A Guide for Private Domestic Well Owners

Compiled by the
California State Water Resources Control Board
Division of Water Quality
GAMA Program

Revised April 2011

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DISCLAIMER

This document is provided for informational purposes only. Water quality problems in private domestic wells may occur even when precautions are taken. This guide can help well owners with water quality testing and interpretation, and contains tips to help preserve and maintain a problem-free, clean well. For additional questions, please contact your local environmental health agency, or contact GAMA Program Manager John Borkovich at 916-341-5779.

ACRONYMS and ABBREVIATIONS

mg/l = milligrams per liter
µg/l = micrograms per liter. A microgram is 1/1000th of a milligram
Mgal = million gallons
Mgal/day = million gallons per day
CDPH = California Department of Public Health
DTSC = Department of Toxic Substances Control
DWR = Department of Water Resources
SWRCB = State Water Resources Control Board
US EPA = United States Environmental Protection Agency
USGS = United States Geological Survey

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INTRODUCTION

What is Groundwater?

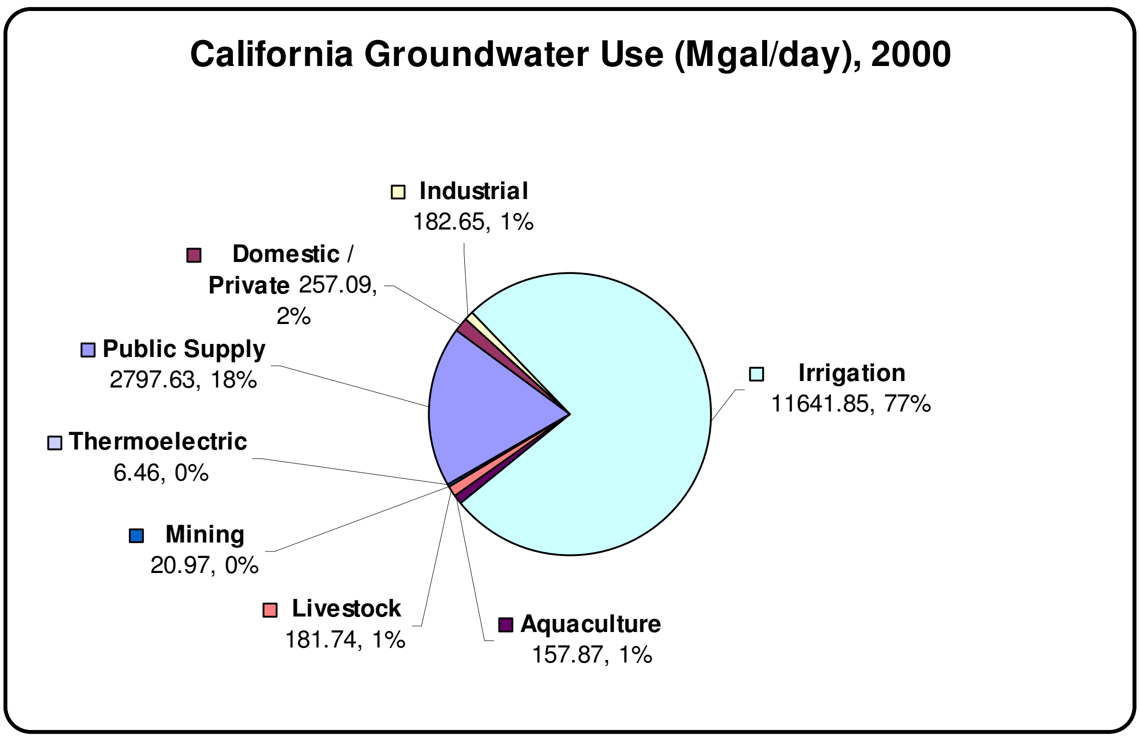
Groundwater is water that fills spaces between soil and rocks in the ground. Most groundwater comes from rain and snow that falls to the ground and percolates downward through naturally-occurring openings. Irrigation water, percolation ponds, and other sources can also contribute to groundwater. The area in the ground that is filled with water is called the saturated zone, and the top of the saturated zone is called the water table. The water table can be very near or far below the ground surface.

Who Uses Groundwater?

Approximately half the people in the United States use groundwater for drinking water. Californian's use about 15 billion gallons of groundwater – per day! Most groundwater is used for agricultural crop irrigation and industrial purposes.

Over 16 million Californian's get at least part of their drinking water from groundwater, from both public supplies and private domestic wells. Groundwater use in California increases during drought conditions. Over 11 billion gallons of groundwater per day are used for agricultural irrigation, helping to make California's agricultural economy one of the largest in the United States.

- Californians use more groundwater than any other state – about 15 billion gallons per day.
- Californians use approximately 20% of all the groundwater consumed in the United States.
- Californians use twice as much groundwater as the next highest state (Texas).
- Most of the groundwater used in California is for agricultural crop irrigation.



Data from "Estimated Use of Water in the United States for County-Level Data for 2000," USGS. Mgal/day is millions of gallons per day.

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GROUNDWATER BASICS

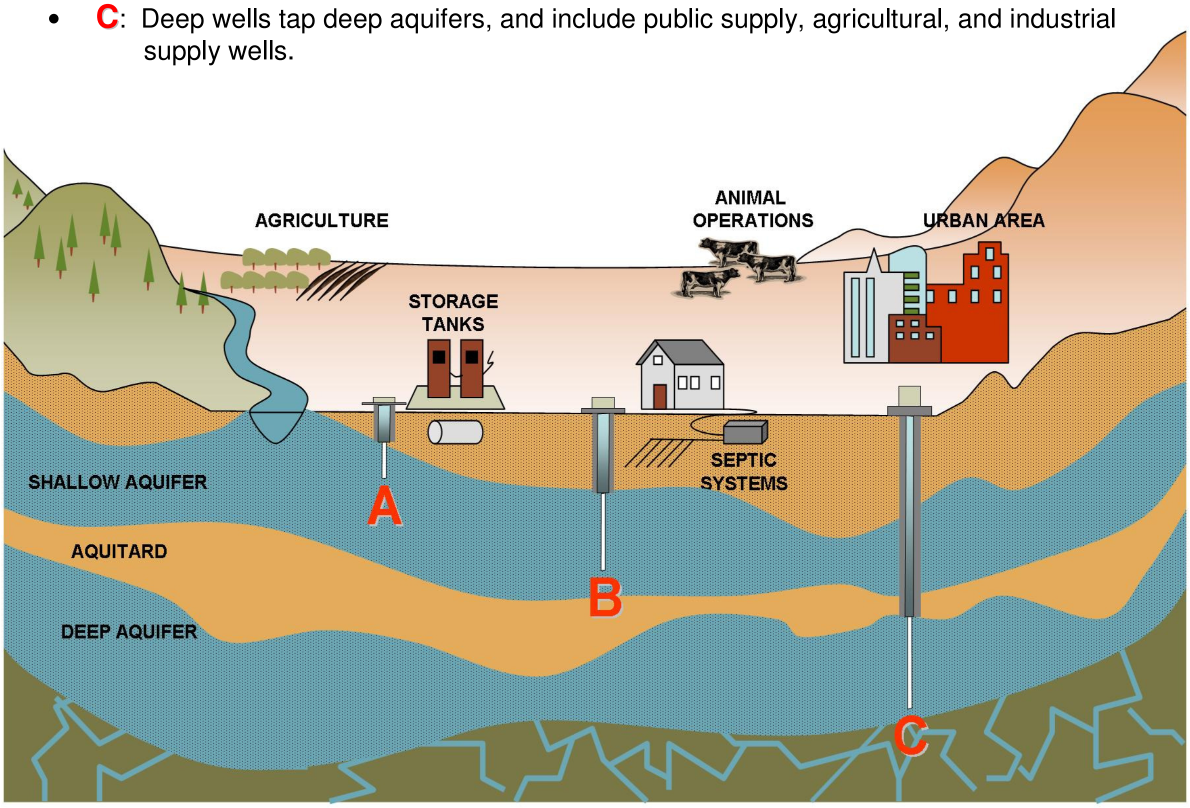
How Do We Get Groundwater?
Most groundwater is brought to the surface by pumping it from a well. There are several types of wells: public supply wells, irrigation wells, industrial supply wells, monitoring wells, and private domestic wells. Artesian wells flow without pumping.

What's In Groundwater?
Groundwater quality is related to several factors including geology, climate, and land use. Many naturally occurring chemicals in groundwater come from dissolving rocks, soil, and decaying plant material. Well water can become contaminated. Human activities can increase the concentration of naturally occurring substances like salts, minerals, and nitrate. Poor well construction or placement close to a potential source of contamination can affect domestic well water quality. Domestic well owners are responsible for testing their well water to ensure its quality.

Other compounds, such as pesticides and volatile organic compounds (VOCs), do not occur naturally in the environment. These substances can enter groundwater through spills, irrigation, wastewater percolation fields, septic systems, animal facilities, leaking underground fuel storage tanks, and other sources.

Wells draw water from different depths, and can be affected by different pollution sources. Types of wells and possible pollution sources are illustrated in the figure below:

- **A**: Shallow wells capture water from shallow aquifers close to the surface. Some private domestic wells are shallow wells.
- **B**: Intermediate wells can tap either deep or shallow aquifers, and can include private domestic, agricultural, and industrial supply wells.
- **C**: Deep wells tap deep aquifers, and include public supply, agricultural, and industrial supply wells.



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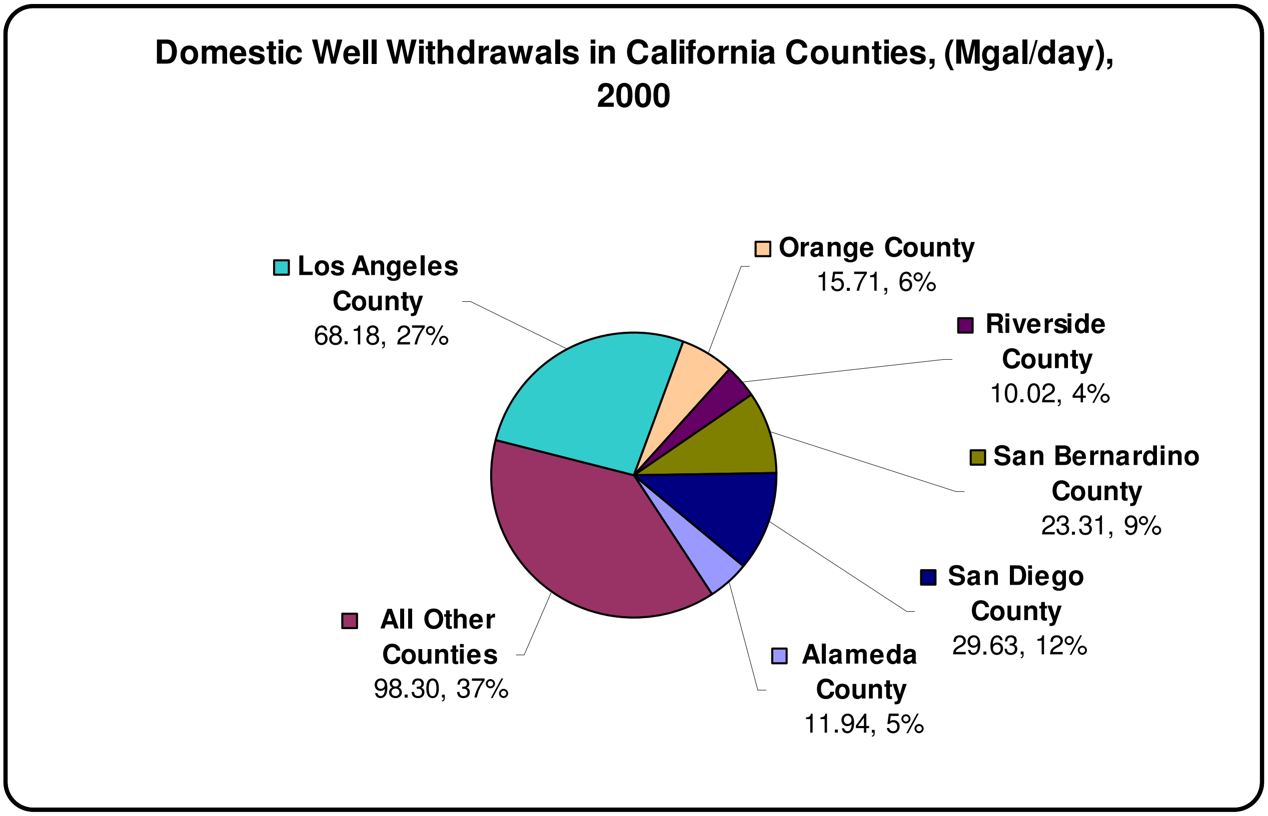
PRIVATE DOMESTIC WELL USE IN CALIFORNIA

As of 2010, the drinking water for about 1.4 million state residents comes from over 600,000 private domestic wells. The majority of domestic wells are located in southern California. Los Angeles, San Diego, San Bernardino, Orange, and Riverside counties account for 58% of domestic well groundwater withdrawals in the state.



Data from "Estimated Use of Water in the United States for County-Level Data for 2000," USGS

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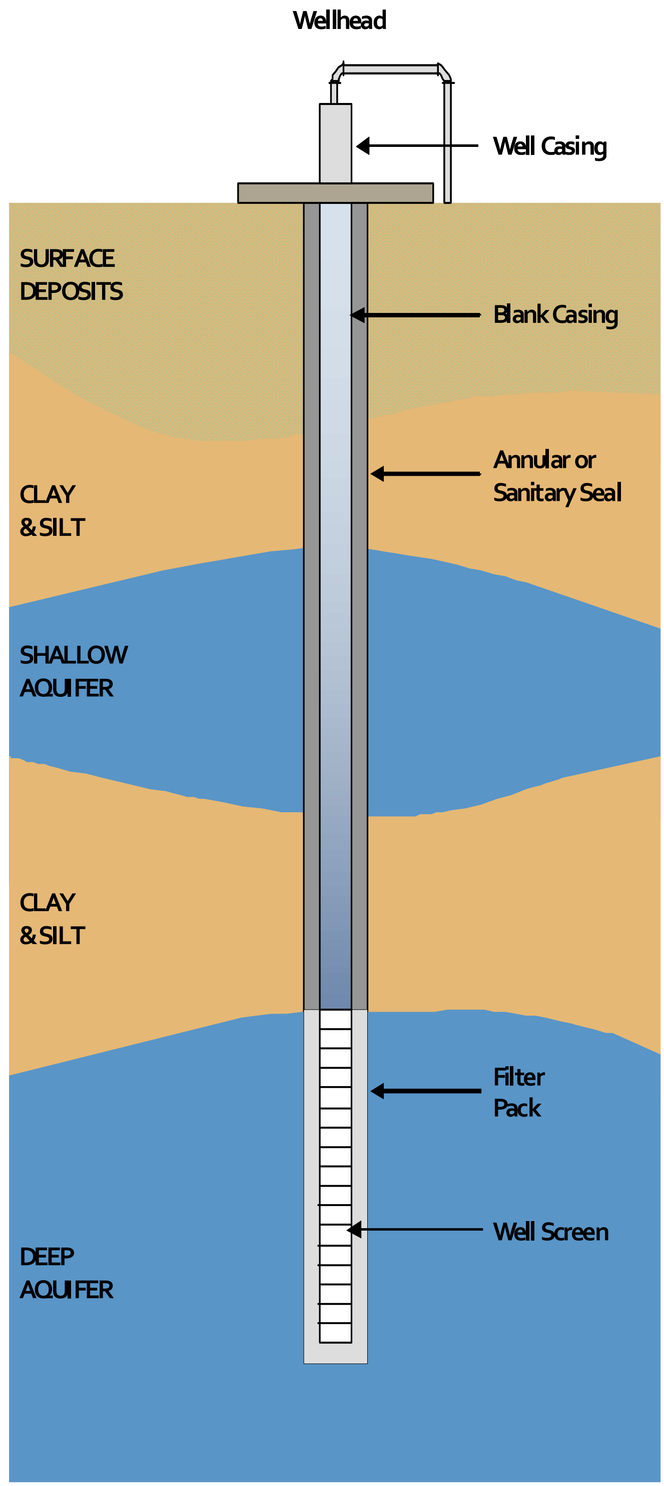
WELL CONSTRUCTION

Well owners obtain permits from local environmental health agencies or local water districts before construction, modification, or destruction takes place. The State of California does not issue well construction permits; however, the Department of Water Resources (DWR) and the State Water Resources Control Board (SWRCB) have established well construction standards (**Well Standards**). Domestic wells must be drilled by a licensed contractor, and must meet applicable local and/or state well standards. When choosing a location for a well, make sure the area is free of potential sources of contamination (see "Water Quality Protection" on page 12).

The driller will record geologic information at the drill site and will submit a copy of this information (**Driller Log or Well Completion Report**) to both the homeowner and the local permitting agency. The drill hole will intersect layers of sand or gravel that produce water (**Aquifers**). The driller may pass through upper shallow aquifers to find a deeper aquifer with better production or water quality. A length of plastic or steel pipe (**Well casing**) is installed in the drill hole. The bottom of the well casing will have thin cuts or perforations in it (**Well screen**), or can be open at the bottom (**Open Hole**) so that water can enter the well.

To keep fine sand, silt, and clay from entering the well, the driller will surround the well screen with sand (**Filter pack**). The driller must also install a concrete or cement seal (**Annular or Sanitary seal**) between the upper portions of the drill hole and the well casing. Well seal depths are generally mandated by local agencies or water districts.

The annular sanitary seal extends to the surface, where it creates a concrete pad with the well casing extending out of the middle (**Wellhead**). The casing should extend above the surface and be securely capped so that nothing – including surface water – can enter the well. The concrete pad should slope away from the well. Unless the well is artesian, a pump is placed in the well to bring water to the surface.



WATER QUALITY TESTING

How to Test a Water Well

The best way to test the quality of your well's water is to have a California State-certified drinking water testing laboratory conduct the analyses. The laboratory will supply the sampling bottles and can help you sample the well. You can also have an outside business collect a sample of your well and interpret the results for you. A list of drinking water laboratories certified by the State of California Department of Public Health (CDPH) is available and is searchable by county: http://www.cdph.ca.gov/certlic/labs/Documents/ELAPLablist.xls

What to Test For

Recommended tests and testing frequency are shown in Table 1 below. It's recommended that well owners should test for total coliform bacteria, nitrate, and electrical conductivity (EC) annually. More thorough testing should take place if you suspect contamination or notice a change in taste or appearance of your water.

Sampling Costs

Estimated sampling costs are shown in Table 1 below. Basic sampling costs can range from $100 to $400 dollars. Hiring an outside business to sample your well and interpret the results will likely cost more. Ask an accredited laboratory from the CDPH list (referenced above) for a written estimate before sampling.

Interpreting Test Results

The State of California does not regulate water quality in private domestic wells. CDPH regulates the water quality in public water systems. Comparing your well's test results to public drinking water standards can be helpful. These standards are found on-line at: http://www.cdph.ca.gov/certlic/drinkingwater/Documents/DWdocuments/EPAandCDPH-11-28-2008.pdf

Table 1 on the following page provides basic information and guidance for interpreting your test results. More information about contaminants and potential health effects can be obtained by calling the US Environmental Protection Agency's (US EPA) Safe Drinking Water Hotline (1-800-426-4791).

Commonly Encountered Contaminants

Drinking water, including bottled water, may contain trace amounts of some chemical constituents. Many are natural in origin, as water can dissolve naturally occurring minerals as it flows over or through the ground.

Commonly observed water contaminants are briefly summarized below:

- Microbes (viruses and bacteria) can come from sewage, septic systems, animal operations, and wildlife.
- Minerals, including salts, nitrate, and metals, can be naturally-occurring or can result from human activities at the surface.
- Pesticides and herbicides from agricultural, urban stormwater, and residential uses can be found in well water. Pesticides or herbicides should not be applied within 100 feet of a private domestic well.
- Organic chemicals from industry, gasoline stations, agriculture, stormwater runoff, and septic systems have been detected in groundwater.
- Radioactive elements typically occur naturally; however, human activities at the surface can release naturally occurring radioactive elements from sediments and bedrock.

The table below includes recommended tests and possible interpretations for those test results. Consult a water treatment professional for a more detailed interpretation of your test results.

TABLE 1: Water Quality Tests for Domestic Well Owners				
Recommended Test			**Interpreting your results**	
Test	**Recommended Frequency**	**Cost***	**If the lab report shows:**	**Then you may want to consider:**
Coliform Bacteria	Test for total coliform annually; fecal if total coliforms are detected.	$20 - 50	Present	First re-test another sample to verify the results. Eliminate cause, disinfect, and retest. Increase testing frequency; if recurrent problems persist, consult a water treatment professional for more advice. Some bacteria may cause serious illness or death.
Nitrate (NO_3)	Annually	$25 - 45	$\geq$ 45 mg/L as NO_3 or $\geq$ 10 mg/L as N	First re-test another sample to verify the results. Install a treatment system or find an alternate water supply. Consult a water treatment professional for more advice.
Electrical Conductivity (EC)	Annually	$10 - 20	> 1600 µmhos/cm or significantly different from previous result.	Test for minerals, nitrate, and/or VOCs to determine the possible cause of the high EC.
MINERALS Aluminum (Al) Arsenic (As) Barium (Ba) Cadmium (Cd) Chromium (Cr) Fluoride (F) Iron (Fe) Lead (Pb) Manganese (Mn) Mercury (Hg) Selenium (Se) Silver (Ag)	Every 5-10 years or if the following significant changes occur: • EC changes • Taste, color, or odor changes • Surrounding land use changes	Package $250 - 300 Individual $20 - 30 Mercury $30 - 40	Al >0.2 mg/l As > 0.01 mg/l Ba >1.0 mg/l Cd >0.005 mg/l Cr >0.05 mg/l F >2.0 mg/l Fe >0.3 mg/l Pb >0.015 mg/l Mn >0.05 mg/l Hg >0.002 mg/l Se >0.05 mg/l Ag >0.1 mg/l	Compare to previous results. Consider retesting for any high results. Install a treatment system or find an alternate water supply. The appropriate treatment system depends on your overall water chemistry and the constituents that need to be removed. Consult a water treatment professional for more advice.
Volatile Organic Compounds	See MINERALS, above	Package $150-300	Any detection	Ask lab to re-test. If confirmed, consult a water treatment professional for more advice.

* Estimated costs as of 2009. Some labs report minerals in µg/L. 1 mg/L is equal to 1,000 µg/L.
"$\geq$" means "greater or equal to."

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Tests for Specific Water Quality Problems

Some well owners may have specific issues or problems with their well water. Table 2 outlines several common problems in drinking water, and substances you can test for. Not every problem and possible cause is a health risk. Less-frequently encountered water quality issues are not listed in Table 2; consult a water treatment professional if your particular water quality problem is not listed or for a more thorough discussion of the causes of water quality problems.

TABLE 2: Possible Causes of Common Taste, Odor, and Appearance Problems in Domestic Wells

Problem	Possible Cause
Water is orange or reddish brown	High levels of iron (Fe)
Porcelain fixtures or laundry are stained brown or black	Manganese (Mn) and/or iron (Fe) can cause staining
White spots on the dishes or white encrustation around fixtures	High levels of calcium (Ca) and magnesium (Mg) can cause hard water, which leaves spots
Water is blue	High levels of copper (Cu)
Water smells like rotten eggs	Hydrogen sulfide (H_2S)
Water heater is corroding	Water can be corrosive. Very corrosive water can damage metal pipes and water heaters
Water appears cloudy, frothy, or colored	Suspended particulates, detergents, and sewage can cause water to appear cloudy, frothy, or colored
Your home's plumbing system has lead pipes, fittings, or solder joints	Corrosive water can cause lead (Pb), copper (Cu), cadmium (Cd), and zinc (Zn) to leach from lead pipes, fittings, and solder joints
Water has a turpentine odor	Methyl tertiary butyl ether (MTBE) or other organic compounds
Water has a chemical smell or taste	Volatile or semi-volatile organic compounds (VOCs) or pesticides

Residents near landfills, industry, dry cleaners, gas stations, and/or automobile repair shops may wish to consider testing for VOCs, metals, total dissolved solids (TDS), and petroleum hydrocarbons. Well owners in agricultural and livestock areas may consider testing for pesticides, nitrate, bacteria, and TDS.

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WATER QUALITY TREATMENT

Examples of domestic well treatment systems include activated alumina filters, activated charcoal filters, air stripping, anion exchange, chlorination, reverse osmosis, ozonation, and ultraviolet radiation. The type of treatment system used will depend on the type of water quality issues you are trying to address. It is important to know what your water quality issues are *before* installing a treatment system. Not all water treatment systems will work for every type of contaminant. Most treatment systems also require routine maintenance and upkeep – improperly maintained systems can cause more damage than having no treatment system at all. A treatment system, installation, and maintenance can be expensive, depending on what particular water quality problem you're trying to address. Talk to a water treatment professional, and ask for a guarantee that the system you want to install will work for your situation. A list of water treatment professionals can likely be found in a local phone book. Contact your county environmental health office for additional help in finding a water quality professional who can help you select and install an appropriate treatment system.

In some cases, it may be necessary to drill a new well that taps a less contaminated aquifer, or to obtain an alternative water supply. Treatment systems may not be successful in every situation.

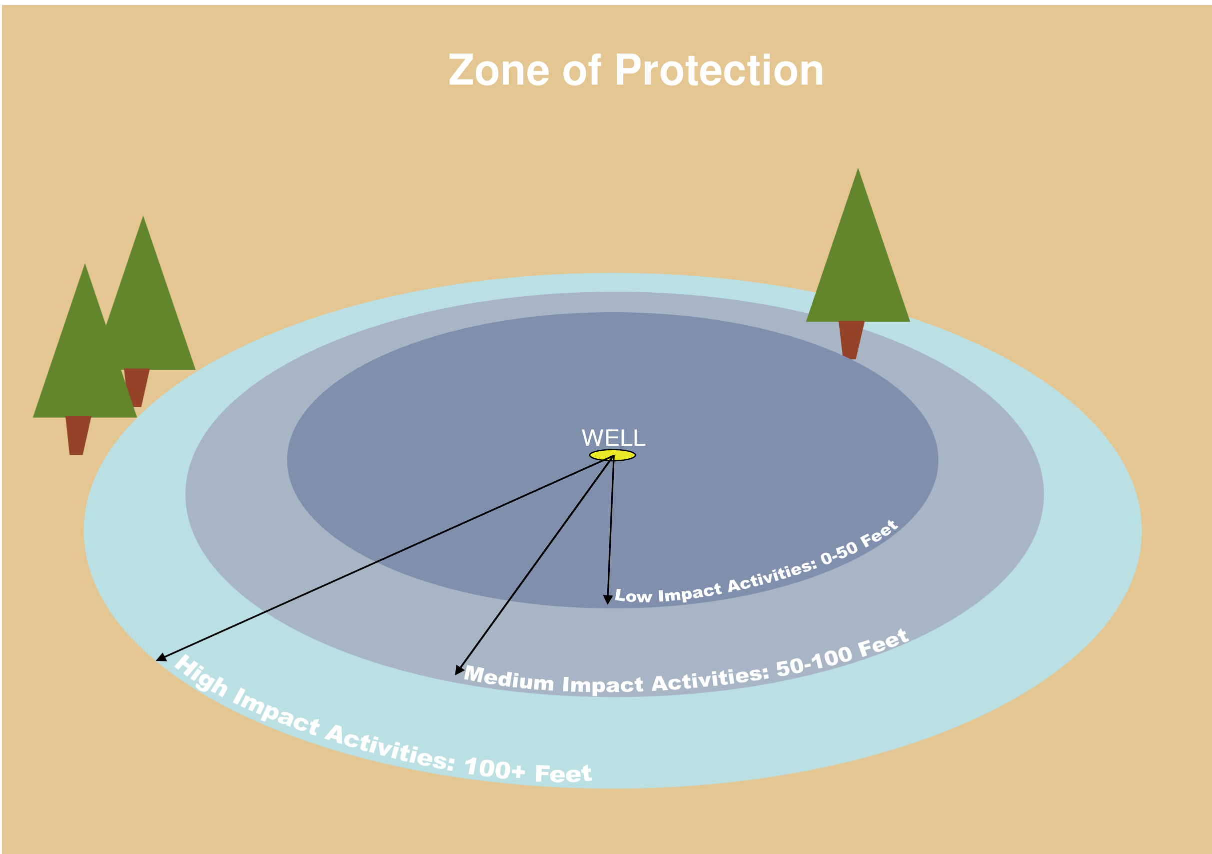
WELL DESTRUCTION

Unused and abandoned wells can allow for contamination of aquifers used as drinking water sources. The risk of groundwater contamination increases when other wells are operating, since pumping can draw poor quality water down the abandoned well and into the drinking water aquifer. To prevent unnecessary contamination, wells that are no longer being used must be destroyed.

The DWR has developed standards for well destruction. These standards are available in Bulletins 74-81 and 74-90, and can be found on-line at: http://www.dpla.water.ca.gov/sd/groundwater/california_well_standards/well_standards_content.html. Usually, the abandoned well is entirely filled with cement or similar compounds. Local environmental health agencies are responsible for specific well destruction standards and typically require well destruction permits. In some cases, local well destruction standards may be more stringent than State of California standards. The deconstruction work must be completed by a State licensed contractor.

WATER QUALITY PROTECTION

Preventing groundwater contamination is the best way to keep your well water clean. Groundwater typically moves slowly, so any contamination can take decades to naturally flush clean. The layer of ground between the surface and groundwater will provide some protection, but is not a perfect filter. The farther away possible contamination activities are from your well, the more soil is available to filter out contaminants if an accidental spill or release occurs. Local health agencies may have legally-mandated setbacks. The US EPA recommends that private well owners establish a “zone of protection” around their well. This zone should be considered off-limits for storing, mixing, spraying, spilling, burying, or dumping anything that might contaminate your water supply. Check with your local agencies to see if there are any specific ordinances requiring setbacks for animal enclosures, septic systems, and other types of facilities. The State of California does not regulate the location of private domestic wells.



LOW IMPACT ACTIVITIES

- Recreation area
- House
- Outdoor furniture and play areas

MEDIUM IMPACT ACTIVITIES

- Garage
- Boat
- City sewer lines

HIGH IMPACT ACTIVITIES

- Chemical storage
- Animal enclosures
- Manure/compost piles
- Machine/auto repair
- Septic system

Source: USEPA

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Protect your well, and protect your water:

- Only low-impact facilities, such as a house, outdoor play area, or outdoor furniture should be located within 50 feet of the well. Do not mix or store any material that might contaminate your water supply within 50 feet of your well. Medium and high impact activities should only occur at safe distances.

- Animal enclosures and septic systems should have a minimum setback of 100 feet from a domestic well.

- Do not store or mix pesticides, fertilizers, lawn-care products, paint or paint cleaners, hazardous cleaning products, gasoline (including gasoline generators), or automotive wastes near the well.

- Do not dispose of hazardous materials (including some types of household cleaners, paint and paint cleaners, automotive waste, and pesticides) to a septic system – these substances are not treated in a typical septic system, and can easily migrate to groundwater. Take hazardous household chemicals to a designated collection center for disposal.

- Septic systems should be located downhill (downgradient) from a domestic well, and 100 feet from any drinking water source.

- Inspect your well at least once a year for cracks in the casing and seal, or any other types of leaks or possible sources of contamination. If issues are noted, have a State-licensed contractor repair the well.

RESOURCE GUIDE

There are many sources of information on private domestic wells. Programs that can help answer private domestic well water quality questions are provided below.

Local Government
County environmental health agencies are typically responsible for issuing well construction/abandonment/destruction permits, septic system permits, and other issues associated with private domestic wells. Consult your phone book or conduct an internet search to find the specific agency in your county responsible for private domestic well oversight. Some local agencies run hazardous household waste programs. Such programs typically offer tips for use, recycling, and disposal of these products.

State Government
The State of California does not regulate the water quality in private domestic wells. However, state agencies can be helpful in dealing with water quality issues and identifying threats to water quality.

California Department of Public Health (CDPH): The CDPH Division of Drinking Water and Environmental Management is responsible for the regulation and monitoring of public water systems (a public water system serves 200 or more homes). Visit the Division of Drinking Water and Environmental Management website at: http://www.cdph.ca.gov/programs/Pages/DDWEM.aspx

California Department of Water Resources (DWR): DWR provides groundwater level and water quality data. DWR's Integrated Water Resources Information System (IWRIS) is a web-based GIS application that allows users to access, integrate, query, and visualize multiple sets of data. Visit the DWR website at: http://www.water.ca.gov

Department of Toxic Substances Control (DTSC): The DTSC can help answer questions about hazardous materials and waste, reducing household use of hazardous materials, locating disposal and handling facilities for specific types of household materials, and where to report illegal dumping and spills. Visit the DTSC website at: http://www.dtsc.ca.gov

State Water Resources Control Board (SWRCB): The SWRCB is responsible for the adjudication of water rights and water quality protection. Visit the SWRCB website at: http://www.waterboards.ca.gov

- **Groundwater Ambient Monitoring and Assessment (GAMA) Program**: The GAMA Program is the SWRCB's comprehensive groundwater quality monitoring program for California. The main goals of GAMA are to improve statewide groundwater monitoring and to increase the availability of groundwater quality information to the public. Visit the GAMA website at: http://www.waterboards.ca.gov/gama

- **GeoTracker GAMA**: GeoTracker GAMA provides user-friendly internet access to groundwater quality data in California. GeoTracker GAMA provides water quality data for raw, or untreated, groundwater and integrates and provides tools to analyze several datasets. Visit the GeoTracker GAMA Introduction page at: http://www.waterboards.ca.gov/gama/geotracker_gama.shtml

- **Regional Water Resources Control Boards** (Regional Boards): Regional Boards develop Basin Plans for their hydrologic areas, issue waste discharge requirements (WDRs), take enforcement action against violators, and monitor water quality. To find the Regional Board for your area, visit the following website at: http://www.waterboards.ca.gov/water_boards.shtml

Federal Government: US EPA Safe Drinking Water Hotline:
The Federal Government does not regulate water quality in private domestic wells. However, the US EPA provides helpful information to domestic well owners. The Safe Drinking Water Hotline is available to help understand regulations and programs developed in response to the Safe Drinking Water Act. The hotline can be reached at (800) 426-4791. Visit the website at: www.epa.gov/safewater/privatewells/index2.html

Photo: Private domestic well water sampling.

ACKNOWLEDGEMENTS

The SWRCB would like to acknowledge and thank the Santa Clara Valley Water District and the San Diego County Department of Environmental Health for use of their informational fliers in the development of this document.

For additional information, please contact GAMA Program Manager John Borkovich at (916) 341-5779 or jborkovich@waterboards.ca.gov.

Photo: A domestic well showing the well casing, cover, and conveyance system.
The well is located inside a shed with a concrete floor.

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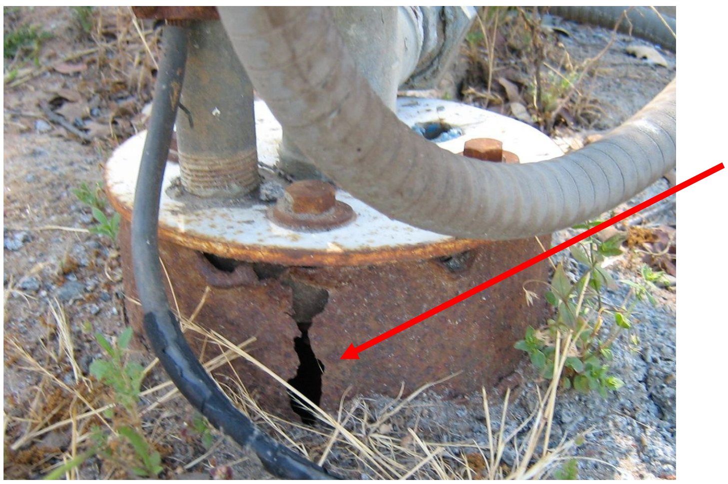
APPENDIX: Photographic Guide to Common Well Maintenance Issues

Proper well maintenance can help prevent groundwater contamination. The following are examples of commonly observed well maintenance issues and suggestions on how to minimize potential contamination at your well

Cracked Well Casing



A cracked well casing may allow surface water and contaminants into your well. One of the most common water quality issues associated with a cracked well casing is the presence of coliform bacteria. Other chemicals can also be introduced into the well through the cracked casing. Consult a water quality professional, like a licensed well driller to repair or replace the cracked casing.

Missing Plugs and Other Well Openings

Many wells have a small plug located at the top of the well casing. The plug may degrade over time and sometimes fall off. If the plug is missing, the well is directly open to potential contamination. The most frequently observed contaminant associated with a missing plug are coliform bacteria. Replacing a missing plug is an effective way to reduce potential contamination.

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Well Location: Near Storage Tanks

Storage tanks for hazardous materials should be kept at least 100 feet from your well. Gasoline products, VOCs, and pesticides are the most common contaminants associated with spills or leaks from storage tanks. Keeping your fuel tanks at least 100 feet away from your well may help avoid well water contamination.

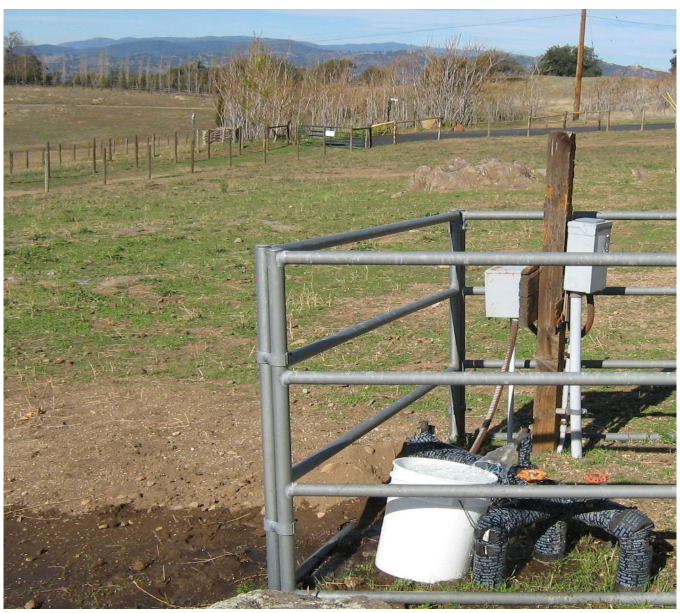
Well Location: Agricultural Areas

Locating a well close to agricultural areas – such as orchards or row crops – increases the likelihood of detecting nutrients (such as nitrate), salts and pesticides in your well water.
Your well should be located at least 100 feet from areas of pesticide or fertilizer application.

Well Location: Downhill (Downgradient) from a Contaminant Source

Avoid placing your well downhill from a potential contaminant source like a fuel tank or a septic system. Groundwater flow direction typically follows topography – so a leak from an uphill or upgradient contaminant source could potentially affect your well water quality.

Well Location: Animal Enclosures



Manure is a source of microbial contaminants (including coliform bacteria), nutrients (such as nitrate), and salts. Your well should be located at least 100 feet from any permanent animal enclosure.

Well Location: Storage of Hazardous Substances

Storing hazardous substances near your well increases the potential for well water contamination. Hazardous substances including paint, petroleum products (like gasoline), pesticides, herbicides, fertilizers, and solvents should be stored or mixed at least 100 feet from your well location.

Excess Vegetation Surrounding Your Well

Overgrowth of vegetation near your well may lead to root damage of the casing, creating a conduit for possible well water contamination.

Do not apply herbicides, pesticides, or other chemicals to vegetation near your well, as these chemicals may contaminate your well water.

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DRAFT

Voluntary Domestic Well Assessment Project

El Dorado County Data Summary Report

STATE WATER RESOURCES CONTROL BOARD
GROUNDWATER AMBIENT MONITORING AND ASSESSMENT PROGRAM

September 2005

Water Boards

ACKNOWLEDGEMENTS

The Groundwater Ambient Monitoring and Assessment Program (GAMA) would like to thank the many individuals from various state and local agencies, organizations, and interested parties who participated in the El Dorado County implementation of the Voluntary Domestic Well Assessment Project (Voluntary Project).

The GAMA Program would like to thank the California Department of Health Services (DHS), the California Department of Water Resources (DWR), and the California Conference of Directors of Environmental Health (CCDEH) for sharing their experiences and expertise with domestic well water quality during the development of the Voluntary Project. In addition, we would also like to acknowledge the AB 599 (Statutes of 2001, Groundwater Quality Monitoring Act of 2001) Interagency Task Force (ITF) and Public Advisory Committee (PAC) for their support. Their contribution during the development of the GAMA Program’s statewide monitoring effort helped identify important issues affecting domestic well use and water quality.

We would also like to thank the El Dorado County Environmental Management Department, especially Greg Stanton and Christine Mearse, for participating in the El Dorado County implementation of the Voluntary Project. Thanks also to the El Dorado County Assessor’s Office for providing the information necessary to contact domestic well owners in El Dorado County.

A number of State Water Resources Control Board (State Water Board), Division of Water Quality staff, particularly in the GAMA Program Unit, had primary staff responsibility for the Voluntary Project. Those individuals include Carol Anacker-Hubbard, Chris Cochrane, Adam Harris, Jan Stepek, and Brett Wyckoff. We also appreciate all the State Water Board staff that participated in the sampling effort.

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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 (mg/L)[2]	Results Range (mg/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				
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.

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

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

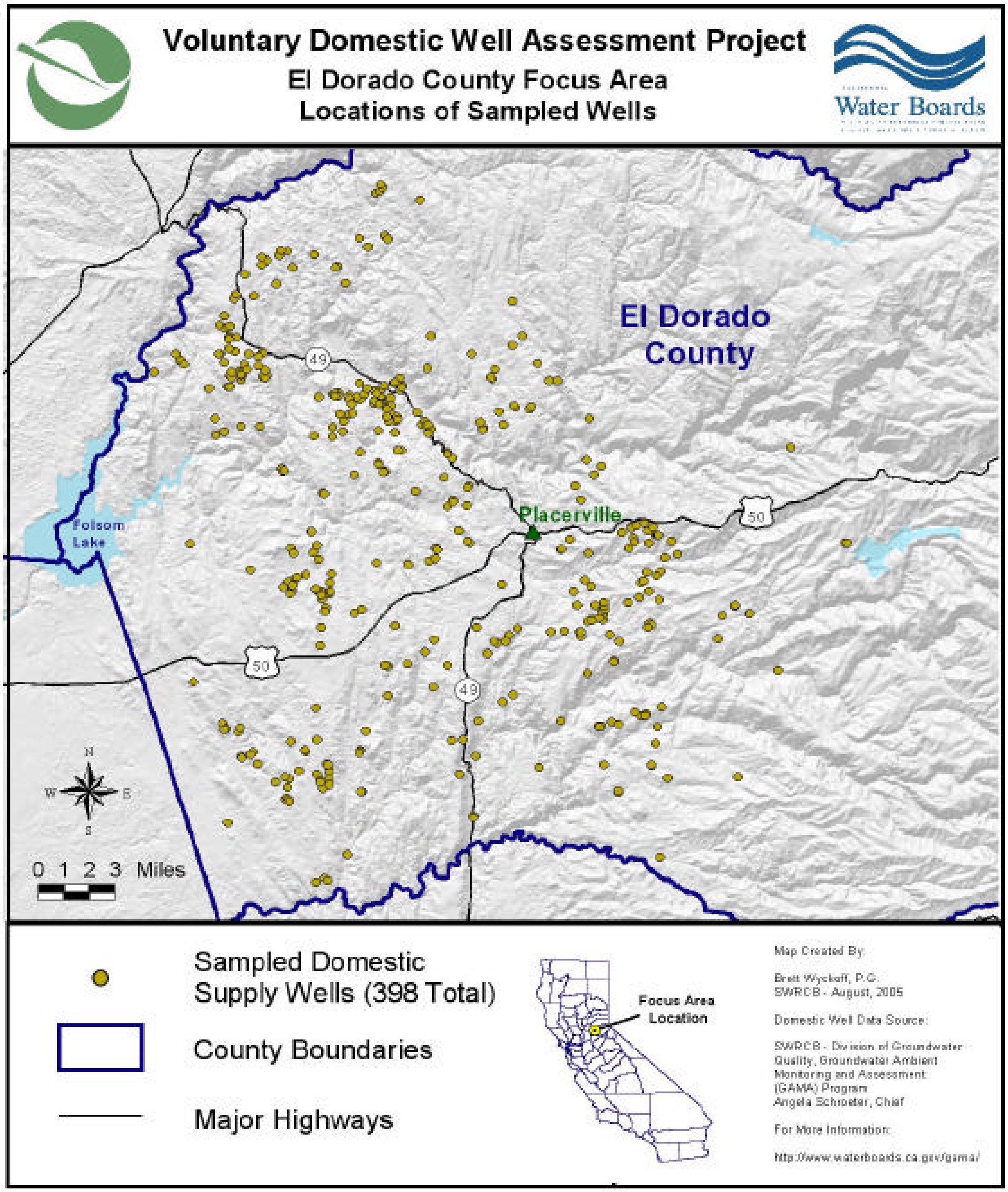

Figure 1. El Dorado County domestic wells sampled as part of the Voluntary Project.

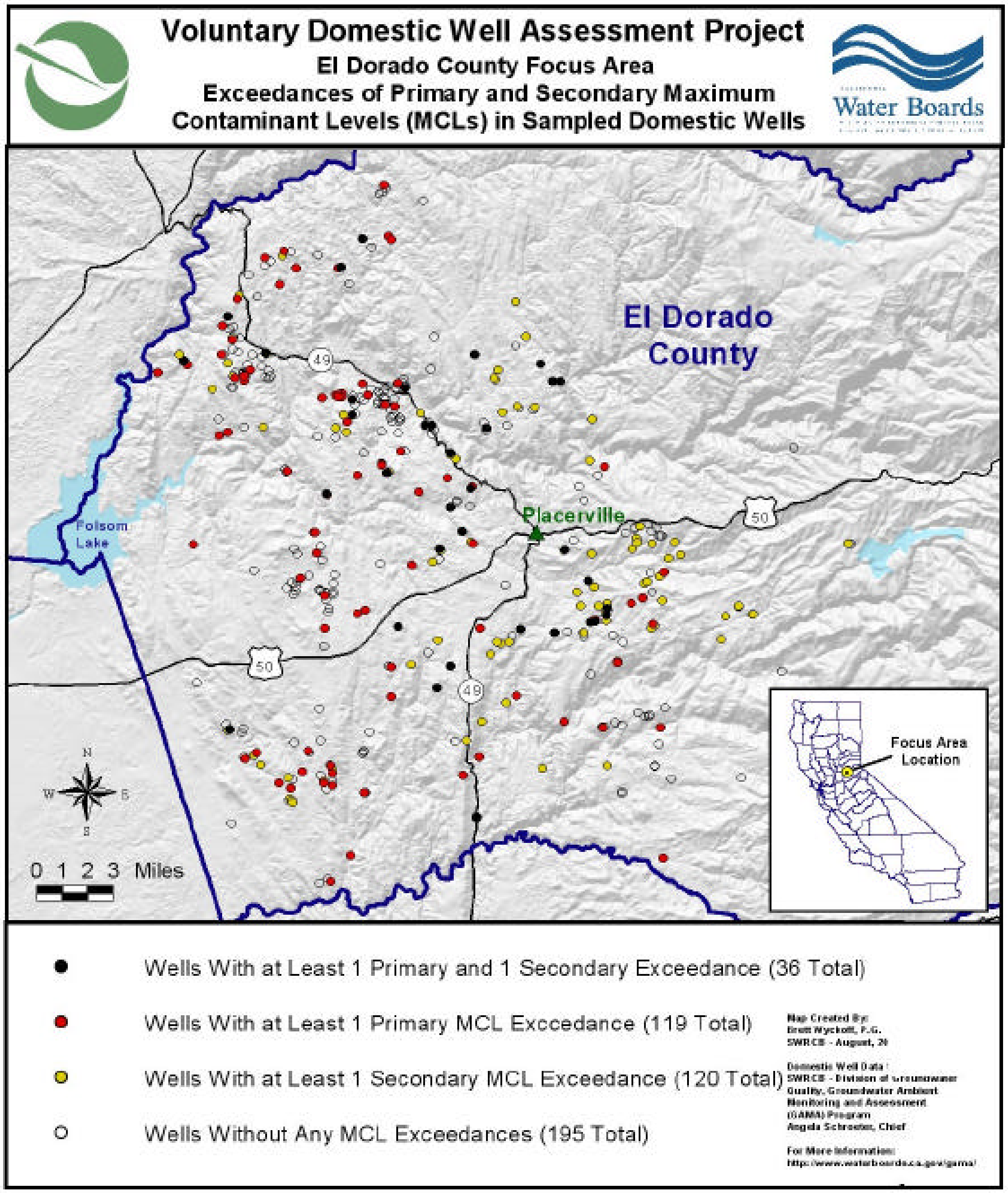

Figure 2. El Dorado County wells sampled as part of the Voluntary Project with detections greater than State primary and secondary drinking water standards for public water systems.

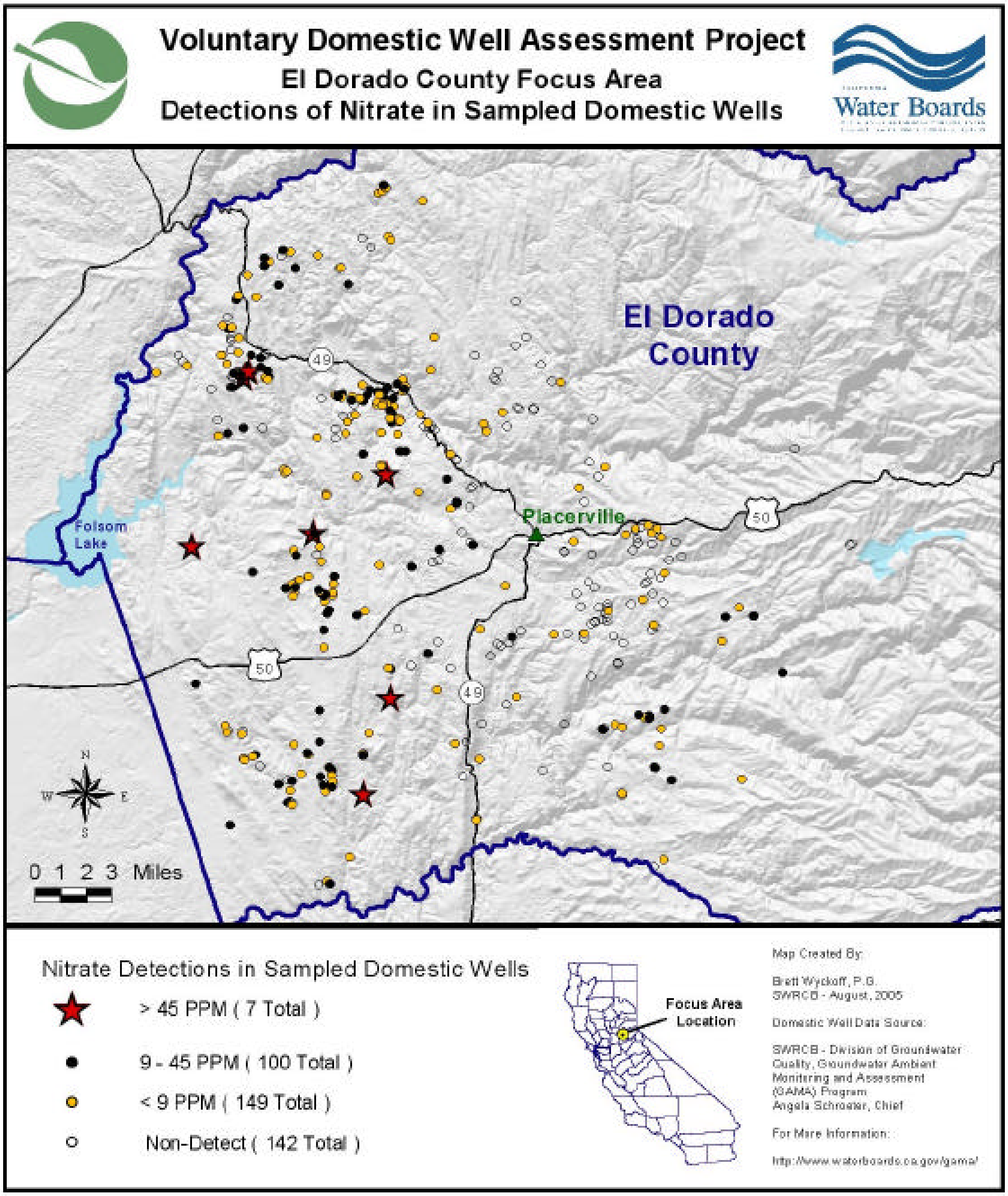

Figure 3. Nitrate (as NO_3) detections in El Dorado County domestic wells sampled by the Voluntary Project.

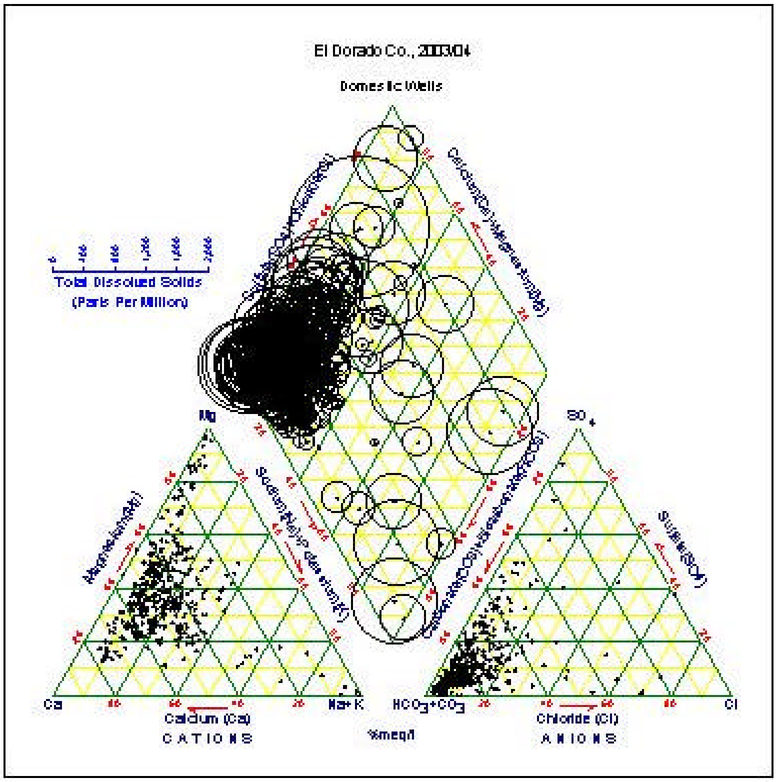

Figure 4. Piper diagram for Voluntary Project ground water samples collected from 398 domestic wells in El Dorado County.

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6. El Dorado County Environmental Management Department, "A Guide For The Private Well Owner", March 2004.

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8. Mueller, David K., Hamilton, Pixie A., Helsel, Dennis R., Hitt, Kerie J., and Barbara C. Ruddy, "Nutrients in Ground Water and Surface Water of the United States--An Analysis of Data Through 1992," U.S. Geological Survey Water Resources Investigations Report 95-4031, 1995.

9. Santa Clara Valley Water District, "A Guide For The Private Well Owner", 2001.

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

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.

13. U.S. Environmental Protection Agency, Office of Water, Protect our Health from Source to Tap – National Drinking Water Program Highlights, EPA-816-K-01-001, May 2001.

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] (µg/L)	Number of detections above PQL	Concentration Range (µg/L)
Microbiological			
Total Coliforms	1	111	Presence
Fecal Coliforms	1	14	Presence
General Minerals and Chemical Parameters			
Bicarbonate Alkalinity as $CaCO_3$	1	397	6.3 - 490
Carbonate Alkalinity as $CaCO_3$	4	1	8.3 - 60
Hydroxide Alkalinity as $CaCO_3$	1000	0	-
Total Alkalinity as $CaCO_3$	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 $CaCO_3$	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 (NO_3-N)	NA	NA	NA
Nitrate as NO_3	1	256	1 - 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 SO_4	2	391	0.6 - 280
Total Dissolved Solids	10	398	24 - 890

Compound Name (Alias)	PQL[1] (μg/L)	Number of detections above PQL	Concentration Range (μg/L)
Turbidity, Laboratory	0.1 NTU	7	0.12 – 48 NTU
Inorganic Chemicals			
Aluminum	50	48	50 - 1500
Antimony	6	2	11 -12
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	1 - 21
Selenium	5	4	6 - 12
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	-

Compound Name (Alias)	PQL[1] (µg/L)	Number of detections above PQL	Concentration Range (µg/L)
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	-

Compound Name (Alias)	PQL[1] (μg/L)	Number of detections above PQL	Concentration Range (μg/L)
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

Compound Name (Alias)	PQL[1] (µg/L)	Number of detections above PQL	Concentration Range (µg/L)
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.

El Dorado Irrigation District

SB 610 Water Supply Assessment for the Village of Marble Valley Specific Plan

SB 610 Water Supply Assessment

Prepared for the
Village of Marble Valley Specific Plan

Final

August 2013

Prepared by:

Tully & Young

Comprehensive Water Planning

Prepared for:

El Dorado Irrigation District

Approved by Eldorado Irrigation District Board of Directors on August 26, 2013 as action item #8

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Table of Contents

SECTION 1 – PROJECT INTRODUCTION

1.1 INTRODUCTION

In December 2012, the El Dorado Irrigation District (EID) received a letter from the El Dorado County Planning Department (County) requesting the completion of a Water Supply Assessment (WSA) for the Village of Marble Valley Specific Plan (hereafter referred to as the "Proposed Project"). As the proposed water supply purveyor for the Proposed Project, EID has prepared this WSA to assess the availability and sufficiency of EID's water supplies to meet the Proposed Project's estimated water demands. This document provides the necessary information to comply with the assessment of sufficiency as required by statute.

Statutory Background

Enacted in 2001, Senate Bill 610 added section 21151.9 to the Public Resources Code requiring that any proposed "project," as defined in section 10912 of the Water Code, comply with Water Code section 10910, et seq. Commonly referred to as a "SB 610 Water Supply Assessment," Water Code section 10910 outlines the necessary information and analysis that must be included in an environmental analysis of the project (e.g. CEQA compliance) to ensure that proposed land developments have a sufficient water supply to meet existing and planned water demands over a 20-year projection.

Proposed "projects" requiring the preparation of a SB 610 water supply assessment include, among others, residential developments of more than 500 dwelling units, shopping centers or business establishments employing more than 1,000 persons or having more than 500,000 square feet of floor space, commercial office buildings employing more than 1,000 persons or having more than 250,000 square feet of floor space and projects that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project.[1]

The Proposed Project requires a WSA because it contemplates more than 500 new dwelling units as detailed in Section 1.2.

Document Organization

This WSA supports the Proposed Project's environmental review process and analyzes the sufficiency of water supplies to meet projected water demands of the Proposed Project through the required planning horizon. The WSA is organized according to the following sections:

- **Section 1: Project Introduction**. This section provides an overview of WSA requirements, and a detailed description of the Proposed Project, especially the land-use elements that will require water service.

[1] Water Code § 10912, subdivision (a).

- **Section 2: Proposed Project Estimated Water Demands**. This section describes the methodology used to estimate water demands of the Proposed Project and details the estimated water demands at build-out of the Proposed Project.

- **Section 3: Other Estimated Water Demands**. This section details the other water demands currently served by EID and anticipated to be served based on information in the El Dorado County's (County) General Plan as well as known and potential planned modifications since the County's adoption of the General Plan.

- **Section 4: Water Supply Characterization**. This section characterizes the EID water supply portfolio that will serve the Proposed Project along with other current and future water demands. Water rights, along with water service contracts and agreements are characterized for normal, single dry, and multiple dry year conditions.

- **Section 5: Sufficiency Analysis**. This section assesses whether sufficient water will be available to meet the Proposed Project water demands, while recognizing existing and other potential planned water demands within the EID service area. To provide the necessary conclusions required by statute, the analysis integrates the demand detailed in Section 2 and Section 3 with the characterization of EID's water supply portfolio detailed in Section 4.

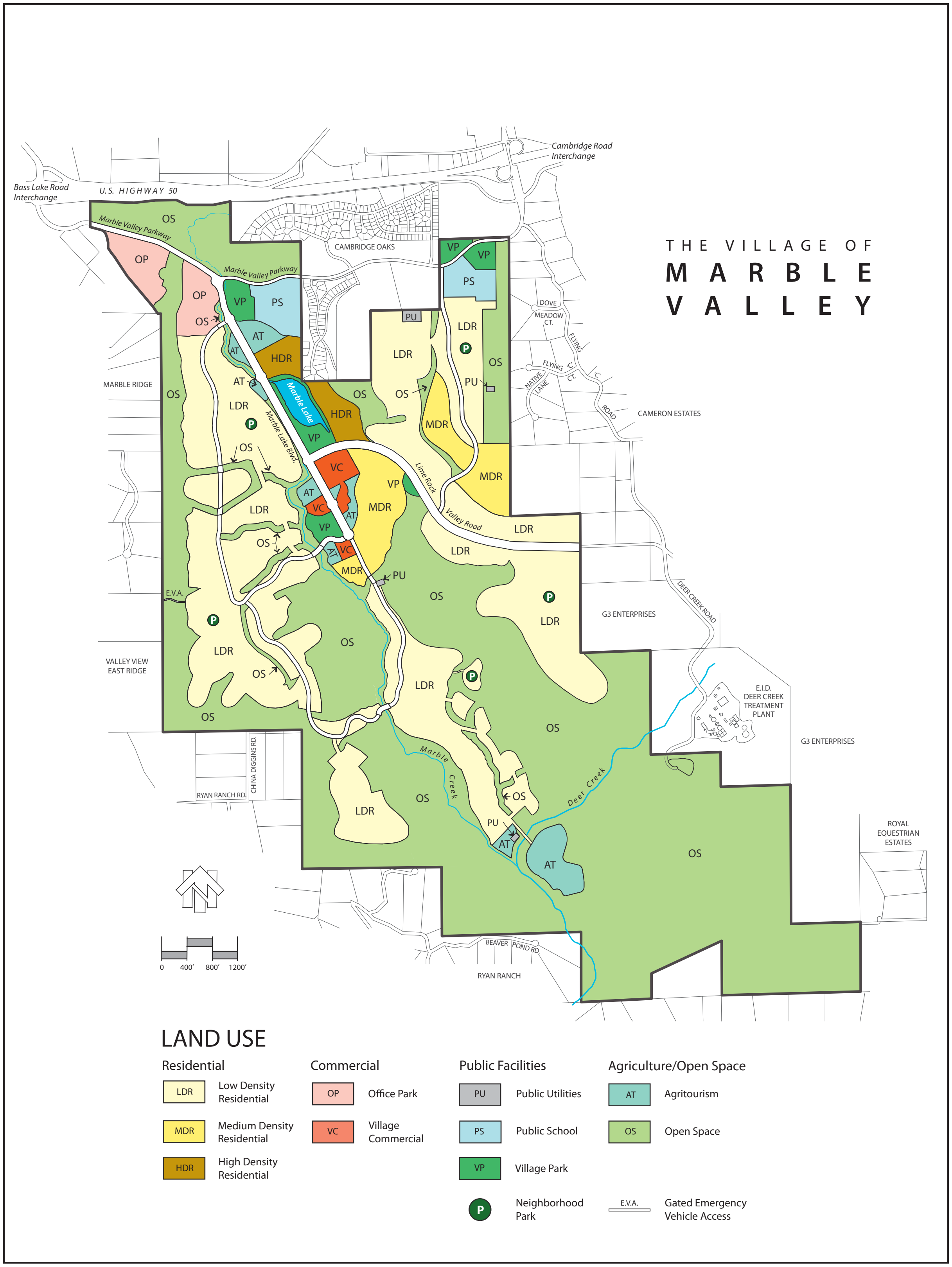
1.2 PROPOSED PROJECT DESCRIPTION

The Proposed Project is a planned development between Bass Lake and Cambridge Roads, south of Highway 50 encompassing approximately 2,340 acres in the unincorporated community of El Dorado Hills (see **Figure 1-1**).

The Proposed Project includes 3,236 residences, commercial space, village and neighborhood parks, agricultural uses, two schools, and open space. Proposed residential dwelling units include 193 custom lots on approximately 1 acre, 125 custom homes on approximately 1/2 acre-lots, 982 production lots with densities of 3 to 4 dwelling units per acre (designated "medium density-low"), 663 production lots with densities of 4 to 5 dwelling units per acre (designated "medium density-high"), 981 lots with densities of 7 to 12 dwelling units per acre (designated "Condo/Duplex"), and 292 high-density units (designated "multi-family"). Parks are spread throughout the project and include private parks in the gated areas, joint use parks along side the schools, village parks for non gated areas, a large park around the lake, and a historic park. The project includes about 475,000 square feet of commercial, retail, office, and other non-residential space residing on about 58 acres on the project site. Both a K5 and K8 school are planned for about 35 acres. About 55 acres of vineyards are to be planted on site both in designated lots and in some medians for aesthetics.

Table 1-1 summarizes the proposed land use acreages.

Figure 1-1 – Proposed Project Location and Land Uses



Torrence Planning
26 April 2013

1.2.2 Projected Land Uses

Table 1-1 – Summary of Proposed Build-Out Land Uses and Acreages[2]

Land Use	Description	Acres	Units
1 Acre Custom Homes	1 DU/Ac	198	193
1/2 Acre Custom Homes	2 DU/Ac	62	125
3-4 per Acre Production Homes	3-4 DU/Ac	277	982
4-5 per Acre Production Homes	4-5 DU/Ac	148	663
Condominiums/Town Homes	5-12 DU/Ac	85	772
High Density Residential	12-24 DU/Ac	28	501
Office Park/Commercial	--	60	--
Schools	--	35	--
Parks	--	47	--
Open Space	--	1,282	--
ROW and Landscaping	--	73	--
Vineyards	--	55	--
	Total	**2,350**	**3,236**

1.3 PROPOSED PROJECT PHASING

Table 1-2 describes the Proposed Project's four construction phases. Each phase represents a portion of the development, focusing on particular land-use classifications. Before constructing homes, commercial space, or other parts of the development, the proponents will begin site grading and project-wide infrastructure development. Some infrastructure and site grading will continue throughout all phases of the Proposed Project, as necessary. These activities include installing facilities for potable water, recycled water (as appropriate for the Proposed Project), sewer, electric, telecommunications, gas, stormwater, and roads. During these activities, a small water demand will exist – referred to in this WSA as "construction water." This demand is included in the yearly water demands presented in Section 2.

The initial phase will result in approximately one quarter of the Proposed Project demanding water service by 2020, with the three subsequent phases each adding an additional quarter as they are completed. All construction is planned to be completed by 2035, within the 20-year planning horizon of this WSA.

[2] Specific Plan Land Use Summary was provided by El Dorado County of Development Services Department.

Table 1-2 – Proposed Project Schedule

Land Use	Phase 1 By 2020	Phase 2 2021-2025	Phase 3 2026-2030	Phase 4 2031-2035	Total
1 Acre Custom Homes	25	20	100	48	193
1/2 Acre Custom Homes	25	25	--	75	125
3-4 per Acre Production Homes	215	378	--	389	982
4-5 per Acre Production Homes	--	--	663	--	663
Condominiums/Town Homes	75	522	175	--	772
High Density Residential	209	50	228	14	501
Total	549	995	1,166	526	**3,236**

SECTION 2 – PROPOSED PROJECT ESTIMATED WATER DEMANDS

2.1 INTRODUCTION

This section describes the methodology, provides the supporting evidence, and presents the estimated water demands for the Proposed Project. For the purpose of estimating water demand, the Proposed Project is planned to develop according to the phasing in **Table 1-2**.

2.2 DETERMINING UNIT WATER DEMAND FACTORS

As detailed in Section 1, the Proposed Project has specific residential and non-residential land-uses with defined residential lot-sizes, types of commercial uses and other characteristics. As these attributes vary among the types of proposed land-uses, so too will the water needs. To understand the water needs of the entire Proposed Project, unique demand factors that correspond with each unique land use are necessary. This subsection presents the methodology for determining the baseline unit water use demand factors that become the basis of the Proposed Project water demand estimates. Two distinct groups of demand factors are presented: (1) residential, and (2) non-residential.

2.3 PRIMARY SOURCE OF BASELINE WATER USE DATA

Because the Proposed Project is very similar in nature to particular elements built as part of the Serrano and El Dorado Hills developments over the past few decades, recent water use data for comparable products in these neighborhoods provides a reliable foundation for EID to establish new project-specific water demands. Through comparison of Proposed Project land-use elements to existing land uses, EID determined appropriate existing, established neighborhoods and commercial facilities that best aligned with each unique residential and non-residential project element. For each comparable neighborhood, EID gathered and assessed total annual water use for the years 2008 through 2012. This selected period of water use best represents 1) the highest build-out percentage within each selected area (including established back-yard landscapes), and 2) varied water use over a range of climatic conditions reflecting various rainfall amounts and timing. Average annual uses were derived from the data and are discussed under the respective land-use categories.

2.4 BASELINE RESIDENTIAL WATER USE DEMAND FACTORS

The Proposed Project anticipates specific residential products that fall within general lot-size designations. The size of the lot will have the largest impact on the annual per-lot demand for water. Indoor demands remain relatively consistent regardless of lot size, with the exception of apartments, which tend to have fewer people living in each unit and thus a slightly lower indoor use.

For purposes of this WSA, the per-lot demand for residential lots will be described as "the acre-feet of water use annually per dwelling unit" – or simply put, acre-feet/dwelling unit (af/du). This value will reflect indoor and outdoor uses expected for a typical dwelling unit for each of the following classifications:[3]

- 1-acre custom lots
- ½-acre custom lots
- 8,000 to 10,000 square-foot production lots
- 5,000 to 7,000 square-foot production lots
- Condominiums/townhouses
- Multi-family housing with community facilities including pool and/or clubhouse

The method and basis for determining the baseline unit water demand factor for each of these classifications is detailed in the following subsections.

1-Acre Custom Home Lots

Water demand factors for the proposed large lots are based on recent water use data records for residential lots in the Serrano development – specifically existing residential lots located on Greenview Drive, Errante Drive, and others. The proposed lots in this category average at about 1 acre. However, not all land on these lots will be landscaped. For instance, a lot may include hillside and/or areas of oak woodland that must be protected, resulting in a diminished area for the home's footprint, outdoor hardscapes and landscaping. Generally, the house itself is large, with extensive outdoor features including pools, hardscapes, water features, and significant landscaping with well-maintained turf areas.

Based on available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is approximately 1.16 af/du.

½-Acre Custom Home Lots

Water demand factors for the proposed large lots are based on recent water use data records for residential lots in the Serrano development – specifically existing residential lots located on Renaissance Way and Renaissance Place. The proposed lots in this category average at about 1/2-acre though have a project minimum of 15,000 square feet. Landscaping on the lot may be based on a predetermined landscaping package for a production home. Generally, the house itself is large, with extensive outdoor features including pools, hardscapes, water features, and significant landscaping with well-maintained turf areas.

Based on available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is approximately 0.87 af/du.

[3] These classifications reflect EID's defined water demand factor categories as EID believes they best relate to the Proposed Project's land-use classifications as shown in the Table 1-1.

8,000 to 10,000 Square-foot Production Lots

The proposed project will include a large number of lots reserved for production homes on lots typically described as "large" for a residential community. For these lots, ranging up to ¼-acre or more, water demands will be based on recent water use data records for similar lots in the Serrano development – specifically Village D2 and portions of Village E, which includes numerous similar-sized lots. In contrast to the smaller lot production homes described in the next classification, these lots will retain adequate area on the lot for well-maintained turf and other landscaping. As much as one-half, but not less than about one-quarter, of the lot may still remain for landscaping, after accounting for the home's footprint and hardscape areas – equating to a few thousand to several thousand square-feet. Though less landscaped area than the custom home lots, the landscaped area will drive water use on these lots.

Based on the available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is 0.55 af/du.

5,000 to 7,000 Square-foot Production Lots

The Proposed Project includes numerous proposed lots with average of 4 to 5 dwelling units per acre. As a result of the limited outdoor area, many of these lots are limited to front-yard landscaping with well-maintained turf, and back yards often only including hardscapes, pools or other amenities, and lower water using landscapes. Unit water demands are based on recent water use data records for similar lots in the Serrano development – specifically Village D1A, portions of Village E and Euer Ranch, which include numerous similar-sized lots.

Based on the available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is 0.50 af/du.

Condominiums/Townhouses

The Proposed Project includes numerous proposed lots characterized as being condominiums or townhomes (7 to 12 units per acre). These proposed lots are anticipated to be similar to projects in the El Dorado Hills area, most notable the Regalo Project in Serrano. The Proposed Project includes large attached housing units, with large individual landscape yards and common areas.

Based on the available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is 0.40 af/du.

Multi-Family Housing

The Proposed Project includes numerous multi-family housing elements characterized as multi-family housing. These lots will include community landscaping, multi-story housing structures, community pools and other amenities. These projects are anticipated to be similar to the existing indoor and outdoor demands of the Sterling Apartment and Vineyard Apartment properties currently served by EID. Although both of these properties differ in their layouts and landscape types and coverage, both use approximately the same quantity of water on a per-dwelling unit basis.

Based on the available historic meter data for similar developments served by EID, the baseline unit water demand factor for this land-use category is 0.16 af/du – inclusive of both indoor and outdoor demands.

Residential Indoor Water Use

Based on EID meter data for the past several years, indoor water use for typical single-family homes averages about 0.18 af/du.[4]. The value drops for apartments as a result of less people on average living in each apartment unit.[5] This value can be used to derive separation of residential demands that could be served with non-potable supplies, such as recycled water from the Deer Creek and/or El Dorado Hills wastewater treatment facilities (see Section 2.7.2).

2.5 Modifying Baseline Values

All of the above-developed water demand factors for the residential classifications are based on similar existing developments in the El Dorado Hills area. However, since construction of the existing houses, a few changes have occurred that will reduce the Proposed Project's water demands from the baseline unit water demands derived from existing meter data. These include:

- CAL Green Code
- California Model Water Efficient Landscape Ordinance

CAL Green Code

In January 2010, the California Building Standards Commission adopted the statewide mandatory Green Building Standards Code (CAL Green Code) that requires the installation of water-efficient indoor infrastructure for all new projects beginning January 1, 2011. CAL Green Code was incorporated as Part 11 into Title 24 of the California Code of Regulations.[6] The CAL Green Code applies to the planning, design, operation, construction, use and occupancy of every newly constructed building or structure. All proposed land uses must satisfy the indoor water use infrastructure standards necessary to meet the CAL Green Code. The CAL Green Code requires residential and nonresidential water efficiency and conservation measures for new buildings and structures that will reduce the overall potable water use inside the building by 20 percent. The 20 percent water savings can be achieved in one of the following ways: (1) installation of plumbing fixtures and fittings that meet the 20 percent reduced flow rate specified in the CAL Green Code, or (2) by demonstrating a 20 percent reduction in water use from the building

[4] This value is a subset of the total usage estimated for a dwelling unit under each land-use category. Data from 2012 Water Resources and Service Reliability Report, EID, August 13, 2012, Appendix Table A, p.42

[5] El Dorado County indicates the average household size is 2.63 persons per occupied unit. (El Dorado County General Plan, 2008 Housing Element, August 2008 (Amended April 2009), p. 4-7).

[6] The CAL Green Code is Part 11 in Title 24.

"water use baseline."[7] The Proposed Project will satisfy one of these two requirements through the use of appliances and fixtures such as high-efficiency toilets, faucet aerators, on-demand water heaters, as well as Energy Star and California Energy Commission-approved appliances.

California Model Water Efficient Landscape Ordinance

In 2006, the Water Conservation in Landscaping Act was enacted, which required the Department of Water Resources to update the Model Water Efficient Landscape Ordinance (MWELO).[8] In fall of 2009, the Office of Administrative Law (OAL) approved the updated MWELO, which required that a retail water supplier adopt the provisions of the MWELO by January 1, 2010 or enact its own provisions equal to or more restrictive than the MWELO provisions.

The provisions of the MWELO are applicable to new construction with a landscape area greater than 2,500 square feet.[9] The MWELO provides a methodology to calculate total water use based upon a given plant factor and irrigation efficiency. Finally, MWELO requires the landscape design plan to delineate hydrozones (based upon plant factors) and then assign a unique valve for each hydrozone (low, medium, high water use).[10] The design of landscape irrigation systems is anticipated to better match the needs of grouped plant-types and thus result in more efficient outdoor irrigation.

Applying Conservation to Baseline Demand Factors

Collectively, these and other factors will put downward pressure on the baseline residential unit water demand factors – potentially dropping each unit demand by up to 10 percent for the larger lots. **Table 2-1** provides a summary of the baseline demand factor for each residential land-use category, the anticipated savings from the conservation mandates, and the resulting unit demand factor used to estimate the Proposed Project's water use.

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[7] See CAL Green Code.
[8] Gov. Code §§ 65591-65599
[9] CCR Tit. 23, Div. 2, Ch. 27, Sec. 490.1.
[10] CCR Tit. 23, Div. 2, Ch. 27, Secs. 492.3(a)(2)(A) and 492.7(a)(2).

Table 2-1 – Summary of Residential Baseline and Proposed Project Demand Factors

EID Water Demand Category (Relates to Table 1-1 Land Use)	**Density Range**	**Current Factor (af/du)**	**Conservation Applied**	**Factor Used (af/du)**
1 Acre Custom Homes	1 DU/Ac	1.16	10%	1.04
1/2 Acre Custom Homes	2 DU/Ac	0.87	8%	0.80
8,000-10,000 sf Lots	3 - 4 DU/Ac	0.55	5%	0.52
5,000-7,000 sf Lots	4 - 5 DU/Ac	0.50	5%	0.48
Condominiums/Town Homes	7 - 12 DU/Ac	0.40	4%	0.38
Multi-Family Housing[1]	15 - 24 DU/Ac	0.16	2%	0.16

1. The Multi-family Housing values remain constant due to rounding. The "current factor" was determined to be 0.165 af/du.

2.6 Baseline Non-Residential Water Use Demand Factors

Similar to the residential water demand factors, non-residential factors are based upon recent water use trends for similar types of land classifications.

For purposes of this WSA, the per-lot demand for non-residential lots is described as "the acre-feet of water use annually per acre of land" – or simply put, acre-feet/acre (af/ac). This value reflects indoor and outdoor water needs expected for a typical non-residential use for each of the following classifications:

- Office Park/Village Commercial
- Public and Neighborhood Parks
- Schools
- Other miscellaneous uses, including street medians, recreational lake, vineyards, and environmental mitigation

The method and basis for determining the baseline unit water demand factor for each of these classifications is detailed in the following subsections.

Office Park/Village Commercial

The proposed office park/village commercial facilities are anticipated to be "office space" as well as "retail and entertainment" in nature. Analysis of recent meter data for both the La Borgata retail facility on El Dorado Hills Boulevard and the Village Green office/public facility at the corner of Silva Valley and Serrano Parkways indicates that water use on a per-acre basis is nearly consistent, with the retail space using about 2.15 af/ac and the office facility using 1.95 af/ac. Although the Village Green indoor facilities have lower use, the area has more turf landscaped area (not including Village Green park), which matches, on a gross acre-by-acre comparison with the higher indoor retail demands and limited landscaping of the restaurants at La Borgata.

Based on the available historic meter data for similar facilities served by EID, the unit water demand factor is 2.0 af/ac.

Public and Neighborhood Parks

The Proposed Project includes five neighborhood parks, two village joint-use parks, and two special use parks. Neighborhood parks will include expansive turf areas, playfields, and other park amenities. Village joint-use parks will be adjacent to the school facilities and consist of similar features as the neighborhood parks. The special use parks, that surround the lake and historical site, differ from the other parks and are analyzed on a net landscaped acreage to match the water use estimates. Based upon recent water meter data for similar park facilities in the El Dorado Hills area – namely Bella Terra Park, Allan Lindsey Park, and the Village A, C, L3, and L4 parks – a representative water demand factor was identified. A "smart meter" controls the irrigation system at each existing park. These devices adjust water use to actual climate data, including precipitation events. Thus, the recent meter data is very indicative of expected demands for the new parks, which will also be outfitted with similar technology.

Based on the available historic meter data for similar facilities served by EID, the unit water demand factor is 2.77 af/ac.

Schools

The Proposed Project includes two schools: a Kindergarten through 5th grade, and a Kindergarten through 8th grade. The schools will use adjacent village parks for school-related recreational activities, and will include turf playfields. As an example, the water use at Oak Meadows Elementary on Silva Valley Parkway provides a useful representation of the expectations for the two proposed school facilities. Oak Meadows, operational by 2004, has an average water use of 1.70 af/ac – representing a use of about 0.019 af/student. For comparison, other schools in the area were analyzed and had very comparable per-student water use rates for similar facilities. But, the range in school use varied from as much as 2.5 af/ac to 0.8 af/ac – depending on factors like total school footprint, number of students and amenities. The average among seven schools analyzed was 1.43 af/ac. For purposes of this WSA, the average value would be an appropriate estimation for the future school sites.

Based on the available historic meter data for similar facilities served by EID, the unit water demand factor will use a baseline value of approximately 1.43 af/ac.

Other Miscellaneous Uses

The Proposed Project has additional miscellaneous uses including landscaped street medians, environmental mitigation requirements, a recreational lake, vineyards, gate houses at entrances to private streets, sewer lift stations, and construction water. These uses have minimal impacts to the overall per-project total water use due to their limited size and water needs, and some are temporary in nature.

Landscape Street Medians and Community Entrances

The Proposed Project includes proposed landscaping along street corridors and at entrances to particular residential areas, as is common in El Dorado Hills. Since comparable data is not available due to the variety of landscapes used in existing street medians around El Dorado Hills, unit water demands for this category is derived from the MWELO (see prior discussion under "residential land-uses"). To provide flexibility to the Proposed Project to landscape as needed, the entire width of the landscaped area was assumed to demand the maximum use allowed by MWELO.[11] This maximum is determined as 70 percent of the reference evapotranspiration for the area. Using available maps from the California Department of Water Resources, the reference evapotranspiration for the Proposed Project area is approximately 57 inches per year.[12] The resulting demand factor is 3.3 af/ac.

Oak Woodlands Management

As of the preparation of this WSA, the mitigation requirements for impacts to oak woodlands resulting from the Proposed Project are as detailed in the County's Policy 7.4.4.4.[13] For purposes of estimating the water demands of this Proposed Project element, the WSA assumes mitigation will include establishing new trees, likely with associated irrigation water to assure seedlings are established. As defined in the County's Oak Woodland Management Plan Monitoring Program:

> *"Replacement of removed tree canopy . . . is subject to intensive to moderate management and 10 to 15 years of monitoring, respectively. The survival rate shall be 90 percent as specified in the approved monitoring plan for the project, prepared by a qualified professional. Acorns may be used instead of saplings or one gallon trees."*

> *"Management intensity assumes that 10 years after planting 1 year old saplings that trees that have been nurtured with high management intensity will be on average 2 inches DBH with 90 percent survival; moderate management intensity will result in trees that are on average 1.5 inches DBH with 85 percent survival."*

More precisely, an intensive management program is required to obtain 90 percent survival. The management includes10 years of monitoring for one-gallon/one year old saplings and 15 years of

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[11] Although this may be higher than seen by EID for current street medians and community entrances, this conservative assumption allows the Proposed Project with flexibility to landscape these areas up to the full demands of MWELO.

[12] Reference Evapotranspiration is obtained from the map available at http://wwwcimis.water.ca.gov/cimis/cimiSatEtoZones.jsp

[13] The County Board of Supervisors has an Oak Woodland Management Plan (OWMP) codified as Chapter 17.73 of the County Code (Ord. 4771. May 6, 2008.). The primary purpose of this plan is to implement the Option B provisions of Policy 7.4.4.4. On September 24, 2012, the Board of Supervisors directed the Development Services Department to prepare a General Plan amendment to amend Policies 7.4.2.8, 7.4.2.9, 7.4.4.4, 7.4.4.5, 7.4.5.1, and 7.4.5.2 and their related implementation measures to clarify and refine the County's policies regarding oak tree protection and habitat preservation. (This excerpt was copied from the following El Dorado County web site: http://www.edcgov.us/Government/Planning/General_Plan_Oak_Woodlands.aspx on May 4, 2013.)

monitoring if acorns are planted. Any trees/acorns that do not survive within the monitoring periods are to be replaced within that time, so that 90 percent survival is achieved at the end of the monitoring period.

Because establishment of new trees is highly dependent on site conditions (soil depth and composition, depth to water table, slope, aspect, existing vegetation), planting conditions (water year, starting from acorns or saplings, weed mats, mulch, density of plantings and other adjacent veg, etc.), establishment and maintenance practices (manual or installed irrigation systems, and irrigation intervals), and the required success criteria (target % survival), the estimated water demands are difficult to predict.[14] However, in order to be reasonably conservative, this WSA assumes that each acre of habitat mitigation will require 1 acre-foot per acre of annual irrigation for a period of 15 years.[15] For instance, if the Proposed Project must mitigate with 10 acres of woodland, the demand would be 10 acre-feet annually. All oak woodland will be established prior to build-out and require no on-going irrigation.

Recreational Lake

The recreational lake is expected to need augmentation water to maintain desired lake elevations. Currently, the lake fills from adjacent groundwater seepage and stormwater runoff. Based on characterizations of this seepage from Proposed Project representatives, the water elevation often lowers during the summer and fall as surface evaporation outpaces seepage. To maintain water level elevations in the 10-acre lake, and estimated 6 to 10 acre-feet per surface acre of the lake will be assumed. For the entire lake, this equates to between 60 and 100 acre-feet. For purposes of the WSA, an assumed annual demand of 85 acre-feet will be used.

Vineyards

The Proposed Project will include approximately 55 acres of vineyards spread throughout the project. These vineyards serve as both an aesthetic feature and a business function – actively producing wine grapes. The majority of the planting is located on lots spread between differing housing types. Vineyards are also used in medians and other ornamental type plantings where appropriate. The use of vineyards in this fashion results in lower water use than fully landscaped medians. The vineyard water use estimates is based on a collection of documents from the University of California – Cooperative Extension combined with input for a local producer and winemaker. Reviewing water use data from *Wine Grape Cost and Return Studies, El Dorado and Amador Counties*, as well as other areas with similar climates and elevations, water demand range from 5 to 12 inches per year for established vines. In the interest of being conservative,

[14] A qualified professional will likely develop the project specific oak management plan. More detailed water use will be available in this plan. Review of information from oak mitigation projects in the area revealed a range of planting types, irrigation methods, and management time frames. Overall, irrigation demands were all low as would be expected for a native species.

[15] A conservative water demand number and a long management window were assumed to provide the Proposed Project applicants flexibility in meeting the oak woodland mitigation requirements.

the 12-inch annual value is used.[16] To account for any additional water demands while establishing the vines, this WSA assumes that twice the water will be needed in the first few years following planting. As shown in **Table 2-3**, the initial demand upon planning (included for the first 5-year increment for each vineyard planning phase) is 2 acre-feet/acre. This value drops to 1 acre-foot/acre for the remainder of the analysis period for a particular planting phase.

Gate Houses at Private Entrances

No usable comparison exists in the EID water use history to represent the demand of a gate house. A gate house consists of a small building with a single bathroom. The average country club employee per shift uses 50 Liters per day, or just over 13.2 gallons.[17] Assuming two employees per shift and 3 shifts per day, the resulting water use comes out to about 0.09 acre-feet per year. To be conservative, the demand used is rounded up to 0.1 acre-feet per year.

Sewer Lift Stations

Lift station demand comes in form of maintenance of the stations. Operational flushing at these lift stations is the primary water use. Based on EID records for such operations, each lift station is assumed to demand 2.5 acre-feet of water annually.

Construction Water

As stated in Section 1, early phases of the Proposed Project will include site grading and infrastructure installation. These and other construction elements will require dust suppression and other incidental water uses. These are estimated to be nominal, and do not continue beyond the construction phases of the Proposed Project. For purposes of identifying incremental water demands, construction water is assumed within this WSA to be 11 acre-feet per year (this is well over 3.5 million gallons – or nearly 900 fill-ups of a 4,000 gallon water truck annually).

Modifications to Reflect Additional Water Use Reductions

Similar to the residential demand factors, the above-developed water demand factors for the non-residential classifications are based on similar existing developments in the El Dorado Hills area. Considerations to reduce these baseline values for conservation factors, however, are not required, since demand factors for many of the landscaped features, such as parks, will not change from the existing values – with the exception of commercial land-uses. The landscape-dominant demand factors are affected primarily by climatic conditions that drive plant evapotranspiration. In other words, an acre of turf at a park will still use the same amount of water in the new parks as the existing parks. Commercial land-uses, however, are adjusted downward slightly to reflect the CAL Green Code and likely modifications to landscape designs (compared to existing establishments) to limit outdoor water use. Schools are kept consistent

[16] *The water demand is one dimensional and total demand is dependent on area. For the purposes of this WSA, acres are used for the second dimension. Therefore, one acre-foot of water is multiplied by each acre of vineyard. The result is 1 acre-foot/acre which is used in this documents calculations*

[17] Tchobanoglous, George, and Edward Schroeder. *Water Quality*. Menlo Park: Addison Wesley Longman, 1987

with the existing demand factor, since the data is based on the average of several schools and the exact configuration and number of students at the proposed schools is not fully defined. **Table 2-2** summarizes the non-residential demand factors used in this WSA.

Table 2-2 – Summary of Non-Residential Demand Factors

Land Use	Current Factor (af/ac)	Conservation % Applied	Factor Used (af/ac)
Office Park/Commercial	2.00	3%	1.94
Parks	2.77	0%	2.77
Schools	1.43	0%	1.43
ROW Landscaping	3.30	0%	3.30
Open Space	0.00	0%	0.00

2.7 Proposed Project Water Demand Projection

Combining the Proposed Project's land-use details and phasing as summarized in **Table 1-1** and **Table 1-2** with the demand factors presented in **Table 2-1** and **Table 2-2**, the water demands for the project from initiation to build-out are estimated. At completion, the Proposed Project is estimated to need 1,927 acre-feet of water annually (prior to considerations of non-revenue water, described in the next subsection) as shown in **Table 2-3**.

2.7.1 Non-Revenue Water Demands

The demand factors presented earlier in this section represent the demand for water at the customer's meter for each category. To fully represent the demand on EID's water resources, non-revenue water also needs to be included. Non-revenue water represents all of the water necessary to deliver to the customer accounts and reflects distribution system leaks, water demands from potentially un-metered uses such as fire protection, hydrant flushing, and unauthorized connections, and inescapable inaccuracies in meter readings.[18] In most instances, the predominant source of non-revenue water is from system leaks – the loss from fittings and connections from EID's water sources through treatment plants, tanks, pumping plants, major delivery system back-bone pipelines, and community distribution systems. Because a significant portion of the delivery system used to bring water to the Proposed Project already exists, the benefits of new piping within the Proposed Project has limited effect on the overall percentage of non-revenue water necessary to operate the system.

[18] The American Water Works Association and the California Urban Water Conservation Council recognize the inherent non-revenue water that is either lost or mis-accounted in urban treated water distribution systems and suggest purveyors strive for a value of 10% of all delivered water. Obtaining this value is dependent on numerous factors including the age and extent of distribution system infrastructure, meter rehabilitation programs, and how a purveyor accounts for actions such as fire flows and hydrant flushing.

Although EID has an established program for identifying and accounting for most unbilled and other system losses, there are still pipeline leaks, unmetered uses, unauthorized connections, meter inaccuracies, and other losses that are difficult to specifically quantify. Consistent with the District's methodology for calculating future water meter availability, as defined in the *2012 Water Resources and Service Reliability Report,* non-revenue water is projected at a fixed rate of 13 percent. Non-revenue demand is estimated to add 250 acre-feet per year at build-out to the Proposed Project's land-use demands, bringing the estimated build-out water demand attributed to the Proposed Project to 2,177 acre-feet annually (see **Table 2-3**).

2.7.2 Recycled Water Demand

A portion of the Proposed Project's demands (see Figure 1-1) could be met with recycled water provided by EID (see Section 4.3). As previously noted, other than the high-density multi-family units, residential potable demands require about 0.18 acre-feet annually per household. The remaining portion of the unit demand factor for each type of residential lot could be met with recycled water (see **Table 2.1** for unit demand factors). For the high-density residential units, the potable water requirement is lower due to fewer customers per unit on average when compared to other housing types. Using these unit water demand assumptions, coupled with the number of residential units, the Proposed Project could meet approximately 937 acre-feet of the 1,510 acre-feet of residential water demand with recycled water – prior to consideration of non-revenue water demands.

Non-residential components of the Proposed Project could also be met with recycled water, especially the parks, vineyards and lake supplementation. Removing the small potable demands for parks and the limited commercial properties, the Proposed Project could meet 355 acre-feet of the 417 acre-feet of total non-residential demand with recycled water – prior to the consideration of non-revenue water demands. Combined, recycled water could serve approximately 1,292 acre-feet of the Proposed Project's demand (see **Table 2-4**).

Table 2-4 – Estimated Demand Met with Recycled Water

	Demand (af/yr)		
	Residential	Non-Res	Total
Potable	572	62	635
Recycled	937	355	1,292
Total Demand	**1,510**	**417**	**1,927**

Table 2-3 – Estimated Proposed Project Water Demands from Start-up to Build-out

	Unit Count or Acreage						Demand Factor (af/du or af/ac)						Demand (af/yr)					
Category	Current	2015	2020	2025	2030	2035	Current	2015	2020	2025	2030	2035	Current	2015	2020	2025	2030	2035
Residential																		
1 Acre Custom Homes	0	0	25	45	145	193	1.16	1.04	1.04	1.04	1.04	1.04	0	0	26	47	152	202
1/2 Acre Custom Homes	0	0	25	50	50	125	0.87	0.80	0.80	0.80	0.80	0.80	0	0	20	40	40	100
8,000-10,000 sf Lots	0	0	215	593	593	982	0.55	0.53	0.53	0.53	0.53	0.53	0	0	113	312	312	517
5,000-7,000 sf Lots	0	0	0	0	663	663	0.50	0.48	0.48	0.48	0.48	0.48	0	0	0	0	315	315
Condominiums/Town Homes	0	0	75	597	772	772	0.40	0.38	0.38	0.38	0.38	0.38	0	0	29	228	295	295
Multi-Family Housing	0	0	209	259	487	501	0.16	0.16	0.16	0.16	0.16	0.16	0	0	34	42	79	81
												Subtotal	0	0	222	669	1,192	1,510
Commercial																		
Office Park/Commercial	0	0	0	12	27	58	2.00	1.94	1.94	1.94	1.94	1.94	0	0	0	22	52	112
Schools	0	0	0	0	19	35	1.43	1.43	1.43	1.43	1.43	1.43	0	0	0	0	28	50
Gate House	0	0	1	1	1	1	0.10	0.10	0.10	0.10	0.10	0.10	0	0	0	0	0	0
												Subtotal	0	0	0	23	80	162
Public																		
Parks	0	5	13	14	22	22	2.77	2.77	2.77	2.77	2.77	2.77	0	14	37	40	60	60
Open Space	0	1,282	1,282	1,282	1,282	1,282	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0
Lake	0	0	1	1	1	1	85.00	85.00	85.00	85.00	85.00	85.00	0	0	85	85	85	85
Vineyards Phase 1	0	0	18	18	18	18	0.00	0.00	2.00	1.00	1.00	1.00	0	0	35	18	18	18
Vineyards Phase 2	0	0	0	13	13	13	0.00	0.00	0.00	2.00	1.00	1.00	0	0	0	26	13	13
Vineyards Phase 3	0	0	0	0	10	10	0.00	0.00	0.00	0.00	2.00	1.00	0	0	0	0	20	10
Vineyards Phase 4	0	0	0	0	0	14	0.00	0.00	0.00	0.00	0.00	2.00	0	0	0	0	0	28
Lift Stations	0	0	2	2	2	2	2.50	2.50	2.50	2.50	2.50	2.50	0	0	5	5	5	5
												Subtotal	0	14	162	173	201	219
Other																		
ROW & landscape lots	0	0	6	11	11	11	3.30	3.30	3.30	3.30	3.30	3.30	0	0	18	36	36	36
Mitigation Demands	0	100	225	225	125	0	1.00	1.00	1.00	1.00	1.00	1.00	0	100	225	225	125	0
Construction Water	0	2	2	2	2	0	5.50	5.50	5.50	5.50	5.50	5.50	0	11	11	11	11	0
												Subtotal	0	111	254	272	172	36
												Total Water Demand	**0**	**125**	**638**	**1,137**	**1,646**	**1,927**
												Non-Revenue Demand at 13%	0	16	83	148	214	250
												Total Proposed Project Demand	**0**	**141**	**721**	**1,285**	**1,860**	**2,177**

SECTION 3 – OTHER ESTIMATED WATER DEMANDS

3.1 INTRODUCTION

As stated in this excerpt from Water Code Section 10910(b)(3): *"[T]he water supply assessment for the project shall include a discussion with regard to whether the public water system's total projected water supplies available…will meet the projected water demand associated with the proposed project, in addition to the public water system's existing and planned future uses…"* This section details EID's other "existing and planned future uses." For purposes of this WSA, existing and planned future uses are subdivided into the following:

- **Other Currently Proposed Projects** – in addition to the Proposed Project, El Dorado County (County) is the Lead Agency (pursuant to CEQA) for four additional proposed development projects. As Lead Agency, the County has requested separate WSAs from EID for each of these other projects. Because detailed land-use information is available for three of the four projects and separate WSAs are being developed for these three in parallel to this WSA, each of these three projects have unique water demand estimates that are included in this WSA.[19]

- **All Other Existing and Planned Future Uses –** in addition to the Proposed Project and the Other Currently Proposed Projects, existing customers and anticipated growth in the County must be quantified. The subdivisions of this category are:

    - **Current Customers and Uses** – using 2012 as a baseline condition, this category reflects the current range of EID's potable and recycled water customers. Because these customers and uses already exist, keeping them separate from planned future uses allows an analysis to reflect anticipated reductions in use over time as EID continues to implement its urban water conservation programs targeted at many of the existing customers.[20]

    - **Adjusted General Plan Update Land Use Growth** – in addition to the identified development projects currently undergoing County CEQA review, the County's 2004 General Plan Update (GPU) anticipates continued urban growth throughout the EID service area. This growth is accounted for in the EID 2013 *Integrated*

[19] EID understands the fourth project, San Stino, to be undergoing changes to its land-use plans at the time of drafting this WSA. Lacking the details needed to determine water demands similar to the other WSAs currently being completed, the San Stino project is reflected in the next subgroup of demands (see Section 3.3).

[20] New customers added to EID's system will have lower demand factors, as discussed in Section 2, and will be less likely to implement additional conservation or see much reduction when changes are made. For instance, many existing customers may still have 3 gallon per flush toilets or even 1.6 gallon per flush toilets, which when replaced, will likely only use 1.28 gallons. New houses will be constructed, per the CAL Green Code, with 1.28 gallon per flush toilets. EID has had conservation and incentives programs for more than 20 years.

Water Resources Master Plan (2013 IWRMP) and serves as the primary water demand driver into the future. Adjustments to anticipated GPU growth to reflect the "Other Currently Proposed Projects" and other proposed land-use changes, however, must be made. The adjustments discussed under this category include: (1) potential changes in the 2004 General Plan land use designations as identified in Facility Improvement Letters received and analyzed by EID; and (2) the removal of the Proposed Project and other proposed project uses being developed under concurrent WSAs.

- **Other Authorized Uses** – EID does not anticipate increases above 2012 levels in other authorized potable water uses such as fire flows, meter testing, water quality flushing, and ditch system operations. Demands for this category of water use is removed from the general plan growth and included separately.

- **Non-Revenue Water** – As discussed in Section 2.7.1, an additional demand is seen by EID to treat and deliver water to all customers. Referred to as non-revenue water, this water demand represents a 13 percent increase added to estimated customer demands. This value represents a long-term average experienced by EID.

3.2 Other Currently Proposed Projects

As mentioned in the previous section, El Dorado County is the Lead CEQA Agency for four additional proposed development projects and has requested EID to prepare WSA's for each development concurrent with this Proposed Project WSA. EID is currently drafting three of these four WSAs.[21] The estimate of water demand for each WSA follows the same methods used in Section 2 of this WSA, with specific unit demand factors applied to each unique land use element. The other projects are:

- Central El Dorado Hills – located along El Dorado Hills Blvd north of Hwy 50, this projects is a planned infill mixed development with primarily residential units and some commercial space.
- Lime Rock Valley Specific Plan – located adjacent to the Village of Marble Valley, this development is a planned residential community with a variety of lot sizes and housing types.
- Dixon Ranch Residential Project – located northeast of the Proposed Project, this development is a planned residential community with a range of lot sizes and housing types, including a number of "age-restricted" units, accompanied by a community club house, parks, ponds, and trails.

[21] EID understands that the San Stino development project is undergoing changes to the land-use plans previously submitted to the County. Therefore, EID has not begun the WSA for that project.

Based on the detailed analysis completed in the other WSAs, these "Other Currently Proposed Projects" represent approximately 1,330 acre-feet per year of new demand by 2035. **Table 3-1**, presented later in this section, summarizes the estimated water demands as determined and detailed in the concurrent WSAs for each unique project. The values shown are the estimated customer and use demands and do not include the additional water associated with non-revenue percentages attributable to the treatment and distribution for each project (see Section 3.5).

3.3 ALL OTHER EXISTING AND PLANNED FUTURE USES

In simple terms, this category of use would typically reflect all the other water demands anticipated by EID that are in addition to the Proposed Project. However, because of the unique circumstance that other WSAs are concurrently being drafted by EID, this category must be adjusted to remove those other well-defined water demands. Furthermore, because other potential changes to the 2004 GPU have been brought to EID's attention, and EID anticipates changes to current customer uses, a more detailed assessment of future demands is warranted. This subsection describes:

- Current Customers and Uses
- Adjusted GPU Land Use Growth
- Other Authorized Uses

3.3.1 Current Customers and Uses

Current customers and uses in the contiguous EID service area provide a baseline from which to assess additional demand from the Proposed Project and other potential planned uses. For purposes of the WSA, the deliveries to current customers in 2012 were used to define this baseline. Based on the 2012 EID *Water Diversion Report*, EID diverted 36,580 acre-feet into its potable water system. In addition to the potable water, EID served 2,404 acre-feet of recycled water to meet customer demands.[22] Combined, the current water demand is represented as 38,984 acre-feet. This value includes the non-revenue water (see Section 2.7.1), including system losses, necessary to deliver these supplies from their respective treatment plants to the customer meter. This value also includes 1,269 acre-feet sold to the City of Placerville.[23]

Since the WSA uses 2012 as a baseline, the "current" demand varies from that used in the recently adopted 2013 IWRMP, which used the year 2008 for its baseline.[24] Given on-going conservation efforts, adoption of new rate structures, and other drivers, EID has seen an overall decrease in the annual customer use since the IWRMP selected its baseline. Therefore the 2012

[22] See EID 2013 Water Resources and Reliability Report (Table 14)
[23] See EID Consumption Report: Reporting Year 2012 (Table on p. 7)
[24] The IWRMP, adopted by the EID Board in March 2013, began several years ago and at the time used 2008 as a baseline. Since that time, EID's annual diversions have dropped from a high in 2008 of about 45,000 acre-feet to 35,678, 33,453, and 36,580 in 2010, 2011, and 2012, respectively. Combined with recycled water deliveries, the 2012 demand is lower than that used for the 2013 IWRMP, but greater than 2010 and 2011.

baseline used for this WSA is more representative of the baseline use expected into the future from these existing customers and uses.

A slight adjustment to this baseline is necessary, however, to project it into the future. Although this demand will remain relatively constant since it does not add any new uses (additional uses are discussed in the next subsections), a slight decrease is assumed that reflects on-going implementation of conservation and installation of new water-using fixtures by existing customers. EID's continued leadership in conservation will enable existing customers to retrofit toilets, receive appliance rebates for new household items such as dishwashers, water heaters and clothes washers, and implement irrigation efficiency improvements through various incentives. Additional reductions in existing customer demands will also occur simply as a result of the natural replacement of old fixtures and appliances with lower water-use devices. For purposes of the WSA, EID estimates the reduction in current customer demand will be approximately 2% by 2020 and an additional 1% by 2035. This is consistent with EID's expectations necessary to meet its per-capita water use targets as detailed in the 2010 Urban Water Management Plan.[25]

3.3.2 Adjusted GPU Land Use Growth

In the 2004 GPU, the County made growth projections using land-use zoning throughout the County. Within the contiguous EID water service area, the GPU land-use zoning correlates to EID defined unit water demand factors. During preparation of the recently adopted 2013 IWRMP, EID used GIS-based land-use designations, combined with the water demand factors, to develop estimated growth in water demand. Absent any changes to the 2004 GPU land-use designations, the 2013 IWRMP demand projections would provide a valid representation of future water needs. However, because several proposed changes to the GPU land-use designations have been submitted – both through the County's formal process, such as is the situation with the Proposed Project and Other Planned Projects, and through an EID process explained below – the 2013 IWRMP demand projections require refinement. The steps to adjust these demands included:

- Removal of Proposed Project and Other Planned Projects water demands
- Modifying land-use zoning based on Facility Improvement Letters
- Determining Growth to Year 2035

Once these steps were completed, the analysis reassessed the water demand using the water demand factors applied in the 2013 IWRMP.

Step 1: Removal of Proposed Project and Other Planned Project Water Demands

The first step in adjusting the water demands was to remove the detailed water demands estimated in this WSA for the Proposed Project and for the Other Planned Projects (see

[25] See Section 3 of the 2010 UWMP available here: http://www.eid.org/modules/showdocument.aspx?documentid=338

Section 2 and Section 3.2). This step involved removing the specific acreage and water demand factors from the 2013 IWRMP analysis. The 2004 GPU included land-use zoning for the lands underlying the Proposed Project as well as the Other Planned Projects. In the 2013 IWRMP, water demands were estimated using the existing zoning. Removing these land uses eliminates the potential to double-count the associated acreage when assessing the remaining GPU expected growth.

Step 2: Modifying Land-use Zoning based on FILs
When investigating water service from EID for development projects (e.g. lot splits, land use changes, and new service to existing parcels), existing landowners submit a Facilities Improvement Letter (FIL). This document allows EID to assess whether infrastructure or supplies are available to serve the proposed project. In some instances, the FILs include proposed land-use zoning changes not previously incorporated into EID water demand projections. By using GIS to map the locations of the FILs requesting a change in land-use zoning, EID was able to identify where changes to the 2013 IWRMP demand estimates would occur. About 25 specific FILs were identified as having land-use designation changes. These identified parcels were removed from the prior analysis to eliminate potential double counting of demands.

In a separate analysis, the water demand for this subset of parcels was recalculated using the appropriate water demand factor for the new proposed land-use classification (e.g. water needs for these parcels may have previously been calculated based on very-low density housing, but is requesting a change to higher density housing). Through the analysis, an increased demand of approximately 3,000 acre-feet over the 2013 IWRMP projections was identified.

Step 3: Determining Growth to 2035
The GPU identifies anticipated build-out conditions for the County and, as a subset, for the EID contiguous water service area. Since this WSA assesses water demands in 5-year increments only to 2035 – well short of the anticipated timing of the County's build-out – the amount of build-out growth occurring by 2035 must be determined. This was done for both the parcels identified with new land-use zoning through the FIL analysis, and for the remaining parcels with original GPU land-use designations.

Because there is little detail about planned development rates for the FIL-related parcels, this WSA assumed that these parcels would have full water demand usage by 2035.[26] This is a conservative estimate, since some of these lands may not develop by 2035 or may never

[26] This assumption also considers that a landowner would likely only submit a FIL to EID if they are seriously contemplating the development activity. Thus, there is a higher likelihood that these parcels will develop at a faster rate than other generally anticipated growth for the remaining parcels in the GPU.

develop. Thus, the estimated increase in demand of approximately 3,000 acre-feet was assumed to occur by 2035 with the 2013 IWRMP growth rate applied.

For the remaining parcels, growth rates used to determine the degree of development were based on EID's 2013 IWRMP. In the 2013 IWRMP, growth rates for the El Dorado Hills, and Western/Eastern water service areas were identified for specific year-ranges.[27] This WSA uses those growth rates for the remaining parcels. Using the 2013 IWRMP growth rates, the analysis determined build-out for the El Dorado and Western/Eastern service areas occurs after 2035.

During this adjustment, special attention was provided to the City of Placerville. The City purchases potable water from EID for distribution to its residents. The 2013 IWRMP projected future water demands for the City based on the City's existing General Plan. This WSA assumes the same rate of growth and build-out demand as the 2013 IWRMP for the City.

Upon completion of these steps, the adjusted demand for the GPU land uses was determined. **Table 3-1** summarizes the anticipated increase in water demand during each 5-year increment as a result of these adjustments to the GPU land-uses.

3.3.3 Other Authorized Uses

In addition to the sale of water to metered customers, EID has a set of water demands it refers to as "Other Authorized Uses." This designation is for the following existing uses:

- Knolls Reservoir Assessment District
- Private Fire Services
- Temporary Water Use Permit
- Bulk Water Stations - Permanent
- Bulk Water Stations - Temporary
- Lift Stations
- Collection System Flushing
- Spills, Overflows, and Flushing
- Clear Creek Aesthetics Flow Maintenance District

Of these, the Clear Creek aesthetic flows comprise over 80 percent of the annual authorized uses. Lift stations and temporary use permits comprise another 10 percent. The current demand of approximately 2,200 acre-feet is already reflected in the "Current Customers and Uses." EID anticipates no growth in these authorized water uses, with the total demand to remain constant at 2,200 acre-feet through 2035.

[27] EID Integrated Water Resources Master Plan, adopted March 2013 (Table 9-2).

3.4 Non-Revenue Water Demands

The subtotal values in **Table 3-1** represent the demand for water at the customer's meter for each category. To fully represent the demand placed on EID's water resources, non-revenue water also needs to be included. Non-revenue water represents all of the water necessary to deliver to the meter and reflects distribution system leaks, water demands from potentially un-metered uses of fire protection, fire hydrant flushing, and unauthorized connections, and inescapable inaccuracies in meter readings.[28] In most instances, the predominant source of non-revenue water is from system losses – the loss from fittings and connections from the District's water sources through treatment plants, tanks, pumping plants, major delivery system back-bone pipelines, and community distribution systems.

Although the District has an established program for identifying and accounting for most unbilled and other system losses, there are still pipeline leaks, unmetered uses, unauthorized connections, meter inaccuracies, and other losses that are difficult to specifically quantify. Consistent with the District's methodology for calculating future water meter availability, as defined in the *2012 Water Resources and Service Reliability Report,* non-revenue water is projected at a fixed rate of 13 percent.

As shown in **Table 3-1**, non-revenue demand for Existing and Planned Future Uses is estimated to be about 7,500 acre-feet per year by 2035.

3.5 Estimated Existing and Planned Future Uses

Combining the estimated water demand for Other Currently Planned Projects (see Section 3.2 with the All Other Existing and Planned Future Uses demand (Current Customers and Uses plus the Adjusted GPU Land Use values), the total estimated demand during each 5-year increment to 2035 is derived (see subtotal water demand in **Table 3-1)**.

[28] See footnote 14

Table 3-1 – All Other Existing and Planned Future Uses

Category	Estimated Demand (af/yr)					
	Current	2015	2020	2025	2030	2035
Other Currently Proposed Projects	0	163	696	1,052	1,272	1,332
Current Customers and Uses [1]	38,984	34,154	33,809	33,694	33,579	33,464
Adjusted GPU Land Use [2]	0	514	2,853	7,975	14,718	22,830
Subtotal Water Demand	**38,984**	**34,831**	**37,359**	**42,721**	**49,570**	**57,627**
	Current	2015	2020	2025	2030	2035
Non-Revenue Water at 13%	--	4,528	4,857	5,554	6,444	7,491
Total Water Demand	**38,984**	**39,359**	**42,216**	**48,275**	**56,014**	**65,117**

1. The "Current Customers and Uses" demand value includes the "Other Authorized Uses." The Value is greater under the "Current" condition because "Non-Revenue Water" is included in the current year. All other years will have "non-revenue water" added on a separate line. A 3% conservation decrease occurs by 2035.
2. "Adjusted GPU Land Use" reflects changes to the 2004 GPU as determined by FILs submitted to EID. This value also does NOT include the other proposed projects currently undergoing County CEQA review.

3.6 Total Estimated Demand

The other existing and planned future water demands described in this section represent the total demands anticipated *in addition to* the water demands of the Proposed Project. Combining the estimated Proposed Project water demands of 2,177 acre-feet annually (see **Table 2-3**) with the estimated Existing and Planned Future water demands of approximately 65,000 acre-feet annually (see **Table 3-1**), a total estimated demand for EID water supplies by 2035 is determined. Estimated existing and planned future water demands, inclusive of non-revenue water needs, for each 5-year increment to 2035 are presented in **Table 3-2**. The estimated demand for EID Water supplies is 67,295 acre-feet annually.

Table 3-2 – Total Estimated Water Demands

Category	Estimated Demand (af/yr)					
	Current	2015	2020	2025	2030	2035
Proposed Project	0	141	721	1,285	1,860	2,177
Existing and Planned Future Uses	38,984	39,359	42,216	48,275	56,014	65,117
Total Water Demand	**38,984**	**39,500**	**42,937**	**49,560**	**57,874**	**67,295**

Of note is that the estimated water demand for 2035 presented in **Table 3-2** fits within the range of total demands presented in Table 9-1 of the 2013 IWRMP (estimated to be between 61,262 acre-feet and 77,315 acre-feet). The primary differences is that the 2013 IWRMP used 2008 as a baseline demand, which is substantially higher than EID has seen in the last several years. This WSA uses 2012 as a baseline. The 2008 value was approximately 45,000 acre-feet, while the 2012 value is 38,984 – or about 39,000 acre-feet. This represents a difference of about 6,000 acre-feet. Starting from a different baseline quantity and year, and then applying the 2013 IWRMP growth rates, results in a different estimated total demand when reaching 2035.

SECTION 4 – WATER SUPPLY CHARACTERIZATION

4.1 INTRODUCTION

This section explains the intended water supply that EID will use to serve the Proposed Project.[29] EID will meet the Proposed Project's water demands by utilizing water assets derived from its existing sources as well as through future asset acquisition efforts with El Dorado County Water Agency. This section details the Proposed Project's available water supplies and entitlements as well as its planned water supplies and entitlements in both normal water years and dry water years. The Proposed Project exists completely in El Dorado Irrigation District's contiguous water service area (see **Figure 4-1**) and may be served with both treated water and recycled water.[30]

El Dorado Irrigation District maintains two primary interconnected water systems in its contiguous service area: the El Dorado Hills system and the Western/Eastern system, along with a separate recycled water system. The El Dorado Hills water system obtains its primary supplies under rights and entitlements from Folsom Reservoir. The Western/Eastern system derives its supplies from sources under rights and entitlements emanating from further up the American River watershed and the Cosumnes River watershed. The recycled water system serves treated wastewater from the El Dorado Hills wastewater treatment plant and the Deer Creek wastewater treatment plant.

The water assets can be further categorized by the service area they primarily serve and the treatment plant they flow through. Water derived from Folsom Reservoir is delivered to the El Dorado Hills water treatment plant and serves the El Dorado Hills area. Water derived from upstream American River watershed diversions and storage reservoirs generally use the Reservoir 1 Water Treatment Plant while the Cosumnes River diversions use Reservoir A Water Treatment Plant to serve the Western/Eastern area. Water assets from these upstream diversions can be delivered by gravity feed to the El Dorado Hills area, but assets from Folsom Reservoir are not delivered outside the El Dorado Hills area due to infrastructure limitations. The following subsections describe these water supplies and delivery mechanics in more detail.

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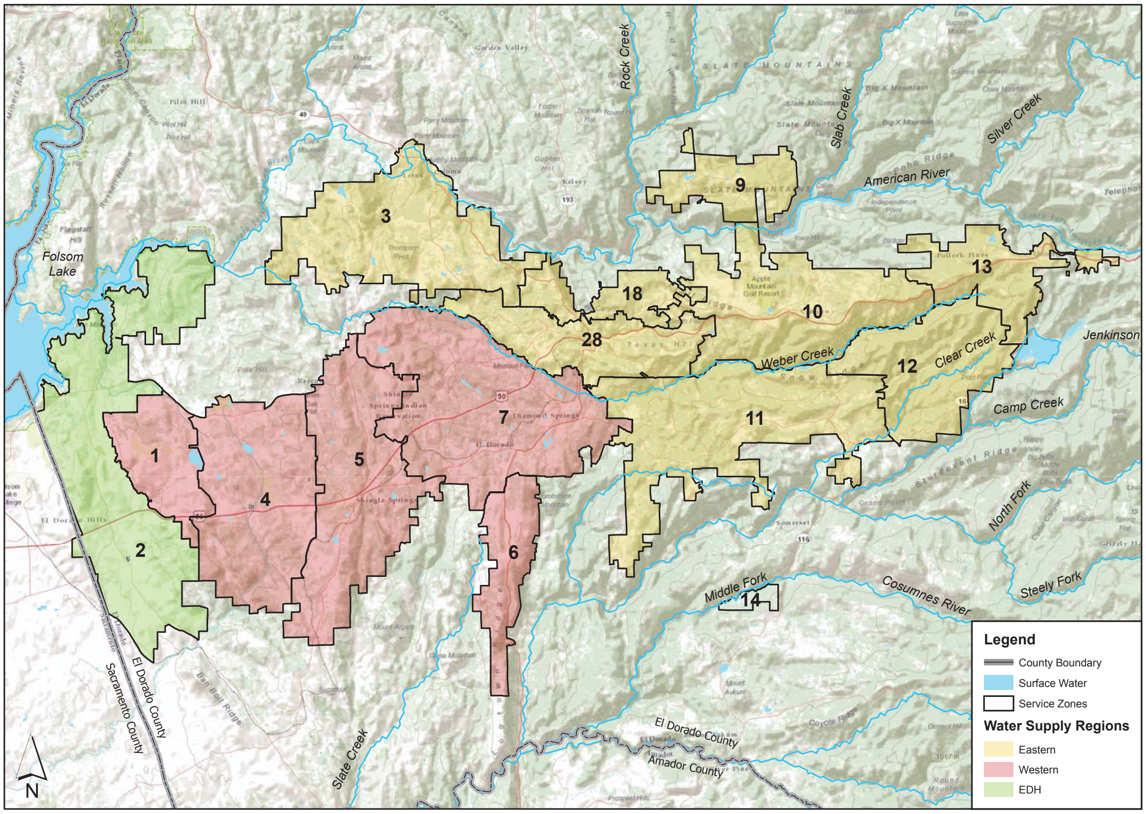
[29] CWC § 10910(d)(1) requires that "The assessment… include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project, and a description of the quantities of water received in prior years by the public water system…under existing water supply entitlements, water rights, or water service contracts. (2) An identification of existing water supply entitlements, water rights, or water service contracts held by the public water system…shall be demonstrated by providing information related to all of the following: (A) Written contracts or other proof of entitlement to an identified water supply. (B) Copies of a capital outlay program for financing the delivery of a water supply that has been adopted by the public water system. (C) Federal, state, and local permits for construction of necessary infrastructure associated with delivering the water supply. (D) Any necessary regulatory approvals that are required in order to be able to convey or deliver the water supply."

[30] EID also has surface water assets that it serves to two non-contiguous areas as well as raw water assets that are used for agricultural purposes. These water assets are irrelevant to the Proposed Project contemplated in this Water Supply Assessment and are, therefore, not analyzed.

Figure 4-1 – El Dorado Irrigation District Service Area
(from Figure 8-7, Integrated Water Resources Master Plan, EID, March 2013)



4.2 Treated Water Supplies

EID's treated water supplies identified for the Proposed Project are derived from a number of water rights and entitlements as detailed in **Table 4-1**. The maximum available water assets column in **Table 4-1** does not account for other hydrological, technical, regulatory, and contractual limitations that apply to the water assets for normal year and dry year deliveries. These issues are addressed in the other two columns in the table. EID's water assets available for the Proposed Project include water rights and entitlements that EID currently has in its possession and planned water rights and entitlements that it will control in the future.

4.2.1 Water Rights and Entitlements Description

Generally, EID's water assets are derived from pre-1914 appropriative water rights, licensed and permitted appropriative water rights, Central Valley Project (CVP) contracts, Warren Act contracts (that allow non-federal water assets to be wheeled through the federal storage and conveyance facilities), and recycled water generated from the effluent treated at the District's two wastewater treatment plants. The District's counsel has recently confirmed all of these water rights and entitlements. Pertinent information regarding these water assets is included in **Appendix A** of this document as required by Water Code section 10910(d).

Water for the Proposed Project will be derived from both Folsom Reservoir and upstream American River and Cosumnes River diversions. As shown in **Table 4-1**, the primary water assets for diversion at Folsom Reservoir are: CVP Contract 14-06-200-1375A-LTR1, and License 2184 and several pre-1914 water rights incorporated into Warren Act contract 06-WC-20-3315. EID is seeking to finalize its Warren Act contract for diversions of Permit 21112 at Folsom Reservoir. EID also has additional water assets under the El Dorado – SMUD Cooperation Agreement and a Central Valley Project water entitlement derived from El Dorado County Water Agency's Fazio water supply. These water assets will be described in **Section 4.2.2**.

Table 4-1 – Water Rights, Entitlements, and Supply Availability

Water Right or Entitlement	Maximum Water Assets Available (Ac-ft)	Normal Year Planned Supply Availability (Ac-ft)	Dry-Year Planned Supply Availability (Ac-ft)
License 2184 and pre-1914 ditch rights including Warren Act Contract 06-WC-20-3315	4,560	4,560	3,000
Licenses 11835 and 11836	33,400	23,000	20,920 [A]
CVP Contract 14-06-200-1375A-LTR1	7,550	7,550	5,660
Pre-1914 American River diversion and storage rights	15,080	15,080	15,080
Permit 21112	17,000	17,000	17,000
Subtotal Existing	**77,590**	**67,190**	**61,660**
Central Valley Project Fazio water entitlement (PL 101-514 (1990) Fazio) [D]	7,500	7,500	5,625
Applications 5645X12, 5644X02 and partial assignment of Applications 5645, 5644 with El Dorado-SMUD Cooperation Agreement [E]	40,000 [B]	30,000	5,000 [C]
Subtotal Planned	**47,500**	**37,500**	**10,625**
Recycled Water	5,600	5,600	5,600
Total	**130,690**	**110,290**	**77,885**

[A] This is the modeled safe-yield of this water right during a single dry-year. For planning purposes, the second and third dry years of a three-year dry period are assumed to be 17,000 acre-feet, and 15,500 acre-feet, respectfully
[B] Section 5.1.1 of the El-Dorado SMUD Cooperation Agreement indicates that 40,000 acre-feet of SMUD water will be available after 2025. For conservative Normal Year planning purposes, the District uses 30,000 acre-feet of available supply.
[C] Available supply is 15,000 acre-feet in a single dry year but in preparing for multiple dry years EID anticipates using only 5,000 acre-feet per year for a three year period.
[D] Available starting in 2015
[E] Available starting in 2025

License 2184 and Pre-1914 Water Rights

Water rights associated with Weber Dam, Weber Creek (Farmer's Free Ditch), Slab Creek (Summerfield Ditch), and Hangtown Creek (Gold Hill Ditch) are available to be diverted at Folsom Reservoir under a long-term Warren Act Contract, with approximately 4,560 acre-feet available each year from these sources. A Warren Act Contract allows the use of federal facilities to take non-CVP water such as these supplies. The 40-year contract commenced on March 1, 2011 and has a maximum net contract amount of 4,560 acre-feet per year. The contract total also assumes a 15% conveyance loss between the former points of diversion and Folsom Reservoir, which can be adjusted at a later date by mutual agreement without amending the contract. The annual water diversion season is limited to April through November 15 and the water must be used for municipal and industrial purposes in the El Dorado Hills and Cameron Park areas.

Licenses 11835 and 11836

Licenses 11835 and 11836 allow for 33,400 acre-feet of diversion in EID's upstream system in the Cosumnes River watershed. These diversions are stored in Jenkinson Lake, the largest storage reservoir in EID, formed by two earth and rock dams across Sly Park Creek near Pollock Pines with a maximum capacity of 41,033 acre-feet. The dam was constructed as a portion of the United States Bureau of Reclamation (USBR) CVP in 1955. With the transfer of ownership from the USBR of the Sly Park dam and associated lands and facilities in 2003, EID not only operates and maintains the Jenkinson Lake and Sly Park Dam facilities, including recreational aspects, but also holds the water rights. The average annual use from this facility is approximately 23,000 acre-feet, though EID's annual water right is for 33,400 acre-feet of total beneficial use. This water supply is used entirely within EID's contiguous service area. Under average flow conditions, Jenkinson Lake is operated to maintain 14,000 to 18,000 acre-feet of carryover storage each year. The outlet works at Sly Park Dam have a maximum capacity of 125 cfs. Water is released to the Reservoir A Water Treatment Plant for subsequent treatment, transmission, and distribution.

Jenkinson Lake contributes approximately 20,920 acre-feet per year to EID's system firm yield. Over the past five years, EID's annual diversions from Jenkinson Lake have averaged approximately 22,600 acre-feet per year. EID's maximum and minimum diversions from this particular water source during this five-year period were 25,745 and 20,800 acre-feet per year, respectively.

USBR CVP Contract 14-06-200-1375A-LTR1

Surface water from Folsom Reservoir is provided to the El Dorado Hills area. By contract with the USBR for Folsom Reservoir water, EID is entitled to 7,550 acre-feet per year. The contract includes provisions for use in a particular area that generally encompasses the El Dorado Hills and Cameron Park areas. Folsom Reservoir is operated by the USBR as part of the CVP, a multipurpose project that provides flood control, hydroelectricity, drinking water, and water for irrigation.

The El Dorado Hills County Water District entered into a USBR Contract in 1964 for water supply from Folsom Reservoir. The contract had a not-to-exceed limit of 37,600 acre-feet per year. When EID annexed the El Dorado Hills County Water District in 1973, the contract was assigned to EID, and subsequently, in 1979, an amendatory contract replaced the original 1964 contract and reduced the maximum annual supply quantity of Folsom Reservoir water to 6,500 acre-feet per year. In 1983, the USBR increased the maximum annual supply quantity from 6,500 to 7,500 acre-feet per year. EID also annexed and succeeded to a USBR Contract for 50 acre-feet per year to supply the Lakehills area in El Dorado Hills. In 2006, these two contracts were consolidated into a single 40-year USBR Contract with a maximum quantity of 7,550 acre-feet per year.

Pre-1914 South Fork American River and Project 184

EID acquired Project 184 from Pacific Gas and Electric (PG&E) in 1999. Project 184 includes reservoirs and associated dams, 22 miles of canals, a 21 Mw powerhouse, and other ancillary facilities. Prior to the transfer of ownership and water rights, EID held a contract to purchase water from PG&E and its predecessor, Western States Gas and Electric Co. The original water rights claims date back to 1856, with additional claims being filed in the 1860s and 1870s. The water rights for diversions from Echo Lake were established in 1880 in a California Supreme Court decision. Then, in 1918, the California Railroad Commission (predecessor to the California Public Utilities Commission) recognized the use of water from the El Dorado Canal for irrigation and domestic purposes.

The sources of this water supply include natural flows in the South Fork American River and its tributaries, and stored water in Silver, Aloha, Echo, and Caples Lakes. The supply is diverted from the South Fork American River at Kyburz and is conveyed via the El Dorado Canal to the El Dorado Forebay. Some additional water is obtained by diversions into the El Dorado Canal from streams tributary to the South Fork American River. EID takes consumptive use of the water supply at the Main Ditch Intake, located at the El Dorado Forebay. This particular supply contributes 15,080 acre-feet per year to EID's system firm yield.

Water diversions of up to 156 cfs can be made from the South Fork American River at the diversion dam. In addition to these direct diversion rights, EID also has pre-1914 diversion and storage rights associated with portions of the waters stored in Silver Lake, Caples Lake, and Lake Aloha and all of the waters stored in Echo Lake.

El Dorado Forebay is filled by the surface water supply from the Project 184 facilities upstream in the South Fork American River basin and at Echo Lake. EID has a consumptive water entitlement of 15,080 acre-feet per year delivery at the Forebay. The entitlement is a pre-1914 water right, and diversions are made in compliance with the 40-year Federal Energy Regulatory Commission Project 184 operating license issued to EID in October 2006. Because the full entitlement can be provided in all years including the most severe historic single dry year of 1977, this source of water is considered assured, and not subject to shortage from hydrologic droughts.

Permit 21112 and Warren Act Contract

The State Water Resources Control Board (SWRCB) issued EID a water right permit in 2001 for an additional 17,000 acre-feet per year of water supply associated with Project 184 facilities and power operations to be taken at Folsom Reservoir. This water supply was authorized under Permit 21112 for diversion and consumptive use anywhere within EID's contiguous service area. There are no cutback provisions on this supply.

The El Dorado County Water Agency (EDCWA) and EID applied to the SWRCB to obtain water rights for consumptive use of waters previously stored and released for power generation from Caples, Silver, and Aloha Lakes, as well as certain direct diversions from the South Fork American River, all of which have been used by Project 184 for hydroelectric power generation or instream flows. The EDCWA later assigned all of its rights under this application to EID. The SWRCB granted the right to appropriate 17,000 acre-feet per year of water. Permit 21112 allows EID to make direct diversions from the South Fork American River at Folsom Reservoir; to store in Caples, Silver, and Aloha Lakes; and to redivert the water released from storage. The sole approved point of take for consumptive purposes is Folsom Reservoir.

A diversion from Folsom Reservoir requires acquiescence from the USBR and issuance of a Warren Act Contract. EID has diverted water under this right under a temporary urgency basis and the Warren Act Contract is pending.

Recycled Water Supplies

EID produces recycled water at both the El Dorado Hills and Deer Creek wastewater treatment plants which is then used by EID's customers for irrigation of residential landscape and commercial landscape. The availability of recycled water is currently limited to the El Dorado Hills and Cameron Park areas. EID anticipates a 2035 recycled water supply totaling 5,600 acre-feet per year (see Section 4.3 for further details).

4.2.2 Planned Water Supplies

EID has plans to acquire and use two additional water supplies from EDCWA for use within its service area to make available for the Proposed Project – water under the El Dorado-SMUD Cooperation Agreement and water under EDCWA's Fazio CVP supply. This section describes these supplies.

El Dorado-SMUD Cooperation Agreement

As shown in **Table 4-1**, the additional supplies include a grouping of water right applications and assignment of existing water right applications totaling approximately 40,000 acre-feet of water. This supply is being developed by the El Dorado Water and Power Authority (EDWPA). EDWPA is a Joint Powers Authority consisting of El Dorado County, El Dorado County Water Agency and El Dorado Irrigation District (collectively, El Dorado Parties). EDWPA was formed to pursue additional water supplies for the western slope of El Dorado County as determined by the El Dorado County General Plan. This need is identified in the El Dorado County Water Agency Water Resources Development and Management Plan (Water Plan).[31] The Water Plan is

[31] http://www.edcgov.us/water/final_water_resources_plan.html

designed to coordinate water resource planning activities within El Dorado County and identifies water supply needs for the western slope of El Dorado County of approximately 34,000 acre-feet per year (AFA) at the 2025 demand level.

In 2005, the El Dorado Parties signed the "El Dorado – SMUD Cooperation Agreement" (included with **Appendix A**), which would help meet the Water Plan's identified water supply needs. This Agreement requires SMUD to make annual deliveries of up to 30,000 acre-feet of water through 2025 and 40,000 acre-feet thereafter from SMUD's Upper American River Project (UARP) to the El Dorado Parties. In 2008, EDWPA petitioned the SWRCB for partial assignment of two applications for diversion and storage to obtain water supplies necessary to trigger SMUD's obligations. A Draft Environmental Impact Report has been prepared in support of the water rights application and was circulated in July 2010. EDWPA is currently in the protest settlement phase and the CEQA process is anticipated to be completed in 2014 with award of water rights shortly thereafter.

The El Dorado-SMUD Cooperation Agreement also obliges SMUD to provide carryover storage and delivery to EID of up to 15,000 acre-feet of drought protection water supplies to be obtained by EDWPA. Based on demand projections, EID anticipates that only 30,000 acre-feet of the 40,000 acre-feet identified in the water right applications and the El Dorado – SMUD Cooperative Agreement will be available to EID in normal years. Moreover, EID has planned that a mere 5,000 acre-feet of the water supply will be available for EID's uses in each dry year. This number is derived from Appendix H of the El Dorado – SMUD Cooperation Agreement describing deliveries available from carryover storage. Both of these conservative assumptions are shown in **Table 4-1**. EID has planned this supply to be available starting in 2025.

Fazio CVP Supply

EID is also in the final stages of securing 7,500 acre-feet of CVP water supplies in conjunction with EDCWA. In 1990, Congress directed the Secretary of the Interior, through the USBR, to enter into a new CVP Municipal and Industrial (M&I) water service contract with EDCWA for up to 15,000 acre-feet of water annually (Section 206 of P.L. 101-514). The CVP water service contract requires requisite compliance by EDCWA and the USBR with CEQA, NEPA, and ESA statutes.

In 2009, a draft EIS/EIR was released for public review and comment for the CVP M&I water rights contract. In 2010, USBR advised EDCWA that it would take another 5 years before the CVP-Operations Criteria and Plan (OCAP) related litigation would allow the EIS to move forward. As a result, EDCWA made the decision to detach the EIR from the EIS – essentially separating the CEQA and NEPA processes. EDCWA certified the Final EIR and approved the project in January 2011. EDCWA then prepared and submitted to USBR a draft Biological Assessment (BA) in September 2011 and a draft Final EIS in October 2011. USBR submitted the draft Final EIS to NOAA Fisheries in December 2011. Final EIS completion and contract execution is pending completion of ESA consultation with NOAA Fisheries.

The CVP contract seeks to acquire 15,000 acre-feet of CVP project water, of which at least 7,500 acre-feet would be made available to EID by subcontracts with EDCWA.[32] Diversions by EID would occur at its existing intake in Folsom Reservoir, conveyed to the El Dorado Hills Water Treatment Plant, and delivered to a specific place of use location in El Dorado Hills and Cameron Park areas as shown in Figure ES-2 of EDCWA's EIR.

The contract negotiations and environmental compliance efforts are ongoing. These actions allow EID to use this water supply in this WSA as a planned supply that will be available to EID in the future to serve the Proposed Project. The approval of the contract terms as well as finalization of the environmental documents will allow EID to apply the water supplies under this contract entitlement to municipal and industrial beneficial uses. EID has planned this water supply to be available starting in 2015.

4.2.3 Normal Year Water Supply Availability

As shown in **Table 4-1**, EID's total water entitlements under its existing and planned supplies does not equate to the amount of water available in normal years in the future. The normal year water supplies will be described in this section.

Excluding recycled supplies, EID's secured water rights and entitlements available for the Proposed Project total 67,190 acre-feet. As shown in the sufficiency analysis in Section 5, this amount is insufficient to serve EID's future demand incorporating the Proposed Project and all planned future projects. Accordingly, this section assesses both EID's secured supplies and additional planned supplies. EID's water supplies associated with the entire secured and planned water assets totals 110,290 acre-feet per year.

The 67,190 acre-feet of secured supplies include appropriative water right license 2184 and pre-1914 appropriative water rights associated with Slab Creek, Hangtown Creek and Weber Creek. As described above, these rights are collectively combined for conveyance purposes in a Warren Act Contract, No. 06-WC-20-3315, that allows for storage in and diversion from Folsom Reservoir. The total volume is 4,560, net of a negotiated 15% conveyance loss under the terms of the Warren Act contract. For purposes of serving the Proposed Project, EID assumes full diversion at 4,560 in normal years under these water assets.

Appropriative water right licenses 11835 and 11836 are also secured supplies. These supplies can be diverted from several creeks in the Cosumnes River watershed (Camp, Hazel, and Sly

[32] Central Valley Project Water Supply Contracts Under Public Law 101-514 (Section 206): Proposed Contract Between the U.S. Bureau of Reclamation and the El Dorado County Water Agency, and Proposed Subcontracts Between the El Dorado County Water Agency and the El Dorado Irrigation District, and Between the El Dorado County Water Agency and the Georgetown Divide Public Utility District Final Environmental Impact Report at ES-1, January 2011.

Park) and are typically stored in Jenkinson Lake. The maximum rate of diversion is 500 cfs for a total possible diversion volume of 33,400. However, due to limitations in storage availability in Jenkinson Lake assessed through OASIS hydrologic modeling, the maximum available normal year supply for the Proposed Project is 23,000 acre-feet.[33] Although EID has diverted as much as 25,745 acre-feet from this reservoir, EID does not anticipate using more than 23,000 acre-feet under this right for its normal year diversions in the future.

Central Valley Project Contract 14-06-200-1375A-LTR1 is a secured supply available for immediate use for the Proposed Project. This CVP contract entitlement requires the USBR to deliver up to 7,550 acre-feet of water from its SWRCB water right permits on the American River to EID.

As described in Section 4.2.1, EID also has a number of pre-1914 appropriative water rights on the American River with storage components in Silver Lake, Lake Aloha, Caples Lake, and Echo Lake. For purposes of this document, these are collectively called the pre-1914 American River water rights.[34] The total volume of water available under the pre-1914 American River water rights is 15,080 acre-feet in normal years.

Appropriative water right permit 21112 is a secured supply for purposes of this WSA. Permit 21112 allows EID to divert up to 17,000 acre-feet of water per year from Folsom Reservoir to be used in EID's service area. EID has diverted water under this permit as part of a temporary urgency in 2008. EID must finalize its Warren Act Contract to divert this water at Folsom Reservoir. However, based upon the availability of the supply in Permit 21112, the ability to store the water in Caples, Silver, and Aloha lakes, and the pending conveyance agreement with USBR, the normal-year availability of this supply is 17,000 acre-feet.[35]

As described in Section 4.2.2, EID's planned water supplies include the CVP Fazio supply of 7,500 acre-feet as authorized under federal law. Once secured, EID should receive normal-year deliveries of the full entitlement just as USBR promises to other CVP M&I contract holders on the American River system. There is no reason to believe that this contract entitlement will be different than other CVP contract entitlements on the American River system.

Last, as described in Section 4.2.2, EID's planned water supplies derived from the EDWPA appropriative water right applications filings and assignments, as well as the El Dorado – SMUD Cooperation Agreement, indicate that EID should receive normal-year water deliveries of 30,000 acre-feet per year starting in 2025 and then as much as 40,000 acre-feet of deliveries thereafter.

[33] 2013 Water Resources Report

[34] California Water Code section 10910(d)(2)(A) requires "proof of entitlement" of each individual water right that is combined into this pre-1914 American River water rights grouping. These documents are contained in **Appendix A** of this Water Supply Assessment.

[35] EID Urban Water Management Plan 2010 Update, July 2011 at page 4-7 of 22. Follow-up discussion with EID Counsel on water availability on April 23, 2013.

Based on demand projections, the District uses 30,000 acre-feet of normal-year deliveries under these collective applications and the El Dorado-SMUD Cooperation Agreement.

4.2.4 Dry-Year Water Supply Availability

As shown in **Table 4-1**, EID anticipates less water being available in dry years than is otherwise available in normal years as described in Section 4.2.3. Dry-year supplies include supply reductions attributable to hydrologic droughts and regulatory curtailments. The dry-year water supplies are described in this section.

EID's entire normal-year secured and planned water assets total 110,290 acre-feet per year. In dry years, EID's total water assets equal 77,885 acre-feet. Of this total supply, 61,660 acre-feet are secured water assets and 16,225 acre-feet are planned water assets.

As described in Section 4.2.3, the secured water assets include License 2184 and the additional pre-1914 appropriative rights that are included in Warren Act contract 06-WC-20-3315, Licenses 11835 and 11836, CVP Contract 14-06-200-1375A-LTR1, the pre-1914 American River water rights grouping, and Permit 21112. All of these water rights are subject to different regulatory and hydrological restrictions that could result, in some instances, in reduction of the water supplies available under the right or entitlement in dry years.

The water rights contained in the Warren Act Contract 06-WC-20-3315 have some level of regulatory restrictions and hydrological uncertainty. EID's 2010 UWMP indicates that the estimated dry-year yield associated with this water asset is 3,000 acre-feet per year based upon regional hydrologic conditions.[36] Accordingly, based upon the presumed hydrologic conditions, the dry-year reliability for this supply in three consecutive dry years is 3,000 acre-feet per year.

Licenses 11835 and 11836 have a full diversion entitlement of 33,400 acre-feet per year. Of that amount, carryover storage in Jenkinson Lake and diminished inflow reduce that entitlement to a normal-year supply of 23,000 acre-feet per year. In dry years, this amount is further reduced based upon hydrologic conditions as well as carryover storage needs for future years from Jenkinson Lake. Accordingly, based upon the OASIS hydrologic modeling report, EID reduces this supply's availability to 20,920 acre-feet in a single dry year. Thus, 20,920 acre-feet per year is used in this WSA as the dry-year safe yield number for a single dry year. To be conservative, EID plans for this supply to be further reduced during year two and again in year three of and three consecutive dry years. This WSA uses 17,000 acre-feet and 15,500 acre-feet as the available supply in year two and year three of a multi-year drought, respectfully.

CVP Contract 14-06-200-1375A-LTR1 has a normal-year entitlement of 7,500 acre-feet per year. The USBR, however, assesses the dry-year supply availability of its CVP M&I contracts

[36] EID Urban Water Management Plan 2010 Update, July 2011 at page 4-6 of 22. Follow-up discussion with EID Counsel on water availability on April 23, 2013.

through the CVP M&I Shortage Policy. Based on inflow and storage criteria developed at the joint operations center, USBR can reduce contract water supplies under the CVP M&I Shortage Policy by up to 25% of historic use with various adjustments made for population, use of non-CVP water and extraordinary conservation actions.[37] With these adjustments in mind, USBR calculates the reduced CVP M&I delivery essentially based upon the average of the three previous normal years of use under the CVP contract. Under the strictest interpretation of this policy, if the water under the CVP contract was not used, then the dry year water is not available. But, USBR has considered that use of non-CVP supplies in lieu of CVP water use may be used to calculate use under this shortage policy. For purposes of this analysis, however, we have determined that based upon normal growth in demand in EID's service area, EID's customers would utilize the entire contract entitlement in normal years in the future. As such, EID calculates its dry-year reduction for this Proposed Project based upon three years of full use of its contract allocation. Accordingly, the dry year supply under this water contract entitlement is 5,660 acre-feet per year.

EID's pre-1914 American River water rights-grouping has a normal-year reliability of 15,080 acre-feet per year. Based upon the early priority date of these water assets and the storage capability within EID's system associated with these water assets, they are not reduced at all in a single dry year or three consecutive dry years.

Permit 21112 is another secure dry-year water asset. EID's 2010 UWMP states "there are no cutback provisions on this supply."[38] As such, the dry year reliability of Permit 21112 is 17,000 acre-feet per year.

As described in Section 4.2.2, EID's planned supplies include the CVP Fazio supply, and the several rights and contract that make up the UARP SMUD water. All of these assets combined have a three consecutive dry year supply reliability of 10,625 acre-feet per year.

The CVP Fazio supply is another CVP M&I contract supply that is subject to the same Municipal and Industrial shortage provisions described above for EID's other CVP contract entitlement. EID's expected portion of the Fazio supply has a normal-year contract allocation of 7,500 acre-feet per year. Assuming under the rules described above that EID is able to use its entire contract entitlement in the future, a 25% reduction from the contract entitlement reduces the delivery by 1,875 acre-feet per year. As such, the single dry year reliability and three consecutive dry year reliability under this contract is 5,625 acre-feet per year.

[37] Reclamation has the authority to reduce the supply volumes even further under extreme conditions – Health and Safety criteria – but this sort of supply reduction would only occur in extreme drought and would be offset by reductions in demand in EID's service area, as needed, to maintain basic Health and Safety conditions. The District's drought contingency plans address these situations.
[38] This assertion was confirmed in a telephone conversation with the District's Counsel on April 23, 2013.

Last, the UARP SMUD water that is derived from the numerous water right applications and assignments as well as the El Dorado-SMUD Cooperative Agreement indicates that the water available under these components in dry years could be severely curtailed. Appendix H of the Agreement states that annual deliveries can be superseded and deliveries from carryover drought storage can be reduced to as little as 5,000 acre-feet in a declared Critically Dry year if SMUD reservoir storage drops below 100,000 acre-feet (approximately 25%). Out of an abundance of caution, EID anticipates only 5,000 acre-feet of carryover drought-supply water would be available each year over the course of a three-year drought.

4.3 RECYCLED WATER SUPPLIES

EID uses recycled water to meet some current non-potable demands within its service area. EID may expand its development and use of recycled water in the future to meet a portion of the non-potable demands associated with the Proposed Project and other anticipated new demands. EID's current recycled water use is about 2,200 acre-feet per year. This use will expand incrementally over time. By 2035, EID anticipates a supply of 5,600 acre-feet of recycled water per year within its service area.[39]

EID's recycled water system consists of supply from the El Dorado Hills wastewater treatment plant and the Deer Creek wastewater treatment plant. These treatment plants have an interconnected network of transmission and distribution pipelines, pump stations, storage tanks, pressure reducing stations, and appurtenant facilities located within the communities of El Dorado Hills and Cameron Park.[40] EID mandates the use of recycled water through Board Policy 7010, wherever economically and physically feasible as determined by the Board, for non-domestic purposes.[41] At this time, non-domestic use includes commercial landscape irrigation, residential or multi-family dual-plumbed landscape irrigation, construction water, and recreational impoundments.

Recycled water availability is an outcome of increased municipal and domestic demand and wastewater production as a byproduct of this demand. In other words, annual recycled water production capabilities are based on the total wastewater flows to the treatment plants. With the population and industrial demands growing in this region, as described in Section 3, the availability of recycled water will increase. EID is taking a conservative view of the growth in recycled water based upon its current production levels, estimated regional population growth, facility expansion identified in its 2013 IWRMP and WWFMP, treated water discharge requirements, and its ability to capture and store recycled water supplies in the future. The total recycled water available for use in 2035 is estimated to be 5,600 acre-feet per year.[42]

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[39] EID Integrated Water Resources Master Plan, March 31, 2013

[40] EID Urban Water Management Plan 2010 Update, July 2011 at page 4-10 of 22.

[41] EID Urban Water Management Plan 2010 Update, July 2011 at page 4-6 of 22.

[42] EID Integrated Water Resources Master Plan, March 31, 2013 at page 221.

Accordingly, Table 4-2 shows the incremental recycled water assets that would be available over time for the District's non-potable water uses.

Table 4-2 – Timing of Recycled Water and Quantities

Year	Recycled Water Supply (acre-feet)
Current	2,200
2015	2,400
2020	2,600
2025	3,100
2030	4,200
2035	5,600

4.4 FACILITY COSTS AND FINANCING

EID's recently completed 2013 IWRMP and WWFMP identify and allocate the future costs of capital expansion and replacement needs, and addresses financing mechanisms for EID's water assets. These costs and financing mechanisms are hereby incorporated by reference.

The District establishes and periodically updates its Facility Capacity Charges (FCCs) to recover the cost of those portions of existing District facilities that will be used by future customers and to fund needed expansion, or additional capacity, of District facilities to serve new users. The District periodically reviews its FCCs to ensure they accurately reflect the costs of providing service to new customers. Currently the District is updating the FCCs to incorporate projects identified in the adopted 2013 IWRMP. The FCC update is currently under review by the Board and a developer committee, and the District anticipates adoption of the updated FCCs in August 2013.

4.5 REGULATORY APPROVALS AND PERMITS

As described in Section 4.2.2, EID has water assets that require further regulatory approvals, permit compliance, and contract approvals. Each water asset has its own set of regulatory requirements that are assessed in this section.

Appropriative water right Permit 21112 issued by the SWRCB has not been perfected. In order to perfect an appropriative water right, EID must put all of the water assets under that permit to beneficial use. Upon putting the water to beneficial uses and meeting all of the other conditions in the water right permit, EID will be eligible to obtain a water right license for this appropriative water right. Attaining a water right license further fortifies the legitimacy of the water right for EID's continual use in the future. There is no indication that EID will have difficulty in obtaining a water right license for Permit 21112.

Permit 21112 also requires a Warren Act Contract to be negotiated and approved by the USBR. The Warren Act Contract will allow EID to divert water from Folsom Reservoir for delivery to the El Dorado Hills Water Treatment Plant. Although the District may choose to divert some of the water upstream of Folsom Reservoir through other SWRCB regulatory processes, a Warren Act Contract is essential for any diversions emanating from Folsom Reservoir. EID is currently in negotiations with USBR to obtain a long-term contract. While those negotiations continue, short-term Warren Act Contracts are also obtainable, if needed. There are no foreseeable reasons that these negotiations will not succeed. Both EID's Board of Directors and USBR officials will need to execute the contract once the terms have been drafted, and EID will need to obtain judgment in a judicial action to validate the contract.

The Fazio water supply also has additional regulatory approvals and permits pending. This CVP contract entitlement is authorized by Public Law 101-514. The 15,000 acre-feet of water supply is contemplated to be split equally between Georgetown Divide Public Utilities District and EID. As described in Section 4.2.2, EDCWA is negotiating with USBR on behalf of EID to secure the CVP contract entitlement authorized by this federal statute and finalize the EIS. Accordingly, EID will continue to work with EDCWA and USBR to finalize acquisition of this water supply. Upon completion of the EIS, the EDCWA's designee and USBR officials will need to execute the CVP water supply contract, and EDCWA may need to obtain judgment in a judicial action validating the contract.

The pending water right applications and application assignments before the SWRCB as well as the El Dorado – SMUD Cooperation Agreement constitute the last water supply that is pending further regulatory approvals. As described in Section 4.2.2, EDWPA is awaiting approvals from SWRCB for these water assets. Upon SWRCB approval, EID will obtain 30,000 acre-feet of water under the El Dorado – SMUD Cooperation Agreement.

The SWRCB water right process requires the SWRCB to conduct an internal project review of the applicable technical and hydrological information as well as consider the broader effects on other legal users of water throughout the watershed before issuing a permit. This regulatory process may eventually necessitate a SWRCB hearing where testimony from proponents and opponents of the water right permit is heard and weighed by the SWRCB Board Members before issuing the conditioned permits. Once permits have been issued, then the District must comply with the permit terms and perfect application of the water supplies to beneficial use in order to acquire water right licenses associated with the appropriative water rights.

The El Dorado – SMUD Cooperation Agreement is an agreement among the various parties to cooperate in facilitating the storage and delivery of these water assets to the identified purveyors. As such, through the processing of the water right applications and the furtherance of compliance with the terms of those agreements, the water assets considered there are likely to be available to

EID. The regulatory approvals and permits needed to finalize EID's control over these water assets are moving forward.

4.6 SUPPLY SUMMARY

EID has two broad categories of water assets that are available for the Proposed Project – the secured water assets and planned water assets. Collectively, these supplies total 110,290 acre-feet in normal water years and 77,885 acre-feet in a single dry water year. In year two and year three of a multi-year drought, supplies are further reduced to 73,965 acre-feet and 72,465 acre-feet, respectfully.

As described above, the secured water assets include appropriative water right License 2184 and the accompanying pre-1914 appropriative water rights held under Warren Act Contract 06-WC-20-3315, appropriative water right Licenses 11835 and 11836, CVP Contract 14-060200-1375A-LTR1, the pre-1914 American River storage and diversion appropriative water rights, and Permit 21112. The normal year water supplies available to EID under the secured assets total 67,190 acre-feet per year. In dry years, the water supplies available to EID under the secured assets totals 61,660 acre-feet per year.

The planned water assets, although partially secured, are not yet fully available for EID's use to serve the Proposed Project contemplated in this WSA. As described above, these assets are sufficiently secure to be considered planned supplies for the Proposed Project in 2035. In normal years, the water supplies under these assets total 37,500 acre-feet. In dry years, the water supplies under these assets total 10,625 acre-feet.

Finally, the recycled water assets in both normal and dry years, derived from planned growth and continual indoor water usage regardless of year type, total 5,600 acre-feet in 2035.

SECTION 5 – SUFFICIENCY ANALYSIS

5.1 INTRODUCTION

The analysis detailed in this section provides a basis for determining whether sufficient water supplies exist to meet the estimated water demand of the Proposed Project.[43]

This section includes:

- Analysis of sufficiency, considering variations in supply and demand characteristics under normal, single-dry and multi-dry hydrologic conditions,
- Analysis conclusions

5.2 SUFFICIENCY ANALYSIS

The sufficiency analysis integrates the water demands detailed in Section 2 and Section 3 with the water supplies characterized in Section 4. The results are presented in **Table 5-1** beginning with "current" conditions (recognized as 2012) and continuing with 5-year increments from 2015 through 2035. While the analysis at various intervals before build-out is important, the most critical projection for the sufficiency analysis occurs in 2035. This analysis assumes that the Proposed Project, along with the other projects simultaneously undergoing a WSA analysis (see Section 3.3), are fully constructed by 2035, and other anticipated growth continues as described in Section 3.4.

Table 5-1 incorporates the Proposed Project water demand projection in **Table 2-3**, assuming the Proposed Project develops as detailed in Section 1, and the estimated water demands for all other existing and planned future uses through 2035 as detailed in **Table 3-2**. **Table 5-1** also presents the available water supplies for the contiguous EID service area during normal, single-dry and multiple-dry years, as detailed in Section 4. The water demands and available supplies in a single dry-year and multiple dry-year condition are discussed in the following subsections.

[43] CWC § 10910 (c)(4) provides that "If the city or county is required to comply with this part pursuant to subdivision (b), the water supply assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the city or county for the project during normal, single dry, and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses."

Table 5-1 – Comparable Analysis of Supply and Demand

Year	Project Water Demand (af/yr)	All Other EID Water Demands (af/yr)	Total Water Demands (af/yr)	Non-Revenue Water @ 13%	Demands with Loss	EID Water Supplies: Surface Water: Hydrologic Year Type		EDH Service Area (af/yr)	West/East Service Area (af/yr)	Total (af/yr)	Recycled Water (af/yr)	Total Available Water Supply (af/yr)	Projected Surplus/ (Shortfall) (af/yr)
Current	0	38,984	38,984	N/A	38,984	Normal		29,110	38,080	67,190	2,200	69,390	30,406
	0	40,933	40,933	N/A	40,933	Single Dry		25,660	36,000	61,660		63,860	22,927
	0	40,933	40,933	N/A	40,933	Multiple Dry	Year 1	25,660	36,000	61,660		63,860	22,927
	0	38,068	38,068	N/A	38,068		Year 2	25,660	32,080	57,740		59,940	21,872
	0	34,793	34,793	N/A	34,793		Year 3	25,660	30,580	56,240		58,440	23,647
2015	125	34,831	34,956	4,544	39,500	Normal		36,610	38,080	74,690	2,400	77,090	37,590
	131	36,573	36,704	4,771	41,475	Single Dry		31,285	36,000	67,285		69,685	28,210
	131	36,573	36,704	4,771	41,475	Multiple Dry	Year 1	31,285	36,000	67,285		69,685	28,210
	122	34,012	34,134	4,437	38,572		Year 2	31,285	32,080	63,365		65,765	27,193
	111	31,087	31,198	4,056	35,254		Year 3	31,285	30,580	61,865		64,265	29,011
2020	638	37,359	37,997	4,940	42,937	Normal		36,610	38,080	74,690	2,600	77,290	34,353
	670	39,227	39,897	5,187	45,084	Single Dry		31,285	36,000	67,285		69,885	24,801
	670	39,227	39,897	5,187	45,084	Multiple Dry	Year 1	31,285	36,000	67,285		69,885	24,801
	623	36,481	37,104	4,824	41,928		Year 2	31,285	32,080	63,365		65,965	24,037
	569	33,343	33,912	4,409	38,321		Year 3	31,285	30,580	61,865		64,465	26,144
2025	1,137	42,721	43,859	5,702	49,561	Normal		19,610	85,080	104,690	3,200	107,890	58,329
	1,194	44,858	46,052	5,987	52,039	Single Dry		14,285	58,000	72,285		75,485	23,446
	1,194	44,858	46,052	5,987	52,039	Multiple Dry	Year 1	14,285	58,000	72,285		75,485	23,446
	1,111	41,718	42,828	5,568	48,396		Year 2	14,285	54,080	68,365		71,565	23,169
	1,015	38,129	39,144	5,089	44,233		Year 3	14,285	52,580	66,865		70,065	25,832
2030	1,646	49,570	51,216	6,658	57,874	Normal		19,610	85,080	104,690	4,100	108,790	50,916
	1,728	52,048	53,777	6,991	60,768	Single Dry		14,285	58,000	72,285		76,385	15,617
	1,728	52,048	53,777	6,991	60,768	Multiple Dry	Year 1	14,285	58,000	72,285		76,385	15,617
	1,607	48,405	50,012	6,502	56,514		Year 2	14,285	54,080	68,365		72,465	15,951
	1,469	44,241	45,710	5,942	51,652		Year 3	14,285	52,580	66,865		70,965	19,313
2035	1,927	57,627	59,554	7,742	67,295	Normal		19,610	85,080	104,690	5,600	110,290	42,995
	2,023	60,508	62,531	8,129	70,660	Single Dry		14,285	58,000	72,285		77,885	7,225
	2,023	60,508	62,531	8,129	70,660	Multiple Dry	Year 1	14,285	58,000	72,285		77,885	7,225
	1,881	56,273	58,154	7,560	65,714		Year 2	14,285	54,080	68,365		73,965	8,251
	1,720	51,432	53,152	6,910	60,061		Year 3	14,285	52,580	66,865		72,465	12,404

5.2.1 Single Dry Year Supply and Demand Conditions

Under this condition, EID would anticipate a variance from the normal-year analysis, including: (1) shortage in full availability of supplies as detailed in **Section 4**, and (2) an increase in water demand. The increase in demand is based on the following:

- Landscape irrigation demands will increase to reflect the generalized earlier start of the landscape irrigation season due to limited rainfall in the single driest year. Since this increase only applies to the outdoor portion of a customer's demand, an adjustment factor of 5 percent is applied to the total normal-year water demand values.
- Historically, during single dry year circumstances, EID does not implement its shortage contingency plan,[44] since the extent of the dry conditions into future years is unknown. EID follows adopted policies and its 2008 *Drought Preparedness Plan* when implementing any voluntary or mandatory demand reduction measures.

As a result of these factors, the Proposed Project water demand and those of the other existing and planned uses is expected to increase in a single dry year above the demand expected under normal hydrologic circumstances. Additionally, as detailed in Section 4, EID anticipates a decrease in available water supplies. These changes are shown in **Table 5-1**.

5.2.2 Multi-Dry Year Supply and Demand Conditions

When a single dry year expands into a series of dry years, water supply and demand conditions will continue to evolve. Under such a multi-dry year, EID would anticipate many similar conditions that were assumed for the single-dry year, including: (1) shortage in full availability of supplies as detailed in Section 4, and (2) increases in projected demands. However, when entering the second and third year of a sequence of dry-years, EID would implement necessary policies to manage limited water supplies.[45] Demands over a series of three dry years are adjusted as follows:

- Year 1 – the first year mimics a "single-dry year" condition, where demands increase approximately 5 percent and EID shortage policies are not yet invoked (see Section 5.2.1).
- Year 2 – The demands again mimic a "single-dry year" and would be expected to increase by 5 percent above normal year conditions. However, when recognizing a second dry-year, EID would invoke the first stage of the Drought Preparedness Plan. This stage states: "*The objective of Stage 1 is to initiate public awareness of predicted water shortage conditions, and encourage voluntary water conservation to decrease*

[44] See EID Board Policy AR 5011-Water Supply Management Conditions (available at http://www.eid.org/modules/showdocument.aspx?documentid=2687).
[45] See EID Board Policy AR 5011-Water Supply Management Conditions (available at http://www.eid.org/modules/showdocument.aspx?documentid=2687).

normal demand up to 15%."[46] As part of this stage, EID implements drought water rates among other specified activities to encourage conservation. For purposes of this WSA, the demand reduction achieved under Stage 1 is estimated to be 7 percent of the already higher single dry-year demand.

- Year 3 – Upon entering the third dry year, EID would invoke the second stage of the Drought Preparedness Plan. This stage states: "*The objective of Stage 2 is to increase public understanding of worsening water supply conditions, encourage voluntary water conservation measures, and then if necessary, enforce mandatory conservation measures in order to decrease normal demand up to 30%.*"[47] Under this Stage, EID increases efforts to reduce demand. For purposes of this WSA, the savings achieved under Stage 2 is estimated to be 15 percent of the already higher single dry-year demand.

As a result of these factors, the Proposed Project water demand and those of the Other Existing and Planned Uses is expected to increase in the first year of a multi dry-year condition above that estimated during normal hydrologic circumstances. In subsequent years, the demand will drop as elements of EID's Drought Preparedness Plan are implemented. These changes are shown in **Table 5-1**.

5.2.3 Analysis

As shown in **Table 5-1**, the demand and supply are compared under each hydrologic condition for each 5-year increment out to 2035. The resulting "supply surplus" or "supply shortfall" is shown in the final column. Based on the analyses, EID anticipates it will have sufficient water under all hydrologic conditions in each of the 5-year increments through 2035. Notably, the "surplus" supply is lowest during the second year of a multi-dry year condition, since this is the circumstance where demand is only slightly constrained, while supplies are the most constrained. Yet, even under such circumstances, sufficient water should be available.

5.3 Sufficiency Analysis Conclusions

As detailed in **Section 2**, this WSA estimates water demands for the Proposed Project of 2,177 acre-feet per year at build-out (including non-revenue water demands). The annual water demand estimate for all existing and planned projects in the contiguous EID service area, as detailed in **Section 3**, is approximately 67,300 acre-feet per year by 2035. After accounting for these demand projections for the next twenty years, EID should have sufficient water to meet the demands of the Proposed Project and its other service area demands for at least the next 20 years.

[46] See EID Board Policy AR 5011.2-Water supply slightly restricted Drought Stage 1 – Voluntary reductions in use (available at http://www.eid.org/modules/showdocument.aspx?documentid=2687).
[47] See EID Board Policy AR 5011.3-Water supply slightly restricted Drought Stage 2 – Voluntary and mandatory reductions (available at http://www.eid.org/modules/showdocument.aspx?documentid=2687).

The conclusion that EID should have sufficient water available to meet the needs of the Proposed Project, in addition to the other demands in its service area through 2035, rests on the following set of assumptions:

- EID, EDCWA, and EDWPA successfully execute the contracts and obtain the water right permit approvals for currently unsecured water supplies discussed in Section 4. Absent these steps, the water supplies currently held by EID and recognized to be diverted under existing contracts and agreements would be insufficient in 2035 to meet the Proposed Project demands along with all other existing and planned future uses.
- EID will commit to implement Facility Capacity Charges in an amount sufficient to assure the financing is available as appropriate to construct the necessary infrastructure as detailed in the March 2013 EID *Integrated Water Resources Master Plan*.
- Demand in single-dry years includes an additional 5 percent of demand over the normal year demand during the same time period. This conservative assumption accounts for the likelihood that EID customers will irrigate earlier in the season to account for dry spring conditions. This hypothetical demand augmentation may or may not manifest in dry years, but this conservative assumption further tests the sufficiency of water supplies during dry conditions.
- The estimated demands include 13 percent to account for non-revenue water losses (e.g. distribution system losses).

The finding of this WSA is that EID should have sufficient water to meet the demands of Proposed Project and its other service area demands for the next 20 years.

TYPICAL WATER DEMANDS FOR RURAL RESIDENTIAL PARCELS (and for other uses)

Estimated daily per person water use indoors		
Type of use	*Average gallons per day (GPD)*	*GPD if using water efficient fixtures**
Toilet	18.5	8.2*
Clothes Washer	15	10*
Shower	11.6	8.8*
Faucet	10.9	10.8*
Other domestic	1.6	1.6
Bath	1.2	1.2
Dishwasher	1	0.7*
Leakage	9.5	4*
Total	69.3	45.2

Adapted from American Water Works Association, 2008.

Estimated daily outdoor water use	
Type of use	*Average gallons per day*
Lawn and Garden (per 1000 sq. ft.) Assumes 1-inch per day (typical)	600
Livestock Drinking (per animal):	
Beef, yearlings	20
Brood Sows, nursing	6
Cattle or Steers	12
Dairy	20
Dry Cows or Heifers	15
Goat or Sheep	2
Hogs/Swine	4
Horse or Mules	12
Livestock Facilities	
Dairy Sanitation (milkroom)	500
Floor Flushing (per 100 sq. ft.)	10
Sanitary Hog Wallow	100
Poultry (per 100 birds):	
Chicken	5 - 10
Ducks	22
Turkeys	10 - 25

Adapted from Small Water System, Conference of State Sanitary Engineers, 1977, 1979, 1981.

Estimated Water use by Crops					
Elevation	*Inches of water required per season**				
	Pome fruits	Stone fruits	Grapes	Pasture	Christmas trees
500-1000	N/A	N/A	N/A	50	N/A
1000-1500	N/A	N/A	22	46	N/A
1500-2000	44	44	18	43	N/A
2000-2500	39	39	15	N/A	9
2500-3000	36	36	13	N/A	7
3000-3500	33	33	10	N/A	6
3500-4000	31	31	N/A	N/A	6

Some of the water needs are met by rainfall, but the vast majority requires irrigation. Pome fruits include apples and pears. Stone fruits include cherries, peaches, plum, and nectarines.
**Assume 1 inch of water in 1000 square feet area is approximately 600 gallons
El Dorado Irrigation District, Irrigation Management System, Kirk Taylor, 2008

Other types of establishments	
Typical water demand	*Average gallons per day*
Airport (per passenger)	3 - 5
Apartment, multiple family (per resident)	50
Bathhouse (per bather)	10
Boardinghouse (per boarder)	50
Additional kitchen reqs. for nonresident boarders	10
Camp:	
Construction, semipermanent (per worker)	50
Day, no meals served (per camper)	15
Luxury (per camper)	100 - 150
Resort, day and night, limited plumbing (per camper)	50
Tourist, central bath and toilet facilities (per person)	35
Cottage, seasonal occupancy (per resident)	50
Club:	
Country (per resident member)	100
Country (per nonresident member present)	25
Factory (gallons per person per shift)	15 - 35
Highway rest area (per person)	5
Hotel:	
Private baths (2 persons per room)	50
No private baths (per person)	50
Institution other than hospital (per person)	75 - 125
Hospital (per bed)	250 - 400
Laundry, self-serviced (gallons per washing [per customer]	50
Motel:	
Bath, toilet, and kitchen facilities (per bed space)	50
Bed and toilet (per bed space)	40
Park:	
Overnight, flush toilets (per camper)	25
Trailer, own bath units, no sewer connection (per trailer)	25
Trailer, own baths, connected to sewer (per person)	50

Typical water demand	*Average gallons per day*
Picnic:	
Bathhouses, showers, and flush toilets (per picnicker)	20
Toilet facilities only (gallons per picnicker)	10
Restaurant:	
Toilet facilities (per patron)	7 - 10
No toilet facilities (per patron)	2-1/2 - 3
Bar and cocktail lounge (additional quantity per patron)	2
School:	
Boarding (per pupil)	75 - 100
Day, cafeteria, gymnasiums, and showers (per pupil)	25
Day, cafeteria, no gymnasiums or showers (per pupil)	20
Day, no cafeteria, gymnasiums or showers (per pupil)	15
Service station (per vehicle)	10
Store (per toilet room)	400
Theater:	
Drive-in (per car space)	5
Movie (per auditorium seat)	5
Worker:	
Construction (per person per shift)	50
Day (school or offices per person per shift)	15

Adapted from Small Water System, Conference of State Sanitary Engineers, 1977, 1979, 1981.

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