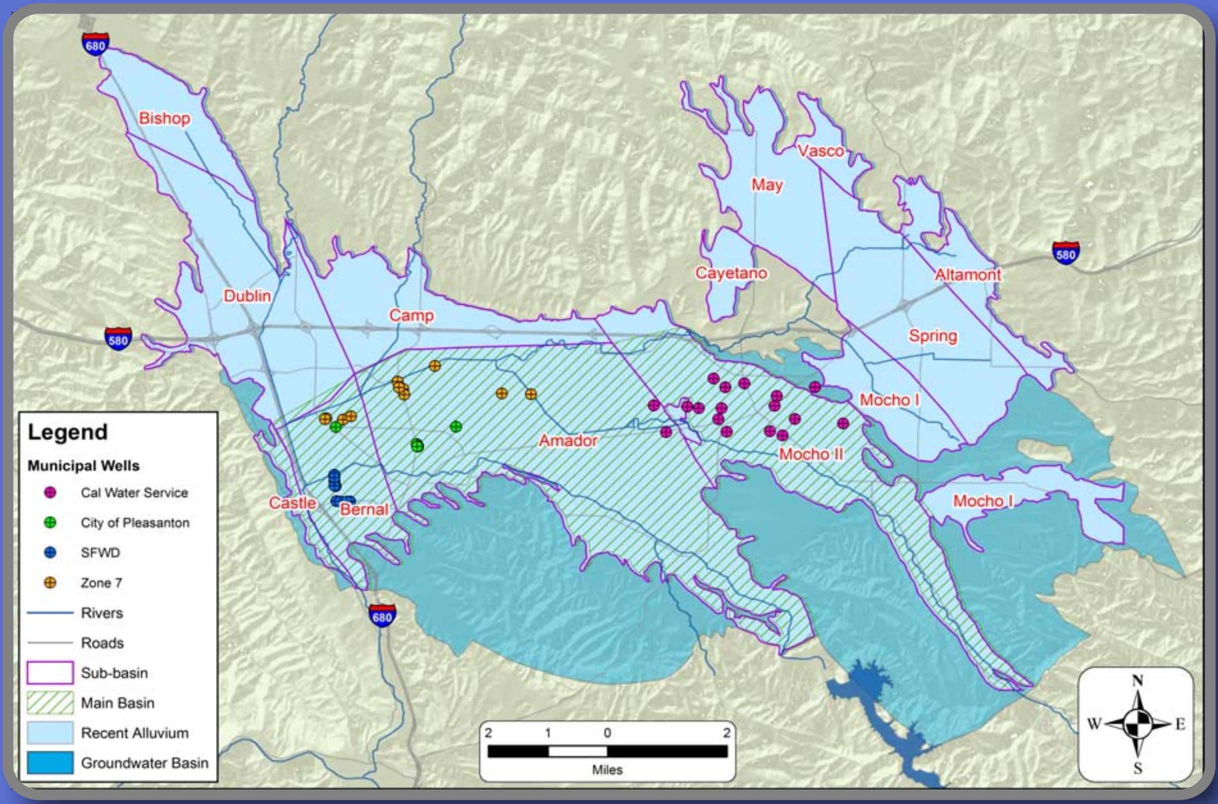
Annual Report for the

Groundwater Management Program

2013 Water Year

(October 2012 through September 2013)

Livermore Valley Groundwater Basin



August 2014

Zone 7 Water Agency

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Livermore Valley Groundwater Basin

ZONE 7 WATER AGENCY

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Acronyms and Abbreviations

Abbrev	Description	Abbrev	Description
µg/L	Micro grams per liter	GWE	Groundwater Elevation
ACEH	Alameda County Environmental Health	HI	Hydrologic Inventory
ACWD	Alameda County Water District	LAVWMA	Livermore-Amador Valley Water Management Agency
ADLLV	Arroyo De La Laguna at Verona	LDV	Lake Del Valle
ADVP	Arroyo Del Valle Pleasanton	LOP	Local Oversight Program
ALP	Arroyo Las Positas	LWRP	Livermore Water Reclamation Plant
ALP_ELCH	Arroyo Las Positas at El Charro	M&I	Municipal and Industrial
ALPL	Arroyo Las Positas near Livermore	MCL	Maximum contaminant level
AMHAG	Arroyo Mocho Hageman	mg/L	Milligrams per liter
AM_KB	Arroyo Mocho at Kaiser Bridge	MGDP	Mocho Groundwater Demineralization Plant
AMNL	Arroyo Mocho near Livermore	MND	Mitigated negative declaration
AMP	Arroyo Mocho Pleasanton	msl	Mean sea level
AVBLC	Arroyo Valle below Lang Canyon	MTBE	Methyl tertiary-butyl ether
AVNL	Arroyo Valle near Livemore	NMP	Nutrient Management Plan
AF	Acre-feet	NPDES	National Pollutant Discharge Elimination System
AF/yr	Acre-feet per year	PCE	Tetrachlorethylene
ALP	Arroyo Las Positas	ppb	Parts per billion
bgs	Below ground surface	PPWTP	Patterson Pass Water Treatment Plant
BMOs	Basin management objectives	RO	Reverse osmosis
BTEX	Benzene, toluene, ethylbenzene, xylene	ROWD	Request of Waste Discharge
CASGEM	California Statewide Groundwater Elevation Monitoring	RWQCB	California Regional Water Quality Control Board
CDPH	California Department of Health Services	SBA	South Bay Aqueduct
CEC	Constituents-of-emerging-concern	SCADA	Supervisory Control and Data Aquisition
CIMIS	California Irrigation Management System	SCS	Soil Conservation Service
COL	Chain of Lakes	SFPUC	San Francisco Public Utilities Commission
CEQA	California Environmental Quality Act	SFEI	San Francisco Estuary Institute
cfs	Cubic feet per second	SMP	Salt Management Plan
CIP	Capital Improvement Program	SNMP	Salt Nutrient Management Plan
CWS	California Water Service	SWP	State Water Project
CY	Calendar year	SWRCB	State Water Resources Control Board
DCE	Dichloroethene	TAF	Thousand acre-feet
DSRSD	Dublin San Ramon Services District	TBA	Tertiary-butyl alcohol
DVWTP	Del Valle Water Treatment Plant	TCE	Trichloroethylene
DWR	California Department of Water Resources	TDS	Total dissolved solids
EBRPD	East Bay Regional Parks District	TKN	Total Kjeldahl nitrogen
EIR	Environmental Impact Report	TPHd	Total petroleum hydrocarbons as diesel
ETo	Evapotranspiration	TPHg	Total petroleum hydrocarbons as gasoline
ft	Feet	USGS	U.S. Geological Survey
GAC	Granulated Activated Carbon	VA	Veteran's Administration
GIS	Geographic information systems	VC	Vinyl chloride
GPD	Gallons per day	WMP	Well Master Plan
GPQ	Groundwater Pumping Quota	WWMP	Wastewater Management Plan
GWMP	Groundwater Management Plan	WY	Water year

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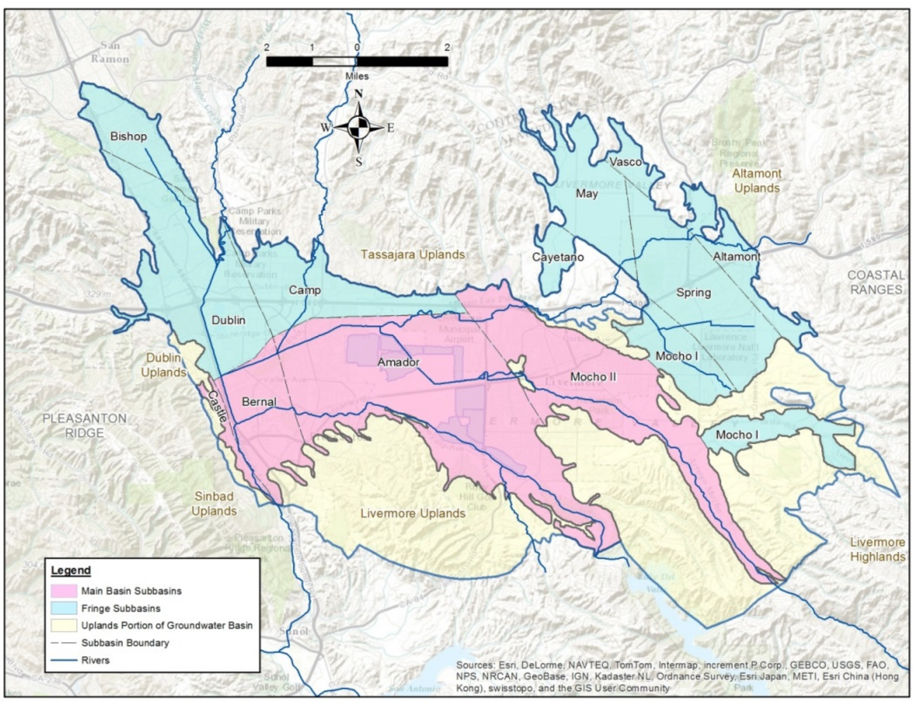
1 Introduction

1.1 Background

The Livermore Valley Groundwater Basin is an inland alluvial basin underlying the east-west trending Livermore-Amador Valley (Valley) in northeastern Alameda County. The Valley covers about 42,000 acres, extends approximately 14 miles in an east-west direction, and varies from three to six miles in width. It is surrounded primarily by north-south trending faults and hills of the Diablo Range. The Livermore Valley Groundwater Basin is located in the heart of the Valley and extends south into the hills south of Pleasanton and Livermore. The Main Basin (shown below in *Figure 1.1-A*) is a portion of the Livermore Valley Groundwater Basin that contains the highest yielding aquifers and generally the best quality groundwater. Groundwater flow is generally from southeast and east to the west, towards the municipal wellfields in the central western area of the basin.

Figure 1.1-A: Map of Livermore Valley Groundwater Basin



1.1.1 Groundwater Management Planning Act Requirements

Figure 1.1-B shows Groundwater Management Planning Act requirement and where it was addressed in the original 2005 Groundwater Management Plan (GMP) and where the updated information, if any, can be located in the Annual Report for the 2013 Water Year (October 2012 through September 2013).

Figure 1.1-B: Groundwater Management Planning Act Requirements

Water Code Reference	Requirement	Location in 2005 GMP	Location of update in 2013 Water Year Annual Report
§10753.7(a)(3)	Description of groundwater area to be managed		
	Map	Figures 1-1 and 2-1	*Figure ES-1* and *Figure 1.1-A*
	Description	Overview located in Chapter 1; also see Section 3.1.1.	Section 1.2
§10753.7(a)(1)	Basin Management Objectives	Included in Section 1.4	Section 1.1.2
§10753.7(a)(2)	Plan to involve other agencies and the public	Included in Section 4.3	No update
§10753.7(a)(4)	Monitoring protocols	Sections 3.2, 3.3, and 4.5	Chapter 2
§10753.8	Plan components		
	Control of saline water intrusion	Sections 4.6.5 and 5.1.2	Section 3.3.1
	Identification and management of wellhead protection areas and recharge areas	Sections 3.3, 5.1.4.2, and 5.1.4.4	Sections 3.1.2.2 and 3.3.3
	Regulation of the migration of contaminated groundwater	Sections 3.5 and 5.1.4.5	Sections 2.4.3 and 3.3.3.2
	Administration of a well abandonment and well destruction program	Section 5.1.4.2	Section 3.3.3.1
	Mitigation of conditions of overdraft	Sections 3.2, 3.3, 4.6.2, and 4.6.3	Sections 2.4.2 and 3.1.2
	Replenishment of groundwater extracted by water producers	Sections 3.3, 4.5.7, 4.6.2, and 4.6.3	Sections 3.1.2 and 3.2.2
	Monitoring of groundwater levels and storage	Section 4.5.2	Section 2.4.2 and 3.1
	Facilitating conjunctive use operations	Section 5.1.3	Section 3.2.4

Water Code Reference	Requirement	Location in 2005 GMP	Location of update in 2013 Water Year Annual Report
	Identification of well construction policies	Section 5.1.4.2	Section 3.3.3.1
	Construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling and extraction projects	Section 5.1.4	Section 3.3.3
	Development of relationships with state and federal regulatory agencies	Section 4.4	No update
	Review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination	Section 4.5	Section 2.7
§10753.2	Details of Public Hearing(s) and Plan Adoption	Section 5.3	No update

1.1.2 Groundwater Management Objectives

The primary groundwater Basin Management Objectives (BMOs) of Zone 7 are to provide for the control and conservation of waters for beneficial future uses, the conjunctive use of groundwater and surface water, the importation of additional surface water, and the use of the groundwater basin to provide water storage for imported surface water used during drought periods.

The primary BMOs implemented by Zone 7 include:

- Monitoring and maintenance of groundwater levels through conjunctive use and management of regional water supplies:
  - Maintain water levels high enough to provide emergency reserves adequate for worst credible drought and unplanned import outages,
  - allow for gravel mining by optimizing groundwater levels to allow for gravel mining while maintaining adequate reserves for municipal supply, and
  - prevent overdraft that would otherwise occur from too much pumping (maintain total pumping at or below sustainable/safe yields);

- Groundwater quality—monitoring and management, as well as tracking and addressing any degradation:

  - Maintain or improve groundwater quality to achieve Regional Water Quality Control Board's Basin Plan Objectives for groundwater (*California Regional Water Quality Control Board, San Francisco Bay Region 2011*),
  - protect and enhance the quality of the groundwater, halt degradation from salt buildup,
  - offset impacts of water recycling and wastewater disposal through integrated Salt Management Plan (SMP), recharge with relatively low total dissolved solids (TDS)/hardness imported or storm/local surface water,
  - manage quality on a regional basis as measured at municipal wells (such as those operated by both the retail water agencies and Zone 7), protecting and improving groundwater quality within the Main Basin (as described in Chapter 3), and
  - minimize threats of groundwater pollution through groundwater protection;

- Monitor and prevent inelastic land surface subsidence from occurring as result of groundwater withdrawals:
  - maintain water levels above historic lows, and
  - monitor benchmark elevations and shift pumping to other wells if inelastic subsidence is detected;

1.2 Hydrogeologic Setting

This section provides a brief summary of the hydrogeologic setting of the Livermore Valley Groundwater Basin. A more detailed description can be found in Zone 7's Groundwater Management Plan (*Zone 7, 2005a*).

1.2.1 Geology

The Valley and portions of the surrounding uplands overlie groundwater-bearing materials. These materials consist of deposits from alluvial fans, streams, and lakes (of Pleistocene-Holocene age; less than about 1.6 million years old) that range in thickness from a few feet along the margins to nearly 800 feet (ft) in the west-central portion (*Figure 1-1*). The alluvium consists of unconsolidated gravel, sand, silt, and clay. The southeastern region of the Valley is the most important groundwater recharge area and consists mainly of sand and gravel that was deposited by the ancestral and present Arroyo Valle and Arroyo Mocho.

The Livermore Formation (Pleistocene age; 11,000 to 1.6 million years old), found below the majority of the alluvium in the groundwater basin, consists of beds of clayey gravels and sands, silts, and clays that are unconsolidated to semi-consolidated. However, the contact between the overlying alluvium and the Livermore Formation is nearly impossible to discern from drill cuttings and electrical logs. This formation is estimated to be 4,000 ft thick in the southern and western portion of the basin. These sediments display lower yields in the upland areas.

The Tassajara and Green Valley Formations, located in the Tassajara Uplands north of the Valley, are roughly Pliocene in age (1.6 to 5.3 million years old). They basically consist of sandstone, tuffaceous sandstone/siltstone, conglomerate, shale, and limestone. Water movement from these formations to the alluvium of the fringe and Main Basins is minimized by faults and angular unconformities or by stratigraphic disconformities along the formation-alluvium contacts.

The lateral movement of groundwater is restricted by the presence of geologic structures which create boundaries. These include: the Parks Boundary (which was initially considered to be fault-related, but may be a depositional boundary between recent alluvium and older material), as well as, the Livermore, Pleasanton, Calaveras, and Greenville faults.

1.2.2 Main Basin and Sub-Basins

The Main Basin is comprised of the Castle, Bernal, Amador and Mocho II Subbasins (shown above on *Figure 1.1-A*). It is bounded on the:

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

The Main Basin is connected primarily to the fringe areas through the shallow alluvium. Subsurface inflow into the deeper portions of the Main Basin from the fringe subbasins is considered to be minor. The deeper aquifers of the Main Basin are primarily recharged through vertical migration of groundwater within the Main Basin itself. The Main Basin aquifers have the highest transmissivity. All of the Valley's municipal supply wells are completed in Main Basin aquifers.

1.2.3 Aquifer Zones

Although multiple aquifers have been identified in the Main Basin alluvium, wells have been classified generally as being in one of two aquifer zones, separated by a relatively continuous silty clay aquitard up to about 50 ft thick:

1.2.3.1 Upper Aquifer Zone

The upper aquifer zone consists of alluvial materials, including primarily sandy gravel and sandy clayey gravels. These gravels are usually encountered underneath a confining surficial clay layer typically 5 to 70 ft below ground surface [bgs] in the west and exposed at the surface in the east. The overburden thicknesses have been contoured and are shown on *Figure 1-2* along with the limits of the confining layer and the main recharge area of the Main Basin. The base of the upper aquifer zone is at about 80 to 150 ft bgs. 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.

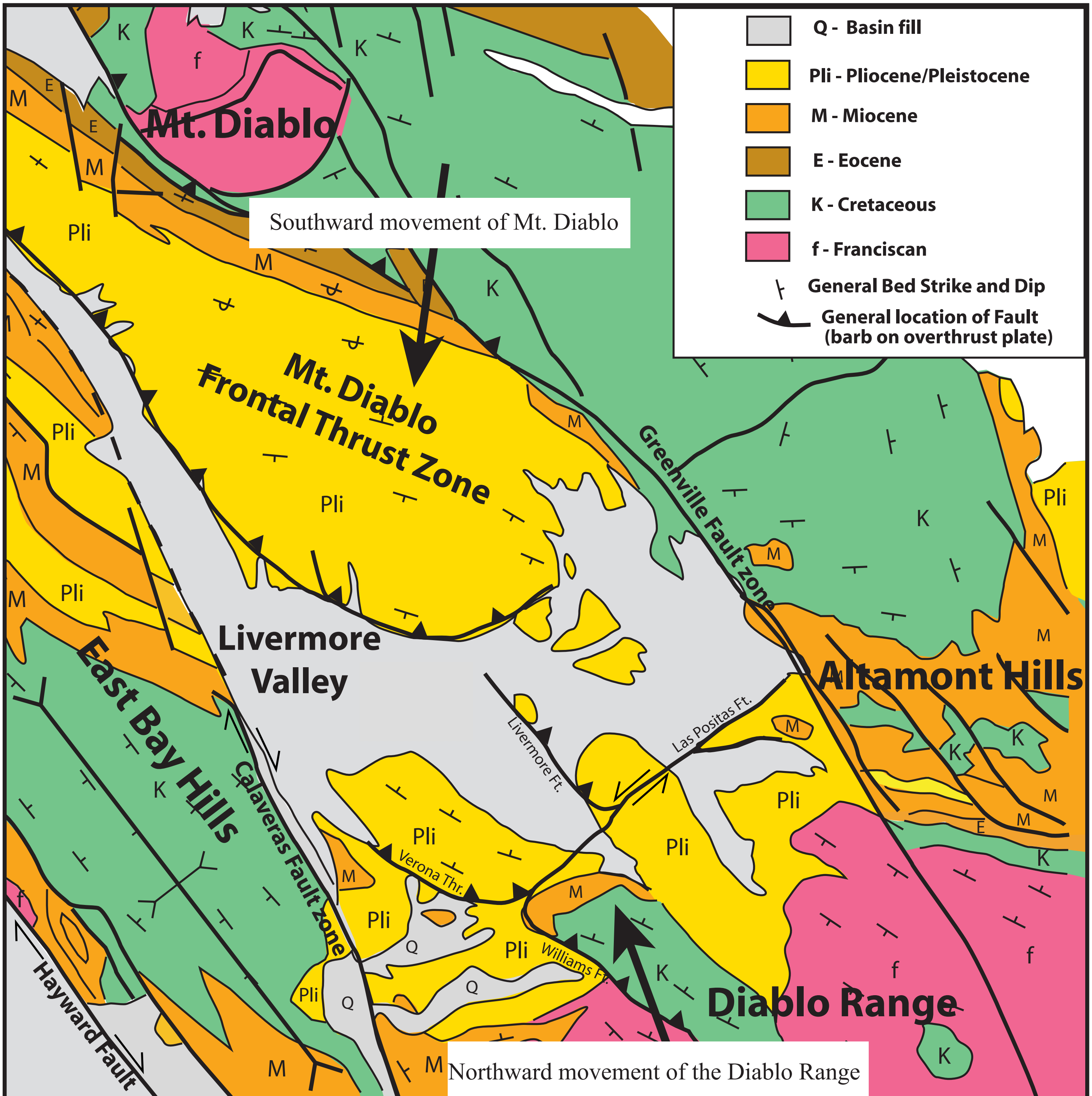
1.2.3.2 Lower Aquifer Zone

All sediments encountered below the clay aquitard in the center portion of the basin have been known collectively as the Lower Aquifer Zone. The aquifer materials consist of semi-confined to confined, coarse-grained, water-bearing units interbedded with relatively low permeability, fine-grained units. It is believed that the Lower Aquifer Zone derives most of its water from the Upper Aquifer Zone through the leaky aquitard(s) when groundwater heads in the upper zone are greater than those in the lower zone.

1.2.4 Groundwater Quality

In the western Main Basin, groundwater is a calcium-magnesium-bicarbonate water type and has historically been considered “hard.” The rising salinity is associated with several factors but is primarily associated with the shallow saline groundwater flowing into the basin or flowing into recharging streams from adjacent fringe basins. Imported water brings additional salts into the basin some of which are left in the soil as evapotranspiration occurs (subsequent leaching with rain or further application of irrigation water transports salts to the groundwater table). Increased salinity attributable to irrigation in a semi-arid region is another major issue.

The northern extent of the Livermore-Amador Valley 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 Livermore area, has magnesium as the predominant cation.



Approximate Scale: 1" = 6 miles

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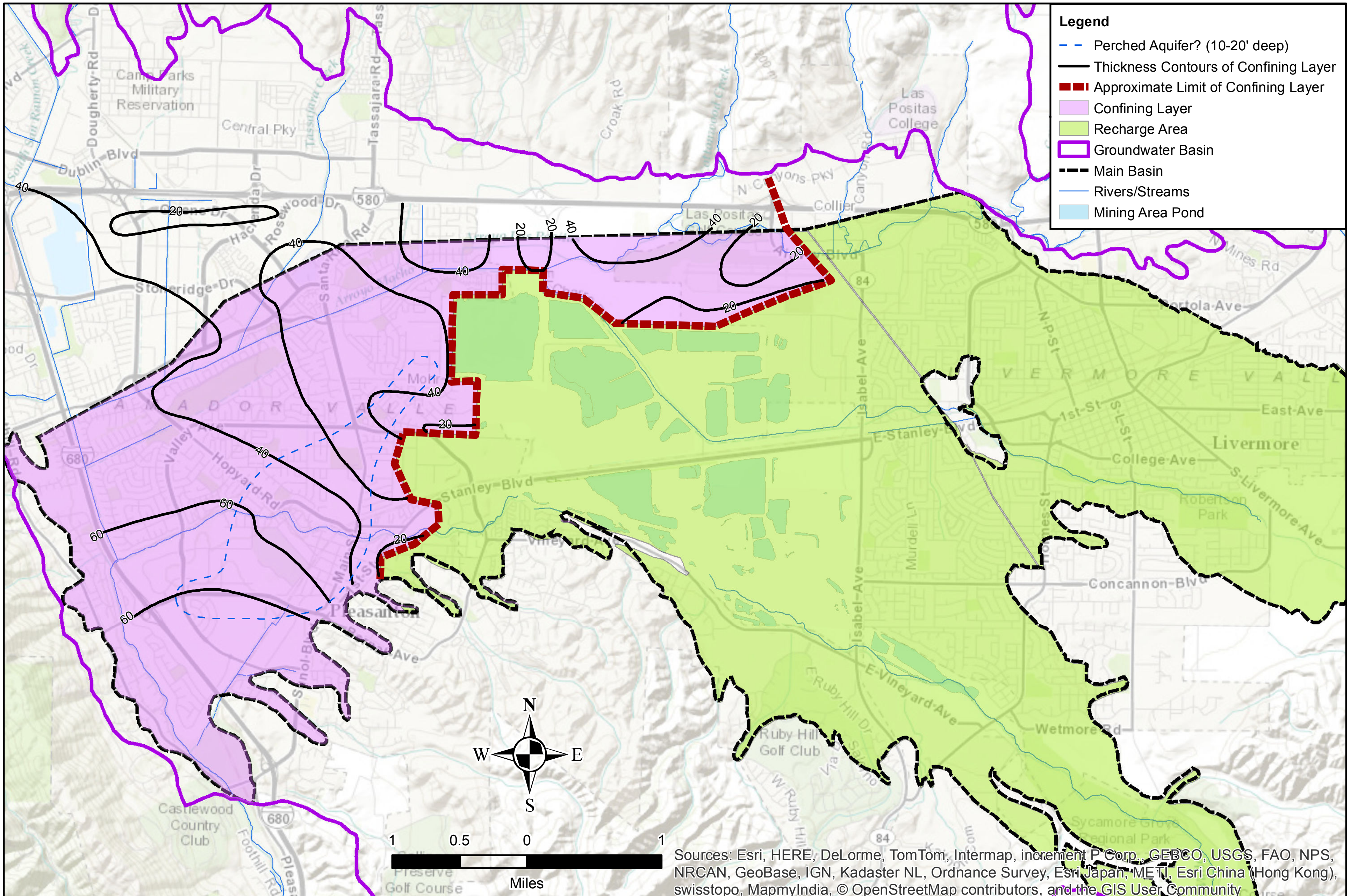
A generalized geologic/ tectonic map of the greater Livermore Valley area. The current Livermore Valley is the result of the deformation of the Proto-Livermore Basin between the southward movement of the Mt. Diablo thrusts and the northward component of movement of the Diablo Range, south of the valley. There has been minor deformation of the Valley adjacent to the Calaveras and Greenville fault zones.

Norfleet Consultants	Generalized Geologic/Tectonic Map of the Livermore Valley		
	Preliminary Stratigraphic Evaluation, Main Basin		
	PROJ NO: 031616	DATE: 1/15/04	FIGURE: 3-1 (orig)

Figure 1-1



ZONE 7 WATER AGENCY
100 North Canyons Parkway, Livermore, CA

DRAWN: TR/CW

REVIEWED: MK

Scale: 1" = 1 Mile

Date: July 28, 2014

File: P:\GWS\Programs\GWMP\2013AnnRpt\Figures\Fig1-2-ThickClayOverburden.mxd

Figure 1-2
Recharge Area and Confining Layer Above Upper Aquifer