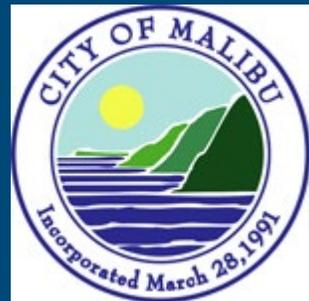


Project Update and Facility Status

City of Malibu Landslide Assessment District 98-1 Big Rock Mesa

October 6, 2020



Who is Yeh and Associates, Inc.

Yeh specializes in evaluating Geologic Hazards and providing recommendations to mitigate them.

Founded in 1999 in Denver, Colorado; 160 staff

- Geotechnical Engineers, Engineering Geologists, Construction Management
- California Offices: Ventura and Grover Beach

Key Personnel for this project:

- Loree Berry, PE
- Nick Simon, GIT
- John Duffy, PG, CEG

Familiarity with long-term Landslide Management and State of the Art Monitoring Technologies:

- Current - Ferguson Landslide, Yosemite Area, CA
- Current - Freemont Hall Landslide, CalPoly SLO, CA
- 2017 – Big Sur Coastal Landslides, Santa Cruz and Monterey Counties, CA
- Ongoing - Harbor Terrace, Avila Beach, CA
- Ongoing - City of Colorado Springs Studies, CO



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Brief History of LAD 98-1

Assessment
District
Boundary

Historic
Landslide

- WATER IN: imported water and rainfall/precipitation
- WATER OUT: wells, hydraugers, evaporation, collected surface drainage

Abbreviated Timeline:

1947 – Development Underway

1983 – Main Landslide- 137 acres

1986-1996 – Extensive Slope Stability Studies and Installation of many of the existing facilities

1991 – City of Malibu Incorporated

1998 – City forms LAD 98-1

Improving stability of the Mesa by lowering groundwater with a dewatering system. Monitoring of slope inclinometers and water levels to assess the effectiveness of the dewatering. Improvements to maintain, repair, and replace dewatering and monitoring facilities.

2020 – Operating and Maintaining the same Assessment District 98-1



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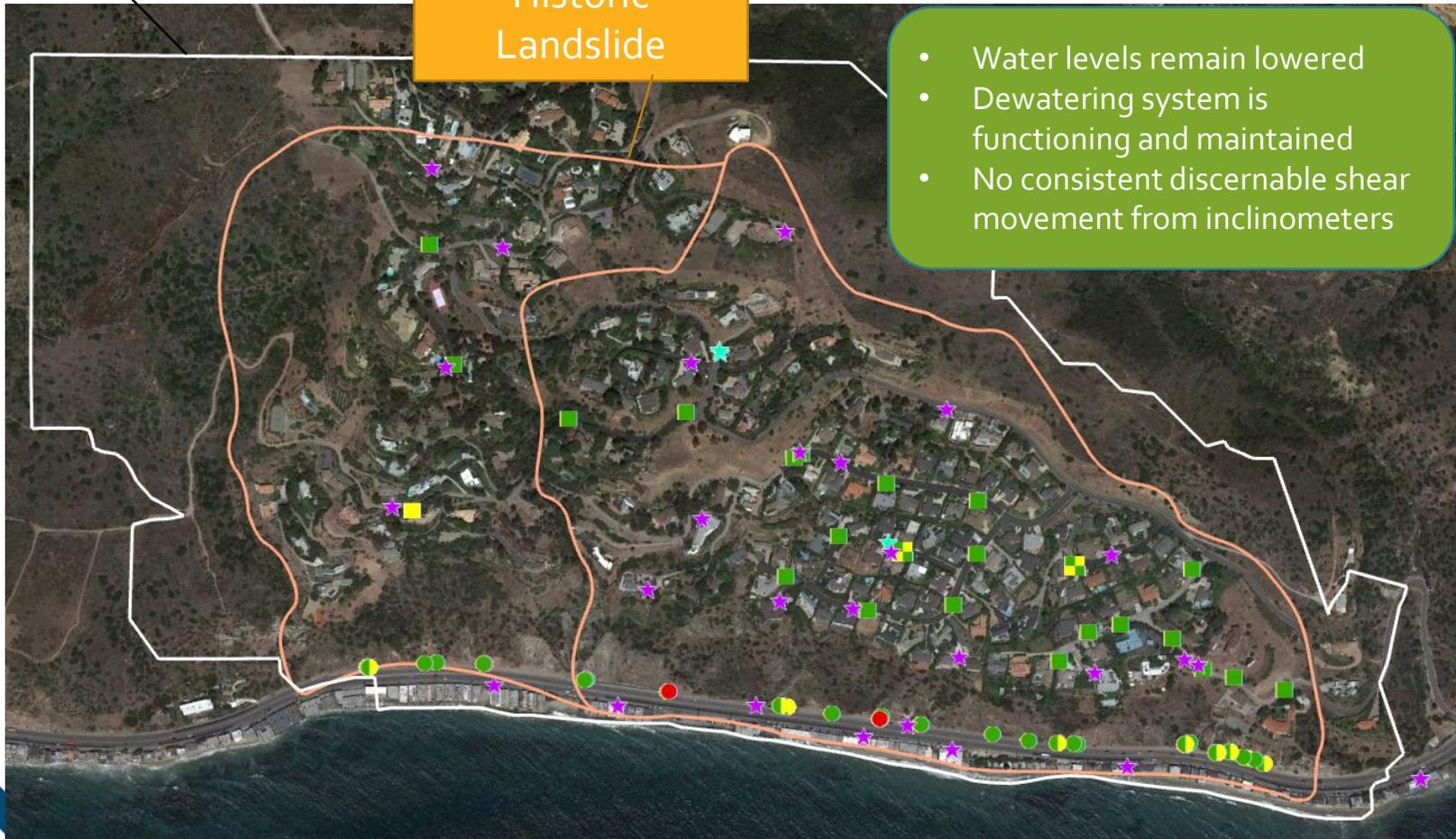
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Scope of LAD 98-1

Assessment
District
Boundary

Historic
Landslide

- Water levels remain lowered
- Dewatering system is functioning and maintained
- No consistent discernable shear movement from inclinometers



Yeh was hired in June 2020 to maintain and monitor the existing LAD.

- ✓ Monitor and measure
 - Dewatering output
 - Water levels
- ✓ Survey slope inclinometers
- ✓ Maintain/repair equipment
- ✓ Replace equipment (CIP)
- ☐ Current Equipment Includes:
 - 23 dewatering wells
 - 37 hydraugers
 - 29 standpipes
 - 28 inclinometer casings



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Monitoring and Maintenance since July 1, 2020

- Recorded Flow from 23 Dewatering Well Meters
 - Measured and Recorded Discharge from 37 Hydraugers
 - Measured and Recorded Water Level Measurements in 29 Standpipes
 - Completed sampling and testing NPDES Permit
 - Performed baseline surveys on Inclometers
 - Performed an inventory of facilities
 - Scheduled maintenance of hydrauger conveyance along PCH
 - Completed Maintenance and Repairs on the following dewatering wells:
 - Replaced pumps : W-2, W-17, BYA-1
 - Video Logged: W-2, W-3, W-17
 - Installed groundwater sounding tube: W-2, W-3, W-17, BYA-1
 - Repaired pump controls/electronics: W-8, W-18
 - Replaced flow meter: W-2, BYA-4
 - Repaired broken discharge line at vault: BYA-6
- } 3 months collected



Historical Data Trends –Dewatering

Sources of Dewatering:

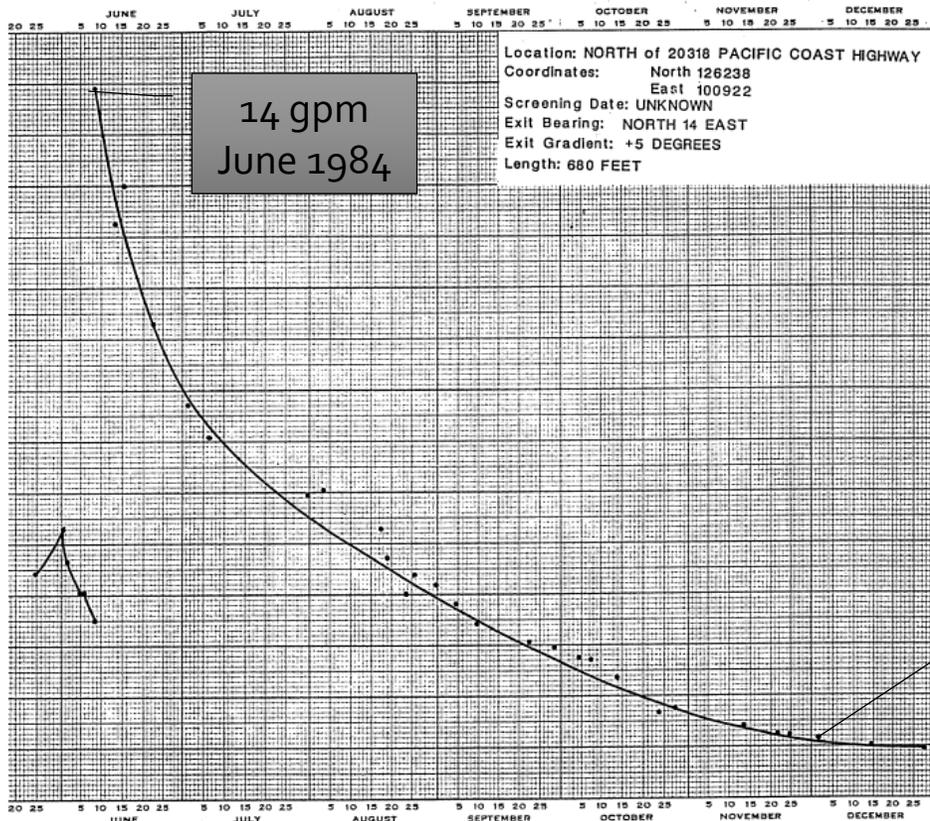
1. Dewatering Wells – active system; uses submersible electric pumps to lower and maintain lower groundwater levels within an area surrounding the well
2. Hydraugers – passive system; will drain when water is present

Lower Discharge Volume over time does NOT mean the system is not working

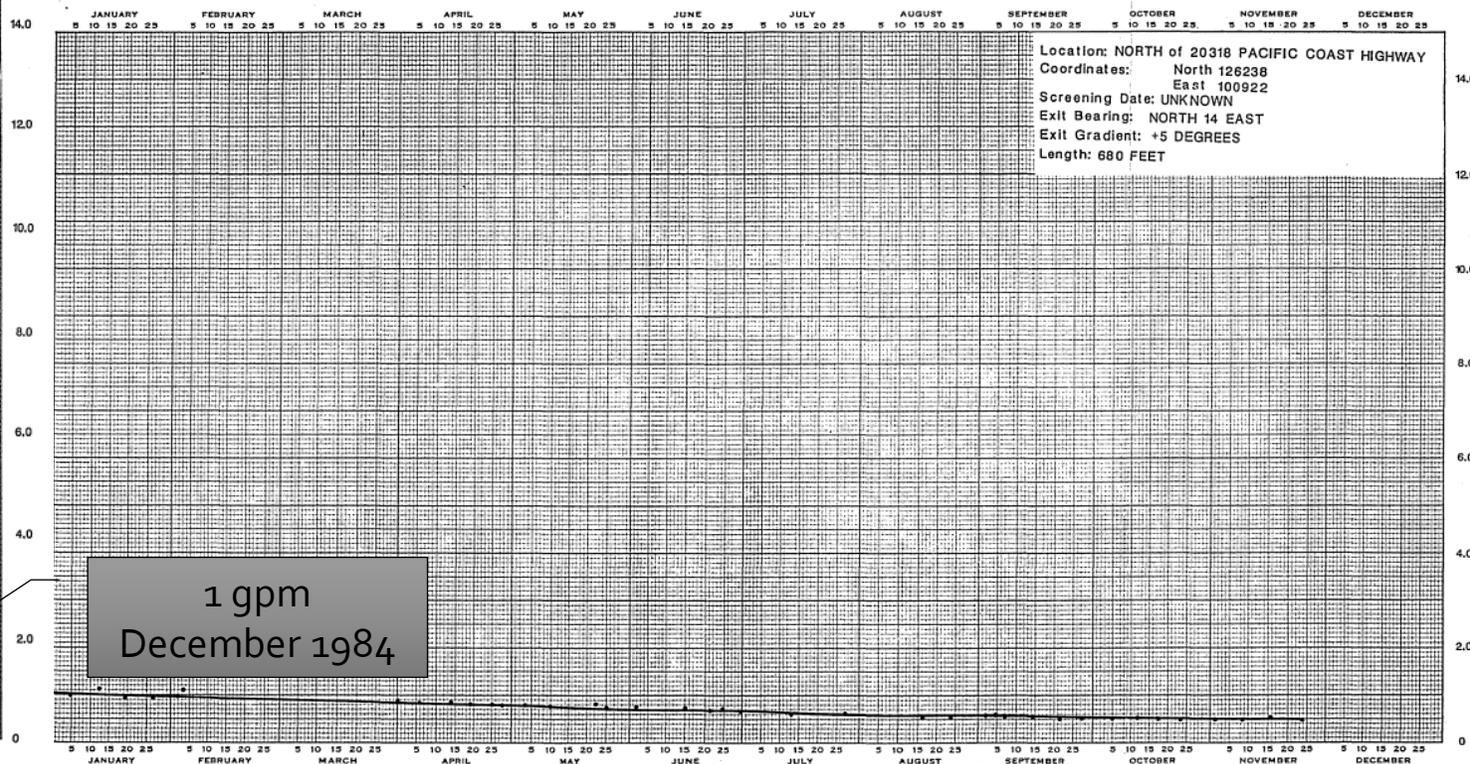
- Water levels decrease = less well surface below water table = less recharge = lower dewatering volume
- Hydraugers commonly slow/stop after surrounding area drains
 - Very sudden drop after install, then steady or no flow
 - Some installed hydraugers never produced water
 - Some reactivate with rain or increased water levels

Historical Data Trends – Hydraugers

H-4



PRODUCTION YEAR - 1984

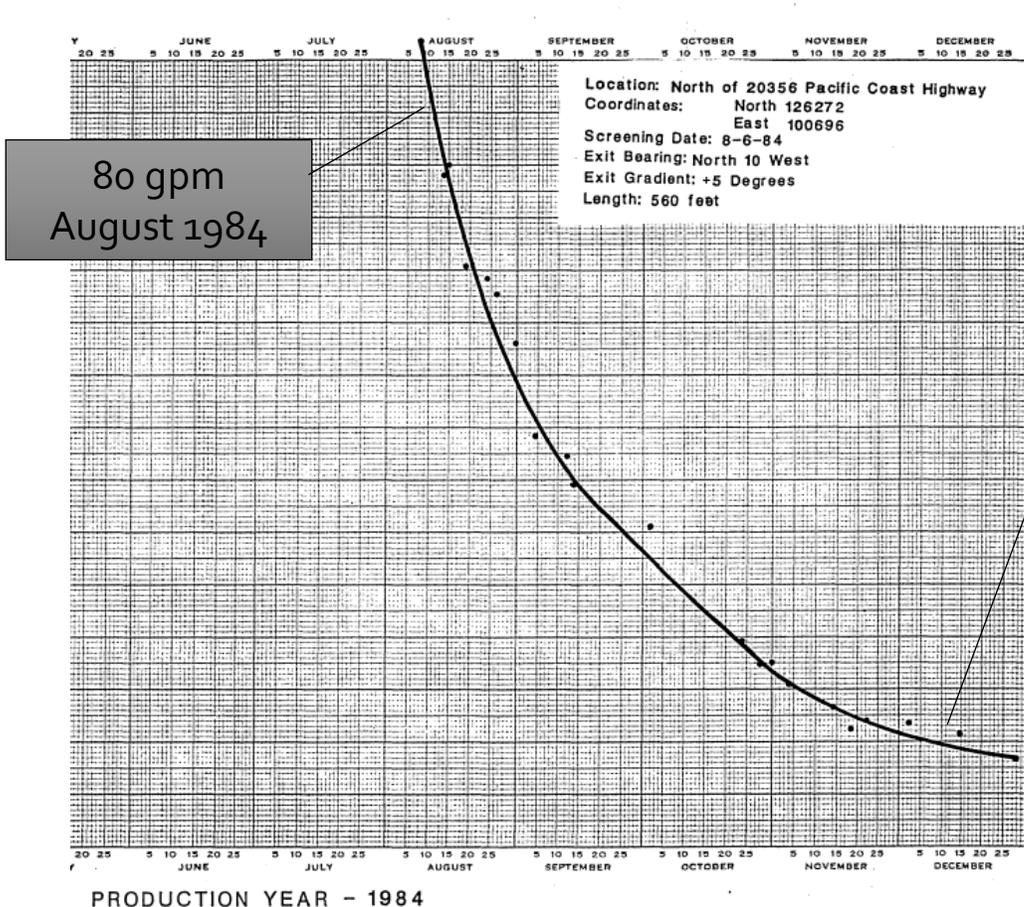


PRODUCTION YEAR - 1985

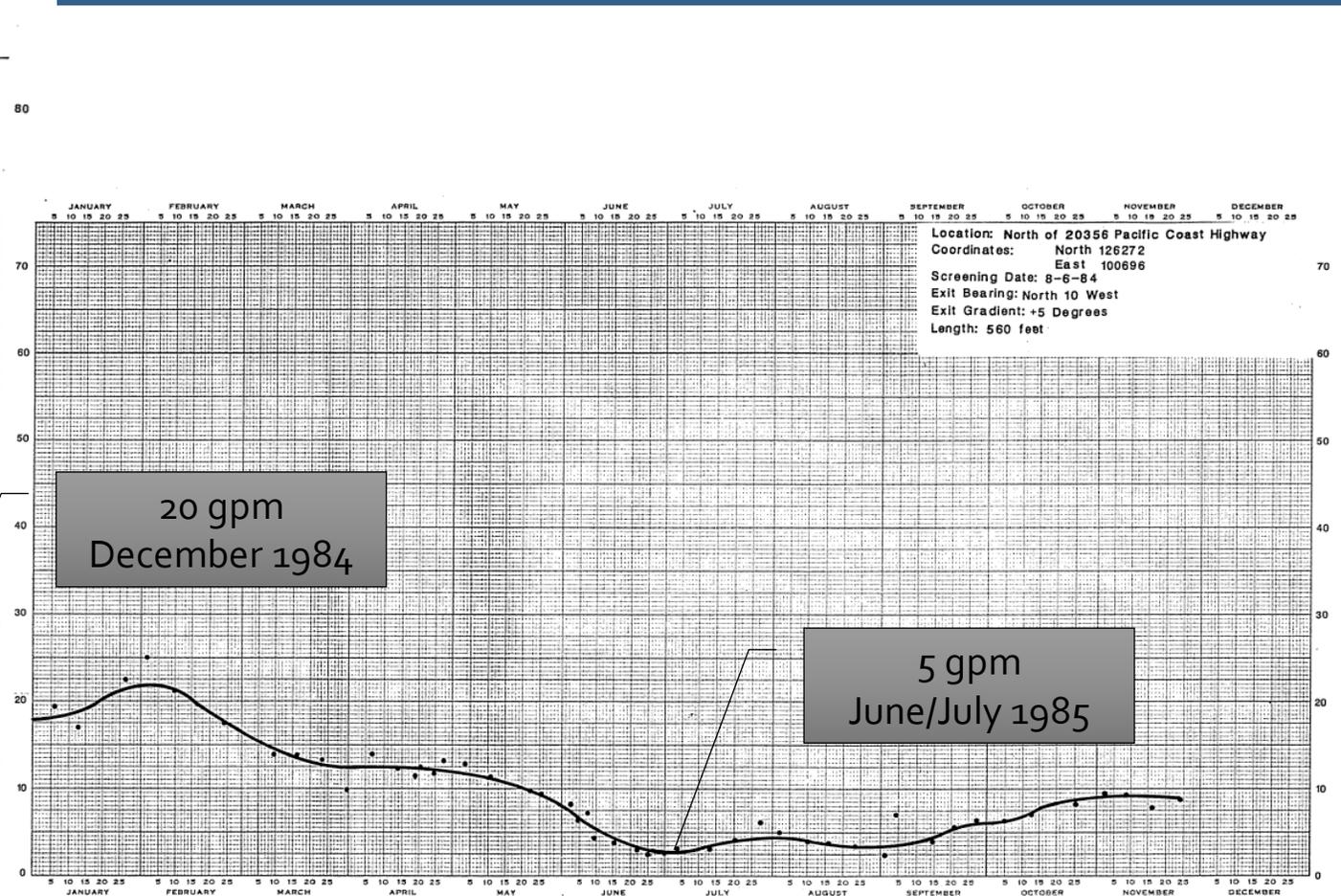


Historical Data Trends – Hydraugers

HD-3



PRODUCTION YEAR - 1984



PRODUCTION YEAR - 1985



Historical Data Trends – Water Levels

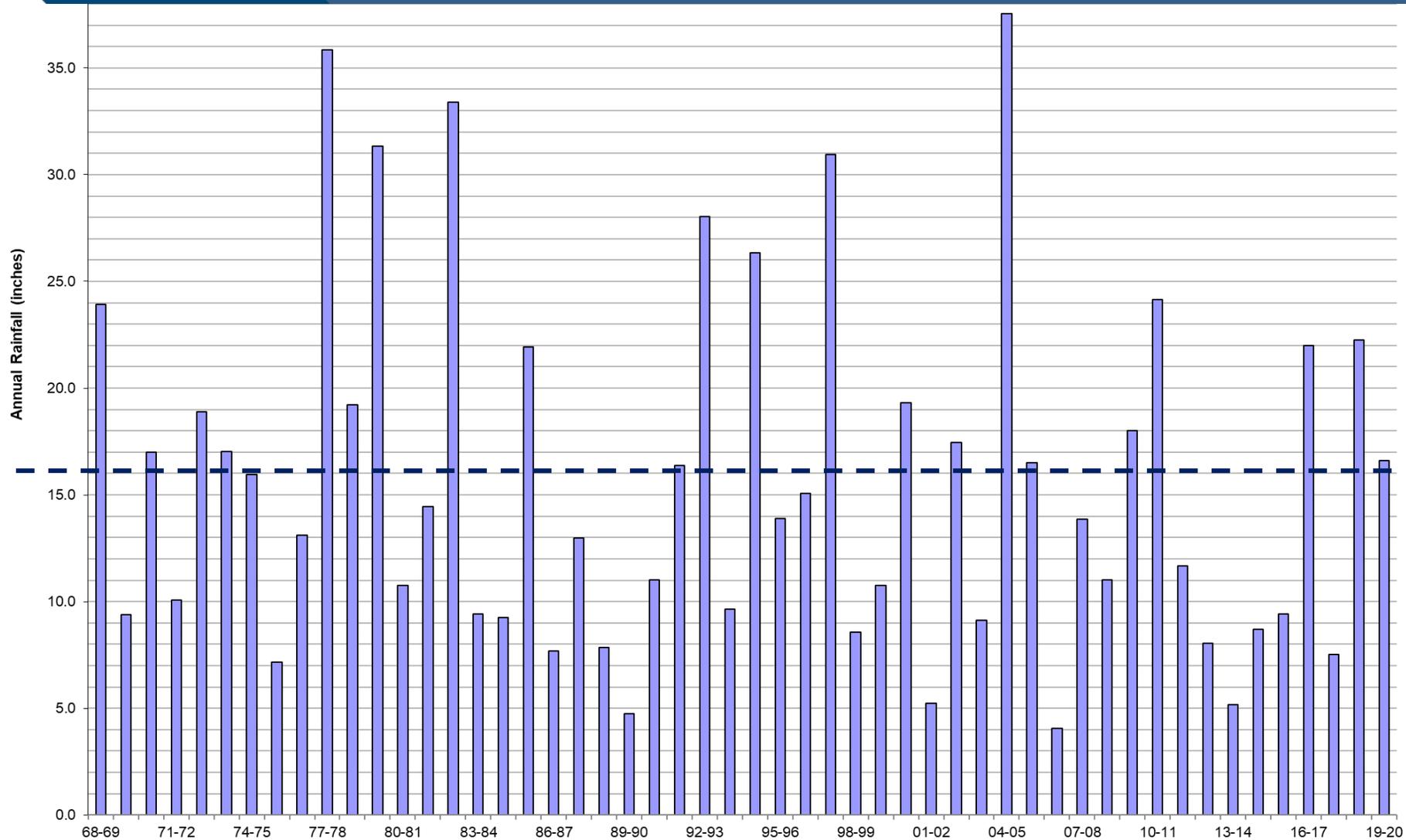
Facility Type	ID	Earliest Reading	Depth to Water (feet) (earliest)	Water Depth** October 2020 (feet)	Difference in Water Level
D. Well	W-1	1983	63.3	125.0	-61.7 feet
Standpipe	SP-33	1985	98.0	245.0	-147.0 feet
D. Well	W-3	1983	13.5	161.5	-148.0 feet
D. Well	W-8	1983	54.7	161.0	-106.3 feet
D. Well	W-16	1984	94.9	179.7	-85.0 feet
Standpipe	SP-16	1984	61.0	147.11	-86.1 feet
D. Well	BYA-4	1991	142.0	247.9	-105.9 feet
Standpipe	SP-10	1983	160.0	251.0	-91.0 feet

** Measurements taken after nearby pumps were turned off for 24 hours or more

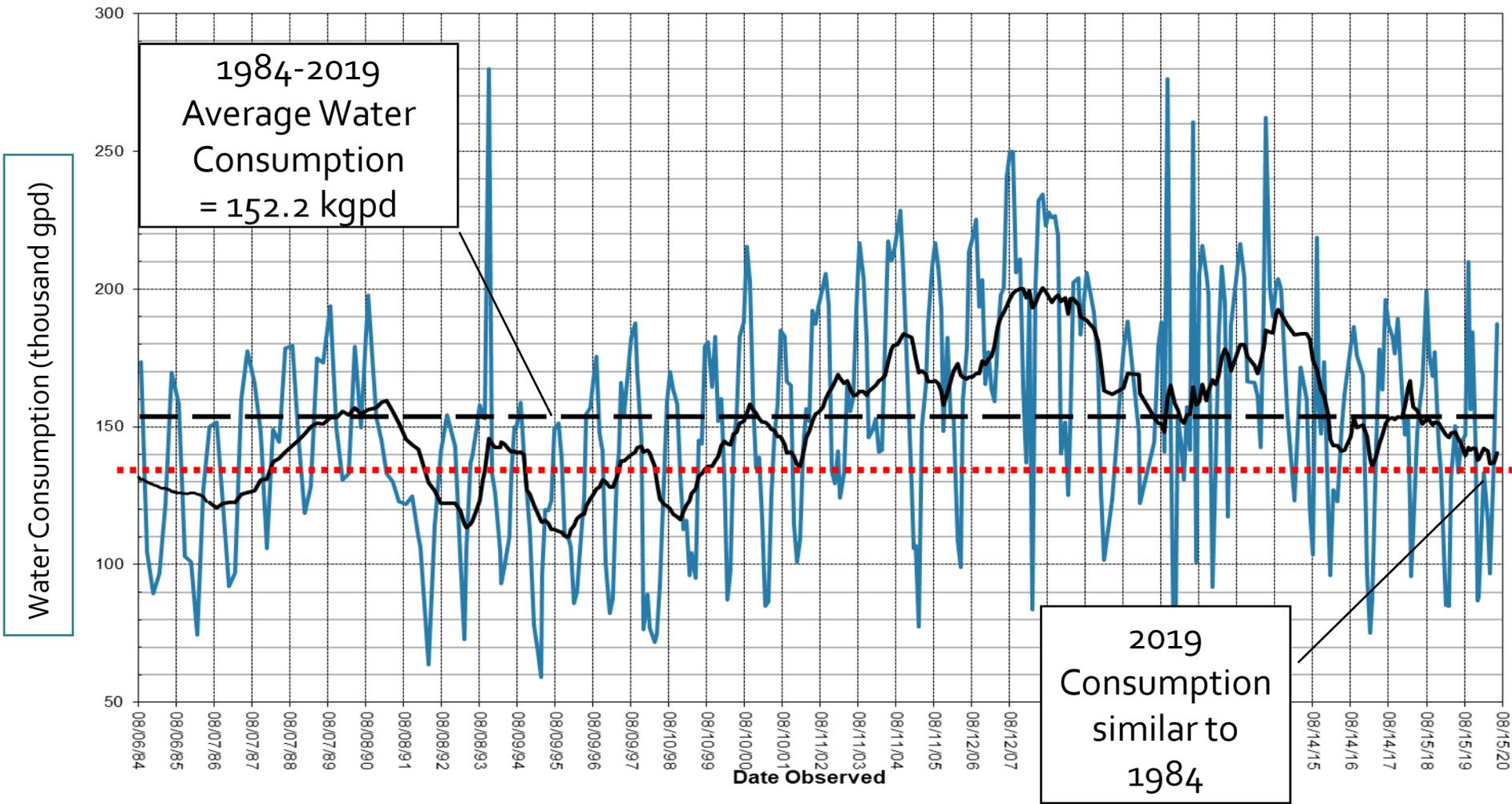


Historical Data Trends – Rainfall

Ave: 15.4"
(1968-2020)



Historical Data Trends – Water Usage



Response to E.D. Michaels (relative to LAD98-1 SOW)

1. The project dewatering wells and hydraugers are functioning :
 - 23 of 23 dewatering wells are functioning
 - 34 of 37 hydraugers have consistent flow or seasonal flow
 - Remaining 4 are checked but have not shown flow in many years
2. Groundwater level measurements in standpipes and dewatering wells indicate 2020 water levels are well below 1980 water levels and near or below 1991 water levels
3. Lowered dewatering production combined with lowered groundwater levels = dewatering system IS functioning
4. 2019 water usage is similar to 1984
5. Slope inclinometer data does NOT reveal a consistent pattern of discernable shear.



Next Steps for 2020 Fall/Winter

- Monthly Monitoring, as-needed Maintenance within our SOW
- Compliance testing and reporting for NPDES Permit
- Pressure transducers in 6 locations (CIP)
 - (W-2, W-3/PC-1, BYA-1, SP-9A, SP-20)
 - to continuously monitor groundwater levels through the next rain season
 - to assist in interpreting if reading is measuring a wet casing or the actual water level
- Replace BYA-1 electrical equipment box (CIP)
- Plan and schedule hydrauger cleanout cycle (CIP)



Function of Dewatering Facilities

WHERE DO WE GO FROM HERE?

- ❑ Developed basic rating procedure to help identify next improvements
- ❑ Assigned Functionality Status to Wells and Hydraulics -

Green = functioning and maintained

Yellow = functioning but flagged for improvement

Red = not functioning

[go through maps] –

10 Year Capital Improvement Plan

FACTS regarding existing Capital Improvement Planning

- Currently ~\$100,000 per year
- Intended for: Rotating hydrauger flushing, major rehabilitation or replacement of wells, hydraugers, inclinometers
- One improvement every 1 to 3 years
- Difficult to prioritize over that period of time

FY 20/21 (\$100k)

- Replace pump in BYA-1 - \$11k (*completed*)
- BYA-1 electrical box replacement- \$45k
- Install 6 pressure transducers - \$8k
- Partial hydrauger flushing - \$36k

	Next Capital Improvements	Estimated Cost*
1	Deepen BYA-1	\$300k
2	Install 3 new Hydraugers	\$100k
3	Deepen BYA-15	\$250k
4	Deepen W-3	\$250k
5	Flush Hydraugers (assume 1,200 lin ft)	\$100k



Recommended Improvements

Recommended Improvements	Benefits	Approx. Cost
<p>A Increase funding of assessment district for:</p> <ul style="list-style-type: none">• Increase capital improvement funding to \$200k per year• Increase funding for water quality testing add'l \$300k• Increase funding to create a reserve fund of add'l \$100k per year	<p>Provides adequate funding to perform additional capital projects and improve water quality testing. Having a reserve fund will help during emergency situations.</p>	<p>\$600k per year</p>
<p>B Increase scope of work to include:</p> <ul style="list-style-type: none">• Historic and future InSAR data for monitoring surface movement (1995-2020 + upcoming 12 mos) - \$18k• Annual InSAR data collection for monitoring ground surface movements for \$12k per year	<p>This recommended item will aid in the ability to recognize potential trends of ground movement to supplement the inclinometer data, prioritize locations for monitoring or improvement, early warning of movement.</p>	<p>\$18k - one-time cost \$12k per year</p>



Recommended Improvements

Recommended Improvements	Benefits	Approx. Cost
<p>C Increase scope of work to include:</p> <ul style="list-style-type: none"> • Repair surface drainage and plastic slope/bench protection in headscarp region 	<p>Less water allowed to enter headscarp. However, this would require additional easements from private property owners and annual maintenance</p>	<p>\$70k – one-time cost \$15k – annual maintenance</p>
<p>D Increase scope of work to include:</p> <ul style="list-style-type: none"> • Replace dewatering pumps with dedicated pressure transducer controls – \$20k per well x 23 wells • Install digital flow meters connected by cellular (23 meters) for \$35k 	<p>These recommended items will allow us to obtain continuous groundwater level data in all wells, refine pump controls for maximum efficiency, and assist in making the data more accessible</p>	<p>\$500k - one-time cost</p>
<p>E Increase scope of work to include:</p> <ul style="list-style-type: none"> • Permanent Slope Inclinerometers with pressure transducer or sim. • Install remote transmitter to record and view data remotely monitoring • Web-based system • \$30k to 35k per location @ 29 locations 	<p>This recommendation will reduce the labor hours associated with manual survey of inclinometers, provide frequent measurements and early warning of movement, would be installed with vibrating wire piezometers to water levels at same location</p>	<p>\$1M – one-time cost</p>

Recommended Improvements

Recommended Improvements	Benefits	Approx. Cost
F Complete 10-year recommended capital projects in one year	This accelerates the installation of important system improvements that are recommended now	\$1M – one-time cost
G Increase scope of work to include: <ul style="list-style-type: none"><li data-bbox="173 776 1276 868">• Slope Stability Modelling and Analysis of the Big Rock Mesa Landslide complex	Labor vs Results have relatively low benefit relative to improving and maintaining Big Rock Mesa	\$300-400k – one-time cost



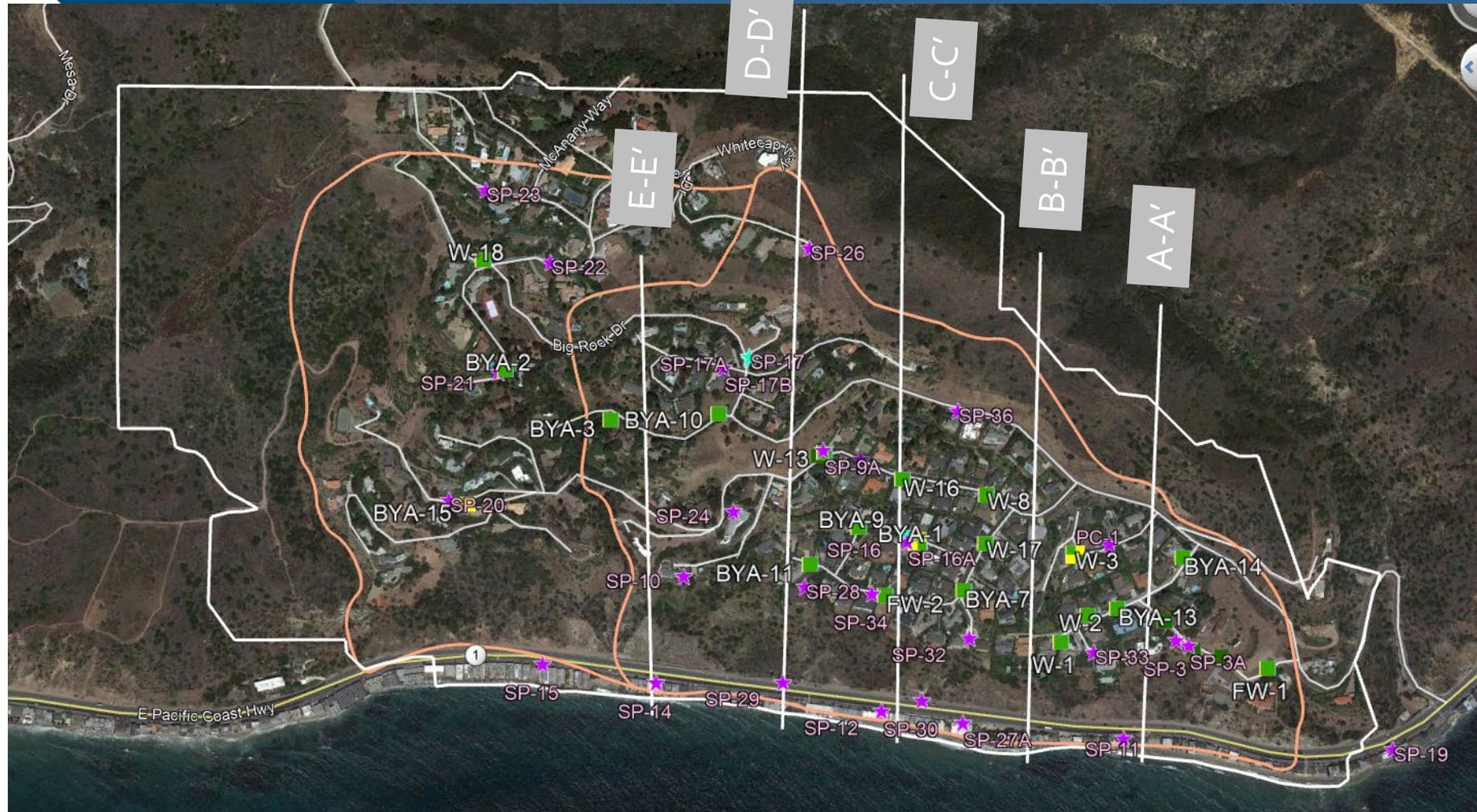
Thank you...



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2020 Groundwater Levels vs. BYA 1992 Cross Sections



2020 Groundwater Levels vs. BYA 1992 Cross Sections

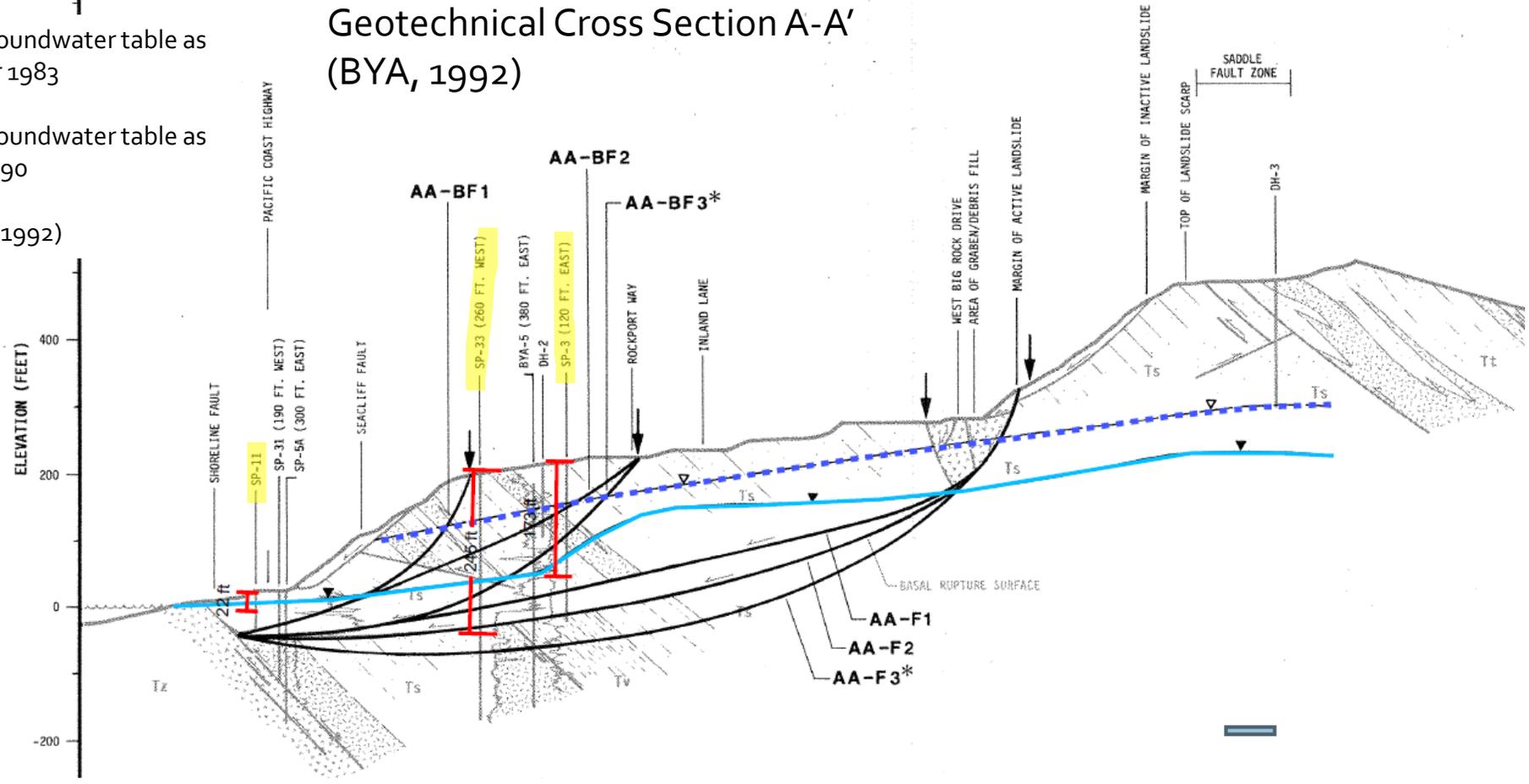
Geotechnical Cross Section A-A'
(BYA, 1992)



Estimated Groundwater table as of September 1983

Estimated Groundwater table as of October 1990

Source: BYA (1992)

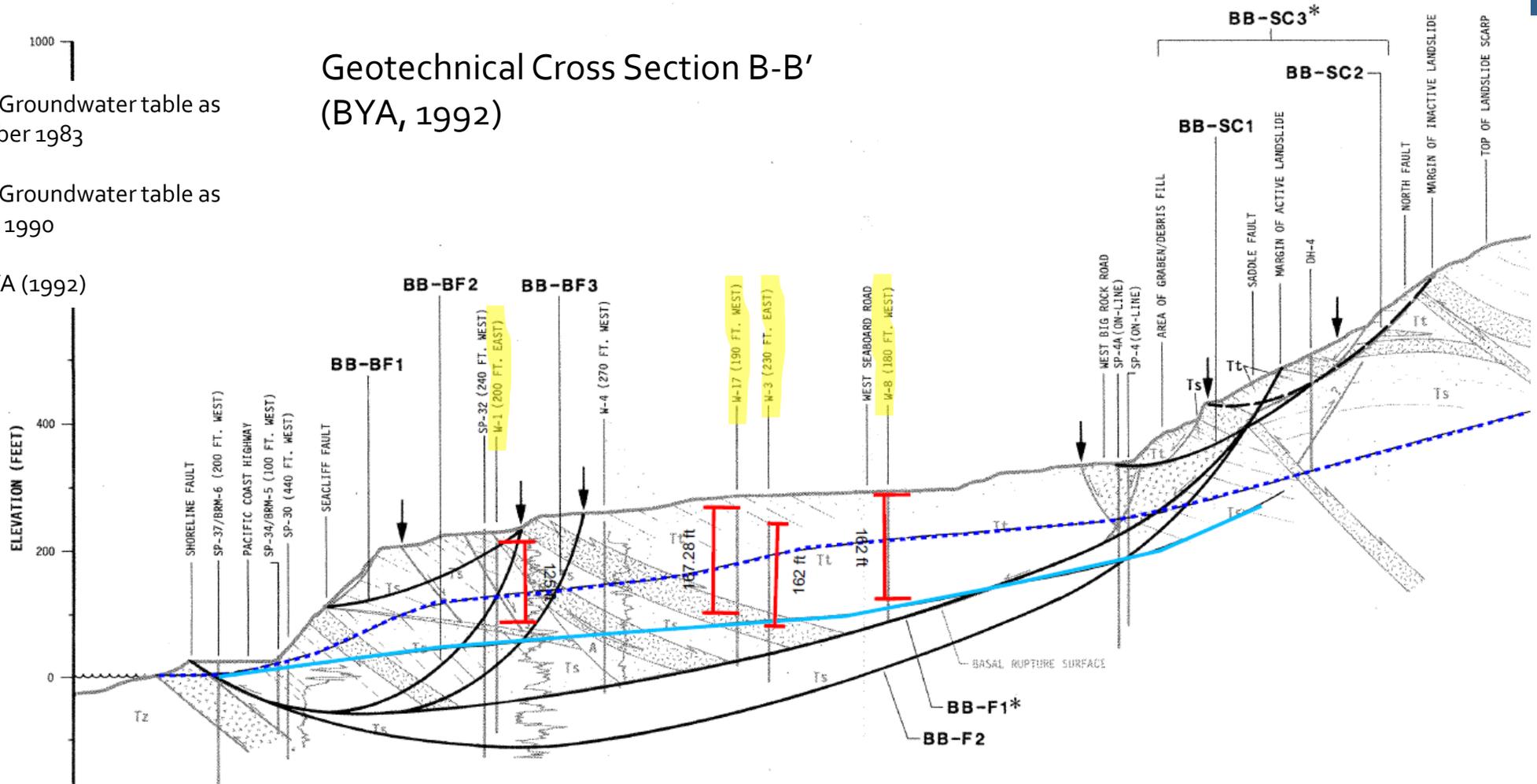


2020 Groundwater Levels vs. BYA 1992 Cross Sections

Estimated Groundwater table as of September 1983

Estimated Groundwater table as of October 1990

Source: BYA (1992)



2020 Groundwater Levels vs. BYA 1992 Cross Sections

C

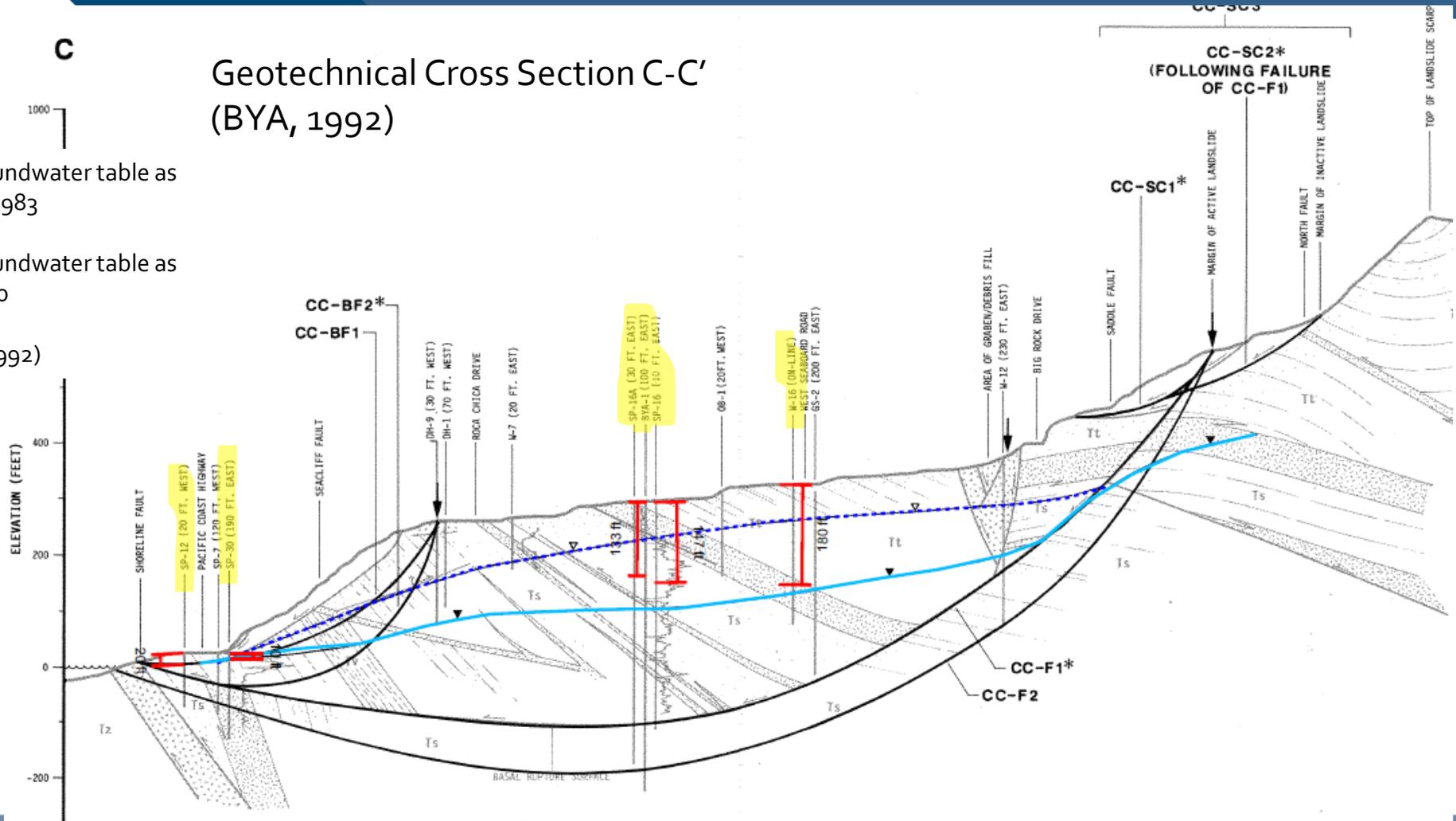
Geotechnical Cross Section C-C'
(BYA, 1992)

1000

Estimated Groundwater table as of September 1983

Estimated Groundwater table as of October 1990

Source: BYA (1992)



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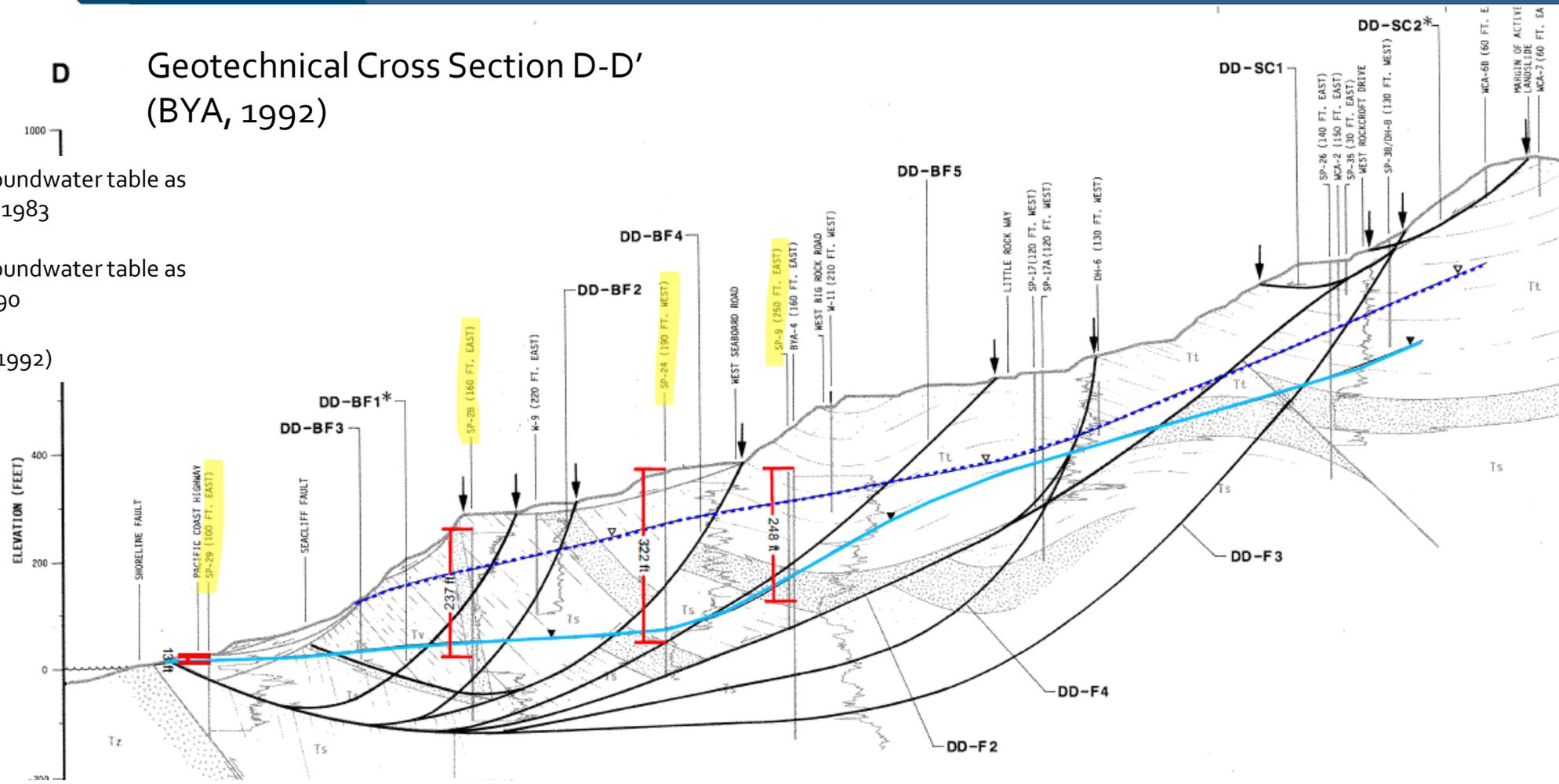
2020 Groundwater Levels BYA 1992 Cross Sections

D Geotechnical Cross Section D-D'
(BYA, 1992)

Estimated Groundwater table as of September 1983

Estimated Groundwater table as of October 1990

Source: BYA (1992)



2020 Groundwater Levels vs. BYA 1992 Cross Sections

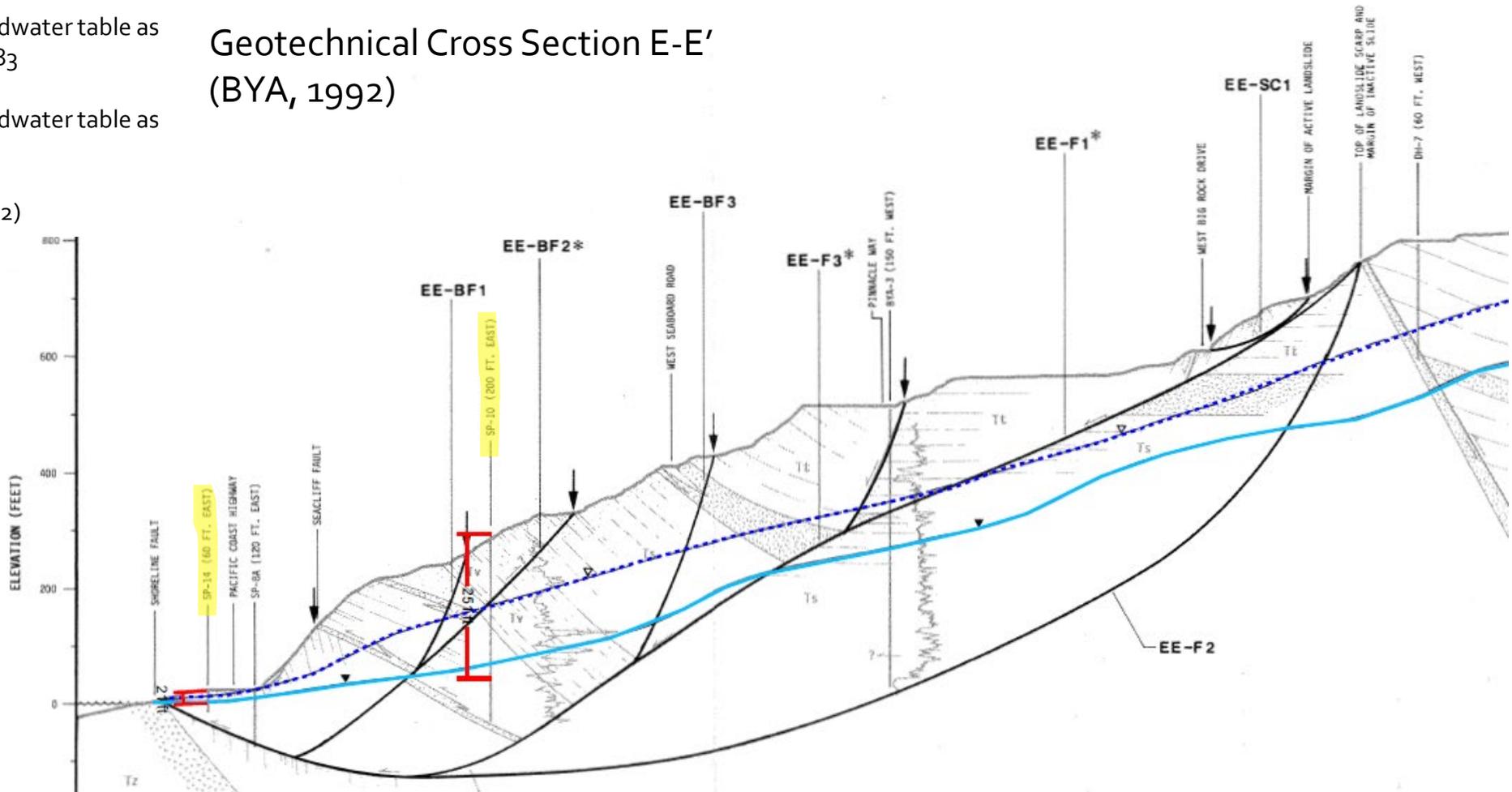


Estimated Groundwater table as of September 1983

Estimated Groundwater table as of October 1990

Source: BYA (1992)

Geotechnical Cross Section E-E' (BYA, 1992)



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