Zone 7 Water Agency

Groundwater Nitrate Sources in the Buena Vista Area

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Prepared for the

Zone 7 Water Agency

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EXECUTIVE SUMMARY

A plume of high nitrate concentration has been detected in the main groundwater basin underlying the City of Livermore for many decades. The nitrate concentration in the groundwater exceeds State and Federal Safe Drinking Water limits. Based on the direction of flow within the groundwater basin, the plume appears to begin in the vicinity of the Buena Vista Avenue/Tesla Road area. Past evaluations of the nitrate in the groundwater have indicated that rural land uses including septic tank leachate, livestock, and agricultural activities could be primary sources for the nitrogen.

This report evaluates potential nitrogen sources in a 670 acre study area near the intersection of Buena Vista Avenue and Tesla Road, which is the area where the plume appears to originate. Nitrogen loadings and losses from multiple sources were estimated to determine a net mass balance for nitrogen entering the groundwater. The volume of water recharged to the groundwater basin was estimated to determine the resulting concentration of nitrate in the groundwater. Historical land uses were also evaluated to determine if past land use practices were still affecting the nitrate concentration. Historical sources of high nitrates include wastewater land application areas in the western portion of the plume, multiple chicken ranches and rose farms in the eastern portion of the plume along Buena Vista Avenue, and residential areas formerly served by septic tanks.

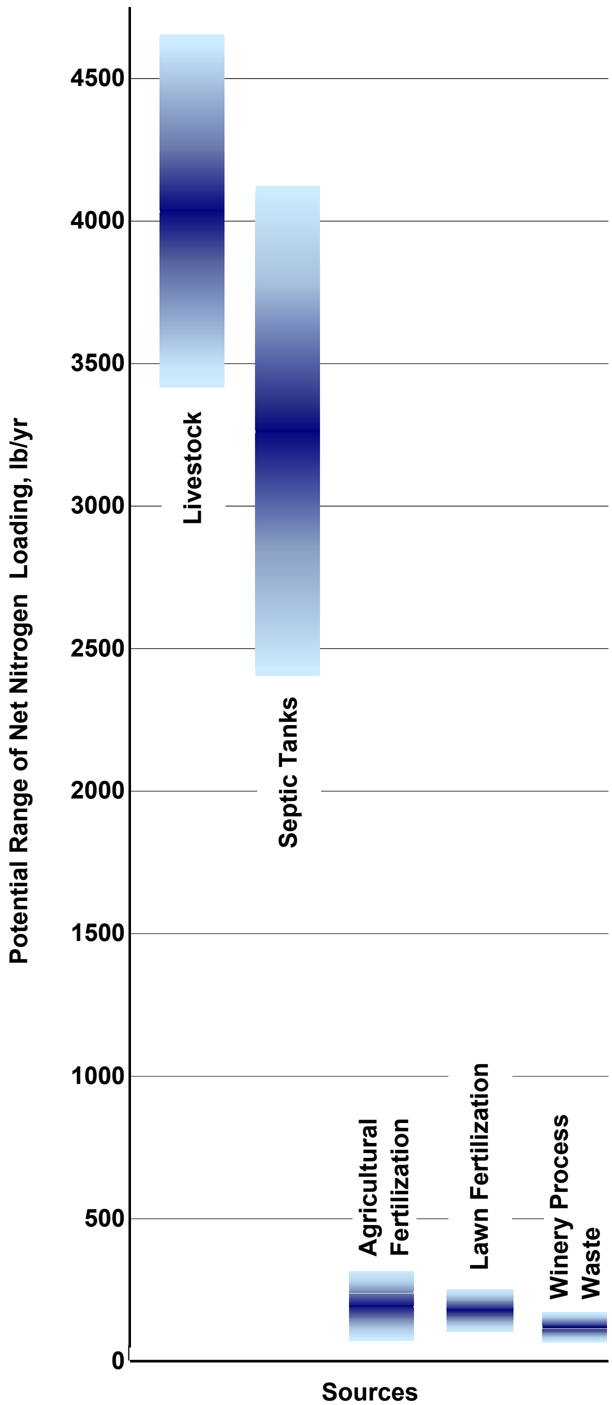
Water within the groundwater basin moves generally west at a rate of 330 feet per year. The residence time of water within the nitrate plume is approximately 90 years, assuming the water is not extracted from wells. Water in the eastern portion of the plume shows effects of current land uses. The water in the western portion of the nitrate plume shows effects from historical land uses.

Land uses within the study area have been relatively stable for the last 50 years and include a rural residential area along Buena Vista, Almond, and East Avenues, vineyards and wineries along Tesla Road, and commercial and private horse stables. The “newer” water in the eastern portion of the nitrate plume continues to show elevated nitrate concentrations from the current land use activities.

The nitrogen mass balance model indicated that septic tank leachate and livestock manure together provide over 90 percent of the current nitrate loadings within the study area. The estimated range of relative net contributions from each source in the study area is shown on Figure ES-1.

After nitrates enter the groundwater, their concentration can be reduced only through dilution with rainfall recharge or other groundwaters with lower nitrate concentration, or by pumping out the groundwater and reducing the nitrate concentration either through treatment or through crop uptake by using it to irrigate turf or other landscaped areas without other supplemental fertilization.

Figure ES-1 Net Nitrate Loading Within Study Area



The Zone 7 Water Agency has established programs to reduce the amount of nitrate entering the groundwater including a resolution to limit residential septic tanks to one per 5 acres and to limit commercial septic tanks to a density no greater than residential. Continued implementation of nitrogen reduction programs will eventually result in reduced groundwater nitrate concentration. Candidate activities to reduce the excess nitrogen loading to the groundwater basin include the following:

- Replace existing septic tanks overlying the main groundwater basin with sewered connections to a municipal or community treatment plant
- Prohibit new septic tanks in areas overlying the main groundwater basin
- Limit the number of livestock per acre and/or use Best Management Practices (BMP's) to limit animal waste from leaching into the groundwater
- Continue encouragement of BMP's for lawn fertilization to prevent over-application of nitrogen
- Continue encouragement of BMP's for vineyard fertilization and winery process waste disposal to prevent over-application of nitrogen
- Contain/remediate groundwater by pumping wells and treatment systems such as nitrification/denitrification or reverse osmosis

- Contain/remediate groundwater by pumping wells and removal through crop uptake by irrigation of turf or landscaped areas.
- Remove nitrogen from municipal recycled water through a treatment process such as nitrification/denitrification or reverse osmosis before it is used for irrigation over the main groundwater basin

The problem of high nitrates has been mitigated to date by importing potable water to Buena Vista Avenue residents and by blending groundwater with low nitrate water sources to meet drinking water standards. Zone 7 has also provided input to Alameda County to limit the density of new residential and commercial septic tanks. These actions have addressed the immediate health problems and should result in stabilization of the nitrate concentration, although at its current high levels.

Reducing the nitrate concentrations already in the groundwater will require a containment/remediation action plus a reduction in the ongoing nitrate loading from existing sources. For example, removing the residential septic tanks and replacing them with a sewered connection to a wastewater treatment facility would reduce the nitrate loading concentration entering the groundwater by over 35 percent, although at a significant cost. This option is evaluated in a report entitled “ Wastewater Treatment Options for the Buena Vista Area”, RMC, May 2002.

INTRODUCTION

The Zone 7 Water Agency (Zone 7), which is the wholesale water supplier for the Livermore Valley, monitors the groundwater quality on a continuing basis and has noted a persistent plume of high nitrates in the main groundwater basin. State and Federal safe drinking water standards require nitrate concentrations to be less than 45 mg/l (or 10 mg/l expressed as Nitrogen). The concentration of nitrates in the identified groundwater plume ranges from 35 mg/l up to 70 mg/l, which exceeds the drinking water standards.

Zone 7 has investigated key high nitrate areas over the last four decades. Table 1 summarizes the status of potential sources of nitrogen.

Table 1 Summary of Potential Nitrate Sources

Source	Status
Wastewater Land Application	Discontinued
Urban Lawn Fertilization	Continues
Historic Farming along Buena Vista	Discontinued
Agricultural Fertilization	Continues, although type of farming has changed primarily to vineyards
Livestock	Continues in rural areas
Septic Tanks	
Bess-Marina Area	Discontinued
Springtown	Discontinued
Mines Road Area	Continues
Buena Vista and Almond Areas	Continues

As shown, whereas the majority of potential nitrate sources within the urban limits have been discontinued, rural areas adjacent to the groundwater basin remain as potential sources due to the nature of their land uses. Zone 7 continues to focus its efforts in these areas on four key elements

1. Monitoring and reviewing high TDS and high nitrate concentrations in the area
2. Continuing to map the changing land and water uses in the area
3. Improving geologic and hydrologic data through detailed review of new wells constructed in the area
4. Providing input to Alameda County to ensure appropriate monitoring is done as new Ordinances are implemented

Figure 1 shows the Zone 7 mapping of groundwater nitrate concentrations from 1995 through 2000. The mapping is based on 110 data sampling control points. There are several high nitrate plumes associated with current and historical sources of nitrates. The plume on the south side of Arroyo Mocho appears to be related to the rodeo grounds and previous septic tank usage in the Bess-Marina area. The plume in the northeast section of town corresponds to the previous septic tanks in the Springtown area. Plumes at Mines Road and the eastern portion of Tesla Road are underlying areas of current septic tank usage. With the exception of the Mines Road and eastern Tesla Road plumes, the sources associated with the other smaller plumes have been discontinued and the nitrates in the groundwater are a legacy from historical land uses.

This report focuses on the main plume with its eastern edge near Buena Vista Avenue and the southern edge in the vicinity of Tesla Road. This main groundwater plume extends northwest for approximately 30,000 feet, following the direction of flow within the groundwater basin. The precise boundaries of the groundwater plume are not known since there are no current control points immediately up-gradient of the Buena Vista Avenue and Tesla Road intersection. However, data from1990-91 indicates that the Mines Road and Buena Vista plumes were separated at that time. The shape of the plume is also influenced by the Arroyo Mocho that forms the plume's southern boundary and helps dilute the nitrate concentration near the boundary through infiltration.

Past studies, in particular an April 1980 report prepared by Zone 7 entitled "Preliminary Assessment of Nitrate-Nitrogen Loading Agents and Removal Mechanisms Impacting Local Ground Waters Within The Livermore-Amador Valley of California", have pointed to a number of potential sources for the high nitrogen loading, including agricultural wastes, livestock wastes, wastewater reclamation, and fertilization of lawns and crops. Particular attention has been given to septic tank leachate from the residential area along and near Buena Vista Avenue as potentially one of the main sources of nitrogen. This evaluation focuses on a 670 acre study area in the vicinity of the southeast border of the plume, which includes the rural residential areas on and near Buena Vista, and the agricultural areas along Tesla Road east and west of Buena Vista Avenue.

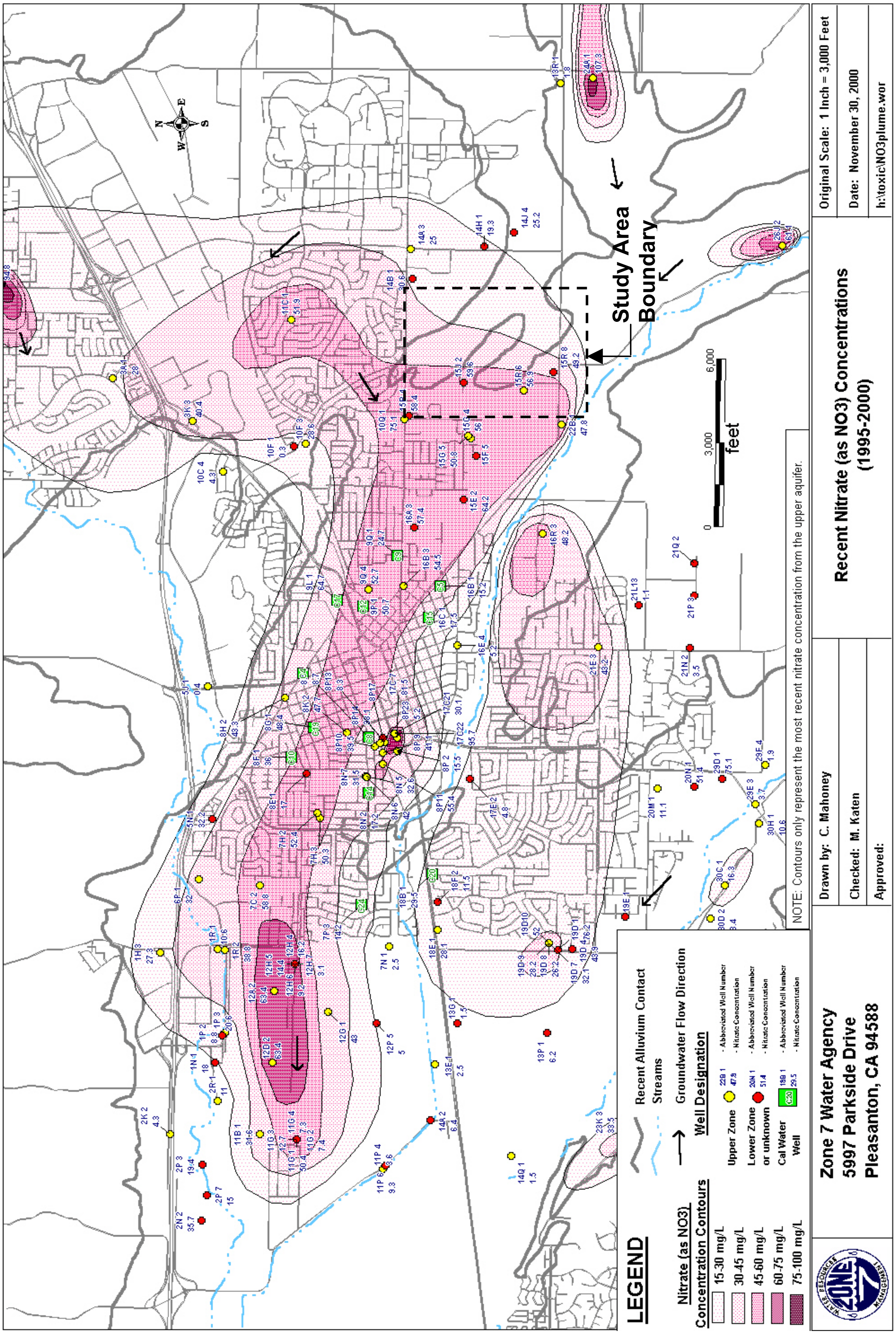
This study has the following goals:

- Identify the major sources of nitrogen within the study area
- Identify the nitrogen removal mechanisms acting within the study area
- Perform a preliminary nitrogen mass balance for the study area
- Identify potential nitrogen management programs

The study includes the following sections:

- Discussion of the Nitrogen Cycle
- Description of the Study Area
- Potential Nitrogen Sources, Losses, and Net Loading
- Potential Volumetric Loading
- Estimated Nitrate Concentrations
- Nitrogen Management Options

Figure 1 Nitrate Concentrations

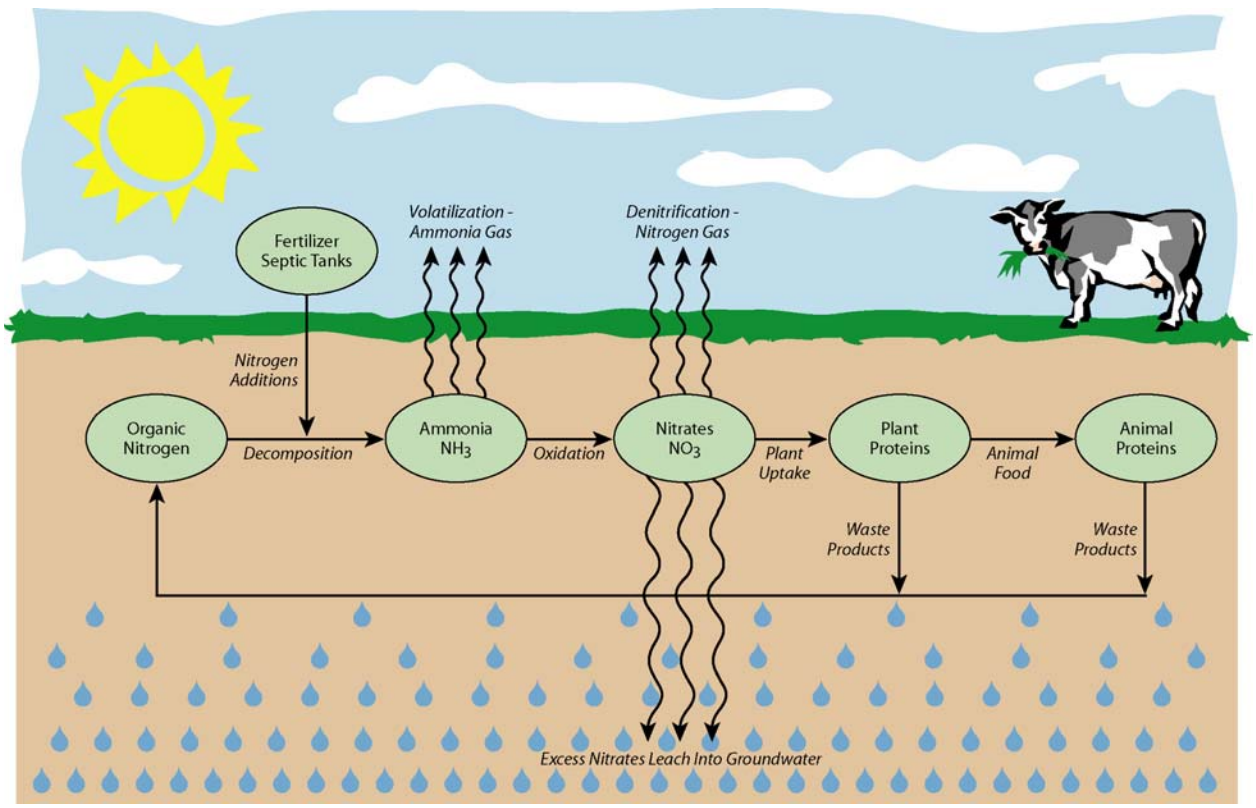


NITROGEN CYCLE

Nitrogen Forms

Nitrogen is one of the most abundant elements in the environment. It is found in the cells of all living things and is a major component of proteins. As plants and animals use nitrogen to produce protein, and as the plants and animal waste products decompose, the nitrogen is converted to various forms as shown below in the nitrogen cycle.

Figure 2 The Nitrogen Cycle



Plant and animal waste products become organic nitrogen. The organic nitrogen decomposes to become ammonia nitrogen. As nitrogen passes through the well-drained, aerobic soils in the South Livermore Valley it is quickly oxidized to nitrates. If it is not removed through natural removal processes such as crop uptake or soil denitrification, the nitrate continues to leach down until it enters the groundwater basin. The nitrate in the groundwater is in a very stable form because the natural nitrogen removal mechanisms do not occur within the groundwater. After nitrate enters groundwater the concentration can be reduced only by dilution with rainfall or groundwater of lower nitrate concentrations, or discharge to creeks or wells.

Nitrate Removal Processes

Nitrogen can be removed from the nitrogen cycle through several natural nitrogen removal processes.

Crop Uptake

Nitrogen is one of the essential nutrients for plant life. Plants assimilate nitrogen in the ammonium or nitrate form and convert it into proteins for use in cell production. As the plants die and decay the organic nitrogen is released to the soil as humus, which is then converted by bacteria in the soil to nitrates. When crops are harvested and removed from the site, a portion of the nitrogen is also removed from the soil. Fertilizers and soil amendments are then used to restore the soil's fertility.

Ammonia Volatilization

Nitrogen at the soil surface, particularly nitrogen in livestock manure, can be removed through a volatilization process in which ammonia dissociates to ammonia gas and hydrogen. This process requires alkaline soil conditions and works best when the nitrogen is contained in a liquid or semi-liquid medium. This process has been cited as a principal nitrogen removal mechanism for livestock manure in open pasture.

Soil Denitrification

Denitrification is the conversion of nitrates to nitrogen gas by denitrifying bacteria within the soil. The denitrifying bacteria survive only when there is an absence of free oxygen and an availability of abundant carbon as a food source. These conditions are present in the inter-granular soil spaces in the top feet of most soil columns and can be a significant nitrogen removal process.

STUDY AREA

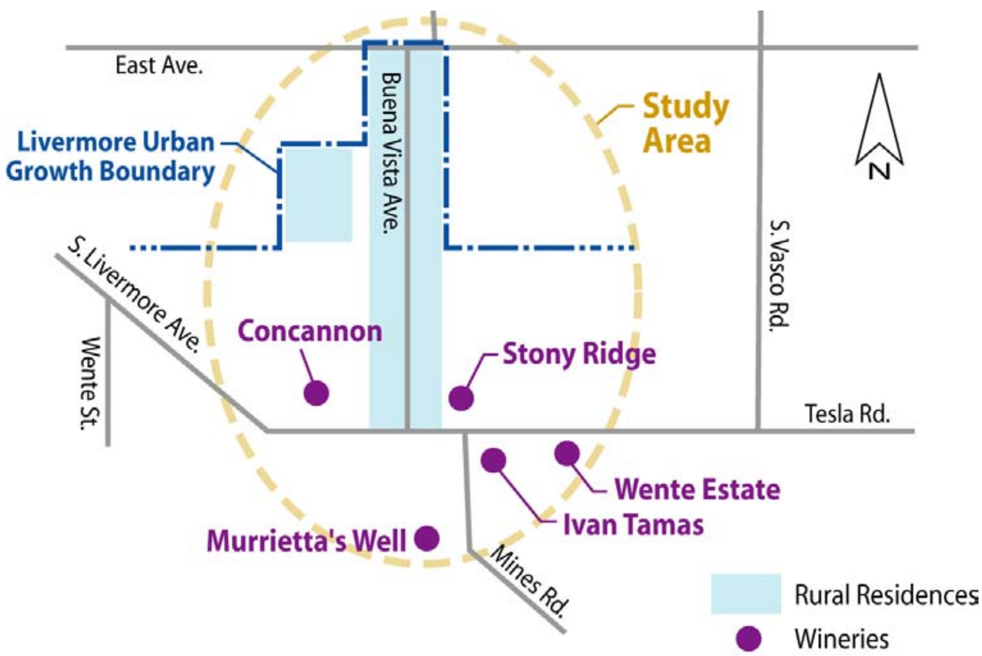
The groundwater within the main groundwater basin flows northwest. Monitoring programs by Zone 7 indicate that the water in the main groundwater basin travels at a rate of approximately 0.9 ft per day, or 330 feet per year. The high nitrate plume is approximately 30,000 feet in length. Water entering the groundwater near the eastern edge of the plume would therefore take approximately 90 years to reach the western edge, assuming the water is not removed through any of the municipal and private wells in the area.

The southeast edge of the plume is in the vicinity of Buena Vista Avenue between East Avenue and Tesla Road. The plume of high nitrates in the Livermore groundwater basin has been noted in monitoring wells for at least thirty years. The nitrates in the groundwater are likely from numerous historical and current sources. As shown in Table 1, although most of the urban sources have been discontinued, there is ongoing nitrate input from rural sources. Previous studies have identified septic tank leachate from the houses along Buena Vista Avenue as potentially one of the main sources of nitrates in the groundwater plume (Reference 4). This study therefore focuses on the relative nitrogen contributions from various sources near the plume's area of origination, i.e. the area near the intersection of the Buena Vista Avenue and Tesla Road study area.

Current Land Uses in the Study Area

The study area, as shown on Figure 3, is part of the South Livermore Valley, an unincorporated area of eastern Alameda County immediately south of the City of Livermore. The area is rural in nature and consists primarily of vineyards and wineries with rural homes along Buena Vista Avenue between East Avenue and Tesla Road and additional pockets of rural homes on Almond Avenue and East Avenue. Many of the residents also have livestock on their parcels. Potable water is supplied to most of the Buena Vista residents by California Water Service. However, since the area is outside the City of Livermore's Urban Growth Boundary (UGB), it is not served by the municipal wastewater collection and treatment system. Wastewater generated within the study area is treated with individual septic tanks and on-site leach fields.

Figure 3 Study Area



Information from the City of Livermore Planning Department indicates there are three scenarios by which the rural residents outside of the Urban Growth Boundary could be served by sewers rather than septic tanks:

1. The City could extend the sewer down Buena Vista Ave without annexation as long as it is a) contiguous with the City limits, b) for only residential connections as long as they were for 10 or fewer existing parcels and c) only if the residents sign a binding agreement that they would not subdivide their parcels or conduct non-residential (e.g., commercial) activities on them. The Buena Vista area meets the requirement for being contiguous with the City, but since there are more than 10 parcels involved, this scenario would not apply.

2. For greater than 10 residential connections, unanimous approval would be required by all LAVWMA agencies in addition to the binding agreements above regarding not subdividing their parcels and not conducting commercial activities.
3. The City could annex Buena Vista Avenue, thereby eliminating the LAVWMA approval requirement. However, to annex Buena Vista Ave and move the Urban Growth Boundary, the City would have to obtain voter approval. Approval of the Pleasanton City Council and Alameda County may also be required since they were both signers of the South Livermore Plan, which precluded the growth-inducing services beyond the UGB.

Currently, there are approximately 100 rural houses on septic tanks in a 155 acre area along Buena Vista, Almond, and East Avenues, with about 80 percent located on Buena Vista. In addition to the homes, there are six wineries, commercial and private horse stables, a dog kennel, and approximately 460 acres of vineyards. These land uses have been essentially unchanged for the past 50 years. In considering the groundwater residence time, the eastern portion of the plume is attributable to the land uses that have been in place for the last 50 years. Since the plume still contains high nitrates even within the "newer" water on its eastern edge, it is evident that excess nitrogen loading continues to enter the groundwater from current land uses.

Historical Land Uses

Zone 7 staff has done a preliminary evaluation of the historical land uses within the study area. The evaluation, including photos and mapping, is included as an appendix to this report. The State Department of Water Resources and Zone 7 began mapping the area in the late 1950's. Pre-1950's data is harder to find and is typically anecdotal and non-quantitative. Anecdotal evidence from long-time residents indicates that prior to the 1950's there was extensive chicken farming along Buena Vista Avenue. There are also anecdotal accounts of rose farms and row crops in the area during the same era.

These land uses likely resulted in excess nitrogen loading to the soil from manure and fertilizer. The nitrogen would have been converted to nitrate as it leached through the soil column before entering the groundwater. As the groundwater has flowed to the west over the decades, the nitrate concentrations attributable to the historic land uses have also moved west.

The nitrate concentrations in the western portion of the plume are similar to those of the "newer" water in the eastern portion with the exception of an area of very high nitrates near the Livermore Water Reclamation Facility. The Reclamation Facility used to dispose of wastewater through land application overlying this area. It is probable that the area of high nitrate concentrations is associated with the high nitrates contained in the applied wastewater. There are also pockets of high nitrates underlying areas that were formerly served by septic tanks including the Bess-Marina and Springtown areas.

The historical land uses are of interest in that they show excess nitrogen loading to the groundwater basin has been a problem for many decades. It also shows the vulnerability of the groundwater basin in that the effects of land use activities that may have occurred 90 years ago are still seen within the groundwater basin. The nitrate plume due to historical land uses will remain in the basin until the water is removed through discharge to creeks or wells, or is diluted with rainfall or other lower nitrate groundwater.

NITROGEN LOADING

The main sources of nitrogen within the study area include the following:

- Septic Tank Leachate
- Livestock
- Lawn Fertilization
- Agricultural Fertilization
- Winery Process Waste

The nitrogen from these sources changes forms as it moves through the nitrogen cycle and much of the nitrogen is removed through a variety of natural processes including crop uptake, soil denitrification, and ammonia volatilization. The following sections describe each source of nitrogen, the natural nitrogen removal processes acting upon it, and the resulting net nitrogen loading to the groundwater basin within the study area. The estimated sources and losses are based on literature values since there are no site-specific data available. To reflect the variability within the literature values, the potential net nitrogen is shown as a range encompassing the range of potential sources and losses.

Septic Tank Leachate

Nitrogen Sources

Septic tank effluent is discharged into the soil through leach fields. The nitrogen forms in the leachate are about 75% ammonium and 25% organic nitrogen. Conditions in the aerobic leach field are amenable to complete the conversion of ammonia to nitrate. By the time the septic tank leachate reaches the groundwater, essentially all of the nitrogen is in the nitrate form. Typical nitrogen concentrations in municipal wastewater range from 20 to 80 mg/l as nitrogen depending on the strength of the wastewater (Reference 1, 231). For this study, the nitrogen concentration used in the mass balance ranges from 30 mg/ (Reference 2) to 40 mg/l (Reference 1).

Residential Area There are approximately 100 houses served by septic tanks in the residential area within the study area. Approximately 80 percent of them are along Buena Vista Avenue with the rest on Almond Avenue and East Avenue near Buena Vista. The volume of septic tank leachate from the residential area can be estimated from design values contained in the Alameda County Draft Ordinance for Individual Sewage Treatment Systems (Reference 3, Section 23). The draft Ordinance states that peak daily sewage flows from residential buildings shall be calculated based on 150 gallons per day per bedroom. Assuming an average day flow of 50 to 65% of peak daily flow, and assuming an average of 3 bedrooms per dwelling unit, the average daily septic tank flow per dwelling unit is 225 to 300 gallons per day per dwelling unit.

The total annual nitrate loading from 100 houses is calculated as follows:

High Estimate: $(300 \text{ gpd/house})*(100 \text{ houses})*(40 \text{ mg/l}))*(8.34x\ 10^{-6})^{a} = 3{,}650 \text{ lb/yr}$

Low Estimate: $(225 \text{ gpd/house})*(100 \text{ houses})*(30 \text{ mg/l}))*(8.34x\ 10^{-6})^{a} = 2{,}050 \text{ lb/yr}$

([a] Where 8.34×10^{-6} is a conversion factor to lb/yr)

Wineries In addition to the rural residences, the wineries have septic tanks and leach fields to handle the domestic wastewater from employees, residents, and visitors. The Draft Ordinance also contains guidelines for wastewater flow from commercial establishments (Reference 3, Section 29). The wineries within the study area were contacted to determine the number of employees, visitors, and meals served. This information, combined with the Draft Ordinance guidelines, results in the following volume of septic tank leachate from the wineries along Tesla Road.

Table 2 Septic Tank Leachate from Wineries

	Winery				
Category	**Wente**	**Tamas**	**Murietta's Well**	**Concannon**	**Stony Ridge**
No. of Residents	0	0	3	0	
gpcd	100	100	100	100	
Residential Flow, gpd	0	0	300	0	
No. employees	80	4	1	15	
gpcd	15	15	15	15	
Employee Flow, gpd	1,200	60	15	225	
No. visitors	200	15	100	50	
gpcd	2.5	2.5	2.5	2.5	
Visitors Flow, gpd	500	37.5	250	125	
Subtotal, gpd	1,750	100	650	400	1000 (a)
Total Sanitary Flow, gpd	3,900				

([a]) Stony Ridge Wastewater Treatment Evaluation, Questa Engineering, 2000

Assuming a nitrogen concentration of 30 to 40 mg/l, the total nitrogen loading from the winery septic tanks is as follows:

High Estimate: $(3{,}9000\text{gpd})*(365\ d/yr)*(40\ mg/l)*(8.34x\ 10^{-6})^{a} = 470\ lb/yr$

Low Estimate: $(3{,}9000\text{gpd})*(365\ d/yr)*(30\ mg/l)*(8.34x\ 10^{-6})^{a} = 360\ lb/yr$

([a] Where $8.34x\ 10^{-6}$ is a conversion factor to lb/yr)

Nitrogen Losses

Septic tank leach fields release water below the root zone of most lawn plants so it is not available for crop uptake. Ammonia in the aerobic soil column is converted into nitrate nitrogen. However, the anaerobic conditions of the groundwater basin are not suitable for denitrification because there is a lack of organic matter, which is filtered by the overlying earth materials. As a result, the nitrogen in the septic tank leachate moves into the groundwater as nitrate nitrogen and remains in that form in the groundwater basin (Reference 4, Table B)

Livestock

Nitrogen Sources

Livestock can be a major source of nitrogen. A horse produces about 110 lb of nitrogen per year in its waste, equal to that of 10 humans (average of References 4 through 7). The study area contains a commercial stable and many of the rural houses have private stables with one or two horses for personal use. Reports of the number of livestock in the residential area have varied from 20 to 50 horses with assorted other livestock. For the mass balance, a total of 45 horses in private stables and 10 in the commercial stable will be used as an estimate of the total livestock loading.

Another potential source of nitrogen loading from livestock is a dog kennel near the corner of Buena Vista and Tesla Road. However, the dog kennel operator has indicated that the dog solid wastes are collected daily and disposed of out of the study area. Liquid wastes are subject to ammonia volatilization and therefore the nitrogen loading from the kennel will not be included.

The total estimated annual nitrogen from the horses within the study area is as follows:

Commercial stable: (10 horses)(110 lb nitrogen per horse per year) = 1,100 lb/year*

Private stables: (45 horses)(110 lb nitrogen per horse per year) = 4,960 lb/year*

Nitrogen Losses

Nitrogen in manure can be removed through ammonia volatilization at the soil surface or through soil denitrification within the soil column. It has been estimated that approximately 15 to 25% of the nitrogen in manure is lost through ammonia volatilization and that 10 to 25% of the remaining nitrogen after volatilization is lost through soil denitrification (Reference 4, Table B).

Lawn Fertilization

Nitrogen Sources

Lawn fertilization, if done to excess, can become an important nitrogen source. Recommended lawn fertilization rates for nitrogen range from 40 to 152 lb N/acre-year. For this study, an average value of 65 lb. N/acre-yr is used (Reference 4, Table A), (Reference 8). To estimate the mass loading of nitrogen from lawn fertilization, it is assumed that 5% of the residential area along Buena Vista. The total nitrogen loading from lawn fertilization within the study area is as follows:

Lawn fertilization: (155 acres)(5 percent)*(65 lb N/acre-yr) = 500 lb/year*

Nitrogen Losses

Nitrogen added as fertilizer is removed either through crop uptake or through soil denitrification. It is estimated that approximately 45 to 75% of the applied fertilizer for lawn crops is removed through crop uptake, and that 10 to 25% of the remaining nitrogen after crop uptake is lost through soil denitrification (Reference 4, Table B)

Agricultural Fertilization

Nitrogen Sources

The study area contains a large number of vineyards. Grapes have a relatively low nitrogen demand compared to other types of agricultural crops and excess nitrogen in vineyards can cause excess vigor, poor bud fruitfulness, excessive berry drop, and delayed crop maturity. Vineyard managers therefore closely control the amount of nitrogen added to the crops to avoid these problems. Fertilizer is not added every year. When it is applied, it is added in liquid form through drip irrigation system and the volume applied is only what the managers think the vine will immediately uptake. The drip irrigation rate is

controlled by a series of soil moisture sensors so that the irrigation water remains in the top 21 inches of soil column. The fertilizer is therefore contained within the root zone. Fertilizer records for the larges vineyard in the study area show that an average of 5.2 lb N/acre-year was applied over the past two years. (Reference 9).

Although there are over 2,000 acres of vineyards in production in the South Livermore Valley, many of the fields are not located over the main groundwater basin. Excess fertilizer from these fields would not enter the main groundwater basin. There are approximately 460 acres in production that overly the main groundwater basin near the area of the plume's origination. The total nitrogen loading from agricultural fertilization within the study area is as follows:

Agricultural Fertilization: (460 acres)(5.2 lb N/acre-yr) = 2,410 lb/year*

Nitrogen Losses

As with lawn fertilization, nitrogen in agricultural fertilizer is removed through crop uptake or soil denitrification. Since the fertilizer application is carefully managed due to the detrimental effects of excess nitrogen on grape growth, the vineyard agronomist estimates that 95% of the applied fertilizer for vineyards is removed immediately through crop uptake. For the nitrogen remaining after crop uptake, 10 to 25% is lost through soil denitrification (Reference 4, Table B).

Winery Process Waste

Nitrogen Sources

The wineries produce two types of waste material. Domestic wastewater from employees and visitors is treated through septic tanks and on-site leach fields. Process waste consists of grape stems, leaves, and skins produced from the grape harvest and crushing season. The nitrogen content of process waste has been reported to range from 1 to 40 mg/l (Reference 10). For this study, a mid-range value of 20 mg/l is estimated.

The volume of process waste produced is a function of the volume of wine produced. The Alameda County Draft Ordinance (Reference 3, Section 25) estimates that two gallons of process waste are produced for every gallon of wine. The wineries in the study area were contacted and estimated their total annual volume of wine production at 1,080,000 gallons. Using the Draft Ordinance guidelines, this results in a process waste volume of: (2)*(1,080,000) or 2,160,000 gallons.

Assuming a total of 2,160,000 gallons of process waste at a nitrogen concentration of 20 mg/l, the total annual nitrogen loading from winery process waste is as follows:

$$\textit{Winery Process Waste:}\quad (2{,}160{,}000\ \text{gal})*(20\ \text{mg/l})*(8.34\text{x}\ 10^{-6})^{a} = 360\ \text{lb/yr}$$

([a] Where $8.34\text{x}\ 10^{-6}$ is a conversion factor to lb/yr)

Nitrogen Losses

At the Wente winery, the liquid process waste is separated from the grape stems, leaves, and skins. The liquid is stored in tanks and is used for dust control on dirt ranch roads where it almost immediately evaporates. The solid wastes are composted and then re-incorporated back into the soil. The winery process waste acts as a fertilizer and is removed through crop uptake or soil denitrification. Since the application is not as carefully controlled as the addition of chemical fertilizer, for the mass balance it is estimated that 45 to 75% of the process waste is used for crop uptake and10 to 25% of the remaining nitrogen after crop uptake is lost through soil denitrification (Reference 4, Table B).

Net Nitrogen Loading

The total estimated nitrogen loading from sources within the study area is summarized on Table 3. The table shows the loadings from the residential area, from the winery area along Tesla Road, and for the study area as a whole.

Table 3 Net Nitrogen Loading in Study Area

	Septic Tank		Winery Process Waste		Livestock		Lawn Fertilization		Agricultural Fertilization	
	High Input	Low Input	Low Losses	High Losses	Low Losses	High Losses	Low Losses	High Losses	Low Losses	High Losses
Residential Area										
Total Input, lb/yr	3,650	2,050	0	0	4,964	4,964	504	504	0	0
Losses, lb/yr, due to:										
Crop Uptake	0	0	0	0	0	0	227	378	0	0
Ammonia Volatilization	0	0	0	0	745	1,241	0	0	0	0
Soil Denitrification	0	0	0	0	422	931	28	31	0	0
Total Losses, lb/yr	0	0	0	0	1,166	2,172	254	409	0	0
Net Loading, lb/yr	3,650	2,050	0	0	3,797	2,792	249	94	0	0
Total Net Loading, lb-N/yr	**High Input**	**7,696**	**Low Input**	**4,936**						
Tesla Road Area										
Total Input, lb/yr	470	360	360	360	1,103	1,103	0	0	2,410	2,410
Losses, lb/yr, due to:										
Crop Uptake	0	0	162	270	0	0	0	0	2,049	2,290
Ammonia Volatilization	0	0	0	0	165	276	0	0	0	0
Soil Denitrification	0	0	20	23	94	207	0	0	36	30
Total Losses, lb/yr	0	0	182	293	259	483	0	0	2,085	2,320
Net Loading, lb/yr	470	360	178	68	844	620	0	0	325	90
Total Net Loading, lb-N/yr	**High Input**	**1,817**	**Low Input**	**1,138**						

Total Study Area	Septic Tank		Winery Process Waste		Livestock		Lawn Fertilization		Agricultural Fertilization	
	High	Low	High	Low	High	Low	High	Low	High	Low
Net Loading, lb-N/yr	4,120	2,410	178	68	4,641	3,412	249	94	325	90
Total Net Loading, lb-N/yr	**High Input**	**9,514**	**Low Input**	**6,075**						

Figure 4 Nitrogen Sources

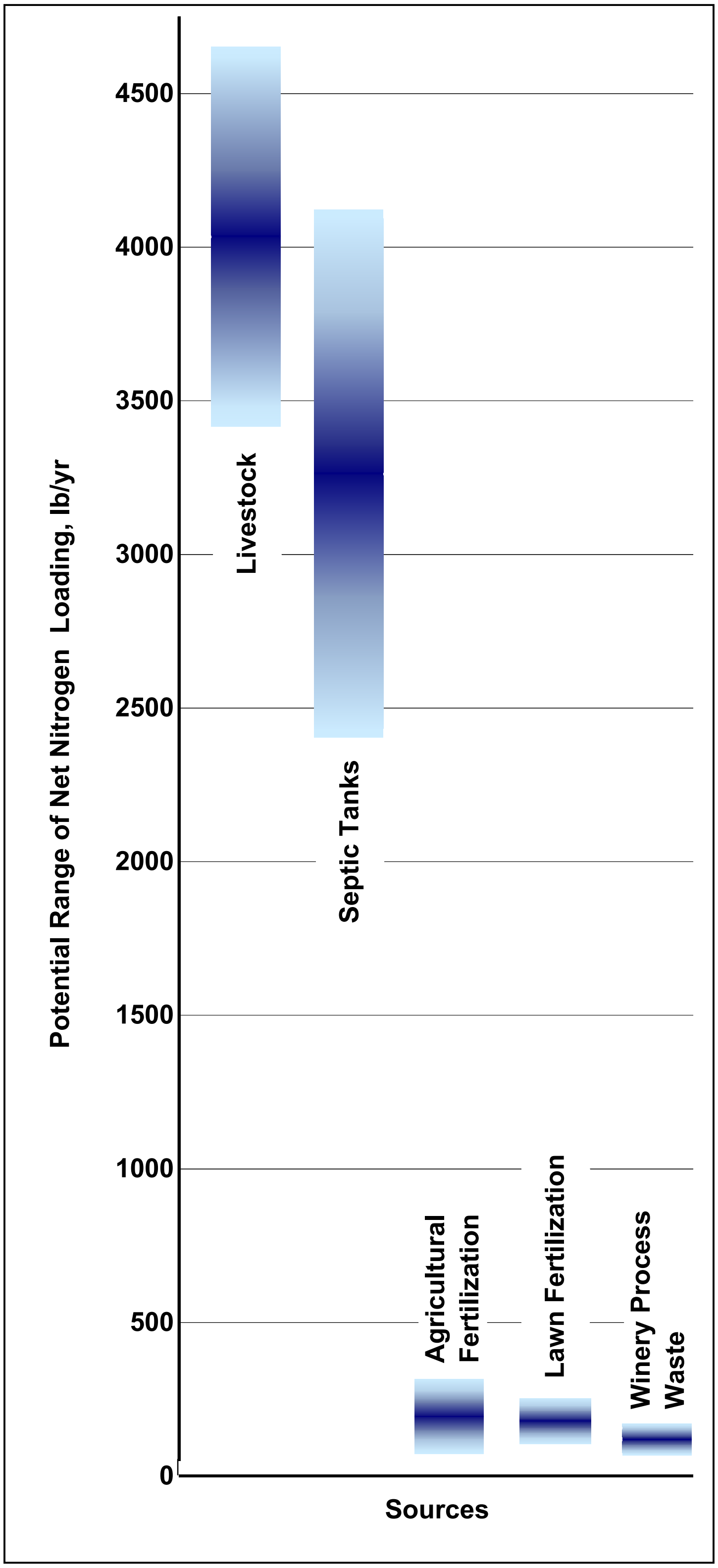


Figure 4 shows the range of potential net nitrogen input from each of the sources. As shown, the majority of the nitrogen loading in the study area is due to livestock and septic tank leachate. The other nitrogen sources are relatively insignificant by comparison.

VOLUMETRIC LOADING

This section calculates the approximate concentration of nitrate resulting from the net loading calculated above. This requires an estimate of the annual volume of water entering the groundwater basin from sources within the study area. These sources of water include the following:

- Septic Tank Leachate
- Winery Process Waste
- Rainfall Recharge
- Urban Irrigation Recharge
- Agricultural Irrigation Recharge

The estimated volume of water attributable to each source is calculated below.

Septic Tank Leachate

Residential Area As calculated previously, the flow per house is 225 to 300 gallons per day. Using the average of the flow range and a total of 100 houses on septic tanks, the average annual septic tank leachate flow from the residential areas is:

Residential Septic Tank Leachate: (262.5 gal/house/ day)(100 houses)*(365 days/year) = 9,580,000 gallons per year*

Tesla Road Wineries The flow from the winery septic tanks was also estimated using the Draft Ordinance guidelines for commercial facilities. As calculated previously, the estimated annual flow from the winery septic tanks is:

Winery Septic Tank Leachate: (3900 gal/day)(365 days/year) = 1,420,000 gallons per year*

Winery Process Waste

The flow associated with the winery process waste was estimated using the Draft Ordinance guidelines for wineries along with the annual wine production values for the wineries within the study area (Reference 3, Section 25). The liquid processing waste from Wente winery, which represents 80% of the total is used for dust control on the dirt ranch roads, where it evaporates. The other 20 percent of the liquid process waste from the other wineries process liquid is re-incorporated into their fields. The estimated flow from the winery process waste is therefore:

Winery Process Waste: (2 gal waste/gal wine)(1,080,000 gal wine)*(20 percent) = 432,000 gallons/year*

Rainfall Recharge

Zone 7 has developed a model for predicting the rainfall and applied water recharge rates within the main groundwater basin (Reference 11). The model divides the groundwater basin into numerous nodes and predicts the recharge rate per node depending on land uses and permeability within the node. The study area is part of Node 40 of the model. The predicted rainfall recharge rate is 1.79 inches-acre/year (or 0.15 ft-acre/yr) within Node 40. Using this unit recharge rate, yields the following total volume of recharge for the study area:

Rainfall Recharge: (670 acres)(0.15 ft-acre/yr) = 100 AF/yr or 32,564,000 gallons/year*

Storm water runoff was evaluated in a previous study by Zone 7 (Reference 4) and was not determined to be a significant factor in nitrogen loading or groundwater recharge.

Urban Irrigation Recharge

The Zone 7 applied water recharge model uses a recharge rate for lawn irrigation of 8.7 in-acre/year (or 0.725 ft-acre/year). For this estimate, it is assumed that 5% of the residential area is fertilized lawn, or approximately 8 acres total. The resulting recharge volume from urban irrigation is as follows:

Buena Vista Avenue Irrigation Recharge: (8 acres)(0.725 ft-acre/yr) = 15 AF/yr or 1,831,000 gallons/year*

Agricultural Irrigation Recharge

The Zone 7 applied water recharge model uses a recharge rate for agricultural irrigation of approximately 7 in-acre/year. However, the model assumes a conventional spray irrigation system that is far less efficient than the drip irrigation systems now used in the vineyards in the study area. Drip irrigation systems are designed to deliver water slowly and more continuously to keep irrigation water within the root zone and reduce the amount of irrigation water wasted to recharge. For the vineyards in the study area, the irrigation rate is controlled by soil moisture sensors set at 9 inches, 21 inches, and 33 inches below the soil surface. The irrigation rate is controlled so that all of the moisture is kept within the root zone and there is no increase in the lowest soil moisture level. Since the water is applied directly to the root zone, evaporation, runoff, and leaching are minimized (Reference 12). Based on irrigation practices within the study area, a recharge rate for the drip irrigation system of half that of rainfall recharge, or 0.08 ft-acre/yr will be used. It is also assumed that of the 515 acres of agricultural area within the study area, 90 percent or 460 acres, is actually planted with grapes, with the remainder being roads, buildings, and service areas.

The resulting recharge volume from agricultural irrigation is as follows:

Tesla Road Agricultural Irrigation Recharge: (460 acres)(0.08 ft-acre/yr) = 12 AF/yr or 12,080,000 gallons/year*

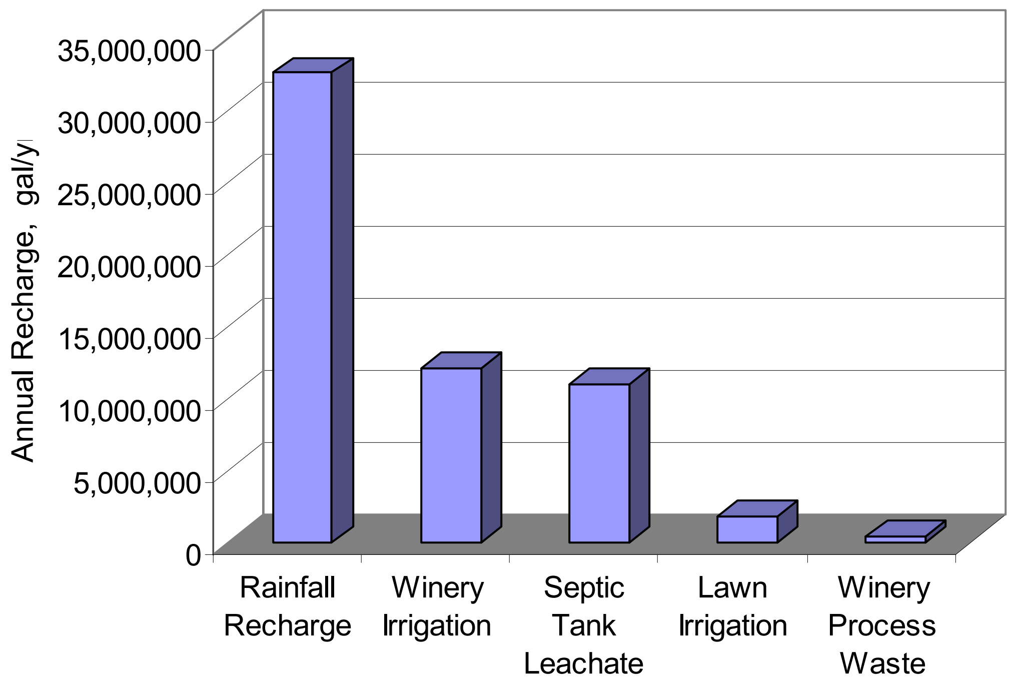
Total Annual Recharge

The total annual recharge volume within the study area is summarized on Table 4 and in Figure 5.

Table 4 Total Annual Recharge

Source	Recharge Volume, gal/yr
Rainfall Recharge	32,564,000
Winery Irrigation	12,082,000
Septic Tank Leachate	11,000,000
Lawn Irrigation	1,831,000
Winery Process Waste	432,000
Total	57,909,000

Figure 5 Applied Water Recharge



ESTIMATED NITRATE CONCENTRATION

The estimated ground water concentration of nitrogen attributable to sources within the study area is the net nitrogen loading divided by the recharge rate. The relationship between concentration, volume, and loading is as follows:

(Concentration in mg/l)=(Loading of nitrogen in lbs/yr)/(Volume in gallons)(8.3 x10^{-6}, a conversion factor to lb/day)*

The net nitrogen loadings and the recharge volumes have been calculated in the previous sections. Solving this equation for concentration for the study area results in the estimated nitrogen concentration shown on the following table.

Table 5 Estimated Nitrate Concentrations

	Total Study Area	
	High	Low
Net Loading, lb/year	9,514	6,075
Recharge Rate, million gallons/year	57.9	57.9
Estimated Nitrogen Concentration, mg/l	20	13
Estimated NO3 Concentration, mg/l	89	57

The mass balance model contains numerous assumptions including the actual volume and strength of the septic tank leachate, the exact number of livestock within the study area, the nitrate concentration of the winery process waste, the amount of fertilizer applied to each lawn and vineyard, the recharge rate of the drip irrigation systems, etc. Further field studies to define each parameter could lead to a mass balance model that more closely matches the concentrations found in the sampling data. However, the relative contributions of nitrogen from the various sources is unlikely to change, i.e. the primary contributors of nitrogen in the study area are livestock manure and septic tank leachate. In view of the data known to date, the range of nitrate concentrations estimated by the mass balance model is reasonably close to the actual values seen in the control points.

NITROGEN MANAGEMENT OPTIONS

This evaluation of historical land uses and development of a mass balance model reveals two conclusions:

- The groundwater shows effects of excess nitrogen loading for many decades
- Excess nitrogen is still entering the groundwater from current land uses

The mass balance model shows there are multiple sources of nitrogen in the groundwater. The most significant sources of loading appear to be septic tank leachate and livestock manure. Less significant sources include agricultural and lawn fertilization and winery process wastes. Reduction of the excess nitrogen loading will eventually reduce the groundwater nitrate concentration, although the reduction will not be seen for several decades.

Candidate activities to reduce the excess nitrogen loading to the groundwater basin could include the following:

- Replace existing septic tanks overlying the main groundwater basin with sewered connections to a municipal or community treatment plant
- Prohibit new septic tanks in areas overlying the main groundwater basin
- Limit the number of livestock per acre and/or use Best Management Practices (BMP’s) to limit animal waste from leaching into the groundwater
- Continue encouragement of BMP’s for lawn fertilization to prevent over-application of nitrogen
- Continue encouragement of BMP’s for vineyard fertilization and winery process waste disposal to prevent over-application of nitrogen
- Contain/remediate groundwater by pumping wells and treatment systems such as nitrification/denitrification or reverse osmosis
- Contain/remediate groundwater by pumping wells and removal through crop uptake by irrigation of turf or landscaped areas.
- Remove nitrogen from municipal recycled water through a treatment process such as nitrification/denitrification or reverse osmosis before it is used for irrigation over the main groundwater basin

If the existing residential septic tanks in the study area were replaced with a sewered connection to a treatment facility, the net nitrate concentration of the leachate entering the groundwater would be reduced by over 30 percent as shown on the following table.

Table 6 Net Nitrogen Loading in Study Area

Nitrogen Loading	With residential septic tanks	Without residential septic tanks	Percent Reduction
Net Nitrogen Loading, lb/yr	6,070 to 9,510	4,020 to 5,860	36%
Total Volumetric Loading, gal/yr	57,900,000	48,300,000	16%
Estimated Nitrogen Conc., mg/l	13 to 20	10 to 15	23%
Estimated NO3 Conc, mg/l	57 to 89	45 to 65	23%

CONCLUSIONS

The main plume of high nitrates in the groundwater basin appears to begin in the vicinity of the Buena Vista Avenue/Tesla Road study area. This report identified potential sources of groundwater nitrate loadings in a study area encompassing the rural residential area near Buena Vista Avenue and the adjacent areas of Tesla Road. The estimated net nitrogen loading from each source within the study area is as follows:

Table 7 Net Nitrogen Loadings Within the Study Area

Source	Range of Potential Net Nitrogen Loading, lb/year	Percent of Total Loading
Septic Tank Leachate	2,410 to 4,100	41%
Livestock	3,410 to 4,640	53%
Lawn Fertilization	100 to 250	1.5%
Agricultural Fertilization	90 to 320	2%
Winery Process Waste	70 to 180	2.5%
Total	6,100 to 9,500	

The mass balance model includes numerous assumptions including the actual volume and strength of the septic tank leachate, the exact number of livestock within the study area, the nitrate concentration of the winery process waste, the amount of fertilizer applied to each lawn and vineyard, the recharge rate of the drip irrigation systems, etc. The mass balance model estimate of resulting groundwater nitrate concentrations due to this nitrogen loading is reasonably close to actual values and shows the relative contributions of each source. More field sampling and on-site data collection could change the absolute values used in the model, but are unlikely to change the relative contributions, i.e. septic tank leachate and animal wastes are the primary sources of excess nitrates.

The effects of nitrogen loadings from historic land uses are still seen in the western portion of the nitrate plume. Nitrate that has already entered the groundwater will remain in the groundwater for decades to come. Water is currently removed through wells and used for drinking water. It could also be removed and nitrates could be removed through treatment (such as reverse osmosis) or through crop uptake by spreading it on irrigated landscape or turf. The nitrate concentrations in the "newer" water in the eastern portion of the plume are also high, indicating that excess nitrogen is still entering the groundwater basin from a number of sources, primarily septic tank leachate and livestock manure.

Programs to reduce the amount of excess nitrogen entering the groundwater in the future should focus on reduction of the septic tank leachate, management of animal wastes, and continued implementation of best management practices for application of fertilizer and winery wastes.

Attachments:

References	
Attachment A	Nitrogen Mass Balance Model
Attachment B	Historical Land Uses Within Study Area

References

1 Wastewater Engineering: Collection, Treatment, Disposal and Reuse, Metcalf & Eddy, McGraw-Hill, 1991

2 Reclaimed Wastewater Quality, Livermore Water Reclamation Plant, Water Years 1999 and 2000.

3 Alameda County Ordinance, Chapter 15.16.120, 4th Draft

4 Preliminary Assessment of Nitrate-Nitrogen Loading Agents and Removal Mechanisms Impacting Local Ground Waters Within the Livermore-Amador Valley of California, Zone 7, April 1980

5 Livestock Manure Production Rates and Nutrient Content, J.C. Barker, S.C. Hodges, F.R. Walls, North Carolina Agricultural Chemicals Manual, 2001

6 Manure Production and Characteristics, American Society of Agricultural Engineers, 2000

7 Estimating Manure Nutrients from Livestock and Poultry (beef cow), University of Nebraska, 1998

8 Lime And Fertilizer Suggestions For Lawns, A. H. Bruneau And C. H. Peacock, Crop Science; S. C. Hodges, Soil Science, 2001

9 Fertilizer Records, Wente East Ranch, 2000-2001.

10 Markham Winery NPDES Application to Regional Water Quality Control Board, December 1988, Summit Engineering Inc.

11 Applied Water Recharge Model for the Main Groundwater Basin, Zone 7 Water Agency, January 1997

12 Efficient Irrigation, March 1996, Bilderback and Powell, North Carolina Cooperative Extension Service

Attachment A
Nitrogen Mass Balance Model

Nitrogen Sources

Septic Tank Leachate

Residential

High Estimate

Flow (1)	(300 gal/day/du)	x	(100 du)	=	30,000 gpd		
					(10,950,000 gpy)		
					x		
Concentration					(40 mg/l)		
					x		
Conversion factor to lb/yr					8.34×10^{-6}		
Total Loading, lb/yr						=	**3,650**

Low Estimate

Flow (1)	(225 gal/day/du)	x	(100 du)	=	22,500 gpd		
					(8,212,500 gpy)		
					x		
Concentration					(30 mg/l)		
					x		
Conversion factor to lb/yr					8.34×10^{-6}		
Total Loading, lb/yr						=	**2,050**

Tesla Road

High Estimate

Flow (1)	=	3,900 gpd		
		(1,423,500 gpy)		
		x		
Concentration		(40 mg/l)		
		x		
Conversion factor to lb/yr		8.34×10^{-6}		
Total Loading, lb/yr			=	**470**

Low Estimate

Flow (1)	=	3,900 gpd		
		(1,423,500 gpy)		
		x		
Concentration		(30 mg/l)		
		x		
Conversion factor to lb/yr		8.34×10^{-6}		
Total Loading, lb/yr			=	**360**

Livestock

Residential

Horses, lb/yr (3)	(110.3 lbs/horse/yr)	x	(45 horses (4))	=	**4,964**

Tesla Road

Horses, lb/yr (3)	(110.3 lbs/horse/yr)	x	(10 horses (4))	=	**1,103**

Residential Landscape Fertilization

Total Residential Area		=	155 acres	
Percent lawn area	5%			
Total Lawn area			8 acres	
Unit loading (3)	65 lb/acre/yr			
Total Loading, lb/yr				**504**

Vineyard Fertilization

Total Area of Vineyards within Study Area		464 acres	
Unit loading (5)	5.2 lb/acre/yr		
Total Loading, lb/yr			**2,410**

Winery Process Waste

Flow (2)	(2 gal waste/gal wine)	x	(1080000 gal of wine)	=	(2,160,000 gallons)		
					x		
Concentration					(20 mg/l)		
					x		
Conversion factor to lb/yr					8.34×10^{-6}		
Total Loading, lb/yr						=	**360**

Total Nitrogen-N Input to Basin from Sources within Study Area			**15,510**
	High Value	Low Value	
Residential Septic Tanks	3,650	2,050	
Tesla Septic Tanks	470	360	
Residential Livestock	4,964	4,964	
Tesla Livestock	1,103	1,103	
Urban Fertilization	504	504	
Vineyard Fertilization	2,410	2,410	
Winery Waste	360	360	
Total Input	13,460	11,750	

Nitrogen Losses

	Percent of Nitrogen Lost				
Types of Nitrogen Losses [3]	Septic Tank	Winery Process Waste	Livestock	Lawn Fertilization	Vineyard Fertilization
Crop Uptake					
High Loss	0%	75%	0%	75%	95%
Low Loss	0%	45%	0%	45%	85%
Ammonia Volatilization					
High Loss	0%	0%	25%	0%	0%
Low Loss	0%	0%	15%	0%	0%
Soil Denitrification (percent of remaining N after other losses)					
High Loss	0%	25%	25%	25%	25%
Low Loss	0%	10%	10%	10%	10%

Net Nitrogen Loading

	Septic Tank		Winery Process Waste		Livestock		Lawn Fertilization		Agricultural Fertilization	
	High Input	Low Input	Low Losses	High Losses	Low Losses	High Losses	Low Losses	High Losses	Low Losses	High Losses
Residential Area										
Total Input, lb/yr	3,650	2,050	0	0	4,964	4,964	504	504	0	0
Losses, lb/yr, due to:										
Crop Uptake	0	0	0	0	0	0	227	378	0	0
Ammonia Volatilization	0	0	0	0	745	1,241	0	0	0	0
Soil Denitrification	0	0	0	0	422	931	28	31	0	0
Total Losses, lb/yr	0	0	0	0	1,166	2,172	254	409	0	0
Net Loading, lb/yr	3,650	2,050	0	0	3,797	2,792	249	94	0	0
Total Net Loading, lb-N/yr	**High Input**	**7,696**	**Low Input**	**4,936**						
Tesla Road Area										
Total Input, lb/yr	470	360	360	360	1,103	1,103	0	0	2,410	2,410
Losses, lb/yr, due to:										
Crop Uptake	0	0	162	270	0	0	0	0	2,049	2,290
Ammonia Volatilization	0	0	0	0	165	276	0	0	0	0
Soil Denitrification	0	0	20	23	94	207	0	0	36	30
Total Losses, lb/yr	0	0	182	293	259	483	0	0	2,085	2,320
Net Loading, lb/yr	470	360	178	68	844	620	0	0	325	90
Total Net Loading, lb-N/yr	**High Input**	**1,817**	**Low Input**	**1,138**						
Total Study Area	**Septic Tank**		**Winery Process Waste**		**Livestock**		**Lawn Fertilization**		**Agricultural Fertilization**	
	High	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**
Net Loading, lb-N/yr	4,120	2,410	178	68	4,641	3,412	249	94	325	90
Total Net Loading, lb-N/yr	**High Input**	**9,514**	**Low Input**	**6,075**						
Percent of Total	43.3%	39.7%	1.9%	1.1%	48.8%	56.2%	2.6%	1.6%	3.4%	1.5%

Volumetric Input

Septic Tank Leachate - BV		AF/yr	29	gal/yr	9,580,000
Septic Tank Leachate -Tesla		AF/yr	4	gal/yr	1,420,000
Winery Process Waste					
Total Process Waste		2,160,000			
Percent generated by Wente & reused for dust control		80%			
Net Volume for Recharge		432,000			432,000
Rainfall Recharge					
Recharge Rate, Node 40 (6)	1.79 in/yr/acre				
	0.149 ft/yr/acre				
Total acres in Study Area	670				
Total Rainfall Recharge		AF/yr	100		32,564,000
Residential Irrigation Recharge					
Recharge Rate, Node 40 (6)	8.7 in/yr/acre				
	0.725 ft/yr/acre				
Irrig.acres in Study Area	8				
Total Irrigation Recharge		AF/yr	5.6		1,831,000
Vineyard Irrigation Recharge					
Recharge Rate, Node 40 (6)	3.5 in/yr/acre				
	0.080 ft/yr/acre				
Irrig.acres in Study Area	464				
Total Irrigation Recharge		AF/yr	37		12,082,000

Total Volumetric Input into Groundwater from Study Area

	Total Study Area
Septic Tank Leachate	11,000,000
Winery Process Waste	432,000
Rainfall Recharge	32,564,000
Lawn Irrigation	1,831,000
Winery Irrigation	12,082,000
Total	57,909,000

Resultant Nitrogen Concentration

	Total Study Area	
	High	Low
Net Loading, lb/year	9,514	6,075
Recharge Rate, MG/year	57.9	57.9
Estimated Nitrogen Conc., mg/l	20	13
Estimated NO3 Conc, mg/l	89	57

Resultant Nitrogen Concentration without Residential Septic Tanks

	Total Study Area		Percent Reduction		
	High	Low	High	Low	Average
Net Loading, lb/year	5,864	4,025	38.4%	33.7%	36.1%
Recharge Rate, MG/year	48.3	48.3	16.5%	16.5%	16.5%
Estimated Nitrogen Conc., mg/l	15	10	26.1%	20.6%	23.4%
Estimated NO3 Conc, mg/l	65	45	26.1%	20.6%	23.4%

References

(1) Treatment alternatives for the South Livermore Valley, RMC Engineers, September 2001
(2) Alameda County Draft Ordinance for Individual Septic Systems, 4th Draft
(3) Waters Within the Livermore-Amador Valley of California, Zone 7, April 1980
(4) Based on visual count of Buena Vista Avenue resident
(5) Cooperative Extension, April 1998. Application rate = 35 lb/acre/yr, crop uptake = 33 lbs/acre/yr.
(6) Main Groundwater Bain, Rainfall and applied Water Recharge per Unit Area, Zone 7, January 1997

Attachment B
Buena Vista Avenue Historical Land Use Survey

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

5997 PARKSIDE DRIVE PLEASANTON, CA 94588-5127 PHONE (925) 484-2600 FAX (925) 462-3914

Date: Thursday, September 6, 2001

To: Matt Katen, Senior Engineer, Groundwater Protection Group

From: Mary Lim, Water Resources Technician I

Subject: Buena Vista Avenue Historical Land Use Survey

Purpose

Buena Vista Avenue is located in South Livermore, between East Ave. and Tesla Rd. and lies just east of South Livermore Ave. Buena Vista Ave lies on the main groundwater basin in South Livermore, which has elevated nitrate levels. Currently, the residents on Buena Vista Ave. are on septic tanks and most of the residents are serviced by California Water Service (CWS). The purpose of this historical land use survey is to determine if there are any contributors of nitrates, other than the septic tanks, in this area.

Buena Vista Land Use Survey

Barbara Bundtshaw, History Docent, Livermore Heritage Guild

Ms. Bundtshaw was unable to find any historical records indicating there were poultry farms or rose farms on Buena Vista Ave. She found a record in the 1940's where EC Kelley raised homing pigeons on Buena Vista Ave. Jackson & Perkins, who cultivates roses, had rose farms off of East Ave, specifically on Jackson Ave. They had their first major crop in 1938 and in the 1940's they had planted roses on 40 acres of the Gatsomer Wagoner Farm, just west of the now Lawrence Livermore Laboratory. No documentation was found regarding leasing land on Buena Vista Ave for growing roses. Other historical nurseries in the area included the San Lorenzo Nursery off of Vasco Road and the DaVore Nursery that had approximately 500 acres of land behind Jackson Elementary and 500 acres near the airport.

Director James Concannon, Concannon Vineyards

To Mr. Concannon's knowledge, Buena Vista Ave. had been partitioned off since he can remember. He remembers that there had always been almond orchards along Buena Vista Ave. He also remembered that there was one chicken farmer along Buena Vista Ave that went out of business approximately 30 years ago.

Valerie Raymond, Buena Vista Ave Resident

Mrs. Raymond has been a resident of Buena Vista Ave since 1963. She stated that currently there are approximately 75 homes on this street, mainly serviced by CWS. At the time she became a resident of Buena Vista Ave, her neighbor had a chicken farm, which had approximately 7000 laying hens (See Figure 1 for location). Her neighbor went out of business in the 1970's. She indicated that historically, there was extensive chicken farming along Buena Vista Ave. In the 1950's, a disease swept the area killing off many chickens and therefore causing several chicken farms to go out of business. When Mrs. Raymond purchased her home, she indicated that there was a barn on the property that used to house chickens. She also gave me some historical information regarding Buena Vista Ave. She said that in the late 1800's to 1910, subdivisions of approximately 10 acres were created. Buena Vista Ave. was a gravel road until the 1930's, when it became a private road. Since then, Alameda County had rezoned the area several times.

Sheila Barry, Natural Resources Advisor, UC Cooperative Extension, Santa Clara County

Ms. Barry wrote "The Alameda Creek Watershed, Its History as a Working Landscape" for the Agricultural Committee of the Alameda Creek Watershed Management Plan (Attachment 1). This paper summarizes agricultural use along the Alameda Creek Watershed as early as 1795. She does make reference to agricultural use in the Livermore Valley. However, it does not contain site-specific information. She referred me to the Alameda County Resource Conservation District (RCD) offices to look at historical aerials and soil surveys of the area. She noted that irrigation and fertilizer were limited in the early 1900's.

Alameda County Resource Conservation District (RCD) Office

At the NRCS & RCD Office, I obtained historical aerials of the area from the years 1940 and 1958 (Attachment 2), there are row crops seen just adjacent of Buena Vista Ave on the east side. However, these row crops are not clear in the 1958 aerial.

Burt Kurtner, Alameda County Agriculture Department

The historical aerial of the area from the 1940 was faxed over to this department for research. Mr. Kurtner was unable to find information on this particular area. He indicated that in the 1930's, there was a cattle feed lot off of Charlotte Way, which is approximately 1 mile NE from Buena Vista Ave. He also noted that the soil on Buena Vista Ave was mainly gravel and if there were poultry farms in that area, the manure was most likely disposed of on the adjacent ground.

Conclusion

Unfortunately, there are limited written historical records available on Buena Vista Ave. The significant piece of historical information in regards to farming on this street was the one chicken farm that housed 7000 laying hens, which was adjacent to Mrs. Raymond's residence. Based on Mrs. Raymond's knowledge, there was extensive chicken farming in the early 1900's. However, none of the other sources could confirm the presence of and the extent of these chicken farms. If there was extensive chicken farming on Buena Vista Ave in the early 1900's, the manure generated from these farms would have been disposed of onsite, which may have contributed nitrates to the local groundwater as precipitation leached through the soil.

Attachment 1: The Alameda Creek Watershed, Its History as a Working Landscape

Attachment 2: Buena Vista Ave Historical Aerial Photos, 1940 & 1958

cc: Jim Horen

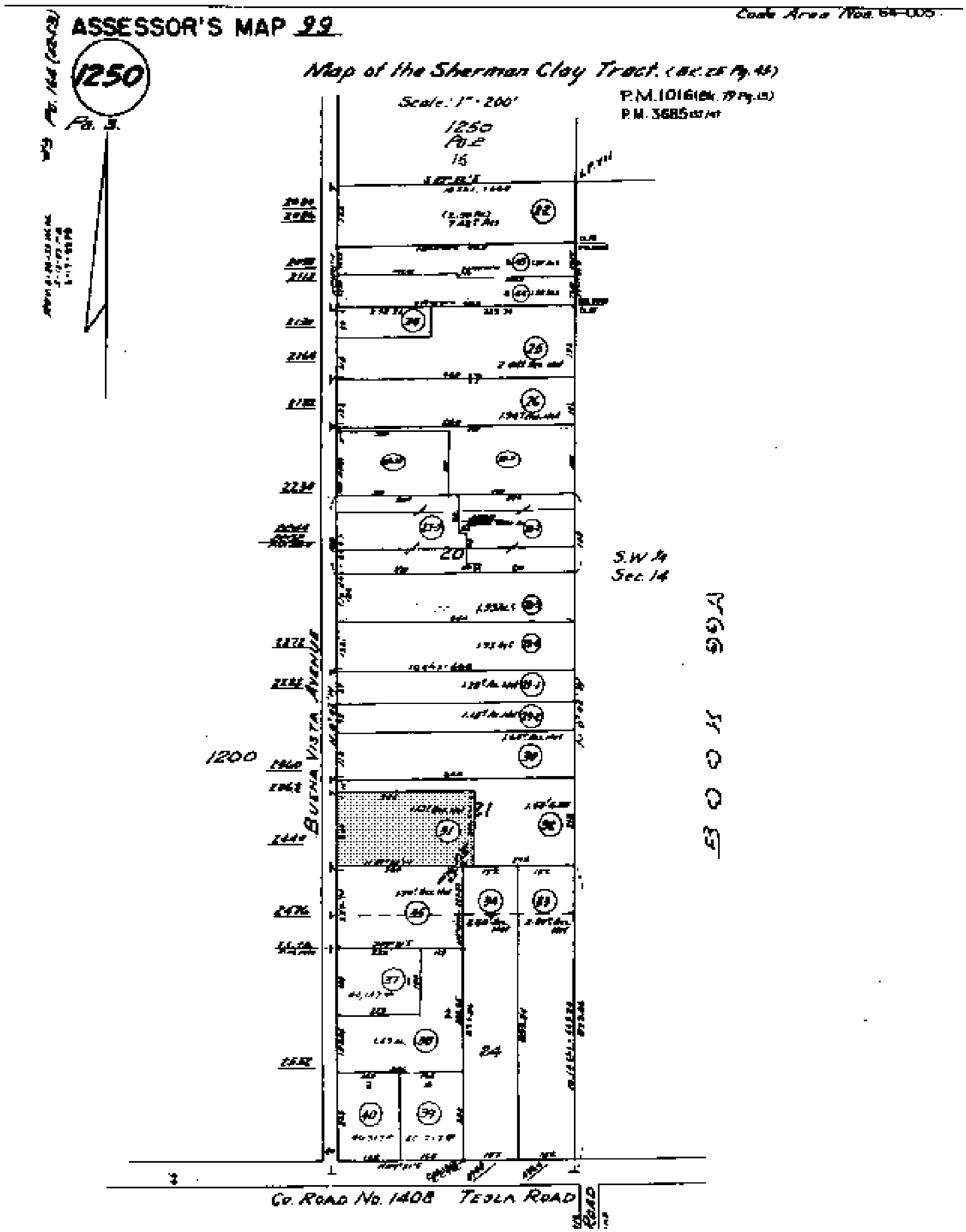
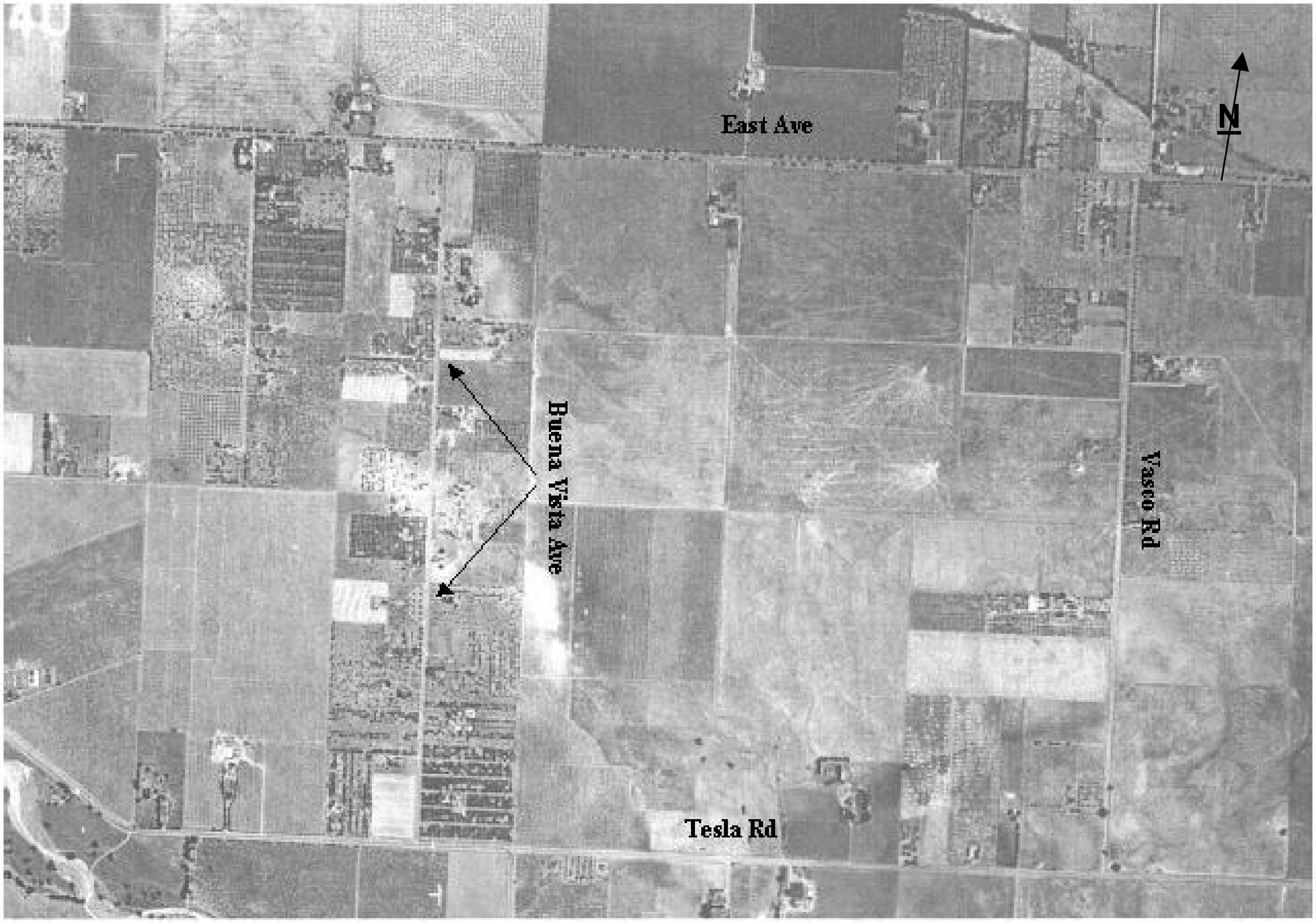


Figure 1. Buena Vista Ave Parcel Map

The shaded area of Parcel #31 used to contain a chicken farm until the

Buena Vista Avenue 1940 Aerial



Buena Vista Avenue 1958 Aerial