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Voluntary Domestic Well Assessment Project
El Dorado County Data Summary Report

STATE WATER RESOURCES CONTROL BOARD

GROUNDWATER AMBIENT MONITORING AND ASSESSMENT PROGRAM

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Water Boards

ACKNOWLEDGEMENTS

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Executive Summary

In January 2002, the State Water Board GAMA Program Unit initiated the Voluntary Domestic Well Assessment Project (Voluntary Project). Currently, the quality of domestic well water in California is largely unknown. Domestic well sampling programs in other states have detected chemicals such as nitrate and coliform bacteria in domestic wells. The Voluntary Project samples private domestic wells in California for chemicals that could degrade water quality and provides the results to the well owners. The Voluntary Project focuses, as resources permit, on specific areas of the state and provides a previously unavailable sampling of water quality in domestic wells in California. Voluntary Project focus areas are chosen in coordination with local environmental health agencies, based upon domestic well use and the existing knowledge of water quality and land use. The State Water Board incurs the costs of sampling and analysis, and the results are provided to domestic well owners as quickly as possible, as well as to the appropriate local environmental health agencies and the Regional Boards. Because water quality in individual domestic wells is largely unregulated, participation is voluntary.

Currently, no federal or state water quality standards regulate domestic wells. The Voluntary Project uses state maximum contaminant levels (MCLs) as a benchmark for domestic well water quality data. The MCL is the highest concentration of a contaminant allowed in public drinking water (i.e. public supply wells) and is an enforceable water quality standard. “Primary” MCLs address health concerns and “Secondary” MCLs address esthetics, such as taste and odor. In general, public water systems treat or blend sources of water to ensure compliance with drinking water standards. Many private domestic well owners may be using well water exclusively and may not have the option to treat or blend their water to improve water quality.

During 2003 and 2004, and as part of a small pilot study in 2001, the Voluntary Project sampled 398 private domestic wells in El Dorado County. Of the domestic wells sampled, approximately 30 percent (119 wells, some wells detected multiple chemicals) would not pass state primary drinking water standards for public water systems. This statistic demonstrates that private domestic wells are vulnerable to contamination that may affect public health. The most common reasons for primary MCL exceedance were positive detection of coliform (total coliform present in 111 domestic wells and fecal coliform present in 14 domestic wells), followed by arsenic (15 domestic wells) and nitrate (7 domestic wells). Although additional research is necessary to determine the degree that domestic wells are impacted and the sources of water quality contamination, the results of the El Dorado County implementation of the Voluntary Project underscore the importance of understanding the impact of chemical contaminants to domestic wells, and taking measures to protect and monitor the quality of water provided by them.

Voluntary Domestic Well Assessment Project El Dorado County Data Summary Report

State Water Resources Control Board

Groundwater Ambient Monitoring and Assessment Program

Introduction

In January 2002, the State Water Board GAMA Unit initiated the Voluntary Project. In addition to a small-scale pilot study conducted in 2001, the Voluntary Project has been implemented in two focus areas: Yuba County (2002) and El Dorado County (Phase I - 2003 and Phase II - 2004).

In 2003 and 2004, and as part of a 2001 pilot study, the Voluntary Project sampled 398 domestic wells in El Dorado County (*Figure 1*). Water samples collected from domestic wells were analyzed for total and fecal coliform bacteria, general minerals and chemical parameters, inorganic chemicals, volatile organic chemicals (VOCs), and stable isotopes of oxygen and hydrogen. The results were transmitted to the participants, along with public education materials for domestic well owners and users. The purpose of this report is to summarize the domestic well water quality data collected in El Dorado County. The relationship between domestic well water quality and other factors such as geology and land use will be discussed in subsequent reports.

Background

The California Legislature, Governor, and private citizens have become increasingly concerned about groundwater quality and drinking water well closures. This is due, in part, to increasing detections of chemicals such as the gasoline additive MTBE, industrial solvents, and more recently the chemical perchlorate. To address these concerns, the Supplemental Report of the 1999 Budget Act, and later the Groundwater Quality Monitoring Act of 2001 (Water Code Section 10780 et seq.), required the State Water Board to develop a comprehensive ambient groundwater monitoring plan.
The primary objectives of the GAMA Program are to improve comprehensive statewide groundwater monitoring, create a centralized groundwater quality database, and increase the availability of groundwater quality information to the public. The GAMA Program has two main components: A comprehensive, statewide groundwater monitoring program which focuses on public drinking water wells, and the Voluntary Project. The Voluntary Project provides a previously unavailable sampling of water

quality in domestic wells. Because water quality in individual domestic wells is largely unregulated, participation in the project is voluntary and the project focuses, as resources permit, on specific areas of the state based on domestic well use and the availability of local domestic well information.

Based on data from the 1990 U.S. Census, more than 500,000 private domestic wells provide drinking water for more than one million persons in California (State of California, 1999). The number of domestic wells per county is identified in *Table 1.* The current number of private domestic wells is likely closer to 600,000 based on an extrapolation of the domestic well data included in the 2003 Onsite Wastewater Treatment Systems Status Report (CWTRC and US EPA Region 9, 2003).

TABLE 1. NUMBER OF DOMESTIC WELLS PER COUNTY (TOP TEN COUNTIES SHOWN IN BOLD)

County	No. of Domestic Wells	County	No. of Domestic Wells
Alameda	2,106	Orange	866
Alpine	200	Placer	13,882
Amador	5,063	Plumas	3,877
Butte	**20,000**	**Riverside**	**17,814**
Calaveras	14,966	Sacramento	14,604
Colusa	1,895	San Benito	2,666
Contra Costa	7,267	**San Bernardino**	**18,000**
Del Norte	2,435	**San Diego**	**15,764**
El Dorado	11,659	San Francisco	0
Fresno	11,084	**San Joaquin**	**23,239**
Glenn	4,000	San Luis Obispo	12,686
Humboldt	4,315	San Mateo	1,679
Imperial	1,105	Santa Barbara	3,517
Inyo	2,022	Santa Clara	6,926
Kern	11,790	Santa Cruz	8,088
Kings	5,106	Shasta	11,909
Lake	5,476	Sierra	217
Lassen	5,298	Siskiyou	6,624
Los Angeles	11,012	Solano	4,559
Madera	11,205	**Sonoma**	**33,877**
Marin	1,606	**Stanislaus**	**16,895**
Mariposa	5,413	Sutter	8,311
Mendocino	10,590	Tehama	7,477
Merced	**15,000**	Trinity	1,565
Modoc	2,250	**Tulare**	**20,007**
Mono	1,500	Tuolumne	6,549
Monterey	12,000	Ventura	2,401
Napa	6,599	Yolo	4,566
Nevada	**15,956**	Yuba	6,063

Source: State of California, Department of Finance, City/County Population and Housing Estimates, 1991-1999, with 1990 census counts. Sacramento California, May 1999.

The quality of domestic well water in California is largely unknown. Each domestic well owner is responsible for ensuring the water quality of his own domestic well. In many areas of the state, domestic wells traditionally produce very high quality drinking water.

In recent years, however, chemicals from industrial spills, leaking underground fuel tanks, and agricultural applications have impacted our drinking water aquifers. Also, biological pathogens from sewers, septic systems and animal facilities infiltrate into the subsurface (Santa Clara Valley Water District; El Dorado County, 2004). These contaminants can find their way through natural protective layers of clay and silt and enter our drinking water aquifers. This problem can be exacerbated by the presence of improperly constructed wells, abandoned wells, or wells located too near a potential contaminant source, such as a septic system. Domestic well sampling programs in other states have detected chemicals, such as nitrates and coliform bacteria, in domestic wells (NJDEP, 2004).

The Voluntary Project samples private domestic wells in California for chemicals that could degrade water quality and provides the results and interpretation to well owners and local environmental health agencies. In addition, the Voluntary Project includes a public education component to aid the public in understanding water quality data and water quality issues affecting domestic wells. Voluntary Project focus areas are chosen in coordination with local environmental health agencies, based upon domestic well use and the existing knowledge of water quality and land use. The State Water Board incurs the costs of sampling and analysis, and the results are provided to domestic well owners as quickly as possible, as well as to the appropriate local environmental health agencies and Regional Boards.

Project Objectives

The primary goal of the Voluntary Project is to provide the public with specific information regarding domestic well water quality. In addition, domestic well water quality data will be analyzed collectively with existing groundwater information and public supply well data collected as part of the GAMA Program, to help assess California groundwater quality and identify issues that may impact private domestic well water.

The specific objective of the El Dorado County Phase I and Phase II sampling efforts was to collect domestic well water quality data for the foothill areas of El Dorado County and provide information to domestic well owners and local environmental health agencies.

Hydrogeologic Setting - El Dorado County

El Dorado County is located in the Sierra Nevada geomorphic province of California, east of the Great Valley province and west of the Basin and Range province. The Sierra Nevada province is characterized by steep-sided hills and narrow, rocky stream channels. This province consists of uplifted Pliocene and older deposits resulting from episodes of plate tectonics, granitic intrusion, and volcanic activity. Subsequent glaciation and Pleistocene/Holocene volcanic activity led to the east-west orientation of most stream channels. The southwestern foothills of El Dorado County are composed of rocks of the Mariposa Formation including amphibolite, serpentinite, and pyroxenite.

The Calaveras Formation occurs in northwestern areas of the county, and includes metamorphic rocks such as chert, slate, quartzite, and mica schist. In addition, limited serpentinite formations are located in this area. The higher peaks in the eastern part of the county consist primarily of igneous and metamorphic rocks intruded by granite, a main soil parent material at higher elevations.

Although groundwater does not penetrate the hard rock mass, it can be found flowing in fractures below the ground surface. The characteristics of a fractured hard rock system that affect the ability of water users to develop groundwater resources include the size and location of fractures, the interconnection between fractures, and the amount of material deposited within fractures. In addition, fracture width generally decreases with depth. Therefore, groundwater recharge, movement and storage of water in fractures of hard rock are limited.

According to the 1990 Census data, there are more than 11,650 domestic wells in El Dorado County serving approximately 32,000 persons. Data from the 2003 Onsite Wastewater Treatment Systems Status Report indicates that an additional 1,067 domestic wells were installed in El Dorado County between 1998 and 2000, for a county total of nearly 13,000 domestic wells. During the drought of 1976 and 1977, El Dorado County Division of Environmental Health (DEH) initiated a water well survey, canvassing residents with wells in 15 county planning areas. *Table 2* lists median depth and estimated production rate for wells in the 15 areas.

El Dorado County does not require testing or tracking of the quality of water from private single-family or agricultural wells (EDAW, 2003). However, a bacteriological and/or chemical analysis may be required by the El Dorado County DEH on any proposed water supply before a building permit is issued (Policy 800.02 DEH Policies and Procedures Manual). For a fee, DEH staff members will test for bacteria and compliance with the County's well-construction-standard ordinance upon request by lending agencies or concerned property owners.

TABLE 2. WELL CHARACTERISTICS IN EL DORADO COUNTY

County Planning Area	Number of Wells Surveyed	Median Depth (Feet)	Median Rate (gpm)
Camino-Fruitridge	57	100	5
Cool	29	200	5
El Dorado/Diamond Springs	19	150	4
Finnon	37	150	10
Garden Valley	70	150	10
Gold Hill	2	---	5-10
Kelsey	45	125	4
Latrobe	23	200	5
Lotus-Coloma	66	<100	10
Pilot Hill	21	150	7
Pollock Pines	10	---	8
Pleasant Valley	199	100	6
Rescue	120	125	10
Shingle Springs	42	125	4
Somerset/Fairplay/Mt Aukum	---	---	10

Source: Calkins, Carla, Water Well Survey Report, June 1978

In general, groundwater quality in El Dorado County is considered good to excellent, but historically there has been no reliable database (EDAW, 2003). As the county's population increases and more people rely upon local groundwater for their water supply, groundwater quality becomes a more prominent concern. According to the El Dorado County General Plan Environmental Impact Report (EDAW, 2003), major sources of potential groundwater pollution include septic tanks or septic leach fields, underground fuel tanks, spillage of hazardous materials or commercial waste, and infiltration of agricultural byproducts, including fertilizer and livestock waste. In addition, improperly located and constructed water wells present additional water quality concerns.

Approach

The Voluntary Project utilizes standard groundwater sample collection methods and laboratory analyses to identify domestic wells where water quality may be of concern. All water samples were collected from domestic wells by State Water Board staff and analyzed by Department of Health Services (DHS) certified drinking water test laboratories. Samples were analyzed for total and fecal coliform bacteria, general minerals and chemical parameters, inorganic chemicals, and volatile organic chemicals (VOCs). In addition, a subset of the samples was also analyzed for the stable isotopes of oxygen and hydrogen. A detailed list of the analytes specific to El Dorado County domestic wells sampled is included in the Appendix. For the purposes of this report, all detections of chemicals above the Practical Quantitation Limit (PQL) are used in calculating detection frequencies. The PQL defines the lowest concentration of an analyte that can be reliably measured within specified limits of precision and accuracy during routine laboratory operating conditions (40 CFR 257.23).

Methods

El Dorado County was selected as a focus area to conduct private domestic well water testing because of the large number of domestic well users and the accessibility of local domestic well information. The El Dorado County Assessor's Office provided the Voluntary Project with an electronic database containing approximately 6,000 domestic well owner names, mailing addresses, and parcel map book numbers. Voluntary Project staff identified book number sections on the El Dorado County parcel map and determined the number of domestic well owners within each book number section. This information was then used to select specific local foothill communities on the parcel map to conduct domestic well testing.
El Dorado County communities selected to conduct domestic well testing:

- Cameron Park
- Coloma
- Cool
- Diamond Springs
- El Dorado
- El Dorado Hills
- Fairplay
- Garden Valley
- Georgetown
- Greenwood
- Grizzly Flats
- Kelsey
- Latrobe
- Lotus
- Mt. Aukum
- Pilot Hill
- Pleasant Valley
- Placerville
- Rescue
- Shingle Springs
- Somerset

Well Selection

Domestic well owners within the selected communities were mailed a Voluntary Project brochure. The Voluntary Project brochure was developed to inform domestic well owners about the well testing and invite them to participate. Each brochure has a detachable card for well owners to complete and return to the State Water Board. Information in the brochure includes general information about the Voluntary Project, domestic well water quality and the responsibilities of the domestic well owner, along with the importance of regularly testing domestic well water quality. The brochure also indicates that results are for information only, and that the State Water Board cannot require or provide service to correct the drinking water quality of privately owned domestic wells.

Voluntary Project contact information is available in both English and Spanish. Domestic Well owners are instructed to sign the brochure and mail in the detachable card. State Water Board staff contact potential participants to schedule a sampling time and location. In general, domestic well owners must be present during well sampling.

Using domestic well owner location data provided by the El Dorado County Assessor's Office, more than 2,600 Voluntary Project brochures were mailed to potential participants. The Voluntary Project sampled 398 domestic wells in El Dorado County, some as a direct response to the Voluntary Project brochure and some as a response to the well owner contacting the State Water Board for information on the Voluntary Project.

Sample Collection

Of the 398 domestic wells sampled in El Dorado County, 190 domestic wells were sampled as part of Phase I (February 4 – May 29, 2003) and 201 domestic wells were sampled as part of Phase II (April 12 – June 18, 2004). An additional 6 domestic wells in El Dorado County were sampled as part of the Voluntary Project pilot study and 1 domestic well in El Dorado County was sampled during the 2002 Voluntary Project implementation in Yuba County.

Sampling was conducted in accordance with the Voluntary Project Sampling and Analysis Plan (State Water Board, 2003 and 2004). Procedures utilized by the Voluntary Project were implemented to minimize the potential for airborne contamination of samples and cross contamination between wells. These procedures also helped to collect a representative groundwater sample at each domestic well. If it was not feasible to collect a representative sample, a sample was collected with a field notation documenting the collection method. In general, sampling was performed in a manner that allowed collection of a groundwater sample that had not been altered by any water storage and/or treatment system. In some cases, one or more of the following scenarios may have influenced water sampling procedures:

- Sample collected from pipe at the holding tank prior to the pressure tank
- Sample collected at or after the pressure tank
- Sample collected prior to the pressure tank, but no back-flow valve in place
- Sample collected after water filter or water treatment system

At most wells, samples were drawn from the faucet closest to the well prior to any filter or water treatment system. In El Dorado County, samples from approximately 25 wells were collected post-treatment system and therefore may not accurately represent groundwater conditions.

Limited information on domestic well construction data and technical parameters were available from most owners. Well owners provided well construction reports for 39, or approximately 10% of the wells tested. Voluntary Project staff contacted the California Department of Water Resources (DWR) in an effort to confirm well construction data and locate missing information. Prior to sampling, each domestic well was located using global positioning system (GPS) technology. In addition, Voluntary Project staff collected additional information on any potentially contaminating activities (PCA) in the vicinity of the domestic well. Field parameters of electrical conductivity, pH, total dissolved solids (TDS), and temperature were measured at the time of the sampling. All field information was documented on a field form and later entered into the

Voluntary Project database. Samples were stored on ice and transported to the laboratory for analysis within 24 hours. Water samples testing positive for total coliform were tested for fecal coliform and domestic well owners were notified of positive test results within 24 hours.

El Dorado County Phase I (2003) samples were analyzed by Twining Laboratory Inc. in Fresno, California. Phase II (2004) samples were analyzed by Alpha Analytical Laboratories Inc. in Ukiah, California. Domestic wells sampled as part of the 2001 Voluntary Project pilot study were analyzed by Sierra Foothill Laboratory in Jackson, California.

A subset of the wells were also analyzed for the stable isotopes of oxygen and hydrogen to provide information on source water and recharge conditions. These analyses were conducted by Lawrence Livermore National Laboratory (LLNL) and will be discussed in a subsequent report.

Quality Control

A Quality Assurance Plan was developed for the GAMA program and was utilized during the collection of the El Dorado County samples. This plan included basic training requirements for sampling personnel, standard operating procedures for sample collection and transport, analysis techniques and standards for laboratories, standard methods for equipment calibration, maintenance and use, and instructions for quality control sample collection. Quality control samples (trip blank and duplicate samples) were collected at approximately 10 percent of the domestic wells to determine if contaminants were introduced during sample collection, processing, storage, transportation, or laboratory analysis.

Results

Voluntary Project results for El Dorado County may be divided into two categories: Primary Drinking Water Contaminants and Secondary Drinking Water Parameters. In addition, general mineral and inorganic chemical data may also be used to describe local groundwater geochemistry.

Currently, no federal or state water quality standards regulate domestic wells. The Voluntary Project uses state maximum contaminant levels (MCLs) as a benchmark for domestic well water quality data. The MCL is the highest concentration of a contaminant allowed in public drinking water (i.e. public supply wells) and is an enforceable water quality standard. “Primary” MCLs address health concerns and “Secondary” MCLs address esthetics, such as taste and odor. In general, public water systems treat or blend sources of water to ensure compliance with drinking water standards. Many domestic well owners may be using well water exclusively and may not have the option to treat or blend their water to improve water quality.

Basic groundwater geochemistry was also evaluated using Piper diagrams. Piper diagrams illustrate ion concentrations and total dissolved solids for multiple water samples.

Primary Drinking Water Contaminants

Based on water quality data collected from 398 domestic wells in El Dorado County, 119 individual wells exceeded the state primary MCLs for at least one constituent. The most common reasons for primary MCL exceedance were positive detection of coliform (total coliform present in 111 domestic wells and fecal coliform present in 14 domestic wells), followed by arsenic (15 domestic wells) and nitrate (7 domestic wells). The primary drinking water contaminant data is summarized in *Table 3* and *Figure 2.*

Secondary Drinking Water Parameters

Based on water quality data collected from 398 domestic wells in El Dorado County, 120 individual wells exceeded the state secondary MCLs for at least one constituent. The most common reasons for secondary MCL exceedance were manganese (98 domestic wells) and iron (81 domestic wells), followed by aluminum (11 domestic wells). The secondary drinking water contaminant data is summarized in *Table 4* and *Figure 2*.

TABLE 3. PRIMARY DRINKING WATER CONTAMINANTS – DATA FROM 398 DOMESTIC WELLS LOCATED IN EL DORADO COUNTY.

Chemical	Number of Wells with Detections	Number of Wells Exceeding the Primary MCL	State Primary MCL (µg/L)[2]	Results Range (µg/L)[2]	Common source of contaminant in drinking water[1]
Microbiological Contaminants					
Total Coliform	111	111	Absence	Presence	Total coliforms are naturally present in the environment; Fecal coliform and *E.coli* come from human and animal fecal waste.
Fecal Coliform	14	14	Absence	Presence	
Inorganic Contaminants					
Aluminum	48	1	1000	50 - 1500	Erosion of natural deposits; residue from some surface water treatment processes
Antimony	2	2	6	11 - 12	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder
Arsenic	94	15	10[a]	2 - 110	Erosion of natural deposits; runoff from orchards, glass and electronics production wastes
Nickel	25	1	100	11 - 150	Erosion of natural deposits; discharge from metal factories
Nitrate (as NO_3)	256	7	45 mg/L	1 – 84 mg/L	Runoff and leaching from fertilizer use; leaching from septic tanks and sewage; erosion of natural deposits
Nitrate + Nitrite (as N)	242	7	10,000	150 – 19,000	
Volatile Organic Contaminants					
Benzene	2	1	1	0.5 - 15	Discharge from plastics, dyes and nylon factories; leaching from gas storage tanks and landfills

[1] California Department of Health Services, "Preparing Your California Drinking Water Consumer Confidence Report – Guidance for Water Suppliers", January 2005.
[2] Micrograms/Liter unless otherwise stated
[a] The new federal MCL for arsenic, 10 micrograms/liter (µg/L), becomes effective on January 23, 2006.

TABLE 4. SECONDARY DRINKING WATER PARAMETERS – DATA FROM 398 DOMESTIC WELLS LOCATED IN EL DORADO COUNTY.

Chemical	Number of Wells with Detections	Number of Wells Exceeding the Secondary MCL	State Secondary MCL (µg/L)[2]	Results Range (µg/L)[2]	Common source of contaminant in drinking water[1]
Aluminum	48	11	200	50 - 1500	Erosion of natural deposits; residue from some surface water treatment processes
Iron	123	81	300	65 - 87000	Leaching from natural deposits; industrial wastes
Manganese	121	98	50	20 - 1800	Leaching from natural deposits
Methyl-*tert*-butyl ether (MTBE)	4	1	5	1.8 - 5.7	Leaking underground storage tanks; discharge from petroleum and chemical factories;
Zinc	54	1	5000	31 - 5800	Runoff/leaching from natural deposits; industrial wastes
Color	3	1	15 Units	4 - 29 Units	Naturally occurring organic materials
Turbidity	7	3	5 NTU	0.12 – 48 NTU	Soil runoff

[1] California Department of Health Services, "Preparing Your California Drinking Water Consumer Confidence Report – Guidance for Water Suppliers", January 2005.
[1] Micrograms/Liter unless otherwise noted

Nitrate

Of particular interest are the nitrate data from El Dorado County. In general, nitrate contaminated groundwater is in part caused by excessive use of fertilizer, animal waste from dairies and feedlots, explosives, and human waste (i.e. septic systems). Nitrate concentrations in natural groundwaters are typically less than 2 mg/L nitrate as nitrogen, equivalent to approximately 9 mg/L nitrate as NO_3 (Mueller and others, 1995). Based on water quality data collected from 398 domestic wells in El Dorado County, 256 domestic wells had detections of nitrate (*Figure 3*). Of those, 7 domestic wells exceeded the MCL of 45 mg/L (nitrate as NO_3) and 100 domestic wells had concentrations above 9 mg/L (nitrate as NO_3), indicating that the source of nitrate is likely due to human activities.

Additional Chemicals of Concern

Several chemicals of concern were detected but at levels below the state MCLs. For the purposes of this report, chemicals of concern include chemicals for which there is a state primary MCL or action level (AL). Detections for these chemicals are shown in *Table 5*.

TABLE 5. ADDITIONAL CHEMICALS OF CONCERN – DATA FROM 398 DOMESTIC WELLS LOCATED IN EL DORADO COUNTY.

Chemical	Number of Wells with Detections	State Primary MCL[2] (ug/L)	Results Range (ug/L)	Common source of contaminant in drinking water[1]
Inorganic Contaminants				
Barium	99	1000	11 - 900	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Cadmium	1	5	2.3	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries, and paints
Chromium	2	50	1 - 14	Discharge from steel and pulp mills; erosion of natural deposits
Flouride	212	2000	110 – 1600	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories
Selenium	4	50	6 - 12	Discharge from petroleum, glass, and metal refineries; erosion of natural deposits; discharge from mines and chemical manufacturers; runoff from livestock lots (feed additive)
Volatile Organic Contaminants				
Dichloromethane	2[b]	5	1.2	Discharge from pharmaceutical and chemical factories; insecticide
Tert-Butyl-alcohol (TBA)	1	12[a]	5.5	Leaking underground storage tanks; discharge from petroleum and chemical factories;
Tetrachloroethylene (PCE)	1	5	.66	Discharge from factories, dry cleaners, and auto shops (metal degreaser)
Toluene	4	150	0.85 - 29	Discharge from petroleum and chemical factories; underground gas tank leaks
Xylenes (Total)	1	1750	1.2	Discharge from petroleum and chemical factories; fuel solvent
Disinfection Byproducts, Disinfectant Residuals, and Disinfection Byproduct Precursors				
Total Trihalomethanes (TTHMs)	6	80	0.61 - 21	Byproduct of drinking water chlorination
Radioactivity				

Chemical	Number of Wells with Detections	State Primary MCL[2] (ug/L)	Results Range (ug/L)	Common source of contaminant in drinking water[1]
Gross Alpha	1	15 pCi/L	7.64 pCi/L	Erosion of natural deposits

[1] California Department of Health Services, "Preparing Your California Drinking Water Consumer Confidence Report – Guidance for Water Suppliers", January 2005.
[2] Maximum Contaminant Level or State Action Level (AL) where noted.
[a] State Action Level
[b] Dichloromethane was also detected in one trip blank at a similar concentration.

Groundwater Geochemistry

Basic groundwater geochemistry was also evaluated using a Piper diagram. Piper diagrams illustrate ion concentrations and total dissolved solids for multiple water samples. The Piper diagram plots the major ions as percentages of milli-equivalents in two base triangles. The total cations and the total anions are set equal to 100% and the data points in the two triangles are projected onto an adjacent grid. This plot reveals useful properties and relationships for large water sample groups. The main purpose of the Piper diagram is to show clustering of data points to indicate water samples that have similar geochemical compositions.

El Dorado County domestic well samples were plotted on a Piper diagram using RockWorks99 software. The results are depicted graphically in *Figure 4.* The diagram indicates that groundwater in the sampled area is a bicarbonate, sodium-magnesium type. This suggests mostly carbonate and dolomite source of dissolved mineral in groundwater. Small sub-facies of magnesium type and sodium-potassium type of water can be distinguished within the graph.

Quality Control Results

The Voluntary Project carried out a quality assurance/quality control program to quantify the repeatability and precision of the field sampling program results.

Thirty-two trip blank samples were analyzed as part of the El Dorado County implementation of the Voluntary Project. Dichloromethane was detected in one trip blank sample. Dichloromethane was also detected in two water samples at similar concentrations collected the same day, and was not detected in any other water sample from El Dorado County. Therefore, the source of contamination may be a result of contamination during collection, transportation or shipment of water samples that day. No other chemicals were detected in any of the trip blanks.

Random duplicate samples were obtained at approximately 10 percent of all sampling locations. Duplicate samples were obtained immediately following collection of the primary sample, using the same sampling protocol. Duplicate samples were labeled so as not to be differentiable from other samples at the processing laboratory. Handling and processing of the duplicate samples occurred at the same time as the primary samples. Repeatability and precision of duplicate sample measurements was quantified in two ways.

1. Results from each sample and its duplicate were first grouped and the percent difference[1] was calculated for each positive detection of a constituent in at least one of each duplicate sample pair. If both sample and duplicate sample reported non-detect results, the results were not included in estimation of sampling precision and repeatability. If these samples had been included, total reported error would be substantially lower. Thus, percent differences only refer to chemical detections, and do not include the repeatability of non-detect measurements. Median and interquartile range percent errors for detected constituents in each sample and duplicate sample were calculated and are reported.

2. Chemicals were then grouped by individual constituents and the percent difference was calculated for individual constituents detected in at least one of two duplicate samples. Non-detect results for one constituent in both sample and duplicate sample were not included, but would lower total reported error substantially if included. Median and interquartile range percentage errors for all individual detected constituents were calculated and reported for constituents for which three or more detections were available for comparison.

Results:

1. Thirty-six duplicate samples were obtained in El Dorado County during the sampling program. For these samples, each duplicate sample pair reported an average of 24 constituents for comparison. Of these 24 constituents, most samples reported pH, Hardness as $CaCO_3$, Alkalinity, Bicarbonate Alkalinity, Total Dissolved Solids and Specific Conductance, reducing to approximately 18 the average number of chemical constituent detections per sample pair.

2. For 17 of 21 paired constituents with three or more detections available for comparison, the median difference of sample constituents where at least one sample detected the presence of a chemical constituent above the Practical Quantitation Limit (PQL) was less than 3 percent. For the four additional constituents, the median difference was between 6 percent and 14 percent.

3. For 32 of 36 duplicate paired samples, the median difference of sample constituents where at least one sample detected the presence of a chemical constituent above the PQL was less than 5 percent. For the four additional duplicate paired samples, the median difference was between 5 percent and 9 percent.

4. Twenty-two individual constituents reported a detection in one sample and a non-detect result in another. Of these, 14 samples detected a concentration of less than twice the PQL in one sample and a non-detect in the other sample. Eight samples detected a concentration of greater than twice the PQL in one sample and a non-detect in the other.

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[1] Percent difference is defined here as the difference between sample and duplicate compared to the original sample result, reported in percent.

Data Limitations

When reviewing Voluntary Project results, it is important to remember that the project is voluntary and limited in scope. The water quality data only represents those domestic wells that were selected for invitation and where the well owners agreed to participate in the project and is only generally applicable to the region sampled. In addition, in most cases, laboratory analyses were conducted on an untreated or raw water sample collected prior to any water treatment system. Many houses or wells may already have treatment systems in place to improve water quality. Therefore, the Voluntary Project test results may not reflect information regarding potable drinking water subsequent to the use of an installed treatment system. Further analysis of post-treatment samples collected at a kitchen tap is necessary to evaluate the effectiveness of any treatment system. In general, Voluntary Project test results are not confirmed through the collection and analysis of a second, or confirmation sample.

Although the Voluntary Project provides a previously unavailable sampling of water quality in domestic wells, the list of parameters is limited. Other types of compounds may be present in water if the well is near specific sources of contamination. Caution must be used not to infer that these contaminants are not present in the drinking water. Inferences about water quality may only be made for the tested parameters.

Domestic Well Water Testing

To assure the quality of domestic well water, the Voluntary Project encourages private well owners to test their drinking water supply for common contaminants once a year and general minerals every five years. At the minimum, tests for nitrates and coliform bacteria should be performed to detect potential contamination problems of these acute parameters as soon as possible. Testing should also be performed if domestic well water becomes discolored, has a particular odor or objectionable taste, someone in the household is pregnant or nursing, a neighbor finds an unsafe contaminant, or if it is suspected for any reason that the drinking water may contain any other kind of contamination. In addition, testing should be completed whenever a well pump is replaced or if a well is reconditioned.

Analytical tests on potable well water should be performed by a DHS certified drinking water test laboratory. A list of DHS Certified Laboratories can be attained by contacting the DHS Environmental Laboratory Accreditation Program (ELAP) office at (510) 540-2800 or visiting the DHS Internet site at http://www.dhs.ca.gov/ps/ls/ELAP/default.htm.

For more information…

For more information on the Voluntary Project or to review data summary reports from additional focus areas, please visit the State Water Board GAMA Internet site at http://www.waterboards.ca.gov/gama/ or contact the GAMA Program (916) 341-5250.

Figures

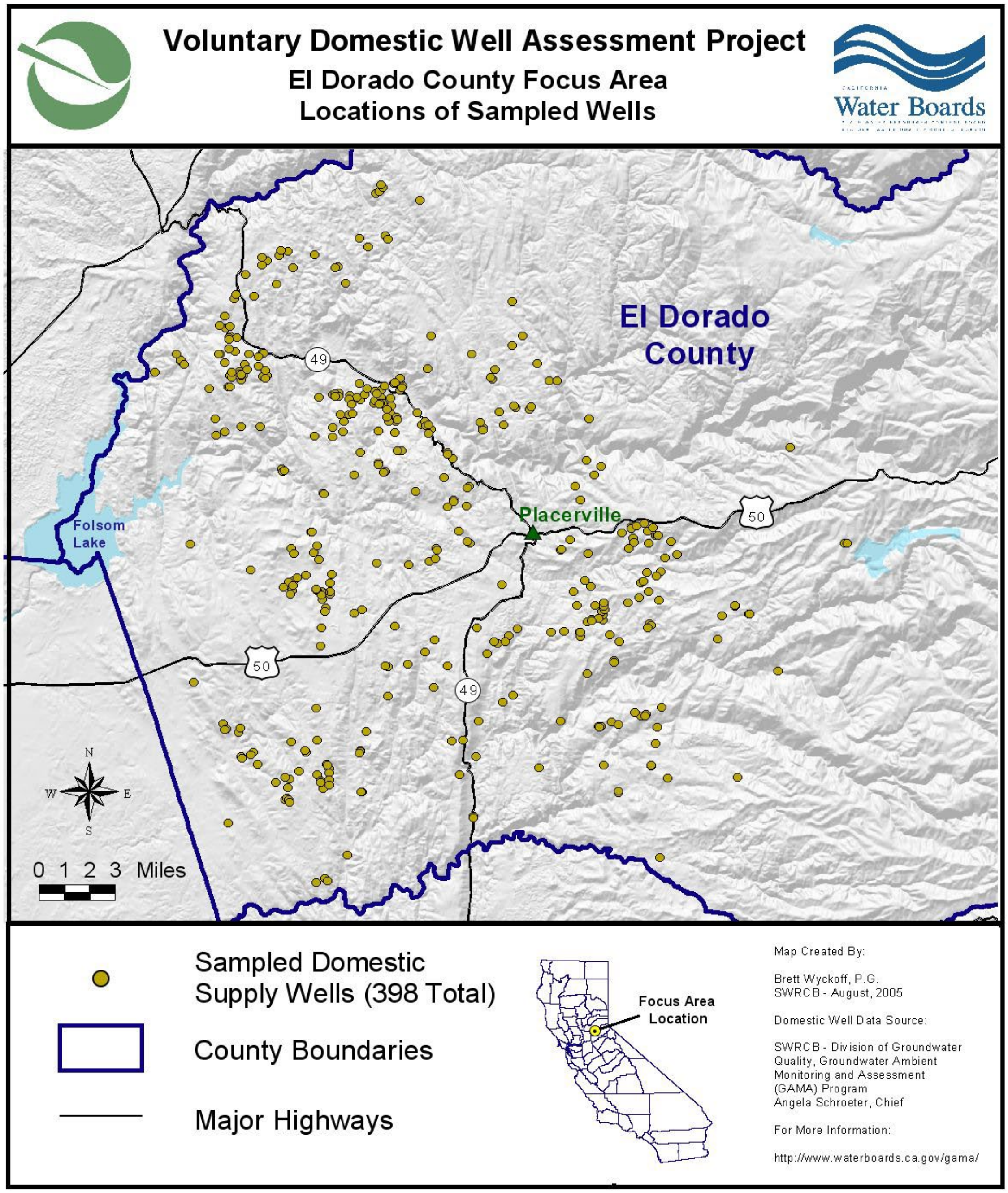

FIGURE 1. EL DORADO COUNTY DOMESTIC WELLS SAMPLED AS PART OF THE VOLUNTARY PROJECT.

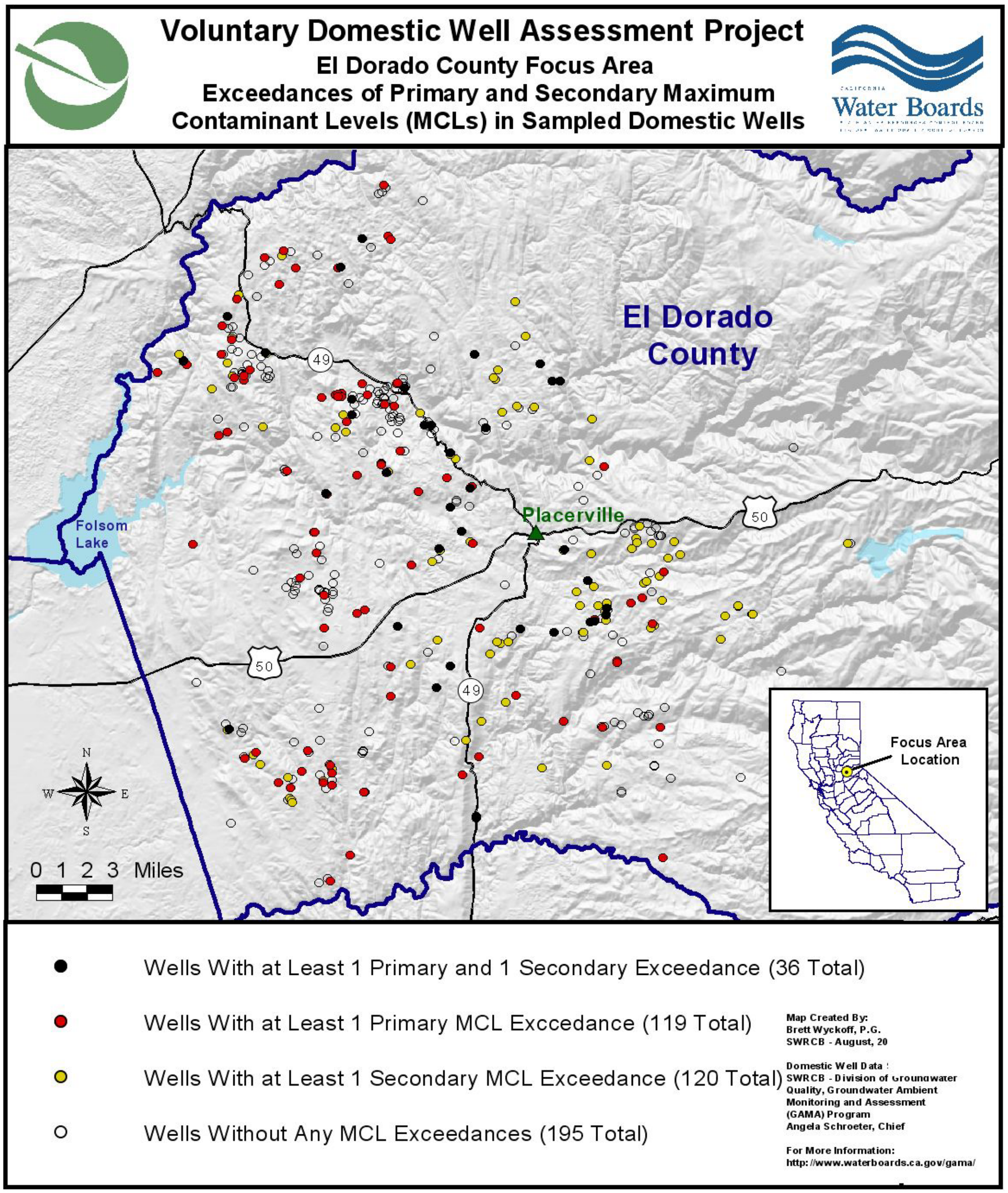

FIGURE 2. EL DORADO COUNTY WELLS SAMPLED AS PART OF THE VOLUNTARY PROJECT WITH DETECTIONS GREATER THAN STATE PRIMARY AND SECONDARY DRINKING WATER STANDARDS FOR PUBLIC WATER SYSTEMS.

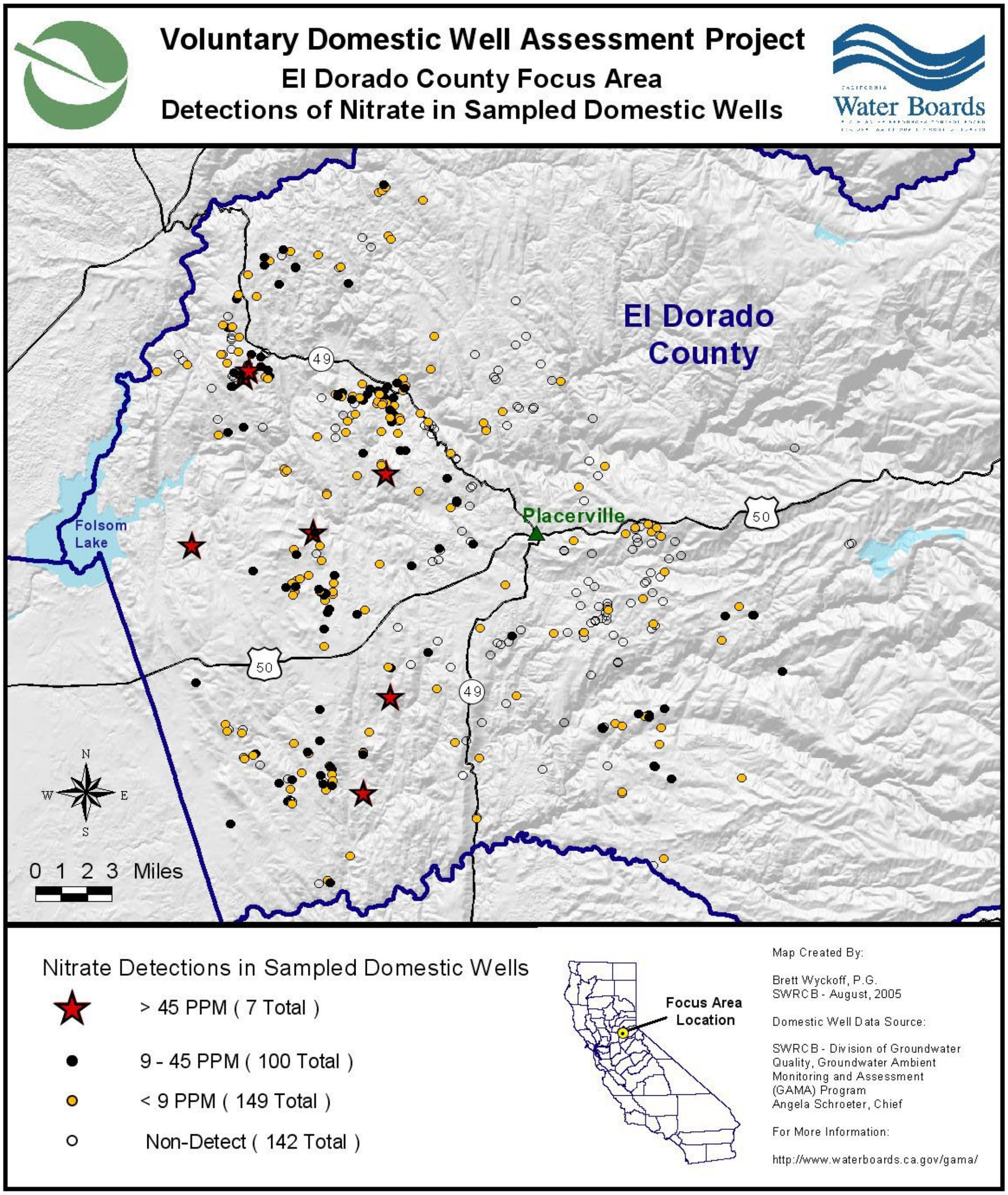

FIGURE 3. NITRATE (AS NO3) DETECTIONS IN EL DORADO COUNTY DOMESTIC WELLS SAMPLED BY THE VOLUNTARY PROJECT.

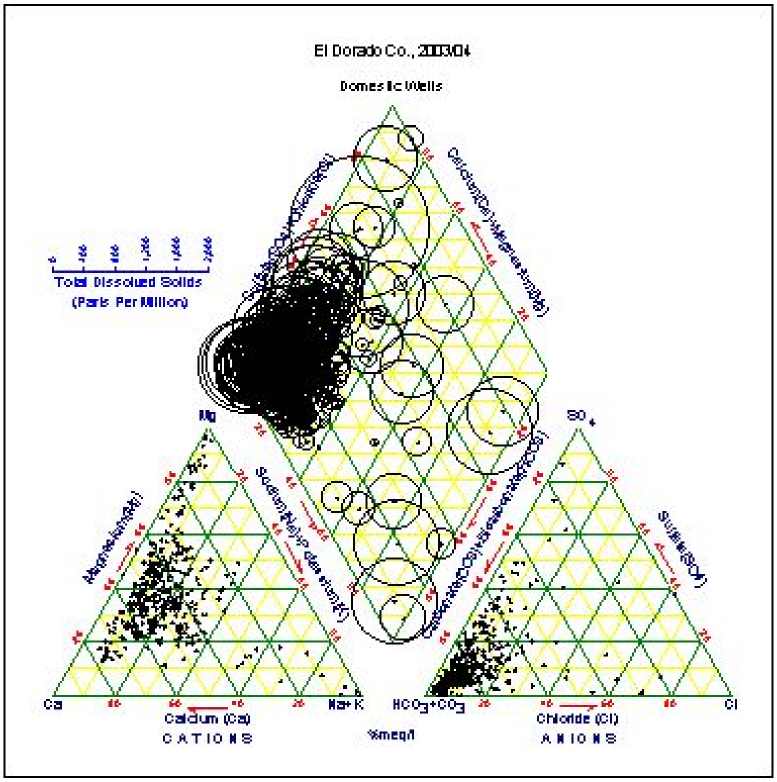

FIGURE 4. PIPER DIAGRAM FOR VOLUNTARY PROJECT GROUND WATER SAMPLES COLLECTED FROM 398 DOMESTIC WELLS IN EL DORADO COUNTY.

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3. California Wastewater Training and Research Center (CWTRC) and US Environmental Protection Agency (US EPA) Region 9, Status Report: Onsite Wastewater Treatment Systems in California, August 2003.

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5. EDAW, El Dorado County General Plan Environmental Impact Report, May 2003.

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11. State Water Resources Control Board, Report to the Governor and Legislature, A Comprehensive Groundwater Quality Monitoring Program For California, March 2003.

12. State Water Resources Control Board, Voluntary Domestic Well Assessment Project Sampling and Analysis Plan, 2003 and 2004.

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Appendix

The following is a detailed list of the analytes specific to the El Dorado County implementation of the Voluntary Domestic Well Assessment Project. Laboratory analytical data provided by Sierra Foothill Laboratory, Twining Laboratories, Alpha Analytical Laboratories Inc., and Lawrence Livermore National Laboratory.

Compound Name (Alias)	PQL[1] (µ g/L)	Number of detections above PQL	Concentration Range (µ g/L)
Microbiological			
Total Coliforms	1	111	Presence
Fecal Coliforms	1	14	Presence
General Minerals and Chemical Parameters			
Bicarbonate Alkalinity as CaCO3	1	397	6.3 - 490
Carbonate Alkalinity as CaCO3	4	1	8.3 - 60
Hydroxide Alkalinity as CaCO3	1000	0	-
Total Alkalinity as CaCO3	1	398	11 - 410
Carbonate	1000	NA	NA
Chloride	2	398	1.6 - 250
Color	3 Units	3	4 – 29 Units
Cyanide	0.02	0	-
Fluoride	0.1	212	0.1 – 1.6
Hardness, Total as CaCO3	5	397	2.1 - 680
Hydroxide	1000	NA	NA
Langelier Index	NA	NA	NA
Methyl Blue Activated Substances (MBAS)	50	47	50 - 130
Nitrate Nitrogen (NO3-N)	NA	NA	NA
Nitrate as NO3	1	256	Jan-84
Nitrate + Nitrite (as Nitrogen)	400	242	150 - 19000
Nitrite (as Nitrogen)	NA	NA	NA
Odor	1	7	1
pH, Laboratory	1	208	5.9 – 8.2
Specific Conductance, Laboratory	1	197	60 - 800
Sulfate as SO4	2	391	0.6 - 280
Total Dissolved Solids	10	398	24 - 890
Turbidity, Laboratory	0.1 NTU	7	0.12 – 48 NTU
Inorganic Chemicals			
Aluminum	50	48	50 - 1500
Antimony	6	2	12-Nov
Arsenic	2	94	2 - 110
Barium	10	99	11 - 900
Beryllium	1	0	-

Cadmium	1	1	2.3
Calcium	1	398	0.72 - 220
Chromium, Total	10	3	1 – 14
Copper	20	20	22 - 440
Iron	100	123	65 - 87000
Lead	5	12	3.6 - 110
Magnesium	1	397	0.16 - 210
Manganese	20	121	20 - 1800
Mercury	1	0	-
Nickel	10	25	6 - 150
Potassium	1	206	21-Jan
Selenium	5	4	12-Jun
Silver	10	0	-
Sodium	1	396	1.2 - 330
Thallium	1	0	-
Zinc	50	54	31 - 5800
Volatile Organic Chemicals			
Acetone	5	14	20 - 200
Acrylonitrile (Acritet)	5	0	-
Benzene	0.3	2	0.5 - 15
Bromobenzene	0.5	0	-
Bromochloromethane	0.5	0	-
Bromodichloromethane (Dichlorobromomethane)	0.5	1	0.5
Bromoform	0.5	1	38
Bromomethane	0.5	0	-
n-Butylbenzene	0.5	0	-
sec-Butylbenzene	0.5	0	-
Carbon disulfide	5	0	-
Carbon tetrachloride	0.5	0	-
Chlorobenzene (Monochlorobenzene)	0.5	0	-
Chloroethane	0.5	0	-
Chloroform	0.5	12	0.5 - 20
Chloromethane	0.5	0	-
2-Chlorotoluene	0.5	0	-
4-Chlorotoulene	0.5	0	-
1,2-Dibromo-3-chloropropane (DBCP)	0.5	0	-
1,2-Dibromoethane (Ethylene Dibromide, EDB)	0.5	0	-
Dibromomethane	0.5	0	-
1,2-Dichlorobenzene (o -DCB)	0.5	0	-
1,3-Dichlorobenzene	0.5	0	-

1,4-Dichlorobenzene (p-DCB)	0.5	0	-
1,2-Dichlorobenzene	NA	0	-
Dichlorodifluoromethane (CFC-12)	0.5	0	-
trans-1,4-Dichloro-2-butene	5	NA	NA
1,1-Dichloroethane (1,1-DCA)	0.5	0	-
1,2-Dichloroethane (1,2-DCA)	0.5	0	-
1,1-Dichloroethene (1,1-DCE)	0.3	0	-
cis-1,2-Dichloroethene(c-1,2-DCE)	0.5	0	-
trans-1,2-Dichloroethene(t-1,2-DCE)	0.5	0	-
Dichloromethane	0.5	2[a]	1.2
1,2-Dichloropropane	0.5	0	-
1,3-Dichloropropane	0.5	0	-
2,2-Dichloropropane	0.5	0	-
1,1-Dichloropropene	0.5	0	-
trans-1,3-Dichloropropene	0.5	0	-
Ethylbenzene	0.5	0	-
Hexachlorobutadiene	0.5	0	-
2-Hexanone	5	NA	NA
Isopropylbenzene	0.5	0	-
p-Isopropyltoluene	0.5	0	-
Methyl ethyl ketone	1	1	36
Methyl iodide	2	NA	NA
Methyl isobutyl ketone	1	0	-
Methyl-tert-butyl-ether (MTBE)	0.5	4	1.8 - 5.7
Methylene chloride (Dichloromethane)	0.5	2	1.2
Naphthalene	0.5	0	-
n-Propylbenzene (1-Phenylpropane)	0.5	0	-
Styrene	0.5	0	NA
1,1,1,2- Tetrachloroethane	0.5	0	-
tert-Amyl-Methyl Ether (TAME)	NA	0	-
tert-Butyl Alcohol (TBA)	2	1	5.5
Tert-Butylbenzene	NA	0	-
1,1,2,2-Tetrachloroethane	0.5	0	-
Tetrachloroethene (PCE)	0.5	1	0.66
Toluene	0.5	4	0.85 - 29
1,2,3-Trichlorobenzene	0.5	0	-
1,2,4-Trichlorobenzene	0.5	0	-
1,1,1-Trichloroethane (1,1,1-TCA)	0.5	0	-
1,1,2-Trichloroethane (1,1,2-TCA)	0.5	0	-
Trichloroethene (TCE)	0.5	0	-

1,1,2-Trichloro-1,2,2-trifluoroethane	0.5	0	-
Trichlorofluoromethane	0.5	0	-
1,2,3-Trichloropropane	0.5	0	-
Trihalomethanes (total)	0.5	6	0.5 - 21
1,2,4-Trimethylbenzene	0.5	0	-
1,3,5-Trimethylbenzene	0.5	0	-
Vinyl Chloride (VC)	0.5	0	-
m,p-Xylene	0.5	0	-
o-Xylene	0.5	1	1.2
Xylenes (total)	0.5	1	1.2
Additional Parameters			
Gross Alpha	NA	1	7.64 pCi/L
Stable isotopes of oxygen and hydrogen	NA	NA	NA

[1] Practical Quantitation Limit (PQL). In cases where multiple PQLs apply, the lowest PQL is indicated.
[a] Dichloromethane was also detected in one trip blank at a similar concentration.
NA – Data currently not available.