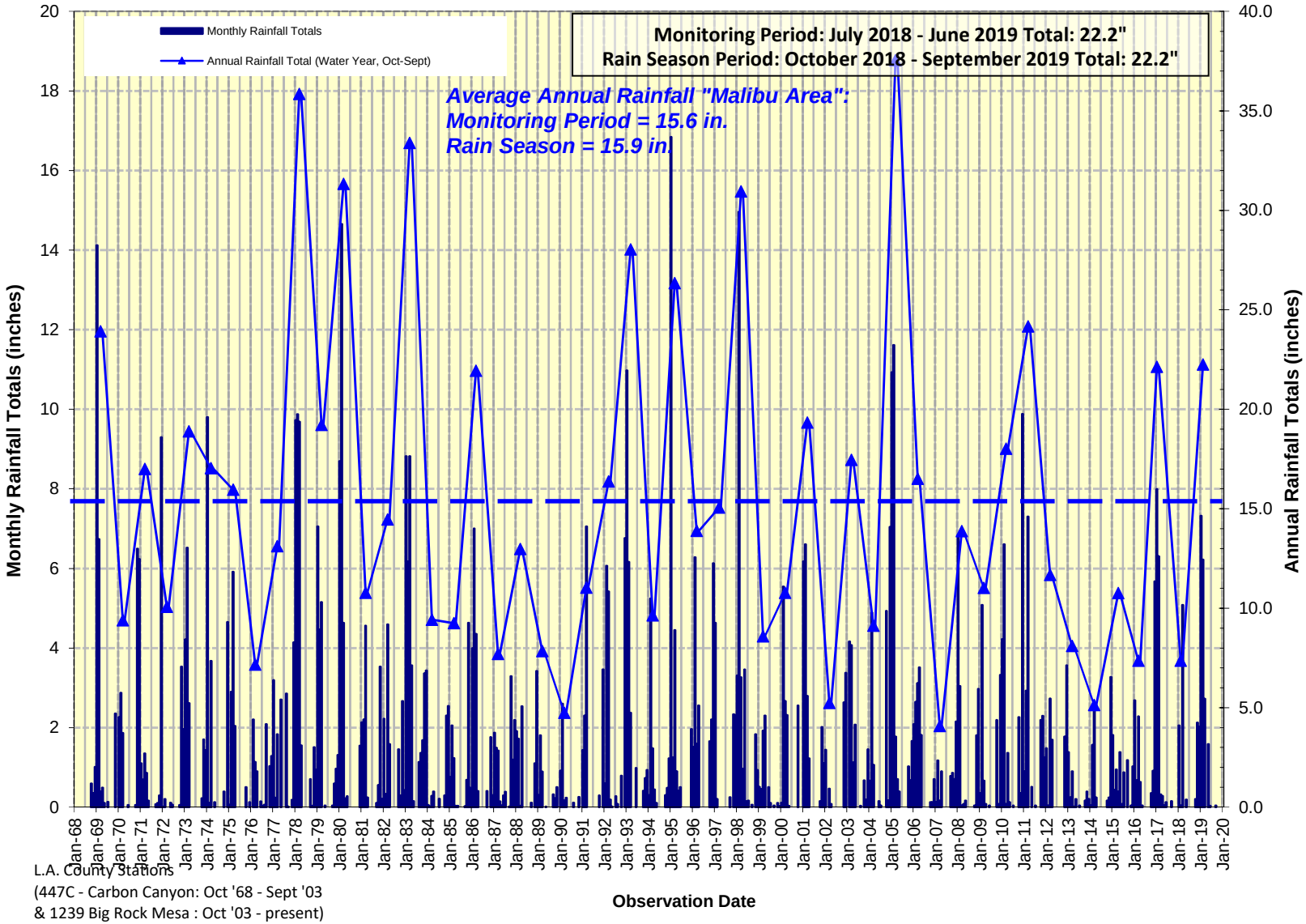
N:\Projects\3399_CityofMalibu\3399-004_MalibuRd\Outputs\2013_10_01_AnnualReport\mxd\Plate01_SiteLocation.mxd, 10/4/2013, CDean



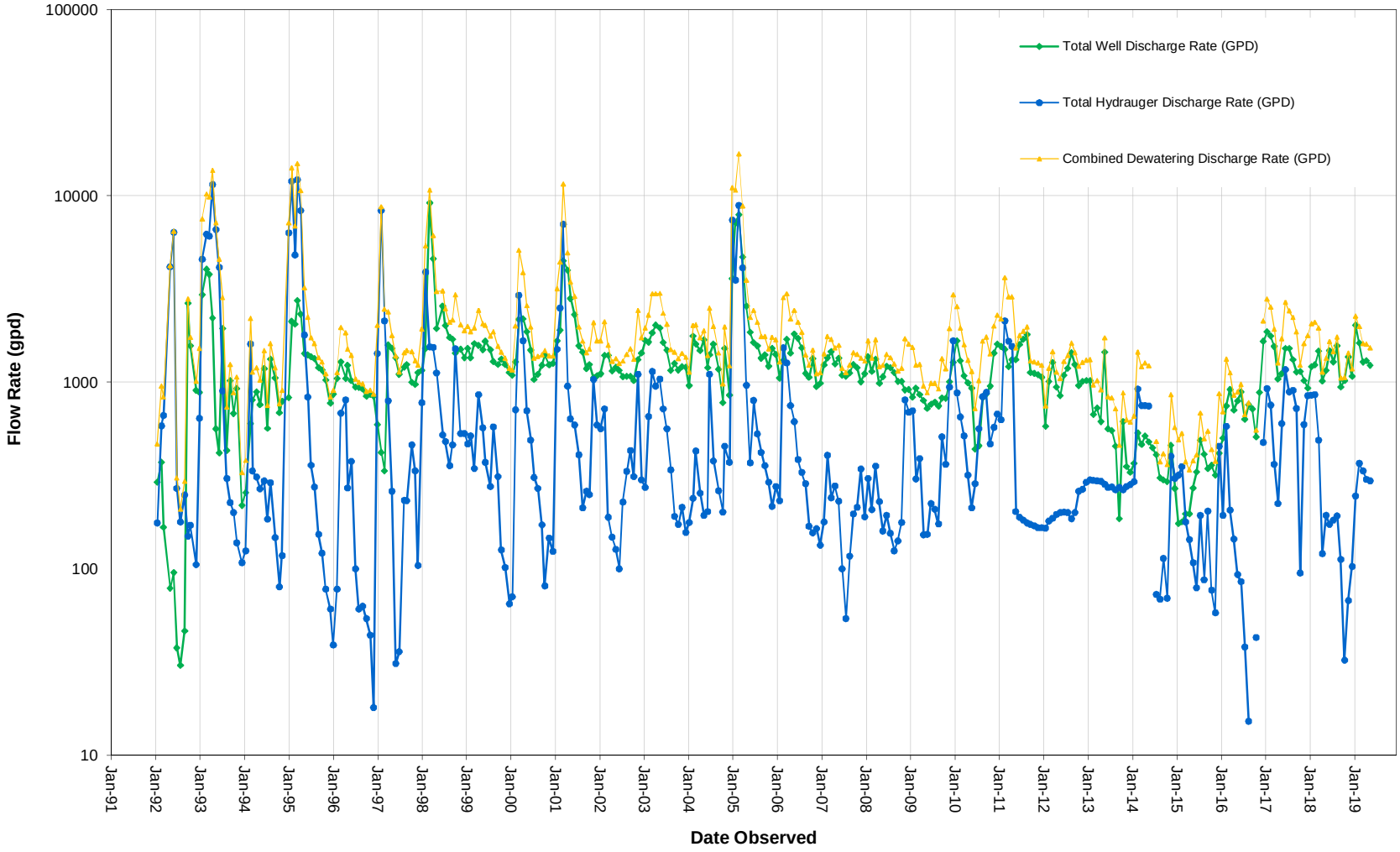
N:\Projects\3399_CityofMalibu\3399-004_MalibuRd\Outputs\2013_10_01_AnnualReport\mxd\Plate02-Instrumentation_MR.mxd, 12/4/2013, CDean

ASSESSMENT DISTRICT MAP
Malibu Road Landslide Assessment District
Malibu, California

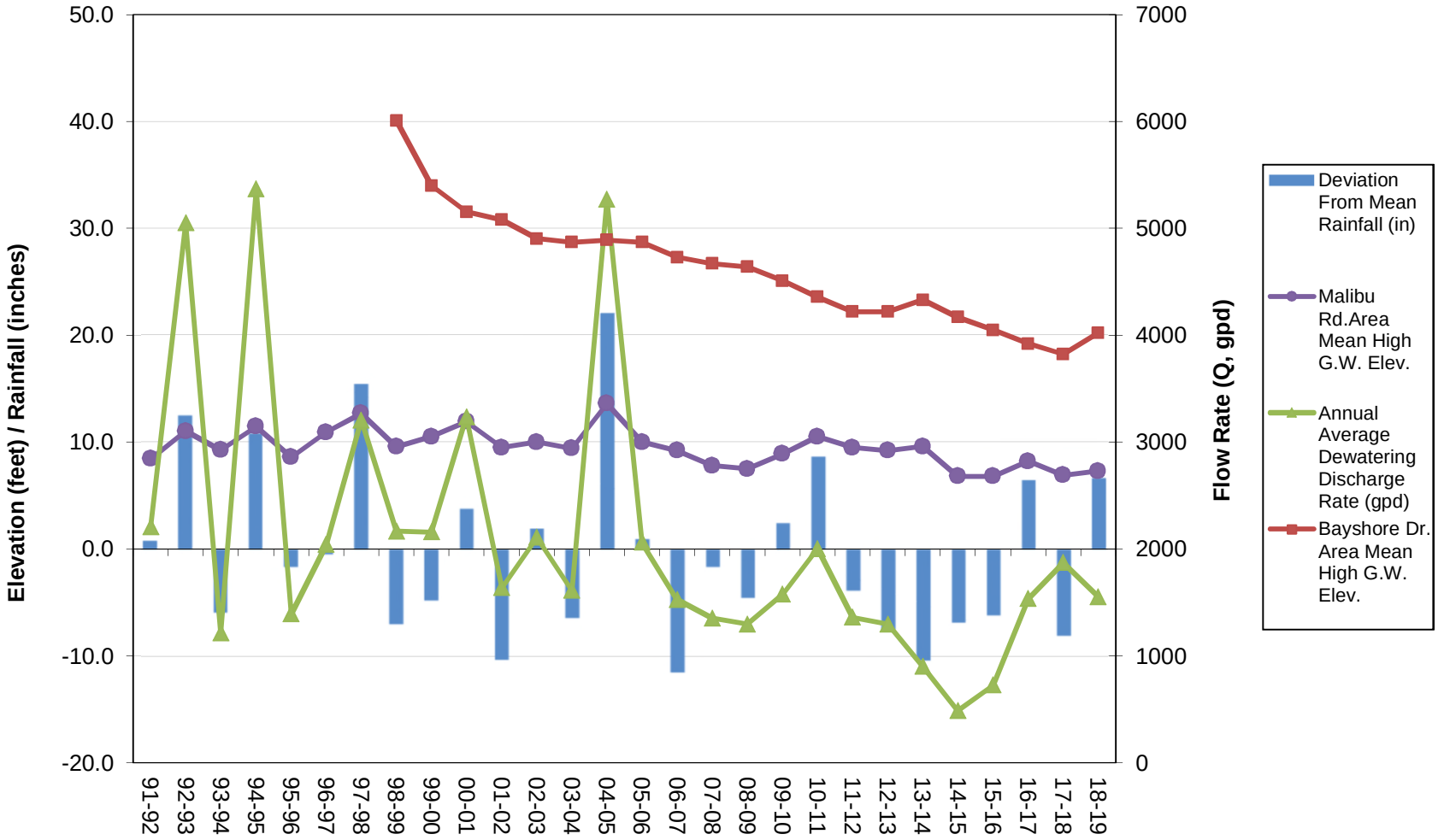
PLATE 2



RAINFALL GRAPH
Malibu Road Landslide Assessment District
Malibu, California



TOTAL DISCHARGE - WELLS AND HYDRAUGERS
Malibu Road Landslide Assessment District
Malibu, California



** Graph shows the mean value of the highest groundwater elevations recorded for each standpipe piezometer during the monitoring year.*

GROUNDWATER LEVELS, DEWATERING, AND RAINFALL
Malibu Road Landslide Assessment District
Malibu, California

APPENDIX A
GROUNDWATER DATA

MALIBU ROAD LAD - Standpipe Piezometer Information						
Standpipe ID	**Previous Reference Elevation (8/91)**	**Updated Reference Elevation (4/00)**	**Casing Depth (ft)**	**Perforation Interval**	**Installed By**	**Notes**
W-2A	22.6	20.6	9.0	Unknown	LA COUNTY	Dry
W-3A	22.0	20.5	32.5	Unknown	LA COUNTY	Buried
PZ-A	20.0	19.8	17.2	Unknown	LA COUNTY	
PZ-B	20.0	19.1	27.9	Unknown	LA COUNTY	
PZ-C	20.0	19.4	29.7	Unknown	LA COUNTY	
PZ-D	20.0	19.2	24.7	Unknown	LA COUNTY	
PZ-E	20.0	21.4	15.8	Unknown	LA COUNTY	
SI-5+	59.0	59.3	78.0	-19.0 to -14.0	BYA	
SI-6++	57.0	58.0	78.0	-21.0 to -16.0	BYA	

Note: + Formerly designated as MR-5
++ Formerly designated as MR-6

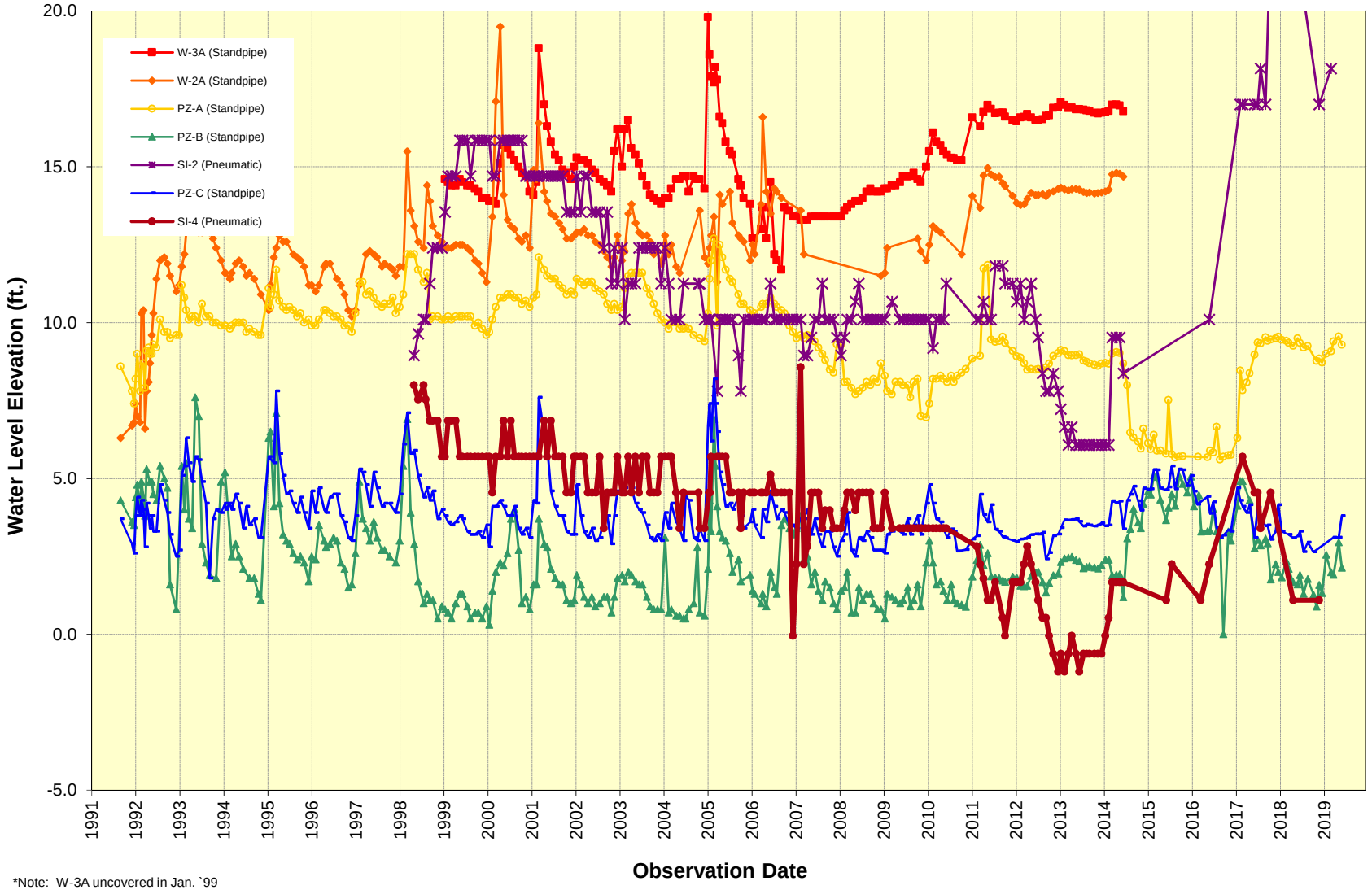
MALIBU ROAD LAD - Pneumatic Piezometer Information						
Well Identification	**Previous Reference Elevation (8/91)**	**Updated Reference Elevation (4/00)**	**Tip Depth (ft.)**	**Tip El. (ft)**	**Installed By**	**Notes**
SI-1*	20.0	20.1	34.6	-14.6	BYA	leaking
SI-2	20.0	19.7	65.1	-45.1	BYA	
SI-3*	20.0	20.3	49.8	-29.8	BYA	clogged
SI-4	22.0	18.9	43.9	-21.9	BYA	
SI-5 Tip 1	59.0	59.3	60	-1	BYA	
SI-5 Tip 2**	59.0	59.3	40	19	BYA	
SI-6 Tip 1	57.0	58.0	60	-3	BYA	
SI-6 Tip 2**	57.0	58.0	40	17	BYA	
SI-1A	20.0	20.0	50	-30	FUGRO	

Note: SI-1 thru SI-4 were previously designated MR98-1 thru MR98-4
SI-5 and SI-6 were previously designated MR-5 and MR-6
* Peizometer not functioning

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT - SUMMARY OF GROUNDWATER DATA

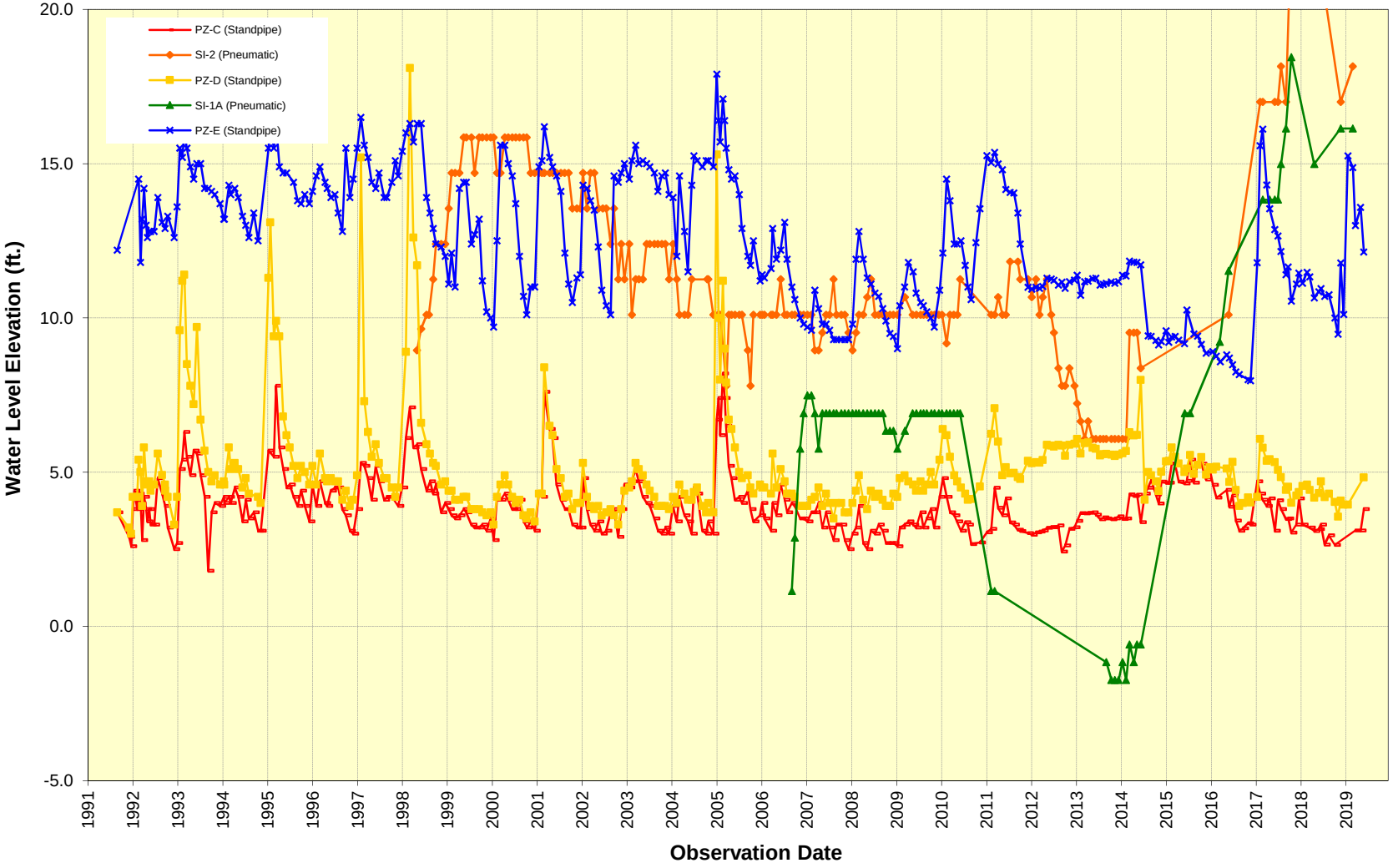
Standpipe / Piezometer I.D.		91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	Mean '91-'19	Stand Dev.	18-19 vs. 97-98	18-19 vs. mean
MALIBU ROAD - Standpipe Piezometers																																	
W-2A	Mean El.	8.3	12.3	12.1	11.8	11.7	11.2	12.4	12.8	13.5	13.7	12.9	12.6	12.3	12.8	13.4	13.7	--	--	--	14.1	14.2	14.2	14.4	DRY	DRY	DRY	DRY	DRY				
	Highest El.	11.4	13.6	13.1	12.8	12.2	12.3	15.5	14.4	19.5	16.4	13.4	13.8	12.8	14.1	16.6	14.3	--	--	--	15.0	14.7	14.3	14.8	DRY	DRY	DRY	DRY	DRY				
W-3A	Mean El.								14.5	14.4	15.5	15.0	15.3	14.3	16.4	13.9	13.1	13.6	14.3	15.2	16.1	16.6	16.8	16.8	UTL	UTL	UTL	UTL	UTL				
	Highest El.								14.6	15.7	18.8	15.4	16.5	14.7	19.8	15.5	13.7	13.9	14.7	16.1	17.0	16.7	17.1	17.0	UTL	UTL	UTL	UTL	UTL				
PZ-A	Mean El.	8.6	10.1	10.0	10.4	10.2	10.5	11.1	10.4	10.2	11.1	11.2	11.0	10.3	10.8	10.7	9.9	8.5	8.1	7.9	9.2	9.0	8.9	8.8	6.3	6.0	6.9	9.4	9.1	*9.4*	*1.4*	*-2.0*	*-0.3*
	Highest El.	9.3	11.2	10.6	11.7	10.5	11.3	12.2	11.6	10.9	12.1	11.4	11.6	11.6	12.7	11.4	10.6	9.3	8.7	8.3	11.9	9.6	9.1	9.1	8.0	7.5	9.0	9.6	9.6	*10.4*	*1.4*	*-2.6*	*-0.8*
PZ-B	Mean El.	4.4	4.5	2.9	3.7	2.6	2.9	3.4	1.0	1.3	2.3	1.3	1.5	1.0	2.8	1.7	2.7	1.3	1.0	1.6	1.8	1.7	2.1	2.1	4.1	4.2	3.8	2.3	1.8	*2.4*	*1.1*	*-1.6*	*-0.6*
	Highest El.	5.3	7.6	5.2	7.1	3.5	4.9	6.9	1.3	2.6	4.0	1.9	2.0	3.1	6.9	2.6	3.8	2.0	1.3	3.0	2.9	2.0	2.5	2.4	5.1	5.1	4.9	3.1	3.0	*3.8*	*1.8*	*-4.0*	*-0.8*
PZ-C	Mean El.	3.6	4.6	3.9	4.7	4.2	4.2	5.1	4.0	3.6	4.5	3.6	4.1	3.4	5.2	3.9	3.7	3.0	3.0	3.7	3.4	3.1	3.3	3.7	4.6	4.8	3.7	3.5	3.1	*3.9*	*0.6*	*-2.0*	*-0.8*
	Highest El.	4.4	6.3	4.9	7.8	4.7	5.3	7.1	4.7	4.3	7.6	4.8	5.1	4.2	8.2	4.6	4.1	3.9	3.4	4.8	4.5	3.4	3.7	4.3	5.3	5.4	4.7	4.2	3.8	*5.0*	*1.3*	*-3.3*	*-1.2*
PZ-D	Mean El.	4.4	6.9	5.1	7.6	5.0	5.9	7.8	4.7	4.0	4.8	4.2	4.3	4.1	7.0	4.7	4.2	4.0	4.4	5.1	5.2	5.3	5.8	5.9	5.0	5.1	4.8	4.5	4.2	*5.1*	*1.1*	*-3.6*	*-1.0*
	Highest El.	5.8	11.4	6.7	13.1	5.8	15.2	18.1	5.9	4.9	8.4	5.3	5.3	4.6	15.3	5.6	4.7	4.9	4.9	6.4	7.1	5.9	6.1	8.0	5.8	5.6	6.1	5.1	4.8	*7.4*	*3.7*	*-13.3*	*-2.6*
PZ-E	Mean El.	13.0	14.3	13.9	14.5	14.2	14.6	15.2	12.8	12.7	13.3	12.5	14.1	13.8	15.6	12.1	10.5	10.4	10.4	11.6	13.5	11.9	11.2	11.4	9.3	9.1	11.4	11.4	11.9	*12.5*	*1.7*	*-3.3*	*-0.6*
	Highest El.	14.5	16.0	15.0	16.3	14.9	16.5	16.3	14.4	15.6	16.2	14.3	15.6	14.9	17.9	14.0	13.1	12.8	11.8	14.5	15.4	14.1	11.4	11.8	9.6	10.3	16.1	12.7	15.3	*14.3*	*2.0*	*-1.1*	*0.9*
Area Average	Mean El.	7.0	8.8	8.0	8.8	8.0	8.2	9.2	8.6	8.5	9.3	8.7	9.0	8.5	10.1	8.6	8.2	6.8	6.9	7.5	9.0	8.8	8.9	9.0	5.9	5.8	6.1	6.2	6.0	*8.0*	*1.2*	*-3.2*	*-2.0*
	Highest El.	8.5	11.0	9.3	11.5	8.6	10.9	12.7	9.6	10.5	11.9	9.5	10.0	9.4	13.6	10.0	9.2	7.8	7.5	8.9	10.5	9.5	9.2	9.6	6.8	6.8	8.2	6.9	7.3	*9.5*	*1.7*	*-5.4*	*-2.2*
Change vs. Prior	Mean El.		1.7	-0.8	0.8	-0.8	0.3	0.9	-0.6	-0.1	0.8	-0.6	0.3	-0.5	1.6	-1.5	-0.4	-1.4	0.1	0.6	1.5	-0.2	0.1	0.1	-3.1	-0.1	0.3	0.1	-0.2				
	Highest El.		2.6	-1.8	2.2	-2.9	2.3	1.8	-3.1	0.9	1.4	-2.4	0.5	-0.6	4.1	-3.5	-0.9	-1.4	-0.3	1.4	1.7	-1.0	-0.3	0.5	-2.9	0.0	1.4	-1.3	0.4				
Bayshore Drive - Standpipe Piezometers																																	
SI-5	Mean El.								35.5	32.2	30.7	30.1	29.3	29.0	28.6	28.2	27.8	27.3	26.3	22.6	18.8	16.5	16.4	18.0	17.4	14.3	12.2	11.2	11.1	*23.0*	*7.7*		*-11.9*
	Highest El.								37.8	33.4	31.2	30.4	29.7	29.2	29.0	28.4	28.0	27.5	27.0	24.3	20.5	17.6	17.2	19.4	18.3	15.6	12.9	11.5	15.6	*24.0*	*7.4*		*-8.5*
SI-6	Mean El.								38.8	32.6	31.2	29.9	27.9	27.7	27.2	27.9	26.0	25.7	25.4	25.3	26.1	26.4	26.7	26.8	24.8	25.1	25.2	24.8	24.5	*27.4*	*3.4*		*-2.9*
	Highest El.								42.4	34.6	31.9	31.2	28.4	28.2	28.8	29.0	26.5	25.9	25.7	25.8	26.7	26.8	27.1	27.2	25.1	25.4	25.5	25.0	24.8	*28.2*	*4.1*		*-3.4*
Area Average	Mean El.								37.2	32.4	31.0	30.0	28.6	28.3	27.9	28.0	26.9	26.5	25.8	23.9	22.4	21.5	21.6	22.4	21.1	19.7	18.7	18.0	17.8	*25.2*	*5.2*		*-7.4*
	Highest El.								40.1	34.0	31.5	30.8	29.1	28.7	28.9	28.7	27.3	26.7	26.4	25.1	23.6	22.2	22.2	23.3	21.7	20.5	19.2	18.2	20.2	*26.1*	*5.4*		*-5.9*
Change vs. Prior	Mean El.									-4.7	-1.5	-1.0	-1.3	-0.3	-0.4	0.2	-1.2	-0.4	-0.6	-1.9	-1.5	-0.9	0.1	0.8	-1.3	-1.4	-1.0	-0.7	-0.2				
	Highest El.									-6.1	-2.5	-0.7	-1.8	-0.4	0.2	-0.2	-1.5	-0.6	-0.3	-1.3	-1.5	-1.4	0.0	1.1	-1.6	-1.2	-1.3	-1.0	2.0				
MALIBU ROAD - Pneumatic Piezometers																																	
SI-1	Mean El.								Piezometer Not Functioning																								
	Highest El.								Piezometer Not Functioning																								
SI-1A	Mean El.																5.8	6.9	6.5	6.9	Piezometer Not Functioning				8.6	13.8	15.7	16.1	*10.1*	*4.4*	*16.1*	*6.1*
	Highest El.																7.5	6.9	6.9	6.9	Piezometer Not Functioning				11.5	13.8	18.4	16.1	*11.0*	*4.7*	*16.1*	*5.1*
SI-2	Mean El.								9.3	13.2	15.6	15.1	14.1	11.9	11.5	10.1	9.9	9.9	10.1	10.2	10.2	11.0	7.4	7.1		10.1	17.0	19.5	17.6	*11.9*	*3.3*	*8.3*	*5.6*
	Highest El.								9.6	15.9	15.9	15.9	14.7	13.6	12.4	11.3	11.3	10.1	11.3	10.7	11.3	10.7	11.8	9.5	9.5		10.1	17.0	22.8	18.2	*13.0*	*3.5*	*8.5*	*5.1*
SI-3	Mean El.								Piezometer Not Functioning																								
	Highest El.								Piezometer Not Functioning																								
SI-4	Mean El.								7.8	6.6	5.7	6.0	5.2	4.8	5.0	4.9	4.5	4.0	4.0	3.9	3.4	1.8	1.6	-0.3	0.3		1.7	5.1	3.4	1.7	*3.9*	*2.1*	*-6.1*	*-2.2*
	Highest El.								8.0	8.0	6.9	6.9	5.7	5.7	5.7	5.7	5.1	8.6	4.6	4.6	3.4	2.8	2.8	1.1	1.7		2.3	5.7	4.6	2.3	*4.9*	*2.2*	*-5.8*	*-2.6*
Bayshore Drive - Pneumatic Piezometers																																	
SI-5 Tip 1	Mean El.								34.2	34.7	36.3	34.2	33.9	32.7	37.6	33.6	31.8	31.7	26.9	25.1	22.9	21.7	18.9	19.0		20.6	27.6	26.7	23.2	*28.7*	*6.1*		*-5.4*
	Highest El.								34.8	39.4	45.1	35.9	37.1	35.9	44.0	34.8	33.6	34.8	30.1	26.7	24.4	22.6	20.9	20.9		22.1	29.0	26.7	24.4	*31.2*	*7.5*		*-6.8*
SI-5 Tip 2	Mean El.								35.4	36.1	39.1	35.8	36.5	34.0	39.5	33.7	29.8	29.2	26.0	25.2	26.8	26.3	24.3	25.1		24.8	30.5	29.8	27.1	*30.8*	*5.1*		*-3.7*
	Highest El.								37.5	42.1	51.3	37.5	40.9	37.5	49.0	37.5	35.1	40.9	27.1	26.5	27.7	28.8	24.8	26.5		25.9	30.5	30.5	28.2	*34.3*	*7.8*		*-6.1*
SI-6 Tip 1	Mean El.								42.4	Piezometer Not Functioning											25.7	25.9	23.8	24.6		27.1	34.8	35.6	34.9	*30.5*	*6.5*		*4.4*
	Highest El.								44.1	Piezometer Not Functioning											26.8	27.4	24.0	26.3		30.3	36.1	38.4	34.9	*32.0*	*6.7*		*2.9*
SI-6 Tip 2	Mean El.								44.5	44.6	46.0	44.4	43.0	42.0	43.8	41.0	39.5	39.0	39.0	41.4	40.0	37.7	34.9	35.9		34.5	52.2	42.5	41.1	*41.3*	*4.2*		*-0.3*
	Highest El.								45.7	48.0	51.5	45.7	45.7	43.4	49.1	42.2	42.2	42.8	39.9	42.8	41.6	39.3	35.9	38.2		36.5	56.1	44.5	41.1	*43.6*	*5.0*		*-2.5*

SUMMARY OF GROUNDWATER DATA
Malibu Road Landslide Assessment District
Malibu, California

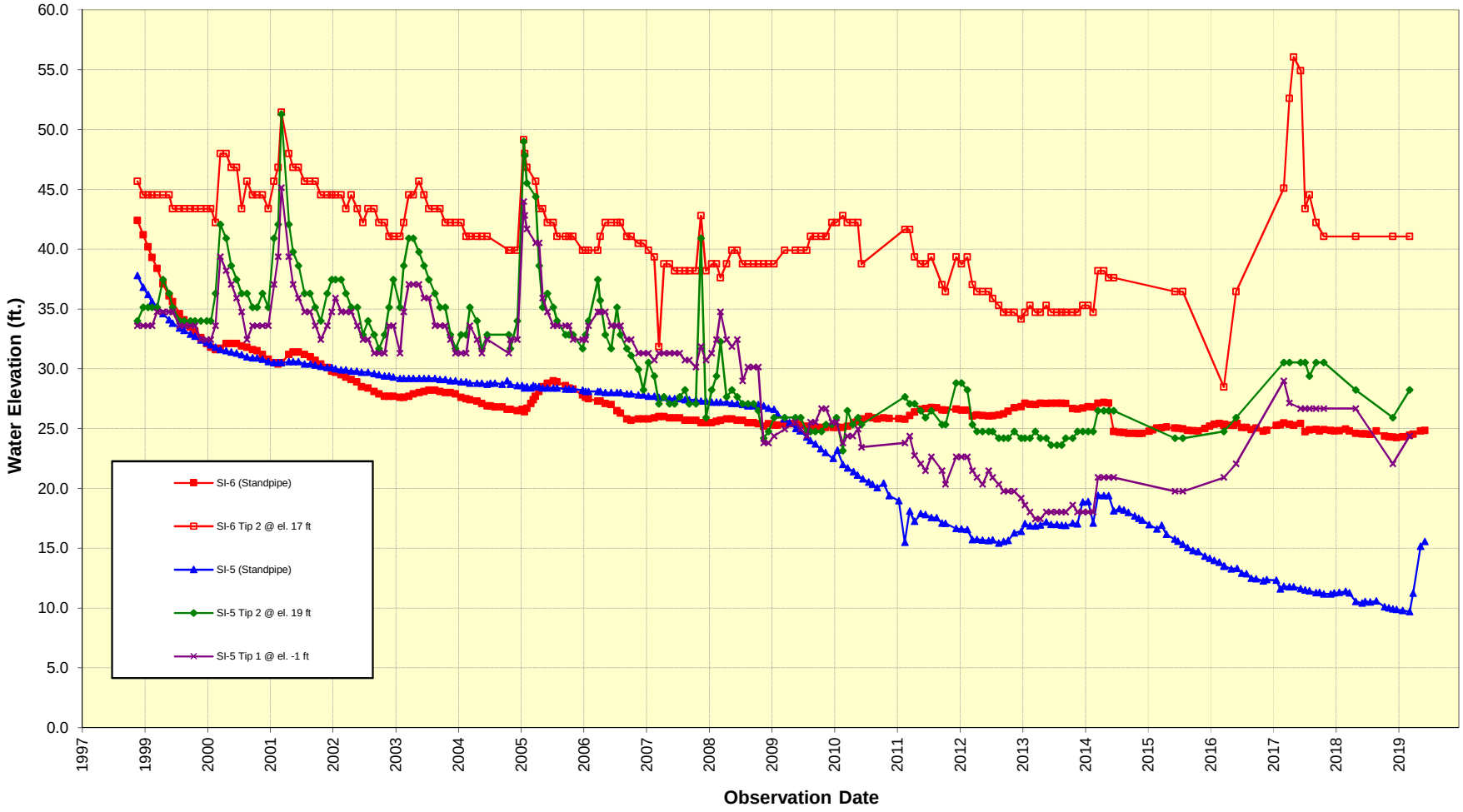


*Note: W-3A uncovered in Jan. `99

GROUNDWATER HYDROGRAPH
Malibu Road (West End)
Malibu Road Landslide Assessment District
Malibu, California



GROUNDWATER HYDROGRAPH
Malibu Road (East End)
Malibu Road Landslide Assessment District
Malibu, California



GROUNDWATER HYDROGRAPH
Bayshore Drive
Malibu Road Landslide Assessment District
Malibu, California

APPENDIX B
DEWATERING DATA

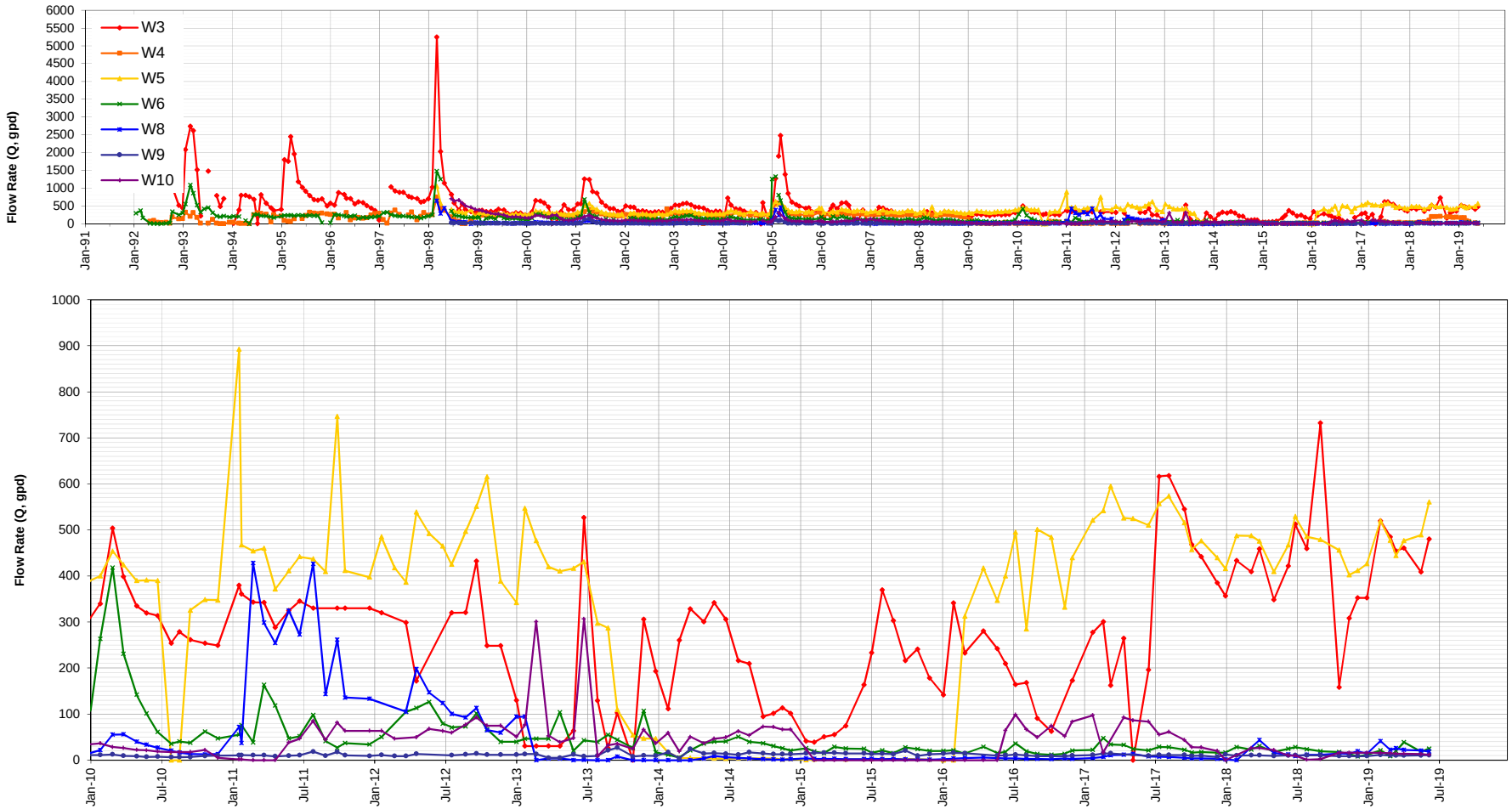
MALIBU ROAD LAD - Dewatering Well Information							
Well ID	Vault Elevation (ft.)	Bottom Elevation (ft.)	Pump Elevation (ft.)	Pump Size (hp)	2018-2019 Mean Pumping Rate (gpd)	% of Total Well Production	Installed By
W-3	19.5	-4.0	Unknown	1/2	437	32%	LA Co.
W-4	20.0	-9.0	Unknown	1/2	141	10%	LA Co.
W-5	19.0	-9.5	Unknown	1/2	474	35%	LA Co.
W-6	20.0	-4.5	Unknown	1/2	20	1%	LA Co.
W-8	27.5	11.0	Unknown	1/2	19	1%	LA Co.
W-9	20.0	-40.0	-35.0	1/3	10	1%	LA Co.
W-10	19.0	-40.0	-35.0	1/3	13	1%	LA Co.
W-11	61.0	1.0	13.0	1/3	149	11%	BYA
W-12	58.0	-2.0	8.0	1/3	14	1%	BYA
W-14	60.0	-20.0	Unknown	1/3	51	4%	Fugro
NW-1	Unknown	Unknown	Unknown	Unknown	16	1%	Homeowner
NW-2	Unknown	Unknown	Unknown	Unknown	20	1%	Homeowner
NW-3	Unknown	Unknown	Unknown	Unknown	9	1%	Homeowner

MALIBU ROAD LAD- Hydrauger Information						
Hydrauger ID	Installed Length (ft.)	Bearing	Functional Length* (ft)	2018-2019 Mean Flow Rate (gpd)	% of Total Production	Installed By
HD-1**	Unknown	N05E	74	0	0%	LA County
HD-2**	Unknown	N21E	34	0	0%	LA County
HD-3**	Unknown	N06E	13	0	0%	LA County
HD-4	Unknown	N29E	53	0	0%	LA County
HD-5	Unknown	N13E	41	0	0%	LA County
HD-6	Unknown	N08W	55	35	17%	LA County
HD-7	Unknown	N26E	87	0	0%	LA County
HD-8	Unknown	N19E	92	22	11%	LA County
HD-8A	Unknown	Unknown	Unknown	57	28%	Unknown
HD-9	Unknown	N34E	76	0	0%	LA County
HD-10	Unknown	N19E	55	0	0%	LA County
HD-11	Unknown	N11E	78	0	0%	LA County
HD-12	Unknown	N08E	70	0	0%	LA County
HD-13	Unknown	N09E	79	0	0%	LA County
HD-14	Unknown	N08E	80	0	0%	LA County
HD-15	Unknown	N14E	82	0	0%	LA County
HD-16	Unknown	N15E	69	0	0%	LA County
HD-17**	150	N15E	150	0	0%	BYA
HD-18	150	N18E	150	0	0%	BYA
HD-19	150	N10E	150	0	0%	BYA
HD-20	150	N09W	150	19	10%	BYA
HD-21	150	N22E	150	0	0%	BYA
HD-22	180	N13E	180	47	23%	Fugro West
HD-23	160	N01E	160	21	10%	Fugro West

*Note: * Measured on 4/1/98 (except HD-22 and HD-23 installed 1/22/05)*

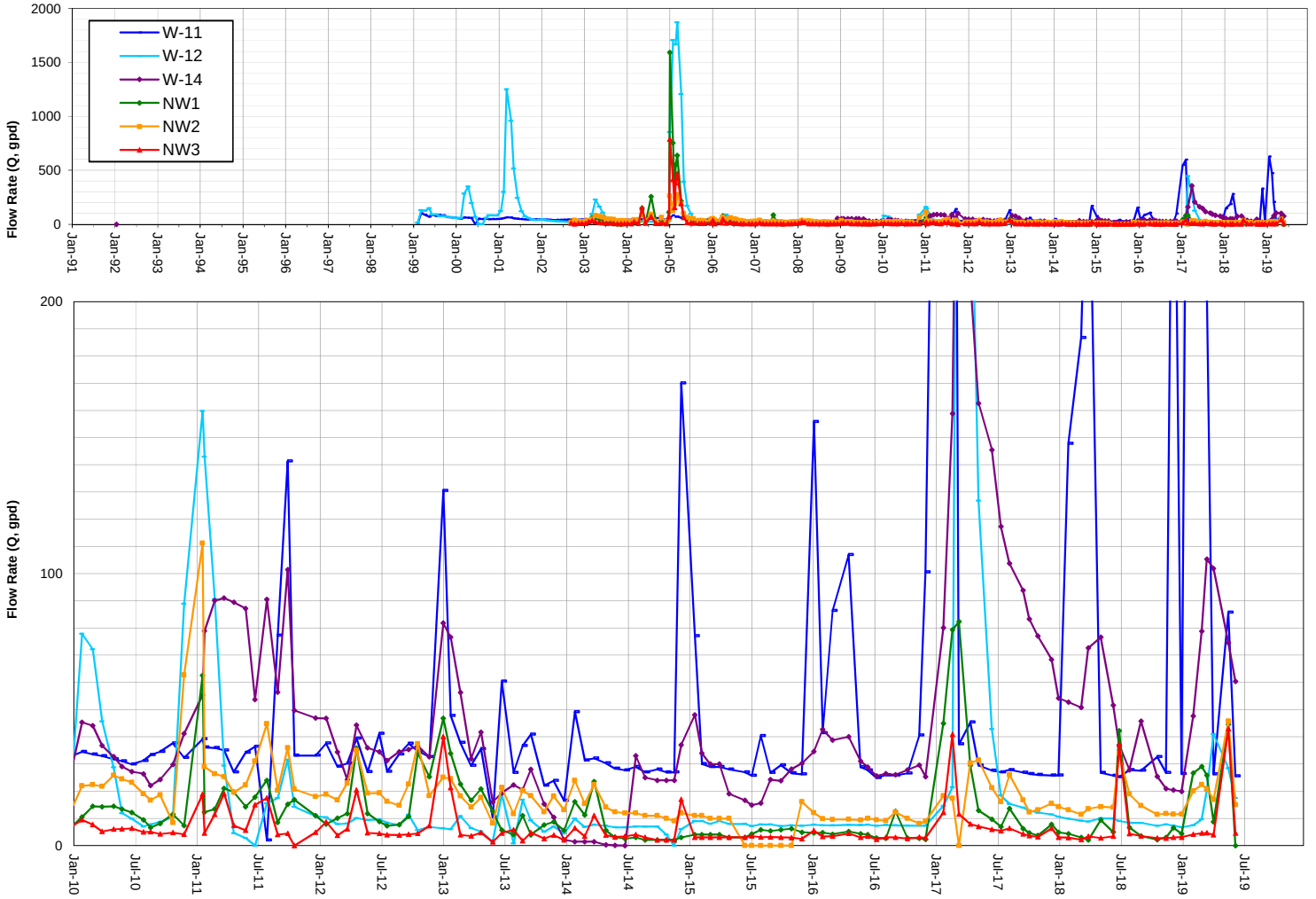
*** buried/unable to locate*

DEWATERING WELL / HYDRAUGER INFORMATION
Malibu Road Landslide Assessment District
Malibu, California



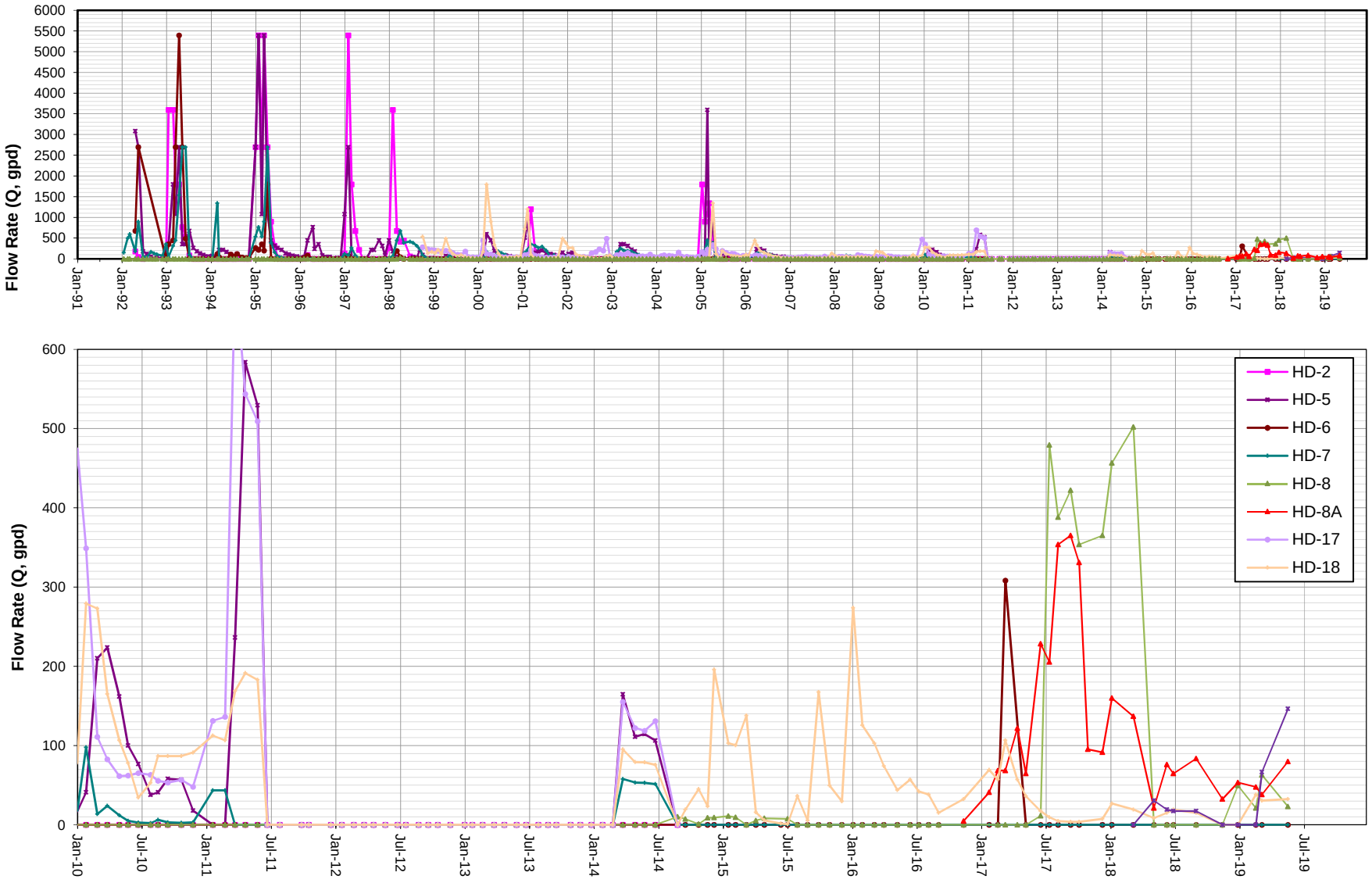
DEWATERING WELL DISCHARGE RATE GRAPH
Malibu Road
Malibu Road Landslide Assessment District
Malibu, California

PLATE B-2a



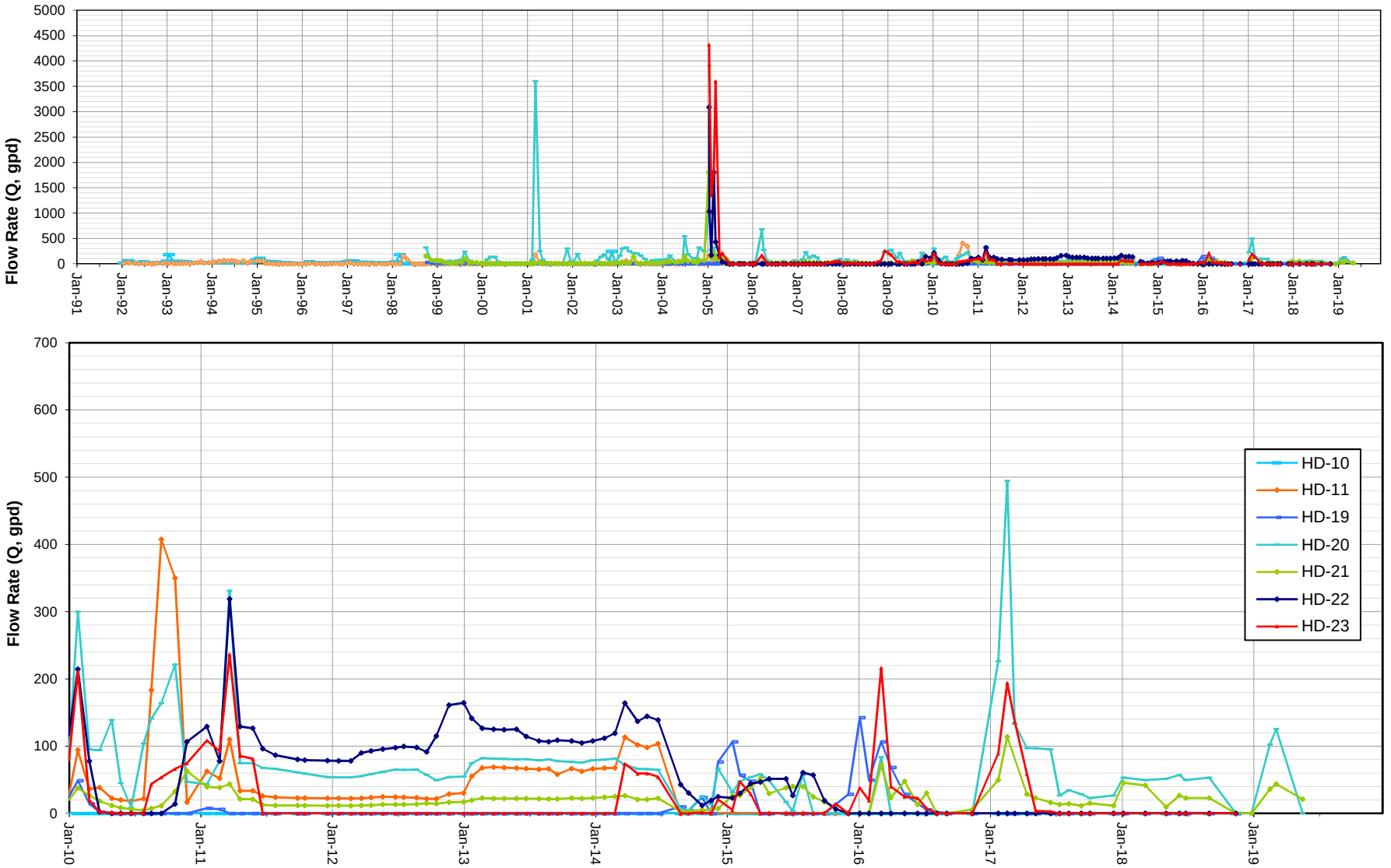
DEWATERING WELL DISCHARGE RATE GRAPH
Bayshore Drive
Malibu Road Landslide Assessment District
Malibu, California

PLATE B-2b



HYDRAUGER DISCHARGE RATE GRAPH
Malibu Road (West End)
Malibu Road Landslide Assessment District
Malibu, California

PLATE B-3a



HYDRAUGER DISCHARGE RATE GRAPH
Malibu Road (East End)
Malibu Road Landslide Assessment District
Malibu, California

PLATE B-3b

APPENDIX C
SLOPE INCLINOMETER DATA

MALIBU ROAD LAD - Slope Inclinometer Interpretation Summary									
	SI-1 (MR98-1)	**SI-1A**	**SI-2** (MR98-2)	**SI-2A**	**SI-3** (MR98-3)	**SI-4** (MR98-4)	**SI-4A**	**SI-5**	**SI-6**
Installation Details									
Previous Ref.Elev.(8/91)	20.0	20.0	20.0	20.0	20.0	22.0	N/A	59.0	57.0
Updated Ref.Elev.(4/00)	20.1	20.0	19.7	19.7	20.3	18.9	18.9	59.3	58.0
Depth (ft.)	34	50	64	64	49	43	50	78	78
Install Date	Apr-98	Aug-06	Apr-98	Sep-10	Apr-98	Apr-98	Aug-12	Apr-98	Apr-98
A+ Axis orientation (deg)	184	197	201	200	190	204	204	176	186
Casing	RST	SI	RST	RST	RST	RST	SI	SI	SI
Installer	BYA	Fugro	BYA	Fugro	BYA	BYA	Fugro	BYA	BYA
Interpreted Rupture Depth (ft)	30-32	23-30	28-32	28-32	35-38	32-34	32-34	unknown	unknown
Status	D	F	D	F	D	D	F	F	F
Reading Interval	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Semi	Semi	Semi
Interpreted Movement (inches)									
2018-2019	**NR**	--	**NR**	--	**NR**	**NR**	--	--	--
2017-2018	**NR**	--	**NR**	--	**NR**	**NR**	--	--	--
2016-2017	**NR**	0.1	**NR**	0.15	**NR**	**NR**	0.15	--	--
2015-2016	**NR**	--	**NR**	--	**NR**	**NR**	--	--	--
2014-2015	**NR**	<0.1	**NR**	--	**NR**	**NR**	--	--	--
2013-2014	**NR**	0.1	**NR**	--	**NR**	**NR**	--	--	--
2012-2013	**NR**	<0.1	**NR**	<0.1	**NR**	**NR**	--	0.1	0.1
2011-2012	**NR**	<0.1	**NR**	**--**	**NR**	--	NR	--	<0.1
2010-2011	**NR**	<0.1	**NR**	**--**	**NR**	0.6	NR	--	<0.1
2009-2010	**NR**	<0.1	**NR**	--	**NR**	--	NR	--	<0.1
2008-2009	**NR**	<0.1	<0.1 **(4)**	**NR**	**NR**	--	NR	--	<0.1
2007-2008	**NR**	<0.1	--	**NR**	**NR**	--	NR	--	<0.1
2006-2007	**NR**	**NR**	--	**NR**	**NR**	--	NR	--	0.1
2004-2005	0.5 **(3)**	**NR**	0.4	**NR**	>1**(3)**	0.4 to 0.5	NR	~ 0.2 *	--
2003-2004 **(1)**	--	**NR**	--	**NR**	--	--	NR	--	--
2002-2003	~ 0.2 *	**NR**	~ 0.1 *	**NR**	--	--	NR	--	--
2001-2002	--	**NR**	--	**NR**	--	--	NR	--	--
2000-2001	0.5	**NR**	0.4	**NR**	0.3	0.6	NR	--	--
1999-2000	--	**NR**	--	**NR**	--	--	NR	--	--
1998-1999	3.1	**NR**	1.5	**NR**	4.1	1.3 **(2)**	NR	--	--

NOTES:

D Destroyed

F Functioning

NI No information

(1) Readings only through March 2004

(2) Readings are through 2000, although majority of movement occurred in 1998

(3) Inclinometer sheared off in January, 2005.

(4) Inclinometer sheared off winter of 2009.

NR No reading

-- No clearly defined interpreted movement.

~ 0.1 * Indicated displacement is less than reliable instrument accuracy. Interpreted movement is theoretical.

SUMMARY OF SLOPE INCLINOMETERS

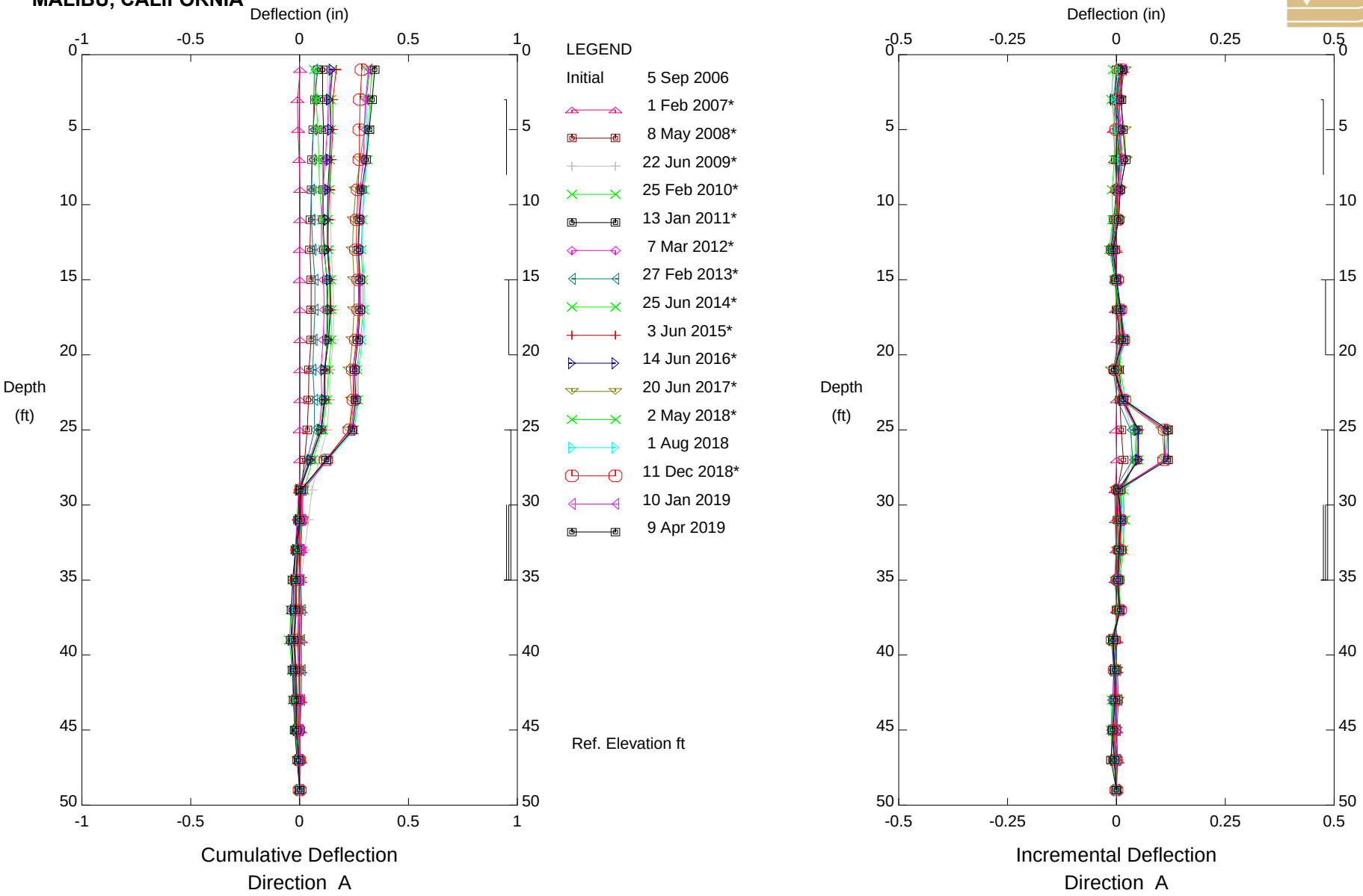
Malibu Road Landslide Assessment District

Malibu, California

PLATE C-1

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-1A

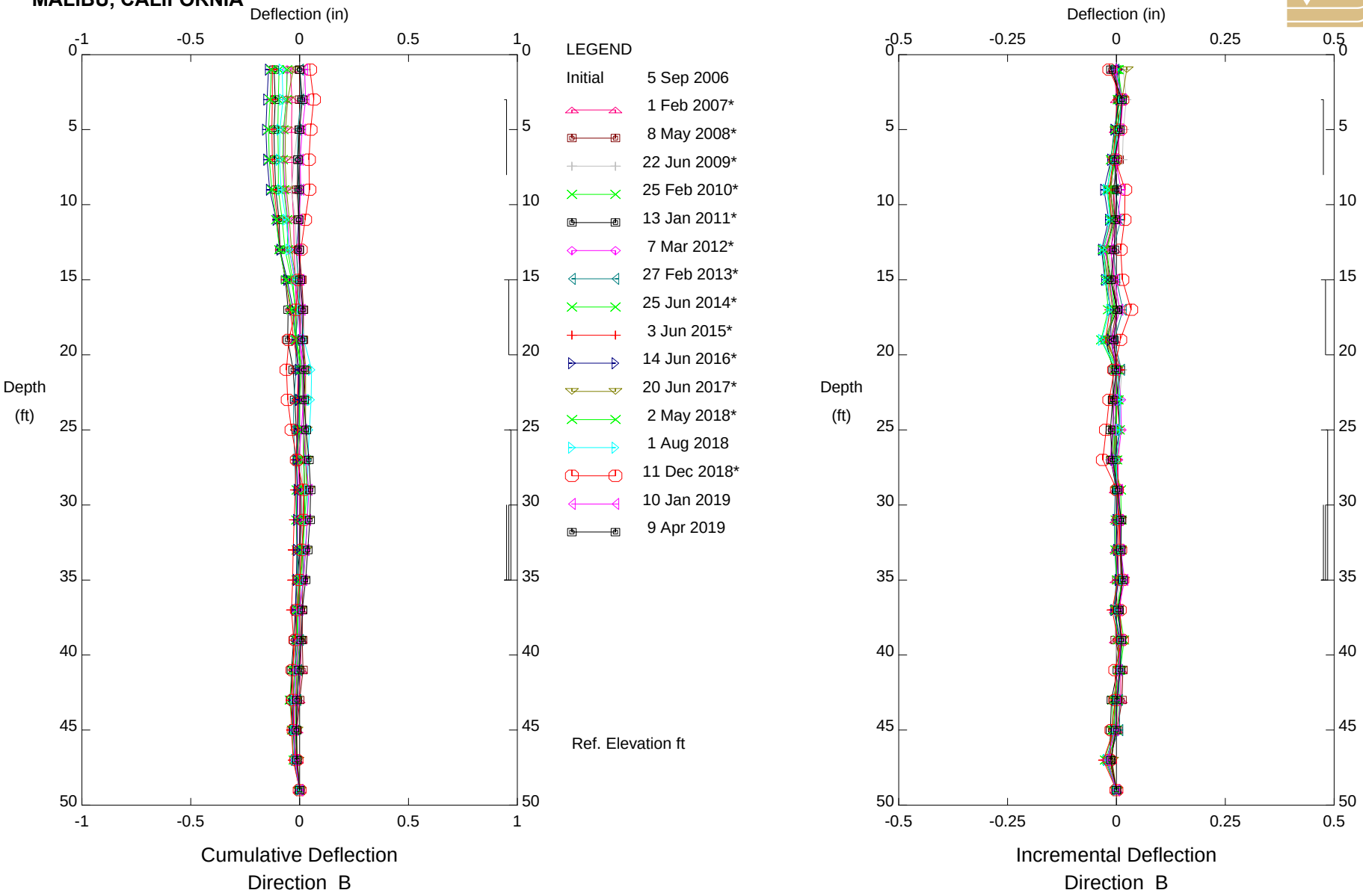
City of Malibu

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

PLATE C2-a

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-1A

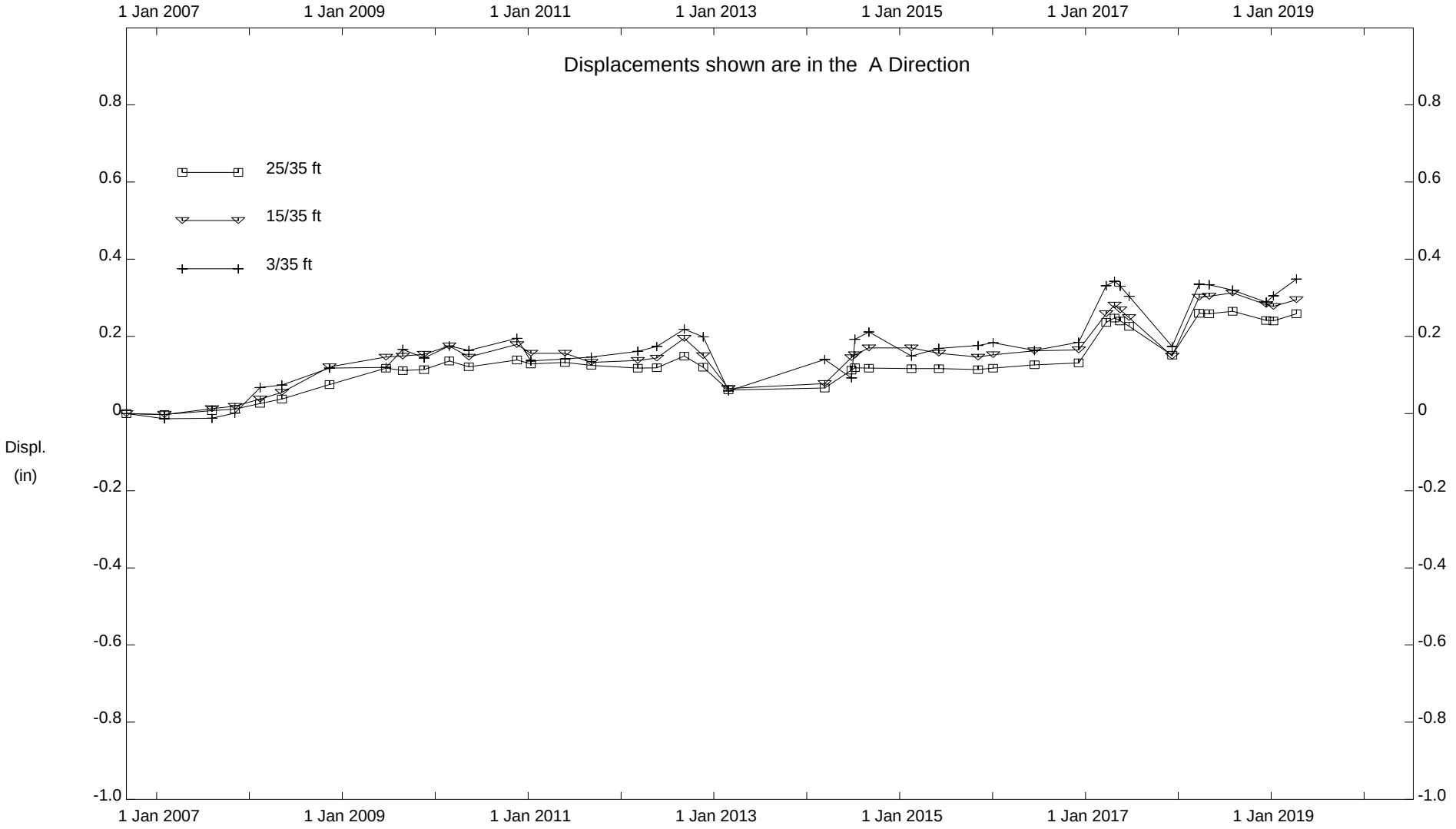
City of Malibu

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

PLATE C2-b

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



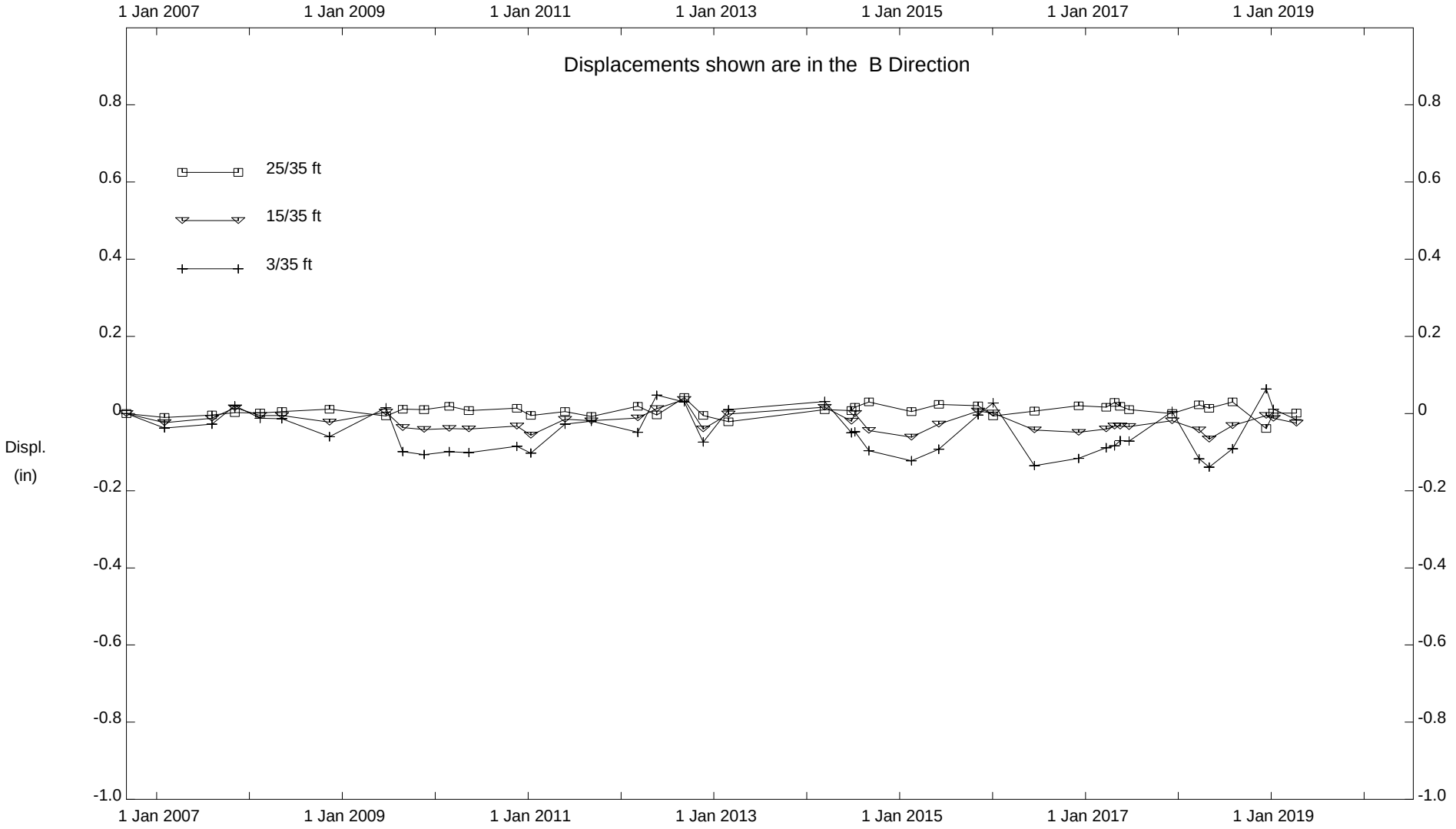
Assessment District 98-3, Inclinometer SI-1A

City of Malibu

PLATE C2-c

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



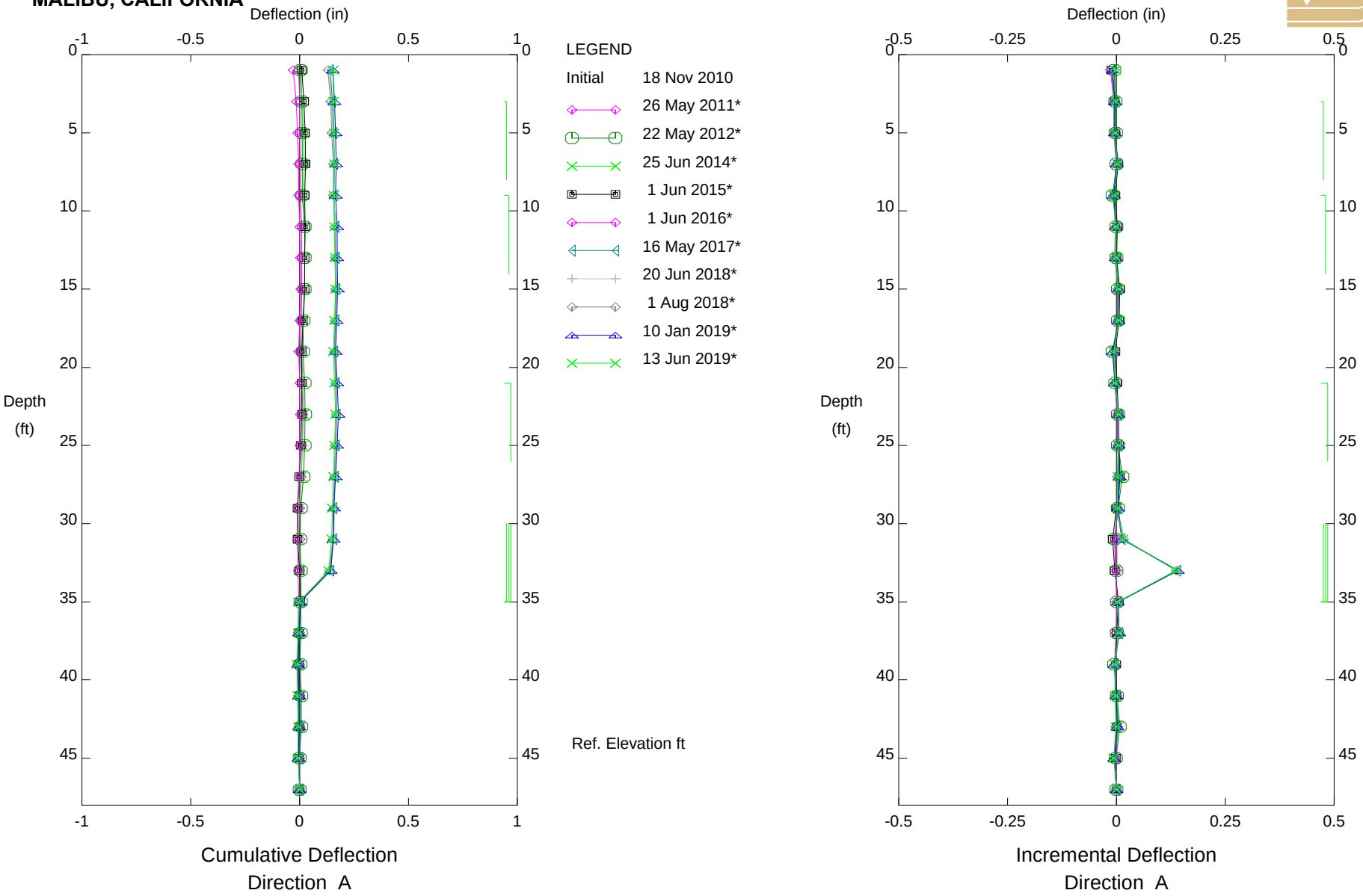
Assessment District 98-3, Inclinometer SI-1A

City of Malibu

PLATE C2-d

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-2A

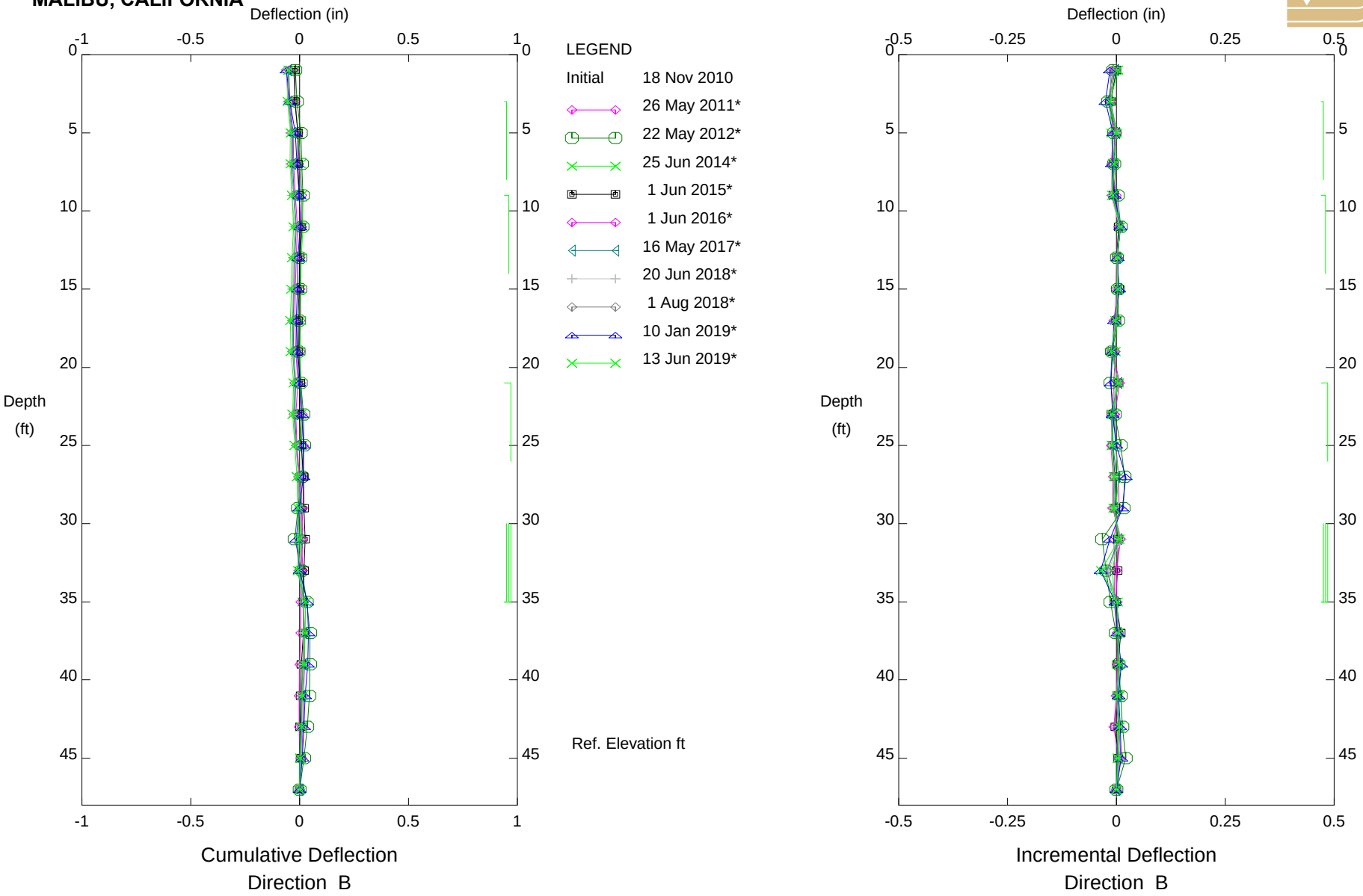
City of Malibu

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

PLATE C3-a

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-2A

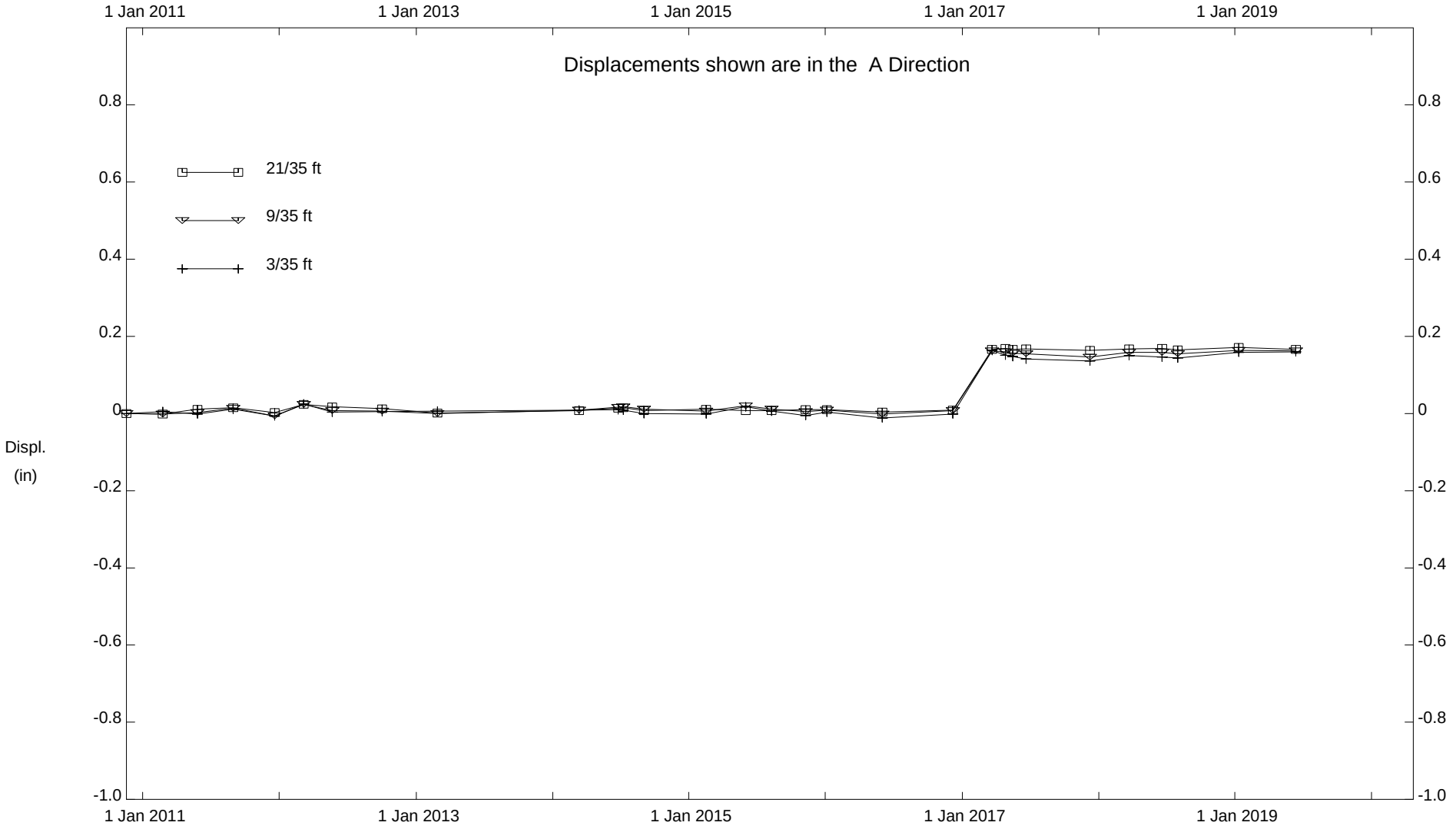
City of Malibu

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

PLATE C3-b

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



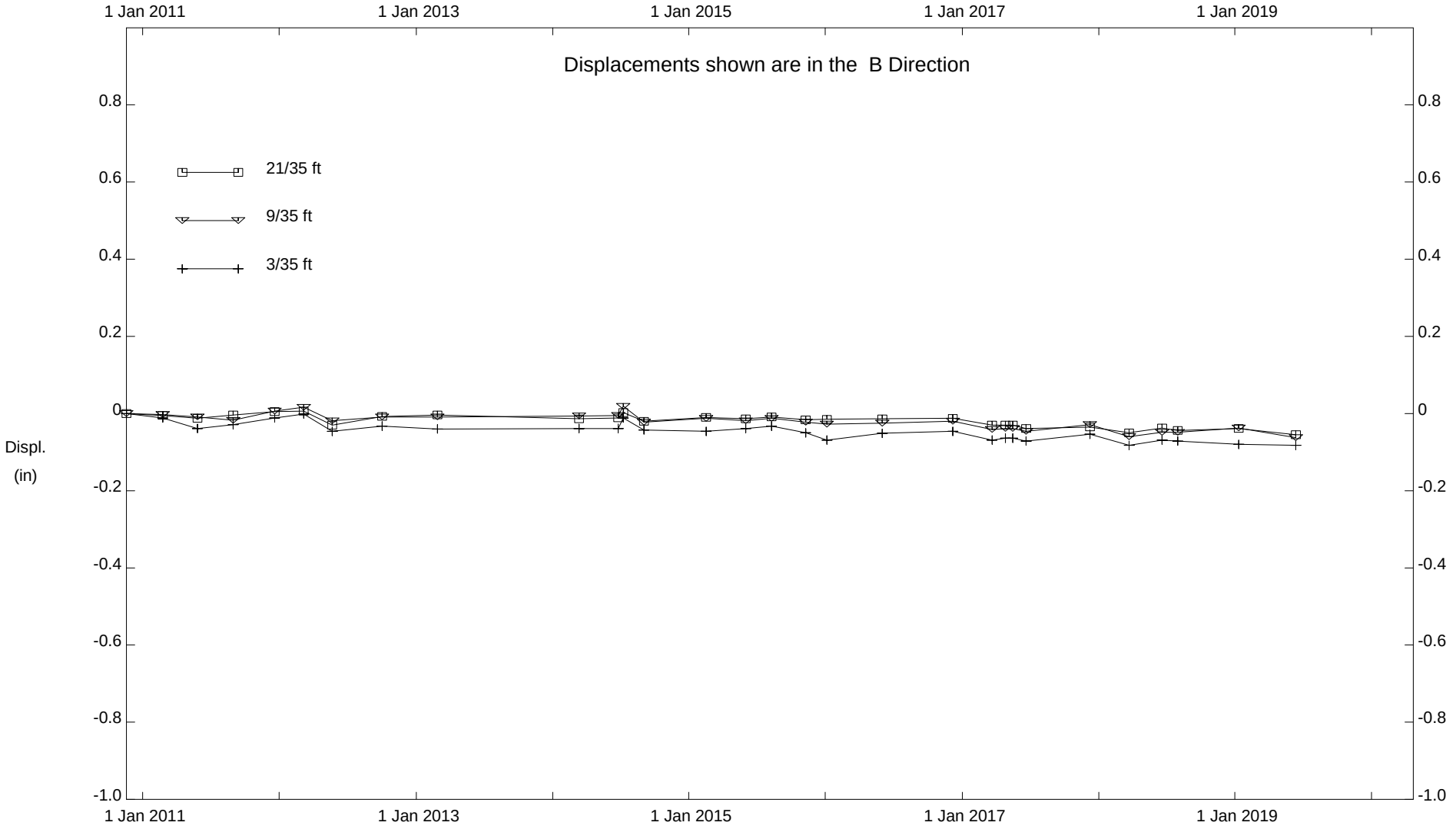
Assessment District 98-3, Inclinometer SI-2A

City of Malibu

PLATE C3-c

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



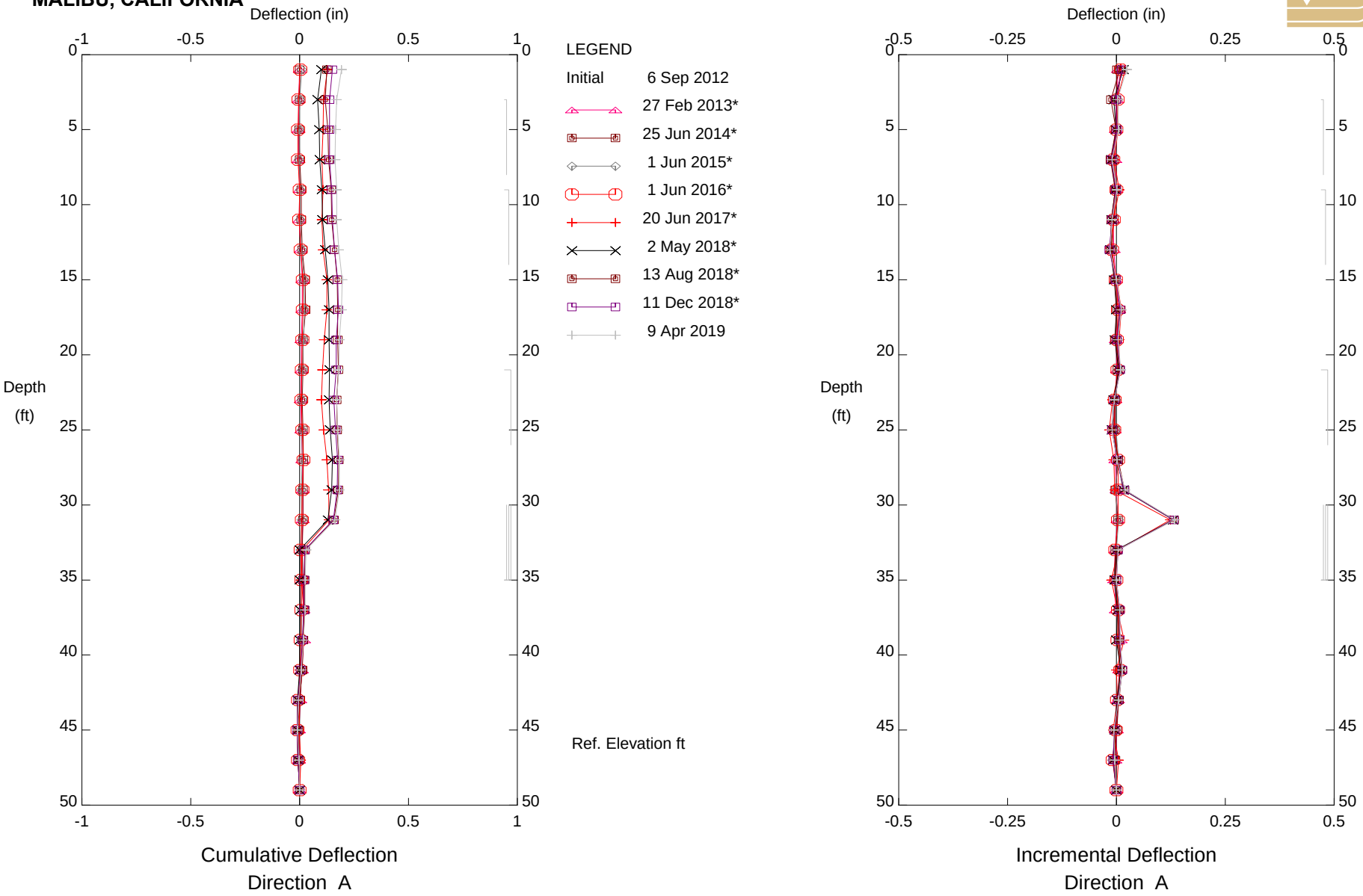
Assessment District 98-3, Inclinometer SI-2A

City of Malibu

PLATE C3-d

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-4A

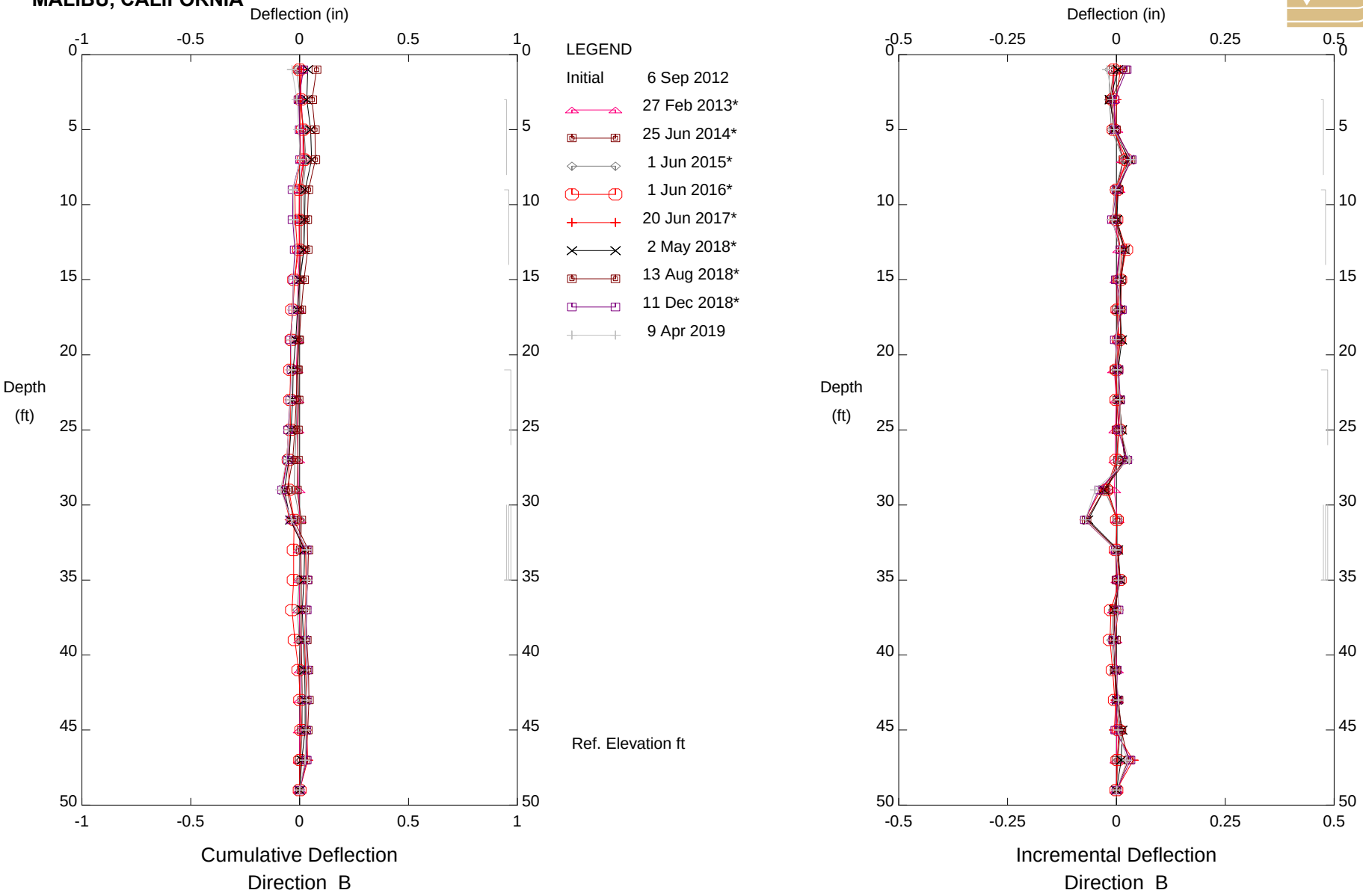
City of Malibu

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

PLATE C4-a

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-4A

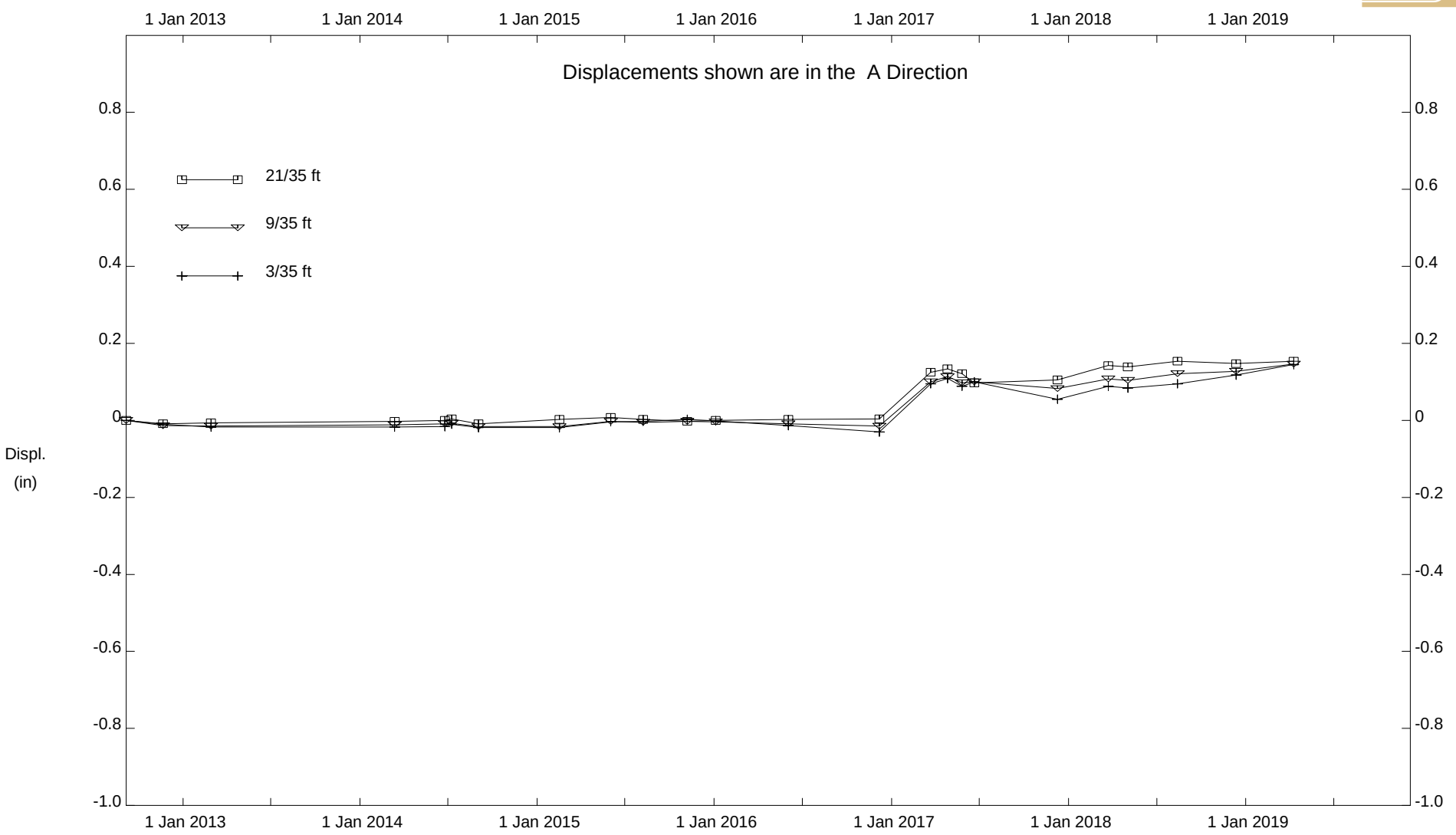
City of Malibu

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

PLATE C4-b

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



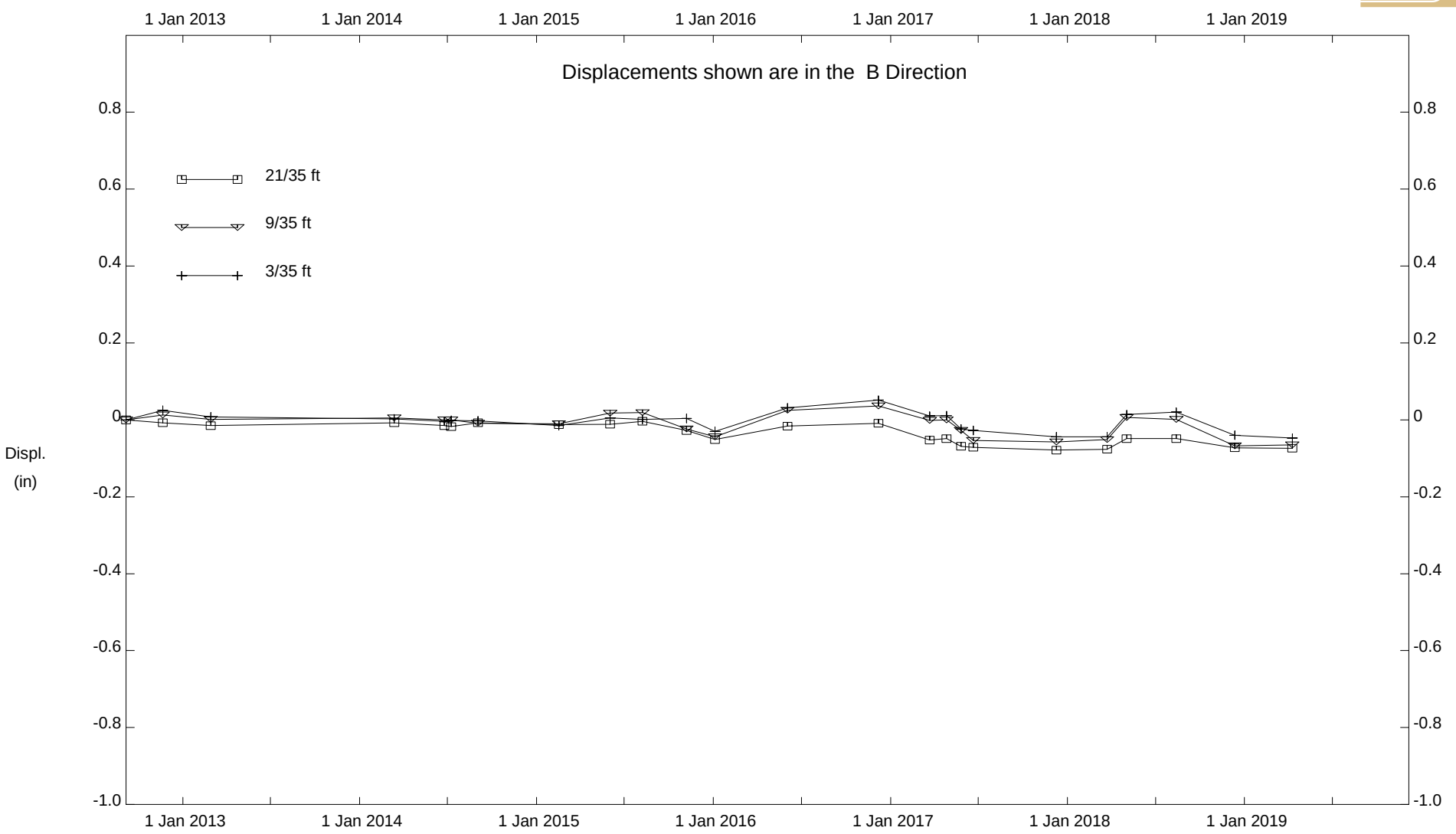
Assessment District 98-3, Inclinometer SI-4A

City of Malibu

PLATE C4-c

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



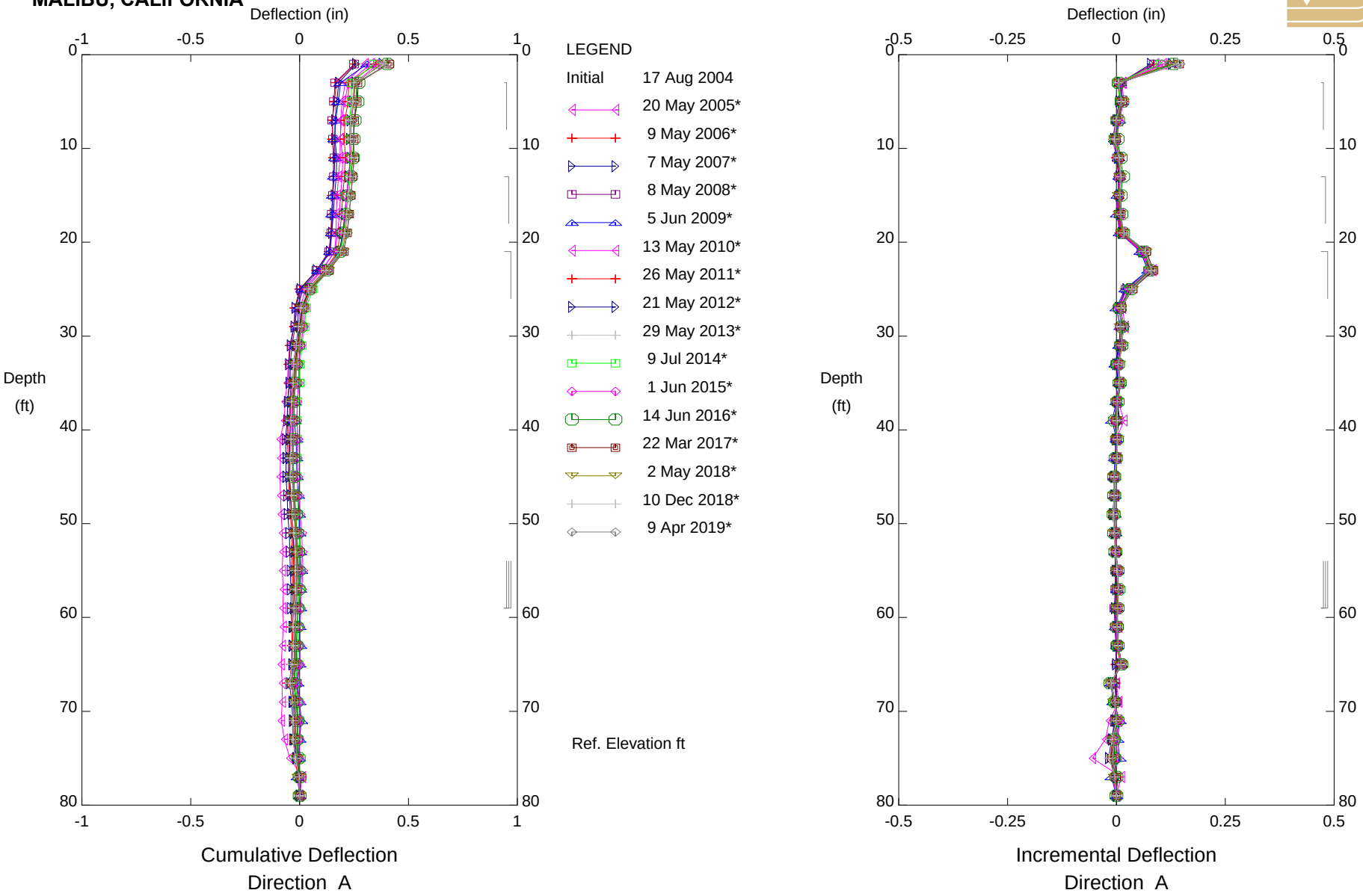
Assessment District 98-3, Inclinometer SI-4A

City of Malibu

PLATE C4-d

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-5

City of Malibu

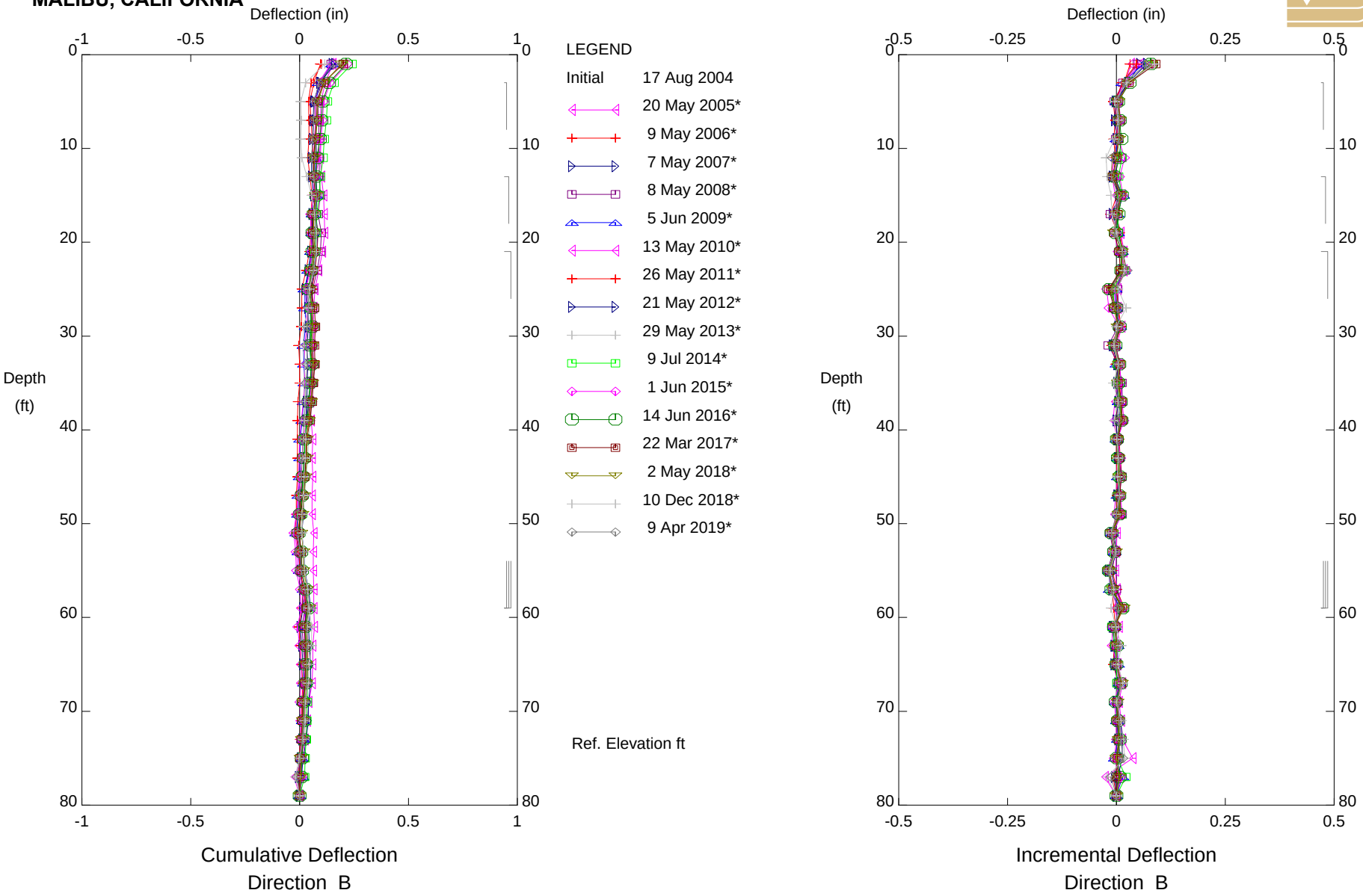
Sets marked * include zero shift and/or rotation corrections.

PLATE C5-a

O:\Management\04_2016\04_6216_0604_Malibu Road AD\01_FIELD DATA\Inclinometer Data\GTL\2018-2019 Adjusted Baselines\SI-5.gtl

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-5

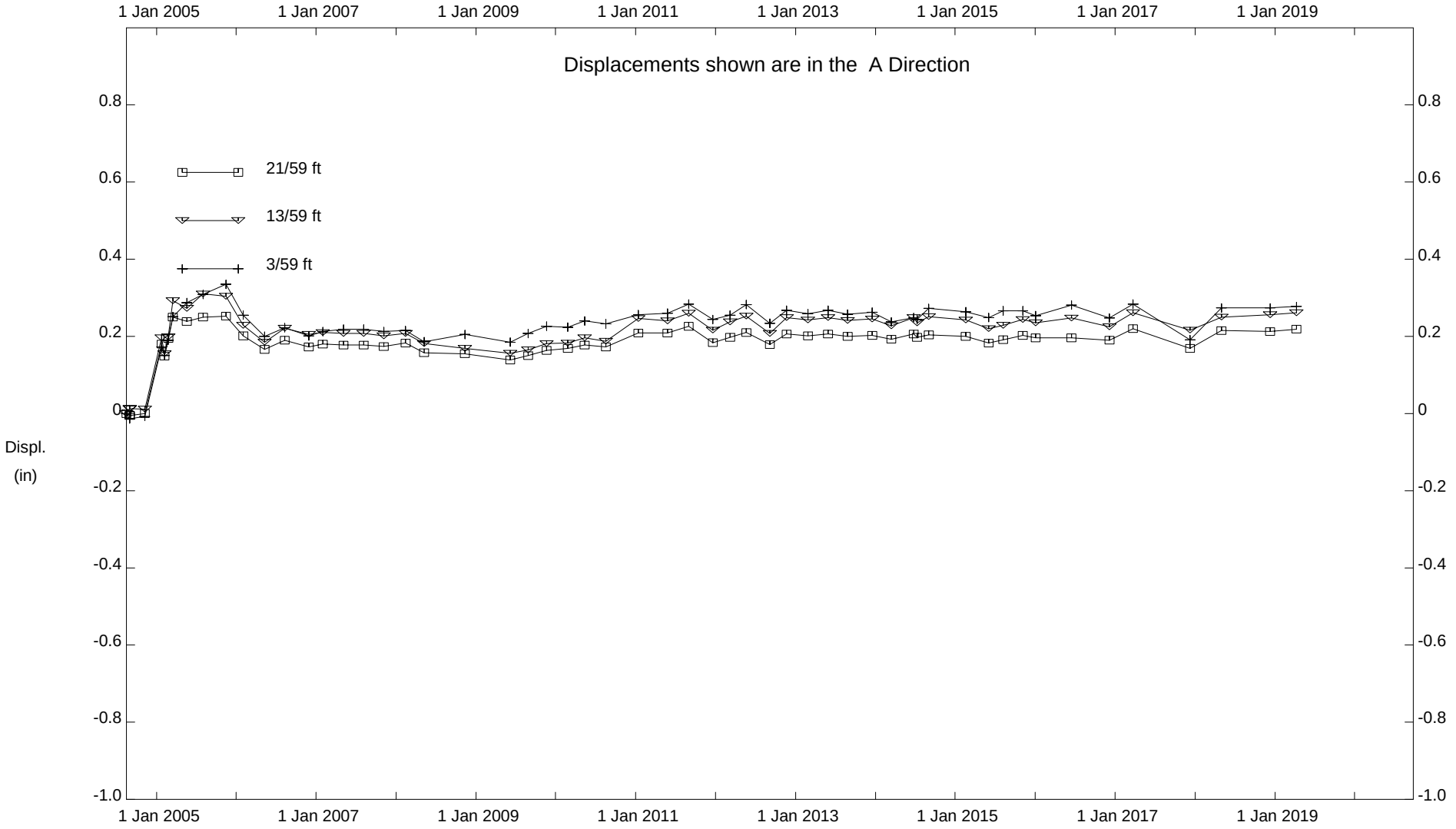
City of Malibu

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

PLATE C5-b

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



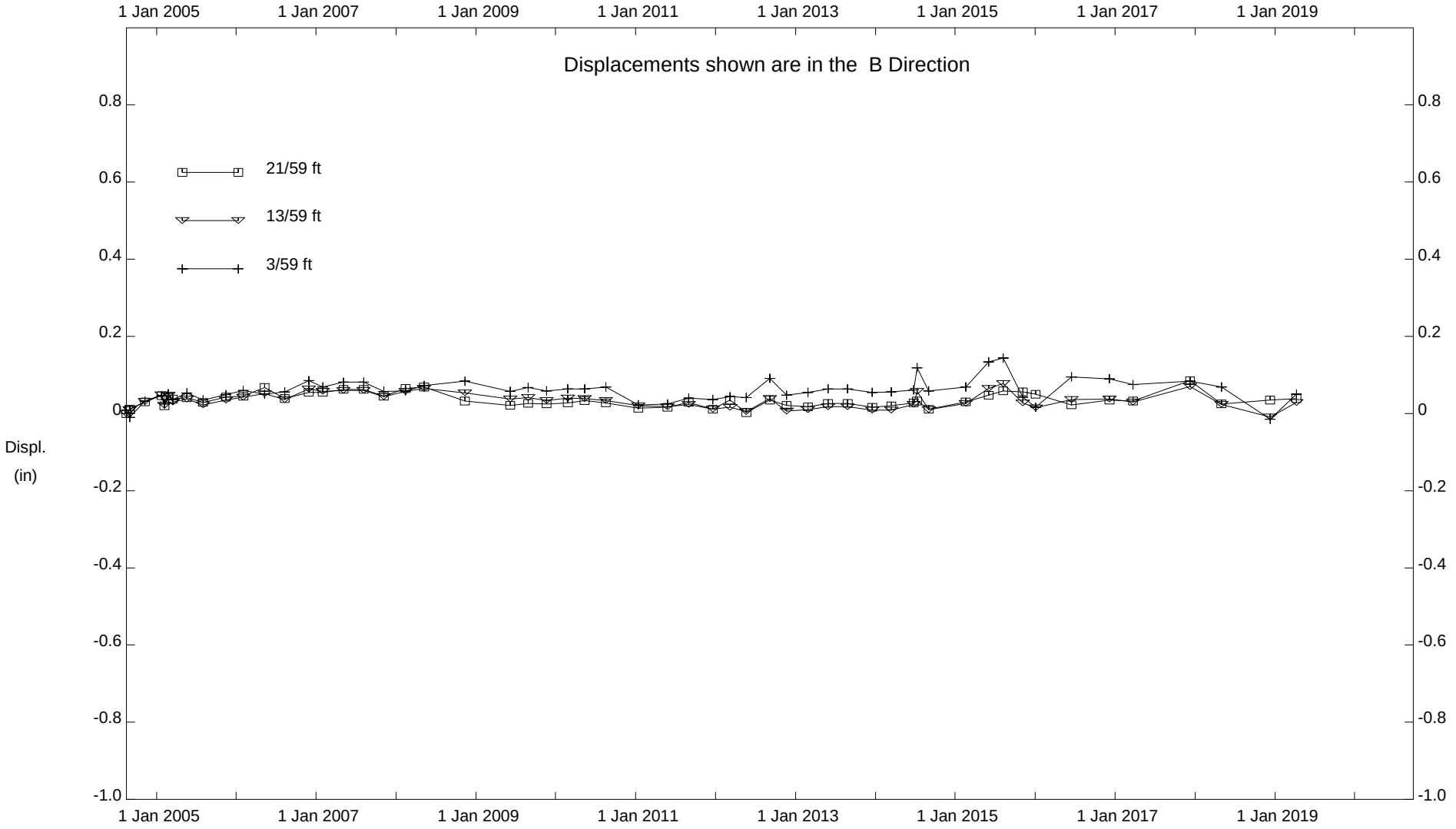
Assessment District 98-3, Inclinometer SI-5

City of Malibu

PLATE C5-c

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



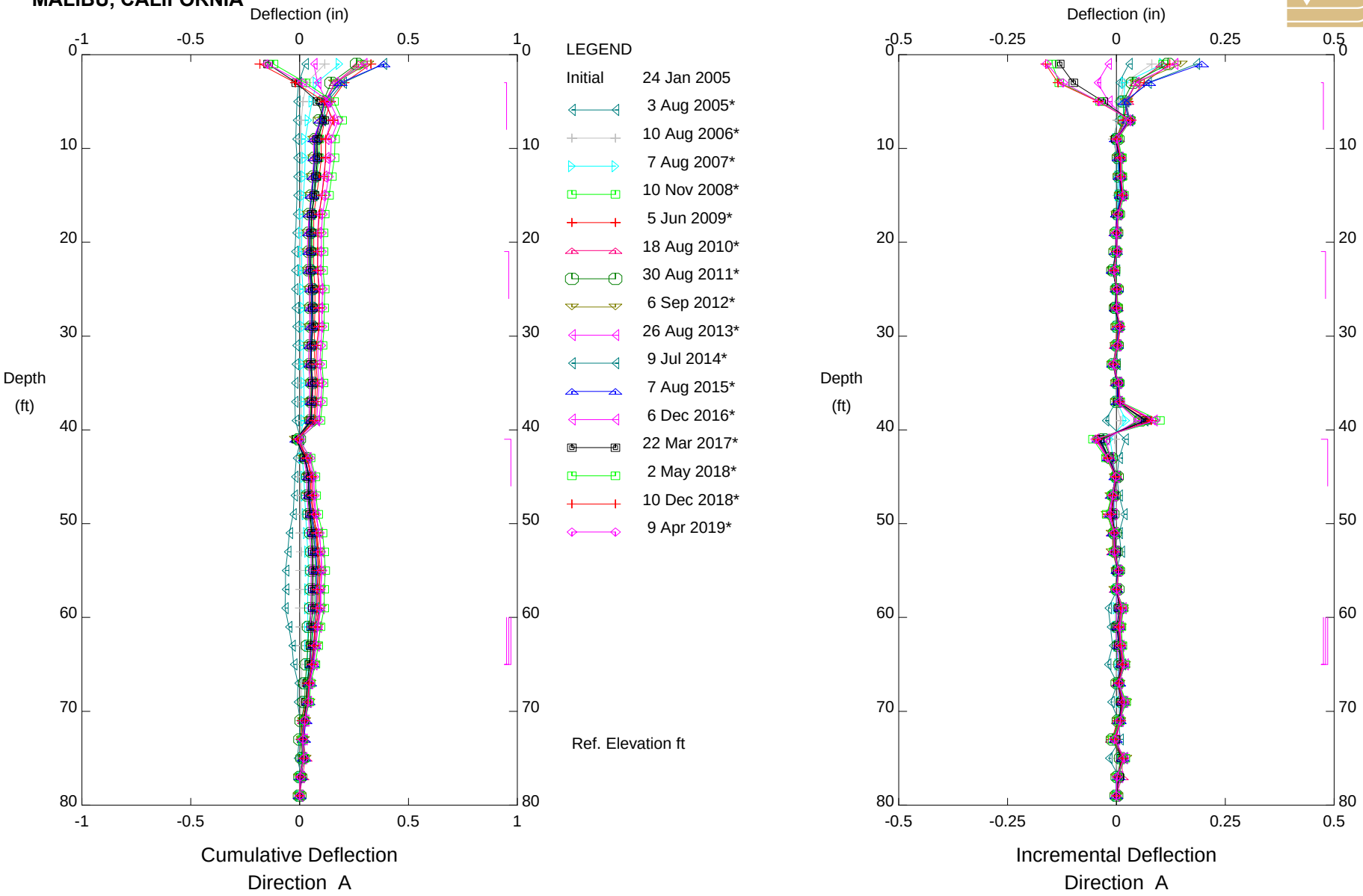
Assessment District 98-3, Inclinometer SI-5

City of Malibu

PLATE C5-d

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-6

City of Malibu

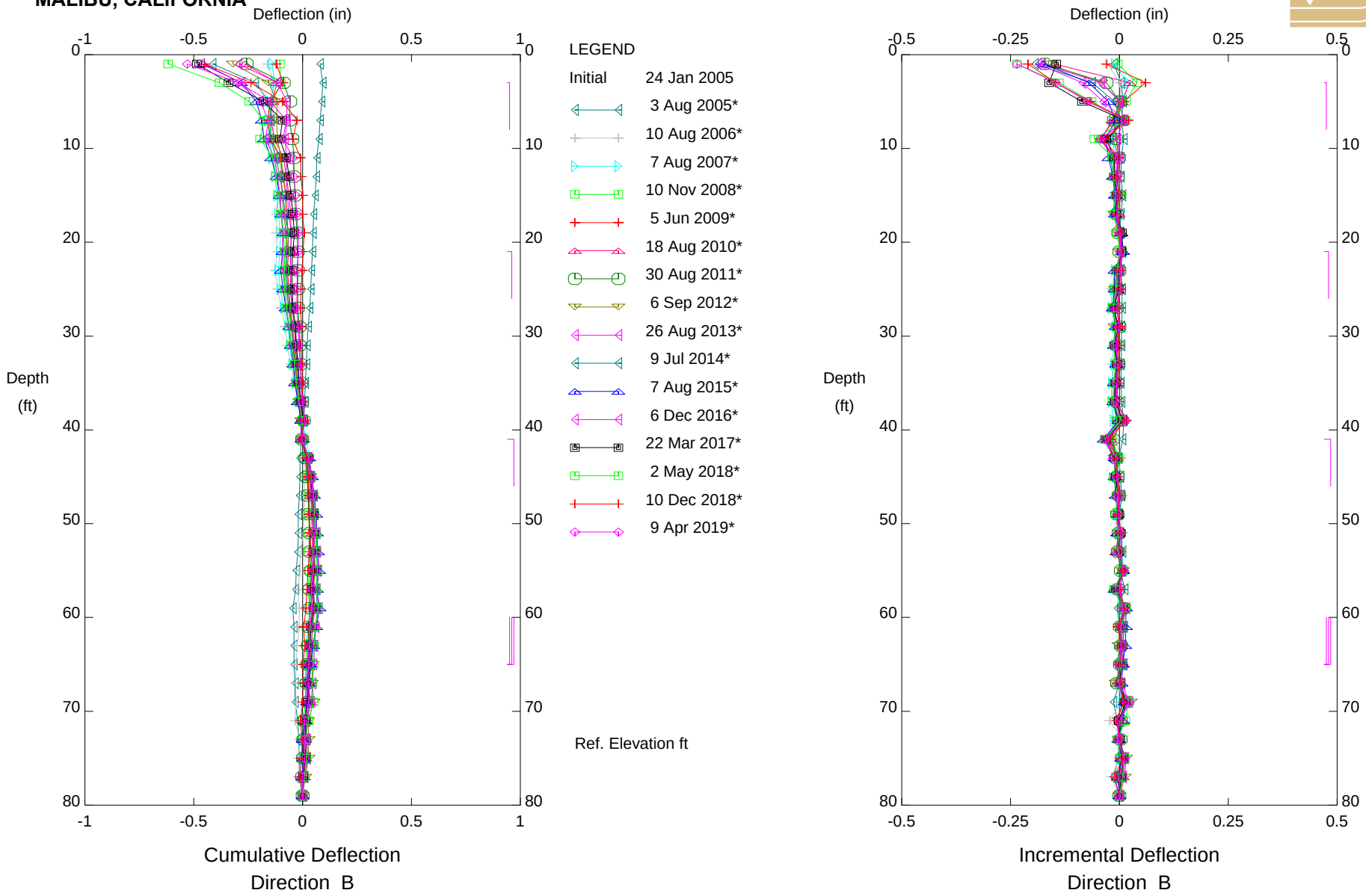
Sets marked * include zero shift and/or rotation corrections.

PLATE C6-a

O:\Management\04_2016\04_6216_0604_Malibu Road AD\01_FIELD DATA\Inclinometer Data\GTL\2018-2019 Adjusted Baselines\SI-6.gtl

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-6

City of Malibu

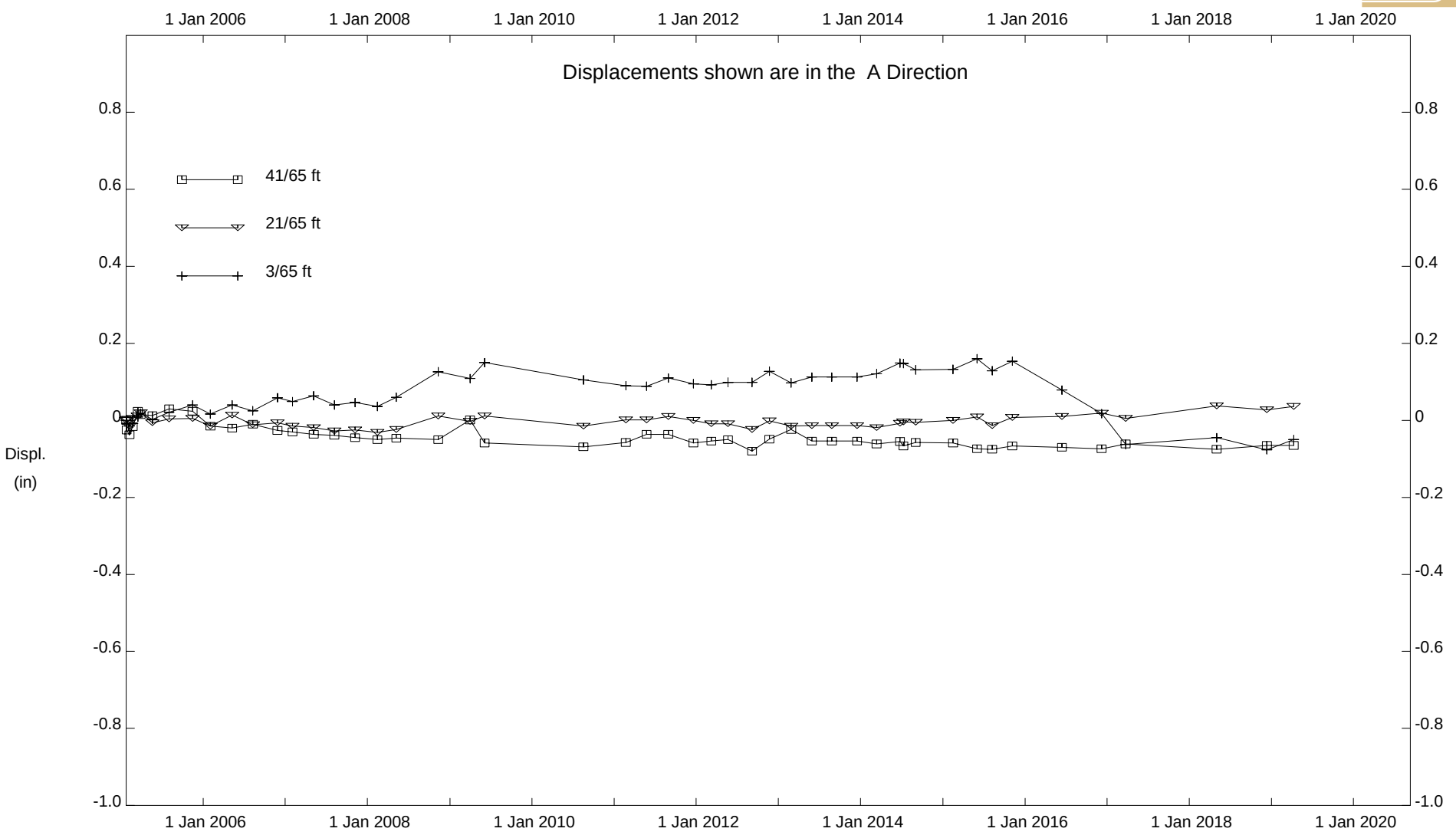
Sets marked * include zero shift and/or rotation corrections.

PLATE C6-b

O:\Management\04_2016\04_6216_0604_Malibu Road AD\01_FIELD DATA\Inclinometer Data\GTL\2018-2019 Adjusted Baselines\SI-6.gtl

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



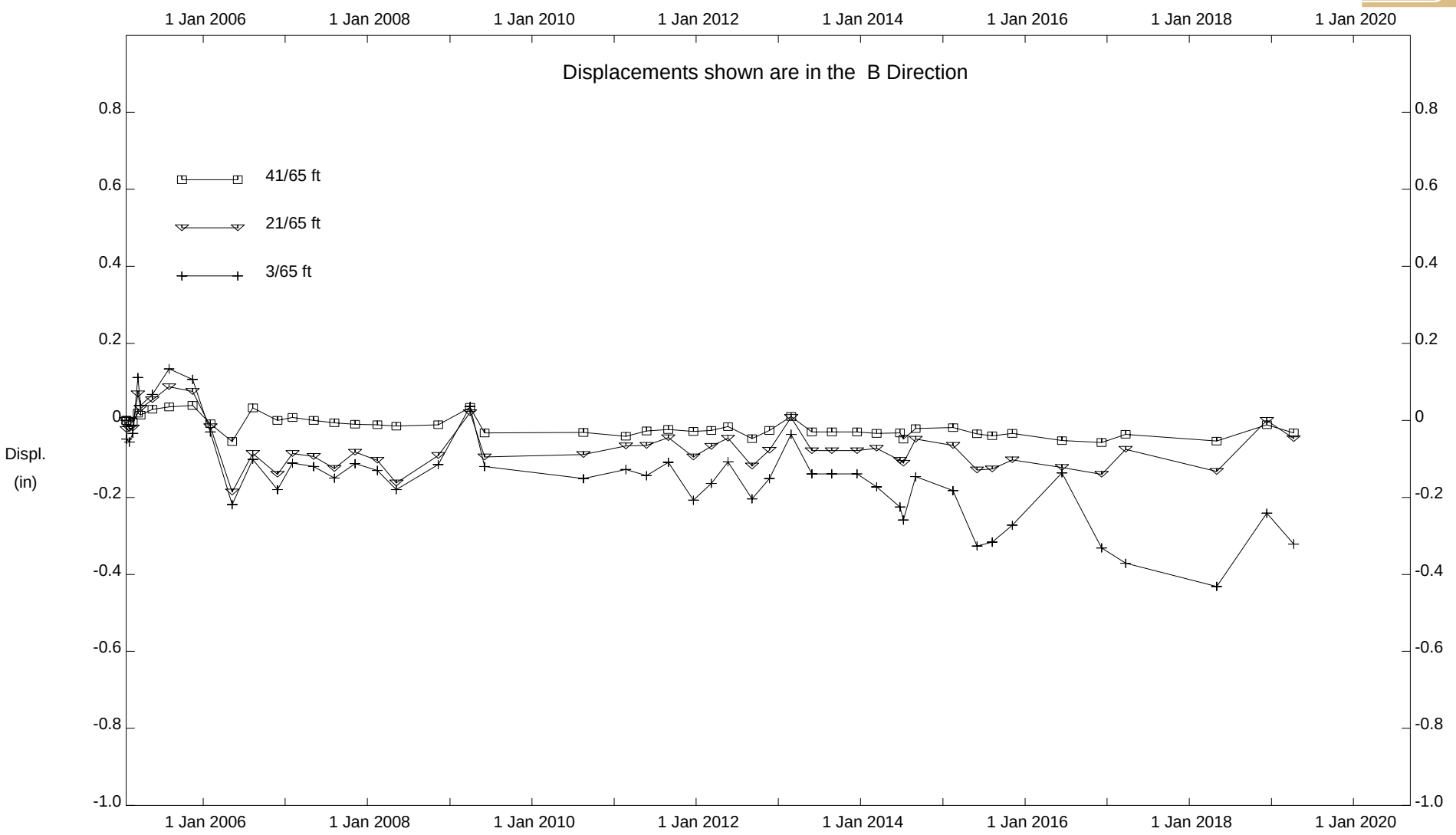
Assessment District 98-3, Inclinometer SI-6

City of Malibu

PLATE C6-c

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
FY18-19 ANNUAL REPORT
MALIBU, CALIFORNIA

Fugro USA Land, Inc. - Ventura, CA



Assessment District 98-3, Inclinometer SI-6

City of Malibu

PLATE C6-d