

Nitrate

Nitrate in the lower aquifer was only detected above the MCL in the eastern portion of the Mocho II Subbasin (*Figure 2.4-18*). While smaller in extent, the general location of this plume underlies the nitrate plume in the upper aquifer, suggesting that some of the nitrate in the upper aquifer has migrated into the lower aquifer. For the 2013 Water Year (October 2012 through September 2013), the highest concentration of nitrate in a lower aquifer well was 55.80 mg/L in 3S/2E 8H 3 (compared to 49.60 mg/L in the 2012 Water Year [October 2011 through September 2012] in the same well).

Boron

In general, boron is not a problem in the lower aquifer where detections are typically less than 1 mg/L. However, boron was detected above 2 mg/L in three lower aquifer wells in the 2013 Water Year (October 2012 through September 2013) as follows (*Figure 2.4-19*):

1. Boron was detected in one well in the eastern portion of the Mocho II Subbasin: 2.2 mg/L in monitoring well 3S/2E 23E 2 (compared to 2.4 mg/L in the 2012 Water Year in the same well).
2. Boron was also detected above 2 mg/L in two monitoring wells near the Hopyard Well No. 9 in the northern portion of the Bernal Basin: 2.21 mg/L in 3S/1E 17D 4 (compared to 2.48 mg/L in the 2012 Water Year) and 2.09 mg/L in 3S/1E 17D11 (compared to 2.32 mg/L in the 2012 Water Year). However, concentrations in Hopyard 9 itself, have always been below 0.6 mg/L.

The source of boron is unconfirmed, but may be from localized natural alkali/marine sediments, localized pollutants or may have migrated vertically from a shallower zone during the pumping of the lower aquifers.

2.5 Subsidence Monitoring Program

This section describes the details of Zone 7's subsidence (ground surface elevations) monitoring for the 2013 Water Year (October 2012 through September 2013).

2.5.1 Program Description

The Subsidence Monitoring Program is designed to monitor for changes in surface elevation with respect to changes in groundwater storage, and alert Zone 7 in the event that groundwater withdrawals may be significantly impacting surface elevations. Typically, there are small changes, up and down, in surface elevations that correspond with seasonal and annual changes in groundwater levels. Those that are within the historically observed values, where surface

elevation losses during net groundwater loss periods are fully recovered when groundwater levels return to their original elevations are considered “elastic” subsidence, and not damaging to the storage capacity of the aquifer. Conversely, groundwater withdrawal related subsidence that is not recoverable with aquifer recharge is considered “inelastic” and may be detrimental to both, surface structures and aquifer storage capacity.

This monitoring program, which began in earnest in 2002, involves conducting high precision leveling surveys across the Bernal and Amador Subbasins; starting and ending at stable bedrock elevation stations (A1-1.0 and A1-17.0) and passing through or near Zone 7 and City of Pleasanton wellfields (*Figure 2.5-1*). In addition, elevations and vertical distances between certain wellhead features such as concrete pads, floors, pedestals, casing flanges, and water level reference points are monitored for change. The normal monitoring frequency is twice per year, corresponding with the semi-annual groundwater level monitoring events (spring and fall), however the frequency can be increased as needed if the risk of inelastic subsidence increases, e.g. during low groundwater level periods.

Prior to the current subsidence monitoring procedures, Zone 7 conducted a study of historical benchmark elevation data throughout the western subbasins and concluded that there was no evidence of significant inelastic subsidence due to the historic groundwater pumping. This is the technical basis for Zone 7’s Well Master Plan mitigation measure of maintaining static groundwater levels above the historic lows as a deterrent of inelastic subsidence (WMP 2005).

The 2013 Water Year (October 2012 through September 2013) program included surveying elevations in a network of about 60 benchmarks and other survey points in the spring and fall at approximately the same time that basin-wide groundwater levels were measured (Section 2.4.2). *Figure 2.5-2* contains a list of all land surface elevation monitoring locations for the 2013 Water Year program. These benchmarks were surveyed by Kier & Wright Civil Engineers and Surveyors, Inc., of Livermore, California. Zone 7 also surveyed the additional wellhead features listed on *Figure 2.5-2*.

These sites, labeled with a suffix of “-Diff”, were measured monthly to investigate whether there is any indication of potential inelastic subsidence occurring between the semiannual surveying events.

The following items have changed from the 2012 Water Year (October 2011 through September 2012) Program or are items of note for the 2013 Water Year (October 2012 through September 2013):

In the 2013 Water Year, Zone 7 extended the B4 circuit to include the Chain of Lakes Wellfield. As a result of this added effort, all of Zone 7’s production wellfields are now monitored for evidence of subsidence.

2.5.2 2013 Water Year Results

Figure 2.5-3 shows the most recent (October 2013) survey results and includes the elevation changes since the October 2012 and April 2013 measurements. *Figure 2.5-4* shows the change in surface elevations since the previous year (October 2012) spatially. Most of Zone 7's survey benchmarks have dropped in elevation during the 2013 Water Year (October 2012 through September 2013). From October 2012 to October 2013, the average decrease in land elevation was 0.047' with the largest drops having occurred somewhat concentrically around the Mocho wellfield (maximum -0.095'), Hopyard Well #6 (maximum -0.062'), and Pleasanton Well #8 (maximum -0.062').

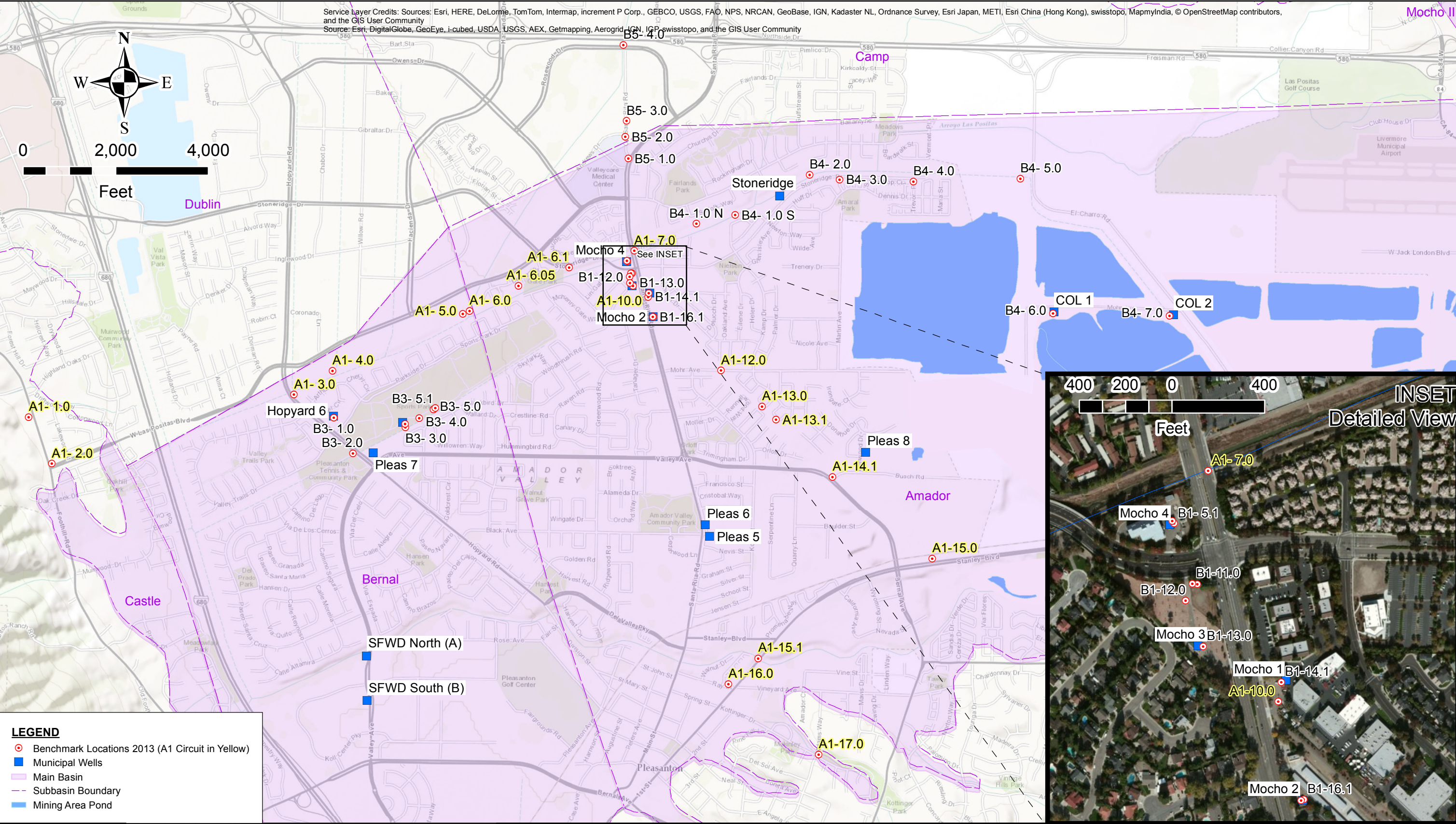
A-circuit survey points are graphed, along with Key Well water elevations, on *Figure 2.5-5* (Bernal Subbasin) and *Figure 2.5-6* (Amador Subbasin). *Figure 2.5-7* (Bernal Subbasin - Hopyard 6 Well), *Figure 2.5-8* (Amador Subbasin - Mocho Wellfield), and *Figure 2.5-9* (Amador Subbasin - Stoneridge) show graphs of land surface elevation changes and groundwater elevation at Zone 7's municipal wells. These graphs show a one-time jump in ground surface elevation in September 2006. This is because Site A1-9.0 was originally believed to be on stationary bedrock and therefore its elevation was held constant. However, in 2007 Water Year (October 2006 through September 2007) it was determined that the site had actually been moving elastically. Therefore, starting with the September 2006 dataset, the data calculations were readjusted so that A1-9.0 elevations could vary, artificially creating the elevation shift seen in the graphs in 2006. It was removed from the program in 2007.

2.6 Wastewater and Recycled Water

This section presents a summary of wastewater and recycled water use in Livermore Valley. As part of this program, Zone 7 compiles and reviews data on the volume and quality of wastewater collected and recycled water used within the watershed from the Livermore Wastewater Recycling Plant (LWRP), and Dublin San Ramon Services District (DSRSD) Water Reclamation plant. Onsite disposal of wastewater from the Veterans Hospital sewage treatment plant and individual septic systems within the groundwater basin are also accounted for in this section.

2.6.1 Introduction

Wastewater disposal concerns have been greatly reduced in the valley through the implementation of municipal wastewater treatment and export projects and the restriction of high-density unsewered development over the Main Basin in the 1970's and early 1980's. In the late 1980's and early 1990's, Zone 7 partnered with the cities, wastewater agencies, and the permitting agency (RWQCB) to develop a master water recycling permit. The permit goals were essentially to maximize the beneficial use of recycled water while protecting the groundwater basin from possible water quality degradation. One of the permit conditions was to develop a



ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

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SCALE: 1 in = 2,000 ft
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FIGURE 2.5-2 SURVEY POINTS AND DESCRIPTIONS 2013 WATER YEAR (Oct 2012 to Sep 2013)

Sites Surveyed by Kier & Wright

Site ID	Well ID	Survey Points	Description
A1- 1.0		G972	Brass disk located in sidewalk
A1- 2.0		Foot-La-Pos	Chisel mark on bridge footing
A1- 3.0		C972	Brass disk mounted on bridge platform
A1- 4.0		Mocho-Chabot	Brass disk located on access road
A1- 5.0		Mocho-Tass-W	Brass disk located on access road
A1- 6.0		Mocho-Tass-E	Brass disk located on access road
A1- 6.05		Mocho TP48	
A1- 6.1		Mocho_CB	Chisel mark on catch basin
A1-10.0		Vine-Pipe	Brass disk in concrete
A1-12.0		Mohr-RR	Spike at Mohr Ave and RR
A1-13.1		COP RE 25281	Replaced A1-13.0 on 4/13/09
A1-14.1		Bush-Valley	
A1-15.0		D8	Brass disk on bridge foundation
A1-15.1		BM-P929 Reset	
A1-16.0		V1	Brass disk
A1-17.0		K2	Brass disk, NGVD Benchmark
B1- 1.0		Mocho-san MP3	Disk located on bridge platform
B1- 2.0		Mocho-san MP2	Disk located on bridge platform
B1- 3.0		Mocho-san MP1	Disk located on bridge platform
B1- 4.0	3S/1E 8H 3	Army Well 2, Floor	Chisel mark on pumphouse floor
B1- 5.1	3S/1E 8H18	STP640 MN/W	Replaced B1-5.0 on 4/13/09
B1- 7.0		Mocho-Stone MP1	Disk located on bridge platform
B1- 8.0		Mocho-Stone MP2	Disk located on bridge platform
B1- 9.0		Mocho-Stone MP3	Disk located on bridge platform
B1-10.0		Mocho-Stone MP4	Disk located on bridge platform
B1-13.0	3S/1E 9M 4	Mocho 3, Shiner	Shiner at entrance door
B1-14.1	3S/1E 9M 2	Mocho 1, Floor	
B1-16.1	3S/1E 9M 3	Mocho 2, Floor	
B3- 1.0		Mocho-Park	Brass disk on concrete vault
B3- 2.0		1H ALA	County Benchmark
B3- 3.0	3S/1E 17D12	Hop 9 BM	Benchmark, rod in access road
B3- 4.0		MP1 (Disc)	
B3- 5.0		MP2 (Disc)	
H7- C	3S/1E 17D10		Hopyard 7 Well (Punch)
B4- 1.0 S		AMP-Ctl S	Brass Disk on Control
B4- 1.0 N		AMP-Ctl N	
B4- 2.0	3S/1E 9B 1	Stoneridge, Floor	Chisel mark at entrance door
B4- 3.0		GUZMAN PKWY	
B4- 4.0		Trevor Pkwy at Stoneridge	
B4- 5.0		El Charro at Arroyo Mocho	
B4- 6.0	3S/1E 11M 3	Chain of Lakes 2	
B4- 7.0	3S/1E 10K 3	Chain of Lakes 1	
B5- 1.0		OSRR-BC	New Monument disk
B5- 2.0		OSRR-Andrew	New Monument disk
B5- 3.0		OSRR-Cafe	New Monument disk
B5- 4.0		Tass-Rose	Disk on bridge foundation (formerly A1-8.0)

Additional Wellhead Features Monitored by Zone 7

Site ID	Well Id	Survey Points	Description
COL1-Diff	3S/1E 10K 3	Chain of Lakes 1, Pedestal	COL1 pedestal to ground difference
COL2-Diff	3S/1E 11M 3	Chain of Lakes 2, Pedestal	COL2 pedestal to ground difference
H6-C	3S/1E 18A 6	Hopyard 6, Casing	Hop 6 casing / flange
H6-D	3S/1E 18A 6	Hopyard 6, Drain	Hop 6 drain
H6-Diff	3S/1E 18A 6	Hopyard 6, Pedestal	Hop 6 pedestal to ground difference
H6-F	3S/1E 18A 6	Hopyard 6, Floor	Hop 6 chisel mark on pumphouse floor
H6-P	3S/1E 18A 6	Hopyard 6, Pedestal	Hop 6 well pedestal
H6-RP	3S/1E 18A 6	Hopyard 6, RP	Hop 6 reference point
H9-T	3S/1E 17D12	Hopyard 9, Transformer	Hop 9 transformer pad
H9-C	3S/1E 17D12	Hopyard 9, Casing	Hop 9 casing / flange
H9-Diff	3S/1E 17D12	Hopyard 9, Pedestal	Hop 9 pedestal to ground difference
H9-F	3S/1E 17D12	Hopyard 9, Floor	Hop 9 chisel mark on pumphouse floor
H9-P	3S/1E 17D12	Hopyard 9, Pedestal	Hop 9 well pedestal
H9-RP	3S/1E 17D12	Hopyard 9, RP	Hop 9 reference point
M1-C	3S/1E 9M 2	Mocho 1, Casing	Mocho 1 casing / flange
M1-P	3S/1E 9M 2	Mocho 1, Pedestal	Mocho 1 well pedestal
M1-RP	3S/1E 9M 2	Mocho 1, RP	Mocho 1 reference point
M1-T	3S/1E 9M 2	Mocho 1, Transformer	Mocho 1 transformer pad
M2-Diff	3S/1E 9M 3	Mocho 2, Pedestal	Mocho 2 pedestal to ground difference
M3-C	3S/1E 9M 4	Mocho 3, Casing	Mocho 3 casing / flange
M3-Diff	3S/1E 9M 4	Mocho 3, Pedestal	Mocho 3 pedestal to ground difference
M3-P	3S/1E 9M 4	Mocho 3, Pedestal	Mocho 3 well pedestal
M3-RP	3S/1E 9M 4	Mocho 3, RP	Mocho 3 reference point
M3-T	3S/1E 9M 4	Mocho 3, Transformer	Mocho 3 transformer pad
M4-C	3S/1E 8H18	Mocho 4, Casing	Mocho 4 casing / flange
M4-Diff	3S/1E 8H18	Mocho 4, Pedestal	Mocho 4 pedestal to ground difference
M4-P	3S/1E 8H18	Mocho 4, Pedestal	Mocho 4 well pedestal
M4-RP	3S/1E 8H18	Mocho 4, RP	Mocho 4 reference point
M4-T	3S/1E 8H18	Mocho 4, Transformer	Mocho 4 transformer pad
S-C	3S/1E 9B 1	Stoneridge, Casing	Stoneridge casing / flange
S-D	3S/1E 9B 1	Stoneridge, Drain	Stoneridge drain
S-Diff	3S/1E 9B 1	Stoneridge, Pedestal	Stoneridge pedestal to ground difference
S-P	3S/1E 9B 1	Stoneridge, Pedestal	Stoneridge well pedestal
S-RP	3S/1E 9B 1	Stoneridge, RP	Stoneridge reference point

Monitoring Frequency

Circuit	Frequency
A1 Circuit*	Semi-annually
B1 Mocho loop	Semi-annually
B3 Hopyard wells loop	Semi-annually
B4 Stoneridge well loop	Semi-annually
B5 Tassajara - Rosewood	Annually
Municipal Wells	As needed

Legend

*	Not including the A1 North Segment, which was discontinued in 2007
■	Probable bedrock sites



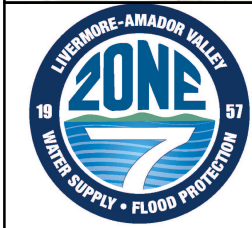
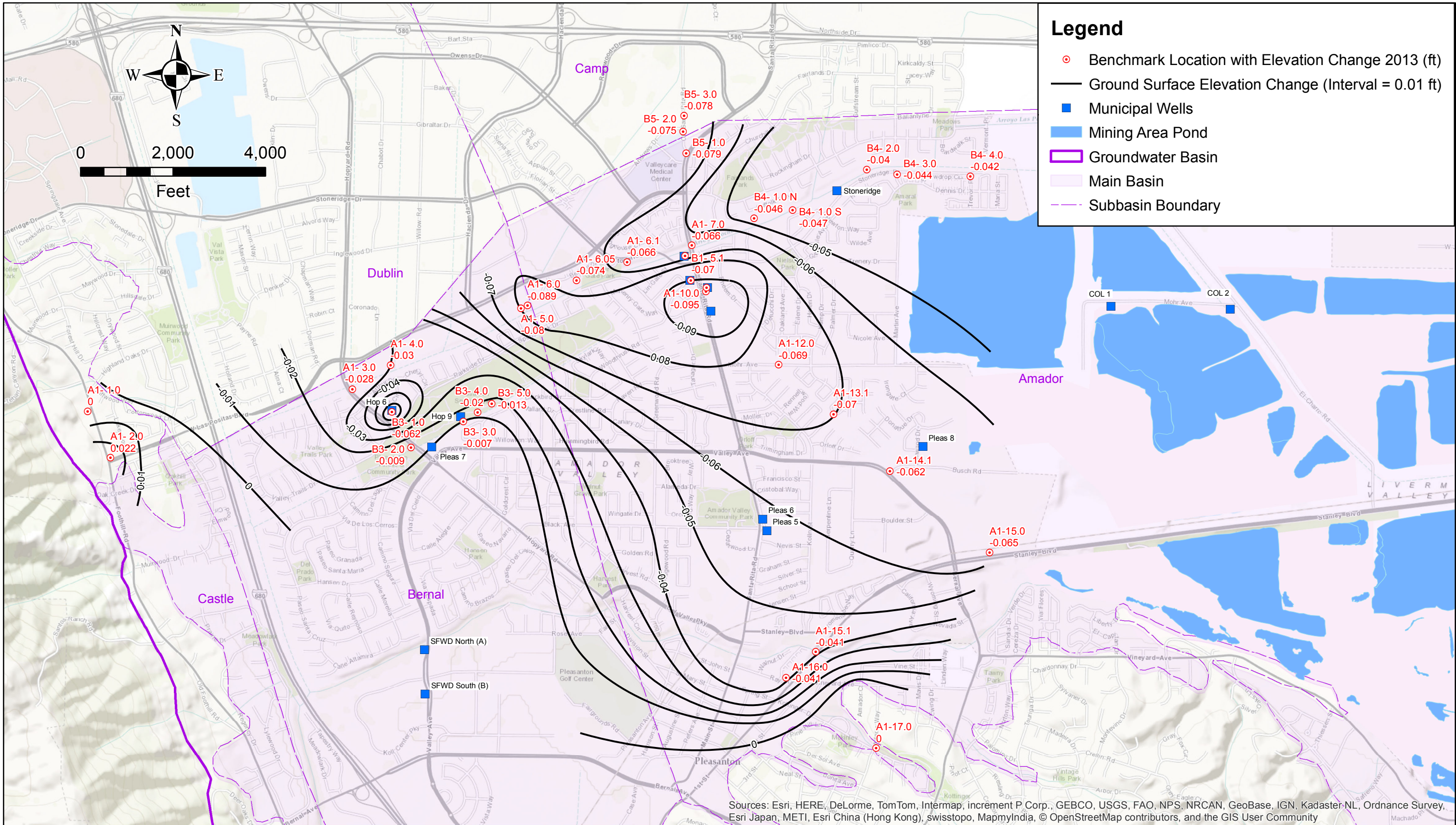
**FIGURE 2.5-3
KIER AND WRIGHT SURVEY MEASUREMENTS
2013 WATER YEAR (Oct 2012 to Sep 2013)**

Site	Site Description	Fall 2012 (Oct 3 & 4) Elevation in ft NAVD88	Spring 2013 (Apr 16 & 17) Elevation in ft NAVD88	Fall 2013 (Oct 8) Elevation in ft NAVD88	Change in Elevation (ft)		
					Seasonal		Annual
					Fall 12 to Spring 13	Spring 13 to Fall 13	Fall 12 to Fall 13
A1- 1.0	G972*	365.705	365.705	365.705	0.000	0.000	0.000
A1- 2.0	Foothill and Las Positas	405.439	405.447	405.461	0.008	0.014	0.022
A1- 3.0	C972	330.566	330.550	330.538	-0.016	-0.012	-0.028
A1- 4.0	Arroyo Mocho at Chabot Crk	324.015	323.999	323.985	-0.016	-0.014	-0.030
A1- 5.0	Arroyo Mocho at Tassajara Crk West	327.135	327.085	327.055	-0.050	-0.030	-0.080
A1- 6.0	Arroyo Mocho at Tassajara Crk East	327.818	327.760	327.729	-0.058	-0.031	-0.089
A1- 6.05	Arroyo Mocho at Tassajara Crk East	329.384	329.316	329.310	-0.068	-0.006	-0.074
A1- 6.1	Arroyo Mocho Pleasanton Control	332.652	332.607	332.586	-0.045	-0.021	-0.066
A1- 7.0	M1257	341.892	341.852	341.826	-0.040	-0.026	-0.066
A1-10.0	Vineyard Pipeline at Santa Rita Rd	340.942	340.899	340.847	-0.043	-0.052	-0.095
A1-12.0	Mohr Ave at Iron Horse	347.535	347.480	347.466	-0.055	-0.014	-0.069
A1-13.1	COP RE 25281	349.997	349.948	349.927	-0.049	-0.021	-0.070
A1-14.1	Busch and Valley	356.881	356.836	356.819	-0.045	-0.017	-0.062
A1-15.0	D8	367.034	367.004	366.969	-0.030	-0.035	-0.065
A1-15.1	BM-P929 Reset	361.493	361.476	361.452	-0.017	-0.024	-0.041
A1-16.0	V1	367.045	367.020	367.004	-0.025	-0.016	-0.041
A1-17.0	K2*	399.808	399.808	399.808	0.000	0.000	0.000
B1- 5.1	Mocho 4	336.702	336.660	336.632	-0.042	-0.028	-0.070
B1-13.0	3S/1E 9M 4	336.467	336.424	336.405	-0.043	-0.019	-0.062
B1-14.1	3S-1E 9M 2 New	341.026	340.990	340.935	-0.036	-0.055	-0.091
B1-16.2	3S-1E 9M 3 New	NA	341.589	341.534	NA	-0.055	NA
B3- 1.0	MOCHO-PARK	323.097	NA	323.035	NA	NA	-0.062
B3- 2.0	1H ALA	320.562	NA	320.553	NA	NA	-0.009
B3- 3.0	HOP9-BM	321.543	NA	321.536	NA	NA	-0.007
B3- 4.0	PLEASANTON CANAL	323.600	NA	323.580	NA	NA	-0.020
B3- 5.0	HOP7 MP1	322.556	NA	322.543	NA	NA	-0.013
H7-C	Hop7 Casing	324.873	NA	324.864	NA	NA	-0.009
B4- 1.0 S	AMP-CTL S	322.048	322.013	322.001	-0.035	-0.012	-0.047
B4- 1.0 N	AMP-CTL N	322.187	322.151	322.141	-0.036	-0.010	-0.046
B4- 2.0	Stoneridge Wellhouse	344.774	344.743	344.734	-0.031	-0.009	-0.040
B4- 3.0	GUZMAN PKWY	343.886	343.849	343.842	-0.037	-0.007	-0.044
B4- 4.0	Trevor Pkwy at Stoneridge	346.496	346.458	346.454	-0.038	-0.004	-0.042
B4- 5.0	El Charro at Arroyo Mocho	NA	357.573	357.580	NA	0.007	NA
B4- 6.0	Chain of Lakes 2	NA	363.814	363.863	NA	0.049	NA
B4- 7.0	Chain of Lakes 1	NA	358.275	358.285	NA	0.010	NA
B5- 1.0	OSRR-BC	344.016	343.975	343.937	-0.041	-0.038	-0.079
B5- 2.0	OSRR-ANDREW	343.087	343.044	343.012	-0.043	-0.032	-0.075
B5- 3.0	OSRR-CAFÉ	344.529	344.478	344.451	-0.051	-0.027	-0.078
B5- 4.0	Tass-Rose	349.654	349.601	349.654	-0.053	0.053	0.000

* Fixed Reference Point

NM = Not measured

NA = Not applicable/available



ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA

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SCALE: 1 in = 2,000 ft

DATE: Jul 21, 2014

Figure 2.5-4
Ground Surface Elevation Change (ft)
Fall 2012 to Fall 2013
Livermore Valley Groundwater Basin



FIGURE 2.5-5
CUMULATIVE LAND SURFACE ELEVATION CHANGES
SINCE START OF PROGRAM
BERNAL SUBBASIN

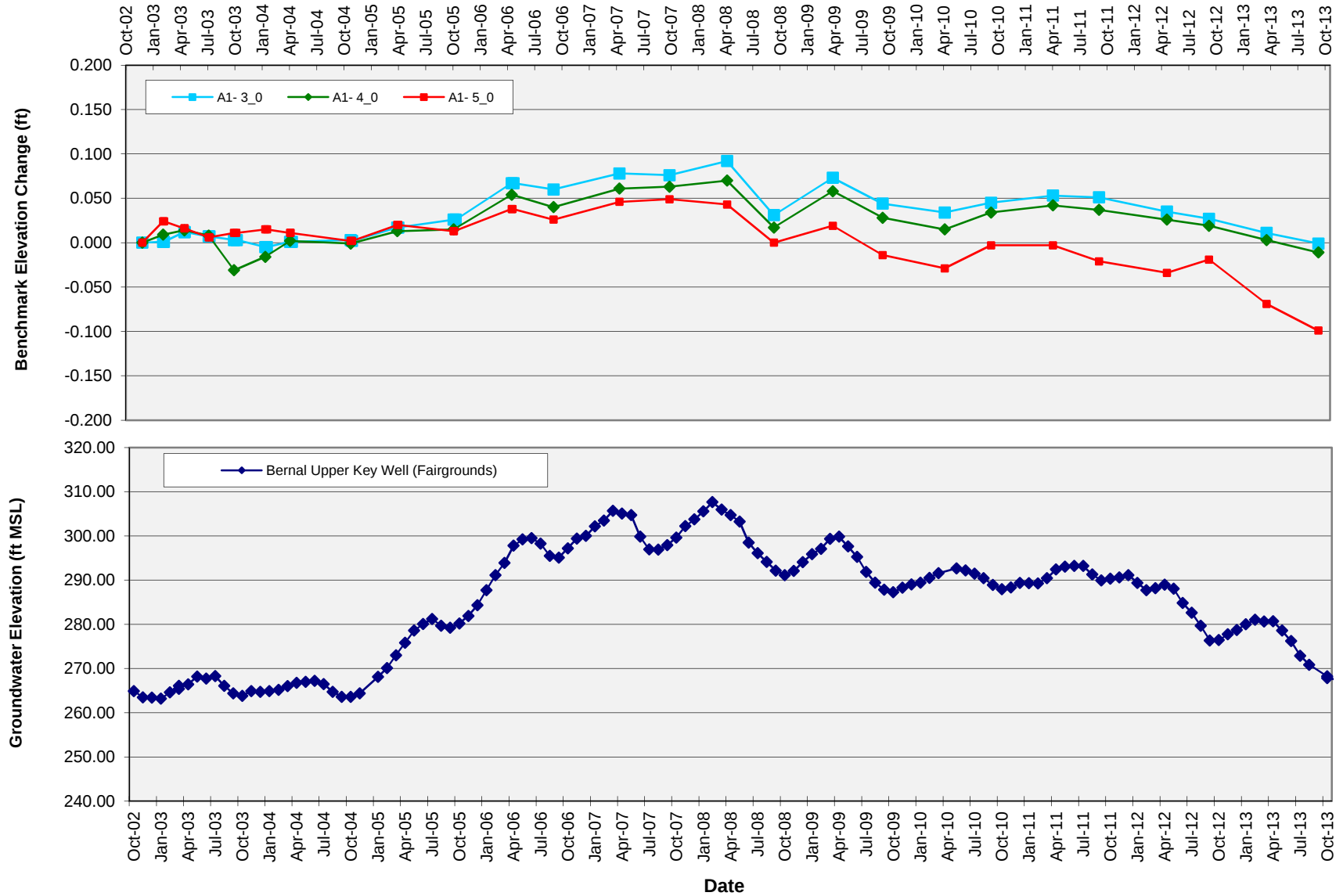




FIGURE 2.5-6
CUMULATIVE LAND SURFACE ELEVATION CHANGES
SINCE START OF PROGRAM
AMADOR SUBBASIN

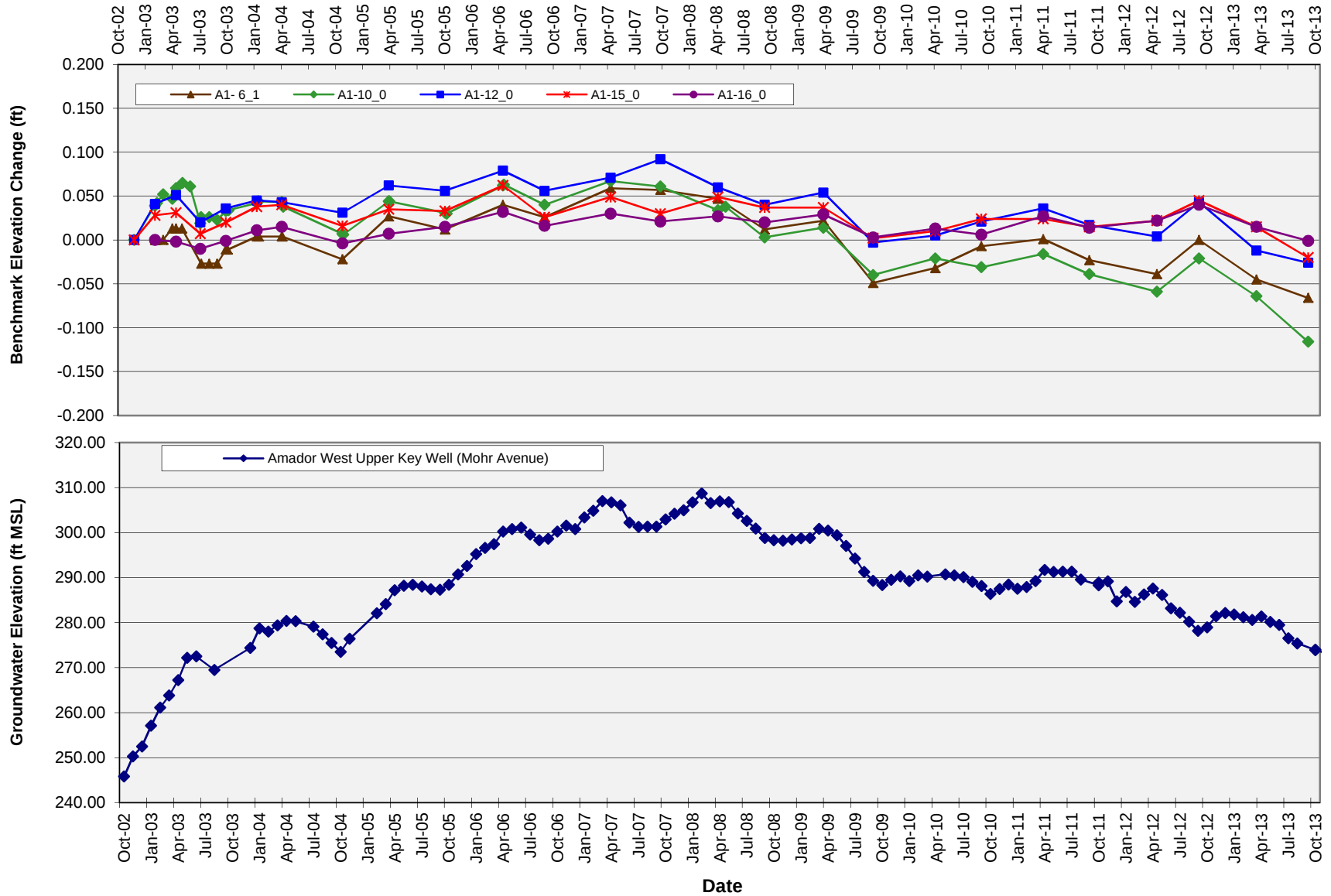




FIGURE 2.5-7
GRAPHS OF LAND SURFACE ELEVATION AND
GROUNDWATER ELEVATION VERSUS TIME
BERNAL SUBBASIN - HOPYARD 6 WELL

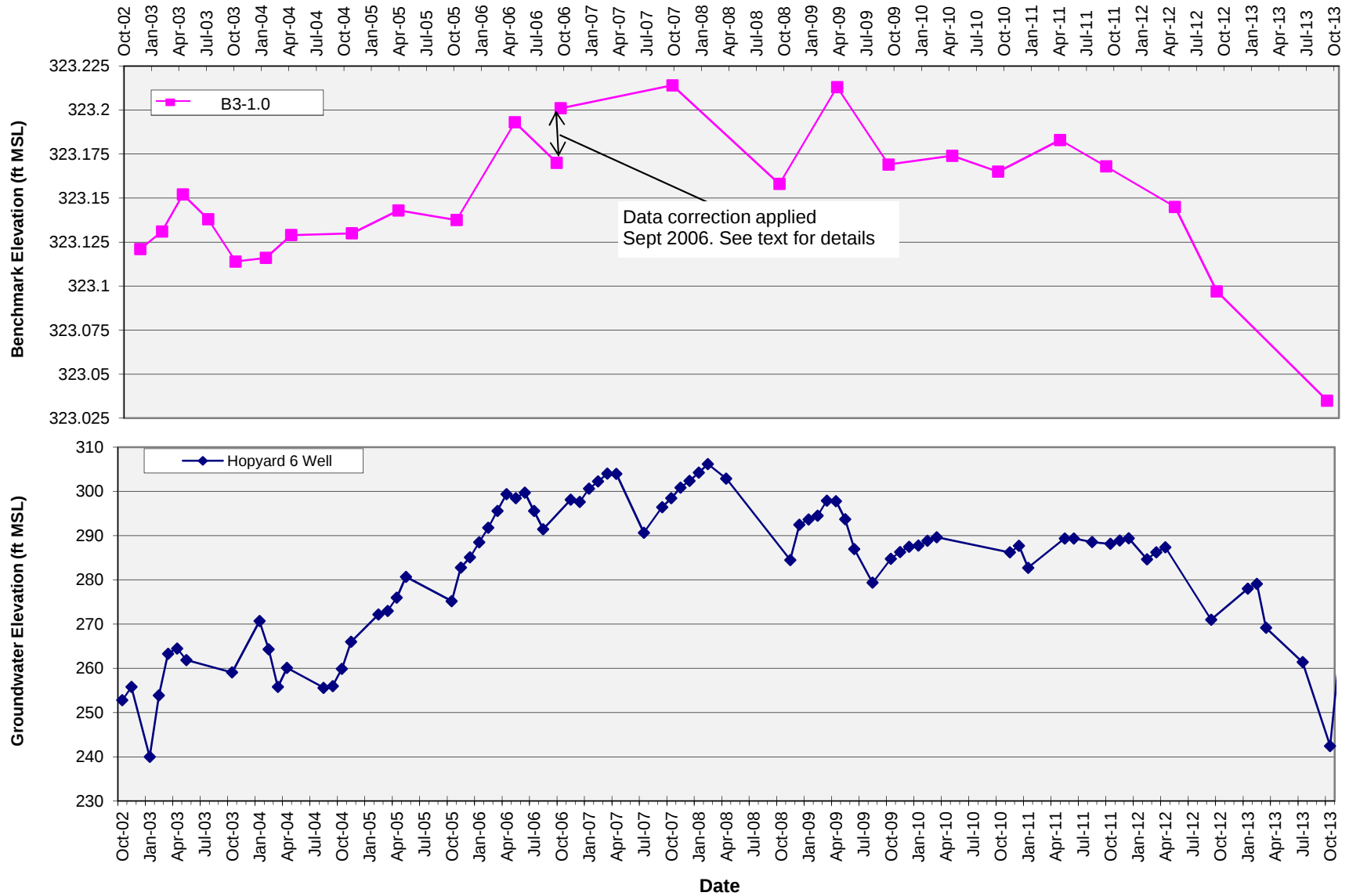




FIGURE 2.5-8
GRAPHS OF LAND SURFACE ELEVATION AND
GROUNDWATER ELEVATION VERSUS TIME
AMADOR SUBBASIN - MOCHO WELLFIELD

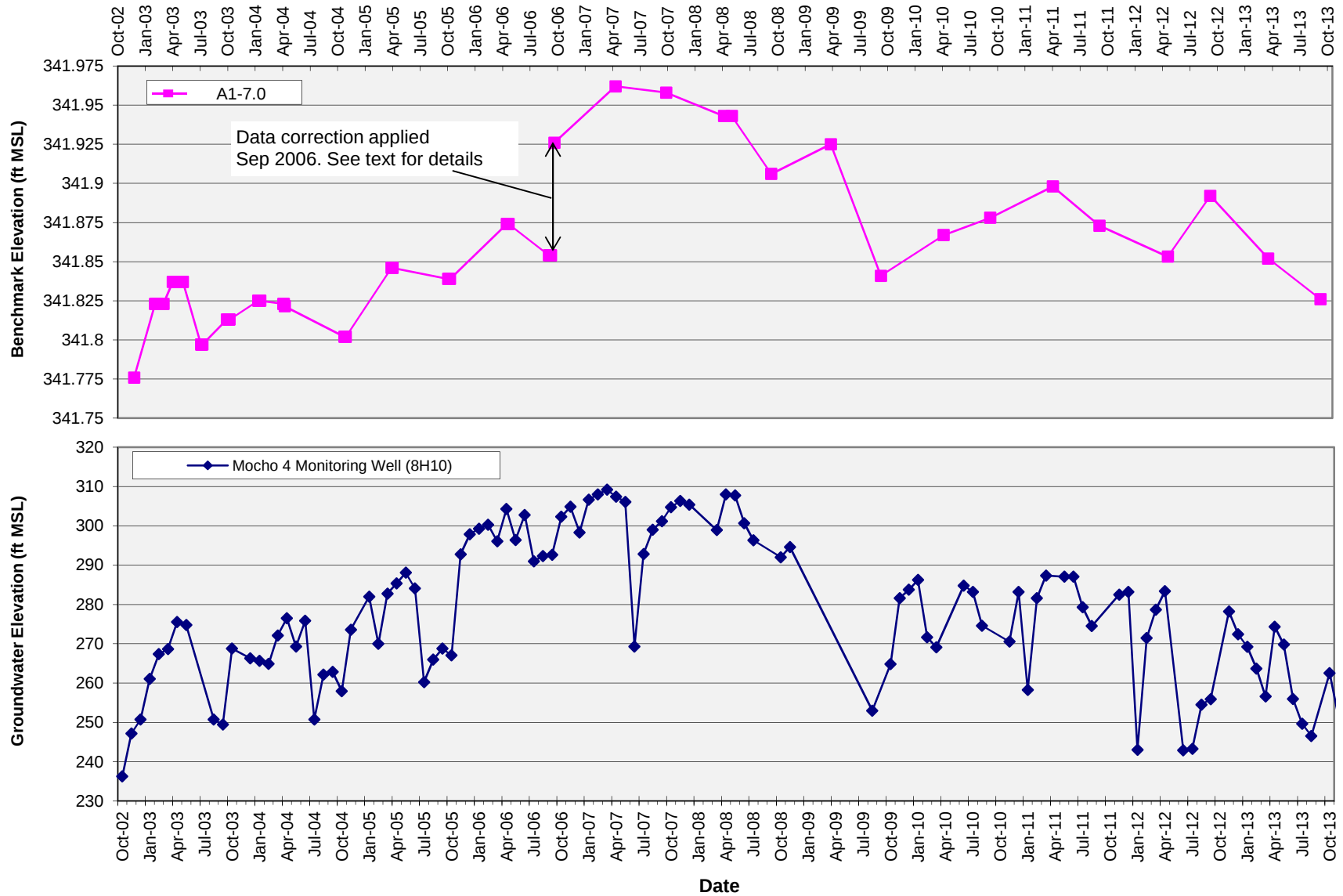




FIGURE 2.5-9
GRAPHS OF LAND SURFACE ELEVATION AND
GROUNDWATER ELEVATION VERSUS TIME
AMADOR SUBBASIN - STONERIDGE WELL

