ZONE 7 BOARD OF DIRECTORS
Water Resources Committee
Wednesday, November 5, 2014
4:00 p.m.

Location: Boardroom
Zone 7 Administration Building
100 North Canyons Parkway
Livermore, CA 94551

Director Greci
Director McGrail
Director Stevens

A G E N D A

1. Public Comment on Items Not on Agenda

2. Draft Nutrient Management Plan

3. Status Update on Draft Well Ordinance and Proposed Permit Fees

4. Verbal Comments

5. Adjournment

10/31/14

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, ZONE 7
100 NORTH CANYONS PARKWAY • LIVERMORE, CA 94551 • PHONE (925) 454-5000 • FAX (925) 454-5727

ORIGINATING SECTION: GROUNDWATER SECTION
CONTACT: Tom Rooze/Matt Katen

AGENDA DATE: November 5, 2014 ITEM NO. 2

SUBJECT: Draft Nutrient Management Plan

SUMMARY:

Staff has prepared a draft Nutrient Management Plan (NMP) for the Livermore Valley Groundwater Basin. The draft plan would expand the Salt Management Plan and, by extension, the Groundwater Management Plan for the Valley. It is available on the Zone 7 website: www.zone7water.com. The following are highlights contained in the draft plan:

- In 2009 the State Water Resources Control Board adopted a Recycled Water Policy that requires Salt/Nutrient Management Plans (SNMPs) be completed for all groundwater basins using recycled water that do not already have approved Salt Management Plans (SMP).
- Although not required here since Zone 7's SMP has already been approved by the Regional Board, the draft plan fills the gaps in the Salt Management Plan so, together, the plans meet the new requirements.
- Nitrate is the main nutrient of concern in the Basin. The Regional Board's Basin Objective (BO) for nitrate is 45 mg/L as NO_3.
- Average nitrate concentrations in the Basin are approximately 15 mg/L, but there are ten Areas of Concern with localized nitrate concentrations above the BO.
- Basin wide nitrate concentrations are not expected to change significantly in the future. Average nitrate concentrations are projected to decrease in the main basin and increase only slightly in the fringe basins to the north and east (about 1 to 2 mg/L) at build-out and will be well below the BO and the limit set for multiple recycled water irrigation projects in the State Recycled Water Policy.
- For those areas of the Basin with proposed recycled water irrigation projects, the recycled water will cause nitrate concentrations to rise only slightly (<1 mg/L) at build-out.
- The NMP recommends continued use of existing BMPs for fertilizer application, recycled water irrigation and manure management at livestock and equestrian facilities for regional nitrogen management.
- The NMP recommends some new permitting criteria for new Onsite Wastewater Treatment Systems (OWTS) within the Areas of Concern.
- Zone 7, ACEH and RWQCB are cooperating on the development of acceptable criteria for granting approval for new OWTS permits within the Areas of Concern.

FUNDING:

The NMP development effort is funded 70 % from Fund 120 –Renewal Replacement and System Wide Improvements and 30% from Fund 73 - Expansion.

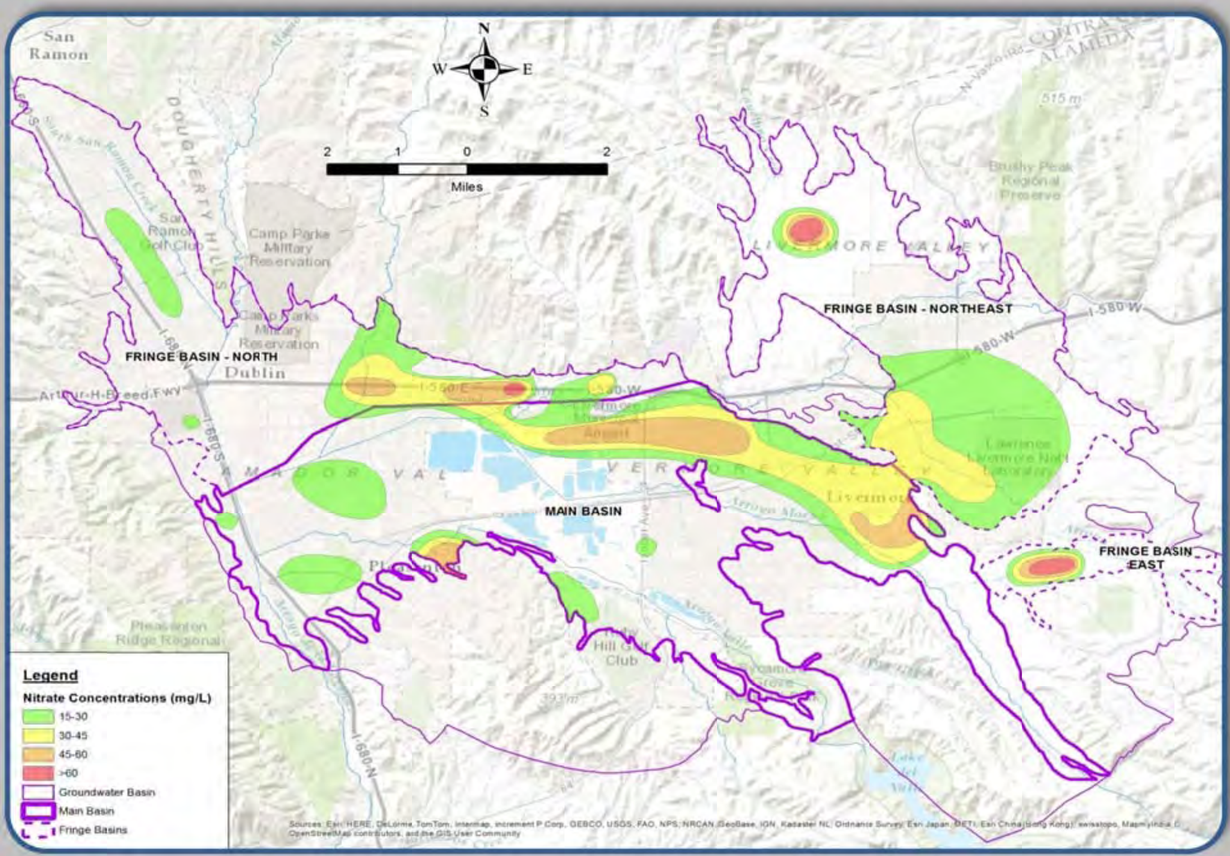
RECOMMENDED ACTION:

For information and discussion.

Nutrient Management Plan

For the

Livermore Valley Groundwater Basin



November 2014

PREPARED BY:

ZONE 7 WATER AGENCY
100 North Canyons Parkway
Livermore, CA 94551
(925) 454-5000

Nutrient Management Plan

Livermore Valley Groundwater Basin

November 2014

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PREPARED BY:

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Table of Contents

Page

List of Figures — Page

Acronyms and Abbreviations

Abbrev	Description	Abbrev	Description
AC	Assimilative Capacity	LWRP	Livermore Water Reclamation Plant
ACEH	Alameda County Environmental Health	MCL	Maximum contaminant level
AF	Acre-feet	mg/L	Milligrams per liter
AF/yr	Acre-feet per year	N	Nitrogen
bgs	Below ground surface	NMP	Nutrient Management Plan
BMO	Basin Management Objective	NO_3	Nitrate Ion
BMP	Best Management Practices	OWTS	Onsite Wastewater Treatment System
BOs	Basin Objectives	PO_4	Phosphate Ion
CASGEM	CA Statewide GW Elevation Monitoring	POTW	Publicly owned treatment works
CDA	Community Development Agency	ROWD	Request of Waste Discharge
CDPH	California Department of Health Services	RRE	Rural Residential Equivalence
CEC	Constituents-of-emerging-concern	RWQCB	Regional Water Quality Control Board
CIMIS	California Irrigation Management System	SBA	South Bay Aqueduct
CEQA	California Environmental Quality Act	SCVWD	Santa Clara Valley Water District
CWS	California Water Service	SCWA	Sonoma County Water Agency
DSRSD	Dublin San Ramon Services District	SMP	Salt Management Plan
DWR	California Department of Water Resources	SNMP	Salt Nutrient Management Plan
EIR	Environmental Impact Report	SWP	State Water Project
ft	Feet	SWRCB	State Water Resources Control Board
GIS	Geographic information systems	TAF	Thousand acre-feet
GWMP	Groundwater Management Plan	TDS	Total dissolved solids
GPQ	Groundwater Pumping Quota	TKN	Total Kjeldahl nitrogen
LAFCO	Local Agency Formation Commission	USGS	U.S. Geological Survey
LAMP	Local Agency Management Program	WDR	Waste Discharge Requirements
lbs	Pounds	WWMP	Wastewater Management Plan

1 Background

1.1 Introduction

Zone 7 Water Agency (Zone 7) has actively managed the Livermore Valley Groundwater Basin (California Department of Water Resources [DWR] Basin No. 2-10) for over 50 years. Zone 7 prepared a Salt Management Plan (SMP) in 2004 to address the increasing level of total salts in the Main Basin of the Livermore Valley Groundwater Basin. The SMP was designed to protect the long-term water quality of the Main Basin and is a permit condition of the Master Water Recycling Permit, Regional Water Quality Control Board (RWQCB) Order No. 93-159, issued jointly to Zone 7, the City of Livermore, and Dublin San Ramon Services District (DSRSD). The SMP was approved by the RWQCB in October 2004 and was incorporated into Zone 7's Groundwater Management Plan (GWMP) in 2005. The status of salt management is updated in Zone 7's annual GWMP reports, copies of which are submitted to the RWQCB to satisfy associated permit reporting requirements.

In February 2009, the State Water Resources Control Board (SWRCB) adopted a Recycled Water Policy (SWRCB, Resolution No. 2009-0011) to encourage and facilitate the increased use of recycled water statewide. The policy requires among other things, that Salt/Nutrient Management Plans (SNMPs) be completed for all groundwater basins using recycled water in California. Because there is already an approved SMP for the Livermore Valley Groundwater Basin, a new SNMP is not required. However, to make the existing SMP comparable to the SNMP described in the Recycled Water Policy, Zone 7 has prepared this Nutrient Management Plan (NMP) as an addendum to its 2004 SMP, and by extension its GWMP. This plan does not cover other groundwater basins within the Zone 7 Service Area (Sunol Valley, San Joaquin – Tracy Subbasin) because there are no recycled water projects planned in those basins.

This report is organized into the following sections:

- **Section 1: Introduction** – provides an overview of the report.
- **Section 2: Livermore Valley Groundwater Basin Characteristics** – provides an overview of the groundwater basin including groundwater inventory and basin water quality.
- **Section 3: Basin Nutrient Evaluation** – describes how Zone 7 manages the groundwater basin for storage and water quality.
- **Section 4: Proposed Projects and Antidegradation Analysis** – describes the proposed recycled water irrigation projects and how this plan addresses the State's antidegradation policy (SWRCB, Resolution Number 68 – 16).
- **Section 5: Goals and Strategies** – describes the nutrient management options and strategies and outlines the nutrient management goals for groundwater, wastewater, and recycled water.
- **Section 6: Plan Implementation** – describes the implementation measures and provides an overview of the basin monitoring program.
- **Section 7: References** – a list of reports and documents that were used to prepare this report.

1.2 Purpose and Management Objectives

This NMP summarizes Zone 7's approach to managing nutrient loading in the Livermore Valley Groundwater Basin. The main purposes of this nutrient management plan are to:

- Provide an assessment of the existing and future groundwater nutrients concentrations;
- Address the additional nutrient loading anticipated from the planned expansion of recycled water use over the groundwater basin; and
- Identify specific high groundwater nitrate areas and describe the planned management actions developed to address these impacted areas.

Zone 7's primary groundwater Basin Management Objective (BMO) is to provide for the control, protection and conservation of groundwater for future beneficial uses. The RWQCB's Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) designates the following beneficial uses for groundwater in the Livermore Valley Groundwater Basin:

- Municipal and Domestic Supply
- Industrial Service and Process Supply
- Agricultural Supply

The Basin Plan also specifies Groundwater Quality Objectives for total dissolved solids (TDS) and nitrate for the Livermore Valley Groundwater Basin as follows:

Central Basin

TDS:	Ambient or 500 milligrams per liter (mg/L), whichever is lower
Nitrate (as NO3):	45mg/L

Fringe Subbasins

TDS:	Ambient or 1,000 mg/L, whichever is lower
Nitrate (as NO3):	45mg/L

Upland and Highland Areas

California domestic water quality standards set forth in California Code of Regulations, Title 22 and current county standards.

Waters designated for use as domestic or municipal water supply shall not contain concentrations of chemicals in excess of natural concentrations or the limits specified in California Code of Regulations, Title 22, Chapter 15, particularly Tables 64431-A and 64431-B of Section 64431, Table 64444-A of Section 64444, and Table 4 of Section 64443.

1.3 Regulatory Framework

1.3.1 Master Water Recycling Permit and Salt Management Plan

In 1993, the RWQCB issued a joint Master Water Recycling Permit (Master Permit) (Order No. 93-159) to Zone 7, DSRSD, and the City of Livermore authorizing the three agencies to produce, distribute and manage recycled water throughout the Livermore-Amador Valley (Valley). The Master Permit required that an SMP be developed to fully offset both current salt loading from natural sources and operations and any future salt loading associated with new recycled water projects before any extensive water recycling projects could be implemented in the Valley.

Between 1994 and 1999, Zone 7 developed a draft SMP for the Livermore Valley Groundwater Basin through a collaborative process with its retail water supply customers and the public. The SMP was finalized and approved by the RWQCB in 2004, and later incorporated into Zone 7's GWMP.

DSRSD and the City of Livermore have since filed for, and have been granted, coverage under a regional General Water Reuse Order (General Order No. 96-011) to administer their current and future landscape irrigation recycled water projects within their individual jurisdictions. As with the Master Permit, the General Order requires that an SMP be developed and approved. The Master Permit has been kept active by the RWQCB at the request of DSRSD and Livermore only to address potential future groundwater recharge projects.

The City of Pleasanton has applied for permit coverage for their planned recycled water use projects under the same general order that DSRSD and City of Livermore's recycled water programs are operating under (General Order No. 96-011), and reference Zone 7's approved SMP in their application to satisfy the order's SMP requirement.

1.3.2 State Recycled Water Policy

In 2009, the SWRCB adopted a Recycled Water Policy (SWRCB, Resolution No. 2009-0011) which requires that SNMPs be completed for all groundwater basins using recycled water in California. However, since an approved SMP already exists for the Livermore Valley Groundwater Basin, a new SNMP is not required.

In June 2014, the SWRCB adopted General Water Quality Order No. 2014-0090-DWQ to promote and regulate landscape irrigation recycled water projects within the state. This general order was written to be consistent with the State's Recycled Water Policy in that it requires an SNMP be prepared and adopted by the RWQCB. This NMP will be submitted to the RWQCB as an amendment to the previously adopted SMP, and by extension Zone 7's GWMP.

1.3.3 Onsite Wastewater Treatment Systems

Alameda County Environmental Health (ACEH) regulates the operation, installation, alteration, and repair of individual onsite wastewater treatment systems (OWTS), (i.e., septic tank systems) in all of Alameda County under the authority of Chapter 15.18 of the Alameda County General Ordinance. ACEH may also, in consultation with the RWQCB and other applicable agencies, identify boundaries of areas of special concern and adopt additional or modified requirements to address special environmental concerns in those areas. ACEH's 2007 Onsite Wastewater and Individual/Small Water Systems Regulations were developed in collaboration with Zone 7, and include special provisions for the Upper Alameda Creek Watershed, above Niles; such as a moratorium for new septic systems in unincorporated Happy Valley and a larger minimum parcel size requirement for new septic tank systems in the rest of the watershed than in other parts of the County.

In June 2012, the SWRCB adopted a new policy that establishes siting, design, operation, and maintenance criteria for OWTS, statewide. The purpose of this Policy is to allow the continued use of OWTS by providing local agencies a streamlined regulatory tool with clear criteria and a flexible alternative for protecting water quality and public health from OWTS impacts where local conditions call for special requirements to be implemented. The OWTS Policy gives the RWQCBs the principal responsibility to oversee implementation and calls for incorporating the OWTS Policy requirements into all Basin Plans. The San Francisco Bay RWQCB adopted a Basin Plan amendment in June 2014 that incorporates the State's new OWTS Policy.

The OWTS policy allows for local agencies such as counties and cities to adopt programs to manage OWTS within their jurisdictions. As such, ACEH is planning to work with RWQCB staff to develop a Local Agency Management Program (LAMP) pursuant to the policy that addresses local conditions while still protecting water quality and public health.

1.3.4 Zone 7 Wastewater Management Plan

In 1982, Zone 7 adopted its Wastewater Management Plan for the Unsewered, Unincorporated Area of Alameda Creek Watershed above Niles (WWMP) (*Zone 7, 1982*), which provides wastewater management policies intended to prevent further degradation of water quality from onsite wastewater disposal systems in the Livermore Valley, Sunol Valley, and Niles Cone groundwater basins. An additional policy was added in 1985 that limited the use of septic systems for new commercial development (Zone 7 Resolution 1165).

Although ACEH issues permits for OWTSs in Alameda County, Zone 7 requires special approval for any of the following septic systems located within the Valley:

- Any new septic system constructed, partially or fully, for a commercial or industrial use;
- Any conversion of a residential septic system to a commercial or industrial use; or
- Any new residential septic system that discharges greater than one rural residential equivalence of wastewater (i.e., greater than an annual average of 320 gallons/day) per 5 acres.

1.3.5 Groundwater Management Plan and Annual Reports

In 2005, Zone 7 compiled and documented all of its groundwater management policies, objectives, and programs, including its WWMP and SMP, into its comprehensive GWMP for the Livermore Valley Groundwater Basin, which the DWR recognizes as a SB1938-compliant GWMP. Zone 7's GWMP provides a detailed description of the groundwater management goals and practices used for the Livermore Valley Groundwater Basin, as well as detailed descriptions of the subbasin boundaries; hydrologic settings; historical groundwater use and overdraft; practices and measures used to prevent future overdraft and groundwater quality degradation; and stakeholder involvement during the development of the GWMP. Another significant portion of the GWMP addresses the numerous monitoring programs and protocols employed by Zone 7 to quantify, manage and protect the basin's groundwater supplies.

The GWMP itself is intended to be a "living document," and as such, undergoes periodic reevaluations and updates as conditions and management goals may change. Periodic adjustments to the GWMP are noted in the Annual Reports for the Groundwater Management Program (years 2005 to 2013), available online at www.zone7water.com. Major revisions are handled through a formal revision or addendum process that involves collaboration between Zone 7, the RWQCB, Zone 7's retailers, and other stakeholders in an open public process.

In 2014, California passed three new bills (Senate Bills 1168 and 1319, Assembly Bill 1739) designed to achieve sustainable groundwater management in the state within the next 20 years. In SB 1168, Zone 7 was deemed the exclusive local agency to manage groundwater within its statutory boundaries with powers to comply with this new part of the Water Code.

1.4 Stakeholder Involvement

This NMP was developed with cooperation and input from regulatory agencies (e.g., RWQCB, ACEH, Alameda County Community Development Agency [Alameda CDA]), property owners, Zone 7's Retailers (City of Livermore, DSRSD, City of Pleasanton, California Water Service), and other interested parties. The following meetings took place from June 2013 to November 2014 to discuss the calculation methods, results, and proposed actions:

- June 2013: Meeting at RWQCB with Sonoma County Water Agency (SCWA), RMC, Santa Clara Valley Water District (SCVWD) also in attendance.
- July 2013: Status meetings with Zone 7 Retailers.
- October 2013: Status meeting with Zone 7 Retailers
- October 2013: Public meeting with presentation to Zone 7's Board Water Resources Committee discussing preliminary results.

- January 2014: Follow-up public meeting and presentation to Zone 7's Board Water Resources Committee.
- March 2014: Progress meeting with RWQCB, SCVWD, SCWA.
- April 2014: Public stakeholder meeting with property owners and residents in May School, Buena Vista and Greenville Areas of Concern. Staff from ACEH and Alameda CDA were also in attendance.
- July 2014: Progress meeting with RWQCB, ACEH and Alameda CDA
- October 2014: Progress meeting with Zone 7 Retailers to discuss final results.
- November 2014: Progress meeting with RWQCB, ACEH, and Alameda CDA to discuss final results.
- November 2014: Public meeting with presentation to Zone 7's Board Water Resources Committee to discuss final results.
- November 2014: Public meeting with presentation to Zone 7's Board to present final report.

1.5 CEQA Considerations

This Nutrient Management Plan is exempt from the California Environmental Quality Act (CEQA) under the general rule that CEQA only applies to projects with the potential for significant effects on the environment (Section 15061.b.3). A notice of exemption has been filed with the Alameda County Clerk-Recorder. This Plan is an addendum to the existing Groundwater Management Plan, which in 2005 was also found to be exempt from CEQA.

The NMP provides a focused assessment of current and anticipated issues and concerns relating to nitrate concentrations in the groundwater basin. Best management practices are identified – focused primarily on minimizing nitrogen loading over the groundwater basin. The BMPs are inherently protective measures for the environment, and therefore no significant impacts will occur as a result of implementation of the Plan.

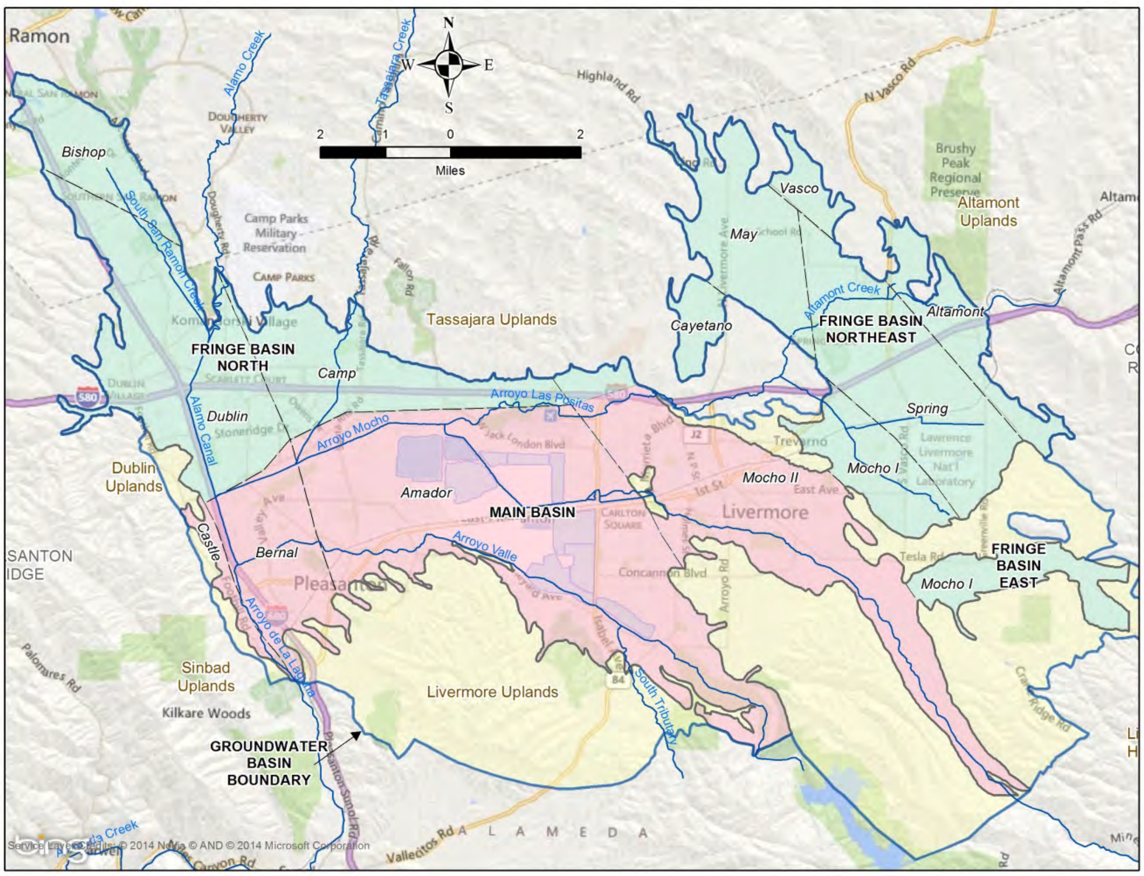
The plan does not identify the need for new or modified infrastructure. Should Zone 7 wish to undertake such a project in the future to help meet NMP related goals, it would require project-specific analysis under CEQA.

2 Livermore Valley Groundwater Basin Characteristics

2.1 Groundwater Basin Overview

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 GWMP (*Zone 7, 2005a*). The Livermore Valley Groundwater Basin (*Figure 2-1*) is an inland alluvial basin underlying the east-west trending Livermore-Amador Valley (Valley) in northeastern Alameda County.

Figure 2-1: Map of Livermore Valley Groundwater Basin and Subbasins (DWR, 1974)



The Main Basin is a portion of the Livermore Valley Groundwater Basin that contains the highest yielding aquifers and generally the best quality groundwater. The Fringe Basins consist primarily of shallow, lower-yielding alluvium containing relatively poor quality groundwater. The upland area portions of the groundwater basin consist primarily of lower-yielding bedrock of the Livermore, Tassajara, and Green Valley Formations.

Six principal streams flow into and/or through the Main Basin and join in the southeast where the Arroyo de la Laguna flows out of the valley. The five arroyos shown in *Figure 2-1* and listed below are essentially tributaries to the Arroyo de la Laguna:

- Arroyo Valle,
- Arroyo Mocho,
- Arroyo Las Positas,
- South San Ramon Creek,
- Tassajara Creek, and
- Alamo Creek/Canal.

Average precipitation ranges from 14 inches per year at the eastern edge of the Valley to over 20 inches per year in the western portion.

2.1.1 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. 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 tend to have low-yielding groundwater 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.

2.1.2 Main and Fringe Basins

The Main Basin and Fringe Basins (shown on *Figure 2-1*) are comprised of the subbasins listed below:

Main Basin	Fringe Basin North	Fringe Basin Northeast	Fringe Basin East
• Castle	• Bishop	• Altamont	• Mocho I (southern portion)
• Bernal	• Camp	• Cayetano	
• Amador	• Dublin	• May	
• Mocho II		• Spring	
		• Vasco	
		• Mocho I (northern portion)	

All of the Valley's municipal supply wells are completed in the Main Basin aquifers, which have the highest transmissivity in the Valley. *Figure 2-2* (from *Zone 7, 2014*) shows the recharge area for the Main Basin. The most relevant of the Fringe Basins to the NMP is the Fringe Basin North due to its connectivity with the Main Basin (*Section 2.1.3.1*) and because of the amount of recycled water use, both existing and proposed, in that portion of the basin.

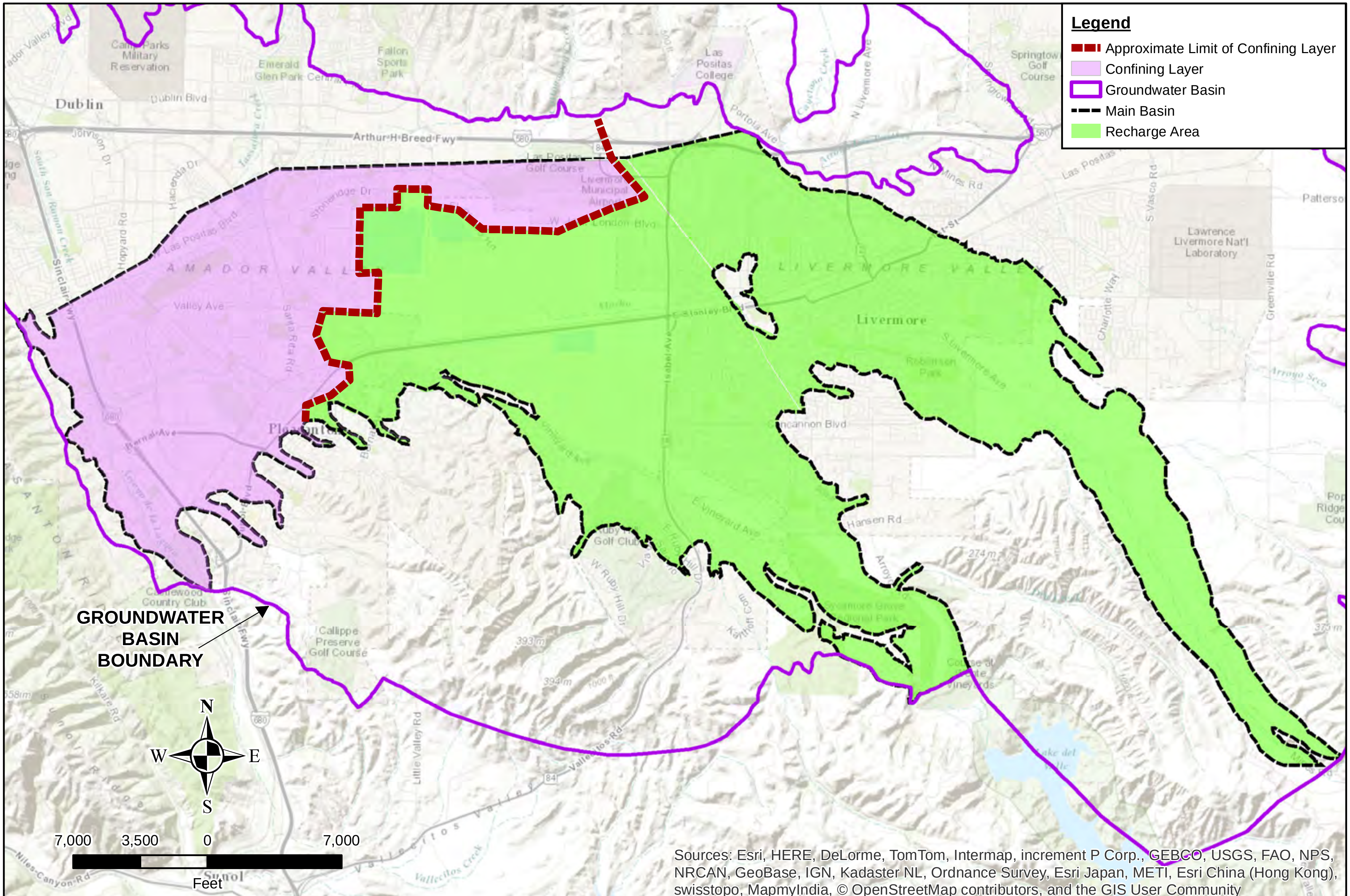
2.1.3 Aquifer Zones

2.1.3.1 Overview

Water levels in the Main Basin typically vary with seasonal recharge and extraction. The highest water levels usually are found at the end of the rainy season and lowest water levels at the end of the high demand summer/fall seasons; however, this trend can change during periods of extended drought or multi-year storage replenishment (*Section 2.2.1*). Zone 7 maintains a system of Key Wells that is used to monitor general conditions in each of the Main Basin's Subbasins.

Although multiple aquifers have been identified in the Main Basin alluvium, wells have been classified generally as being in one of two aquifer zones (upper or lower), separated by a relatively continuous silty-clay aquitard up to about 50 ft thick. Groundwater in both the upper and lower aquifer zones generally follows a westerly flow pattern, similar to the surface water streams, along the structural central axis of the valley toward municipal pumping centers.

The Main Basin is connected primarily to the fringe areas through the shallow alluvium, especially across the northern boundaries of the Main Basin. 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.



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

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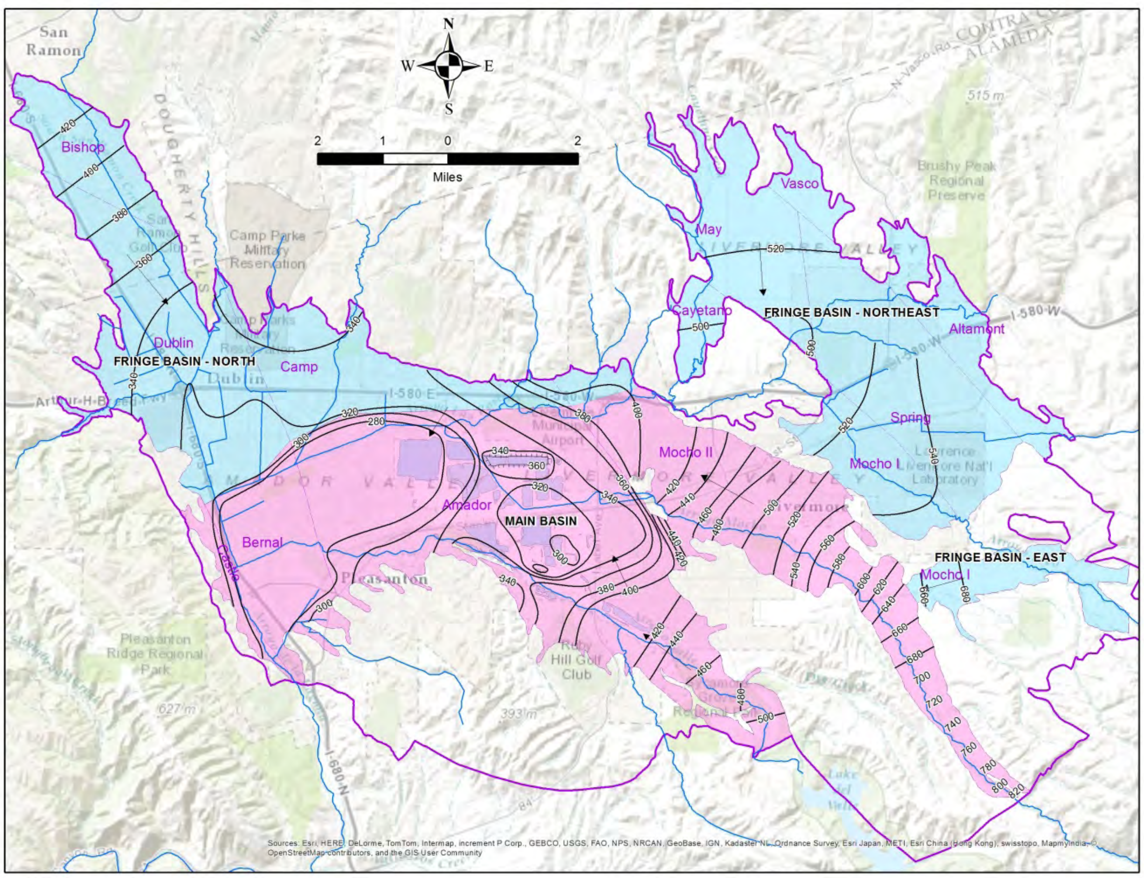
Figure 2-2
Recharge Area and Confining Layer Above Upper Aquifer

2.1.3.2 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 base of the upper aquifer zone ranges from 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.

Figure 2-3: Gradient in Upper Aquifer, October 2013

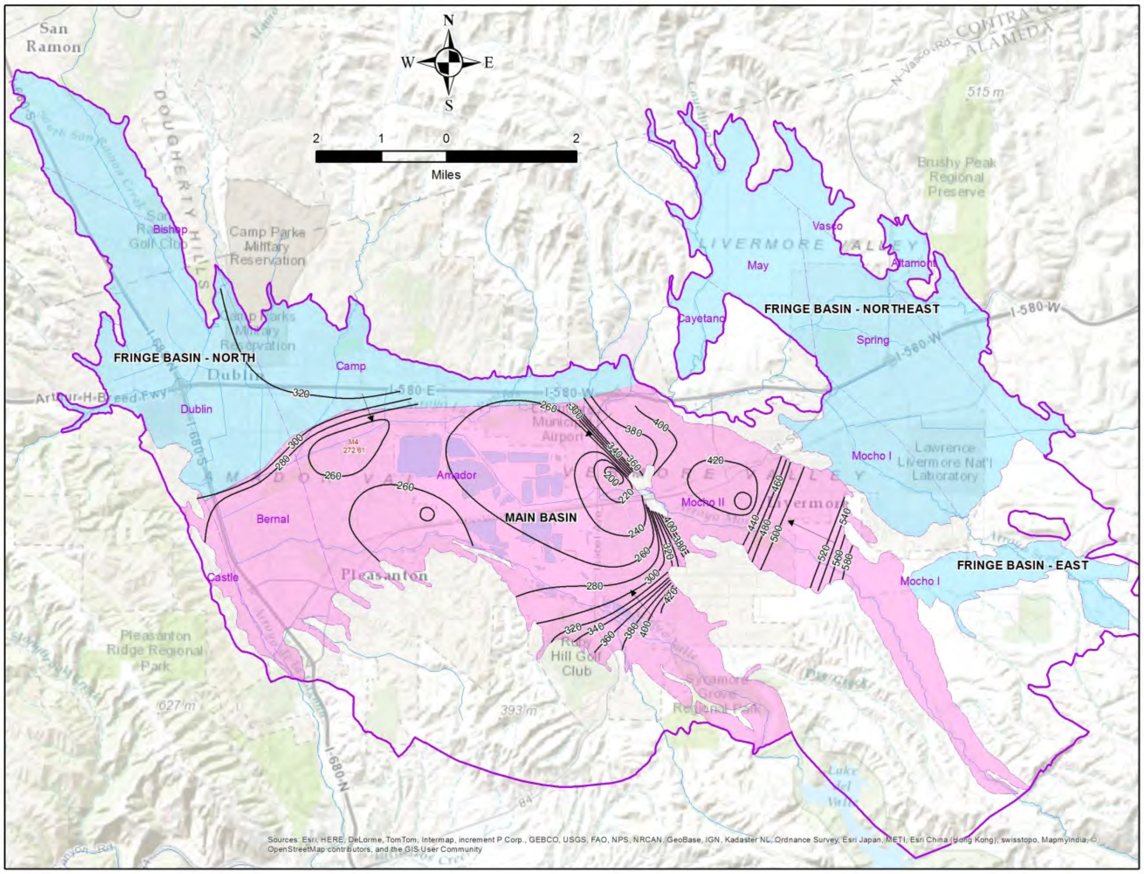


The groundwater gradient in the Upper Aquifer is generally from east to west towards the Bernal Subbasin, then to the south where groundwater flows out of the Main Basin (see *Figure 2-3*). The gradient typically ranges from 0.005 to 0.025 with isolated areas of flatter or steeper gradients, especially near subbasin boundaries.

2.1.3.3 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.

Figure 2-4: Gradient in Lower Aquifer, October 2013



In the Lower Aquifer, the groundwater gradient within the Mocho II and Amador Subbasins ranges from 0.001 to 0.05 with groundwater flowing generally westward along the longitudinal axis of the Livermore-Amador Valley (see *Figure 2-4*). In the Bernal Subbasin, the gradient (typically less than 0.006) is slightly to the north and east towards the Hopyard and Mocho Wellfields. Typically, the lowest elevations correspond to the municipal pumping wellfields within each subbasin.

There are two major subsurface structural features that act as partial barriers to the lateral movement of groundwater in the Lower Aquifer. These features define the sub-basin boundaries between the Mocho II and Amador Subbasins, and between the Dublin and Camp fringe basins and the Main Basin. Groundwater levels are significantly higher on the up-gradient sides of these partial barriers, but it is believed that groundwater cascades across these linear features providing some subsurface recharge for the adjacent subbasin.

2.1.4 Land Use

The majority of the land use over the Main and Fringe Basins is considered urban (60%), 7% is dedicated to gravel mining, 6% is used for irrigated agriculture, and the remaining areas are open space (27%).

Zone 7 has an established Land Use Monitoring Program that identifies changes in land use with an emphasis on changes in impervious areas and the volume and quality of irrigation water that could impact the volume or quality of water recharging the Main Basin. Land use data are derived from aerial photography, permit applications, field observations, and City and County planning documents. The current land use categories are:

- Residential (rural)
- Residential (low density)
- Residential (medium density)
- Residential (high density)
- Commercial and Business
- Industrial
- Public
- Public (Irrigated Park)
- Agriculture (vineyard)
- Agriculture (non-vineyard)
- Mining Area – Pit
- Water Body
- Golf Course
- Open Space

The source of the water that supplies each of the land use polygons is also catalogued. The sources of water are identified as:

- Delivered (municipal) water
- Groundwater
- Recycled water

Land use and source water information are used to calculate rainfall and applied water recharge and salt and nutrient loading. Current and future land uses and their associated loading contributions are discussed in more detail in *Section 3*.

2.2 Groundwater Inventory

2.2.1 Conjunctive Use

Zone 7 imports extra surface water from the State Water Project's (SWP) South Bay Aqueduct (SBA) and artificially recharges it in the Main Basin (currently using stream percolation in losing reaches). This recharged SWP water is then available to Zone 7 for pumping during dry years. In normal years, Zone 7 operates its wells to augment production during demand peaks and whenever a shortage or interruption occurs in surface water supply or treatment. However, Zone 7 has also pumped groundwater as a salt management strategy. The decision of which well(s) to pump first is based on pumping costs, pressure zone needs, delivered aesthetic water quality issues, operational status, and demineralization facility capacity. Although reduced groundwater pumping may have a positive impact on groundwater storage and delivered water quality, increased groundwater pumping has a beneficial impact on the basin's salt loading because much of the salt in the pumped groundwater eventually leaves the basin as wastewater export.

2.2.2 Groundwater Storage

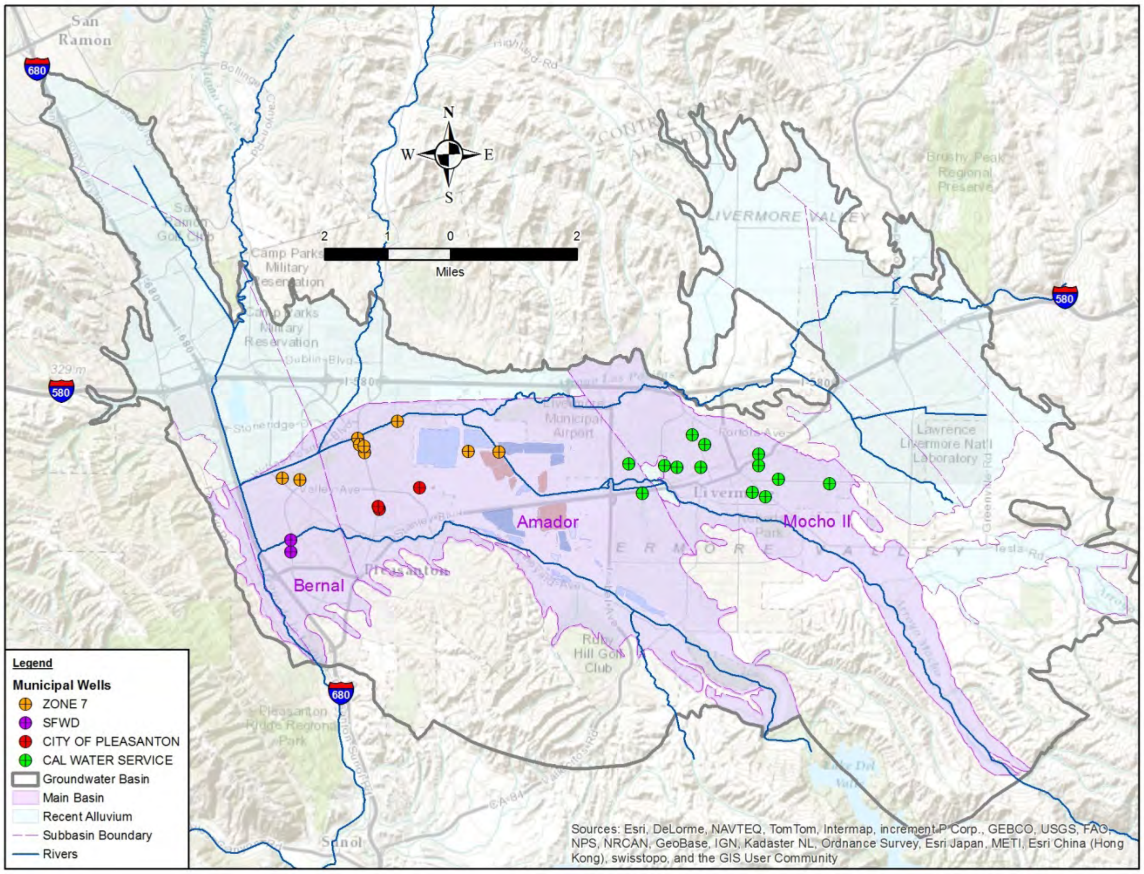
The Main Basin is estimated to hold up to 254 thousand acre-feet (TAF) whereas the fringe basins are estimated to hold 243 TAF. Zone 7 quantifies the total groundwater storage of the Main Basin by averaging the values computed by two independent methods: a groundwater elevation method and a hydrologic inventory method. Additional information on these two methods can be found in Zone 7's annual GWMP reports.

One of Zone 7's groundwater basin management objectives is to maintain water levels above historical lows to minimize the risk of inducing land subsidence. Therefore, not all of the total groundwater storage is considered accessible. "Operational" or "Available" Storage is the approximate amount of storage available above the historical low groundwater surface (about 126 TAF). The remainder (approximately 128 TAF) is estimated reserves stored below historical lows.

2.2.3 Groundwater Production

Zone 7 provides water resources management services to about 220,000 residents of the Valley. Zone 7 integrates management of both surface and groundwater supplies for conjunctive use and reliability of water supplies. Groundwater typically makes up 15-25% of the water supplied by Zone 7 to its retail water supply agencies; however, higher groundwater use can occur during droughts and surface water outages. In addition, two of the four retailers independently operate supply wells, as do other domestic and agricultural users, so the total amount of groundwater makes up a higher percentage of the total regional supply (typically 20-40%). All of the Valley's municipal supply wells are completed in Main Basin aquifers (*Figure 2-5*).

Figure 2-5: Map of Municipal Wells



2.2.4 Groundwater Sustainability

Zone 7 strives to manage the basin's groundwater sustainability. To assure sustainability, Zone 7 quantifies the supply and demand components (*Figure 2-6*) and their calculated annual volumes each year and makes sure that the long-term averages do not indicate overdraft conditions. The results are presented in Zone 7's Annual Reports for the GWMP (see *Zone 7, 2014* for the most recent example).

The Main Basin's "natural," sustainable, groundwater yield is defined as the amount of water that can be pumped from the groundwater basin and replenished by long-term average, natural supply. The long-term, natural sustainable yield is calculated based on local precipitation and natural recharge over a century of hydrologic records and projections of future recharge conditions. Applied water recharge has been historically included in the "natural" sustainable yield because of its sustainable contribution to groundwater recharge.

Figure 2-6: Groundwater Supply and Demand Components

Inflow and Outflow Components	Normal Water Year (AF/yr)
Natural Sustainable Yield Supply	
Natural Stream Recharge	5,700
Arroyo Valle Prior Rights	900
Rainfall Recharge	4,300
Applied (Irrigation) Water Recharge	1,600
Subsurface Inflow	1,000
Basin Overflow	-100
Inflow Total	**13,400**
Natural Sustainable Yield Demand	
Municipal pumping by Retailers	7,214*
Other groundwater pumping	1,186
Agricultural pumping	400
Mining Area Losses	4,600
Outflow Total	**13,400**
Managed Supply	
Artificial Stream Recharge	
Inflow Total	**Varies†**
Managed Demand	
Municipal Pumping by Zone 7	
Outflow Total	**Varies†**

**Retailer Groundwater Pumping Quota (GPQ) for a Calendar Year*

†Artificial stream recharge and Zone 7 pumping amounts are determined by the availability of surface water

The long-term, natural sustainable yield in the Main Basin was estimated to be about 13,400 acre-feet (AF) annually (*Zone 7, 1992*). While the natural sustainable yield approximates long-term-average natural recharge, the actual amount of natural recharge varies from year to year depending on the amount of local precipitation and irrigation during the year.

Zone 7's artificial recharge operations allow the groundwater basin to yield additional water, which is as sustainable as the supply of imported surface water. Zone 7 contracts with the SWP to import water that is released from the SBA or from Lake Del Valle (a SWP reservoir also operated by the California Department of Water Resources) into the arroyos for the purpose of augmenting the natural stream recharge.

Historically, Zone 7's annual groundwater pumping has varied with the availability of imported surface water and the capacity to treat that surface water. However, Zone 7 also operates its wells for salt management, to supply short-term demand peaks, and to compensate for treatment and conveyance system interruptions. The decision of which well(s) to pump is based on groundwater elevations, pumping costs, pressure zone needs, delivered aesthetic water quality issues, salt management needs, operational status, and groundwater demineralization facility capacity. Although reduced groundwater pumping may have a positive impact on groundwater storage and delivered water quality, increased groundwater pumping has a beneficial impact on the basin's salt loading because much of the salt in the pumped groundwater eventually leaves the basin as wastewater export. Annual variability can be accommodated as long as the long-term average groundwater demands don't exceed the sustainable average recharge.

2.3 Basin Water Quality (Nutrients)

2.3.1 Overview

In addition to managing the basin for supply sustainability, Zone 7 manages the basin for groundwater quality. In general, groundwater quality throughout most of the Main Basin is suitable for most types of urban and agriculture uses with some minor localized water quality degradation. Zone 7's annual GWMP reports (see *Zone 7, 2014* for the 2013 report) present more details of the groundwater quality monitoring and management programs for the basin.

The nutrient constituent of concern for this plan is nitrate since it is the only nutrient that has had a significant impact on groundwater quality. The Basin Objective (BO) for nitrate is 45 mg/L (measured as NO_3) for both the Main and Fringe Basins (*California RWQCB, 2011*). Phosphate is also monitored as part of the GWMP, but is encountered in concentrations well below the water quality standards and is not considered a significant nutrient of concern for the Livermore Valley Groundwater Basin. *Figure 2-7* below shows the maximum concentrations encountered in each of the basin areas.

Figure 2-7: Maximum Concentration of Nutrients in Basin Areas

		Concentration Max (2001-2014)			
	Standard	Main Basin	Fringe North	Fringe Northeast	Fringe East
Nutrient	mg/L	mg/L	mg/L	mg/L	mg/L
Nitrate (as NO_3)	45$^{(1)}$	95	340$^{(2)}$	190	163
Phosphate (as PO_4)	5$^{(3)}$	2.85	3.65	1.93	0.34

(1) MCL from CDPH and BO from RWQCB
(2) Only 2 sample results above 100 mg/L
(3) Recommended limit from World Health Organization

2.3.2 Nitrate Concentrations

The results from Zone 7's annual groundwater sampling are used to prepare nitrate concentrations maps each year for Zone 7's Groundwater Management Program annual reports. The 2013 nitrate concentration contours from the upper and lower aquifers are shown in *Figure 2-8* and *Figure 2-9* below:

Figure 2-8: Nitrate Concentrations in Upper Aquifer

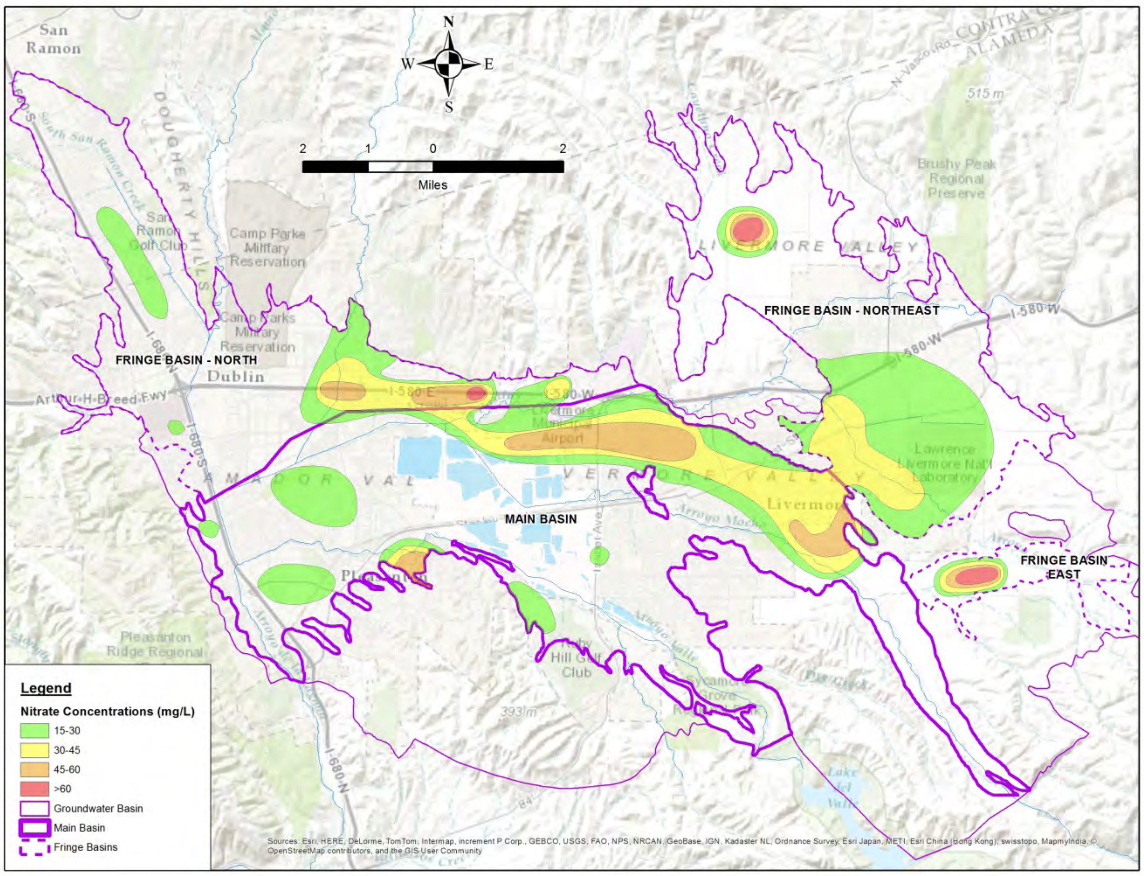
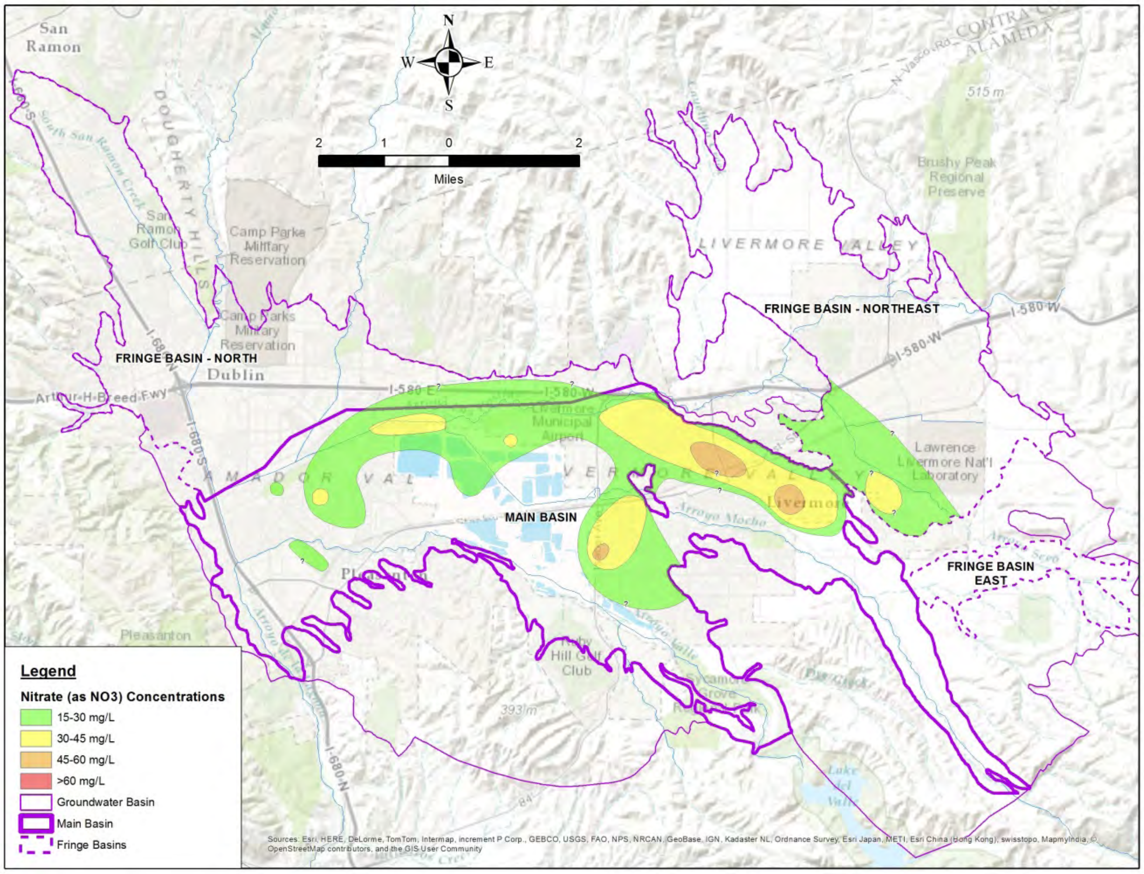


Figure 2-9: Nitrate Concentrations in Lower Aquifer



Average nitrate concentrations are resolved by first using *ArcGIS's Spatial Analyst* to calculate the volume-weighted average nitrate concentration (measured as NO_3) for each groundwater storage node from the nitrate concentration maps. The groundwater storage nodes are the same polygonal areas referred to in Zone 7's Groundwater Management Plan (*Zone 7, 2005a*) and used to calculate groundwater storage at the end each water year. *Figure 2-10* shows the layout of the nodes, and the average upper and lower aquifer nitrate concentrations for each node from the 2013 monitoring well sampling results (*Zone 7, 2014*).

Figure 2-10: Nitrate Concentrations by Node

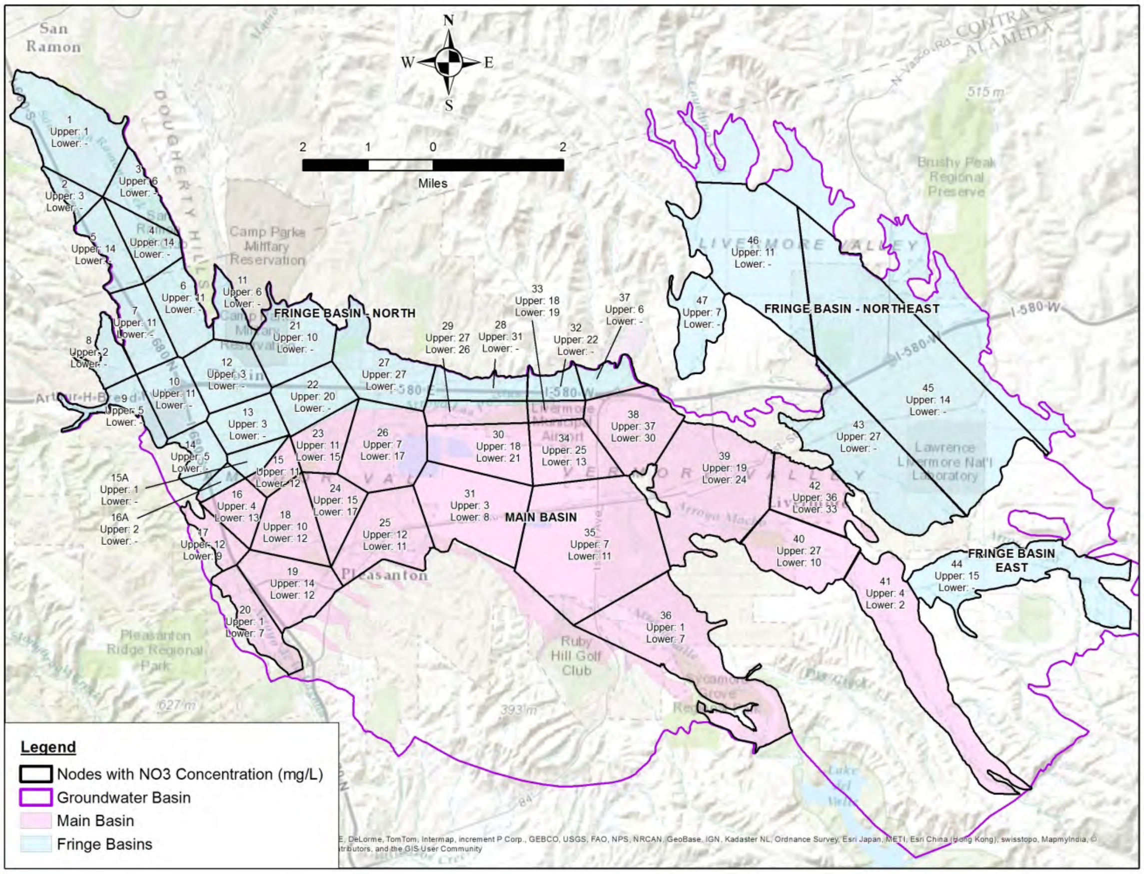


Figure 2-11 below shows the storage volume, average nitrate concentrations, and assimilative capacity (AC) by node, aquifer, subbasin, and basin areas (see *Section 2.3.3* for discussion on how assimilative capacity is calculated).

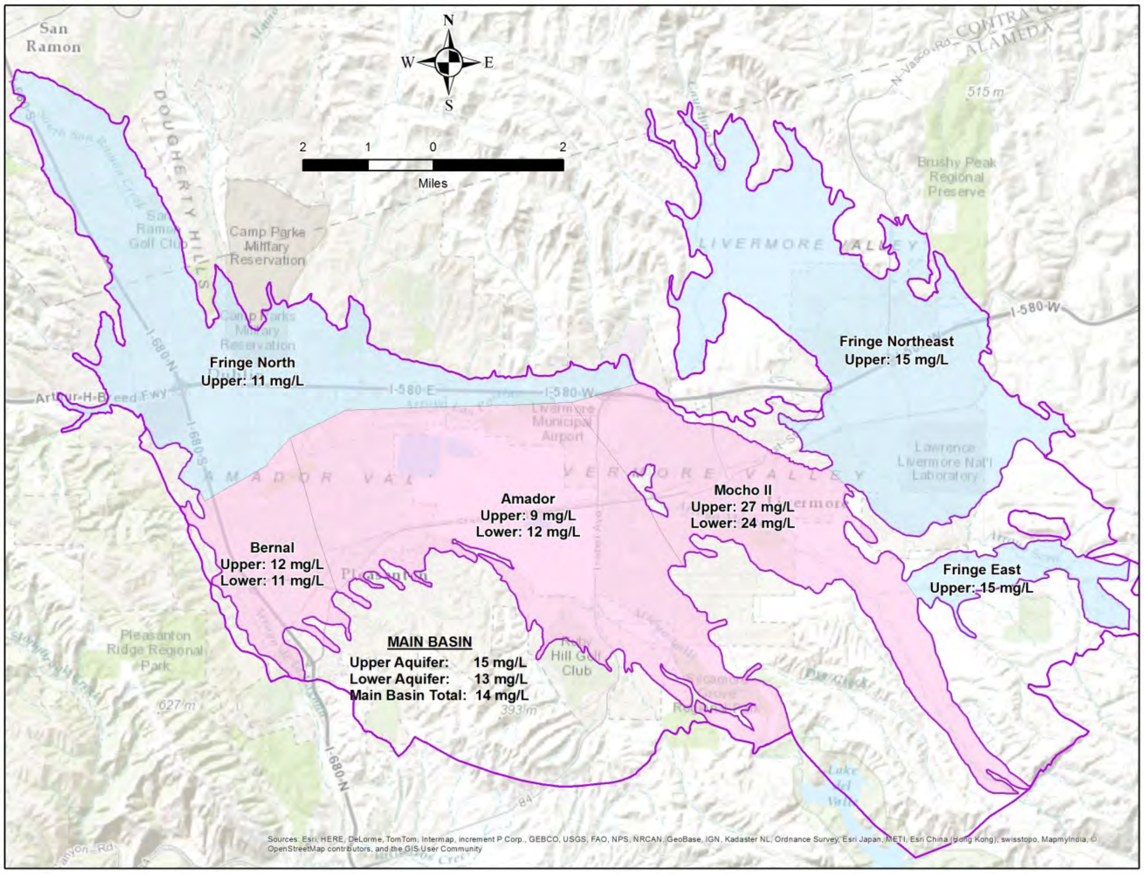
Figure 2-11: Storage (AF), Nitrate Concentrations (as NO_3 in mg/L) and Assimilative Capacity (mg/L) by Node, Subbasin, and Basin Area

			Upper			Lower			Total Basin		
NODE	**Basin**	**Subbasin**	**Storage**	**NO_3**	**AC**	**Storage**	**NO_3**	**AC**	**Storage**	**NO_3**	**AC**
NODE 1	FBN		28,888	1	44	-	-	-	28,888	1	44
NODE 2	FBN		3,363	3	42	-	-	-	3,363	3	42
NODE 3	FBN		6,303	6	39	-	-	-	6,303	6	39
NODE 4	FBN		6,236	14	31	-	-	-	6,236	14	31
NODE 5	FBN		5,914	14	31	-	-	-	5,914	14	31
NODE 6	FBN		7,349	11	34	-	-	-	7,349	11	34
NODE 7	FBN		6,825	11	34	-	-	-	6,825	11	34
NODE 8	FBN		4,263	2	43	-	-	-	4,263	2	43
NODE 9	FBN		5,119	5	40	-	-	-	5,119	5	40
NODE 10	FBN		7,219	11	34	-	-	-	7,219	11	34
NODE 11	FBN		4,918	6	39	-	-	-	4,918	6	39
NODE 12	FBN		10,142	3	42	-	-	-	10,142	3	42
NODE 13	FBN		8,035	3	42	-	-	-	8,035	3	42
NODE 14	FBN		5,495	5	40	-	-	-	5,495	5	40
NODE 15A	FBN		106	1	44	-	-	-	106	1	44
NODE 16A	FBN		96	2	43	-	-	-	96	2	43
NODE 15	MB	Bernal	535	11	34	1,771	12	33	2,306	12	33
NODE 16	MB	Bernal	600	4	41	2,654	13	32	3,253	11	34
NODE 17	MB	Bernal	1,499	12	33	1,602	9	36	3,100	11	34
NODE 18	MB	Bernal	2,649	10	35	5,457	12	33	8,106	12	33
NODE 19	MB	Bernal	3,784	14	31	5,579	12	33	9,363	13	32
NODE 20	MB	Bernal	913	1	44	3,656	7	38	4,569	6	39
NODE 21	FBN		17,445	10	35	-	-	-	17,445	10	35
NODE 22	FBN		11,837	20	25	-	-	-	11,837	20	25
NODE 23	MB	Amador	2,129	11	34	2,812	15	30	4,942	13	32
NODE 24	MB	Amador	2,660	15	30	2,993	17	28	5,653	16	29
NODE 25	MB	Amador	7,483	12	33	6,979	11	34	14,462	12	33
NODE 26	MB	Amador	8,884	7	38	8,923	17	28	17,807	12	33
NODE 27	FBN		17,655	27	18	-	-	-	17,655	27	18
NODE 28	FBN		7,814	31	14	-	-	-	7,814	31	14
NODE 29	MB	Amador	4,620	27	18	1	26	19	4,621	27	18
NODE 30	MB	Amador	7,216	18	27	5,735	21	24	12,951	19	26
NODE 31	MB	Amador	8,402	3	42	15,010	8	37	23,412	6	39
NODE 32	FBN		1,024	22	23	-	-	-	1,024	22	23
NODE 33	MB	Amador	639	18	27	479	19	26	1,118	19	26
NODE 34	MB	Amador	2,755	25	20	5,618	13	32	8,373	17	28
NODE 35	MB	Amador	8,831	7	38	22,775	11	34	31,607	9	36
NODE 36	MB	Amador	10,863	1	44	1	7	38	10,865	1	44
NODE 37	MB	Amador	209	6	39	0	12	33	209	6	39
NODE 38	MB	Mocho II	4,915	37	8	1,629	30	15	6,544	35	10
NODE 39	MB	Mocho II	10,011	19	26	4,251	24	21	14,263	21	24
NODE 40	MB	Mocho II	10,930	27	18	2,267	10	35	13,197	24	21
NODE 41	MB	Mocho II	10,889	4	41	1	2	43	10,890	4	41
NODE 42	MB	Mocho II	7,647	36	9	1,759	33	12	9,406	35	10
NODE 43	FBNE		8,622	27	18	-	-	-	8,622	27	18
NODE 44	FBE		6,830	15	30	-	-	-	6,830	15	30
NODE 45	FBNE		62,141	14	31	-	-	-	62,141	14	31
NODE 46	FBNE		-	11	34	-	-	-	-	11	34
NODE 47	FBNE		-	7	38	-	-	-	-	7	38
Bernal			9,981	11	34	20,717	11	34	30,698	11	34
Amador			64,692	10	35	71,326	12	33	136,018	11	34
Mocho II			44,392	22	23	9,908	24	21	54,299	22	23
Main Basin			**119,064**	**15**	**30**	**101,951**	**13**	**32**	**221,015**	**14**	**31**
FB-North			**166,046**	**11**	**34**				**166,046**	**11**	**34**
FB-Northeast*			**70,762**	**15**	**30**				**70,762**	**15**	**30**
FB-East			**6,830**	**15**	**30**				**6,830**	**15**	**30**
TOTAL*			**362,702**	**13**	**32**	**101,951**	**13**	**32**	464,653	**13**	**32**

** not including Nodes 46 and 47 (no storage info available)*
Storage in AF, NO_3 Concentration in mg/L, AC = Assimilative Capacity

The average volume-weighted concentrations were then calculated for each subbasin, aquifer, and basin area; and the results are as shown in *Figure 2-12* below.

Figure 2-12: Nitrate Concentrations by Subbasin, Aquifer, and Basin Area



The 2013total average nitrate concentration in the upper aquifer is 15 mg/L, with all subbasins between 9 mg/L and 27 mg/L. The average nitrate concentration in the lower aquifer is 13 mg/L, with all subbasins between 11 mg/L and 24 mg/L. The overall concentration for the Main Basin is 14 mg/L. The average concentrations in the Fringe Basins (which only consist of an upper aquifer) ranged between 11 mg/L and 15 mg/L. All average basin concentrations are well below the BO (45 mg/L); however, there are Areas of Concern (described in *Section 2.4*) where local nitrate concentrations do exceed the BO.

2.3.3 Assimilative Capacity

Assimilative Capacity, the natural capacity of the groundwater basin to absorb pollutants, is the difference between the BO (45 mg/L) and the average concentration of the basin with a relatively conservative contaminant like nitrate. The assimilative capacity for each of the nodes and basins are shown in *Figure 2-13* and are summarized below by basin area.

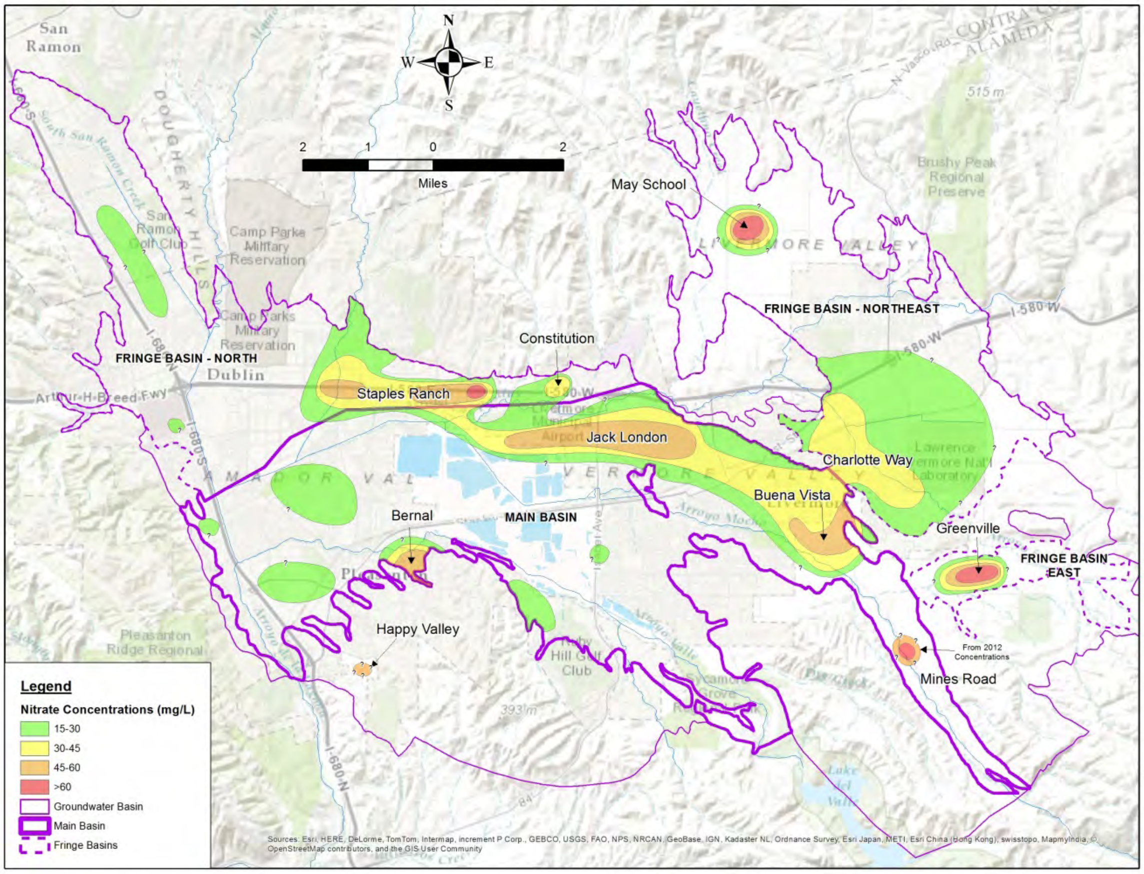
Figure 2-13: Average Nitrate Concentrations and Assimilative Capacities by Basin Area

BASIN AREA	**Average NO_3** (mg/L)	**Basin Objective** (mg/L)	**Assimilative Capacity** (mg/L)
Main Basin	14	45	31
Fringe Basin - North	11	45	34
Fringe Basin – Northeast	15	45	30
Fringe Basin – East	15	45	30

2.4 Areas of Concern

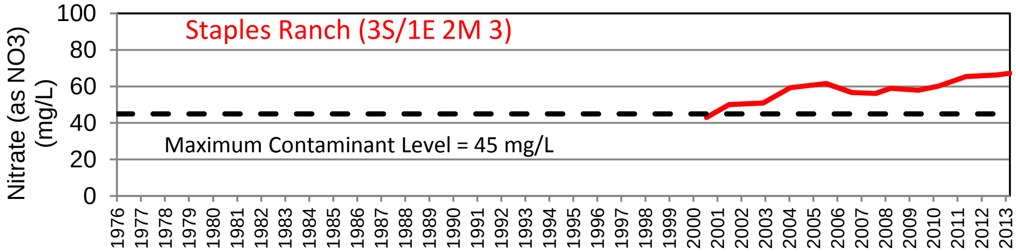
Average nitrate concentrations are well below the BO (45 mg/L) in all four groundwater basin areas in the Livermore Valley Groundwater Basin, however there are ten local Areas of Concern where nitrate concentrations are above the BO. These areas are shown in *Figure 2-14* and *Figure 2-15* and are described below, roughly from West to East. Five of the ten Areas of Concern have a higher-than average density of septic tanks in use, which has led to the development of special requirements for new septic tank applications in these areas. The septic tank management goals and strategies and associated implementation plan for these five Areas of Concern are discussed in detail in *Sections 5.5.2 and 6.1.5.2*.

Figure 2-14: Nitrate Areas of Concern

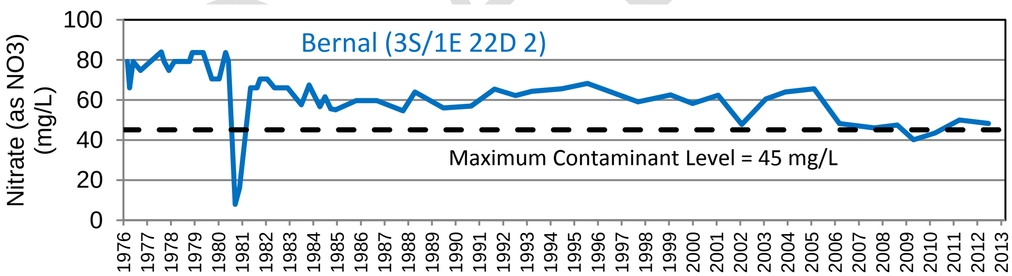


1. **Happy Valley** – The County adopted a moratorium on new septic tanks for the Happy Valley area in the 1970's when several domestic wells tested high for nitrate. There were, and still are, over 100 septic tanks in this unincorporated part of Pleasanton. There are no dedicated monitoring wells in Happy Valley; however, many of the domestic wells have been tested for nitrate since 1973. In 2012, Zone 7 and ACEH conducted voluntary testing of water samples domestic wells in Happy Valley. Seven of the 31 wells had nitrate concentrations that exceeded the maximum contaminant level (MCL) of 45 mg/L, with one reaching 124 mg/L. Most of the high nitrate occurrences were detected in the central portion of this enclosed sub-basin. In a letter dated October 3, 2014, the Local Agency Formation Commission (LAFCO) has asked the City of Pleasanton to report back within six months to the commission on the results of a study to identify how water and sewer services will be provided to the Happy Valley area.

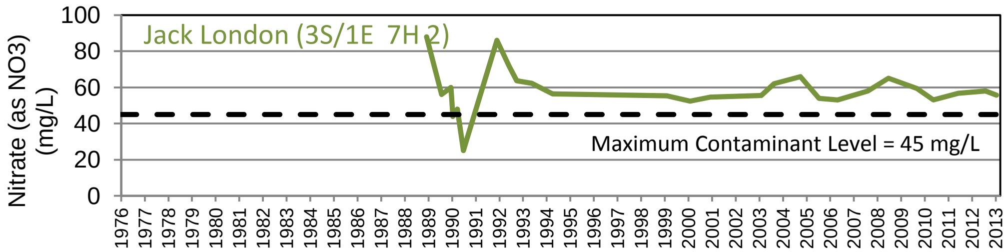
2. **Staples Ranch** – This elongated Area of Concern runs from west to east in the southern portion of the Camp Subbasin in the eastern portion of Dublin. Concentrations have been slowly rising (see graph below) to a maximum concentration 66.43 mg/L in the 2013 Water Year (October 2012 to September 2013). No active nitrogen sources have been identified; however, this may be a remnant of past dairy operations in the area that were discontinued long ago but are slowly migrating toward the monitoring well.



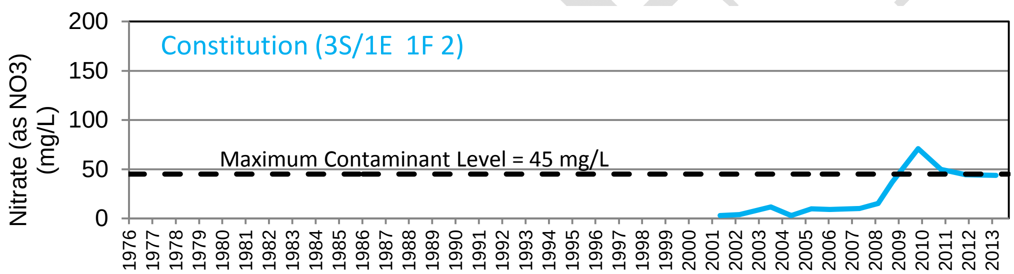
3. **Bernal** – The long-term trend of nitrate concentrations in 3S/1E 22D 2 (in the southern portion of the Amador West Subbasin, see graph below) has been slowly declining, however, recently concentrations have been fluctuating around the MCL. The source of high nitrate and the reason for the fluctuating concentrations has not been identified, but it is speculated that the nitrate may have been entering the Main Basin as hill-front recharge and/or subsurface inflow from the neighboring Livermore Uplands to the south but its source(s) are diminishing as urban development spreads into the Upland area.



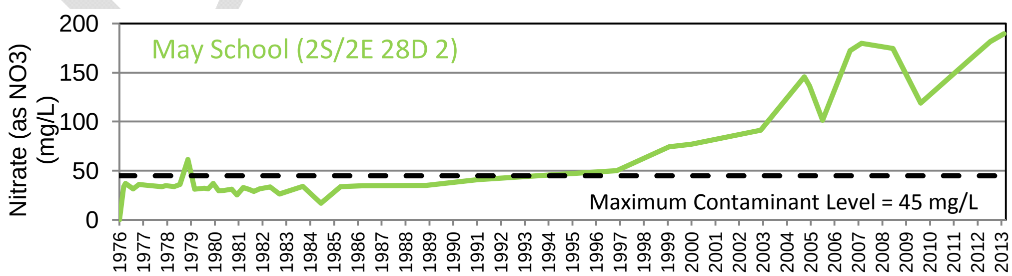
4. **Jack London –** This Area of Concern extends from the eastern portion of the Mocho II Subbasins to the northeastern portion of the Amador Subbasin. Portions of this nitrate plume date back to at least the 1960s. Nitrate concentrations appear to have stabilized at just above the MCL (58 mg/L in 3S/1E 7H 2, see graph below). The sources are believed to be historical municipal wastewater disposal, historical and existing agricultural practices, and historical and current recycled water use.



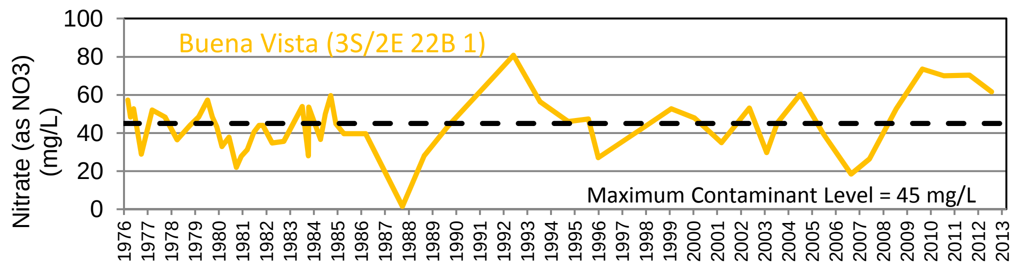
5. **Constitution** – This Area of Concern exists near the boundary of the Mocho II, Camp, and Amador Sub-basins and is up-gradient from the Las Positas Golf Course in Livermore. Nitrate concentrations in 3S/1E 1F 2 (see graph below) show an upward trend; however, concentrations in 3S/1E 2R 1 (see *Figure 2-15*), down-gradient from 3S/1E 1F 2, are relatively stable. The source of the nitrate is unconfirmed but may possibly be from historical septic tanks and agricultural practices, current landscape fertilizer, and/or recycled water use.



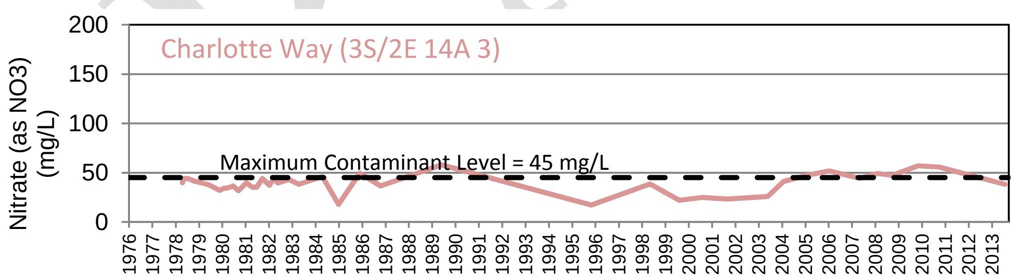
6. **May School** - The highest nitrate concentration detected in the basin is located in the May Subbasin near May School Rd (maximum concentration of 189.54 mg/L in 2013, see graph below). In the 2008 Water Year (October 2007 to September 2008), as part of a one-time water quality study in this area, Zone 7 sampled and analyzed several domestic wells in the area to determine the extent of nitrate contamination. These results (presented in the 2008 Annual Report for the Groundwater Management Program, *Zone 7, 2009*) suggested that the nitrate appeared to be relatively localized with the highest concentration in the vicinity of 2S/2E 28D 2. The source of high nitrate was not identified; however, it likely comes from agricultural land use in that area.



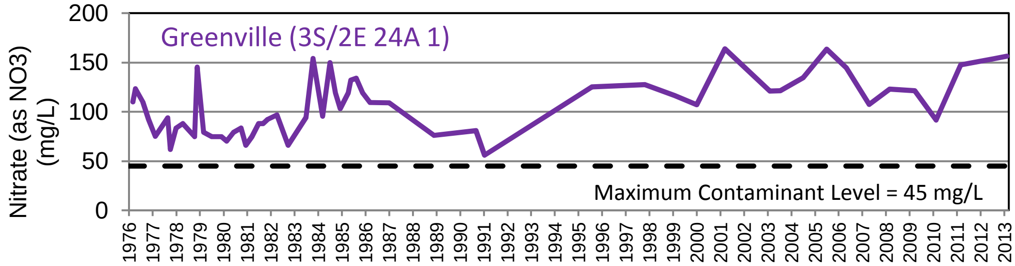
7. **Buena Vista** - This nitrate plume exists in the central and eastern portion of the Mocho II Subbasin. The concentration in 3S/2E 22B 1 (see graph below), near the proximal end of the plume, fluctuates above and below the MCL, but has been above the MCL for the last few years (61.56 mg/L in the 2013 Water Year). The potential sources of the nitrate are existing septic tanks and historical agricultural practices, livestock manure, and composting vegetation. There are over 100 septic tanks still in use near the proximal end of the plume, and documented historical poultry ranching, and crop and floral farming along Buena Vista Avenue. There are also an abundant amount of wineries in the area, although viticulturists use very little nitrate-based fertilizer.



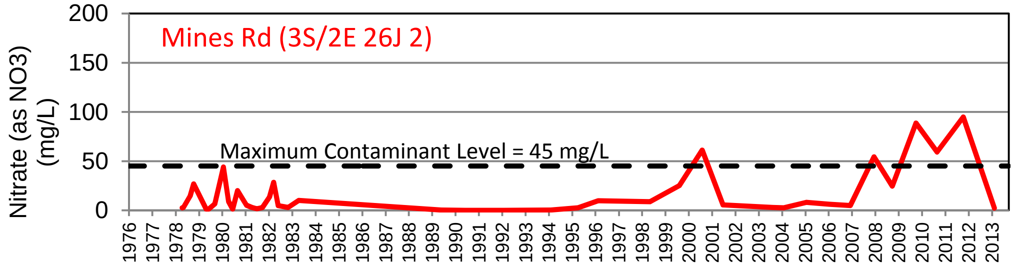
8. **Charlotte Way**- This plume exists in the western portion of the Mocho I Subbasin and may commingle with the Buena Vista Area of Concern in the eastern portion of the Mocho II Subbasin. Nitrate concentrations in 3S/2E 14A 3 (see graph below) have fluctuated above and below the MCL, most recently dropping below the MCL to 38.31 mg/L in the 2013 Water Year. The cause is believed to be historical septic tanks, fertilizer applications, and other agricultural impacts in the Buena Vista area that have migrated down-gradient.



9. **Greenville** – This Area of Concern is represented by a single well located near the corner of Tesla and Greenville Roads. The maximum concentration of nitrate was 163.90 mg/L in 2001 Water Year (October 2000 to September 2001), with a concentration of 156.33 mg/L in the 2013 Water Year (see graph below). The source of nitrate in this well is unconfirmed, but may be from historical chicken farming, and other agricultural land uses located up-gradient of the monitoring well. There is concern for the potential increase in onsite wastewater disposal from future commercial development planned for this area.



10. **Mines Road** – This Area of Concern, which is also represented by a single well (3S/2E 26J 2, see graph below), is located along Mines Road. Nitrate concentrations in this well have fluctuated widely ranging from non-detect to a maximum of 94.77 mg/L in October 2011. The reason for the fluctuations are unknown, but may be related to agriculture and changes in precipitation.



NITRATE AREAS OF CONCERN AND TRENDS

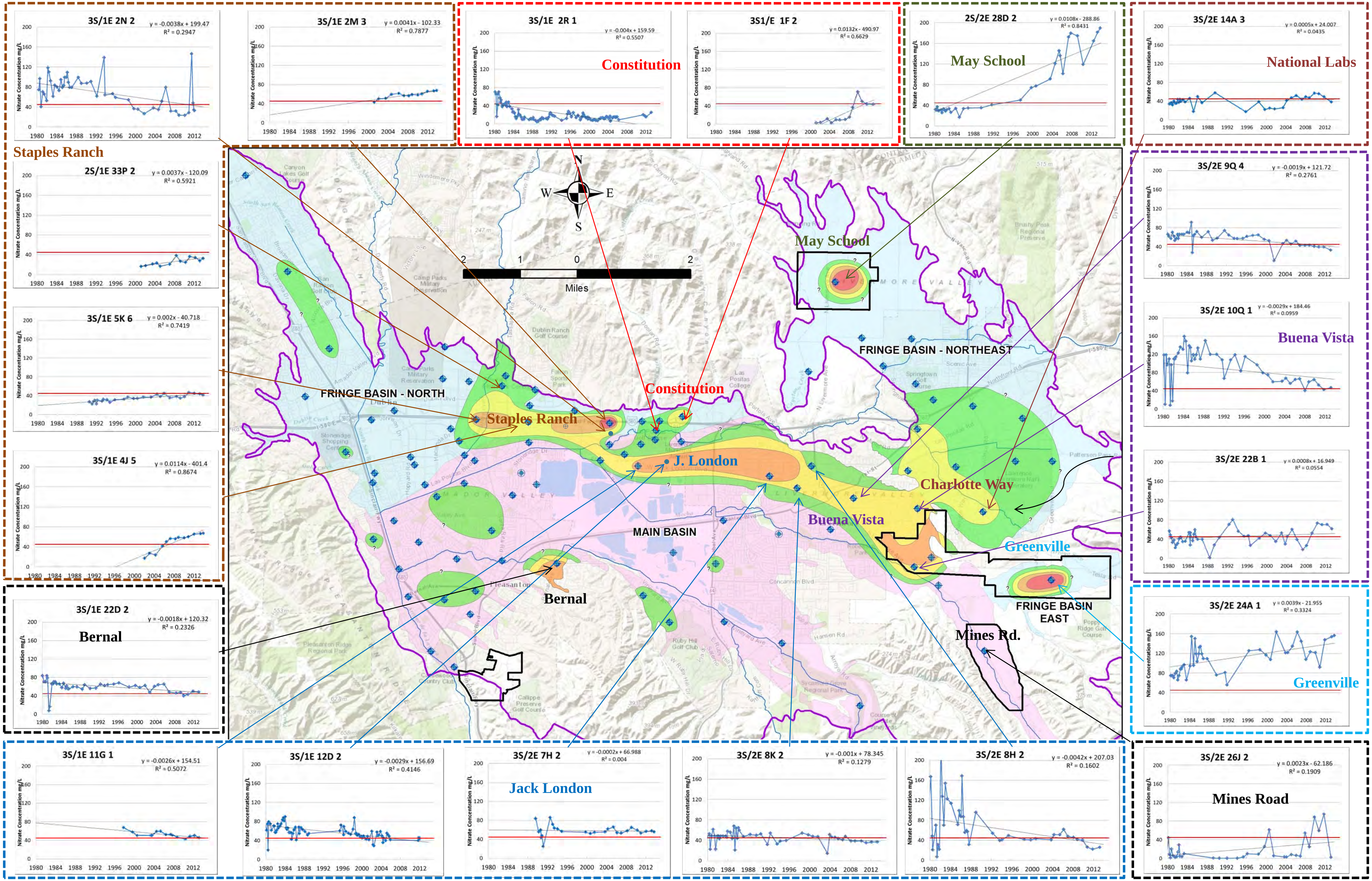


FIGURE 2-15

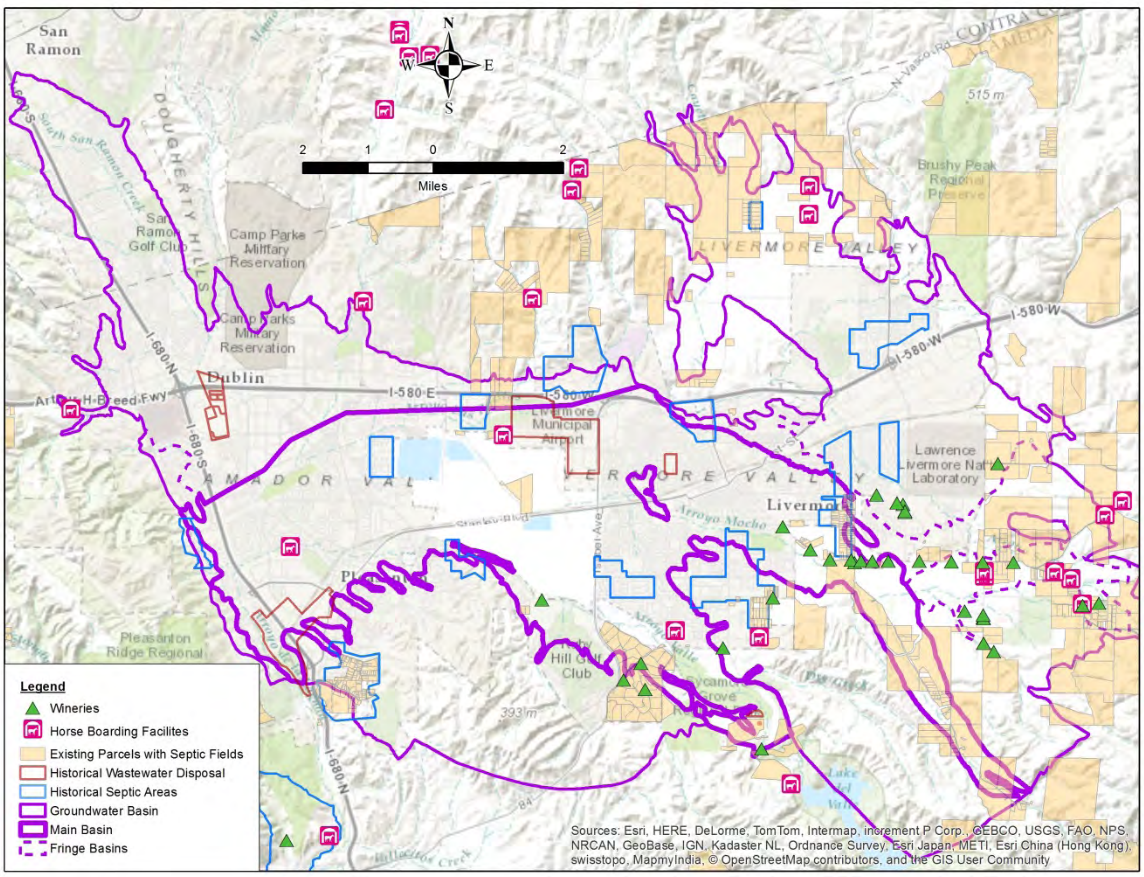
3 Basin Nutrient Evaluation

3.1 Historical Sources of Nitrate

The most significant historical sources of nitrate in the basin (shown in *Figure 3-1*) are from:

- Composting vegetation (buried and surficial)
- Municipal wastewater and sludge disposal
- Septic tanks
- Concentrated animal boarding/ranching (horse boarding, chicken and/or cattle ranching)
- Applied fertilizers (crops and landscape)

Figure 3-1: Historical and Existing Sources of Nitrate



Many of the contributing activities are still active today, however in much smaller quantities. Fertilizer application areas are not shown in *Figure 3-1* because records of fertilizer applications were not available for this plan and therefore are assumed.

3.2 Conceptual Model

3.2.1 Fate and Transport of Nitrate

To determine if groundwater nitrate concentrations will rise or drop over the long-term, one must calculate the net nitrate loading on the groundwater basin. However, net nitrate loading is difficult to calculate because nitrate readily converts to and from other nitrogen compounds (e.g., nitrite, ammonia, elemental nitrogen) in the unsaturated soil zone. Therefore, it is common to use total nitrogen as the metric for determining potential net nitrate loading.

The fate and transport of nitrogen compounds in the unsaturated zone is complex, with transformation, attenuation, uptake, and leaching in various environments. The following excerpt is from *Moran, et al, 2011*.

> *Nitrogen may be applied to crops in various forms such as animal manure, anhydrous ammonia, urea, ammonium sulfate, calcium nitrate, or ammonium nitrate, but all forms may eventually be converted to nitrate and transported away from the shallow soil zone to streams or groundwater. Denitrification, which converts nitrate to nitrogen or nitrous oxide gas, can mitigate nitrate loading to streams and groundwater, and can occur in any zone where certain geochemical conditions are met, viz. low oxygen, the presence of an electron donor such as organic carbon or reduced sulfur, and a population of denitrifying bacteria. The hyporheic zone of streams, riparian buffer zones, poorly drained soils, and saturated zones with low dissolved oxygen are all environments where bacteria are generally present and conditions favorable for denitrification may exist.*

However, once in the saturated groundwater zone, nitrogen is relatively stable, and primarily exists as nitrate. Some denitrification can occur in the saturated zone, but not readily in the oxygen-rich conditions that are so common in the shallow aquifers of the Livermore Valley Groundwater Basin. Since nitrate is soluble in water, it is transported with the groundwater through the aquifers.

3.2.2 Methodology

3.2.2.1 Introduction

To calculate the net nitrogen loading, Zone 7 sums the current nitrogen loading from all the sources and removal components, which are shown in *Figure 3-2* below.

Figure 3-2: Existing Nitrogen Sources and Removal

NITROGEN SOURCES	NITROGEN REMOVAL
Stream Recharge	Soil Processes
Rainfall Recharge	• Denitrification
Pipe Leakage	• Soil texture (absorption)
Subsurface Inflow	• Plant Uptake
Horse Boarding (manure)	Groundwater Pumping (wastewater export)
Rural (septic and livestock manure)	Mining Export
Winery (septic and process water)	Subsurface Outflow
Applied water (well water and recycled)	
Fertilizers (agriculture and turf)	

In most cases, nitrogen loading from each component above (e.g., stream recharge, rainfall recharge, pipe leakage, etc.) can be quantified by multiplying water volume, which Zone 7 calculates annually as part of its groundwater inventory, by the concentration of nitrogen compounds in the water. For example, to calculate the nitrogen loading from stream recharge, the volume of stream recharge is multiplied by the average nitrate concentration in the stream water.

3.2.2.2 Manure, Septic, and Wastewater

To calculate the nitrogen loading from horse boarding facilities, rural properties with septic systems, and wineries; Zone 7 calculated the number of facilities or properties from aerial photographs and land use data and then applied a nitrogen loading rate per facility/property, obtained from literature review and shown on *Figure 3-3* below.

Figure 3-3: Nitrogen Loading Rates from Horse Boarding, Rural Properties, and Wineries

LAND USE CATEGORY	Nitrogen Loading lbs/acre-yr
Horse Boarding (Manure)	75
Rural (Septic and Manure)	49
Wineries (septic & process water) Small (per facility/yr)	54
Medium (per facility/yr)	200
Large (per facility/yr)	355

3.2.2.3 Irrigation and Fertilizer Application

Nitrogen loading from fertilized irrigation (fertigation) and the corresponding removal from soil processes (evapotranspiration, denitrification, soil absorption, and plant uptake) was estimated by using the following formula (where N = nitrogen):

Leached N to Groundwater = N from Applied Fertilizer + N in Source Water – N lost in Soil

*N from Applied Fertilize*r is calculated by using land use estimates for irrigated acreage, irrigation season, and fertilizer application rates:

N from Applied Fertilizer = Percentage Irrigated Area x Time Irrigated x N Application Rate

The land use values for irrigation are listed below in *Figure 3-4*:

Figure 3-4: Nitrogen Loading Rates from Fertilized Irrigation by Land Use

LAND USE CATEGORY	**Irrigation Constants**		**Applied Nitrogen Fertilizer Application**
	Irrigated Area[1] %	**Irrigation Season** Months	lbs N/irr acre
Agriculture - Other	72%	Apr - Sep	133
Agriculture - Vineyard	48%	Apr - Sep	29
Golf Course	60%	Oct - Sep	91
Mining Area Other	0%	NA	0
Mining Area Pit	0%	NA	0
Mining Area Pond	0%	NA	0
Open Space	0%	NA	0
Public (Schools, Government Bldgs, etc.)	10%	Oct - Sep	91
Roads	0%	NA	0
Rural Residential	1%	Oct - Sep	91
Urban Commercial and Industrial	10%	Oct - Sep	91
Urban Park	49%	Oct - Sep	91
Urban Residential High Density	27%	Oct - Sep	91
Urban Residential Low Density	8%	Oct - Sep	91
Urban Residential Medium Density	32%	Oct - Sep	91
Water	0%	NA	0

N from Source Water is calculated using estimated water application rates by land use and source water concentration. Zone 7 calculated average water application rates by land use (see *Figure 3-5* below, in units per acre of land use and per acre of irrigated area) using its areal recharge spreadsheet model which calculates applied water recharge (along with rainfall recharge and unmetered groundwater pumping) for the Main Basin and Fringe Basin North. The model uses rainfall, evaporation, soil type, irrigation efficiency, pervious area, pervious area irrigated, and irrigation season to calculate applied water rates for 500 ft by 500 ft cells that correspond to those used in Zone 7's groundwater model.

Figure 3-5: Source Water Application Rates from Irrigation by Land Use

LAND USE CATEGORY	**Water Application Rate** AF/acre	**Water Application Rate** AF/irr acre
Agriculture - Other	0.7	1.0
Agriculture - Vineyard	0.6	1.3
Golf Course	1.1	1.8
Public (Schools, Government Bldgs, etc.)	0.5	5
Rural Residential	0.6	6
Urban Commercial and Industrial	0.3	3
Urban Park	1.1	2.2
Urban Residential High Density	0.7	2.6
Urban Residential Low Density	0.4	5
Urban Residential Medium Density	1.0	3.1

The concentration of the source water was calculated using data collected as part of Zone 7's groundwater annual monitoring programs. The concentration ranges for the last ten years and the average used in the calculations is presented below in *Figure 3-6*.

Figure 3-6: Nitrate Concentrations in Irrigation Source Water

Water Type	**NO_3 Range mg/L**	**NO_3 Average mg/L**
Delivered (municipal)	ND-19.8	3.6
Groundwater (supply wells)	ND-147	23.3
Recycled water*	108-196	152

**All nitrogen from NO_3, NO_2, and TKN assumed to convert to nitrate.*
ND = Not Detected above the Detection Limit

Nitrate concentrations for recycled water in the Valley are usually below detection limits, however other compounds (nitrite, ammonia, and organic nitrogen) contain nitrogen and can be converted to nitrate in the subsurface. Zone 7 assumed that all the nitrogen from these compounds has the potential to convert to nitrate. This is likely not the case, but provides a conservative upper limit of possible nitrate accumulation in the groundwater basin. Also, for this evaluation, it was assumed that for certain land uses (e.g., commercial, agriculture), professional landscapers will reduce the volume of applied fertilizer to account for the nitrogen in the source water.

For this study, the *N Lost in Soil* from evapotranspiration, denitrification, soil absorption, and plant uptake is assumed to be 90% of the nitrogen applied (*Horsley Witten Group, 2009*).

3.3 Nitrogen Loading Calculations

3.3.1 Current Nitrogen Loading

To calculate current nitrogen loading, Zone 7 applied the methodology described in *Section 3.2.2* using the following data sets:

- Daily precipitation for an average year
- Daily evaporation for an average year
- 2013 Land-Use (shown in *Figure 3-7*)
- 2013 Source Water Distribution (shown in *Figure 3-8*)

Figure 3-7: 2013 Land Use

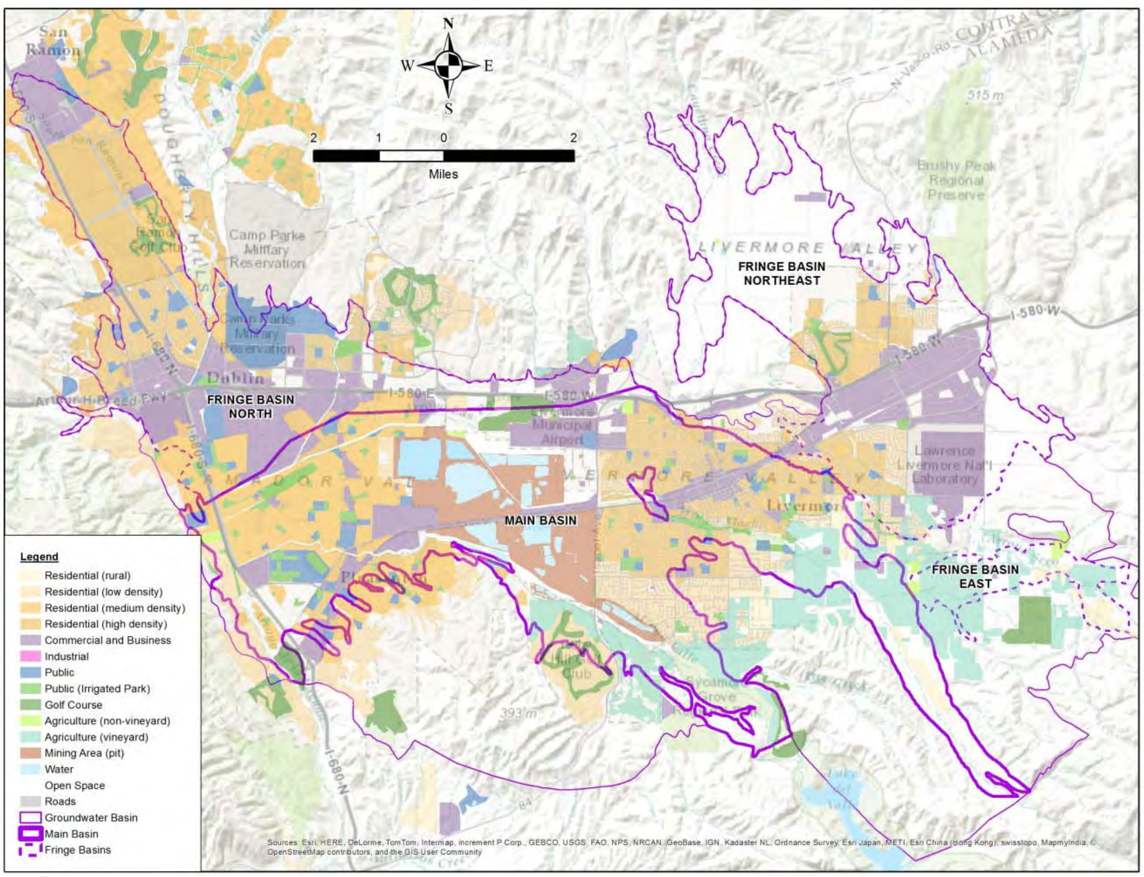
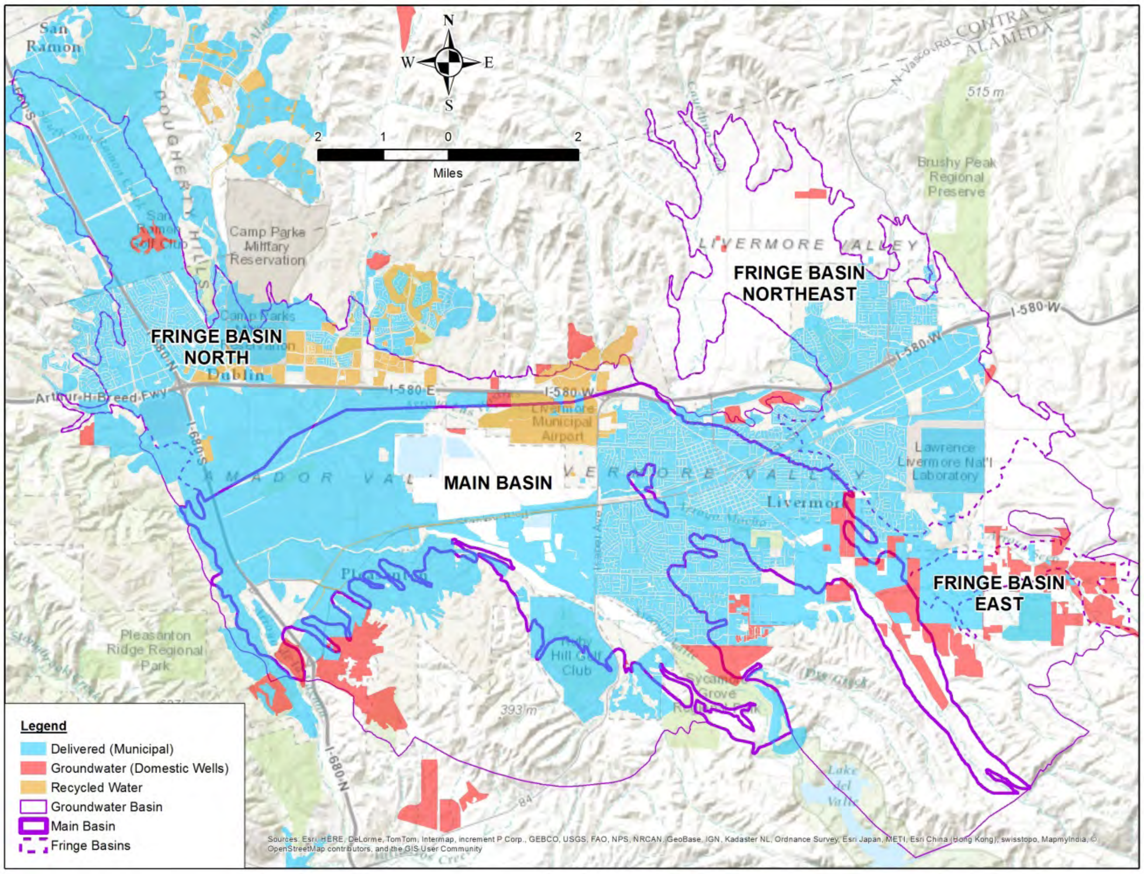
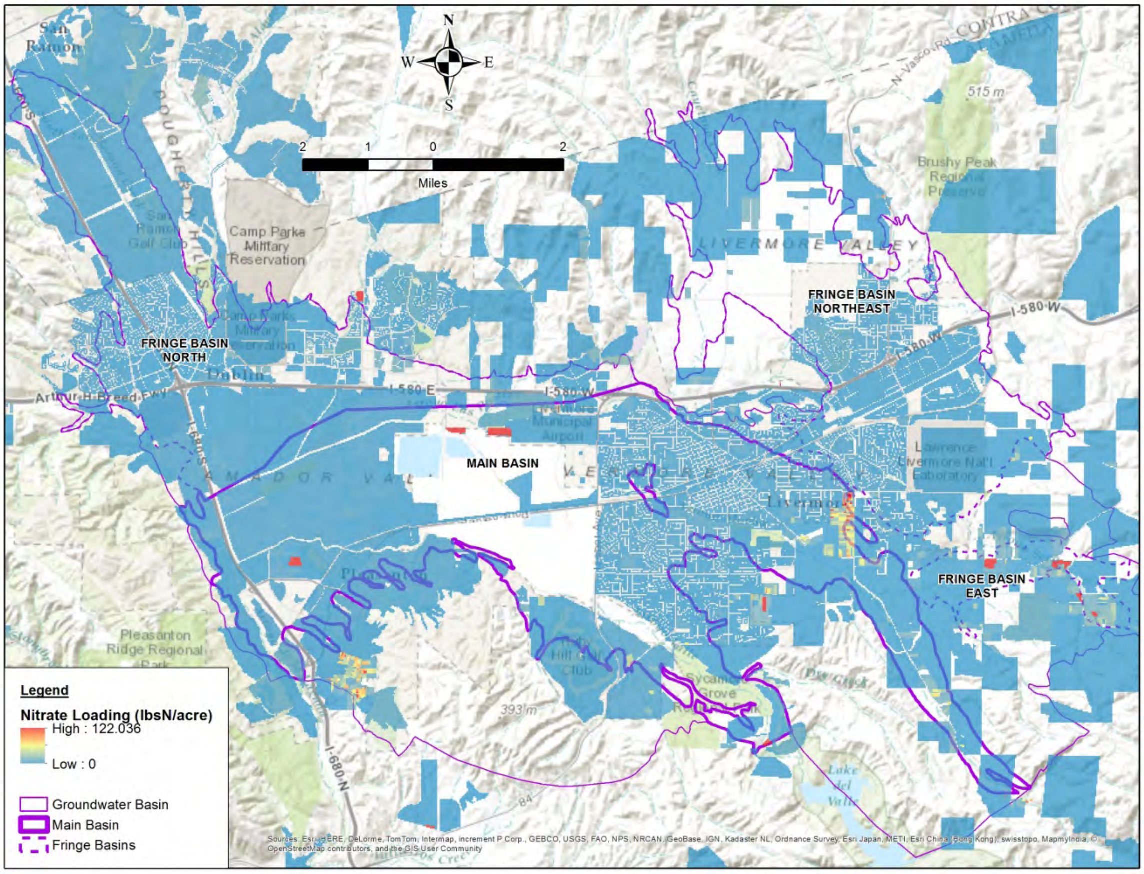


Figure 3-8: 2013 Source Water Distribution



The resulting total current nitrogen loading from all sources is shown on the map in *Figure 3-9* below.

Figure 3-9: Total Nitrate Loading (in lbs N/acre)



The net nitrogen loading from each component (loading and removal) is shown by basin area in *Figure 3-10* and is summarized in *Figure 3-11* below:

FIGURE 3-10
NET NITROGEN LOADING BY BASIN
CURRENT LAND USE WITH AVERAGE RAINFALL

	MAIN BASIN					FRINGE BASIN (NORTH)					FRINGE BASIN (NORTHEAST)					FRINGE BASIN (EAST)				
COMPONENTS	**Units**		**Concentration or Rate**		**N Loading lbs N/yr**	**Units**		**Concentration or Rate**		**N Loading lbs N/yr**	**Units**		**Concentration or Rate**		**N Loading lbs N/yr**	**Units**		**Concentration or Rate**		**N Loading lbs N/yr**
LOADING	**18,795**	**AF**	**6**	**mg/L**	**74,216**	**3,300**	**AF**	**11**	**mg/L**	**23,471**	**3,105**	**AF**	**5**	**mg/L**	**10,379**	**517**	**AF**	**23**	**mg/L**	**7,477**
Stream Recharge	10,895	AF	1	mg/L	8,398	150	AF	4	mg/L	326	1,049	AF	1	mg/L	668	100	AF	1	mg/L	62
Nat Stream Recharge	*5,700*	*AF*	*0.94*	*mg/L*	*3,315*	*150*	*AF*	*3.50*	*mg/L*	*326*	*999*	*AF*	*1.00*	*mg/L*	*619*	*100*	*AF*	*1.00*	*mg/L*	*62*
AV Prior Rights	*900*	*AF*	*1.58*	*mg/L*	*881*															
Art Stream Recharge	*4,295*	*AF*	*1.58*	*mg/L*	*4,202*						*50*		*1.58*	*mg/L*	*49*					
Rainfall Recharge	4,300	AF	0.50	mg/L	1,333	1,486	AF	0.50	mg/L	461	960	AF	0.50	mg/L	298	276	AF	0.50	mg/L	86
Leakage	1,000	AF	21	mg/L	13,020	485	AF	21	mg/L	6,309	50	AF	21	mg/L	651	10	AF	21	mg/L	130
Applied Water	1,600	AF	39	mg/L	38,431	1,180	AF	22	mg/L	16,375	1,046	AF	14	mg/L	8,762	130	AF	89	mg/L	7,199
Irrigation (fertilizer)					*23,452*					*15,836*					*5,964*					*864*
Horse Boarding	*52*	*acre*	*75*	*lbs/acre*	*3,914*	*0*	*acre*	*75*	*lbs/acre*	*0*	*0*	*acre*	*75*	*lbs/acre*	*0*	*40*	*acre*	*75*	*lbs/acre*	*2,978*
Rural Septic/Manure	*186*	*properties*	*49*	*lbs/prop*	*9,114*	*11*	*properties*	*49*	*lbs/prop*	*539*	*56*	*properties*	*49*	*lbs/prop*	*2,744*	*63*	*properties*	*49*	*lbs/prop*	*3,087*
Winery Large	*3*	*wineries*	*355*	*lbs/winery*	*1,065*	*0*	*wineries*	*355*	*lbs/winery*	*0*	*0*	*wineries*	*355*	*lbs/winery*	*0*	*0*	*wineries*	*355*	*lbs/winery*	*0*
Winery Medium	*2*	*wineries*	*200*	*lbs/winery*	*400*	*0*	*wineries*	*200*	*lbs/winery*	*0*	*0*	*wineries*	*200*	*lbs/winery*	*0*	*0*	*wineries*	*200*	*lbs/winery*	*0*
Winery Small	*9*	*wineries*	*54*	*lbs/winery*	*486*	*0*	*wineries*	*54*	*lbs/winery*	*0*	*1*	*wineries*	*54*	*lbs/winery*	*54*	*5*	*wineries*	*54*	*lbs/winery*	*270*
Subsurface Inflow	1,000	AF	21.02	mg/L	13,034	0	AF	0.44	mg/L	0	0	AF	0.44	mg/L	0	0	AF	0.44	mg/L	0
REMOVAL	**-18,795**	**AF**	**10**	**mg/L**	**-122,235**	**-3,300**	**AF**	**8**	**mg/L**	**-17,236**	**-3,105**	**AF**	**14**	**mg/L**	**-26,777**	**-517**	**AF**	**15**	**mg/L**	**-4,804**
Zone 7 Pumping	-5,940	AF	18.30	mg/L	-67,390															
Retailer Pumping	-6,570	AF	10.78	mg/L	-43,921															
Ag Pumping	-400	AF	9.32	mg/L	-2,310	-133	AF	0.44	mg/L	-36	-53	AF	15.00	mg/L	-493	-21	AF	15.00	mg/L	-195
Other Pumping	-1,185	AF	11.17	mg/L	-8,205															
Mining Losses	-4,600	AF	0.13	mg/L	-382															
Subsurface Outflow	-100	AF	0.44	mg/L	-27	-3,166	AF	8.76	mg/L	-17,200	-3,052	AF	13.89	mg/L	-26,284	-496	AF	15.00	mg/L	-4,608
Subsurface to Streams						*-2,166*	*AF*	*3.10*	*mg/L*	*-4,166*	*-3,052*	*AF*	*13.89*	*mg/L*	*-26,284*	*-496*	*AF*	*15.00*	*mg/L*	*-4,608*
Subsurface to MB						*-1,000*	*AF*	*21.02*	*mg/L*	*-13,034*										
NET NITROGEN LOADING					**-48,019**					**6,234**					**-16,398**					**2,674**

Figure 3-11: Summary of Current Total Nitrogen Loading and Removal

BASIN AREA	**N LOADING** lbs N/yr	**N REMOVAL** lbs N/yr	**NET N LOADING** lbs N/yr
Main Basin	74,216	- 122,235	- 48,019
Fringe Basin North	23,471	-17,236	6,234
Fringe Basin Northeast	10,379	- 26,777	- 16,398
Fringe Basin East	7,477	- 4,804	2,674

The largest source of nitrogen for the basin areas is irrigation (32% to 67% of total loading), with the exception of the Fringe Basin East, where nitrogen loading from irrigation is only 12% of total loading. In the Fringe Basin East, nitrogen loading is predominantly from horse boarding facilities (40%) and septic tanks (41%). Septic tanks also contribute a significant source of nitrogen (26%) in the Fringe Basin Northeast.

The largest removal of nitrogen in the Main Basin is from groundwater pumping (99.7%). In the Fringe Basin areas, where there is little groundwater pumping, the majority of nitrogen removal is from subsurface outflow (95% to 99.8%). However, because there are no wells down-gradient of the Fringe Basin East, the nitrate concentration of the subsurface outflow is unknown. For the calculations presented in *Figure 3-10,* Zone 7 used the average concentration of the basin.

In the Main Basin the net nitrogen loading is negative because of nitrogen removal by groundwater pumping. In the Fringe Basin Northeast the net nitrogen loading is also negative primarily because of high nitrate concentrations in the subsurface outflow. However, the net annual nitrogen loading is increasing in the Fringe Basin North and Fringe Basin East because there is little groundwater pumping or subsurface outflow and no other major nitrogen removal mechanisms.

3.3.2 Future Nitrate Loading

The planning horizon for this study is 2050, which is close to when "buildout" of the cities is currently projected. At "buildout," the following land use changes are expected to be completed:

- Aggregate mining activities, converting to other uses.
- Urban development per Municipal General Plans
- South Livermore Plan development
- Recycled water project expansions

To calculate nitrogen loading at "buildout," Zone 7 applied the methodology described in *Section 3.2.2* using the following data sets:

- Daily precipitation for an average year
- Daily evaporation for an average year
- Land-Use at Buildout (shown in *Figure 3-12* below)
- Source Water Distribution at Buildout (shown in *Figure 3-13* below)

Figure 3-12: Land Use at Buildout

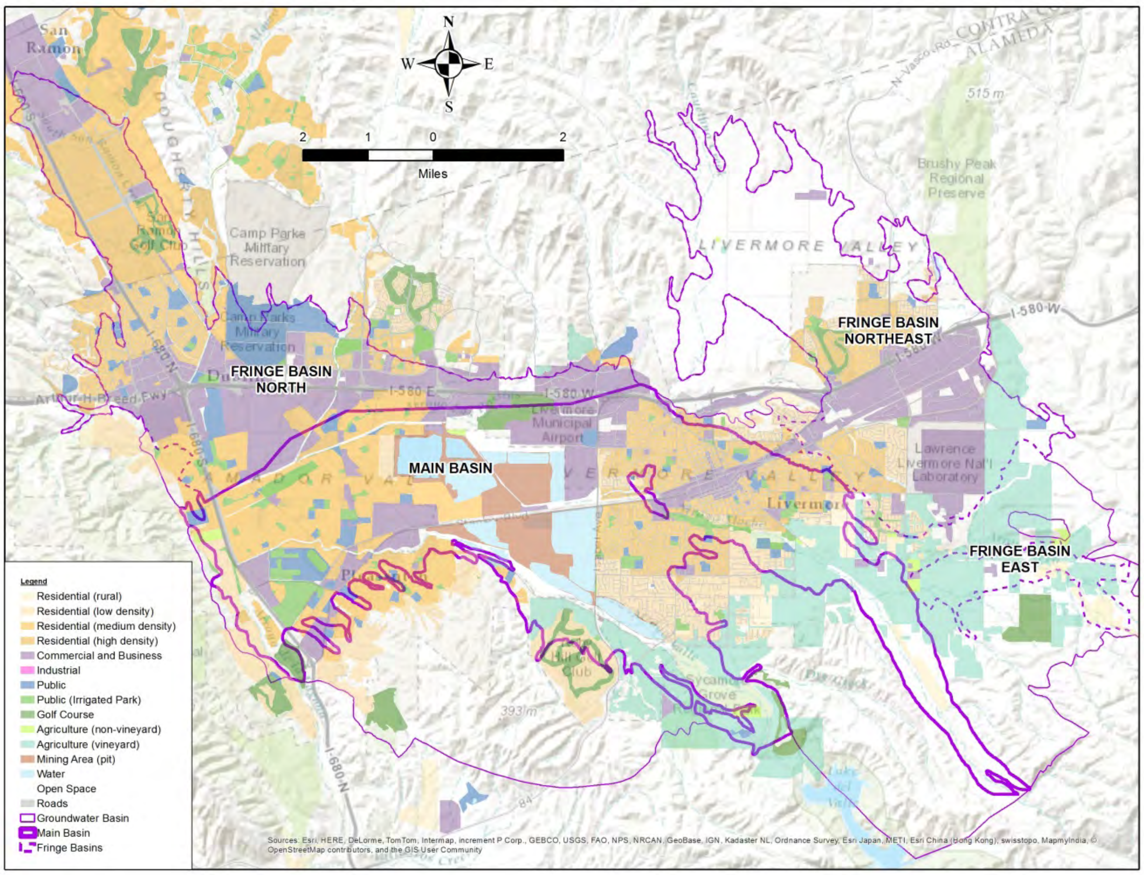
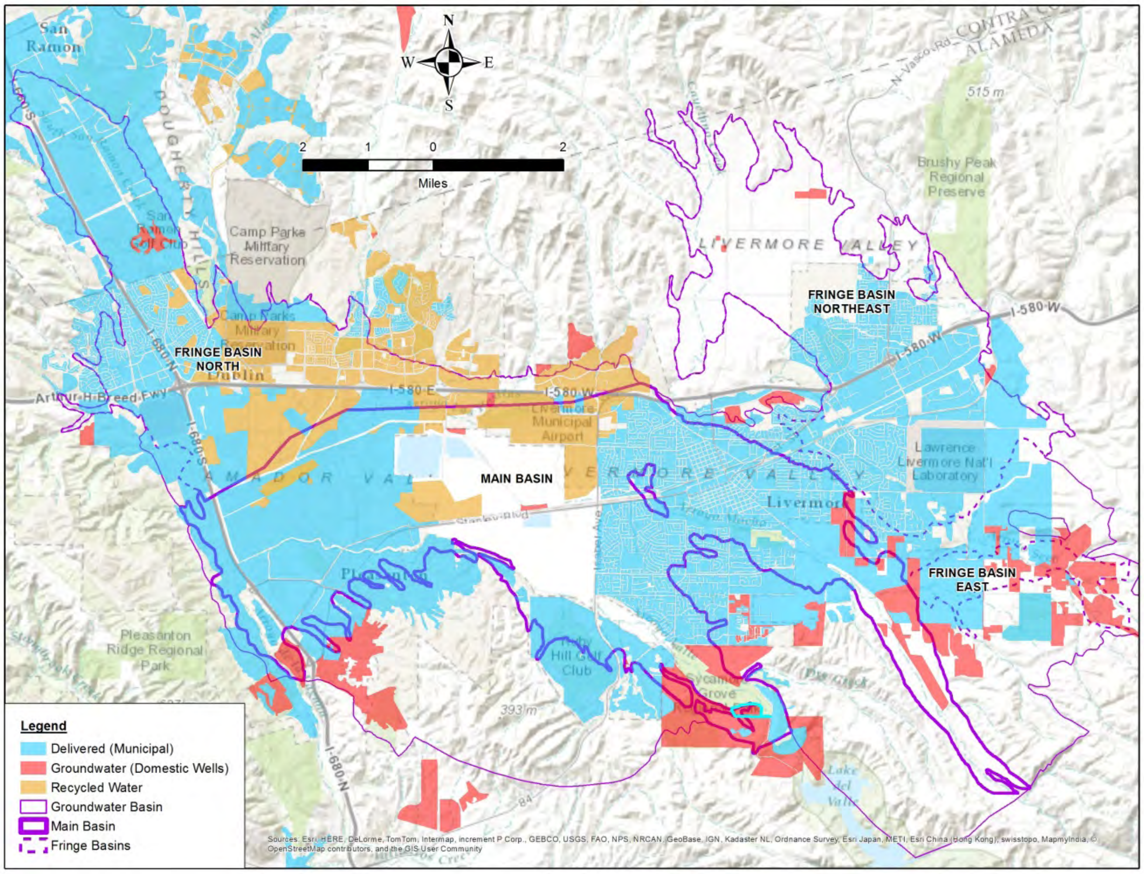


Figure 3-13: Source Water Distribution at Buildout



The net nitrogen loading from each component (loading and removal) is shown by basin area in *Figure 3-14* and is summarized in *Figure 3-15* below:

FIGURE 3-14
NET NITROGEN LOADING BY BASIN
LAND USE AT BUILDOUT WITH AVERAGE RAINFALL

	MAIN BASIN					FRINGE BASIN (NORTH)					FRINGE BASIN (NORTHEAST)					FRINGE BASIN (EAST)				
COMPONENTS	**Units**		**Concentration or Rate**		**N Loading lbs N/yr**	**Units**		**Concentration or Rate**		**N Loading lbs N/yr**	**Units**		**Concentration or Rate**		**N Loading lbs N/yr**	**Units**		**Concentration or Rate**		**N Loading lbs N/yr**
LOADING	**17,395**	**AF**	**7**	**mg/L**	**78,595**	**3,300**	**AF**	**13**	**mg/L**	**26,430**	**3,105**	**AF**	**6**	**mg/L**	**11,814**	**517**	**AF**	**27**	**mg/L**	**8,628**
Stream Recharge	9,495	AF	1	mg/L	7,028	150	AF	4	mg/L	326	1,049	AF	1	mg/L	668	100	AF	1	mg/L	62
Nat Stream Recharge	*5,700*	*AF*	*0.94*	*mg/L*	*3,315*	*150*	*AF*	*3.50*	*mg/L*	*326*	*999*	*AF*	*1.00*	*mg/L*	*619*	*100*	*AF*	*1.00*	*mg/L*	*62*
AV Prior Rights	*900*	*AF*	*1.58*	*mg/L*	*881*															
Art Stream Recharge	*2,895*	*AF*	*1.58*	*mg/L*	*2,833*						*50*		*1.58*	*mg/L*	*49*					
Rainfall Recharge	4,300	AF	0.50	mg/L	1,333	1,486	AF	0.50	mg/L	461	960	AF	0.50	mg/L	298	276	AF	0.50	mg/L	86
Leakage	1,000	AF	21	mg/L	13,020	485	AF	21	mg/L	6,309	50	AF	21	mg/L	651	10	AF	21	mg/L	130
Applied Water	1,600	AF	45	mg/L	44,180	1,180	AF	26	mg/L	19,335	1,046	AF	16	mg/L	10,197	130	AF	103	mg/L	8,350
Irrigation (fertilizer)					*29,201*					*18,796*					*6,369*					*985*
Horse Boarding	*52*	*acre*	*75*	*lbs/acre*	*3,914*	*0*	*acre*	*75*	*lbs/acre*	*0*	*0*	*acre*	*75*	*lbs/acre*	*0*	*40*	*acre*	*75*	*lbs/acre*	*2,978*
Rural Septic/Manure	*186*	*properties*	*49*	*lbs/prop*	*9,114*	*11*	*properties*	*49*	*lbs/prop*	*539*	*66*	*properties*	*49*	*lbs/prop*	*3,234*	*73*	*properties*	*49*	*lbs/prop*	*3,577*
Winery Large	*3*	*wineries*	*355*	*lbs/winery*	*1,065*	*0*	*wineries*	*355*	*lbs/winery*	*0*	*0*	*wineries*	*355*	*lbs/winery*	*0*	*0*	*wineries*	*355*	*lbs/winery*	*0*
Winery Medium	*2*	*wineries*	*200*	*lbs/winery*	*400*	*0*	*wineries*	*200*	*lbs/winery*	*0*	*0*	*wineries*	*200*	*lbs/winery*	*0*	*0*	*wineries*	*200*	*lbs/winery*	*0*
Winery Small	*9*	*wineries*	*54*	*lbs/winery*	*486*	*0*	*wineries*	*54*	*lbs/winery*	*0*	*11*	*wineries*	*54*	*lbs/winery*	*594*	*15*	*wineries*	*54*	*lbs/winery*	*810*
Subsurface Inflow	1,000	AF	21.02	mg/L	13,034						0	AF	0.44	mg/L	0	0	AF	0.44	mg/L	0
REMOVAL	**-17,395**	**AF**	**8**	**mg/L**	**-81,224**	**-3,300**	**AF**	**8**	**mg/L**	**-17,236**	**-3,105**	**AF**	**14**	**mg/L**	**-26,777**	**-517**	**AF**	**16**	**mg/L**	**-5,202**
Zone 7 Pumping	-5,940	AF	12.19	mg/L	-44,905															
Retailer Pumping	-6,570	AF	7.18	mg/L	-29,267															
Ag Calculated	-400	AF	6.21	mg/L	-1,539	-133	AF	0.44	mg/L	-36	-53	AF	15.00	mg/L	-493	-21	AF	16.25	mg/L	-212
Other Pumping	-1,185	AF	7.47	mg/L	-5,486															
Mining Losses	-3,200	AF	0.00	mg/L	0															
Subsurface Outflow	-100	AF	0.44	mg/L	-27	-3,166	AF	8.76	mg/L	-17,200	-3,052	AF	13.89	mg/L	-26,284	-496	AF	16.25	mg/L	-4,991
Subsurface to Streams						*-2,166*	*AF*	*3.10*	*mg/L*	*-4,166*	*-3,052*	*AF*	*13.89*	*mg/L*	*-26,284*	*-496*	*AF*	*16.25*	*mg/L*	*-4,991*
Subsurface to MB						*-1,000*	*AF*	*21.02*	*mg/L*	*-13,034*										
NET NITROGEN LOADING					**-2,629**					**9,194**					**-14,963**					**3,426**

Figure 3-15: Summary of Total Nitrogen Loading and Removal at Buildout

BASIN	N LOADING (lbs N/yr)	N REMOVAL (lbs N/yr)	NET N LOADING (lbs N/yr)
Main Basin	78,595	- 81,224	- 2,629
Fringe Basin North	26,430	-17,236	9,194
Fringe Basin Northeast	11,814	-26,777	-14,963
Fringe Basin East	8,628	-5,202	3,426

At "buildout," the largest components of loading and removal of nitrogen are the same as those currently, with only slight percentage changes. The largest source of nitrogen loading for the basin areas is irrigation (37% to 71% of total loading, a slight increase over the current 32% to 67%), with the exception of the Fringe Basin East, where nitrogen loading from irrigation is only 11% of total loading (12% currently). In the Fringe Basin East, nitrogen loading is predominantly from horse boarding facilities (34%, compared to 40% currently) and septic tanks (42%, compared to 41% currently). Septic tanks also contribute a significant source of nitrogen (28%, compared to 26% currently) in the Fringe Basin Northeast.

The largest removal of nitrogen in the Main Basin is predicted to be from groundwater pumping (99.98%, currently 99.7%). In the Fringe Basin areas, where there is little groundwater pumping, the majority of nitrogen removal will be from subsurface outflow (95% to 99.8%, same as current). However, because there are no wells down-gradient of the Fringe Basin East, the nitrate concentration of the subsurface outflow is unknown. For the calculations presented in *Figure 3-14*, Zone 7 used the average concentration of the basin.

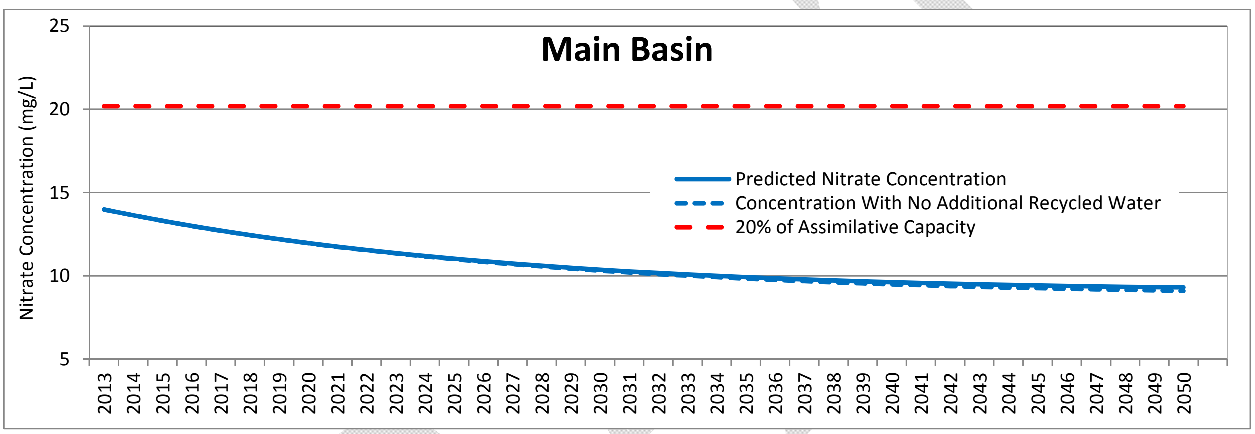
At "buildout," the net nitrogen loading in the Main Basin will continue to be negative because of nitrogen removal by groundwater pumping. In the Fringe Basin Northeast the net nitrogen loading will continue to be negative primarily because of high nitrate concentrations in the subsurface outflow. However, the net annual nitrogen loading will continue to be positive in the Fringe Basin North and Fringe Basin East because there is little groundwater pumping or subsurface outflow and no other major nitrogen removal mechanisms.

3.4 Projected Nitrate Concentrations

Zone 7 created a spreadsheet model to estimate future nitrogen concentrations for the four basin areas. These are presented and discussed by basin area below. Also shown on the graphs for the Main Basin and Fringe Basin North, where the recycled water irrigation projects are planned, are the predicted concentrations if there were no additional recycled water irrigation projects. According to the Recycled Water Policy, a recycled water irrigation project must use less than 10% of the available assimilative capacity or multiple projects must use less than 20% of available assimilative capacity. Since there are three planned recycled water projects in the Valley (by DSRSD, Livermore, and Pleasanton), the results are assessed relative to 20% of the available assimilative capacity.

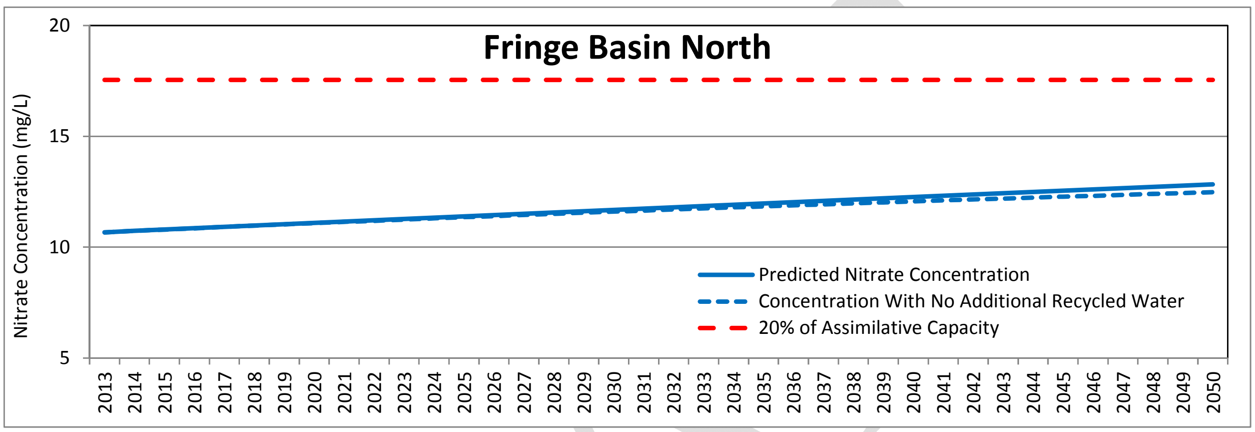
Nitrate concentrations in the Main Basin are expected to drop (see *Figure 3-16* below) primarily because of the removal of nitrates by groundwater pumping. The graph below also shows that there is only a minor expected increase in concentrations (<1 mg/L) from future planned recycled water, primarily because it is assumed that for the majority of land uses, nitrogen loading from the recycled water irrigation projects will be offset by reduced fertilizer application (*Section 3.2.2*).

Figure 3-16: Predicted Nitrate Concentrations in Main Basin



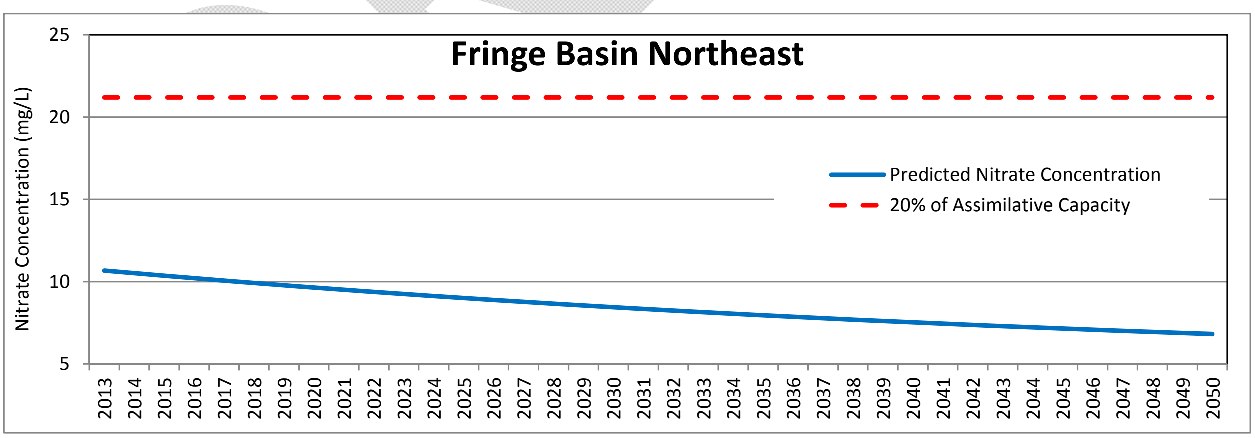
While net nitrate loading is positive in the Fringe Basin North, the total nitrogen loading increase is small relative to the overall volume of water in the basin. Therefore concentrations are only expected to rise slightly (about 2 mg/L) and are not expected to approach the limit of 20% of the assimilative capacity (see *Figure 3-17* below). Also, there is only a minor expected increase in concentrations (<1 mg/L) from future planned recycled water, primarily because the nitrogen loading from the recycled water irrigation projects will be offset by reduced fertilizer application.

Figure 3-17: Predicted Nitrate Concentrations in Fringe Basin North



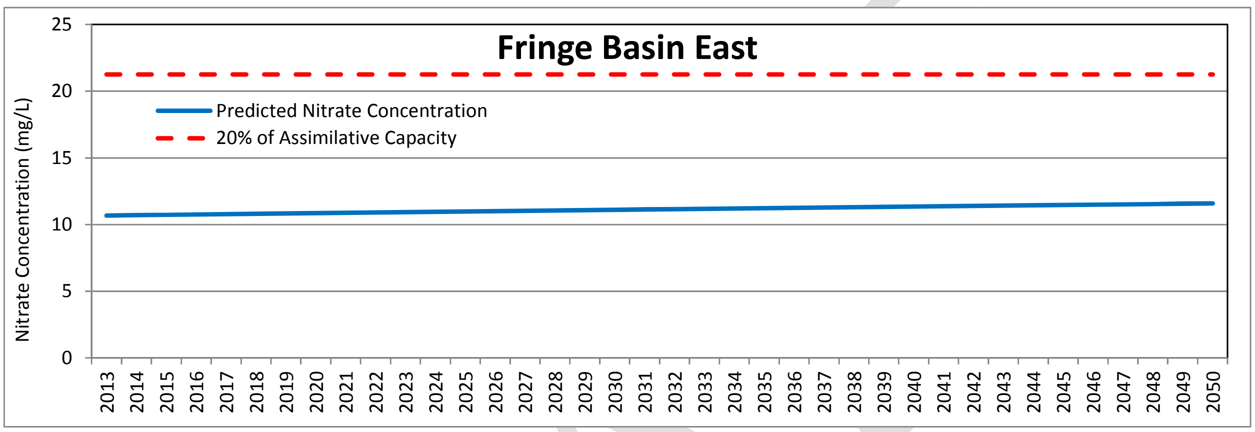
Nitrate concentrations in the Fringe Basin Northeast are expected to drop (see *Figure 3-18* below) because of the net negative nitrogen loading, primarily because of nitrate losses due to subsurface overflow from the basin. No recycled water irrigation projects are planned over this basin.

Figure 3-18: Predicted Nitrate Concentrations in Fringe Basin Northeast



Due to the positive net nitrogen loading primarily from anticipated increases in rural residential and agri-commercial land uses (livestock manure and septic system leachate), nitrate concentrations are expected to rise only slightly (about 1 mg/L) in the Fringe Basin East (see *Figure 3-19* below), and are anticipated to remain below the 20% of the assimilative capacity limit. No recycled water irrigation projects are planned over this basin.

Figure 3-19: Predicted Nitrate Concentrations in Fringe Basin East



4 Proposed Projects and Antidegradation Analysis

4.1 Recycled Water Projects

The Recycled Water Policy and other state-wide planning documents recognize the tremendous need for and benefits of increased recycled water use in California. As stated in the Recycled Water Policy *"The collapse of the Bay-Delta ecosystem, climate change, and continuing population growth have combined with a severe drought on the Colorado River and failing levees in the Delta to create a new reality that challenges California's ability to provide the clean water needed for a healthy environment, a healthy population and a healthy economy, both now and in the future. …….We strongly encourage local and regional water agencies to move toward clean, abundant, local water for California by emphasizing appropriate water recycling, water conservation, and maintenance of supply infrastructure and the use of stormwater (including dry-weather urban runoff) in these plans; these sources of supply are drought-proof, reliable, and minimize our carbon footprint and can be sustained over the long-term."* Clearly, the benefits in terms of sustainability and reliability of recycled water use cannot be overstated (quoted from *RMC, 2013*).

Recycled water represents a significant potential resource for the Valley. Livermore, Pleasanton, and DSRSD plan to expand the use of recycled water for turf and landscape irrigation projects over the next few years. The location of existing and future recycled water use is shown in *Figure 3-13*. The estimated volumes of future planned recycled water use are shown in the figure below:

Figure 4-1: Existing and Future Recycled Water Use

Location	**Volume AF**	**Inside Main Basin %**
	Existing	
Livermore	1,700	59%
DSRSD	2,800	0%
	Future	
East Pleasanton Plan	300	100%
Pleasanton Phase 1	1,700	41%
Staples Ranch	200	50%
DSRSD – planned	300	0%
Livermore - planned	300	100%

Mitigation of the water quality concerns related to salt loading from recycled water use is addressed in Zone 7's SMP (*Zone 7, 2004, Chapter 3, Section 3.3.1.1*) and in Zone 7 Annual Reports for the GWMP (most recent is *Zone 7, 2014* for the 2013 Water Year, October 2012 to September 2013). Zone 7 is collaborating with Livermore, DSRSD, and Pleasanton to incorporate future planned recycled water use expansions, and to plan for future groundwater demineralization facilities to mitigate for the potential impact to groundwater and delivered water quality.

4.2 Stormwater Capture Projects

Zone 7 supports low impact development projects with pervious surfaces that allow for improved management of stormwater and enhanced groundwater recharge, particularly in developed areas (*Zone 7, 2011*). As stated in the Recycled Water Policy, *it is also the intent of the State Water Board that because stormwater is typically lower in nutrients and salts and can augment local water supplies, the inclusion of a significant stormwater use and recharge component within the salt/nutrient management plans is critical to the long-term sustainable use of water in California.* While there are currently no proposed large-scale plans for stormwater capture and recharge in the Valley, the County and Cities have required stormwater capture and recharge for various small-scale projects. Zone 7 encourages the continuation of this concept into future land development.

Zone 7 does include stormwater recharge as part of its areal recharge and stream flow recharge calculations, however the effect of individual, small-scale stormwater capture and recharge projects is not included at this time due to the uncertainties in the projected quantity and volumes. The current calculations represent a conservative approach since storm water capture and recharge would likely decrease nitrate concentrations in the groundwater basin. Future updates to this plan may re-evaluate this approach as future projects are proposed.

4.3 SWRCB Recycled Water Policy Criteria

Section 9 Anti-Degradation of the SWRCB's Recycled Water Policy states, in part:

> *a. The State Water Board adopted Resolution No. 68-16 as a policy statement to implement the Legislature's intent that waters of the state shall be regulated to achieve the highest water quality consistent with the maximum benefit to the people of the state.*
>
> *b. Activities involving the disposal of waste that could impact high quality waters are required to implement best practicable treatment or control of the discharge necessary to ensure that pollution or nuisance will not occur, and the highest water quality consistent with the maximum benefit to the people of the state will be maintained…..*
>
> *d. Landscape irrigation with recycled water in accordance with this Policy is to the benefit of the people of the State of California. Nonetheless, the State Water Board finds that the use of water for irrigation may, regardless of its source, collectively affect groundwater quality over time. The State Water Board intends to address these impacts in part through the development of salt/nutrient management plans described in paragraph 6.*
>
> *(1) A project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan satisfying the provisions of paragraph 6(b) is in place*

may be approved without further antidegradation analysis, provided that the project is consistent with that plan.

(2) A project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan satisfying the provisions of paragraph 6(b) is being prepared may be approved by the Regional Water Board by demonstrating through a salt/nutrient mass balance or similar analysis that the project uses less than 10 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin (or multiple projects using less than 20 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin).

4.4 Antidegradation Assessment

Section 3.4 includes graphs of future average nitrate concentrations for scenarios with and without the proposed recycled water irrigation projects in the Main Basin and Fringe Basin North. The graphs show that irrigation with recycled water contributes very minor nutrient loading in the basins (<1%), and that the recycled water projects do not use more than 20% of the available assimilative capacity. Nitrogen loading from recycled water can be minimized even further by employing recycled water irrigation BMPs (*Section 5.3*), and fertilizer BMPs (*Section 5.2*) when turf or landscape fertilizers (or fertigation) are applied along with recycled water.

The NMP analysis finds that recycled water use can be increased while still protecting and improving groundwater quality for beneficial uses. *Figure 4-2* addresses how the proposed recycled water irrigation projects comply with each of the components of SWRCB's Anti Degradation Policy (Resolution No. 68-16).

Figure 4-2: Antidegradation Assessment

<table>
<tr><th>SWRCB Resolution No. 68-16 Component</th><th>Antidegradation Assessment</th></tr>
<tr><td>Water quality changes associated with proposed recycled water project(s) are consistent with the maximum benefit of the people of the State.</td><td rowspan="3">The irrigation projects will
contribute only a minimal increase (<1 mg/L) in groundwater nitrate concentrations at urban buildout.
will not use more than 20% of the available Assimilative Capacity
will not cause groundwater quality to exceed Basin Plan Objectives</td></tr>
<tr><td>The water quality changes associated with proposed recycled water project(s) will not unreasonably affect present and anticipated beneficial uses.</td></tr>
<tr><td>The water quality changes will not result in water quality less than prescribed in the Basin Plan.</td></tr>
<tr><td>The projects are consistent with the use of best practicable treatment or control to avoid pollution or nuisance and maintain the highest water quality consistent with maximum benefit to the people of the State.</td><td>Because all planned recycled water projects over the groundwater basin are landscape irrigation projects, most of the nitrogen from these projects will be removed by plant uptake and volatilization (and some by bacterial denitrification under certain conditions). Additional nitrogen loading will be avoided with the use of recycled water and fertilizer use BMPs (see Section 6.1)</td></tr>
<tr><td>The proposed project(s) is necessary to accommodate important economic or social development.</td><td>The recycled water projects are crucial for continued sustainability of the Valley's water supply and are part of the urban growth plans for Cities of Dublin, Livermore, and Pleasanton.</td></tr>
<tr><td>Implementation measures are being or will be implemented to help achieve Basin Plan Objectives in the future.</td><td>Both, the SMP and the NMP contain measures that have been or will be implemented to address current and future salt and nutrient loading of the Groundwater Basin.</td></tr>
</table>

5 Nutrient Management Goals and Strategies

5.1 Introduction

As shown in *Section 3.4* above, basin-wide nitrogen concentrations are expected to drop or stay relatively constant over the long-term; however, there are some existing high nitrate concentrations in local areas of concern (*Section 2.4*). This chapter presents the goals and strategies for mitigating nitrate concentrations in the groundwater basin primarily by focusing on minimizing nitrogen loading over the groundwater basin.

The primary sources of nitrogen loading over the groundwater basin are from fertilizer application, recycled water irrigation, leaching of livestock manure, and onsite wastewater treatment systems (OWTS). Best Management Practices (BMPs) are the best tools for minimizing nitrogen loading from irrigation (fertigation), turf and crop fertilization practices, and penned livestock facilities such as horse boarding facilities. And while the additional nitrogen loading from future recycled water project expansions is expected to be small (*Section 3.4*), it would be prudent to employ the fertilizer application BMPs as well as the recycled water irrigation BMPs for all recycled water irrigation projects.

OWTS use in the Valley involves domestic and commercial septic tanks and systems to treat and dispose of winery process wastewater. OWTS management, especially in the Areas of Concern, requires long-term goals and strategies for ensuring impacts from new onsite wastewater disposal systems are not going to create a new nitrate problem or exacerbate an existing one. Eventually, the conventional septic tank systems in the Areas of Concern should be converted to alternative systems having nitrogen reduction treatment, or the affected homes and businesses should be connected to a municipal or community sewer system. Management of onsite treatment and disposal of wastewater from wine making and bottling processes is under the RWQCB’s jurisdiction, and is currently provided for through the RWQCB’s waste discharge requirement (WDR) permit program. Although WDRs are an effective means for managing nutrient loading from this land use, improvements are needed in stakeholder guidance and permit compliance.

5.2 Fertilizer Application

Goal 5.2: Minimize nitrogen loading from fertilizer application

Strategy 5.2a: Promote the use of fertilizer BMPs (*Section 6.1.2*) to avoid over-application of fertilizers. Using results of soil and irrigation water chemical testing to determine the appropriate amount of additional fertilizer to apply is a good way to lessen excess leachable nitrogen in the soil.

Strategy 5.2b: Limiting irrigation water application to the crop and landscape plants’ agronomic rate will reduce the amount of nutrient-rich leachate that migrates below the vegetation root zone and into the underlying aquifer(s).

5.3 Recycled Water Irrigation

Goal 5.3: Minimize nitrogen loading from recycled water irrigation projects

Strategy 5.3a: Follow Recycled Water Policy guidance for landscape irrigation projects. Minimize recharge of nitrogen by irrigating landscapes to the prescribed agronomic rates. Account for the nitrogen content of the recycled water when determining how much fertilizer to apply.

Strategy 5.3b: Maintain low levels of nitrogen in the produced recycled water by keeping the nitrogen concentrations in the source water low and/or optimize low nitrogen levels in recycled water production.

5.4 Livestock Manure Management

Goal 5.4: Minimize nitrogen loading from concentrated livestock facilities such as horse boarding, training, and breeding facilities

Strategy 5.4: Promote the use of BMPs (*Section 6.1.4*) such as manure management and controlling site drainage to prevent nutrient contamination of rainfall runoff and irrigation return flows that may percolate to groundwater and/or flow into surface water bodies.

5.5 Onsite Wastewater Treatment Systems

5.5.1 General Septic Tank Management

Goal 5.5.1: Minimize nitrogen loading from new onsite wastewater treatment systems (OWTS), e.g., septic tank systems.

Strategy 5.5.1a: Continue applying Zone 7 policies and County Ordinance and Regulation provisions, e.g., 1 Rural Residential Equivalence (RRE)/5 Ac max.

Strategy 5.5.1b: Continue to work with ACEH to ensure that: 1) they are aware of groundwater nitrate issues in the Livermore Valley Groundwater Basin; 2) that variance requests are given the appropriate scrutiny; and 3) their OWTS approvals are consistent with adopted NMP goals and objectives.

5.5.2 Septic Tank Management in Areas of Concern

Goal 5.5.2: Reduce nitrogen loading from septic tanks in Areas of Concern.

Strategy 5.5.2a: Increase understanding of existing conditions and causes, and set realistic management goals and apply adaptive management as necessary.

Strategy 5.5.2b: Require new development projects utilizing OWTS in the Areas of Concern to reduce and/or minimize the overall nitrogen loading to the property.

Strategy 5.5.2c: On at least an annual basis, assess performance of wastewater treatment systems, estimate area-wide nitrogen loading and monitor groundwater quality beneath the Areas of Concern.

5.5.3 Winery Process Wastewater

Goal 5.6: Minimize nitrogen loading from onsite disposal practices of winery process wastewater.

Strategy 5.6a: Require local wine producers and bottlers to apply for and comply with RWQCB WDRs for the proper treatment and disposal of winery process waste streams.

Strategy 5.6b: Develop guidance document(s) to assist both project proponents and RWQCB staff with Report of Waste Discharge (ROWD) and WDR development and evaluations.

6 Plan Implementation

6.1 Implementation Measures

6.1.1 Introduction

Nitrate concentrations are expected to remain well below 20% of the assimilative capacity limit for all four groundwater areas in the Livermore Valley Groundwater Basin; however there are local Areas of Concern where nitrate concentrations are above the Basin Objective (BO, 45 mg/L as NO_3). The main sources of nitrogen loading throughout the groundwater basin include fertilizer application, recycled water irrigation, livestock facilities, and onsite wastewater treatment systems. The implementation measures presented below are designed to minimize loading from these main sources, particularly in the Areas of Concern shown on *Figure 2-14* and described in *Section 2.4*.

6.1.2 Fertilizer BMPs

Fertilizer application should be adjusted to the needs of the plants/crops to which it is being applied and take into account the nutrients already present in soil and irrigation water to avoid over-fertilization. The implementation plan is to continue the following fertilizer BMPs:

- Targeted application of fertilizer and soil amendments – limit the application of salts and nutrients to the area at the point of the irrigation drip emitter, rather than broadcast across a large area.

- Adjust fertilizer amounts to account for nutrients already present in irrigation water and soil. Nutrient levels can be assessed by testing soil and water.

- Apply irrigation at agronomic rates to prevent nutrients in fertilizer from leaching into the groundwater.

- Effective vineyard management includes regular soil and petiole testing to help understand what, and how much, nutrients need to be added to the soil to produce the desired grape production and flavor. When the soil and petiole testing includes nitrogen as a test parameter, the results can be used to ensure that the amount of additional nitrogen applied is limited to that amount needed by the vines.

6.1.3 Recycled Water Irrigation BMPs

The use of recycled water for irrigation is controlled by California Code of Regulations, Title 22 (Title 22). In addition to adhering to the Title 22 regulations related to recycled water, the implementation plan will continue the following recycled water BMPs:

- Reduce application of fertilizer to account for nitrogen in the recycled water.
- Irrigate during evening and early morning hours to reduce evaporation and human exposure.
- An effective irrigation system should be used that applies recycled water at agronomic rates. Infiltration of recycled water past the active root zone should be limited to only what is needed to remove salts from the root zone.

6.1.4 Livestock Manure Management

Livestock and Equestrian Facilities are another source of nitrates due to concentrated amounts of manure where animals are kept. Equestrian Facilities include horse boarding, training, and breeding facilities. The plan recommends to continue the following livestock manure management BMPs:

- Manure management – remove manure regularly. If manure can't be removed daily then it should be covered and stockpiled on an impervious surface. Surface water should be prevented from reaching the storage area.
- Building and site design – should keep animal areas, such as paddocks and corrals, as dry as possible during the rainy season.
- Wash rack design – should not allow water to flow into storm drains, creeks, ponds, or recharge areas. Wash racks should be connected to the sanitary sewer, if possible.
- Site referral and review process – a process is in place for new sites and modifications of existing sites to be reviewed by Zone 7. This process can be used to encourage facilities that support BMPs. It is also an opportunity to educate the public on nitrate BMPs.

Additional guidance for manure management can be found in existing documents such as *Horse Manure Management – A Guide for Bay Area Horse Keepers (Buchanan et al., 2003)*.

6.1.5 Onsite Wastewater Treatment and Disposal

Limitations for the expansion of municipal sewer coverage in the Livermore-Amador Valley associated with the establishment of urban growth boundaries has resulted in the continued reliance of OWTS for development in the unincorporated areas. In particular, the continued growth of winery-related commercial development in or near the south Livermore high nitrate areas is a concern for maintaining or improving groundwater quality. Septic systems that may have been allowed in the past may not be appropriate in the future as conditions and circumstances surrounding particular locations change or become known.

As provided for in the RWQCB Basin Plan, ACEH has committed to developing a Local Agency Management Program (LAMP) for RWQCB approval that will address their management of OWTS in unincorporated Alameda County. A LAMP is a management program where local agencies establish minimum standards that are different from those specified in the State OWTS Policy, but are necessary to protect water quality and public health. Requirements for different minimum lot size for new development using OWTS and the addition of nitrogen-removing treatment equipment on OWTS for certain conditions are examples of special provisions that ACEH will likely include in its LAMP.

6.1.5.1 General Septic Tank Program

One of the purposes of the Alameda County Onsite Wastewater and Individual/Small Water Systems Ordinance and Regulations is to prevent environmental degradation of surface water and groundwater from onsite disposal of private sewage to the greatest extent possible. Included in the regulations are special provisions for the Upper Alameda Creek Watershed, above Niles; namely:

a. a minimum parcel size requirement of 5 acres for new single-family septic tank systems; and
b. a maximum discharge of 320 gallons per day per 5 acres for commercial septic tank systems.

Continued application of the general provisions of the County OWTS Ordinance and Regulation and these special provisions should minimize the groundwater nitrate impact from septic tank use in the majority of the unincorporated areas of the Livermore Valley Groundwater Basin except in the Areas of Concern. Additionally, the following measures should be accomplished:

- Zone 7 and ACEH should continue working together to ensure that both agencies are aware of groundwater issues in the Livermore Valley Groundwater Basin and that any OWTS approvals are consistent with the adopted NMP goals and objectives.

- Zone 7 and ACEH should continue to collaborate on the decisions surrounding approval of new septic tank use for commercial facilities' domestic wastewater disposal on a case-by-case basis and to evaluate the potential risks and make proper decisions as additional information becomes available.

- Zone 7 and ACEH should continue to collaborate on assessing the potential risks and impact(s) associated with granting OWTS regulation variances and on developing any special requirements necessary to ensure groundwater quality protection.

6.1.5.2 Septic Tank Management in Areas of Concern

Zone 7 has identified ten Areas of Concern with elevated nitrate concentrations in groundwater. Current and past onsite wastewater disposal practices are thought to be an important contributor to the high nitrate concentrations found in these areas. As such, ongoing and future wastewater disposal projects in the Areas of Concern should be managed with a bias towards reduction of the current loading. It is also important to increase the understanding of the extent of the nitrate impacts in many of these areas and to monitor the concentration trends as projects add and subtract wastewater loading in these areas. Towards these goals the following measures should be performed:

- Zone 7 will coordinate further characterization and monitoring of the local nitrate plumes by working with ACEH, RWQCB and various property owners and consultants on the development of plans for the construction and operation of additional monitoring wells.

- Zone 7 should continue its effort to inform ACEH and Alameda CDA of the nitrate issues in the Livermore Valley Groundwater Basin and to collaborate on development plans, permit reviews, and CEQA analyses for projects involving onsite wastewater disposal in Areas of Concern to assure approvals are consistent with adopted NMP goals and objectives.

- Local Agency Formation Commission (LAFCO), developers and County and City planning agencies should continue to work together to create opportunities for discontinuing onsite disposal of nutrient-rich wastewater within the Areas of Concern; such as connecting dwellings and businesses to municipal or community sewage treatment works when feasible.

- ACEH, Zone 7, and RWQCB should work together on the development, approval, and implementation of the LAMP with Zone 7 identifying the special need areas, contributing local groundwater and geologic expertise, and providing ongoing regional groundwater monitoring.

In five of the ten Areas of Concern, septic tank use is the predominant method of wastewater disposal, but unlike the other five Areas of Concern, there are no current plans for extending the municipal sewer service to these five OWTS areas. The five areas are:

- Happy Valley (*Figure 6-2*)
- Buena Vista (*Figure 6-4*)
- Mines Road (*Figure 6-5*)
- May School (*Figure 6-3*)
- Greenville (*Figure 6-4*)

Accordingly, special OWTS permit requirements have been developed for new septic tank applications received for these five Areas of Concern. These five special OWTS permit requirement areas are shown in *Figure 6-1* to *Figure 6-5*, and the recommended permit requirements are summarized below and presented in a table in *Figure 6-6*.

These special permit requirements are designed to reduce the amount of nitrogen loading from OWTS in the five Areas of Concern over time by requiring replacement of old conventional septic tank systems with new treatment systems when the opportunity arises. For example, in order to add an additional single-family dwelling with a new septic system to a parcel that already has an existing single-family dwelling with a conventional septic tank, the project must include installation of pre-treatment equipment, capable of removing 65% of the nitrogen content from the wastewater stream, on both OWTS (new and existing systems). As a consequence, the net result would be an onsite loading reduction from a pre-project total of one rural residential equivalence (1.0 RRE) to a post- project total of 0.7 RRE. (0.35 + 0.35 RRE).

Where a new OWTS is proposed for a single-family dwelling on an existing vacant parcel (i.e., historic lot-of-record) in a special permit requirement area, the project is automatically required to install nitrogen-removing pre-treatment equipment capable of removing either a minimum of 50% or 65% of the nitrogen from the residential wastewater depending whether the vacant lot is 5 acres or greater or less than 5 acres.

Because wastewater generated by commercial operations can result in higher loading rates than residential flows, the permitting of OWTS for new commercial projects within the special permit requirement areas require higher level of scrutiny. At a minimum, projects must include a nitrogen-removing system, but also must demonstrate by analysis that the project will result in an improved nitrate condition beneath the site and not cause the offsite condition to worsen. Many of the commercial use OWTS will fall under the RWQCB's jurisdiction and thus be subject to their Report of Waste Discharge (ROWD) requirements.

These same permit criteria are anticipated to be incorporated into the County's LAMP and used by the RWQCB while developing Waste Discharge Requirements (WDR) for commercial projects within their purview if they prove to be effective at improving or halting groundwater quality degradation in these Areas of Concern. The following are measures specific to the special permit requirement areas:

- Until ACEH's LAMP has been finalized and approved by the RWQCB, ACEH should incorporate and implement an interim permit approval policy such as the one recommended in *Figure 6-6*.
- Zone 7 should continue to refine the special permit area boundaries as more groundwater quality data becomes available in the future.
- Zone 7 and ACEH will continue to support RWQCB in its WDR decisions and specific requirements.

Figure 6-1: Special OWTS Permit Areas

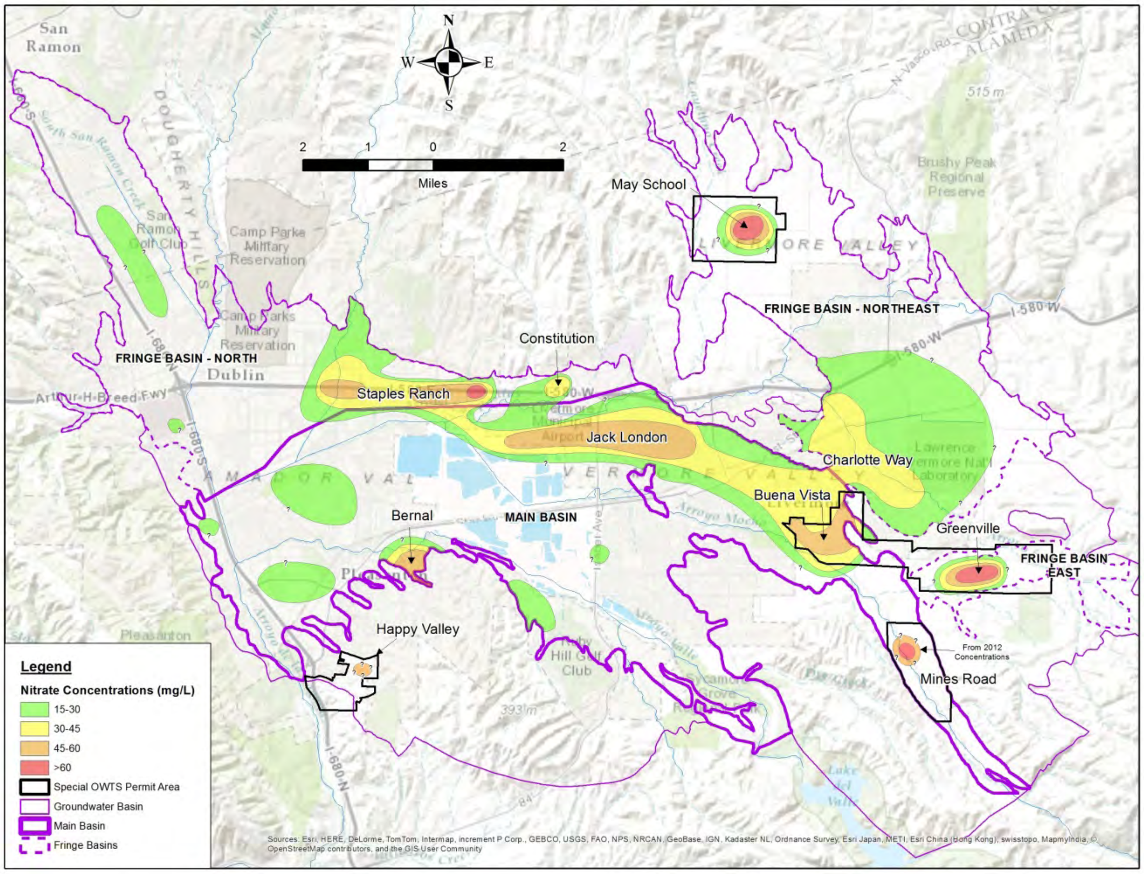


Figure 6-2: Happy Valley Areas of Concern

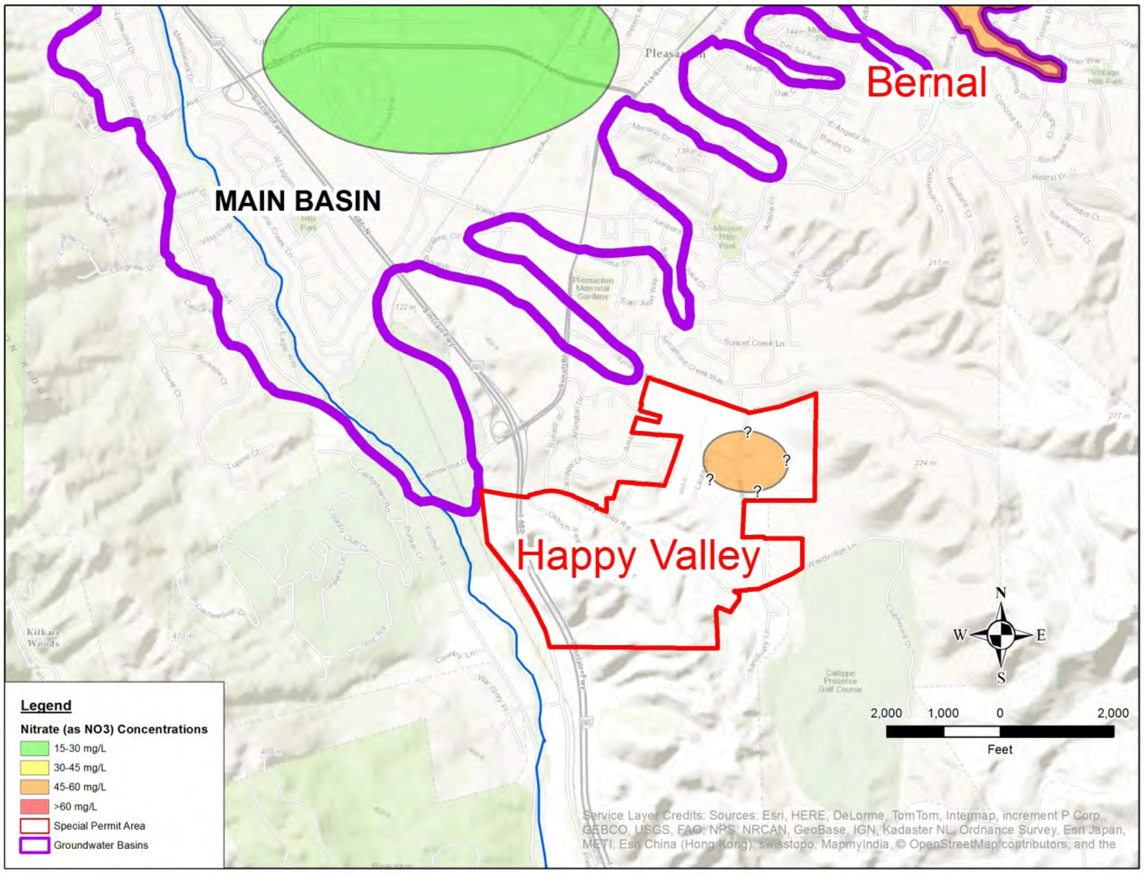


Figure 6-3: May School Area of Concern

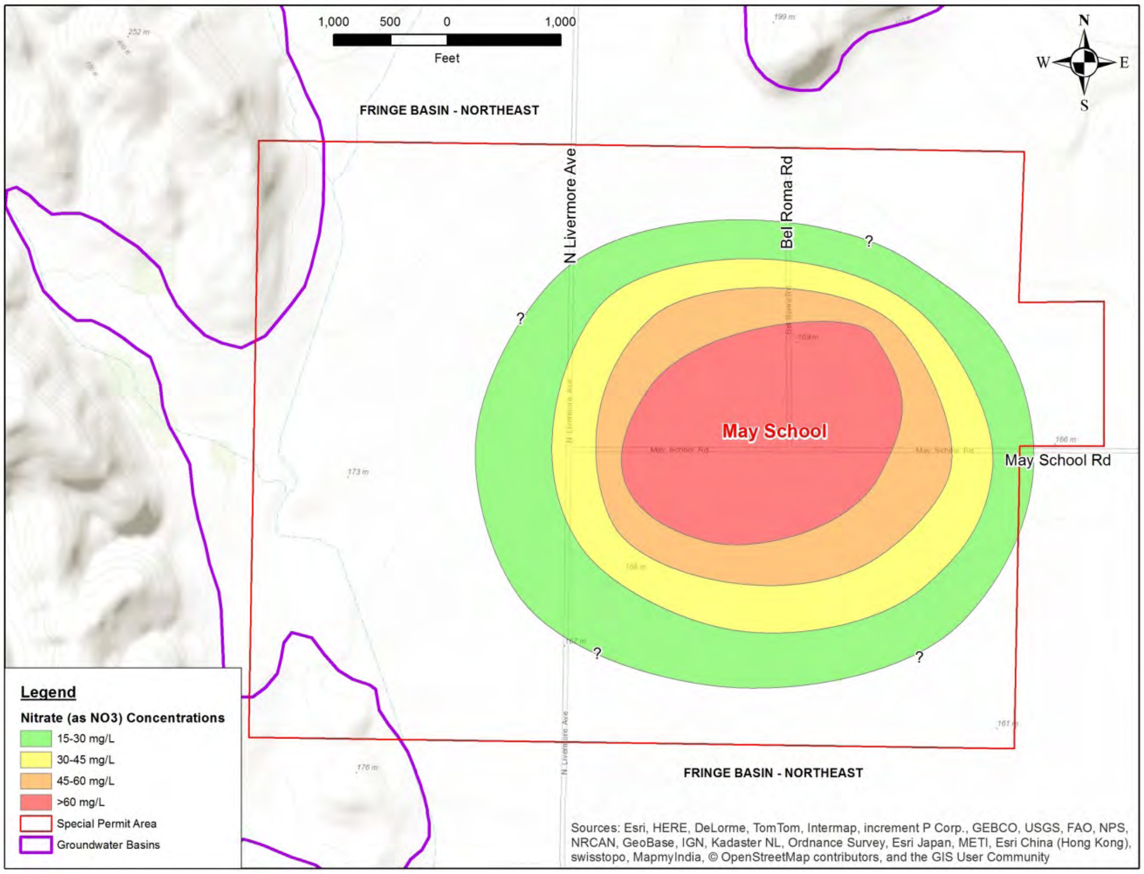


Figure 6-4: Buena Vista/Greenville Areas of Concern

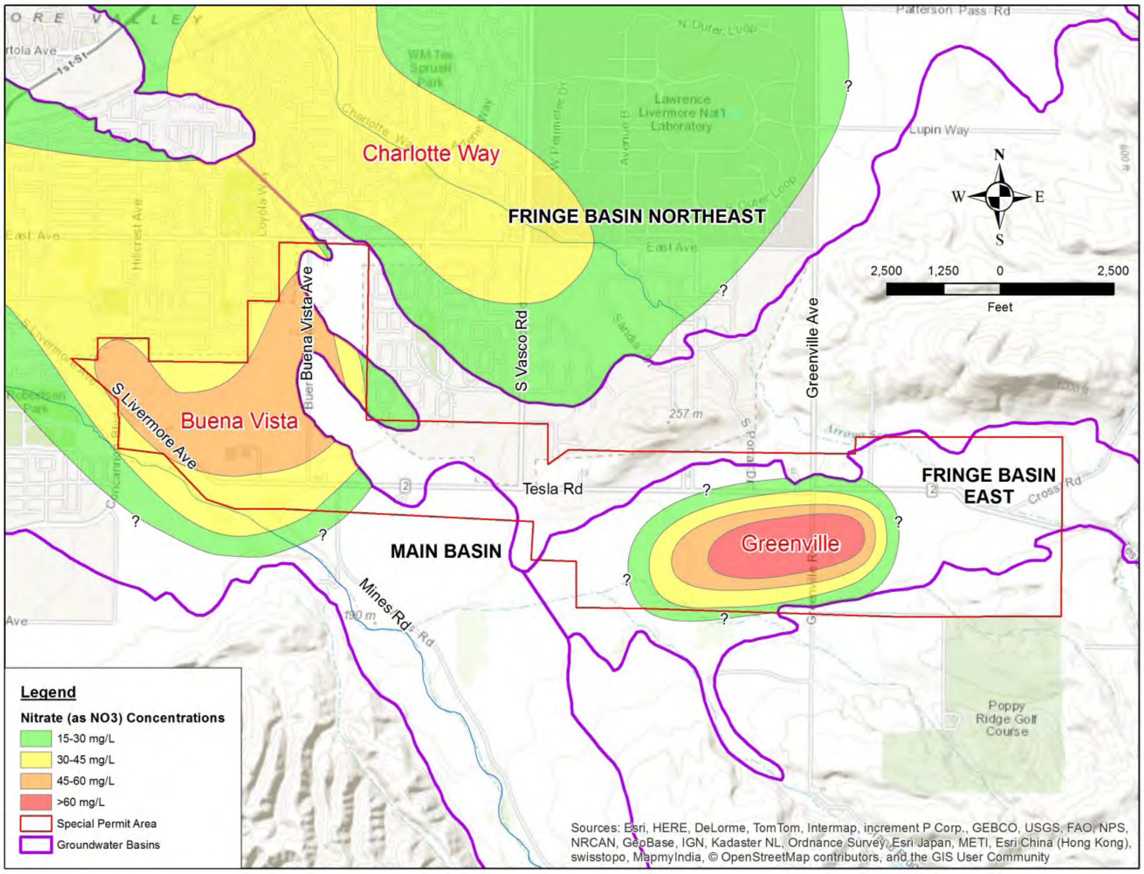


Figure 6-5: Mines Road Areas of Concern

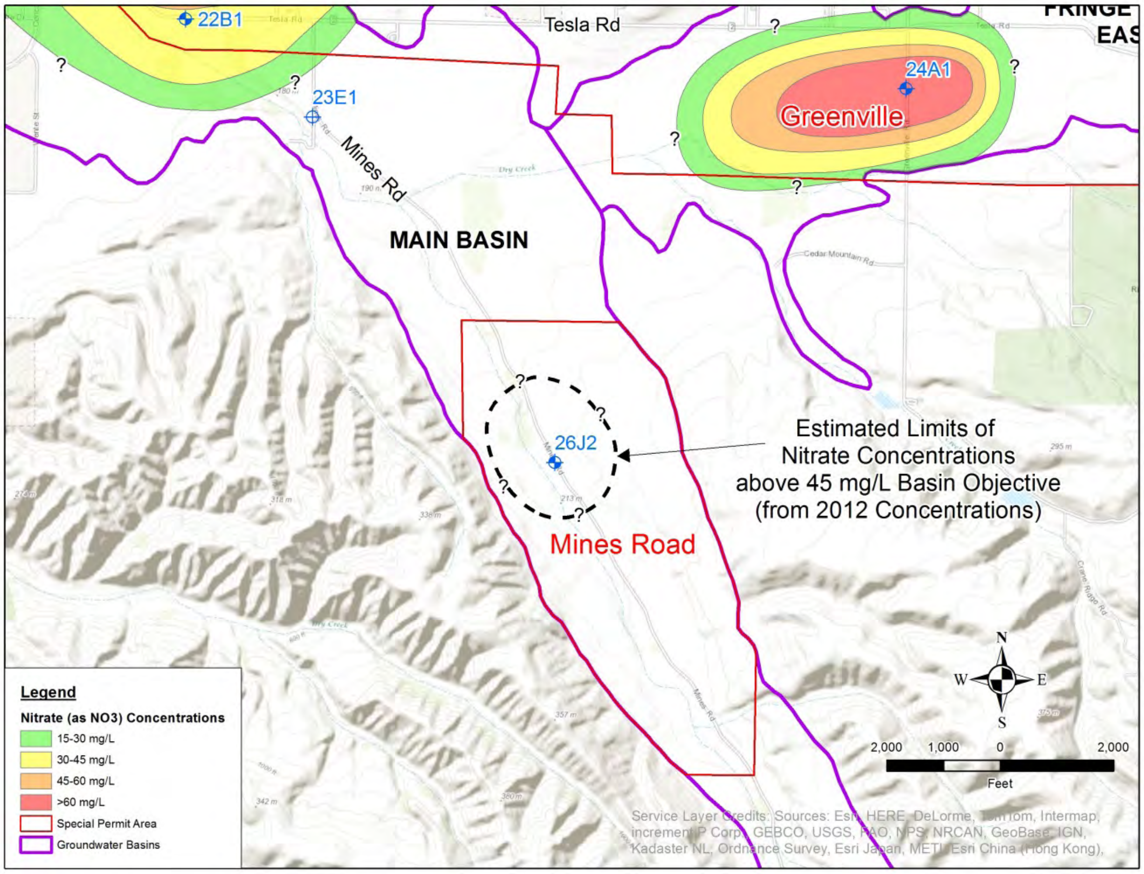


FIGURE 6-6
PROPOSED SEPTIC TANK PERMIT REQUIREMENTS
INSIDE AREAS OF CONCERN

DRAFT

Development Type	Septic Tank Permit Type	Requirement[1]
Residential Dwelling	*Remodel/add-on to existing dwelling* *No new septic system required*	*Grandfathered.*
	Remodel/add-on to existing dwelling *New septic system required*	*Must install nitrogen reducing engineered system so that nitrogen loading will not exceed 0.5 RRE (17 lbs/yr max).*
	New secondary dwelling unit - historic lot-of-record (pre-1982, <5 acres) *Existing septic system with new septic system required*	*Must install nitrogen reducing engineered system(s) so that nitrogen loading will not exceed 0.7 RRE (23.8 lbs/yr max).*
	New dwelling on undeveloped historic lot-of-record (pre-1982, <5 acres) *New septic system required*	*Must install nitrogen reducing engineered system so that nitrogen loading will not exceed 0.35 RRE (11.9 lbs/yr max).*
	New dwelling on undeveloped lot (>5 Acres) *New septic system required*	*Must install nitrogen reducing engineered system so that nitrogen loading will not exceed 0.5 RRE (17 lbs/yr max).*
Retail, Commercial or Industrial Use (including wineries, event centers, restaurants, and B&Bs)[2]	*Self-contained (porta-potties or holding tank)*	*Maintain records of offsite disposal (0 lbs/yr).*
	New development historic lot-of-record (pre-1982) *Existing septic system with new OWTS required*	*Must demonstrate that the total post-project onsite nitrogen loading will be at least 30% less than the total onsite nitrogen loading existing before the project (typically 23.8 lbs/yr max).*
	New development on undeveloped historic lot-of-record (pre-1982, < 5 acres) *New OWTS required*	*Must demonstrate that the nitrogen loading will not exceed 0.35 RRE (11.9 lbs/yr max).*
	New development on undeveloped lot-of-record (> 5 acres) *New OWTS required*	*Must demonstrate that the per-acre nitrogen loading rate will not exceed 0.5 RRE on 5 acres (3.4 lbs/yr per acre max).* *OR* *Hydrogeologic study must assess current groundwater nitrate conditions beneath the site and demonstrate that nitrate concentration of total onsite recharge[3] does not exceed 36 mg/L (80% of MCL) or the maximum concentration at the site, whichever is lower, and OWTS nitrogen loading does not exceed 1 RRE on 5 acres (6.8 lbs/yr per acre max).*

[1] Loading rates calculated based on 1 RRE = 34 lbs/yr
[2] Water Board may require Report of Waste Discharge for these new wastewater systems.
[3] Assume that 18% of rainfall naturally recharges to groundwater unless study demonstrates otherwise.

OWTS = Onsite Wastewater Treatment System
RRE = Rural Residential Equivalence
MCL = Maximum Conaminant Level (NO_3 = 45 mg/L)

6.1.5.3 Winery Process Wastewater

There are currently over 50 wineries located over the Livermore Valley Groundwater Basin, however, many of them do not produce or bottle wine onsite. The ones that do produce or bottle wine, also produce a wastewater stream during the wine production and bottling operations. This winery process water, which contains nutrients, is often disposed in evaporation ponds, on the surface as irrigation or dust control water, or in the subsurface using OWTS and leachfields. Regardless of which of these disposal methods are used, the RWQCB has authority to regulate the discharge; thus a Report of Waste Discharge is required to be submitted to the RWQCB for the discharge of wastewater to the surface or subsurface. The RWQCB will then approve the discharge by issuing Waste Discharge Requirements, waive the need of a WDR, or deny approval of the discharge.

- To assist applicants with their ROWD preparation and the RWQCB with their evaluation of ROWDs and WDR decisions, Zone 7 and ACEH will continue to provide relevant information on groundwater occurrence, use, quality and vulnerability to the RWQCB and applicants.

- The preparation of a guidance document on the proper treatment and disposal of wastewater and organic wastes generated from the wine making and wine bottling processes would be beneficial for the development of plans that are effective at minimizing nutrient loading to the groundwater basin.

6.2 Basin Monitoring Programs

6.2.1 Introduction

Zone 7 currently monitors the following as part of its GWMP:

- groundwater (levels and quality),
- climatological (precipitation and evaporation),
- surface water (streamflow and quality),
- mining area (mining activities and water export volumes),
- land use (area),
- groundwater production (volume and quality),
- land surface subsidence (inelastic and elastic), and
- wastewater/recycled water (use and quality).

The monitoring programs focus on the Main Basin where groundwater is pumped for municipal uses, but monitoring stations are located throughout the groundwater basin to assess conditions in the fringe and upland basins. The programs are designed to assess the sustainability and quality of the groundwater basin, and the results are used in water resources management planning and decision making. Complete descriptions of the monitoring programs are provided in Zone 7's GWMP and SMP. The components of the programs that address nutrient monitoring are outlined below. These programs are evaluated annually and revised as necessary as part of Zone 7's Annual Reports for the GWMP.

Zone 7's existing monitoring programs already address nutrient monitoring, and no changes are proposed at this time. However, Zone 7 will continue to work with property owners and developers to fully characterize nitrate concentrations and nitrogen loading for projects inside the Areas of Concern. This might include the installation and monitoring of additional wells up-gradient and down-gradient of areas with high nitrate concentrations.

State policy does not require monitoring for Constituents of Emerging Concern (CECs) for basins where recycled water use is limited to irrigation projects. Since the recycled water use in the Valley is currently limited to irrigation projects, Zone 7 does not monitor for CECs at this time; however Zone 7 will continue to review the regulations and Valley conditions to assess whether future CEC monitoring is appropriate.

6.2.2 Nutrient Specific Monitoring Programs

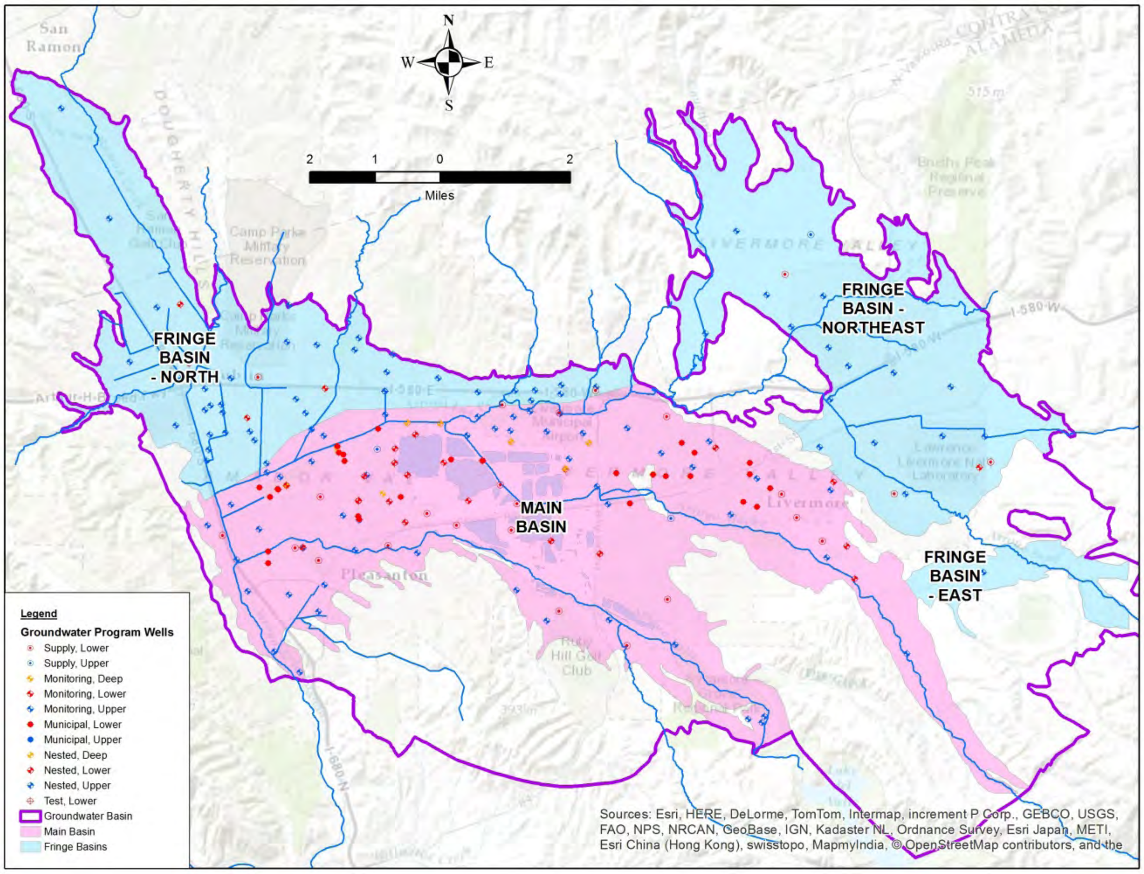
Climatological Monitoring – Zone 7's network of seven rainfall stations, two pan evaporation stations, and one California Irrigation Management Information System (CIMIS) station provide daily rainfall and evaporation data for basin recharge calculations. This information is used to calculate the volume of recharge, evaporation, and nitrogen loading from rainfall.

Surface Water Monitoring – This program focuses on the four main gaining and losing streams that impact the groundwater basin (i.e., Arroyo Valle, Arroyo Mocho, Arroyo Las Positas, and Arroyo De La Laguna), and the diversions and accretions that affect the flows into or from each of them. Zone 7 measures the inflow and outflow from the streams to quantify the volume of water recharging or discharging from the groundwater basin's aquifers. Zone 7 also samples and analyzes water from the streams to provide a record of water quality for the basin's recharge and discharge waters from which the groundwater basin's annual nitrate loading is calculated.

Zone 7's Water Level Monitoring – Zone 7 measures groundwater levels in over 230 monitoring and production wells (see *Figure 6-7* below) twice per year during seasonal extremes (i.e., spring highs and fall lows) for storage tracking. Water level measurements are also measured monthly in some wells to monitor subsidence, adjust recharge operations, and identify when semi-annual water level measurements should be scheduled.

Zone 7's Water Quality Sampling –Zone 7 samples groundwater at least annually from all accessible groundwater wells in the program. Samples are analyzed by Zone 7's laboratory for metals and general minerals (including Nitrate as NO_3 and Phosphate as PO_4).

Figure 6-7: Map of Program Wells



Land Use Monitoring – Zone 7 maps and quantifies Valley land use (see *Figure 3-7* for the 2013 land use map) for areal recharge calculations (e.g., rainfall recharge, applied water recharge, and unmetered groundwater pumping for agriculture) and salt/nutrient loading (e.g., from irrigation, horse boarding facilities, and properties with septic tanks). The program identifies changes in land use with an emphasis on changes in impervious areas and the volume and quality of irrigation water that could impact the volume or quality of water recharging the Main Basin. Land use data are derived from aerial photography, permit applications, field observations, and City and County planning documents.

Wastewater and Recycled Water Monitoring - Zone 7 compiles and reviews data on the volume and quality of wastewater collected and recycled water used within the watershed from the Livermore Water Reclamation Plant (LWRP), DSRSD Water Reclamation plant, and the Veterans Hospital sewage treatment plant. Zone 7 also reviews Septic Tank Use Applications located within the Valley for compliance with Zone 7's Wastewater Management Plan. Zone 7 must approve all onsite disposal systems for new commercial developments or any residential system that will potentially exceed the loading allowed for the site.

6.3 Implementation Schedule

- The Implementation Measure BMPs for Fertilizers, Irrigation, and Livestock Manure Management are already in place throughout the Valley.

- Zone 7's groundwater monitoring programs are also already in place; just the new monitoring wells discussed in *Section 6.1.5.3* could be constructed and added to the existing programs.

- The special OWTS permit approval requirements are currently being applied by ACEH.

- ACEH, Zone 7, and RWQCB staff will begin to work on the LAMP before the end of 2014 and anticipate completing the effort in 2015.

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LIVERMORE-AMADOR VALLEY
ZONE 7
19 57
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