FY21/22 Maintenance and Monitoring

AD98-3, Malibu Road

City of Malibu, California

Yeh Project No.: 220-278

November 14, 2022

Prepared for:

City of Malibu
23825 Stuart Ranch Rd.
Malibu, California 90265
Attn: Mr. Arthur Aladjadjian

Prepared by:

Yeh and Associates, Inc.
56 East Main St., Suite 104
Ventura, California 93001
Phone: 805-481-9590

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

56 E. Main Street, Suite 104
Ventura, CA 93001
(805) 481-9590, ext. 271
www.yeh-eng.com

November 14, 2022

Project No. 220-278

City of Malibu
23825 Stuart Ranch Rd.
Malibu, California 90265

Attn: Mr. Arthur Aladjadjian, Public Works Superintendent

Subject: Annual Monitoring and Maintenance Report FY21/22, City of Malibu Assessment District 98-3, Malibu Road, Malibu, CA

Dear Mr. Aladjadjian:

Yeh and Associates, Inc. is pleased to submit this monitoring and maintenance report FY21/22 City of Malibu Assessment District AD-3, Malibu Road in Malibu, California. This report was prepared in accordance with our Agreement for Professional Services, dated June 22, 2020 between the City of Malibu and Yeh and Associates, Inc. This report provides geotechnical an annual summary of monitoring and maintenance for the project over fiscal year July 1, 2021 to June 30, 2022.

The geotechnical services consisted of monitoring and maintenance, data management, public outreach, reporting, and capital improvement planning. A map showing the location of the maintenance and monitoring facilities are provided on Plate 1. Plate 2 provides a summary of maintenance activities performed during the monitoring year.

We appreciate the opportunity to be of service. Please contact Loree Berry at 805-289-9590 x271 or Lberry@yeh-eng.com if you have questions or require additional information.

Sincerely,
YEH AND ASSOCIATES, INC.

Nick Simon
Project Geologist

Loree A. Berry, PE
Senior Project Manager

REGISTERED PROFESSIONAL ENGINEER
LOREE A. BERRY
No. 73221
Exp. 12-31-22
CIVIL
STATE OF CALIFORNIA

Table of Contents

List of Figures

List of Tables

List of Plates

Plate No.

List of Appendices

Page No.

1. Purpose and Scope of Study

Yeh and Associates (Yeh) was retained by the City of Malibu (City) to perform maintenance and monitoring of the existing geotechnical instrumentation and dewatering facilities within the City of Malibu's Malibu Road Landslide Assessment District, 98-3. The project location is shown by the polygon on Figure 1. This report presents monitoring results, a maintenance summary, and facilities status for the monitoring year July 2021 through July 2022 (monitoring year). Yeh monitors groundwater levels, surveys slope inclinometers, and measures the dewatering flow from dewatering wells and horizontal drains. Yeh also oversees and maintains function of the monitoring and dewatering facilities. Plate 1 shows the approximate locations of the specific assessment district facilities. Table 1 summarizes the equipment inventory and the approximate frequency of monitoring and maintenance over the monitoring year. Plate 2 and Section 4.0 of this report and provides detailed summary of the maintenance activities performed during this monitoring period.

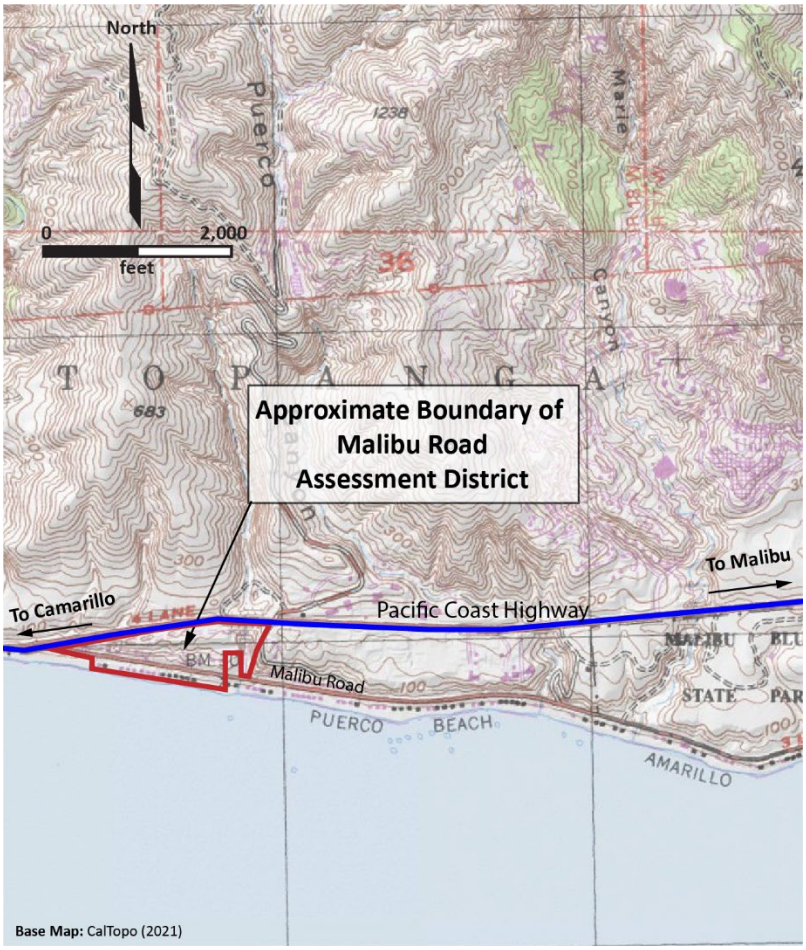


Figure 1: Project Location Map

Table 1. Summary of Annual Monitoring and Maintenance

Type of Monitoring Instrument or Dewatering Device	Number of Locations	Brief Description	Monitoring Frequency	Maintenance Effort[2]
Standpipe piezometer	7[1]	2.75-inch PVC, or other casing, used to measure depth to groundwater using electric sounder or by a transducer/datalogger	monthly; hourly data from pressure transducer	low
Inclinometer survey casings	5[1]	2.75-inch diameter grooved casings made of PVC, used to survey for shear displacement by an inclinometer probe	quarterly	low
Dewatering wells	14	6-inch or 12-inch diameter steel or PVC casings equipped with 0.5 to 1/3 HP submersible pump and connected to electrical controls, pumped water flows through meter and into conveyance piping to discharge	monthly	high
Horizontal Drains (hydraugers)	19	1-inch to 1.5-inch perforated PVC casings drilled slightly higher than horizontal into the slope along Malibu Road for up to 180feet and used to drain groundwater that intercepts the casing. Flow can be measured along Malibu Road before it flows to discharge	monthly	medium
Big Rock Mesa Rain Gauge #1239	1	Documented Rainfall, Data obtained from Los Angeles County Public Works	monthly	N/A

Notes:
[1] - SI-5 and SI-6 are used as both inclinometers and standpipe piezometer.
[2] - maintenance effort (generalized): "high" – services monthly, "medium" – services quarterly, "low" – services annually

2. MONITORING

The following provides the result of monitoring the water level in standpipe piezometers and the results of inclinometer surveys performed. For the purposes of discussion and context throughout the report, the monitoring results are discussed with respect to two areas within the 1978 landslide boundaries; Malibu Road and Bayshore Drive:

- **Malibu Road:** The southern portion of landslide including Malibu Road and the toe of the 1978 landslide.
- **Bayshore Drive:** The northern portion of the landslide above Malibu Road and including Bayshore Drive and the 1978 headscarp.

2.1 GROUNDWATER LEVELS

Groundwater levels were measured approximately monthly in 7 standpipe piezometers shown on Plate 1. Pneumatic piezometers were installed with some of the inclinometers up until 1998. They were measured intermittently to assess for perched water conditions. Some of the existing pneumatic piezometers no longer function and the reliability of some of the remaining locations are not certain. Pneumatic piezometers were not measured during the monitoring year. Appendix A includes historic pneumatic piezometer results

Groundwater level data and hydrographs for individual standpipes are presented in Appendix A for the FY21/22 monitoring year. Water levels are acquired by lowering an electric probe into the standpipe to contact the groundwater surface and manually record the depth to water.

Table 2 summarizes the average groundwater levels over the monitoring year for standpipe water levels along Malibu Road and along Bayshore Drive and the change from the prior monitoring year.

Table 2: Summary of Average Groundwater Elevations

Area Averaged	Total No. of Standpipes Monitored	2021-2022 Average Groundwater Elevation (ft)	Change in Average Groundwater Elevation from Prior Monitoring Period (ft)	2021-2022 Average Peak Groundwater Elevation (ft)	Change in Average Peak Groundwater Elevation from Prior Monitoring Period (ft)
Malibu Road	5	6.4	-0.2	7.0	+.02
Bayshore Drive	2	26.5	-.08	27.6	-.02

2.1.1 Malibu Road Area

Five standpipes are in use for groundwater level monitoring in the Malibu Road area. The average groundwater level for the Malibu Road area remained relatively unchanged relative to the prior monitoring year, decreasing by 0.2 feet. Groundwater levels measured within individual standpipes maintained consistent with some variations in response to rainfall and tidal influence.

2.1.2 Bayshore Drive area

Two standpipes are in use for groundwater level monitoring in the Bayshore Drive Area. The average groundwater level for the Bayshore Drive Area decreased by 0.2 feet since the prior monitoring year. The decrease reflects water level changes in SI-5 which had shown an increasing trend since March 2019 until approximately July 2020. During the FY21/22 monitoring year, the water level in SI-5 decreased by 3 feet with a decreasing trend since July 2020 except for an increase in December 2021 to January 2022. Water levels in SI-6 remained relatively unchanged. Yeh is coordinating additional data collection and troubleshooting activities to evaluate the reason for the rise in water level in SI-5.

2.2 Slope Inclinometers

2.2.1 Summary of Slope Inclinometer Monitoring Events

Page B-1 provides a historic summary of the project inclinometers. Appendix B provides cumulative and incremental profile change plots in the A and B directions for each of the inclinometers surveyed over the FY21/22 monitoring year. Due to use of a replacement inclinometer cable starting in Q1 of 2021, new baseline surveys were performed for each of the inclinometer locations in March of 2021 except for SI-2a and SI-4a which were baseline surveyed in August 2021. Inclinometers were assessed for distinct shear-type movement. The inclinometers did not display shear-type movement over the monitoring year.

3. WATER BUDGET TRACKING

3.1 RAINFALL DATA

Yeh obtained rainfall data for the 2021-2022 monitoring year from the Big Rock Mesa Rain Gauge #1239 operated by the Los Angeles County Department of Public Works. Plate 3 - Rainfall Graph displays historical monthly and average annual rainfall for the Malibu Road area from October 1968 through September 2022. Prior to 1984, rainfall data was obtained from the Carbon Canyon Rain Gauge #447C and after 1984 from the Big Rock Mesa Rain Gauge #1239. Recorded rainfall for the Malibu Road area over monitoring year totaled 12.52 inches, which is 2.8 inches below the 54-year area average of 15.3 inches. Approximately 10.20 of the 12.52 total inches were received in a series of rain events in December 2021 with a single event on December 29 and 30 that recorded 5.71-inches. Other rainfall events included 1.34-inches of rainfall in March with all other months receiving a total of from 0 to 0.6 inches. Plate 5 –Groundwater levels, Dewatering and Rainfall shows annual rainfall deviation from the 54-year mean and compares rainfall changes to total dewatering output and the annual mean high groundwater levels for each area. Dewatering production typically reacts to rainfall totals. During the 2021-2022 monitoring year, total dewatering production decreased in response to continued below-average rainfall and due to lowered dewatering production during well maintenance.

3.2 DEWATERING

Yeh tracks dewatering production for pumping dewatering wells installed throughout the assessment district and gravity flow horizontal drains (hydraugers) installed in the bluff along Malibu Road. During the 2021-2022 monitoring year total dewatering production from all facilities averaged 579 gallons per day (gpd) a decrease of 40-percent from the previous monitoring years' total average production of 966 gpd. These values represented a decrease of 71-percent less than the historical production average of 1977 gpd calculated from 1991 to present and 89-percent less than the maximum average annual production of 5,369 gpd recorded during the 1994-1995 monitoring year.

3.2.1 DEWATERING WELL PRODUCTION

Yeh performed monthly monitoring for discharge rates of the 14 active district dewatering wells. Well production is measured approximately monthly for each well by reading flow totalizers that are installed along the discharge line. Production data and well status for individual wells is included in Page C-1 through C-3. A graph showing total production since 1992 is included on Plate 4.

During the 2021-2022 monitoring year, the average total well production was 497 gpd which is 35-percent lower than last year's average production of 770 gpd and 37-percent less than the historical production average of 1,198 gpd calculated from 1991 to present and 83-percent less than the maximum average annual production of 2,930 gpd recorded during the 2004-2005 monitoring year.

Well production typically varies in response to rainfall totals. The dewatering well production decrease over this monitoring year is consistent with the historically low rainfall totals and extended drought conditions at the project. In addition to continued drought conditions, dewatering wells W-3, W-4, W-5, W-6, W-9 and W-10 have recorded periods of no production due to maintenance and repairs as detailed on Plate 2.

3.3 HYDRAUGER PRODUCTION

Hydrauger production is measured directly from a sampling port installed on each hydrauger. Yeh performed monthly monitoring to measure flow from 19 hydraugers, of which only three to four locations have recorded consistent flow in recent years. Most of the hydraugers flow intermittently in response to rainfall. Production data and status for individual hydrauger is included in Appendix C. A graph showing total hydrauger production since 1992 is included on Plate 4.

During the 2021-2022 monitoring year, the average monthly hydrauger production was 83 gpd which is approximately 58-percent less than last year's average monthly production of 196 gpd and 89-percent less than the historical production average of 777 gpd calculated from 1991 to present and 98-percent less than the maximum average annual production of 3,925 gpd recorded during the 1994-1995 monitoring year. Over the monitoring year, 76-percent of all hydrauger production was from 3 hydraugers with four other hydraugers producing intermittently. Hydrauger production was highest in January in response to December rainfall. The decrease in average annual hydrauger production is consistent with historically low annual rainfall. Decrease in flow may also be due in part to degradation, clogging by soil and mineralization of the hydraugers; however, this is difficult to assess given the concurrent ongoing drought conditions.

4. MAINTENANCE AND CAPITAL IMPROVEMENTS

A summary table of the maintenance and capital improvement activities performed over this monitoring year is provided on Plate 2. Typical maintenance activities to dewatering wells include assessing and replacing or repairing dewatering well pumps, well electronics and well controls; Typical maintenance to hydraugers included PVC repairs within the conveyance piping for discharge. Capital improvements include replacement and rehabilitation of existing facilities and special projects to improve the monitoring and maintenance capabilities.

5. EMERGENCY SERVICES

On the evening of January 6, 2021 an uncontrolled discharge from a watermain break near culvert MTD-10 caused erosion and partial slope failure from MTD-10 westward approximately 100 feet. The waterline is owned and maintained by Los Angeles County Waterworks District 29. Yeh was contacted by the City on January 7, 2021 and dispatched personnel onsite on January 7 and 8 to investigate potential impacts to district facilities. Yeh personnel surveyed slope inclinometers and did not

observe shear type movement. Yeh personnel noted that several district facilities were damaged or buried and after the event, maintained communication with the City and Water District to confirm repairs and recovery of the impacted assessment district facilities were completed. It should be noted that the slope behind MTD-10 and approximately 100 feet west remains in an over-steepened condition by the erosion and the slope may be susceptible to additional or more frequent erosion.

6. Additional Observations and Monitoring

- Rainfall totals for the 2021-2022 monitoring year were below average extending drought conditions.
- Yeh installed PVC sounding tubes in dewatering wells W-14 and W-11 and are recording water level data at least hourly with a downhole pressure transducer. That data will be used to evaluate pump cycle timing, drawdown, and recharge, troubleshooting groundwater conditions, and improve dewatering efficiency. The findings will be documented in future reports.
- Site reconnaissance and facility inventory was performed following the December 2021 storm events. The following conditions were observed, and mitigation options are being considered for capital improvement programming:
    - A storm drain near 25325 Bayshore Drive was apparently clogged and as a result, storm water and mud and flowed over the roadway and several inches of mud was deposited on the street from near the storm drain to approximately 300 feet west. The flow continued over the roadway and onto the vacant lot west of 25325 and caused erosion and piping through existing rodent burrows along the southern edge of Bayshore Road. Additional reconnaissance revealed that the likely source of the mud was from erosion and debris flows originating on slopes on the north side of Highway 1 and flowing south under Highway 1 through an existing culvert until reaching the occluded storm drain on Bayshore Drive.
    - Ground cracks were observed near the top of the western construction access road leading to the vacant lot west of 25325 Bayshore Drive. The cracking was monitored approximately weekly and then twice a month for 4 months and the area is now observed during scheduled monthly instrument readings. The cracking appears to be limited to the construction access road, which is believed to consist of uncontrolled fill.
- The slope behind MTD-10 and approximately 100 feet west remains in an over-steepened condition by the erosion and the slope may be susceptible to additional or more frequent erosion.

7. Recommendations for Maintenance and Capital Improvements

- A modern form of repeatable surface survey should be re-introduced and continued for the project as a consistent means to observe and evaluate potential land movement throughout the extent of the assessment district area and more specifically in-between inclinometer casing locations.
- Plan and design for stormwater improvements to reduce stormwater and debris infiltration onto the undeveloped ground between Malibu Road and Highway 1.

- Coordinate a solution to repair or replace the obstructed and damaged storm drain on Bayshore Drive.
- Replace Inclinometer SP-3.
- Upgrade dewatering well flow meters with near real-time data transmitting capability.

8. 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. (2019), "Annual Assessment District No. 98-3 (Malibu Road) FY 2019-2020," dated June 26.

Fugro USA Land, Inc. (2020), "Annual Report, July 2019 through June 2020 Malibu Road Landslide Assessment District, Malibu, California," dated August 2020.

_____ (2019), "Annual Report, July 2018 through June 2019 Malibu Road Landslide Assessment District, Malibu, California," dated November 2019.

_____ (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.

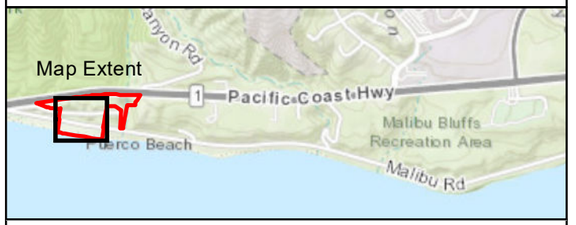
Leighton and Associates, Inc. (1979), "Final Report, Geotechnical Investigation of Landslide Conditions Affecting Puerco West Area, Malibu, California," dated September 4.

Yeh and Associates, Inc. (Yeh) (2022), "Annual Report, July 2020 through June 2021, Malibu Road Landslide Assessment District, Malibu, California," dated June 2022.

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT MALIBU, CALIFORNIA

MONITORING INSTRUMENTATION AND DEWATERING FACILITIES MAP

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services



Bayshore Drive

Malibu Road

HD-1 HD-2 HD-3 HD-4 HD-5 HD-6 HD-7 HD-8 HD-9 HD-10 HD-11 HD-12 HD-13 HD-14 HD-15 HD-16 HD-17 HD-18 HD-19 HD-20 HD-21 HD-22 HD-23

W-3A W-13 W-2A PZ-A W-3 MTD-9 PZ-B SI-4 SI-4A W-10 W-4 PZ-C W-9 W-5 SI-2A SI-2 SI-3 PZ-D W-6 MTD-10 SI-1 SI-1A PZ-E NHD-A NHD-B NHD-C W-8

SI-6 W-12 W-14 SI-5 W-11 NW-1 NW-2 NW-3

- Dewatering Well
- Dewatering Well (out of service)
- Slope Inclinometer/Standpipe Piezometer
- Slope Inclinometer/Standpipe Piezometer (standpipe only, not usable for inclinometer)
- Standpipe Piezometer
- Standpipe Piezometer (buried)
- Pneumatic Piezometer
- Pneumatic Piezometer (nonfunctioning)
- Nonproducing Hydrauger
- Private Hydrauger
- Producing Hydrauger
- Hydrauger (unable to locate)
- Hydrauger Installed Length
- Storm Drain Outfall
- District Boundary
- Recent Landslide of 1978 (Boundary from Leighton, 1979)
- Ancient Landslide (Boundary from Leighton, 1979)

N

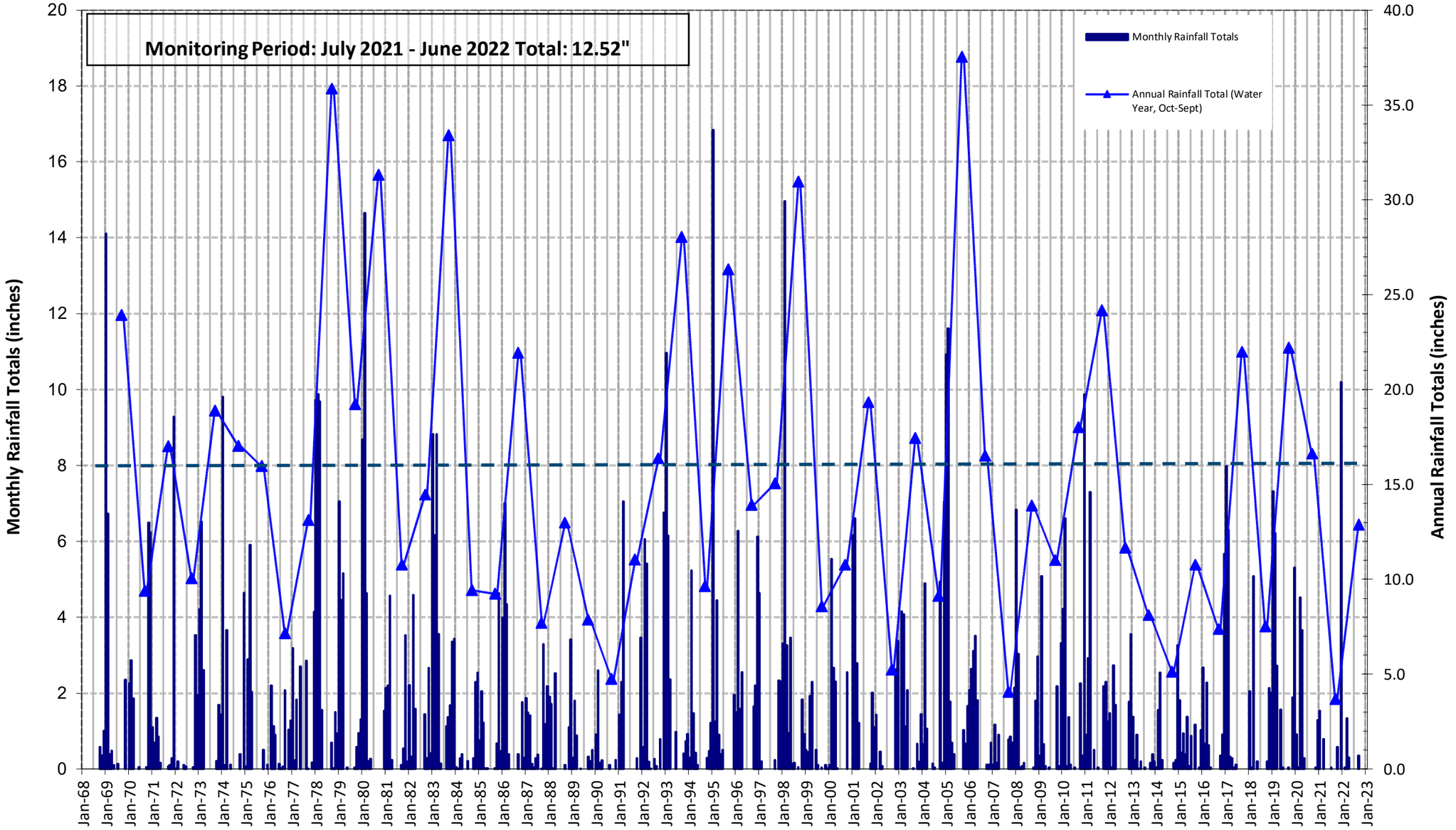
SCALE 1:800

100 50 0 100 Feet

DATE:	PROJECT NUMBER:	PLATE:
1/26/22	220-278	1
DRAWN BY:	APPROVED BY:	
MB	NS/LB	

Document Path: X:\Projects\2020 Projects\220-278 Malibu Road\MR Layout.mxd

ROW ID	FY21/22 MAINTENANCE SUMMARY Date Entered	Facility	Description/Observation	Status or Resolution
		DEWATERING WELLS		
1	Jul-20	W-12, W-14,	above ground discharge lines, leaking at W-14 and W-12, both repeatedly disconnected or broken, keep getting run over, black tubing decomposing.	pending, awaiting status of CMP repair in same area. Received quotes from Burns Pacific 1/31/21 specific to the W-14 and W-12 discharge lines. Considered for 22/23 monitoring year.
2	Jul-20	W-14	possible low production relative to nearby water level, no access to measure water level	Assessed by CP 10/16/20, possible that water level is near pump intake, pump intake depth unknown, airline measured 0 psi. Pump removed by Coast 12/1/20, pump replaced 12/9/20 and installed 1-inch sounding tube.
3	Oct-20	main electrical panel for all well control panels	Panel box is leaning forward and being pushed off base by above ground water line. Needs to be relocated or modified to avoid eventually shearing electrical conduit from panel to wells and from electrical pole source to panel.	11/24/20: Burn Pacific excavated soil around box and removed vegetation to access panel. Currently coordinating with BP and Quest for repair or relocation options. Also coordinating with LADWP Waterworks District 29 to ensure box/panel repairs or relocation do not impact stability of above ground water line which may now be partially supported by the box.
4	Jul-20	Well control Boxes W-6 and W-8	Partially buried by slope soil creep and covered with vegetation, unable to routinely access panels for maintenance, boxes at risk of being pushed off pedestal by soil creep, boxes at risk of corrosion where in contact with soil and vegetation	12/15/20 Onsite with BP to assess and scope and record measurements 8/16/21-8/17/21: BP removed vegetation, excavated soil around control boxes and constructed protection consisting of 8x8 lumber doweled into ground around boxes
5	Feb-21	W-9	low / not producing / no power at pump	8/2/21: CP replaces pump saver with new pump saver 8/19/21: Re-assessed by Yeh and noted that the pump saver switches pump off instantly, unable to calibrate 8/20/21: Re-assessed by CP 8/20/21 who also noted the new pump saver could not be calibrated, ordered new pump saver 8/25/21: CP replaced pump saver again, well is pumping with normal Amps, return to service.
6	Mar-21	W-6	low production / stopped production noted after 3/2021 monthly check	3/19/21: assessed by Yeh, no power to pump 3/20/21, assessed by CP, circuit breaker in well control panel has failed and cannot be reset and pump saver has failed and need to be replaced. Access to well panel is too difficult to work, will suspend repairs until well panel is cleared and protection constructed 8/17/2021: BP constructed, excavated and cleared vegetation and constructed well control protection panel. 9/8/2021: CP replaced circuit breaker and pump saver, pump is running but very high Amps (21 Amps) with no production, will need to pull/replace pump.(New item see line 7)
7	Sep-21	W-6	After replacing circuit breaker and pump saver, pump is running at High amps with no production< CP to replace pump/motor	12/9/2021: CP removed pump. 12/13/2021: CP installed new pump and installed 1-inch sounding tube. Well returned to service 12/26/2021: Yeh performed post pump replacement assessment noted buzzing noise from electrical panel (new item see line 17) 1/12/22: Yeh post-repair assessment, well pump is operating normally, however discharge line is leaking beneath pavement topping out of vault and flowing overland to storm drain
8	Jan-21	W-10	low/ no production	Well re- assessed by Yeh 8/19/21, pump is running normal amps but meter not moving and no discharge heard, WL @16.66' TOC. assessed by CP 8/20/21, disconnected discharge and observed no flow, suspect drop pipe is broken, will need to remove, inspect and replace. Pump removed by CP 9/8/21... pump is physically broken will need to be replaced. Video logged by Well Rehab Services 10/14/21. Pump replaced 12/10/21, sounding tube installed.
9	Jan-21	W-8	low/ no production	1/21: well assessment by Yeh after power restored by Edison in 12/3/2020. Assessment shows no production, pump shuts off after seconds, unable to measure Amps. 8/19/21 and CP 8/20/21: Assessed by Yeh after BP cleared vegetation and excavated well panel. Water level is at or below pump intake or well is dry, based on reported pump elevations. Consider removing pump and video logging well for possible rehab in FY 22-23.
10	Jan-21	W-4	not pumping, no power	7/8/21: Assessed by CP , well has power, is running at 21 amps, 15 amp circuit breaker not turning pump off, pump saver not turning off pump, pump/motor and electronics need to be replaced 8/12/21: CP removes pump 8/19/21: WRS video logged well 10/4/21-10/5/21: WRS 2 days of chemically treating and scrubbing/swabbing well casing for biologic growth and mineral scale and hydro Vacced debris form bottom of well. 12/9/21: CP installed new pump/ motor, drop pipe, 1" sounding tube and well panel electronics. Well returned to service
11	Jul-21	W-3	not pumping, no power	7/22/21 - assessed and returned to service by CP, circuit breaker on main Edison panel was off, does not appear to have been tripped by well. Production and recharge assessed by Yeh 8/19/21, timer changed from 90 to 30 minutes. Will continue to monitor.
12	Jul-21	W-4	bolts holding well cover broke during well repairs	11/15/21: repaired by Burns Pacific, vault cover rotated 90 degrees and new holes are drilled into concrete collar, installed threaded bushings and new bolts.
13	Sep-21	W-6	Burns pacific informed by resident that well cover on W-6 is open and they can see down into well, appears to be inner well cover is missing and had just had a steel plate laid over it, but not attached to anything	11/15/21: emergency/temporary repair, BP welds plate over missing part of well cover. Will need to fabricate replicate well access portion of well cover
14	Sep-21	W-14	Ongoing low production. Transducer deployed in sounding tube 9/3/21 to 9/21/21. Noted poor well recharge on transducer data	10/2/21: CP removes pump 10/14/21: WRS video logged well to assess casing condition consulted with WRS regarding potential well rehab, based on casing condition scrubbing and swabbing are not recommended at this time. Yeh to continue assessment for low production 12/8/21: CP reinstalls the original pump
15	Oct-21	W-10	video log shows W-10 casing with mineralization, clogged screen	consider scheduling chem treatment and scrubbing for 22-23 FY
16	Nov-21	W-3	during monthly production noted no production	12/10/21 assess by CP, noted low WL. Will continue to monitor.
17	Dec-21	W-6	Yeh noted loud buzzing noise from pump electronics in well control box, appears to be the old (original 1980) pump controls, pump turned off pending assessment	12/29/2021: CP rewires pump controller and power to bypass old wiring. Return to service.
18	Jan-22	W-6	During poste -repair well assessment, Yeh observed water leaking form discharge line	1/17/22: Yeh with BP assess leak and existing vaults for estimate to repair discharge and replace vaults. Exposed and submerged wires in small vault will requires an electrician. Yeh is currently coordinating with BP and Quest Electric to repair leak and replace vaults during FY 22-23
19	Jan-22	eastern portion of slope	water main break at storm drain MTD-10 caused erosion and flooding from MTD-10 west approximately 100 feet of MTD 10	1/7/22: yeh onsite to perform inclinometer survey, measure water levels and assess facilities. 1/8/22 Yeh onsite for inclinometer resurvey assess facility damages, PZ-a, -c, -D are buried, well control panels W-6 and W-5 are buried, hydraugers HD -22, -23, -10 are undercut and unsupported. 1/22/22 Yeh assessed repairs made by Water district excavated and repaired buried and damaged facilities
		HYDRAUGERS		
20	Dec-21	Conveyance line flowing west into MTD-9	hydraugers flowing into this conveyance began showing flow backing up during monthly monitoring	1/25/22: Yeh excavated conveyance line to locate, assess and partially cleared clog 3/16/22: Yeh excavated, cut and removed approximately 10 feet of 4" conveyance line from west end of line and manually cleared clog, re- extended PVC discharge into MTD-9
21	Mar-21	HD-9	BP cut hydrauger HD-9 and conveyance line in March of 2020 to accommodate installation of well box W-4 protective structure. Repairs caused wells W-4 and 5 to flow into hydrauger HD-9 and back into slope.	8/17/21: BP realigned discharge and conveyance line so flow from wells no longer flows into HD-9
		INCLINOMETERS		
N/A	N/A	N/A	N/A	N/A

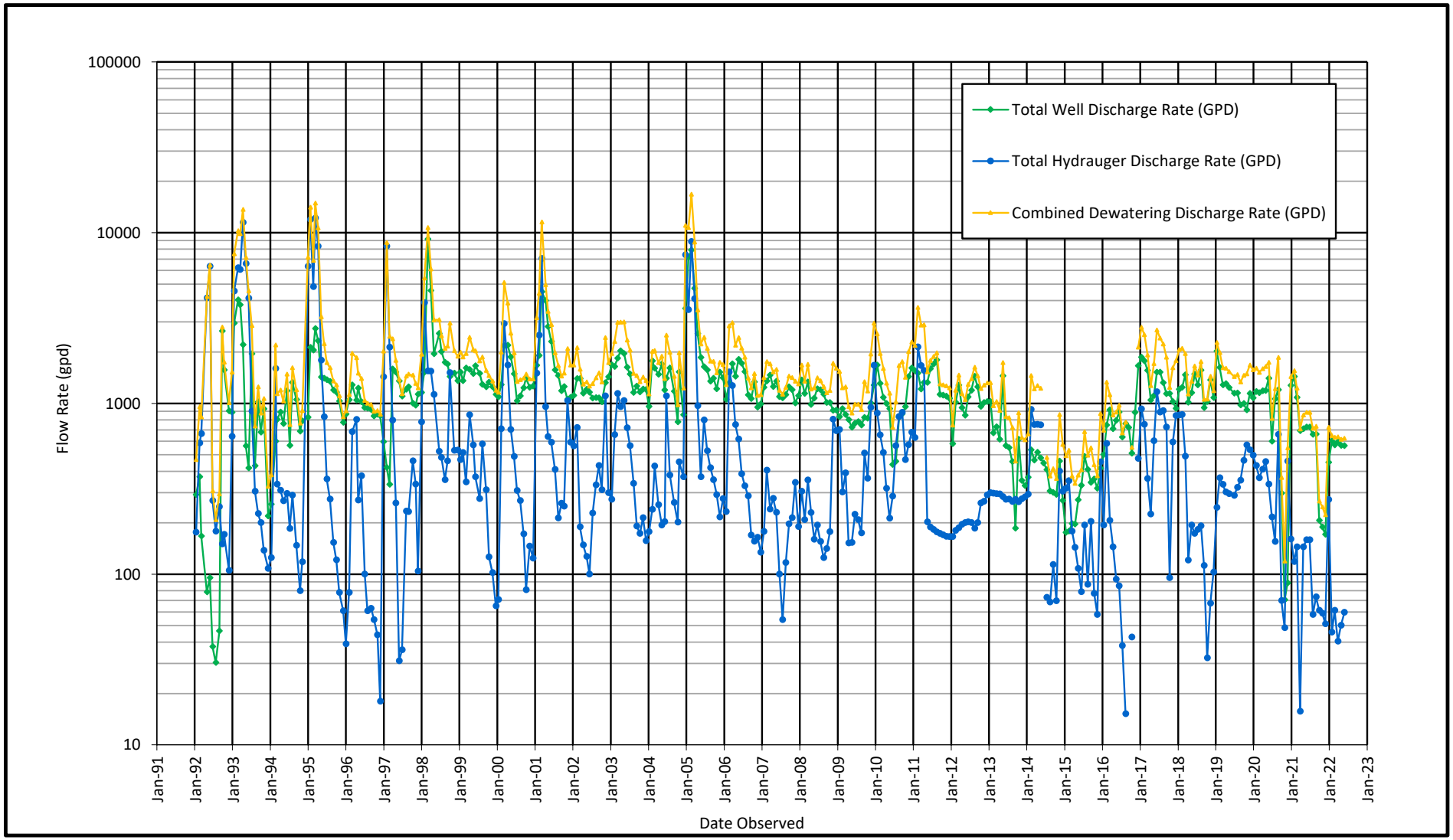


L.A. County Stations
(447C - Carbon Canyon: Oct '68 - Nov 1983
& 1239 Big Rock Mesa : Dec. 1983 - present)

RAINFALL GRAPH
Malibu Road Landslide Assessment District
Malibu, California

PLATE 3

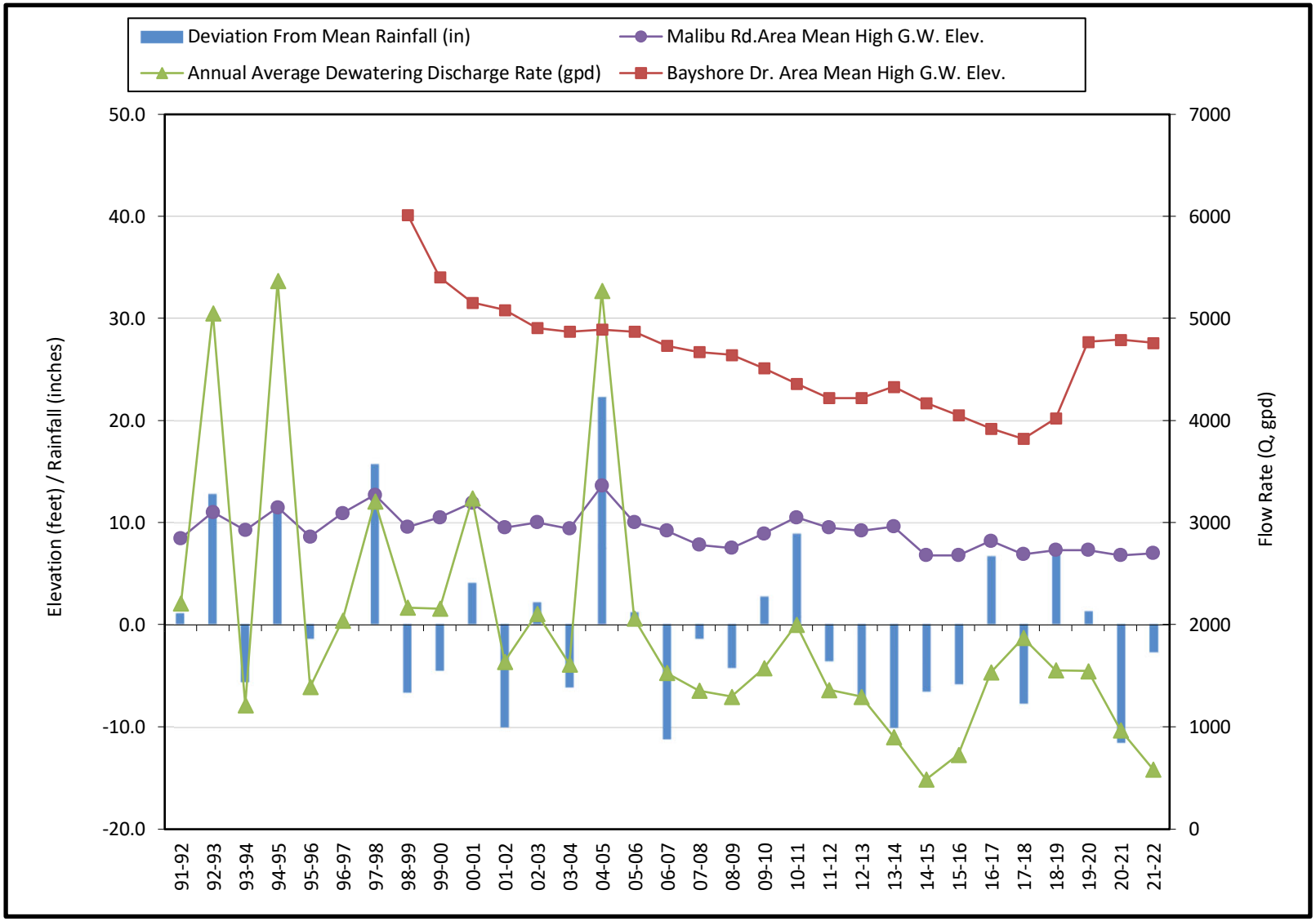
Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services



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

PLATE 4

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services



** 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 LEVELS

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

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	functioning as of 2020, not measured
SI-3*	20.0	20.3	49.8	-29.8	BYA	clogged
SI-4	22.0	18.9	43.9	-21.9	BYA	functioning as of 2020, not measured
SI-5 Tip 1	59.0	59.3	60	-1	BYA	functioning as of 2020, not measured
SI-5 Tip 2	59.0	59.3	40	19	BYA	functioning as of 2020, not measured
SI-6 Tip 1	57.0	58.0	60	-3	BYA	functioning as of 2020, not measured
SI-6 Tip 2	57.0	58.0	40	17	BYA	functioning as of 2020, not measured
SI-1A	20.0	20.0	50	-30	FUGRO	functioning as of 2020, not measured

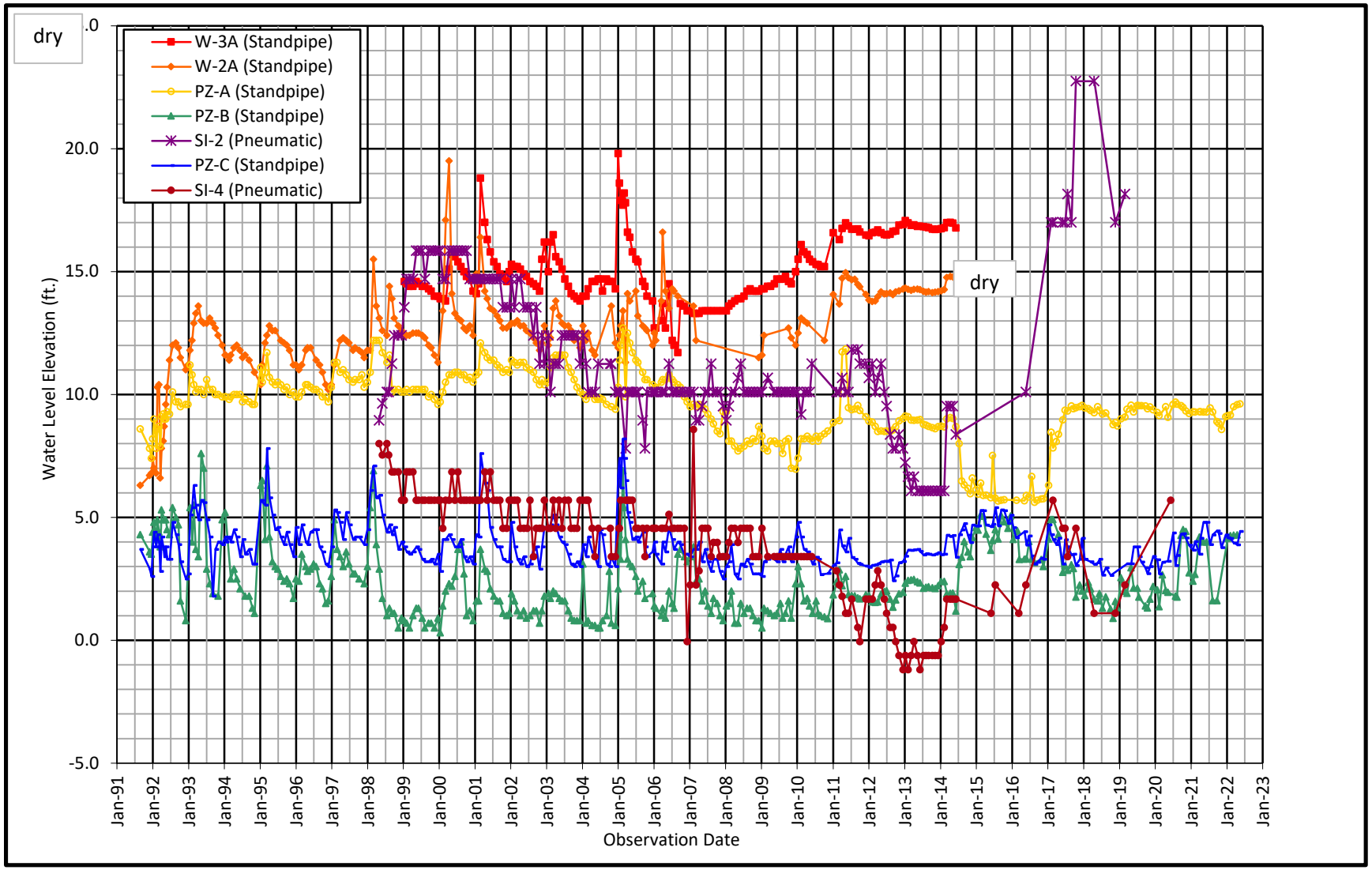
Note: SI-1 thru SI-4 were previously designated MR98-1 thru MR98-4
SI-5 and SI-6 were previously designated MR-5 and MR-6
* Peizometer not functioning

PIEZOMETER INFORMATION
Malibu Road Landslide Assessment District
Malibu, California

MALIBU ROAD LANDSLIDE ASSESSMENT DISTRICT - SUMMARY OF GROUNDWATER DATA

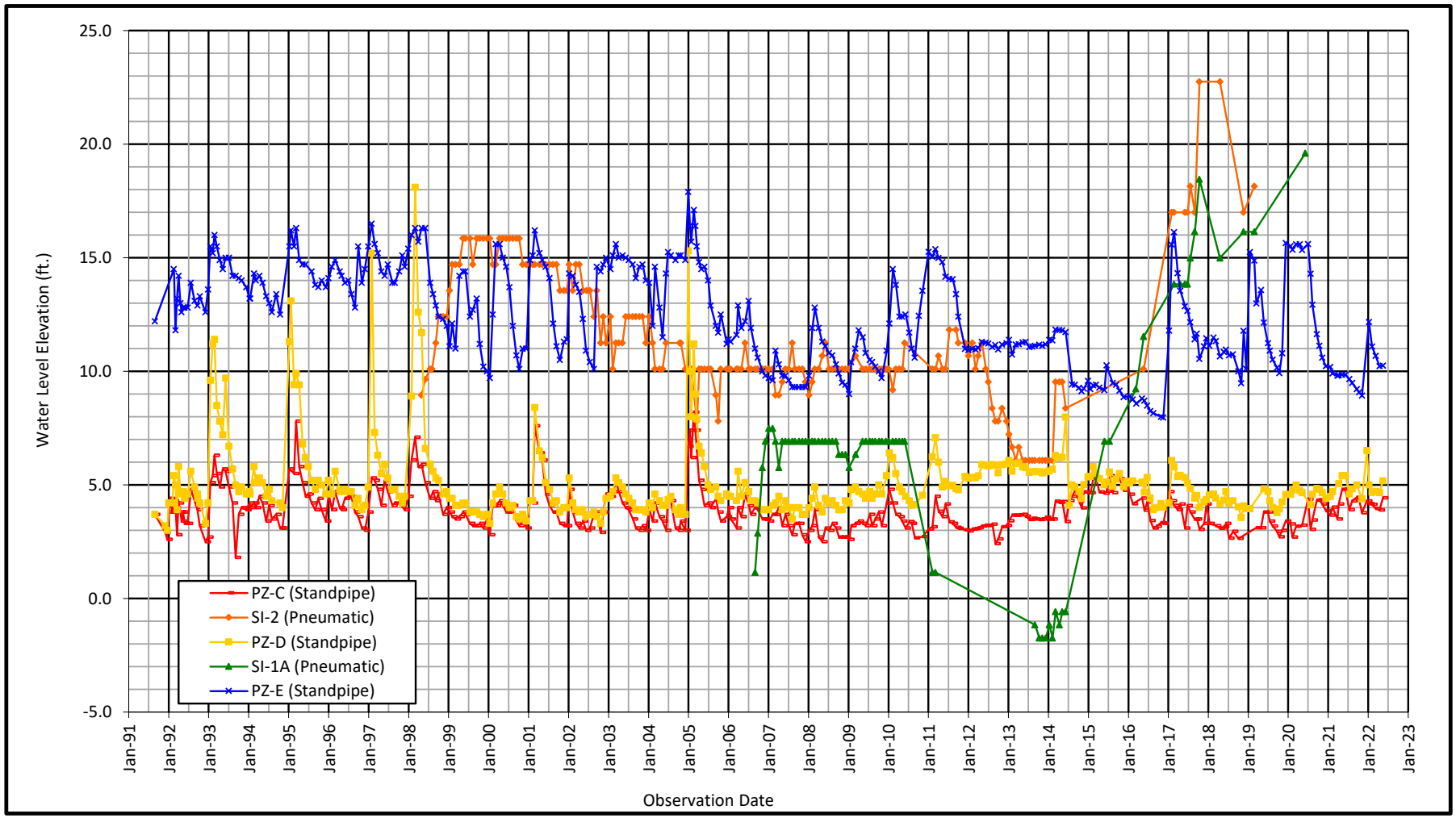
Standpipe / Piezometer I.D.		91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Mean '91-'22	Stand Dev.	21-22 vs. 97-98	21-22 vs. mean
MALIBU ROAD - Standpipe Piezometers																																				
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	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	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	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	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	9.4	9.2	*9.4*	*1.4*	*-1.9*	*-0.2*
	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	9.6	9.7	9.6	*10.3*	*1.4*	*-2.6*	*-0.7*
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	1.9	3.4	3.5	*2.5*	*1.1*	*0.1*	*1.0*
	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	2.7	4.5	4.3	*3.8*	*1.8*	*-2.6*	*0.5*
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	3.2	4.0	4.2	*3.9*	*0.6*	*-0.9*	*0.3*
	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	3.8	4.8	4.8	*4.9*	*1.2*	*-2.3*	*-0.1*
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	4.4	4.7	5.0	*5.1*	*1.0*	*-2.8*	*-0.1*
	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	5.0	5.4	6.5	*7.2*	*3.5*	*-11.6*	*-0.7*
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	13.0	11.3	10.1	*12.4*	*1.7*	*-5.2*	*-2.4*
	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	15.7	9.7	9.6	*14.1*	*2.2*	*-6.7*	*-4.4*
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	6.4	6.6	6.4	*7.9*	*1.2*	*-2.8*	*-1.5*
	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	7.3	6.8	7.0	*9.2*	*1.8*	*-5.7*	*-2.3*
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	0.4	0.2	-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	0.1	-0.5	0.2				
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	26.5	30.0	28.7	*23.7*	*7.4*		*5.1*
	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	30.4	30.8	30.1	*24.8*	*7.2*		*5.3*
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	24.7	24.7	24.3	*27.1*	*3.3*		*-2.7*
	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	25.0	24.9	25.1	*27.8*	*4.0*		*-2.7*
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	25.6	27.3	26.5	*25.4*	*4.8*		*1.2*
	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	27.7	27.9	27.6	*26.3*	*5.1*		*1.3*
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	7.8	1.7	-0.8				
	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	7.5	0.2	-0.2				
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	19.6			*11.1*	*5.2*	*19.6*	*8.5*
	Highest El.																7.5	6.9	6.9	6.9	Piezometer Not Functioning				11.5	13.8	18.4	16.1	19.6			*12.0*	*5.2*	*19.6*	*7.6*
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	10.1	10.2	11.0	7.4	7.1		10.1	17.0	19.5	17.6			*11.9*	*3.3*		
	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*		
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	5.7		*3.9*	*2.1*	*-2.1*	*1.8*
	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	5.7		*4.9*	*2.1*	*-2.3*	*0.8*
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	24.4			*28.5*	*6.0*		*-4.1*
	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	24.4			*30.8*	*7.4*		*-6.5*
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	23.6			*30.4*	*5.2*		*-6.8*
	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	23.6			*33.8*	*8.0*		*-10.2*
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	36.1			*31.1*	*6.4*		*5.0*
	Highest El.								44.1	Piezometer Not Functioning											26.8	27.4	24.0	26.3		30.3	36.1	38.4	34.9	36.1			*32.4*	*6.5*		*3.6*
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	41.1			*41.3*	*4.1*		*-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	41.1			*43.5*	*4.9*		*-2.4*

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



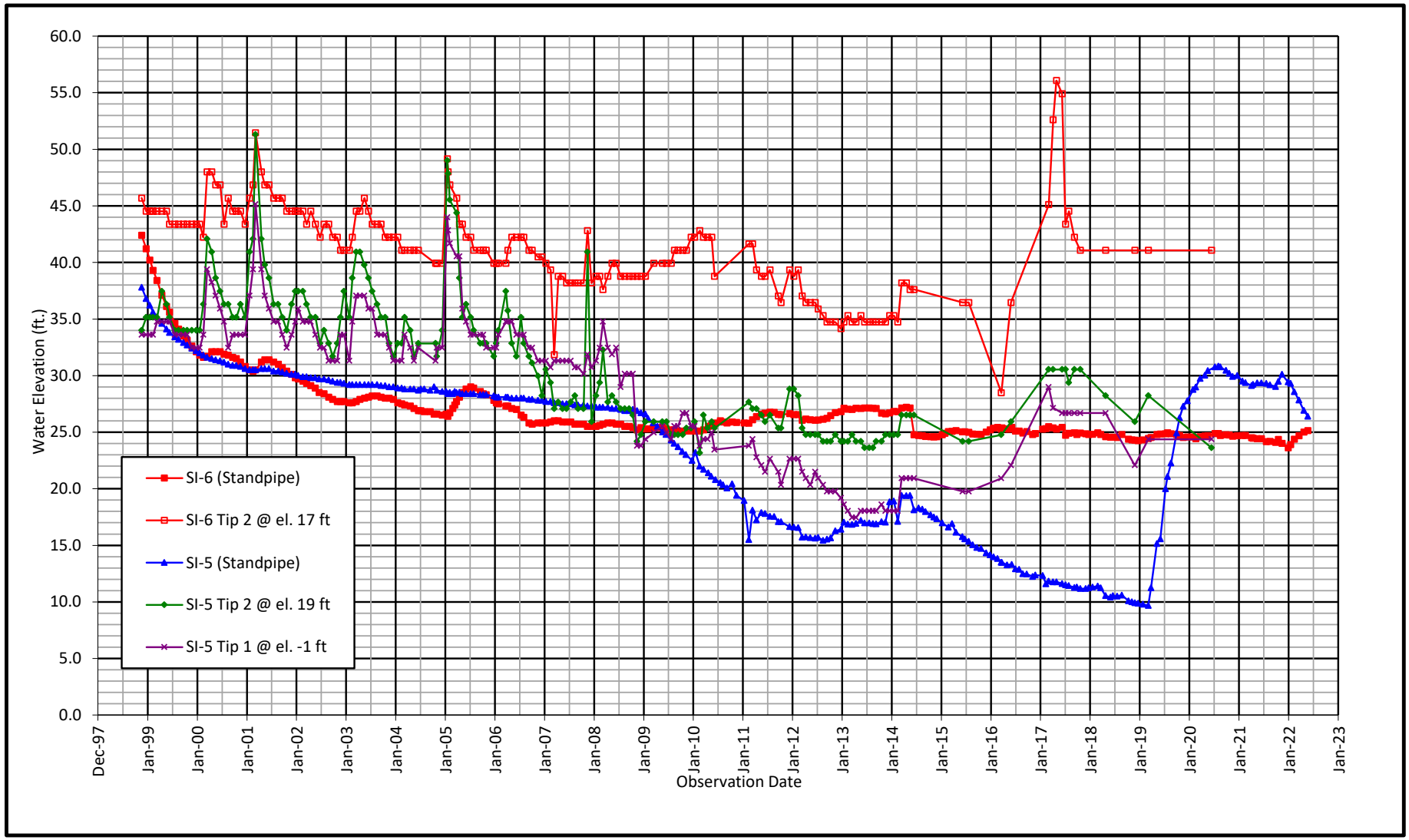
GROUNDWATER HYDROGRAPH
Malibu Road (West End)
Malibu Road Landslide Assessment District
Malibu, California

PLATE A-3



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

PLATE A-4



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

PLATE A-5

APPENDIX B - SLOPE INCLINOMETERS

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	Quaterly	Quaterly	Quarterly	Quarterly	Quarterly	Quarterly	Quarterly	Qaurerly	Quarterly
Interpretation Movement (inches)									
2021-2022	**NR**	--	**NR**	--	**NR**	**NR**	--	--	--
2020-2021	**NR**	--	**NR**	--	**NR**	**NR**	--	--	--
2019-2020	**NR**	--	**NR**	--	**NR**	**NR**	--	--	--
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.

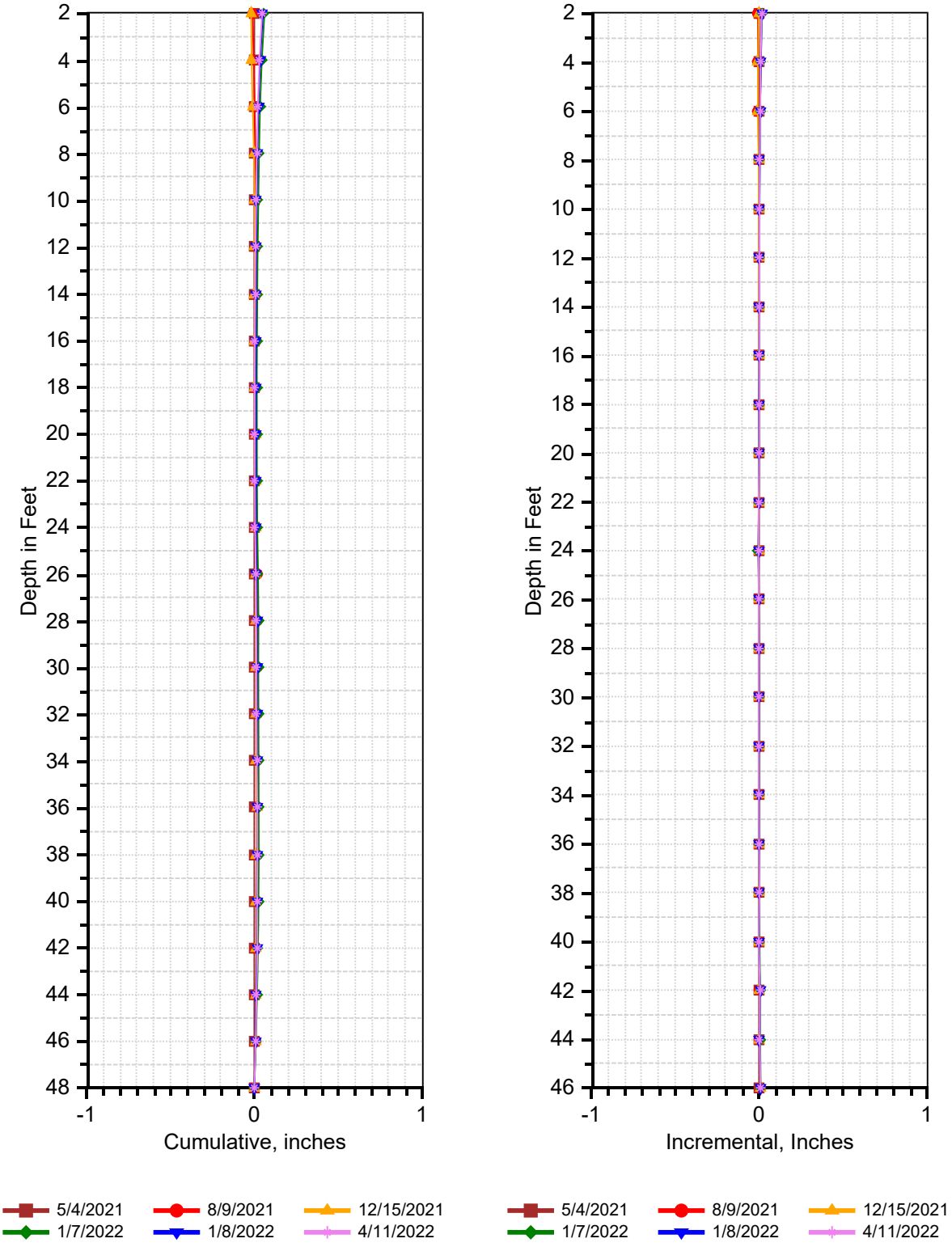
SUMMARY OF SLOPE INCLINOMETERS

Malibu Road Landslide Assessment District

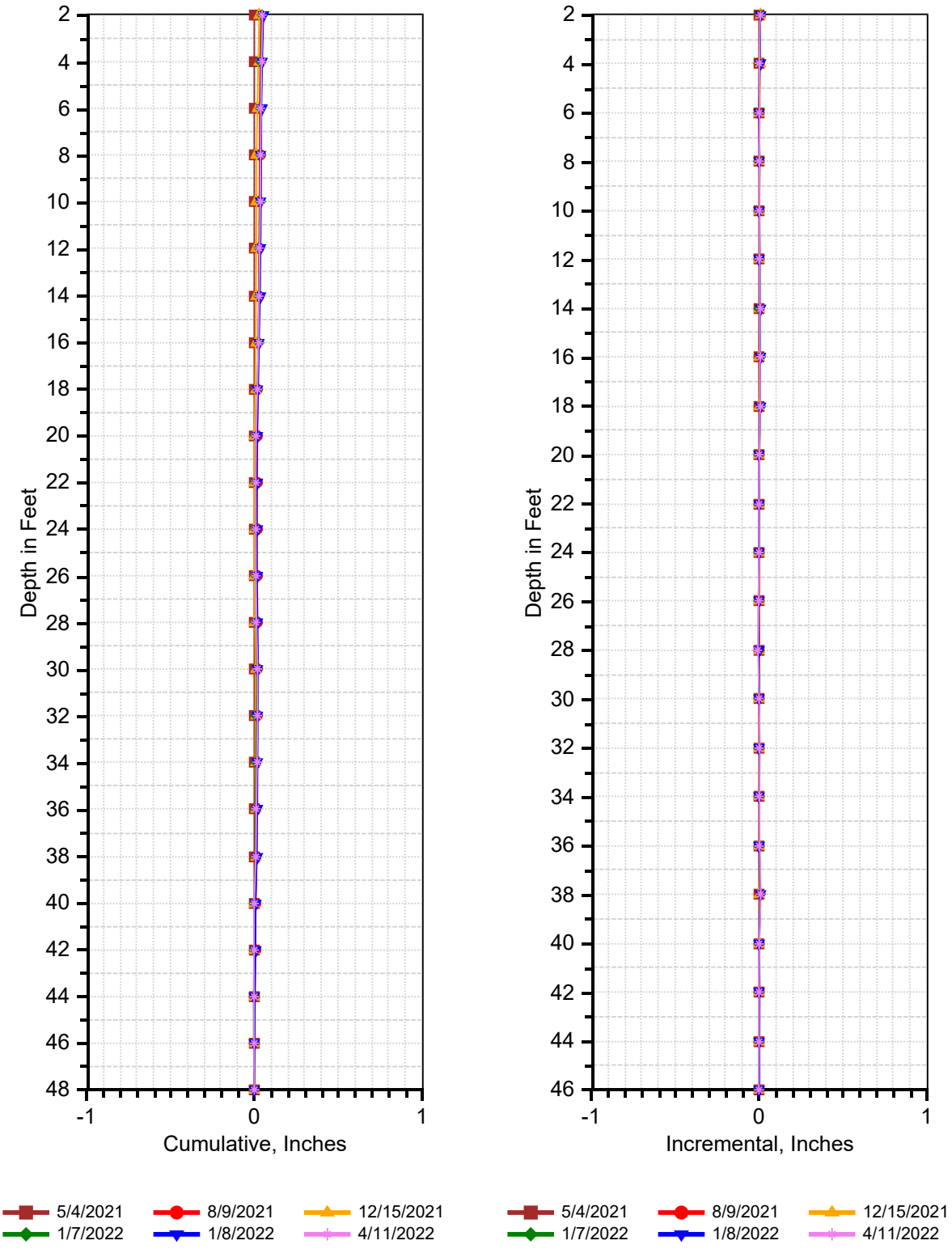
Malibu, California

PLATE B-1

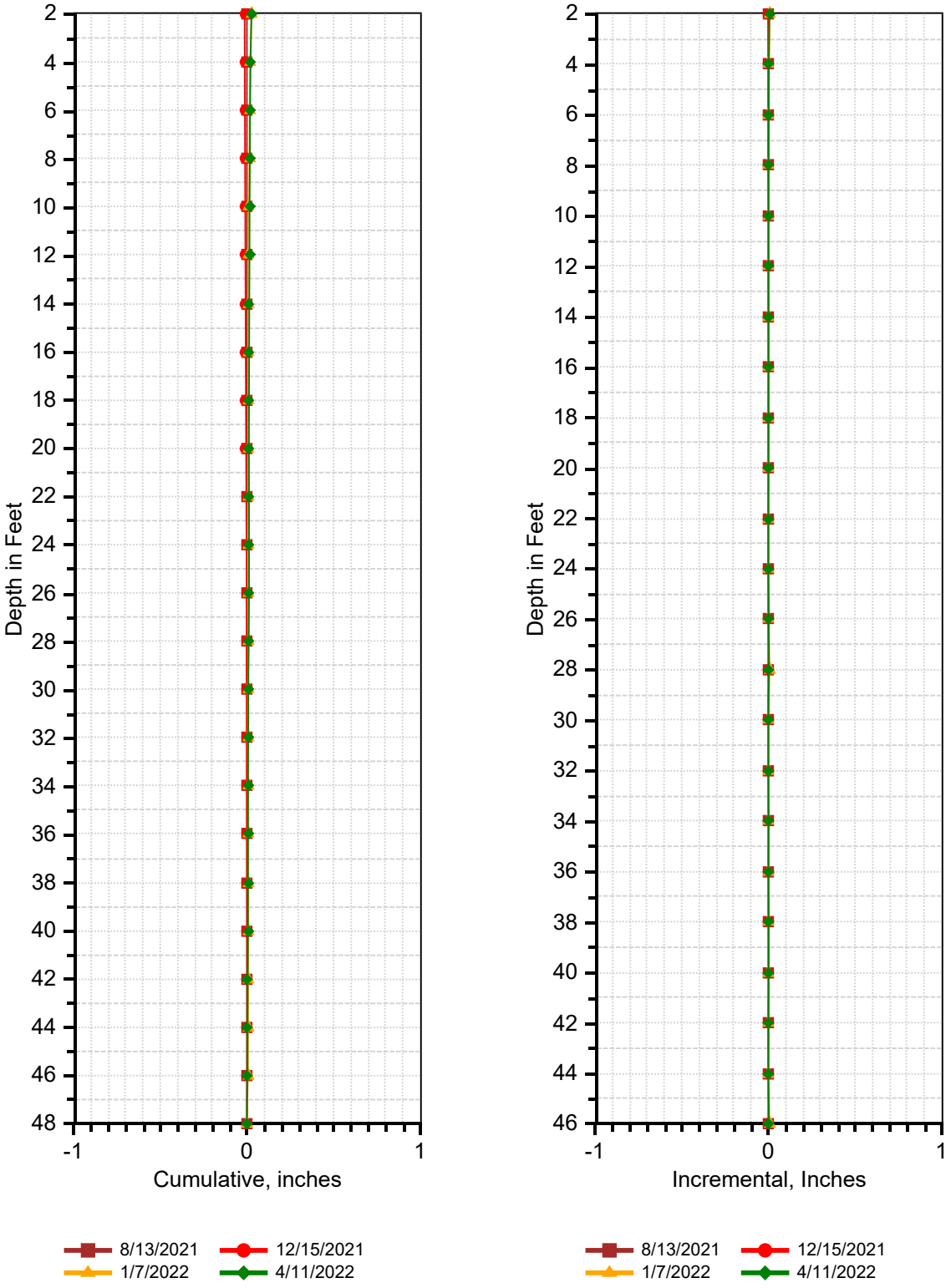
SI-1A A Direction



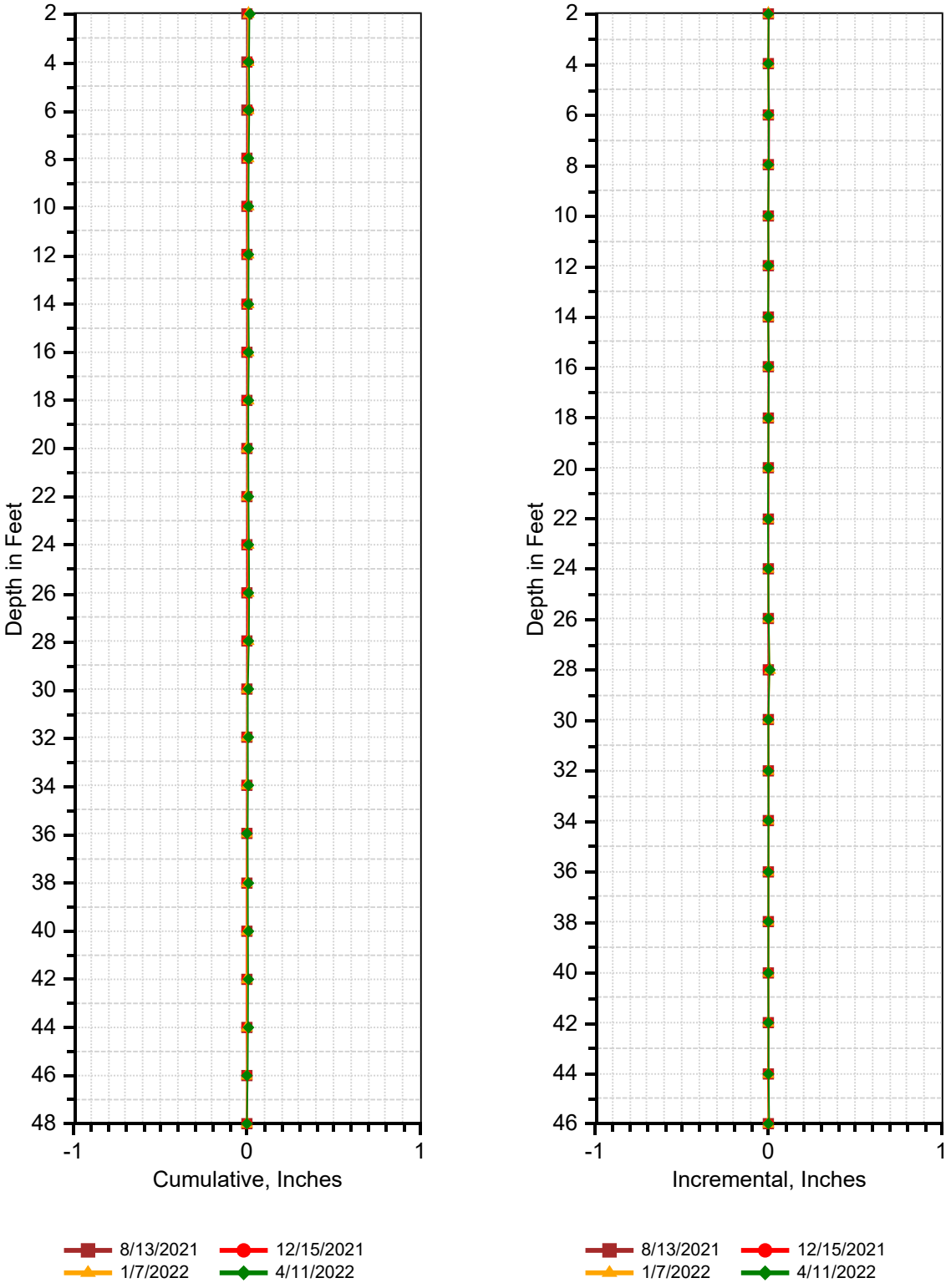
SI-1A B Direction



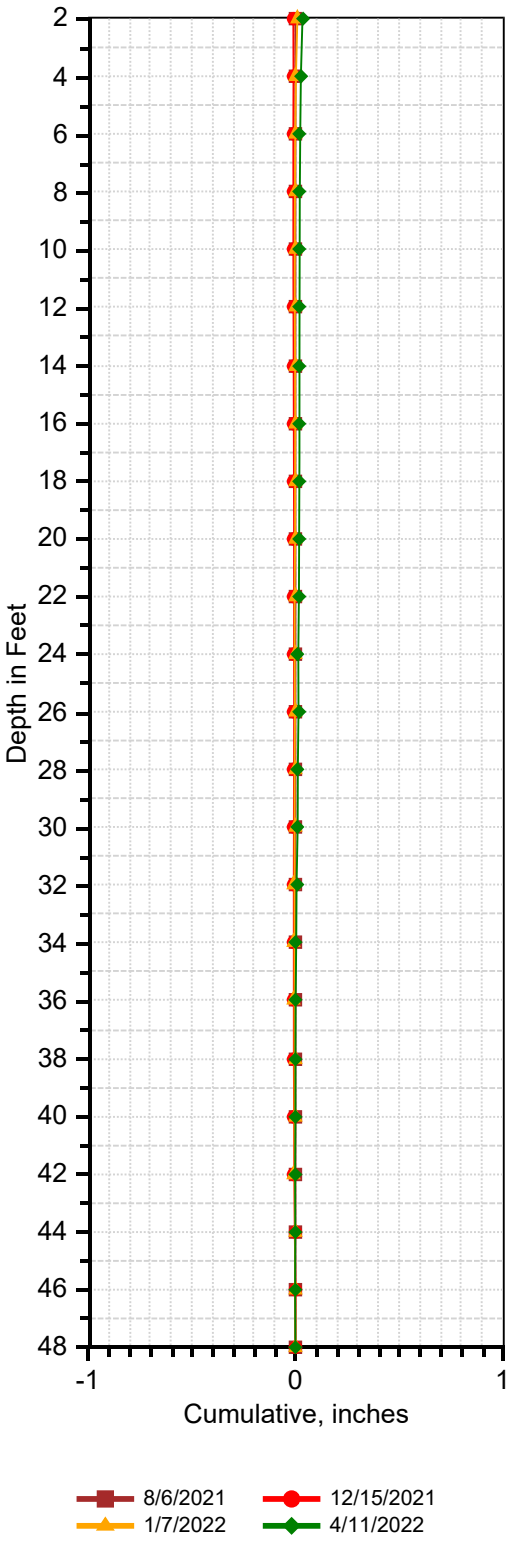
SI-2A A Direction

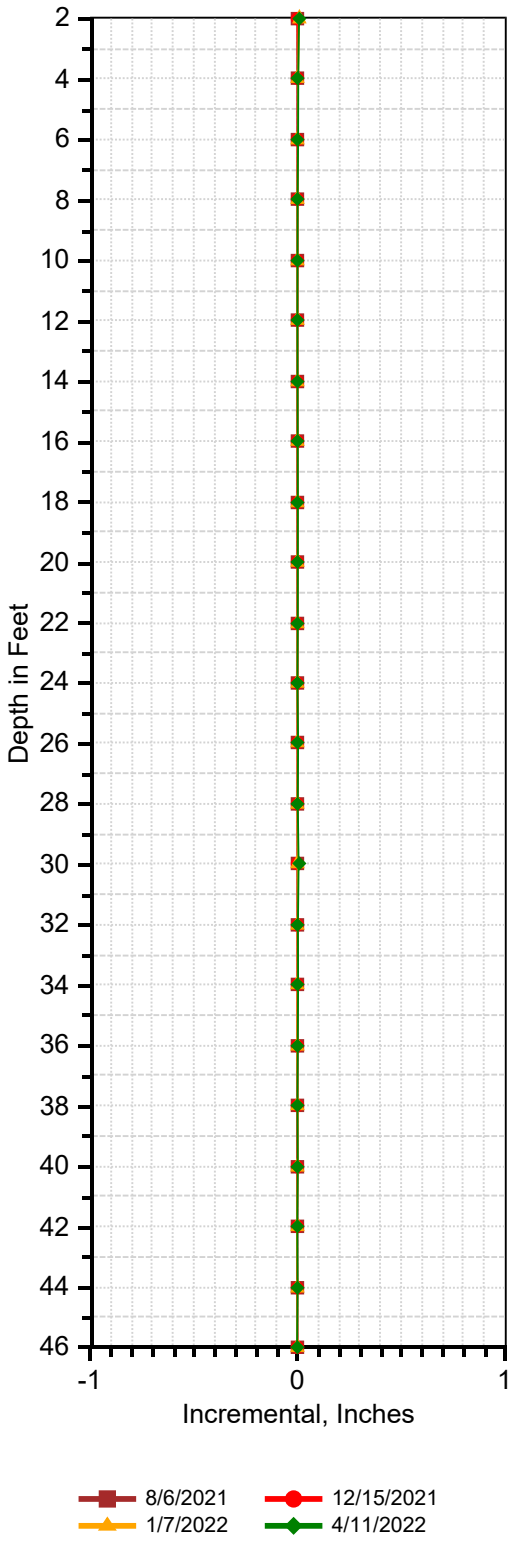


SI-2A B Direction

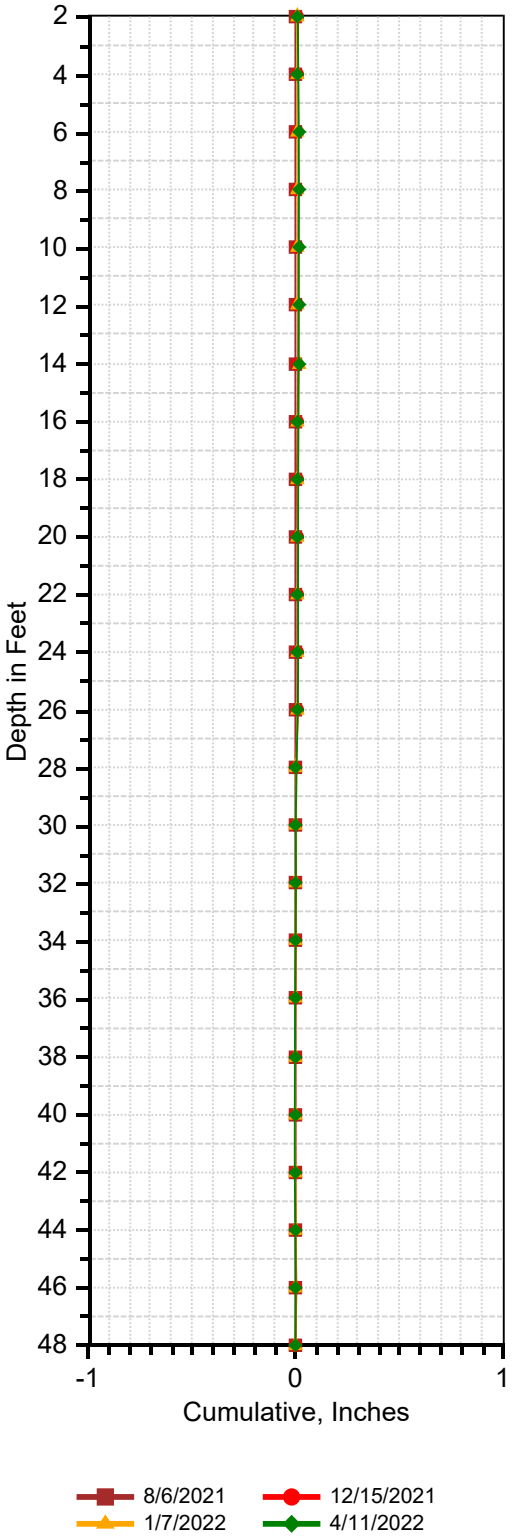


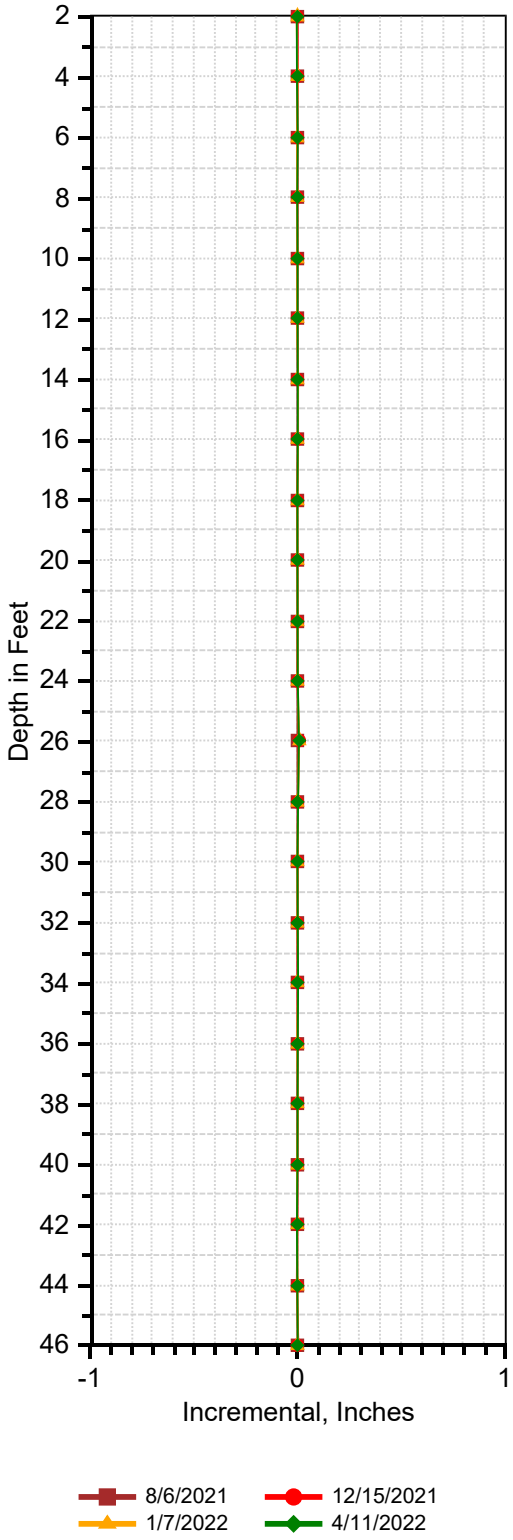
SI-4A A Direction



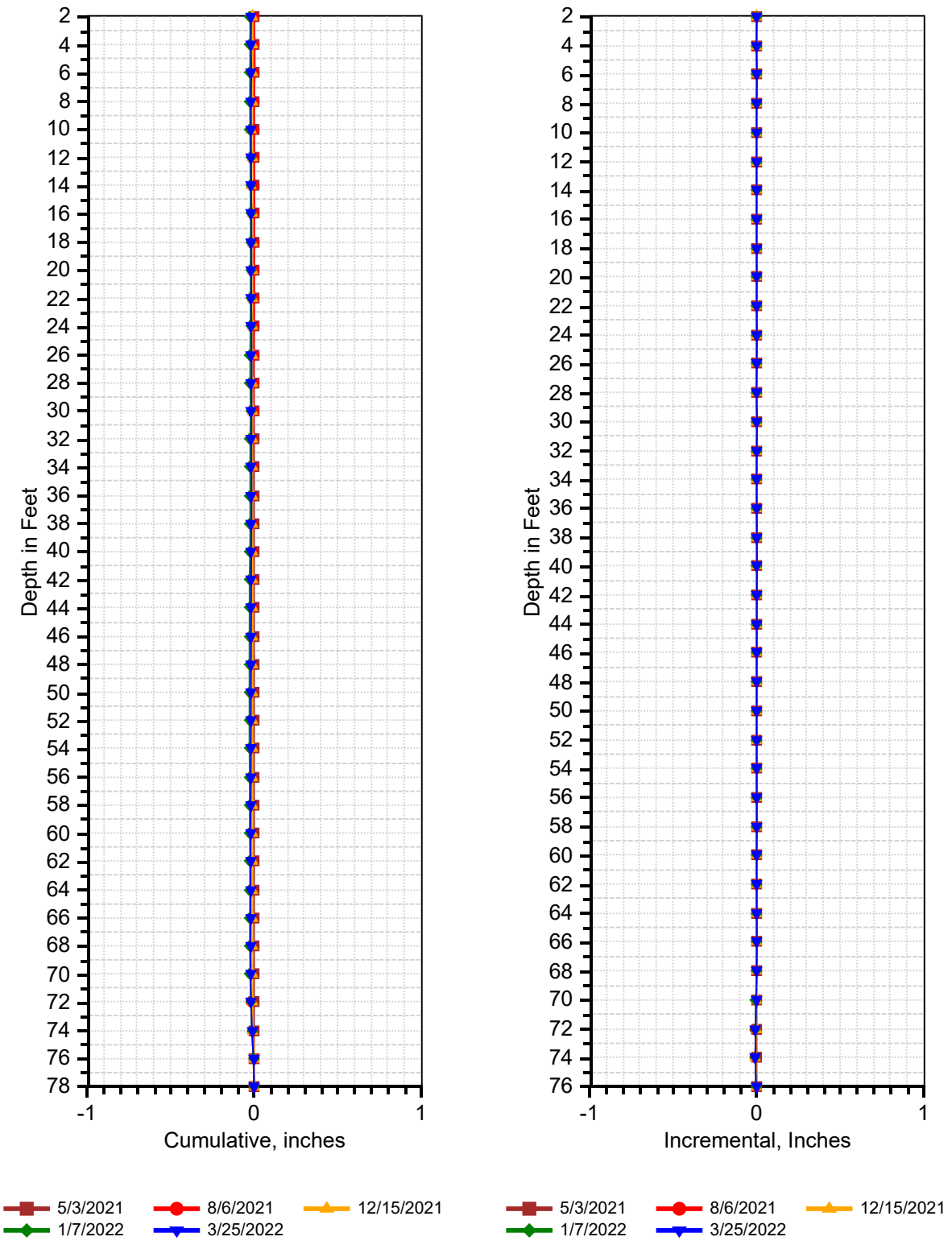


SI-4A B Direction

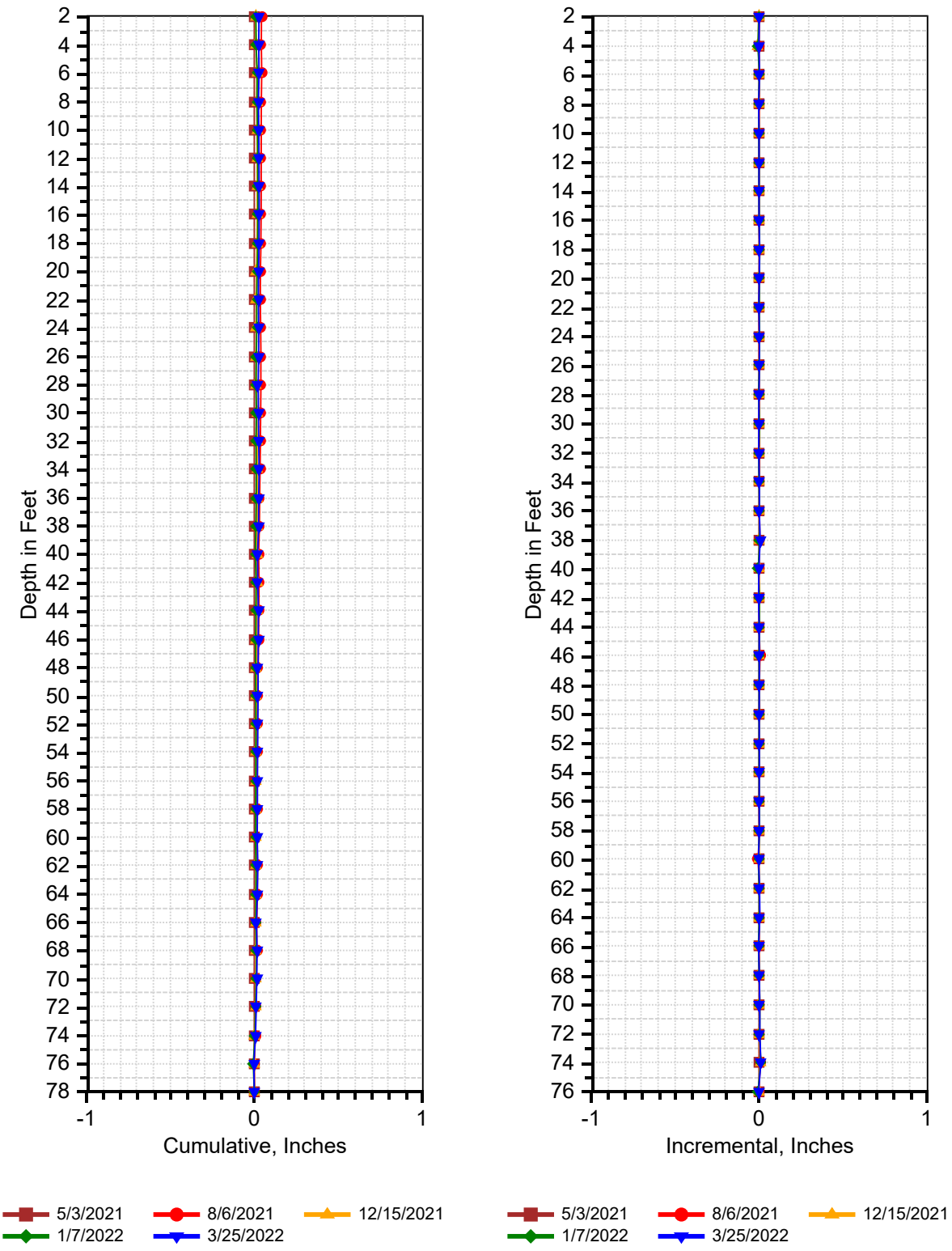




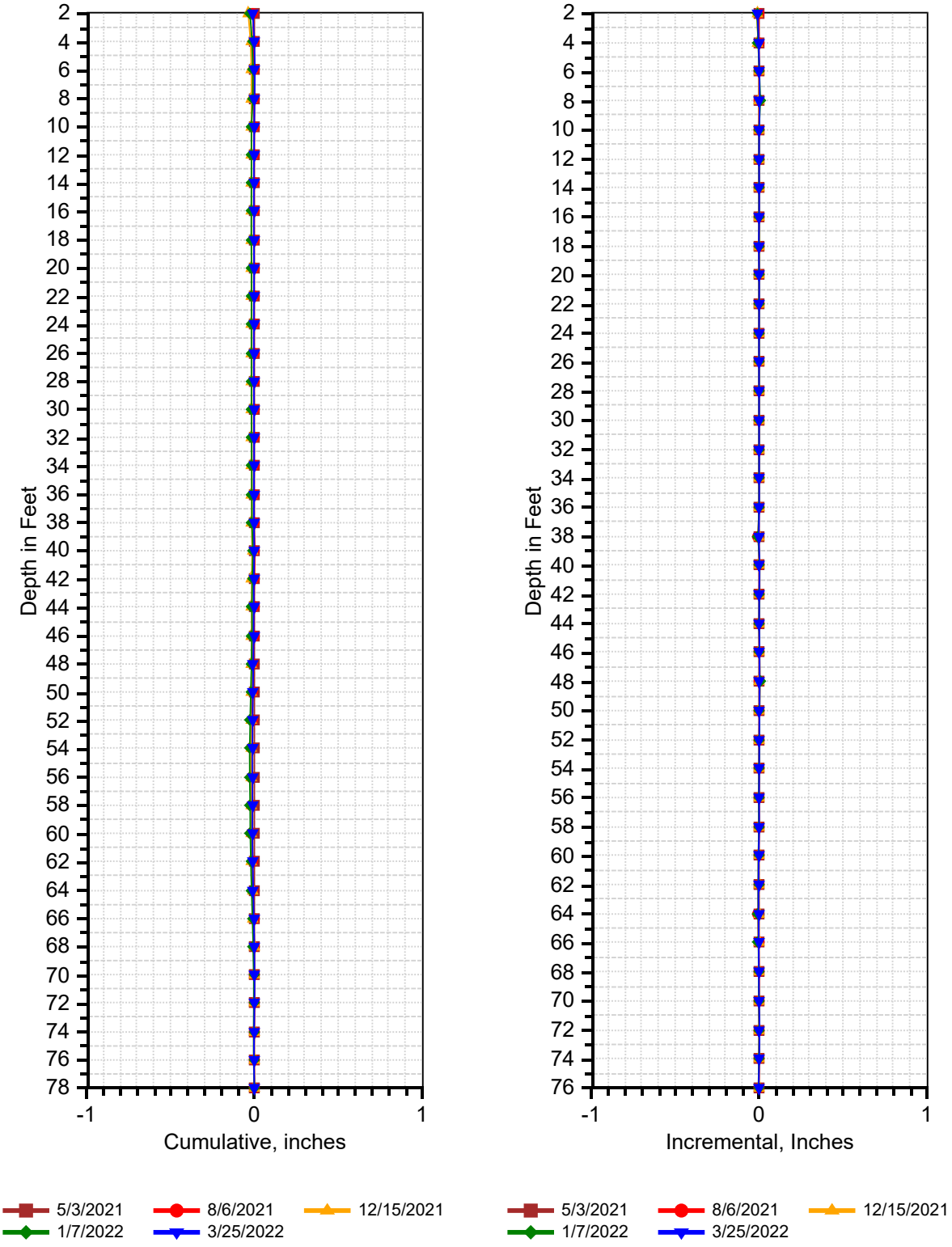
SI-5 A Direction



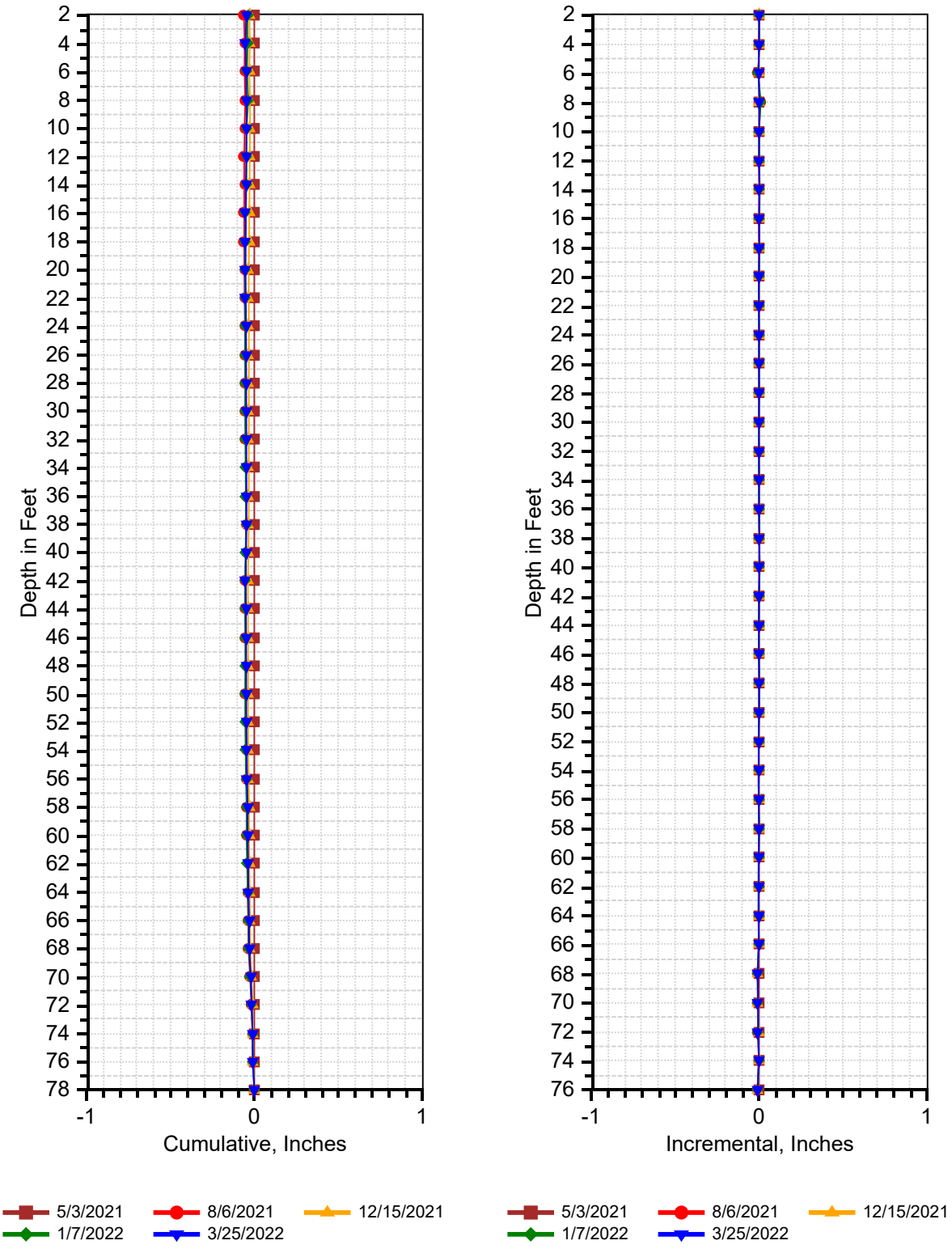
SI-5 B Direction



SI-6 A Direction



SI-6 B Direction



APPENDIX C - DEWATERING

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

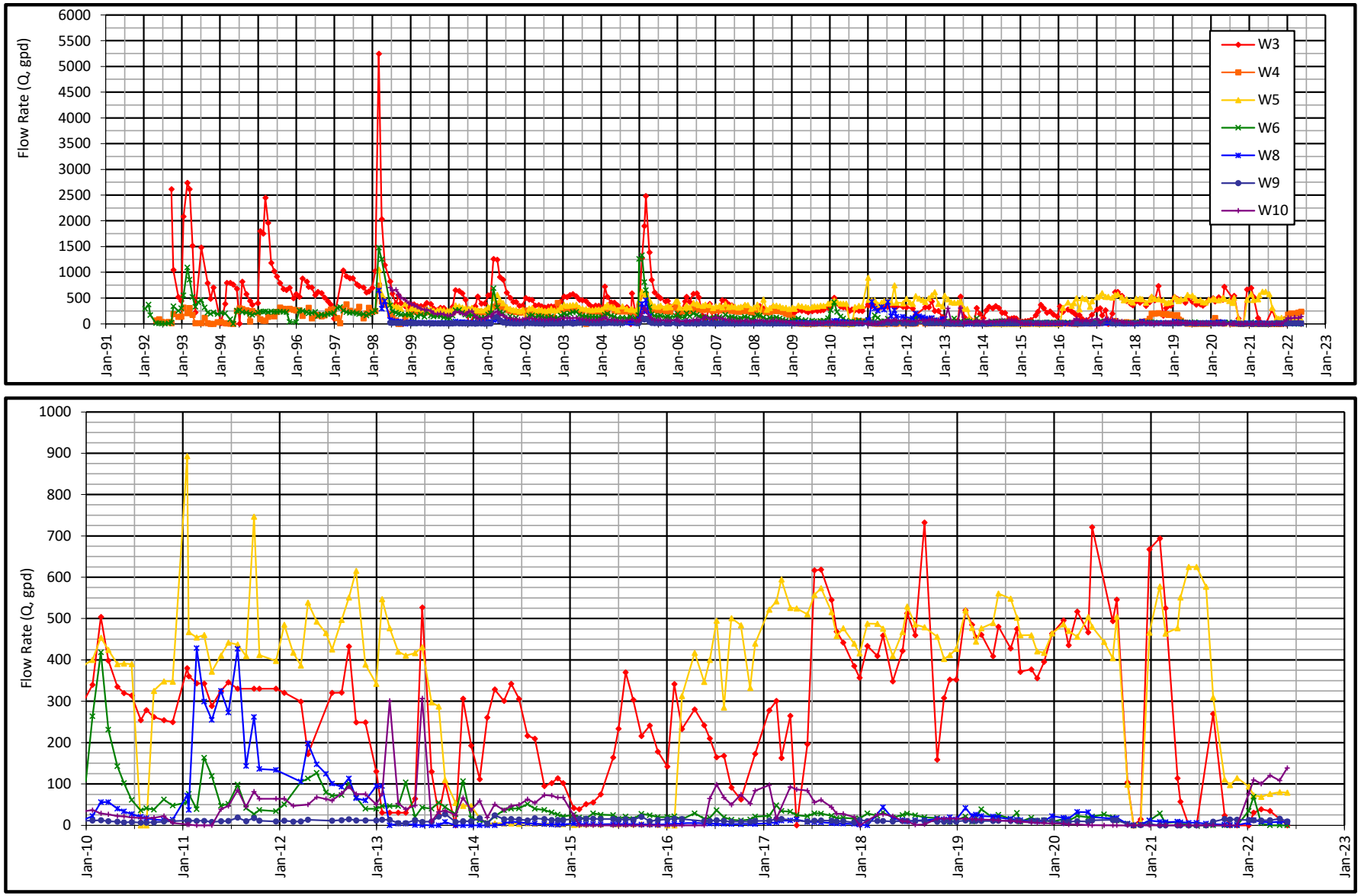
MALIBU ROAD LAD - Dewatering Well Information							
Well ID	Vault Elevation (ft.)	Bottom Elevation (ft.)	Pump Elevation (ft.)	Pump Size (hp)	2021-2022 Mean Pumping Rate (gpd)	% of Total Well Production	Installed By
W-3	19.5	-4.0	Unknown	1/2	38	8%	LA Co.
W-4	20.0	-9.0	-4.0	1/2	94	19%	LA Co.
W-5	19.0	-9.5	Unknown	1/2	192	38%	LA Co.
W-6	20.0	-4.5	0.0	1/2	9	2%	LA Co.
W-8	27.5	11.0	Unknown	1/2	6	1%	LA Co.
W-9	20.0	-40.0	-35.0	1/3	11	2%	LA Co.
W-10	19.0	-26.0	-21.0	1/3	55	11%	LA Co.
W-11	61.0	1.0	13.0	1/3	27	5%	BYA
W-12	58.0	-2.0	8.0	1/3	16	3%	BYA
W-13	20.0	-28.0	N/A	N/A	0	0%	Fugro
W-14	60.0	-20.0	Unknown	1/3	35	7%	Fugro
NW-1	Unknown	Unknown	Unknown	Unknown	5	1%	Homeowner
NW-2	Unknown	Unknown	Unknown	Unknown	10	2%	Homeowner
NW-3	Unknown	Unknown	Unknown	Unknown	4	1%	Homeowner

MALIBU ROAD LAD- Hydrauger Information						
Hydrauger ID	Installed Length (ft.)	Bearing	Functional Length* (ft)	2021-2022 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-5A	Unknown	N13E	41	21	25%	LA County
HD-6	Unknown	N08W	55	0	0%	LA County
HD-7	Unknown	N26E	87	0	0%	LA County
HD-8	Unknown	N19E	92	6	7%	LA County
HD-8A	Unknown	Unknown	Unknown	31	38%	Unknown
HD-9	Unknown	N34E	76	11	13%	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	5	6%	BYA
HD-19	150	N10E	150	0	0%	BYA
HD-20	150	N09W	150	2	2%	BYA
HD-21	150	N22E	150	8	9%	BYA
HD-22	180	N13E	180	0	0%	Fugro West
HD-23	160	N01E	160	0	0%	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

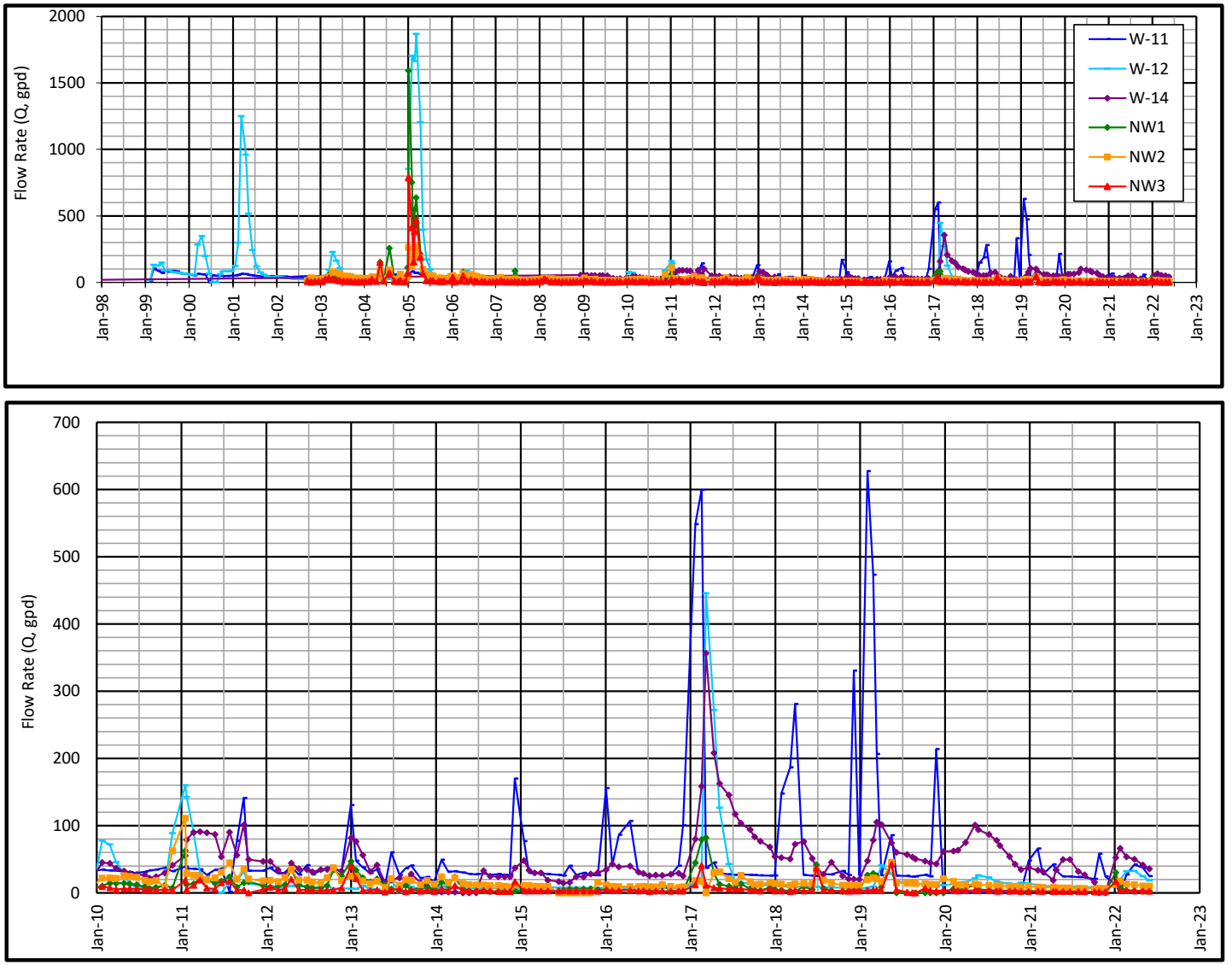
Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services



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

PLATE C-2

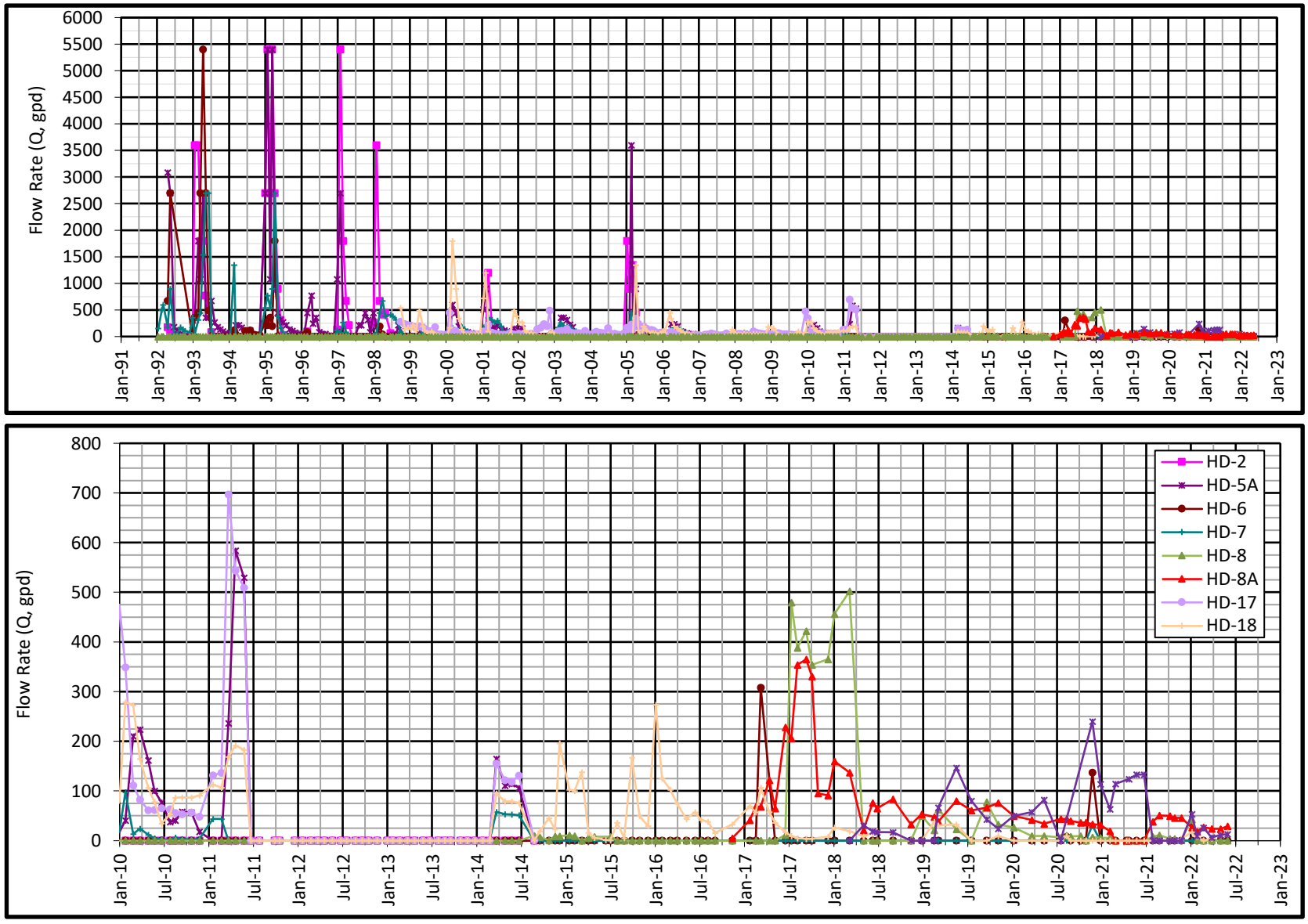
Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services



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

PLATE C-3

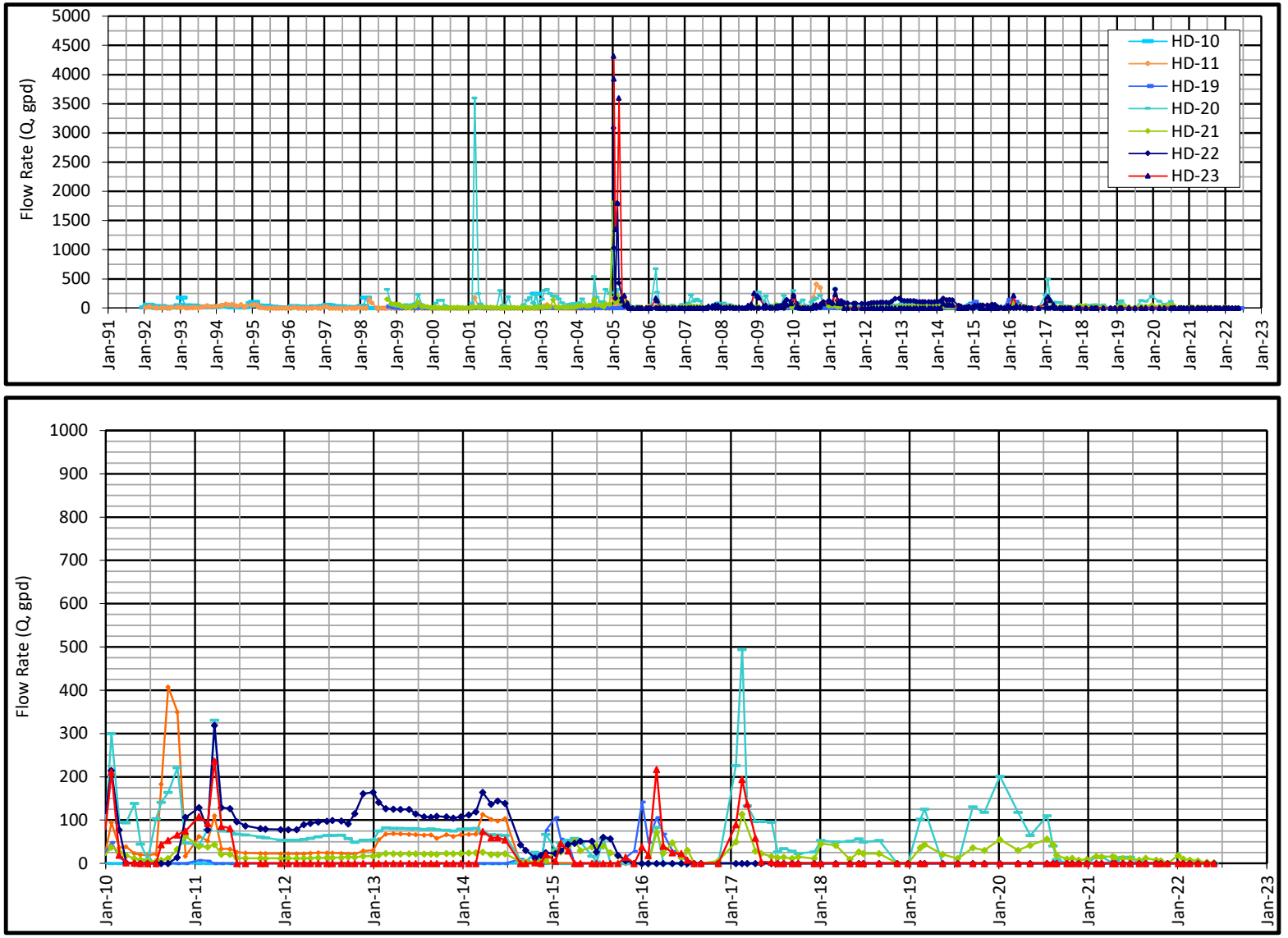
Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services



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

PLATE C-4

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services



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

PLATE C-5