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Annual Report for the Sustainable Groundwater Management Program 2020 Water Year

Livermore Valley Groundwater Basin

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Livermore Valley Groundwater Basin

Sustainable Groundwater Management Program

2020 Year (October 2019 – September 2020)

Livermore Valley Groundwater Basin

ZONE 7 WATER AGENCY

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Acronyms and Abbreviations

Abbrev	Description	Abbrev	Description
µg/L	Micrograms per liter	DWR	California Department of Water Resources
ACCDA	Alameda County Community Development Agency	EBMUD	East Bay Municipal Utilities District
ACDEH	Alameda County Department of Environmental Health	EBRPD	East Bay Regional Parks District
ACNP	Alamo Canal near Pleasanton	EIR	Environmental Impact Report
ADLLV	Arroyo de la Laguna at Verona	EPA	Environmental Protection Agency
ADVP	Arroyo Del Valle Pleasanton	ESL	Environmental screening level
AF	Acre-feet	ETo	Evapotranspiration
AF/yr	Acre-feet per year	ft	Feet
ALP	Arroyo Las Positas	GDE	Groundwater-dependent ecosystem
ALP_ELCH	Arroyo Las Positas above El Charro	GIS	Geographic information system
ALPL	Arroyo Las Positas near Livermore	GPQ	Groundwater Pumping Quota
ALTC	Altamont Creek	GSA	Groundwater Sustainability Agency
AMHAG	Arroyo Mocho Hageman	GSP	Groundwater Sustainability Plan
AM_KB	Arroyo Mocho at Kaiser Bridge	GWMP	Groundwater Management Plan
AMNL	Arroyo Mocho near Livermore	GWE	Groundwater Elevation
AMP	Arroyo Mocho Pleasanton	HI	Hydrologic Inventory
AOC	Area of Concern	HRL	Health reference level
AVADLL	Arroyo Valle at Arroyo de la Laguna	InSAR	Interferometric Synthetic Aperture Radar
AVBLC	Arroyo Valle below Lang Canyon	ISCO	In-situ chemical oxidation
AVNL	Arroyo Valle near Livermore	LAMP	Local Agency Management Program
BBID	Byron-Bethany Irrigation District	LAVWMA	Livermore-Amador Valley Water Management Agency
bgs	Below ground surface	lbs	Pounds
BMPs	Best management practices	LDV	Lake Del Valle
CaCO3	Calcium carbonate	LLNL	Lawrence Livermore National Laboratory
CASGEM	California Statewide Groundwater Elevation Monitoring	LRI	Livermore Rain Index
CCNP	Chabot Canal near Pleasanton	LTCP	Low-Threat Underground Storage Tank Closure Policy
CCR	California Code of Regulations	LWRP	Livermore Water Reclamation Plant
CEC	Constituents-of-emerging-concern	MCL	Maximum contaminant level
CEQA	California Environmental Quality Act	mg/L	Milligrams per liter
cfs	Cubic feet per second	MGDP	Mocho Groundwater Demineralization Plant
CIMIS	California Irrigation Management Information System	MOU	Memorandum of Understanding
CIP	Capital Improvement Program	msl	Mean sea level
COLs	Chain of Lakes	MTBE	Methyl tertiary-butyl ether
Cr	Chromium	N	Nitrogen
CrVI	Hexavalent chromium	NC	North Canyons
CWS	California Water Service	NL	Notifications Level
CY	Calendar year	NMP	Nutrient Management Plan
DCE	Dichloroethene	NO_3	Nitrate Ion
DERWA	DSRSD-EBMUD Recycled Water Authority	OWTS	Onsite wastewater treatment system
DDW	California State Water Resources Control Board Division of Drinking Water	PCE	Tetrachloroethylene
DSRSD	Dublin San Ramon Services District	PFAS	Per- and polyfluoroalkyl substances
DTSC	Department of Toxic Substances Control	PFBS	Perfluorobutanesulfonic acid
DVWTP	Del Valle Water Treatment Plant	PFOA	Perfluorooctanoic acid

Abbrev	Description	Abbrev	Description
PFOS	Perfluorooctanesulfonic acid	SVE	Soil vapor extraction
POTW	Publicly owned treatment works	SWP	State Water Project
ppb	Parts per billion	SWRCB	State Water Resources Control Board
ppt	Parts per trillion	TAF	Thousand acre-feet
PPWTP	Patterson Pass Water Treatment Plant	TCE	Trichloroethylene
PRG	Preliminary Remediation goals	TDS	Total dissolved solids
RL	Response Level	TKN	Total Kjeldahl nitrogen
RO	Reverse osmosis	TSS	Toxic Sites Surveillance
RP	Responsible Party	USEPA	U.S. Environmental Protection Agency
RWQCB	California Regional Water Quality Control Board	USGS	U.S. Geological Survey
SBA	South Bay Aqueduct	VA	Veteran's Administration
SGMA	Sustainable Groundwater Management Act	WBIC	Weather-Based Irrigation Controller
SFPUC	San Francisco Public Utilities Commission	WMP	Well Master Plan
SMP	Salt Management Plan	WWMP	Wastewater Management Plan
SMP	Surface mining permit	WY	Water year (October 1 through September 30)
SNMP	Salt Nutrient Management Plan		

Executive Summary

ES.1 Introduction

Alameda County Flood Control and Water Conservation District, Zone 7 (Zone 7 Water Agency or Zone 7) provides water management in the Livermore Valley Groundwater Basin (California Department of Water Resources [DWR] Basin 2-10) as part of its mission to *Deliver safe, reliable, efficient, and sustainable water services,* and more specifically address Strategic Plan initiatives #7 - Manage as the Groundwater Sustainability Agency (GSA) and implement the groundwater management plan and #8 - Study and refine knowledge of the groundwater basins. Zone 7 manages imported surface water as the local wholesale agency. In addition, the agency has managed local surface and groundwater resources for beneficial uses for more than 50 years. Consistent with its management responsibilities, duties, and powers, Zone 7 is designated in the 2014 Sustainable Groundwater Management Act (SGMA) as the exclusive GSA within its boundaries (*Figure ES-A*).

This Annual Report for the Sustainable Groundwater Management Program 2020 Water Year Livermore Valley Groundwater Basin (2020 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 2020 Water Year (WY) (October 1, 2019 through September 30, 2020). 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: Land Surface Elevation
- Section 9: Land Use
- Section 10: Wastewater and Recycled Water
- Section 11: Groundwater Storage
- Section 12: Groundwater Supply Sustainability
- Section 13: Water Quality Sustainability

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

Figure ES-A: Livermore Valley Groundwater Basin

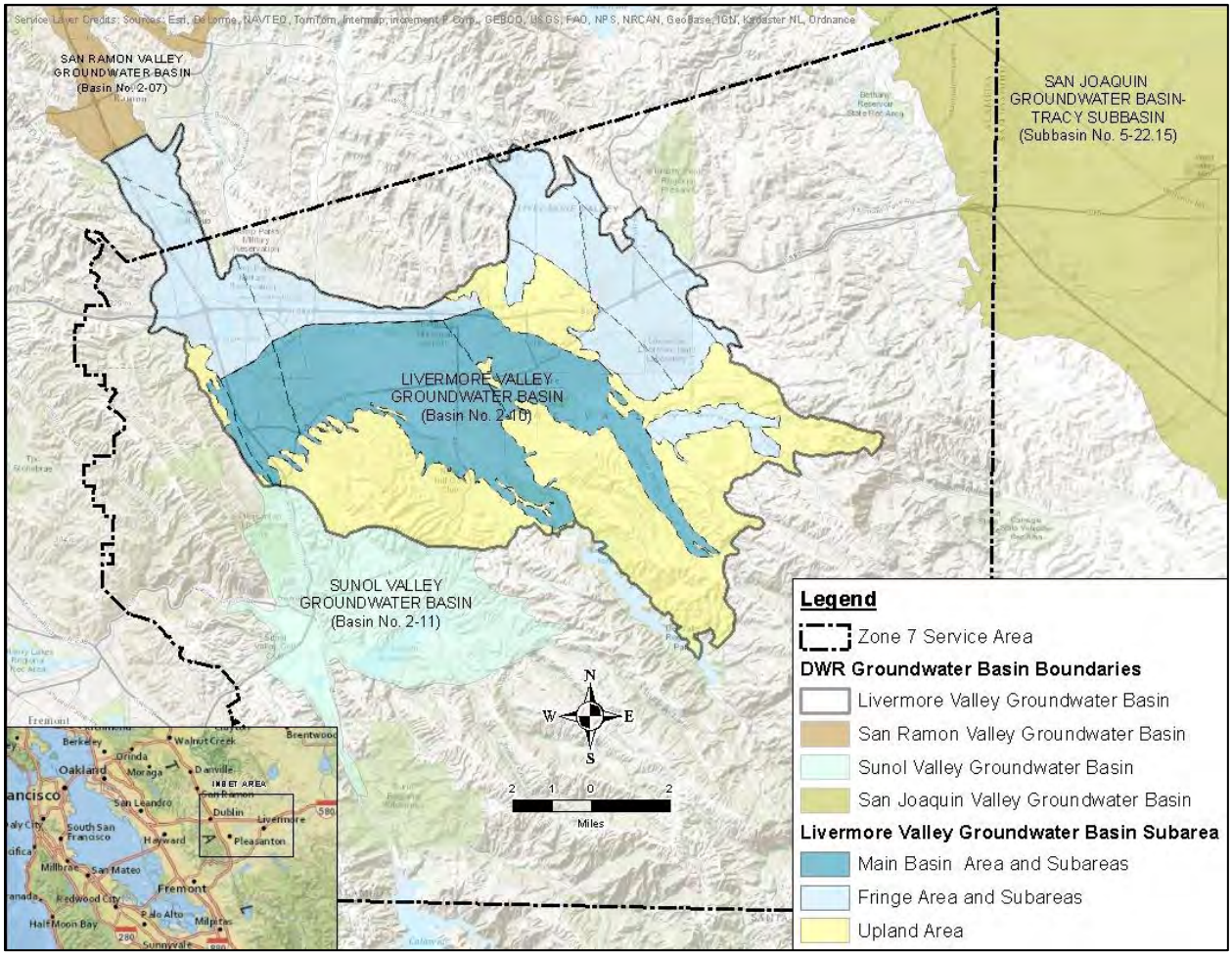


Table ES-A: Location of Required Items in the Sustainable Groundwater Management Program Annual Report 2020 WY

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 1.3, Zone 7 Service Area • Section 1.6, Plan Area • Section 1.7, Basin and Hydrogeologic Setting • Section 1.7.1, Basin Management Areas • Section 1.8, Aquifer Zones • Section 1.9, Groundwater Characteristics	• Figure 1-1, Map of Livermore Valley Groundwater Basin, Zone 7 Service Area, and Basin Management Areas and Subareas

Annual Report Requirement (23 CCR Article 7, Sections from Water Code § 10733.2)	Location(s) in Report	
	Text Section	Figures
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 2020 Water Years • Figure 6-4: Groundwater Gradient Map, Upper Aquifer, Spring 2020 WY • Figure 6-5: Groundwater Gradient Map, Upper Aquifer, Fall 2020 WY • Figure 6-6: Change in Groundwater Elevation, Upper Aquifer, Fall 2019 WY to Fall 2020 WY • Figure 6-8: Groundwater Gradient Map, Lower Aquifer, Spring • Figure 6-9: Groundwater Gradient Map, Lower Aquifer, Fall 2020 WY

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, 2020 WY (AF) • Table 11-B: Groundwater Storage Summary, 2020 WY (in Thousand AF) • Table 11-2: Description of Hydrologic Inventory Components • Table 11-3: Historical Groundwater Storage, Hydrologic Inventory Method, 1974 to 2020 Water Years	• Figure 11-3: Graph of Historical Groundwater Storage, 1974 to 2020 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 2020 Calendar Year (AF)	• Figure 12-1: Livermore-Amador Valley Water Supply and Use, 2020 Water Year • Figure 12-2: Valley Water Production from Imported Water and Groundwater, 1974 to 2020 Water Years • Figure 11-5: Main Basin Groundwater Production, 1974 to 2020 Water Years

Annual Report Requirement (23 CCR Article 7, Sections from Water Code § 10733.2)	Location(s) in Report	
	Text Section	Figures
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 Section 11, Groundwater Storage • 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, 2020 Water Year
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 2019 WY to Fall 2020 WY • Figure 11-2: Change in Groundwater Storage, Fall 2019 to Fall 2020 WY

Annual Report Requirement (23 CCR Article 7, Sections from Water Code § 10733.2)	Location(s) in Report	
	Text Section	Figures
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 2020 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 13, Water Quality 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
GW groundwater
HI Hydrologic Inventory Method
OWTS On-Site Wastewater Treatment System
WY water year

ES.2 2020 Groundwater Conditions Overview

ES.2.1. Overview

Zone 7 has been managing groundwater resources sustainably for the past 50 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 2020 WY. Overall, groundwater conditions in the Livermore Valley Groundwater Basin are stable and have recovered from the 2011-2015 drought.

Figure ES-B: Bernal Key Well Hydrograph

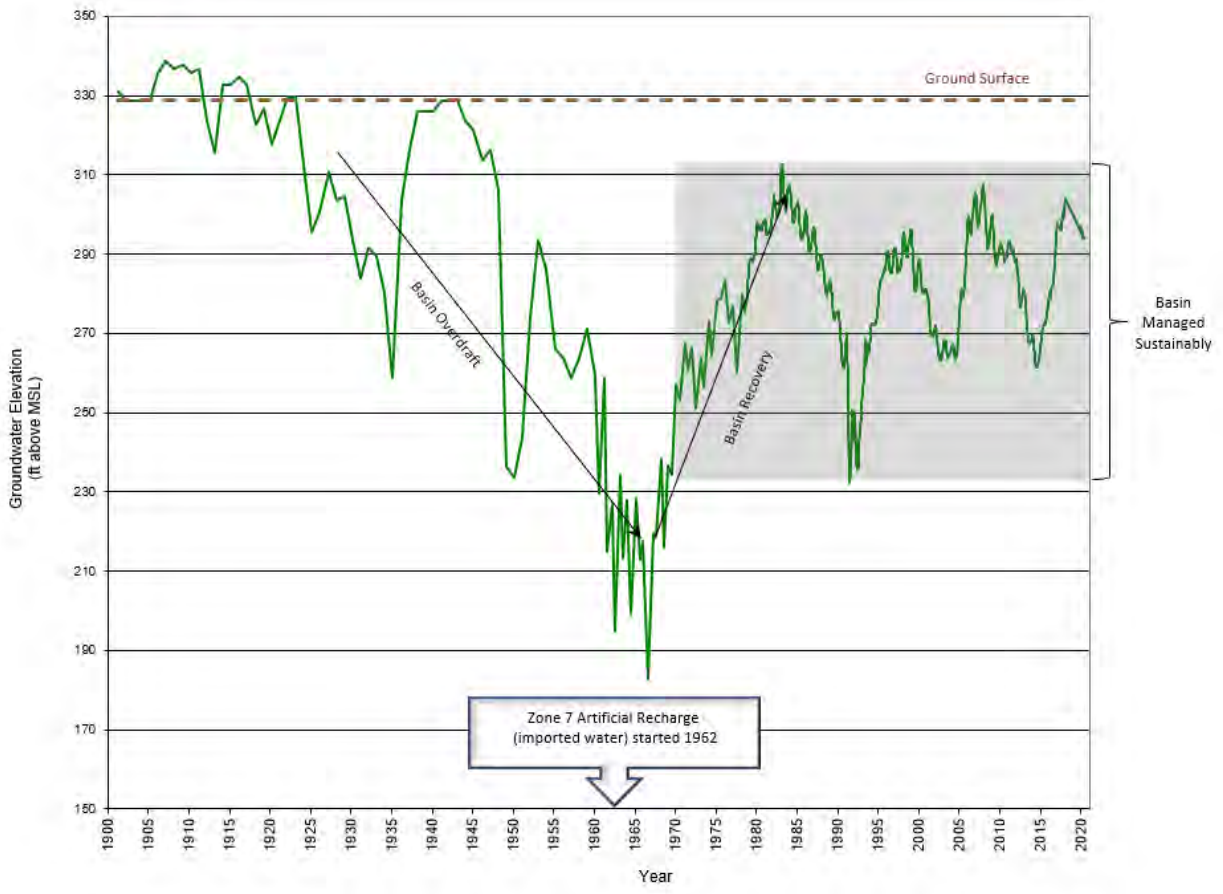


Table ES-B summarizes the five sustainability indicators, their associated undesirable results, and minimum thresholds as presented in the Alternative Groundwater Sustainability Plan (GSP). The table also includes the 2020 WY status for each indicator and any action taken in the 2020 WY or planned for the upcoming water year. More in-depth descriptions of each sustainability indicator can be found in the sections of this Executive Summary that immediately follow and in later chapters of this 2020 Annual Report.

Table ES-B: Summary of Sustainability Indicators and 2020 WY Status

Sustainability Indicator	Undesirable Results Alt GSP	Minimum Threshold Alt GSP	Status 2020 WY	Action Taken
Groundwater Levels	Loss of wellfield or loss of domestic supply well	Historic Lows	Main Basin was 10’ to 160’ above historic lows in all areas except limited areas surrounding Lake B and Lake D 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 239.5 TAF, (111.5 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 = 677 mg/L TDS was detected above the minimum threshold in several municipal supply wells	Increase municipal supply pumping, operation of MGDP, and artificial groundwater recharge with low TDS water
		NO3 (as N) > 10mg/L	NO3 (as N) exceeded threshold in Mocho II Subarea, but overall continues to decrease with time	Continue to monitor
		Boron > 1.4 mg/L	Boron just barely exceeded threshold in one well in the Mocho Wellfield at 1.41 mg/L	Continue to monitor
		Total Chromium > 0.050 mg/L[1]	Chromium threshold was not 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 less than 0.04' for the year	No action needed
Surface Water-Groundwater Interaction	Depletion of surface water in the Alkali Sink	Elev 491' in 2S/2E 34E1 Elev 501' in 2S/2E 27P2	Elev 493.9' in 2S/2E 34E1 Elev 501.55' in 2S/2E 27P2	No action needed

[1]The minimum threshold was changed from CrVI < 0.010 mg/L in the Alternative GSP to Total Cr < 0.050 mg/L after SWRCB rescinded the CrVI MCL in 20

[2]One upper aquifer monitoring well in a fringe basin and one upper aquifer monitoring well in the main 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 2020 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 2020 WY are described in *Section 5, Surface Water-Groundwater Interaction*. Additional potential groundwater dependent ecosystems (GDEs) are being investigated for the Five-Year Update of the Alternative GSP.

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 most of the Fringe Areas.

Groundwater levels for the 2020 WY followed a typical historical seasonal pattern: rising in the beginning of the water year with rainfall recharge and reduced pumping, levelling off in late spring, and then dropping during the second half of the water year as groundwater demand increased. Compared to the levels at the end of the 2019 WY, when the basin was largely full, groundwater elevations generally decreased everywhere in the Main Basin. In general, groundwater elevations remained considerably above the threshold elevations (historic lows).

Upper Aquifer water levels generally dropped throughout the Main Basin by an average of 5 to 10 feet in each of the subbasins because of mining activity and below-average rainfall and artificial stream recharge. Groundwater levels in the Fringe Areas (which only have one aquifer) stayed relatively constant throughout 2020 WY, varying generally by less than approximately 5 feet (ft).

At the end of the water year, groundwater levels in the vicinity of the Bernal Subarea were more than 110 ft above the historic low. In the Amador Subarea, levels were generally 25–90 ft above the historic lows except in the immediate vicinity of two mining excavations that were being dewatered during the water year. Over the majority of the Mocho II Subarea, the end-of-year groundwater levels were 50–135 ft above historical lows.

Water levels in the immediate vicinity of Lakes B and D (mining area) were below the historic low water level in the 2020 WY, with no observed undesirable results. The water level in Lake B was 2 ft below the historic low, while Lake D was about 45 ft below the historic low. The water levels are drawn down in that area due to dewatering by the quarry operator for mining activities. Zone 7 continues to monitor the localized impacts of this use for any potential undesirable

results. *Section 6, Groundwater Elevations,* further describes Groundwater Elevation Monitoring Program and results for the 2020 WY.

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 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. Zone 7's Groundwater Quality 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). In addition, per- and polyfluoroalkyl substances (PFAS) were added to the list of analytes for all municipal supply wells and select monitoring wells in the 2019 WY. The sampling for PFAS continued in the 2020 WY with additional monitoring wells sampled to help identify the extent and source of PFAS. Zone 7 also has programs that review permits, correspondence, and monitoring reports required by other agencies related to contamination and nutrient loads (see *ES 3.2, Water Quality Sustainability*). Overall, there were no significant groundwater quality changes relative to the minimum thresholds encountered during the 2020 WY. A summary of the results of each of these constituents for the 2020 WY are provided below.

TDS

The TDS minimum thresholds for the basin are 500 milligrams per liter (mg/L) in the Main Basin and 1000 mg/L in the Fringe Areas. In the upper aquifer, there continues to be two main areas of the groundwater basin where TDS concentrations exceed 1,000 mg/L, both are in the northern portions of the Fringe Area. The highest TDS concentration was encountered in the northwest portion of the Fringe Area at 20,380 mg/L (19,600 mg/L last year). In the lower aquifer, many of the municipal supply wells in the Pleasanton area produced water having TDS concentrations above the minimum threshold. The highest concentration was detected in a San Francisco Public Utilities Commission (SFPUC) well at 932 mg/L (829 mg/L last year). The highest TDS concentration detected in a Zone 7 well was in the Mocho 4 Well at 854 mg/L (962 mg/L last year). Zone 7 used its Mocho Groundwater Demineralization Plant (MGDP) to help reduce the TDS in delivered water in the 2020 WY. Other planned corrective actions and strategies are described in *Section 5.3.3.2, Salt Management Strategy of the Alternative GSP*.

Nitrates

There are ten Areas of Concern (AOCs) in the basin with historic nitrate concentrations above the minimum threshold (10 mg/L nitrate as nitrogen). During the 2020 WY, the highest concentration of nitrate in the upper aquifer was encountered in the May School AOC at 42 mg/L (32.3 mg/L

last year). In the lower aquifer, nitrate was only detected above the minimum threshold in the Buena Vista AOC with a maximum nitrate concentration at 11.2 mg/L (11 mg/L last year). The nitrate plumes appear to be stable and will continue to be monitored.

Boron

Boron is a naturally occurring element in the Livermore Valley Groundwater Basin with a basin minimum threshold 1.4 mg/L. There are two main areas in the upper aquifer where Boron exists above the minimum threshold, both in the northern Fringe Areas. The highest concentration continues to be in the northeastern portion of the Fringe Area at 29 mg/L (31 mg/L last year). In the lower aquifer, Boron was detected above the minimum threshold in one monitoring well at 2.6 mg/L in the Mocho II Subarea (1.78 mg/L last year) and in one municipal supply well at 1.41 mg/L in Zone 7's Mocho 3 well (1.6 mg/L last year).

Chromium

The minimum threshold for total chromium in groundwater is 0.050 mg/L, which matches the State's MCL. During the 2020 WY , total chromium was detected above the minimum threshold in two upper aquifer monitoring wells: one located in the northwest portion of the Fringe Area at 0.108 mg/L (not detected last year) and one located in the northeastern portion of the Fringe Area at 0.094 mg/L (0.063 mg/L last year). Total chromium was not detected above the minimum threshold in any municipal supply wells or lower aquifer monitoring wells in 2020 WY.

PFAS

PFAS are a large group of human-made substances that do not occur naturally in the environment and are classified by the Environmental Protection Agency (EPA) as "contaminants of emerging concern". While there are no current federal or California State limits (e.g., Maximum Contaminant Levels [MCLs]) for any PFAS compounds, in December 2019 the EPA published draft screening levels of 40 parts per trillion (ppt) and Preliminary Remediation goals (PRGs) of 70 ppt for perfluorooctanesulfonic acid (PFOS) and/or perfluorooctanoic acid (PFOA) (combined or individually) for groundwater that is a current or potential source of drinking water. During the 2020 WY Zone 7 sampled its municipal wells quarterly for PFAS as required by the California State Water Resources Control Board Division of Drinking Water (DDW) and tested several other monitoring program wells to determine if PFAS contamination is widespread. Only one of Zone 7's municipal wells had PFOS concentrations (Mocho Well 1 at 110 ppt) that exceeded the PRGs. Also during the water year, Zone 7 hired Jacobs Engineering, Inc. to conduct a PFAS Potential Source Investigation (*Jacobs, 2020*). The investigation, which concluded in December 2020, included recommendations for additional sampling of existing monitoring wells. Those wells will be incorporated into the 2021 WY sampling program. Jacob's report and other information on PFAS are located on the Zone 7 website: http://www.zone7water.com/pfas-information.

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*.

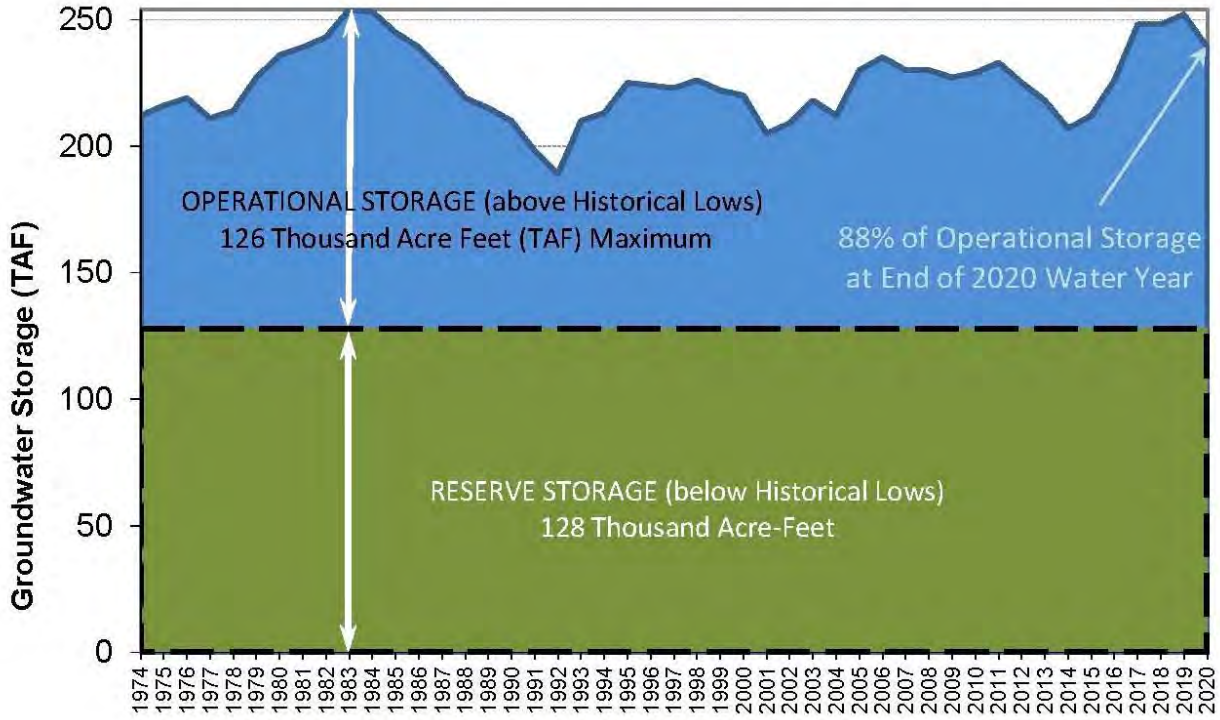
ES.2.5. Subsidence

Up through the 2018 WY, Zone 7 contracted with a licensed land surveyor to measure the land surface elevations of approximately 40 benchmarks that extended from bedrock outside of the Main Basin to the vicinity of Zone 7's production wellfields. In 2016, Zone 7 contracted with TRE Canada, Inc. (TRE) to evaluate Interferometric Synthetic Aperture Radar (InSAR) as an alternative to land surveying for subsidence monitoring. Starting in 2019, Zone 7 is now using InSAR instead of the land surveys for analyzing land subsidence. Again for the 2020 WY, Zone 7 contracted with TRE Altamira to acquire satellite data collected since the previous year's study. This year's study indicated that there continues to be no inelastic (permanent) defomation; just seasonal and cyclical surface elevation fluctuations that correlate with groundwater elevation fluctuations. These "elastic" fluctuations generally have been + or - 0.07 ft per year; and were less than 0.04 ft of net change during the 2020 WY. 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 estimate the total storage of the Main Basin at the end of each water year (see *Section 2.4.1 of the Alternative GSP*). *Section 11*, *Groundwater Storage* presents the storage volume for the 2020 WY and shows an overall decrease of 12.3 thousand acre-feet (TAF) between the end of the 2019 WY and the end of the 2020 WY. Operational groundwater storage at the end of 2020 WY was 111.5 TAF, which is about 88% 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 2020 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 2020 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 the 2020 WY, Zone 7 imported 26,200 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 excess groundwater pumping by retailers through quotas, as well as artificial recharge and adjustments to Zone 7 groundwater pumping. In addition, Zone 7 carefully monitors a series of former quarry lakes, known as the Chain of Lakes (COLs), 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 technically feasible. The next steps that were identified include a regional water demand study, regional water supply updates, and technical studies regarding the COLs and groundwater injection well 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 2020 WY, 116 drilling permits were issued with groundwater quality protection conditions, and 79% of the permitted work was physically inspected by Zone 7 permit compliance staff. Two new soil and groundwater contamination cases were identified and are being actively monitored and addressed along with 54 other active contamination cases within Zone 7's service area. Seven of these cases are being considered for closure.

Zone 7 also continued to implement its SMP and NMP to monitor, assess, reduce, and manage salt and nutrient loading. As part of its strategy to manage salt loading, Zone 7 exported 1,231 tons of salt from the Valley through the operation of the 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, mainly through the approval process for non-residential (e.g. commercial and industrial) OWTS use authorizations. One authorization for a nonresidential OWTS was approved in the 2020 WY. Additional updates or changes made to these programs during the 2020 WY are discussed in *Section 13, Water Quality Sustainability*.

1 Agency and Basin Information

1.1 Introduction

Alameda County Flood Control and Water Conservation District, Zone 7 (Zone 7 Water Agency or Zone 7) provides water management in the Livermore Valley Groundwater Basin (California Department of Water Resources (DWR) Basin 2-10) as part of its mission to *Deliver safe, reliable, efficient, and sustainable water services,* and more specifically address Strategic Plan initiatives #7 - Manage as the Groundwater Sustainability Agency (GSA) and implement the groundwater management plan and #8 - Study and refine knowledge of the groundwater basins. Zone 7 manages imported surface water as the local wholesale agency. In addition, the agency has managed local surface and groundwater resources for beneficial uses for more than 50 years. Consistent with its management responsibilities, duties, and powers, Zone 7 is designated in the 2014 Sustainable Groundwater Management Act (SGMA) as the exclusive GSA within its boundaries (*Figure 1-1*).

Prior to assuming the role of the GSA for the Livermore Valley Groundwater Basin, Zone 7 has been generating annual groundwater reports for public review and submission to the California Department of Water Resources (DWR) since the 2005 Water Year (WY). In 2005, Zone 7 adopted a Groundwater Management Plan (GWMP), which documented ongoing policies and programs for managing groundwater to support existing and future beneficial uses in the valley (*Zone 7, 2005a*). This was amended in June 2015 with the adoption of the Nutrient Management Plan (NMP) (*Zone 7, 2015b*), which added to both the GWMP and the 2004 Salt Management Plan (SMP) (*Zone 7, 2004*). In December 2016, Zone 7 submitted the Alternative Groundwater Sustainability Plan (GSP) for the Livermore Valley Groundwater Basin (Alternative GSP) (*Zone 7, 2016e*) to DWR in compliance with SGMA. The Alternative GSP was approved by DWR in July 2019. The first Five-Year Update to the Alternative GSP is due in January 2022.

This Annual Report for the Livermore Valley Groundwater Basin Sustainable Groundwater Management Program 2020 Water Year (2020 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. In an effort to keep this report concise, historical and reference materials included in the Alternative GSP (*Zone 7, 2016e*) have not been repeated here.

All of the data included in this report are conveyed based on the 2020 WY (i.e., October 1, 2019 through September 30, 2020); however, due to other reporting obligations, some information in this report (e.g., retailer groundwater pumping quota in *Section 11, Groundwater Storage)* is compiled and reported on a calendar year (CY) basis (i.e., January 1 through December 31, 2020).

1.2 Basin Management

This subsection discusses management actions that have taken place since the last Annual Report. Minor changes to each monitoring program, if any, are discussed in the corresponding section. For more information about overall basin management, see *Section 5*, *Projects and Management Actions* of the Alternative GSP (*Zone 7, 2016e*).

In March 2020, Zone 7 was awarded a grant by DWR entitled *Five Year Update: 2022 Alternative Groundwater Sustainability Plan for Livermore Valley Groundwater Basin* for Round 3 of the Sustainable Groundwater Management Planning Grant program funded by Proposition 68 and Proposition 1. The overarching goal of this grant project is to prepare a Five-Year Update for the 2016 Alternative GSP that addresses the DWR recommendations on the original Alternative GSP and addresses data needs and analyses identified by Zone 7 staff. The scope of work includes:

- Adding additional groundwater monitoring wells to address data gaps in the Fringe and Upland Areas,
- Expanding Zone 7's cross-section network,
- Extending the existing Areal Recharge Spreadsheet Model to Fringe and Upland Areas,
- Further studying per- and polyfluoroalkyl substances (PFAS) as a constituent of concern,
- Developing interferometric synthetic aperture radar (InSAR) techniques to monitor subsidence over a larger portion of the groundwater basin,
- Investigating additional existing groundwater dependent ecosystems (GDE), and
- Evaluating management actions taken to reduce high nitrate concentrations in key areas.

The grant award is for $500,000. Specific details on the project can be found at:

http://www.zone7water.com/alternative-groundwater-sustainability-plan.

1.3 Zone 7 Service Area

No changes have occurred to the Service Area or major customers during the period of this annual report.

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)

The agency also provides imported surface water directly to 82 untreated water customers. These direct connections largely supply local agricultural uses.

1.4 Zone 7 Programs

No major changes have occurred to the Zone 7 programs during this reporting period. Minor modifications to each program, if any, are discussed in their corresponding section. 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, 2016e*). Overall, Zone 7 has sustainably managed the groundwater basin to avoid undesirable results. The historical groundwater data show that the Basin has been operated sustainably since the mid-1970s, including 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. Although some datasets predate 1974, this date was chosen to represent the most comprehensive and consistent collection of data.

Zone 7 is the lead agency for many water resource management programs and coordinates with groundwater resource programs of others in the Basin. The status and results of these programs for the 2020 WY are described in the following chapters of this report:

- Chapter 2: Precipitation and Evaporation – monitoring climatological conditions,
- Chapter 3: Surface Water - measuring stream flows and quality,
- Chapter 4: Mining Area - monitoring mining activities, pond elevations, and water quality in quarry-made lakes,

- Chapter 5: Surface Water/Groundwater Interaction – monitoring areas of shallow groundwater that affect surface ecosystems (e.g. Groundwater Dependent Ecosystems or GDEs),

- Chapter 6: Groundwater Elevations - monitoring groundwater levels using long-term well measurements coupled with a detailed groundwater basin numerical model,

- Chapter 7: Groundwater Quality - monitoring water quality through annual groundwater sampling for salt, nutrient, PFAS, and other parameters,

- Chapter 8: Land Surface Elevation - monitoring land surface elevation changes,

- Chapter 9: Land Use – monitoring land use over the basin,

- Chapter 10: Wastewater and Recycled Water – monitoring wastewater and recycled water volumes/quality and promoting sound recycled water use,

- Chapter 11: Groundwater Storage – calculating groundwater storage for both natural and artificial (i.e., Zone 7's conjunctive use - recharged and pumped) components,

- Chapter 12: Groundwater Supply Sustainability – managing groundwater supplies to meet current and future demands through sustainable conjunctive use (stream recharge and groundwater pumping), and

- Chapter 13: Groundwater Quality Sustainability – managing groundwater quality by permitting well installations and destructions, monitoring toxic site cleanups, and calculating salt and nutrient loading.

1.5 Groundwater Management Ordinances and Policies

No changes occurred in groundwater ordinances or policies during the reporting period.

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.

Well Ordinance: Zone 7 administers the drilling/well permit program within its service area pursuant to a Memorandum of Understanding (MOU) with Alameda County and ordinances adopted by the Cities of Dublin, Pleasanton, and Livermore. 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 intent to use must be filed at Zone 7. The permits issued during the 2020 WY are discussed in *Section 13.2* of this report.

Wastewater Management Policies: 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 (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 Alameda County Department of Environmental Health (ACDEH) administers the County Onsite Wastewater Treatment Systems (OWTS) Ordinance, Zone 7 approval is explicitly required for nonresidential uses within the Upper Alameda Creek Watershed (Resolution 1165). The nonresidential OWTS applications submitted to Zone 7 during the 2020 WY are discussed in *Section 13.5.3* of this report.

1.6 Plan Area

No changes occurred to the plan area during the reporting period. 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. While the Alameda County portion of the Basin lies wholly within Zone 7's Service Area, the northwestern portion of the Basin extends beyond the Zone 7 Service Area into Contra Costa County. In 2016, Zone 7 entered into a MOU with East Bay Municipal Utilities District (EBMUD), City of San Ramon, and DSRSD under which Zone 7 will serve as the GSA for the Contra Costa portion of the Basin.

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 (Basin No. 2-11), which is also a very-low priority basin to the southwest of the Livermore Valley Groundwater Basin. A small portion of the Tracy Subbasin (Basin No. 5-22.15), a medium priority basin, is located within the Zone 7 service area. This portion of the Tracy Subbasin is managed by Byron-Bethany Irrigation District (BBID) under a MOU between BBID and Zone 7 dated April 26, 2017.

Zone 7 used the updated (2016) DWR Bulletin 118 boundary for the Livermore Valley Groundwater Basin in its Alternative GSP and this 2020 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.

1.7 Basin and Hydrogeologic Setting

1.7.1 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 floor 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 Valley floor and extends south and north into the uplands of Pleasanton and Livermore. Groundwater generally flows 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, 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 Areas, and Upland Areas shown in *Figure 1-1* and listed in *Table 1-A*.

Table 1-A: Basin Management Areas

Basin	Area	General Description
Main Basin	19,809 acres	Central portion of Valley floor
Fringe Areas	21,956 acres	Edges of Valley floor
Upland Areas	27,778 acres	Gently sloping Valley wall
Total	69,557 acres	

1.7.2 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 is hydraulically connected to the Fringe Areas through the shallow alluvium; however, subsurface inflow from the Fringe Areas into the deeper portions of the Main Basin is

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

considered to be minor due to subsurface geologic barriers believed to be either faulting or an alluvium/bedrock contact. 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 Basin itself. The Main Basin aquifers generally have the highest transmissivity and the best quality groundwater. All of the Valley's municipal supply wells are completed in the "Lower" Main Basin Aquifer Zone (described in *Section 1.8.3*), and some include the deeper Livermore Formation.

1.7.3 Fringe Areas and Subareas

The Fringe Areas are defined by water-bearing areas outside of the Main Basin that consist of 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 Areas and the Main Basin is through the Upper Aquifer. In general, lower alluvium aquifer units in the Main Basin do not extend into the Fringe Area. Domestic wells located in the Fringe Area are typically completed in the deeper aquifers of the Livermore Formation.

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

- Along the northern and eastern boundaries between these two areas, currently estimated at about 900 acre-feet per year (AF/yr), and
- Along the northwestern boundary (at the Bernal Subarea) of the Main Basin estimated to be about 100 AF/yr.

1.7.4 Upland Areas

The Upland Areas are primarily defined by areas where the recent alluvium is absent but the Livermore Formation and other older water-bearing bedrock units are exposed. 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 Upland Areas leaves as runoff and contributes to streams in both the Fringe Areas and Main Basin. A small amount of deep percolation of precipitation in the Upland Areas may also contribute to the Main Basin's subsurface inflow. The northern portion of the Upland Areas is called the Tassajara Uplands, and the southern and eastern portions are called the Livermore Uplands (*Figure 1-1*). Neither of these Upland Areas have been further divided into subareas 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 Areas demonstrate that current uses/withdrawals are currently sustainable.

1.8 Aquifer Zones

1.8.1 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. In the Main Basin, the two aquifer zones are generally separated by a relatively continuous silty clay aquitard, which is up to 50 feet (ft) thick and occurs between 80 and 175 ft below ground surface (bgs). 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 and Upland Areas.

1.8.2 Upper Aquifer Zone

The Upper Aquifer consists of alluvial materials, primarily including sandy gravel and clayey or silty gravels. These gravels are usually encountered underneath a confining surficial clay or silty clay layer, typically 5 to 70 ft bgs in the west and exposed at the surface in the east. They are present in the Main Basin and Fringe Areas. The base of the Upper Aquifer Zone varies from 80 to 175 ft bgs in the Main Basin and 10 to 70 ft bgs in the Fringe Area (*DWR, 1974*). 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.

1.8.3 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.

1.9 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 generally has lower total dissolved solids (TDS) 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 (RWQCB) San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) (*RWQCB, 2011*). For more information on the characteristics of the groundwater basin see *Section 1.3.6, Beneficial Uses* of the Alternative GSP.

1.10 Monitoring Networks and Modeling

Changes to the monitoring network or modeling parameters made during the reporting period are provided in more detail identifying the changes in subsequent subsections of this 2020 WY Annual Report. 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: 1. Precipitation and Evaporation Monitoring, 2. Surface Water Monitoring, 3. Groundwater Elevation Monitoring, 4. Groundwater Quality Monitoring, 5. Land Surface Elevation Monitoring, and 6. Wastewater and Recycled Water Monitoring. Zone 7 uses a proprietary data management system to store and analyze data gathered in these programs. 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 only the Main and North Fringe Subareas of the Basin. Additional information regarding the groundwater model is provided in *Section 2.6, Groundwater Model*, of the Alternative GSP.

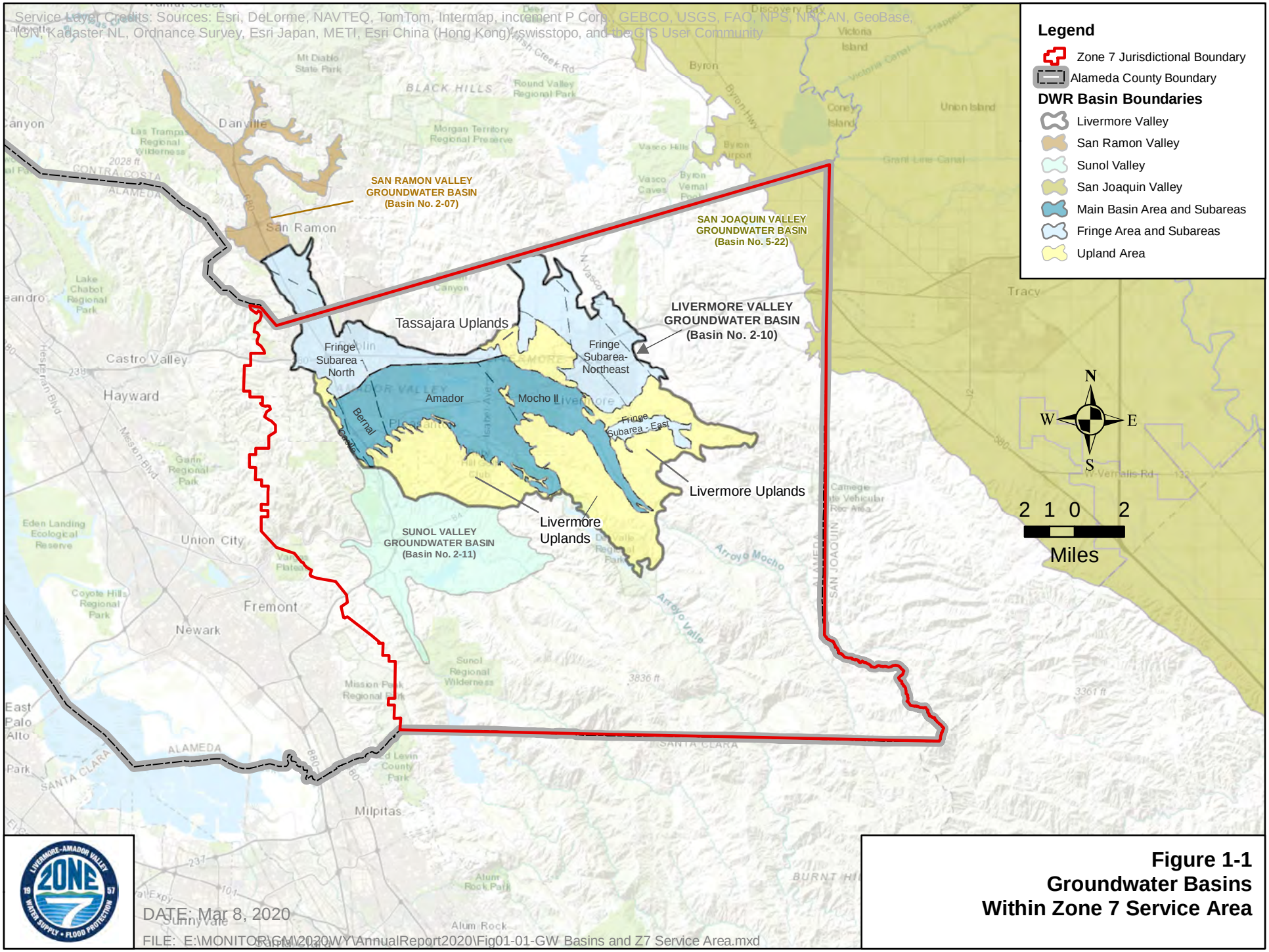


Figure 1-1
Groundwater Basins
Within Zone 7 Service Area

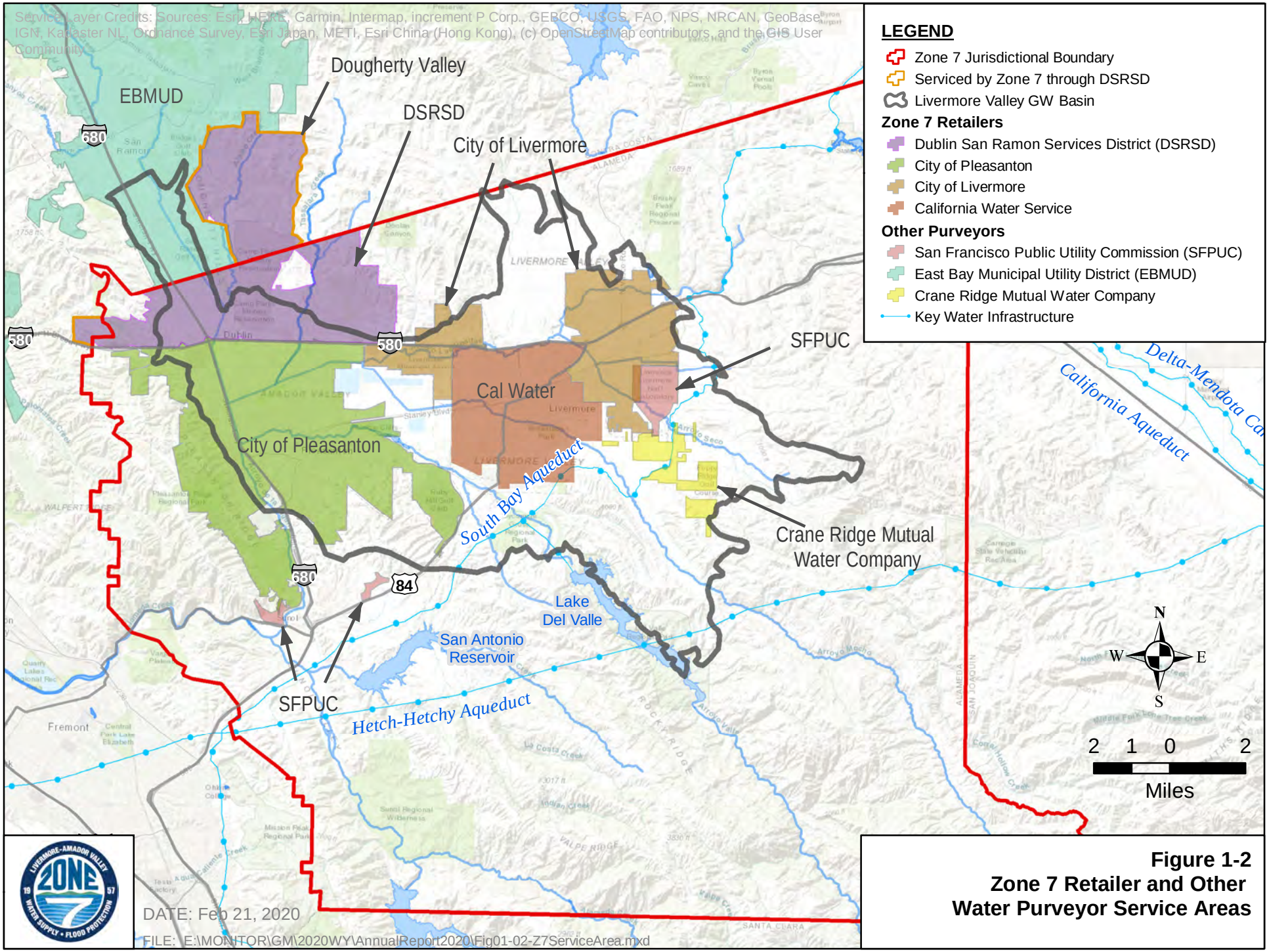


Figure 1-2
Zone 7 Retailer and Other Water Purveyor Service Areas

2 Precipitation and Evaporation

2.1 Program Description

2.1.1 Monitoring Network

Detailed information on Zone 7's overall Climatological Monitoring Program can be found in *Section 4.2, Climate Monitoring* of the Alternative GSP. Zone 7 uses a network of climatological stations (see *Figure 2-1* and *Table 2-1*) to provide high-quality data for water inventory calculation 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 fully-watered, full-cover grass surface. The pan evaporation stations at Lake Del Valle (LDV) and Livermore Water Reclamation Plant (LWRP) measure evaporation directly. This data is then converted to ETo to use with the CIMIS readings to calculate pond evaporation. 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).

2.1.2 Program Changes for the Water Year

The names of the stations in the program have been modified so that:

- "_STA" was removed.
- Station numbers were reformatted to 3 characters.

So, for example, Station CM_STA_17 was renamed to CM_017.

As of June 1st, 2020, Station 15E (CM_015E or 15E) at Wellingham Drive in Livermore (which has data back to 1871) is no longer collecting data. The National Weather Service is now redirecting 15E data requests to the rain gauge at Livermore Municipal Airport (KLVK) located two miles west of 15E. Therefore, Zone 7 added the CM_KLVK gauge to the program and created a Livermore Rainfall Index (LRI) for the attached figures and tables that consists of CM_015E data up to June 2020 and the CM_KLVK data thereafter (*Figure 2-2*).

2.2 Results for the 2020 Water Year

In the 2020 WY, total rainfall on the watershed was 65% of average (*Table 2-2*). Rainfall totals from individual stations ranged from 7.46 inches (58% of average) at Arroyo Mocho near Livermore (CM_AMNL) to 22.55 inches (93% of average) at Lick Observatory (CM_044) in Santa Clara County. Rainfall for the LRI totaled 10.48 inches (72% of average) in the 2020 WY.

ETo for the 2020 WY was 48.89 inches (113% of normal) at LDV Station (CM_LDV); 50.23 inches (98% of normal) at the CIMIS Station 191 (CM_191); and 47.05 inches (102% of normal) at the LWRP Station (CM_LWRP).

Rainfall and evaporation information is provided in the following tables.

- Table 2-1, Table of Climatological Stations, 2020 WY
- Table 2-2, Monthly Precipitation Data, 2020 WY
- Table 2-3, Historical Monthly Precipitation (inches), Monitoring Station 15E, Livermore, 1871 to 2020 WY
- Table 2-4, Monthly Evapotranspiration Data, 2020 WY
- Table 2-5, Historical Monthly Pan Evaporation (inches), Monitoring Station Lake Del Valle, Livermore

TABLE 2-1
TABLE OF CLIMATOLOGICAL STATIONS
2020 WATER YEAR

PRECIPITATION NETWORK

SITE	COMPUTER SITE ID	STATION NAME	LOCATION	OBSERVER	ELEV-ATION	STATION ESTABLISHED	15 MIN RECORD	MEAN ANNUAL (IN)
15E	CM_015E**	Hafner NOAA Livermore	Wellingham Drive, Livermore	Mr. Ron Hafner	480	1871 to 2020	-	14.49
17	CM_017	Del Valle Plant	601 East Vallecitos Rd, Livermore	ZONE 7	640	1974	1978 to Present	15.97
24	CM_024	Patterson Plant	Patterson Pass Rd, Livermore	ZONE 7	680	1963	1969 to 2016	12.85
34	CM_034	Mocho Wellfield	Santa Rita Rd, Pleasanton	ZONE 7	340	1968	1970 to 2010	17.88
44	CM_044	Mt Hamilton	Lick Observatory, Mt. Hamilton	Lick Observatory	4209	1881	-	24.34
101	CM_101	Tassajara	Camino Tassajara Rd, Danville	Mrs. Joan Hansen	800	1912	-	18.46
170	CM_170	Parkside	Parkside Drive, Pleasanton	ZONE 7	330	1986	1986 to 2005	20.51
191	CM_191	CIMIS Station	Alameda County Fairgrounds Golf Course	DWR	335	2004	2004 to Present	17.03
ALTC_BD	CM_ALTC_BD	Altamont Creek	at ALTC_BD surface water station	ZONE 7	500	2015	2015 to Present	13.26
AMNL	CM_AMNL	Arroyo Mocho Near Livermore	at AMNL surface water station	ZONE 7	750	2015	2015 to Present	12.80
AMP	CM_AMP	Arroyo Mocho Pleaslanton	At AMP Surface Water Station	ZONE 7	335	2016	2016 to Present	12.97
AVBLC	CM_AVBLC	Arroyo Valle Below Lang Canyon	at AVBLC surface water station	Alameda County	757	2016	2016 to Present	-
KLVK	CM_KLVK**	Rain Gauge Lat Livermore Municipal Airport	Livermore Municipal Airport	NOAA	395	1998	-	-
LG1_DB	CM_LG1_DB	Line G-1 at Dublin BLVD	Dublin Blvd and Scarlett Dr, Dublin	ZONE 7	336	2019	2019 to Present	-
LJ1_BDB	CM_LJ1_BDB	Line J-1 Below Dublin BLVD	Dublin Doulevard, Dublin	ZONE 7	332	2019	2019 to Present	-
NC	CM_NC	North Canyons Office	Zone 7's North Canyons building	ZONE 7	450	2015	2015 to Present	12.23
SGE	CM_SGE	Rain Gauge at Sunol Glen Elementary School	Sunol Glen Elementary School at Main St and Bond St	ZONE 7	253	2016	2016 to Present	-
TC_BI580	CM_TC_BI580	Tassajara Creek below I-580	Old Santa Rita Rd, Pleasanton	ZONE 7	342	2018	2019 to Present	-

EVAPORATION NETWORK

SITE	COMPUTER SITE ID	STATION NAME	LOCATION	OBSERVER	ELEV-ATION	STATION ESTABLISHED	15 MIN RECORD	MEAN ANNUAL (IN)
LDV	CM_LDV	Lake Del Valle	Lake Del Valle	DWR	760	1968	-	43.18
LWRP	CM_LWRP	Livermore Water Reclamation Plant	Lake Del Valle	LWRP	410	1974	-	46.17
191	CM_191	CIMIS Station	Alameda County Fairgrounds Golf Course	DWR	335	2004	2004 to Present	51.29

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

** Livermore Rainfall Index comprises of CM_015E to June 2020 and CM_KLVK thereafter.

TABLE 2-2
MONTHLY PRECIPITATION DATA
2020 WATER YEAR

MONTHLY PRECIPITATION IN INCHES

	MONITORING STATION																	2020 Network Average	% Historic Network Average
	LRI	17	24	34	44	101	170	191	ALTC	AMNL	AMP	AVBLC*	LG1_DB*	LJ1_BDB*	NC	SGE*	TC_BI580*		
OCT	0.00	0.00	0.00	0.00	0.08	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	0.5%
NOV	0.97	1.11	0.79	0.98	1.65	0.78	1.10	0.90	0.93	0.93	0.96	1.81	1.26	1.41	0.83	1.76	1.02	1.13	61.0%
DEC	2.91	1.97	2.52	2.63	6.36	3.70	2.82	2.98	2.28	1.93	2.23	3.50	1.99	2.21	1.83	2.06	2.07	2.71	103.3%
JAN	1.05	1.19	1.00	0.98	3.12	1.19	1.46	1.02	0.96	0.82	0.78	1.20	0.88	1.10	0.97	1.36	0.77	1.17	38.1%
FEB	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	0.00	0.00	0.00	0.00	0.00	0.0%
MAR	2.97	2.92	2.15	2.26	6.26	1.73	2.71	2.57	2.91	1.75	1.97	3.42	1.59	1.91	2.33	3.31	1.89	2.63	93.4%
APR	1.72	1.96	1.31	2.02	2.94	1.62	2.48	2.14	1.50	1.43	1.81	2.50	1.78	1.98	1.69	2.45	1.81	1.95	136.1%
MAY	0.75	0.26	0.17	0.68	2.14	1.14	1.27	1.05	0.08	0.59	0.56	0.50	1.21	0.81	0.25	0.38	0.84	0.75	147.4%
JUN	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	0.00	0.00	0.00	0.00	0.00	0.0%
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	0.00	0.00	0.00	0.00	0.00	0.0%
AUG	0.11	0.04	0.02	0.15	0.00	0.21	0.24	0.17	0.02	0.01	0.09	0.00	0.22	0.17	0.08	0.21	0.06	0.11	325.1%
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	0.00	0.00	0.00	0.00	0.00	0.0%
TOTAL	**10.48**	**9.45**	**7.96**	**9.70**	**22.55**	**10.37**	**12.08**	**10.83**	**8.68**	**7.46**	**8.40**	**12.93**	**8.93**	**9.59**	**7.98**	**11.53**	**8.46**	**10.43**	
% AVG	**72%**	**59%**	**62%**	**54%**	**93%**	**56%**	**59%**	**64%**	**65%**	**58%**	**65%**	**	**	**	**65%**	**	**	**65%**	

* Not included in Network Average due to insufficient age

** Not enough data for average calculation.

LRI Livermore Rain Index (CM_015E to June 2020 and CM_KLVK thereafter)

Preliminary Data

DISTRIBUTION OF DAILY PRECIPITATION

Number of days with rainfall greater than reference

Rainfall	MONITORING STATION																	2020 Network
(inches)	15	17	24	34	44	101	170	191	ALTC	AMNL	AMP	AVBLC	LG1_DB	LJ1_BDB	NC	SGE	TC_BI580	Average
>Trace	55	53	50	43	49	63	44	43	49	45	51	59	43	46	49	62	46	50
>0.1	20	19	19	24	28	43	25	26	19	20	23	24	23	24	20	28	24	24
>0.5	8	6	6	5	4	14	8	7	6	3	6	9	6	6	4	6	5	6
>1	1	1	0	1	1	5	4	2	1	0	0	2	1	1	1	2	0	1
>2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 2-3
HISTORICAL MONTHLY PRECIPITATION
Livermore Rainfall Index (CM_015/CM_KLVK)
1871 to 2020 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	132%
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	114%
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	99%
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	131%
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	100%
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	130%
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%

TABLE 2-3
HISTORICAL MONTHLY PRECIPITATION
Livermore Rainfall Index (CM_015/CM_KLVK)
1871 to 2020 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	137%
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	65%
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	118%
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%
2019	0.18	1.64	1.54	2.66	6.31	2.58	0.30	1.63	0.00	0.00	0.00	0.22	17.06	16.84	118%
2020	0.00	0.97	2.91	1.05	0.00	2.97	1.72	0.75	0.00	0.00	0.11	0.00	10.48	10.59	72%
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.21	4.82	36%
MEAN	0.71	1.64	2.64	2.90	2.47	2.19	1.09	0.47	0.11	0.01	0.03	0.23	14.49	14.52	100%

TABLE 2-4
MONTHLY EVAPOTRANSPIRATION (ETo) DATA
2020 WATER YEAR

MONTHLY REFERENCE EVAPOTRANSPIRATION (Eto) (inches)

				2020 Network Average	% Historic Network Average
	LDV	LWRP	191		
OCT	4.47	4.24	4.04	4.25	123.2%
NOV	2.57	2.48	1.94	2.33	134.4%
DEC	0.77	0.81	0.90	0.83	68.1%
JAN	0.81	0.95	1.30	1.02	86.7%
FEB	2.45	2.64	2.96	2.68	160.5%
MAR	2.11	2.87	2.98	2.65	94.0%
APR	3.61	3.62	4.72	3.98	98.4%
MAY	6.02	5.40	6.53	5.99	109.0%
JUN	6.91	6.66	7.79	7.12	109.3%
JUL	7.21	6.62	7.99	7.27	100.7%
AUG	7.04	6.55	6.86	6.82	105.8%
SEP	4.92	4.19	4.68	4.59	90.2%
TOTAL	**48.89**	**47.05**	**52.69**	**49.54**	
% AVG	**113%**	**102%**	**103%**	**106%**	

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 2020 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	102%
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	105%
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	98%
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	90%
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	94%
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	95%
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	100%
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	104%
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	96%
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	99%
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	94%
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	101%
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	95%
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	97%
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	86%
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	106%
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	103%
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	90%
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	101%
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	108%
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	107%
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	94%
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	102%
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	106%
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	116%
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	109%
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%
2018	6.53	2.15	2.60	1.51	3.33	3.46	5.30	7.95	10.43	12.22	9.84	8.11	73.43	73.66	109%
2019	5.88	4.07	1.70	1.93	1.57	3.22	5.99	6.27	10.99	11.55	11.25	8.36	72.78	71.79	108%
2020	6.99	4.01	1.20	1.27	3.82	3.29	5.64	9.41	10.80	11.26	11	7.68	76.37	77.59	113%
MAXIMUM	6.99	4.07	2.93	3.43	3.82	5.17	7.61	10.51	11.87	12.43	11.77	9.47	78.28	78.65	116%
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	5.19	2.47	1.52	1.44	2.01	3.60	5.48	7.82	9.48	10.76	9.79	7.89	67.45	67.45	100%

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

Water Year = October to September

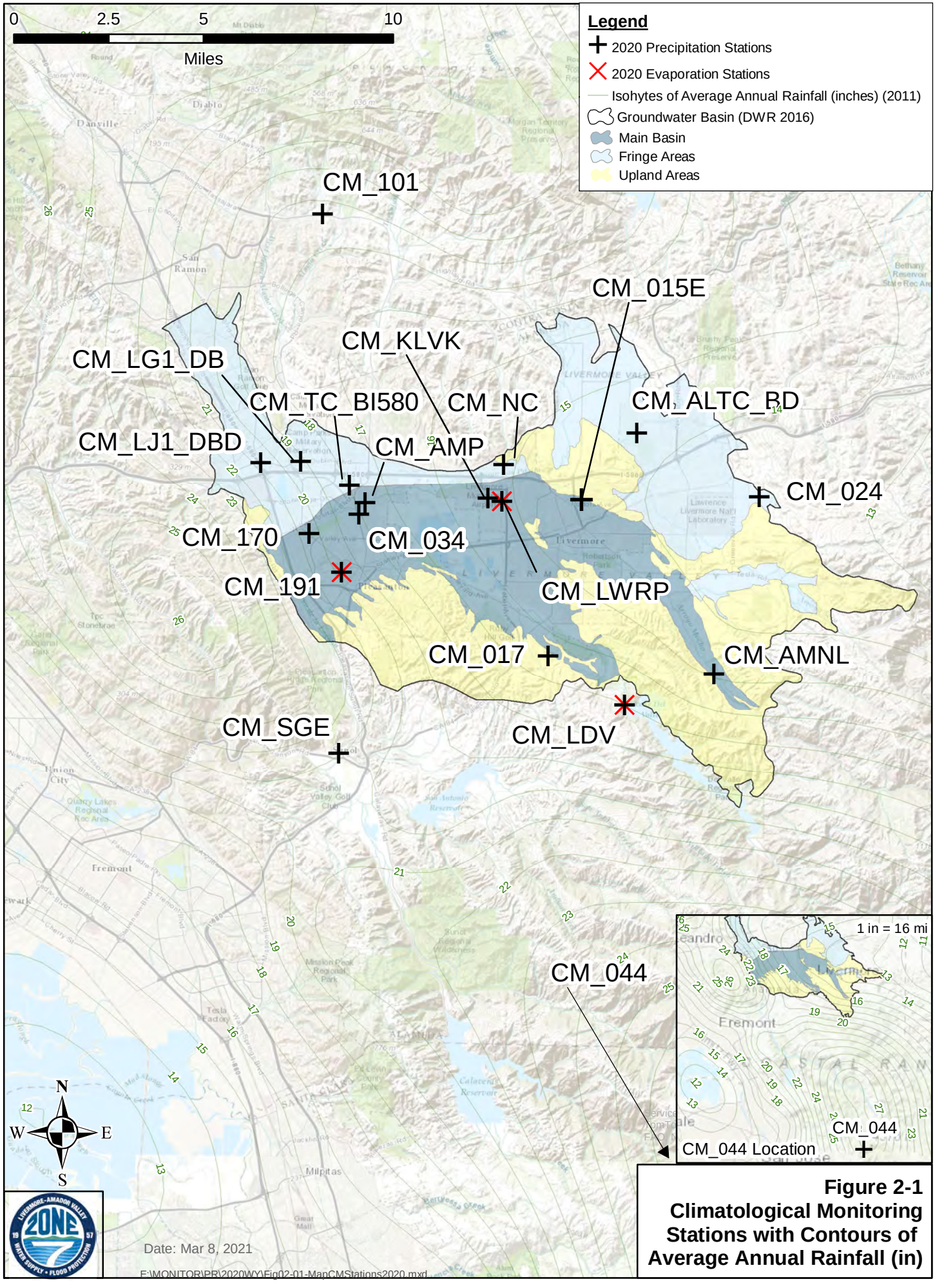
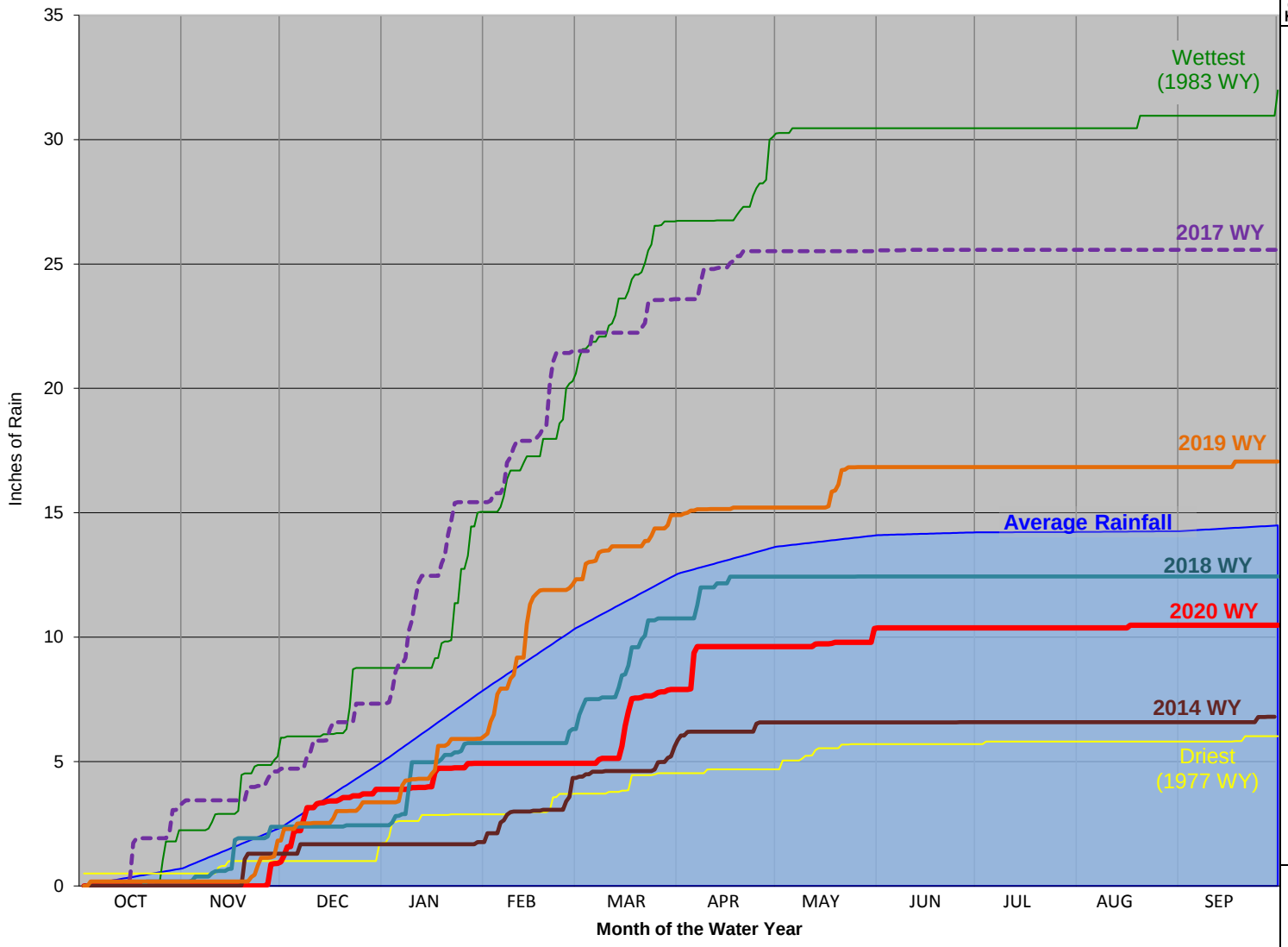


Figure 2-1
Climatological Monitoring Stations with Contours of Average Annual Rainfall (in)

FIGURE 2-2
ZONE 7 WATER AGENCY
Graph of Livermore Rainfall Index (CM_15E to June 2020, CM_KLVK thereafter)



	Total Annual Rainfall	% Avg	Probability of Exceedence
Wettest (1983 WY)	31.98"	221%	1%
2017 WY	25.57"	176%	3%
2019 WY	17.06"	118%	28%
Average Rainfall	14.50"	100%	41%
2018 WY	12.44"	86%	60%
2020 WY	10.48"	72%	82%
2014 WY	6.80"	47%	97%
Driest (1977 WY)	6.02"	42%	98%

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Monthly (inches)	0.00	0.97	2.91	1.05	0.00	2.97	1.72	0.75	0.00	0.00	0.11	0.00
% Monthly Avg	0%	59%	110%	36%	0%	136%	159%	161%	0%	0%	323%	0%
YTD (inches)	0.00	0.97	3.88	4.93	4.93	7.90	9.62	10.37	10.37	10.37	10.48	10.48
% Average YTD	0%	41%	78%	62%	48%	63%	71%	74%	73%	73%	73%	72%
% Annual Avg	0%	7%	27%	34%	34%	55%	66%	72%	72%	72%	72%	72%

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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, and Arroyo de la Laguna) and the diversions, releases, and natural runoff that affect the flows into and out of each of them. *Figure 3-1* shows all the stations monitored for the 2020 WY. *Table 3-1* includes pertinent details of all the stations.

The Surface Water Monitoring Program utilizes a main network of stream gauge stations and flow meters to compute the quantity of water flowing past each station and the amount of water recharging the Basin between them. At least once per year, water samples are collected from the 10 main stations and submitted to Zone 7's laboratory for analysis of TDS, nutrients, metals, and other minerals from which salt and nutrient loading (and removal) are computed, see *Section 13, Water Quality Sustainability*.

Several other auxiliary surface water monitoring stations have been established as high flow and/or stream temperature 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 Surface Water Monitoring Program's main network that is used to assess groundwater sustainability; however, an addition was made to the auxiliary programs, as follows:

- One new high-flow-only stream gauge was installed in August 2020: Arroyo Seco at Southfront Road (AS_SFR, see *Figure 3-1*). This site is currently only recording stream level and water temperature. Streamflow will be added when high flow measurements are obtained.

3.2 Results for the 2020 Water Year

3.2.1 Introduction

Twenty surface water recorder stations and five flow meters were operated and maintained for the Surface Water Monitoring Program in the 2020 WY. Data was tabulated monthly for 11 of the stations (10 main stations plus Station Alamo Canal near Pleasanton [ACNP]) in *Table 3-2*. Water samples were collected from all 10 main stations and analyzed to identify the quality of water recharging and discharging from the groundwater basin (*Table 3-3*).

The following sections outline the Surface Water Monitoring Program activities for the 2020 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 2020 WY.

- The watershed runoff total into Lake Del Valle (LDV), as recorded by Arroyo Valle below Lang Canyon (AVBLC) was 2,701 acre-feet (AF); 11.0% of average.
- There were no flood releases into Arroyo Valle from LDV (Station LDV_FLD_TTL).
- Zone 7 released 3,855 AF from the South Bay Aqueduct (SBA) into Arroyo Valle for artificial recharge, 110% of average. Zone 7 discontinued these releases on July 30 due to low State Water Project (SWP) allocations (20%).
- "Live stream" conditions were maintained in the Arroyo Valle with natural and artificial flows until August 9, 2020.
- Peak flows recorded on the Arroyo Valle were 30.8 cubic feet per second (cfs) at Arroyo Valle near Livermore (AVNL) and 73.2 cfs at Arroyo Del Valle at Pleasanton (ADVP); the water year annual mean flows for each station were 5.7 and 2.0 cfs, respectively.
- As is usually the case recently (and for the expected future), the aggregate mining companies did not make any discharges into the Arroyo Valle in the 2020 WY.
- East Bay Regional Parks District (EBRPD) diverted 271 AF from the Arroyo Valle into Shadow Cliffs Lake (Station AV_DIV_SC) for recreation and groundwater recharge, 44% of average.

3.2.3 Arroyo Mocho

The following are items of special note for the Arroyo Mocho in the 2020 WY.

- The total upper watershed runoff that flowed into the Valley, past Station Arroyo Mocho near Livermore (AMNL), was 812 AF (23% of average).
- The peak flows recorded at AMNL and Arroyo Mocho at Livermore (AMHAG) were 73 cfs and 227 cfs, respectively; the 2020 WY annual mean flows for each station were 1.1 and 0.3 cfs, respectively.
- No water releases were made into Arroyo Mocho from the SBA for artificial groundwater recharge purposes (Station SBA_AM, average about 3,500 AF).

3.2.4 Arroyo Las Positas

The following are items of special note for the Arroyo Las Positas in the 2020 WY.

- The peak flows recorded on the Arroyo Las Positas were 314 cfs at Station Arroyo Las Positas at Livermore (ALPL) and 256 cfs at Station Arroyo Las Positas above El Charro Road (ALP_ELCH); the 2020 WY annual mean flows at each station were 4.6 and 4.3 cfs, respectively.
- As is usually the case recently (and for the expected future), 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 2020 WY.

- A total of 15,548 AF of water flowed out of the Valley past Station Arroyo de la Laguna at Verona (ADLLV); 29.7% of average.
- The peak flow recorded at ADLLV was 1,350 cfs; the 2020 WY annual mean flow was 21.4 cfs.

TABLE 3-1
TABLE OF SURFACE WATER MONITORING STATIONS AND MONITORING INFORMATION
2020 WATER YEAR

Station ID	Station Name	Station Type	Flow Range	Flow Freq	Gauge Height	Flow (Q)	Water Temp	Other Parameters	WQ Freq	Primary Operator
ALAMO CANAL - LINE F										
ACNP	Alamo Canal near Pleasanton	Stream Gauge	Entire	15 Min	x	x	15 Min	SSD	-	USGS
AC_WCD	Alamo Creek at Willow Creek Dr	Stream Gauge	High	15 Min	x	x	15 Min	-	-	Zone 7
ALTAMONT CREEK - LINE R										
ALTC_BD	Altamont Creek at Bluebell Drive	Stream Gauge	High	15 Min	x	x	15 Min	-	-	Zone 7
SBA_ALTC	SBA Turnout to Altamont Creek	Flow Meter	Low	15 Min	-	x	-	-	-	DWR
ARROYO DE LA LAGUNA - LINE B										
ADLLV	Arroyo De La Laguna at Verona	Stream Gauge	Entire	15 Min	x	x	15 Min	pH, SC	Annual	USGS
ARROYO LAS POSITAS - LINE H										
ALP_ELCH	Arroyo Las Positas above El Charro Road	Stream Gauge	Entire	15 Min	x	x	15 Min	-	Annual	Zone 7
ALPL	Arroyo Las Positas at Livermore	Stream Gauge	Entire	15 Min	x	x	15 Min	Turb, SSD	Annual	Zone 7
LLNL_ALP	LLNL Treated Groundwater Discharge to ALP	Estimated	Low	Daily	-	x	-	-	-	LLNL
ARROYO MOCHO - LINE G										
AMHAG	Arroyo Mocho at Livermore	Stream Gauge	Entire	15 Min	x	x	15 Min	Turb, SSD	Annual	Zone 7
AM_KB	Arroyo Mocho at Kaiser Bridge	Stream Gauge	Entire	15 Min	x	x	15 Min	-	Annual	Zone 7
AMNL	Arroyo Mocho near Livermore	Stream Gauge	Entire	15 Min	x	x	15 Min	-	Annual	Zone 7
AMP	Arroyo Mocho near Pleasanton	Stream Gauge	Entire	15 Min	x	x	15 Min	Turb, SSD	Annual	Zone 7
MA_COPE_I	Cope Lake to Lake I	Lake Gauge	Low	Hourly	x	x	-	-	-	Zone 7
MA_VUL_COPE	Vulcan Discharge to Cope Lake	Flow Meter	Low	Daily	-	x	-	-	-	Vulcan
SBA_AM	SBA Turnout to Arroyo Mocho	Flow Meter	Low	15 Min	-	x	-	-	-	DWR
ARROYO SECO - LINE P										
AS_SFR	Arroyo Seco at Southfront Rd	Stream Gauge	High	15 Min	x	x	15 Min	-	-	Balance
ARROYO VALLE - LINE E										
ADVP	Arroyo Valle at Pleasanton	Stream Gauge	Entire	15 Min	x	x	15 Min	-	Quarterly*	Zone 7
AVADLL	Arroyo Valle above Arroyo De La Laguna	Water Temp	-	-	-	-	15 Min	-	-	Zone 7
AVBLC	Arroyo Valle below Lang Canyon	Stream Gauge	Entire	15 Min	x	x	15 Min	-	Annual	USGS
AVCAT	Arroyo Valle along Camp Arroyo Trail	Water Temp	-	-	-	-	15 Min	-	-	Zone 7
AVDCC	Arroyo Valle at Dry Creek Confluence	Water Temp	-	-	-	-	15 Min	-	-	Zone 7
AV_DIV_SC	Arroyo Valle Diversion to Shadow Cliffs	Flow Meter	Low	Daily	-	x	-	-	-	EBRPD
AV_ISABEL	Arroyo Valle at Isabel Ave	Water Temp	-	-	-	-	15 Min	-	-	Zone 7
AVNL	Arroyo Valle near Livermore	Stream Gauge	Entire	15 Min	x	x	15 Min	-	Quarterly*	USGS
AVSCPK18	Arroyo Valle at Shadow Cliffs Pond K18	Water Temp	-	-	-	-	15 Min	-	-	Zone 7
AVSGP	Arroyo Valle at Sycamore Grove Park	Water Temp	-	-	-	-	15 Min	-	-	Zone 7
LDV_FLD_GATE	Lake Del Valle Flood Gate	Calculated	High	15 Min	-	x	-	-	-	DWR
SBA_TO1_AV	SBA Turnout 1 to Arroyo Valle	Estimated	Low	15 Min	-	x	-	-	-	Zone 7
SBA_TO2_AV	SBA Turnout 2 to Arroyo Valle	Flow Meter	Low	15 Min	-	x	15 Min	-	-	DWR
CHABOT CANAL - LINE G-1										
CCNP	Chabot Canal below Stoneridge Drive nr Pleasanton	Stream Gauge	High	15 Min	x	x	15 Min	-	-	Zone 7
LG1_DB	Line G1 at Dublin Blvd	Stream Gauge	High	15 Min	x	-	15 Min	-	-	Zone 7
SOUTH SAN RAMON CREEK - LINE J										
LJ1_BDB	Line J1 Below Dublin Blvd	Stream Gauge	High	15 Min	x	-	15 Min	-	-	Zone 7
SSRC_AVBLVD	South San Ramon Creek above Amador Valley Blvd	Stream Gauge	High	15 Min	x	x	15 Min	-	-	Zone 7
TASSAJARA CREEK - LINE K										
TC_BI580	Tassajara Creek below I580	Stream Gauge	High	15 Min	x	x	15 Min	-	-	Zone 7

* Satisfies water rights requirements. Turb = Turbidity. SSD = Suspended Sediment Discharge. SC = Specific Conductance.

TABLE 3-2
MONTHLY FLOWS (ACRE-FEET)
STREAMFLOW GAUGING STATIONS
2020 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	451	76	2	0	0	126	156	113	170	518
NOV	0	487	165	3	13	0	311	253	249	559	1,294
DEC	304	237	148	117	50	38	906	607	630	1,436	3,101
JAN	331	233	45	138	8	0	447	358	356	781	1,579
FEB	158	372	69	80	0	0	162	180	154	221	572
MAR	447	414	331	217	60	45	830	542	618	877	2,675
APR	1,353	333	347	241	72	54	802	461	542	1,186	3,138
MAY	106	356	57	13	0	0	192	184	151	547	1,043
JUN	2	538	40	2	0	0	126	152	94	184	458
JUL	0	660	79	0	0	0	112	158	81	135	404
AUG	0	45	9	0	0	0	104	149	75	164	405
SEP	0	37	0	0	0	0	103	142	77	145	361
TOTAL	**2,701**	**4162**	**1,364**	**812**	**201**	**137**	**4,220**	**3,339**	**3,140**	**6,404**	**15,548**

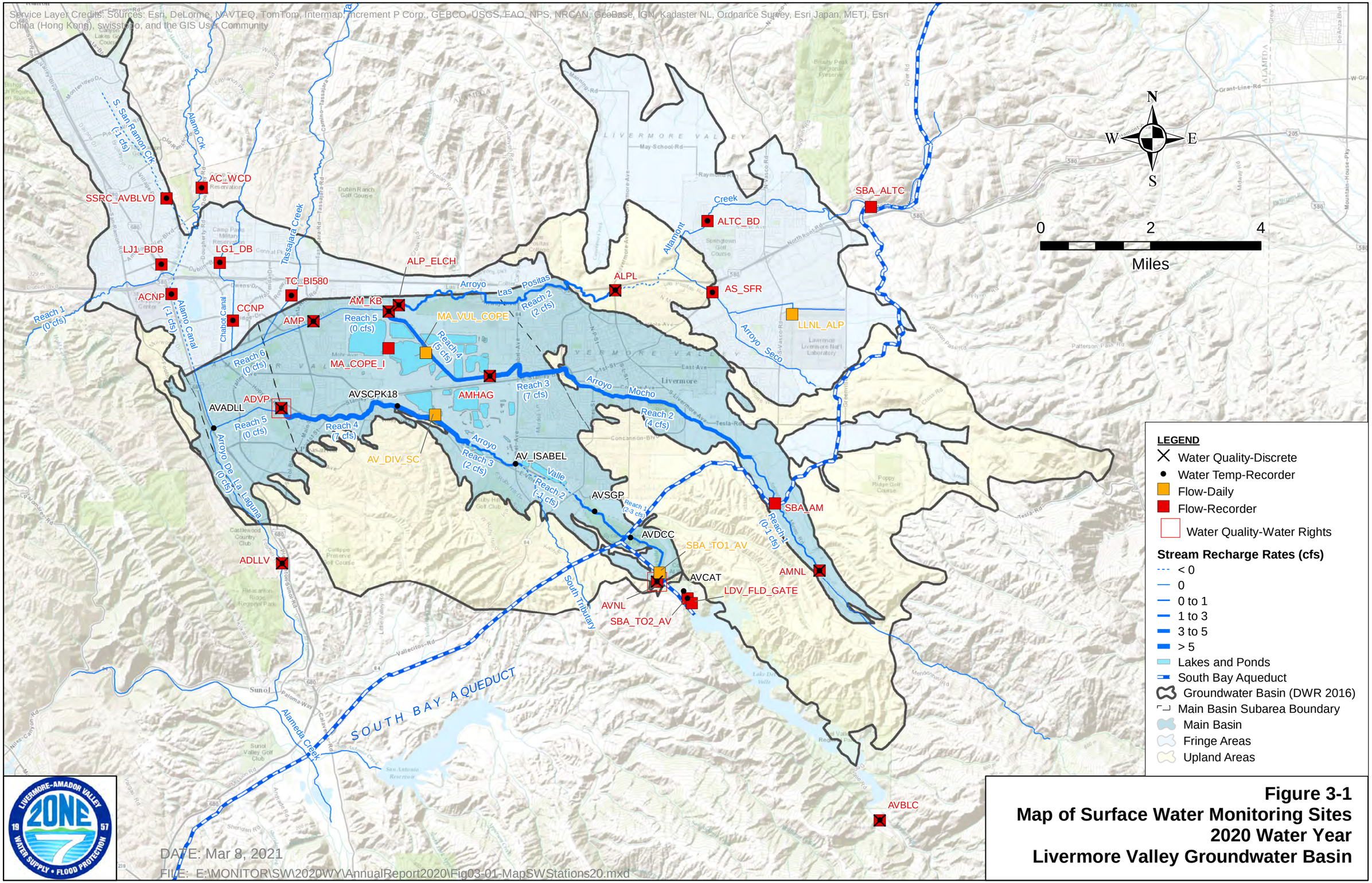
* USGS Stations

These recorder locations are high flow only and are not presented in this table : AC_WCD, ALTC_BD, AS_SFR, CCNP, LG1_DB, LJ1_BDB, SSRC_AVBLVD, and TC_BI580

These recorder locations are only flow input sites and are not presented in this table: SBA_TO2_AV, SBA_AM, and SBA_ALTC

TABLE 3-3
TABLE OF SURFACE WATER QUALITY RESULTS
2020 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	9/17/2020	13:32	7*	23.2	1461	7.9	74	47	166	4.1	417	144	198	0.38	14.6	1450	3.1	< 100	< 1	857	379
ADVP	11/25/2019	11:13	0.5*	10.3	465	7.3	35	16	35	2.3	206	25	28	< 0.1	4.1	200	1.2	< 100	< 1	247	154
ADVP	3/25/2020	13:23	4.4*	12.3	416	7.5	32	13	30	2	147	28	32	< 0.1	4.1	200	< 1	< 100	< 1	214	133
ALP_ELCH	9/16/2020	14:43	1.3*	21	1394	8.3	58	48	171	3.8	404	88	223	1.4	18.6	2850	2.6	< 100	< 1	820	343
ALPL	9/16/2020	13:36	2.4*	19.6	1370	8.2	68	49	166	2.5	433	82	211	3.12	27.8	2870	2.1	< 100	2.2	837	372
AM_KB	3/16/2020	10:50	10.3*	0.0	75	6.8	5	2	0	0.0	32	2	3	0.32	0.0	0.0	0.000	0.00	0.00	0	22
AMHAG	3/16/2020	13:00	6.1*	0.0	91	6.8	7	2	0	0.0	35	3	6	0.32	0.0	0.0	0.000	0.00	0.00	0	26
AMNL	5/18/2020	13:35	0.2*	18.8	993	7.9	44	96	44	3	555	55	44	< 0.1	11.8	880	< 1	< 100	1.4	573	507
AMP	9/16/2020	15:46	1.7*	23.8	1488	8.5	64	48	180	5	391	95	259	2.87	16.9	2100	2.6	< 100	< 1	880	358
AVBLC	5/18/2020	14:35	2.6*	20.3	574	8.3	50	34	31	1.9	272	67	17	< 0.1	10.1	660	< 1	< 100	< 1	349	265
AVNL	11/25/2019	12:51	7.2*	12.8	358	7.4	21	10	32	2.1	106	29	33	0.38	10.3	200	1.6	< 100	< 1	192	93
AVNL	3/25/2020	14:25	6.5*	14	507	7.5	29	14	52	2.5	120	49	57	0.35	7.9	300	1.7	< 100	< 1	273	130
AVNL	9/16/2020	16:40	0.4*	18.2	695	8	49	25	60	3.1	241	83	56	< 0.1	18.2	760	2	< 100	< 1	413	223



LEGEND

- Water Quality-Discrete
- Water Temp-Recorder
- Flow-Daily
- Flow-Recorder
- Water Quality-Water Rights

Stream Recharge Rates (cfs)

- < 0
- 0
- 0 to 1
- 1 to 3
- 3 to 5
- > 5
- Lakes and Ponds
- South Bay Aqueduct
- Groundwater Basin (DWR 2016)
- Main Basin Subarea Boundary
- Main Basin
- Fringe Areas
- Upland Areas

DATE: Mar 8, 2021
FILE: E:\MONITOR\SW\2020WY\AnnualReport2020\Fig03-01-MapSWStations20.mxd

Figure 3-1
Map of Surface Water Monitoring Sites
2020 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. Presently, two mining companies, CEMEX and Vulcan Materials, have on-going surface mining operations for the extraction and sale of sands and gravels. Finer-grained materials (e.g., silts) that have been excavated but have not been sold are stored onsite and/or are used to backfill quarry excavations.

All water generated during mining that is discharged to a non-quarry property is metered and tracked as it exits the Valley in the 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 lower aquifers to mining operation dewatering. Zone 7 is evaluating the impacts of these changes in mining activities to drinking water supplies. Groundwater is 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 mining quarry lakes ("Chain of Lakes" or "COLs", Lakes A through I and Cope Lake) will ultimately be transferred to Zone 7 for future water resources management purposes. To date, Zone 7 has received titles to two lakes: Lake I and Cope Lake. Project management actions on the COLs Recharge Projects in the 2020 WY are discussed in *Section 12.6 Chain of Lakes Recharge Projects* of this report. 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

No changes were made to the program in the 2020 WY.

4.2 Results for the 2020 Water Year

4.2.1 Water Elevations

Table 4-1 summarizes the water levels observed in the mining area ponds for the 2020 WY. Water elevations were measured in most of the pits in the mining area that contained water (lakes and ponds) during the 2020 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 (Lake B), 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 Groundwater Elevations*. 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 after being filled with fine-grained materials. Therefore, water levels in these ponds no longer correlate with the surrounding Upper Aquifer groundwater elevations observed in surrounding monitoring wells.

4.2.2 Water Quality

Water quality was monitored in select mining ponds in May 2020. Salinity in the mining area ponds, measured as TDS, ranged from 233 mg/L in P10, which is supplied by Arroyo Valle, to 530 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.

Ponds K28 (Lake H) and K37 (Lake I) were sampled for per- and polyfluoroalkyl substances (PFAS) during the 2019 WY as part of Zone 7's assessment into the occurrence of PFAS in the groundwater basin. PFAS was detected in both lakes at levels just above the EPA's screening level (40 parts per trillion [ppt]***Error! Reference source not found.***) and below the preliminary remediation goal (70 ppt). The results are discussed in *Section 7.2.6, PFAS*. No ponds were sampled during the 2020 WY, however, Zone 7 is continuing to expand PFAS sampling in the groundwater basin and is considering sampling additional mining ponds.

4.2.3 Mining Activities and Water Budget

Aggregate mining activities during the 2020 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 P42 (future Lake B) during the 2020 WY. Estimated groundwater transfers and losses associated with the mining area are shown in *Table 4-A* and discussed below.

Table 4-A: Estimated Groundwater Transfer and Losses in Mining Area (AF)

Activity	2020 WY	2019 WY
Mining Area Transfers*		
Vulcan to Cope Lake	7,906	13,864
Cope Lake to Lake I	7,562	11,879
Diverted to Shadow Cliffs	271	444
Mining Area Losses		
Processing Losses**	700	700
Net Pond Precip/Evaporation	4,140	2,885
Pumped GW Exported from Valley	0	0

* Transfers made to locations outside of the quarries.

** Estimated

Vulcan Materials did not discharge water into either Arroyo Mocho or Arroyo Valle during the 2020 WY. For the sixth consecutive year, all water discharges made by Vulcan Materials were captured in Cope Lake. In total, Vulcan discharged 7,906 AF of water into Cope Lake, of which an estimated 7,562 AF flowed into Lake I via the Cope-to-Lake I conduit during the 2020 WY. CEMEX also did not discharge any pumped groundwater into the arroyos during the 2020 WY. The groundwater pumped from pits P46 (Lake J) and P42 (future Lake B) 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. Although this extracted groundwater is not leaving the Basin, except by evaporation, the effect of dewatering in P42 (future Lake B), P46 (future Lake J), R24 (future Lake E), and R28 (future Lake D) contributed a localized groundwater depressions in the Amador East Subarea groundwater levels (see *Section 6, Groundwater Elevations*).

Based on ETo monitoring data for the 2020 WY and historic gravel sales information, an estimated total 4,140 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 2020 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 271 AF during the 2020 WY, compared to 444 AF in the 2019 WY.

TABLE 4-1
SEMIANNUAL WATER LEVELS IN MINING AREA PONDS
2020 WATER YEAR

EXCAVATIONS								CURRENT PONDS								
Excavation	Chain of Lake	Display Name	Original Ground Elev	Deepest Mined Depth (ft)		Pit Area	Mining Status	Pond Name	Pond Area	Contact with Aquifer	Water Elev Status	Mining Use	Pond Elevation (ft MSL, NAVD88)			
				Elev	*Depth*	*(acres)*			*(acres)*				*Fall 19*	*Spring 20*	*Fall 20*	*WY Diff*
CALROCK/RHODES & JAMIESON/PLEASANTON GRAVEL COMPANY/CALMAT/VULCAN																
MA-C001	Lake C	C1/ Lake C	410	360	50	32.2	Excavated	MA-C001	6	No	Static	Unused	361.9	NM	358.6	-3.26
MA-C002		C2	410	360	50	6.1	Excavated									
MA-C003		C3	410	360	50	11.3	Excavated									
MA-C004		C4	400	390	10	1.7	Backfilled									
MA-C005		C5	400	290	110	19.2	Backfilled									
MA-C006	Lake C	C6/ Lake C	400	385	15	12.4	Excavated									
MA-C007	Lake D	C7/ Lake D	400	330	70	22.1	Backfilled									
MA-C008A	Lake D	C8A/ Lake D	410	330	80	20.2	Backfilled									
MA-C009	Lake D	C9/ Lake D	410	310	100	20.8	Active Mining									
MA-C008B	Lake D	C8B/ Lake D	410	340	70	26.8	Backfilled									
MA-C010	Lake D	C10/ Lake D	410	310	100	62.3	Active Mining									
MA-R003		R3	370	240	130	14.8	Excavated	MA-R003	7.8	No	Lined	Settling Pond	343.6	343.94	345.6	2.06
MA-R004		R4	380	240	140	16.5	Excavated	MA-R004	11	Yes	InFlux	Water Storage	309.7	317.52	315.6	5.9
MA-R005		R5	380	240	140	31.1	Backfilled									
MA-R008	Lake G	R8/ Lake G	365	260	105	46	Excavated	MA-R008	6.7	No	Lined	Water Storage	NM	NM	NM	
MA-R010		R10	380	370	10	2.2	Backfilled									
MA-R011		R11	390	370	20	3.4	Backfilled									
MA-R012		R12	370	240	130	39.4	Backfilled									
MA-R013		R13	370	270	100	28.3	Backfilled									
MA-R014		R14	400	380	20	11.5	Backfilled									
MA-R021		R21	380	280	100	44.2	Excavated	MA-R021	28	No	Lined	Settling Pond	NM	NM	NM	
MA-R022	Lake F	R22/ Lake F	380	290	90	79.3	Excavated	MA-R022	64.4	No	Lined	Water Storage	366.3	365.02	364	-2.25
MA-R023		R23	380	270	110	27.5	Excavated	MA-R023	21.6	No	Lined	Settling Pond	359.7	360.24	360.7	0.94
MA-R024	Lake E	R24A/ Lake E	390	155	235	55.9	Excavated	MA-R024A	30.6	Yes	Depressed	Dewatering	184.4	199.39	235.3	50.87
MA-R025	Lake E	R25/ Lake E	395	300	95	43.7	Backfilled									
MA-R027		R27	380	300	80	59.5	Excavated	MA-R027	21.1	No	Lined	Unused	NM	NM	NM	
MA-R028	Lake D	R28/ Lake D	400	165	235	62.9	Active Mining	MA-R028	0.2	Yes	Depressed	Dewatering	220.9	166.11	168.4	-52.52

TABLE 4-1
SEMIANNUAL WATER LEVELS IN MINING AREA PONDS
2020 WATER YEAR

EXCAVATIONS								CURRENT PONDS								
Excavation	Chain of Lake	Display Name	Original Ground Elev	Deepest Mined Depth (ft)		Pit Area	Mining Status	Pond Name	Pond Area	Contact with Aquifer	Water Elev Status	Mining Use	Pond Elevation (ft MSL, NAVD88)			
				Elev	*Depth*	*(acres)*			*(acres)*				*Fall 19*	*Spring 20*	*Fall 20*	*WY Diff*
KAISER GRAVELS/HANSON AGGREGATES																
MA-K001		K1	350	325	25	3.4	Backfilled									
MA-K002		K2	350	325	25	3.2	Backfilled									
MA-K004		K4	350	315	35	13	Backfilled									
MA-K005		K5	350	315	35	10.4	Backfilled									
MA-K006		K6	350	325	25	13.4	Backfilled									
MA-K007		K7	350	320	30	11.7	Backfilled									
MA-K008		K8	350	320	30	17.7	Backfilled									
MA-K009		K9	360	305	55	57.4	Backfilled									
MA-K010		K10	370	355	15	4.4	Backfilled									
MA-K011		K11	370	315	55	24	Backfilled									
MA-K012		K12	370	275	95	37.7	Backfilled									
MA-K013		K13	370	275	95	14.9	Backfilled									
MA-K014		K14	370	275	95	5.6	Backfilled									
MA-K015		K15	360	265	95	142.3	Excavated	MA-K015	81.8	Yes	Elevated	Water Storage	331.3	328.83	327.3	-3.99
MA-K018	Lake Boris	K18/ Lake Boris	360	330	30	24.5	Excavated	MA-K018	11.9	Yes	Lined	Unused	350.4	350.57	349	-1.41
MA-K019		K19A	350	335	15	8	Excavated	MA-K019A	2.1	Yes	Static	Unused	NM	NM	NM	
MA-K024		K24	360	220	140	87.9	Backfilled	MA-K024								
MA-K028	Lake H	K28/ Lake H	360	220	140	89.6	Reclaiming	MA-K028	67.3	Yes	Static	Water Storage	316.2	312.86	307.4	-8.86
MA-K030	Cope Lake	K30/ Cope Lake	370	240	130	233.9	Reclaimed	MA-K030	188.2	No	Lined	Settling Pond	333.4	NM	331.3	-2.06
MA-K032		K32	360	335	25	34.2	Backfilled									
MA-K033		K33	360	335	25	12.8	Backfilled									
MA-K037	Lake I	K37/ Lake I	360	220	140	300.8	Reclaimed	MA-K037	258.8	Yes	Elevated	Water Storage	314.8	311.014	302.8	-12.06

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
2020 WATER YEAR

EXCAVATIONS								CURRENT PONDS								
Excavation	Chain of Lake	Display Name	Original Ground Elev	Deepest Mined Depth (ft) *Elev*	Deepest Mined Depth (ft) *Depth*	Pit Area *(acres)*	Mining Status	Pond Name	Pond Area *(acres)*	Contact with Aquifer	Water Elev Status	Mining Use	Pond Elevation (ft MSL, NAVD88) *Fall 19*	Pond Elevation (ft MSL, NAVD88) *Spring 20*	Pond Elevation (ft MSL, NAVD88) *Fall 20*	Pond Elevation (ft MSL, NAVD88) *WY Diff*
PACIFIC AGGREGATE/RMC/LONESTAR/CEMEX																
MA-P001		P1	380	360	20	0.8	Backfilled									
MA-P002		P2	380	360	20	1.9	Excavated	MA-P002	1.2	Yes	Elevated	Water Storage	NM	NM	NM	
MA-P003		P3	400	360	40	8.5	Backfilled									
MA-P004		P4	400	360	40	7.8	Excavated									
MA-P006		P6	380	280	100	28.8	Backfilled									
MA-P007		P7	380	280	100	16.7	Backfilled									
MA-P010		P10	400	340	60	34	Excavated	MA-P010	16.5	Yes	Static	Unused	363.8	365.31	361	-2.81
MA-P011		P11	380	340	40	6.9	Excavated									
MA-P012	Island Pond	P12/ Island Pond	360	330	30	29.5	Excavated	MA-P012	14.9	Yes	Lined	Unused	351.4	351.48	349.5	-1.97
MA-P013		P13	380	300	80	2.6	Backfilled	MA-P013	1	Yes	Elevated	Water Storage	NM	NM	NM	
MA-P021		P21	380	240	140	10.5	Backfilled									
MA-P027		P27	390	250	140	31	Excavated	MA-P027	10.1	Yes	Static	Water Storage	280.4	279.56	277.4	-2.97
MA-P028	Lake A	P28/Lake A	420	360	60	24.6	Reclaiming	MA-P028	8.2	Yes	Static	Water Storage	407.3	411.42	406.3	-1.01
MA-P034		P34	380	270	110	46	Backfilled									
MA-P039	Lake B	P39/ Lake B	410	380	30	36.4	Active Mining									
MA-P040		P40	390	260	130	14.5	Excavated	MA-P040	0.2	Yes	Static	Unused	NM	NM	NM	
MA-P041	Lake A	P41/ Lake A	410	370	40	91.3	Reclaiming	MA-P041	57.5	Yes	Static	Water Storage	412.2	413.68	411.7	-0.52
MA-P042	Lake B	P42/ Lake B	380	250	130	101.8	Active Mining	MA-P042	8.6	Yes	Depressed	Dewatering	292.9	286.39	255.8	-37.16
MA-P043		P43	390	240	150	130.9	Excavated	MA-P043	99.4	No	Lined	Settling Pond	NM	NM	NM	
MA-P044		P44	390	250	140	20	Excavated	MA-P044	15	Yes	Elevated	Water Storage	352.9	352.73	345	-7.91
MA-P045		P45	380	310	70	25	Excavated	MA-P045	17.7	Yes	Elevated	Water Storage	NM	NM	NM	
MA-P046	Lake J	P46/ Lake J	380	251	129	23.8	Active Mining	MA-P046	7.5	Yes	Depressed	Active Mining	NM	285.98	294	

TABLE 4-2
WATER QUALITY RESULTS FOR SELECT METALS AND MINERALS
2020 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
MA-C001	5/6/20	ZONE7	26.3	846	9	34	50	77	3.1	222	37	150	< 0.1	0.9	400	6.5	< 200	< 2	478	291
MA-K015	5/7/20	ZONE7	25	711	8.7	32	31	76	4	202	56	96	< 0.1	5.4	440	2.2	< 100	< 1	407	206
MA-K018	5/7/20	ZONE7	23.9	434	8.8	31	16	36	1.4	135	37	50	< 0.1	5.4	200	1	< 100	< 1	250	145
MA-K028	5/6/20	ZONE7	24.4	865	8.6	34	54	83	2.6	290	53	121	< 0.1	6.4	660	6.9	1660	4.8	508	307
MA-K030	5/6/20	ZONE7	21	648	8.8	38	38	45	2.3	219	48	88	0.15	11.3	300	2.2	< 100	1.2	389	251
MA-K037	5/6/20	ZONE7	20.4	728	8.7	38	43	54	2.2	235	50	99	< 0.1	7.5	400	6.1	< 200	< 2	420	271
MA-P010	5/6/20	ZONE7	27.3	403	9.4	19	18	41	2.2	120	18	52	< 0.1	1.7	210	5.1	532	< 2	233	122
MA-P012	5/7/20	ZONE7	22.6	464	8.5	36	17	39	1.7	153	38	53	< 0.1	6	220	< 1	< 100	< 1	269	157
MA-P027	5/7/20	ZONE7	21.9	630	8.5	41	24	58	1.6	174	50	96	< 0.1	9.2	380	< 1	< 100	< 1	371	201
MA-P028	5/7/20	ZONE7	23.6	951	8.8	36	47	98	3.2	242	40	176	< 0.1	2.1	430	2.6	< 100	< 1	530	281
MA-P041	5/7/20	ZONE7	23.8	999	8.8	36	45	94	2.8	244	41	156	< 0.1	3	390	5.7	< 200	< 2	507	273
MA-P042	5/7/20	ZONE7	22	585	8.3	48	21	49	1.6	203	44	69	< 0.1	11.3	310	< 1	< 100	< 1	348	206
MA-P042A	5/7/20	ZONE7	21.5	614	8.3	50	21	53	1.7	207	43	75	< 0.1	17.3	280	4.2	1630	5.2	366	214
MA-P044	5/7/20	ZONE7	22.1	616	8.6	44	23	54	1.9	190	48	84	< 0.1	10.5	360	1.3	< 100	< 1	366	205
MA-P046	5/7/20	ZONE7	22.7	807	8	68	33	58	2.3	279	51	98	0.86	16.1	430	< 1	< 100	< 1	470	306
MA-R003	5/6/20	ZONE7	20.7	736	8.3	40	39	51	2.8	227	47	102	< 0.1	15.6	350	5.4	1830	6.6	413	262
MA-R004	5/6/20	ZONE7	22.6	667	8.6	41	35	44	2.1	215	44	87	0.47	15.6	300	3.7	< 200	3	385	246
MA-R022	5/6/20	ZONE7	23.7	681	8.6	37	41	43	2.1	216	46	88	0.86	19	300	< 1	390	4.4	394	263
MA-R023	5/6/20	ZONE7	23	685	8.5	40	42	43	2	233	45	88	0.69	16.9	300	4.2	511	4.8	400	275
MA-R024A	5/6/20	ZONE7	22.6	723	8.7	33	52	45	2	221	46	91	1.64	23.5	350	4	< 200	5.6	419	298
MA-R028	5/6/20	ZONE7	19.6	647	8.1	57	24	41	1.5	216	43	79	0.98	19.5	290	3.6	513	5	377	242

- = Not Analyzed; X = Suspect Result

LEGEND

- Supply
- Monitor
- Nested
- Mining Pond
- 2020 Contours (Interval = 10')
- Hatch pattern towards lower elevation

Mining Status

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

Excavation Status

- Active Mining
- Excavated
- Backfilled with Silt and Clay
- Reclaiming
- Reclaimed
- Main Basin
- Fringe Areas
- Upland Areas

N
W E
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0 2,000 4,000
Feet

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Figure 4-1
Gravel Mining Pits with Groundwater Elevation Contours (September 2020)
Livermore Valley Groundwater Basin

5 Surface Water-Groundwater Interaction

5.1 Program Description

5.1.1 Monitoring Network

Background information regarding this program is provided in *Section 3.3.5, Surface Water-Groundwater Interaction* of the Alternative GSP. The Alternative GSP identified the Springtown Alkali Sink in the May and Spring Subareas as the only known area in the Livermore Valley Groundwater Basin that is thought to be a Groundwater Dependent Ecosystem (GDE) for the purposes of SGMA. Additional potential GDEs are being investigated for the Five-Year Update of the Alternative GSP.

In the Springtown Alkali Sink, the contribution of groundwater to surface water features is limited and the effects are seasonal. The Alkali Sink supports an alkali-saline wetland habitat with seasonal surface ponding and shallow, seasonal, high-salinity groundwater. Salt-tolerant plants, vernal pool biota, and several protected species including the Palmate-Bracted Bird's Beak, California tiger salamander, and the fairy shrimp are found in the Alkali Sink area. 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 preservation of natural groundwater levels and flow patterns, as there are no major groundwater extractors in this portion of the basin.

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 (34E1) is located at the southwestern, lower end of the sink.
- Well 2S/2E 27P 2 (27P2) is in the center portion of the sink.

The relative monitoring well locations can be seen in *Figure 5-1*. As part of its Groundwater Elevation Program (*Section 6, Groundwater Elevations*), Zone 7 also measures water levels in several other wells to monitor groundwater flow patterns in that portion of the Fringe Area.

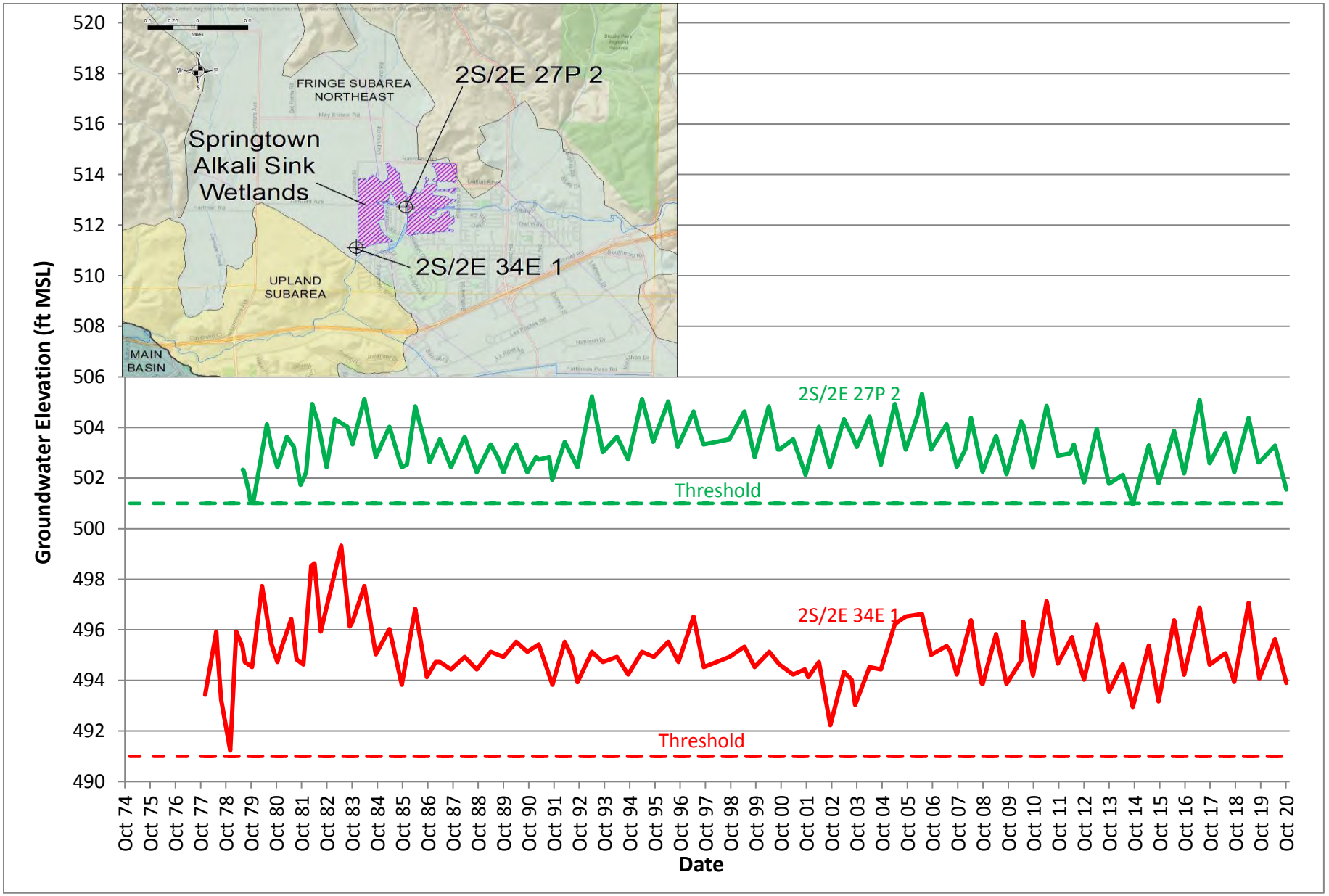
5.1.2 Program Changes for the Water Year

There were no changes to this program for the 2020 WY.

5.2 Results for the 2020 WY

Ongoing monitoring by Zone 7 has verified steady groundwater levels and no increase in surface water depletion in the Alkali Sink since the late 1970s. *Figure 5-1* shows the hydrographs for the two monitored wells in the immediate vicinity of the Alkali Sink. As demonstrated by the hydrographs, groundwater levels continued to be above the wells' respective Minimum Threshold elevations (501 ft msl for 27P2 and 491 ft msl for 34E1) during the 2020 WY and within the range of normal elevation fluctuations (0.5 to 5 feet above the Minimum Threshold elevations). The gradient flow patterns in the area are shown on *Figure 6-4* (Spring 2020) and *Figure 6-5* (Fall 2020) and continue to remain relatively unchanged throughout its recorded history.

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



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1/19/2021

6 Groundwater Elevations

6.1 Program Description

6.1.1 Monitoring Network

Background information regarding the Groundwater Elevation Monitoring Program is provided in *Sections 3.3.1 and 4.5* of the Alternative GSP. This 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 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 and Upland Areas.

As shown in *Figure 6-1* and *Table 6-1*, there were 221 wells in the Zone 7 Groundwater Elevation Monitoring Program for the 2020 WY. Well construction details for the program wells are shown in *Table 6-2*. Groundwater elevations (shown in feet above Mean Sea Level [msl]) in most of these wells were measured at least two times during the water year (spring and fall, *Table 6-3*).

Water levels were also measured once 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 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 Zone 7's California Statewide Groundwater Elevation Monitoring (CASGEM) Program obligation. An additional well (3S/2E 29F 4) was voluntarily added in 2019 at the request of a member of the public. 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 2020 Water Year

Well Number	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
3S/2E 29F 4*	Southern Amador	Upper		x

* = Voluntary CASGEM monitoring well.

6.1.2 Program Changes for the 2020 Water Year

Table 6-B below lists the changes that were made to the Groundwater Elevation Monitoring Program for the 2020 WY. These changes are also applicable to the Groundwater Quality Monitoring Program, which is discussed in *Section 7, Groundwater Quality* of this Annual Report.

Table 6-B: Program Wells Changes during the 2020 Water Year

Action	Reason	Note
Well 3S/3E 6Q 4 Removed from program	Well was destroyed	3S/3E 6Q 3 still in program

6.2 Results for the 2020 Water Year

6.2.1 Overview

Groundwater levels for the 2020 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 water year as rainfall ceased and pumping demands increased. Compared to the levels at the end of the 2019 WY where the basin was largely full, groundwater elevations generally decreased everywhere in the Main Basin. In general, groundwater elevations remained well above the threshold elevations (historic lows). However, mining area dewatering operations created a localized depression in groundwater

levels that exceeded the historic low in two of the mining area pits as discussed in *Section 4.2.1* above and *Section 6.2.3* below. Zone 7 continues to monitor this area's impact and relationship to the rest of the basin with respect to storage and subsidence. The impacts appear to be very localized and more information on subsidence monitoring can be found in *Section 8 Land Surface Elevation* of this report.

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 seasonal demands in the warmer months, and when surface water treatment plant outages occur. Key Well water levels in all subareas ended the 2020 WY at least 5 feet below those from the previous year (*Table 6-C*).

Table 6-C: Groundwater Elevation Change in Key & CASGEM Wells from Fall 2019 to Fall 2020

		Groundwater Elevation (feet msl)		Change in Elevation (feet)		
				Seasonal		Annual
Well	Name	Spring 2020	Fall 2020	Fall 2019 to Spring 2020	Spring 2020 to Fall 2020	Fall 2019 to Fall 2020
3S/1E 20C 8	Key_Bern_U	296.8	290.1	-0.8	-6.6	-7.5
3S/1E 20C 9	Key_Bern_L	296.1	286.5	-1.5	-9.6	-11.1
3S/1E 9P 9	Key_AMW_U	302.2	294.5	-3.2	-7.7	-10.9
3S/1E 9P11	Key_AMW_L	292.0	270.7	-2.4	-21.3	-23.7
3S/1E 11G 2	Key_AME_U	314.9	306.4	-2.3	-8.5	-10.8
3S/1E 12K 4	Key_AME_L	267.7	254.4	-1.6	-13.3	-14.9
3S/2E 8N 2	Key_MO2_U	433.3	423.5	1.0	-9.9	-8.9
3S/2E 8H 4	Key_MO2_L	431.5	421.2	4.8	-10.3	-5.5
3S/1E 12K 4		288.1	259.7	-0.2	-28.4	-28.6
3S/1E 6F 3		325.4	324.6	0.7	-0.8	-0.1
3S/2E 19D 7		313.8	306.3	-10.4	-7.6	-18.0
3S/2E 29F 4		449.3	446.5	0.1	-2.8	-2.8

msl = mean sea level

Table 6-3 contains spring high (generally collected in April) and fall low (generally collected in September) groundwater elevations for all program wells and includes a comparison with fall of the previous water year. Upper and Lower Aquifer levels during the 2020 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 2020 WY, representing the highest and lowest groundwater elevations observed, respectively. The groundwater gradient in the Upper Aquifer was generally from east to west and ranged from 0.005 to 0.025 ft/ft. Quarry dewatering operations in the eastern Amador Subarea create groundwater depressions in pits where water is pumped and mounds in pits that are not clay-lined and where excess water is stored. The water from the dewatering of Lakes B (P42) and J (P46) was discharged into other adjacent clay-lined mining pits; while the water from Lakes D and E was eventually discharged into Cope Lake, after which it was conveyed into Lake I and was recharged back into the groundwater basin.

During the first half of the 2020 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 slightly above the upper threshold elevation at which basin overflow occurs. Consequently, approximately 146 AF (*Section 11, Groundwater Storage*) of water overflowed from the Upper Aquifer into the Arroyo de la Laguna during the 2020 WY and exited the valley.

Figure 6-6 illustrates the change in groundwater elevation in the Upper Aquifer from Fall 2019 to Fall 2020. *Figure 6-7* shows the depth to the top of the Upper Aquifer groundwater table at the end of the 2020 WY. Upper Aquifer water levels generally dropped throughout the Main Basin by an average of 5 to 10 feet in each of the subbasins because of mining activity and below-average rainfall and artificial stream recharge (see *Section 11.1.4*). A notable exception occurred in mining pond R24A (future Chain of Lake E) where the water level rose more than 50 feet when the mining company (Vulcan) ceased pond dewatering (see *Section 4.2.1*).

Groundwater levels in the Fringe Areas (which contain only one aquifer layer) stayed relatively constant throughout 2020 WY, generally varying by less than 5 ft (*Figure 6-6*). For more information regarding historic elevations and trends observed for the Fringe 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 high and fall low of the 2020 WY, respectively. In general, the groundwater gradient runs toward the center of the basin where there are piezometric depressions created around several municipal wellfields and three mining pits (Lakes B, D, and E) that appear to extend into the lower aquifer. The lowest groundwater elevation in the Lower Aquifer corresponded to the pond in mining excavation for Lake D (R28 at 168 ft above msl). The westernmost CWS municipal supply wells (CWS 20 and CWS 24) also pull groundwater from this portion of the subarea.

There appears to be a mound in the lower aquifer of about 10 feet underneath Lake I. This mound suggests that the diversion of excess mined water into Lake I (via Cope Lake, see *Sections 4.2.3 and 6.2.2*) since 2014 is impacting the lower aquifer.

As is usually the case, groundwater elevations in the Mocho II Subarea during the 2020 WY were about 60 to 90 ft higher than those to the west, across the Livermore Fault in the Amador Subarea. Deep groundwater elevations in the Dublin/Camp/Bishop Fringe Subareas were 15–30 ft higher than those across the Main Basin Boundary to the south.

Figure 6-10 shows the change in groundwater elevation in the Lower Aquifer from Fall 2019 to Fall 2020. Lower Aquifer water levels dropped significantly (up to about 45 feet) in portions of the Basin from Fall 2019 to Fall 2020 from below average recharge (rainfall and stream), above average municipal pumping, and deeper mining activity.

Figure 6-11 shows the height of lower aquifer groundwater levels above historic lows at the end of the 2020 WY. Groundwater levels in the vicinity of the Bernal Subarea were up to about 110 ft above the historic low. In the Amador Subarea, levels were generally 25–90 ft above the historic lows except in the immediate vicinity of two mining excavations that were being dewatered during the 2020 WY; the water level in Lake B (P42) was 2 ft below the historic low, while Lake D (R28) was about 45 ft below the historic low. Over the central portion of the Mocho II Subarea where there is municipal pumping, the end-of-year groundwater levels were 50–135 ft above historical lows. Other portions of the Mocho II Subarea, not affected by the municipal pumping, remained relatively stable at or slightly above historic lows.

TABLE 6-1
GROUNDWATER ELEVATION PROGRAM
WELLS WITH MONITORING FREQUENCY
2020 WATER YEAR

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs				
State Name	Well Name	Subbasin	Aq		Key	CASGEM	GW/SW	WR	Muni
1S4E31P005	CASGEM Tracy WAPA	Tracy	U	2					
2S1E32E001	End of Arnold Rd	None	U	2					
2S1E32N001	Camp Parks	Camp	U	2					
2S1E32Q001	Summer Glen Dr	Camp	U	2					
2S1E33L001	Gleason Dr @ Tassajara	None	U	2					
2S1E33P002	Central Pkwy at Emerald Glen	Camp	U	2					
2S1E33R001	Central Pkwy @ Grafton	None	U	2					
2S1W15F001	BOLLINGER	Bishop	U	2					
2S1W26C002	PINE VALLEY	Dublin	U	2					
2S1W36E003	Kolb Park	Dublin	U	2					
2S1W36F001	Dublin High shallow	Dublin	L	2					
2S1W36F002	Dublin High mid	Dublin	L	2					
2S1W36F003	Dublin High deep	Dublin	L	2					
2S2E27C002	Dagnino Rd	Spring	U	2					
2S2E27P002	hartford ave east	Spring	U	2			√		
2S2E28D002	May School	May	U	2					
2S2E28J002	FCC Well	May	L	2					
2S2E28Q001	hartford ave	May	U	2					
2S2E32K002	jenson's N liv. Ave	Cayetano	U	2					
2S2E34E001	Mud City	May	U	2			√		
2S2E34Q002	Hollyhock & Crocus	Spring	U	2					
2S3E01D001	CASGEM Tracy PGE	Tracy	U	2					
3S1E01F002	Constitution Dr	Camp	U	2					
3S1E01H003	Collier Canyon g1	Camp	U	2					
3S1E01J003	Triad Vineyard	Camp	L	12					
3S1E01J004	Collier Vineyards	Camp	L	2					
3S1E01L001	Kitty Hawk	Camp	U	2					
3S1E01P002	Airport gas g5	Amador	U	2					
3S1E01P003	New airport well	Amador	L	2					
3S1E02J002	Maint. Bldg	Camp	U	2					
3S1E02J003	Doolan Rd East	Camp	U	2					
3S1E02K002	Doolan Rd West	Camp	U	2					
3S1E02M003	Friesman Rd North	Camp	U	2					
3S1E02N006	Friesman Rd South	Amador	U	2					
3S1E02P003	Crosswinds Church	Camp	L	2					
3S1E02Q001	LPGC #1	Amador	U	2					
3S1E02R001	Beebs	Amador	U	2					
3S1E03G002	fallon rd	Camp	U	2					
3S1E04A001	SMP-DUB-2	Camp	U	2					
3S1E04J005	Pimlico shallow	Camp	U	2					
3S1E04J006	Pimlico deep	Camp	U	2					
3S1E04Q002	gulfstream	Amador	U	2					
3S1E05K006	Rosewood shallow	Camp	U	2					
3S1E05K007	Rosewood deep	Camp	L	2					

Aq = Aquifer: U = Upper; L = Lower; D = Deep	Monitoring Frequency indicates the number of measurements taken during the water year.
OTHER: Key = Key Wells; GW/SW = Groundwater Surface Water Interaction; WR = Water Rights; Muni = Municipal wells	

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs				
State Name	Well Name	Subbasin	Aq		Key	CASGEM	GW/SW	WR	Muni
3S1E05L003	Oracle	Camp	U	2					
3S1E05P006	Owens Park	Camp	U	2					
3S1E06F003	Dublin Ct	Dublin	U	2		√			
3S1E06G005	Nissan Repair	Dublin	L	2					
3S1E06N002	DSRSD MW-3	Dublin	U	2					
3S1E07B002	Hopyard rd	Dublin	L	2					
3S1E07B012	Hacienda Arch	Dublin	U	2					
3S1E07G007	Chabot Well	Dublin	U	2					
3S1E07J005	Thomas Hart School	Dublin	U	2					
3S1E08B001	Lizard Well	Amador	U	2					
3S1E08G004	Apache	Amador	U	2					
3S1E08H009	Mocho 4 Nested Shallow	Amador	L	2					
3S1E08H010	Mocho 4 Nested Middle	Amador	L	2					
3S1E08H011	Mocho 4 Nested deep	Amador	D	2					
3S1E08H013	Mocho 3 mon	Amador	D	2					
3S1E08H018	Mocho 4	Amador	L	2					√
3S1E08K001	Cockroach well	Amador	U	2					
3S1E08N001	sports park	Bernal	U	2					
3S1E09H010	NW Lake I Shallow	Amador	U	2					
3S1E09H011	NW Lake I Deep	Amador	L	2					
3S1E09J007	SW Lake I Shallow	Amador	U	2					
3S1E09J008	SW Lake I Middle	Amador	L	2					
3S1E09J009	SW Lake I Deep	Amador	L	2					
3S1E09M002	Mocho 1	Amador	L	2					√
3S1E09M003	Mocho 2	Amador	L	2					√
3S1E09M004	Mocho 3	Amador	L	2					√
3S1E09P005	Key_AmW_U (Mohr Key)	Amador	U	12	√	√			
3S1E09P009	Mohr Ave Shallow	Amador	L	12					
3S1E09P010	Key_AmW_L	Amador	L	12	√	√			
3S1E09P011	Mohr Ave Deep	Amador	L	12					
3S1E10A002	El C harro Rd	Amador	U	2					
3S1E10B008	Kaiser Rd Shallow	Amador	L	2					
3S1E10B009	Kaiser Rd Middle 1	Amador	L	2					
3S1E10B010	Kaiser Rd Middle 2	Amador	L	2					
3S1E10B011	Kaiser Rd Deep	Amador	D	2					
3S1E10B014	COL 5 Monitoring	Amador	L	2					
3S1E10D002	Stoneridge Shallow	Amador	L	2					
3S1E10D003	Stoneridge Middle 1	Amador	L	2					
3S1E10D004	Stoneridge Middle 2	Amador	L	2					
3S1E10D005	Stoneridge Deep	Amador	D	2					
3S1E10D007	North Lake I Shallow	Amador	U	2					
3S1E10D008	North Lake I Cluster 2	Amador	L	2					
3S1E10K002	COL 1 Monitoring	Amador	L	2					
3S1E10N002	South Lake I Shallow	Amador	U	2					
3S1E10N003	South Lake I Deep	Amador	L	2					
3S1E11B001	Airport West	Amador	U	2					
3S1E11C003	LAVWMA ROW	Amador	U	2					
3S1E11G001	Key_AmE_U	Amador	U	12	√	√			
3S1E11G002	Rancho Charro Middle 1	Amador	L	12					
3S1E11G003	Rancho Charro Middle 2	Amador	L	12					
3S1E11G004	Rancho Charro Deep	Amador	D	12					

Aq = Aquifer: U = Upper; L = Lower; D = Deep	Monitoring Frequency indicates the number of measurements taken during the water year.
OTHER: Key = Key Wells; GW/SW = Groundwater Surface Water Interaction; WR = Water Rights; Muni = Municipal wells	

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs				
State Name	Well Name	Subbasin	Aq		Key	CASGEM	GW/SW	WR	Muni
3S1E11M002	COL 2 Monitoring	Amador	L	2					
3S1E11P006	New Jamieson Residence	Amador	L	2					
3S1E12A002	Airport South	Amador	U	2					
3S1E12D002	LWRP G6	Amador	U	2					
3S1E12G001	Oaks Park Shallow	Amador	U	2					
3S1E12H004	LWRP Shallow	Amador	L	2					
3S1E12H005	LWRP Middle 1	Amador	L	2					
3S1E12H006	LWRP Middle 2	Amador	L	2					
3S1E12H007	LWRP Deep	Amador	D	2					
3S1E12K002	Oaks Park Mid	Amador	L	12					
3S1E12K003	Key_AmE_L	Amador	L	12	√	√			
3S1E12K004	Oaks Park Deep	Amador	D	12		√			
3S1E13P005	LGA Grant Nested 1	Amador	U	12					
3S1E13P006	LGA Grant Nested 2	Amador	L	12					
3S1E13P007	LGA Grant Nested 3	Amador	L	12					
3S1E13P008	LGA Grant Nested 4	Amador	L	12					
3S1E14B001	Industrial Asphalt	Amador	L	2					
3S1E14D002	South Cope Lake	Amador	L	2					
3S1E15F003	Kaiser #8	Amador	L	2					
3S1E15J003	shadow cliff	Amador	L	2					
3S1E15M003	Bush/Valley South	Amador	L	2					
3S1E16A004	Bush/Valley Mid	Amador	L	2					
3S1E16B001	Bush/Valley North	Amador	D	2					
3S1E16C002	Santa Rita Valley Shallow	Amador	L	2					
3S1E16C003	Santa Rita Valley Middle	Amador	L	2					
3S1E16C004	Santa Rita Valley Deep	Amador	L	2					
3S1E16E004	black ave - cultural	Amador	U	2					
3S1E16L002	Pleas 4	Amador	L	2					√
3S1E16P005	Vervais Monitor	Amador	U	12				√	
3S1E16R001	Stanley Berry Farm	Amador	L	2					
3S1E17B004	Casterson	Amador	L	2					
3S1E17D003	Hopyard Nested Shallow	Bernal	L	2					
3S1E17D004	Hopyard Nested Middle 1	Bernal	L	2					
3S1E17D005	Hopyard Nested Middle 2	Bernal	L	2					
3S1E17D006	Hopyard Nested Middle 3	Bernal	L	2					
3S1E17D007	Hopyard Nested Deep	Bernal	D	2					
3S1E17D010	Hopyard 7	Bernal	L	2					
3S1E17D011	Hopyard 9 Monitoring Well	Bernal	L	2					
3S1E18A005	Pleas 7	Bernal	L	2					√
3S1E18E004	Valley Trails II	Bernal	U	2					
3S1E18J002	camino segura	Bernal	U	2					
3S1E18N001	merritt	Bernal	L	2					
3S1E19A010	SFWD South (B)	Bernal	L	2					√
3S1E19A011	SFWD North (A)	Bernal	L	2					√
3S1E19C004	del valle & laguna	Bernal	U	2					
3S1E19K001	680/bernal	Bernal	U	2					
3S1E20B002	Fairgrounds Potable	Bernal	L	2					
3S1E20C007	Key_Bern_U	Bernal	U	12	√	√		√	
3S1E20C008	Key_Bern_L	Bernal	L	12	√	√			
3S1E20C009	Fair Nested Deep	Bernal	L	12					
3S1E20J004	civic center	Bernal	U	2					

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

Monitoring Frequency indicates the number of measurements taken during the water year.

OTHER: Key = Key Wells; GW/SW = Groundwater Surface Water Interaction; WR = Water Rights; Muni = Municipal wells

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs				
State Name	Well Name	Subbasin	Aq		Key	CASGEM	GW/SW	WR	Muni
3S1E20M011	S.F "M"LINE	Bernal	U	2					
3S1E20Q002	20Q2	Bernal	U	2					
3S1E22D002	vineyard trailer	Amador	U	2					
3S1E23J001	1627 vineyard trailer	Amador	L	2					
3S1E24Q001	Ruby Hills	Amador	L	2					
3S1E25C003	Katz Winery Mansion	Amador	U	2					
3S1E29M004	f.c. channel	Castle	U	12				√	
3S1E29P002	castlewood dr	Bernal	U	2					
3S1W01B009	DSRSD Shallow	Dublin	L	2					
3S1W01B010	DSRSD Middle	Dublin	L	2					
3S1W01B011	DSRSD Deep	Dublin	L	2					
3S1W02A002	McNamara's	Dublin	U	2					
3S1W12B002	Stoneridge Mall Rd	Dublin	U	2					
3S1W12J001	DSRSD South	Dublin	U	2					
3S1W13J001	muirwood dr	Castle	U	2					
3S2E01F002	Brisa at Circuit City	Spring	U	2					
3S2E02B002	south front rd	Spring	U	2					
3S2E03A001	Bluebell	Spring	U	2					
3S2E03K003	first & S. front rd	Mocho I	U	2					
3S2E05N001	Spider Well	Mocho II	M	2					
3S2E07C002	jaws - york way - G4	Mocho II	U	2					
3S2E07H002	dakota	Mocho II	U	2					
3S2E07N002	Isabel & Arroyo Mocho	Amador	U	2					
3S2E07P003	CWS 24	Amador	L	2					√
3S2E07R002	CWS 31 Monitoring	Mocho II	D	2					
3S2E07R003	CWS 31	Upland	L	2					√
3S2E08H002	North k	Mocho II	U	2					
3S2E08H003	Key_Mo2_L	Mocho II	L	12	√	√			
3S2E08H004	N Liv Ave Deep	Mocho II	L	12					
3S2E08K002	Key_Mo2_U (Livermore Key)	Mocho II	U	12	√	√			
3S2E08N002	CWS 14	Mocho II	L	2					√
3S2E08P001	CWS 8	Mocho II	L	2					√
3S2E08Q009	D-2	Mocho II	L	2					
3S2E09Q004	school st	Mocho II	U	2					
3S2E10F003	hexcel	Mocho I	U	2					
3S2E10Q001	almond	Mocho II	U	2					
3S2E10Q002	LLNL W-703	Mocho II	L	2					
3S2E11C001	joan way	Mocho I	U	2					
3S2E12C004	LLNL W-486	Spring	U	2					
3S2E12J003	LLNL W-017A	Spring	L	2					
3S2E14A003	S. vasco @east ave	Mocho I	U	2					
3S2E14B001	5763 east ave	Mocho I	L	2					
3S2E15E002	Retzlaff Winery	Mocho II	L	2					
3S2E15L001	Concannon 2	Mocho II	U	2					
3S2E15M002	Concannon 1	Mocho II	U	2					
3S2E15Q006	Concannon Old Pumping	Mocho II	L	2					
3S2E15R017	Buena Vista Shallow	Mocho II	U	2					
3S2E15R018	Buena Vista Deep	Mocho II	L	2					
3S2E16A003	Memory Gardens	Mocho II	L	2					
3S2E16C001	CWS 15	Mocho II	L	2					√
3S2E16E004	pepper tree	Mocho II	U	2					

Aq = Aquifer: U = Upper; L = Lower; D = Deep	Monitoring Frequency indicates the number of measurements taken during the water year.
OTHER: Key = Key Wells; GW/SW = Groundwater Surface Water Interaction; WR = Water Rights; Muni = Municipal wells	

SITE INFORMATION				Montoring Frequency	Other GW Elevation Programs				
State Name	Well Name	Subbasin	Aq		Key	CASGEM	GW/SW	WR	Muni
3S2E17E002	Mocho Street	Mocho II	U	2					
3S2E18B001	CWS 20	Amador	L	2					√
3S2E18E001	E. stanley	Amador	U	2					
3S2E19D007	Isabel Shallow	Amador	U	12		√			
3S2E19D008	Isabel Middle 1	Amador	L	12					
3S2E19D009	Isabel Middle 2	Amador	L	12					
3S2E19D010	Isabel Deep	Amador	L	12					
3S2E19N003	Shallow Cemex Nested	Amador	U	12					
3S2E19N004	Deep Cemex Nested	Amador	L	12					
3S2E20M001	Alden Lane	Amador	L	2					
3S2E22B001	grapes	Mocho II	U	2					
3S2E23E001	Mines Nested Shallow	Mocho II	U	2					
3S2E23E002	Mines Nested Deep	Mocho II	L	2					
3S2E24A001	S. greenville	Mocho I	U	2					
3S2E26J002	mines rd	Mocho II	U	2					
3S2E29F004	usgs wetmore	Amador	U	12		√		√	
3S2E30C001	Vineyard 30C 1	Amador	L	12					
3S2E30D002	vineyard	Amador	U	12				√	
3S2E32E007	DVWTP 32E7	Upland	U	2					
3S2E33G001	Crohare	Amador	U	12				√	
3S2E33K001	VA	Amador	U	4					
3S2E33L001	VA/CROHARE FENCE	Amador	U	4					
3S3E06Q003	PPWTP South Monitoring	Altamont	U	2					
3S3E07D002	7D 2	Spring	U	2					
TOTALS:				**221**	**8**	**12**	**2**	**6**	**14**

Aq = Aquifer: U = Upper; L = Lower; D = Deep	Monitoring Frequency indicates the number of measurements taken during the water year.
OTHER: Key = Key Wells; GW/SW = Groundwater Surface Water Interaction; WR = Water Rights; Muni = Municipal wells	

TABLE 6-2
GROUNDWATER PROGRAM
WELL CONSTRUCTION DETAILS
2020 WATER YEAR

Site	Map	Type	Other Name	Completed	Basin	Aquifer	RP	TD	Dia	Perf
2S1E32E001	32E1	monitor	End of Arnold Rd	12/28/2000	None	U	392.56	70	2	55 - 70
2S1E32N001	32N1	monitor	Camp Parks	7/1/1976	Camp	U	360.79	44	2.5	35 - 41
2S1E32Q001	32Q1	monitor	Summer Glen Dr	12/29/2000	Camp	U	367.55	45	2	30 - 45
2S1E33L001	33L1	monitor	Gleason Dr @ Tassajara	12/27/2000	None	U	389.46	80	2	65 - 80
2S1E33P002	33P2	monitor	Central Pkwy at Emerald Glen P	12/20/2000	Camp	U	370.05	55	2	45 - 55
2S1E33R001	33R1	monitor	Central Pkwy @ Grafton	10/23/2001	None	U	358.5	60	2	40 - 60
2S1W15F001	15F1	monitor	BOLLINGER	9/28/1976	Bishop	U	439.44	60	2.5	50.3 - 55.3
2S1W26C002	26C2	monitor	PINE VALLEY	9/28/1976	Dublin	U	406.53	50	2.5	40 - 45
2S1W36E003	36E3	monitor	Kolb Park	9/13/1977	Dublin	U	346.51	60	2.5	50 - 55
2S1W36F001	36F1	nested	Dublin High shallow	5/8/1996	Dublin	L	342.71	190	2	140 - 180
2S1W36F002	36F2	nested	Dublin High mid	5/8/1996	Dublin	L	342.71	320	2	270 - 310
2S2E27P002	27P2	monitor	hartford ave east	6/18/1979	Spring	U	505.43	68	4	35 - 63
2S2E28D002	28D2	monitor	May School	11/2/1976	May	U	555.15	55	2.5	45 - 50
2S2E28J002	28J2	industrial	FCC Well	7/26/1984	May	L	522.292	230	6	50 - 230
2S2E28Q001	28Q1	monitor	hartford ave	11/2/1976	May	U	513.04	28	2.5	17.6 - 22.6
2S2E32K002	32K2	monitor	jenson's N liv. Ave	12/20/1977	Cayetano	U	507.43	43	2.5	33 - 38
2S2E34E001	34E1	monitor	Mud City	12/21/1977	May	U	499.73	49	2.5	40 - 45
2S2E34Q002	34Q2	monitor	Hollyhock & Crocus	12/12/2001	Spring	U	507.24	50	2	25 - 50
3S1E01F002	1F2	monitor	Constitution Dr	12/18/2000	Camp	U	428.44	40	2	25 - 40
3S1E01H003	1H3	monitor	Collier Canyon g1	12/20/1977	Camp	U	422.8	80	2.5	70 - 75
3S1E01J004	1J04	irrigation	Collier Vineyards	2/6/2018	Camp	L		300	12	260 - 280
3S1E01L001	1L1	monitor	Kitty Hawk	12/19/2000	Camp	U	403.04	70	2	60 - 70
3S1E01P002	1P2	monitor	Airport gas g5	12/11/1975	Amador	U	389.64	50	2.5	40 - 45
3S1E01P003	1P3	supply	New airport well	7/28/1988	Amador	L	394.44	480	12	245 - 460
3S1E02J002	2J2	monitor	Maint. Bldg	7/16/2003	Camp	U	380.89	41	2	31 - 41
3S1E02J003	2J3	monitor	Doolan Rd East	7/16/2003	Camp	U	406.35	65	2	55 - 65
3S1E02K002	2K2	monitor	Doolan Rd West	12/10/1975	Camp	U	397.04	46	2.5	36.5 - 41.5
3S1E02M003	2M3	monitor	Friesman Rd North	11/13/2000	Camp	U	365.04	50	2	35 - 50
3S1E02N006	2N6	monitor	Friesman Rd South	11/13/2000	Amador	U	366.14	55	2	40 - 55
3S1E02P003	2P3	domestic	Crosswinds Church	9/26/1977	Camp	L	371.73	380	10	340 - 372
3S1E02Q001	2Q1	monitor	LPGC #1	7/16/2003	Amador	U	369.92	45	2	35 - 45
3S1E02R001	2R1	monitor	Beebs	11/1/1975	Amador	U	376.29	33	2.5	21 - 26
3S1E03G002	3G2	monitor	fallon rd	1/18/1978	Camp	U	354.24	50	2.5	40 - 45
3S1E04A001	4A1	monitor	SMP-DUB-2	10/23/2001	Camp	U	350.67	49.5	2	29.5 - 49.5
3S1E04J005	4J5	monitor	Pimlico shallow	10/25/2001	Camp	U	345.2	47	2	22 - 47
3S1E04J006	4J6	monitor	Pimlico deep	10/24/2001	Camp	U	345.55	110	2	68 - 110
3S1E04Q002	4Q2	monitor	gulfstream	12/13/1977	Amador	U	345.42	90	2.5	80 - 85
3S1E05K006	5K6	monitor	Rosewood shallow	6/7/1990	Camp	U	346.05	75	4	40 - 70
3S1E05K007	5K7	monitor	Rosewood deep	6/8/1990	Camp	L	346.19	150	4	134 - 144
3S1E05L003	5L3	monitor	Oracle	12/11/2001	Camp	U	339.43	40	2	15 - 40
3S1E05P006	5P6	monitor	Owens Park	12/19/2000	Camp	U	336.65	35	2	25 - 35
3S1E06F003	6F3	monitor	Dublin Ct	9/29/1976	Dublin	U	329.82	36	2.5	27 - 32
3S1E06N002	6N2	monitor	DSRSD MW-3	3/20/1985	Dublin	U	335.2	67	4	47 - 67
3S1E06N003	6N3	monitor	DSRSD MW-4	12/4/1984	Dublin	U	340.74	72		52 - 72

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	Map	Type	Other Name	Completed	Basin	Aquifer	RP	TD	Dia	Perf
3S1E06N006	6N 6	monitor	DSRSD NE-76	11/9/2007	Dublin	U	333.58	75	2	50 - 70
3S1E07B002	7B2	monitor	Hopyard rd	5/17/1979	Dublin	L	327.77	152	4	143 - 149
3S1E07B012	7B12	monitor	Hacienda Arch	7/31/2002	Dublin	U	327.82	70	2	50 - 70
3S1E07D001	7D 1	monitor	DSRSD SW-75	11/6/2007	Dublin	U	330.09	75	2	54 - 74
3S1E07D003	7D 3	monitor	DSRSD SE-70	11/2/2007	Dublin	U	332.28	70	2	45 - 65
3S1E07G007	7G7	monitor	Chabot Well	1/22/2002	Dublin	U	327.33	55	2	35 - 55
3S1E07J005	7J5	monitor	Thomas Hart School	7/10/2002	Dublin	U	326.78	50	2	30 - 50
3S1E08B001	8B1	monitor	Lizard Well	5/31/1979	Amador	U	338.28	148	4	55 - 82
3S1E08G004	8G4	monitor	Apache	12/19/2001	Amador	U	341.47	85	2	60 - 85
3S1E08H009	8H9	nested	Mocho 4 Nested Shallow	12/12/1996	Amador	L	338.53	240	2	210 - 230
3S1E08H010	8H10	nested	Mocho 4 Nested Middle	12/12/1996	Amador	L	339.26	440	2	290 - 430
3S1E08H011	8H11	nested	Mocho 4 Nested deep	12/21/1996	Amador	D	339.26	720	2	520 - 720
3S1E08H013	8H13	monitor	Mocho 3 mon	12/11/1998	Amador	D	338.96	800	2	570 - 790
3S1E08H018	M4	muni	Mocho 4	11/1/2000	Amador	L	341.94	745	20	515 - 730
3S1E08K001	8K1	monitor	Cockroach well	1/23/1978	Amador	U	332.37	99	2.5	89 - 94
3S1E08N001	8N1	monitor	sports park	8/27/1976	Bernal	U	323.68	72	2.5	62 - 67
3S1E09B001	St1	muni	Stoneridge	1/28/1992	Amador	L	349.23	810	20	250 - 800
3S1E09J007	9J7	nested	SW Lake I Shallow	11/23/2004	Amador	U	357.36	2	2	120 - 140
3S1E09J008	9J8	nested	SW Lake I Middle	11/23/2004	Amador	L	357.55	305	2	280 - 300
3S1E09J009	9J9	nested	SW Lake I Deep	11/23/2004	Amador	L	357.68	505	2	480 - 500
3S1E09M002	M1	muni	Mocho 1	4/6/1964	Amador	L	343.95	530	16	150 - 510
3S1E09M003	M2	muni	Mocho 2	5/4/1967	Amador	L	347.47	575	18	250 - 570
3S1E09M004	M3	muni	Mocho 3	11/1/2000	Amador	L	342.89	498	20	315 - 493
3S1E09P005	9P5	monitor	Key_AmW_U (Mohr Key)	12/6/1977	Amador	U	349.4	105	2.5	95 - 100
3S1E09P009	9P9	nested	Mohr Ave Shallow	3/23/2005	Amador	L	349.59	210	2	185 - 205
3S1E09P010	9P10	nested	Key_AmW_L	3/23/2005	Amador	L	349.51	310	2	285 - 305
3S1E09P011	9P11	nested	Mohr Ave Deep	3/23/2005	Amador	L	349.44	425	2	405 - 420
3S1E10A002	10A2	monitor	El C harro Rd	5/10/1979	Amador	U	367.35	88	4	70 - 80
3S1E10B008	10B8	nested	Kaiser Rd Shallow	6/18/1997	Amador	L	353.6	200	2	100 - 190
3S1E10B009	10B9	nested	Kaiser Rd Middle 1	6/18/1997	Amador	L	353.49	294	2	244 - 284
3S1E10B010	10B10	nested	Kaiser Rd Middle 2	6/18/1997	Amador	L	353.52	600	2	400 - 590
3S1E10B011	10B11	nested	Kaiser Rd Deep	6/18/1997	Amador	D	353.52	810	2	660 - 800
3S1E10B014	10B14	monitor	COL 5 Monitoring	2/26/2014	Amador	L	355.591	690	2	390 - 690
3S1E10B016	COL5	muni	COL 5	7/19/2014	Amador	L	357.584	690	18	390 - 690
3S1E10D002	10D2	nested	Stoneridge Shallow	9/10/1998	Amador	L	349.32	212	2	182 - 212
3S1E10D003	10D3	nested	Stoneridge Middle 1	9/10/1998	Amador	L	349.28	322	2	262 - 312
3S1E10D004	10D4	nested	Stoneridge Middle 2	9/10/1998	Amador	L	349.3	616	2	366 - 606
3S1E10D005	10D5	nested	Stoneridge Deep	9/10/1998	Amador	D	349.32	790	2	710 - 780
3S1E10K002	10K2	monitor	COL 1 Monitoring	1/17/2007	Amador	L	358.68	590.6	4	195.5 - 585.6
3S1E10K003	COL1	muni	COL 1	2/27/2008	Amador	L	363.79	530	18	205 - 530
3S1E11B001	11B1	monitor	Airport West	12/11/1975	Amador	U	369.35	43	2.5	33 - 38
3S1E11C003	11C3	monitor	LAVWMA ROW	12/22/2003	Amador	U	364.82	55	2	35 - 55
3S1E11G001	11G1	nested	Key_AmE_U	4/8/1997	Amador	U	371.62	120	2	100 - 110
3S1E11G002	11G2	nested	Rancho Charro Middle 1	4/8/1997	Amador	L	371.61	350	2	230 - 340
3S1E11G003	11G3	nested	Rancho Charro Middle 2	4/8/1997	Amador	L	371.64	590	2	380 - 580
3S1E11G004	11G4	nested	Rancho Charro Deep	4/8/1997	Amador	D	371.68	790	2	620 - 780
3S1E11M002	11M2	monitor	COL 2 Monitoring	9/25/2007	Amador	L	365.96	700	4.5	199 - 699
3S1E11M003	COL2	muni	COL 2	2/14/2008	Amador	L	369.24	684	18	345 - 684
3S1E11P006	11P6	domestic	New Jamieson Residence	3/10/2000	Amador	L	376.67	400	5	240 - 380
3S1E12A002	12A2	monitor	Airport South	12/11/1975	Amador	U	401.35	69	2.5	63.7 - 68.7
3S1E12D002	12D2	monitor	LWRP G6		Amador	U	384.45	44.6		36 - 41

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Site	Map	Type	Other Name	Completed	Basin	Aquifer	RP	TD	Dia	Perf
3S1E12G001	12G1	monitor	Oaks Park Shallow	12/12/1975	Amador	U	404.47	73	2.5	63 - 68
3S1E12H004	12H4	nested	LWRP Shallow	1/8/1998	Amador	L	407.75	270	2	185 - 260
3S1E12H005	12H5	nested	LWRP Middle 1	1/8/1998	Amador	L	407.78	400	2	360 - 390
3S1E12H006	12H6	nested	LWRP Middle 2	1/8/1998	Amador	L	407.75	480	2	410 - 468
3S1E12H007	12H7	nested	LWRP Deep	1/8/1998	Amador	D	407.67	684	2	609 - 674
3S1E12K002	12K2	nested	Oaks Park Mid	11/1/2005	Amador	L	406.29	300	2	210 - 295
3S1E12K003	12K3	nested	Key_AmE_L	11/1/2005	Amador	L	406.83	475	2	355 - 470
3S1E12K004	12K4	nested	Oaks Park Deep	11/1/2005	Amador	D	406.71	575	2	550 - 570
3S1E13P005	13P5	nested	LGA Grant Nested 1	11/2/2010	Amador	U	399.97	135	2	110 - 130
3S1E13P006	13P6	nested	LGA Grant Nested 2	11/2/2010	Amador	L	399.93	255	2	230 - 250
3S1E13P007	13P7	nested	LGA Grant Nested 3	11/2/2010	Amador	L	399.97	375	2	350 - 370
3S1E13P008	13P8	nested	LGA Grant Nested 4	11/2/2010	Amador	L	399.94	605	2	580 - 600
3S1E14B001	14B1	industrial	Industrial Asphalt		Amador	L	384.2	435	8	200 - 410
3S1E14D002	14D2	monitor	South Cope Lake	8/30/2006	Amador	L	371.83	740	14.5	170 - 740
3S1E15J003	15J3	supply	shadow cliff	12/2/1980	Amador	L	344.59	196	8	154 - 184
3S1E15M003	15M3	monitor	Bush/Valley South	12/15/1998	Amador	L	362.88	600	2	280 - 590
3S1E16A002	P8	muni	Pleas 8	3/27/1992	Amador	L	358.2	500	20	200 - 495
3S1E16A004	16A4	monitor	Bush/Valley Mid	12/3/1998	Amador	L	359.36	603	2	260 - 580
3S1E16B001	16B1	monitor	Bush/Valley North	12/18/1998	Amador	D	355.81	805	2	605 - 800
3S1E16C002	16C2	nested	Santa Rita Valley Shallow	4/14/2005	Amador	L	344.38	190	2	165 - 185
3S1E16C003	16C3	nested	Santa Rita Valley Middle	4/14/2005	Amador	L	344.27	305	2	280 - 300
3S1E16C004	16C4	nested	Santa Rita Valley Deep	4/14/2005	Amador	L	344.16	375	2	355 - 370
3S1E16E004	16E4	monitor	black ave - cultural	12/15/1977	Amador	U	351.69	105	2.5	95 - 100
3S1E16L005	P5	muni	Pleas 5	4/4/1962	Amador	L	358.05	685	18	149 - 650
3S1E16L007	P6	muni	Pleas 6	6/1/1966	Amador	L	354.47	647	18	165 - 647
3S1E16P005	16P5	monitor	Vervais Monitor	10/8/1976	Amador	U	354.51	75	2.5	64 - 69
3S1E17B004	17B4	supply	Casterson	1/1/1950	Amador	L	337.69	248	8	0 - 248
3S1E17D003	17D3	nested	Hopyard Nested Shallow	8/6/1996	Bernal	L	325.13	108	4	92 - 98
3S1E17D004	17D4	nested	Hopyard Nested Middle 1	8/6/1996	Bernal	L	325.14	236	4	206 - 226
3S1E17D005	17D5	nested	Hopyard Nested Middle 2	8/6/1996	Bernal	L	325.13	308	4	266 - 286
3S1E17D006	17D6	nested	Hopyard Nested Middle 3	8/6/1996	Bernal	L	325.12	408	4	378 - 398
3S1E17D007	17D7	nested	Hopyard Nested Deep	8/6/1996	Bernal	D	325.13	684	4	654 - 674
3S1E17D011	17D11	monitor	Hopyard 9 Monitoring Well	12/16/1998	Bernal	L	324.84	603	2	340 - 505
3S1E17D012	H9	muni	Hopyard 9	11/5/1999	Bernal	L	327.9	315	18	235 - 310
3S1E18A006	H6	muni	Hopyard 6	2/1/1987	Bernal	L	326.74	500	18	158 - 490
3S1E18E004	18E4	monitor	Valley Trails II	5/31/1979	Bernal	U	320.21	83	4	69 - 79
3S1E18J002	18J2	monitor	camino segura	10/20/1977	Bernal	U	323.02	71	2.5	61 - 66
3S1E19A010	SF-B	muni	SFWD South (B)		Bernal	L	337.02	331		189 - 327
3S1E19A011	SF-A	muni	SFWD North (A)	10/9/2001	Bernal	L	334.27	330	18	196 - 320
3S1E19C004	19C4	monitor	del valle & laguna	6/11/1979	Bernal	U	322.23	78	4	68 - 73
3S1E19K001	19K1	monitor	680/bernal	12/8/1975	Bernal	U	321.54	57.6	2.5	47.6 - 52.6
3S1E20B002	20B2	supply	Fairgrounds Potable	12/27/1961	Bernal	L	344.03	500	12	218 - 500
3S1E20C003	20C3	supply	Fairgrounds Potable Backup		Bernal	L	338.6	110	14	74 - 107
3S1E20C007	20C7	monitor	Key_Bern_U	6/15/2000	Bernal	U	338.66	153	2	65 - 145
3S1E20C008	20C8	nested	Key_Bern_L	10/20/2008	Bernal	L	338.67	315	2	295 - 315
3S1E20C009	20C9	nested	Fair Nested Deep	10/20/2008	Bernal	L	338.78	515	2	495 - 515
3S1E20J004	20J4	monitor	civic center	12/5/1975	Bernal	U	331.62	72	2.5	62 - 67
3S1E20M011	20M11	monitor	S.F "M"LINE	10/12/1977	Bernal	U	325.73	71	2.5	61 - 66
3S1E20Q002	20Q2	monitor	20Q2	2/17/1976	Bernal	U	325.82	65	10	45 - 53
3S1E22D002	22D2	monitor	vineyard trailer	10/28/1976	Amador	U	368.05	72	2.5	62 - 67
3S1E23J001	23J1	domestic	1627 vineyard trailer	3/4/1958	Amador	L	428.2	120	8	0 - 120

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Site	Map	Type	Other Name	Completed	Basin	Aquifer	RP	TD	Dia	Perf
3S1E25C003	25C3	monitor	Katz Winery Mansion	11/28/1990	Amador	U	454.16	146	2	70 - 140
3S1E29M004	29M4	monitor	f.c. channel	12/4/1975	Castle	U	310.94	57	2.5	47 - 52
3S1E29P002	29P2	monitor	castlewood dr	12/9/1975	Bernal	U	302.82	42	2.5	32 - 37
3S1W01B009	1B9	nested	DSRSD Shallow	2/15/1996	Dublin	L	333.56	162	2	122 - 152
3S1W01B010	1B10	nested	DSRSD Middle	2/15/1996	Dublin	L	333.57	414	2	274 - 404
3S1W01B011	1B11	nested	DSRSD Deep	2/15/1996	Dublin	L	333.74	560	2	480 - 550
3S1W01J001	1J1	monitor	DSRSD MW-1	12/4/1984	Dublin	U	334.36	70		47 - 64
3S1W02A002	2A2	monitor	McNamara's	10/7/1976	Dublin	U	369.4	47	2.5	37 - 42
3S1W12A009	12A 9	monitor	DSRSD NW-75	11/7/2007	Dublin	U	332.14	74	2	49 - 69
3S1W12B002	12B2	monitor	Stoneridge Mall Rd	6/21/1996	Dublin	U	342.89	39.5	4	20 - 50
3S1W12J001	12J1	monitor	DSRSD South	12/9/1975	Dublin	U	329.31	62	2.5	52 - 57
3S1W13J001	13J1	monitor	muirwood dr	10/7/1976	Castle	U	343.94	48	2.5	39 - 44
3S2E01F002	1F2	monitor	Brisa at Circuit City	12/22/1977	Spring	U	572.99	68.6	2.5	59 - 64
3S2E02B002	2B2	monitor	south front rd	6/7/1976	Spring	U	539.45	46	2.5	36.9 - 41.9
3S2E03A001	3A1	monitor	Bluebell	12/21/1977	Spring	U	517.63	54	2.5	44 - 49
3S2E03K003	3K3	monitor	first & S. front rd	12/12/1977	Mocho I	U	522.83	60	2.5	50 - 55
3S2E05N001	5N1	supply	Spider Well	10/5/1977	Mocho II	M	444	210	10	0 - 210
3S2E07C002	7C2	monitor	jaws - york way - G4	4/6/1978	Mocho II	U	420.84	49	2.5	39 - 44
3S2E07H002	7H2	monitor	dakota	7/29/1989	Mocho II	U	442.85	54	2	44 - 54
3S2E07N002	7N2	monitor	Isabel & Arroyo Mocho	12/20/2012	Amador	U	422	162	2	132 - 152
3S2E07P003	CWS24	muni	CWS 24	4/4/1972	Amador	L	431.46	510	16	300 - 490
3S2E07R003	CWS31	muni	CWS 31	9/20/2002	Upland	L	446	583	16	410 - 528
3S2E08F001	CWS10	muni	CWS 10	5/15/1954	Mocho II	L	456.24	470	16	143 - 433
3S2E08G001	CWS19	muni	CWS 19	4/15/1960	Mocho II	L	465.05	465	16	120 - 455
3S2E08H002	8H2	monitor	North k	6/14/1976	Mocho II	U	469.61	46	2.5	36 - 41
3S2E08H003	8H3	nested	Key_Mo2_L	7/10/2009	Mocho II	L	477.25	195	2	170 - 190
3S2E08H004	8H4	nested	N Liv Ave Deep	7/10/2009	Mocho II	L	476.97	385	2	360 - 380
3S2E08K002	8K2	monitor	Key_Mo2_U (Livermore Key)	12/13/1977	Mocho II	U	464.78	74	2.5	64 - 69
3S2E08N002	CWS14	muni	CWS 14	1/16/1958	Mocho II	L	453.64	526	10	140 - 515
3S2E08Q009	8Q 9	monitor	D-2	6/15/1999	Mocho II	L	464.7	114	2	99 - 114
3S2E09Q001	CWS9	muni	CWS 9	2/18/1952	Mocho II	L	518.15	572	14	180 - 492
3S2E09Q004	9Q4	monitor	school st	11/1/1977	Mocho II	U	505.425	80	2.5	70 - 75
3S2E10F003	10F3	monitor	hexcel	12/12/1977	Mocho I	U	534.84	45	2.5	35 - 40
3S2E10Q001	10Q1	monitor	almond	11/1/1976	Mocho II	U	555.36	43.5	2.5	33.5 - 39
3S2E10Q002	10Q2	monitor	LLNL W-703	12/3/1990	Mocho II	L	549.569	325	4.5	298 - 325
3S2E11C001	11C1	monitor	joan way	11/1/1976	Mocho I	U	556.347	66.2	2.5	56.2 - 61.2
3S2E12C004	12C4	monitor	LLNL W-486	3/11/1988	Spring	U	591.46	108	4.5	100 - 108
3S2E12J003	12J3	monitor	LLNL W-017A	5/20/1981	Spring	L	631.05	160	5	127 - 157
3S2E14A003	14A3	monitor	S. vasco @east ave	12/13/1977	Mocho I	U	602.24	110	2.5	100 - 105
3S2E14B001	14B1	domestic	5763 east ave	5/26/1983	Mocho I	L	593.36	300	9	146 - 234
3S2E15E002	15E2	irrigation	Retzlaff Winery	11/14/1983	Mocho II	L	549.69	192	8	104 - 189
3S2E15L001	15L1	monitor	Concannon 2	10/10/2013	Mocho II	U	561.5	40.5	2	20 - 40.5
3S2E15M002	15M2	monitor	Concannon 1	10/10/2013	Mocho II	U	549.46	45	2	25 - 45
3S2E15R017	15R17	nested	Buena Vista Shallow	12/14/2006	Mocho II	U	592.41	63	2	38 - 58
3S2E15R018	15R18	monitor	Buena Vista Deep	12/15/2007	Mocho II	L	592.47	138	2	113 - 133
3S2E16A003	16A3	irrigation	Memory Gardens	5/1/1972	Mocho II	L	527.06	240	10	91 - 240
3S2E16C001	CWS15	muni	CWS 15	2/18/1958	Mocho II	L	510.97	584	16	150 - 523
3S2E16E004	16E4	monitor	pepper tree	12/15/1977	Mocho II	U	506.26	45	2.5	35 - 40
3S2E17E002	17E2	supply	Mocho Street	3/30/1962	Mocho II	U	467.71	94	6	0 - 94
3S2E18B001	CWS20	muni	CWS 20	1/30/1961	Amador	L	438.56	497	16	190 - 465
3S2E18E001	18E1	monitor	E. stanley	4/22/1977	Amador	U	423.86	133.8	2.5	123.8 - 128.8

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	Map	Type	Other Name	Completed	Basin	Aquifer	RP	TD	Dia	Perf
3S2E19D007	19D7	nested	Isabel Shallow	1/29/1999	Amador	U	415.07	180	2	100 - 180
3S2E19D008	19D8	nested	Isabel Middle 1	1/29/1999	Amador	L	415.04	260	2	210 - 260
3S2E19D009	19D9	nested	Isabel Middle 2	1/29/1999	Amador	L	414.98	390	2	280 - 390
3S2E19D010	19D10	nested	Isabel Deep	1/29/1999	Amador	L	414.89	470	2	420 - 470
3S2E19N003	19N3	nested	Shallow Cemex Nested	7/27/2018	Amador	U	418.45	120	2	105 - 115
3S2E19N004	19N4	nested	Deep Cemex Nested	7/27/2018	Amador	L	417.96	203	2	188 - 198
3S2E20M001	20M1	supply	Alden Lane	9/15/1928	Amador	L	478.79	184	12	0 - 184
3S2E22B001	22B1	monitor	grapes	7/8/1976	Mocho II	U	585.88	31.9	2.5	21.9 - 26.9
3S2E23E001	23E1	nested	Mines Nested Shallow	9/2/2004	Mocho II	U	613.36	40	2	20 - 35
3S2E23E002	23E2	nested	Mines Nested Deep	9/2/2004	Mocho II	L	613.23	110	2	95 - 105
3S2E24A001	24A1	monitor	S. greenville	11/1/1976	Mocho I	U	717.7	46.3	2.5	36.3 - 41.3
3S2E26J002	26J2	monitor	mines rd	12/27/1977	Mocho II	U	689.92	44	2.5	34 - 39
3S2E29F004	29F4	monitor	usgs wetmore	10/28/1976	Amador	U	457.5	36	2.5	26 - 31
3S2E30C001	30C1	supply	Vineyard 30C 1	3/16/1995	Amador	L	439.41	150	6	125 - 145
3S2E30D002	30D2	monitor	vineyard	6/18/1979	Amador	U	431.6	44	4	24 - 39
3S2E32E007	32E7	monitor	DVWTP 32E7	7/16/1991	Upland	U	610.94	37	6	19 - 34
3S2E33G001	33G1	monitor	Crohare	12/12/1975	Amador	U	511.52	17	2.5	9 - 14
3S2E33K001	33K1	monitor	VA		Amador	U	546.83	15	2.5	7 - 12
3S2E33L001	33L1	monitor	VA/CROHARE FENCE		Amador	U	557.63	16	2.5	11 - 16
3S3E06Q003	6Q3	monitor	PPWTP South Monitoring	8/29/2016	Altamont	U	681.07	30	2	20 - 30
3S3E07D002	7D2	monitor	7D 2	11/1/1976	Spring	U	621.94	72	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 2019 TO FALL 2020

Well Number	Well Depth	Aquifer	Subarea	Fall 2019		Spring 2020		Fall 2020		Change in Elevation (ft)		
										Seasonal		Annual
				Depth to Water	GW Elev	Depth to Water (ft)	GW Elev	Depth to Water (ft)	GW Elev	Fall 19 to Spring 20	Spring 20 to Fall 20	Fall 19 to Fall 20
1S4E31P005	24	U	Tracy	17.6	42.4	18.4	41.6	18.5	41.5	-0.8	-0.1	-0.9
2S1E32E001	70	U	None	34.5	358.0	36.0	356.6	37.7	354.9	-1.5	-1.7	-3.2
2S1E32N001	44	U	Camp	17.7	343.1	18.2	342.6	19.2	341.6	-0.5	-1.1	-1.6
2S1E32Q001	45	U	Camp	26.1	341.5	26.8	340.7	28.0	339.6	-0.8	-1.1	-1.9
2S1E33L001	80	U	None	48.1	341.3	51.1	338.4	52.0	337.5	-3.0	-0.9	-3.9
2S1E33P002	55	U	Camp	30.4	339.7	32.0	338.1	32.9	337.2	-1.6	-0.9	-2.5
2S1E33R001	60	U	None	17.9	340.6	18.7	339.8	19.9	338.6	-0.8	-1.2	-2.1
2S1W15F001	60	U	Bishop	9.8	429.6	10.0	429.5	11.1	428.3	-0.2	-1.1	-1.3
2S1W26C002	50	U	Dublin	23.9	382.6	24.8	381.7	25.7	380.9	-0.9	-0.8	-1.8
2S1W36E003	60	U	Dublin	4.1	342.4	3.5	343.0	4.7	341.8	0.6	-1.2	-0.6
2S1W36F001	190	L	Dublin	10.5	332.2	10.5	332.2	11.6	331.1	0.0	-1.1	-1.1
2S1W36F002	320	L	Dublin	7.8	335.0	6.5	336.2	9.2	333.5	1.3	-2.7	-1.4
2S1W36F003	520	L	Dublin	15.6	327.2	16.4	326.4	24.3	318.4	-0.8	-7.9	-8.7
2S2E27C002	108	U	Spring	12.5	529.7	13.6	528.6	14.3	527.9	-1.1	-0.7	-1.8
2S2E27P002	68	U	Spring	2.8	502.6	2.2	503.3	3.9	501.6	0.7	-1.7	-1.1
2S2E28D002	55	U	May	30.6	524.6	30.5	524.7	30.6	524.6	0.1	-0.1	0.0
2S2E28J002	230	L	May	6.6	515.7	6.1	516.2	7.1	515.2	0.4	-1.0	-0.6
2S2E28Q001	28	U	May	6.7	506.3	4.9	508.2	7.0	506.1	1.9	-2.1	-0.2
2S2E32K002	43	U	Cayetano	8.7	498.8	8.5	499.0	8.8	498.7	0.2	-0.3	-0.1
2S2E34E001	49	U	May	5.7	494.1	4.1	495.6	5.8	493.9	1.6	-1.7	-0.2
2S2E34Q002	50	U	Spring	3.7	503.6	2.5	504.8	3.7	503.6	1.2	-1.2	0.0
2S3E01D001	80	U	Tracy	9.4	80.7	10.2	79.8	11.6	78.4	-0.8	-1.4	-2.2
3S1E01F002	40	U	Camp	18.8	409.6	19.4	409.0	20.5	408.0	-0.6	-1.1	-1.7
3S1E01H003	80	U	Camp	25.6	397.3	25.3	397.5	27.6	395.2	0.3	-2.4	-2.1
3S1E01J004	300	L	Camp	NA	NA	NA	NA	NA	NA	-	-	-
3S1E01L001	70	U	Camp	51.7	351.3	55.2	347.9	57.5	345.5	-3.5	-2.3	-5.8
3S1E01P002	50	U	Amador	19.4	370.2	21.6	368.1	23.6	366.0	-2.2	-2.0	-4.2
3S1E01P003	480	L	Amador	118.9	275.6	122.0	272.5	143.4	251.1	-3.1	-21.4	-24.5
3S1E02J002	41	U	Camp	13.3	367.6	11.5	369.4	15.4	365.5	1.8	-4.0	-2.2
3S1E02J003	65	U	Camp	25.2	381.2	25.3	381.1	26.1	380.3	-0.1	-0.8	-0.9
3S1E02K002	46	U	Camp	24.9	372.1	24.8	372.3	26.2	370.8	0.2	-1.4	-1.3
3S1E02M003	50	U	Camp	15.6	349.4	15.5	349.6	15.7	349.3	0.1	-0.3	-0.1
3S1E02N006	55	U	Amador	28.9	337.3	28.1	338.1	29.2	337.0	0.8	-1.1	-0.3
3S1E02P003	380	L	Camp	97.0	274.8	99.5	272.2	126.4	245.3	-2.5	-26.9	-29.5
3S1E02Q001	45	U	Amador	19.2	350.7	18.6	351.4	21.2	348.8	0.7	-2.6	-1.9
3S1E02R001	33	U	Amador	17.0	359.3	15.9	360.4	20.1	356.2	1.1	-4.2	-3.1
3S1E03G002	50	U	Camp	8.4	345.8	11.6	342.6	10.8	343.4	-3.2	0.8	-2.4
3S1E04A001	50	U	Camp	15.1	335.6	16.0	334.7	17.1	333.6	-0.9	-1.1	-2.0
3S1E04J005	47	U	Camp	13.4	331.8	14.1	331.2	15.7	329.5	-0.7	-1.7	-2.3
3S1E04J006	110	U	Camp	13.9	331.7	15.8	329.7	17.8	327.8	-1.9	-1.9	-3.9
3S1E04Q002	90	U	Amador	33.8	311.7	37.7	307.8	44.2	301.2	-3.9	-6.5	-10.5
3S1E05K006	75	U	Camp	12.8	333.3	12.9	333.2	14.6	331.5	-0.1	-1.7	-1.8
3S1E05K007	150	L	Camp	16.5	329.7	17.8	328.4	19.9	326.3	-1.3	-2.1	-3.4
3S1E05L003	40	U	Camp	12.5	327.0	12.3	327.2	13.0	326.5	0.2	-0.7	-0.5
3S1E05P006	35	U	Camp	10.7	326.0	10.8	325.8	11.7	324.9	-0.1	-0.9	-1.0
3S1E06F003	36	U	Dublin	5.1	324.7	4.4	325.4	5.2	324.6	0.7	-0.8	-0.1
3S1E06G005	200	L	Dublin	7.9	324.3	7.7	324.5	8.4	323.8	0.2	-0.7	-0.5
3S1E06N002	67	U	Dublin	13.0	322.2	12.6	316.1	13.4	321.8	-6.2	5.7	-0.5
3S1E07B002	152	L	Dublin	8.4	319.4	8.4	319.4	9.2	318.5	0.0	-0.9	-0.9
3S1E07B012	70	U	Dublin	10.6	317.2	10.5	317.3	11.7	316.1	0.1	-1.2	-1.1
3S1E07G007	55	U	Dublin	11.7	315.6	11.7	315.7	13.2	314.1	0.0	-1.5	-1.5
3S1E07J005	50	U	Dublin	13.9	312.9	14.3	312.4	15.8	311.0	-0.4	-1.4	-1.9
3S1E08B001	148	U	Amador	34.3	304.0	37.2	301.1	43.4	294.9	-2.8	-6.2	-9.0
3S1E08G004	85	U	Amador	37.4	304.1	40.1	301.4	46.2	295.3	-2.6	-6.2	-8.8
3S1E08H009	240	L	Amador	42.7	295.9	47.4	291.1	75.4	263.1	-4.8	-28.0	-32.8
3S1E08H010	440	L	Amador	46.7	292.5	53.7	285.6	97.7	241.5	-7.0	-44.0	-51.0
3S1E08H011	720	D	Amador	53.5	285.8	62.4	276.9	89.8	249.5	-8.9	-27.4	-36.3
3S1E08H013	800	D	Amador	52.8	286.1	54.2	284.8	89.0	250.0	-1.4	-34.8	-36.2
3S1E08H018	745	L	Amador	57.9	284.1	68.8	273.2	94.0	247.9	-10.9	-25.2	-36.2
3S1E08K001	99	U	Amador	33.6	298.8	35.3	297.1	44.6	287.8	-1.8	-9.3	-11.0
3S1E08N001	72	U	Bernal	24.6	299.1	26.3	297.4	33.3	290.4	-1.6	-7.0	-8.6
3S1E09H010	145	U	Amador	42.6	310.3	46.8	306.1	53.7	299.2	-4.1	-6.9	-11.0
3S1E09H011	190	L	Amador	52.3	300.8	55.0	298.0	69.8	283.3	-2.8	-14.8	-17.5
3S1E09J007	2	U	Amador	48.2	309.2	52.1	305.2	60.0	297.4	-3.9	-7.8	-11.8
3S1E09J008	305	L	Amador	62.8	294.7	65.4	292.2	86.6	270.9	-2.6	-21.2	-23.8
3S1E09J009	505	L	Amador	72.2	285.5	76.5	281.2	110.5	247.2	-4.3	-34.0	-38.3
3S1E09M002	530	L	Amador	48.0	296.0	50.7	293.3	75.0	269.0	-2.7	-24.3	-27.0
3S1E09M003	575	L	Amador	51.8	295.7	57.7	289.8	106.4	241.1	-5.9	-48.7	-54.6
3S1E09M004	498	L	Amador	32.7	310.2	33.5	309.4	NA	NA	-0.8	-	-
3S1E09P005	105	U	Amador	44.0	305.4	47.2	302.2	54.9	294.5	-3.2	-7.7	-10.9
3S1E09P009	210	L	Amador	48.9	300.7	51.6	298.0	64.6	285.0	-2.7	-13.0	-15.7

U = Upper; L = Lower; NM = Not Measured; NA = Not Available
OBS = Obstructed; - = Not Applicable; highlight = Key Well
E:\MONITOR\GM\2020WY\AnnualReport2020\Tbl06-03 TblSAWaterLevels20.xls

TABLE 6-3
SEMIANNUAL GROUNDWATER LEVELS
(Feet above Mean Sea Level, NAVD88)
FALL 2019 TO FALL 2020

Well Number	Well Depth	Aquifer	Subarea	Fall 2019		Spring 2020		Fall 2020		Change in Elevation (ft)		
										Seasonal		Annual
				Depth to Water	GW Elev	Depth to Water (ft)	GW Elev	Depth to Water (ft)	GW Elev	Fall 19 to Spring 20	Spring 20 to Fall 20	Fall 19 to Fall 20
1S4E31P005	24	U	Tracy	17.6	42.4	18.4	41.6	18.5	41.5	-0.8	-0.1	-0.9
2S1E32E001	70	U	None	34.5	358.0	36.0	356.6	37.7	354.9	-1.5	-1.7	-3.2
2S1E32N001	44	U	Camp	17.7	343.1	18.2	342.6	19.2	341.6	-0.5	-1.1	-1.6
2S1E32Q001	45	U	Camp	26.1	341.5	26.8	340.7	28.0	339.6	-0.8	-1.1	-1.9
2S1E33L001	80	U	None	48.1	341.3	51.1	338.4	52.0	337.5	-3.0	-0.9	-3.9
2S1E33P002	55	U	Camp	30.4	339.7	32.0	338.1	32.9	337.2	-1.6	-0.9	-2.5
3S1E09P010	310	L	Amador	55.1	294.4	57.5	292.0	78.8	270.7	-2.4	-21.3	-23.7
3S1E09P011	425	L	Amador	65.9	283.5	67.1	282.4	100.5	249.0	-1.2	-33.4	-34.6
3S1E10A002	88	U	Amador	44.8	322.6	47.7	319.6	53.4	313.9	-3.0	-5.7	-8.6
3S1E10B008	200	L	Amador	49.0	304.6	50.9	302.8	62.8	290.9	-1.9	-11.9	-13.8
3S1E10B009	294	L	Amador	61.5	292.0	63.7	289.8	81.6	271.9	-2.2	-17.9	-20.1
3S1E10B010	600	L	Amador	73.1	280.4	76.9	276.6	107.1	246.4	-3.8	-30.2	-34.0
3S1E10B011	810	D	Amador	75.9	277.6	76.0	277.5	106.7	246.8	-0.1	-30.7	-30.8
3S1E10B014	690	L	Amador	78.5	277.1	81.8	273.8	112.3	243.3	-3.3	-30.5	-33.8
3S1E10D002	212	L	Amador	49.6	299.7	51.9	297.4	67.3	282.0	-2.3	-15.4	-17.7
3S1E10D003	322	L	Amador	56.0	293.3	71.9	277.4	79.6	269.7	-15.9	-7.7	-23.6
3S1E10D004	616	L	Amador	65.0	284.3	59.0	290.3	104.8	244.5	6.0	-45.8	-39.8
3S1E10D005	790	D	Amador	70.0	279.3	71.8	277.5	107.6	241.7	-1.8	-35.8	-37.6
3S1E10D007	145	U	Amador	46.3	314.8	50.2	310.9	NA	NA	-3.9	-	-
3S1E10D008	215	L	Amador	60.7	300.3	63.3	297.7	58.1	302.9	-2.6	5.2	2.6
3S1E10K002	591	L	Amador	68.6	290.1	71.0	287.7	88.0	270.7	-2.4	-17.0	-19.4
3S1E10N002	195	U	Amador	46.1	312.1	NM	NM	57.8	300.4	-	-	-11.7
3S1E10N003	195	L	Amador	57.2	300.8	59.0	299.0	73.3	284.7	-1.8	-14.3	-16.1
3S1E11B001	43	U	Amador	29.0	340.4	29.5	339.9	32.5	336.9	-0.5	-2.9	-3.4
3S1E11C003	55	U	Amador	30.4	334.4	30.2	334.6	31.7	333.1	0.2	-1.5	-1.3
3S1E11G001	120	U	Amador	54.4	317.2	56.7	314.9	65.3	306.4	-2.3	-8.5	-10.8
3S1E11G002	350	L	Amador	99.1	272.6	107.7	264.0	122.1	249.5	-8.6	-14.4	-23.0
3S1E11G003	590	L	Amador	95.2	276.5	101.2	270.5	127.3	244.3	-6.0	-26.1	-32.1
3S1E11G004	790	D	Amador	95.2	276.5	92.6	279.1	122.6	249.1	2.6	-30.0	-27.4
3S1E11M002	700	L	Amador	81.7	284.3	89.8	276.2	107.4	258.6	-8.1	-17.6	-25.7
3S1E11P006	400	L	Amador	99.6	277.1	100.8	275.9	123.1	253.6	-1.1	-22.3	-23.5
3S1E12A002	69	U	Amador	31.1	370.3	31.6	369.7	36.5	364.9	-0.5	-4.9	-5.4
3S1E12D002	45	U	Amador	30.0	354.5	33.0	351.5	35.0	349.5	-3.0	-2.0	-5.0
3S1E12G001	73	U	Amador	55.2	349.3	56.4	348.1	58.5	346.0	-1.1	-2.1	-3.3
3S1E12H004	270	L	Amador	140.5	267.3	144.8	263.0	153.9	253.9	-4.3	-9.1	-13.4
3S1E12H005	400	L	Amador	133.0	274.7	132.4	275.4	156.1	251.7	0.6	-23.7	-23.0
3S1E12H006	480	L	Amador	131.9	275.8	130.5	277.2	154.5	253.3	1.4	-24.0	-22.5
3S1E12H007	684	D	Amador	113.3	294.4	114.7	292.9	139.3	268.4	-1.5	-24.6	-26.0
3S1E12K002	300	L	Amador	156.1	250.2	159.4	246.9	157.7	248.6	-3.4	1.7	-1.7
3S1E12K003	475	L	Amador	139.9	267.0	139.2	267.7	152.5	254.4	0.7	-13.3	-12.6
3S1E12K004	575	D	Amador	118.5	288.2	118.7	288.1	147.1	259.7	-0.2	-28.4	-28.6
3S1E13P005	135	U	Amador	106.2	293.8	NA	NA	NA	NA	-	-	-
3S1E13P006	255	L	Amador	121.9	278.1	NA	NA	NA	NA	-	-	-
3S1E13P007	375	L	Amador	121.5	278.4	NA	NA	NA	NA	-	-	-
3S1E13P008	605	L	Amador	106.6	293.3	NA	NA	NA	NA	-	-	-
3S1E14B001	435	L	Amador	107.9	276.3	110.2	274.0	132.3	251.9	-2.3	-22.1	-24.5
3S1E14D002	740	L	Amador	83.7	288.1	83.6	288.2	96.8	275.0	0.1	-13.2	-13.1
3S1E15F003	625	L	Amador	80.5	288.5	78.8	290.2	100.3	268.7	1.8	-21.5	-19.8
3S1E15J003	196	L	Amador	62.0	282.6	61.0	283.6	89.3	255.3	1.0	-28.3	-27.3
3S1E15M003	600	L	Amador	83.0	279.9	79.0	283.8	106.7	256.2	3.9	-27.7	-23.7
3S1E16A004	603	L	Amador	75.3	284.0	77.4	282.0	111.2	248.2	-2.1	-33.8	-35.9
3S1E16B001	805	D	Amador	77.7	278.1	75.4	280.4	113.9	241.9	2.3	-38.5	-36.2
3S1E16C002	190	L	Amador	50.6	293.8	51.0	293.4	74.0	270.4	-0.4	-23.0	-23.4
3S1E16C003	305	L	Amador	62.9	281.4	56.9	287.4	96.3	248.0	6.0	-39.4	-33.4
3S1E16C004	375	L	Amador	67.0	277.2	59.0	285.2	100.2	244.0	8.0	-41.2	-33.2
3S1E16E004	105	U	Amador	44.4	307.3	46.0	305.7	55.9	295.8	-1.6	-9.8	-11.5
3S1E16L002	151	L	Amador	50.2	296.1	53.7	292.6	56.5	289.8	-3.5	-2.8	-6.3
3S1E16P005	75	U	Amador	38.5	316.0	39.0	315.5	57.1	297.5	-0.5	-18.0	-18.6
3S1E16R001	239	L	Amador	70.1	292.5	71.2	291.3	92.3	270.2	-1.1	-21.1	-22.3
3S1E17B004	248	L	Amador	38.3	299.4	39.7	298.0	50.0	287.7	-1.4	-10.3	-11.7
3S1E17D003	108	L	Bernal	27.0	298.1	28.7	296.5	41.1	284.0	-1.7	-12.5	-14.1
3S1E17D004	236	L	Bernal	27.0	298.1	28.9	296.3	43.0	282.1	-1.9	-14.2	-16.0
3S1E17D005	308	L	Bernal	27.0	298.2	28.7	296.4	43.0	282.1	-1.7	-14.3	-16.0
3S1E17D006	408	L	Bernal	26.9	298.3	27.8	297.4	29.0	296.1	-0.9	-1.2	-2.1
3S1E17D007	684	D	Bernal	19.7	305.4	19.2	305.9	19.6	305.5	0.5	-0.4	0.1
3S1E17D010	425	L	Bernal	29.9	298.2	31.2	296.9	45.3	282.8	-1.4	-14.1	-15.5
3S1E17D011	603	L	Bernal	26.4	298.4	27.2	297.6	34.7	290.1	-0.8	-7.5	-8.3
3S1E18A005	454	L	Bernal	32.2	295.1	34.5	292.8	39.2	288.1	-2.3	-4.7	-7.0
3S1E18E004	83	U	Bernal	22.8	297.4	24.2	296.0	30.3	290.0	-1.4	-6.1	-7.4
3S1E18J002	71	U	Bernal	24.5	298.5	26.0	297.0	32.7	290.3	-1.5	-6.7	-8.2
3S1E18N001	708	L	Bernal	24.3	295.1	25.9	293.5	34.7	284.8	-1.6	-8.8	-10.4

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 2019 TO FALL 2020

Well Number	Well Depth	Aquifer	Subarea	Fall 2019		Spring 2020		Fall 2020		Change in Elevation (ft)		
										Seasonal		Annual
				Depth to Water	GW Elev	Depth to Water (ft)	GW Elev	Depth to Water (ft)	GW Elev	Fall 19 to Spring 20	Spring 20 to Fall 20	Fall 19 to Fall 20
1S4E31P005	24	U	Tracy	17.6	42.4	18.4	41.6	18.5	41.5	-0.8	-0.1	-0.9
2S1E32E001	70	U	None	34.5	358.0	36.0	356.6	37.7	354.9	-1.5	-1.7	-3.2
2S1E32N001	44	U	Camp	17.7	343.1	18.2	342.6	19.2	341.6	-0.5	-1.1	-1.6
2S1E32Q001	45	U	Camp	26.1	341.5	26.8	340.7	28.0	339.6	-0.8	-1.1	-1.9
2S1E33L001	80	U	None	48.1	341.3	51.1	338.4	52.0	337.5	-3.0	-0.9	-3.9
2S1E33P002	55	U	Camp	30.4	339.7	32.0	338.1	32.9	337.2	-1.6	-0.9	-2.5
3S1E19A010	331	L	Bernal	39.9	297.2	42.1	294.9	50.7	286.3	-2.2	-8.6	-10.8
3S1E19A011	330	L	Bernal	34.3	299.9	36.5	297.8	44.7	289.5	-2.2	-8.2	-10.4
3S1E19C004	78	U	Bernal	22.7	299.5	24.3	297.9	31.4	290.9	-1.6	-7.0	-8.6
3S1E20B002	500	L	Bernal	NM	NM	NA	NA	NM	NM	-	-	-
3S1E20C007	153	U	Bernal	40.1	298.5	41.9	296.8	48.5	290.1	-1.8	-6.6	-8.4
3S1E20C008	315	L	Bernal	41.1	297.6	42.6	296.1	52.2	286.5	-1.5	-9.6	-11.1
3S1E20C009	515	L	Bernal	41.4	297.4	43.4	295.4	51.8	287.0	-2.0	-8.4	-10.4
3S1E20J004	72	U	Bernal	31.5	300.1	33.1	298.5	38.3	293.3	-1.6	-5.2	-6.8
3S1E20M011	71	U	Bernal	24.0	301.8	25.5	300.3	32.1	293.6	-1.5	-6.6	-8.1
3S1E20Q002	65	U	Bernal	18.7	307.2	19.0	306.9	21.8	304.1	-0.3	-2.8	-3.1
3S1E22D002	72	U	Amador	47.0	321.1	51.4	316.7	56.7	311.4	-4.4	-5.3	-9.7
3S1E23J001	120	L	Amador	87.6	340.6	92.2	336.0	93.8	334.4	-4.6	-1.6	-6.2
3S1E24Q001	440	L	Amador	86.0	341.5	90.8	336.7	100.3	327.2	-4.8	-9.5	-14.3
3S1E25C003	146	U	Amador	87.9	366.2	90.7	363.5	92.4	361.8	-2.8	-1.7	-4.5
3S1E29M004	57	U	Castle	16.3	294.6	16.6	294.4	22.6	288.3	-0.2	-6.1	-6.3
3S1E29P002	42	U	Bernal	26.8	276.0	26.4	276.4	28.0	274.9	0.4	-1.5	-1.1
3S1W01B009	162	L	Dublin	8.5	325.1	8.2	325.3	9.1	324.4	0.3	-0.9	-0.6
3S1W01B010	414	L	Dublin	4.3	329.3	289.0	44.6	4.0	329.6	-284.7	285.0	0.3
3S1W01B011	560	L	Dublin	8.2	325.5	7.0	326.7	12.8	320.9	1.2	-5.8	-4.6
3S1W02A002	47	U	Dublin	24.8	344.6	24.6	344.8	27.7	341.7	0.2	-3.1	-2.9
3S1W12B002	40	U	Dublin	20.9	322.0	19.5	323.4	21.7	321.2	1.4	-2.1	-0.8
3S1W12J001	62	U	Dublin	16.2	313.1	15.7	313.6	17.4	312.0	0.5	-1.7	-1.2
3S1W13J001	48	U	Castle	29.9	314.0	26.9	317.0	30.8	313.2	3.0	-3.8	-0.9
3S2E01F002	69	U	Spring	23.5	549.5	23.3	549.7	23.8	549.2	0.2	-0.5	-0.3
3S2E02B002	46	U	Spring	9.6	529.9	8.9	530.6	10.4	529.1	0.7	-1.5	-0.8
3S2E03A001	54	U	Spring	5.6	512.0	4.1	513.5	5.9	511.8	1.5	-1.8	-0.3
3S2E03K003	60	U	Mocho I	13.6	509.3	13.6	509.2	14.0	508.8	-0.1	-0.4	-0.4
3S2E05N001	210	M	Mocho II	29.8	414.2	27.5	416.6	34.1	410.0	2.3	-6.6	-4.3
3S2E07C002	49	U	Mocho II	25.3	395.5	24.7	396.2	27.2	393.6	0.7	-2.6	-1.9
3S2E07H002	54	U	Mocho II	27.1	415.7	26.0	416.9	32.3	410.6	1.1	-6.3	-5.2
3S2E07N002	162	U	Amador	120.0	302.0	122.7	299.4	135.5	286.5	-2.7	-12.8	-15.5
3S2E07P003	510	L	Amador	136.4	295.0	141.3	290.2	166.0	265.5	-4.9	-24.7	-29.6
3S2E07R002	805	D	Mocho II	3.2	442.8	2.8	443.2	4.0	442.0	0.4	-1.2	-0.8
3S2E07R003	583	L	Upland	85.5	360.5	22.9	423.2	NA	NA	62.7	-	-
3S2E08H002	46	U	Mocho II	29.6	440.1	22.1	447.5	36.5	433.1	7.4	-14.4	-7.0
3S2E08H003	195	L	Mocho II	50.6	426.7	45.8	431.5	56.1	421.2	4.8	-10.3	-5.5
3S2E08H004	385	L	Mocho II	105.2	371.8	48.2	428.7	78.2	398.8	57.0	-30.0	27.0
3S2E08K002	74	U	Mocho II	32.4	432.4	31.5	433.3	41.3	423.5	1.0	-9.9	-8.9
3S2E08N002	526	L	Mocho II	48.4	405.3	75.4	378.3	99.0	354.6	-27.0	-23.6	-50.6
3S2E08P001	273	L	Mocho II	39.3	428.9	38.0	430.2	48.5	419.7	1.3	-10.5	-9.2
3S2E08Q009	114	L	Mocho II	26.2	438.5	25.2	439.5	36.1	428.6	1.1	-10.9	-9.8
3S2E09Q004	80	U	Mocho II	22.0	482.5	24.1	481.3	36.0	469.5	-1.2	-11.9	-13.0
3S2E10F003	45	U	Mocho I	13.1	521.8	13.5	521.3	14.7	520.2	-0.4	-1.1	-1.6
3S2E10Q001	44	U	Mocho II	24.1	531.3	26.0	529.4	28.7	526.7	-1.9	-2.7	-4.6
3S2E10Q002	325	L	Mocho II	29.4	520.2	32.1	517.3	34.0	515.4	-3.0	-1.9	-4.9
3S2E11C001	66	U	Mocho I	27.1	530.0	27.7	528.7	28.4	528.0	-1.3	-0.7	-2.1
3S2E12C004	108	U	Spring	NA	NA	55.6	535.8	NA	NA	-	-	-
3S2E12J003	160	L	Spring	83.5	547.6	NA	NA	82.1	546.7	-	-	-0.8
3S2E14A003	110	U	Mocho I	69.3	532.5	NA	NA	NA	NA	-	-	-
3S2E14B001	300	L	Mocho I	109.6	483.8	64.1	529.2	65.0	528.3	45.5	-0.9	44.5
3S2E15E002	192	L	Mocho II	27.1	522.6	40.5	509.2	55.2	494.5	-13.4	-14.7	-28.1
3S2E15L001	41	U	Mocho II	12.4	549.1	29.8	531.7	39.3	522.2	-17.3	-9.6	-26.9
3S2E15M002	45	U	Mocho II	30.7	518.7	32.9	516.6	45.2	504.2	-2.1	-12.4	-14.5
3S2E15Q006	301	L	Mocho II	51.1	526.5	50.0	527.5	59.3	518.3	1.1	-9.3	-8.2
3S2E15R017	63	U	Mocho II	13.1	579.4	9.1	583.3	12.8	579.6	4.0	-3.7	0.3
3S2E15R018	138	L	Mocho II	22.0	570.5	12.8	579.7	26.2	566.3	9.2	-13.4	-4.2
3S2E16A003	240	L	Mocho II	32.8	494.2	34.3	492.8	77.4	449.7	-1.4	-43.1	-44.5
3S2E16C001	584	L	Mocho II	75.0	436.0	59.1	451.9	71.5	439.5	15.9	-12.4	3.5
3S2E16E004	45	U	Mocho II	16.2	490.1	17.6	488.7	30.1	476.2	-1.5	-12.5	-13.9
3S2E17E002	94	U	Mocho II	NM	NM	NA	NA	NA	NA	-	-	-
3S2E18B001	497	L	Amador	138.2	300.4	114.0	324.6	NM	NM	24.2	-	-
3S2E18E001	134	U	Amador	87.9	336.0	83.2	340.7	97.8	326.1	4.7	-14.6	-9.9
3S2E19D007	180	U	Amador	90.8	324.3	101.2	313.8	108.8	306.3	-10.4	-7.6	-18.0
3S2E19D008	260	L	Amador	91.2	323.8	101.5	313.5	109.2	305.8	-10.3	-7.7	-18.0
3S2E19D009	390	L	Amador	120.5	294.5	120.9	294.1	150.4	264.6	-0.4	-29.5	-29.9

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 2019 TO FALL 2020

Well Number	Well Depth	Aquifer	Subarea	Fall 2019		Spring 2020		Fall 2020		Change in Elevation (ft)		
										Seasonal		Annual
				Depth to Water	GW Elev	Depth to Water (ft)	GW Elev	Depth to Water (ft)	GW Elev	Fall 19 to Spring 20	Spring 20 to Fall 20	Fall 19 to Fall 20
1S4E31P005	24	U	Tracy	17.6	42.4	18.4	41.6	18.5	41.5	-0.8	-0.1	-0.9
2S1E32E001	70	U	None	34.5	358.0	36.0	356.6	37.7	354.9	-1.5	-1.7	-3.2
2S1E32N001	44	U	Camp	17.7	343.1	18.2	342.6	19.2	341.6	-0.5	-1.1	-1.6
2S1E32Q001	45	U	Camp	26.1	341.5	26.8	340.7	28.0	339.6	-0.8	-1.1	-1.9
2S1E33L001	80	U	None	48.1	341.3	51.1	338.4	52.0	337.5	-3.0	-0.9	-3.9
2S1E33P002	55	U	Camp	30.4	339.7	32.0	338.1	32.9	337.2	-1.6	-0.9	-2.5
3S2E19D010	470	L	Amador	98.1	316.8	101.0	313.9	127.9	287.0	-2.9	-26.9	-29.8
3S2E19N003	120	U	Amador	40.3	378.2	44.5	374.0	49.1	369.3	-4.3	-4.6	-8.9
3S2E19N004	203	L	Amador	32.0	385.9	37.5	380.4	45.1	372.9	-5.5	-7.5	-13.0
3S2E20M001	184	L	Amador	49.9	428.9	49.2	429.6	55.4	423.4	0.7	-6.2	-5.5
3S2E22B001	32	U	Mocho II	15.1	570.8	15.1	570.8	Dry	Dry	0.0	-	-
3S2E23E001	40	U	Mocho II	16.8	596.6	16.4	597.0	18.0	595.4	0.3	-1.6	-1.3
3S2E23E002	110	L	Mocho II	14.6	598.7	14.3	598.9	16.1	597.1	0.3	-1.8	-1.5
3S2E24A001	46	U	Mocho I	19.8	698.0	19.5	698.2	18.3	699.4	0.3	1.2	1.5
3S2E26J002	44	U	Mocho II	10.5	679.5	7.3	682.6	12.4	677.5	3.2	-5.1	-1.9
3S2E29F004	36	U	Amador	8.3	449.2	8.2	449.3	11.0	446.5	0.1	-2.8	-2.8
3S2E30C001	150	L	Amador	24.2	415.3	32.0	407.4	34.0	405.4	-7.8	-2.0	-9.8
3S2E30D002	44	U	Amador	21.3	410.3	21.5	410.1	22.4	409.2	-0.2	-0.9	-1.2
3S2E32E007	37	U	Upland	19.5	591.5	NA	NA	17.8	593.1	-	-	1.6
3S2E33G001	17	U	Amador	9.1	502.5	9.0	502.5	9.9	501.7	0.1	-0.9	-0.8
3S3E06Q003	30	U	Altamont	8.9	672.2	11.8	669.2	8.9	672.2	-2.9	2.9	0.0
3S3E07D002	72	U	Spring	46.2	576.3	NA	NA	NA	NA	-	-	-

U = Upper; L = Lower; NM = Not Measured; NA = Not Available
OBS = Obstructed; - = Not Applicable; highlight = Key Well
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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

Wells in 2020 GW Elevation Program

- Supply, Lower
- Supply, Upper
- Monitoring, Deep
- Monitoring, Lower
- Monitoring, Upper
- Municipal, Lower
- Nested, Deep
- Nested, Lower
- Nested, Upper
- Key Wells
- Main Basin
- Fringe Areas
- Upland Areas
- Mining Pond
- Streams
- Township-Range Line

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Figure 6-1
Map of Wells in
2020 Groundwater Elevation Program
Livermore Valley Groundwater Basin

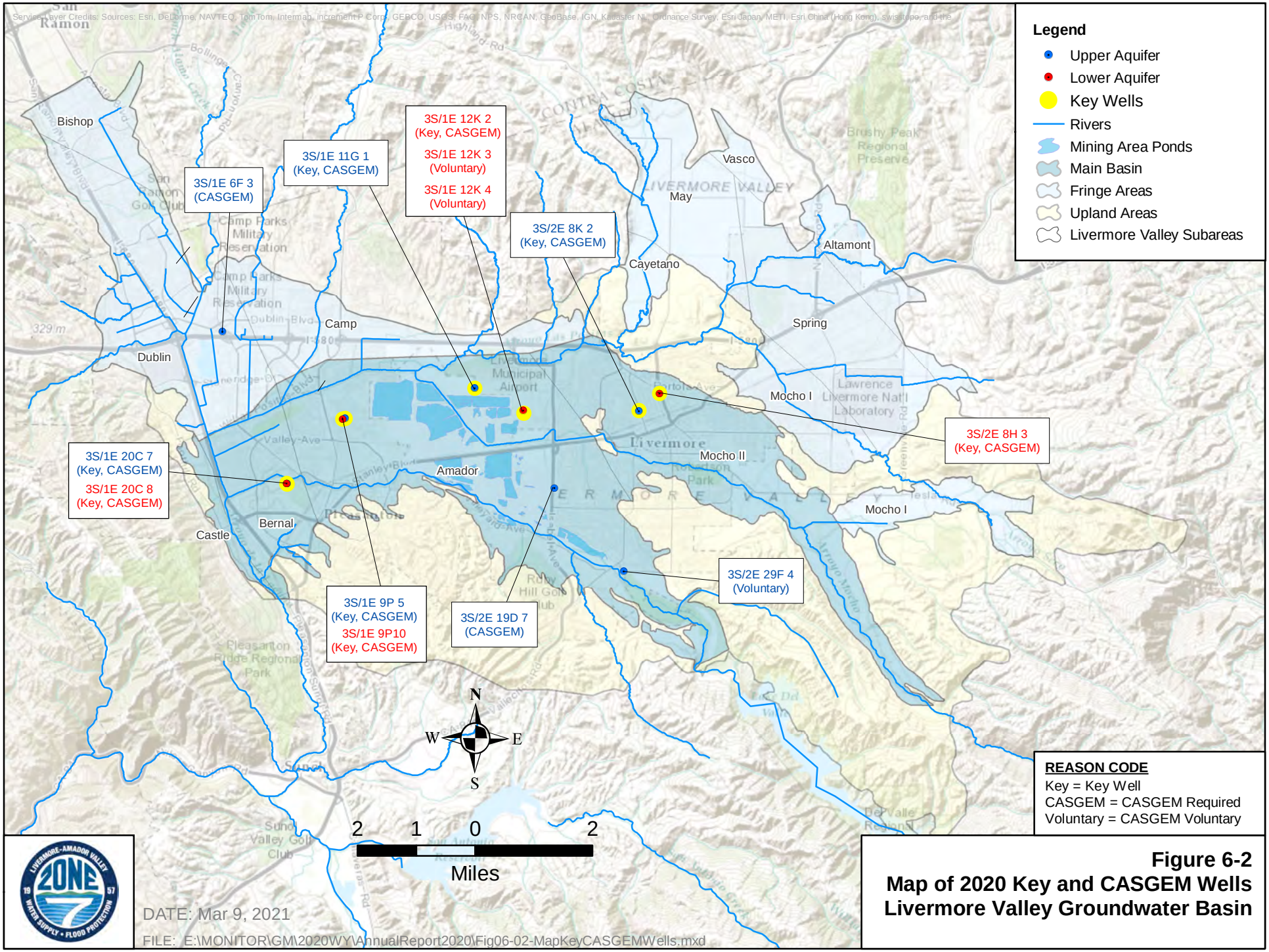
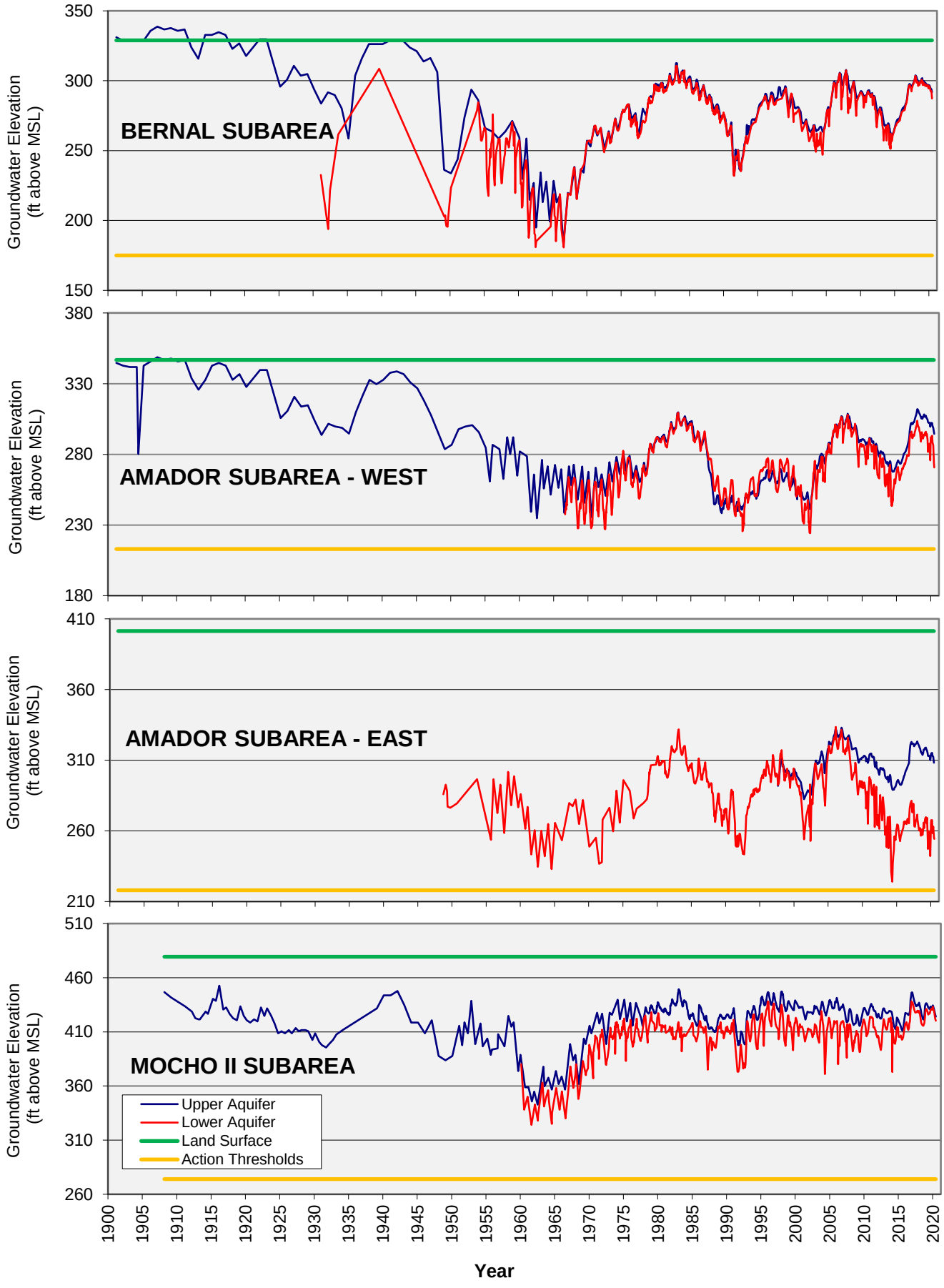


Figure 6-2
Map of 2020 Key and CASGEM Wells
Livermore Valley Groundwater Basin

FIGURE 6-3
HISTORICAL KEY WELL HYDROGRAPHS
1901 to 2020 WATER YEARS



LEGEND

2020 Program Wells (Upper Aquifer)

- Supply
- Monitor
- Nested
- Mining Pond
- Key Wells
- Contours (Interval = 10')
- Hatch pattern towards lower elevation
- Streams
- Township-Range Line
- Main Basin
- Fringe Area
- Upland Area

Mining Pond Status

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

2S/1W 2S/1E 2S/2E 2S/3E
3S/1W 3S/1E 3S/2E 3S/3E
4S/1W 4S/1E 4S/2E 4S/3E

N W E S

0 2 4
Miles

DATE: Mar 10, 2021
FILE: E:\MONITOR\GM\2020WY\AnnualReport2020\Fig06-04-GradientSpringUpper20.mxd

Figure 6-4
Groundwater Gradient Map
Upper Aquifer; Spring 2020 (April)
Livermore Valley Groundwater Basin

LEGEND

2020 Program Wells (Upper Aquifer)

- Supply
- Monitor
- Nested
- Mining Pond
- Key Wells
- 2020 Contours (Interval = 10')
- Hatch pattern towards lower elevation
- Streams
- Township-Range Line
- Main Basin
- Fringe Area
- Upland Area

Mining Pond Status

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

N
W E
S

0 2 4
Miles

DATE: Mar 10, 2021
FILE: E:\MONITOR\GM\2020WY\AnnualReport2020\Fig06-05-GradientFallUpper20.mxd

Figure 6-5
Groundwater Gradient Map
Upper Aquifer; Fall 2020 (September)
Livermore Valley Groundwater Basin

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

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
- Mining Ponds 2020
- Main Basin
- Fringe Area
- Upland Area

FRINGE SUBAREA - NORTH

UPLAND SUBAREA

MAIN BASIN

UPLAND SUBAREA

FRINGE SUBAREA - NORTHEAST

FRINGE SUBAREA - EAST

UPLAND SUBAREA

UPLAND SUBAREA

UPLAND SUBAREA

N

W E

S

0 2 4

Miles

DATE: Jan 26, 2021

FILE: E:\MONITOR\GM\2020WY\AnnualReport2020\Fig06_06-ChangeGradientUpper20.mxd

Figure 6-6
Change in Groundwater Elevation
Upper Aquifer; Fall 2019 to Fall 2020
Livermore Valley Groundwater Basin

LEGEND

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
- Mining Ponds 2020
- Streams

FRINGE SUBAREA - NORTH

UPLAND SUBAREA

MAIN BASIN

UPLAND SUBAREA

UPLAND SUBAREA

FRINGE SUBAREA - NORTHEAST

FRINGE SUBAREA - EAST

UPLAND SUBAREA

N

W E

S

0 2 4

Miles

DATE: Jan 27, 2021

FILE: E:\MONITOR\GM\2020WY\AnnualReport2020\Fig06-07-DepthToUpperGWTable20.mxd

Figure 6-7
Depth to Groundwater
Upper Aquifer; Fall 2020 (September)
Livermore Valley Groundwater Basin

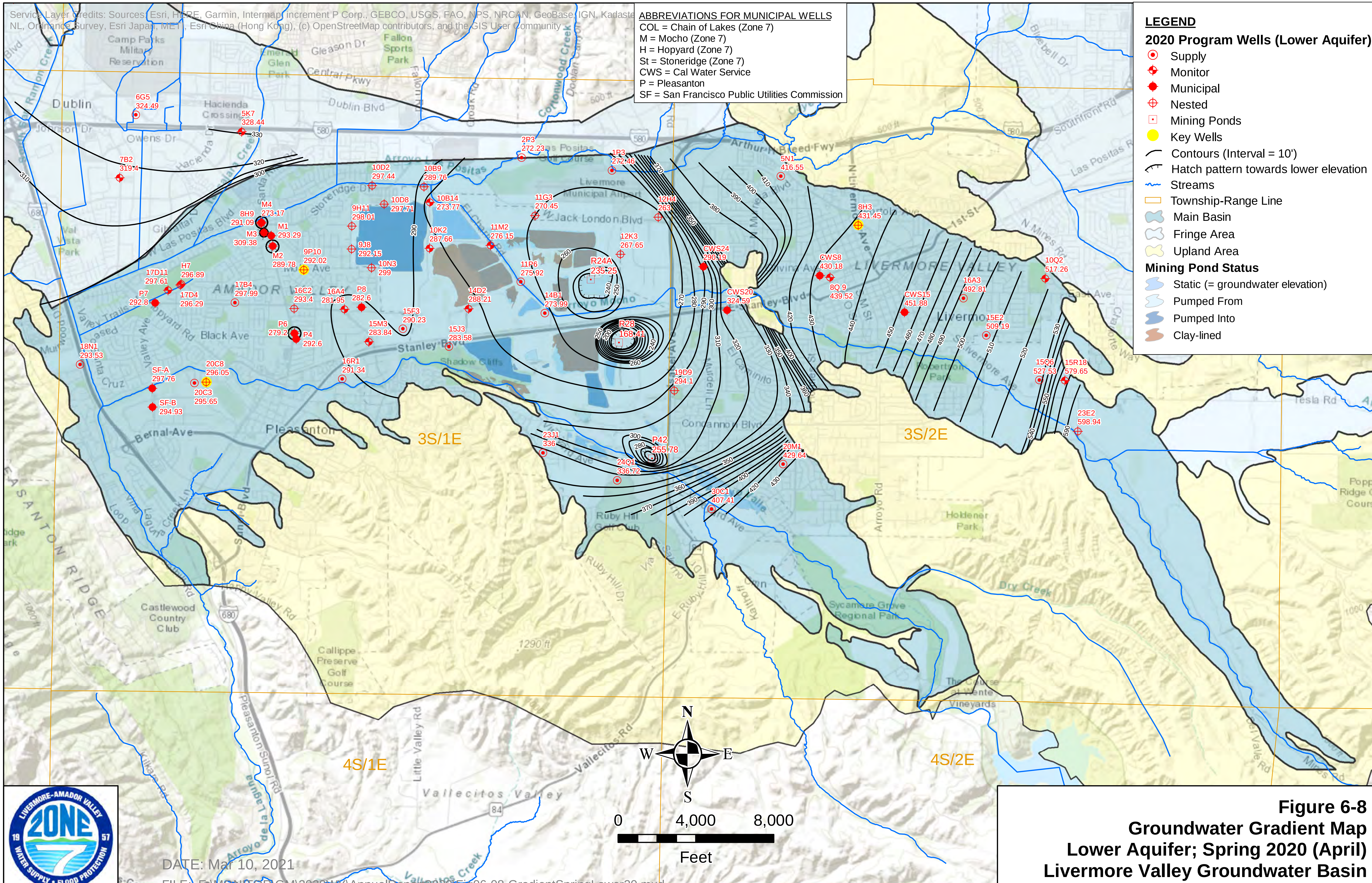


Figure 6-8
Groundwater Gradient Map
Lower Aquifer; Spring 2020 (April)
Livermore Valley Groundwater Basin

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

2020 Program Wells (Lower Aquifer)
- Supply
- Monitor
- Municipal
- Nested
- Mining Ponds
- Key Wells
- Contours (Interval = 10')
- Hatch pattern towards lower elevation
- Streams
- Township-Range Line
- Main Basin
- Fringe Area
- Upland Area

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

3S/1E
3S/2E
4S/1E
4S/2E

N
W
E
S

0 4,000 8,000
Feet

DATE: Mar 10, 2021
FILE: F:\MONITORGM\2020WY\AnnualReport2020\Fig06-09-GradientFallLower20.mxd

Figure 6-9
Groundwater Gradient Map
Lower Aquifer; Fall 2020 (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
- Township-Range Line
- Streams
- Municipal Supply Wells

UPLAND SUBAREA

FRINGE SUBAREA - NORTH

FRINGE - NOR

MAIN BASIN

R24A

R28

P42

3S/1E

2E

UPLAND SUBAREA

FRINGE SUBAREA - EAST

UPLAND SUBAREA

UPLAND SUBAREA

4S/1E

4S/2E

W

N

W E

S

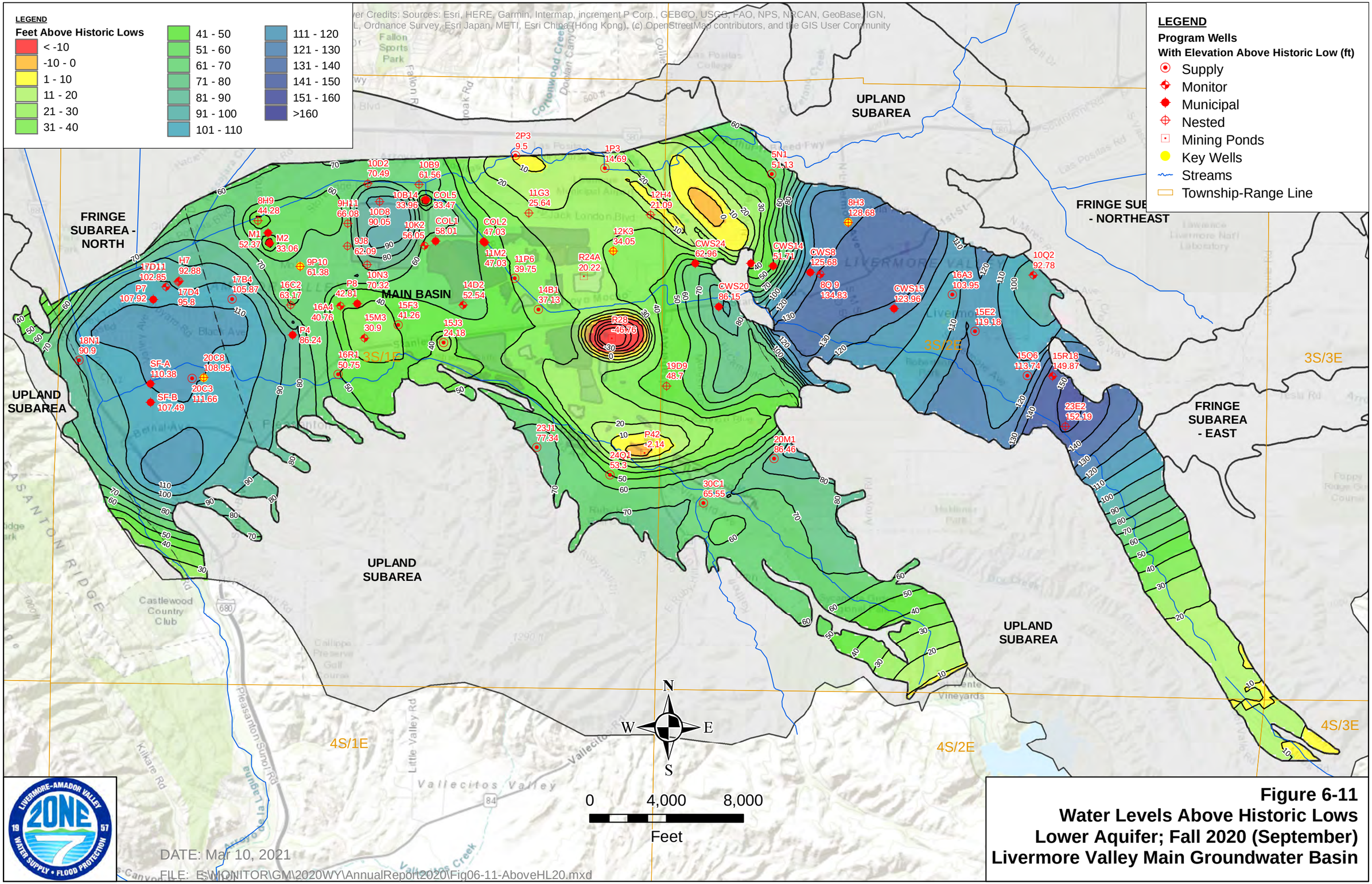
0 4,000 8,000

Feet

DATE: Mar 10, 2021

FILE: E:\MONITOR\GM\2020WY\AnnualReport2020\Fig06-10_ChangeGradientLower20.mxd

Figure 6-10
Change in Groundwater Elevation
Lower Aquifer; Fall 2019 to Fall 2020
Livermore Valley Main Groundwater Basin



DATE: Mar 10, 2021

FILE: F:\MONITOR\GM\2020WY\AnnualReport2020\Fig06-11-AboveHL20.mxd

Figure 6-11
Water Levels Above Historic Lows
Lower Aquifer; Fall 2020 (September)
Livermore Valley Main Groundwater Basin

7 Groundwater Quality

7.1 Program Description

7.1.1 Monitoring Network

Background information regarding the Groundwater Quality Program is provided in *Sections 3.3.3 and 4.6* of the Alternative GSP. 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. Zone 7 maintains a robust monitoring network of 218 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 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*. *Figure 7-1* shows the well locations.

7.1.2 Constituents of Concern

7.1.2.1 Metals and Minerals

Zone 7 conducts annual sampling and analysis for inorganic constituents-of-concern for meeting the Livermore Valley Groundwater Basin (Basin) groundwater quality objectives. The primary constituents include TDS, nitrate, boron, and total chromium. The following is a summary of the groundwater quality objectives and minimum thresholds for these constituents.

- 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 Nitrogen [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)

7.1.2.2 Other CECs

Per- and polyfluoroalkyl substances (PFAS) are a large group of human-made substances that do not occur naturally in the environment. PFAS are classified by the Environmental Protection

Agency (EPA) as "contaminants of emerging concern" (CECs). These substances have been used extensively in the United States since the 1940's, particularly in surface coating and protectant formulations due to their ability to repel oil, grease, and water. There is limited research to date, but some studies show that they may cause adverse health effects. Additional research is needed to determine the full scope of PFAS impacts on human health.

While there are no current federal or California State limits (e.g., MCLs), both the EPA and California State Water Resources Control Board Division of Drinking Water's (DDW) have published regulatory limits for PFAS compounds (see *Table 7-A* below).

Table 7-A: Regulatory Limits for PFAS Compounds (in ppt)

Agency	Type of Limit	PFOS	PFOA	PFBS**
US EPA	Screening Level	40*	40*	-
	Preliminary Remediation Goal (PRG)	70*	70*	-
SWRCB-DDW	Notification Level (NL)	6.1	5.1	500
	Response Level (RL)	40	10	5,000

* Either individually or combined.
** Pending

7.1.3 Program Changes for the Water Year

The Sampling Program changes made in the 2020 WY involved one of the same monitoring well changes identified in *Section 6.1.2* for the Groundwater Elevation Program and shown below in *Table 7-B.*

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

Action	Reason	Note
Well 3S/3E 6Q 4 Removed from program	Well was destroyed	Nearby 3S/3E 6Q 3 is still in program
Well 3S/2E 32E 7 Added to program	Down-gradient of ponds at Del Valle Water Treatment Plant	Already in Groundwater Levels Program

Up until recently, CWS did not consistently test their Livermore municipal supply wells for all four constituents-of-concern (TDS, Nitrate, Boron, and Chromium) discussed in this report. At Zone 7's

request, CWS tested some of their well samples for the four constituents of concern and suppled the results to Zone 7 starting in the 2020 WY.

In March 2019, the DDW launched a state-wide phased investigation and issued orders to operators of hundreds of susceptible drinking water sources, including Zone 7 and City of Pleasanton, to conduct quarterly PFAS monitoring for at least one year. Since then, DDW also issued orders to operators of selected landfills, airports, and chrome-plating facilities to conduct PFAS monitoring and investigations.

During the 2020 WY, 60 wells were sampled and tested for PFAS compounds (see *Section 7.1.2.2* above), some more than once. This total includes data from seven Zone 7, six CWS, and three City of Pleasanton municipal wells. In addition to the DDW-required quarterly monitoring of the municipal wells, Zone 7 sampled and tested several other monitoring program wells for PFAS to determine if PFAS contamination is widespread. Due to the prevalence of PFAS in the environment and the extremely low reporting limits (i.e., parts per trillion), the groundwater from these wells was sampled using DDW's PFAS Sampling Guidelines (DDW, 2020). Also in 2020, Zone 7 hired Jacobs Engineering, Inc. to conduct a PFAS Potential Source Investigation (*Jacobs, 2020*) that included recommendations for additional sampling of existing monitoring wells. *Section 7.2.6* of this report includes a summary of the Jacobs report and testing results from the wells sampled this year for PFAS.

7.2 Results for the 2020 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 for select metals and minerals from groundwater samples collected for the Groundwater Quality Program during the 2020 WY.
- *Table 7-3* contains a summary of the PFAS results for the 2020 WY.
- *Figure 7-1* shows the locations of all wells sampled for the water quality monitoring program in the 2020 WY.
- *Figure 7-2* shows graphs of historical and recent TDS concentrations in the eight Key Wells.
- *Figure 7-3* through *Figure 7-10* are iso-concentration maps of TDS, nitrate, boron, and total Cr for the Upper and Lower Aquifers, respectively.

- *Figure 7-11* and *Figure 7-12* show the PFOS concentration results in map view for the Upper and Lower Aquifers, respectively.

- *Figure 7-13* through *Figure 7-16* 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 2020 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 western portion of the Fringe Subarea and extending south into the northwestern portion of the Main Basin. 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 poorer quality water from Arroyo Las Positas, and legacy wastewater and sludge disposal practices in the Pleasanton and Livermore areas.
- In the northeastern portion of the Fringe Subarea. This high-TDS area is likely due to poorer quality water that runs off 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 drinking water quality. The Basin Objective 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 900 mg/L in the 2020 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 of the basin and municipal pumping in the western basin that pulls high-TDS groundwater laterally and downward from the North Fringe Subarea and the Upper Aquifer.

Many of the municipal supply wells in the Pleasanton area produced water with TDS concentrations greater than the minimum threshold of 500 mg/L during the 2020 WY. The highest concentrations were detected as follows:

- The Mocho wellfield had one well above 800 mg/L (854 mg/L in Mocho 4).
- One of the San Francisco Public Utilities Commission (SFPUC) wells in the Bernal wellfield (SF-A) detected TDS at 932 mg/L.
- A monitoring well (3S/1E 17B 4) located central to four active wellfields (Mocho, Hopyard, Bernal, and Busch Valley) had TDS at 902 mg/L.

The source of these high TDS concentrations is believed to be the Upper Aquifer Zone, which has had TDS concentrations as high as 2,000 mg/L in the same area directly above the Mocho well screened intervals. 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 wellfield. Zone 7 can strip and export much of the salts from the water produced by the Mocho wells with its onsite groundwater demineralization facility (MGDP). See *Section 13.4.2.3* for details on the Mocho Groundwater Demineralization Plant's (MGDP's) use in the 2020 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 revisit the strategies and their effectiveness for the 5-year update to the Alternative GSP in 2022.

7.2.3 Nitrates

7.2.3.1 Upper Aquifer Zone

Zone 7's Nutrient Management Plan (NMP, *Zone 7, 2015b*) studied nitrate occurrences within the Livermore Groundwater Basin, as well as its nitrate loading and assimilative capacity. 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 ten local high nitrate Areas of Concern (AOC) where nitrate concentrations persist above the Basin Objective and minimum threshold (*Figure 7-5)*. Also, the NMP commits Zone 7 to monitoring the conditions in these AOCs and promoting Best Management Practices (BMPs) that lead to reductions in nutrient loading. The following are the nitrate monitoring results for the ten AOCs during the 2020 WY (roughly from west to east).

- **Happy Valley**—Nitrate concentrations were not monitored in this Upland AOC in the 2020 WY; however, when studied in the 2013 WY by Zone 7 and ACDEH, the nitrate occurrences were found to be stable.

- **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 2020 WY, the concentration was just below the MCL of 10 mg/L at 9.58 mg/L (10.5 mg/L for the 2019 WY).
- **Staples Ranch**—This AOC is in the eastern portion of the Northern Fringe Subarea. It extends westward from monitoring well 3S/1E 2M 3 along the Main Basin boundary. In the 2020 WY, the nitrate concentration was detected above the threshold after dropping below in the 2019 WY (12.5 mg/L in 2020 WY compared to 4.25 mg/L in 2019 WY). A second area of elevated concentrations in this AOC existed historically to the west near Tassajara Creek; however, for the past few years, nitrate concentrations in this portion of the AOC have dropped below the minimum threshold (9.3 mg/L in 2020 WY and 9.07 mg/L in 2019 WY, both in 3S/1E 5K 6).
- **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 15.7 mg/L during the 2020 WY which is consistent with the past few years (16.8 mg/L in 2019 WY).
- **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 nitrate concentration detected in this AOC during the 2020 WY was 13.2 mg/L in 3S/1E 12D 2 (compared to last year's highest concentration at 18.2 mg/L in the same well).
- **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 was further delineated by historical data from several domestic supply wells located in the Bel Roma neighborhood. Again, for the 2020 WY, only 2S/2E 28D 2 was sampled and had a concentration of 42 mg/L (versus 32.3 mg/L in the 2019 WY). Over the last six years the nitrate concentrations in the monitoring wells have varied between 16.7 mg/L and 42.8 mg/L.
- **Charlotte Way**—The high nitrate in this AOC exists in the western portion of the Mocho I Subarea and may be commingled with Buena Vista's nitrate plume 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 2020 WY, only one of the three wells sampled exceeded the minimum threshold; 13.8 mg/L in 3S/2E 3K 3, compared to 9.15 mg/L in 2019 WY. Nitrate concentrations were detected just below the minimum threshold in two other monitoring wells at 9.83 mg/L in 3S/2E 14A 3 (12 mg/L in the 2019 WY) and at 9.35 mg/L in 3S/2E 10F 3 (11 mg/L in the 2019 WY).
- **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

2020 WY, the highest concentration was detected in the northeastern portion of the plume at 15.2 mg/L in 3S/2E 10Q 1 (16.6 mg/L in 2019 WY).

- **Greenville**—This 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 2020 WY, 3S/2E 24A 1 had a concentration of 24.5 mg/L (25.4 mg/L in 2019 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 2020 WY, the nitrate concentration in 3S/2E 26J 2 was below the MCL at 1.37 mg/L down from 3.67 mg/L in 2019 WY.

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 2020 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 2020 WY, nitrate concentrations exceeded the minimum threshold in two monitoring wells (11.2 mg/L in 3S/2E 8H 3 and 10.8 mg/L in 3S/2E 16A 3). Four other wells, including two municipal supply wells located in the same AOC had nitrate concentrations that approached the minimum threshold (8.7 mg/L in CWS 10, 8.04 mg/L in CWS 9, 9.6 mg/L in 3S/2E 15E 2, and 9.35 mg/L in 3S/2E 5N 1). Overall, this Lower Aquifer nitrate plume has been relatively stable over the last five years.

7.2.4 Boron

7.2.4.1 Introduction

Boron is a naturally occurring element in the Livermore Valley Groundwater Basin; elevated concentrations likely are caused by natural processes affecting alkali/marine sediments (particularly prevalent in eastern watersheds). While there is no MCL for boron, the United States Environmental Protection Agency (USEPA) has identified a Health Reference Level (HRL) of 1,400 micrograms per liter (µg/L). Boron also becomes a problem for irrigated crops when present at levels above 1,000 or 2,000 µg/L, depending on the crop sensitivity. Boron is a groundwater

parameter of interest for the valley's agriculture and golf communities because of its potential for impact on certain irrigated crops and turf. The minimum threshold was set at 1,400 µg/L.

7.2.4.2 Upper Aquifer Zone

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 2020 WY (12,000 µg/L) was found near the center of this area in 3S/1E 4J 5, compared to 9,880 µg/L in the 2019 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 2020 WY was detected at 29,000 µg/L in 2S/2E 27P 2, compared to 31,000 µg/L in the 2019 WY.

The source of boron is likely 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 Arroyo Las Positas and lower Arroyo Mocho. This occurrence of elevated boron may be from high-boron groundwater discharging into the Arroyo Las Positas in the eastern portion of the Valley and flowing downstream to the Arroyo Mocho, recharging groundwater along the way. The eastern portion of the Arroyo Las Positas has been a gaining stream and continuously flowing into the Arroyo Mocho since the 1981 WY.

7.2.4.3 Lower Aquifer Zone

In the 2020 WY, boron was detected above 1,400 µg/L in the Lower Aquifer in the following areas of the groundwater basin (*Figure 7-8*):

- In municipal supply well Mocho 3, in Zone 7's Mocho Wellfield, at 1,410 µg/L (compared to 1,810 µg/L in the 2019 WY).

- In monitoring well 3S/2E 23E 2, in the southeastern portion of the Mocho II Subarea, at 2,610 µg/L (compared to 1,780 µg/L in the 2019 WY).

7.2.5 Chromium

7.2.5.1 Introduction

Chromium (Cr) is typically found at very low concentrations in groundwater in the Basin. It can be a naturally occurring element or an anthropogenic impact. Prior to August 2017, the Basin Objective and the minimum threshold in the Alternative GSP had been set at the MCL for hexavalent chromium (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 (CCR). 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 the minimum thresholds in the Alternative GSP have been set based on the State's drinking water standards, Zone 7 adjusted the minimum threshold for Cr to match the State's Cr MCL that is in effect; currently 50 µg/L.

7.2.5.2 Upper Aquifer Zone

Cr concentrations exceeded the 50 µg/L threshold in two Upper Aquifer monitoring wells during the 2020 WY sampling effort (*Figure 7-9*).

- Cr was detected at 94 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. Samples from this well have typically exhibited high Cr values in the past (63 µg/L in the 2019 WY).

- Cr was detected at 108 µg/L in monitoring well 3S/1E 7G 7 located in the North Fringe Subarea just north of the Main Basin. This well has recently been non-detect for chromium; however, chromium was detected in this well at 140 µg/L during the 2009 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 as shown on *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.

7.2.6 PFAS

7.2.6.1 Introduction

Zone 7 began sampling for PFAS compounds in the 2019 WY. Based on the detections in some of the supply wells and the limited set of monitoring wells sampled, Zone 7 hired Jacobs Engineering, Inc. to conduct a PFAS Potential Source Investigation (*Jacobs, 2020*). The investigation, which concluded in December 2020, included recommendations for additional sampling of existing monitoring wells. Those wells will be incorporated into the 2021 WY sampling program. Jacob's PFAS Potential Source Investigation Report and other information on PFAS are located on the Zone 7 website: http://www.zone7water.com/pfas-information.

Table 7-3 shows the concentrations of all PFAS compounds detected in groundwater during the 2020 WY. Of those PFAS compounds detected, only perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS) have any regulatory limits (see *Table 7-A*), and of those three compounds, PFOS had the highest concentrations relative to regulatory limits. Therefore, the two maps generated for this report (discussed below by aquifer) show PFOS concentrations (in ppt).

7.2.6.2 Upper Aquifer Zone

Figure 7-11 shows PFOS concentrations in the upper aquifer. Monitoring wells previously sampled and presented in the 2019 WY Annual Report were not resampled in the 2020 WY; however, additional wells were sampled to help determine the extent of PFOS in the groundwater basin. The results from both water years are presented in *Figure 7-11.*

- While most of the wells sampled in the 2019 WY had PFOS detections, those concentrations that were above the EPA's 40 ppt screening level and above the DDW's 70 ppt response level (RL) appear to be northeast of the mining area in the vicinity of the Jack London Boulevard. The highest concentration detected in the upper aquifer remains 450 ppt in well 3S/1E 10A 2 sampled in the 2019 WY, which is just southeast of the airport.

- Two wells sampled in the 2020 WY (3S/2E 19D 7 and 19N 3) that were east of Isabel Avenue and south of Stanley Boulevard were both non-detect for PFOS.

- In the 2020 WY five wells were sampled north and east of the highest concentration area. These wells ranged from non-detect to 40 ppt (in well 3S/1E 4J 5). The PFOS detected in 3S/1E 4J 5 does not appear to be connected to the plume southeast of the airport and may come from a separate source.

7.2.6.3 Lower Aquifer Zone

Figure 7-12 shows PFOS concentrations in the lower aquifer wells that were sampled in either the 2019 or 2020 WYs. For wells that were sampled more than once, the map shows the highest PFOS concentrations detected. In nested well sets, the map shows the lower aquifer well with the highest PFOS concentration. The 2019 WY samples are labeled black with gray highlights in the map.

- Wells with concentrations above the EPA's 40 ppt screening level are within a roughly-triangular area that stretched from the southwestern edge of the airport (north of the mining area) to the City of Pleasanton's Wellfield (west of the mining area) and to Zone 7's Mocho Wellfield (northwest of the mining area).

- There were two areas where PFOS concentrations exceeded the DDW's RL (70 ppt):

    - The first extended west from the airport to Zone 7's Mocho Wellfield. This area included 3S/1E 10B 8, which had the highest concentration detected in the groundwater basin, at 1,400 ppt in the 2020 WY. Zone 7's Mocho 1 municipal well was the only municipal well in this area with PFOS concentrations above the RL at 110 ppt in the 2020 WY.

    - The second was at Pleasanton's Well 8 (Pleas 8 or P8), which had a maximum concentration of PFOS at 110 ppt in the 2020 WY. During the 2019 WY the PFOS concentrations ranged from 68 to 120 ppt. This area of elevated PFOS concentration appears to be relatively isolated as evidenced by several wells with concentrations below the RL both north (roughly up-gradient) and west (down-gradient) of Pleas 8.

- Eight of Zone 7's municipal wells have tested above the Notification Level (NL) for PFOS (6.5 ppt) in the 2020 WY, but only one of the municipal wells, Mocho 1 (i.e., 3S/1E 9M 2), had PFOS concentrations (110 ppt) that exceeded DDW's recommended RL of 70 ppt. Four of Zone 7's wells also tested above the NL for PFOA (5.1 ppt). Although additional PFAS compounds were also detected in Zone 7's water supplies, at present there are no regulatory guidelines for these contaminants.

- PFOS was detected in five of six CWS wells sampled in the 2020 WY. None of the wells had concentrations above the RL (70ppt).

Zone 7 continues to monitor and characterize PFAS in the Basin. For the 2021 WY, Zone 7 plans to add new sampling sites based on the recommendations of Jacob's PFAS Potential Source Investigation to further characterize the extent and potential sources of PFAS.

TABLE 7-1
GROUNDWATER QUALITY PROGRAM
TABLE OF PROGRAM WELLS WITH SAMPLING FREQUENCY
2020 WATER YEAR

SITE INFORMATION				*Sampling Frequency*	*Other Programs*			
State Name	*Well Name*	*Subbasin*	*Aq*		*WR*	*Muni*	*PFAS*	*WWRW*
2S1E32E001	End of Arnold Rd	None	U	1				
2S1E32N001	Camp Parks	Camp	U	1				
2S1E32Q001	Summer Glen Dr	Camp	U	1				
2S1E33L001	Gleason Dr @ Tassajara	None	U	1				
2S1E33P002	Central Pkwy at Emerald Glen	Camp	U	1				
2S1E33R001	Central Pkwy @ Grafton	None	U	1				
2S1W15F001	BOLLINGER	Bishop	U	1				
2S1W26C002	PINE VALLEY	Dublin	U	1				
2S1W36E003	Kolb Park	Dublin	U	1				
2S1W36F001	Dublin High shallow	Dublin	L	1				
2S1W36F002	Dublin High mid	Dublin	L	1				
2S2E27P002	hartford ave east	Spring	U	1				
2S2E28D002	May School	May	U	1				
2S2E28J002	FCC Well	May	L	1				
2S2E28Q001	hartford ave	May	U	1				
2S2E32K002	jenson's N liv. Ave	Cayetano	U	1				
2S2E34E001	Mud City	May	U	1				
2S2E34Q002	Hollyhock & Crocus	Spring	U	1				
3S1E01F002	Constitution Dr	Camp	U	1				
3S1E01H003	Collier Canyon g1	Camp	U	4				
3S1E01J004	Collier Vineyards	Camp	L	1				
3S1E01L001	Kitty Hawk	Camp	U	1				
3S1E01P002	Airport gas g5	Amador	U	1				
3S1E01P003	New airport well	Amador	L	4				
3S1E02J002	Maint. Bldg	Camp	U	1				
3S1E02J003	Doolan Rd East	Camp	U	1				
3S1E02K002	Doolan Rd West	Camp	U	1				
3S1E02M003	Friesman Rd North	Camp	U	1			√	
3S1E02N006	Friesman Rd South	Amador	U	1				
3S1E02P003	Crosswinds Church	Camp	L	1				
3S1E02Q001	LPGC #1	Amador	U	1			√	
3S1E02R001	Beebs	Amador	U	4				
3S1E03G002	fallon rd	Camp	U	1			√	
3S1E04A001	SMP-DUB-2	Camp	U	1			√	
3S1E04J005	Pimlico shallow	Camp	U	1			√	
3S1E04J006	Pimlico deep	Camp	U	1			√	
3S1E04Q002	gulfstream	Amador	U	1			√	
3S1E05K006	Rosewood shallow	Camp	U	1				
3S1E05K007	Rosewood deep	Camp	L	1				
3S1E05L003	Oracle	Camp	U	1				
3S1E05P006	Owens Park	Camp	U	1				
3S1E06F003	Dublin Ct	Dublin	U	1				
3S1E06N002	DSRSD MW-3	Dublin	U	1				
3S1E06N003	DSRSD MW-4	Dublin	U	1				

Aq = Aquifer: U = Upper; L = Lower; D = Deep	Frequency: Q = Quarterly; SA = SemiAnnually; A = Annually
OTHER: WR = Water Rights; Muni = Municipal wells; PFAS = Sampled for PFAS Compounds; WWRW = Wastewater and Recycled Water	

SITE INFORMATION				Sampling Frequency	Other Programs			
State Name	Well Name	Subbasin	Aq		WR	Muni	PFAS	WWRW
3S1E06N006	DSRSD NE-76	Dublin	U	1				
3S1E07B002	Hopyard rd	Dublin	L	1				
3S1E07B012	Hacienda Arch	Dublin	U	1				
3S1E07D001	DSRSD SW-75	Dublin	U	1				
3S1E07D003	DSRSD SE-70	Dublin	U	1				
3S1E07G007	Chabot Well	Dublin	U	1				
3S1E07J005	Thomas Hart School	Dublin	U	1				
3S1E08B001	Lizard Well	Amador	U	1				
3S1E08G004	Apache	Amador	U	1				
3S1E08H009	Mocho 4 Nested Shallow	Amador	L	1				
3S1E08H010	Mocho 4 Nested Middle	Amador	L	1				
3S1E08H011	Mocho 4 Nested deep	Amador	D	1				
3S1E08H013	Mocho 3 mon	Amador	D	1				
3S1E08H018	Mocho 4	Amador	L	4		√	√	
3S1E08K001	Cockroach well	Amador	U	1				
3S1E08N001	sports park	Bernal	U	1				
3S1E09B001	Stoneridge	Amador	L	4		√		
3S1E09J007	SW Lake I Shallow	Amador	U	1				
3S1E09J008	SW Lake I Middle	Amador	L	1				
3S1E09J009	SW Lake I Deep	Amador	L	1				
3S1E09M002	Mocho 1	Amador	L	4		√	√	
3S1E09M003	Mocho 2	Amador	L	4		√	√	
3S1E09M004	Mocho 3	Amador	L	4		√	√	
3S1E09P005	Key_AmW_U (Mohr Key)	Amador	U	1				
3S1E09P009	Mohr Ave Shallow	Amador	L	1				
3S1E09P010	Key_AmW_L	Amador	L	1				
3S1E09P011	Mohr Ave Deep	Amador	L	1				
3S1E10A002	El C harro Rd	Amador	U	1			√	
3S1E10B008	Kaiser Rd Shallow	Amador	L	1			√	
3S1E10B009	Kaiser Rd Middle 1	Amador	L	1			√	
3S1E10B010	Kaiser Rd Middle 2	Amador	L	1			√	
3S1E10B011	Kaiser Rd Deep	Amador	D	1			√	
3S1E10B014	COL 5 Monitoring	Amador	L	1				
3S1E10B016	COL 5	Amador	L	4		√	√	
3S1E10D002	Stoneridge Shallow	Amador	L	1			√	
3S1E10D003	Stoneridge Middle 1	Amador	L	1			√	
3S1E10D004	Stoneridge Middle 2	Amador	L	1			√	
3S1E10D005	Stoneridge Deep	Amador	D	1			√	
3S1E10K002	COL 1 Monitoring	Amador	L	1				
3S1E10K003	COL 1	Amador	L	4		√	√	
3S1E11B001	Airport West	Amador	U	4				
3S1E11C003	LAVWMA ROW	Amador	U	1			√	
3S1E11G001	Key_AmE_U	Amador	U	1			√	
3S1E11G002	Rancho Charro Middle 1	Amador	L	1			√	
3S1E11G003	Rancho Charro Middle 2	Amador	L	1			√	
3S1E11G004	Rancho Charro Deep	Amador	D	1			√	
3S1E11M002	COL 2 Monitoring	Amador	L	1				
3S1E11M003	COL 2	Amador	L	4		√	√	
3S1E11P006	New Jamieson Residence	Amador	L	1				
3S1E12A002	Airport South	Amador	U	4			√	
3S1E12D002	LWRP G6	Amador	U	4			√	

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OTHER: WR = Water Rights; Muni = Municipal wells; PFAS = Sampled for PFAS Compounds; WWRW = Wastewater and Recycled Water

SITE INFORMATION				Sampling Frequency	Other Programs			
State Name	Well Name	Subbasin	Aq		WR	Muni	PFAS	WWRW
3S1E12G001	Oaks Park Shallow	Amador	U	4			√	
3S1E12H004	LWRP Shallow	Amador	L	1			√	
3S1E12H005	LWRP Middle 1	Amador	L	1			√	
3S1E12H006	LWRP Middle 2	Amador	L	1			√	
3S1E12H007	LWRP Deep	Amador	D	1			√	
3S1E12K002	Oaks Park Mid	Amador	L	1			√	
3S1E12K003	Key_AmE_L	Amador	L	1			√	
3S1E12K004	Oaks Park Deep	Amador	D	1			√	
3S1E13P005	LGA Grant Nested 1	Amador	U	1				
3S1E13P006	LGA Grant Nested 2	Amador	L	1				
3S1E13P007	LGA Grant Nested 3	Amador	L	1				
3S1E13P008	LGA Grant Nested 4	Amador	L	1				
3S1E14B001	Industrial Asphalt	Amador	L	1				
3S1E14D002	South Cope Lake	Amador	L	1				
3S1E15J003	shadow cliff	Amador	L	1				
3S1E15M003	Bush/Valley South	Amador	L	1				
3S1E16A002	Pleas 8	Amador	L	1		√	√	
3S1E16A004	Bush/Valley Mid	Amador	L	1			√	
3S1E16B001	Bush/Valley North	Amador	D	1				
3S1E16C002	Santa Rita Valley Shallow	Amador	L	1			√	
3S1E16C003	Santa Rita Valley Middle	Amador	L	1			√	
3S1E16C004	Santa Rita Valley Deep	Amador	L	1			√	
3S1E16E004	black ave - cultural	Amador	U	1				
3S1E16L005	Pleas 5	Amador	L	1		√	√	
3S1E16L007	Pleas 6	Amador	L	1		√	√	
3S1E16P005	Vervais Monitor	Amador	U	2	√			
3S1E17B004	Casterson	Amador	L	1				
3S1E17D003	Hopyard Nested Shallow	Bernal	L	1				
3S1E17D004	Hopyard Nested Middle 1	Bernal	L	1				
3S1E17D005	Hopyard Nested Middle 2	Bernal	L	1				
3S1E17D006	Hopyard Nested Middle 3	Bernal	L	1				
3S1E17D007	Hopyard Nested Deep	Bernal	D	1				
3S1E17D011	Hopyard 9 Monitoring Well	Bernal	L	1				
3S1E17D012	Hopyard 9	Bernal	L	4		√		
3S1E18A006	Hopyard 6	Bernal	L	4		√		
3S1E18E004	Valley Trails II	Bernal	U	1			√	
3S1E18J002	camino segura	Bernal	U	1			√	
3S1E19A010	SFWD South (B)	Bernal	L	1		√		
3S1E19A011	SFWD North (A)	Bernal	L	1		√		
3S1E19C004	del valle & laguna	Bernal	U	1			√	
3S1E19K001	680/bernal	Bernal	U	1				
3S1E20B002	Fairgrounds Potable	Bernal	L	1				
3S1E20C003	Fairgrounds Potable Backup	Bernal	L	1				
3S1E20C007	Key_Bern_U	Bernal	U	2	√			
3S1E20C008	Key_Bern_L	Bernal	L	1				
3S1E20C009	Fair Nested Deep	Bernal	L	1				
3S1E20J004	civic center	Bernal	U	1				
3S1E20M011	S.F "M"LINE	Bernal	U	1				
3S1E20Q002	20Q2	Bernal	U	1				
3S1E22D002	vineyard trailer	Amador	U	1				
3S1E23J001	1627 vineyard trailer	Amador	L	1				

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OTHER: WR = Water Rights; Muni = Municipal wells; PFAS = Sampled for PFAS Compounds; WWRW = Wastewater and Recycled Water

SITE INFORMATION				Sampling Frequency	Other Programs			
State Name	Well Name	Subbasin	Aq		WR	Muni	PFAS	WWRW
3S1E25C003	Katz Winery Mansion	Amador	U	1				
3S1E29M004	f.c. channel	Castle	U	1				
3S1E29P002	castlewood dr	Bernal	U	1				
3S1W01B009	DSRSD Shallow	Dublin	L	1				
3S1W01B010	DSRSD Middle	Dublin	L	1				
3S1W01B011	DSRSD Deep	Dublin	L	1				
3S1W01J001	DSRSD MW-1	Dublin	U	1				
3S1W02A002	McNamara's	Dublin	U	1				
3S1W12A009	DSRSD NW-75	Dublin	U	1				
3S1W12B002	Stoneridge Mall Rd	Dublin	U	1				
3S1W12J001	DSRSD South	Dublin	U	1				
3S1W13J001	muirwood dr	Castle	U	1				
3S2E01F002	Brisa at Circuit City	Spring	U	1				
3S2E02B002	south front rd	Spring	U	1				
3S2E03A001	Bluebell	Spring	U	1				
3S2E03K003	first & S. front rd	Mocho I	U	1				
3S2E05N001	Spider Well	Mocho II	M	1				
3S2E07C002	jaws - york way - G4	Mocho II	U	4				
3S2E07H002	dakota	Mocho II	U	1				
3S2E07N002	Isabel & Arroyo Mocho	Amador	U	1				
3S2E07P003	CWS 24	Amador	L	1		√	√	
3S2E07R003	CWS 31	Upland	L	1		√	√	
3S2E08F001	CWS 10	Mocho II	L	1		√		
3S2E08G001	CWS 19	Mocho II	L	1		√	√	
3S2E08H002	North k	Mocho II	U	1				
3S2E08H003	Key_Mo2_L	Mocho II	L	1				
3S2E08H004	N Liv Ave Deep	Mocho II	L	1				
3S2E08K002	Key_Mo2_U (Livermore Key)	Mocho II	U	1				
3S2E08N002	CWS 14	Mocho II	L	1		√	√	
3S2E08Q009	D-2	Mocho II	L	1				
3S2E09Q001	CWS 9	Mocho II	L	1		√	√	
3S2E09Q004	school st	Mocho II	U	1				
3S2E10F003	hexcel	Mocho I	U	1				
3S2E10Q001	almond	Mocho II	U	1				
3S2E10Q002	LLNL W-703	Mocho II	L	1				
3S2E11C001	joan way	Mocho I	U	1				
3S2E12C004	LLNL W-486	Spring	U	1				
3S2E12J003	LLNL W-017A	Spring	L	1				
3S2E14A003	S. vasco @east ave	Mocho I	U	1				
3S2E14B001	5763 east ave	Mocho I	L	1				
3S2E15E002	Retzlaff Winery	Mocho II	L	1				
3S2E15L001	Concannon 2	Mocho II	U	1				
3S2E15M002	Concannon 1	Mocho II	U	1				
3S2E15R017	Buena Vista Shallow	Mocho II	U	1				
3S2E15R018	Buena Vista Deep	Mocho II	L	1				
3S2E16A003	Memory Gardens	Mocho II	L	1				
3S2E16C001	CWS 15	Mocho II	L	1		√		
3S2E16E004	pepper tree	Mocho II	U	1				
3S2E17E002	Mocho Street	Mocho II	U	1				
3S2E18B001	CWS 20	Amador	L	1		√	√	
3S2E18E001	E. stanley	Amador	U	1				

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OTHER: WR = Water Rights; Muni = Municipal wells; PFAS = Sampled for PFAS Compounds; WWRW = Wastewater and Recycled Water

SITE INFORMATION				Sampling Frequency	Other Programs			
State Name	Well Name	Subbasin	Aq		WR	Muni	PFAS	WWRW
3S2E19D007	Isabel Shallow	Amador	U	1			√	
3S2E19D008	Isabel Middle 1	Amador	L	1			√	
3S2E19D009	Isabel Middle 2	Amador	L	1			√	
3S2E19D010	Isabel Deep	Amador	L	1			√	
3S2E19N003	Shallow Cemex Nested	Amador	U	1			√	
3S2E19N004	Deep Cemex Nested	Amador	L	1			√	
3S2E20M001	Alden Lane	Amador	L	1				
3S2E22B001	grapes	Mocho II	U	1				
3S2E23E001	Mines Nested Shallow	Mocho II	U	1				
3S2E23E002	Mines Nested Deep	Mocho II	L	1				
3S2E24A001	S. greenville	Mocho I	U	1				
3S2E26J002	mines rd	Mocho II	U	1				
3S2E29F004	usgs wetmore	Amador	U	2	√			
3S2E30C001	Vineyard 30C 1	Amador	L	1				
3S2E30D002	vineyard	Amador	U	1				
3S2E32E007	DVWTP 32E7	Upland	U	1				
3S2E33G001	Crohare	Amador	U	2	√			
3S2E33K001	VA	Amador	U	4				√
3S2E33L001	VA/CROHARE FENCE	Amador	U	4				√
3S3E06Q003	PPWTP South Monitoring	Altamont	U	1				
3S3E07D002	7D 2	Spring	U	1				
Totals:	**218**			**282**	**8**	**36**	**60**	**8**

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TABLE 7-2
WATER QUALITY RESULTS FOR SELECT METALS AND MINERALS
2020 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
2S1E32E001	5/27/20	ZONE7	22.1	1312	7	127	30	117	1.5	599	29	114	8.65	42.8	< 100	3.1	< 100	1.5	795	442
2S1E32N001	5/27/20	ZONE7	21.4	1071	7.4	85	21	114	1.9	363	36	138	2.29	32.1	460	1.9	< 100	5.1	617	299
2S1E32Q001	5/27/20	ZONE7	22	2148	6.9	165	68	201	2.7	632	91	369	5.72	32.1	770	< 2	< 200	4.2	1265	692
2S1E33L001	3/5/20	ZONE7	-	1332	7.1	105	28	153	1.4	513	43	163	4.9	30	420	2.4	< 100	7	798	377
2S1E33P002	3/5/20	ZONE7	-	2845	7.1	248	91	311	2.2	864	60	597	6.85	30	960	< 5	< 500	21	1796	996
2S1E33R001	3/5/20	ZONE7	-	731	7.4	64	13	82	3.6	259	23	87	4	30	110	2.7	< 100	21	448	214
2S1W15F001	9/7/20	ZONE7	22.5	1474	6.8	156	62	92	1.3	706	37	155	< 0.1	21.4	210	1.9	198	< 1	872	645
2S1W26C002	5/27/20	ZONE7	19.8	819	6.8	96	19	48	1	404	36	36	5.64	30	140	2.8	< 100	2.4	490	318
2S1W36E003	5/27/20	ZONE7	20.6	1036	7	126	27	61	< 1	400	99	74	3.76	40.7	< 200	7.7	258	2.2	641	426
2S1W36F001	5/12/20	ZONE7	19.8	758	7.7	66	19	87	1.2	421	17	42	< 0.1	21.4	270	10	< 100	< 1	461	244
2S1W36F002	5/12/20	ZONE7	20.7	873	7.7	42	14	136	0.8	402	< 1	98	< 0.1	23.5	590	142	141	< 1	513	161
2S2E27P002	6/24/20	ZONE7	28.7	4504	7.7	72	47	769	2.9	211	< 1	1492	< 0.1	25.7	29000	< 5	< 500	< 5	2513	375
2S2E28D002	6/24/20	ZONE7	29	1539	7.4	72	39	172	2.6	253	43	280	42	32.1	800	5.3	< 200	27	952	341
2S2E28J002	6/25/20	ZONE7	19.6	956	8.3	4	4	247	0.7	382	61	87	< 0.1	18.6	1600	< 1	< 100	< 1	616	26
2S2E28Q001	6/24/20	ZONE7	33.1	1217	7.8	36	32	166	1.1	371	98	152	1.36	42.8	720	12	1620	26	719	222
2S2E32K002	6/24/20	ZONE7	31.4	942	7.6	37	31	124	1.9	327	57	126	2.36	36.4	500	5.4	< 100	11	585	220
2S2E34E001	6/25/20	ZONE7	29.9	1167	8.1	8	10	275	0.7	380	72	147	< 0.1	25.7	3000	26	< 100	< 1	728	60
2S2E34Q002	6/25/20	ZONE7	33.7	1793	7.7	63	67	192	1.2	269	139	374	0.99	30	3400	8.4	< 200	< 2	1004	432
3S1E01F002	6/24/20	ZONE7	26.3	1375	7.1	105	39	122	0.8	554	26	161	6.44	49.2	260	5.8	< 100	3.4	804	423
3S1E01H003	11/12/19	LWRP	-	1840	-	71	38	240	1.4	-	77	340	15.2	32	1230.	-	-	-	1100	-
3S1E01H003	2/11/20	LWRP	-	1860	-	67	42	250	1.4	-	74	341	15.7	33	1260.	-	-	-	1110	-
3S1E01H003	9/20/20	LWRP	-	1860	-	72	43	270	1.5	-	75	313	15	34	1380.	-	-	-	1100	-
3S1E01L001	6/25/20	ZONE7	27.4	1730	7.2	74	43	216	1.6	557	52	236	17.6	32.1	3400	< 1	< 100	6.5	1007	362
3S1E01P002	11/12/19	LWRP	-	1460	-	73	43	160	2.2	-	81	264	0.5	22	3280.	-	-	-	860	-
3S1E01P002	2/11/20	LWRP	-	1450	-	62	43	160	1.7	-	79	287	0.5	22	2480.	-	-	-	840	-
3S1E01P002	9/20/20	LWRP	-	1450	-	73	49	170	2.7	-	78	290	0.52	25	3150.	-	-	-	840	-
3S1E02J002	5/19/20	ZONE7	19.7	3579	7.5	179	91	453	2.2	578	211	810	7.2	27.8	5300	< 5	< 500	6.7	2091	823
3S1E02J003	6/24/20	ZONE7	24.6	1389	7.2	50	26	228	18	310	106	253	2.29	15	1100	3.9	< 200	22	859	234
3S1E02K002	6/24/20	ZONE7	25.3	1132	7.7	21	20	206	2.2	501	49	97	6.47	21.4	1020	6.8	< 100	14	693	134
3S1E02M003	3/5/20	ZONE7	-	2026	7.4	42	53	350	2.3	850	79	203	12.5	16.7	1660	7.9	< 200	37	1222	324
3S1E02N006	5/19/20	ZONE7	20.4	1650	7.3	80	49	197	1.8	503	90	256	< 0.1	19.9	3300	3.5	< 100	2.3	942	402
3S1E02P003	8/11/20	ZONE7	21.7	812	7.8	41	34	92	1.8	296	53	79	4.1	25.7	660	2.5	< 100	5.8	492	242
3S1E02Q001	10/15/19	ZONE7	20.7	1880	7.4	80	47	226	7	477	115	322	0.36	16	2830	9.9	910	< 2	1050	394
3S1E02Q001	9/2/20	ZONE7	24	1895	7.5	84	52	239	7.3	494	148	326	0.64	19	2940	6.8	1150	< 2	1122	424
3S1E02R001	11/12/19	LWRP	-	1870	-	98	62	180	1.5	-	94	363	9.9	27	2920.	-	-	-	1110	-
3S1E02R001	2/11/20	LWRP	-	1740	-	84	63	180	1.8	-	84	310	7	27	2750.	-	-	-	1030	-
3S1E02R001	9/20/20	LWRP	-	1660	-	86	64	190	1.4	-	77	274	9.1	28	3350.	-	-	-	990	-
3S1E03G002	3/4/20	ZONE7	23	1334	7.6	65	32	202	2.2	566	25	163	< 0.1	23.5	800	7	< 100	< 1	792	294
3S1E04A001	3/5/20	ZONE7	-	1670	7.2	135	32	183	1.1	526	41	276	3.08	25.7	430	2.7	< 100	3	967	470
3S1E04J005	3/4/20	ZONE7	23.5	3275	7.8	41	49	800	1.6	978	234	496	5.69	20.3	12000	8.3	< 500	< 3.5	2152	304
3S1E04J006	3/4/20	ZONE7	20.3	1742	7.4	106	40	215	2.6	439	87	318	2.29	25.7	1640	3	< 100	< 1	1021	430
3S1E04Q002	5/20/20	ZONE7	21.2	1729	7.5	88	54	218	2.3	434	87	309	2.24	23.5	2300	3.8	< 200	6.8	1006	442
3S1E05K006	6/9/20	ZONE7	32.8	2007	7.4	135	57	263	1.9	666	221	225	9.3	21.4	1880	2.3	< 200	2.4	1294	573
3S1E05K007	6/9/20	ZONE7	29.7	971	7.9	27	32	143	1.8	323	127	72	< 0.1	32.1	960	9.5	< 100	< 1	595	200
3S1E05L003	6/9/20	ZONE7	32.7	1512	7.6	63	35	170	1.1	441	182	168	< 0.1	23.5	990	3.7	< 100	1.2	861	302
3S1E05P006	5/20/20	ZONE7	20.6	4013	7.2	262	162	469	1.9	563	1097	562	4.43	27.8	1600	< 5	< 500	< 5	2882	1322
3S1E06F003	5/27/20	ZONE7	22.3	4372	7	280	154	490	3	577	690	895	< 0.1	21.4	2900	< 5	< 500	< 5	2818	1335
3S1E06M002	12/27/19	DSRSD	14.2	8701	7.28	-	-	-	-	-	2610	379	0.158	-	-	-	-	-	7025	-
3S1E06M002	4/28/20	DSRSD	20.1	8448	7.41	-	-	-	-	-	3060	388	< 0.1	-	-	-	-	-	7080	-
3S1E06N002	12/26/19	DSRSD	17.3	23620	6.8	-	-	-	-	-	1370	9000	< 0.1	-	-	-	-	-	20340	-

- = Not Analyzed; X = Suspect Result

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TABLE 7-2
WATER QUALITY RESULTS FOR SELECT METALS AND MINERALS
2020 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
3S1E06N002	4/28/20	DSRSD	21.5	21960	6.87	-	-	-	-	-	1440	8420	< 0.1	-	-	-	-	-	16520	-
3S1E06N003	12/27/19	DSRSD	16.2	1180	8.48	-	-	-	-	-	230	92.1	19.8	-	-	-	-	-	1000	-
3S1E06N003	4/28/20	DSRSD	24.7	1593	8.54	-	-	-	-	-	357	144	16.6	-	-	-	-	-	1082	-
3S1E06N004	12/26/19	DSRSD	16.2	3816	7.53	-	-	-	-	-	1450	179	3.4	-	-	-	-	-	2952	-
3S1E06N004	4/28/20	DSRSD	22.6	4488	7.21	-	-	-	-	-	2060	181	0.23	-	-	-	-	-	4088	-
3S1E06N005	12/27/19	DSRSD	17.4	28430	7.23	-	-	-	-	-	5680	10400	< 0.1	-	-	-	-	-	23900	-
3S1E06N005	4/28/20	DSRSD	24.3	32280	7.28	-	-	-	-	-	5190	11800	< 0.1	-	-	-	-	-	24520	-
3S1E06N006	12/27/19	DSRSD	16.8	25890	7.12	-	-	-	-	-	332	3740	0.856	-	-	-	-	-	14940	-
3S1E06N006	4/28/20	DSRSD	21.9	23520	7.19	-	-	-	-	-	1070	9840	< 0.1	-	-	-	-	-	20380	-
3S1E07B002	6/9/20	ZONE7	24.8	691	8.8	8	9	146	1.6	242	19	92	0.1	10.1	960	2.7	< 100	1.3	410	54
3S1E07B012	6/9/20	ZONE7	29.4	15290	7.2	494	406	2550	7.2	341	1977	4592	< 0.1	20.3	1960	< 25	< 2500	49	10214	2904
3S1E07D001	12/27/19	DSRSD	18.8	3655	7.09	-	-	-	-	-	118	729	< 0.1	-	-	-	-	-	1570	-
3S1E07D001	4/27/20	DSRSD	22.2	4513	7.2	-	-	-	-	-	142	1360	< 0.1	-	-	-	-	-	3198	-
3S1E07D002	12/26/19	DSRSD	19	21670	6.9	-	-	-	-	-	11800	3490	< 0.1	-	-	-	-	-	22520	-
3S1E07D002	4/27/20	DSRSD	21.8	23810	7.14	-	-	-	-	-	10900	4150	< 0.1	-	-	-	-	-	22900	-
3S1E07D003	12/27/19	DSRSD	18.1	15110	7.31	-	-	-	-	-	170	5970	< 0.1	-	-	-	-	-	11460	-
3S1E07D003	4/28/20	DSRSD	18.6	19430	7.02	-	-	-	-	-	459	7760	< 0.1	-	-	-	-	-	13730	-
3S1E07D004	12/27/19	DSRSD	18	30740	7.12	-	-	-	-	-	8810	9960	< 0.1	-	-	-	-	-	28360	-
3S1E07D004	4/28/20	DSRSD	19.7	33270	7.16	-	-	-	-	-	9150	11400	< 0.1	-	-	-	-	-	29300	-
3S1E07G007	6/9/20	ZONE7	32.6	18330	7.1	415	521	3250	6.6	496	2753	5090	< 0.1	20.8	5300	< 20	< 2000	108	12301	3180
3S1E07J005	5/13/20	ZONE7	20	2569	7.3	106	97	376	2.6	965	442	184	< 0.1	27.8	7600	3.5	< 200	2.7	1711	663
3S1E08B001	9/2/20	ZONE7	18.2	1947	7.9	98	85	256	2	603	255	251	0.63	23.5	3000	< 2	< 200	< 2	1271	595
3S1E08G004	5/20/20	ZONE7	21.1	1972	7.4	73	62	267	2.3	624	127	279	4.63	27.8	3600	< 2	< 200	13	1166	437
3S1E08H018	10/7/19	ZONE7	19.4	1409	7.4	99	64	118	3.2	483	117	179	2.97	22.5	1280	1.3	< 100	5.9	854	512
3S1E08H018	7/8/20	ZONE7	19.5	1403	7.2	98	64	120	3.5	467	113	172	2.79	27.8	1330	< 1	< 100	5.4	841	508
3S1E08K001	5/13/20	ZONE7	18.7	2031	7.1	165	133	126	3.4	753	279	192	2.7	30	1900	< 2	< 200	8.9	1311	960
3S1E08N001	5/13/20	ZONE7	19.1	2213	7.2	176	135	157	3.8	806	331	204	2.56	32.1	2600	< 2	< 200	7.1	1447	997
3S1E09B001	10/8/19	ZONE7	19.3	1075	7.6	73	61	68	2.4	393	73	130	3.52	21.4	530	1.9	< 100	7.5	638	433
3S1E09B001	7/7/20	ZONE7	19.9	934	7.6	63	54	62	2.4	348	58	104	3.02	27.8	440	1.4	< 100	6.8	557	379
3S1E09J007	5/7/20	ZONE7	20.9	746	7.5	50	31	62	1.8	248	50	100	< 0.1	14.3	520	< 1	< 100	< 1	432	252
3S1E09J008	5/7/20	ZONE7	23.7	942	7.5	91	40	38	2	298	61	136	0.41	19.9	350	< 1	< 100	3.7	537	392
3S1E09J009	5/7/20	ZONE7	20.2	681	7.4	53	43	25	1.7	296	41	58	3.42	25.7	230	< 1	< 100	9.8	409	310
3S1E09M002	10/7/19	ZONE7	17.5	1090	7.4	60	55	93	2.2	358	68	143	1.87	21.6	1060	1.3	< 100	4.5	628	377
3S1E09M002	7/7/20	ZONE7	17.9	1023	7.5	55	50	87	2.1	334	69	129	0.94	27.8	1010	< 1	122	3.5	589	342
3S1E09M003	10/7/19	ZONE7	17.8	1066	7.3	71	45	87	2.3	350	78	134	1.52	18.3	1020	< 1	< 100	5.7	615	363
3S1E09M003	7/8/20	ZONE7	17.9	1009	7.2	67	43	82	2.2	327	73	121	1.16	23.5	940	< 1	< 100	4.4	578	345
3S1E09M004	10/7/19	ZONE7	18.2	1105	7.4	53	41	118	2.4	375	88	137	1.41	22.3	1410	1.4	< 100	6.6	653	301
3S1E09M004	7/6/20	ZONE7	18.3	1067	7.5	55	41	119	2.6	353	83	127	1.44	27.8	1280	1	< 100	5.2	636	305
3S1E09P005	8/10/20	ZONE7	23	721	7.2	53	29	59	2	211	51	99	0.16	16.9	500	< 1	< 100	1.6	415	251
3S1E09P009	5/7/20	ZONE7	18.5	788	7.2	52	30	68	1.9	256	62	104	0.22	20.5	670	< 1	< 100	2	465	252
3S1E09P010	5/7/20	ZONE7	25.3	882	7.3	82	39	45	1.7	311	61	112	1.47	19.7	370	< 1	< 100	3	520	364
3S1E09P011	5/7/20	ZONE7	18.5	445	7.9	34	11	51	1.3	207	34	19	< 0.1	19.3	470	6.1	< 100	< 1	272	130
3S1E10A002	10/1/19	ZONE7	19	1930	7.1	85	84	247	2.6	537	119	305	9.97	30	2830	2	< 100	5.4	1182	558
3S1E10A002	5/19/20	ZONE7	18.5	1915	7.3	83	76	235	2.9	532	119	294	9.46	32.1	2900	< 2	< 200	6.9	1146	521
3S1E10B008	8/18/20	ZONE7	20.3	1455	7.3	70	75	136	2.1	552	82	160	9.62	27.8	2740	1.9	< 100	14	868	482
3S1E10B009	8/18/20	ZONE7	31.5	1081	7.6	62	55	86	2.2	392	62	120	6.37	25.7	1100	2.4	< 100	6.9	635	382
3S1E10B010	8/18/20	ZONE7	20	731	7.6	42	39	55	1.7	306	42	65	2.94	25.7	430	1.9	< 100	9	435	266
3S1E10B011	8/18/20	ZONE7	20.6	798	7.6	49	42	56	1.9	314	45	65	5.57	27.8	540	1.8	< 100	6.6	466	295
3S1E10B014	5/19/20	ZONE7	21	627	7.7	46	40	33	1.7	264	34	44	4.39	27.8	260	1	< 100	13	376	280
3S1E10B016	10/8/19	ZONE7	18.7	705	7.5	46	42	35	1.7	300	39	52	3.81	21.4	340	1.2	< 100	16	402	288

- = Not Analyzed; X = Suspect Result

TABLE 7-2
WATER QUALITY RESULTS FOR SELECT METALS AND MINERALS
2020 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
3S1E10B016	7/7/20	ZONE7	18.6	656	7.7	47	40	38	1.8	296	39	46	3.64	27.8	340	1	< 100	13	402	282
3S1E10D002	8/19/20	ZONE7	20	1079	7.8	31	33	162	1.1	438	46	115	< 0.1	23.5	1430	11	< 100	< 1	629	214
3S1E10D003	8/19/20	ZONE7	27	1120	7.6	67	57	62	2.1	310	62	110	7.63	25.7	1130	1.5	< 100	9.3	573	403
3S1E10D004	8/19/20	ZONE7	20.6	795	7.6	48	42	56	1.6	311	44	76	3.61	25.7	460	1.5	< 100	13	463	293
3S1E10D005	8/19/20	ZONE7	20.8	610	7.6	42	35	38	1.8	269	32	39	4.85	27.8	210	< 1	< 100	10	370	249
3S1E10K003	10/8/19	ZONE7	16.2	889	7.4	58	50	39	1.8	307	47	101	2.36	19.2	360	< 1	< 100	8.5	478	351
3S1E10K003	7/6/20	ZONE7	17.8	845	7.5	61	52	42	1.9	316	47	100	2.14	23.5	390	< 1	< 100	5.9	493	368
3S1E11B001	11/12/19	LWRP	-	1820	-	72	60	230	1.1	-	99	290	11.3	28	4600.	-	-	-	1100	-
3S1E11B001	2/11/20	LWRP	-	1790	-	62	59	220	1.1	-	99	270	10.8	28	2100.	-	-	-	1060	-
3S1E11B001	9/20/20	LWRP	-	1790	-	67	61	230	1.1	-	96	266	9.5	30	4100.	-	-	-	1070	-
3S1E11C003	10/15/19	ZONE7	20.2	1792	7.1	76	60	218	1.7	553	92	265	4.44	17.9	2900	4.2	< 100	4.5	1023	437
3S1E11C003	8/19/20	ZONE7	31.1	1741	7.3	79	58	218	1.6	558	93	254	4.68	21.4	3000	3.4	< 100	2.4	1021	437
3S1E11G001	10/1/19	ZONE7	20.7	1243	7.3	71	76	105	3.1	493	67	120	10.1	36.4	1000	1.6	< 100	7.6	766	491
3S1E11G001	8/18/20	ZONE7	27.1	1231	7.3	65	79	89	2.6	496	69	120	10.2	34.2	890	1.4	< 100	6.5	748	488
3S1E11G002	10/1/19	ZONE7	20.5	1251	7.3	66	80	99	2.9	484	67	120	10.1	34.2	1040	5.8	< 200	8.7	753	495
3S1E11G002	8/18/20	ZONE7	27.3	1096	7.9	63	71	69	2	435	60	108	7.53	25.7	770	< 1	< 100	8.8	647	449
3S1E11G003	10/1/19	ZONE7	19.9	663	7.5	46	43	33	1.8	292	37	46	3.75	27.8	270	< 1	< 100	14	396	294
3S1E11G003	8/18/20	ZONE7	21	668	7.5	42	44	30	1.6	297	38	45	3.77	25.7	250	< 1	< 100	12	389	286
3S1E11G004	10/1/19	ZONE7	19.7	1265	7.4	69	76	103	2.9	478	67	120	10.2	36.4	1030	1.6	< 100	7.8	755	484
3S1E11G004	8/18/20	ZONE7	20.9	645	7.5	38	40	46	1.9	325	40	29	2.56	27.8	290	1.3	< 100	17	394	260
3S1E11M003	10/8/19	ZONE7	17.7	733	7.5	49	41	31	1.6	277	40	64	4.17	19.6	280	< 1	< 100	10	401	291
3S1E11M003	7/6/20	ZONE7	18.4	705	7.4	50	44	32	1.7	285	41	61	3.89	25.7	290	< 1	< 100	7.7	414	306
3S1E11P006	5/19/20	ZONE7	18.9	745	7.5	70	32	42	1.9	248	48	88	1.08	18.8	390	< 1	< 100	3.7	428	307
3S1E12A002	11/12/19	LWRP	-	1260	-	69	84	56	2.5	-	69	151	11.5	33	620.	-	-	-	410	-
3S1E12A002	2/11/20	LWRP	-	1250	-	65	85	54	2.7	-	63	147	12.1	33	330.	-	-	-	740	-
3S1E12A002	9/20/20	LWRP	-	1220	-	60	85	53	2.4	-	64	143	11	36	610.	-	-	-	730	-
3S1E12D002	11/12/19	LWRP	-	1680	-	93	81	140	2.9	-	74	154	13.2	38	3400.	-	-	-	670	-
3S1E12D002	2/11/20	LWRP	-	1680	-	96	96	160	5.6	-	68	154	12.1	35	2330.	-	-	-	1020	-
3S1E12D002	9/20/20	LWRP	-	1650	-	91	100	170	6.3	-	70	154	11	38	3280.	-	-	-	1010	-
3S1E12G001	10/1/19	ZONE7	22.3	1083	7.1	55	74	72	2.4	413	59	106	8.62	30	560	5.8	< 200	11	640	443
3S1E12G001	11/12/19	LWRP	-	1100	-	57	68	60	2.1	-	57	127	9.1	32	670.	-	-	-	560	-
3S1E12G001	2/11/20	LWRP	-	1100	-	57	68	60	2.2	-	55	128	9.3	31	400.	-	-	-	650	-
3S1E12G001	9/20/20	LWRP	-	1080	-	54	71	61	2.2	-	61	126	9	35	800.	-	-	-	640	-
3S1E12H004	5/6/20	ZONE7	20.1	770	7.6	58	51	33	1.7	328	46	64	4.74	27.8	300	< 1	< 100	10	464	355
3S1E12H005	5/6/20	ZONE7	20.9	655	7.7	51	43	30	1.8	306	41	44	2.78	30	280	< 1	< 100	15	404	305
3S1E12H006	5/6/20	ZONE7	21.4	590	7.9	47	31	41	1.9	293	36	27	2.02	27.8	220	1.5	< 100	18	365	245
3S1E12H007	5/6/20	ZONE7	20.5	470	8.6	5	3	102	0.8	206	18	35	1.37	23.5	500	27	< 100	< 1	296	25
3S1E12K002	5/6/20	ZONE7	28.7	602	7.7	42	37	30	1.4	231	35	63	1.83	25.7	250	< 1	< 100	4.8	356	260
3S1E12K003	5/6/20	ZONE7	20.7	649	7.6	42	39	31	1.7	279	38	46	4.07	30	230	< 1	< 100	14	383	266
3S1E12K004	5/6/20	ZONE7	21.1	351	7.8	19	17	27	1.2	163	10	24	1.92	21	130	< 1	< 100	3.5	208	116
3S1E14B001	8/11/20	ZONE7	19.1	807	7.5	73	34	45	1.7	287	54	98	1.26	18.2	380	< 1	< 100	2.8	471	322
3S1E14D002	5/19/20	ZONE7	20.5	848	7.4	72	34	60	2	269	51	109	0.55	20.3	510	< 1	< 100	3.4	483	320
3S1E15J003	8/19/20	ZONE7	19.6	852	7.1	84	41	50	2	395	26	69	1.86	16.5	200	< 1	1260	< 1	491	379
3S1E15M003	8/10/20	ZONE7	20.1	853	7.2	70	37	57	1.6	287	43	99	5.48	25.7	210	< 1	< 100	1.8	499	327
3S1E16A004	10/2/19	ZONE7	21.5	964	7.4	108	43	44	2.1	332	56	108	2.35	23.5	400	< 1	< 100	4.4	559	447
3S1E16A004	8/10/20	ZONE7	20.7	914	7.6	96	37	41	1.9	347	55	94	2.46	21.4	330	< 1	< 100	3.9	528	392
3S1E16B001	8/10/20	ZONE7	20.2	581.1	7.6	55	22	37	1.5	256	35	41	2.32	23.5	230	1.2	< 100	10	351	229
3S1E16C002	3/4/20	ZONE7	17.9	942	7.4	83	38	75	2.1	250	113	116	0.71	21.4	580	< 1	< 100	3.1	576	365
3S1E16C003	3/4/20	ZONE7	17.4	1165	7.4	117	58	68	2.8	478	69	125	4.37	25.7	600	< 1	< 100	6	721	531
3S1E16C004	3/4/20	ZONE7	16.9	1171	7.4	117	56	68	2.8	469	69	124	4.31	25.7	700	< 1	< 100	5.9	713	523

- = Not Analyzed; X = Suspect Result

TABLE 7-2
WATER QUALITY RESULTS FOR SELECT METALS AND MINERALS
2020 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
3S1E16E004	6/4/20	ZONE7	25	1212	7.1	120	58	79	2.8	503	71	109	5.47	23.5	700	< 1	< 100	3.8	735	539
3S1E16P005	6/9/20	ZONE7	24.7	489	7	34	21	37	2.2	187	28	50	< 0.1	8.8	220	< 1	< 100	< 1	273	172
3S1E16P005	9/2/20	ZONE7	21.1	519	6.9	38	26	33	2.2	204	28	55	0.22	13.5	300	< 1	< 100	< 1	297	202
3S1E17B004	8/10/20	ZONE7	20	1525	7.2	150	83	69	3.2	651	76	147	7.27	21.4	600	< 1	< 100	4.2	902	716
3S1E17D012	10/7/19	ZONE7	17.5	998	7.4	88	56	42	2.1	425	65	84	4.66	19.5	390	1.1	170	9.1	587	451
3S1E17D012	7/7/20	ZONE7	17.7	876	7.4	78	48	43	2	389	53	69	4.37	23.5	400	< 1	< 100	6.9	528	392
3S1E18A006	10/7/19	ZONE7	18	1027	7.4	78	50	75	2	414	82	91	3.07	20.3	550	1.6	< 100	6.3	616	401
3S1E18A006	7/7/20	ZONE7	17.9	1060	7.4	83	50	79	2.1	431	86	91	3.11	25.7	600	1.4	< 100	5.2	644	412
3S1E18E004	10/2/19	ZONE7	19.1	803	7.5	60	22	80	0.9	301	62	59	< 0.1	21.4	500	< 1	< 100	< 1	454	241
3S1E18E004	5/13/20	ZONE7	17.3	719	7.4	56	21	74	0.9	312	65	46	< 0.1	25.7	490	< 1	289	< 1	443	227
3S1E18J002	10/2/19	ZONE7	22.7	3673	6.9	206	217	412	3	924	665	561	< 0.1	25.7	1620	18	< 100	1.3	2545	1409
3S1E18J002	6/4/20	ZONE7	26.9	3452	7.4	187	187	361	3	846	550	525	< 0.1	23.5	1400	18	< 500	5.9	2253	1238
3S1E19A010	6/16/20	UNKN	-	1320	7.35	132	66.9	56	2.51	417	98.7	123	2.51	-	-	< 2	< 100	< 10	873	613
3S1E19A011	6/16/20	UNKN	-	1540	7.33	147	78.3	53.4	2.59	367	114	212	2.06	-	-	< 2	< 100	< 10	932	720
3S1E19C004	10/2/19	ZONE7	18.2	923	7.5	76	52	55	2.3	367	67	83	< 0.1	15.2	350	1.1	< 100	< 1	532	404
3S1E19C004	6/4/20	ZONE7	26.3	711	7.9	47	39	52	1.9	286	23	79	< 0.1	12.2	330	1.1	166	< 1	396	279
3S1E19K001	5/13/20	ZONE7	20	1495	7.1	121	92	99	2.7	644	209	96	< 0.1	15	600	2.4	< 100	< 1	952	680
3S1E20C007	5/12/20	ZONE7	18.6	670	7.2	54	28	53	2.1	277	44	61	0.72	17.3	320	< 1	< 100	2.7	399	248
3S1E20C007	8/10/20	ZONE7	20.3	671	7	51	31	54	2	276	43	59	0.64	17.5	300	< 1	< 100	2.5	396	256
3S1E20C008	5/12/20	ZONE7	19	982	7.4	108	44	45	2.1	430	51	85	5.17	21.4	250	3.3	< 100	4.3	591	454
3S1E20C009	5/12/20	ZONE7	24.5	993	7.5	93	51	54	2.2	424	63	92	3.03	23.5	400	1.2	< 100	4.5	601	443
3S1E20J004	6/4/20	ZONE7	29.7	1001	6.8	53	38	125	1.3	376	55	101	4.99	32.1	600	< 1	< 100	2.2	613	289
3S1E20M011	6/4/20	ZONE7	32.3	923	7.1	80	44	58	2.2	382	58	77	3.05	23.5	380	< 1	< 100	2.4	544	381
3S1E20Q002	6/4/20	ZONE7	27.8	1355	7.2	71	75	126	1.3	627	19	165	< 0.1	23.5	570	< 1	9900	1.7	790	488
3S1E22D002	6/4/20	ZONE7	27.9	996	6.7	45	42	119	0.8	311	56	111	9.58	47.1	< 100	< 1	< 100	3.2	616	285
3S1E23J001	6/11/20	ZONE7	20.4	896	6.8	49	40	68	1.2	170	15	181	5.8	36.4	110	< 1	< 100	2.7	500	287
3S1E25C003	6/11/20	ZONE7	22.4	796	7.2	52	30	73	1.5	246	28	110	3.68	25.7	350	< 1	< 100	2.4	458	254
3S1E29M004	5/13/20	ZONE7	17.3	558	6.9	44	25	42	2	240	28	48	< 0.1	23.5	300	16	3800	< 1	331	212
3S1E29P002	5/13/20	ZONE7	18.7	1121	7.2	56	53	118	2.1	548	16	115	< 0.1	20.5	1400	< 1	198	1.3	651	360
3S1W01B009	5/12/20	ZONE7	19.8	1176	7.6	74	30	152	1.6	406	93	119	6.95	23.5	550	6	< 100	< 1	724	306
3S1W01B010	5/12/20	ZONE7	19.6	806	7.6	48	13	123	0.8	385	< 1	88	< 0.1	27.8	520	133	134	< 1	491	174
3S1W01B011	5/12/20	ZONE7	20.3	905	7.9	30	8	154	1	272	< 1	161	< 0.1	25.7	600	19	< 100	< 1	514	108
3S1W01J001	12/26/19	DSRSD	17.2	3077	7.28	-	-	-	-	-	637	232	< 0.1	-	-	-	-	-	2070	-
3S1W01J001	4/28/20	DSRSD	23.7	2951	7.27	-	-	-	-	-	576	234	0.1299	-	-	-	-	-	2036	-
3S1W01J002	12/26/19	DSRSD	19.2	2399	7.29	-	-	-	-	-	517	95.1	11.1	-	-	-	-	-	1660	-
3S1W01J002	4/28/20	DSRSD	23.6	2461	7.34	-	-	-	-	-	526	109	9.07	-	-	-	-	-	1672	-
3S1W02A002	5/27/20	ZONE7	21.1	1596	6.7	185	40	107	0.8	664	81	179	2.91	23.5	420	1.6	< 100	2.1	956	627
3S1W12A009	12/26/19	DSRSD	17.5	6810	7.22	-	-	-	-	-	116	2300	< 0.1	-	-	-	-	-	4236	-
3S1W12A009	4/27/20	DSRSD	21.3	6770	7.14	-	-	-	-	-	107	2280	< 0.1	-	-	-	-	-	5112	-
3S1W12A010	12/26/19	DSRSD	17.4	2669	7.45	-	-	-	-	-	722	156	3.97	-	-	-	-	-	1862	-
3S1W12A010	4/27/20	DSRSD	23.1	2805	7.56	-	-	-	-	-	796	118	2.15	-	-	-	-	-	1944	-
3S1W12B002	5/27/20	ZONE7	21.7	1062	6.6	104	34	68	0.6	361	110	100	0.53	36.4	210	1	< 100	< 1	633	400
3S1W12J001	6/4/20	ZONE7	28.3	1492	7.4	98	34	185	1.4	437	210	149	< 0.1	25.7	700	2.9	< 100	2	919	385
3S1W13J001	5/13/20	ZONE7	19.6	905	6.6	87	41	44	0.6	329	111	72	3.5	25.7	170	< 1	< 100	1	559	388
3S2E01F002	6/15/20	ZONE7	24.5	1434	7.4	112	39	143	6.2	497	54	216	0.82	42.8	1630	2.3	< 100	4.9	862	441
3S2E02B002	6/25/20	ZONE7	34.9	474	6.9	35	10	37	3.8	162	6	58	0.2	12.2	< 200	3.4	720	2.4	243	131
3S2E03A001	6/25/20	ZONE7	35.8	1038	7.7	51	29	113	1.2	299	75	131	5.11	36.4	1400	2.9	< 100	19	607	247
3S2E03K003	6/15/20	ZONE7	22.2	1128	7.3	56	39	109	1.8	336	79	129	13.8	30	1200	3.8	214	32	671	301
3S2E05N001	8/19/20	ZONE7	21.3	861	7.4	54	56	42	1.8	317	45	79	9.35	27.8	400	< 1	< 100	9.3	503	366
3S2E07C002	11/12/19	LWRP	-	1250	-	62	84	53	3.6	-	68	146	11.4	37	490.	-	-	-	740	-

- = Not Analyzed; X = Suspect Result

TABLE 7-2
WATER QUALITY RESULTS FOR SELECT METALS AND MINERALS
2020 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
3S2E07C002	2/11/20	LWRP	-	1220	-	53	86	54	3.3	-	57	146	11.5	37	290.	-	-	-	730	-
3S2E07C002	9/20/20	LWRP	-	700	-	58	91	57	3.3	-	63	140	12	39	580.	-	-	-	700	-
3S2E07H002	6/30/20	ZONE7	26.6	1205	7.1	56	72	116	3.2	430	154	96	12.5	32.1	710	< 1	< 100	< 1	796	438
3S2E07N002	5/20/20	ZONE7	18.1	535	7.7	30	33	31	1.6	183	37	58	1.29	25.7	220	< 1	< 100	2.8	312	211
3S2E07P003	10/30/19	BSK	-	-	-	-	-	-	-	-	-	-	4.6	-	-	-	-	< 10	270	-
3S2E07R003	7/14/20	BSK	-	-	-	-	-	-	-	-	-	-	4.2	-	-	-	-	< 10	490	-
3S2E08H002	6/30/20	ZONE7	27.7	1438	7.7	50	109	98	1.1	463	126	177	7.48	34.2	380	< 1	< 100	4.9	858	573
3S2E08H003	8/11/20	ZONE7	20.6	1270	7.3	79	85	64	1.6	437	78	148	11.2	30	430	< 1	< 100	6.3	750	548
3S2E08H004	8/11/20	ZONE7	21.3	1039	7.7	42	44	115	1.9	340	38	137	5.33	25.7	660	2.1	< 100	6.7	595	286
3S2E08K002	8/11/20	ZONE7	24.1	1077	7.4	57	82	55	1.9	374	70	118	9.51	30	380	2.9	391	5.5	640	480
3S2E08N002	8/11/20	BSK	-	-	-	-	-	-	-	-	-	-	-	-	400	-	-	-	470	-
3S2E09Q004	6/30/20	ZONE7	25.9	1164	7.3	50	92	78	1.8	381	88	151	10.3	38.5	770	3.2	1160	8.4	733	504
3S2E10F003	6/15/20	ZONE7	24	1526	7.1	78	100	112	1.6	528	102	199	9.35	34.2	1370	< 2	< 200	7.3	928	607
3S2E10Q001	6/30/20	ZONE7	26.7	1655	7.1	77	118	118	1.5	524	123	231	15.2	36.4	1650	< 1	< 100	3.8	1030	678
3S2E10Q002	3/5/20	ZONE7	-	787	7.8	48	35	58	1.9	189	90	95	6.96	27.8	760	1.4	< 100	12	481	264
3S2E11C001	6/15/20	ZONE7	22.9	136	7.1	21	2	5	1.4	71	6	2	0.78	11.3	< 100	1.2	< 100	1.2	87	60
3S2E12C004	3/5/20	ZONE7	-	1094	7.9	51	9	164	1.8	126	138	191	3.36	34.2	3640	3.4	< 100	94	667	167
3S2E12J003	3/5/20	ZONE7	-	691	7.7	40	12	74	3.1	63	63	147	0.34	23.5	390	2.1	< 100	< 1	395	149
3S2E14A003	6/15/20	ZONE7	22.6	1063	7.2	89	39	70	2.3	478	32	87	9.83	30	520	3	540	25	628	383
3S2E14B001	8/11/20	ZONE7	19.5	1008	7.6	72	42	79	2	324	48	121	9.52	25.7	670	< 1	< 100	10	592	353
3S2E15E002	9/9/20	ZONE7	21.7	1146	7.4	56	83	57	1.6	414	87	114	9.6	27.8	560	< 1	131	2.6	673	482
3S2E15R017	6/30/20	ZONE7	34.6	993	7.5	45	86	45	1.6	363	70	106	12.2	30	600	< 1	< 100	8.8	617	464
3S2E15R018	6/30/20	ZONE7	29.3	654	7.6	48	41	33	1.5	320	45	45	1.15	30	210	< 1	133	< 1	407	289
3S2E16A003	8/11/20	ZONE7	19.7	1124	7.5	49	89	51	1.4	369	84	126	10.8	27.8	430	< 1	< 100	4	658	490
3S2E16E004	6/30/20	ZONE7	25.9	605	7.1	26	38	48	1.9	233	42	62	1.76	18.8	280	< 1	< 100	1.2	359	222
3S2E18B001	3/24/20	BSK	-	-	-	-	-	-	-	-	-	-	6.6	-	-	-	-	< 10	370	-
3S2E18E001	5/20/20	ZONE7	21.9	539	7.5	36	35	23	1.9	178	35	58	1.49	25.7	220	< 1	< 100	2.6	309	234
3S2E19D007	2/13/20	ZONE7	16.7	1071	7.5	89	61	39	2.3	323	27	174	5.72	27.8	< 100	< 1	< 100	7.5	605	474
3S2E19D008	2/13/20	ZONE7	14.3	1035	7.5	87	57	37	2.2	309	26	167	5.71	27.8	< 100	< 1	< 100	7.2	582	452
3S2E19D009	2/13/20	ZONE7	16.7	512	7.3	42	18	37	1.5	156	16	56	8.69	27.8	< 100	< 1	< 100	2.3	314	178
3S2E19D010	2/13/20	ZONE7	16.2	765	7.2	66	29	50	1.9	218	31	100	10.8	30	< 100	< 1	< 100	1.3	463	286
3S2E19N003	5/20/20	ZONE7	22.4	534	7.7	39	19	53	1.7	235	25	43	0.2	30	230	5.2	757	2.5	328	178
3S2E19N004	5/20/20	ZONE7	28.1	694	7.9	25	14	106	2.6	252	31	75	< 0.1	16.5	350	26	< 100	< 1	395	120
3S2E20M001	2/13/20	ZONE7	18.3	964	7.2	70	45	76	1.9	334	63	114	3.28	23.5	300	1.5	< 100	< 1	573	358
3S2E22B001	6/25/20	ZONE7	30.5	1400	7.3	63	116	65	1.3	478	173	144	4.7	32.1	460	3.2	< 200	< 2	851	635
3S2E23E001	6/11/20	ZONE7	30.8	769	7.7	36	56	48	1.7	353	36	57	2.4	23.5	410	< 1	< 100	3.2	443	321
3S2E23E002	6/11/20	ZONE7	27.9	1133	7.7	41	61	104	2.8	379	47	163	< 0.1	23.5	2610	2.8	< 100	2.2	630	353
3S2E24A001	6/15/20	ZONE7	25.9	1513	6.9	119	57	127	1.9	527	67	168	24.5	32.1	990	< 2	< 200	5.7	940	533
3S2E26J002	6/11/20	ZONE7	24.7	999	7.5	45	64	61	2.2	476	47	75	1.37	15.8	570	2.8	543	21	551	376
3S2E29F004	6/11/20	ZONE7	31.4	671	7.7	66	29	41	1.7	306	56	37	< 0.1	21.4	320	5.4	< 100	< 1	403	284
3S2E29F004	9/2/20	ZONE7	24.7	665	7.6	70	31	43	1.7	313	60	38	< 0.1	23.5	300	6.3	116	< 1	422	303
3S2E30C001	5/20/20	ZONE7	-	756	7.4	56	32	57	2	270	44	69	6.18	27.8	410	2.4	< 100	2.1	449	272
3S2E30D002	6/11/20	ZONE7	26.9	580	7.1	43	23	47	1.9	216	32	58	0.5	17.3	250	< 1	< 100	< 1	331	203
3S2E32E007	6/25/20	ZONE7	25.9	677	6.9	38	27	56	1.6	173	45	91	5.08	20.8	140	< 1	< 100	< 1	387	206
3S2E33G001	6/11/20	ZONE7	29.2	474	7.4	30	17	46	2.6	140	41	53	< 0.1	14.8	290	1.5	< 100	< 1	273	145
3S2E33G001	9/2/20	ZONE7	28	592	7.3	49	27	37	3	227	70	45	< 0.1	17.5	600	1.4	< 100	< 1	360	233
3S2E33K001	12/27/19	VA	21	1940	8.1	-	-	-	-	-	-	290	2.1	-	-	-	-	-	1150	-
3S2E33K001	6/30/20	VA	30	1500	8.5	-	-	-	-	-	-	320	0.25	-	-	-	-	-	1240	-
3S2E33K001	9/23/20	VA	25	2100	7.5	-	-	-	-	-	-	300	0.8	-	-	-	-	-	1030	-
3S2E33L001	12/27/19	VA	19	1240	7.4	-	-	-	-	-	-	170	3.1	-	-	-	-	-	702	-

- = Not Analyzed; X = Suspect Result

TABLE 7-2
WATER QUALITY RESULTS FOR SELECT METALS AND MINERALS
2020 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
3S2E33L001	3/18/20	VA	14.5	1010	7.3	-	-	-	-	-	-	130	3.9	-	-	-	-	-	636	-
3S2E33L001	6/30/20	VA	25	864	7.8	-	-	-	-	-	-	140	0.51	-	-	-	-	-	812	-
3S2E33L001	9/23/20	VA	23.6	1320	7.2	-	-	-	-	-	-	180	1.3	-	-	-	-	-	842	-
3S3E06Q003	9/2/20	ZONE7	27	2067	7.4	108	44	350	3	363	417	262	7.05	55.6	6570	< 2	< 200	3.5	1450	451
3S3E07D002	6/15/20	ZONE7	27.6	2417	7.5	117	66	347	2.8	258	300	483	6.05	49.2	6810	< 5	< 500	11	1519	564

- = Not Analyzed; X = Suspect Result

TABLE 7-3
WATER QUALITY RESULTS FOR PFAS
2020 WATER YEAR
(Only PFAS Compounds with detected concentrations shown)

Well	Well Name	Aquifer	Sampled	Units	PFBS	PFDA	PFDoA	PFHpA	PFHxA	PFHxS	PFNA	PFOA	PFOS
3S/1E 2M 3	Friesman Rd North	U	3/5/20	ng/L	2.2	< 2	< 2	< 2	< 2	3.4	< 2	< 2	< 2
3S/1E 2Q 1	LPGC #1	U	10/15/19*	ng/L	13	< 2	< 2	< 2	2	22	< 2	4.7	37
3S/1E 3G 2	fallon rd	U	3/4/20	ng/L	2.5	< 2	< 2	< 2	< 2	7.4	< 2	< 2	< 2
3S/1E 4A 1	SMP-DUB-2	U	3/5/20	ng/L	8.8	< 2	< 2	4.6	10	23	< 2	8.5	16
3S/1E 4J 5	Pimlico shallow	U	3/4/20	ng/L	22	< 2	< 2	< 2	< 2	21	< 2	< 2	40
3S/1E 4J 6	Pimlico deep	U	3/4/20	ng/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
3S/1E 4Q 2	gulfstream	U	5/20/20	ng/L	< 2	< 2	< 2	< 2	< 2	5.5	< 2	< 2	3.1
3S/1E 8H18	**Mocho 4**	L	10/7/19*	ng/L	4.8	< 2	< 2	< 2	3.7	16	< 2	3.6	14
3S/1E 9M 2	**Mocho 1**	L	10/7/19*	ng/L	12	< 2	< 2	3.5	11	76	< 2	8.9	110
3S/1E 9M 3	**Mocho 2**	L	10/7/19*	ng/L	8	< 2	< 2	2.7	7	43	< 2	5.9	50
3S/1E 9M 4	**Mocho 3**	L	10/7/19*	ng/L	6.6	< 2	< 2	2.5	5.8	31	< 2	5.7	39
3S/1E 9M 4	**Mocho 3**	L	7/6/20	ng/L	6.6	< 2.0	< 2.0	2.3	5.2	27	< 2.0	5.3	35
3S/1E 10A 2	El C harro Rd	U	10/1/19*	ng/L	25	< 2	< 2	4.1	18	120	< 2	13	450
3S/1E 10B 8	Kaiser Rd Shallow	L	8/18/20	ng/L	130	< 2	< 2	27	120	590	< 2	50	1400
3S/1E 10B 9	Kaiser Rd Middle 1	L	8/18/20	ng/L	14	< 2	< 2	3.6	16	110	< 2	7	100
3S/1E 10B10	Kaiser Rd Middle 2	L	8/18/20	ng/L	3.1	< 2	< 2	< 2	2.2	15	< 2	< 2	24
3S/1E 10B11	Kaiser Rd Deep	D	8/18/20	ng/L	5.5	< 2	< 2	< 2	5.9	42	< 2	2.9	54
3S/1E 10B16	**COL 5**	L	10/8/19*	ng/L	2.6	< 2	< 2	< 2	2.9	20	< 2	< 2	40
3S/1E 10D 2	Stoneridge Shallow	L	8/19/20	ng/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
3S/1E 10D 3	Stoneridge Middle 1	L	8/19/20	ng/L	12	< 2	< 2	2.8	12	96	< 2	5.9	150
3S/1E 10D 4	Stoneridge Middle 2	L	8/19/20	ng/L	< 2	< 2	< 2	< 2	< 2	3	< 2	< 2	4.1
3S/1E 10D 5	Stoneridge Deep	D	8/19/20	ng/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
3S/1E 10K 3	**COL 1**	L	7/6/20	ng/L	5.8	< 2.0	< 2.0	2	5.1	29	< 2.0	5.3	38
3S/1E 11C 3	LAVWMA ROW	U	10/15/19*	ng/L	30	< 2	< 2	7.4	28	130	2.8	19	360
3S/1E 11G 1	Key_AmE_U	U	10/1/19*	ng/L	25	< 2	< 2	8.3	24	87	< 2	16	210
3S/1E 11G 1	Key_AmE_U	U	8/18/20	ng/L	25	< 2	< 2	7.8	26	100	< 2	15	210
3S/1E 11G 2	Rancho Charro Middle 1	L	10/1/19*	ng/L	26	< 2	< 2	7.7	23	98	< 2	14	160
3S/1E 11G 2	Rancho Charro Middle 1	L	8/18/20	ng/L	19	< 2	< 2	4.3	15	70	< 2	8.2	69
3S/1E 11G 3	Rancho Charro Middle 2	L	10/1/19*	ng/L	< 2	< 2	< 2	< 2	< 2	2.6	< 2	< 2	26
3S/1E 11G 4	Rancho Charro Deep	D	10/1/19*	ng/L	25	< 2	< 2	7.5	23	93	< 2	14	170
3S/1E 11G 4	Rancho Charro Deep	D	8/18/20	ng/L	2	< 2	< 2	< 2	< 2	8.2	< 2	< 2	18
3S/1E 11M 3	**COL 2**	L	7/6/20	ng/L	3.3	< 2.0	< 2.0	< 2.0	2.7	14	< 2.0	2.3	15
3S/1E 12A 2	Airport South	U	10/15/19*	ng/L	15	< 2	< 2	11	20	52	< 2	19	100
3S/1E 12D 2	LWRP G6	U	10/15/19*	ng/L	8.5	< 2	< 2	14	36	76	< 2	12	100
3S/1E 16A 2	**Pleas 8**	L	12/3/19	ng/L	7.5	< 1.8	< 1.8	8.1	12	60	4	7.5	69
3S/1E 16C 2	Santa Rita Valley Shallow	L	3/4/20	ng/L	< 2	< 2	< 2	< 2	< 2	8.1	< 2	< 2	9.6
3S/1E 16C 3	Santa Rita Valley Middle	L	3/4/20	ng/L	4.3	< 2	< 2	< 2	2.3	15	< 2	< 2	9.9
3S/1E 16C 4	Santa Rita Valley Deep	L	3/4/20	ng/L	4.2	< 2	< 2	< 2	2.3	15	< 2	< 2	8.6
3S/1E 16L 5	**Pleas 5**	L	12/3/19	ng/L	4.7	< 1.8	< 1.8	2.2	3.9	19	< 1.8	3.3	21
3S/1E 16L 7	**Pleas 6**	L	12/3/19	ng/L	5	< 1.8	< 1.8	2.5	4.5	23	< 1.8	3.6	22
3S/1E 18E 4	Valley Trails II	U	10/2/19*	ng/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
3S/1E 19A10	**SFWD South (B)**	L	10/7/20	ng/L	< 2	< 2	< 2	< 2	< 2	3	< 2	< 2	< 2
3S/1E 19A11	**SFWD North (A)**	L	10/7/20	ng/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
3S/1E 19C 4	del valle & laguna	U	10/2/19*	ng/L	2.2	< 2	< 2	< 2	< 2	2.7	< 2	< 2	6.9
3S/1E 20B 2	**Fairgrounds Potable**	L	12/11/19	ng/L	2.9	< 2	< 2	< 2	< 2	8.6	< 2	< 2	5.7

Municipal Wells are Bold

- = Not Analyzed

* = Sampled in 2020 WY, but included in 2019 Report

U=Upper; L=Lower; D=Deep

E:\MONITOR\GQ\2020WY\AnnualReport2020\Tbl07-03-PFASResults20.xlsx

2/9/2021

TABLE 7-3
WATER QUALITY RESULTS FOR PFAS
2020 WATER YEAR
(Only PFAS Compounds with detected concentrations shown)

Well	Well Name	Aquifer	Sampled	Units	PFBS	PFDA	PFDoA	PFHpA	PFHxA	PFHxS	PFNA	PFOA	PFOS
3S/1E 20B 2	**Fairgrounds Potable**	L	5/18/20	ng/L	3.1	< 2	< 2	< 2	< 2	11	< 2	< 2	6.2
3S/1E 20B 2	**Fairgrounds Potable**	L	7/29/20	ng/L	3	< 2	< 2	< 2	< 2	9.2	< 2	< 2	4.3
3S/2E 7P 3	**CWS 24**	L	5/20/20	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
3S/2E 7R 3	**CWS 31**	L	5/19/20	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	5
3S/2E 8G 1	**CWS 19**	L	1/30/20	ug/L	5	< 2	< 2	< 2	5	10	< 2	6	21
3S/2E 8N 2	**CWS 14**	L	5/7/20	ug/L	< 2	< 2	< 2	< 2	< 2	3	< 2	< 2	5
3S/2E 9Q 1	**CWS 9**	L	5/7/20	ug/L	5	< 2	< 2	< 2	4	9	< 2	4	16
3S/2E 9Q 1	**CWS 9**	L	7/2/20	ug/L	5	< 2	< 2	< 2	3	9	< 2	4	16
3S/2E 18B 1	**CWS 20**	L	5/7/20	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	4	4
3S/2E 19D 7	Isabel Shallow	U	2/13/20	ng/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
3S/2E 19D 8	Isabel Middle 1	L	2/13/20	ng/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.9
3S/2E 19D 9	Isabel Middle 2	L	2/13/20	ng/L	< 2.0	< 2.0	< 2.0	< 2.0	4.2	2.8	< 2.0	3.3	13
3S/2E 19D10	Isabel Deep	L	2/13/20	ng/L	3.2	< 2.0	< 2.0	3.6	9	4.4	< 2.0	7.1	10
3S/2E 19N 3	Shallow Cemex Nested	U	5/20/20	ng/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2
3S/2E 19N 4	Deep Cemex Nested	L	5/20/20	ng/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	4

Municipal Wells are Bold
- = Not Analyzed
* = Sampled in 2020 WY, but included in 2019 Report
U=Upper; L=Lower; D=Deep

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 Areas
- Upland Areas
- Rivers
- Township Range Meridian

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

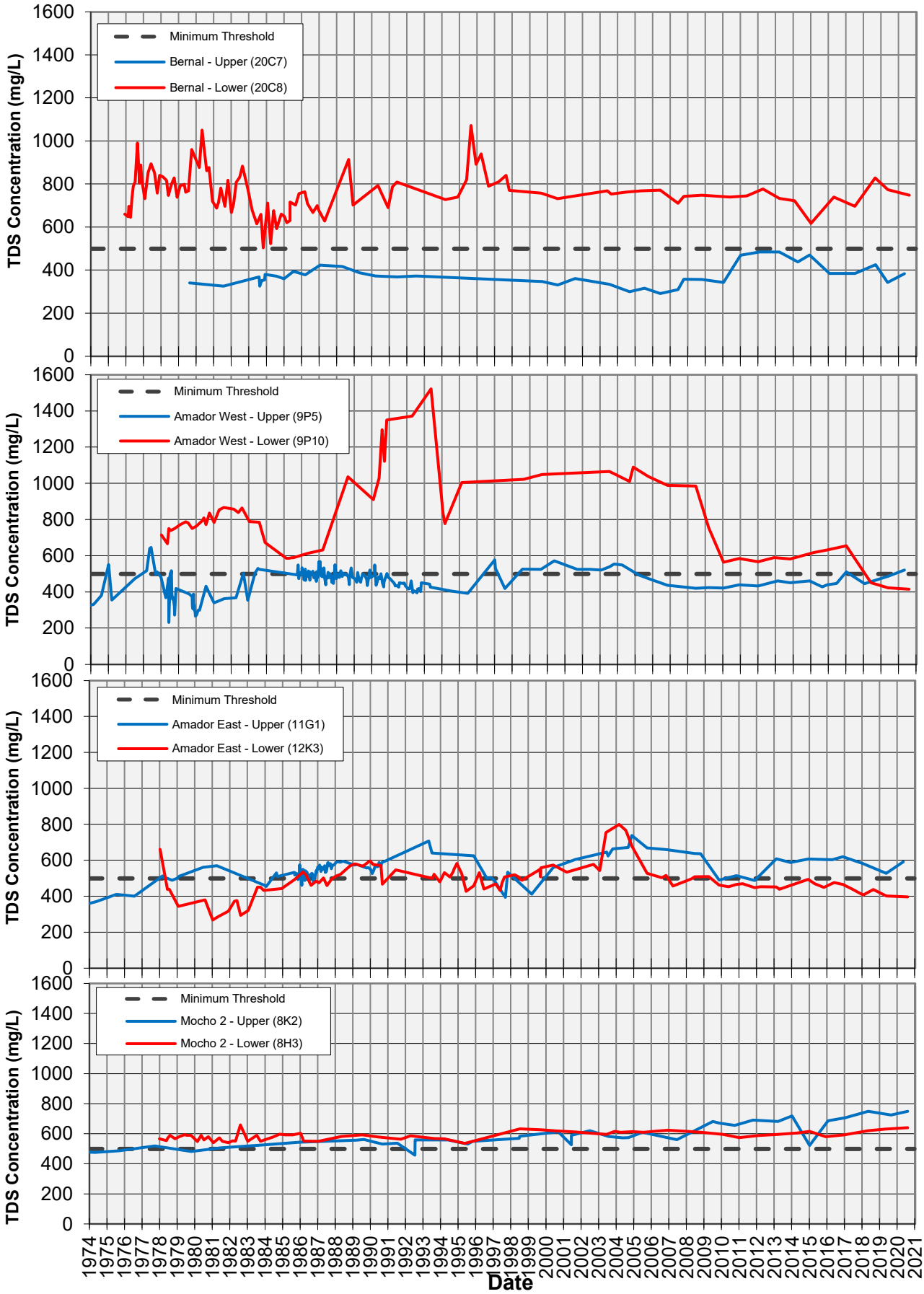
N W E S

0 2 4
Miles

DATE: Mar 10, 2021
FILE: E:\MONITOR\GQ\2020WY\AnnualReport2020\Fig07-01-MapGQWells20.mxd

Figure 7-1
Map of Wells in
2020 Groundwater Quality Program
Livermore Valley Groundwater Basin

FIGURE 7-2
TDS CONCENTRATIONS IN KEY WELLS
1974 TO 2020 WATER YEARS



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2/24/2021

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

LEGEND

2020 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 this WY

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

2020 TDS Concentrations (mg/L)

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

2S/1W 2S/1E 2S/2E 2S/3E
3S/1W 3S/1E 3S/2E 3S/3E
4S/1W 4S/1E 4S/2E 4S/3E

N W E S

0 2 4
Miles

DATE: Mar 10, 2021
FILE: E:\MONITOR\GQ\2020WY\AnnualReport2020\Fig07-03_TDSUpper20.mxd

Figure 7-3
TDS Concentrations (mg/L)
Upper Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

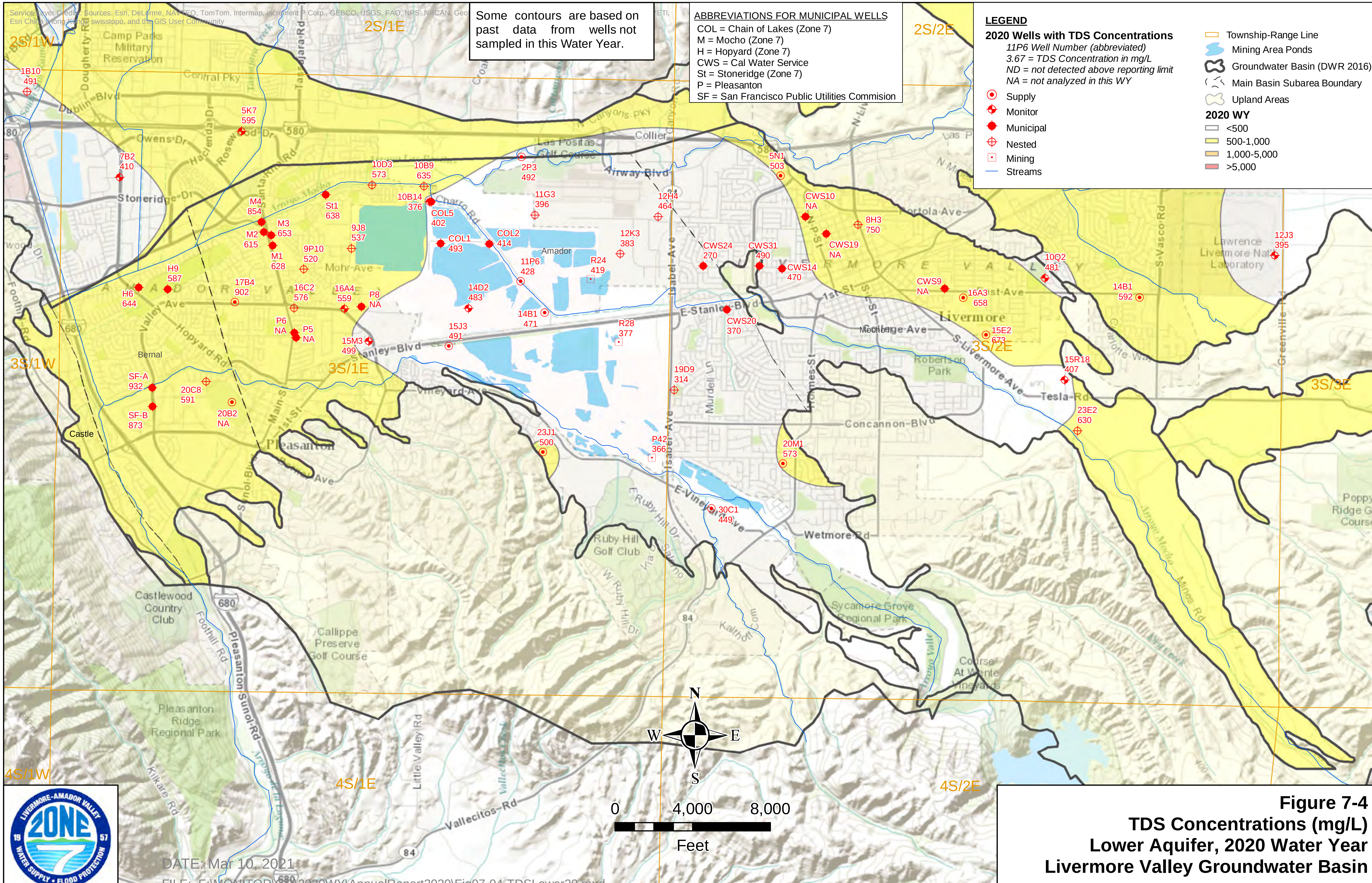

Figure 7-4
TDS Concentrations (mg/L)
Lower Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

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

LEGEND

2020 Wells with Nitrate (as N) Concentrations

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

- Supply
- Monitor
- Nested
- Mining
- OWTS Permit Area
- Mining Area Ponds
- Groundwater Basin (DWR 2016)
- Main Basin Subarea Boundary
- Upland Areas
- Streams
- Township-Range Line

2020 Nitrate (as N) Concentrations (mg/L)

- <7
- 7-10
- 10-13
- >13

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

2S/1W 2S/1E 2S/2E 2S/3E
3S/1W 3S/1E 3S/2E 3S/3E
4S/1W 4S/1E 4S/2E 4S/3E

N W E S

0 2 4
Miles

DATE: Mar 10, 2021
FILE: E:\MONITOR\GQ\2020WY\AnnualReport2020\Fig07-05_NO3NUpper20.mxd

Figure 7-5
Nitrate as N Concentrations (mg/L)
Upper Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

Some contours are based on past data from wells not sampled in this 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

2020 Wells with Nitrate (as N) Concentrations
11P6 Well Number (abbreviated)
3.67 = Nitriate (as N) Concentration in mg/L
ND = not detected above reporting limit
NA = not analyzed in this WY
Supply
Monitor
Municipal
Nested
Mining
OWTS Permit Area

Mining Area Ponds
Groundwater Basin (DWR 2016)
Main Basin Subarea Boundary
Upland Areas
Streams
Township-Range Line

2020 Nitrate (as N) Concentrations (mg/L)
<7
7-10
10-13
>13

1B10 ND
5K7 ND
7B2 0.1
St1 3.52
10D3 7.63
10B9 6.37
2P3 4.1
10B14 4.39
COL5 3.81
11G3 3.77
12H4 4.74
5N1 9.35
CWS10 8.7
8G1 NA
8H3 11.2
M4 2.97
M1 1.87
M3 1.44
M2 1.52
9J8 0.41
COL1 2.36
COL2 4.17
12K3 4.07
CWS24 4.6
CWS31 4.7
CWS14 3.79
9P10 1.47
11P6 1.08
R24 1.64
H6 3.11
H9 4.66
17B4 7.27
16C2 0.71
16A4 2.46
16A2 NA
14D2 0.55
CWS20 7.5
CWS9 8.04
16A3 10.8
10Q2 6.96
12J3 0.34
14B1 9.52
15E2 9.6
P6 NA
P5 2.4
15M3 5.48
15J3 1.86
14B1 1.26
R28 0.98
19D9 8.69
15R18 1.15
SF-A 2.06
SF-B 2.51
20C8 5.17
20B2 NA
23J1 5.8
P42 ND
20M1 3.28
23E2 ND
30C1 6.18

Charlotte Way
Buena Vista
Mines Road
Happy Valley

3S/1W
3S/1E
3S/2E
3S/3E
4S/1W
4S/1E
4S/2E

N
W
E
S

0 4,000 8,000
Feet

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Figure 7-6
Nitrate as N Concentrations (mg/L)
Lower Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

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

LEGEND

2020 Wells with Boron Concentrations

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

- Supply
- Monitor
- Nested
- Mining
- Streams
- Mining Area Ponds
- Groundwater Basin (DWR 2016)
- Main Basin Subarea Boundary
- Upland Areas
- Township-Range Line

2020 Boron Concentrations (µg/L)

- <1000
- 1000-1400
- 1400-3000
- >3000

2S/1W 2S/1E 2S/2E 2S/3E
3S/1W 3S/1E 3S/2E 3S/3E
4S/1W 4S/1E 4S/2E 4S/3E

N W E S

0 2 4
Miles

DATE: Mar 10, 2021
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Figure 7-7
Boron Concentrations (µg/L)
Upper Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

Some contours are based on past data from wells not sampled in this 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

2020 Wells with Boron Concentrations

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

- Supply
- Monitor
- Municipal
- Nested
- Mining

- Mining Area Ponds
- Groundwater Basin (DWR 2016)
- Main Basin Subarea Boundary
- Upland Areas
- Streams

2020 Boron Concentrations (µg/L)

- <1,000
- 1,000-1,400
- 1,400-3,000
- >3,000
- Township-Range Line

1B10 520
5K7 960
7B2 960
St1 530
10D3 1130
10B9 1100
2P3 660
5N1 400
M4 1330
M1 1060
M3 1410
M2 1020
10B14 260
COL5 340
11G3 270
12H4 300
CWS10 NA
CWS19 NA
8H3 430
9J8 350
COL2 290
COL1 390
12K3 230
CWS24 NA
CWS31 580
CWS14 400
H6 600
H9 400
9P10 370
11P6 390
R24 350
10Q2 760
12J3 390
CWS9 NA
16A3 430
14B1 670
17B4 600
16C2 580
16A4 400
P8 NA
Amador
14D2 510
CWS20 150
14B1 380
15E2 560
P6 NA
P5 NA
15M3 210
15J3 200
R28 290
19D9 ND
15R18 210
23E2 2610
20C8 250
SF-A NA
SF-B NA
20B2 NA
23J1 110
P42 310
20M1 300
30C1 410
3S/1E
3S/2E
3S/3E
4S/1E
4S/2E
4S/3E
Dublin
Camp Parks Military Reservation
Bernal
Castle
Pleasanton
Livermore
Mocho I
Mocho II
Lawrence Livermore National Laboratory
Ruby Hill Golf Club
Castlewood Country Club
Callippe Preserve Golf Course
Pleasanton Ridge Regional Park
Sycamore Grove Regional Park
Robertson Park
Poppy Ridge Golf Course
Course At Wente Vineyards
Las Positas Golf Course
Dublin Blvd
Stoneridge Dr
Owens Dr
Central Pky
Camp Parks
Collier Canyon Rd
Airway Blvd
Las Positas
Valley Ave
Hopyard Rd
Bernal
Stanley Blvd
E Stanley Blvd
Vineyard Ave
Main St
1st St
College Ave
Concannon Blvd
Tesla Rd
Wetmore Rd
E Vineyard Ave
Ruby Hill Dr
W Ruby Hill Dr
Foothill Rd
Pleasanton Sunol Rd
Little Valley Rd
Vallecitos Rd
Kilkare Rd
Mohr Ave
Portola Ave
S Vasco Rd
Greenville Rd
Tesla Rd
Arroyo Mocho
Arroyo Las Positas
Arroyo Valle
Arroyo Mocho Mines Rd
Kaltho
Murdell Ln
Isabel Ave
Hacienda Dr
Tassajara Rd
Santa Rita Rd
Rosewood Dr
Croak Rd
Canyons Pky
N Livermore Ave
Livermore Valley
580
680
84
N
W
E
S

0 4,000 8,000
Feet

DATE:Mar 10, 2021
FILE: E:\MONITOR\GO\2020WY\AnnualReport2020\Fig07-08-BoronLower20.mxd

Figure 7-8
Boron Concentrations (µg/L)
Lower Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

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

LEGEND

2020 Wells with Cr (Total) Concentrations

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

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

2020 Chromium (Total) Concentrations (µg/L)

- <10
- 10-30
- 30-50
- >50
- Township-Range Line

2S/1W 2S/1E 2S/2E 2S/3E
3S/1W 3S/1E 3S/2E 3S/3E
4S/1W 4S/1E 4S/2E 4S/3E

N W E S

0 2 4
Miles

DATE: Mar 10, 2021
FILE: E:\MONITOR\GQ\2020WY\AnnualReport2020\Fig07-09_CrUpper20.mxd

Figure 7-9
Total Chromium Concentrations (µg/L)
Upper Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

Some contours are based on past data from wells not sampled in this 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

2020 Wells with Cr (Total) Concentrations
11P6 Well Number (abbreviated)
3.67 = Cr Concentration in mg/L
ND = not detected above reporting limit
NA = not analyzed in this WY

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

2020 Cr (as Total) Concentrations (µg/L)
- <10
- 10-30
- 30-50
- >50
- Township-Range Line

1B10 ND
5K7 ND
7B2 1.3
St1 7.5
10D3 9.3
10B9 6.9
2P3 5.8
5N1 9.3
M4 5.9
M3 6.6
M1 4.5
M2 5.7
10B14 13
COL5 16
COL1 8.5
COL2 10
11G3 14
12H4 10
12K3 14
9J8 3.7
9P10 3
11P6 3.7
R24 5.6
14B1 2.8
14D2 3.4
15J3 ND
R28 5
15M3 1.8
P6 NA
P5 NA
16C2 3.1
16A4 4.4
P8 NA
17B4 4.2
H6 6.3
H9 9.1
20C8 4.3
20B2 NA
SF-A ND
SF-B ND
19D9 2.3
23J1 2.7
P42 5.2
20M1 ND
30C1 2:1
CWS10 NA
CWS19 NA
8H3 6.3
CWS24 ND
CWS31 ND
CWS14 NA
CWS20 ND
CWS15 NA
CWS9 NA
16A3 4
10Q2 12
15E2 2.6
12J3 ND
14B1 10
15R18 ND
23E2 2.2

3S/1E
3S/2E
3S/3E
4S/1E
4S/2E
4S/3E

Camp Parks Military Reservation
Dougherty Rd
Dublin Blvd
Central Pky
Owens Dr
Stoneridge Dr
Hacienda Dr
Rosewood Dr
Tassajara Rd
Santa Rita Rd
Airway Blvd
Las Positas Golf Course
Collier Canyon Rd
Portola Ave
Mohr Ave
Valley Ave
Hopyard Rd
Stanley Blvd
E Stanley Blvd
Isabel Ave
Murdell Ln
Vineyard Ave
Main St
1st St
S St
College Ave
Livermore Ave
Robertson Park
Tesla Rd
Concannon Blvd
E Vineyard Ave
Wetmore Rd
Ruby Hill Dr
W Ruby Hill Dr
Ruby Hill Golf Club
Sycamore Grove Regional Park
Arroyo Mocho
Arroyo Mocho Mines Rd
Kaltho
Course At Wente Vineyards
Poppy Ridge Golf Course
Lawrence Livermore National Laboratory
S Vasco Rd
Greenville Rd
Foothill Rd
Pleasanton Sunol Rd
Castlewood Country Club
Callippe Preserve Golf Course
Pleasanton Ridge Regional Park
Kilkare Rd
Little Valley Rd
Vallecitos Rd
Livermore
Pleasanton
680
580
84

N
W
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S

0 4,000 8,000
Feet

DATE: Mar 10, 2021
FILE: E:\MONITOR\GO\2020WY\AnnualReport2020\Fig07-10-CrLower20.mxd

Figure 7-10
Total Chromium Concentrations (µg/L)
Lower Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

LEGEND

11P6 Well Number (abbreviated)
3.67 = PFOS Concentration in ppt
2019 Concentrations shown in gray
ND = not detected above reporting limit

- Supply
- Monitor
- Nested
- Mining
- Streams

Based on Max Concentration

- 40-70 ppt
- >70 ppt

- Mining Area Ponds
- Groundwater Basin (DWR 2016)
- Main Basin Subarea Boundary
- Upland Areas
- Livermore Airport
- Livermore Water Reclamation Plant
- DSRSD Regional Treatment Facility

Application of Recycled Water

- Irrigated with DSRSD Effluent
- Irrigated with LWRP Effluent
- Township-Range Line

4A1
16

4J5
40

4Q2
3:1

3G2
ND

2M3
ND

2N6
47

2J3
9.3

1P2
26

2R1
55

11C3
360

2Q1
37

12A2
100

12D2
100

12G1
68

10A2
450

LkH
44

LkI
46

9J7
26

9P5
29

18E4
ND

18J2
3.4

19C4
6.9

19D7
ND

19N3
ND

DSRSD

LWRP

3S/1E

N
W E
S

0 3,000 6,000
Feet

DATE: Mar 10, 2021
FILE: E:\MONITORING\GQ\2020WY\AnnualReport2020\Fig07-11-PFOSUpper20.mxd

Figure 7-11
PFOS Concentrations (ppt)
Upper Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

LEGEND

11P6 Well Number (abbreviated)
3.67 = PFOS Concentration in ppt
2019 Concentrations shown in gray
ND = not detected above reporting limit

- Supply
- Monitor
- Municipal
- Nested
- Streams

Based on Max Concentrations

- 40-70 ppt
- >70 ppt

- Mining Area Ponds
- Groundwater Basin (DWR 2016)
- Main Basin Subarea Boundary
- Upland Areas
- Livermore Airport
- Livermore Water Reclamation Plant
- DSRSD Regional Treatment Facility

Application of Recycled Water

- Irrigated with DSRSD Effluent
- Irrigated with LWRP Effluent
- Township-Range Line

4J6 ND
10D3 150
10B8 1400
2P3 ND
11G2 160
LWRP 12H4 5.3
M4 14
M1 110
M3 39
M2 50
St1 12
8H9 20
9J8 60
COL5 40
COL1 38
COL2 16
12K2 6.9
CWS24 ND
CWS31 5.4
CWS14 5
H9 ND
H6 ND
9P10 19
16C3 9.9
16A4 37
P8 110
P6 25
P5 21
CWS20 3.6
19D9 13
19N4 4
20B2 6.2
DSRSD
3S/1E
Pleasanton
AMADOR VALLEY

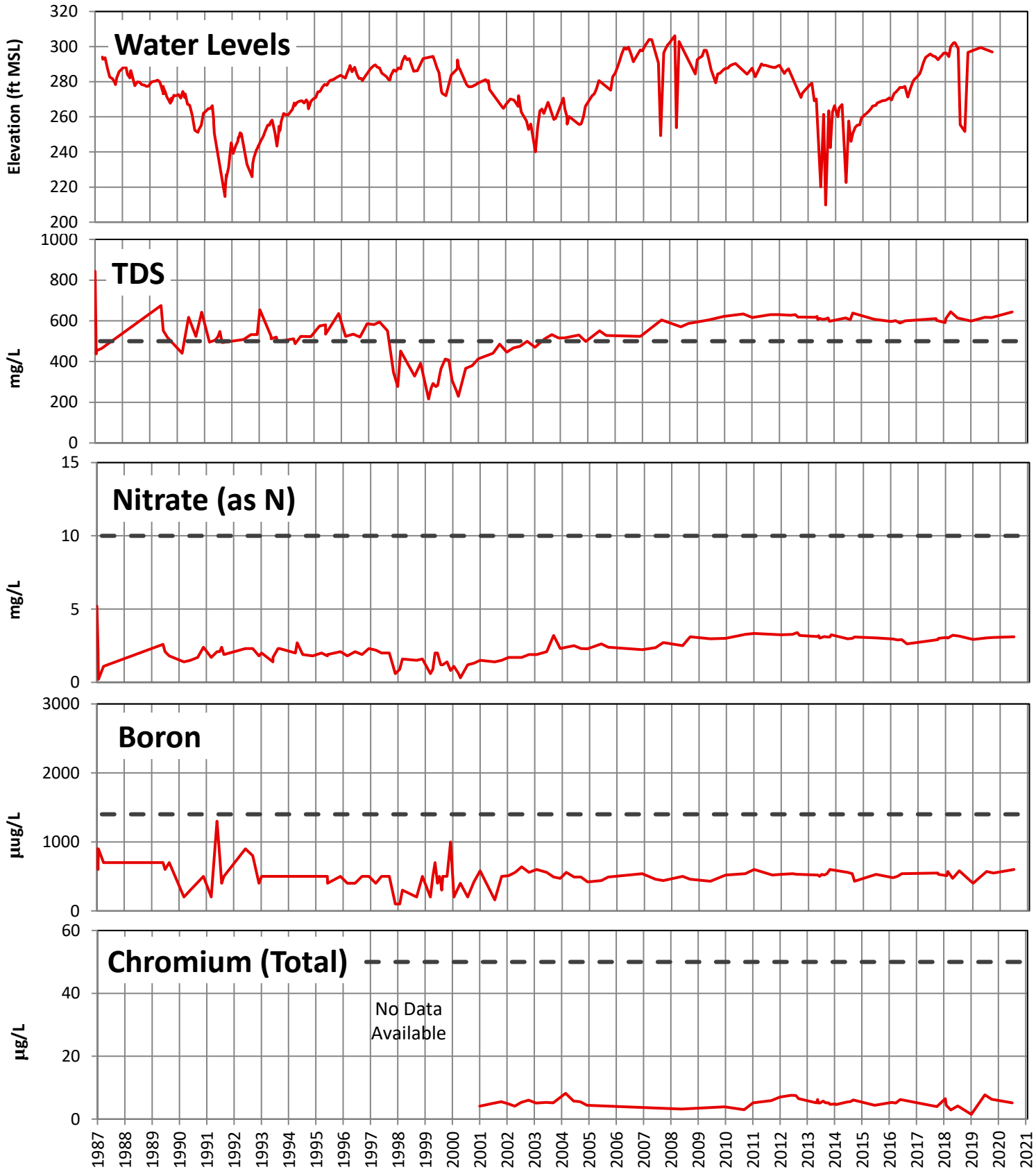
N
W
E
S

0 3,000 6,000
Feet

DATE: Mar 10, 2021
FILE: E:\MONITOR\GQ\2020WYAnnualReport2020\Fig07-12-PFOSLower20.mxd

Figure 7-12
PFOS Concentrations (ppt)
Lower Aquifer, 2020 Water Year
Livermore Valley Groundwater Basin

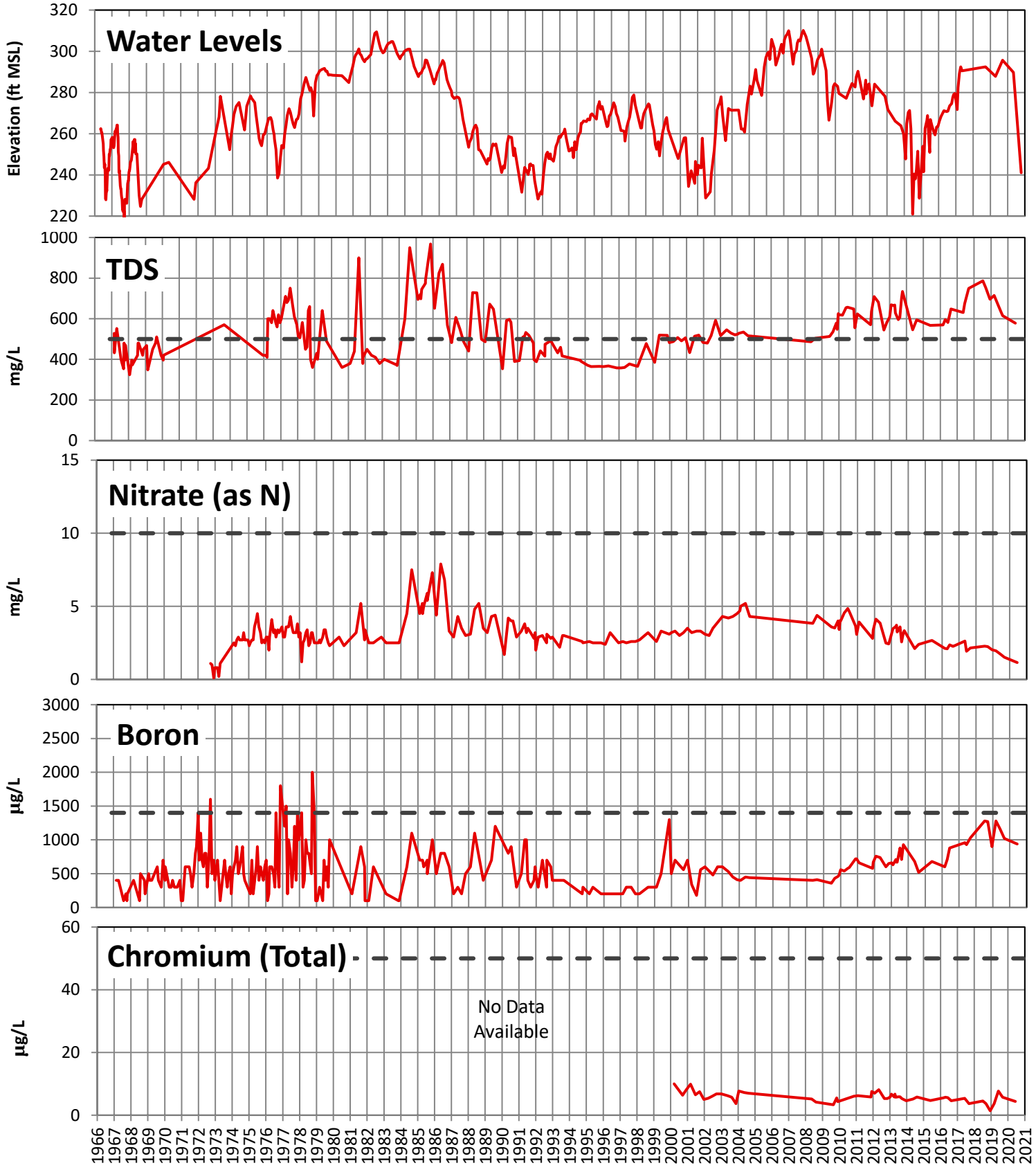
FIGURE 7-13
HYDRO-CHEMO GRAPH FOR 3S/1E 18A 6 (HOPYARD 6)
1987 to 2020 WATER YEARS
BERNAL SUBAREA - LOWER AQUIFER



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

E:\MONITOR\GQ\2020WY\AnnualReport2020\Fig07-13to16-HydroChemoGraphs20.xlsx\F7-13Grph

FIGURE 7-14
HYDRO-CHEMO GRAPH FOR 3S/1E 9M 3 (Mocho 2)
1967 to 2020 WATER YEARS
AMADOR SUBAREA WEST - LOWER AQUIFER



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

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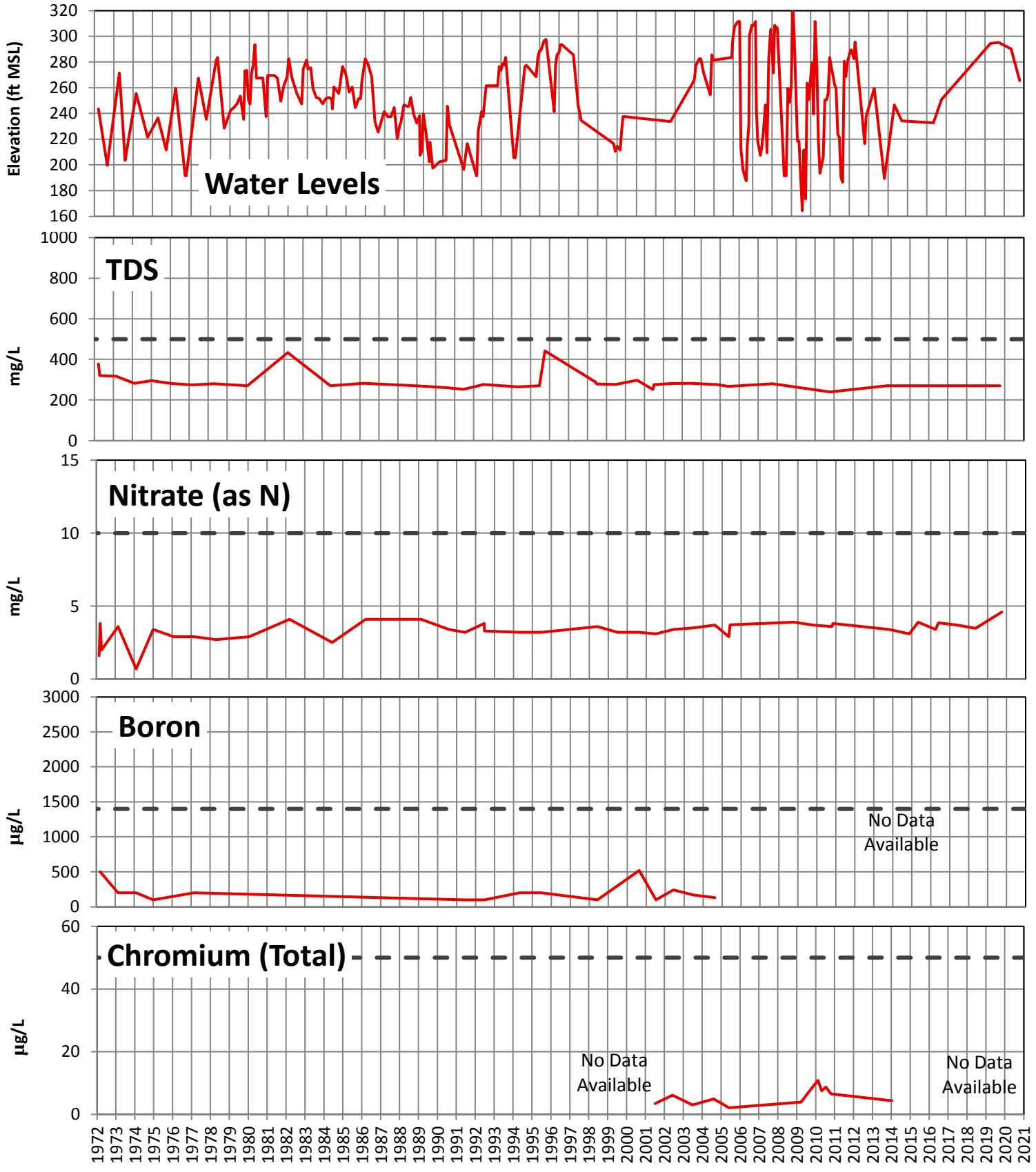
FIGURE 7-15
HYDRO-CHEMO GRAPH FOR 3S/2E 7P 3 (CWS 24)
1973 to 2020 WATER YEARS
AMADOR SUBAREA EAST - LOWER AQUIFER



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

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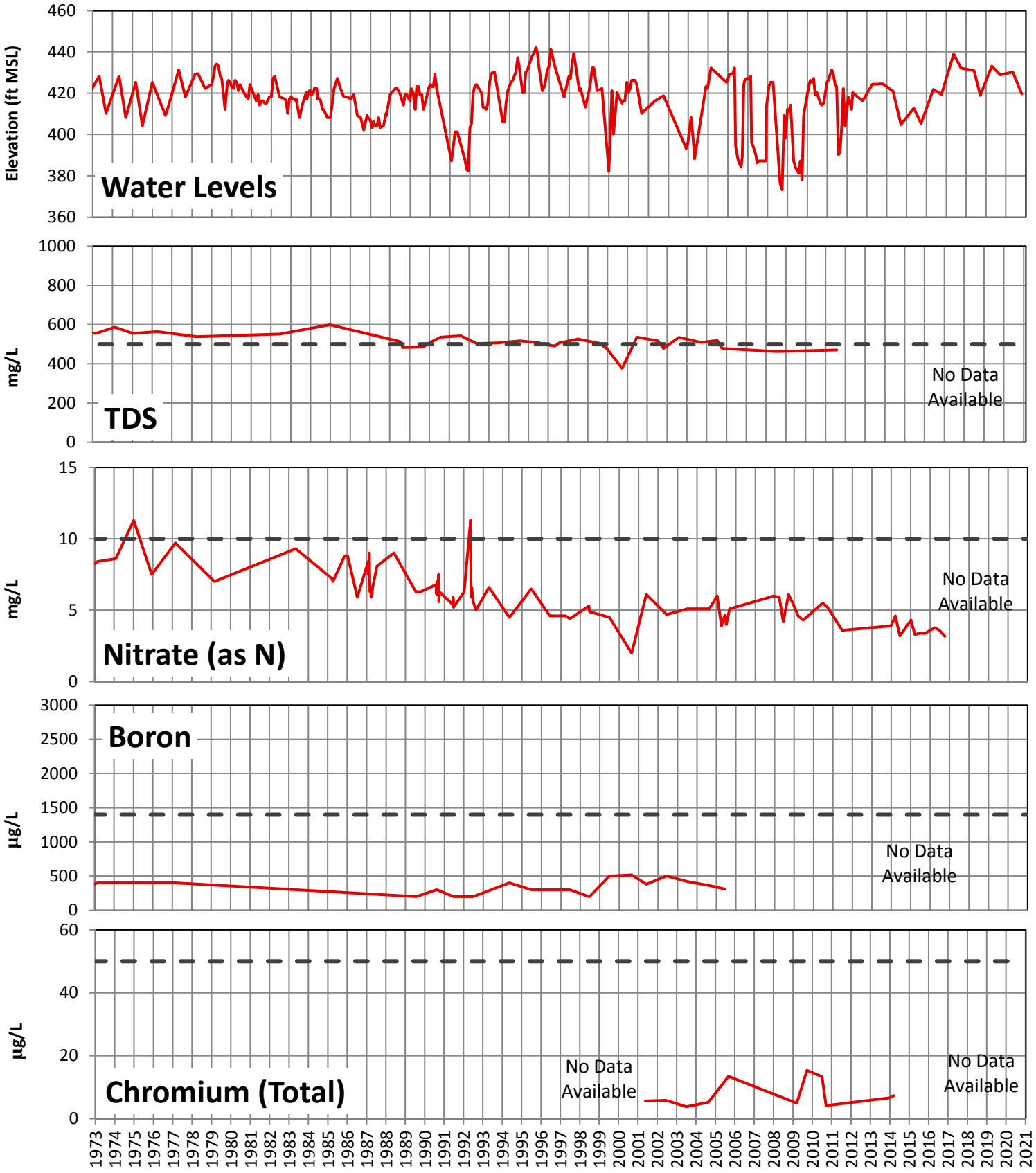
FIGURE 7-16
HYDRO-CHEMO GRAPH FOR 3S/2E 8P 1 (CWS 8)
1974 to 2020 WATER YEARS
MOCHO II SUBAREA - LOWER AQUIFER



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

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8 Land Surface Elevation

8.1 Program Description

8.1.1 Monitoring Network

Background information regarding Zone 7's land surface elevation monitoring is provided in *Section 2.3.9, Land Subsidence,* of the Alternative GSP. This section describes the details of Zone 7's ongoing Land Surface Elevation Monitoring Program for subsidence and the results for the 2020 WY. Up until the 2018 WY, Zone 7 contracted with a licensed land surveyor to measure land surface elevations within the Main Basin boundary twice per year. The program included 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 included reference benchmarks located in bedrock outside of the alluvial basin.

In the 2016 WY, Zone 7 contracted with TRE Altamira (TRE) to evaluate Interferometric Synthetic Aperture Radar (InSAR) as an alternative to land surveying for subsidence monitoring. TRE analyzed InSAR data from three different satellites over a 24-year period (from 1992 to 2016) which included approximately 120 satellite images with between 415 and 1,202 measuring points per square mile. Each measuring point contains a deformation time series, including cumulative displacement, average deformation rate, acceleration, and seasonal amplitude. The study results correlated well with topographic surface measurements taken by land surveys within the same period. An added benefit of the InSAR dataset was that it included a larger area (i.e., the entire Main Basin) than the land surveying. The resulting TRE 2016 report was included in Zone 7's Alternative GSP (Attachment I).

Starting in the 2019 WY, instead of continuing the land surveying program, Zone 7 used InSAR for monitoring land subsidence. For this study, TRE included all the Livermore Valley Groundwater Basin area, including the entire Main Basin, the Fringe, and the Upland Areas. The results of TRE's study are presented in the resulting report (see *Appendix 8-1*) and discussed below.

8.1.2 Program Changes for the 2020 Water Year

For the 2020 WY, Zone 7 contracted again with TRE to perform an analysis of satellite data for the Livermore Valley collected since the 2016 WY.

8.2 Results for the 2020 Water Year

Figure 8-1 shows the extent of the InSAR study performed this year, the locations of the selected InSAR points, and the land surface deformation from the 2019 WY to 2020 WY. The TRE report (*Appendix 8-1*) includes the following additional figures and tables:

- *Figures 10 and 11* (pages 16 and 17) show the cumulative land surface elevation change for the current water year.

- *Figures 13 through 15* (pages 19 to 21) show graphs of ground surface elevation and groundwater elevation.

In general, observed land surface elevation changes between September 2019 to September 2020 generally rose or dropped within +/- 0.04 feet (*Figure 8-1*), which is within the range Zone 7 considers to be "elastic deformation" (i.e., rebounds to the original elevation when groundwater levels return to previous levels). The following items summarize other findings from the InSAR analysis:

- Several areas in the mining area appear to have dropped more than 0.10 feet (indicated by red dots in *Figure 8-1*) or rose over 0.25 inches (indicated by blue dots). These are likely due to changes in excavation and additional grading activities, and not from land subsidence.

- Ground surface elevations near Zone 7's Mocho Wellfield, dropped up to approximately 0.04 feet. This change is consistent with elastic, ground-surface elevation changes caused by previous drops in groundwater elevations.

LEGEND

Land Surface Elevation Change (ft)

- < -0.10
- -0.1 to -0.08
- -0.08 to -0.06
- -0.06 to -0.04
- -0.04 to -0.02
- -0.02 to - 0
- 0 - 0.02
- 0.02 - 0.04
- 0.04 - 0.06
- 0.06 - 0.08
- 0.08 - 0.10

- Monitoring Wells
- Municipal Wells
- Main Basin
- Fringe SubAreas
- Upland Area
- Mining Area
- Mining Area Ponds

Stoneridge
COL 5
Key_AmE_U
8H9
Mocho 4
Mocho 3
Mocho 1
Mocho 2
COL 1
COL 2
Hopyard 6
Key_AmW_U
Hopyard 9
Pleas 6
Pleas 8
Pleas 5
SFWD North (A)
Key_Ber_U
SFWD South (B)
CWS 10
CWS 19
CWS 24
CWS 31
Key_Mo2_U
CWS 14
CWS 8
CWS 9
CWS 20
CWS 15
CWS 5

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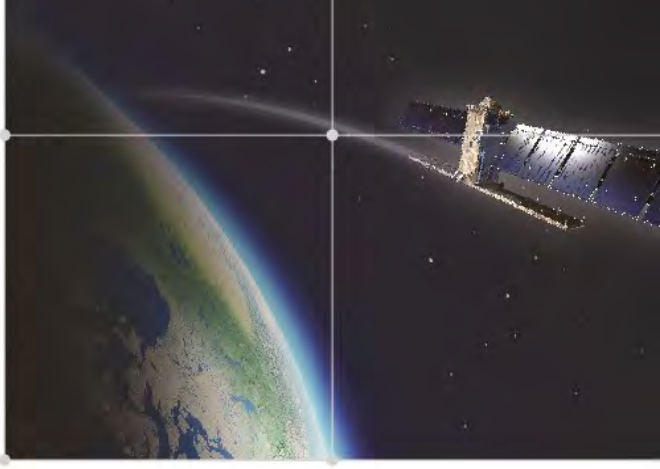
Figure 8-1
Land Surface Elevation Change from September 2019 to September 2020 Livermore Valley Groundwater Basin

APPENDIX 8-1

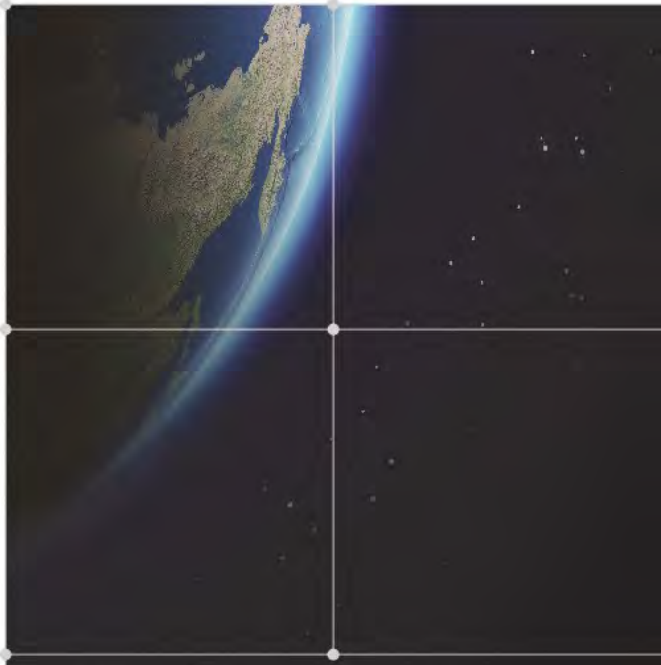
InSAR Analysis of Ground Deformation over Livermore, 2014 December-2019 September



InSAR Analysis of Ground Displacement over Livermore for the period 2014 - 2020

Technical Report

February 2021



TRE ALTAMIRA

A CLS Group Company

Report Specifications

Client:	**Zone 7 Water Agency**
Attention:	Tom Rooze
Address:	100 N. Canyons Parkway Livermore, CA 94551-9486

Reference:	
Title:	InSAR Analysis of Ground Displacement over Livermore
TRE ALTAMIRA Delivery Reference:	JO20-1257-CA REP 1.0
Client Reference (PO):	

Prepared by:	**TRE ALTAMIRA Inc.**
Author(s):	Vicky Hsiao
Verified by:	Giacomo Falorni
Approved by:	Giacomo Falorni
Date:	19 Feb 2021
Version:	1.3

Executive Summary

This report describes the results of the InSAR ground displacement analysis over Livermore covering the period 13 March 2015 to 30 September 2020. TRE Altamira used its SqueeSAR® algorithm to process Sentinel satellite imagery and produce 2-D ground displacement measurements that were then calibrated using GNSS stations in the area. This report provides an update to the displacement measurements provided in 2019.

The following points summarize the key findings:

- Localized subsidence is detected in 2020
    - An interpolated map of annual (September to September) ground displacement shows over -0.25 inches of subsidence from 2019 to 2020 in the Main Basin.
- There appears to be a weak correlation between variations in groundwater levels at Key_AMW_U, Key_Bern_U and well 3S1E08H009, and ground displacement.
- Generalized westward movement is present throughout the AOI.

Confidentiality disclaimer

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Acronyms and Abbreviations

AOI	Area of Interest
ATS	Average Time Series
CS	Cross-Section
cRTS	Common Time Series of Residuals
DEM	Digital Elevation Model
DInSAR	Differential Interferometric SAR
DS	Distributed Scatterer(s)
ENVISAT	ENVISAT Satellite
ERS	European Remote Sensing Satellite
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
InSAR	Interferometric Synthetic Aperture Radar
LOS	Line of Sight
LTS	LOS Time Series
MP	Measurement Point
PS	Permanent Scatterer(s)
SAR	Synthetic Aperture Radar
SNT	Sentinel Satellite
SqueeSAR®	The most recent InSAR algorithm patented by TRE
TS	Time Series
UNAVCO	UNAVCO Data Center

1. Introduction

TRE ALTAMIRA Inc. (TRE) has been contracted by the Zone 7 Water Agency (Zone 7) to provide a 2-D SqueeSAR ground displacement update over the Livermore and Pleasanton areas. The InSAR study includes:

- A historical study using LOS ERS, Envisat and Sentinel satellite imagery covering the periods 1992 – 2000, 2003 – 2010, and 2015 – 2016, respectively [Completed in 2016].
- 2019 Annual InSAR monitoring using 2D Sentinel satellite imagery covering the periods 2015 – 2019 [Completed in 2019].
- 2020 Annual InSAR monitoring using 2D Sentinel satellite imagery covering the periods 2015 – 2020 [Current report].

1.1. Area of Interest

The AOI for Livermore comprises urban as well as very dry, sparsely vegetated areas and covers approximately 121 square miles (Figure 1). The terrain is flat with moderate hills and presents conditions suitable for the application of InSAR.

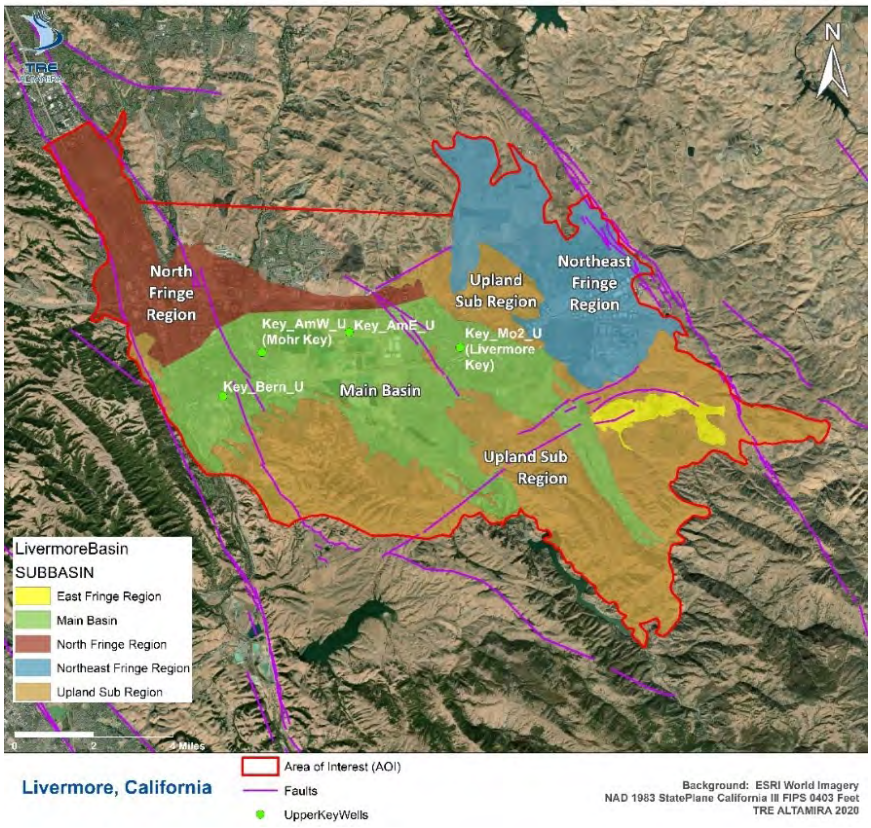

Figure 1: Livermore Area of Interest (AOI).

2. Radar Data

Radar images were acquired over Livermore by the Sentinel (SNT) satellite from both descending (satellite travelling from north to south and imaging to the west) and ascending orbits (satellite travelling from south to north and imaging to the east), with a 12-day revisit frequency. A total of 190 images from the descending orbit, covering the period 31 December 2014 - 30 September 2020, and 171 from the ascending orbit, spanning 13 March 2015 - 30 September 2020, were processed (Table 1). The temporal distribution of the radar imagery is shown in Figure 2. Appendix 2 provides additional information on the satellite acquisition data details.

Table 1: Satellite acquisition parameters and image acquisition information.

Satellite	Pixel Resolution	Orbit	LOS Angle (Θ)	Revisit Frequency	# of Images	Date Range
Sentinel	65 ft x 15 ft	Descending	42.3°	12 days (6-day since Aug 2019)	190	31 Dec 2014 – 30 Sep 2020
		Ascending	41.9°	12 days (6-day since Jan 2019)	171	13 Mar 2015 – 30 Sep 2020

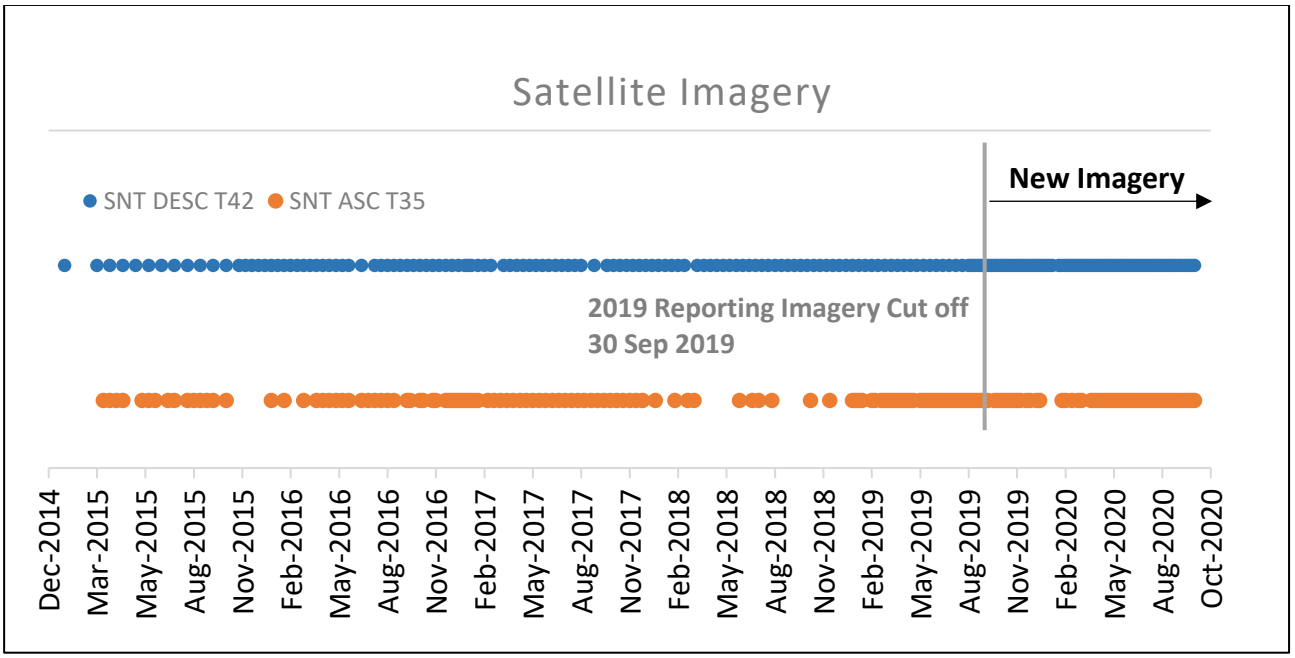

Figure 2: Temporal distribution of Sentinel ascending and descending radar images processed over Livermore.

3. Overview of Results

This section provides a summary of the techniques used and a general overview of the results, while Section 4 further describes areas of displacement in more detail. Refer to the Handbook for further details the technology and techniques used.

3.1. SqueeSAR Analysis

SqueeSAR identifies measurement points (MPs) from objects on the ground that display a stable return to the satellite in every image of an image archive. The MPs belong to two different families (Figure 3):

- Permanent Scatterers (PS): point-wise radar targets characterized by highly stable radar signal return (e.g. buildings, rocky outcrops, linear infrastructures, etc.)
- Distributed Scatterers (DS): patches of ground exhibiting a lower but homogenous radar signal return (e.g. rangeland, debris fields, arid areas, etc.). DS therefore refer to small areas covering several pixels rather than to a single target or object on the ground. For clarity of presentation and ease of interpretation, DS are represented as individual points.

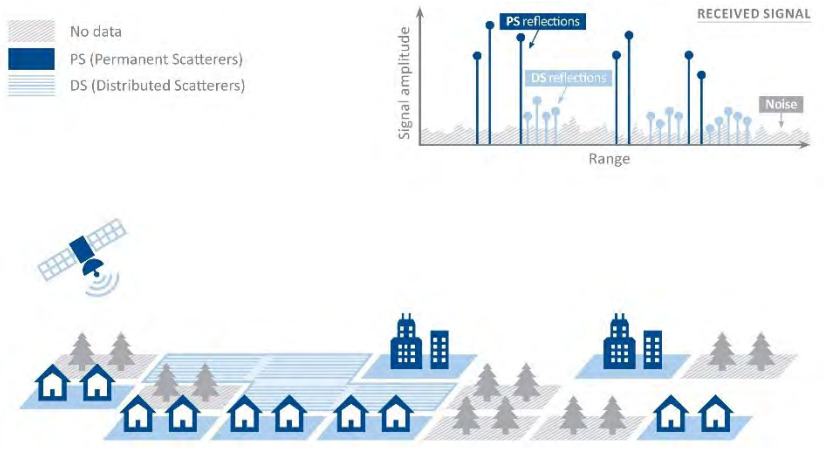

Figure 3: Schematic of PS and DS radar targets.

In InSAR analyses, all measurements are 1-D readings along the sensor's line-of-sight (LOS) as the true vector of displacement is projected onto the LOS. The same displacement will produce different readings when viewed from different angles (Figure 4). Negative values (red) indicate surface displacement away from the satellite, while positive values (blue) indicate surface displacement towards the satellite. The LOS displacement rates are calculated from a linear regression of the ground movement measured over the entire

period covered by the satellite images. Each measurement point corresponds to a Permanent Scatterer (PS) or a distributed scatterer (DS), and is color-coded according to its annual rate of movement and direction:

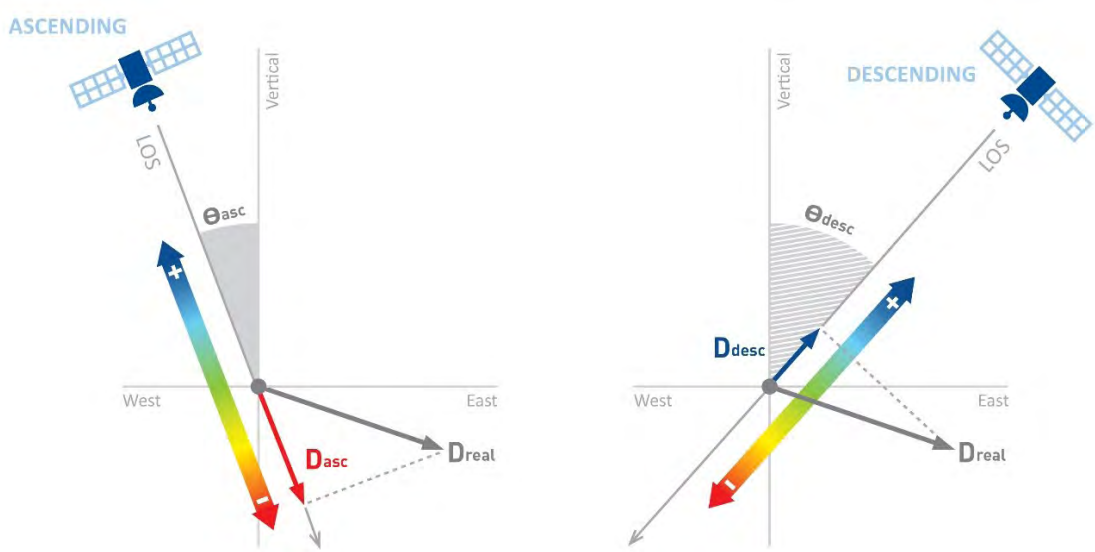

Figure 4: SqueeSAR measures the projection of real movement (D_{real}) onto the LOS. The same real movement (D_{real}) will produce a different value from a different LOS (different inclination or different acquisition geometry).

Displacement measurements obtained by the SqueeSAR algorithm are differential in space and time. Measurements are spatially related to the reference point, and temporally to the date of the first available satellite image. The reference point is assumed to be motionless and selected for its radar properties and motion behavior. Any seasonal trends present in the displacement data will be highlighted by the [SEASOM_AMP] field, which estimates amplitude of the average annual displacement.

The trigonometric combination of SqueeSAR results obtained from different orbits (i.e. ascending and descending), over the same area and overlapping period, produces 2-D (vertical and east-west) measurements of ground movement (Figure 5) in a gridded format, as different measurement points are identified from the two orbits. MPs contained within a same cell are averaged and a new unique, derived time series of displacement is obtained for each grid cell.

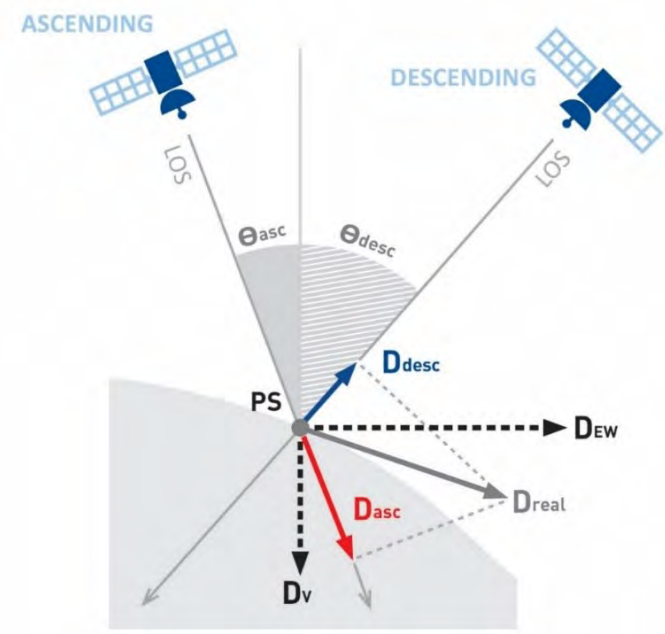

Figure 5: Example of motion decomposition combining ascending and descending acquisitions geometry.

As in the LOS analysis, average annual displacement rates in a 2-D analysis are calculated from a linear regression of the ground movement measured over the entire time interval covered by the analysis and all measurements are relative to a chosen reference point. Each point is color-coded according to the magnitude of movement:

- In a vertical data set, negative values (red) indicate downward surface displacement (i.e. subsidence), while positive values (blue) indicate upward surface displacement (i.e. uplift).
- In an east-west data set, negative values (red) indicate westward motion, while positive values (blue) indicate eastward motion.

The SqueeSAR data are calibrated using GNSS (Global Navigation Satellite System) stations P228 and P229 from UNAVCO. Appendix 3 provides additional information on the details for the calibration methodology.

3.2. 2-D and Line-of-Sight Results

The LOS displacement rates, measured in inches per year, were computed from the ascending archive (13 March 2015 to 30 September 2020) and the descending archive (31 December 2014 to 30 September 2020). These LOS results were calibrated using GPS stations located within the area of interest to account for regional ground displacement trends (Figure 6, uncalibrated results in Figure 7). The calibrated LOS (Ascending and Descending) results were then used to produce calibrated 2-D (East-West and Vertical) measurements (Figure 8, uncalibrated results in Figure 9). The calibrated 2-D output highlights an area of uplift in the western portion of the AOI and generalized westward movement throughout the AOI. Further observations are described in Section 4.

Various parameters of the analysis, including measurement point density and precision, are indicated in Table 2. Note that more heavily vegetated areas may produce a lower density of measurement points. Furthermore, as the radar signal in these areas is weaker the displacement readings may be noisier.

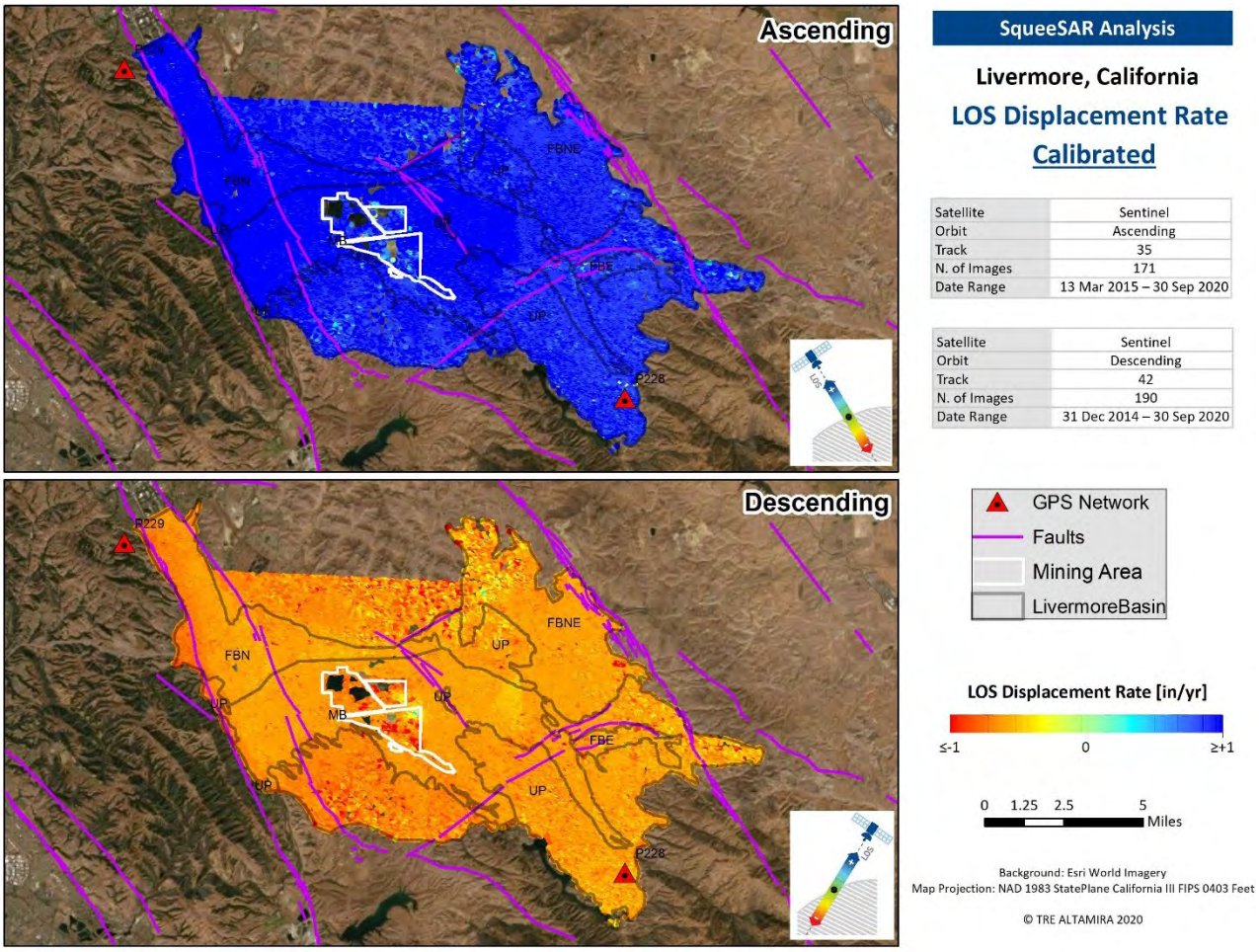

Figure 6: Ascending and Descending calibrated displacement rates over the AOI for the entire study period.

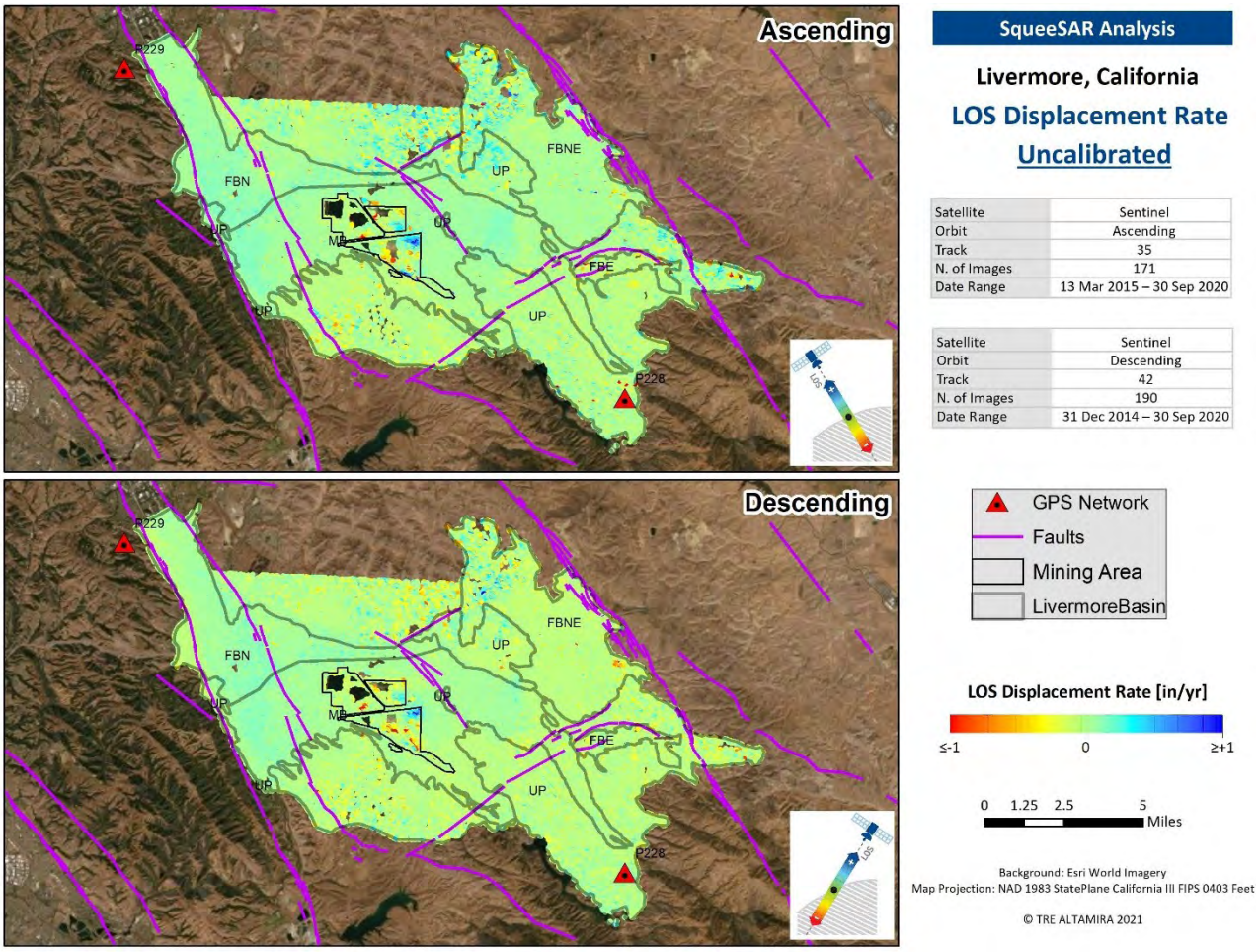

Figure 7: Ascending and Descending uncalibrated displacement rates over the AOI for the entire study period.

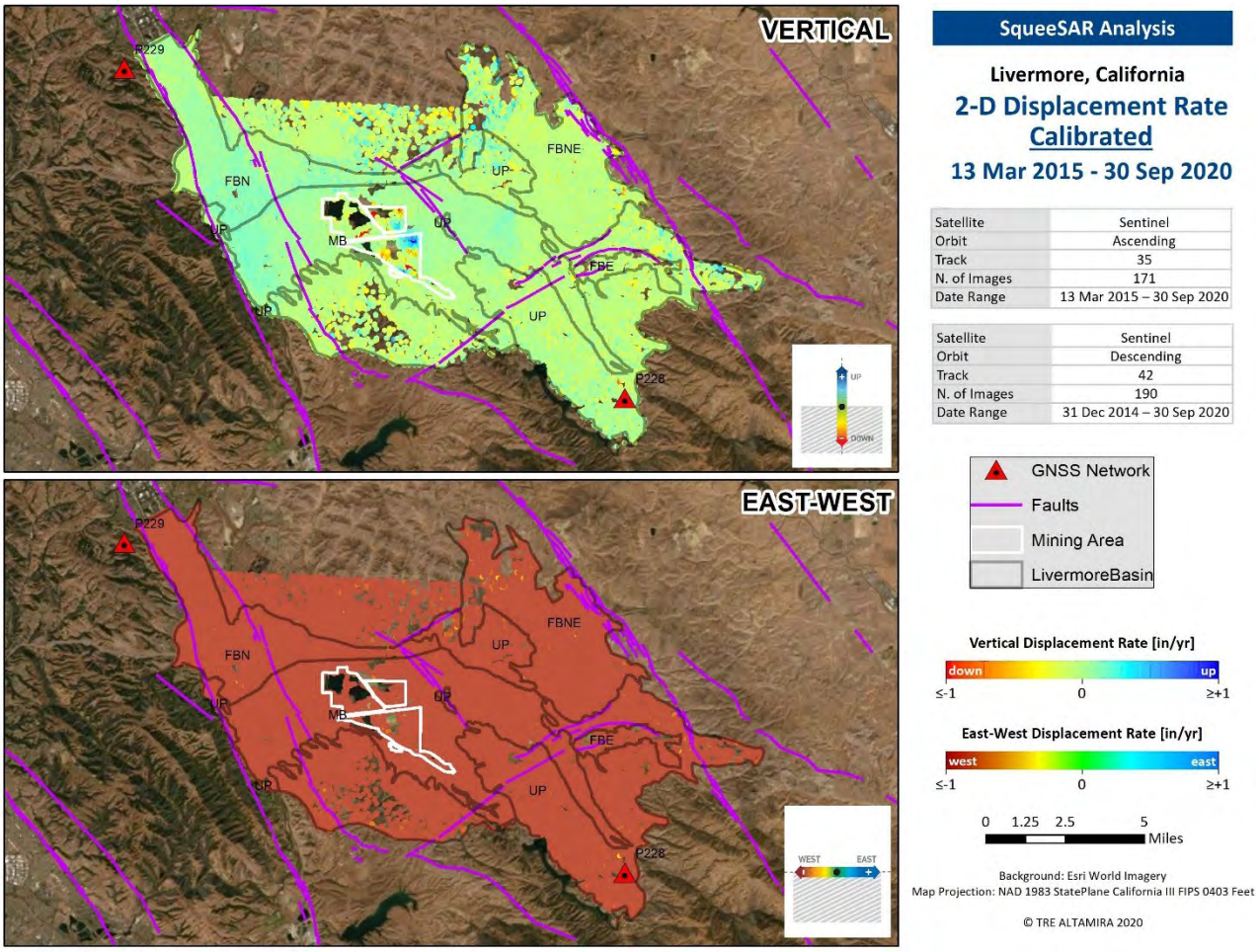

Figure 8: East-West and Vertical calibrated displacement rates over the AOI for the entire study period.

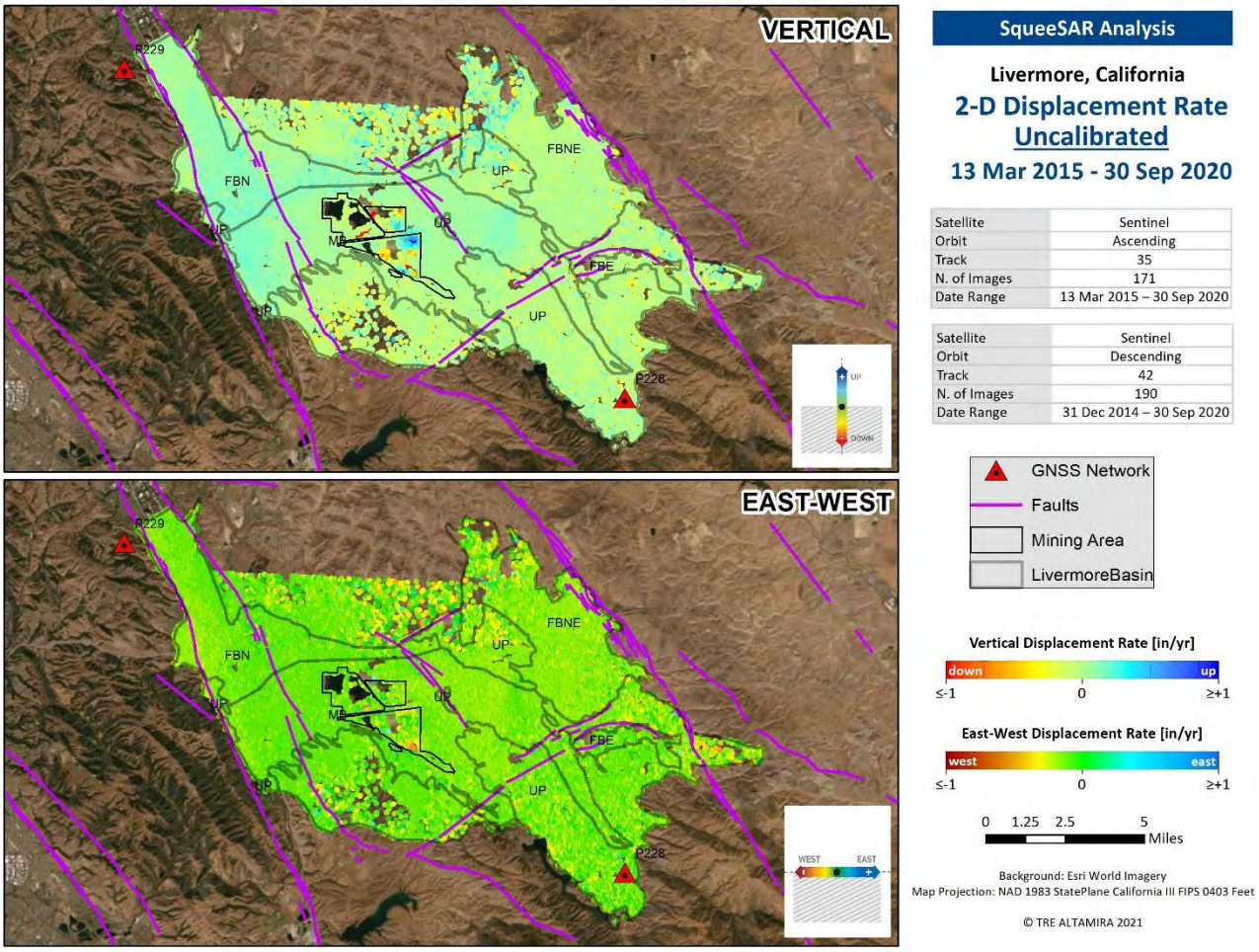

Figure 9: East-West and Vertical uncalibrated displacement rates over the AOI for the entire study period.

Table 2: Properties of the SqueeSAR analyses. *Based on uncalibrated LOS and 2D results.

Attribute	Ascending	Descending	Vertical	East-West
Date Range	13 Mar 2015 – 30 Sep 2020	31 Dec 2014 – 30 Sep 2020	13 Mar 2015– 30 Sep 2020	13 Mar 2015 – 30 Sep 2020
N. of Images	171	190	246	246
Total points (PS + DS)	120,467	124,723	41,665	41,665
Number of PS	82,924	86,639	/	/
Number of DS	37,543	38,084	/	/
Average Point Density (pts/mi^2)	996	1031	344	344
Average Displacement Rate Standard Deviation (in/yr)	±0.02	±0.01	±0.02	±0.02
Average Time Series Error Bar (in)	±0.15	±0.15	/	/

4. Observations

All data analyses in this section use uncalibrated vertical data, which is simply referred to as vertical data in the following.

4.1. Annual Ground Displacement

Figure 10 and Figure 11 outlines annual (September to September) cumulative displacement within the AOI. Within the North Fringe Region sub-basin (FBN) and the northwest Main Basin (MB), uplift is observed between 2016 to 2019, while up to -0.25 inches of subsidence is detected in the Main Basin (within the mining area) in 2020.

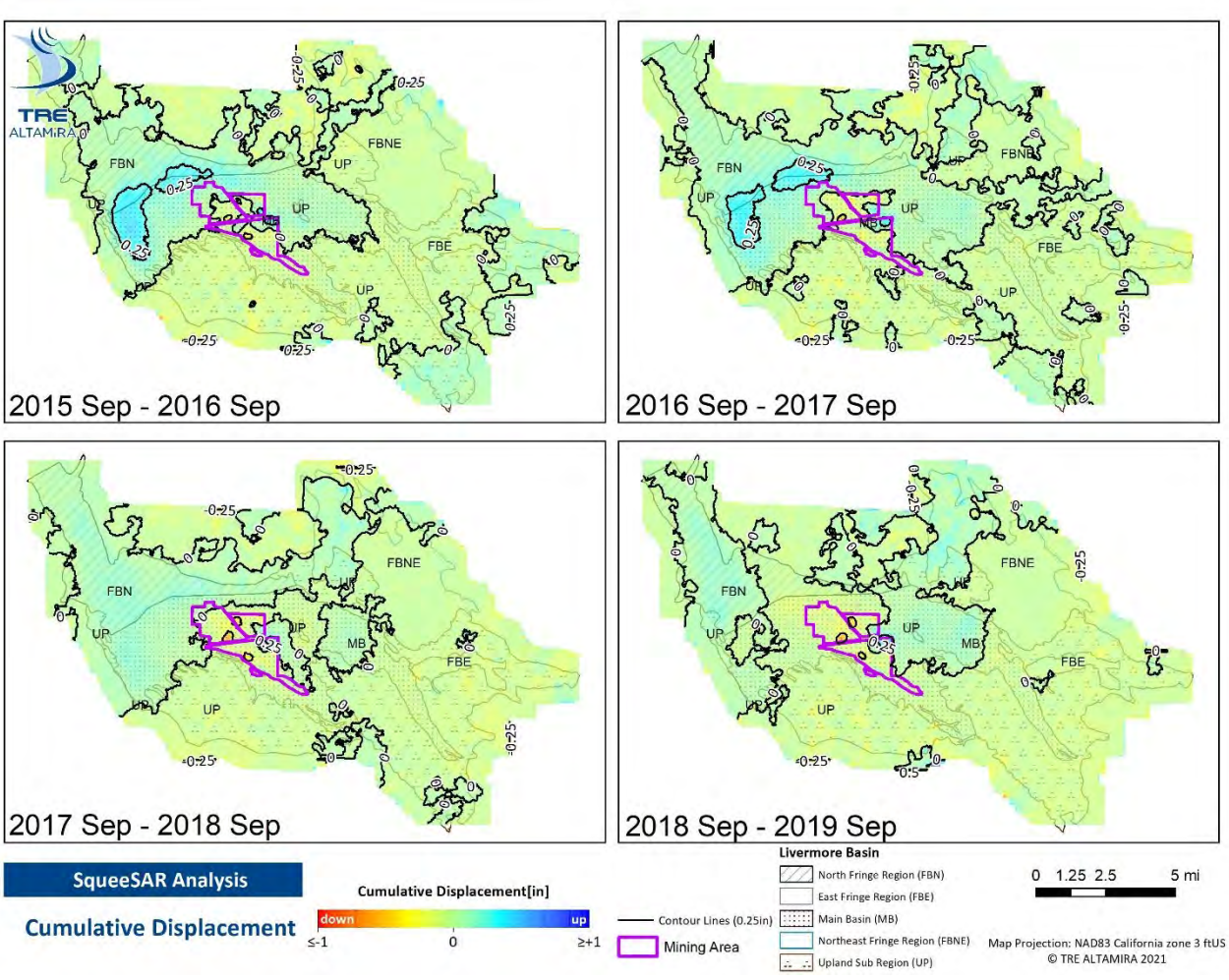

Figure 10: Interpolated map showing annual (September to September) ground displacement from 2015 to 2019. Contour lines have a 0.25-inch interval.

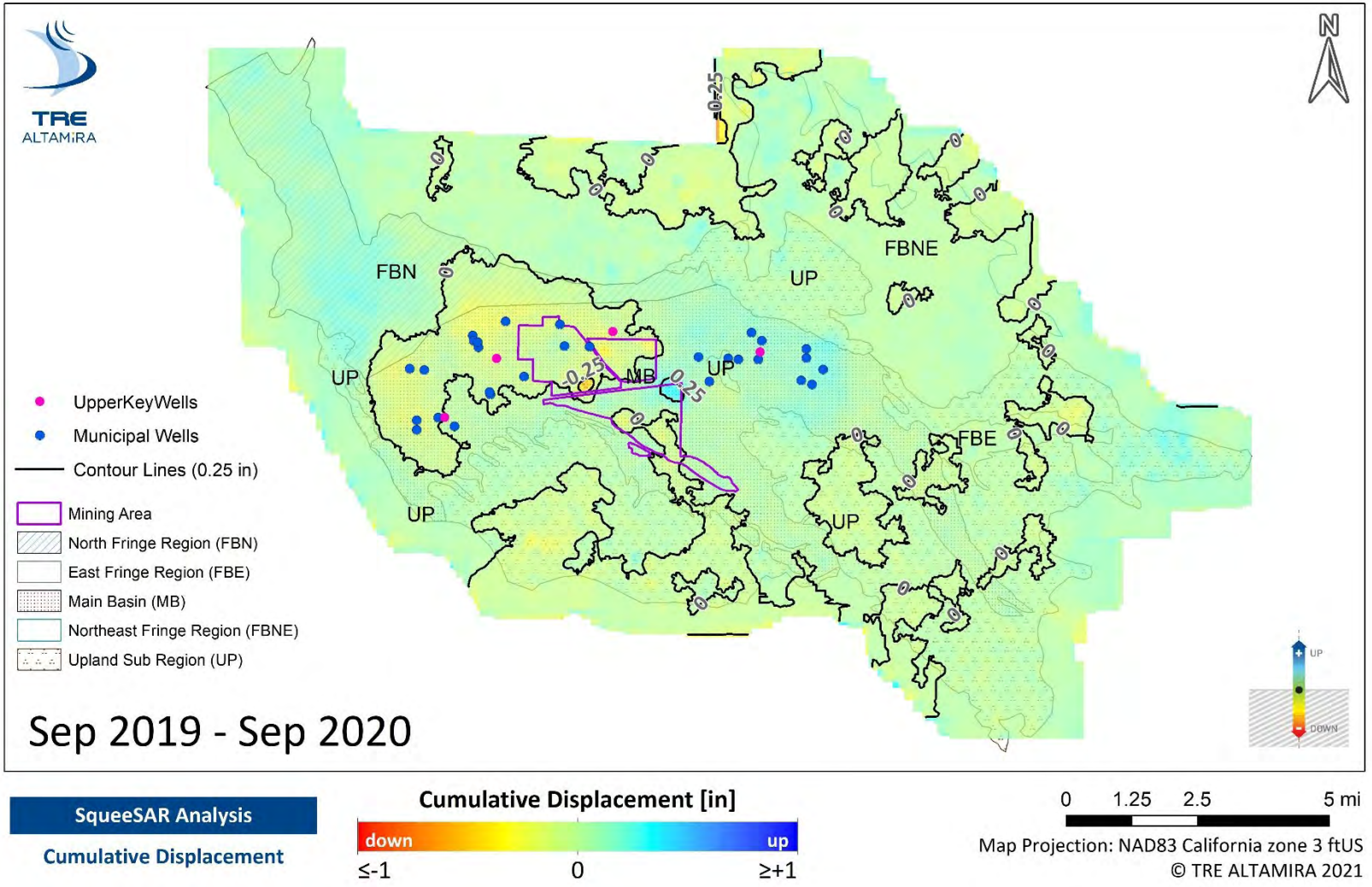

Figure 11: Interpolated map showing annual (September to September) ground displacement from 2019 to 2020. Contour lines have a 0.25-inch interval.

4.2. Comparison with Groundwater Levels

The relationship between groundwater levels and ground displacement was investigated by comparing vertical measurements (within a 500 foot buffer of four key wells and well 3S1E08H009) with groundwater levels (Figure 12). The results may be weakly correlated, including decreased groundwater levels matching minor ground subsidence (at Key_AMW_U, Key_Bern_U and well 3S1E08H009) in the last year (Figure 13 and Figure 14). The measurement points within 500 ft buffer to the wells are listed in Table 3.

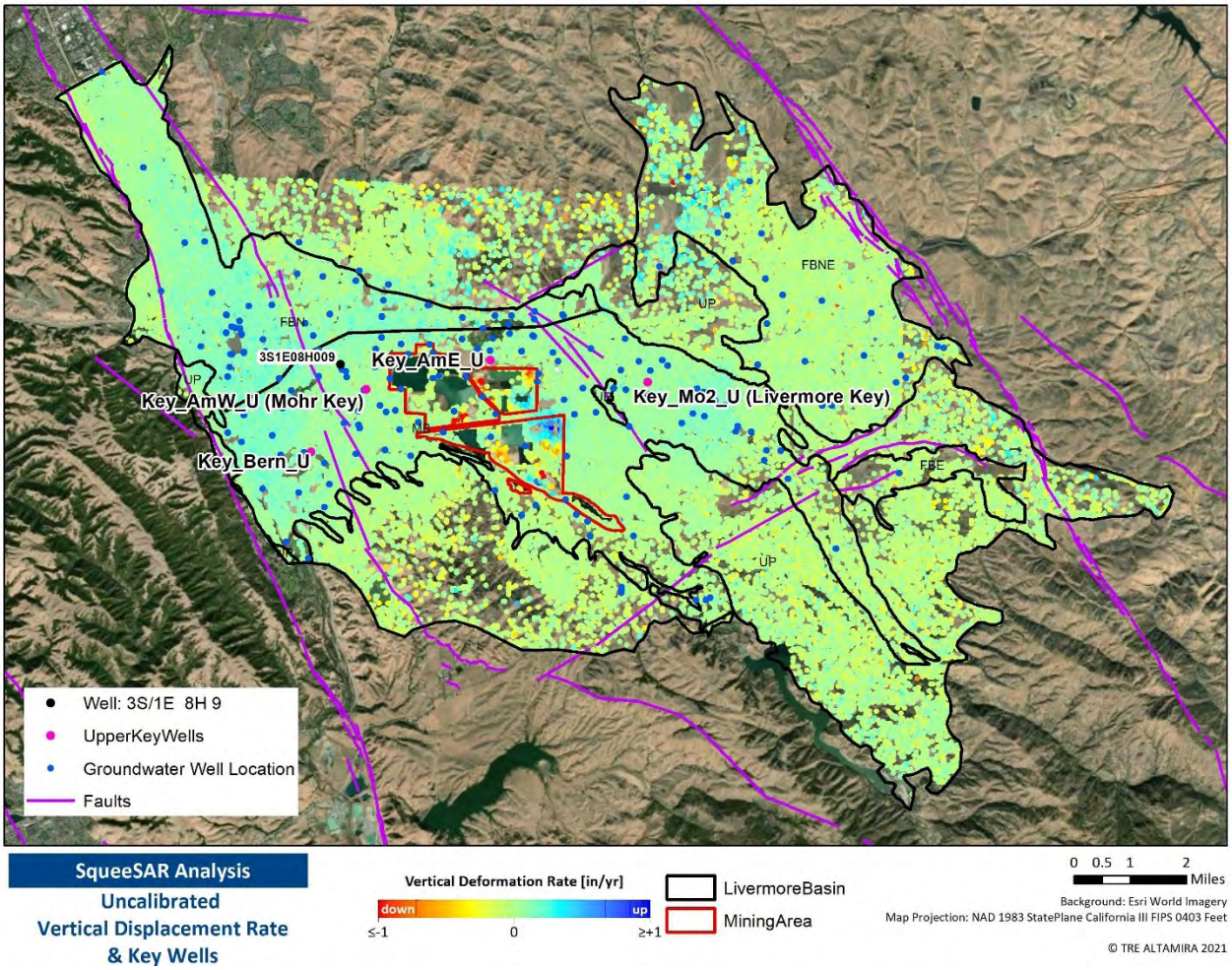

Figure 12: Key well locations, ground displacement and faults.

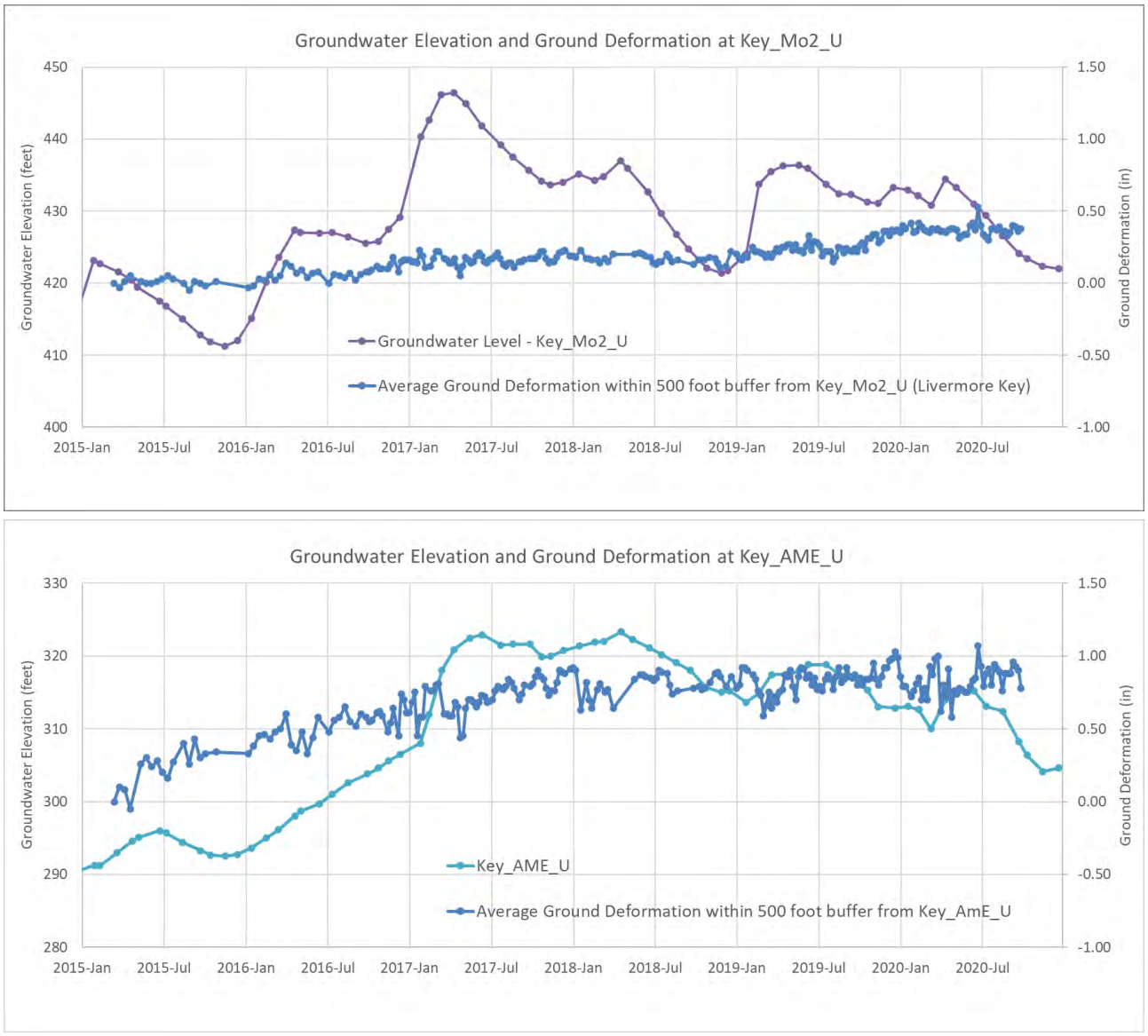

Figure 13: Groundwater elevation vs. ground displacement at Key_Mo2_U (top) and Key_AME_U (bottom).

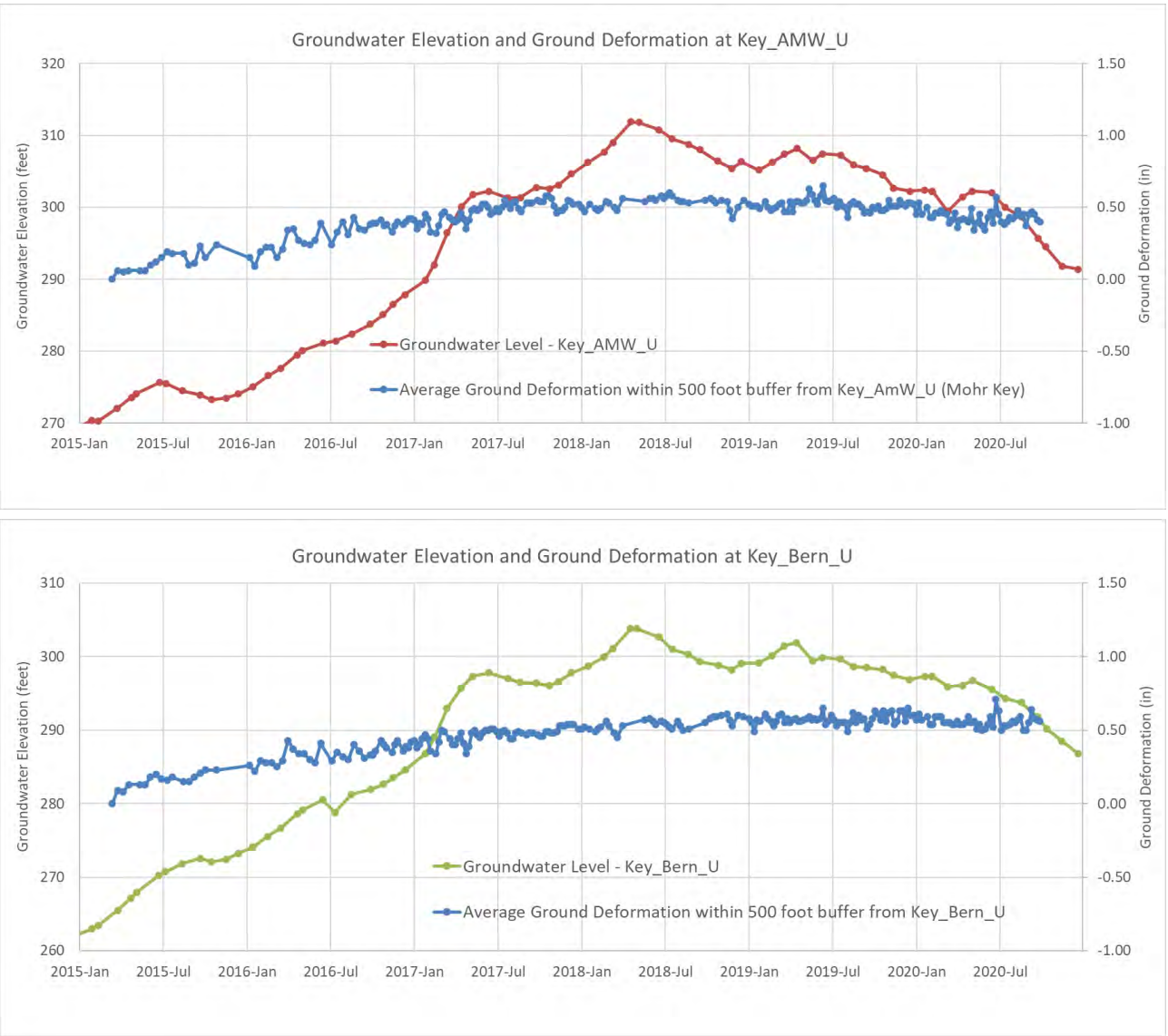

Figure 14: Groundwater elevation vs. ground displacement at Key_AMW_U (top) and Key_Bern_U (bottom).

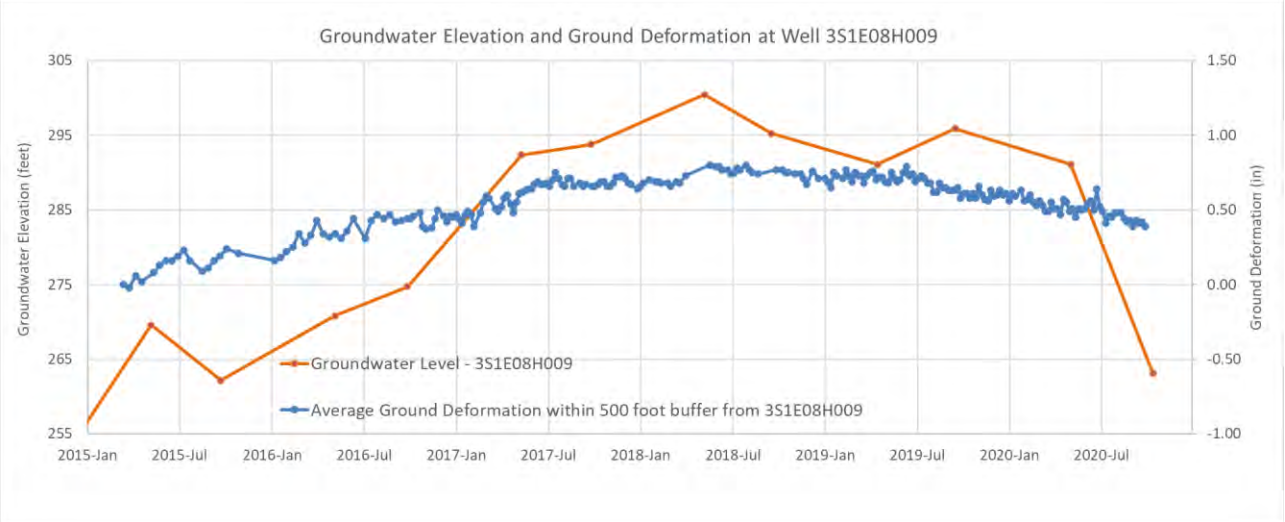

Figure 15: Groundwater elevation vs. ground displacement at well 3S1E08H009.

Table 3: Measurement points within 500-foot buffer to the wells.

Key Wells	Measurement point CODE
Key_Mo2_U	A3UQ07K, A3U4KLT, A3VBFTD, A3VWVF5, A3WIB0X, A3TJ502, A3UQ07M, A3VBFTE, A3VWVF6, A3WIB0Y, A3TJ503, A3U4KLV, A3VBFTF, A3VWVF7, A3WIB0Z, A3UQ07O, A3VBFTG, A3WIB10, A3U4KLX
Key_AME_U	A40OC6W, A43NI7S, A42GN0B, A4322M3
Key_AMW_U	A3RQU27, A3QJYUO, A3RQU28, A3SC9O0, A3SXP9T, A3PYJ8Y, A3RQU2A, A3SC9O2, A3SXP9U, A3QJYUR, A3R5EGJ, A3SXP9V, A3QJYUS, A3RQU2C
Key_Bern_U	A36B89C, A354D1T, A35PSNL, A36B89D, A36WNV5, A34IXG2, A35PSNM, A354D1V, A35PSNN, A36B89F, A36WNV7, A37I3GZ, A34IXG4, A35PSNO, A36WNV8, A35PSNP, A36B89H, A36WNV9
3S1E08H009	A402WIO, A3YALPD, A3YW1B5, A40OC4H, A3ZHGWY, A40OC4I, A419RQA, A3YW1B7, A3ZHGWZ, A3YALPG, A419RQC, A3YW1B9, A3ZHGX1, A402WIT, A40OC4L

5. Summary and Recommendations

TRE Altamira used its SqueeSAR® algorithm to process Sentinel images coupled with a GNSS calibration procedure to carry out a 2-D analysis of ground displacement over Livermore spanning 13 March 2015 to 30 September 2020. The current analysis provides an annual update for the period September 2019 to September 2020.

Up to -0.25 inches observed over the Main Basin over Livermore in 2020. The precision of the InSAR results is maintained within a quarter of an inch (±0.15 inches).

Appendix 1: Delivered Files

List of Deliverables

Table 4 list the deliverables including the present report, the InSAR data files and an updated version of the TRE toolbar, a software tool for assisting with the loading, viewing and interrogation of the data in ESRI ArcGIS 10.x software (For set-up procedure and functionalities, see the attached manual *TREToolbarSetup_5.0.pdf*).

Table 4: List of deliverables.

Description	File name
SqueeSAR Data	**LOS Calibrated & Uncalibrated:** Ascending: LIVERMORE_SNT_T35_A_SEP2020_NAD83_IMPERIAL_CA3030A1S.shp Descending: LIVERMORE_SNT_T42_D_SEP2020_NAD83_IMPERIAL_CA3030A2S.shp **2-D Calibrated & Uncalibrated:** Vertical: LIVERMORE_SNT_VERT_SEP2020_NAD83_IMPERIAL_CA3030A3V.shp East-West: LIVERMORE_SNT_EAST_SEP2020_NAD83_IMPERIAL_CA3030A4E.shp
MXD project file containing all the data (ESRI ArcGIS version 10.0 and 10.8)	Livermore_InSAR_Analysis_2014-2020.mxd
Technical Report	Livermore_Annnual_SqueeSAR_Analysis_2020_Report.pdf
TRE Toolbar v5.8.5 (ESRI® ArcGIS 10.x)	TREToolbar_5.0 TREToolbarSetup_5.0.pdf

Database Structure

The SqueeSAR vector data are delivered in a shapefile format and projected to NAD_1983_StatePlane_California_III_FIPS_0403_Feet (EPSG:2227) coordinates. The shapefile of each elaboration contains details about the measurement points identified, including displacement rate, elevation, cumulative displacement and quality index. The information associated within the database files (dbf) are described in Table 5.

Table 5: Description of the fields contained in the database of the vector data. *Field is only present in LOS data sets.

Field	Description
CODE	Measurement Point (MP) identification code.
HEIGHT*	Topographic Elevation referred to WGS84 ellipsoid of the measurement point [ft].
H_STDEV*	Height standard deviation of the measurement point [ft].
VEL	MP displacement rate [in/yr]. • **Ascending LOS:** Positive values correspond to motion toward the satellite (i.e. uplift and/or westward movement); negative values correspond to motion away from the satellite (i.e. downward and/or eastward movement). • **Descending LOS:** Positive values correspond to motion toward the satellite (i.e. uplift and/or eastward movement); negative values correspond to motion away from the satellite (i.e. downward and/or westward movement). • **Vertical (VEL_V):** Positive values indicate uplift; negative values indicate downward movement. • **E-W Horizontal (VEL_E):** Positive values indicate eastward movement; negative values westward movement.
V_STDEV	Displacement rate standard deviation [in/yr].
ACC*	Acceleration rate [in/yr^2].
A_STDEV*	Standard deviation of the acceleration value [in/yr^2].
SEASPM_AMP*	Average seasonal amplitude [in]
S_AMP_STD*	Average seasonal amplitude standard deviation [in]
SEASON_PHS*	Average seasonal phase [day]
S_PHS_STD*	SEASON_PHS standard deviation [day]
COHERENCE*	Quality measure between 0 and 1.

STD_DEF*	Displacement time series error bar [in]
EFF_AREA*	This parameter represents the effective extension of the area [ft^2] covered by Distributed Scatterers (DS). For permanent scatterers (PS), its value is set to 0.
Dyyyymmdd	Series of columns that contain the displacement values of successive acquisitions relative to the first acquisition available [in].

TREmaps

TREmaps® is our proprietary online GIS platform to view and interrogate the InSAR datasets. TREmaps has been completely revamped to include features and functionality previously available only within the TRE ArcGIS toolbar. Little or no training is required and no specialized GIS software is necessary. With internet access, the platform allows data to be overlaid on an optical image and to perform various operations on the data.

Functionalities include:

- Time-Series tool to view the history of displacement for each measurement point
- Average Time-Series tool to view the average history of displacement for a group of selected points.
- Cross-section tool to view the evolution of the ground surface over time
- Data download and data export (of subsets of data) to common formats (SHP, KML, GeoDB, CSV)
- Dynamic filtering tool to filter a subset of the results by a specified time period
- Client data integration.

TREmaps is hosted by Microsoft Azure, with all the advantages of data security and the cloud-based environment, with minimal downtime and robust internet connectivity. TREmaps runs directly on most Internet browsers and is accessed through a secure client login.

To log in, please go to:

https://tremaps5.tre-altamira.com/treaviewer

For assistance on any of the functions, please click the Help icon on the viewer or go to:

https://site.tre-altamira.com/tremaps-getting-started/

Appendix 2: Additional Radar Data Details

InSAR-based approaches measure surface displacement on a one-dimensional plane, along the satellite line-of-sight (LOS). The LOS angle varies depending on the satellite and on the acquisition parameters while another important angle, between the orbit direction and the geographic North, is nearly constant.

An ascending orbit denotes a satellite travelling from south to north and imaging to the east, while a descending orbit indicates a satellite travelling from north to south and imaging to the west. Table 6 lists the values of the angles for this study, while Figure 16 and Figure 17 show the geometry of the image acquisitions over the site for the ascending and descending orbits, respectively. The symbol Θ (theta) represents the angle the LOS forms with the vertical and δ (delta) the angle formed with the geographic north.

Table 6: Satellite viewing angles for the study.

Satellite	Wavelength	Orbit	Beam Mode/ Track	Symbol	Angle
Sentinel	C-Band 2.19 in	Ascending	35	**θ**	41.92°
				δ	10.48°
		Descending	42	**θ**	42.34°
				δ	8.94°

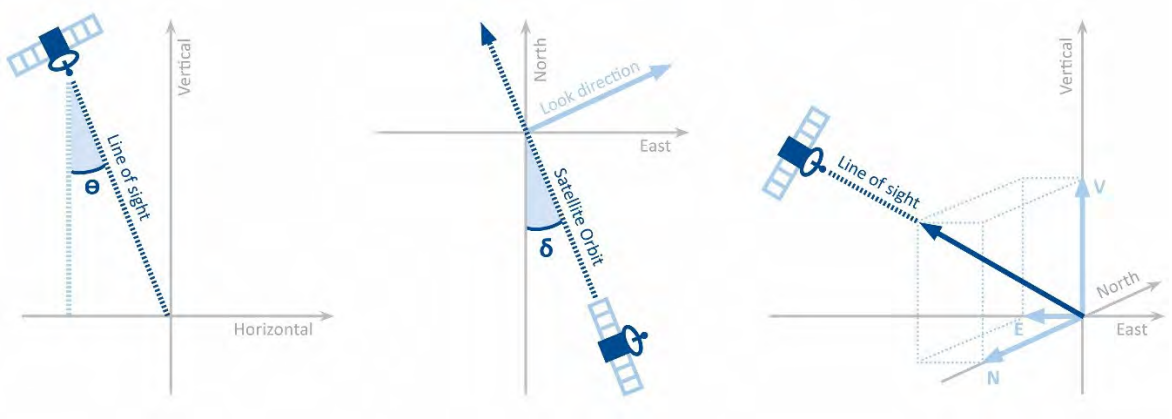

Figure 16: Geometry of the image acquisitions along the ascending orbit.

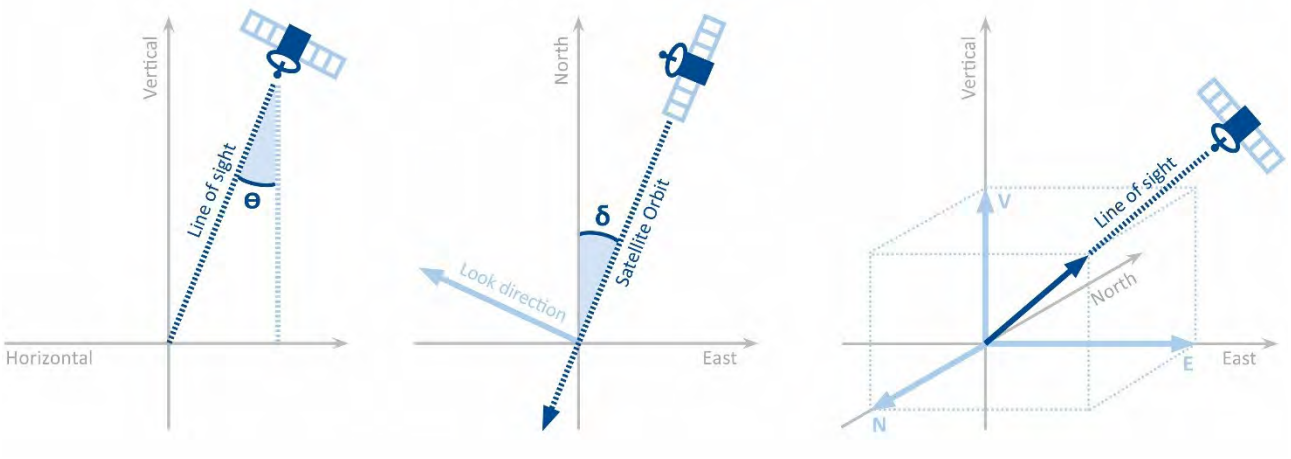

Figure 17: Geometry of the image acquisitions along the descending orbit.

Appendix 3: Calibration Methodology

The **calibration methodology** applied to Livermore consists of the following steps (Figure 18):

1. Data collection: InSAR LOS measurements and GNSS measurements are collected independently.
2. Time series filtering:
    a) To reduce the noise of GNSS measurements, the daily time series are filtered using a 30-day moving average (15 days prior and 15 days following any given date). The filtered GNSS 3-D measurements are then projected to the satellite 1-D LOS to create a GNSS LOS time series (LTS). This step allows a direct comparison of the two independent measurements (measurement direction correspondence).

    b) All InSAR measurement points (MP) within a 100 meter radius of each GNSS are selected and used to calculate an average time series (ATS) for the period of overlap with the GNSS time series (one ATS for each GNSS). This step allows the comparison of data collected at a same location over a corresponding period of time (spatial and temporal correspondence).
3. Plane removal: to remove possible linear errors related to potential satellite orbital inaccuracies, a difference in average velocity (linear trend) is calculated for each ATS and corresponding LTS. The differences calculated for each ATS and LTS pair are then used to estimate and remove a first order surface (plane) from the InSAR data. The time series of each InSAR MP are now corrected from any possible linear trend related to orbital inaccuracies.
4. Absolute calibration: to tie the two measurement techniques together and convert the relative InSAR measurements to the absolute reference of the GNSS network, it is necessary to calibrate the InSAR time series. The procedure involves the generation of a time series of residuals by comparing the ATS to the corresponding LTS for each GNSS location. All the time series of residuals are then averaged to define a common time series of residuals (cRTS). This cRTS represents the movement of the local InSAR reference points with respect to the absolute GNSS reference frame. The cRTS is then removed from every InSAR MP time series.

5. Absolute Vertical InSAR: The output of the absolute calibration is a LOS InSAR data set fixed to the same absolute reference system of the GNSS network. The calibration is performed separately for each orbit (ascending and descending) and the absolute LOS InSAR results will then be combined to produce the vertical and horizonal east/west displacement.

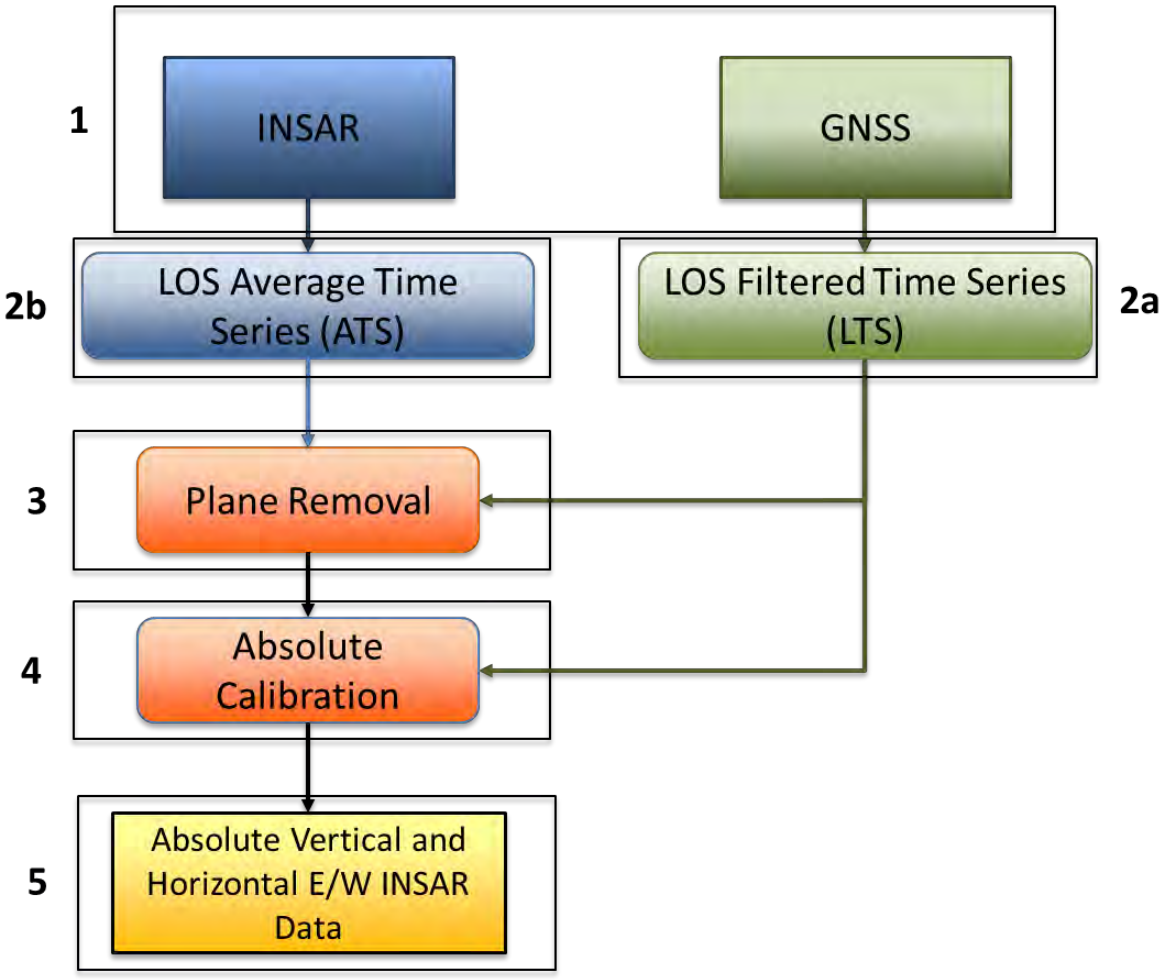

Figure 18: Diagram of the calibration methodology applied over the site.

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9 Land Use

9.1 Program Description

9.1.1 Monitoring Network

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

9.1.2 Program Changes for the Water Year

There were no changes to the Land Use Monitoring Program during the 2020 WY.

9.2 Results for the 2020 Water Year

Although there was some in-fill development that occurred during the 2020 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 land use type and main irrigation water type (i.e., delivered water, groundwater, or recycled water) for the Main Basin, Fringe Areas, and Upland Areas.

TABLE 9-1
LAND USE ACREAGE (in acres)
2020 WATER YEAR
LIVERMORE VALLEY GROUNDWATER BASIN

Basin / Category / Irrigation Water Source	Main Basin					Fringe Areas					Upland Areas				
	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	1	0	0	1,841
Total Agricultural	***1,552***	***113***	***0***	***0***	***1,666***	***708***	***28***	***0***	***0***	***735***	***1,986***	***48***	***0***	***0***	***2,033***
Commercial and Business	1,406	42	400	0	1,849	3,872	117	1,268	0	5,257	387	15	28	0	430
Public	563	0	400	0	962	957	3	57	0	1,018	143	0	88	0	232
Public (Irrigated Park)	563	0	118	0	680	185	0	87	0	272	97	0	11	0	108
Residential (high density)	421	0	0	0	421	264	0	158	0	422	29	0	15	0	44
Residential (medium density)	6,446	0	17	0	6,463	5,279	0	45	0	5,324	2,937	0	49	0	2,986
Residential (low density)	147	150	0	0	297	20	0	0	0	20	185	177	0	0	362
Roads	0	0	0	78	78	0	0	0	701	701	0	0	0	93	93
Total Urban	***9,545***	***192***	***934***	***78***	***10,749***	***10,576***	***120***	***1,616***	***701***	***13,013***	***3,778***	***192***	***192***	***93***	***4,255***
Golf Course	140	90	126	0	356	230	15	66	0	311	466	172	0	0	638
Residential (rural)	41	155	0	0	196	19	373	0	0	392	166	192	0	0	358
Mining Area (pit)	0	0	0	1,959	1,959	0	0	0	0	0	0	0	0	0	0
Open Space	0	0	102	3,748	3,850	0	0	0	7,440	7,440	0	0	0	20,324	20,324
Water	0	0	0	1,034	1,034	0	0	0	65	65	0	0	0	170	170
Total Other	***181***	***245***	***229***	***6,740***	***7,394***	***249***	***389***	***66***	***7,505***	***8,208***	***632***	***364***	***0***	***20,494***	***21,490***
TOTALS FOR 2020 WY	**11,278**	**550**	**1,163**	**6,818**	**19,809**	**11,532**	**536**	**1,681**	**8,206**	**21,956**	**6,396**	**603**	**192**	**20,587**	**27,778**
TOTALS FOR 2019 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**
CHANGE SINCE PREVIOUS YEAR	**4**	**0**	**155**	**-159**	**0**	**64**	**0**	**106**	**-170**	**0**	**14**	**50**	**0**	**-64**	**0**

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

N
W E
S

0 6,000 12,000
Feet

LEGEND

- 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
- Roads
- Open Space

Irrigation Source Water

- Municipal or Imported
- Groundwater
- Recycled Water

Basin Region

- Main Basin
- Fringe Area
- Upland Area

Date: Jan 19, 2021
FILE: E:\MONITOR\Land Use\2020WY\Fig09-01-LUMap2020.mxd

Figure 9-1
Map of Land Use
2020 Water Year
Livermore Valley Groundwater Basin

10 Wastewater and Recycled Water

10.1 Program Description

10.1.1 Monitoring Network

For more information on Zone 7's Wastewater and Recycled Water Monitoring Program, see *Section 4.8, Wastewater and Recycled Water Monitoring*, of the Alternative GSP. The City of Livermore and the 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 2020 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*).

10.1.2 Program Changes for the Water Year

There were no changes to the Wastewater and Recycled Water Monitoring Program during the 2020 WY.

10.2 Results for the 2020 Water Year

10.2.1 Wastewater and Recycled Water Volumes

In the 2020 WY, about 96% of the wastewater produced over the groundwater basin was treated at LWRP and DSRSD. A total of 17,676 AF of municipal wastewater was treated at the two POTWs, of which 10,629 AF (60%) was exported and about 7,176 AF (41%) was recycled and used primarily for landscape irrigation (compared to 34% in the 2019 WY). About 25% of the LWRP's

recycled water (609 AF) and 9% of DSRSD's recycled water (427 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*). A summary of the wastewater volumes for the 2020 WY are presented in *Table 10-A* below.

Table 10-A: Municipal Wastewater and Recycled Water Volumes (AF) for the 2020 WY

Water Type	LWRP	DSRSD	Total
Wastewater Influent	6,141	11,535	17,676
Treated Effluent Exported via LAVWMA*	4,590	6,039	10,629
Total Volume Recycled	2,426	4,750	7,176
RW Applied to Main Basin**	609	427	1,036

* Does not include Zone 7 Demin Plant discharge to LAVWMA via DSRSD
** Recycled water 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
RW Recycled Water

Recycled water continues to account for small fractions of the Valley's water supply (15%) and Main Basin recharging waters (approximately 2%); however, of greater benefit, the recycled water use in the 2020 WY potentially conserved up to 7,176 AF of water that might have otherwise come from groundwater storage.

The program also 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. The age of wastewater and recycled water pipelines is considered in the estimation of "Pipe Leakage." 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 estimated volumes of leachate from these three sources for the 2020 WY are presented in *Table 10-B* below.

Table 10-B: Other Wastewater Volumes (AF) for the 2020 Water Year

	VA Hospital*	Septic Tanks*	Pipe Leakage**	Total
Wastewater Leachate	50	80	551	681

* Estimated total over the Main Basin

** Calculated. Includes leakage from sanitary sewer & RW pipes

10.2.2 Wastewater and Recycled Water Quality

The recycled water from both wastewater plants met the DDW's "Title 22" water quality standards for irrigation uses during the 2020 WY. While salt (*Section 10.2.2.1*, below) and nutrients (specifically nitrate, see *Section 10.2.2.2*) are the primary constituents of concern for wastewater and recycled water applied over the Main Basin, other constituents of emerging concern (CECs) will need to be considered if recycled water is used for future aquifer recharge projects.

10.2.2.1 Salt Loading

Table 10-C below presents the estimated salt loading over the Main Basin from applied wastewater and recycled water during the 2020 WY.

Table 10-C: Salt Loading from Applied Recycled Water and Wastewater for 2020 WY

Source	Volume (AF)	TDS Average (mg/L)	Salt Applied (tons)
LWRP RW	609	578	478
DSRSD RW	427	726	421
Total RW	*1,036*	*639*	*899*
VA Hospital	50	573	39
Septic	80	600	65
Pipe Leakage	551	466	349
Total WW	*681*	*490*	*453*
Total	***1,717***	***722***	***1,352***

DSRSD Dublin San Ramon Services District
LWRP Livermore Wastewater Reclamation Plant
RW Recycled Water
WW Wastewater

Zone 7 assumes that the entire salt mass in the applied water is transported through the vadose zone (area above the water table), 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 827 tons (approximately 7%) of the Main Basin's salt inflow (12,471 tons) was attributed to recycled water use over the Main Basin during the 2020 WY (see *Table 13-B*). However, if potable water supplies would have been used for this irrigation demand, the salt loading would have been about 473 tons or only about 354 tons less. This difference is significantly less than the 1,230 tons that were removed by Zone 7's Mocho Groundwater Demineralization Plant (MGDP) in the 2020 WY (see *Table 13-C*).

10.2.2.2 Nitrogen Loading

Table 10-D below presents the estimated nitrogen loading over the Main Basin from applied wastewater and recycled water during the 2020 WY.

Table 10-D: Nitrogen Loading from Applied Recycled Water and Wastewater for the 2020 WY

Source	Volume (AF)	Nitrogen Compounds (mg/L) NO3(N)	NO2(N)	TKN	Nitrogen Applied (lbs)
LWRP RW	609	0.1	0.8	52.5	87,392
DSRSD RW	427	0.8	1.6	30.0	35,594
Total RW	*1,036*	*0.4*	*1.1*	*43.2*	*122,986*
VA Hospital	50	11.1	0.1	5.0	1,025
Septic	80	35.0	0.0	0.0	1,719
Pipe Leakage	551	0.2	0.5	19.9	30,167
Total WW	*681*	*5.1*	*0.4*	*16.5*	*32,911*
Total	***1,717***	***2.3***	***0.8***	***32.6***	***155,897***

DSRSD Dublin San Ramon Services District
LWRP Livermore Wastewater Reclamation Plant
NO3(N) Nitrate as Nitrogen
NO2(N) Nitrite as Nitrogen
RW Recycled Water
TKN Total Kejldahl Nitrogen
WW Wastewater
lbs pounds

The three nitrogen compounds in *Table 10-D* above represent the nitrogen content potentially available for conversion to nitrate as the water percolates through the soil. The table shows that about 156,000 pounds of nitrogen was applied over the Main Basin during the 2020 WY. However, from a practical standpoint, much of the nitrogen will be removed from the percolate through soil denitrification and plant uptake processes.

LEGEND

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

Source of Recycled Water
- DSRSD
- LWRP

Application of Recycled Water 2020
- DSRSD
- City of Livermore
- City of Pleasanton
- Main Basin
- Fringe Areas
- Upland Areas
- Rivers

Dublin
DSRSD
Pleasanton
LWRP
Livermore
VA Ponds
VA Plant
N
W
E
S
0
6,000
12,000
Feet

DATE: Mar 10, 2020
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Figure 10-1
Wastewater and Recycled Water Application Areas 2020 WY
Livermore Valley Groundwater Basin

11 Groundwater Storage

11.1 Groundwater Storage Calculations

11.1.1 Groundwater Storage Threshold

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 storage of 128 TAF, or about one half of total storage volume. This 126 TAF (254 TAF – 128 TAF) is considered the Operational Storage. Groundwater below this minimum 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.

11.1.2 Calculation Methods

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 11.1.3*) 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*, in the Alternative GSP). The HI method (*Section 11.1.4*) involves accounting for inflows and outflows for each water year 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*, in the Alternative GSP). Storage volumes from the two methods are averaged to quantify the total storage of the Main Basin (*Section 11.1.5*). See *Section 2.4.1, Overview of Methodology*, of the Alternative GSP for more details.

11.1.3 Groundwater Elevation Results

The GWE method yielded a total storage of 231.6 TAF at the end of 2020 WY, which is 16.8 TAF less than the GWE value calculated for the 2019 WY. *Figure 11-1* shows the Upper and Lower Aquifer groundwater elevations used to calculate the GWE method storage for the 2020 WY. The change in storage from Fall 2019 to Fall 2020 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 2020 WY.

11.1.4 Hydrologic Inventory Results

The HI method produced a total storage value of 247.2 TAF for the end of 2020 WY, which is about 7.9 TAF less than the end of 2019 WY HI value. The results of the HI method for the 2020 WY are summarized below in *Table 11-A*. All 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 water years 1974 to 2020 are tabulated in *Table 11-3,* and charted in *Figure 11-3* along with the water year type (e.g., wet, normal, dry, etc.) noted for each year. *Figure 11-4* shows a map of the pumping well locations during the 2020 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, 2020 WY (AF)

CATEGORY	Sustainable Avg	2020	% of Avg	Change from 2019
SUPPLIES	**19,800**	**13,515**	**68%**	**-10,110**
Stream Recharge Artificial	5,300	2,461	46%	-482
Stream Recharge Natural	6,600	3,511	53%	-4,151
Rainfall Recharge	4,300	2,869	67%	-5,719
Applied Water Recharge	1,600	2,465	154%	179
Pipe Leakage	1,000	1,209	121%	64
Subsurface Inflow	1,000	1,000	100%	0
DEMANDS	**18,800**	**21,447**	**114%**	**2,305**
Zone 7 Pumping excluding DSRSD	5,300	11,101	209%	3,081
Other Pumping	8,400	5,248	62%	-1,366
Agricultural Pumping	400	112	28%	-1
Mining Losses	1,400	700	50%	0
Evapotranspiration (ETo)	3,200	4,140	129%	1,255
Subsurface Outflow	100	146	146%	-663
NET CHANGE (SUPPLY - DEMAND)	**1,000**	**-7,932**		**-12,415**
TOTAL STORAGE (HI Method)		**247,232**		**-7,932**

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

11.1.5 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 2020 WY was calculated to be 239.5 TAF, with 111.5 TAF of groundwater available as operational storage, which is about 88% of the total operational storage capacity (i.e., 126 TAF from 1983 WY).

Table 11-B: Groundwater Storage Summary, 2020 WY (in Thousand AF)

Storage Calculation Method	End of 2019 WY	End of 2020 WY	Change in Storage
Groundwater Elevations (GWE)	248.5	231.7	-16.8
Hydrologic Inventory (HI)	255.2	247.2	-8.0
Total Storage (average of GWE & HI)	251.8	239.5	-12.3
Operational Storage*	123.8	111.5	-12.3

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

For the past few years, the groundwater storage values calculated by both the GWE and HI Methods have been within about 6 TAF. However, during the 2020 WY the GWE storage dropped significantly (16.8 TAF) more than the HI storage (7.9 TAF) for a total difference now of 15.5 TAF between the two storage values. And while there have been significant differences between the two methods in the past that converged a few years later (e.g., 1992 and 2008/2009), in this case the GWE storage is less than the HI storage; in the past the opposite was true. The reason for this divergence is unclear; however, with the GWE storage, there appear to be nodes that exhibited significant decreases in storage where there does not appear to be a known corresponding demand. For example, *Figure 11-2* shows a total storage drop in Nodes 39 and 40 of about 3.3 AF, while CWS only reported pumping 1.1 TAF. Also, Nodes 30, 31, and 35, which include the mining area, decreased a total of 6.1 TAF, while the mining companies reported no significant exports or losses. Zone 7 staff will continue to investigate possible reasons for this significant difference.

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 2020 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 45 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 2020 WY.

Table 11-C: Natural Groundwater Inflow and Demand, 2020 WY

Component	Estimated Sustainable Values (AF/Yr)	2020 WY (AF)	Percentage of Sustainable Average
Natural Recharge	13,400	9,699	72%
Natural Demand	13,400	10,200	76%
Net Natural Recharge	0	-501	-4%*

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

Just over half (7,214 AF) of the "natural" demand (13,400 AF) comes from groundwater pumped by Zone 7's retailers. The retailers are permitted by contract to pump a Groundwater Pumping Quota (GPQ) (accounted for on a calendar year [CY] basis) without having to pay a replenishment fee to Zone 7. They can carry forward any un-pumped GPQ (up to 20% of their GPQ). The retailer's GPQ, along with their groundwater pumping volumes for the 2020 CY, are shown in *Table 11-D* below. None of the retailers pumped more than their respective GPQ in 2020 WY.

Table 11-D: Retailer Groundwater Pumping and Quotas in 2020 Calendar Year (AF)

Retailer	GPQ	Carryover from 2019	Pumped in 2020	Carryover to 2021**
City of Pleasanton	3,500	3	3,110	393
Cal Water Service (CWS)	3,069	614	1,063	614
DSRSD (pumped by Zone 7)	645	0	645	0
City of Livermore (not used)*	31	-	0	-
Total	**7,214**	**617**	**4,818**	**1,007**

AF = Acre-feet
GPQ = Groundwater Pumping Quota
* = 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 "losing stream" 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 imported 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 2020 WY. Since 1974, Zone 7 has artificially recharged 66,982 AF more than it has pumped (*Figure 11-6)*. 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: Conjunctive Use Supply and Demand, 2020 WY

Component	Estimated Sustainable Avg (AF/Yr)	2020 WY (AF)	Percentage of Sustainable Average
Artificial Recharge	5,300	2,461	46%
Zone 7 Pumping	5,300	11,101	209%
Net Artificial Recharge	**0**	**-8,640**	**-163%***

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

TABLE 11-1
TOTAL MAIN BASIN STORAGE BY SUBAREA (AF)
GROUNDWATER ELEVATION METHOD
1974 TO 2020 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	42,806	82,580	53,961	209,661
2015	31,714	46,582	81,338	53,952	213,586
2016	32,205	53,885	82,970	57,583	226,642
2017	32,391	67,540	86,073	59,564	245,568
2018	32,409	71,452	85,745	56,347	245,954
2019	32,410	70,196	84,985	60,942	248,533
2020	32,361	61,215	81,401	56,701	231,679

Calculated as one aquifer
Sum of 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
1974-2020 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
8 Station Rain Index (N. CA)(in)	78.6	48.8	28.3	19.0	71.6	39.1	59.6	37.6	84.8	88.5	58.1	37.8	72.1	28.6	34.9	50.1	36.0
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**
Urban - Municipal	1,074	766	1,354	1,375	1,087	1,179	810	1,284	668	690	1,253	1,027	998	1,328	1,377	1,053	1,025
Urban - Recycled Water	0	0	27	16	26	13	21	7	12	8	16	6	12	8	5	14	5
Agricultural - Municipal (SBA)	74	109	157	124	95	118	147	182	140	165	208	182	232	245	289	240	265
Agricultural - Groundwater	384	280	513	525	352	388	281	241	174	139	198	210	190	137	152	140	153
Golf Courses - Groundwater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golf Courses - Recycled Water	0	0	64	68	75	73	73	60	54	63	62	55	61	47	63	60	64
Others	1,206	1,322	1,042	915	1,160	1,270	1,394	315	312	279	425	404	411	95	118	123	182
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**	**16,045**
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**	**11,255**
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	257
3S/1E 1P3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*46*
Castlewood	*156*	*92*	*227*	*230*	*149*	*166*	*0*	*0*	*52*	*101*	*198*	*182*	*146*	*215*	*253*	*191*	*211*
Tri-Valley Golf	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
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**	**1,478**
SFWD	500	0	62	304	252	365	168	513	150	549	107	410	543	663	493	359	548
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**	**-5,692**
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**	**210,176**

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)	**212**	**216**	**219**	**211**	**214**	**227**	**236**	**239**	**243**	**254**	**253**	**245**	**239**	**230**	**219**	**215**	**210**
AVAILABLE STORAGE (TAF)	**84**	**88**	**91**	**83**	**86**	**99**	**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
1974-2020 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
8 Station Rain Index (N. CA)(in)	32.2	36.0	65.3	31.8	85.4	61.3	68.8	82.4	54.8	56.7	33.0	46.3	59.7	47.3	57.4	80.1	37.3	34.9	46.8	53.6
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**	**27,853**	**20,780**	**23,211**	**15,691**	**24,052**	**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**	**652**	**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**	**8,601**	**16,195**	**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	4,512	4,476	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*	*1,111*	*939*	*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**
Urban - Municipal	222	1,288	1,108	1,252	1,060	1,467	1,632	1,472	1,549	1,743	1,770	1,888	1,749	1,926	1,834	1,747	1,983	2,124	2,064	1,894
Urban - Recycled Water	2	0	11	14	13	18	21	15	12	21	19	30	10	14	15	26	24	7	52	84
Agricultural - Municipal (SBA)	242	279	177	192	257	347	401	104	57	64	59	67	66	64	63	63	62	68	68	67
Agricultural - Groundwater	109	133	96	100	92	100	109	26	11	12	11	13	12	12	12	12	12	13	13	12
Golf Courses - Groundwater	0	0	0	0	0	0	0	42	49	55	56	60	56	61	58	56	63	68	65	60
Golf Courses - Recycled Water	26	66	48	63	58	75	58	50	65	66	69	72	47	75	58	59	71	74	66	64
Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	**21,104**	**17,237**	**13,555**	**15,503**	**16,064**	**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	**17,355**	**13,331**	**9,132**	**6,499**	**4,594**	**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	252	222	286	245	139	182	169	249	256	245	223	218	208	203	207	199	249	241	250	208
3S/1E 1P3	*101*	*36*	*138*	*36*	*41*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Castlewood	*151*	*186*	*131*	*186*	*82*	*159*	*146*	*236*	*235*	*223*	*193*	*193*	*193*	*173*	*191*	*177*	*222*	*213*	*222*	*188*
Tri-Valley Golf	*0*	*0*	*17*	*23*	*16*	*23*	*23*	*13*	*21*	*22*	*30*	*25*	*15*	*30*	*16*	*22*	*27*	*28*	*28*	*20*
Agricultural Pumpage	**382**	**355**	**213**	**218**	**150**	**212**	**266**	**73**	**81**	**231**	**227**	**119**	**93**	**92**	**88**	**88**	**87**	**96**	**95**	**94**
SFWD	20	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)	**-8,389**	**-6,628**	**14,974**	**592**	**13,031**	**1,873**	**-1,390**	**2,511**	**-4,911**	**-3,674**	**-11,666**	**62**	**8,309**	**-4,560**	**13,193**	**8,790**	**-3,639**	**-3,011**	**-4,997**	**4,290**
INVENTORY STORAGE (AF)	**201,787**	**195,159**	**210,133**	**210,725**	**223,756**	**225,629**	**224,239**	**226,750**	**221,839**	**218,165**	**206,499**	**206,561**	**214,870**	**210,310**	**223,503**	**232,293**	**228,654**	**225,643**	**220,646**	**224,936**

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	224	227	222	218	206	207	215	210	224	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)	**198**	**189**	**210**	**213**	**225**	**224**	**223**	**226**	**222**	**220**	**205**	**209**	**218**	**212**	**230**	**235**	**230**	**230**	**227**	**229**
AVAILABLE STORAGE (TAF)	**70**	**61**	**82**	**85**	**97**	**96**	**95**	**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
1974-2020 WATER YEARS (in Acre-Feet, except where indicated)

	WATER YEAR (Oct - Sep)										1974 - 2020		
COMPONENTS	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**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	17.1	10.5	14		
8 Station Rain Index (N. CA)(in)	72.8	41.5	46.3	31.3	37.2	57.8	94.6	40.9	70.7	31.7	53		
Evap at Lake Del Valle (in)	64.5	73.2	73.9	78.3	73.6	72.6	69.3	73.4	72.8	76.4	67		
Arroyo Valle Stream flow (AF)	28634	1557	7801	272	2217	19436	89173	2783	36944	2397	24892		**1169933**
Water Year Type*	W	BN	D	C	C	BN	W	BN	W	C			
SUPPLY	**27,315**	**18,442**	**20,158**	**10,452**	**18,753**	**28,293**	**38,895**	**17,164**	**23,625**	**13,515**	**20,165**	**19,800**	**947,750**
Injection Well Recharge	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**71**	**0**	**3,322**
Stream Recharge	**17,595**	**12,734**	**13,457**	**5,820**	**11,469**	**18,083**	**20,495**	**9,560**	**10,605**	**5,972**	**11,927**	**11,900**	**560,552**
Artificial Stream Recharge	4,555	8,778	7,887	3,826	3,766	8,910	9,615	6,773	2,943	2,461	5,309	5,300	249,528
Arroyo Valle	*768*	*3,613*	*1,916*	*924*	*3,718*	*3,983*	*3,271*	*3,778*	*2,168*	*2,045*	*1,799*	*1,640*	*84,555*
Arroyo Mocho	*3,671*	*5,059*	*5,961*	*2,844*	*0*	*4,927*	*6,344*	*2,995*	*775*	*416*	*3,400*	*3,530*	*159,802*
Arroyo las Positas	*116*	*106*	*10*	*58*	*48*	*0*	*0*	*0*	*0*	*0*	*110*	*130*	*5,172*
Natural Stream Recharge	11,272	3,355	4,200	1,987	6,822	8,289	10,433	1,938	6,439	2,595	5,715	5,700	268,614
Arroyo Valle	*8,540*	*1,676*	*2,790*	*891*	*4,567*	*4,749*	*6,053*	*740*	*3,419*	*793*	*2,539*	*1,800*	*119,315*
Arroyo Mocho	*2,293*	*1,225*	*838*	*587*	*1,748*	*2,794*	*3,775*	*590*	*2,393*	*1,072*	*2,290*	*2,600*	*107,624*
Arroyo las Positas	*439*	*454*	*572*	*509*	*507*	*746*	*605*	*608*	*627*	*730*	*887*	*1,300*	*41,675*
Arroyo Valle Prior Rights	1,768	601	1,370	7	881	884	447	849	1,223	916	902	900	42,409
Rainfall Recharge	**5,771**	**1,462**	**2,708**	**1,075**	**3,735**	**6,554**	**14,087**	**3,220**	**8,588**	**2,869**	**4,675**	**4,300**	**219,730**
Lake Recharge	*0*	*0*	*0*	*2,428*	*4,322*	*6,785*	*13,029*	*15,003*	*13,248*	*7,529*	*1,326*	*NA*	*62,343*
Pipe Leakage	**776**	**811**	**847**	**884**	**921**	**958**	**996**	**1,034**	**1,146**	**1,209**	**445**	**1,000**	**20,922**
Applied Water Recharge	**2,172**	**2,435**	**2,147**	**1,674**	**1,629**	**1,697**	**2,316**	**2,350**	**2,286**	**2,465**	**2,061**	**1,600**	**96,889**
Urban - Municipal	1,849	2,061	1,750	1,229	1,143	1,312	1,957	2,020	1,956	2,109	1,436	1,280	67,505
Urban - Recycled Water	133	159	189	220	275	160	147	106	119	129	48	26	2,242
Agricultural - Municipal (SBA)	61	68	64	66	61	88	77	80	80	80	137	92	6,461
Agricultural - Groundwater	11	13	7	20	18	15	14	14	14	14	117	12	5,504
Golf Courses - Groundwater	59	65	62	66	67	65	61	63	61	66	29	146	1,384
Golf Courses - Recycled Water	59	70	75	73	65	59	60	66	57	67	60	44	2,819
Others	0	0	0	0	0	0	0	0	0	0	233	0	10,973
Subsurface Basin Inflow	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**	**986**	**1,000**	**46,336**
DEMAND	**20,421**	**28,880**	**25,700**	**22,604**	**12,717**	**12,888**	**13,636**	**16,879**	**19,142**	**21,447**	**19,415**	**18,800**	**912,518**
Municipal Pumpage	**13,430**	**20,463**	**16,823**	**16,662**	**8,284**	**9,176**	**10,714**	**11,966**	**14,635**	**16,349**	**11,661**	**13,700**	**548,071**
Zone 7 (excluding DSRSD)	5,618	11,461	8,909	8,137	1,920	1,357	3,243	4,215	8,021	11,101	4,202	5,300	197,479
Zone 7 for DSRSD	646	644	646	645	645	645	645	645	645	645	247	645	11,611
City of Pleasanton	3,435	3,900	3,301	3,740	2,775	3,752	4,222	3,913	3,785	2,701	3,264	3,500	153,386
Cal. Water Service	2,673	3,333	2,770	3,085	2,012	2,575	1,878	2,389	1,296	904	2,761	3,070	129,780
Camp Parks	0	0	0	0	0	0	0	0	0	0	188	0	8,819
SFWD	442	482	482	398	309	286	214	253	286	322	403	450	18,956
Fairgrounds	301	318	350	286	268	231	208	196	270	321	288	310	13,527
Domestic	107	90	105	115	112	110	107	115	116	108	109	200	5,123
Golf Courses	208	236	260	257	243	220	198	240	216	247	200	225	9,390
3S/1E 1P3	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*8*	*0*	*397*
Castlewood	*187*	*214*	*233*	*227*	*213*	*195*	*176*	*218*	*194*	*225*	*178*	*205*	*8,351*
Tri-Valley Golf	*21*	*22*	*27*	*30*	*30*	*25*	*22*	*22*	*22*	*22*	*14*	*20*	*642*
Agricultural Pumpage	**85**	**95**	**486**	**640**	**590**	**115**	**109**	**113**	**113**	**112**	**996**	**400**	**46,818**
SFWD	0	0	0	0	0	0	0	0	0	0	128	0	6,015
Concannon	0	0	0	0	0	0	0	0	0	0	22	0	1,047
Calculated	85	95	486	640	590	115	109	113	113	112	846	400	39,756
Mining Use	**6,906**	**8,322**	**8,391**	**5,302**	**3,843**	**3,597**	**2,813**	**4,236**	**3,585**	**4,840**	**6,369**	**4,600**	**299,337**
Stream Export	4,277	4,676	4,796	850	0	0	0	0	0	0	3,345	700	157,219
Discharges to Cope Lake	*0*	*0*	*0*	*5,420*	*4,890*	*7,700*	*13,452*	*15,562*	*13,864*	*7,906*	*1,464*	*NA*	*68,793*
Evaporation	1,929	2,946	2,895	3,752	3,143	2,897	2,113	3,536	2,885	4,140	2,332	3,200	109,612
Production	700	700	700	700	700	700	700	700	700	700	692	700	32,506
Subsurface Basin Overflow	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**564**	**809**	**146**	**389**	**100**	**18,292**
NET RECHARGE (AF)	**6,893**	**-10,438**	**-5,542**	**-12,153**	**6,037**	**15,405**	**25,259**	**285**	**4,482**	**-7,932**	**750**	**1,000**	**35,232**
INVENTORY STORAGE (AF)	**231,829**	**221,391**	**215,849**	**203,696**	**209,733**	**225,138**	**250,397**	**250,682**	**255,164**	**247,232**	**223,876**	**13,400**	

STORAGE CALCULATION	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
INVENTORY (Rounded to TAF)	232	221	216	204	210	225	250	251	255	247
GW ELEVATIONS (Rounded to TAF)	235	228	221	210	214	227	246	246	249	232
AVERAGE STORAGE (TAF)	**233**	**225**	**218**	**207**	**212**	**226**	**248**	**248**	**252**	**239**
AVAILABLE STORAGE (TAF)	**105**	**97**	**90**	**79**	**84**	**98**	**120**	**120**	**124**	**111**

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 2020)

- Main Basin (U=Upper; L=Lower)
- Fringe Area (Single Aquifer)
- Upland Area
- Streams

Node 1
416.6

Node 2
398

Node 3
383.8

Node 4
365.6

Node 5
372.4

Node 6
337.7

Node 7
341.9

Node 8
363.8

Node 9
347.3

Node 10
324.6

Node 11
342.9

Node 12
324.8

Node 13
317.2

Node 14
315.4

Node 15
U: 296.2
L: 293.7

Node 15A
314.8

Node 16A
310.9

Node 16
U: 291.4
L: 290.6

Node 17
U: 305.3
L: 289.3

Node 18
U: 288.8
L: 287.7

Node 19
U: 291.4
L: 288.7

Node 20
U: 291.6
L: 290.1

Node 21
341.8

Node 22
326.2

Node 23
U: 294.8
L: 285.2

Node 24
U: 293
L: 285.2

Node 25
U: 302.3
L: 272.8

Node 26
U: 299.1
L: 281.1

Node 27
336.1

Node 28
352.7

Node 29
U: 335.7
L: 261.0

Node 30
U: 316.6
L: 260.1

Node 31
U: 316.2
L: 269.6

Node 32
395.8

Node 33
U: 368.8
L: 268.8

Node 34
U: 336.2
L: 252.6

Node 35
U: 325.2
L: 270.1

Node 36
U: 450
L: 457.3

Node 37
403.9

Node 38
U: 399.5
L: 363.9

Node 39
U: 446.8
L: 417.6

Node 40
U: 535.9
L: 501.9

Node 41
U: 688.6
L: 639.5

Node 42
U: 517.6
L: -

Node 43
528

Node 44
719.9

Node 45
537.2

Node 46
518.8

Node 47
502.6

N
W E
S

0 2 4
Miles

DATE: Mar 10, 2021

FILE: E:\MONITOR\GWStorage\2020WY\AnnualReport2020\Fig11-01-MapNodalGWE20.mxd

Figure 11-1
Mean Groundwater Elevation By Node
Upper and Lower Aquifers; Fall 2020
Livermore Valley Groundwater Basin

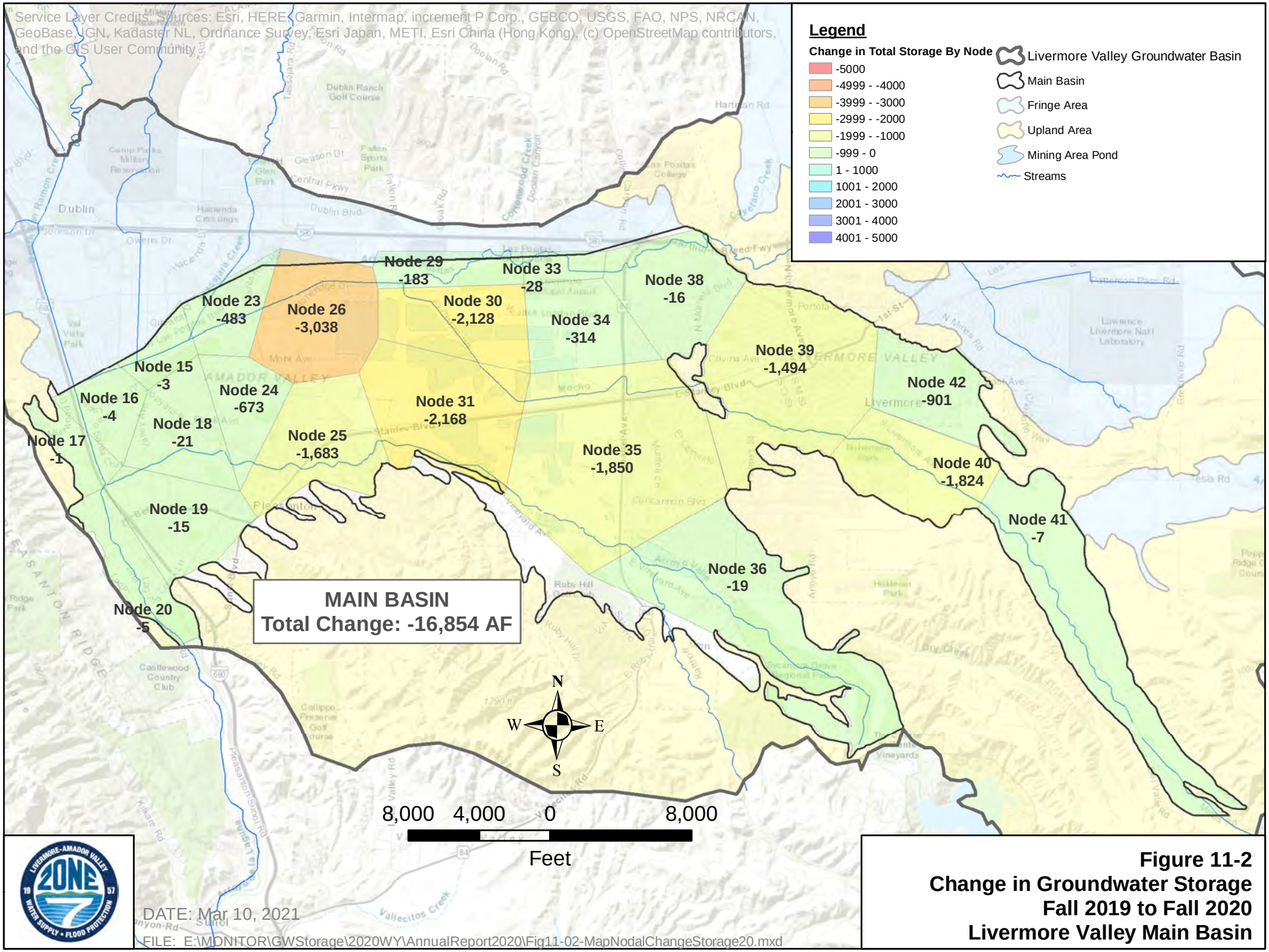

Figure 11-2
Change in Groundwater Storage
Fall 2019 to Fall 2020
Livermore Valley Main Basin

FIGURE 11-3
GRAPH OF GROUNDWATER STORAGE 1974 - 2020 WATER YEARS
LIVERMORE VALLEY GROUNDWATER BASIN

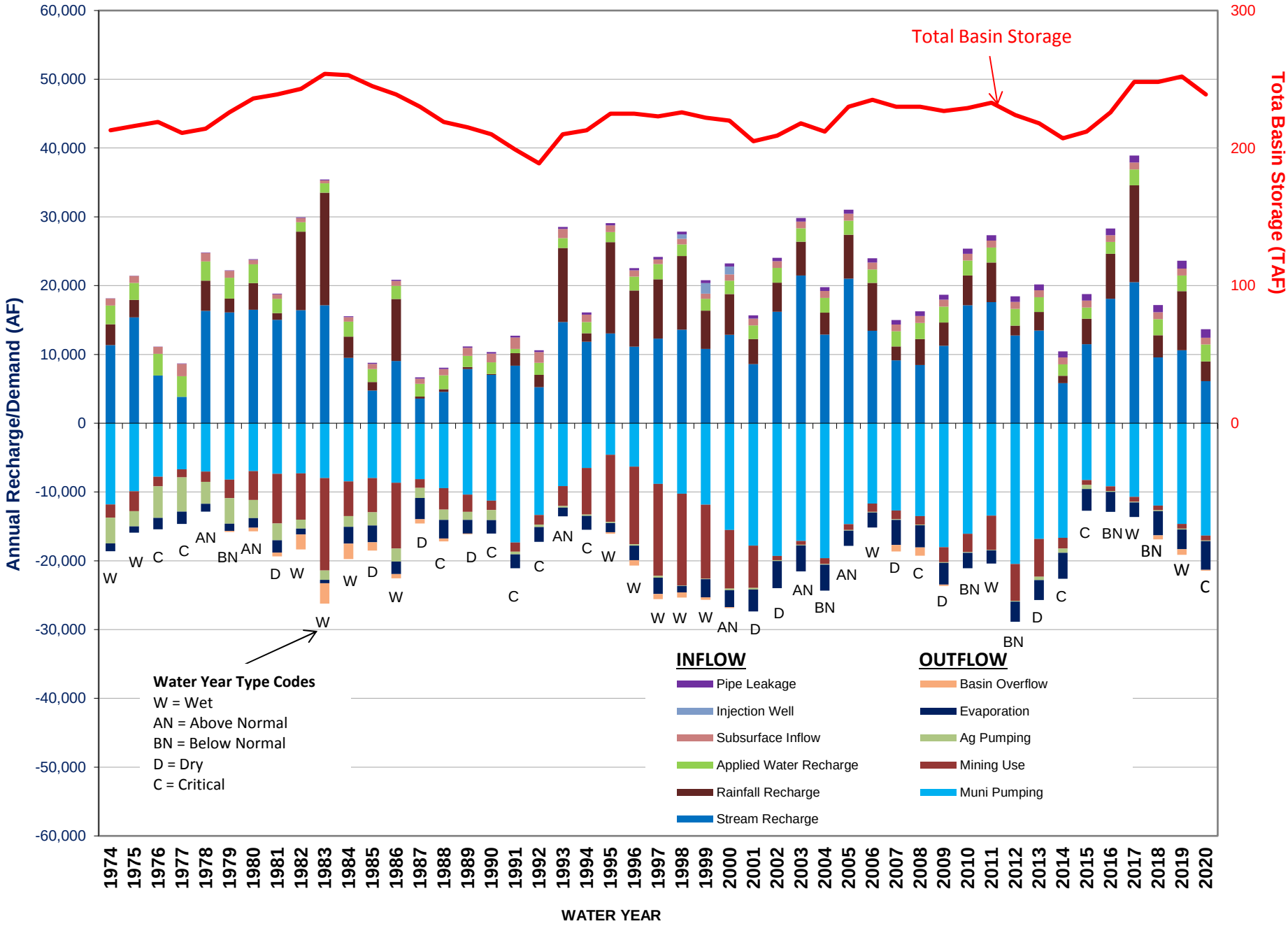

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Figure 11-3

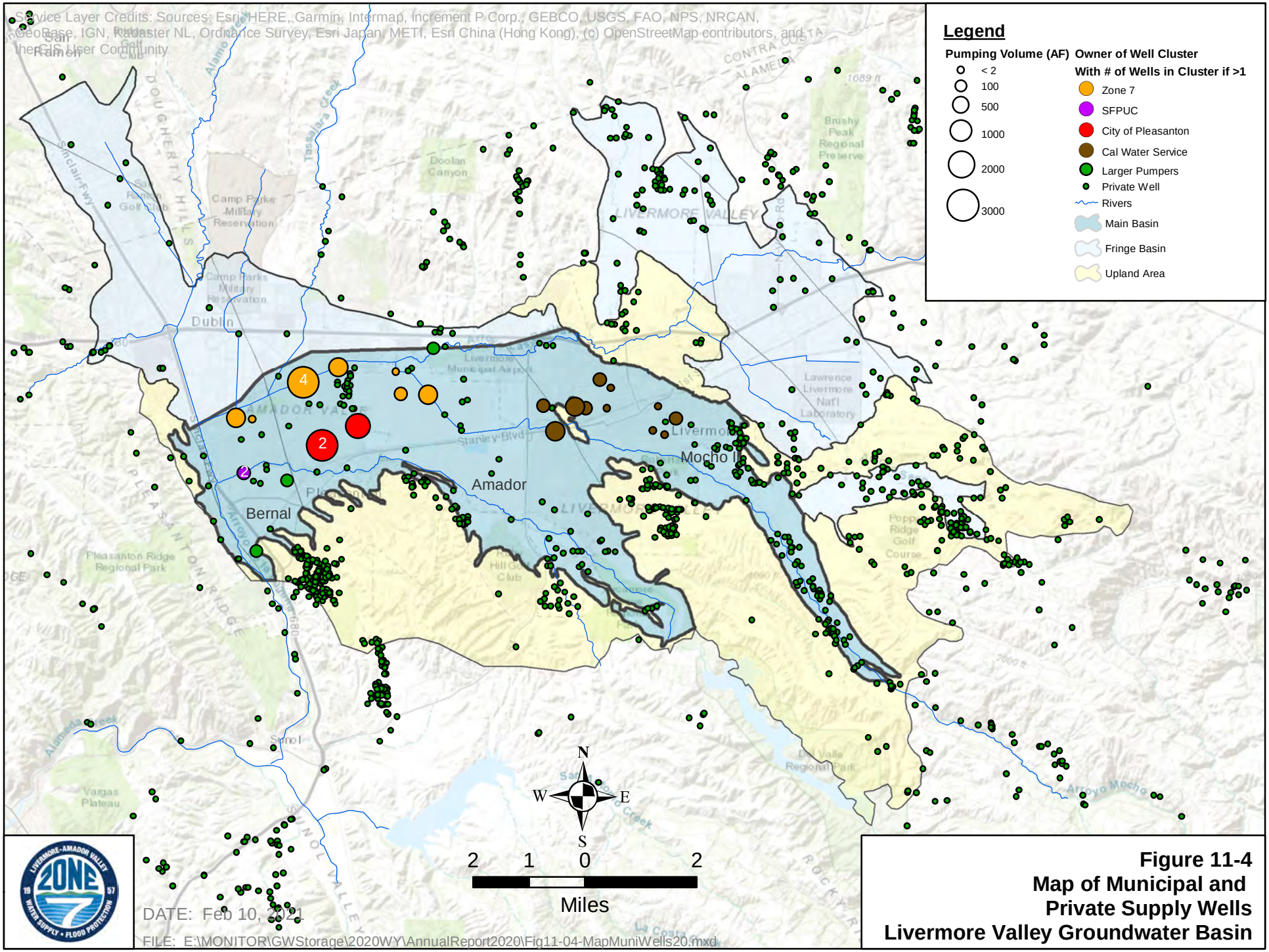
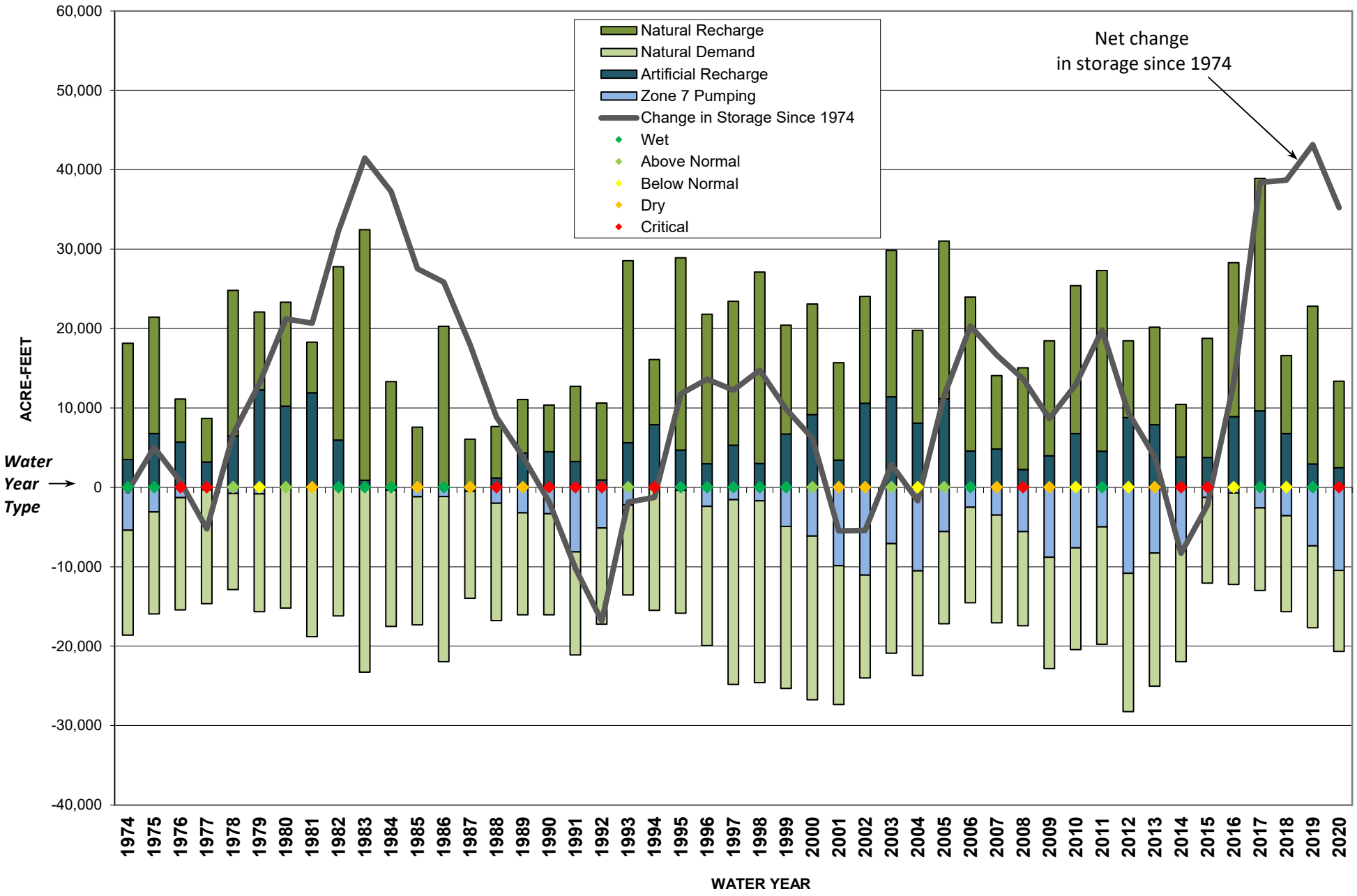


Figure 11-4
Map of Municipal and Private Supply Wells
Livermore Valley Groundwater Basin

FIGURE 11-5
CUMULATIVE CHANGE IN NATURAL AND ARTIFICIAL RECHARGE AND DEMAND 1974 - 2020 WATER YEARS
LIVERMORE VALLEY GROUNDWATER BASIN



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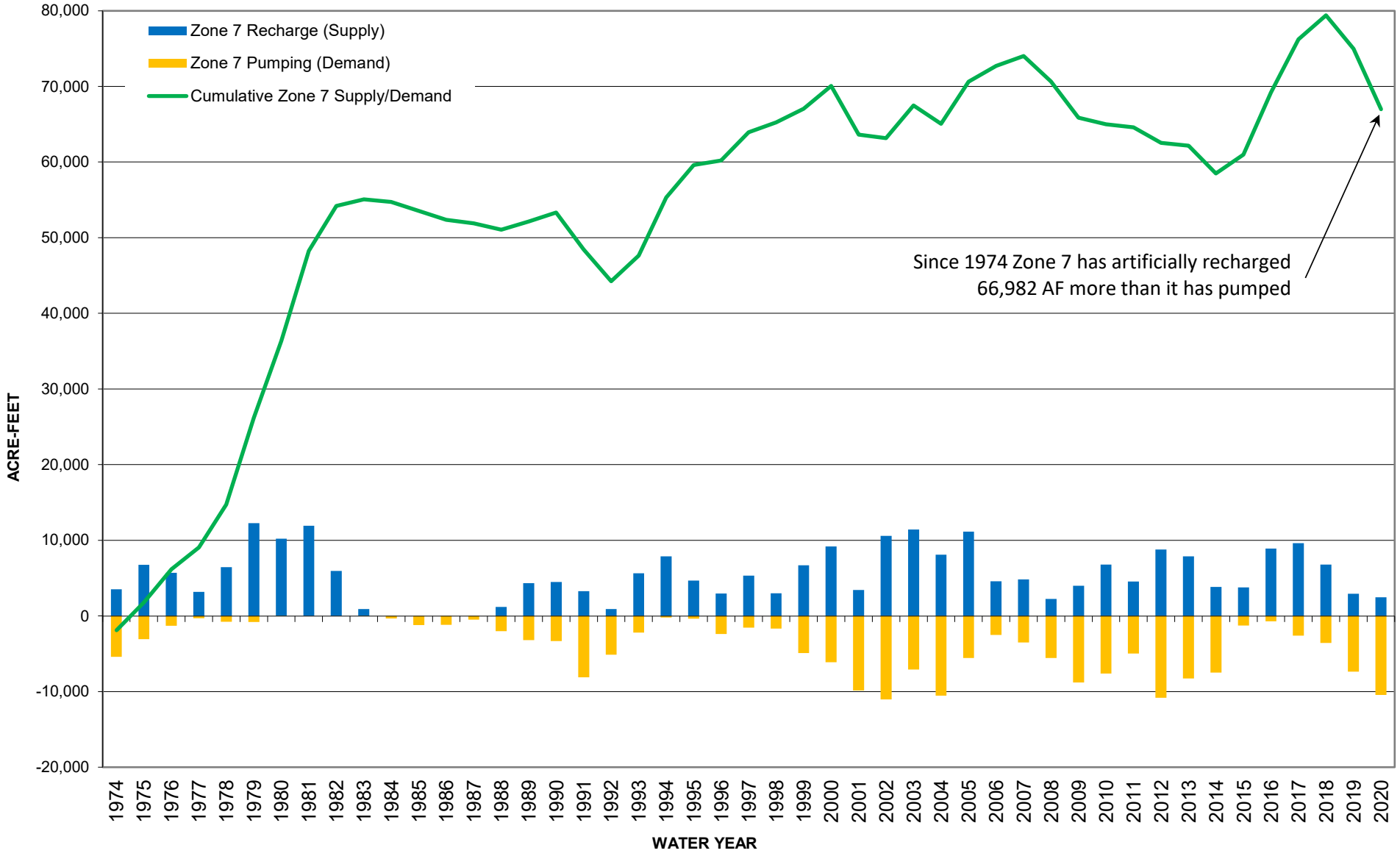
3/10/2021

FIGURE 11-6
GRAPH OF CUMULATIVE CONJUNCTIVE USE SUPPLY AND DEMAND SINCE 1974 WY
LIVERMORE VALLEY GROUNDWATER BASIN



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12 Groundwater Supply Sustainability

12.1 Introduction

This section provides an update on the projects 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 for sustainable groundwater levels and storage, avoidance of subsidence, and protection of groundwater dependent eco-systems (GDEs). Zone 7 ensures that local groundwater supplies are not depleted by importing an average of 75% of the Valley's water demand (60% in 2020 WY). This imported water is delivered to Zone 7 through the South Bay Aqueduct (SBA) and is used for municipal and agricultural supplies and for recharging the Main Basin aquifers (artificial recharge). In accordance with DWR's accounting time-interval of SWP water, the totals in this section of the report are presented by Calendar Year (CY). 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.

The SWP allocation for the 2020 CY was 20% of Zone 7's maximum allocation (80,619 AF). *Table 12-A* shows Zone 7's imported water supplies for 2020 CY and the amounts being carried over to the 2020 CY.

- Imported surface water supplies in the 2020 CY made up 60% of regional water demands. This imported surface water allowed 33,761 AF of groundwater to be conserved instead of being pumped to meet this demand.

Table 12-A: Imported Water Sources for the 2020 Calendar Year (AF)

Source	Available at end of 2019	Added in 2020 *	Used in 2020	Carryover to 2021
State Water Project	**10,810**	**16,124**	**18,070**	**8,864**
Table A	*0*	*16,124*	*7,260*	*8,864*
Article 56	*10,810*	*0*	*10,810*	*0*
Byron-Bethany Irrigation District†	**0**	**0**	**0**	**0**
Kern Groundwater Basin	**117,075**	**0**	**1,000**	**116,075**
Semitropic	*87,170*	*0*	*1,000*	*86,170*
Cawelo	*29,905*	*0*	*0*	*29,905*
Other	**0**	**7,111**	**7,111**	**0**
Turnback Pool	*0*	*0*	*0*	*0*
Yuba/Other	*0*	*7,111*	*7,111*	*0*
Lake Del Valle (AV Water Rights)	**8,100**	**600**	**8,700**	**0**
Total	***135,985***	***23,835***	***34,881***	***124,939***

* 20% State Water Project Allocation for 2020 WY

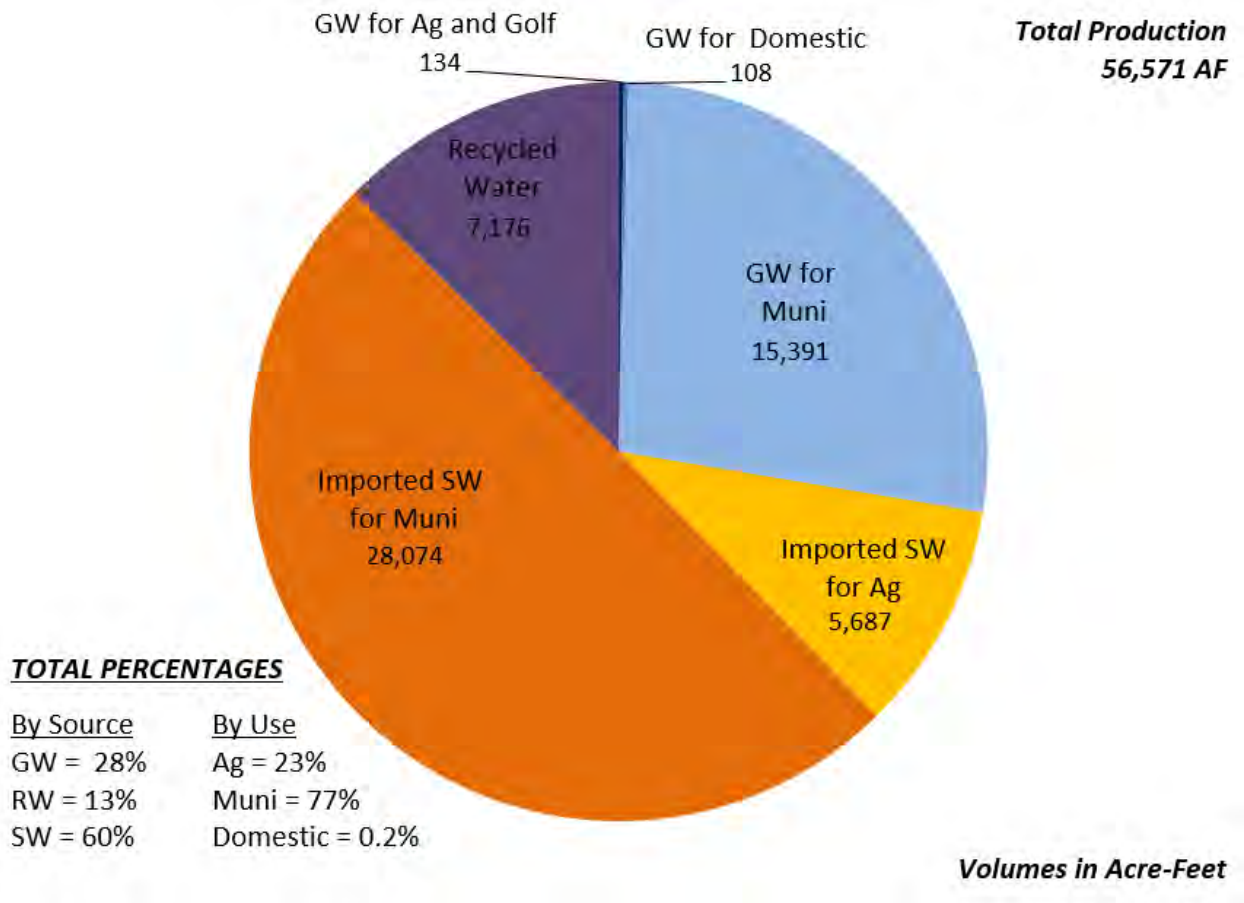
† BBID Agreement terminated in 2021 WY

AV = Arroyo Valle

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* (by Water Year) and *Figure 12-1* (by Water Year except where noted).

Figure 12-A: Valley-Wide Water Production for the 2020 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 2020 WYs. The following activities occurred during the 2020 WY:

- Total groundwater production in the Valley (including by Zone 7, retailers, agriculture, domestic, etc.) supplied about 28% of the total Valley-wide water demand in the 2020 WY.

- Of the 11,746 AF of groundwater pumped by Zone 7 during the 2020 WY, about 11,346 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 28% of the total treated water production that Zone 7 delivered to its retailers during the 2020 WY (on average, groundwater makes up about 15% of Zone 7's annual treated water deliveries).

12.4 Future Supply Reliability

Zone 7 continues to implement a multi-faceted 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 (COLs).
- Maximized groundwater storage in Kern County groundwater banks.
- Access to emergency water supply in the local COLs.
- Support of the Delta Conveyance Project (former CA WaterFix) to restore yield from the 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 future water supply portfolio. In 2020, Zone 7 continued its petition to extend Zone 7's water rights permit for diverting surface water captured in Lake Del Valle from the upper Arroyo Valle. Under the existing permit, Zone 7's average annual yield from the upper Arroyo Valle is about 7,300 AF/yr. A diversion structure from Arroyo Valle into Lake A, and a pipeline connecting Lake A to other lakes in the COLs, are included in Zone 7's Capital Improvement Plan (CIP, 2018-2028). Once constructed, these projects will facilitate the capture and storage of additional water from the Del Valle Watershed up to about 3,000 AF/yr on average.

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. Zone 7 elected to use 1,000 AF of its allocation in Semitropic in the 2020 CY. Zone 7 currently has 116,075 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 Delta Conveyance Project, 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. At this time, while the project's design is still being re-evaluated, Zone 7 is assuming that some form of the Delta Conveyance Project would be in-service by 2040.

Zone 7 is also continuing 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 or San Francisco Public Utilities Commission). 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 Chain of Lakes, and water in Lake Del Valle available to meet its demands. An intertie with another agency could provide an additional 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 groundwater dependent eco-systems. Responsive to the Urban Water Management Planning Act, all the urban retailers within the Basin (CWS, DSRSD, Livermore, and Pleasanton) have prepared Urban Water Management Plans which include a Water Shortage Contingency Plan that provides a response to drought and other shortages. As documented in Zone7's *2015 Urban Water Management Plan* (*Zone 7, 2016c*), Zone 7 is on track with all applicable 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 2020 WY, Zone 7 continued its regional coordination of conservation programs, including community workshops and other education/training events, school education programs, and rebates and water-saving giveaway programs, with adjustments made for pandemic conditions.

12.6 Chain of Lakes Recharge Projects

The Chain of Lakes (COLs) are 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 COLs were envisioned as a large water management facility to be used by Zone 7. The COLs 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 COLs is provided in *Section 2.3.10.3*, *Mining Areas*, *Section 4.4*, *Chain of Lakes and Quarry Operations Monitoring*, and *Section 5.2.4*, *COLs Recharge Projects* of the Alternative GSP.

During the 2020 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 is still responding to the RWQCB comments on the design submitted in the 2017 WY, and future diversion operations are still being evaluated. Once installed, this diversion facility will allow SWP water released from the SBA to be diverted from the Arroyo Mocho into Lake H, and ultimately, Lake I for groundwater recharge. Lake H is connected to Lake I via a 30-inch-diameter conduit.

Another quarry operator, CEMEX, submitted a revised application to amend SMP-23 and the associated reclamation plan in the 2019 WY. The amendment eliminated any additional mining in Pits P28 and P41 (Lake A), while increasing the amount mined in Pits P42 (Lake B) and P46 (Lake J). 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 around Lake B during the 2018 WY. CEMEX has also had additional studies completed as part of the Environmental Impact Report (EIR) process for their 2019 amendment. The EIR is shceulded to be completed in the 2021 WY. Staff will continue to work closely with the ACCDA on the SMP-23 amendment process.

The original COLs were anticipated to be completed by 2030; however, due to various circumstances, mining and reclamation is now anticipated to be completed closer to 2060.

Therefore, Zone 7 is planning to complete a Chain of Lakes Pipeline that will convey water to and from the Del Valle Water Treatment Plant (DVWTP), the SBA, and the available lakes in the COLs. This infrastructure will allow use of the lakes for water management operations as early as 2025. The Chain of Lakes Pipeline will be a multi-use pipeline expected to perform the following key functions:

- convey excess imported surface water supply to the COLs for recharging the groundwater basin,
- capture and convey excess water from the Arroyo Del Valle watershed for storage and recharge in the COLs, and
- supply raw water from the COLs for treatment at the DVWTP under emergency/drought situations.

In February 2020, Zone 7 initiated a Chain of Lakes Pipeline Alignment Study to assess possible alignments for the future pipeline.

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 has 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 2020 WY, Zone 7 staff continued the process of reevaluating Zone 7's supply well needs. Site specific evaluation and future well construction will depend on the outcome of PFAS investigations and future regulatory requirements. It is anticipated that the WMP will be updated after more is known about the extent of PFAS in the basin.

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 Basin from unsustainable extraction of groundwater could have adverse economic effects, including loss of arable land, a decline in property values, increased pumping costs due to the lowering of 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 plans to establish a permit system to authorize water management practices otherwise prohibited where those practices are for reasonable and beneficial use of groundwater.

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.

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 can contribute to groundwater storage when incidental percolation occurs during irrigation of landscapes and crops.

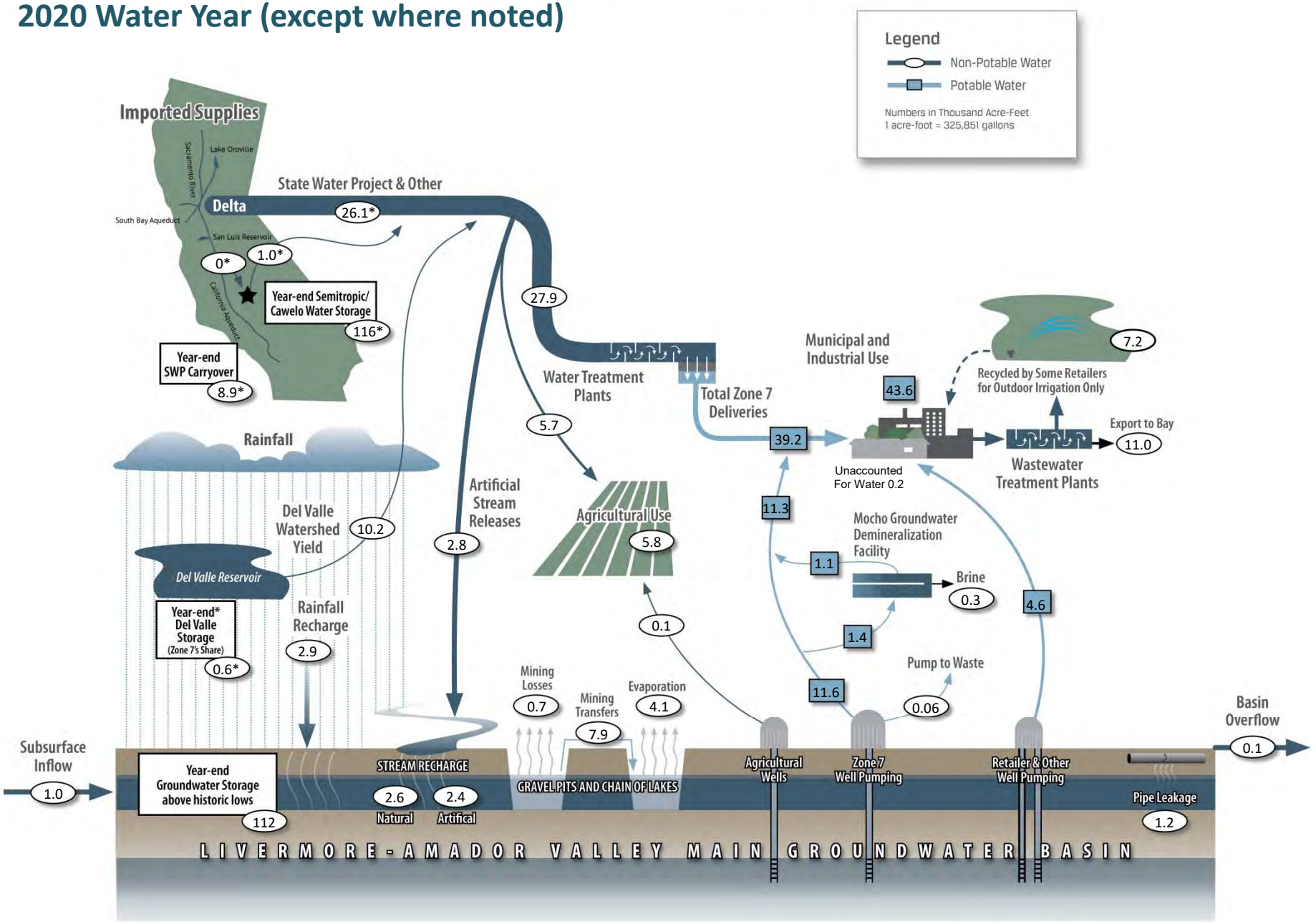
Most of the recycled water used in the Valley is for landscape irrigation, with a minor amount used for dust suppression, grading projects, and crop irrigation. Only a small portion of the applied recycled water percolates to the groundwater supply; most of the applied water is evaporated, taken up by plant roots, lost through plant transpiration, or retained as moisture in the unsaturated zone. The total amount of recycled water for the 2020 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 treated 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 COLs, groundwater desktop and field investigations, and potential groundwater injection well locations.

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

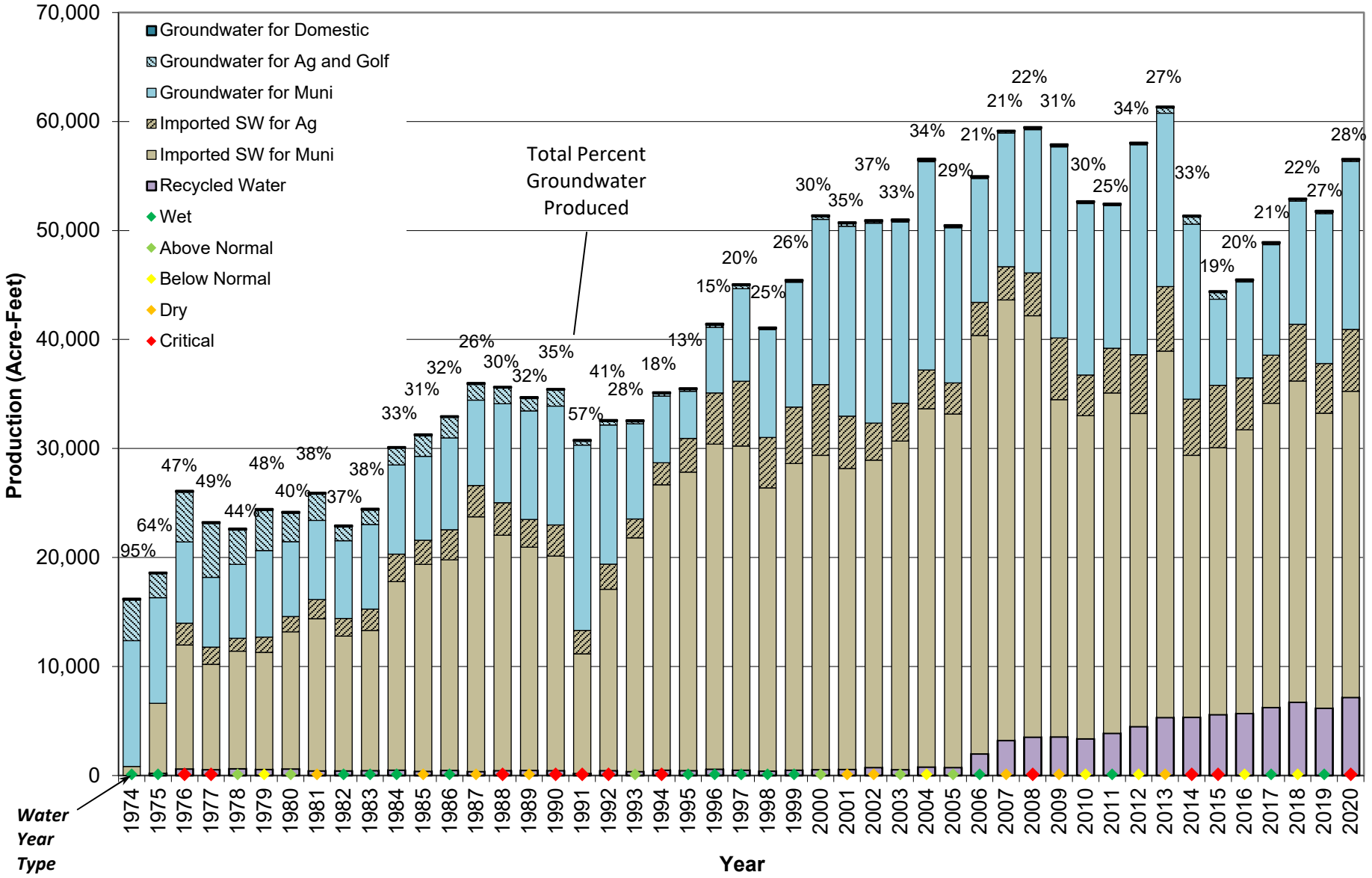
2020 Water Year (except where noted)

Figure 12-1



* 2020 Calendar Year

FIGURE 12-2
VALLEY WATER PRODUCTION FROM IMPORTED WATER AND GROUNDWATER
1974 TO 2020 WATER YEARS



E:\MONITOR\GWStorage\2020WY\AnnualReport2020\Fig12-02-GrphTotalProduction74to20NEW.xlsx
3/10/2021

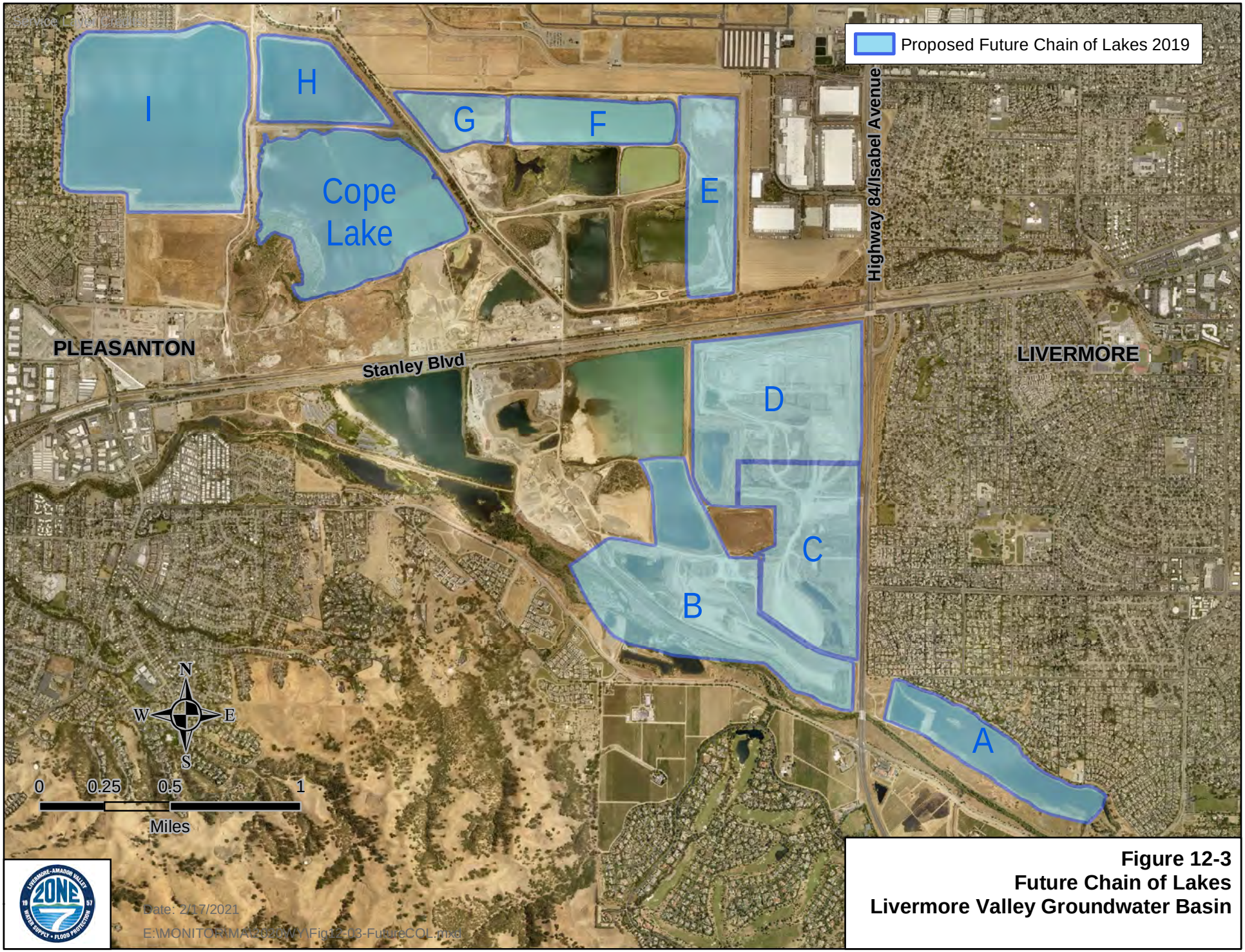


Figure 12-3
Future Chain of Lakes
Livermore Valley Groundwater Basin

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. For example, Zone 7 started sampling for PFAS and Cr before the regulatory requirements were released. In addition, Zone 7's Board has a Water Quality Policy that states that Zone 7's delivered water quality will meet a threshold that is 80% of the MCL. Specific Zone 7 groundwater quality programs and management actions include:

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

- The Toxic Sites Surveillance (TSS) Program - 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.

- Salt Management Program - addresses the increase in TDS observed in some portions of the groundwater basin as outlined and addressed in Zone 7's 2004 Salt Management Plan (SMP, *Zone 7, 2004*). Implementation has included modifications to existing conjunctive use programs, plus development of the Zone 7 Mocho Groundwater Demineralization Plant (MGDP).

- Nutrient Management Program - involves ongoing monitoring of nitrate in groundwater and coordination with land use agencies and ACDEH to manage nitrogen loading to the Basin, as outlined and addressed in Zone 7's 2015 Nutrient Management Plan (NMP, *Zone 7, 2015b*).

The following sections provide the 2020 WY updates to the above programs including details of any significant changes that were made during the water year.

13.2 Well Ordinance Program

Zone 7 administers the associated well permit program within its service area including the three incorporated cities (Dublin, Livermore, and Pleasanton) pursuant to a 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 with Zone 7.

During the 2020 WY, Zone 7 issued 116 drilling permits, 23 less permits than in the 2019 WY. *Table 13-A* details the breakdown of the types of permits issued during the 2020 WY and their quantities.

Table 13-A: Well Ordinance Permits Issued in the 2020 Water Year

Permit Type	Quantity
Geotechnical Investigations	59
Well Destructions	15
Contamination Investigations/Remediation	18
Water Supply Wells	11
Groundwater Monitoring	8
Cathodic Protection Wells	5
Total	***116***

- Eleven (11) water supply well permits were issued in the 2020 WY. The pre-drought average was 25 per year.

- About 79% of the permitted well work was physically inspected by Zone 7 permit compliance staff; the remaining 21% could 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 and 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 2020 WY.

13.3.2 Active Cases

In the 2020 WY, Zone 7 tracked the progress of 56 active sites where contamination has been detected in groundwater or is threatening groundwater. Eleven 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 283 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 13-1* through *Figure 13-3*, Livermore, Pleasanton/Sunol, and Dublin, respectively). *Table 13-1* contains a summary for each of the 56 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 the 2020 WY. In addition, copies of plans, reports, directive letters, and background data on the cases can be found at the State Water Resources Control Board's (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

Three toxic sites were granted "Case Closed" status in the 2020 WY. Their locations are shown on *Figure 13-4* and are summarized below (from west to east).

- Site 68: Chevron, #9-2582 (Dublin Auto Wash), Dublin. This case met the Low-Threat Underground Storage Tank Closure Policy (LTCP) Scenario 2 criteria for closure. Some localized methyl tertiary-butyl ether (MTBE) contamination remains in groundwater, but the plume appears to be decreasing. There are no municipal supply wells in Dublin and the site is over 1,000 ft from any private supply wells. ACDEH closed this case and Zone 7 staff did not object to its closure.

- Site 31: Dublin Toyota Pontiac, Dublin. The Regional Water Quality Control Board (RWQCB) closed this case under the LTCP. This case met all the required general and media-specific criteria of the LTCP Case Closure Policy. The petroleum release is limited to the soil and shallow groundwater, the nearest existing supply well is greater than 1,000 feet from the defined plume boundary, and the dissolved concentration of benzene and MTBE met the LTCP criteria for groundwater. Although the contaminant plume is over 100 feet in length and there is a drainage channel less than 1,000 feet from the projected

plume boundary, a site-specific evaluation shows low threat of contaminated groundwater impacting the drainage channel. Zone 7 staff did not object to the case closure.

- Site 191: Former Beacon, #3604/Ultramar, Livermore. In September 2018, the Responsible Party (RP) submitted a Conceptual Site Model Update and Closure Request. Multiple remedial technologies have been conducted at the site over the past 25 years including excavation, soil vapor extraction (SVE), air sparging, oxygen injection, and in-situ chemical oxidation (ISCO). ACDEH agreed to the case being closed under LTCP Scenario 5 because the remaining contaminant plume poses low risk to human and environmental health. Staff did not object to the closure of this case.

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 2020 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 (from west to east):

- Site 209: Shell #13-5244, Dublin. MTBE in the groundwater is the main concern at this site. Soil excavation in the source area was performed, and quarterly groundwater monitoring indicates the MTBE constituent plume is stable. The lateral extent of MTBE in groundwater is not fully defined, however this site is at least 2,000 feet from the nearest supply well. ACDEH did not dispute the RP's assertions that the *General Criteria and Media Specific Criteria for Direct Contact and Outdoor Air Exposure* have been satisfactorily addressed and *Media Specific Criteria for Groundwater* have been addressed to the extent practicable. This case meets the criteria presented in the LTCP and is therefore eligible for regulatory case closure pursuant to California Health and Safety Code Section 25296. Staff does not object to closure of this case.

- Site 284: Former Crow Canyon Dry Cleaner, Dublin. The RP requested closure in 2015 based on the success of remedial actions, and because the vapor measurements are below Environmental Screening Levels (ESLs). Vapor contamination is the main concern at the site. The groundwater detections for tetrachloroethylene (PCE) and trichloroethylene (TCE) are below their respective MCL. 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. Staff does not object to the groundwater case closure if the additional work is completed to ACDEH satisfaction and the groundwater detections remain below MCLs.

- Site 308: Green on Park Place, Dublin. The case was slated for closure in 2014 but the case closure was never finalized. The only tasks remaining in October 2014 involved properly disposing of contaminated stockpiled soil. ACDEH sent a compliance letter to the RP in the 2019. Staff does not object to the closure of this case if the remaining tasks are completed to ACDEH satisfaction.

- 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 PCE, TCE, and 1, 1-Dichloroethene (DCE). The RP requested permission to discontinue groundwater monitoring, for the well to be destroyed, the case closed, and the deed restriction rescinded. The Department of Toxic Substances Control (DTSC) approved discontinuing the groundwater sampling and then requested a well decommissioning plan. DTSC said the removal of the deed restriction will need to be done in accordance with Health and Safety Code 25224 following the well decommissioning. Staff does not object to the pending closure.

- Site 317: Walgreens Spill, Sunol. Case was approved for closure by ACDEH under the LTCP. To finalize the case closure, ACDEH required the RP to remove any remaining waste from the site and to provide a report by April 22, 2018. The report has not been submitted to GeoTracker, so the case closure is still pending. There was no progress in the 2020 WY. Staff does not object to the case closure if the remaining tasks are completed to ACDEH satisfaction .

- Site 313: Just Tires, Livermore. This case is a soil contamination case slated for closure; no fuel contaminants were detected in groundwater beneath the site. Comments on pending closure were due January 2016. ACDEH sent multiple letters to the RP to finalize the closure report, but they have not responded. There was no progress in the 2020 WY. Staff does not object to the pending case closure if the remaining tasks are completed to ACDEH satisfaction.

- Site 292: K&S Heavy Equipment, Livermore. A Subsurface Investigation Report submitted to ACDEH recommended no further investigation based no residual contaminant mass found in soil beneath the extent of the historic excavation and no organochlorine pesticides detected. Groundwater contamination is not an issue at this site. The RP concluded there is no indication that a risk is present from vapor intrusion into the property building or to workers at the property. Case closure was initiated by ACDEH, which required administrative items be addressed prior to closure approval. Staff does not object to the pending case closure if the remaining tasks are completed to ACDEH satisfaction.

13.3.5 New Cases

The following new cases were added to the Zone 7 TSS Program in the 2020 WY. Their locations are shown on *Figure 13-4.*

- Site 335: J Cleaners, Livermore. This site operated as a dry cleaner in the early 1970s until late 2007. Soil samples collected in 2006 and 2009 detected PCE. The extent of soil vapor and groundwater contamination is being assessed before redevelopment.

- Site 337: Pacific Avenue Cleaners, Livermore. This case involves one operating dry cleaner in an existing strip mall structure that used PCE from about 1966 to 2010 and a gasoline service station on the western end of the site that operated from about 1963 to 1988. PCE has been detected in soil, soil vapor, and groundwater exceeding the current ESLs. Fuel related chemicals benzene and xylenes, along with solvents acetone and methyl ethyl ketone were detected in soil vapor samples. The site is currently being considered for redevelopment.

13.4 Salt Management

13.4.1 Introduction and Strategy

Agriculture and urban development over the Basin have led to rising salt concentrations in local groundwater as irrigation concentrates the salts and minerals through evapotranspiration processes. This results in higher salinity leachate and percolate recharging groundwater, which impacts overall groundwater TDS concentrations. 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 to select the combination of salt management strategies to be implemented each year. The available SMP strategies include salt removal by groundwater pumping, salt export through the operation of Zone 7's 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 2020 WY

13.4.2.1 Salt Management Actions

No changes were made involving the SMP or SMP strategies in the 2020 WY. The following is a summary of the salt management actions conducted by Zone 7 during the 2020 WY:

- Zone 7 pumped 11,746 AF of higher TDS (585 mg/L, average) groundwater into its distribution system, which resulted in 9,331 tons of salts being removed from the groundwater basin.
- Zone 7 exported 1,231 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 2,461 AF of lower TDS (202 mg/L, average) surface water, which added 675 tons of salt to the Basin.

13.4.2.2 Salt Loading Calculations

Table 13-2 contains the salt loading totals for each Hydrologic Inventory (HI) component for water years 1974 through 2020*. Table 13-B* below shows the salt loading summary for the 2020 WY. These salt loading calculations consider 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 HI and multiplying it by the volume for each HI component (*Section 11.1.3., Hydrologic Inventory Results).* Net change in salt mass alone is not a good indicator of the change in water quality because it does not consider the amount of water associated with the salt mass increase (or decrease). For example, 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 (*Figure 13-5*). 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 net 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 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.

Table 13-B: Salt Loading Summary for 2020 WY

Category	Volume (AF)	Salt Mass (Tons)	TDS Concentration (mg/L)	Change in Concentration from 2019 WY (mg/L)
Inflow	13,516	12,486	680	96
Outflow	21,447	12,961	445	-3
Net (In – Out)	-7,931	-475	44	
Basin Total	**247,232**	**227,384**	**677**	**20**

- In the 2020 WY, the total salt mass added to the Main Basin by all the inflow (Supply) components was approximately 12,486 tons, whereas the total mass of salts removed from the Basin by all the outflow (Demand) components is estimated at 12,961 tons; a net decrease of 475 tons.

- While the salt load decreased during the 2020 WY, the end-of-water-year theoretical average TDS concentration for the Main Basin increased by 20 mg/L from the previous water year average (657 mg/L TDS in 2019 WY) to 677 mg/L (*Figure 13-5*). This is because the basin storage dropped by 7,931 AF, which essentially concentrates the remaining salt in storage.

13.4.2.3 Groundwater Demineralization Program

Zone 7's 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 that produces 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 the regional wastewater export pipeline operated by the LAVWMA and DSRSD-EBMUD Recycled Water Authority (DERWA).

- During the 2020 WY, the MGDP produced 344 AF of brine (compared to 480 AF in the 2019 WY) that resulted in the export of about 1,230 tons of salt from the Main Basin through the LAVWMA pipeline (compared to 1,869 tons in the 2019 WY).

- Since its inception, the MGDP has exported 18,631 tons of salt from the Valley. *Table 13-C* below presents the salts removed by the MGDP from its construction in 2009 through the 2020 WY.

Table 13-C: 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
2019	480	2,867	1,869	3.89
2020	344	2,633	1,230	3.58
TOTAL	**4,366**	**3,141**	**18,631**	**4.27**

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 (as nitrogen [N]) in drinking water is 10 mg/L, which is also the value used as the Basin Objective by the RWQCB and as the minimum threshold by Zone 7. Monitoring results for nutrients in the groundwater for the 2020 WY are reported in *Section 7.2.3.*

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 assessed existing and projected future groundwater nutrient concentrations for planned recycled water expansion and future development in the Livermore Valley. The NMP concluded that although overall basin groundwater quality is not expected to degrade, there is still a need to monitor and manage nutrient loading. A description of the NMP is provided in *Section 5.3.4.1*, *NMP*, of the Alternative GSP.

The NMP outlined plans to minimize nitrogen loading from existing sources. The NMP also presented planned actions for addressing positive nutrient loads and high groundwater nitrate concentrations in localized Areas of Concern (AOCs) where onsite wastewater treatment systems (OWTS, e.g., septic systems) use is the typical method for sewage disposal (which can be a contributor to nitrate contamination). To minimize nitrogen loading, the NMP called for the continued use of BMPs for such facilities as horse boarding facilities, vineyards, irrigated turf/landscapes, and wineries. The NMP also recommended implementing additional OWTS performance measures for new and replacement OWTS in the AOCs (see *Section 13.5.3* below). The NMP included an implementation schedule that recognized the ongoing monitoring and BMPs and presented a specific schedule for AOC investigations. During the 2020 WY, Zone 7 continued working with ACDEH to implement the NMP measures.

13.5.3 OWTS Management

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 within Alameda County. In addition, Zone 7 Board approval is explicitly required for nonresidential uses of OWTS 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. One new authorization for nonresidential OWTS was granted by the Zone 7 Board in the 2020 WY for the Chouinard Vineyards and Winery on Palomares Road.

TABLE 13-1
TOXIC SITES SURVEILLANCE - ACTIVE SITES SUMMARY
2020 WATER YEAR

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
1	Lawrence Livermore National Laboratory	Lawrence Livermore Lab	7000 East Avenue	Livermore	3A3	7	ACEH	SFRWQCB accepted the February 2019 Final Soils Screening and Management Plan, Lawrence Livermore National Laboratory and Site 300.

CHEMICAL	CONCENTRATION ug/L
TCE	610

GEOTRACKER ID: T0600191466

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
5	Sandia National Laboratory	Sandia National Labs	7011 East Avenue	Livermore	3A3	8	RWQCB	SFBRWQCB concurred with partial closure of Solid Waste Management Unit #16 in December 2019 stating the closure report adequately details the soil sampling activities completed at the Site and indicatesthat no significant release of contamination has occurred beneath theclosed segmentsof SWMU #16.

CHEMICAL	CONCENTRATION ug/L
TPHd	650
NO3	NS
CCL4	1.5
CR(IV)	0.23

GEOTRACKER ID: T0600191470

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
11	Intel	Intel Livermore Fabrication Plant 3	250 North Mines Road	Livermore	2A3	8	RWQCB	The 2019 Annual Monitoring and Technical Report was approved by RWQCB.

GEOTRACKER ID: SL18368788

CHEMICAL	CONCENTRATION ug/L
TCE	100
1,2-DCE	120
VC	71
PCE	5.9

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
11	Intel	Intel Livermore Fabrication Plant 3	250 North Mines Road	Livermore	2A3	8	RWQCB	The Regional Water Board's directive letter dated August 23, 2019, required that Intel Corporation (Intel) submit a report addressing outstanding concerns of residual contamination and risk at the Site.

GEOTRACKER ID: SL18368788

CHEMICAL	CONCENTRATION ug/L
TCE	100
1,2-DCE	120
VC	71
PCE	5.9

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
11	Intel	Intel Livermore Fabrication Plant 3	250 North Mines Road	Livermore	2A3	8	RWQCB	The February 2020 Water Board response to the Intel November 25th report commented that the sump pump in Building 3 provides hydraulic control of the groundwater VOC plume at the Intel site.

GEOTRACKER ID: SL18368788

CHEMICAL	CONCENTRATION ug/L
TCE	100
1,2-DCE	120
VC	71
PCE	5.9

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
11	Intel	Intel Livermore Fabrication Plant 3	250 North Mines Road	Livermore	2A3	8	RWQCB	1/3 The Water Board responded to the January 2020 Mine's Road report. No decisions on site closure will be made until the RMP is submitted and approved and vapor intruction guidance is published. The Water Board response asserted that further remediation is feasible at the Site and requests Intel's evaluation of six specific technologies for the Site. The Response requested that Intel provide more specific estimated cleanup times.

GEOTRACKER ID: SL18368788

CHEMICAL	CONCENTRATION ug/L
TCE	100
1,2-DCE	120
VC	71
PCE	5.9

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
11	Intel	Intel Livermore Fabrication Plant 3	250 North Mines Road	Livermore	2A3	8	RWQCB	2/3 The Water Board commented that groundwater in the Site area is not likely to be used as source of drinking water because the low permeability soils restrict water production prohibiting beneficial well yields and determined that no additional time estimate is needed. The Response discussed concerns regarding potential vinyl chloride (VC) accumulation at the Site and requests that Intel provide evidence that reductive dehalogenation is not likely to stall causing the accumulation of VC.

GEOTRACKER ID: SL18368788

CHEMICAL	CONCENTRATION ug/L
TCE	100
1,2-DCE	120
VC	71
PCE	5.9

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
11	Intel	Intel Livermore Fabrication Plant 3	250 North Mines Road	Livermore	2A3	8	RWQCB	3/3 The Water Boord response requested that Intel provide an updated risk assessment. Because groundwater contamination has been shown to be stable or decreasing, the Water Board determined that it is unlikely that the risk due to groundwater exposure has increased since the 2005 risk assessment.

GEOTRACKER ID: SL18368788

CHEMICAL	CONCENTRATION ug/L
TCE	100
1,2-DCE	120
VC	71
PCE	5.9

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
14	Nucleopore Corporation	Former Clorox Campus - Building 9	7035 Commerce Circle	Pleasanton	2A2	7	RWQCB	Verification Monitoring and Rquiest for Closure Report was submitted to the RWQC in August 2020. Groundwater analytical results were presented for December 2019, March 2020, and June 2020. TCE concentrations above the MCL were detected in six wells, PCE concentrations above the MCL of were detected in three wells, and cDCE concentrations above the MCL were dectected in one well. Freon was also detected above the MCL.

CHEMICAL	CONCENTRATION ug/L
Freon 113	

GEOTRACKER ID: T0600191468

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
14	Nucleopore Corporation	Former Clorox Campus - Building 9	7035 Commerce Circle	Pleasanton	2A2	7	RWQCB	Soil vapor analytical results were also presented for one sampling event prior to SVE shutdown on October 2018 and 9 subseqent rebound events through June 2020. PCE was detected in the first 5 of 9 rebound testing events. Natual attenuation is presented by Rosso Environmental in the concludsions as appropriate final remedial measure for shallow groundwater contaminated with chlorinated VOCs.

CHEMICAL	CONCENTRATION ug/L
Freon 113	

GEOTRACKER ID: T0600191468

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
36	Richmond Lox/ Salinas Reinforcement	Salinas Reinforcing Inc.	355 South Vasco Road	Livermore	3A3	5C	RWQCB	In December 2019, Montclair submitted the Investigation and Annual Site Status Report to provide updated deeper zone groundwater and soil gas volatile organic compound (VOC) data for the southern area of the Site for determining whether VOC concentrations are decreasing in that area.

CHEMICAL	CONCENTRATION ug/L
TCE	770
TPHg	NA
BENZ	NA

GEOTRACKER ID: SL18266687

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
36	Richmond Lox/ Salinas Reinforcement	Salinas Reinforcing Inc.	355 South Vasco Road	Livermore	3A3	5C	RWQCB	SFBRWQCB responded to the closure evaluation and workplan in March 2020 requiring further investigation to confirm if the railroad spur area is a possible additional TCE spill source location, demonstration of temporal concentration decline of TCE with repeatable data from fixed monitoring locations, assement of additional TCE sources, and determination of the full vertical and lateral downgradient extent of TCE groundwater contamination. In addition, they required remedial and mitigation meausre to control sources. Workplan is pending.

GEOTRACKER ID: SL18266687

CHEMICAL	CONCENTRATION ug/L
TCE	770
TPHg	NA
BENZ	NA

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
37	Applied Biosystems (formerly Kaiser Aluminum & Chemical)	Applied Biosystems	6001 (Formerly 6177) Sunol Boulevard	Pleasanton	2C	8	DTSC	Closure of Groundwater Monitoring Well GEI-2S Work Plan was implemented in November 2019 under Zone 7 permit 2019039. Annual certification for the Covenant to Restrict Use of Property was submitted in January, 2020.

GEOTRACKER ID: 01280050

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

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
84	Livermore Redevelopment Agency	Arrow Rentals	187 North L Street	Livermore	1A2	7	ACEH	The Soil Vapor Well Installation Report was submitted in August 2020. Vapor was sampled for TPH, VOCs, and methane. Analytical results reported TPHg, Toluene, Ethanol, Acetone, 2-proponal, and PCE in some samples. This report concludes that results meet the Petroleum Vapor Intrusion to Indoor Air criteria of the State Water Resources Control Board's Low Threat Underground Storage Tank Case Closure Policy (LTCP).

GEOTRACKER ID: T0600100116

CHEMICAL	CONCENTRATION ug/L
TPHg	9,200
TPHd	NA
MTBE	48
BENZ	3,000

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
84	Livermore Redevelopment Agency	Arrow Rentals	187 North L Street	Livermore	1A2	7	ACEH	Ground Zero submitted the Well Destruction and Installation Report to ACDEH in December 2019. A total of 8 soil samples from 3 borings were collected and analyzed for TPHg, benzene, BTEX, and MTBE using EPA Method 8260B and LUFT GC/MS. TPHg was detected in one sample. Three of the 5 new wells were dry and therefore unable to be developed for the subsequent monitoring.

GEOTRACKER ID: T0600100116

CHEMICAL	CONCENTRATION ug/L
TPHg	9,200
TPHd	NA
MTBE	48
BENZ	3,000

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
84	Livermore Redevelopment Agency	Arrow Rentals	187 North L Street	Livermore	1A2	7	ACEH	An Additional Soil Gas Invetigation Workplan was submitted in October 2019 for additional data to estimate the potential risk of vapor intrusion. Ground Zero proposed the installation of soil gas wells and performing two soil gas sampling events to coincide with late fall and early winter.

GEOTRACKER ID: T0600100116

CHEMICAL	CONCENTRATION ug/L
TPHg	9,200
TPHd	NA
MTBE	48
BENZ	3,000

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
115	LASC/MOSC (Livermore Arcade)	Livermore Arcade (Miller's Outpost)	1410/1554 First Street	Livermore	1A2	7	RWQCB	In October 2019, the Semi-Annual Goundwater Monitoring Report was submitted for the first and second quarter of 2019. PCE, TCE, Cis-1,2-DCE, Vinyl Chloide, were detected in shallow and deep zone wells above reporting limits. According to APEX, PCE concentrations in the LASC and MOSC source areas have decreased.

GEOTRACKER ID: SL18227625

CHEMICAL	CONCENTRATION ug/L
PCE	14
TCE	3.9
cis-1,2-DCE	6.9
Vinyl Chloride	6.3

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
137	Busick Air Conditioning	Busick Gearing Properties	6341 Scarlett Court	Dublin	2A3	5C	RWQCB	RWQCB issued a directive letter on October 15, 2019 requiring a technical report for the vapor intrusion assessment and groundwater investigation at the site, in addition to the implementation of the remedial investigation workplan dated March 12, 2014. The technical report was due February 24,2020.

CHEMICAL	CONCENTRATION ug/L
TCE	5,200
PCE	120

GEOTRACKER ID: SL20256874

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
149	Kaiser Sand and Gravel	Hanson Aggregates	3000 Busch Road	Pleasanton	2A4	5R	ACEH	ACDEH concurred with USL Pleasanton's request for case closure of SCP Case No. RO0002941 and RO0002952. Remedial Action Plans were required to be submitted to ACDEH for review and approval to address the site's remaining environmental concerns and will be conducted under two new SCP cases (RO0003458 and RO0003459), in conjunction with the site's future development activities. Well and probe destruction, and disposal of investigation and remediation derived waste are required for issuance of a Remedial Action Completion Certificate.

CHEMICAL	CONCENTRATION ug/L
BENZ	ND
TPHd	50

GEOTRACKER ID: SLT19719376

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
149	Kaiser Sand and Gravel	Hanson Aggregates	3000 Busch Road	Pleasanton	2A4	5R	ACEH	SLT19719376 and SL0600101555 (AOCs 2 through 9) are eligible for closure as of 9/18/2020. T10000009398 (AOC 6 and 7) is open for long term management as of 7/18/2017.

CHEMICAL	CONCENTRATION ug/L
BENZ	ND
TPHd	50

GEOTRACKER ID: SLT19719376

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
209	Shell Oil	SHELL #13-5244	8999 San Ramon Road	Dublin	2C	8	ACEH	RP submitted the Additional Site Assessment and Update to the Conceptual Model to ACDEH for additional testing performed in 2019. Additional sampling included one soil sample and 3 goundwater samples. MTBE and TBA were detected in the soil sample. No COCs were detected above reporting limits in the groundwater samples. The report concludes MTBE in the intermediate zone to be adequately defined and groundwaterr in the deep zone defined to water quality objectives in the predominantly downgradient direction. Wayne Perry requested closure.

CHEMICAL	CONCENTRATION ug/L
TPHd	1,300
TPHg	220
TBA	5,000
MTBE	130

GEOTRACKER ID: T0600159797

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
209	Shell Oil	SHELL #13-5244	8999 San Ramon Road	Dublin	2C	8	ACEH	In June 2020, ACDEH concurred that the Case meets the criteria presented in the LTCP and is therefore eligible for regulatory case closure pursuant to California Health and Safety Code (H&SC) Section 25296.10. ACDEH updated the Low Threat Policy Checklist and the Path to Closure Plan in the Case file on the State Water Board's GeoTracker Database to reflect their evaluation and has assigned the Case a status of "Open - Eligible for Closure".

CHEMICAL	CONCENTRATION ug/L
TPHd	1,300
TPHg	220
TBA	5,000
MTBE	130

GEOTRACKER ID: T0600159797

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
209	Shell Oil	SHELL #13-5244	8999 San Ramon Road	Dublin	2C	8	ACEH	A Well Abandonment Workpan was submitted to ACDEH in August, 2020. This plan was approved in October 2020.

CHEMICAL	CONCENTRATION ug/L
TPHd	1,300
TPHg	220
TBA	5,000
MTBE	130

GEOTRACKER ID: T0600159797

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
209	Shell Oil	SHELL #13-5244	8999 San Ramon Road	Dublin	2C	8	ACEH	Eligible for closure as of 6/29/2020.

CHEMICAL	CONCENTRATION ug/L
TPHd	1,300
TPHg	220
TBA	5,000
MTBE	130

GEOTRACKER ID: T0600159797

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
232	Bordoni Ranch LLC and Green Valley Corporation Tenancy in Common	Groth Brothers Chevrolet	59 South L Street	Livermore	2A2	5R	RWQCB	The Revised Vapor Intrusion Mitigation System Design Report was submitted on November 1st, 2019.

CHEMICAL	CONCENTRATION ug/L
BENZ	46
MTBE	1,200
TPHg	61,000
PCE	3000

GEOTRACKER ID: SL0600147081

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
238	All Rents	All Rents	2247 Second Street	Livermore	1A2	5C	UNK	A source investigation workplan was due July 20, 2018. An extension was discussed in April 2019.

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

GEOTRACKER ID: T10000008261

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
242	Alameda County Fairgrounds	Fairground Main Well (3S/1E 20B 2)	4501 Pleasanton Avenue	Pleasanton	1A1	1		American Cleaners (T10000008240) has been identified as a potential source of the contamination of the fairgroud well. Zone 7 provided fairground well logs and contact information to the RP.

CHEMICAL	CONCENTRATION ug/L
PCE	16

GEOTRACKER ID:

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
259	City of Livermore	CHEVRON #30-7233 /Mills Square Park/Performing Arts Theater	2259 First Street	Livermore	2A4	7	ACEH	The Final Supplemental Remedial Action Implementaion Plan (RAIP) was submitted in September 2020. The plan proposed excavation in Areas 1, 2, and 3. ACDEH approved the plan with additional requirements to collect soil samples above and bleow potentially impacted intervals when advancing soil borings in Area 3. Samples will be analyzed for TPHg, TPHd, TPHmo and BTEX.

CHEMICAL	CONCENTRATION ug/L
TPHg	3000
BENZ	0.5
TPHd	140

GEOTRACKER ID: T0600196622

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
259	City of Livermore	CHEVRON #30-7233 /Mills Square Park/Performing Arts Theater	2259 First Street	Livermore	2A4	7	ACEH	In May 2020, ACDEH concluded anaerobic biological oxidation had not been completely effective in removing TPH in groundwater and required additional secondary source removal beneath the site via one of the four other remedial actions that were previously evaluated in the Remedial Action Plan (RAP).

CHEMICAL	CONCENTRATION ug/L
TPHg	3000
BENZ	0.5
TPHd	140

GEOTRACKER ID: T0600196622

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
264	Livermore Redevelopment Agency/Signature Properties	Railroad Ave-Livermore Site	1934 - 1950 Railroad Avenue at North L Street	Livermore	2A4	1	ACEH	This case has been inactive since 2005. ACEH transferred this case to the Regional Water Board. No documents have been added to geotracker since the 2005 Sample and Analysis Plan was uploaded. There was no activity in the 2020 WY.

GEOTRACKER ID: T06019726132

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

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
284	Gabriel Chiu	Former Crow Canyon Dry Cleaner	7272 or 7242 San Ramon Road	Dublin	3C	8	ACEH	A Data Gap Evaluation, Work Plan, Site Conceptual Model, and Interim Risk Management Plan were due May 2020.

GEOTRACKER ID: T06019764784

CHEMICAL	CONCENTRATION ug/L
TCE	3
PCE	22

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
291	Country Club Cleaners	Perciva/Metro Valley Cleaners	224 Rickenbacker Circle	Livermore	3A2	7	ACEH	6/28/2020 - RP proposed to perform a soil vapor survey to evaluate the potential subsurface vapor and/or indoor intrusion pathways and identity if there are any human health and/or environmental risks to the onsite building and the adjacent commercial building located at 236 Rickenbacker Circle to west; the vacant lot located at 212 Rickenbacker Circle to the east; and the businesses located at 72 and 84 Rickenbacker Circle to the south.

GEOTRACKER ID: T06019748481

CHEMICAL	CONCENTRATION ug/L
PCE	4.9

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
291	Country Club Cleaners	Perciva/Metro Valley Cleaners	224 Rickenbacker Circle	Livermore	3A2	7	ACEH	9/20/2020 - RP submitted a Site Assemessment Report, the Passive Soil Gas Sampling Technical Memorandum to present the quantitative mass and soil gas analytical results from the August 28 to September 1, 2020 sampling events. Chlorinated solvents, primarily consisting of PCE, TCE, t-1,2-DCE, and c-1,2-DCE, were detected within the footprint of the former dry cleaning machine along the south side of the onsite building. RP proposed to install the additional PSG samplers to provide further lateral delineation of the onsite impacts.

CHEMICAL	CONCENTRATION ug/L
PCE	4.9

GEOTRACKER ID: T06019748481

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
292	CW Roen	Former K&S Heavy Equipment	495 Greenville Road	Livermore	2C	8	ACEH	ACDEH review of Site Characterization report required a workplan to address data gaps associated with historical remedial excavations and the evaluation of pesticides and herbicides. The Site Investigation Work Plan was subsequently submitted on 11/30/2019.

GEOTRACKER ID: T06019726510

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
292	CW Roen	Former K&S Heavy Equipment	495 Greenville Road	Livermore	2C	8	ACEH	A Subsurface Investigation Report was submitted in May 2020. Soil samples were collected at depths from 5 to 15 feet below ground surface and sampled for TPH, VOCs, SVOCs, and metals. Metals and VOCs were detected below ESLs.

GEOTRACKER ID: T06019726510

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
292	CW Roen	Former K&S Heavy Equipment	495 Greenville Road	Livermore	2C	8	ACEH	Subsurface Investigation Report, Revision 1 reccomended no further investigation based no residual contaminant mass found beneath the extent of the historic excavation, and no organochlorine pesticides.

GEOTRACKER ID: T06019726510

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
292	CW Roen	Former K&S Heavy Equipment	495 Greenville Road	Livermore	2C	8	ACEH	Eligible for closure as of 3/3/2020.

GEOTRACKER ID: T06019726510

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
298	Chevron	Former Chevron Records Facility	6400 Sierra Court	Dublin	2B4	7	RWQCB	SWRCB issued a letter approving the request by the RP to have the review of site clean up requirements to continue to be held in abeyance until 12/23/2021. The original request for the petition to be held in abeyance expired 12/23/19.

GEOTRACKER ID: SL0600196603

CHEMICAL	CONCENTRATION ug/L
TCE	690
cis 1,2-DCE	1200
VC	20

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
299	TDW Construction	Nica Metals	101 Greenville Road	Livermore	3A2	3A	ACEH	Site is non-compliant. Soil removal and a site assessment were due May 2010. ACDEH issued notice of violation letters in 2009 and 2010. There was no change in status for this case in the 2020 WY.

CHEMICAL	CONCENTRATION ug/L
GRO	unknown

GEOTRACKER ID: SLT19765274

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
302	Federal Corrections Institution Dublin	FCI Dublin	5701 8th Street	Dublin	3A1	3B	ACEH	Case is inactive as of 1/21/2016.

CHEMICAL	CONCENTRATION ug/L
TPHd	680,000

GEOTRACKER ID: SLT19749067

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
307	City of Pleasanton Public Works	City of Pleasanton Theater Parking Lot	0 Kottinger Drive	Pleasanton	3B1	5C	ACEH	Inactive as of 1/21/2016.

CHEMICAL	CONCENTRATION ug/L
TPHg	
TPHmo	

GEOTRACKER ID: T10000001164

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
308	Stockbridge/BHV Emerald Place Land Co	Green on Park Place	5411 Martinelli Way	Dublin	3C	8	ACEH	Slated for closure in 2014. No action in 2020.
GEOTRACKER ID:	T10000005547							
312	Cemex	Cemex Sunol	6527 Calaveras Road	Sunol	3A1	1	ACEH	Case is listed as inactive with no updates in GeoTracker for the the 2020 WY.
GEOTRACKER ID:	T10000003431							
313	Good Year Tire and Rubber Company	Just Tires	1485 First Street	Livermore	2C	8	ACEH	No updates were reported for this case in the 2020 WY. Comments on pending closure were due January 2017.
GEOTRACKER ID:	T10000003435							

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
317	Walgreens	Walgreens Spill Sunol	9494 Koopman Road	Sunol	2C	8	ACEH	Eligible for closure as of 5/6/2020.

CHEMICAL	CONCENTRATION ug/L
TPHd	349

GEOTRACKER ID: T10000006478

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
318	E&B Natural Resources Management Corporation	G.I.G Oil Production Facility	8467 Patterson Pass Road	Livermore	2A4	8	ACEH	ACDEH has not responded to the RP's case closure request in 2017. All soil and groundwater samples were non-detect for fuel contaminants and within background range for metals.

CHEMICAL	CONCENTRATION ug/L

GEOTRACKER ID: T10000007269

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
319	Johnson Drive Holdings I, LLC/Clorox Products Manufacturing	Former Clorox Site - Building 7	7200 - 7208 Johnson Drive	Pleasanton	2A2	5R	RWQCB	An annual estimation letter was submitted in July 2020 for the expected outcome of work in the fiscal year 2020/2021 including further direction on the site investigation and update of site cleanup requirement. In October 2020, the RWQCB approved the expansion of the SVE system to include 6 additional soil vapor wells in an effort to accelarate clean up time.

GEOTRACKER ID: T10000007118

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
320	Ready Family Partnership, LP	Dublin Crossroads Center & Park Ave Cleaners	7100-7120 Dublin Boulevard	Dublin	2A4	5C	ACDEH	There were no new regulatory activities in 2020 water year.
GEOTRACKER ID: T10000004783								
322	Pacific Locomotive Association DBA Niles Canyon Railway	Niles Canyon Railway	9 Kilkare Road	Sunol	3B1	7	ACDEH	ACDEH sent a notice to comply letter in July 2020 for submission of Revised Site Investigation Report. A reponse was received in July 2020 to review.
GEOTRACKER ID: T10000006021					**CHEMICAL**	**CONCENTRATION ug/L**		
					PCE	36		
323	Stoll Main Street Trust	Former American Cleaners	555 Main Street	Pleasanton	2A4	3A	RWQCB	One deep monitoring well was installed according to the Deep Groundwater Assessment Work Plan submitted in April 2020. SVE pilot test wells were installed and are pending test startup. The site assessment work plan, interim remedial action plan, and montly status reports have been delayed. The Water Board has been communicating with the responsible party.
GEOTRACKER ID: T10000008240					**CHEMICAL**	**CONCENTRATION ug/L**		
					PCE	49,000		
					TCE	1,600		
					Cis 1,2 DCE	2,900		

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
324	MidPen Housing Corporation	Chestnut Square	1651 and 1665 Chestnut Street	Livermore	1A2	7	ACDEH	ACDEH approved vapor probe installations in September 2020. RP proposed air sampling and soil gas probe locations based on proximity to previously detected PCE concentrations in soil gas.

CHEMICAL	CONCENTRATION ug/L
PCE	15
TPHd	130

GEOTRACKER ID: T10000007202

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
324	MidPen Housing Corporation	Chestnut Square	1651 and 1665 Chestnut Street	Livermore	1A2	7	ACDEH	ACDEH cleared the site for occupancy and changed the case status to long term management. ACDEH is proceeding with regulatory case closure of Cleanup Program Case No. RO0003179 and has transitioned regulatory oversight to two separate Long-Term Management Cases identified by ACDEH Case Nos. RO0003461 (Chestnut Square Family Housing) and RO0003460 (Chestnut Square Senior Housing).Case closure of RO0003179 will be contingent upon finalization and recordation of institutional controls, financial assurance mechanisms, and administrative controls for the two associated Long-Term Management Cases.

CHEMICAL	CONCENTRATION ug/L
PCE	15
TPHd	130

GEOTRACKER ID: T10000007202

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
325	MidPen Housing Corporation	217 North N St	217 North N Street	Livermore	2A1	7	ACDEH	No new regulatory activity was reported in Geotracker for the 2020 WY.

CHEMICAL	CONCENTRATION ug/L
PCE	13

GEOTRACKER ID: T10000011094

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
326	City of Livermore	Livermore Department of Public Works	Rincon and Juniper and Spruce	Livermore	1A1	1	RWQCB	A Site Assessment Workplan was approved by the RWQCB in December 2019 for soil gas sampling. Soil gas samples was analyzed for PCE, TCE, cis-1,2-DCE, trans-1,2-DCE,1,1-DCE, 1,2-DCA, and vinyl chloride following the U.S. EPA Test Method 8260C. Comments from the approval letter described an investigation of California Water Service (CWS) public water supply well 10-01. This investigation concluded that the Site was not the source of the PCE contamination reported in CWS well 10-01.

CHEMICAL	CONCENTRATION ug/L
PCE	

GEOTRACKER ID: SLT2O09096

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
327	BMMR USA, Inc.	VIP Cleaners	1809 Santa Rita Road, Suite F	Pleasanton	2A2	3B	RWQCB	An additional remedial investigation was performed to further investigate elevated levels of TCE, PCE and TPHg detected in soil gas and groundwater, and elevated levels of PCE in soil. The report for this invetigation was submitted in July, 2020 and is pending regulatory approval. Elevated levels of PCE was detected in two of the 4 groundwater samples and elevated levels of TPHg was detected in 1 of 4 groundwater samples.

CHEMICAL	CONCENTRATION ug/L
PCE	140
TPHg	130

GEOTRACKER ID: T10000008254

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
328	Diamond Properties, Inc	Pleasanton Lucky Cleaners	6051 W. Las Positas Blvd.	Pleasanton	3B1	3A	RWQCB	The 2019 Source Investigation Report was approved by SFBRWQCB. No further investigation is required. This site will remain in GeoTracker database as noncase information.

GEOTRACKER ID: T10000008267

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
329	Terrell Bates & Kimberly R Trust	Pleasanton French Laundry (Former)	560 Main Street	Pleasanton	2A4	3A	RWQCB	A 2019 Site Assessment reported detections of PCE in one soil sample below SFBRWQCB soil screening levels for residential and commercial/inductrial scenarios, and PCE in one grab water sample just under MCL. PCE was reported in all but one soil gas sample above the SFBRWQCB soil gas vapor intrusion residential screening levels.

CHEMICAL	CONCENTRATION ug/L
PCE	4.8

GEOTRACKER ID: T10000008241

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
329	Terrell Bates & Kimberly R Trust	Pleasanton French Laundry (Former)	560 Main Street	Pleasanton	2A4	3A	RWQCB	The Regional Water Quality Control Board approved the Indoor Air Samping and Analysis Work Plan and Addendum in February 2020 for additional air sampling at the site and the surrounding areas in order to determine whether subsurface contamination poses a threat to human health through the vapor intrusion pathway. No additional soil or groundwater sampling was included in the plan.

CHEMICAL	CONCENTRATION ug/L
PCE	4.8

GEOTRACKER ID: T10000008241

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
330	FFHS Associates - Gateway, L.P. ; Margo Foster	City Cleaners	4855 Hopyard Road, Suite C	Pleasanton	2A4	3A	RWQCB	The Interim Source Area Removal Workplan was approved in March, 2020 for an evaluation of four remedial alternatives that recommends excavation for tetrachlorothene (PCE) impacted soil removal and soil vapor extraction (SVE) for removing residual PCE in soil and soil gas. The interim remedial action report is due.

GEOTRACKER ID: T10000008237

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
331	Taylor Corporation; John Tanke	Taylor Corporation	5775 Brisa Street	Livermore	2A1	3B	RWQCB	In May 2020, SFBRWQCB concluded that groundwater pollution detected beneath the Taylor Property is likely the result of the migration of pollutants in groundwater from upgradient sources. They may revisit this finding should future data indicate otherwise.
GEOTRACKER ID: T10000013016								
332	Renn Transportation	Renn Transportation Fuel Spill	I-680	Sunol	2A2	7	ACDEH	On September 16, 2019, over 3,000 gallons of gasoline was released on I-680 near mile marker 119, south of 5815 Mission Road, as a result of a collision. Gasoline flowed down a concrete channel from 680 near Happiness Kennels where the channel is not lined. 4 Monitoring wells and 2 vapor wells were installed under drilling permit 2020009.
GEOTRACKER ID: T10000013696								
332	Renn Transportation	Renn Transportation Fuel Spill	I-680	Sunol	2A2	7	ACDEH	ACDEH Conditional Approval for Implementation of Work Plan dated March, 9 2020 concurred that the results of environmental sampling should be compared to the ESL for gasoline range petroleum hydrocarbons, however, the results of environmental sampling must also be compared to applicable ESLs for other applicable constituents of concern, including benzene, toluene, ethylbenzene, xylenes, and naphthalene. According to ACDEH, an additional monitoring well in the source area to the proposed installations is appropriate.
GEOTRACKER ID: T10000013696								

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
335	J Cleaners	J Cleaners	2093 Railroad Avenue	Livermore	1A2	3A	RWQCB	New site assessment as of 12/31/2019. J Cleaners operated in the early 1970s until late 2007. Soil samples collected in 2006 and 2009 detected tetrachloroethene (PCE). Currently assessing soil vapor and groundwater contamination previous to redevelopment.

GEOTRACKER ID: T10000008401

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
335	J Cleaners	J Cleaners	2093 Railroad Avenue	Livermore	1A2	3A	RWQCB	In May 2020, the SFBRWQCB approved the Vapor Intrusion Assessment Workplan for soil gas well installation down to 15 feet in addition to further assessment of groundwater. Elevated concentrations of PCE had not been detected at depths of approximately 60 feet beneath the Site; however, according to SFBRWQCB, further assessment of groundwater downgradient of the Site was warranted.

GEOTRACKER ID: T10000008401

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
336	Old Train Depot	Old Train Depot	2009 Railroad Avenue	Livermore	1A2	5C	RWQCB	Site assessment as of 12/22/2020.

GEOTRACKER ID: T10000016758

CHEMICAL	CONCENTRATION ug/L
PCE	
TPHd	
TPHg	

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
336	Old Train Depot	Old Train Depot	2009 Railroad Avenue	Livermore	1A2	5C	RWQCB	A Site Assessment and Summary Report was submitted in April, 2020. PCE was detected in well MW-4 at a concentration of 10.2 µg/L during the July 26, 2018 sampling. PCE concentrations ranged from 4.6 µg/L to 16 µg/L in grab shallow zone groundwater (66 to 70 ft bgs) samples. PCE was detected at a concentration of 4.9 µg/L at 41 to 45 ft bgs in perched zone groundwater. These concentrations exceed the 2019 Tier 1 ESL of 0.64 µg/L.

GEOTRACKER ID: T10000016758

CHEMICAL	CONCENTRATION ug/L
PCE	
TPHd	
TPHg	

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
336	Old Train Depot	Old Train Depot	2009 Railroad Avenue	Livermore	1A2	5C	RWQCB	A Site Assessment and Summary reported TPHg and TPHd detected at maximum concentrations of 170 µg/L and 330 µg/L, respectively during perched groundwater sampling in 2005, and were above the Tier 1 ESLs. Chloroform detected in the July 11, 2018 grab sample from the boring for well MW-4 contained a concentration of 1.3 µg/L, above the Tier I ESL of 0.81 µg/L.

GEOTRACKER ID: T10000016758

CHEMICAL	CONCENTRATION ug/L
PCE	
TPHd	
TPHg	

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
337	Pacific Avenue Cleaners	Pacific Avenue Cleaners	3018 Pacific Avenue	Livermore	1A2	3B	RWQCB	New site assessment as of 10/31/2019. This case involves one operating dry cleaner (PCE use ~1966-2010) located in an existing strip mall structure.. Also, a gasoline service station operated on the western end of the site ~1963-1988. The site is currently being considered for redevelopment. PCE has been found in soil, soil vapor, and groundwater in and around the site exceeding the current Environmental Screening Levels (ESLs).

GEOTRACKER ID: T10000008716

CHEMICAL	CONCENTRATION ug/L
PCE	

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
337	Pacific Avenue Cleaners	Pacific Avenue Cleaners	3018 Pacific Avenue	Livermore	1A2	3B	RWQCB	SFBRWQCB approved a workplan in March of 2020 to assess the extent of contamination in groundwater and soil vapor (where 2019 Environmental Screening Levels are exceeded); and to evaluate if remedial actions are needed to reduce or eliminate future human health risks. The Property is currently being considered for redevelopment.

CHEMICAL	CONCENTRATION ug/L
PCE	

GEOTRACKER ID: T10000008716

338	Quality Cleaners	Quality Cleaners	2048 First Street	Livermore	1A1	3A	RWQCB	A new geotracker case was created for Quality Cleaners. City of Livermore requested that the Downtown Core Project to be managed as two cleanup sites, J Cleaners and Quality Cleaners. The old Train Depot is also part of the DownTwon Core Project.

GEOTRACKER ID: T10000014462

339	Sparklizing Cleaners	Sparklizing Cleaners	855 Rincon	Livermore	1A2	5R	RWQCB	In November RWQCB approved the Investigation Completion Report. The RWQCB required a long-term soil vapor monitoring plan, and a deed restriction that refers to the O&M plan and the SMP.

GEOTRACKER ID: T10000008739

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
340	Arroyo Crossing	Arroyo Crossing	1364 Arroyo Road	Livermore	3A1	7	RWQCB	Case remains open due to electronic reporting incompliance.
GEOTRACKER ID: SL0600174278								
341	Warmington Homes - Hansen Hills	Warmington Homes - Hansen Hills	Silvergate Drive	Livermore	3A1	NR	RWQCB	Inactive as of 6/4/2009. No records have been uploaded to Geotracker for this site.
GEOTRACKER ID: SL18307727								
342	Camp Parks	Camp Parks	0 Parks RFTA	Dublin	3A2	8	ACDEH	UST site inactive as of 1/21/16. ACEH approved No further Action letter in 1996 but site is non-complianct due to failure to upload documents electronically.
GEOTRACKER ID: T06019796867								

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES
343	Laguna Oaks Site	Laguna Oaks Site	3465 Old Foothill Road	Pleasanton	3A1	3B	RWQCB	Inactive as of 2016.
	GEOTRACKER ID: T06019749061							
344	Pleasanton Assisted Living Facility	Pleasanton Assisted Living Facility	0 JUNIPERO ST & SUNOL	Pleasanton	3A2	3B	RWQCB	Inactive as of 2016.
	GEOTRACKER ID: T06019724209							

Z7 ID	OWNER	SITE NAME	ADDRESS	CITY	PRIORITY	STATUS	LEAD AGENCY	NOTES

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 2020 WATER YEARS

SALT INFLOW COMPONENTS	1974	1975	1976	1977	1978	1979	1980
NATURAL STREAM RECHARGE	3,210	3,464	874	581	4,638	1,723	2,706
Total Arroyo Valle	1,018	1,041	391	315	957	707	777
Flood releases recharge	100	344	0	0	216	0	128
Non Flood Natural Inflow	918	697	391	315	741	707	649
Arroyo Mocho	1,717	2,043	293	76	3,206	636	1,358
Arroyo Las Positas	475	380	190	190	475	380	571
AV PRIOR RIGHTS	361	418	31	0	494	267	386
ARTIFICIAL STREAM RECHARGE	986	2,201	1,914	2,289	3,286	3,699	2,897
Arroyo Valle	293	1,174	509	883	1,427	1,599	1,234
Arroyo Mocho	340	497	875	876	1,350	1,570	1,432
Arroyo Las Positas	353	530	530	530	509	530	231
INJECTION WELL RECHARGE	0	0	0	0	0	0	0
RAINFALL RECHARGE	0	0	0	0	0	0	0
Lake Recharge	*0*	*0*	*0*	*0*	*0*	*0*	*0*
LEAKAGE	21	25	30	35	41	48	56
APPLIED WATER RECHARGE	7,670	7,218	9,123	10,675	8,352	8,304	7,175
SUBSURFACE BASIN INFLOW	2,038	2,038	2,058	3,648	2,506	2,017	1,325
NET INFLOW	14,286	15,364	14,030	17,228	19,317	16,058	14,545

OUTFLOW COMPONENTS	1974	1975	1976	1977	1978	1979	1980
MUNICIPAL PUMPAGE	-7,217	-6,577	-5,074	-4,382	-4,579	-5,351	-4,458
Zone 7 Wells - Hop, Stone, COL	0	0	0	0	0	0	0
Zone 7 Wells - Mocho	-3,303	-2,057	-842	-201	-506	-532	-26
Demin Salts Exported from Valley	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Pumpage	-3,914	-4,520	-4,232	-4,181	-4,073	-4,819	-4,432
AGRICULTURAL PUMPAGE	-2,289	-1,476	-2,997	-3,241	-2,081	-2,420	-1,678
MINING USE	-1,126	-1,725	-802	-668	-869	-1,603	-2,508
Stream Export	-745	-1,345	-422	-287	-489	-1,223	-2,127
Evaporation	0	0	0	0	0	0	0
Processing Losses	-380	-380	-380	-380	-380	-380	-380
GROUNDWATER BASIN OVERFLOW	0	0	0	0	0	-173	-612
NET OUTFLOW	-10,632	-9,778	-8,873	-8,291	-7,529	-9,547	-9,256

NET SALT INFLOW (Tons)	3,654	5,586	5,157	8,937	11,788	6,511	5,289
CUMULATIVE SALT INFLOW (Tons)*	3,654	9,240	14,397	23,334	35,122	41,633	46,922

TDS Concentration Calculations	1974	1975	1976	1977	1978	1979	1980
Net Basin Recharge (AF)	-478	5,508	-4,311	-5,953	11,942	6,394	8,103
Basin Storage (HI Method)(AF)	211,522	217,030	212,719	206,766	218,708	225,102	233,205
Total Salt in Main Basin (tons)	133,252	138,838	143,995	152,932	164,720	171,231	176,520
Main Basin TDS Concentration (mg/L)	464	471	498	544	554	560	557
Cumulative Increase in TDS Conc (mg/L)**	14	21	48	94	104	110	107

* 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 2020 WATER YEARS

SALT INFLOW COMPONENTS	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
NATURAL STREAM RECHARGE	1,513	4,803	7,657	5,286	3,058	4,941	2,852	2,610	2,782	2,480
Total Arroyo Valle	579	1,048	1,433	936	375	779	232	372	187	206
Flood releases recharge	0	271	624	20	0	415	0	0	0	0
Non Flood Natural Inflow	579	777	809	916	375	364	232	372	187	206
Arroyo Mocho	478	2,614	4,626	2,508	932	2,269	458	490	440	233
Arroyo Las Positas	456	1,141	1,598	1,842	1,751	1,893	2,162	1,748	2,155	2,041
AV PRIOR RIGHTS	251	502	381	236	328	286	283	325	356	125
ARTIFICIAL STREAM RECHARGE	3,238	1,617	184	0	0	0	0	525	1,585	1,809
Arroyo Valle	1,719	663	0	0	0	0	0	0	51	132
Arroyo Mocho	1,394	894	184	0	0	0	0	525	1,534	1,677
Arroyo Las Positas	125	60	0	0	0	0	0	0	0	0
INJECTION WELL RECHARGE	0	0	0	0	0	0	0	0	0	0
RAINFALL RECHARGE	0	0	0	0	0	0	0	0	0	0
Lake Recharge	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
LEAKAGE	65	74	84	94	105	115	125	136	147	158
APPLIED WATER RECHARGE	5,507	4,709	4,723	5,046	5,938	6,632	5,558	6,834	6,015	6,541
SUBSURFACE BASIN INFLOW	1,284	1,284	876	1,325	1,528	1,508	1,569	1,875	2,364	2,568
NET INFLOW	11,858	12,989	13,905	11,987	10,957	13,482	10,387	12,305	13,249	13,681

OUTFLOW COMPONENTS	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
MUNICIPAL PUMPAGE	-4,700	-4,748	-5,410	-5,525	-5,752	-6,465	-5,537	-6,662	-6,915	-7,185
Zone 7 Wells - Hop, Stone, COL	0	0	0	0	0	0	0	0	-54	-441
Zone 7 Wells - Mocho	0	0	-17	-227	-863	-869	-326	-1,425	-2,082	-1,683
Demin Salts Exported from Valley	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Pumpage	-4,700	-4,748	-5,393	-5,298	-4,889	-5,595	-5,211	-5,237	-4,779	-5,062
AGRICULTURAL PUMPAGE	-1,553	-844	-912	-1,015	-1,378	-1,428	-998	-1,043	-776	-944
MINING USE	-4,372	-4,161	-7,834	-2,857	-2,814	-6,011	-839	-2,301	-1,728	-918
Stream Export	-3,992	-3,781	-7,454	-2,476	-2,433	-5,535	-364	-1,825	-1,253	-443
Evaporation	0	0	0	0	0	0	0	0	0	0
Processing Losses	-380	-380	-380	-380	-380	-475	-475	-475	-475	-475
GROUNDWATER BASIN OVERFLOW	-635	-2,494	-3,418	-2,587	-1,386	-693	-693	-462	-122	0
NET OUTFLOW	-11,260	-12,247	-17,574	-11,984	-11,330	-14,597	-8,067	-10,468	-9,541	-9,047

NET SALT INFLOW (Tons)	598	742	-3,669	3	-373	-1,115	2,320	1,837	3,708	4,634
CUMULATIVE SALT INFLOW (Tons)*	47,520	48,262	44,593	44,596	44,223	43,108	45,428	47,265	50,973	55,607

TDS Concentration Calculations	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Net Basin Recharge (AF)	-528	11,593	9,192	-4,203	-9,722	-1,684	-7,906	-9,106	-4,973	-5,692
Basin Storage (HI Method)(AF)	232,677	244,270	253,462	249,259	239,537	237,853	229,947	220,841	215,868	210,176
Total Salt in Main Basin (tons)	177,118	177,860	174,191	174,194	173,821	172,706	175,026	176,863	180,571	185,205
Main Basin TDS Concentration (mg/L)	560	536	506	514	534	535	560	590	616	649
Cumulative Increase in TDS Conc (mg/L)**	110	86	56	64	84	85	110	140	166	199

* 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 2020 WATER YEARS

SALT INFLOW COMPONENTS	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NATURAL STREAM RECHARGE	3,356	3,665	5,743	2,544	4,376	4,331	4,639	5,704	3,727	3,409
Total Arroyo Valle	575	743	1,083	300	1,034	400	1,450	1,661	1,361	956
Flood releases recharge	98	0	528	0	472	336	183	524	0	55
Non Flood Natural Inflow	477	743	555	300	562	64	1,267	1,137	1,361	901
Arroyo Mocho	1,023	814	2,174	995	1,580	2,627	1,741	2,292	996	857
Arroyo Las Positas	1,758	2,108	2,486	1,249	1,762	1,304	1,448	1,751	1,370	1,596
AV PRIOR RIGHTS	290	151	276	321	306	87	93	188	149	175
ARTIFICIAL STREAM RECHARGE	1,590	410	1,953	2,795	1,026	491	1,325	500	1,352	2,276
Arroyo Valle	36	185	385	293	49	31	472	107	321	242
Arroyo Mocho	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
INJECTION WELL RECHARGE	0	0	0	0	0	0	0	204	497	498
RAINFALL RECHARGE	0	0	0	0	0	0	0	0	0	0
Lake Recharge	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
LEAKAGE	169	181	193	206	220	234	248	263	279	294
APPLIED WATER RECHARGE	6,918	5,793	5,109	4,989	3,323	4,071	4,887	4,367	3,479	4,314
SUBSURFACE BASIN INFLOW	3,423	3,199	2,710	2,221	2,017	1,875	1,386	1,651	1,528	1,846
NET INFLOW	15,746	13,399	15,984	13,076	11,268	11,089	12,578	12,877	11,011	12,812

OUTFLOW COMPONENTS	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
MUNICIPAL PUMPAGE	-11,014	-8,752	-6,072	-3,867	-2,681	-3,874	-5,192	-6,468	-6,101	-8,560
Zone 7 Wells - Hop, Stone, COL	-1,679	-1,185	-859	-85	-87	-754	-270	-475	-2,362	-2,553
Zone 7 Wells - Mocho	-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*
Other Pumpage	-6,023	-5,455	-4,604	-3,757	-2,469	-2,353	-4,240	-5,596	-3,572	-5,224
AGRICULTURAL PUMPAGE	-249	-236	-142	-130	-88	-130	-155	-47	-46	-188
MINING USE	-970	-1,007	-2,134	-4,928	-6,883	-7,507	-9,983	-9,588	-8,642	-5,792
Stream Export	-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
Processing Losses	-475	-475	-475	-475	-475	-466	-523	-504	-561	-475
GROUNDWATER BASIN OVERFLOW	0	0	0	0	-226	-968	-960	-998	-482	-175
NET OUTFLOW	-12,233	-9,995	-8,348	-8,925	-9,878	-12,479	-16,290	-17,101	-15,271	-14,715

NET SALT INFLOW (Tons)	3,513	3,404	7,636	4,151	1,390	-1,390	-3,712	-4,224	-4,260	-1,903
CUMULATIVE SALT INFLOW (Tons)*	59,120	62,524	70,160	74,311	75,701	74,311	70,599	66,375	62,115	60,212

TDS Concentration Calculations	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Net Basin Recharge (AF)	-8,389	-6,628	14,974	592	13,031	1,873	-1,390	2,511	-4,911	-3,674
Basin Storage (HI Method)(AF)	201,787	195,159	210,133	210,725	223,756	225,629	224,239	226,750	221,839	218,165
Total Salt in Main Basin (tons)	188,718	192,122	199,758	203,909	205,299	203,909	200,197	195,973	191,713	189,810
Main Basin TDS Concentration (mg/L)	688	725	700	712	675	665	657	636	636	640
Cumulative Increase in TDS Conc (mg/L)**	238	275	250	262	225	215	207	186	186	190

* 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 2020 WATER YEARS

SALT INFLOW COMPONENTS	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
NATURAL STREAM RECHARGE	**3,666**	**3,267**	**7,097**	**3,105**	**5,796**	**4,962**	**3,260**	**4,078**	**4,367**	**5,080**
Total Arroyo Valle	**1,823**	**1,399**	**2,833**	**1,081**	**3,652**	**2,274**	**1,450**	**2,691**	**2,554**	**2,974**
Flood releases recharge	0	193	302	0	731	0	0	327	0	1,383
Non Flood Natural Inflow	1,823	1,206	2,531	1,081	2,921	2,274	1,450	2,364	2,554	1,591
Arroyo Mocho	**575**	**886**	**2,996**	**838**	**1,241**	**1,813**	**839**	**380**	**540**	**1,211**
Arroyo Las Positas	**1,268**	**982**	**1,268**	**1,186**	**903**	**875**	**971**	**1,007**	**1,273**	**895**
AV PRIOR RIGHTS	**224**	**399**	**416**	**383**	**80**	**524**	**219**	**100**	**407**	**0**
ARTIFICIAL STREAM RECHARGE	**1,351**	**3,503**	**2,811**	**2,480**	**1,949**	**1,266**	**1,359**	**727**	**1,248**	**1,690**
Arroyo Valle	501	647	399	476	619	330	782	727	686	635
Arroyo Mocho	839	2,855	2,412	2,004	1,300	914	577	0	562	1,055
Arroyo Las Positas	11	1	0	0	30	22	0	0	0	0
INJECTION WELL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
RAINFALL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lake Recharge	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
LEAKAGE	**313**	**333**	**352**	**372**	**393**	**414**	**436**	**458**	**481**	**504**
APPLIED WATER RECHARGE	**5,074**	**5,606**	**4,618**	**5,090**	**4,824**	**3,223**	**5,157**	**6,258**	**6,152**	**5,079**
SUBSURFACE BASIN INFLOW	**1,970**	**1,970**	**1,970**	**1,970**	**2,513**	**2,309**	**2,174**	**2,214**	**2,106**	**1,997**
NET INFLOW	**12,598**	**15,078**	**17,264**	**13,400**	**15,555**	**12,698**	**12,605**	**13,835**	**14,761**	**14,350**

OUTFLOW COMPONENTS	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
MUNICIPAL PUMPAGE	**-10,467**	**-12,061**	**-11,096**	**-12,419**	**-10,057**	**-5,557**	**-8,423**	**-9,271**	**-14,577**	**-12,609**
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**
Zone 7 Wells - Mocho	**-1,745**	**-3,322**	**-2,271**	**-3,762**	**-3,003**	**-1,170**	**-1,976**	**-1,402**	**-5,448**	**-6,563**
Demin Salts Exported from Valley	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*-798*	*2,759*
Other Pumpage	**-4,855**	**-5,049**	**-5,465**	**-4,459**	**-5,196**	**-3,005**	**-5,107**	**-4,651**	**-5,208**	**-4,756**
AGRICULTURAL PUMPAGE	**-182**	**-94**	**-73**	**-79**	**-80**	**-46**	**-43**	**-68**	**-68**	**-73**
MINING USE	**-4,520**	**-475**	**-276**	**-438**	**-454**	**-658**	**-584**	**-714**	**-1,341**	**-1,428**
Stream Export	-4,006	-111	0	-84	-94	-218	-274	-305	-913	-1,057
Evaporation	0	0	0	0	0	0	0	0	0	0
Processing Losses	-514	-364	-276	-354	-360	-440	-310	-409	-428	-371
GROUNDWATER BASIN OVERFLOW	**0**	**0**	**0**	**0**	**0**	**0**	**-738**	**-1,080**	**-171**	**0**
NET OUTFLOW	**-15,169**	**-12,630**	**-11,445**	**-12,936**	**-10,591**	**-6,261**	**-9,788**	**-11,133**	**-16,157**	**-14,110**

NET SALT INFLOW (Tons)	**-2,571**	**2,448**	**5,819**	**464**	**4,964**	**6,437**	**2,817**	**2,702**	**-1,396**	**240**
CUMULATIVE SALT INFLOW (Tons)*	**57,641**	**60,089**	**65,908**	**66,372**	**71,336**	**77,773**	**80,590**	**83,292**	**81,896**	**82,136**

TDS Concentration Calculations	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Net Basin Recharge (AF)	-11,666	62	8,309	-4,560	13,193	8,790	-3,639	-3,011	-4,997	4,290
Basin Storage (HI Method)(AF)	206,499	206,561	214,870	210,310	223,503	232,293	228,654	225,643	220,646	224,936
Total Salt in Main Basin (tons)	187,239	189,687	195,506	195,970	200,934	207,371	210,188	212,890	211,494	211,734
Main Basin TDS Concentration (mg/L)	**667**	**676**	**670**	**686**	**662**	**657**	**677**	**695**	**706**	**693**
Cumulative Increase in TDS Conc (mg/L)**	**217**	**226**	**220**	**236**	**212**	**207**	**227**	**245**	**256**	**243**

* 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 2020 WATER YEARS

SALT INFLOW COMPONENTS	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	AVG	TOTAL
NATURAL STREAM RECHARGE	**5,459**	**2,026**	**2,242**	**1,820**	**3,735**	**3,366**	**4,948**	**1,315**	**3,531**	**1,952**	**3,654**	**171,744**
Total Arroyo Valle	**3,039**	**553**	**963**	**356**	**1,664**	**1,620**	**2,392**	**249**	**1,185**	**285**	**1,190**	**55,953**
Flood releases recharge	150	0	0	0	0	0	404	0	-53	0	165	7,751
Non Flood Natural Inflow	2,889	553	963	356	1,664	1,620	1,988	249	1,238	285	1,026	48,202
Arroyo Mocho	**2,056**	**949**	**751**	**973**	**1,472**	**945**	**1,882**	**430**	**1,648**	**834**	**1,335**	**62,735**
Arroyo Las Positas	**364**	**524**	**528**	**491**	**599**	**801**	**674**	**636**	**698**	**833**	**1,129**	**53,056**
AV PRIOR RIGHTS	**384**	**196**	**409**	**3**	**395**	**288**	**91**	**208**	**249**	**249**	**261**	**12,290**
ARTIFICIAL STREAM RECHARGE	**882**	**2,851**	**2,519**	**1,483**	**1,689**	**2,571**	**2,046**	**1,494**	**558**	**675**	**1,598**	**75,100**
Arroyo Valle	167	1,178	573	339	1,667	1,299	667	924	442	556	541	25,419
Arroyo Mocho	698	1,649	1,943	1,120	0	1,272	1,379	570	116	119	981	46,129
Arroyo Las Positas	17	24	3	24	22	0	0	0	0	0	76	3,552
INJECTION WELL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**26**	**1,199**
RAINFALL RECHARGE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Lake Recharge	*0*	*0*	*0*	*1,603*	*2,736*	*3,641*	*6,743*	*8,295*	*6,864*	*3,979*	*720*	*33,861*
LEAKAGE	**527**	**551**	**403**	**600**	**625**	**651**	**677**	**703**	**778**	**821**	**299**	**14,038**
APPLIED WATER RECHARGE	**4,295**	**6,074**	**8,158**	**5,654**	**6,505**	**5,251**	**4,421**	**5,707**	**5,625**	**6,588**	**5,801**	**272,629**
SUBSURFACE BASIN INFLOW	**2,024**	**2,092**	**448**	**1,834**	**2,051**	**2,078**	**2,106**	**2,078**	**2,187**	**2,201**	**1,999**	**93,959**
NET INFLOW	**13,571**	**13,790**	**14,179**	**11,394**	**15,000**	**14,205**	**14,289**	**11,505**	**12,928**	**12,486**	**13,637**	**640,959**

OUTFLOW COMPONENTS	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	AVERAGE	TOTAL
MUNICIPAL PUMPAGE	**-9,873**	**-16,765**	**-12,781**	**-11,831**	**-6,080**	**-6,194**	**-7,635**	**-8,700**	**-10,427**	**-12,388**	**-10,163**	**-339,102**
Zone 7 Wells - Hop, Stone, COL	**-1,197**	**-2,785**	**-3,595**	**-2,639**	**-870**	**-750**	**-1,107**	**-1,938**	**-1,982**	**-4,441**	**-2,470**	**-54,340**
Zone 7 Wells - Mocho	**-4,040**	**-8,204**	**-3,997**	**-3,713**	**-1,080**	**-666**	**-2,200**	**-2,642**	**-4,895**	**-4,890**	**-3,072**	**-67,576**
Demin Salts Exported from Valley	*2,006*	*4,064*	*2,479*	*1,047*	*76*	*183*	*949*	*1,168*	*1,869*	*1,231*	*362*	*17,033*
Other Pumpage	**-4,625**	**-5,766**	**-5,179**	**-5,583**	**-4,128**	**-4,779**	**-4,326**	**-4,120**	**-3,549**	**-3,057**	**-4,621**	**-217,186**
AGRICULTURAL PUMPAGE	**-68**	**-77**	**-393**	**-515**	**-490**	**-92**	**-84**	**-87**	**-101**	**-97**	**-666**	**-31,295**
MINING USE	**-2,756**	**-3,064**	**-3,042**	**-502**	**-417**	**-378**	**-364**	**-388**	**-368**	**-363**	**-3,412**	**-160,375**
Stream Export	-2,368	-2,665	-2,655	-442	0	0	0	0	0	0	-2,211	-103,914
Evaporation	0	0	0	0	0	0	0	0	0	0	0	0
Processing Losses	-388	-399	-387	-364	-417	-378	-364	-388	-372	-363	-415	-19,485
GROUNDWATER BASIN OVERFLOW	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-506**	**-758**	**-113**	**-435**	**-20,450**
NET OUTFLOW	**-12,697**	**-19,906**	**-16,216**	**-12,848**	**-6,987**	**-6,664**	**-8,083**	**-9,681**	**-11,654**	**-12,961**	**-11,557**	**-543,173**

NET SALT INFLOW (Tons)	**874**	**-6,116**	**-2,037**	**-1,454**	**8,013**	**7,541**	**6,206**	**1,824**	**1,274**	**-475**	**2,081**	**97,786**
CUMULATIVE SALT INFLOW (Tons)*	**83,010**	**76,894**	**74,857**	**73,403**	**81,416**	**88,957**	**95,163**	**96,987**	**98,261**	**97,786**		

TDS Concentration Calculations	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Net Basin Recharge (AF)	6,893	-10,438	-5,542	-12,153	6,037	15,405	25,259	285	4,482	-7,932
Basin Storage (HI Method)(AF)	231,829	221,391	215,849	203,696	209,733	225,138	250,397	250,682	255,164	247,232
Total Salt in Main Basin (tons)	212,608	206,492	204,455	203,001	211,014	218,555	224,761	226,585	227,859	227,384
Main Basin TDS Concentration (mg/L)	**675**	**687**	**697**	**734**	**741**	**715**	**661**	**665**	**657**	**677**
Cumulative Increase in TDS Conc (mg/L)**	**225**	**237**	**247**	**284**	**291**	**265**	**211**	**215**	**207**	**227**

* Basinwide salt buildup since 1973

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

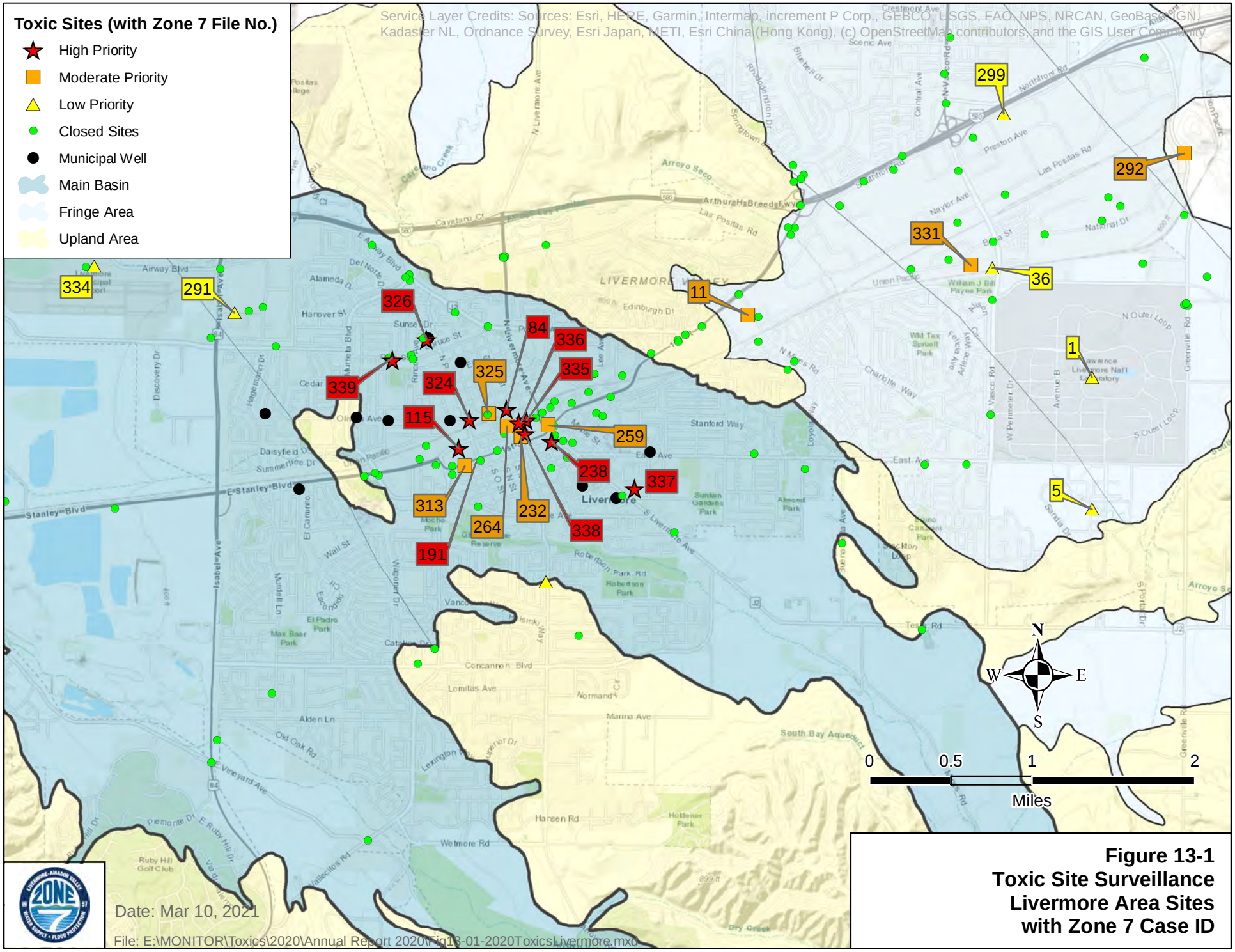


Figure 13-1
Toxic Site Surveillance
Livermore Area Sites
with Zone 7 Case ID

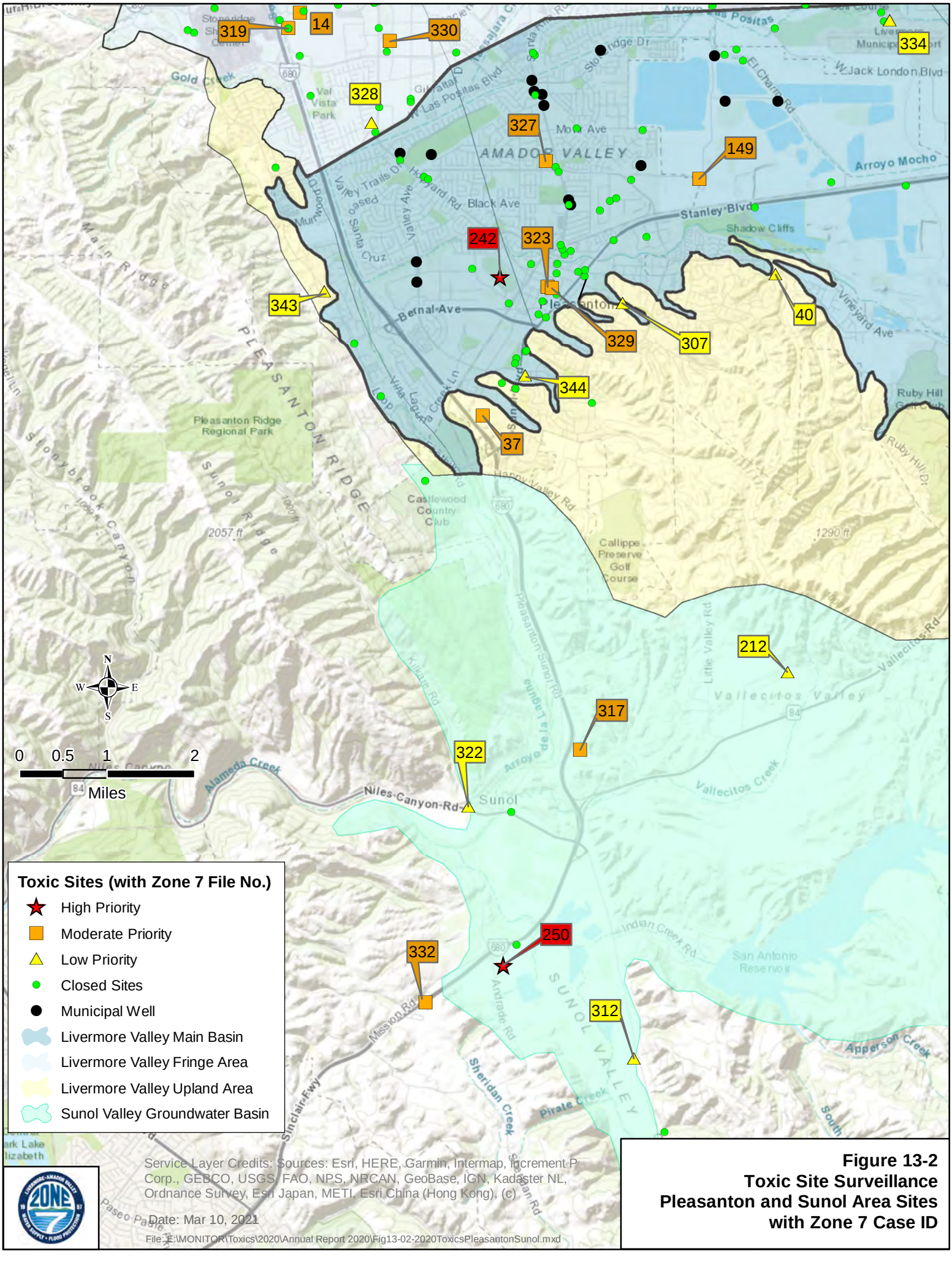
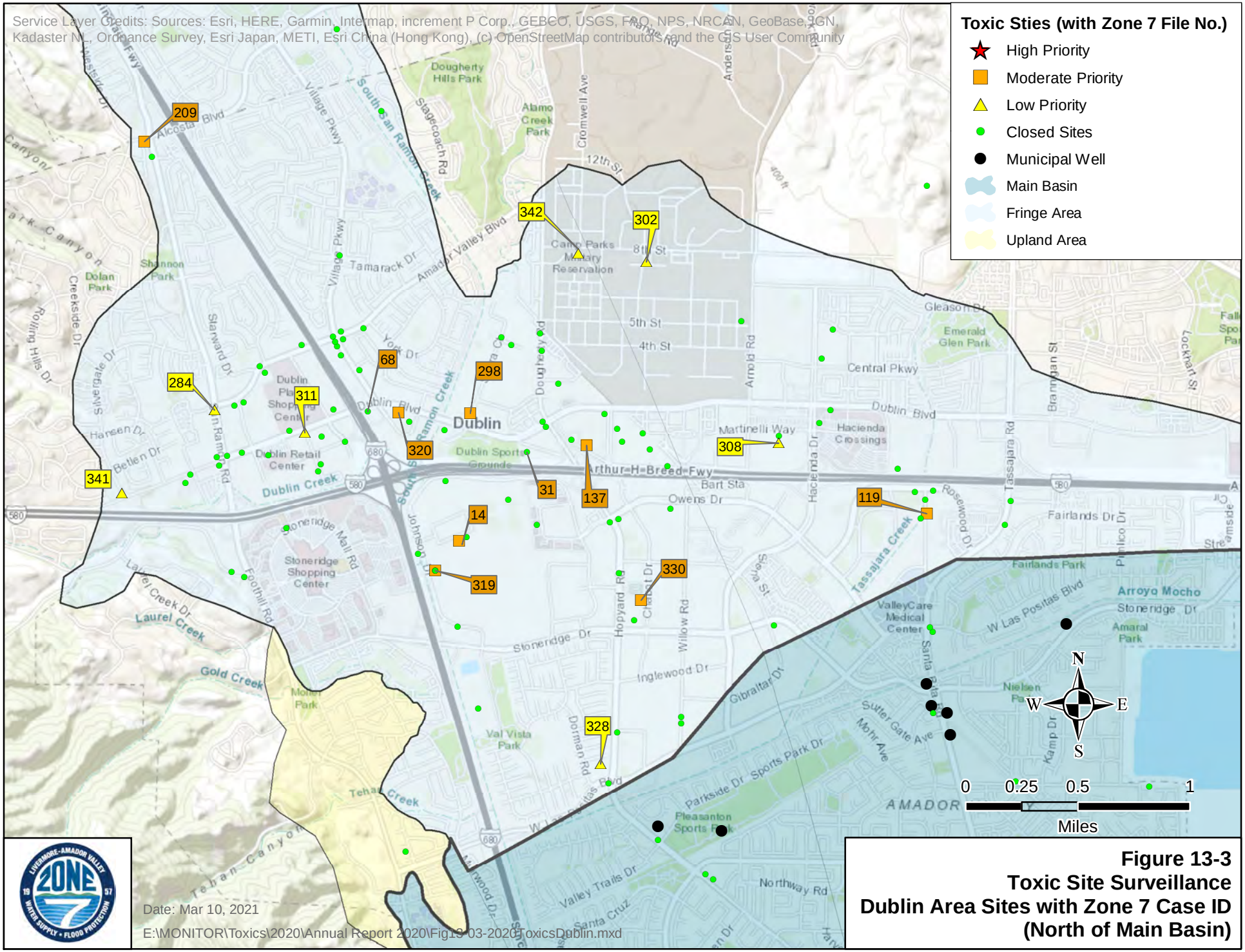


Figure 13-2
Toxic Site Surveillance
Pleasanton and Sunol Area Sites
with Zone 7 Case ID



Date: Mar 10, 2021

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

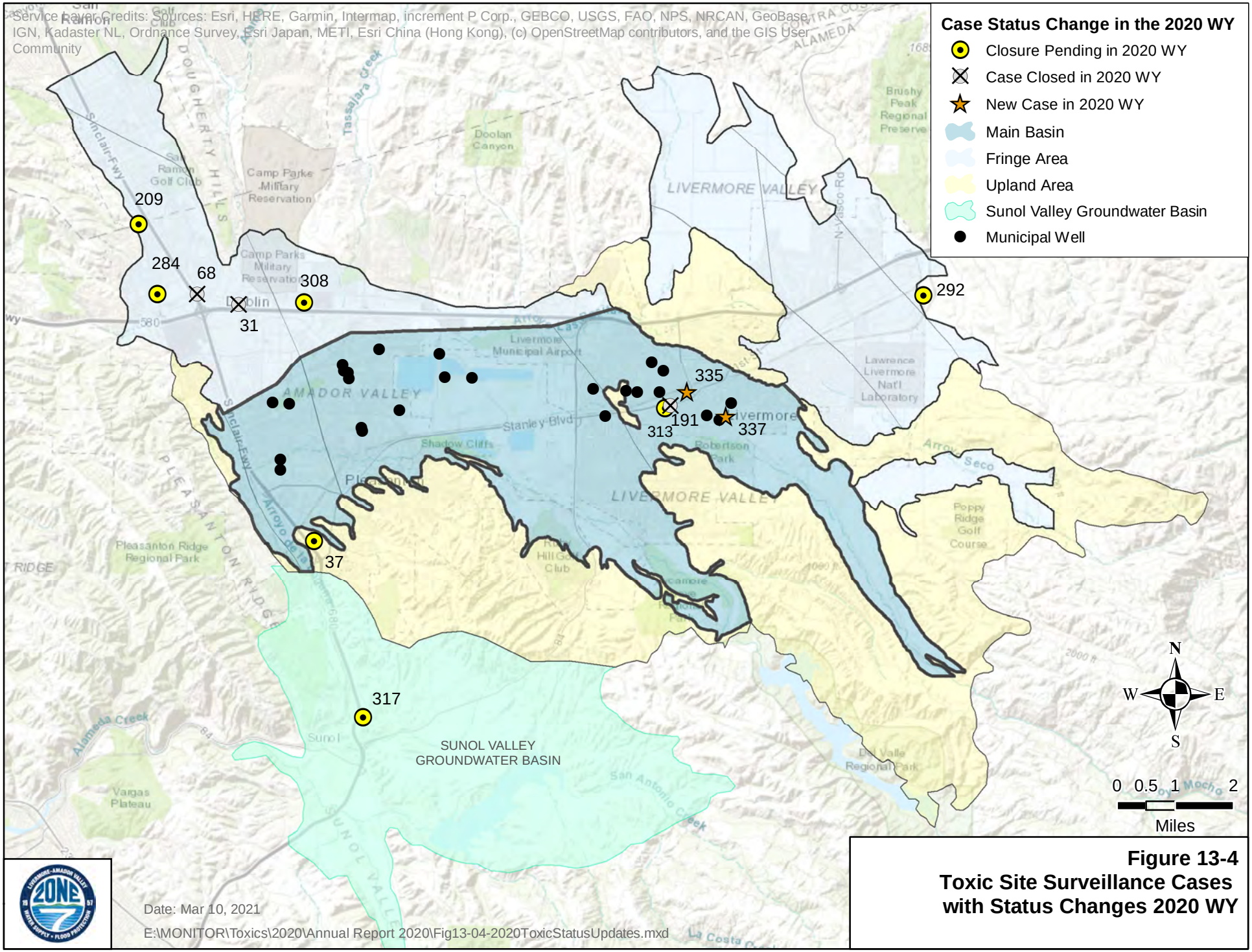
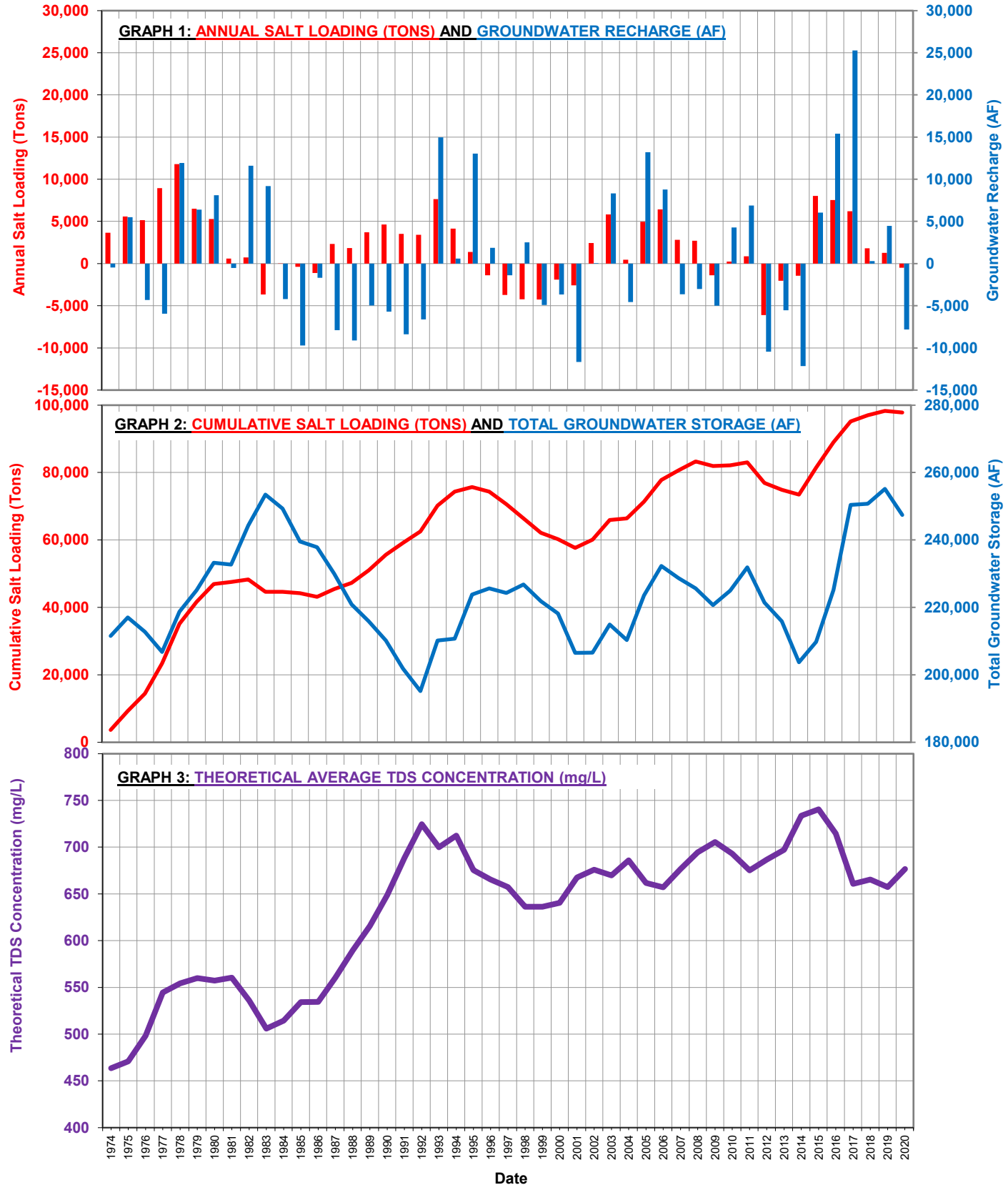


Figure 13-4
Toxic Site Surveillance Cases with Status Changes 2020 WY

FIGURE 13-5
MAIN BASIN SALT LOADING AND TDS CONCENTRATION
1974 to 2020 WATER YEARS



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