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GROUNDWATER AMBIENT MONITORING AND ASSESSMENT (GAMA)

DOMESTIC WELL PROJECT
GROUNDWATER QUALITY DATA REPORT
YUBA COUNTY FOCUS AREA

California State Water Resources Control Board
Groundwater Protection Section
July 2010

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ACKNOWLEDGEMENTS

The GAMA Program staff and management thank all of the volunteer well owners and cooperating county and state agencies that participated in the Yuba County Domestic Well Project.

ABBREVIATIONS AND ACRONYMS

CDPH	California Department of Public Health
DWR	California Department of Water Resources
EC	Electrical Conductivity
GAMA	Groundwater Ambient Monitoring and Assessment
LLNL	Lawrence Livermore National Laboratory
MCL	Maximum Contaminant Level
NL	Notification Level
SMCL	Secondary Maximum Contaminant Level
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
VOCs	Volatile Organic Compounds
μg/L	Micrograms per Liter
mg/L	Milligrams per Liter

ABSTRACT

The State Water Resources Control Board (State Water Board) established the Groundwater Ambient Monitoring and Assessment (GAMA) Program in 2000. Private domestic wells in Yuba County were sampled in 2002 as part of the GAMA Domestic Well Project. Yuba County was selected for sampling due to the large number of domestic wells located within the county and the availability of well-owner data. A total of 128 wells were sampled by Water Board staff, primarily in the valley and foothill areas of the county. The 128-well total includes wells sampled as part of an initial domestic well pilot project, and includes several wells in surrounding Sutter, Butte, Placer, and El Dorado Counties.

Groundwater samples were analyzed by an accredited environmental laboratory for commonly observed chemical constituents such as bacteria (total and fecal coliform), inorganic parameters (metals, major anions and general minerals), and volatile organic compounds (VOCs). Test results were compared against three public drinking water standards established by the California Department of Public Health (CDPH): primary maximum contaminant levels (MCLs), secondary maximum contaminant levels (SMCLs), and notification levels (NLs). These water quality standards are used for comparison purposes only, since private domestic well water quality is not regulated by the State of California. A total of fifteen constituents were detected at concentrations above public drinking water standards, of which two constituents were above multiple public drinking water standards. Ten constituents were detected above a primary MCL, and five constituents were above an SMCL. Two of the constituents detected above an SMCL were also above NLs.

The ten constituents detected at concentrations above a primary MCL included total and fecal coliform bacteria, aluminum, antimony, arsenic, nickel, nitrate, thallium, 1,2-dichloroethane, and trichloroethylene (TCE). Total coliform bacteria were the most frequently detected constituent above an MCL (31 wells). Fecal coliform bacteria were present in four wells. Arsenic was detected in seven wells at concentrations above the MCL. All other constituents detected above a primary MCL were observed in three or fewer wells.

The five constituents detected at concentrations above SMCLs included aluminum, iron, manganese, electrical conductivity (EC), and total dissolved solids (TDS). Manganese was the most frequently detected constituent above a drinking water standard, and was present in 39 wells at concentrations greater than the SMCL. Lead and manganese were detected at concentrations above NLs. Neither lead nor manganese exceeded the NL in more than two percent of the sampled wells.

INTRODUCTION

More than 95 percent of Californians get their drinking water from a public or municipal source - these supplies are typically treated to ensure that the water is safe to drink. However, private domestic wells supply drinking water to approximately 1.6 million Californians. Those served by public or municipal supplies should be concerned about groundwater quality too, as groundwater supplies part or all of the water delivered to approximately 15 million municipal public water supply users. Contaminated groundwater results in treatment costs, well closures, and new well construction which increases costs for consumers.

Groundwater is also an important source of irrigation and industrial supply water. Reliance upon this resource is expected to increase in the future, in part due to increased agricultural and industrial demand, drought, climate change, and population/land-use changes. Consequently, there are growing concerns regarding groundwater quality in California, and whether decreases in quality will affect the availability of this resource. Since the 1980s, over 8,000 public groundwater drinking water sources have been shut down – some due to the detection of chemicals such as nitrate, arsenic, or methyl tert-butyl ether (MTBE).

The State Water Board created the Groundwater Ambient Monitoring and Assessment (GAMA) Program to address public concerns over groundwater quality. The primary objectives of the GAMA Program are to improve comprehensive statewide groundwater monitoring and to increase the public availability of groundwater quality information. The data gathered by GAMA highlight regional and local groundwater quality concerns, and may be used to evaluate whether there are specific chemicals of concern in specific areas throughout the state. The GAMA Program consists of four current projects:

- **Domestic Well Project**: Samples domestic wells for commonly detected chemicals, at no cost to well owners who volunteer. To date, Domestic Well Project staff have sampled over 1,000 private domestic wells in five county focus areas: Yuba (2002), El Dorado (2003-2004), Tehama (2005), Tulare (2006), and San Diego (2008-2009).

- **Priority Basin Project**: A comprehensive, statewide groundwater monitoring program that primarily uses public groundwater supply wells in high-use, or “priority,” groundwater basins. These high-use basins contain more than 95% of all public groundwater supply wells. As of April 2009, the Priority Basin Project has sampled over 1,700 wells in over 90 different groundwater basins. The United States Geological Survey (USGS) is the project technical lead, with support from LLNL.

- **Special Studies Project**: Focuses on identification of contaminant sources and assessing the effects of remediation in private domestic and public supply wells. The Special Studies Project also studies aquifer storage and recovery projects. LLNL is the project technical lead.

- **GeoTracker GAMA**: A publicly-accessible, map-based on-line query tool that helps users find useful groundwater quality data and information.

This Data Summary Report summarizes Domestic Well Project results from 128 domestic wells sampled in the Yuba County Focus Area during 2002. Sampled well locations are shown in Figure 2.

Domestic Well Project Overview

Domestic wells differ from public drinking water supply wells in several respects; domestic wells are generally shallower, are privately owned, supply a single household, and tend to be located in more rural settings where public water supply systems are not available. Census data indicate that there are over 600,000 private domestic wells in California, supplying water to approximately 1.6 million Californians. Due to low pumping rates, the volume of groundwater use by domestic well owners is estimated at 2 percent of the total groundwater volume used in California. The State of California does not regulate water quality in private domestic wells. As a result, many well owners do not have an accurate assessment of their own well water quality.

Domestic well owners are responsible for testing the water quality of their domestic well to know if the water is safe for consumption. Domestic wells typically produce very high quality drinking water. However, poor well construction or placement close to a potential source of contamination can result in poor water quality. Chemicals from surface-related activities such as industrial spills, leaking underground fuel tanks, and agricultural applications can impact groundwater. Biological pathogens from sewers, septic systems, and animal facilities can infiltrate into groundwater. Naturally-occurring chemicals can also contaminate groundwater supplies.

Water quality testing results from the Domestic Well Project are compared to existing groundwater information and public supply well data to help assess California groundwater quality and to better identify issues that may impact private domestic well water.

HYDROGEOLOGIC SETTING

Major Water-Bearing Formations

Yuba County is located in the east-central portion of the Sacramento Valley. It is bounded on the west by the Feather River and to the east by the foothills of the Sierra Nevada. Westernmost Yuba County is characterized by the low-gradient, flat valley-fill sediments typical of the Central Valley. Geography in central and eastern Yuba County is comprised of rolling foothills and higher-elevation areas bisected by steep canyons.

While some isolated groundwater basins are found in the Sierra Nevada Mountains, the majority of the water-bearing formations are located in the valley portion of the county in the Yuba Basin. The Department of Water Resources divides the Yuba Basin into north and south sections (Department of Water Resources Basin Numbers 5-21.60 and 5-21.61). The major water-bearing geologic formations in the basin include:

- Cretaceous and Eocene deposits*:* Cretaceous-age deposits (65-145 million years old) underlie most of the Central Valley, usually at great depth. Cretaceous-age deposits are found at depths of approximately ~600 feet in portions of Yuba County. Eocene-age deposits (55 to 34 million years old) lie above the Cretaceous sediments. The Ione Formation is probably the most well-known of these deposits and consists of sands and clays that formed in a fluvial-estuarine environment. Eocene deposits are generally found between ~250 and 480 feet below ground surface.

- The Mehrten Formation: The late Miocene to mid-Pliocene (approximately 16 to 3.4 million years old) Mehrten formation has limited surface exposure in Yuba County. However, the Mehrten is found at depth throughout much of the county. The Mehrten is composed of fluvial dark volcanic sands, gravels, and clay beds. The coarse-grained units can produce high quantities of water.

- The Laguna Formation: The Pliocene (5.3 to 2.5 million years old) Laguna Formation consists of silts and clays with thin and discontinuous sands and gravels. The Laguna is intermittently exposed along the east side of the Central Valley in Yuba County. While the Laguna is a major water-bearing formation, yields are often low in comparison to younger coarser-grained sediments due to the fine grained nature of the deposit.

- The Older Alluvium Formation: The Pleistocene (2.5 to 0.012 million years old) Older Alluvium is the predominant surface geologic deposit in Yuba County. The deposit consists of silt, sand, and gravels with minor clay. The thickness of the deposit varies, ranging from the surface to a maximum depth of approximately 150 feet. Wells drilled into this formation may yield up to 2,000 gallons per minute (gpm).

- Other floodplain, stream channel, and dredger tailing deposits: Younger floodplain and river channel deposits consisting of coarse gravels, conglomerates, and sands are located throughout the county. These deposits are important groundwater recharge areas. Extending downstream from the Sierras, river valleys have been extensively mined for gold. The remnant deposits, called dredger tailings, may be in excess of 125 feet thick in locations.

Groundwater levels in Yuba County show seasonal drawdown due to summer crop and landscape irrigation. Areas that use groundwater as the primary water supply typically show increased seasonal drawdown, while areas that use more surface water supplies show relatively small seasonal variation in groundwater elevation.

METHODS

Well Selection

Yuba County was selected by GAMA due to the large number of private domestic wells within the county and the availability of electronic well owner data. Yuba County is not considered a major groundwater user in California (Figure 3). However, Yuba County has been active in groundwater management, and encouraged the State Water Board to conduct the initial Domestic Well Project focus area within the county.

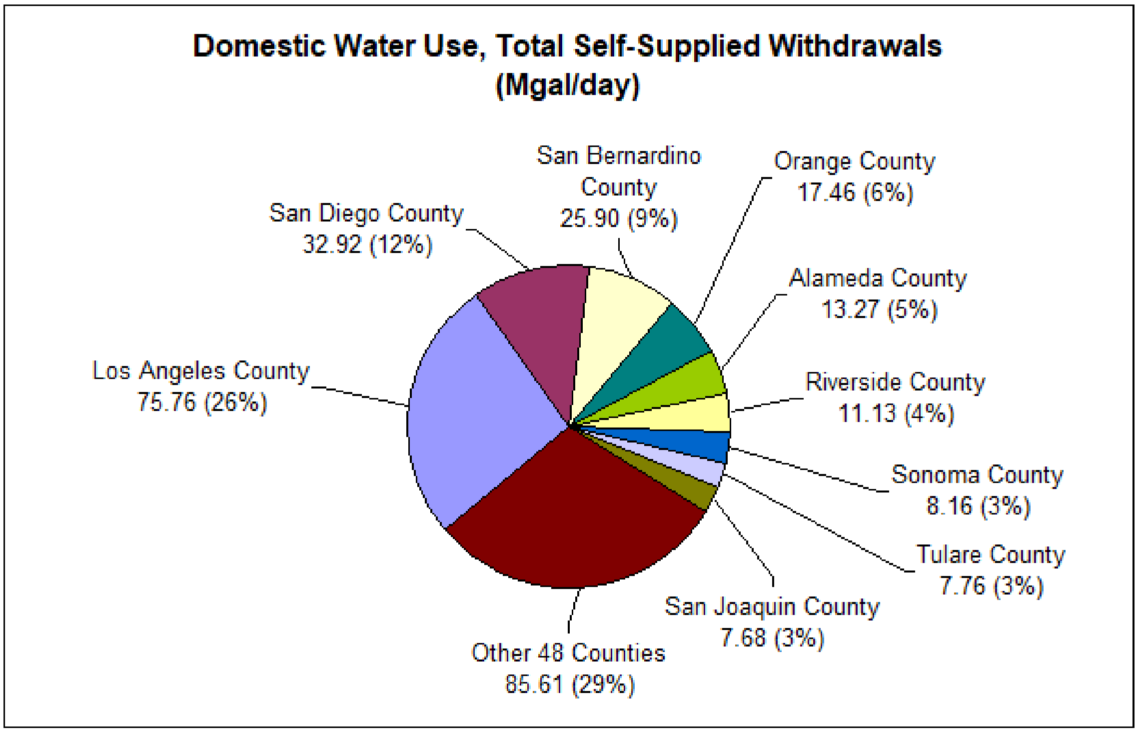


Figure 1: Top Ten California Counties for Domestic Water Use

Source: USGS, 2000

Prior to sampling within Yuba County, the State Board conducted a Pilot Project sampling event. The purpose of the Pilot Project was to outline sampling techniques, methods, and quality control procedures for future domestic well sampling. State Board staff contacted ten potential participants that owned domestic wells in local communities. Flyers announcing free domestic well sampling were mailed to the ten well owners. Nine of the ten owners responded to the flyer indicating that they were willing to participate in the pilot study and have their wells tested. Testing for the Pilot Project occurred in January 2002.

Yuba County officials provided GAMA with an electronic database with location information for over 900 domestic well owners. Flyers announcing free domestic well testing were mailed to 792 Yuba County residents. Ninety-eight well owners responded to the flyer requesting that State Board staff test their well water.

Twenty-eight well owners heard through word-of-mouth that free testing was being offered and contacted GAMA staff directly. Eleven former residents of Yuba County received a forwarded flyer and requested that the wells at their new residences be sampled. These eleven residents resided in Butte, El Dorado, Placer, and Sutter Counties. The testing results from these wells were included in the Yuba County Focus Area. Several residents who initially volunteered later withdrew from the project, leaving a total of 106 participants who owned a total of 119 wells. These 119 wells were sampled during spring and summer 2002. The addition of the nine Pilot Project wells brings the total number of wells with results included in the Yuba County focus area to 128.

Sample and Data Collection

Well construction information was obtained from either well owners or well completion reports (well logs). Observations at each well noted the location of nearby septic systems, large-scale agriculture, or livestock enclosures that could result in contamination of the well. Well locations were recorded using a Geographic Positioning Satellite (GPS) unit. Water temperature, pH, and specific electrical conductance were measured and documented in the field.

Groundwater samples were collected as close to the well head as possible. Most often the sample was collected from a faucet or spigot just before or after the pressure tank. New nitrile gloves were worn by field staff during sample collection to minimize contamination during sampling. Samples were collected in laboratory supplied pre-cleaned bottles, and were stored in an iced cooler until delivery to the lab within 24 hours.

Trip blank and duplicate samples were collected at approximately 10 percent of the well locations. These samples are collected and analyzed to help determine if cross contamination was introduced during sample collection, processing, storage, and/or transportation. All trip blank and duplicate data results were within acceptable range criteria.

Test Results

Groundwater samples were tested by Sierra Foothills Laboratory, in Jackson, California for the following:

- Bacteria (total and fecal coliform)
- Inorganics (metals, major anions and general minerals)
- Volatile organic compounds (VOCs)

Test results were mailed to the Yuba domestic well owners in a letter from the State Water Board. A summary list of test results was also shared with State and local health officials to assist in well owner inquiries and concerns.

RESULTS

Well Locations

Seventy-eight of the 128 (61%) Yuba County focus area wells were located within the Sierra foothills area; the remaining 41 wells (39%) are located within the Yuba sub-basin or other Central Valley aquifers (Figure 2). The majority of the Pilot Study wells are located in the foothill regions of El Dorado and Placer Counties.

Well Construction Data

Well completion depth data were available for 101 of the sampled wells. The data comes from driller's reports provided by the well owners, word-of-mouth information from the well owners, and information provided by Yuba County Department of Environmental Health. Well completion depths are shown in Table 1. Approximately half of the sampled wells were completed between 100 and 200 feet below ground surface (bgs). This suggests that the shallow aquifer system provides an adequate supply and quality for domestic use. A number of wells were completed a depths greater than 200 feet bgs, including six wells completed at depths over 550 feet bgs.

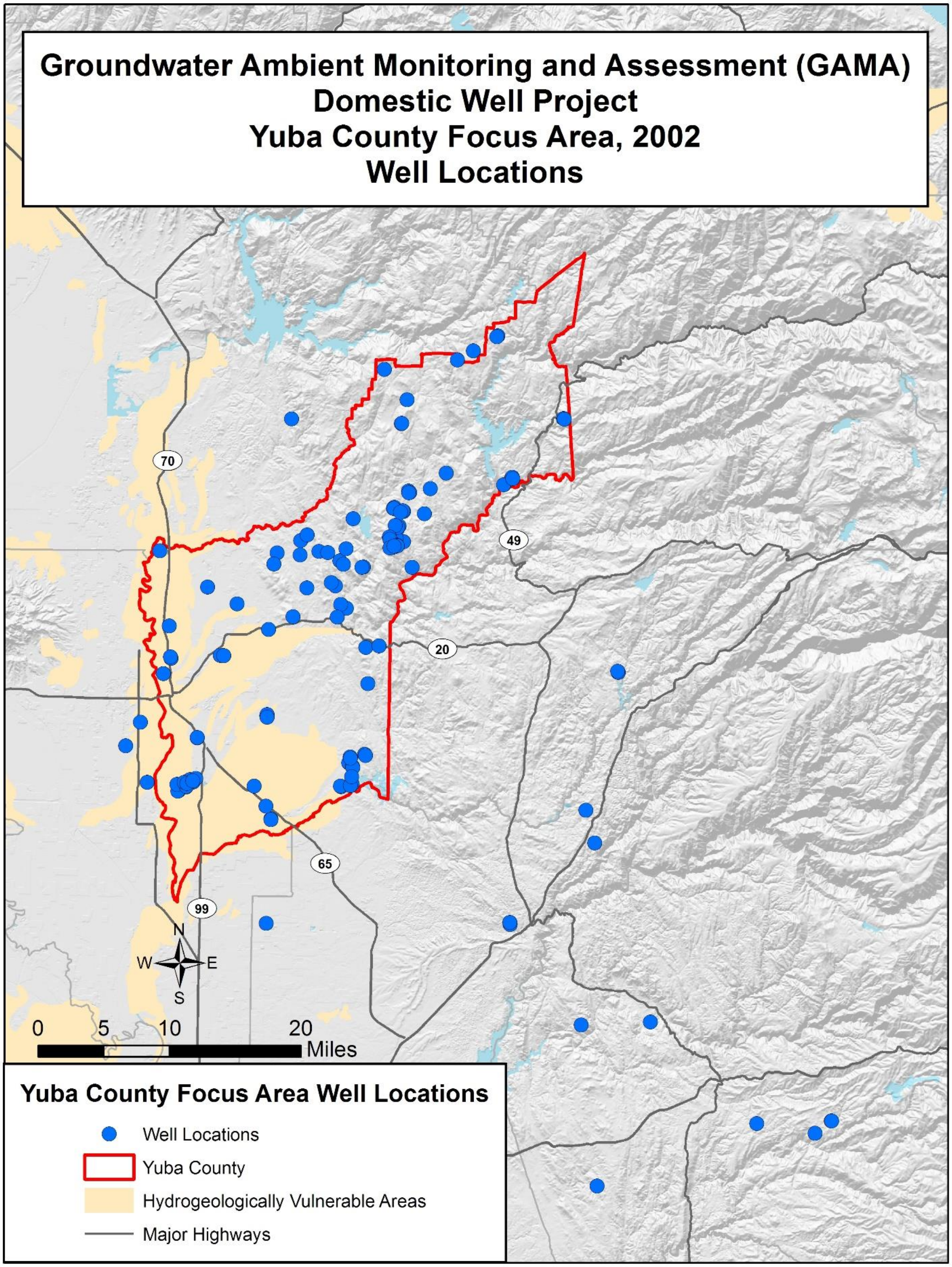
Table 1: Domestic Well Depths

GAMA Domestic Well Project, Yuba County Focus Area

Total Well Depth (feet bgs)	Number of Wells
0-49	0
50-99	8
100-149	29
150-199	21
200-249	8
250-299	9
300-349	5
350-399	6
400-449	3
450-499	4
500-549	2
>550	6

Note: Well construction data not available for all wells

Figure 2: Locations of Sampled Domestic Wells



<u>Detections Above a Drinking Water Standard</u>

The Domestic Well Project compares analytical results to Federal and State water quality standards established to protect public (municipal) drinking water quality: CDPH primary maximum contaminant levels (MCLs), secondary MCLs (SMCLs), and notification levels (NLs). The MCL is the highest concentration of a contaminant allowed in public drinking water. Primary MCLs address health concerns, while secondary MCLs (SMCLs) address aesthetics, such as taste and odor. NLs are health-based advisory levels for chemicals in public drinking water that do not have an MCL or SMCL. These water quality standards are used for comparison purposes only, since private domestic well water quality is not regulated by the State of California.

Analytes that were detected in one or more wells above a drinking water standard:

- Total and Fecal Coliform Bacteria
- Nitrate (NO_3^-)
- Aluminum
- Arsenic
- Antimony
- Nickel
- Lead
- Iron
- Manganese
- Thallium
- Electrical Conductivity (EC) and Total Dissolved Solids (TDS)
- 1,2-Dichloroethane
- Trichloroethylene (TCE)

A summary of all analytes detected above a drinking water standard is outlined in Table 2. Detailed results of the domestic well sampling are summarized below.

<u>Coliform Bacteria</u>

Total coliform bacteria were detected in 31 wells (24% of 128 wells). Four of the wells with positive total coliform detections also tested positive for fecal coliform (3% of sampled wells). Figure 3 shows the distribution of total and fecal coliform bacteria detected in sampled domestic wells.

Table 2: Summary of Detections Above a Drinking Water Standard

GAMA Domestic Well Project – Yuba County Focus Area (2002)

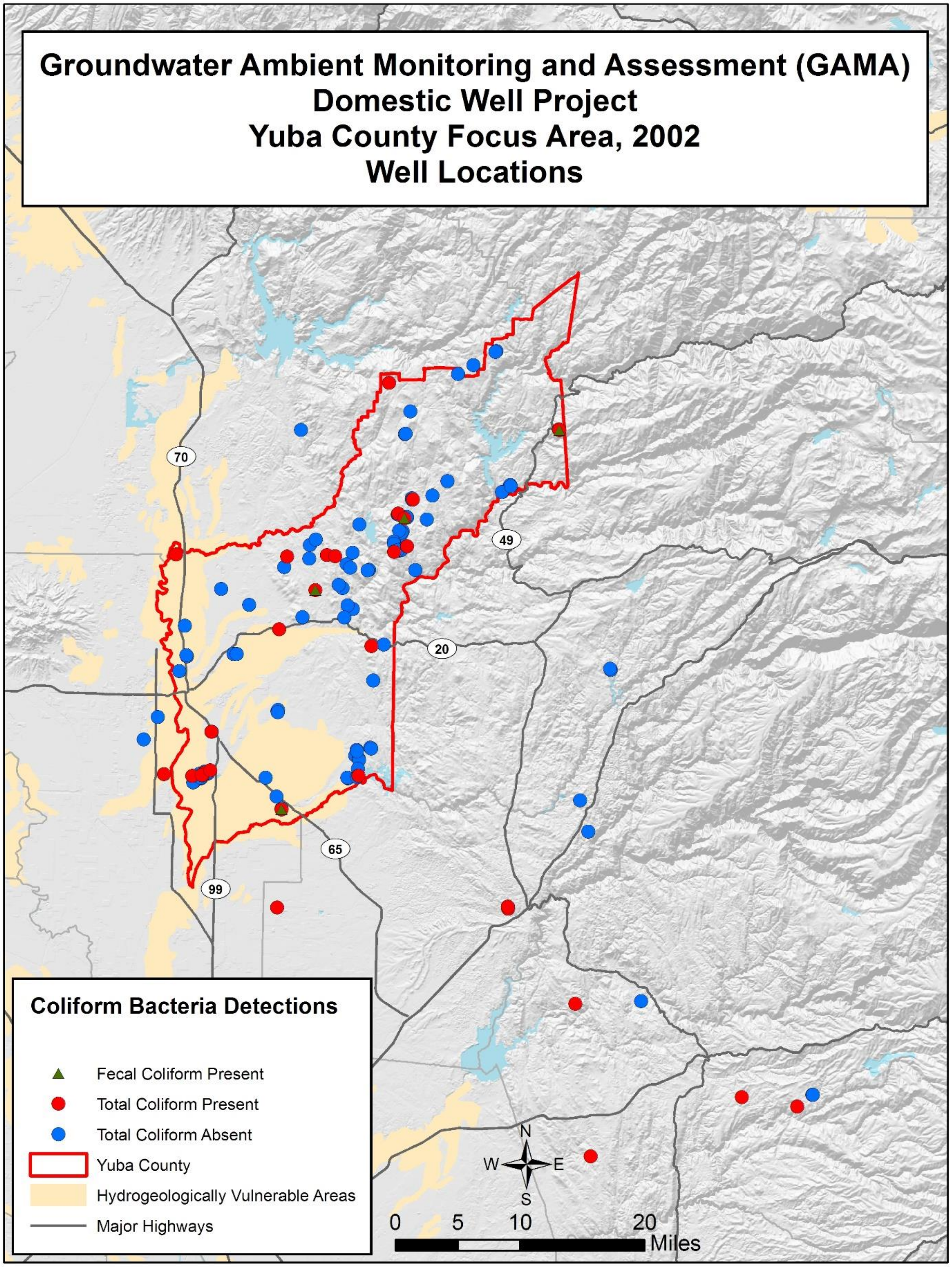
Total Number of Wells Sampled: 128[1]

Compound	Number of Wells above Public Drinking Water Standards	Percentage	Range of Detections Above a Public Drinking Water Standard	Public Drinking Water Standard[2,3] MCL	Public Drinking Water Standard[2,3] SMCL	Public Drinking Water Standard[2,3] NL
Bacteria Indicators						
Total Coliform	31	24%	NA[4]	Present		
Fecal Coliform	4	3%	NA[4]	Present		
Metals						
Aluminum	26	20%	201 – 1,630 µg/L	1,000 µg/L	200 µg/L	
Antimony	1	1%	6.2 µg/L	6 µg/L		
Arsenic	7	5%	11 – 29 µg/L	10 µg/L		
Iron	21	17%	310 – 9,440 µg/L		300 µg/L	
Lead	2	2%	45 – 60 µg/L			15 µg/L
Manganese	39	30%	60 – 1,690 µg/L		50 µg/L	500 µg/L
Nickel	2	2%	113 – 180 µg/L	100 µg/L		
Thallium	1	1%	2.2 µg/L	2 µg/L		
Major Ions						
Electrical Conductivity (EC)	2	2%	1,670 – 2,020 µmhos/cm		1,600 µmhos/cm	
Nitrate (NO_3^-)	2	2%	57 – 59 mg/L	45 mg/L		
Total Dissolved Solids (TDS)	2	2%	1,230 – 1,240 mg/L		1,000 mg/L	
Organic Compounds (VOCs)						
1,2-Dichloroethane	1	1%	1.4 µg/L	0.5 µg/L		
Trichloroethylene (TCE)	1[5]	1%	180 µg/L	5 µg/L		

Notes:

1. Includes Pilot Study wells, and wells in the following adjacent counties: El Dorado (7), Placer (6), Sutter (3), Butte (2) and Nevada (2).
2. MCL = California Department of Public Health (CDPH) Primary Maximum Contaminant Level; SMCL = CDPH Secondary Maximum Contaminant Level; NL = CDPH Notification Level
3. µg/L = micrograms per liter, or parts per billion (ppb); mg/L = milligrams per liter, or parts per million (ppm). A microgram is 1/1000th of a milligram.
4. Coliform are evaluated on a presence/absence criteria. No range can be determined.
5. A duplicate sample collected from this same well only minutes later had a TCE concentration of zero µg/L.

Figure 3: Total and Fecal Coliform Results



General Minerals

General minerals detected in domestic well samples are summarized in Table 3. General minerals include measures of alkalinity, hardness, and total dissolved solids (TDS). All of the general minerals listed in Table 3, with the exception of foaming agents (MBAS), naturally occur in groundwater. However, human activities such as using laundry detergents, water softeners, and some agricultural activities can sometimes change the concentrations of these minerals in groundwater.

There are no established regulatory levels for many general mineral analytes; only foaming agents (MBAS), EC, and TDS have SMCLs. MBAS, which are typically associated with the presence of detergents, were not detected in any sample. TDS, which is an estimate of the total concentration of all non-settleable (dissolved) components in water, was detected at concentrations above the SMCL (1,000 mg/L) in two wells. EC was also measured above the SMCL (1,600 µmhos/cm) in two wells.

Table 3: General Minerals

GAMA Domestic Well Project, Yuba County Focus Area

Analyte	Range of Detected Values (mg/L)	Public Drinking Water Standard (mg/L)	Number of Wells Above Standard
Total Alkalinity (as $CaCO_3$)	12 – 492	NA	–
Bicarbonate	12 – 492	NA	–
Carbonate	5.9 – 8.3	NA	–
Calcium	3.2 – 164	NA	–
Magnesium	0.97 – 143	NA	–
Sodium	0.69 – 114	NA	–
Foaming Agents (MBAS)	All <0.10	0.5 SMCL	0
Hardness (Total) as $CaCO_3$	10 – 997	NA	–
pH, Laboratory	5.9 – 8.1	NA	–
Total Dissolved Solids (TDS)	38 – 1,240	1,000 SMCL	2
Electrical Conductivity (EC)	28 – 2,020	1,600 µmhos/cm SMCL	2

Notes:
1. SMCL = Secondary Maximum Contaminant Level
2. mg/L = milligrams per liter
3. NA = Health or aesthetic standards are not available for this constituent
4. µmhos/cm = micromhos per centimeter

Major Anions

Major anions detected in domestic well samples are summarized in Table 4. Only nitrate (NO_3^-) was detected above a drinking water standard. Nitrate was detected in 76 total wells and was detected in two wells above the MCL (45 mg/L as NO_3^-). Chloride, fluoride, nitrite, and sulfate were detected at concentrations below applicable drinking water standards.

Table 4: Major Anions

GAMA Domestic Well Project, Yuba County Focus Area

Analyte	Range of Detected Values (mg/L)	Public Drinking Water Standard (mg/L)	Number of Wells Above Standard
Chloride	1 – 429	500 SMCL	0
Fluoride	0.1 – 0.41	2 MCL	0
Nitrate (as NO_3^-)	0.23 – 57.59	45 MCL	2
Nitrite (as N)	0.093	1 MCL	0
Sulfate	0.71 – 292	500 MCL	0

Notes:
1. MCL = Maximum Contaminant Level, SMCL = Secondary Maximum Contaminant Level
2. mg/L = milligrams per liter

Metals

Metals detected in domestic well samples are summarized in Table 5. Seven metals (aluminum, arsenic, antimony, iron, lead, nickel, and manganese) were detected at concentrations above a public drinking water standard. A summary of all metals detected above a drinking water standard is provided below. Arsenic, aluminum, manganese, and iron detections are shown in Figure 4 through Figure 7, respectively.

- Aluminum was detected in 126 wells, at concentrations ranging from 21 to 1,630 µg/L. Aluminum was detected above the SMCL (200 µg/L) in 26 wells, and was detected above the primary MCL (1,000 µg/L) in three wells.

- Arsenic was detected in 50 wells, at concentrations ranging from 2.2 to 29 µg/L. Arsenic was detected above the MCL (10 µg/L) in seven wells.

- Antimony was detected in one well at a concentration of 6.2 µg/L, above the MCL (6 µg/L).

- Iron was detected in 70 wells, at concentrations ranging from 50 to 9,400 µg/L. Iron was detected above the SMCL (300 µg/L) in 21 wells.

- Lead was detected in 18 wells, at concentrations ranging from 3 to 60 µg/L. Lead was detected above the NL (15 µg/L) in two wells.

- Manganese was detected in 59 wells, at concentrations ranging from 2 to 1,690 µg/L. Manganese was detected above the SMCL (50 µg/L) in 39 wells, and above the NL (500 µg/L) in two wells.

- Nickel was detected in eight wells, at concentrations ranging from 3.3 to 180 µg/L. Nickel was detected above the MCL (100 µg/L) in two wells.

- Thallium was detected in nine wells, at concentrations ranging from 1 to 2.2 ug/L. Thallium was detected above the MCL (2 µg/L) in one well.

The locations of wells with detections above a drinking water standard for arsenic, aluminum, manganese, and iron are shown in Figure 4 through Figure 7, respectively.

Table 5: Metals

GAMA Domestic Well Project, Yuba County Focus Area

Analyte	Range of Detected Values (µg/L)	Public Drinking Water Standard (µg/L)	Number of Wells Above Standard
Aluminum	21 – 1,630	200 SMCL 1,000 MCL	26 3
Antimony	6.2	6 MCL	1
Arsenic	2.2 – 29	10 MCL	7
Barium	11 – 680	1,000 MCL	0
Beryllium	< 1.0	4 MCL	0
Cadmium	2.2	5 MCL	0
Chromium (Total)	1 – 38	50 MCL	0
Copper	4 – 21	1,000 SMCL	0
Iron	50 – 9,400	300 SMCL	21
Lead	3 – 60	15 NL	2
Manganese	2 – 1,690	50 SMCL 500 NL	39 2
Nickel	3.3 – 180	100 MCL	2
Selenium	1 – 7.5	50 MCL	0
Silver	<10.0	100 SMCL	0
Thallium	1 – 2.2	2 MCL	1
Zinc	20 – 970	5,000 SMCL	0

Notes:

1. MCL = Maximum Contaminant Level, SMCL = Secondary Maximum Contaminant Level, NL = Notification level
2. µg/L = micrograms per liter

Figure 4: Arsenic Concentrations

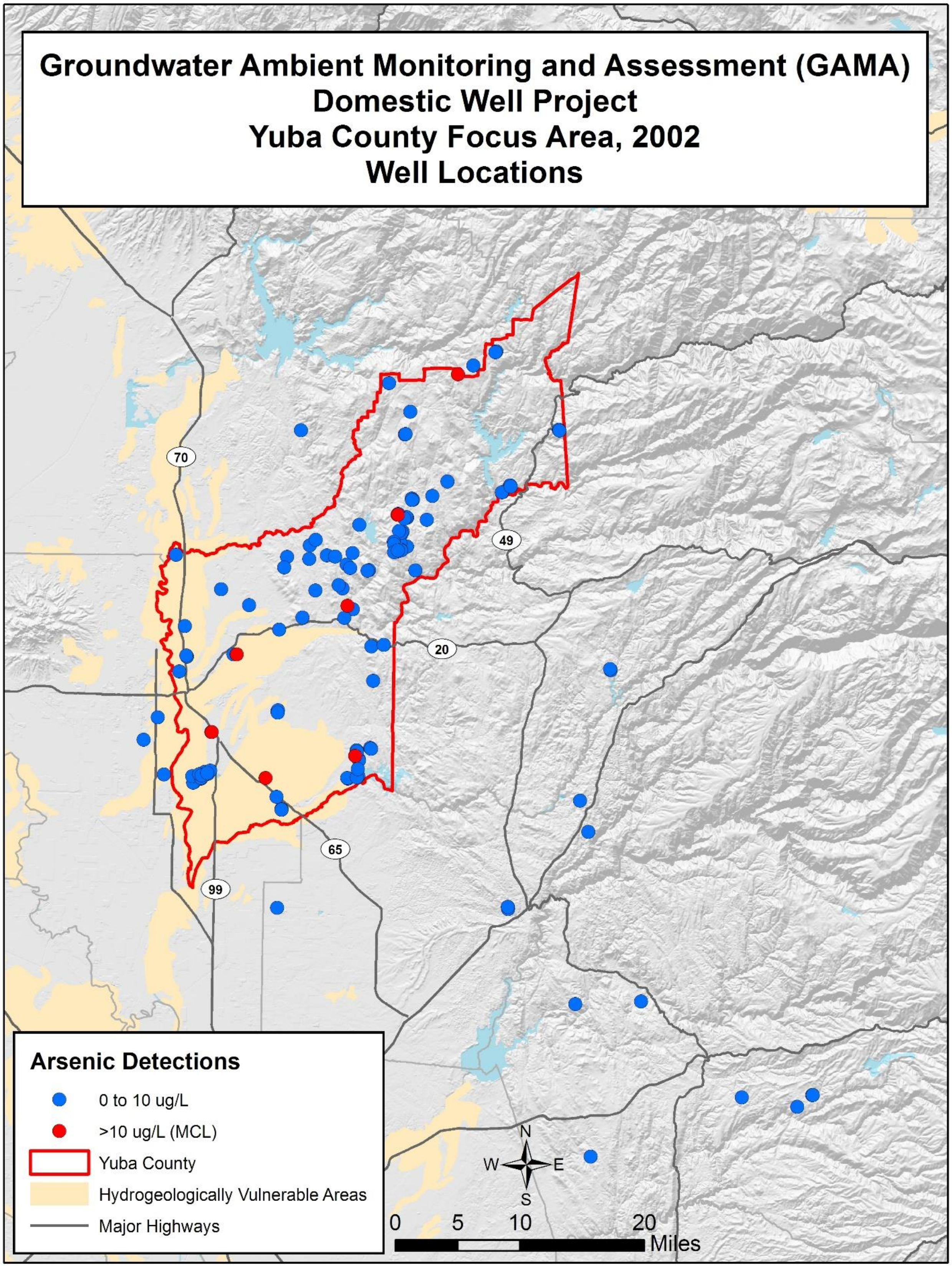


Figure 5: Aluminum Concentrations

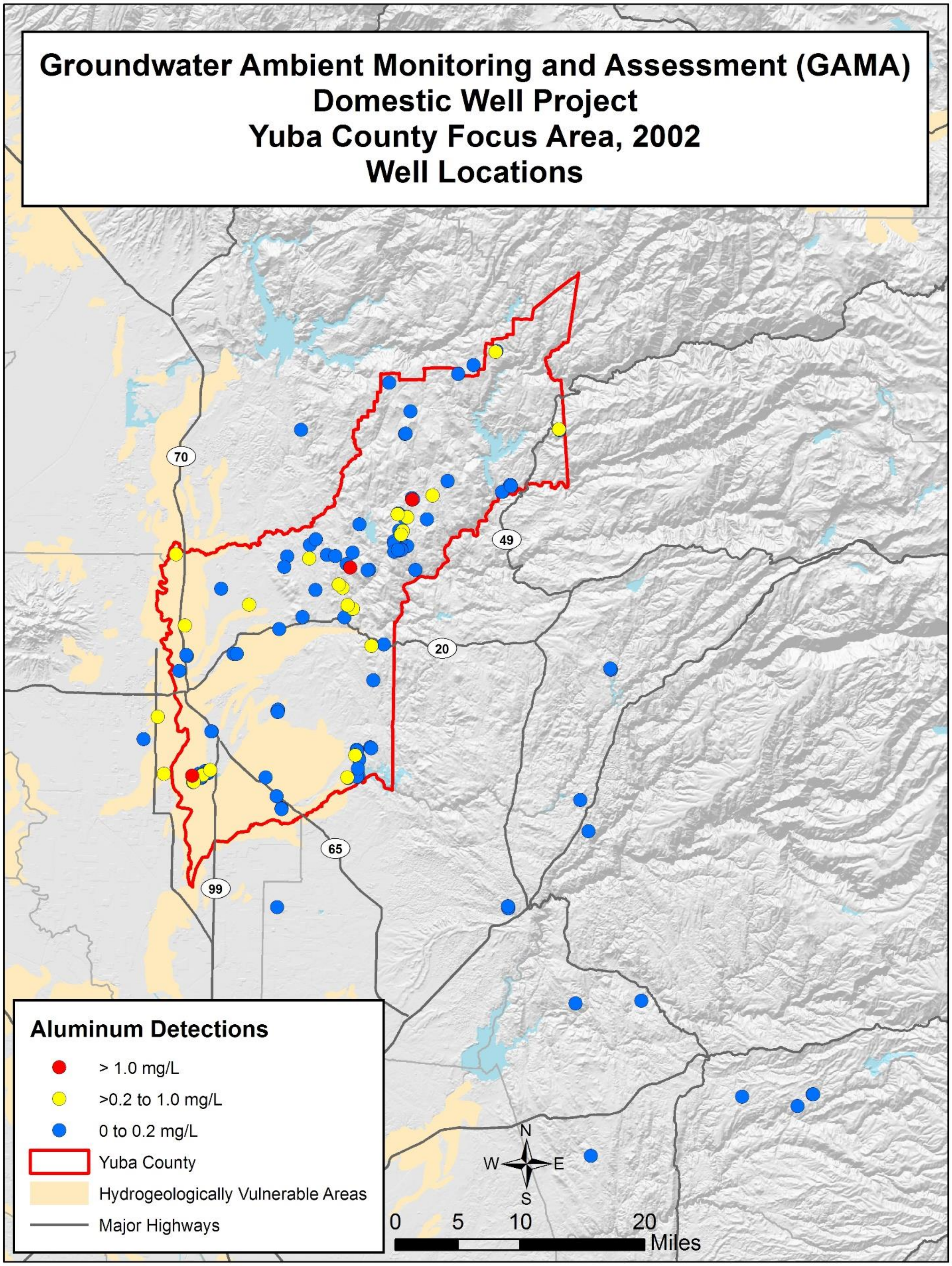


Figure 6: Manganese Concentrations

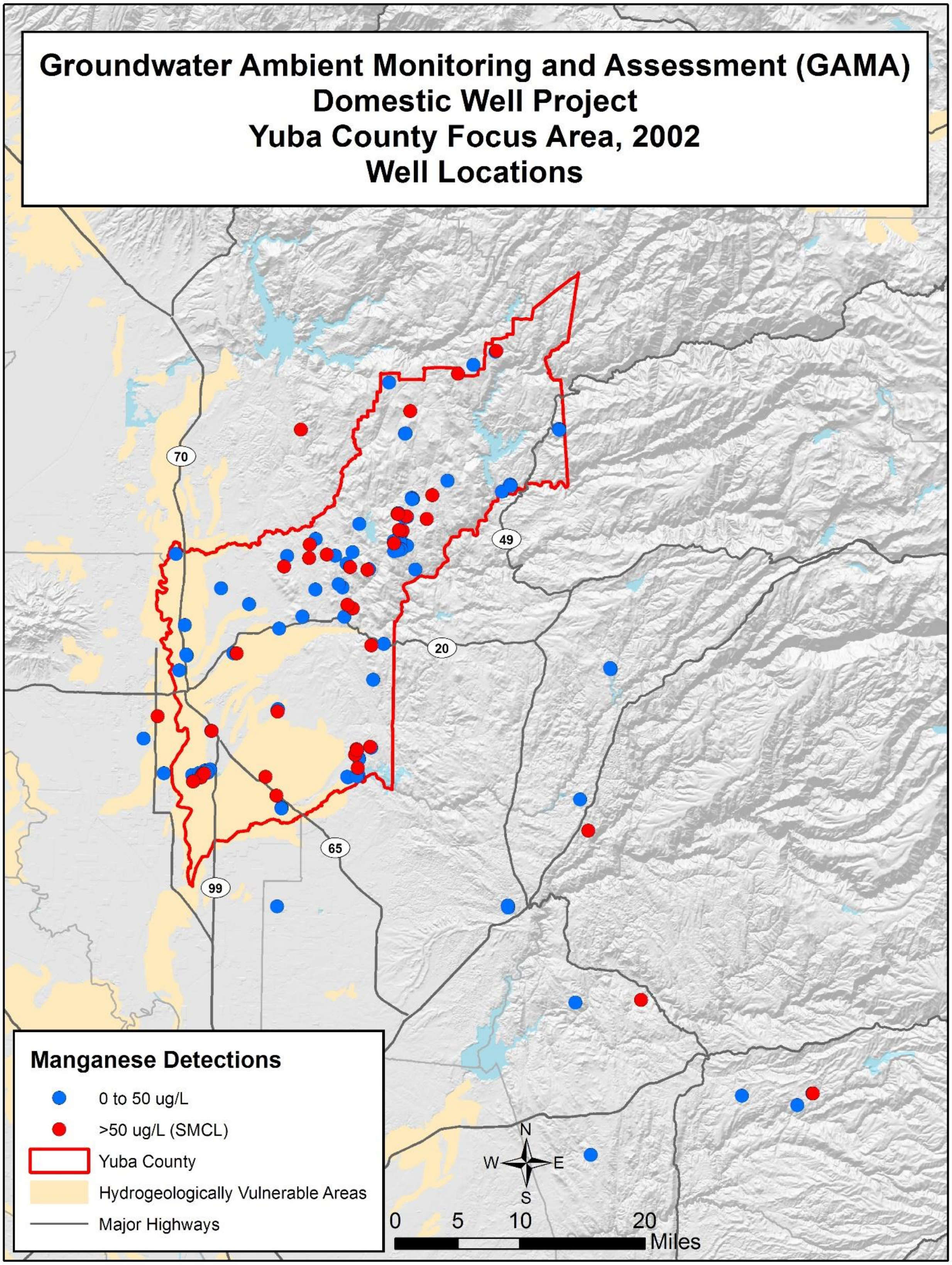
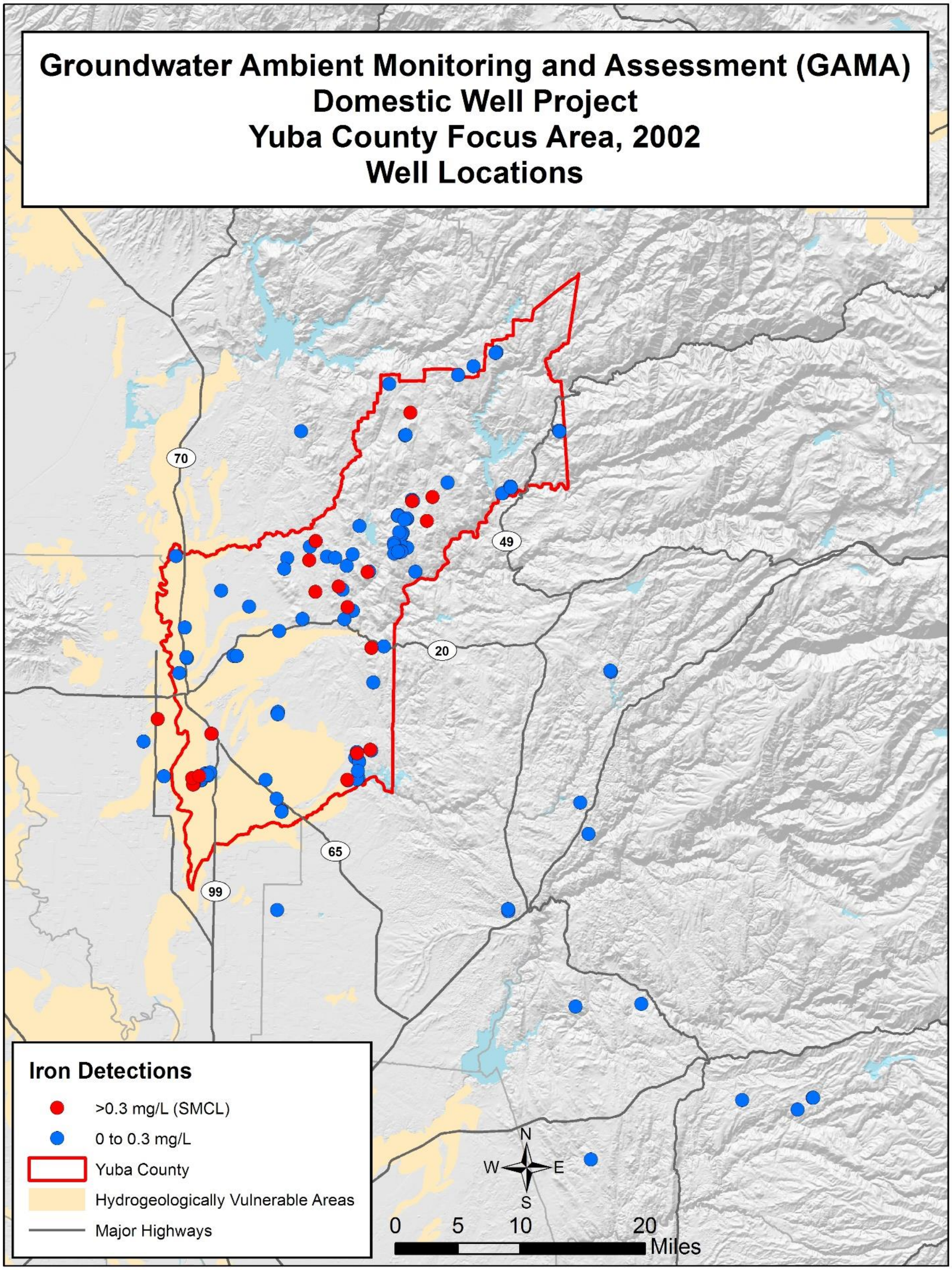


Figure 7: Iron Concentrations



Volatile Organic Compounds (VOCs)

VOCs detected in domestic wells are summarized in Table 6. Two VOCs were detected at concentrations above public drinking water standards. Low-level concentrations of four additional VOCs were detected.

- 1,2-Dichloroethane was detected in one well at a concentration of 1.4 µg/L, above the MCL of 0.5 µg/L.

- Trichloroethylene (TCE) was detected in one well at a concentration of 180 µg/L, above the MCL of 5 µg/L. However, TCE was not detected in a second duplicate sample collected from the same well only moments after the initial sample.

- Tetrachloroethylene (PCE) was detected in one well at a concentration of 3.6 µg/L, below the MCL of 5 µg/L.

- Toluene was detected in two wells at concentrations ranging from 1.2 to 3.2 µg/L. Toluene was below the MCL (150 µg/L) in both wells.

- 2-Butanone (Methyl Ethyl Ketone, or MEK) was detected in one well at a concentration of 54 µg/L. There is no primary or secondary MCL for 2-butanone.

- MTBE was detected in one well at a concentration of 1.9 µg/L. The detection was below the SMCL (5 µg/L) and MCL (13 µg/L).

Table 6: Volatile Organic Compounds (VOCs)

GAMA Domestic Well Project, Yuba County Focus Area

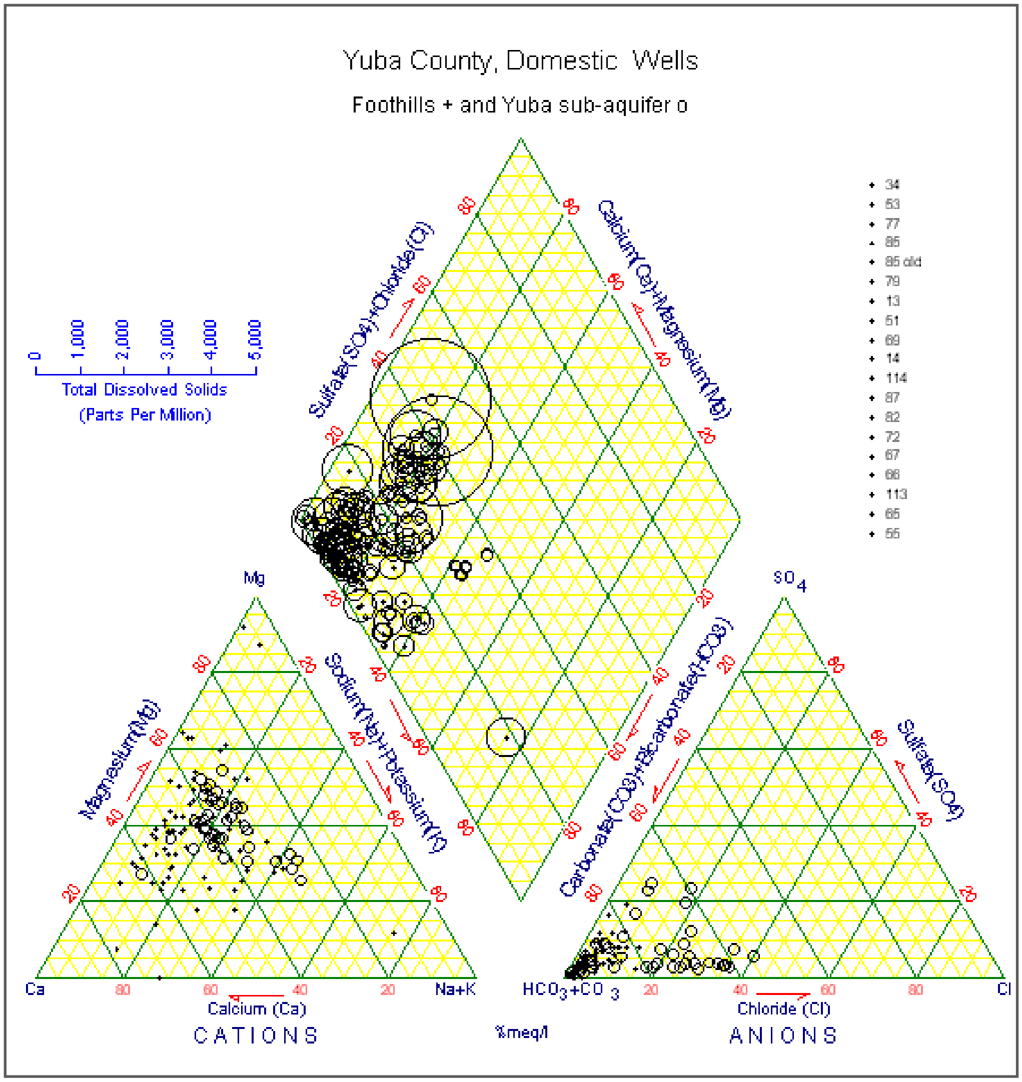
Analyte	Range of Detected Values (µg/L)	Public Drinking Water Standard (µg/L)	Number of Wells Above Standard
1,2-Dichloroethane	1.4	0.5 MCL	1
Trichloroethylene (TCE)	180	5 MCL	1
Tetrachloroethylene (PCE)	3.6	5 MCL	0
Toluene	1.2 – 3.2	150 MCL	0
2-Butanone (MEK)	54	NA	0
MTBE	1.9	5 SMCL 13 MCL	0 0

Notes:
1. MCL = Maximum Contaminant Level
2. SMCL = Secondary Maximum Contaminant Level
3. µg/L = micrograms per liter
4. NA = Health or aesthetic standards are not available for this constituent

Piper Diagram

Based on the analytical data, the samples collected from wells within the Sierra foothills are mainly comprised of calcium-bicarbonate type water. Samples in the valley (Yuba sub-basin) shifts towards sulfide-chloride water (Figure 8). TDS concentrations are indicated by the size of the circle in the diamond-area of the piper diagram below.

Figure 8: Piper Diagram



POSSIBLE SOURCES OF CONTAMINANTS

Fifteen constituents were detected above water quality standards in the Yuba County Focus Area. Five of these constituents were observed in more than five percent of the sampled wells. Potential sources for these constituents, summarized from groundwater collected across the country, are discussed below. The focus of this sampling was not to pinpoint a source of chemicals found in groundwater, and the source descriptions do not imply that a chemical observed in a domestic well comes from any single, specific source. The summaries are provided as information for well owners. Additional information for domestic well owners is available on the GAMA website at: http://www.waterboards.ca.gov/gama/wq_privatewells.shtml

Bacteria Indicators

Total coliform bacteria are naturally present in the environment, and in general are harmless to people. However, some coliforms may cause illness in humans, and the presence of coliforms is an indication that other micro-organisms may be present. Fecal coliforms are found in human and animal wastes and, when present, indicate contamination. Drinking water that contains coliform bacteria increases the risk of becoming ill, and should not be consumed

Arsenic and Aluminum

Arsenic and aluminum occur naturally occurs in soil, water, air, plants, and animals — and are widely distributed throughout the Earth's crust. Weathering of arsenic and aluminum-containing rocks is the primary natural source of these metals in the environment. The most significant human sources of arsenic in groundwater are mining of metal sulfides, pesticides, insecticides, cattle and sheep dips, and algaecides. Detections of arsenic in Central Valley groundwater – even at concentrations above the MCL of 0.01 mg/L – may likely be natural in origin. Human exposure to arsenic can result in illness and even death. Long term exposure of arsenic has been linked to certain types of cancers. Concentrations of aluminum above the SMCL will affect taste and color of drinking water. Chronic exposure of aluminum above the MCL may affect the nervous system.

Iron and Manganese

Iron and manganese have water quality standards associated with color, odor, and taste (SMCLs). Both metals naturally occur in soil and rocks, and most frequently enter the environment through natural weathering. Concentrations above SMCLs may lead to discoloration, metallic or bitter tasting water, and staining. Manganese has a notification level of 500 µg/L. Ingestion of manganese at high concentrations can lead to neurological disorders, including memory loss and loss of balance.

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