Addressing Nitrate in California's Drinking Water

TECHNICAL REPORT 8:

Regulatory and Funding Options for Nitrate Groundwater Contamination

With a Focus on Tulare Lake Basin and Salinas Valley Groundwater

Report for the State Water Resources Control Board Report to the Legislature

California Nitrate Project,
Implementation of Senate Bill X2 1

Center for Watershed Sciences
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Prepared for the California State Water Resources Control Board

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Acronyms and Abbreviations

Abbreviation	Full Name
AB	Assembly Bill
AMBAG	Association of Monterey Bay Area Governments
AQUA	Association of People United for Water
ARRA	American Recovery and Reinvestment Act
AWP	Agricultural Waiver Program
BMP	Best Management Practices
CAA	Cleanup and Abatement Account
CalEPA	California Environmental Protection Agency
CalNRA	California Natural Resources Agency
CCR	California Code of Regulations
CCR	Consumer Confidence Report
CDBG	Community Development Block Grant
CDFA	California Department of Food and Agriculture
CDPH	California Department of Public Health
CoBank	Cooperative Bank
CRWA	California Rural Water Association
CV-SALTS	Central Valley Salinity Alternative for Long-Term Sustainability
CVSC	Central Valley Salinity Coalition
CWA	Clean Water Act
CWC	Community Water Center
CWSRF	Clean Water State Revolving Fund
DPEIR	Draft Program Environmental Impact Report (of the Central Valley ILRP)
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection
DWSRF	Drinking Water State Revolving Fund
EDA	U.S. Economic Development Administration
EPG	Expense Reimbursement Grant Program
ERP-ETT	Enforcement Policy Response and Enforcement Targeting Tool
FFLDRS	Feed, Fertilizer and Livestock Drugs Regulatory Services
FMIP	Fertilizing Materials Inspection Program
GAMA	Groundwater Ambient Monitoring and Assessment
HAC	Housing Assistance Council
HSNC	Historical Significant Non-Compliers
HUD	U.S. Department of Housing and Urban Development
I-Bank	California Infrastructure and Economic Development Bank
ILRP	Irrigated Lands Regulatory Program
IRWM	Integrated Regional Water Management

ISRF	Infrastructure State Revolving Fund
KCWA	Kern County Water Agency
LLNL	Lawrence Livermore National Lab
MCL	Maximum Contaminant Level
MCWA	Monterey County Water Resources Agency
MHI	Median Household Income
MUN	Municipal or domestic water supply (beneficial use)
NDWC	National Drinking Water Clearinghouse
NMP	Nutrient Management Plan
NPDES	National Pollutant Discharge Elimination System
NRWA	National Rural Water Association
NWG	Nitrate Working Group
OW	EPA's Office of Water
PES	Payment for Ecosystem Services
PHG	Public Health Goal
Porter-Cologne	Porter-Cologne Water Quality Control Act (California Water Code § 13000 et seq.)
PPL	Project Priority List
PWS	Public Water System
RCAC	Rural Community Assistance Corporation
RCAP	Rural Community Assistance and Partnership
RUS	Rural Utilities Service
SB	Senate Bill
SDWA	Safe Drinking Water Act
SDWSRF	Safe Drinking Water State Revolving Fund
SEP	Supplement Environmental Program
SHE	Self-Help Enterprises
SRF	State Revolving Fund
U.S. EPA	United States Environmental Protection Agency
U.S.C.	United States Code
USDA	United States Department of Agriculture
USGS	U.S. Geological Survey
WARMF	Watershed Analysis Risk Management Framework
WDR	Waste Discharge Requirements
WEP	Water Environmental Program
WMP	Waste Management Plan

Unit Conversions

Metric to US		US to Metric	
Mass		*Mass*	
1 gram (g)	0.04 ounces (oz)	1 ounce	28.35 grams
1 kilogram (kg)	2.2 pounds (lb)	1 pound	0.45 kilograms
1 megagram (Mg) (1 tonne)	1.1 short tons	1 short ton (2000 lb)	0.91 megagrams
1 gigagram (Gg) (1000 tonnes)	1102 short tons	1000 short tons	0.91 gigagrams
Distance		*Distance*	
1 centimeter (cm)	0.39 inches (in)	1 inch	2.54 centimeters
1 meter (m)	3.3 feet (ft)	1 foot	0.30 meters
1 meter (m)	1.09 yards (yd)	1 yard	0.91 meters
1 kilometer (km)	0.62 miles (mi)	1 mile	1.61 kilometers
Area		*Area*	
1 square meter (m^2)	10.8 square feet (ft^2)	1 square foot	0.093 square meters
1 square kilometer (km^2)	0.39 square miles (mi^2)	1 square mile	2.59 square kilometers
1 hectare (ha)	2.8 acres (ac)	1 acre	0.40 hectares
Volume		*Volume*	
1 liter (L)	0.26 gallons (gal)	1 gallon	3.79 liters
1 cubic meter (m^3) (1000 L)	35 cubic feet (ft^3)	1 cubic foot	0.03 cubic meters
1 cubic kilometer (km^3)	0.81 million acre-feet (MAF, million ac-ft)	1 million acre-feet	1.23 cubic kilometers
Farm Products		*Farm Products*	
1 kilogram per hectare (kg/ha)	0.89 pounds per acre (lb/ac)	1 pound per acre	1.12 kilograms per hectare
1 tonne per hectare	0.45 short tons per acre	1 short ton per acre	2.24 tonnes per hectare
Flow Rate		*Flow Rate*	
1 cubic meter per day (m^3/day)	0.296 acre-feet per year (ac-ft/yr)	1 acre-foot per year	3.38 cubic meters per day
1 million cubic meters per day (million m^3/day)	264 mega gallons per day (mgd)	1 mega gallon per day (694 gal/min)	0.0038 million cubic meters/day

Nitrate Units

*Unless otherwise noted, nitrate concentration is reported as milligrams/liter as nitrate (mg/L as NO_3^-).

To convert from:

Nitrate-N (NO_3-N)	→	Nitrate (NO_3^-)	multiply by 4.43
Nitrate (NO_3^-)	→	Nitrate-N (NO_3-N)	multiply by 0.226

Summary

In California Senate Bill SBX2 1 (SBX2 1), the Legislature required the State Water Resources Control Board (State Water Board) to prepare a Report to the Legislature to "improve understanding of the causes of [nitrate] groundwater contamination, identify potential remediation solutions and funding sources to recover costs expended by the State … to clean up or treat groundwater, and ensure the provision of safe drinking water to all communities." The State Water Board contracted with the University of California to address the Legislative mandate of SBX2 1. As part of that effort, this technical report reviews existing and potential future funding and regulatory programs for managing nitrate contamination in the groundwater and drinking water supplies in the Salinas Valley and Tulare Lake Basin. Major factual findings are made and several promising directions for regulatory and funding actions are proposed.

Nitrate contamination of groundwater is widespread, and many parts of the Salinas Valley and Tulare Lake Basin have high concentrations of nitrate in drinking water. Current regulatory programs have not effectively controlled groundwater nitrate contamination and water quality in these areas has largely worsened for decades, a trend which seems likely to continue.[2] Looking forward, promising options exist to manage nitrate contamination of groundwater, but it will take years to decades for source control programs introduced today to improve drinking water quality.[2] Existing nitrate contamination will continue to travel, increasing both the area and concentration of groundwater nitrate contamination in the study area. A range of safe drinking water actions (alternative water supplies or drinking water treatment),[3] groundwater remediation,[4] and source reduction actions[5] are needed to provide residents with safe drinking water supplies. The cost of providing safe drinking water to the most susceptible populations in the study area is estimated to be at least $20-$36 million per year.[6]

The slow response of groundwater quality to source reduction implies that the most immediate State efforts should emphasize safe drinking water actions. However, the costs to provide safe drinking water to affected communities in this region are high, due to the large number of groundwater-contaminating nitrate sources, the dispersed population, and the high incidence of elevated nitrate levels in drinking water. As a consequence, communities in the study area have requested more Safe Drinking Water Funds relative to other communities in the State (see Figure 2). Many of these community public water systems[7] are small water systems,[8] which often already face chronic financial problems. They have difficulty in applying for and meeting the eligibility requirements to receive existing State funds for drinking water because smaller systems lack economies of scale and often have less technical,

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[2] See Technical Report 4: Groundwater Nitrate Occurrence (Boyle et al. 2012)
[3] See Technical Report 6: Drinking Water Treatment for Nitrate (Jensen et al. 2012); and Technical Report 7: Alternative Water Supply Options for Nitrate Contamination (Honeycutt et al. 2012)
[4] See Technical Report 5: Groundwater Remediation and Management for Nitrate (Viers et al. 2012)
[5] See Technical Report 3: Nitrogen Source Reduction to Protect Groundwater Quality (Dzurella et al. 2012)
[6] See Technical Report 7: Alternative Water Supply Options (254,000 highly susceptible people on community water systems or domestic wells) (Honeycutt et al. 2012)
[7] Small community public water system: a water system with 15 or more service connections and regulated by the State
[8] Small water system: a water system that has less than 200 connections (can be regulated or unregulated by the State)

managerial, and financial capacity than larger systems. State small[9] and local small water systems[10] may not have the resources to form a public entity,[11] so they are ineligible for many State funding sources (State Revolving Fund, State bonds, etc.). When funding is provided, these systems often lack the capacity to manage operation and maintenance costs or make loan repayments. Revising existing funding programs to encourage and guide good long-term local decisions; providing assistance to small systems in the application and management process; and combining successful funding programs may increase the funds available to small systems and increase the effectiveness of these funds in providing safe drinking water. Encouraging regional consolidation of small water systems can also be promising to address nitrate contamination as well as other safe drinking water challenges.

In the long-term, many regulatory options could reduce nitrate contamination from nonpoint sources, but some are preferable to others in terms of abatement costs; monitoring and enforcement costs; information requirements; and the ability to raise revenue. Overall, regulation of fertilizer is easier to design, administer, and enforce than regulation of diffuse nitrate leachate discharges to groundwater. Market-based regulatory approaches (of fertilizer application or of nitrate leachate) often can achieve a water quality target at a lower cost than prescriptive standards. However, no regulatory option is without its drawbacks: e.g., regulation of fertilizer may not achieve the drinking water quality objective at all drinking water systems.

Despite the existence of funding programs for safe drinking water, additional funding sources are needed. A fertilizer fee is a promising funding source that also creates incentives for dischargers to use fertilizer and water more efficiently. Farmers are currently exempt from a sales tax on fertilizer (if applied to land used for food or for feed for food animals) (CA State Board of Equalization 2004), so if this fee were set at a sales tax rate of 7.5% on the cost of nitrogen, it has the potential to raise an estimated $28 million annually, [12] nearly enough to provide alternative water supplies to the highly susceptible populations in the study area.

Major Findings

Regulatory Programs and Options

1. **To date, regulatory programs have been insufficient to control nitrate contamination of groundwater.** Discharges from agriculture (fertilizers and animal wastes) are the largest source of nitrate contamination of groundwater,[13] but there is no current or historic regulatory program that functionally holds these dischargers responsible (with the possible exception of the 2007 Central

[9] State small water system: a water system with 5-14 connections and unregulated by the State.
[10] Local small water system: a water system with less than five connections and unregulated by the State.
[11] A legally-approved public entity is a public water system or another legal entity that has authority to contract and incur debt on behalf of the community.
[12] Assume: 7.5% sales tax and a fertilizer retail price of $0.75 per pound (Technical Report 3: Nitrate Source Reduction to Protect Groundwater Quality, Dzurella et al. 2012)
[13] See Technical Report 2: Nitrogen Source and Loading to Groundwater (Viers et al. 2012)

Valley Dairy General Order, which will see stricter enforcement over the next few years). Overall, nitrate concentrations in groundwater have not decreased in the last three decades; in fact, concentrations have even increased in some areas.[14] Some regulatory programs have recently introduced mandatory monitoring programs, but monitoring alone will not improve water quality.[14]

2. **Many years are needed for regulatory actions to reduce nitrate in groundwater and improve drinking water quality.** The physical properties of nitrate in groundwater mean that regulatory actions on fertilizer or nitrate leachate today will not bring drinking water sources into water quality compliance for years to decades.[14]

3. **Many options exist to regulate nitrate in groundwater, but there is no ideal solution.** The costs of regulatory options vary greatly, and while no option is perfect, some seem preferable to others.

4. **Regulating fertilizer application has lower monitoring and enforcement costs and information requirements than does regulating nitrate leachate, but it may be less effective in achieving nitrate reduction targets.** While the regulation of fertilizer application is easier to implement and enforce than the regulation of nitrate leachate, it is less likely that water quality standards will be met. Due to non-uniform mixing, transport, and dispersion of nitrate in groundwater, it is difficult to quantify the impact of a unit of fertilizer on nitrate contamination of drinking water over time.

5. **Costs to farmers for reducing nitrate contamination can be lower with market-based regulatory actions (fertilizer fees or cap-and-trade programs) than with technology mandates or prescriptive standards because of the additional flexibility farmers have in complying with market-based regulations.** Market-based instruments also encourage the development and adoption of new technologies to reduce fertilizer use, but they may lead to the formation of contamination hot spots.

6. **Well-defined and enforceable regulatory requirements are needed for liability rules to work.** In California, all groundwater is considered to be suitable, or potentially suitable, for municipal or domestic water supply and should be so designated by the Regional Water Quality Control Boards (Regional Water Boards), with a few exceptions.[15] Under existing water code, groundwater is protected from degradation affecting its designated beneficial uses, but this protection is rarely enforced in the case of nonpoint source pollution. Section 13304 of the California Water Code (Porter-Cologne Act) gives the Regional Water Boards authority to force polluters to pay for alternative water supplies for affected users of public water systems and private wells. Legislation might be useful to solidify Regional Water Board authority to apply this provision broadly.

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[14] See Technical Report 4: Groundwater Nitrate Occurrence (Boyle et al. 2012)

[15] Waters with very high TDS, for example. See Section 4.9 De-designation of Beneficial Use and also, State Water Board Resolution No. 88-63

Funding Programs and Options

1. **Current funding programs have not met systems' stated need to ensure safe drinking water in the Salinas Valley and Tulare Lake Basin.**[16] These areas face large costs to deal with high nitrate concentrations. Compared to other areas of California, groups in the study area have requested more Safe Drinking Water State Revolving Funds to address nitrate contamination ($29 per person compared to $5 per person statewide, see Figure 2. Providing safe drinking water or alternative water supplies to highly susceptible populations in the study area is estimated to cost at least $20-$36 million per year ($80-$142/year per susceptible person or $5-$9/year per acre of irrigated land).[16]

2. **Most current State funding for nitrate contamination of drinking water is temporary.** State funding for safe drinking water is currently dominated by general obligation bonds for loans through State propositions, Federal economic stimulus package grants, and State revolving fund loans. All are temporary sources except for the State revolving fund loans, which are self-financed long-term sources.

3. **Small water system costs are high**[17] **and these small systems already face chronic financial problems.** In small and rural communities, housing is often low density and spread across a relatively large area; the infrastructure needed to transport water from the source to a household in a rural area is more expensive than for urban areas. Small systems also often lack the economies of scale and the technical, managerial, and financial capacity to repay loans, complete funding applications, and pay both recurring and unexpected operation and maintenance costs. This implies that unit costs of safe drinking water and responding to nitrate contamination will be higher in rural and small communities.

4. **While regionalization**[18] **of drinking water systems is sometimes promising, little funding is provided for facilitating this solution**. California often provides funding to drinking water systems for the physical consolidation[19] of systems, but it provides no support or training for non-construction regionalization activities (e.g., a facilitator brings systems together to assess the feasibility of consolidation, or a technical expert performs asset mapping and financial planning for a group of water systems).

5. **Options exist to raise funds for safe drinking water, but all require that someone bear the cost and many are awkward or insufficient.** Water use fees, groundwater pumping fees, bottled water fees,

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[16] See Technical Report 7: Alternative Water Supply Options (Honeycutt et al. 2012)

[17] EPA. 2011. National Characteristics of Drinking Water Systems Serving 10,000 or Fewer People (U.S. EPA 2011b)

[18] Regionalization: "a creation of an appropriate management or contractual administrative organization or a coordinated physical system plan of two or more community public water systems in a geographical area for the purpose of utilizing common resources and facilities to their optimum advantage" (Grigg 1989)

[19] Consolidation: "one community public water system being absorbed into, combined with, or served by other utilities to gain the resources they lack otherwise" (Raucher, Megan Harrod, & Marca Hagenstad 2004)

crop fees, and fertilizer fees are a few of the many potential sources for funding safe drinking water and source reduction actions.

6. **Some funding options give polluters a useful price signal.** Fertilizer (or nitrate leachate) fees and auctioned permits induce emitters to reduce use of fertilizer or nitrate.

7. **Farmers do not pay sales tax on fertilizer in California**[20].

Promising Actions

Regulatory Programs and Options

1. **Provide immediate safe drinking water to groundwater nitrate affected areas.** Since nitrate source reduction or groundwater remediation will take years to decades to significantly improve drinking water quality,[21] residents currently receiving unsafe drinking water require other alternatives in the immediate future, regardless of source reduction and management.

2. **Identify populations at risk of contaminated drinking water.** California Department of Public Health (CDPH), California Department of Food and Agriculture (CDFA), and State Water Board, in coordination with Department of Water Resources (DWR), issue a report every 5 years to identify populations at risk of contaminated drinking water and monitor long-term trends of the State's success in providing safe drinking water as a supplement to the California Water Plan Update.

3. **Regional Water Boards designate areas where groundwater sources of drinking water are at risk of being contaminated by nitrate.**

4. **Convene a State Groundwater Data Task Force.** California Environmental Protection Agency (CalEPA), in coordination with California Natural Resources Agency (CalNRA) and CDPH, convene an independently led State Groundwater Data Task Force to examine the efficacy of current State and local efforts to collect, maintain, report, and use groundwater data for California's groundwater quality and quantity problems.

5. **Convene a State Groundwater Task Force.** CalEPA, CalNRA, and CDPH maintain a permanent and independently led State Groundwater Task Force to periodically assess State technical and regulatory groundwater programs in terms of effectiveness in addressing California's groundwater quality and quantity problems. These reports could be incorporated into each California Water Plan Update.

6. **Examine successful Department of Pesticde Regulation (DPR) programs for lessons to manage nitrogen.** CalEPA and CDFA examine successful Department of Pesticide Regulation (DPR) data collection, analysis, education, and enforcement programs for lessons to manage nitrogen and

[20] (CA State Board of Equalization 2004)
[21] See Technical Report 4: Groundwater Nitrate Occurrence (Boyle et al. 2012)

consider expanding or building upon the existing DPR program to include comprehensive nitrogen use reporting to support nitrate discharge management.

7. **Nitrate dischargers incur the social costs of their discharges. This policy is already implied for drinking water costs under Section 13304 of the California Water Code (Porter-Cologne Water Quality Control Act).** Without regulations on nitrate source loading, nonpoint sources do not pay for the impact of their nitrate contamination to groundwater. Requiring nitrate dischargers to pay for nitrate contamination provides incentives for them to reduce nitrate discharges and ensures that those benefitting from nitrate discharge pay for the cost of contamination.

8. **Regulatory actions focus on nitrogen fertilizer use (including organic fertilizer sources).** Most nitrate discharge to groundwater is from nonpoint sources, particularly cropland, with substantial additional loading from manure.[22] Existing regulatory programs appear to address point sources of nitrate contamination well, but could be extended to include nonpoint sources.

9. **Regulatory actions should focus on controlling fertilizer application rather than nitrate leachate.** The high costs and technical difficulties of field, farm-based, or countywide nitrate leachate regulations could be prohibitive. A fertilizer application regulation that reduces nitrate discharges to groundwater is coarser and less direct, but much less costly.

10. **Market-based instruments are likely to perform better than command-and-control approaches.** Market-based approaches have lower costs than command-and-control approaches because they provide dischargers with more flexibility to comply with nitrate regulations.

11. **A fertilizer fee is a promising form of regulation and funding.** In the short run, a fee on fertilizer use (including organic fertilizer sources) seems preferable to a cap-and-trade system since it could take advantage of existing infrastructure. Since fertilizers are currently exempt from sales taxes in California (CA State Board of Equalization 2004), the State could expand sales taxes to include fertilizer purchases. The impact a fertilizer fee has on nitrate contamination depends on a) the sensitivity of demand for fertilizer to a price change and b) the size of the fee. The long-term feasibility and desirability of a cap-and-trade system for nitrogen management could be evaluated.

Funding Programs and Options

1. **Where appropriate, combine funding programs.** Consolidating funding programs should lower administrative and application costs and improve program effectiveness. A single program will also ease demands on community applicants. For example, water supply and wastewater problems are often intertwined, and linking these sources of funding would reduce upgrade costs for small systems.

2. **Allocate funding to long-term drinking water solutions, particularly regionalization or consolidation of small systems.** Small drinking water systems face many challenges, including

[22] See Technical Report 2: Nitrogen Sources and Loading to Groundwater (Viers et al. 2012)

nitrate-contaminated groundwater. Connecting to larger systems or consolidating with other small systems can allow such problems to be addressed more effectively and at lower cost. But regionalization and consolidation of systems often requires costly upgrades for smaller systems (e.g., water meters or new pipeline) or requires the larger system to take on an undesirable amount of risk. The State and counties have an interest in encouraging regionalization and consolidation activities to avoid longer-term financial difficulties, water system service inadequacies, and public health problems.

3. **Provide more financial assistance to small systems.** Small systems generally have more difficulty applying for funding programs and repaying loans. A grant or other special assistance program could be established to provide additional help to small systems. Such a program might be part of a larger consolidated effort by CDPH, the State Water Board, DWR, an Integrated Regional Water Management Plan, and the counties to address the problems of small water and wastewater systems.

4. **Create State funding programs for domestic well owners and for State small and local small water systems.** Currently, only water systems served by a public entity can apply for State safe drinking water funds (such as the State Revolving Fund). Domestic well owners and small communities with no recognized water systems thereby lack the funding sources available to public water systems. Assistance may also be provided to these small systems to help them form legally recognized entities.

5. **Increase the current mill assessment rate on nitrogen fertilizer to its fully authorized amount.** CDFA already oversees a mill assessment on fertilizer sales for research and education regarding the use and handling of fertilizing materials (including environmental effects), which is currently only half of its authorized amount. Raising the assessment to the fully authorized amount would raise roughly $3 million per year statewide. $1 million of this could be used for research and education regarding the use and handling of fertilizing materials (including environmental effects), or if current statute is changed, to fund some alternative drinking water supply efforts.

6. **Introduce a special fee on nitrogen fertilizer sales statewide, perhaps equivalent to a sales tax.** This economic signal could both reduce nitrogen applications and help fund safe drinking water solutions, nitrate source load reduction efforts, and nitrate monitoring and assessment programs. Expanding sales tax to include fertilizer could generate $28 million per year in the study area and might reduce applied nitrogen by 1.6%.[23] Similar fees/excise taxes could be considered for organic fertilizer sources (manure, green waste, wastewater effluent, biosolids, etc.).

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[23] Assume: 7.5% sales tax on the cost of nitrogen and a fertilizer retail price of $0.75 per pound of nitrogen, and 500 million pounds (227 GgN) of fertilizer used in the Salinas Valley and Tulare Lake Basin. See Technical Report 3: Nitrate Source Reduction to Protect Groundwater Quality (Dzurella et al. 2012)

7. **Consider a more comprehensive statewide fee on water use to support many beneficial activities**. Some of such revenues could fund management and safe drinking water actions in areas affected by nitrate contamination, including short-term emergency drinking water measures for disadvantaged communities. Assuming a fee is placed on statewide gross urban and agricultural water use,[24] the fee would need to be $0.5-$0.9 per acre-foot per year to provide safe drinking water to the estimated highly susceptible population of the study area.[25] Likewise, a fee only on statewide gross urban water use[26] would need to be $2.3-$4.1 per acre-foot per year.

[24] Statewide gross urban and agricultural water use is estimated at 41.7 MAF per year. (Hanak et al. 2011)
[25] See Technical Report 7: Alternative Water Supply Options (Honeycutt et al. 2012)
[26] Statewide gross urban water use is estimated at 8.7 MAF per year. (Hanak et al. 2011)

1 Introduction

This report reviews funding and regulatory options to manage present and future nitrate contamination in California's Salinas Valley and Tulare Lake Basin. In this section, we begin with a short description of the study areas, followed by an overview of how California and the Federal government have regulated nitrate in drinking water. In Sections 2-5, we examine existing State, Federal, local, and nongovernmental regulatory programs and then discuss potential future regulatory options available to the State. The format is then repeated for current funding programs and potential future funding options.

1.1 Study Area Description

Drinking water users in the Salinas Valley and Tulare Lake Basin regions are particularly susceptible to nitrate contamination for three main reasons: lack of monitoring of small water systems, magnitude of contamination, and low socioeconomic status.

Monitoring. Many small communities and rural households are on state small or local small systems (unregulated by the State), or on unregulated wells. While community public water systems (serving 15 or more connections) are required by the California Department of Public Health (CDPH) to monitor quarterly nitrate levels, and state-small systems (5-14 connections) are regulated either locally or by CDPH, smaller systems often have no monitoring requirement. Approximately 12% of the Tulare Lake Basin population and 10% of the Salinas Valley receive drinking water from a groundwater well supplying water to fewer than five households.[27] Technical Report 7, Alternative Water Supply Options (Honeycutt et al. 2012) finds that approximately 254,000 people in the study area are susceptible to nitrate contamination of drinking water. Of this total, 220,000 are on community public water systems (>15 connections) or state-small water systems (4-14 connections); and 34,000 are self-supplied (domestic wells) or local-small water systems (2-4 connections).

Contamination. These regions have more and larger nitrate contamination sources than most other regions in California. Major sources of groundwater nitrate contamination are fertilizer and animal manure use on agricultural lands, with some localized contributions from animal farming operations, wastewater treatment plants, food processing facilities, and septic systems. Four of the study area counties rank among the top five counties for 2007 agricultural sales (crop and livestock sales): Fresno ($3.7 billion), Tulare ($3.3 billion), Kern ($3.2 billion), and Monterey County ($2.2 billion) (USDA 2007).

Socioeconomics. Over 17% of the Tulare Lake Basin population and over 10% of the Monterey County population live in poverty (USDA 2008). Many low-income communities cannot afford adequate drinking water treatment or alternative water supplies when nitrate levels exceed the maximum contaminant level (MCL) for drinking water, particularly when served by unregulated state and local

[27] Census block group data from 1990 (U.S. Census Bureau 2011). Refer to Technical Report 7, Alternative Water Supply Options (Honeycutt *et al.* 2012) for a formal definition.

small water systems. Increased costs and reduced water quality are often linked to the lack of technical, managerial, and financial capacity in small and disadvantaged communities. A recent study showed that community public water systems in areas of the Central Valley with a higher minority population or a lower socioeconomic status have statistically higher nitrate levels and that this disparity is especially prevalent among smaller public water systems (Balazs et al. 2011).

1.2 Regulatory History of Nitrate in Drinking Water

In 1969, faced with the absence of national water pollution or contamination control legislation, California adopted the Porter-Cologne Water Quality Control Act (Porter-Cologne) (California Water Code § 13000 et seq.). Porter-Cologne grants the State Water Resources Control Board (State Water Board) authority over the protection of State water quality and establishes the Regional Water Quality Control Boards (Regional Water Boards) to carry out these policies at the regional and local level. Subsequently, Congress passed the Clean Water Act of 1972 (CWA) (33 U.S.C. § 1251 et seq.) and the Safe Drinking Water Act of 1974 (SDWA) (42 U.S.C. § 300f et seq.). These acts provide the Federal regulatory framework to manage contaminants in water bodies and drinking water. While the SDWA regulates the quality of delivered drinking water in public water supply systems, the CWA regulates the discharge of contaminants into surface waters of the United States. The CWA does not regulate the contamination of groundwater, which is the focus of this report.

Under the authority of the SDWA, the U.S. Environmental Protection Agency (U.S. EPA) develops and sets drinking water quality standards and oversees State or local implementation of the standards. In 1992, U.S. EPA's Phase II Rule established the Federal maximum contaminant level (MCL) for nitrate in drinking water (U.S. EPA 2011a). California's Office of Environmental Health Hazard Assessment later performed its own risk assessment of nitrate and adopted the Federal MCL in 1997 as a public health goal (PHG), or the level at which no known or anticipated adverse effects on health will occur (costs to comply with this level are not considered) (CDPH 2008).

In California, the Federal framework provided by the CWA and the SDWA are implemented through two separate agencies; the State Water Board implements the CWA, and CDPH implements the SDWA. Currently, only the State Water Board has authority to regulate activities that adversely affect the quality of drinking water sources. Although CDPH does not have authority to regulate sources of contamination to the groundwater, it still maintains groundwater programs with the ultimate goal of protecting the provision of safe drinking water. For example, CDPH's Drinking Water Source Assessment and Protection (DWSAP) program collects monitoring data on possible contaminating activities near drinking water sources (septic tanks, landfills, etc.).

In contrast to the CWA, Porter-Cologne regulates discharges to both surface water and groundwater in California. It requires the State Water Board and the Regional Water Boards (both together, the California Water Boards) to regulate waste discharge to these water bodies from both point sources and nonpoint sources. The Regional Water Boards handle National Pollutant Discharge Elimination System (NPDES) permits for point source discharges to surface water and develop various permit programs (e.g., waste discharge requirements (WDRs), discharge permits, and conditional waivers of waste discharge) for nonpoint and point source discharges to surface water and groundwater. Under the authority of Porter-Cologne, the Regional Water Boards also develop a "basin plan" that explicitly identifies all beneficial uses of individual water bodies (surface water and groundwater) within a Regional Water Board's region and develops measures to protect these beneficial uses. Waste discharge requirements set by the Regional Water Boards must be consistent with the basin plan objectives, including the State Water Board's anti-degradation policy (State Water Board Resolution 68-16), which requires that existing high water quality be maintained to meet beneficial uses (State Water Board 2006). Specifically, any actions that affect surface water or groundwater quality "must (1) be consistent with maximum benefit to the people of the State, (2) not unreasonably affect present and anticipated beneficial use of the water, and (3) not result in water quality less than that prescribed in water quality plans and policies." (State Water Board 2006). Since this anti-degradation policy is a State Water Board resolution, it may be changed (with respect to groundwater)[28] at the discretion of the State Water Board and does not need new legislative authority. Despite the mandates under Resolution 68-16, currently there are no permit requirements placed on agricultural non-point source discharges to groundwater.

In the groundwater basins of the Central Valley and Central Coast regions of California, monitoring of nitrate began long before the national nitrate MCL was established. Since the early 1950s, the Department of Water Resources (DWR) has been gathering nitrate data in areas of the Salinas Valley (Snow, Mills, & Zidar 1988). In 1978, the Association of Monterey Bay Area Governments (AMBAG) published a study concluding that agricultural activities were the primary contributors to the high nitrate levels in the groundwater (AMBAG 1978). Then in 1988, the Monterey County Water Resources Agency (MCWRA) produced the first report documenting nitrate levels in groundwater in the Salinas Valley (Snow *et al.* 1988). Similarly, a 1989 study by the California Department of Food and Agriculture's Nitrate Working Group quantified various sources of nitrate (Nitrate Working Group 1989). These reports were among the first to point out the current and future nitrate trends and how this could harm public health in these areas.

In response to the problem of nitrate in groundwater, planning, regulatory, and funding programs were developed to reduce future contamination and mitigate the health and financial effects of existing contamination. The next section reviews the existing planning and regulatory programs and Section 4 reviews the existing funding programs.

[28] There is a federal anti-degradation policy for surface water, but not for groundwater.

2 Current Planning and Regulatory Programs That Address Nitrate in Groundwater

Planning and regulatory programs have been implemented at the Federal, State, and local levels to reduce the adverse effects of nitrate-contaminated drinking water. These programs contain monitoring, enforcement, and other guidelines, that could provide the foundation for future programs to address both the public health and economic impacts of nitrate contamination. This section considers the strengths and weaknesses of current programs and recommends future actions to enhance their effectiveness.

2.1 Overview of Current Planning and Regulatory Programs

Many regulatory and planning programs in the study area provide regulatory structure or technical and managerial support to water systems, communities, farmers, dairies, and others who deal with nitrate contamination in groundwater. Statutes also provide a regulatory framework for nitrate contamination of groundwater and drinking water. Current regulatory/planning programs and statutes that have the ability to reduce groundwater nitrate contamination are summarized in Table 1. These programs/statutes have components that target nitrate source reduction or groundwater remediation. Table 2 is a summary of current programs and statutes related to groundwater nitrate and drinking water. These provide for data collection, information, and education on nitrate sources and groundwater nitrate. Some of these programs regulate nitrate in drinking water.

For a more detailed description of all programs refer to Appendix B: Summary of Current Planning and Regulatory Programs. In the study area, there are several Federal programs/statutes (Table 1 and Table 2, blue), State programs/statutes (purple), and nongovernmental programs/agencies (orange) relevant to nitrate contamination and its effects on drinking water.

Table 1. Summary of directly applicable programs and statutes for reducing nitrate contamination in groundwater.

AGENCY	PROGRAM/STATUTE [year created/passed]	GOAL/PURPOSE
U.S. Environmental Protection Agency (U.S. EPA)	Supplemental Environmental Programs (SEP) [1998]	Environmentally beneficial project that a violator of environmental laws may choose to perform (under an enforcement settlement) in addition to the actions required by law to correct the violation.
State Water Resources Control Board (State Water Board)	Porter-Cologne Water Quality Control Act [1969]	Grants the State Water Board authority over State water quality policy and aims to regulate activities in California to achieve the highest reasonable water quality.
	Recycled Water Policy [2009]	Resolution No. 2009-0011: Calls for development of salt and nutrient management plans and promotes recharge of clean storm water.
Regional Water Quality Control Boards	Cleanup and Abatement Order (CAO)	CA Water Code § 13304: Allows the Regional Water Board to issue a directive to a polluter to require cleanup of waste discharged into waters of the State.
Central Coast Regional Water Quality Control Board	Irrigated Lands Regulatory Program (ILRP) [2004, draft in 2011]	*General Conditional Waiver of Waste Discharge Requirements, 3-Tiered Agricultural Regulatory Program (2004):* Groundwater quality monitoring required to different degrees based on discharger's tier. *Draft (2001):* Requires Tier 3 dischargers with high nitrate loading to meet specified Nitrogen Mass Balance Ratios or implement a solution that leads to an equivalent nitrogen load reduction.
Central Valley Regional Water Quality Control Board	Irrigated Lands Regulatory Program (ILRP) [2003, draft in 2011]	*Conditional Wavier of Waste Discharge Requirements of Discharges from Irrigated Lands:* Interim program to regulate irrigated lands. Does not address groundwater. *Recommended ILRP Framework (2011):* Development of new monitoring and regulatory requirements (includes groundwater).
	CV-SALTS [2006]	Planning effort to develop and implement a basin plan amendment for comprehensive salinity and nitrate management.
	Dairy Program [2007]	*Waste Discharge Requirements General Order for Existing Milk Cow Dairies:* Confined animal facilities must comply with set statewide water quality regulations, and existing milk cow dairies must conduct nutrient and groundwater monitoring plans.
California Department of Food and Agriculture (CDFA)	Feed, Fertilizer and Livestock Drugs Regulatory Services (FFLDRS)	Manages licenses, registration and inspection fees, and a mill tax levied on fertilizer sales, to fund research and educational projects that improve fertilizer practices and decrease environmental impacts from fertilizer use.

Table 2. Summary of programs and statutes related to groundwater nitrate and drinking water (data collection, information, education, or regulation of drinking water).

AGENCY	PROGRAM/STATUTE [year created/passed]	GOAL/PURPOSE
U.S. Environmental Protection Agency (U.S. EPA)	Safe Drinking Water Act (SDWA) [1974, 1986, 1996]	Mandates EPA to set the drinking water standards and to work with States, localities, and water systems to ensure standards are met.
	Phase II Rule [1992]	Established Federal maximum contaminant level (MCL) for nitrate in public water systems.
	Enforcement Response Policy – Enforcement Targeting Tool	Focuses on high-priority systems with health-based violations or monitoring or reporting violations that can mask acute health-based violations.
U.S. Department of Agriculture (USDA)	Rural Utilities Service: National Drinking Water Clearinghouse [1977]	Provides technical assistance and educational materials to small and rural drinking water systems.
California Department of Public Health (CDPH)	22 CCR § 64431	Established State maximum contaminant level (MCL) for nitrate in public water systems.
	Drinking Water Source Assessment and Protection (DWSAP)	Evaluation of possible contaminating activities surrounding groundwater and surface water sources for drinking water.
	Expense Reimbursement Grant Program (EPG)	Education, training, and certification for small water system (serving <3,301 people) operators.
	Groundwater Ambient Monitoring and Assessment (GAMA)	Improves statewide groundwater monitoring and increases availability of groundwater quality information. Funded by Prop 50 and special fund fees.
Assembly Bill 3030	[1993]	Permits local agencies to adopt programs to manage groundwater and requires all water suppliers overlying useable groundwater basins to develop groundwater management plans which include technical means for monitoring and improving groundwater quality.
Kern County Water Agency (KCWA)	[1961]	Collects, interprets, and distributes groundwater quality data in Kern County.
Monterey County Health Department		Implements a tiered, regular nitrate sampling program based on increasing nitrate concentration for local small water systems and for state-small water systems in Monterey County.
Southern San Joaquin Valley Water Quality Coalition	[2002]	Protects and preserves water quality in the Tulare Lake Basin through surface water quality monitoring and dissemination of collected data. Particular focus is on agricultural discharge areas. Does not currently focus on groundwater.
Tulare County Water Commission	[2007]	Discusses water issues impacting Tulare County and advises the Tulare County Board of Supervisors. Special focus on nitrate in groundwater and improving drinking water in small communities.

Monterey County Water Resources Agency (MCWRA)	[1947]	Provides water quality management and protection through groundwater quality monitoring (including nitrate levels) and research and outreach efforts to growers to improve fertilizer management and reduce nitrate leaching.
The Waterkeeper Alliance	Monterey Coastkeeper [2007]	Collaborates with the State Water Board to ensure effective monitoring requirements for agricultural runoff and more stringent waste discharge requirements for other nitrate sources.
Rural Community Assistance Partnership (RCAP)	[1979]	Uses publications, training, conferences, and technical assistance to help communities of less than 10,000 people to access safe drinking water, treat & dispose of wastewater, finance infrastructure projects, understand regulations, and manage water facilities.
National Rural Water Association (NRWA)	[1976]	Offers drinking water system technical advice (operation, management, finance, and governance) and advocates for small/rural systems to ensure regulations are appropriate.
California Rural Water Association	[1990]	Provides online classes, onsite training, low cost educational publications, and other forms of technical advice for rural water and wastewater systems.
Self-Help Enterprises (SHE)	Community Development Program [1965]	Provides technical advice and some seed money to small/rural/poor communities for the planning studies and funding applications associated with drinking water system projects.
Community Water Center	Association of People United for Water (AGUA) [2006]	Advocates for regional solutions to chronic local water problems in the San Joaquin Valley. Focused on securing safe drinking water, particularly from nitrate impacted sources.

Despite the long list of programs and statutes related to nitrate contamination (Table 1 and 2), very few can be directly applied to decreasing nitrate contamination to groundwater (Table 1). Additionally, to date, these programs/statutes have been insufficient to control nitrate contamination of groundwater. Overall, nitrate concentrations in groundwater have not decreased in the last three decades; concentrations have increased in many areas.[29] Though Federal law establishes a nitrate MCL, State law has not implemented a regulatory program stringent enough to ensure that groundwater nitrate concentrations are at or below the drinking water standard. While dischargers are supposed to be held responsible for adverse effects to groundwater (under Porter-Cologne), no current or historical regulatory program functionally holds nitrate dischargers responsible. This may develop in the near future with the current development of the Irrigated Lands Regulatory program in the Central Valley and with the 2007 Central Valley Dairy General Order, which will see stricter enforcement over the next few years.

[29] See Technical Report 4: Groundwater Nitrate Occurrence (Boyle et al. 2012)

Some ongoing efforts with potential to reduce nitrate contamination in the future are the Agricultural Regulatory Program by the Central Coast Regional Water Quality Control Board (Central Coast Regional Water Board), the renewal of the Irrigated Lands Regulatory Program by the Central Valley Regional Water Quality Control Board (Central Valley Regional Water Board), and the development of comprehensive salt and nitrate management regulatory programs across California under a State Water Board mandate, the Central Valley Salinity Coalition (CV-SALTS).

Some regulatory programs have recently introduced mandatory monitoring programs. While monitoring programs are essential to understanding nitrate contamination and evaluating the success of nitrate management programs, monitoring alone will not improve water quality. Monitoring programs are more likely to be successful when they are adopted in conjunction with immediate safe drinking water options or longer-term source reduction and data management actions.

Immediate safe drinking water actions

Currently, many details are still unknown about nitrate contamination. Given the physical properties of nitrate in the groundwater, it is difficult to understand how, where, and when a contamination source will affect groundwater, and ultimately, drinking water.[30] We know that it will take years to decades for a nitrate source reduction or groundwater remediation program to significantly improve drinking water quality,[30] so alternative water supply options are necessary immediate actions to ensure safe drinking water.

Organized monitoring is needed to understand who is facing the most risk, but none of the current safe drinking water regulatory programs (see Table 1, Table 2, and Appendix B) have used monitoring data to explicitly identify populations at risk of contaminated drinking water. The “closest” program is CDPH’s DWSAP which identifies possible contaminating activities near groundwater sources of drinking water. While this program identifies the contamination to which the drinking water source is most vulnerable, it does not mandate action to help reduce future contamination, nor does it identify the State’s most highly susceptible populations.

One option is that CDPH and the State Water Board, in coordination with DWR, issue a report every five years to identify populations at risk of contaminated drinking water and monitor long-term trends of the State’s success in providing safe drinking water. This report could supplement each California Water Plan Update.

Longer-term source reduction and data management actions

To ensure long-term protection for sources of drinking water, nitrate source reduction actions will be needed. Many current source reduction efforts such as the Dairy Program and the Irrigated Lands Program (ILRP) include plans for groundwater monitoring so that the success of these programs can be evaluated (see Table 1, Table 2, and Appendix B), but none have gathered information at the regional

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[30] See Technical Report 4: Groundwater Nitrate Occurrence (Boyle et al. 2012)

scale to better understand areas at high risk of contamination. The Regional Water Boards could then use these data to officially designate groundwater drinking water sources at risk for nitrate contamination.

Currently, multiple agencies under many planning and regulatory programs hold nitrate monitoring data (see Table 2 and Appendix B). This dispersion of data holdings may lead to a duplication of data collection efforts and make it difficult to gain a comprehensive understanding of nitrate contamination of groundwater. Unfortunately, no feedback mechanism exists to assess current monitoring, planning, or regulatory programs, and therefore no method to identify data gaps or cost-effectiveness. An independently-led State Groundwater Task Force, convened by the California Environmental Protection Agency (CalEPA) in coordination with the California Natural Resources Agency (CalNRA) and CDPH, could evaluate the efficacy and potential overlap of such programs throughout the State.

The California Department of Food and Agriculture (CDFA) currently administers the Feed, Fertilizer and Livestock Drugs Regulatory Services (FFLDRS) program to license, register, collect inspection fees, and manage the mill tax on fertilizer sales (see Table 1 and Appendix B). However, this program does not collect data on fertilizer applications (where, how much, etc.), which could provide information for understanding groundwater nitrate contamination. Currently, the California Department of Pesticide Regulation (DPR) manages the full reporting of agricultural pesticide use (the county agriculture commissioners are required to report all agricultural pesticide use monthly), as required by State regulations (3 CCR sections 6624 – 6628) and conducts groundwater monitoring programs. This type of program is lacking in California for nitrate use, so one option could be for CalEPA to evaluate promising solutions, e.g., the creation of a new program in CalEPA to coordinate with DPR, or the expansion of the current DPR program for the reporting of nitrogen applications (including synthetic fertilizer and any organic sources of land applied nitrogen).

2.2 Major Findings: Current Planning and Regulatory Programs

1. **To date, regulatory programs have been insufficient to control nitrate contamination of groundwater.** Discharges from agriculture (fertilizers and animal wastes) are the largest source of nitrate contamination of groundwater,[31] but there is no current or historic regulatory program that functionally holds these dischargers responsible (with the possible exception of the 2007 Central Valley Dairy General Order, which will see stricter enforcement over the next few years). Overall, nitrate concentrations in groundwater have not decreased in the last three decades; in fact, concentrations have even increased in some areas.[32] Some regulatory programs have recently introduced mandatory monitoring programs, but monitoring alone will not improve water quality.[32]

2. **Many years are needed for regulatory actions to reduce nitrate in groundwater and improve drinking water quality.** The physical properties of nitrate in groundwater mean that regulatory

[31] See Technical Report 2: Nitrogen Source and Loading to Groundwater (Viers et al. 2012)
[32] See Technical Report 4: Groundwater Nitrate Occurrence (Boyle et al. 2012)

actions on fertilizer or nitrate leachate today will not bring drinking water sources into water quality compliance for years to decades.[32]

2.3 Promising Actions: Current Planning and Regulatory Programs

1. **Provide immediate safe drinking water to groundwater nitrate affected areas.** Since nitrate source reduction or groundwater remediation will take years to decades to significantly improve drinking water quality,[33] residents currently receiving unsafe drinking water require other alternatives in the immediate future, regardless of source reduction and management.

2. **Identify populations at risk of contaminated drinking water.** California Department of Public Health (CDPH), California Department of Food and Agriculture (CDFA), and State Water Board, in coordination with Department of Water Resources (DWR), issue a report every 5 years to identify populations at risk of contaminated drinking water and monitor long-term trends of the State's success in providing safe drinking water as a supplement to the California Water Plan Update.

3. **Regional Water Boards designate areas where groundwater sources of drinking water are at risk of being contaminated by nitrate.**

4. **Convene a State Groundwater Data Task Force.** California Environmental Protection Agency (CalEPA), in coordination with California Natural Resources Agency (CalNRA) and CDPH, convene an independently led State Groundwater Data Task Force to examine the efficacy of current State and local efforts to collect, maintain, report, and use groundwater data for California's groundwater quality and quantity problems.

5. **Convene a State Groundwater Task Force.** CalEPA, CalNRA, and CDPH maintain a permanent and independently led State Groundwater Task Force to periodically assess State technical and regulatory groundwater programs in terms of effectiveness in addressing California's groundwater quality and quantity problems. These reports could be incorporated into each California Water Plan Update.

6. **Examine successful Department of Pesticde Regulation (DPR) programs for lessons to manage nitrogen.** CalEPA and CDFA examine successful Department of Pesticide Regulation (DPR) data collection, analysis, education, and enforcement programs for lessons to manage nitrogen and consider expanding or building upon the existing DPR program to include comprehensive nitrogen use reporting to support nitrate discharge management.

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[33] See Technical Report 4: Groundwater Nitrate Occurrence (Boyle et al. 2012)

3 Future Regulatory Options to Manage Nitrate

Section 3 outlines potential future regulatory options to manage nitrate in groundwater. We first discuss the four dimensions along which we compare proposed regulatory options: 1) abatement costs; 2) monitoring and enforcement costs; 3) information requirements; and 4) their ability to raise revenues. In Section 3.2, we discuss whether future regulations should focus on fertilizer application or nitrate leachate discharge to groundwater. We then summarize an array of available regulatory options and ultimately recommend market-based regulations of fertilizer over command-and-control approaches and regulation of nitrate leachate. Case studies describing regulatory options appear in Appendix A: Regulatory Options in Practice.

3.1 Assumptions, Limitations, and Analytical Criteria

There are several assumptions and limitations of this analysis. First, we look only at nitrate contamination that originates from agricultural sources (including organic fertilizer sources). Agricultural sources are the primary source of nitrate in the Salinas Valley and Tulare Lake Basin with synthetic fertilizer application to crops amounting to 52 percent of annual nitrogen loading and manure application contributing over 31 percent to annual nitrogen loading.[34] While all dischargers are supposed to be held responsible for adverse effects to groundwater (under Porter-Cologne, see Section 1.2 above), there is no current or historic regulatory program that holds agricultural dischargers responsible (with the possible exception of the 2007 Central Valley Dairy General Order, which will see stricter enforcement over the next few years).

Second, our comparison of regulatory options is qualitative (as opposed to quantitative) – each policy option is ranked as high, medium or low for each evaluation criterion. To rank and compare regulatory options, we relied on the economics literature that describes how these instruments should work in theory; discussions with experts (on groundwater nitrate contamination) about the current and future state of knowledge; and case studies that highlight the lessons learned from the actual implementation of these regulations (see Appendix A: Regulatory Options in Practice).

Regulatory options can be compared in many ways. We choose four metrics:

- **abatement costs** (the cost incurred by non-point sources to reduce nitrate)
- **administrative costs** (monitoring and enforcement costs)
- **information requirements**
- **revenue raising**

Depending on the audience, each criterion may take on a range of interpretations. To remain consistent, we define each dimension before beginning our analysis. Based on the ranking of each

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[34] See Technical Report 2: Nitrogen Sources and Loading to Groundwater (Viers et al. 2012)

regulatory option along these four criteria, we determined the most promising options to manage nitrate.

Abatement costs measure the costs to dischargers to reduce nitrogen loading so as to achieve a nitrate standard. This criterion does not include monitoring, enforcement, and information costs. Rather it focuses on the overall nitrate reduction costs incurred by non-point sources to achieve a nitrate goal. For example, an abatement cost could be the cost incurred by a farm to install a technology that reduces nitrate runoff. Historically, abatement costs have been the largest share of costs for pollution control policies (Keohane & Olmstead 2007).[35]

Administrative costs describe the costs to implement, monitor and enforce a policy instrument, and typically are the second largest share of costs for pollution control policies (Keohane & Olmstead 2007). These costs vary across regulations because of differences in technical feasibility. Administrative costs for nitrate contamination of groundwater will depend on "mixing" in the environment, specifically the mixing between the point of discharge into groundwater and the point of use. With uniform mixing, each unit of contamination has the same effect on environmental quality, regardless of where and when the contaminant is discharged. In contrast, with nitrate in groundwater, the effect of a single unit of nitrate leachate on drinking water quality largely depends on where (relative to the drinking water source location) and when nitrate is discharged. We refer to this as "non-uniform mixing."[36] Higher administrative costs from "non-uniform mixing" will influence the choice of a regulatory instrument. For example, it is difficult to measure the amount of nitrate leachate from a farm, so the administrative costs needed to implement, monitor and enforce a regulation on nitrate leachate are likely high. A further complication with a nitrate leachate regulation is that many farmers often affect the regional water quality, so it may be difficult to trace nitrate emissions to a specific nonpoint source. In contrast, it is easy to monitor and measure fertilizer application and therefore administratively cheaper to regulate fertilizer use.

Information requirements describe the information needed to implement a regulation. For example, before establishing a regulation for nitrate leachate, the mixing properties of nitrate and the time horizon for nitrate to reach drinking water sources must be understood.

Revenue-raising describes the ability of a regulatory instrument to generate funding. Some regulatory instruments may both regulate nitrate and raise revenue. We choose revenue-raising as a criterion since Senate Bill SBX2 1 (SBX2 1) also requires an investigation of funding options to support remediation, treatment, or alternative water supplies.

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[35] Also refer to Section 3 in Technical Report 3 (Dzurella et al. 2012)

[36] Due to the physical properties of nitrate in soil and groundwater, contamination does not mix evenly in the groundwater and the exact leachate rate to the drinking water source varies depending on when and where nitrate leachate is released.

3.2 What Can Be Regulated?

Before discussing the various regulatory options, we must discuss what to regulate. We focus on two regulatory units – fertilizer application (including manure) and nitrate leachate (from fields to groundwater). An instrument that regulates fertilizer application is an input regulation, since it regulates an input to nitrate contamination rather than actual nitrate contamination of groundwater. In contrast, a nitrate leachate regulation directly targets nitrate contamination of groundwater.

In theory, the abatement costs of a nitrate leachate regulation should be lower than those from a fertilizer regulation. This occurs because farmers have more flexibility in complying with a nitrate leachate regulation than a fertilizer regulation. As an example, suppose the regulator can choose between a performance standard on fertilizer application or nitrate leachate. A performance standard might establish either a per hectare limit on fertilizer use or on an allowable nitrate leachate. With a per hectare fertilizer limit, farms can only attain the performance standard by reducing their use of fertilizer. By contrast with a fertilizer standard, farms have more flexibility in complying with a nitrate leachate standard, so the cost of abatement will likely be less. A farm can reduce nitrate leachate by: reducing the quantity of fertilizer applied to a hectare of land, reducing irrigation water applications, changing the crop mix, or combining various options.

A second advantage of a nitrate leachate regulation is that the likelihood of a drinking water quality standard being met is higher. With a fertilizer application regulation, there is uncertainty over the impact that a unit of fertilizer will have on nitrate contamination of groundwater over time, making it difficult to assess whether compliance with a fertilizer regulation will lead to compliance with a water quality standard.

A nitrate leachate regulation targets the contaminant itself and in theory, the abatement costs of this regulation are lower. However, the administrative costs and information requirements to implement this direct leachate regulation far exceed those to regulate fertilizer use. A nitrate leachate regulation must account for "non-uniform mixing," which is the complex movements of nitrate to water sources. The effect of a pound of nitrate on water quality within an aquifer varies with the location of discharge, climate, and the characteristics of the underlying aquifer. Before introducing a leachate regulation, we would need to understand how nitrate leached from a given nonpoint source ultimately affects groundwater quality around that specific site. Because of natural and anthropogenic variability, gaining an adequate understanding would likely have prohibitively high information requirements. The non-uniform mixing aspect of a nitrate leachate regulation also makes the administrative costs high.

As a regulation incorporates measures to account for non-uniform mixing, the likelihood of meeting a contaminant standard increases, but so do the administrative costs and the information requirements. Imagine that a basin-wide cap-and-trade system (or a tax or prescriptive standard) on nitrate leachate was introduced. If a regulator established a tradable permit system in which farms were allowed to trade on a one-to-one basis (a pound of nitrate from farm A for a pound of nitrate from any other farm, regardless of the day or the location), then the complexity and variability of nitrate flows might cause the nitrate concentration in water sources to exceed the cap. This problem holds true for any regulation on nitrate, whether it is cap-and-trade, fees/taxes, technology standards, or compliance standards.

The establishment of trading ratios, similar to an exchange rate, can allow a permit system to account for non-uniform mixing. Ideally, an individual exchange rate would be set up for all potential trades between sources and across time. Continuing with the earlier example, it may be that farm A can now discharge one pound of leachate if it purchases two pounds of permits from farm B or three pounds of permits from farm C. The exchange rate for permits between A & B, A & C, and B & C is ½, ⅓, and ⅔, respectively. While ideal in theory, a leachate regulation that accounts for non-uniform mixing would be difficult and expensive to implement. The information requirements needed to understand how nitrate leachate from a given field source ultimately affects water quality are large. Even if we could fully define the relationship between source-specific nitrate effluent and groundwater quality, which we cannot, the costs to monitor and enforce this regulation would be high, perhaps prohibitively so. The abatement costs, administrative costs, and information requirements are summarized in Table 3 for fertilizer application and for nitrate leachate.

Table 3. Regulating fertilizer application versus nitrate leachate.

Regulated Entity	Abatement Costs	Administrative Costs	Information Requirements
Fertilizer Application	Higher – regulate input	Low	Low
Nitrate Leachate	Lower – regulate contaminant	High	High

Though the high administrative costs and information requirements of a nitrate leachate regulation make a fertilizer regulation preferable, a regulation on fertilizer application also has its weaknesses. A fertilizer regulation does not guarantee a nitrate leachate standard will be met, because fertilizer use is only an indirect measure of the amount of nitrate leached to groundwater. This weakness may be avoided, or at least decreased, through careful structuring of the fertilizer regulation, e.g., by accounting for the amount of harvested nitrogen expected for each crop type (but in turn, this may increase administrative costs). Regulating both nitrate leachate and fertilizer application might also avoid this problem, but would likely impose the high administrative and implementation costs of a leachate regulation together with the higher abatement costs of a fertilizer regulation. However, if farms already provide detailed accounting of air emissions, pesticide use, water use, salt discharges, and other environmental fluxes, then perhaps the additional costs of nitrate accounting would not be too great.

One potential statutory obstacle to implementing a fertilizer regulation is that Porter-Cologne is currently set up to regulate based on discharge requirements (nitrate leachate), not inputs like fertilizer application. Well-designed regulatory programs may be able to work around this obstacle. For example, a fertilizer application regulation with a "representative" groundwater monitoring program could be used to confirm the degree to which the regulation of fertilizer applications can succeed in meeting groundwater quality objectives.

3.3 Direct Regulatory Options

We now discuss various regulatory options to manage nitrate contamination of groundwater, beginning with a description of technology mandates and performance standards. We refer to these regulatory options as direct regulatory options or prescriptive policies, since they directly regulate the behavior of non-point sources.

3.3.1 Technology Mandates

A technology mandate would require all nitrate dischargers to install a specific technology or follow a specific management practice. Technology mandates to reduce the quantity of nitrate entering aquifers could include minimum seal depth for wells and backflow prevention devices.

For example, the State of California requires farmers to follow a pre-determined set of management practices to manage pesticides. Specifically, DPR restricts pesticide-handling practices within 100 feet of unprotected wellheads.[37]

3.3.2 Performance Standards

A performance standard sets a limit on the quantity of nitrate effluent that an individual farm or dairy can discharge. The regulation may specify a maximum effluent rate (pounds of nitrate effluent per hectare) or a maximum allowable quantity of fertilizer application (pounds of nitrogen per hectare) or a nitrogen mass balance ratio.

An example of a performance standard is seen with the WDR General Order for Existing Milk Dairy Cows (No. R5-2007-0035), which requires dairies to maintain a land application of total nitrogen that is less than 1.65 times the total nitrogen removed from the land through harvest and crop removal. The regulation does not outline how a dairy must achieve this standard; rather it sets a standard and allows the dairy to choose how to meet this ratio.

3.4 Taxes and Fees

Market-based instruments, such as cap-and-trade and taxes (fees), regulate fertilizer application (or total nitrate contamination) in the area of study (the Salinas Valley and Tulare Lake Basin), rather than fertilizer application (or groundwater contamination) from each nonpoint source, as is the case with

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[37] California Department of Pesticide Regulation. Groundwater Protection Program Regulations. Accessed at: http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp_regs.htm. (CA DPR 2011)

technology mandates and performance standards. With a fertilizer fee, a price is placed on fertilizer and the quantity of fertilizer application is determined by farmers[38].

3.4.1 Nitrate Leachate Tax

A nitrate leachate tax or fee establishes a price per unit of nitrate leachate in the recharge area of the drinking water source. Since nonpoint sources must pay for the nitrate they discharge, they are forced to internalize (at least in part) the cost that groundwater contamination imposes on society (e.g., health impacts from consumption of contaminated drinking water). Taxes on water contamination have been used to regulate heavy metals and organic discharges in the Netherlands, water pollution in France, industrial polluters in Colombia, and the palm oil industry in Malaysia (Olmstead 2010). A nitrate effluent fee must account for "non-uniform mixing" of nitrate in the water source. Differentiated fees are needed to address this non-uniformity. These fees should be source specific, and reflective of the effect that a unit of nitrate effluent from a given source will have on drinking water quality.

3.4.2 Fertilizer Tax

A fertilizer tax or fee is an input fee since it is placed on an input to nitrate contamination, rather than the nitrate contamination itself. In theory, as the cost of fertilizer use increases, farms use less fertilizer, switch which crops are grown, and adopt more fertilizer-efficient technologies.

3.5 Cap-and-Trade

With cap-and-trade regulation, a total quantity of allowable leachate or fertilizer application is established in a county or aquifer. Tradable permits or allowances are then allocated to the regulated farmers or auctioned off in a market, with each permit corresponding to a unit of allowable nitrate leachate to the groundwater or to a unit of applied fertilizer. A cap-and-trade approach sets the quantity on fertilizer application or nitrate leachate emissions and allows the market to determine the price per unit of effluent or fertilizer. In the United States, Title IV of the Clean Air Act Amendments addressed the problem of acid rain by creating a cap-and-trade system for the regulation of sulfur dioxide (Stavins 2001). For a case study example of cap-and-trade, see Appendix A: Regulatory Options in Practice, Watershed-Based Effluent Trading.

3.5.1 Fertilizer Cap-and-Trade

One potential regulatory option is to set a cap on the quantity of fertilizer use in the study area counties. Under such a cap-and-trade system, initial fertilizer permits could be freely distributed or auctioned off. With an auction, the sale price for fertilizer would reflect the social cost of fertilizer, which includes the private marginal cost to produce fertilizer and the marginal social damages caused by a unit of fertilizer.

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[38] See Technical Report 3: Nitrate Source Reduction to Protect Groundwater Quality (Dzurella et al. 2012)

3.5.2 Nitrate Leachate Cap-and-Trade

An alternative policy to regulate nitrate leachate would be to cap the concentration of nitrate in the underlying aquifer and establish a water quality trading program for nonpoint sources within the aquifer. One example of water quality trading for point sources is the salinity trading program in Australia's Hunter River (Olmstead 2010). Under this (surface water) program, point sources were freely allocated permits to discharge saline water into the river and a real-time trading system was implemented, since the impact of saline water on water quality in the river depends on constantly changing flow conditions. An analogous agricultural groundwater quality trading program for nitrate could be employed.

3.6 Hybrid Solutions

Hybrid options are also available to regulate nitrate. For over 15 years, the Netherlands has used a hybrid approach to manage nitrate (for the detailed case study, see Appendix A: Regulatory Options in Practice, The Dutch Experience). Under this system, agricultural sources are regulated using a performance standard and a fertilizer fee. Hybrid regulations may offer a practical alternative to manage nitrate leachate.

3.7 Information Disclosure

In the area of study, approximately ten percent of households receive drinking water from local small water suppliers (2-4 connections) or rely on domestic wells, both of which are unregulated at the State or local level (see Technical Report 7, Alternative Water Supply Options, Honeycutt et al. 2012). Information disclosure about the quality of drinking water from these sources may be a low-cost and viable regulation to manage nitrate for unregulated water systems. Information disclosure will not decrease nitrate in groundwater levels, but it may help encourage the installation of affordable treatment devices or the use of bottled water, thereby reducing the public health risk of nitrate-contaminated groundwater. Recent work suggests that community water suppliers reduced violations of drinking water quality standards after they were required to disclose violations to their customers (Bennear & Olmstead 2008).

Under the SDWA, community water suppliers in the U.S. have been required since 1998 to publish Consumer Confidence Reports (CCRs) that describe a water system's compliance with water quality standards. In California, CDPH extends the applicability of CCRs, requiring community systems serving at least 15 connections to provide annual CCRs. Extending mandatory information disclosure about drinking water quality to smaller systems may lead to improved drinking water quality and a decreased public health risk, at a relatively low cost. Additionally, information disclosure could be expanded to include discharges to groundwater by nitrate dischargers (governed under California's Porter-Cologne Act).

3.8 Liability Rules

Under liability rules, decision makers can hold either the polluter or the manufacturer of contaminants responsible for contamination. Liability rules could be used to force the polluter to internalize the external costs of nitrate contamination to groundwater. Liability rules for groundwater contamination are already in place, both domestically and in the European Union. In the U.S., the CWA established strict liability of polluters of oil and other hazardous substances. More recently, the European Union has set up The Environmental Liability Directive in which polluters are held responsible for the environmental damage they cause to water, soil or species (Olmstead 2010). For detailed examples of liability rules in action, see Appendix A: Regulatory Options in Practice, Liability from Groundwater Contamination from Pesticide Use.

Section 13304 of Porter-Cologne states that "A cleanup and abatement order issued by the State Water Board or a Regional Water Board may require the provision of, or payment for, uninterrupted replacement water service, which may include wellhead treatment, to each affected public water supplier or private well owner." This provides authority for a Regional Water Board to require landowners contributing to nitrate risk to groundwater drinking water supplies to support drinking water actions for affected public water supplies and private wells. In a sense, this establishes a liability rule and mechanism to regulate nitrate contamination of drinking water sources.

3.9 Negotiation or Payment for Drinking Water Quality

Another regulatory option to manage nitrate in drinking water or groundwater is to establish a market for the payment of drinking water quality, or more generally for environmental or ecosystem services. Environmental services describe benefits provided by healthy ecosystems, including biodiversity conservation, carbon sequestration, watershed protection, and natural treatment systems for drinking water. Property owners benefit from these environmental services; however, most of the benefits from these services accrue to external parties. Since private landowners are not compensated for the social benefits from these services, in the absence of market intervention, these valuable services will be underprovided.

In Mexico, one of the largest Payment for Environmental Services (PES) programs has been established to protect forestland from deforestation and safeguard the hydrologic services that it provides (CONAFOR 2009). In this program, the government of Mexico pays landowners to forego land clearing for agriculture. PES programs provide an incentive-based mechanism to lessen environmental degradation and protect hydrologic services. For a more detailed case study of payment for ecosystem services see Appendix A: Regulatory Options in Practice, Payment for Ecosystem Services in New York City.

An analogous program in the study area counties might have the public pay farmers to alter their farming practices to reduce nitrate leachate or alternatively, the farmers might pay the counties for the right to discharge nitrate. In the Salinas Valley and Tulare Lake Basin, groundwater is currently designated for drinking water use. This designation status requires that water quality in the aquifer meet drinking water quality standards. If a nitrate limit is established, then nonpoint source polluters in the region can either choose to meet this limit or pay to provide the affected inhabitants with safe drinking water. If the cost of the latter option is less, then it will be beneficial for farmers to pay for the right to discharge nitrate. Under both scenarios, consumers receive safe drinking water; however, the cost paid by farmers differs. This reflects the famous Coase Theorem[39] in environmental economics.

3.10 De-designation of Beneficial Use

Currently, all water bodies in California are assigned designated or "beneficial uses." Beneficial uses include recreation; agricultural uses; support of water and estuary ecosystems; support of fish migration; industrial uses; municipal and domestic supply; and others (California Water Code § 13050). In most cases, the default designation for groundwater is domestic and municipal water use (under State Water Board Resolution 88-63), though it can be designated for agricultural, industrial, municipal, or domestic use. Currently, the beneficial use designation for groundwater quality in the Salinas Valley and Tulare Lake Basin counties includes drinking water. As a result, the water quality in these groundwater basins must be suitable for drinking water.

Under Porter-Cologne, the Regional Water Boards are required to define the beneficial use for each water body. Water quality objectives must also conform to "anti-degradation" under the CWA section 131.12 (surface water only) and the 1968 State Water Board Resolution 68-16 (*the Statement of Policy with Respect to Maintaining High Quality of Waters in California*). Anti-degradation prohibits the degradation of water quality to levels above the water quality objectives needed to meet beneficial uses. Any actions that can degrade water quality must (1) be consistent with maximum benefit to the people of the State; (2) not unreasonably affect present and anticipated beneficial use of the water; and (3) not result in water quality less than that prescribed in water quality plans and policies. Designated uses and the anti-degradation policy are the basis for regulatory actions to enforce basin plans.

Porter-Cologne recognizes that water quality may be changed without unreasonably affecting the beneficial use. State Board Resolution 88-63 recognizes that in certain instances, exceptions should be made to the designation of groundwater as a drinking water source. The re-designation (or de-designation) of beneficial use refers to the regulatory process that alters the current designated use of groundwater. Currently, under State Water Board policy, where nitrate contamination is high and "cannot reasonably be treated for domestic use using either Best Management Practices (BMPs) or best economically achievable treatment practices" (State Water Board Resolution 88-63), one possible regulatory option is to de-designate portions of a groundwater basin as a source of municipal or domestic supply, which potentially removes certain discharge and groundwater remediation requirements that must otherwise be met. This would shift responsibility for treatment to drinking water users.

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[39] Trading of externalities will be efficient if there are no transaction costs. The assignment of property rights is unimportant.

Since the groundwater anti-degradation policy and the default MUN designation are both State Water Board policies, they may be changed at the discretion of the State Water Board, without the need for new legislative authority, as long as the new resolution is consistent with Porter-Cologne.

3.11 Comparing Regulatory Instruments

We now compare regulatory instruments to determine the most promising ones to regulate nitrate contamination of groundwater. Table 4 below summarizes our qualitative comparison of all regulatory options to manage nitrate across four dimensions (abatement costs, monitoring and enforcement costs, information requirements, and ability to raise revenues). First, we compare direct regulatory instruments (technology mandates and performance standards) to market-based approaches (cap-and-trade and fees). We then discuss the feasibility of liability rules and de-designation as well as the role of information disclosure. Lastly, we compare fertilizer fees to a fertilizer cap-and-trade system, and ultimately recommend a fertilizer fee as the preferred tool to manage nitrate contamination of groundwater.

3.11.1 Comparing Direct Regulatory Instruments to Market-Based Approaches

Technology mandates: Technology mandates are relatively easy to implement from an administrative standpoint, since the regulator simply needs to verify that a technology has been adopted and properly installed. However, technology mandates are disadvantageous when evaluated in terms of abatement costs. In theory, an equivalent reduction in nitrate could be achieved at a lower cost. In practice, technology mandates are often an order of magnitude more costly than market-based approaches (Keohane & Olmstead 2007). Additionally, Porter-Cologne explicitly prohibits technology standards for controlling waste discharge, so existing legislation could not be used to enforce a technology mandate.

Technology mandate vs. performance standard: Performance standards offer farms and other entities more flexibility than technology mandates. For example, a farmer can choose to meet the performance standard by changing the crops grown on a farm, reducing fertilizer use, investing in irrigation efficiency capital, or combinations of these (see Technical Report 3: Nitrate Source Reduction to Protect Groundwater Quality (Dzurella et al. 2012) for other examples). The abatement costs of compliance under a performance standard tend to be less than those under technology mandates, since farms may choose how to meet the standard. However, performance standards are more costly in terms of abatement costs than market-based approaches, since each farmer separately determines how to comply with the standard.

Performance standard vs. market regulation: Compared to a performance standard on fertilizer use, market-based instruments (a fertilizer fee or a fertilizer cap-and-trade system) are more cost effective; that is, the abatement costs to achieve a fertilizer target are lower. Under a performance standard, each farmer is required to reduce fertilizer use by the same quantity, though the marginal costs to reduce fertilizer use may differ across farms. In contrast, a fertilizer cap-and-trade system caps the total amount of fertilizer use, but lets the market determine the allocation of fertilizer use among regulated farmers. A fertilizer fee places a price on fertilizer and allows farmers to choose how much to fertilizer to apply.

To illustrate the advantage of market-based instruments such as a cap-and-trade, imagine that there are two farms in the Tulare Lake Basin and in the absence of fertilizer regulations each farm applies ten tons of fertilizer. The regulator enters, caps the total amount of fertilizer at ten tons, and allocates five tons of fertilizer to each farm. These farms differ in the marginal costs to reduce fertilizer use, perhaps because they grow different crops, use different amounts of labor, or use different irrigation technologies. It costs farm A $100 to reduce the fifth ton of fertilizer and it costs farm B $50 to reduce the fifth ton of fertilizer use. Farm B would be willing to sell a fertilizer permit for any amount above $50 and farm A would be willing to purchase a fertilizer permit if the price was less than $100. Due to variation in the marginal costs of abatement, it is mutually advantageous to trade fertilizer permits. Trading among farmers is beneficial to both the seller and buyer of fertilizer permits and reduces the costs of meeting a fertilizer cap. With a cap-and-trade system, growers will trade until the marginal costs of fertilizer abatement are equivalent across all farms. Under a performance standard, each farm would be required to reduce fertilizer by five tons, though both would benefit if they were free to trade fertilizer permits.

Table 4. Summary of regulatory instruments to manage nitrate contamination to groundwater.

<table>
<tr><th>Regulatory Options</th><th>Abatement Costs</th><th>Monitoring and Enforcement Costs</th><th>Information Requirements</th><th>Revenue Raising</th></tr>
<tr><td>Technology Mandate</td><td>High</td><td colspan="2" rowspan="4">Fertilizer Application: Low
Nitrate Leachate: High</td><td>No (unless fines)</td></tr>
<tr><td>Performance Standard</td><td>Medium</td><td>No (unless fines)</td></tr>
<tr><td>Fee</td><td>Low</td><td>Yes</td></tr>
<tr><td>Cap-and-Trade</td><td>Low</td><td>Yes (if permits auctioned)</td></tr>
<tr><td>Information Disclosure</td><td>Medium</td><td>Low</td><td>Low</td><td>No (unless fines)</td></tr>
<tr><td>Liability Rules</td><td>N/A</td><td>High</td><td>High</td><td>Yes</td></tr>
<tr><td>Payment for Water Quality</td><td>Low</td><td>Low (if payment made to farmers)
High (if payment made to State)</td><td>High</td><td>Yes (if payment made to State)</td></tr>
<tr><td>De-designation of Beneficial Use</td><td>N/A</td><td>High</td><td>Medium</td><td>No</td></tr>
</table>

3.11.2 Feasibility of Liability Rules and De-designation

As illustrated in the case study on liability rules on pesticide use (see Appendix A: Regulatory Options in Practice, Liability from Groundwater Contamination from Pesticide Use), in the long-run, liability rules are a potentially viable regulation to manage nitrate contamination. However, a handful of concerns must be addressed before liability rules pose a credible threat to nitrate polluters. First, in theory, liability rules hold polluters responsible for clean-up costs. However, in practice, liability rules are at times not enforced and when they are, the public sector often shares remediation costs with the polluter, thereby lessening their "bite". A second concern with liability rules is how the regulator defines cleanup costs. The regulator may choose environmental remedies that do not restore polluted drinking water sources to their original state. Another disadvantage of liability rules is that the costs involved in establishing liability are often excessive. This is likely to be further exaggerated with nitrate in groundwater because of the complexities of groundwater flow and contaminant transport processes. Phrased differently, it is difficult to trace groundwater contamination of a drinking water source to a particular non-point source.

Legislation exists to make liability rules a promising management tool in the future. Porter-Cologne Section 13304 provides authority for the Regional Water Boards to require landowners contributing nitrate to groundwater drinking water supplies to support drinking water actions for affected public water supplies and private wells.

The de-designation of a portion of or a whole groundwater basin is a lengthy and costly process because of the expected political and local push-back and the necessary steps required for both State Water Board and Office of Administrative Law approval. The State requires that a basin plan amendment is required to de-designate the basin as a source of municipal and domestic water supply (MUN) (Central Valley Regional Water Board 2011), so an alternative drinking water plan will need to already be in place at the time of de-designation. Further, there are explicit restrictions on de-designation. Specifically, State Water Board regulations (Resolution No. 88-63) only allows MUN de-designation of groundwater with high TDS, insufficient sustained water yield, or contamination that cannot be reasonably treated (State Water Board 2006). Historic examples of de-designation in California have typically been a result of natural water quality concerns. Allowing de-designation of areas degraded by human activity may encourage continued and extensive degradation in other areas because this would remove the liability of dischargers. Currently, the administrative costs required for de-designation are excessive, making other regulatory options preferable to de-designation.

3.11.3 Role of Information Disclosure

In the case of drinking water quality, information disclosure in the form of consumer confidence reports may provide little incentive for small systems to reduce nitrate concentrations. Large systems face costs in the form of customer complaints and CDPH oversight from disclosure of safe drinking water quality violations. The costs of customer complaints increase with the population served simply because there is a larger population to issue complaints. When a water supplier serves a small (2 to 4 connections) and comparatively disadvantaged population, the costs of disclosing a violation may be much lower, thereby limiting (at least in the short-term) the potential of this regulatory option to improve drinking water quality.

3.11.4 Choosing Among Market-Based Approaches – Fees v. Cap-and-Trade

Weighted along three of our analytical criteria – abatement costs, administrative and enforcement costs, and information requirements – market-based instruments to manage fertilizer are preferred. Market-based approaches have lower administrative costs and information requirements than liability rules or de-designation, and have lower abatement costs than direct regulatory instruments. When choosing between a fertilizer fee and a fertilizer cap-and-trade system, in the near-term, a fertilizer fee has distinct advantages.

First, a fertilizer fee will generate revenues. These revenues could be used for the construction of improved drinking water infrastructure or further treatment of existing sources. Alternatively, fee revenues could be returned to emitters as a refund, used to subsidize technologies to improve management practices, or for research and development of improved nutrient management practices and extension/training programs.

A cap-and-trade system may or may not generate revenues, depending on the allocation of permits. If fertilizer permits are auctioned off, the government will collect revenues from the sale of fertilizer permits. In theory, the revenues collected from the auctioning of fertilizer allowances will equal those collected from a fee. If fertilizer allowances are freely allocated to non-point sources, then non-point sources gain the revenues that the government would collect under a fertilizer fee. Which sources gain the revenues depends on the initial allocation of permits. Though the initial distribution of permits will alter which farms gain revenues, it does not change the overall cost of abatement.

Another reason to prefer a fertilizer fee in the short-run is because the administrative infrastructure already exists to implement this regulation. Since fertilizers are currently exempt from sales taxes in California (if applied to land used for food or for feed for food animals) (CA State Board of Equalization 2004), the State could set a fee on fertilizer at a sales tax rate of 7.5%. The State would not need to develop new infrastructure to implement a fertilizer fee. It could simply extend the sales tax in California to include a fertilizer fee. While a tax would go into the State's general fund, a fee could have a designated purpose such as safe drinking water to areas facing high nitrate concentrations in the groundwater. In contrast, the state would need to develop new administrative infrastructure to implement a cap and trade system for groundwater.

3.12 Major Findings: Future Regulatory Options

1. **Many options exist to regulate nitrate in groundwater, but there is no ideal solution.** The costs of regulatory options vary greatly, and while no option is perfect, some seem preferable to others.

2. **Regulating fertilizer application has lower monitoring and enforcement costs and information requirements than does regulating nitrate leachate, but it may be less effective in achieving nitrate reduction targets.** While the regulation of fertilizer application is easier to implement and enforce than the regulation of nitrate leachate, it is less likely that water quality standards will be

met. Due to non-uniform mixing, transport, and dispersion of nitrate in groundwater, it is difficult to quantify the impact of a unit of fertilizer on nitrate contamination of drinking water over time.

3. **Costs to farmers for reducing nitrate contamination can be lower with market-based regulatory actions (fertilizer fees or cap-and-trade programs) than with technology mandates or prescriptive standards because of the additional flexibility farmers have in complying with market-based regulations.** Market-based instruments also encourage the development and adoption of new technologies to reduce fertilizer use, but they may lead to the formation of contamination hot spots.

4. **Well-defined and enforceable regulatory requirements are needed for liability rules to work.** In California, all groundwater is considered to be suitable, or potentially suitable, for municipal or domestic water supply and should be so designated by the Regional Water Quality Control Boards (Regional Water Boards), with a few exceptions.[40] Under existing water code, groundwater is protected from degradation affecting its designated beneficial uses, but this protection is rarely enforced in the case of nonpoint source pollution. Section 13304 of the California Water Code (Porter-Cologne Act) gives the Regional Water Boards authority to force polluters to pay for alternative water supplies for affected users of public water systems and private wells. Legislation might be useful to solidify Regional Water Board authority to apply this provision broadly.

3.13 Promising Actions: Future Regulatory Options

1. **Nitrate dischargers incur the social costs of their discharges. This policy is already implied for drinking water costs under Section 13304 of the California Water Code (Porter-Cologne Water Quality Control Act).** Without regulations on nitrate source loading, nonpoint sources do not pay for the impact of their nitrate contamination to groundwater. Requiring nitrate dischargers to pay for nitrate contamination provides incentives for them to reduce nitrate discharges and ensures that those benefitting from nitrate discharge pay for the cost of contamination.

2. **Regulatory actions focus on nitrogen fertilizer use (including organic fertilizer sources).** Most nitrate discharge to groundwater is from nonpoint sources, particularly cropland, with substantial additional loading from manure.[41] Existing regulatory programs appear to address point sources of nitrate contamination well, but could be extended to include nonpoint sources.

3. **Regulatory actions should focus on controlling fertilizer application rather than nitrate leachate.** The high costs and technical difficulties of field, farm-based, or countywide nitrate leachate regulations could be prohibitive. A fertilizer application regulation that reduces nitrate discharges to groundwater is coarser and less direct, but much less costly.

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[40] Waters with very high TDS, for example. See Section 4.9 De-designation of Beneficial Use and also, State Water Board Resolution No. 88-63

[41] See Technical Report 2: Nitrogen Sources and Loading to Groundwater (Viers et al. 2012)

4. **Market-based instruments are likely to perform better than command-and-control approaches.** Market-based approaches have lower costs than command-and-control approaches because they provide dischargers with more flexibility to comply with nitrate regulations.

5. **A fertilizer fee is a promising form of regulation and funding.** In the short run, a fee on fertilizer use (including organic fertilizer sources) seems preferable to a cap-and-trade system since it could take advantage of existing infrastructure. Since fertilizers are currently exempt from sales taxes in California (CA State Board of Equalization 2004), the State could expand sales taxes to include fertilizer purchases. The impact a fertilizer fee has on nitrate contamination depends on a) the sensitivity of demand for fertilizer to a price change and b) the size of the fee. The long-term feasibility and desirability of a cap-and-trade system for nitrogen management could be evaluated.

4 Current Funding Programs

In addition to the planning and regulatory programs, several State, Federal, and local agencies, as well as nongovernmental organizations, have established funding programs related to nitrate contamination in California's groundwater. This section summarizes existing funding sources available from these agencies to reduce nitrate source loading to groundwater, remediate contaminated groundwater, and provide safe drinking water to affected communities.

4.1 Information on Current Sources of Funding

State funding for safe drinking water is currently dominated by general obligation bonds for loans through State propositions, Federal economic stimulus package grants, and State revolving fund loans.

The most recent propositions that provided loans or grants for drinking water infrastructure or water quality protection/improvement are Propositions 82 [1988], 13 [2000], 50 [2002], and 84 [2006]. All are State general obligation bonds, which are repaid through the general fund. A general obligation bond is a municipal bond secured by the use of State or local government resources to repay bond holders. Often, general obligation bonds levy a property tax or decrease local property tax revenues to meet debt service requirements.

The American Recovery and Reinvestment Act (ARRA) of 2009 created an economic stimulus package that allowed for an increase in the Federal budget deficit. This 2009 stimulus package allocated $160 million in funding to the Federal Safe Drinking Water State Revolving Fund.

State revolving funds also have been a major source of funding for projects that support safe drinking water goals. While water systems still bear most project costs, the State revolving funds subsidize a portion of the costs with low-interest loans. These programs work like environmental infrastructure banks (Figure 1) where the funding program is a self-perpetuating loan assistance authority for water quality improvement projects. It is capitalized by Federal and State contributions and the pot of money is able to continually grow through: investment and interest earnings; principal repayments; and bond proceeds from leveraging. Revenues are recycled back into the program and since grants are not allowed, the funds do not dissipate. More recently, some funding programs, like the State Revolving Fund and the Integrated Regional Water Management Programs, have targeted small and disadvantaged communities by setting aside funds specifically for these populations.

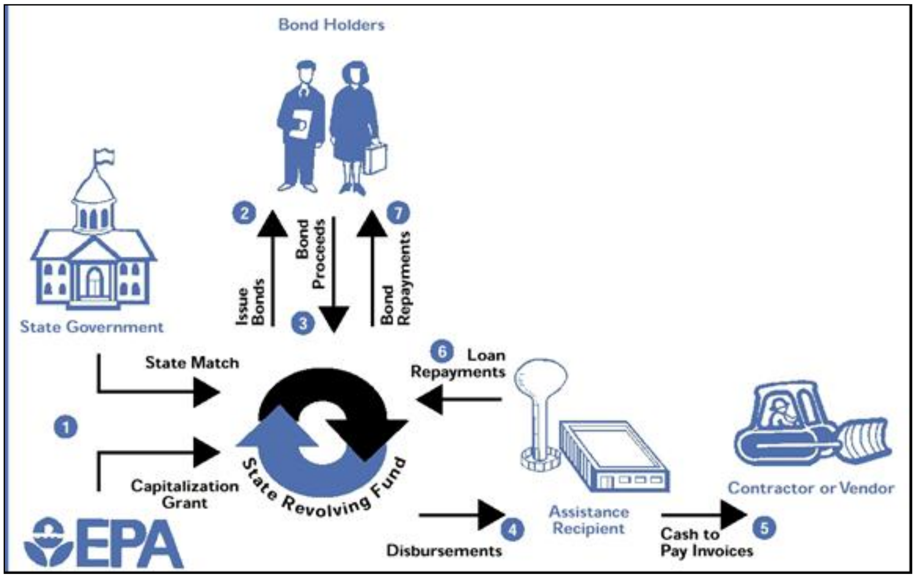

Figure 1. Structure of the State Revolving Fund. (U.S. EPA CWSRF Branch 2006, reproduced with permission)

In addition to these major sources of funding for safe drinking water, some fees exist to help prevent groundwater contamination from nitrate sources. One example is CDFA's mill assessment on fertilizer, which provides funding for research on the use and handling of fertilizer, including environmental effects. Nongovernmental and non-profit funding also exists for drinking water, water quality, and water supply improvements. Typically, these pools of money are significantly smaller and more limited than State and Federal resources.

4.2 Summary of Current Funding Programs

A summary of existing funding sources to address problems related to nitrate in drinking water is shown in Table 5. In general, these programs are structured to provide assistance for activities related to alternative water supplies and nitrate load reduction. California has eighteen relevant State funding programs, administered by four agencies (Table 5, purple). The Federal government manages an additional three funding programs (blue). Three large nongovernmental drinking water funding programs in the study area are highlighted in orange. For a more detailed review of these programs, see Appendix C: Description of Current Funding Programs for Safe Drinking Water. Several State funding efforts for safe drinking water infrastructure are also reviewed by the California Financing Coordinating Committee.[42]

[42] http://www.cfcc.ca.gov/

Table 5. Summary of existing funding sources for safe drinking water.

AGENCY	PROGRAM [year passed or created]	FUNDING PROVIDED (in millions of dollars)
California Department of Public Health (CDPH)	Safe Drinking Water State Revolving Fund [SDWSRF] [1996] (grants and loans)	**Generally $100-$150:** Low interest loans and some grants to support water systems with technical, managerial, and financial development and infrastructure improvements.
	Proposition 84 [2006] (grants) **(fully allocated)**	**$180:** Small community improvements. **$60:** Protection and reduction of contamination of groundwater sources. **$10:** Emergency and urgent projects.
	Proposition 50 [2002] (grants) **(fully allocated)**	**$50:** Water security for drinking water systems. **$69:** Community treatment facilities and monitoring programs. **$105:** Matching funds for Federal grants for public water system infrastructure improvements.
State Water Resources Control Board (State Water Board)	Clean Water State Revolving Fund (CWSRF) [1987] (loans)	**$200 - $300 per year:** Water quality protection projects, wastewater treatment, nonpoint source contamination control, and watershed management.
	Small Community Wastewater Grants [2004, amended 2007] (grants)	**$86 (fees on the CWSRF):** Loan forgiveness to small disadvantaged communities and grants to non-profits which provide technical assistance and training to these communities in wastewater management and preparation of project applications.
	Proposition 50 [2002] (grants) **(fully allocated)**	**$100:** Drinking water source protection, water contamination prevention, and water quality blending and exchange projects.
	Agricultural Drainage Program [1986] (loans) **(fully allocated)**	**$30:** Addressing treatment, storage, conveyance or disposal of agricultural drainage.
	Dairy Water Quality Grant Program [2005] (grants) **(fully allocated)**	**$5 (Prop 50):** Regional and on-farm dairy projects to address dairy water quality impacts.
	Nonpoint Source Implementation Program [2005] (grants)	**$5.5 per year:** Projects that reduce or prevent nonpoint source contamination to ground and surface waters.
	Cleanup and Abatement Account [2009]	**$9 in 2010:** Clean up or abate a condition of contamination affecting water quality.
	Integrated Regional Water Management (IRWM) [2002] (grants) **(fully allocated)**	**$380 (Prop 50):** Planning ($15) and implementation ($365) projects related to protecting and improving water quality, and other projects to ensure sustainable water use.

California Department of Water Resources (DWR)	Integrated Regional Water Management (IRWM) [2002] (grants)	**$500 remaining (Prop 84):** Regional water planning and implementation.
	Local Groundwater Assistance Grant [2008] (grants)	**$4.7 anticipated for 2011-2012 (Prop 84):** Groundwater studies, monitoring and management activities.
	Proposition 82 [1988] (loans)	**$22:** New local water supply feasibility & construction loans.
	Water Use Efficiency Grant Program [2001] (grants)	**$15 in 2011 (Prop 50):** Water use efficiency projects for agriculture, such as: wellhead rehabilitation, water and wastewater treatment, conjunctive use, water storage tanks.
	Agricultural Water Conservation Loan Program [2003] (loans)	**$28 (Prop 13):** Agricultural water conservation projects, such as: lining ditches, tailwater or spill recovery systems, & water use measurement.
	Infrastructure Rehabilitation Construction Grants [2001] (grants) **(fully allocated)**	**$57 (Prop 13):** Drinking water infrastructure rehabilitation and construction projects in poor communities.
California Infrastructure and Economic Development Bank (I-Bank)	Infrastructure State Revolving Fund (ISRF) [1994] (loans)	**$0.25– $10 per project:** Construction or repair of publicly owned water supply, treatment and distribution systems.
U.S. Department of Agriculture (USDA)	Rural Utilities Service - Water and Environmental Programs (RUS WEPs) (loans and grants)	**$15.5 :** Development and rehabilitation of community public water systems (less than 10,000 people), including: emergency community water assistance grants, predevelopment planning grants, technical assistance, guaranteed loans, and a household well water program.
U.S. Department of Housing and Development (HUD)	Community Development Block Grant (CDBG) (grants)	**$500 in 2010 for CA:** Community development projects: feasibility studies, final plans and specs, site acquisition and construction, and grant administration.
U.S. Department of Commerce	Economic Development Administration (EDA) (grants)	**Grants up to 50% of project costs:** Supports economic development, planning, and technical assistance for public works projects.
Rural Community Assistance Corporation (RCAC)	Drinking Water Technical Assistance and Training Services Project (loans)	**$1.2 per year:** Administers funds from the US EPA Office of Groundwater & Drinking Water for infrastructure projects, including water.
The Housing Assistance Council (HAC)	Small Water/Wastewater Fund (loans)	**Up to $0.25 per project:** Loans for land acquisition, site development, and construction.
Cooperative Bank (CoBank)	Water and Wastewater Loan (loans)	**$1 per project:** Water and wastewater infrastructure, system improvements, water right purchases, and system acquisitions. **$0.05-$0.5 per project:** Construction costs.

A variety of funding programs exist for the development of alternative water supply actions. Funding is available for capital investments in new water supplies, safe drinking water treatment, aging infrastructure replacement, water use efficiency, and water meter installation. Funds also are available to educate communities and systems about water quality contamination and to support technical, managerial, and financial capacity building. A very small amount of money is available to help systems prepare funding applications and perform pre-investment planning.

The diversity of funding sources for safe drinking water makes it difficult for drinking water systems or communities to navigate the litany of agencies and programs. Each program has its own funding application to understand and complete. One promising action for the State could be to combine appropriate funding programs to ease demands on community applicants, lower administrative costs, and improve overall statewide funding effectiveness.

Most safe drinking water funding programs do not provide support for operation and maintenance costs; the State of California specifically does not fund operation and maintenance activities. Additionally, not all drinking water funding programs support the regionalization[43] of multiple water systems or the consolidation[44] of smaller districts. For example, while New Mexico's Rural Community Assistance Corporation (RCAC) office receives State funding for regionalization, California's RCAC office only receives State funding for training activities like operator certification. When funding is provided for regionalization and consolidation activities, money is restricted to construction activities such as the installation of a new pipeline or water meters. California's RCAC funding does not support institutional activities such as forming a joint powers authority, hiring a facilitator to organize pilot projects (brings together water systems and evaluate the feasibility of collaboration), or hiring a technical expert to help water systems perform asset mapping and financial planning.

Current funding programs have not met systems' stated need to ensure safe drinking water in the Salinas Valley and Tulare Lake Basin.[45] These areas have disproportionately high costs to deal with high nitrate concentrations. Compared to other areas of California, groups in the study area have requested more Safe Drinking Water Funds to address nitrate contamination ($29 per person compared to $5 per person statewide, see Figure 2). Providing safe drinking water or alternative water supplies to highly susceptible populations in the study area is estimated to cost at least $20-$36 million per year ($80-$142/year per susceptible person or $5-$9/year per acre of irrigated land).[45] Most current State funding for nitrate contamination problems is temporary (general obligation bonds for loans through State propositions and the Federal economic stimulus package grants) and many programs have already been fully allocated (see Table 5). Long-term funding for safe drinking water is needed.

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[43] Regionalization: "a creation of an appropriate management or contractual administrative organization or a coordinated physical system plan of two or more community public water systems in a geographical area for the purpose of utilizing common resources and facilities to their optimum advantage" (Grigg 1989).
[44] Consolidation: "one community public water system being absorbed into, combined with, or served by other utilities to gain the resources they lack otherwise" (Raucher et al. 2004).
[45] See Technical Report 7: Alternative Water Supply Options (Honeycutt et al. 2012)

Small water systems typically have higher per capita funding needs than larger systems. In small and rural communities, households are usually spread out; the infrastructure needed to transport water from the source to a household in a rural area is more expensive than for urban areas. This implies that unit costs of safe drinking water will be higher in rural or small communities. Small water systems also often lack the economies of scale to economically treat nitrate contaminated ground water, and the technical, managerial, and financial capacity to repay loans, complete funding applications, and pay both recurring and unexpected operation and maintenance costs. Further, many State funding programs (State Revolving Fund, State Bonds, etc.) only accept applications from water systems served by a public entity,[46] so domestic well owners and small communities with no recognized water system lack a major State funding source. This policy is inconsistent with the Environmental Justice principles in California's laws and policies, which are based on "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws and policies" (California Government Code section 65040.12).

In addition to funding programs for safe drinking water, programs are also available for nitrate source load reduction. There are programs to help convert communities from septic to sewer systems, install wastewater treatment upgrades, monitor groundwater quality, and protect receiving water quality in both surface water and groundwater. Planning activities are funded through programs like Integrated Regional Water Management. Funding for agricultural nutrient management education, training, and research also is available.

The California Department of Food and Agriculture (CDFA) oversees a mill assessment on fertilizer sales (see Appendix B: Summary of Current Planning and Regulatory Programs that Address Nitrate in Groundwater). Revenues are used for research and education of proper use and handling of fertilizing materials (including environmental effects) and to support the program. Currently, the assessment is only set at half of its authorized amount. Raising the assessment to the fully authorized amount would raise roughly $3 million per year statewide. $1 million of this could be used for the described fertilizer-use activities, or if current statute is changed, to fund some alternative drinking water supply efforts.

4.3 Current Funding Example: Safe Drinking Water State Revolving Fund[47]

The Safe Drinking Water State Revolving Fund (SDWSRF), created under the Federal SDWA, is one of the largest funding sources for community water systems in California, so it is presented here as an example program.

The SDWSRF allows CDPH to provide low interest loans and other assistance to public water systems. This fund supports: (1) infrastructure improvements; (2) water system technical, managerial, and

[46] A legally-approved public entity is a public water system or another legal entity that has authority to contract and incur debt on behalf of the community.
[47] (CDPH 2011)

financial capacity development; and (3) water and energy efficiency projects. As part of this program, CDPH establishes an annual project priority list based on applications from water systems. From this list, they create a "fundable list" of projects they intend to fund, assuming each system can meet all program requirements.

CDPH specifically addresses disadvantaged communities and small water systems in their project priority and fundable lists. Communities with lower median household incomes are given higher priority. Disadvantaged communities can also receive the following additional assistance from the SDWSRF: 1) zero percent interest rates (compared to 3-4%), 2) extended repayment periods of 30 years (compared to 20 years), and 3) forgiveness of up to 80% of the loan principal (CDPH, 2010). With the recent adoption of AB 983, severely disadvantaged communities may now be eligible for up to 100% grant funding (AB 983, 2011).

Derived from the 2010-2011 Final Project Priority List, Figure 2 shows that in dollars per person, more money was requested for drinking water projects in the study area counties relative to all of California. Despite the host of regulated contaminants, the 2010-2011 project priority list reflects the severity of nitrate contamination in the Tulare Lake Basin and Salinas Valley. Approximately 9% of funds sought (derived from the SDWSRF list) for all drinking water projects listed in the study area are related to nitrate contamination (install new treatment facilities, upgrade existing facilities, connect a pipeline to other drinking water systems, etc.). In comparison, only 1.6% of the statewide project costs are listed for nitrate projects. Figure 2 shows that $29 per person in the Tulare Lake Basin counties and $28 per person in Monterey County has been requested for nitrate projects, while the statewide requests are only $5 per Californian.

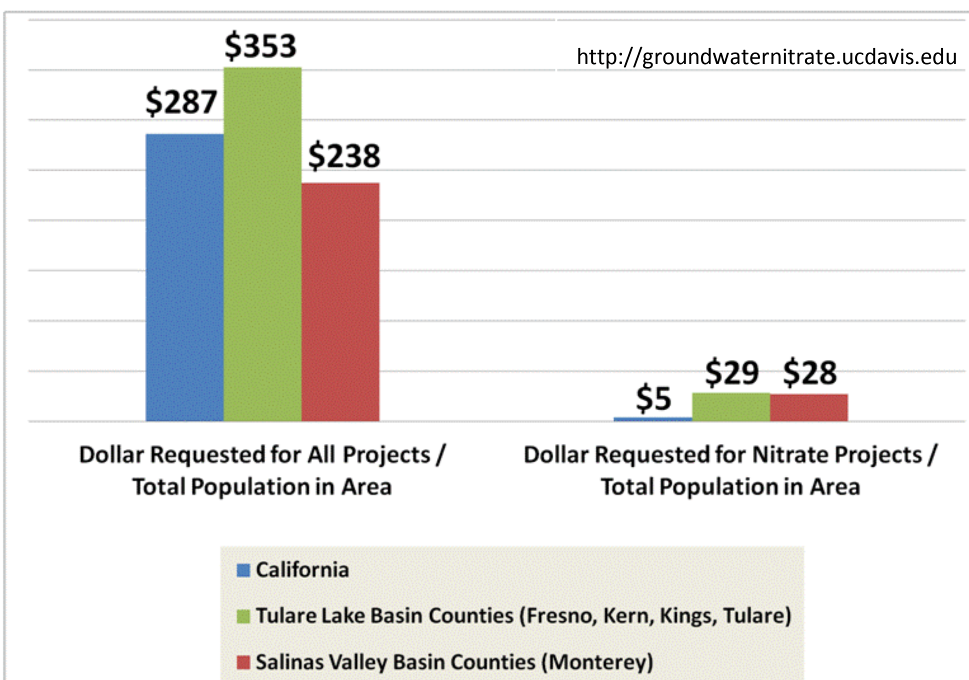

Figure 2. Dollar requested per person on proposals made to the 2010-2011 Safe Drinking Water State Revolving Fund (Final Fundable Project Priority List, Oct. 2010).

While this analysis only shows data from formal funding requests that have been approved, it is still useful for comparing the study area to the rest of the State. Looking solely at systems that are currently aware of their nitrate problem and who were able to apply to the SDWSRF, California will need at least $4 per person to fulfill the current statewide funding requests and around $27-28 per person in the five study area counties (Table 6, below). The total actual need for nitrate projects could be much higher when accounting for communities who were either unaware of their nitrate problem, unconcerned with the consequences, or unable to formally apply for funding.

Table 6. Unmet qualified project needs after allocation of 2010-2011 Safe Drinking Water State Revolving Fund.

	Total Area Population (Dept. of Finance 2010)	Type of Drinking Water Project	People with Unmet Requested Need (Millions)	Unmet Requested Need (Millions)	Dollar of Unmet Requested Need Per Total Area Population
All of California	38,648,090	All	41.94	10,859	281
		Nitrate	1.29	167	4
Tulare Lake Basin Counties: Fresno, Kern, Kings, Tulare	2,397,451	All	1.17	824	344
		Nitrate	0.12	66	28
Salinas Valley County: Monterey	435,878	All	0.40	103	236
		Nitrate	0.03	12	27

After the allocation of all available funds for the 2010-2011 SDWSRF, study area counties have approximately $78 million in unfulfilled funding requests for nitrate (Table 6). This can be compared to the alternative water supply cost analysis discussed in the Alternative Water Supply Options Technical Report 7 (Honeycutt et al. 2012), which estimated a present value cost of $212-$424 million ($17-34 million *per year*) to provide safe drinking water to the 220,000 "highly susceptible" people on public water systems in the study area. The alternative water supply cost estimate is significantly larger than the requested funding for SDWSRF. This is because the (Technical Report 7) estimate includes all water systems that have recorded delivered nitrate levels above the MCL, as well as those with no recorded nitrate levels. The SDWSRF project priority list only includes projects for which the community is both aware of their nitrate problems and has been able to navigate through the complicated and time-intensive funding application process.

4.4 Major Findings: Current Funding Programs

1. **Current funding programs have not met systems' stated need to ensure safe drinking water in the Salinas Valley and Tulare Lake Basin.**[48] These areas face large costs to deal with high nitrate

[48] See Technical Report 7: Alternative Water Supply Options (Honeycutt et al., 2012)

concentrations. Compared to other areas of California, groups in the study area have requested more Safe Drinking Water State Revolving Funds to address nitrate contamination ($29 per person compared to $5 per person statewide, see Figure 2). Providing safe drinking water or alternative water supplies to highly susceptible populations in the study area is estimated to cost at least $20-$36 million per year ($80-$142/year per susceptible person or $5-$9/year per acre of irrigated land).[48]

2. **Most current State funding for nitrate contamination of drinking water is temporary.** State funding for safe drinking water is currently dominated by general obligation bonds for loans through State propositions, Federal economic stimulus package grants, and State revolving fund loans. All are temporary sources except for the State revolving fund loans, which are self-financed long-term sources.

3. **Small water system costs are high[49] and these small systems already face chronic financial problems.** In small and rural communities, housing is often low density and spread across a relatively large area; the infrastructure needed to transport water from the source to a household in a rural area is more expensive than for urban areas. Small systems also often lack the economies of scale and the technical, managerial, and financial capacity to repay loans, complete funding applications, and pay both recurring and unexpected operation and maintenance costs. This implies that unit costs of safe drinking water and responding to nitrate contamination will be higher in rural and small communities.

4. **While regionalization of drinking water systems is sometimes promising, little funding is provided for facilitating this solution**. California often provides funding to drinking water systems for the physical consolidation of systems, but it provides no support or training for non-construction regionalization activities (e.g., a facilitator brings systems together to assess the feasibility of consolidation, or a technical expert performs asset mapping and financial planning for a group of water systems).

4.5 Promising Actions: Current Funding Programs

1. **Where appropriate, combine funding programs.** Consolidating funding programs should lower administrative and application costs and improve program effectiveness. A single program will also ease demands on community applicants. For example, water supply and wastewater problems are often intertwined, and linking these sources of funding would reduce upgrade costs for small systems.

2. **Allocate funding to long-term drinking water solutions, particularly regionalization or consolidation of small systems.** Small drinking water systems face many challenges, including

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[49] EPA. 2011. National Characteristics of Drinking Water Systems Serving 10,000 or Fewer People. (U.S. EPA 2011b)

nitrate-contaminated groundwater. Connecting to larger systems or consolidating with other small systems can allow such problems to be addressed more effectively and at lower cost. But regionalization and consolidation of systems often requires costly upgrades for smaller systems (e.g., water meters or new pipeline) or requires the larger system to take on an undesirable amount of risk. The State and counties have an interest in encouraging regionalization and consolidation activities to avoid longer-term financial difficulties, water system service inadequacies, and public health problems.

3. **Provide more financial assistance to small systems.** Small systems generally have more difficulty applying for funding programs and repaying loans. A grant or other special assistance program could be established to provide additional help to small systems. Such a program might be part of a larger consolidated effort by CDPH, the State Water Board, DWR, an Integrated Regional Water Management Plan, and the counties to address the problems of small water and wastewater systems.

4. **Create State funding programs for domestic well owners and for State small and local small water systems.** Currently, only water systems served by a public entity can apply for State safe drinking water funds (such as the State Revolving Fund). Domestic well owners and small communities with no recognized water systems thereby lack the funding sources available to public water systems. Assistance may also be provided to these small systems to help them form legally recognized entities.

5. **Increase the current mill assessment rate on nitrogen fertilizer to its fully authorized amount.** CDFA already oversees a mill assessment on fertilizer sales for research and education regarding the use and handling of fertilizing materials (including environmental effects), which is currently only half of its authorized amount. Raising the assessment to the fully authorized amount would raise roughly $3 million per year statewide. $1 million of this could be used for research and education regarding the use and handling of fertilizing materials (including environmental effects), or if current statute is changed, to fund some alternative drinking water supply efforts.

5 Future Funding Options

Current funding programs are insufficient to address the long-term issue of nitrate contamination. In this section, we outline an array of potential future funding options to support groundwater remediation, provide safe drinking water to affected communities, and reduce nitrate loading to the groundwater. It will take years to decades for an implemented nitrate regulatory program to affect drinking water quality, so immediate funding for safe drinking water is necessary.

In Section 5.3, we describe the funding options and then compare these sources in Section 5.4. We first compare non-agricultural fees to agricultural fees and recommend that funding sources should focus on agricultural fees. Next, we discuss various agricultural fees, concluding that a fee on nitrate or fertilizer is the preferred funding source. Finally, we recommend a fertilizer fee as the most promising funding option.

5.1 Overview and Summary Table

As discussed in Section 4, there are a number of existing funding programs such as the State revolving loans and grants that support safe drinking water. These programs, however, tend to be temporary in duration and have been ineffective in meeting the needs of at-risk populations, especially those on small water systems. Even if these programs are expanded, more revenue will be needed to support continued safe drinking water in the long-term. There are a number of other funding options to consider.

Table 7 provides a list of potential funding options, ranks the ability of each option to reduce nitrate contamination, lists who bears the burden of payment, and cites a relevant example.

Table 7. Summary of future State funding options.

OPTION	INCENTIVE TO REDUCE NITRATE	WHO PAYS?	EXAMPLE
Crop Tax	No	Producers and consumers of food	State Sales Tax Rate for Soft Drinks: The State of Maryland charges a 6% sales tax for soft drinks
Fixed Fee on drinking water agricultural water	 No No	 Drinking water users Agricultural users	Federal Communications Commission Universal Service Fee: A fixed fee placed on monthly phone bill to assure universal access to telecommunications for low-income and high-cost rural populations.
Volumetric Fee on drinking water agricultural water	 No Low	 Drinking water users Agricultural users	Gas Public Purpose Program Surcharge: A volumetric fee on gas bills in California to fund assistance programs for low-income gas customers, energy efficiency programs, and public-interest research.
Groundwater Pumping Fee	Medium	Agricultural groundwater users	Pajaro Valley Groundwater Pumping Fee: A per acre-foot charge to secure financing for debt stabilization and to address groundwater overdraft.
Fee/Tax on Bottled Water	No	Consumers of bottled water	California Redemption Value: A refundable fee placed on recyclable bottles at the point of sale.
Agricultural Property Tax	No	Agricultural property owners	CA State Property Tax: A statewide ad valorem tax equal to a percentage of the purchase price is collected from all properties in the State, with some exceptions.
Fertilizer Tax/Fee	High	Consumers of fertilizer	Mill Assessment Program: The State imposes a fee of 2.1 cents per dollar on pesticide sales at the point of first sale into the State.
Nitrate Leachate Tax/Fee	Highest	Nitrate emitters	Duty on Wastewater: In the Netherlands, a tax of approximately $3.60 is imposed on each kg of nitrate in wastewater.
Cap-and-Trade with Auctioned Permits	High/ Highest	Consumers of fertilizer and nitrate emitters	Title IV of the Clean Air Act Amendments: Established a tradable permit approach to control sulfur dioxide emissions. A small portion of permits sold in an auction.

5.2 Assumptions and Limitations

This analysis presents a wide range of potential funding options. We do not discuss how these revenues should be distributed. Revenues from these options could be used to remediate groundwater, treat groundwater, alter farming practices, or fund safe drinking water (or fund programs unrelated to nitrate in groundwater). Regulatory agencies will have the discretion to best choose how to employ these funds.

We evaluate funding sources along two criteria: 1) the potential of funding sources to reduce nitrate use among non-point agricultural sources and 2) which individuals will bear the burden of payment. Where possible, we also provide a back-of-the-envelope estimate of the per capita cost of each funding source to fund water supply actions in the study area. Future work may compare funding mechanisms along additional criteria; however, such a comparison is beyond the scope of this study.

5.3 Funding Sources

5.3.1 Water Fees

The State could employ a range of water fees to raise funds including a fixed monthly fee on drinking water, a volumetric fee on drinking water, a volumetric fee on irrigated water, a fixed fee on agricultural water, a groundwater pumping fee, or a fee on bottled water. The population base for generating the revenues for these funding sources could also vary, and fee increases could apply to the entire State or only to the Salinas Valley and Tulare Lake Basin.

Fixed fee on water use: An increase in the fixed fee on water use is one funding source option. Under this funding option, a fixed fee on drinking, agricultural, or irrigated water (depending on the funding option employed) would be charged to each consumer regardless of the quantity of water consumed. As the population charged this fixed fee increases, the fee incurred by each individual could be decreased.

Volumetric fee on water use and groundwater pumping fee: With a volumetric fee, the State or County would charge a fee, in addition to the current price, for each unit of water used. For example, California relies on the Gas Public Purpose Program Surcharge to fund gas assistance programs for low-income customers (PG&E 2009). As of January 1, 2011 Pacific Gas and Electric (PG&E) applied a surcharge of $0.08 per therm of natural gas used (PG&E 2011a), or on average, $3.60 per year per household.[50] A volumetric fee on statewide gross urban water use[51] would need to be $2.3-$4.1 per acre-foot per year to provide safe drinking water to the highly susceptible population of the study area.[52] If a fee is placed on both statewide gross urban and agricultural water use,[53] the fee would need to be at least $0.5-$0.9

[50] Average yearly household natural gas usage is 45 therms. (PG&E 2011b)
[51] Statewide gross urban water use is estimated at 8.7 MAF per year. (Hanak et al. 2011)
[52] See Technical Report 7: Alternative Water Supply Options (Honeycutt et al. 2012)
[53] Statewide gross urban and agricultural water use is estimated at 41.7 MAF per year. (Hanak et al. 2011)

per acre-foot per year to provide safe drinking water to the estimated highly susceptible population of the study area.[54] One acre-foot is approximately the amount of water consumed by one family over two years. Alternatively, this volumetric fee could be limited to groundwater users and could take the form of a volumetric groundwater pumping tax.

Fixed fee on bottled water: A fixed fee or tax could be added to bottled water sales. One can imagine a fee on bottled drinking water that resembles the bottle tax added to the purchase of recyclable bottles. This fee could be collected to fund actions related to the management of groundwater nitrate contamination.

5.3.2 Nitrate Contamination-Related and Agricultural Fees

Revenues can also be generated by imposing fees on a range of nitrate contamination-related or agricultural goods. We discuss the potential of a crop tax, nitrate fees, fertilizer fees, and a cap-and-trade system. In addition to these funding options for managing nitrate contamination, other potential instruments include an agricultural property tax, a fee on septic tank discharge, or a wastewater fee.

Crop tax: A crop tax (which could be extended to include dairies and poultry) could be implemented as an ad valorem tax on the value of the crop, a unit tax on crop weight, or a unit tax based on the nitrate volume (or concentration) used to grow a crop. If a crop tax were imposed throughout the State, the tax would be very small. If consumers and producers do not alter behavior in response to a small crop tax, then the tax would need to equal $4 per thousand dollars of crop sold in the study area to fund the provision of alternative water supplies (assuming that it costs $36 million annually to provide safe drinking water to the 254,000 highly susceptible population,[54] and $9 billion dollars of crops are sold per year (USDA 2007).

Fertilizer or nitrate leachate fee: A fee on fertilizer or nitrate leachate reduces nitrate contamination to groundwater and raises revenue. Currently, there is no sales tax on fertilizer in California (CA Board of Equalization 2009). As discussed in Technical Report 3 (Dzurella et al. 2012), a fee on fertilizer that is approximately equal to the sales tax rate might raise $28 million in revenue annually and reduce nitrogen application by 1.6 percent in the study area.[55]

Cap-and-trade with auctioned permits: The auctioning of fertilizer application permits (the right to apply one unit of fertilizer) or nitrate leachate permits (the right to leach one unit of nitrate to groundwater) under a cap-and-trade system could generate funds. Under certain assumptions, the revenue from the auctioning of permits will equal the amount generated under a fee or tax.

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[54] See Technical Report 7: Alternative Water Supply Options (Honeycutt et al. 2012)
[55] Assume: 7.5% sales tax on the cost of nitrogen, a fertilizer retail price of $0.75 per pound of nitrogen, and 500 million pounds (227 GgN) of fertilizer used in the Salinas Valley and Tulare Lake Basin (see Section 3 of Technical Report 3: Nitrate Source Reduction to Protect Groundwater Quality, Dzurella et al. 2012)

5.4 Comparing Funding Sources

We now compare funding sources to determine the most promising options to raise revenues for safe drinking water supply actions, nitrate source loading reduction, or groundwater remediation. First we compare **agricultural fees** (crop taxes, fixed/volumetric agricultural water fees, groundwater pumping fees, agricultural property taxes/fees, fertilizer taxes/fees, nitrate leachate taxes/fees, and auctioned fertilizer/nitrate permits) to **non-agricultural fees** (fixed/volumetric fees on drinking water and fees on bottled water), and recommend agricultural fees. We then discuss the various agricultural fees and ultimately recommend a fertilizer fee as the preferred funding source.

5.4.1 Agricultural vs. Non-Agricultural Fees

The advantage of an agricultural fee over a non-agricultural fee is that it requires nitrate emitters to internalize the social costs of their behavior. Nitrates leached from agricultural and dairy sources impose a real cost on society in the form of contaminated drinking water. However in the absence of regulation, the producers of nitrate do not bear the costs of their behavior. Rather, residents in the areas with contaminated drinking water incur these costs either by drinking contaminated water, paying for water treatment or purchasing alternative water supplies. An agricultural fee, at least partly, requires nitrate polluters to incur some of the social costs of their behavior. Different agricultural fees vary in the extent to which they require polluters to internalize the social costs of their behavior.

There are advantages to non-agricultural fees. First, as the population incurring the fee increases, as would be the case under a statewide drinking water fee or food tax, the cost borne by each individual declines. Under a statewide drinking water fee, the rate increase would be small, amounting to $2.3-$4.1 per acre, and negligibly impact individual income. Second, since the rate increase is small, there may be little resistance to a statewide fee; however, introducing drinking water fees to fund drinking water actions in the Salinas Valley and Tulare Lake Basin may establish a precedent that quickly leads to the use of drinking water fees to fund many other drinking water-related programs.

Since agricultural fees require nitrate emitters to partly pay for the costs of their behavior, we recommend agricultural fees over non-agricultural fees.

5.4.2 Choosing Among Agricultural Fees

The drawbacks of a fixed fee: Fixed agricultural fees describe funding sources that rely on fixed fees to generate revenues. Under a fixed fee, all nitrate emitters will pay the same fee regardless of their behavior. There are two main disadvantages to a fixed fee. First, nitrate emitters have no incentive to alter their nitrate emissions, since they pay the same fee irrespective of nitrate emissions. Second, the fees borne by non-point sources are not proportional to the nitrates leached; rather, they are uniform across non-point sources. In contrast, volumetric fees provide some incentive for nitrate emitters to alter their behavior, and for this reason are preferred to fixed fees.

The drawbacks of a crop tax: A small crop tax amounting to $4 per thousand dollars of crop sold in the study area could fund the provision of water supply actions. However, we prefer other agricultural fees to a crop tax for three reasons. First, a crop tax provides a weak signal for non-point sources to reduce nitrate emissions since the tax is on the value of the crop rather than on nitrate emissions. If non-point sources altered behavior in response to a crop tax, they could do so by reducing water use, labor, fertilizer application, etc. A second drawback of a crop tax is that it is regressive, since low-income individuals spend a larger share of their income on food. Finally, a crop tax may also induce individuals to reduce the consumption of fruits and vegetables since these products become marginally more expensive with a food tax.

The drawbacks of water fees: A volumetric water fee describes an indirect fee on nitrate contamination of groundwater. Under this fee, non-point sources face a direct incentive to reduce water use rather than fertilizer use. While water and nitrate use are positively correlated, it is not the case that a 1-unit reduction in water use will cause a 1-unit reduction in nitrate use. A volumetric water fee places the burden of payment for water supply actions on water intensive farms rather than nitrate-intensive farms. In contrast, a nitrate or fertilizer fee places the burden of payment on nitrate emitters. These funding sources also provide a stronger incentive for nitrate emitters to reduce nitrate use.

5.4.3 The Advantage of a Fertilizer Fee

Compared to the other funding sources, nitrate fees, auctioned nitrate permits, fertilizer fees, and auctioned fertilizer permits are preferred since they require nitrate emitters to more wholly internalize the costs of their behavior. Among these funding sources, we prefer a fertilizer fee. We recommend a fertilizer funding option over a nitrate funding source, since the administrative costs and information requirements to implement a nitrate fee or permit are high (refer to Section 3.2 for a detailed discussion). We favor a fertilizer fee over auctioned permits since the administrative infrastructure exists to expand the sales tax to include fertilizer (refer to Section 3.11.4 for a detailed discussion). This fee could either be applied based on the percent nitrogen or with a unit cost per weight of fertilizer. While a fee that accounts for the concentration of nitrogen will better link the fee to groundwater nitrate contamination potential, a cost based fee is easier to implement.

5.5 Major Findings: Future Funding Options

1. **Options exist to raise funds for safe drinking water, but all require that someone bear the cost and many are awkward or insufficient.** Water use fees, groundwater pumping fees, bottled water fees, crop fees, and fertilizer fees are a few of the many potential sources for funding safe drinking water and source reduction actions.

2. **Some funding options give polluters a useful price signal.** Fertilizer (or nitrate leachate) fees and auctioned permits induce emitters to reduce use of fertilizer or nitrate.

3. **Farmers do not pay sales tax on fertilizer in California**[56].

5.6 Promising Actions: Future Funding Options

1. **Introduce a special fee on nitrogen fertilizer sales statewide, perhaps equivalent to a sales tax.** This economic signal could both reduce nitrogen applications and help fund safe drinking water solutions, nitrate source load reduction efforts, and nitrate monitoring and assessment programs. Expanding sales tax to include fertilizer could generate $28 million per year in the study area and might reduce applied nitrogen by 1.6%.[57] Similar fees/excise taxes could be considered for organic fertilizer sources (manure, green waste, wastewater effluent, biosolids, etc.).

2. **Consider a more comprehensive statewide fee on water use to support many beneficial activities**. Some of such revenues could fund management and safe drinking water actions in areas affected by nitrate contamination, including short-term emergency drinking water measures for disadvantaged communities. Assuming a fee is placed on statewide gross urban and agricultural water use,[58] the fee would need to be $0.5-$0.9 per acre-foot per year to provide safe drinking water to the estimated highly susceptible population of the study area.[59] Likewise, a fee only on statewide gross urban water use[60] would need to be $2.3-$4.1 per acre-foot per year.

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[56] (CA State Board of Equalization 2004)

[57] Assume: 7.5% sales tax on the cost of nitrogen, a fertilizer retail price of $0.75 per pound of nitrogen, and 500 million pounds (227 GgN) of fertilizer used in the Salinas Valley and Tulare Lake Basin (Technical Report 3: Nitrate Source Reduction to Protect Groundwater Quality, Dzurella et al. 2012)

[58] Statewide gross urban and agricultural water use is estimated at 41.7 MAF per year. (Hanak et al. 2011)

[59] See Technical Report 7: Alternative Water Supply Options (Honeycutt et al. 2012)

[60] Statewide gross urban water use is estimated at 8.7 MAF per year. (Hanak et al. 2011)

6 Summary of Promising Actions

6.1 Regulatory Programs and Options

1. **Provide immediate safe drinking water to groundwater nitrate affected areas.** Since nitrate source reduction or groundwater remediation will take years to decades to significantly improve drinking water quality,[61] residents currently receiving unsafe drinking water require other alternatives in the immediate future, regardless of source reduction and management.

2. **Identify populations at risk of contaminated drinking water.** California Department of Public Health (CDPH), California Department of Food and Agriculture (CDFA), and State Water Board, in coordination with Department of Water Resources (DWR), issue a report every 5 years to identify populations at risk of contaminated drinking water and monitor long-term trends of the State's success in providing safe drinking water as a supplement to the California Water Plan Update.

3. **Regional Water Boards designate areas where groundwater sources of drinking water are at risk of being contaminated by nitrate.**

4. **Convene a State Groundwater Data Task Force.** California Environmental Protection Agency (CalEPA), in coordination with California Natural Resources Agency (CalNRA) and CDPH, convene an independently led State Groundwater Data Task Force to examine the efficacy of current State and local efforts to collect, maintain, report, and use groundwater data for California's groundwater quality and quantity problems.

5. **Convene a State Groundwater Task Force.** CalEPA, CalNRA, and CDPH maintain a permanent and independently led State Groundwater Task Force to periodically assess State technical and regulatory groundwater programs in terms of effectiveness in addressing California's groundwater quality and quantity problems. These reports could be incorporated into each California Water Plan Update.

6. **Examine successful Department of Pesticde Regulation (DPR) programs for lessons to manage nitrogen.** CalEPA and CDFA examine successful Department of Pesticide Regulation (DPR) data collection, analysis, education, and enforcement programs for lessons to manage nitrogen and consider expanding or building upon the existing DPR program to include comprehensive nitrogen use reporting to support nitrate discharge management.

7. **Nitrate dischargers incur the social costs of their discharges. This policy is already implied for drinking water costs under Section 13304 of the California Water Code (Porter-Cologne Water Quality Control Act).** Without regulations on nitrate source loading, nonpoint sources do not pay for the impact of their nitrate contamination to groundwater. Requiring nitrate dischargers to pay for nitrate contamination provides incentives for them to reduce nitrate discharges and ensures that those benefitting from nitrate discharge pay for the cost of contamination.

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[61] See Technical Report 4: Groundwater Nitrate Occurrence (Boyle et al. 2012)

8. **Regulatory actions focus on nitrogen fertilizer use (including organic fertilizer sources).** Most nitrate discharge to groundwater is from nonpoint sources, particularly cropland, with substantial additional loading from manure.[62] Existing regulatory programs appear to address point sources of nitrate contamination well, but could be extended to include nonpoint sources.

9. **Regulatory actions should focus on controlling fertilizer application rather than nitrate leachate.** The high costs and technical difficulties of field, farm-based, or countywide nitrate leachate regulations could be prohibitive. A fertilizer application regulation that reduces nitrate discharges to groundwater is coarser and less direct, but much less costly.

10. **Market-based instruments are likely to perform better than command-and-control approaches.** Market-based approaches have lower costs than command-and-control approaches because they provide dischargers with more flexibility to comply with nitrate regulations.

11. **A fertilizer fee is a promising form of regulation and funding.** In the short run, a fee on fertilizer use (including organic fertilizer sources) seems preferable to a cap-and-trade system since it could take advantage of existing infrastructure. Since fertilizers are currently exempt from sales taxes in California (CA State Board of Equalization 2004), the State could expand sales taxes to include fertilizer purchases. The impact a fertilizer fee has on nitrate contamination depends on a) the sensitivity of demand for fertilizer to a price change and b) the size of the fee. The long-term feasibility and desirability of a cap-and-trade system for nitrogen management could be evaluated.

6.2 Funding Programs and Options

1. **Where appropriate, combine funding programs.** Consolidating funding programs should lower administrative and application costs and improve program effectiveness. A single program will also ease demands on community applicants. For example, water supply and wastewater problems are often intertwined, and linking these sources of funding would reduce upgrade costs for small systems.

2. **Allocate funding to long-term drinking water solutions, particularly regionalization or consolidation of small systems.** Small drinking water systems face many challenges, including nitrate-contaminated groundwater. Connecting to larger systems or consolidating with other small systems can allow such problems to be addressed more effectively and at lower cost. But regionalization and consolidation of systems often requires costly upgrades for smaller systems (e.g., water meters or new pipeline) or requires the larger system to take on an undesirable amount of risk. The State and counties have an interest in encouraging regionalization and consolidation activities to avoid longer-term financial difficulties, water system service inadequacies, and public health problems.

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[62] See Technical Report 2: Nitrogen Sources and Loading to Groundwater (Viers et al., 2012)

3. **Provide more financial assistance to small systems.** Small systems generally have more difficulty applying for funding programs and repaying loans. A grant or other special assistance program could be established to provide additional help to small systems. Such a program might be part of a larger consolidated effort by CDPH, the State Water Board, DWR, an Integrated Regional Water Management Plan, and the counties to address the problems of small water and wastewater systems.

4. **Create State funding programs for domestic well owners and for State small and local small water systems.** Currently, only water systems served by a public entity can apply for State safe drinking water funds (such as the State Revolving Fund). Domestic well owners and small communities with no recognized water systems thereby lack the funding sources available to public water systems. Assistance may also be provided to these small systems to help them form legally recognized entities.

5. **Increase the current mill assessment rate on nitrogen fertilizer to its fully authorized amount.** CDFA already oversees a mill assessment on fertilizer sales for research and education regarding the use and handling of fertilizing materials (including environmental effects), which is currently only half of its authorized amount. Raising the assessment to the fully authorized amount would raise roughly $3 million per year statewide. $1 million of this could be used for research and education regarding the use and handling of fertilizing materials (including environmental effects), or if current statute is changed, to fund some alternative drinking water supply efforts.

6. **Introduce a special fee on nitrogen fertilizer sales statewide, perhaps equivalent to a sales tax.** This economic signal could both reduce nitrogen applications and help fund safe drinking water solutions, nitrate source load reduction efforts, and nitrate monitoring and assessment programs. Expanding sales tax to include fertilizer could generate $28 million per year in the study area and might reduce applied nitrogen by 1.6%.[63] Similar fees/excise taxes could be considered for organic fertilizer sources (manure, green waste, wastewater effluent, biosolids, etc.).

7. **Consider a more comprehensive statewide fee on water use to support many beneficial activities**. Some of such revenues could fund management and safe drinking water actions in areas affected by nitrate contamination, including short-term emergency drinking water measures for disadvantaged communities. Assuming a fee is placed on statewide gross urban and agricultural water use,[64] the fee would need to be $0.5-$0.9 per acre-foot per year to provide safe drinking water to the estimated highly susceptible population of the study area.[65] Likewise, a fee only on statewide gross urban water use[66] would need to be $2.3-$4.1 per acre-foot per year.

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[63] Assume: 7.5% sales tax on the cost of nitrogen, a fertilizer retail price of $0.75 per pound of nitrogen, and 500 million pounds (227GgN) of fertilizer used in the Salinas Valley and Tulare Lake Basin (See Section 3 of Technical Report 3: Nitrate Source Reduction to Protect Groundwater Quality, Dzurella et al. 2012)
[64] Statewide gross urban and agricultural water use is estimated at 41.7 MAF per year. (Hanak et al. 2011)
[65] See Technical Report 7: Alternative Water Supply Options (Honeycutt et al., 2012)
[66] Statewide gross urban water use is estimated at 8.7 MAF per year. (Hanak et al. 2011)

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Appendix A: Regulatory Options in Practice

Watershed-Based Effluent Trading

Watershed-based effluent trading programs (also called water quality trading programs or nutrient trading programs) are market-based instruments used to effectively meet water quality goals at a lower cost (Selman et al. 2009). Such trading programs allow point source polluters to purchase contamination discharge reductions from other point or nonpoint source polluters that have lower marginal costs of abatement. Trading between point sources, which are regulated by EPA's National Pollutant Discharge Elimination System (NPDES), and nonpoint sources, which are excluded from State and Federal water quality regulations, could significantly lower the costs to comply with drinking water quality standards. Nonpoint source contamination abatement costs could be up to 65 times less than that of point sources (Bacon 1993) and the inclusion of nonpoint source contamination reduction in lieu of tertiary treatment could save $15 billion in abatement costs (U.S. EPA 1992).

Under a permit system, a measurable target is set for contamination abatement or water quality and sources are allowed to trade contamination permits between each other such that the total target is met. For this target to be met, one must understand the mixing and transport properties of a contaminant, which can be difficult. Kerr and others examined the information required and proposed a level of analysis needed to define allowances and set trading caps for a nutrient trading system to control nutrient inputs to a lake (Kerr, Lauder, & Fairman 2007). They found that caps on inputs from the trading program could not be defined until nutrient flows into the lake were scientifically estimated. They also found that assigning landowners a specific groundwater lag zone would assign nutrient loading values appropriate to the time lag of contaminant transport in groundwater.

In 2003, the EPA officially approved and recommended water quality trading to achieve watershed goals (Chesapeake Bay Foundation 2011), encouraging States to develop water quality programs to mitigate excess nutrient concentrations. At the same time, the agency recognized the limitations of water quality trading and found this approach to be feasible only when 1) there is an incentive for facilities to reduce their effluent contamination; 2) there is variation in abatement costs across sources; 3) contamination of a watershed can be reduced without requiring all sources to abate; and 4) all major stakeholders are engaged in the design and implementation of a water quality trading program (U.S. EPA 2003). The diffuse nature of groundwater and the absence of water quality regulations for nonpoint sources add difficulty in managing groundwater contamination.

Currently, in the U.S. at least 23 water trading programs have completed at least one trade; some examples are provided in *Environmental and Natural Resource Economics* (Tietenberg & Lewis 2003).

Thirteen statewide water quality trading guidance, policies or rules exist or are in development in the U.S., including (Selman et al. 2009):

- Connecticut Water Quality Trading Legislation,
- Delaware State Trading Initiatives (*under development*),
- Florida Water Quality Trading Rules (*under development*),
- Idaho Pollutant Trading Guidance,
- Maryland State Water Quality Trading Policy (*under development*),
- Michigan Water Quality Trading Rules,
- Minnesota Water Quality Trading Policy (*under development*),
- Ohio Water Quality Trading Policy
- Oregon Final Internal Management Directive of Water Quality Trading,
- Pennsylvania State Water Quality Trading Policy,
- Virginia State Water Quality Trading Rules,
- West Virginia Water Quality Trading Guidance (*under development*), and
- Georgia Water Quality Trading Initiatives (*under development*).

Long Island Sound Nitrogen Credit Exchange Program, Connecticut

In 2001, Connecticut imposed a Total Maximum Daily Load (TMDL) on the Long Island Sound that limits the amount of nitrogen that can be discharged into the estuary. Initially, Long Island Sound point source dischargers were allocated a number of permits such that each source would comply with the TMDL. However, since TMDL compliance was regulated at the estuary level, substantial trading could occur among point sources. Seventy nine point sources engaged in trading (State of Connecticut 2011). In 2002, a Nitrogen Credit Exchange (NCE) was formally created to facilitate all nitrogen credit exchanges within the Long Island Sound (Selman *et al.* 2009). Between 2002 and 2009, about 15.5 million nitrogen credits were exchanged, with a total purchased and sold value of $45.9 million (State of Connecticut 2010). It is estimated that this trading program generated potential savings of 300 to 400 million dollars (compared to more traditional approaches).

Pennsylvania Water Quality Trading Program

In 2006, Pennsylvania issued water quality trading guidance to allow point source trading with point and nonpoint sources to achieve nitrogen and phosphorus loading reductions (Selman *et al.* 2009). The program requires all sources to meet legal baseline requirements before nutrient and sediment reductions are considered eligible for trading. For point sources, this baseline effluent limit is the TMDL set by the NPDES permit and for nonpoint sources the baseline is determined by the existing regulation for each type of nonpoint source. For agricultural operations, this implies that sources must comply with existing State nutrient management laws. Between 2006 and 2009, five point and nonpoint source trades occurred (Selman *et al.* 2009). To address complications that arise due to uncertainty in nonpoint source abatement and the diffuse behavior of contamination in water, the regulator has suggested "establishing a threshold above legal baseline for generation of credits" (State of Pennsylvania 2007).

Nutrient Trading in the Chesapeake Bay Watershed

In 2001, the Chesapeake Bay Program established principles and guidelines for nutrient trading in the Chesapeake Bay Watershed (Chesapeake Bay Foundation 2011). Of the States bordering the watershed, Maryland, Pennsylvania and Virginia have passed legislation related to nutrient trading and are now in the implementation process. Virginia primarily allows point source trading, and limits nonpoint source trading to only new or expanding facilities. In Pennsylvania, a participant must comply with applicable State and Federal regulations before engaging in water quality trading. The Chesapeake Bay Foundation, the regulatory agency that oversees the Chesapeake Bay Program, established a margin of safety to account for the uncertainty in nonpoint source controls when allowing point-nonpoint source trades by imposing a minimum credit ratio of 2:1 for trades between nonpoint and point sources.

Liability from Groundwater Contamination from Pesticide Use

Throughout the U.S., liability rules have been applied and enforced to regulate pesticide contamination in groundwater. Liability rules vary across States with some States holding polluters strictly liable, others finding polluters liable only if due care was not taken, and still others implementing no liability rules. Under strict liability rules, the farmers and manufacturers identified as the liable parties are responsible for paying the costs to clean up the contaminated source and providing alternative sources of drinking water to the water users. With due care liability rules, a polluter is only liable for damages if a “due care” standard is not met.

The difficulty with liability rules is in identifying the liable party. This is especially true with groundwater pollution due to non-uniform mixing and the time lag between leachate/emissions and drinking water contamination. Some States have enforced liability rules to regulate pesticides in groundwater, suggesting that liability rules could also be applied to regulate nitrate.

In Connecticut, the pesticide ethylene dibromide (EDB) contaminated groundwater wells and the State applied legislation that held agricultural sources liable for contamination (Centner, 1989). The liable parties ultimately settled and farmers and manufacturers agreed to split the cost to provide potable water to affected water users. Prior to this case, farmers in Connecticut were exempt from pesticide contamination liability if they complied with certain requirements.

In California, a different approach was taken in interpreting and applying liability rules. The groundwater sources in many cities and water districts were contaminated with dibromochloropropane (DBCP) and 1,2,3-trichloropropane (TCP). However, it was difficult to prove that the behavior of specific farmers and manufacturers had polluted the water source. Instead, many water districts and cities sued the manufacturers of DBCP and TCP (Berck & Helfand 2010). Since it was known that these chemicals had contaminated the groundwater sources, the manufacturers were held responsible. For example, in 1996 the City of Lodi settled a lawsuit against DBCP manufacturers in which the manufacturers agreed to pay the costs related to DBCP treatment for 40 years (City of Lodi 2011). In 2008, the City of Bakersfield filed a lawsuit against TCP manufacturers, claiming that that these manufacturers contaminated about 15% of the city's wells (Ferguson 2008). Similarly, the cities of Shafter, Delano and Wasco have also filed suits. These cases are still pending.

Hawaii also has been involved in lawsuits against manufacturers of DBCP and TCP (de Naie & McMahon 2011). In 1996, the Maui Water Board sued companies that supplied DBCP due to contamination found in groundwater wells in Haiku and West Maui. The settlement resulted in the chemical companies paying Maui County $3 million towards capital costs of a new filtration plant and about $200,000 operating costs every year for 40 years. The chemical companies also agreed to assist Maui County in complying with Federal and State standards for DBCP levels within 50 of their wells.

In these cases, liability rules led to funding alternative water supplies or the implementation of water treatment and monitoring. The enforcement of liability rules occurs when a liable party is identified. For nitrate in groundwater, it seems the polluter would be liable if a 'hot spot' was created and the manufacturer would be liable when the polluter is unidentified. For the Salinas Valley and Tulare Lake Basin, a "due care" standard would encourage farmers to reduce the amount of nitrogen applied and would hold them responsible for any contamination over that standard. The application of liability rules for managing pesticides suggests that it is feasible for managing nitrate. However, the long time period between nitrogen application and drinking-water impacts can make liability rules awkward and reduce their effectiveness.

Payment for Ecosystem Services in New York City

Currently, New York City participates in a payment for ecosystem services (PES) program for watershed protection. Under the US Safe Drinking Water Act (SDWA) the City was required to meet the State water quality standards by either constructing a water filtration plant at an estimated cost of $6 billion in capital and $300 million in annual operating costs (Postel & Thompson Jr. 2005) or implementing a much less expensive watershed protection program. The City successfully requested a waiver from the SDWA filtration requirement and negotiated an agreement with upstream landowners and communities within the Catskill-Delaware watershed to establish a watershed protection plan. In 1997, a memorandum of agreement (MOA) was signed by State and Federal officials, environmental organizations and 70 watershed towns and villages to invest $1.5 billion over ten years to restore and protect the watershed (Postel & Thompson Jr. 2005). Program financing comes from bonds issued by the City and increases in residential water bills.

The program's fundamental activities include land acquisition; a program to manage and reduce agricultural runoff; a program for better forestry management; a program for enhanced stream management to reduce erosion and habitat degradation; improvements for wastewater infrastructure in the watershed; construction of an ultraviolet disinfection plant; and new regulation and enforcement of mechanisms to ensure continued water quality protection within the watershed (Postel & Thompson Jr. 2005). As of 2004, the City has put $1 billion into the watershed protection program (Ward 2004). The negotiated partnership creates a watershed that provides high quality drinking water, provides landowners with additional income, and improves recreational usage for nearby communities.

In this instance, negotiation or payment for ecosystem services led to the provision of safe drinking water at a lower cost than the default water filtration plant. By linking the ecosystem service providers with the beneficiaries, New York City successfully executed a comprehensive watershed protection program that delivers safe drinking water at a relatively low cost. New York City's watershed protection program is an example of a PES program that guarantees the supply of high-quality drinking water and is financed via residential water bills and City bonds. Communities within the Tulare Lake Basin and Salinas Valley should examine potential partnerships amongst State and Federal officials, environmental organizations, and those liable for potential sources of contamination.

The Dutch Experience

(Mayzelle & Harter 2011)

In response to increasingly intensive animal production and a growing awareness of its effects on nitrate concentrations in surface water and groundwater, the European Council Nitrate Directive (ND) (Council Directive 91/67/EEC) was established in 1991 as part of the European Union (EU) Water Framework. The ND imposes a performance standard of 50 mg/L N (as nitrate) on effluent, groundwater and surface water quality levels within all EU countries. Furthermore, each country is required to establish nitrate contamination reduction plans, monitor program effectiveness, and regularly report their findings to the European Council (EC) (EU Publications Office). Compliance with the ND is costly in terms of time, expertise, and money; however, countries that do not meet ND standards face huge fines from the EC. While the ND does very little in the way of explicitly specifying how countries should act in efforts to comply with these requirements, plans that do not propose to regulate manure application at ND standards (i.e., land application rates in the range of 170-210 kg N/ha) have been historically rejected.

As an agricultural hotspot, the Netherlands has struggled to meet the ND requisites. To fulfill the obligatory ND requirements (Ondersteijn 2002), the Dutch government first created the Mineral Accounting System (MINAS) in 1998 (Henkens & Van Keulen 2001). MINAS was a farm-gate policy created to ensure the balance of nitrogen (N) and phosphorus (P) inputs (fertilizer and feed) and outputs (products and manure) on individual farms via balance sheets (Oenema, van Liere, & Schoumans 2005). MINAS resembled a farm-gate performance standard that was enforced by a penalty tax for excess N and P inputs: farms consuming more N or P than could be accounted for via harvest outputs would be fined per kilogram of N or P lost to the environment (as of 2003, fines of € 2.27/kg N [$ 1.40/lbs N] were enforced, more than seven times the cost of N fertilizer at the time). MINAS was popular for its simplicity, and was well supported by government aid. RIVM (Netherland's National Institute for Public Health and the Environment), which monitors N and P soil and water concentrations nationally, reports that nitrogen surpluses in agricultural areas fell substantially beginning in 1998 as a result of its implementation. Nevertheless, the EU declared the Dutch MINAS policy noncompliant with ND requirements, stating that the policy did not directly regulate water nitrate concentrations (Henkens & Van Keulen 2001).

In response to the EU's rejection of MINAS, the Netherlands implemented an additional policy in 2002: the Mineral Transfer Agreement System (MTAS). MTAS was a cap-and-trade system that prescribed manure (not inorganic fertilizer) application rates (as per ND objectives) and allowed farmers to purchase surplus application rights from those farmers applying manure to their land below legal limits. Rather than repealing MINAS, however, the Dutch increased enforceable fines under MINAS to serve as a safety net under the newly implemented MTAS (Ondersteijn 2002). Water nitrate levels continued to fall at pre-MTAS rates (Henkens & Van Keulen 2001; Ondersteijn 2002; Berentsen & Tiessink 2003; Helming & Reinhard 2009), suggesting that the implementation of MTAS in addition to MINAS had little or no effect.

Given the apparent futility of MTAS, and following the repeated rejection of MINAS by the European court of justice in 2003, both MTAS and MINAS were abandoned by the Dutch government by 2006. The two competing regulations were replaced by a composite policy that enforces N as well as P application standards for both manure and inorganic fertilizer, thereby satisfying both ND standards and the unique challenges encountered in Dutch territory, while minimizing administrative and economic costs. The composite policy remains in effect to date.

Appendix B: Summary of Current Planning and Regulatory Programs that Address Nitrate in Groundwater

Water quality management efforts also occur through many planning and regulatory programs, and statutes. They provide regulatory structure or technical and managerial support to water systems, communities, farmers, dairies, and others who deal with nitrate contamination in groundwater. Some only provide indirect assistance to managing nitrate contamination to the groundwater, and are marked as such.

U.S. Environmental Protection Agency (U.S. EPA)[67]

The Environmental Protection Agency (U.S. EPA) is responsible nationally for protecting human health and natural ecosystems.[68] U.S. EPA implements its authorities through ten U.S. EPA Regions, other Federal agencies, State and local governments, and tribal regulatory partners.

The Clean Water Act (CWA) of 1972 led U.S. EPA to set water quality standards for point discharges to surface waters and to control groundwater contamination by setting industry-wide effluent standards. Section 402 of the Clean Water Act, for example, required U.S. EPA to establish the National Pollutant Discharge Elimination System (NPDES) and to authorize permits under this program. The CWA does not provide a mechanism for regulating discharges to groundwater, so the permits (Waste Discharge Requirements) issued under the State Water Board are the only tool to currently regulate nitrate discharges to groundwater (see description of State Water Resources Control Board, below).

The U.S. EPA's Office of Water (OW) is responsible for implementing the Clean Water Act, the Safe Drinking Water Act, and several other statutes. They protect human health, support economic and recreational activities, and secure sufficient ecological habitat through the management of water bodies and ecosystems. The OW consists of several organizations: the American Indian Environmental Office; the Office of Wetlands, Oceans and Watersheds; the Office of Science and Technology; the Office of Wastewater Management; and the Office of Ground Water and Drinking Water.[68] The Office of Ground Water and Drinking Water maintains several activities to protect groundwater and protect public health through the provision of safe drinking water. U.S. EPA's Enforcement Policy Response and Enforcement Targeting Tool Programs are described below.

[67] http://water.epa.gov/aboutow/org/programs/owintro.cfm
[68] U.S.EPA Office of Water Information, accessed January 2011. Available at: http://water.epa.gov/aboutow/org/programs/owintro.cfm

U.S. EPA: Enforcement Policy Response and Enforcement Targeting Tool (ERP-ETT)[69]

[Indirect Assistance for Nitrate in Groundwater]

Over more than the past decade, violations of Safe Drinking Water Act regulations have mounted. Often these non-compliers are small rural systems which cannot afford the fine usually imposed after a violation occurs. EPA determined that these fines were just perpetuating the problem. As a result, the EPA recently revised and put in place a new system for tracking violations and their severity for public health for a given system and then monitoring the duration from violation to correction to better identify and then focus attention and effort on those systems that consistently struggle to comply with drinking water regulations.

The goal of the new system of supervision/monitoring is to help return systems to compliance more rapidly and sustainably. These non-compliance systems are dominated by small systems, across the USA. Small community water systems (<3,300 connections) have a 40-60% higher rate of "historical significant non-compliers" (HSNC) compared to large systems (>50,000 connections). While only 2% of California CWSs are classified as HSNCs, over 90% of these HSNC systems are "small" (US EPA definition is a system of less than 3,300 connections or 10,000 people). The new ERP-ETT system assigns a weight (# of points) to each type of violation, based on its threat to public health, and includes points for persistence of the violation (tracking the # of years since the first unaddressed violation occurred), in order to rank systems with health-based violations within the monitoring system. The existing system does not differentiate level of risk of a violation, treating all violations as equal, and does not provide information about trends in violations over time or about other violations over time of the same system. In the Central Valley, the main health-based violations among "small" systems of less than 500 people (there are 771 such sized systems in the Central Valley) are bacteria, nitrate and arsenic (Connie Li, US EPA Reg 9, UC Merced talk).

U.S. EPA: Supplemental Environmental Programs[70]

A Supplemental Environmental Program is agreed to under an enforcement settlement and is an environmentally beneficial project that a violator of environmental laws may choose to perform in addition to the actions required by law to correct the violation. The environmental project must be related to the violation and accomplished in place of other penalties. EPA defines seven specific categories that may be performed by the violating company: pollution prevention, pollution reduction, public health, environmental restoration and protection, assessment and audits, environmental compliance promotion, and emergency planning and preparedness. A company may, for example, pay a community for safe drinking water treatment to resolve a previous contaminating activity that affected groundwater quality.

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[69] http://www.epa.gov/compliance/resources/policies/civil/sdwa/drinking_water_erp_2009.pdf
[70] http://www.epa.gov/oecaerth/civil/seps

United States Department of Agriculture (USDA): National Drinking Water Clearinghouse, West Virginia University[71]

[Indirect Assistance for Nitrate in Groundwater]

The National Drinking Water Clearinghouse (NDWC) is sponsored by USDA's Rural Development Program Rural Utilities Service. Their engineers and experts provide technical assistance for small and rural drinking water treatment plants. They also inform communities on topics such as available funding options and Federal and State drinking water regulations. The NDWC publishes drinking water newsletters, technical brief fact sheets, and a magazine, all of which are valuable sources of information for small and rural water systems that face nitrate or other contaminants in their drinking water.

California Department of Public Health (CDPH)

CDPH: Drinking Water Source Assessment and Protection (DWSAP)[72]

[Indirect Assistance for Nitrate in Groundwater]

Since 1997, CDPH has used $7.5 million allocated from the State Revolving Fund for evaluating possible contaminating activities (PCAs) surrounding groundwater and surface water sources for drinking water. As of 2003, 94% of public water systems in California had been evaluated. This program helps communities better understand the vulnerability of their drinking water and prioritize use of limited funds towards source reduction and cleanup.

CDPH: Expense Reimbursement Grant Program (EPG)[73]

[Indirect Assistance for Nitrate in Groundwater]

Through a grant from the U.S. EPA, CDPH provides education, training, and certification for small water system operators. CDPH contracts Cooperative Personnel Services (CPS) to carry out these tasks. Eligible systems serve a community or non-transient population of less than 3,301 people.

State Water Resources Control Board (State Water Board)[74]

The State Water Board and each Regional Water Board are the principal State agencies responsible for the coordination and control of a unified and effective water quality control program in the State of California (Water Code § 13001). The State Water Board formulates and adopts State policy for water

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[71] http://www.nesc.wvu.edu/ndwc/articles/OT/WI03/SRFandRUS.html
[72] http://www.cdph.ca.gov/certlic/drinkingwater/pages/dwsap.aspx
[73] http://www.cps.ca.gov/tlc/sws/
[74] http://www.swrcb.ca.gov

quality consisting of: a) water quality principles and guidelines for long-range resource planning, including ground water and surface water management programs and control and use of recycled water; b) water quality objectives at key locations for planning and operation of water resources development projects and for water quality control activities; and c) other principles, guidelines, and objectives deemed essential by the State Water Board for water quality control to provide a suitable living environment for California residents (Water Code § 13140 and § 13142).

The State Water Board adopts the water quality control plans (Basin Plans) prepared by each of the Regional Water Boards in California (33 U.S.C. 1313 (a), Water Code § 13170) as part of the California Water Plan. Each Regional Water Board must submit to the State Water Board a Regional Water Quality Control Plan (Basin Plan), except the Central Valley Regional Water Board, which has two plans: the Sacramento and San Joaquin River Basins and Tulare Lake Basin. These Basin Plans define beneficial uses for groundwater and surface water, set water quality levels to protect these beneficial uses, and establish programs for meeting these water quality objectives. Beneficial uses to be protected include, but are not limited to, "domestic, municipal, agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves" (Water Code § 13050 (f)). The water quality standards must be reviewed every three years under the Clean Water Act and periodically under the California Water Code.[75]

The California Water Code Section 13263 authorizes the California Water Boards to issue Waste Discharge Requirements (WDRs) for projects or activities that discharge waste to waters of the State. The Federal Clean Water Act does not contain a mechanism to regulate discharges to groundwater (only surface water), so WDRs are the only regulatory tool that can be used to ensure that discharges to California groundwater does not exceed water quality objectives. The California Water Boards may find it in the public interest to issue a waiver of a WDR instead of a WDR. A waiver is limited to five years and has explicit conditions for protecting water quality.

In October 2001, the Groundwater Quality Monitoring Act of 2001 (AB 599) was established by the California Assembly. The Groundwater Quality Monitoring Act of 2001 required the State Water Board, an Interagency Task Force, and a Public Advisory Committee to: establish a comprehensive statewide groundwater quality monitoring program; increase the accessibility of groundwater quality data to the public; and allow groundwater basin assessment. Assessment is defined by AB599 as "assessing susceptibility of groundwater to water quality degradation, characterizing current water quality in a basin, and predicting future water quality under various conditions."

State Water Board: The Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act was adopted in 1969 and granted the State Water Board the ultimate authority over State water quality policy (Water Code § 13146). The main goal of the Porter-Cologne Act is to regulate activities in California to achieve the highest reasonable water quality;

[75] Clean Water Act § 303(c) and California Water Code § 13240.

"reasonable" is defined after the demands on the waters and total values involved are considered (Water Code § 13146).

The framework of Porter-Cologne laid out the framework for future regulations and programs, including: the Dairy Waste Discharge Requirements regulatory program (focused on groundwater contamination from dairies), the Irrigated Lands Regulatory Program (initially focused on discharges to surface water only from all irrigation sources, but is now considering discharges to groundwater), and the Central Valley Salinity Alternative for Long-Term Sustainability (focused on surface water and groundwater and considers both salt and nitrate).

State Water Board: Groundwater Ambient Monitoring and Assessment (GAMA) Program[76]

[Indirect Assistance for Nitrate in Groundwater]

The GAMA Program, created in 2000, was officially mandated by the State legislature under the Groundwater Quality Monitoring Act of 2001 (AB 599) and is funded by Proposition 50 and special fund fees. It aims to improve statewide groundwater quality monitoring and increase the availability of groundwater quality information. With 95% of California's population on public water systems, and another 1.7 million on self-supply or very small systems less than 15 connections, reliant on groundwater for some or all of their drinking water, GAMA has a mandate to integrate disparate data collection efforts and initiate new programs as needed, to develop a comprehensive integrated statewide groundwater monitoring program. The USGS and Lawrence Livermore National Laboratory have been collaborators on this initiative, providing scientific expertise for developing the initial monitoring plan in 2003 and leading various groundwater quality assessments.

The GAMA Program consists of:

1) GeoTracker GAMA, an on-line searchable database that standardizes and integrates groundwater quality monitoring data collected by: the California Water Boards, the California Departments of Public Health, Pesticide Regulation, and Water Resources; the United States Geological Survey; and Lawrence Livermore National Laboratory into a unified data information system. GeoTracker GAMA covers over 150,000 locations in California. GeoTracker GAMA has been an important source on historical and current measurements of nitrate levels and co-constituents in groundwater in the Salinas Valley and Tulare Lake Basin study areas.

2) Priority Basin Project, focusing on 116 of 472 DWR groundwater basins in California, organized into study units, and with sampling and assessment of groundwater quality in priority basins for the presence and levels of CDPH regulated contaminants as well as other unregulated contaminants. The UC Davis Nitrate Project Study Area involves 4 GAMA Priority Basin Project Study Units: Kern, SE San Joaquin Valley, W. San Joaquin Valley, and Monterey.

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[76] http://www.swrcb.ca.gov/water_issues/programs/gama/

3) Domestic Wells Project, a voluntary groundwater testing program for domestic wells with samples collected and tested at no cost by State Water Board staff. Over 1,000 domestic wells have been sampled so far in 5 counties, including Tulare. Tulare County domestic wells were sampled in 2006 under this project, and nitrate at or above the 10 mg/L nitrogen MCL (45 mg/L as nitrate) were found in over 40% of the sampled wells at levels up to 54 mg/L of N. Four percent of wells exceeded the nitrite MCL.

4) Special Projects, involving specialized research and study projects to measure and understand processes of groundwater contamination.

State Water Board: Recycled Water Policy[77]

In 2009, the State Water Board adopted Resolution No. 2009-0011: Recycled Water Policy. This policy sets goals for increasing the use of recycled water and storm water by 2020, including a goal for all regions to develop salt and nutrient management plans by 2012. These plans are to be managed on a basin-wide or watershed-wide basis. The State Water Board strongly encourages regions to include storm water use and recharge plans in their salt and nutrient management plans because storm water is typically lower in salt and nutrients. Each salt and nutrient management plan will also include a basin/sub-basin wide monitoring program dependent on the site-specific characteristics, but sufficient to determine if water quality objectives are being met.

Regional Water Quality Control Boards (Regional Water Boards)

Cleanup and Abatement Order (CAO)

Under authority of the Porter-Cologne Act, CA Water Code Section 13304 provides authority to the Regional Water Boards to compel known groundwater dischargers to clean up or cease degradation. Section 13304 states: "any person who has discharged or discharges waste into the waters of this State in violation of any waste discharge requirement …or who has caused or permitted….any waste to be discharged or….discharged into the waters of the State.…shall upon order of the regional board, clean up the waste or abate the effects of the waste". If a polluter refuses to comply with a CAO, the Regional Water Quality Control Board can request that the California Attorney General sue the polluter to force it to comply with the CAO.

Water Code Section 13304 also states that "A cleanup and abatement order issued by the state board or a regional board may require the provision of, or payment for, uninterrupted replacement water service, which may include wellhead treatment, to each affected public water supplier or private well owner." This provides authority for a regional board to require landowners contributing to nitrate risk to groundwater drinking water supplies to support drinking water actions for affected public water supplies and private wells.

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[77]http://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/docs/recycledwaterpolicy_approved.pdf

Central Coast Regional Water Quality Control Board (Central Coast Regional Water Board)[78]

The Central Coast Regional Water Board has jurisdiction over Santa Cruz, San Benito, Monterey, San Luis Obispo, and Santa Barbara Counties, and parts of Santa Clara, San Mateo, Kern, and Ventura Counties. It regulates activities over approximately three million hectares, with irrigated agricultural lands covering about 435,000 hectares.[79] The Central Coast Regional Water Board aims to complete the following by 2025: (1) 80% of aquatic habitat is healthy; (2) 80% of watershed lands will be properly managed to keep watersheds healthy and functioning well; and (3) 80% of groundwater will test clean according to the the Central Coast Regional Water Board's TDS and nitrate standards.[80] The Central Coast Ambient Monitoring Program (CCAMP) is the Central Coast Regional Water Board's water quality monitoring and assessment program. CCAMP gathers groundwater monitoring data from the U.S. Geological Survey, the Department of Health Services, and DWR and manages the databases to facilitate the Central Coast Regional Water Board's use. Under the Recycled Water Policy they have Salt and Nutrient Management Plan Requirements; stakeholders must develop implementation plans for meeting objectives for salts and nutrients.

To address the nitrate contamination of groundwater, the Central Coast Regional Water Board has created the Irrigated Lands Regulatory Program (also known as the Agricultural Regulatory Program) to regulate discharges from irrigated agricultural lands and encourage best management practices (BMPs), water quality monitoring, and proper implementation of corrective actions.

Central Coast Regional Water Board: Irrigated Lands Regulatory Program (ILRP)

Central Coast Regional Water Board's Irrigated Lands Regulatory Program (ILRP) specifically addresses crucial water quality issues on a priority watershed basis, continually assessing and tracking the progress of improvements in water quality and agricultural land management (Central Coast Regional Water Board, 2011). The priority watersheds are the Salinas River, Santa Maria, and Pajaro watersheds. The Conditional Waiver of WDRs for Discharges from Irrigated Lands was adopted in 2004, known as the Agricultural Waiver Program (AWP), and expired on September 30, 2011. The AWP is a voluntary negotiated agreement between the Central Coast Regional Water Board, growers, and environmental organizations. The AWP uses BMPs and rules for managing on-farm water resources to reach environmental goals, with the threat of mandatory regulatory action as incentive for a discharger to join the program. Farmers are required to complete ambient water quality monitoring, attend fifteen hours of educational classes, create a farm plan, and implement BMPs (Dowd et al., 2008). Waivers last for five years, with the quantity and quality of the reporting designated by the tier classification of the

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[78] http://www.swrcb.ca.gov/rwqcb3/

[79] Central Coast Regional Water Board. Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. Draft Order No. R3-2011-0006.

[80] San Luis Obispo Science and Ecosystem Alliance. Achieving Management and Conservation Goals through the Application of Ecosystem-based Management of the Central Coast of California. August 27, 2008. http://groups.ucanr.org/HumboldtBayEBM/files/59049.pdf

discharger. Tier 1 dischargers are are generally considered sustainable (does not use chlorpyrifos or diazinon, is far from an Imparied Surface Waterbody, and any nitrogen discharges are far from public water systems wells); Tier 3 dischargers either have a high potential to discharge nitrogen to groundwater or apply chlorpyrifos/diazinon near an Impaired Waterbody; and Tier 2 dischargers fall in between the other two categories. A Tier 1 discharger provides an updated management-practice list two and a half years through the waiver and a Tier 2 discharger submits annual progress reports identifying current management practices and projections of educational goals completion (Dowd et al., 2008). If a discharger has not completed the educational classes after three years of the waiver, they are at risk of being issued a WDR. To decrease water quality monitoring costs, the Central Coast Regional Water Board and stakeholders agreed on a monitoring program for farmers to cooperatively monitor the main stems and tributaries of the Central Coast Region, sampling nutrients, temperature, orthophosphate, chlorophyll *a*, dissolved oxygen, total dissolved solids, pH, turbidity, and discharge (Dowd et al., 2008). The existing Conditional Waiver of Waste Discharge Requirements (WDRs) for Dischargers from Irrigated Lands (Irrigated Ag Order R3-2010-0040) was extended on July 8, 2010 (Central Coast Regional Water Board, 2011), March 29, 2011, and again on September 30, 2011.

The current order (Agricultural Order No. R3-2004-0117, dated Sept. 30, 2011) has been extended through September 30th, 2012. The Central Coast Regional Water Board is currently making revisions to the 2004 Agricultural Order. The September 1st, 2011 draft of the Agricultural Order requires Tier 3 dischargers with high nitrate loading risk to meet specified Nitrogen Mass Balance Ratios or implement an alternative solution that leads to an equivalent nitrogen load reduction.

Central Valley Regional Water Quality Control Board (Central Valley Regional Water Board)[81]

The Central Valley Regional Water Board has jurisdiction over nearly 40% of the State, including all or part of 38 of the State's 58 counties and about 80% of the State's irrigated agricultural land (Central Valley Regional Water Board, 2010). The Tulare Lake Basin section of the study area is within the Central Valley Regional Water Board's Fresno Boundary of Responsibility. The three major watersheds in the Central Valley Region are the Tulare Lake Basin, and the drainages of the Sacramento River and the San Joaquin River. The Central Valley Regional Water Board supervises the following programs to protect groundwater quality and to clean up contaminated groundwater: (1) Waste Discharge Requirements (WDRs); (2) Land Disposal (Title 27) Program; (3) Underground Storage Tank Program; (4) Cleanup Program; and (5) Federal Facilities Program.

The Central Valley Regional Water Board manages two main programs which affect ground water quality and specifically nitrate concentration: the Irrigated Lands Regulatory Program (ILRP) and the Central Valley Salinity Alternative for Long-Term Sustainability (CV-SALTS) program.

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[81] http://www.swrcb.ca.gov/rwqcb5/

Central Valley Regional Water Board: Irrigated Lands Regulatory Program (ILRP)[82]

The current Irrigated Lands Regulatory Program (ILRP) in the Central Valley was created in 2003 as an interim program to regulate irrigated lands until 2011, when the long-term program will be completed.

The Draft Program Environmental Impact Report (DPEIR) for the long-term Central Valley ILRP was released on July 28, 2010. The Draft PEIR discusses five programmatic alternatives for regulating irrigated agriculture dischargers and their impacts, with Alternative 2[83] designated as the Central Valley Regional Water Board's Staff-Recommended Program (Central Valley Regional Water Board, DPEIR, 2010). A group of nonprofit organizations provided comments on the Draft, noting insufficient protection of water quality objectives or beneficial uses, recommending that the Central Valley Regional Water Board "revisit both its economic and environmental analyses as well as the components of the final program", and use Alternative 4[84] as the foundation of a revised program.[85] The nonprofit organizations believe an effective program can be formed from a fair and balanced analysis which involves: (1) collection of information on baseline parameters such as farm practices and water quality; (2) farm-level education and assistance requirements, and representative monitoring to ensure best management practices; (3) accountability by enforcement to induce compliance; and (4) plans to clean up legacy and continued agricultural contamination.[85]

Water quality plans will be required for areas where problems are known. The groundwater program would specifically look for nitrate, pathogens, and pesticides. Each grower would need to submit a farm evaluation. This plan will facilitate nitrate monitoring, increase the availability of water quality data, and ideally (through awareness) decrease the excessive application of nitrate fertilizer.

The August 2011 Recommended ILRP Framework proposes establishing three tiers: Tier 1 is for constituents that could affect, but do not pose a threat to, water quality; Tier 2 is assigned if the threat from irrigated agriculture is unknown; and Tier 3 will be assigned if irrigated agriculture is causing or contributing to a known water quality problem from a specific constituent. Tier 1 areas will generally not be required to monitor water quality, while Tiers 2 and 3 will be required to submit water quality monitoring and assessment reports. Agricultural operations in Tier 3 areas for which nitrate is the contaminant of concern will be required to prepare and maintain a farm-specific nutrient management plan (Central Valley Regional Water Board, Draft Requirements for Nutrient Management Plans in High Priority Groundwater Areas, Aug. 2011).

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[82] http://www.swrcb.ca.gov/centralvalley/water_issues/irrigated_lands/index.shtml

[83] Third party groups function as legal entities to represent the growers. The regulatory mechanisms will be established by the Central Valley Regional Water Board to be flexible to account for a variety of environmental conditions and agricultural operations.

[84] Growers or other legal entities responsible for waste discharges by a group of growers would apply to the Central Valley Regional Water Board for direct oversight with the option for regional monitoring by a third party.

[85] Community Water Center et al. Comments on the ILRP Staff Report, Economic Analysis and DPEIR, Sept. 2010

Central Valley Regional Water Board: CV-SALTS[86,87]

In 2006, the Central Valley Regional Water Board, the State Water Board, and affiliated stakeholders initiated an effort to address salinity and nitrate problems in the Central Valley and to establish solutions for improved water quality.[86] The Central Valley Salinity Alternative for Long-Term Sustainability (CV-SALTS) is a collaborative basin planning effort aimed at developing and implementing the policies and science to create sustainable and comprehensive salinity and nitrate management.[86] A primary goal of CV-SALTS is to update the policies and regulations of the Water Quality Control Plans "to facilitate cost effective salinity management while protecting beneficial uses of surface and ground waters".[86] New water quality objectives for salts and nitrate will be established and where the objectives are not met a comprehensive implementation plan will be established to protect water quality and meet the objectives in the near future. In 2008, the Central Valley Salinity Coalition (CVSC) was formed to represent stakeholders collaborating with the Central Valley Regional Water Board to efficiently manage salinity in the Central Valley. All efforts needed to complete the goals of CV-SALTS are administered and financed by the CVSC.

In 2010, Larry Walker Associates and others conducted the first pilot study of the CV-SALTS initiative to address the salt and nutrient management problems in the Central Valley and to guide stakeholders in creating effective salt and nutrient management plans. Input data sets were identified and assembled for the Watershed Analysis Risk Management Framework (WARMF) model to quantitatively relate salt and nitrate sources and sinks within the Yolo, Modesto, and Tule River areas.[88] The study found irrigation and fertilizer/land application to be the principal inputs of nitrate to near-surface groundwater and found nitrate is accumulating in near-surface groundwater.

A draft outline of stakeholder (i.e., polluters, environmental NGOs, etc.) proposed elements for a salt and nitrate management plan is available on the CVSC website.[89] The salinity and nitrate management plans will outline basin monitoring programs, identify salinity and nitrate sources and processes, create a nutrient budget, identify the population affected, analyze and compare trends with beneficial uses and water quality objectives, and develop policies. Basin Plan Amendments will be completed May 2015.

Central Valley Regional Water Board: Dairy Program[90]

To comply with the Porter-Cologne Water Quality Control Act (California Water Code Division 7), the Central Valley Regional Water Board created the Dairy Program, also known as the Confined Animal Facility Program, to regulate confined animal facilities, including dairies, feedlots, poultry facilities, and

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[86] http://www.swrcb.ca.gov/centralvalley/water_issues/salinity/index.shtml
[87] http://www.cvsalinity.org/
[88] CV-SALTS: Salt and Nitrate Sources Pilot Implementation Study Report, February 2010. Larry Walker Associates, and others.
[89] The non-profit coalition of stakeholders, known as the CVSC, accessed December 2010. Available at: http://www.cvsalinity.org/index.php/documents/cat_view/39-docs/49-documents-related-to-salt-and-nutrient-management-planning.
[90] http://www.swrcb.ca.gov/rwqcb5/water_issues/dairies/index.shtml

horse facilities.[91] Under the Dairy Program, dairies, feedlots and other confined animal facilities must comply with set statewide water quality regulations and existing milk cow dairies of all sizes must follow waste discharge requirements. Requirements for the dairy production area and land application area are outlined in the Waste Discharge Requirements General Order for Existing Milk Cow Dairies (General Order) adopted on May 3, 2007.[91] The General Order requires that all domestic and agricultural supply wells and subsurface (tile) drainage systems in the production and/or land application areas be sampled by November 3, 2007, and then annually under the General Order.[92] The General Order requires existing milk cow dairies to conduct nutrient and groundwater monitoring, measuring electrical conductivity, total ammonia nitrogen and un-ionized ammonia nitrogen (NH_3-N). The General Order requires that each dairy implement their Waste Management Plan (WMP) by 2011 and their Nutrient Management Plan (NMP) by 2012. The WMP ensures "the production area of the dairy facility is designed, constructed, operated and maintained so that dairy wastes generated at the dairy are managed in compliance with WDR General Order No. R5-2007-0035 in order to prevent adverse impacts to groundwater and surface water quality".[92] The NMP is created to "budget and manage the nutrients applied to the land application area(s) considering all sources of nutrients, crop requirements, soil types, climate, and local conditions in order to prevent adverse impacts to surface water and groundwater quality".[92]

California Department of Food and Agriculture (CDFA)

The California Department of Food and Agriculture (CDFA) is the lead agency responsible for protecting California's agriculture, enforcing environmental regulations on agricultural production, and ensuring equitable marketing to consumers. In 1988, the CDFA secretary appointed the Nitrate Working Group (NWG) to study California's agricultural nitrate problem. In 1989, the NWG wrote "Nitrate and Agriculture in California", a report which identified California's "nitrate-sensitive areas", recommended a prioritized plan for those areas to start and implement nitrate management programs, and improved farming practices to decrease nitrate loads to groundwater. In 1990, the Director of the CDFA established the Nitrate Management Program (NMP) and tasked them with implementing the report recommendations. The NMP then led to the creation of the Fertilizing Materials Inspection Program (FMIP) and a Fertilizer Research and Education Program (FREP), described below.

CDFA: Feed, Fertilizer and Livestock Drugs Regulatory Services (FFLDRS)

The CDFA Inspection Services Division has a Feed, Fertilizer and Livestock Drugs Regulatory Services (FFLDRS) Branch which runs the FMIP and FREP programs. FMIP regulates the manufacture, distribution, licensing, and labeling of fertilizing materials in California, to provide safety and quality assurance. FMIP has a Fertilizer Inspection Advisory Board comprised of nine members in charge of

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[91] Central Valley Regional Water Board Dairy Program, accessed November 2010. Available at: http://www.swrcb.ca.gov/rwqcb5/water_issues/dairies/index.shtml
[92] Order No. R5-2007-0035. Waste Discharge Requirements for General Order for Existing Milk Cow Dairies. May 3, 2007. Available at http://www.waterboards.ca.gov/centralvalley/adopted_orders/GeneralOrders/R5-2007-0035.pdf

recommending proposed regulations to the Secretary of Agriculture. The structure and functions of the FMIP could be expanded to regulate and track fertilizer use applications and to collect fees on fertilizer sales, with little need for legislative action.

FREP funds and researches methods for ensuring fertilizer use is environmentally safe and proper handling practices are followed. FREP was the first attempt at voluntary action to reduce nitrate in response to the 1989 "Nitrates and Agriculture in California" Report. FREP involves funding farmer education and research about nutrient management. FFLDRS programs are funded from a mill tax and license, registration and inspection fees. Currently a total assessment of $0.0015 per dollar of fertilizer sales is collected, however the Food and Agricultural Code allows an assessment of up to three mills ($0.003). This $0.0015 assessment consists of a $0.0005 per dollar sales assessment on all commercial fertilizer to fund research and educational projects that improve farming practices and decrease environmental impacts due to fertilizer use,[93] and a $0.001 per dollar of sales assessment to pay a "fertilizing materials" inspection assessment.[94] The fertilizer research assessment ($0.0005) currently generates about $1 M per year. This funding source could be quickly and easily increased because the code allows up to two mills ($0.002) per dollar of sales to be imposed on all fertilizing materials distributed in California and an additional assessment of up to one mill ($0.001) per dollar of sales to be imposed on all licensees to provide funding for research and education pertaining the use and handling of fertilizing material and any environmental effects.[95] Since the current assessments collected for licensing and research and educational projects is only half of the allowed amount, the assessments could be raised to the full three mill assessment.

Assembly Bill 3030 (Groundwater Management Act)[96]

[Indirect Assistance for Nitrate in Groundwater]

Since 1993, Assembly Bill 3030 has permitted local agencies to adopt programs to manage groundwater. The Central Valley Project Improvement Act further requires that all water suppliers which overlie a useable groundwater basin develop a groundwater management plan under AB 3030 guidelines. AB 3030 lists technical components which may be included, such as the identification of well construction policies, the coordination of land use planning to reduce the risk of groundwater contamination, and the identification of wellhead protection areas. The technical components of AB 3030 provide a means for local agencies to protect their local resources from nitrate contamination. Once a plan is adopted, the local agency must pass rules and regulations which maintain consistency with the plan.

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[93] The California Food and Agriculture Fertilizer Research and Education Program: The California Food and Agricultural Code Section 14611(b), accessed December 2010. Available at: http://www.cdfa.ca.gov/is/fflders/pdfs/2010_FREP_Proceedings.pdf

[94] The California Food and Agriculture Fertilizing Materials Inspection Program: Fertilizing Materials Inspection Assessment, accessed December 2010. Available at: http://www.cdfa.ca.gov/is/fflders/fertilizer.html

[95] The California Department of Food and Agricultural Code: Division 7, Chapter 5, Article 6, Section 14611, accessed January 2011. Available at: http://www.leginfo.ca.gov/cgi-bin/displaycode?section=fac&group=14001-15000&file=14611-14611

[96] http://www.water.ca.gov/groundwater/gwmanagement/ab_3030.cfm

Kern County Water Agency (KCWA) [97]

[Indirect Assistance for Nitrate in Groundwater]

The Kern County Water Agency (KCWA) monitors and reports groundwater quality and levels in Kern County. This information is primarily used in conjunction with groundwater banking and recharge projects. The KCWA monitors around 240 wells monthly and 800 semiannually. The well data are critical to understanding historical nitrate levels in the county groundwater basins and for catching future changes in water quality before contamination affects public health.

Monterey County Water Resources Agency (MCWRA) [98]

[Indirect Assistance for Nitrate in Groundwater]

The Monterey County Water Resources Agency (MCWRA) (established as the Monterey County Flood Control and Water Conservation District in 1947 and renamed in 1990), provides flood and water quality management and protection to the people of Monterey County. The Board has nine members appointed by the Monterey County Farm Bureau, Monterey Grower-Shipper Association, the Monterey County Farm Advisory Committee, County Supervisors, and the Mayor's Select Committee.[99]

One of their six listed purposes for collecting water quality data is to evaluate nitrate in groundwater. Their nitrate monitoring program existed since 1978, with a 1995 study showing that 28% of 350 sampled wells exceeded the nitrate MCL.[100] The highest concentrations were seen in the Upper Valley, East Side, and Forebay Subareas.

For the local agriculture community, MCWRA has a water quality planning program that includes research efforts and outreach to growers to improve irrigation efficiency and fertilizer management to effectively reduce nitrate leaching. As an educational guide, they provide online access to Nitrate Management Fact Sheets that describe water and fertilizer management techniques, guidelines for handling fertilizers, and methods for accounting for nitrate already present in the soil and water. They also provide instruction on how to properly monitor and sample for nitrogen in the soil and water, as well as resources for ordering nitrogen test kits and strips.

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[97] http://www.kcwa.com

[98] http://www.mcwra.co.monterey.ca.us

[99] An article written by Monterey Coastkeeper on October 21, 2010. Available at: http://yubanet.com/california/Monterey-Coastkeeper-Sues-Monterey-County-Water-Resources-Agency-To-Protect-Water-Quality.php

[100] Water Resources Data Report: Water Year 1995. MCWRA. http://www.mcwra.co.monterey.ca.us/Agency_data/Hydrogeologic%20Reports/WaterResourcesDataReport/Section6_WaterQuality.pdf

Monterey County Health Department

[Indirect Assistance for Nitrate in Groundwater]

The Monterey County Health Department implements a tiered nitrate sampling program based on increasing concentration for local small water systems and state-small water systems. If the system has recently measured a nitrate concentration at or above the MCL, the system must increase their sampling rate from yearly to quarterly. Monterey County Health Department's nitrate sampling program is more stringent than the State regulations, which only require one-time monitoring for nitrate at the point of initial permit application (CCR Title 22).

Southern San Joaquin Valley Water Quality Coalition[101]

[Indirect Assistance for Nitrate in Groundwater]

The Southern San Joaquin Valley Water Quality Coalition was established in 2002 as a result of a request by the Central Valley Regional Water Board to create a voluntary water quality monitoring program as part of the region-wide consideration of agricultural discharge permitting. The Coalition was formed to serve the Tulare Lake Basin watershed and involves various agencies, including the Kern County Water Agency and Kings River Water Association. The Coalition publishes an annual report which documents their efforts to protect and preserve water quality supplies and water rights in the watershed. Recently, the Coalition was named a member of the stakeholder work group responsible for evaluating and updating the Irrigated Lands Regulatory Program for the Central Valley Regional Water Board.

Tulare County Water Commission

[Indirect Assistance for Nitrate in Groundwater]

The Tulare County Water Commission meets once a month to discuss water issues affecting Tulare County. The Commission includes engineers, water district managers, elected officials and community activists and serves as an advisory body to the Tulare County Board. The Commission, along with the Community Water Center, lobbied for funding to address the drinking and wastewater needs of disadvantaged communities in the Tulare Lake Basin. This $2 million project is currently underway (The Disadvantaged Community Water Study Project). A major focus of this project is identifying the overlap of disadvantaged communities and poor groundwater quality areas. This analysis will be more detailed than the rough analysis in this report (see Alternative Water Supply Report) and will evaluate community-specific solutions.

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[101] http://www.ssjwqc.org

Rural Community Assistance and Partnership (RCAP)[102]

[Indirect Assistance for Nitrate in Groundwater]

The Rural Community Assistance Partnership is a national organization of six regional partners which helps communities of less than 10,000 people, often disadvantaged and frequently with populations of less than 2,500. Through publications, training events, conferences, toolboxes, and hands-on technical assistance, RCAP helps people living in rural communities to: access safe drinking water supplies, properly treat and dispose of wastewater, finance infrastructure projects, understand regulations, and manage water facilities. They do not provide loans or grants to communities, but they provide financial operations assistance and guidance. RCAP receives funding from the U.S. Department of Agriculture Rural Development program, EPA's Office of Groundwater and Drinking Water and Office of Waste Water Management, and the Office of Community Services of the U.S. Department of Health and Human Services.

Monterey Coastkeeper

[Indirect Assistance for Nitrate in Groundwater]

The Monterey Coastkeeper is a non-profit organization serving Monterey and Santa Cruz Counties and portions of San Mateo, Santa Clara and San Benito Counties. The Coastkeeper advocates for effective government, public policy, and active community participation for the protection of water quality. The Monterey Coastkeeper particularly seeks more effective monitoring requirements of agricultural runoff and collaborates with the State Water Board to ensure the success of the Agricultural Waiver Program. In 2010, the Monterey Coastkeeper encouraged the Central Coast Regional Water Board to adopt more stringent waste discharge requirements for the Gallo Cattle facility near Gonzales. As a result, the Central Coast Regional Water Board also required Gallo to create a groundwater management plan.

National Rural Water Association (NRWA)[103]

[Indirect Assistance for Nitrate in Groundwater]

The National Rural Water Association is the largest water and wastewater utility membership organization in the U.S. They focus primarily on systems with less than 10,000 people but they also have representatives from 94% of public water systems overall. They offer technical advice in the areas of operation, management, finance, and governance. NRWA advocates for small and rural systems to insure that rules and regulations are appropriate for everyone and that sufficient funding is available to these systems. Additionally, they have developed a library of free white papers for rural and small water

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[102] http://www.rcap.org
[103] http://www.nrwa.org

and wastewater systems. These reports are valuable to small and rural systems where data and information are often difficult to obtain.

California Rural Water Association (CRWA)[104]

[Indirect Assistance for Nitrate in Groundwater]

Incorporated in 1990, the California Rural Water Association is a state affiliate of the National Rural Water Association. CRWA provides online classes, onsite training, low cost educational publications, and other forms of technical advice for rural water and wastewater systems. They also provide legislative representation, aid in developing new rate schedules, installing new testing methods, understanding government regulations, or updating operator certification requirements specifically for small rural community water and wastewater needs.

Self-Help Enterprises (SHE)

[Indirect Assistance for Nitrate in Groundwater]

Self-Help Enterprises (SHE) helps low-income families in the San Joaquin Valley to help themselves through the improvement of their water systems, among other projects. They can provide seed money to small rural disadvantaged communities for preparing reports and studies needed for funding applications for water system construction and improvements. They also assist these communities in preparing their applications to programs providing water system funding by providing human resources and the technical assistance to develop adequate water delivery and wastewater disposal systems. Drinking water projects involving nitrate contamination have been a major part of their work. SHE partnered with the Community Water Center to offer free well testing and funding advice to the community of Monson who faced high levels of nitrate and DBCP.

Community Water Center (CWC)[105]

[Indirect Assistance for Nitrate in Groundwater]

The Community Water Center (CWC) advocates for providing safe drinking water to all communities in the San Joaquin Valley, regardless of economic condition. They lobby local and State government, support policies, educate local agencies and communities, and organize community projects. Recently, the CWC published a study of nitrate contamination of drinking water and related health effects, specifically in the San Joaquin Valley. This document was designed to educate local communities so they are aware of the nitrate problem and understand their options for obtaining safe drinking water.

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[104] http://www.calruralwater.org/CRWA.htm
[105] http://www.communitywatercenter.org/

The CWC coordinates the AGUA Coalition (la Asociación de Gente Unida por el Agua, or the Association of People United for Water). AGUA campaigns for regional solutions to enduring water system problems in the San Joaquin Valley. They are currently focused on protecting groundwater sources for drinking water use from contaminants, especially nitrate. Recently, the CWC brought nation-wide attention to the nitrate contamination issue in the Central Valley by organizing the visit of a U.N. representative.

Appendix C: Description of Current Funding Programs for Safe Drinking Water

This appendix summarizes existing funding programs for safe drinking water in the study area. These resources are available from the national to the local level.

California Department of Public Health (CDPH)

The California Department of Public Health (CDPH) is responsible for implementing Public Resources Code (PRC) Sections 75020 through 75023 and 75025 under Chapter 2: Safe Drinking Water and Water Quality Projects. They administer both State and Federal funds to improve drinking water systems.

CDPH: Safe Drinking Water State Revolving Fund (SDWSRF)[106]

This is one of the State's major forms of funding for local capital improvements. A description of the Safe Drinking Water State Revolving Fund (SDWSRF) is found above in Section 4.3 Current Funding Example: Safe Drinking Water State Revolving Fund.

CDPH: Proposition 84[107]

[Fully Allocated]

Proposition 84 (the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006), allocated $1.5 billion of its $5.4 billion in general obligation bonds to CDPH, DWR, and the State Water Board for safe drinking water and water quality projects. CDPH received funding for four main purposes related to public water systems.

Emergency and urgent projects were allocated $10 million to ensure the immediate health and safety of drinking water supplies. Projects include: emergency interties with larger water systems; tank, pump, and well replacements; design, installation, and initial operation costs for water treatment systems, and the provision of bottled water when necessary. In 2007, this emergency fund provided approximately $81,000 for water districts within Tulare County to replace well equipment.[108]

Small community drinking water system improvements to help meet the safe drinking water standards were allocated $180 million. Priority is given to projects that reduce nitrate and other chemical contaminants in disadvantaged communities. Construction grants are limited to $5 million per project. Funding also is available for feasibility studies and engineering reports, so water systems can meet

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[106] http://www.cdph.ca.gov/services/funding/Pages/SRF.aspx
[107] http://www.cdph.ca.gov/services/funding/Pages/Prop84.aspx
[108] CDPH's Proposition 84: Emergency Safe Drinking Water Supply Program, accessed January 2011. Tulare County water districts: Ducor Community Services District, Lanare Community Services District, Tooleville MWC and West Goshen MWC. Available at: http://bondaccountability.resources.ca.gov/plevel1.aspx?id=1&pid=4

application requirements for construction grants. A small amount of this funding ($5 million) is available for community technical assistance.[109]

Prevention and reduction of contamination of groundwater sources that serve drinking water systems was allocated a total of $60 million. Projects must be ready to begin implementation immediately and must protect groundwater that provides at least one third of water for a community. The maximum grant per applicant is $10 million. Additional points are given to projects that: serve disadvantaged communities, affect a population greater than 100,000, or address contaminants with acute health effects.[109],[110] Additionally, $50 million was allocated to increase the SDWSRF.[109]

CDPH: Proposition 50[111]

[Fully Allocated]

Proposition 50 (the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002) awarded $3.4 billion to various State departments. CDPH was allocated $50 million for water security projects for drinking water systems. These include emergency interties, improvement and installation of treatment facilities, and monitoring programs. $69 million was set aside to help community and small community water utilities meet safe drinking water standards by providing grants for infrastructure improvements, pilot studies, and the improvement of water quality monitoring, treatment, and distribution facilities. An additional $105 million was provided as match funds for Federal grants for public water system infrastructure improvements.[112,113]

State Water Resources Control Board (State Water Board)

The State Water Board has funding programs to reduce contamination of surface and groundwater from point and non-point sources; the main programs are described below.

State Water Board: Clean Water State Revolving Fund (CWSRF)[109]

In 1987, an amendment to the Clean Water Act established the Clean Water State Revolving Fund (CWSRF) for water quality projects. The CWSRF is funded through Federal grants (most recently the American Recovery and Reinvestment Act (ARRA) of 2009), State funds, and revenue bonds (including Prop 84: $73.2 million to reduce or prevent contamination of impaired water bodies). The fund provides low-interest or subsidized loans for construction of publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, and water recycling facilities. Up to $50 million per year is allowed for each applying agency, program, or water system. Funded projects include wastewater

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[109] http://bondaccountability.resources.ca.gov/plevel1.aspx?id=2&pid=4
[110] http://www.cdph.ca.gov/services/funding/Documents/Prop84/Prop84Section75025Criteria-09-17-2009.pdf
[111] http://www.cdph.ca.gov/services/funding/Pages/Prop50.aspx
[112] http://www.resources.ca.gov/bond/Prop_50_Summary_of_Programs2.pdf
[113] http://www.resources.ca.gov/bonds_prop50.html

treatment plant upgrades and improvements, water reclamation, plant nitrification and de-nitrification facilities, and sewer replacements. This program and funding provides a source of financing for municipal and septic source loading reductions by facilitating the replacement of septic systems or treating wastewater discharges for nitrate. $200-$300 million total is dispersed annually.

State Water Board: Small Community Wastewater Grants[114]

In conjunction with the CWSRF is the Small Community Wastewater Grant program for disadvantaged small communities. This program was established in 2004 and funds up to 90% of the costs of planning, design, and construction for publicly-owned wastewater treatment and collection facilities in qualifying communities. It specifically addresses the unique needs of small communities with less than 20,000 people and with financial hardships (quantified by a median household income of less than 80% of the statewide MHI). Funds may be used to improve wastewater collection and treatment systems, including the replacement of old pipes and septic systems to reduce contamination to surface and groundwater.

This grant program has been financed with funds from Propositions 40 and 50 in the past and now receives funds from a small fee on CWSRF loan agreements. In 2009, $86 million of obtained ARRA Federal funds of the CWSRF were used to forgive the principal loan amount for 25 small and disadvantaged community wastewater projects. As part of the small community strategy, the State Water Board also makes grants to non-profit organizations (such as RCAC) to provide free technical assistance and training to small disadvantaged communities in wastewater infrastructure management and system operations, and in assessment and preparation of project applications.

State Water Board: Proposition 50[115]

[Fully Allocated]

Proposition 50 awarded $100 million to the State Water Board for grants to public agencies and nonprofit organizations to improve water quality. Funds can be used for: drinking water source protection projects (including well head protection from nitrate and other contaminants), water contamination prevention programs, and water quality blending and exchange projects.

State Water Board: Agricultural Drainage Loan Program[116]

[Fully Allocated]

This loan program is for projects that address treatment, storage, conveyance or disposal of agricultural drainage that threatens waters of the State. $100,000 per project is allowed for feasibility studies with a $5 million per project cap on implementation costs. Overall, $30 million was allocated to this program and there is currently $10.4 million still available.

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[114] http://www.swrcb.ca.gov/water_issues/programs/grants_loans/small_community_wastewater_grant/index.shtml
[115] http://www.resources.ca.gov/bond/Prop_50_Summary_of_Programs2.pdf
[116] http://www.swrcb.ca.gov/water_issues/programs/grants_loans/agdrain/agdrain_mgmt.shtml

State Water Board: Dairy Water Quality Grant Program[117]

[Fully Allocated]

Proposition 50 included $5 million for regional and on-farm dairy projects that address water quality impacts from dairies. Water quality planning and both regional and on-farm projects were allowed. The dairy operator was required to have completed the environmental stewardship short course of CDQAP (California Dairy Quality Assurance Program). The final list of recommended projects was developed in 2006, so applications are no longer being accepted.

State Water Board: Federal Clean Water Act Section 319: Nonpoint Source Implementation Program

Through the Clean Water Act Section 319, the State Water Board provides grants (with a match requirement) for implementation of measures and practices that reduce or prevent nonpoint source contamination to ground and surface waters. Normally, individual requests up to $1 million are accepted and $4.5-5.5 million is allocated per year.

State Water Board: Cleanup and Abatement Account[118]

The Cleanup and Abatement Account (CAA) was established through Water Code Sections 13440-13443. The State Water Board is responsible for the financial management of the program. The CAA may provide funds to the State Water Board, the Regional Water Boards, and other public agencies authorized to cleanup a waste or abate the effects of a waste. The CAA funds are used to clean up a waste, abate the effects of a waste, and remediate an unforeseen water contamination problem. Often, a viable responsible party has not been identified. In 2009, $12 M was provided for 24 projects, four of which were in the study area (Richgrove CSD, Mettler County Water District, North Shafter Wastewater Project, and the Central Valley Salinity Work Group). In 2010, another $9 M was provided to support 15 projects; two of these projects were located in the study area (San Jerardo Wastewater Improvement Project and Central Valley Salt and Nutrient Plan).

State Water Board: Integrated Regional Water Management (IRWM) (Proposition 50)

[Fully Allocated]

The Integrated Regional Water Management (IRWM) program was launched following the passage of the IRWM Act of 2002 (SB 1672) to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality, quantity, and reliability. In 2002, Proposition 50 allocated $15 million for planning projects and $365 million for implementation projects related to protecting and improving water quality and other projects to ensure sustainable water use. A 25% cost

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[117] http://www.swrcb.ca.gov/water_issues/programs/grants_loans/dairy/index.shtml
[118] http://www.waterboards.ca.gov/water_issues/programs/grants_loans/caa/

share is required of all localities, programs, and other groups looking for funding from the IRWM program.

Department of Water Resources (DWR)

DWR: Integrated Regional Water Management (IRWM) Financial Assistance (Propositions 50, 84)[119]

DWR also has several Integrated Regional Water Management (IRWM) grant program funding opportunities. Proposition 50 (2002) provided $500 million specifically to DWR to fund competitive grants for projects consistent with an adopted IRWM plan (CWC § 79560-79565). Proposition 84 (2006) provided $1 billion total ($60 million to the Tulare Lake region and $52 for the Central Coast region) to DWR for IRWM Planning and Implementation (PRC §75001-75130). All Proposition 50 funds have been allocated and approximately $500 M remains of the Proposition 84 funds.[120]

DWR: Local Groundwater Assistance (Prop 50 & Prop 84)[121]

Under the Department of Water Resources' Local Groundwater Assistance program, financing is provided to local public agencies with authority to manage groundwater resources for projects that involve: groundwater data collection, modeling, monitoring and management studies; monitoring programs and installation of equipment; basin management; development of information systems; and other groundwater related work. Funds were initially available from Proposition 50 ($6.4 million total and limited to $250,000 per applicant). Renewed funding from Proposition 84 was available in 2010/11.

DWR: New Local Water Supply Feasibility Study[122] and Construction Funds[123] (Proposition 82)

Managed by DWR and funded from Prop 82, this program has $22 million of loan money for feasibility study and construction activities, but only towards projects which will improve *existing* water supply (diversion, storage, or distribution) problems. Local public agencies can apply for loans for projects such as canals, dams, reservoirs, groundwater extraction facilities or other construction or improvements to their water supplies. While the maximum loan amount for feasibility studies is small, it does allow systems or communities to evaluate potential new water sources. It permits a loan up to $0.5 million per eligible feasibility study with 5 year repayment limit and up to $5 million per eligible construction

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[119] http://www.water.ca.gov/irwm/
[120] California Resources Agency. August 2011. Proposition 84 Allocation Balance Report. Accessed December 2011: http://bondaccountability.resources.ca.gov/Attachments/b1a801cb-36af-44c7-854e-3b9047a4525f/29/Prop84AllocationBalanceReport.pdf
[121] http://www.water.ca.gov/lgagrant/
[122] http://www.grantsloans.water.ca.gov/loans/feasibility.cfm
[123] http://www.water.ca.gov/grantsloans/prop82/

project with a 20 year repayment limit. The interest rate is the rate of the State's most recent obligation bonds. Applications are processed on a continuous basis.

DWR: Water Use Efficiency Grant Program (Prop 50)[124]

Proposition 50 established $180 million for grants for urban and agricultural water conservation, recycling, and other water use efficiency programs. $105 million of this allocation was awarded to DWR for the Water Use Efficiency Program. This program supports projects to improve agricultural water use efficiency, including: research and development, feasibility studies, training and education, and technical assistance. Specific projects include: wellhead rehabilitation, new storage tanks, water and wastewater treatment, etc. Up to $3 million is available per project. Local cost share is required, but disadvantaged communities may be eligible for a waiver. $15 million will be available for the 2011 funding cycle.[125]

DWR: Agricultural Water Conservation Program (Prop 13)[126]

Loans to agriculture under the Agricultural Water Conservation Program, created by Prop 13, are also available ($28 M total) under DWR's Water Use Efficiency financial assistance programs. These cover capital outlay and construction of up to $5 million per project for agricultural water conservation, including such activities as lining or piping of ditches; automating canal structures; improvements to water distribution system controls; tailwater or spill recovery systems; major improvements or replacement of leaking agricultural distribution systems; purchasing and installing water measurement devices; and capital improvements for on-farm irrigation. Irrigation application improvements are a key way to improving nitrogen application efficiency.

DWR: Infrastructure Rehabilitation Construction Grants (Proposition 13)[127]

[Fully Allocated]

The Infrastructure Rehabilitation Program is a grant program authorized under Prop 13 to provide assistance to poor communities for construction projects and feasibility studies to fix or replace failing water distribution systems that threaten the health, safety, and economy of these areas. The demand for funding far exceeded the amount of money allocated under Proposition 13. Since the program began in 2001, it received more than 71 proposals representing about $124 million during three funding cycles. Of these requests, it awarded $56.4 million for 22 feasibility studies and 20 construction projects. Presently, all program funds have been committed and the applications are closed.

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[124] http://www.water.ca.gov/wateruseefficiency/finance/
[125] California Financing Coordinating Committee. 2011. Funding Fair Handbook. Accessed December 2011 at: http://www.cfcc.ca.gov/res/docs/CFCC_Handbook_WebPosting.pdf
[126] http://www.water.ca.gov/wateruseefficiency/finance/
[127] http://www.grantsloans.water.ca.gov/docs/ircon/awardscon.pdf

California Infrastructure and Economic Development Bank (I-Bank)[128]

The California Infrastructure and Economic Development Bank (I-Bank) can issue tax exempt and taxable revenue bonds for a variety of projects which promote the revitalization of employment and the overall CA economy. One program, the Infrastructure State Revolving Fund (ISRF), provides low cost loans to public agencies for water supply, treatment and distribution projects. The ISRF funds $250,000 to $10 million per project for a 30 year loan period. Only agencies which are a subdivision of local government may apply; i.e. cities, counties, redevelopment agencies, special districts, assessment districts, joint powers authorities and non-profit corporations formed on behalf of a local government.

United States Department of Agriculture (USDA) Rural Utilities Service (RUS)[129]

The USDA Rural Utilities Service administers the Water and Environmental Programs (WEP) which supports drinking water, wastewater, and storm water facilities for rural communities of less than 10,000 people. Support includes loans, grants, and technical assistance, either directly to the facilities or indirectly through non-profit groups.

In the last eight years, RUS WEP provided more than $13 billion in loans and grants for rural water and waste infrastructure[130]. With additional funding in 2009 from the American Recovery and Reinvestment Act, RUS was able to invest $2.5 million under the Water and Waste Disposal Loan and Grant Program.[130]

The WEP has 7 main funding programs, discussed below.

USDA-RUS: Water and Waste Disposal Direct Loans and Grants

As part of the WEP, USDA-RUS manages the Water and Waste Disposal Direct Loans and Grants program. This program provides funds to public bodies and non-profit organizations to develop water and waste disposal systems in rural areas. Specifically, funds are limited to: construction, land acquisition, legal fees, engineering fees, capitalized interest, equipment, initial operation and maintenance costs, project contingencies, and any other cost needed to complete the project. Grants are given for up to 75% of eligible project costs when the service area MHI is less than 80% of the State MHI.

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[128] http://www.ibank.ca.gov/infrastructure_loans.htm
[129] http://www.rurdev.usda.gov/UWEP_HomePage.html
[130] http://www.rurdev.usda.gov/SupportDocuments/Adelstein3-23-10.pdf

USDA-RUS: Water and Waste Disposal Guaranteed Loans

In addition to direct loans, guaranteed loans are also available for the construction or improvement of water and waste disposal projects. Qualifying applicants will be unable to obtain (at reasonable rates) the necessary credit without the guarantee. Public bodies and non-profit organizations benefit from these loans which are made and serviced by lenders such as banks, savings and loan associations, mortgage companies and other eligible lenders under the Guarantee Loan Program.

USDA-RUS: Water and Waste Revolving Fund Grants

Through the Water and Waste Revolving Fund Program, USDA-RUS issues grants to private non-profit corporations which have previously operated successful revolving loan funds to rural areas. These loan funds may only be issued to communities in rural areas for use with pre-development costs of water and wastewater projects or short-term small capital improvement projects not part of the regular operations and maintenance of current water and wastewater systems. A maximum of $100,000 may be made available per project.

USDA-RUS: Individual Household Water Well Program

Additional grants are provided by USDA-RUS to private non-profit corporations through the Individual Household Water Well Program. These grants establish loan programs for individuals who need capital to construct, refurbish, or service their well system. The maximum loan amount per well is $8,000.

USDA-RUS: Predevelopment Planning Grants

Grants of up to $15,000 or 75% of the total project cost (whichever is lower) may be awarded to communities or water systems for assistance in preparing a water project application. Eligible applicants must provide proof that they are unable to pay the necessary predevelopment costs.

USDA-RUS: Emergency Community Water Assistance Grants

Communities which face or expect to face an abrupt and severe decrease in water quality may apply to USDA-RUS for an emergency community water assistance grant. Typical events which cause the decline in water quality are: a natural disaster such as drought, earthquake, flood, tornado, or hurricane; a disease outbreak; or a chemical spill/leakage/seepage. Projects which relieve a decline in the quantity and quality of drinking water through the construction of a new water source and/or treatment plant are eligible for full project funding up to $500,000. Communities facing emergency repairs or replacements of facilities on existing systems due to acute concerns (e.g. washed out river crossing in a distribution system, or construction of distribution lines to individuals not currently on the system, whose wells have gone dry) may apply for up to $150,000 for distribution waterline extensions, breaks or repairs on distribution waterlines, and operation and maintenance.

USDA-RUS: Technical Assistance and Training Grants

USDA-RUS manages a technical assistance and training program which funds the educational and technical capacity building programs of private non-profit and tax-exempt organizations. Applicable to the study area, organizations receiving funding for these activities are: RCAP, the National Rural Water Association, and the National Drinking Water Clearinghouse. These individual programs are described in Appendix B: Summary of Current Planning and Regulatory Programs that Address Nitrate in Groundwater. In addition to technical assistance efforts, these non-profit organizations may also use the funding to assist communities in preparing funding applications for water or waste projects.

US Department of Housing and Urban Development (HUD): Community Development Block Grant Program[131]

The Community Development Block Grant (CDBG) program, administered by the U.S. Department of Housing and Urban Development, provides grants to States to fund economic development, housing, public improvements, public services, and administrative and planning. Within the public improvement category, funds are available to construct or improve community water and sewer systems, build technical capacity, and assist nonprofit organizations who aid in community development.

HUD has the responsibility to ensure that the States are following Federal regulations and policies. The majority of the program responsibilities fall on the States, including: determining how to allocate funds among communities, formulating community development goals, and ensuring that at least 70 percent of its CDBG grant funds are used to benefit low- and moderate- income persons.

The CDBG program funds cities with less than 50,000 people and counties less than 200,000. The State of California may use up to $100,000 plus 50% of their incurred administrative costs per project. Up to 3% of California's total allocation from HUD may be used on technical assistance. In 2010, HUD provided almost $500 million for CDBG programs in California.

U.S. Economic Development Administration (EDA)[132]

The U.S. Economic Development Administration (EDA) is an agency within the U.S. Department of Commerce. The EDA's Public Works and Economic Development Program provides grants for the construction, expansion, or upgrade of infrastructure (including water and wastewater) in communities facing economic distress, natural disasters, or the depletion of natural resources. The goal of this program is to create and sustain long-term private sector job opportunities in distressed communities. The funds may be used for land acquisition, construction, renovation, expansion, improvement, or

[131] http://www.hud.gov/offices/cpd/communitydevelopment/programs/stateadmin/
[132] http://www.eda.gov/InvestmentsGrants/Investments.xml

design of a public works facility. The grants cover up to 50 percent of project costs. During 2009, EDA awarded $13 million for public works projects across the United States.

EDA also offers technical assistance to public and nonprofit groups which work with communities on project planning and feasibility studies. During 2009, EDA awarded $135,000 for technical assistance projects in California.

Rural Community Assistance Corporation (RCAC)[133]

The Rural Community Assistance Corporation (RCAC), based in California, is RCAP's western regional partner. They focus on areas with populations of 2,000 or less, minority communities, and disadvantaged communities. Their projects help improve access to safe drinking water supplies, develop and maintain wastewater systems, protect the groundwater, and improve access to financial assistance resources. Their overarching goal is to help small water and wastewater systems to build the technical, managerial, and financial capacity necessary to comply with State and Federal regulations. Often, this assistance is financed by State and Federal contracts, and is thus free to the community.

RCAC also administers $1.2 million per year from the US EPA for water and wastewater construction loan funds. As of September 30, 2010, they have supported over 46,000 individual water and wastewater connections.

RCAC's New Mexico office has initiated and managed the regionalization of a few small water systems into larger organizations with more technical, managerial, and financial capacity. Recently, five New Mexico small drinking water systems (totaling 8,000 people) merged to form the Lower Rio Grande Public Water Works Authority Agency. Their model could be used in California to help solve the deficiencies in functioning and capacity of small community water and wastewater systems.

The Housing Assistance Council (HAC)[134]

The Housing Assistance Council administers the Small Water/Wastewater Loan Fund nationally at interest rates equal to or below the market rate. Small short-term loans of $100,000 to $250,000 are made to local nonprofits, for profits, and government entities that are developing housing for lower income rural communities. These loans can be used to finance predevelopment, land acquisition, site development, and construction phases of a water or wastewater infrastructure project.

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[133] http://www.rcac.org
[134] http://www.ruralhome.org

Cooperative Bank (CoBank)[135]

The Cooperative Bank (CoBank) offers a national Water and Wastewater Loan Program for communities of fewer than 20,000 people. These loans, typically around $1 million, are used to finance new water and wastewater infrastructure projects, system improvements, water right purchases, and system acquisitions. Smaller loans of $50,000 to $500,000 are also offered to help cover initial construction costs.

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[135] http://www.cobank.com