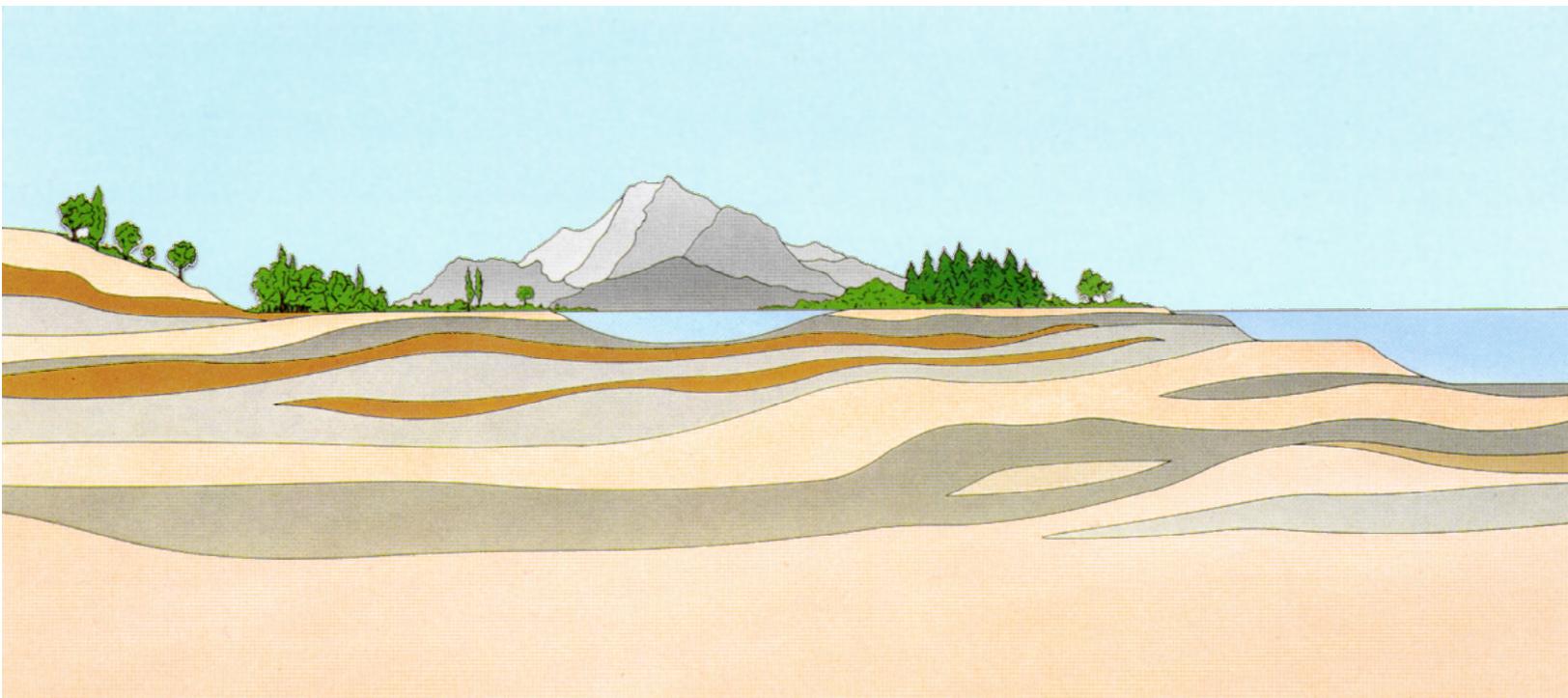

FUGRO WEST, INC.



**ANNUAL REPORT
JULY 2008 THROUGH JUNE 2009
MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT
MALIBU, CALIFORNIA**

Prepared for:
CITY OF MALIBU

October 2009
Fugro Project No. 3399.004





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October 19, 2009
Project No. 3399.004

City of Malibu
23815 Stuart Ranch Road
Malibu, California 90265

Attention: Mr. Claudio Sanchez

Subject: Annual Report, July 2008 through June 2009, Malibu Road Landslide Assessment District

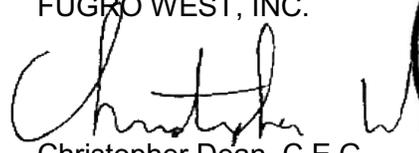
Dear Mr. Sanchez,

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 2008 through June 2009.

Fugro appreciates the opportunity to be of service to the City of Malibu and the District homeowners. Please contact us at (805) 650-7000, if you have any questions regarding this report.

Sincerely,
FUGRO WEST, INC.


Alexis M. Spencer
Project Engineer/Project Manager


Christopher Dean, C.E.G.
Senior Engineering Geologist




Lauren J. Doyel, P.E.
Associate Engineer



Copies Submitted: (2) Addressee
(1) City of Malibu - Geology & Soils Staff



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1.0 INTRODUCTION

1.1 AUTHORIZATION

Fugro West, Inc. (Fugro), performed the work summarized in this report in accordance with our contract with the City of Malibu (City) and consistent with the cost estimate document "Exhibit A-FY 2008-2009 Maintenance Cost Estimate" presented in the Annual Assessment Report (Taussig, 2008).

1.2 BACKGROUND

The Malibu Road Landslide Assessment District was established in 1981 by the County of Los Angeles 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 feasibly using dewatering methods only. The County administered the assessment district until 1991 when the City incorporated. Since then, 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, 2008, and June 30, 2009 (hereafter, the "monitoring period").

Routine monitoring data collected during this 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 nine standpipes and eight pneumatic piezometers;
- Monthly dewatering production readings from nine dewatering wells owned by the Assessment District and three wells owned by a private homeowner on Bayshore Drive;
- Monthly dewatering production readings from 23 horizontal drains (hydraugers);
- Quarterly ground deformation measurements from five slope inclinometers; and
- Periodic maintenance of dewatering and monitoring facilities.

The operating condition of the instrumentation and dewatering facilities was checked during each field monitoring/observation visit and by evaluating preliminary data in the office as it was received. Maintenance was performed as needed based upon the field observations and preliminary data evaluation.

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 evaluation of the stability of the landslide.



1.4 REPORT ORGANIZATION

This report summarizes the monitoring data collected during the monitoring period and presents conclusions regarding the annual monitoring results. An outline of the report is presented as the Table of Contents. 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 in Malibu at City Hall and the Malibu Library. Reports may also be viewed on the City's website at <http://www.ci.malibu.ca.us>. Paper copies or electronic versions on CD (pdf format) are also available for purchase from the City and Fugro.

2.0 MONITORING

2.1 RAINFALL DATA

Rainfall totals were tabulated based on recorded values from the Los Angeles County Rainfall Station 1239 - located at Big Rock Mesa. A combination graph of historical and annual cumulative monthly rainfall totals is shown on Plate 3 - Rainfall Graph.

Rainfall data indicate that approximately 11.02 inches of precipitation fell during the monitoring period from July 2008 through June 2009. The average rainfall total from 1968 to 2009 in the Malibu area for the period July through June is approximately 16.02 inches.

Rainfall data is usually analyzed in terms of the annual "rain season" that covers the time period October 1 through September 30. Rainfall for October 1, 2008, through June 30, 2009, was approximately 11.02 inches. This is approximately 69 percent of the average rainfall total of 16.02 inches for the rain seasons of 1968 through 2009.

2.2 GROUNDWATER MONITORING

The groundwater level data collected during this monitoring period are summarized in Appendix A. Groundwater levels fluctuate throughout the year and from year to year in response to natural and man-made influences. The primary natural influence is varying precipitation. Man-made influences include:

- Recharge from septic systems;
- Recharge from irrigation;
- Alterations to surface drainage by grading, landscaping, storm drains, and rain gutters;
- Accidental water discharges from leaking utilities (water, irrigation, sewer, storm drain), and swimming pools; and
- Dewatering activities including pumping dewatering wells and hydraugers.



Typically, groundwater levels rise relatively quickly following significant rainfall and gradually lower after the wet season ends. Groundwater levels measured in standpipe piezometers (wells) and pneumatic piezometers are depicted on Plates A1 through A5 in Appendix A. 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

Nine standpipe piezometers (W-2A, W-3A, PZ-A, PZ-B, PZ-C, PZ-D, PZ-E, SI-5 and SI-6) were measured regularly over the monitoring period. 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. The locations of the standpipe piezometers are depicted on Plate 2 - Assessment District Map, and groundwater hydrographs are presented in Appendix A.

2.2.2 Pneumatic Piezometers

Inclinometers installed within the assessment district after 1997 were typically outfitted with one or two pneumatic piezometer sensors. Nine sensors were measured regularly over the monitoring period; one piezometer was added (SI-1A) in August 2006. Each sensor records groundwater elevations by measuring differential air pressure between the instrument sensor and groundwater surface across a flexible bladder. The locations of the piezometers are depicted in Plate 2, and hydrographs are presented in Appendix A.

2.2.3 Groundwater Level Discussion

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 piezometer was calculated (Appendix A, Plate A-2).

Groundwater levels rose significantly following record rainfall in the winter of 2004 to 2005. Since about April 2005, groundwater levels declined and are now lower than average levels for the period 1991 through 2009. The average and highest annual groundwater levels are indicated below:

Table 1. Summary of Average Groundwater Elevations by Area

Location	Average Groundwater El. 2008-2009	Change vs. Prior Year Average	Peak Groundwater El. 2008-2009	Change vs. Prior Year Peak
Malibu Road	6.9	+0.1	7.4	-0.4
Bay Shore Drive	25.8	-0.6	26.4	-0.3

All units are in feet

2.3 DEWATERING PRODUCTION

2.3.1 Dewatering Well Production

A graph of the production rate for all dewatering wells is presented on Plate 4. Graphs showing production rates of individual wells are provided in Appendix B. Production data for the dewatering wells indicates the following:

- The average total well production rate for this monitoring period was approximately 962 gallons per day (gpd). This represents a decrease of about 16.1 percent from the previous monitoring period of 1,147 gpd.
- A replacement dewatering well, W-14, was installed in the fall of 2008 on Bayshore Drive. Due to the installation of this well, production rates in W-4 and W-10 (located downslope on Malibu Road) have been greatly reduced.

2.3.2 Hydrauger Production

A graph of the production rate for all hydraugers is presented on Plate 4. A graph of production rates for all hydraugers is included in Appendix B. Data for the hydraugers indicates the following:

- The average production rate for all hydraugers over the monitoring period is approximately 333 gpd. This represents an increase of approximately 61 percent from the average production rate of 206 gpd for the previous monitoring period.
- This increase in production is most likely attributed to the hydrauger cleaning performed in June 2008.

2.3.3 Total Dewatering Production

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

- The average total dewatering rate during the monitoring period was approximately 1,295 gpd. This represents a 4.2 percent decrease in the average rate relative to the 1,353 gpd average recorded during the previous monitoring period.

2.4 SLOPE INCLINOMETER MEASUREMENTS

Fugro monitored four slope inclinometers on a quarterly basis to measure subsurface ground deformation through June 2009. Slope inclinometer measurement plots are presented in Appendix C for each monitored inclinometer installation. Two plots for each slope inclinometer are presented. The first plot has a baseline reading from the final round of monitoring in the 2007 to 2008 monitoring year, showing any ground movement within the 2008 to 2009 monitoring year. The second plot has a baseline reading from January or



February 2005, except for SI-1A. SI-1A was installed in August 2006 and has a baseline reading from September 2006. Only readings with validated checksums¹ are presented.

Interpretation of inclinometer data along Malibu Road for SI-1A and SI-4 shows no significant movement during the 2008-2009 monitoring year. There was difficulty obtaining data below 28 feet in SI-2, indicating that SI-2 was "sheared off" in the winter of 2009. However, less than 0.1 inches was recorded during the monitoring period, which is less than the reliable accuracy of the instrument. Therefore, deformation, which made the SI impassable with the probe can, most likely attributed to previous movement, as summarized on Plate C-1.

Inclinometers SI-5 and SI-6 are located on Bayshore Drive, upslope and outside the defined limit of the most recent 1998 movement. No significant movement was observed during this monitoring year in SI-5 or SI-6.

3.0 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 (typically within a matter of a few hours to a few days of identifying a problem). Generally, repairs and maintenance consisted of well pump and electrical repairs, and cleanout of the hydrauger system. The repairs performed are summarized on the following table:

Table 2. Maintenance Activities

Date	Facility	Work Performed
July 21, 2008	Hydraugers	Flushed out conveyance line, vault and power box maintenance, storm drain clearing
August 21, 2008	Hydraugers	Flushed out conveyance line
September 23, 2008	Hydraugers	Flushed out conveyance line; vault and power box maintenance
October 20, 2008	Hydraugers	Flushed out conveyance line
October 28, 2008	W-11, W-12	Removed flexible tubing used as conveyance line
December 23, 2008	Dewatering well	Install caps on posts; vault maintenance
December 23, 2008	W-3, W-5 and W-6	Rust-proofing, abrasion, primer, finish coat
March 20, 2009	HD-20	Temporary repair to damaged hydrauger

¹ Checksums are a data validation technique for slope inclinometers where the "0" (downslope) and "180" (upslope) readings are summed and the theoretical result should be zero.

3.2 CAPITAL IMPROVEMENT PROJECTS

One replacement dewatering well, W-14, was installed on Bayshore Drive between existing dewatering wells W-11 and W-12 and was completed in October of 2008. The dewatering well is 80 feet in depth and has produced an average of approximately 54 gpd during the monitoring period. A diagram of the well is shown in Appendix D.

A new slope inclinometer is proposed for the 2010-2011 monitoring period to replace SI-2 and SI-3 because they became impassable due to cumulative deformation in 2009 and 2005 respectively.

4.0 SUMMARY AND CONCLUSIONS

4.1 SUMMARY

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

- The 2008-2009 monitoring year had below average rainfall with 11.02 inches recorded in Malibu. Rainfall during the rainfall season was about two-thirds the historical average.
- Groundwater levels in the assessment district area were below normal levels.
- Readings for the five slope inclinometers show no significant movement during the 2008 to 2009 monitoring year, except for limited movement in SI-2 which resulted in the "shearing off" of the inclinometer. A new inclinometer is proposed for 2010-2011 to replace SI-2 and SI-3 on Malibu Road`.
- A replacement dewatering well was installed in October 2008 on Bayshore Drive.
- Water conservation is encouraged throughout the Malibu Road area to reduce future groundwater level increases. Control of ground water levels within the landslide area is critical to maintaining the stability of the landslides. The following are suggested:
 1. Rain Gutters - Installation and Maintenance.
 2. Limit Irrigation.
 3. Use of low-flow toilet and plumbing fixtures.
- 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.

5.0 REFERENCES

- Bing Yen and Associates, Inc. (1991), "Monitoring, Instrumentation, and Dewatering Facilities at Calle del Barco, Puerco Beach, Latigo Canyon, and Rambla Pacifico (2 wells) Landslide Sites," dated October 4.
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- _____ (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.
- _____ (1994), "Annual Observation & Maintenance Report for the Period July 1993 to July 1994, Malibu Road, Malibu, California," dated September.
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- _____ (1996), "Annual Observation & Maintenance Report for the Period July 1995 to July 1996, Malibu Road, Malibu, California," dated September.
- _____ (1997), "Annual Observation & Maintenance Report for the Period July 1996 to July 1997, Malibu Road, Malibu, California," dated June.
- _____ (1998), "Annual Observation & Maintenance Report for the Period July 1997 to April 1998, Malibu Road, Malibu, California," dated April.
- _____ (1999), "Annual Observation & Maintenance Report for the Period April 1998 to March 1999, Malibu Road, Malibu, California," dated May.
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_____ (2005), "Annual Assessment District No. 98-3 (Malibu Road) FY 2005-06," dated June 13.

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_____ (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



BASE MAP SOURCE: USGS 1:100,000-scale Metric Topographic Map of Los Angeles, California (1979).

SITE LOCATION MAP
Malibu Road Landslide Assessment District
Malibu, California

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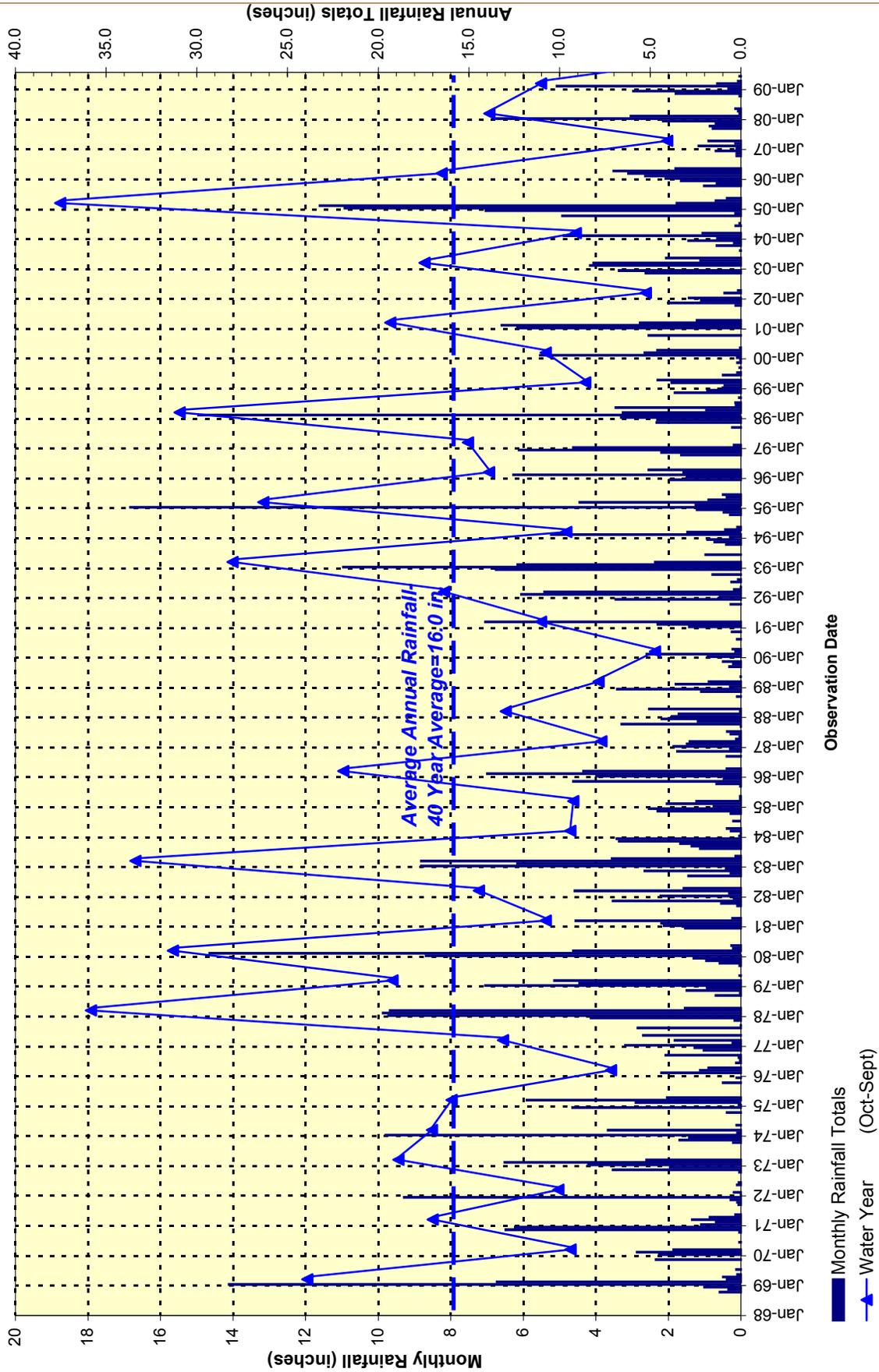


LEGEND

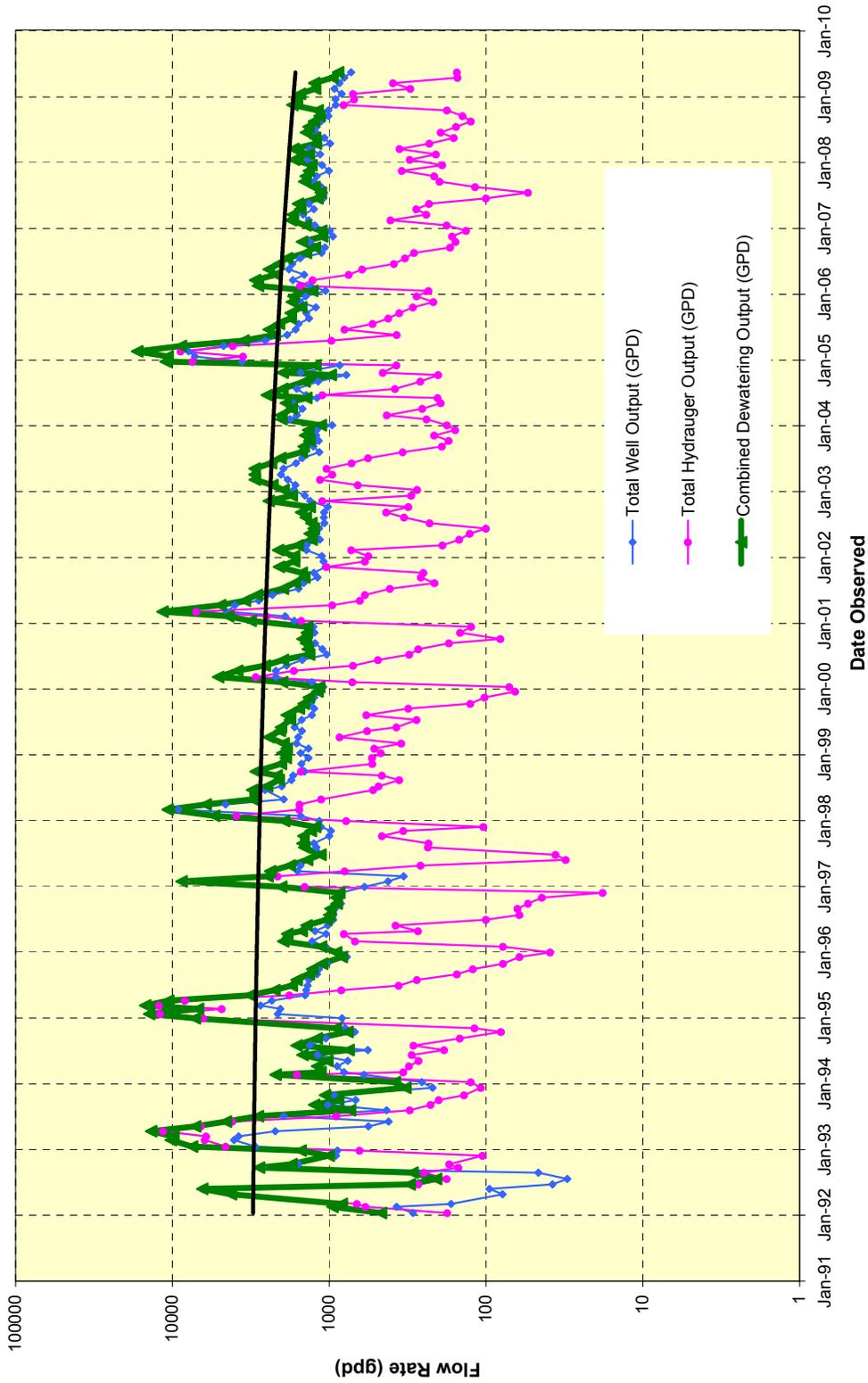
- Dewatering Well
- Replacement Dewatering Well
- Slope Inclinometer
- Destroyed Slope Inclinometer
- Standpipe Piezometer
- Storm Drain Outfall
- Producing Hydrauger (solid line showing unobstructed pipe)
- Nonproducing Hydrauger
- Coordinate Grid: California State Plane, Zone 5, NAD 83, Feet
- Assessment District No. 98-3 Boundary
- Qlsr Recent Landslide of 1978 (Boundary from Leighton, 1979)
- Qlsa Ancient Landslide (Boundary from Leighton, 1979)

ASSESSMENT DISTRICT MAP
 Malibu Road Landslide
 Assessment District
 Malibu, California

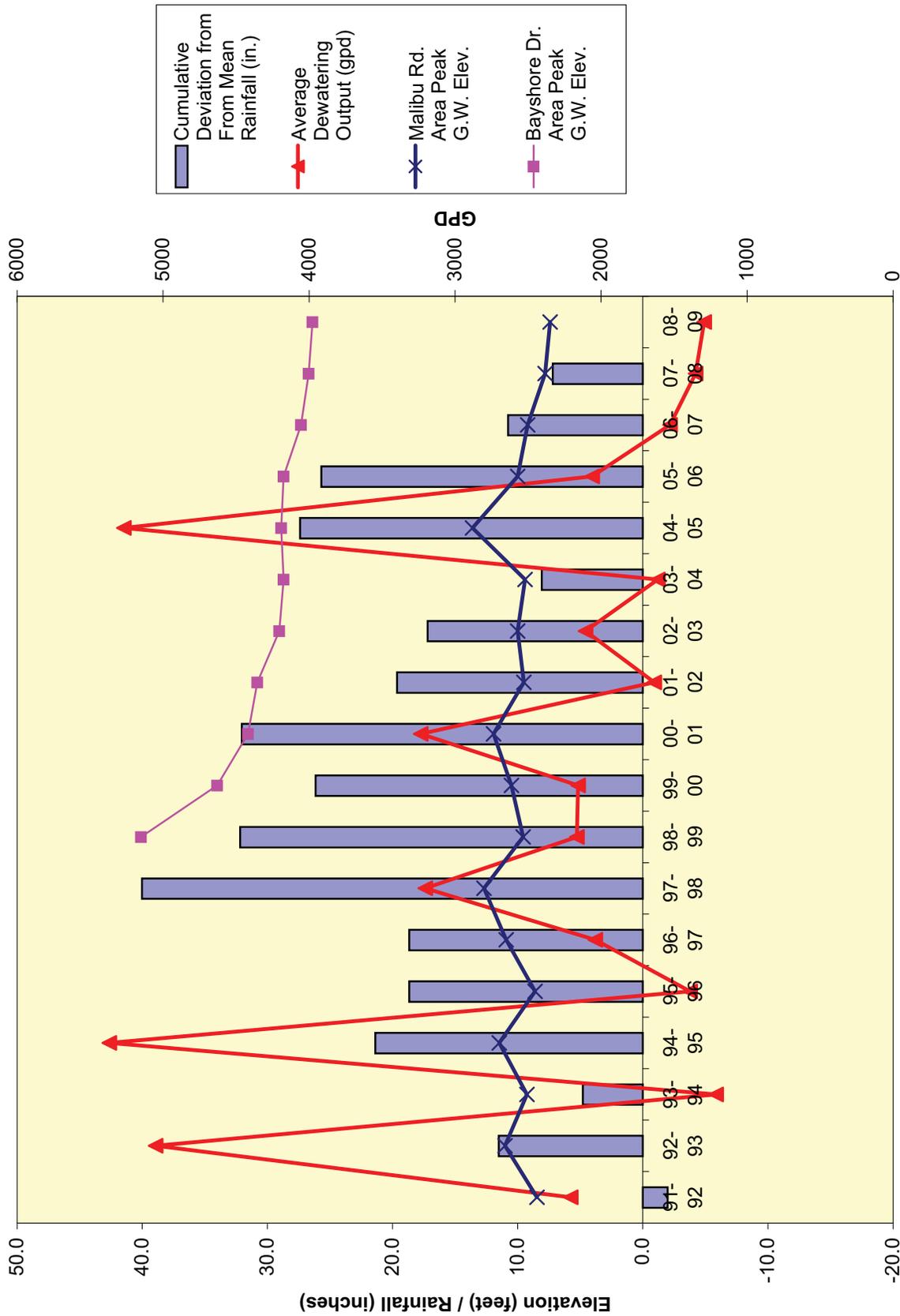
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MALIBU AREA - MONTHLY AND ANNUAL RAINFALL
 Malibu Road Landslide Assessment District
 Malibu, California



DEWATERING GRAPH
Total Output - all Wells and Hydraugers
Malibu Road Landslide Assessment District
Malibu, California



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

SUMMARY GRAPH
Groundwater Levels, Dewatering, and Rainfall
 Malibu Road Landslide Assessment District
 Malibu, California

**APPENDIX A
GROUNDWATER DATA**



MALIBU ROAD - Standpipe Piezometer Information					
Well Identification	Previous Reference Elevation (8/91)	Updated Reference Elevation (4/00)	Depth (ft.)*	Perforation Interval	Installed By
W-2A	22.6	20.6	9.0	Unknown	LA COUNTY
W-3A	22.0	20.5	32.5	Unknown	LA COUNTY
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

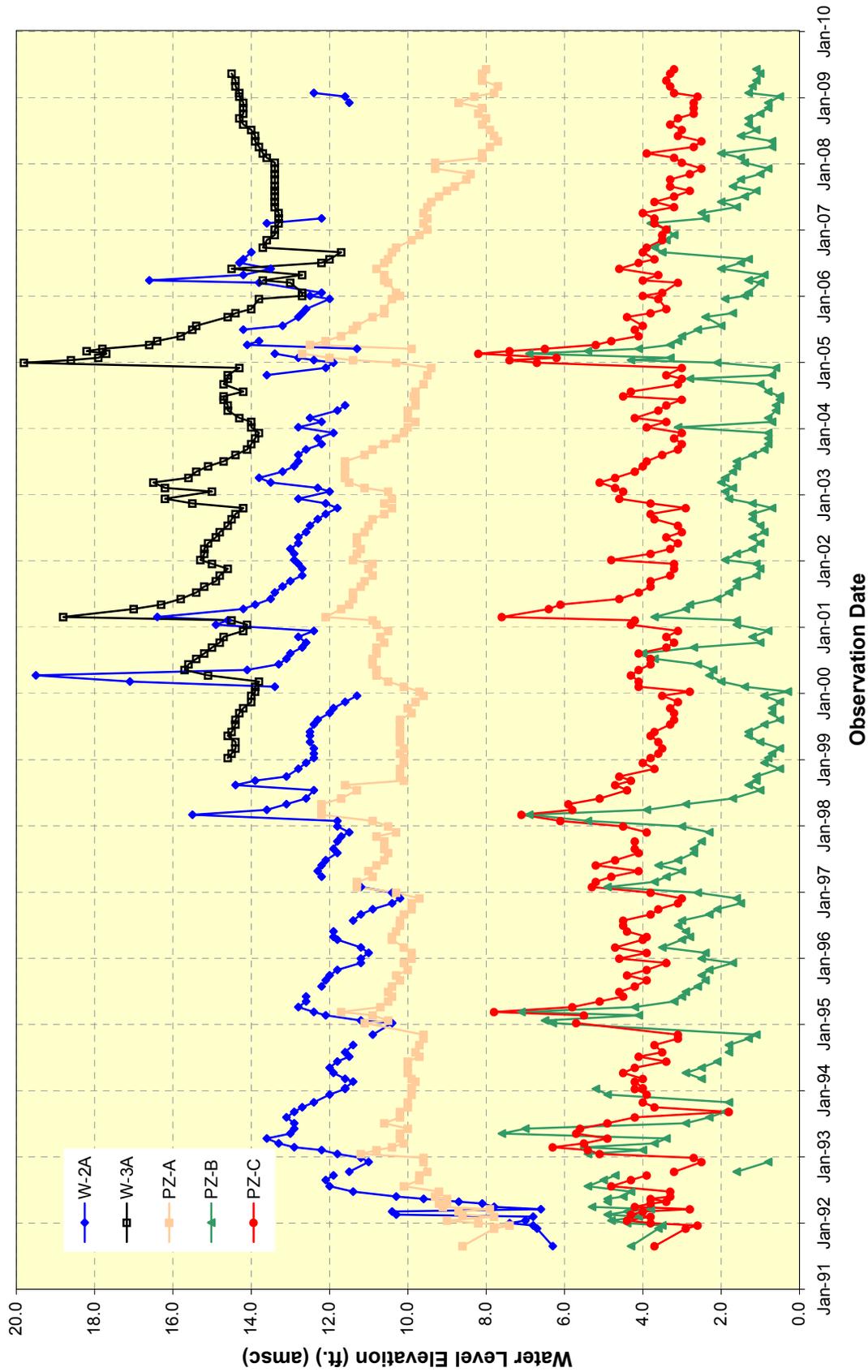
Note: + Formerly designated as MR-5
 ++ Formerly designated as MR-6

MALIBU ROAD - Pneumatic Piezometer Information					
Well Identification	Previous Reference Elevation (8/91)	Updated Reference Elevation (4/00)	Tip Depth (ft.)	Tip Elev (ft.)	Installed By
SI-1	20.0	20.1	34.6	-14.6	BYA
SI-2	20.0	19.7	65.1	-45.1	BYA
SI-3	20.0	20.3	49.8	-29.8	BYA
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		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

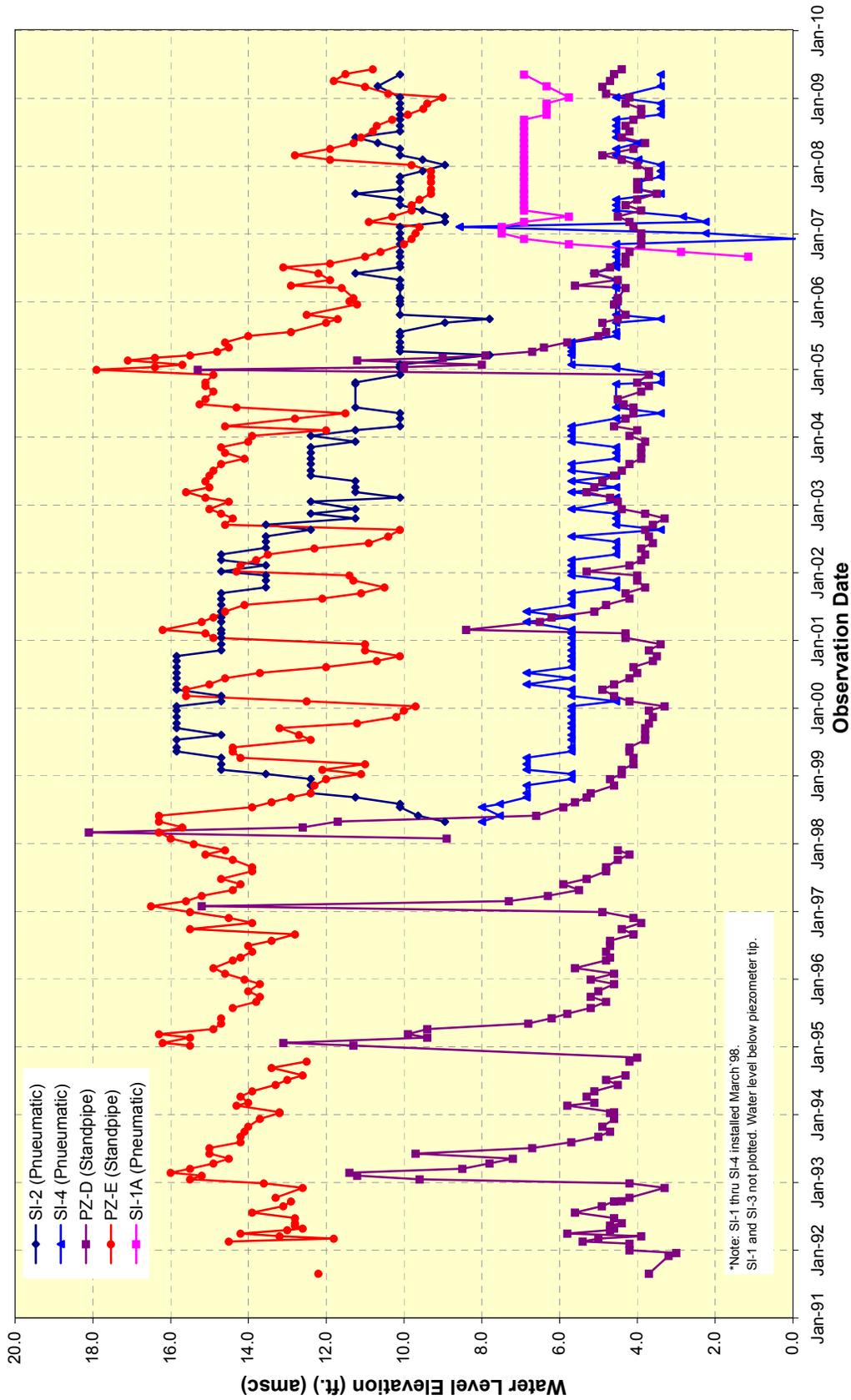


MALIBU ROAD - SUMMARY OF GROUNDWATER DATA																									
Piezometer I.D.	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	Highest Recorded	Mean '91 - '09	Stand Dev.	08-09 vs 97-98	08-09 vs mean		
MALIBU ROAD - Standpipe Piezometers																									
W-2A	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	--	--	Apr-00	12.3	1.3	--	--		
	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	--	--	19-05	14.1	2.0	--	--		
W-3A																									
PZ-A	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	Mar-05	10.2	0.9	-3.0	-2.1		
	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	12-7	11.0	1.1	-3.5	-2.3		
PZ-B	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	May-93	2.3	1.2	-2.3	-1.3		
	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	7-6	4.0	2.1	-5.6	-2.7		
PZ-C	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	Mar-05	4.0	0.6	-2.0	-1.0		
	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	8-2	5.3	1.5	-3.7	-1.9		
PZ-D	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	Mar-98	5.2	1.3	-3.5	-0.8		
	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	18-1	8.1	4.4	-13.2	-3.2		
PZ-E	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	Jan-05	13.2	1.6	-4.8	-2.8		
	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	17-9	15.0	1.5	-4.5	-3.2		
Area Average	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		8.4	0.8		-1.5		
Change vs Prior	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	7.4		10.1	1.6		-2.6		
	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	0.1							
	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	-0.4	-0.4							
Bayshore Drive - Standpipe Piezometers																									
SI-5									35.5	32.2	30.7	30.1	29.3	29.0	28.6	28.2	27.8	27.3	26.3	Nov-98	29.5	2.6		-3.3	
									37.8	33.4	31.2	30.4	29.7	29.2	29.0	28.4	28.0	27.5	27.0	31-8	30.1	3.1		-3.1	
SI-6									38.8	32.6	31.2	29.9	27.9	27.7	27.2	27.9	26.0	25.7	25.4	Nov-98	29.1	3.9		-3.7	
									42.4	34.6	31.9	31.2	28.4	28.2	28.8	29.0	26.5	25.9	25.7	42-4	30.2	4.8		-4.5	
Area Average									37.2	32.4	31.0	30.0	28.6	28.3	27.9	28.0	26.9	26.5	25.8		29.3	3.2		-3.5	
Change vs Prior									40.1	34.0	31.5	30.8	29.1	28.7	28.9	28.7	27.3	26.7	26.4		30.2	4.0		-3.8	
									-4.7	-1.5	-1.0	-1.3	-0.3	-0.4	0.2	-1.2	-0.4	-0.6							
									-6.1	-2.5	-0.7	-1.8	-0.4	0.2	-0.2	-1.5	-0.6	-0.3							
MALIBU ROAD - Pneumatic Piezometers																									
SI-1																									
SI-1A																									
SI-2									9.3	13.2	15.6	15.1	14.1	11.9	11.5	10.1	9.9	10.1	10.2	May-98-Oct-00	11.7	2.2	0.9	-1.6	
									9.6	15.9	15.9	15.9	14.7	13.6	12.4	11.3	11.3	10.1	11.3	10.7	15.9	12.7	2.4	1.0	-2.0
SI-3																									
SI-4									7.77	6.6	5.7	6.0	5.2	4.8	5.0	4.9	4.5	4.0	4.0	3.9	Feb-07	5.2	1.2	-3.9	-1.3
									8.0	8.0	6.9	6.9	5.7	5.7	5.7	5.7	5.1	8.6	4.6	4.6	8.6	6.3	1.4	-3.5	-1.7
Bayshore Drive - Pneumatic Piezometers																									
SI-5 Tip 1									34.2	34.7	36.3	34.2	33.9	32.7	37.6	33.6	31.8	31.7	26.9	Mar-01	33.4	2.8		-6.5	
									34.8	39.4	45.1	35.9	37.1	35.9	44.0	34.8	33.6	34.8	30.1	45-1	36.9	4.4		-6.7	
SI-5 Tip 2									35.4	36.1	39.1	35.8	36.5	34.0	39.5	33.7	29.8	29.2	26.0	Mar-01	34.1	4.2		-8.1	
									37.5	42.1	51.3	37.5	40.9	37.5	49.0	37.5	35.1	40.9	27.1	51-3	39.7	6.6		-12.6	
SI-6 Tip 1									42.4																
									44.1																
SI-6 Tip 2									44.5	44.6	46.0	44.4	43.0	42.0	43.8	41.0	39.5	39.0	39.0	Mar-01	42.4	2.5		-3.4	
									45.7	48.0	51.5	45.7	45.7	43.4	49.1	42.2	42.2	42.8	39.9	51-5	45.1	3.4		-5.2	

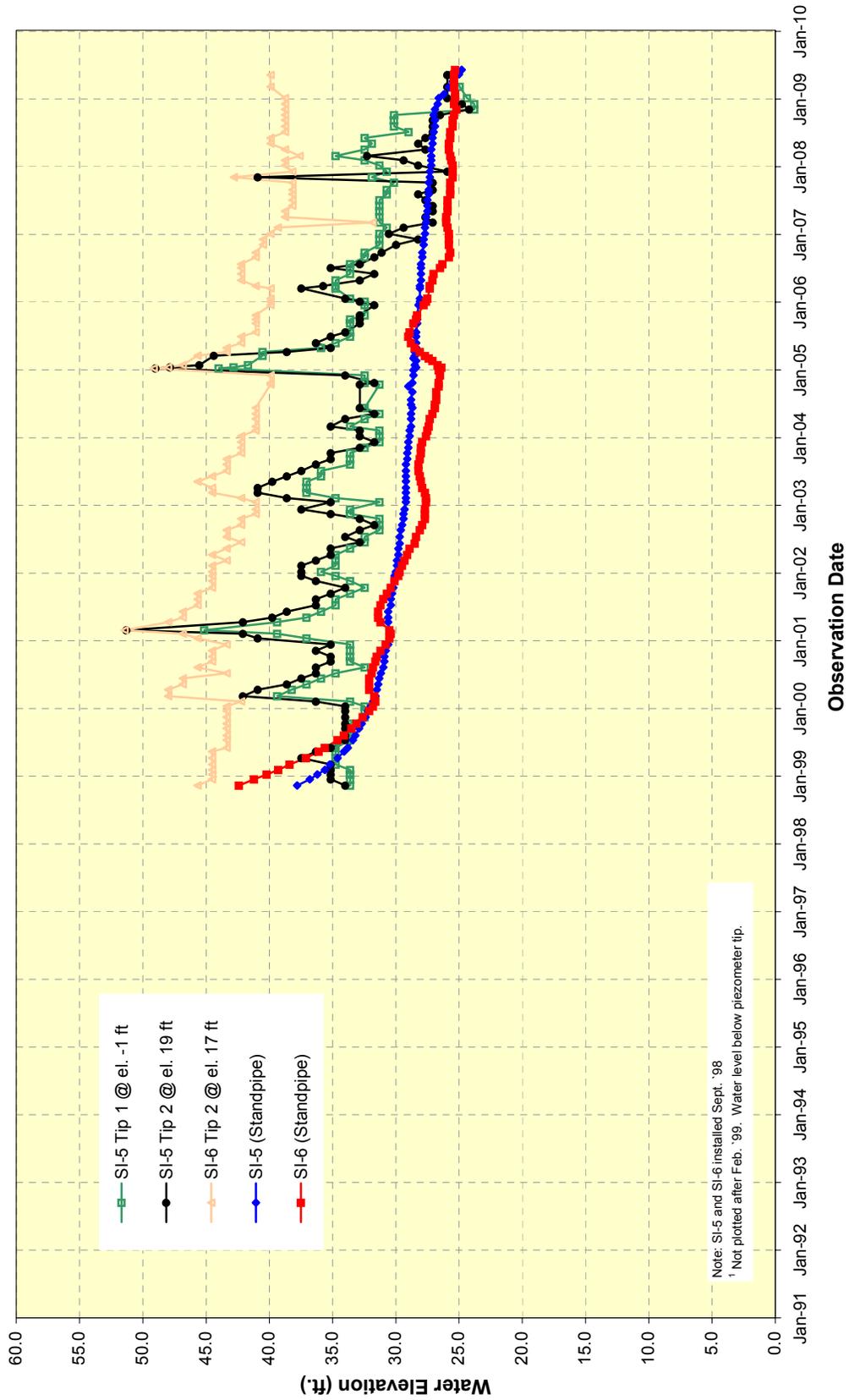


*Note: W-3A uncovered in Jan. '99

GROUNDWATER HYDROGRAPH
Malibu Road (West End)



GROUNDWATER HYDROGRAPH
Malibu Road (East End)



GROUNDWATER HYDROGRAPH
 Bayshore Drive

**APPENDIX B
DEWATERING DATA**



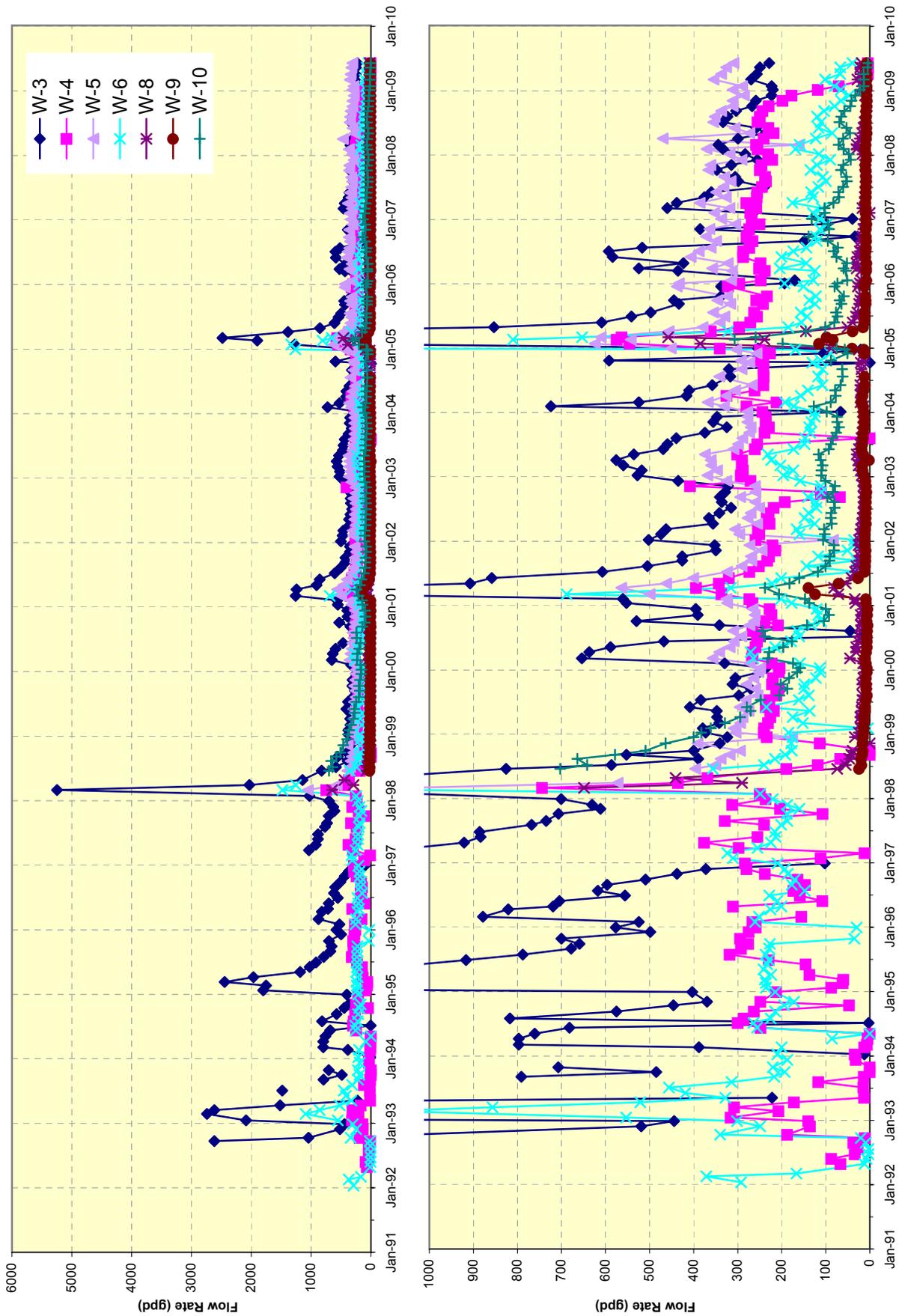
MALIBU ROAD - Dewatering Well Information								
Well	ID	Vault Elevation (ft.)	Bottom Elevation (ft.)	Pump Elevation (ft.)	Pump Size (hp)	2008-2009 Pumping Rate* (gpd)	% of Total Well Production	Installed By
W-3		19.5	-4.0	Unknown	1/2	263	27%	LA Co.
W-4		20.0	-9.0	Unknown	1/2	130	13%	LA Co.
W-5		19.0	-9.5	Unknown	1/2	324	33%	LA Co.
W-6		20.0	-4.5	Unknown	1/2	79	8%	LA Co.
W-8		27.5	11.0	Unknown	1/2	15	2%	LA Co.
W-9		20.0	-40.0	-35.0	1/3	7	1%	LA Co.
W-10		19.0	-40.0	-35.0	1/3	32	3%	LA Co.
W-11		61.0	1.0	13.0	1/3	33	3%	BYA
W-12		58.0	-2.0	8.0	1/3	8	1%	BYA
W-14		60.0	-20.0		1/3	52	5%	Fugro
NW-1						12	1%	Homeowner
NW-2						20	2%	Homeowner
NW-3						6	1%	Homeowner

Note: * Average pumping rate during this monitoring period

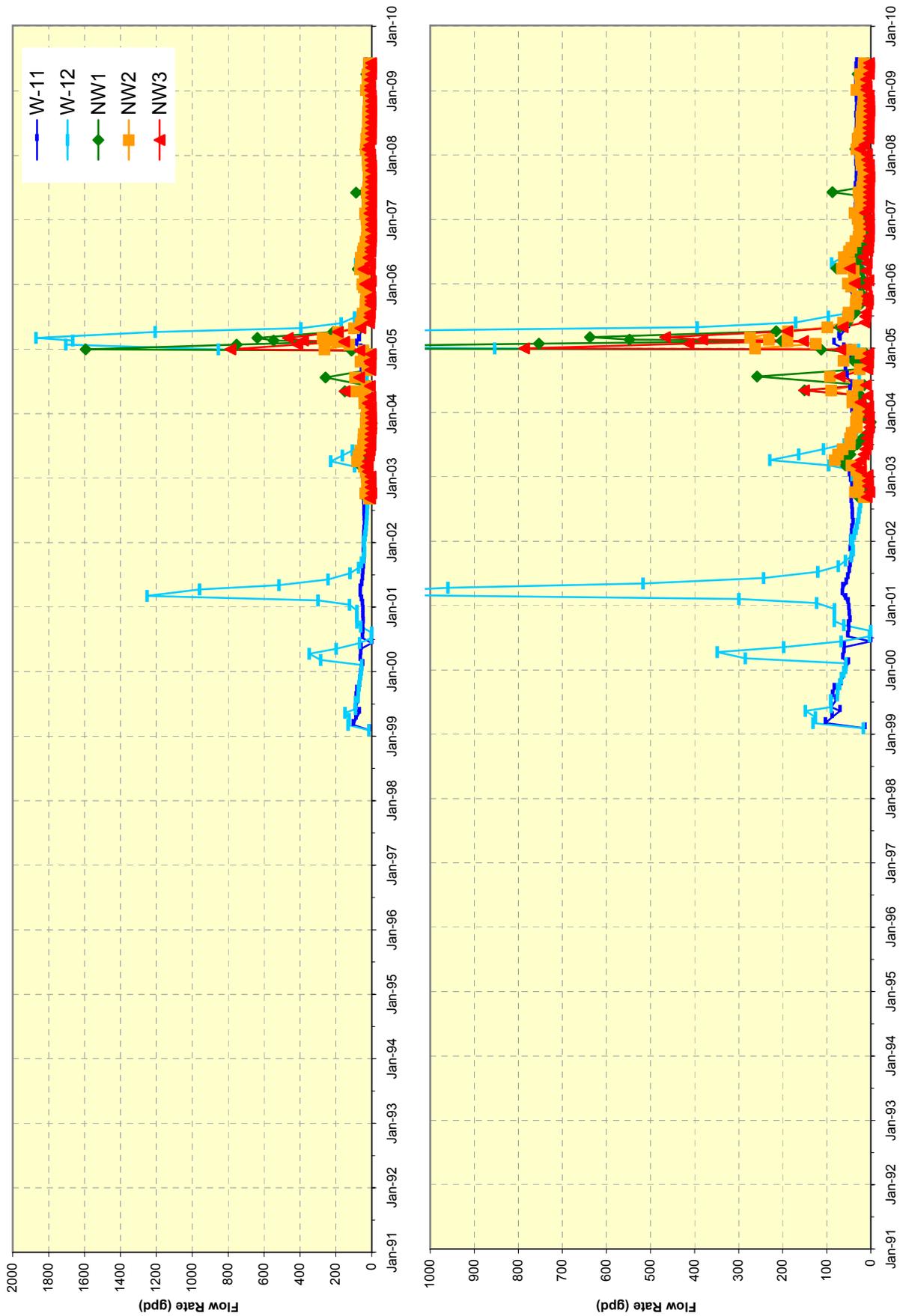
Hydrauger ID	Installed Length (ft)	Bearing	Functional Length** (ft)	2008-2009 Flow Rate* (gpd)	% of Total Production	Installed By
HD-1	Unknown	N05E	74	0.0	0%	LA Co.
HD-2	Unknown	N21E	34	0.0	0%	LA Co.
HD-3	Unknown	N06E	13	0.0	0%	LA Co.
HD-4	Unknown	N29E	53	0.0	0%	LA Co.
HD-5	Unknown	N13E	41	11.6	4%	LA Co.
HD-6	Unknown	N08W	55	0.0	0%	LA Co.
HD-7	Unknown	N26E	87	3.1	1%	LA Co.
HD-8	Unknown	N19E	92	0.0	0%	LA Co.
HD-9	Unknown	N34E	76	0.0	0%	LA Co.
HD-10	Unknown	N19E	55	0.0	0%	LA Co.
HD-11	Unknown	N11E	78	0.7	0%	LA Co.
HD-12	Unknown	N08E	70	0.0	0%	LA Co.
HD-13	Unknown	N09E	79	0.0	0%	LA Co.
HD-14	Unknown	N08E	80	0.0	0%	LA Co.
HD-15	Unknown	N14E	82	0.0	0%	LA Co.
HD-16	Unknown	N15E	69	0.0	0%	LA Co.
HD-17	150	N15E	150	59.4	18%	BYA
HD-18	150	N18E	150	67.2	21%	BYA
HD-19	150	N10E	150	0.0	0%	BYA
HD-20	150	N09W	150	98.2	30%	BYA
HD-21	150	N22E	150	11.7	4%	BYA
HD-22	180	N13E	180	0.0	0%	FugroWest
HD-23	160	N01E	160	74.3	23%	FugroWest

Note: * Average flow rate during this monitoring period

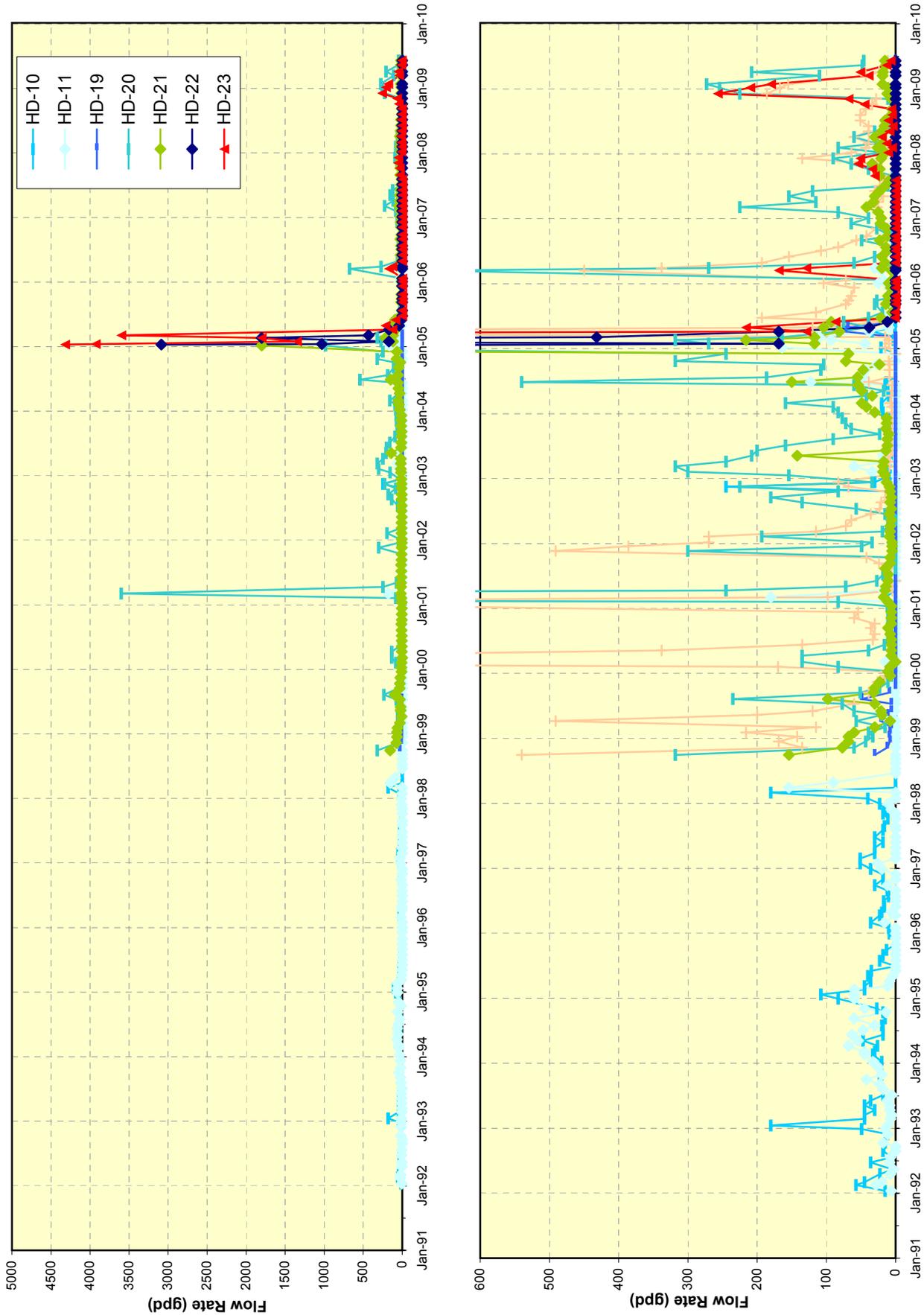
** Measured on 4/1/98 (except HD-22 and HD-23 installed 1/22/05)



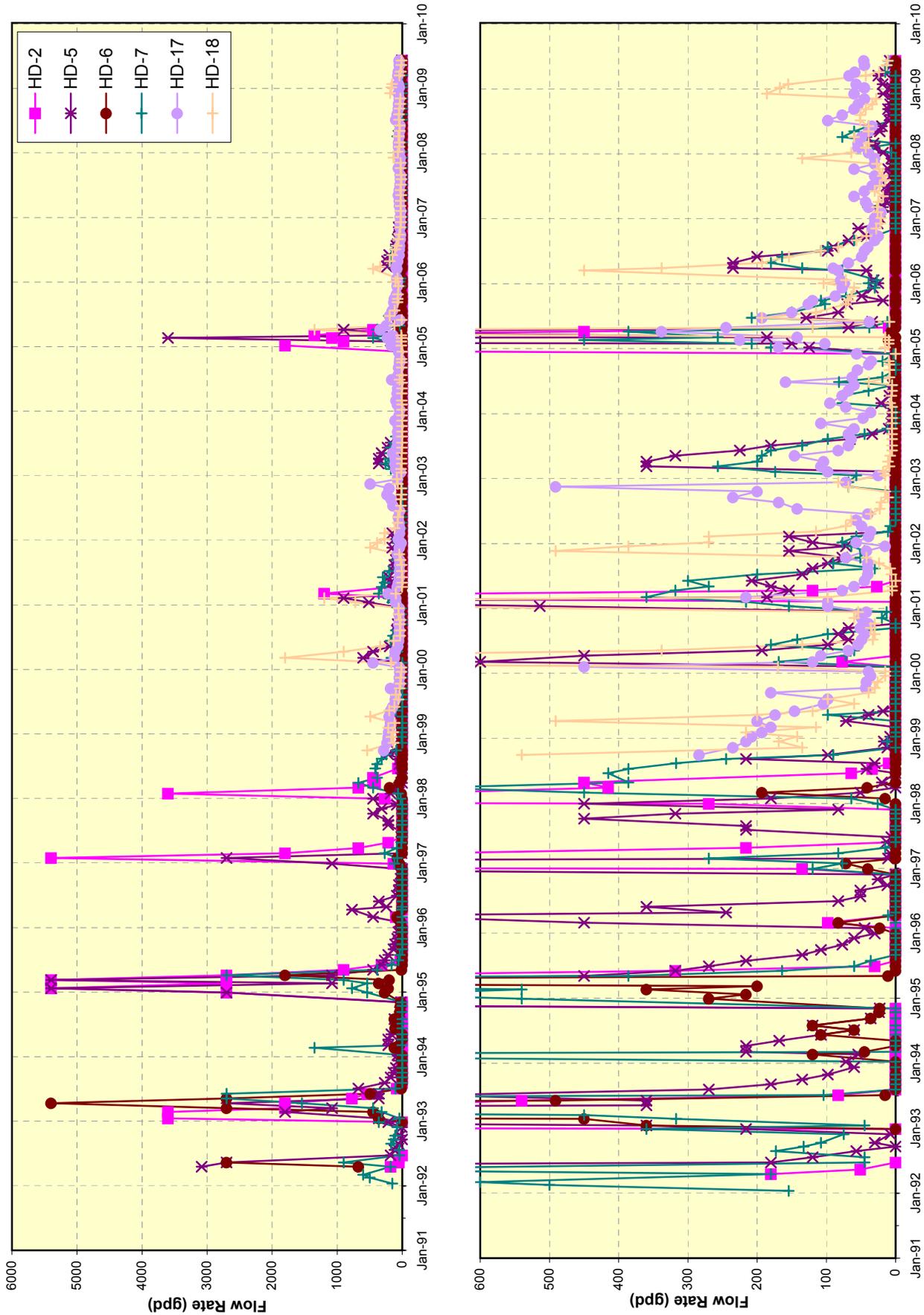
DEWATERING WELL GRAPH
Discharge Rates for Malibu Road Dewatering Wells
(Same Chart at Different Scales)



DEWATERING WELL GRAPH
Discharge Rates for Bayshore Drive Dewatering Wells
(Same Chart at Different Scales)



HYDRAUGER GRAPH
 Discharge Rates for all Hydraugers
 (Same Chart at Different Scales)



HYDRAUGER GRAPH
Discharge Rates for all Hydraulaugers
(Same Chart at Different Scales)

APPENDIX C
SLOPE INCLINOMETER DATA



MALIBU ROAD - Slope Inclinometer Interpretation Summary

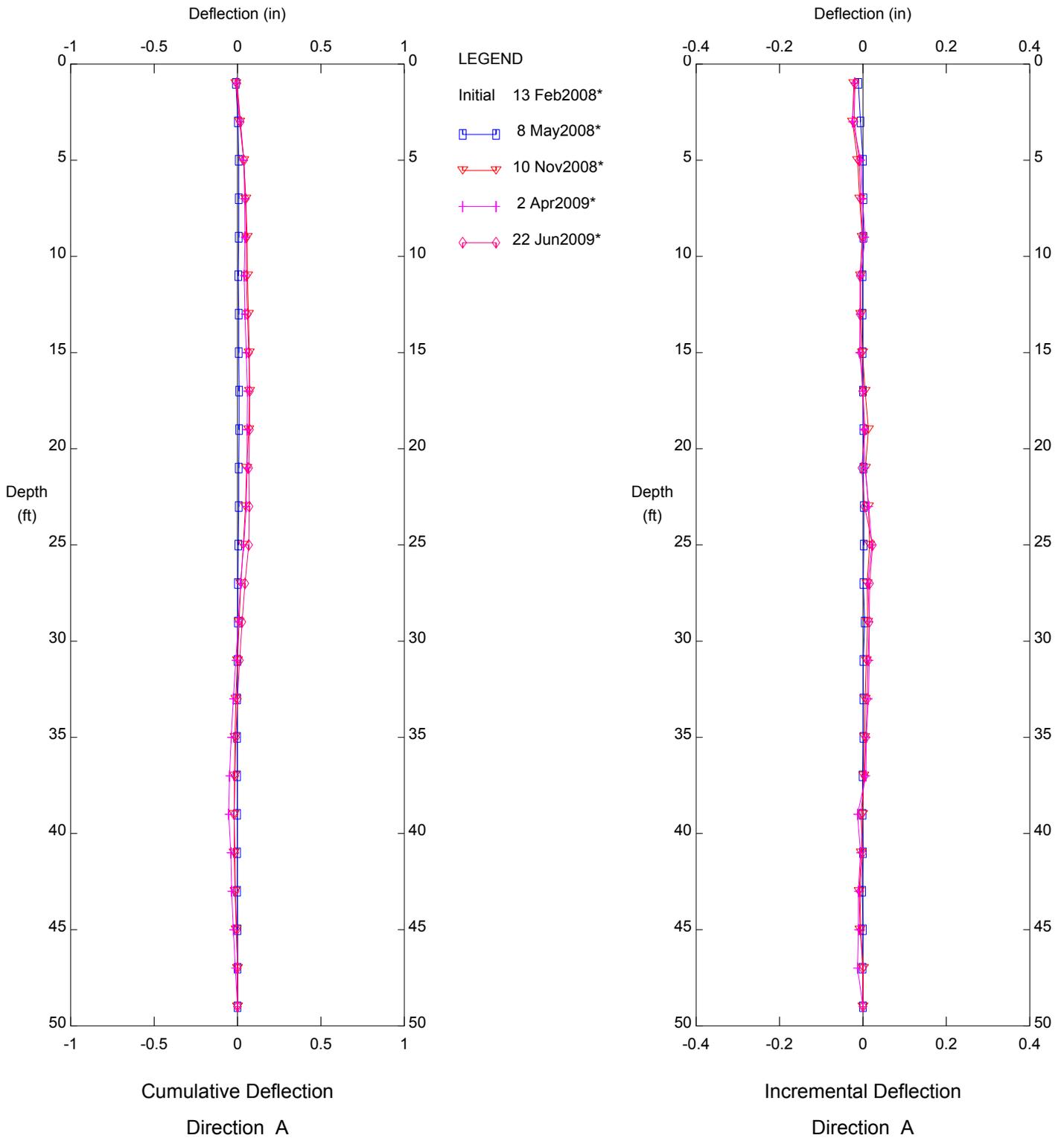
	SI-1 (MR98-1)	SI-1A	SI-2 (MR98-2)	SI-3 (MR98-3)	SI-4 (MR98-4)	SI-5	SI-6
Installation Details							
Previous Ref.Elev.(8/91)	20.0	20.0	20.0	20.0	22.0	59.0	57.0
Updated Ref.Elev.(4/00)	20.1	20.0	19.7	20.3	18.9	59.3	58.0
Depth (ft.)	34	50	64	49	43	78	78
Install Date	Apr-98	Aug-08	Apr-98	Apr-98	Apr-98	Apr-98	Apr-98
A+ Axis orientation (deg)	184		201	190	204	176	186
Casing	RST	SI	RST	RST	RST	SI	SI
Installer	BYA	FWI	BYA	BYA	BYA	BYA	BYA
Interpreted Rupture Depth (ft)	30-32	30-32	28-32	35-38	32-34	unknown	unknown
Reading Interval	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly
Interpretation Movement (inches)							
2008-2009	NR	--	< 0.1 *	NR	--	--	--
2007-2008	NR	--	--	NR	--	--	--
2006-2007	NR	N/A	--	NR	--	--	--
2004-2005	0.5 (3)	NA	0.4	>1(3)	0.4 to 0.5	~ 0.2 *	--
2003-2004 (1)	--	NA	--	--	--	--	--
2002-2003	~ 0.2 *	NA	~ 0.1 *	--	--	--	--
2001-2002	--	NA	--	--	--	--	--
2000-2001	0.5	NA	0.4	0.3	0.6	--	--
1999-2000	--	NA	--	--	--	--	--
1998-1999	3.1	N/A	1.5	4.1	1.3 (2)	--	--

NOTES:

- (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, no readings below slide plane
- (4) Inclinometer sheared off winter of 2009, no readings below slide plane
- NR** No readings
- No clearly defined interpreted movement.
- ~ 0.05 * Indicated displacement is less than reliable instrument accuracy. Interpreted movement is theoretical.



Fugro West, Inc. - Ventura, CA



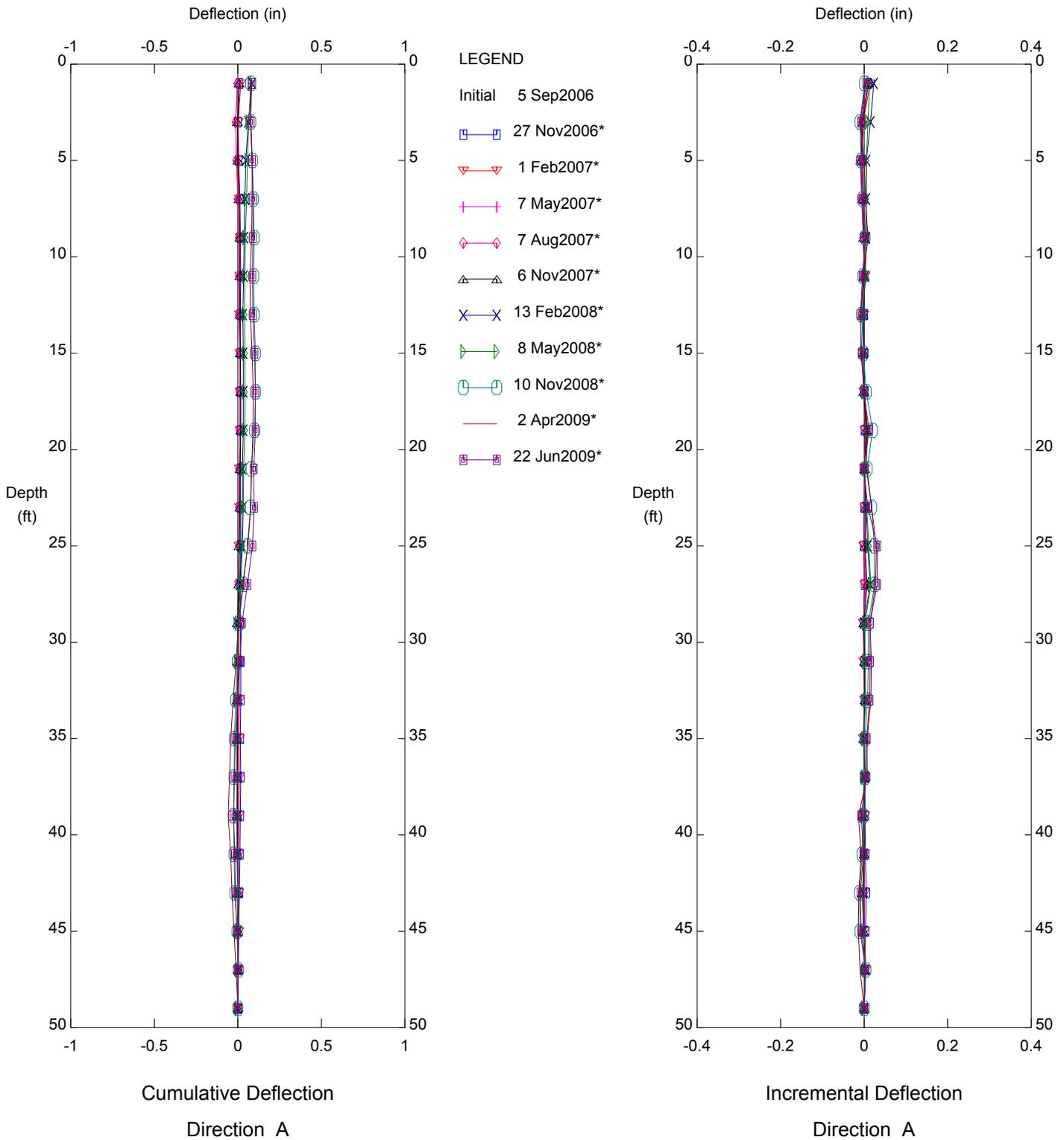
MAL-RD, Inclinometer SI1A

Depth of Readings = 48

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



Fugro West, Inc. - Ventura, CA



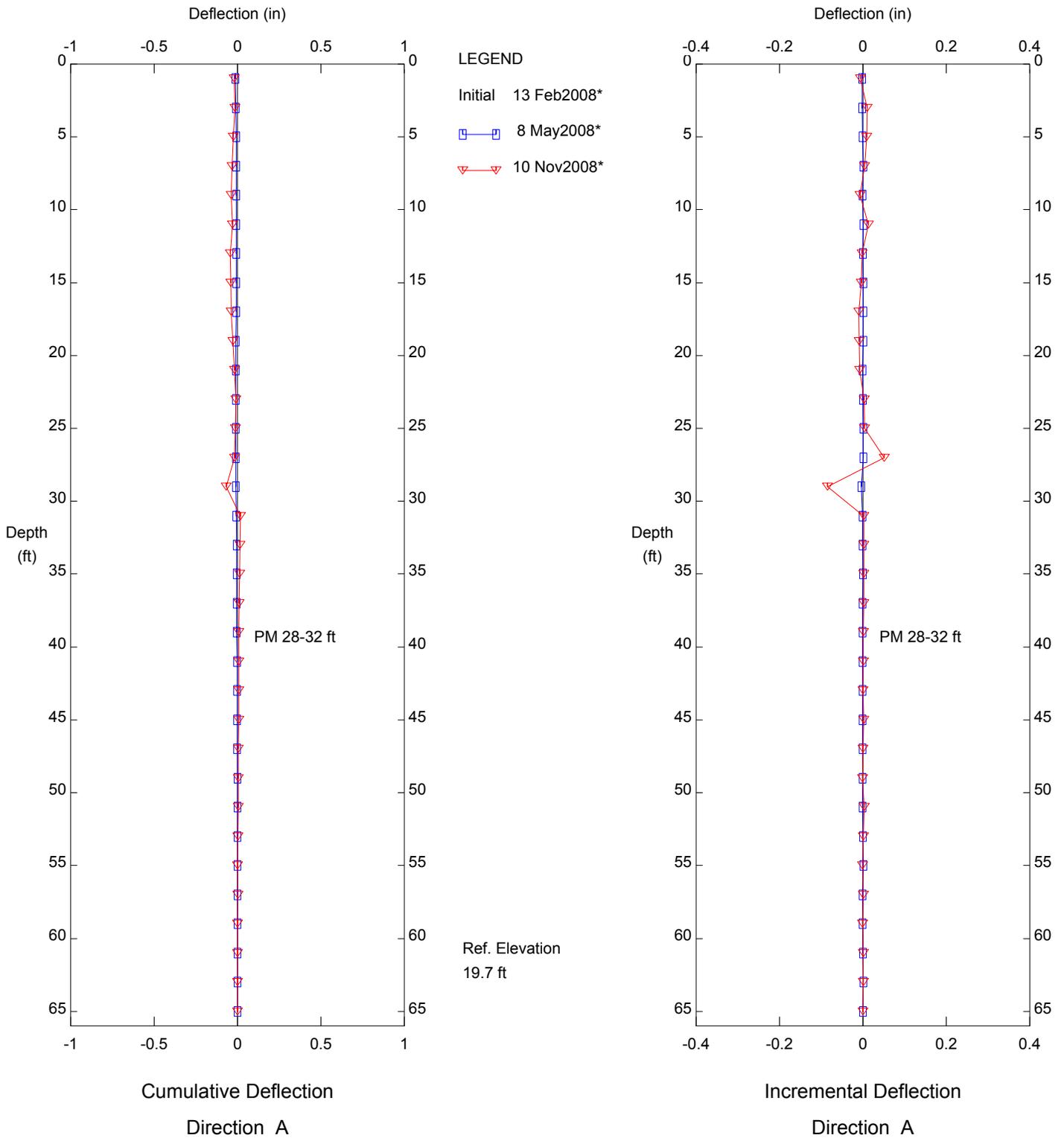
MAL-RD, Inclinometer SI1A

Depth of Readings = 48

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



Fugro West, Inc. - Ventura, CA



MALIBU ROAD, Inclinometer SI-2

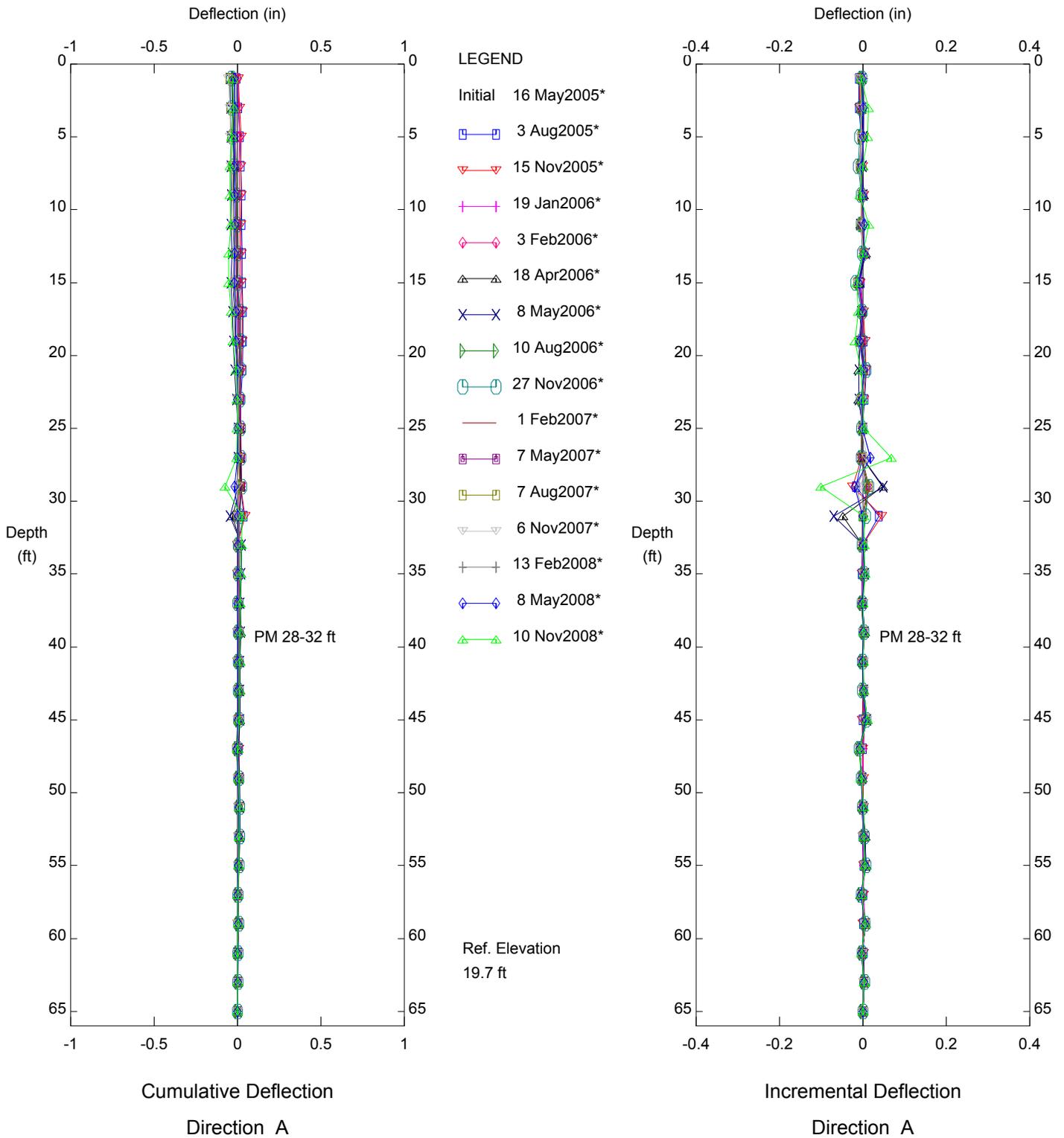
Depth of readings = 66 ft

Azimuth = 201

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



Fugro West, Inc. - Ventura, CA



MALIBU ROAD, Inclinometer SI-2

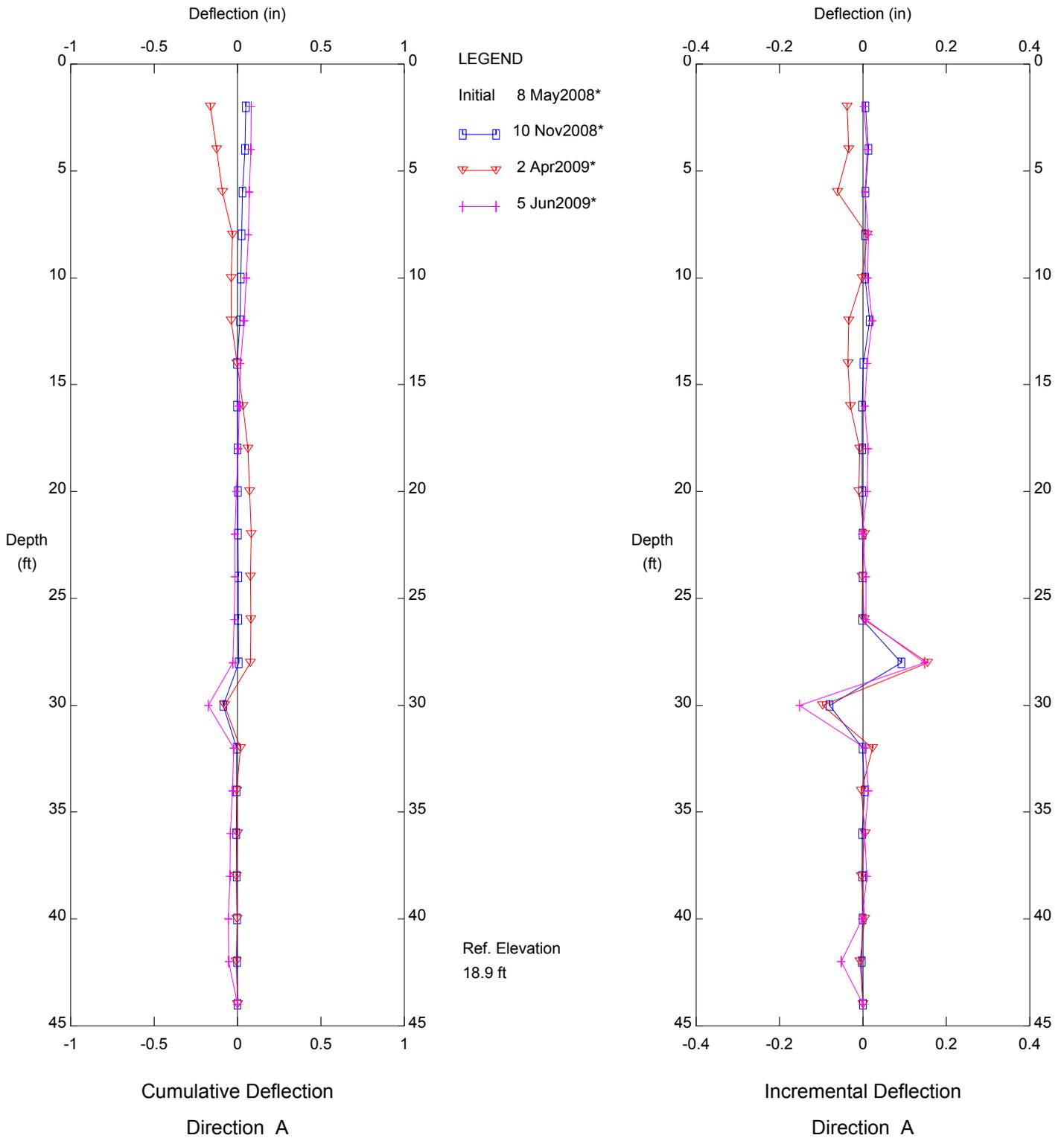
Depth of readings = 66 ft

Azimuth = 201

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



Fugro West, Inc. - Ventura, CA



MALIBU ROAD, Inclinometer SI-4

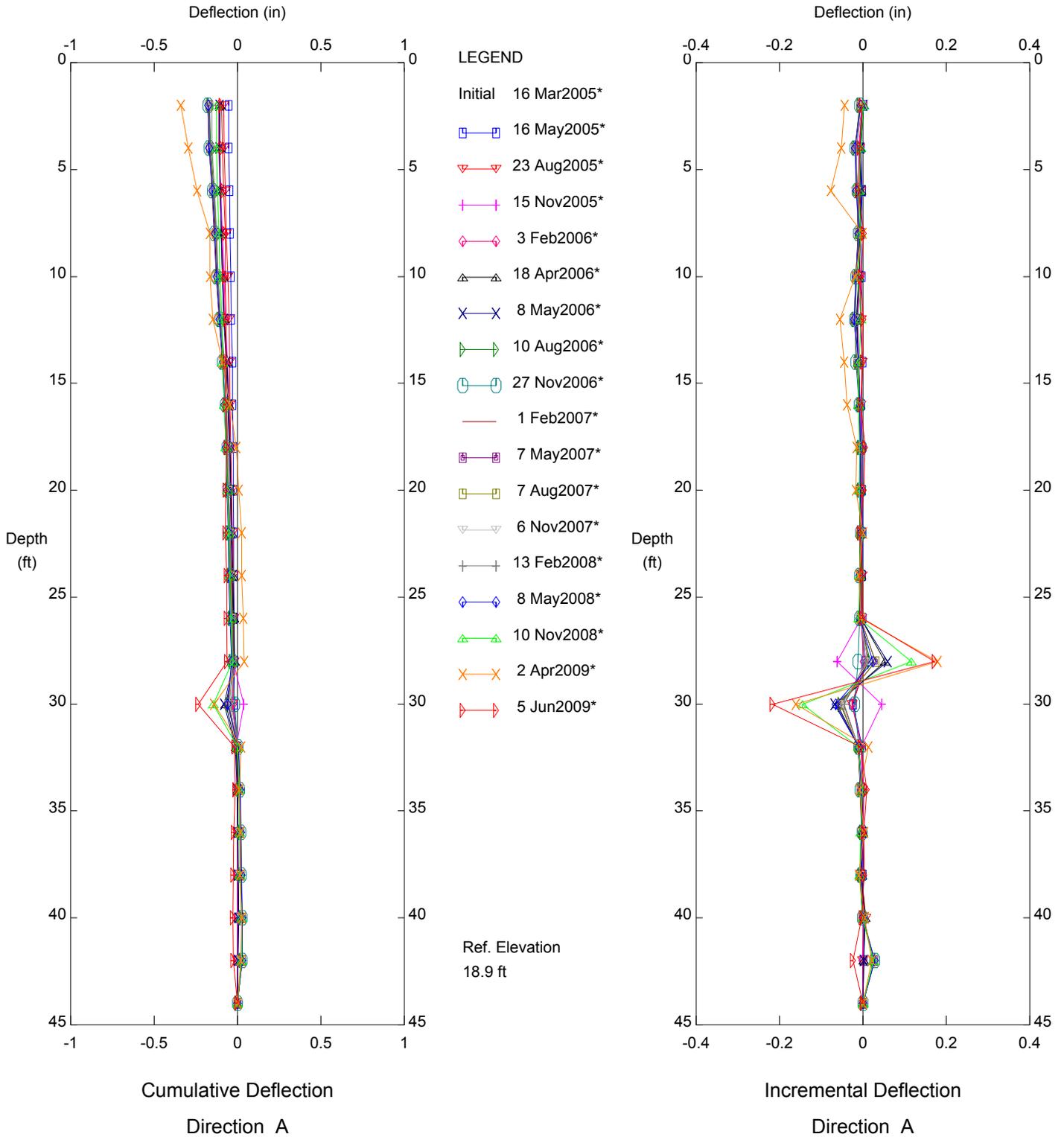
Depth of readings = 41 ft

Azimuth = 204

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



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MALIBU ROAD, Inclinometer SI-4

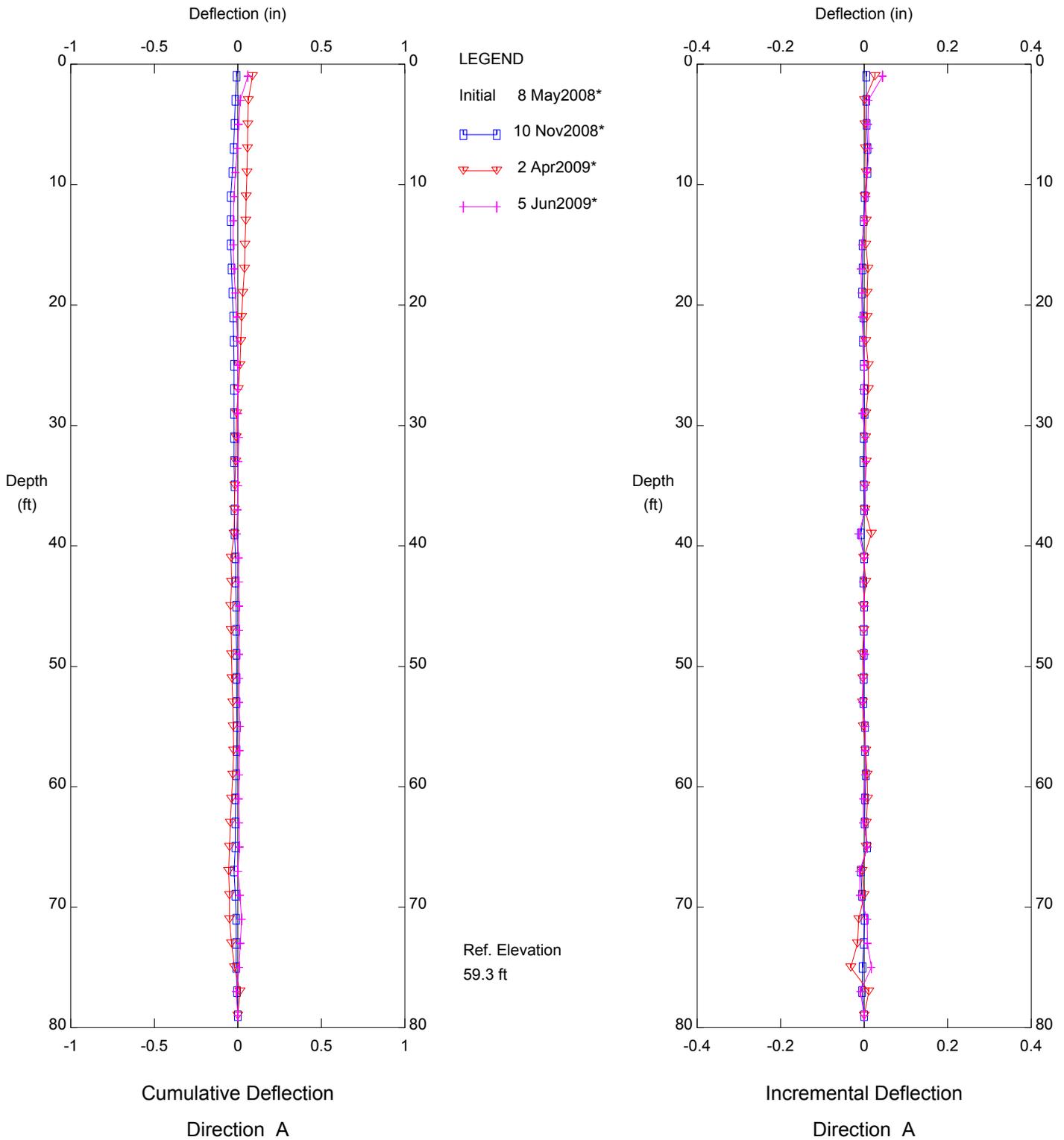
Depth of readings = 41 ft

Azimuth = 204

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



Fugro West, Inc. - Ventura, CA



MALIBU ROAD, Inclinometer SI-5

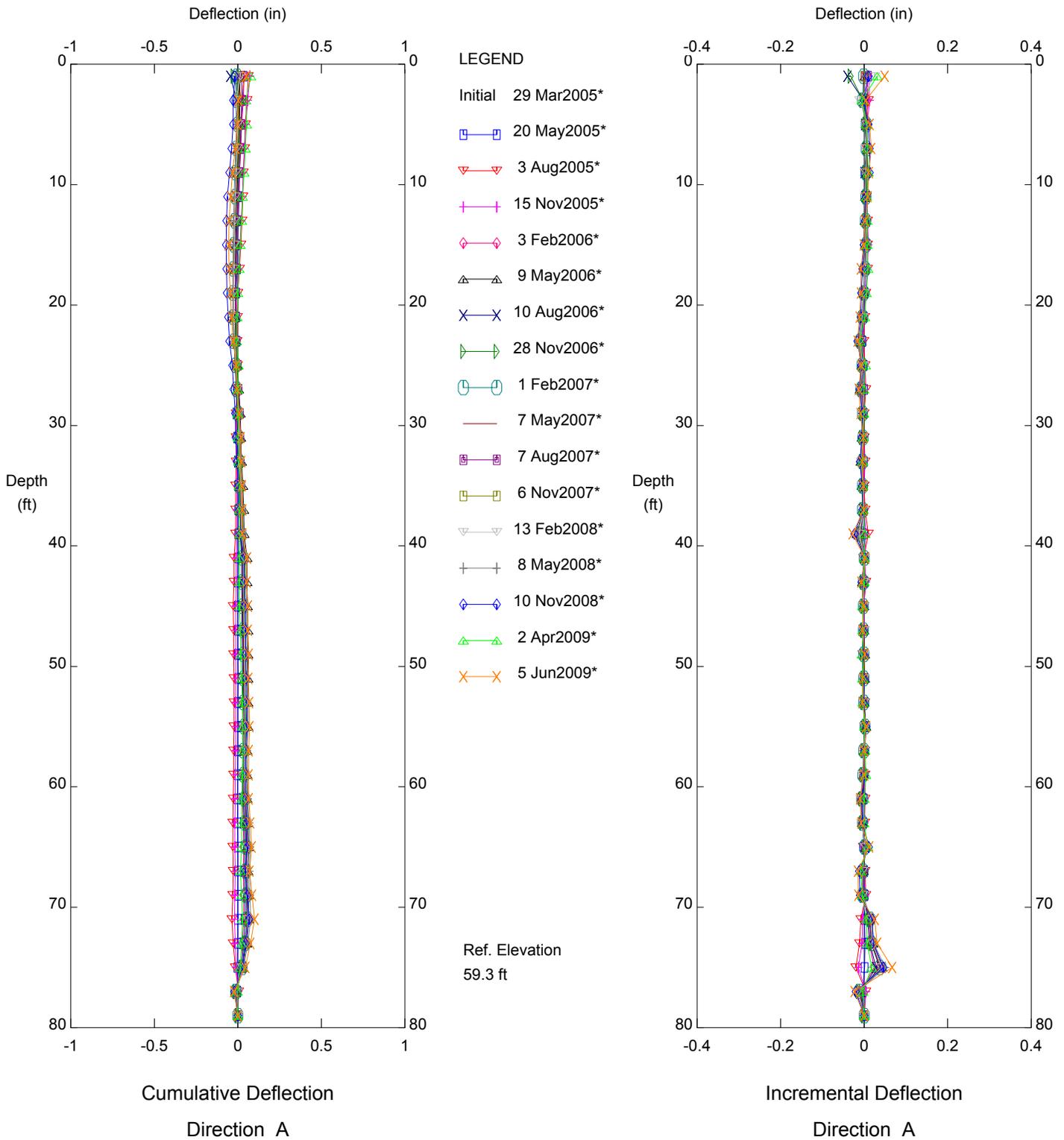
Depth of readings = 78 ft

Azimuth = 176

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



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MALIBU ROAD, Inclinometer SI-5

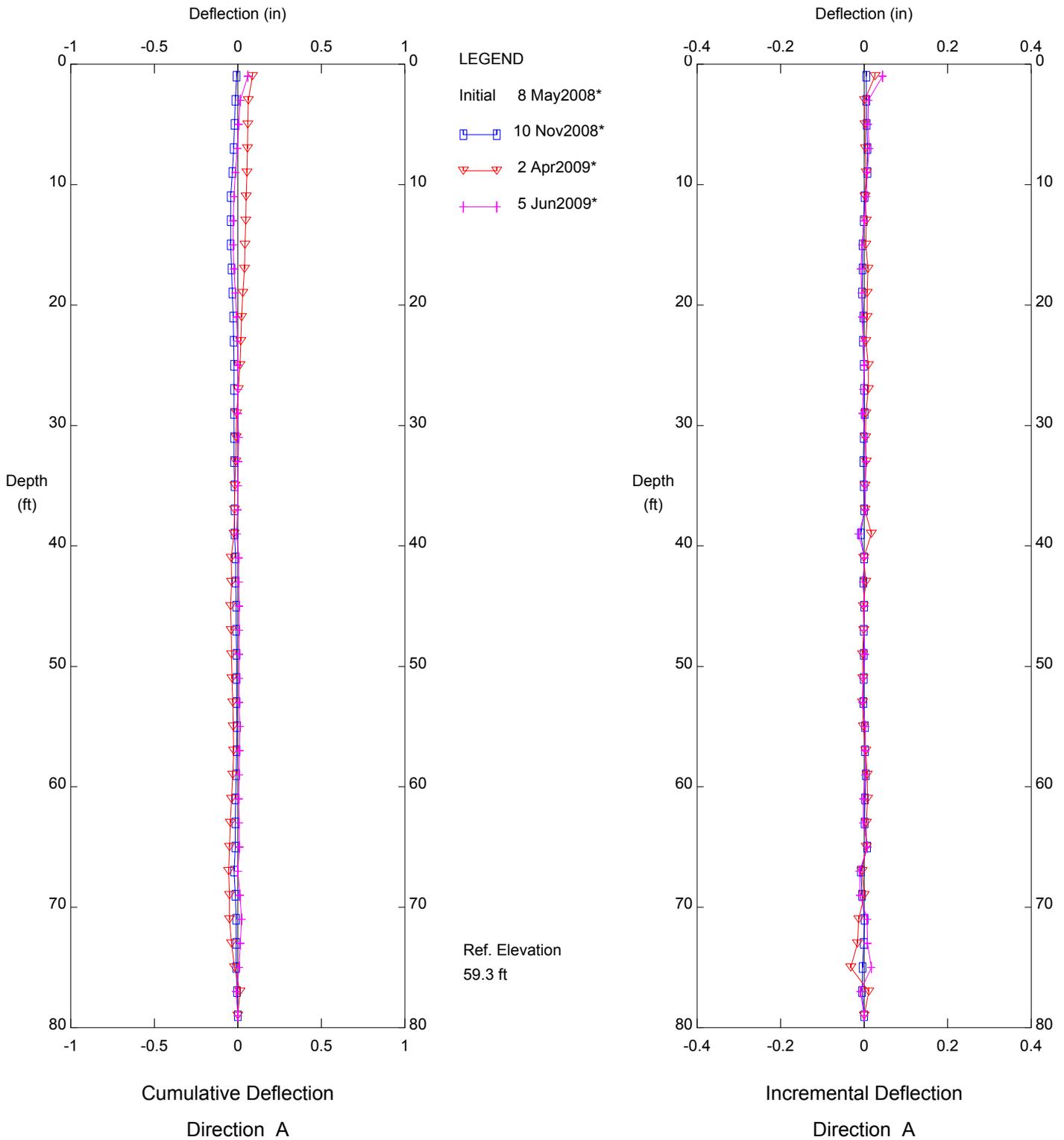
Depth of readings = 78 ft

Azimuth = 176

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



Fugro West, Inc. - Ventura, CA



MALIBU ROAD, Inclinometer SI-5

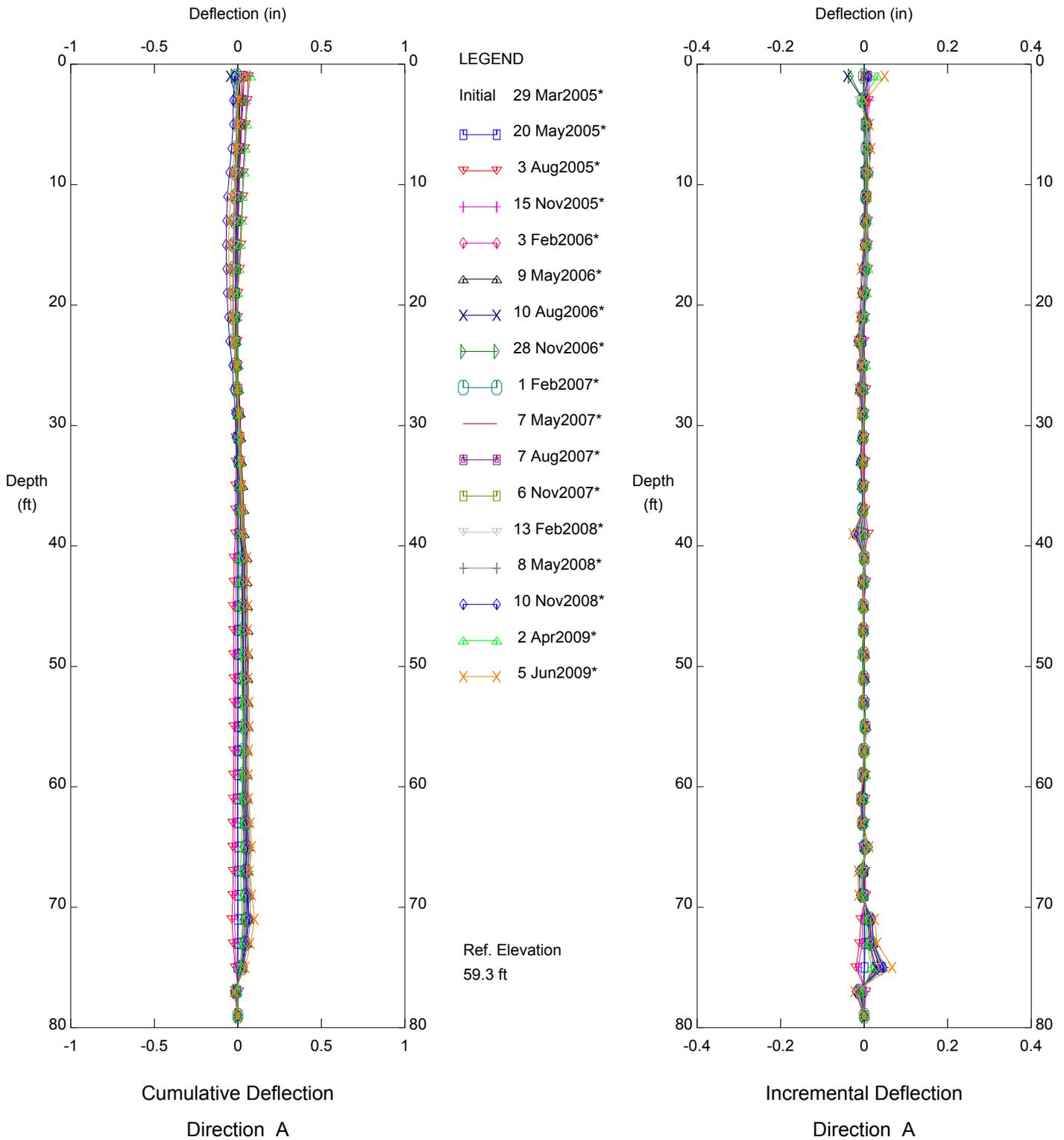
Depth of readings = 78 ft

Azimuth = 176

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



Fugro West, Inc. - Ventura, CA



MALIBU ROAD, Inclinometer SI-5

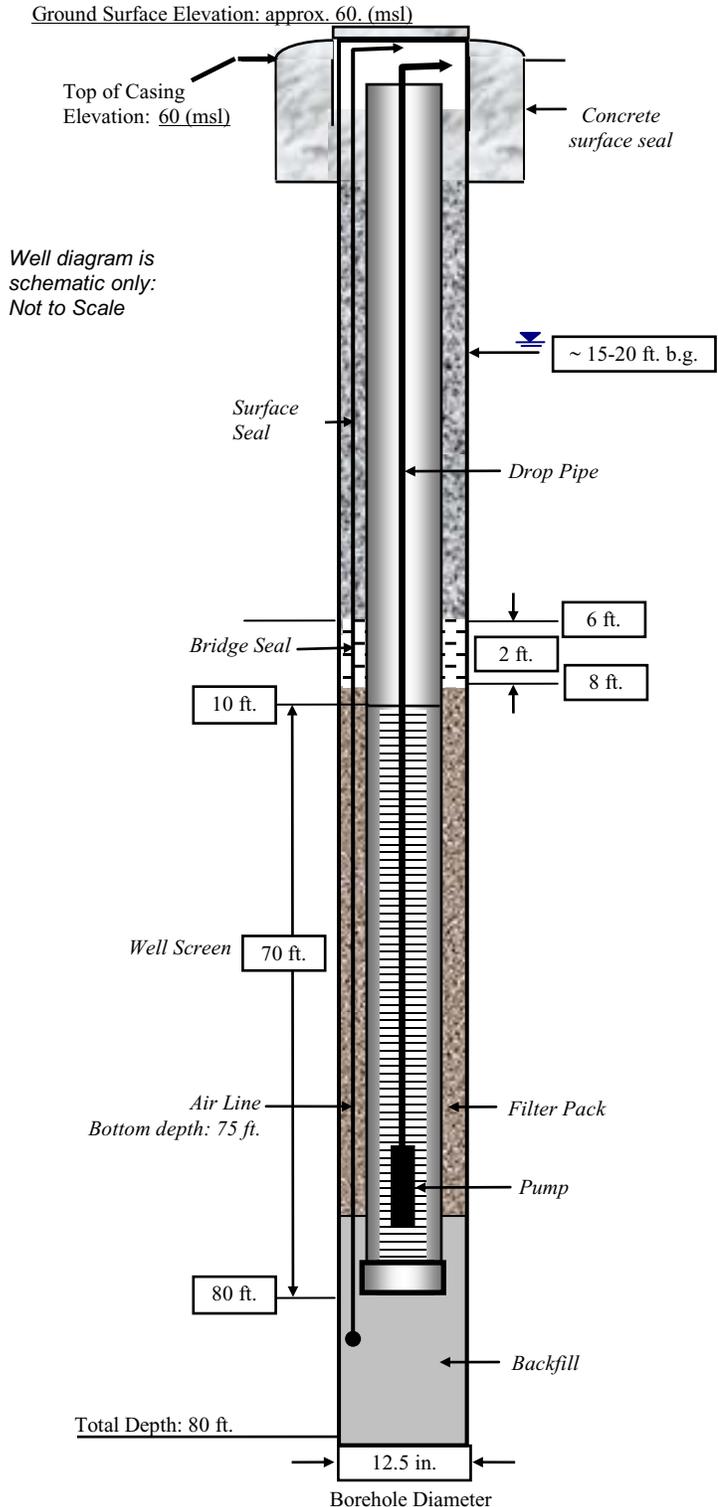
Depth of readings = 78 ft

Azimuth = 176

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

APPENDIX D
REPLACEMENT DEWATERING WELL

Well No.:	Project: City of Malibu – Malibu Road Landslide Assessment District
Project No: 3399.004	Site Address: , Malibu, CA



WELLHEAD SURFACE COMPLETION:

Material/Type: Christy® traffic-rated vault
 Size: 17in x 30in. x 18in vault

SURFACE SEAL:

Material: Class I/II Portland Cement with 5% Bentonite

BRIDGE SEAL:

Material: Bentonite Pellets
 Length: 2 foot

FILTER PACK:

Material: # 3 Monterey Silica Sand
 Interval: 10 - 80 feet

WELL CASING:

Material: SCH 80 or SDR 17 PVC
 Diameter: 6 inch
 Length: 10 feet
 Joint: Flush thread

WELL SCREEN:

Material: SCH 80 or SDR 17 PVC
 Diameter: 6 inch
 Slot Size: 0.040 inch
 Length: 70 feet
 Joint: Flush thread

BOTTOM CAP:

Type: 6 in. PVC slip - cement weld

BACKFILL:

Material: n.a.
 Interval:

DROP PIPE:

Type: 1 in. dia Certalock PVC

PUMP:

Type: _____
 Intake Depth: ft.

AIRLINE:

Type: ¼ in. HPDE Tube
 Bottom Depth: 45 ft.

WELL CONSTRUCTION DIAGRAM