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Annual Report for the Sustainable Groundwater Management Program 2018 Water Year

Livermore Valley Groundwater Basin

Annual Report for the

Sustainable Groundwater Management Program

2018 Water Year (October 2017 – September 2018)

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ZONE 7 WATER AGENCY

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Table of Contents

List of Figures and Tables

In Text **Page**

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Acronyms and Abbreviations

Abbrev	Description	Abbrev	Description
µg/L	Micro grams per liter	DWR	California Department of Water Resources
ACCDA	Alameda County Community Development Agency	EBRPD	East Bay Regional Parks District
ACEH	Alameda County Environmental Health	EIR	Environmental Impact Report
ACNP	Alamo Canal near Pleasanton	ESL	Environmental screening level
ACWD	Alameda County Water District	ETo	Evapotranspiration
ADLLV	Arroyo de la Laguna at Verona	ft	Feet
ADVP	Arroyo Del Valle Pleasanton	GIS	Geographic information systems
AF	Acre-feet	GPD	Gallons per day
AF/yr	Acre-feet per year	GPQ	Groundwater Pumping Quota
ALP	Arroyo Las Positas	GSA	Groundwater Sustainability Agency
ALP_ELCH	Arroyo Las Positas at El Charro	GSP	Groundwater Sustainability Plan
ALPL	Arroyo Las Positas near Livermore	GWMP	Groundwater Management Plan
ALTC	Altamont Creek	GWE	Groundwater Elevation
AMHAG	Arroyo Mocho Hageman	HI	Hydrologic Inventory
AM_KB	Arroyo Mocho at Kaiser Bridge	HRL	Health reference level
AMNL	Arroyo Mocho near Livermore	ISCO	In-situ chemical oxidation
AMP	Arroyo Mocho Pleasanton	LAMP	Local Agency Management Program
AOC	Area of Concern	LAVWMA	Livermore-Amador Valley Water Management Agency
AVADLL	Arroyo Valle at Arroyo de la Laguna	lbs	Pounds
AVBLC	Arroyo Valle below Lang Canyon	LDV	Lake Del Valle
AVNL	Arroyo Valle near Livermore	LLNL	Lawrence Livermore National Laboratory
BBID	Byron-Bethany Irrigation District	LTCP	Low-Threat Underground Storage Tank Closure Policy
bgs	Below ground surface	LWRP	Livermore Water Reclamation Plant
BMOs	Basin management objectives	MCL	Maximum contaminant level
BMPs	Best management practices	mg/L	Milligrams per liter
BO	Basin objective	MGDP	Mocho Groundwater Demineralization Plant
BTEX	Benzene, toluene, ethylbenzene, xylene	MOU	Memorandum of Understanding
CASGEM	California Statewide Groundwater Elevation Monitoring	msl	Mean sea level
CCNP	Chabot Canal near Pleasanton	MTBE	Methyl tertiary-butyl ether
CEC	Constituents-of-emerging-concern	NAVD	North American Vertical Datum
CEQA	California Environmental Quality Act	N	Nitrogen
cfs	Cubic feet per second	NC	North Canyons
CIMIS	California Irrigation Management Information System	NMP	Nutrient Management Plan
COL	Chain of Lakes	NO_3	Nitrate Ion
Cr	Chromium	NOP	Notice of Preparation
CrIII	Trivalent chromium	NPDES	National Pollutant Discharge Elimination System
CrVI	Hexavalent chromium	OWTS	Onsite wastewater treatment system
CWS	California Water Service	PCE	Tetrachloroethylene
CY	Calendar year	POTW	Publicly owned treatment works
DCE	Dichloroethene	ppb	Parts per billion
DOE	Department of Energy	PRP	Potential responsible party
DSRSD	Dublin San Ramon Services District	RAP	Remedial Action Plan

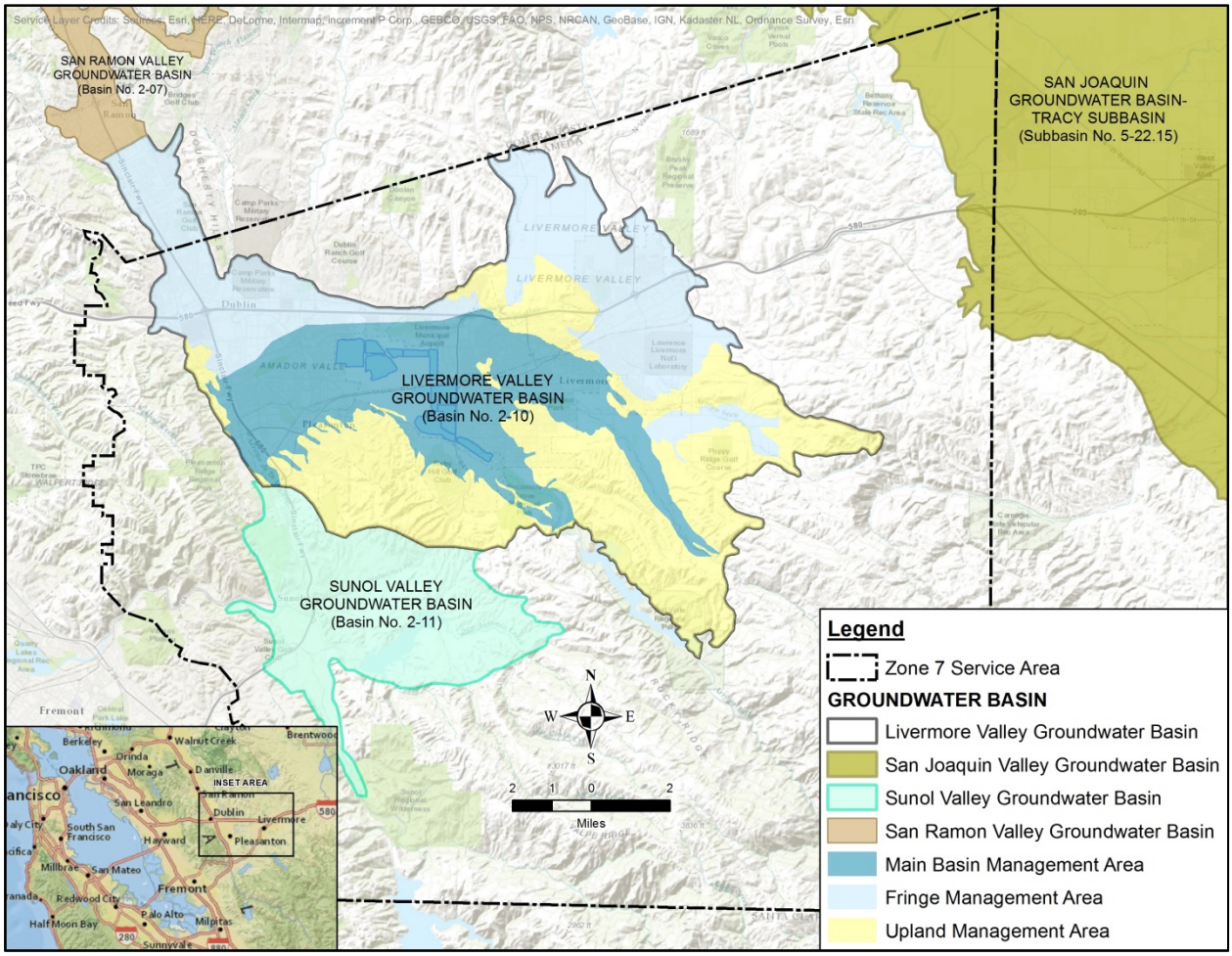
Abbrev	Description	Abbrev	Description
RO	Reverse osmosis	TKN	Total Kjeldahl nitrogen
RP	Responsible Party	TPHd	Total petroleum hydrocarbons as diesel
RRE	Rural residential equivalent	TPHg	Total petroleum hydrocarbons as gasoline
RWQCB	California Regional Water Quality Control Board	TSS	Toxic Sites Surveillance
SBA	South Bay Aqueduct	USEPA	U.S. Environmental Protection Agency
SGMA	Sustainable Groundwater Management Act	USGS	U.S. Geological Survey
SLIC	Spills, Leaks, Investigations, and Clean-ups	UST	Underground storage tank
SFPUC	San Francisco Public Utilities Commission	VA	Veteran's Administration
SMP	Salt Management Plan	VC	Vinyl chloride
SNMP	Salt Nutrient Management Plan	VOC	Volatile organic compound
SWP	State Water Project	WBIC	Weather-Based Irrigation Controller
SWRCB	State Water Resources Control Board	WDR	Waste Discharge Requirement
TAF	Thousand acre-feet	WMP	Well Master Plan
TBA	Tertiary-butyl alcohol	WQO	Water Quality Objective
TCE	Trichloroethylene	WWMP	Wastewater Management Plan
TDS	Total dissolved solids	WY	Water year (October 1 through September 30)

Executive Summary

ES.1 Introduction

Zone 7 Water Agency (Zone 7) has managed and imported local surface water and groundwater resources for beneficial uses in the Livermore Valley Groundwater Basin (*Figure ES-A*) for more than 55 years. Consistent with its management responsibilities, duties, and powers, Zone 7 is designated in the 2009 Sustainable Groundwater Management Act (SGMA) as the exclusive Groundwater Sustainability Agency (GSA) within its jurisdictional boundaries.

Figure ES-A: Livermore Valley Groundwater Basin



This *2018 Water Year Groundwater Management Program Annual Report for the Livermore Valley Groundwater Basin* (2018 Annual Report) was prepared in compliance with Title 23, California Code of

Regulations Section 356, *Annual Report and Periodic Evaluations by the Agency* for the 2018 Water Year (WY) (October 1, 2017 through September 30, 2018). It summarizes this year's groundwater monitoring, evaluation, and management efforts in the Livermore Valley Groundwater Basin. *Table ES-A* provides a summary of the required information and the specific location(s) in the report where required information is provided.

For this Annual Report, the results for each of the water resource monitoring, evaluation, and management programs are summarized in the Executive Summary, while the details are provided in the following sections.

- Section 1: Agency and Basin Information
- Section 2: Precipitation and Evaporation
- Section 3: Surface Water
- Section 4: Mining Area
- Section 5: Surface Water-Groundwater Interaction
- Section 6: Groundwater Elevations
- Section 7: Groundwater Quality
- Section 8: Subsidence
- Section 9: Land Use
- Section 10: Wastewater and Recycled Water
- Section 11: Groundwater Storage
- Section 12: Groundwater Supply Sustainability
- Section 13: Water Quality Sustainability

In an effort to avoid duplication, material included in the *Alternative Groundwater Sustainability Plan for the Livermore Valley Groundwater Basin* (Alternative GSP) (*Zone 7, 2016d*) has not been repeated here, but specific sections are referenced when more background detail may be desired.

Table ES-A: Location of Required Items in the 2018 Groundwater Management Annual Report

Annual Report Requirement (23 CCR Article 7, Sections from Water Code § 10733.2)	Location(s) in Report	
	Text Section	Figures
356.2 (a) General information, including an executive summary and a location map depicting the basin covered by the report.	Executive Summary Section 1, Agency and Basin Information • Section 1.1, Introduction • Section 1.2, Zone 7 Service Area • Section 1.4, Plan Area • Section 1.5, Basin and Hydrogeologic Setting • Section 1.5.1, Basin Management Areas • Section 1.6, Aquifer Zones • Section 1.7, Groundwater Characteristics	• Figure 1-1, Map of Livermore Valley Groundwater Basin, Zone 7 Service Area, and Basin Management Areas and Subareas
356.2 (b) (1) Groundwater elevation data from monitoring wells identified in the monitoring network shall be analyzed and displayed as follows: (A) Groundwater elevation contour maps for each principal aquifer in the basin illustrating, at a minimum, the seasonal high and seasonal low groundwater conditions. (B) Hydrographs of groundwater elevations and water year type using historical data to the greatest extent available, including from January 1, 2015, to current reporting year.		• Figure ES-1, Key Well Hydrograph (Bernal) • Figure 6-3: Historical Key Well Hydrographs, 1901 to 2018 Water Years • Figure 6-4: Groundwater Gradient Map, Upper Aquifer, Spring • Figure 6-5: Groundwater Gradient Map, Upper Aquifer, Fall • Figure 6-6: Change in Groundwater Elevation, Upper Aquifer, Fall 2017 to Fall 2018 • Figure 6-8: Groundwater Gradient Map, Lower Aquifer, Spring • Figure 6-9: Groundwater Gradient Map, Lower Aquifer, Fall

Annual Report Requirement (23 CCR Article 7, Sections from Water Code § 10733.2)	Location(s) in Report	
	Text Section	Figures
356.2 (b) (2) Groundwater extraction for the preceding water year. Data shall be collected using the best available measurement methods and shall be presented in a table that summarizes groundwater extractions by water use sector, and identifies the method of measurement (direct or estimate) and accuracy of measurements, and a map that illustrates the general location and volume of groundwater extractions.	Section 11, Groundwater Storage • Table 11-A: HI Method Groundwater Storage Supply and Demand Volumes, 2018 WY (AF) • Table 11-B: Groundwater Storage Summary, 2018 WY (in Thousand AF) • Table 11-2: Description of Hydrologic Inventory Components • Table 11-3: Historical Groundwater Storage, Hydrologic Inventory Method, 1974 to 2018 Water Years	• Figure 11-3: Graph of Historical Groundwater Storage, 1974 to 2018 Water Years
356.2 (b) (3) Surface water supply used or available for use, for groundwater recharge or in-lieu use shall be reported based on quantitative data that describes the annual volume and sources for the preceding water year.	Section 12, Groundwater Supply Sustainability • Table 12-A: Imported Water Sources for the 2018 Calendar Year (AF)	• Figure 12-1: Livermore-Amador Valley Water Supply and Use, 2018 Water Year • Figure 12-2: Valley Water Production from Imported Water and Groundwater, 1974 to 2018 Water Years • Figure 11-5: Main Basin Groundwater Production, 1974 to 2018 Water Years
356.2 (b)(4) Total water use shall be collected using the best available measurement methods and shall be reported in a table that summarizes total water use by water use sector, water source type, and identifies the method of measurement (direct or estimate) and accuracy of measurements. Existing water use data from the most recent Urban Water Management Plans or Agricultural Water Management Plans within the basin may be used, as long as the data are reported by water year.	Section 12, Groundwater Supply Sustainability • Table 11-2: Description of Hydrologic Inventory Components Section 9, Land Use • Table 9-1: Table of Livermore Valley Land Use Acreage	• Figure 12-1: Livermore-Amador Valley Water Supply and Use, 2018 Water Year

Annual Report Requirement (23 CCR Article 7, Sections from Water Code § 10733.2)	Location(s) in Report	
	Text Section	Figures
356.2 (b)(5)(A) Change in groundwater in storage maps for each principal aquifer in the basin.	Section 11, Groundwater Storage	• Figure 6-10: Change in Groundwater Elevation, Lower Aquifer, Fall 2017 to Fall • Figure 11-2: Change in Groundwater Storage, Fall 2017 to Fall 2018
356.2 (b)(5)(B) A graph depicting water year type, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.		• Figure 11-3: Graph of Historical Groundwater Storage, 1974 to 2018 Water Years

Annual Report Requirement (23 CCR Article 7, Sections from Water Code § 10733.2)	Location(s) in Report	
	Text Section	Figures
356.2 (c) A description of progress towards implementing the Plan, including achieving interim milestones, and implementation of projects or management actions since the previous annual report.	Section 11, Groundwater Storage • Section 11.2, Groundwater Budget Section 12, Groundwater Supply Sustainability • Section 12.1, Introduction • Section 12.2, Import of Surface Water • Section 12.4, Future Supply Reliability • Section 12.5, Water Conservation • Section 12.6, Chain of Lakes Recharge Projects • Section 12.7, Well Master Plan • Section 12.9, Existing and Future Recycled Water Use Section 12, Groundwater Supply Sustainability • Section 13.2, Well Ordinance Program • Section 13.3, Toxic Site Surveillance Program • Section 13.4.2, Salt Management • Section 13.5, Nutrient Management • Section 13.5.3, OWTS Management	

AF	acre-feet	OWTS	On-Site Wastewater Treatment System
GW	groundwater	WY	water year
HI	Hydrologic Inventory Method		

ES.2 2018 Groundwater Conditions Overview

ES.2.1. Overview

Zone 7 has been managing groundwater resources sustainably for the past 40 years as demonstrated in *Figure ES-B*. Zone 7 was able to keep the groundwater resources replenished and minimize reliance on groundwater production to meet potable water demands during the 2018 WY. Overall, groundwater conditions in the Livermore Basin are stable and have recovered from the 2011-2015 drought.

Figure ES-B: Bernal Key Well Hydrograph

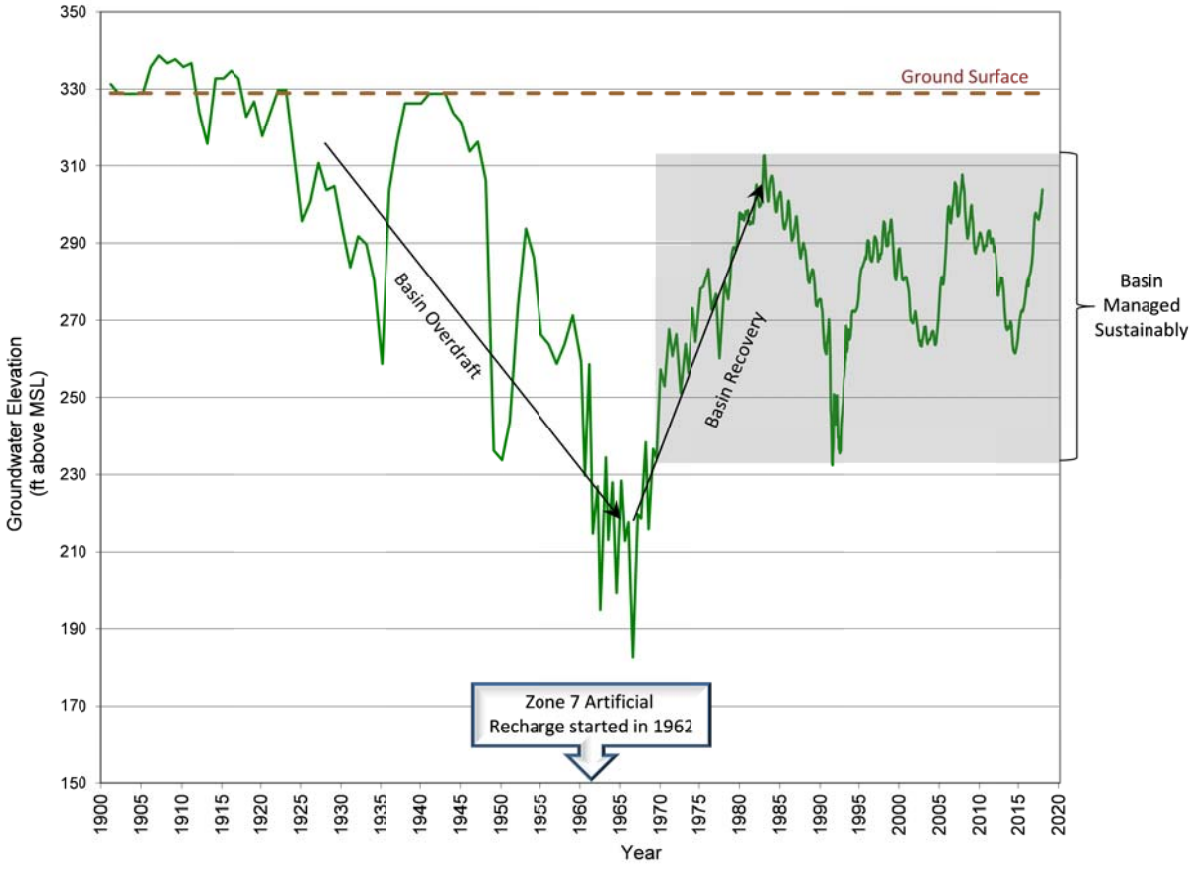


Table ES-B summarizes the five sustainability indicators, their associated undesirable results and minimum thresholds as presented in the *2015 Alternative GSP* (*Zone 7, 2016d*). The table also includes the 2018 WY status for each indicator and any action taken in the 2018 WY or planned for the upcoming WY. More in depth descriptions of each sustainability indicator can be found in the sections of the Executive Summary that immediately follow, as well as in this 2018 Annual Report for the Sustainable Groundwater Management Program.

Table ES-B: Summary of Sustainability Indicators and 2018 WY Status

Sustainability Indicator	Undesirable Results 2015 Alt GSP	Minimum Threshold 2015 Alt GSP	Status 2018 WY	Action Taken
Groundwater Levels	Loss of wellfield or loss of domestic supply well	Historic Lows	Main Basin was 40' to 150' above historic lows in all areas except a limited area surrounding Lake E due to mining activities	Increased monitoring of the quarry operations to prevent undesirable results
Groundwater Storage	Chronic loss of storage	Total Storage above 128 TAF (Historic Low)	Total Storage at 249 TAF, (121 TAF above Historic Low)	No action needed
Groundwater Quality	Lower Aquifer degradation resulting in wellfield not being suitable to provide drinking water supply	TDS >500 mg/L	Main Basin avg TDS = 655 mg/L TDS was detected above the minimum threshold in Mocho Wellfield municipal supply wells	Increase municipal supply pumping, operation of MGDP, and artificial groundwater recharge with low TDS water in 2019 WY
		NO3 (as N) > 10mg/L	NO3 (as N) exceeded threshold in northeastern Mocho II Subarea	Continue to monitor
		Boron > 1.4 mg/L	Boron exceeded threshold in two wells in the Mocho Wellfield up to 2.0 mg/L	Continue to monitor
		Total Chromium > 0.050 mg/L[1]	Chromium threshold wasn't exceeded in any municipal or lower aquifer wells[2]	No action needed
Land Subsidence	Inelastic subsidence	Land surface elevation decrease of 0.4'	Elastic fluctuations of 0.05' per cycle with less than 0.2' overall	No action needed
Surface Water-Groundwater Interaction	Depletion of surface water in the Alkali Sink	Elevation 491' in 2S/2E 34E1 Elevation 501' in 2S/2E 27P2	Elevation 493.94' in 2S/2E 34E1 Elevation 502.23' in 2S/2E 27P2	No action needed

[1]The minimum threshold was changed from CrVI < 0.010 mg/L in the 2015 Alternative GSP to Total Cr < 0.050 mg/L after SWRCB rescinded the CrVI MCL in 2017 so we are using the Total Cr MCL of 0.050 mg/L instead.

[2]One upper aquifer monitoring well in a fringe basin exceeded the threshold.

ES.2.2. Surface Water – Groundwater Interaction

Ongoing monitoring and management by Zone 7 have supported the maintenance of steady groundwater levels in the Springtown Alkali Sink area, indicating no significant surface water depletion since the late 1970s. Results for 2018 WY indicate that groundwater levels continue to be above the thresholds defined in the Alternative GSP. Zone 7's ongoing Surface Water-Groundwater Interaction Monitoring Program and results for the 2018 WY are described in *Section 5, Surface Water-Groundwater Interaction*.

ES.2.3. Groundwater Levels

Zone 7's Groundwater Elevation Monitoring Program includes the measurement of groundwater levels in monitoring and production wells to confirm that management objectives are met, to assess groundwater supplies, and to define any new management objectives needed to achieve sustainability. The program focuses on the Main Basin, where groundwater is pumped for municipal uses. However, water levels are also measured in the fringe areas.

Groundwater levels for the 2018 WY followed a typical historical seasonal pattern: Rising in the beginning of the year with rainfall recharge and reduced pumping, and levelling off and then dropping the second half of the WY as rainfall decreased and demand increased. The seasonal fluctuations are greater in the Lower Aquifer where more pumping occurs to meet demands in the warmer months.

Upper Aquifer water levels in western portion of the Main Basin generally rose up to about five feet (ft) from Fall 2018 to Fall 2017 because of the near average rainfall recharge and less than average municipal pumping during the WY. In the eastern portion of the Amador Subbasin, Upper Aquifer water levels dropped over 30 ft because of reduced stream recharge along the Arroyo Mocho, continued removal of groundwater from gravel mining pits, and municipal pumping.

At the end of the WY, lower aquifer groundwater levels in the Bernal Subarea were more than 120 ft above the historic low, and 40–90 ft above the historic lows in the Amador Subarea. Over the majority of the Mocho II Subarea, the end-of-year groundwater levels were 90–150 ft above historical lows.

Water levels in the immediate vicinity of Lake E have been below the historic low water level of 220 ft mean sea level (msl) since 2012, with no observed undesirable results. The water levels are drawn down in that area due to dewatering by the quarry operator for mining activities. During the 2018 WY, water levels in the area of Lake E were 45 ft below the historic low.

Section 6, Groundwater Elevations, further describes Groundwater Elevation Monitoring Program and results for the 2018.

ES.2.4. Groundwater Quality

Groundwater quality is an important factor in achieving and maintaining sustainable groundwater resources. The main purpose of monitoring groundwater quality is to assure that remediation of past groundwater degradation is proceeding, and that no new degradation has occurred or is currently taking place. Zone 7 also has programs that review permits and monitoring reports related to contamination and nutrient loads (see *ES 3.1, Water Quality Sustainability*). Zone 7 maintains a robust monitoring network of wells for annual sampling and reporting. Each well in the program is monitored and/or sampled to fulfill one or more specific objectives. The groundwater monitoring program conducts annual sampling and analysis for inorganic constituents of concern for meeting the Livermore Basin groundwater quality objectives. The four main constituents of concern that are monitored and have set minimum thresholds are total dissolved solids (TDS), nitrate, boron, and chromium (Cr). A brief summary of the results of each of these constituents for the 2018 WY are provided.

Many of the municipal supply wells in the Pleasanton area produced water having TDS concentrations greater than the minimum threshold of 500 milligrams per liter (mg/L) during 2018 WY. The highest TDS concentrations were detected in samples collected from two Zone 7 supply wells in the Mocho wellfield (1,010 mg/L in Mocho 3 and 1,026 mg/L in Mocho 4) and a monitoring well located central to four active wellfields used for municipal and public supply (1,284 mg/L in 3S/1E 17B4). The source of these high TDS concentrations is believed to be the Upper Aquifer Zone, which has TDS concentrations as high as 2,000 mg/L in the same area directly above the Mocho well completions. Zone 7 has the ability to strip and export much of the salts from the water produced by the Mocho wells with its onsite groundwater demineralization facility (MGDP) which it plans to use more in 2019 WY. Other planned corrective actions and strategies are described in *Section 5.3.3.2, Salt Management Strategy of the Alternative GSP*.

In the Lower Aquifer, nitrate was only detected above the minimum threshold in one Area of Concern (AOC), the Buena Vista AOC, during the 2018 WY. Nitrate concentrations exceeded the minimum threshold in two monitoring wells (13.1 mg/L in 3S/2E 8H 3 and 10.3 mg/L in 3S/2E 16A 3). Two municipal supply wells located in the same AOC had nitrate concentrations that approached the minimum threshold (8.9 mg/L in CWS10 and 9.6 mg/L in CWS9). This will continue to be monitored.

Boron has been detected above the minimum threshold of 1.4 mg/L in a handful of lower aquifer monitoring wells in the past and again in the 2018 WY. Boron was detected at slightly above 2.0 mg/L for the first time in a municipal supply well in the Mocho Wellfield. This will continue to be monitored.

In the Alternative GSP, the minimum threshold for Cr was set at the maximum contaminant level (MCL) for hexavalent chromium (CrVI) was set at, which was 0.010 mg/L at the time. The CrVI MCL was removed from the State regulations in 2017 by the SWRCB, and their reliance on the MCL for total Cr at 0.050 mg/L was reestablished. As a result, the minimum threshold for Cr in groundwater was changed to total Cr < 0.050 mg/L to match the State's MCL change. No total Cr detections exceeded this threshold in any municipal supply wells or lower aquifer monitoring wells in 2018 WY. Total Cr above 0.050 mg/L was detected in one upper aquifer monitoring well located in the Fringe Subarea-Northeast.

Overall, there were no significant groundwater quality changes relative to the minimum thresholds encountered during the 2018 WY. More detailed results of Zone 7's Groundwater Quality Monitoring Program can be found in *Section 7, Groundwater Quality*. A description of Zone 7's management actions regarding groundwater basin quality can be found in *Section 13, Water Quality Sustainability*.

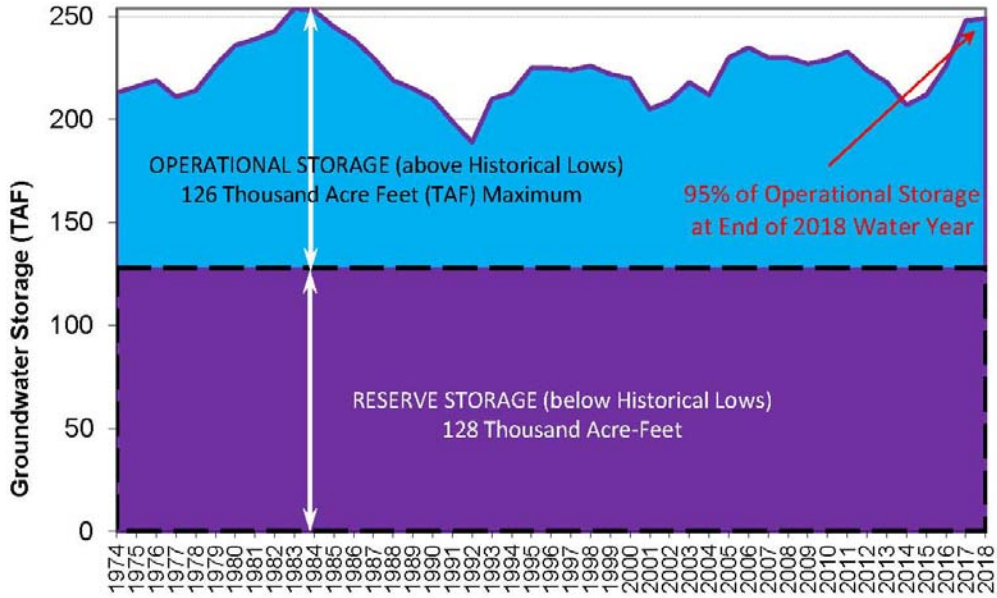
ES.2.5. Subsidence

The Land Surface Elevation Monitoring Program encompasses Zone 7's production wellfields, a network of elevation benchmarks, and reference benchmark points located in bedrock outside of the alluvial basin. There continues to be no inelastic deformation observed during the life of the existing monitoring program. Elastic fluctuations generally have been within 0.05 ft per cycle and < 0.2 ft overall since the monitoring began in 2002. During the 2018 WY, ground surface elevations generally rose in most of the monitored areas due to the high water levels in the Basin. The results are presented in *Section 8, Land Surface Elevation*.

ES.2.6. Groundwater Storage

Zone 7 uses two methods for calculating groundwater storage in the Main Basin: The Groundwater Elevation (GWE) Method and the Hydrologic Inventory (HI) Method. Storage volumes from the two methods are averaged to calculate the total storage of the Main Basin (see *Section 2.4.1 of the Alternative GSP*). *Section 11*, *Groundwater Storage,* presents the storage volume for the 2018 WY, which shows an overall increase of 1.4 thousand acre-feet (TAF) between the end of the 2017 WY and the end of the 2018 WY. Operational groundwater storage at the end of 2018 WY was 121.4 TAF, which is about 95% of the estimated historical high operational storage (*Figure ES-C*). The minimum threshold for groundwater storage is shown as the line between Reserve Storage and Operational Storage in *Figure ES-C.* There were no undesirable results for groundwater storage in the 2018 WY.

Figure ES-C: Operational Storage in Main Basin Management Area



ES.3 Project and Management Action Overview

Zone 7 is currently implementing a variety of programs to assess, manage, monitor, and protect groundwater supplies. *Section 12, Groundwater Supply Sustainability* and *Section 13, Water Quality Sustainability* provide details on the key programs Zone 7 managed and implemented during 2018 WY.

ES.3.1. Groundwater Supply Sustainability

To achieve sustainable groundwater levels, Zone 7 carefully manages all available water supplies, including imported surface water, local surface water, groundwater, and recycled water. During 2018 WY, Zone 7 imported 28,217 acre-feet (AF) of water to meet potable uses and continued to pursue efforts to strengthen supply reliability of imported water and reduce demand through continued promotion of local conservation efforts. Zone 7 also continued to manage groundwater through monitoring natural recharge and demand, limiting groundwater pumping by retailers through the use of quotas as well as artificial recharge and limiting Zone 7 groundwater pumping. In addition, Zone 7 carefully monitors a series of former quarry lakes, known as the Chain of Lakes (COL), for water storage and groundwater replenishment. Zone 7 was part of a joint effort by the Tri-Valley water agencies, studying the technical feasibility of potable reuse, or purified recycled water, to enhance long-term water supply reliability. In May 2018, the Tri-Valley water agencies completed the Joint Tri-Valley Potable Reuse Technical Feasibility Study. The results showed that potable reuse was indeed technically feasible. The next steps that were identified include a regional water demand study, regional water supply updates, and technical studies regarding the COL and groundwater injection siting. These and Zone 7's other groundwater supply management actions are discussed in *Section 12, Groundwater Supply Sustainability.*

ES.3.2. Water Quality Sustainability

Preserving or improving groundwater quality is a key component of sustainable groundwater management. Zone 7 administers four key programs to ensure the protection of groundwater quality: the Water Well Ordinance Program, the Toxic Site Surveillance Program, the Salt Management Plan (SMP), and the Nutrient Management Plan (NMP). During the 2018 WY, 165 drilling permits were issued with groundwater quality protection conditions, and 82% of the permitted work was physically inspected by Zone 7 permit compliance staff. One new soil and groundwater contamination case was identified and is being actively monitored and addressed along with 42 other active contamination cases within Zone 7's service area. Zone 7 also continued to implement its Salt Management and NMPs to monitor, assess, reduce and manage salt and nutrient loading. As part of its strategy to manage salt loading, Zone 7 exported 1,168 tons of salt from the Valley via the Mocho Groundwater Demineralization Plant (MGDP). For nutrient management, Zone 7 has a role in managing On-Site Wastewater Treatment System (OWTS) densities within the Livermore Valley Groundwater Basin and watershed through the issuance of non-residential (e.g. commercial and industrial) use permits. No new permits were issued in the 2018 WY; however, Zone 7 paid out a total of $24,747.61 in rebates to two homeowners in the Buena Vista high nitrate area-of-concern that replaced their existing conventional septic systems with two new OWTS that have integrated pre-treatment modules for reducing nitrogen (N) content in their effluent. Additional updates or changes made to these programs during the 2018 WY are discussed in *Section 13, Water Quality Sustainability*.

1 Agency and Basin Information

1.1 Introduction

Zone 7 Water Agency (Zone 7) provides water services in addition to flood protection, and has managed imported and local surface and groundwater resources for beneficial uses in the Livermore Valley Groundwater Basin (California Department of Water Resources [DWR] Basin 2-10) for more than 55 years. In 2005, Zone 7 adopted a Groundwater Management Plan (GWMP), which documented ongoing policies and programs for managing groundwater to support existing and beneficial uses in the valley (Zone 7 2005). This was amended in June 2015 with the adoption of the Nutrient Management Plan (NMP). Consistent with its management responsibilities, duties, and powers, Zone 7 is designated in the 2009 Sustainable Groundwater Management Act (SGMA) as the exclusive Groundwater Sustainability Agency (GSA) within its boundaries (*Figure 1-1*).

In December 2016, Zone 7 completed the *Alternative Groundwater Sustainability Plan for the Livermore Valley Groundwater Basin* (Alternative GSP)(*Zone 7, 2016d*). The Alternative SGP was submitted to DWR in December 2016 in compliance with SGMA. This *2018 Groundwater Annual Report for the Livermore Valley Groundwater Basin* (2018 Annual Report) is prepared in compliance with Title 23, California Code of Regulations Section 356, Annual Report and Periodic Evaluations by the Agency.

The results for each of the water resource monitoring, evaluation, and management programs are summarized in the Executive Summary, while the details are provided in the main report sections. In an effort to keep this report concise, historical and reference materials included in the Alternative GSP have not been repeated here.

All of the data included in this report are conveyed based on the 2018 Water Year (WY) (i.e., October 1, 2017 through September 30, 2018); however, due to other reporting obligations, some information in Section 2, *Groundwater Conditions*, Section 2.1.2, *Demand Components,* regarding retailer pumping is also compiled and reported on a calendar year (CY) basis (i.e., January 1 through December 31, 2018).

1.2 Zone 7 Service Area

The Zone 7 water service area (*Figure 1-1*) is located about 40 miles southeast of San Francisco, and encompasses an area of approximately 425 square miles of the eastern portion of Alameda County, including the Livermore-Amador Valley, Sunol Valley, and portions of the Diablo Range. Zone 7 also serves a portion of Contra Costa County (Dougherty Valley in San Ramon) through an out-of-service-area agreement with Dublin San Ramon Service District (DSRSD).

As the water wholesaler, Zone 7 supplies treated State Water Project (SWP) water to four local retail water supply agencies (*Figure 1-2*).

- California Water Service —Livermore District (CWS)
- Dublin San Ramon Services District (DSRSD),
- City of Livermore (Livermore)
- City of Pleasanton (Pleasanton)

1.3 Zone 7 Programs

Zone 7 is the lead agency for many water resource management programs and coordinates with groundwater resource programs of others in the basin. Zone 7 programs include the following.

- Monitoring groundwater using long-term well measurements coupled with a detailed groundwater basin numerical model;
- Monitoring land surface elevation changes;
- Importing, artificially recharging, and banking surface water to meet future demands;
- Implementing a conjunctive use program that maximizes use of the storage capacity of the groundwater basin, including long-term implementation of the Chain of Lakes (COL) Program;
- Managing groundwater pumping for sustainability;
- Maintaining sustainable long-term groundwater storage volumes with natural and imported supplies;
- Promoting sound recycled water use; and
- Identifying and planning for future supply needs and demand impacts.

Through these and other programs, Zone 7 has sustainably managed the groundwater basin to avoid undesirable results. The historical groundwater data shows that the basin has been operated sustainably for over 40 years, and through three major droughts. Most of the datasets discussed in this annual report date back to 1974, allowing a comprehensive, long-term assessment of Zone 7's basin management.

The history of Zone 7 Water Agency, including its statutory responsibilities and its ongoing coordination with other local agencies in the basin, is described in *Section 1.2*, *Zone 7 Water Agency* of the Alternative GSP (*Zone 7, 2016*).

1.4 Sustainable Groundwater Management Ordinance

In 2017, Zone 7 adopted its Sustainable Groundwater Management Ordinance (Ordinance) to enhance existing sustainable management programs for the local groundwater basin. The Ordinance recognizes groundwater as an essential resource for municipal, industrial, and domestic uses, as well as agricultural production, and sets provisions for groundwater protection within Eastern Alameda County. Nothing in the ordinance determines or alters water rights, groundwater rights, or existing county ordinances. The Ordinance is discussed in more detail in *Section 12.8* of this report.

1.5 Plan Area

The Plan Area (*Figure 1-1*) is the entire Livermore Valley Groundwater Basin (DWR Basin No.2-10), encompassing approximately 69,600 acres (109 square miles) in Alameda and Contra Costa counties. The Plan Area is referred to as the Basin in this document. Adjacent groundwater basins are the San Ramon Valley (Basin No. 2-07), a very-low priority basin that extends to the northwest in Contra Costa County, and the Sunol Valley (No. 2-11), which is a very-low priority basin to the southwest of the Livermore Valley Groundwater Basin.

To be consistent with the State's official groundwater basin boundaries, Zone 7 used the updated (2016) DWR Bulletin 118 boundary for the Livermore Valley Groundwater Basin in its Alternative GSP and this *2018 Groundwater Annual Report for the Livermore Valley Groundwater Basin* (2018 Annual Report). This boundary differs slightly from the basin boundary used in the original GWMP and earlier annual reports.

Details regarding the plan area, including surface and well water supplies, land use, general plans, and well permitting are provided in Section 1.3, *Plan Area*, of the Alternative GSP.

1.6 Basin and Hydrogeologic Setting

1.6.1 Basin Management Areas

The Livermore Valley Groundwater Basin is an inland alluvial basin underlying the east-west trending Livermore-Amador Valley (Valley) in northeastern Alameda County. The Valley covers about 42,000 acres, extends approximately 14 miles in an east-west direction, and varies from 3 to 6 miles in width. It is surrounded primarily by north-south trending faults and the hills of the Diablo Range. The Livermore Valley Groundwater Basin is located in the heart of the Valley and extends south into the uplands south of Pleasanton and Livermore. The Main Basin (see *Figure 1-1*) is a portion of the Livermore Valley Groundwater Basin that contains the highest yielding aquifers and generally the best quality groundwater. Groundwater flow is generally from the southeast and east to the west, toward the municipal wellfields in the West Amador and Bernal Subareas.

For more detailed information about the history of the Livermore Valley Groundwater Basin, and additional details regarding the physical setting, climate, streams, groundwater-dependent ecosystems (GDEs), soils, and geology, see *Section 2, Basin Setting,* of the Alternative GSP. For purposes of groundwater management, the basin has been divided into three management areas based on varying geologic, hydrogeologic, and groundwater conditions. These are the Main Basin, Fringe Subareas, and Upland Areas shown in *Figure 1-1*and listed in *Table 1-A*.

Table 1-A: Basin Management Areas

Basin	Area
Main Basin	19,809 acres
Fringe Subareas	21,956 acres
Upland Areas	27,778 acres
Total	69,557 acres

1.6.2 Main Basin

The Main Basin[1] covers almost 20,000 acres and contains the thickest alluvial deposits, the highest-yielding aquifers, and the best-quality groundwater within the basin.

The Main Basin includes the Castle, Bernal, Amador, and Mocho II Subareas (*Figure 1-1*) and is defined by the following boundaries.

- North by the Parks Boundary, which separates the Dublin and Camp Subareas of the fringe basin from the Bernal and Amador Subareas. This boundary was initially considered to be fault-related, but may be a depositional boundary between recent alluvium and older material.
- East by shallow bedrock separating the Mocho I (fringe basin) and Mocho II (Main Basin) Subareas.
- South by the tilted Livermore Formation in the Livermore Uplands.
- West by the Pleasanton Ridge, the Dublin Uplands, and the Calaveras Fault.

The Main Basin is hydraulically connected to the fringe areas through the shallow alluvium; however, subsurface inflow from the fringe subareas into the deeper portions of the Main Basin is considered to be minor. The deeper aquifers of the Main Basin are primarily recharged by rainfall and surface waters where they outcrop in the Upland areas and through vertical migration of groundwater within the Main

[1] Prior to 1985, this area was called the central basin; for the past 30 years the term *Main Basin* has been used.

Basin itself. The Main Basin aquifers have the highest transmissivity. All of the Valley's municipal supply wells are completed in "Lower" Main Basin aquifers, and some include the deeper Livermore Formation.

Additional details are provided in *Section 2.2.2.3*, *Subareas within the Main Basin,* in the Alternative GSP.

1.6.3 Fringe Management Area and Subareas

The Fringe Management Area is defined by areas outside of the Main Basin that contain thinner deposits of recent alluvium underlain by relatively shallow bedrock. These areas are also characterized by lower-permeability aquifers overlain by clay-rich soils. Because the alluvium is generally thinner, the primary hydraulic connection between the Fringe Management Area and the Main Basin Management Area is through the Upper Aquifer. In general, Lower Aquifer units in the Main Basin do not extend into the Fringe Management Area. Domestic wells located in the Fringe Management Area are typically completed in the deeper aquifers of the Livermore Formation.

Areas of significant subsurface inflows through the Upper Aquifer from the Fringe Management Area into the Main Basin Management Area occur in the following locations.

- Along the northern and eastern boundaries between the two areas, currently estimated at about 900 AF per year (AFY)

- Along the northwestern boundary (at the Bernal Subarea) of the Main Basin estimated to be about 100 AFY, as estimated by transect wells

Similar to the Main Basin Management Area, nine subareas have been defined in the Fringe Management Area to delineate areas of similar groundwater conditions and provide a reference framework for locating wells. Subareas in the northwest include Bishop, Dublin, and Camp Subareas. Subareas in the northeast and east include Cayetano, May, Vasco, Altamont, Spring, and Mocho I Subareas.

1.6.4 Uplands Management Area

The Uplands Management Area is primarily defined by areas where the recent alluvium is absent but the Livermore Formation and other older water-bearing bedrock units are present. These consolidated units are more resistant to erosion and form low, rolling hills around the more-gently sloping alluvial valley. Most of the precipitation that falls on the Uplands Management Area leaves the area as runoff and contributes to streams in both the Fringe and Main Basin Management Areas. A small amount of deep percolation of precipitation in the Uplands may also contribute to the Main Basin's subsurface inflow. Subsurface inflow from the Uplands Management Area into the Main Basin Management Area has been estimated at about 360 AFY. Formal subareas have not been delineated in the Uplands Management Area because of the absence of significant groundwater pumping and the lack of need for localized groundwater management actions. The long history of groundwater levels in the few domestic and livestock supply wells present in the Upland Management Area demonstrate that current uses/withdrawals are sustainable.

1.7 Aquifer Zones

1.7.1 Introduction

Although multiple aquifers have been identified in the Main Basin alluvium, wells have been classified generally as being completed in either the Upper or Lower Aquifer Zone. Additional details as well as a stratigraphic cross section of the Main Basin Upper and Lower Aquifers are provided in Section 2.2.3, Basin Hydrostratigraphy, of the Alternative GSP. Such differentiation is not applicable to the Fringe Basins. In the Main Basin, the two zones are generally separated by a relatively continuous silty clay aquitard, which is up to 50 feet (ft) thick beneath the Upper Aquifer Zone (80–150 ft below ground surface [bgs]).

1.7.2 Upper Aquifer Zone

The Upper Aquifer consists of alluvial materials, including primarily sandy gravel and clayey or silty gravels. These gravels are usually encountered underneath confining surficial clay or silty clay layer typically 5–70 ft bgs in the west and exposed at the surface in the east. They are present in the Main and Fringe Management Areas. The base of the Upper Aquifer Zone varies from 80–150 ft bgs in the Main Basin and 10-70 ft bgs in the Fringe Management. Groundwater in this zone is generally unconfined; however, when water levels are high, portions of the Upper Aquifer Zone in the western portion of the Main Basin can become confined.

1.7.3 Lower Aquifer Zone

All aquifers encountered below the confining aquitard in the central portions of the Main Basin are known collectively as the Lower Aquifer Zone. The Lower Aquifer materials consist of coarse-grained, water-bearing units interbedded with relatively low-permeability, fine-grained units. The Lower Aquifer Zone derives most of its water from the Upper Aquifer Zone through the leaky aquitard(s) when piezometric heads in the upper zone are greater than those in the lower zone. Some replenishment may also come from the water-bearing members of the Livermore Formation that are in contact with the Lower Aquifer Zone.

1.8 Groundwater Characteristics

The northern extent of the Livermore Valley Groundwater Basin is dominated by a sodium- rich water, while much of the western part of the basin near Pleasanton has a magnesium-sodium characteristic (i.e., both magnesium and sodium are dominant cations). The area along the eastern portion of the basin, beneath the City of Livermore, has magnesium as the predominant cation. Most groundwater in the Main Basin, where all of the Valley's municipal supply wells are completed, is hard or very hard (i.e., calcium carbonate [$CaCO_3$] greater than 120 milligrams per liter [mg/L]). Groundwater tends to be the hardest in the western portion of the Main Basin. Groundwater of the Lower Aquifer Zone is generally of better quality than that of the Upper Aquifer Zone; however, both aquifer zones are designated for potable use in the Regional Water Quality Control Board Water

Quality Control Plan (Basin Plan, *California Regional Water Quality Control Board [RWQCB], 2011*; see *Section 1.3.6* of the Alternative GSP).

1.9 Monitoring Networks and Modeling

Zone 7 has developed and implemented an extensive basin-wide monitoring network that has expanded and improved over time. The overall objective of the monitoring network is to provide sufficient information to allow tracking of groundwater conditions to meet the sustainability goal of the basin, including the prevention of undesirable results. The monitoring network includes six distinct monitoring programs: Climate Monitoring, Surface Water Monitoring, Groundwater Elevation Monitoring, Groundwater Quality Monitoring, Land Surface Elevation Monitoring, Wastewater and Recycled Water Monitoring; and a proprietary data management system to store and analyze data gathered. Details regarding the monitoring programs are provided in *Section 4, Monitoring Networks,* of the Alternative GSP.

Zone 7 also maintains a numerical groundwater model of the basin for analyzing various groundwater basin management actions. This MODFLOW model uses Groundwater Vistas and various MODFLOW packages (e.g., NWT, MT3D) to perform the modeling calculations. The active part of the groundwater model encompasses the Amador, Bernal, Bishop, Camp, Castle, Dublin, and Mocho II Subareas of the Basin. Additional information regarding the groundwater model is provided in *Section 2.6, Groundwater Model*, of the Alternative GSP. Updates made to the monitoring network and modeling during the 2018 WY are provided in subsequent sections of this 2018 Annual Report.

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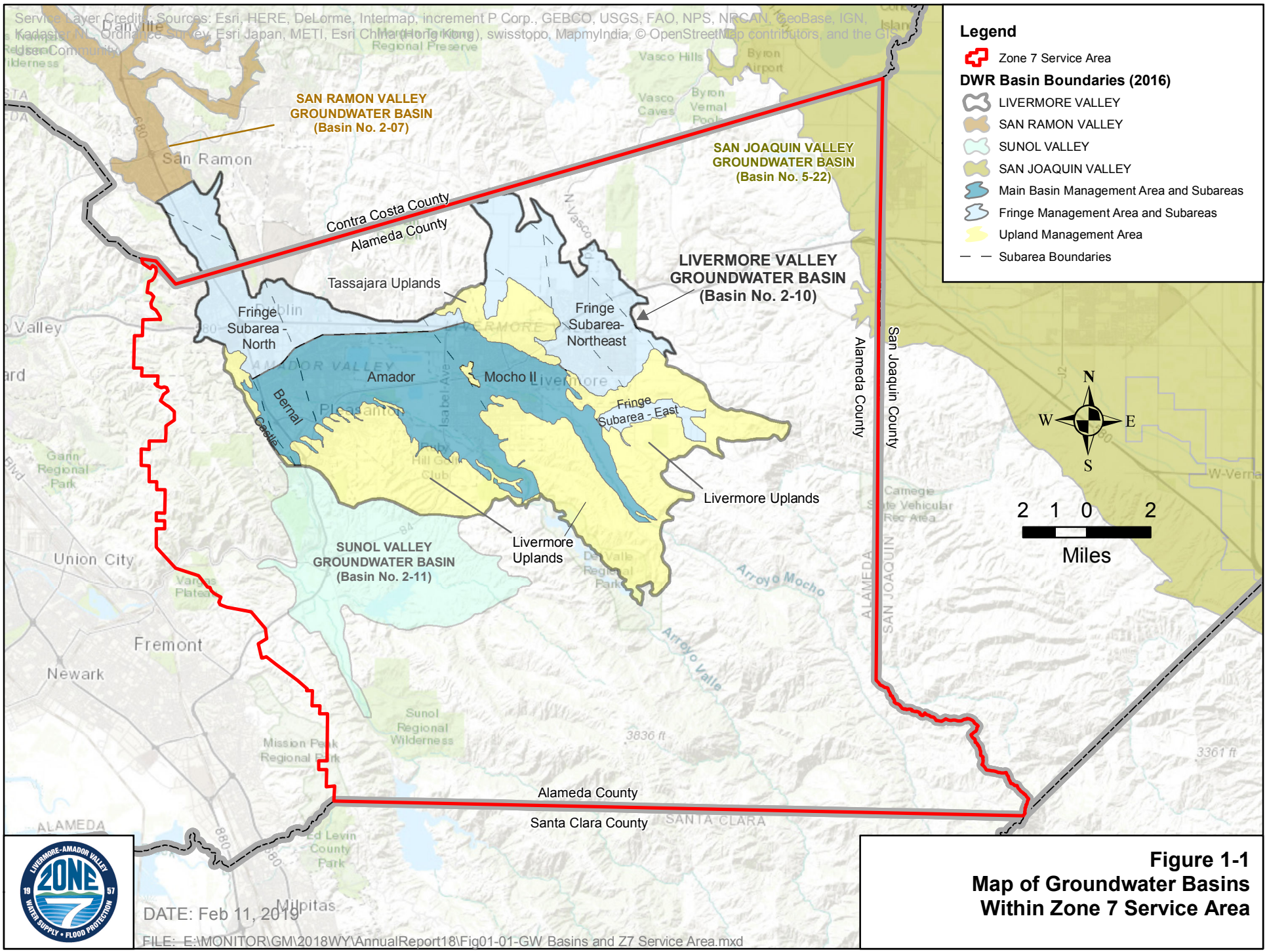

Figure 1-1
Map of Groundwater Basins Within Zone 7 Service Area

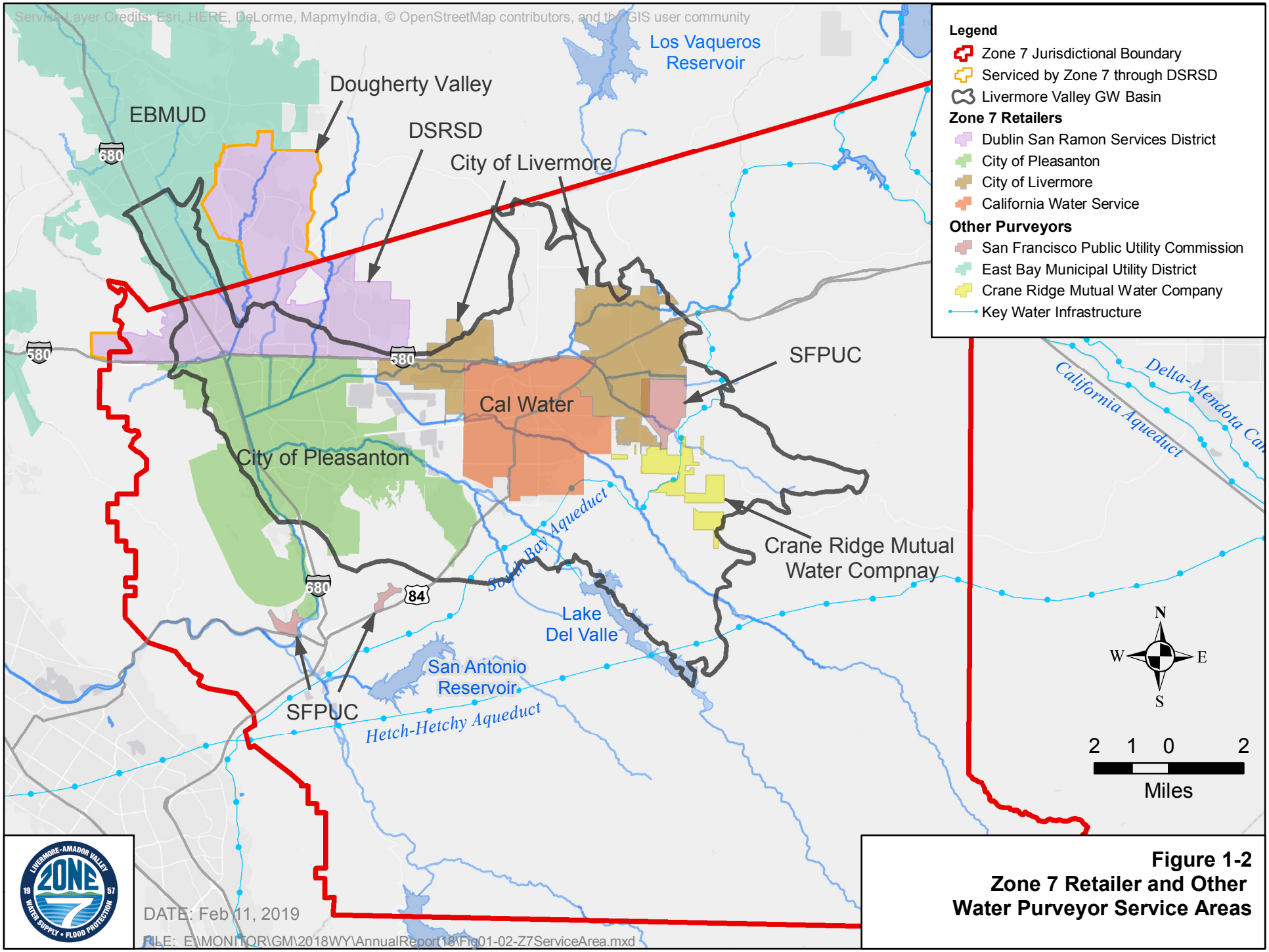

Figure 1-2
Zone 7 Retailer and Other Water Purveyor Service Areas

2 Precipitation and Evaporation

2.1 Program Description

2.1.1 Monitoring Network

Zone 7 uses a network of climatological stations (see *Figure 2-1*and *Table 2-1*) to provide high-quality data for water inventory and management decisions, including both daily record stations and 15-minute recorder stations. Zone 7's climatological monitoring program also contains both reference evapotranspiration (ETo) and pan evaporation stations to determine water losses to the atmosphere. Station 191 California Irrigation Management Information System (CIMIS) is a reference ETo station which estimates the ETo value of the water used by a well-watered, full-cover grass surface. The pan evaporation stations at Lake Del Valle (LDV) and Livermore Water Reclamation Plant (LWRP) measure evaporation directly, which is converted to ETo to use with the CIMIS readings to calculate evaporation from the mining ponds. The CIMIS Station's ETo is also used as part of Zone 7's Water Conservation program to help regulate weather-based irrigation controllers (WBICs, also known as "SMART" Controllers).

For more detailed information on Zone 7's overall Climatological Monitoring Program, see *Section 4.2, Climate Monitoring,* of the Alternative GSP.

2.1.2 Program Changes for the Water Year

There were no changes to this program for the 2018 WY.

2.2 Results for the 2018 Water Year

In the 2018 WY, total rainfall on the watershed was 77% of the average WY (*Table 2-2*). Rainfall totals from individual stations ranged from 10.29 inches at Patterson Pass Water Treatment Plant (Station 24) (80% of average) to 20.76 inches (86% of average) at Lick Observatory (Station 44). At Station 15e in Livermore, the station with the longest historical record (1871-2018) (*Table 2-3* and *Figure 2-2*), rainfall totaled 12.44 inches (86% of average) in the 2018 WY.

ETo for the 2018 WY was 47.01 inches (110% of normal) at the LDV Station, 51.45 inches (100% of normal) at the CIMIS station (191), and 42.65 inches (93% of normal) at the LWRP Station (*Table 2-4*).

Additional information is provided in the following tables.

- *Table 2-1*, *Table of Climatological Stations, 2018 WY*
- *Table 2-2, Monthly Precipitation Data, 2018 WY*
- *Table 2-3, Historical Monthly Precipitation (inches), Monitoring Station 15E, Livermore, 1871 to 2018 WY*
- *Table 2-4, Monthly Evapotranspiration Data, 2018 WY*
- *Table 2-5, Historical Monthly Pan Evaporation (inches), Monitoring Station Lake Del Valle, Livermore*

TABLE 2-1
TABLE OF CLIMATOLOGICAL STATIONS
2018 WATER YEAR

PRECIPITATION NETWORK

SITE	COMPUTER SITE ID	STATION NAME	LOCATION	OBSERVER	ELEV-ATION	STATION ESTABLISHED	15 MIN RECORD	MEAN ANNUAL (IN)
15E	CM_STA 15E	NOAA Livermore	Wellingham Drive, Livermore	MR. RON HAFNER	480	1871	-	14.50
17	CM_STA 17	Del Valle Plant	601 East Vallecitos Rd, Livermore	ZONE 7	640	1974	1978 to Present	16.14
24	CM_STA 24	Patterson Plant	Patterson Pass Rd, Livermore	ZONE 7	680	1963	1969 to Present	12.92
34	CM_STA 34	Mocho Wellfield	Santa Rita Rd, Pleasanton	ZONE 7	340	1968	1970 to 2010	18.01
44	CM_STA 44	Mt Hamilton	Lick Observatory, Mt. Hamilton	LICK OBSERVATORY	4209	1881	-	24.19
101	CM_STA 101	Tassajara	Camino Tassajara Rd, Danville	MRS. JOAN HANSEN	800	1912	-	18.63
170	CM_STA 170	Parkside	Parkside Drive, Pleasanton	ZONE 7	330	1986	1986 to 2005	20.56
191	CM_STA 191	CIMIS Station	Alameda County Fairgrounds, Pleasanton	DWR	335	2004	2004 to Present	17.18
ALTC	CM_STA ALTC	Altamont Creek	at ALTC_BD surface water station	ZONE 7	500	2015	2015 to Present	-
AMNL	CM_STA AMNL	Arroyo Mocho Near Liv	at AMNL surface water station	ZONE 7	750	2015	2015 to Present	-
AMP	CM_STA AMP	Arroyo Mocho Pleas	At AMP Surface Water Station	ZONE 7	335	2016	2016 to Present	-
NC	CM_STA NC	North Canyons Office	Zone 7's North Canyons building	ZONE 7	450	2015	2015 to Present	-

EVAPORATION NETWORK

SITE	COMPUTER SITE ID	STATION NAME	LOCATION	OBSERVER	ELEV-ATION	STATION ESTABLISHED	15 MIN RECORD	MEAN ANNUAL (IN)
LDV	CM_STA LDV-EV	Lake Del Valle	Arroyo Rd, Livermore	DWR	760	1969	-	42.92
LWRP	CM_STA LWRP-EV	Livermore Water Reclamation Plant	Jack London Drive, Livermore	LWRP	410	1974	-	46.04
191	CM_STA 191-ETO	CIMIS Station	Alameda County Fairgrounds, Pleasanton	DWR	335	2004	-	51.23

* Stations LDV and LWRP record evaporation using pan evaporation equipment. ETo is derived using : ETo= Pan Evaporation x 0.6402

TABLE 2-2
MONTHLY PRECIPITATION DATA
2018 WATER YEAR

MONTHLY PRECIPITATION IN INCHES

	MONITORING STATION												2018 Network Average	% Historic Network Average
	CM_STA 15E	CM_STA 17	CM_STA 24	CM_STA 34	CM_STA 44	CM_STA 101	CM_STA 170	CM_STA 191	CM_STA ALTC	CM_STA AMNL	CM_STA AMP	CM_STA NC		
	15E	**17**	**24**	**34**	**44**	**101**	**170**	**191**	**ALTC**	**AMNL**	**AMP**	**NC**		
OCT	0.18	0.10	0.17	0.17	0.31	0.24	0.25	0.24	0.10	0.25	0.15	0.12	0.21	21.7%
NOV	2.20	2.44	1.90	2.03	3.82	2.56	2.44	2.18	1.61	1.70	1.99	1.71	2.45	117.4%
DEC	0.06	0.11	0.06	0.05	0.16	0.10	0.01	0.04	0.01	0.09	0.03	0.02	0.07	2.3%
JAN	3.30	3.33	3.01	3.61	4.83	3.79	3.97	3.43	2.63	2.84	3.21	3.07	3.66	107.7%
FEB	0.57	0.44	0.38	0.39	0.91	0.57	0.39	0.35	0.48	0.40	0.39	0.49	0.50	16.1%
MAR	4.44	3.56	2.98	4.51	6.64	5.47	5.28	4.58	3.51	3.42	3.85	3.52	4.68	169.8%
APR	1.68	1.54	1.79	1.67	3.96	2.74	1.88	1.68	1.92	1.76	1.62	1.50	2.12	150.9%
MAY	0.01	0.01	0.00	0.00	0.13	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.02	4.4%
JUN	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.02	12.1%
JUL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
AUG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
SEP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0%
TOTAL	**12.44**	**11.54**	**10.29**	**12.43**	**20.76**	**15.47**	**14.22**	**12.64**	**10.26**	**10.46**	**11.24**	**10.43**	**13.72**	
% AVG	**86%**	**71%**	**80%**	**69%**	**86%**	**83%**	**69%**	**74%**	**	**	**	**	**77%**	

*Average Rainfall for Station 191 calculated from data collected at the station from 2004 to present.
**Insufficient data for average calculation

DISTRIBUTION OF DAILY PRECIPITATION

Number of days with rainfall greater than reference

Rainfall (inches)	MONITORING STATION												2018 Network Average
	15E	**17**	**24**	**34**	**101**	**44**	**170**	**191**	**ALTC**	**AMNL**	**AMP**	**NC**	
>Trace	75	76	67	77	90	81	77	81	72	73	82	72	77
>0.1	55	48	45	53	68	58	56	51	48	46	48	47	52
>0.5	18	17	19	22	36	22	22	23	17	13	22	19	21
>1	3	7	2	9	13	8	12	8	4	3	6	5	7
>2	0	0	0	1	2	1	4	2	0	0	1	1	1

TABLE 2-3
HISTORICAL MONTHLY PRECIPITATION
MONITORING STATION 15E, LIVERMORE (INCHES)
1871 to 2018 WATER YEARS

Water Year	OCTWY	NOVWY	DECWY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL OCT-SEP	TOTAL JULY-JUNE	% AVERAGE OCT-SEP
1871	NA	NA	NA	1.42	1.93	0.36	1.25	0.02	0.00	0.00	0.00	0.00	NA	NA	NA
1872	0.00	1.13	11.69	2.15	2.69	0.65	0.43	0.00	0.32	0.00	0.00	0.00	19.06	19.06	131%
1873	0.00	1.22	3.87	1.04	3.73	0.68	0.15	0.00	0.00	0.00	0.00	0.00	10.69	10.69	74%
1874	0.42	0.70	4.48	2.96	1.03	1.34	0.95	0.32	0.06	0.00	0.00	0.30	12.56	12.26	87%
1875	1.67	2.03	0.20	5.40	1.20	0.35	0.00	0.00	0.52	0.00	0.00	0.00	11.37	11.67	78%
1876	0.00	7.23	1.62	2.68	3.01	4.39	0.73	0.33	0.00	0.00	0.00	0.00	19.99	19.99	138%
1877	1.26	0.10	0.00	2.47	0.56	1.10	0.13	0.39	0.00	0.00	0.00	0.00	6.01	6.01	41%
1878	1.27	1.29	0.73	4.61	6.73	2.01	0.96	0.06	0.00	0.00	0.00	0.00	17.66	17.66	122%
1879	0.24	0.31	0.17	2.83	1.78	2.49	0.75	1.34	0.20	0.00	0.00	0.00	10.11	10.11	70%
1880	0.83	1.06	1.94	1.48	1.80	1.45	6.51	0.91	0.00	0.00	0.00	0.00	15.98	15.98	110%
1881	0.00	0.65	7.75	2.40	2.62	1.06	1.93	0.00	0.04	0.00	0.00	0.00	16.45	16.45	113%
1882	0.08	0.78	1.97	1.07	1.72	4.85	1.03	0.20	0.00	0.00	0.00	0.34	12.04	11.70	83%
1883	1.52	1.48	0.38	2.38	0.63	3.45	1.50	2.18	0.00	0.00	0.00	0.35	13.87	13.86	96%
1884	1.52	0.57	0.44	4.03	5.29	5.92	2.70	0.20	1.73	0.00	0.10	0.30	22.80	22.75	157%
1885	1.14	0.02	6.22	1.72	0.36	0.78	1.29	0.08	0.00	0.00	0.00	0.05	11.66	12.01	80%
1886	0.00	6.20	1.94	4.20	0.24	1.18	2.36	0.00	0.00	0.40	0.00	0.00	16.52	16.17	114%
1887	0.30	0.70	0.81	0.90	6.23	0.23	1.60	0.00	0.00	0.00	0.00	0.80	11.57	11.17	80%
1888	0.00	0.61	3.51	3.20	0.94	2.51	0.60	0.66	0.30	0.00	0.00	0.76	13.09	13.13	90%
1889	0.00	3.80	2.21	0.46	0.67	5.15	0.51	2.25	0.00	0.00	0.00	0.00	15.05	15.81	104%
1890	3.94	2.95	8.63	5.24	3.71	2.85	0.86	0.48	0.00	0.00	0.00	1.20	29.86	28.66	206%
1891	0.00	0.00	3.31	0.54	4.18	2.50	1.88	0.40	0.15	0.00	0.00	1.32	14.28	14.16	98%
1892	0.05	0.38	4.42	0.84	1.08	3.96	0.90	1.30	0.00	0.00	0.00	0.45	13.38	14.25	92%
1893	1.65	4.97	7.27	3.02	3.12	3.68	1.40	0.73	0.00	0.00	0.00	0.00	25.84	26.29	178%
1894	0.00	1.59	2.14	4.97	5.36	0.81	0.58	1.19	0.52	0.00	0.00	1.45	18.61	17.16	128%
1895	1.15	0.50	8.56	6.83	1.56	1.81	1.26	1.25	0.00	0.00	0.00	0.22	23.14	24.37	160%
1896	0.83	1.69	1.28	7.16	0.17	1.50	3.11	0.39	0.00	0.00	0.73	0.55	17.41	16.35	120%
1897	1.48	3.02	1.71	1.89	3.54	4.04	0.24	0.00	0.08	0.00	0.00	0.06	16.06	17.28	111%
1898	1.43	0.52	1.31	1.47	1.78	0.78	0.45	0.96	0.35	0.00	0.00	0.95	10.00	9.11	69%
1899	0.74	0.25	1.61	2.60	0.08	4.81	0.35	0.15	0.22	0.00	0.00	0.00	10.81	11.76	75%
1900	2.52	2.49	2.07	2.44	0.34	1.11	0.86	1.10	0.00	0.00	0.00	0.18	13.11	12.93	90%
1901	1.93	4.48	1.06	2.69	5.15	0.95	1.80	1.58	0.00	0.00	0.00	0.68	20.32	19.82	140%
1902	0.70	1.99	0.74	0.99	3.62	2.69	0.75	0.32	0.00	0.00	0.13	0.00	11.93	12.48	82%
1903	0.47	2.07	0.87	3.19	0.94	5.65	0.81	0.12	0.00	0.00	0.00	0.00	14.12	14.25	97%
1904	0.00	2.16	0.59	0.89	4.18	3.71	1.56	0.24	0.00	0.00	0.32	1.62	15.27	13.33	105%
1905	1.00	0.78	1.42	2.43	2.30	3.12	0.93	1.89	0.00	0.00	0.00	0.00	13.87	15.81	96%
1906	0.00	1.01	1.18	5.56	2.67	5.18	0.95	1.61	0.56	0.00	0.00	0.20	18.92	18.72	130%
1907	0.03	1.34	6.45	3.22	1.86	8.85	0.47	0.16	0.56	0.00	0.00	0.00	22.94	23.14	158%
1908	0.81	0.04	3.90	2.27	1.35	0.73	0.28	0.53	0.00	0.00	0.00	0.03	9.94	9.91	69%
1909	0.27	0.60	1.55	10.18	3.96	1.94	0.00	0.00	0.05	0.00	0.00	0.62	19.17	18.58	132%
1910	0.75	1.68	5.77	2.50	1.14	1.90	0.10	0.00	0.04	0.00	0.00	0.10	13.98	14.50	96%
1911	0.29	0.10	1.32	12.60	1.42	4.45	0.69	0.24	0.07	0.00	0.00	0.00	21.18	21.28	146%
1912	0.43	0.29	1.71	2.66	0.20	1.99	0.73	0.94	0.65	0.00	0.00	0.48	10.08	9.60	70%
1913	0.71	0.44	0.81	2.63	0.38	1.65	0.54	0.58	0.01	0.27	0.02	0.00	8.04	8.23	55%
1914	0.00	2.47	3.17	7.10	2.11	0.66	0.76	0.45	0.19	0.00	0.00	0.00	16.91	17.20	117%
1915	0.45	0.33	3.96	4.16	5.79	1.50	0.66	2.66	0.00	0.00	0.00	0.00	19.51	19.51	135%
1916	0.00	0.76	4.41	11.35	2.17	1.47	0.21	0.05	0.00	0.00	0.00	0.44	20.86	20.42	144%
1917	0.50	0.68	3.28	1.06	3.37	1.08	0.15	0.02	0.00	0.00	0.00	0.04	10.18	10.58	70%
1918	0.00	0.43	0.66	0.59	3.08	3.32	0.61	0.00	0.00	0.00	0.00	5.72	14.41	8.73	99%
1919	0.39	2.38	1.51	1.03	4.58	2.33	0.05	0.00	0.00	0.00	0.00	0.48	12.75	17.99	88%
1920	0.15	0.33	2.21	0.22	0.71	3.52	1.07	0.00	0.13	0.00	0.00	0.00	8.34	8.82	58%
1921	2.03	1.43	3.81	3.38	0.59	0.83	0.16	1.05	0.00	0.00	0.00	0.05	13.33	13.28	92%
1922	0.15	1.17	3.38	1.51	5.46	1.83	0.23	0.27	0.00	0.00	0.00	0.00	14.00	14.05	97%
1923	0.54	2.86	5.43	1.80	0.65	0.15	2.15	0.00	0.02	0.00	0.00	0.82	14.42	13.60	99%
1924	0.25	0.76	0.87	1.40	0.93	0.65	0.28	0.07	0.00	0.00	0.00	0.00	5.21	6.03	36%
1925	1.30	1.53	2.63	1.02	3.74	1.14	1.75	1.41	0.04	0.00	0.00	0.00	14.56	14.56	100%
1926	0.00	0.97	1.14	2.44	3.58	0.16	3.11	0.11	0.00	0.00	0.00	0.00	11.51	11.51	79%
1927	0.93	2.83	0.78	1.74	3.49	1.54	1.73	0.10	0.18	0.00	0.00	0.03	13.35	13.32	92%
1928	1.71	1.43	2.00	1.46	0.89	3.43	1.43	0.45	0.00	0.00	0.00	0.00	12.80	12.83	88%
1929	0.00	2.57	2.76	1.26	0.87	1.07	0.70	0.03	0.83	0.00	0.00	0.00	10.09	10.09	70%
1930	0.01	0.00	1.81	3.64	1.91	1.88	1.14	0.43	0.00	0.00	0.00	0.20	11.02	10.82	76%
1931	0.58	1.15	0.26	3.45	1.67	0.57	0.36	0.93	0.11	0.00	0.00	0.00	9.08	9.28	63%
1932	0.27	1.89	5.63	1.29	3.15	0.19	0.41	0.37	0.00	0.00	0.00	0.00	13.20	13.20	91%
1933	0.00	0.51	2.03	4.51	0.44	2.09	0.13	0.70	0.03	0.00	0.00	0.01	10.45	10.44	72%
1934	0.75	0.00	3.69	1.29	2.86	0.00	0.13	0.60	0.53	0.00	0.00	0.27	10.12	9.86	70%
1935	0.62	2.71	2.32	3.53	0.52	3.16	3.28	0.00	0.00	0.00	0.04	0.00	16.18	16.41	112%
1936	0.79	0.21	1.53	3.28	6.76	0.71	0.63	0.46	0.10	0.00	0.00	0.00	14.47	14.51	100%
1937	0.40	0.02	3.26	3.38	4.13	5.07	0.68	0.17	0.20	0.00	0.00	0.00	17.31	17.31	119%
1938	0.55	2.46	4.57	2.40	6.14	4.09	0.90	0.02	0.00	0.00	0.00	0.00	21.13	21.13	146%
1939	1.00	1.08	0.52	2.40	1.57	2.18	0.53	0.18	0.00	0.00	0.00	0.16	9.62	9.46	66%
1940	1.23	0.15	0.78	8.13	5.14	2.60	0.35	0.14	0.00	0.00	0.00	0.25	18.77	18.68	129%
1941	0.50	0.43	4.63	3.24	4.19	2.07	2.76	0.23	0.00	0.00	0.03	0.00	18.08	18.30	125%
1942	0.72	0.89	5.34	3.89	1.68	1.42	3.10	1.00	0.00	0.00	0.00	0.09	18.13	18.07	125%
1943	1.08	3.05	1.73	4.48	1.68	2.39	1.14	0.00	0.06	0.00	0.00	0.00	15.61	15.70	108%
1944	0.30	0.53	1.23	2.36	4.89	1.01	0.94	0.73	0.00	0.00	0.00	0.00	11.99	11.99	83%
1945	0.77	3.41	2.03	0.87	3.68	3.19	0.20	0.17	0.00	0.00	0.02	0.00	14.34	14.32	99%
1946	1.07	2.07	2.98	0.76	1.23	1.69	0.02	0.61	0.00	0.24	0.00	0.02	10.69	10.45	74%
1947	0.02	2.93	2.07	0.69	1.45	2.34	0.53	0.17	0.36	0.00	0.00	0.00	10.56	10.82	73%
1948	1.84	0.85	0.51	0.20	1.11	2.79	2.50	1.03	0.16	0.03	0.00	0.00	11.02	10.99	76%
1949	0.46	0.34	2.71	1.39	2.47	3.38	0.02	0.34	0.00	0.03	0.16	0.05	11.35	11.14	78%

Water Year = October to September

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TABLE 2-3
HISTORICAL MONTHLY PRECIPITATION
MONITORING STATION 15E, LIVERMORE (INCHES)
1871 to 2018 WATER YEARS

Water Year	OCTWY	NOVWY	DECWY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL OCT-SEP	TOTAL JULY-JUNE	% AVERAGE OCT-SEP
1950	0.08	1.20	1.21	4.65	1.54	1.44	0.85	0.59	0.01	0.00	0.00	0.08	11.65	11.81	80%
1951	1.84	5.95	4.95	2.23	1.81	1.82	0.55	0.35	0.06	0.00	0.00	0.00	19.56	19.64	135%
1952	1.04	3.01	6.07	7.60	1.40	2.36	2.20	0.16	0.04	0.00	0.00	0.10	23.98	23.88	165%
1953	0.01	2.11	6.33	2.07	0.05	1.12	1.42	0.61	0.59	0.00	0.15	0.00	14.46	14.41	100%
1954	0.21	1.33	0.64	2.19	2.27	3.00	0.73	0.16	0.27	0.00	0.00	0.04	10.84	10.95	75%
1955	0.00	1.68	3.33	2.45	1.69	0.38	1.28	0.65	0.00	0.00	0.01	0.01	11.48	11.50	79%
1956	0.01	1.31	10.15	5.49	1.15	0.14	1.92	0.63	0.00	0.00	0.00	0.63	21.43	20.82	148%
1957	0.79	0.03	0.48	2.65	2.23	1.30	1.14	2.65	0.04	0.00	0.00	0.05	11.36	11.94	78%
1958	1.06	0.37	1.62	3.16	5.37	4.44	3.74	0.66	0.41	0.00	0.00	0.02	20.85	20.88	144%
1959	0.09	0.14	0.86	2.45	3.59	0.29	0.35	0.00	0.00	0.00	0.07	1.89	9.73	7.79	67%
1960	0.00	0.00	0.75	2.98	4.12	0.60	0.48	0.42	0.00	0.02	0.00	0.01	9.38	11.31	65%
1961	0.05	2.92	1.25	2.08	1.04	1.92	1.03	0.69	0.19	0.00	0.13	0.16	11.46	11.20	79%
1962	0.15	2.24	0.82	0.73	5.61	1.82	0.22	0.00	0.00	0.00	0.00	0.00	11.59	11.88	80%
1963	3.64	0.28	1.55	1.40	4.50	2.60	3.47	0.70	0.00	0.00	0.00	0.33	18.47	18.14	127%
1964	0.93	3.18	0.19	2.37	0.08	1.57	0.21	0.48	0.32	0.00	0.12	0.04	9.49	9.66	65%
1965	0.85	2.44	4.91	2.11	0.59	1.73	1.53	0.00	0.00	0.00	0.21	0.00	14.37	14.32	99%
1966	0.03	4.22	3.23	1.05	1.17	0.17	0.33	0.10	0.12	0.17	0.00	0.11	10.70	10.63	74%
1967	0.00	3.43	2.35	6.14	0.29	4.15	4.65	0.19	0.48	0.00	0.00	0.02	21.70	21.96	150%
1968	0.24	0.88	1.62	3.93	0.90	2.40	0.43	0.15	0.00	0.00	0.00	0.00	10.55	10.57	73%
1969	0.43	2.48	3.04	6.28	4.76	0.55	1.24	0.08	0.00	0.00	0.00	0.00	18.86	18.86	130%
1970	1.10	0.49	2.34	5.38	1.18	1.42	0.40	0.07	0.32	0.00	0.00	0.00	12.70	12.70	88%
1971	0.41	5.24	5.27	1.19	0.33	1.75	1.37	0.54	0.00	0.00	0.00	0.13	16.23	16.10	112%
1972	0.04	0.46	3.27	0.90	0.79	0.14	0.64	0.00	0.04	0.00	0.00	0.58	6.86	6.41	47%
1973	2.98	4.91	2.22	5.50	3.38	2.63	0.29	0.03	0.00	0.00	0.00	0.08	22.02	22.52	152%
1974	2.08	3.71	3.80	1.50	0.71	2.69	1.62	0.00	0.00	0.00	0.00	0.00	16.11	16.19	111%
1975	0.50	0.66	1.98	0.84	3.65	5.24	1.42	0.00	0.06	0.10	0.35	0.00	14.80	14.35	102%
1976	1.27	0.08	0.21	0.30	1.46	0.48	0.39	0.00	0.18	0.00	0.91	0.95	6.23	4.82	43%
1977	0.50	0.50	0.73	1.15	0.83	0.82	0.16	1.01	0.00	0.10	0.00	0.22	6.02	7.56	42%
1978	0.13	1.34	3.07	5.44	2.95	3.07	2.49	0.01	0.00	0.00	0.00	0.04	18.54	18.82	128%
1979	0.00	2.16	0.58	4.52	3.19	1.86	0.88	0.34	0.00	0.06	0.00	0.00	13.59	13.57	94%
1980	1.51	1.13	2.66	4.16	4.24	1.36	1.32	0.48	0.00	0.70	0.00	0.00	17.56	16.92	121%
1981	0.04	0.28	1.18	3.97	1.11	2.94	0.61	0.11	0.00	0.00	0.00	0.06	10.30	10.94	71%
1982	2.07	3.44	2.57	5.29	2.16	5.58	1.50	0.00	0.28	0.00	0.01	1.48	24.38	22.95	168%
1983	2.24	3.72	2.80	6.28	5.56	6.14	3.51	0.21	0.00	0.00	0.50	1.02	31.98	31.95	221%
1984	0.27	5.44	3.44	0.33	1.87	1.00	0.53	0.01	0.03	0.00	0.00	0.04	12.96	14.44	89%
1985	1.25	4.71	1.51	0.48	1.25	2.62	0.32	0.07	0.22	0.00	0.03	0.13	12.59	12.47	87%
1986	0.89	2.69	1.97	2.04	7.11	4.09	0.40	0.14	0.00	0.01	0.00	0.45	19.79	19.49	136%
1987	0.04	0.08	0.92	1.83	3.47	2.30	0.16	0.09	0.00	0.00	0.00	0.00	8.89	9.35	61%
1988	0.87	1.40	2.30	1.78	0.38	0.26	1.15	0.45	0.10	0.00	0.00	0.00	8.69	8.69	60%
1989	0.11	1.92	2.03	0.81	0.95	2.94	0.88	0.08	0.10	0.00	0.00	1.33	11.15	9.82	77%
1990	1.13	1.02	0.10	1.54	2.46	0.87	0.37	1.78	0.00	0.02	0.00	0.06	9.35	10.60	64%
1991	0.08	0.39	1.45	0.31	2.20	5.87	0.34	0.35	0.08	0.00	0.21	0.04	11.32	11.15	78%
1992	1.65	0.31	1.19	1.39	4.61	1.97	0.43	0.00	0.09	0.00	0.00	0.00	11.64	11.89	80%
1993	0.90	0.15	4.99	6.41	4.53	2.91	0.63	0.51	0.30	0.00	0.00	0.00	21.33	21.33	147%
1994	0.57	2.00	1.81	0.94	3.33	0.15	1.20	1.78	0.04	0.00	0.00	0.00	11.82	11.82	82%
1995	0.58	3.08	1.36	6.64	0.33	6.66	1.02	0.92	0.70	0.00	0.00	0.00	21.29	21.29	147%
1996	0.00	0.01	5.37	5.17	4.10	2.34	1.91	1.05	0.00	0.00	0.00	0.00	19.95	19.95	138%
1997	1.08	2.55	4.43	5.81	0.15	0.06	0.15	0.29	0.17	0.00	0.42	0.00	15.11	14.69	104%
1998	0.28	4.23	1.95	5.47	7.30	2.37	1.37	2.00	0.13	0.00	0.00	0.18	25.28	25.52	174%
1999	0.54	2.48	0.73	3.23	3.33	1.67	0.99	0.08	0.01	0.00	0.03	0.04	13.13	13.24	91%
2000	0.15	1.26	0.25	4.61	4.87	1.25	0.59	0.69	0.18	0.00	0.01	0.24	14.10	13.92	97%
2001	1.97	0.49	0.45	1.92	2.89	1.22	1.80	0.00	0.12	0.00	0.00	0.09	10.95	11.11	76%
2002	0.37	1.92	5.09	0.72	0.62	1.65	0.16	0.68	0.00	0.00	0.00	0.00	11.21	11.30	77%
2003	0.00	2.65	7.01	0.66	1.31	1.07	3.09	0.95	0.00	0.00	0.29	0.00	17.03	16.74	117%
2004	0.02	2.02	3.57	2.19	4.01	0.39	0.18	0.11	0.00	0.00	0.00	0.58	13.07	12.78	90%
2005	2.77	0.89	3.01	2.81	3.55	3.41	1.53	1.03	0.05	0.00	0.00	0.25	19.30	19.63	133%
2006	0.17	0.65	5.40	2.22	1.32	4.79	2.60	0.34	0.00	0.00	0.00	0.00	17.49	17.74	121%
2007	0.20	1.68	2.25	0.52	3.92	0.33	0.44	0.11	0.00	0.00	0.00	0.21	9.66	9.45	67%
2008	1.12	0.71	2.05	4.79	1.89	0.10	0.02	0.00	0.00	0.00	0.00	0.00	10.68	10.89	74%
2009	0.33	1.40	1.56	1.34	3.31	2.29	0.23	0.51	0.11	0.00	0.00	0.31	11.39	11.08	79%
2010	2.79	0.21	2.02	3.53	2.36	1.57	2.10	0.24	0.00	0.00	0.00	0.00	14.82	15.13	102%
2011	1.00	2.02	3.87	0.78	2.69	4.10	0.22	0.46	1.07	0.00	0.00	0.00	16.21	16.21	112%
2012	1.06	0.93	0.04	1.52	0.52	2.57	2.01	0.02	0.12	0.00	0.00	0.01	8.80	8.79	61%
2013	0.27	3.40	4.22	1.07	0.47	0.33	0.44	0.14	0.04	0.00	0.00	0.33	10.71	10.38	74%
2014	0.00	1.30	0.38	0.08	2.58	1.25	0.98	0.00	0.01	0.00	0.00	0.22	6.80	6.91	47%
2015	0.17	1.19	8.23	0.00	1.62	0.25	0.78	0.50	0.33	0.00	0.01	0.05	13.13	13.29	91%
2016	0.02	2.49	2.55	3.95	0.69	3.30	2.14	0.21	0.00	0.00	0.00	0.00	15.35	15.41	106%
2017	3.34	1.37	2.62	8.10	6.07	2.09	1.93	0.03	0.02	0.00	0.00	0.00	25.57	25.57	176%
2018	0.18	2.20	0.06	3.30	0.57	4.44	1.68	0.01	0.00	0.00	0.00	0.00	12.44	12.44	86%
MAXIMUM	3.94	7.23	11.69	12.60	7.30	8.85	6.51	2.66	1.73	0.70	0.91	5.72	31.98	31.95	221%
MINIMUM	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.21	4.82	36%
MEAN	0.72	1.64	2.65	2.92	2.46	2.18	1.09	0.46	0.11	0.01	0.03	0.23	14.50	14.53	100%

TABLE 2-4
MONTHLY EVAPOTRANSPIRATION (ETo) DATA
2018 WATER YEAR

MONTHLY REFERENCE EVAPOTRANSPIRATION (Eto) (inches)

	LDV	LWRP	191	2018 Network Average	% Historic Network Average
OCT	4.18	3.84	3.70	3.91	114.8%
NOV	1.38	1.36	1.49	1.41	81.6%
DEC	1.66	1.93	1.74	1.78	146.1%
JAN	0.97	0.94	1.08	1.00	82.7%
FEB	2.13	1.98	2.61	2.24	140.2%
MAR	2.22	1.70	2.99	2.30	80.4%
APR	3.39	3.09	4.63	3.70	91.1%
MAY	5.09	4.71	5.63	5.14	93.1%
JUN	6.68	6.02	7.72	6.81	105.5%
JUL	7.82	6.77	8.06	7.55	105.1%
AUG	6.30	5.74	6.62	6.22	97.0%
SEP	5.19	4.56	5.18	4.98	97.6%
TOTAL	**47.01**	**42.65**	**51.45**	**47.04**	
% AVG	**110%**	**93%**	**100%**	**101%**	

1) ETo values for LDV and LWRP were approximated using : ETo= Pan Evaporation x 0.642

TABLE 2-5
HISTORICAL MONTHLY PAN EVAPORATION
MONITORING STATION LAKE DEL VALLE, LIVERMORE (INCHES)
1969 to 2018 WATER YEARS

Water Year	OCTWY	NOVWY	DECWY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL OCT-SEP	TOTAL JULY-JUNE	% AVERAGE OCT-SEP
1969	3.20	2.50	1.54	0.66	1.08	4.89	5.92	9.99	7.84	11.38	11.77	8.32	69.09	NA	103%
1970	4.04	2.94	1.12	1.23	2.29	4.96	5.83	8.88	8.88	11.52	9.92	9.16	70.77	71.64	106%
1971	5.07	2.14	1.05	1.33	2.12	3.67	5.17	6.54	8.91	10.92	10.30	9.12	66.34	66.60	99%
1972	5.91	3.01	1.49	1.53	2.01	4.74	6.52	8.84	10.03	11.63	10.40	7.12	73.23	74.42	109%
1973	3.67	1.30	0.93	1.14	1.20	2.98	6.36	8.69	10.59	10.89	10.21	7.33	65.29	66.01	97%
1974	4.70	1.86	0.85	1.40	1.73	2.40	4.16	7.31	9.14	9.68	9.73	7.94	60.90	61.98	91%
1975	5.52	2.15	1.44	1.73	1.99	3.01	3.64	8.27	8.63	9.45	9.39	7.45	62.67	63.73	93%
1976	3.72	2.28	1.58	2.45	1.96	3.94	5.56	8.47	9.85	9.80	7.05	6.80	63.46	66.10	95%
1977	4.82	2.75	2.59	1.08	2.12	3.84	7.15	5.48	9.28	11.24	8.89	6.74	65.98	62.76	98%
1978	5.12	2.70	1.37	0.99	1.43	2.57	3.73	8.69	8.91	10.52	10.24	7.90	64.17	62.38	96%
1979	5.80	2.24	1.51	1.25	1.29	2.29	4.80	8.36	11.02	10.40	9.23	9.47	67.66	67.22	101%
1980	4.14	1.85	1.95	1.66	1.40	3.82	4.78	6.22	8.18	9.41	9.17	7.16	59.74	63.10	89%
1981	5.86	3.30	1.79	1.08	2.18	2.83	5.80	8.11	11.82	11.34	10.23	7.72	72.06	68.51	107%
1982	4.43	2.10	1.14	1.23	2.10	2.25	4.59	7.55	7.31	10.34	10.58	6.83	60.45	61.99	90%
1983	4.53	1.50	1.54	1.72	1.54	2.17	4.05	6.71	8.34	10.44	9.35	7.82	59.71	59.85	89%
1984	4.37	1.86	1.08	1.52	1.79	4.29	5.32	9.04	9.88	11.99	9.80	9.24	70.18	66.76	105%
1985	4.02	1.63	1.11	1.18	2.70	3.09	5.95	7.75	10.40	11.49	9.23	6.38	64.93	68.86	97%
1986	5.05	2.27	1.11	1.11	1.75	3.55	4.96	7.44	8.67	10.20	8.88	6.10	61.09	63.01	91%
1987	4.84	3.47	1.22	1.45	2.08	3.19	6.43	7.90	8.73	8.46	8.97	7.29	64.03	64.49	95%
1988	4.71	1.71	1.50	1.21	2.94	5.17	5.30	7.22	8.92	11.46	8.90	7.90	66.94	63.40	100%
1989	4.81	1.85	1.64	1.39	1.57	2.75	5.75	7.70	9.30	11.30	9.14	6.41	63.61	65.02	95%
1990	4.86	2.95	1.75	1.57	1.83	3.64	5.74	7.86	9.18	10.19	9.21	7.09	65.87	66.23	98%
1991	6.56	3.48	1.95	1.86	2.44	2.63	5.00	6.42	8.50	10.25	8.00	7.61	64.70	65.33	96%
1992	6.45	3.03	1.71	0.96	1.65	2.84	5.91	8.87	8.23	10.01	10.76	7.82	68.24	65.51	102%
1993	5.12	2.79	1.19	1.21	1.42	2.83	4.93	6.61	9.64	10.23	10.02	8.18	64.17	64.33	96%
1994	4.65	3.27	1.22	1.49	1.36	4.12	5.23	6.38	10.01	10.03	10.31	7.44	65.51	66.16	98%
1995	4.94	1.66	0.76	0.73	1.61	2.33	4.75	5.22	8.18	10.06	10.39	7.65	58.28	57.96	87%
1996	6.23	2.80	0.88	1.33	1.66	3.85	6.38	8.12	9.68	12.03	11.13	7.48	71.57	69.03	107%
1997	5.44	2.05	1.04	1.02	2.67	4.82	6.45	8.95	9.40	10.32	8.78	8.52	69.46	72.48	104%
1998	5.25	1.82	1.60	1.19	0.96	2.80	4.36	4.13	7.10	9.91	10.57	7.51	57.20	56.83	85%
1999	4.51	1.63	1.41	1.32	1.58	2.93	5.25	7.04	8.70	10.51	8.58	7.53	60.99	62.36	91%
2000	6.86	2.73	2.51	1.57	1.55	3.91	5.48	7.16	9.66	9.23	9.82	7.86	68.35	68.06	102%
2001	3.84	1.84	1.68	1.45	2.20	4.14	4.86	10.05	10.92	9.78	9.75	7.98	68.49	67.89	102%
2002	6.56	2.56	1.47	1.97	2.56	4.63	5.65	7.82	9.87	11.08	9.87	9.13	73.17	70.60	109%
2003	5.64	3.23	1.73	1.26	2.31	4.04	4.05	7.62	9.78	12.14	9.23	8.84	69.87	69.74	104%
2004	6.71	1.72	1.12	1.08	2.22	4.99	7.38	8.66	9.46	10.16	9.88	8.76	72.14	73.55	108%
2005	4.86	2.21	1.54	1.14	1.54	3.20	4.93	6.60	8.37	11.13	10.65	7.41	63.58	63.19	95%
2006	5.19	2.50	1.50	1.52	2.47	3.04	3.81	8.54	9.82	12.43	9.37	8.42	68.61	67.58	102%
2007	5.27	2.09	2.22	1.98	1.71	4.34	5.86	8.58	9.59	9.814	10.45	7	68.90	71.86	103%
2008	4.45	3.25	1.68	1.37	2.14	4.60	6.65	8.66	10.37	10.54	10.54	8.42	72.67	70.43	108%
2009	6.27	2.40	1.35	2.04	1.95	3.90	6.24	8.52	9.09	11.053	10.12	8.63	71.566	71.26	107%
2010	4.84	3.00	1.28	1.20	1.61	3.91	4.65	6.40	9.52	10.2	9.08	8.26	63.95	66.21	95%
2011	4.98	2.43	1.13	1.53	2.46	2.64	5.64	7.13	8.22	10.25	9.62	8.46	64.49	63.70	96%
2012	4.73	2.30	2.93	2.49	2.84	3.46	5.52	8.84	10.19	11.27	10.58	8.08	73.23	71.63	109%
2013	5.28	2.55	1.89	1.48	2.51	4.74	7.61	9.09	10.20	11.78	9.35	7.45	73.93	75.28	110%
2014	6.04	3.41	2.59	3.43	2.43	4.66	6.23	10.51	10.77	11.05	9.56	7.6	78.28	78.65	117%
2015	6.26	2.73	1.16	1.79	2.65	4.96	6.62	7.31	10.01	10.73	10	9.37	73.59	71.70	110%
2016	5.81	2.19	1.20	0.75	2.80	3.30	5.70	7.92	11.87	12.29	9.71	9.06	72.6	71.64	108%
2017	4.74	2.32	1.56	1.16	1.49	3.78	5.18	8.93	9.78	12.02	10.04	8.34	69.34	70.00	103%
MAXIMUM	6.86	3.48	2.93	3.43	2.94	5.17	7.61	10.51	11.87	12.43	11.77	9.47	78.28	78.65	117%
MINIMUM	3.20	1.30	0.76	0.66	0.96	2.17	3.64	4.13	7.10	8.46	7.05	6.10	57.20	56.83	85%
MEAN	5.12	2.42	1.50	1.43	1.96	3.62	5.47	7.82	9.40	10.70	9.73	7.88	67.04	67.02	100%

ETo can be approximated using: ETo= Pan Evaporation x 0.6402

Water Year = October to September

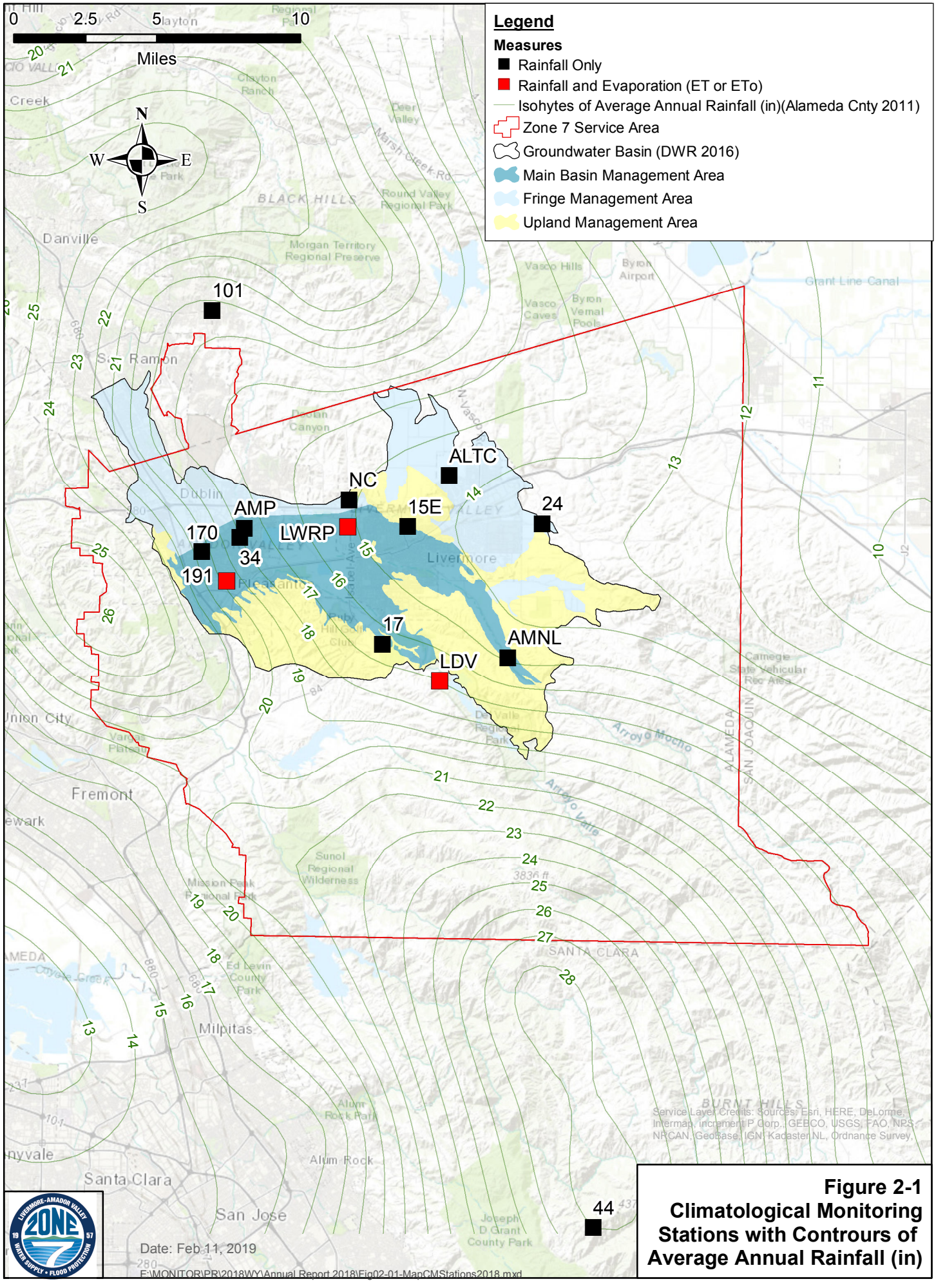
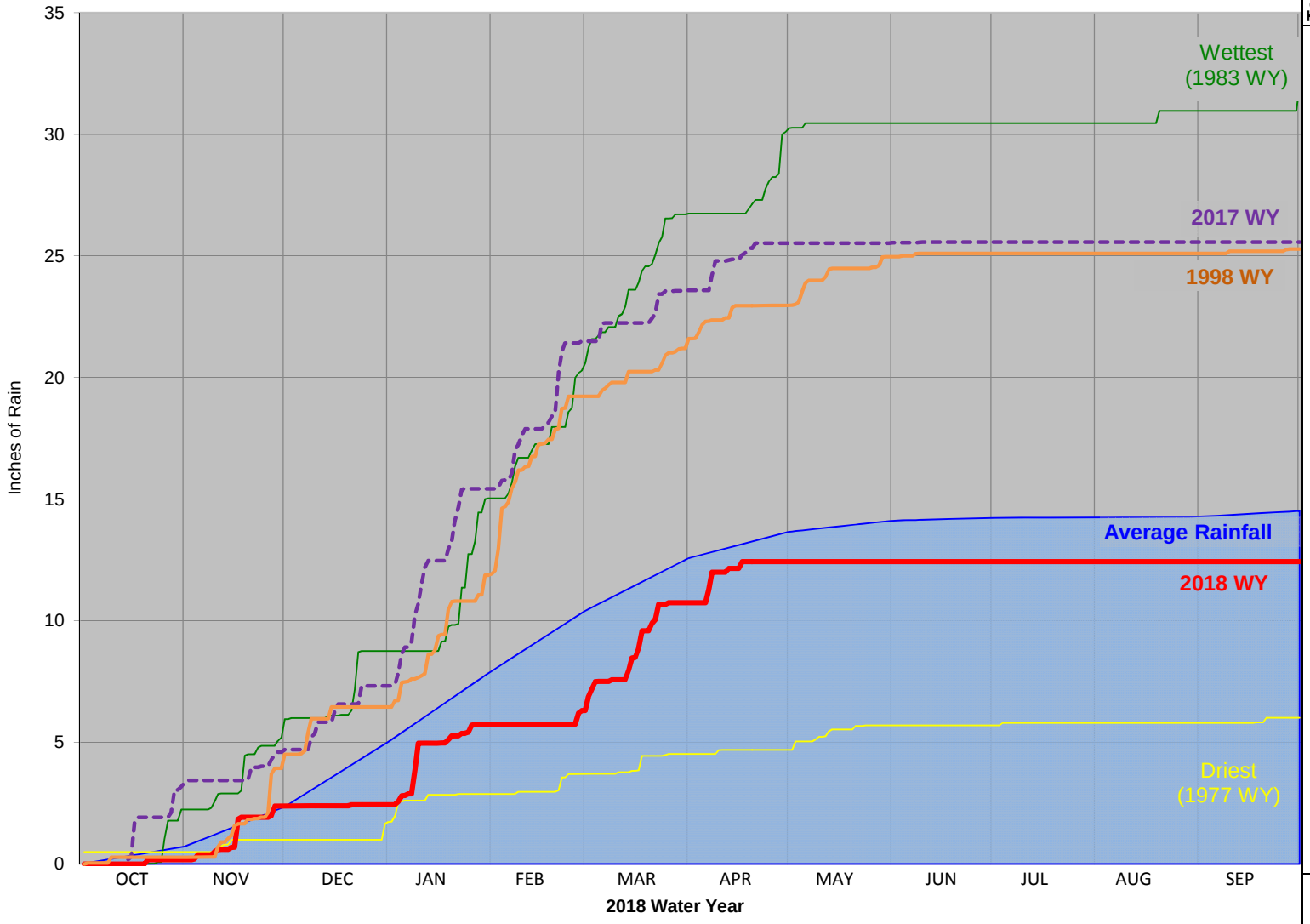


Figure 2-1
Climatological Monitoring Stations with Contours of Average Annual Rainfall (in)

FIGURE 2-2
ZONE 7 WATER AGENCY
GRAPH OF LIVERMORE RAINFALL (STATION 15E NOAA)



	Total Annual Rainfall	% Avg	Probability of Exceedence
Wettest (1983 WY)	31.98"	220%	1%
2017 WY	25.57"	176%	3%
1998 WY	25.28"	174%	3%
Average Rainfall	14.52"	100%	41%
2018 WY	12.44	86%	60%
Driest (1977 WY)	6.02"	41%	98%

Monthly (inches)	0.18	2.20	0.06	3.30	0.57	4.44	1.68	0.01	0.00	0.00	0.00	0.00
% Monthly Avg	25%	134%	2%	113%	23%	205%	155%	2%	0%	0%	0%	0%
YTD (inches)	0.18	2.38	2.44	5.74	6.31	10.75	12.43	12.44	12.44	12.44	12.44	12.44
% Average YTD	25%	101%	49%	72%	61%	85%	91%	88%	87%	87%	87%	86%
% Annual Avg	1%	16%	17%	40%	43%	74%	86%	86%	86%	86%	86%	86%

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3 Surface Water

3.1 Program Description

3.1.1 Monitoring Network

Zone 7's Surface Water Monitoring Program focuses on the four main gaining and losing streams that affect the groundwater basin (Arroyo Valle, Arroyo Mocho, Arroyo Las Positas (ALP), and Arroyo de la Laguna), and the diversions and accretions that affect the flows into or from each of them. *Table 3-1* and *Figure 3-1* show all the stations monitored for the 2018WY. *Table 3-1* also includes a description of all of the stations discussed below.

The program utilizes a network of stream gauge stations and flow meters to compute the quantity of water flowing past each station and the amount recharging the basin between them. At least once per year, water samples are collected from the 10 main gauge sites and submitted to Zone 7's laboratory for analysis of total dissolved solids (TDS), nutrients, metals, and other minerals from which salt and nutrient loading (and removal) are computed.

Several other surface water monitoring stations have been established as high flow- and/or stream temperature-only monitoring stations to augment the data collected at the 10 main stations for various ongoing flood management and habitat studies (*Table 3-1* and *Figure 3-1*). For detailed information on Zone 7's Surface Water Monitoring Program, see *Section 4.3*, *Surface Water Monitoring,* of the Alternative GSP.

3.1.2 Program Changes for the Water Year

No changes were made to the main Surface Water Monitoring Program that affects the groundwater sustainability. However, a few changes were made to the auxiliary programs, as follows.

- In February 2018, the stream gauge equipment at South San Ramon Creek above Amador Valley Boulevard (SSRC_AVBLVD) was reinstalled and activated. The equipment had been stolen in 2017 after being in service for two years and two months.

- In February 2018, the stream gauge station on Alamo Creek at Willow Creek Drive (AC_WCD) was upgraded to begin transmitting its data to the publically-accessible WaterLOG Storm Central® website: https://stormcentral.waterlog.com/public/Zone7.

3.2 Results for the 2018 Water Year

3.2.1 Introduction

Nineteen surface water recorder stations were operated and maintained for the Surface Water Monitoring Program in 2018WY. Data was tabulated monthly for 11 of the stations (10 main gauges plus Station Alamo Canal near Pleasanton [ACNP], see *Table 3-2*). Water samples were collected from 9 of the 10 main stations and analyzed to identify the quality of water recharging and discharging from the groundwater basin (*Table 3-3*). A sample was not collected from the Arroyo Mocho Hageman at Livermore Station (AMHAG) due to the channel reach drying up on April 8, 2018 and not being used for artificial recharge after that date.

The following sections outline the Surface Water Monitoring Program activities for the 2018 WY (listed by stream), and highlight the findings and conclusions from these activities.

3.2.2 Arroyo Valle

The following are items of special note for the Arroyo Valle in the 2018 WY.

- The watershed runoff total into LDV, as recorded by the Arroyo Valle below Lang Canyon (AVBLC) was 2,780 acre-feet (AF); 11% of average.
- There were no flood releases made from LDV (Station LDV_FLD_TTL) into Arroyo Valle.
- Artificial releases into Arroyo Valle from the South Bay Aqueduct (SBA) totaled 5,661 AF from two turnouts (SBA_TO2_AV and SBA_TO1_AV).
- Peak flows recorded on the Arroyo Valle was 18.5 cubic feet per second (cfs) at Arroyo Valle near Livermore (AVNL) and 88 cfs at Arroyo Del Valle at Pleasanton (ADVP); the WY annual means were 7.1 and 2.0 cfs, respectively.
- The aggregate mining companies did not make any discharges into the Arroyo Valle in 2018 WY.
- East Bay Regional Parks District (EBRPD) diverted 858 AF from the Arroyo Valle into Shadow Cliffs Lake (Station AV_DIV_SC) for recreation and groundwater recharge.
- "Live stream" conditions were maintained in the Arroyo Valle with natural and artificial flows on all but 11 days during 2018 WY. Eight of the 11 days occurred during vegetation removal below LDV when DWR shut off releases from the SBA to facilitate the work.

3.2.3 Arroyo Mocho

The following are items of special note for the Arroyo Mocho in the 2018 WY.

- The total upper watershed runoff that flowed into the Valley, past Station Arroyo Mocho near Livermore (AMNL) was 460 AF (13% of average).

- The peak flows recorded on the Arroyo Mocho were 24 cfs at AMNL and 250 cfs at AMHAG; the WY annual means were 0.6 and 1.9 cfs, respectively.

- Releases into Arroyo Mocho from the SBA for artificial groundwater recharge purposes totaled 3,076 AF (Station SBA_AM). After February 1, no further artificial releases were made to the Arroyo Mocho for the remainder of the WY because the groundwater basin was nearly full.

3.2.4 Arroyo Las Positas

The following are items of special note for the ALP in the 2018 WY.

- Numerous low flow stream gauging interferences occurred at Station Arroyo Las Positas at Livermore (ALPL) as the result of equipment thefts and vandalism.

- The peak flow recorded at Station Arroyo Las Positas at El Charro (ALP_ELCH) was 426 cfs; the WY annual mean was 5.5 cfs.

- No water releases were made from the SBA into Altamont Creek (Station SBA_ALTC), a tributary to the ALP.

3.2.5 Arroyo de la Laguna

The following are items of special note for the Arroyo de la Laguna in the 2018 WY.

- A total of 19,489 AF of water flowed out of the valley past Station Arroyo de la Laguna at Verona (ADLLV); 37% of average.

- The peak flow recorded at ADLLV was 1,790 cfs; the WY annual mean was 26.9 cfs.

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TABLE 3-1
TABLE OF SURFACE WATER MONITORING STATIONS AND MONITORING FREQUENCIES
2018 WATER YEAR

Station ID	Description	Program and Frequency				
		Flow		*Quality*		*Other*
		Type	Freq	Temp*	Sample	Wtr Rights
ARROYO VALLE - LINE E						
AVBLC	Arroyo Valle below Lang Canyon	Recorder	15 Min	15 Min	Annual	-
LDV_FLD_GATE	Lake Del Valle Flood Gate	Calculated	Daily	-	-	-
LDV_FLD_TTL	Lake Del Valle Total Flood Release	Calculated	Daily	-	-	-
AVRUNOFF	Arroyo Valle Runoff	Calculated	Daily	-	-	-
SBA_TO2_AV	SBA Turnout 2 to Arroyo Valle	Recorder	15 Min	15 Min	-	-
AVCAT	Arroyo Valle along Camp Arroyo Trail	None	-	15 Min	-	-
AVNL	Arroyo Valle near Livermore	Recorder	15 Min	15 Min	Quarterly	Quarterly
SBA_TO1_AV	SBA Turnout 1 to Arroyo Valle	Calculated	Daily	-	-	-
SBA_AV_TTL	SBA Turnouts to Arroyo Valle - Total	Calculated	Daily	-	-	-
AVDCC	Arroyo Valle at Dry Creek Confluence	None	-	15 Min	-	-
SBA_AV_BLOWOFF	SBA Blowoff Releases to Arroyo Valle	Calculated	Daily	-	-	-
AVSGP	Arroyo Valle at Sycamore Grove Park	None	-	15 Min	-	-
DVWTP_DISCH	DVWTP Discharge to South Tributary	Meter	Daily	-	-	-
AV_ISABEL	Arroyo Valle at Isabel	None	-	15 Min	-	-
AV_DIV_SC	Arroyo Valle Diversion to Shadow Cliffs	Meter	Daily	-	-	-
AVSCPK18	Arroyo Valle at Shadow Cliffs Pond K18	None	-	15 Min	-	-
ADVP	Arroyo Valle at Pleasanton	Recorder	15 Min	15 Min	Quarterly	Quarterly
AVADLL	Arroyo Valle above Arroyo De La Laguna	None	-	15 Min	-	-
ARROYO MOCHO - LINE G						
AMNL	Arroyo Mocho near Livermore	Recorder	15 Min	15 Min	Annual	-
SBA_AM	SBA Turnout to Arroyo Mocho	Recorder	15 Min	-	-	-
AM_StanRch_10	Stanley Reach at 10 ft Downstream of Flood Bridge	Recorder	-	15 Min	-	-
AM_StanRch_4050	Stanley Reach at 4050 ft	None	-	15 Min	-	-
AMHAG	Arroyo Mocho at Livermore	Recorder	15 Min	15 Min	Annual	-
MA_VUL_COPE	Vulcan Discharge to Cope Lake	Meter	Daily	-	-	-
MA_COPE_I	Cope Lake to Lake I	Meter	Hourly	-	-	-
AM_KB	Arroyo Mocho at Kaiser Bridge	Recorder	15 Min	15 Min	Annual	-
AMP	Arroyo Mocho near Pleasanton	Recorder	15 Min	15 Min	Annual	-
ARROYO LAS POSITAS - LINE H						
SBA_ALTC	SBA Turnout to Altamont Creek	Recorder	15 Min	-	-	-
PPWTP_DISCH	PPWTP Discharge to Arroyo Las Positas	Meter	Daily	-	-	-
LLNL_ALP	LLNL Treated Groundwater Discharge to ALP	Calculated	Daily	-	-	-
LLNL_SECO	LLNL Treated Groundwater Discharge to Arroyo Seco	Calculated	Daily	-	-	-
ALPL	Arroyo Las Positas at Livermore	Recorder	15 Min	15 Min	Annual	-
ALP_ELCH	Arroyo Las Positas above El Charro Road	Recorder	15 Min	15 Min	Annual	-
ARROYO DE LA LAGUNA - LINE B						
ADLLV	Arroyo De La Laguna at Verona	Recorder	15 Min	15 Min	Annual	-
ALAMO CANAL - LINE F						
ACNP	Alamo Canal near Pleasanton	Recorder	15 Min	15 Min	-	-
ALAMO CREEK - LINE F						
AC_WCD	Alamo Creek at Willow Creek Dr near Dublin	Recorder	15 Min	15 Min	-	-
ALTAMONT CREEK - LINE R						
ALTC_SGC	Altamont Creek to Springtown Golf Course	Meter	Daily	-	-	-
ALTC_BD	Altamont Creek at Bluebell Drive	Recorder	15 Min	15 Min	-	-
CHABOT CANAL - LINE G-1						
CCNP	Chabot Canal below Stoneridge Drive nr Pleasanton	Recorder	15 Min	15 Min	-	-
SOUTH SAN RAMON CREEK - LINE J						
SSRC_AVBLVD	South San Ramon Creek above Amador Valley Blvd	Recorder	15 Min	15 Min	-	-

* Water temperature only at some sites for Habitat Monitoring.

Other notes: ADLLV also includes 15 minute pH and SC. AM_StanRch_10 is water-level-only (no flow calculations) for 2018 WY.

TABLE 3-2
MONTHLY FLOWS (ACRE-FEET)
STREAMFLOW GAUGING STATIONS
2018 WATER YEAR

MONTH	ARROYO VALLE Below LANG CANYON* AVBLC	ARROYO VALLE Near LIVERMORE* AVNL	ARROYO VALLE At PLEASANTON ADVP	ARROYO MOCHO Near LIVERMORE AMNL	ARROYO MOCHO At LIVERMORE AMHAG	ARROYO MOCHO At KAISER BRIDGE AM_KB	ARROYO MOCHO Near PLEASANTON AMP	ARROYO LAS POSITAS At LIVERMORE ALPL	ARROYO LAS POSITAS At EL CHARRO ALP_ELCH	ALAMO CANAL Near PLEASANTON* ACNP	ARROYO DE LA LAGUNA At VERONA* ADLLV
OCT	0	343	72	9	69	1	152	172	122	195	543
NOV	14	405	167	32	402	90	676	438	461	957	2,376
DEC	16	353	49	33	289	0	153	167	150	227	592
JAN	294	317	298	84	413	175	1,353	684	859	1,867	4,033
FEB	110	366	51	33	5	0	245	208	239	293	758
MAR	1,661	179	375	176	140	69	1,484	805	1,102	2,479	5,596
APR	581	299	97	69	26	14	721	494	588	1,784	3,100
MAY	105	402	49	16	0	0	169	183	149	222	668
JUN	2	633	65	7	0	0	123	151	100	153	498
JUL	0	693	35	2	0	0	108	142	78	135	395
AUG	0	750	99	0	0	0	112	150	92	151	491
SEP	0	424	83	0	0	0	94	128	69	149	441
TOTAL	**2,783**	**5164**	**1,440**	**460**	**1,344**	**348**	**5,391**	**3,721**	**4,010**	**8,611**	**19,489**

* USGS Stations

Note: Monthly streamflows are not calculated or presented in this table at these recorder locations: AC_WCD, ALTC_BD, CCNP, and SSRC_AVBLVD are high-flow-only monitoring sites; SBA_TO2_AV, SBA_AM, and SBA_ALTC are streamflow input sites.

TABLE 3-3
TABLE OF SURFACE WATER QUALITY RESULTS
2018 WATER YEAR

							Mineral Constituents (mg/L)									Select Metals (ug/L)				TDS	Hard
SITE ID	Date	Time	FLOW (cfs)	TEMP. °C	SC mS/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3N	SiO2	B	As	Fe	Cr	mg/L	mg/L
ADLLV	8/22/2018	13:24	8.4	23.3	1246	8.3	61	46	124	3.3	357	141	166	0.22	11.3	1230	3.1	< 100	< 1	733	341
ADVP	12/19/2017	11:02	0.8	6.4	434	7.5	35	17	26	2.6	182	27	29	< 0.1	7.7	180	1.1	< 100	< 1	235	157
ADVP	3/12/2018	13:49	2.0	12.6	478	7.8	37	18	33	2.2	182	33	40	< 0.1	6.1	200	1.1	< 100	< 1	260	168
ADVP	8/6/2018	11:22	1.4	21.9	471	7.7	28	17	42	2	156	35	53	< 0.1	4.9	240	1.6	< 100	< 1	259	140
ALP_ELCH	8/22/2018	12:03	1.4	20.3	1290	8.3	53	53	130	3.2	391	84	189	1.55	12.4	2220	1.8	< 100	< 1	728	349
ALPL	8/22/2018	10:45	2.2	19.3	1335	8.1	68	53	124	2.3	427	79	192	3.53	25.7	2300	1.5	< 100	2.5	773	388
AM_KB	3/1/2018	14:28	4.9	13.1	57	7.1	4	3	4	1.3	24	2.3	2.7	0.34	2.6	< 100	< 1	< 100	< 1	33	21
AMNL	4/26/2018	14:47	0.4	21	938	8.2	48	83	40	3.3	517	56	34	< 0.1	12.6	550	< 1	< 100	< 1	537	461
AMP	8/22/2018	12:27	1.7	20.1	1330	8.1	57	49	133	4.4	392	79	202	1.37	13.5	1930	2.5	< 100	< 1	740	342
AVBLC	4/26/2018	14:09	4.0	22.4	580	8.4	51	28	25	2	248	66	15	< 0.1	12.8	370	< 1	< 100	< 1	326	245
AVNL	12/19/2017	12:02	5.7	8.9	415	7.7	22	13	37	3.1	97	31	59	0.48	15.4	130	1	< 100	< 1	231	108
AVNL	3/12/2018	14:38	3.8	15.5	533	7.9	28	14	48	2.8	122	48	64	0.46	13.3	260	1.4	< 100	< 1	281	128
AVNL	8/6/2018	11:57	12.1	21.8	303	7.7	13	9	28	1.7	79	16	35	< 0.1	9.8	< 100	2.3	< 100	< 1	152	69

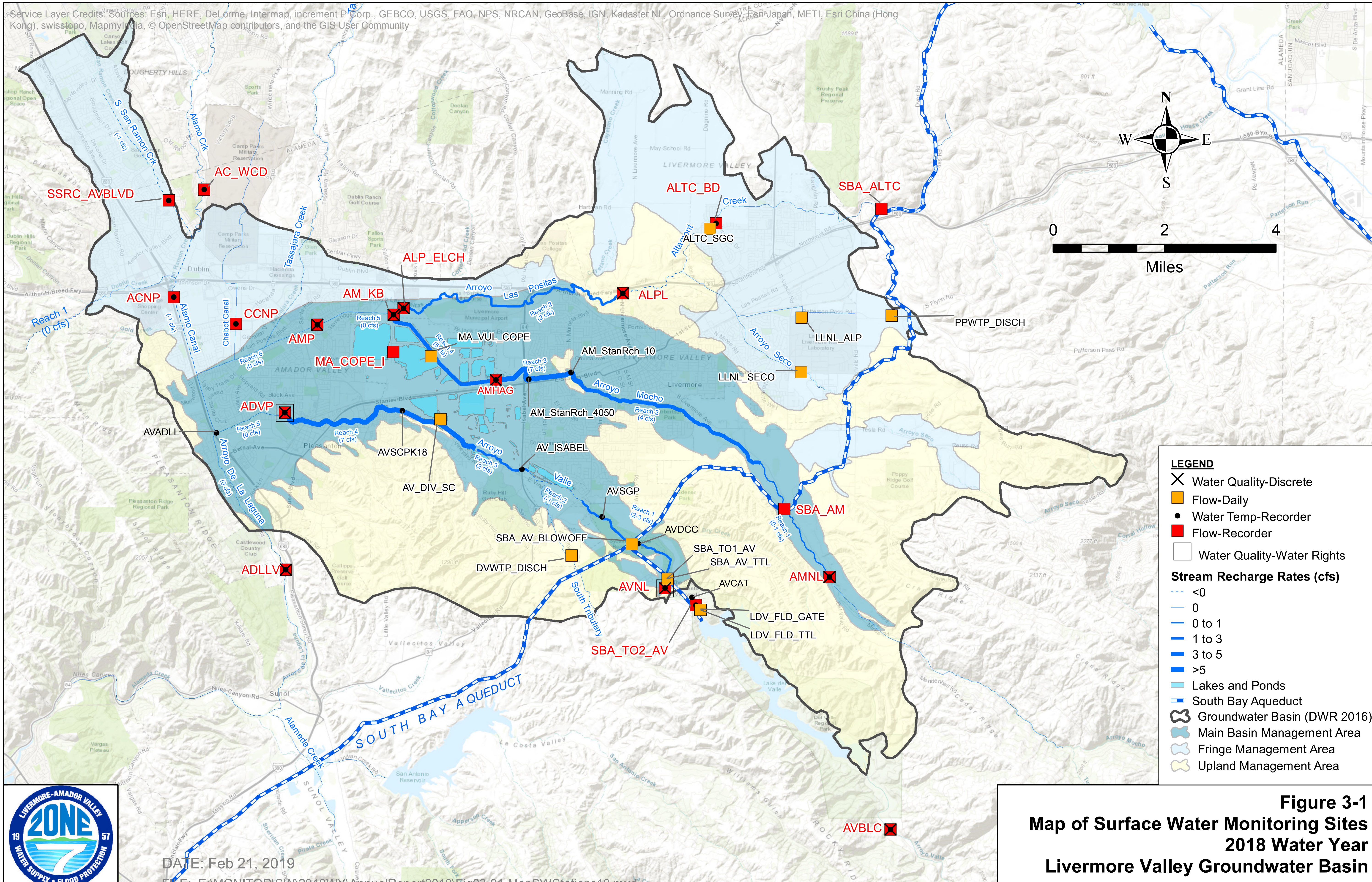

Figure 3-1
Map of Surface Water Monitoring Sites
2018 Water Year
Livermore Valley Groundwater Basin

4 Mining Area

4.1 Program Description

4.1.1 Monitoring Network

The Chain of Lakes/Mining Area Monitoring Program includes water level measurements and water quality analysis for many of the mining area ponds or quarry lakes within the Livermore Valley.

All water generated during mining that is discharged to a non-quarry property is metered and tracked as it exits the Valley in arroyos. This program also tracks mining evaporation and includes estimates of groundwater lost due to the export of moist gravels. In general, quarry pits have been excavated into the Upper Aquifer; however, recently a few have been excavated into layers that appear to connect to the Lower Aquifer, exposing groundwater to larger evaporative losses. Groundwater is also pumped from some of the pits and transferred to others or discharged to the arroyos to facilitate the gravel extraction in the pits being actively mined. In addition, backfill of former quarry ponds with fine-grained materials results in an impediment to groundwater flow in the aquifers.

Ownership of 10 of the mining quarry lakes ("Chain of Lakes" or "COL", A through I and Cope Lake) have been or will be transferred to Zone 7 for future water resources management purposes. Project management actions on the COL Recharge Projects are discussed in *Section 5.2.4, Chain of Lakes Recharge Projects*, of the Alternative GSP. For more detailed information on the Chain of Lakes/Mining Area Monitoring Program, see *Section 4.4 Chain of Lakes and Quarry Operations Monitoring*, of the Alternative GSP.

4.1.2 Program Changes for the Water Year

Pond R28 (future Lake D) was added back into the water elevation and quality monitoring program in 2018 WY. It had been removed from the program in 2017 WY because access was limited and dangerous while that particular pit was actively mined. It was added back into the program for 2018 because access has improved.

4.2 Results for the 2018 Water Year

4.2.1 Water Elevations

Table 4-1 summarizes the water levels observed in the mining area ponds for the 2018 WY. Water elevations were measured in most of the pits in the mining area that contained water (lakes and ponds) during the 2018 WY. *Figure 4-1* provides the groundwater elevation contours for the gravel mining pits and surrounding monitoring wells. The water elevations from the pits that are directly connected with the Upper Aquifer are included in the Groundwater Monitoring Program's dataset. This includes water elevations from mining area pits R24A/Lake E, R28/Lake D, and P42, which appear to be in contact with

both the Upper and Lower Aquifers. These three pond elevations are included in both the Upper and Lower Aquifer groundwater elevation contour maps presented in *Section 6*. Pond R24A is no longer being actively mined; however, its water level is kept low to facilitate reclamation activities. Ponds R3, R8/Lake G, R22/Lake F, and R23, are no longer considered connected to the Upper Aquifer due to filling with fine-grained materials and lack of correlation between pond water levels and Upper Aquifer groundwater elevations.

4.2.2 Water Quality

Water quality was monitored in select mining ponds in September 2018. Salinity in the mining area ponds, measured as total dissolved solids (TDS), ranged from 236 mg/L in K-18/Lake Boris, which is supplied by Arroyo Valle, to 536 mg/L in pond P28 (future Lake A). See *Table 4-2* for the results of the water quality sampling conducted in the mining area.

4.2.3 Mining Activities and Water Budget

Aggregate mining activities during the 2018 WY were conducted by Vulcan Materials (formerly Calmat) and CEMEX (formerly RMC Lonestar). Vulcan Materials continued mining operations in Pit R28 (future Lake D) while CEMEX focused its mining in Pit P46 (future Lake J) during the 2018 WY. Estimated volumes associated with the mining area are shown in *Table 4-A* and discussed below.

Table 4-A: Estimated Mining Area Volumes (AF)

Activity	2018	2017
Mining Area Transfers*		
Vulcan to Cope Lake	15,562	13,452
Cope Lake to Lake I	14,181	12,029
Diverted to Shadow Cliffs	857	434
Mining Area Losses		
Processing Losses	700	700
Net Pond Precip/Evaporation	3,536	2,113
Pumped GW Exported from Valley	0	0

* Transfers made to locations outside of the quarries.

Vulcan Materials did not discharge water into either Arroyo Mocho or Arroyo Valle during the 2018 WY. For the fourth consecutive year, all water discharges made by Vulcan Materials were captured in Cope Lake. In total, Vulcan discharged 15,562 AF of water into Cope Lake, of which an estimated 14,181 AF flowed into Lake I via the Cope-to-Lake I conduit during the 2018 WY. Although this extracted groundwater is not leaving the Basin, except by evaporation, the effect of dewatering in R24 (future Lake E) and R28 (future Lake D) contributed a localized groundwater depression in the Amador East Subarea groundwater levels (see *Section 6*). The westernmost CWS municipal supply wells (CWS 20 and CWS 24) also pull groundwater from this portion of the subarea.

CEMEX also did not discharge any pumped groundwater into the arroyos during the 2018 WY. The groundwater pumped from their active excavation P46 (future Lake J) was transferred to other onsite ponds and used as a gravel wash water source. Consequently, some of this water evaporated or left the Valley as exported gravel moisture, and some percolated through the pond bottoms and sides, and back into the aquifer.

Based on ETo monitoring data for the 2018 WY and historic gravel sales information, an estimated total 3,536 AF of water evaporated from all the mining area ponds, and about 700 AF left the Basin as exported gravel moisture from the CEMEX and Vulcan operations during the 2018 WY.

Zone 7 continued its cooperative off-site recharge program with the EBRPD, using the Shadow Cliffs Lake as a spreading pond. The EBRPD operated its diversion equipment that siphons water from the Arroyo Valle into Shadow Cliffs diverting 857 AF during the 2018 WY, compared to 435 AF in the 2017 WY.

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TABLE 4-1
SEMIANNUAL WATER LEVELS IN MINING AREA PONDS
2018 WATER YEAR

EXCAVATIONS							PONDS									
Pit	COL Name	Original Ground Elev	Deepest Mined Depth (ft)		Pit Area	Mining Status	Pond Area	Contact with Aquifer	Water Elev Status	Mining Use	Measurement Frequency		Pond Elevation (ft MSL, NAVD88)			
			Elev	*Depth*	*(acres)*		*(acres)*				*Levels*	*Quality*	*Fall 17*	*Spring 18*	*Fall 18*	*WY Diff*
CALROCK/RHODES & JAMIESON/VULCAN/PLEASANTON GRAVEL COMPANY/CALMAT																
C1/ Lake C	C	410	360	50	32.2	Excavated	0.1	Yes	Static	Unused	SA	A	388.4	382.03	372.2	-16.21
C2	C	410	360	50	6.1	Excavated										
C3	C	410	360	50	11.3	Excavated										
C4	C	400	390	10	1.7	Backfilled										
C5		400	290	110	19.2	Backfilled										
C6/ Lake C	C	400	385	15	12.4	Excavated										
C7/ Lake D	D	400	330	70	22.1	Backfilled										
C8A/ Lake D	D	410	330	80	20.2	Backfilled										
C8B/ Lake D	D	410	340	70	26.8	Backfilled										
C9/ Lake D	D	410	360	50	20.8	Active										
C10/ Lake D	D	410	320	90	62.3	Active										
R3		370	240	130	14.8	Excavated	5.9	No	Lined	Settling Pond	SA	A	345.7	343.13	344.8	-0.97
R4		380	240	140	16.5	Excavated	10.4	Yes	InFlux	Water Storage	SA	A	315.5	310.65	315.6	0.164
R5		380	240	140	31.1	Backfilled										
R8/ Lake G	G	365	260	105	46	Excavated	42.4	No	Lined	Water Storage						
R10		380	370	10	2.2	Backfilled										
R11		390	370	20	3.4	Backfilled										
R12		370	240	130	39.4	Backfilled										
R13		370	270	100	28.3	Backfilled										
R14		400	380	20	11.5	Backfilled										
R21		380	280	100	44.2	Excavated	17.6	No	Lined	Settling Pond						
R22/ Lake F	F	380	290	90	79.3	Excavated	65.8	No	Lined	Water Storage	SA	A	364.5	367.46	366.1	1.593
R23		380	270	110	27.5	Excavated	21.4	No	Lined	Settling Pond	SA	A	359.3	360.64	361.6	2.292
R24		390	200	190	86.9	Active										
R24A/ Lake E	E	390	150	240	55.9	Active	26.4	Yes	Depressed	Active Mining	SA	A	186.1	176.85	163.7	-22.48
R25/ Lake E	E	395	300	95	43.7	Backfilled										
R27		380	300	80	59.5	Excavated	11.3	No	Lined	Unused						
R28/ Lake D	D	400	320	80	62.9	Active	0.5	Yes	Depressed	Active Mining					219.3	

TABLE 4-1
SEMIANNUAL WATER LEVELS IN MINING AREA PONDS
2018 WATER YEAR

EXCAVATIONS							PONDS									
Pit	COL Name	Original Ground Elev	Deepest Mined Depth (ft)		Pit Area	Mining Status	Pond Area	Contact with Aquifer	Water Elev Status	Mining Use	Measurement Frequency		Pond Elevation (ft MSL, NAVD88)			
			Elev	*Depth*	*(acres)*		*(acres)*				*Levels*	*Quality*	*Fall 17*	*Spring 18*	*Fall 18*	*WY Diff*
KAISER GRAVELS/HANSON AGGREGATES																
K1		350	325	25	3.4	Backfilled										
K2		350	325	25	3.2	Backfilled										
K4		350	315	35	13	Backfilled										
K5		350	315	35	10.4	Backfilled										
K6		350	325	25	13.4	Backfilled										
K7		350	320	30	11.7	Backfilled										
K8		350	320	30	17.7	Backfilled										
K9		360	305	55	57.4	Backfilled										
K10		370	355	15	4.4	Backfilled										
K11		370	315	55	24	Backfilled										
K12		370	275	95	37.7	Backfilled										
K13		370	275	95	14.9	Backfilled										
K14		370	275	95	5.6	Backfilled										
K15		360	265	95	142.3	Excavated	83	Yes	Elevated	Water Storage	SA	A	330.6	332.08	332.8	2.177
K18/ Lake Boris	Lake Boris	360	330	30	24.5	Excavated	10.8	Yes	Static	Unused	SA	A	350.4	350.29	350.4	-0.047
K19		350	335	15	11.1	Backfilled										
K19A		350	335	15	8	Excavated	2.1	Yes	Static	Unused						
K24		360	220	140	87.9	Backfilled										
K28/ Lake H	H	360	220	140	89.6	Excavated	58.2	Yes	Static	Water Storage	SA	A	312.3	319.54	318.3	5.995
K30/ Cope Lake	Cope Lake	370	240	130	233.9	Excavated	188.4	No	Lined	Settling Pond	SA	A	333.6	334.34	332.8	-0.813
K32		360	335	25	34.2	Backfilled										
K33		360	335	25	12.8	Backfilled										
K37/ Lake I	I	360	220	140	300.8	Excavated	236.4	Yes	Elevated	Water Storage	SA	A	310.1	320.03	317.2	7.06

COL = Chain of Lake, A = Annual; SA = Semiannual,
WY Diff = Water Year Difference (Fall to Fall)

TABLE 4-1
SEMIANNUAL WATER LEVELS IN MINING AREA PONDS
2018 WATER YEAR

EXCAVATIONS							PONDS									
Pit	COL Name	Original Ground Elev	Deepest Mined Depth (ft)		Pit Area	Mining Status	Pond Area	Contact with Aquifer	Water Elev Status	Mining Use	Measurement Frequency		Pond Elevation (ft MSL, NAVD88)			
			Elev	*Depth*	*(acres)*		*(acres)*				*Levels*	*Quality*	*Fall 17*	*Spring 18*	*Fall 18*	*WY Diff*
PACIFIC AGGREGATE/RMC/LONESTAR/CEMEX																
P1		380	360	20	0.8	Backfilled										
P2		380	360	20	1.9	Excavated	1.2	Yes	Elevated	Water Storage						
P3	B	400	360	40	8.5	Backfilled										
P4	B	400	360	40	7.8	Excavated										
P6		380	280	100	28.8	Backfilled										
P7		380	280	100	16.7	Backfilled										
P10		400	340	60	34	Excavated	17.2	Yes	Static	Unused	SA	A	364.9	365.25	363.7	-1.142
P11		380	340	40	6.9	Excavated										
P12/ Island Pond	Island Pond	360	330	30	29.5	Excavated	14.9	Yes	Static	Unused	SA	A	351.5	350.8	351.7	0.147
P13		380	300	80	2.6	Backfilled	1	Yes	Elevated	Water Storage						
P21		380	240	140	10.5	Backfilled										
P27		390	250	140	31	Excavated	6.9	Yes	Static	Water Storage	SA	A	281	282.45	280.5	-0.456
P28	A	420	360	60	24.6	Excavated	7.4	Yes	Static	Water Storage	SA	A	407.4	413	406.9	-0.5
P34		380	270	110	46	Excavated										
P39/ Lake B	B	410	380	30	36.4	Excavated										
P40/ Lake C	C	390	260	130	14.5	Excavated	1.1	Yes	Static	Unused			338.2			
P41/ Lake A	A	410	370	40	91.3	Excavated	53	Yes	Static	Water Storage	SA	A	412.8	413.69	412	-0.823
P42/ Lake B	B	380	250	130	101.8	Excavated	1.7	Yes	Depressed	Active Mining	SA	A	281.8	284.62	285.3	3.555
P43		390	240	150	130.9	Excavated	83.2	No	Lined	Settling Pond						
P44		390	250	140	20	Excavated	7.5	Yes	Elevated	Water Storage	SA	A	338.9	349.82	351.2	12.264
P45	B	380	310	70	25	Excavated	10.6	Yes	Elevated	Water Storage						
P46/ Lake J	J	380	80	300	0	Active				Active Mining						

TABLE 4-2
WATER QUALITY RESULTS FOR MINING AREA WATER SAMPLES
2018 WATER YEAR

						Mineral Constituents (mg/L)									Select Metals (ug/L)				TDS	Hard
SITE ID	DATE	DTW (Ft)	TEMP. °C	EC umhos/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3	SiO2	B	As	Fe	Cr	mg/L	mg/L
MA-C 1	9/25/18	372.22	22.8	872	8.5	49	48	56	3.9	293	39	121	< 0.44	6.9	370	3	< 100	< 1	473	320
MA-K 15	9/24/18	332.8	25.6	718	8.7	30	32	69	4	204	56	104	< 0.44	7.5	400	2.8	< 100	< 1	409	207
MA-K 18	9/24/18	350.39	25.3	422	8.5	30	17	34	2.2	159	27	40	< 0.44	5.4	210	1.6	< 100	< 1	236	145
MA-K 28	9/25/18	318.32	23.9	846	8.8	31	54	66	2.5	276	48	118	< 0.44	8.8	570	2.9	< 100	< 1	477	300
MA-K 30	9/25/18	332.77	21.9	703	8.8	29	50	41	2.7	231	44	94	< 0.44	19	270	2.5	< 100	< 1	407	276
MA-K 37	9/25/18	317.18	22.7	743	8.9	26	52	49	2.5	222	45	100	< 0.44	8.3	400	3	< 100	< 1	418	279
MA-P 10	9/24/18	363.71	25.3	522	9	26	25	44	3	191	14	72	< 0.44	1.1	250	3.8	< 100	< 1	288	168
MA-P 12	9/24/18	351.67	22.5	419	8.6	31	16	33	2.3	169	27	37	< 0.44	4.7	210	1.6	< 100	< 1	237	144
MA-P 27	9/24/18	280.5	22.9	671	8.8	38	30	54	1.8	187	50	97	< 0.44	12.6	380	1.4	< 100	< 1	379	219
MA-P 28	9/24/18	406.86	22.6	994	8.6	30	51	93	3.3	257	38	183	< 0.44	5.1	390	2.9	< 100	< 1	536	285
MA-P 41	9/24/18	411.99	22.3	926	8.9	26	52	83	3	230	42	172	< 0.44	6.4	360	2.5	< 100	< 1	511	279
MA-P 42	9/24/18	285.31	23.3	652	8.3	49	28	49	1.7	232	43	86	< 0.44	16.5	300	1.2	< 100	< 1	390	237
MA-P 44	9/24/18	351.16	23.6	671	8.7	35	30	54	2.2	183	52	99	< 0.44	10.5	350	1.6	< 100	< 1	377	212
MA-R 3	9/25/18	344.76	21.4	747	8.6	41	51	40	2.7	269	47	92	2.17	15.2	260	1	< 100	1	429	312
MA-R 4	9/25/18	315.63	21.9	748	8.3	50	47	36	2.1	281	45	83	10.81	24.4	240	< 1	< 100	3.3	440	319
MA-R 22	9/25/18	366.06	23.9	682	8.8	38	46	37	2.3	230	46	88	5.4	20.8	260	< 1	< 100	2.9	410	285
MA-R 23	9/25/18	361.59	22.5	703	8.7	40	46	38	2.3	246	46	88	4.74	22.5	260	< 1	< 100	2.7	418	290
MA-R 28	9/25/18	219.31	22.7	701	8.3	52	31	45	1.9	215	48	99	1.59	18.2	320	< 1	< 100	1.2	405	258

LEGEND

2018 Program Wells (Upper Aquifer)
- *10K2 Well Number (abbreviated)*
- *284.7 Groundwater Elevation (NM = Not Measured)*
- Supply
- Mining Pond
- Monitoring
- Nested

Groundwater Contours (elev in NAVD88)
- 2018 Contours (Interval = 10')
- Hatch pattern towards lower elevation

Mining Area Excavations 2018
- Active Excavation
- Excavated
- Backfilled with Silt and Clay

Mining Area Ponds 2018
- Static (= groundwater elevation)
- Pumped From
- Pumped Into
- Clay-lined

- Rivers
- Main Basin
- Fringe Management Area
- Upland Management Area
- Subarea Boundaries
- Township-Range Line

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Figure 4-1
Gravel Mining Pits with Groundwater Elevation Contours (September 2018)
Livermore Valley Groundwater Basin

5 Surface Water-Groundwater Interaction

5.1 Program Description

5.1.1 Monitoring Network

Although Zone 7 continues to monitor locations across the valley where groundwater may be high, the Springtown Alkali Sink is the only known area in the Livermore Valley Groundwater Basin that may be considered a groundwater-dependent ecosystem for the purposes of SGMA. The contribution of groundwater is limited in this area and the effects are seasonal. The sink supports an alkali-saline wetland habitat with seasonal surface ponding and shallow, seasonal high-salinity groundwater. The Alkali Sink supports salt-tolerant plants, vernal pool biota, and several protected species including the Palmate-Bracted Bird's Beak, California tiger salamander, and the fairy shrimp. The Alkali Sink has long been a focus of preservation and restoration efforts (including collaboration by Zone 7 with other agencies). The basic method for avoiding undesirable effects on the Alkali Sink is the natural maintenance of local groundwater levels and flow patterns, as there are no major groundwater extractors in this subarea. Background information regarding this program is provided in *Section 3.3.5, Surface Water-Groundwater Interaction,* of the Alternative GSP.

Zone 7 monitors groundwater levels in two wells located in the vicinity of the Alkali Sink to ensure groundwater levels remain sufficiently high to support the Alkali Sink:

- Well 2S/2E 34E 1 is located at the southwestern, lower end of the sink.
- Well 2S/2E 27P 2 is located in the center portion of the sink.

As part of its Groundwater Elevation Program (*Section 6*), Zone 7 also measures water levels in several other wells to monitor groundwater flow patterns in that portion of the Northeastern Fringe Management Area.

5.1.2 Program Changes for the Water Year

There were no changes to this program for the 2018 WY.

5.2 Results for the 2018 WY

Ongoing monitoring and management by Zone 7 have supported the maintenance of steady groundwater levels in the vicinity of the Alkali Sink, indicating no increase in surface water depletion since the late 1970s. *Figure 5-1* shows the hydrographs for the two monitored wells in the immediate vicinity of the Alkali Sink. As shown, groundwater levels fluctuated from 2 ft to 4 ft above the Minimum Thresholds during the 2018 WY. The gradient flow patterns in the area are shown on *Figure 6-4* (Spring 2018) and *Figure 6-5* (Fall 2018), and continue to remain relatively unchanged throughout its history.

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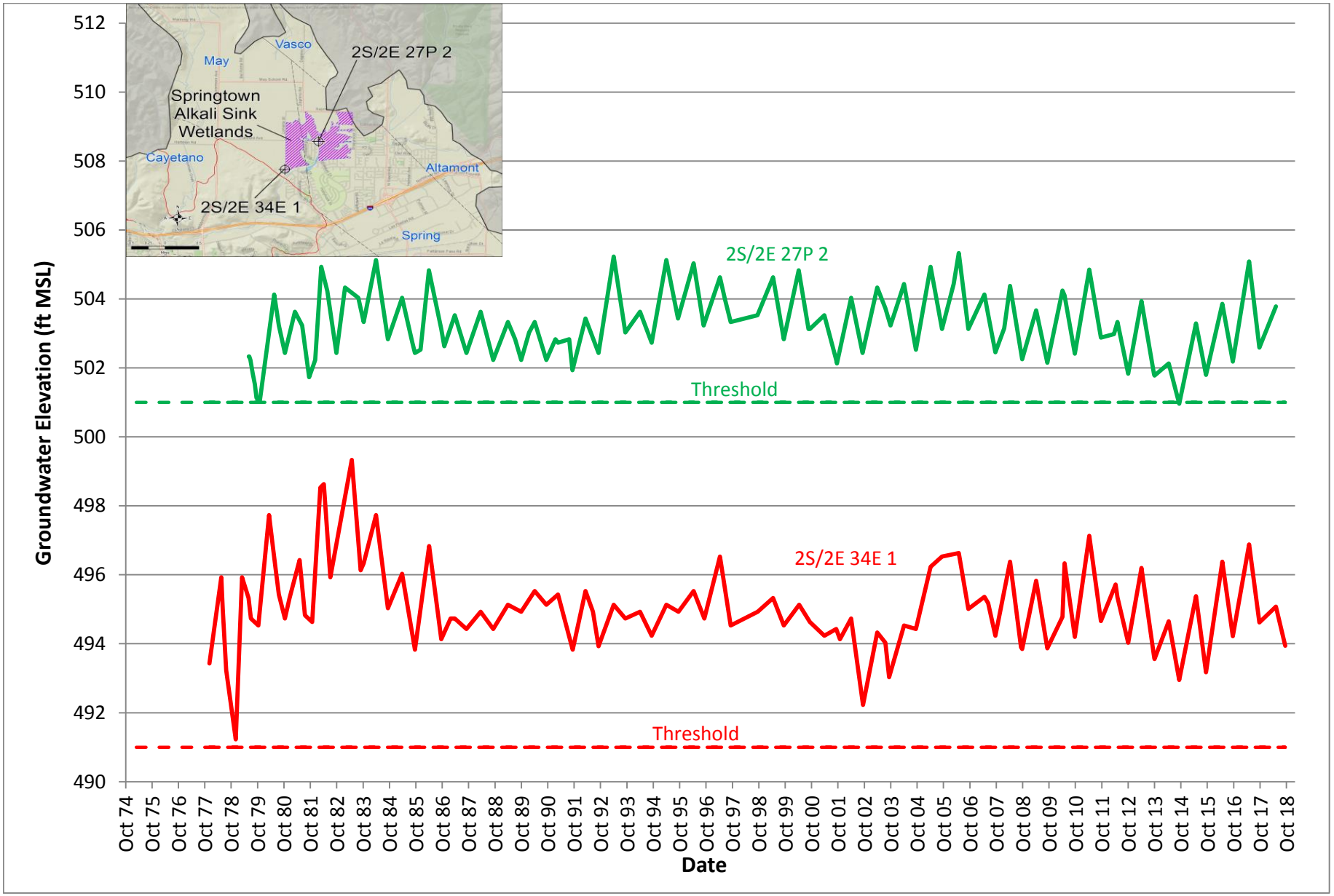
FIGURE 5-1
HYDROGRAPHS IN THE VICINITY OF THE ALKALI SINK AND SPRINGTOWN SPRINGS
LIVERMORE VALLEY GROUNDWATER BASIN



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6 Groundwater Elevations

6.1 Program Description

6.1.1 Monitoring Network

The Groundwater Elevation Monitoring includes the measurement of groundwater levels in monitoring and production wells to confirm that management objectives are met, to assess groundwater supplies, and to define any new management objectives needed to maintain sustainability. The program focuses on the Main Basin, where groundwater is pumped for municipal uses. However, water levels are also measured in the Fringe Management Area.

As shown in *Figure 6-1* and *Table 6-1*, there were 226 wells in the Zone 7 Groundwater Elevation Monitoring Program for 2018 WY. Groundwater elevations in the majority of these wells were measured at least two times during the water year (WY, spring and fall). Well construction details for the program wells are shown in *Table 6-2*.

Water levels were also measured at least one time per month in eight key index monitoring wells ("Key Wells") located in the central parts of the three largest subareas of the Main Basin (Bernal, Amador, and Mocho II); where the municipal pumping occurs. Because the Amador Subarea is more than twice the size of the other two subareas, it is split into the Amador West and Amador East Subareas. Each subarea is represented by an Upper and a Lower Aquifer Key Well.

Spring and fall results from these eight Key Wells are combined with spring and fall water level data from three additional monitoring wells to satisfy to Zone 7's California Statewide Groundwater Elevation Monitoring (CASGEM) Program obligation. The wells currently being monitored for the Key Well and CASGEM Programs are shown in *Table 6-A* below and *Figure 6-2*.

Table 6-A: Table of Key and CASGEM Wells for the 2018 Water Year

Well Number	Basin/Subarea	Aquifer	Key Well	CASGEM
3S/1E 20C 7	Bernal	Upper	x	x
3S/1E 20C 8	Bernal	Lower	x	x
3S/1E 9P 5	Amador West	Upper	x	x
3S/1E 9P10	Amador West	Lower	x	x
3S/1E 11G 1	Amador East	Upper	x	x
3S/1E 12K 3	Amador East	Lower	x	x
3S/2E 8K 2	Mocho II	Upper	x	x
3S/2E 8H 3	Mocho II	Lower	x	x
3S/1E 12K 4	Amador East	Lower		x
3S/1E 6F 3	Northern Fringe	Upper		x
3S/2E 19D 7	Southern Amador	Lower		x

6.1.2 Program Changes for the 2018 Water Year

Table 6-B below lists the changes that were made to the Groundwater Elevation Monitoring Program for the 2018 WY. These changes are also applicable to the Groundwater Quality Monitoring Program, which is discussed in *Section 7* of this Annual Report.

Table 6-B: Program Wells Changes during the 2018 Water Year

Action	Reason	Note
Well 3S/1E 7M2 removed from program	Well was destroyed during land use change	No need to replace; use levels from 12J1
Well 3S/3E 7M2 removed from program	Very difficult to measure	No need to replace; use levels from 12J3
Well 3S/2E 8G1 (CWS19) removed from program	Obstruction in sounding tube	Pumping well; use levels from 8H3 and 8H4 cluster
Well 3S/2E 9Q1 (CWS 9) removed from program	Obstruction in sounding tube	Pumping well; use levels from 8H3 and 8H4 cluster
Well 3S/2E 16B1 (CWS 5) removed from program	Obstruction in sounding tube	Pumping well; use levels from 8H3 and 8H4 cluster
Well 3S/1E 23J1 changed to Lower Aquifer	23J1 levels not representative of Upper Aquifer	Water levels appear to correspond with those in the Lower Aquifer
Well 3S/2E 19N 3 added to Lower Aquifer	New mining area well	Shallower of the two wells in the nested set. Only measured in Fall 2018.
Well 3S/2E 19N 4 added to Lower Aquifer	New mining area well	Deeper of the two wells in the nested set. Only measured in Fall 2018.

In an effort to streamline the program, several wells that were previously measured monthly are now measured semi-annually (2 times per year; spring and fall):

- 3S/1E 8H 9
- 3S/1E 8H10
- 3S/1E 8H11
- 3S/1E 8H13
- 3S/1E 9M 3
- 3S/1E 10B14
- 3S/1E 11M 2
- 3S/1E 12G 1
- 3S/1E 17D 3
- 3S/1E 17D 4
- 3S/1E 17D 5
- 3S/1E 17D 6
- 3S/1E 17D 7
- 3S/3E 6Q 3
- 3S/3E 6Q 4

6.2 Results for the 2018 Water Year

6.2.1 Overview

Groundwater levels for the 2018 WY followed a typical historical seasonal pattern: rising in the beginning of the year with rainfall recharge and minimal pumping occurring, levelling off in late spring, and then dropping during the second half of the WY as rainfall ceased and pumping demands increased. Compared to the levels at the end of the 2017 WY, groundwater elevations generally rose in the western portion of the basin, and dropped in the eastern portion. In general, groundwater elevations remained above the threshold elevations (historic lows), except in two of the mining area pits as discussed in *Section 4.2.1* above and *Section 6.2.3* below.

Graphs of Key Well water levels (*Figure 6-3*) demonstrate the annual seasonal trends in both the Upper and Lower Aquifer systems. The seasonal fluctuations are greater in the Lower Aquifer where more pumping occurs to meet higher demands in the warmer months, and when surface water treatment plant outages occur. Key Well water levels in the Bernal and Amador West Subareas ended the 2018 WY up to 5.3 ft above those at the end of the 2017 WY, whereas levels in the Amador East and Mocho II Subareas ended the 2018 WY up to 17.3 ft below those from the previous year (*Table 6-C*).

Table 6-C: Groundwater Elevation Change in Key and CASGEM Wells from Fall 2017 to Fall 2018

		Groundwater Elevation (feet MSL)		Change in Elevation (feet)		
				Seasonal		Annual
Well	Name	Spring 2018	Fall 2018	Fall 2017 to Spring 2018	Spring 2018 to Fall 2018	Fall 2017 to Fall 2018
3S/1E 20C 7	Key_Bern_U	303.8	299.3	7.4	-4.5	2.9
3S/1E 20C 8	Key_Bern_L	302.8	296.3	10.4	-6.4	3.9
3S/1E 9P 5	Key_AMW_U	311.8	308.0	9.1	-3.8	5.3
3S/1E 9P10	Key_AMW_L	301.2	295.6	7.4	-5.5	1.8
3S/1E 11G 1	Key_AME_U	322.3	318.0	0.6	-4.2	-3.6
3S/1E 12K 3	Key_AME_L	268.2	261.9	-10.9	-6.3	-17.3
3S/2E 8K 2	Key_MO2_U	436.0	424.8	0.3	-11.2	-10.9
3S/2E 8H 3	Key_MO2_L	427.5	416.6	-0.5	-10.9	-11.3
3S/1E 12K 4	CASGEM 12K4	282.3	275.7	6.5	-6.6	-0.1
3S/1E 6F 3	CASGEM 6F3	325.0	323.9	0.8	-1.1	-0.3
3S/2E 19D 7	CASGEM 19D7	332.5	322.9	-3.6	-9.7	-13.3

MSL = mean sea level

Table 6-3 contains spring (collected in April 2018) and fall (collected in September 2018) groundwater elevations for all program wells and includes a comparison with fall 2017. Upper and Lower Aquifer levels during the 2018 WY are described in more detail in *Sections 6.2.2* and *6.2.3* below; however, for more information on general groundwater gradient and water level trends, see *Section 2.3.3, Groundwater Occurrence and Flow*, and *Section 2.3.4, Groundwater Levels*, of the Alternative GSP.

6.2.2 Upper Aquifer Levels

Figure 6-4 and *Figure 6-5* show groundwater elevation contours in the Upper Aquifer for the spring and fall of the 2018 WY, representing the highest and lowest groundwater elevations observed, respectively. *Figure 6-6* illustrates the change in groundwater elevation in the Upper Aquifer from fall of 2017 to fall of 2018. *Figure 6-7* shows the depth to the top of the Upper Aquifer groundwater table at the end of the 2018 WY.

During the 2018 WY, the groundwater gradient in the Upper Aquifer was generally from east to west and ranged from 0.005 to 0.025. Quarry dewatering operations in the eastern Amador Subarea create groundwater depressions in the vicinity of the pits from which water is pumped. The same conditions have been observed during previous years.

Upper Aquifer water levels in western portion of the Main Basin generally rose up to about five ft from fall 2018 to fall 2017 (*Figure 6-6*) because of the near average rainfall recharge, and less than average municipal pumping during the WY. In the eastern portion of the Amador Subbasin, Upper Aquifer water levels dropped over 30 ft because of reduced stream recharge along the Arroyo Mocho, continued removal of groundwater from mined pits, and municipal pumping. Upper Aquifer water levels in the Mocho II Subbasin dropped up to about 15 ft in some places because of reduced stream recharge along the Arroyo Mocho, and municipal pumping in that portion of the basin (*Figure 6-6*).

During the 2018 WY, water levels in wells in the southwestern portion of the basin near the Arroyo de la Laguna (as indicated primarily by the Bernal Upper Key Well, 3S/1E 20C 7, and Well 3S/1E 29M 4) were above the upper threshold elevation at which basin overflow occurs. Consequently, approximately 564 AF (*Section 11*) of water overflowed from the Upper Aquifer into the Arroyo de la Laguna during the 2018 WY.

Groundwater levels in the Fringe Management Areas (which only have an Upper Aquifer) stayed relatively constant throughout 2018 WY, varying generally by less than approximately 5 ft (*Figure 6-6*). For more information regarding historic elevations and trends observed for the Fringe Management Area and Subareas, refer to Section 2.2.2.4, *Fringe Management Area and Subareas*, of the Alternative GSP.

6.2.3 Lower Aquifer Levels

Figure 6-8 and *Figure 6-9* show groundwater elevation contours in the Lower Aquifer for the spring and fall of the 2018 WY. In general, the groundwater gradient in the Mocho II and Amador Subareas in the Lower Aquifer was from east to the west and ranged from 0.001 to 0.05. In the Bernal Subarea, the gradient was slightly to the north and east and was typically less than 0.01. Piezometric depressions were created around several wellfields because of municipal pumping around the time of the spring and fall measurements. Other depressions exist in the vicinity of three mining pits (Lakes B, D, and E) that appear to extend into the lower aquifer. The lowest elevations in the Lower Aquifer corresponded to the ponds in mining excavations for Lake D (MA-R28 at 219 ft above mean sea level [MSL]) and Lake E (MA-R24A at 164 ft above MSL).

During the 2018 WY, groundwater elevations in the Mocho II Subarea were about 60 to 70 ft higher than those to the west, across the Livermore Fault in the Amador Subarea. Groundwater elevations in the Dublin/Camp/Bishop Fringe Subareas were 20–30 ft higher than those across the Main Basin Boundary to the south.

As shown in *Figure 6-10*, Lower Aquifer water levels in the western portion of the basin varied only slightly (+ or - about 10 ft) from fall 2018 to fall 2017. However, water levels in the eastern portion of the basin dropped by over 15 ft in some places from municipal pumping and mining activity. At the end

of the WY, groundwater levels in the vicinity of the Bernal Subarea were more than 120 ft above the historic low (*Figure 6-11).* Over the majority of the Mocho II Subarea, the end-of-year groundwater levels were 90–150 ft above historical lows; however in the northwest portion of the subarea, a lack of groundwater elevation data makes the result less certain. In the Amador Subarea, levels were generally 40–90 ft above the historic lows except in the immediate vicinity of two mining excavations that were being dewatered during the WY; the water level in Lake D was 7 ft above the historic low, while Lake E was 45 ft below the historic low.

Since 2012, water levels resulting from mining dewatering in the immediate vicinity of Lake E have been below the historic low water level of 215 ft msl for a number of years with no observed undesirable results. Similar to the overall basin hydrology, those water levels near mining operations declined substantially during the drought from 2012 through 2016, and showed some recovery during the wet year of 2017, but then returned to the 2013 levels in the 2018 WY.

TABLE 6-1
GROUNDWATER ELEVATION PROGRAM
WELLS WITH MONITORING FREQUENCY
2018 WATER YEAR

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs			
State Name	Well Name	Subbasin	Aq		WR	CASGEM	Muni	Key
1S/4E 31P 5	CASGEM Tracy WAPA	Tracy	U	SA		√		
2S/1E 32E 1	End of Arnold Rd	Camp	U	SA				
2S/1E 32N 1	Camp Parks	Camp	U	SA				
2S/1E 32Q 1	Summer Glen Dr	Camp	U	SA				
2S/1E 33L 1	Gleason Dr @ Tassajara	Camp	U	SA				
2S/1E 33P 2	Central Pkwy at Emerald Glen	Camp	U	SA				
2S/1E 33R 1	Central Pkwy @ Grafton	Camp	U	SA				
2S/1W 15F 1	BOLLINGER	Bishop	U	SA				
2S/1W 26C 2	PINE VALLEY	Dublin	U	SA				
2S/1W 36E 3	Kolb Park	Dublin	U	SA				
2S/1W 36F 1	Dublin High shallow	Dublin	L	SA				
2S/1W 36F 2	Dublin High mid	Dublin	L	SA				
2S/1W 36F 3	Dublin High deep	Dublin	L	SA				
2S/2E 27C 2	Dagnino Rd	Spring	U	SA				
2S/2E 27P 2	hartford ave east	Spring	U	SA				
2S/2E 28D 2	May School	May	U	SA				
2S/2E 28J 2	FCC Well	May	L	SA				
2S/2E 28Q 1	hartford ave	May	U	SA				
2S/2E 32K 2	jenson's N liv. Ave	Cayetano	U	SA				
2S/2E 34E 1	Mud City	May	U	SA				
2S/2E 34Q 2	Hollyhock & Crocus	Spring	U	SA				
2S/3E 1D 1	CASGEM Tracy PGE	Tracy	U	SA		√		
3S/1E 1F 2	Constitution Dr	Mocho II	U	SA				
3S/1E 1H 3	Collier Canyon g1	Mocho II	U	SA				
3S/1E 1L 1	Kitty Hawk	Camp	U	SA				
3S/1E 1P 2	Airport gas g5	Amador	U	SA				
3S/1E 1P 3	New airport well	Amador	L	SA				
3S/1E 2J 2	Maint. Bldg	Camp	U	SA				
3S/1E 2J 3	Doolan Rd East	Camp	U	SA				
3S/1E 2K 2	Doolan Rd West	Camp	U	SA				
3S/1E 2M 3	Friesman Rd North	Camp	U	SA				
3S/1E 2N 6	Friesman Rd South	Amador	U	SA				
3S/1E 2P 3	Crosswinds Church	Camp	L	SA				
3S/1E 2Q 1	LPGC #1	Amador	U	SA				
3S/1E 2R 1	Beebs	Amador	U	SA				
3S/1E 3G 2	fallon rd	Camp	U	SA				
3S/1E 4A 1	SMP-DUB-2	Camp	U	SA				
3S/1E 4J 5	Pimlico shallow	Camp	U	SA				
3S/1E 4J 6	Pimlico deep	Camp	U	SA				
3S/1E 4Q 2	gulfstream	Amador	U	SA				
3S/1E 5K 6	Rosewood shallow	Camp	U	SA				
3S/1E 5K 7	Rosewood deep	Camp	L	SA				
3S/1E 5L 3	Oracle	Camp	U	SA				
3S/1E 5P 6	Owens Park	Camp	U	SA				

Aq = Aquifer: U = Upper; L = Lower; D = Deep	Frequency: R = Recorder; M = Monthly; Q = Quarterly; SA = Semiannually; A = Annually
OTHER: WR = Water Rights; Muni = Municipal wells; Key = Key Wells	

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs			
State Name	Well Name	Subbasin	Aq		WR	CASGEM	Muni	Key
3S/1E 6F 3	Dublin Ct	Dublin	U	SA		√		
3S/1E 6G 5	Nissan Repair	Dublin	L	SA				
3S/1E 6N 2	DSRSD MW-3	Dublin	U	SA				
3S/1E 7B 2	Hopyard rd	Dublin	L	SA				
3S/1E 7B12	Hacienda Arch	Dublin	U	SA				
3S/1E 7G 7	Chabot Well	Dublin	U	SA				
3S/1E 7J 5	Thomas Hart School	Dublin	U	SA				
3S/1E 8B 1	Lizard Well	Amador	U	SA				
3S/1E 8G 4	Apache	Amador	U	SA				
3S/1E 8H 9	Mocho 4 Nested Shallow	Amador	L	SA				
3S/1E 8H10	Mocho 4 Nested Middle	Amador	L	SA				
3S/1E 8H11	Mocho 4 Nested deep	Amador	D	SA				
3S/1E 8H13	Mocho 3 mon	Amador	D	SA				
3S/1E 8H18	Mocho 4	Amador	L	SA			√	
3S/1E 8K 1	Cockroach well	Amador	U	SA				
3S/1E 8N 1	sports park	Bernal	U	SA				
3S/1E 9B 1	Stoneridge	Amador	L	M			√	
3S/1E 9H10	NW Lake I Shallow	Amador	U	SA				
3S/1E 9H11	NW Lake I Deep	Amador	L	SA				
3S/1E 9J 7	SW Lake I Shallow	Amador	U	SA				
3S/1E 9J 8	SW Lake I Middle	Amador	L	SA				
3S/1E 9J 9	SW Lake I Deep	Amador	L	SA				
3S/1E 9M 2	Mocho 1	Amador	L	SA			√	
3S/1E 9M 3	Mocho 2	Amador	L	SA			√	
3S/1E 9M 4	Mocho 3	Amador	L	SA			√	
3S/1E 9P 5	Key_AmW_U (Mohr Key)	Amador	U	M		√		√
3S/1E 9P 9	Mohr Ave Shallow	Amador	L	M				
3S/1E 9P10	Key_AmW_L	Amador	L	M		√		√
3S/1E 9P11	Mohr Ave Deep	Amador	L	M				
3S/1E 10A 2	El C harro Rd	Amador	U	SA				
3S/1E 10B 8	Kaiser Rd Shallow	Amador	L	SA				
3S/1E 10B 9	Kaiser Rd Middle 1	Amador	L	SA				
3S/1E 10B10	Kaiser Rd Middle 2	Amador	L	SA				
3S/1E 10B11	Kaiser Rd Deep	Amador	D	SA				
3S/1E 10B14	COL 5 Monitoring	AMADOR	L	SA				
3S/1E 10D 2	Stoneridge Shallow	Amador	L	SA				
3S/1E 10D 3	Stoneridge Middle 1	Amador	L	SA				
3S/1E 10D 4	Stoneridge Middle 2	Amador	L	SA				
3S/1E 10D 5	Stoneridge Deep	Amador	D	SA				
3S/1E 10D 7	North Lake I Shallow	Amador	U	SA				
3S/1E 10D 8	North Lake I Cluster 2	Amador	L	SA				
3S/1E 10K 2	NorthWest Cope Lake	Amador	L	M				
3S/1E 10K 3	COL 1	Amador	L	SA			√	
3S/1E 10N 2	South Lake I Shallow	Amador	U	SA				
3S/1E 10N 3	South Lake I Deep	Amador	L	SA				
3S/1E 11B 1	Airport West	Amador	U	SA				
3S/1E 11C 3	LAVWMA ROW	Amador	U	SA				
3S/1E 11G 1	Key_AmE_U	Amador	U	M		√		√
3S/1E 11G 2	Rancho Charro Middle 1	Amador	L	M				
3S/1E 11G 3	Rancho Charro Middle 2	Amador	L	M				
3S/1E 11G 4	Rancho Charro Deep	Amador	D	M				

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OTHER: WR = Water Rights; Muni = Municipal wells; Key = Key Wells	

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs			
State Name	Well Name	Subbasin	Aq		WR	CASGEM	Muni	Key
3S/1E 11M 2	COL 2 Monitoring	Amador	L	SA				
3S/1E 11M 3	COL 2	Amador	L	SA			√	
3S/1E 11P 6	New Jamieson Residence	Amador	L	SA				
3S/1E 12A 2	Airport South	Amador	U	SA				
3S/1E 12D 2	LWRP G6	Amador	U	SA				
3S/1E 12G 1	Oaks Park Shallow	Amador	U	SA				
3S/1E 12H 4	LWRP Shallow	Amador	L	SA				
3S/1E 12H 5	LWRP Middle 1	Amador	L	SA				
3S/1E 12H 6	LWRP Middle 2	Amador	L	SA				
3S/1E 12H 7	LWRP Deep	Amador	D	SA				
3S/1E 12K 2	Oaks Park Mid	Amador	L	M		√		
3S/1E 12K 3	Key_AmE_L	Amador	L	M		√		√
3S/1E 12K 4	Oaks Park Deep	Amador	D	M		√		
3S/1E 13P 5	LGA Grant Nested 1	Amador	U	SA				
3S/1E 13P 6	LGA Grant Nested 2	Amador	L	SA				
3S/1E 13P 7	LGA Grant Nested 3	Amador	L	SA				
3S/1E 13P 8	LGA Grant Nested 4	Amador	L	SA				
3S/1E 14B 1	Industrial Asphalt	Amador	L	SA				
3S/1E 14D 2	South Cope Lake	Amador	L	SA				
3S/1E 15F 3	kaiser #8	Amador	L	SA				
3S/1E 15J 3	shadow cliff	Amador	L	SA				
3S/1E 15M 3	Bush/Valley South	Amador	L	SA				
3S/1E 16A 2	Pleas 8	AmWest	L	M			√	
3S/1E 16A 4	Bush/Valley Mid	Amador	L	SA				
3S/1E 16B 1	Bush/Valley North	Amador	D	SA				
3S/1E 16C 2	Santa Rita Valley Shallow	Amador	L	SA				
3S/1E 16C 3	Santa Rita Valley Middle	Amador	L	SA				
3S/1E 16C 4	Santa Rita Valley Deep	Amador	L	SA				
3S/1E 16E 4	black ave - cultural	Amador	U	SA				
3S/1E 16L 2	Pleas 4	Amador	L	M				
3S/1E 16L 5	Pleas 5	Amador	L	M			√	
3S/1E 16L 7	Pleas 6	Amador	L	M			√	
3S/1E 16P 5	Vervais Monitor	Amador	U	M	√			
3S/1E 16R 1	Stanley Berry Farm	Amador	L	SA				
3S/1E 17B 4	Casterson	Amador	L	SA				
3S/1E 17D 3	Hopyard Nested Shallow	Bernal	L	SA				
3S/1E 17D 4	Hopyard Nested Middle 1	Bernal	L	SA				
3S/1E 17D 5	Hopyard Nested Middle 2	Bernal	L	SA				
3S/1E 17D 6	Hopyard Nested Middle 3	Bernal	L	SA				
3S/1E 17D 7	Hopyard Nested Deep	Bernal	D	SA				
3S/1E 17D10	Hopyard 7	Bernal	L	SA				
3S/1E 17D11	Hopyard 9 Monitoring Well	Bernal	L	SA				
3S/1E 17D12	Hopyard 9	Bernal	L	SA			√	
3S/1E 18A 5	Pleas 7	Bernal	L	M			√	
3S/1E 18A 6	Hopyard 6	Bernal	L	M			√	
3S/1E 18E 4	Valley Trails II	Bernal	U	SA				
3S/1E 18J 2	camino segura	Bernal	U	SA				
3S/1E 18N 1	merritt	Bernal	L	SA				
3S/1E 19A10	SFWD South (B)	Bernal	L	SA				
3S/1E 19A11	SFWD North (A)	Bernal	L	SA			√	
3S/1E 19C 4	del valle & laguna	Bernal	U	SA				

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Frequency: R = Recorder; M = Monthly; Q = Quarterly; SA = Semiannually; A = Annually

OTHER: WR = Water Rights; Muni = Municipal wells; Key = Key Wells

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs			
State Name	Well Name	Subbasin	Aq		WR	CASGEM	Muni	Key
3S/1E 19K 1	680/bernal	Bernal	U	SA				
3S/1E 20B 2	Fairgrounds Potable	Bernal	L	SA				
3S/1E 20C 7	Key_Bern_U	Bernal	U	M	√	√		√
3S/1E 20C 8	Key_Bern_L	Bernal	L	M		√		√
3S/1E 20C 9	Fair Nested Deep	Bernal	L	M				
3S/1E 20J 4	civic center	Bernal	U	SA				
3S/1E 20M11	S.F "M"LINE	Bernal	U	SA				
3S/1E 20Q 2	20Q2	Bernal	U	SA				
3S/1E 22D 2	vineyard trailer	Amador	U	SA				
3S/1E 23J 1	1627 vineyard trailer	Amador	L	SA				
3S/1E 24Q 1	Ruby Hills	Amador	L	SA				
3S/1E 25C 3	Katz Winery Mansion	Amador	U	SA				
3S/1E 29M 4	f.c. channel	Castle	U	M	√			
3S/1E 29P 2	castlewood dr	Bernal	U	SA				
3S/1W 1B 9	DSRSD Shallow	Dublin	L	SA				
3S/1W 1B10	DSRSD Middle	Dublin	L	SA				
3S/1W 1B11	DSRSD Deep	Dublin	L	SA				
3S/1W 2A 2	McNamara's	Dublin	U	SA				
3S/1W 12B 2	Stoneridge Mall Rd	Dublin	U	SA				
3S/1W 12J 1	DSRSD South	Dublin	U	SA				
3S/1W 13J 1	muirwood dr	Castle	U	SA				
3S/2E 1F 2	Brisa at Circuit City	Spring	U	SA				
3S/2E 2B 2	south front rd	Spring	U	SA				
3S/2E 3A 1	Bluebell	Spring	U	SA				
3S/2E 3K 3	first & S. front rd	Mocho I	U	SA				
3S/2E 5N 1	Spider Well	Mocho II	M	SA				
3S/2E 7C 2	york way - jaws - G4	Mocho II	U	SA				
3S/2E 7H 2	dakota	Mocho II	U	SA				
3S/2E 7N 2	Isabel & Arroyo Mocho	AmWest	L	SA				
3S/2E 7P 3	CWS 24	Amador	L	SA			√	
3S/2E 7R 2	CWS 31 Monitoring	Mocho II	D	M				
3S/2E 7R 3	CWS 31	Mocho II	L	SA			√	
3S/2E 8F 1	CWS 10	Mocho II	L	SA			√	
3S/2E 8G 1	CWS 19	Mocho II	L	SA			√	
3S/2E 8H 2	North k	Mocho II	U	SA				
3S/2E 8H 3	Key_Mo2_L	Mocho II	L	M		√		√
3S/2E 8H 4	N Liv Ave Deep	Mocho II	L	M				
3S/2E 8K 2	Key_Mo2_U (Livermore Key)	Mocho II	U	M		√		√
3S/2E 8N 2	CWS 14	Mocho II	L	SA			√	
3S/2E 8P 1	CWS 8	Mocho II	L	SA			√	
3S/2E 8Q 9	D-2	Mocho II	L	SA				
3S/2E 9Q 1	CWS 9	Mocho II	L	SA			√	
3S/2E 9Q 4	school st	Mocho II	U	SA				
3S/2E 10F 3	hexcel	Mocho I	U	SA				
3S/2E 10Q 1	almond	Mocho II	U	SA				
3S/2E 10Q 2	LLNL W-703	Mocho II	L	SA				
3S/2E 11C 1	joan way	Mocho I	U	SA				
3S/2E 12C 4	LLNL W-486	Spring	U	SA				
3S/2E 12J 3	LLNL W-017A	Spring	L	SA				
3S/2E 14A 3	S. vasco @east ave	Mocho I	U	SA				
3S/2E 14B 1	5763 east ave	Mocho I	L	SA				

Aq = Aquifer: U = Upper; L = Lower; D = Deep

Frequency: R = Recorder; M = Monthly; Q = Quarterly; SA = Semiannually; A = Annually

OTHER: WR = Water Rights; Muni = Municipal wells; Key = Key Wells

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs			
State Name	Well Name	Subbasin	Aq		WR	CASGEM	Muni	Key
3S/2E 15E 2	Retzlaff Winery	Mocho II	L	SA				
3S/2E 15L 1	Concannon 2	Mocho II	U	SA				
3S/2E 15M 2	Concannon 1	Mocho II	U	SA				
3S/2E 15Q 6	Concannon Old Pumping	Mocho II	L	SA				
3S/2E 15R17	Buena Vista Shallow	Mocho II	U	SA				
3S/2E 15R18	Buena Vista Deep	Mocho II	L	SA				
3S/2E 16A 3	Memory Gardens	Mocho II	L	SA				
3S/2E 16B 1	CWS 5	Mocho II	L	SA			√	
3S/2E 16C 1	CWS 15	Mocho II	L	SA			√	
3S/2E 16E 4	pepper tree	Mocho II	U	SA				
3S/2E 17E 2	Mocho Street	Mocho II	U	SA				
3S/2E 18B 1	CWS 20	Amador	L	SA			√	
3S/2E 18E 1	E. stanley	Amador	U	SA				
3S/2E 19D 7	Isabel Shallow	Amador	U	SA		√		
3S/2E 19D 8	Isabel Middle 1	Amador	L	SA				
3S/2E 19D 9	Isabel Middle 2	Amador	L	SA				
3S/2E 19D10	Isabel Deep	Amador	L	SA				
3S/2E 19N 3	Shallow Cemex Nested	Amador	L	SA				
3S/2E 19N 4	Deep Cemex Nested	Amador	L	SA				
3S/2E 20M 1	Alden Lane	Amador	L	SA				
3S/2E 22B 1	grapes	Mocho II	U	SA				
3S/2E 23E 1	Mines Nested Shallow	Mocho II	U	SA				
3S/2E 23E 2	Mines Nested Deep	Mocho II	L	SA				
3S/2E 24A 1	S. greenville	Mocho I	U	SA				
3S/2E 26J 2	mines rd	Mocho II	U	SA				
3S/2E 29F 4	usgs wetmore	Amador	U	M	√			
3S/2E 30C 1	Vineyard 30C 1	Amador	L	SA				
3S/2E 30D 2	vineyard	Amador	U	M	√			
3S/2E 33G 1	Crohare	Amador	U	M	√			
3S/2E 33K 1	VA	Amador	U	Q				
3S/2E 33L 1	VA/CROHARE FENCE	Amador	U	Q				
3S/3E 6Q 3	PPWTP South Monitoring	Altamont	U	SA				
3S/3E 6Q 4	PPWTP North Monitoring	Altamont	U	SA				
3S/3E 7D 2	7D 2	Spring	U	SA				
		TOTALS:		**231**	**6**	**14**	**24**	**8**

Aq = Aquifer: U = Upper; L = Lower; D = Deep	Frequency: R = Recorder; M = Monthly; Q = Quarterly; SA = Semiannually; A = Annually
OTHER: WR = Water Rights; Muni = Municipal wells; Key = Key Wells	

TABLE 6-2
GROUNDWATER PROGRAM
WELL CONSTRUCTION DETAILS
2018 WATER YEAR

Site	Type	Other Name	Owner	Basin	Aquifer	RP	TD	Dia	Perf
1S/4E 31P 5	monitor	CASGEM Tracy WAPA	WESTERN AREA POWER A	Tracy	Upper	60	24	4	8 - 23
2S/1E 32E 1	monitor	End of Arnold Rd	ZONE 7	Camp	Upper	392.56	70	2	55 - 70
2S/1E 32N 1	monitor	Camp Parks	ZONE 7	Camp	Upper	360.79	44	2.5	35 - 41
2S/1E 32Q 1	monitor	Summer Glen Dr	ZONE 7	Camp	Upper	367.55	45	2	30 - 45
2S/1E 33L 1	monitor	Gleason Dr @ Tassajara		Camp	Upper	389.46	80	2	65 - 80
2S/1E 33P 2	monitor	Central Pkwy at Emerald Glen	ZONE 7	Camp	Upper	370.05	55	2	45 - 55
2S/1E 33R 1	monitor	Central Pkwy @ Grafton	ZONE 7	Camp	Upper	358.5	60	2	40 - 60
2S/1W 15F 1	monitor	BOLLINGER	ZONE 7	Bishop	Upper	439.44	60	2.5	50.3 - 55.3
2S/1W 26C 2	monitor	PINE VALLEY	ZONE 7	Dublin	Upper	406.53	50	2.5	40 - 45
2S/1W 36E 3	monitor	Kolb Park	ZONE 7	Dublin	Upper	346.51	60	2.5	50 - 55
2S/1W 36F 1	nested	Dublin High shallow		Dublin	Lower	342.71	190	2	140 - 180
2S/1W 36F 2	nested	Dublin High mid	DSRSD	Dublin	Lower	342.71	320	2	270 - 310
2S/1W 36F 3	nested	Dublin High deep	DSRSD	Dublin	Lower	342.71	520	2	440 - 510
2S/2E 27C 2	domestic	Dagnino Rd	JACK PIECEFIELD	Spring	Upper	542.14	108	8	41 - 56
2S/2E 27P 2	monitor	hartford ave east	ZONE 7	Spring	Upper	505.43	68	4	35 - 63
2S/2E 28D 2	monitor	May School	ZONE 7	May	Upper	555.15	55	2.5	45 - 50
2S/2E 28J 2	industrial	FCC Well		May	Lower	518.84	230	6	50 - 230
2S/2E 28Q 1	monitor	hartford ave		May	Upper	513.04	28	2.5	17.6 - 22.6
2S/2E 32K 2	monitor	jenson's N liv. Ave	ZONE 7	Cayetano	Upper	507.43	43	2.5	33 - 38
2S/2E 34E 1	monitor	Mud City	ZONE 7	May	Upper	499.73	49	2.5	40 - 45
2S/2E 34Q 2	monitor	Hollyhock & Crocus	ZONE 7	Spring	Upper	507.24	50	2	25 - 50
2S/3E 1D 1	irrigation	CASGEM Tracy PGE	PG&E	Tracy	Upper	90	80	6	40 - 80
3S/1E 1F 2	monitor	Constitution Dr	ZONE 7	Mocho II	Upper	428.44	40	2	25 - 40
3S/1E 1H 3	monitor	Collier Canyon g1	ZONE 7	Mocho II	Upper	422.8	80	2.5	70 - 75
3S/1E 1L 1	monitor	Kitty Hawk	ZONE 7	Camp	Upper	403.04	70	2	60 - 70
3S/1E 1P 2	monitor	Airport gas g5	ZONE 7	Amador	Upper	389.64	50	2.5	40 - 45
3S/1E 1P 3	supply	New airport well	CITY OF LIVERMORE	Amador	Lower	394.44	480	12	245 - 460
3S/1E 2J 2	monitor	Maint. Bldg	ZONE 7	Camp	Upper	380.89	41	2	31 - 41
3S/1E 2J 3	monitor	Doolan Rd East	ZONE 7	Camp	Upper	406.35	65	2	55 - 65
3S/1E 2K 2	monitor	Doolan Rd West	ZONE 7	Camp	Upper	397.04	46	2.5	36.5 - 41.5
3S/1E 2M 3	monitor	Friesman Rd North	ZONE 7	Camp	Upper	365.04	50	2	35 - 50
3S/1E 2N 6	monitor	Friesman Rd South	ZONE 7	Amador	Upper	366.14	55	2	40 - 55
3S/1E 2P 3	domestic	Crosswinds Church	Crosswinds Church	Camp	Lower	371.73	380	10	340 - 372
3S/1E 2Q 1	monitor	LPGC #1	ZONE 7	Amador	Upper	369.92	45	2	35 - 45
3S/1E 2R 1	monitor	Beebs	ZONE 7	Amador	Upper	376.29	33	2.5	21 - 26
3S/1E 3G 2	monitor	fallon rd	ZONE 7	Camp	Upper	354.24	50	2.5	40 - 45
3S/1E 4A 1	monitor	SMP-DUB-2	ZONE 7	Camp	Upper	350.67	49.5	2	29.5 - 49.5
3S/1E 4J 5	monitor	Pimlico shallow	ZONE 7	Camp	Upper	345.2	47	2	22 - 47
3S/1E 4J 6	monitor	Pimlico deep	ZONE 7	Camp	Upper	345.55	110	2	68 - 110
3S/1E 4Q 2	monitor	gulfstream	ZONE 7	Amador	Upper	345.42	90	2.5	80 - 85
3S/1E 5K 6	monitor	Rosewood shallow	ZONE 7	Camp	Upper	346.05	75	4	40 - 70
3S/1E 5K 7	monitor	Rosewood deep	ZONE 7	Camp	Lower	346.19	150	4	134 - 144
3S/1E 5L 3	monitor	Oracle	ZONE 7	Camp	Upper	339.43	40	2	15 - 40
3S/1E 5P 6	monitor	Owens Park	ZONE 7	Camp	Upper	336.65	35	2	25 - 35

RP = Reference Point Elevation (in feet above MSL)
TD = Total Depth of well (in feet below ground surface)
Dia = Diameter of well casing (in inches)
Perf = Preferated interval (in feet below ground surface), uppermost - lowermost

Site	Type	Other Name	Owner	Basin	Aquifer	RP	TD	Dia	Perf
3S/1E 6F 3	monitor	Dublin Ct	ZONE 7	Dublin	Upper	329.82	36	2.5	27 - 32
3S/1E 6G 5	supply	Nissan Repair	VALLEY NISSAN/VOLVO	Dublin	Lower	332.22	200	8	103 - 178
3S/1E 6N 2	monitor	DSRSD MW-3	DSRSD	Dublin	Upper	335.2	67	4	47 - 67
3S/1E 7B 2	monitor	Hopyard rd	ZONE 7	Dublin	Lower	327.77	152	4	143 - 149
3S/1E 7B12	monitor	Hacienda Arch	ZONE 7	Dublin	Upper	327.82	70	2	50 - 70
3S/1E 7G 7	monitor	Chabot Well	ZONE 7	Dublin	Upper	327.33	55	2	35 - 55
3S/1E 7J 5	monitor	Thomas Hart School	ZONE 7	Dublin	Upper	326.78	50	2	30 - 50
3S/1E 8B 1	monitor	Lizard Well	ZONE 7	Amador	Upper	338.28	148	4	55 - 82
3S/1E 8G 4	monitor	Apache	ZONE 7	Amador	Upper	341.47	85	2	60 - 85
3S/1E 8H 9	nested	Mocho 4 Nested Shallow	DSRSD	Amador	Lower	338.53	240	2	210 - 230
3S/1E 8H10	nested	Mocho 4 Nested Middle	DSRSD	Amador	Lower	339.26	440	2	290 - 430
3S/1E 8H11	nested	Mocho 4 Nested deep	DSRSD	Amador	Deep	339.26	720	2	520 - 720
3S/1E 8H13	monitor	Mocho 3 mon	ZONE 7	Amador	Deep	338.96	800	2	570 - 790
3S/1E 8H18	muni	Mocho 4	ZONE 7	Amador	Lower	341.94	745	20	515 - 730
3S/1E 8K 1	monitor	Cockroach well	ZONE 7	Amador	Upper	332.37	99	2.5	89 - 94
3S/1E 8N 1	monitor	sports park	ZONE 7	Bernal	Upper	323.68	72	2.5	62 - 67
3S/1E 9B 1	muni	Stoneridge	ZONE 7	Amador	Lower	349.23	810	20	250 - 800
3S/1E 9H10	nested	NW Lake I Shallow	ZONE 7	Amador	Upper	352.89	145	2	120 - 140
3S/1E 9H11	nested	NW Lake I Deep	ZONE 7	Amador	Lower	353.04	190	2	165 - 185
3S/1E 9J 7	nested	SW Lake I Shallow	ZONE 7	Amador	Upper	357.36	505	2	120 - 140
3S/1E 9J 8	nested	SW Lake I Middle	ZONE 7	Amador	Lower	357.55	305	2	280 - 300
3S/1E 9J 9	nested	SW Lake I Deep	ZONE 7	Amador	Lower	357.68	505	2	480 - 500
3S/1E 9M 2	muni	Mocho 1	ZONE 7	Amador	Lower	343.95	530	16	150 - 510
3S/1E 9M 3	muni	Mocho 2	ZONE 7	Amador	Lower	347.47	575	18	250 - 570
3S/1E 9M 4	muni	Mocho 3	ZONE 7	Amador	Lower	342.89	498	20	315 - 493
3S/1E 9P 5	monitor	Key_AmW_U (Mohr Key)	ZONE 7	Amador	Upper	349.4	105	2.5	95 - 100
3S/1E 9P 9	nested	Mohr Ave Shallow	ZONE 7	Amador	Lower	349.59	210	2	185 - 205
3S/1E 9P10	nested	Key_AmW_L	ZONE 7	Amador	Lower	349.51	310	2	285 - 305
3S/1E 9P11	nested	Mohr Ave Deep	ZONE 7	Amador	Lower	349.44	425	2	405 - 420
3S/1E 10A 2	monitor	El C harro Rd	ZONE 7	Amador	Upper	367.35	88	4	70 - 80
3S/1E 10B 8	nested	Kaiser Rd Shallow		Amador	Lower	353.6	200	2	100 - 190
3S/1E 10B 9	nested	Kaiser Rd Middle 1	DSRSD	Amador	Lower	353.49	294	2	244 - 284
3S/1E 10B10	nested	Kaiser Rd Middle 2	DSRSD	Amador	Lower	353.52	600	2	400 - 590
3S/1E 10B11	nested	Kaiser Rd Deep	DSRSD	Amador	Deep	353.52	810	2	660 - 800
3S/1E 10B14	monitor	COL 5 Monitoring	ZONE 7	Amador	Lower	355.591	690	2	390 - 690
3S/1E 10D 2	nested	Stoneridge Shallow	DSRSD	Amador	Lower	349.32	212	2	182 - 212
3S/1E 10D 3	nested	Stoneridge Middle 1	DSRSD	Amador	Lower	349.28	322	2	262 - 312
3S/1E 10D 4	nested	Stoneridge Middle 2	DSRSD	Amador	Lower	349.3	616	2	366 - 606
3S/1E 10D 5	nested	Stoneridge Deep	DSRSD	Amador	Deep	349.32	790	2	710 - 780
3S/1E 10D 7	nested	North Lake I Shallow	ZONE 7	Amador	Upper	361.06	145	2	118 - 138
3S/1E 10D 8	nested	North Lake I Cluster 2	ZONE 7	Amador	Lower	361.02	215	2	190 - 210
3S/1E 10K 2	monitor	NorthWest Cope Lake	ZONE 7	Amador	Lower	358.68	590.6	4	195.5 - 585.6
3S/1E 10K 3	muni	COL 1	ZONE 7	Amador	Lower	363.79	530	18	205 - 530
3S/1E 10N 2	nested	South Lake I Shallow	ZONE 7	Amador	Upper	358.16	195	2	125 - 145
3S/1E 10N 3	nested	South Lake I Deep	ZONE 7	Amador	Lower	358	195	2	170 - 190
3S/1E 11B 1	monitor	Airport West	ZONE 7	Amador	Upper	369.35	43	2.5	33 - 38
3S/1E 11C 3	monitor	LAVWMA ROW	ZONE 7	Amador	Upper	364.82	55	2	35 - 55
3S/1E 11G 1	nested	Key_AmE_U	DSRSD	Amador	Upper	371.62	120	2	100 - 110
3S/1E 11G 2	nested	Rancho Charro Middle 1	DSRSD	Amador	Lower	371.61	350	2	230 - 340
3S/1E 11G 3	nested	Rancho Charro Middle 2	DSRSD	Amador	Lower	371.64	590	2	380 - 580
3S/1E 11G 4	nested	Rancho Charro Deep	DSRSD	Amador	Deep	371.68	790	2	620 - 780

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Site	Type	Other Name	Owner	Basin	Aquifer	RP	TD	Dia	Perf
3S/1E 11M 2	monitor	COL 2 Monitoring	ZONE 7	Amador	Lower	365.96	700	4.5	199 - 699
3S/1E 11M 3	muni	COL 2	ZONE 7	Amador	Lower	369.24	684	18	345 - 684
3S/1E 11P 6	domestic	New Jamieson Residence	DOUG JAMIESON	Amador	Lower	376.67	400	5	240 - 380
3S/1E 12A 2	monitor	Airport South	ZONE 7	Amador	Upper	401.35	69	2.5	63.7 - 68.7
3S/1E 12D 2	monitor	LWRP G6	ZONE 7	Amador	Upper	384.45	44.6		36 - 41
3S/1E 12G 1	monitor	Oaks Park Shallow	ZONE 7	Amador	Upper	404.47	73	2.5	63 - 68
3S/1E 12H 4	nested	LWRP Shallow	CITY OF LIVERMORE	Amador	Lower	407.75	270	2	185 - 260
3S/1E 12H 5	nested	LWRP Middle 1	CITY OF LIVERMORE	Amador	Lower	407.78	400	2	360 - 390
3S/1E 12H 6	nested	LWRP Middle 2	CITY OF LIVERMORE	Amador	Lower	407.75	480	2	410 - 468
3S/1E 12H 7	nested	LWRP Deep	CITY OF LIVERMORE	Amador	Deep	407.67	684	2	609 - 674
3S/1E 12K 2	nested	Oaks Park Mid	ZONE 7	Amador	Lower	406.29	300	2	210 - 295
3S/1E 12K 3	nested	Key_AmE_L	ZONE 7	Amador	Lower	406.83	475	2	355 - 470
3S/1E 12K 4	nested	Oaks Park Deep	ZONE 7	Amador	Deep	406.71	575	2	550 - 570
3S/1E 13P 5	nested	LGA Grant Nested 1	ZONE 7	Amador	Upper	399.97	135	2	110 - 130
3S/1E 13P 6	nested	LGA Grant Nested 2	ZONE 7	Amador	Lower	399.93	255	2	230 - 250
3S/1E 13P 7	nested	LGA Grant Nested 3	ZONE 7	Amador	Lower	399.97	375	2	350 - 370
3S/1E 13P 8	nested	LGA Grant Nested 4	ZONE 7	Amador	Lower	399.94	605	2	580 - 600
3S/1E 14B 1	industrial	Industrial Asphalt	VULCAN MATERIALS	Amador	Lower	384.2	435	8	200 - 410
3S/1E 14D 2	monitor	South Cope Lake	ZONE 7	Amador	Lower	371.83	740	16	170 - 740
3S/1E 15F 3	supply	kaiser #8	KAISER	Amador	Lower	368.99	640	14	195 - 615
3S/1E 15J 3	supply	shadow cliff	EAST BAY REGIONAL PARK	Amador	Lower	344.59	196	8	154 - 184
3S/1E 15M 3	monitor	Bush/Valley South	ZONE 7	Amador	Lower	362.88	600	2	280 - 590
3S/1E 16A 2	muni	Pleas 8	CITY OF PLEASANTON	AmWest	Lower	358.2	510	20	200 - 495
3S/1E 16A 4	monitor	Bush/Valley Mid	ZONE 7	Amador	Lower	359.36	603	2	260 - 580
3S/1E 16B 1	monitor	Bush/Valley North	ZONE 7	Amador	Deep	355.81	805	2	605 - 800
3S/1E 16C 2	nested	Santa Rita Valley Shallow	ZONE 7	Amador	Lower	344.38	190	2	165 - 185
3S/1E 16C 3	nested	Santa Rita Valley Middle	ZONE 7	Amador	Lower	344.27	305	2	280 - 300
3S/1E 16C 4	nested	Santa Rita Valley Deep	ZONE 7	Amador	Lower	344.16	375	2	355 - 370
3S/1E 16E 4	monitor	black ave - cultural	ZONE 7	Amador	Upper	351.69	105	2.5	95 - 100
3S/1E 16L 2	monitor	Pleas 4	CITY OF PLEASANTON	Amador	Lower	355.86	151	12	56 - 136
3S/1E 16L 5	muni	Pleas 5	CITY OF PLEASANTON	Amador	Lower	358.05	685	18	149 - 650
3S/1E 16L 7	muni	Pleas 6	CITY OF PLEASANTON	Amador	Lower	354.47	647	18	165 - 647
3S/1E 16P 5	monitor	Vervais Monitor	ZONE 7	Amador	Upper	354.51	75	2.5	64 - 69
3S/1E 16R 1	supply	Stanley Berry Farm	R.L. IRBY	Amador	Lower	362.5	239	10	70 - 226
3S/1E 17B 4	supply	Casterson	LLOYD HAINES	Amador	Lower	337.69	248	8	0 - 248
3S/1E 17D 3	nested	Hopyard Nested Shallow	ZONE 7	Bernal	Lower	325.13	108	4	92 - 98
3S/1E 17D 4	nested	Hopyard Nested Middle 1	ZONE 7	Bernal	Lower	325.14	236	4	206 - 226
3S/1E 17D 5	nested	Hopyard Nested Middle 2	ZONE 7	Bernal	Lower	325.13	308	4	266 - 286
3S/1E 17D 6	nested	Hopyard Nested Middle 3	ZONE 7	Bernal	Lower	325.12	408	4	378 - 398
3S/1E 17D 7	nested	Hopyard Nested Deep	ZONE 7	Bernal	Deep	325.13	684	4	654 - 674
3S/1E 17D10	monitor	Hopyard 7	ZONE 7	Bernal	Lower	328.13	425	24	185 - 415
3S/1E 17D11	monitor	Hopyard 9 Monitoring Well	ZONE 7	Bernal	Lower	324.84	603	2	340 - 505
3S/1E 17D12	muni	Hopyard 9	ZONE 7	Bernal	Lower	327.9	315	18	235 - 310
3S/1E 18A 5	muni	Pleas 7	CITY OF PLEASANTON	Bernal	Lower	329.05	454	18	120 - 440
3S/1E 18A 6	muni	Hopyard 6	ZONE 7	Bernal	Lower	326.74	500	18	158 - 490
3S/1E 18E 4	monitor	Valley Trails II	ZONE 7	Bernal	Upper	320.21	83	4	69 - 79
3S/1E 18J 2	monitor	camino segura	ZONE 7	Bernal	Upper	323.02	71	2.5	61 - 66
3S/1E 18N 1	supply	merritt	RALPH MERRITT	Bernal	Lower	319.43	708	12	229 - 610
3S/1E 19A10	muni	SFWD South (B)	SFPUC	Bernal	Lower	337.02	331		189 - 327
3S/1E 19A11	muni	SFWD North (A)	SFPUC	Bernal	Lower	334.27	330	18	196 - 320
3S/1E 19C 4	monitor	del valle & laguna	ZONE 7	Bernal	Upper	322.23	78	4	68 - 73

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Dia = Diameter of well casing (in inches)
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Site	Type	Other Name	Owner	Basin	Aquifer	RP	TD	Dia	Perf
3S/1E 19K 1	monitor	680/bernal	ZONE 7	Bernal	Upper	321.54	57.6	2.5	47.6 - 52.6
3S/1E 20B 2	supply	Fairgrounds Potable	ALAMEDA COUNTY	Bernal	Lower	342.62	500	12	218 - 500
3S/1E 20C 7	monitor	Key_Bern_U	ZONE 7	Bernal	Upper	338.66	153	2	65 - 145
3S/1E 20C 8	nested	Key_Bern_L	ZONE 7	Bernal	Lower	338.67	315	2	295 - 315
3S/1E 20C 9	nested	Fair Nested Deep	ZONE 7	Bernal	Lower	338.78	515	2	495 - 515
3S/1E 20J 4	monitor	civic center	ZONE 7	Bernal	Upper	331.62	72	2.5	62 - 67
3S/1E 20M11	monitor	S.F "M"LINE	ZONE 7	Bernal	Upper	325.73	71	2.5	61 - 66
3S/1E 20Q 2	monitor	20Q2	CITY OF PLEASANTON	Bernal	Upper	325.82	65	10	45 - 53
3S/1E 22D 2	monitor	vineyard trailer	ZONE 7	Amador	Upper	368.05	72	2.5	62 - 67
3S/1E 23J 1	monitor	1627 vineyard trailer	D. SAFRENO	Amador	Lower	428.2	120	8	0 - 120
3S/1E 24Q 1	supply	Ruby Hills	RUBY HILLS	Amador	Lower	427.5	440	14	200 - 400
3S/1E 25C 3	monitor	Katz Winery Mansion	RUBY HILLS	Amador	Upper	454.16	146	2	70 - 140
3S/1E 29M 4	monitor	f.c. channel	ZONE 7	Castle	Upper	310.94	57	2.5	47 - 52
3S/1E 29P 2	monitor	castlewood dr	ZONE 7	Bernal	Upper	302.82	42	2.5	32 - 37
3S/1W 1B 9	nested	DSRSD Shallow	DSRSD	Dublin	Lower	333.56	162	2	122 - 152
3S/1W 1B10	nested	DSRSD Middle	DSRSD	Dublin	Lower	333.57	414	2	274 - 404
3S/1W 1B11	nested	DSRSD Deep	DSRSD	Dublin	Lower	333.74	560	2	480 - 550
3S/1W 2A 2	monitor	McNamara's	ZONE 7	Dublin	Upper	369.4	47	2.5	37 - 42
3S/1W 12B 2	monitor	Stoneridge Mall Rd	ZONE 7	Dublin	Upper	342.89	39.5	4	20 - 50
3S/1W 12J 1	monitor	DSRSD South	ZONE 7	Dublin	Upper	329.31	62	2.5	52 - 57
3S/1W 13J 1	monitor	muirwood dr	ZONE 7	Castle	Upper	343.94	48	2.5	39 - 44
3S/2E 1F 2	monitor	Brisa at Circuit City	ZONE 7	Spring	Upper	572.99	68.6	2.5	59 - 64
3S/2E 2B 2	monitor	south front rd	ZONE 7	Spring	Upper	539.45	46	2.5	36.9 - 41.9
3S/2E 3A 1	monitor	Bluebell	ZONE 7	Spring	Upper	517.63	54	2.5	44 - 49
3S/2E 3K 3	monitor	first & S. front rd	ZONE 7	Mocho I	Upper	522.83	60	2.5	50 - 55
3S/2E 5N 1	supply	Spider Well	TRAILER RANCH	Mocho II	Mixed	444	210	10	0 - 210
3S/2E 7C 2	monitor	york way - jaws - G4	ZONE 7	Mocho II	Upper	420.84	49	2.5	39 - 44
3S/2E 7H 2	monitor	dakota	CITY OF LIVERMORE	Mocho II	Upper	442.85	54	2	44 - 54
3S/2E 7N 2	monitor	Isabel & Arroyo Mocho	ZONE 7	AmWest	Lower	422	162	2	132 - 152
3S/2E 7P 3	muni	CWS 24	CAL WATER SERVICE	Amador	Lower	431.46	510	16	300 - 490
3S/2E 7R 2	monitor	CWS 31 Monitoring	CAL WATER SERVICE	Mocho II	Deep	446	805	2	750 - 805
3S/2E 7R 3	muni	CWS 31	CAL WATER SERVICE	Mocho II	Lower	446	583	16	410 - 528
3S/2E 8F 1	muni	CWS 10	CAL WATER SERVICE	Mocho II	Lower	456.24	576	16	143 - 433
3S/2E 8G 1	muni	CWS 19	CAL WATER SERVICE	Mocho II	Lower	465.05	465	16	120 - 455
3S/2E 8H 2	monitor	North k	ZONE 7	Mocho II	Upper	469.61	46	2.5	36 - 41
3S/2E 8H 3	nested	Key_Mo2_L	ZONE 7	Mocho II	Lower	477.25	195	2	170 - 190
3S/2E 8H 4	nested	N Liv Ave Deep	ZONE 7	Mocho II	Lower	476.97	385	2	360 - 380
3S/2E 8K 2	monitor	Key_Mo2_U (Livermore Key)	ZONE 7	Mocho II	Upper	464.78	74	2.5	64 - 69
3S/2E 8N 2	muni	CWS 14	CAL WATER SERVICE	Mocho II	Lower	453.64	526	10	140 - 515
3S/2E 8P 1	muni	CWS 8	CAL WATER SERVICE	Mocho II	Lower	468.2	273	10	122 - 263
3S/2E 8Q 9	monitor	D-2	B&C GAS	Mocho II	Lower	464.7	114	2	99 - 114
3S/2E 9P 1	muni	CWS 12	CAL WATER SERVICE	Mocho II	Lower	501.28	515	16	192 - 492
3S/2E 9Q 1	muni	CWS 9	CAL WATER SERVICE	Mocho II	Lower	518.15	572	14	180 - 492
3S/2E 9Q 4	monitor	school st	ZONE 7	Mocho II	Upper	504.35	80	2.5	70 - 75
3S/2E 10F 3	monitor	hexcel	ZONE 7	Mocho I	Upper	534.84	45	2.5	35 - 40
3S/2E 10Q 1	monitor	almond	ZONE 7	Mocho II	Upper	555.36	43.5	2.5	33.5 - 39
3S/2E 10Q 2	monitor	LLNL W-703	LLNL	Mocho II	Lower	549.33	325	4.5	298 - 325
3S/2E 11C 1	monitor	joan way	ZONE 7	Mocho I	Upper	557.1	66.2	2.5	56.2 - 61.2
3S/2E 12C 4	monitor	LLNL W-486	LLNL	Spring	Upper	591.46	108	4.5	100 - 108
3S/2E 12J 3	monitor	LLNL W-017A	LLNL	Spring	Lower	628.84	160	5	127 - 157
3S/2E 14A 3	monitor	S. vasco @east ave	ZONE 7	Mocho I	Upper	601.87	110	2.5	100 - 105

RP = Reference Point Elevation (in feet above MSL)
TD = Total Depth of well (in feet below ground surface)
Dia = Diameter of well casing (in inches)
Perf = Preferated interval (in feet below ground surface), uppermost - lowermost

Site	Type	Other Name	Owner	Basin	Aquifer	RP	TD	Dia	Perf
3S/2E 14B 1	domestic	5763 east ave	LAS POSITAS SWIM CLUB	Mocho I	Lower	593.36	300	9	146 - 234
3S/2E 15E 2	irrigation	Retzlaff Winery	BOB TAYLOR	Mocho II	Lower	549.69	192	8	104 - 189
3S/2E 15L 1	monitor	Concannon 2	CONCANNON	Mocho II	Upper	561.5	40.5	2	20 - 40.5
3S/2E 15M 2	monitor	Concannon 1	CONCANNON	Mocho II	Upper	549.46	45	2	25 - 45
3S/2E 15Q 6	irrigation	Concannon Old Pumping	CONCANNON	Mocho II	Lower	577.56	301	12	220 - 301
3S/2E 15R17	nested	Buena Vista Shallow	ZONE 7	Mocho II	Upper	592.41	63	2	38 - 58
3S/2E 15R18	nested	Buena Vista Deep	ZONE 7	Mocho II	Lower	592.47	138	2	113 - 133
3S/2E 16A 3	irrigation	Memory Gardens	MEMORY GARDENS	Mocho II	Lower	527.06	240	10	91 - 240
3S/2E 16B 1	muni	CWS 5	CAL WATER SERVICE	Mocho II	Lower	520.22	410	14	140 - 390
3S/2E 16C 1	muni	CWS 15	CAL WATER SERVICE	Mocho II	Lower	510.97	584	16	150 - 523
3S/2E 16E 4	monitor	pepper tree	ZONE 7	Mocho II	Upper	506.26	45	2.5	35 - 40
3S/2E 17E 2	supply	Mocho Street	JOHN & BARBARA STEIGE	Mocho II	Upper	467.71	94	6	0 - 94
3S/2E 18B 1	muni	CWS 20	CAL WATER SERVICE	Amador	Lower	438.56	497	16	190 - 465
3S/2E 18E 1	monitor	E. stanley	ZONE 7	Amador	Upper	423.86	133.8	2.5	123.8 - 128.8
3S/2E 19D 7	nested	Isabel Shallow	ZONE 7	Amador	Upper	415.07	180	2	100 - 180
3S/2E 19D 8	nested	Isabel Middle 1	ZONE 7	Amador	Lower	415.04	260	2	210 - 260
3S/2E 19D 9	nested	Isabel Middle 2	ZONE 7	Amador	Lower	414.98	390	2	280 - 390
3S/2E 19D10	nested	Isabel Deep	ZONE 7	Amador	Lower	414.89	470	2	420 - 470
3S/2E 19N 3	nested	Shallow Cemex Nested	CEMEX - Rob Walker	Amador	Lower	418.45	120	2	105 - 115
3S/2E 19N 4	nested	Deep Cemex Nested	CEMEX - Rob Walker	Amador	Lower	417.96	203	2	188 - 198
3S/2E 20M 1	supply	Alden Lane	ALDEN LANE NURSERY	Amador	Lower	478.79	184	12	0 - 184
3S/2E 22B 1	monitor	grapes	ZONE 7	Mocho II	Upper	585.88	31.9	2.5	21.9 - 26.9
3S/2E 23E 1	nested	Mines Nested Shallow	ZONE 7	Mocho II	Upper	613.36	40	2	20 - 35
3S/2E 23E 2	nested	Mines Nested Deep	ZONE 7	Mocho II	Lower	613.23	110	2	95 - 105
3S/2E 24A 1	monitor	S. greenville	ZONE 7	Mocho I	Upper	717.7	46.3	2.5	36.3 - 41.3
3S/2E 26J 2	monitor	mines rd	ZONE 7	Mocho II	Upper	689.92	44	2.5	34 - 39
3S/2E 29F 4	monitor	usgs wetmore	ZONE 7	Amador	Upper	457.5	36	2.5	26 - 31
3S/2E 30C 1	supply	Vineyard 30C 1	WHITE OAK LANDSCAPE	Amador	Lower	439.41	150	6	125 - 145
3S/2E 30D 2	monitor	vineyard	ZONE 7	Amador	Upper	431.6	44	4	24 - 39
3S/2E 33G 1	monitor	Crohare	ZONE 7	Amador	Upper	511.52	17	2.5	9 - 14
3S/2E 33K 1	monitor	VA	ZONE 7	Amador	Upper	546.83	15	2.5	7 - 12
3S/2E 33L 1	monitor	VA/CROHARE FENCE	ZONE 7	Amador	Upper	557.63	25	2.5	11 - 16
3S/3E 6Q 3	monitor	PPWTP South Monitoring	ZONE 7	Altamont	Upper	681.07	30	2	20 - 30
3S/3E 6Q 4	monitor	PPWTP North Monitoring	ZONE 7	Altamont	Upper	690.04	30	2	20 - 30
3S/3E 7D 2	monitor	7D 2	ZONE 7	Spring	Upper	622.84	74	2.5	64 - 69

RP = Reference Point Elevation (in feet above MSL)
TD = Total Depth of well (in feet below ground surface)
Dia = Diameter of well casing (in inches)
Perf = Preferated interval (in feet below ground surface), uppermost - lowermost

TABLE 6-3
SEMIANNUAL GROUNDWATER LEVELS
(Feet above Mean Sea Level, NAVD88)
FALL 2017 TO FALL 2018

Well Number	Well Depth	Aquifer	Subarea	Fall 2017		Spring 2018		Fall 2018		Change in Elevation (ft)		
										Seasonal		Annual
				Depth to Water	GW Elev	Depth to Water (ft)	GW Elev	Depth to Water (ft)	GW Elev	Fall 17 to Spring 18	Spring 18 to Fall 18	Fall 17 to Fall 18
1S/4E 31P 5	24	U	Tracy	14.5	45.5	16.2	43.8	16.8	43.2	-1.8	-0.6	-2.4
2S/1E 32E 1	70	U	Camp	35.4	357.2	35.8	356.8	36.5	356.0	-0.4	-0.8	-1.2
2S/1E 32N 1	44	U	Camp	18.3	342.5	18.0	342.8	19.6	341.2	0.3	-1.6	-1.3
2S/1E 32Q 1	45	U	Camp	26.6	341.0	26.7	340.9	27.5	340.1	-0.1	-0.8	-0.9
2S/1E 33L 1	80	U	Camp	51.1	338.4	50.5	339.0	50.7	338.8	0.6	-0.2	0.4
2S/1E 33P 2	55	U	Camp	33.3	336.8	31.8	338.3	31.9	338.2	1.5	-0.1	1.4
2S/1E 33R 1	60	U	Camp	20.7	337.8	20.1	338.4	19.9	338.6	0.6	0.2	0.8
2S/1W 15F 1	60	U	Bishop	10.0	429.4	9.0	430.4	10.1	429.3	1.0	-1.1	-0.1
2S/1W 26C 2	50	U	Dublin	23.4	383.2	23.0	383.5	25.6	380.9	0.4	-2.6	-2.2
2S/1W 36E 3	60	U	Dublin	4.5	342.0	3.4	343.1	4.8	341.8	1.1	-1.4	-0.3
2S/1W 36F 1	190	L	Dublin	20.2	322.5	13.4	329.3	20.3	322.5	6.8	-6.9	0.0
2S/1W 36F 2	320	L	Dublin	18.7	324.0	13.6	329.2	14.2	328.5	5.1	-0.6	4.5
2S/1W 36F 3	520	L	Dublin	42.2	300.6	27.6	315.1	29.5	313.2	14.6	-1.9	12.7
2S/2E 27C 2	108	U	Spring	13.5	528.7	14.3	527.9	4.7	537.4	-0.8	9.6	8.8
2S/2E 27P 2	68	U	Spring	2.8	502.6	1.7	503.8	3.2	502.2	1.2	-1.6	-0.4
2S/2E 28D 2	55	U	May	31.2	523.9	31.0	524.2	31.3	523.9	0.3	-0.3	-0.1
2S/2E 28J 2	230	L	May	4.4	514.5	6.0	512.8	6.2	512.7	-1.6	-0.2	-1.8
2S/2E 28Q 1	28	U	May	6.2	506.8	4.2	508.9	6.7	506.3	2.1	-2.6	-0.5
2S/2E 32K 2	43	U	Cayetano	8.4	499.0	8.2	499.3	8.8	498.6	0.3	-0.7	-0.4
2S/2E 34E 1	49	U	May	5.1	494.6	4.7	495.1	5.8	493.9	0.5	-1.1	-0.7
2S/2E 34Q 2	50	U	Spring	3.8	503.5	4.0	503.2	4.9	502.4	-0.2	-0.9	-1.1
2S/3E 1D 1	80	U	Tracy	9.1	81.0	8.8	81.2	10.5	79.6	0.3	-1.7	-1.4
3S/1E 1F 2	40	U	Mocho II	17.8	410.7	19.6	408.8	19.5	408.9	-1.8	0.1	-1.7
3S/1E 1H 3	80	U	Mocho II	24.0	398.8	23.8	399.1	26.5	396.3	0.2	-2.7	-2.5
3S/1E 1L 1	70	U	Camp	51.2	351.9	50.1	352.9	51.3	351.8	1.1	-1.2	-0.1
3S/1E 1P 2	50	U	Amador	17.0	372.7	17.4	372.3	18.9	370.8	-0.4	-1.5	-1.9
3S/1E 1P 3	480	L	Amador	114.0	280.5	114.1	280.4	121.0	273.5	-0.1	-6.9	-7.0
3S/1E 2J 2	41	U	Camp	12.7	368.2	10.6	370.3	13.7	367.2	2.0	-3.1	-1.0
3S/1E 2J 3	65	U	Camp	22.7	383.7	25.2	381.1	25.6	380.8	-2.5	-0.4	-2.9
3S/1E 2K 2	46	U	Camp	37.2	359.8	24.2	372.9	25.5	371.6	13.1	-1.3	11.7
3S/1E 2M 3	50	U	Camp	15.6	349.5	15.5	349.5	16.6	348.5	0.1	-1.1	-1.0
3S/1E 2N 6	55	U	Amador	28.6	337.6	26.9	339.3	29.5	336.6	1.7	-2.6	-0.9
3S/1E 2P 3	380	L	Camp	92.8	279.0	91.4	280.4	97.7	274.0	1.4	-6.3	-4.9
3S/1E 2Q 1	45	U	Amador	18.0	351.9	16.9	353.1	19.2	350.7	1.1	-2.3	-1.2
3S/1E 2R 1	33	U	Amador	15.0	361.3	13.6	362.7	17.0	359.3	1.4	-3.4	-2.0
3S/1E 3G 2	50	U	Camp	11.6	342.6	10.8	343.5	11.2	343.1	0.9	-0.4	0.4
3S/1E 4A 1	50	U	Camp	17.9	332.8	16.4	334.3	16.4	334.3	1.5	0.0	1.5
3S/1E 4J 5	47	U	Camp	15.9	329.4	13.5	331.7	14.5	330.7	2.3	-1.0	1.3
3S/1E 4J 6	110	U	Camp	17.2	328.3	14.4	331.1	15.1	330.4	2.8	-0.7	2.1
3S/1E 4Q 2	90	U	Amador	37.2	308.3	27.7	317.7	30.9	314.5	9.4	-3.2	6.3
3S/1E 5K 6	75	U	Camp	13.8	332.3	12.5	333.6	13.7	332.4	1.3	-1.2	0.1
3S/1E 5K 7	150	L	Camp	17.6	328.6	15.8	330.4	16.8	329.4	1.8	-1.1	0.8
3S/1E 5L 3	40	U	Camp	12.7	326.8	12.5	327.0	12.6	326.8	0.2	-0.2	0.0
3S/1E 5P 6	35	U	Camp	10.3	326.4	10.6	326.1	10.6	326.0	-0.3	-0.1	-0.4
3S/1E 6F 3	36	U	Dublin	5.6	324.2	4.8	325.0	5.9	323.9	0.8	-1.1	-0.3
3S/1E 6G 5	200	L	Dublin	9.6	322.6	8.1	324.1	9.4	322.8	1.6	-1.3	0.2
3S/1E 6N 2	67	U	Dublin	13.8	321.4	12.7	322.5	14.0	321.2	1.1	-1.3	-0.2
3S/1E 7B 2	152	L	Dublin	9.3	318.5	9.7	318.1	9.0	318.8	-0.3	0.6	0.3
3S/1E 7B12	70	U	Dublin	11.0	316.8	9.9	318.0	10.8	317.1	1.2	-0.9	0.3
3S/1E 7G 7	55	U	Dublin	12.1	315.2	10.8	316.5	12.0	315.4	1.3	-1.1	0.2
3S/1E 7J 5	50	U	Dublin	14.5	312.3	13.0	313.8	14.0	312.8	1.4	-1.0	0.4
3S/1E 8B 1	148	U	Amador	36.9	301.4	20.7	317.6	32.5	305.8	16.3	-11.9	4.4
3S/1E 8G 4	85	U	Amador	39.8	301.7	31.4	310.0	35.3	306.2	8.3	-3.8	4.5
3S/1E 8H 9	240	L	Amador	44.8	293.8	38.1	300.4	43.3	295.2	6.6	-5.2	1.4
3S/1E 8H10	440	L	Amador	48.2	291.1	44.1	295.2	50.3	289.0	4.0	-6.2	-2.2
3S/1E 8H11	720	D	Amador	53.4	285.8	46.3	292.9	57.0	282.3	7.1	-10.7	-3.6
3S/1E 8H13	800	D	Amador	53.0	286.0	45.6	293.3	54.6	284.3	7.4	-9.0	-1.6
3S/1E 8H18	745	L	Amador	57.8	284.2	50.5	291.5	61.2	280.8	7.3	-10.7	-3.4
3S/1E 8K 1	99	U	Amador	35.7	296.7	27.3	305.1	32.4	300.0	8.3	-5.1	3.3
3S/1E 8N 1	72	U	Bernal	27.4	296.3	18.6	305.1	24.3	299.4	8.8	-5.7	3.0
3S/1E 9B 1	810	L	Amador	NA	-	37.8	311.5	40.4	308.9	-	-2.6	-
3S/1E 9H10	145	U	Amador	45.3	307.6	36.0	316.9	39.3	313.6	9.3	-3.3	5.9
3S/1E 9H11	190	L	Amador	53.0	300.0	46.8	306.3	50.5	302.6	6.3	-3.7	2.6
3S/1E 9J 7	505	U	Amador	50.6	306.8	41.5	315.9	45.0	312.4	9.2	-3.5	5.7
3S/1E 9J 8	305	L	Amador	63.4	294.1	57.2	300.4	62.0	295.6	6.2	-4.8	1.4
3S/1E 9J 9	505	L	Amador	72.9	284.8	65.6	292.0	75.6	282.1	7.3	-10.0	-2.7
3S/1E 9M 3	575	L	Amador	NA	-	NA	-	55.0	292.5	-	-	-
3S/1E 9M 4	498	L	Amador	35.1	307.8	47.7	295.2	NA	-	-12.6	-	-
3S/1E 9P 5	105	U	Amador	46.7	302.7	37.6	311.8	41.4	308.0	9.1	-3.8	5.3
3S/1E 9P 9	210	L	Amador	50.5	299.1	42.9	306.7	46.8	302.8	7.6	-3.9	3.7

U = Upper; L = Lower; NM = Not Measured; NA = Not Available
OBS = Obstructed; - = Not Applicable; highlight = Key Well
E:\MONITOR\GM\2018WY\AnnualReport18\Tbl06-03 TblSAWaterLevels18.xls

TABLE 6-3
SEMIANNUAL GROUNDWATER LEVELS
(Feet above Mean Sea Level, NAVD88)
FALL 2017 TO FALL 2018

Well Number	Well Depth	Aquifer	Subarea	Fall 2017		Spring 2018		Fall 2018		Change in Elevation (ft)		
										Seasonal		Annual
				Depth to Water	GW Elev	Depth to Water (ft)	GW Elev	Depth to Water (ft)	GW Elev	Fall 17 to Spring 18	Spring 18 to Fall 18	Fall 17 to Fall 18
1S/4E 31P 5	24	U	Tracy	14.5	45.5	16.2	43.8	16.8	43.2	-1.8	-0.6	-2.4
2S/1E 32E 1	70	U	Camp	35.4	357.2	35.8	356.8	36.5	356.0	-0.4	-0.8	-1.2
2S/1E 32N 1	44	U	Camp	18.3	342.5	18.0	342.8	19.6	341.2	0.3	-1.6	-1.3
2S/1E 32Q 1	45	U	Camp	26.6	341.0	26.7	340.9	27.5	340.1	-0.1	-0.8	-0.9
2S/1E 33L 1	80	U	Camp	51.1	338.4	50.5	339.0	50.7	338.8	0.6	-0.2	0.4
2S/1E 33P 2	55	U	Camp	33.3	336.8	31.8	338.3	31.9	338.2	1.5	-0.1	1.4
3S/1E 9P10	310	L	Amador	55.7	293.8	48.4	301.2	53.9	295.6	7.4	-5.5	1.8
3S/1E 9P11	425	L	Amador	65.3	284.2	56.9	292.6	NA	-	8.4	-	-
3S/1E 10A 2	88	U	Amador	47.4	320.0	41.6	325.7	42.7	324.7	5.7	-1.1	4.7
3S/1E 10B 8	200	L	Amador	51.8	301.8	45.5	308.1	48.8	304.9	6.3	-3.3	3.1
3S/1E 10B 9	294	L	Amador	60.2	293.3	55.4	298.1	60.3	293.2	4.8	-4.8	0.0
3S/1E 10B10	600	L	Amador	70.6	282.9	67.7	285.8	74.2	279.3	2.9	-6.5	-3.6
3S/1E 10B11	810	D	Amador	71.5	282.0	69.6	283.9	74.2	279.3	1.9	-4.6	-2.7
3S/1E 10B14	690	L	Amador	86.1	269.5	70.0	285.6	79.1	276.5	16.0	-9.1	6.9
3S/1E 10D 2	212	L	Amador	49.7	299.7	43.5	305.8	47.9	301.4	6.2	-4.4	1.8
3S/1E 10D 3	322	L	Amador	56.0	293.3	50.1	299.2	55.4	293.9	5.9	-5.3	0.6
3S/1E 10D 4	616	L	Amador	64.5	284.8	60.8	288.5	68.4	280.9	3.7	-7.6	-3.8
3S/1E 10D 5	790	D	Amador	66.6	282.7	63.6	285.7	69.9	279.4	3.0	-6.3	-3.3
3S/1E 10D 7	145	U	Amador	51.1	310.0	41.0	320.1	43.6	317.5	10.1	-2.5	7.6
3S/1E 10D 8	215	L	Amador	60.9	300.1	55.8	305.2	59.1	302.0	5.1	-3.3	1.8
3S/1E 10K 2	591	L	Amador	69.5	289.2	61.9	296.8	67.0	291.7	7.6	-5.1	2.5
3S/1E 10K 3	530	L	Amador	91.4	272.4	73.0	290.8	80.5	283.3	18.4	-7.5	10.9
3S/1E 10N 2	195	U	Amador	49.8	308.3	40.1	318.1	43.2	315.0	9.7	-3.1	6.6
3S/1E 10N 3	195	L	Amador	58.2	299.8	51.1	306.9	55.1	302.9	7.1	-4.0	3.1
3S/1E 11B 1	43	U	Amador	28.2	341.2	27.8	341.6	29.3	340.1	0.4	-1.5	-1.1
3S/1E 11C 3	55	U	Amador	29.7	335.2	29.3	335.5	30.3	334.5	0.3	-0.9	-0.6
3S/1E 11G 1	120	U	Amador	50.0	321.6	49.4	322.3	53.6	318.0	0.6	-4.2	-3.6
3S/1E 11G 2	350	L	Amador	94.1	277.5	94.1	277.5	100.5	271.1	0.0	-6.4	-6.4
3S/1E 11G 3	590	L	Amador	90.8	280.9	90.2	281.5	96.8	274.8	0.6	-6.7	-6.1
3S/1E 11G 4	790	D	Amador	89.5	282.2	85.2	286.5	93.2	278.5	4.3	-8.0	-3.7
3S/1E 11M 2	700	L	Amador	79.1	286.9	76.1	289.9	81.3	284.7	3.0	-5.2	-2.2
3S/1E 11M 3	684	L	Amador	NA	-	87.4	281.9	95.1	274.2	-	-7.7	-
3S/1E 11P 6	400	L	Amador	98.9	277.7	NA	-	NA	-	-	-	-
3S/1E 12A 2	69	U	Amador	26.5	374.9	28.2	373.1	32.9	368.5	-1.7	-4.6	-6.4
3S/1E 12D 2	45	U	Amador	28.0	357.1	29.0	355.5	29.0	355.5	-1.7	0.0	-1.7
3S/1E 12G 1	73	U	Amador	49.8	354.7	51.9	352.5	55.4	349.1	-2.1	-3.5	-5.6
3S/1E 12H 4	270	L	Amador	132.0	275.8	135.5	272.3	143.7	264.1	-3.5	-8.2	-11.7
3S/1E 12H 5	400	L	Amador	126.1	281.7	127.8	279.9	135.2	272.6	-1.8	-7.4	-9.2
3S/1E 12H 6	480	L	Amador	126.4	281.4	125.3	282.5	133.3	274.5	1.1	-8.0	-6.9
3S/1E 12H 7	684	D	Amador	165.3	242.4	149.6	258.1	153.1	254.6	15.7	-3.4	12.2
3S/1E 12K 2	300	L	Amador	146.3	260.0	150.7	255.6	160.2	246.1	-4.4	-9.6	-14.0
3S/1E 12K 3	475	L	Amador	127.7	279.2	138.6	268.2	144.9	261.9	-10.9	-6.3	-17.3
3S/1E 12K 4	575	D	Amador	130.9	275.8	124.4	282.3	131.1	275.7	6.5	-6.6	-0.1
3S/1E 13P 5	135	U	Amador	87.0	293.8	106.6	293.4	106.0	294.0	-0.4	0.6	0.2
3S/1E 13P 6	255	L	Amador	98.1	282.6	121.5	278.4	123.1	276.9	-4.2	-1.6	-5.8
3S/1E 13P 7	375	L	Amador	96.0	284.7	121.4	278.6	124.8	275.2	-6.1	-3.4	-9.5
3S/1E 13P 8	605	L	Amador	118.4	262.4	128.6	271.3	134.0	265.9	9.0	-5.4	3.6
3S/1E 14B 1	435	L	Amador	104.2	280.0	104.7	279.5	108.3	275.9	-0.5	-3.6	-4.1
3S/1E 14D 2	740	L	Amador	81.3	290.5	79.1	292.7	83.0	288.8	2.2	-3.9	-1.7
3S/1E 15F 3	640	L	Amador	87.2	281.8	76.2	292.8	85.2	283.8	11.1	-9.0	2.0
3S/1E 15J 3	196	L	Amador	61.3	283.3	53.0	291.6	61.1	283.5	8.3	-8.1	0.2
3S/1E 15M 3	600	L	Amador	85.7	277.2	74.2	288.7	84.1	278.8	11.6	-10.0	1.6
3S/1E 16A 2	510	L	Amador	80.3	277.9	65.4	290.7	88.7	267.4	12.8	-23.3	-10.5
3S/1E 16A 4	603	L	Amador	75.0	284.3	64.1	295.3	76.4	283.0	10.9	-12.3	-1.4
3S/1E 16B 1	805	D	Amador	72.5	283.3	62.6	293.3	74.4	281.4	9.9	-11.9	-1.9
3S/1E 16C 2	190	L	Amador	51.0	293.4	42.3	302.1	48.8	295.6	8.7	-6.6	2.1
3S/1E 16C 3	305	L	Amador	63.7	280.6	48.1	296.1	61.1	283.2	15.5	-13.0	2.5
3S/1E 16C 4	375	L	Amador	66.0	278.2	49.0	295.1	63.4	280.8	16.9	-14.4	2.6
3S/1E 16E 4	105	U	Amador	50.2	301.5	37.8	313.9	43.0	308.7	12.5	-5.2	7.3
3S/1E 16L 2	151	U	Amador	57.2	298.7	43.1	303.2	48.0	298.3	4.5	-4.9	-0.4
3S/1E 16L 5	685	L	Amador	57.2	300.9	45.4	300.9	50.0	296.3	0.1	-4.6	-4.6
3S/1E 16L 7	647	L	Amador	NA	-	48.8	294.7	63.1	280.4	-	-14.3	-
3S/1E 16P 5	75	U	Amador	37.9	316.7	36.8	317.7	38.1	316.4	1.1	-1.3	-0.3
3S/1E 16R 1	239	L	Amador	70.3	292.2	59.7	302.8	68.8	293.7	10.6	-9.1	1.5
3S/1E 17B 4	248	L	Amador	41.7	296.0	32.7	305.0	40.4	297.3	9.0	-7.7	1.3
3S/1E 17D 3	108	L	Bernal	30.0	295.1	24.0	301.2	29.3	295.8	6.0	-5.3	0.7
3S/1E 17D 4	236	L	Bernal	31.4	293.7	25.2	299.9	30.8	294.4	6.2	-5.5	0.6
3S/1E 17D 5	308	L	Bernal	31.6	293.6	24.1	301.0	29.8	295.4	7.4	-5.6	1.8
3S/1E 17D 6	408	L	Bernal	30.4	294.7	23.7	301.4	28.4	296.8	6.7	-4.7	2.0
3S/1E 17D 7	684	D	Bernal	21.3	303.8	20.0	305.1	20.5	304.7	1.3	-0.5	0.9

U = Upper; L = Lower; NM = Not Measured; NA = Not Available
OBS = Obstructed; - = Not Applicable; highlight = Key Well
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TABLE 6-3
SEMIANNUAL GROUNDWATER LEVELS
(Feet above Mean Sea Level, NAVD88)
FALL 2017 TO FALL 2018

Well Number	Well Depth	Aquifer	Subarea	Fall 2017		Spring 2018		Fall 2018		Change in Elevation (ft)		
										Seasonal		Annual
				Depth to Water	GW Elev	Depth to Water (ft)	GW Elev	Depth to Water (ft)	GW Elev	Fall 17 to Spring 18	Spring 18 to Fall 18	Fall 17 to Fall 18
1S/4E 31P 5	24	U	Tracy	14.5	45.5	16.2	43.8	16.8	43.2	-1.8	-0.6	-2.4
2S/1E 32E 1	70	U	Camp	35.4	357.2	35.8	356.8	36.5	356.0	-0.4	-0.8	-1.2
2S/1E 32N 1	44	U	Camp	18.3	342.5	18.0	342.8	19.6	341.2	0.3	-1.6	-1.3
2S/1E 32Q 1	45	U	Camp	26.6	341.0	26.7	340.9	27.5	340.1	-0.1	-0.8	-0.9
2S/1E 33L 1	80	U	Camp	51.1	338.4	50.5	339.0	50.7	338.8	0.6	-0.2	0.4
2S/1E 33P 2	55	U	Camp	33.3	336.8	31.8	338.3	31.9	338.2	1.5	-0.1	1.4
3S/1E 17D10	425	L	Bernal	33.8	294.3	27.0	301.1	32.5	295.7	6.8	-5.5	1.3
3S/1E 17D11	603	L	Bernal	29.9	295.0	23.2	301.7	27.6	297.3	6.7	-4.4	2.3
3S/1E 17D12	315	L	Bernal	35.2	292.7	29.6	298.3	35.1	292.8	5.6	-5.6	0.1
3S/1E 18A 5	454	L	Bernal	35.2	293.9	27.3	300.0	44.3	283.0	6.1	-17.0	-10.9
3S/1E 18A 6	500	L	Bernal	34.2	292.6	24.4	302.3	NA	-	9.7	-	-
3S/1E 18E 4	83	U	Bernal	25.0	295.2	17.6	302.6	22.4	297.8	7.4	-4.8	2.6
3S/1E 18J 2	71	U	Bernal	26.9	296.1	19.0	304.1	24.1	299.0	8.0	-5.1	2.9
3S/1E 18N 1	708	L	Bernal	28.2	291.2	19.4	300.1	25.1	294.3	8.8	-5.8	3.1
3S/1E 19A10	331	L	Bernal	42.9	294.2	35.1	301.0	40.6	296.4	6.8	-4.6	2.2
3S/1E 19A11	330	L	Bernal	38.6	295.7	30.7	303.6	36.5	297.8	7.9	-5.8	2.1
3S/1E 19C 4	78	U	Bernal	25.4	296.8	17.6	304.7	22.5	299.7	7.9	-4.9	2.9
3S/1E 19K 1	58	U	Bernal	27.4	294.2	19.3	302.2	24.5	297.1	8.1	-5.2	2.9
3S/1E 20B 2	500	L	Bernal	50.3	292.4	43.4	299.2	NA	-	6.9	-	-
3S/1E 20C 7	153	U	Bernal	42.3	296.4	34.9	303.8	39.4	299.3	7.4	-4.5	2.9
3S/1E 20C 8	315	L	Bernal	46.3	292.4	35.9	302.8	42.4	296.3	10.4	-6.4	3.9
3S/1E 20C 9	515	L	Bernal	45.6	293.2	35.7	303.0	41.7	297.1	9.9	-5.9	4.0
3S/1E 20J 4	72	U	Bernal	32.8	298.8	27.1	304.5	31.2	300.4	5.7	-4.1	1.6
3S/1E 20M11	71	U	Bernal	26.4	299.3	NA	-	23.7	302.1	-	-	2.8
3S/1E 20Q 2	65	U	Bernal	18.6	307.2	16.4	309.4	17.8	308.0	2.2	-1.4	0.8
3S/1E 22D 2	72	U	Amador	48.6	319.5	45.2	322.9	48.0	320.1	3.4	-2.8	0.6
3S/1E 23J 1	120	L	Amador	78.6	349.6	85.1	343.1	90.4	337.8	-6.5	-5.3	-11.8
3S/1E 24Q 1	440	L	Amador	96.0	331.6	90.5	337.0	95.5	332.0	5.4	-5.0	0.4
3S/1E 25C 3	146	U	Amador	80.0	374.2	86.0	368.2	89.8	364.4	-6.0	-3.8	-9.8
3S/1E 29M 4	57	U	Castle	19.0	291.9	13.1	297.9	16.3	294.6	5.9	-3.2	2.7
3S/1E 29P 2	42	U	Bernal	26.8	276.0	25.7	277.1	26.8	276.0	1.1	-1.1	0.0
3S/1W 1B 9	162	L	Dublin	12.4	321.1	9.2	324.3	12.7	320.9	3.2	-3.5	-0.3
3S/1W 1B10	414	L	Dublin	12.3	321.2	9.3	324.2	9.4	324.2	3.0	0.0	3.0
3S/1W 1B11	560	L	Dublin	29.3	304.4	20.1	313.7	20.6	313.2	9.3	-0.5	8.8
3S/1W 2A 2	47	U	Dublin	24.7	344.7	23.4	346.0	26.5	343.0	1.3	-3.0	-1.8
3S/1W 12B 2	40	U	Dublin	21.1	321.8	19.5	323.4	21.6	321.3	1.6	-2.1	-0.5
3S/1W 12J 1	62	U	Dublin	17.2	312.1	14.8	314.5	16.8	312.5	2.4	-2.0	0.4
3S/1W 13J 1	48	U	Castle	30.1	313.8	25.2	318.7	30.6	313.4	4.9	-5.3	-0.4
3S/2E 1F 2	69	U	Spring	24.7	548.3	24.3	548.7	24.7	548.3	0.4	-0.4	0.0
3S/2E 2B 2	46	U	Spring	9.5	529.9	8.6	530.8	10.0	529.4	0.9	-1.4	-0.5
3S/2E 3A 1	54	U	Spring	5.7	511.9	3.9	513.7	8.6	509.0	1.8	-4.7	-2.9
3S/2E 3K 3	60	U	Mocho I	13.5	509.4	13.4	509.5	13.8	509.0	0.1	-0.4	-0.3
3S/2E 5N 1	210	M	Mocho II	27.9	416.1	28.2	415.8	35.3	408.7	-0.3	-7.1	-7.4
3S/2E 7C 2	49	U	Mocho II	23.7	397.1	24.0	396.9	26.7	394.1	-0.3	-2.7	-3.0
3S/2E 7H 2	54	U	Mocho II	25.1	417.8	25.2	417.7	31.7	411.2	-0.1	-6.5	-6.6
3S/2E 7N 2	162	L	Amador	107.6	314.4	117.7	304.3	130.7	291.3	-10.2	-13.0	-23.1
3S/2E 7R 2	805	D	Mocho II	3.6	442.4	3.1	442.9	3.5	442.5	0.5	-0.4	0.1
3S/2E 7R 3	583	L	Mocho II	84.3	361.7	72.8	373.2	100.8	345.2	11.5	-28.0	-16.5
3S/2E 8H 2	46	U	Mocho II	24.1	445.6	26.6	443.0	40.1	429.5	-2.5	-13.5	-16.1
3S/2E 8H 3	195	L	Mocho II	49.3	427.9	49.8	427.5	60.7	416.6	-0.5	-10.9	-11.3
3S/2E 8H 4	385	L	Mocho II	115.3	361.7	96.1	380.9	119.5	357.4	19.2	-23.5	-4.3
3S/2E 8K 2	74	U	Mocho II	29.1	435.7	28.8	436.0	40.0	424.8	0.3	-11.2	-10.9
3S/2E 8N 2	526	L	Mocho II	47.1	406.5	42.6	411.1	65.9	387.8	4.5	-23.3	-18.8
3S/2E 8P 1	273	L	Mocho II	36.1	432.2	37.2	431.0	49.3	418.9	-1.2	-12.0	-13.2
3S/2E 8Q 9	114	L	Mocho II	22.6	442.1	23.6	441.2	35.3	429.4	-0.9	-11.8	-12.7
3S/2E 9Q 4	80	U	Mocho II	20.2	484.2	18.8	485.6	32.3	472.1	1.4	-13.5	-12.1
3S/2E 10F 3	45	U	Mocho I	12.7	522.1	12.4	522.4	13.8	521.0	0.3	-1.4	-1.1
3S/2E 10Q 1	44	U	Mocho II	23.1	532.3	21.5	533.8	26.0	529.3	1.5	-4.5	-3.0
3S/2E 10Q 2	325	L	Mocho II	27.7	521.9	NA	-	32.8	516.8	-	-	-5.1
3S/2E 11C 1	66	U	Mocho I	26.8	530.3	26.5	530.6	27.8	529.3	0.3	-1.3	-1.0
3S/2E 12C 4	108	U	Spring	56.4	533.7	55.9	534.2	56.4	533.7	0.5	-0.5	0.1
3S/2E 14B 1	300	L	Mocho I	62.4	531.0	63.2	530.2	64.3	529.1	-0.8	-1.1	-1.9
3S/2E 15E 2	192	L	Mocho II	35.7	514.0	35.0	514.7	51.2	498.5	0.7	-16.3	-15.6
3S/2E 15L 1	41	U	Mocho II	27.4	534.1	20.3	541.2	35.4	526.1	7.0	-15.1	-8.0
3S/2E 15M 2	45	U	Mocho II	30.4	519.1	26.4	523.1	43.2	506.3	4.0	-16.8	-12.8
3S/2E 15Q 6	301	L	Mocho II	56.9	520.7	52.3	525.3	58.9	518.7	4.6	-6.6	-2.0
3S/2E 15R17	63	U	Mocho II	12.5	579.9	9.4	583.1	13.4	579.1	3.1	-4.0	-0.9
3S/2E 15R18	138	L	Mocho II	18.3	574.2	11.5	581.0	20.0	572.5	6.8	-8.5	-1.7
3S/2E 16A 3	240	L	Mocho II	32.2	494.9	30.4	496.6	44.5	482.6	1.7	-14.0	-12.3
3S/2E 16C 1	584	L	Mocho II	101.7	409.3	86.1	424.9	100.0	411.0	15.7	-13.9	1.8

U = Upper; L = Lower; NM = Not Measured; NA = Not Available
OBS = Obstructed; - = Not Applicable; highlight = Key Well
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TABLE 6-3
SEMIANNUAL GROUNDWATER LEVELS
(Feet above Mean Sea Level, NAVD88)
FALL 2017 TO FALL 2018

Well Number	Well Depth	Aquifer	Subarea	Fall 2017		Spring 2018		Fall 2018		Change in Elevation (ft)		
										Seasonal		Annual
				Depth to Water	GW Elev	Depth to Water (ft)	GW Elev	Depth to Water (ft)	GW Elev	Fall 17 to Spring 18	Spring 18 to Fall 18	Fall 17 to Fall 18
1S/4E 31P 5	24	U	Tracy	14.5	45.5	16.2	43.8	16.8	43.2	-1.8	-0.6	-2.4
2S/1E 32E 1	70	U	Camp	35.4	357.2	35.8	356.8	36.5	356.0	-0.4	-0.8	-1.2
2S/1E 32N 1	44	U	Camp	18.3	342.5	18.0	342.8	19.6	341.2	0.3	-1.6	-1.3
2S/1E 32Q 1	45	U	Camp	26.6	341.0	26.7	340.9	27.5	340.1	-0.1	-0.8	-0.9
2S/1E 33L 1	80	U	Camp	51.1	338.4	50.5	339.0	50.7	338.8	0.6	-0.2	0.4
2S/1E 33P 2	55	U	Camp	33.3	336.8	31.8	338.3	31.9	338.2	1.5	-0.1	1.4
3S/2E 16E 4	45	U	Mocho II	29.0	477.2	17.2	489.0	27.7	478.6	11.8	-10.4	1.4
3S/2E 17E 2	94	U	Mocho II	NA	-	24.0	443.7	NA	-	-	-	-
3S/2E 18E 1	134	U	Amador	55.0	368.9	79.6	344.3	91.4	332.5	-24.6	-11.8	-36.4
3S/2E 19D 7	180	U	Amador	78.9	336.2	82.5	332.5	92.2	322.9	-3.6	-9.7	-13.3
3S/2E 19D 8	260	L	Amador	80.0	335.1	86.5	328.5	91.0	324.1	-6.5	-4.5	-11.0
3S/2E 19D 9	390	L	Amador	132.1	282.9	131.8	283.2	137.3	277.7	0.3	-5.5	-5.2
3S/2E 19D10	470	L	Amador	124.2	290.7	127.6	287.3	130.1	284.8	-3.4	-2.5	-6.0
3S/2E 20M 1	184	L	Amador	50.4	428.4	47.1	431.7	53.5	425.3	3.3	-6.4	-3.1
3S/2E 22B 1	32	U	Mocho II	15.3	570.6	14.9	571.0	NA	-	0.4	-	-
3S/2E 23E 1	40	U	Mocho II	16.5	596.8	14.0	599.4	16.8	596.6	2.5	-2.8	-0.2
3S/2E 23E 2	110	L	Mocho II	14.3	599.0	NA	-	15.1	598.1	-	-	-0.9
3S/2E 24A 1	46	U	Mocho I	18.1	699.6	18.1	699.6	19.7	698.0	0.0	-1.6	-1.6
3S/2E 26J 2	44	U	Mocho II	9.1	680.9	7.3	682.7	11.1	678.8	1.8	-3.8	-2.0
3S/2E 29F 4	36	U	Amador	8.5	449.0	8.6	448.9	8.5	449.0	-0.1	0.1	0.0
3S/2E 30C 1	150	L	Amador	24.7	415.5	25.6	413.8	28.1	411.3	-1.7	-2.5	-4.2
3S/2E 30D 2	44	U	Amador	21.2	410.4	21.3	410.4	21.4	410.2	-0.1	-0.2	-0.3
3S/2E 33G 1	17	U	Amador	7.8	503.7	8.7	502.8	8.7	502.8	-0.9	0.0	-0.9
3S/2E 33K 1	15	U	Amador	9.3	537.5	6.7	540.1	6.3	540.5	2.6	0.4	3.0
3S/2E 33L 1	25	U	Amador	11.7	545.9	9.2	548.4	4.0	553.6	2.5	5.2	7.7
3S/3E 6Q 3	30	U	Altamont	6.8	674.2	6.8	674.3	6.8	674.3	0.1	0.0	0.1
3S/3E 6Q 4	30	U	Altamont	11.7	678.3	11.8	678.3	11.6	678.5	0.0	0.2	0.2
3S/3E 7D 2	74	U	Spring	47.2	575.2	NA	-	46.9	575.5	-	-	0.3
MA-C 1	-	U	Amador	0.0	388.4	0.0	382.0	0.0	372.2	-6.4	-9.8	-16.2
MA-K 15	-	U	Amador	0.0	330.6	0.0	332.1	0.0	332.8	1.5	0.7	2.2
MA-K 18	-	U	Amador	0.0	350.4	0.0	350.3	0.0	350.4	-0.1	0.1	0.0
MA-K 28	-	U	Amador	0.0	312.3	0.0	319.5	0.0	318.3	7.2	-1.2	6.0
MA-K 30	-	U	Amador	0.0	333.6	0.0	334.3	0.0	332.8	0.8	-1.6	-0.8
MA-K 37	-	U	Amador	0.0	310.1	0.0	320.0	0.0	317.2	9.9	-2.8	7.1
MA-P 10	-	U	Amador	0.0	364.9	0.0	365.3	0.0	363.7	0.4	-1.5	-1.1
MA-P 12	-	U	Amador	0.0	351.5	0.0	350.8	0.0	351.7	-0.7	0.9	0.1
MA-P 27	-	U	Amador	0.0	281.0	0.0	282.5	0.0	280.5	1.5	-1.9	-0.5
MA-P 28	-	U	Amador	0.0	407.4	0.0	413.0	0.0	406.9	5.6	-6.1	-0.5
MA-P 41	-	U	Amador	0.0	412.8	0.0	413.7	0.0	412.0	0.9	-1.7	-0.8
MA-P 42	-	U	Amador	0.0	281.8	0.0	284.6	0.0	285.3	2.9	0.7	3.6
MA-P 44	-	U	Amador	0.0	338.9	0.0	349.8	0.0	351.2	10.9	1.3	12.3
MA-R 3	-	U	Amador	0.0	345.7	0.0	343.1	0.0	344.8	-2.6	1.6	-1.0
MA-R 4	-	U	Amador	0.0	315.5	0.0	310.7	0.0	315.6	-4.8	5.0	0.2
MA-R 22	-	U	Amador	0.0	364.5	0.0	367.5	0.0	366.1	3.0	-1.4	1.6
MA-R 23	-	U	Amador	0.0	359.3	0.0	360.6	0.0	361.6	1.3	1.0	2.3
MA-R 28	-	U	Amador	NA	-	NA	-	0.0	219.3	-	-	-

U = Upper; L = Lower; NM = Not Measured; NA = Not Available
OBS = Obstructed; - = Not Applicable; highlight = Key Well
E:\MONITOR\GM\2018WY\AnnualReport18\Tbl06-03 TblSAWaterLevels18.xls

ABBREVIATIONS FOR MUNI WELLS
CWS= California Water Service
M = Mocho (Zone 7)
H = Hopyard (Zone 7)
St = Stoneridge (Zone 7)
P = Pleasanton
SF = San Francisco Public Utilities Commision

LEGEND

Well Colors
- Upper Aquifer
- Lower Aquifer
- Deep Aquifer
- Key Wells

Well Symbols
- Supply
- Monitor
- Municipal
- Nested Monitoring
- Main Basin
- Fringe Management Area
- Upland Management Area

Mining Area Ponds 2018
- Static (= groundwater elevation)
- Pumped From
- Pumped Into
- Clay-lined
- Subarea Boundaries
- Rivers
- Township-Range Line

2S/1W 2S/1E 2S/2E 2S/3E
3S/1W 3S/1E 3S/2E 3S/3E

N W E S

0 6,000 12,000
Feet

DATE: Mar 18, 2019
FILE: E:\MONITOR\GM\2018WY\AnnualReport18\Fig06-01-MapAllWellsGM18.mxd

Figure 6-1
Map of Wells in
2018 Groundwater Elevation Program
Livermore Valley Groundwater Basin

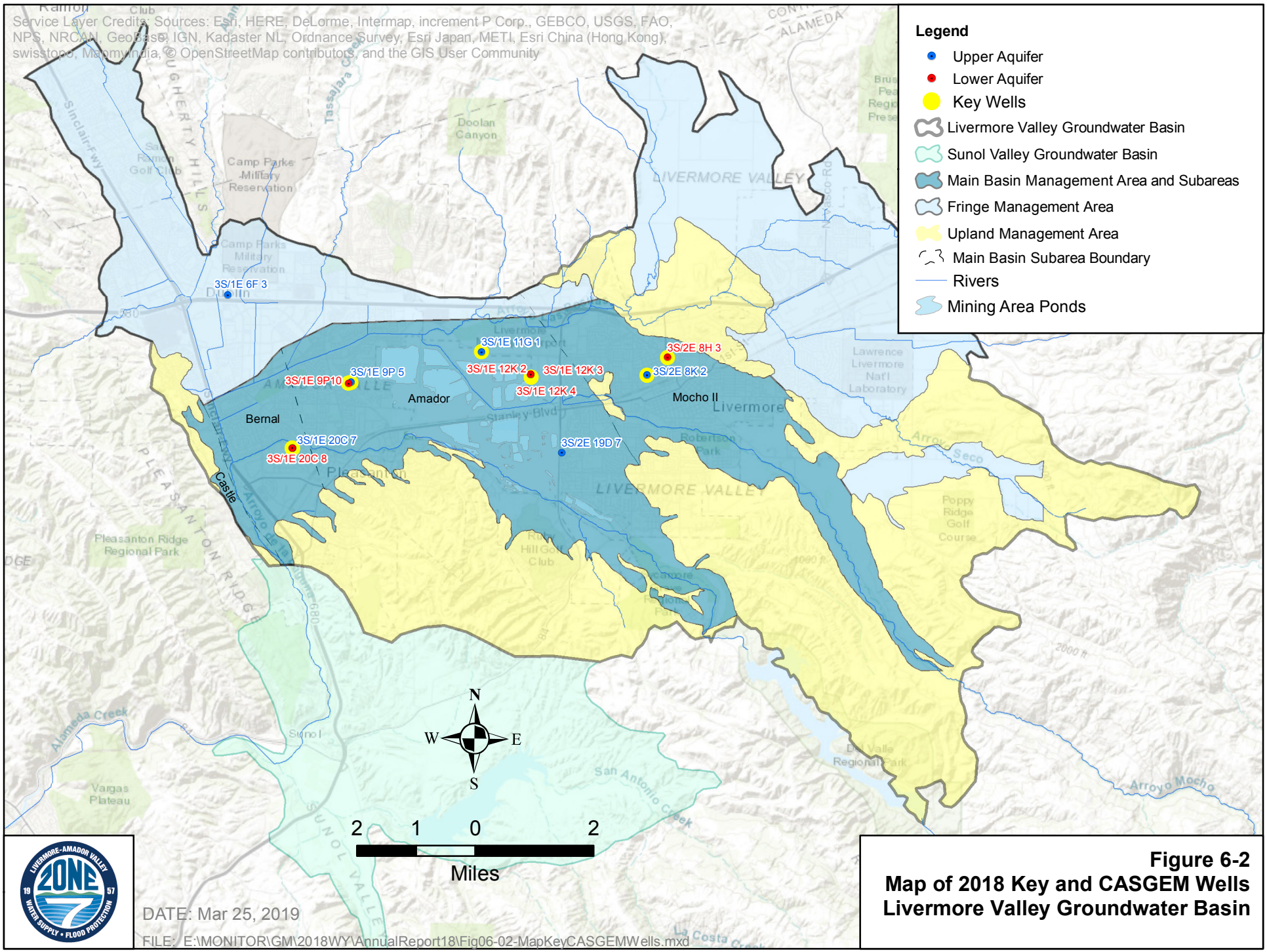
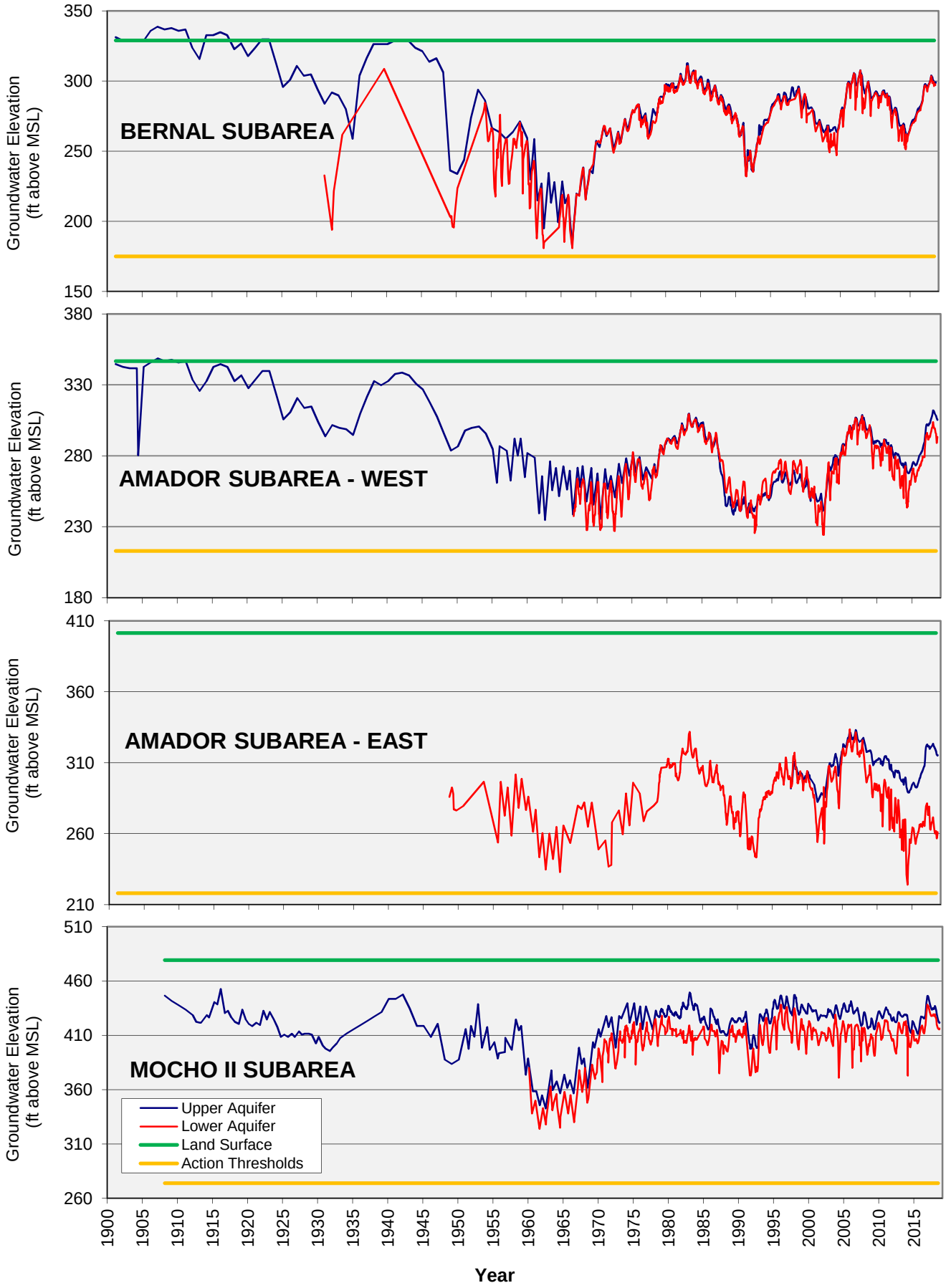


Figure 6-2
Map of 2018 Key and CASGEM Wells
Livermore Valley Groundwater Basin

FIGURE 6-3
HISTORICAL KEY WELL HYDROGRAPHS
1901 to 2018 WATER YEARS



LEGEND

2018 Program Wells (Upper Aquifer)
- Supply
- Monitor
- Nested
- Mining Pond
- Key Wells
- 2018 Contours (Interval = 10')
- Hatch pattern towards lower elevation
- Rivers

- Main Basin
- Fringe Management Area
- Upland Management Area
- Main Basin Subarea Boundary

Mining Area Ponds 2018
- Static (= groundwater elevation)
- Pumped From
- Pumped Into
- Clay-lined

- Township-Range Line

2S/1W · 2S/1E · 2S/2E · 3S/1W · 3S/1E · 3S/2E · 3S/3E

N W E S

0 2 4
Miles

DATE: Mar 25, 2019
FILE: E:\MONITOR\GM\2018WY\AnnualReport18\Fig06-04-GradientSpringUpper18.mxd

Figure 6-4
Groundwater Gradient Map
Upper Aquifer; Spring 2018 (April)
Livermore Valley Groundwater Basin

LEGEND

2018 Program Wells (Upper Aquifer)
- Supply
- Monitor
- Nested
- Mining Pond
- 2018 Contours (Interval = 10' or 20')
- Hatch pattern towards lower elevation
- Rivers

- Main Basin
- Fringe Management Area
- Upland Management Area
- Main Basin Subarea Boundary

Mining Area Ponds 2018
- Static (= groundwater elevation)
- Pumped From
- Pumped Into
- Clay-lined
- Township-Range Line

2S/1W 2S/2E 2S/1E 3S/1W 3S/3E 3S/1E 3S/2E

N W E S

0 2 4
Miles

DATE: Mar 26, 2019
FILE: E:\MONITOR\GM\2018WY\AnnualReport18\Fig06-05-GradientFallUpper18.mxd

Figure 6-5
Groundwater Gradient Map
Upper Aquifer; Fall 2018 (September)
Livermore Valley Groundwater Basin

LEGEND

- Elevation Difference (ft)
- < -45
- -45 to -35
- -35 to -25
- -25 to -15
- -15 to -5
- -5 to 5
- 5 to 15
- 15 to 25
- 25 to 35
- 35 to 45
- 45 to 55
- Main Basin
- Fringe Management Area
- Upland Management Area
- Main Basin Subarea Boundary
- Livermore Valley Groundwater Basin

FRINGE SUBAREA - NORTH

UPLAND SUBAREA

FRINGE SUBAREA - NORTHEAST

UPLAND SUBAREA

MAIN BASIN

FRINGE SUBAREA - EAST

UPLAND SUBAREA

UPLAND SUBAREA

UPLAND SUBAREA

N

W E

S

0 2 4

Miles

DATE: Mar 25, 2019

FILE: E:\MONITOR\GM\2018WY\AnnualReport18\Fig06-06-ChangeGradientUpper18.mxd

Figure 6-6
Change in Groundwater Elevation
Upper Aquifer; Fall 2017 to Fall 2018
Livermore Valley Groundwater Basin

LEGEND

Groundwater Basin Regions

- Main Basin
- Fringe Area
- Upland Area
- Main Basin Subarea Boundary

Depth to Groundwater (ft)

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- 80 - 90
- 90 - 100
- 100 - 110
- 110 - 120
- 120 - 130
- 130 - 140
- 140 - 150
- Rivers

N
W E
S

0 2 4
Miles

DATE: Mar 25, 2019
FILE: E:\MONITOR\GM\2018WY\AnnualReport18\Fig06-07-DepthToUpperGWTable.mxd

Figure 6-7
Depth to Groundwater
Upper Aquifer; Fall 2018 (September)
Livermore Valley Groundwater Basin

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadas NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

ABBREVIATIONS FOR MUNICIPAL WELLS
COL = Chain of Lakes (Zone 7)
M = Mocho (Zone 7)
H = Hopyard (Zone 7)
St = Stoneridge (Zone 7)
CWS = Cal Water Service
P = Pleasanton
SF = San Francisco Public Utilities Commission

LEGEND

2018 Program Wells (Lower Aquifer)
- Supply
- Monitor
- Municipal
- Nested
- Mining Pond
- Key Wells
- 2018 Contours (Interval = 10')
- Hatch pattern towards lower elevation
- Rivers

- Main Basin
- Fringe Management Area
- Upland Management Area
- Main Basin Subarea Boundary

Mining Area Ponds 2018
- Static (= groundwater elevation)
- Pumped From
- Pumped Into
- Clay-lined
- Township-Range Line

3S/1W 2S/1W 2S/1E 3S/1E 3S/2E 3S/3E

N W E S

0 4,000 8,000
Feet

DATE: Mar 25, 2019
FILE: F:\MONITOR\GM\2018WY\AnnualReport18\Fig06-08-GradientSpringLower18.mxd

Figure 6-8
Groundwater Gradient Map
Lower Aquifer; Spring 2018 (April)
Livermore Valley Groundwater Basin

ABBREVIATIONS FOR MUNICIPAL WELLS
COL = Chain of Lakes (Zone 7)
M = Mocho (Zone 7)
H = Hopyard (Zone 7)
St = Stoneridge (Zone 7)
CWS = Cal Water Service
P = Pleasanton
SF = San Francisco Public Utilities Commission

LEGEND

2018 Program Wells (Lower Aquifer)
- Supply
- Monitor
- Municipal
- Nested
- Mining Pond
- Key Wells
- 2018 Contours (Interval = 10')
- Hatch pattern towards lower elevation
- Rivers
- Main Basin
- Fringe Management Area
- Upland Management Area
- Main Basin Subarea Boundary

Mining Area Ponds 2018
- Static (= groundwater elevation)
- Pumped From
- Pumped Into
- Clay-lined
- Township-Range Line

3S/1W
3S/1E
3S/2E
3S/3E

N
W
E
S

0 4,000 8,000
Feet

DATE: Mar 25, 2019
FILE: F:\MONITOR\GM\2018WY\AnnualReport18\Fig06-09-GradientFallLower18.mxd

Figure 6-9
Groundwater Gradient Map
Lower Aquifer; Fall 2018 (September)
Livermore Valley Groundwater Basin

LEGEND

Elevation Difference (ft)
- < -45
- -45 to -35
- -35 to -25
- -25 to -15
- -15 to -5
- -5 to 5
- 5 to 15
- 15 to 25
- 25 to 35
- 35 to 45
- 45 to 55

Liv Valley Sub Regions
- Main Basin
- Fringe Area
- Upland Area
- Main Basin Subarea Boundary
- Municipal Supply Wells

FRINGE SUBAREA - NORTH

UPLAND SUBAREA

MAIN BASIN

FRINGE SUBAREA - NORTHEAST

FRINGE SUBAREA - EAST

UPLAND SUBAREA

UPLAND SUBAREA

UPLAND SUBAREA

N

W E

S

0 4,000 8,000

Feet

DATE: Mar 28, 2019

FILE: F:\MONITOR\GM\2018WY\AnnualReport18\Fig06-10-ChangeGradientLower18.mxd

Figure 6-10
Change in Groundwater Elevation
Lower Aquifer; Fall 2017 to Fall 2018
Livermore Valley Groundwater Basin

LEGEND

Feet Above Historic Lows

- < -10
- -10 - 0
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80
- 81 - 90
- 91 - 100
- 101 - 110
- 111 - 120
- 121 - 130
- 131 - 140
- 141 - 150
- 151 - 160
- >160

LEGEND

2018 Program Wells (Lower Aquifer)

With Elevation Above Historic Low (ft)

- Supply
- Monitor
- Municipal
- Nested
- Mining Pond
- Township-Range Line

Livermore Valley Regions

- Main Basin
- Fringe Management Area
- Upland Management Area
- Main Basin Subarea Boundary

Mining Area Ponds

- Static (= groundwater elevation)
- Pumped From
- Pumped Into
- Clay-lined

N

W E

S

0 4,000 8,000

Feet

DATE: Mar 26, 2019

FILE: E:\MONITOR\GM\2018WY\AnnualReport18\Fig06-11-AboveHL18.mxd

Figure 6-11
Water Levels Above Historic Lows
Lower Aquifer; Fall 2018 (September)
Livermore Valley Groundwater Basin

7 Groundwater Quality

7.1 Program Description

7.1.1 Monitoring Network

Groundwater quality is an important factor in achieving and maintaining a sustainable groundwater resource. Correcting existing and legacy groundwater quality issues is a slow process and can sometimes take decades to achieve the groundwater quality goals. The main purpose of monitoring groundwater quality is to assure that remediation of past groundwater degradation is proceeding, and that no new degradation has occurred or is occurring. Details regarding Zone 7's groundwater quality monitoring network are provided in *Section 4.6*, *Groundwater Quality Monitoring*, of the Alternative GSP. The groundwater monitoring program conducts annual sampling and analysis for inorganic constituents-of-concern for meeting the Livermore Valley Groundwater Basin (Basin) groundwater quality objectives. The primary constituents-of-concern include: total dissolved solids (TDS), nitrate, boron, and total chromium. The following is a summary of the groundwater quality objectives and minimum thresholds for these constituents-of-concern.

- TDS (Main Basin): 500 mg/L, (State secondary maximum contaminant level [MCL], recommended range)
- TDS (Fringe Areas): 1,000 mg/L, (State secondary MCL, upper range)
- Nitrate (as N): 10 mg/L (State primary MCL)
- Boron: 1.4 mg/L (1,400 micrograms per liter [µg/L]) (an agricultural and human health target)
- Total Chromium (Cr): 0.05 mg/L (50 µg/L) (State primary MCL)

The water quality objective (WQO) and minimum threshold for Cr in the Livermore Valley Basin was changed from 10 µg/L Hexavalent Chromium (CrVI) to 50 µg/L Total Cr in the 2017 WY when the State withdrew the MCL for CrVI returned to regulating it through the previously established MCL for Total Cr (50 µg/L).

As shown in *Figure 7-1*, Zone 7 maintains a robust monitoring network of 222 wells that are sampled at least annually for water quality analyses. Each well in the program was sampled to fulfill one or more specific monitoring objectives. *Table 7-1* lists all of the wells in the routine sampling program, the represented subbasin and aquifer, the frequency of sampling, and any other programs that are satisfied by their sampling. Additional well construction details for each of the wells in the program are provided in *Table 6-2*.

7.1.2 Program Changes for the Water Year

The Sampling Program changes made in the 2018 WY involved the same monitoring well removals and additions identified in Section 6.1.2 for the Groundwater Elevation Program, and repeated below in Table 7-A.

Table 7-A: Program Wells Changes during the Water Year

Action	Reason
Well 3S/1E 7M2 was removed from program	Well was destroyed during land use change
Well 3S/3E 7M2 was removed from program	Very difficult to sample
Well 3S/2E 19N 3 was added to Lower Aquifer	New mining area monitoring well installed
Well 3S/2E 19N 4 was added to Lower Aquifer	New mining area monitoring well installed

In addition, monitoring well 3S/1E 23J 1 was reclassified as a lower aquifer well as discussed in *Section 6.1.2*. For the 2018 WY, California Water Service (CWS) only provided nitrate results for their CWS municipal supply wells in Livermore. Zone 7 will try to re-establish routine annual sampling and reporting of all the constituents-of-concern for the CWS wells in 2019 WY.

7.2 Results for the 2018 Water Year

7.2.1 Introduction

Concentrations and spatial distribution of the constituents tracked by Zone 7 are presented in the following figures and tables:

- *Table 7-2* contains the groundwater quality results from groundwater samples collected for the Groundwater Quality Program during the 2018 WY.
- *Figure 7-2* shows historical graphs of TDS concentrations in the eight Key Wells.
- *Figure 7-3* through *Figure 7-10* are maps of TDS, nitrate, boron, and total Cr concentrations for the Upper and Lower Aquifers.
- *Figure 7-11* through *Figure 7-14* are groundwater hydro-chemographs showing time-series trends of TDS, nitrate, and boron concentrations with respect to groundwater levels for select wells in each of the major subareas.

7.2.2 Total Dissolved Solids

7.2.2.1 Upper Aquifer Zone

TDS concentrations in groundwater in the Upper Aquifer Zone are influenced by the volume, TDS concentration, and proximity of recharging waters; leaching of salts from subsurface sediments and bedrock; and vadose zone thickness. Over the last 40 years there has been a general upward trend in TDS concentrations, principally in the western portion of the Main Basin. Concentrations in the eastern and central portions of the valley have stayed relatively low, especially during times of significant stream recharge.

During the 2018 WY, the TDS concentrations in groundwater were lowest in the areas adjacent to the Arroyo Valle and the Arroyo Mocho, where they were generally less than 500 mg/L. There continues to be two main areas of the groundwater basin where TDS concentrations exceed 1,000 mg/L in the Upper Aquifer Zone (*Figure 7-3)*:

- In the southern portion of the North Fringe Subarea, extending into the northwestern Main Basin subareas. This high TDS area is most likely due to the combination of the concentrating effects of urban irrigation, leaching of buried lacustrine and marine sediments, recharge of poor quality water from Arroyo Las Positas (APL), and legacy wastewater and sludge disposal practices in the Pleasanton and Livermore areas.
- In the eastern portion of the Northeast Fringe Subarea. This high-TDS area is likely due to poor quality water that runs off of the marine sediments on the east and north of the groundwater basin and recharges the basin along the hill-fronts.

7.2.2.2 Lower Aquifer Zone

Water from the Lower Aquifer Zone is generally of good quality. The Basin Objective (BO) and minimum threshold of 500 mg/L is met in the central portion of the Main Basin. Around the margins of the Main Basin, TDS concentrations are slightly higher, generally ranging from 500 mg/L to 700 mg/L in the 2018 WY (see *Figure 7-4*). The distribution of TDS concentrations is likely caused by deep percolation of low-TDS surface waters in the central portion and higher TDS water being pulled laterally and downward from the North Fringe Subarea and the Upper Aquifer by the municipal pumping occurring in the Lower Aquifer in Pleasanton.

Many of the municipal supply wells in the Pleasanton area produced water having TDS concentrations greater than the minimum threshold of 500 mg/L during 2018 WY. The highest TDS concentrations were detected in samples collected from two Zone 7 supply wells in the Mocho wellfield (1,010 mg/L in Mocho 3 and 1,026 mg/L in Mocho 4) and a monitoring well located central to four active wellfields used for municipal and public supply (1,284 mg/L in 3S/1E 17B4). The source of these high TDS concentrations is believed to be the Upper Aquifer Zone, which has TDS concentrations as high as 2,000 mg/L in the same area directly above the Mocho well completions. When the Mocho wells are pumped, a very large vertical gradient is created between the Upper and Lower Aquifer Zones, inducing flow between the two zones. The sealing of three onsite abandoned cross-zoned wells in 2013 does not

appear to have slowed the rising TDS trend observed in the Mocho wells. Zone 7 has the ability to strip and export much of the salts from the water produced by the Mocho wells with its onsite groundwater demineralization facility (MGDP) which it plans to use more in 2019 WY. See *Section 13.4.2.3* for details on the MGDP's use in the 2018 WY. Other planned corrective actions and strategies are described in *Section 5.3.3.2, Salt Management Strategy of the Alternative GSP*. Additionally, Zone 7 plans to continue investigating the potential path(s) of the TDS migration to the wells and possible resolutions for the matter.

7.2.3 Nitrates

7.2.3.1 Upper Aquifer Zone

Nitrate occurrences within the Livermore Groundwater Basin, as well as its nitrate loading and assimilative capacity, were studied as part of Zone 7's Nutrient Management Plan (NMP) (*Zone 7, 2015*). The NMP was approved by the RWQCB in 2016 and submitted as part of the Alternative GSP later that year. The complete NMP is also available on the Zone 7 website (www.Zone7water.com).

The NMP identified 10 local high nitrate Areas of Concern (AOCs) where nitrate concentrations persist above the BO and minimum threshold (*Figure 7-5)*. Also, the NMP commits Zone 7 to monitoring the conditions in these AOC's and promoting Best Management Practices (BMPs) that lead to reductions in nutrient loading. The following are the nitrate monitoring results for the 10 AOCs during the 2018 WY.

- **Bernal**—This AOC is based on nitrate concentrations from one well (3S/1E 22D 2) in the southern portion of the Upper Aquifer of the Amador West Subarea. The long-term trend of concentrations in this well has been slowly declining. In the 2018 WY, the concentration was just above the MCL of 10 mg/L at 10.7 mg/L (8.41 mg/L for the 2017 WY).
- **Staples Ranch**—This AOC is in the eastern portion of the northern Fringe Basin. It extends westward from monitoring well 3S/1E 2M 3 (14.8 mg/L in 2018 WY and 15.3 mg/L in 2017 WY) along the Main Basin boundary. A second area of elevated concentrations in this AOC exists to the west near Tassajara Creek, however, for the 2018 WY and 2017 WY, nitrate concentrations in this area have dropped below the minimum threshold (9.09 mg/L in 2018 WY and 8.84mg/L in 2017 WY, both in 3S/1E 5K 6).
- **Jack London**—This AOC extends from the eastern portion of the Mocho II Subarea to the northeastern portion of the Amador Subarea. Several wells in the Upper Aquifer have consistently had nitrate concentrations above the MCL. The highest concentration detected in the 2018 WY was 19.6 mg/L in 3S/1E 2R 1, whereas 36.7 mg/L was detected in 3S/1E 12A 2 in the 2017 WY.
- **Constitution**—This AOC exists near the boundary of the Mocho II, Camp, and Amador Subareas, and is up-gradient from the Las Positas Golf Course in Livermore. Nitrate concentrations were detected above the MCL in 3S/1E 1H 3, at 17 mg/L during the 2018 WY (19.2 mg/L in 2017 WY).
- **May School**—Historically, the nitrate concentration in this AOC has been characterized annually by the results of a single monitoring well (2S/2E 28D 2); however, the associated nitrate plume

has been further delineated by historical data from several domestic supply wells located in the Bel Roma neighborhood. For the 2018 WY, only 2S/2E 28D 2 was sampled. The result was 25.9 mg/L versus 29.7 mg/L in the 2017 WY.

- **Charlotte Way**—This AOC exists in the western portion of the Mocho I Subarea, and may commingle with the Buena Vista AOC in the eastern portion of the Mocho II Subarea. Elevated nitrate concentrations have been typically detected in three monitoring wells in this AOC. However, in the 2018 WY, only two of the three samples exceeded the minimum threshold; 13.5 mg/L in 3S/2E 10F 3 and 12.4 mg/L in 3S/2E 14A 3 (12.7 mg/L and 8.8 mg/L in 2017 WY, respectively).

- **Buena Vista**—This nitrate plume is defined by several wells in the central and eastern portion of the Mocho II Subarea in both the Upper and Lower Aquifers. During the 2018 WY, the highest concentration was detected in the northeastern portion of the plume (18.9 mg/L in 3S/2E 10Q1, 12.0 mg/L in 2017); whereas, in 2017 WY, the highest concentration was detected in the southwest portion (18.7 mg/L in 3S/2E 15M 2, 13.1 mg/L in 2018 WY).

- **Greenville**—This Fringe Area East AOC is situated primarily along Tesla Road, east of Vasco Road. It is routinely characterized by the results of a single monitoring well (3S/2E 24A 1); however, the associated nitrate plume was further delineated during a study conducted during the 2015 WY (*Zone 7, 2016a*). In the 2018 WY, 3S/2E 24A 1 had a concentration of 28.3 mg/L (15.7 mg/L in 2017 WY).

- **Mines Road**—This AOC is monitored by a single well (3S/2E 26J 2) located in the Upper Aquifer in the southern portion of the Main Basin along Mines Road. Nitrate concentrations in this well have fluctuated widely, ranging from non-detect to a maximum of 21.4 mg/L in October 2011. For the 2018 WY, the nitrate concentration in 3S/2E 26J 2 was well below the MCL at 0.56 mg/L. (5.2 mg/L in 2017 WY)

- **Happy Valley**—Nitrate concentrations were not monitored in this Upland AOC in the 2018 WY; however, when studied in 2013 WY by Zone 7 and Alameda County Department of Environmental Health, the nitrate occurrences were found to have been stable.

7.2.3.2 Lower Aquifer Zone

In the Lower Aquifer, nitrate was only detected above the minimum threshold in the Buena Vista AOC during the 2018 WY *(Figure 7-6*).

- **Buena Vista**—The general location of this plume underlies the Buena Vista nitrate plume in the Upper Aquifer, suggesting that some of the nitrate in the Upper Aquifer has migrated into the Lower Aquifer. This plume also appears to have migrated towards, and possibly co-mingled with, the Jack London plume. In the 2018 WY, nitrate concentrations exceeded the minimum threshold in two monitoring wells (13.1 mg/L in 3S/2E 8H 3 and 10.3 mg/L in 3S/2E 16A 3). A couple of other wells, including two municipal supply wells located in the same AOC had nitrate concentrations that approached the minimum threshold (8.9 mg/L in CWS10 and 9.6 mg/L in CWS9).

7.2.4 Boron

7.2.4.1 Upper Aquifer Zone

Boron is a naturally occurring element typically found at very low concentrations in groundwater from the Basin. While there is no MCL for boron, the minimum threshold was set at 1,000 µg/L because when it is present at levels above 1,000 µg/L (or 2,000 µg/L, depending on the crop's sensitivity), it can harm some irrigated crops.

Boron exists at elevated concentrations in the Upper Aquifer in the following areas of the groundwater basin *(Figure 7-7*):

- There is a plume of elevated boron concentrations that extends along the boundary between the North Fringe Subarea and the Main Basin. This localized concentration of boron has been relatively stable for many years. The highest concentration measured in the 2018 WY (8,240 µg/L) was found near the center of this area in 3S/1E 4J 5 (compared to 9,200 µg/L in the 2017 WY).

- Elevated boron concentrations were also detected in parts of the Northeastern and Eastern Fringe Subareas. The highest concentration detected in these areas in the 2018 WY was detected at 31,900 µg/L in 2S/2E 27P 2 (compared to 30,900 µg/L in the 2017 WY).

The source of boron may be from natural alkali/marine sediments in the east, but this is unconfirmed. It should be noted that the boron detected in the western portion of the basin primarily occurs along the ALP and lower Arroyo Mocho. It is believed that this occurrence of elevated boron may be from high-boron groundwater in the eastern portion of the Valley that discharged into the ALP in the Springtown area and flowed downstream to the Arroyo Mocho, recharging groundwater along the way. The ALP has been a continuously flowing stream since the 1981 WY.

7.2.4.2 Lower Aquifer Zone

In general, boron is not a problem in the Lower Aquifer; detections are typically less than the 1,400 µg/L minimum threshold. However, boron was detected above 1,400 µg/L in four Lower Aquifer wells located in two separate municipal supply wellfields, and in one monitoring well located in southeastern Mocho II Subarea in the 2018 WY as follows (*Figure 7-8*).

- Boron was detected above the minimum threshold in two monitoring wells located in the Hopyard Wellfield in the Bernal Basin in the 2018 WY. It was detected at 2,480 µg/L in 3S/1E 17D 4 (compared to 2,600 µg/L in the 2017 WY) and 2,720 µg/L in 3S/1E 17D11 (compared to 2,400 µg/L in the 2017 WY). However, it has never been detected above 900 µg/L in either of the Hopyard municipal supply wells.

- Boron was detected above the minimum threshold in the Mocho Wellfield in the 2018 WY. It was found at 2,010 µg/L in the municipal supply well Mocho 3 and at 1,460 µg/L in Mocho 4.

This is the first time that concentrations of boron have been detected at greater than 2,000 µg/L in the Mocho Wellfield.

- Boron was detected in the Lower Aquifer monitoring well 3S/2E 23E 2, in the southeastern portion of the Mocho II Subarea, at 2,220 µg/L in 2018 WY (compared to 2,300 µg/L in the 2017 WY).

7.2.5 Chromium

7.2.5.1 Introduction

Chromium (Cr) is typically found at very low concentrations in groundwater from the Basin. It can be a naturally occurring element or an anthropogenic impact. Prior to August 2017, the BO and the minimum threshold in the *Alternative GSP* had been set at the MCL for CrVI, which was 10 µg/L. In August 2017, under orders of the Superior Court, the State Water Resources Control Board (SWRCB) withdrew the CrVI regulation from the California Code of Regulations. Until the SWRCB establishes a new MCL for CrVI, they have returned to using the more general total Cr MCL of 50 µg/L to ensure public water systems are safe. Since all of the minimum thresholds above have been set based on the State's drinking water standards, Zone 7 has adjusted the Alternative GSP's minimum threshold for Cr to match the State's Cr MCL that is currently in effect.

7.2.5.2 Upper Aquifer Zone

Cr concentrations exceeded the 50 µg/L threshold in one Upper Aquifer monitoring well during the 2018 WY sampling effort. Cr was detected at 69 µg/L in monitoring well 3S/2E 12C 4, which is located on the Lawrence Livermore National Laboratory (LLNL) site in the East Fringe Subarea (*Figure 7-9*). Samples from this well have typically exhibited high Cr values in the past (63 µg/L in the 2017 WY).

7.2.5.3 Lower Aquifer Zone

Cr was not detected above the MCL in any of the monitored Lower Aquifer wells. However, Cr was detected in several monitoring and production wells at greater than the former minimum threshold of 10 µg/L (*Figure 7-10*).

Because the locations of the slightly elevated Cr concentrations in the Lower Aquifer Zone do not coincide with those in the Upper Aquifer Zone, it is likely that the Cr in the Lower Aquifer Zone is not a result of vertical migration from the Upper Aquifer Zone. It may be the result of localized leaching of naturally occurring chromium-rich minerals in those portions of the Lower Aquifer Zone.

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TABLE 7-1
GROUNDWATER QUALITY PROGRAM
TABLE OF PROGRAM WELLS WITH SAMPLING FREQUENCY
2018 WATER YEAR

SITE INFORMATION				*Sampling Frequency*	*Other Programs*			
State Name	*Well Name*	*Subbasin*	*Aq*		*WR*	*Muni*	*SMP*	*NMP*
2S/1E 32E 1	End of Arnold Rd	Camp	U	A			T-HAC-1	
2S/1E 32N 1	Camp Parks	Camp	U	A			T-HAC-2	
2S/1E 32Q 1	Summer Glen Dr	Camp	U	A			32Q1	
2S/1E 33L 1	Gleason Dr @ Tassajara	Camp	U	A			33L1	
2S/1E 33P 2	Central Pkwy at Emerald Glen	Camp	U	A			33P2	
2S/1E 33R 1	Central Pkwy @ Grafton	Camp	U	A			T-DUB-1	
2S/1W 15F 1	BOLLINGER	Bishop	U	A				
2S/1W 26C 2	PINE VALLEY	Dublin	U	A				
2S/1W 36E 3	Kolb Park	Dublin	U	A			36E3	
2S/1W 36F 1	Dublin High shallow	Dublin	L	A				
2S/1W 36F 2	Dublin High mid	Dublin	L	A				
2S/1W 36F 3	Dublin High deep	Dublin	L	A				
2S/2E 27P 2	hartford ave east	Spring	U	A				
2S/2E 28D 2	May School	May	U	A			T-MAY-1	
2S/2E 28J 2	FCC Well	May	L	A				
2S/2E 28Q 1	hartford ave	May	U	A			T-MAY-2	
2S/2E 32K 2	jenson's N liv. Ave	Cayetano	U	A				
2S/2E 34E 1	Mud City	May	U	A			T-MAY-3	
2S/2E 34Q 2	Hollyhock & Crocus	Spring	U	A			T-SPR-2	
3S/1E 1F 2	Constitution Dr	Mocho II	U	A			T-AIR-1	
3S/1E 1H 3	Collier Canyon g1	Mocho II	U	Q			1H3	
3S/1E 1L 1	Kitty Hawk	Camp	U	A			T-AIR-2	
3S/1E 1P 2	Airport gas g5	Amador	U	A			T-AIR-3	
3S/1E 1P 3	New airport well	Amador	L	Q				
3S/1E 2J 2	Maint. Bldg	Camp	U	A			T-GLF-2	
3S/1E 2J 3	Doolan Rd East	Camp	U	A			T-GLF-1	
3S/1E 2K 2	Doolan Rd West	Camp	U	A			2K2	
3S/1E 2M 3	Friesman Rd North	Camp	U	A			T-FRI-1	
3S/1E 2N 6	Friesman Rd South	Amador	U	A			T-FRI-3	
3S/1E 2P 3	Crosswinds Church	Camp	L	A				
3S/1E 2Q 1	LPGC #1	Amador	U	A			T-GLF-3	
3S/1E 2R 1	Beebs	Amador	U	Q				
3S/1E 3G 2	fallon rd	Camp	U	A				
3S/1E 4A 1	SMP-DUB-2	Camp	U	A			T-DUB-2	
3S/1E 4J 5	Pimlico shallow	Camp	U	A			T-DUB-3	
3S/1E 4J 6	Pimlico deep	Camp	U	A			T-DUB-4	
3S/1E 4Q 2	gulfstream	Amador	U	A				
3S/1E 5K 6	Rosewood shallow	Camp	U	A				
3S/1E 5K 7	Rosewood deep	Camp	L	A				
3S/1E 5L 3	Oracle	Camp	U	A			T-HAC-3	
3S/1E 5P 6	Owens Park	Camp	U	A			T-HAC-4	
3S/1E 6F 3	Dublin Ct	Dublin	U	A			6F3	
3S/1E 6N 2	DSRSD MW-3	Dublin	U	A				
3S/1E 6N 3	DSRSD MW-4	Dublin	U	A				

Aq = Aquifer: U = Upper; L = Lower; D = Deep	Frequency: Q = Quarterly; SA = SemiAnnually; A = Annually
OTHER: WR = Water Rights; Muni = Municipal wells; Key = Key Wells; SMP = Salt Management Plan; NMP = Nutrient Management Plan	

SITE INFORMATION				Sampling Frequency	Other Programs			
State Name	Well Name	Subbasin	Aq		WR	Muni	SMP	NMP
3S/1E 6N 6	DSRSD NE-76	Dublin	U	A				
3S/1E 7B 2	Hopyard rd	Dublin	L	A				
3S/1E 7B12	Hacienda Arch	Dublin	U	A			T-CHA-1	
3S/1E 7D 1	DSRSD SW-75	Dublin	U	A				
3S/1E 7D 3	DSRSD SE-70	Dublin	U	A				
3S/1E 7G 7	Chabot Well	Dublin	U	A			T-CHA-2	
3S/1E 7J 5	Thomas Hart School	Dublin	U	A			T-CHA-3	
3S/1E 8B 1	Lizard Well	Amador	U	A			T-HAC-5	
3S/1E 8G 4	Apache	Amador	U	A			T-HAC-6	
3S/1E 8H 9	Mocho 4 Nested Shallow	Amador	L	A				
3S/1E 8H10	Mocho 4 Nested Middle	Amador	L	A				
3S/1E 8H11	Mocho 4 Nested deep	Amador	D	A				
3S/1E 8H13	Mocho 3 mon	Amador	D	A				
3S/1E 8H18	Mocho 4	Amador	L	Q				
3S/1E 8K 1	Cockroach well	Amador	U	A				
3S/1E 8N 1	sports park	Bernal	U	A				
3S/1E 9B 1	Stoneridge	Amador	L	Q				
3S/1E 9J 7	SW Lake I Shallow	Amador	U	A				
3S/1E 9J 8	SW Lake I Middle	Amador	L	A				
3S/1E 9J 9	SW Lake I Deep	Amador	L	A				
3S/1E 9M 2	Mocho 1	Amador	L	Q				
3S/1E 9M 3	Mocho 2	Amador	L	Q				
3S/1E 9M 4	Mocho 3	Amador	L	Q				
3S/1E 9P 5	Key_AmW_U (Mohr Key)	Amador	U	A				
3S/1E 9P 9	Mohr Ave Shallow	Amador	L	A				
3S/1E 9P10	Key_AmW_L	Amador	L	A				
3S/1E 9P11	Mohr Ave Deep	Amador	L	A				
3S/1E 10A 2	El C harro Rd	Amador	U	A				
3S/1E 10B 8	Kaiser Rd Shallow	Amador	L	A				
3S/1E 10B 9	Kaiser Rd Middle 1	Amador	L	A				
3S/1E 10B10	Kaiser Rd Middle 2	Amador	L	A				
3S/1E 10B11	Kaiser Rd Deep	Amador	D	A				
3S/1E 10B14	COL 5 Monitoring	AMADOR	L	A				
3S/1E 10B15	COL 5	Amador	L	Q				
3S/1E 10D 2	Stoneridge Shallow	Amador	L	A				
3S/1E 10D 3	Stoneridge Middle 1	Amador	L	A				
3S/1E 10D 4	Stoneridge Middle 2	Amador	L	A				
3S/1E 10D 5	Stoneridge Deep	Amador	D	A				
3S/1E 10K 2	NorthWest Cope Lake	Amador	L	A				
3S/1E 10K 3	COL 1	Amador	L	A				
3S/1E 11B 1	Airport West	Amador	U	Q			11B1	
3S/1E 11C 3	LAVWMA ROW	Amador	U	A			T-GLF-4	
3S/1E 11G 1	Key_AmE_U	Amador	U	A				
3S/1E 11G 2	Rancho Charro Middle 1	Amador	L	A				
3S/1E 11G 3	Rancho Charro Middle 2	Amador	L	A				
3S/1E 11G 4	Rancho Charro Deep	Amador	D	A				
3S/1E 11M 2	COL 2 Monitoring	Amador	L	A				
3S/1E 11M 3	COL 2	Amador	L	A				
3S/1E 11P 6	New Jamieson Residence	Amador	L	A				
3S/1E 12A 2	Airport South	Amador	U	Q			12A2	
3S/1E 12D 2	LWRP G6	Amador	U	Q				

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OTHER: WR = Water Rights; Muni = Municipal wells; Key = Key Wells; SMP = Salt Management Plan; NMP = Nutrient Management Plan

SITE INFORMATION				Sampling Frequency	Other Programs			
State Name	Well Name	Subbasin	Aq		WR	Muni	SMP	NMP
3S/1E 12G 1	Oaks Park Shallow	Amador	U	Q				
3S/1E 12H 4	LWRP Shallow	Amador	L	A				
3S/1E 12H 5	LWRP Middle 1	Amador	L	A				
3S/1E 12H 6	LWRP Middle 2	Amador	L	A				
3S/1E 12H 7	LWRP Deep	Amador	D	A				
3S/1E 12K 2	Oaks Park Mid	Amador	L	A				
3S/1E 12K 3	Key_AmE_L	Amador	L	A				
3S/1E 12K 4	Oaks Park Deep	Amador	D	A				
3S/1E 13P 5	LGA Grant Nested 1	Amador	U	A				
3S/1E 13P 6	LGA Grant Nested 2	Amador	L	A				
3S/1E 13P 7	LGA Grant Nested 3	Amador	L	A				
3S/1E 13P 8	LGA Grant Nested 4	Amador	L	A				
3S/1E 14B 1	Industrial Asphalt	Amador	L	A				
3S/1E 14D 2	South Cope Lake	Amador	L	A				
3S/1E 15J 3	shadow cliff	Amador	L	A				
3S/1E 15M 3	Bush/Valley South	Amador	L	A				
3S/1E 16A 2	Pleas 8	AmWest	L	A				
3S/1E 16A 4	Bush/Valley Mid	Amador	L	A				
3S/1E 16B 1	Bush/Valley North	Amador	D	A				
3S/1E 16C 2	Santa Rita Valley Shallow	Amador	L	A				
3S/1E 16C 3	Santa Rita Valley Middle	Amador	L	A				
3S/1E 16C 4	Santa Rita Valley Deep	Amador	L	A				
3S/1E 16E 4	black ave - cultural	Amador	U	A				
3S/1E 16L 2	Pleas 4	Amador	L	A				
3S/1E 16L 5	Pleas 5	Amador	L	A				
3S/1E 16L 7	Pleas 6	Amador	L	A				
3S/1E 16P 5	Vervais Monitor	Amador	U	SA	√			
3S/1E 17B 4	Casterson	Amador	L	A				
3S/1E 17D 3	Hopyard Nested Shallow	Bernal	L	A				
3S/1E 17D 4	Hopyard Nested Middle 1	Bernal	L	A				
3S/1E 17D 5	Hopyard Nested Middle 2	Bernal	L	A				
3S/1E 17D 6	Hopyard Nested Middle 3	Bernal	L	A				
3S/1E 17D 7	Hopyard Nested Deep	Bernal	D	A				
3S/1E 17D11	Hopyard 9 Monitoring Well	Bernal	L	A				
3S/1E 17D12	Hopyard 9	Bernal	L	Q				
3S/1E 18A 5	Pleas 7	Bernal	L	A				
3S/1E 18A 6	Hopyard 6	Bernal	L	Q				
3S/1E 18E 4	Valley Trails II	Bernal	U	A				
3S/1E 18J 2	camino segura	Bernal	U	A				
3S/1E 19A10	SFWD South (B)	Bernal	L	A				
3S/1E 19A11	SFWD North (A)	Bernal	L	A				
3S/1E 19C 4	del valle & laguna	Bernal	U	A				
3S/1E 19K 1	680/bernal	Bernal	U	A				
3S/1E 20B 2	Fairgrounds Potable	Bernal	L	A				
3S/1E 20C 3	Fairgrounds Potable Backup	Bernal	L	A				
3S/1E 20C 7	Key_Bern_U	Bernal	U	SA	√			
3S/1E 20C 8	Key_Bern_L	Bernal	L	A				
3S/1E 20C 9	Fair Nested Deep	Bernal	L	A				
3S/1E 20J 4	civic center	Bernal	U	A				
3S/1E 20M11	S.F "M"LINE	Bernal	U	A				
3S/1E 20Q 2	20Q2	Bernal	U	A			T-PLE-3	

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SITE INFORMATION				Sampling Frequency	Other Programs			
State Name	Well Name	Subbasin	Aq		WR	Muni	SMP	NMP
3S/1E 22D 2	vineyard trailer	Amador	U	A			T-BER-3	
3S/1E 23J 1	1627 vineyard trailer	Amador	L	A				
3S/1E 25C 3	Katz Winery Mansion	Amador	U	A				
3S/1E 29M 4	f.c. channel	Castle	U	A				
3S/1E 29P 2	castlewood dr	Bernal	U	A				
3S/1W 1B 9	DSRSD Shallow	Dublin	L	A				
3S/1W 1B10	DSRSD Middle	Dublin	L	A				
3S/1W 1B11	DSRSD Deep	Dublin	L	A			1B11	
3S/1W 1J 1	DSRSD MW-1	Dublin	U	A				
3S/1W 2A 2	McNamara's	Dublin	U	A			2A2	
3S/1W 12A 9	DSRSD NW-75	Dublin	U	A				
3S/1W 12B 2	Stoneridge Mall Rd	Dublin	U	A				
3S/1W 12J 1	DSRSD South	Dublin	U	A				
3S/1W 13J 1	muirwood dr	Castle	U	A				
3S/2E 1F 2	Brisa at Circuit City	Spring	U	A				
3S/2E 2B 2	south front rd	Spring	U	A				
3S/2E 3A 1	Bluebell	Spring	U	A			T-SPR-1	
3S/2E 3K 3	first & S. front rd	Mocho I	U	A			3K3	
3S/2E 5N 1	Spider Well	Mocho II	M	A				
3S/2E 7C 2	york way - jaws - G4	Mocho II	U	Q				
3S/2E 7H 2	dakota	Mocho II	U	A				
3S/2E 7N 2	Isabel & Arroyo Mocho	AmWest	L	A				
3S/2E 7P 3	CWS 24	Amador	L	A				
3S/2E 7R 3	CWS 31	Mocho II	L	A				
3S/2E 8F 1	CWS 10	Mocho II	L	A				
3S/2E 8G 1	CWS 19	Mocho II	L	A				
3S/2E 8H 2	North k	Mocho II	U	A				
3S/2E 8H 3	Key_Mo2_L	Mocho II	L	A				
3S/2E 8H 4	N Liv Ave Deep	Mocho II	L	A				
3S/2E 8K 2	Key_Mo2_U (Livermore Key)	Mocho II	U	A				
3S/2E 8N 2	CWS 14	Mocho II	L	A				
3S/2E 8P 1	CWS 8	Mocho II	L	A				
3S/2E 8Q 9	D-2	Mocho II	L	A				
3S/2E 9P 1	CWS 12	Mocho II	L	A				
3S/2E 9Q 1	CWS 9	Mocho II	L	A				
3S/2E 9Q 4	school st	Mocho II	U	A				
3S/2E 10F 3	hexcel	Mocho I	U	A				
3S/2E 10Q 1	almond	Mocho II	U	A				
3S/2E 10Q 2	LLNL W-703	Mocho II	L	A				
3S/2E 11C 1	joan way	Mocho I	U	A			11C1	
3S/2E 12C 4	LLNL W-486	Spring	U	A				
3S/2E 12J 3	LLNL W-017A	Spring	L	A				
3S/2E 14A 3	S. vasco @east ave	Mocho I	U	A				
3S/2E 14B 1	5763 east ave	Mocho I	L	A				
3S/2E 15E 2	Retzlaff Winery	Mocho II	L	A				
3S/2E 15L 1	Concannon 2	Mocho II	U	A				
3S/2E 15M 2	Concannon 1	Mocho II	U	A				
3S/2E 15R17	Buena Vista Shallow	Mocho II	U	A				
3S/2E 15R18	Buena Vista Deep	Mocho II	L	A				
3S/2E 16A 3	Memory Gardens	Mocho II	L	A				
3S/2E 16B 1	CWS 5	Mocho II	L	A				

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SITE INFORMATION				Sampling Frequency	Other Programs			
State Name	Well Name	Subbasin	Aq		WR	Muni	SMP	NMP
3S/2E 16C 1	CWS 15	Mocho II	L	A				
3S/2E 16E 4	pepper tree	Mocho II	U	A				
3S/2E 17E 2	Mocho Street	Mocho II	U	A				
3S/2E 18B 1	CWS 20	Amador	L	A				
3S/2E 18E 1	E. stanley	Amador	U	A				
3S/2E 19D 7	Isabel Shallow	Amador	U	A				
3S/2E 19D 8	Isabel Middle 1	Amador	L	A				
3S/2E 19D 9	Isabel Middle 2	Amador	L	A				
3S/2E 19D10	Isabel Deep	Amador	L	A				
3S/2E 19N 3	Shallow Cemex Nested	Amador	L	A				
3S/2E 19N 4	Deep Cemex Nested	Amador	L	A				
3S/2E 20M 1	Alden Lane	Amador	L	A				
3S/2E 22B 1	grapes	Mocho II	U	A				
3S/2E 23E 1	Mines Nested Shallow	Mocho II	U	A				
3S/2E 23E 2	Mines Nested Deep	Mocho II	L	A				
3S/2E 24A 1	S. greenville	Mocho I	U	A			24A1	
3S/2E 26J 2	mines rd	Mocho II	U	A				
3S/2E 29F 4	usgs wetmore	Amador	U	SA	√			
3S/2E 30C 1	Vineyard 30C 1	Amador	L	A				
3S/2E 30D 2	vineyard	Amador	U	A			T-VIN-3	
3S/2E 33G 1	Crohare	Amador	U	SA	√			
3S/2E 33K 1	VA	Amador	U	Q				
3S/2E 33L 1	VA/CROHARE FENCE	Amador	U	Q				
3S/3E 6Q 3	PPWTP South Monitoring	Altamont	U	A				
3S/3E 7D 2	7D 2	Spring	U	A				
			Totals:	**222**	**6**	**0**	**48**	**0**

Salt Management Plan (SMP) Designations

T-AIR = Airport Transect
T-BER = Bernal Transect
T-CHA = Chabot Transect
T-DUB = East Dublin Transect
T-FRI = Friesman Transect
T-HAC = Hacienda Transect
T-HV = Happy Valley Transect
T-LIV = South Livermore Transect
T-MAY = May Transect
T-PLE = Pleasanton Transect
T-RH = Ruby Hill Transect
T-SPR = Springtown Transect
T-VIN = Vineyard Transect
T-WEN = Wente Transect

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TABLE 7-2
WATER QUALITY RESULTS
2018 WATER YEAR

			TEMP	EC		Mineral Constituents (mg/L)									Select Metals (ug/L)				TDS	Hard
SITE ID	DATE	By	°C	umhos/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3N	SiO2	B	As	Fe	Cr	mg/L	mg/L
2S/1E 32E 1	12/6/17	ZONE7	-	1259	7.1	135	26	102	1.6	559	32	152	4.96	40.7	< 100	2.5	< 100	< 1	787	445
2S/1E 32N 1	4/26/18	ZONE7	19.8	1139	7.2	100	24	108	2	361	47	177	2.52	34.9	330	1.3	< 100	3.6	682	349
2S/1E 32Q 1	12/6/17	ZONE7	-	1649	7	139	51	150	2.5	659	60	220	4.24	32.1	490	1.1	< 100	3.9	998	558
2S/1E 33L 1	12/6/17	ZONE7	-	1262	7.1	99	36	121	2.6	503	47	166	5.38	30	290	1.3	< 100	5.3	774	396
2S/1E 33P 2	12/6/17	ZONE7	-	1845	7.3	132	57	166	3.2	576	92	310	7.04	21.4	730	< 1	< 100	5	1097	565
2S/1E 33R 1	12/6/17	ZONE7	-	758	7.6	64	19	67	1.6	288	20	94	3.17	25.7	110	2.4	< 100	11	448	239
2S/1W 15F 1	5/1/18	ZONE7	20.7	1551	7	162	60	79	1.3	648	42	184	< 0.1	27.2	< 500	< 5	< 500	< 5	875	652
2S/1W 26C 2	5/1/18	ZONE7	19.8	732	7	99	19	36	1.1	354	26	29	7.81	37.4	91	3.02	< 100	1.2	456	326
2S/1W 36E 3	5/1/18	ZONE7	19.5	978	7.1	133	26	54	0.8	389	93	74	5.13	47.7	100	4	< 100	< 1	643	439
2S/1W 36F 1	5/1/18	ZONE7	18.7	746	7.4	67	15	78	1.3	393	17	37	< 0.1	27.6	180	5.3	< 100	< 1	437	230
2S/1W 36F 2	5/1/18	ZONE7	19.3	881	7.6	40	15	125	1	390	< 1	98	< 0.1	28	486	150	290	< 1	500	162
2S/2E 27P 2	1/17/18	ZONE7	19.9	4670	7.6	83	42	861	3.3	216	< 1	1517	< 0.1	27.8	31900	< 1	520	< 1	2641	380
2S/2E 28D 2	1/17/18	ZONE7	19.3	1067	7.4	55	23	116	2.6	218	33	140	25.9	27.8	650	4.2	< 100	5.1	620	234
2S/2E 28J 2	9/24/18	ZONE7	-	967	8.4	5	4	179	0.8	382	56	87	< 0.1	20.5	1330	< 1	< 100	< 1	549	28
2S/2E 28Q 1	1/17/18	ZONE7	19.5	1127	7.9	44	31	148	1.5	366	97	148	1.22	34.2	680	11	< 100	< 1	691	236
2S/2E 32K 2	7/11/18	ZONE7	21.8	1100	7.6	40	35	117	2	342	67	129	2.81	40.7	550	5.8	< 100	9.3	612	245
2S/2E 34E 1	4/26/18	ZONE7	19.1	1391	8	22	19	234	1.5	355	96	216	< 0.1	32.1	1490	20	< 100	< 1	797	133
2S/2E 34Q 2	4/26/18	ZONE7	21.3	1589	7.6	78	66	188	1.7	263	133	412	1.22	39.2	2570	2.1	< 100	< 1	1053	467
3S/1E 1F 2	5/1/18	ZONE7	17.8	1320	7.1	114	45	124	1.4	524	45	167	3.33	52.9	201	3.5	< 100	1	822	470
3S/1E 1H 3	1/18/18	LWRP	-	1910	-	73	43	260	1.4J	-	78	245	17	32	1280.	-	-	-	1140	-
3S/1E 1H 3	5/9/18	LWRP	-	1880	-	74	46	280	1.4J	-	80	332	16.6	34	1230.	-	-	-	1110	-
3S/1E 1H 3	7/18/18	LWRP	-	1730	-	66	43	240	1.2	-	68	314	14.5	31	1090.	-	-	-	990	-
3S/1E 1L 1	7/11/18	ZONE7	26	1475	7.4	63	34	212	1.5	619	58	112	12.4	32.1	4050	3.7	< 100	6.7	873	297
3S/1E 1P 2	1/18/18	LWRP	-	1450	-	71	45	170	2.3J	-	85	184	0.7	23	3280.	-	-	-	870	-
3S/1E 1P 2	5/9/18	LWRP	-	1460	-	72	49	180	2.4J	-	88	244	0.5	25	3150.	-	-	-	870	-
3S/1E 1P 2	7/18/18	LWRP	-	1470	-	69	47	170	2.3	-	86	231	0.6	23	3230.	-	-	-	860	-
3S/1E 2J 2	5/1/18	ZONE7	19.1	2994	7.1	144	72	373	2.8	621	211	537	5.45	32.5	4425	3.3	< 100	7.2	1702	657
3S/1E 2J 3	5/1/18	ZONE7	20.5	1358	7.4	54	39	135	3.5	395	40	211	4.76	30.8	407	2.9	< 100	1.3	729	296
3S/1E 2K 2	5/1/18	ZONE7	19.5	1132	7.7	20	19	173	1.9	465	47	107	6.75	25.5	718	4.9	< 100	10.9	653	128
3S/1E 2M 3	7/11/18	ZONE7	21	2053	7.3	72	36	323	2.5	798	81	208	14.8	27.8	2770	2.4	< 100	18	1209	328
3S/1E 2N 6	7/11/18	ZONE7	18.4	1655	7.3	79	50	174	1.8	490	97	252	0.18	19.7	3140	2.2	< 100	< 1	916	402
3S/1E 2P 3	2/21/18	ZONE7	-	749	8.1	39	34	71	1.9	294	44	79	4.3	26.5	590	1.4	< 100	< 1	463	237
3S/1E 2Q 1	7/11/18	ZONE7	20.5	2071	7.5	110	59	212	5.3	512	122	332	4.97	20.3	2980	3.5	400	< 1	1135	518
3S/1E 2R 1	1/18/18	LWRP	-	2360	-	130	92	210	1.9J	-	100	331	19.6	28	3200.	-	-	-	1410	-
3S/1E 2R 1	5/9/18	LWRP	-	2310	-	140	100	240	1.8J	-	130	416	14.4	29	3650.	-	-	-	1410	-
3S/1E 2R 1	7/18/18	LWRP	-	2260	-	120	93	220	1.7	-	130	397	13.2	28	4000.	-	-	-	1340	-
3S/1E 3G 2	1/18/18	ZONE7	18.4	1312	7.4	47	26	192	2.1	599	27	152	0.18	19.3	1440	6.7	< 100	< 1	762	223
3S/1E 4A 1	1/18/18	ZONE7	20.7	1330	7.2	122	23	121	1.7	412	36	221	3.14	23.5	280	1.6	< 100	4.3	765	400
3S/1E 4J 5	1/18/18	ZONE7	18.8	2500	7.8	26	25	456	1.3	665	137	406	2.92	17.1	8240	11	< 100	< 1	1412	169
3S/1E 4J 6	1/18/18	ZONE7	18.4	1820	7.2	121	43	202	2.8	463	100	358	1.93	25.7	1630	< 1	< 100	< 1	1089	481
3S/1E 4Q 2	12/6/17	ZONE7	-	2096	7.4	92	87	234	1.9	600	108	393	4.22	23.5	3060	1.9	< 100	11	1255	588
3S/1E 5K 6	12/6/17	ZONE7	-	2001	7.4	145	56	218	2	652	229	242	9.09	21.2	1490	1.4	< 100	< 1	1276	592
3S/1E 5K 7	4/25/18	ZONE7	20	988	7.6	58	26	131	1.5	348	149	76	< 0.1	28.5	800	11	< 100	< 1	642	252
3S/1E 5L 3	4/25/18	ZONE7	21.8	1611	7.5	96	52	192	1.4	515	288	142	< 0.1	25.3	800	2.8	< 100	< 1	1051	454
3S/1E 5P 6	4/25/18	ZONE7	21.3	3757	7.2	262	160	330	2.2	524	1115	521	6.36	30.8	900	< 1	< 100	< 1	2707	1314
3S/1E 6F 3	5/8/18	ZONE7	21.2	4269	6.9	281	128	466	3.6	592	693	905	< 0.1	25.9	2893	< 5	< 500	< 5	2794	1228
3S/1E 7B 2	9/19/18	ZONE7	24.6	750	8.7	10	10	132	1.7	242	31	91	< 0.1	12	800	4.4	< 100	< 1	416	66
3S/1E 7B12	4/25/18	ZONE7	20	14310	7.1	543	400	2282	6.9	317	1671	4470	< 0.1	27.2	< 2000	< 20	< 2000	23	9556	3006
3S/1E 7G 7	7/12/18	ZONE7	20.9	18610	7	500	522	3000	10	455	2838	5296	< 0.1	19.9	4490	< 1	< 100	< 1	12410	3400
3S/1E 7J 5	4/25/18	ZONE7	21	2489	7.2	143	113	340	3.1	867	476	177	< 0.1	35.7	5390	< 5	< 500	< 5	1715	824

- = Not Analyzed; X = Suspect Result

TABLE 7-2
WATER QUALITY RESULTS
2018 WATER YEAR

			TEMP	EC		Mineral Constituents (mg/L)									Select Metals (ug/L)				TDS	Hard
SITE ID	DATE	By	°C	umhos/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3N	SiO2	B	As	Fe	Cr	mg/L	mg/L
3S/1E 8B 1	7/12/18	ZONE7	19.5	1607	7.3	71	61	161	1.9	519	149	184	0.98	25.7	2320	< 1	450	< 1	914	431
3S/1E 8G 4	3/19/18	ZONE7	20.2	2604	7.2	129	99	332	2.9	833	246	400	5	31.7	4510	< 1	< 100	2.2	1674	729
3S/1E 8H 9	3/19/18	ZONE7	19.3	1506	7.5	127	66	99	2.8	483	137	191	2.94	28.2	1060	< 1	< 100	2.5	903	588
3S/1E 8H10	3/19/18	ZONE7	19.5	1492	7.4	100	64	115	2.9	487	134	186	4.54	31.5	1080	< 1	< 100	3.9	894	514
3S/1E 8H11	3/19/18	ZONE7	19.7	1741	7.3	154	79	107	3.9	607	155	201	4.39	30	1260	< 1	< 100	3.6	1049	708
3S/1E 8H13	12/5/17	ZONE7	-	1689	7.2	138	72	103	4	582	151	206	3.46	25.7	1390	< 1	< 100	5.7	1002	642
3S/1E 8H18	10/3/17	ZONE7	19.9	1557	7.3	102	87	101	3.8	538	137	177	3.98	28	1230	< 1	< 100	3.6	919	613
3S/1E 8H18	2/5/18	ZONE7	19.5	1622	7.3	151	69	117	3.6	552	125	198	4.23	32.5	1460	< 1	< 100	4.2	987	660
3S/1E 8H18	4/11/18	ZONE7	19.3	1706	7.2	134	82	109	3.8	589	148	209	4.2	30.8	1090	< 1	< 100	2.7	1026	672
3S/1E 8H18	7/9/18	ZONE7	19.8	1588	7.4	122	74	111	3.8	572	142	198	4.23	32.1	1440	< 1	< 100	3.8	984	610
3S/1E 8K 1	12/5/17	ZONE7	-	1712	7.2	141	124	92	3.7	694	276	171	2.35	27.8	1120	< 1	< 100	6.3	1188	862
3S/1E 8N 1	12/5/17	ZONE7	-	2319	7	194	131	123	4.3	852	399	204	8.05	30	1390	< 1	< 100	5.9	1541	1025
3S/1E 9B 1	10/16/17	ZONE7	-	922	7.5	47	61	60	2.1	349	53	93	3.72	25.7	460	< 1	< 100	5.5	531	371
3S/1E 9B 1	4/10/18	ZONE7	19	971	7.5	68	54	52	2.2	362	61	100	3.59	28.2	390	1.3	< 100	5.1	561	393
3S/1E 9B 1	7/9/18	ZONE7	20	822	7.7	56	43	49	2.1	324	52	80	3.42	30	410	1.2	< 100	6.6	488	317
3S/1E 9J 7	12/5/17	ZONE7	-	929	7.4	49	44	72	2.6	292	55	130	< 0.1	16.3	630	< 1	< 100	< 1	513	304
3S/1E 9J 8	6/12/18	ZONE7	18.5	853	7.3	87	39	33	1.9	301	49	117	1.37	21.4	330	< 1	< 100	5	503	379
3S/1E 9J 9	6/12/18	ZONE7	19.5	678	7.3	51	45	23	1.6	296	44	57	3.76	27.8	240	< 1	< 100	9.2	412	313
3S/1E 9M 2	10/5/17	ZONE7	18.8	1109	7.3	56	62	109	2.3	387	61	149	3.11	24.4	1040	< 1	< 100	3.1	669	397
3S/1E 9M 2	2/28/18	ZONE7	17.3	1112	7.4	66	61	83	2.4	368	64	150	2.82	28.9	900	< 1	< 100	2.7	650	413
3S/1E 9M 2	4/11/18	ZONE7	17.4	1165	7.2	67	57	86	2.2	391	63	148	3.1	29.1	1100	< 1	< 100	4.5	659	403
3S/1E 9M 2	7/11/18	ZONE7	17.8	1178	7.6	63	56	81	2.3	392	67	146	3.15	27.8	1090	< 1	150	3.6	651	390
3S/1E 9M 3	10/5/17	ZONE7	17.5	1207	7.3	89	67	96	2.5	407	97	166	2.15	21.6	1030	< 1	< 100	3.7	749	498
3S/1E 9M 3	8/7/18	ZONE7	18	1351	7.3	99	65	81	2.7	441	108	179	2.28	23.5	1280	< 1	120	4.5	786	516
3S/1E 9M 4	2/5/18	ZONE7	18	1641	7.2	109	82	141	3.2	576	134	208	3.94	31.2	2010	< 1	< 100	4.9	1010	610
3S/1E 9M 4	4/11/18	ZONE7	17.9	1634	7.2	110	69	126	3.3	588	116	199	3.59	28.9	1500	< 1	< 100	3.4	959	560
3S/1E 9P 5	6/12/18	ZONE7	20.4	749	7.1	58	28	62	2.6	243	53	104	0.42	20.8	680	< 1	< 100	1.3	4500	260
3S/1E 9P 9	1/30/18	ZONE7	-	1132	7.2	74	44	80	3	342	72	143	0.92	21.4	940	< 1	< 100	2.3	610	366
3S/1E 9P10	1/30/18	ZONE7	-	794	7.3	66	32	41	1.9	259	52	94	1.89	21.4	380	< 1	< 100	3.9	4450	297
3S/1E 9P11	1/30/18	ZONE7	-	993	7.4	67	61	31	2.1	374	48	102	3.94	27.8	280	< 1	< 100	12	541	419
3S/1E 10A 2	6/12/18	ZONE7	19.7	1794	7.2	75	74	192	2.8	658	122	269	9.33	32.1	3010	< 1	< 100	4.3	1132	492
3S/1E 10B 8	6/12/18	ZONE7	19.4	1577	7.3	80	80	122	2.5	568	96	182	8.39	30	2810	1.3	< 100	12	910	530
3S/1E 10B 9	6/12/18	ZONE7	19.7	1161	7.5	63	64	76	2.4	412	66	133	7.4	27.8	1290	< 1	< 100	6.7	668	422
3S/1E 10B10	6/12/18	ZONE7	20.1	683	7.4	48	43	37	1.7	296	46	62	3.82	30	380	< 1	< 100	7.8	431	297
3S/1E 10B11	9/10/18	ZONE7	20	970	7.6	64	49	61	2.3	341	48	101	6.27	32.1	940	1.3	< 100	4.7	553	362
3S/1E 10B14	9/17/18	ZONE7	19.2	665	7.6	53	41	28	1.7	287	37	47	4.51	30	270	< 1	< 100	8.4	399	301
3S/1E 10B15	10/3/17	ZONE7	18.9	718	7.4	48	46	33	1.9	309	42	50	4.01	27.8	340	< 1	< 100	9.4	419	308
3S/1E 10B15	2/5/18	ZONE7	18.4	703	7.8	56	40	35	1.8	287	41	50	4	31	360	< 1	< 100	12	414	304
3S/1E 10B15	4/9/18	ZONE7	19	707	7.6	52	42	32	1.8	313	40	47	3.83	29.1	300	< 1	< 100	11	415	302
3S/1E 10B15	7/9/18	ZONE7	19.7	675	7.7	48	41	32	1.8	307	40	45	4.07	30	330	< 1	< 100	12	408	289
3S/1E 10D 2	7/12/18	ZONE7	19.1	1449	7.5	60	63	115	2	457	103	176	7.28	27.8	1680	2.9	< 100	4.8	805	411
3S/1E 10D 3	7/12/18	ZONE7	19.3	1243	7.5	75	72	74	2.4	462	70	146	9.38	25.7	1150	1.1	< 100	7.2	735	485
3S/1E 10D 4	7/12/18	ZONE7	20	759	7.5	48	40	44	1.7	291	47	78	3.98	27.8	440	< 1	< 100	11	448	285
3S/1E 10D 5	9/18/18	ZONE7	17.6	633	7.5	50	36	33	2	280	35	41	5.19	32.1	240	< 1	< 100	7.5	390	273
3S/1E 10K 2	9/10/18	ZONE7	20.1	961	7.3	85	46	42	1.9	322	44	134	0.98	23.5	530	< 1	< 100	2.1	539	402
3S/1E 10K 3	10/5/17	ZONE7	18.1	819	7.4	54	56	46	2	320	43	84	3.63	21.8	360	< 1	< 100	5.7	481	364
3S/1E 10K 3	2/5/18	ZONE7	17.1	836	7.5	65	49	38	1.9	317	45	90	3.66	27.8	380	< 1	< 100	6.8	489	365
3S/1E 10K 3	4/9/18	ZONE7	17.3	852	7.5	62	51	35	1.9	325	50	88	3.36	25.5	320	< 1	< 100	5.3	489	365
3S/1E 10K 3	7/9/18	ZONE7	18	826	7.6	61	49	37	1.9	325	48	95	3.56	27.8	400	< 1	< 100	6.6	496	354
3S/1E 11B 1	1/18/18	LWRP	-	1790	-	68	60	220	1.1J	-	95	182	10.8	29	3300.	-	-	-	1080	-

- = Not Analyzed; X = Suspect Result

TABLE 7-2
WATER QUALITY RESULTS
2018 WATER YEAR

			TEMP	EC		Mineral Constituents (mg/L)									Select Metals (ug/L)				TDS	Hard
SITE ID	DATE	By	°C	umhos/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3N	SiO2	B	As	Fe	Cr	mg/L	mg/L
3S/1E 11B 1	5/9/18	LWRP	-	1780	-	73	68	240	1.2J	-	96	249	10.2	30	4050.	-	-	-	1070	-
3S/1E 11B 1	7/18/18	LWRP	-	1790	-	70	65	230	1.2	-	100	246	10.8	29	5950.	-	-	-	1080	-
3S/1E 11C 3	9/19/18	ZONE7	18.8	1747	7.2	84	63	203	1.8	555	90	258	4.09	24.6	2890	3.1	< 200	< 2	1016	470
3S/1E 11G 1	9/10/18	ZONE7	20.6	1294	7.1	78	100	77	3	538	66	137	13.9	40.7	1200	< 1	< 100	4.8	8280	607
3S/1E 11G 2	9/10/18	ZONE7	29.9	781	7.6	57	48	45	2.2	356	46	56	4.31	32.1	490	1	< 100	12	481	340
3S/1E 11G 3	9/10/18	ZONE7	21.5	645	7.4	50	44	26	1.7	302	39	45	4	32.1	270	< 1	< 100	9.9	404	306
3S/1E 11G 4	9/10/18	ZONE7	24.2	674	7.7	47	39	38	2.1	329	40	29	2.8	30	310	1.1	< 100	15	400	279
3S/1E 11M 2	9/17/18	ZONE7	19.4	805	7.4	53	48	43	2	301	46	90	3.92	21.2	420	< 1	< 100	3.3	469	330
3S/1E 11M 3	10/3/17	ZONE7	18.8	719	7.3	49	44	27	1.7	285	43	59	4.31	24.4	270	< 1	< 100	6.7	408	304
3S/1E 11M 3	2/5/18	ZONE7	17.8	708	7.5	57	41	31	1.6	278	42	62	4.42	28	290	< 1	< 100	7.4	419	313
3S/1E 11M 3	4/9/18	ZONE7	18.1	770	7.5	59	45	33	1.8	314	44	63	4.66	25.7	310	< 1	< 100	6.9	447	333
3S/1E 11M 3	7/9/18	ZONE7	19.1	715	7.6	55	43	31	1.7	291	43	61	4.43	27.8	320	< 1	< 100	7.6	426	315
3S/1E 11P 6	8/6/18	ZONE7	20.1	731	7.4	69	35	35	1.7	263	56	96	1.14	18.4	370	< 1	< 100	2.9	446	316
3S/1E 12A 2	1/18/18	LWRP	-	1350	-	76	100	67	3.2J	-	74	108	13.2	35	770.	-	-	-	820	-
3S/1E 12A 2	5/9/18	LWRP	-	1340	-	74	110	68	3.5J	-	78	138	13.2	35	710.	-	-	-	890	-
3S/1E 12A 2	7/18/18	LWRP	-	1350	-	72	100	66	3.4	-	81	137	13.1	34	480.	-	-	-	800	-
3S/1E 12D 2	1/18/18	LWRP	-	1630	-	92	88	160	3J	-	83	109	13.3	36	2930.	-	-	-	1040	-
3S/1E 12D 2	5/9/18	LWRP	-	1620	-	87	90	160	2.4J	-	77	124	15	38	2880.	-	-	-	1010	-
3S/1E 12D 2	7/18/18	LWRP	-	1620	-	84	87	160	2.6	-	80	120	14.7	37	3100.	-	-	-	1010	-
3S/1E 12G 1	1/18/18	LWRP	-	1240	-	68	87	73	2.6J	-	59	107	13.2	31	960.	-	-	-	730	-
3S/1E 12G 1	5/9/18	LWRP	-	1200	-	64	88	76	2.7J	-	60	129	11	34	870.	-	-	-	730	-
3S/1E 12G 1	7/18/18	LWRP	-	1180	-	58	79	70	2.5	-	60	121	10.8	33	1040.	-	-	-	700	-
3S/1E 12H 4	7/30/18	ZONE7	24.3	707	7.5	43	49	25	1.6	298	43	54	3.21	30	270	< 1	< 100	9	407	308
3S/1E 12H 5	9/6/18	ZONE7	19.1	689	7.5	53	48	28	1.9	301	41	46	3.16	34.2	310	3.2	< 100	9.7	415	330
3S/1E 12H 6	9/6/18	ZONE7	19.7	612	7.7	46	41	33	2	306	37	27	2.21	36.4	250	1.7	< 100	16	383	284
3S/1E 12H 7	9/6/18	ZONE7	21.3	667	7.8	48	46	24	1.7	290	39	38	2.48	36.4	280	2	< 100	11	387	310
3S/1E 12K 2	9/17/18	ZONE7	24.5	714	7.4	45	47	35	1.8	288	40	70	3.77	27.8	280	< 1	< 100	3.7	4250	306
3S/1E 12K 3	9/17/18	ZONE7	20.2	636	7.5	45	44	27	1.7	294	38	44	4.31	36.4	260	< 1	< 100	11	400	293
3S/1E 12K 4	9/17/18	ZONE7	20.2	303	7.6	19	18	24	1.2	155	7.9	21	1.91	25.7	140	< 1	< 100	2.6	202	122
3S/1E 14B 1	8/6/18	ZONE7	19.6	750	7.5	77	30	29	1.7	280	51	79	2.46	21.4	340	< 1	< 100	4.1	439	317
3S/1E 14D 2	9/18/18	ZONE7	19.8	752	7.4	71	30	48	1.7	252	47	97	0.83	21.4	500	< 1	< 100	< 1	444	302
3S/1E 15J 3	8/6/18	ZONE7	20	902	7.2	38	71	41	2	407	44	83	1.28	18.8	430	< 1	1400	< 1	504	389
3S/1E 15M 3	9/18/18	ZONE7	19.6	786	7.2	78	36	42	1.5	285	42	97	5.39	30	300	< 1	< 100	< 1	491	343
3S/1E 16A 2	11/6/17	ZONE7	-	711	7.7	74	28	35	2	268	47	70	1.98	21	280	< 1	< 100	5.2	419	301
3S/1E 16A 4	9/18/18	ZONE7	19.5	855	7.5	109	36	34	1.9	324	49	112	2.1	25.7	300	< 1	< 100	3.3	537	420
3S/1E 16B 1	1/30/18	ZONE7	-	753	7.5	74	26	30	1.9	276	44	75	1.77	23.5	270	< 1	< 100	4.9	419	292
3S/1E 16C 2	1/30/18	ZONE7	-	957	7.3	81	37	44	2.2	292	57	129	1.51	21.4	480	< 1	< 100	3.6	522	354
3S/1E 16C 3	1/30/18	ZONE7	-	1360	7.4	128	49	66	3.2	471	76	156	3.06	25.7	810	< 1	< 100	6	750	522
3S/1E 16C 4	1/30/18	ZONE7	-	844	7.5	86	30	34	2.3	304	46	86	2.97	25.7	260	< 1	< 100	8.3	474	339
3S/1E 16E 4	3/19/18	ZONE7	19.1	1337	7	152	56	67	2.9	578	77	151	5.79	24.2	560	< 1	< 100	2.4	841	610
3S/1E 16L 7	11/6/17	ZONE7	-	1080	7.7	110	47	52	2.7	396	64	123	3.6	23.5	470	< 1	< 100	3.8	635	468
3S/1E 16P 5	3/19/18	ZONE7	18.3	460	6.9	34	18	30	2.3	173	32	38	0.22	12.1	200	< 1	< 100	< 1	253	160
3S/1E 16P 5	8/29/18	ZONE7	18.1	473	6.7	29	25	34	2	181	30	56	< 0.1	11.1	240	< 1	< 100	< 1	276	176
3S/1E 17B 4	8/6/18	ZONE7	24.1	2018	7.2	6	2	38	580	711	76	166	9.36	23.5	740	< 1	< 100	4.4	1284	23
3S/1E 17D 3	7/23/18	ZONE7	19.3	1336	7.2	120	80	50	2.4	579	96	115	7.6	25.7	480	< 1	< 100	5	808	630
3S/1E 17D 4	7/23/18	ZONE7	20.7	1268	8.4	15	6	204	1.4	282	21	233	< 0.1	21.4	2480	5.6	< 100	< 1	645	63
3S/1E 17D 5	7/23/18	ZONE7	28.9	1221	8.8	17	10	203	1.2	279	8.5	232	< 0.1	12.8	2340	38	< 100	< 1	630	83
3S/1E 17D 6	7/23/18	ZONE7	19.9	1370	8.7	12	6	230	1.4	271	12	287	< 0.1	18.6	1610	3.7	< 100	< 1	702	53
3S/1E 17D 7	7/23/18	ZONE7	20.4	1428	9.2	6	4	240	1.9	209	3.8	339	< 0.1	4.9	1690	42	< 100	< 1	710	32
3S/1E 17D11	7/23/18	ZONE7	21.4	1288	8.1	14	5	214	1.2	286	< 1	252	< 0.1	23.5	2720	8.9	< 100	< 1	652	54

- = Not Analyzed; X = Suspect Result

TABLE 7-2
WATER QUALITY RESULTS
2018 WATER YEAR

			TEMP	EC		Mineral Constituents (mg/L)									Select Metals (ug/L)				TDS	Hard
SITE ID	DATE	By	°C	umhos/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3N	SiO2	B	As	Fe	Cr	mg/L	mg/L
3S/1E 17D12	2/6/18	ZONE7	-	917	7.5	99	40	43	2.1	402	52	77	4.96	26.3	400	< 1	< 100	5.6	560	412
3S/1E 17D12	4/10/18	ZONE7	17.7	898	7.3	88	46	37	2	385	47	70	4.52	24.4	330	< 1	< 100	4.4	525	408
3S/1E 17D12	7/11/18	ZONE7	18	885	7.6	76	42	37	1.9	377	46	68	4.4	23.5	400	< 1	< 100	6.5	500	363
3S/1E 18A 6	10/3/17	ZONE7	17.8	942	7.3	75	50	67	2.1	420	77	86	3	24.6	530	< 1	< 100	4	602	393
3S/1E 18A 6	1/25/18	ZONE7	17.2	1034	7.4	73	44	66	2.3	405	79	89	3.06	23.5	510	1.3	< 100	6.5	591	363
3S/1E 18A 6	2/6/18	ZONE7	-	1007	7.4	88	42	71	1.9	409	79	87	3.02	28	570	1.2	< 100	4.4	612	392
3S/1E 18A 6	4/10/18	ZONE7	17.8	1090	7.2	93	54	62	2.1	441	86	90	3.21	25.5	470	< 1	< 100	2.9	645	456
3S/1E 18A 6	7/9/18	ZONE7	19.8	1014	7.5	77	46	68	2.1	429	80	87	3.16	27.8	580	1	< 100	4.2	614	382
3S/1E 18E 4	5/15/18	ZONE7	16.9	673	7.4	55	19	66	0.9	300	63	48	< 0.1	28	402	< 1	180	< 1	428	216
3S/1E 18J 2	5/15/18	ZONE7	18.2	3280	7.2	219	169	276	4.1	518	600	616	0.21	27	900	< 1	120	< 1	2168	1244
3S/1E 19A11	10/12/17	ZONE7	-	1502	7.5	144	93	49	2.6	493	118	191	2.09	19.7	430	< 1	< 100	2.1	871	743
3S/1E 19C 4	5/15/18	ZONE7	18.4	967	7.2	94	51	49	2.2	404	112	78	2.52	27.6	296	< 1	170	< 1	624	445
3S/1E 19K 1	5/15/18	ZONE7	19.4	1494	7.1	114	88	92	2.7	605	269	95	< 0.1	16.1	485	< 1	< 100	< 1	975	649
3S/1E 20B 2	10/3/17	ZONE7	-	903	7.3	86	40	70	2.1	360	53	87	4.24	22.7	410	< 1	< 100	1.4	557	380
3S/1E 20B 2	9/14/18	ZONE7	-	928	7	80	41	49	1.9	358	50	86	3.9	30	420	< 1	< 100	1.5	532	370
3S/1E 20C 3	10/3/17	ZONE7	-	870	7.4	89	41	65	2.1	363	60	90	3.24	17.7	390	< 1	< 100	2.9	559	392
3S/1E 20C 7	1/31/18	ZONE7	-	724	7.2	55	27	49	2.5	267	48	69	1.34	18.8	340	< 1	< 100	2.6	4070	249
3S/1E 20C 7	8/29/18	ZONE7	18.9	737	7.1	56	34	47	2.1	281	57	78	1.53	18.2	360	< 1	< 100	1.7	4370	278
3S/1E 20C 8	1/31/18	ZONE7	-	1029	7.3	93	46	39	2.5	435	50	90	5.54	21.4	230	< 1	< 100	5.3	5810	422
3S/1E 20C 9	1/31/18	ZONE7	-	1002	7.4	79	64	43	2.5	408	61	92	2.82	25.7	390	< 1	< 100	5	581	461
3S/1E 20J 4	1/31/18	ZONE7	-	1086	6.8	53	54	104	1.3	415	59	102	5.35	32.1	540	< 1	< 100	1.7	633	356
3S/1E 20M11	5/15/18	ZONE7	18.8	977	7.2	72	37	47	2	321	64	90	1.89	25.7	306	< 1	< 100	< 1	504	332
3S/1E 20Q 2	9/5/18	ZONE7	22	1351	7.3	84	97	110	1.7	623	32	161	0.12	23.5	750	< 1	4500	< 1	816	610
3S/1E 22D 2	5/15/18	ZONE7	20	975	6.7	41	37	91	1.1	288	53	97	10.7	47.1	67	< 1	< 100	< 1	556	254
3S/1E 25C 3	8/29/18	ZONE7	19.5	778	7	48	32	57	1.4	240	32	108	4.12	25.7	280	< 1	< 100	< 1	440	250
3S/1E 29M 4	8/29/18	ZONE7	18.4	1191	7.2	94	57	82	2.9	623	< 1	110	< 0.1	27.8	1360	19	1700	< 1	680	468
3S/1E 29P 2	8/28/18	ZONE7	18.6	1721	7.4	84	87	140	2.4	692	22	210	< 0.1	20.1	1810	< 2	< 200	< 2	906	566
3S/1W 1B 9	9/5/18	ZONE7	19.7	880	7.7	52	21	110	1.5	335	44	110	0.44	25.7	510	4	< 100	< 1	531	217
3S/1W 1B10	9/5/18	ZONE7	19.6	813	7.7	48	16	108	0.9	361	< 1	91	< 0.1	32.1	580	190	370	< 1	474	186
3S/1W 1B11	9/5/18	ZONE7	19.9	865	7.7	30	11	134	1.1	262	< 1	170	< 0.1	27.8	810	21	< 100	< 1	503	120
3S/1W 2A 2	1/31/18	ZONE7	-	1651	6.7	187	39	108	0.9	672	83	196	4.1	25.7	330	1.2	< 100	1.3	989	629
3S/1W 12B 2	1/31/18	ZONE7	-	722	6.8	91	30	54	0.6	296	121	77	2.77	36.4	210	< 1	< 100	1.2	568	352
3S/1W 12J 1	1/31/18	ZONE7	-	1540	7.3	94	41	175	1.3	435	239	168	0.66	27.8	660	2.1	< 100	< 1	964	405
3S/1W 13J 1	1/31/18	ZONE7	-	902	6.6	87	37	40	0.7	309	109	78	4.2	25.7	180	< 1	< 100	1.1	548	370
3S/2E 1F 2	8/28/18	ZONE7	18.8	2723	7.4	129	55	361	2.7	227	194	725	5.01	53.5	8910	< 1	< 500	3.9	1654	549
3S/2E 2B 2	8/28/18	ZONE7	21.1	1941	7.3	119	52	170	1.7	265	101	419	7.07	38.5	1970	< 1	< 100	7.2	1063	512
3S/2E 3A 1	4/26/18	ZONE7	21.4	975	7.6	67	35	114	1.4	279	74	174	6.86	45.6	1090	2.3	< 100	19	679	312
3S/2E 3K 3	8/28/18	ZONE7	20.6	1020	7.8	51	43	81	2.2	296	61	123	9.52	27.8	1380	< 1	< 100	9.7	577	304
3S/2E 7C 2	1/18/18	LWRP	-	1380	-	67	100	63	3.8J	-	82	99	14.1	38	750.	-	-	-	820	-
3S/2E 7C 2	5/9/18	LWRP	-	1340	-	67	110	67	4J	-	84	139	13	39	640.	-	-	-	810	-
3S/2E 7C 2	7/18/18	LWRP	-	1320	-	64	100	62	3.9	-	81	134	13	38	740.	-	-	-	780	-
3S/2E 7H 2	4/26/18	ZONE7	23.2	1447	7.2	64	76	112	3.3	401	155	95	14.2	38.5	600	1.1	< 100	< 1	804	473
3S/2E 7N 2	9/19/18	ZONE7	19.9	562	7.3	32	35	29	1.6	177	37	63	1.43	26.1	170	< 1	< 100	1.2	317	224
3S/2E 8F 1	3/20/18	CWS	-	-	-	-	-	-	-	-	-	-	8.962	-	-	-	-	-	-	-
3S/2E 8H 2	5/16/18	ZONE7	19.2	1170	6.6	40	80	68	1	356	87	146	9.69	37.9	241	< 1	< 100	1.7	678	430
3S/2E 8H 3	5/16/18	ZONE7	19.7	1290	7.1	81	79	54	1.7	416	84	151	13.1	35.1	341	< 1	< 100	4.3	749	527
3S/2E 8H 4	5/16/18	ZONE7	20.5	1126	7.4	48	47	105	2.3	336	31	166	5.69	30.4	439	1.1	< 100	8.2	621	314
3S/2E 8K 2	5/16/18	ZONE7	20.5	1063	7.2	56	75	44	2.1	373	71	106	10.8	35.1	278	< 1	< 100	3.24	6210	449
3S/2E 8N 2	3/14/18	CWS	-	-	7.83	-	-	-	-	-	-	-	-	-	-	< 2	260	< 10	-	-
3S/2E 8Q 9	5/16/18	ZONE7	19.8	844	7.3	48	64	41	2.2	324	53	92	5.18	27.2	315	< 1	< 100	2.4	510	384

- = Not Analyzed; X = Suspect Result

TABLE 7-2
WATER QUALITY RESULTS
2018 WATER YEAR

			TEMP	EC		Mineral Constituents (mg/L)									Select Metals (ug/L)				TDS	Hard
SITE ID	DATE	By	°C	umhos/cm	pH	Ca	Mg	Na	K	HCO3	SO4	Cl	NO3N	SiO2	B	As	Fe	Cr	mg/L	mg/L
3S/2E 9Q 1	12/26/17	CWS	-	-	-	-	-	-	-	-	-	-	9.55	-	-	-	-	-	-	-
3S/2E 9Q 4	5/15/18	ZONE7	19.4	1199	7.5	49	84	61	1.6	370	89	139	10.2	40	572	< 1	< 100	< 1	692	468
3S/2E 10F 3	5/16/18	ZONE7	20	1702	7.1	97	128	112	1.5	575	114	233	13.5	38.9	968	< 1	< 100	< 1	1067	769
3S/2E 10Q 1	5/16/18	ZONE7	20.8	1704	6.8	81	137	113	1.5	532	128	247	18.9	41.5	1028	< 1	< 100	< 1	1095	766
3S/2E 10Q 2	3/12/18	ZONE7	-	767	7.8	50	33	49	2	200	65	89	6.49	28	710	< 1	< 100	11	444	258
3S/2E 11C 1	5/16/18	ZONE7	19.2	756	7.3	58	23	76	2.3	233	39	118	2.98	36.2	315	< 1	< 100	3.8	481	240
3S/2E 12C 4	3/12/18	ZONE7	-	1141	8.1	51	8	137	2.2	112	147	183	3.7	34.9	3190	1.7	< 100	69	636	161
3S/2E 12J 3	3/12/18	ZONE7	-	752	8.1	41	15	65	3.2	61	60	151	0.32	24	390	1.1	< 100	< 1	391	163
3S/2E 14A 3	5/16/18	ZONE7	20	1060	7.1	102	42	71	2.9	457	36	84	12.4	32.7	376	< 1	< 100	7.5	651	428
3S/2E 14B 1	8/6/18	ZONE7	20.3	932	7.4	72	42	64	2.6	331	48	119	9.74	27.8	640	< 1	< 100	11	582	351
3S/2E 15E 2	8/6/18	ZONE7	25.4	256	7.4	11	8	23	2	74	12	35	0.16	9	< 100	2.6	< 100	< 1	137	61
3S/2E 15L 1	8/28/18	ZONE7	25.5	1160	7.5	45	98	59	1.6	391	111	130	13.2	34.2	530	< 1	< 100	1.4	730	516
3S/2E 15M 2	8/28/18	ZONE7	21.7	1017	7.7	62	78	32	2.6	360	72	100	13.1	30	220	1.3	< 100	6.8	612	476
3S/2E 15R17	4/26/18	ZONE7	20.1	1005	7.5	48	88	41	1.7	357	70	88	13.4	36.8	420	< 1	< 100	9.3	609	483
3S/2E 15R18	4/26/18	ZONE7	20	697	7.7	54	45	31	1.7	321	48	45	1.66	36	170	< 1	< 100	< 1	427	320
3S/2E 16A 3	8/13/18	ZONE7	19.5	1139	7.4	47	93	40	1.6	387	83	127	10.3	30	430	< 1	< 100	3.2	658	501
3S/2E 16E 4	5/15/18	ZONE7	18.8	587	7.2	24	33	41	2.4	191	39	69	1.63	21.2	235	< 1	< 100	< 1	331	196
3S/2E 18B 1	4/12/18	CWS	-	-	-	-	-	-	-	-	-	-	7.417	-	-	-	-	-	-	-
3S/2E 18E 1	5/15/18	ZONE7	19.2	497	7.3	34	37	19	1.7	181	41	70	1.9	28.9	186	< 1	< 100	1.7	329	237
3S/2E 19D 7	8/13/18	ZONE7	27.1	960	7.4	70	54	27	2	287	23	153	5.78	25.7	< 100	< 1	< 100	6.6	522	399
3S/2E 19D 8	8/13/18	ZONE7	26.5	949	7.4	72	53	28	2	278	22	147	5.77	25.7	< 100	< 1	< 100	6.7	512	398
3S/2E 19D 9	8/13/18	ZONE7	18.7	425	7.4	29	16	24	1.2	142	11	36	7.52	27.8	< 100	< 1	< 100	2.4	248	139
3S/2E 19D10	8/13/18	ZONE7	19	808	7.2	58	37	38	1.7	232	34	102	11.6	27.8	< 100	< 1	< 100	1.1	464	298
3S/2E 19N 3	8/13/18	ZONE7	20.8	596	8.2	43	13	62	2.9	260	31	44	< 0.1	27.8	240	9.1	< 100	< 1	361	162
3S/2E 19N 4	8/8/18	ZONE7	21	597	8.3	22	11	78	2	219	23	64	< 0.1	16.7	350	13	< 100	< 1	328	100
3S/2E 20M 1	8/13/18	ZONE7	19.6	1013	6.9	65	52	55	2	322	55	138	6.21	23.5	200	< 1	< 100	< 1	577	376
3S/2E 22B 1	4/26/18	ZONE7	19	1443	7.1	81	129	67	1.7	463	197	165	6.34	39.8	320	< 1	< 100	< 1	937	733
3S/2E 23E 1	3/8/18	ZONE7	20.8	875	7.6	45	62	47	2.5	346	49	77	8.63	25.3	450	1.2	< 100	8.2	517	367
3S/2E 23E 2	3/8/18	ZONE7	21	1095	7.7	45	65	96	2.8	379	46	162	1.39	33.2	2220	1.1	< 100	< 1	644	379
3S/2E 24A 1	3/8/18	ZONE7	19.8	1560	6.9	137	71	118	2.2	549	80	154	28.3	34.7	880	< 1	< 100	1.3	993	634
3S/2E 26J 2	3/8/18	ZONE7	18.9	1033	7.5	52	88	50	2.8	532	57	51	0.56	17.1	600	< 1	< 100	< 1	583	493
3S/2E 29F 4	3/8/18	ZONE7	18.6	614	7.4	54	21	38	1.7	242	47	44	0.13	20	290	4.1	< 100	< 1	346	222
3S/2E 29F 4	8/28/18	ZONE7	21.5	631	7.7	52	31	32	1.6	266	56	45	< 0.1	18.4	320	4.5	< 100	< 1	367	256
3S/2E 30D 2	3/8/18	ZONE7	20.9	562	7.4	42	20	43	1.9	207	36	50	0.52	16.5	240	< 1	< 100	< 1	314	187
3S/2E 33G 1	3/8/18	ZONE7	13.5	533	7.4	34	16	45	2.2	130	51	64	0.31	13.8	260	< 1	< 100	< 1	291	151
3S/2E 33G 1	9/5/18	ZONE7	21.1	403	7.1	38	17	27	2.4	159	40	27	< 0.1	15.4	240	1.1	< 100	< 1	245	165
3S/2E 33K 1	12/14/17	VA	18	1910	7.3	-	-	-	-	-	-	250	1.9	-	-	-	-	-	1090	-
3S/2E 33K 1	3/21/18	VA	16.5	1950	7.4	-	-	-	-	-	-	270	2.2	-	-	-	-	-	1040	-
3S/2E 33K 1	6/22/18	VA	18.7	1850	7.2	-	-	-	-	-	-	280	2.4	-	-	-	-	-	1050	-
3S/2E 33K 1	9/12/18	VA	22.2	1860	7.6	-	-	-	-	-	-	270	1.8	-	-	-	-	-	1070	-
3S/2E 33L 1	12/14/17	VA	18	1410	6.8	-	-	-	-	-	-	180	3.6	-	-	-	-	-	807	-
3S/2E 33L 1	3/21/18	VA	15.3	1110	6.9	-	-	-	-	-	-	130	5.6	-	-	-	-	-	603	-
3S/2E 33L 1	6/22/18	VA	18.8	1260	6.9	-	-	-	-	-	-	170	0.54	-	-	-	-	-	605	-
3S/2E 33L 1	9/12/18	VA	20.6	1220	7.1	-	-	-	-	-	-	170	0.91	-	-	-	-	-	808	-
3S/2E 36K 1	3/20/18	ZONE7	-	1671	8.1	10	27	239	1.9	435	2.9	331	< 0.1	13.2	3560	< 1	< 100	< 1	844	137
3S/3E 6Q 3	9/5/18	ZONE7	20.5	2125	7.3	138	45	268	3.4	353	440	293	6.87	62.1	6900	< 1	< 100	2.5	1454	530
3S/3E 7D 2	4/26/18	ZONE7	21	2606	7.3	157	75	307	3.6	236	291	559	8.31	65.9	5170	< 5	< 500	5.1	1612	701
4S/2E 10E 1	3/20/18	ZONE7	-	1176	8.2	35	49	145	4.4	460	77	141	1.57	19.4	950	< 1	< 100	< 1	711	290
4S/2E 10L 1	3/20/18	ZONE7	-	1269	7.7	20	46	185	5	731	54	55	< 0.1	15.3	1370	< 1	< 100	< 1	743	239

- = Not Analyzed; X = Suspect Result

ABBREVIATIONS FOR MUNICIPAL WELLS
COL = Chain of Lakes (Zone 7)
M = Mocho (Zone 7)
H = Hopyard (Zone 7)
St = Stoneridge (Zone 7)
CWS = Cal Water Service
P = Pleasanton
SF = San Francisco Public Utilities Commision

LEGEND

Well Colors
- Upper Aquifer
- Lower Aquifer
- Deep Aquifer

Well Symbols
- Supply
- Monitor
- Municipal
- Nested Monitoring
- KeyWells
- Mining Area Ponds
- Main Basin
- Fringe Management Area
- Upland Management Area
- Rivers
- Township-Range Line

2S/1W 2S/1E 2S/2E 2S/3E
3S/1W 3S/1E 3S/2E 3S/3E

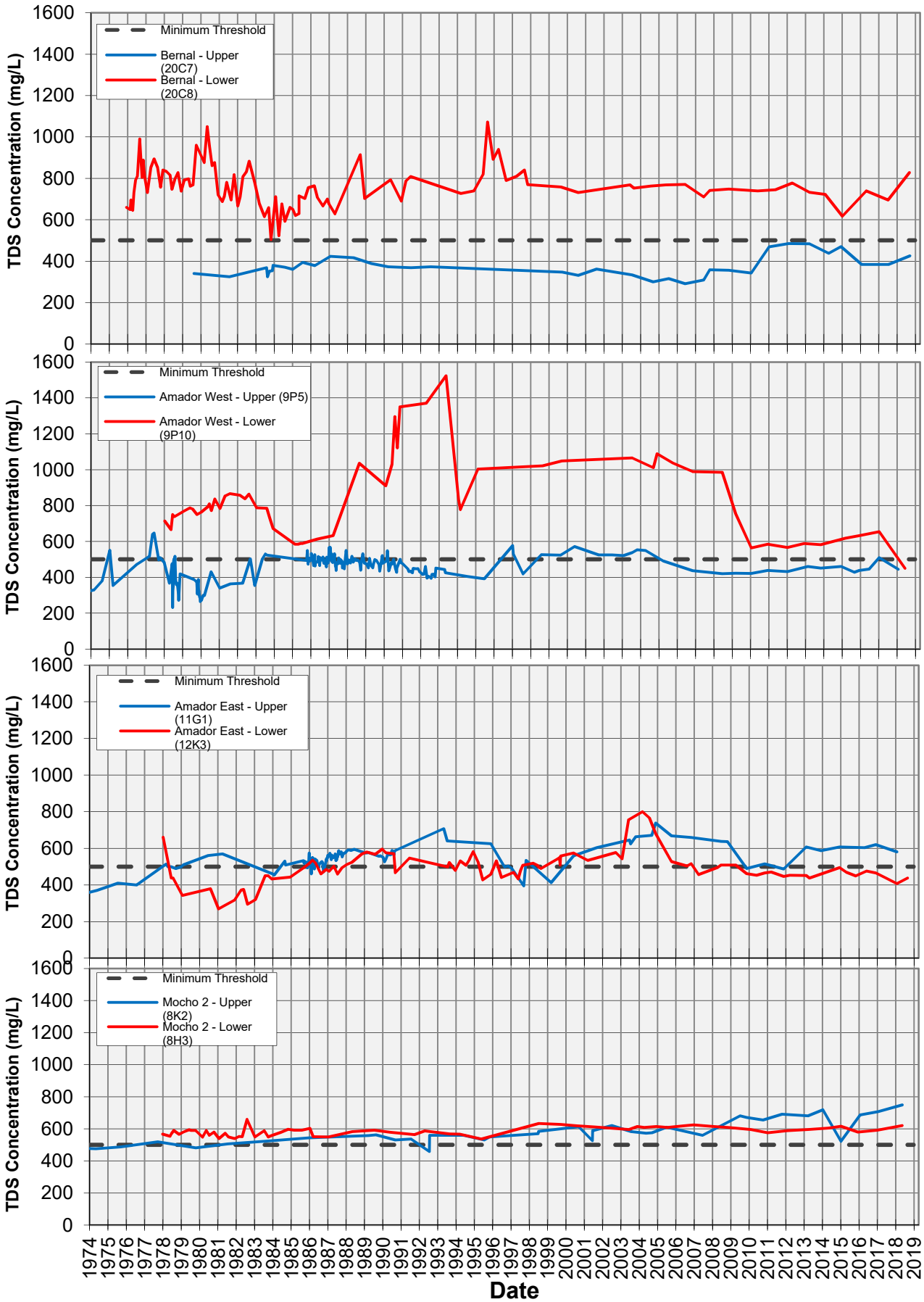
N W E S

0 2 4
Miles

DATE: Mar 12, 2019
FILE: E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-01-MapGQWells18.mxd

Figure 7-1
Map of Wells in
2018 Groundwater Quality Program
Livermore Valley Groundwater Basin

FIGURE 7-2
TDS CONCENTRATIONS IN KEY WELLS
1974 TO 2018 WATER YEARS



E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-02-KeyWellTDS18.xls
3/11/2019

Figure 7-2

Some contours are based on past data from wells not sampled in the Water Year.

LEGEND

Wells with TDS Concentrations

11P6 Well Number (abbreviated)
3.67 TDS Concentration in mg/L
ND = not detected above reporting limit
NA = not analyzed in 2018 WY

- Supply
- Monitor
- Nested
- Mining
- Streams
- Mining Area Ponds
- Upland Management Area
- Main Basin Subarea Boundary

2018 TDS Concentrations (mg/L)

- <500
- 500-1,000
- 1,000-5,000
- >5,000
- Township-Range Line

N
W E
S

0 2 4
Miles

DATE: Mar 25, 2019
FILE: E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-03-TDSUpper18.mxd

Figure 7-3
TDS Concentrations (mg/L)
Upper Aquifer, 2018 Water Year
Livermore Valley Groundwater Basin

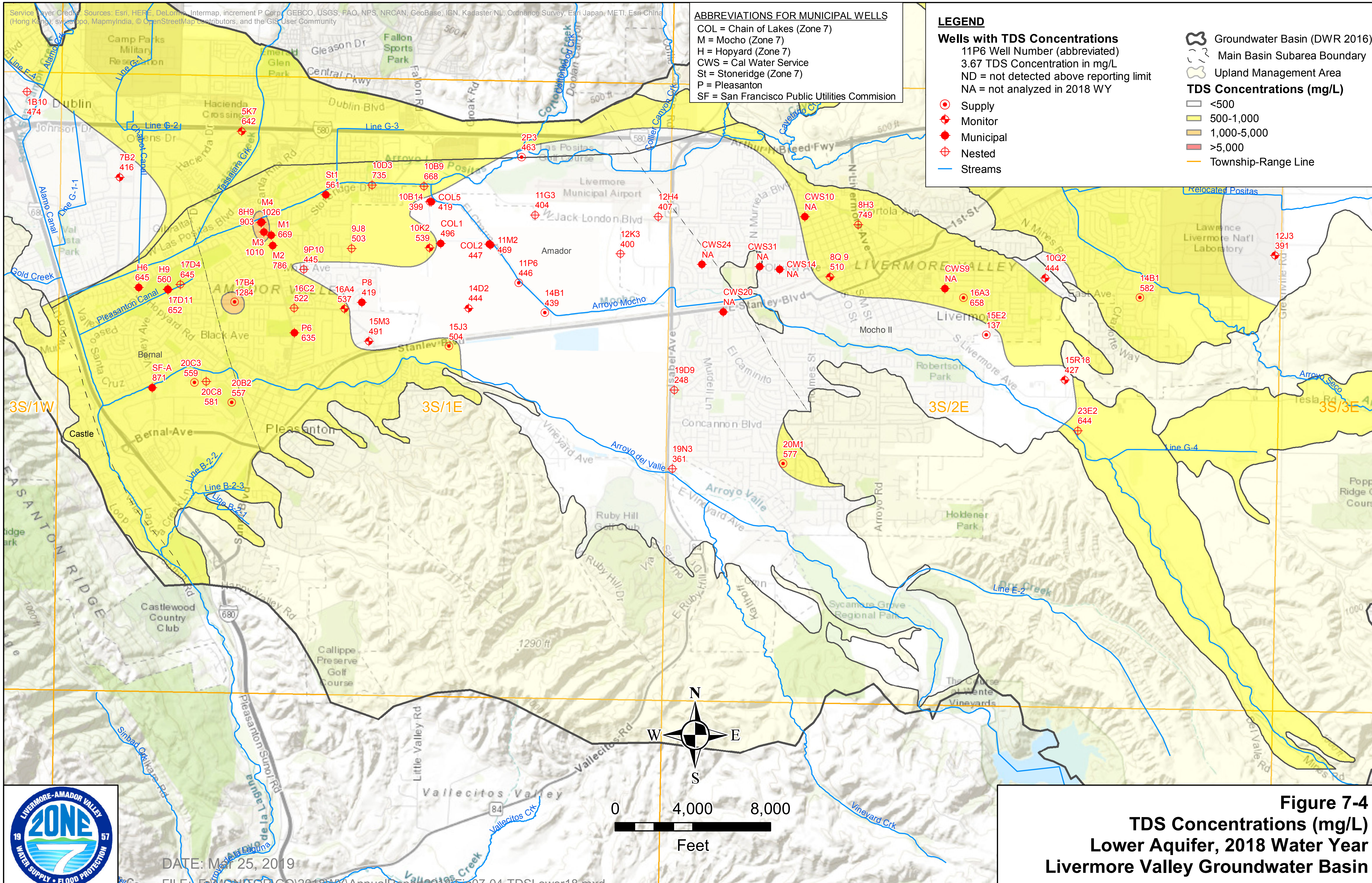


Figure 7-4
TDS Concentrations (mg/L)
Lower Aquifer, 2018 Water Year
Livermore Valley Groundwater Basin

Some contours are based on past data from wells not sampled in the Water Year.

LEGEND

Wells with NO3N Concentrations

11P6 Well Number (abbreviated)
3.67 Nitrate (as N) Concentration in mg/L
ND = not detected above reporting limit
NA = not analyzed in 2018 WY

- Supply
- Monitor
- Nested
- Mining
- Rivers
- Mining Area Ponds
- Groundwater Basin (DWR 2016)
- Upland Management Area
- Main Basin Subarea Boundary

Nitrate (as N) Concentrations (mg/L)

- <7
- 7-10
- 10-13
- >13
- Township-Range Line

May School
Constitution
Staples Ranch
Jack London
Charlotte Way
Greenville
Buena Vista
Bernal
Happy Valley
Mines Road

2S/1W
2S/1E
2S/2E
3S/1W
3S/1E
3S/2E
3S/3E

N
W
E
S

0 2 4
Miles

DATE: Mar 25, 2019
FILE: E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-05-NO3NUpper18.mxd

Figure 7-5
Nitrate as N Concentrations (mg/L)
Upper Aquifer, 2018 Water Year
Livermore Valley Groundwater Basin

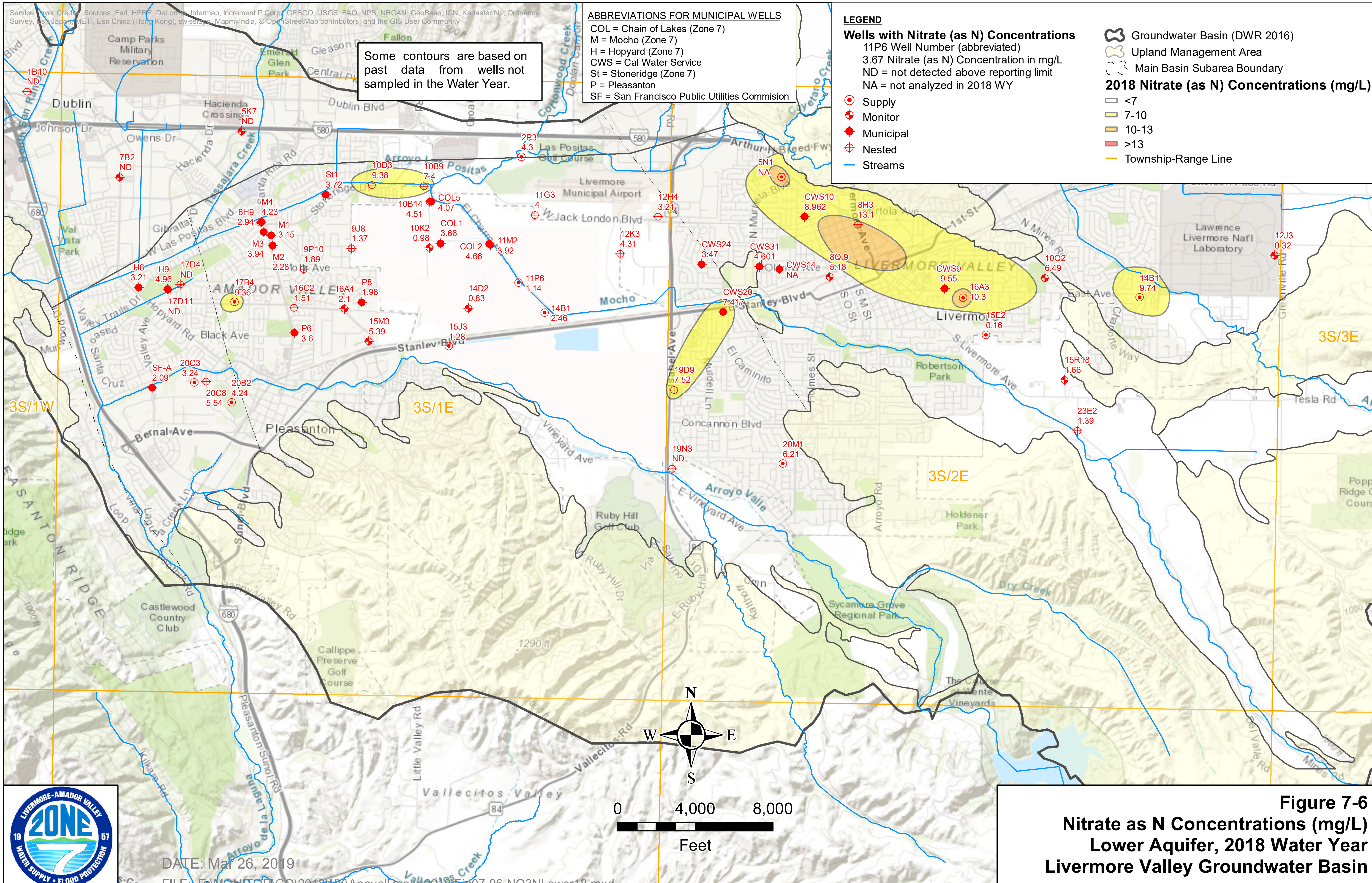


Figure 7-6
Nitrate as N Concentrations (mg/L)
Lower Aquifer, 2018 Water Year
Livermore Valley Groundwater Basin

Some contours are based on past data from wells not sampled in the Water Year.

LEGEND

Wells with Boron Concentrations

Labels
- 11P6 Well Number (abbreviated)
- 3.67 Boron Concentration in ug/L
- ND = not detected above reporting limit
- NA = not analyzed in 2018 WY

- Supply
- Monitor
- Nested
- Mining
- Mining Area Ponds
- Groundwater Basin (DWR 2016)
- Upland Management Area
- Main Basin Subarea Boundary

2018 Boron Concentrations (µg/L)
- <1000
- 1000-1400
- 1400-3000
- >3000
- Township-Range Line
- Rivers

N W E S

0 2 4 Miles

DATE: Mar 25, 2019
FILE: E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-07-BoronUpper18.mxd

Figure 7-7
Boron Concentrations (µg/L)
Upper Aquifer, 2018 Water Year
Livermore Valley Groundwater Basin

Some contours are based on past data from wells not sampled in the Water Year.

ABBREVIATIONS FOR MUNICIPAL WELLS
COL = Chain of Lakes (Zone 7)
M = Mocho (Zone 7)
H = Hopyard (Zone 7)
CWS = Cal Water Service
St = Stoneridge (Zone 7)
P = Pleasanton
SF = San Francisco Public Utilities Commision

LEGEND

Wells with Boron Concentrations
11P6 Well Number (abbreviated)
3.67 Boron Concentration in ug/L
ND = not detected above reporting limit
NA = not analyzed in 2018 WY
Supply
Monitor
Municipal
Nested
Streams

Mining Area Ponds

Boron Concentrations (µg/L)
<1000
1000-1400
1400-3000
>3000
Groundwater Basin (DWR 2016)
Upland Management Area
Main Basin Subarea Boundary
Township-Range Line

3S/1W
3S/1E
3S/2E
3S/3E

N
W
E
S

0 4,000 8,000
Feet

DATE: May 25, 2019
FILE: F:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-08-BoronLower18.mxd

Figure 7-8
Boron Concentrations (µg/L)
Lower Aquifer, 2018 Water Year
Livermore Valley Groundwater Basin

Some contours are based on past data from wells not sampled in the Water Year.

LEGEND

Wells with Cr (Total) Concentrations

11P6 Well Number (abbreviated)
3.67 Chromium (Total) Concentration in ug/L
ND = not detected above reporting limit
NA = not analyzed in 2018 WY

- Supply
- Monitor
- Nested
- Mining
- Rivers
- Mining Area Ponds

Chromium (Total) Concentrations (µg/L)

- <10
- 10-30
- 30-50
- >50
- Groundwater Basin (DWR 2016)
- Upland Management Area
- Main Basin Subarea Boundary
- Township-Range Line

N
W E
S

0 2 4
Miles

DATE: Mar 25, 2019
FILE: E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-09-CrUpper18.mxd

Figure 7-9
Total Chromium Concentrations (µg/L)
Upper Aquifer, 2018 Water Year
Livermore Valley Groundwater Basin

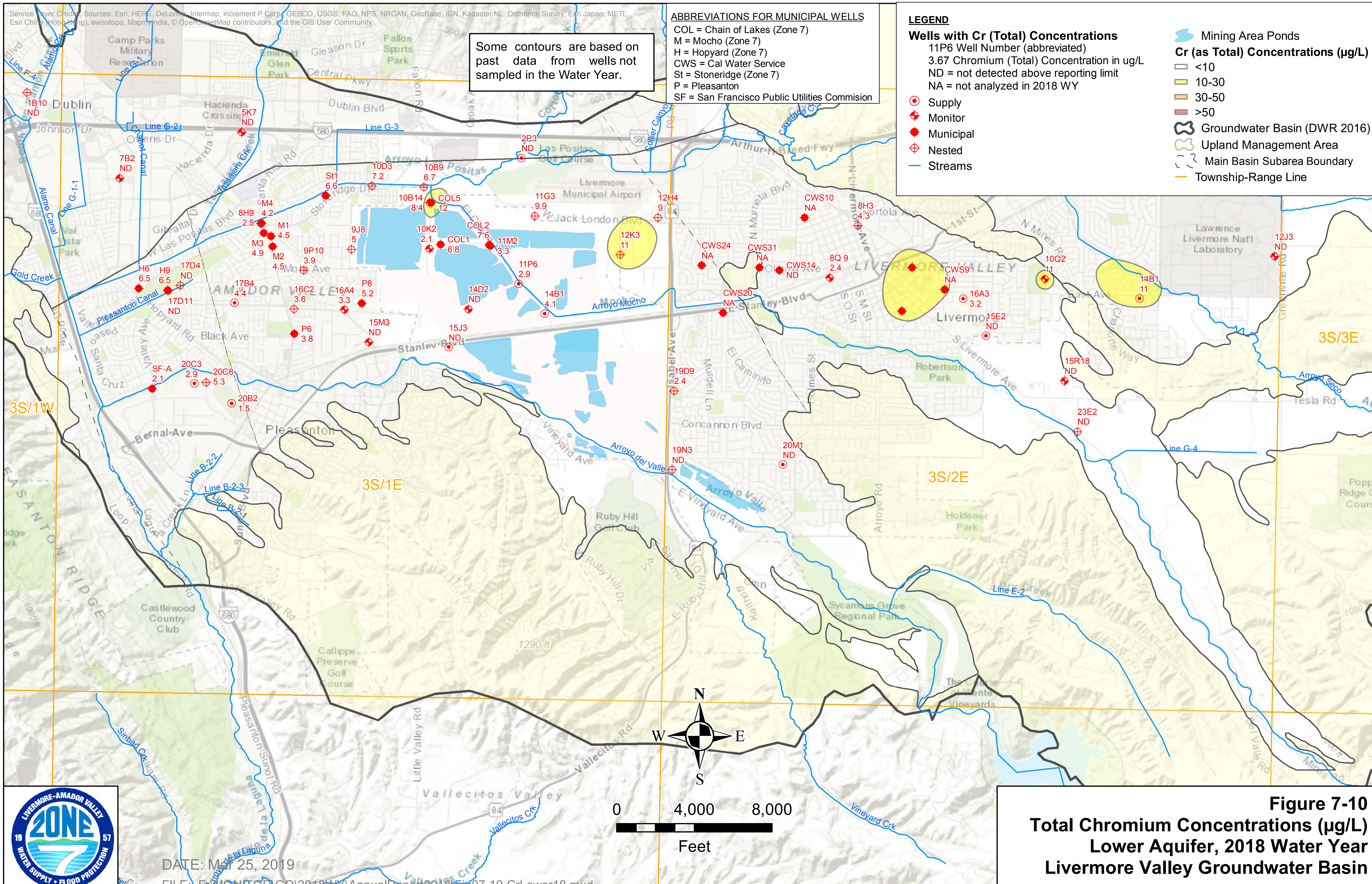
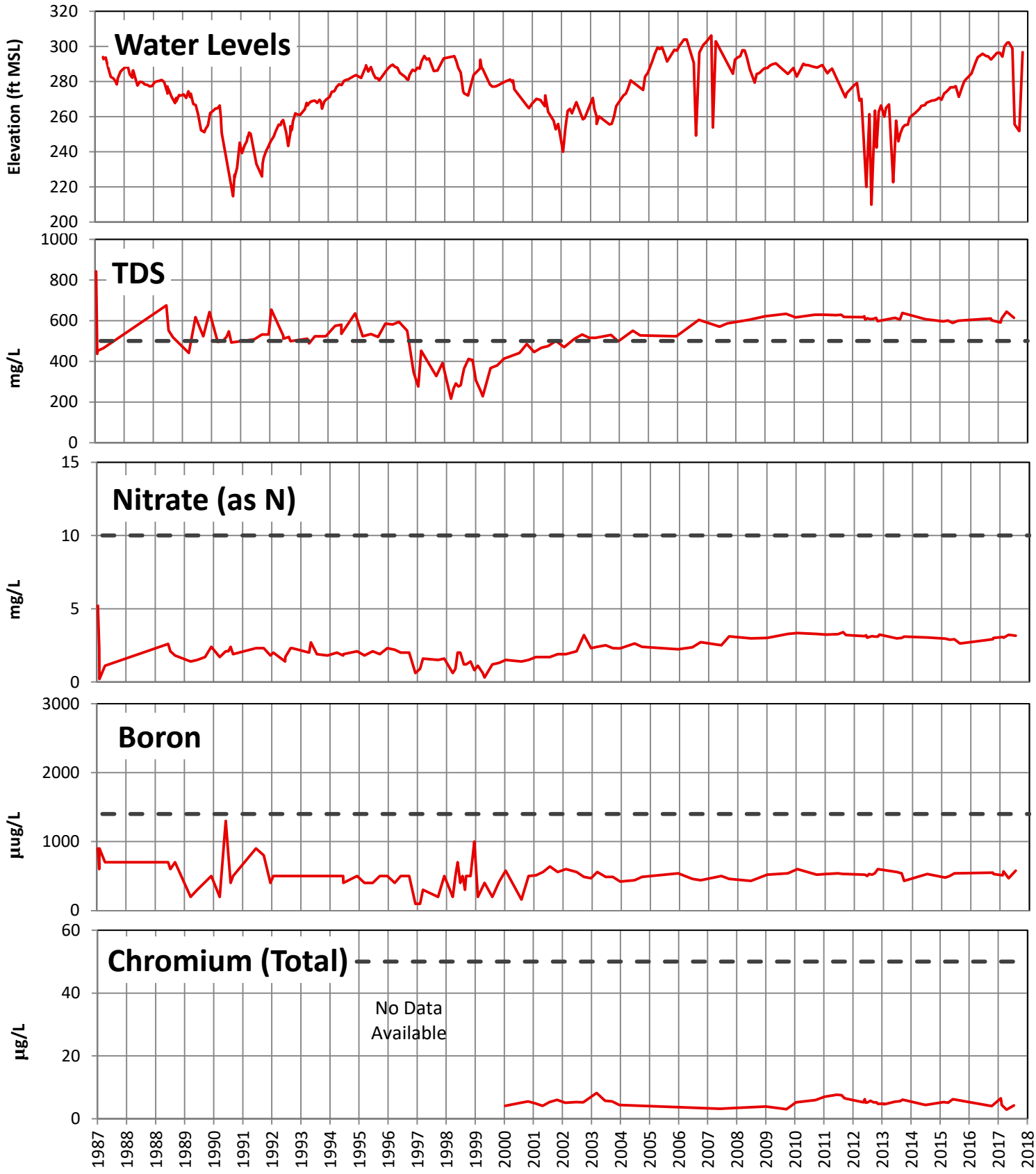


Figure 7-10
Total Chromium Concentrations (µg/L)
Lower Aquifer, 2018 Water Year
Livermore Valley Groundwater Basin

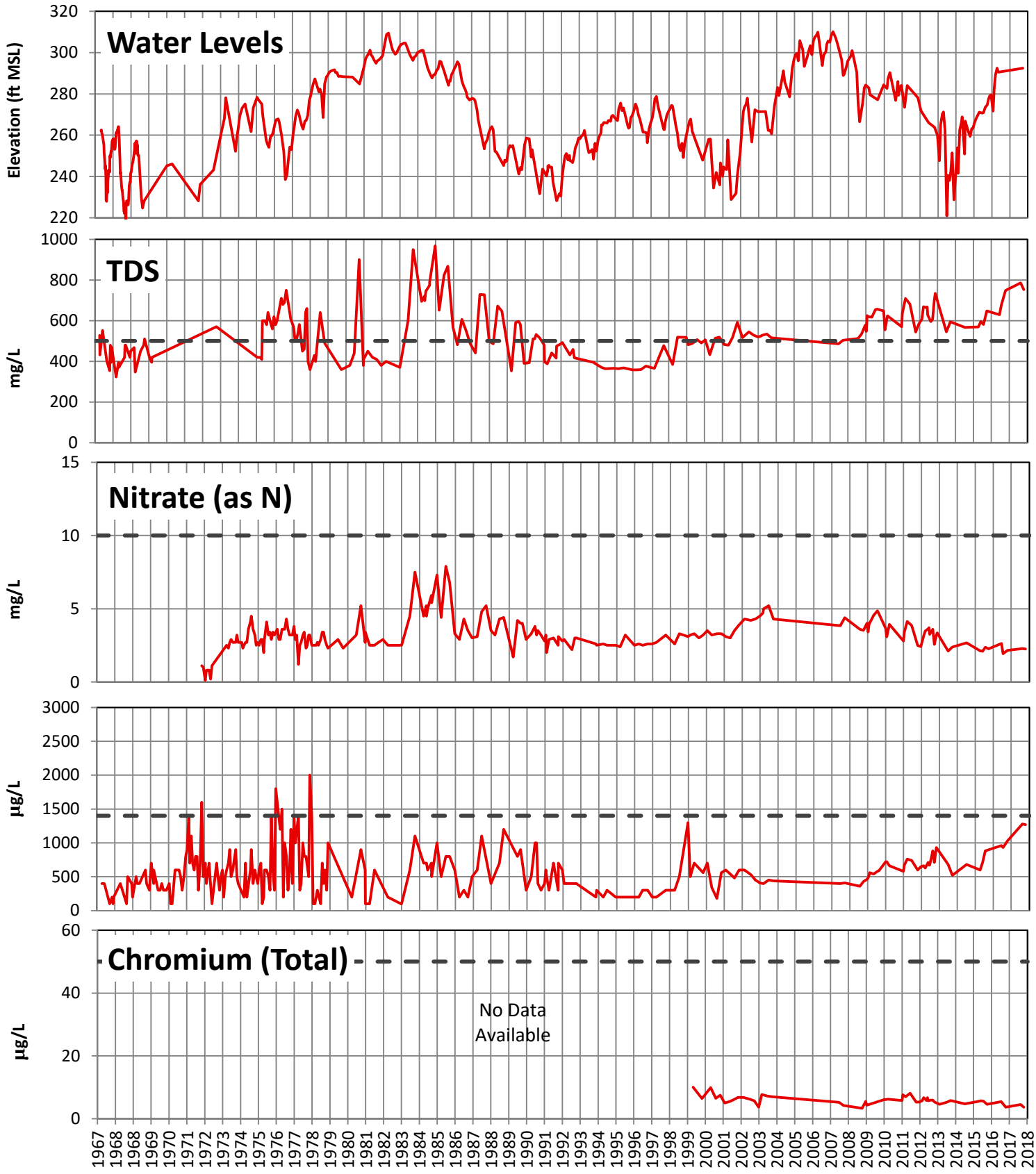
FIGURE 7-11
HYDRO-CHEMO GRAPH FOR 3S/1E 18A 6 (HOPYARD 6)
1987 to 2018 WATER YEARS
BERNAL SUBAREA - LOWER AQUIFER



Well Depth = 500'; Wellhead Elevation = 327'; Well Screen Depth: 215 to 490' bgs. Minimum Threshold = - - - - -

E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-11to14-HydroChemoGraphs18.xlsx\F3-11Grph

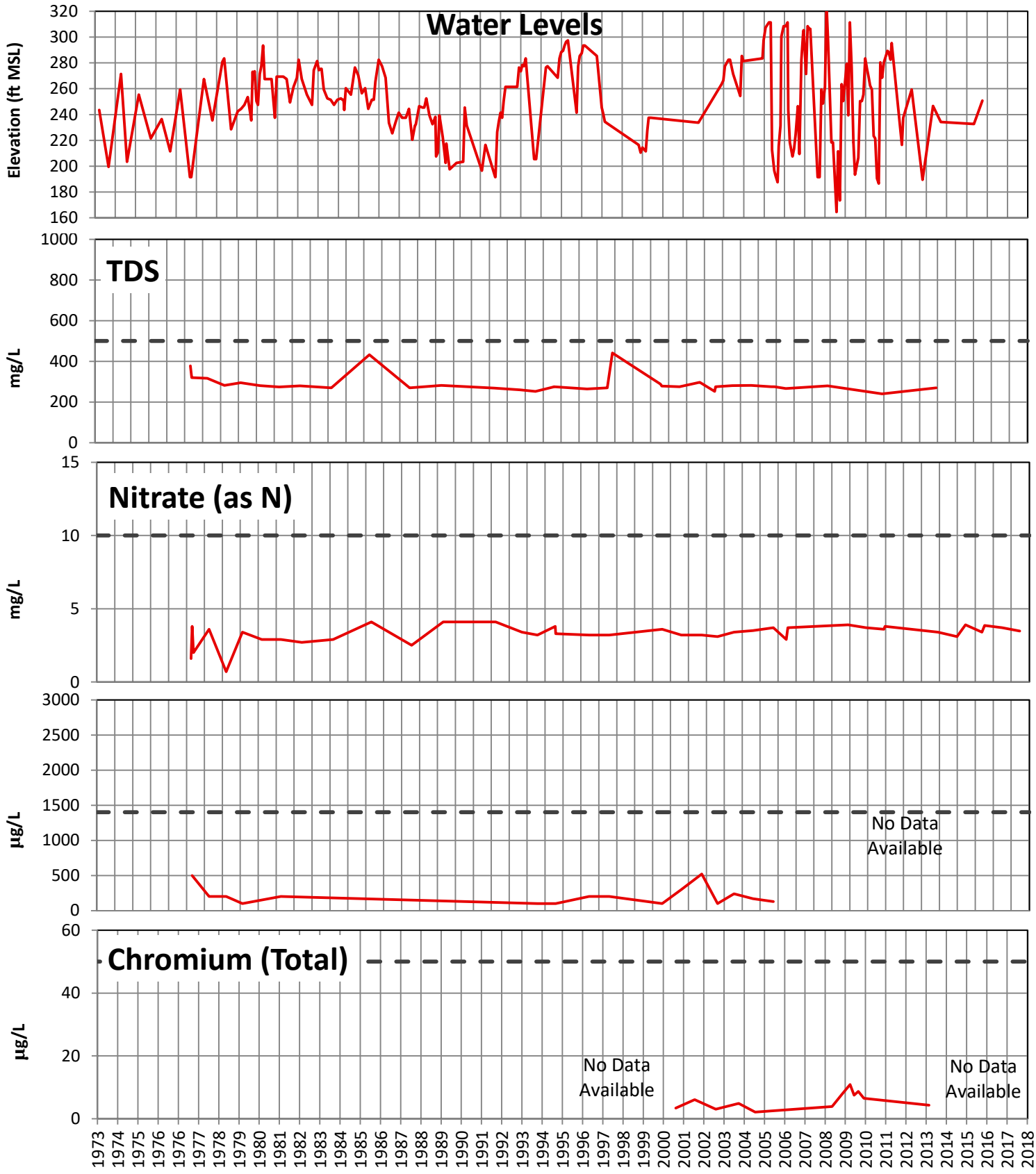
FIGURE 7-12
HYDRO-CHEMO GRAPH FOR 3S/1E 9M 3 (Mocho 2)
1967 to 2018 WATER YEARS
AMADOR SUBAREA WEST - LOWER AQUIFER



Well Depth = 575'; Wellhead Elevation = 344'; Well Screen Depth: 250 to 570' bgs. Minimum Threshold = ----

E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-11to14-HydroChemoGraphs18.xlsx\F3-12Grph

FIGURE 7-13
HYDRO-CHEMO GRAPH FOR 3S/2E 7P 3 (CWS 24)
1973 to 2018 WATER YEARS
AMADOR SUBAREA EAST - LOWER AQUIFER



Well Depth = 510'; Wellhead Elevation = 429'; Well Screen Depth: 300 to 490' bgs.

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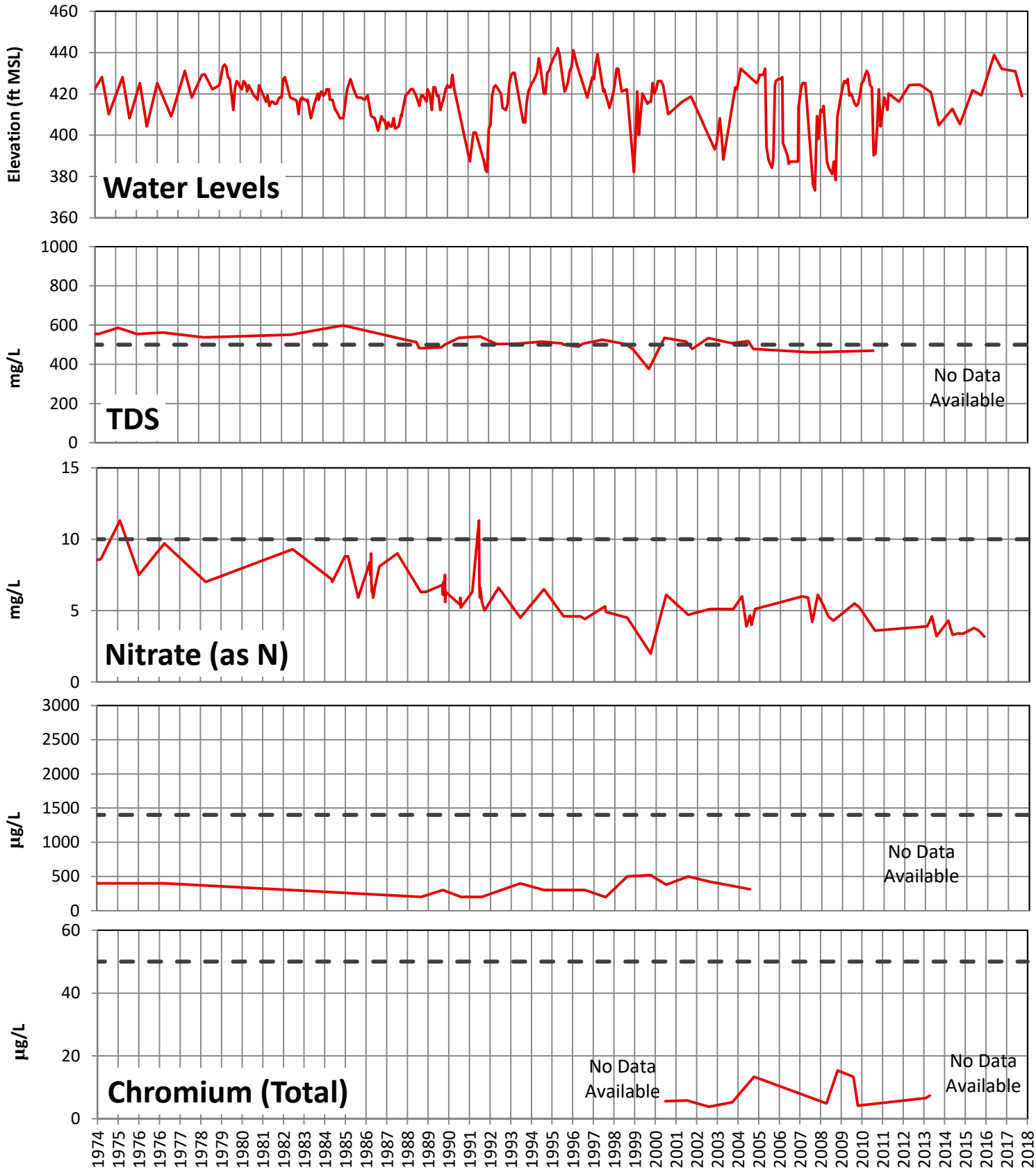
FIGURE 7-14
HYDRO-CHEMO GRAPH FOR 3S/2E 8P 1 (CWS 8)
1974 to 2018 WATER YEARS
MOCHO II SUBAREA - LOWER AQUIFER



Well Depth = 273'; Wellhead Elevation = 466'; Well Screen Depth: 122 to 263' bgs. Minimum Threshold = ----

E:\MONITOR\GQ\2018WY\AnnualReport2018\Fig07-11to14-HydroChemoGraphs18.xlsx\F3-14Grph

8 Land Surface Elevation

8.1 Program Description

8.1.1 Monitoring Network

This section describes the details of Zone 7's ongoing Land Surface Elevation Monitoring Program for subsidence and the results for the 2018 WY. Background information regarding Zone 7's land surface conditions and historic monitoring is provided in *Section 2.3.9, Land Subsidence,* of the Alternative GSP. The program includes a network of approximately 40 elevation benchmarks encompassing Zone 7's production wellfields and spanning the Bernal and Amador Subareas within the Main Basin. The program also includes reference benchmarks located in bedrock outside of the alluvial basin. The land surface elevation surveys are conducted semiannually, the results of which are presented in Zone 7's Annual Reports.

Zone 7's Land Surface Elevation Monitoring Program involves conducting high-precision spirit-level surveys across the Bernal and Amador Subareas, 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 8-1*. From the main A1 circuit, several looped or branched circuits are also surveyed in the same manner to assess land surface elevation changes within other Zone 7 wellfields (Circuits B1, B3, and B4) and across the northern Main Basin boundary (Circuit B5). Circuit B4, which was originally created to monitor elevation changes near Stoneridge Well No. 1, was expanded in 2013 to include the new Chain of Lakes (COL) wellfield. Vertical distances between certain wellhead features, typically between a concrete pedestal and the floor, are also monitored for change and are labeled with "Diff". The normal survey frequency is twice per year for Circuits A1, B1, B3, and B4 and the wellhead features, corresponding with the semiannual groundwater level monitoring events (spring and fall), but only once per year for Circuit B5 (fall). *Table 8-1* and *Figure 8-1* show the land surface elevation monitoring locations for the 2018 WY program.

8.1.2 Program Changes for the Water Year

There were no changes to this program for the 2018 WY.

8.2 Results for the 2018 Water Year

Kier & Wright Civil Engineers and Surveyors, Inc., of Livermore, California, performed the elevation surveys during the weeks of May 7 and September 24, 2018, while Zone 7 staff surveyed the additional wellhead features. *Table 8-2* contains the survey results for the 2018 WY, and reports the seasonal and annual elevation changes between the fall 2017 and fall 2018 surveys. The spatial distribution of the changes in land surface elevations observed during this time period is shown on *Figure 8-2*.

The running net elevation changes, since the start of the monitoring program, at select benchmarks are graphed and grouped by relative proximity to wellfields on *Figure 8-3* (Hopyard), *Figure 8-4* (Mocho), *Figure 8-5* (Chain of Lakes) and *Figure 8-6* (Busch-Valley). For reference, representative groundwater elevations are also plotted on the figures.

Similar to previous years, all observed benchmark elevation changes, except for those for B4-7.0 at COL Well #1, were within the range Zone 7 considers to be "elastic deformation" (i.e., -0.20 to +0.20 ft relative to the origin). The benchmark elevations (except B4-7.0) fluctuated between -0.011 ft and +0.066 ft, with most rising relative to their re fall 2017 WY's elevations.

Site B4-7.0 (COL 1) continues to show a relatively significant loss in elevation, -0.120 ft in 2018 WY and 0.778 ft overall. A geotechnical investigation conducted at the COL 1 wellsite by Cal Engineering & Geology (CEG) for Zone 7 concluded that the site is situated on 40–90 ft of uncompacted fill that is undergoing settlement and/or early landslide movement. The other COL Wellfield benchmarks (B4-4.0, B4-5.0, and B4-6.0) appear to be unaffected by the settlement. Zone 7 is exploring possible alternative or additional benchmark locations outside of the uncompacted fill area for monitoring elevation changes in the COL wellfield in the future.

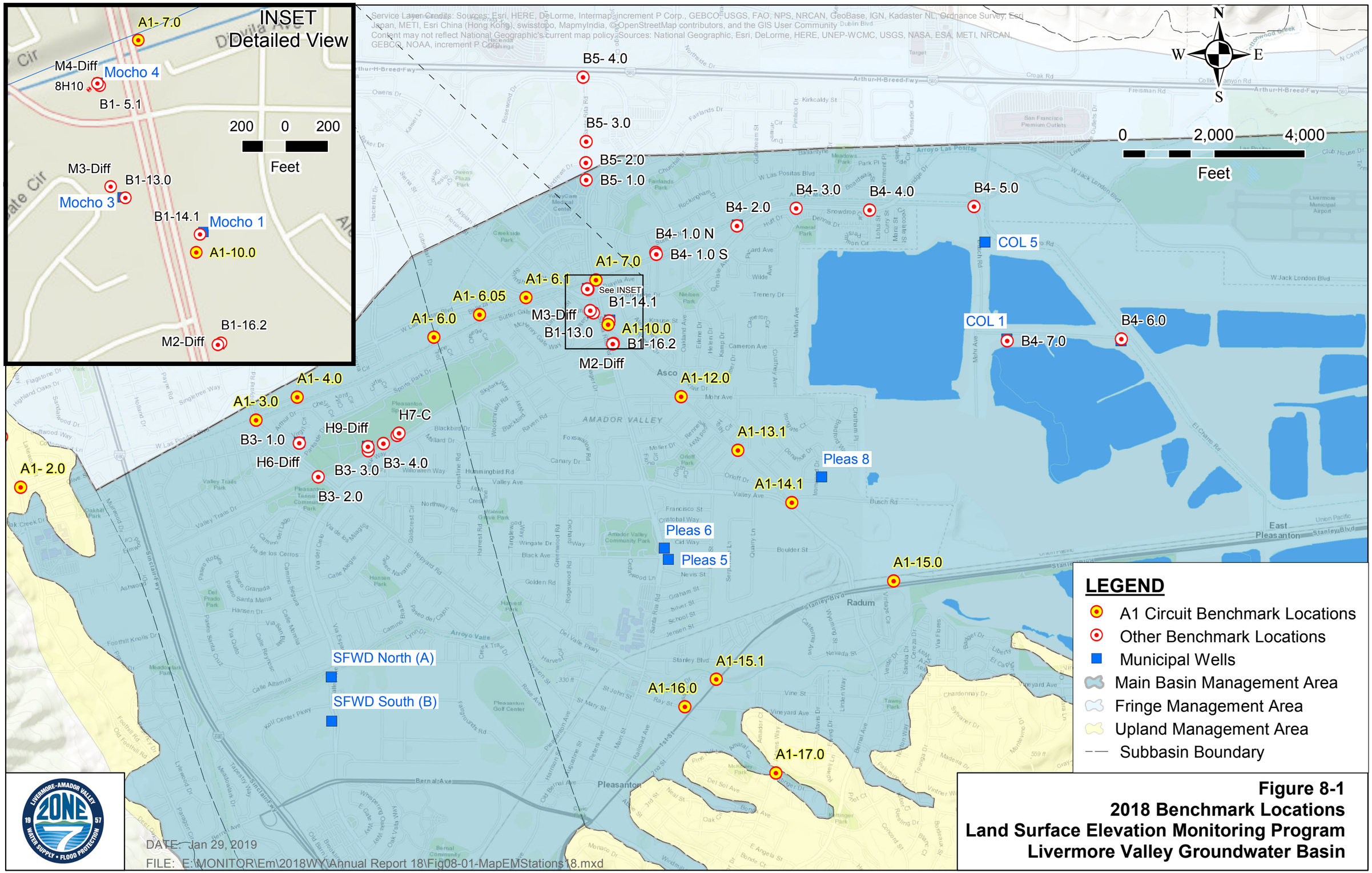
TABLE 8-1
SURVEY POINTS AND DESCRIPTIONS
2018 WATER YEAR

Well	Circuit	Surveyor	Other Name	Location	First Meas	Frequency
A1- 1.0	A1	K&W	G972	Foothill Rd	Nov 02	SemiAnnual
A1- 2.0	A1	K&W	Foothill and Las Positas	NE corner Las Positas Ave and Foothill	Nov 02	SemiAnnual
A1- 3.0	A1	K&W	C972	Hopyard Bridge on Mocho	Nov 02	SemiAnnual
A1- 4.0	A1	K&W	Arroyo Mocho at Chabot Crk	Mocho & Chabot Canal confluence	Nov 02	SemiAnnual
A1- 6.0	A1	K&W	Arroyo Mocho at Tassajara Crk East	Confluence Tassajara Crk and Mocho	Feb 03	SemiAnnual
A1- 6.05	A1	K&W	Arroyo Mocho at Flora Ct	Chisel on E concrete apron on Arroyo Mocho	Feb 03	SemiAnnual
A1- 6.1	A1	K&W	Arroyo Mocho Pleasanton Control	North FC channel West of Stoneridge Mocho Bridge	Feb 03	SemiAnnual
A1- 7.0	A1	K&W	M1257	Brass disk located on SE side of Santa Rita Mocho Bridge	Nov 02	SemiAnnual
A1-10.0	A1	K&W	Vineyard Pipeline at Santa Rita Rd	Mocho 1	Nov 02	SemiAnnual
A1-12.0	A1	K&W	Mohr Ave at Iron Horse	Monument box Mohr Ave & Ironhorse trail	Nov 02	SemiAnnual
A1-13.1	A1	K&W	COP RE 25281	Inside round "water" box on Ironhorse Trail	Apr 08	SemiAnnual
A1-14.1	A1	K&W	Busch and Valley	Disc near Busch/Valley intersection	Oct 07	SemiAnnual
A1-15.0	A1	K&W	D8	Brass disk on bridge foundation	Nov 02	SemiAnnual
A1-15.1	A1	K&W	BM-P929 Reset	First Street at Arooyo Valle Bridge	Apr 03	SemiAnnual
A1-16.0	A1	K&W	V1	Ray St at Old RR tracks	Feb 03	SemiAnnual
A1-17.0	A1	K&W	K2	NE Corner Kottinger and Adams on birdge	Nov 02	SemiAnnual
B1- 5.1	B1	K&W	Mocho 4	Mocho 4 site	Apr 09	SemiAnnual
B1-13.0	B1	K&W	3S/1E 9M 4	Mocho 3 Shiner at entrance door	Feb 03	SemiAnnual
B1-14.1	B1	K&W	3S-1E 9M 2 New	Chisel at M1 entrance door	Nov 04	SemiAnnual
B1-16.2	B1	K&W	B1-16.2	Mocho 2	Apr 13	SemiAnnual
B3- 1.0	B3	K&W	MOCHO-PARK	Parkside	Nov 02	SemiAnnual
B3- 2.0	B3	K&W	1H ALA	Hopyard at Pleasanton Canal	Nov 02	SemiAnnual
B3- 3.0	B3	K&W	HOP 9-BM	FC Channel near Hop9	Feb 03	SemiAnnual
B3- 4.0	B3	K&W	PLEASANTON CANAL	Along Pleasanton Canal	Jan 04	SemiAnnual
B3- 5.0	B3	K&W	HOP 7 MP1	Along the Pleasanton Canal	Jan 04	SemiAnnual
H7-C	B3	K&W	Hop 7 Casing	Hop7 Casing	Apr 03	SemiAnnual
B4- 1.0 N	B4	K&W	AMP-CTL N	AMP Control	Feb 03	SemiAnnual
B4- 1.0 S	B4	K&W	AMP-CTL S	AMP Control	Feb 03	SemiAnnual
B4- 2.0	B4	K&W	Stoneridge Wellhouse	Door at Stoneridge Well	Feb 03	SemiAnnual
B4- 3.0	B4	K&W	GUZMAN PKWY	Guzman Pkwy, Pleasanton	Jan 04	SemiAnnual
B4- 4.0	B4	K&W	Trevor Pkwy at Stoneridge	Trevor Pkwy, Pleasanton	Jan 04	SemiAnnual
B4- 5.0	B4	K&W	El Charro at Arroyo Mocho	West El Charro Rd Bridge at Arroyo MochoTP697 CS	Apr 13	SemiAnnual
B4- 6.0	B4	K&W	Chain of Lakes 2	TP709 PK/W	Apr 13	SemiAnnual
B4- 7.0	B4	K&W	Chain of Lakes 1	TP715 CUT-X	Apr 13	SemiAnnual
B5- 1.0	B5	K&W	OSRR-BC	New Monument disk	Feb 03	Annual
B5- 2.0	B5	K&W	OSRR-ANDREW	New Monument disk	Feb 03	Annual
B5- 3.0	B5	K&W	OSRR-CAFÉ	Monument box in middle of Old Santa Rita Road	Feb 03	Annual
B5- 4.0	B5	K&W	Tass-Rose	Santa Rita at Rosewood	Feb 03	Annual
H6-Diff	Hop	Z7	H6-Diff	Hop 6 pedestal to ground difference	Jan 09	Monthly
H9-Diff	Hop	Z7	H9-Diff	Hop 9 pedestal to ground difference	Jan 09	Monthly
M2-Diff	Mocho	Z7	M2-Diff	Mocho 2 pedestal to ground difference	Jan 09	Monthly
M3-Diff	Mocho	Z7	M3-Diff	Mocho 3 pedestal to ground difference	Jan 09	Monthly
M4-Diff	Mocho	Z7	M4-Diff	Mocho 4 pedestal to ground difference	Jan 09	Monthly
S-Diff	Mocho	Z7	S-Diff	Stoneridge pedestal to ground difference	Jan 09	Monthly

TABLE 8-2
KIER AND WRIGHT SURVEY MEASUREMENTS
2018 WATER YEAR

Site	Site Description	Fall 2017 Elevation in ft NAVD88	Spring 2018 Elevation in ft NAVD88	Fall 2018 Elevation in ft NAVD88	Change in Elevation (ft)		
					Fall 2017 to Spring 2018	Spring 2018 to Fall 2018	Fall 2017 to Fall 2018
A1- 1.0	G972	365.705	365.705	365.705	0.000	0.000	0.000
A1- 2.0	Foothill and Las Positas	405.480	405.469	405.469	-0.011	0.000	-0.011
A1- 3.0	C972	330.619	330.637	330.639	0.018	0.002	0.020
A1- 4.0	Arroyo Mocho at Chabot Crk	324.058	324.082	324.084	0.024	0.002	0.026
A1- 6.0	Arroyo Mocho at Tassajara Crk East	327.840	327.846	327.849	0.006	0.003	0.009
A1- 6.05	Arroyo Mocho at Flora Ct	329.365	329.364	329.367	-0.001	0.003	0.002
A1- 6.1	Arroyo Mocho Pleasanton Control	332.682	332.689	332.692	0.007	0.003	0.010
A1- 7.0	M1257	341.922	341.932	341.936	0.010	0.004	0.014
A1-10.0	Vineyard Pipeline at Santa Rita Rd	340.820	340.842	340.847	0.022	0.005	0.027
A1-12.0	Mohr Ave at Iron Horse	347.538	347.547	347.552	0.009	0.005	0.014
A1-13.1	COP RE 25281	350.003	350.008	350.014	0.005	0.006	0.011
A1-14.1	Busch and Valley	356.874	356.883	356.888	0.009	0.005	0.014
A1-15.0	D8	367.020	367.020	367.027	0.000	0.007	0.007
A1-15.1	BM-P929 Reset	361.498	361.493	361.497	-0.005	0.004	-0.001
A1-16.0	V1	367.036	367.032	367.035	-0.004	0.003	-0.001
A1-17.0	K2	399.808	399.808	399.808	0.000	0.000	0.000
B1- 5.1	Mocho 4	336.651	336.701	336.711	0.050	0.010	0.060
B1-13.0	3S/1E 9M 4	336.448	336.498	336.501	0.050	0.003	0.053
B1-14.1	3S-1E 9M 2 New	340.921	340.983	340.987	0.062	0.004	0.066
B1-16.2	B1-16.2	341.469	341.507	341.491	0.038	-0.016	0.022
B3- 1.0	MOCHO-PARK	323.058	323.088	323.054	0.030	-0.034	-0.004
B3- 2.0	1H ALA	320.604	320.620	320.633	0.016	0.012	0.029
B3- 3.0	HOP 9-BM	321.615	321.622	321.615	0.007	-0.007	0.000
B3- 4.0	PLEASANTON CANAL	323.620	323.640	323.644	0.020	0.004	0.024
B3- 5.0	HOP 7 MP1	322.570	322.590	322.583	0.020	-0.007	0.013
B4- 1.0 N	AMP-CTL N	322.228	322.253	322.244	0.025	-0.009	0.016
B4- 1.0 S	AMP-CTL S	322.089	322.114	322.104	0.025	-0.010	0.015
B4- 2.0	Stoneridge Wellhouse	344.804	344.819	344.817	0.015	-0.002	0.013
B4- 3.0	GUZMAN PKWY	343.906	343.929	343.922	0.023	-0.007	0.016
B4- 4.0	Trevor Pkwy at Stoneridge	346.503	346.525	346.519	0.022	-0.006	0.016
B4- 5.0	El Charro at Arroyo Mocho	357.621	357.648	357.642	0.027	-0.006	0.021
B4- 6.0	Chain of Lakes 2	363.816	363.870	363.868	0.054	-0.002	0.052
B4- 7.0	Chain of Lakes 1	357.617	357.546	357.497	-0.071	-0.049	-0.120
B5- 1.0	OSRR-BC	344.030	NA	344.036	NA	NA	0.006
B5- 2.0	OSRR-ANDREW	343.103	NA	343.114	NA	NA	0.011
B5- 3.0	OSRR-CAFÉ	344.563	NA	344.565	NA	NA	0.002
B5- 4.0	Tass-Rose	349.657	NA	349.663	NA	NA	0.006
H7-C	Hop 7 Casing	324.908	324.918	324.926	0.010	0.008	0.018

* Fixed Reference Point NM = Not measured NA = Not applicable/available



DATE: Jan 29, 2019
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Figure 8-1
2018 Benchmark Locations
Land Surface Elevation Monitoring Program
Livermore Valley Groundwater Basin

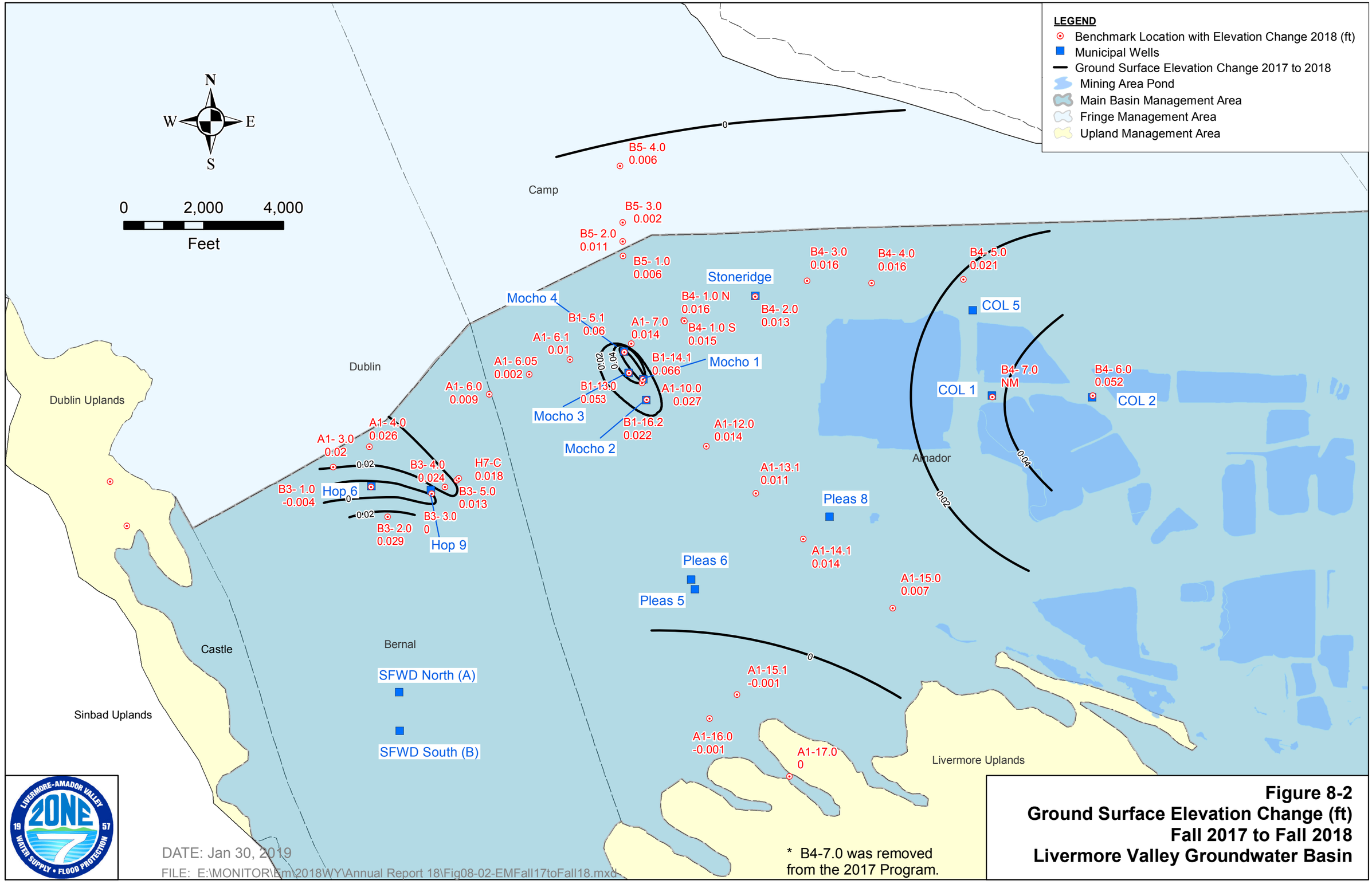

Figure 8-2
Ground Surface Elevation Change (ft)
Fall 2017 to Fall 2018
Livermore Valley Groundwater Basin

* B4-7.0 was removed from the 2017 Program.

DATE: Jan 30, 2019

FILE: E:\MONITOR\Em\2018WY\Annual Report 18\Fig08-02-EMFall17toFall18.mxd

FIGURE 8-3
NET LAND SURFACE ELEVATION CHANGES
HOPYARD WELLFIELD

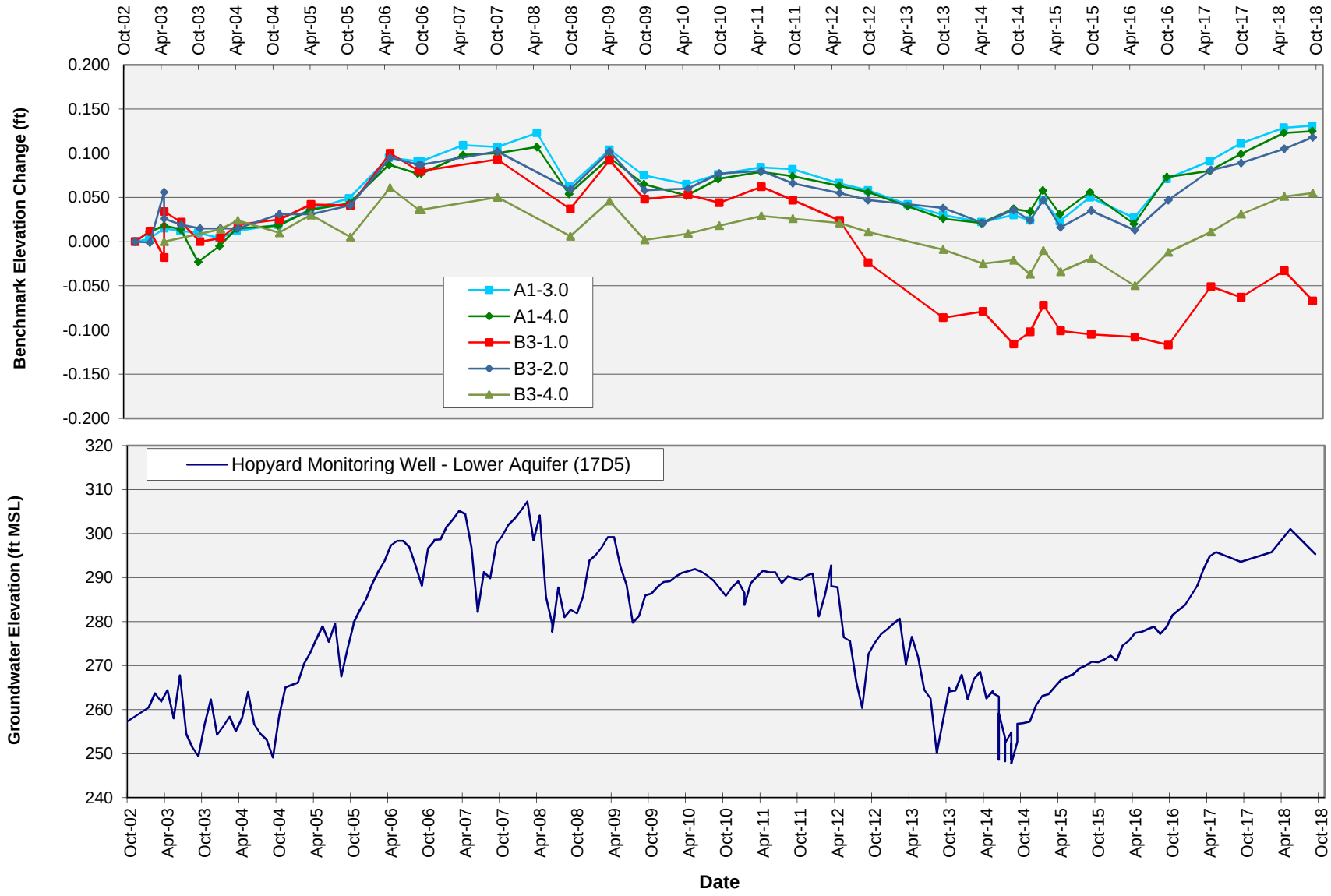

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FIGURE 8-4
NET LAND SURFACE ELEVATION CHANGES
MOCHO WELLFIELD

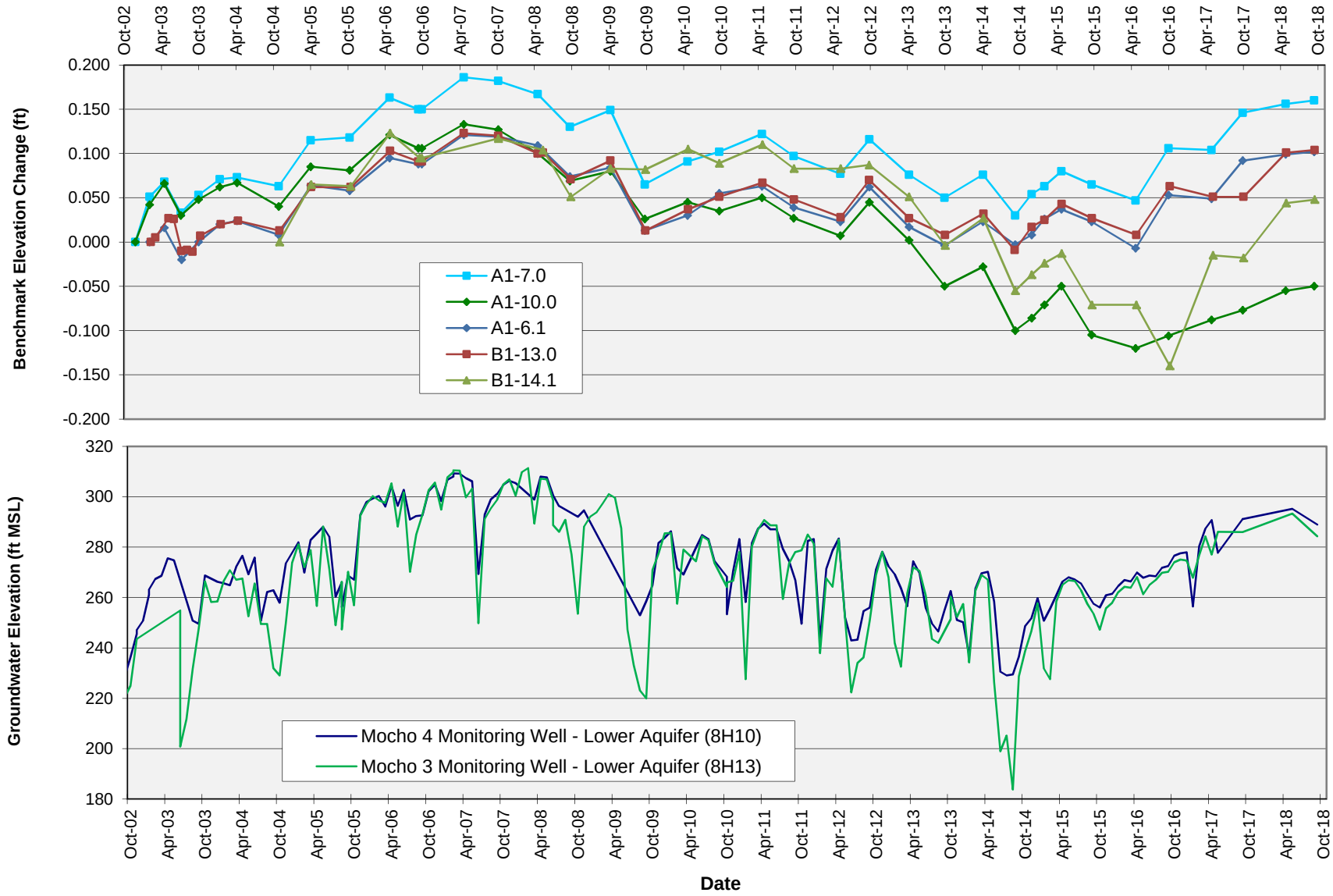
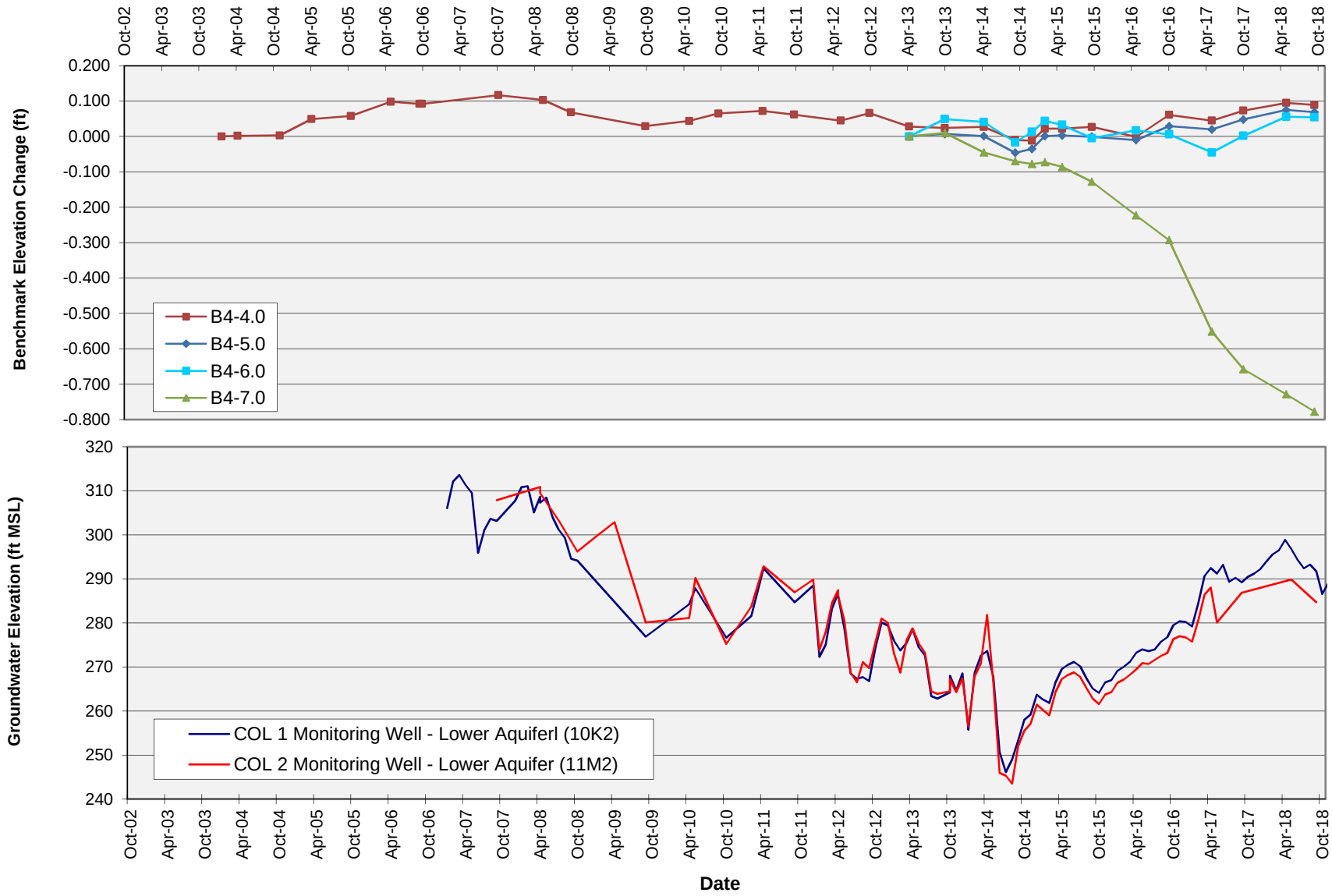


FIGURE 8-5
NET LAND SURFACE ELEVATION CHANGES
CHAIN OF LAKES WELLFIELD



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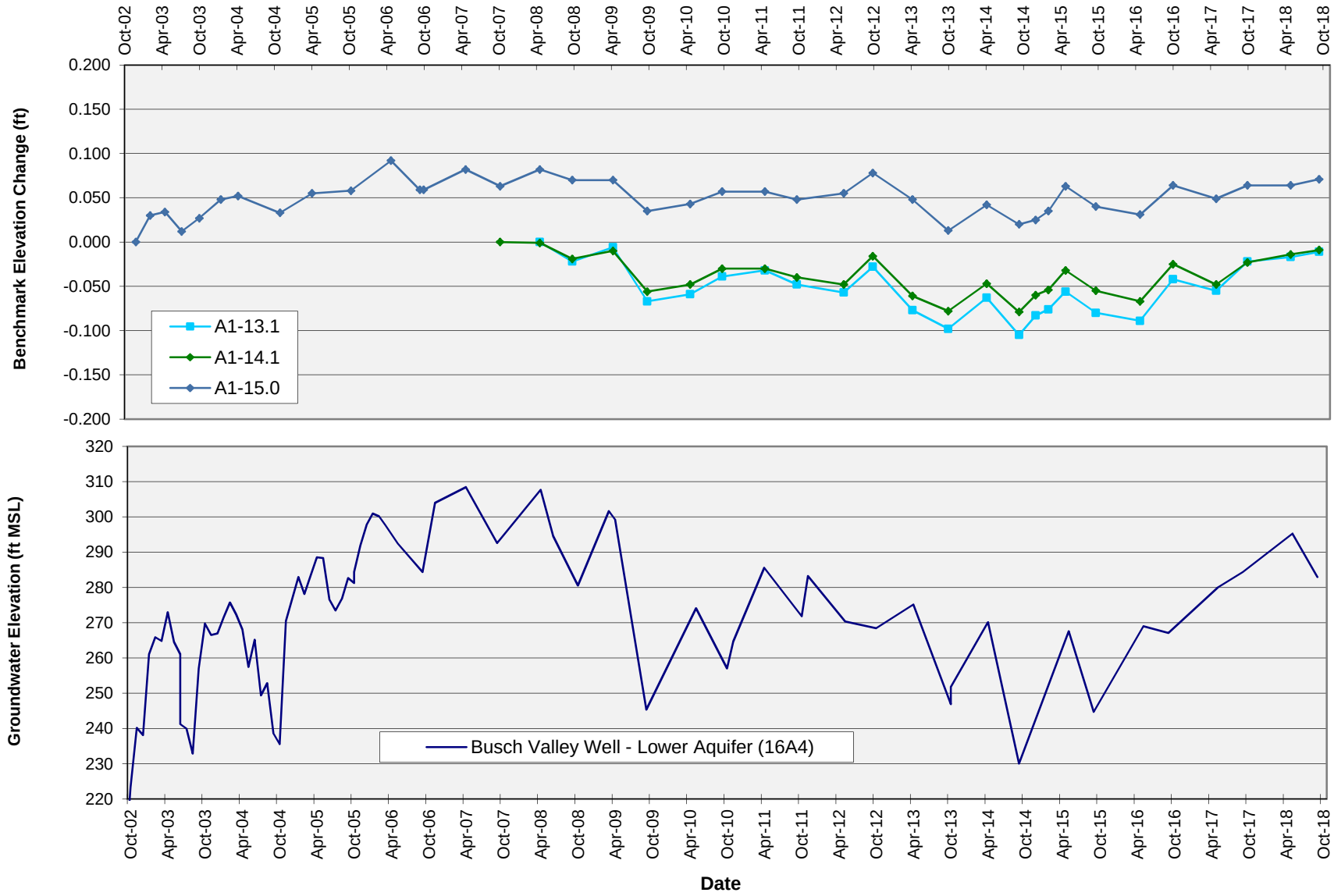
2/28/2019

FIGURE 8-6
NET LAND SURFACE ELEVATION CHANGES
BUSCH VALLEY WELL



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2/5/2019

9 Land Use

9.1 Program Description

9.1.1 Monitoring Network

This section presents the results of Zone 7's Land Use Monitoring Program for the 2018 WY. Zone 7 monitors land use changes in the Valley as part of the long-range groundwater basin management program. The Land Use Monitoring Program identifies significant changes in land use using aerial photography, site visits, and development referrals reviewed by Zone 7. The emphasis is on changes in pervious areas, and quantity and quality of irrigation water that could affect the volume or quality of water recharging the Main Basin. The information is used by Zone 7 to quantify areal recharge (i.e., "rainfall recharge" and "applied water recharge").

For more information on Zone 7's Land Use Monitoring Program, see the *Section 1.3.1, Land Use*, of the Alternative GSP.

9.1.2 Program Changes for the Water Year

There were no changes to the Land Use Monitoring Program during the 2018 WY.

9.2 Results for the 2018 Water Year

Although there was some in-fill development that occurred during the 2018 WY, no major land use changes that would significantly affect the groundwater supply or groundwater quality were identified by Zone 7's land use review efforts. *Figure 9-1* shows the various land use areas in the Livermore Valley Groundwater Basin, and their main source of irrigation water, as understood by Zone 7. *Table 9-1* lists the acreage of each type of the land use type by Groundwater Management Area and main irrigation water type: i.e., delivered water, groundwater, or recycled water.

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TABLE 9-1
LAND USE ACREAGE (in acres)
2018 WATER YEAR
LIVERMORE VALLEY GROUNDWATER BASIN

Category / Basin / Irrigation Water Source	Main Basin					Fringe Basin					Upland Basin				
	DW	GW	RW	none	Total	DW	GW	RW	none	Total	DW	GW	RW	none	Total
Agriculture (non-vineyard)	56	94	0	0	150	0	28	0	0	28	146	47	0	0	193
Agriculture (vineyard)	1,497	19	0	0	1,516	708	0	0	0	708	1,840	0	0	0	1,840
Total Agricultural	***1,552***	***113***	***0***	***0***	***1,666***	***708***	***28***	***0***	***0***	***735***	***1,986***	***47***	***0***	***0***	***2,032***
Commercial and Business	1,402	42	347	0	1,792	3,827	117	1,182	0	5,126	387	14	28	0	430
Public	563	0	399	0	961	886	3	57	0	946	141	0	88	0	229
Public (Irrigated Park)	563	0	118	0	680	164	0	87	0	251	97	0	11	0	108
Residential (high density)	421	0	0	0	421	261	0	158	0	419	28	0	15	0	43
Residential (medium density)	6,426	0	17	0	6,443	5,362	0	25	0	5,386	2,862	0	49	0	2,911
Residential (low density)	165	150	0	0	315	20	0	0	0	20	250	173	0	0	423
Roads	0	0	0	78	78	0	0	0	701	701	0	0	0	93	93
Total Urban	***9,540***	***192***	***880***	***78***	***10,689***	***10,518***	***120***	***1,510***	***701***	***12,849***	***3,764***	***187***	***192***	***93***	***4,237***
Golf Course	140	90	128	0	357	230	15	66	0	311	466	172	0	0	638
Residential (rural)	43	155	0	0	198	13	373	0	0	386	166	147	0	0	313
Mining Area (pit)	0	0	0	2,038	2,038	0	0	0	0	0	0	0	0	0	0
Open Space	0	0	0	3,827	3,827	0	0	0	7,610	7,610	0	0	0	20,388	20,388
Water	0	0	0	1,035	1,035	0	0	0	65	65	0	0	0	170	170
Total Other	***182***	***245***	***128***	***6,899***	***7,454***	***243***	***389***	***66***	***7,675***	***8,372***	***632***	***319***	***0***	***20,558***	***21,509***
TOTALS FOR 2018 WY	**11,274**	**550**	**1,008**	**6,977**	**19,809**	**11,468**	**536**	**1,576**	**8,376**	**21,956**	**6,382**	**553**	**192**	**20,651**	**27,778**
TOTALS FOR 2017 WY	**11,500**	**501**	**994**	**6,811**	**19,806**	**11,378**	**555**	**1,617**	**8,404**	**21,953**	**6,391**	**528**	**189**	**20,669**	**27,776**
CHANGE SINCE PREVIOUS YEAR	**-226**	**49**	**14**	**166**	**3**	**90**	**-18**	**-42**	**-28**	**3**	**-9**	**25**	**3**	**-17**	**1**

Irrigation Water Sources
DW = Delivered Municipal Water
GW = Groundwater
RW = Recycled Water

N
W E
S

0 6,000 12,000
Feet

LEGEND

- Main Basin
- Fringe Area
- Upland Area

Irrigation Source Water

- Municipal or Imported
- Groundwater
- Recycled Water
- Residential (rural)
- Residential (low density)
- Residential (medium density)
- Residential (high density)
- Commercial and Industrial
- Public
- Public (Irrigated Schools and Parks)
- Golf Course
- Agriculture (non-vineyard)
- Agriculture (vineyard)
- Mining Area (pit)
- Water
- Open Space
- Roads

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Figure 9-1
Map of Land Use
2018 Water Year
Livermore Valley Groundwater Basin

10 Wastewater and Recycled Water

10.1 Program Description

10.1.1 Monitoring Network

The City of Livermore and the Dublin San Ramon Services District (DSRSD) are currently responsible for treating the vast majority of wastewater produced within the Valley. Both of these publicly owned treatment works (POTWs) produce secondary-treated and tertiary-treated effluent, which is disinfected and either reclaimed and used for landscape irrigation or exported from the Valley through the Livermore-Amador Valley Water Management Agency (LAVWMA) export pipeline.

Beginning in the 2017 WY and continuing through the 2018 WY, City of Pleasanton used recycled water produced by Livermore and DSRSD for landscape irrigation in the City of Pleasanton. Pleasanton's usage is included in the Livermore Water Reclamation Plant (LWRP) and DSRSD recycled water totals reported in this report.

Elsewhere in the Basin, a minor amount of untreated or partially-treated wastewater may reach the groundwater supply as percolate. The sources of this unmanaged supply component include the Veterans Administration (VA) Hospital onsite sewage treatment plant, residential and commercial septic systems located over the entire groundwater basin, and leaking municipal sewer lines throughout the cities. This report attempts to quantify (estimate) these minor water supply components, as they often have some significance for the computed Main Basin's salt and nutrient loading (*Sections 13.4* and *13.5*).

For more information on Zone 7's Wastewater and Recycled Water Monitoring Program, see the *Section 4.8, Wastewater and Recycled Water Monitoring*, of the Alternative GSP.

10.1.2 Program Changes for the Water Year

There were no changes to the Wastewater and Recycled Water Monitoring Program during the 2018 WY.

10.2 Results for the 2018 Water Year

10.2.1 Municipal Wastewater and Recycled Water

In the 2018 WY, about 97% of the wastewater produced over the groundwater basin was treated at LWRP and DSRSD. The wastewater volumes for the 2018 WY are presented in *Table 10-A* below.

Table 10-A: Wastewater and Recycled Water Volumes (AF) for the 2018 Water Year

	LWRP	DSRSD	Total
Wastewater Influent	6,153	11,558	17,711
Treated Effluent Exported via LAVWMA*	4,709	7,391	12,100
Total Volume Recycled	2,367	4,364	6,731
RW Applied to Main Basin**	522	344	866

* Does not include Zone 7 Demin Plant discharge to LAVWMA via DSRSD

** Only the portion of recycled water that was applied over the Main Basin as landscape irrigation.

DSRSD Dublin San Ramon Services District
LAVWMA Livermore-Amador Valley Water Management Agency
LWRP Livermore Wastewater Reclamation Plant

In the 2018 WY, a total of 17,711 AF of municipal wastewater was treated at the two POTWs, of which 12,100 AF (68%) was exported and about 6,731 (38%) was recycled and used primarily for landscape irrigation (33% in the 2017 WY). About 22% of the LWRP's recycled water (522 AF) and 8% of DSRSD's recycled water (344 AF) was applied to landscapes over the Main Basin (including City of Pleasanton's applications). The remaining recycled water was applied on areas outside of the Main Basin; primarily on areas overlying the northern Fringe Subarea and the Tassajara uplands (*Figure 10-1*).

Recycled water continues to account for small fractions of the Valley's water supply (13%) and Main Basin recharging waters (approximately 2%); however, of greater benefit, the recycled water use in the 2018 WY potentially conserved up to 6,731 AF of water that might have otherwise come from groundwater storage.

10.2.2 Recycled Water Quality.

The recycled water from both wastewater plants met the State Water Resource Control Board, Division of Drinking Water's "Title 22" water quality standards for irrigation uses during the 2018 WY. *Table 10-B* below presents the concentration ranges of salts (measured as TDS) and nitrogen (N) compounds in the applied recycled water during the 2018 WY.

Table 10-B: Recycled Water Quality (mg/L, except where noted) for the 2018 Water Year

Compound	LWRP	DSRSD
Salts		
Total Dissolved Solids (TDS)	520-610	626-808
Nitrogen Compounds		
Nitrogen (as NO_3)	0.061-0.12	ND-0.6
Nitrogen (as NO_2)	0.33-1.7	0.5-3.4
Total Kjeldahl Nitrogen (TKN)	45-50	18-46
Nitrogen Loading (lbs/AF)	123-137	49-128

DSRSD Dublin San Ramon Services District
LWRP Livermore Wastewater Reclamation Plant
ND not-detected
lbs/AF pounds per acre-feet

Zone 7 assumes that the entire salt mass in the applied water is transported through the vadose zone, surficial clays, if any, and eventually reaches groundwater. This leads to a conservative (potentially high) estimate of the salt loading attributed to recycled water applications. About 876 tons (approximately 8%) of the Main Basin's salt inflow (10,937 tons) was attributed to recycled water use over the Main Basin during the 2018 WY. However, if potable water supplies would have been used for this irrigation demand, the salt loading would have been about 508 tons or only about 368 tons less. This difference is significantly less than the 1,168 tons that was removed by Zone 7's Mocho Groundwater Demineralization Plant (MGDP) in the 2018 WY.

The three N compounds in *Table 10-B* above represent the N content potentially available for conversion to nitrate as the water percolates through the soil. The bottom row of the table shows the total N loading (in pounds (lbs) of N per AF) from all N loading. However, from a practical standpoint, much of the N will be removed from the percolate through soil denitrification and plant uptake processes.

While salt and nutrients are the primary constituents of concern for wastewater and recycled water applications over the Main Basin, other constituents of emerging concern (CECs) would need to be considered if recycled water is used for future aquifer recharge projects.

10.2.3 Other Applied Wastewater

The program assumes that a small amount of untreated wastewater leaches to the Main Basin from the VA Hospital wastewater treatment ponds located in southern Livermore, domestic onsite wastewater treatment systems (OWTS) (e.g., septic systems), and leaking wastewater pipelines that run throughout the groundwater basin. There have been no significant changes in land use or septic system densities over the Main Basin that would change the estimated water contribution from these sources in recent

years. The pipeline age is considered in the estimation of "Pipe Leakage." The estimated volumes of leachate from these three sources for the 2018 WY are presented in *Table 10-C, below*.

Table 10-C: Other Wastewater Volumes (AF) for the 2018 Water Year

	VA Hospital*	Septic Tanks*	Pipe Leakage**	Total
Wastewater Leachate	50	80	454	584

* Estimated total over the Main Basin, based on size and number of OWTS
** Calculated. Includes leakage from sanitary sewer and recycled water pipes
AF acre-feet
OWTS Onsite Wastewater Treatment System

Table 10-D presents the estimated concentration ranges of salts (i.e., TDS) and N compounds in the wastewater leachate for the 2018 WY.

Table 10-D: Other Wastewater Quality (mg/L, except where noted) for the 2018 Water Year

Compound	VA Hospital	Septic Tank Leachate	Pipe Leakage
Salts			
Total Dissolved Solids (TDS)	361-613	500–700	520-808
Nitrogen Compounds			
Nitrogen (as NO_3)	607–26	ND–Trace	ND–0.6
Nitrogen (as NO_2)	3.5-15	ND–Trace	0.3-3.4
Total Kjeldahl Nitrogen (TKN)	0.15-0.2	50–90*	18-50
Nitrogen Loading (lbs/AF)	3-134	136–245	49-137

* Estimated
lbs/AF pounds per acre-feet
mg/L milligrams per liter
ND not-detected

LEGEND

Wastewater Facilities
- Veterans Hospital Facilities
- Livermore Water Reclamation Plant
- DSRSD Regional Treatment Facility
- LAVWMA Pipeline

Source Recycled Water
- DSRSD
- LWRP

Application of Recycled Water
- DSRSD
- City of Livermore
- City of Pleasanton
- Approximate Limit of Confining Layer
- Existing Parcels with OWTS
- Livermore Valley Groundwater Basin
- Main Basin
- Fringe Management Area
- Upland Management Area
- Main Basin (Recharge Area)
- Streams

DSRSD

LWRP

VA Ponds

VA Plant

N
W E
S

0 6,000 12,000
Feet

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Figure 10-1
Wastewater and Recycled Water Application Areas 2018 WY
Livermore Valley Groundwater Basin

11 Groundwater Storage

11.1 Groundwater Storage Calculations

11.1.1 Calculation Methods

To avoid significant depletion of groundwater storage, Zone 7 operates the Livermore basin such that groundwater in storage remains between a full basin volume (254 thousand acre-feet [TAF]) and the historic low water levels, which represents about one half of total storage volume. This 126,000 AF is referred to as Operational Storage. The minimum threshold for basin storage is 128 TAF, which represents the remaining emergency basin storage when water levels throughout the Main Basin are at historic lows. Groundwater below the threshold is regarded as Reserve Storage that is unavailable during nonemergency conditions. Most of the groundwater in storage is contained in the Main Basin, which is characterized by the largest saturated thickness.

Zone 7 uses two methods for calculating groundwater storage in the Main Basin: The Groundwater Elevation (GWE) Method and the Hydrologic Inventory (HI) Method. The GWE method (*Section 11.1.2*) uses groundwater level data and storage coefficients for "nodes" (originally developed by DWR in 1974) to estimate the total volume of water in the Main Basin (see *Sections 2.2.3.4, Representation of Aquifers and Aquitards in Groundwater Models*, and *2.4.1, Overview of Methodology*, of the Alternative GSP). The HI method (*Section 11.1.3*) involves accounting for inflows and outflows for each WY and adds the net change in storage to the previous year's volume (see *Sections 2.4.2, Current Groundwater Budget*, and *2.4.3, Historical Groundwater Budget*, of the Alternative GSP). Storage volumes from the two methods are averaged to quantify the total storage of the Main Basin (*Section 11.1.4*. See *Section 2.4.1, Overview of Methodology*, of the Alternative GSP for more details).

11.1.2 Groundwater Elevation Results

The GWE method yielded a total storage of 245.6 TAF at the end of 2018 WY, which is 0.2 TAF less than the GWE value calculated for 2017 WY. *Figure 11-1* shows the Upper and Lower Aquifer groundwater elevations used to calculate the GWE method storage for the 2018 WY. The change in storage from fall 2017 to fall 2018 for each Main Basin node is shown in *Figure 11-2*. *Table 11-1* shows the historical annual GWE groundwater storage volumes for each subarea from the 1974 WY to 2018 WY.

11.1.3 Hydrologic Inventory Results

The HI method produced a total storage value of 253.2 TAF for the end of 2018 WY; which is about 3.0 TAF more than the end of 2017 WY HI value. The results of the HI method for the 2018 WY are summarized below in *Table 11-A*. All of the HI components are listed in *Table 11-2* along with their method of measurement and their approximate accuracy. The historic HI components and results for WYs 1974 to 2018 are tabulated in *Table 11-3,* and charted in *Figure 11-3* along with the WY type (e.g.,

wet, normal, dry, etc.) noted for each year. *Figure 11-4* shows a map of the pumping well locations during the 2018 WY, and a representation of the relative volumes of water pumped from each well.

Table 11-A: HI Method Groundwater Storage Supply and Demand Volumes, 2018 WY (AF)

CATEGORY	Sustainable Avg	2018	% of Avg	Change from 2017
SUPPLIES	**19,800**	**19,862**	**100%**	**-19,033**
Stream Recharge Artificial	5,300	6,773	128%	-2,842
Stream Recharge Natural	6,600	2,787	42%	-8,093
Rainfall Recharge	4,300	6,554	152%	-7,533
Applied Water Recharge	1,600	1,713	107%	-603
Pipe Leakage	1,000	1,034	103%	38
Subsurface Inflow	1,000	1,000	100%	0
DEMANDS	**18,800**	**16,890**	**90%**	**3,254**
Zone 7 Pumping excluding DSRSD	5,300	4,215	80%	972
Other Pumping	8,400	7,761	92%	290
Agricultural Pumping	400	115	29%	6
Mining Losses	1,400	700	50%	0
Evapotranspiration	3,200	3,536	110%	1,423
Subsurface Outflow	100	564	564%	564
NET CHANGE (SUPPLY - DEMAND)	**1,000**	**2,972**		**-22,287**
TOTAL STORAGE (HI Method)		**253,236**		**2,972**

AF = acre-feet
Avg = average
DSRSD = Dublin San Ramon Services District

11.1.4 Total Storage

The total groundwater storage for the Main Basin is computed by averaging the storage estimates from the GWE and HI methods (*Table 11-B)*. As a result, the total groundwater in storage at the end of 2018 WY was approximated at 248 TAF, with 120 TAF of groundwater available as operational storage, which is about 95% of the total operational storage capacity (i.e., 126 TAF from 1983 WY).

Table 11-B: Groundwater Storage Summary, 2018 WY (in Thousand AF)

Storage Calculation Method	End of 2017 WY	End of 2018 WY	Change in Storage
Groundwater Elevations (GWE)	245.8	245.6	-0.2
Hydrologic Inventory (HI)	250.3	253.2	2.9
Total Storage (average of GWE & HI)	248.0	249.4	1.4
Operational Storage*	120.0	121.4	1.4

* Operational Storage = Total Storage-Reserve Storage (i.e., 128 TAF)

11.2 Groundwater Budget

11.2.1 Budget Categories

Groundwater inflows and outflows in the Main Basin are budgeted in two categories.

- Natural Recharge and Demand—groundwater not managed or pumped by Zone 7
- Artificial Recharge and Zone 7 Pumping—groundwater managed and pumped by Zone 7 (i.e., "Conjunctive Use")

Annual recharge and demand for both the natural and artificial components, from the 1974 WY to the 2018 WY, are charted in *Figure 11-5*. The figure also shows the cumulative groundwater storage relative to the 1974 WY storage value, which supports the notion that that groundwater storage has been managed sustainably over the last 44 years.

11.2.2 Natural Recharge and Demand

In 1992, Zone 7 estimated that the long-term average "natural" groundwater inflow into the Main Basin is about 13,400 AF annually (Zone 7, 1992). This long-term average (shown as the "sustainable values" in the tables below) was primarily based on average local precipitation and natural recharge over a century of hydrologic records; however, the actual amount of natural recharge varies from year to year depending on the amount of local precipitation during the year. Recharge from irrigation (applied water) is also included in the "natural" inflow total, because of its steady, sustainable, contribution to groundwater recharge in the Basin.

The "natural" groundwater demand (outflow), which includes groundwater pumping (other than Zone 7's), evapotransporation (ETo), mining losses, and groundwater basin overflow is allocated to the "natural" inflow. As a routine, Zone 7 monitors each "natural" demand component and checks whether it is within the projected sustainable average range. *Table 11-C* below summarizes the results for the 2018 WY.

Table 11-C: Natural Groundwater Inflow and Demand, 2018 WY

Component	Estimated Sustainable Values (AF/Yr)	2018 WY (AF)	Percentage of Sustainable Average
Natural Recharge	13,400	11,490	86%
Natural Demand	13,400	12,111	90%
Net Natural Recharge	0	-621	-5%*

AF = acre-feet
AF/Yr = acre-feet per year
* = percent of Sustainable Natural Recharge

Much of the "natural" demand (7,214 AF of the total 13,400 AF) comes from groundwater pumped by Zone 7's retailers. By contract, the retailers are permitted to pump a Groundwater Pumping Quota (GPQ), accounted for a calendar year (CY) basis, without having to pay a replenishment fee to Zone 7. They are allowed to carry forward any un-pumped GPQ (up to 20% of their GPQ). The retailer's GPQ, along with their groundwater pumping volumes for the 2018 CY, are shown in *Table 11-D* below. None of the retailers pumped more than their respective GPQ in 2018 WY.

Table 11-D: Retailer Groundwater Pumping and Quotas in 2018 Calendar Year (AF)

Retailer	GPQ	Carryover 2017	Pumped in 2018	Carryover to 2019**
City of Pleasanton	3,500	0	3,497	3
Cal Water Service	3,069	614	2,396	614
DSRSD (pumped by Zone 7)	645	0	645	0
City of Livermore (not used)*	31	-	0	-
Total	7,214	614	6,538	617

AF = Acre-feet
GPQ = Groundwater Pumping Quota
* = City of Livermore no longer pumps groundwater, GPQ not included in totals or carryover.
** = Maximum of 20% of GPQ can be carried over

11.2.3 Artificial Recharge and Demand—Conjunctive Use

Since the 1960s, Zone 7 has actively embraced a "conjunctive use" approach to basin management by integrating local and imported surface water supplies with the local conveyance, storage, and groundwater recharge features. These features include local arroyos (which are also used as flood protection facilities during wet seasons) and two former quarry pits (Lake I and Cope Lake). Zone 7's "artificial recharge" operation involves releasing imported water supplies into the local arroyos to recharge the groundwater basin. The volume of artificial recharge is dependent on Zone 7's annual SWP allocations, precipitation captured locally, and water supply operations plans. Typically, Zone 7 will commence artificial recharge operations during times of surplus import water availability.

While groundwater pumping by the retailers is accounted for in the "natural" budget (see above), Zone 7's groundwater pumping and artificial recharge volumes are accounted for in the "conjunctive use" budget. Zone 7's annual groundwater production and artificial recharge operations vary with the availability of surface water, treatment plant capacity, and the available groundwater storage space.

Table 11-E below shows the artificial recharge and Zone 7's groundwater pumping totals for the 2018 WY. These totals do not include the water Zone 7 pumps for DSRSD (usually 645 AF/yr), which is considered part of the "natural" demand.

Table 11-E: Artificial Recharge and Zone 7 Groundwater Pumping in 2018 WY

Component	Estimated Sustainable Avg (AF/Yr)	2018 WY (AF)	Percentage of Sustainable Average
Artificial Recharge	5,300	6,773	128%
Zone 7 Pumping	5,300	4,215	80%
Net Artificial Recharge	0	2,558	48%*

AF = acre-feet
AF/Yr = acre-feet per year
Avg = average
* = percent of Sustainable Artificial Recharge

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TABLE 11-1
TOTAL MAIN BASIN STORAGE BY SUBAREA (AF)
1974 TO 2018 WATER YEARS

Water Year	Bernal	Amador		Mocho II	Total
		Amador West	Amador East		
1974	49,651	52,916	80,671	29,821	213,060
1975	51,149	54,220	80,840	28,872	215,080
1976	54,180	56,319	86,194	29,012	225,705
1977	51,970	53,968	81,889	27,954	215,782
1978	50,272	52,077	79,541	27,751	209,641
1979	52,863	56,739	89,122	29,210	227,933
1980	55,952	60,000	94,014	29,500	239,466
1981	57,910	61,890	95,688	30,224	245,712
1982	57,623	61,228	93,235	29,156	241,242
1983	58,654	63,488	100,642	31,492	254,277
1984	59,021	64,418	102,569	31,626	257,635
1985	58,487	64,024	95,703	31,568	249,782
1986	56,723	60,837	95,019	27,719	240,298
1987	55,723	58,635	91,170	25,147	230,675
1988	54,486	53,217	83,377	25,672	216,752
1989	52,754	51,260	82,836	27,433	214,282
1990	50,712	50,879	80,834	27,321	209,746
1991	44,627	49,348	76,543	24,631	195,148
1992	29,663	35,438	74,569	44,036	183,707
1993	29,749	38,787	83,668	58,498	210,702
1994	30,941	39,437	88,405	56,713	215,496
1995	32,193	43,156	89,255	60,834	225,438
1996	32,217	42,917	87,147	60,865	223,146
1997	32,240	41,992	88,781	59,157	222,171
1998	32,292	43,411	88,094	61,336	225,132
1999	32,065	43,310	86,462	60,595	222,432
2000	31,894	42,591	87,539	59,947	221,971
2001	30,720	40,853	73,347	58,231	203,151
2002	30,685	37,537	84,101	59,655	211,979
2003	30,597	41,563	87,464	60,749	220,372
2004	30,518	43,784	79,394	59,614	213,311
2005	31,969	48,734	93,624	61,720	236,047
2006	32,382	53,465	91,801	60,685	238,333
2007	32,401	54,368	90,431	54,733	231,934
2008	32,365	54,160	91,852	56,097	234,473
2009	32,350	51,088	91,709	57,605	232,752
2010	32,350	50,282	92,034	59,167	233,833
2011	32,353	50,631	92,683	59,214	234,881
2012	31,772	47,442	90,429	58,154	227,798
2013	30,892	44,226	87,040	58,684	220,843
2014	30,313	42,686	82,580	53,961	209,541
2015	31,714	46,575	81,338	53,952	213,579
2016	32,205	53,894	82,970	57,583	226,651
2017	32,391	67,727	86,073	59,564	245,755
2018	32,409	71,068	85,745	56,347	245,570

Calculated as one aquifer
Calculated as Upper and Lower Aquifers

TABLE 11-2
DESCRIPTION OF HYDROLOGIC INVENTORY COMPONENTS
LIVERMORE VALLEY GROUNDWATER BASIN

COMPONENTS	*DESCRIPTION/REMARK*	*Direct/ Indirect*	*HOW CALCULATED/MEASURED*	*ESTIMATED ACCURACY*
SUPPLY INDICES				
Rainfall	Pleasanton rainfall (Parkside Office)	Direct	Measured by Zone 7	0.5 in
Evaporation	Evaporation at Lake Del Valle Station	Direct	Collected by DWR	0.5 in
Streamflow	Arroyo Valle Streamflow if Lake Del Valle Dam did not exist	Direct	USGS Stream Gage Station AV_BLC	10 AF
Water Year Type	Indicator of Water Year in Sacramento Valley	Direct	DWR California Data Exchange Center	-
SUPPLY COMPONENTS				
NATURAL STREAM RECHARGE				
ARROYO VALLE	AV natural recharge.	Indirect	Stream Inflows - Stream Outflows	100 AF
ARROYO MOCHO	AM natural recharge.	Indirect	Stream Inflows - Stream Outflows	100 AF
ARROYO LAS POSITAS	ALP natural recharge.	Indirect	Stream Inflows - Stream Outflows	100 AF
ARTIFICIAL RECHARGE				
ARROYO VALLE	Total artificial recharge on Arroyo Valle minus AV_RC_PR	Indirect	Stream Inflows - Stream Outflows	100 AF
ARROYO VALLE PRIOR RIGHTS	AVBLC flow that would have recharged if no dam. Subset of AV_RC.	Indirect	Formula based on AVBLC flow.	100 AF
ARROYO MOCHO	Total artificial recharge on Arroyo Mocho	Indirect	Stream Inflows - Stream Outflows	100 AF
ARROYO LAS POSITAS	Total artificial recharge on Arroyo Las Positas	Indirect	Stream Inflows - Stream Outflows	100 AF
INJECTION WELL RECHARGE	Injection at Hop 6 from 1998 to 2000	Direct	Metered by Zone 7	10 AF
RAINFALL RECHARGE	Recharge from rainfall	Indirect	Calculated by Areal Recharge Model	1000 AF
PIPE LEAKAGE	Pipe leakage that recharges the GW basin	Indirect	Estimated using length and age of pipes	500 AF
APPLIED WATER RECHARGE				
URBAN MUNICIPAL (GW & SBA)	Applied recharge in urban area - delivered water (gw & sba)	Indirect	Calculated by Areal Recharge Model	100 AF
URBAN RECYCLED WATER	Applied water recharge from urban area - recycled water	Indirect	Calculated using Wastewater Plant deliveries	10 AF
AGRICULTURAL (SBA)	Total applied recharge from 'untreated' ag sources (untreated SBA)	Indirect	Calculated by Areal Recharge Model	100 AF
AGRICULTURAL (GW)	Total applied water recharge from groundwater ag sources	Indirect	Calculated by Areal Recharge Model	100 AF
GOLF COURSES (GW)	Applied water from golf courses on groundwater	Indirect	Calculated by Areal Recharge Model	100 AF
GOLF COURSES (RW)	Applied water from golf courses from recycled water	Indirect	Calculated using Wastewater Plant deliveries	10 AF
SUBSURFACE BASIN INFLOW	Subsurface Inflow from Northern Fringe Basin	Indirect	Estimated historically groundwater contours	500 AF
DEMAND COMPONENTS				
MUNICIPAL PUMPING				
ZONE 7	Total pumping by Zone 7, including pumping to waste	Direct	Metered by Zone 7	10 AF
DSRSD	*Pumping by Zone 7 for DSRSD.*	*Direct*	*DSRSD Groundwater Pumping Quota*	*0 AF*
PLEASANTON	Pumping by Pleasanton.	Direct	Metered by Pleasatnon	10 AF
CALIFORNIA WATER SERVICE	Pumping by CWS.	Direct	Metered by CWS	10 AF
SFPUC	Pumping by SF Public Utilities Commission	Direct	Metered by SFPUC	10 AF
FAIRGROUNDS	Pumping by Alameda County Fairgrounds	Indirect	Metered by Fairgrounds	10 AF
DOMESTIC	Pumping from active domestic, supply, and potable wells	Indirect	Estimated: Number of Wells x 0.5 AF/yr	50 AF
GOLF COURSES				
CASTLEWOOD GOLF COURSE	*Pumping for Castlewood Golf Course*	*Indirect*	*Estimated using historical meter data*	*50 AF*
TRI VALLEY GOLF CENTER	*Pumping for TriValley Golf Driving Range*	*Indirect*	*Calculated by Areal Recharge Model*	*50 AF*
AGRICULTURAL PUMPING	Unmetered pumping for agriculture	Indirect	Calculated by Areal Recharge Model	100 AF
MINING				
EXPORT	Total mining area releases that leave the basin	Indirect	Calculated from metered data and stream recharge rate	50 AF
EVAPORATION	Pond evaporation & rainfall.	Indirect	Calculated using lake area, evaporation, and rainfall	100 AF
PROCESSING	Mining Area processing losses	Indirect	Estimated at 700 AF/Yr	100 AF
SUBSURFACE BASIN OUTFLOW	Basin overflow leaving basin	Indirect	Formula based on GW elevation and synoptic data	100 AF

TABLE 11-3
HISTORICAL GROUNDWATER STORAGE
HYDROLOGIC INVENTORY (HI) METHOD
1974-2018 WATER YEARS (in Acre-Feet, except where indicated)

	WATER YEAR (Oct - Sep)																	
COMPONENTS	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
INDICES																		
Rainfall at Livermore (in)	16.1	14.8	6.2	6.0	18.5	13.6	17.6	10.3	24.4	32.0	13.0	12.6	19.8	8.9	8.7	11.2	9.4
Evap at Lake Del Valle (in)	60.9	62.7	63.5	66.0	64.2	67.7	59.7	72.1	60.5	59.7	70.2	64.9	61.1	64.0	66.9	63.6	65.9
Arroyo Valle Stream flow (AF)	30538	28307	475	177	43749	9721	45800	5817	61427	125882	25653	7282	67903	3023	1506	1988	815
Water Year Type*	W	W	C	C	AN	BN	AN	D	W	W	W	D	W	D	C	D	C
SUPPLY	**18,140**	**21,437**	**11,121**	**8,683**	**24,813**	**22,213**	**23,830**	**18,821**	**29,942**	**35,412**	**15,547**	**8,784**	**20,866**	**6,670**	**8,071**	**11,170**	**10,353**
Injection Well Recharge	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Stream Recharge	**11,340**	**15,400**	**6,910**	**3,820**	**16,330**	**16,110**	**16,480**	**15,040**	**16,420**	**17,158**	**9,486**	**4,747**	**9,045**	**3,565**	**4,549**	**7,880**	**7,026**
Artificial Stream Recharge	3,509	6,750	5,695	3,190	6,442	12,266	10,211	11,918	5,952	901	0	0	0	0	1,172	4,320	4,488
Arroyo Valle	*1,439*	*4,320*	*1,875*	*1,300*	*3,002*	*5,886*	*4,541*	*6,328*	*2,442*	*0*	*0*	*0*	*0*	*0*	*0*	*139*	*304*
Arroyo Mocho	*1,670*	*1,830*	*3,220*	*1,290*	*2,840*	*5,780*	*5,270*	*5,130*	*3,290*	*901*	*0*	*0*	*0*	*0*	*1,172*	*4,181*	*4,184*
Arroyo las Positas	*400*	*600*	*600*	*600*	*600*	*600*	*400*	*460*	*220*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Natural Stream Recharge	6,060	7,110	1,100	630	8,850	2,860	4,850	2,200	8,620	14,387	8,326	3,541	8,168	2,696	2,653	2,589	2,250
Arroyo Valle	*2,400*	*2,950*	*360*	*290*	*2,450*	*1,290*	*1,750*	*840*	*2,970*	*4,893*	*2,580*	*751*	*2,831*	*527*	*679*	*458*	*418*
Arroyo Mocho	*3,160*	*3,760*	*540*	*140*	*5,900*	*1,170*	*2,500*	*880*	*4,810*	*8,514*	*4,616*	*1,716*	*4,176*	*843*	*902*	*809*	*428*
Arroyo las Positas	*500*	*400*	*200*	*200*	*500*	*400*	*600*	*480*	*840*	*980*	*1,130*	*1,074*	*1,161*	*1,326*	*1,072*	*1,322*	*1,404*
Arroyo Valle Prior Rights	1,771	1,540	115	0	1,038	984	1,419	922	1,848	1,870	1,160	1,206	877	869	724	971	288
Rainfall Recharge	**3,031**	**2,523**	**0**	**0**	**4,398**	**2,002**	**3,891**	**967**	**11,423**	**16,357**	**3,110**	**1,249**	**9,008**	**290**	**398**	**283**	**141**
Lake Recharge	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Pipe Leakage	**31**	**37**	**44**	**51**	**60**	**71**	**82**	**95**	**109**	**124**	**139**	**155**	**169**	**185**	**200**	**217**	**233**
Applied Water Recharge	**2,738**	**2,477**	**3,158**	**3,022**	**2,795**	**3,041**	**2,727**	**2,089**	**1,360**	**1,344**	**2,162**	**1,884**	**1,904**	**1,860**	**2,004**	**1,630**	**1,694**
Subsurface Basin Inflow	**1,000**	**1,000**	**1,010**	**1,790**	**1,230**	**990**	**650**	**630**	**630**	**430**	**650**	**750**	**740**	**770**	**920**	**1,160**	**1,260**
DEMAND	**18,618**	**15,929**	**15,432**	**14,636**	**12,871**	**15,819**	**15,727**	**19,349**	**18,349**	**26,220**	**19,750**	**18,506**	**22,550**	**14,575**	**17,176**	**16,143**	**15,881**
Municipal Pumpage	**11,806**	**9,881**	**7,782**	**6,721**	**7,022**	**8,207**	**6,982**	**7,361**	**7,281**	**7,965**	**8,473**	**7,990**	**8,652**	**8,152**	**9,431**	**10,393**	**11,209**
Zone 7 (excluding DSRSD)	5,403	3,090	1,292	309	776	816	41	0	0	25	348	1,199	1,163	480	2,017	3,213	3,327
Zone 7 for DSRSD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
City of Pleasanton	2,264	2,497	1,707	3,271	2,640	3,273	2,961	3,089	3,565	3,886	3,486	3,056	3,705	3,310	3,548	3,316	3,856
Cal. Water Service	2,612	2,852	2,781	1,312	1,964	2,358	2,489	2,695	2,286	2,660	3,035	2,788	2,774	3,276	2,761	2,850	3,073
Camp Parks	769	808	980	925	796	881	819	808	713	630	647	40	0	0	0	0	0
SFWD	302	242	495	374	397	413	372	402	348	321	378	353	484	491	472	443	362
Fairgrounds	200	200	200	200	200	200	200	267	217	242	281	272	280	280	280	280	280
Domestic	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Golf Courses	156	92	227	230	149	166	0	0	52	101	198	182	146	215	253	191	211
Agricultural Pumpage	**3,744**	**2,217**	**4,596**	**4,970**	**3,191**	**3,711**	**2,628**	**2,433**	**1,295**	**1,342**	**1,556**	**1,914**	**1,911**	**1,470**	**1,476**	**1,166**	**1,360**
SFWD	500	0	62	304	252	365	168	513	150	549	107	410	543	663	493	359	430
Concannon	6	15	20	20	20	70	250	112	0	0	68	0	60	26	59	0	0
Calculated	3,238	2,202	4,514	4,646	2,919	3,276	2,210	1,808	1,145	793	1,381	1,504	1,308	781	924	807	930
Mining Use	**3,068**	**3,831**	**3,054**	**2,945**	**2,658**	**3,751**	**5,586**	**9,005**	**7,613**	**13,953**	**7,481**	**7,402**	**11,387**	**4,353**	**5,869**	**4,484**	**3,312**
Stream Export	1,219	2,200	690	470	800	2,000	3,480	6,530	6,050	12,760	4,340	4,265	8,858	558	2,443	1,808	665
Discharges to Cope Lake	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Evaporation	1,149	931	1,664	1,775	1,158	1,051	1,406	1,775	863	493	2,441	2,437	1,829	3,095	2,726	1,976	1,947
Production	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700
Subsurface Basin Overflow	**0**	**0**	**0**	**0**	**0**	**150**	**530**	**550**	**2,160**	**2,960**	**2,240**	**1,200**	**600**	**600**	**400**	**100**	**0**
NET RECHARGE (AF)	**-478**	**5,508**	**-4,311**	**-5,953**	**11,942**	**6,394**	**8,103**	**-528**	**11,593**	**9,192**	**-4,203**	**-9,722**	**-1,684**	**-7,906**	**-9,106**	**-4,973**	**-5,528**
INVENTORY STORAGE (AF)	**211,522**	**217,030**	**212,719**	**206,766**	**218,708**	**225,102**	**233,205**	**232,677**	**244,270**	**253,462**	**249,259**	**239,537**	**237,853**	**229,947**	**220,841**	**215,868**	**210,340**

STORAGE CALCULATION	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
INVENTORY (Rounded to TAF)	212	217	213	207	219	225	233	233	244	253	249	240	238	230	221	216	210
GW ELEVATIONS (Rounded to TAF)	213	215	226	216	210	228	239	246	241	254	258	250	240	231	217	214	210
AVERAGE STORAGE (TAF)	**213**	**216**	**219**	**211**	**214**	**226**	**236**	**239**	**243**	**254**	**253**	**245**	**239**	**230**	**219**	**215**	**210**
AVAILABLE STORAGE (TAF)	**85**	**88**	**91**	**83**	**86**	**98**	**108**	**111**	**115**	**126**	**125**	**117**	**111**	**102**	**91**	**87**	**82**

Artificial Components Natural Components

*Water Year Type (CDEC Sacramento Valley)
W = Wet; AN = Above Normal;
BN = Below Normal; D = Dry; C = Critical

TABLE 11-3
HISTORICAL GROUNDWATER STORAGE
HYDROLOGIC INVENTORY (HI) METHOD
1974-2018 WATER YEARS (in Acre-Feet, except where indicated)

	WATER YEAR (Oct - Sep)																			
COMPONENTS	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
INDICES																				
Rainfall at Livermore (in)	11.3	11.6	21.3	11.8	21.3	20.0	15.1	25.3	13.1	14.1	11.0	11.2	17.0	13.1	19.3	17.5	9.7	10.7	11.4	14.8
Evap at Lake Del Valle (in)	64.7	68.2	64.2	65.5	58.3	71.6	69.5	57.2	61.0	68.3	68.5	73.2	69.9	72.1	63.6	68.6	68.9	72.7	71.6	64.0
Arroyo Valle Stream flow (AF)	9909	11692	52831	3424	67142	51058	54115	87819	15169	18949	8156	7848	19648	11410	26930	28325	2027	18059	11231	12914
Water Year Type*	C	C	AN	C	W	W	W	W	W	AN	D	D	AN	BN	AN	W	D	C	D	BN
SUPPLY	**12,715**	**10,610**	**28,529**	**16,095**	**29,095**	**22,556**	**24,184**	**27,201**	**20,780**	**23,211**	**15,858**	**24,062**	**29,840**	**19,778**	**31,021**	**23,960**	**14,998**	**16,258**	**18,659**	**25,382**
Injection Well Recharge	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,524**	**1,146**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Stream Recharge	**8,347**	**5,247**	**14,714**	**11,838**	**13,058**	**11,109**	**12,284**	**13,603**	**10,813**	**12,842**	**8,768**	**16,205**	**21,483**	**12,885**	**21,025**	**13,418**	**9,154**	**8,448**	**11,249**	**17,144**
Artificial Stream Recharge	3,261	914	5,621	7,883	4,672	2,968	5,314	2,343	5,174	8,019	3,428	10,588	11,409	8,084	11,143	4,583	4,811	2,229	3,984	6,773
Arroyo Valle	*82*	*412*	*1,182*	*798*	*179*	*144*	*1,827*	*413*	*1,181*	*890*	*1,476*	*1,831*	*1,547*	*1,670*	*2,277*	*1,216*	*2,879*	*2,229*	*2,104*	*2,459*
Arroyo Mocho	*3,178*	*502*	*4,439*	*7,085*	*4,493*	*2,824*	*3,487*	*1,930*	*3,993*	*7,129*	*1,930*	*8,755*	*9,862*	*6,414*	*8,698*	*3,205*	*1,932*	*0*	*1,880*	*4,314*
Arroyo las Positas	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*22*	*2*	*0*	*0*	*168*	*162*	*0*	*0*	*0*	*0*
Natural Stream Recharge	4,418	3,997	8,247	3,080	7,259	7,743	6,607	10,533	5,091	4,178	4,679	4,486	8,462	3,458	9,589	6,905	3,536	5,913	6,018	10,371
Arroyo Valle	*1,215*	*970*	*2,754*	*735*	*2,818*	*1,426*	*2,753*	*4,401*	*1,796*	*1,389*	*2,440*	*2,259*	*4,397*	*1,447*	*5,980*	*3,043*	*1,941*	*4,030*	*3,958*	*6,909*
Arroyo Mocho	*1,883*	*1,711*	*3,903*	*1,263*	*3,144*	*5,226*	*2,670*	*4,560*	*1,833*	*1,539*	*961*	*1,279*	*2,980*	*1,082*	*2,854*	*3,104*	*858*	*1,077*	*970*	*2,547*
Arroyo las Positas	*1,320*	*1,315*	*1,591*	*1,082*	*1,297*	*1,091*	*1,184*	*1,572*	*1,462*	*1,250*	*1,278*	*949*	*1,085*	*929*	*755*	*758*	*737*	*806*	*1,090*	*915*
Arroyo Valle Prior Rights	668	337	846	876	1,127	398	362	727	548	644	660	1,131	1,612	1,343	293	1,930	807	306	1,247	0
Rainfall Recharge	**1,838**	**1,760**	**10,761**	**1,242**	**13,243**	**8,176**	**8,634**	**10,692**	**5,540**	**5,924**	**3,644**	**4,239**	**4,899**	**3,192**	**6,378**	**6,969**	**1,987**	**3,782**	**3,375**	**4,315**
Lake Recharge	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Pipe Leakage	**249**	**267**	**285**	**304**	**324**	**344**	**365**	**387**	**410**	**434**	**461**	**490**	**518**	**548**	**579**	**610**	**642**	**675**	**708**	**742**
Applied Water Recharge	**602**	**1,766**	**1,440**	**1,621**	**1,480**	**2,007**	**2,221**	**1,709**	**1,743**	**1,960**	**1,985**	**2,129**	**1,940**	**2,153**	**2,039**	**1,962**	**2,214**	**2,353**	**2,327**	**2,181**
Subsurface Basin Inflow	**1,680**	**1,570**	**1,330**	**1,090**	**990**	**920**	**680**	**810**	**750**	**906**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**
DEMAND	**21,177**	**17,202**	**13,417**	**15,467**	**16,023**	**20,683**	**25,574**	**25,342**	**25,691**	**26,885**	**27,357**	**23,991**	**21,531**	**24,338**	**17,828**	**15,169**	**18,636**	**19,269**	**23,656**	**21,091**
Municipal Pumpage	**17,254**	**13,296**	**8,994**	**6,463**	**4,553**	**6,324**	**8,824**	**10,264**	**11,832**	**15,520**	**17,806**	**19,307**	**17,123**	**19,635**	**14,686**	**11,697**	**12,681**	**13,516**	**18,022**	**16,064**
Zone 7 (excluding DSRSD)	8,119	5,136	2,215	213	368	2,388	1,565	1,682	4,912	6,140	9,864	11,047	7,734	11,175	6,213	3,157	4,146	6,210	9,439	8,274
Zone 7 for DSRSD	0	0	0	0	0	0	0	0	0	0	0	0	645	645	645	645	645	645	645	645
City of Pleasanton	4,164	3,368	3,252	2,578	1,262	1,333	3,208	3,935	2,563	4,558	3,112	3,579	3,674	3,688	3,604	3,587	3,638	2,387	3,660	3,280
Cal. Water Service	3,966	3,744	2,570	2,626	2,053	1,551	2,947	3,595	3,271	3,567	3,707	3,458	3,979	2,911	3,166	3,106	2,971	3,143	3,123	2,844
Camp Parks	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SFWD	408	410	414	396	370	411	477	460	380	532	472	448	423	481	436	467	494	492	446	417
Fairgrounds	346	336	282	325	285	343	342	230	333	369	318	423	327	365	284	441	443	289	335	284
Domestic	100	113	113	116	116	117	117	113	116	109	109	134	134	167	131	93	96	109	123	112
Golf Courses	151	186	148	209	98	182	169	249	256	245	223	218	208	203	207	199	249	241	250	208
Agricultural Pumpage	**556**	**355**	**213**	**218**	**150**	**212**	**266**	**73**	**81**	**231**	**227**	**119**	**93**	**92**	**88**	**88**	**87**	**96**	**95**	**94**
SFWD	194	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concannon	11	0	0	0	0	0	0	0	0	140	143	25	0	2	0	0	0	0	0	0
Calculated	351	346	213	218	150	212	266	73	81	91	84	94	93	91	88	88	87	96	95	94
Mining Use	**3,367**	**3,551**	**4,210**	**8,786**	**11,120**	**13,381**	**15,724**	**14,255**	**13,416**	**11,010**	**9,324**	**4,564**	**4,314**	**4,610**	**3,055**	**3,385**	**4,947**	**4,452**	**5,346**	**4,934**
Stream Export	639	712	2,219	6,070	9,071	10,577	12,661	12,617	10,082	7,827	5,461	143	0	163	150	487	594	523	1,493	1,996
Discharges to Cope Lake	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Evaporation	2,028	2,139	1,291	2,016	1,349	2,104	2,363	938	2,634	2,483	3,163	3,951	3,764	3,762	2,205	2,198	3,653	3,230	3,153	2,238
Production	700	700	700	700	700	700	700	700	700	700	700	470	550	686	700	700	700	700	700	700
Subsurface Basin Overflow	**0**	**0**	**0**	**0**	**200**	**766**	**760**	**750**	**362**	**125**	**0**	**0**	**0**	**0**	**0**	**0**	**921**	**1,205**	**194**	**0**
NET RECHARGE (AF)	**-8,462**	**-6,592**	**15,112**	**628**	**13,072**	**1,873**	**-1,390**	**1,859**	**-4,911**	**-3,674**	**-11,499**	**72**	**8,309**	**-4,560**	**13,193**	**8,790**	**-3,639**	**-3,011**	**-4,997**	**4,290**
INVENTORY STORAGE (AF)	**201,878**	**195,286**	**210,398**	**211,026**	**224,098**	**225,971**	**224,581**	**226,440**	**221,529**	**217,855**	**206,356**	**206,428**	**214,737**	**210,177**	**223,370**	**232,160**	**228,521**	**225,510**	**220,513**	**224,803**
STORAGE CALCULATION	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
INVENTORY (Rounded to TAF)	202	195	210	211	224	226	225	226	222	218	206	206	215	210	223	232	229	226	221	225
GW ELEVATIONS (Rounded to TAF)	195	184	211	215	225	223	222	225	222	222	203	212	220	213	236	238	232	234	233	234
AVERAGE STORAGE (TAF)	**199**	**189**	**210**	**213**	**225**	**225**	**224**	**226**	**222**	**220**	**205**	**209**	**218**	**212**	**230**	**235**	**230**	**230**	**227**	**229**
AVAILABLE STORAGE (TAF)	**71**	**61**	**82**	**85**	**97**	**97**	**96**	**98**	**94**	**92**	**77**	**81**	**90**	**84**	**102**	**107**	**102**	**102**	**99**	**101**

Artificial Components Natural Components

*Water Year Type (CDEC Sacramento Valley)
W = Wet; AN = Above Normal;
BN = Below Normal; D = Dry; C = Critical

TABLE 11-3
HISTORICAL GROUNDWATER STORAGE
HYDROLOGIC INVENTORY (HI) METHOD
1974-2018 WATER YEARS (in Acre-Feet, except where indicated)

	WATER YEAR (Oct - Sep)								1974 - 2018		
COMPONENTS	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**AVG**	**Sust Avg**	**TOTAL**
INDICES											
Rainfall at Livermore (in)	16.2	8.8	10.7	6.8	13.1	15.4	25.6	12.4	15		
Evap at Lake Del Valle (in)	64.5	73.2	73.9	78.3	73.6	72.6	69.3	73.4	67		
Arroyo Valle Stream flow (AF)	28634	1557	7801	272	2217	19436	89173	2783	25124		**1130591**
Water Year Type*	W	BN	D	C	C	BN	W	BN			
SUPPLY	**27,315**	**18,442**	**20,158**	**10,452**	**18,753**	**28,293**	**38,895**	**19,862**	**20,285**	**19,800**	**912,834**
Injection Well Recharge	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**59**	**0**	**2,670**
Stream Recharge	**17,595**	**12,734**	**13,457**	**5,820**	**11,469**	**18,083**	**20,495**	**9,560**	**12,092**	**11,900**	**544,152**
Artificial Stream Recharge	4,555	8,778	7,887	3,826	3,766	8,910	9,615	6,773	5,425	5,300	244,124
Arroyo Valle	*768*	*3,613*	*1,916*	*924*	*3,718*	*3,983*	*3,271*	*3,778*	*1,785*	*1,640*	*80,342*
Arroyo Mocho	*3,671*	*5,059*	*5,961*	*2,844*	*0*	*4,927*	*6,344*	*2,995*	*3,525*	*3,530*	*158,611*
Arroyo las Positas	*116*	*106*	*10*	*58*	*48*	*0*	*0*	*0*	*115*	*130*	*5,172*
Natural Stream Recharge	11,272	3,355	4,200	1,987	6,822	8,289	10,433	1,938	5,772	5,700	259,757
Arroyo Valle	*8,540*	*1,676*	*2,790*	*891*	*4,567*	*4,749*	*6,053*	*740*	*2,558*	*1,800*	*115,103*
Arroyo Mocho	*2,293*	*1,225*	*838*	*587*	*1,748*	*2,794*	*3,775*	*590*	*2,315*	*2,600*	*104,159*
Arroyo las Positas	*439*	*454*	*572*	*509*	*507*	*746*	*605*	*608*	*900*	*1,300*	*40,495*
Arroyo Valle Prior Rights	1,768	601	1,370	7	881	884	447	849	895	900	40,270
Rainfall Recharge	**5,771**	**1,462**	**2,708**	**1,075**	**3,735**	**6,554**	**14,087**	**6,554**	**4,702**	**4,300**	**211,608**
Lake Recharge	*0*	*0*	*0*	*2,428*	*4,322*	*6,785*	*13,029*	*15,016*	*924*	*NA*	*41,580*
Pipe Leakage	**776**	**811**	**847**	**884**	**921**	**958**	**996**	**1,034**	**413**	**1,000**	**18,567**
Applied Water Recharge	**2,172**	**2,435**	**2,147**	**1,674**	**1,629**	**1,697**	**2,316**	**1,713**	**2,033**	**1,600**	**91,501**
Subsurface Basin Inflow	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**985**	**1,000**	**44,336**
DEMAND	**20,421**	**28,880**	**25,700**	**22,604**	**12,717**	**12,888**	**13,636**	**16,890**	**19,369**	**18,800**	**871,599**
Municipal Pumpage	**13,430**	**20,463**	**16,823**	**16,662**	**8,284**	**9,176**	**10,714**	**11,976**	**11,482**	**13,700**	**516,700**
Zone 7 (excluding DSRSD)	5,618	11,461	8,909	8,137	1,920	1,357	3,243	4,215	3,963	5,300	178,357
Zone 7 for DSRSD	646	644	646	645	645	645	645	645	229	645	10,321
City of Pleasanton	3,435	3,900	3,301	3,740	2,775	3,752	4,222	3,913	3,264	3,500	146,900
Cal. Water Service	2,673	3,333	2,770	3,085	2,012	2,575	1,878	2,389	2,835	3,070	127,580
Camp Parks	0	0	0	0	0	0	0	0	196	0	8,819
SFWD	442	482	482	398	309	286	214	253	408	450	18,348
Fairgrounds	301	318	350	286	268	231	208	206	288	310	12,946
Domestic	107	90	105	115	112	110	107	115	109	200	4,899
Golf Courses	208	236	260	257	243	220	198	240	190	225	8,530
Agricultural Pumpage	**85**	**95**	**486**	**640**	**590**	**115**	**109**	**115**	**1,037**	**400**	**46,650**
SFWD	0	0	0	0	0	0	0	0	135	0	6,071
Concannon	0	0	0	0	0	0	0	0	23	0	1,047
Calculated	85	95	486	640	590	115	109	115	878	400	39,532
Mining Use	**6,906**	**8,322**	**8,391**	**5,302**	**3,843**	**3,597**	**2,813**	**4,236**	**6,465**	**4,600**	**290,912**
Stream Export	4,277	4,676	4,796	850	0	0	0	0	3,494	700	157,219
Discharges to Cope Lake	*0*	*0*	*0*	*5,420*	*4,890*	*7,700*	*13,452*	*15,562*	*1,045*	*NA*	*47,024*
Evaporation	1,929	2,946	2,895	3,752	3,143	2,897	2,113	3,536	2,280	3,200	102,587
Production	700	700	700	700	700	700	700	700	691	700	31,106
Subsurface Basin Overflow	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**564**	**385**	**100**	**17,337**
NET RECHARGE (AF)	**6,893**	**-10,438**	**-5,542**	**-12,153**	**6,037**	**15,405**	**25,259**	**2,972**	**916**	**1,000**	**41,235**
INVENTORY STORAGE (AF)	**231,696**	**221,258**	**215,716**	**203,563**	**209,600**	**225,005**	**250,264**	**253,236**	**222,691**	**13,400**	

STORAGE CALCULATION	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
INVENTORY (Rounded to TAF)	232	221	216	204	210	225	250	253
GW ELEVATIONS (Rounded to TAF)	235	228	221	210	214	227	246	246
AVERAGE STORAGE (TAF)	**233**	**224**	**218**	**207**	**212**	**226**	**248**	**249**
AVAILABLE STORAGE (TAF)	**105**	**96**	**90**	**79**	**84**	**98**	**120**	**121**

Artificial Components Natural Components

*Water Year Type (CDEC Sacramento Valley)
W = Wet; AN = Above Normal;
BN = Below Normal; D = Dry; C = Critical

LEGEND

Node (with Mean GW Elev, Fall 2018)

- Main Basin
- Fringe Subarea
- Upland Management Area

Node 1
U: 416.7
L: -

Node 2
U: 398
L: -

Node 3
U: 383.5
L: -

Node 4
U: 365.4
L: -

Node 5
U: 372.4
L: -

Node 6
U: 337.6
L: -

Node 7
U: 341.8
L: -

Node 8
U: 347.2
L: -

Node 9
U: 338.2
L: -

Node 10
U: 324.6
L: -

Node 11
U: 340.5
L: -

Node 12
U: 324.6
L: -

Node 13
U: 317.3
L: -

Node 14
U: 315.6
L: -

Node 15
U: 301
L: 296.0

Node 15A
U: 313.8
L: -

Node 16
U: 296.8
L: 295.4

Node 16A
U: 310.9
L: -

Node 17
U: 306.3
L: 296.4

Node 18
U: 298.7
L: 293.9

Node 19
U: 300
L: 295.6

Node 20
U: 296.8
L: 292.9

Node 21
U: 341.7
L: -

Node 22
U: 326.7
L: -

Node 23
U: 304.7
L: 293.5

Node 24
U: 304.4
L: 294.6

Node 25
U: 315.4
L: 289.4

Node 26
U: 312.3
L: 297.7

Node 27
U: 335.7
L: -

Node 28
U: 352.5
L: -

Node 29
U: 337.8
L: 283.3

Node 30
U: 324
L: 279.2

Node 31
U: 322.8
L: 285.0

Node 32
U: 396.7
L: -

Node 33
U: 370.5
L: 283.7

Node 34
U: 338.5
L: 263.3

Node 35
U: 332.4
L: 282.3

Node 36
U: 450.2
L: 460.1

Node 37
U: 407.9
L: -

Node 38
U: 399.7
L: 370.1

Node 39
U: 447.1
L: 412.0

Node 40
U: 533.4
L: 514.4

Node 41
U: 688.6
L: 639.1

Node 42
U: 517.5
L: -

Node 43
U: 529.6
L: -

Node 44
U: 719.7
L: -

Node 45
U: 537.8
L: -

Node 46
U: 520.7
L: -

Node 47
U: 498
L: -

N
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0 2 4
Miles

DATE: Mar 13, 2019
FILE: E:\MONITOR\GWStorage\2018WY\AnnualReport2018\Fig11-01-MapNodalGWE18.mxd

Figure 11-1
Mean Groundwater Elevation By Node
Upper and Lower Aquifers; Fall 2018
Livermore Valley Groundwater Basin

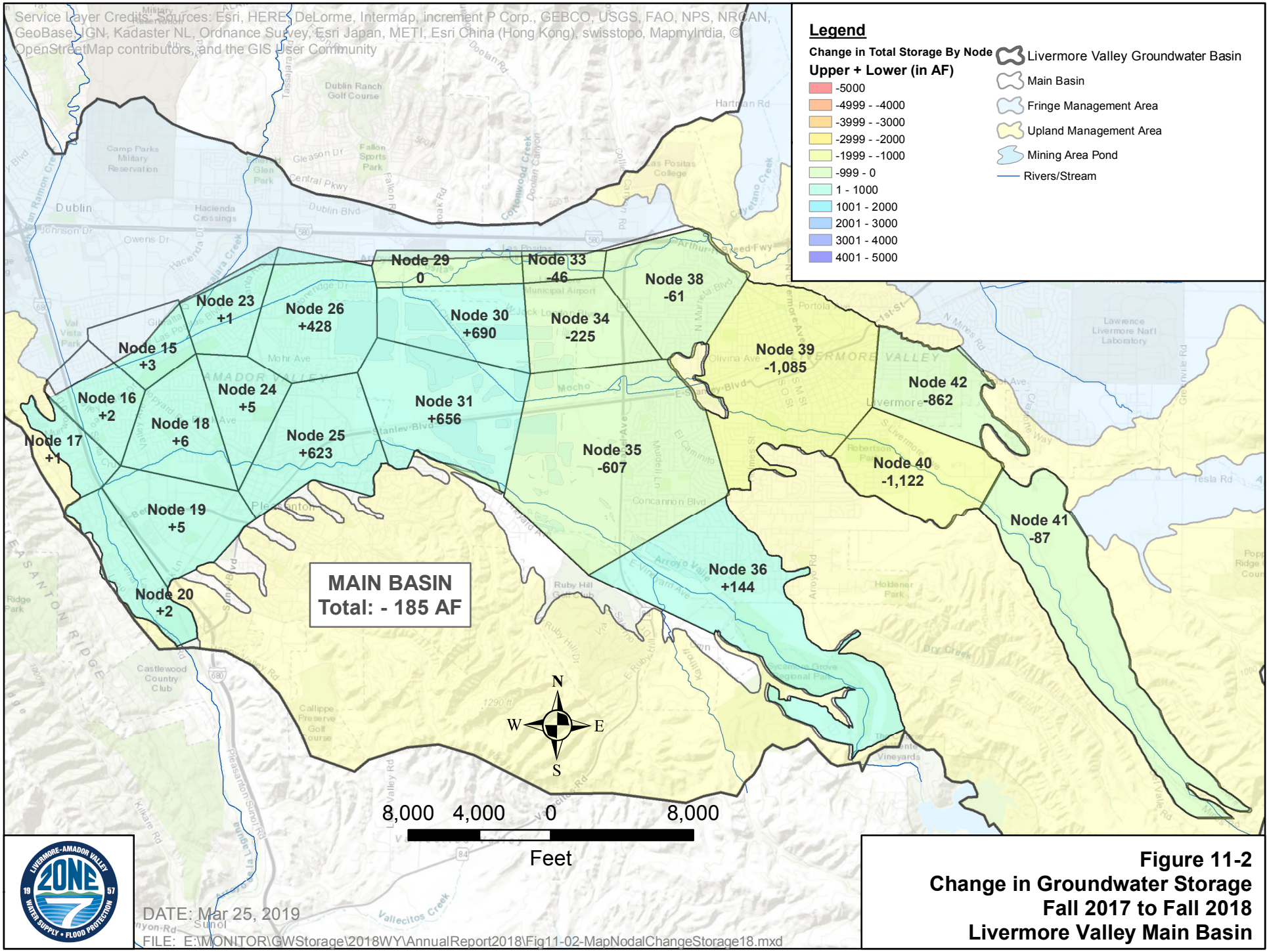
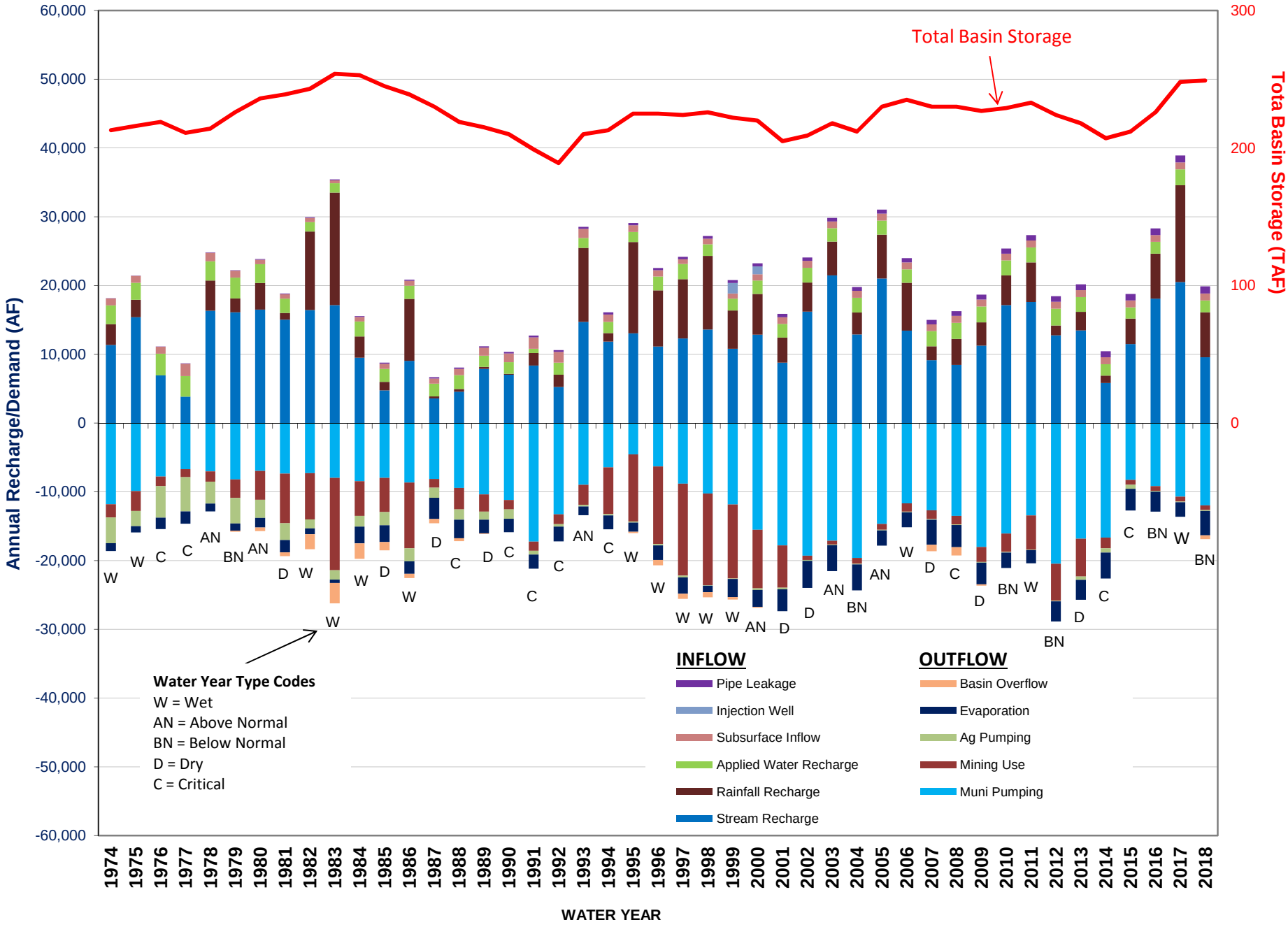


Figure 11-2
Change in Groundwater Storage
Fall 2017 to Fall 2018
Livermore Valley Main Basin

FIGURE 11-3
GRAPH OF GROUNDWATER STORAGE 1974 - 2018 WATER YEARS
LIVERMORE VALLEY GROUNDWATER BASIN



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3/13/2019

Figure 11-3

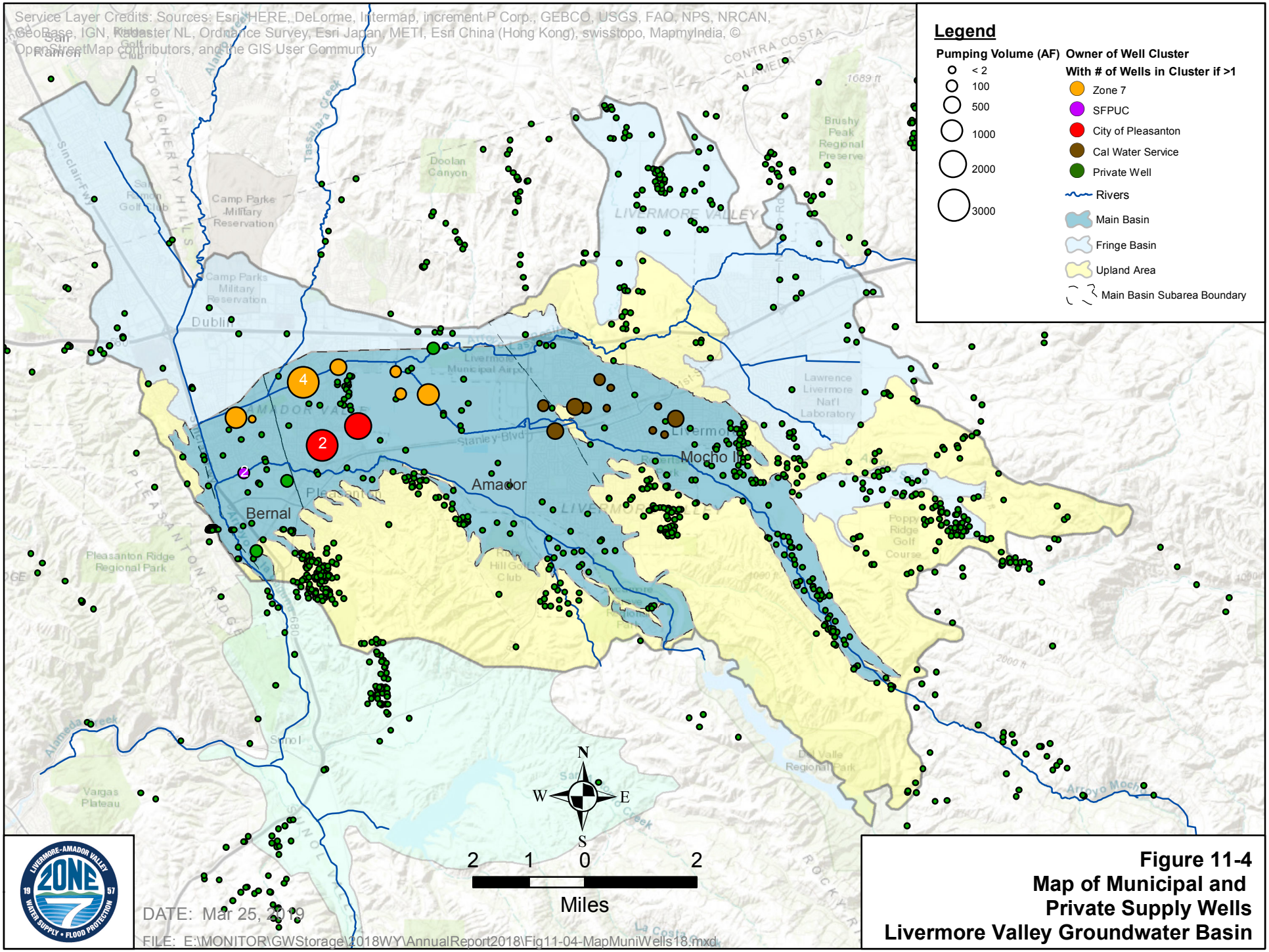
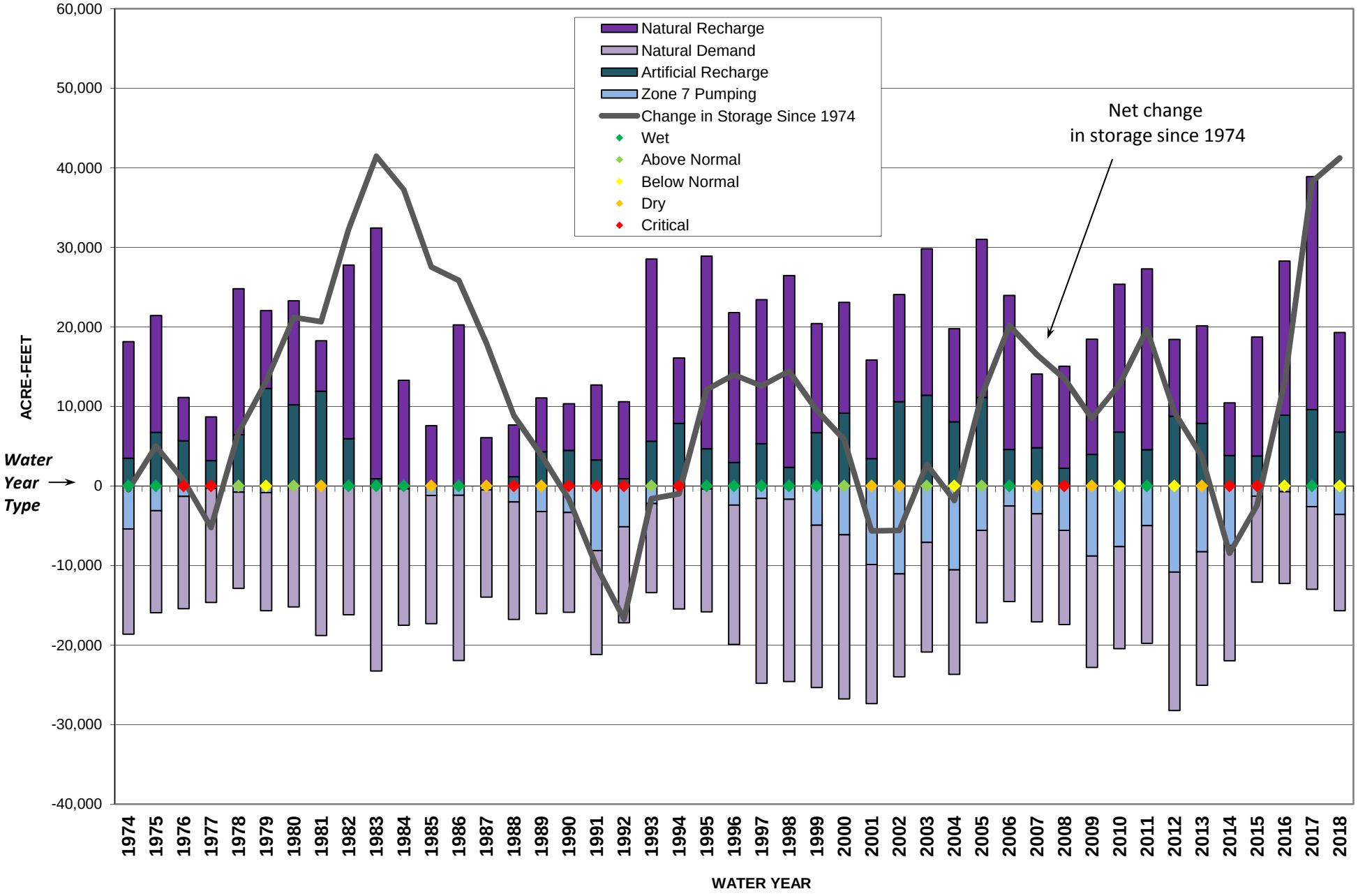


Figure 11-4
Map of Municipal and Private Supply Wells
Livermore Valley Groundwater Basin

FIGURE 11-5
CUMULATIVE CHANGE IN NATURAL AND ARTIFICIAL RECHARGE AND DEMAND 1974 - 2018 WATER YEARS
LIVERMORE VALLEY GROUNDWATER BASIN



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12 Groundwater Supply Sustainability

12.1 Introduction

This section provides an update on the project and management actions described in *Section 5*, *Projects and Management Actions*, of the Alternative GSP. Zone 7 is sustainably managing the Livermore Valley Groundwater Basin through numerous interrelated programs to assess, manage, monitor, and protect the groundwater supply. Using information from its robust monitoring programs, Zone 7 adaptively manages its groundwater supply with regard for current hydrologic conditions, water demands, water quality conditions, and future water supply/demand forecasts. In addition to continuing the monitoring programs that are critical to Zone 7's sustainable groundwater management, Zone 7 is also working to improve long-term surface water supply reliability, maximize conjunctive use opportunities, provide watershed protection, and support water recycling operations.

12.2 Import of Surface Water

The availability of State Water Project (SWP) supplies is fundamental to Zone 7's maintenance of its basin measurable objectives with regard to sustainable groundwater levels and storage, avoidance of subsidence, and protection of surface water beneficial uses. Zone 7 ensures that local water supplies (e.g., groundwater) are not depleted by importing approximately 80% of the Valley's water supply (delivered to Zone 7's retailers and to agricultural customers through the South Bay Aqueduct (SBA) and recharging the Main Basin with surplus surface water when available (artificial recharge). Details regarding the surface water supply sources and contract amounts are provided in *Section 2.4.4.2*, *Imports and Surface Water Supplies*, of the Alternative GSP. *Table 12-A* below shows Zone 7's imported water supplies for 2018 and the supplies being carried over to 2019. In accordance with DWR's accounting time-interval of SWP water, the totals in that table are presented by calendar year (CY). The SWP allocation for 2018 CY was 35% of Zone 7's maximum allocation (35% x 80,619 AF) or 28,217 AF. Zone 7 did not withdraw or transfer any water from its out-of-basin storage banks.

Table 12-A: Imported Water Sources for the 2018 Calendar Year (AF)

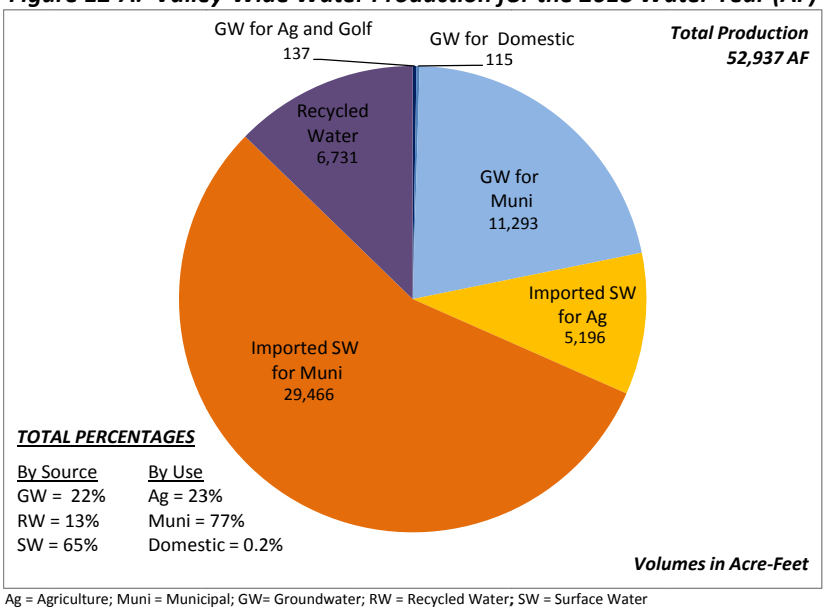
Source	Available at end of 2017	Added in 2018 *	Used in 2018	Carryover to 2019
State Water Project	15,739	28,217	36,909	7,047
Table A		28,217	21,170	7,047
Article 56	15,739		15,739	0
Byron-Bethany Irrigation District (BBID)	0	0	0	0
Kern Groundwater Basin	128,970	0	0	128,970
Semitropic	104,065	0	0	104,065
Cawelo	24,905	0	0	24,905
Other	0	2,614	2,614	0
Turnback Pool	0	0	0	0
Yuba/Other	0	2,614	2,614	0
Lake Del Valle (AV Water Rights)	0	1,197	0	1,197
Total	273,679	34,642	42,137	266,184

* = 35% State Water Project Allocation for 2018 WY
AV = Arroyo Valle
See Alternative GSP for descriptions of the individual source descriptions.

12.3 Valley-Wide Water Production and Use

The volume of water produced and used in the Livermore Valley is shown in *Figure 12-A* below (by Water Year [WY]) and *Figure 12-1* (by WY except where noted).

Figure 12-A: Valley-Wide Water Production for the 2018 Water Year (AF)



Ag = Agriculture; Muni = Municipal; GW= Groundwater; RW = Recycled Water; SW = Surface Water

Figure 12-2 shows the historical percentage of groundwater production relative to total Valley-wide production from the 1974 to 2018 WYs. The following activities occurred during 2018 (CY or WY as indicated):

- Imported surface water supplies in 2018 CY made up 65% of regional water deliveries. This imported surface water allowed 34,662 AF of groundwater to be conserved instead of being pumped to meet this demand.

- Of the 4,860 AF of groundwater pumped by Zone 7 during 2018 WY, about 4,542 AF went into production; the remainder of which is accounted for in pumping losses and exported brine from the groundwater demineralization process. Zone 7's total produced groundwater was about 13% of the total treated water production that Zone 7 delivered to its retailers during the 2018 WY (on average, groundwater makes up about 15% of Zone 7's annual treated water deliveries).

- Total groundwater production in the Valley (including by Zone 7, retailers, agriculture, domestic, etc.) supplied about 22% of the total Valley-wide water demand in the 2018 WY.

12.4 Future Supply Reliability

Zone 7 continues to implement a multifaceted strategy for securing the long-term reliability of the water supply system to meet the needs of both existing and future customers. This strategy includes the following components.

- Increased yield from the Arroyo Valle local water right using the Chain of Lakes (COL).

- Maximized groundwater storage in Kern County groundwater banks.

- Access to emergency water supply in the local COL.

- California WaterFix (CA WaterFix) to increase yield from the State Water Project (SWP).

- Pursuit of alternative water supply (e.g., Sites Reservoir, potable reuse, interagency transfers and regional desalination) and storage (e.g., Los Vaqueros Expansion) options.

Local water is a key component of Zone 7's water supply portfolio. In 2018, Zone 7 continued to work on a petition to extend Zone 7's water right permit for diverting surface water captured in Lake Del Valle (LDV) from Arroyo Valle runoff. Under the existing water right permit, Zone 7's average annual yield from the upper Arroyo Valle is about 7,300 AF, including water routed to Zone 7's treatment plant and water used in Zone 7's artificial recharge program. A diversion facility into Lake A and a pipeline through the COL area (COL–Cope Lake to Del Valle Water Treatment Plant [DVWTP] Pipeline) are planned in Zone 7's Capital Improvement Plan (CIP), and will facilitate capture and use of additional water released from LDV; potentially increasing Zone 7's average water rights yield by 3,000 - 10,300 AF/yr.

Investments in out-of-basin groundwater banks in Kern County (i.e., Cawelo Groundwater Banking Program and Semitropic Stored Water Recovery Unit) allow Zone 7 to augment imported surface water supplies during times of low SWP allocations (e.g., the recent drought). Zone 7 currently has 128,970 AF of water banked in the Kern Groundwater Basin.

In a normal year, about 80% of Zone 7's supply is derived from the SWP. The SWP reliability has been declining over the years due to increasingly stringent regulations, declining Delta conditions and infrastructure, and climate change. To protect the Valley's major water supply, Zone 7 has been supporting the CA WaterFix, the State of California's proposed project to upgrade the SWP system infrastructure and operations, and improve its long-term reliability while protecting the Sacramento-San Joaquin Delta (Delta) ecosystem. As of early 2019, the project's design is being re-evaluated under California's new governor. At this time, Zone 7 is assuming that a CA WaterFix project would be in-service around 2035.

Zone 7 also continues to evaluate alternative water supply and storage options such as the Bay Area Regional Desalination Project, potable reuse, Los Vaqueros Expansion, Sites Reservoir, and water transfers. Ultimately, Zone 7 may choose to implement one or several of these options depending on the results of the studies and planning efforts, the amounts and timing of development and conservation, and the determination of costs and benefits to the Valley.

Finally, Zone 7 has been evaluating the feasibility of an intertie with another major water agency (e.g., East Bay Municipal Utilities District (EBMUD) or San Francisco Public Utilities Commission (SFPUC). An outage of the SBA or major disruptions in the Delta would prevent Zone 7 access to most of its water supplies, leaving only groundwater, water in the COL, and water in LDV available to meet its demands. An intertie with another agency could also provide another source of water during an emergency or drought, and could also facilitate water transfers.

Additional information regarding Zone 7's efforts to increase future supply reliability is provided in *Section 5.2.1, Import of Surface Water*, of the Alternative GSP and Zone 7's Water Supply Evaluation Update (*Zone 7, 2016b*).

12.5 Water Conservation

By managing water demands, water conservation is basic to ongoing achievement of basin measurable objectives including management of groundwater levels and storage, avoidance of land subsidence, maintenance of groundwater quality, and protection of environmental benefits associated with surface water that is connected to groundwater. Responsive to the Urban Water Management Planning Act, all of the urban retailers in the entire basin (Cal Water, DSRSD, EBMUD, Livermore, and Pleasanton) have prepared at least 2010 and 2015 Urban Water Management Plans which include a Water Shortage Contingency Plan that provides a response to drought and other shortages. As documented in the *2015 Urban Water Management Plan*, Zone 7 is on track with all applicable best management practices (BMPs) for water demand management.

In addition, Zone 7 continues to work closely with the retailers on the Valley-wide conservation program, providing rebates, offering public outreach and education, and securing grants to support the program. Zone 7 regularly updates the program to focus on the most cost-effective elements and to implement the latest regulations. Water conservation by Zone 7 and the retailers is ongoing and discussed in greater detail in *Section 5.2.6*, *Water Conservation*, of the Alternative GSP. Throughout the 2018 WY, Zone 7 continued its regional coordination of conservation programs, including community

workshops and other events, school education programs, and rebates and water-saving giveaway programs.

12.6 Chain of Lakes Recharge Projects

The COL is a series of former quarry lakes located in the heart of the Livermore-Amador Valley (*Figure 12-3*). Best described in the 1981 Specific Plan for Livermore Amador Valley Quarry Area Reclamation (Alameda County 1981), the COL were envisioned as a large water management facility to be used by Zone 7. The COL will ultimately consist of ten lakes (named Lakes A through Lake I, and Cope Lake) connected through a series of conduits. The general vision is that Zone 7 would use the lakes for water management and related purposes. Water management includes, but is not limited to, groundwater recharge, surface water storage and conveyance, and flood protection.

Of the ten lakes, two have been transferred to Zone 7 ownership (Lake I and Cope Lake) and are currently operated and maintained by Zone 7 for water storage and groundwater replenishment. The remaining lakes are still being mined or reclaimed under surface mining permits (SMPs) issued to the individual quarry operators by the Alameda County Community Development Agency (ACCDA) (the administrative representative of the state for mining operations and reclamation). Background information on the COL is provided in *Section 2.3.10.3*, *Mining Areas*, *Section 4.4*, *COL and Quarry Operations Monitoring*, and *Section 5.2.4*, *COL Recharge Projects*, of the Alternative GSP.

During the 2018 WY, Zone 7 continued to work with Hanson Aggregates (former quarry operator for Lakes H, I, and Cope) while they continue the process of permitting a future diversion structure to divert artificial flows from Arroyo Mocho into Lake H. The U.S. Army Corp of Engineers approved the permit application submitted by Hanson in the 2017 WY. Hanson submitted a permit application with the approved design to the Regional Water Quality Control Board (RWQCB) in the 2017 WY. The RWQCB comments on the design and future operations of the diversion are still being addressed. Once installed, this diversion facility will allow SWP water released from the SBA to be diverted from the Arroyo Mocho into Lake H and, and ultimately, Lake I for groundwater recharge. Lake H is connected to Lake I via a 30-inch-diameter conduit.

CEMEX submitted an application to amend SMP-23 in the 2017 WY that included additional mining in Pits P28 and P41 (Lake A), Pit P42 (Lake B) and P46 (Lake J). CEMEX withdrew the application in 2018 when they decided to forego additional mining in Pits P28 and P41, but with the intention to submit a revised application later. Zone 7 is working with CEMEX to understand the potential impacts the proposed deeper mining in Lakes B and J will have on the groundwater basin. Zone 7 and CEMEX participated together on a hydrogeologic study to further characterize the hydrogeology in the area of Lake B during the 2018 WY. In addition, staff continue to work closely with the ACCDA that oversees the surface mining permit program for Alameda County and the SMP-23 amendment process.

12.7 Well Master Plan

In the early 2000s, Zone 7 identified the need to increase its groundwater production capacity to meet customer demands during projected droughts and water shortage emergencies. Zone 7's Well Master

Plan (WMP), adopted by the Zone 7 Board in 2005, concluded that Zone 7 would need to install several new municipal water supply wells over the next 20-30 years to maintain Zone 7's potable water reliability goal. Additional benefits of these new wells would include providing Zone 7 with improved operational flexibility to pump its stored water resources, and remove dissolved salts from more of the groundwater basin.

Since 2005, Zone 7 constructed three new municipal supply wells (COL 1, COL 2 and COL 5) bringing Zone 7's total to ten wells. In 2012, Zone 7's Board adopted new reliability goals. Together with implementation of additional water conservation measures, and expansion of recycled water use by retailers, the need for new wells has changed. During the 2018 WY, Zone 7 staff began the process of reevaluating Zone 7's well needs and plans to update the well construction schedule, accordingly during the 2019 WY.

12.8 Sustainable Groundwater Management Ordinance

On June 21, 2017, the Zone 7 Board of Directors adopted the Zone 7 Sustainable Groundwater Management Ordinance (Zone 7 Ordinance 2017-01). The ordinance was created to enhance existing sustainable management programs for the local groundwater basin. The ordinance can be viewed and downloaded from Zone 7 website:

http://www.zone7water.com/images/pdf_docs/groundwater/groundwater_ordinance_2017-01.pdf

The Zone 7 Sustainable Groundwater Management Ordinance recognizes groundwater as an essential resource for municipal, industrial, and domestic uses, as well as agricultural production, and sets provisions for groundwater protection within Eastern Alameda County. Not protecting the basins from unsustainable extraction of groundwater could have adverse economic effects, including loss of arable land, a decline in property values, increased pumping costs due the lowering groundwater levels, and increased water quality treatment. Nothing in the ordinance determines or alters water rights, groundwater rights, or existing county ordinances (such as the well ordinance that establishes fees and criteria for permitting new wells).

Under the ordinance, the following actions are prohibited.

- The unsustainable extraction or wasteful use of groundwater within the service area.
- The export of water to areas or users outside the service area.
- The waste or unreasonable use of surface water within the service area.

Zone 7 will establish a permit system to authorize water management practices otherwise prohibited where those practices are for reasonable and beneficial use of groundwater. Water management activities that will be allowed when carried out in compliance with a permit issued by Zone 7 include the following.

- Dewatering of shallow water tables where the net benefits of the removal of subsurface water substantially outweighs the loss of water because of damage the high water table reasonably may cause to agriculture, industry, commerce and other property uses.

- Reasonable use of groundwater resources to supplement or replace surface water released for other reasonable and beneficial purposes, such as fisheries, ecosystem habitat, or downstream water quality or quantity needs.

- Conservation of water in compliance with applicable state law that authorizes public water agencies to transfer water outside its usual place of use. Conservation programs may include, but are not limited to, irrigation practices in agricultural areas where the crops grown use less water, or communities that produce recycled water, fix leaks, or promote other water-saving devices and methods to conserve water on a temporary or permanent basis.

- Recharge of groundwater in locations in the service area that are capable of improving groundwater conditions in order to meet total water demands of beneficial uses in the hydrologic and groundwater basin.

- Remediation of contaminated groundwater that is pumped and treated to remove contaminants that are in violation of standards for beneficial uses.

- Export of water that reasonably supports agricultural operations on property outside the service area that is contiguous with property within the service area and is under common ownership.

The ordinance also includes provisions that allow Zone 7 to continue to collect groundwater data from all parties, including public water agencies that extract groundwater within the service area, for the purpose of monitoring existing groundwater conditions and trends; the information necessary to develop effective sustainable groundwater management plans (GWMPs) and policies.

12.9 Existing and Future Recycled Water Use

Zone 7 views recycled water as a valuable component of the local water portfolio when managed appropriately under a Salt Nutrient Management Plan (SNMP). Recycled water can reduce the demand for surface water imports and pumped groundwater, and contribute to groundwater storage when incidental percolation occurs during irrigation of landscapes and crops.

Most of the recycled water used in the Valley is for landscape irrigation, with a minor amount used for dust suppression, grading projects, and crop irrigation. Only a small portion of the applied recycled water percolates to the groundwater supply; most of the applied water is evaporated, taken up by plant roots, lost through plant transpiration, or retained as moisture in the unsaturated zone. The total amount of recycled water for the 2018 WY is discussed in *Section 10*, *Wastewater and Recycled Water*.

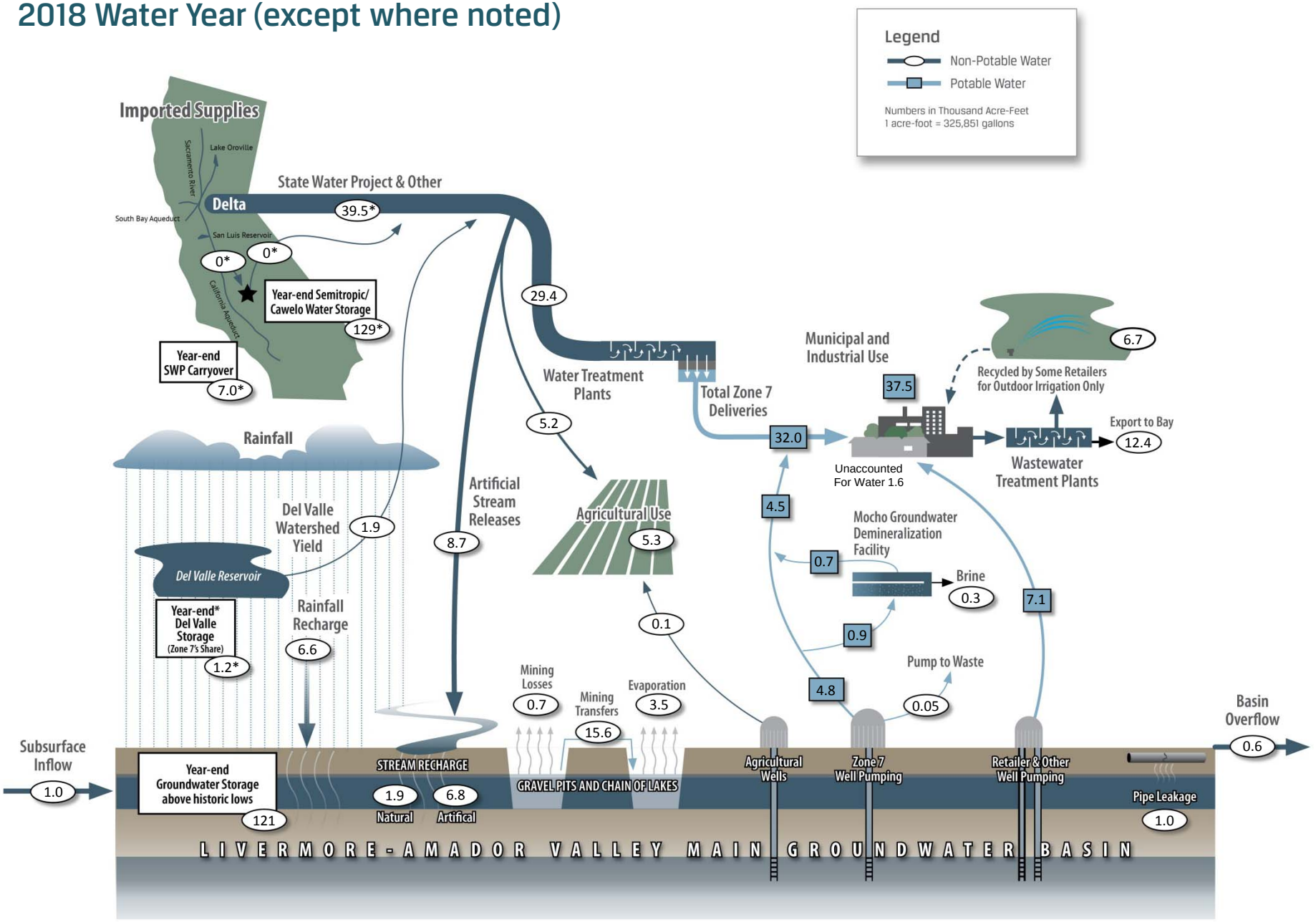
From 2016 to the present, Zone 7 continues to be part of a joint effort by the Tri-Valley water agencies, studying the technical feasibility of potable reuse, or purified recycled water, to enhance long-term water supply reliability. In May 2018, the Tri-Valley water agencies completed the Joint Tri-Valley

Potable Reuse Technical Feasibility Study. The primary goals of the study were to evaluate the feasibility of a wide range of potable reuse options for the Tri-Valley based on technical, financial, and regulatory considerations, and to recommend next steps for the agencies if potable reuse was found to be technically feasible. The results suggested that potable reuse was indeed technically feasible. Options for potable reuse that were evaluated include purification followed by either groundwater recharge (through injection or surface water recharge) or blending with other surface water and treating the blend at a Zone 7 surface water treatment plant. Connecting a water purification facility directly to the water transmission system was not considered in the study. The next steps that were identified include a regional water demand study, regional water supply updates, and technical studies regarding the COL and potential groundwater injection well locations.

Livermore-Amador Valley Water Supply & Use (in Thousands of Acre-Feet)

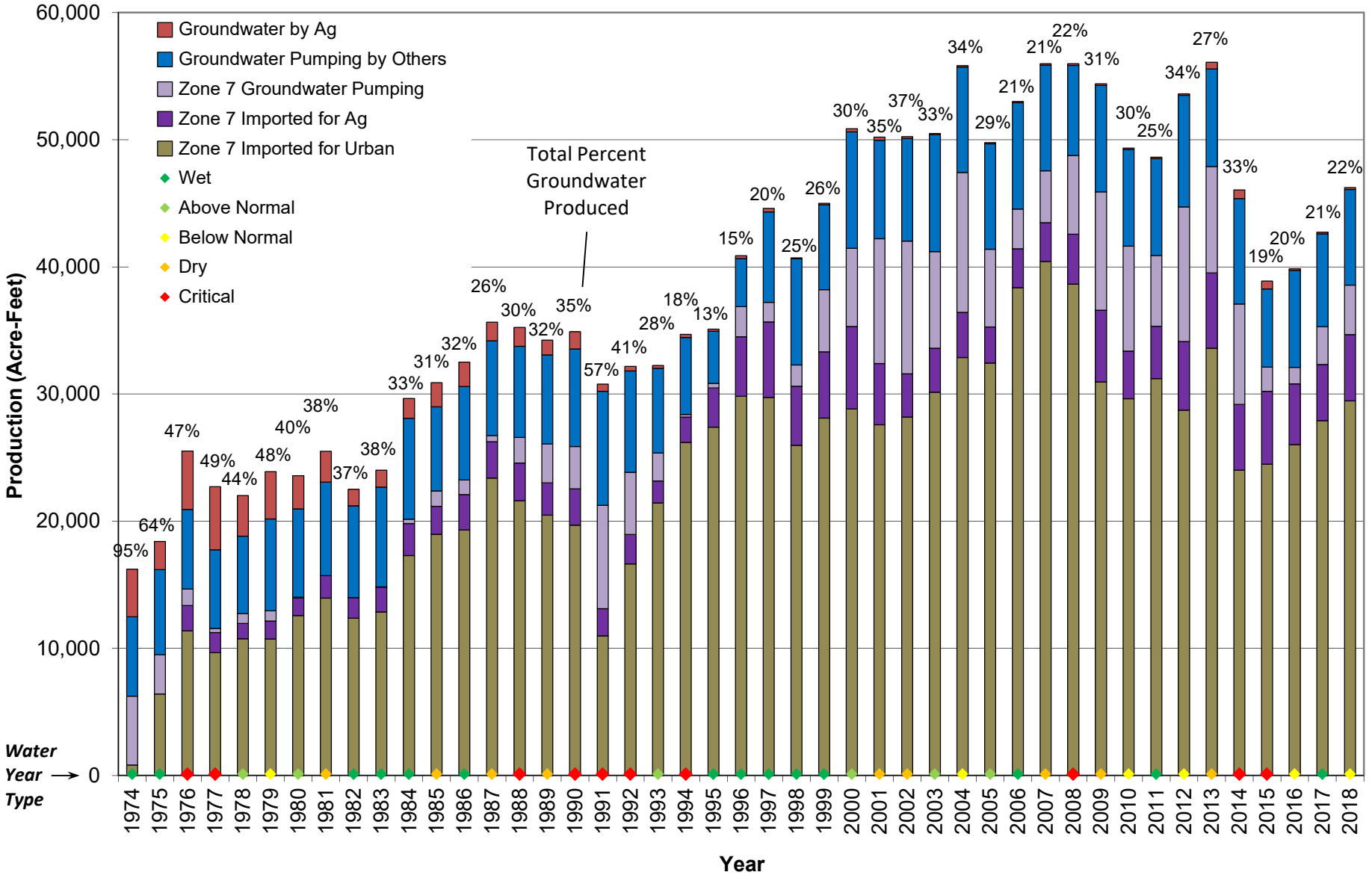
2018 Water Year (except where noted)

Figure 12-1



* 2018 Calendar Year

FIGURE 12-2
VALLEY WATER PRODUCTION FROM IMPORTED WATER AND GROUNDWATER
1974 TO 2018WATER YEARS



E:\MONITOR\GWStorage\2018WY\AnnualReport2018\Fig12-02-GrphTotalProduction74to18.xlsx
3/15/2019

Figure 12-2

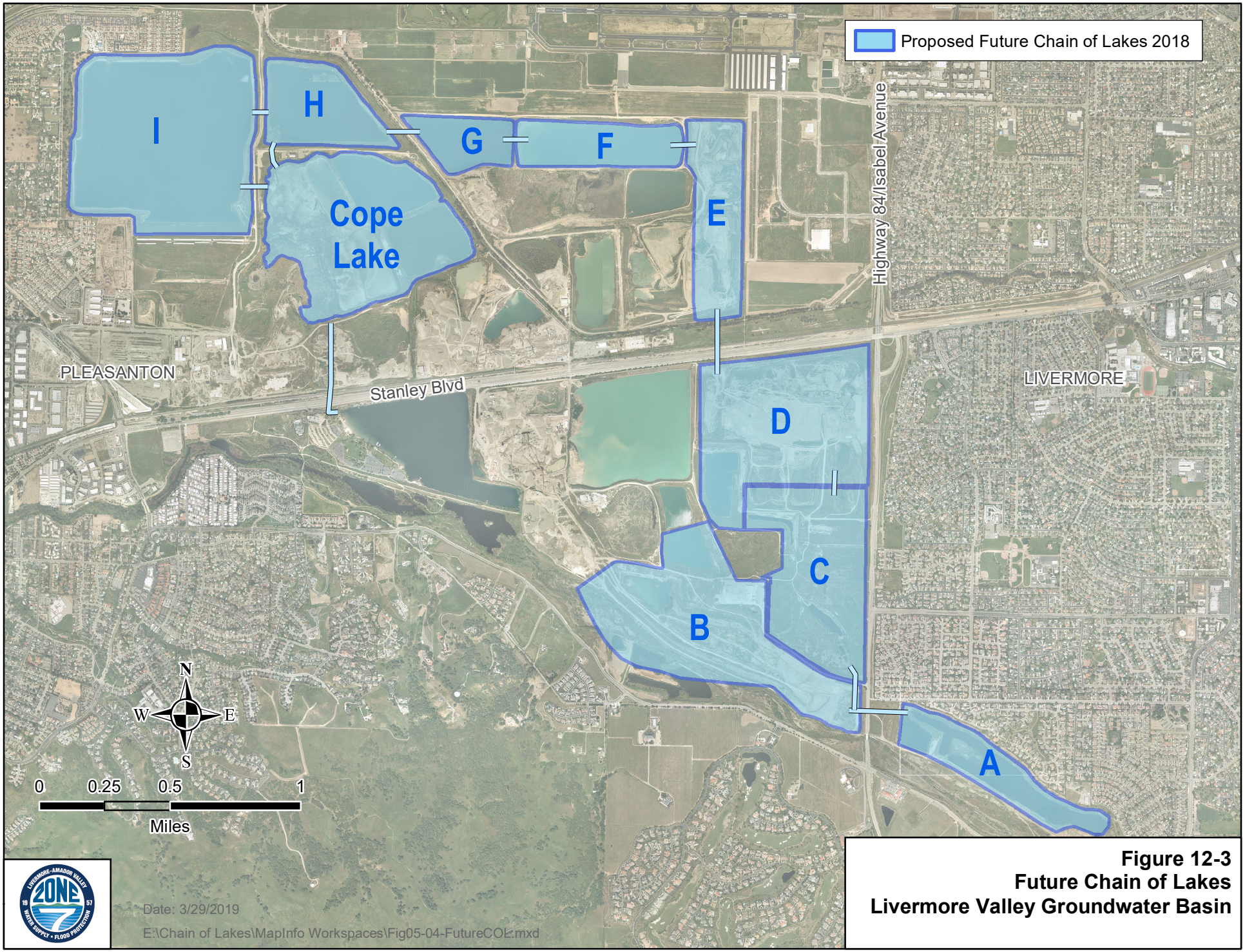


Figure 12-3
Future Chain of Lakes
Livermore Valley Groundwater Basin

13 Water Quality Sustainability

13.1 Introduction

Recognizing the importance of the groundwater basin for supply and storage, Zone 7 has long championed groundwater quality protection. Its ongoing programs are directly beneficial for maintaining groundwater quality, meeting basin plan objectives (*California RWQCB, 2011*), and are indirectly supportive of groundwater supply objectives. Specific Zone 7 groundwater quality projects and management actions include:

- The Well Ordinance Program, which requires permitting for the construction, repair, reconstruction, destruction or abandonment of wells and borings. The program also includes permit compliance inspections.

- The Toxic Sites Surveillance (TSS) Program, which tracks progress of polluted sites across the groundwater basin that pose a potential threat to drinking water. Zone 7 also interfaces with lead regulatory agencies to ensure that their actions adequately protect groundwater quality.

- The 2004 Salt Management Plan (SMP, *Zone 7 2004*) is a substantial 450-page document reflecting a cooperative effort to address the increase in total dissolved solids (TDS) observed in some portions of the groundwater basin. Implementation has included modifications to existing conjunctive use programs, plus development of the Zone 7 Mocho Groundwater Demineralization Plant (MGDP).

- The 2015 Nutrient Management Plan (NMP, *Zone 7 2015b*) was conceived as an addendum to the SMP. Implementation of the NMP involves ongoing monitoring of nitrate in groundwater, and coordination with land use agencies for BMP requirements to manage nitrogen loading to the Basin, plus coordination with Alameda County Department of Environmental Health (ACDEH).

The following sections describe significant updates or changes that were made with regard to the above programs and plans in the 2018 WY.

13.2 Well Ordinance Program

Zone 7 administers the associated well permit program within its service area and the three incorporated cities (Dublin, Livermore, and Pleasanton) pursuant to a Memorandum of Understanding (MOU) with Alameda County and ordinances adopted by the three cities. As a result, any planned new well construction, soil-boring construction, or well destruction must be permitted by Zone 7 before the work is started. Additionally, all unused or abandoned wells must be properly destroyed; or, if there are plans to use the well in the future, a signed statement of future intent must be filed at Zone 7.

During the 2018 WY, Zone 7 issued 165 drilling permits; thirteen more permits than in the 2017 WY. *Table 13-A* details the breakdown of the types of permits issued during the 2018 WY and their quantities.

Table 13-A: Well Ordinance Permits Issued in the 2018 Water Year

Permit Type	Quantity
Geotechnical Investigations	87
Well Destructions	11
Contamination Investigations/Remediation	42
Water Supply Wells	11
Groundwater Monitoring	12
Cathodic Protection Wells	2
Total	165

Eleven water supply well permits were issued in the 2018 WY. The pre-drought average was 25 per year. About 82% of the permitted well work was physically inspected by Zone 7 permit compliance staff; the balance was allowed to proceed with self-monitoring and reporting efforts when a licensed professional was supervising the project.

13.3 Toxic Site Surveillance Program

13.3.1 Program Description

Through the TSS Program, Zone 7 documents and tracks polluted sites that pose a potential threat to drinking water. In general, the TSS Program monitors two types of contamination threatening groundwater: petroleum-based fuel products and industrial chemical contamination (e.g., chlorinated solvents).

The TSS Program is directly applicable to the basin measurable objective of maintaining and protecting groundwater quality through its provision of information to agencies and the public. The TSS Program also supports basin measurable objectives of maintaining groundwater levels and storage; the TSS Program helps to protect municipal wells that have an integral role in conjunctive use. There were no administrative changes to the TSS monitoring program in the 2018 WY.

13.3.2 Active Cases

In the 2018 WY, Zone 7 tracked the progress of 43 active sites where contamination has been detected in groundwater or is threatening groundwater. Eight of these active sites have a contaminant plume that is within 2,000 ft of a water supply well or a surface water source, and are therefore classified as “High Priority” cases due to their impact or threat of impact on potable groundwater supplies. Zone 7’s database also contains 281 other contamination cases that have been either “Closed” or classified as

"No Action Required" because they have been sufficiently cleaned up and/or pose minimal threat to drinking water supplies.

The locations of all the toxic sites, and their proximity to the Valley's municipal water wells, are shown on the accompanying individual area maps (*Figure 13-1through Figure 13-3)*, Livermore, Pleasanton/Sunol, and Dublin). *Table 13-1* contains a summary for each of the 43 active sites including the case status, its priority, and which agency is responsible for providing oversight for the case. It also identifies the contaminants of concern for each case and provides brief notes regarding the cases. In addition, copies of plans, reports, directive letters, and background data on the cases can be found at the SWRCB's GeoTracker website: *http://geotracker.waterboards.ca.gov/*. The GeoTracker number for each case (if one is assigned) is also included in *Table 13-1*.

13.3.3 Case Closures

No toxic sites were granted "Case Closed" status in the 2018 WY; however, closure requests for seven cases were pending decisions at the end of the 2018 WY (see the following Section). One new case (Site 327) was added to the Zone 7 database in the 2018 WY.

13.3.4 Sites Pending Closure Review

"Case Closure" was requested by representatives for the seven contamination sites listed below. Their locations are provided on *Figure 13-4.* At the end of the 2018 WY, the lead agencies were still considering the requests, but may ask for additional information before making their decision. Cases approved for closure by ACDEH must be reviewed and accepted by the RWQCB before they are officially closed. Information on each pending closure request, including Zone 7's recommendations, is summarized as follows:

- Site 31: Dublin Toyota Pontiac, Dublin. ACDEH has recommended the case for closure under the Low-Threat Underground Storage Tank Closure Policy (LTCP). In 2016, ACDEH did not support the SWRCB closure recommendation and requested additional indoor vapor sampling. The additional samples support closure under the LTCP Scenario 5. Closure will be granted after the comment period (September 21, 2018), well destruction, waste removal, and the supporting report which is due October 22, 2018. Staff does not object to the pending case closure.

- Site 37: Applied Biosystems, Pleasanton. A 5-year remedial action review report was submitted by the RP in July 2018. The report showed that the groundwater concentrations in the sole remaining monitoring well were below MCLs for tetrachloroethylene (PCE), trichloethylene (TCE), and 1, 1-Dichloroethene (DCE). The RP requested that groundwater monitoring be discontinued, the well be destroyed, case closed, and the deed restriction be lifted. DTSC approved discontinuing the groundwater sampling but will need the RP to submit a well decommissioning plan prior to well destruction. DTSC said the removal of the deed restriction will need to be done in accordance with Health and Safety Code 25224.

- Site 68: Chevron, #9-2582 (Dublin Auto Wash), Dublin. This case meets the LTCP Scenario 2 criteria for closure. Some localized methyl tertiary-butyl ether (MTBE) contamination remains in

groundwater but the plume appears to be stable and decreasing. There are no municipal supply wells in Dublin. The site is over 1,000 ft from any private supply wells, and Zone 7 staff does not object to its closure. The ACDEH caseworker notified the RP that they were out of compliance on uploading reports to GeoTracker. There was no progress made by the RP in the 2018 WY.

- Site 259: Mills Square Park, Livermore. RP conducted additional sampling and remediation activities required by ACDEH to obtain closure after the initial closure request was denied in the 2017 WY. All monitoring wells were destroyed under a Zone 7 permit, and a report was submitted to ACDEH. Staff does not object to the pending case closure.

- 284: Former Crow Canyon Dry Cleaner, Dublin. The RP requested closure in the 2015 WY based on the success of the active remediation to reduce the contamination at the source, and because the vapor measurements are below Environmental Screening Levels (ESLs). Vapor contamination is the main concern at the site. PCE and TCE remain above the maximum contaminant level (MCL) in groundwater in only localized areas. Since this site is in a portion of a fringe basin not used for water supply, Zone 7 staff does not object to its closure. ACDEH directed the RP to conduct additional work to move ACDEH's consideration forward. The RP has not followed through with the work requested by ACDEH. There was no other update for the 2018 WY.

- Site 313: Just Tires, Livermore. This case is slated for closure. Comments on pending closure were due January 2016. The case is a soil contamination case. No fuel contaminants were detected in groundwater beneath the site. Staff does not object to the pending case closure. ACDEH sent multiple letters to the RP but they have not responded to finalize the closure. There was no progress in the 2018 WY.

- Site 317: Walgreens Spill, Sunol. Case was approved for closure by ACDEH under the LTCP. The RP was required to remove any remaining waste from the site and provide ACDEH with a report by April 22, 2018 to finalize the requirements for case closure. The report has not been submitted to GeoTracker so the case closure is still pending. Staff does not object to the case closure approval.

13.3.5 New Cases

One new case (Site 327) was added to the Zone 7 TSS Program in the 2018 WY. Its location is shown on *Figure 13-4.*

- Site 327: VIP Cleaners, Pleasanton. The case was opened by the RWQCB as part of the regional dry cleaner assessment. PCE and TCE were detected at elevated levels in soil gas in a subsurface investigation in 2016. Based on the results, RWQCB has requested additional investigation. A workplan was approved in August 2018. The investigation, including grab groundwater samples, was scheduled for October 2018 and the report was due November 2018.

13.4 Salt Management

13.4.1 Introduction and Strategy

Agriculture and Urban development over the Basin has led to rising salt concentrations in local groundwater. Mainly, irrigation of crops and landscape concentrates the salts and minerals delivered in the source water, through evapotranspiration processes, which results in higher salinity leachate and percolate recharging groundwater and impacting its TDS concentration. Impacts from historic, and to a lesser degree, current wastewater disposal practices have also contributed to the increase of groundwater salinity in the Basin. Without management and/or mitigation, groundwater salinity would continue to rise (*Zone 7 2004)*.

In 2004, Zone 7 prepared a SMP (*Zone 7 2004*) to reduce annual salt loading and increase salt removal to protect the long-term water quality of the Main Basin, while expanding the area's use of recycled water. The SMP was approved by the RWQCB in October 2004 and then incorporated into Zone 7's Groundwater Management Plan in 2005 (*Zone 7 2005a*).

The SMP is an active ongoing program that uses an adaptive management approach, based on hydrologic conditions, prior year salt balance, availability and quality of import water, and budget constraints, to select the combination of salt management strategies to be implemented in a given year. The available SMP tools include: salt removal by groundwater pumping; salt exportation through the operation of Zone 7's groundwater demineralization facility (MGDP), and reduction of groundwater salinity by artificially recharging lower salinity imported water. See *Section 5.3.3.2, Salt Management Strategy* of the Alternative GSP for more information on the salt management strategies employed by Zone 7.

13.4.2 Salt Management for 2018 WY

13.4.2.1 Salt Management Actions

No changes were made involving the SMP or SMP tools in the 2018 WY. The following is a summary of the salt management actions conducted by Zone 7 during the 2018 WY:

- Zone 7 pumped 4,860 AF of higher TDS (693 mg/L, average) groundwater into its distribution system, which resulted in 4,580 tons of salts being removed from the groundwater basin.
- Zone 7 exported 1,168 tons of salts from the Valley with the operation of its MGDP groundwater demineralization facility (discussed in *Section 13.4.2.3*).
- Zone 7 imported and artificially recharged 6,773 AF of lower TDS (220 mg/L, average) into the Basin.

13.4.2.2 Salt Loading Calculations

Zone 7's salt loading calculations take into account the addition and removal of salt mass to and from the Main Basin by tracking or estimating the TDS concentration of each Supply and Demand component of the Hydrologic Inventory (HI) and multiplying it by the volume for each HI component (*Section 11.1.3., Hydrologic Inventory Results*). *Table 13-2* contains the results for each HI component for WYs 1974 through 2018.

In the 2018 WY, the total salt mass added to the Main Basin by all the inflow (Supply) components was approximately 10,900 tons, whereas, the total mass of salts removed from the basin by all the outflow (Demand) components is estimated at 10,300 tons; a net increase of 600 tons. However, net change in salt mass alone is not a good indicator of the change in water quality because it does not take into account the amount of water associated with the salt mass increase (or decrease); e.g., a larger volume of water having a lower TDS concentration could conceivably contain more salt mass than a smaller volume with higher TDS concentration. Accordingly, Zone 7 calculates an end-of-water-year theoretical average TDS concentration for the entire Main Basin for comparison with previous years. For this approximation, Zone 7 assumes a starting average TDS concentration of 450 mg/L in 1973 (*DWR 1974*), and then calculates a running annual average TDS concentration based on the annual inflows and outflows and salt load and removals for each year since then. The results are believed to be conservative or "worst case" because the computation assumes that all of the salts in the applied waters are added to groundwater during the annual time-step that they are applied. In reality, some of the salts may end up being fixed in the vadose zone and confining clays.

In the 2018 WY, the weighted average TDS concentration of all the water recharging the Main Basin's aquifers was 405 mg/L, whereas the weighted average TDS of all the water removed from the basin was 422 mg/L. While the salt load for the 2018 WY was almost 600 tons, the end-of-water-year theoretical average TDS concentration for the Main Basin (655 mg/L) decreased by 6 mg/L from the previous WY average (*Figure 13-5*). This is because the salt load was accompanied by almost 3000 AF of recharge, which is essentially the same as diluting the water already in storage (661 mg/L TDS in 2017 WY) with 3000 AF of water having a TDS concentration of 147 mg/L (600 tons/3,000 AF).

13.4.2.3 Groundwater Demineralization Program

Zone 7's Mocho Groundwater Demineralization Plant (MGDP) reduces salt buildup in the groundwater basin while improving delivered water quality to meet targets established in Zone 7's Water Quality Policy. The MGDP is a reverse osmosis (RO) membrane-based treatment system producing product water with extremely low TDS. The demineralized water is blended with other groundwater (non-demineralized) or system water to achieve the desired overall delivered water TDS and hardness. The brine concentrate from the RO process is exported out of the watershed to San Francisco Bay by way of DSRSD through the regional wastewater export pipeline operated by the Livermore-Amador Valley Water Management Agency (LAVWMA) and DSRSD-EBMUD Recycled Water Authority (DERWA).

Table 13-B below presents the salts removed by the MGDP from its construction in 2009 to the 2018 WY. Since its inception, the MGDP has exported 15,532 tons of salt from the Valley. During the 2018 WY, the MGDP produced 268 AF of brine (compared to 244 AF in the 2017 WY) that resulted in the export of

about 1,168 tons of salt from the Main Basin through the LAVWMA pipeline (compared to 949 tons in the 2017 WY).

Table 13-B: Salts Removed by Zone 7's Mocho Groundwater Demineralization Plant Operations

Water Year	Brine Volume Exported from Valley (AF)	Average Brine TDS Concentration (mg/L)	Salt Mass Exported (Tons)	Salt Removed per AF of Brine Export (Tons/AF)
2009	192	3,059	798	4.16
2010	675	3,010	2,760	4.09
2011	429	3,445	2,008	4.68
2012	935	3,198	4,062	4.34
2013	518	3,522	2,478	4.78
2014	214	3,607	1,049	4.9
2015	16	3,474	76	4.75
2016	51	2,662	184	3.61
2017	244	2,863	949	3.89
2018	268	3,209	1,168	4.36
TOTAL	3,542	3,228	15,532	4.39

AF = acre-feet TDS = total dissolved solids
mg/L = milligrams per liter

13.5 Nutrient Management

13.5.1 Introduction

The principal nutrient of concern in the Livermore Valley is nitrate. The State MCL for nitrate in drinking water is 10 mg/L, which is also the value used as the Basin Objective (BO) by the RWQCB and as the minimum threshold by Zone 7. The results of monitoring for nutrients in the groundwater for the 2018 WY are reported in *Section 7.1.*

13.5.2 Nutrient Management Plan

In June 2015, Zone 7 adopted its NMP (*Zone 7 2015b*), and by resolution the RWQCB concurred with the findings and measures of the NMP in March 2016. The NMP assesses the existing and projected future groundwater nutrient concentrations relative to the current and planned expansion of recycled water projects and future development in the Livermore Valley. The NMP concludes that although overall basin groundwater quality is not expected to degrade, there is still a need to further monitor, assess, reduce, and/or manage future nutrient loading. A description of the NMP is provided in *Section 5.3.4.1*, *NMP*, of the Alternative GSP.

The NMP outlines plans to simultaneously refine the extent of nitrate Areas of Concern (AOCs) and minimize nitrogen (N) loading from existing sources. The NMP also presents planned actions for addressing positive nutrient loads and high groundwater nitrate concentrations in localized AOCs where the use of onsite wastewater treatment systems (OWTS) is the typical method for sewage disposal (which can be a contributor to nitrate contamination). To minimize N loading, the NMP calls for the continued use of BMPs for such facilities as horse boarding facilities, vineyards, irrigated turf/landscapes, and wineries. The NMP also recommends implementing additional OWTS performance measures for new and replacement OWTS in the AOCs (see *Section 13.5.3* below). The NMP includes an implementation schedule that recognizes the ongoing monitoring and BMPs, and presents a specific schedule for AOC investigations.

To refine the extent of the AOCs, Zone 7 initiated a study in late 2015 of nitrate occurrences in South Livermore, the results of which were presented in the 2016 Annual Report (*Zone 7 2017b*). During the 2018 WY, Zone 7 continued working with ACDEH to implement the NMP measures. Zone 7 also took advantage of opportunities to obtain additional groundwater samples from private homeowners' wells as they arose, and to work with ACDEH and RWQCB to require monitoring wells for OWTS projects where appropriate.

13.5.3 OWTS Management

In 1982, the Zone 7 Board of Directors adopted the *Wastewater Management Plan (WWMP) for the Unsewered, Unincorporated Area of Alameda Creek Watershed above Niles* (WWMP, *Zone 7 1982*) and its recommended policies (Resolution No. 1037). A separate policy was established in 1985 that prohibits the use of septic tanks for new developments zoned for commercial or industrial uses (Resolution 1165). Whereas ACDEH administers the County OWTS Ordinance, and is responsible for reviewing OWTS plans and issuing permits for the installation, repair, alteration, and operation of OWTS in Alameda County, Zone 7 approval is explicitly required for nonresidential uses within the Upper Alameda Creek Watershed (Resolution 1165). See *Section 5.3.5*, *OWTS Management*, of the Alternative GSP for more information on Zone 7's role in managing OWTS densities within the Livermore Valley Groundwater Basin and watershed.

In the 2018 WY, no new authorizations for nonresidential OWTS were granted; however, staff did respond to several inquiries about Zone 7's requirements for OWTS authorization for a couple of new wineries and cannabis cultivation sites, and a public cemetery that are being planned in various unincorporated areas around the watershed. Zone 7 authorization applications have not yet been received for any of these potential commercial operations.

Also in 2018 WY, Zone 7 paid out a total of $24,747.61 in rebates to two homeowners in the Buena Vista high nitrate area-of-concern that replaced their existing conventional septic systems with two new OWTS that have integrated pre-treatment modules for reducing N content in their effluent. Because there has been low level of interest in the rebate program since it was established in 2015 to further the goals of Zone 7's NMP (there have only been two applications received), and because the benefits at that level of participation are unclear, the program is under consideration to be suspended.

TABLE 13-1
TOXIC SITES SURVEILLANCE - ACTIVE SITES SUMMARY
2018 WATER YEAR

ID: **1** ***NAME:*** Lawrence Livermore Lab ***OWNER:*** Lawrence Livermore National Laboratory ***PRIORITY:*** 3A3 ***STATUS*** 7

ADDRESS: 7000 East Avenue , Livermore ***GEOTRACKER ID:*** T0600191466 ***LEAD:*** ACEH

CHEMICAL	*CONCENTRATION ug/L*
TCE	670

At the end of the 3rd Quarter 2018, a cumulative site total of approximately 1,736 kilograms (kg) of volatile organic compounds (VOCs) from groundwater and 1,606 kg of VOCs from soil vapor have been removed from the site. In 2017, VOC concentrations declined or remained stable. The 2017 annual report is available. Https://www-envirinfo.llnl.gov/siteAnnualReports.php The 2018 report is not yet available but the 3rd Quarter self monitoring report shows similar concentrations to 2017. A Fifth Five Year Review Report was submitted and four monitoring wells were installed in 2017.

ID: **5** ***NAME:*** Sandia National Labs ***OWNER:*** Sandia National Laboratory ***PRIORITY:*** 3A3 ***STATUS*** 8

ADDRESS: 7011 East Avenue, Livermore ***GEOTRACKER ID:*** T0600191470 ***LEAD:*** RWQCB

CHEMICAL	*CONCENTRATION ug/L*
TPHd	1,000
NO3	23
CCL4	1.7
CR(IV)	NS-dry

The 2018 SNL Annual Report is not yet available. The 2017 results showed PCE = ND; Carbontetrachloride = 1.8 ppb and Trichlormethane = 0.93 pbb at the Landfill. TPHd was detected at one well in consectutive sampling rounds at concentrations up to 1,000 ppb at the Fuel Oil Spill. The detections are being attributed to the heavy rainfall in 2016/2017 raising the water table up to 7 feet in the area bringing the water in the well in contact with residual fuel in the vadose zone. Trend graphs will be included in future reports if detections continue.

ID: **11** ***NAME:*** Intel Livermore Fabrication Plant 3 ***OWNER:*** Intel ***PRIORITY:*** 2A3 ***STATUS*** 8

ADDRESS: 250 North Mines Road, Livermore ***GEOTRACKER ID:*** SL18368788 ***LEAD:*** RWQCB

CHEMICAL	*CONCENTRATION ug/L*
TCE	110
1,2-DCE	250
VC	110
PCE	3

RP continues to work toward closure of the case. The approved remediation is natural attenuation but the RP has added extra remediation to try to expedite clean up and closure. In the 2017 Annual Report the RP recommended additional sampling of the "temporary" wells installed in 2008. If the wells are non-detect they will request approval from RWQCB to destroy the wells. A 2018 Annual Report has not been submitted to GeoTracker yet. RWQCB issued another NOV letter to Mines Road LLC for the required deed restriction prohibiting the use of groundwater and limiting the Site to commercial/industrial uses.

ID: 31 **NAME:** Dublin Toyota Pontiac **OWNER:** Ozzie Davis Pontiac Toyota **PRIORITY:** 2C **STATUS** 8

ADDRESS: 6450 Dublin Court, Dublin **GEOTRACKER ID:** T0600102153 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TPHg	Not Accessible
MTBE	240
BENZ	Not Accessible
TBA	270

ACDEH has recommended the case for closure under the LTCP. In 2016, ACDEH did not support the SWRCB closure recommendation and requested additonal indoor vapor sampling. Closure will be granted after the commnet period (September 21, 2018), well destruction, waste removal, and the suporting report which is due October 22, 2018.

ID: 36 **NAME:** Salinas Reinforcing Inc. **OWNER:** Richmond Lox/ Salinas Reinforcement **PRIORITY:** 3A3 **STATUS** 5C

ADDRESS: 355 South Vasco Road, Livermore **GEOTRACKER ID:** SL18266687 **LEAD:** RWQCB

CHEMICAL	CONCENTRATION ug/L
TCE	770
TPHg	NA
BENZ	NA

The RP submitted a 2018 Annual Site Status Report. The RP conducted an offsite groundwater investigation to define the lateral and vertical extent of contamination originating from the Site. Grab groundwater samples showed TCE concentrations up to 5,100 ug/L in the shallow and 3,100 ug/L in the deeper water bearing zones downgradient from the site on the neighboring property. The RP is claiming this must be from additional spills that must have originalted offsite. Therefore the RP is not recommending additional investigation. RWQCB has not yet commented.

ID: 37 **NAME:** Applied Biosystems **OWNER:** Applied Biosystems (formerly Kaiser Aluminum & Chemical) **PRIORITY:** 2C **STATUS** 8

ADDRESS: 6001 (Formerly 6177) Sunol Boulevard, Pleasanton **GEOTRACKER ID:** 01280050 **LEAD:** DTSC

CHEMICAL	CONCENTRATION ug/L
PCE	22
TCE	0.59
1,1-DCE	9.8

A 5-year remedial action review report was submitted by the RP in July 2018. The report showed that the groundwater concentrations in the remaining monitoring well were below MCLs for PCE, TCE, and 1,1-DCE. The RP requested that groundwater monitoring be discontinued, the well be destroyed, case closed, and the deed restriction be lifted. DTSC approved discontinuing the groundwater sampling but will need the RP to submit a well decommisioning plan prior to well destruction. They also said the removal of the deed restriction will need to be done in accordance with Health and Safety Code 25224.

Former LUFTcase #T0600191128 was closed 7/13/2009. This case involved a diesel fuel tank spill.

ID: 68 **NAME:** Chevron, #9-2582 (Dublin Auto Wash) **OWNER:** Chevron **PRIORITY:** 2C **STATUS** 8

ADDRESS: 7240 Dublin Boulevard, Dublin **GEOTRACKER ID:** T0600100355 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
MTBE	130
BENZ	270
TPHg	2,700

ACDEH sent a letter in June 2018 notifying the RP that they are out of compliance and need to update GeoTracker as well as provide updated information to ACDEH. There doesn't appear to be any progress made by the RP in the 2018 WY.

ID: 84 **NAME:** Arrow Rentals **OWNER:** Livermore Redevelopment Agency **PRIORITY:** 1A2 **STATUS** 7

ADDRESS: 187 North L Street, Livermore **GEOTRACKER ID:** T0600100116 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TPHg	6,600
TPHd	NA
MTBE	71
BENZ	2,800

The RP submitted a workplan in response to a ACDEH directive letter dated Jan 18, 2018. ACDEH rejected the workplan because it was missing important items required in the directive letter. The most significant was an updated SCM. The RP stated in the workplan that they would revise the SCM after collecting more data in the field. ACDEH will not accept the proposed scope of work without an updated SCM to verify that the proposed data collection is sufficient and appropriate. There is discrepencies in the existing data and more information is needed to evaluate extent of contamination.

ID: 115 **NAME:** Livermore Arcade (Miller's Outpost) **OWNER:** LASC/MOSC (Livermore Arcade) **PRIORITY:** 1A2 **STATUS** 7

ADDRESS: , Livermore **GEOTRACKER ID:** SL18227625 **LEAD:** RWQCB

CHEMICAL	CONCENTRATION ug/L
PCE	52
TCE	6.1
cis-1,2-DCE	37
Vinyl Chloride	20

The modified groundwater monitoring program was continued in 2018. EISB effectiveness monitoring was completed in May 2018. SVE system at MOSC was shut down in February 2018. Soil vapor sampling was also conducted in the first half of 2018. Second half of the 2018WY the RP plans to continue the monitoring programs, evaluate data according to the Revised Contingency Plan, re-start the SVE system at MOSC until asymptotic influent PID readings are reached, and collect vapor samples.

ID: 137 **NAME:** Busick Gearing Properties **OWNER:** Busick Air Conditioning **PRIORITY:** 2A3 **STATUS** 5C

ADDRESS: 6341 Scarlett Court, Dublin **GEOTRACKER ID:** SL20256874 **LEAD:** RWQCB

CHEMICAL	CONCENTRATION ug/L
TCE	5,200
PCE	120

A supplemental remedial investigation workplan was submitted to the RWQCB in March 2014. The proposed investigation includes collecting soil and GW samples at the source area and an investigation into off-site sources that could be contributing to the contamination. RWQCB provided comments in August 2014 but a revised workplan or investigation report has not been submitted to GeoTracker. An Annual Estimate for SCP Cost Recovery Oversight letter was sent in June 2018. No other updates in the 2018WY.

ID: 149 **NAME:** Hanson Aggregates **OWNER:** Kaiser Sand and Gravel **PRIORITY:** 2A4 **STATUS** 5R

ADDRESS: 3000 Busch Road, Pleasanton **GEOTRACKER ID:** SL0600101555 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
BENZ	ND
TPHd	50

ACDEH has been working with the RP to develop a closure plan. The RP wants to develop the site with mixed use in the future so they want to remediate to residential standards. ACDEH, with input from Zone 7, approved a soil import management plan for the site in 2018 so that any soil inported to the site will not adversly impact groundwater and surface water. Some contaminated soil will still need to be removed from the stie. The site is still under an active Surface Mining Permit issued to Hanson (SMP-30/31).

ID: 191 **NAME:** Former Beacon, #3604 **OWNER:** Ultramar/Tesoro No. 67076 **PRIORITY:** 1A2 **STATUS** 7

ADDRESS: 1619 First Street, Livermore **GEOTRACKER ID:** T0600101410 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TPHg	35,700
MTBE	15
BENZ	2,100
TBA	190

In September 2018, the RP sumitted a Conceptual Site Model Update and Closure Request. Multiple remedial technologies have been conducted at the site over the past 25 years inlcyding excavation, SVE, air sparging, oxygen injection, and ISCO. In Nov 2017, the RP installed two additional monitoring wells to deliniate the plume. The closure request concludes that the site does not meet the groundwater-specific criteria for categories 1 through 4 of the LTCP due to proximity to water supply well CWS08 and benzene concentrations greater than 1,000 µg/l at one well. However, the RP claims that the residual impacts appear to pose a low risk to human and environmental health in accordance with category 5 of the LTCP.

ID: 232 **NAME:** Groth Brothers Chevrolet **OWNER:** Bordoni Ranch LLC and Green Valley C **PRIORITY:** 2A2 **STATUS** 5C

ADDRESS: 59 South L Street, Livermore **GEOTRACKER ID:** SL0600147081 **LEAD:** RWQCB

CHEMICAL	CONCENTRATION ug/L
BENZ	3,100
MTBE	1,200
TPHg	61,000
PCE	38

The RWQCB requested the RP submit a Confirmation Sampling Workplan and Updated Site Risk Assessment and Risk Management Plan in 2016. The RWQCB extended the deadlines an additonal 90 days for these documents due to the pending property ownership transfer. The documents are still not submitted on GeoTracker and there are no updates for the 2018 WY. Several USTs on the site obtained case closure. T0600101656 case is closed as of 11/5/2009 with oil and grease remaining in soil up to 1,100 ppm.
Remaining environmental issues are being tracked as SL0600147081

ID: 238 **NAME:** All Rents **OWNER:** All Rents **PRIORITY:** 1A2 **STATUS** 5C

ADDRESS: 2247 Second Street, Livermore **GEOTRACKER ID:** T10000008261 **LEAD:** UNK

CHEMICAL	CONCENTRATION ug/L
1,2-DCE	14
TCE	250
PCE	430

Staff have been working with the RWQCB to try to elevate this site to an official contamination case. The RWQCB effort in 2016 included this site in the request for site histories and added it to GeoTracker as a "non-case information site". In 2018 WY, staff provided the RWQCB with the site investigation and correspondance that we had in our files. The RWQCB sent a letter of approval for the site history and a requirment for a work plan. The workplan was not received and an overdue notice was sent on September 21, 2018.

ID: 242 **NAME:** Fairground Main Well (3S/1E 20B 2) **OWNER:** Alameda County Fairgrounds **PRIORITY:** 1A1 **STATUS** 1

ADDRESS: 4501 Pleasanton Avenue, Pleasanton **GEOTRACKER ID:** **LEAD:**

CHEMICAL	CONCENTRATION ug/L
PCE	16

In 2016, RWQCB staff started looking into potential RPs. They sent letters to all current and former dry cleaners in the area. Zone 7 staff provided all the data we have to help with the investigation. In 2018 a dozen former dry cleaner sites upgradient of the Fairgrounds remain in GeoTracker as "non-case information sites" but one has turned into an active case with ongoing investigation. Not all of the sites have responded to the RWQCB requests for site histories or for additional investigation so more cases may devlop.

ID: 250 **NAME:** Sunol Tree Gas **OWNER:** Murray Kelsoe **PRIORITY:** 1A1 **STATUS** 7

ADDRESS: 3004 andrade Road, Sunol **GEOTRACKER ID:** T0600114064 **LEAD:** RWQCB

CHEMICAL	CONCENTRATION ug/L
TBA	150
TPHg	420
MTBE	47

The case can't be closed under the LTCP since the site is not served by a public water supply but the RWQCB can issue a no further action letter. The RWQCB issued a Notice of Intent to Issue a No Further Action Letter in April 2017 but withdrew the Pending Case Closure in October 2018. The RWQCB is also requiring a technical report in additon to the Plume Stablity Report already submitted in Jan 2018.

ID: 259 **NAME:** CHEVRON #30-7233 /Mills Square Park/Performing Arts Theater **OWNER:** City of Livermore **PRIORITY:** 1C3 **STATUS** 8

ADDRESS: 2259 First Street, Livermore **GEOTRACKER ID:** T0600196622 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TPHg	14,000
BENZ	1,500
TPHd	11,000

RP conducted additional sampling and remediation activities required by ACDEH for closure. All monitoring wells were destroyed under a Zone 7 permit and a report was submitted to ACDEH. Case closure is pending.

ID: 264 **NAME:** Railroad Ave-Livermore Site **OWNER:** Livermore Redevelopment Agency/Signature Properties **PRIORITY:** 2A4 **STATUS** 1

ADDRESS: 1934 - 1950 Railroad Avenue at North L Street, Livermore **GEOTRACKER ID:** T06019726132 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
MTBE	280
BENZ	130
TPHg	1,200
PCE	30

Case inactive since 2005. ACEH transferred case to Reg Board. Only document in GeoTracker is a 2005 Sampling and Analysis Plan. No activity in the 2018 WY.

ID: 284 **NAME:** Former Crow Canyon Dry Cleaner **OWNER:** Gabriel Chiu **PRIORITY:** 3C **STATUS** 8

ADDRESS: 7272 or 7242 San Ramon Road, Dublin **GEOTRACKER ID:** T06019764784 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TCE	3
PCE	22

The RP requested closure in 2015 but did not respond to ACDEH requirements for additional evaluation and modification to the methodology of the Human Health Risk Assessment. The main concern is vapor contamination at the site. The groundwater detections are below MCLs for chlorinated solvents. Zone 7 staff does not object to case closure for groundwater. In 2018 ACDEH requested additional funding due to past due owed and amount of work still required to reach closure.

ID: 291 **NAME:** Perciva/Metro Valley Cleaners **OWNER:** Country Club Cleaners **PRIORITY:** 3A2 **STATUS** 7

ADDRESS: 224 Rickenbacker Circle, Livermore **GEOTRACKER ID:** T06019748481 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
PCE	4.9

Low concentrations of PCE have been detected in groundwater beneath the site. However, new soil vapor sampling has detected PCE and TCE significantly above ESLs in soil vapor at the site. ACDEH issued a Notice to Comply letter to the RP in 2017 and requested a meeting with the RP to discuss the case. In 2018 there was an email exchange between the RP and ACDEH. The RP indicated an intention to comply and cleanup the site but is applying for funding and requested some additional background data from ACDEH.

ID: 292 **NAME:** Former K&S Heavy Equipment **OWNER:** CW Roen **PRIORITY:** 2A4 **STATUS** 3A

ADDRESS: 495 Greenville Road, Livermore **GEOTRACKER ID:** T06019726510 **LEAD:** ACEH

The RP submitted a workplan for additional investigation. The workplan only proposed shallow borings of 5 feet below ground surface. ACEH responded that they would like to see deeper soil samples and borings advanced to groundwater and groundwater samples collected and analyzed for the potential contaminants. A revised workplan is due January 28, 2019.

ID: 298 **NAME:** Former Chevron Records Facility **OWNER:** Chevron **PRIORITY:** 2B4 **STATUS** 7

ADDRESS: 6400 Sierra Court, Dublin **GEOTRACKER ID:** SL0600196603 **LEAD:** RWQCB

CHEMICAL	CONCENTRATION ug/L
TCE	110
cis 1,2-DCE	320
VC	28

RP submitted the 2018 Risk Management Implementation and Status Report. The report includes an evaluation of the effectiveness of the remediation. Additional injections into the biowall (installed) in 2015 were conducted in 2018. Samples collected from the Alamo Canal were ND. TCE concentrations in wells are generally decreaseing especially near the source area and near injection points. Semi-annual monitoring will continue.

ID: 299 **NAME:** Nica Metals **OWNER:** TDW Construction **PRIORITY:** 3A2 **STATUS** 3A

ADDRESS: 101 Greenville Road, Livermore **GEOTRACKER ID:** SLT19765274 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
GRO	unknown

Site is non-compliant. Soil removal and implementation of site assessment was due May 2010. ACEH issued NOV letters in 2009 and 2010. No change in 2018 WY.

ID: 302 **NAME:** FCI Dublin **OWNER:** Federal Corrections Institution Dublin **PRIORITY:** 3A1 **STATUS** 3B

ADDRESS: 5701 8th Street, Dublin **GEOTRACKER ID:** SLT19749067 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TPHd	680,000

In 2010 ACEH responded to the Site Investigation Report that further investigation is needed to determine groundwater gradient and extent of contamination. Quarterly monitoring was required. The RP submitted a case closure request in Oct 2010. The case is still open and ACEH has not agreed to closure. No change in 2018 WY.

ID: 307 **NAME:** City of Pleasanton Theater Parking Lot **OWNER:** City of Pleasanton Public Works **PRIORITY:** 3B1 **STATUS** 5C

ADDRESS: 0 Kottinger Drive, Pleasanton **GEOTRACKER ID:** T10000001164 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TPHg	
TPHmo	

The new ACEH caseworker sent a letter on May 21, 2018 requesting a meeting to move the case to closure. No additoinal notes on GeoTracker for the 2018 WY.

ID: 311 **NAME:** Crown Chevrolet Cadillac Isuzu **OWNER:** Crown Chevrolet **PRIORITY:** 3A1 **STATUS** 5R

ADDRESS: 7544 Dublin Boulevard, Dublin **GEOTRACKER ID:** 10000001616 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TPHg	4,900
TPHd	6,200
TPHmo	64
PCE	90
TCE	51

The RP has installed a Permable Reactive Barrier (PRB) and a Vapor Mitigation System (VMS) at the site during development. Both have been monitored for a year to evaluate performance. The RP is now asking ACEH to close the case and convert it to an O&M case. ACEH response is pending. The RP has also changed the monitoring cycle from monthly to quarterly with the approval of ACEH.

ID: 312 **NAME:** Cemex Sunol **OWNER:** Cemex **PRIORITY:** 3A1 **STATUS** 1

ADDRESS: 6527 Calaveras Road, Sunol **GEOTRACKER ID:** T10000003431 **LEAD:** ACEH

CEMEX responded to ACEH's letter asking for funds to cover oversight. They said the spill was contained and cleaned up immediately after release the same day ACEH was notified. A report was filed within two days. They don't feel there is cause to open a case for investigation/remediation. Case is listed as Inactive on GeoTracker. No update in the 2018 WY.

ID: 313 **NAME:** Just Tires **OWNER:** Good Year Tire and Rubber Company **PRIORITY:** 2C **STATUS** 8

ADDRESS: 1485 First Street, Livermore **GEOTRACKER ID:** T10000003435 **LEAD:** ACEH

Caseworker sent multiple letters in 2016 that the case was ready for closure. No additional work has been done by the RP to finalize case closure in 2017 or 2018.

ID: 317 **NAME:** Walgreens Spill Sunol **OWNER:** Walgreens **PRIORITY:** 2C **STATUS** 8

ADDRESS: 9494 Koopman Road, Sunol **GEOTRACKER ID:** T10000006478 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L
TPHd	349

Case was approved for closure by ACDEH under the LTCP. The RP was required to remove any remaining waste from the site and provide ACDEH with a report by April 22, 2018 to finalize the requirements for case closure. The report has not been submitted to GeoTracker so the case closure is still pending.

ID: 318 **NAME:** G.I.G Oil Production Facility **OWNER:** E&B Natural Resources Management C orporation **PRIORITY:** 2A4 **STATUS** 8

ADDRESS: 8467 Patterson Pass Road, Livermore **GEOTRACKER ID:** T10000007269 **LEAD:** ACEH

CHEMICAL	CONCENTRATION ug/L

ACDEH has still not responded to the RP's case closure request. All soil and groundwater samples were non-detect for fuel contaminants and within background range for metals.

ID: 319 **NAME:** Former Clorox Site - Building 7 **OWNER:** Johnson Drive Holdings I, LLC/Clorox Products Manufacturing Company **PRIORITY:** 2A2 **STATUS** 5R

ADDRESS: 7200 - 7208 Johnson Drive, Pleasanton **GEOTRACKER ID:** T10000007118 **LEAD:** RWQCB

This portion of the site including Building 7 remains open while the portion of the site containing Building 8 has closed (TS#316, GeoTracker ID T10000005195). RWQCB approved additional site investigation. The RP asked for approval to submit the report in mid-October 2018 due to site access and permitting delays. The RWQCB agreed to October 15, 2018 for the report submittal.

ID: 320 **NAME:** Dublin Crossroads Center & Park Ave Cleaners **OWNER:** Ready Family Partnership, LP **PRIORITY:** 2A4 **STATUS** 5C

ADDRESS: 7100-7120 Dublin Boulevard, Dublin **GEOTRACKER ID:** T10000004783 **LEAD:** ACDEH

ACDEH sent a letter to the RP in May 2018 requesting a meeting with the new caseworker. The letter states the case has been idle since 2016 and the meeting would discuss how the case could move to closure. No updates in GeoTracker on any meetings or progress on the case.

ID: 322 **NAME:** Niles Canyon Railway **OWNER:** Pacific Locomotive Association DBA Niles Canyon Railway **PRIORITY:** 3B1 **STATUS** 7

ADDRESS: 9 Kilkare Road, Sunol **GEOTRACKER ID:** T10000006021 **LEAD:** ACDEH

No updates in the 2018 WY. An oil leak was discovered from a locomotive on the Niles Canyon Railway. Soil was removed and confirmation sampling was conducted under the direction of the ACEH. The very delinquent report was submitted to ACEH on 7/20/2016. The RP requested closure. ACEH response is still pending

ID: 323 **NAME:** Former American Cleaners **OWNER:** Stoll Main Street Trust **PRIORITY:** 2A4 **STATUS** 3A

ADDRESS: 555 Main Street, Pleasanton **GEOTRACKER ID:** T10000008240 **LEAD:** RWQCB

The RWQCB approved a workplan for an additional site investigation. The scope of work includes installtion of 5 monitoring wells, 1 boring with grab groundwater sample, and installation of 8 soil vapor nested wells. The RP was encountering difficulty with permitting and access. The RWQCB approved extension of the investigation report to October 2018.

ID: 324 **NAME:** Chestnut Square **OWNER:** MidPen Housing Corporation **PRIORITY:** 1A2 **STATUS** 5C

ADDRESS: 1651 and 1665 Chestnut Street, Livermore **GEOTRACKER ID:** T10000007202 **LEAD:** ACDEH

2/26/18-The case was opened in October 2016 due to site redevelopment. The site has been vacant but will be redeveloped into senior and family housing. There are chlorinated soivents in soil gas and could be a concern for indoor vapor. The investigations so far have concluded that the contamination is coming from off-site. The RP is working with ACDEH to develop a corrective action plan to clean up this site and the adjacent property (TS#325 217 North N).

ID: 325 **NAME:** 217 North N St **OWNER:** MidPen Housing Corporation **PRIORITY:** 2A1 **STATUS** 3A

ADDRESS: 217 North N Street, Livermore **GEOTRACKER ID:** T10000011094 **LEAD:** ACDEH

9/10/18-ACDEH released a Fact Sheet on the site. The proposed development of the site will include a vapor mitigation system with vapor barriers and passive venting along with excavation and removal of contaminated soil. The comment period for the Corrective Action Plan is open until 9-28-18. The contamination is from an upgradient site so the CAP doesn't include remidiation just mitigation to protect future residents.

ID:	**326**	**NAME:**	Livermore Department of Public Works	**OWNER:**	City of Livermore	**PRIORITY:**	1A1	**STATUS**	1
		ADDRESS:	Rincon and Juniper and Spruce, Livermore	**GEOTRACKER ID:**	SLT2O09096	**LEAD:**	RWQCB		

No new information in the 2018 WY. In March 2017, the RWQCB sent the City of Livermore a letter requesting information on previous site uses and discharges that could have been a source of PCE in CWS 10.

ID:	**327**	**NAME:**	VIP Cleaners	**OWNER:**	BMMR USA, Inc.	**PRIORITY:**	2A2	**STATUS**	3B
		ADDRESS:	1809 Santa Rita Road, Suite F, Pleasanton	**GEOTRACKER ID:**	T10000008254	**LEAD:**	RWQCB		

ASSESSMENT & INTERIM REMEDIAL ACTION AS OF 8/14/2018. The case was opened by the RWQCB as part of the regional dry cleaner assessment. PCE and TCE were detected at elevated levels in soil gas in a subsurface investigation in 2016. Based on the results RWQCB has requested additional investigation and has opened the case. A workplan was approved in August 2018. The investigation, including grab groundwater samples, was scheduled for October 2018 and the report is due Novemeber 2018.

Z7 ID - corresponds to file number in TSS database and the location on site maps
OWNER - responsible party for the contamination investigation/cleanup
SITE NAME - indicates a site name if different from owner
PRIORITY - the first number of the priority code indicates whether the case is high priority (1), moderate priority (2), or low priority (3).
STATUS - the status code is based on the RWQCB ranking of the progress of a case (see below)
NOTES - highlights, cureent activites, or concerns at a site.

CASE STATUS CODES:
1 - Leak Confirmed
3A - Preliminary Site Assessment Workplan Submitted
3B - Preliminary Site Assessment Underway
5C - Pollution Characterization Underway
5R Remediation Workplan (Corrective Action Plan) Submitted
7 - Remediation Underway
8 - Post Remediation Monitoring Begun
CL - Case Closure
NR - Further investigation not required
ReO - Reopened

CONCENTRATION ug/L - the most recent concentration in groundwater in micrograms per liter (parts per billion)
CHEMICAL - the chemicals of concern at the site.

BENZ - benzene
CCl4 - carbon tetrachloride
Cr(VI) - hexavalent chromium
1,2-DCE - 1,2-dichloromethene
DRO - diesel range organics
GRO - gasoline range organics
MTBE - methyl tertiary-butyl ether
NO3 - nitrate
PCE - tetrachloroethene
TBA - tertiary-butyl alchohol
TCE - trichloroethene
TOLU - toluene
TPHd - total petroleum hydrocarbons diesel
TPHg - total petroleum hydrocarbons gasoline
TPHmo - total petroleum hydrocarbons motoroil
VC - vinyl chloride
XYL - xylenes

TABLE 13-2
HISTORICAL SALT LOADING (in tons)
1974 TO 2018 WATER YEARS

SALT INFLOW COMPONENTS	YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
NATURAL STREAM RECHARGE		**3,210**	**3,464**	**874**	**581**	**4,638**	**1,723**	**2,706**	**1,513**	**4,803**	**7,657**	**5,286**	**3,058**
Total Arroyo Valle		**1,018**	**1,041**	**391**	**315**	**957**	**707**	**777**	**579**	**1,048**	**1,433**	**936**	**375**
Flood releases recharge		100	344	0	0	216	0	128	0	271	624	20	0
Non Flood Natural Inflow		918	697	391	315	741	707	649	579	777	809	916	375
Arroyo Mocho		**1,717**	**2,043**	**293**	**76**	**3,206**	**636**	**1,358**	**478**	**2,614**	**4,626**	**2,508**	**932**
Arroyo Las Positas		**475**	**380**	**190**	**190**	**475**	**380**	**571**	**456**	**1,141**	**1,598**	**1,842**	**1,751**
AV PRIOR RIGHTS		**361**	**418**	**31**	**0**	**494**	**267**	**386**	**251**	**502**	**381**	**236**	**328**
ARTIFICIAL STREAM RECHARGE		**986**	**2,201**	**1,914**	**2,289**	**3,286**	**3,699**	**2,897**	**3,238**	**1,617**	**184**	**0**	**0**
Arroyo Valle		293	1,174	509	883	1,427	1,599	1,234	1,719	663	0	0	0
Arroyo Mocho		340	497	875	876	1,350	1,570	1,432	1,394	894	184	0	0
Arroyo Las Positas		353	530	530	530	509	530	231	125	60	0	0	0
INJECTION WELL RECHARGE		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
RAINFALL RECHARGE		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lake Recharge		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
LEAKAGE		**21**	**25**	**30**	**35**	**41**	**48**	**56**	**65**	**74**	**84**	**94**	**105**
APPLIED WATER RECHARGE		**7,670**	**7,218**	**9,123**	**10,675**	**8,352**	**8,304**	**7,175**	**5,507**	**4,709**	**4,723**	**5,046**	**5,938**
SUBSURFACE BASIN INFLOW		**2,038**	**2,038**	**2,058**	**3,648**	**2,506**	**2,017**	**1,325**	**1,284**	**1,284**	**876**	**1,325**	**1,528**
		14,286	**15,364**	**14,030**	**17,228**	**19,317**	**16,058**	**14,545**	**11,858**	**12,989**	**13,905**	**11,987**	**10,957**

OUTFLOW COMPONENTS	YEAR	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
MUNICIPAL PUMPAGE		**-7,217**	**-6,577**	**-5,074**	**-4,382**	**-4,579**	**-5,351**	**-4,458**	**-4,700**	**-4,748**	**-5,410**	**-5,525**	**-5,752**
Zone 7 Wells - Hop, Stone, COL		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Zone 7 Wells - Mocho		**-3,303**	**-2,057**	**-842**	**-201**	**-506**	**-532**	**-26**	**0**	**0**	**-17**	**-227**	**-863**
Demin Salts Exported from Valley		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Pumpage		**-3,914**	**-4,520**	**-4,232**	**-4,181**	**-4,073**	**-4,819**	**-4,432**	**-4,700**	**-4,748**	**-5,393**	**-5,298**	**-4,889**
AGRICULTURAL PUMPAGE		**-2,289**	**-1,476**	**-2,997**	**-3,241**	**-2,081**	**-2,420**	**-1,678**	**-1,553**	**-844**	**-912**	**-1,015**	**-1,378**
MINING USE		**-1,126**	**-1,725**	**-802**	**-668**	**-869**	**-1,603**	**-2,508**	**-4,372**	**-4,161**	**-7,834**	**-2,857**	**-2,814**
Stream Export		-745	-1,345	-422	-287	-489	-1,223	-2,127	-3,992	-3,781	-7,454	-2,476	-2,433
Evaporation		0	0	0	0	0	0	0	0	0	0	0	0
Processing Losses		-380	-380	-380	-380	-380	-380	-380	-380	-380	-380	-380	-380
GROUNDWATER BASIN OVERFLOW		**0**	**0**	**0**	**0**	**0**	**-173**	**-612**	**-635**	**-2,494**	**-3,418**	**-2,587**	**-1,386**
		-10,632	**-9,778**	**-8,873**	**-8,291**	**-7,529**	**-9,547**	**-9,256**	**-11,260**	**-12,247**	**-17,574**	**-11,984**	**-11,330**

NET SALT INFLOW (Tons)		**3,654**	**5,586**	**5,157**	**8,937**	**11,788**	**6,511**	**5,289**	**598**	**742**	**-3,669**	**3**	**-373**
CUMULATIVE SALT INFLOW (Tons)*		**3,654**	**9,240**	**14,397**	**23,334**	**35,122**	**41,633**	**46,922**	**47,520**	**48,262**	**44,593**	**44,596**	**44,223**

TDS Concentration Calculations	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Net Basin Recharge (AF)		-478	5,508	-4,311	-5,953	11,942	6,394	8,103	-528	11,593	9,192	-4,203	-9,722
Basin Storage (HI Method)(AF)	212,000	211,522	217,030	212,719	206,766	218,708	225,102	233,205	232,677	244,270	253,462	249,259	239,537
Total Salt in Main Basin (tons)	129,598	133,252	138,838	143,995	152,932	164,720	171,231	176,520	177,118	177,860	174,191	174,194	173,821
Main Basin TDS Concentration (mg/L)	**450**	**464**	**471**	**498**	**544**	**554**	**560**	**557**	**560**	**536**	**506**	**514**	**534**
Cumulative Increase in TDS Conc (mg/L)**		**14**	**21**	**48**	**94**	**104**	**110**	**107**	**110**	**86**	**56**	**64**	**84**

* Basinwide salt buildup since 1973

** Basinwide TDS concentration increase relative to 1973 value of 450 mg/L

TABLE 13-2
HISTORICAL SALT LOADING (in tons)
1974 TO 2018 WATER YEARS

SALT INFLOW COMPONENTS YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NATURAL STREAM RECHARGE	**4,941**	**2,852**	**2,610**	**2,782**	**2,480**	**3,356**	**3,665**	**5,743**	**2,544**	**4,376**	**4,331**	**4,639**	**5,704**	**3,727**	**3,409**
Total Arroyo Valle	**779**	**232**	**372**	**187**	**206**	**575**	**743**	**1,083**	**300**	**1,034**	**400**	**1,450**	**1,661**	**1,361**	**956**
Flood releases recharge	415	0	0	0	0	98	0	528	0	472	336	183	524	0	55
Non Flood Natural Inflow	364	232	372	187	206	477	743	555	300	562	64	1,267	1,137	1,361	901
Arroyo Mocho	**2,269**	**458**	**490**	**440**	**233**	**1,023**	**814**	**2,174**	**995**	**1,580**	**2,627**	**1,741**	**2,292**	**996**	**857**
Arroyo Las Positas	**1,893**	**2,162**	**1,748**	**2,155**	**2,041**	**1,758**	**2,108**	**2,486**	**1,249**	**1,762**	**1,304**	**1,448**	**1,751**	**1,370**	**1,596**
AV PRIOR RIGHTS	**286**	**283**	**325**	**356**	**125**	**290**	**151**	**276**	**321**	**306**	**87**	**93**	**188**	**149**	**175**
ARTIFICIAL STREAM RECHARGE	**0**	**0**	**525**	**1,585**	**1,809**	**1,590**	**410**	**1,953**	**2,795**	**1,026**	**491**	**1,325**	**500**	**1,352**	**2,276**
Arroyo Valle	0	0	0	51	132	36	185	385	293	49	31	472	107	321	242
Arroyo Mocho	0	0	525	1,534	1,677	1,554	225	1,568	2,502	977	460	853	393	1,031	2,034
Arroyo Las Positas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INJECTION WELL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**497**	**498**
RAINFALL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lake Recharge	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
LEAKAGE	**115**	**125**	**136**	**147**	**158**	**169**	**181**	**193**	**206**	**220**	**234**	**248**	**263**	**279**	**294**
APPLIED WATER RECHARGE	**6,632**	**5,558**	**6,834**	**6,015**	**6,541**	**6,918**	**5,793**	**5,109**	**4,989**	**3,323**	**4,071**	**4,887**	**4,367**	**3,479**	**4,314**
SUBSURFACE BASIN INFLOW	**1,508**	**1,569**	**1,875**	**2,364**	**2,568**	**3,423**	**3,199**	**2,710**	**2,221**	**2,017**	**1,875**	**1,386**	**1,651**	**1,528**	**1,846**
	13,482	**10,387**	**12,305**	**13,249**	**13,681**	**15,746**	**13,399**	**15,984**	**13,076**	**11,268**	**11,089**	**12,578**	**12,673**	**11,011**	**12,812**

OUTFLOW COMPONENTS YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MUNICIPAL PUMPAGE	**-6,465**	**-5,537**	**-6,662**	**-6,915**	**-7,166**	**-10,970**	**-8,736**	**-6,010**	**-3,853**	**-2,665**	**-3,874**	**-5,192**	**-6,468**	**-6,101**	**-8,560**
Zone 7 Wells - Hop, Stone, COL	**0**	**0**	**0**	**-54**	**-441**	**-1,679**	**-1,185**	**-859**	**-85**	**-87**	**-754**	**-270**	**-475**	**-2,362**	**-2,553**
Zone 7 Wells - Mocho	**-869**	**-326**	**-1,425**	**-2,082**	**-1,683**	**-3,313**	**-2,111**	**-609**	**-24**	**-125**	**-767**	**-682**	**-397**	**-167**	**-783**
Demin Salts Exported from Valley	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Pumpage	**-5,595**	**-5,211**	**-5,237**	**-4,779**	**-5,042**	**-5,978**	**-5,439**	**-4,542**	**-3,743**	**-2,453**	**-2,353**	**-4,240**	**-5,596**	**-3,572**	**-5,224**
AGRICULTURAL PUMPAGE	**-1,428**	**-998**	**-1,043**	**-776**	**-868**	**-363**	**-236**	**-142**	**-130**	**-88**	**-130**	**-155**	**-47**	**-46**	**-188**
MINING USE	**-6,011**	**-839**	**-2,301**	**-1,728**	**-918**	**-970**	**-1,007**	**-2,134**	**-4,928**	**-6,883**	**-7,507**	**-9,983**	**-9,588**	**-8,642**	**-5,792**
Stream Export	-5,535	-364	-1,825	-1,253	-443	-495	-532	-1,658	-4,453	-6,408	-7,041	-9,460	-9,084	-8,081	-5,316
Evaporation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Processing Losses	-475	-475	-475	-475	-475	-475	-475	-475	-475	-475	-466	-523	-504	-561	-475
GROUNDWATER BASIN OVERFLOW	**-693**	**-693**	**-462**	**-122**	**0**	**0**	**0**	**0**	**0**	**-226**	**-968**	**-960**	**-998**	**-482**	**-175**
	-14,597	**-8,067**	**-10,468**	**-9,541**	**-8,952**	**-12,303**	**-9,979**	**-8,286**	**-8,911**	**-9,862**	**-12,479**	**-16,290**	**-17,101**	**-15,271**	**-14,715**

NET SALT INFLOW (Tons)	**-1,115**	**2,320**	**1,837**	**3,708**	**4,729**	**3,443**	**3,420**	**7,698**	**4,165**	**1,406**	**-1,390**	**-3,712**	**-4,428**	**-4,260**	**-1,903**
CUMULATIVE SALT INFLOW (Tons)*	**43,108**	**45,428**	**47,265**	**50,973**	**55,702**	**59,145**	**62,565**	**70,263**	**74,428**	**75,834**	**74,444**	**70,732**	**66,304**	**62,044**	**60,141**

TDS Concentration Calculations	1973	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Net Basin Recharge (AF)		-1,684	-7,906	-9,106	-4,973	-5,528	-8,462	-6,592	15,112	628	13,072	1,873	-1,390	1,859	-4,911	-3,674
Basin Storage (HI Method)(AF)	212,000	237,853	229,947	220,841	215,868	210,340	201,878	195,286	210,398	211,026	224,098	225,971	224,581	226,440	221,529	217,855
Total Salt in Main Basin (tons)	129,598	172,706	175,026	176,863	180,571	185,300	188,743	192,163	199,861	204,026	205,432	204,042	200,330	195,902	191,642	189,739
Main Basin TDS Concentration (mg/L)	**450**	**535**	**560**	**590**	**616**	**648**	**688**	**724**	**699**	**712**	**675**	**665**	**657**	**637**	**637**	**641**
Cumulative Increase in TDS Conc (mg/L)**		**85**	**110**	**140**	**166**	**198**	**238**	**274**	**249**	**262**	**225**	**215**	**207**	**187**	**187**	**191**

* Basinwide salt buildup since 1973

** Basinwide TDS concentration increase relative to 1973 value of 450 mg/L

TABLE 13-2
HISTORICAL SALT LOADING (in tons)
1974 TO 2018 WATER YEARS

SALT INFLOW COMPONENTS YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
NATURAL STREAM RECHARGE	**3,856**	**3,267**	**7,097**	**3,105**	**5,796**	**4,962**	**3,260**	**4,078**	**4,367**	**5,080**	**5,459**	**2,026**	**2,242**	**1,820**	**3,735**
Total Arroyo Valle	**1,823**	**1,399**	**2,833**	**1,081**	**3,652**	**2,274**	**1,450**	**2,691**	**2,554**	**2,974**	**3,039**	**553**	**963**	**356**	**1,664**
Flood releases recharge	0	193	302	0	731	0	0	327	0	1,383	150	0	0	0	0
Non Flood Natural Inflow	1,823	1,206	2,531	1,081	2,921	2,274	1,450	2,364	2,554	1,591	2,889	553	963	356	1,664
Arroyo Mocho	**575**	**886**	**2,996**	**838**	**1,241**	**1,813**	**839**	**380**	**540**	**1,211**	**2,056**	**949**	**751**	**973**	**1,472**
Arroyo Las Positas	**1,458**	**982**	**1,268**	**1,186**	**903**	**875**	**971**	**1,007**	**1,273**	**895**	**364**	**524**	**528**	**491**	**599**
AV PRIOR RIGHTS	**224**	**399**	**416**	**383**	**80**	**524**	**219**	**100**	**407**	**0**	**384**	**196**	**409**	**3**	**395**
ARTIFICIAL STREAM RECHARGE	**1,351**	**3,503**	**2,811**	**2,480**	**1,949**	**1,266**	**1,359**	**727**	**1,248**	**1,690**	**882**	**2,851**	**2,519**	**1,483**	**1,689**
Arroyo Valle	501	647	399	476	619	330	782	727	686	635	167	1,178	573	339	1,667
Arroyo Mocho	839	2,855	2,412	2,004	1,300	914	577	0	562	1,055	698	1,649	1,943	1,120	0
Arroyo Las Positas	11	1	0	0	30	22	0	0	0	0	17	24	3	24	22
INJECTION WELL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
RAINFALL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lake Recharge	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1,603*	*2,736*
LEAKAGE	**313**	**333**	**352**	**372**	**393**	**414**	**436**	**458**	**481**	**504**	**527**	**551**	**403**	**600**	**625**
APPLIED WATER RECHARGE	**5,074**	**5,606**	**4,618**	**5,090**	**4,824**	**3,223**	**5,157**	**6,258**	**6,152**	**5,079**	**4,295**	**6,074**	**8,158**	**5,654**	**6,505**
SUBSURFACE BASIN INFLOW	**1,970**	**1,970**	**1,970**	**1,970**	**2,513**	**2,309**	**2,174**	**2,214**	**2,106**	**1,997**	**2,024**	**2,092**	**448**	**1,834**	**2,051**
	12,788	**15,078**	**17,264**	**13,400**	**15,555**	**12,698**	**12,605**	**13,835**	**14,761**	**14,350**	**13,571**	**13,790**	**14,179**	**11,394**	**15,000**

OUTFLOW COMPONENTS YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
MUNICIPAL PUMPAGE	**-10,467**	**-12,061**	**-11,096**	**-12,419**	**-10,057**	**-5,557**	**-8,423**	**-9,271**	**-14,577**	**-12,609**	**-9,873**	**-16,765**	**-12,781**	**-11,831**	**-6,080**
Zone 7 Wells - Hop, Stone, COL	**-3,867**	**-3,690**	**-3,360**	**-4,198**	**-1,858**	**-1,382**	**-1,340**	**-3,217**	**-3,920**	**-1,290**	**-1,197**	**-2,785**	**-3,595**	**-2,639**	**-870**
Zone 7 Wells - Mocho	**-1,745**	**-3,322**	**-2,271**	**-3,762**	**-3,003**	**-1,170**	**-1,976**	**-1,402**	**-5,448**	**-6,563**	**-4,040**	**-8,204**	**-3,997**	**-3,713**	**-1,080**
Demin Salts Exported from Valley	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*-798*	*-2,759*	*-2,006*	*-4,064*	*-2,479*	*-1,047*	*-76*
Other Pumpage	**-4,855**	**-5,049**	**-5,465**	**-4,459**	**-5,196**	**-3,005**	**-5,107**	**-4,651**	**-5,208**	**-4,756**	**-4,625**	**-5,766**	**-5,179**	**-5,583**	**-4,128**
AGRICULTURAL PUMPAGE	**-182**	**-94**	**-73**	**-79**	**-80**	**-46**	**-43**	**-68**	**-68**	**-73**	**-68**	**-77**	**-393**	**-515**	**-490**
MINING USE	**-4,520**	**-475**	**-276**	**-438**	**-454**	**-658**	**-584**	**-714**	**-1,341**	**-1,428**	**-2,756**	**-3,064**	**-3,042**	**-502**	**-417**
Stream Export	-4,006	-111	0	-84	-94	-218	-274	-305	-913	-1,057	-2,368	-2,665	-2,655	-442	0
Evaporation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Processing Losses	-514	-364	-276	-354	-360	-440	-310	-409	-428	-371	-388	-399	-387	-364	-417
GROUNDWATER BASIN OVERFLOW	**0**	**0**	**0**	**0**	**0**	**0**	**-738**	**-1,080**	**-171**	**0**	**0**	**0**	**0**	**0**	**0**
	-15,169	**-12,630**	**-11,445**	**-12,936**	**-10,591**	**-6,261**	**-9,788**	**-11,133**	**-16,157**	**-14,110**	**-12,697**	**-19,906**	**-16,216**	**-12,848**	**-6,987**

NET SALT INFLOW (Tons)	**-2,381**	**2,448**	**5,819**	**464**	**4,964**	**6,437**	**2,817**	**2,702**	**-1,396**	**240**	**874**	**-6,116**	**-2,037**	**-1,454**	**8,013**
CUMULATIVE SALT INFLOW (Tons)*	**57,760**	**60,208**	**66,027**	**66,491**	**71,455**	**77,892**	**80,709**	**83,411**	**82,015**	**82,255**	**83,129**	**77,013**	**74,976**	**73,522**	**81,535**

TDS Concentration Calculations	1973	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Net Basin Recharge (AF)		-11,499	72	8,309	-4,560	13,193	8,790	-3,639	-3,011	-4,997	4,290	6,893	-10,438	-5,542	-12,153	6,037
Basin Storage (HI Method)(AF)	212,000	206,356	206,428	214,737	210,177	223,370	232,160	228,521	225,510	220,513	224,803	231,696	221,258	215,716	203,563	209,600
Total Salt in Main Basin (tons)	129,598	187,358	189,806	195,625	196,089	201,053	207,490	210,307	213,009	211,613	211,853	212,727	206,611	204,574	203,120	211,133
Main Basin TDS Concentration (mg/L)	**450**	**668**	**677**	**671**	**687**	**663**	**658**	**677**	**695**	**706**	**694**	**676**	**687**	**698**	**735**	**742**
Cumulative Increase in TDS Conc (mg/L)**		**218**	**227**	**221**	**237**	**213**	**208**	**227**	**245**	**256**	**244**	**226**	**237**	**248**	**285**	**292**

* Basinwide salt buildup since 1973

** Basinwide TDS concentration increase relative to 1973 value of 450 mg/L

TABLE 13-2
HISTORICAL SALT LOADING (in tons)
1974 TO 2018 WATER YEARS

SALT INFLOW COMPONENTS YEAR	2016	2017	2018	AVG	TOTAL
NATURAL STREAM RECHARGE	**3,366**	**4,948**	**1,315**	**3,699**	**166,451**
Total Arroyo Valle	**1,620**	**2,392**	**249**	**1,211**	**54,483**
Flood releases recharge	0	404	0	173	7,804
Non Flood Natural Inflow	1,620	1,988	249	1,037	46,679
Arroyo Mocho	**945**	**1,882**	**430**	**1,339**	**60,253**
Arroyo Las Positas	**801**	**674**	**636**	**1,149**	**51,715**
AV PRIOR RIGHTS	**288**	**91**	**208**	**262**	**11,792**
ARTIFICIAL STREAM RECHARGE	**2,571**	**2,046**	**1,494**	**1,641**	**73,867**
Arroyo Valle	1,299	667	924	543	24,421
Arroyo Mocho	1,272	1,379	570	1,020	45,894
Arroyo Las Positas	0	0	0	79	3,552
INJECTION WELL RECHARGE	**0**	**0**	**0**	**22**	**995**
RAINFALL RECHARGE	**0**	**0**	**0**	**0**	**0**
Lake Recharge	*3,641*	*6,743*	*8,302*	*512*	*23,025*
LEAKAGE	**651**	**677**	**703**	**276**	**12,439**
APPLIED WATER RECHARGE	**5,251**	**4,421**	**5,140**	**5,774**	**259,849**
SUBSURFACE BASIN INFLOW	**2,078**	**2,106**	**2,078**	**1,990**	**89,571**
	14,205	**14,289**	**10,938**	**13,666**	**614,964**

OUTFLOW COMPONENTS YEAR	2016	2017	2018	AVERAGE	TOTAL
MUNICIPAL PUMPAGE	**-6,194**	**-7,635**	**-8,700**	**-9,961**	**-316,115**
Zone 7 Wells - Hop, Stone, COL	**-750**	**-1,107**	**-1,938**	**-2,396**	**-47,918**
Zone 7 Wells - Mocho	**-666**	**-2,200**	**-2,642**	**-2,890**	**-57,791**
Demin Salts Exported from Valley	*-183*	*-949*	*-1,168*	*-345*	*-15,529*
Other Pumpage	**-4,779**	**-4,326**	**-4,120**	**-4,676**	**-210,406**
AGRICULTURAL PUMPAGE	**-92**	**-84**	**-88**	**-692**	**-31,137**
MINING USE	**-378**	**-364**	**-388**	**-3,295**	**-148,279**
Stream Export	0	0	0	-2,309	-103,914
Evaporation	0	0	0	0	0
Processing Losses	-378	-364	-388	-417	-18,750
GROUNDWATER BASIN OVERFLOW	**0**	**0**	**-1,172**	**-450**	**-20,245**
	-6,664	**-8,083**	**-10,348**	**-11,535**	**-519,092**

NET SALT INFLOW (Tons)	**7,541**	**6,206**	**590**	**2,130**	**95,872**
CUMULATIVE SALT INFLOW (Tons)*	**89,076**	**95,282**	**95,872**		

TDS Concentration Calculations	1973	2016	2017	2018
Net Basin Recharge (AF)		15,405	25,259	2,972
Basin Storage (HI Method)(AF)	212,000	225,005	250,264	253,236
Total Salt in Main Basin (tons)	129,598	218,674	224,880	225,470
Main Basin TDS Concentration (mg/L)	**450**	**715**	**661**	**655**
Cumulative Increase in TDS Conc (mg/L)**		**265**	**211**	**205**

* Basinwide salt buildup since 1973

** Basinwide TDS concentration increase relative to 1973 value of 450 mg/L

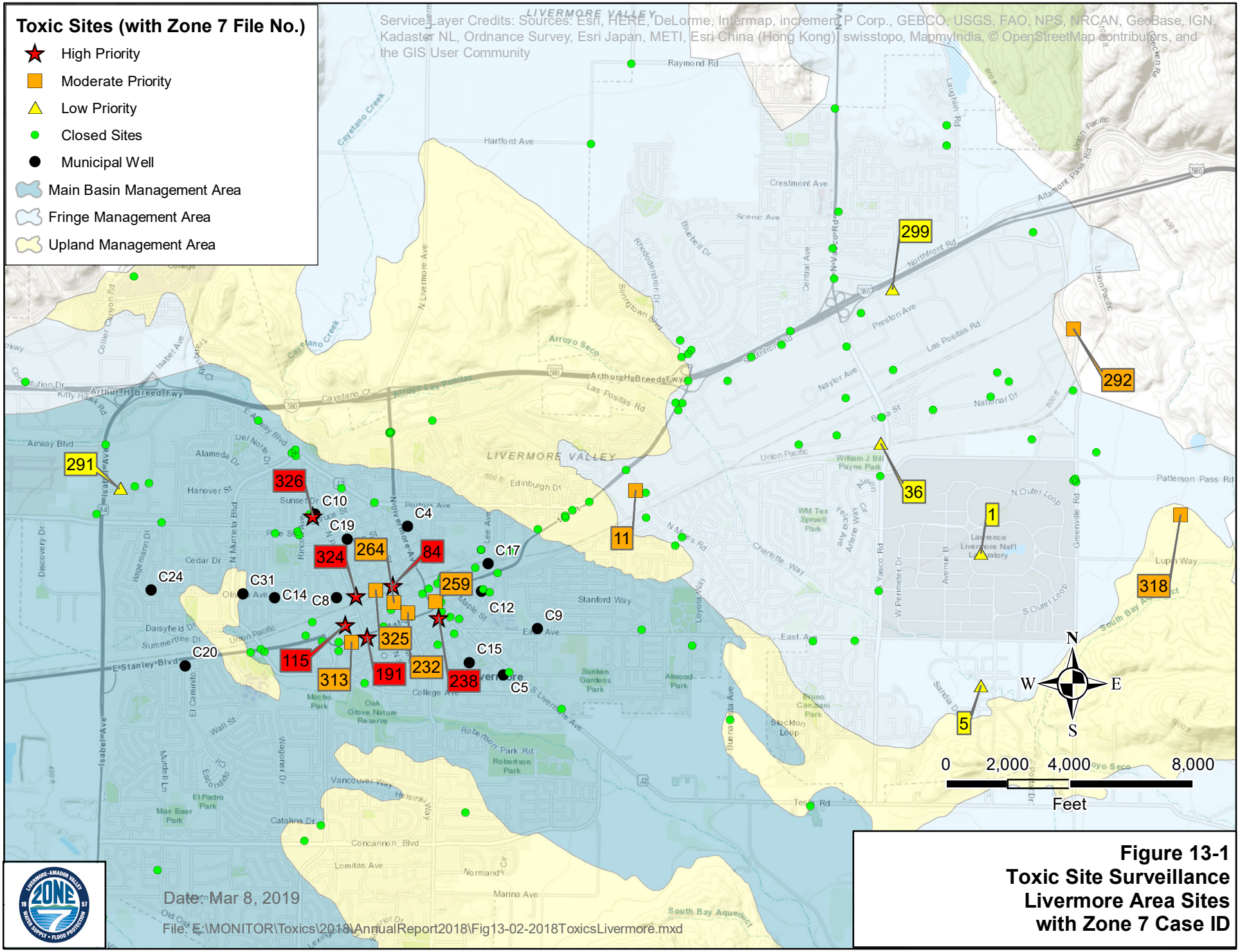
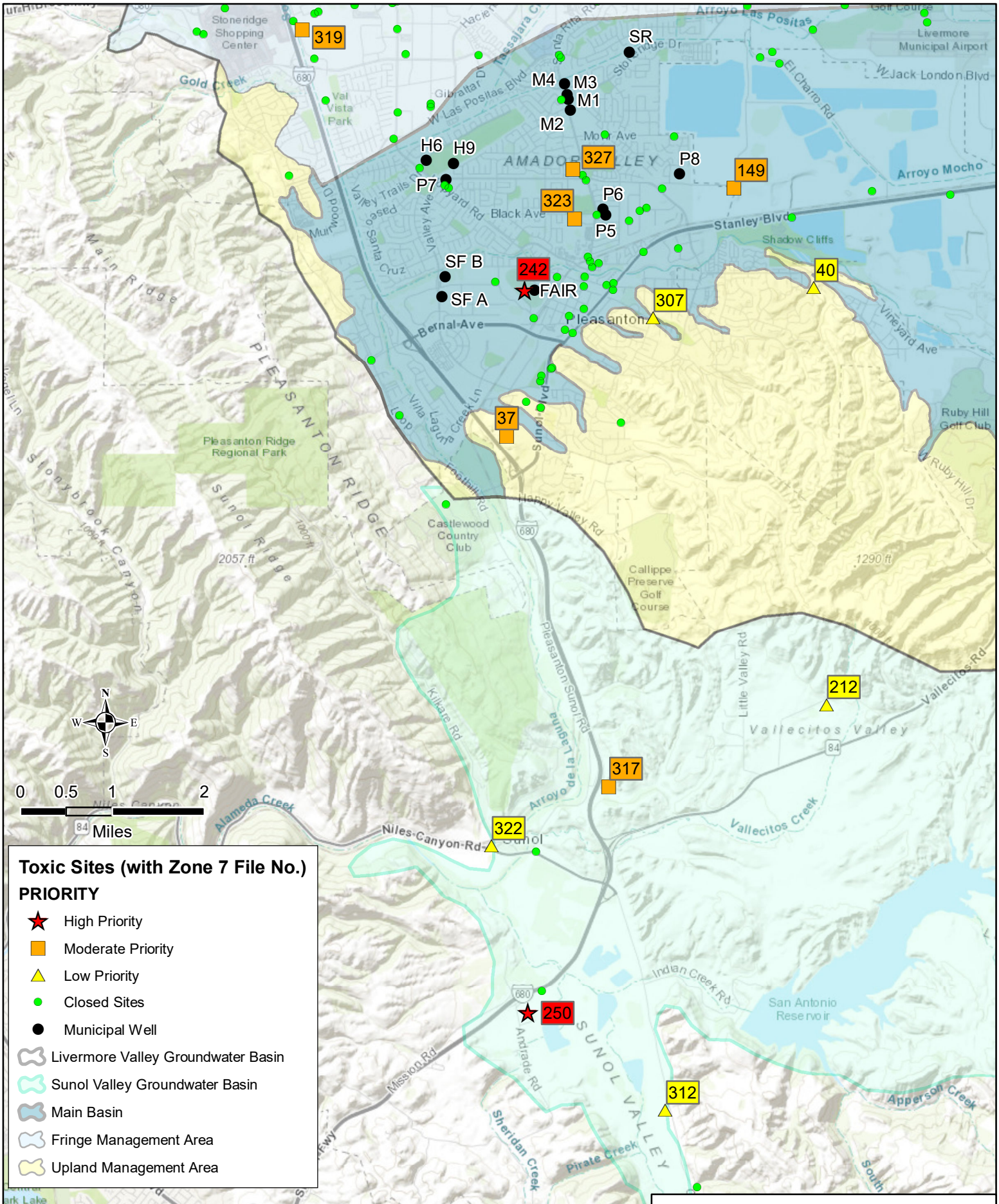


Figure 13-1
Toxic Site Surveillance
Livermore Area Sites
with Zone 7 Case ID



Toxic Sites (with Zone 7 File No.)

PRIORITY

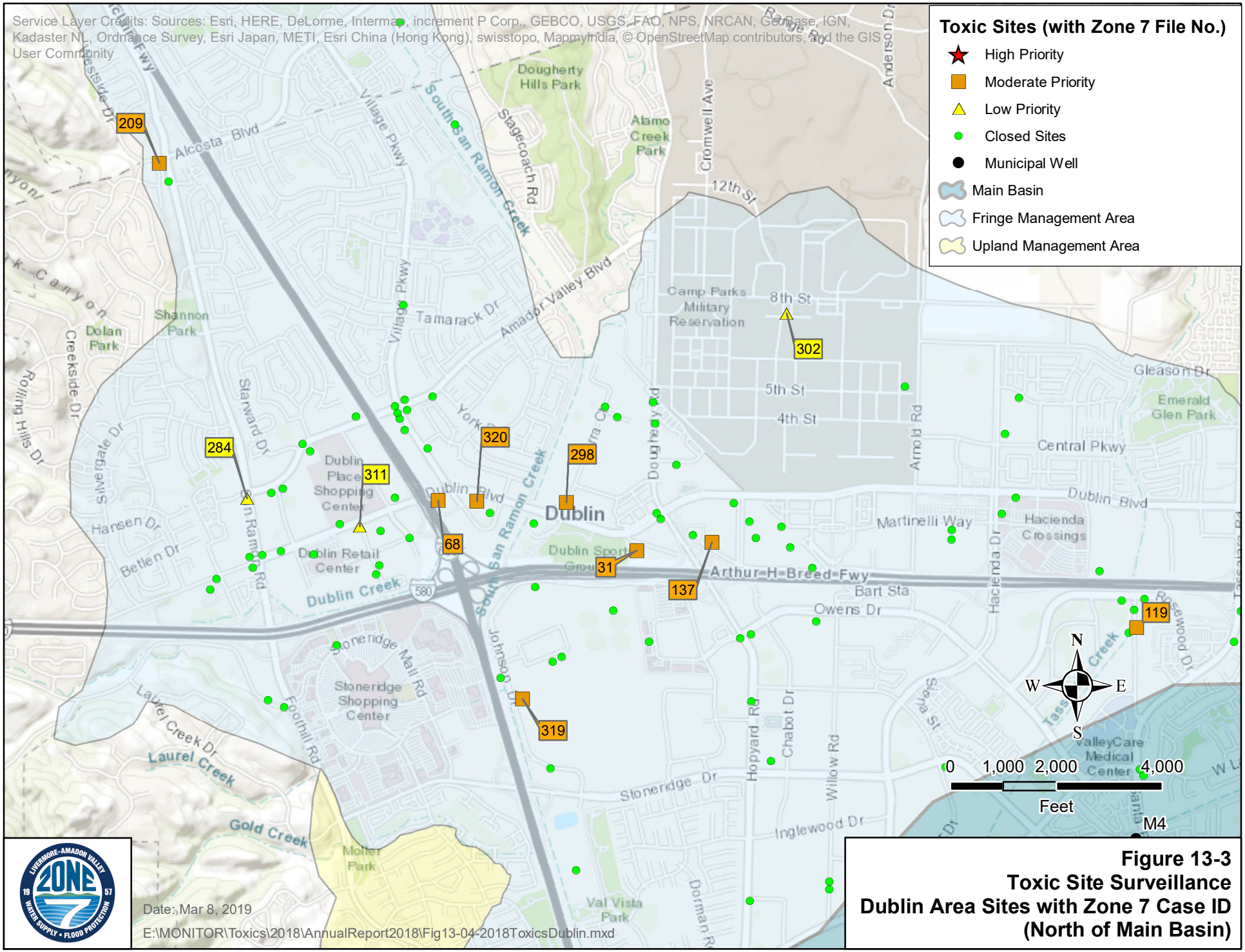
- High Priority
- Moderate Priority
- Low Priority
- Closed Sites
- Municipal Well
- Livermore Valley Groundwater Basin
- Sunol Valley Groundwater Basin
- Main Basin
- Fringe Management Area
- Upland Management Area

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo,

Date: Mar 8, 2019

File: E:\MONITOR\Toxics\2018\AnnualReport2018\Fig13-03-2018ToxicsPleasantonSunol.mxd

Figure 13-2
Toxic Site Surveillance
Pleasanton and Sunol Area Sites
with Zone 7 Case ID



Date: Mar 8, 2019

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Figure 13-3
Toxic Site Surveillance
Dublin Area Sites with Zone 7 Case ID
(North of Main Basin)

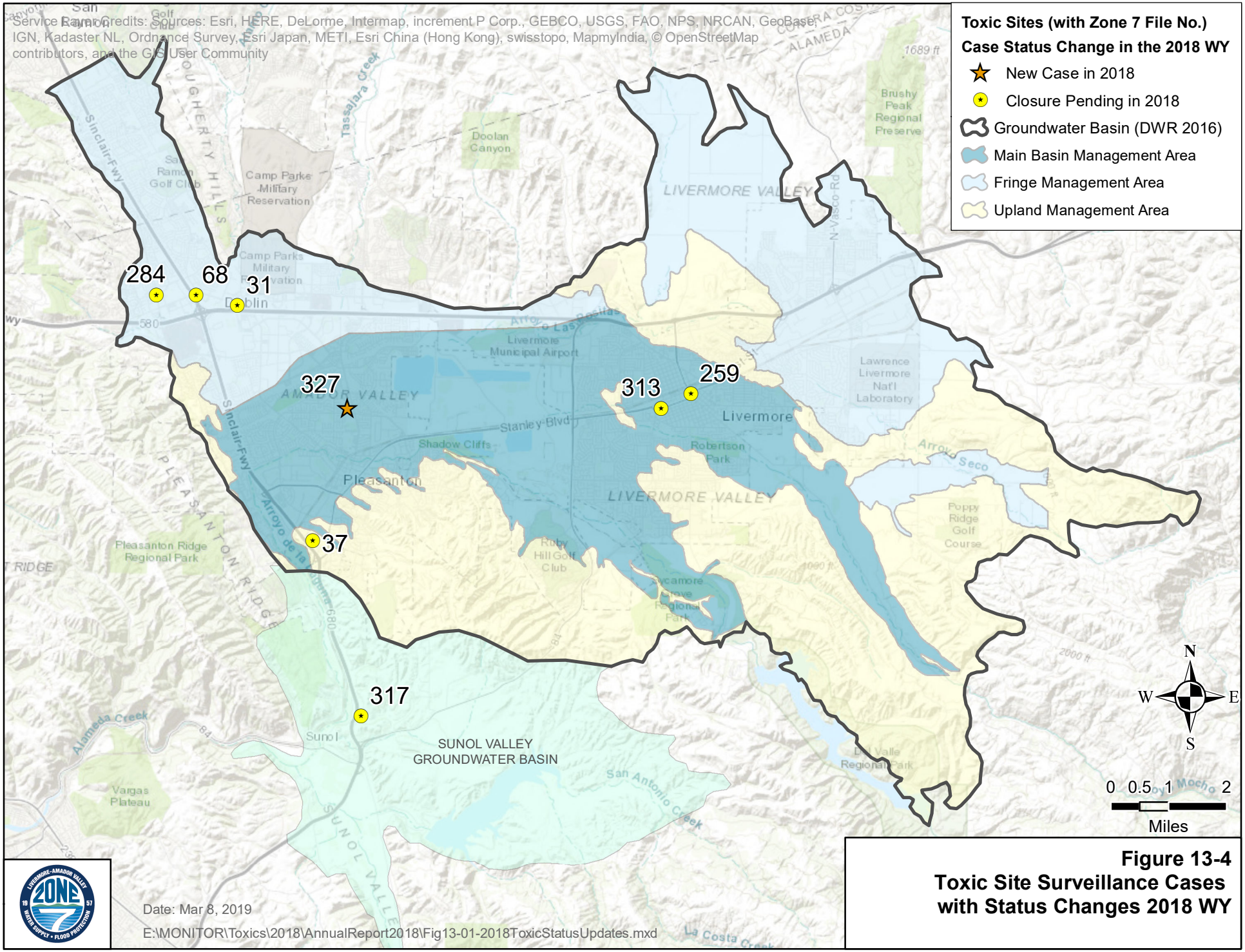
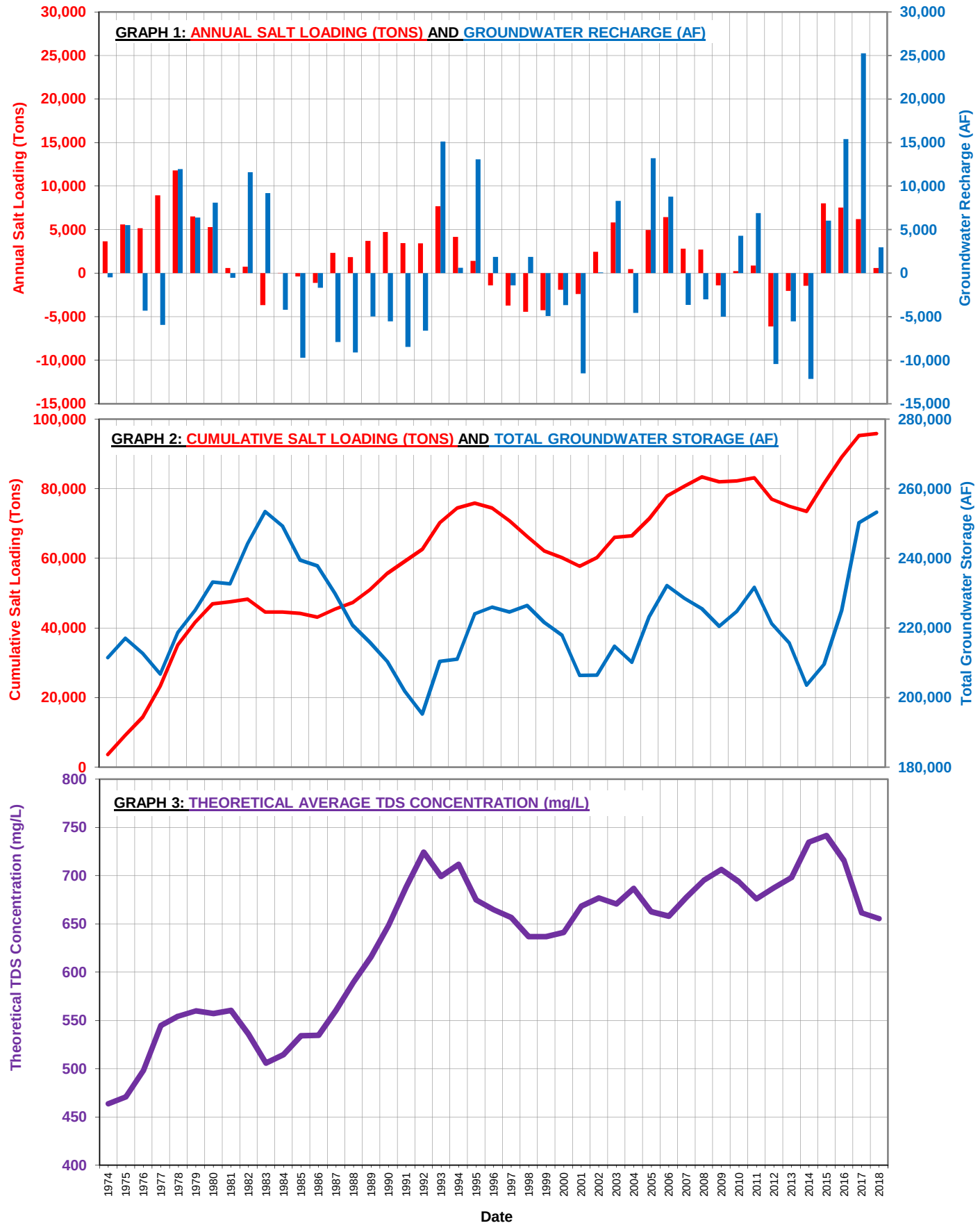


Figure 13-4
Toxic Site Surveillance Cases with Status Changes 2018 WY

FIGURE 13-5
MAIN BASIN SALT LOADING AND TDS CONCENTRATION
1974 to 2018 WATER YEARS



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