MADERA REGIONAL GROUNDWATER MANAGEMENT PLAN

A partnership between:
City of Chowchilla
Chowchilla Water District
City of Madera
Madera County
Madera Irrigation District
South-East Madera County United

Date Signed: 12-9-2014

DECEMBER 2014

PREPARED BY:

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NOTICE

Gravelly Ford Water District was initially part of the stakeholder group as a Groundwater Management Plan Participant, but withdrew in March 2014. This Groundwater Management Plan may still contain references to Gravelly Ford Water District.

ADOPTED BY:

Madera Irrigation District

Signature _____

Title_____

Date_____

City of Madera

Signature _____

Title_____

Date_____

Chowchilla Water District

Signature _____

Title_____

Date_____

City of Chowchilla

Signature _____

Title_____

Date_____

County of Madera

Signature _____

Title_____

Date_____

South-East Madera County United

Signature _____

Title_____

Date_____

EXECUTIVE SUMMARY

ES-1. Goals of the Groundwater Management Plan

The goal of this Plan is to provide the framework and technical data to allow for effective groundwater management which moves to restore, where possible, and maintain a high quality and dependable groundwater resource. This Plan documents the existing groundwater management efforts throughout the Groundwater Management Plan (GMP) area and planned efforts to improve groundwater management. The GMP Participants include Chowchilla Water District, City of Chowchilla, City of Madera, Madera County, Madera Irrigation District, and South-East Madera County United.

The goals of the Plan are supported by each of the participants, though not every agency will find it necessary or appropriate to implement every mitigation measure identified in this Plan. The Plan is written to address area-wide issues, but specific measures may only be feasible (technically or economically) in certain subareas. The Plan identifies the measures that may be feasible for each partner agency and leaves the final decisions on implementation to the individual boards of directors and city councils.

ES-2. Basin Management Objectives

The GMP Participants have adopted several overarching Basin Management Objectives which have guided preparation of the recommendations in this Plan. These consist of:

- Collaborative Governance
- Stabilization of Groundwater Levels
- Subsidence Mitigation
- Recovery of Groundwater Levels
- Public Awareness
- Economic Viability

ES-3. Groundwater Overdraft and Sustainability

Of the several Basin Management Objectives, the most critical and the one that drives all the others is the objective of achieving groundwater sustainability, which is defined as "*development and use of groundwater in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences*." (Alley et al. 1999) A large list of projects has been identified by the GMP Participants to initiate a program for implementation and work towards maintaining groundwater levels. These are listed in **Section 9.3**.

Determination of an available groundwater supply in a groundwater region (groundwater that can be pumped without causing overdraft) is a complex effort; an estimation was made using data including imported surface water, water used throughout the region by municipal and agricultural uses, water returned to the aquifer via natural and intentional

recharge, and the calculated change in underground water storage as measured by the changes in groundwater elevation over the region to approximate an area-wide water balance.

In **Section 2.5,** the Plan discusses region-wide overdraft. The 2008 IRWMP calculated the cumulative overdraft in the Valley area to be 99,000 AF/year. The area covered by this Plan does not include the entire Valley area of the County, since it excludes several active districts that did not participate in the Plan. Overdraft was estimated to average 143,000 AF/year over the period from 1980-2011. Future overdraft (2014 and beyond) is estimated to be 259,000 AF/year. The increase in overdraft can be attributed primarily to increased cropping, maturation of existing tree crops, and impacts from the San Joaquin River Restoration.

ES-4. Land Subsidence

Within certain portions of the GMP area, land subsidence results from excessive groundwater pumping over time. Unabated, such pumping can cause unwanted land surface disruptions. In reviewing work performed by the Department of Water Resources (DWR) and the United States Bureau of Reclamation (USBR) related to the San Joaquin River Restoration Project, it appears that substantial land subsidence is occurring in the Red Top area of Madera County, and that the rate of subsidence has increased in recent years with increased groundwater pumping in the area. The Red Top area is located in the west-northwest portion of the GMP area near the axis of the valley where the majority of the historic land subsidence has been documented.

DWR and USBR are both very interested in the subsidence issues in the Red Top area as it relates to the San Joaquin River Restoration Project and to capacity of the existing flood control channels. Neighboring agencies are concerned as well with what is happening and what can be done to limit land subsidence. Subsidence in this area, and across the valley in general, is a subject at the center of discussions within the state and the State Legislature regarding potential legislation to address groundwater and possible State regulation. **Section 2.7** describes the historical background of this subject in more detail. The basin management objectives set forth in **Section 3** include a specific objective regarding subsidence limitation and mitigation.

In **Section 7**, the Plan discusses factors that affect groundwater sustainability and provides a list of over twenty strategies for mitigating groundwater overdraft, for consideration by the GMP Participants as may be appropriate for each.

ES-5. Groundwater Monitoring

Of all the factors affecting groundwater sustainability mentioned above, overdraft and calculated direction from changes in groundwater storage over time is the most direct method of determining the state of a groundwater basin. No matter the other factors, over a long time period, if the groundwater elevation is declining, the groundwater basin is in a state of overdraft. If the groundwater elevation is increasing, uses and natural groundwater discharge are less than supplies and the basin is recovering. It should be noted that the Madera and Chowchilla sub basins are used conjunctively, meaning that

groundwater and surface water are used collectively for municipal and agricultural purposes and the groundwater basin is used as a storage reservoir. During wet years, less groundwater pumping is required and recharge is practiced so that excess surface water supplies can be added to water into below-ground storage. In dry years, less surface water is available, more groundwater is pumped to meet demands and groundwater levels decline. Because of this variable use, it is expected that water levels will rise and fall, but in a balanced groundwater basin those levels will be relatively stable over a longer time period.

Section 6 of the Plan describes current groundwater monitoring efforts, both as to groundwater surface elevation and groundwater quality, and describes recommended improvements to the program to help the partner agencies have a more thorough understanding of how the state of the aquifer is changing. The Plan finds that groundwater monitoring data is actually less comprehensive now than it was several years ago, since numerous wells that had been previously monitored are no longer being monitored. Intensification of a semi-annual monitoring program will give each of the GMP Participants strong data from which to make informed decisions regarding groundwater management, and will be the foundation of achieving the overall Basin Management Objectives.

Section 7 expands that recommendation and describes how the groundwater in the region must be protected from contamination due to transport of contaminants occurring as a result of over-pumping in areas of high-quality water. Several potential mitigation measures are included for consideration by each GMP Participant.

ES-6. On-Going Groundwater Operations and Management

An on-going groundwater overdraft as large as the one this region must manage means that significant and broad-based action will be required to bring the region to the point of groundwater sustainability. Review of the water use numbers shows that the issue is too large to be solved by any individual agency or economic sector. It is expected that solving the problem will need to be accomplished in a regional context across all economic sectors and industries in a manner consistent with the boundaries identified in the State's Bulletin 118 consistent with the Madera and Chowchilla sub basins.

Managing the region's groundwater resource to a sustainable level fairly and equitably will require ongoing cooperation among all the stakeholders in the region, as well as real sacrifices on a number of fronts. These upcoming policy and management decisions have led the GMP Participants to recommend formation of a region-wide groundwater management authority, in the form of a Joint Powers Authority (JPA) amongst the partner agencies. This JPA would be a powerful tool for the accomplishment of the goals set forth in this Plan, vested with the authority to make region-wide policy with respect to groundwater use, short of imposing groundwater use moratoria on properties or land uses within the region. The JPA could also be granted the power to levy and collect groundwater pumping charges and other fees meant to provide incentives to reduce groundwater use and increase overall water conservation.

Similar JPAs have been created in over a dozen areas of California. The details of the JPA agreements vary widely, and the GMP Participants will have a high degree of latitude in designing a JPA that will be best suited to the Madera region. These JPAs have proven to be effective tools in those regions for creating equitable and effective groundwater management without resorting to adjudication of the basins. In other words, the regions have maintained local control by their willingness to submit to the controls and policies necessary to reach sustainability.

Section 5 deals in more detail with how a JPA could be set up and what might be the extents and limitations of its authorities.

Readers are cautioned that it was beyond the scope of this project to perform a detailed water budget for each participant. While data exists to make water budget calculations at the sub-regional level, making them at the agency footprint level would require groundwater flow data that are not available without constructing an extensive network of monitor wells throughout the region. Interpolating the sub-regional calculations to the agency footprint level without that supplementary data would be an approximation beyond the prudent use of the available information. It is recommended that as the regional groundwater effort advances, a detailed water budget should be performed to the agency level. This will be helpful in identifying more-detailed information about each agency and the associated impacts that occur from actions by its neighbors. Trends may also become more visible.

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List of Abbreviations

AB	Assembly Bill
AF	acre-feet
AFY	acre-feet/year
bgs	below ground surface
BMO	basin management objective
BNSF	Burlington Northern Santa Fe Railway
CASGEM	California State Groundwater Elevation Monitoring program
CCID	Central California Irrigation District
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CFU	colony forming unit
CGPS	continuous global positioning satellite
CSD	community services district
CVP	Central Valley Project
CWD	Chowchilla Water District
DBCP	dibromochloropropane
DOGGER	California Division of Oil, Gas and Geothermal Resources
DPH	Department of Public Health
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EC	electrical conductivity
EDB	ethylene dibromide
EPA	Environmental Protection Agency
GAC	Groundwater Advisory Committee
GAMA	Groundwater Ambient Monitoring and Assessment Program
GFWD	Gravelly Ford Water District
GMP	Groundwater Management Plan
GPS	global positioning system
HPC	heterotrophic plate count
HSA	Hydrologic Study Area
ID	Irrigation District
InSAR	Interferometric synthetic aperture radar
IRWMP	Integrated Regional Water Management Plan
JPA	Joint Powers Agreement / Joint Powers Authority
KDSA	Kenneth D. Schmidt and Associates
KDWCD	Kaweah Delta Water Conservation District
LLNL	Lawrence Livermore National Laboratory
mAF	million acre-feet
MCL	Maximum contaminant level
MD	Maintenance District
MG	million gallons
MGD	million gallons per day
MID	Madera Irrigation District
MOA	Memorandum of Agreement

MOU	Memorandum of Understanding
msl	mean sea level
mya	million years ago
NAVSTAR	Navigation Satellite Timing and Ranging
NGS	National Geodetic Survey
OBGMA	Ojai Basin Groundwater Management Agency
P&P	Provost & Pritchard Consulting Group
PBO	plate boundary observatory
RCD	Resource Conservation District
RCWD	Root Creek Water District
RWQCB	Regional Water Quality Control Board
SA	Service Area
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
SEMCU	South-East Madera County United
SGA	Sacramento Groundwater Authority
SJJRP	San Joaquin River Restoration Project
SLDMWA	San Luis & Delta-Mendota Water Authority
SMWA	Sacramento Metropolitan Water Authority
TAC	Technical Advisory Committee
TDS	total dissolved solids
TID	Tulare Irrigation District
UNAVCO	University NAVSTAR Consortium
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USGS	United States Geologic Survey
WCD	Water Conservation District
WHPA	wellhead protection area
WSJV	Western San Joaquin Valley
WWTP	wastewater treatment plant

1. INTRODUCTION

1.1. Overview

This Groundwater Management Plan (GMP or Plan) is a collaborative effort between the City of Chowchilla, City of Madera, Madera Irrigation District, Chowchilla Water District, Madera County and South-East Madera County United. These agencies will hereafter be called the Plan Participants or GMP participants. Other agencies or entities that may have an interest in the plan will be called Stakeholders. This GMP addresses regional groundwater management issues, as well as local groundwater management by each participating agency. Each participant maintains sovereign groundwater management over their respective service areas. Refer to Section 1.5 for more details on the groundwater management authority of the GMP Participants.

This Groundwater Management Plan satisfies the new requirements for GMPs created by the September 2002 California State Senate Bill No. 1938 and 2011 Senate Bill 359, which amended Sections 10753 and 10795 of the California Water Code. This Plan also addresses recommended components for a Groundwater Management Plan described in Appendix C of Department of Water Resources Bulletin 118 (2003 Update). Section 1.6 shows the required and recommended components for GMPs.

In September 2014, the State of California passed Senate Bill 1168, Assembly Bill 1739, and Senate Bill 1319, which are collectively known as the Sustainable Groundwater Management Act. These bills impose mandates for sustainable groundwater management on local agencies in high- and medium-priority groundwater basins, and require development of Groundwater Sustainability Plans, which will supplant Groundwater Management Plans such as this one. The State must develop detailed guidelines for what to include in the Groundwater Sustainability Plans. This GMP will not fully satisfy the requirements of this new legislation, but much of the information herein will be useful in developing a Groundwater Sustainability Plan in coming years.

The primary purpose for this plan is to demonstrate that local groundwater management efforts can be meaningful. Adjudication of the groundwater basin by the State may be likely in the near future if a coordinated, regional effort is not implemented to improve groundwater conditions, and to limit subsidence along the San Joaquin River in northwestern Madera County. Additional purposes for preparing this regional GMP include:

1. Satisfy new State requirements for GMPs.
2. Update and document the region's goals and objectives for groundwater management.
3. Update information on local groundwater conditions so the GMP is a useful reference document.

4. Maintain the participant's eligibility for certain State grants, loans and special drought assistance that require an updated GMP.
5. Continue each of the participant's authority to responsibly manage local groundwater with the intent to sustainably meet local water needs.
6. Improve water management on a regional basis to avoid adjudication of the local groundwater basin by the State.

This plan outlines the framework for regional and local groundwater management efforts in the valley floor portion of Madera County and the portion of Merced County covered by Chowchilla Water District. Several of the GMP participants have previously prepared Groundwater Management Plans, but those plans do not satisfy all the current GMP requirements. The Participants have chosen to prepare a regional GMP so the plan can more effectively address topics that are regional in nature, such as groundwater overdraft and land subsidence, or are better addressed with a regional approach, such as data collection and public education. It is intended that each participant will implement the appropriate regional concepts in their local jurisdictions. **Table 1.1** shows the previous GMPs and when each was developed.

Table 1.1 – Previous Groundwater Management Plans

Participant	Date of Previous GMP
City of Chowchilla	1997
Chowchilla Water District	1997
Gravelly Ford Water District	1998
City of Madera	None
Madera County	2002
Madera Irrigation District	1999
South-East Madera County United	None

Hereafter in this report, the terms 'region' and 'regional' refer to the cumulative jurisdictional areas covered by these agencies.

The other public water agencies in the valley portion of Madera County were offered the opportunity to participate in this plan, but chose not to for a variety of reasons. These areas include Madera Water District, Root Creek Water District, Clayton Water District, Progressive Water District, Sierra Water District, New Stone Water District and Columbia Canal Company. Of these, Madera Water District, Columbia Canal Company, Aliso Water District and Root Creek Water District have Groundwater Management Plans that comply with recent State laws. The other districts are inactive or do not have a GMP, and are included in the County's tabulations.

1.2. Report Organization

This report is organized according to the required content for GMPs outlined in the California Water Code. General categories that are addressed include descriptions of the regional geology and hydrogeology, basin management objectives, stakeholder involvement, groundwater monitoring, groundwater resources protection, groundwater sustainability, groundwater operations, and groundwater planning and management. Within these categories, specific groundwater management elements are described including existing activities and planned actions to improve groundwater management.

Some of these topics are discussed in more than one section, which is a reflection of Water Code requirements. Specifically groundwater quality, land subsidence and groundwater overdraft are discussed in multiple sections, as shown in **Table 1.2**.

Table 1.2 – Groundwater Management Plan Topics Addressed in Multiple Sections

Topic	Related GMP Sections
Groundwater Quality	2.7 – Groundwater Quality
	5.2 – Groundwater Quality Monitoring
	6.3 – Saline Water Intrusion
	6.4 – Migration of Contaminated Groundwater
	6.5 – Groundwater Quality Protection
Land Subsidence	2.7 – Land Subsidence
	5.4 – Land Subsidence Monitoring
	7.5 – Land Subsidence Mitigation
Groundwater Overdraft	2.5 – Groundwater Overdraft and Available Groundwater Supplies
	2.6 – Geologic Potential for Groundwater Recharge
	7.2 – Overdraft Mitigation
	7.3 – Groundwater Replenishment
	7.4 – Conjunctive Use of Water Resources

1.3. Background Information

This section provides an overview of each of the GMP Participants as well as the region's geography, climate, hydrologic features, geology, land use, water demands, groundwater supplies and surface water supplies. Information is provided for each agency, and collectively the data is used in a regional analysis of groundwater conditions. Refer to Section 8.2 - Operation of Facilities for more details on water-related infrastructure in the region. A map showing the locations of each participating agency is shown as **Figure 1.1**.

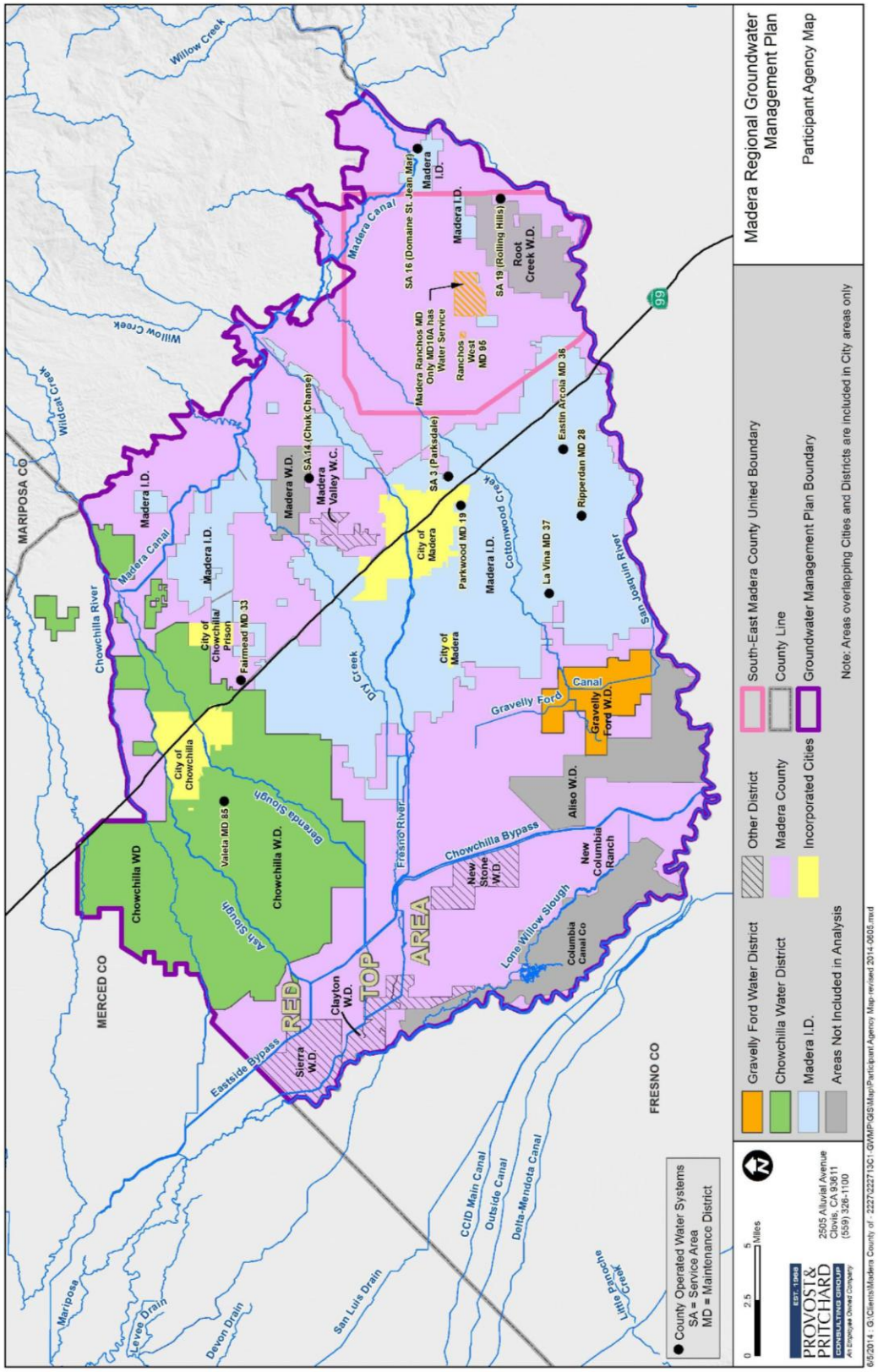

Figure 1.1 – Participating Agency Map

1.3.1 Participants Overview

City of Chowchilla

The City of Chowchilla, incorporated in 1923, covers approximately 11.72 square miles (7,500 acres) and has a population of 19,000 (US Census, 2013), including about 6,600 inmates at two local prisons. The two local prisons are surrounded by County of Madera lands, effectively creating a 1,323-acre city island east of the main city limits. The prisons together farm about 780 acres and provide their own water and sewage services.

The City of Chowchilla is governed by a five member City Council which sets policy for city government, city services, and economic development. The City Council has the authority to pass emergency ordinances for the immediate preservation or protection of public health, property or safety. Various commissions and committees, including the Airport Advisory Committee, Heritage Preservation Commission, Parks & Recreation Commission, and the Planning Commission, act in advisory capacities to the City Council.

Chowchilla Water District

Irrigation in the Chowchilla region began in the late 1800s using artesian wells, but by the 1940s diminished groundwater supplies threatened the area's continued economic viability. The Chowchilla Water District was formed in 1949 for the purpose of furnishing a supplemental water supply for agriculture within its boundaries. Until that time, the lands within the District boundaries had been part of the Madera Irrigation District. In the ensuing years, additional acreage was added to the District. In 1988, the LaBranza Water District and Chowchilla Water District consolidated into the current Chowchilla Water District.

In 1950, the District signed its original water service contract with the U.S. Bureau of Reclamation, for water delivery from the Friant Division of the Central Valley Project. In 1968, the District signed a second water service contract with the U.S. Bureau of Reclamation, for water delivery from the Buchanan Unit of the Central Valley Project.

Since its inception, the District has provided consistent and reliable surface water to its constituents, resulting in improvements to local groundwater conditions. The District currently consists of approximately 129.2 square miles (88,700 acres), which includes an overlap of 6,100 acres with the City of Chowchilla. The District includes lands in both Madera and Merced counties.

The mission of the Chowchilla Water District is to protect, enhance, and manage surface and groundwater resources of the District in order to meet present and future water demands within the District. The District is governed by a five-member Board of Directors.

City of Madera

The City of Madera is the largest city in Madera County and serves as the County seat. The City had an estimated 2013 population of 62,200. Laid out in 1876 at the end of a lumber flume and incorporated in 1907, it now occupies approximately 10,000 acres (15.8 square miles). Utilizing a Council and Manager form of government, six City Council members and a separately-elected Mayor address the legislative needs of the city. The City Manager is appointed by the City Council to administer the overall city organization. Madera is a full-service city, operating its own water and wastewater systems, and hosting a full range of community-based programs and services. Strategic planning in the City is driven by Vision Madera 2025, a community-based visioning program completed in 2006, and by the City's Comprehensive General Plan.

Madera County

Madera County was formed in 1893 and encompasses 2,174 square miles (1.4 million acres). The valley portion of the County is covered by this GMP, excluding Cities and Irrigation/Water Districts with adopted GMPs (see **Figure 1.1**). This area covers 432 square miles (277,000 acres) and has a population of about 27,000 with about 19,700 residing in eight Maintenance Districts and four Service Areas that are provided water by the County. Large areas of unincorporated lands are cropped or grazed and operate on private domestic and irrigation wells. A large portion of the eastern end of Madera County (within the valley) has high bedrock, limited alluvium and little groundwater supply, despite being in a DWR defined groundwater basin. Local wells in this area have limited groundwater yield, and groundwater is typically only pumped from small stockwater wells.

A five member Board of Supervisors (BOS) oversees the duties and functions of Madera County government. Supervisors work with the elected department heads and hire other department heads to run the various departments. The BOS may set County policy, but works within the constraints of State and Federal law. It is the duty of the BOS to submit a balanced budget to the State. The Board meets regularly on the first four Tuesdays of the month and any member of the public may bring matters before the Board if the item is placed on the meeting agenda. The BOS is the governing body for the following: Madera County Flood and Water Conservation Agency, Maintenance Districts and Service Areas, Public Finance Authority, and Redevelopment Agency.

Madera Irrigation District

Madera Irrigation District (MID) is a public agency, established by the State Legislature as a Special Act District. It is governed by a five-member Board of Directors who are elected at large but who must reside within the division they serve. A large segment of the City of Madera (City) is included within the District as well as portions of Madera Water District. Each registered voter who resides within the City has the opportunity to vote for the Director of his or her choice and may opt to run for the directorship. In addition to the services rendered to the lands within the District, the District also conveys agricultural water to the Gravelly Ford Water District. The District is also a partner in the Madera-Chowchilla Water and Power Authority.

The District was formed in 1920 to bring surface water to the Madera area. The District presently encompasses an area of about 129,000 acres, with about 9,400 acres overlapping with the City of Madera. About 10,800 acres within MID are known as "subordinate lands," which have a lower priority to surface water than other lands in the District. Excluding the City of Madera overlap area, MID has a population of 11,900 according to the 2013 census.

The District has a Central Valley Project (CVP) repayment contract with United States Bureau of Reclamation (USBR) providing up to 85,000 acre-feet (AF) of Class 1 and 186,000 AF of Class 2 water per year from the Friant Division (Millerton Lake). CVP water is released from Millerton Lake through the Friant Dam, and then conveyed through the Madera Canal for delivery into the District's service area. The District also entered into a CVP repayment contract with the USBR for the yield from the Hidden Unit (Hensley Lake). The average annual supply available to the District under the Hidden Unit contract is approximately 24,000 AF per year.

The District has Pre-1914 rights to divert water from Big Creek, known as the Big Creek Diversion, and the North Fork of Willow Creek, known as the Soquel Diversion. The Big Creek Diversion originates in Big Creek, a tributary of the Merced River. This Diversion is located just upstream of Fish Camp, CA, and redirects water to flow down Lewis Creek, a tributary of the upper Fresno River. The Soquel Diversion originates in North Fork Willow Creek, a tributary of the San Joaquin River. This Diversion is located approximately nine miles upstream of Bass Lake, where the Diversion can redirect water to flow through the Soquel Ditch to Nelder Creek, a tributary of the upper Fresno River. Alternatively, water can be left in North Fork Willow Creek, and allowed to flow to Bass Lake and eventually to the San Joaquin River, where it can be diverted in Friant Dam. MID also has a Pre-1914 water right on the Fresno River. MID expects surface water supplies to increase by 10,000 AF/year in the future as they sell less of their water, and some growers import some surface water.

South-East Madera County United

South-East Madera County United (SEMCU) is a non-profit mutual benefit organization dedicated to representing the interests of the residents, property owners, and businesses in the SEMCU Area. It is bounded to the north by Highway 145, on the south by the San Joaquin River, on the east by Highway 41, and on the west by the Burlington Northern Santa Fe Railway ("BNSF") and by Avenue 32 1/2 north of its intersection with the BNSF Railway. It occupies an area of 97.6 square miles (~62,500 acres). There are two identified communities within the SEMCU area. The larger is the Madera Ranchos with about 12,000 people and around 3,500 homes. Most residential lots are either 2.5 or five acres in size, although there are some one-acre lots and a number of larger parcels. Rural residential development is common in the area. The smaller community is Rolling Hills, located on the west side of SR 41, between Avenue 10 and Avenue 11-1/2. It is comprised of 300 homes; virtually all lots are one acre in size. Both of these areas are unincorporated and represented by Madera County. The population within the SEMCU area was estimated to be 10,500 in 2013.

SEMCU is a participant in the GMP but does not own or operate groundwater extraction, recharge or conjunctive use facilities. It is a non-profit educational organization and has no land-use planning authority. However, SEMCU represents numerous public and private interests in its area and provides input and comments on water related land-use policies. In representing local interests, SEMCU studies issues facing its members, such as access to water, transportation, schools, and energy, and works with local governments and private entities to find working solutions to regional problems. Additionally, SEMCU strives to advocate for its members wherever and whenever the opportunity arises and to obtain grant funding to help address area needs. More information on SEMCU can be found on their website: http://semcu.com/about.php).

1.3.2 Geography

The Madera Regional GMP area is located in the geographic center of California in the San Joaquin Valley. The GMP area generally includes the valley portion of Madera County and a portion of Chowchilla Water District that is within Merced County. The borders of the GMP area are generally defined by the DWR Groundwater Basin boundaries to the east, the San Joaquin River on the south and west, and the Chowchilla River on the north. The GMP area considered under the jurisdiction of Madera County includes County lands that are not under the jurisdiction of a City, or active water district or irrigation district. Areas excluded from the GMP include Root Creek Water District, Madera Water District, Aliso Water District and Columbia Canal Company. The area of each GMP participant is shown in **Figure 1.1** and summarized in **Table 1.3.**

Table 1.3 – Groundwater Management Plan Participant Areas

Participant	Area		Notes
	Square Miles	Acres	
Chowchilla Water District	129	82,700	Excludes City areas, includes subordinate lands
City of Chowchilla	12	7,500	Includes prisons
City of Madera	16	10,100	
County of Madera	432	277,000	Includes unincorporated areas outside of Cities and districts
Madera Irrigation District	187	119,600	Excludes City areas; includes subordinate lands
South-East Madera County United	98	62,500	Overlaps with Cities, districts and county
Total (excluding SEMCU overlap)	776	496,900	

1.3.3 Climate

The climate of the GMP area is characterized by cool, mild winters and hot, dry

summers. Temperatures in the summer often exceed 100 degrees Fahrenheit. Fog can be experienced for long periods in the winter, with low temperatures typically in the mid-30's and occasionally dropping into the 20's. Average annual precipitation is about 10 inches, with 80 percent of the rainfall occurring in the winter months. The frost-free growing season averages around 250 days per year.

Water supplies can vary substantially year to year due to wide variations in precipitation in the GMP area and its upper watersheds. The California Department of Water Resources created an index that provides a comparison of normal, single-dry and multiple-dry years in the San Joaquin Valley. The data is presented as the Chronological Reconstructed Sacramento and San Joaquin Valley Water Year Hydrologic Classification Indices (Index), and covers the period from 1901 to 2013. DWR has defined certain base years as average, single-dry and multiple-dry. These are presented in **Table 1.4** with the estimated unimpaired runoff each year.

Table 1.4 – Comparison of Unimpaired Runoff in Normal and Dry Years

Description	Base Year	Runoff (mAF)	Percentage of Average Year	Water Supply Index
Average Water Year	1921	5.90	100%	3.23
Single-Dry Water Year	1977	1.05	18%	0.84
Multiple-Dry Water Years	1929-1931	2.58[1]	44%	1.74[2]
Single-Dry Year	2012	2.76	47%	2.18
Single-Dry Year	2013	3.05	52%	1.76

Notes: [1] Average runoff for 3 year period.
[2] Average index over 3 year period

Table 1.4 shows that water supplies can be substantially lower than average in dry years, and less than half of normal for as long as three consecutive years. As well, to illustrate the most current condition in the region, water supplies in 2012 and 2013 have been about one-half of the average and it is likely that due to a lack of storage in the watershed, in terms of lack of soil moisture and minimal snow pack, that 2014 may be as dry a year as 1977.

1.3.4 Hydrologic Features

The major hydrologic features in the GMP area, including reservoirs, rivers, streams, flood bypass channels, and canals are shown in **Figure 1.2**. Major rivers include the San Joaquin River, Fresno River and Chowchilla River. The Eastside Bypass and Chowchilla Bypass are the backbone of the flood control conveyance facilities. MID and CWD have extensive irrigation canal systems.

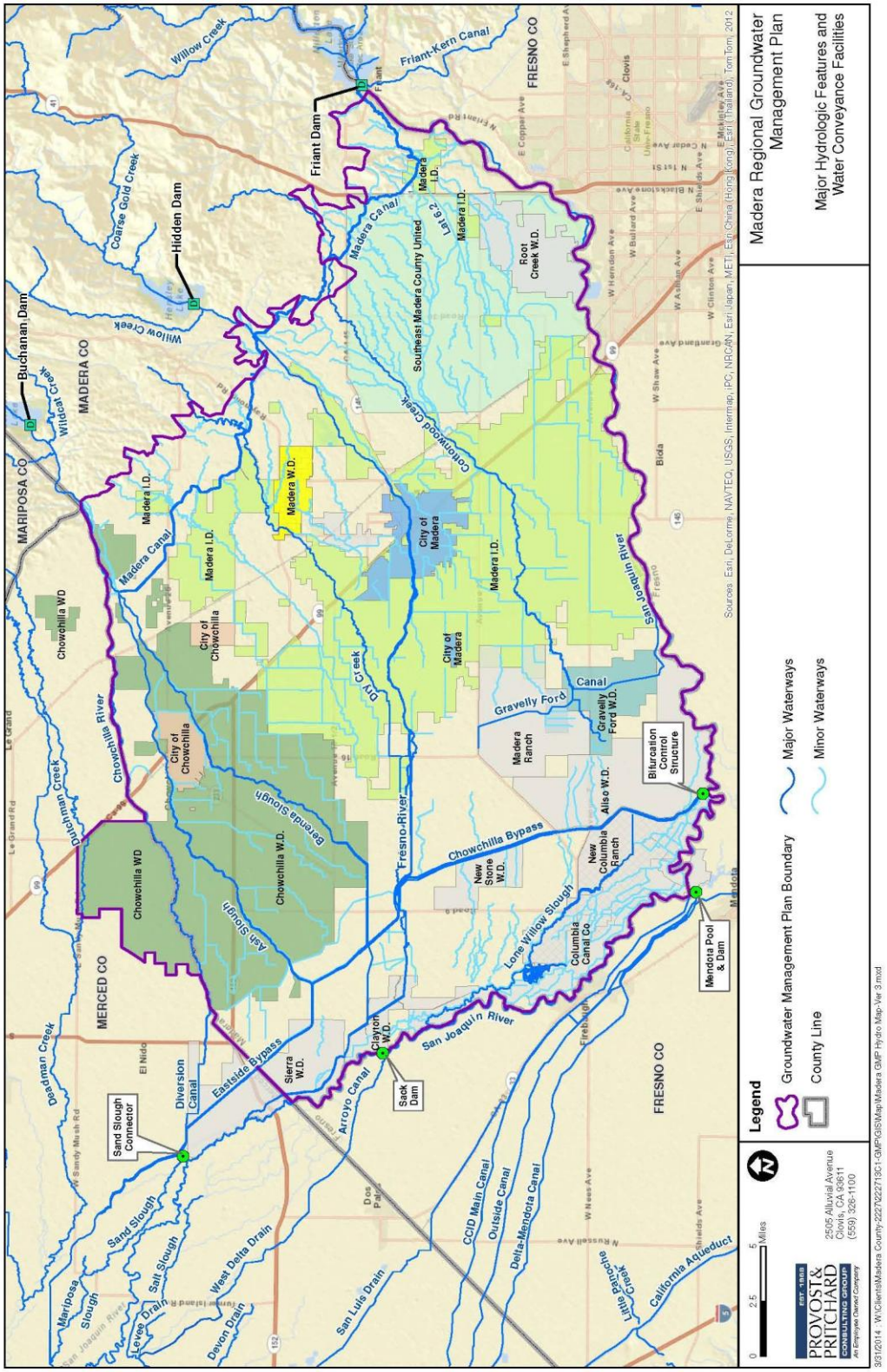

Figure 1.2 – Major Hydrologic Features and Water Conveyance Facilities

1.3.5 Geology

The GMP area encompasses the majority of the Madera Groundwater Sub-basin, and portions of the Chowchilla and Delta Mendota Groundwater Sub-basins (a map and discussion of the extent of these groundwater basins is provided in Section 2.1). These Sub-basins are defined by the California Department of Water Resources Bulletin 118-80. These Sub-basins are within the San Joaquin Valley Groundwater Basin and the San Joaquin Basin Hydrologic Study area.

The Madera and Chowchilla Sub-basins are considered to be 'critically overdrafted' by the California Department of Water Resources. Groundwater levels in the GMP area have gradually declined over time. The Corcoran Clay, a major confining bed in the San Joaquin Valley, is present in the western portion of the Plan area. See Section 2 for more details on the geology of the GMP area.

1.3.6 Domestic Water Demand

Domestic water demands are defined as water used for domestic (indoor and landscape) purposes in urban and rural areas. The Cities directly provide water to their residents, and the County provides water to residents of the 12 Maintenance Districts and Service Areas in the Plan area. Rural residents living in the irrigation districts, water districts and other unincorporated areas also pump domestic water from their private wells. **Table 1.5** summarizes domestic water demands in the GMP area based on the most recent statistics

Table 1.5 – Domestic Water Demands

Area	Per Capita Usage (gal/day)	Annual Demand (AF/year)
City of Chowchilla	311	3,500
City of Madera	195	12,700
County Maintenance Districts / Service Areas	168	3,700
Unincorporated County lands	168	1,400
Madera Irrigation District	168	2,200
Chowchilla Water District	168	600
Gravelly Ford Water District	168	20
	Total	24,100

The per capita water usage values were obtained from the City's Urban Water Management Plans, 2008 Madera County IRWMP, and current water use and population statistics.

Urban growth was relatively high in the early and mid-2000's in Madera County but recently has been relatively flat. Evaluating future population growth is beyond the scope of this Plan. However, it is recommended that population growth be evaluated in a separate study to forecast the impacts it may have on future groundwater overdraft. Important factors that may impact population growth include available water supplies, local economic activity, and improvement in local schools.

1.3.7 Agricultural Water Demands

Cropping Data

Agricultural cropping data was collected to estimate agricultural water demands in the GMP area. Several sources of cropping data were found including:

1. California Department of Water Resources (DWR) - Land Use Data
2. California Department of Conservation – Farmland Mapping and Monitoring Data
3. Madera County Agricultural Commissioner's office
4. USDA CropScape
5. Local Irrigation and Water District cropping records

The DWR Land Use Data is generally considered the most accurate and reliable source because it is collected by trained staff who use a combination of aerial photographs and field verification. However, DWR surveys are only performed in each County about once every six years, and the most recent survey was performed in 2011. DWR data was also used in crop demand estimates in the 2008 IRWMP and it can provide a meaningful comparison to changes since 2007. As a result, the 2011 DWR data was projected to 2013 based on historical cropping changes since 2003.

The Madera County Agricultural Commissioner's Office had 2013 cropping data, which is based on pesticide permit applications. This data is not field verified, but is the most recent data available. The data does not include records for organic farms since they do not require pesticide permits, although these cover a relatively small part of the County. Nevertheless, the larger organic farms and dairies were identified, and cropping was assumed to be similar to the year before they converted to organic operations.

During the preparation of this report, the Irrigated Lands Regulatory Program was contacted as a potential source of cropping data. However, ILRP members were still in the process of organizing and collecting data and none was available for release.

Crop Water Demands in GMP Area

General land use in the GMP area is shown in **Figure 1.3.** The cropping data for **Figure 1.3** was acquired from the Madera County Agricultural Commissioner's Office and can be found in **Appendix A**. **Figure 1.3** shows that almost 54% of the land is planted in permanent crops, and 69% of the total land is cropped. There is potential for further agricultural development since 21% of the land has not been developed.

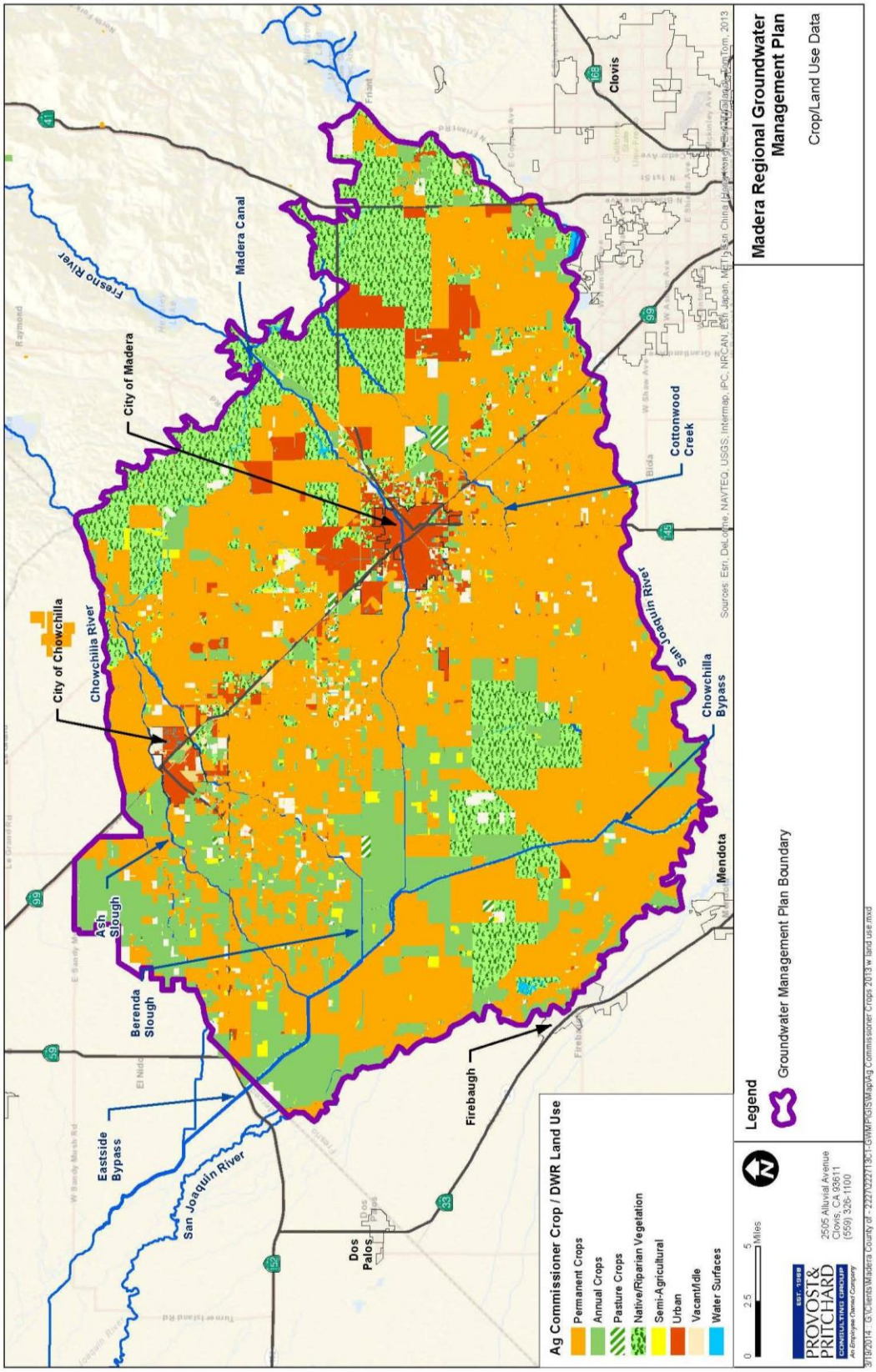

Figure 1.3 – Crop / Land Use Data

Countywide cropping data is shown in **Table 1.6** for several years. DWR data from 2011 was projected to 2013 based on average annual historical changes between 2003 and 2011. The estimated water demands are within 0.5% of those estimated using the 2013 data from the Madera County Agricultural Commissioner's Office.

Table 1.6 – County-wide Cropping and Agricultural Water Demands

Year	Cropping Data Source	Acreage	Applied Water Demands (AF/year)
2003	DWR	314,800	1,010,000
2011	DWR	360,900	1,022,000
2013	DWR (projected)	372,600	1,050,000
2013	County Agricultural Commissioner's Office	357,700	1,044,000

The projected DWR data and County Agricultural Commissioner's Office have similar applied water demands, but the acreage varies by approximately 4%. A review of the data shows that 2013 included a reduction in low-water-use crops, such as grains, and an increase in medium- and high-water use crops, including corn and truck crops, thus explaining the discrepancy.

Agricultural plantings have increased substantially in recent years. Much of the plantings have been tree crops that cannot be fallowed in dry years. In addition, the demand for certain crops, such as almonds, is very strong and may encourage further development. An evaluation of future agricultural water demands is beyond the scope of this plan, but is needed to assess the impacts of future irrigation demands on groundwater overdraft.

Crop Water Demands in Participating Agencies

Table 1.7 shows cropped area and agricultural water demands for each agency. Refer to **Appendix A** for water demand calculations. Both Cities include small areas that are cropped and hence have some agricultural water demand.

Table 1.7 – Agency Cropping and Agricultural Water Demands (2013)

Area	Cropped Acreage	Annual Demand (AF/year)
City of Chowchilla	1,500	4,000
City of Madera	1,100	2,500
Unincorporated County Lands	141,000	418,000
Madera Irrigation District	104,000	286,000
Chowchilla Water District	68,500	215,000
Gravelly Ford Water District	7,600	20,400
Total	**323,700**	**945,900**

Note: The values for MID and CWD exclude areas that overlap with the Cities. This was done to avoid double-counting areas and water demands.

The total cropped area in **Table 1.7** differs from the acreage presented in **Table 1.6** because certain areas which have adopted Groundwater Management Plans (Root Creek Water District, Aliso Water District, Columbia Canal Company and Madera Water District) were excluded from the latter summary.

1.3.8 Groundwater Supplies

All of the GMP Participants use groundwater to meet at least a portion of their water demands. Groundwater serves an important reserve supply to supplement surface water deliveries. Below is a summary of groundwater usage in each agency, including groundwater used directly by the agency and groundwater pumped from private wells within the agency boundaries. Groundwater pumpage is directly measured by some municipal agencies, but is not measured on domestic or agricultural wells. Domestic groundwater pumping was based on population and typical per capita use rates (see **Table 1.5**). Groundwater pumping in agricultural areas was estimated as the difference between water demands and surface water deliveries.

Table 1.8 - Average Annual Groundwater Pumpage (2004-2013)

Agency	Agency Groundwater Pumpage (AF)	Private Groundwater Pumpage (AF)	Total Pumpage (AF)
Chowchilla Water District	0	118,600	118,600
City of Chowchilla	4,100	2,600	6,700
City of Madera	12,700	600	13,300
County of Madera	3,700	398,800	402,500
Gravelly Ford Water District	0	16,300	16,300
Madera Irrigation District	0	185,000	185,000
Total	20,500	721,900	742,400

Notes:

1. Values are total groundwater pumpage. Net pumpage is less due to deep percolation of irrigation and percolation of wastewaters.
2. These are historical values. Future pumping will likely increase due to reductions in surface water deliveries as a result of the San Joaquin River Restoration settlement.

1.3.9 Surface Water Supplies

Madera Irrigation District, Chowchilla Water District and Gravelly Ford Water District each meet significant portions of their water demands with surface water. The County of Madera provides a small amount of surface water to one of their Service Areas. In addition, an estimated 10,000 AF/year of riparian water is delivered to other private lands in unincorporated areas of Madera County.

The Cities of Madera and Chowchilla do not have surface water rights or contracts. However, within the limits of each City there are cropped lands that receive some surface water from local water or irrigation districts. Owners of those parcels pay assessments to the districts, and as a result partially fund the importation of surface water to the GMP area. The City of Madera also purchased 300 AF of floodwater in 2009 from MID as a pilot study on groundwater recharge. **Table 1.9** summarizes the historical surface water deliveries in the GMP area, followed by more detailed descriptions of those supplies.

SEMCU does not have the authority to hold water rights or water contracts.

Table 1.9 – Historical Surface Water Supplies in the Groundwater Management Plan Area

Agency	Average Annual Supplies (2004-2013)	Notes
Chowchilla Water District	135,000	Excludes CWD lands in City of Chowchilla
City of Chowchilla	1,400	CWD water delivered to cropped land in City
City of Madera	1,900	MID water delivered to cropped land in City
County of Madera	20,000	Sumner Hills Service Area, riparian agricultural water, some MID water
Gravelly Ford Water District	10,500	
Madera Irrigation District	188,000	Excludes MID lands in City of Madera
Total	**356,800**	

Note: Values include surface water that is delivered directly to growers and recharge basins, and lost as canal seepage.

These surface water supplies have been and will continue to be reduced to provide water for the San Joaquin River Restoration. Those impacts are described in Section 7.1 – Issues Impacting Groundwater Sustainability.

Chowchilla Water District

Irrigation in the Chowchilla region began in the late 1800s with artesian wells, but by the 1940s diminished groundwater supplies threatened the area's continued economic viability. The Chowchilla Water District was formed in 1949 for the purpose of furnishing a supplemental water supply for agriculture within its boundaries. Until that time, the District had been part of the Madera Irrigation District.

In the ensuing years additional acreage was added to the District. In 1988, the LaBranza Water District and Chowchilla Water District were consolidated into the current Chowchilla Water District. In 1950, the District signed its original water service contract with the U.S. Bureau of Reclamation (USBR) for water delivery from the Friant Division of the Central Valley Project (Friant CVP). In 1968, the District signed a second water service contract with USBR for water delivery from the Buchanan Unit of the Central Valley Project.

Since its inception, the District has provided consistent and reliable surface water to its constituents, resulting in improvements to groundwater conditions. The District services

over 400 landowners on about 88,000 acres of land in southern Merced and northern Madera counties.

Chowchilla Water District (CWD) receives water from three main sources: the San Joaquin River, the Chowchilla River and Merced Irrigation District. Chowchilla Water District's current Friant CVP contract provides for an annual maximum of 55,000 AF of Class 1 water and an annual maximum of 160,000 AF of Class 2 water, all supplied via the Madera Canal. The District receives an annual average of 48,500 AF from its Buchanan Unit contract, and purchases surplus water from Merced Irrigation District in varying quantities when it is available.

Gravelly Ford Water District

Gravelly Ford Water District's contract with the USBR is for 14,000 AF of Class 2 water, delivered through the San Joaquin River. The District has also been able to take some water from Cottonwood Creek, and buy additional water from Madera Irrigation District and the USBR. The average annual surface water supply between 2004 and 2013 was 10,500 AF, and in some years no water has been available.

Madera Irrigation District

The Madera Irrigation District purchases and wheels or delivers water to growers within its boundaries. Madera Irrigation District has a Central Valley Project (CVP) repayment contract with United States Bureau of Reclamation (USBR) providing up to 85,000 acre feet (AF) of Class 1 and 186,000 AF of Class 2 water per year from the Friant Division (Millerton Lake). The CVP water is released from Millerton Lake through the Friant Dam, and then conveyed through the Madera Canal for delivery into the District's service area. The District also entered into a CVP repayment contract with the USBR for the yield from the Hidden Unit (Hensley Lake). Under the Hidden Unit contract, the average annual supply available to the District is approximately 24,000 AF per year.

The District has Pre-1914 rights to divert water from Big Creek via the Big Creek Diversion and from the North Fork of Willow Creek via the Soquel Diversion. The Big Creek Diversion originates in Big Creek, a tributary of the Merced River. This Diversion is located just upstream of Fish Camp, CA, and redirects water to flow down Lewis Creek, a tributary of the upper Fresno River. The Soquel Diversion originates in North Fork Willow Creek, a tributary of the San Joaquin River. This Diversion is located approximately nine miles upstream of Bass Lake, and can divert water to flow through the Soquel Ditch to Nelder Creek, a tributary of the upper Fresno River. Alternatively, water can be left in North Fork Willow Creek, allowed to flow to Bass Lake and eventually to the San Joaquin River, and diverted at Friant Dam into the Madera Canal. MID also has a Pre-1914 water right on the Fresno River.

County of Madera

The County of Madera manages Sumner Hills Service Area (SA-16) which is supplied with first-priority water released into the San Joaquin River from Millerton Lake by the USBR, under the terms of Holding Contract 7. Sumner Hills' average annual demands

are 120 AF. In addition, an estimated 10,000 AF of other riparian water is delivered to unincorporated lands each year.

1.4. Goals and Objectives of Groundwater Management Plan

The purpose of this GMP is to develop a coordinated and comprehensive approach to the evaluation and management of groundwater resources in the area covered by the GMP. The goal of this Plan is to provide the framework and technical data to allow for effective groundwater management which moves to restore, where possible, and maintain a high quality and dependable groundwater resource. The goals and proposed actions in this plan will likely evolve as other concerns and issues arise.

This Plan documents the existing groundwater management efforts in the GMP area and planned efforts to improve groundwater management. The objective the GMP is to help the GMP Participants meet the following goals:

1. Develop a collaborative relationship with all the GMP participants to address groundwater management issues on a regional scale.
2. Identify policies, priorities and goals for a collaborative approach to regional management of the groundwater.
3. Develop new surface water sources and the necessary infrastructure to bring the groundwater within the GMP area to a balance.
4. Stabilize groundwater levels in order to minimize pumping costs and energy use, and to provide groundwater reserves for use in droughts.
5. Maximize the use of surface water, including available flood water, for beneficial use, and thus reduce stress on groundwater resources.
6. Prevent groundwater degradation by protecting groundwater quality, importing clean surface water, and preventing intrusion of poor quality groundwater.
7. Preserve, and, where feasible, enhance the existing quality of the area's groundwater.
8. Address potential impacts to groundwater from changes in surface water supplies resulting from surface water losses in the region (i.e. San Joaquin River Restoration), urban and agricultural development, and drought.
9. Prevent surface water or groundwater exports that would reduce the long-term reliability of groundwater.
10. Coordinate groundwater management efforts between regional water users.
11. Responsibly manage the local groundwater resources so adjudication is unnecessary.
12. Maintain a groundwater-monitoring program to provide an early warning system to future problems.
13. Increase knowledge of the local geology and hydrogeology to better understand threats to groundwater quality and quantity.
14. Minimize land subsidence caused by groundwater pumping through in-lieu groundwater recharge, direct recharge, and wise and conservative use of pumped groundwater.

1.5. Groundwater Rights and Statutory Authority for Groundwater Management

Basic Groundwater Rights in California

The following discussion of current California Law regarding groundwater is excerpted from *Sustainability from the Ground Up, Groundwater Management in California – A Framework*, published by Association of California Water Agencies (ACWA) in 2011. In the Foreword of this document, the authors state "*the challenge of providing sustainable groundwater management must be met by local and regional agencies and not by centralized state regulation*." The authors continue "..*the job is far from done. While there are numerous case studies in successful management, efforts must be expanded in many parts of the state to achieve sustainable outcomes*." This document is included as **Appendix B**.

Under current California law, landowners are entitled to pump and use reasonable amounts of groundwater from a basin underlying their land. *Correlative rights* and *appropriative rights* are the two foundational principles of California law germane to groundwater use. Under the doctrine of "correlative rights," landowners overlying a common source of groundwater are limited to using a reasonable share of the resource. "Reasonable" groundwater use is relative to the amount of overlying land owned by the landowner and the physical condition of the groundwater basin. When there is insufficient water to meet the cumulative demands of the overlying landowners, those users are expected to reduce their demands *correlatively* to bring groundwater extractions within the safe yield of the basin and prevent overdraft.

Entities other than overlying users, such as cities, may be entitled to "*appropriative*" water from the basin for use as a municipal supply when water surplus to the needs of the overlying users is available. Unless otherwise permitted, appropriators must curtail their use when there is no surplus.

Summary of Groundwater and Surface Water Law

Under California law, water is characterized as either groundwater or surface water. Groundwater is divided into subterranean stream or percolating groundwater. Surface water and subterranean streams are subject to the permitting authority of the State Water Resources Control Board, while percolating groundwater is not. In areas where there is a hydrologic connection between surface water and groundwater, a number of early cases provide foundational legal doctrine. The following three points are excerpted from ACWA (2011) and the reader is referred to that document or the actual case law for more details.

- User of percolating groundwater may diminish flows in a surface stream only if the groundwater is put to reasonable use on lands overlying the groundwater basin.
- Overlying owners may extract groundwater for use on overlying lands, despite impacts on downstream riparians and down-gradient overlying pumpers.
- Riparian and overlying rights are treated as extracting water from a common source and so have joint rights to reasonable shares of the resource.

Key Definitions

The brief overview of the basic concepts of groundwater use under current California Law provided must be understood in the context of several terms which are defined below, including "safe yield," "surplus" and "overdraft." This GMP will use these terms, with the exception of "safe yield," as defined by ACWA (2011) throughout the remainder of the Plan. Other terms regarding groundwater are included here and most are from the 2011 ACWA document with the appropriate reference cited. In place of "safe yield," this GMP uses the term "Available Groundwater."

- Adjudication – product of a judicial process involving parties in a groundwater basin to determine the nature and quantity of each producer's share of the basin's safe yield. ACWA 2011.

- Applied Water – the amount of water, from any source, needed to meet the demand for beneficial use by the user. (DWR California Water Plan Update, 2005)
- Available Groundwater – The volume of groundwater that can be presently pumped without causing groundwater overdraft.
- Conjunctive Use – the coordinated and planned use of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. (ACWA, 2011)
- Consumptive Use – quantity of applied water that is not available for immediate or economical reuse. (DWR California Water Plan Update, 2005)
- Deep Percolation – water applied to crops and landscaped areas that exceeds evapotranspiration demands and percolates to the groundwater, sometimes referred to as Applied Water Recharge
- Groundwater Banking – a water management tool designed to increase water supply reliability. Makes use of dewatered aquifer space to store water during wet years, so that stored water can be pumped and used during dry years. (ACWA, 2011)
- Intentional Recharge – surface water purposely recharged into a groundwater aquifer
- Natural Groundwater Recharge – water from any natural source such as rainfall or seepage from rivers and streams that recharges groundwater resources
- Overdraft – "….*overdraft occurs when extractions exceed safe yield* Safe Yield – S*afe yield refers to "the maximum quantity of water which can be withdrawn annually from a groundwater supply under a given set of conditions without causing an undesirable result". California Supreme Court, Los Angeles v. San Fernando case, 1975*. The phrase *"undesirable result" is understood to refer* to "*a gradual lowering of the groundwater levels resulting in depletion of the supply."*

(This term is not used in this GMP because no groundwater supply is considered safe or sustainable in the long-term, and the groundwater yield is dynamic and constantly changing. Instead the term Available Groundwater (see above) is used).

- Subsidence – the gradual settling or sudden sinking of the Earth's surface due to changes that take place underground. (ACWA, 2011)
- Surplus – Surplus refers to "*the amount of water in a groundwater basin in excess of safe yield*." (San Fernando Court, City of Los Angeles v. City of San Fernando, 1975)
- Sustainability – "*development and use of groundwater in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences*." (Alley, W. M., Reilly, T.E., and Franke, O.L, 1999)

Legislation Authorizing Groundwater Management Plans

California Assembly Bill No. 3030 (AB 3030), which became law on January 1, 1993, authorized local agencies that are within groundwater basins as defined in California Department of Water Resources (DWR) Bulletin 118-80, and that meet certain other criteria, to prepare and adopt Groundwater Management Plans. Each of the Plan Participants (with the exception of SEMCU, which is a private not-for-profit organization) qualifies under the law.

The law created by AB 3030, now codified in California Water Code Section 10753, et. Seq., was amended by 2002 California Senate Bill 1938 (SB 1938), which also identified new requirements for GMPs. In 2011, Senate Bill 359 added additional requirements, mostly related to public outreach. This GMP meets the requirements of AB 3030, SB 1938 and SB 359.

Local Sovereignty

This GMP serves as both a regional planning document and a local GMP for each of the GMP Participants. Each agency maintains sovereign control over groundwater in its service area, and no agency, including Madera County, is granted rights or permission to manage groundwater in another jurisdiction. This reservation of sovereignty is supported by California Water Code Section 10750.8 (a) which states "*A local agency may not manage groundwater pursuant to this part within the service area of another local agency without the agreement of that other entity*."

Powers Granted to Adopting Agencies

The powers granted to each agency adopting a GMP are codified in the California Water Code and existing state legislation. These powers include:

1. The agency may take any actions needed to replenish the groundwater within the GMP area, including buying and selling water, delivering water in lieu of

groundwater pumping, and spreading water for recharge.

2. The agency may take actions needed to protect or prevent interference with water, water quality, or water rights within the agency.

3. Using water quality goals, the agency may take any action needed to preserve the water within the agency for beneficial uses. These actions include preventing contaminants from entering agency groundwater supplies, removing contaminants, locating and characterizing contaminants within the agency's groundwater supply, identifying parties responsible for contamination of groundwater, and performing studies relative to the listed water quality goals.

4. The agency may enter into agreements with other local agencies or private parties to manage mutual groundwater supplies, including those existing in overlapping areas.

5. The agency may levy and collect general groundwater replenishment assessments, as well as water extraction fees based on the amount of groundwater extracted from the aquifer. However, these fees must be ratified by a majority vote in an election, according to the election rules applicable to the agency.

6. The agency may sue to recover the amount of agency expenditures for protection of groundwater quality from parties responsible for contamination.

7. The agency is granted additional powers of a Replenishment Agency, which allows it to:
   a) Acquire and operate facilities, waters and rights needed to replenish the groundwater supplies;
   b) Store water in groundwater basins, acquire water rights, import water into the Agency, and conserve water;
   c) Participate in legal proceedings as required to defend water rights, and water supplies, and to prevent unlawful exportation of water from the agency;
   d) Under certain conditions, to exercise the right of eminent domain;
   e) Act jointly with other entities in order to economically perform required activities;
   f) Carry out investigations required to implement programs;
   g) Fix rates for water for replenishment purposes;
   h) Recapture and reclaim water as provided for in Water Code Section 60221; and
   i) Fix the terms and conditions of contracts for use of surface water

in-lieu of groundwater.

1.6. Groundwater Management Plan Components

This GMP includes the required and voluntary components for a GMP as identified in California Water Code Section 10753, et. seq. This Plan is also consistent with the recommended elements for a GMP as identified in DWR Bulletin 118 (2003), Appendix C. **Table 1.10** identifies the appropriate section of the GMP where each component is addressed.

Table 1.10 – Location of Groundwater Management Plan Components

Description		Plan Section(s)
California Water Code Mandatory Requirements (10750 et seq.)		
1.	Documentation of public involvement	1.5, **Appendix C**
2.	Groundwater basin management objectives	1.2, 3
3.	Monitoring and management of groundwater elevations, groundwater quality, land subsidence, and surface water	5.1 – 5.4
4.	Plan to involve other agencies located in the groundwater basin	4.3
5.	Monitoring protocols	5.3
6.	Map of groundwater basin and agencies overlying the basin	**Figure 2.1**
California Water Code Voluntary Components (10750 et seq.)		
7.	Control of saline water intrusion	6.3
8.	Identification and management of wellhead protection areas and recharge areas	6.2, 7.2, 7.3
9.	Regulation of the migration of contaminated groundwater	6.3, 6.4
10.	Administration of well abandonment and well destruction program	6.1
11.	Mitigation of overdraft conditions	7.2, 7.3
12.	Replenishment of groundwater extracted by water users	7.3
13.	Monitoring of groundwater levels and storage	5.1, 9.2
14.	Facilitating conjunctive use operations	7.4
15.	Identification of well construction policies	8.1
16.	Construction and operation by local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects	8.2
17.	Development of relationships with state and federal regulatory agencies	4.2, 4.3
18.	Review of land use plans and coordination with land use planning agencies	9.1
Additional Components Recommended by DWR (App. C of Bulletin 118)		
19.	Advisory committee of stakeholders	4.1
20.	Description of the area to be managed under the Plan	1.1, 2
21.	Descriptions of actions to meet management objectives and how they will improve water reliability	4 – 9
22.	Periodic groundwater reports	9.2
23.	Periodic re-evaluation of Groundwater Management Plan	9.4

1.7. Adoption of Plan

Refer to **Appendix C** for documentation on the adoption of the GMP and the public process that was followed.

Groundwater Advisory Committee

The Regional Groundwater Advisory Committee (GAC or Committee) is comprised of representatives from the six entities that sponsored the GMP and who worked collaboratively to prepare this GMP. Each Plan Participant also has its own governing body to address local groundwater issues within their service area. GAC meetings were held regularly during the preparation of the GMP.

Plan adoption

As required by California Water Code Section 10753.2(a), the Plan Participants published a series of public notices, held public meetings, and adopted resolutions required for preparing and adopting this GMP. Public notices were published in local newspapers. The public was provided a 30-day period to review the draft GMP. No comments were received from the public. These public outreach efforts are summarized in **Table 1.11** below.

Table 1.11 – Public Participation in Groundwater Management Plan Update

Phase of Public Noticing	Description	Date
Intent to update GMP	Notice of hearing published	September 2013
	Hearing held. Resolution adopted.	September 24, 2013
Public Review	Notice of hearing published	November 8, 15, 2014
	Hearing held.	December 9, 2014
GMP Adoption	Final GMP adopted by GMP Participants[1]	Varies

1 – The GMP was adopted by the Plan Participants at six separate Board and council meetings. The respective resolutions can be found in **Appendix C**.

2. GEOLOGY AND HYDROGEOLOGY

This section discusses the geology and hydrogeology of GMP area and immediate surrounding areas. The purpose of this section is to provide general background information on the local hydrogeology that will aid in selecting and implementing groundwater management programs.

The following sections include technical discussions on the region's groundwater. These are intended to provide geologists, engineers, and water managers a greater understanding of the area's stratigraphy, groundwater conditions, and hydrogeologic parameters. The content of this chapter requires a basic understanding of some geologic principles and terminology. Less technical discussions on groundwater management programs can be found in Sections 3-9.

2.1. Groundwater Basins and Subbasins Description

The GMP area is underlain by the San Joaquin Valley Groundwater Basin. The San Joaquin Valley Groundwater Basin covers a vast area and encompasses the alluvial deposits under the valley floor from the Sierra Nevada Mountains to the east, the Coast Range mountains to the west, the Sacramento Valley and Delta to the north, and the San Emigidio and Tehachapi mountains to the south. The San Joaquin Valley Groundwater Basin lies within the San Joaquin River and Tulare Lake Hydrologic Regions and covers approximately 13,900 square miles and has been divided into 16 subbasins. The GMP area is within the San Joaquin River Hydrologic Region and is underlain by three groundwater subbasins (**Figure 2.1**) as defined by the California Department of Water Resources (DWR) in "*California's Groundwater, Bulletin 118 – Update 2003*". These subbasins are the Chowchilla, Madera, and Delta-Mendota subbasins. A subbasin is defined as follows:

> "A groundwater basin is defined as an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined […] features that significantly impede groundwater flow such as rock or sediments with very low permeability or a geologic structure such as a fault. […]
>
> "A subbasin is created by dividing a groundwater basin into smaller units using geologic and hydrologic barriers or, more commonly, institutional boundaries […]. These subbasins are created for the purpose of collecting and analyzing data, managing water resources, and managing adjudicated basins."

DWR was directed by legislation to define critical overdraft in 1978 and report which subbasins were in critical overdraft. The *California Water Plan Update* of 2009 restates that the eastern San Joaquin (County), Chowchilla, and Madera subbasins as being in critical condition of overdraft. A comprehensive assessment of overdraft in California's subbasins has not been completed since 1980.

Bulletin 118-80 defined critical overdraft as:

> *"A basin is subject to critical conditions of overdraft when the present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts."*

Chowchilla Subbasin

The Chowchilla subbasin is shown in **Figure 2.1**, and is identified as Basin 5-22.05 by DWR. As defined in DWR Bulletin 118, the subbasin covers an area of 248 square miles and is located in Madera County and a small portion of Merced County. The subbasin is bound by the Columbia Canal Company Service Area on the east and the San Joaquin River on the west. To the north, the subbasin is bound by the southern portion of the Merced subbasin. The southern boundary consists of an irregular pattern and borders the northern portion of the Madera subbasin. This basin has been characterized as being critically overdraft since 1980 by DWR. Groundwater recharge is primarily from deep percolation of applied irrigation water (DWR, 1995).

Madera Subbasin

The Madera subbasin is shown in **Figure 2.1** and is identified as Basin 5-22.06 by DWR. As defined in DWR Bulletin 118, the subbasin covers an area of 614 square miles and is located entirely within Madera County. It is bound on the south by the San Joaquin River, on the west by the eastern boundary of the Columbia Canal Service Area, on the north by the south boundary of the Chowchilla subbasin, and on the east by the crystalline basement bedrock of the Sierra Nevada foothills. DWR Bulletin 118 characterizes this basin as being in critical overdraft since 1980 by DWR.

Delta-Mendota Subbasin

The Delta-Mendota Subbasin is shown in **Figure 2.1** and is identified as Basin 5-22.07 by DWR. As defined in DWR Bulletin 118, the subbasin covers an area of 1,170 square miles and encompasses a small portion of western Madera County and is largely in Fresno County and portions of Stanislaus and Merced counties. It is bound on the west by the Coast Ranges, on the north by the Stanislaus/San Joaquin county line, and on the east generally by the San Joaquin River. The southern boundary is irregular and consists of portions of the western Kings subbasin and the Westside subbasin. DWR Bulletin 118 states that groundwater levels within the Delta-Mendota subbasin have been relatively stable and this subbasin is not considered to be in overdraft.

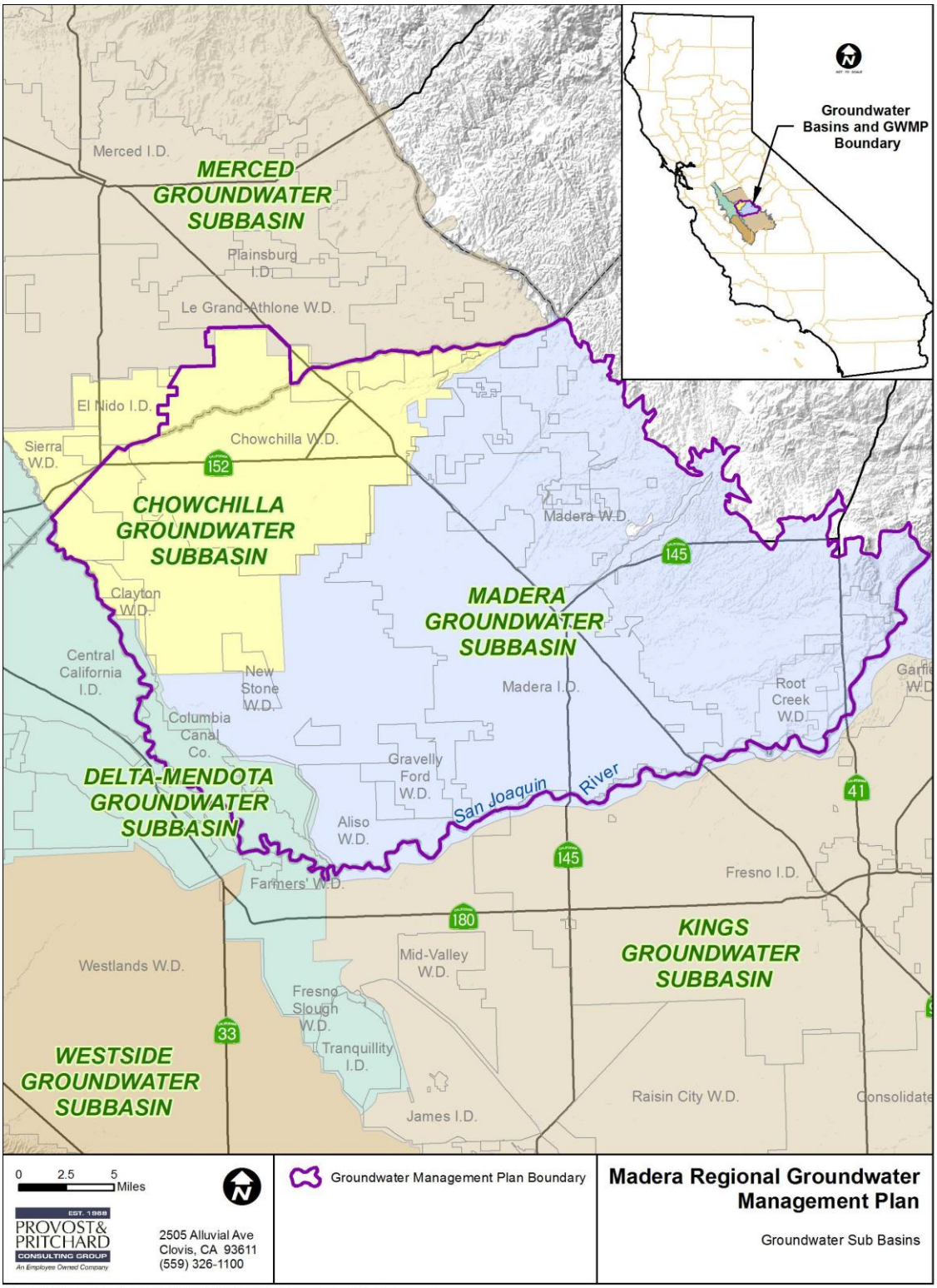

Figure 2.1 – Groundwater Sub-basins

2.2. Geomorphology and Soils

The GMP area consists of generally flat agricultural land, sloping to the west, with the Sierra Nevada Mountains rising to the east. Fluvial and alluvial processes have formed the landforms within the San Joaquin Valley portion of GMP plan area. Precipitation in the Sierra Nevada Mountains adjacent to the GMP area has drained westward and deposited sediments into the San Joaquin Valley, creating the dominant geomorphic features in the valley. Three major drainages developed east of the Madera area, the Chowchilla, Fresno, and San Joaquin Rivers. Each stream transported sediment out and onto the valley floor developing overlapping alluvial fans. The alluvial fan size appears to increase to the south. In cross section, alluvial fans are wedge-shaped or lens-shaped. Sediments in alluvial fans decrease in grain size with increasing distance from the source.

The Chowchilla River flows west along the northern portion of Madera County and spills into the Berenda and Ash Sloughs. The Fresno River flows west through the central portion of the county where it joins the San Joaquin River in the west. The San Joaquin River flows west along the southern portion of Madera County before turning north in the axial portion of the valley, creating the western boundary of Madera County. Each river deposited sediments on the valley floor. There tends to be a larger amount of coarse-grained sediments near the valley margin and more fine-grained sediments downstream. As flood events occurred, the streams would overbank their channels and deposit fine-grained sediments to the north and south of each river channel. Alluvial fans form multiple stream channels over the cycle of formation and often overlap with other alluvial fans.

The flood plain deposits of each of the major alluvial fans increase in size from north to south. The flood plain of the Chowchilla River is half a mile wide and less than five (5) miles long (Bertoldi, 1970). The flood plain of the Fresno River is near one-mile wide and 10 miles long (Bertoldi, 1970). The flood plain of the San Joaquin River is the largest and has a maximum width of about two miles and extends 25 miles below Friant Dam (Bertoldi, 1970).

Soils that have developed on top of the alluvial fans have varying degrees of infiltration characteristics. The development and extent of soils are dependent on the degree of weathering of the source material. **Figure 2.2** depicts the soils in the Madera area based on infiltration rates. A prominent soil designation throughout the eastern valley in the GMP plan area is Hydrologic Group Soil D, indicated by the red color as shown in **Figure 2.2**. This type of soil is primarily located in-between the major drainages of the county and has the lowest infiltration rate. It is apparent that soil with the greatest infiltration rate, Hydrologic Soil A, are within the main channels of the major stream systems. The soils become less permeable further from the alluvial fan deposits.

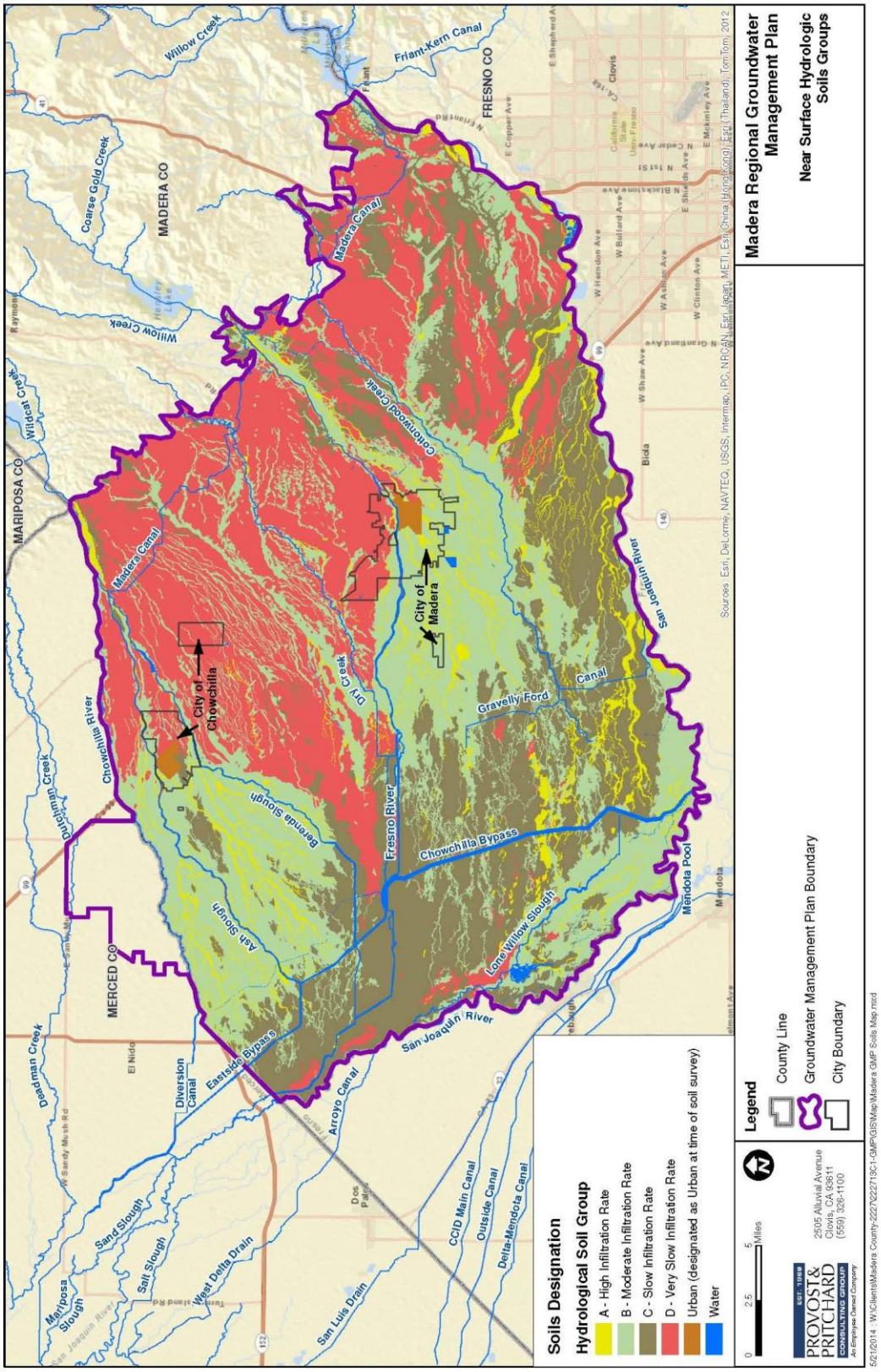

Figure 2.2 – Near Surface Hydrologic Soils Groups

2.3. Geology and Hydrogeology

The Great Valley of California is an asymmetrical structural trough filled with Mesozoic (deposited 248 million years ago [mya] to 99 mya) and Cenozoic (65 mya to present) sediments that reach a thickness of approximately 30,000 feet. The Great Valley consists of the Sacramento Valley in the north and the larger San Joaquin Valley in the south. The San Joaquin Valley represents the lower two-thirds of the Great Valley of California and is approximately 200 miles long and up to 70 miles wide, bound on the north by the Sacramento-San Joaquin Delta, the Sierra Nevada mountains on the east, the Coast Range Mountains on the west, and the Tehachapi and San Emigdio Mountains to the south.

The freshwater aquifer systems underlying the GMP area consist of the younger alluvium and older alluvium and are contained in the Late Tertiary and Quaternary continental deposits (Page, 1986). These deposits increase with thickness from north to south and are up to 3,000 feet thick in the GMP area (USGS, 2012). Sediments generally are coarser at the proximal sides of the fans, closest to the Sierra Nevada Mountains, and become finer towards the center of the valley. Below is a discussion on the regional geologic formations identified in the subsurface in the GMP area as well as their water bearing capacities.

Stratigraphy

Mitten, LeBlanc, and Bertoldi (1970) characterized the subsurface geology underlying the GMP area. The geologic units, from deep to shallow (oldest to youngest), consist of crystalline basement rock, marine sediments, marine and undifferentiated continental sediments, consolidated continental sediments (including the Ione Formation and Mehrten Formation), and unconsolidated sediments. The stratigraphic succession of deposits in the valley include, from oldest to youngest: crystalline basement rock, marine and continental sedimentary rocks, Ione Formation, Mehrten Formation, continental deposits of tertiary and quaternary age, and continental deposits of quaternary age. The youngest formation is further divided into the Older Alluvium and the Younger Alluvium.

Crystalline Basement Rock

The basement complex of pre-Tertiary age consists of mostly granitic and metamorphic rocks (Bateman *et. al.,* 1963). As shown on **Figure 2.3**, the basement complex outcrops east of the older alluvium. The crystalline basement rock underlies the entire GMP plan area at depth. The crystalline basement rock is comprised of the Sierra Nevada batholith (map symbol grMz) and partly the western metamorphic belts, consisting of meta-volcanic and meta-sedimentary (map symbol J) strata (Bateman *et. al*., 1963). This formation likely contains groundwater in fractures, but does not provide significant groundwater to the GMP area.

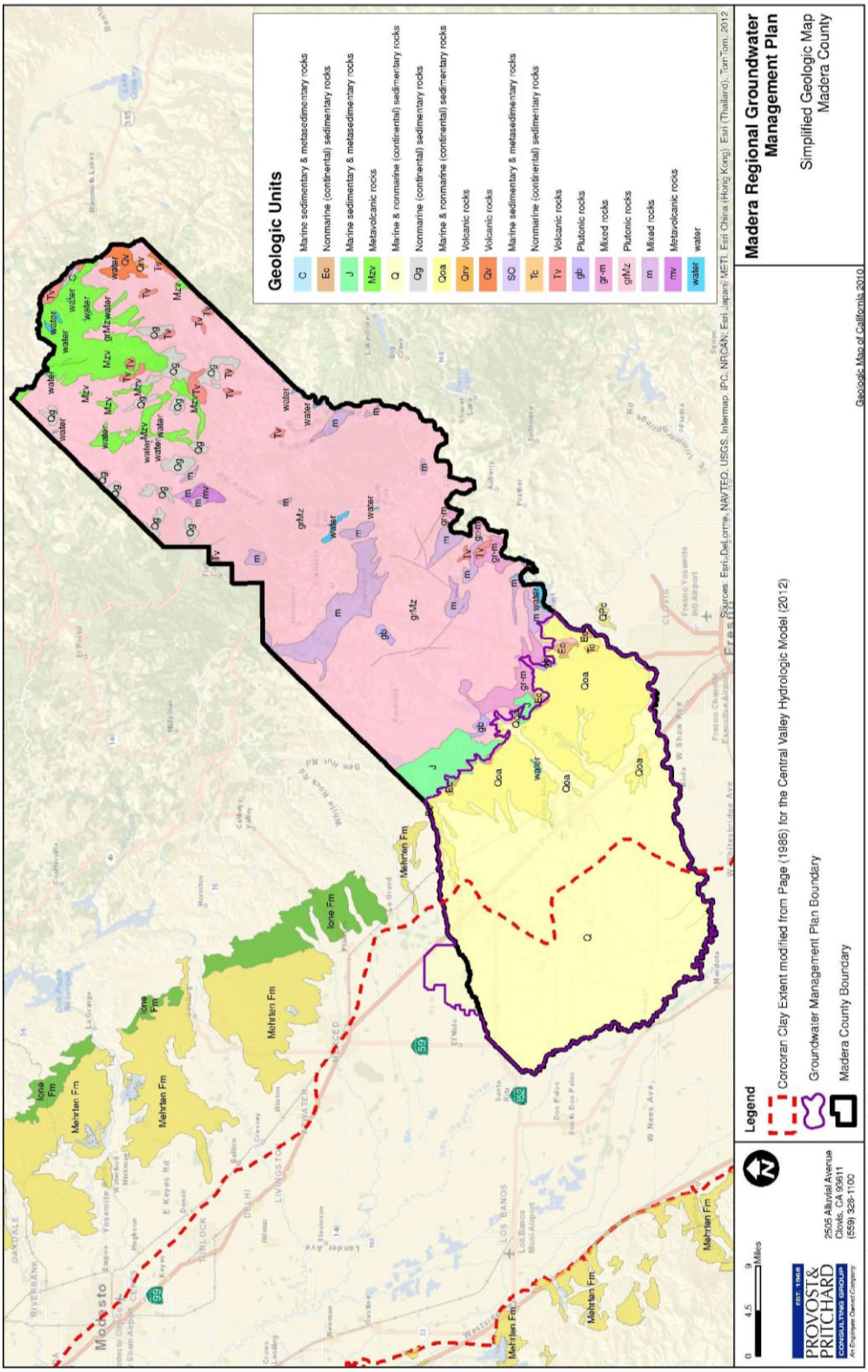

Figure 2.3 – Simplified Geologic Map – Madera County

Marine and Continental Sedimentary Rocks
The marine and continental rocks of pre-Tertiary and Tertiary age overlie the basement complex and underlie the western part of the Madera area. The formations do not outcrop in the area, but can be tracked in the subsurface (Mitten *et. al*. 1970). These rocks consist mostly of sandstone, claystone, siltsone, and shale. The marine sedimentary rocks most likely contain connate saline water and do not provide useable groundwater to the GMP area.

Ione Formation
The Ione Formation outcrops in the eastern portion of the valley and caps many of the hills northwest of Friant Dam (Mitten et. al. 1970). The Ione Formation is a sedimentary formation and was deposited in both a marine and non-marine environment. The Eocene Ione Formation outcrops discontinuously along the western margin of the Central Valley and consists of sandstone and conglomerates. During the late Cenozoic, a period of erosion eroded the Ione Formation in the Chowchilla River area (Helley, 1978). The Ione Formation does not provide groundwater to the GMP area. This is significant because the absence of the Ione Formation reduces the recharge potential of the groundwater basin in the GMP area.

Mehrten Formation
The Mehrten Formation is a significant geologic formation within the San Joaquin Valley. The Mehrten Formation is Mio-Pliocene in age and consists of a sequence of volcaniclastic and volcanic rocks. The Mehrten Formation unconformably overlies the Ione Formation. The Mehrten Formation is comprised of two distinct geologic units. The first consists of sediments deposited under alluvial and fluvial conditions and are comprised of gravel, sand, silt, and clay size sediments. The second unit consists of dense volcanic flows of tuff breccia with some interbedded conglomerates and sandstones. As shown in **Figure 2.3**, the Mehrten Formation outcrops north of the GMP plan area but is not present in Madera County. Sierra Nevada uplift and a period of erosion thought to occur at a higher rate in the south, and glaciation and the associated alluvial fans are thought to have eroded the Mehrten Formation (Helley, 1978). Exposures of the Mehrten Formation have not been identified in the area of the alluvial fan created by the Chowchilla River (Helley, 1978) or in the Madera area. The Mehrten is an important aquifer that stretches from Merced County north to Sutter County. The fact that it is not present in the eastern portion of the GMP area is a significant reason that groundwater recharge does not occur at a rate as it does in the subbasins north of the GMP area. Three miles southeast of Chowchilla, a recent test hole drilled to a depth of 1,000 feet encountered black sand that could be the Mehrten Formation; however, the geophysical surveys indicated that the water in this formation was not fresh as the formation above and could be slightly brackish (personal communication Larry Ernst). The depth to brackish water was reported at approximately 710 feet below ground surface at this location, or an elevation of approximately -510 feet MSL. The base to fresh water map (Page, 1977) predicts the depth between -600 to -800 feet MSL, slightly deeper than was observed in this test hole.

Continental Deposits of Tertiary and Quaternary age
The continental deposits of Tertiary and Quaternary age underlie most of Madera County, but do not crop out at the surface. The formation dips gently southwest and overlies the marine and continental rocks (Mitten *et. al*., 1970). The deposit consists of interbedded, poorly sorted sand, silt, clay and conglomerate, with layers of hardpan. The deposits becomes finer grained with depth and distance from the foothills. The lower part of the deposits contains blue and green clays and the upper portion contains red, yellow, and brown clays, which are interpreted to have been deposited under reducing and oxidizing conditions, respectively. In the past, few water wells penetrated the continental deposits. The water bearing capacity of this formation is unclear at this time; however, many new agricultural wells are drilling deeper into this formation to produce additional groundwater. As these wells are put into production over the next several years, additional information with regard to well yields, water quality, and aquifer recharge will become available.

Continental Deposits of Quaternary Age (Older Alluvium)
The older alluvium of Pleistocene and Holocene age underlies most of the GMP area (Mitten *et. al*., 1970). As shown in **Figure 2.4**, the older alluvium (map symbol Qoa) outcrops south of the San Joaquin River and north of the Chowchilla River. Janda (1965) correlated the formation near Little Table Mountain with the Turlock Lake, Riverbank, and Modesto Formations of Davis and Hall (1959). The older alluvium dips gently southwest and ranges in thickness from zero to about 1,000 feet (Mitten *et. al*. 1970). It overlies the continental deposits of Tertiary and Quaternary age and overlaps the Ione Formation (where present) and the basement complex. The older alluvium consists mostly of interbedded lenses of clay, silt, sand, and some gravel. Cemented hardpan occurs throughout the area near the ground surface. The source of the older alluvium is from the Sierra Nevada (Mitten *et. al*. 1970). The older alluvium decreases in grain size with depth and grades into the underlying fine-grained continental deposits of Tertiary and Quaternary age (Mitten *et. al*. 1970). The base of the older alluvium is defined where the resistivity on electric logs reflect a change from relatively coarse to fine grained sediment (Mitten *et. al*. 1970).

Mitten *et. al.* (1970) summarized aquifer characteristics based on aquifer tests made by the USGS in the late 1960's and reported aquifer transmissivity values ranging from 18,000 to 99,000 gallons per day per foot (gpd/ft) of drawdown in the Madera area. Based on multiple well tests throughout the Madera area, transmissivities of deposits above a depth of 500 feet (with significant coarse-grained deposits) range in transmissivities from 50,000 to 250,000 gpd/ft of drawdown. The underlying continental deposits normally range in transmissivities from about 10,000 to 30,000 gpd/ft of drawdown (Boyle, 2008).

Continental Deposits of Quaternary Age (Younger Alluvium)
The younger alluvium is a well-sorted sedimentary formation and overlies the older alluvium. It does not contain cemented hard pan, which differentiates it from the older alluvium. As shown in **Figure 2.4**, the younger alluvium (map symbol Q) overlies the

older alluvium and covers a significant portion of the GMP plan area. The younger alluvium is indistinguishable from the older alluvium in the subsurface. The estimated thickness ranges from zero to 50 feet and is unsaturated, except when saturated near streams and channels (Mitten *et.al* 1970).

Corcoran Clay (E Clay)

To better depict the aquitards in the southern San Joaquin Valley, Croft (1972) identified several extensive clay layers in the subsurface that he designated, youngest to oldest, by letters A through F. The A and E clays are the most significant clay layers in the vicinity of the GMP area, but only the E clay is present in the GMP area based on Crofts mapping. The E clay is the thickest and most laterally extensive of the clay layers identified and mapped by Croft. The A clay has been mapped locally at shallow depths southwest of the GMP area at depths of 10 to 60 feet and is generally less than 60 feet thick (Croft, 1972). Elevated groundwater salinity has been identified west of the GMP area, and north of the mapped A clay in the subsurface. This potentially indicates that the A clay extends further north than previously mapped. This correlation will require additional studies.

The E Clay, which includes the Corcoran Clay Member of the Tulare Formation, is a regional confining layer and underlies approximately 3,500 square miles in the San Joaquin Valley (Croft, 1972). Within the upper portion of the Older Alluvium, the Corcoran Clay divides the San Joaquin Valley freshwater aquifer system into an unconfined to semi-confined upper system and a largely confined lower system (USGS, 2012). The Corcoran Clay has been identified in the subsurface in the western portion of the GMP area, as shown in **Figure 2.5**. The Corcoran Clay ranges in depth between 80 and 350 feet, however, it does not outcrop in the GMP area (Croft, 1972). The E clay dips gently from a depth of 80 feet below ground surface near Chowchilla to a depth of 400 feet below ground surface towards the southwestern portion of the GMP area. It consists mostly of clay, silty clay, or silt and divides the Older Alluvium into confined and unconfined aquifers. In contrast to other clays in the subsurface, the Corcoran Clay appears gray, greenish gray, or bluish gray (Mitten *et. al*. 1970). Water well drillers commonly referred to this clay as the “blue clay”. Portions of the Corcoran Clay consist of a matrix of diatomaceous clays, which are compressible when the pore pressure is reduced by dewatering. The compression of the diatom rich matrix is thought to be the main reason for the extreme inelastic compression and the associated land subsidence overlying the Corcoran Clay.

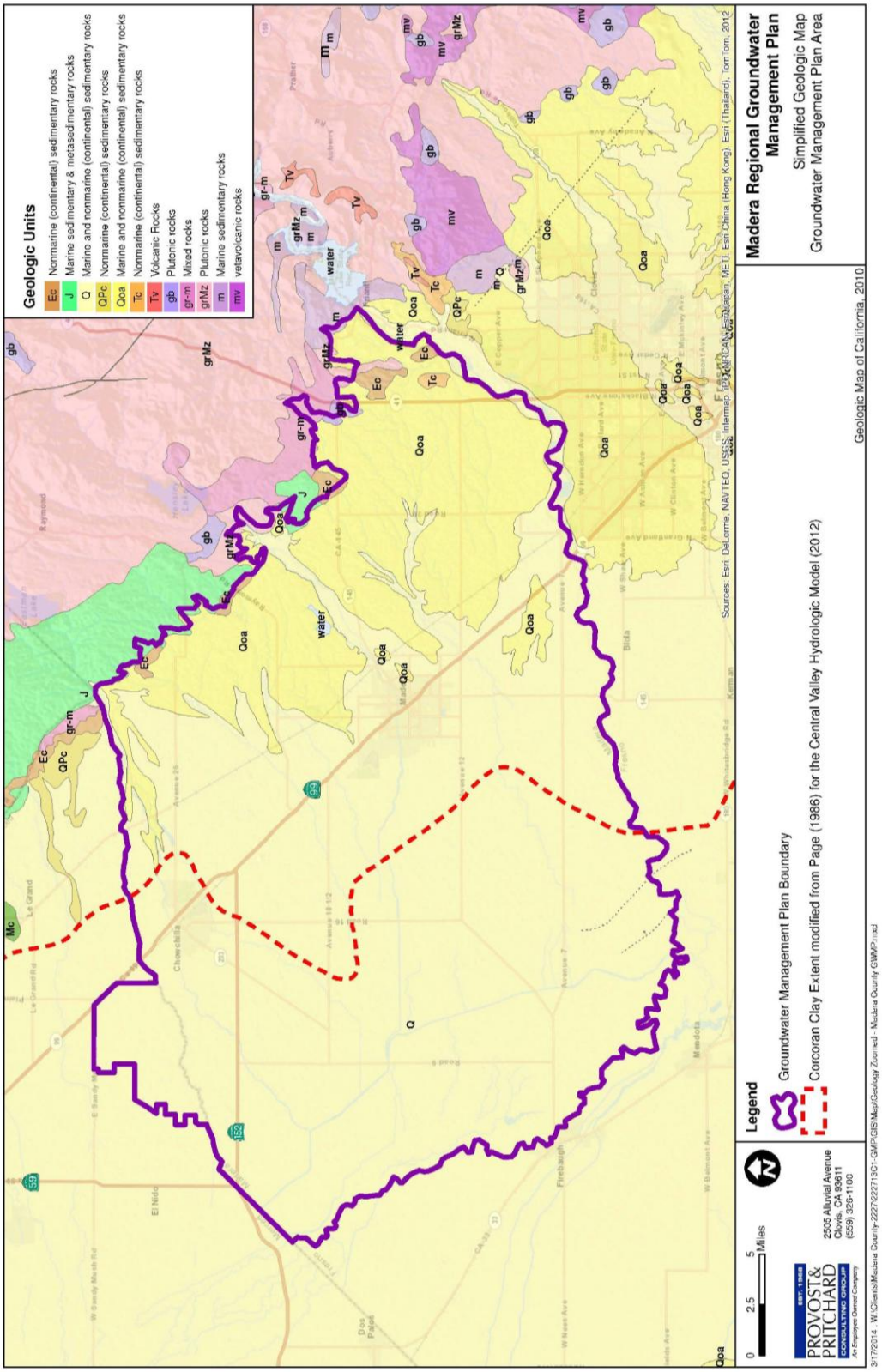

Figure 2.4 – Simplified Geologic Map – Groundwater Management Plan Area

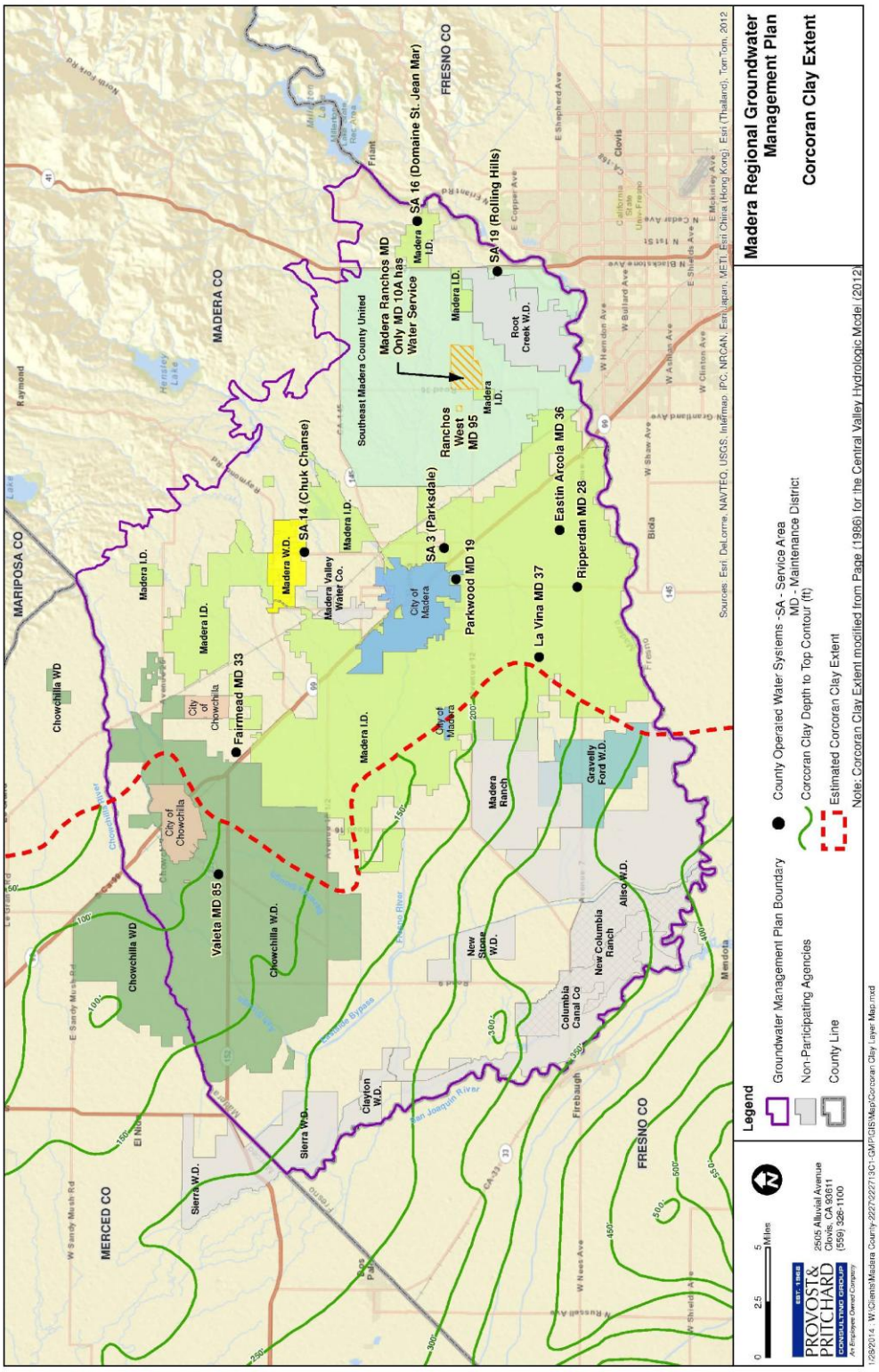

Figure 2.5 – Corcoran Clay Extent

2.4. Groundwater Elevations and Flow Direction

This section discusses the available groundwater level data, recent groundwater elevation contours, groundwater flow direction and existing cones of depression. Existing groundwater level data is limited and recommendations are given for improving monitoring.

Groundwater Levels

Recent and readily available groundwater level data was obtained from several GMP Participants for the fall 2013 season. Although not a GMP Participant, fall 2013 water level data was also obtained for Root Creek Water District. Fall 2013 data was used because it: 1) provides the most recent data, and; 2) illustrates the condition of the aquifer after a summer of groundwater withdrawals. Groundwater elevation contours were estimated based on the data provided (**Figure 2.6**). The following should be noted concerning the data sources used for the groundwater level information:

- Chowchilla Water District monitors 142 wells, of which 79 have fall 2013 water level data.
- Madera Irrigation District monitors 161 wells, of which 85 have fall 2013 water level data.
- Root Creek Water District – water level data available for 22 wells.
- Madera County supplied information from eight wells in valley-floor Maintenance Districts and Service Areas.
- The City of Madera and City of Chowchilla monitor groundwater levels, but the data was not readily available for the analysis.
- No fall 2013 groundwater level data was collected for the Western Madera County Subsidence Study. The participants in the study only measure groundwater levels in the spring.
- The California Department of Water Resources no longer measures wells in Madera County (personal communication with DWR staff, March 2014).
- The USBR reports their water level data to the DWR, and only eight of those wells are available on CASGEM.
- No readily available data in the un-districted areas of the county, except for data from Madera County.

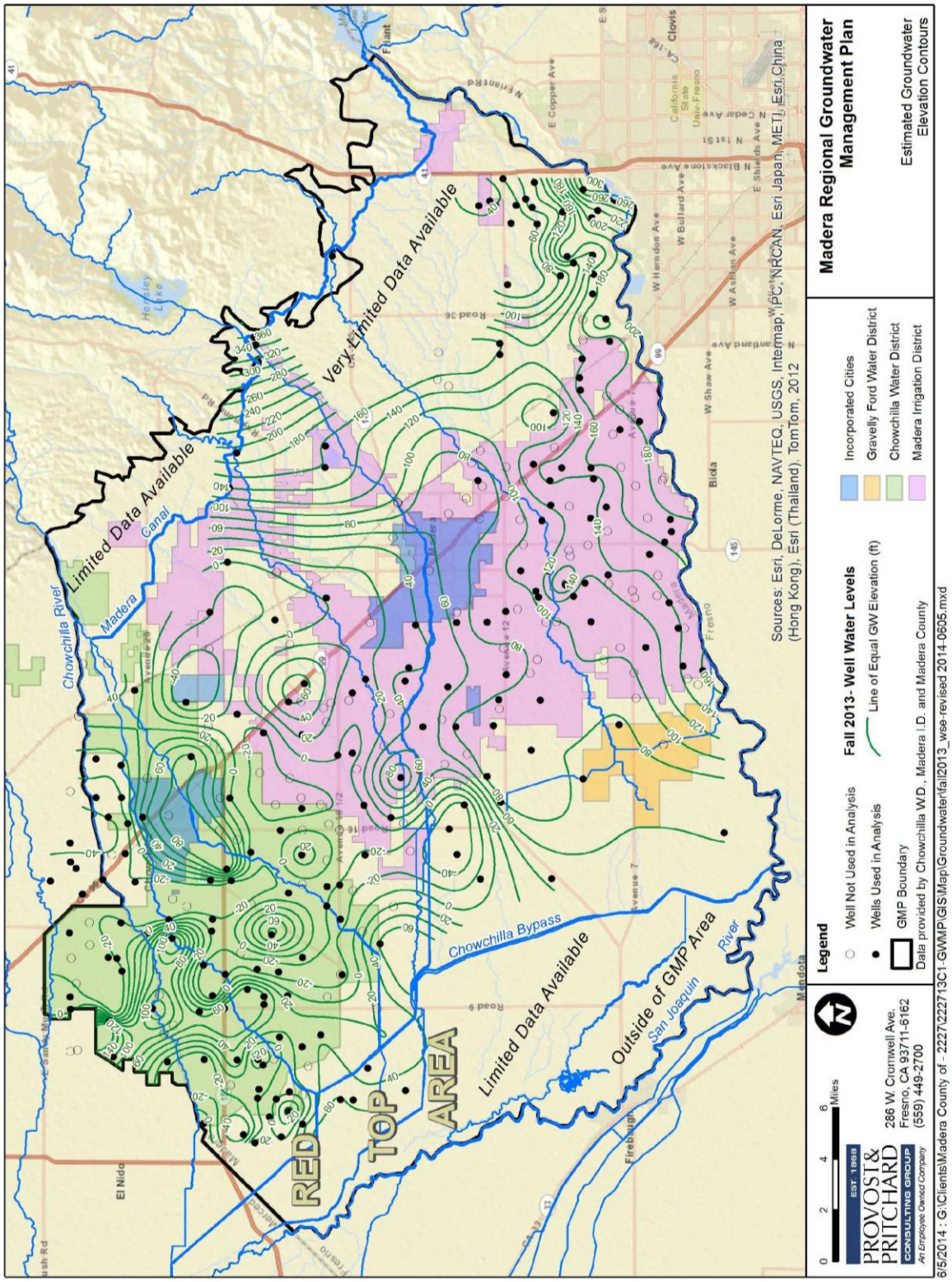

Figure 2.6 – Estimated Groundwater Elevation Contours

Groundwater Monitoring

The majority of the water level data available falls within MID and CWD. Outside of the districted areas readily available water level data is sparse. Water level monitoring programs in the un-districted areas, or areas that receive little or no surface water, are as a whole deficient. Much fewer water level measurements are available in the east part of the valley floor, where the greatest water level declines are occurring. As well, as shown on **Figure 2.6** very little water-level data was available in the cities. The City of Madera does monitor groundwater levels annually, but the data was not readily available or organized/formatted in a manner that would allow it to be used in the evaluation. The relative paucity of data outside of the Districted areas, coupled with a general lack of knowledge concerning well construction details, stresses the importance of implementing a robust regional groundwater level monitoring program as described in **Section 5.1 – Groundwater Level Monitoring Program**. The following items should be considered when reviewing the estimated groundwater contours and will need to be considered when developing a regional groundwater monitoring network:

- Well construction details are lacking for most of the wells, and determining the perforated interval and aquifer being measured will require a separate detailed study; therefore groundwater contours were developed without knowledge of specific aquifers monitored by a given well.
- The supplied water level data sheets do not indicate the aquifer(s) monitored by a given well.
- Only the eight CASGEM wells, supplied by the County of Madera, and the Root Creek WD wells have measuring point elevation data, therefore the depth to water information from the MID and CWD wells were estimated from a GIS elevation model.
- KDSA indicates that confined groundwater, caused by local confining clay layers, is found east of the Corcoran Clay.
- KDSA also indicates that below depths of several hundred feet, usually below 200 feet, groundwater is confined regardless of whether or not the Corcoran Clay is present.

Derivation of Groundwater Elevation Contours

Groundwater elevation contours were estimated from available water level data. As **Figure 2.6** shows, wells in relatively close proximity to one another can have significantly different water elevations. This is likely caused by several factors 1) groundwater elevations in wells across the study area appear to be affected to varying degrees by confining conditions, 2) water level measurements are taken with different types of measuring devices 3) water levels taken within a season may be several months apart and 4) groundwater level data taken when a well is running or to soon after the well was shutoff will affect the data. This emphasizes the importance of

developing standard protocols to be used throughout the GMP area to measure groundwater levels.

Groundwater Flow and Cones of Depression

The most consistent and reliable groundwater elevation contours are found along the San Joaquin River from the Root Creek area to about 5 miles west of Highway 145. Through this area groundwater flows northwest into the region due to recharge from the San Joaquin River. Generally flow is west to southwest across the study area with numerous groundwater mounds and depressions indicating that groundwater can locally flow in any direction-either towards a depression or away from a mound. This is readily apparent in areas west of Highway 99, where confining conditions are more prevalent. However, it should be noted that groundwater elevation contours based on fall readings often show more groundwater depressions due to prolonged pumping during the growing season. These seasonal affects to groundwater are partly ameliorated when analyzing spring water level data.

Past groundwater contour maps indicate that one of the largest groundwater depressions in the area is south of Highway 145 northeast of the Santa Fe railroad. This depression coincides with a large area with limited surface water. This groundwater depression is not evident on **Figure 2.6** due to a lack of recent data in this area. In the area east of Fairmead another groundwater depression is evident which also coincides with an area with limited groundwater supplies (MID annexed lands and Chowchilla Correctional Facilities). This groundwater depression is evident on **Figure 2.6**. Historically several additional groundwater depressions were present in the un-districted areas west of MID and CWD. These depressions are not evident on **Figure 2.6** due to lack of recent data for this area, but are evident on historic DWR groundwater elevation contour maps (not included).

Subsidence Area Groundwater-level Monitoring

KDSA contoured equal groundwater elevations for the upper and lower aquifers underlying the west side of the County for January-February of 2013. This work was performed as part of an expanded monitoring program in areas experiencing subsidence. This program does not measure water levels in the fall. As shown in **Figure 2.7**, the direction of groundwater flow in the upper aquifer in this part of the County is towards the northeast, away from the San Joaquin River. Groundwater in the lower aquifer was moving from the south, southwest and southeast toward a pumping depression in the area of Highway 152 and the Merced/Madera County line, as shown in **Figure 2.8**. Groundwater elevation contour maps for the lower aquifer exist only for the western portion of the Madera area, due to lack of measurements in deep wells on the eastern side. Of note on the groundwater elevation maps, **Figures 2.7 and 2.8** is similar groundwater elevations in both the upper and lower aquifers in the area north of the confluence of Ash Slough and the Eastside Bypass. South of this area, near the T10S R14E and T11S R14E line, water elevations in the upper aquifer are much as 50 feet higher than in the lower aquifer. This, coupled with the steep northeasterly groundwater gradient in the upper aquifer, indicates that water elevations in the upper

aquifer have declined in the area north of the Ash Slough and the Eastside Bypass confluence. Based on this information, upper aquifer groundwater elevations in this area have been reduced significantly over historic conditions.

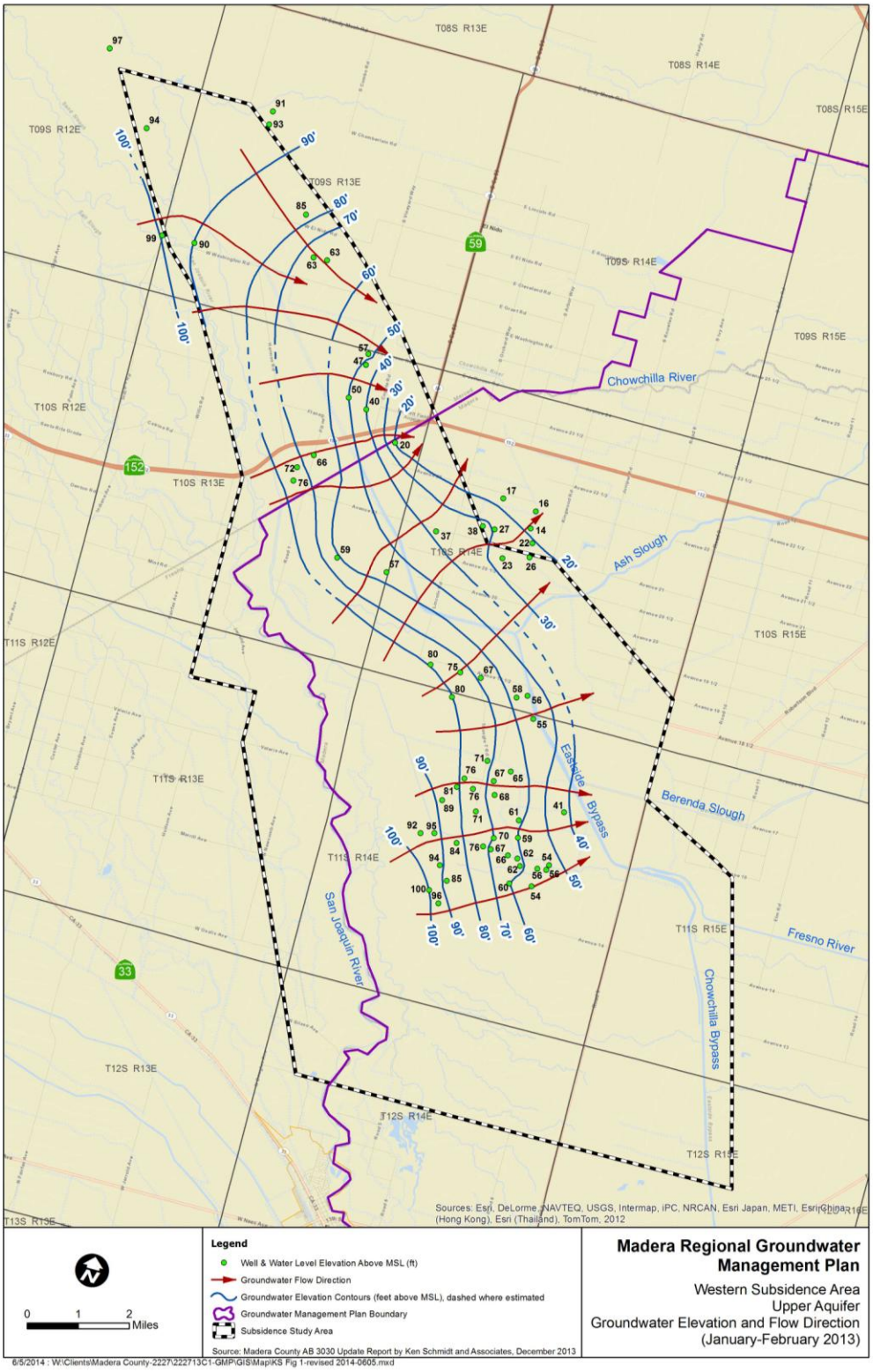

Figure 2.7 – Western Subsidence Area – Upper Aquifer – Groundwater Elevation and Flow Direction (Jan-Feb 2013)

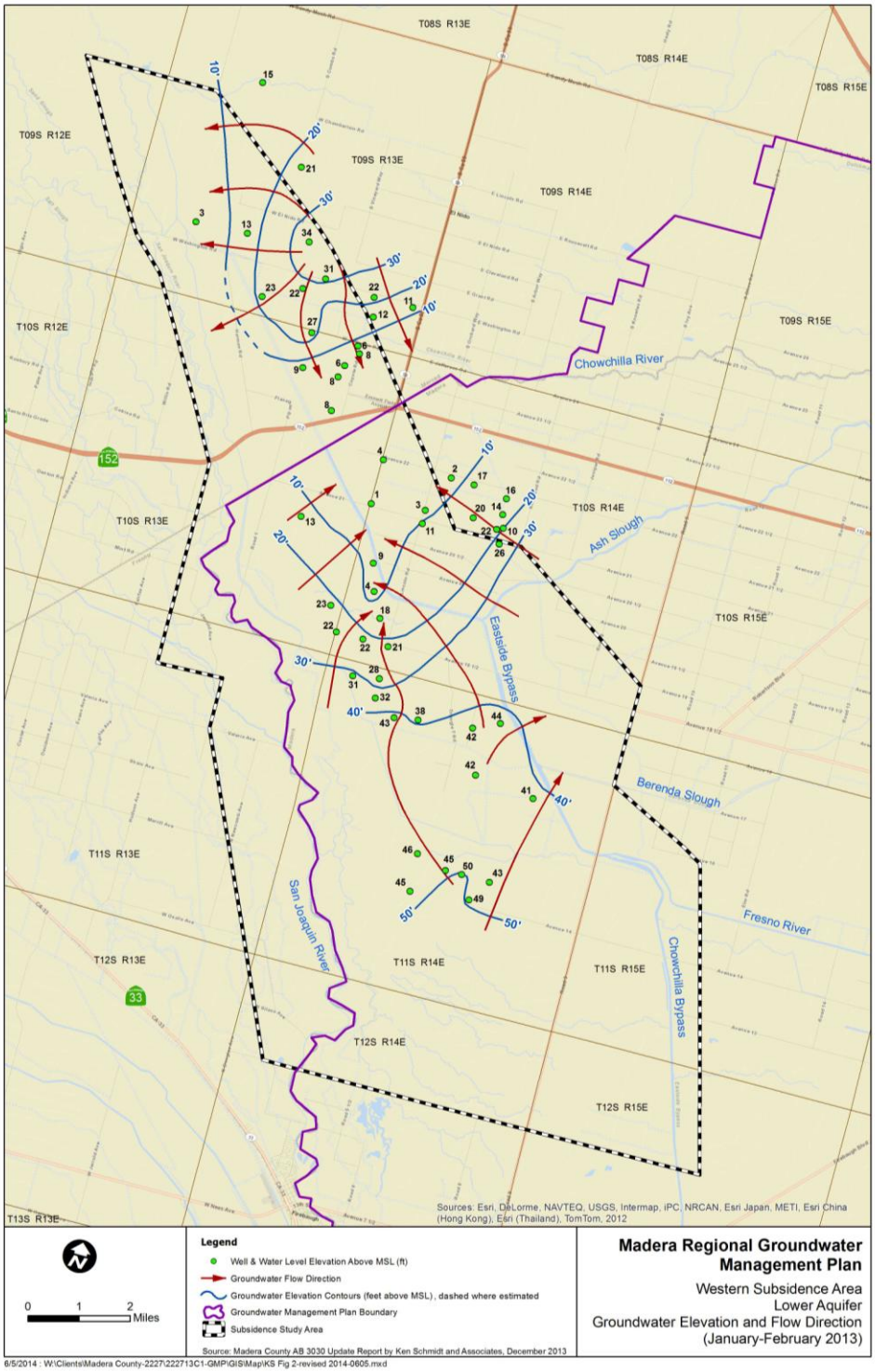

Figure 2.8 – Western Madera Subsidence Area – Lower Aquifer - Groundwater Elevation Contour and Flow Direction (Jan-Feb 2013)

2.5. Groundwater Overdraft and Available Groundwater Supplies

Overview

This section discusses current groundwater level trends, historical and projected future overdraft, and estimates of available groundwater. Groundwater overdraft was estimated for the entire GMP area. Available groundwater, defined as the amount of groundwater that can be withdrawn without causing overdraft, was also estimated for the GMP area. The estimates are preliminary and should be refined with more detailed agency-specific water balance studies including monitoring of groundwater flow between agency service areas.

Groundwater overdraft can be estimated based on an evaluation of long-term groundwater levels. Calculation of the available groundwater supply is more complex. In addition to changes in groundwater levels, this calculation must also consider water demands, surface water supplies, natural and artificial recharge, and groundwater flows in and out of the area being considered. The calculation therefore includes some inherent uncertainty. Available groundwater may change over time as natural recharge, groundwater inflows/outflows and practices in neighboring areas change. Overdraft is recommended as a more reliable parameter because it is derived from water level changes that reflect groundwater inflows, outflows and unknown stressors to the resource, and should be the quantitative measurement for making ongoing groundwater management and planning decisions.

Readers are cautioned that it was beyond the scope of this GMP to perform a detailed water budget for each participant. While data exists to make water budget calculations at the sub-regional level, making them at the agency footprint level would require groundwater flow data that are not available without constructing an extensive network of monitor wells throughout the region. Interpolating the sub-regional calculations to the agency footprint level without that supplementary data would be an approximation beyond the prudent use of the available information.

Average Annual Groundwater Level Decline

Over the past 30 years, groundwater levels in the GMP area have experienced significant declines due to overdraft. **Figure 2.9** shows the average annual rate of groundwater level decline in feet from 1980 to 2011 in the GMP area. These declines were determined by using trend lines for the decline of the shallowest levels each year and another set of lines for the deepest levels each year. The average of these two lines for each hydrograph was used to represent the average water-level declines.

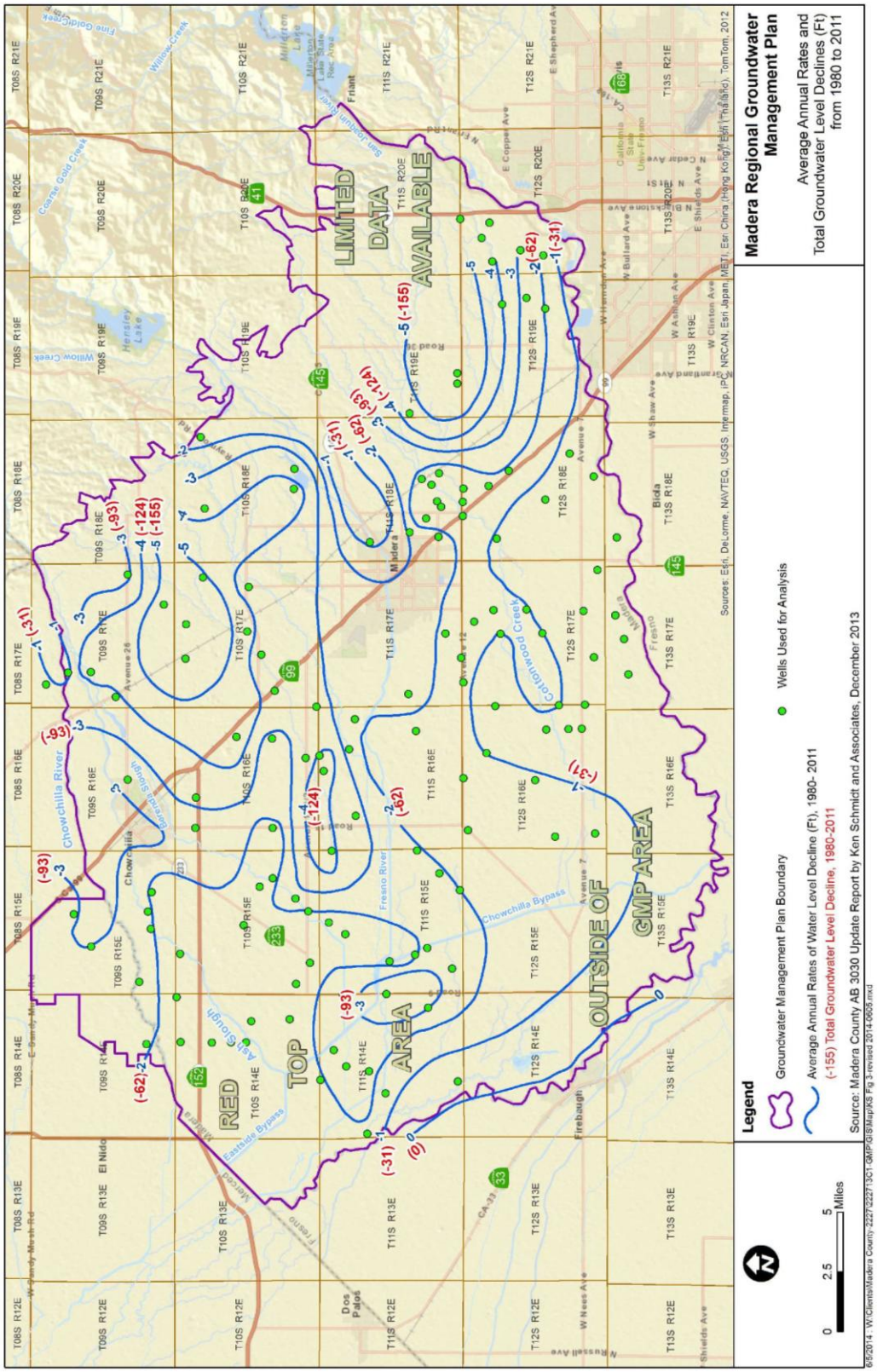

Figure 2.9 – Average Annual Rates and Total Groundwater Level Declines (ft) from 1980 to 2011

Long-term hydrographs with reliable trends were not available in certain areas, and the map represents the best available data in the GMP area. These data were used to establish historical overdraft and available groundwater through 2011. More recent data (up to 2013) were available for only a subset of the important hydrographs that show reliable long-term trends, so a comprehensive map through 2013 cannot be made. However, the estimates were projected to 2013 based on current conditions, which are discussed in the following section.

In general, average annual declines are greater on the eastern side of the GMP area, at up to five (5) feet or even more in the southeast and northeast. Increased agricultural demands, particularly the conversion of native grasslands to permanent crops, has increased the rate of decline in the eastern portion of the GMP area.

There have been virtually no water-level declines during the past three decades near the San Joaquin River downstream of Mendota Pool. There is insufficient long-term data to make the same conclusion upstream of Mendota Pool along the San Joaquin River. Rates of water-level decline generally increase with distance from the Chowchilla River, Fresno River and San Joaquin River, confirming the importance of recharge from river seepage. For example, near the Fresno River east of the City of Madera, the average water-level decline has been less than one foot per year.

It is clear that increased and intensified agricultural development has made a major impact on groundwater levels. Since 2003, about 80,000 acres of new orchards have been developed. A substantial percentage of these new plantings occurred along the western edge of the Valley floor. Some orchards replaced existing annual crops, but many were planted on previously fallow land. While the trees have a lower irrigation demand than annual crops when they are immature, water use from those orchards will continue to increase over the next few years as the trees grow to maturity. That means that even absent additional plantings in coming years, agricultural water demands in those areas of new plantings will increase from the present rate and are estimated to peak around the year 2017.

The contours in **Figure 2.9** are intended to pertain primarily to the unconfined aquifer, or the upper aquifer. However, many of the wells are composite, and tap the unconfined and confined aquifer. Information on which wells tap which aquifer is not readily available without an extensive investigation. Experience indicates that water levels in composite wells are usually closer to water levels in the lower aquifer than those in the upper aquifer (Kenneth D. Schmidt Associates, **Appendix F**). As a result, the estimated changes in groundwater levels, and the overdraft values presented below, may be overestimated.

Previous Overdraft Estimates

In the 2008 Madera County IRWMP (Boyle, 2008), groundwater overdraft was estimated in six specific areas in the Valley portion of Madera County. The six subareas are shown in **Figure 2.10**. These subareas were identified in the 2008

IRWMP for Madera County (Boyle, 2008) and generally cover the valley portion of Madera County. The exact basis for the boundaries was not documented, but they do represent areas with different hydrologic conditions and separate political governance. Some small areas in the eastern portion of the GMP area were not included when the subareas were delineated in 2008 because they generally have little to no groundwater supply from wells completed in valley alluvium; the majority of wells are completed in hardrock and have very little water supply. It should also be noted that some of the lands in the Northeast and Westerly Undistricted areas are within water districts, portions of irrigation districts or water companies (**Figure 2.10**). The subareas also do not include the Merced County portion of Chowchilla Water District, which was evaluated in this GMP. As part of the 2008 IRWMP, overdraft was estimated for the subareas for 2006. The 2006 overdraft is shown in **Figure 2.10** and summarized in **Table 2.1.**

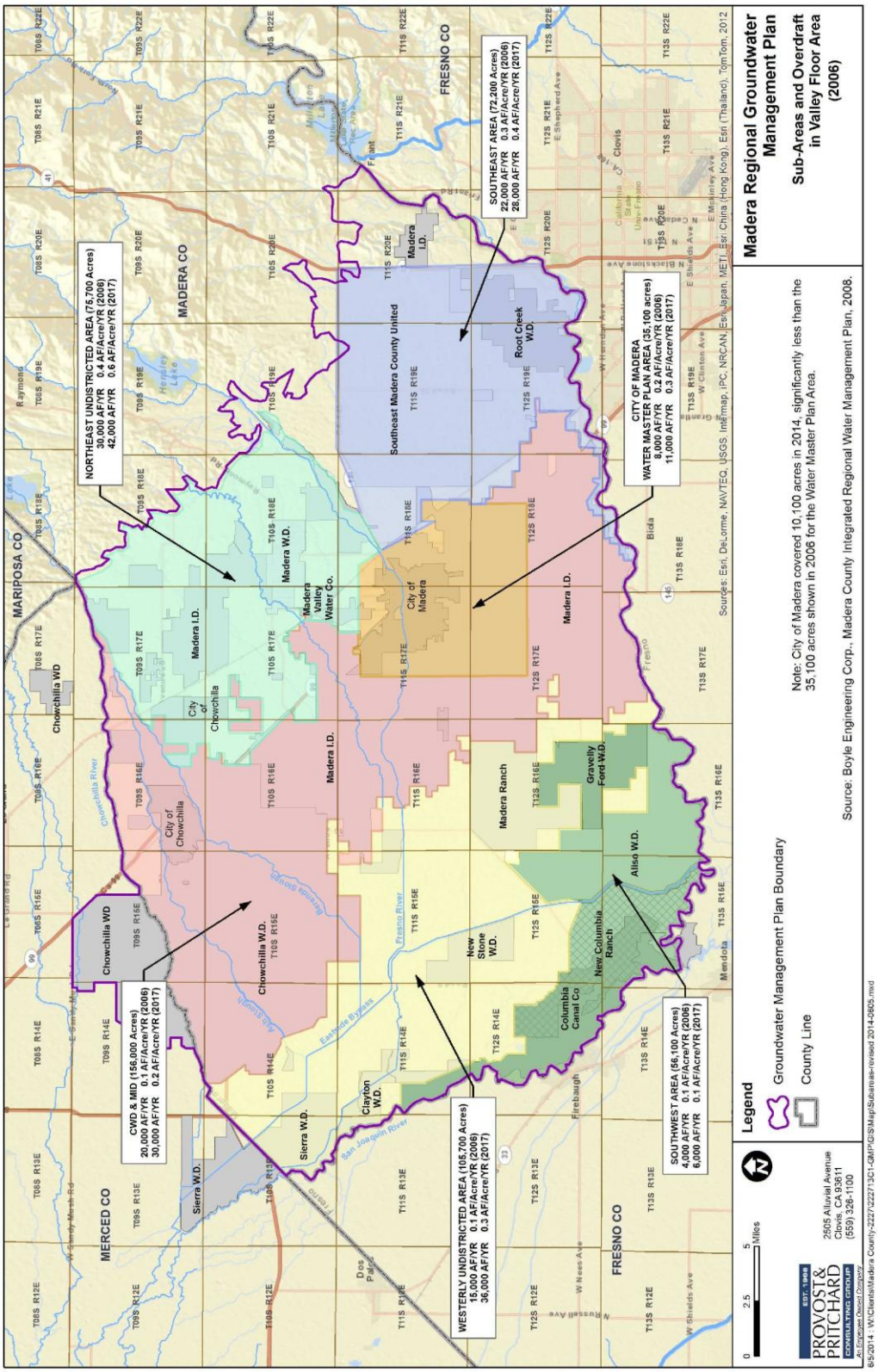

Figure 2.10 – Sub-Areas and Overdraft in Valley Floor Area (2006)

Table 2.1 – Groundwater Overdraft in Subareas (2006)

Subarea	Acreage	2006 Overdraft (AF/year)[1]
Chowchilla Water District and Madera Irrigation District	156,000	20,000
Westerly Undistricted Area	105,700	15,000
Southwest Area	56,100	4,000
City of Madera Water Master Plan Area[2]	35,100	8,000
Southeast Area	72,200	22,000
Northeast Undistricted Area	75,700	30,000
Total	**508,000**	**99,000**

1 – Value from 2008 Madera Integrated Regional Water Management Plan
2 – This area is considerably larger than the current City limits which cover 10,100 acres, and even includes lands outside of the City's sphere of influence and planning area. It is reported here as it was shown in the 2008 IRWMP.

Other previous overdraft estimates included 74,000 AF/year from 1970-1991 (Swanson, 1998) and 68,000 AF/year from 1990-1998 (Todd Engineers, 2002).

Below are discussions on an overdraft estimate for the entire GMP area. The footprints evaluated for the subareas in **Table 2.1**, and for the total area evaluated in this GMP, differ. The subareas generally includes the valley portion of Madera County, minus some areas in the east that are not considered to have groundwater supplies. The area evaluated in this GMP encompasses all of the GMP Participants, including the Merced County portion of CWD. The area evaluated in this GMP excludes the areas covered by Root Creek Water District, Madera Water District, Aliso Water District and Columbia Canal Company.

<u>Historical Overdraft</u>
Historical overdraft was estimated using groundwater hydrographs that had continuous or near continuous data from 1980-2011. Overdraft was based on the following formula:

Estimated Overdraft = Avg. Annual Water Level Decline x Avg. Specific Yield x Acreage

= 2.4 feet/year (from **Figure 2.9**) x 0.13 x 458,900 acres = 143,000 AF/year

The specific yield value is an average determined from previous reports by Kenneth D. Schmidt and Associates, values used in previous MID studies, values used in the San Joaquin River Restoration litigation, and experience with test holes, wells and groundwater evaluations in Madera County.

The area with a groundwater supply (451,900 acres) is slightly less than the total area of the GMP (496,900 acres). A portion of the eastern end of Madera County lands is considered to have no alluvial groundwater supply despite being within a DWR-defined groundwater basin. This area is estimated at 45,000 acres. This area has shallow soils, high bedrock, no groundwater elevation data, and lack of irrigated agriculture. The area only supports small domestic and livestock wells with limited capacity. In the 2008 IRWMP, a similar area of limited groundwater supply was recognized and considered in overdraft calculations.

Projected Overdraft and Available Groundwater Supplies by Agency

Future groundwater overdraft and Available Groundwater were estimated for the GMP area. 'Available Groundwater' is defined as the amount of groundwater that can be pumped without causing groundwater overdraft. As discussed above, historical overdraft was determined for the period of 1980-2011 based on long-term groundwater level declines. Future overdraft was estimated based on these values and consideration of the following:

1. Recent changes in cropping patterns and acreages
2. Maturation of all existing orchards by 2017
3. Surface water reductions from the San Joaquin River Restoration
4. Additional seepage due to San Joaquin River Restoration flows
5. The difference in hydrology between the historical period 1980-2011 (considered about 10% wetter than normal) and an average hydrologic period.

Available groundwater was determined based on a preliminary water budget analysis, and how much groundwater can be pumped without causing overdraft. Available groundwater cannot be precisely determined for a variety of reasons, including uncertainty in data, and limited groundwater level records, but estimates are provided.

Table 2.2 shows the estimated overdraft, available groundwater and several other parameters for the overall GMP area.

Table 2.2 – Summary of Regional Hydrologic Parameters

Description	Units	Value
Total Area	acres	496,900
Area with Groundwater Supply	acres	451,900
Irrigable Area	acres	315,100
Surface Water	AF/year	314,300
Water Demands (urban and ag.)	AF/year	970,000
Future Overdraft	AF/year	259,000
Available Groundwater	AF/year	438,400

Note: This table lists some of the primary hydrologic parameters in the region. It does not provide all the components of a water budget.

The future overdraft predictions assume no significant increase in agricultural or urban water demands, and no further reductions in surface water supplies beyond those predicted for the San Joaquin River Restoration Project (see Section 7.1). Further studies are needed to validate these assumptions or estimate future changes in supplies and demands. The analysis also does not consider potential impacts on water supplies from climate change, which should also be addressed in separate studies.

Recharged groundwater does not recognize political boundaries and agencies that import surface water often see their groundwater flow to other areas. Thus groundwater supplies can change over time as neighboring areas change their practices, so the available groundwater and overdraft needs to be periodically re-evaluated.

Overdraft and available groundwater can both be used to manage groundwater, but overdraft is recommended for several reasons. For example, groundwater management in Arizona has been focused on progressively reducing groundwater overdraft for more than three decades, without specifically evaluating the available groundwater. Groundwater overdraft is much simpler to determine, as it can be calculated by examining water-level trends and specific yields. To the contrary, 'available groundwater' by its nature depends on items such as river seepage, groundwater flows, well pumping, and deep percolation of applied waters that cannot be directly measured with any precision from agency to agency, and can only be estimated. Data is even lacking for accurate estimates for some of these variables. Presently, there are not adequate water-level maps or values for aquifer transmissivity at the right locations (i.e. at the boundaries between entities) to do this. Because groundwater overdraft estimates already take these other items into consideration (i.e. as reflected by water-level trends), overdraft estimates are highly useful in groundwater management.

There are many inadequacies in the data needed to perform a water budget, which emphasizes the need for improved monitoring to provide better overdraft and available groundwater estimates. This evaluation should be viewed as the first in a series of water resources evaluations needed to manage the region's groundwater.

2.6. Geologic Potential for Groundwater Recharge

Groundwater recharge is the process by which groundwater is replenished. The geologic formations that comprise the aquifer system underlying the GMP area extend well beyond the local agencies' jurisdictional boundaries. Several processes are responsible for natural recharge of the groundwater basin. On a regional scale, surface water flowing over the surface expression of the geologic formations (surface outcrops) allows for direct infiltration into the hydrogeologic system. Locally, groundwater recharge occurs where surface water flows over permeable sediment (gravels and sand) in the river channels, allowing for direct infiltration of surface water (see **Figure 2.11**). Deep percolation of applied irrigation water also recharges the groundwater basin in areas where impermeable formations do not exist.

The amount of groundwater that can be recharged is dependent on the available storage space within the aquifer(s). Depending on the separation of the bottom of the river or stream and that of the groundwater, streams can either "lose" water into the underlying aquifer(s) or "gain" water. Where groundwater levels are at or above the elevation of the surface water, groundwater will flow into the stream (gaining stream). Where there is separation between the groundwater and surface water, water flowing downstream will recharge into the groundwater basin (losing stream). Conversely, if groundwater levels are at the land surface, there will be refusal of any "new" water in the subsurface. Throughout the GMP area, there is significant available storage due to low groundwater levels.

DWR groundwater contour maps, as shown in **Figure 2.6,** above, indicate that the groundwater basins underlying the GMP area received recharge through under seepage from the San Joaquin and Fresno Rivers. As shown in **Figure 2.6**, above, water recharge occurs beneath the San Joaquin River. Local agricultural interests are increasingly implementing localized groundwater recharge programs using both percolation basins and in-lieu recharge. Due to the hardpan and low infiltration rates in the eastern portion of the County within the GMP area, the majority of surface runoff during storm events flows overland and most water does not percolate into the subsurface. Section 2.2 – Geomorphology and Soils, provides some discussion on the surficial soils and potential for recharge.

Those areas conducive to recharge, i.e. underlain by soils with moderate to high infiltration rates, are mainly found west to southwest of the Cities of Madera and Chowchilla. Other areas with soils of high infiltration rates are intermittently found as stream or river deposits radiating from the San Joaquin River and to a lesser extent the Chowchilla River. Along the major rivers and streams areas with the potential for recharge exists as relatively narrow outcrops of soils with moderate infiltration rates that extend easterly to the edge of the groundwater basin. From a regional groundwater recharge perspective these area are very important areas to focus recharge programs. These areas are primarily up gradient from the majority of the valley floor area, thus water recharge in the eastern portions of the major stream and rivers will eventually flow

down gradient and recharge the area's aquifer to the west. Seepage from streams is the primary source of groundwater recharge for the Madera area, but as climatic conditions change, available recharge opportunities are reduced. Several possibilities exist to promote groundwater recharge.

- Percolation basins, or storm water retention basins, in conjunction with dry wells, can enable storm water to infiltrate into the subsurface. Dry wells are shallow wells, completed up to 100 feet or more below the land surface, which are constructed in the unsaturated zone and can provide for direct recharge into the underlying hydrogeologic system. Where the impermeable hardpan is located, as along the eastern portion of the GMP area, the base of any retention basins needs to be below the elevation of the hard pan. The location of percolation basins should be considered near dry riverbeds, where the soils and geology will allow higher rates of infiltration.
- Direct aquifer storage by constructing wells to inject water into specific aquifers
- Uncontrolled flood releases and year-round flows in the San Joaquin, Chowchilla and Fresno Rivers would enhance recharge of the underlying groundwater basin.

Currently, limited site-specific information on recharge potential is available, or the information has not been gathered and summarized. Some limited recharge studies have been performed, including some for the proposed Madera Water Bank, but overall much of the GMP area has not been studied in detail for recharge potential. Additional investigations are needed to develop large scale recharge projects. These studies would have merit for each GMP Participant. The studies could investigate soils, geology, proximity to conveyance facilities, and include soil testing, exploratory drilling and cone penetration testing. This information would assist in identifying and prioritizing the best locations for recharge. These studies are recommended to identify the most efficient sites and address the critical rate of overdraft in the GMP area.

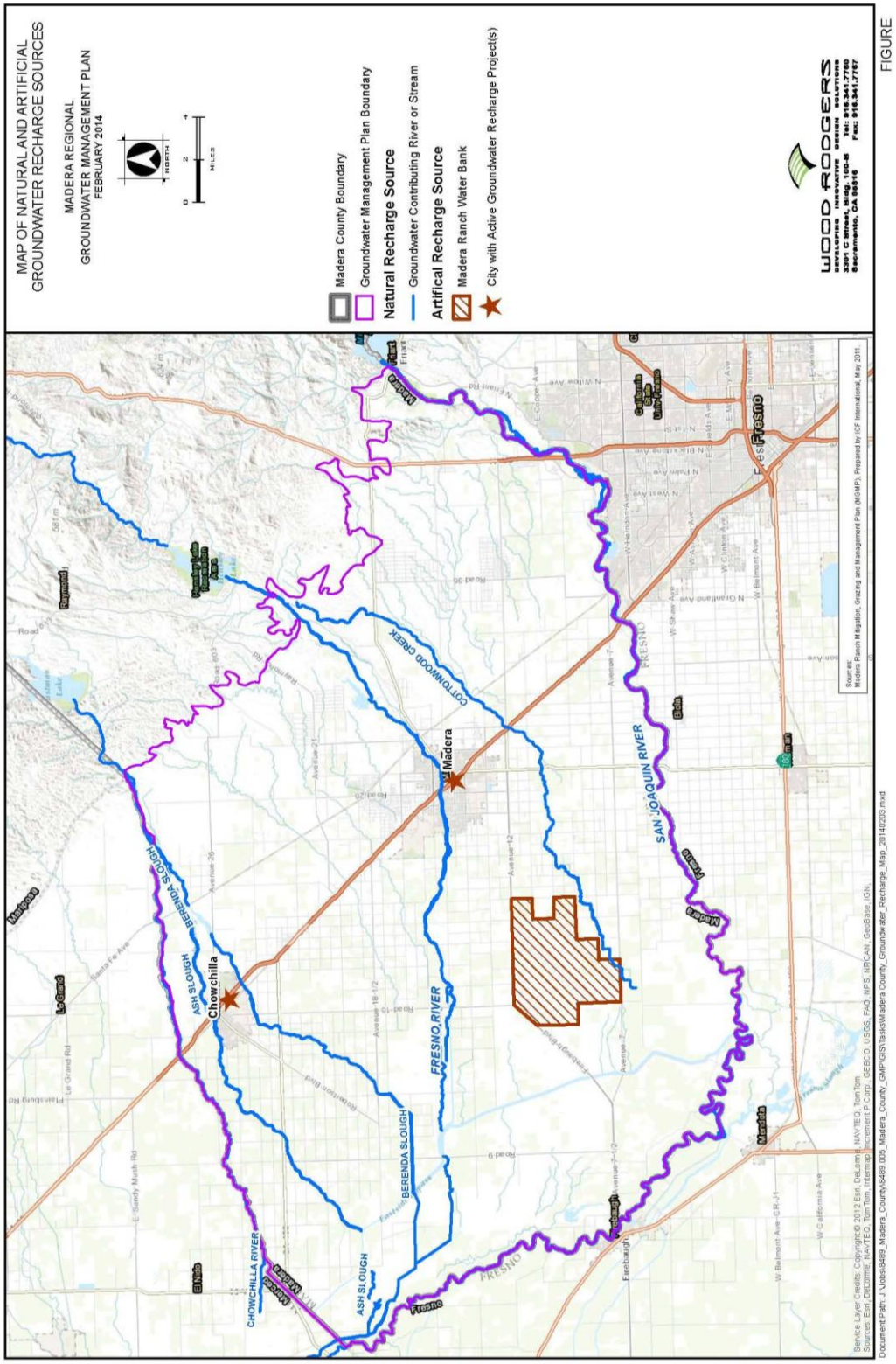

Figure 2.11 – Natural and Artificial Groundwater Recharge Sources

2.7. Groundwater Quality

Groundwater quality within the GMP area is generally good for both domestic supply and agricultural use. However, variations in groundwater quality can make it unacceptable without treatment. Groundwater contamination can be a result of naturally occurring, point source contamination, and/or regional contamination. Some common elements of concern include dissolved salts (as measured by the specific conductance or electrical conductance [EC]), boron, manganese, arsenic, iron, hexavalent chromium, bacteria, uranium, and methane. In many cases, these are naturally occurring, but could also be related to regional or point sources of contamination. Typical sources of anthropogenic contamination originate from gas stations, dry cleaners, high-density animal enclosures, applied fertilizers, leaky sewer lines, wastewater treatment plants, and septic systems.

Water quality data collected by the California Department of Water Resources (DWR), California Department of Public Health (CDPH) database (up to 2013), and local City and County water agencies for wells located within the County were analyzed to characterize spatial and depth-dependent water quality trends within the GMP sub-areas used in the 2008 IRWMP (see **Figure 2.10**). The sub-area boundaries are based on a combination of political and hydrologic boundaries, and are considered appropriate for reporting water quality data.

In 2001, the State of California passed the Groundwater Quality Monitoring Act of 2001 to assess and monitor the quality of groundwater in California (State of California, 2001b, Sections 10780– 10782.3 of the California Water Code, Assembly Bill 599). AB 599 required that the California State Water Resources Control Board (SWRCB) work in coordination with various State of California public agencies and a Public Advisory Committee to integrate existing monitoring programs and design and establish a comprehensive statewide groundwater quality monitoring program (USGS, 2013). In order to assess groundwater quality and establish baseline groundwater quality conditions in aquifers within the State, the SWRCB, in collaboration with the U.S. Geological Survey (USGS) and Lawrence Livermore National Laboratory (LLNL), implemented the Groundwater Ambient Monitoring and Assessment (GAMA) Program (California State Water Resources Control Board, 2010, website at http://www.swrcb.ca.gov/gama/). Currently, the GAMA program consists of four projects:

1. GAMA Priority Basin Project, conducted by the USGS (website at http://ca.water.usgs.gov/gama/)
2. GAMA Domestic Well Project, conducted by the SWRCB
3. GAMA Special Studies, conducted by LLNL
4. GeoTracker GAMA online database, conducted by the SWRCB (USGS, 2013).

Groundwater quality in the Madera, Chowchilla, and Delta-Mendota Subbasins were investigated as part of the GAMA Priority Basin Project Program. The primary objective of the Priority Basin Project within the Madera-Chowchilla and the Western San Joaquin Valley (WSJV) study units, which included the Delta-Mendota and Westside subbasin, was to provide an assessment of water quality in the primary aquifer system. The assessments conducted in the Madera-Chowchilla and WSJV study relied on water-quality and ancillary data collected by the USGS from 35 wells during April–May 2008 for the Madera-Chowchilla study unit, 58 wells during March to July 2010 for the WSJV study unit, and water-quality data reported in the California Department of Public Health (CDPH) database (USGS, 2013). Analysis of the water quality data from these wells was used to characterize both spatial and depth dependent water quality trends within the GMP sub-areas.

Below is a general description of the water quality parameters selected for the characterization of the groundwater basins underlying the GMP area. The data was separated by total well depth into three categories: less than 400 feet deep, 400 to 600 feet deep and greater than 600 feet deep, as delineated on the water quality maps in **Appendix D**. The selected depth intervals are based on the variations observed in the stratigraphic units within the GMP area.

The selected constituents include arsenic, boron, specific conductance, manganese, and nitrate (as NO_3). The spatial and vertical trends in each GMP sub-area are discussed with regard to suitability for agriculture and domestic use.

Arsenic

Arsenic is a naturally occurring element commonly found in groundwater. Its presence in groundwater is a result of the dissolution of the element in sediments containing minerals containing arsenic. Exposure to arsenic above the CDPH maximum contaminant level (MCL) can cause both short and long-term health effects. Long-term exposure to arsenic has been linked to cancer, while short-term exposure to high doses of arsenic can cause other adverse health effects. The CDPH has established a primary MCL of 10 micrograms per liter (µg/L) for arsenic, which was reduced from 50 µg/L in 2008.

Boron

Boron is a necessary element for agriculture, but may become toxic to very sensitive crops above 500 µg/L. For public drinking water systems, the CDPH has established a notification level of 1,000 µg/L for boron.

Specific Conductance

Specific conductance is a property of groundwater that is relatively simple to measure and collect in the field at the wellhead and can help identify and characterize the condition of the freshwater bearing aquifer system. Specific conductance is a measure of how effectively water will conduct electricity in units of both micromhos per centimeter (µmhos/cm) and microsiemens (µS/cm) per centimeter (which are analogous), and

provides for the indirect measurement of the amount of dissolved salts in groundwater. Lower specific conductance values indicate less salt, while higher specific conductance values indicate more salt.

Applied irrigation water with fertilizers as well as water softeners can add salts to the hydrogeologic system, which can increase the specific conductance of the groundwater.

Elevated specific conductance values can also be attributed to naturally occurring brackish or saline water, such as geologic formations which are, or have been in the past, directly connected to a salt water body or where geologic formations were deposited under marine (salt water) conditions which have inherently high dissolved salt concentrations. **Figure 2.12** shows the elevation of the base of fresh water, which is discussed in more detail in Section 6.3 – Saline Water Intrusion. The data comes from Page (1973) and is the most recent published study to evaluate the base of fresh water in Madera County. Data is only available in some of the GMP area.

Manganese

Manganese is a naturally occurring element found in rocks and minerals. Its presence in groundwater is a result of the dissolution of the naturally occurring element. In lower concentrations (below the secondary CDPH MCL of 50 µg/L), manganese may cause aesthetic problems (odor or staining) for domestic and municipal uses, but generally would not pose a health risk.

Nitrate (as NO_3)

Nitrate (as NO_3) is a contaminant which does not naturally occur in the subsurface. Elevated concentrations of nitrate are widespread in the San Joaquin Valley. The CDPH has established a primary MCL of 45 milligrams per liter (mg/L) for nitrate as NO_3. Where elevated concentrations of nitrates are present, it is likely a result of overlying land uses, such as applied fertilizer, septic systems, leaky sewer systems (including transmission lines, storage, and wastewater treatment plants), and high-density animal enclosures, such as dairies.

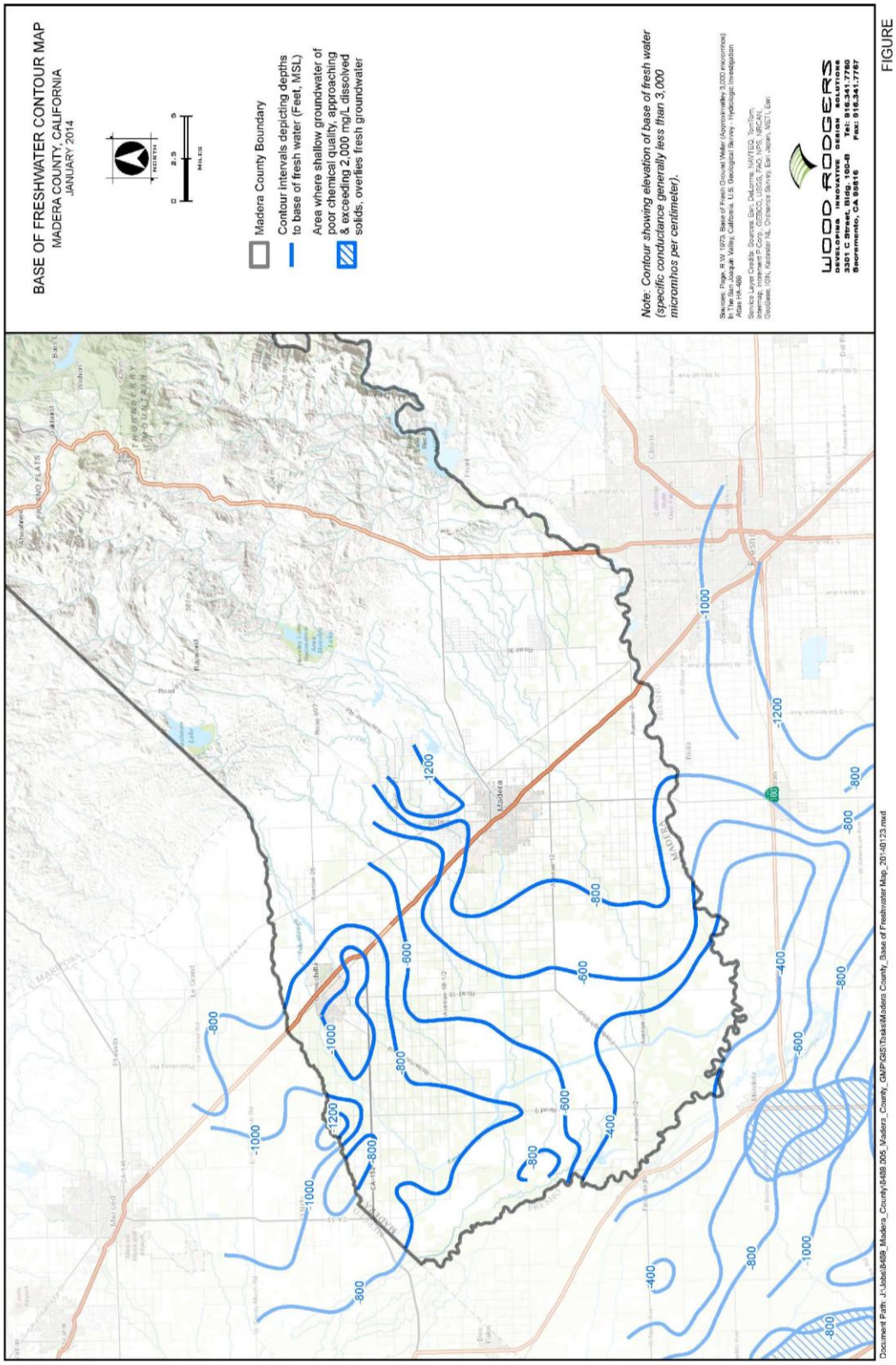

Figure 2.12 – Base of Freshwater Contour Map

Chowchilla Water District and Madera Irrigation District Sub-Area

The Chowchilla Water District (CWD) and Madera Irrigation District (MID) sub-area consists of the central portion of the GMP area (**Figure 2.10**). As illustrated in **Appendix D**, available water quality data indicate that:

- **Arsenic –** concentrations do not exceed the MCL of 10 µg/L.
- **Boron –** concentrations are generally acceptable, with the exception for one data point southwest of Road 16 and Avenue 18½, where boron concentrations ranged from 1,000 to 2,000 µg/L (well construction information for this well is unknown).
- **Specific Conductance –** in a few areas located to the west and southwest of Chowchilla, elevated values for specific conductance near to and/or exceeding the recommended MCL[1] for domestic use are observed in the shallow and intermediate aquifers. A closer examination into the potential source for the elevated specific conductance concentrations revealed that high-density animal enclosures and/or fertilizer plants were in close proximity. Elevated concentrations of specific conductance could be problematic for agricultural and domestic use.
- **Manganese –** concentrations are generally acceptable in this sub-area, with the exception of the area south of the City of Madera in the aquifers less than 400 feet. Concentrations were reported in the remainder of the area between the secondary MCL of 50 µg/L and 150 µg/L.
- **Nitrate (as NO_3) –** wells located west and south of the City of Chowchilla have reported nitrate concentrations that exceed the MCL of 45 mg/L in the shallow aquifer. The occurrence of elevated concentrations observed within these shallow wells can be directly correlated to their close proximity to high-density animal enclosures and fertilizer plants.

Northeast Undistricted Sub-Area

The Northeast Undistricted sub-area generally includes the portions of the GMP area east of Highway 99 and north of the City of Madera (**Figure 2.10**). As illustrated in **Appendix D**, available water quality data indicates that:

- **Arsenic –** concentrations are elevated and exceed the MCL of 10 µg/L in several wells, completed in both the shallow and deep aquifers.
- **Boron –** concentrations are generally acceptable in this sub-area, with values primarily below 500 µg/L.
- **Specific conductance –** concentrations are generally acceptable in this sub-area, with average values ranging between 600 and 900 µmhos/cm.
- **Manganese –** concentrations are generally below the secondary MCL of 50 µg/L

[1] Recommended CDPH MCL for Specific Conductance is 900 µS/cm; upper limit is 1,600 µS/cm; short term is 2,200 µS/cm

throughout the sub-area, with the exception of one well exceeding the secondary MCL (well construction information was unavailable for this data point)
- **Nitrate (as NO_3) –** concentrations are acceptable in this sub-area, with reported concentrations below the MCL of 45 mg/L.

Southeast Undistricted Sub-Area

The Southeast Undistricted sub-area generally includes the portions of the GMP area east of Santa Fe Avenue and south of the Fresno River (**Figure 2.10**). As illustrated in **Appendix D**, available water quality data indicate that:

- **Arsenic –** concentrations are generally acceptable with regard to the MCL of 10 µg/L in the shallower aquifers. Elevated concentrations over 10 µg/L appear to be concentrated in the aquifers below 600 feet.
- **Boron –** concentrations are acceptable for the sub-area, with values ranging from less than 500 to 1,000 µg/L.
- **Specific conductance –** concentrations are acceptable (less than 900 µmhos/cm) with the exception of one data point northwest of the Madera Ranchos (unknown well depth).
- **Manganese –** concentrations appear to be acceptable in the underlying aquifers. One data point in the shallow aquifer indicates elevated manganese concentrations, but is most likely a result of a turbid sample (which results in anomalously high results).
- **Nitrate (as NO_3) –** Elevated concentrations near to or above the MCL of 45 mg/L is of concern for this sub-area and have been documented in the shallow aquifers. This is of concern primarily for domestic wells, which are usually constructed in the shallow aquifers. The primary reason for the elevated concentrations of nitrates in this sub-area is likely the high density of septic systems in the Madera Ranchos.

City of Madera Water Master Plan Sub-Area

The City of Madera Water Master Plan sub-area includes the City of Madera and significant amounts of primarily agricultural lands that surround the City mainly to the south (**Figure 2.10**). This was the area identified in the 2008 IRWMP. According to the City of Madera, it extends beyond their current sphere of influence and planning area. As illustrated in **Appendix D**, available water quality data indicate that:

- **Arsenic –** concentrations are acceptable and below the MCL of 10 µg/L in the sub-area.
- **Boron –** concentrations are below 500 µg/L in the entire sub-area.
- **Specific conductance** – concentrations are generally acceptable within the sub-area, with the exception of several wells in the western portion with elevated concentrations over 1,600 µmhos/cm. These wells do not have construction

information associated with them, but the wells are located to the southwest of the City and are located in an industrial area. Elevated specific conductance concentrations could be problematic for agricultural and domestic use.

- **Manganese** – concentrations appear to be acceptable and below the secondary MCL of 50 µg/L in the sub-area.
- **Nitrate (as NO_3)** – concentrations appears to be under the MCL of 45 mg/L, with the exception of the area southwest of the City where land use potentially affects the shallow aquifer water quality. A closer examination into the potential source for the elevated nitrate concentrations revealed that at these locations, high-density animal enclosures and/or fertilizer plants were in close proximity. Elevated nitrate concentrations can be harmful for domestic use.

Southwest Area Sub-Area

The Southwest Area sub-area encompasses the southwest portion of the GMP area (**Figure 2.10**). As illustrated in **Appendix D**, available water quality data indicate that:

- **Arsenic** – water quality data is inconclusive for the underlying aquifers. West of the sub-area in Firebaugh, the data indicate elevated concentrations of arsenic above the MCL of 10 µg/L, but the depth is unknown for the sampled well.
- **Boron** – appears to be acceptable, with concentrations less than 500 µg/L throughout the sub-area; however, well depths are not known.
- **Specific conductance** – is elevated in the northeastern portion of the sub-area in the shallow aquifer and appears to increase towards the west.
- **Manganese** – water quality data is inconclusive for the underlying aquifers.
- **Nitrate (as NO_3) –** concentrations appear to be at or near the MCL of 45 mg/L in the eastern portion of the sub-area, and decrease in concentration to the west.

Westerly Undistricted Area Sub-Area

The Westerly Undistricted Area sub-area encompasses the portions of the GMP area north of the Southwest Area sub-area and west of the CWD and MID sub-area (**Figure 2.10**). Water quality data is sparse, with the exception for specific conductance and nitrate (as NO_3). As illustrated in **Appendix D**, available water quality data indicate that:

- **Arsenic –** water quality data is inconclusive for the underlying aquifers; however, from the available data points, arsenic appears to be acceptable.
- **Boron** – water quality data is inconclusive for the underlying aquifers; however, from the available data points, boron appears to be acceptable.
- **Specific conductance –** concentrations have been documented to be above 1,600 µmhos/cm in the central portion of the sub-area in the intermediate aquifer and generally increase in concentration towards the southwest portion of the sub-area.

- **Manganese –** water quality data is inconclusive for the underlying aquifers; however, the available data points suggest manganese is acceptable.
- **Nitrate (as NO_3) –** concentrations appear to be above the MCL of 45 mg/L near the central portion of the sub-area in the shallow aquifer. The northwestern portion of the sub-area has elevated concentrations of nitrate (as NO_3) between 30 and 45 mg/L, near to or at the MCL. For the rest of the sub-area, concentrations are below the MCL.

2.8. Land Subsidence

Land subsidence occurs when groundwater levels in confined aquifers decline due to excessive withdrawals of water. This results in compaction of fine-grained sediments (clays) above and within the aquifer system as water is removed from pores between the grains of the sediments. Over time, as more water is removed from the area, the ground level sinks. Land subsidence can lead to reduced conveyance capacity in canals, and damage to structures such as canals, levees, buildings and wells. Subsidence can also cause flooding by creating low spots or reducing gradients in natural channels.

This section discusses the causes of land subsidence and impacts from recent land subsidence. Land subsidence monitoring is discussed in Section 5.4, and land subsidence mitigation measures are discussed in Section 7.5.

Cause of Local Land Subsidence

Land subsidence in the GMP area is caused by pumping groundwater from the deeper confined aquifer that is separated from the shallower unconfined aquifer by the Corcoran Clay. The Corcoran Clay is the regional aquitard throughout the San Joaquin Valley, and is prevalent throughout the western half of the GMP area (see **Figure 2.14**). The area of greatest land subsidence in the GMP area coincides with the area underlain by the Corcoran Clay. The greatest land subsidence has also occurred in western Madera County, particularly in areas along the Eastside Bypass.

History of Land Subsidence in Area

Land subsidence in the GMP area is of historic and ongoing significance. Between 1926 and 1972, subsidence resulted in between -1 and -4 feet of ground surface elevation change (drop) within the western half of the GMP area. The area of greatest subsidence occurred roughly along the path of the East Side Bypass flood control structure of the San Joaquin River (Bull, 1975). The majority of the subsidence has occurred since 1940, when large turbine pumps came into widespread use for extracting water from the deeper confined aquifer which underlies the western half of the GMP area (KDSA, 2013). Surface water from the Delta Mendota Canal (early 1950s) and the California Aqueduct (early 1970s) resulted in decreased groundwater demand, stabilization of groundwater levels and a reduced rate of compaction. Drought conditions during 1976-1977 and 1987-1992 resulted in increased demand for groundwater supply and also an increase in subsidence rates. Drought and regulatory reductions in surface water

deliveries from 2007 through 2013 have forced unprecedented withdrawals of water from the lower aquifer to meet local water demand.

Loss of Storage due to Subsidence

The primary cause of land subsidence in the Sacramento and the San Joaquin Valleys has been the compaction of fine-grained sediments (predominantly clay) in the aquifer system following severe, long-term withdrawal of ground water in excess of recharge (USGS, 1995). Subsidence due to compaction of fine-grained sediments began in the San Joaquin Valley in the 1920's. As water levels declined severely during the 1960's, fine-grained sediments lost water from pore spaces and became compacted. When withdrawal rates decreased and water levels were allowed to recover, compaction rates slowed significantly (USGS 1995). Increased withdrawals during the 1976-77 drought caused additional subsidence, some of which was the result of compaction of coarse-grained sediments. When water levels recovered, the fine-grained sediments remained compacted; however, the land surface rebounded in 1978 because the compacted coarse-grained sediments regained some of their original volume when the former or near former pore pressure was attained (USGS, 1995). During the 1976-77 drought, compaction occurred only in the sand and gravel and was relatively insignificant and, to a degree, reversible (USGS, 1995).

Overall loss of storage space in the GMP area's aquifer can be directly correlated to the amount of subsidence seen at the land surface. However, as is indicated above, subsidence due to aquifer compaction is a result of compaction of the fine grained sediments of the aquifer. The fine grained portions of the aquifer are not typically considered water producing portions. As noted above, the coarser grained sediments, i.e., the sands and gravels, may compact but this compaction is elastic, and is largely reversed with increased water levels. This indicates that while overall the aquifer has compacted and lost storage space, the majority of the loss is in the fine grained layers which do not contribute appreciable water to wells nor are the clay layers usable for the storage of recharged water. The minimal amount of storage loss in the coarser grained sediments, the usable part of the aquifer, is for the most part recoverable and is not considered an appreciable loss of storage space in the usable parts of the aquifer.

Recent Land Subsidence Impacts

Groundwater pumping that results in renewed compaction and land subsidence in the Valley could cause serious operational, maintenance, and construction-design problems for the California Aqueduct, the San Luis & Delta-Mendota canals, and other water-delivery and flood-control canals in the San Joaquin Valley. Subsidence has reduced the flow capacity of several canals that deliver irrigation water to farmers and transport floodwater out of the valley. Several canals managed by the San Luis & Delta-Mendota Water Authority (SLDMWA) and the Central California Irrigation District (CCID) have had reduced freeboard and structural damages that have already required millions of dollars worth of repairs, and more repairs are expected in the future (Sneed, et al. 2013). These instances of land subsidence are not in the GMP area but are adjacent to the westerly portions of the area in the vicinity of the San Joaquin River, and indicate

that subsidence is occurring in broad area of the central part of the San Joaquin Valley. Within the GMP area, subsidence in the vicinity of the San Joaquin River and its flood control structures may cause flooding of Hwy. 152, and a local grade school, threaten valuable farmland and dairies, and jeopardize the San Joaquin River Restoration Program (Provost & Pritchard, 2013).

Recent work by the USGS, USBR, DWR and Kenneth D. Schmidt and Associates (KDSA) indicates that the greatest amount of subsidence in the GMP area is in the area of the East Side Bypass. This is also referred to as the Red-Top Area, which is located in the west-northwest portion of the GMP area near the axis of the valley where the majority of the historic land subsidence has been documented. The land surface elevation transect along Highway 152, **Figure 2.1** shows subsidence along this section since 1972. The maximum subsidence near the Eastside Bypass has amounted to approximately -7 feet. Most of the subsidence west of Highway 33 has occurred since 1988, while subsidence along the eastern portion of the transect occurred before 1988. (KDSA, 2013) **Figure 2.14** shows contours of equal subsidence between 2008 and 2010. It should be noted that during this two-year period the ground surface dropped between -0.1 and -1.7 feet, with the greatest declines in elevation occurring along the East Side Bypass.

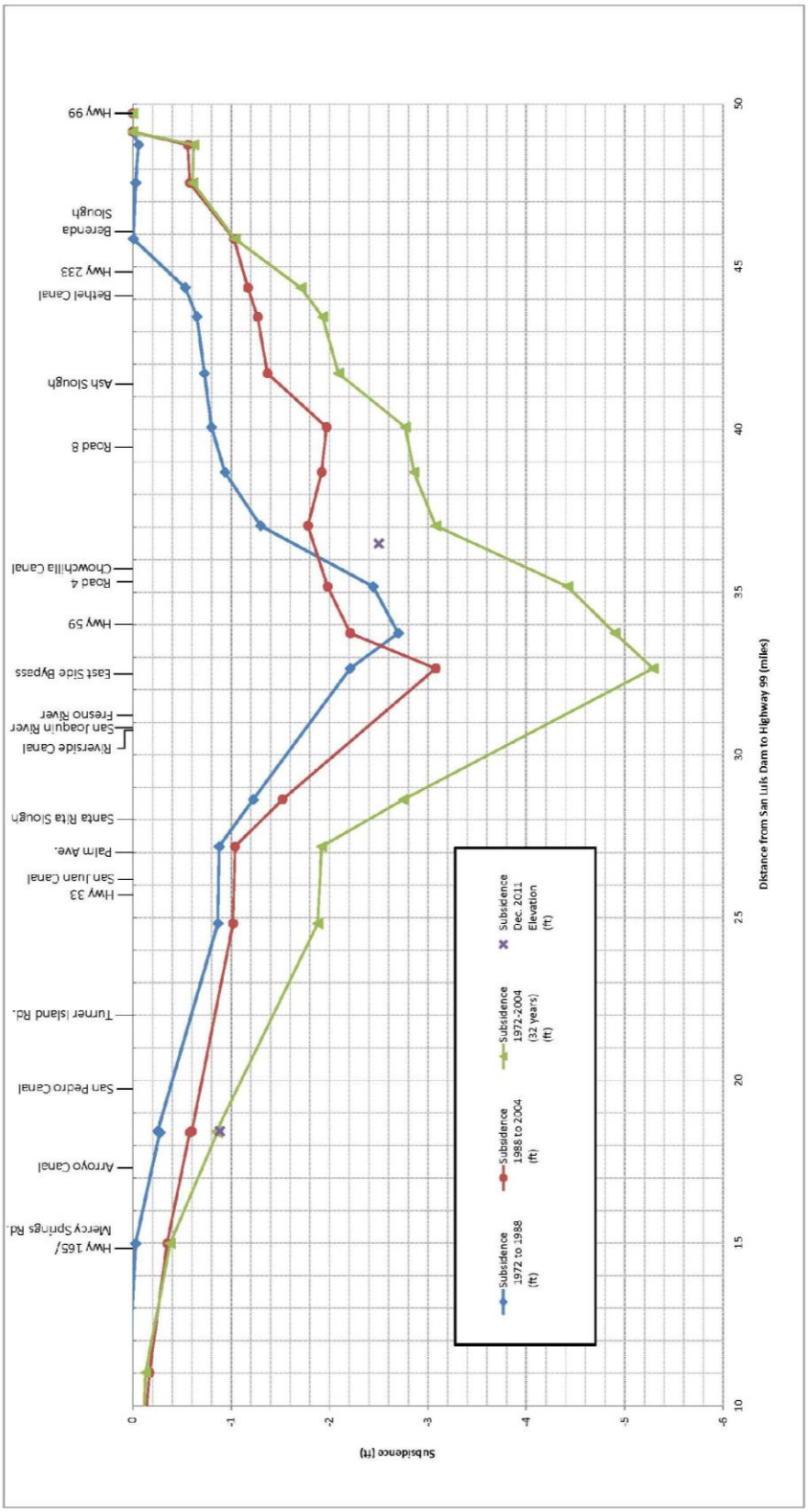

Figure 2.13 – Historical Land Surface Elevations along Highway 152 Transect

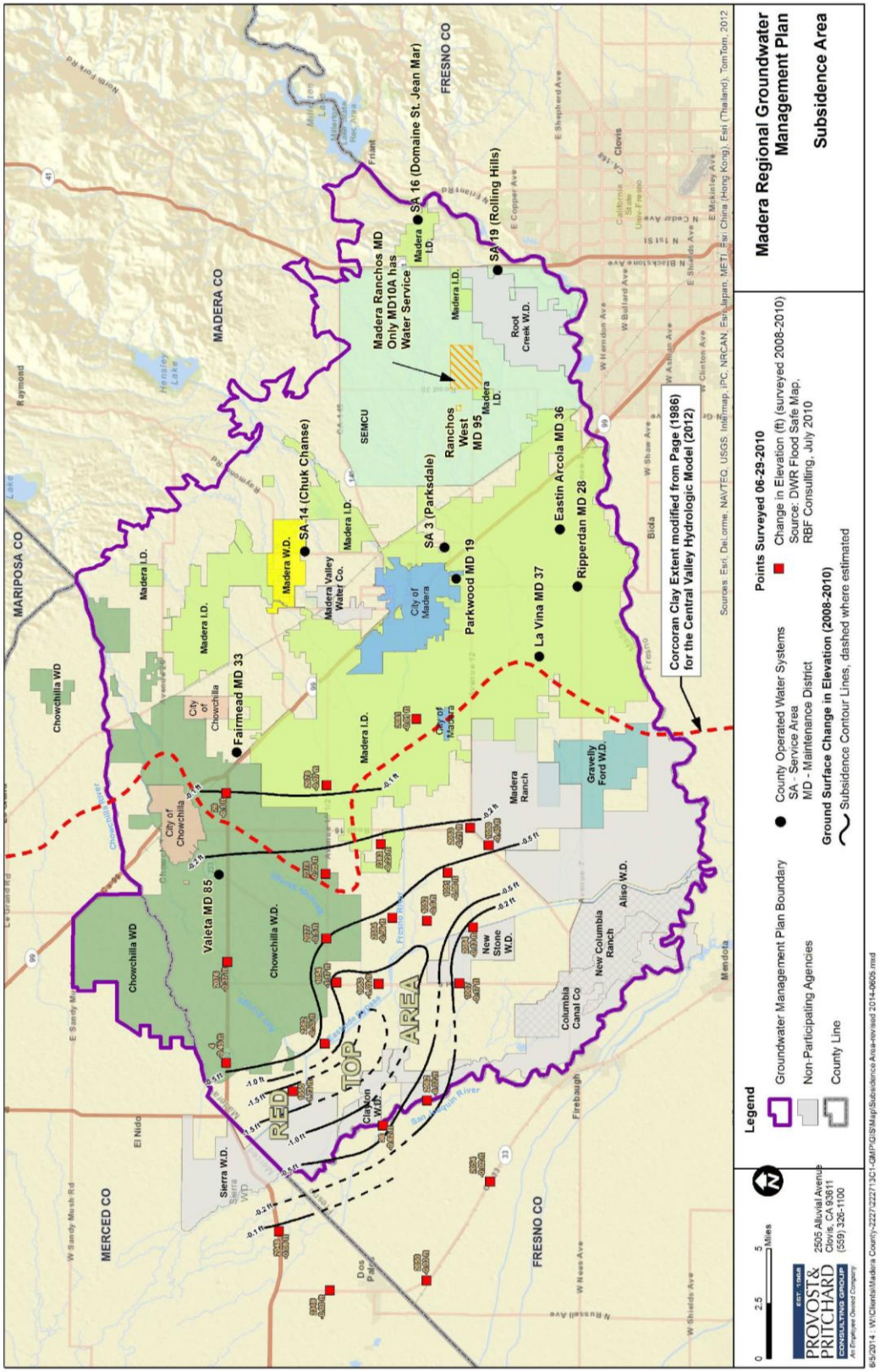

Figure 2.14 – Subsidence Area

Recent information on continued subsidence in this area, as draft maps produced by the USBR, indicates that subsidence in this area has continued through 2013. These maps are not included here because they are draft and have not been reviewed by the Western Madera County Subsidence Project. Over the period from December 2011 to 2012 as much as 0.6 feet of subsidence occurred in the area and from December 2011 to December 2013, subsidence in the area of the Eastside Bypass has been as much as 0.75 feet. However, a draft map of the same area for the period December 2012 to December 2013 indicates that as much as 1.05 feet of subsidence occurred in this area. It is unclear why there is a discrepancy in the draft maps but it is clear that land subsidence has continued in the area.

Department of Water Resources Subsidence Study

In November 2013, DWR generated a detailed study entitled "*Evaluation of the Effects of Subsidence on Flow Capacity in the Chowchilla and Eastside Bypasses.*" The bypasses are major flood control structures that parallel the San Joaquin River along the western edge of the GMP area. The DWR study focuses on changes in levee freeboard (the height of the top of the levee above the water level) and changes in flow capacity in the bypasses that have occurred between 2008 and 2011, and makes projections of potential changes in freeboard and capacity due to continuing subsidence through 2016. The goal of the study was to provide a planning tool for use by the San Joaquin River Restoration Program (SJRRP) in identifying potential impacts on the design and implementation of the projects to achieve the goals of that program.

Subsidence issues impacting the SJRRP are addressed by USBR in "*Subsidence Design Criteria for the San Joaquin River Restoration Program (DRAFT)*." That study used and compared subsidence data from the USGS, US Army Corps of Engineers (USACE), USBR, RBF Consulting and DWR. The agencies used InSAR (USGS), LiDAR (USACE), spirit leveling and GPS instrumentation (DWR/Reclamation/RBF). Topographic data collected by USGS using Interferrogram (InSAR) data between 2008 and 2010 show similar trends as the RBF Consulting data. Bi-annual survey data collected by Reclamation between 2011 and 2012 show similar trends, but subsidence rates vary along the bypass depending on season, year type, and land use. However, general subsidence trends indicated by USBR data are similar to the latest trends indicated by RFB Consulting and USGS data. Differences in subsidence data were attributed to placement of material on top of the levees after the USGS surveys, time frames that the data were taken (RBF 2008-2010, USGS 2008-2010, USBR 2011-2012, and DWR 2008-2012), the accuracy and geographical coverage of the data and the number of control points used in the ground surveys.

The study used the USACE Hydraulic Engineering Center's River Analysis System (HEC-RAS) software to model the bypasses with 2008 topography and 2010 bathymetry where available. Using the annual estimated subsidence rates determined by DWR, two versions of the model were developed, to reflect 2011 and 2016 conditions. The model results indicate the following:

> "*Water surface elevations declined between 2008 and 2011, and are predicted to continue to decline in 2016. Because the changes in topography represent the only variable between the model runs, changes in water surface elevation are caused by the lowering of the ground which, in turn, is the result of subsidence. The results show that freeboard in 2008 and 2011 is generally above 3 to 5 feet along most of the bypass except between Sand Slough and West Washington Road, which is an area of recurring sediment deposition. From 2011 to 2016, it is expected that the continuing subsidence will reduce the freeboard in this area by about 0.5 feet. In the peak subsidence area between Road 4 and Avenue 21, ongoing subsidence is estimated to decrease the freeboard from 2011 to 2016 an additional 1.5 feet. For Highway 152, the projected decrease in freeboard is about 0.7 feet. The opposite is true within the proximity of Avenue 18-1/2, where freeboard is expected to increase from 2011 to 2016 by about 0.7 feet due to the increase of the channel slope, resulting in higher channel capacity, as the result of the subsidence*."

DWR also modeled flow capacity of the bypasses in the study. In that analysis, flow capacity above Ash Slough will still handle published flood design flows. However, in the Eastside Bypass below Ash Slough, flow capacity is less than the assumed flood design flow. Continuing subsidence will further reduce the Eastside Bypass' ability to convey flood flows. The flow capacity in the Eastside Bypass from Ash Slough to Sand Slough was 5,000 cfs less in 2008 than published design flows and 500 cfs less than design from Sand Slough to the Mariposa Bypass. For 2011 and 2016 conditions, subsidence further reduces the flow capacity in these segments of the Bypass.

Due to backwater conditions caused by flood flows from the Kings River, maximum flow capacity in the Ash Slough to Sand Slough section of the Eastside Bypass is reduced to 7,500 cfs and 6,000 cfs in 2011 and 2016, respectively. This is a significant reduction from the flood design flow of 17,500 cfs in this segment of the Bypass. Likely causes include historical subsidence and sediment deposition in this reach, as illustrated from the already-reduced 2008 flood capacity of 9,500 cfs. Along the Eastside Bypass from Sand Slough to the Mariposa Bypass, the 2008 17,000 cfs flow capacity at 4 feet of freeboard was reduced by about 2,500 cfs to 14,500 cfs in 2011, and by another 1,500 cfs to 13,000 cfs in 2016.

Subsidence is reducing the amount of available freeboard in the two bypasses, which affects their abilities to convey flows. Flow capacity in the bypasses has been reduced by up to 2,500 cfs as a result of subsidence since 2008. If subsidence continues, it is estimated that there will be an additional loss in flow capacity from 2011 to 2016, up to 1,500 cfs depending on the segment of Bypass. If future subsidence occurs as expected, additional negative impacts on future flood operations would result.

3. BASIN MANAGEMENT OBJECTIVES

Basin Management Objectives (BMOs) are broad goals for improving the management of a local groundwater basin. BMOs were developed through a collaborative process with the GMP Participants. This process included several general meetings on the GMP, and three focused workshops specifically on BMOs, potential projects and future goals. The BMOs fall into the five main categories shown in **Figure 3.1** with Stabilization of Groundwater Levels by 2024 as the central or overarching Basin Management Objective.

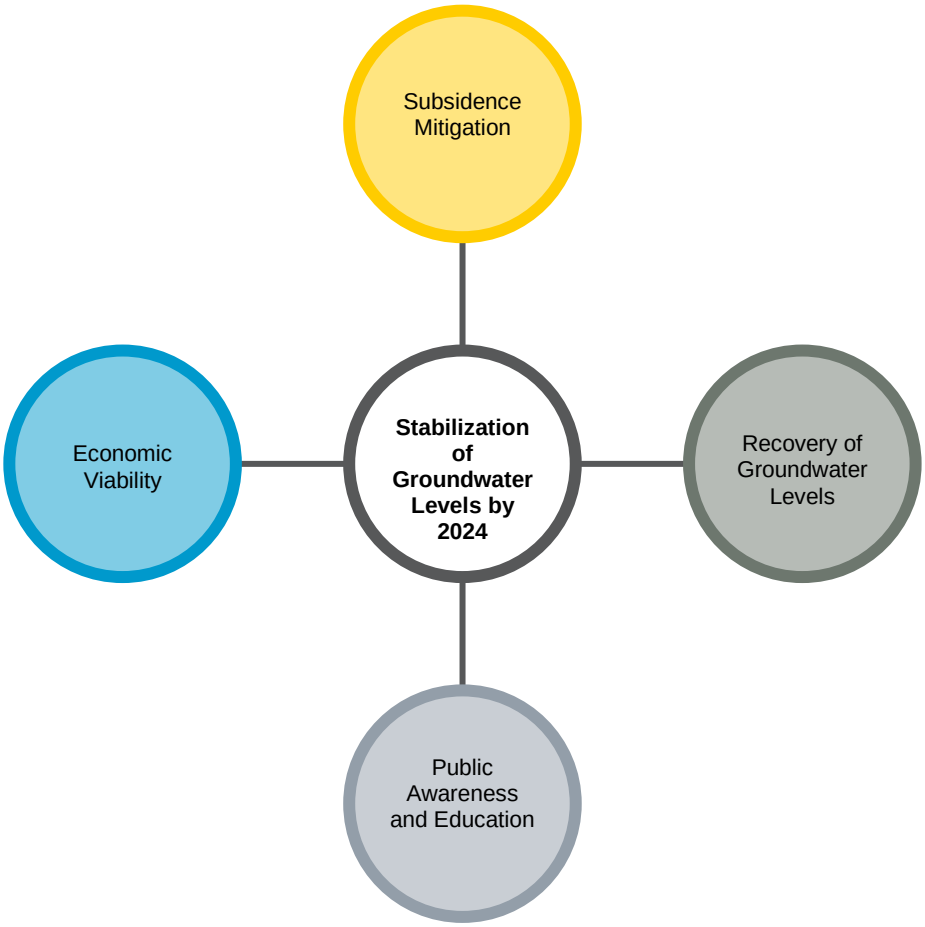

Figure 3.1 – Basin Management Objectives

Following is a description of each BMO.

Stabilization of Groundwater Levels (by 2024)

The overarching and highest-priority goal of the Participant Agencies is to stabilize the groundwater levels by 2024, by approximately 250,000 AF/year. This amount of overdraft reduction by 2024 is based on the estimated projected future overdraft of 259,000 AFY as discussed in Section 2.5. This includes 150,000 AFY reduction in overdraft by reducing groundwater demands, and an additional 100,000 AFY reduction in overdraft through recharge and acquisition of new surface water supplies.

Short Term Goals (1-5 years)

- Implement demand reduction measures to reduce 150,000 AFY of groundwater overdraft
- Identify, develop and construct storm water capture facilities to perform recharge with a minimum yield of 50,000 AFY

Long Term Goals (5-10 years)

- Perform additional recharge, identify and acquire new surface water supplies (50,000 AFY), such as Temperance Flat, watershed management, and storm water capture.
- Prevent degradation of potable water supplies and improve ground water quality where feasible.

Subsidence Mitigation

Continued unabated subsidence may potentially cause un-recoverable damages to groundwater storage capacity, existing infrastructure such as existing flood conveyance and irrigation conveyance facilities, future infrastructure such as future wells, restoration flows and High Speed Rail. Subsidence mitigation is critical in stemming the continued impacts to the western region of Madera County.

Short term Goal (1-5 years):

- Implement demand reduction measures in subsidence areas to reduce the rate of subsidence by half.
- Develop well construction and destruction policies in subsidence areas
- Develop recharge and flood irrigation projects

Long Term Goals (5-10 years):

- Significantly reduce rate of subsidence (near zero)

Recovery of Groundwater Levels after 2024

The goal is the recovery of groundwater levels to sustain a 5 year drought. The recovery of groundwater levels will inherently have multiple benefits such as improved groundwater quality, and reduced pumping cost. The storage needed to accommodate

a 5-year drought will vary by area and drought severity, but could be 15 to 20 feet of groundwater.

Public Awareness and Education

The goal is to provide public education and awareness of groundwater conditions, preparation for the next drought, better understanding of water resources, and causes and impacts of subsidence. A major focus of the educational program will be on K-12 education. Another benefit to this goal is it will enable the timely transfer of accurate and up to date information to public officials so they can make better informed decisions about water and groundwater resources in the Madera region.

Economic Viability

One of the primary goals is to maintain and improve the economic viability of the Madera region. Continued unabated groundwater extractions and continued overdraft is unsustainable and will ultimately lead to depletion of groundwater and a declining water table. Significant demand reductions will be needed during drought years when surface water supplies are significantly reduced and groundwater supplies are not reliable. Demand reduction may lead to some agricultural properties having to fallow lands, municipalities curtailing outdoor water usage, loss of well production in public and private wells, loss of property values, increased unemployment and poverty, and loss of property tax revenues as a result of lower property values.

Properties that have a reliable groundwater supply will generally have increased property values and will be in higher demand. A reliable water supply will allow property owners and investors to make informed investment decisions.

Collaborative Governance

While not considered a standalone objective, the Partners understand that collaborative and regional solutions and management of the groundwater basin is essential to successfully addressing the groundwater resource issues within the basin. Formation of an agency to manage groundwater and promote collaboration among all the stakeholders within the groundwater basin is a key component to that collaboration.

The Partners have determined that formation of a Joint Powers Authority (JPA) may be the most direct and effective way to create such a collaborative governance structure. A JPA is an entity permitted under California Constitution (Section 6502 of the Government Code), whereby two or more entities (local governments, utilities or special districts), may jointly exercise any power common to all of them. JPAs may be used where:

- An activity naturally transcends the boundaries of existing public authorities, such as groundwater management authorities given to local agencies by the state following the agencies' adoption of AB 3030- and SB 1938-compliant groundwater management plans.

- The authority will receive existing powers from the creating governments.
- By combining their efforts, public authorities can achieve economies of scale, generally achieve consensus, improved effectiveness, and improve efficiencies.

A Joint Powers Authority would be distinct from the member authorities; it would have an independent board of directors and its own staff. The JPA Board can be given any of the powers inherent in all of the participating agencies. The authorizing agreement would state the powers the new authority would be allowed to exercise. The term, membership, and standing orders of the Board of the authority must also be specified. The JPA may employ staff and establish policies independently of the constituent authorities. The JPA could also provide a one-stop repository for data collection and sharing of groundwater and water resources data. Through a collaborative effort in collecting and monitoring groundwater data, the region would benefit from scale of economy and efficiencies.

A regional groundwater management authority and definitive mitigation measures would help prevent a state mandated adjudication of the groundwater basin.

Short Term Goals (1-5 years)

- Formation of a collaborative governance/JPA within one year of adoption of the GMP.
- Identify and secure short term funding for operation of JPA

Long Term Goals

- Identify long term funding for operation of JPA

The Basin Management Objectives are reflected in the strategies listed in **Section 7.2 – Overdraft Mitigation** and a list of projects provided in **Section 9.3 – Plan Implementation**.

4. STAKEHOLDER INVOLVEMENT

4.1. Groundwater Advisory Committee / Groundwater Management Agency

This section discusses the existing Groundwater Advisory Committees that oversaw development of this GMP, and potential Groundwater Management Agencies that could be formed to implement the GMP. A Groundwater Advisory Committee is a required component of Groundwater Management Plans and serves to guide and inform decision makers on groundwater related projects and policies.

4.1.1 Regional Groundwater Advisory Committee

The GMP Participants serve as the regional Groundwater Advisory Committee (GAC or Committee) for the Madera Regional Groundwater Management Plan. The GAC is composed of members from Madera County, Madera Irrigation District, Chowchilla Water District, City of Chowchilla, City of Madera, and South-East Madera County United. These participants serve as the GAC on regional groundwater issues.

The main role of the GAC is to provide regional oversight of groundwater concerns and address these concerns through preparation and implementation of this GMP. GAC meetings were held regularly during the preparation of the GMP and will be held as needed to discuss progress towards meeting the goals contained in this GMP.

The GAC will discuss the progress in implementing the Groundwater Management Plan in each regularly scheduled meeting and will have the following responsibilities:

- Review trends in groundwater levels and available information on groundwater quality;
- Evaluate the effectiveness of current groundwater management policies and facilities;
- Discuss the need for new groundwater supply/enhancement facilities;
- Educate landowners on groundwater management issues;
- Assess the overall progress in implementing the programs outlined in the GMP;
- Recommend updates or amendments to the GMP;
- Identify regional and multi-party groundwater projects;
- Review and comment on the Annual Groundwater Report (see Section 9.2); and
- If needed, form special committees or task forces to undertake special groundwater management tasks.

4.1.2 Local Groundwater Advisory Committees

Each participating agency also has their own individual GAC, which is comprised of their respective Boards of Directors/Supervisors or City Councils that serve to inform the respective GMP Participants on groundwater issues. Madera County also has a separate Water Advisory Commission that advises the Madera County Board of Supervisors on water and groundwater issues in the County's service area. Each

member agency currently maintains its own sovereignty for groundwater issues within its boundaries.

4.1.3 Development of Regional Groundwater Management Agency

The first step in developing a regional program should include educating the general public, growers, politicians and other water agencies in Madera County on the need for a regional management entity. As discussed in Section 3, the GMP Participants are planning to create a Joint Powers Authority to provide regional groundwater management within the Plan area. This JPA would provide greater powers in funding and implementing regional solutions to groundwater problems. Such an agency would also supplant the exiting GAC.

If a JPA is formed, each Participating Agency could still maintain local control of their groundwater depending upon the powers and authorities ceded to the JPA. This is a decision the Partner Agencies will need to make during the formation of the JPA.

While the Partner Agencies have already expressed interest in forming a JPA, there are other legal organizations available to manage groundwater. They vary from voluntary agreements to improve cooperation to formation of a new special district. Several examples are provided below:

- **Cooperative Agreements and Memoranda of Agreements**. Cooperative Agreements and Memoranda of Agreement (MOA) are documents written between parties to cooperate on an agreed-upon project or meet an agreed objective. The purpose of an MOA is to have a written understanding of the agreement between parties.

- **Water Conservation Districts.** Water Conservation Districts (WCD) are entities formed under the California Water Conservation District Law of 1931 which superseded the Water Conservation District Law of 1927. According to the law the purposes of water conservation districts are to:

  "*Conserve and store water by dams, reservoirs, ditches, spreading basins, sinking wells, sinking basins, etc.; appropriate, acquire and conserve water and water rights for any useful purpose; obtain water from wells; sell, deliver, distribute or otherwise dispose of water; make surveys; provide recreational facilities; provide flood protection. May reclaim sewage and storm waters. The whole or a part or parts of one or more watersheds of any stream of water or unnavigable river or rivers, or territory adjacent thereto or deriving a water supply therefrom; may be entirely within unincorporated territory or partly within incorporated territory; may be within one or more counties; need not be contiguous*." (DWR, 1977)

  Revenues can come from water sales, sales and leases of property, and charges for use of recreational facilities. Additionally, a WCD can issue general obligation bonds and levy an ad valorem tax on lands and/or property within the district.

- **Other Special Districts.** The formation of other special districts requires the enactment of a new law by the California Legislature. There is precedent for this in that the Legislature has created a number of groundwater management districts to meet the special needs in particular areas of the state. (Correspondence between Kronick, Moskovitz, Tiedemann & Gerard and Eastern Kern County Resource Conservation District; Indian Wells Valley Cooperative Groundwater Management Group, June 11, 1991)

The following are examples of existing legal entities or agreements used for groundwater management in other areas of California.

Indian Wells Valley Cooperative Groundwater Management Group
The Indian Wells Valley Cooperative Groundwater Management Group is a public water data-sharing group consisting of most of the major water producers, other government agencies, and concerned citizens in the Indian Wells Valley in Kern County, CA. In the past, efforts by the individuals or agencies involved were often duplicated. This group was formed to coordinate efforts, share data, and avoid the redundancy of effort. Signatories to the agreement include: U.S. Bureau of Land Management, City of Ridgecrest, County of Kern, Eastern Kern County Resources Conservation District, Indian Wells Valley Airport District, Indian Wells Valley Water District, Inyokern Community Services District, Kern County Water Agency, China Lake Naval Air Weapons Station, and Searles Valley Minerals.

A Technical Advisory Committee (TAC) continually reviews and monitors on-going efforts to better understand the local water resources. This group is also responsible for an extensive well monitoring program and a water recharge study. Numerous studies have been conducted to better understand the groundwater resource in the Valley. Rain and stream gages have been placed in strategic locations in the basin, and over 100 wells are monitored. More information can be found at their website: (http://iwvgroundwater.org/).

Sacramento Groundwater Authority
The Sacramento Groundwater Authority (SGA) is a joint powers authority (JPA) created to manage the Sacramento region's North Area Groundwater Basin (North Area Basin). The SGA's formation in 1998 resulted from a coordinated effort by the Sacramento Metropolitan Water Authority (SMWA) and the Sacramento Area Water Forum (Water Forum) to establish an appropriate management entity for the basin. The SGA is recognized as an essential element to implement a comprehensive solution for preserving the lower American River and ensuring a reliable water supply through the year 2030.

The SGA draws its authority from a joint powers agreement signed by the cities of Citrus Heights, Folsom, and Sacramento and the County of Sacramento to exercise

their common police powers to manage the underlying groundwater basin. In turn, these agencies chose to manage the basin in a cooperative fashion by allowing representatives of the 14 local water purveyors and representatives for agricultural and self-supplied pumpers to serve as the SGA Board of Directors. At the core of the SGA's management responsibility is a commitment to not exceed the average annual sustainable yield of the basin, which was estimated to be 131,000 acre-feet.

To date the SGA has engaged in groundwater studies, monitoring, grant applications, education, and project promotion. They have enacted limited restrictions or controls on groundwater extractions in specific areas where overdraft is occurring. The SGA has also developed policies for groundwater banking, exchanges in the form of credits, a monitoring program and processes to report groundwater extractions on a monthly basis. More information on the SGA can be found on their website: (www.sgah2o.org).

Kaweah Delta Water Conservation District

The Kaweah Delta Water Conservation District (KDWCD) was formed in 1927, under the provisions of California state law known as the Water Conservation Act of 1927, for the purpose of conserving and storing waters of the Kaweah River and for conserving and protecting the underground waters of the Kaweah Delta. Later the Water Conservation Act, as well as the purpose of the District, was expanded to include power generation and distribution.

The District is located in the south central portion of the San Joaquin Valley and lies in portions of both Tulare and Kings Counties. The total area of the District is about 340,000 acres.

The District and the Kaweah River groundwater basin have experienced long-term groundwater overdraft estimated in 2007 to be as much as 40,000 AF/year. The District has performed several groundwater overdraft studies. There are currently over 40 recharge basins within the District covering approximately 5,000 acres. KDWCD owns and operates many of these groundwater recharge basins. The District also performs education, water resources studies and facilitates project development in their area. More information can be found on their website at: (http://kdwcd.com/).

Ojai Basin Groundwater Management Agency

The mission of the Ojai Basin Groundwater Management Agency (OBGMA) is derived from its enabling legislation, the Ojai Basin Groundwater Management Agency Act, which became law in 1991. The act was approved as a response to the needs and concerns of local water agencies, water users, and well owners of the Ojai Basin, located in Ventura County, CA. The Agency was established in the fifth year of a drought, amidst concerns for potential basin overdraft. More information on the agency can be found at their website: http://www.obgma.com/.

The OBGMA has enacted ordinances that specify the requirements for new well permitting, notification of intent to construct, registration of extraction facilities, metering,

reporting of groundwater extractions, and the recordation of wells within the boundaries of the Agency. To date it has not initiated mandated restrictions on groundwater pumping, but it does charge an extraction fee of $17.75 per AF of water.

San Luis Obispo County

On August 27, 2013, the San Luis Obispo County Board of Supervisors adopted County Ordinance No. 3246, which is an "*Urgency Ordinance establishing a moratorium on new or expanded irrigated crop production, conversion of dry farm or grazing land to new or expanded crop production and new development dependent upon a new well in the Paso Robles Groundwater Basin unless such uses offset their total projected water use, including certain exemptions*." On October 8, 2013, The Board of Supervisors continued the Urgency Ordinance for two years (San Luis Obispo County Ordinance No. 3246; 2013).

The Ordinance requires large land uses to offset new water use at a 2:1 ratio, prohibit the creation of new parcels in the basin, and requires changes to the County General Plan to be water-neutral. The Ordinance will not affect the cities of Paso Robles and Atascadero or the towns of Templeton, San Miguel or Shandon, the drilling of wells, or the building of single family homes. Additionally, water from the Nacimiento or State Water Projects shall not be used for development in the rural area of the Paso Robles Groundwater Basin.

Net offsets for agricultural uses can be accomplished by showing that existing water use has been upgraded to achieve water savings equal to the future proposed water use. It can also be accomplished by removing irrigated agricultural land from production. For residential or other development, this can be done by showing that enough fixtures in other residences have been replaced to achieve water savings equal to the proposed future water use. This can also include offsetting of proposed outdoor water use. More information can be found at the following website:
(http://www.slocounty.ca.gov/planning/commguidelines/PRgroundwater.htm)

Existing Activities

- Continue groundwater management through local groundwater advisory committees

Planned Actions

- Develop a regional groundwater management authority, agency or organization
- Develop a framework to equitably manage groundwater resources to achieve the Basin Management Objectives
- Develop mechanisms to fund a regional groundwater management authority, staff and program activities to sustainably manage groundwater resources
- Avoid state adjudication of the Madera regional groundwater basin by demonstrating the effectiveness of local and regional efforts

4.2. Relationships with Other Agencies

The development of relationships between water agencies is important as the GMP Participants implement a regional approach to groundwater management with this GMP. The GMP plan area is located in three separate groundwater sub-basins (see **Figure 2.1**) which extend beyond many political boundaries and includes numerous municipalities, irrigation districts, water districts, private water companies, and private water users (see **Figure 1.1**). This network of interests emphasizes the importance of inter-agency cooperation, and the GMP Participants have historically made efforts to work conjunctively with many other water management agencies. Below is a list of some groups and organizations that they have worked with in managing the local groundwater**:**

- Madera Regional Water Management Group
- Madera-Chowchilla Basin Regional Groundwater Monitoring Group
- Chowchilla Red-Top-City Joint Powers Authority
- South-East Madera County United

A description of each organization and its role in managing groundwater in the GMP area is provided below.

Madera Regional Water Management Group

The Madera Regional Water Management Group (RWMG) was formally organized under a Memorandum of Understanding (MOU) in 2010. There are currently 15 MOU signatories, and all of the GMP Participants are MOU signatories. The RWMG has developed an Integrated Regional Water Management Plan, successfully secured funding for water resources projects, and meets monthly to discuss water related issues and share ideas. The goals of the RWMG overlap strongly with this plan as they both seek benefits from regional cooperation in addressing groundwater issues. More information on the RWMG can be found on their website (http://madera-id.org/index.php/rwmg).

Madera-Chowchilla Basin Regional Groundwater Monitoring Group

The Madera-Chowchilla Basin Regional Groundwater Monitoring Group (Monitoring Group) was formed in 2010 to monitor groundwater levels in the Madera Groundwater sub-basin and Chowchilla Groundwater sub-basin in compliance with California Statewide Groundwater Elevation Monitoring (CASGEM) program, which is described in Section 5.1. The group consists of Madera Irrigation District, Chowchilla Water District, Madera County, Madera Water District, Root Creek Water District, and Gravelly Ford Water District. The monitoring area covers 789 square miles. The group has worked cooperatively to establish a regional groundwater-level monitoring network.

Chowchilla Red-Top-City Joint Powers Authority
The Chowchilla Red-Top-City Joint Powers Authority (JPA) includes the Chowchilla Water District, City of Chowchilla and Chowchilla Red-Topy Resource Conservation District. The JPA was formed in 1997 to develop and implement a groundwater management plan. This is a sub-regional effort to address groundwater issues in the area covered by the three agencies.

South-East Madera County United
South-East Madera County United (SEMCU) is not a water agency, but educates and advocates for responsible and sustainable water management in southeast Madera County. SEMCU is interested in pursuing groundwater recharge projects, particularly in the southeast area of the county where their groundwater subbasin would directly benefit. SEMCU members have been working on a variety of specific projects in collaboration with Madera County Engineering and with some of the development interests in the area. SEMCU is working to collaborate with all agencies and organizations to enhance that aspect of future grant applications. SEMCU leadership is currently working to get a statement from Madera County that the two agencies are working together on groundwater issues, which could help in their efforts to secure additional planning and construction grants, especially where the collaboration will lead to multi-faceted, multi-disciplinary projects with a range of measurable benefits.

Proposed efforts to involve other public agencies and develop new relationships are discussed in Section 4.3.

Existing Activities

- Continue existing relationships with local, state and federal agencies

Planned Actions

- Madera County is a participant of the US Bureau of Reclamation's Sacramento-San Joaquin Basin wide Study and Update

4.3. Plan to Involve the Public and Other Agencies

The GMP Participants are already involved with many neighboring and regional agencies on groundwater management projects. Existing relationships that pertain to groundwater management are described in Section 4.2. Nevertheless, they are always interested in building new relationships with other agencies that share the same groundwater basin. They will also strive to involve the public in groundwater management decisions. Additional cooperative relationships can be achieved through data sharing, inter-agency committees, inter-agency meetings, memorandums of understandings, formal agreements, and collaborations on groundwater projects.

Several water management agencies in the valley portion of Madera County are not involved with this GMP. The GMP Participants will seek to gain support for regional groundwater management from these agencies.

Specific goals for involving the public and other agencies include:

1. Contact neighboring counties to discuss the impacts they are having on the area's groundwater levels

2. Recruit other water agencies to participate in future regional efforts, such as Joint Powers Authorities, or formation of a county-wide groundwater management district.

3. Engage in dialogue with the public and other agencies within, adjacent to or near Madera County, such as:

    a. Madera Water District
    b. Sierra Water District
    c. Aliso Water District
    d. Columbia Canal Company
    e. Progressive Water District
    f. Clayton Water District
    g. New Stone Water District
    h. Madera Oversight Coalition
    i. Madera County Farm Bureau
    j. Lower San Joaquin Levee District
    k. Revive the San Joaquin
    l. Chowchilla Red-Top Resource Conservation District
    m. Madera Valley Water Company
    n. Conservation Districts
    o. Merced County
    p. Fresno County
    q. Central California Irrigation District (CCID)
    r. San Joaquin River Exchange Contractors
    s. City of Fresno
    t. Friant Water Authority
    u. Mendota Pool Group

4. Involve Other State and Federal Agencies. The GMP Participants plan to engage other state and federal agencies, such as:

    a. California Department of Water Resources
    b. The US Bureau of Reclamation (through their 2013 Basin Wide Update)
    c. US Geological Survey (through subsidence elevation monitoring data)
    d. California Department of Public Health (through well construction and destruction)
    e. US Fish and Wildlife
    f. California Fish and Wildlife
    g. Regional Water Quality Control Board
    h. Natural Resource Conservation Service

Existing Activities
None

Planned Actions

- Provide copies of an annual groundwater reports (see Section 9.2) to the public and interested public agencies at their request.
- Recruit other water agencies to participate on regional groundwater management efforts.
- Work with and involve agencies in Madera County on groundwater management such as Root Creek Water District, Madera Water District, Aliso Water District, New Stone Water District, Columbia Canal Company, Clayton Water District, Sierra Water District, Chowchilla Red-Top Resource Conservation District, Madera Valley Water Company, Madera Oversight Coalition, and Lower San Joaquin Levee District.
- Work with adjacent counties and agencies (County of Merced, County of Fresno, City of Fresno, and Friant Water Authority) on groundwater management along county borders to reduce impacts from surrounding regions.
- Work with adjacent water districts and irrigation districts on groundwater management along county borders to reduce offsite impacts, such as CCID, and the Exchange Contractors.
- Continue to work with DWR, Bureau of Reclamation, USGS, California Department of Fish and Wildlife, US Department of Fish and Wildlife, and CDPH.

5. MONITORING PROGRAM

This section discusses monitoring of groundwater levels, groundwater quality, and land surface subsidence. Monitoring is considered critical to future management decisions, and the region's monitoring programs are intended to:

1. Provide warning of potential future problems;
2. Use data gathered to generate information for water resources evaluations;
3. Develop meaningful long-term trends in groundwater characteristics; and
4. Provide data comparable from place to place in the GMP area.

5.1. Groundwater Level Monitoring

Following is a discussion of groundwater level monitoring efforts in the areas served by the GMP participants, and a discussion of a regional groundwater-level monitoring program.

City of Chowchilla
The City of Chowchilla does not regularly measure groundwater levels, but does measure them when they perform maintenance on wells, which is frequent.

City of Madera
The City of Madera measures groundwater levels annually in 19 wells.

Chowchilla Water District
Chowchilla Water District measures groundwater levels in about 140 wells each spring and fall.

Gravelly Ford Water District
Gravelly Ford Water District does not perform groundwater level monitoring, but is a member of local CASGEM group and other agencies measures groundwater levels in their service area.

Madera Irrigation District
The Madera Irrigation District monitors groundwater levels each spring and fall in about 230 wells.

Madera County
Madera County monitors groundwater levels at 14 special districts operated by the county. Twenty five wells are monitored annually and one well has a data logger to provide continuous measurements. No monitoring is performed in other unincorporated areas of the County. There is especially a dearth of data in undistracted areas.

South-East Madera County United

SEMCU does not perform groundwater-level monitoring, but some agencies within the SEMCU area do monitor groundwater levels.

California State Groundwater Elevation Monitoring Program

The California State Groundwater Elevation Monitoring Program (CASGEM) was created by SBx7 6, Groundwater Monitoring, a part of the 2009 Comprehensive Water Package. By passing the bill, the Legislature established for the first time a statewide program to collect groundwater elevations, facilitate collaboration between local monitoring entities and the DWR, and report this information to the public.

In 2010, DWR approved the Madera-Chowchilla Basin Groundwater Monitoring Group (CASGEM Group) as the local monitoring entity. The Group includes Madera Irrigation District, Chowchilla Water District, Gravelly Ford Water District, and Madera County. The group also includes Root Creek Water District and Madera Water District, who are not part of this regional GMP. The total monitoring area covers 789 square miles and includes all of the Madera sub-basin and most of the Chowchilla sub-basin. The Group submits groundwater level data each spring and fall to the DWR.

In 2011, the CASGEM Group submitted a Groundwater Monitoring Plan to DWR. This plan describes:

- Well Network Design
    - Shallow versus deep aquifer wells
    - Minimum well density
    - Spatial distribution of the wells
    - Water level history for wells
    - Inclusion of wells in DWR Water Data Library
    - Use of dedicated monitoring wells
- Well selection criteria
- Addition of future wells to network
- Monitoring frequency
- Field methods for data gathering and reporting of data

Proposed Groundwater Monitoring Program for Madera County

In 2008, Kenneth D. Schmidt and Associates prepared a *Proposed Groundwater Monitoring Program for Madera County*. It included recommendations for monitoring groundwater levels and groundwater quality. Although it was prepared for the County of Madera, the recommendations envision a county-wide monitoring plan including the

GMP Participant service areas, not just the County districts and unincorporated areas outside of special districts. A copy of the plan can be found in **Appendix E**.

The plan states that DWR monitors groundwater levels in about 60 wells in the Valley floor, primarily in undistracted areas. However, these efforts have been scaled back in the anticipation that they will be replaced by CASGEM. DWR staff stated that they no longer measure groundwater levels in Madera County (personal communication with Chris Guevara, DWR, March 2014).

Schmidt cited several challenges with monitoring groundwater levels in the area:

1. Depth and/or perforated interval are not available for many wells being monitored, which complicates interpretation of the water-level records
2. Groundwater level data is not extensive enough in the non-Districted areas, especially the southeast part of the valley floor
3. Some wells tap multiple aquifers (i.e. composite wells) and have water levels intermediate between those in the different aquifers

Schmidt recommended the following:

- Develop two separate water level monitoring networks; one for relatively shallow wells (i.e., about 250 to 330 feet deep or shallower) and the other for deeper wells (commonly about 500 to 900 feet deep, and including only those wells without shallow perforations).
- Install data loggers to provide continuous measurements on at least one dozen wells in the county.
- Add new wells to the monitoring network. Sources of information can include private residential, private agricultural, landfills, wastewater treatment facilities, dairies, gasoline leak sites, and newly constructed dedicated monitoring wells.
- Prepare spring and fall water-level elevation maps for both the shallow and deep groundwater on an annual basis, with an evaluation of groundwater overdraft at least every three years.

In addition, a large number of deep wells have been drilled in the last decade to tap the confined aquifer. Long-term and even recent water-level changes from most of this deep groundwater are unknown in most of the area. Water levels in the deep aquifer are only well known in the Red-Top area (see **Figure 2.7 and 2.8**), which has implemented a detailed groundwater monitoring program and identified the perforated interval for the monitored wells.

Recommendations

The recommendations in Schmidt's report have not been implemented, but would substantially improve the groundwater monitoring network in the GMP area. It is recommended that the GMP Participants develop a regional groundwater level monitoring program similar to Schmidt's recommendations. The program would be more comprehensive than the CASGEM group, include a greater density of wells, and include all the GMP Participants. This could be accomplished through an expansion of the CASGEM program or a new separate program. The program would require participation from numerous agencies including the GMP Participants, and possibly other water agencies in the Madera area. The program would include collection of groundwater level data each spring and fall, and development of groundwater contour and groundwater level maps for the GMP area.

Figure 2.10 shows the network of wells with long-term hydrographs in the DWR database. There is a dearth of data in several areas, especially those outside of special districts. As a result, additional wells should be added to the network. These could be private wells that grant permission to be monitored, or preferably dedicated monitoring wells with data loggers.

Existing Activities

- Measure groundwater levels according to existing monitoring plans in each agency.

Planned Actions

- Require, as a condition of obtaining a well permit, that all new wells will be added to the monitoring grid.
- Add private domestic wells to the monitoring network since they are almost always known to be in the unconfined aquifer.
- Create County-wide groundwater contour maps (elevation and depth) each spring and fall for both the shallow unconfined aquifer and the deep confined aquifer.
- Generate a representative set of long-term hydrographs showing groundwater surface elevation and depth for both the shallow unconfined aquifer and the deep confined aquifer.
- Annually estimate the change in groundwater storage from groundwater contour maps, and compare it to reductions in groundwater pumping and the volume of surface water imported.
- Periodically review the monitoring network to determine if it provides sufficient areal coverage to evaluate groundwater levels.
- Maintain at least the same number of wells in the monitoring network by constructing monitoring wells, or adding new private wells to the network when existing wells are taken out of the monitoring network.
- Protect wells in monitoring program from being abandoned or destroyed.
- Encourage landowners and developers to convert unused wells to monitoring wells. Inform them through existing educational outreach programs that their abandoned well(s) could be useful to monitoring programs.

- Seek grant funds to install dedicated monitoring wells with data loggers.
- Prepare enhanced groundwater level maps after improved groundwater level data is available for the confined and unconfined aquifers
- Conduct aquifer tests along agency boundaries to determine aquifer transmissivity and storativity.
- Request as part of the well replacement/abandonment process that existing wells not be abandoned and utilized as monitoring wells.
- Madera County to consider development of a groundwater monitoring fee associated with the well permits, to partially subsidize groundwater monitoring program.
- Madera County shall develop policy as part of well permits that all new wells have meters installed to allow for possible future data gathering.

5.2. Groundwater Quality Monitoring

Groundwater quality monitoring is an important aspect of groundwater management in the GMP area. Monitoring groundwater quality serves the following purposes:

1. Spatially characterize water quality according to soil types, soil salinity, geology, surface water quality, and land use;
2. Establish a baseline for future monitoring;
3. Compare constituent levels at a specific well over time (i.e. years and decades);
4. Determine the extent of groundwater quality problems in specific areas;
5. Identify groundwater quality protection and enhancement needs;
6. Determine water treatment needs;
7. Identify impacts of recharge and surface water use on water quality;
8. Identify suitable crop types that are compatible with the water characteristics; and
9. Monitor the migration of contaminant plumes.

Groundwater quality in the GMP area is discussed in Section 2.7 – Groundwater Quality. Following are descriptions of monitoring programs in the GMP area.

Irrigation and Water Districts

MID, CWD and GFWD do not perform groundwater quality testing on a regular or periodic basis because they do not provide drinking water. Testing is sometimes performed for project specific purposes, such as when new groundwater banking facilities are being studied. Testing is also performed in the City of Chowchilla, which is within CWD, and the City of Madera, which is partially within the MID service area.

Urban Water

The City of Madera operates 19 wells, and the City of Chowchilla operates 7 wells. The County of Madera operates 12 small public water systems in the GMP area, each of which operates from one to four wells. These public water systems are all operated as either Maintenance Districts (MD) or Service Areas (SA). Eleven of the districts rely entirely on groundwater with a total of 22 wells. One system, Sumner Hills (SA 16) uses surface water from Friant Dam releases to the San Joaquin River. The County analyzes the water quality from each water supply well in Madera Ranchos (MD 10A), Parkwood (MD 19), Ripperdan (MD 28), Fairmead (MD 33), Eastin Arcola (MD 36), La Vina (MD 37), Valeta (MD 85), Parksdale (SA 3), Chuck Chanse (SA 14), Rolling Hills (SA 19) and Ranchos West (MD 95).

The Cities and County test water quality on a routine basis for state- and federally-regulated inorganic and organic constituents, as well as coliform bacteria, as required by the California Department of Public Health (CDPH). The period of sampling varies from quarterly (bacteria) to annually (nitrate), bi-annually (nitrite) to greater than bi-annually for those constituents that meet drinking water standards and do not show changes in concentrations. The two cities and each County district prepare annual Consumer Confidence Reports to inform the public of water quality issues, as required by the State of California.

Water Quality Coalition

The East San Joaquin Water Quality Coalition (Coalition) is a group of agricultural interests and growers formed to represent all “dischargers” who own or operate irrigated lands east of the San Joaquin River within Madera, Merced, Stanislaus, Tuolumne and Mariposa Counties and portions of Calaveras County. In the past monitoring efforts focused on surface water, but are being expanded to groundwater. The goals of the coalition include:

1. File required reports with the Central Valley Regional Water Quality Control Board (Regional Board) to provide conditional waiver coverage for members of the coalition
2. Develop and implement an economical and scientifically valid water monitoring program for area rivers and agricultural drains (as required by the waiver)
3. Spread costs equitably among farm land owners/operators who are coalition members;
4. Communicate to landowners where water monitoring indicates problems and work to solve those problems.

Mendota Pool Group

The Mendota Pool Group is a collection of interests who work together to manage surface water, groundwater, and water quality, and resolve water conflicts in the Mendota Pool area. Mendota Pool is located at the southwestern tip of Madera County,

actually in the County of Fresno. As part of their efforts, an extensive groundwater quality monitoring program has been undertaken by the Pool Group, including a number of wells in the southwest part of the valley floor area and in adjoining areas in Fresno County. Annual monitoring reports are available for this program that provide and interpret this information. The Mendota Pool is an important hydrologic feature in central California because it is hydrologically connected to the San Joaquin River, Kings River, and numerous irrigation canal systems. It is feasible that future flood water, above the capacity of the Madera Canal, can be stored in Mendota Pool and later delivered downstream of Mendota Pool via the San Joaquin River to lands in the western part of Madera County near the San Joaquin River.

Landowner Monitoring

Many landowners test the water quality of their domestic and irrigation wells. Some landowners may provide the test results to the GMP Participants, however, the results are proprietary, and the landowners may ask that the data is used for informational purposes only, and not be released to the general public.

Other Agency Monitoring

Numerous other agencies play important roles in the monitoring and mitigation of groundwater quality. These agencies include the Regional Water Quality Control Board, Environmental Protection Agency, Department of Toxic Substances Control, USGS, and State Water Resources Control Board. The GMP participants make efforts to collect and review pertinent water quality data published by these agencies.

Proposed Improvements

Schmidt (2008) evaluated the current groundwater quality monitoring in the GMP area. Monitoring is performed in urban areas, but otherwise there is no routine mapping of groundwater quality issues, nor plotting of time trends for changes in concentrations of specific constituents. Schmidt recommends collecting data from private wells and regularly developing maps of groundwater quality issues, including high TDS, nitrate, DBCP, alpha activity, manganese, arsenic and high heterotrophic plate counts. In addition, information on vertical trends in groundwater quality (i.e. water quality changes with depth) should be gathered from cities, communities and schools.

Existing Activities

- Perform required groundwater quality testing for potable water systems.
- Regularly collect new water quality information from other agencies and review it to identify any impending groundwater quality problems.

Planned Actions

- Protect wells in monitoring program from being abandoned.
- Develop a central data repository for all available groundwater quality data in the GMP area.

5.3. Groundwater Monitoring Protocols

Monitoring protocols are necessary to ensure consistency in monitoring efforts and are required for monitoring evaluations to be valid. Consistency should be reflected in factors such as location of sample points, sampling procedures, testing procedures, and the time of year when the samples were taken. Without such common ground, comparisons between reports must be carefully considered. Consequently, uniform data gathering procedures are important. The monitoring protocols used are not attached to this GMP due to their length, but they can be found at the website links provided below.

Groundwater Level Monitoring Protocols
Members of the CASGEM Group (CWD, MID, GFWD and Madera County) follow DWR protocols for monitoring groundwater levels. The other GMP participants, City of Chowchilla and City of Madera, do not follow specific protocols, but do follow standard procedures similar to those documented by DWR.

In 2011, the CASGEM Group submitted a Groundwater Monitoring Plan to the DWR. In that plan, the Group's monitoring protocols "*will follow those described in Groundwater Elevation Monitoring Guidelines"* prepared by the DWR in December 2010. Those protocols can be found on the CASEGEM website:
(http://www.water.ca.gov/groundwater/casgem/)

The CASGEM protocols include requirements for:

- Well location data
- Establishing wellhead elevation (reference point)
- Water level measurement devices
- Calibration and maintenance of water level measurement devices
- Field data sheets for water level measurements

Groundwater Quality Monitoring Protocols
Protocols for obtaining groundwater quality samples can vary depending on the type of monitoring program. Routine sampling of constituents for municipal wells will differ from dedicated monitoring wells, private wells and agricultural wells in the sampling interval and types of constituents analyzed as well as the reporting agency overseeing the program (if any). Operators of municipal wells are required to report to and follow protocols set by the California Department of Public Health
(http://www.cdph.ca.gov/Pages/default.aspx).

Any set of protocols for sampling should "*require that ground-water monitoring programs include measurement, sampling, and analytical methods that accurately assess ground-water quality, and that provide early detection of hazardous constituents released to groundwater. Measurement, sampling and analytical methods that are part*

of the ground-water quality program should be documented in the operating record and should include quality assurance and quality control procedures." (U.S. Environmental Protection Agency, 1992)

Two other sources for groundwater quality monitoring protocols include:

1. Ground-Water Data-Collection Protocols and Procedures for the National Water-Quality Assessment Program: Collection and Documentation of Water-Quality Samples and Related Data Open-File Report 95-399; United States Geological Survey, 1995, http://pubs.usgs.gov/of/1995/ofr-95-399/

2. RCRA Ground-water Monitoring: Draft Technical Guidance; U.S. Environmental Protection Agency, 1992. http://www.epa.gov/region9/qa/fieldsamp.html

The following list is compiled from both documents and should be included in the protocols for all groundwater quality monitoring programs:

- Equipment setup
- Well purging, grab samples and field measurements
- Assessment of chemical stability
- Sample collection and processing
- Sample preservation
- Decontamination of field equipment
- Preparation of blank samples
- Chain-of-Custody and records management
- Sample labels
- Sample handling and shipping

Existing Activities

- Continue using standard monitoring protocols developed by DWR, USGS and EPA.

Planned Actions

- Review the adequacy of the water quality monitoring protocols annually and revise them when necessary.
- Develop a standard set of water quality monitoring protocols for all GMP participants.
- Protect wells in monitoring program from being abandoned.
- Develop a standard set of water level monitoring protocols for all GMP participants to follow, especially a common time of year to measure water levels.
- Develop a central data repository for all available groundwater quality and groundwater level data.
- Survey all wells used for water level measurements in subsidence areas for change in ground surface elevation every two years.

5.4. Land Surface Subsidence Monitoring

High groundwater pumping can contribute to land subsidence across a broad area, resulting in aquifer compaction, loss of storage capacity, and adverse effects to surface features such as canals, flood control systems, and water supply pipelines which rely on gravity flow. Land subsidence in the western half of the GMP area is an historic and significant on-going problem. The USGS, California DWR and Kenneth D. Schmidt and Associates have each generated numerous studies documenting the subsidence problems in this area. Land surface elevation surveys which can be used for subsidence studies date back to the 1920s. According to KDSA, studies have centered on the periods 1926 through 1972, and 1992 to the present. Measurement and monitoring for subsidence is performed by a variety of agencies including USGS, DWR, USBR, USACE, San Luis & Delta-Mendota Water Authority (SLDMWA), Central California Irrigation District (CCID), California Department of Transportation (Caltrans), National Geodetic Survey (NGS), University NAVSTAR (Navigation Satellite Timing and Ranging) Consortium (UNAVCO), and various private contractors**.**

Geologic aspects of land subsidence and the results of land subsidence monitoring efforts are presented in Section 2.7 – Land Subsidence. Potential mitigation measures are discussed in Section 7.5 - Land Subsidence Mitigation. Below are discussions on existing and potential land subsidence monitoring techniques.

Current Subsidence Monitoring Programs

Currently, USBR in conjunction with DWR, USGS and USACE obtain subsidence data twice yearly in December and June, and publish maps of the results in January and July as part of the San Joaquin River Restoration Project (SJRRP). SJRRP is developing a technical memorandum entitled "*Subsidence Design Criteria for the San Joaquin River Restoration Program (DRAFT)*."

To address subsidence issues in the Red-Top area of Madera County, the Western Madera County Subsidence Solution Project was formed. It includes Central California Irrigation District, San Luis Canal Company, Washington Area Growers, Red Top Area Growers, Merced County and Madera County. This group gathers and reviews subsidence data collected by other agencies (see **Figure 2.14**). They are also performing technical studies and evaluating subsidence mitigation projects.

Existing subsidence areas may expand, and areas that currently lack subsidence may soon experience subsidence. It is recommended that all agencies in the GMP area that are not actively monitoring subsidence develop a monitoring plan that includes surveying several local benchmarks annually.

Subsidence Monitoring Methods and Technology

Surveying. In the past, subsidence measurement relied upon optical (spirit level) surveying devices and later laser and global positioning satellite (GPS) survey

equipment. This type of measurement is still done today, usually along established highways and water conveyance facilities such as levees and canals.

Extensometers. In the 1950s and 1960s, the USGS, DWR and other agencies installed a number of borehole extensometers which allow for continuous measurement of subsidence. Extensometers are costly to install and require frequent maintenance and calibration. There are presently no extensometers within the GMP area; the closest is a few miles south of the southwest corner of the study area.

Continuous Global Positioning Satellites. Subsidence can also be measured using continuous global positioning satellite (CGPS) data. Various USGS studies obtain CGPS data from the UNAVCO Plate Boundary Observatory (PBO) network of continuously-operating GPS stations. The PBO is the geodetic component of UNAVCO, a consortium of research institutions whose focus is measuring vertical and horizontal plate boundary deformation across the western United States using high-precision measurement techniques.

InSAR. During the last decade the USGS and other groups have been using data from radar emitting satellites in a technique called InSAR (interferometric synthetic aperture radar). This form of remote sensing compares radar images from each pass of an InSAR satellite over a study area to determine changes in the elevation of the land surface (USGS, 2013).

LiDAR. DWR and USBR utilize LiDAR coupled with land elevation surveys to monitor subsidence. LiDAR utilizes a laser device that is flown from an airplane.

Existing Activities

- The US Bureau of Reclamation in conjunction with DWR, and USGS, beginning in 2010 have been measuring subsidence twice yearly in the western half of the GMP area.
- Periodically look for visual signs of land subsidence, such as loss of freeboard in canals and levees, collapsed wellheads, and other damaged infrastructure.
- Development of the Western Madera County Subsidence Solution Project, which includes Central California Irrigation District, San Luis Canal Company, Washington Area Growers, Red Top Area Growers, Merced County and Madera County.
- Continue to acquire subsidence information from various agencies.

Planned Actions

- Participate in any regional efforts to monitor and evaluate land subsidence.
- Educate local growers on the potential for land subsidence and visual indicators of possible subsidence.
- Review newly published land subsidence reports and information prepared by the USGS, DWR, USBR, Caltrans and other organizations.

- Coordinate with cooperative efforts by government agencies, water districts and water users to establish subsidence mitigation measures.
- Develop a cooperative management group to deal with subsidence issues on a regional basis.
- Develop a central repository for all available data and documents concerning subsidence in the region.
- In areas that are not actively monitoring subsidence, identify and monitor several benchmarks for subsidence annually.

6. GROUNDWATER RESOURCES PROTECTION

6.1. Well Abandonment

Existing State law and Madera County ordinance require that owners or lessees properly destroy their abandoned wells. Proper destruction of abandoned wells is necessary to protect groundwater resources since abandoned or improperly destroyed wells can result in contaminated surface water entering the well, and water of different chemical qualities from different strata mixing. In both cases, groundwater can be degraded. The administration and enforcement of the well ordinance is the responsibility of Madera County.

Madera County currently oversees all aspects of water well abandonment in the GMP area, including private wells in unincorporated areas, cities, irrigation districts and water districts. The County requires that wells be abandoned according to State standards documented in Water Well Standards, State of California (DWR, 1981).

Before a property owner can construct a new well, the County requires that abandoned or out of service wells be properly destroyed. Alternatively, they can be converted to dedicated monitoring wells if they are found suitable based on their condition, total depth, perforated interval, location and other criteria.

The City of Madera requires that existing wells be destroyed in conformance with the County's Environmental Health Department standards before a property can connect to the City's municipal water system.

Existing Activities

- Encourage landowners to abandon wells according to State and County standards.

Planned Actions

- Educate landowners through public outreach programs about well abandonment standards, and possible conversion of abandoned wells to monitoring wells.
- Perform inventory of retired wells that have not been properly abandoned to help in enforcing proper abandonment, and identifying potential wells to add to a monitoring network.
- When possible, convert unusable production wells to monitoring wells.

6.2. Wellhead Protection

A Wellhead Protection Area (WHPA) is defined by the Safe Drinking Water Act Amendment of 1986 as "*the surface and subsurface area surrounding a water well or wellfield supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield*." The WHPA may also be

the recharge area that provides the water to a well or wellfield. Unlike surface watersheds that can be easily determined from topography, WHPAs can vary in size and shape depending on subsurface geologic conditions, the direction of groundwater flow, pumping rates and aquifer characteristics. There are several different methods typically used to delineate the lateral boundaries of a WHPA.

The Federal Wellhead Protection Program was established by Section 1428 of the Safe Drinking Water Act Amendments of 1986. The purpose of the program is to protect groundwater sources of public drinking water supplies from contamination, thereby eliminating the need for costly treatment to meet drinking water standards. The program is based on the concept that the development and application of land use controls, usually applied at the local level in California, and other preventative measures, can protect groundwater.

Under the Act, States are required to develop an EPA-approved Wellhead Protection Program. To date, California has no state-mandated program, but instead relies on local agencies to plan and implement programs. This is one of the factors that prompted the State Legislature to enact AB 3030. Wellhead Protection Programs are not regulatory in nature, nor do they address specific sources. They are designed to focus on the management of the resource rather than control a limited set of activities or contaminant sources.

Wellhead protection is performed primarily during design and can include requiring annular seals at the well surface, providing adequate drainage around wells, constructing wells at high locations, and avoiding well locations that may be subject to nearby contaminated flows. Wellhead protection is required for potable water supplies and is not generally required, but is still recommended, for agricultural wells.

Neither the County of Madera water well ordinance nor the City of Chowchilla water well ordinances have sections pertaining directly to wellhead protection areas for public drinking water wells. Both ordinances contain sections pertaining to placement of annular seals to prevent groundwater migration between aquifers. The City of Madera relies on the County's standards.

Existing Activities

- Design new wells with appropriate wellhead protection features.

Planned Actions

- Manage potential sources of contamination to minimize their threat to drinking water sources.
- Develop a contingency plan to prepare for an emergency well closing and to plan for future water supply needs.
- Encourage the establishment of wellhead protection areas for non-municipal wells.

- Develop more detailed wellhead protection standards for Madera County, the City of Chowchilla and the City of Madera.

6.3. Saline Water Intrusion

Saline (or brackish) water intrusion is the induced migration of poor quality water into a freshwater aquifer system. Saline water intrusion is typically observed in coastal aquifers where over pumping of the freshwater aquifer causes salt water from the ocean to encroach inland, contaminating the fresh water aquifer. The proximity of the GMP area to the Pacific Ocean would negate the possibility of saltwater intrusion from the ocean into the underlying freshwater aquifers. However, groundwater with naturally occurring elevated concentrations of salts exist in the aquifers underlying the GMP area.

The base of freshwater, or the depth at which elevated specific conductance is encountered, has been characterized as the boundary where the concentration of specific conductance is over 3,000 µS/cm (Page, 1973). **Figure 2.12** depicts the base of freshwater in the subsurface. Figure 2.12 shows data from the most recent published study to evaluate the base of the freshwater. Figure 2.12 indicates that the base of freshwater becomes shallower towards the southwest boundary of the GMP area and deeper beneath the San Joaquin River on the south and the Chowchilla River to the north. In the deeper portions of the groundwater basins within the GMP area, specific conductance concentrations in excess of 3,000 µS/cm are present. The base to freshwater map also indicates areas southwest of the GMP area where brackish shallow water overlies freshwater. As discussed in Section 2.3, a shallow aquitard (the A clay) is likely associated with the perched water table.

The depth to saline, or brackish water, varies with depth throughout the GMP area (see **Figure 2.12**). The base of freshwater is commonly referred to when discussing the depth of brackish water. Brackish water is also present in the western portion of the GMP area as discrete pockets at shallower depths. Groundwater wells constructed in multiple aquifers can provide a conduit for the upward (or downward) migration of brackish water into freshwater aquifers. Oil and gas wells, which are required to have cemented annular seals throughout the freshwater bearing aquifers, but could also provide a conduit for saline water to migrate upward into the freshwater aquifers if improperly constructed or destroyed.

Preventing the intrusion of brackish water into the freshwater bearing aquifers is critical to protecting the groundwater resources in the GMP area. It is critical to identify and characterize the aquifers with brackish, or saline, waters when constructing new wells. Utilizing exploratory test holes with geophysical surveys or depth specific water quality sampling (monitoring wells) can identify zones of poor quality water. This information can be used to identify the depths of brackish water and to properly design wells to help ensure that aquifers with brackish water are not connected to freshwater aquifers.

Existing Activities
None

Planned Actions

- Update the County's well standards to add additional levels of protection to ensure that the design of new wells prohibits the migration of saline/brackish water into the freshwater bearing aquifers by requiring approved sealing methods to properly seal test holes, which were drilled below the known base to freshwater.
- Amend the County's well standards to require exploratory test holes, or borings, to be abandoned with approved sealing materials from the total depth to ground surface.
- Require, through the well permitting process, the use of geophysical surveys in all new boreholes that have the potential to encounter saline water to enhance groundwater protection by identifying the aquifer zone(s) with elevated concentrations of specific conductance, as well as the depths of confining layers, to design adequate sanitary/annular seals. With this data, future wells can be designed to be isolated from poor water quality and provide aquifer protection.

6.4. Migration of Contaminated Groundwater

Groundwater contamination can be the result of naturally occurring contaminants, point sources contaminants, or regional contaminants.

Improperly constructed groundwater wells (domestic, agricultural, or industrial) and oil and gas wells can become conduits resulting in the migration of poor quality groundwater into aquifers containing good quality water. Groundwater wells constructed with insufficient sanitary/annular seals can result in the downward migration of shallow/near surface contamination through the annulus (the area between the borehole wall and the well casing). Proper sealing methods include cement annular seals strategically placed to prevent the vertical migration of poor quality groundwater in the annulus. Additionally, groundwater wells that connect multiple aquifers of differing water quality and static water levels (head) can cause the vertical migration of contamination between aquifers. Migration of contaminated groundwater can also occur in unsecured abandoned wells or improperly destroyed wells. Unsecured wells are also susceptible to the illegal disposal of hazardous materials. Improperly destroyed wells have the potential to allow contaminants to flow between aquifers.

Several State of California maintained online databases provide information and data on known groundwater contamination, planned and current corrective actions, investigations into groundwater contamination, and groundwater quality from select water supply wells and environmental monitoring wells. These databases are discussed below:

California Water Resources Control Board

The State of California Water Resources Control Board (SWRCB) maintains an online database that identifies known contamination cleanup sites, known leaky underground storage tanks, and permitted underground storage tanks. The online database contains records of investigation and action related to site cleanup activities and groundwater contamination and can be accessed at http://geotracker.waterboards.ca.gov.

The Department of Toxic Substance Control

The State of California Department of Toxic Substance Control (DTSC) provides an online database with access to detailed information on hazardous waste permitted sites, corrective action facilities, as well as existing site cleanup information. Information available through the online database includes investigation, cleanup, permitting, and/or corrective actions that are planned, being conducted or have been completed under DTSCs oversight. The online database can be accessed at http://www.envirostor.dtsc.ca.gov.

Groundwater Ambient Monitoring and Assessment Program

The State Water Resources Control Board GAMA (Groundwater Ambient Monitoring and Assessment) program, as mentioned in Section 2.7, collects data by testing untreated raw water for naturally occurring and man-made chemicals and compiles all of the data into a publicly accessible online database. The online database can be accessed at http://geotracker.waterboards.ca.gov/gama/.

Existing Activities

- As Part of the permitting process for new well construction, require sanitary seal and annular seal depths to avoid creating a conduit for downward migration of shallow contaminated groundwater or co-mingling of aquifers of different water quality (current County regulation).
- As part of process to connect to a municipal water system, require existing wells to be properly abandoned prior to connection to municipal water system to prevent inter-aquifer contamination (current County regulation).

Planned Actions

- Review online databases for existing contaminant plumes, or investigations into groundwater contamination. Ensure that existing well operations and new well operations do not induce downward migration of contaminants.
- As part of the permitting process for new well construction, require sanitary seal and annular seal depths to avoid creating a conduit for downward migration of shallow groundwater contamination or the co-mingling of aquifers of different water quality.
- Design a well abandonment program to identify abandoned wells and develop a plan to properly destroy wells.

6.5. Groundwater Quality Protection

The intent of protecting the quality of groundwater is to minimize activities that could potentially reduce the long-term availability of high-quality groundwater in the GMP area. A brief discussion on the potential impacts of oil and gas development on the GMP area's groundwater resources is also included, as California is in the process of reviewing existing regulations regarding development of these resources.

Updating the County's well standards to add additional levels of protection will help prohibit the downward migration of surface/shallow contaminants or cross connection of aquifers. The County has adopted standards set forth in Chapter II of the State Department of Water Resources Bulletin 74-81, and as supplemented by Bulletin 74-90, entitled "Water Well Standards: State of California", except as otherwise provided in Chapter 13.52 "Well Standards" of the Madera County Municipal Code. Some amendments that could be made to the existing well standards are: (1) require the use of geophysical surveys for all new well projects, (2) increase the required minimum sanitary seal depths (currently 50 feet for municipal supply and 20 feet for agricultural wells), and (3) update the well destruction requirements.

Groundwater Quality Impacts of Oil and Gas Field Development

Hydraulic Fracturing. Hydraulic fracturing, also called fracking, includes stimulating a geologic formation to increase oil production. Hydraulic fracturing has been practiced in California for many years, but has become much more common in recent years. Most oil wells are now fracked. The process of fracking involves pumping water, sand and small concentrations of chemicals (some of which are toxic) underground at high pressure to break up oil-bearing rock formations, allowing the oil to flow more freely. There is some concern that this process can impact the quality of water in usable aquifers above the oil producing formations. Fracking is typically performed at considerable depths, well below usable aquifers. Currently, there are fairly stringent state guidelines that must be met before a well can be stimulated. Among other things, baseline water quality and water quality benchmarks in the usable aquifer must be established before a fracking operation can be permitted. Groundwater quality monitoring wells must be constructed and monitored before, during and after the fracking operation. The oil well must be sealed through and below the bottom of the usable aquifer. In addition to the regulations currently in place, California lawmakers are considering additional regulations and safeguards regarding future fracking in California. Oil companies are also working towards developing safer, bio-degradable chemicals to use in the process.

Disposal of Oilfield Brine and Hydraulic Fracturing Chemicals (wastewater). Oil well development can also impact water quality through disposal of brine wastewater. When oil wells are pumped, large quantities of water are also produced. The water derived from oil field operations can have very high salinity (~50,000 to 100,000 ppm

total dissolved solids) and chemicals post hydraulic fracturing, and there is little demand for treating and recycling the water due to the high costs. Most of this water is disposed in deep injection wells built for this purpose.

Oil and Gas Fields in the GMP Area. There are currently six gas fields in the western portion of the GMP area: Any Field, Ash Slough Gas Field, Gill Ranch Gas Field, Merril Avenue Gas Field, Merril Avenue Southeast Gas Field; and Moffat Ranch Gas Field. To date, 296 gas wells have been drilled and completed. Of this total, 31 wells are actively producing gas, 6 are new with no production data, 3 are idle with the potential for production and 252 have been plugged and abandoned.

All oil, gas and geothermal resource exploration, development, stimulation and production are overseen by the California Division of Oil, Gas and Geothermal Resources (DOGGR). Additionally, all oil/gas field brine disposal is overseen by DOGGR. Information for each well can be obtained through the DOGGR interactive website: http://www.conservation.ca.gov/dog/Pages/Index.aspx.

Existing Activities

- Implement DWR Bulletin 74-84 and 74-91 Water well standards for the construction of new wells.

Planned Actions

- Educate growers on the proper use of pesticides, herbicides and fertilizers.
- Seek funding to improve security at participant facilities and reduce the potential for contamination from acts of vandalism or terrorism.
- Follow State and County well construction standards for wellhead protection to protect groundwater quality.
- Construct, abandon and destroy wells according to State and County standards.
- Assess and identify the availability of high-quality surface water supplies to augment groundwater use, to recharge the groundwater basin, and to create a conjunctive use program.
- Update the County's well standards to reduce the risk of cross contamination or degradation of good quality water, refer to Section 8.1 for more details.

7. GROUNDWATER SUSTAINABILITY

7.1. Issues Impacting Groundwater Sustainability

A number of activities, both natural and man-made can impact groundwater sustainability. Long-term availability of the GMP area's groundwater resource will ensure that present and future demands are met. Establishing responsible groundwater use will help protect groundwater rights and maintain local control. Basin adjudication of the groundwater basin is possible if long-term groundwater sustainability cannot be achieved. Several issues that can impact the long-term groundwater sustainability are discussed below.

Groundwater Overdraft

Groundwater overdraft results in a net loss of the available groundwater resource. The overdraft in the GMP area is projected to be about 259,000 AF per year by 2017 when exiting orchards are mature as discussed in Section 2.5 and calculated in **Table 2.3**. This estimate assumes that no further increases in demands due to cropping or population growth. (It is beyond the scope of this document to forecast future growth but should be performed in a separate study). As overdraft continues, groundwater users are required to pump water from deeper depths and groundwater quality may decline in some areas as deeper water is extracted.

Regional Groundwater Recharge

Large portions of the Madera area geology and climatology is not conducive to groundwater recharge in quantities sufficient to offset the current rate of groundwater use. Large portions of the GMP area, especially in the east, have soils with very slow infiltration rates (**Figure 2.2**). The limited areas with groundwater recharge potential are described in Sections 2.2 and 2.6. Artificial groundwater recharge programs to capture storm water runoff and river flows that would otherwise be lost in flood releases to the sea will be an important tool to help reduce the current rate of depletion of the groundwater basin.

Agricultural/Urban Development

Agriculture is important to the economic viability of the GMP area. Changes in cropping patterns, such as converting dry pasture to permanent crops, have increased overall water demands in recent years. In addition, permanent crops cannot be fallowed in dry years, leading to a hardening of demand regardless of the type of water year. Where groundwater is the sole source for irrigation needs for water-intensive crops, pumping depressions have formed and will enlarge. Pumping depressions result in a reduction of the available resource as well as increased electrical costs to pump the water to the surface.

Every acre of previously-fallow land that is developed, whether for agricultural or urban uses, potentially places a greater demand upon the groundwater aquifer. Currently there are no restrictions on conversion of fallow land to new agricultural uses, and

landowners are entitled to drill water supply wells on their own properties to support such plantings. Urban uses, on the other hand, are regulated not only by each local agency's land use authority but by State Water Code and CEQA. Madera County, for instance, has used these requirements in combination to help assure that proposed new residential developments, particularly in the southeast unincorporated areas of the County, demonstrate groundwater balance plans before project entitlements are granted.

Land Subsidence

Land subsidence is the gradual decline or sudden lowering of the land surface elevations due to inelastic compaction of the underlying sediments. Although there are several causes of inelastic land subsidence, the compression of clay as a result of groundwater extraction is most likely the cause of subsidence documented in the San Joaquin Valley.

Once water is removed (mined) from the compressible clay, the clay compresses, resulting in the lowering of the overlying land surface. The compressed clay can no longer store water, thus there is no opportunity to reverse the subsidence in these areas. Compressible Clays, such as the Corcoran Clay Member of the Tulare Formation, has been mapped over much of the western side of the San Joaquin Valley. The subsidence documented extends over a very large area, with ground surface declines of over 30 feet recorded in some areas. Recent investigations have indicated that subsidence is accelerating in parts of the San Joaquin Valley. Refer to Section 2.7 for more details on land subsidence in the GMP area.

Water Quality Degradation

Conserving the quality of the groundwater resource is a main goal of the GMP participants to ensure enough water of high quality is available for both urban and agricultural uses. A major concern is that the confined fresh water aquifer overlies a second confined aquifer containing extremely saline water with TDS in some areas measured in excess of 10,000 ppm. Water quality degradation could occur if wells are drilled deeper into these marine sediments, thereby tapping the underlying saline waters beneath the fresh water aquifers.

Below the saline water there are deposits of methane gas stored in natural rock formations. Wells completed deep enough could potentially cause upflow of saline water and in some areas methane gas might begin to migrate upward into the fresh water aquifer. Wells that are perforated across multiple aquifer zones can allow water of poor quality to migrate into aquifers with good water quality. As well, direct recharge of surface water in certain areas can cause migration of plumes of contamination. One of the main goals of the GMP Participants is to maintain the high quality groundwater to continue to meet drinking and agricultural standards.

Reductions in Surface and Imported Water

The San Joaquin River Restoration project will continue to reduce available surface

water to the County of Madera, Chowchilla Water District, Gravelly Ford Water District and Madera Irrigation District. Declines in surface water allotments will likely result in additional groundwater extraction to meet water demands.

Reduction in imported surface water deliveries can cause a shift to increasing reliance on groundwater supplies to provide for total water demand. Reductions related to year-to-year climatic changes (drought years and wet years) and environmental issues could reduce the amount of water delivered each year. As surface water imports decline, increased groundwater pumping can cause groundwater levels to decline at an increased rate, as well as increase the incidence of land subsidence.

The San Joaquin River Settlement will reduce water deliveries to water contract holders and leave more water in the river for environmental flows. This will directly impact Friant Division CVP water supplies available to Madera Irrigation, Chowchilla Water District, and Gravelly Ford Water District. Madera County has a Friant contract for 200 AF/year but the water is used in the foothills outside of the GMP area.

Several forms of mitigation were promised to the water contractors, both in terms of water and monies. However, the water contractors have seen limited mitigation so far and the reliability and consistency of future mitigation is questionable. **Table 7.1** shows the anticipated impacts to the districts with and without mitigation.

Table 7.1 – Estimated Losses to Friant Water Contracts from San Joaquin River Settlement (units in AF/year)

District	Total Losses	Losses after all mitigation waters are received
Gravelly Ford WD	1,700	500
Madera ID	27,500	7,500
Chowchilla WD	22,600	6,200
Total	**51,800**	**14,200**

Source: Provost & Pritchard, San Joaquin River Restoration Water Supply Impact Tool, 2007. Losses were estimated using a spreadsheet model based on the anticipated settlement. Impacts to CVP Class I, Class II, and Section 215 water supplies were estimated for each Friant CVP contractor. Mitigation waters were estimated for '$10 water' (additional water provided to contractors for $10/AF), re-circulated San Joaquin River water, and assumed $50 million for recharge projects

The Gravelly Ford Water District has historically been able to purchase about 2,000 AF/year of additional water, beyond their water contract, from USBR. This is water which, in the past, would have flowed past GFWD to a dry portion of the San Joaquin River. The water was sold to GFWD since it did not appear to have habitat benefits to a dry reach of the river. With the advent of the River Restoration program, these water sales have ceased. Since this water was not part of regular CVP supplies, the impact of its loss is not shown in **Table 7.1.** However, the cessation has had a real impact on the regional groundwater overdraft, and a very significant impact on GFWD.

Groundwater Management Funding

Any new property tax assessments will be subject to a Proposition 218 election requiring 2/3 voter approval in order to be imposed. Therefore raising revenues to fund groundwater management, replacement, and monitoring activities would require 2/3 voter approval. In addition, an engineering study would need to be provided identifying the benefits received by each parcel, and the amount of the proposed assessments for each parcel. These requirements add additional cost and make it very difficult to levy any assessments. Other funding alternatives are discussed in Section 9.6 – Program Funding and Fees.

7.2. Overdraft Mitigation

This section provides a list of strategies to mitigate groundwater overdraft, identifies the high priority strategies for each GMP Participant, and describes several of the strategies.

Groundwater overdraft can be mitigated both by reducing demands and increasing surface water supplies. MID, CWD and GFWD all make substantial impacts on groundwater overdraft by importing, on average, a cumulative of about 320,000 AF of surface water each year between 2004 and 2013. Surface water delivered to the City of Madera, City of Chowchilla and Madera County averaged 23,400 AF/year between 2004 and 2013. This water comes from MID, CWD and San Joaquin River riparian rights.

7.2.1 Summary of Overdraft Mitigation Strategies

Numerous alternatives are available to mitigate groundwater overdraft. Identifying strategies to address overdraft is one of the main goals of the Madera Regional Groundwater Management Plan. **Table 7.2** lists over 20 strategies with some potential to help alleviate overdraft. These strategies fall into seven groups, including conjunctive use, surface water, land management, groundwater use restrictions, water conservation, funding and public education. **Table 7.2** also provides the section of the GMP in which the individual strategies are discussed, and the estimated length of time to implement each of the various strategies.

Table 7.2 – Strategies for Addressing Groundwater Overdraft

No.	Category	Description	GMP Section	Estimated Time to Potential Implementation (years)		
1	Conjunctive Use	Groundwater Recharge	7.3, 7.4		1 - 5	
2		Groundwater Banking	7.4		1 - 5	
3		Intentional Irrigation Field Flooding	7.3		1 - 5	
4	Surface Water	Flood and Storm Water Capture (recharge or direct use)	7.3		1 - 5	
5		Identify and Import New Surface Water Supplies	7.2		1 - 5	
6		Increase Surface Water Storage	7.2			>5
7		Increase Conveyance Capacity	7.2		1-5	
8		Surface Water Treatment	7.2			>5
9	Land Management	Agricultural Land Conversion / Reserve Open Space	9.1		1 - 5	
10		Expand Districts/Form New Districts	9.1			>5
11		Crop Conversion (salt tolerant or low water use)	7.6	0 - 1		
12		Land Use Planning Regulations	9.1	0 - 1		
13		Disclaimer for Property Purchases	9.1	0 - 1		
14		Work with Adjacent Entities	4.2, 4.3	0 - 1		
15	Groundwater Use Restrictions	Prohibit Groundwater Exports	7.2	0 - 1		
16		Groundwater Pumping Restrictions	8.1	0 - 1		
17		Restrictions on Well Permits	8.1	0 - 1		
18	Water Conservation	Water Use Restrictions in Droughts	7.6	0 - 1		
19		Agricultural Water Conservation	7.6	0 - 1		
20		Urban Water Conservation	7.6	0 - 1		
21		Water Recycling	7.7			>5
22	Funding	New Fees to Fund Recharge Projects	9.6		1 - 5	
23		Groundwater Pumping Fees	9.6	0 - 1		
24	Education	Public Education	7.6	0 - 1		

These strategies are addressed at a planning level throughout this GMP. They are discussed in various sections because many of them relate to other required sections of GMPs, as dictated by the California Water Code. Those strategies that are not part of a GMP Section are discussed below. When implemented, each of these strategies will

provide a certain amount of overdraft mitigation, but it is certain that numerous strategies will be needed to arrest the total current and projected overdraft.

7.2.2 Proposed Overdraft Mitigation Strategies for GMP Participants

Each strategy listed in **Table 7.2** has geographic and legal limitations. Some are not applicable to certain types of agencies or in certain geographic areas covered in this plan. In addition, some geographic areas have higher rates of overdraft than others and will need to use a larger portfolio of mitigation measures. **Table 7.3** lists the 'high-priority' strategies that apply to each GMP Participant. Some strategies are not listed under a GMP Participant, but they are still considered viable alternatives and may be considered in the future. The GMP Participants determined the high priority strategies in **Table 7.3** through a series of interactive workshops. The Participants considered economic feasibility, practicality of a given strategy, past experience and local knowledge during deliberations.

Table 7.3 – High Priority Strategies for Addressing Groundwater Overdraft

Description	Madera Co.	MID	CWD	City of Chowchilla	City of Madera	SEMCU
Groundwater Recharge	x	x	x		x	x
Groundwater Banking		x				
Intentional Irrigation Field Flooding	x	x	x			
Flood and Storm Water Capture (recharge or direct use)	x	x	x		x	x
Identify and Import New Surface Water Supplies	x	x	x		x	
Increase Surface Water Storage	x	x	x		x	x
Increase Conveyance Capacity	x	x	x		x	
Surface Water Treatment	x	x			x	
Agricultural Land Conversion / Reserve Open Space	x	x	x		x	
Land Use Planning Regulations	x					
Disclaimer for Property Purchases	x					
Work with Adjacent Entities	x	x	x		x	
Prohibit Groundwater Exports	x	x				
Water Use Restrictions in Droughts				x	x	
Agricultural Water Conservation	x	x	x			
Urban Water Conservation	x			x	x	
Water Recycling	x					x
New Fees to Fund Recharge Projects	x	x	x		x	
Public Education				x		x

7.2.3 Description of Overdraft Mitigation Strategies

Following are discussions on several overdraft mitigation strategies that are not covered in other State mandated Sections of the GMP. However, the GMP Participants recognize that the following overdraft mitigation strategies will be important components of addressing overdraft. Refer to **Table 7.2** for the locations within this Plan where the other strategies are addressed.

Increase Surface Water Storage

Increasing surface water storage can have a large positive impact on total annual water supplies. In the region, the three main reservoirs with Sierra Nevada watersheds are Millerton Lake, Hensley Lake, and Eastman Lake. In addition, Madera Lake is a

medium-sized reservoir used for storage and regulation for MID. Building new dams on the local rivers could substantially increase water storage.

The proposed Temperance Flat project, which includes a new dam located upstream of Friant Dam on the San Joaquin River, would conserve about 175,000 AF/year. The GMP area would not receive or be entitled to all of this water. Other interests including the Friant Water Users Authority, San Joaquin River Restoration Project and the San Joaquin River Exchange Contractors would be also be recipients of portions of the water. However, new dams are certainly long-term projects and face significant funding and regulatory hurdles. Raising existing dams may be a more realistic option, but would still be a long-term option and require a minimum of five to ten years to implement.

Dam raising projects are relatively-large endeavors that entail detailed planning, environmental and engineering studies. However, as evidenced by the recent raising of Terminus Dam on the Kaweah River, these projects can be viable. Raising the Terminus Dam spillway by 21 feet increased the available storage in Lake Kaweah by 42,000 AF, from 143,000 AF to 185,000 AF. No recent dam-raising studies for the local reservoirs are available. MID has considered raising Madera Lake Dam, but has not performed any studies to date. Raising Friant Dam, if technically feasible, would not be practically feasible if the Temperance Flat project is constructed since the two facilities would then overlap.

Increase Conveyance Capacity

Increasing conveyance capacity can help increase water deliveries for intentional recharge, and allow delivery of water to lands that rely solely on groundwater. If large-scale recharge and banking projects are developed, existing conveyance facilities may be a limiting factor. For example, Kings River and San Joaquin River floodwaters are available approximately once every three years for about 120 days at a time. If the recharge target is an average of 100,000 AF/year, then facilities capable of accepting 300,000 AF within 120 days would be required. This would require a conveyance capacity of 1,250 cfs for the 120 days. This exceeds the capacity of portions of even the Madera Canal, which is the largest canal in the area, and its capacity ranges from 1,275 cfs down to 625 cfs. Three separate siphons on the Canal are limited to 1,500 cfs each. Estimating the cost of expanding the Madera Canal, or providing alternative reliable conveyance to recharge facilities, would require a detailed feasibility study that evaluates existing demands on the canal, anticipated future demands with San Joaquin River Restoration impacts, choke points, hydraulic grades and right of way issues.

Expand Area Served by Surface Water

Some land areas do not have facilities to receive surface water. Developing infrastructure to allow surface water delivery to these lands would not create new water supplies, but would allow districts to take greater advantage of surplus waters in wet years. The GMP area evaluated for this study includes about 223,000 acres of land that have surface water contracts (CWD, MID and GFWD) and about 295,000 acres of land

that have little to no surface water (unincorporated County, City of Madera, City of Chowchilla).

Chowchilla Water District In-lieu Recharge Study. Fugro (2006) evaluated the benefits of new infrastructure that could deliver surface water to certain areas in CWD that currently lack the ability to use surface water. The Fugro study demonstrated that supplemental deliveries of surface water in-lieu of groundwater pumping would provide significant benefits to the groundwater resources. The study showed that increases in water levels and groundwater storage achieved during wet years do not completely diminish during dry years. Groundwater level increases of 5 to 10 feet were predicted over large portions of CWD even after four dry years.

The Fugro report also included the annual theoretical amount of CVP supplies available to but not purchased by CWD over the base period of 1993 to 2004. This amount ranged from 0 AF in dry years to as much as 40,000 AF in 1995 when Class 1, Class 2, and floodwaters were available. Over the base period, an estimated 127,220 AF, or about 10,600 AF/year, of available surface water went unused. This water was not purchased or used by the District mainly because of insufficient interests by local farmers to purchase the water. District staff noted to Fugro that many farmers believe CVP water was either too expensive or too inconvenient to physically receive into their irrigation systems. Several model scenarios were evaluated, showing water supply benefits ranging from 3,000 AF to 28,000 AF/year. These quantities of unused water supplies, and the benefits of new delivery infrastructure, will likely decrease with the impacts from the San Joaquin River Restoration.

Prohibit Groundwater Exports

Madera County and Madera Irrigation District (MID) both have regulations governing the exportation of groundwater from their service areas (see **Appendix G**). The potential impacts from exporting groundwater are summarized in the Madera County ordinance as follows:

> "*The direct or indirect transfer of groundwater from Madera County may have significant environmental impacts on Madera County including, but not limited to, increased groundwater overdraft; land subsidence; uncontrolled movement of contaminated groundwater, uncontrolled movement of poor quality groundwater; the lowering of groundwater levels; increased groundwater or soil degradation; and loss of aquifer capacity due to land subsidence*" (Article V of Title 13, Madera County Code).

These regulations provide Madera County and MID with regulatory controls over the exportation of groundwater, but also address regulation of groundwater banking. Generally groundwater cannot be exported from the County unless an equivalent amount of other water supplies are imported.

The regulations do not give the County jurisdiction over lands within the boundary of a local water agency or incorporated city. Rather, within these areas, regulatory powers reside with the local water agencies or incorporated cities which are governed by various statutes and regulations, including CEQA, that ensure that groundwater exports address potential environmental impacts. Therefore, all of the GMP Participants have, under existing Codes and Statutes, the regulatory authority to limit groundwater exports. Nevertheless, it is recommended that the other GMP Participants adopt a specific ordinance or regulation, similar to those adopted by Madera County and MID, to restrict groundwater exports.

Identify and Import New Surface Water Supplies

Most of the surface water supplies naturally flowing into the GMP area are fully allocated. The only available unallocated supplies are flood flows, which could potentially be used for groundwater recharge or banking. However, new water supplies could be imported to the GMP area from other parts of the Valley and the State. These may require complex exchanges and would likely have high costs compared to current local water prices.

One example is the long-term water purchase by Root Creek Water District (RCWD), located in southeastern Madera County. RCWD has agreed to purchase up to 7,000 AF/year from the Westside Mutual Water Company, located in Kern County, with prices starting at $600/AF and escalating over time. The water will be delivered to RCWD through a series of exchanges. This is an example of a recent water purchase in Madera County, and illustrates that large water transfers into the area are feasible. The agreement in RCWD will ultimately be absorbed by urban developments. Such costs are probably not realistic for irrigation water.

Potential water purchases are not identified here, but would require personal discussions with other water agencies. There may be some potential in purchasing additional water (above what is currently purchased by CWD) from Merced Irrigation District or the members of the San Joaquin River Exchange Contractors Water Authority.

Regional Surface Water Treatment Plant

A regional surface water treatment plant could be constructed at the base of Madera Lake and send water to the Cities of Madera and Chowchilla, as well as the Madera Ranchos area. The treatment plant would likely use MID and/or CWD surface water supplies. Such a surface water treatment plant could help reduce groundwater pumping in the two Cities and have some positive impact on groundwater levels in CWD and MID. A regional surface water treatment plant has been discussed but no formal studies have been performed. One obstacle is the lack of year-round surface water; this could be addressed by increasing storage space in a local reservoir. MID and CWD currently have contracts for agricultural water, but do not have authority to deliver municipal and industrial water. Amending the contracts may be difficult and face public opposition from local growers. Estimating the cost of a treatment plant

would require a detailed study, but it could be on the order of $50 million to $100 million.

Existing Activities

- Restrict groundwater exports from the GMP area

Planned Actions

- CWD, MID and GFWD will pursue the transfer of surface water supplies into the County
- CWD, MID, and Madera County will increase the number of surface water users
- SEMCU will continue to assist with the demonstration project at Liberty High School
- Madera County and SEMCU will continue efforts for a surface water treatment plant for the Madera Ranchos
- Madera County will continue to pursue removal of vegetation from conveyance facility channels to reduce evapotranspiration to make that water available for delivery and groundwater recharge
- MID to perform analysis of increasing capacity of Madera Canal to convey floodwaters when available

7.3. Groundwater Replenishment

Replenishment of groundwater is an important technique in management of a groundwater supply to mitigate a condition of overdraft. Replenishment of groundwater underlying the Madera region occurs both naturally and through intentional means including deep percolation of crop and landscape irrigation, wastewater effluent percolation, intentional recharge and river seepage. The total recharge in the GMP area is estimated to be about 500,000 AF/year based on data from 2003-2014. Much of the recharge comes from imported surface waters (deep percolation of irrigation and intentional recharge).

Intentional Irrigation Field Flooding, and Flood and Storm Water Capture are identified in **Table 7.2** as strategies to increase groundwater replenishment and are discussed below.

Intentional Irrigation Field Flooding

Intentional irrigation field flooding (field flooding) for groundwater recharge occurs when agricultural fields are flooded with water in excess of the crop water demand. This is not widely practiced in the GMP area, but has some potential to increase the total area of lands that could be utilized for recharge in wet years. Field flooding is normally done on agricultural lands planted to annual crops, especially when the land is fallow. Field flooding would generally be performed on a voluntary basis by growers who wish to contribute to overdraft reduction; as a result some education and promotion may be

necessary. They may also be interested if the flooding can provide pre-irrigation and salt leaching benefits. Generally growers would not flood their fields unless the water is free. It should be noted that intentional field flooding will only benefit groundwater resources if the source of water used to flood fields is not locally pumped groundwater.

The viability of field flooding in the GMP area is further limited by the complex soil profile common throughout the Valley area. Numerous subsurface clay lenses are present, and these impermeable layers restrict the effective percolation of applied surface water to the aquifer.

Field flooding is less viable on lands planted with permanent crops; mainly orchards. Several concerns that would need to be considered are the propensity for root rot, timing of pruning/shredding, and application of insecticide/herbicides. Another main concern, especially for shallow-rooted trees like almonds, is that when the field is saturated, even moderate winds can cause trees to blow over. As well, on lands that have been converted from annual crops to permanent crops, the infrastructure may no longer be in place to facilitate field flooding. Consequently, field flooding probably has limited potential in the GMP area.

Flood and Storm Water Capture

The local cities and districts currently have the facilities to capture significant amounts of flood and storm water. These could be expanded with additional recharge facilities. The following strategies could be used to capture more water for recharge:

- Construct additional stormwater detention and groundwater recharge basins
- Hold stormwater in basins as long as feasible to promote recharge
- Districts could provide water to Cities to recharge in their stormwater basins
- Expand districts so more land is accessible for the capture, storage and recharge of surplus waters
- Develop a maintenance program for existing streams, canals, and recharge basins to maintain and/or improve recharge rates
- Implement LID (Low Impact Development) and green infrastructure to maximize opportunities to infiltrate storm water within urbanized areas
- Coordinate with municipal agencies to encourage coordination of municipal storm water planning with the goals of this GMP

The three main water sources include San Joaquin River, Fresno River and Chowchilla River flows.

1. San Joaquin River. Historical flood releases from the San Joaquin River, and the adjacent Kings River, have typically flowed about once every third year, for about 120 days at a time. This is a good general estimate of available flood water on the San Joaquin River. A proprietary analysis that considers river

restoration impacts estimates that San Joaquin River flood flows will average about 55,000 AF/year in the future.

2. Chowchilla River. Fugro (2006) estimates that flood releases from Buchanan Dam on the Chowchilla River averaged 23,000 AF/year between 1993 and 2004. According to the San Joaquin Valley Water Year Hydrologic Classification Index (http://cdec.water.ca.gov/cgi-progs/iodir/wsihist), this period is hydrologically similar to the period from 1993 to 2013 (indexes of 3.48 versus 3.55). Therefore, 23,000 AF/year is considered a reasonable long-term estimate of available floodwater.

3. Hidden Dam. No studies are readily available on spills from Hidden Dam. Estimating the available water would require a detailed study including a hydrologic simulation of a minimum of 10 years of data and associated water demands. Lacking such a study, the flood flows from Hidden Dam are preliminarily estimated to average about 15-20,000 AF/year, based on basic information on the river, dam and watershed.

Developing accurate estimates of available flood flows would require a detailed study that investigates dam releases over a minimum 10-year period, contract water demands, demands for the flood waters from other agencies, minimum environmental flows, diversion capacities, and the timing of the releases. Such a study can provide a more accurate assessment of available water and recharge potential in the Madera Area.

Estimated Costs to Recharge Water

The cost to develop recharge basins varies, but conceptual costs for general discussion can be estimated using the basic assumptions in **Table 7.4**.

Table 7.4 – General Groundwater Recharge Assumptions (2014 dollars)

Description	Value	Notes
Recharge Basin Cost (Land and facilities)	$25,000/acre	Blend of average cost of several rural recharge projects in Fresno County ($20,000 for land and facilities), and land costs in the City of Madera ($66,000/acre)
Operation and Maintenance Cost	$100/acre/year	
Water Purchase Cost	$50/AF	Typical cost for surplus & flood water in Madera area
Water Availability	120 days every third year	Typical availability of Kings River and San Joaquin River floodwater
Infiltration Rate	0.25 ft/day	Assumed average

The infiltration rate of 0.25 ft/day used in this analysis is a conservative estimate of the long-term infiltration rate. This assumed infiltration rate is estimated based on local experience, the general lack of good recharge sites in the county, and the fact that lands with high infiltration rates may not be available for acquisition, and there has been no county-wide study of infiltration rates. The actual costs per AF to recharge water will need to be determined on a site by site basis during the feasibility phase prior to acquiring property for the purpose of groundwater recharge. In addition, several recent local recharge facilities were not sited based on the infiltration rate of site soils, but rather on the availability of that land for purchase. This clarifies the importance of identifying areas with high potential for recharge as these areas will provide more effective and cost efficient recharge.

Using the data as presented in **Table 7.4**, a one acre basin could recharge on average 10 AF per year or 300 AF over a 30-year life expectancy. This calculation is based on the assumption that water would be available for recharge on average for 120 days per year, and flood waters available for recharge occur on average once every 3 years (120 days/365 days per year X 1 year/3 years) X 0.25 ft/day infiltration rate = ~10 AF per year. The operation, maintenance and water purchase costs would be $10,500/acre over a 30-year period. This results in a unit cost of ($25,000 (land and facilities) + $15,000 (water cost) +3,000 (O&M cost)/300 AF = $143/AF or approximately $145/AF. This does not include the cost to convey water. The cost to develop recharge basins varies geographically and by project, so this number should be considered approximate, but can be useful for general planning purposes. The City of Madera has estimated that the cost to purchase land in the City is $66,000 per acre, however the majority of recharge basins developed in the Plan Area will be on lower value agricultural land; therefore the costs per acre provided above is a blended

estimate.

Approximately 5,000 acres of recharge basins will be needed to mitigate an overdraft of 50,000 AF/year, pursuant to the short term goal of recharging 50,000 AF/year. This short term goal is meant to be achievable in the 1 to 5 year time frame and is a significant step towards the overarching BMO of Stabilization of Groundwater Levels by 2024. The annual cost to mitigate 50,000 AF/year of overdraft would be $7,250,000. Over a 30 year period (the life expectancy of the recharge basins) the total cost would be $218 million.

The estimated cost to mitigate the total overdraft of 259,000 AF/year (at $145/AF) through recharge would be $36.5 million/year, if sufficient surplus waters were available. However, as stated above, the anticipated surplus waters from the Fresno, Chowchilla and San Joaquin Rivers will be on the order of only 100,000 AF/year, and there will be other demands for this water and the timing of the flows will restrict how much can be captured. The GMP Participants have therefore set a goal of increasing recharge by 50,000 AF/year. A detailed study is needed to refine this number. Recharging more water may require importing water from other areas or constructing/raising dams. It is clear that recharge can make a significant contribution to mitigating overdraft, but it must be combined with other alternatives if overdraft is to be arrested.

Existing Activities

- Continue existing recharge programs

Planned Actions

- City of Madera will pursue recharge in the Schmidt Creek Flood Control and Groundwater Recharge Project
- GFWD will analyze expansion of Franklin Secara Basin
- GFWD will expand recharge opportunities in the Gravely Ford Canal-recharge basin
- Madera County and MID will pursue the viability of a dam on the Fresno River
- Madera County and the City of Madera will pursue recharge at Ellis Basin
- Madera County will pursue recharge at the SWC Road 29 and Avenue 29 Basin
- Madera County, MID, and City of Madera will continue to pursue recharge opportunities at the Air Port Basin and Avenue 12 Basin
- Madera County, MID, CWD, and GFWD will make efforts to implement an Irrigation Field Flooding program
- MID, CWD, and City of Madera will pursue recharge opportunities at golf course basins
- Perform detailed study to estimate the ability to capture and recharge floodwaters from the Fresno, Chowchilla and San Joaquin Rivers.

- Perform feasibility studies on existing streams, rivers, and recharge basins to develop strategies to increase recharge rates.
- Plan Participants, except the City of Chowchilla, will pursue future storm water collection/recharge projects

7.4. Conjunctive Use of Water Resources

Conjunctive use or management refers to the coordinated and planned use of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives (ACWA, 2011). Currently, surface water is limited in Madera County. The County of Madera, Chowchilla Water District, Gravelly Ford Water District, and Madera Irrigation District have and utilize surface water supplies to various extents. As GMP Participants secure additional surface water supplies, conjunctive use can be an effective management practice to ensure a long-term groundwater supply. For example, in years of reduced surface water availability, more groundwater could be used and groundwater levels might decline. Conversely, in years of full surface water availability, groundwater use could be curtailed and groundwater levels allowed to recover. Whenever possible, surface water should be used to the fullest extent practical, with groundwater serving as secondary supply. This practice will help maximize the available water supply because unused surface water generally flows downstream and is lost, but unused groundwater remains in the ground and would be available for later use.

Several steps can be taken to help ensure that surface water is fully utilized including: 1) construction of recharge basins; 2) selling or delivering surplus surface water to other agencies in the GMP area; 3) pricing surface water so it is competitive with groundwater pumping costs; and 4) expanding surface water delivery systems so more land can be served.

Implementing the use of recycled water to help offset groundwater withdrawals will reduce demand on the groundwater system. Regional wastewater treatment plants can provide recycled water for irrigation needs to agricultural customers or for landscaping. Recycled water can also be utilized to provide a “new” source of water to aid in incidental groundwater recharge.

Some existing conjunctive use programs in the GMP area are described below:

Madera Irrigation District

The MID Water Supply Enhancement Project (Project) as proposed involves water-banking facilities to recharge groundwater for water supply enhancement. The Project is located on Madera Ranch and consists of approximately 13,646 acres, located in southwestern Madera County south of the Fresno River, approximately five miles southwest of the City of Madera (**Figure 2.12**). The water bank will ultimately have capacity to store up to 250,000 AF/year. The water will recharge the groundwater basin through natural swales (ancient creek beds) and with 323 acres of recharge basins.

The Project aims to bank available surplus surface water in wet years for use in dry years. Currently, the Project is in the planning phase. MID also percolates surface water in the unlined portions of their canal systems and in various basins throughout MID and the City of Madera.

Chowchilla Water District
The CWD percolates water in their unlined canals, local sloughs, recharge basins and City of Chowchilla stormwater basins.

City of Madera
The City of Madera Waste Water Treatment Facility provides primary and secondary treatment with a capacity of 10.1 million gallons per day. The plant has 320 acres of land for effluent incidental recharge and evaporation. The City of Madera storm water system also drains flows to rivers and creeks and detention and retention basins.

City of Chowchilla
The City of Chowchilla provides for incidental recharge and evaporation of secondary effluent from its wastewater treatment facility.

Existing Activities

- Surface water recharged in existing City storm water basins
- Surface water recharged in existing MID basins and canals
- Surface water recharged in CWD canals and sloughs

Planned Activities

- MID's Water Supply Enhancement Project
- CWD will attempt to develop additional surface water storage
- MID and Madera County will evaluate feasibility of increasing storage in Lake Madera
- Identify and preserve lands with the potential for recharge
- Seek funding to develop additional regional recharge capacity
- Annex lands near existing water districts to provide surface water deliveries to meet demands

7.5. Land Subsidence Mitigation

Land subsidence in the GMP area is caused by pumping groundwater from the deeper confined aquifer that is separated from the shallower unconfined aquifer by the Corcoran Clay, the regional aquitard throughout the San Joaquin Valley. Subsidence is a process that can be slowed or stopped, but the inelastic subsidence that occurs in fine-grained layers such as those present in the western part of Madera County cannot be reversed. Any effort to mitigate land subsidence must substantially reduce or eliminate reliance on deep aquifers (those beneath the Corcoran clay) as a water

source.

A coordinated effort in northwestern Madera County, specifically the Red-Top area (see **Figure 1.1** for the location of the Red-Top area), has been implementing methods to mitigate land subsidence. This effort is funded by the local growers, Madera County and Central California Irrigation District. As part of these efforts, the following activities were implemented in 2013 to reduce pumping from the deep aquifer:

- Convert pumping from primarily deep wells to primarily shallow wells on Triangle T Ranch.
- Substitution of two deep wells on Vlot Property for two shallow wells on Triangle T Ranch.
- Fallow late-year forage crops and purchase feed from an outside source.
- Secure and distribute a supplemental water supply from an outside source.

These activities resulted in a 6,000 AF/year reduction in deep well pumping (estimated by CCID District Manager pursuant to observations and conversations with local growers, 2013). These efforts represent a good model of regional cooperation among local agencies to address land subsidence.

Telescoping compression sections can also be used in new wells to reduce the impacts to well casings and well foundations. These do not mitigate the rate of subsidence but reduce collateral damage and impacts. They are typically only affordable on large capacity wells.

Additional long term solutions to achieve a reduction in deep well pumping have been suggested by the Land Subsidence Solution Program, USGS, DWR, Reclamation and other stakeholders. These include:

- Existing wells:
  - Convert to more efficient irrigation practices
  - Convert to crops with a lower water demand
- New Wells
  - Allow only shallow wells to be drilled in subsidence areas
- Development of a groundwater bank in the shallow aquifer (above Corcoran Clay) for overlying farming utilizing all available flood flows from local sources
- Secure a supplemental water supply from an outside source
- Develop a water distribution system to areas not served by surface water

Ultimately, reducing land subsidence comes down to reducing groundwater overdraft. Numerous overdraft mitigation alternatives, including those listed above, are discussed in more detail in Section 7.2 – Overdraft Mitigation.

Existing Activities

- Interagency monitoring and study of subsidence: USGS, USBR, DWR, USACE, and various stakeholders.
- Formation of Western Madera County Subsidence Project, which includes Central California Irrigation District, San Luis Canal Company, Washington Area Growers, Red Top Area Growers, Merced County and Madera County.
- Monthly subsidence coordination meetings between agencies and stakeholders.

Planned Actions

These planned actions primarily apply to CWD and unincorporated areas of Madera County where subsidence is occurring, however, they would apply to other areas if subsidence is observed in the near future:

- Develop a shallow groundwater banking program.
- Develop recharge basins to make use of available flood waters.
- Develop a water well replacement strategy.
- Explore potential to inject flood waters into the deeper aquifer.
- Construct internal conveyance infrastructure improvements to provide surface water to more areas.
- Implement other overdraft mitigation strategies identified in Section 7.2.
- Re-activate existing water districts, or annex into existing nearby water districts to import surface water supplies where feasible.
- Develop an enhanced conjunctive use program to perform intentional recharge in the lower aquifer.
- Madera County plans to develop policies for new well permits in the proximity of the subsidence area, to require wells to be constructed so they extract from the upper aquifer only, and limit the deep well extractions.

7.6. Water Conservation and Education

Water conservation can help reduce water demands and stress on groundwater resources. Below are discussions on agricultural and urban water conservation potential in the GMP area.

Agricultural Water Conservation

Agricultural water conservation through conversion to high efficiency drip and micro-sprinkler systems has limited potential in the GMP area. According to the California Department of Water Resources Land Use Data, Water Conservation and Land and Water Use Section, 66% of the crops in the GMP area already have high efficiency irrigation systems. This reflects the large percentage of the total area planted with

permanent crops. Moreover, local irrigators and water managers have found that these systems do not conserve total water consumed over time, because they result in less deep percolation, and their precise water application paradoxically increases yields and thereby increases evapotranspiration demands. These systems have also allowed sloped land that is unsuitable for flood or furrow irrigation to be developed, thus increasing water demands. In summary, these systems have helped to increase agricultural output, but have not likely reduced water consumption.

Growers of annual crops may be able to change to crops or varieties that are more salt tolerant, drought tolerant or require less water. This can result in significant water savings if performed over a wide area, but may require conversion to less-valuable crops, which could have negative economic impacts. In California, such changes have typically only been made when there are severe water shortages or the high local cost of water has merited such conversions.

The districts already perform a wide variety of other water conservation programs. These include education, volumetric pricing, and numerous other methods. These are already summarized in their Agricultural Water Management Plans submitted to the United States Bureau of Reclamation.

Urban Water Conservation

Both the cities of Chowchilla and Madera currently have urban water conservation plans, as components of state-mandated Urban Water Management Plans.

City of Chowchilla. The City of Chowchilla's water conservation programs are described in their Urban Water Management Plan (Boyle, 2008). They include year-round water scheduling restrictions, enforcement of plumbing efficiency standards, leak detection, public education, water metering, and a drought preparedness plan. The City will also be installing time-of-use smart meters that can assist in detecting leaks, water waste, and watering violations. Lastly, the City plans to increase efforts to enforce their existing regulations through a Conservation Water Patrol. The City's per capita demand is estimated to be about 310 gallons/capita/day, which is high for a metered system in the Valley. A reduction of 20% through conservation is considered reasonable, and matches the goal set by the State of California through the 20 x 2020 Water Conservation Plan. This would reduce City water demands (excluding the prison population) by 700 AF/year.

City of Madera. The City of Madera's water conservation program is described in their Urban Water Management Plan (Carollo Engineers, 2011). They use a variety of methods to encourage conservation, including a water shortage contingency plan, residential water surveys, water system audits, metering, large landscape conservation programs, high-efficiency washing machine and low-water-use toilet rebates, public education, and water waste prohibitions. The City also has a 4-stage water conservation program that requires up to 50% reduction in water use during severe droughts. The City installed water meters 10 to 15 years ahead of State requirements. Conservation

efforts have helped reduce per capita water demands by over 20% since 1996, and per capita water demands are currently less than 200 gallons/capita/day. The City is also examining a modification to their rate structure to encourage conservation. Additional conservation is possible, but anticipated improvements would be smaller than for the City of Chowchilla.

Unincorporated Areas. Unincorporated areas were estimated to have a per capita consumption of 168 gallons/day in the 2008 IRWMP. These estimates are difficult to perform and confirm since most of this water is pumped from private unmetered wells. There are no more recent studies to provide additional data. This is a relatively low per-capita consumption, and conservation potential in these areas is probably still limited.

Various urban water conservation measures are available (metering, low-flow appliances, public education, etc.) to help reduce urban water demands. Requiring the use of native California plants that are drought tolerant and use very little water in new developments could help to reduce water demands. In addition, new buildings are required to have higher water efficiency standards and may have less per capita water demand than older buildings. According to Southwest Hydrology (2009), conservation methods range in cost from about $75/AF to $1,200/AF, with several options around $400/AF. Assuming an average cost of $400/AF, the cost to conserve every 1,000 AF would be $400/AF x 1,000 AF = $400,000. Some of the measures, such as plumbing rertrofits, would have life expectancies of 10 to 15 years. Other measures, such as ordinances and education, would be longer term.

Water Use Restrictions in Droughts

The irrigation and water districts are allocated lower water supplies in dry years and as a result must reduce deliveries to growers. Unit water prices usually increase in dry years since there are some fixed overhead costs that must be paid, regardless of the water allocation. The cities of Madera and Chowchilla both have water shortage contingency plans documented in their Urban Water Management Plans. Madera County is currently developing demand management measures for their water-serving Maintenance Districts and County Service Areas to implement in dry and multiple-dry years.

Public Education

An effective means to conserve water is through educating the public on water conservation methods, elevating awareness of the critical overdraft and land subsidence issues, and increasing awareness of severe water shortages.

Urban Areas. The cities provide information on water conservation programs to their customers though mass mailings (often in the form of utility bill inserts), their websites, and occasionally in the printed media. In addition, the cities also support water conservation programs for public schools. Educating young people has been shown to be an effective means of making the general public aware of certain issues. Students also tend to bring the water conservation message home to their family. The GMP

Participants could work with the local school districts to develop an educational program that specifically addresses groundwater overdraft and the importance of water conservation.

Agricultural Areas. Public awareness and educational programs should also be offered to the local farming and industrial communities. These should include awareness of overdraft and land subsidence issues and their consequences, as well as focused education on increasing irrigation efficiency, conversion to drought tolerant crops, conservation easements, and other methods to reduce crop water demand.

South-East Madera County United. SEMCU has recognized the need for much greater public awareness and knowledge of an entire spectrum of water-related issues, and has begun acting to address that need. SEMCU has published a series of articles in the Ranchos Independent, authored by SEMCU leadership, addressing groundwater decline, overdraft, future water quality issues and more.

As well, SEMCU is planning a “demonstration project” in collaboration with the Golden Valley School District, the California Water Institute at California State University Fresno, Provost & Pritchard Consulting Group and Valley Teen Ranch. The project, which is not yet fully defined, will be designed to provide education to students at Liberty High School about the school’s wastewater treatment plant, the benefits of using recycled water, and water-efficient irrigation practices. The project will also be used to educate the general public, although the format for that program has not been determined. An MOU has been signed by the parties and the group is currently working to develop a final scope and curriculum for the project.

Existing Activities

- Various urban and agricultural water conservation efforts performed by the GMP participants

Planned Actions

- City of Chowchilla will implement a conservation voucher/rebate program for low flow plumbing fixtures, smart irrigation controllers, turf removal and replacement with drought tolerant vegetation
- City of Madera and Madera County will develop commercial metering and water rates
- Develop a demonstration project at Liberty High School on wastewater effluent recycling
- Perform studies to evaluate the potential for further water conservation, and estimate the impact of population growth on urban water demands.
- Educate general public on groundwater overdraft and land subsidence issues.
- Focused education on growers to help increase irrigation efficiency and reduce water demands

- Madera County and City of Chowchilla will increase water wasting enforcement programs
- Madera County and City of Madera will implement a residential metering and water rates program, and water conservation outreach programs
- Cities of Chowchilla and Madera will encourage water conservation in landscaping in both existing and new developments

7.7. Water Recycling

Urban wastewater effluent can be reused in several ways. The water can be percolated and returned to the aquifer. If the water receives tertiary level treatment, it can be directly recycled for unrestricted landscaping, agriculture or industrial use. Sprayfields, often irrigating grass or natural open spaces that would not otherwise be irrigated, have been preferred in the past by the Regional Water Quality Control Board for effluent disposal at certain locations in Madera County, but due to higher evaporation losses they have fewer incidental recharge benefits than percolation ponds and are much less effective than direct recycling of water in replacement of pumped groundwater irrigation. The Central Valley Regional Water Quality Control Board encourages reclamation wherever feasible, and in some locales, where irrigated agriculture is not in proximity and there is limited land available for percolation ponds, sprayfields are a preferred method of effluent disposal.

Water returned to the aquifer through incidental effluent recharge of septic systems, or incidental infiltration of treated effluent, is generally about 35% of the demand. Thus there is large potential for capturing this water and directly using it in areas of need. Following is a discussion of water recycling practices and future goals in the City of Madera, City of Chowchilla, Madera County Special Districts, and other unincorporated communities.

City of Madera

The City of Madera currently discharges all treated wastewater to percolation ponds. The incidental recharge helps to recharge the local groundwater west of the City. The City has installed a well intended to recover percolated effluent and deliver it to MID Canals for direct irrigation use. Although this water would not be considered “recycled” in accordance with definitions in California Code, it would be a relatively effective method of water reuse by the City. In order to meet water quality standards set by MID, the groundwater pumped from underneath the percolation ponds would need to be blended with MID’s surface-sourced canal water. This project is partially developed, but it has encountered some water quality issues with the Regional Water Quality Control Board, and has not been implemented at this time.

The City of Madera also performed a recycled water feasibility study (Montgomery Watson Harza, 2013). Recycling wastewater was found to be technically feasible and the study found there would be demand for the recycled water. However, all alternatives

were considered to be cost-prohibitive at this time; the cost to treat and distribute the water would be far more than potential water fees collected at the rates the City believes could be charged. The report instead recommended that City Well 27, which has required treatment before potable use, be used to provide non-potable water to certain customers, thus conserving the City's supply of potable well water.

City of Chowchilla

The City of Chowchilla currently discharges its secondary wastewater effluent to percolation ponds that incidentally returns to groundwater. The volume discharged is estimated to be about 365 MG/year (1,120 AF/year) with evaporation losses estimated at 10%. The City owns land southwest of the main City Limits intended for a new WWTP. If and when funding becomes available, the City plans to build a tertiary treatment plant and recycle the effluent to park landscaping or farmland.

County Service Areas

Madera County Service Areas and Maintenance Districts operate 16 small sewer systems. Seven of these are located in the Valley floor and the remaining nine are in the Foothills and Mountains subarea. Effluent disposal methods for the Valley districts within the Plan area are by either percolation ponds or sprayfields. No effluent from these districts is directly applied to agricultural crops. None of the WWTPs produce the tertiary-level effluent necessary for application to public landscape areas. The communities served by these districts range from 31 to 259 residential lots each.

Madera Ranchos

SEMCU plans to perform a privately-funded feasibility study to show the severity of the local groundwater quality problems in the Madera Ranchos area, where there is already some community interest in construction of a wastewater treatment system. Should the study demonstrate that a collection and treatment system is technically and financially feasible, the next step would be to apply for funding, either through the Clean Water State Revolving Fund or IRWMP Implementation funds, to design and construct the project. The Regional Water Quality Control Board will likely require recycling of treated waste water to the extent possible for any new waste water treatment facility.

Other Unincorporated Areas

Other unincorporated areas in the GMP area generally use septic systems. All of the wastewater is returned to the underground, and there is no practical way to recycle the water unless sewer systems are installed. In these areas it is assumed that 35% of water is used indoors and returned to groundwater through septic system percolation, with the remaining 65% used for outdoor irrigation and not effectively reused.

Existing Activities

- Percolate wastewater effluent to recharge the groundwater supplies.

Planned Actions

- Develop relationships between urban and agricultural water agencies to use more wastewater effluent for crop irrigation.
- Potentially use recycled water for city landscaping, golf courses, and parks
- Perform feasibility study to evaluate the severity of local groundwater quality problems in Madera Ranchos.
- Madera County and SEMCU will continue efforts to develop a waste water treatment plant for Madera Ranchos

8. GROUNDWATER OPERATIONS

8.1. Well Construction Policies

The GMP Participants follow State standards for well construction as documented in DWR Bulletins 74-81 and 73-90. Madera County and the City of Chowchilla supplement those standards with additional requirements (see **Appendix H**). The City of Madera defers to the County's well standards. Well construction policies fall into three general areas: 1) Policies to protect groundwater quality; 2) Policies to conserve groundwater and prevent land subsidence, and 3) Policies to promote and improve groundwater monitoring and data collection.

8.1.1 Groundwater Quality Protection

Improperly constructed wells can result in contaminated groundwater by creating pathways for pollutants to enter a well through drainage and percolation from the surface, by allowing mixing between aquifers of varying water quality, and through the unauthorized disposal of waste into a well.

The City of Chowchilla municipal water code section 8.20.050, Special Groundwater Protection, states that the City may designate areas where groundwater quality problems are known to exist, and where wells will likely penetrate more than one aquifer. In those locations, the City may require that wells include seals to prevent mixing of water from different aquifers. See **Appendix H** for a copy of the relevant sections of the City code.

Madera County has enacted and is responsible for enforcing a County Well Ordinance that regulates well construction within the unincorporated areas of the County and the City of Madera. Chapter 13.52, Title 13 of the Madera County Code and Chapter 8.2, Title 8 regulate the location, construction, maintenance, abandonment, and destruction of wells that may affect the quality of water within each jurisdiction. The well standards include regulations regarding: 1) drilling test holes; 2) restrictions on well construction in service areas as designated by the Public Utilities Commission; 3) restrictions on wells within 500 feet of existing public water systems; 4) requirement that private parcels have adequate area to site wells and on-site sewage disposal systems; and 5) safeguards against impacts of new wells on neighboring wells. The Madera County well standards are also found in **Appendix H**.

It is recommended that all new domestic and municipal wells require an annular seal of at least 100 feet, in accordance with current CDPH requirements, to avoid near-surface contamination from runoff, surface spills, agricultural amendments, septic systems, and wastewater effluent percolation. In some areas deeper seals may be appropriate due to local conditions. For example, a municipal well being constructed in 2014 by Madera County MD10A in Madera Ranchos will have an annular seal of 350 feet to protect the new well from known nitrate contamination in the area.

Urban and agricultural interests often compete for groundwater near city boundaries, but they have different water quality requirements. It is recommended that the geologic layers with good water quality near urban boundaries be characterized. It is also recommended that the GMP participants consider a policy that requires new agricultural wells on urban boundaries to seal layers with the best water quality for urban uses, so the water is reserved for the urban community.

8.1.2 Groundwater Conservation/Land Subsidence

Groundwater extraction is currently unrestricted in the GMP area and this has exacerbated overdraft and land subsidence. Locally-implemented (as opposed to State-mandated) well construction policies could be adopted to help conserve groundwater. They could range from voluntary programs to restrictions on pumping and well construction. Restrictions could be applied to certain high-priority areas or throughout the entire GMP area. For instance, in areas experiencing land subsidence, a possible permit requirement could be to perforate the casing only in the aquifer above the Corcoran Clay. Other well construction policies could be implemented in these areas as outlined below.

Mandatory restrictions on groundwater consumption are considered measures of last resort, but could be one of the most effective mitigation methods considering the gravity and magnitude of the overdraft situation in the GMP area. Following are possible alternatives for conserving groundwater through well construction policies; these could help to prevent or delay a court-ordered adjudication of the groundwater basin.

- Voluntary agreements to reduce pumping in severely impacted areas (e.g., agreements among an organized group to limit deep wells in the Red-Top area, which is experiencing high levels of subsidence)
- Mandatory restrictions on well drilling or pumping in severely overdrafted areas
- Mandatory restrictions on well drilling or pumping in areas experiencing land subsidence
- Levy additional fees on all new wells to fund overdraft mitigation projects
- Require that retired deep wells in subsidence areas be replaced with shallow wells
- Require parties applying for a new well to read and sign an educational document on aquifer overdraft and land subsidence

8.1.3 Groundwater Monitoring/Data Collection

Groundwater wells that are being abandoned could instead be converted to monitoring wells. During the well abandonment permitting process, wells that are properly constructed to allow for on-going monitoring and data collection could be identified and

possibly included in a monitoring network. In addition, the County could adopt a policy requiring that new wells be added to a monitoring network and require regular water level monitoring as a condition of issuing a well permit. This policy could be constrained geographically to areas where there is currently a lack of monitored wells, or to areas with substantial groundwater level declines.

8.1.4 Private Well Construction

The cities of Madera and Chowchilla do not allow construction of new wells within their City limits, except under very limited circumstances. Typically new private wells are only allowed when an existing private well serving a particular property is failing and an extension of the municipal water systems to the site is not feasible. New private wells are not allowed in support of new development. The purpose of these regulations is to keep the water system under central control by the Cities' water departments.

The County has similar restrictions on construction of new private wells in areas proximate to County water systems, limiting new well construction to replacement of existing private wells where extension of the public system is cost-prohibitive. In undistricted areas, private wells are allowed as a matter of course. New private wells require a County well permit, which are commonly approved as long as well standards are followed. The County requires construction of a public water system to serve new developments in the Valley area with lots smaller than three acres.

Existing Activities

- Continue to enforce existing State, County and City well standards

Planned Actions

- Educate landowners on the existing City, County and State Well Standards
- Increase the minimum depth requirement of sanitary seals to at least 100 feet for all wells

8.2. Operation of Facilities

Following is a description of the water resources facilities in the GMP area and how they are operated.

City of Chowchilla

Drinking Water System

The City of Chowchilla's 2013 population was approximately 19,000, including the inmates of the Central California Women's Facility and Valley State Prison for Women, and is the second largest city in the County. The City relies solely on groundwater to supply its domestic water, but some cropped lands within the City limits do receive surface water from Chowchilla Water District.

The City's water system is comprised of 37 miles of main distribution pipelines, and about 3,770 connections. There are currently seven active groundwater wells (Wells 1, 3, 4, 6, 8, 10 and 11) in service, in addition to two off-line wells and one abandoned well. The total pumping capacity of the wells is 6,000 gpm. Each well site is equipped with a chlorine pump, metering chlorine dosage to the distribution system. The two prisons each have their own separate water systems. (Data primarily from Integrated Regional Water Management Plan, Madera County; Boyle, 2008)

Wastewater Treatment Facility

The City of Chowchilla collects wastewater from its customers via approximately 26 miles of sanitary sewers. There are seven sewage pump stations in Chowchilla. The collected wastewater is treated at a 1.8-MGD wastewater plant. Currently, the treated effluent is discharged to percolation ponds at the wastewater treatment plant. Discharges currently average about 1.0 MGD. (Data primarily from Integrated Regional Water Management Plan, Madera County; Boyle, 2008)

City of Madera

Drinking Water System

The City of Madera's 2013 population was approximately 62,200, and it is the largest urban area in the County. The City covers approximately 15.8 square miles of incorporated area. The City relies solely on groundwater to serve its domestic customers, but some cropped land within the City limits does receive surface water from Madera Irrigation District.

The City's existing water system facilities include 19 groundwater wells, 150 miles of water distribution system pipelines ranging in size from 4 to 14 inches in diameter, about 13,500 connections, and a 1.0-MG elevated water storage tank. The wells are located throughout the City and have completion depths ranging from approximately 300 to 700 feet. The total pumping capacity of the current water system is about 27,000 gpm.

The City also has numerous stormwater basins; some are connected to MID facilities and can receive surface water for recharge. The basins are being operated to maximize the volume of stormwater that is captured and recharged locally. (Data primarily from Integrated Regional Water Management Plan, Madera County; Boyle, 2008)

Wastewater Treatment Facility

Wastewater is collected throughout the City of Madera via a network of sanitary sewer collection pipelines ranging from 8 to 48 inches in diameter. With the aid of five sewer lift stations, the influent is gravity-fed to the WWTP, located approximately seven miles west of the City limits. There are approximately 12,500 residential connections, each typically with a 4-inch sewer service connecting to the main. Commercial and industrial customers number just over 1,000 and are connected with service lines appropriate to

handle their particular wastewater load. The average daily wastewater volume for 2013 was estimated to be approximately 5.19 MGD. The City of Madera has no facilities for extensive storage of the wastewater before treatment. Septic haulers from outside the City service area bring in an additional volume of wastewater. The most recent data show that outside septic waste collection contributes about 7,500 gallons (less than 1 percent of total) per day to the treatment totals, though the biological loading is disproportionately higher due to the higher strength of the septage versus domestic wastewater.

The effluent from the City of Madera's WWTP is disposed to fourteen 20-acre percolation/evaporation ponds. The WWTP Expansion Predesign Report by Boyle (July 2004) proposed a system of recovery wells that would pump groundwater from under the percolation ponds to an MID canal for agricultural irrigation. This pumping of percolated effluent is intended to reduce groundwater mounding under the WWTP and to control elevated concentrations of nitrate or other contaminants in the underlying groundwater. A recovery well has been installed, but the implementation of the project has encountered regulatory hurdles.

Chowchilla Water District

Surface Water Facilities

The Chowchilla Water District receives water from three sources; San Joaquin River (Madera Canal), Chowchilla River (Buchanan Dam) and Merced Irrigation District. The District utilizes portions of the Chowchilla River, Ash Slough and Berenda Slough to convey irrigation water to the District's irrigation water distribution system, which consists of 150 miles of unlined canals and 49 miles of pipeline. There are over 950 turnouts in the system where irrigation water is delivered to water users.

The District utilizes various water management techniques and facilities to deliver water efficiently and accurately to its water users. These facilities include: measurement weirs, water meters, rated canal gates, regulating reservoirs and ponds, long-crested weirs, flap gates and the District's SCADA system. All water released to the District, delivered to water users and leaving the District is measured and recorded in the District's database. (Data primarily from Chowchilla Water District Website; http://cwdwater.com/index.php/about-cwd-2/district-system)

Groundwater Facilities

The District does not own or operate groundwater extraction facilities.

Conjunctive/Recharge Use Facilities

The District purchases water for recharge when available, but is not able to secure an additional water supply solely for recharge. Of all the water that flows through the District's conveyance system, it is estimated that as much as 30 percent of it is lost to seepage. An average of 38,000 AF of water was recharged through the District's conveyance system between 2004 and 2013. Irrigation seepage is estimated to be

approximately 84,000 AF annually. In addition, natural and intentional recharge is accomplished in nearby stream channels (Chowchilla River, Dutchman Creek, Ash Slough), two surface water retention reservoirs (Berenda Reservoir and Minturn Dam), and eight recharge basins located throughout the district (Dairyland Pond, Haynes Pond, Townsend Pond, Rutherford Pond, Askew Pond, Vera Pond, Gregory Pond, and Berenda Pond). (Data primarily from Groundwater Management Plan; Chowchilla Red-Top-City Joint Powers Authority, 1997)

Madera County

Surface Water Facilities

Madera County has a 200 AF/year Class 1 CVP Friant Division contract supply from the San Joaquin River, delivered behind Friant Dam. The County also manages the Sumner Hills Service Area (SA-16), which diverts water released into the San Joaquin River by the USBR for their diversion pursuant to Holding Contract No. 7. (Integrated Regional Water Management Plan, Madera County; Boyle, 2008)

Groundwater Facilities

The County of Madera oversees the water services in eight Maintenance Districts and four Service Areas in the GMP area. These districts/areas are solely dependent on groundwater except for Service Area 16. County water service facilities include 22 water wells and service mains, and the surface water treatment facility for CSA 16.

The larger systems, with a combined capacity of about 2,000 gpm, serve Parkwood, Parksdale, and Madera Ranchos. The remaining systems have capacities ranging from 15 to 900 gpm. (Data primarily from Integrated Regional Water Management Plan, Madera County; Boyle, 2008)

Wastewater Treatment Facilities

Madera County Service Areas and Maintenance Districts operate seven small sewer systems within the GMP area. The smaller wastewater systems most commonly have sanitary sewer systems with asbestos cement, clay, or plastic pipe collection systems; one raw sewage pumping station; an extended aeration treatment process; chlorine disinfection; and treated water pumping. Effluent disposal is handled by percolation ponds and/or sprayfields.

Many of these wastewater systems are in poor condition and need repair. The largest County-operated wastewater system within the GMP area, with more than 500 connections, serves the community of Parksdale. (Data primarily from Integrated Regional Water Management Plan, Madera County; Boyle, 2008)

Unincorporated Areas

Large areas in the County are not served by a County District and rely on private wells for domestic and irrigation water. These areas dispose of wastewater through septic systems.

Madera Irrigation District

Surface Water Facilities
The District's water and distribution system is a combination of open flow primary and secondary laterals, enclosed conduit and natural streams. There are approximately 315 miles of open flow canals and laterals, 115 miles of pipeline and 102 miles of natural streams used for District conveyance and distribution. The open flow canals are comprised of approximately 90 miles of unlined canals and 225 miles of USBR built lined canals.

The District receives water via the Madera Canal from Friant Dam through natural streams and open flow primary laterals. Fresno River water is available from both controlled release and uncontrolled flows from Hidden Dam. Water from the Madera Canal may also be released into the Fresno River. Water is diverted from the Fresno River at the District's Franchi Diversion Weir on the east side of the District.

Groundwater Facilities
The District does not own or operate groundwater extraction facilities, but there are privately owned wells in the District.

Conjunctive/Recharge Use Facilities
The District maintains a number of stormwater and flood retention basins that are used for groundwater recharge. These basins range in retention capacity between 2 and 160 AF each. There are 45 recharge basins within MID, and the City of Madera has facilities which are capable of taking irrigation and floodwater for recharge purposes. Several City stormwater basins are connected to MID irrigation distribution facilities, allowing collected storm water to be beneficially reused. Portions of the City of Madera are within MID and are assessed a monthly charge that is related to the recharge stormwater conveyance benefits created by the District.

South-East Madera County United
South-East Madera County United (SEMCU) is a participant in the GMP but does not own or operate groundwater extraction, recharge or conjunctive use facilities. It is a non-profit education and advocacy organization and has no land-use planning authority. However, SEMCU represents numerous public and private interests in its area and provides input and comments on water related projects.

Existing Activities
None

Planned Actions
- Develop strategic operation of facilities to increase groundwater recharge in canals, recharge basins and storm water basins.
- MID and CWD will automate facility operation

- Madera County, MID, and CWD will implement vegetation removal on creeks and rivers, and increase the capacity of road crossings

9. GROUNDWATER PLANNING AND MANAGEMENT

9.1. Land Use Planning

This section describes the land-use planning authority for each GMP Participant and presents alternative land use planning policies that could improve groundwater management.

Madera County
Land use planning activities in unincorporated areas of Madera County are performed by the County of Madera's Planning Department, and are overseen by the Madera County Planning Commission.

City of Madera
The City of Madera Community Development Department was established in 2006 to facilitate a coordinated approach to planning and development within the City. All phases of the planning and development process are administered through the Community Development Department. Operations managers in the Planning, Building, Engineering, and Public Works Departments all report to the Director of Community Development. The Planning Department is responsible for long range planning within the City and for processing and approving site-specific development proposals. Planning staff members also serve as staff to the Madera Planning Commission.

The City of Madera requires a conditional use permit for new agricultural land uses on land that is designated for urban development. This requirement does not apply to the limited amount of land within the City limits already planned for agriculture uses (such as around the airport).

City of Chowchilla
The Community and Economic Development Department guides and facilitates projects and development activities within the City of Chowchilla. The department is responsible for planning and building activity within the City and for implementation of economic development plans and programs which strengthen and diversify the economic base of Chowchilla.

South-East Madera County United
SEMCU is a non-profit education and advocacy organization and has no land-use planning authority. However, SEMCU represents numerous public and private interests in its area and provides input and comments on water related land-use policies. SEMCU advocates for requiring sustainable water supplies for new urban developments, and supports development of a regional group, JPA or special district to manage the groundwater.

Irrigation and Water Districts

Madera Irrigation District and Chowchilla Water District have no land-use planning authority, therefore regional and local land use planning activities will remain with the appropriate agencies. However, when appropriate, they comment on proposed land use plans that may impact the local groundwater quantity or quality.

The Plan Participants all share some common land-use planning goals including:

1. Preserving areas with high groundwater recharge potential for recharge activities;
2. Protecting areas sensitive to groundwater contamination;
3. Requiring appropriate mitigation for any adverse impacts that land use changes may have on groundwater resources.
4. Requiring hydrogeologic investigations, water supply master plans, and sustainable water supplies for new developments. Current State Water Code requires that urban developments of 500 units or more must demonstrate a sustainable water supply in normal, dry and multiple dry years over a planning horizon of 20 years. The GMP Participants support requirements for a longer-term or permanent water source.

Disclaimer for Property Purchases

Land management agencies are authorized to require that buyers read and sign a disclaimer regarding groundwater supplies. Such a disclaimer could provide educational material on groundwater overdraft and subsidence. In addition, it could state that groundwater supplies are finite, and limit the liability of public agencies if groundwater levels decline or private wells run dry.

Agricultural Land Conversion

Agricultural land could be converted to other uses to reduce water demands. Land conversion falls into three main areas:

1. Agricultural Land Retirement. The County or other special districts could buy and retire agricultural land to reduce water demand. This would be performed on a voluntary basis with landowners willing to sell their property. This method has been highly effective at reducing water demands in Westlands Water District in Fresno and Kings Counties, but it could significantly impact economic output, employment, and tax revenue. Other similar programs have allowed small water usage on the retired land so other uses, such as grazing, are still feasible. As well, agricultural land retirement could preferentially focus on lands that currently have drainage problems, shallow saline groundwater, are no longer suitable for agriculture or have no surface water supply.

2. Conservation Easements. Some state and federal agencies will pay landowners to convert land to conservation easements, which are reserved for habitat

protection or soil conservation. These programs also help to reduce water demands. Some examples include the California Department of Fish and Wildlife Permanent Wetland Easement Program, and the United Stated Department of Agriculture Conservation Reserve Program. Westlands Water District (Fresno and Kings Counties) and Buena Vista Water Storage District (Kern County) have had significant success reducing water demands with conservation easements. In some cases the land is purchased from the landowner, in others the landowner still maintains title to the land but is restricted in the land uses and must still pay property taxes. Some other programs are similar to a lease and the land can be returned to farming after a certain period, such as five or ten years. Education and promotion of existing programs may be needed to get significant participation from local farmers.

3. Conversion to Low-Water-Demand Uses. Irrigated farming land could be converted to other uses that have low water demands, such as grazing, dry land agriculture reliant solely on precipitation, or solar energy development. These lands uses can still contribute to economic output.

Expand Districts/Form New Districts

New or expanded districts can help increase surface water supplies and increase the authority of certain areas to engage in surface water and groundwater management. There are several types of special districts that can be formed under California law, including water districts, irrigation districts, groundwater replenishment districts, community service districts, improvement districts, and maintenance districts. These types of entities are typically local in nature. Regional districts and legal organizations such as conservation districts and Joint Power Authorities are discussed in Section 4.1.

MID, CWD and GFWD have contracts with the USBR for surface water. This reduces the demand on the underlying groundwater resources. A strategy identified in **Table 7.2** to reduce groundwater overdraft is to expand the boundaries of existing districts or form new districts. New districts or annexed lands might have lower priority for water supplies than existing district landowners. The annexed lands or new district areas would primarily be eligible to receive flood water or surplus waters in certain years, similar to the rights associated with subordinate lands in Madera Irrigation District and Chowchilla Water District. The new districts might be able to apply to make floodwater diversions, but would still be junior to the existing districts. Within Madera County, about 277,000 acres is located outside of the two cities and the active districts.

Several benefits can be achieved from expanding districts or creating new districts:

- The legal right to deliver surface water to these areas, if the correct water conveyance facilities are in place.
- Facilities on the new lands could benefit from grants or low interest loans from the state or federal government. These funds could be used for large capital

improvement projects that could convey, store or recharge water supplies.

- More lands that could be potentially developed for intentional recharge.
- Improved ability of the districts to utilize flood waters that currently leave the region when the existing flood storage capacity is exceeded.
- The ability of existing districts to expand groundwater monitoring networks.
- More land becomes eligible for assessments.

The Chowchilla Water District has recently added 10,000 acres of subordinate lands. MID also has about 11,000 acres of subordinate lands. These lands have lower priority to water supplies, and generally can only take surface water after demands are met on other lands. These subordinate lands increase the potential area that surface water can be delivered to.

SEMCU is advocating for creating a self-governed utility provider in their area. MD10A, with about 1,000 connections, is by law governed by the Madera County Board of Supervisors and is staffed by the Madera County Engineering Department. Costs for these services are charged back to the District by the County.

As is typical of the Madera County special districts, the County maintains an Advisory Committee within MD10A. This committee, formed of area residents, provides advisory input to County Staff and the District Supervisor with respect to District operational issues. Communication from the County to the Committee is an important means of communicating to the local residents. However, as an advisory committee, there are real limits to the ability of the committee to effect policy or operational changes. Objective citizen input is limited to voting in Proposition 218 elections which result from proposed County changes in capital improvement strategy.

SEMCU has suggested, and has discussed with other area groups, the possibility of forming a Community Services District (CSD) in the area. Such a new district could take over MD10A's responsibilities for water in the Madera Ranchos, but could also be responsible to pursue development and operation of a wastewater collection, treatment and reuse/disposal system to serve the Madera Ranchos, and develop lands surrounding that community. Since a CSD would be directed by a board of directors elected by voters living within the district, local control would be increased along with the range of services. Taking such an action would require work to establish the feasibility of the CSD, technically and financially, and adequate management expertise would be needed.

Existing Activities

- When appropriate, comment on environmental documents and land-use plans that have the potential to impact groundwater.

Planned Actions

- Promote conservation easements and other land uses that have economic output but lower water demands.
- Where practical expand existing water districts and form new water districts so surface water can be delivered to additional lands.
- MID, Madera County and CWD will pursue increasing the number of surface water users
- At a planning and land-use level, MID, Madera County, CWD, GFWD and the City of Madera will continue to pursue future recharge basin sites
- Explore the establishment of a water agency in the SEMCU area to manage water and wastewater and perform groundwater recharge

9.2. Groundwater Reports

The California DWR included "Periodic Groundwater Reports' in their list of additional components recommended for GMPs (Appendix C of Bulletin 118 – California's Groundwater). The GMP Participants have therefore set a goal to prepare periodic regional groundwater reports to document groundwater conditions. Currently, none of the GMP participants prepare formal groundwater reports, but many collect and evaluate groundwater data on an annual basis, and therefore it is feasible that an annual report may be prepared.

The information in the groundwater report would primarily be used to evaluate the impact from overdraft mitigation measures, forecast future problems, plan future groundwater projects, and develop new groundwater policies. An important step in preparing the report is to develop a regional, coordinated groundwater monitoring program (see recommendations in Section 5.1 – Groundwater Level Monitoring).

The content of the groundwater report may vary based on the needs, available data, and recent accomplishments of the local agencies.

Existing Activities

None

Planned Actions

- Prepare a periodic regional groundwater report, as described above.

9.3. Plan Implementation

Table 9.1 includes an implementation plan for the GMP Participants. The Table lists the major projects they have identified for possible implementation. A legend at the bottom of the table describes the general strategies that the projects belong to. Implementation of each project will be contingent on local approval, favorable economics, and the availability of funding and staff to oversee implementation. Implementation of these projects is expected to result in significant amounts of new knowledge and a substantial reduction in groundwater overdraft in the GMP area.

Table 9.1 – Implementation Plan

Project	Madera Co.	MID	CWD	GFWD	City of Chowchilla	City of Madera	SEMCU
Airport Basin	10	10				10	
Assist with surface water transfers into Madera County		4, 6	4, 6	4,6			
Automation of facilities		8, 2	8, 2	8, 2			
Ave. 12 Basin	10	10					
Commercial Metering/Rates	2					2	
Conservation voucher/rebate program (low flow plumbing fixtures, smart irrigation controllers, turf removal / replacement, etc)					2		
Ellis Basin	10					10	
Expanding Franklin Secara Basin				10, 8			
Flood Irrigation on Fields	10, 8	10, 8	10, 8	10, 8			
Fresno River Dam in City of Madera	1, 8, 10	1, 8, 10				1, 8, 10	
Future Basin Sites	10	10	10	10		10	
Future stormwater collection/recharge projects	8, 10	8, 10	8, 10	8,10		8, 10	8, 10
Golf Course Basins		10	10			10	
Gravelly Ford Canal-Recharge Basin				10, 8			
Increase number of surface water users	2	2	2				
Increase road crossing capacities	7, 8	7, 8	7, 8	7, 8			
Increase surface water storage			1				
Increased water wasting enforcement programs	2				2		
Lake Madera	1, 10	1, 10					
Liberty High School Demonstration Project	2,4,5						2,4,5

Project	Madera Co.	MID	CWD	GFWD	City of Chowchilla	City of Madera	SEMCU
Madera Ranch Water Bank		9					
Madera Ranchos Surface Water Treatment Plant	5						5
Madera Ranchos Wastewater Treatment Plant	3						2
Residential Metering/Rates	2					2	
Schmidt Creek Flood Control and Groundwater Recharge Project						8,10	
SWC Road 29 and Ave 29 Basin	10						
Vegetation Removal in Creeks/Rivers	7,6	7,6	7, 6	7,6			
Water conservation outreach programs	2				2		

Legend:
1 - Increase surface water storage
2 – Urban or agricultural water conservation
3 – Surface water treatment
4 – Work with adjacent entities (Merced County, Mendota Pool, Exchange Contractors, etc.)
5 – Water recycling
6 – Additional surface water supplies
7 – Increase conveyance capacity
8 – Flood and storm water capture
9 – Groundwater banking
10 – Groundwater recharge (existing and new)

9.4. Plan Re-evaluation

The Regional Groundwater Advisory Committee (GAC), which is comprised of representatives from each participant in this GMP, will be responsible for monitoring the progress in implementing the GMP objectives. Refer to Section 4.1 for more information on the membership, policies, and procedures of the GAC. In the future the GAC may be supplanted with a Joint Powers Authority. The GAC will discuss progress in implementing this plan, and the effectiveness of the plan, at each regularly scheduled meeting. As new policies, practices, and ordinances become necessary or desirable, this GMP will be amended as necessary. Each agency will also reevaluate sections pertaining to their jurisdiction annually and may choose to modify specific sections of the GMP.

This GMP will be updated as necessary. An important component of the update will be a reevaluation of overdraft and the effectiveness of overdraft mitigation measures.

Existing Activities
None.

Planned Actions

- Update the GMP at least every five years through a formal public process, or more frequently if a sufficient quantity of revisions, updates and additions have been identified.
- Evaluate the effectiveness of the GMP and need for an update at least once a year.
- Document recommendations for improving or updating the GMP in each Annual Groundwater Report.

9.5. Dispute Resolution

Madera County has a special Water Appeals Board (County Code Chapter 13.06.010) to resolve issues concerning water. The water appeals board may affirm, reverse or modify determinations of administrative staff. The other GMP participants do not have specific procedures for addressing groundwater disputes.

Well disputes related to pumping interference have occurred in the GMP area. Some private landowners have believed that agency wells are impacting their private wells. Sometimes agency-owned and private wells are sited close together, and one or both of the wells should be moved to prevent interference. In addition, there have also been several complaints from residences indicating that they believe their wells have been impacted by nearby agricultural wells.
Groundwater disputes between landowners are not the responsibility of the local water management agencies; however, when asked to, they may choose to help resolve disputes as an impartial mediator. Such efforts are intended to maintain amicable relationships among landowners, educate landowners on groundwater management goals and policies, and avoid an adjudication of the local groundwater basin.

Developing a county-wide groundwater management organization is being considered to help implement the goals and objectives of this GMP. Staff could also assist with groundwater related disputes, especially if they involve regional water management issues or disputes between two separate agencies. Several alternatives for a regional groundwater management organization are discussed in Section 4.1 – Groundwater Advisory Committee.

Existing Activities

- Resolve disputes through existing formal dispute resolution policies.

Planned Actions

- Evaluate the merits and feasibility of developing a county-wide groundwater management program.

9.6. Program Funding and Fees

Numerous alternatives are available to the GMP Participants for funding existing and

planned actions described in this plan. The GMP Participants have discussed these options, and each has indicated which funding alternatives may prove practical and feasible for their agency's use on capital and/or operating expenses necessary to implement this plan. These alternatives and agency selections are listed in **Table 9.2**, and described in the text following:

Table 9.2 – Potential Funding Sources

Funding Source	Madera County	MID	CWD	GFWD	City of Chow.	City of Madera	SEMCU
Development impact fees	x				x	x	
Well permit fees	x						
Property assessments (per acre charge)	x	x	x	x		x	
Property assessments (based on demands and crop usages)	x						
Groundwater pumping surcharge (metered or tiered)	x					x	
Private funding incentives	x						
Grants	x	x	x	x	x	x	x
Local bond measure	x					x	
District assessments	x	x	x	x			
Williamson Act fees	x						
State and Federal funding	x	x	x	x	x	x	x

Development Impact Fees

New building permits and entitlements for projects that would use groundwater could be subject to a fee based on the acreage developed, the number of residential units proposed and/or the estimated water usage of proposed landscape/agricultural plantings.

Well Permit Impact Fee

During the permitting process, a groundwater impact fee could be assessed on each new well constructed. The fee could vary based on the size or estimated pumping

capacity of the well. This fee could be extended to well rehabilitations which result in increased well capacity.

Property Assessments (Per-Acre Fee)
A per-acre fee (or a per-parcel fee) could be harder to implement than some of the other alternatives, since both could be construed as property taxes and could therefore require a super-majority vote of the affected property owners to put into effect. There would, however, be advantages to this funding method. It could apply county-wide (or within a defined benefitted subarea) and would have the potential to raise relatively large sums of money annually without placing excessive burden on any single owner or group of owners.

Property Assessments (Per Demand and Crop Water Usage)
Under AB 3030, local agencies which have prepared and adopted Groundwater Management Plans have the authority to limit groundwater extractions and implement water replenishment fees based upon the amount of groundwater extracted. Extraction-based fees must first be approved by majority vote of impacted landowners. These could be considered realistic alternatives if the State begins to regulate groundwater extractions, or if a groundwater basin adjudication appears imminent.

Groundwater Surcharge (Based on Calculated Water Demand)
A groundwater extraction surcharge could be assessed on agricultural lands within the GMP area based on anticipated water demand, which could be determined from the cropping data that is already submitted to the Madera County Agricultural Commissioner's Office.

Anticipated water demand would be based on standard evapotranspiration rates for each crop and land use in the GMP area. This fee would be equitable both to landowners that use little groundwater, such as ranchers, and to heavier users such as tree orchards. Credit could also be allowed for parcels that receive surface water deliveries which offset groundwater pumping.

Groundwater Surcharge (Based on Actual Volume Pumped)
A groundwater surcharge could be assessed based on the actual volume of groundwater pumped, which would require metering of all wells within the GMP area. Groundwater extractions could be reported in several fashions.

1. Self Reporting. Each property owner would report their groundwater extractions to the County or an established Groundwater Management Authority. The form for the reporting, as well as frequency of reporting and billing, would be up for later determination.

2. Manual Reading and Reporting. The County or an established Groundwater Management Authority could manually read and record the meter readings for

billing purposes. This would incur significant ongoing costs both for labor to carry out the readings as well as costs for vehicles, fuel, and other necessary items.

3. Automated Reading and Reporting. New meters could be installed (and older meters retrofitted) with automatic reading and reporting capabilities incorporating radios and repeaters. The County or an established Groundwater Management Authority could receive this data electronically, reducing processing and administrative costs. Such automated reading and reporting is the current standard of the industry for municipal water metering, based upon the rapid payback of the capital investment in self-reading meters by the reduction in direct and indirect expenses.

Private Funding Incentives

Private organizations and foundations are often-overlooked sources for grants. They will often fund grant application preparation, organizational capacity building, feasibility studies and public education. Operations funding is difficult to get through grants, which are most often limited to one-time expenditures.

Private foundation funding may not be available for construction projects, but often is available for “capacity building,” increasing the skills and abilities of an agency to actually pursue major funding through training in grant writing and project administration skills. Understanding how to create and structure grant applications is critically important to winning grant funds, and each funding agency or foundation is different in how it perceives needs, benefits and the overall mission of the applying agency. An established Groundwater Management Authority will strongly benefit from mastery of these skills.

Private Property Owners

Private property owners could also fund/purchase land conservation easements from other land owners, essentially “Buying" groundwater rights, or paying water users to forgo pumping or reduce their ground water extractions. This approach can be very effective in reducing groundwater overdraft, while avoiding the potential equity concerns associated with mandatory reductions in ground water extractions. However, monitoring and enforcement are critical for ensuring the success of the purchase of conservation easements/ground water rights. This is clearly required to ensure that water right or license holders do not continue to pump contrary to the program or agreement.

Grants and Loans (Public and Private Sources)

Grants designed to fund projects addressing several of the Basin Management Objectives may be available both through public grant programs and from private foundations. The GMP Participants will pursue available grants and low-interest loans from the DWR as well as other State and Federal agencies. The GMP participants realize that funding from State and Federal agencies for groundwater projects will be partially based on the group’s progress in implementing this GMP.

Water quality projects can potentially be funded through State programs addressing water and wastewater projects. Funding from the Federal government is available for water and wastewater projects benefitting small and disadvantaged communities. Potential public funding programs include:

- IRWMP Implementation Grants (Department of Water Resources)
- Local Groundwater Assistance Grants (Department of Water Resources)
- Water Use and Energy Efficiency Grants (United States Bureau of Reclamation)
- State Revolving Fund (Municipal Water Projects – CDPH)
- Clean Water State Revolving Fund (Wastewater Projects – RWQCB)
- Rural Utilities Service (USDA – Water and Wastewater Projects)

Local Bond Measures

Local agencies can propose funding of specific capital improvements via sale of local general obligation bonds, to be paid back by adding incrementally to the property tax collected from each parcel within a benefitted area. The range of projects so financed can be very broad, though generally a project list must be included in the measure that proposes sale of the bonds. The measure is subject to a vote in the benefitted area, and must pass by a two-thirds majority vote. (Only school facilities were affected by the new 55% approval rule passed in Proposition 39 in 2000.)

Under another process involving local bonds, the County and participating Cities and Districts each have the authority to finance capital improvement projects and collect repayment charges from the benefited parties. The authorizing legislation used most often is the Assessment Act of 1913. That Act allows local agencies broad authority to plan and propose capital projects benefitting a group of property owners, and provides a legal framework for spreading the costs of the project (construction, design, legal, finance) back to the benefitted parties.

Frequently, funding comes from the sale of tax-exempt bonds by the local agency, secured by the value of the benefitted properties, and paid back over 20 years by the property owners. The assessment district process can be initiated and driven forward by the local agency. Property owners are kept informed of the project and are given an opportunity to protest the assessments before they are finalized. An assessment district can proceed so long as less than half of the benefitted property owners protest the assessments.

Assessments on District Lands

If irrigation and water districts choose to annex lands and expand into un-districted areas, they would have the authority to collect assessments from the landowners in the newly-annexed areas. These assessments could be parcel-based or area-based. The revenues collected could be used to acquire additional water supplies for delivery or groundwater recharge, or to develop irrigation efficiency or groundwater recharge projects.

Annexation of lands outside a district requires petition of the landowners within the area to be annexed, or is sometimes initiated by a vote of the district's board of directors. The annexation action requires approval by the Local Agency Formation Commission (LAFCo) which will, among other responsibilities, check to make sure that no other districts are already providing the same or similar services to the area in question, and will verify that the proposing district has the managerial and financial resources to manage the annexed lands.

Requirement for an election prior to annexation depends upon the number of people living within the proposed annexed area. If there are up to eight people in the area, the annexation can proceed as an "uninhabited annexation" without a vote. Greater populations within the area require a majority vote of the residents in order to proceed.

Williamson Act Fees

The Williamson Act of the State of California (officially, the California Land Conservation Act of 1965) is a California law that provides a reduction of property tax to owners of farmland and open-space land in exchange for a ten-year agreement that the land will not be developed or otherwise converted to another use. The motivation for the Williamson Act is to promote voluntary land conservation, particularly farmland conservation.

Subsequently, the Open Space Subvention Act of 1971 provided local governments an annual subvention payment of lost property tax revenues from the state. In 2010, legislation was passed by the California State Senate and State Assembly and sent to the Governor for signing in the form of Senate Bill 1142. This bill was created in response to the economic downturn and the State's revenue shortfalls, and suspended the State's subvention payments to local agencies and Counties for the Williamson Act contracts.

The County has approximately 600,000 acres in Williamson Act Contracts. The County has continued to honor the Contracts and provide a tax reduction to landowners without the States subvention payments. The estimated loss of tax revenue to Madera County was approximately $780,000 during the 2012-2013 tax year.

The County could consider not renewing the contracts, or impose an additional fee on contracts which are not funded by State subventions. The revenues collected could be set aside for groundwater management, construction of infrastructure-related projects to perform groundwater recharge, or acquisition of additional surface water supplies to improve groundwater conditions in Madera County.

State and Federal Funds

Because of the magnitude of the groundwater overdraft in the GMP area and the importance of Madera County's agribusiness to the overall economy of the state and nation, it is reasonable to think that the State and Federal governments could choose to

help finance projects to mitigate overdraft. This assistance could take the form of direct project funding contained in legislation approved in Sacramento or Washington, D.C.

Accomplishing this goal would require concerted efforts among the GMP participants to select and develop a project or projects that could be particularly beneficial yet don't have alternative financing sources. Once that is done, the participants would need to work closely with legislators and congressional representatives to convince those people of the merits of the project, and then see if funding approval can be obtained.

This funding strategy is one of the most complex and hard to achieve of any of those listed, but carries one of the largest potential rewards in that the funding capacity of the State and Federal governments is much larger than anything the GMP participants and the people of Madera County can accomplish on their own.

Existing Activities

- Regularly research grant and loan opportunities from the State and Federal governments and apply for these opportunities when they appear advantageous to the GMP participants.

Planned Actions

- Identify which funding mechanisms described above will be adopted by each GMP participant to fund local and regional groundwater management efforts.
- Move toward creation of a Joint Powers Authority for groundwater management, which would be the most logical agency to implement many of these proposed funding strategies.
- Share information on funding opportunities with other agencies that may be potential partners in multi-agency groundwater projects.
- Perform a financial study to estimate the long-term cost of mitigating groundwater overdraft.
- Develop projects to the point of funding viability, so that they can be moved quickly to completion when funding is secured. Potential projects must be more than a listing, but must include background information, technical and financial justification, schematic (or greater) design documents and an attainable schedule.

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MADERA REGIONAL

GROUNDWATER MANAGEMENT PLAN

APPENDICES

MADERA REGIONAL

GROUNDWATER MANAGEMENT PLAN

APPENDIX A – AGRICULTURAL WATER DEMANDS

Madera Regional Groundwater Management Plan
Estimated Agricultural Water Demands

Crop	2003 [1]			2011 [1]			2013 (projected) [2]				2013 Ag Commissioner [5]		
	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)[6]	Estimated Annual Irrigation (1,000 AF)	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)	Average Annual Change (2003-2011)	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)
Grain	1.0	1.2	6.8	42.1	1.3	54.7	5.1	52.3	1.3	68.0	10.5	1.3	13.6
Rice	0.0	0.0	0.0	0.5	5.2	2.4	0.1	0.6	5.2	2.9	0.0	5.2	0.0
Cotton	18.2	3.2	58.2	5.6	2.9	16.5	-1.6	2.5	2.9	7.3	2.3	2.9	6.7
Sugar Beet	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	1.8	0.0	0.0	1.8	0.0
Corn[5]	20.6	2.7	56.4	4.3	2.3	10.0	-2.0	0.3	2.3	0.6	25.3	2.3	58.3
Dry Bean	1.0	2.5	2.5	0.6	2.0	1.3	0.0	0.6	2.0	1.1	0.4	2.0	0.7
Safflower	0.0	0.0	0.0	0.2	1.2	0.3	0.0	0.3	1.2	0.4	0.0	1.2	0.0
Other Field	18.2	2.7	49.1	4.6	2.4	11.0	-1.7	1.2	2.4	3.0	6.4	2.4	15.3
Alfalfa[5]	38.8	4.5	174.2	29.1	4.2	122.1	-1.2	26.6	4.2	111.8	19.6	4.2	82.2
Pasture[5]	4.7	4.4	20.6	4.2	4.3	17.9	-0.1	4.1	4.3	17.4	1.7	4.3	7.1
Process Tomato	1.6	2.5	4.0	2.3	3.6	8.1	0.1	2.4	3.6	8.7	3.8	3.6	13.8
Fresh Tomato	0.4	1.6	0.7	0.0	2.5	0.0	-0.1	0.0	2.5	0.0	0.8	2.5	2.0
Cucumber	0.4	1.2	0.5	0.1	2.4	0.2	0.0	0.0	2.4	0.0	0.1	2.4	0.3
Onion/Garlic	0.4	1.5	0.6	0.0	3.8	0.1	0.0	0.0	3.8	0.0	0.4	3.8	1.6
Other Truck Crops	1.1	1.2	1.3	2.2	1.2	2.6	0.1	2.5	1.2	3.0	2.2	1.2	2.6
Almond/Pistachio	81.1	3.5	280.6	145.1	3.3	481.6	8.0	161.1	3.3	534.7	170.8	3.3	567.0
Other Deciduous	18.4	3.7	68.1	20.9	3.4	72.1	0.3	21.6	3.4	74.3	16.2	3.4	55.7
Subtropical	6.4	2.9	18.8	8.8	2.7	23.5	0.3	9.4	2.7	25.1	7.9	2.7	20.9
Vine	94.0	2.6	240.6	81.8	2.1	174.1	-1.5	78.7	2.1	167.6	80.8	2.1	172.2
Multiple Crop [3]	8.5	3.2	27.2	8.5	2.8	23.8	0.0	8.5	2.8	23.8	8.5	2.8	23.8
Total Acres	**314.8**	-	-	**360.9**	-	-	-	**372.6**	-	-	**357.7**	-	-
Weighted Avg Water Req.	-	**3.2**	**-**	-	**2.8**	**-**	**-**	-	**2.8**	**-**	-	**2.8**	**-**
Total Applied Water	-	**-**	**1,010**	-	**-**	**1,022**	**-**	-	**-**	**1,050**	-	**-**	**1,044**

Notes
1 - 2003 and 2011 cropping data from California Department of Water Resources
2 - Cropping in 2013 was projected based on average annual increases between 2003 and 2011
3 - 'Multiple Crop' acreage was not provided in 2011 data and was assumed to be same as 2003 data
4 - County Ag Commissioner data received from Madera Irrigation District, filtered to include data for 2013 issued pesticide permits.
5 - County Ag Commissioners data adjusted up slightly to account for a large organic dairy that did not require permits in 2013 due to no pesticide application. Correction (based on 2011 Ag Commissioner data) accounts for about 1,600 acres total across three crops.

6 - Unit water demands based on those used in the 2008 IRWMP and are from California DWR Irrigated Crop Area and Crop Water Use - Applied Water for Madera County. Water demands are assumed to include effective precipitation and account for 80% irrigation efficiency. Unit water demands vary for different years due to difference in effective precipitation in different years.

MADERA REGIONAL GROUNDWATER MANAGEMENT PLAN
CITY OF CHOWCHILLA
2013 CROPPING DATA

TOTAL Crop	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)
Grain	0.5375	1.3	0.70
Rice	0.0000	5.24	0.00
Cotton	0.0000	2.93	0.00
Sugar Beet	0.0000	1.82	0.00
Corn	0.0000	2.3	0.00
Dry Bean	0.0000	2.02	0.00
Safflower	0.0000	1.2	0.00
Other Field	0.0986	2.38	0.23
Alfalfa	0.1615	4.2	0.68
Pasture	0.0000	4.25	0.00
Process Tomato	0.0000	3.6	0.00
Fresh Tomato	0.0000	2.47	0.00
Cucumber	0.0000	2.35	0.00
Onion/Garlic	0.0000	3.82	0.00
Other Truck Crops	0.0037	1.2	0.00
Almond/Pistachio	0.6761	3.32	2.24
Other Deciduous	0.0000	3.44	0.00
Subtropical	0.0000	2.66	0.00
Vine	0.0635	2.13	0.14
Multiple Crop	0.0000	2.8	0.00
Total Acres	**1.5409**	-	-
Weighted Avg Water Req.	-	**2.6**	**-**
Total Applied Water	-	**-**	**4.00**

Non-Prison Crop	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)
Grain	0.2757	1.3	0.36
Rice	0.0000	5.24	0.00
Cotton	0.0000	2.93	0.00
Sugar Beet	0.0000	1.82	0.00
Corn[6]	0.0000	2.3	0.00
Dry Bean	0.0000	2.02	0.00
Safflower	0.0000	1.2	0.00
Other Field	0.0986	2.38	0.23
Alfalfa[6]	0.0000	4.2	0.00
Pasture[6]	0.0000	4.25	0.00
Process Tomato	0.0000	3.6	0.00
Fresh Tomato	0.0000	2.47	0.00
Cucumber	0.0000	2.35	0.00
Onion/Garlic	0.0000	3.82	0.00
Other Truck Crops	0.0037	1.2	0.00
Almond/Pistachio	0.3160	3.32	1.05
Other Deciduous	0.0000	3.44	0.00
Subtropical	0.0000	2.66	0.00
Vine	0.0635	2.13	0.14
Multiple Crop [4]	0.0000	2.8	0.00
Total Acres	**0.7576**	-	-
Weighted Avg Water Req.	-	**2.4**	**-**
Total Applied Water	-	**-**	**1.78**

Prison Crop	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)
Grain	0.2618	1.3	0.34
Rice	0.0000	5.24	0.00
Cotton	0.0000	2.93	0.00
Sugar Beet	0.0000	1.82	0.00
Corn[6]	0.0000	2.3	0.00
Dry Bean	0.0000	2.02	0.00
Safflower	0.0000	1.2	0.00
Other Field	0.0000	2.38	0.00
Alfalfa[6]	0.1615	4.2	0.68
Pasture[6]	0.0000	4.25	0.00
Process Tomato	0.0000	3.6	0.00
Fresh Tomato	0.0000	2.47	0.00
Cucumber	0.0000	2.35	0.00
Onion/Garlic	0.0000	3.82	0.00
Other Truck Crops	0.0000	1.2	0.00
Almond/Pistachio	0.3600	3.32	1.20
Other Deciduous	0.0000	3.44	0.00
Subtropical	0.0000	2.66	0.00
Vine	0.0000	2.13	0.00
Multiple Crop [4]	0.0000	2.8	0.00
Total Acres	**0.7833**	-	-
Weighted Avg Water Req.	-	**2.8**	**-**
Total Applied Water	-	**-**	**2.21**

Source: Madera County Agricultural Commissioner's Office

MADERA REGIONAL GROUNDWATER MANAGEMENT PLAN
CHOWCHILLA WATER DISTRICT (excluding overlap with City of Chowchilla)
2013 CROPPING DATA

TOTAL Chowchilla WD Crop	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)
Grain	1.82	1.3	2.36
Rice	0.00	5.24	0.00
Cotton	0.69	2.93	2.01
Sugar Beet	0.00	1.82	0.00
Corn	8.87	2.3	20.41
Dry Bean	0.00	2.02	0.00
Safflower	0.00	1.2	0.00
Other Field	0.27	2.38	0.65
Alfalfa	10.19	4.2	42.80
Pasture	0.09	4.25	0.39
Process Tomato	0.00	3.6	0.00
Fresh Tomato	0.00	2.47	0.00
Cucumber	0.03	2.35	0.08
Onion/Garlic	0.00	3.82	0.00
Other Truck Crops	0.75	1.2	0.90
Almond/Pistachio	36.10	3.32	119.86
Other Deciduous	3.47	3.44	11.95
Subtropical	0.20	2.66	0.52
Vine	5.99	2.13	12.76
Multiple Crop	0.00	2.8	0.00
Total Acres	**68.48**	-	-
Weighted Avg Water	-	**3.1**	**-**
Total Applied Water	-	**-**	**214.69**

Notes:
1) Cropping data from Madera County Agricultural Commissioner's Office and Merced Count
2) Applied water requirements from 2008 Madera County IRWMP which are based on Califo

MADERA REGIONAL GROUNDWATER MANAGEMENT PLAN
COUNTY OF MADERA
2013 CROPPING DATA

Crop	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)
Grain	4.81	1.3	6.25
Rice	0.00	5.24	0.00
Cotton	1.45	2.93	4.25
Sugar Beet	0.00	1.82	0.00
Corn	16.59	2.3	38.15
Dry Bean	0.00	2.02	0.00
Safflower	0.00	1.2	0.00
Other Field	2.96	2.38	7.05
Alfalfa	11.53	4.2	48.41
Pasture	1.13	4.25	4.79
Process Tomato	1.95	3.6	7.03
Fresh Tomato	0.16	2.47	0.40
Cucumber	0.00	2.35	0.00
Onion/Garlic	0.12	3.82	0.45
Other Truck Crops	0.38	1.2	0.46
Almond/Pistachio	67.49	3.32	224.08
Other Deciduous	5.44	3.44	18.72
Subtropical	2.61	2.66	6.94
Vine	23.90	2.13	50.90
Multiple Crop	0.00	2.8	0.00
Total Acres	**140.5279**	-	-
Weighted Avg Water Req.	-	**3.0**	**-**
Total Applied Water	-	**-**	**417.9**

1) Cropping data from Madera County Agricultural Commissioner's Office
2) Applied water requirements from 2008 Madera County IRWMP which are based on Cal

MADERA REGIONAL GROUNDWATER MANAGEMENT PLAN

CITY OF MADERA

2013 CROPPING DATA

Crop	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)
Grain	0.3254	1.3	0.42
Rice	0.0000	5.24	0.00
Cotton	0.0000	2.93	0.00
Sugar Beet	0.0000	1.82	0.00
Corn	0.0000	2.3	0.00
Dry Bean	0.0037	2.02	0.01
Safflower	0.0000	1.2	0.00
Other Field	0.0236	2.38	0.06
Alfalfa	0.0000	4.2	0.00
Pasture	0.0035	4.25	0.01
Process Tomato	0.0000	3.6	0.00
Fresh Tomato	0.0000	2.47	0.00
Cucumber	0.0000	2.35	0.00
Onion/Garlic	0.0000	3.82	0.00
Other Truck Crops	0.0000	1.2	0.00
Almond/Pistachio	0.3144	3.32	1.04
Other Deciduous	0.0374	3.44	0.13
Subtropical	0.0000	2.66	0.00
Vine	0.4006	2.13	0.85
Multiple Crop	0.0000	2.8	0.00
Total Acres	**1.1088**	-	-
Weighted Avg Water Req.	-	**2.3**	**-**
Total Applied Water	-	**-**	**2.5**

1) Cropping data from Madera County Agricultural Commissioner's Office

2) Applied water requirements from 2008 Madera County IRWMP which are based on Ca

MADERA REGIONAL GROUNDWATER MANAGEMENT PLAN
MADERA IRRIGATION DISTRICT (excluding overlap with City of Madera)
2013 CROPPING DATA

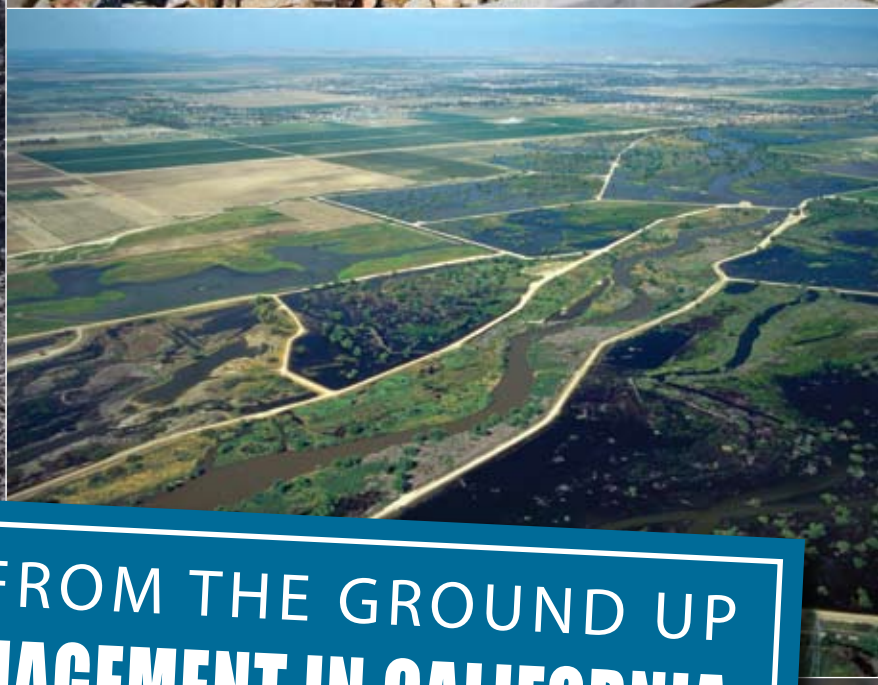
Crop	Irrigated Crop Area (1,000 ac)	Applied Water Requirements (AF/acre)	Estimated Annual Irrigation (1,000 AF)
Grain	2.18	1.3	2.83
Rice	0.00	5.24	0.00
Cotton	0.04	2.93	0.12
Sugar Beet	0.00	1.82	0.00
Corn	1.14	2.3	2.62
Dry Bean	0.36	2.02	0.72
Safflower	0.00	1.2	0.00
Other Field	1.47	2.38	3.49
Alfalfa	1.10	4.2	4.61
Pasture	0.35	4.25	1.47
Process Tomato	0.57	3.6	2.05
Fresh Tomato	0.47	2.47	1.17
Cucumber	0.09	2.35	0.20
Onion/Garlic	0.14	3.82	0.53
Other Truck Crops	0.83	1.2	0.99
Almond/Pistachio	45.56	3.32	151.26
Other Deciduous	5.11	3.44	17.57
Subtropical	2.01	2.66	5.35
Vine	42.64	2.13	90.82
Multiple Crop	0.00	2.8	0.00
Total Acres	**104.04**	-	-
Weighted Avg Water Req.	-	**2.7**	**-**
Total Applied Water	-	**-**	**285.8**

1) Cropping data from Madera County Agricultural Commissioner's Office
2) Applied water requirements from 2008 Madera County IRWMP which are based on Californi

MADERA REGIONAL

GROUNDWATER MANAGEMENT PLAN

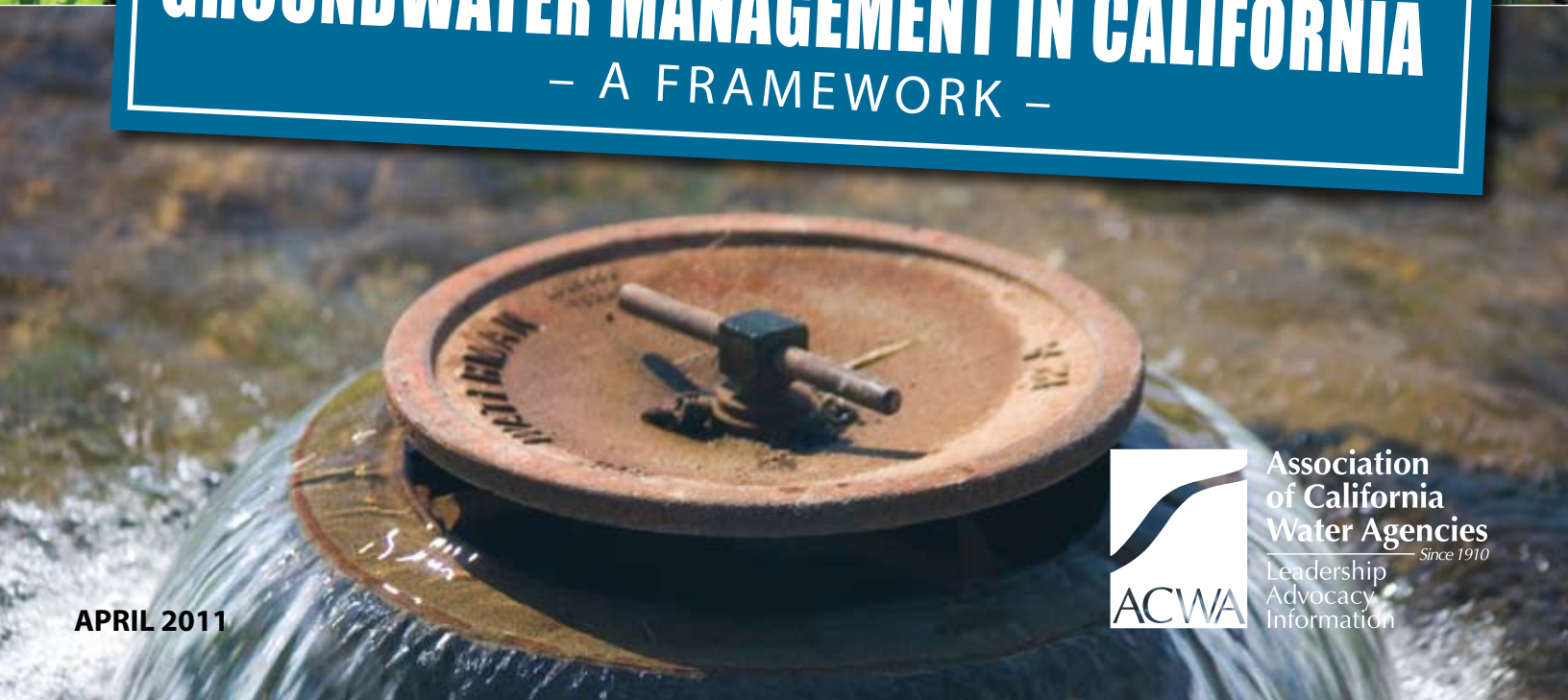
APPENDIX B – SUSTAINABILITY FROM THE GROUND UP: GROUNDWATER MANAGEMENT IN CALIFORNIA



SUSTAINABILITY FROM THE GROUND UP

GROUNDWATER MANAGEMENT IN CALIFORNIA

– A FRAMEWORK –



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Foreword

In 2009, California lawmakers passed historic legislation that marked an important step toward improving the state's water supply reliability and restoring the Sacramento-San Joaquin Delta ecosystem. A critical challenge to achieving the goals of the legislative package is providing more effective management of groundwater resources at a time when California's reliance on its groundwater basins is growing due to a variety of short- and long-term factors.

The Association of California Water Agencies (ACWA) developed this Framework to describe current groundwater management efforts and identify proactive steps to advance sustainable groundwater management as part of the state's overall water management portfolio. ACWA believes the challenge of providing sustainable groundwater management must be met by local and regional agencies and not by centralized state regulation. Locally controlled groundwater management is effective because it is best able to respond to the particular circumstances of, and significant differences in, groundwater basins throughout the state. Local expertise and direct reliance on the resource ensures immediate response to problems and trends, and provides the strongest basis for collaborative regional approaches.

But as this Framework emphasizes, the job is far from done. While there are numerous case studies in successful management, efforts must be expanded in many parts of the state to achieve sustainable outcomes.

ACWA members are not daunted by the challenge. The actions and policy recommendations outlined in this document reflect the on-the-ground experience of experts involved in managing groundwater in every region of California and in a variety of geographic and hydrologic settings. Implementing these actions will help empower local agencies to strengthen their management efforts and contribute to the state's overall need for sustainable groundwater management, today and into the future.

To be successful, sustainable groundwater management must be accomplished in the context of a comprehensive solution that includes conveyance improvements in the Delta, investments in additional surface storage and groundwater storage to meet the co-equal goals, and massive investments in local water resources development.

ACWA members are prepared to step up to the challenge of providing sustainable groundwater management. We stand ready to work with policy makers and water managers to carry out actions and initiatives to promote more effective local groundwater management as part of a comprehensive solution.

Paul Kelley
ACWA President

Greg Zlotnick
ACWA Groundwater
Committee Chair

Timothy Quinn
ACWA Executive Director

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Overview

Groundwater has long been an integral part of California's water supply. Today, it has an even more critical role to play as the state grapples with significant water supply challenges.

California's water management system is arguably among the most complex and innovative in the world. Massive amounts of water are captured, stored and delivered through a combination of man-made and natural features to serve urban, agricultural and environmental needs.

Groundwater was widespread and abundant at the beginning of the 20th century. Its extensive availability contributed to large-scale agricultural and urban growth, which in turn steadily increased demand for and dependence on the resource. Effective management quickly became critical to protecting the future availability and quality of California's groundwater supplies. While many strategies have been implemented over the years to address groundwater management challenges, some are falling short today and require modernization.

Though California does not have a formal state-administered system of regulating and permitting groundwater use, it does have a long history of managing groundwater resources through locally controlled programs developed and refined over the past century.

Many of these programs have been very effective in addressing the state's most difficult groundwater management problems over the years. However, the array of challenges on the horizon will demand even more of local agencies and require a greater commitment to ensuring that local decisions and management contribute to statewide water policy goals.

The current state of California's groundwater should not be considered in isolation since it is largely reflective of broader water management concerns in the state. It has become increasingly clear in recent years that California's aging water supply and management infrastructure can no longer reliably meet the economic and environmental needs of the state. This is readily apparent in the Sacramento-San Joaquin Delta and elsewhere where challenges associated with population growth, drought, climate change, unmanaged groundwater overdraft and environmental concerns await resolution. The growing uncertainty of surface water supplies due to these and other factors has triggered greater reliance on groundwater as a principal or supplemental supply for urban, agricultural and environmental uses (e.g. wildlife refuges). It has also focused attention on groundwater basins as a potential storage solution.

The shift toward greater reliance on groundwater has magnified long-term risks to the quality and quantity of water available from California's groundwater basins. While Californians have relied on groundwater resources to varying degrees over the years, ACWA strongly believes today's growing dependence – intensified by both cyclical and long-term factors – will continue to stress California's groundwater basins unless proactive steps are taken at the local and regional level.

The California Legislature took an important step toward addressing the state's water challenges with passage of comprehensive water legislation in 2009. In addition to an $11.14 billion water bond now targeted for the November 2012 ballot and policy bills addressing Delta governance, water conservation, and water diversion and use, the package included new requirements for groundwater elevation monitoring to help track seasonal and long-term trends in groundwater basins.

ACWA developed this Framework to complement that legislation and advance the dialog on sustainable groundwater management. Produced by a task force of local groundwater managers from throughout the state, the Framework has four main purposes:

1. To define "sustainability" in terms that promote effective groundwater basin management;
2. To describe the current state of groundwater management in California, including an increasing number of successful local and regional management and conjunctive use programs, to provide an accurate and comprehensive foundation on which the public, policy makers and other stakeholders may make informed decisions;
3. To articulate groundwater management practices to address current and future challenges in California groundwater management; and
4. To identify specific policy development needs and recommend ways to enhance accountability, transparency, and the efficacy of sustainable groundwater management in California and its appropriate integration as a critical part of California's overall water management planning portfolio.

As evidenced by effective local and regional programs highlighted in this Framework, (see map, page 22), existing mechanisms for managing groundwater basins are providing an excellent foundation for sustainable management now and into the future. These examples, along with many other programs throughout the state, have generated impressive results and should be utilized as models for other agencies to help achieve the goal of sustainable groundwater management in California.

Locally controlled groundwater management is effective because local and regional entities are the most knowledgeable about their local basins and tend to be the first to notice changes or problems. They are also best suited to address issues unique to their region, including the implementation of proactive plans and actions to meet current and future groundwater needs.

Groundwater management plans developed under AB 3030, SB 1938 and the Integrated Regional Water Management Planning Act offer prime opportunities to enhance effective management and incorporate strategies that can help address the potential consequences of a large-scale shift to groundwater, whether cyclical or permanent. Doing so will also improve coordination and collaboration with state agencies as elevation data is collected pursuant to the new requirements of SBX7 6, enacted as part of the 2009 comprehensive legislative water package.

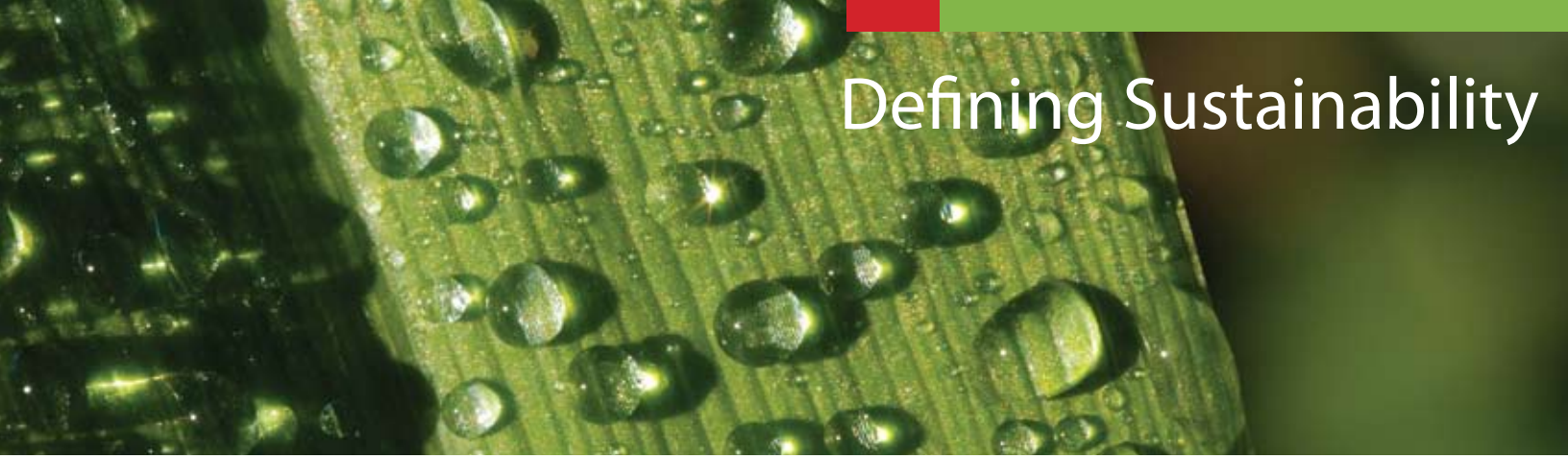
ACWA believes the state Legislature should encourage and support local management policies that appropriately reflect California's geographic and hydrologic diversity rather than institute a state-administered centralized control structure for regulating or permitting the use of groundwater. Statewide permitting and regulation would undermine the effectiveness of existing and planned local investments and would be counterproductive because it would not account for the significant differences in California groundwater basins throughout the state.

The Legislature should focus instead on incentivizing the development and implementation of the best practices outlined in this Framework. Recommendations for doing so are outlined beginning on page 29.

Ultimately, for sustainable groundwater management to succeed, California must invest in improvements to its water storage and conveyance infrastructure to optimize both surface and groundwater supplies. Such investments are critical if conjunctive use and groundwater banking are to realize their full potential as effective strategies to meet California's future demands, both economic and environmental. These investments must complement an ongoing commitment to expanded water use efficiency and water reuse.

ACWA believes that with the actions and policy modifications recommended in this Framework, local agencies can provide sustainable groundwater management, to the benefit of California, without the addition of new layers of state bureaucracy or regulation.

In addition to this Framework, ACWA has adopted Groundwater Management Policy Principles to provide further guidance and recommendations for sustainable management of the state's groundwater resources. The principles can be found on page 32. The Framework and the principles together provide a solid foundation for achieving groundwater management goals in California, and an effective basis for collaboration among the water and environmental communities, agriculture, business and labor leaders, and state and local governments.



Defining Sustainability

Sustainability has emerged as an important principle in natural resources management in recent years. ACWA has adopted policy principles that identify environmental and economic sustainability as co-equal priorities for water management in California.

In the context of groundwater, ACWA defines sustainability as actively managing the resource at the local level in a way that satisfies the needs of both the environment and the economy while ensuring the continued health of the basin. Given the importance of groundwater to California's water supply, sustainable management of the state's groundwater resources is essential to ensuring a reliable water supply and a healthy environment – both today and for generations of Californians to come.

The United States Geological Survey characterizes groundwater sustainability as the "development and use of groundwater in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences."[1]

Inherent in that definition as applied is the long-term protection and maintenance of both groundwater quantity and quality. As evidenced by effective local and regional programs throughout the state, managing groundwater basins to achieve sustainability has many benefits, including:

- More reliable surface and groundwater resources
- Increased opportunities for conjunctive use and recharge projects
- Environmental health / stability
- Drought mitigation
- Water quality improvements
- More effective land use planning and management
- Reduced energy costs associated with pumping

On the other hand, the lack of effective groundwater management contributes no such benefits and has led to the further decline of groundwater resources in certain areas of California. Unacceptable consequences include depletion of existing groundwater supplies, land subsidence, water quality degradation and environmental damage.

1 Alley, W.M., Reilly, T.E., and Franke, O.L. (1999). *Sustainability of Ground-Water Resources:* U.S. Geological Survey Circular 1186.

Groundwater Management Today

In California, groundwater management generally refers to a locally developed and controlled program that integrates groundwater protection, recharge, extraction and monitoring to achieve the long-term sustainability of the resource. Since groundwater basins vary greatly around the state, local control and supervision allow for the most effective and careful management of the resource. One size does not fit all when it comes to groundwater management.

California is known for its diverse ecosystems, topography and geology and for its highly variable water resources. With more than 38 million people and a land area of 100 million acres, California is the most populous state and the third-largest geographically in the country. It is also the most productive agricultural state, producing over half the fruits, nuts and vegetables in the nation.

In 2000, an average water year, California cities and suburbs used about 8.9 million acre-feet (MAF) of water. California agriculture irrigated 9.6 million acres of cropland (includes multi-cropping) using roughly 34 MAF of applied water. Dedicated environmental uses of water, including in-stream flows, wild and scenic flows, required Delta outflow, and managed wetlands, exceeded 39 MAF.[2]

In an average year (based on 1998-2005 data), groundwater resources supply about 35 percent of California's urban, agricultural and managed wetlands water demands (about 15 million acre-feet per year).[3] In dry years, this percentage increases to 40 percent or higher statewide and as high as 60 percent or more in some regions. Nearly half of California's drinking water supply comes from groundwater.

In addition to contributing essential water supplies, the state's groundwater basins provide significant water storage capacity. This storage capability is important in and of itself, but when used in conjunction with surface water storage it can go a long way toward meeting local and regional needs for greater flexibility, increased water supply reliability and improved water quality. This potential is limited, however, by current regulatory and infrastructure constraints on groundwater recharge and extractions. Optimizing large-scale conjunctive use programs will require investments in both surface and groundwater storage.

2 California Department of Water Resources. *California Water Plan Update 2009:* v1c4, pp 4-12, 4-21.
3 California Department of Water Resources. *California Water Plan Update 2009:* v2c8, p 8-10.

APPLIED WATER VS. CONSUMPTIVE USE

According to the California Department of Water Resources, applied water is the amount of water from any source needed to meet the demand for beneficial use by the user. It includes consumptive use, reuse, and outflows. Consumptive use is a quantity of applied water that is not available for immediate or economical reuse. It includes water that evaporates, transpires, or is incorporated into products, plant tissue, or animal tissue. Consumptively used water is removed from available supplies without return to a water resource system (uses such as manufacturing, agriculture, landscaping, food preparation, and in the case of Colorado River water, water that is not returned to the river.)*

*DWR California Water Plan Update 2005 http://www.waterplan.water.ca.gov/docs/cwpu2005/vol2/v2glossary.pdf

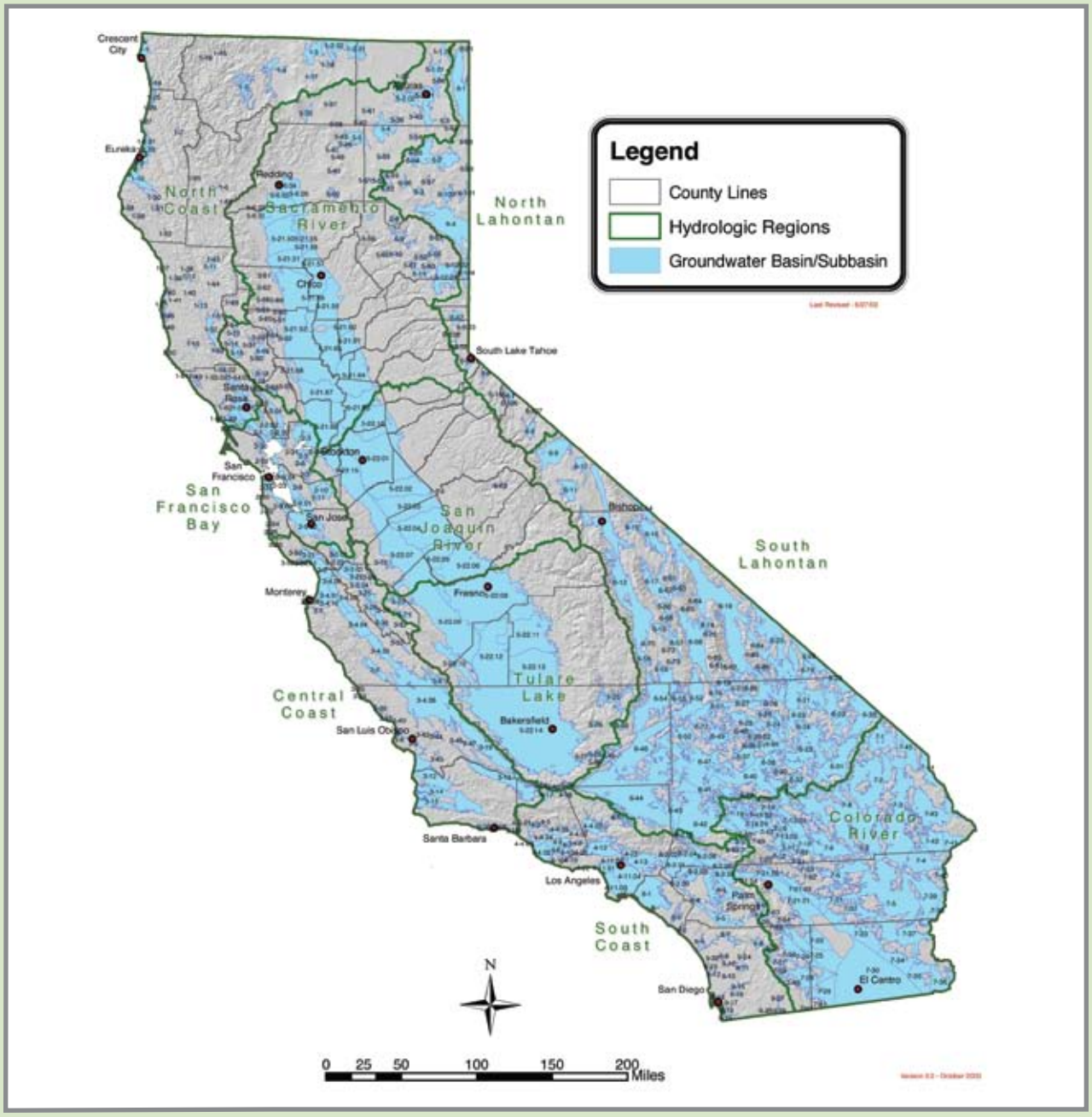
WHERE DOES GROUNDWATER COME FROM?

Much of the water from snowmelt and rain that flows into surface water formations (e.g. creeks, streams, rivers, ponds) percolates into the ground and becomes groundwater. Groundwater can be thousands of years old, but most of the groundwater typically used in California today is extracted a few years to a few decades after its original percolation.

Groundwater is found in two main types of geologic settings in California. The vast majority of groundwater in the state is stored in alluvial basins, which are composed of sediments such as gravel, sand, silt or clay and cover nearly 40 percent of the geographic area of the state. Alluvial basins account for all 515 basins and sub-basins identified in DWR's Bulletin 118. (http://www.water.ca.gov/pubs/groundwater/bulletin_118)

However, groundwater is also stored and extracted from fractured bedrock or sandstone. About 20 percent of the state's municipal supply wells are located in this type of formation, with prime examples found in the Sierra Nevada and the Coast Ranges.

Groundwater Basins in California



Water Supply Infrastructure: Key to Meeting Needs

Precipitation in California varies widely—from place to place, from season to season, and from year to year. Wet years can bring the threat of floods, while dry years can reduce available water supplies and require the temporary drawdown of stored water. This unpredictable hydrology affects not only the amount of surface water available in a given year but also the amount of groundwater available for extraction and use.

The state's water storage and delivery infrastructure was designed to address that unpredictability, protecting communities from floods and capturing winter precipitation and spring snowmelt for strategic delivery in the drier summer and fall months. The system also contributes to effective groundwater management by providing surface water to augment local supply sources and alleviate pressure on groundwater basins.

California's two largest water delivery systems are the State Water Project (SWP) and the federal Central Valley Project (CVP). The SWP, operated by the California Department of Water Resources, delivers water to 25 million Californians and 755,000 acres of irrigated farmland. The CVP, operated by the United States Bureau of Reclamation, provides water for more than 3 million acres of farmland and drinking water to nearly 2 million consumers.

All told, California has nearly 200 surface storage reservoirs with a capacity of 10,000 acre-feet or more, for a combined storage capacity of more than 41 MAF. In addition, there are many other reservoirs smaller than 10,000 acre-feet that are used to manage water for a wide range of uses.

Given the state's highly variable hydrology, surface and groundwater storage facilities are critical to supplying cities, farms, businesses and the environment with adequate water year-round. They are particularly effective when used in concert with each other to make maximum use of water when it's available and store it for use in dry times.

Conjunctive Use: A Critical Part of Sustainable Management

Conjunctive use or management refers to the coordinated and planned use of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. Since surface water and groundwater resources can differ significantly in their availability, quality, cost and other characteristics, managing both resources together, rather than in isolation from each other, allows water managers to use the advantages of each for maximum benefit.

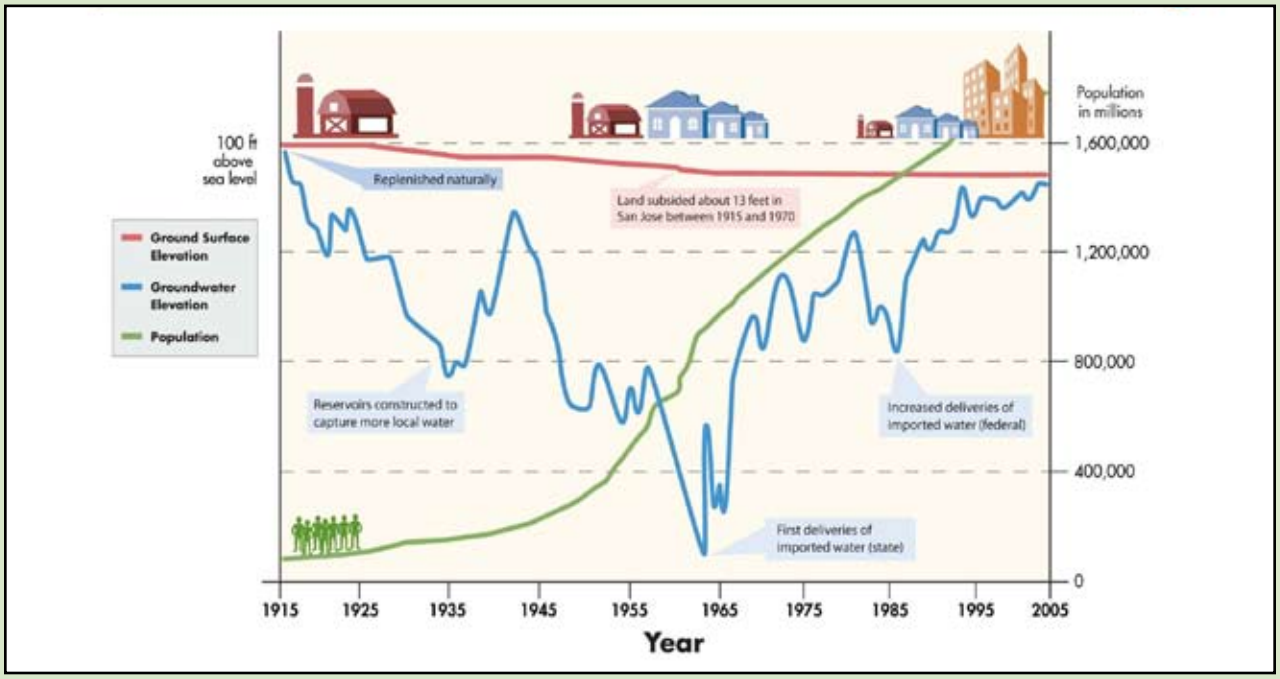
WHAT IS GROUNDWATER BANKING?

Groundwater banking is a water management tool designed to increase water supply reliability. By using dewatered aquifer space to store water during wet years (when there is abundant rainfall and surplus water available), water can be pumped and used during dry years (when there is little rainfall and no surplus water).

Groundwater banking is accomplished two ways: through in-lieu and direct recharge. In-lieu recharge is storing water by utilizing surface water "in-lieu" of pumping groundwater, thereby storing an equal amount in the groundwater basin. Direct recharge is storing water by allowing it to percolate directly to storage in the groundwater basin.*

*Definition courtesy of Semitropic Water Storage District

CONJUNCTIVE MANAGEMENT OF LOCAL AND IMPORTED WATER SUPPLIES: THE KEY TO A SUSTAINABLE SILICON VALLEY



Graphic courtesy of Santa Clara Valley Water District

The Santa Clara Valley Water District has a long record of conjunctive water management. Established in the late 1920s to address groundwater overdraft and subsidence, the district constructed seven dams by 1935 to impound surface water for recharge into percolation facilities. As the graphic illustrates, the post-war boom brought increased demands for water and the return of unsustainable declines in groundwater elevation. Surface reservoir capacity was quadrupled by constructing four additional reservoirs in the 1950s. In 1965, the district began importing surface water from the State Water Project. Groundwater levels began to recover and the rate of subsidence slowed significantly. The rise of Silicon Valley brought increased demands again, and the district added Central Valley Project deliveries to its supply portfolio in the late 1980s. By the mid-1990s groundwater elevations had returned to levels seen at the turn of the 20th century.

Conjunctive use has been practiced for decades in California. In general, conjunctive use programs take advantage of available groundwater storage capacity to "bank" or store surface water through natural and / or artificial recharge for later extraction and use. In many areas, there is tremendous potential to enhance local supplies even further by utilizing storm flows and recycled water with appropriate safeguards to augment groundwater recharge.

Well-planned conjunctive use programs not only enhance local and regional water supply reliability, but can also provide other benefits such as enhanced flood management, improved environmental water management, reduced reliance on the Delta to meet future water supply needs, and water quality improvements.

Conjunctive use projects require investments in surface storage, conveyance systems, recharge and extraction facilities, and management of groundwater basins. Conveyance systems may include lined and / or unlined canals, pipelines, and streams. Recharge options include direct spreading and infiltration in artificial ponds, injection via wells, and induced natural recharge in natural systems. In the strategy known as in-lieu recharge, surface water can be provided to users who normally use groundwater to allow supplies to stay in groundwater basins.

Groundwater may be extracted later for direct use, for pumping back to conveyance systems, or for surface water exchange.

KEY WATER PROJECTS IN CALIFORNIA

<<<

WHAT ARE SOME OF THE SOURCES FOR CONJUNCTIVE USE PROJECTS?

Imported water – Water that is transferred across hydrologic region boundaries from one agency to another. Many parts of the state receive imported water from the State Water Project and Central Valley Project.

Local surface water – Direct deliveries of water from stream flows, as well as water supplies from local storage facilities.

Recycled water – Municipal, industrial, or agricultural wastewater that is treated to produce water that can be reused.

Reclaimed water – Treated water where the inflow water supply is polluted, contaminated, or otherwise tainted.

Desalinated water – Water that has been treated to remove salt for beneficial use. Source water can be brackish (low salinity) or seawater.

Stormwater (runoff) – Water that collects during a precipitation event and may carry pollutants to water courses, causing degradation.*

*For more information, please see Bulletin 160 Water Plan Update 2009 Glossary (http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v4c01ag_cwp2009.pdf)

The Current Regulatory Landscape

California is often criticized for being one of the only Western states without a formal state-administered system of regulating and permitting groundwater use. But while it is true there is no *centralized* system to regulate the use of groundwater, California has developed and refined an effective system of locally controlled groundwater management over the past century.

As noted by the California Legislative Analyst's Office[4], the current system has been successful in addressing the state's most difficult groundwater management problems over the years. The growing list of challenges on the horizon, however, will demand more of local agencies and require a greater commitment to ensuring that local decisions and management contribute to achieving statewide water policy goals.

To that end, ACWA is confident that, with certain modifications recommended in this Framework, local agencies can provide sustainable groundwater management for the benefit of California without the addition of new layers of state bureaucracy or regulation.

Basic Legal Principles Set Foundation

As a general rule, landowners in California are entitled to pump and use a reasonable amount of groundwater from a basin underlying their land. Under the doctrine known as "correlative rights," landowners overlying a common source of groundwater are limited to using a reasonable share, typically based on the amount of overlying land owned by each and the physical condition of the basin. When there is insufficient water to meet the demands of overlying landowners, those users are expected to reduce their demands correlatively to bring their groundwater extractions within the safe yield of the basin and prevent overdraft.

Entities other than overlying users, such as cities, may be entitled to "appropriate" water from the basin for use as a municipal supply when water surplus to the needs of overlying users is available. Unless otherwise prescribed, appropriators must curtail their use when there is no surplus.

As the above paragraphs suggest, the interrelated concepts of "safe yield," "surplus" and "overdraft" are central elements in the legal landscape addressing California groundwater. As defined by the California Supreme Court in the landmark *Los Angeles v. San Fernando* case in 1975, "safe yield" refers to "the maximum quantity of water which can be withdrawn annually from a groundwater supply under a given set of conditions without causing an undesirable result." The phrase "undesirable result" is understood to refer to "a gradual lowering of the groundwater levels resulting eventually in depletion of the supply." "Surplus" refers to "the amount of water in a groundwater basin in excess of safe yield." *City of Los Angeles v. City of San Fernando* (1975) 14 Cal.3d at 278.

The *San Fernando* court also clarified that an overdraft occurs only when extractions exceed safe yield plus "temporary surplus," the latter term defined as the amount of water that can be pumped from a basin to provide storage space for surface water that would otherwise be lost during wet years if it could not be stored in the basin. *Id.* at 279.

4 California Legislative Analyst's Office. 2010. *Liquid Assets: Improving Management of the State's Groundwater Resources.* (http://www.lao.ca.gov/laoapp/PubDetails.aspx?id=2242)

Recognizing Interplay Between Surface Water and Groundwater

Though surface water and groundwater are often interconnected from a hydrologic perspective, they are generally managed and regulated through separate legal regimes in California. The Legislative Analyst's Office and others have called for California's groundwater law to be "modernized" to better reflect the well-established physical connection between groundwater and surface water in many areas.

That recommendation fails to consider, however, that California has a long and reasonably well-developed history of successfully integrating the use of surface water and groundwater, despite the existence of two different legal regimes. Though this "dual system" may not always appear neat and orderly, case law is sufficiently well-developed to suggest that California courts are fully aware of the interplay between surface water and groundwater in specific instances and have crafted legal doctrines to address those hydrologic realities.

A LOOK AT LEGAL CASES OVER THE YEARS

Under California law, water is characterized as being surface water or groundwater. Groundwater is further classified as either a subterranean stream or as percolating groundwater. Surface water and groundwater classified as a subterranean stream are subject to the permitting authority of the State Water Resources Control Board, while groundwater classified as percolating groundwater is not subject to that authority.

In areas where there is a hydrologic connection between groundwater and surface water resources, a number of early cases established the legal rules for interconnected surface water and groundwater systems. These rules form the foundation of groundwater management today.

Potential Interference by Groundwater Pumpers with Surface Water Rights

Case Information	Result
City of Los Angeles v. Hunter (1909) 156 Cal. 603, 607; *McClintock v. Hudson* (1903) 141 Cal. 275, 278; *Los Angeles v. Pomeroy* (1899) 124 Cal. 597, 624.	Found that a user of percolating groundwater may diminish flows in a surface stream only if the groundwater is put to reasonable use on lands overlying the groundwater basin.
Hudson v. Dailey (1909) 156 Cal. 617, 624-627.	Virtually ignores the distinction between riparian rights to surface water and correlative rights to groundwater in finding a right to extract groundwater for use on overlying lands despite impacts on downstream riparians and downgradient overlying pumpers.
Barton Land & Water Co. v. Crafton Water Co. (1915) 171 Cal. 89, 94-95.	Owner of lands overlying a subterranean stream cannot extract water from that stream so as to have an adverse impact on surface water diverters.

Potential Interference by Surface Water Diverters with Groundwater Rights

Case Information	Result
Miller v. Bay Cities Water Co. (1910) 157 Cal. 256, 276-279 (overruled on other grounds in *City of Lodi v. East Bay Municipal District* (1936) 7 Cal.2d 316, 338-339).	California Supreme Court decision that articulated a broad standard protecting the owner of percolating groundwater from surface appropriations of water on non-riparian lands
United States v. Fallbrook Pub. Util. Dist. (S.D. Cal. 1958) 165 F.Supp. 806, 847 (citing *McClintock,* 141 Cal. at 281; *Hudson,* 156 Cal. at 628).	Federal district court decision that found riparian and overlying rights are treated as extracting water from one common source and so have joint rights to reasonable shares of the resource.

Challenges to Sustainable Groundwater Management

To advance sustainable groundwater management, it is essential to understand the growing list of challenges related to California's groundwater basins.

Addressing these challenges will require comprehensive efforts by local agencies individually and within regional partnerships to develop and implement sustainable groundwater management practices. This brief overview describes a number of factors confounding the management of California's groundwater resources.

Declining Sacramento-San Joaquin Delta

The Sacramento-San Joaquin Delta is the hub of California's two main water delivery systems – the State Water Project and the federal Central Valley Project. Court-ordered restrictions to protect species have significantly reduced deliveries from these projects in recent years. This reduction in surface water supplies has hampered conjunctive use projects in some parts of the state and highlighted the need for more sustainable groundwater management as urban, agricultural and environmental users have turned to local groundwater resources as a substitute for increasingly unreliable SWP and CVP deliveries.

Periodic, Inevitable Droughts

The southwestern United States, including California, is prone to periodic droughts. Most recently, three consecutive dry years from 2006-2009 resulted in some of the driest conditions in decades and reduced water storage in key reservoirs to record lows. Regulatory restrictions on SWP and CVP deliveries magnified the impacts of this natural drought.

Prolonged drought has multiple effects on groundwater resources and management. The lack of available surface water can place additional demands on groundwater basins. Less surface water also means less water available for groundwater recharge. If groundwater levels drop as a result of increased demand or reduced recharge, there are additional energy costs to pump groundwater and greater potential for overdraft conditions. Further, the strategic value of conjunctive use projects that rely on surface water reliability can be undermined.

Changing Climate

Climate change will exacerbate the existing water management challenges facing California, including those affecting groundwater resources. Possible consequences include more frequent drought periods, reduced snowpack in the Sierra Nevada, increased flooding intensity as well as impacts to the operation of the state's surface storage facilities.[5] Higher temperatures, particularly in inland areas, could lead to increased demands on water supplies for urban, agricultural and environmental uses.

Changes in rainfall patterns could also result in faster local runoff and reduced natural groundwater recharge. Collectively, these impacts could result in less reliable water supplies and an overall increase in the demand for groundwater supplies.

5 ACWA Policy Principles on Climate Change. March 2010.

"HIGHER HIGHS, LOWER LOWS"

Based upon historical data and modeling, DWR projects that the Sierra snowpack will decline by 25 percent to 40 percent from its historic average by 2050. Climate change is also anticipated to bring warmer storms that result in less snowfall at lower elevations, reducing the total snowpack.* These storm events will, however, increase peak flows and affect the length of the recharge and recovery cycle of reservoirs that is critical to effective conjunctive use projects.

* California Department of Water Resources. *Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water.* October 2008.

Unmanaged Overdraft and Subsidence

Overdraft is defined as the condition of a groundwater basin when the amount of water withdrawn by pumping over the long term exceeds the amount of water that recharges the basin, either through natural or artificial methods. A basin in overdraft tends to not fully recover, even in wet years. While the occasional extraction of groundwater in amounts greater than annual recharge can be part of an effective groundwater management plan, unmanaged or excessive extractions can result in land subsidence, water quality degradation, and environmental impacts.

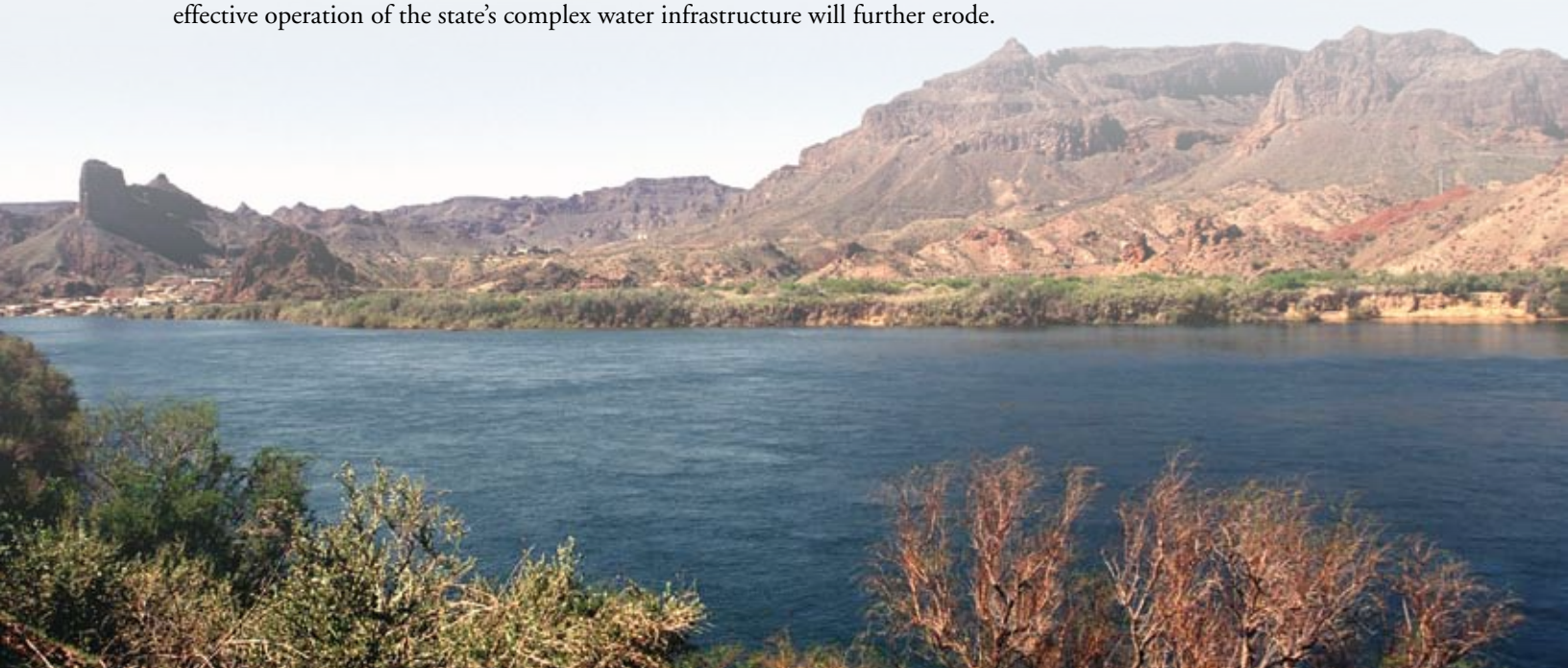
Protracted Drought on the Colorado River

The Colorado River is a key source of water for seven states and Mexico, providing water for some 30 million people to drink and meet household needs, irrigate crops and urban landscapes, operate businesses and replenish groundwater basins. California's annual allocation is 4.4 MAF for irrigation and domestic uses. The Colorado River Basin is in the midst of a multi-year drought that has reduced reservoir storage to record-low levels. These conditions are affecting the reliability of Colorado River supplies for conjunctive use projects and other beneficial uses throughout Southern California. Climate change is expected to further diminish the reliability of deliveries to California.

Aging System and Maintenance Backlog

California has not made significant investments in its backbone water storage and delivery systems, the SWP and CVP, in more than 40 years. In addition, several key components of the projects as originally planned were never built. Constructed when the state's population was just 18 million, the projects are struggling to meet the needs of 38 million Californians today. They also lack the flexibility to meet 21st century demands for both ecosystem health and water supply reliability. These aging facilities also suffer from a backlog of maintenance and repair needs arising from budget and contracting constraints.

Further complicating the effective maintenance of the state's water infrastructure is the growing number of issues related to an aging workforce. It is becoming increasingly difficult to secure professionals for policy and technical positions (such as engineers and water treatment operators), particularly those with extensive experience in California's water industry. As those individuals with expertise begin to retire en masse or find employment elsewhere, effective operation of the state's complex water infrastructure will further erode.



As a result of the increasing physical and workforce limitations, contractual and historic water delivery expectations are not being met and the existing facilities have neither the capacity nor flexibility to adapt to the approaching challenges presented by climate change. The deterioration of the delivery capabilities and reliability of this surface water infrastructure has resulted in, and will continue to contribute to, reductions in the amount of supply available for effective recharge and increasing demands for already-stressed groundwater resources.

At the local and regional level, efforts to maintain and upgrade facilities can be constrained by factors such as Propositions 218, which limits the ability of local agencies to raise rates and fees for a variety of projects and purposes. In addition, the practice of restricting bond funds solely for new construction and not for retrofitting and major maintenance needs can undermine past investments by allowing the foundation upon which they rely to crumble.

Groundwater Quality Degradation

Groundwater quality degradation has become a significant challenge for agencies that manage groundwater. Though groundwater quality can be affected by many factors, some of the most significant threats include chemical contaminants, both naturally occurring and man-made, salinity (including seawater intrusion), landfills and other hazardous waste sites. When groundwater quality is compromised, it may become unsafe for consumption or other uses and it can, without remediation, render the basin unfit for conjunctive use and artificial recharge projects.

Efforts to remediate groundwater contamination can be complicated by a number of issues. Under current law, local agencies that wish to initiate a remediation effort can face numerous disincentives that can hinder or even prevent a proactive approach. Difficulties related to liability, water quality standards, anti-degradation versus non-degradation concerns, assignment of costs and other factors are impediments to clean-up efforts.

Limited Data Collection, Interpretation and Use

In many areas, the lack of a comprehensive approach to systematically managing data on California's groundwater resources is a considerable challenge to sustainable groundwater development. Due to inadequate funding, a comprehensive assessment of groundwater level trends in California's groundwater basins has not been conducted since 1980. While some data is collected through ongoing efforts such as the Groundwater Level and Quality Monitoring Program (DWR), the Groundwater Ambient Monitoring and Assessment (GAMA) Program (administered by the U.S. Geological Survey under contract to the State Water Resources Control Board), and the U.S. Geological Survey Groundwater Information Program, these initiatives are weakened by their limited geographic scope. DWR and the

HOW DOES LAND SUBSIDENCE OCCUR?

Land subsidence is the gradual settling or sudden sinking of the Earth's surface due to changes that take place underground. This movement of earth can be the result of many factors, including groundwater extraction. In some types of groundwater basins, water that is pumped to the surface is drawn from spaces between sand and gravel. In addition, layers of clay can contain large amounts of water, and water pressure in the surrounding aquifer keeps the clay particles slightly apart from each other. When the water pressure in such a basin drops due to extensive pumping, the clay particles are pushed together by the weight of the overlying sediments, which is no longer in equilibrium with the (now lower) water pressure. As clay particles are pressed together for lack of water pressure, water drains out of the clay and the clay layers become compressed (thinner).

The effect of thinner clay layers is seen as a lowering of the land surface – sometimes as much as 20 or 30 feet over the course of a few decades. The lowering of land surface elevation from this process is permanent. Effective groundwater management utilizes the storage capabilities of groundwater basins while preventing significant subsidence from occurring. More information can be found at http://www.water.ca.gov/groundwater/well_info_and_other/land_subsidence.cfm, http://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/.

CONJUNCTIVE USE OPERATIONS AND "OVERDRAFT"

An increasingly common practice in California is to operate a groundwater basin in conjunction with available surface water supplies on a local or regional level. The practice involves exercising the basin, a process that causes the groundwater level to go up and down with wet and dry annual and periodic cycles. During the wet season and during wetter years, surface water is relied on more and the groundwater basin is recharged with surplus surface water, from local and / or imported sources, resulting in groundwater level increases. Such recharge occurs through direct means via spreading basins or in-lieu via surface deliveries that otherwise offset groundwater pumping. During dry years, when less surface water is available, groundwater is relied on more, drawing the groundwater levels down.

In the event of a periodic drought lasting several years, when less surface water is available and groundwater is used more extensively to meet demands, groundwater level trends can sometimes decline quite dramatically without any notable recovery for a longer period of time. The groundwater level trend in a conjunctively managed basin over a period of several years during a drought may appear as long-term overdraft; however, some would refer to this as "managed overdraft" as the downward trend will be offset by recovery cycles in wetter periods utilizing the direct or in-lieu groundwater recharge methods.

SWRCB do not adequately coordinate their statewide monitoring efforts. This lack of comprehensive data management will continue to hinder the ability of local and regional agencies to optimize the use of California's groundwater resources.

Small System Vulnerability

Small community water systems, including many that serve disadvantaged populations, can face unique management challenges not shared by their larger counterparts. Such systems that are dependent on groundwater and / or private wells are especially vulnerable to drought and the effects of climate change because they are typically located in isolated areas with few opportunities for interconnections with other systems, water transfers, or emergency relief. This can also make it more challenging to develop successful conjunctive use programs or implement costly water quality treatment technologies.

Fragmented Regulations

California has a multifaceted and complex regulatory structure. Numerous agencies have jurisdiction over various aspects of groundwater recharge and banking projects, particularly those involving underground storage supplements (USS) and aquifer storage and recovery (ASR). Regulations governing these projects tend to be fragmented, duplicative or unnecessarily complicated. Often-conflicting regulatory requirements affecting the same basin or water supply can also slow or even stall progress on critical projects.

Mounting Environmental Requirements

In addition to a complicated regulatory landscape, local water agencies must adhere to an array of environmental statutes as they plan, develop and operate projects. The California Environmental Quality Act (CEQA), for example, adds numerous layers and requirements that can be a hurdle to moving projects forward. Depending on how they are implemented, the state and federal Endangered Species Acts can also affect development and operation of projects, sometimes at great cost to water supplies. Loss of surface water supplies as a result of environmental regulations can result in greater short-term reliance on groundwater, often with long-term ramifications.

Land Use Decisions and Population Growth

Population growth and commercial development continue to put pressure on resources throughout California. As competition increases for a limited amount of developable land, the need to retain adequate groundwater recharge capability is often overlooked in decisions affecting land use. Activities such as paving and development change the absorption capacity of land, thereby reducing opportunities for natural recharge. In some watershed areas, forestry practices affect in-stream recharge by contributing to siltation, which blocks the absorption capability of creek and river bottoms.

Land use policies and regulations that fail to consider and protect natural and artificial recharge and extraction capabilities create long-term challenges for successful sustainable groundwater management, including permanent reductions in permeable acreage, water quality degradation and land subsidence. Such policies can also exacerbate problems associated with management of stormwater runoff.

Existing Local Management Strategies

California relies on a variety of mechanisms to promote the local control and management of groundwater resources. Since the earliest efforts to manage California's groundwater, the effectiveness and complexity of these strategies has continued to evolve with changing urban and environmental needs and conditions.

As previously noted, every groundwater basin in California presents unique physical and hydrogeological characteristics. In addition, each basin has unique beneficial uses dependent upon water quality, water rights, number and breadth of stakeholders, institutional type and complexity, and other features.[6]

Locally-controlled groundwater management is effective because local and regional entities are the most knowledgeable about their local basins and tend to be the first to notice changes or problems. They are also best suited to address issues unique to their region, including the implementation of proactive plans and actions to meet current and future groundwater needs.

Since local stakeholders and management agencies receive the direct benefits of sustainable management, they are more inclined to support investments in local infrastructure and water quality projects, which in turn leads to more consistent implementation of improvements. Local agencies are also in the best position to identify and assess the consequences of over-reliance on groundwater resources and to evaluate options for improved management. While a certain degree of coordination with the state is important, particularly with regard to data management and funding, one-size-fits-all mandates and uniform statewide protocols tend to be counterproductive because they do not recognize the significant differences in California groundwater basins.

Basic Management Mechanisms

As noted in the Department of Water Resources' California Groundwater Bulletin 118[7], there are three basic mechanisms available for managing groundwater resources in California. These mechanisms include: 1) management by local agencies under authority granted by state statute; 2) coordinated agreements and ordinances; and 3) court adjudications.

Local and regional agencies employ a variety of successful management strategies under these mechanisms, reflecting the diversity of the state's groundwater basins and the diverse beneficial uses of water from those basins. Examples can be found on pages 22 and 23. Financial support and incentives at the state and local levels have also contributed to the success of local and regional groundwater management plans. State policy makers can play a key role in promoting these efforts by providing consistent support and assistance through legislation and funding. Propositions 204, 13, 50 and 84 are examples of this constructive support.

Local Management under Authority Granted by State Statute

Many local water agencies are authorized by statute to institute and conduct some form of groundwater management. Agencies formed under the Water Replenishment District Act and the Water Conservation District Act, for example, are authorized to carry out groundwater replenishment programs and assess fees to pay for groundwater management programs.

6 California Department of Water Resources. *California's Groundwater, Bulletin 118 - Update 2003.* (http://www.water.ca.gov/groundwater/bulletin118/bulletin118update2003.cfm)

7 California Department of Water Resources. *California's Groundwater, Bulletin 118 - Update 2003: Ch. 2.* (http://www.water.ca.gov/pubs/groundwater/bulletin_118/california%27s_groundwater__bulletin_118_-_update_2003_/bulletin118-chapter2.pdf)

FINANCIAL SUPPORT FOR LOCAL GROUNDWATER MANAGEMENT

The California Legislature and voters have approved several propositions that included funding for groundwater quality remediation or local and regional management. The following are the most recent and largest allocations:

The Safe, Clean, Reliable Water Supply Act of 1996 (Proposition 204)

This measure authorized the state to sell $995 million in general obligation bonds for the purposes of restoration and improvement of the Bay-Delta; wastewater treatment, water supply and conservation; and local flood control and prevention. Funds were included in Proposition 204 for a water conservation and groundwater recharge loan program ($30 million) and local water supply development and environmental mitigation ($25 million).

The Safe Drinking Water, Clean Water, Watershed Protection and Flood Protection Act of 2000 (Proposition 13)

Proposition 13 was a $1.97 billion general obligation bond with $230 million earmarked for groundwater programs. The act authorized $200 million for grants for feasibility studies, project design, and construction of conjunctive use facilities (Water Code, § 79170 et seq.) and $30 million in loans for local agency acquisition and construction of groundwater recharge facilities and feasibility study grants for projects potentially eligible for the loan program (Water Code, § 79161 et seq.).

Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50)

California voters approved the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50; Water Code, § 79500 et seq.), which provided for more than $3.4 billion in funding, subject to appropriation by the Legislature, for a number of land protection, water quality and water management activities. Proposition 50 provided $500 million for integrated regional water management, water management projects that will protect communities from drought, protect and improve water quality, and reduce dependence on imported water supplies.

The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Proposition 84)

Proposition 84 authorized $5.488 billion in general obligation bonds to fund safe drinking water, water quality and supply, flood control, waterway and natural resource protection, water pollution and contamination control, state and local park improvements, public access to natural resources, and water conservation efforts. Within Proposition 84 is $60 million for projects that prevent or reduce groundwater contamination, and $1 billion for integrated regional water management (IRWM) planning and implementation.

*Note: The 2009 legislative package included an $11.14 billion water bond (set for the November 2012 ballot) with additional funding for groundwater activities. See page 28 for more on the package.

Currently, 13 local agencies throughout California have specific authority under special legislation to limit or regulate groundwater extraction.

AB 3030 Plans

The Groundwater Management Planning Act, commonly known as AB 3030, greatly expanded the number of local agencies with authority and responsibility over groundwater resources. The act, which became effective in January 1993, was aimed at encouraging more effective local management as an alternative to establishing a state-administered groundwater management structure. AB 3030 was developed by ACWA and its Groundwater Committee, partially in response to the U.S. Environmental Protection Agency's Comprehensive State Ground Water Protection Program (CSGWPP), which promoted comprehensive groundwater quality management on the state level with EPA providing proposed oversight and coordinated funding.

After the passage of AB 3030, many water agencies developed voluntary "3030" plans and significantly increased their involvement in groundwater management. As of 2003, more than 200 agencies have adopted an AB 3030 groundwater management plan.[8] This legislation was a big step forward in formalizing and supporting the local management of groundwater in California. Some plans prepared under its provisions, however, have suffered from little or no implementation, while others have focused primarily on limiting exports of groundwater to other regions, rather than incorporating all elements of a comprehensive management program.

8 California Department of Water Resources. *California's Groundwater, Bulletin 118 - Update 2003: Ch. 2.* (http://www.water.ca.gov/pubs/groundwater/bulletin_118/california%27s_groundwater__bulletin_118_-_update_2003_/bulletin118-chapter2.pdf)

SB 1938 Groundwater Management Programs

In 2002, the Legislature passed SB 1938. This statute provides additional direction and technical guidance to local agencies for developing groundwater management plans and requires the inclusion of basin management objectives relative to groundwater quantity and quality, subsidence and monitoring programs. SB 1938 also requires agencies to have a groundwater management plan that meets certain requirements in order to be eligible for any state grant or loan programs for groundwater projects.

Building upon the positive elements of AB 3030, SB 1938's passage strengthened the effectiveness of groundwater management plans in California. Many agencies have supplemented their existing plans by incorporating the bill's new provisions or are developing entirely new SB 1938 plans to not only sustain the resource but also to ensure eligibility for state grants or loans.

AB 3030 and SB 1938 plans have provided the basis for action and progress. Under the Local Groundwater Assistance Program (AB 303), DWR awarded nearly $28 million in grants between 2000 and 2005 to local agencies to conduct 128 projects involving groundwater management plans or related activities.[9]

DWR also distributed $205 million in funds from Proposition 13 to groundwater recharge and storage feasibility studies, pilot projects and construction projects between 2000 and 2004, with the total value of those efforts (when combined with leveraged local dollars) totaling over $1 billion. Primary benefits from these activities were enhanced groundwater management and improved water supply reliability, but there have been other benefits as well, including improved drinking water quality, groundwater protection, reduced wastewater discharges, dedicated environmental water and improved habitat / wetlands restoration. It is estimated that these projects provide an additional 300,000 acre-feet per year to local California water supplies.[10]

More recent water bond measures have also included funding to support local groundwater management programs. When distributed, that funding will assist local management entities to ensure further progress in the implementation of their plans.

Groundwater management plans developed under AB 3030 and SB 1938 are among the most effective and widely used management techniques in California. As noted, more than 200 plans have been implemented throughout the state. Entities implementing this type of management are also best prepared to work with state agencies as elevation data is collected pursuant to the new requirements of SBX7 6, enacted as part of the 2009 comprehensive legislative package on water. The comprehensive structure of AB 3030 and SB 1938 plans provides a vehicle to simultaneously provide effective management now and into the future while remaining focused on local hydrologic and economic conditions.

Integrated Regional Water Management Plans (IRWMPs)

Proposition 50's passage in 2002 provided additional grants and matching funding for local projects consistent with the new integrated regional water management plan (IRWMP) initiative. IRWMPs require various local entities to

9 California Department of Water Resources. *Local Groundwater Assistance Program Five-Year Report, 2000-2005.* (http://www.water.ca.gov/groundwater/docs/AB303_Finalized_050206.pdf)

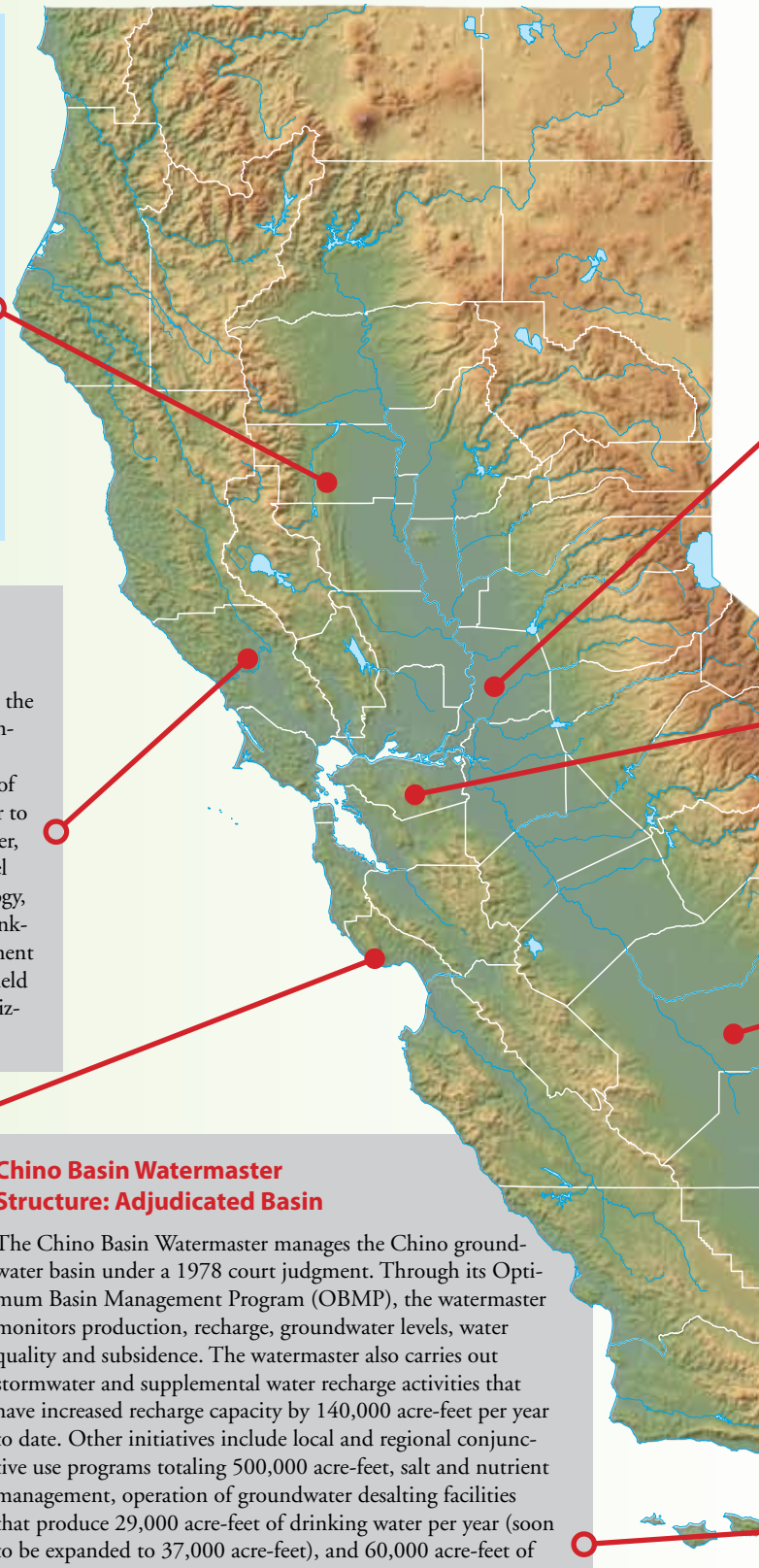
10 California Department of Water Resources. *2000-2004 Proposition 13 Groundwater Grants and Loans Program Summary.* (http://www.grantsloans.water.ca.gov/docs/prop13/Prop_13_Final_Report.pdf)

COMMON CHARACTERISTICS OF SUCCESSFUL GROUNDWATER MANAGEMENT

Elinor Ostrom, who recently won the Nobel Prize in Economics for her work on local governments' management of natural resources, identified a number of characteristics shared by successful efforts to manage groundwater resources. These characteristics include: (i) clearly defined boundaries, both in area and in participants; (ii) rules that are tailored to the local circumstances; (iii) local governance; (iv) active monitoring for compliance with adopted rules; (v) graduated sanctions for violations of those rules; (vi) conflict resolution mechanism within the institution; and (vii) support for local institutions by external governments.*

* Ostrom, Elinor (1990). *Governing the Commons: The Evolution of Institutions for Collective Action.* Cambridge University Press. ISBN 0-521-40599-8.

Case Studies in Effective Local Groundwater Man



Glenn County Groundwater Management Plan
Structure: Groundwater Ordinance

Utilizing a mission and goals statement and a memorandum of understanding (MOU) among local stakeholders, the Glenn County Board of Supervisors adopted a groundwater ordinance in 2000. The ordinance builds on earlier work by a water advisory committee and identifies basin management objectives in key areas to help overcome challenges associated with defining safe yield and overdraft in the Sacramento Valley. Instead of a "one-size-fits-all" approach, the ordinance calls for management objectives to be set for minimum groundwater levels, minimum water quality and maximum subsidence for each of 17 sub-areas in the basin. The creation of the advisory committee, adoption of the ordinance and the subsequent adoption of a Four County MOU in 2006 have led to increased coordination and improved water resources understanding at the county and regional level. An Integrated Regional Water Management Planning process is also under way. (www.glenncountywater.org/management_plan.aspx)

Sonoma Valley Groundwater Management Program
Structure: AB 3030 / SB 1938 Plan

With a primary goal of sustaining groundwater resources for future generations, the Sonoma Valley Groundwater Management Program centers on an SB 1938-compliant plan adopted in 2007. The program includes four main management strategies: conservation, recycled water use to offset groundwater pumping, use of stormwater to recharge groundwater, and banking of winter Russian River water to recharge the basin. Cooperative efforts have helped to bring stakeholders together, while information gathered from the expansion of a voluntary groundwater-level monitoring program has led to increased understanding of the basin hydrogeology, improved public awareness, and better planning. Initiation of a groundwater banking feasibility study, a flood control / groundwater recharge study, and development of a guidebook for homeowners to better manage stormwater are expected to yield broader benefits such as reducing localized groundwater depressions and minimizing or eliminating seawater intrusion. (www.scwa.ca.gov)

Soquel-Aptos Area Groundwater Management Plan
Structure: AB 3030 / SB 1938 Plan

Soquel Creek Water District, Central Water District, the City of Santa Cruz Water Department and the County of Santa Cruz are working cooperatively to manage resources and prevent seawater intrusion. The program centers on activities to limit water demand, maintain groundwater extractions within sustainable quantities, and closely monitor changes in all or part of four groundwater basins. Efforts include aggressive conservation, conjunctive use, and development of a seawater desalination project that will provide water for in-lieu recharge. Cooperative groundwater management has slowed the decline of coastal water levels by collectively reducing demand and reducing pumping toward sustainable levels. Opportunities for interagency projects are identified through regular communications and a collaborative approach. Projects that could not have been undertaken by any one agency are being jointly funded through cost-sharing agreements and / or Integrated Regional Water Management grant funding. (www.soquelcreekwater.org/content/groundwater-management-plan)

Chino Basin Watermaster
Structure: Adjudicated Basin

The Chino Basin Watermaster manages the Chino groundwater basin under a 1978 court judgment. Through its Optimum Basin Management Program (OBMP), the watermaster monitors production, recharge, groundwater levels, water quality and subsidence. The watermaster also carries out stormwater and supplemental water recharge activities that have increased recharge capacity by 140,000 acre-feet per year to date. Other initiatives include local and regional conjunctive use programs totaling 500,000 acre-feet, salt and nutrient management, operation of groundwater desalting facilities that produce 29,000 acre-feet of drinking water per year (soon to be expanded to 37,000 acre-feet), and 60,000 acre-feet of recycled water reuse. The OBMP has enhanced the sustainable yield of the basin, improved water supply reliability as well as water quality, reduced subsidence, and expanded the direct use and recharge of recycled water. It has also reduced demand for imported water from the State Water Project and the Colorado River. (www.cbwm.org)

nagement in California

Sacramento Groundwater Authority
Structure: Joint Powers Authority

SGA draws its authority from a 1998 agreement between the cities of Sacramento, Citrus Heights, Folsom, and the County of Sacramento to utilize their common police powers to protect the basin. Through its SB1938-compliant groundwater management plan and a comprehensive update completed in 2008, SGA has developed a dedicated monitoring well network, a regional groundwater model, a comprehensive groundwater database, and a biennial basin management report to assess the basin's health. Prior to SGA's formation, much of the basin suffered from decades of continually declining groundwater levels. Collaboration through SGA has improved the basin to the point that banked water could be transferred to state and federal programs during recent drought conditions. SGA's efforts also have led to the accelerated cleanup of regional contaminant plumes. The region is now poised to further expand banking and exchange operations, while ensuring a sustainable basin. (www.sgah2o.org)

Zone 7 Water Agency
Structure: AB 3030 Plan

Zone 7 Water Agency has actively managed the Livermore Valley Groundwater Basin for more than 40 years for municipal water supply. It began importing State Water Project water into the watershed in 1962 to reduce groundwater extractions that had left the basin in overdraft. Soon after, the district began artificially recharging the basin by using local "losing" streams to convey and percolate imported water. It continues to manage the basin conjunctively through a comprehensive Groundwater Management Plan that incorporates salinity management to offset the addition of salts from imported and recycled water. Plans are being developed to augment the district's artificial recharge capacity by adding nine aggregate quarry pits that will be used as water storage and aquifer recharge basins. Through its efforts, Zone 7 has curbed groundwater pumping and replenished basin aquifers to levels that can be managed sustainably. (www.zone7water.com)

Upper Kings Basin Integrated Regional Water Management Authority
Structure: Integrated Regional Water Management Plan

Local water agencies in the Kings Groundwater Basin have created a coalition of water districts, private water companies, cities, counties, environmental interests, and other stakeholders to deal with the most pressing local water issues—groundwater depletion, supply reliability and quality. The Upper Kings Basin Integrated Regional Water Management Authority was formed in 2009 to create a sustainable supply of the Kings Basin's finite surface and groundwater resources through balanced regional planning. The IRWMP features an array of projects, including groundwater banking facilities to capture available surface water to enhance local groundwater levels and water quality. A second-phase plan includes surface water exchanges and a groundwater treatment plant to serve disadvantaged communities currently using water of lesser quality. Regional planning and projects will improve supply reliability in dry years and mitigate the Kings Basin's groundwater overdraft. (www.krcd.org/water/ukbirwma)

Orange County Water District
Structure: Special District Act

OCWD was the first agency in California to adopt a groundwater management plan. Originally adopted in 1989, the plan was updated most recently in 2009. In addition to operating one of the most advanced groundwater recharge and monitoring systems in the nation, OCWD manages the largest constructed wetlands in Southern California to naturally filter and clean Santa Ana River flows before entering the recharge area. The district has an active groundwater conjunctive use storage agreement with Metropolitan Water District of Southern California and has constructed the largest planned indirect potable reuse project in the world, the Groundwater Replenishment System, which provides 72,000 acre-feet per year of highly purified water for an expanded seawater barrier and recharge to the aquifer. Successful management of the basin has helped reduce the region's reliance on imported water from Northern California and the Colorado River. (www.ocwd.com)

work collaboratively within a region to develop common water resources management goals and objectives through a transparent process including public involvement. These standards include a list of water management strategies and objectives, including surface and groundwater management, water quality protection and improvement, recycled water and desalination (where appropriate).

The intent of the IRWMP program is to encourage integrated regional strategies for management of water resources and to provide funding, through competitive grants, for projects that protect communities from drought and other extreme weather events, ensure sustainable water uses and environmental stewardship, protect and improve water quality, and improve local water security by reducing dependence on imported water.

Similar to the AB 3030 and SB 1938 processes, local and regional stakeholders have collaborated to develop common water resources management goals and objectives. Multiple plans have emerged since 2002, bolstered by over $1 billion in funding from Propositions 50, 84 and 1E for those agencies with groundwater management plans and / or an urban water management plan. It is anticipated the comprehensive approach outlined through the IRWMP process will continue to play a vital role in sustaining California's overall water supply, particularly if the considerable financial support for the program is maintained in the future.

Coordinated Agreements and Ordinances

Some agencies have entered into coordinated agreements over the years in which multiple water purveyors commit to participate in mutually beneficial management activities, including the analysis of a jointly used basin and the development of joint capital projects and joint operational policies. Enforcement of the agreement and the collection of any fees or levies may be jointly shared among the parties.

In addition, groundwater ordinances have been adopted by some cities and counties. These ordinances may include controls intended to limit or prohibit exports of groundwater to protect the area's groundwater basins. The more general intent is to better coordinate management of water supply and land development. Local governments implementing this type of groundwater management utilize their police power, land use authority and general plan provisions to regulate the use of groundwater in their jurisdiction. These governmental entities are often faced with unique, internal management issues, such as planning department goals that must be coordinated with water or public works department goals and objectives. These ordinances have been most successful when coordinated with an AB 3030 / SB 1938 groundwater management plan.

Other voluntary management strategies are less common, but they can also be successful when implemented proactively and in cooperation with other local and regional stakeholders. Coordinated agreements such as the Sacramento Area Water Forum (including the Sacramento Groundwater Authority) have produced positive results in some regions.

Adjudication

Adjudication is a management method for groundwater basins that have typically exhibited a condition of sustained overdraft for a period of at least five consecutive years. Adjudication is the product of a judicial process involving parties in a groundwater basin to determine the nature and quantity of each producer's share of the basin's safe yield. The process includes the appointment of a watermaster to oversee the court judgment that specifies how much each of the parties to the decision can extract from the basin. There are 22 settled court adjudications of groundwater basins in California, mostly in Southern California.[11] The first basin-wide adjudication of groundwater rights in California was in the Raymond Basin in Los Angeles County in 1949 (*Pasadena v. Alhambra*)[12]and the majority of adjudications were initiated or completed prior to the passage of AB 3030 in 1992.

Adjudicated groundwater basins in California can help to provide certainty by defining and quantifying specific rights for individual producers in the basin. However, application of this strategy indicates significant challenges exist in the affected basin, and parties entering into adjudication should understand the process is time consuming, expensive and complex for the involved parties.

11 California Department of Water Resources. Groundwater Information Center – Court Adjudications. 2011. (http://www.water.ca.gov/groundwater/gwmanagement/court_adjudications.cfm)

12 California Department of Water Resources. *California's Groundwater, Bulletin 118 - Update 2003: Ch. 2.* (http://www.water.ca.gov/pubs/groundwater/bulletin_118/california%27s_groundwater__bulletin_118_-_update_2003_/bulletin118-chapter2.pdf)

Advancing Sustainable Groundwater Management

It is increasingly clear that California's reliance on groundwater is growing. Local groundwater management plans must reflect that reality and incorporate strategies that consider the potential consequences of a large-scale shift to groundwater, whether cyclical or permanent.

The components of AB 3030 and SB 1938, along with the Integrated Regional Water Management Plan approach, provide an excellent foundation for this type of management and their use should be encouraged and incentivized. Engaging stakeholders in the process is a key way to promote broad participation in the development of such plans. As experience shows, cooperation and participation by a wide spectrum of stakeholders — including surface water users — can be extremely beneficial to the development and implementation of sustainable groundwater management programs.

The ideal groundwater management plan addresses the resource on a local level, provides for operational flexibility, and satisfies the needs of both the environment and the economy while ensuring the continued health of the basin.

The following management objectives reflect best practices that will maximize the effectiveness and sustainability of local groundwater management plans.

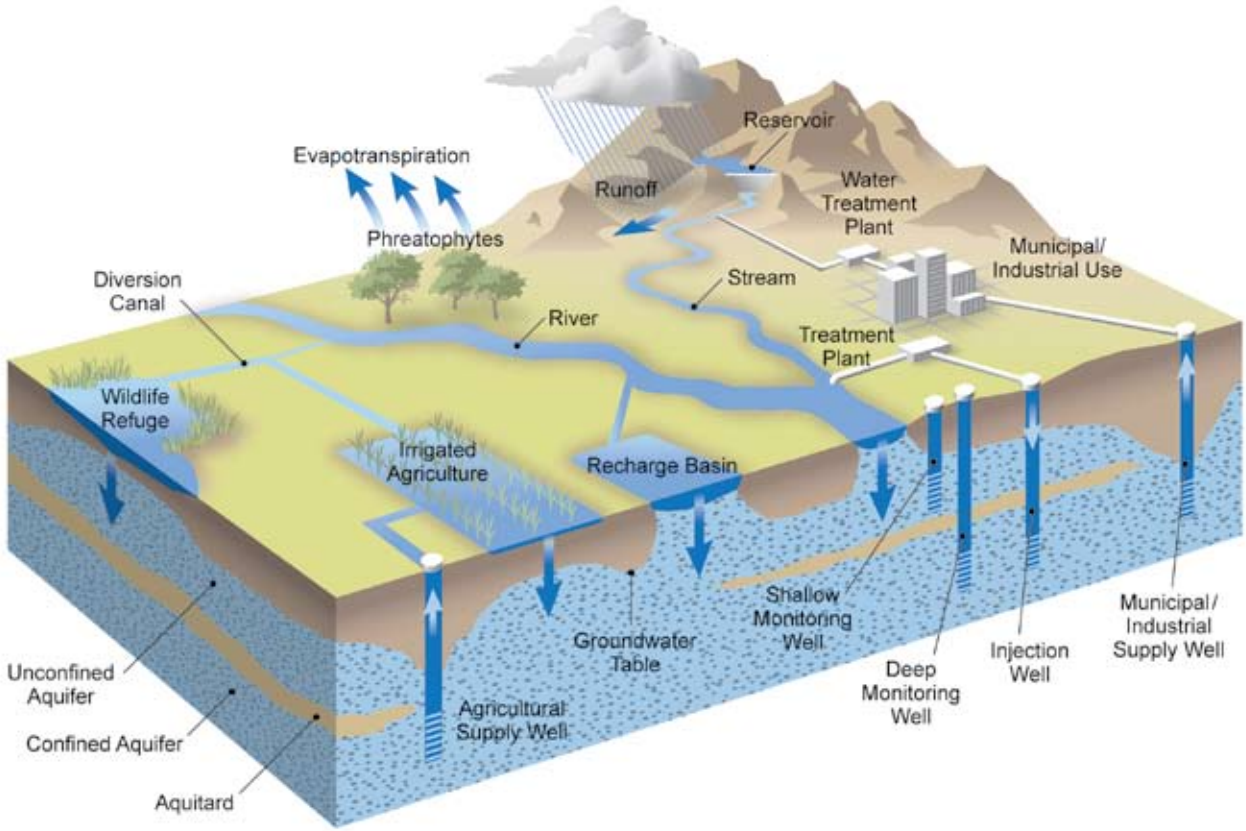
Optimize conjunctive management of surface and groundwater resources. California must invest in surface storage and conveyance improvements as part of a comprehensive plan to restore the Delta ecosystem, ensure a reliable statewide water supply and help recover, improve and sustain the state's economy. Because surface water and groundwater resources are most effective when used in concert with each other, significant investments in surface water storage and conveyance facilities are critical to the success of conjunctive use projects and sustainable groundwater management throughout California.

One of the most effective methods to do this is to ensure that grant programs and regulatory policies reflect the critical link between local and regional groundwater management programs and investments in new storage and conveyance infrastructure. This link is integral to maximizing California's overall water management flexibility.

Groundwater management agencies must also prepare for the effects of future surface water shortages and develop strategies to augment natural and artificial recharge. These strategies should include the increased use of alternative water sources such as stormwater, recycled and desalinated water, as well as additional conservation / water use efficiency efforts, to expand the portfolio of options for groundwater recharge.

Integrate conservation and water use efficiency. Many of the challenges facing groundwater management agencies are driven by the general availability of water for beneficial uses. A continued and intensified commitment to conservation and water use efficiency is critical to addressing these issues. In the context of California water management, water use efficiency means "using water more efficiently to reduce water demand for a given set of beneficial uses."

As with groundwater management efforts, water conservation and water use efficiency programs will only be successful if local water agencies are responsible for their design and implementation. Local water agencies are accountable to their customers for making locally cost-effective decisions that will provide reliable water supplies while balancing other factors, consistent with applicable regulatory requirements. Water conservation and water use efficiency programs are indispensable tools in any agency's portfolio as it develops a sustainable water management plan.



Conceptual model of a typical water management system. Courtesy of the Department of Water Resources.

Undertake comprehensive data collection and analysis. While large amounts of groundwater information are currently being collected and used by multiple local, regional, state and federal agencies and organizations, there are data gaps that can prevent the optimal beneficial use of a groundwater basin. These gaps may also affect relationships among agencies and limit opportunities for regional efforts to sustainably manage a basin's resources. Filling data gaps, ensuring adequate and sustained local groundwater monitoring and making periodic evaluations of the data are the most effective ways to gauge the long-term management risks to groundwater basins (both from a quality and quantity perspective) resulting from increased reliance on groundwater resources. Such fundamental data gathering and assessment are prerequisites to successful, sustainable groundwater management.

Sustainable groundwater management has the best chance of being achieved and maintained if a proper and frequent assessment of the state's groundwater resources is completed, including groundwater level trends, average quantities of groundwater available, and unused storage capacity. Efforts should also focus on groundwater quality data, the effects of current and future contamination and management options for better protecting basins over the long term. This assessment of the groundwater basins' level trends, availability, capacity and quality should be completed and reported by DWR and the appropriate federal agencies (e.g. USGS, NASA), working cooperatively with local groundwater management agencies and optimizing local agency data, evaluations and reports. ACWA was encouraged by the inclusion of a provision requiring such a document in the SBX7 6 legislation and has been working with DWR to develop appropriate, effective and efficient protocols for engaging with local groundwater management agencies.

Most of the groundwater served in California is well managed by local agencies utilizing the appropriate scale of monitoring, data evaluation and reporting through a well-designed groundwater management program. Those areas without, but in need of, active groundwater management programs should be identified, and local agencies should be engaged to implement strategies to move toward sustainability. However, at this time there is limited large-scale groundwater data and information available to systematically assess and accurately describe the status of groundwater basins throughout the state. In addition to developing such information, it is important that representative groundwater level and quality information already collected be made transparent and accessible to interested stakeholders, including adjacent local groundwater managers.

Local and regional entities should share appropriate information and collaborate with other pertinent agencies and the state in developing and implementing sustainable groundwater management programs. Additional efforts may be required to engage individual landowners on a case-by-case basis because sustainable local management of groundwater resources requires accountability, stewardship and transparency by all users. This data collection and transparency of information will not only provide a means for communication and education about the resource, but ultimately will help provide protection to all groundwater users, ensuring a high quality, reliable water supply in each basin. Appropriate local monitoring, measurement and reporting of groundwater basin activity are the only ways to assess whether groundwater basin objectives are being achieved.

Consider the implications of land use decisions. Land use policies that maximize conjunctive use projects and minimize subsidence and groundwater contamination often conflict with common practices of agricultural and urban development throughout California. The constant pressure of residential and commercial development can result in the loss of critical acreage that could be utilized to recharge groundwater basins or ensure storage for areas with unreliable surface supplies. Ironically, areas developed in a way that prevents adequate recharge have the potential to suffer subsidence and a loss of the infrastructure built over the basin. IRWMPs can be an important tool in minimizing such impacts, but it is necessary to collaborate with the developer community to ensure effective communication and reduce potential conflict.

Local agencies should be proactive in identifying and including in a sustainable groundwater management plan the most appropriate areas to serve as dedicated recharge or conjunctive use locations. In addition, land use practices to protect indirect recharge should be promoted to land use jurisdictions for their consideration and implementation, through ordinance where necessary. One example of an indirect approach to conjunctive use is promoting low-impact development (LID), a strategy increasingly used to improve the effectiveness of groundwater recharge and extraction options by minimizing the loss of recharge areas and requiring certain construction practices that increase or maintain the absorption capability of lands overlying groundwater basins. Such efforts, when developed and implemented in coordination with other actions such as enhanced water use efficiency and / or water recycling, present an important opportunity for coordination with local governments and collaboration with stakeholders.

Make public communication and education a priority. Many local and regional groundwater management agencies continue to improve and implement plans that effectively maintain or enhance the health of their basins and provide the foundation for future sustainable management activities. Efforts to educate the public (including policy makers, other local agencies and regulators) about groundwater and successful management approaches can be significantly improved and should be a higher priority for agencies already implementing or working to craft a sustainable groundwater management plan. Information should be made available in a variety of formats and regular workshops should be designed to appeal to all audiences.

WHAT IS LOW-IMPACT DEVELOPMENT?

Low-impact development (LID) is a sustainable practice that benefits water supply and contributes to water quality protection. Unlike traditional stormwater management, which collects and conveys stormwater runoff through storm drains, pipes, or other conveyances to a centralized stormwater facility, LID takes a different approach by using site design and stormwater management to maintain the site's pre-development runoff rates and volumes. The goal of LID is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source of rainfall.*

* State Water Resources Control Board. *Low Impact Development – Sustainable Storm Water Management*. 2011. (http://www.swrcb.ca.gov/water_issues/programs/low_impact_development/index.shtml)

THE 2009 LEGISLATIVE WATER PACKAGE

The comprehensive water package enacted in November 2009 marked a new era for California water. At its core, the new law formalized the co-equal goals of water supply reliability and ecosystem health as state water management policy. The package includes four policy bills and an $11.14 billion water bond measure now targeted to go before California voters on the November 2012 ballot. The policy bills address the Delta ecosystem and its governance, statewide conservation policies applicable to urban, industrial and agricultural water suppliers, development of updated in-stream flow criteria, and groundwater elevation monitoring requirements in every basin and sub-basin in California.

While all of the bills include policies or actions that will directly or indirectly impact groundwater resources, the groundwater monitoring bill, SBX7 6, requires the most of groundwater managers and users. This legislation requires groundwater elevation monitoring for all basins and sub-basins by January 1, 2012 to demonstrate seasonal and long-term elevation trends in groundwater basins. The monitoring provisions are designed to help better manage the resource during both normal water years and drought conditions.

Under the legislation, a local agency or other eligible organization in each basin or sub-basin interested in assuming responsibility for monitoring and reporting groundwater elevations for its respective area was to notify DWR by January 1, 2011. If no entity volunteers for a particular area, DWR will assume the responsibility for monitoring and the affected county and entities will become ineligible for state grants or loans.

This legislation supports local groundwater management by appropriately looking to local and regional agencies as the authorities for monitoring groundwater elevations. ACWA has been an active partner with DWR as the monitoring program protocols have been developed. The state's commitment to supporting the local management approach will help ensure effective implementation.

In addition to the groundwater provisions in SBX7 6, accomplishing the goals included in the Delta package will be a critical part of securing a healthy Delta ecosystem and improvements in water supply reliability for the entire state. It will allow for a more reliable surface supply for users who may otherwise shift to groundwater to satisfy part or all of their water needs.

Implementing activities to reach conservation targets outlined in SBX7 7 will also be important as local agencies seek to reduce long-term stress on groundwater resources, particularly during periods when access to surface water supplies is reduced or eliminated.

While this historic package of water legislation includes much that will contribute to improved water management in California, it alone will not lead to sustainable groundwater management. Though it reflects recognition that the state is facing a multi-faceted water crisis and provides policy and financial support for many projects, much work remains to be done to ensure groundwater resources can be sustained through active management on a local or regional scale.

Recommendations

Throughout this Framework ACWA has described key elements of groundwater management and the growing number of challenges facing local water managers today. Examples of successful, locally coordinated approaches to groundwater management have been provided to highlight best practices that may enhance the effectiveness of management plans. Plans such as these should be developed and expanded at the local or regional level, understanding that sometimes there is a need to engage beyond an individual agency's jurisdictional boundaries.

ACWA firmly believes the state Legislature should encourage and support local management policies that appropriately reflect California's geographic and hydrologic diversity rather than institute a state-administered centralized control structure for regulating or permitting the use of groundwater. Statewide permitting and regulation would undermine the effectiveness of existing and planned local investments and would be counterproductive. The Legislature should focus instead on incentivizing the development and implementation of the best practices outlined in this Framework.

In addition, ACWA stands ready to collaborate in the development of appropriate regulatory and policy-related actions and initiatives that will further promote more effective and comprehensive local groundwater management. To that end, we make the following management and policy recommendations to help ensure the sustainability of California's groundwater resources.

ACWA Groundwater Framework Recommendations

Local Agency Level

1. Excluding small or undeveloped basins, groundwater basins in California that are identified in DWR Bulletin 118 should be operated by local agencies and / or stakeholders consistent with a locally developed groundwater management plan that achieves sustainability with the level of management appropriate for the basin. Groundwater management agencies within any basin where extractions are a significant percentage of the groundwater budget should develop formal groundwater management plans with stated policies and practices. The development of these plans should be open and transparent to allow public engagement in the process and should specifically address all factors related to groundwater management including, but not limited to, conjunctive use where appropriate.

2. Consistent with their respective groundwater management plans and state law, groundwater management agencies should be encouraged to collect and disseminate comprehensive groundwater information to demonstrate short- and long-term sustainability of the basin. Agencies should actively provide that information to DWR and make it accessible to the public.

3. Agencies that do not have an SB 1938 groundwater management plan (or functional equivalent), where applicable, should be ineligible for water-related state grants and loans. Financial support and incentives should be made available to agencies that lack sufficient resources but are committed to developing a groundwater management plan.

State and Regional Agencies

1. DWR should improve the functionality of existing online access portals such as IWRIS and the Water Data Library for groundwater information that utilizes the data collected from local agencies to provide improved public access. Representative information should also be transparent and accessible statewide through other avenues, including the California Water Plan (Bulletin 160) and any updates to Bulletin 118.
2. Where an SB 1938 groundwater management plan (or the functional equivalent) exists, state agencies should develop procedures, where applicable, to issue necessary permits for groundwater projects within 60 days of the certification of the CEQA document by the lead agency. This is especially critical for groundwater replenishment projects.
3. A multi-agency team led by DWR should be created and charged with developing an approach to both coordinate review and facilitate implementation of new local and regional groundwater recharge, groundwater banking and conjunctive use projects. Interagency coordinated review and facilitation of groundwater projects is required to ensure that these sustainable resource management opportunities are implemented efficiently once approved by a local agency as part of its groundwater management plan.
4. The Natural Resources Agency and Cal/EPA should work together to develop incentives for local agencies to implement small-scale groundwater replenishment projects, consistent with the applicable local groundwater management plan.
5. Regional Water Quality Control Boards should encourage and facilitate the process for capable local agencies responsible for groundwater management to proactively remediate contaminated groundwater basins when the local agency determines such remediation will contribute to more sustainable groundwater management.
6. The California Department of Public Health should develop draft criteria for SB 918 (2010), which directs the California Department of Public Health to develop criteria for using recycled water to supplement water storage, no later than December 31, 2011.
7. California agencies must develop a new methodology for encouraging, promoting and supporting infrastructure investments, particularly those that would improve water supply reliability at the local level and those that can work in conjunction with the state's backbone water delivery systems.

Legislative / Legal

1. The state of California should designate the use of surface water for groundwater recharge as a "beneficial use." The designation should apply even when there is no plan for future extraction of the water, as long as it is consistent with an SB 1938 groundwater management plan (or the functional equivalent).
2. California law should be clarified to state that once surface water is recharged as part of a conjunctive use project consistent with an SB 1938 groundwater management plan (or the functional equivalent), such water becomes "groundwater" outside the scope of State Water Resources Control Board jurisdiction.
3. The state of California should provide appropriate protection from liability for any agency responsible for groundwater management that undertakes the cleanup of a contaminated groundwater basin in order to use that basin, including as part of a conjunctive use program.
4. Voting requirements should be reduced to 55 percent for approval of local funding initiatives targeted at investments in new or existing water management infrastructure.
5. California anti-degradation policy, as it is currently interpreted with respect to groundwater recharge projects, should allow local agencies to optimize their groundwater resources, providing that maximum benefit to the public is maintained. Any changes should be made in coordination with groundwater management plans, recognizing the variety of different circumstances throughout the state.
6. County general plans should be required to incorporate land use elements that contribute to and promote effective implementation of an SB 1938 groundwater management plan (or the functional equivalent), as determined in consultation with local agencies responsible for groundwater management.

7. The state of California should ensure that "in-lieu" recharge is protected as part of a conjunctive use program. Put otherwise, a conjunctive use project need not require the direct recharge of surface water or the actual extraction of groundwater if near-term demands can be shifted from one source to the other, thereby accomplishing the goal of the conjunctive use project in both wet and dry years.

Collaborative Actions

1. In order to implement large-scale conjunctive use projects in the Central Valley and elsewhere, the Legislature and federal government should invest in surface water storage and improved Delta conveyance, provide financial support for local and regional infrastructure projects, and modify operations and regulatory policies to optimize conjunctive use opportunities.
2. The state, working with appropriate local entities, should address groundwater-related drinking water quality issues in small or disadvantaged communities by providing technical assistance to identify the best approach to protecting public health.
3. In implementing applicable state laws and developing ordinances, local governments should carefully consider the implications of policies and regulations that affect land use in the areas that overlie basins and advocate projects in collaboration with the developer community that maximize opportunities for recharge and conjunctive use.
4. Sustainable groundwater management may be improved through the use of quantitative groundwater models; state and federal agencies should provide financial support to assist local agencies in constructing such models where appropriate.
5. Protecting groundwater quality should be considered as important as the development of sustainable groundwater supplies. Using the best available science, regulatory and policy efforts to identify long-term solutions for the remediation of contamination issues should be supported on a local, regional and statewide scale, such as the salt and nutrient management plans identified in the State Water Resources Control Board Recycled Water Policy.

ACWA Policy Principles on Groundwater Management

"Groundwater – Invisible No More"

Groundwater is an invaluable resource for California and a critical asset in the state's comprehensive water management portfolio. Groundwater management should be implemented throughout California, and should be done so consistent with the following policy principles adopted by ACWA's Board of Directors.

1. Groundwater resources are best managed by local jurisdictions to effectively and efficiently manage water quality and supplies for beneficial uses. ACWA encourages and supports regional groundwater management strategies such as Integrated Regional Water Management Plans (IRWMP) and other regional partnerships.
2. Local management of groundwater resources requires accountability, stewardship and transparency; and appropriate local monitoring, measurement and reporting of groundwater basin activity to assure groundwater basin objectives are being achieved.
3. ACWA opposes state interference with existing legal rights to groundwater and believes that a state-administered water rights system for groundwater would undermine effective groundwater management and local investments.
4. California's groundwater resources are unique and diverse in physical characteristics, beneficial uses, water rights, legal and institutional governance and management structures, stakeholders and other features. One-size-fits-all state mandates are ineffective and counterproductive.
5. ACWA supports expansion of conjunctive management of surface water and groundwater supplies that contributes to the protection, reliability and sustainability of local, regional and statewide water supplies for water users and the environment. Such an expansion requires increased groundwater and surface storage, the re-operation of surface reservoirs as appropriate, and improved Delta conveyance.
6. Groundwater quality management is integral to optimizing California's groundwater resources. It must be science-based and include improved data management, basin assessments, monitoring, reporting, protection and, where appropriate, remediation.
7. ACWA supports the use of potable, desalinated, recycled and storm waters for groundwater recharge, with appropriate water quality safeguards that protect beneficial uses.
8. Land use policies and regulations that identify, preserve and protect natural and artificial recharge and extraction capabilities are essential for sustainable groundwater management. Land use policies must consider and analyze impacts and potential impacts to groundwater quality.
9. ACWA supports statewide and regional regulatory consistency that acknowledges the diversity of groundwater resources to facilitate the achievement of local and statewide groundwater storage and basin utilization goals.
10. Groundwater management strategies must anticipate and adapt to the effects of climate change.
11. Optimal groundwater management throughout California will require significant federal, state, regional, local and private investment in infrastructure and related facilities. ACWA further supports increased funding for groundwater research, monitoring, and other management programs.
12. ACWA encourages other statewide associations, regional entities and groundwater-related organizations to educate and advocate for expanded and more effective groundwater management throughout California, and will help coordinate such activities.

ACWA Groundwater Committee

Greg Zlotnick, Chair	San Luis & Delta-Mendota Water Authority
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Behzad Ahmadi	Santa Clara Valley WD
David R.E. Aladjem	Western MWD
Lewis Bair	Reclamation Dist. #108
George M. Barber, P.E.	Paradise ID
Greg Bartow	San Francisco PUC
Thaddeus Bettner	Glenn-Colusa ID
Wilmar (Will) L. Boschman	Semitropic WSD
Kirby Brill	Mojave Water Agency
Thomas S. Bunn, III	Crescenta Valley WD
Michelle Casterline	Kern County WA
Grace Chan	Metro WD of Southern California
John Christopher	Rincon del Diablo MWD
Thomas Coleman	Orchard Dale WD
Richard Corneille	San Bernardino Valley WCD
Greg Cross	City of San Diego Public Utilities
Robert T. Dean	Calaveras County WD
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Craig Elitharp	Rancho California WD
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Glenn Farrel	Friant Water Authority
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Karna Harrigfeld	Stockton East WD
Tom Haslebacher	Kern County WA
Donald G. Hauser	Calleguas MWD
Clemens Heldmaier	Montara Water & Sanitary District
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Rick Hoelzel	Kings River CD
Rick Iger	GEI Consultants Inc., Bookman-Edmonston
Jay Jasperse	Sonoma County WA
Barbara Judd	Santa Clara Valley WD
Chris M. Kapheim	Alta ID
Sanford (Sandy) B. Kozlen	Carmichael WD
Charles (Chuck) A. Krieger	Desert WA
Robert A. Krieger	Desert WA
David Luker	Desert WA
Michael R. Markus, P.E.	Orange County WD
Brian Martin	Placer County Water Agency

ACWA Groundwater Committee

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Craig Miller	Inland Empire Utilities Agency
L. Mark Mulkay	Kern Delta WD
Debbie Neev	Laguna Beach CWD
David Orth	Kings River CD
Richard Ottolini	Rancho California WD
Jim Patrick	Rain Bird Corporation
Lynne Plambeck	Newhall CWD
Iris Priestaf	San Benito County WD
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Robert Roscoe	Sacramento Suburban WD
Randy Schoellerman	San Gabriel Basin WQA
Dean Sherrill	Rio Alto WD
Richard Smith	Helix WD
Phyllis Stanin	San Benito County WD
Max Stevenson	Yolo County FC & WCD
Rob Swartz	Regional Water Authority
John Thornton	Municipal Water District of Orange Cnty
Michael Tognolini	East Bay MUD
Mike Wehner	Orange County WD
Daniel Wendell	Marina Coast WD
Dean Wiberg	Foothill MWD
Carol Williams	Main San Gabriel Basin Watermaster
Derrik Williams	Soquel Creek WD
Richard S. Williamson, P.E., R.L.S.	Borrego WD
Robert V. Winchester	Browns Valley ID
Ron Withrow	Princeton-Codora-Glenn ID
John Woodling	Sacramento Groundwater Authority
Glen Wright	City of Santa Rosa - Utilities Dept.
John C. Yeakley	Bear Valley CSD
Tony Zampiello	Main San Gabriel Basin Watermaster

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ACWA is a statewide non-profit association whose 450 public agency members are responsible for about 90% of the water deliveries in California.

MISSION.

ACWA's mission is to assist its members in promoting the development, management and reasonable beneficial use of good quality water at the lowest practical cost in an environmentally balanced manner.

MADERA REGIONAL GROUNDWATER MANAGEMENT PLAN

APPENDIX C – PUBLIC PARTICIPATION IN PLAN ADOPTION

NOTICE OF HEARING ON INTENTION TO PREPARE THE MADERA COUNTY REGIONAL GROUNDWATER MANAGEMENT PLAN

NOTICE IS HEREBY GIVEN that at **September 24, 2013,** at **10:00 a.m.** (PDT) in the Madera County Government Center, Board of Supervisors Chambers, **200 W. 4th Street Madera, California** a public hearing will be held to discuss whether or not Madera County, City of Madera, City of Chowchilla, Madera Irrigation District, Gravelly Ford Water District, Chowchilla Water District and South-Eastern Madera County United should prepare a Regional Groundwater Management Plan. At the meeting Madera County will determine whether to adopt a Resolution of Intent to Prepare a Regional Groundwater Management Plan.

Part 2.75 of Division 6 of the California Water Code permits the adoption and implementation of groundwater management plans to encourage authorized local agencies to manage groundwater resources within their service areas.

Landowners within these agency boundaries and other interested parties are invited to attend the hearing. Copies of the proposed resolution and other relevant written materials will be available for review by the public at the hearing or may be obtained in advance at **Clerk of the Board** located at **200 W. 4th Street Madera, CA 93637.** Opportunity for public questions and input will be provided at the hearing.

In compliance with Water Code § 10753.4 (b), landowners and other interested parties who wish to participate in preparing the Groundwater Management Plan, including becoming a member of a technical advisory committee, may do so by attending the hearing and indicating their interest or by submitting a written letter to **Clerk of the Board, 200 W. 4th Street Madera, CA 93637**.

Tanna G. Boyd
Clerk of the Board of Supervisors
County of Madera

BEFORE
THE BOARD OF SUPERVISORS
OF MADERA COUNTY OF MADERA
STATE OF CALIFORNIA

In the Matter of	)	Resolution No.: 2013 - _____
	)	
MADERA COUNTY GROUND-WATER MANAGEMENT PLAN	)	A RESOLUTION OF INTENT TO PREPARE A REGIONAL GROUND-WATER MANAGEMENT PLAN
	)	
_____	)	

WHEREAS, Part 2.75 of Division 6 of the California Water Code permits the adoption and implementation of groundwater management plans to encourage authorized local agencies to manage groundwater resources within their service areas; and

WHEREAS, the County of Madera previously adopted a groundwater management plan in January 2002; and

WHEREAS, the County of Madera, City of Madera, City of Chowchilla, Madera Irrigation District, Gravelly Ford Water District, South-Eastern Madera County United, and Chowchilla Water District have entered into a Memorandum of Understanding to cooperate and participate in the development of the Madera County Regional Groundwater Management Plan that will meet new State standards for Groundwater Management Plans, and that will outline a plan to manage groundwater on a regional basis and within their respective jurisdictions; and

WHEREAS, each of the parties has the authority pursuant to law and their local governing authorities to enter into this cooperative effort to study and plan for the management of groundwater conditions within their respective jurisdictions; and

WHEREAS, a public hearing was duly noticed consistent with California Water Code Section 10753.2(a), and held on September 24, 2013, to discuss the intent to prepare the Madera County Regional Groundwater Management Plan; and

WHEREAS, the public is invited to participate in the development of the Madera County Regional Groundwater Management Plan; and

WHEREAS, the County believes the preparation of the Madera County Regional Groundwater Management Plan is in the best interests of its constituents and water users.

NOW THEREFORE BE IT RESOLVED, by the Board of Supervisors of the County of Madera, State of California, that it is the intention of the District to prepare the Madera County Regional Groundwater Management Plan in compliance with State standards.

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The foregoing Resolution was adopted this _____ day of _____, 2013, by the following vote:

Director Nevarez voted: _____

Director Rogers voted: _____

Director Farinelli voted: _____

Director Rodriguez voted: _____

Director Wheeler voted: _____

_____
Chairman, Board of Directors

ATTEST:

_____
Clerk, Board of Directors

Approved as to Legal Form:
COUNTY COUNSEL

By _____

S:\County Counsel\Resource Management Agency\Engineering\Resolutions\Intent To Prepare A regional Groundwater Management Plan.rev.doc

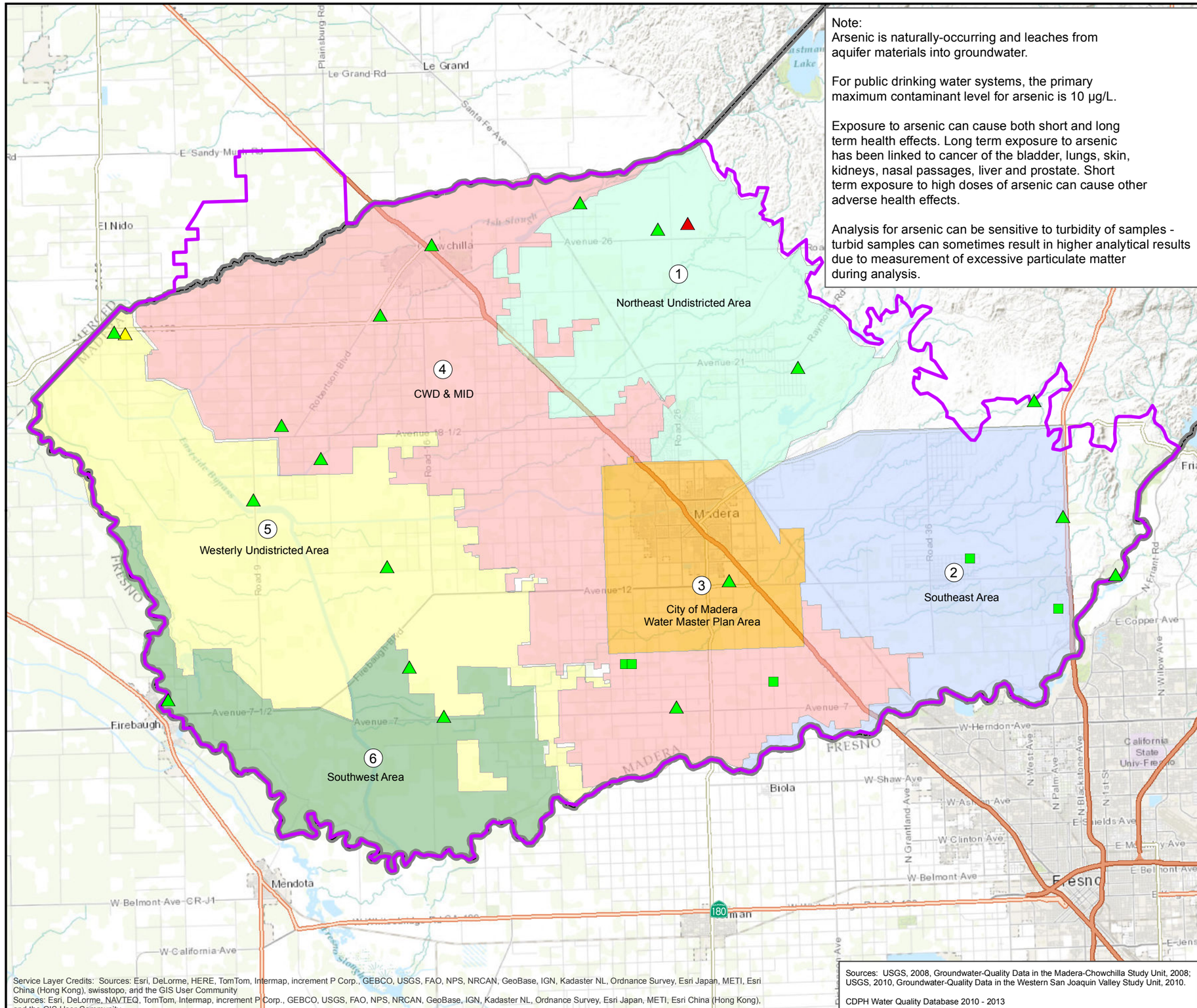
MADERA REGIONAL

GROUNDWATER MANAGEMENT PLAN

APPENDIX D – GROUNDWATER QUALITY MAPS

MAP OF ARSENIC CONCENTRATION IN SHALLOW WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Arsenic is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the primary maximum contaminant level for arsenic is 10 µg/L.

Exposure to arsenic can cause both short and long term health effects. Long term exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. Short term exposure to high doses of arsenic can cause other adverse health effects.

Analysis for arsenic can be sensitive to turbidity of samples - turbid samples can sometimes result in higher analytical results due to measurement of excessive particulate matter during analysis.

NORTH

0 2 4
MILES

Arsenic (µg/L) in City Wells < 400 feet

- < 5
- 5 - 10
- > 10

Arsenic (µg/L) in County Wells < 400 feet

- < 5
- 5 - 10
- > 10

Arsenic (µg/L) in USGS GAMA Wells < 400 feet

- < 5
- 5 - 10
- > 10

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. The represented wells may have different sanitary seal depths and perforation intervals and therefore may represent unique water quality or composite water quality of the shallow aquifers.

Service Layer Credits: Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community
Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008; USGS, 2010, Groundwater-Quality Data in the Western San Joaquin Valley Study Unit, 2010.

CDPH Water Quality Database 2010 - 2013

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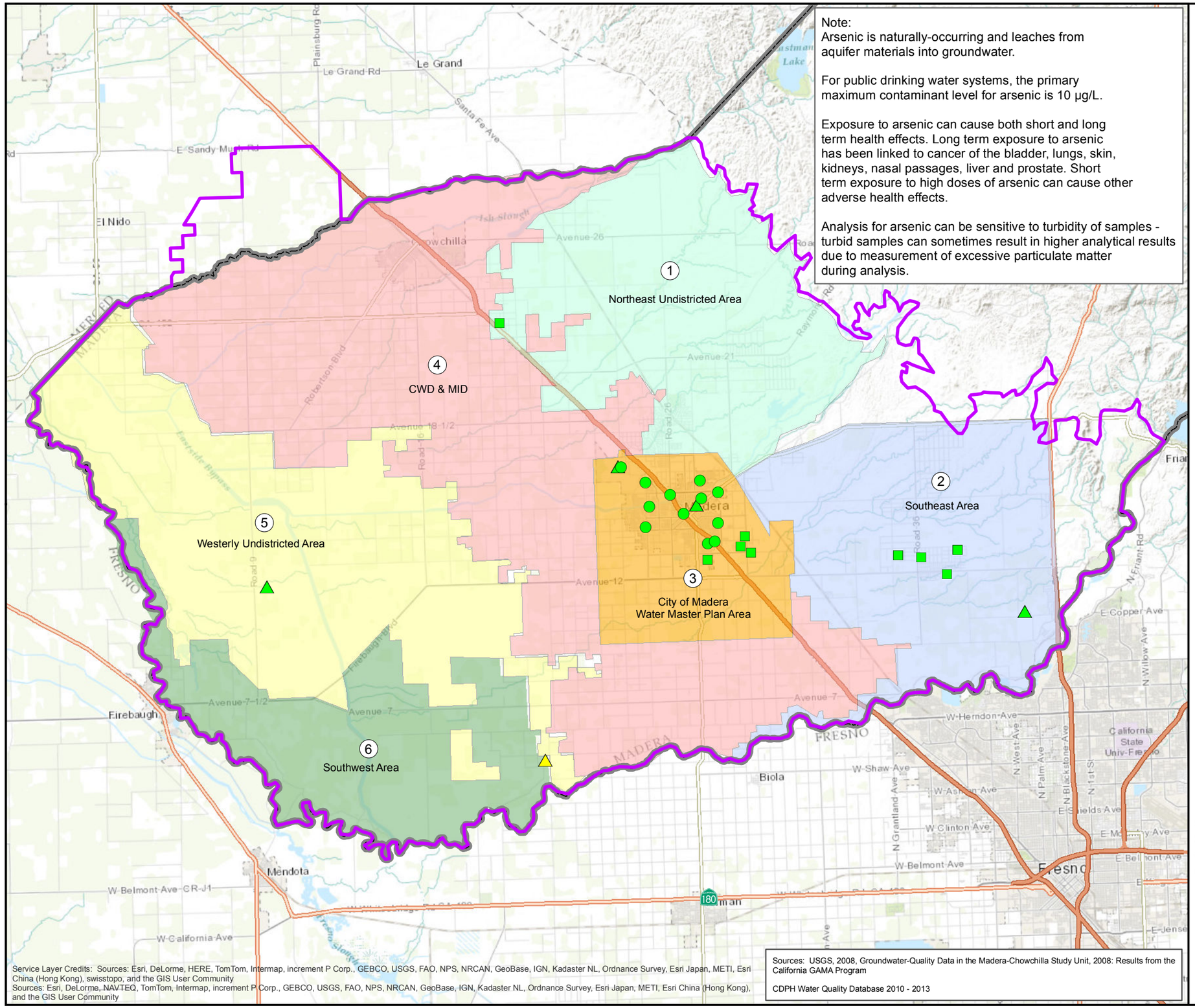
Document Path: J:\Jobs\8489_Madera_County\8489.005_Madera_County_GMP\GIS\Tasks\Water_Quality_Maps\20140402_Updated_Figures\Madera_Arsenic_Map_1_Shallow_20140407.mxd

MAP OF ARSENIC CONCENTRATION IN INTERMEDIATE WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Arsenic is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the primary maximum contaminant level for arsenic is 10 µg/L.

Exposure to arsenic can cause both short and long term health effects. Long term exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. Short term exposure to high doses of arsenic can cause other adverse health effects.

Analysis for arsenic can be sensitive to turbidity of samples - turbid samples can sometimes result in higher analytical results due to measurement of excessive particulate matter during analysis.

NORTH

0 2 4
MILES

Arsenic (µg/L) in City Wells 400 - 600 feet

- < 5
- 5 - 10
- > 10

Arsenic (µg/L) in County Wells 400 - 600 feet

- < 5
- 5 - 10
- > 10

Arsenic (µg/L) in USGS GAMA Wells 400 - 600 feet

- < 5
- 5 - 10
- > 10

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore may represent composite water quality across two or more aquifers.

Service Layer Credits: Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community
Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008: Results from the California GAMA Program

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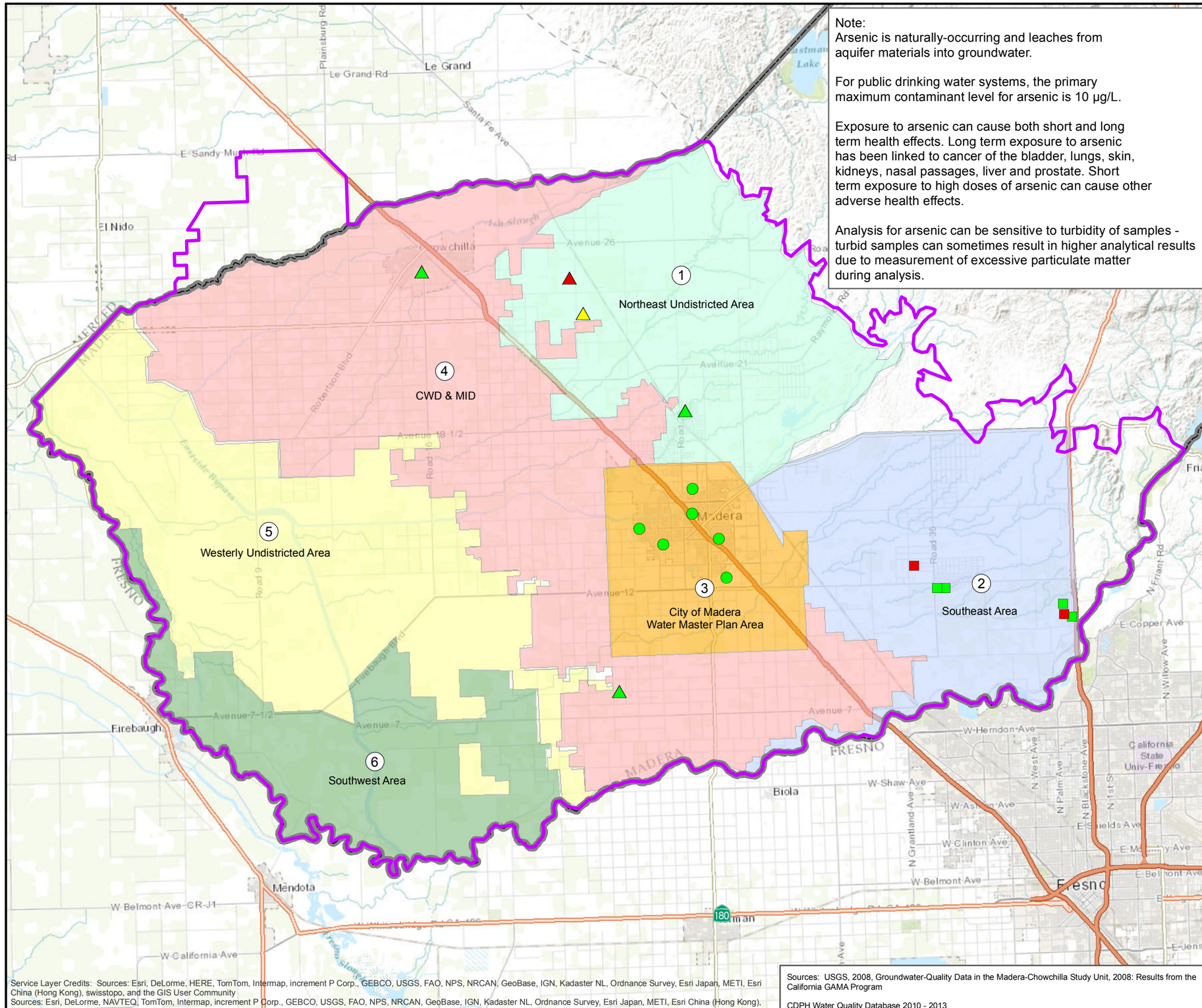
MAP OF ARSENIC CONCENTRATION IN DEEP WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Arsenic is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the primary maximum contaminant level for arsenic is 10 µg/L.

Exposure to arsenic can cause both short and long term health effects. Long term exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. Short term exposure to high doses of arsenic can cause other adverse health effects.

Analysis for arsenic can be sensitive to turbidity of samples - turbid samples can sometimes result in higher analytical results due to measurement of excessive particulate matter during analysis.

NORTH

0 2 4
MILES

Arsenic (µg/L) in City Wells > 600 feet

- < 5
- 5 - 10
- > 10

Arsenic (µg/L) in County Wells > 600 feet

- < 5
- 5 - 10
- > 10

Arsenic (µg/L) in USGS GAMA Wells > 600 feet

- < 5
- 5 - 10
- > 10

- Groundwater Management Plan Boundary
- Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore may represent composite water quality across two or more aquifers.

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Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008: Results from the California GAMA Program

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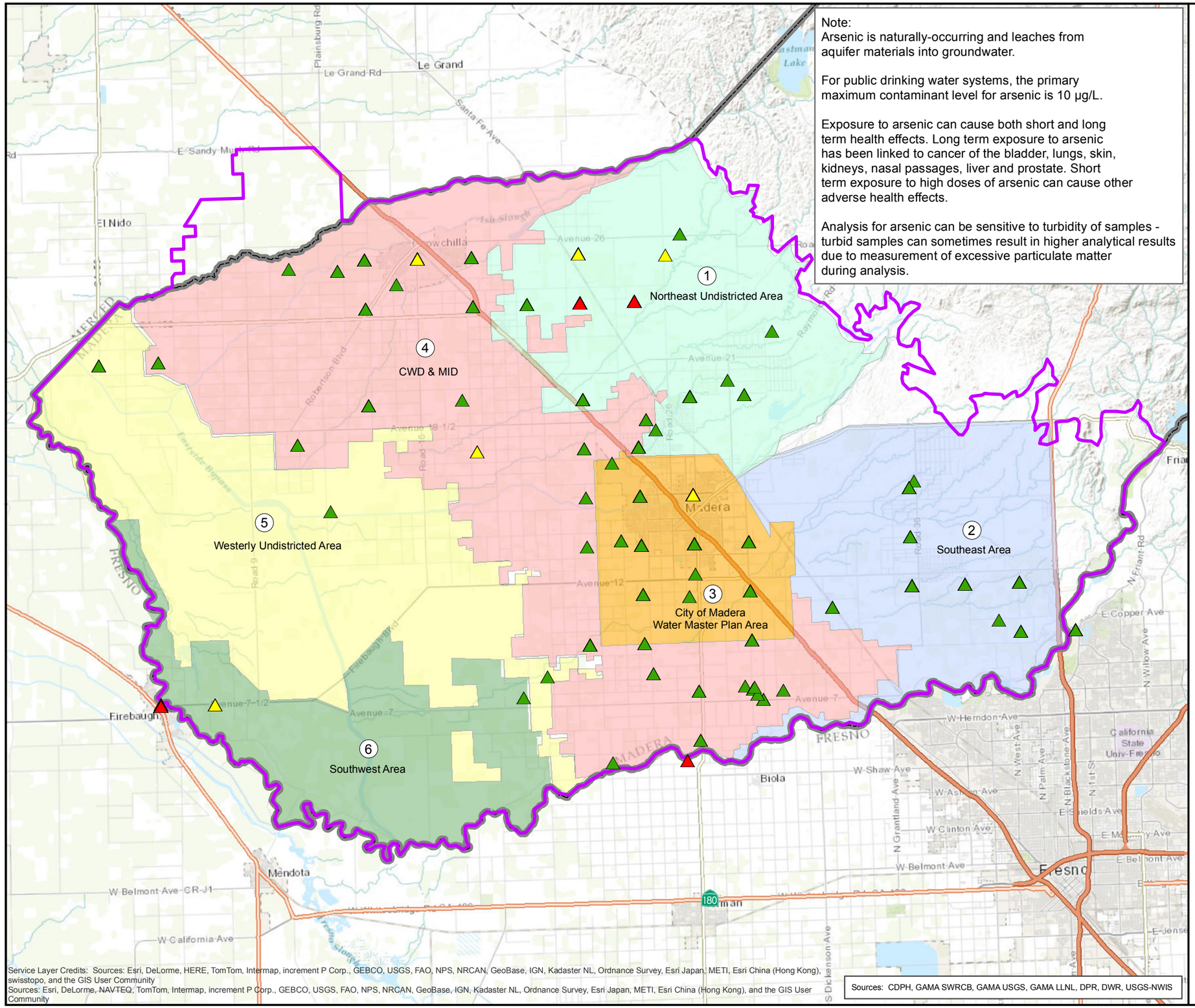
MAP OF ARSENIC CONCENTRATION IN WELLS OF UNKNOWN DEPTH

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Arsenic is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the primary maximum contaminant level for arsenic is 10 µg/L.

Exposure to arsenic can cause both short and long term health effects. Long term exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys, nasal passages, liver and prostate. Short term exposure to high doses of arsenic can cause other adverse health effects.

Analysis for arsenic can be sensitive to turbidity of samples - turbid samples can sometimes result in higher analytical results due to measurement of excessive particulate matter during analysis.

NORTH

0 2 4
MILES

Arsenic (µg/L) in Other USGS GAMA Wells

- < 5
- 5 - 10
- > 10
- Groundwater Management Plan Boundary
- Madera County Boundary

Note: Well construction records were not available for these wells. Some wells may have screen perforations that connect two or more aquifers and may therefore represent composite water quality.

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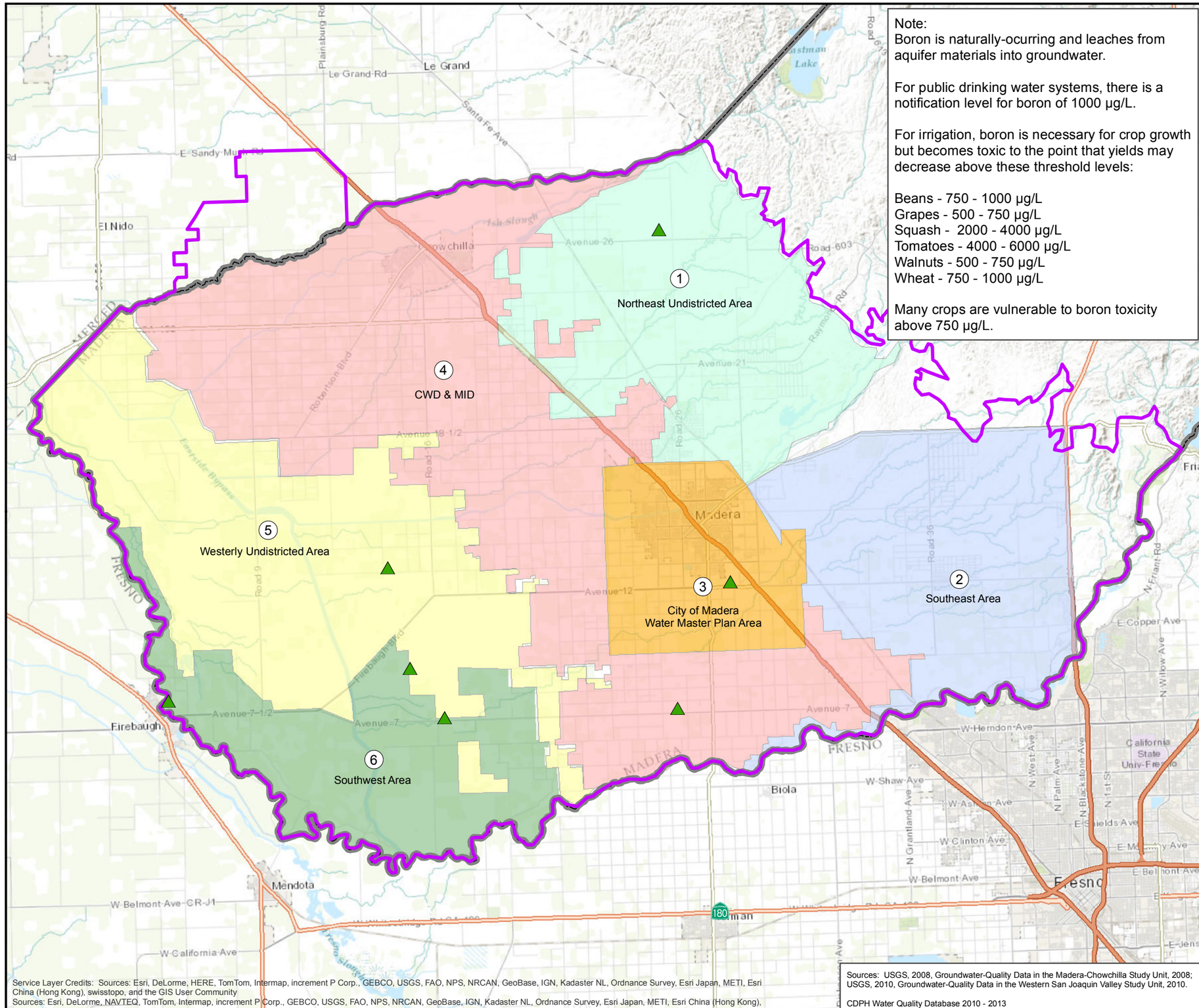
MAP OF BORON CONCENTRATION IN SHALLOW WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



NORTH

0 2 4
MILES

Boron (µg/L) in City Wells < 400 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Boron (µg/L) in County Wells < 400 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Boron (µg/L) in USGS GAMA Wells < 400 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Groundwater Management Plan Boundary

Madera County Boundary

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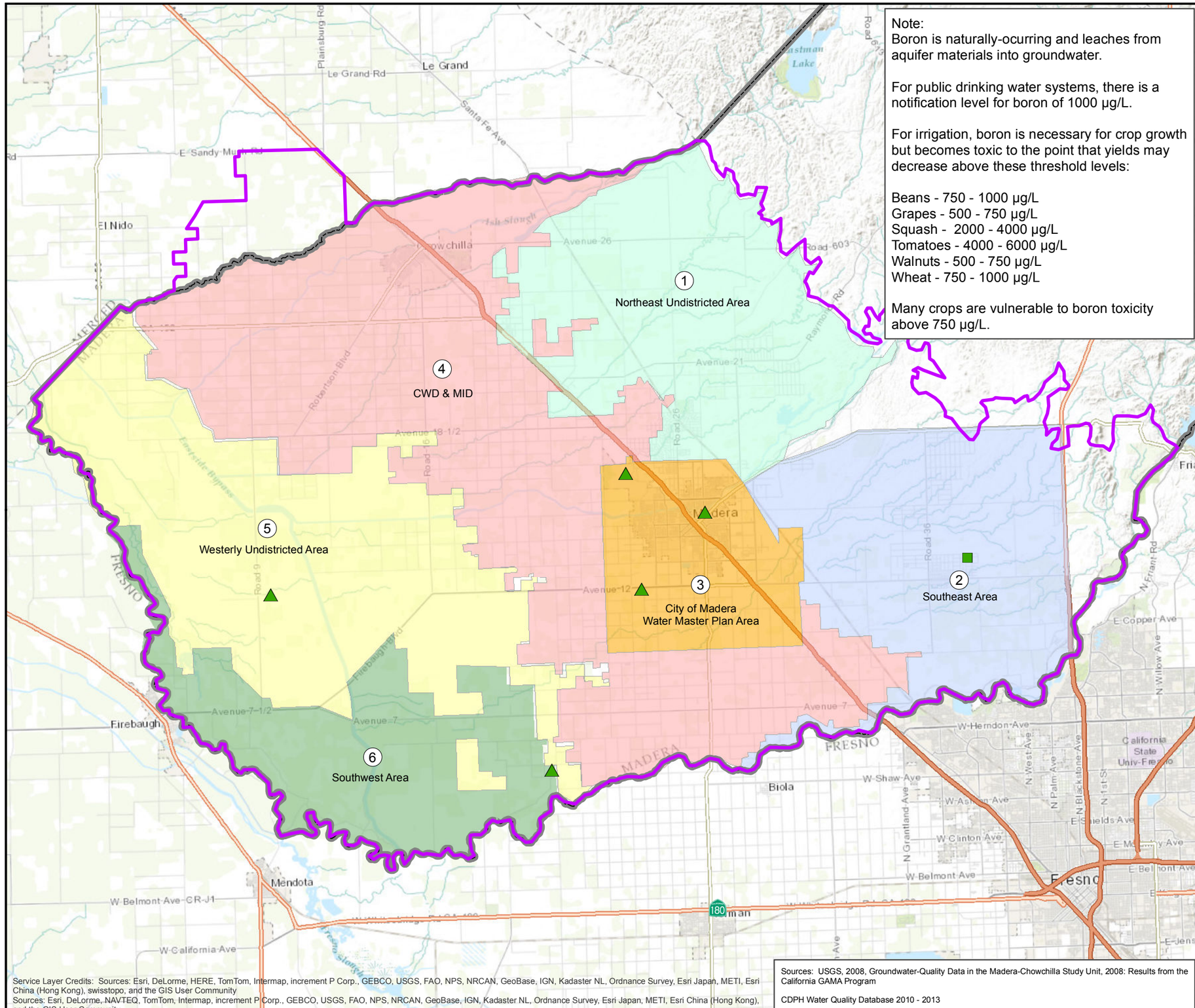
MAP OF BORON CONCENTRATION IN INTERMEDIATE WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Boron is naturally-ocurring and leaches from aquifer materials into groundwater.

For public drinking water systems, there is a notification level for boron of 1000 µg/L.

For irrigation, boron is necessary for crop growth but becomes toxic to the point that yields may decrease above these threshold levels:

Beans - 750 - 1000 µg/L
Grapes - 500 - 750 µg/L
Squash - 2000 - 4000 µg/L
Tomatoes - 4000 - 6000 µg/L
Walnuts - 500 - 750 µg/L
Wheat - 750 - 1000 µg/L

Many crops are vulnerable to boron toxicity above 750 µg/L.

NORTH

0 2 4
MILES

Boron (µg/L) in County Wells 400 - 600 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Boron (µg/L) in City Wells 400 - 600 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Boron (µg/L) in USGS GAMA Wells 400 - 600 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

- Groundwater Management Plan Boundary
- Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore may represent composite water quality across two or more aquifers.

Service Layer Credits: Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community
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Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008: Results from the California GAMA Program

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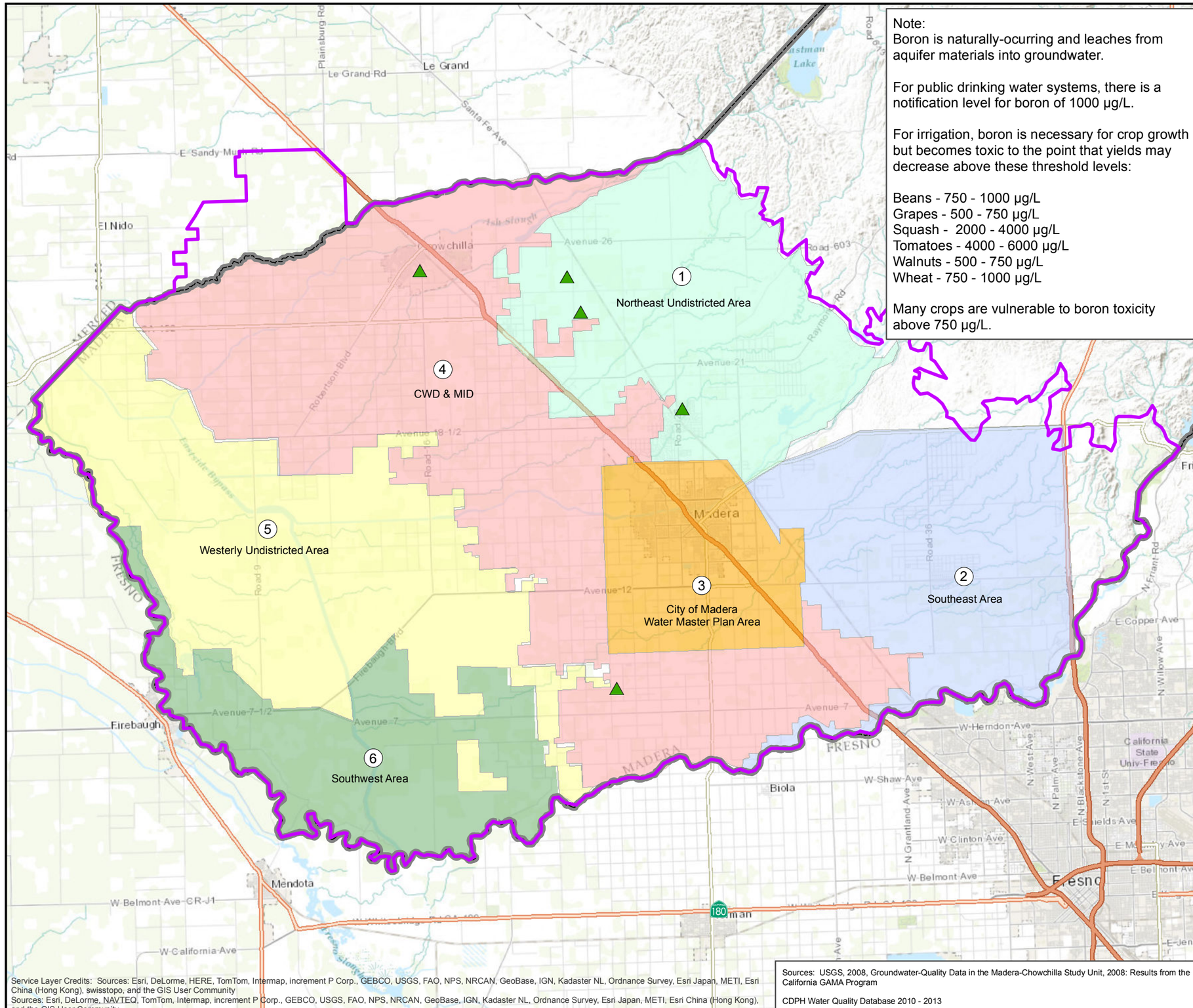
MAP OF BORON CONCENTRATION IN DEEP WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



NORTH

0 2 4
MILES

Boron (µg/L) in City Wells > 600 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Boron (µg/L) in County Wells > 600 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Boron (µg/L) in USGS GAMA Wells > 600 feet

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore may represent composite water quality across two or more aquifers.

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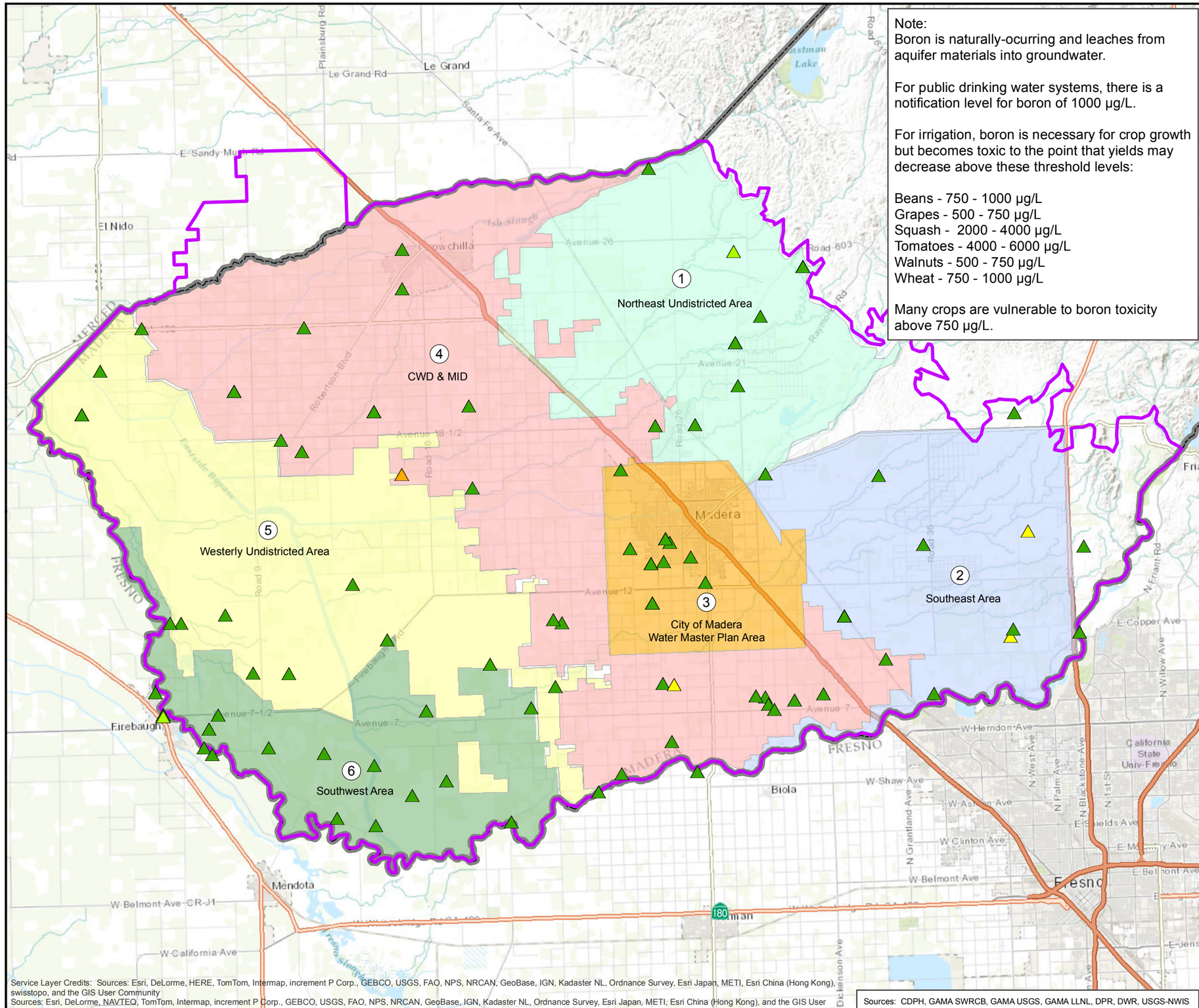
MAP OF BORON CONCENTRATION IN WELLS OF UNKNOWN DEPTH

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Boron is naturally-ocurring and leaches from aquifer materials into groundwater.

For public drinking water systems, there is a notification level for boron of 1000 µg/L.

For irrigation, boron is necessary for crop growth but becomes toxic to the point that yields may decrease above these threshold levels:

Beans - 750 - 1000 µg/L
Grapes - 500 - 750 µg/L
Squash - 2000 - 4000 µg/L
Tomatoes - 4000 - 6000 µg/L
Walnuts - 500 - 750 µg/L
Wheat - 750 - 1000 µg/L

Many crops are vulnerable to boron toxicity above 750 µg/L.

NORTH

0 2 4
MILES

Boron (µg/L) in Other USGS GAMA Wells

- < 500
- 500 - 750
- 750 - 1000
- 1000 - 2000
- > 2000
- Groundwater Management Plan Boundary
- Madera County Boundary

Note: Well construction records were not available for these wells. Some wells may have screen perforations that connect two or more aquifers and may therefore represent composite water quality.

Service Layer Credits: Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community
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Sources: CDPH, GAMA SWRCB, GAMA USGS, GAMA LLNL, DPR, DWR, USGS-NWIS

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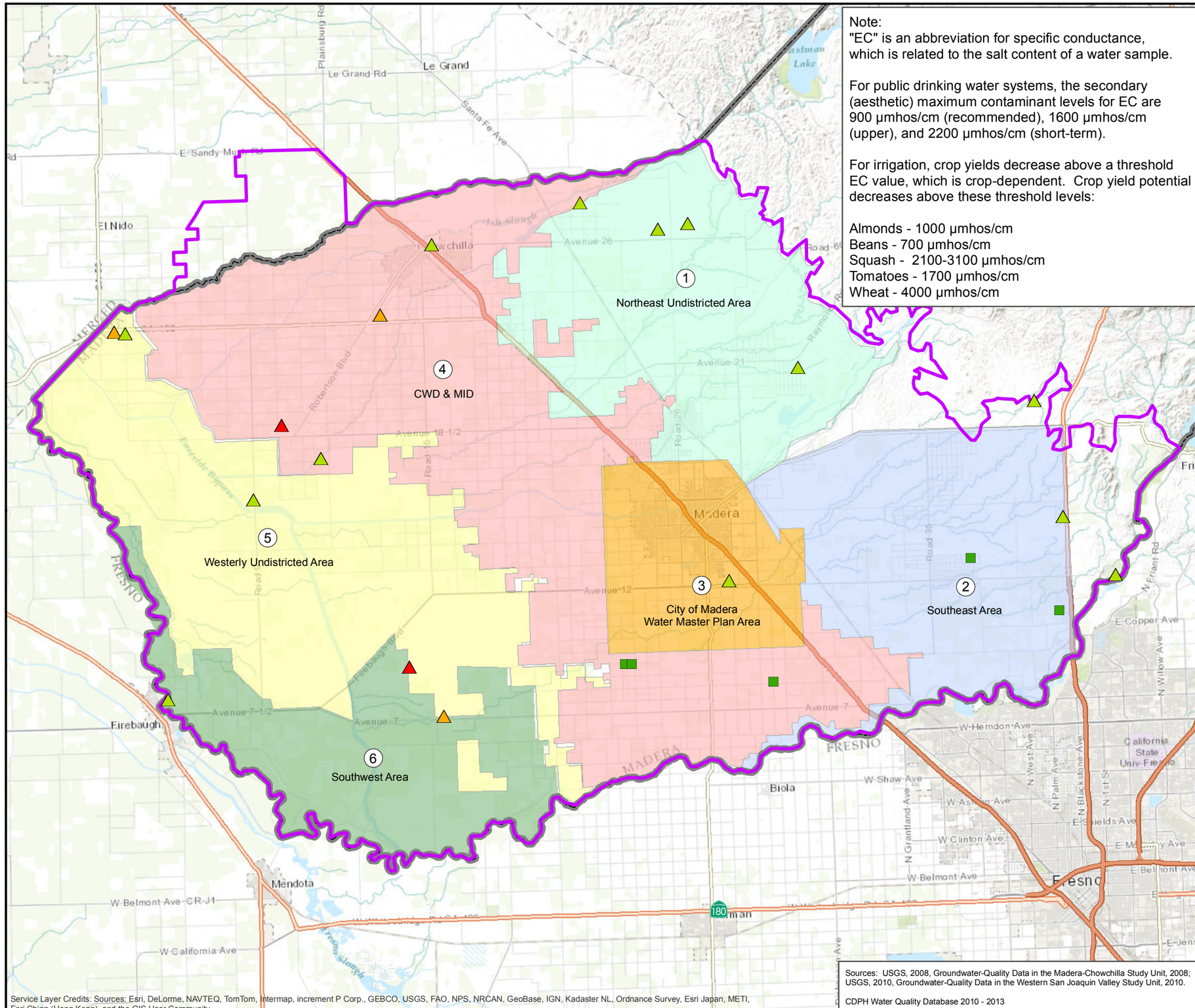
MAP OF SPECIFIC CONDUCTANCE IN SHALLOW WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
"EC" is an abbreviation for specific conductance, which is related to the salt content of a water sample.

For public drinking water systems, the secondary (aesthetic) maximum contaminant levels for EC are 900 µmhos/cm (recommended), 1600 µmhos/cm (upper), and 2200 µmhos/cm (short-term).

For irrigation, crop yields decrease above a threshold EC value, which is crop-dependent. Crop yield potential decreases above these threshold levels:

Almonds - 1000 µmhos/cm
Beans - 700 µmhos/cm
Squash - 2100-3100 µmhos/cm
Tomatoes - 1700 µmhos/cm
Wheat - 4000 µmhos/cm

Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008; USGS, 2010, Groundwater-Quality Data in the Western San Joaquin Valley Study Unit, 2010.

CDPH Water Quality Database 2010 - 2013

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

NORTH

0 2 4
MILES

EC (µmhos/cm) in County Wells < 400 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

EC (µmhos/cm) in City Wells < 400 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

EC (µmhos/cm) in USGS GAMA Wells < 400 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

Groundwater Management Plan Boundary

Madera County Boundary

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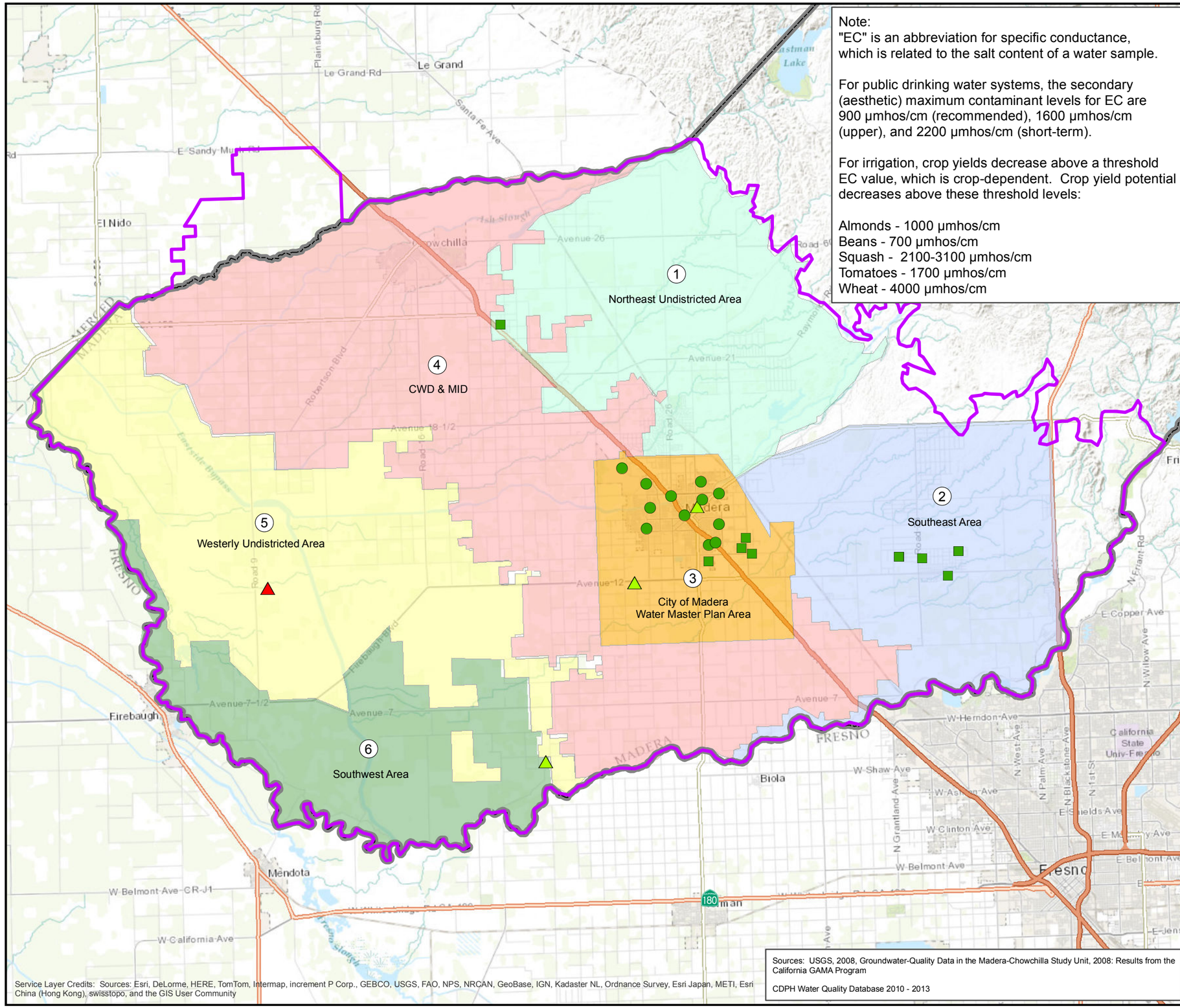
MAP OF SPECIFIC CONDUCTANCE IN INTERMEDIATE WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



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Almonds - 1000 µmhos/cm
Beans - 700 µmhos/cm
Squash - 2100-3100 µmhos/cm
Tomatoes - 1700 µmhos/cm
Wheat - 4000 µmhos/cm

NORTH

0 2 4
MILES

EC (µmhos/cm) in City Wells 400 - 600 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

EC (µmhos/cm) in County Wells 400 - 600 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

EC (µmhos/cm) in USGS GAMA Wells 400 - 600 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore represent composite water quality across two or more aquifers.

Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008: Results from the California GAMA Program

CDPH Water Quality Database 2010 - 2013

Service Layer Credits: Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

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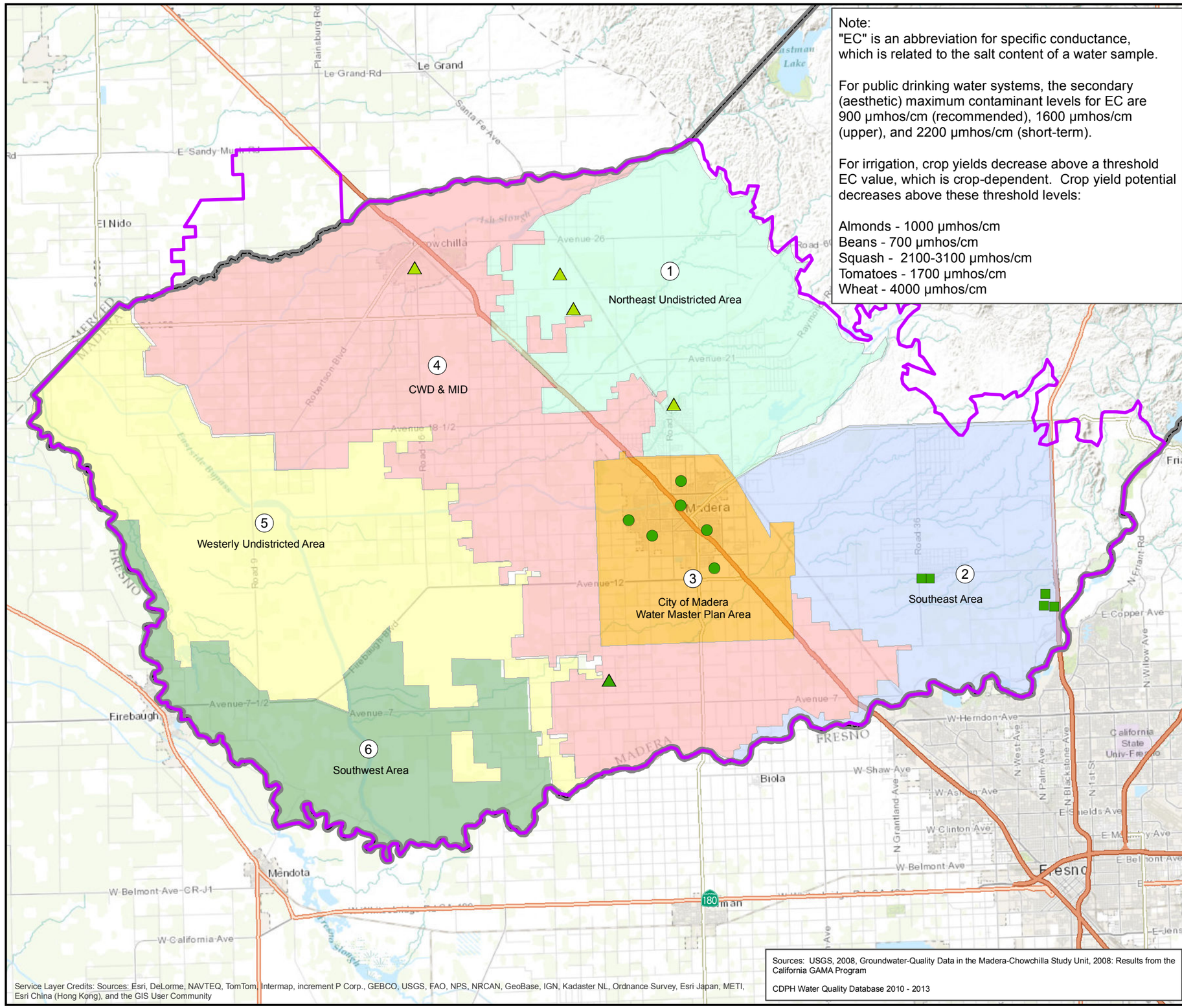
MAP OF SPECIFIC CONDUCTANCE IN DEEP WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
"EC" is an abbreviation for specific conductance, which is related to the salt content of a water sample.

For public drinking water systems, the secondary (aesthetic) maximum contaminant levels for EC are 900 µmhos/cm (recommended), 1600 µmhos/cm (upper), and 2200 µmhos/cm (short-term).

For irrigation, crop yields decrease above a threshold EC value, which is crop-dependent. Crop yield potential decreases above these threshold levels:

Almonds - 1000 µmhos/cm
Beans - 700 µmhos/cm
Squash - 2100-3100 µmhos/cm
Tomatoes - 1700 µmhos/cm
Wheat - 4000 µmhos/cm

NORTH

0 2 4
MILES

EC (µmhos/cm) in City Wells > 600 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

EC (µmhos/cm) in County Wells > 600 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

EC (µmhos/cm) in USGS GAMA Wells > 600 feet

- < 600
- 600 - 900
- 900 - 1600
- > 1600

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore may represent composite water quality across two or more aquifers.

Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008: Results from the California GAMA Program

CDPH Water Quality Database 2010 - 2013

Service Layer Credits: Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), and the GIS User Community

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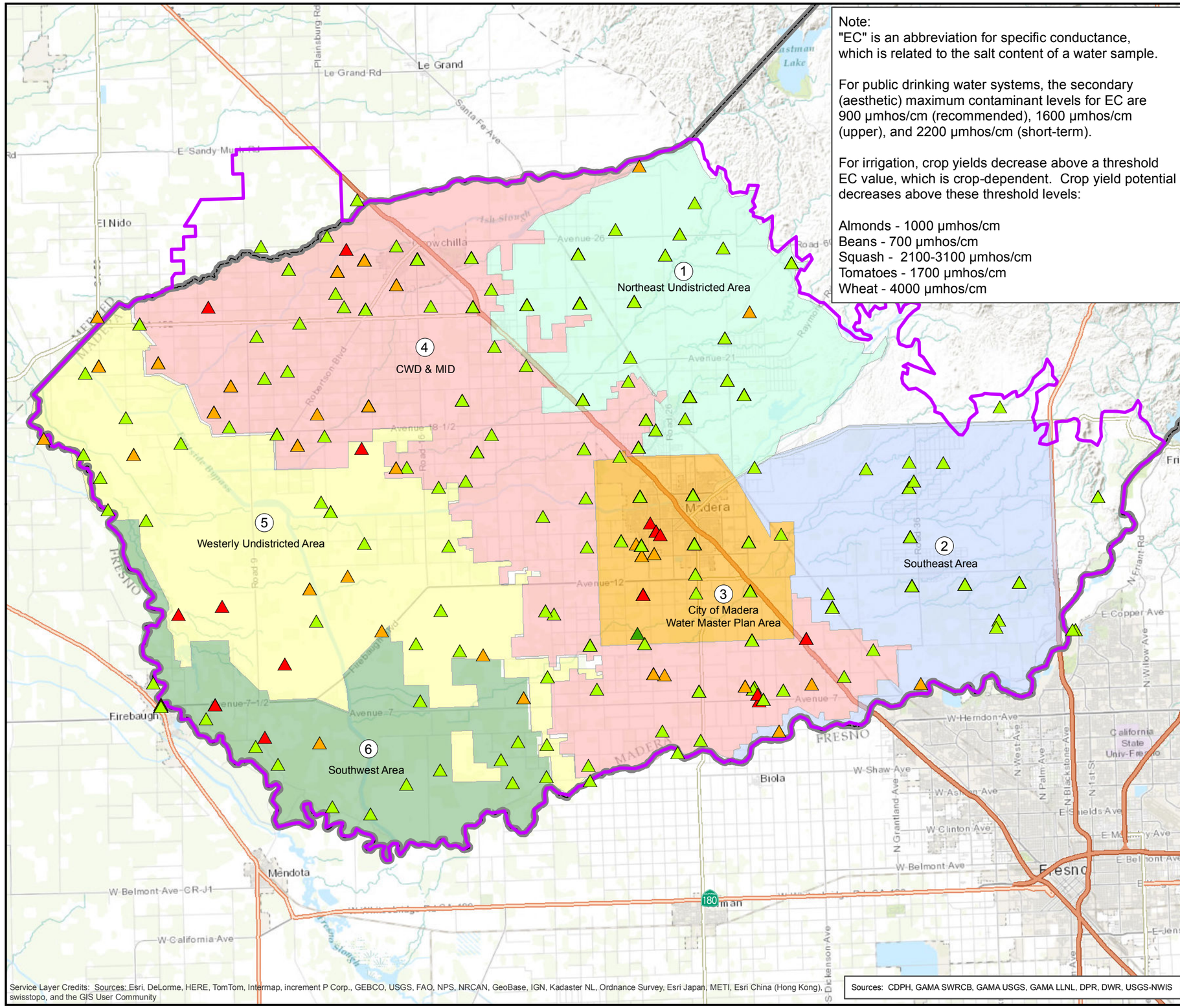
MAP OF SPECIFIC CONDUCTANCE IN WELLS OF UNKNOWN DEPTH

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
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For irrigation, crop yields decrease above a threshold EC value, which is crop-dependent. Crop yield potential decreases above these threshold levels:

Almonds - 1000 µmhos/cm
Beans - 700 µmhos/cm
Squash - 2100-3100 µmhos/cm
Tomatoes - 1700 µmhos/cm
Wheat - 4000 µmhos/cm

NORTH

0 2 4
MILES

EC (µmhos/cm) in Other USGS GAMA Wells

- < 600
- 600 - 900
- 900 - 1600
- > 1600
- Groundwater Management Plan Boundary
- Madera County Boundary

Note: Well construction records were not available for these wells. Some wells may have screen perforations that connect two or more aquifers and may therefore represent composite water quality.

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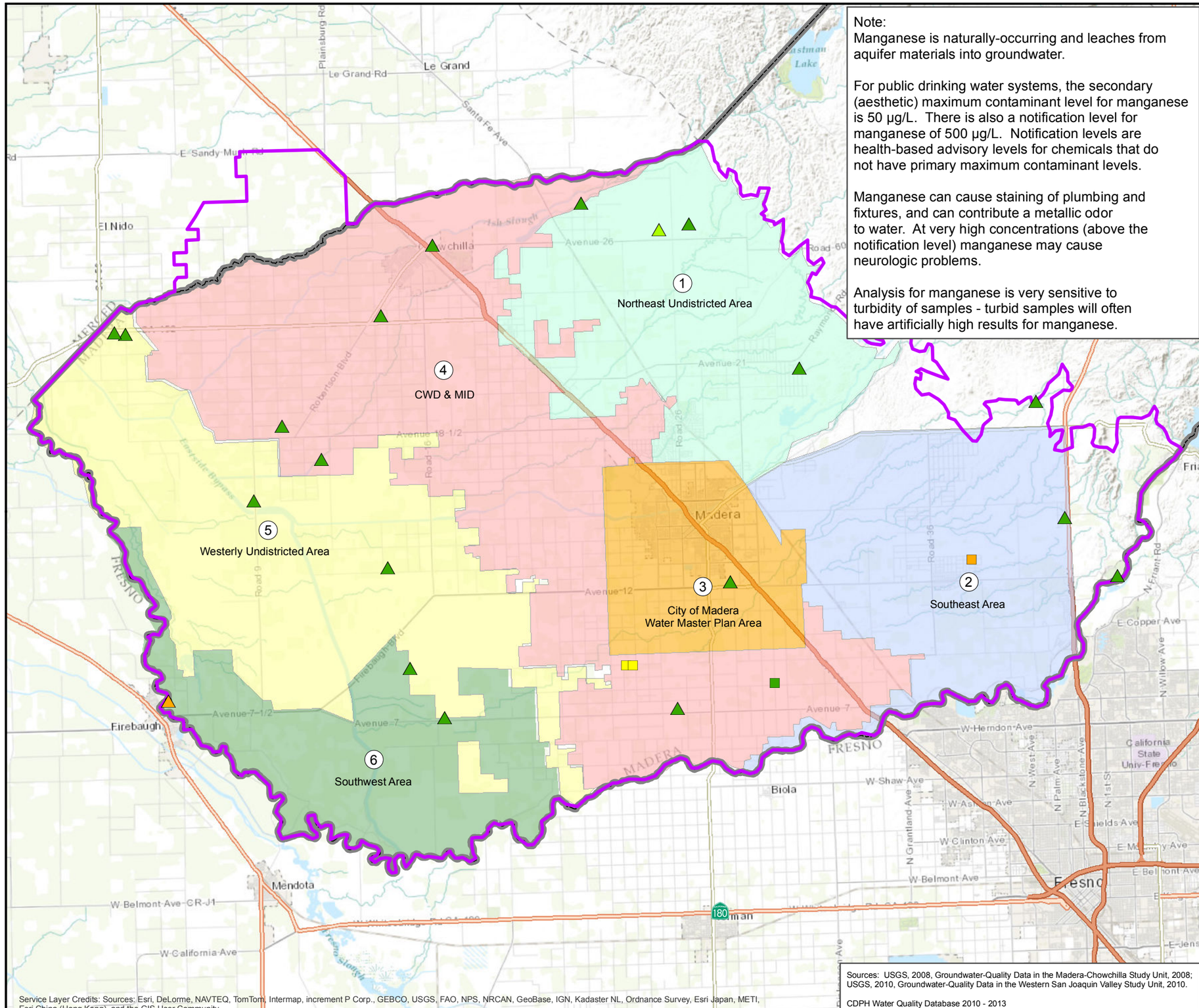
MAP OF MANGANESE CONCENTRATION IN SHALLOW WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Manganese is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the secondary (aesthetic) maximum contaminant level for manganese is 50 µg/L. There is also a notification level for manganese of 500 µg/L. Notification levels are health-based advisory levels for chemicals that do not have primary maximum contaminant levels.

Manganese can cause staining of plumbing and fixtures, and can contribute a metallic odor to water. At very high concentrations (above the notification level) manganese may cause neurologic problems.

Analysis for manganese is very sensitive to turbidity of samples - turbid samples will often have artificially high results for manganese.

Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008; USGS, 2010, Groundwater-Quality Data in the Western San Joaquin Valley Study Unit, 2010.

CDPH Water Quality Database 2010 - 2013

NORTH

0 2 4
MILES

Manganese (µg/L) in City Wells < 400 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Manganese (µg/L) in County Wells < 400 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Manganese (µg/L) in USGS GAMA Wells < 400 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Groundwater Management Plan Boundary

Madera County Boundary

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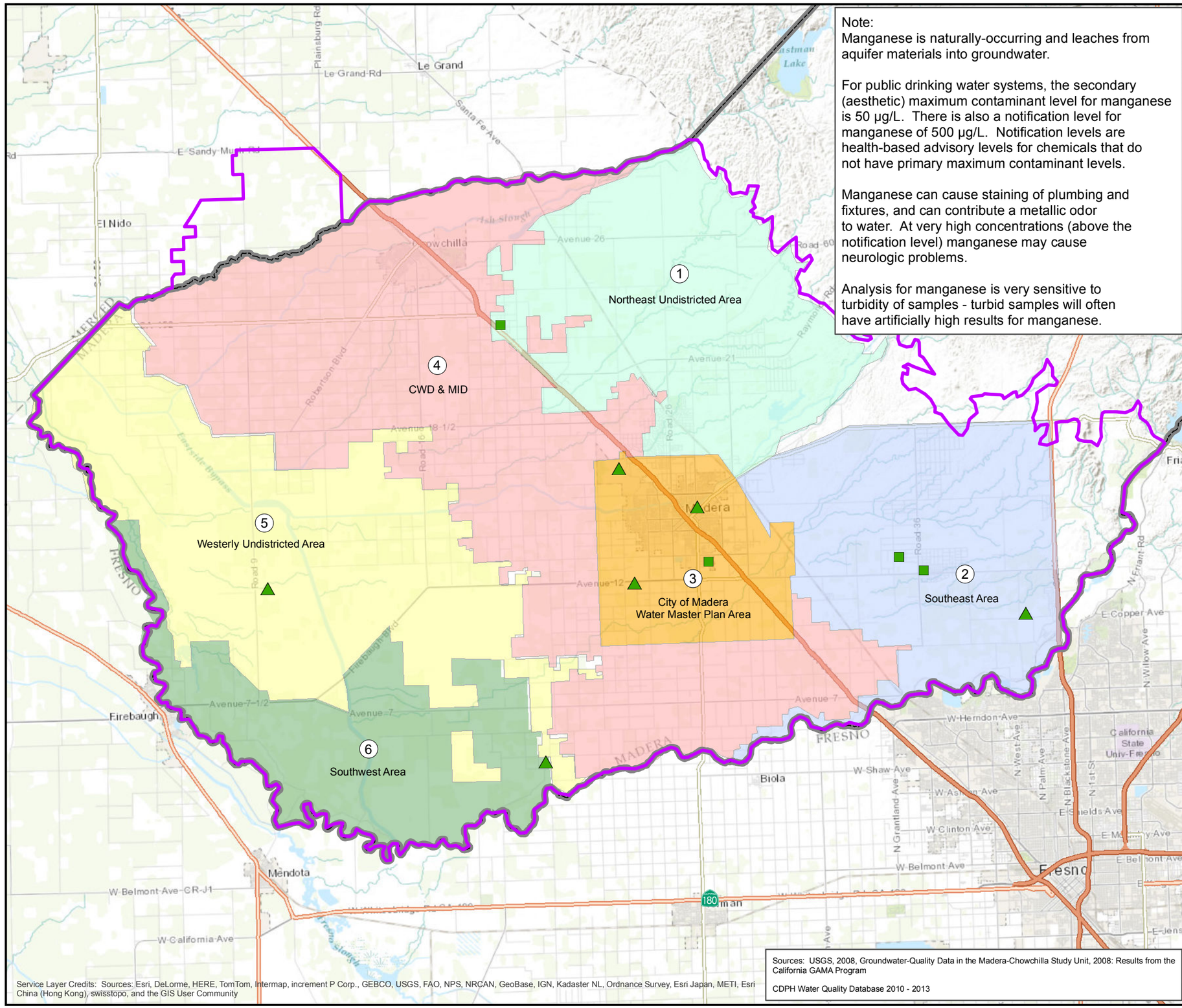
MAP OF MANGANESE CONCENTRATION IN INTERMEDIATE WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



NORTH

0 2 4
MILES

Manganese (µg/L) in City Wells 400 - 600 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Manganese (µg/L) in County Wells 400 - 600 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Manganese (µg/L) in USGS GAMA Wells 400 - 600 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore represent composite water quality across two or more aquifers.

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MAP OF MANGANESE CONCENTRATION IN DEEP WELLS

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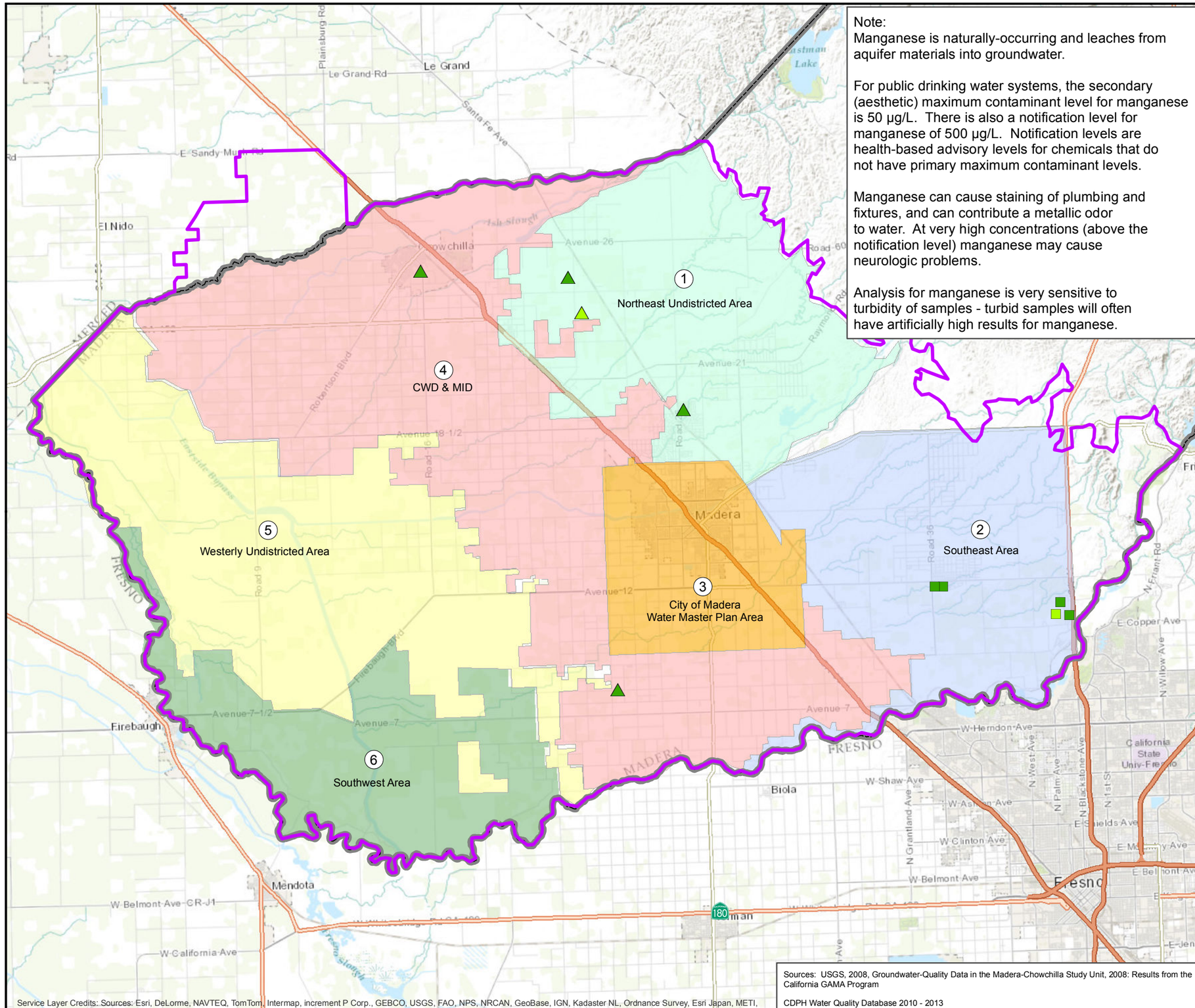
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Manganese is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the secondary (aesthetic) maximum contaminant level for manganese is 50 µg/L. There is also a notification level for manganese of 500 µg/L. Notification levels are health-based advisory levels for chemicals that do not have primary maximum contaminant levels.

Manganese can cause staining of plumbing and fixtures, and can contribute a metallic odor to water. At very high concentrations (above the notification level) manganese may cause neurologic problems.

Analysis for manganese is very sensitive to turbidity of samples - turbid samples will often have artificially high results for manganese.

Sources: USGS, 2008, Groundwater-Quality Data in the Madera-Chowchilla Study Unit, 2008: Results from the California GAMA Program

CDPH Water Quality Database 2010 - 2013

NORTH

0 2 4
MILES

Manganese (µg/L) in City Wells > 600 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Manganese (µg/L) in County Wells > 600 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Manganese (µg/L) in USGS GAMA Wells > 600 feet

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore represent composite water quality across two or more aquifers.

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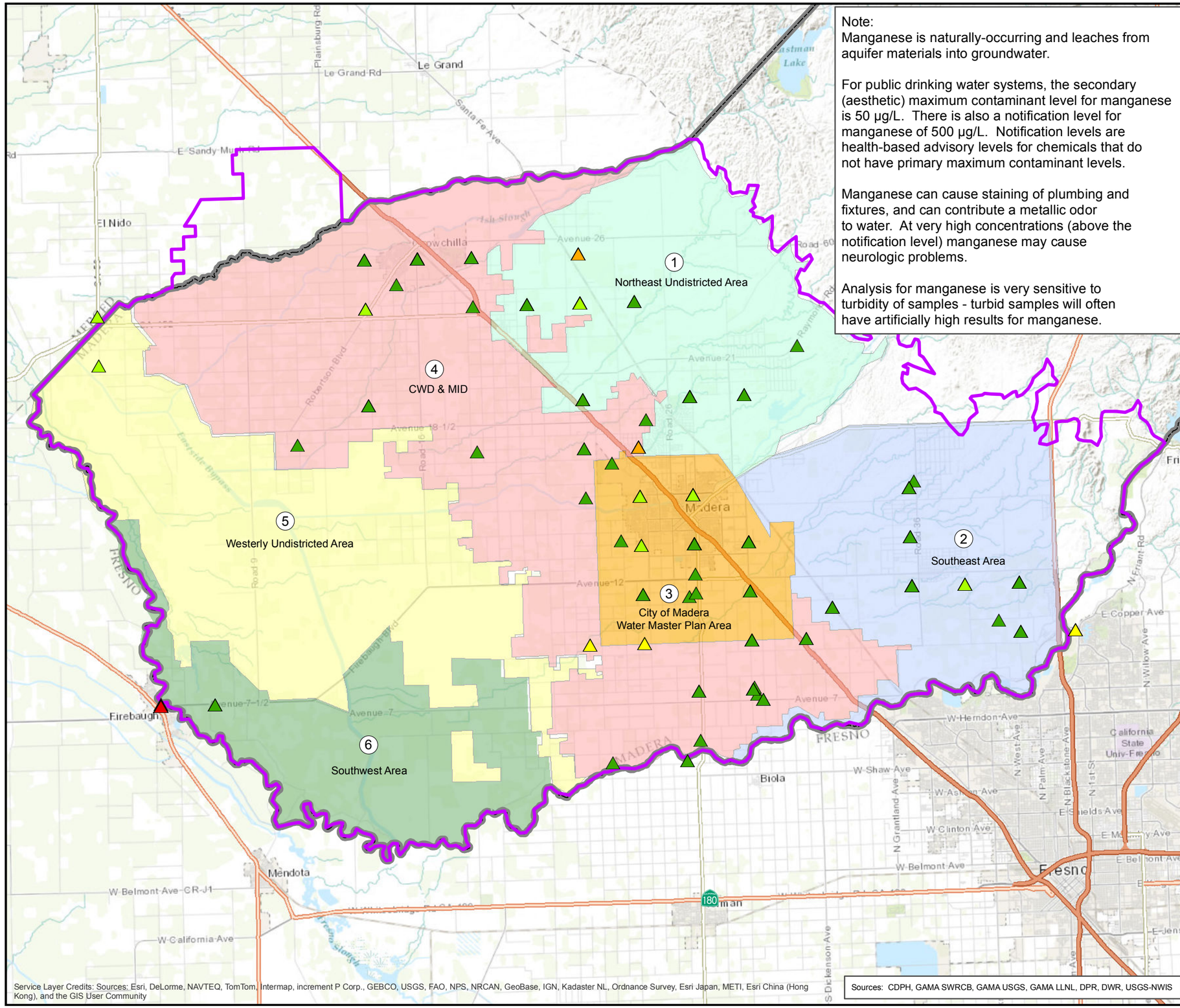
MAP OF MANGANESE CONCENTRATION IN WELLS OF UNKNOWN DEPTH

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note:
Manganese is naturally-occurring and leaches from aquifer materials into groundwater.

For public drinking water systems, the secondary (aesthetic) maximum contaminant level for manganese is 50 µg/L. There is also a notification level for manganese of 500 µg/L. Notification levels are health-based advisory levels for chemicals that do not have primary maximum contaminant levels.

Manganese can cause staining of plumbing and fixtures, and can contribute a metallic odor to water. At very high concentrations (above the notification level) manganese may cause neurologic problems.

Analysis for manganese is very sensitive to turbidity of samples - turbid samples will often have artificially high results for manganese.

NORTH

0 2 4
MILES

Manganese (µg/L) in Other USGS GAMA Wells

- < 25
- 25 - 50
- 50 - 150
- 150 - 500
- > 500
- Groundwater Management Plan Boundary
- Madera County Boundary

Note: Well construction records were not available for these wells. Some wells may have screen perforations that connect two or more aquifers and may therefore represent composite water quality.

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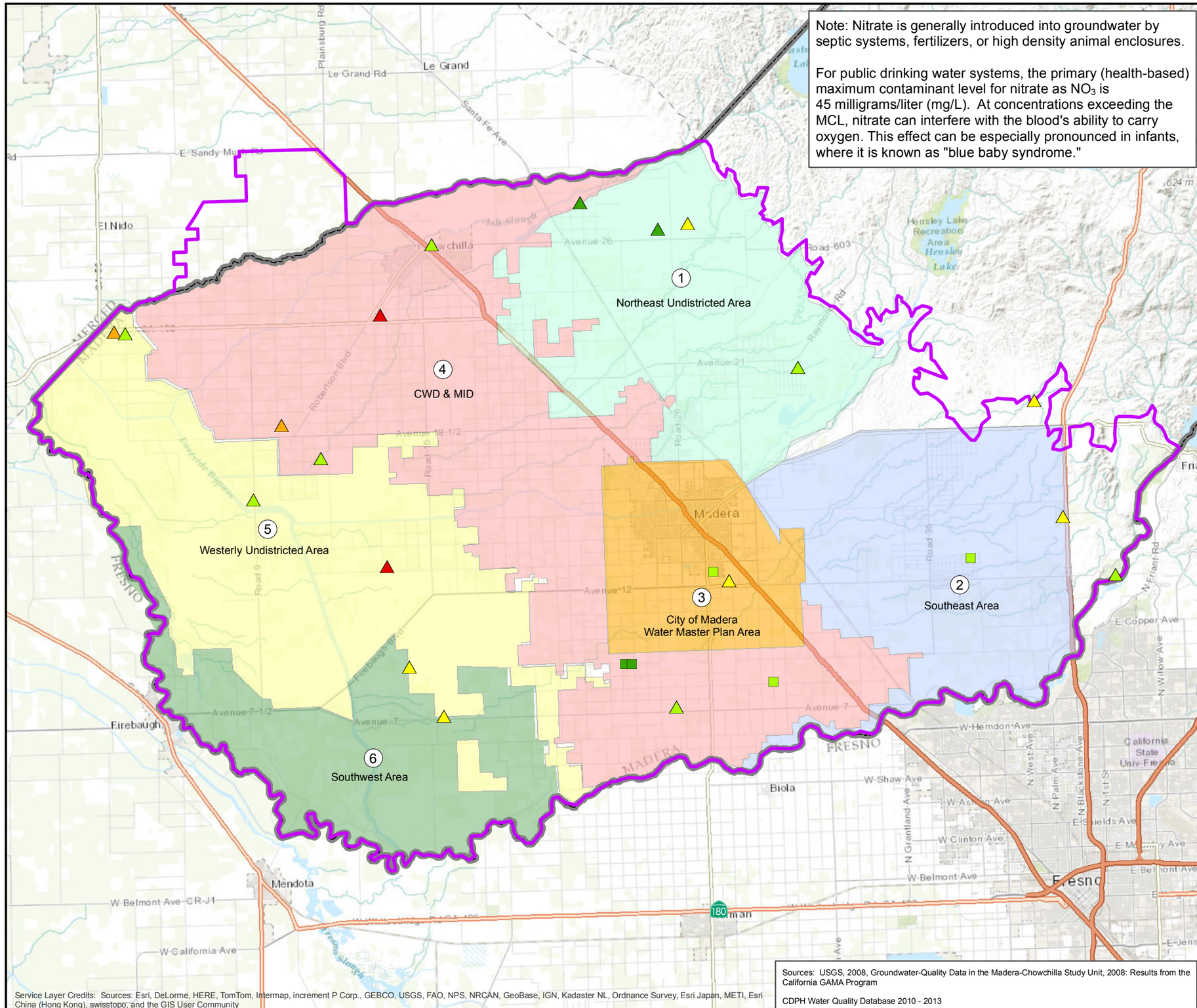
MAP OF NITRATE (AS NO_3) CONCENTRATION IN SHALLOW WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



NORTH

0 2 4
MILES

Nitrate as NO3 (mg/L) in City Wells < 400 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Nitrate as NO3 (mg/L) in County Wells < 400 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Nitrate as NO3 (mg/L) in USGS GAMA Wells < 400 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Groundwater Management Plan Boundary

Madera County Boundary

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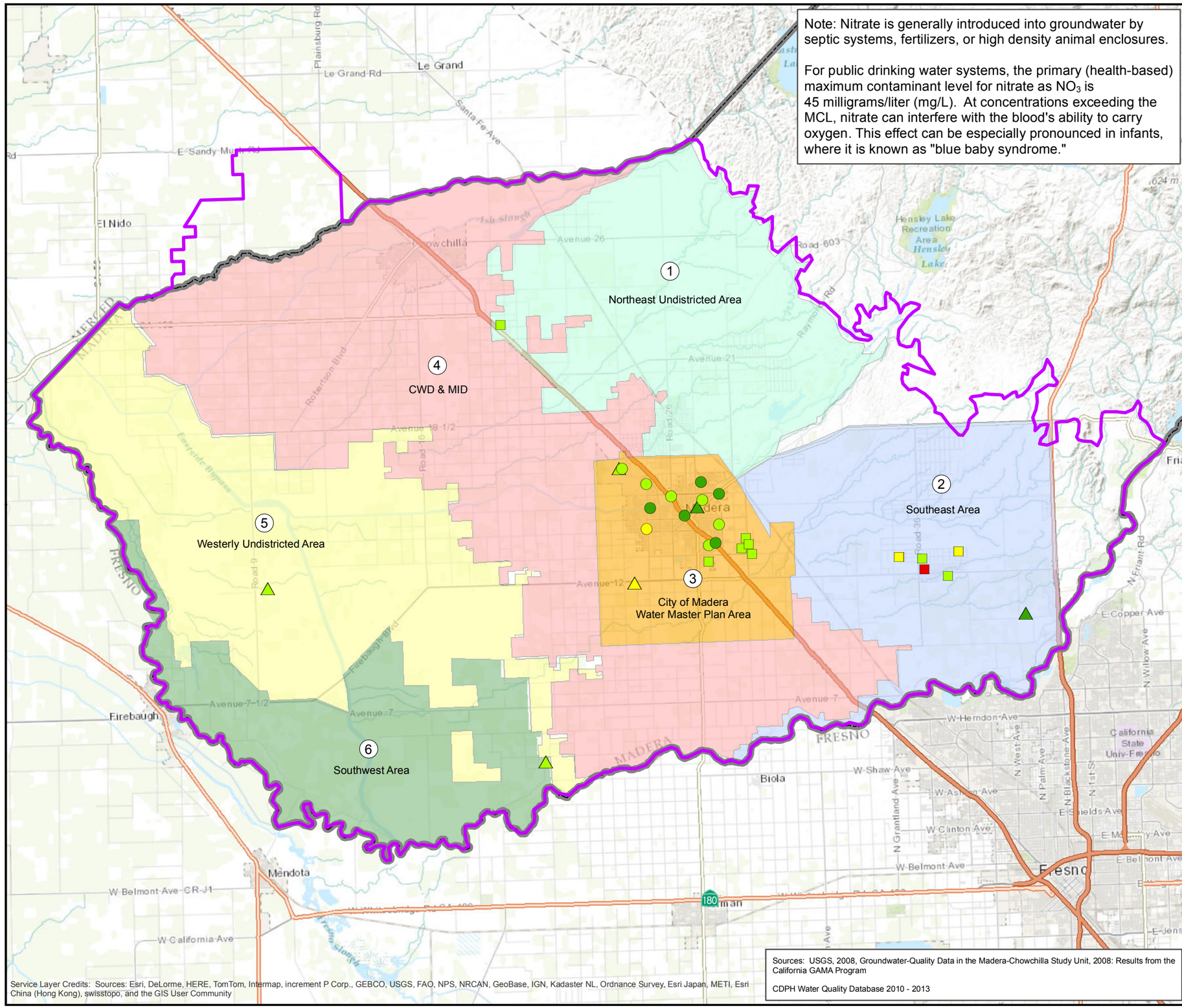
MAP OF NITRATE (AS NO_3) CONCENTRATION IN INTERMEDIATE WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014

Note: Nitrate is generally introduced into groundwater by septic systems, fertilizers, or high density animal enclosures.

For public drinking water systems, the primary (health-based) maximum contaminant level for nitrate as NO_3 is 45 milligrams/liter (mg/L). At concentrations exceeding the MCL, nitrate can interfere with the blood's ability to carry oxygen. This effect can be especially pronounced in infants, where it is known as "blue baby syndrome."



NORTH

0 2 4
MILES

Nitrate as NO_3 (mg/L) in City Wells 400-600 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Nitrate as NO_3 (mg/L) in County Wells 400-600 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Nitrate as NO_3 (mg/L) in USGS GAMA Wells 400-600 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore represent composite water quality across two or more aquifers.

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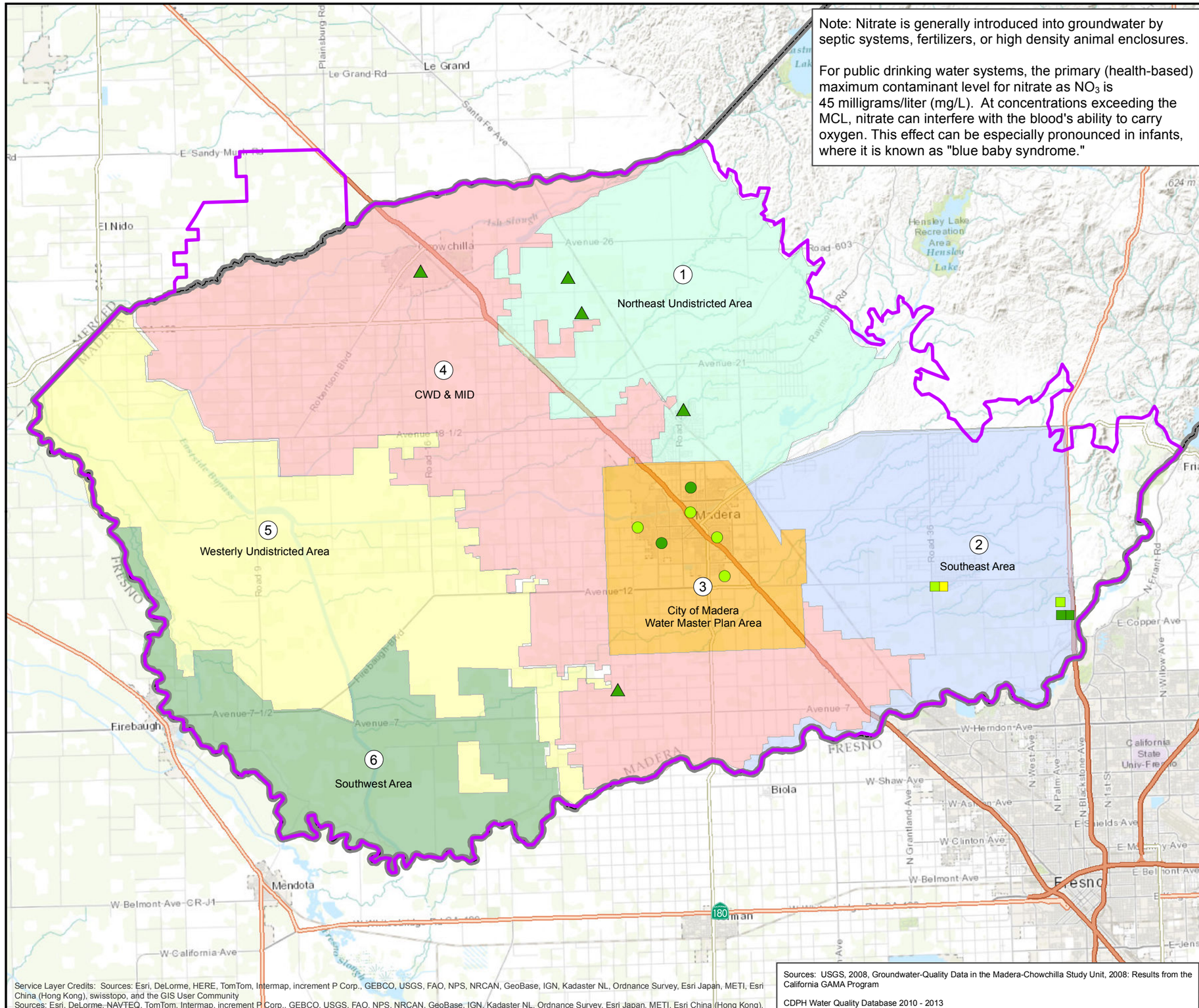
MAP OF NITRATE (AS NO_3) CONCENTRATION IN DEEP WELLS

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



NORTH

0 2 4
MILES

Nitrate as NO_3 (mg/L) in City Wells > 600 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Nitrate as NO_3 (mg/L) in County Wells > 600 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Nitrate as NO_3 (mg/L) in USGS GAMA Wells > 600 feet

- < 5
- 5 - 15
- 15 - 30
- 30 - 45
- > 45

Groundwater Management Plan Boundary

Madera County Boundary

Note: All wells are classified by total well depth. Some wells may have screen perforations that begin shallower than the depth classification and therefore represent composite water quality across two or more aquifers.

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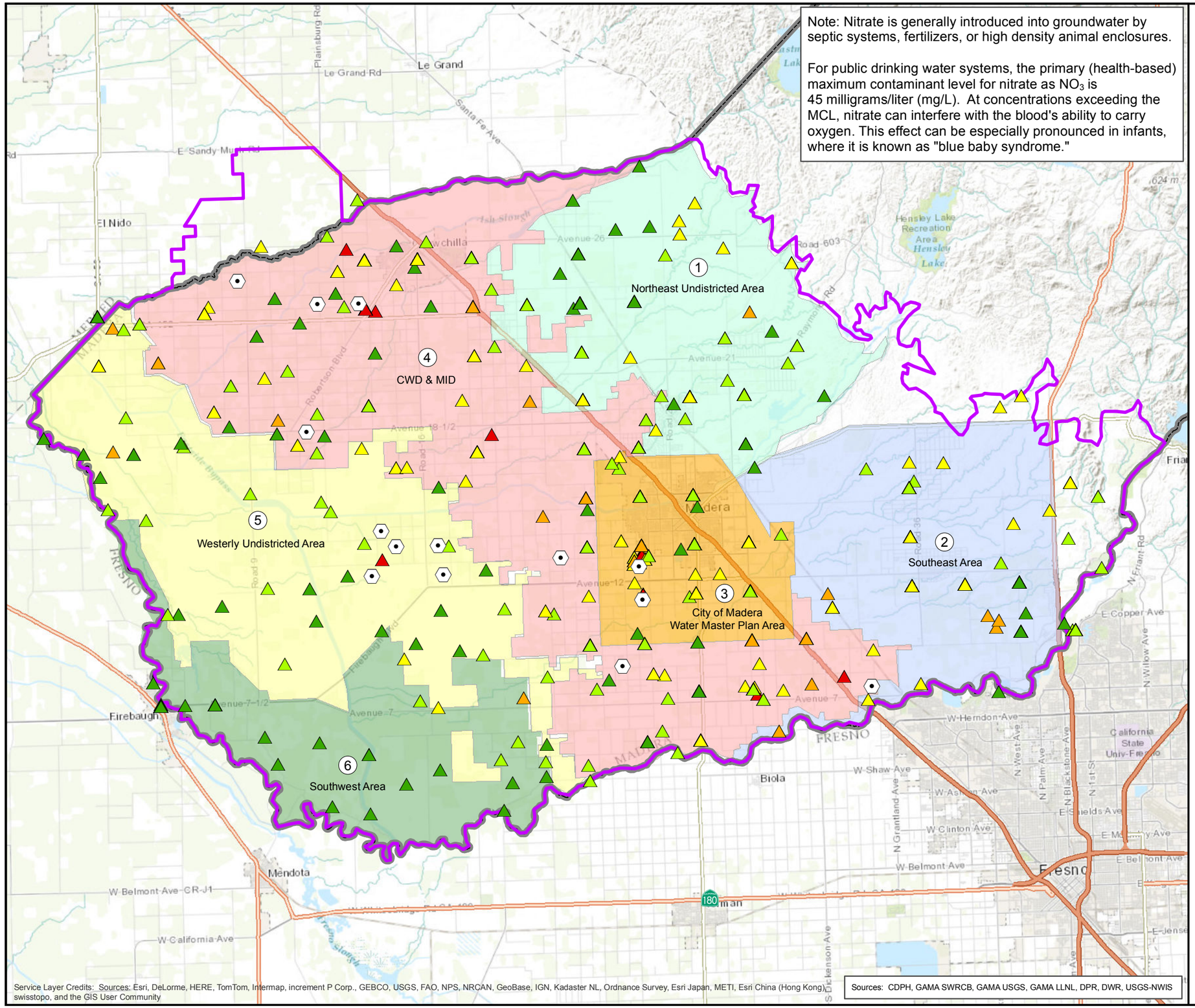
MAP OF NITRATE (AS NO_3) CONCENTRATION IN WELLS OF UNKNOWN DEPTH

MADERA REGIONAL
GROUNDWATER MANAGEMENT PLAN
APRIL 2014



Note: Well construction records were not available for these wells. Some wells may have screen perforations that connect two or more aquifers and may therefore represent composite water quality.

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MADERA REGIONAL

GROUNDWATER MANAGEMENT PLAN

APPENDIX E – PROPOSED GROUNDWATER MONITORING PROGRAM FOR MADERA COUNTY

PROPOSED GROUNDWATER MONITORING PROGRAM FOR MADERA COUNTY

prepared for
Resources Management Agency
County of Madera
Madera, California

by
Kenneth D. Schmidt and Associates
Groundwater Quality Consultants
Fresno, California

January 2008

KENNETH D. SCHMIDT AND ASSOCIATES
GROUNDWATER QUALITY CONSULTANTS
600 WEST SHAW, SUITE 250
FRESNO, CALIFORNIA 93704
TELEPHONE (559) 224-4412

January 4, 2008

Mr. Greg Farley
County Engineer
Madera County RMA
2037 West Cleveland Avenue
Madera, CA 93637

Re: Proposed Groundwater Monitoring Program for Madera County

Dear Greg:

Submitted herewith is our proposed groundwater monitoring program for Madera County. We appreciate the cooperation of Boyle Engineering Corporation, the Chowchilla Water District, the Root Creek Water District, the Columbia Canal Company, the Gravelly Ford Water District, and the Aliso Water District in providing information for this report.

Sincerely Yours,

Kenneth D. Schmidt
Geologist No. 1578
Certified Hydrogeologist
No. 176

KDS/pe

REGISTERED GEOLOGIST • STATE OF CALIFORNIA • KENNETH D. SCHMIDT NO. 1578

REGISTERED GEOLOGIST • STATE OF CALIFORNIA • KENNETH D. SCHMIDT NO. 176 CERTIFIED HYDROGEOLOGIST

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PROPOSED GROUNDWATER MONITORING PROGRAM FOR MADERA COUNTY

INTRODUCTION

In this report, existing groundwater monitoring is described, first in the foothills and mountains, then in the valley floor. Data gaps in the monitoring programs in both of these areas are then discussed. Lastly, a groundwater monitoring program is proposed to address these gaps and to supplement the exiting monitoring.

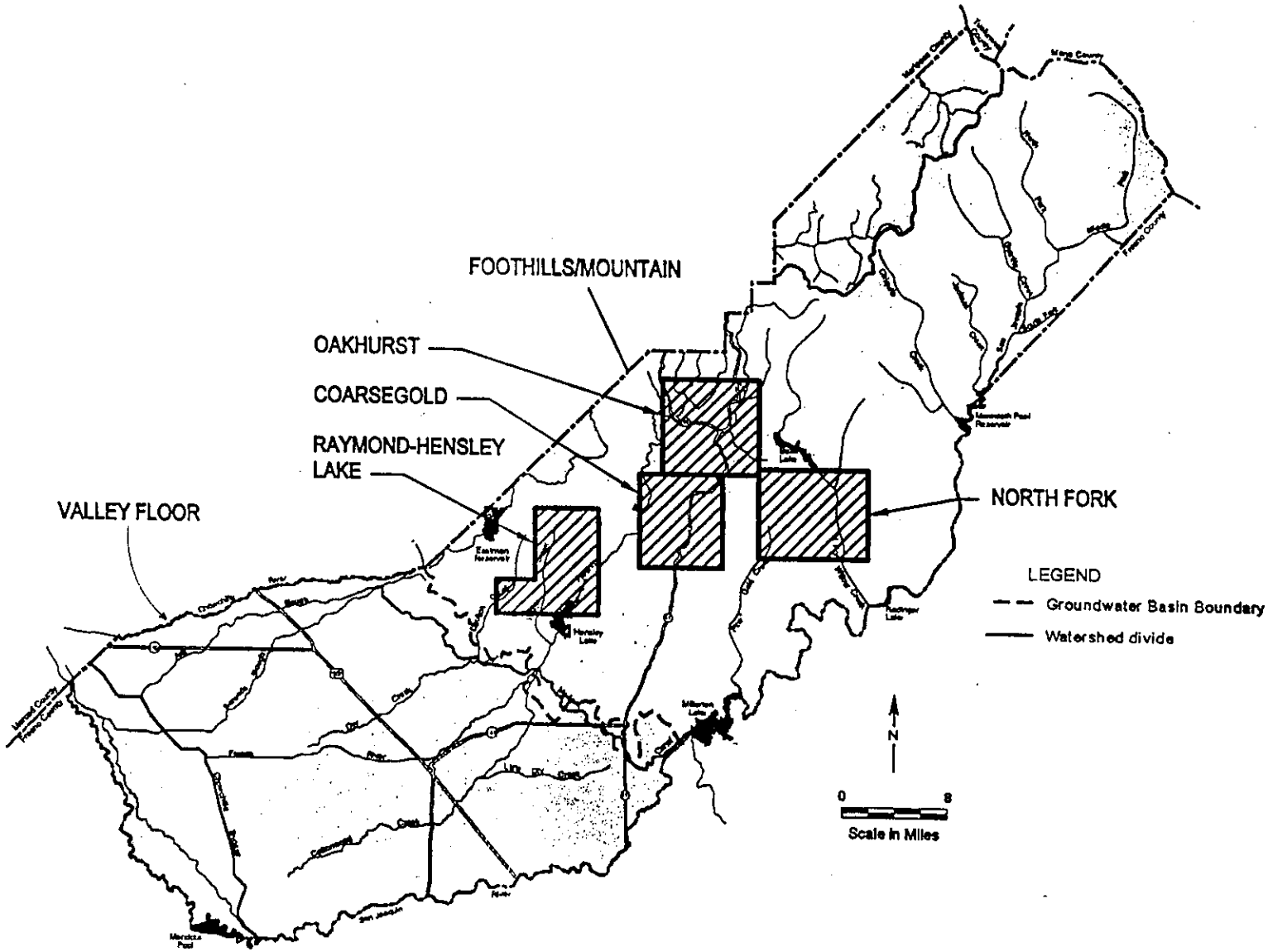
EXISTING MONITORING PROGRAMS

Foothills and Mountains

Figure 1 shows the foothill and mountain part of Madera County, and the locations of four areas were detailed hydrogeologic evaluations have been completed (Oakhurst, North Fork, Coarsegold, and Raymond-Hensley Lake).

Well Completion Reports

Locations of wells, depths, water-producing fracture zones, and airtest yields are all important information that is necessary to conduct hydrogeologic evaluations. Well completion reports for new wells are required to be filed with both Madera County Environmental Health and the California Department of Water Resources (DWR). Unfortunately, the reports in the County files are not readily retrievable. The completion reports in the DWR files are



Basemap from Todd Engineers (2002).

FIGURE 1-LOCATION OF DETAILED STUDY AREAS IN FOOTHILLS AND MOUNTAINS

retrievable and are filed by township, range, and section. The locations of these wells are generally not matched to specific parcels and the well locations are not field checked. Some water well drilling contractors have extensive files of completion reports, but these are considered confidential by most contractors.

Precipitation

Figure 2 shows the locations of precipitation gages in the foothills and mountains of Madera County. In terms of suitability for evaluating groundwater conditions, this network of gages is considered adequate.

Streamflow

Figure 2 also shows streamflow gaging stations in the foothills and mountains. In general, flows for the larger streams, such as the Chowchilla River and Fresno River, are measured, but flows of most smaller streams are not, except for Willow Creek in the North Fork area, Finegold Creek, and Cottonwood Creek near Friant Dam. There are no active streamflow gages in the Coarsegold area. Streamflow, particularly the baseflow, is important in the foothills and mountains for groundwater evaluations. Baseflow represents groundwater discharge to streams, and good examples are the low Fresno River and Coarsegold Creek flows in the early summer. A number of vegetation management programs are underway at some locations, and these can increase streamflow, due to a reduc-

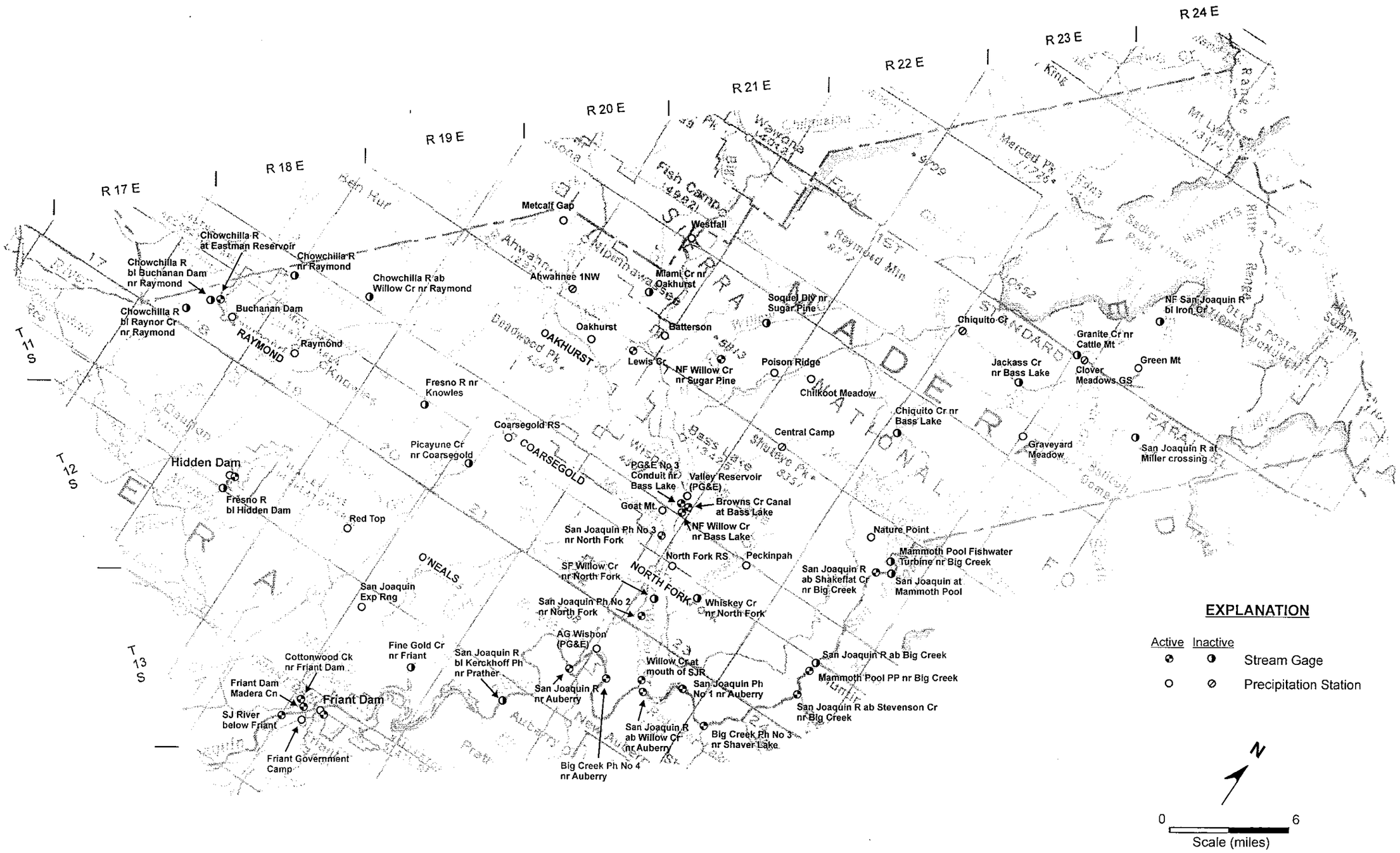


FIGURE 2 - STREAM GAGES AND PRECIPITATION STATIONS IN FOOTHILL AND MOUNTAIN AREA

tion in evapotranspiration. Measurements of streamflow in local areas where such practices have been or are being conducted would be useful.

Pumpage

Pumpage in the foothills and mountains is generally measured only for water system wells. In the areas where detailed hydrogeologic evaluations have been conducted, pumpage of private individual wells was estimated by determining the number of developed lots not connected to water systems and using average water deliveries per connection for water systems. Pumpage information is indicated to be generally suitable for hydrogeologic evaluations.

Water Levels

In general, prior to the detailed hydrogeologic evaluations in the four areas, routine water-level records were primarily limited to those for some water system wells. Some large water systems have excellent water-level records, such as the Yosemite Spring Park Utility and Hillview Water Company. However, many small systems have much less water-level records. Continuous water-level recorders have been maintained for several Chukchansi Casino wells for several years, and these are considered the best records available. As part of the detailed hydrogeologic studies, numerous wells were measured, and the measuring point elevations were determined. This allowed preparation of the first water-level elevation maps to be prepared for the foothill and mountain areas of Madera

County. Also, frequent water-level measurements allowed water-level hydrographs to be prepared and to be compared to precipitation records. There are a number of other water-level measurements that are maintained by water well drillers and pump companies, but for the most part this is not public information.

Groundwater Quality

Prior to the detailed hydrogeologic studies for the four referenced areas, chemical analyses of water samples from wells were primarily limited to wells in moderate to large water systems. As part of the detailed studies, numerous private domestic wells were sampled for determination of key chemcial constituents. This allowed preparation of maps showing groundwater quality problem areas, in many cases for the first time. Identified problems in some areas include high concentrations of total dissolved solids, iron, manganese, uranium, arsenic, and hydrogen sulfide. Also, groundwater of low pH (less than 6) has been identified in some areas. Water from wells in some areas has been treated to remove iron and manganese, and this is common in the Coarsegold area. Probably the most difficult groundwater quality problem in the foothills and mountains is uranium, particularly in parts of the Oakhurst and North Fork areas. Some chemical analyses are available for other private domestic wells, but these are generally not in the public record. Because water system wells with water

quality problems that cannot be readily handled by treatment are often taken out of service and can't be sampled to obtain representative results, time trends for groundwater quality in problem areas have been difficult to determine.

Valley Floor

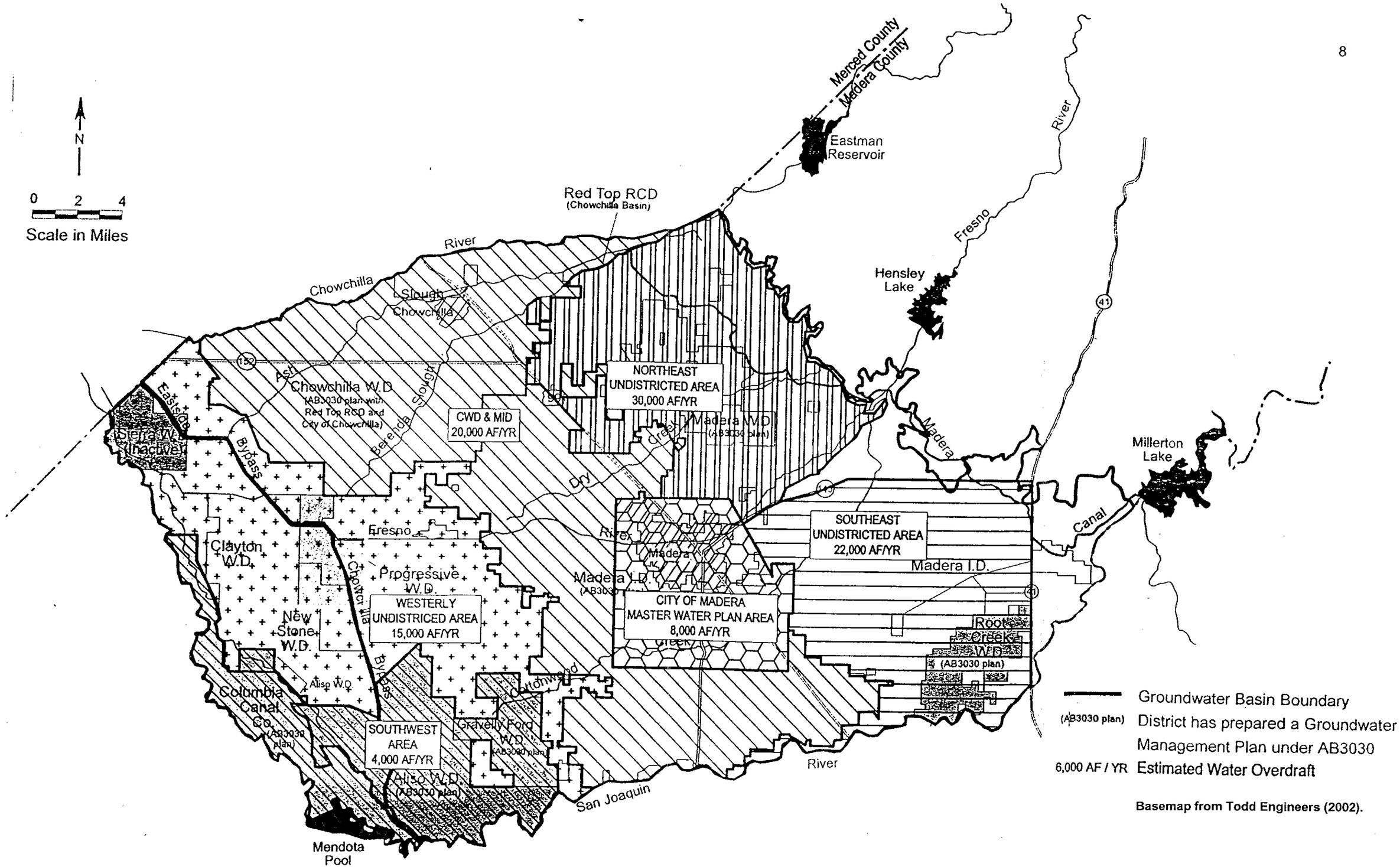
Figure 3 shows the location of the valley floor part of Madera County and irrigation and water districts and subareas within the area. Todd Engineers (2002) evaluated groundwater conditions in this area for the County AB303 groundwater management plan. More detailed hydrogeologic studies have been conducted in parts of this area, including the Chowchilla Water District, Root Creek Water District, City of Madera, and in the vicinity of the Mendota Pool.

Precipitation

Figure 4 shows locations of precipitation stations in the valley floor part of the County. In general, these stations provide adequate information for groundwater evaluations.

Evaporation and Evapotranspiration

Evaporation from surface water bodies is a component of the water budget. Crop evapotranspiration is one of the largest water budget items for the irrigated part of the valley floor. Records from climatological stations where parameters such as pan evaporation and temperature are measured can be used to estimate evapora-



Basemap from Todd Engineers (2002).

FIGURE 3-LOCATIONS OF WATER DISTRICTS AND SUBAREAS IN VALLEY FLOOR AREA

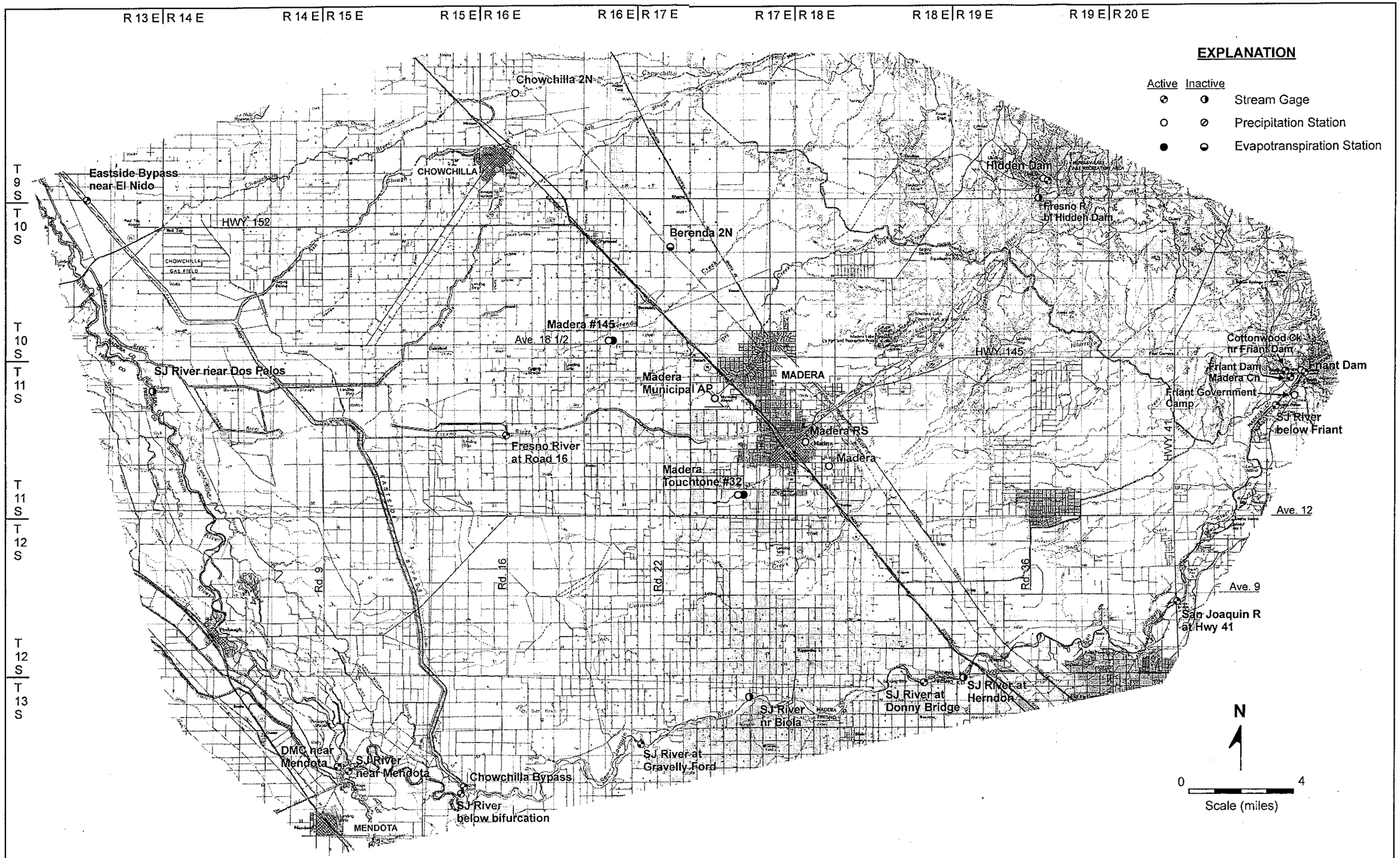


FIGURE 4 - STREAM GAGES AND PRECIPITATION AND EVAPOTRANSPIRATION STATIONS IN VALLEY FLOOR AREA

-tion from free water surfaces and crop evapotranspiration. Locations of these stations in valley floor areas are shown in Figure 4. In terms of groundwater evaluations, these records are considered adequate.

Streamflow

Figure 4 also shows locations of streamgages in or near the valley floor area for the Chowchilla River, Fresno River, and San Joaquin River. The San Joaquin River is gaged below Friant Dam, at the Eastside Bypass, and at Mendota Dam. The Fresno River is gaged below Hidden Dam and at Road 16. The Chowchilla River is gaged below Buchanon Dam (Eastman Lake). In general, downstream flows on the Fresno River and distributaries of the Chowchilla River in Madera County aren't measured, except for diversions for irrigation.

Canal Diversions

Amounts of water diverted from the Madera Canal, the Fresno River, and the Chowchilla River and its distributaries are measured by either the Chowchilla WD or Madera ID. Diversions of San Joaquin River water are measured by the Gravelly Ford Water District, Columbia Canal Company, and private landowners.

Consumptive Use

Periodic crop surveys are normally done in the MID, CWD, Gravelly Ford WD, and Root Creek WD. Crop surveys are not routine-

ly done in undistricted areas. However, the California Department of Water Resources periodically conducts crop surveys in the valley floor area for evaluation of irrigation water use.

Pumpage

Pumpage is one of the largest items in the water budget. In the valley floor area, pumpage for City and other moderate to large water system wells is generally measured by flowmeters. Pumpage is also measured at the Paramount Farms New Columbia Ranch, the Columbia Canal Co., and by some other individual land owners. However, pumpage from most private irrigation wells and private domestic wells is not directly measured. In the past, irrigation well pumpage in the valley floor area has been estimated by agencies such as the U. S. Geological Survey from power consumption records. Pumpage for irrigation can also be estimated from the consumptive use of applied water (based on crop surveys), estimates of the irrigation efficiency, and records of river or canal water use. This is considered a better approach than using power records, but is not as accurate as direct measurements.

Water Levels

Todd Engineers (2002) retrieved electronic water-level records obtained from the California Department of Water Resources for more than 750 wells in the valley floor area. Unfortunately, many of these wells are no longer measured, due to well destruction, water-

level declines, and other factors. A number of Districts routinely measure water levels in the spring and fall and these are provided to the DWR.

Following are the number of wells being measured in or by specific districts in or near the valley floor area:

Madera ID	202
Chowchilla ID	143
Columbia Canal Co.	36
Root Creek WD	18
El Nido ID	10
Aliso WD/Gravely Ford WD	8

MID also measures water levels in 20 other wells in the vicinity of the Madera Ranch water-banking facility. The DWR measures water levels in about 60 other wells in the valley floor area, primarily in undistricted areas. As part of the Mendota Pool Pumpers Group transfer program, a number of wells in the Columbia Canal Co. service area and Aliso WD are measured. As part of this program, continuous water-level recorders are maintained at two compaction recorders near Mendota. There is a total of almost 500 wells that are being measured routinely in the valley floor area. Figure 5 shows the locations of known presently measured wells in the valley floor area.

The DWR, USBR, MID, and CWD prepare water-level elevation maps for all or parts of the valley floor area. The DWR formerly prepared separate maps for the upper and lower aquifers in the west

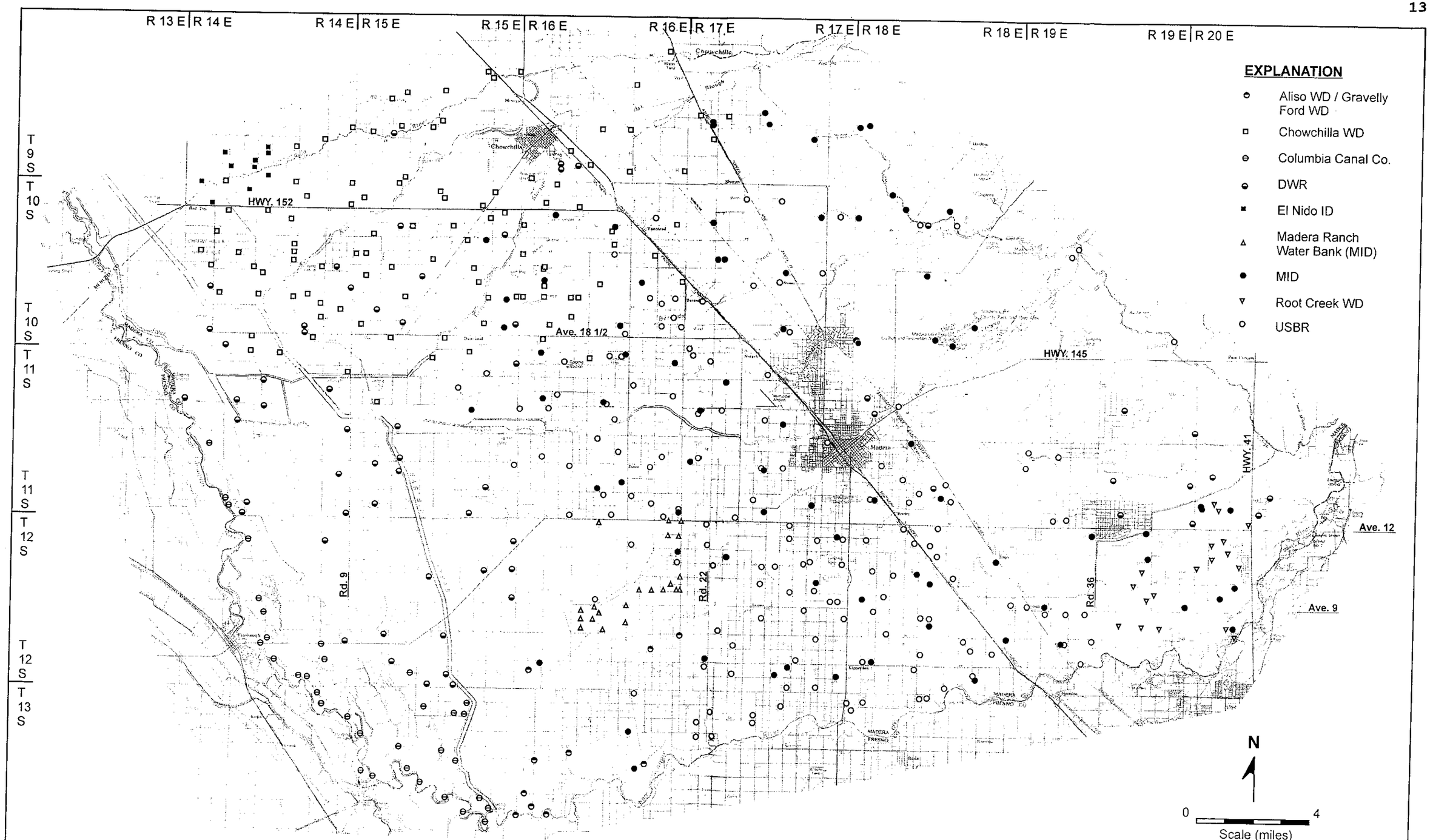


FIGURE 5 - LOCATION OF PRESENTLY MEASURED WELLS IN VALLEY FLOOR AREA

part of the area, but discontinued preparation of the lower aquifer maps in the 1980's. The DWR prepares water-level hydrographs for wells in their network that are available on a website. Unfortunately, water levels in wells throughout much of the valley floor area vary substantially with well depth. Depths and/or perforated intervals for many of the wells being measured aren't available. This complicates interpretation of the water-level records.

Land Subsidence

Land subsidence has been documented in the west part of the valley floor area in Madera County. Historically, most of the subsidence monitoring was done on the west side of the valley in the part of the valley north of the Tule River. Although land subsidence in the San Joaquin Valley was extensively studied through the mid-1960's, much of this monitoring ceased in the mid or late 1960's, when water from the San Luis Canal became available on the west side of the valley. However, monitoring has been reinstituted for subsidence associated with large-scale pumping near the Mendota Pool, where two compaction recorders have been operational since the early 2000's. The National Geodetic Survey periodically determines land surface elevations along Highway 152. Along Highway 152, most of the subsidence has been east of the Eastside Bypass, where most irrigation wells tap groundwater in the confined aquifer below the Corcoran Clay. Subsidence in this area along Highway 152

has been about three feet during the past 16 years (Al Steele, DWR, San Joaquin District). Subsidence monitoring in the western part of Madera County has been fragmentary, particularly during the past several decades.

Groundwater Quality

Extensive groundwater quality monitoring is required for wells in moderate to large water systems, such as in the Cities of Madera and Chowchilla. This information is in the public record. Less groundwater quality monitoring is required for small water systems. Historically, private individual wells in Madera County weren't required to be sampled for chemical analyses, but in recent years sampling has been required. Additionally, the County has required water assessments in recent years for a number of proposed projects, such as lot splits. As part of these studies, water samples were collected from a number of wells for analyses of major inorganic chemical constituents and potential problem constituents. As part of the Mendota Pool Group program, an extensive groundwater quality monitoring has been undertaken and is underway, including a number of wells in the southwest part of the valley floor area and in adjoining areas in Fresno County. Annual monitoring reports are available for this program that provide and interpret this information.

The Root Creek Water District sampled about 40 wells in the District in 2003, as part of a DWR AB303 project (Provost & Prit-

chard and KDSA, 2004). This sampling was done to provide more information on groundwater quality in and near the area where the Gateway Village development is to be built.

Identified groundwater quality problems in parts of the valley floor area include high concentrations of TDS, nitrate, hydrogen sulfide, manganese, arsenic, uranium, DBCP, slime-producing organisms, and methane gas.

High TDS groundwater has been present west of the San Joaquin River for many decades and has been moving to the east into Madera County. High nitrate concentrations are fairly common in shallow groundwater beneath irrigated area, particularly where sandy soils are present. Hydrogen sulfide has been found in some deeper groundwater in blue-green deposits in the east part of the valley floor area and to the west near the valley trough, where shallow groundwater in the Sierran sands is present under reducing conditions. Manganese, arsenic, and slime-producing organisms are a problem in some of the deeper groundwater, primarily in the east part of the valley floor area. DBCP was found in shallow groundwater south of Madera and west of Highway 99, where there are extensive tracts of vineyards and sandy soils. The DBCP concentrations were mapped by Moore (1995). High uranium concentrations have been found in shallow groundwater at the Howard and Lavina Schools, at the City of Madera WWTF, and several other locations north of the San Joaquin River near Highway 99. Figure

6 and 7 show locations of known groundwater quality problem areas in the valley floor area.

DATA GAPS

Foothills and Mountains

The main data gaps in part of of the foothill and mountains are for 1) accessibility of well completion reports, 2) streamflow, 3) water levels, and 4) groundwater quality.

Well Completion Reports

Completion reports for new wells are filed with the County and DWR, but are either not readily accessible or the locations of a number of wells are not accurate enough for use in hydrogeologic evaluations. In addition, a number of completion reports are being submitted electronically to DWR and these are not being processed and are thus not available

Streamflow

Baseflow measurements are particularly valuable for groundwater evaluations. In the Oakhurst Basin, measurements of streamflow on Miami Creek were discontinued many years ago, and there are no streamflow measurements for China Creek. In the Coarsegold Area, streamflow in Coarsegold Creek has not been measured, and the stream gaging on Picayune Creek was discontinued many years ago. In the Raymond-Hensley Lake area, there are no streamflow measurements for Daulton Creek or Willow Creek. Streamflow measurements

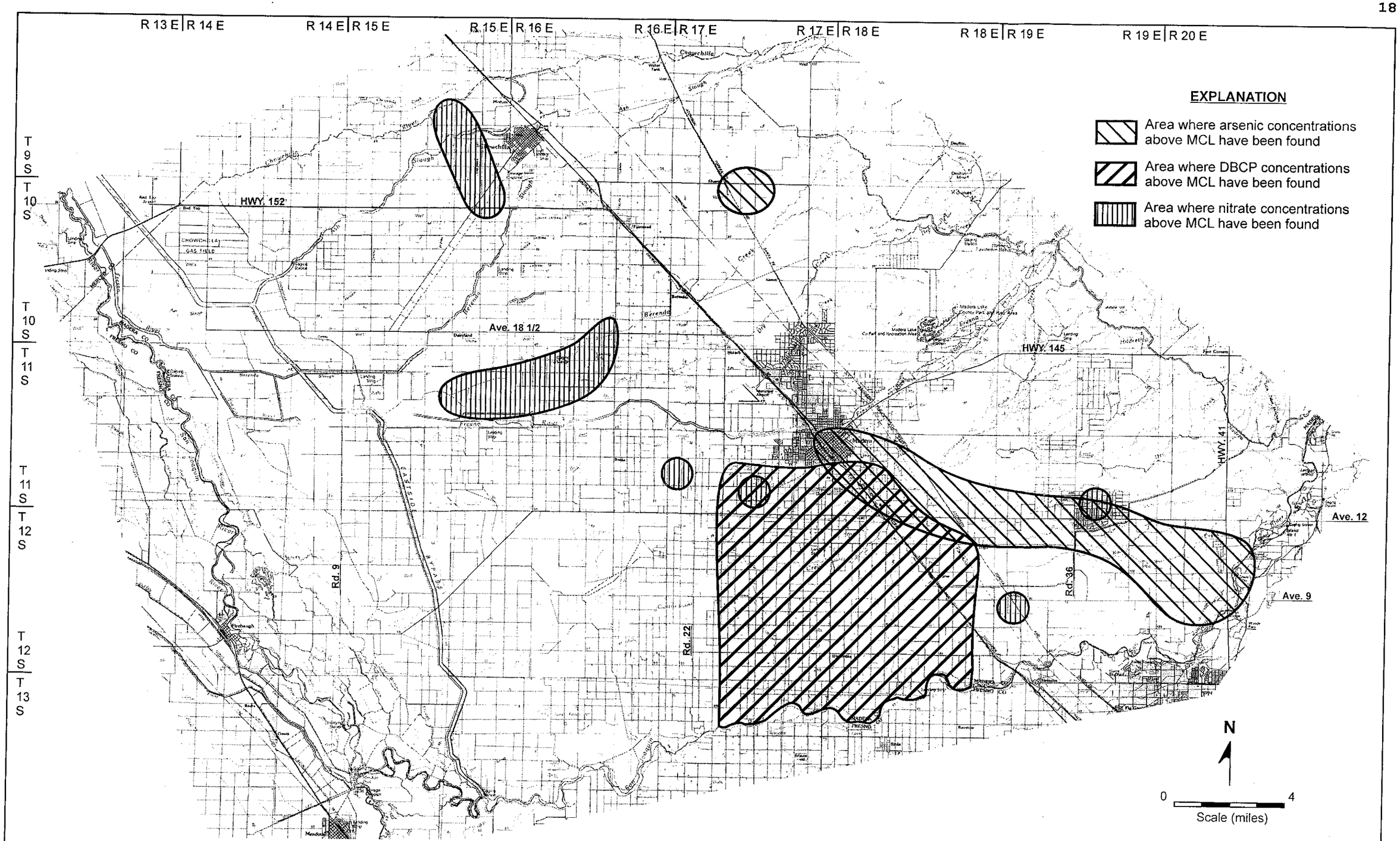


FIGURE 6 - APPROXIMATE LOCATIONS OF KNOWN GROUNDWATER QUALITY PROBLEM AREAS IN VALLEY FLOOR AREA

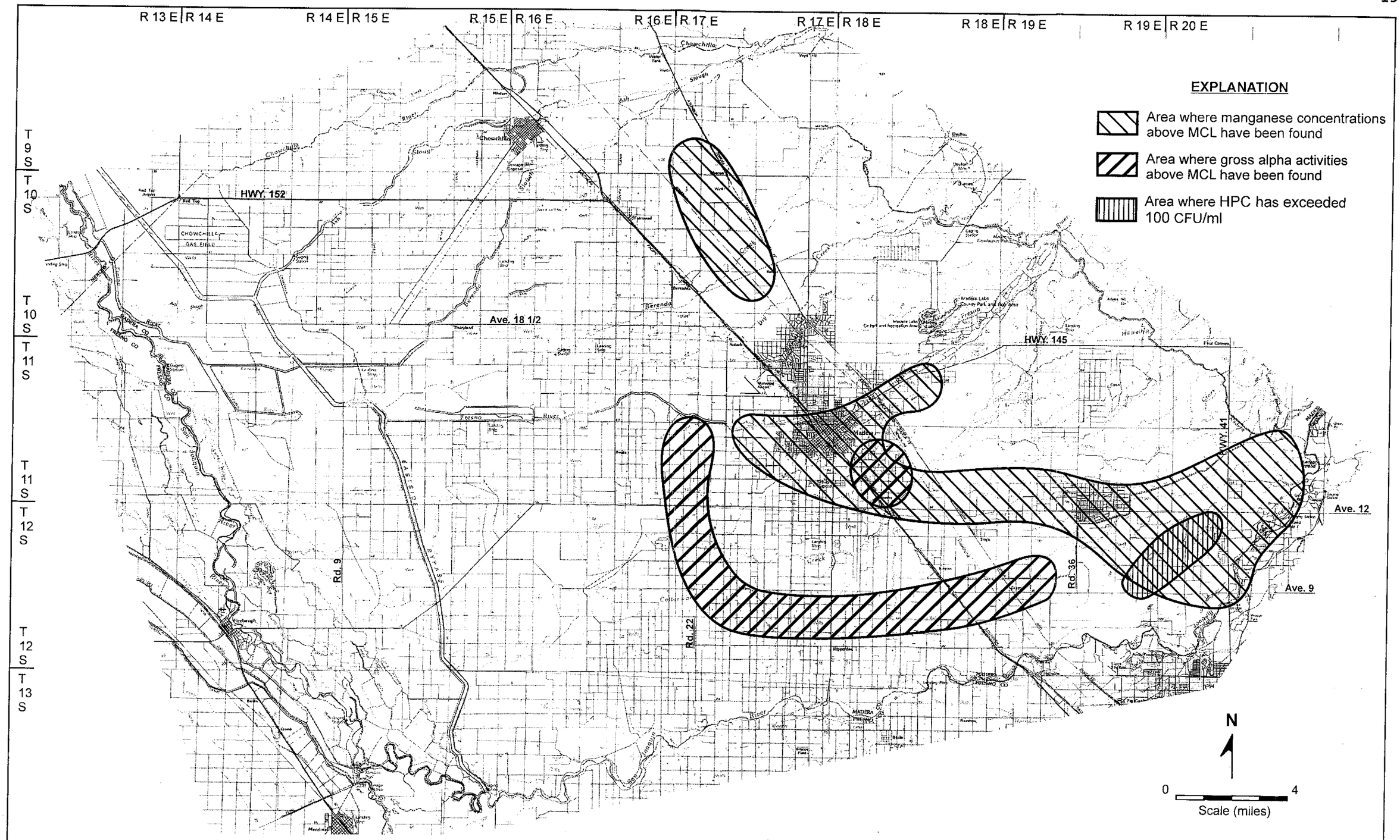


FIGURE 7 - APPROXIMATE LOCATIONS OF KNOWN GROUNDWATER QUALITY PROBLEM AREAS IN VALLEY FLOOR AREA

are also lacking in smaller watersheds where vegetation management has been undertaken in recent years.

Water Levels

Except for some water systems, water levels in wells have generally not been routinely measured, particularly for private domestic wells. Also, water-level maps have not been routinely prepared, nor have water-level hydrographs been maintained, except in a few cases.

Groundwater Quality

In general, the most groundwater quality data are available for wells in relatively large water systems. There has been no sampling required for new private domestic wells, and no routine sampling conducted, except for the wells in water systems and some other private wells. Maps showing groundwater quality problem areas have not been routinely prepared and updated.

Valley Floor

The primary data gaps in the valley floor are for canal flow (spills), pumpage, water levels, land subsidence, and groundwater quality.

Canal Flows

Canal diversions at the head of canals are measured, but flows leaving districts are generally not measured.

Pumpage

Pumpage for most private irrigation, domestic, and industrial wells is not measured. These items are important in preparing water budgets and estimating groundwater overdraft.

Water Levels

The water-level measuring program in the valley floor area is critical in terms of calculating groundwater overdraft. The water-level measurement program has three primary deficiencies: 1) it is not extensive enough in non-Districted areas, particularly in the southeast part of the valley floor area, 2) a number of measured wells are of unknown depth and/or perforated intervals, and 3) a number of measured wells, particularly in the western part of the valley floor area, are composite wells. These wells have water levels that are intermediate between water levels in the upper aquifer (above the Corcoran Clay) and those in the lower aquifer (below this clay). The focus needs to be on developing two separate water-level networks throughout the valley floor part of the County. One would be for relatively shallow wells (i.e., about 250 to 300 feet deep or shallower) and the other for deeper wells (commonly about 500 to 900 feet deep and without shallow perforations). In addition, continuous water-level recorders are recommended at at least one dozen sites in the valley floor area.

Land Subsidence

According to Al Steele of the DWR, there have been more than three feet of subsidence along Highway 152 in the area east of the Eastside Bypass, where there is extensive pumping from the lower aquifer, during the past 16 years. There are no compaction recorders in Madera County to measure compaction associated with land subsidence and no other ongoing routine monitoring program for land subsidence. The only apparent monitoring is periodic surveys of the land surface by the National Geodetic Survey along Highway 152.

Groundwater Quality

Extensive water quality monitoring is required for moderate to large water systems, and an extensive ongoing groundwater quality monitoring program is conducted as part of the Mendota Pool Group pumping program. Some additional well sampling is done by private entities, and most is not in the public record. However, for most private irrigation and industrial wells in the valley floor area, there has been no well sampling where the chemical analyses are in the public record. There is no comprehensive water quality data base for wells in the County other than public supply wells. There has been no routine mapping of groundwater quality problem areas in the valley floor area, and no plotting of time trends for specific problem constituents.

RECOMMENDED ADDITIONAL MONITORING

Foothills and Mountains

Streamflow

In the Oakhurst Basin, it is recommended that the streamgage on Miami Creek be reactivated or replaced and a new streamgage be developed on China Creek, above the confluence with the Fresno River. This work could be done in cooperation with the MID, DWR, or U. S. Geologic Survey. The focus would be to measure baseflow accurately, in addition to amounts of total streamflow each year.

Water Levels

It is recommended that the water-level networks that have been developed for the Oakhurst, North Fork, Coarsegold, and Raymond-Hensley Lake areas in recent years be continued. Also, in areas of concentrated pumping (i.e., water system well fields), continuous water-level measurements are recommended for some wells (such as routinely done at the Chukchansi Casino). On an annual basis, water-level elevations and direction of groundwater flow maps would be prepared for the spring and fall each year, and water-level hydrographs would be updated each year.

Groundwater Quality

New private domestic wells should be sampled and the water analyzed for the major inorganic chemical constituents including nitrate, and for pH, electrical conductivity, iron, manganese, ar-

senic, and alpha activity and the results provided to the County. Water from a number of private wells sampled as part of the detailed studies should be continued to be sampled and analyzed at least every three years. A data base should be developed whereby this information is accessible for use. On a biennial basis (every two years), groundwater quality problem area maps should be updated, based on results of this sampling and results of analyses of water from water system wells. Included would be the following maps:

1. Oakhurst Area: High TDS, nitrate, iron, manganese, and arsenic concentrations and high alpha activities.

2. North Fork Area: High iron, manganese, and arsenic concentrations and high alpha activities.

3. Coarsegold Area: High iron and manganese concentrations and high alpha activities.

4. Raymond and Hensley Lake Areas: High TDS and nitrate concentrations.

Also, for routinely sampled wells where one or more problem constituents are present at elevated levels, water quality hydrographs should be prepared and updated every several years.

Valley Floor

Pumpage

Over the long-term, because of the severe groundwater overdraft, it would be desirable to measure the pumpage from each well in the valley floor area that produces more than about 100 gpm. This is a considerable undertaking, but pumpage is the most important item in the water budget, in terms of groundwater. Until irrigation pumpage is measured, this pumpage can be estimated from other factors, such as crop water demand and canal water and river water use. It is recommended that pumpage in the valley floor area be determined on an annual basis. Also, efforts should be started to have flowmeters installed in as many large-capacity wells as possible, on a volunteer basis.

Consumptive Use

Annual or more frequent crop surveys are needed for the entire valley floor area. This would be done to supplement routine crop surveys that are primarily done in active water districts. Total crop acreages by type would be tabulated and standard DWR consumptive use factors used for each crop in order to calculate the crop consumptive use of applied water.

Consumptive use also needs to be determined in urban and rural residential areas. The extent of irrigated areas can partly be determined from aerial photos. It would be desirable to be able to

compare the total pumpage, surface water use or recharge, and consumptive use in the valley floor area from year to year, and to compare these with groundwater level trends.

Water Levels

The existing network for the valley floor is problematic and needs to be improved and subdivided into at least two depth zones. The network for the shallow zone (or upper aquifer in the western part of the area) would primarily use private domestic wells and shallow irrigation wells (generally less than about 250 to 300 feet deep). The deep zone (lower aquifer in the west part of the valley floor area) would generally be based on measurements for deep City, irrigation, dairy, and industrial wells (generally about 500 to 900 feet deep and without shallow perforations). This improved program would be undertaken in cooperation with DWR, USBR, Cities, active Districts, and others, as necessary.

The goal of this program would be to prepare spring and fall water-level elevation maps for both the shallow and deep groundwater on an annual basis. The direction of groundwater flow would also be shown on these maps. Another important goal in terms of groundwater recharge or water-banking would be to develop a better understanding of the shallowest groundwater, which in a number of situations can't be determined from water-level measurements in water supply wells. This is because such wells often aren't per-

forated near the water level, and tap deeper strata below significant clay layers. Substantial information on the shallowest groundwater is available from soil borings and shallow monitor or observation wells in specific areas, such as at the Madera County Landfill near Fairmead and the City of Madera WWTF. A number of monitor wells have been installed at gasoline leak sites and others are being installed at dairies and other sites. This information should be obtained, compiled, and used to develop maps showing depth to the shallowest groundwater, particularly in areas where it is less than 50 feet deep, or where intentional recharge is practiced.

Water-level hydrographs for wells should be periodically prepared for both the shallow and deep zones. Water-level trends and water budget items should be evaluated at least every three years to estimate groundwater overdraft in the valley floor area.

Land Subsidence

Land surface elevations should be measured every several years along some of the major roads in the area west of Highway 99. Recommended east-west roads are: Highway 152, Avenue 18-1/2, Avenue 14, and Avenue 7. Recommended north-south roads are Road 9, Road 16, and Road 23. In cooperation with Cal Trans and the Madera County Road Department, new benchmarks would be established as necessary and the elevations of these re-surveyed at least every

three years. Maps of land subsidence should then be prepared about every three years, and correlated to groundwater pumping in Madera County and in adjoining areas, such as Fresno County.

Groundwater Quality

Water samples should be collected from each new private domestic well for analyses of major inorganic chemical constituents including nitrate, pH, electrical conductivity, TDS, manganese, arsenic, and alpha activity. In areas where vineyards or tree crops were grown prior to 1980, DBCP, EDB, and TCP should also be determined. This group of constituents would be analyzed in water from new domestic wells in or near the DBCP problem area previously described.

Every several years, information from the Cities and other water systems would be obtained and along with other information used to develop updated maps of groundwater quality problem areas, including: high TDS, nitrate, DBCP, alpha activity (uranium), manganese, arsenic concentrations, and high heterotrophic plate counts (indicator of slime-producing organisms). Selected private wells in known areas of groundwater quality problems should be sampled (with the owners approval) on a routine basis (at least annually) in order to determine time trends. This would help determine if the problem is getting better (i.e., such as due to degradation of DBCP), getting worse, or staying the same.

Information on vertical trends in groundwater quality has been obtained in the City of Madera, at Madera Ranchos, Madera Community College, Rolling Hills, Valley Children's Hospital, and at a number of schools. This information is normally derived from test wells done prior to construction of new public supply wells. Because most of this information has been obtained for public entities, it is publically available. Maps should be prepared and updated every few years showing where this information has been obtained and the results should be interpreted and presented in reports on groundwater quality problem areas.

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MADERA REGIONAL

GROUNDWATER MANAGEMENT PLAN

APPENDIX F – REGIONAL GROUNDWATER LEVELS (Kenneth D. Schmidt and Associates)

REGIONAL GROUNDWATER MANAGEMENT PLAN

Regional Groundwater Levels

Aquifer Conditions

Annual maps showing water-level elevations in the valley floor area are prepared by the DWR. These maps are intended to primarily pertain to the unconfined groundwater, or the upper aquifer. However, in the western part of the Madera area (which is underlain by the Corcoran Clay), these maps are often based on many measurements for composite wells (tapping both the upper and lower aquifers). Although it has been assumed by most investigators that all of the groundwater in the area east of the east edge of the Corcoran Clay is unconfined, drilling and testing of many deep wells in the east part of the Madera Area during recent decades has provided contrary information. That is, relatively thick clay layers are often present below a depth of several hundred feet in the east part of the valley floor. Although these clay layers are not regional in nature, they act to locally confine the underlying groundwater. Thus an enhanced understanding of groundwater in the valley floor area is that groundwater within the uppermost several hundred feet is normally unconfined, whereas the deep groundwater (usually below a depth of at least 200 feet) is usually confined, whether or not

the Corcoran Clay is present. Until recently, water-level maps for the lower aquifer in Madera County were not available.

Water-level monitoring programs as a whole are deficient in much of the valley part of the County. Newer, deeper wells have been drilled, particularly during the last decade, to tap deep confined groundwater. Long-term and even recent water-level changes for most of this deep groundwater are unknown in most of the area. That is, except for the Red Top area, the limited water-level monitoring has continued to generally focus on wells tapping the shallow groundwater, and has not been revised as the newer, deeper wells have been developed.

Groundwater Flow and Cones of Depression

Historically, the direction of groundwater flow in much of the Madera Area in both the upper and lower aquifers was to the southwest, toward the valley trough (the San Joaquin River downstream of Mendota). However, as groundwater pumping increased, particularly after World War II, several large cones of depression developed. One of the largest depressions is located south of Highway 145 and northeast of the Santa Fe Railroad tracks (the southeast area). This depression coincides with an area with limited surface water use, and thus groundwater pumping has been predominant. Another cone of depression is located near

and east of Fairmead. This coincides with another large area with little surface water deliveries. Groundwater pumping is predominant in this area, and water levels have been substantially lowered in recent decades. There are several additional cones of depression in the western part of the Madera Area. In general, these are west of the CWD and MID, and north of the Columbia Canal Company, Aliso WD, and Gravelly Ford WD service areas.

For many decades, instead of flowing uniformly to the southwest in the area upstream of Mendota, groundwater has been flowing away from the San Joaquin River to the northwest. Seepage of streamflow in the San Joaquin River in the reach between Sumner Hills and Mendota is a major source of recharge to groundwater in Madera County. Groundwater also flows away from the river in the reach downstream of Mendota, but to the northeast. This also contributes recharge to the groundwater.

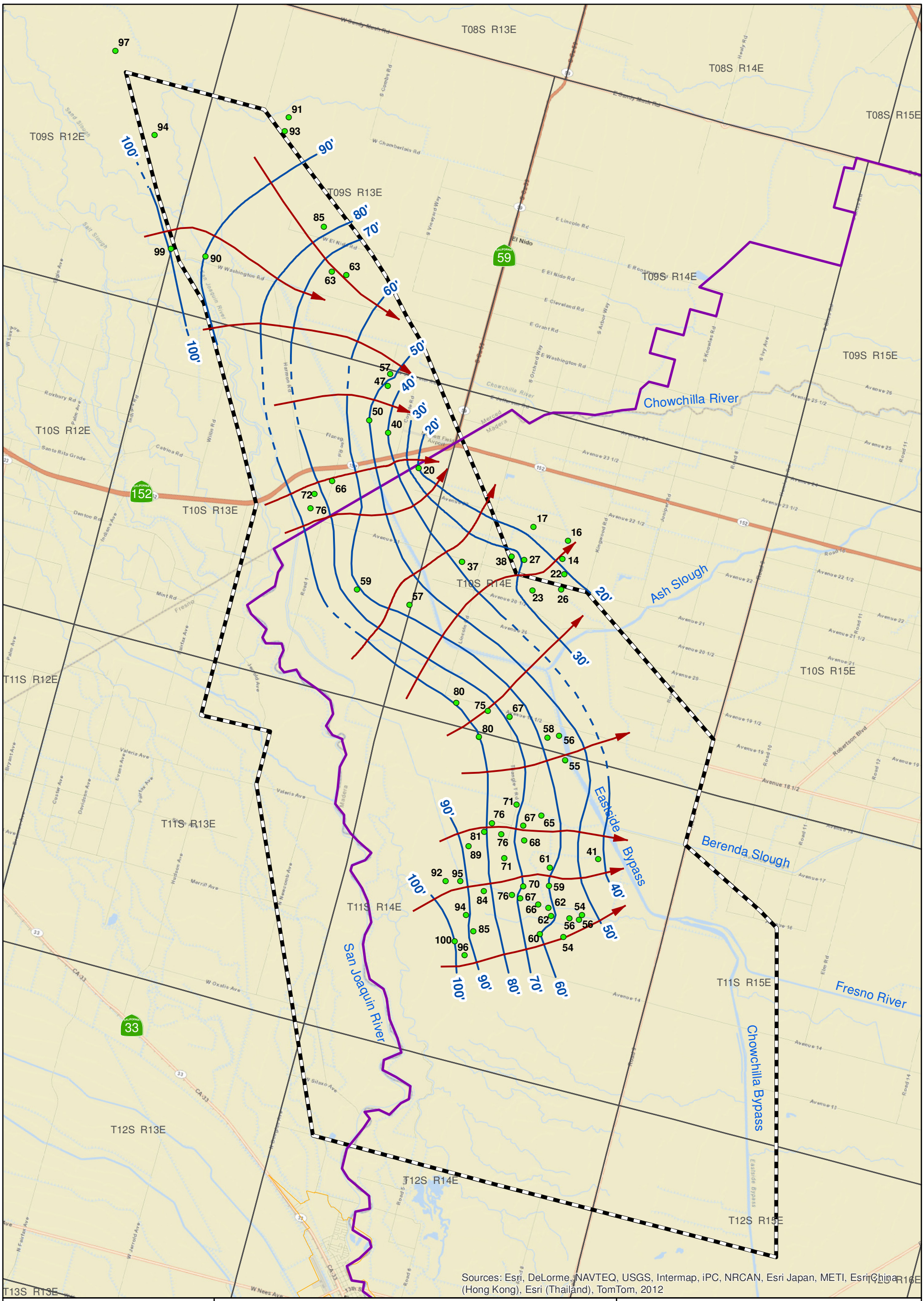
Groundwater Levels in Western Subsidence Area

As part of hydrogeologic studies of the land subsidence in the Red Top area, separate water-level maps for the upper and lower aquifer were prepared for January-February, 2013 (KDSA, 2013). This is the only part of the valley floor area where this has been possible, due to a lack of measurements in deep

wells. Preparation of these maps was based on an intensive private well water-level measurement program that was conducted as part of the subsidence studies.

Figure 1 shows water-level elevations and the direction of groundwater flow in the upper aquifer in the Red Top area in early 2013. The direction of groundwater flow in Madera County was from the San Joaquin River to the northeast. Maps for the upper aquifer for recent years are also available for the Columbia Canal Co. service area. Maps are also available for the Root Creek Water District, which is east of the Corcoran Clay and where one aquifer has been considered to be present. The available maps indicate groundwater flow away from the San Joaquin River and into Madera County, all the way from Little Table Mountain to the east to the Madera-Merced County line on the northwest.

Figure 2 shows water-level elevations and the direction of groundwater flow in the lower aquifer in the Red Top area. In Madera County, groundwater in the lower aquifer was moving from the southwest and south toward a pumping depression south of Red Top. This depression coincides with the area of greatest land subsidence in recent years. This is the only part of the valley floor area in Madera County where a water-level map for the lower aquifer is available. However, limited data indicate that



0 1 2 Miles

Legend

- Well & Water Level Elevation Above MSL (ft)
- Groundwater Flow Direction
- Groundwater Elevation Contours (feet above MSL), dashed where estimated
- Groundwater Management Plan Boundary
- Subsidence Study Area

Source: Madera County AB 3030 Update Report by Ken Schmidt and Associates, December 2013

Madera Regional Groundwater Management Plan

Western Subsidence Area
Upper Aquifer
Groundwater Elevation and Flow Direction
(January-February 2013)

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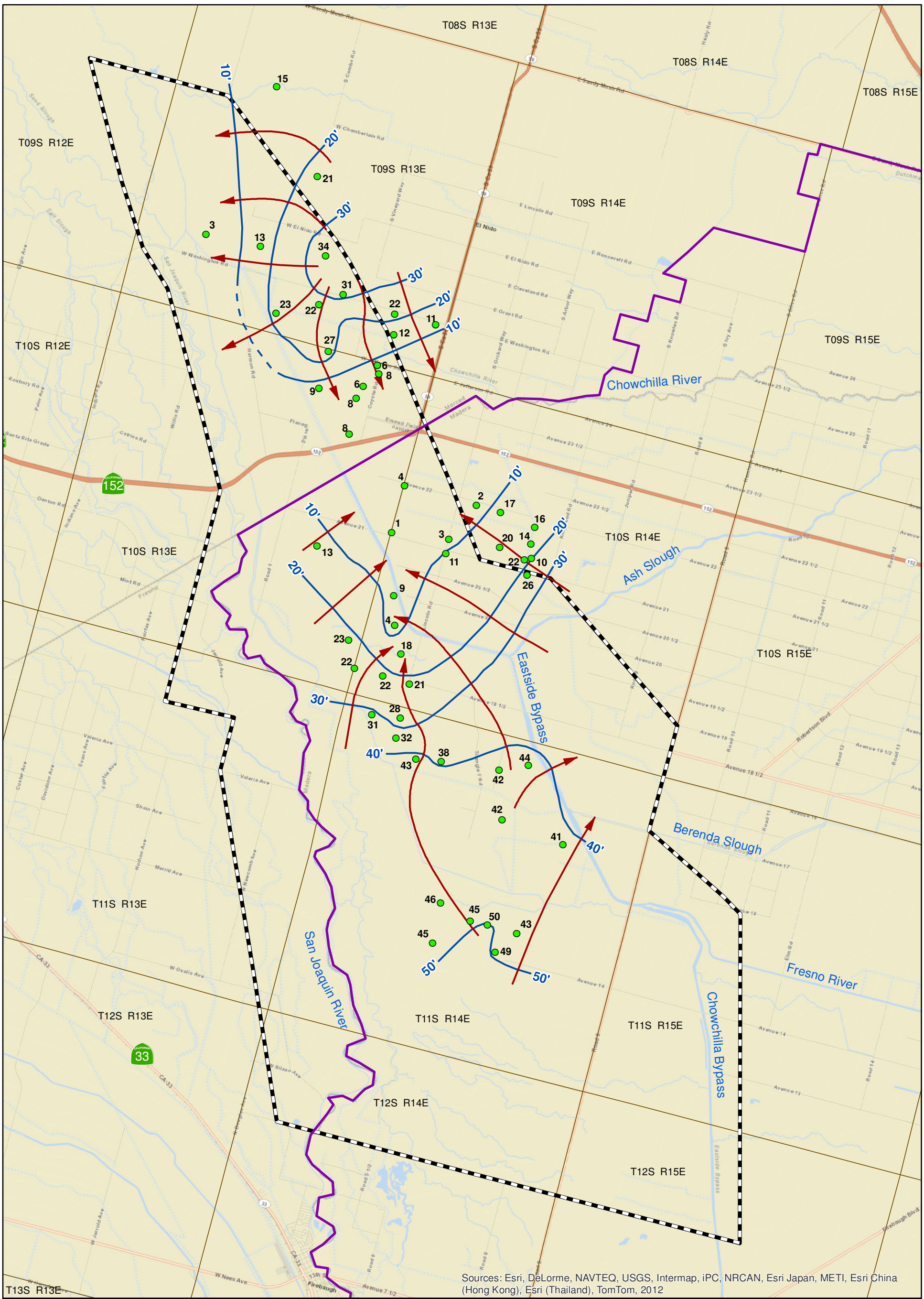
FIGURE 2



0 1 2 Miles

Legend

- Well & Water Level Elevation Above MSL (ft)
- Groundwater Flow Direction
- Groundwater Elevation Contours (feet above MSL), dashed where estimated
- Groundwater Management Plan Boundary
- Subsidence Study Area

Source: Madera County AB 3030 Update Report by Ken Schmidt and Associates, December 2013

Madera Regional Groundwater Management Plan

Western Subsidence Area
Lower Aquifer
Groundwater Elevation and Flow Direction
(January-February 2013)

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east of Mendota, the direction of groundwater flow in the lower aquifer is to the southwest, toward the Westlands Water District.

Water-Level Hydrographs

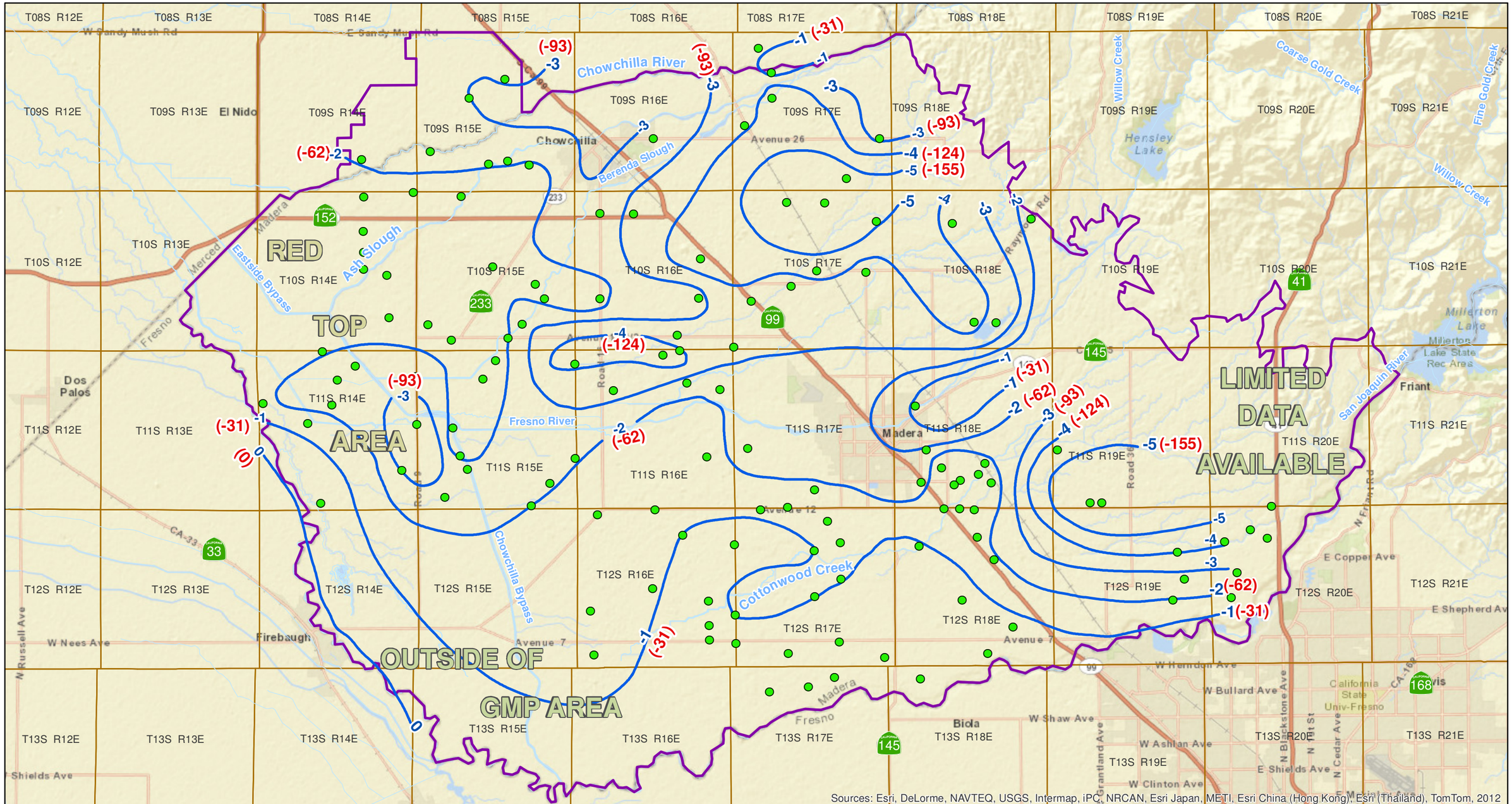
Many modern-day irrigation wells in the area of the westerly cones of depression are perforated opposite both aquifers. The apparent lower levels are partly because the water levels in wells tapping the lower aquifer are lower than those tapping only the upper aquifer. Experience indicates that water levels in composite wells are usually closer to water levels in the lower aquifer than those in the upper aquifer.

Water-level hydrographs are available for the past five decades for hundreds of wells in the valley floor area. Todd Engineers (2002) provided three dozen of these hydrographs in their report for the Madera County AB 3030 program. Most of those hydrographs were for wells in districted areas, where surface water has been available and conjunctive use has been practiced. Much fewer water-level measurements were available for wells in the undistricted areas, particularly in the east part of the valley floor, where the greatest water-level declines are occurring.

As part of the 2008 Madera County IRWMP, KDSA compiled water-

level hydrographs for several hundred wells in the valley floor. These were primarily from the DWR and from the Root Creek WD (RCWD). These hydrographs largely covered the period from 1970 to 2006, and water-level declines determined from them were more representative of recent decades than hydrographs for earlier periods (i.e., prior to the mid-1970's). As part of the present evaluation, as many of these hydrographs as possible were updated through Spring 2011. Long-term hydrographs with reliable trends are available for many wells through Spring 2011. Some measurements are available through 2014, but in order to provide consistent information, data from 1980-2011 were evaluated throughout the area. Attachment A provides representative water-level hydrographs for six areas in the valley floor area.

Figure 3 shows average rates of water-level decline in the valley floor area. These declines were determined by using trend lines for the decline of the shallowest levels each year and another set of lines for the deepest levels each year. The average of these two lines for each hydrograph was used to represent the water-level declines. There has been virtually no water-level decline during the past three decades near the San Joaquin River downstream of Mendota (near the west edge of the valley floor area in Madera County). Water-level declines have averaged about one foot per year farther east, primarily in the



0 2.5 5 Miles

Legend

Groundwater Management Plan Boundary

Wells Used for Analysis

Average Annual Rates of Water Level Decline (Ft), 1980- 2011

(-155) Total Groundwater Level Decline, 1980-2011

Source: Madera County AB 3030 Update Report by Ken Schmidt and Associates, December 2013

Madera Regional Groundwater Management Plan

Average Annual Rates and Total Groundwater Level Declines (Ft) from 1980 to 2011

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area between the Eastside Bypass and the San Joaquin River, and near the San Joaquin River upstream of Mendota. Rates of water-level decline generally increase with increasing distance from the Chowchilla River, the Fresno River, and the San Joaquin River. This confirms the importance of recharge from seepage of streamflow in these rivers. For example, near the Fresno River east of the City of Madera, the average rate of water-level decline has been less than one foot per year. In contrast, the greatest average water-level declines in the valley floor area during the past three decades have exceeded five feet per year. These include large irrigated areas east of the Santa Fe Railroad tracks, where groundwater pumpage supplies the irrigation demand.

The most significant changes in rates of water-level declines for 1980-2011, compared to the 1970-2006 period that was previously evaluated in the 2008 IRWMP, are as follows:

1. A larger area near Madera Ranchos where water-level declines exceeded five feet per year. This is attributed primarily to pumpage for irrigation and little recharge.
2. Smaller rates of decline in the Chowchilla Water District.
3. A larger area between Madera and Chowchilla where water levels have fallen more than three feet per year.

4. Although not shown on Figure 3, there have been substantial water-level declines in the Red Top area during the past five years. Most of the large declines are associated with expanded pumpage from deep wells tapping the lower aquifer. Long-term hydrographs are not available for the lower aquifer for any part of the Madera area, due to a lack of measurements.

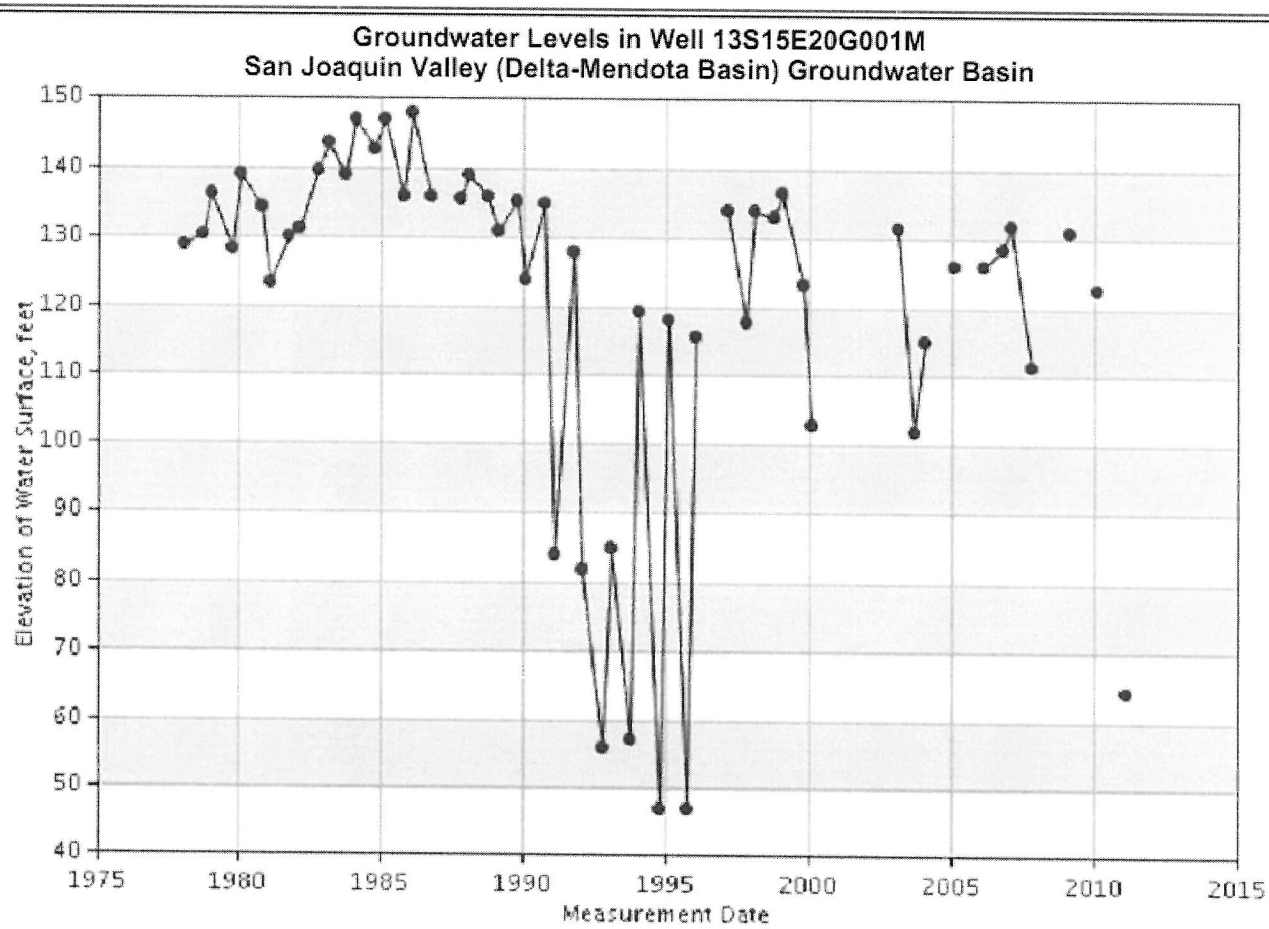
A factor that makes interpretation of recent water-level trends more difficult is the large acreages where orchards have been developed since 2001. In the valley floor area, Provost & Pritchard have determined that about 61,000 more acres of orchards were being irrigated in 2011 than in 2001. A substantial part of this newer acreage is along the western edge of the valley floor area. In some areas, such as the New Columbia Ranch, these crops replaced other crops. When the trees are first grown, they have a relatively low water demand for a number of years, much less than the previous crop demand.

Because of this, the pumpage in some areas has actually decreased in recent years. However, in some other areas where native grasslands have been developed (commonly in the east part of the valley floor area), pumpage has been increased, even when the trees were young.

Other significant areas where new orchards have been developed include the Aliso W.D. and large acreages east of Madera (northeast of the Santa Fe Railroad tracks). The rest of the areas of new orchards since 2001 are generally scattered throughout the valley floor area.

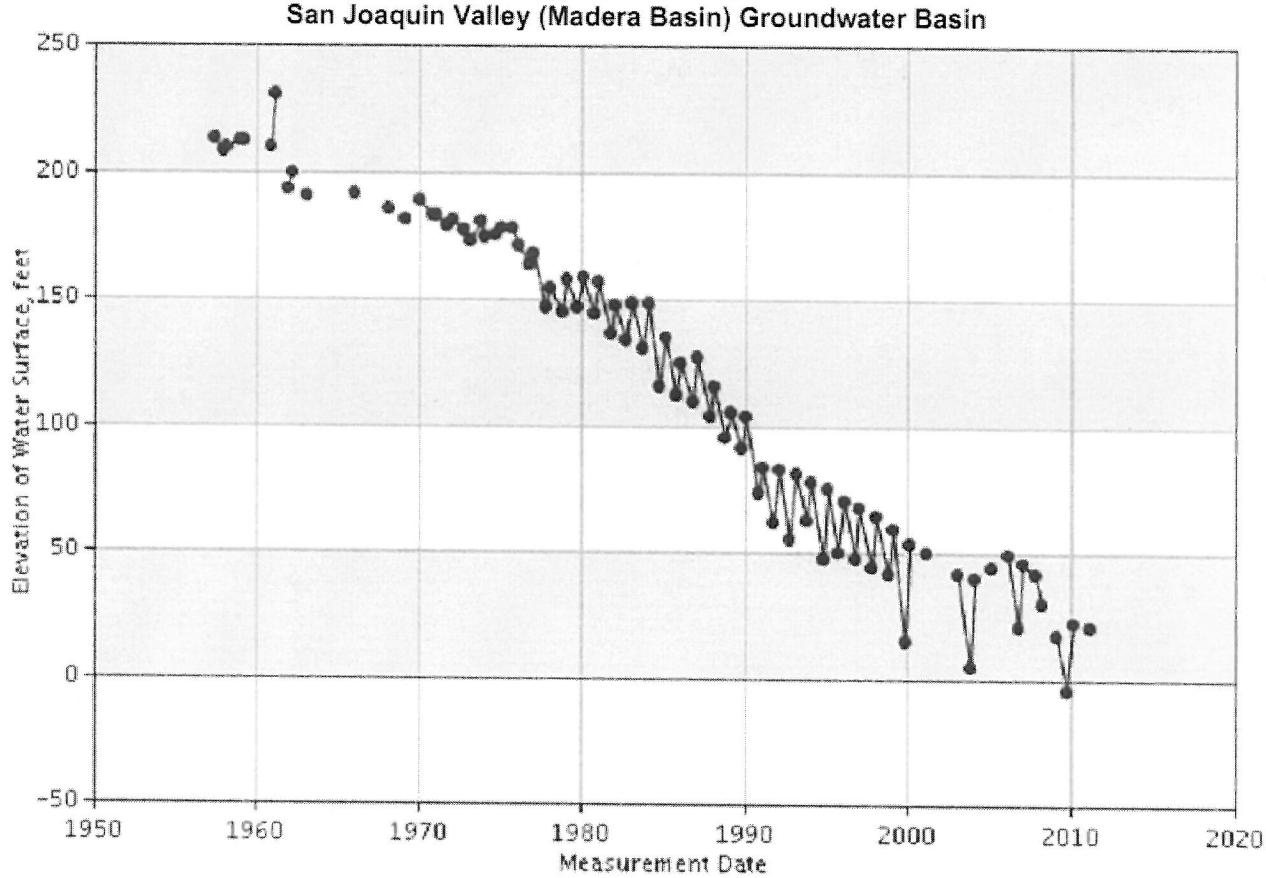
APPENDIX A

REPRESENTATIVE WATER-LEVEL HYDROGRAPHS FOR SUBAREAS



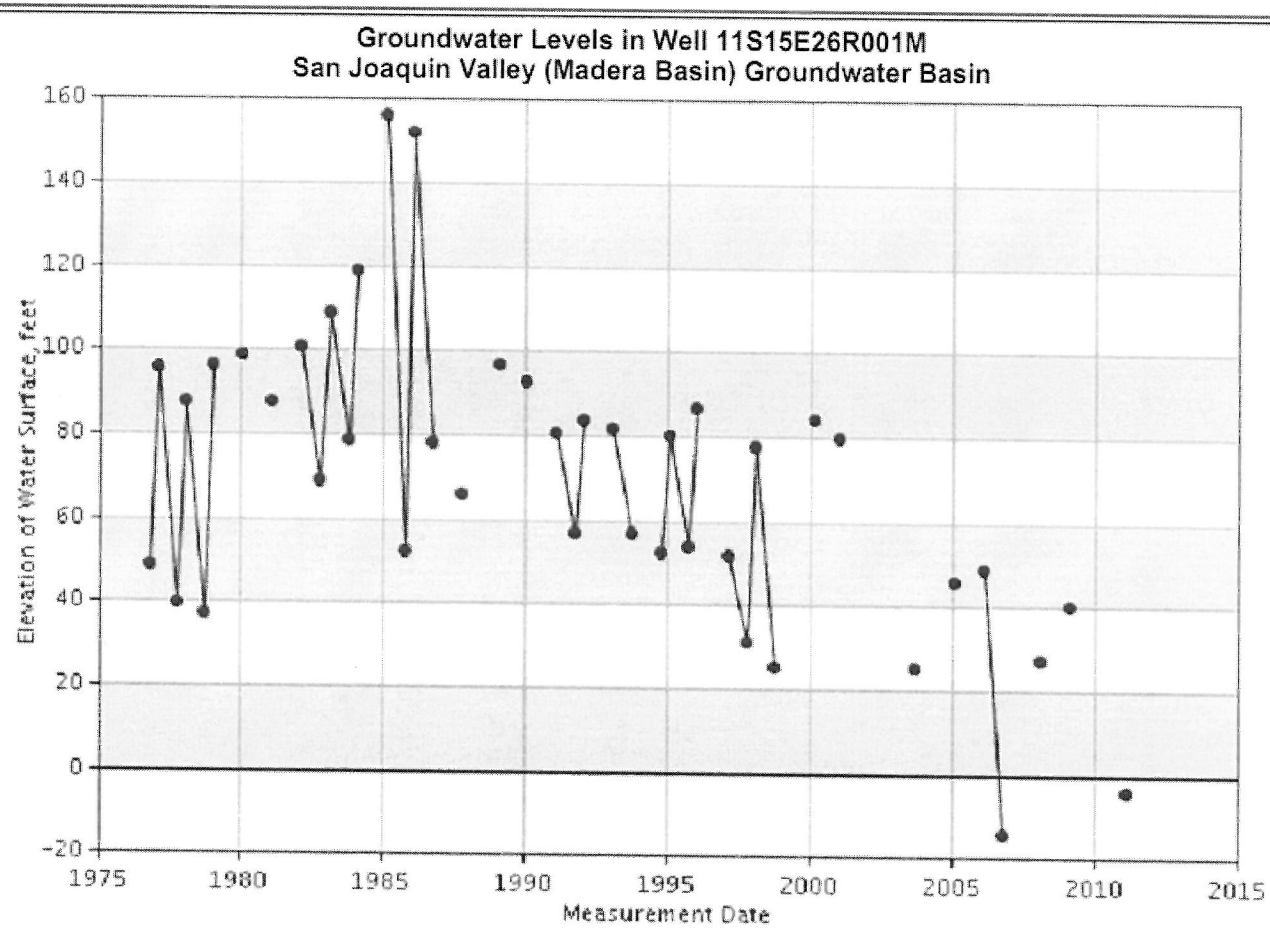
NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Southwest Area



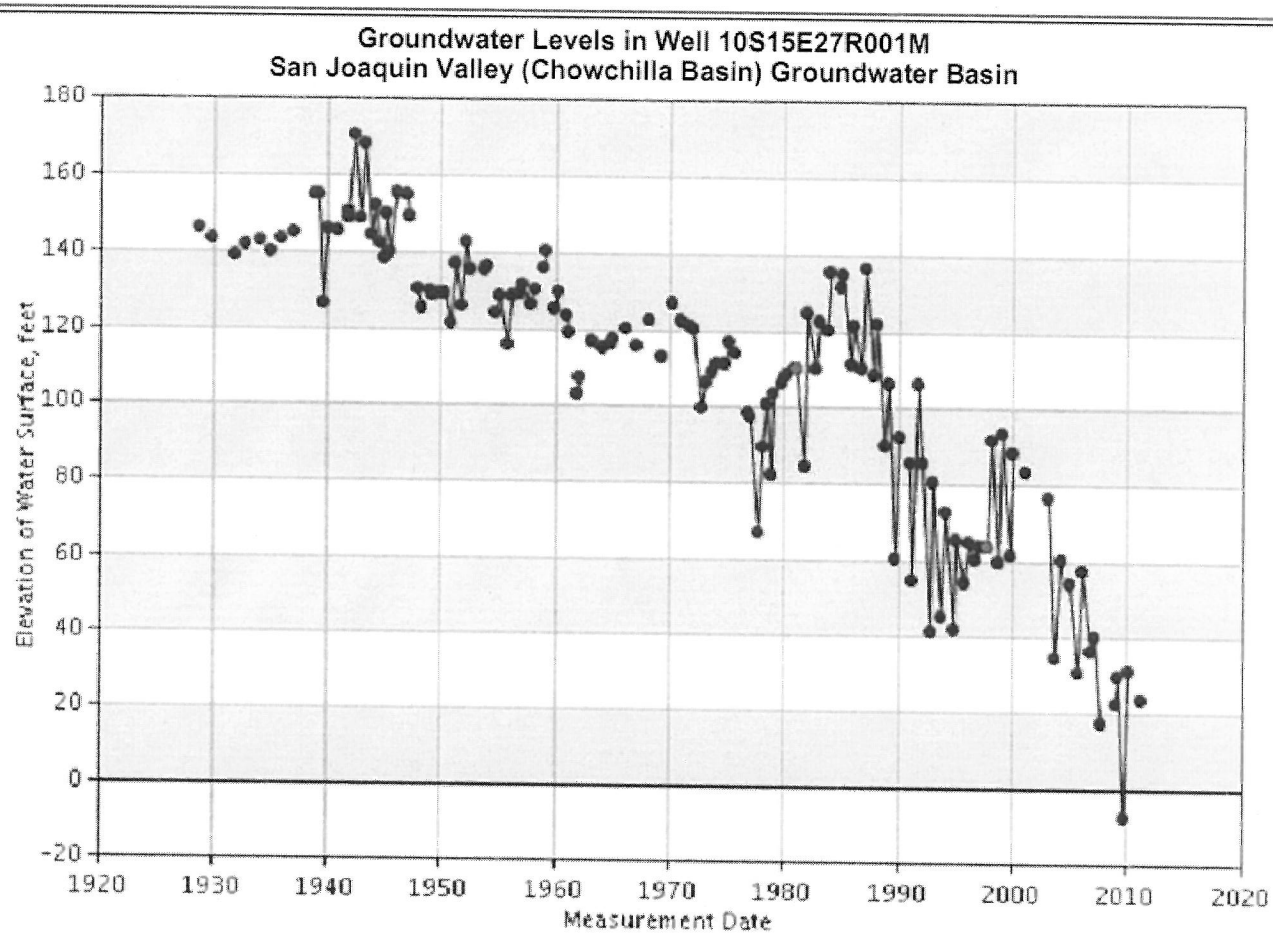
NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Northeast Undistricted Area



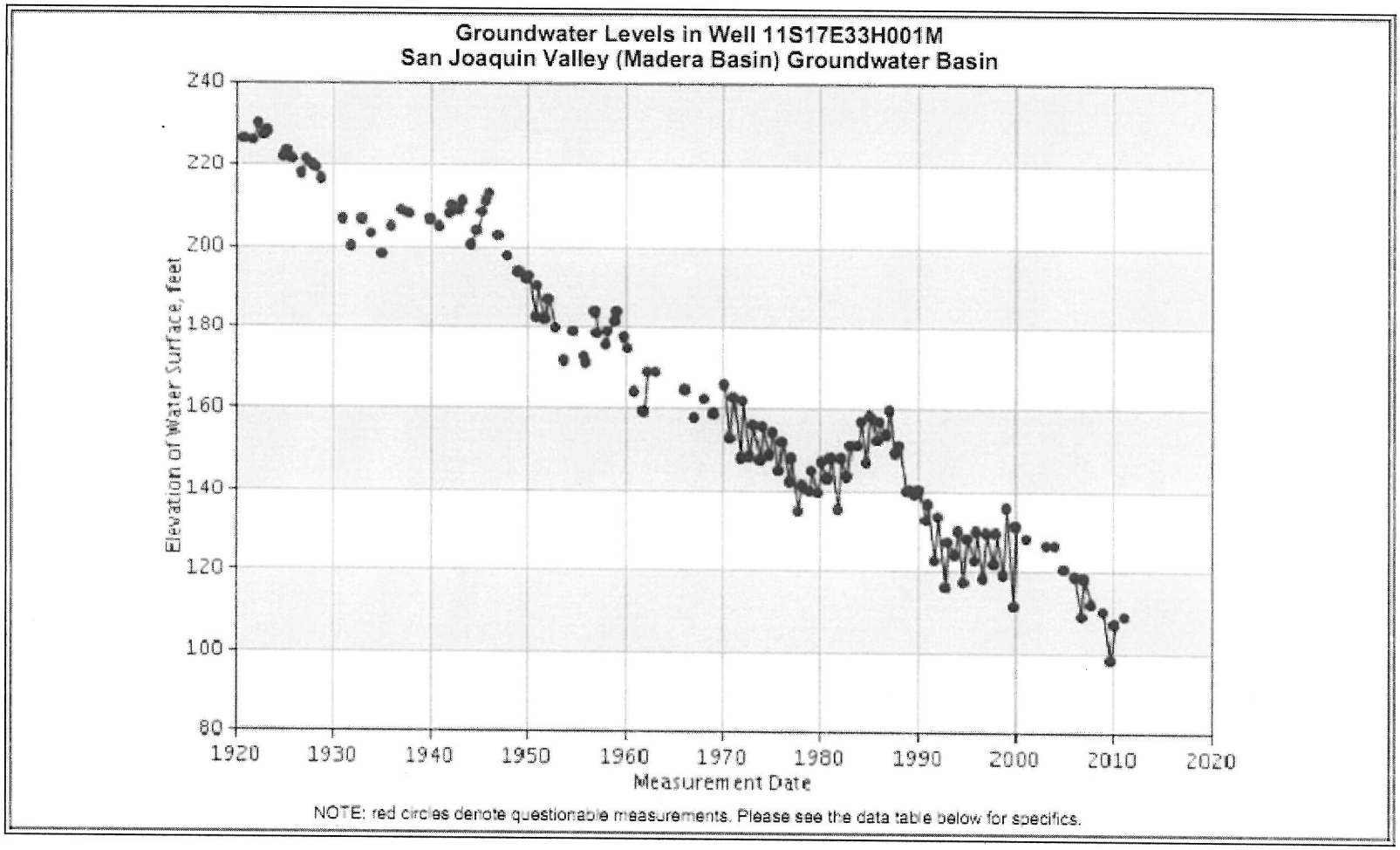
NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Westerly Undistricted Area

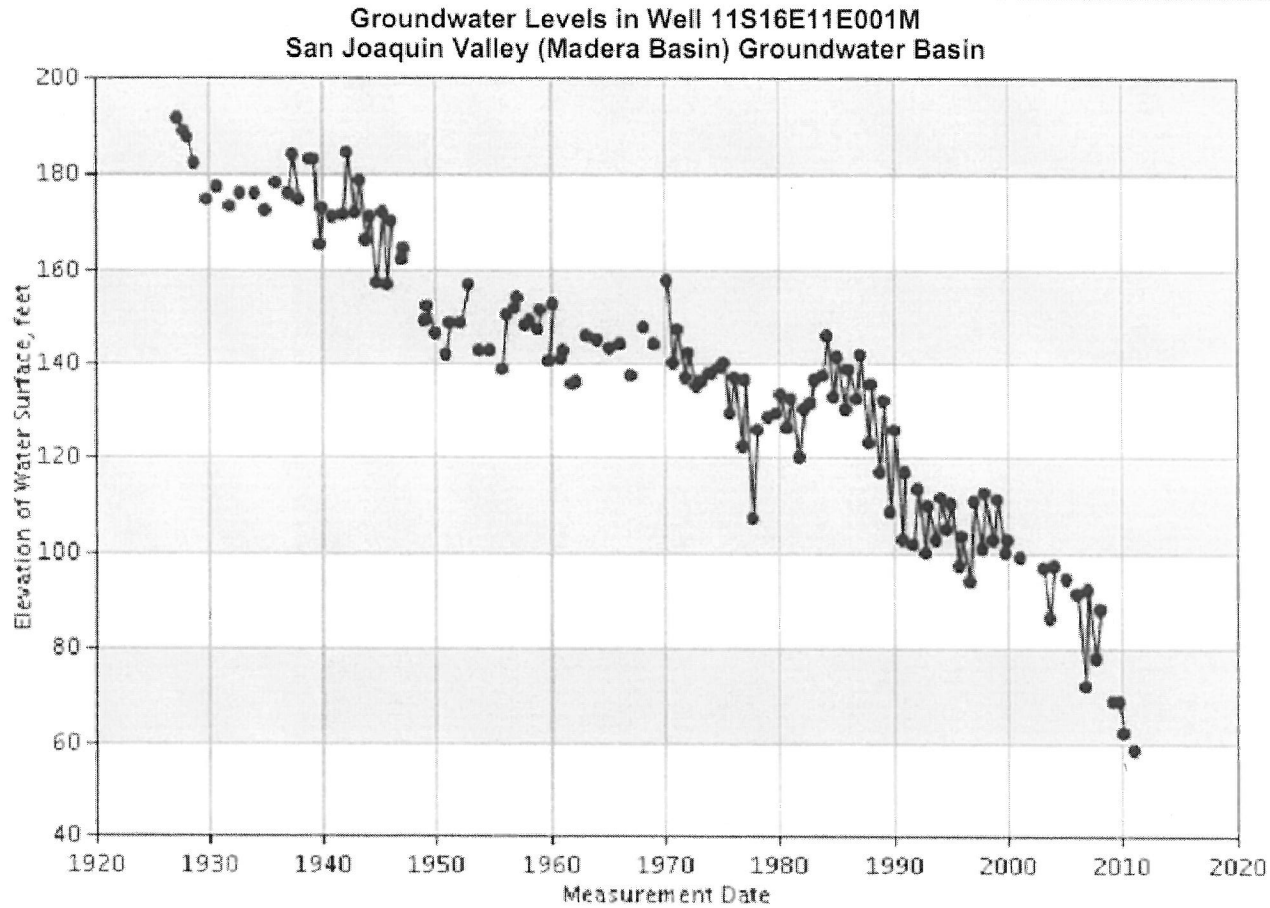


NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Chowchilla Water District

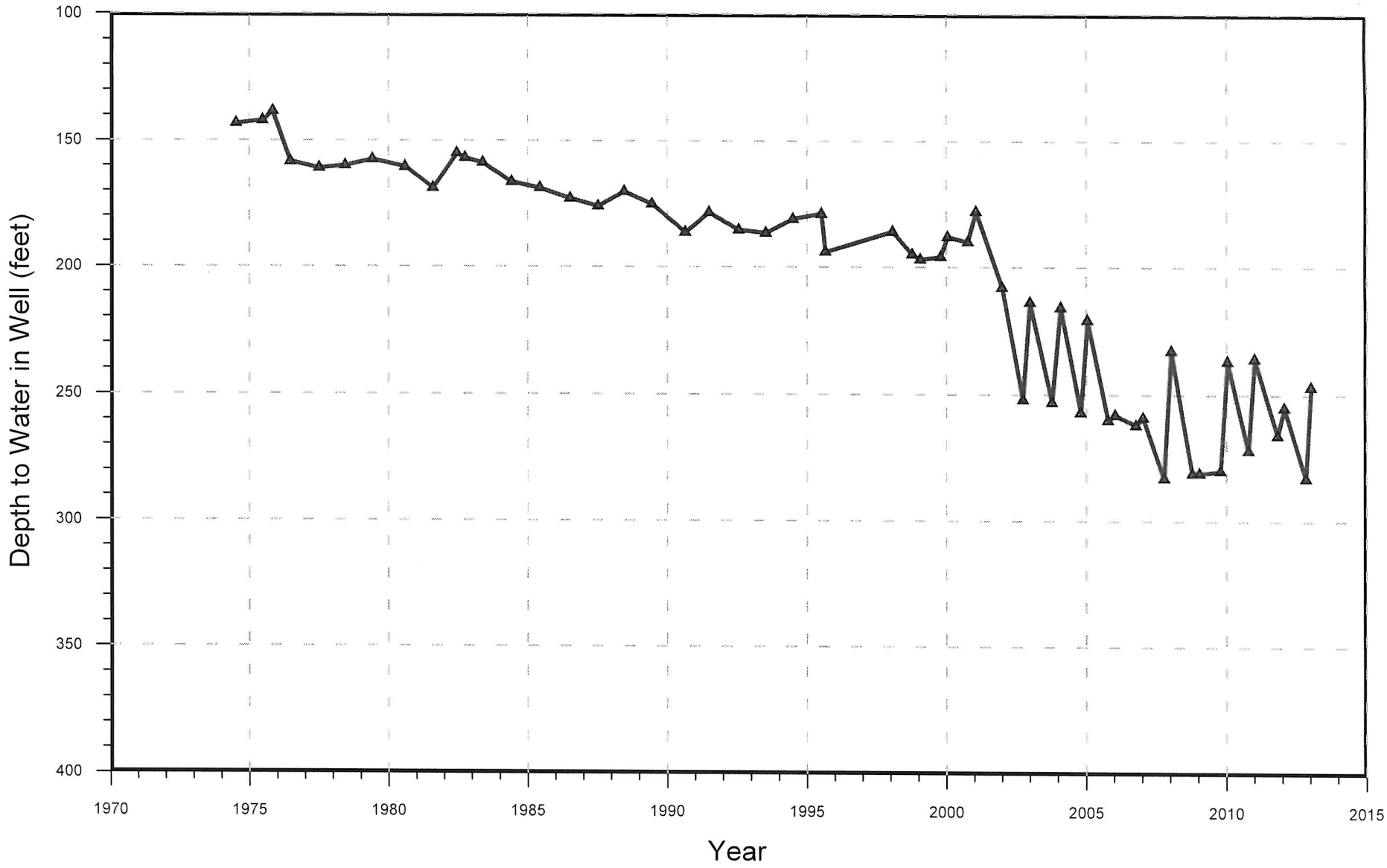


City of Madera
Master Water Plan Area



NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Madera Irrigation District



Root Creek Water District

Well Water Level Hydrograph
Well 12/20 18 J1
Root Creek WD Well #182

MADERA REGIONAL

GROUNDWATER MANAGEMENT PLAN

APPENDIX G – GROUNDWATER EXPORTING AND BANKING REGULATIONS

(COUNTY OF MADERA & MADERA IRRIGATION DISTRICT)

COUNTY OF MADERA

RULES AND REGULATIONS PERTAINING TO GROUNDWATER BANKING AND GROUNDWATER EXPORTS

COUNTY OF MADERA

Chapter 13.100* RULES AND REGULATIONS PERTAINING TO GROUNDWATER BANKING—IMPORTATION OF FOREIGN WATER, FOR THE PURPOSE OF GROUNDWATER BANKING, TO AREAS OF MADERA COUNTY WHICH ARE OUTSIDE OF LOCAL WATER AGENCIES THAT DELIVER WATER TO LANDS WITHIN THEIR BOUNDARIES—EXPORTATION OF GROUNDWATER OUTSIDE THE COUNTY

Sections:

13.100.010 Purpose and intent.
13.100.020 Title.
13.100.030 Definitions.
13.100.040 Lands subject to chapter.
13.100.050 Permits required for exportation of groundwater beyond county boundaries, for groundwater banking, and/or for importation of foreign water for purposes of groundwater banking to areas of Madera County which are outside of local water agencies that deliver water to lands within their boundaries.
13.100.060 Permitting process.
13.100.070 Penalties for violation.
13.100.080 Severability.

13.100.010 Purpose and intent.

A.

Those portions of the county of Madera lying in the floor of the San Joaquin Valley are dependent upon groundwater from the Madera, Chowchilla and Delta-Mendota Groundwater Basins, as delineated by the State Department of Water Resources, for domestic, municipal, industrial, and agricultural purposes. These groundwater basins are severely over drafted and surface supplies of water are imported by the Chowchilla Water District, Columbia Canal Company, Gravelly Ford Water District, Madera Irrigation District and Root Creek Water District to alleviate, to the extent possible, the existing groundwater overdraft. In spite of these importations, the groundwater overdraft still continues.

B.

It is essential to the continued prosperity of the people of Madera County that the quality and quantity of the groundwater supply be maintained to meet the demands of domestic, municipal, industrial, and agricultural users of that supply.

C.

Many areas of Madera County are subject to limited groundwater availability.

D.

Areas of Madera County are or could be or become subject to land subsidence due to the extraction of groundwater.

F.

The direct or indirect transfer of groundwater from Madera County may have significant environmental impacts on Madera County including, but not limited to, increased groundwater overdraft; land subsidence; uncontrolled movement of contaminated groundwater; uncontrolled movement of poor quality groundwater; the lowering of groundwater levels; increased groundwater or soil degradation; and loss of aquifer capacity due to land subsidence.

G.

The direct or indirect transfer of groundwater from Madera County may have significant economic impacts on Madera County including, but not limited to, loss of arable agricultural land; increased pumping costs due to lowered groundwater levels;

increased groundwater quality treatment costs due to movement of contaminated or poor quality groundwater; replacement of wells due to declining groundwater levels, and replacement of damaged wells, conveyance facilities, roads, bridges and other structures due to land subsidence.

H.

The importation of foreign water for the purpose of groundwater banking could, if unregulated, introduce water of an inferior quality into Madera County aquifers, resulting in significant economic and environmental impacts on Madera County, including, but not limited to degradation of groundwater quality, loss of storage capacity for passive recharge, damage elating to high or fluctuating water levels such as drainage problems, crop damage, or damage to building, facility, or well, and other applicable impacts specified in subsections F and G of this section.

I.

Groundwater banking can be reasonable and beneficial if it can be accomplished without:

1. Causing or increasing an overdraft of groundwater underlying the county;
2. Adversely affecting the ability of other groundwater users to use, store, or transmit groundwater within any aquifer(s) underlying the county (for example by utilizing storage that might otherwise be subject to natural or passive recharge and thus depriving other groundwater users of their use of the aquifer and the groundwater derived therefrom);
3. Adversely affecting the reasonable and beneficial uses of groundwater by other groundwater users within the county;
4. Resulting in, expanding, or exacerbating degradation of the quality or quantity of surface or groundwater within Madera County, or groundwater basins and aquifers within Madera County;
5. Resulting in injury to a water replenishment, storage, restoration, or conveyance project or facility;
6. Adversely affecting the surface or subsurface of neighboring or nearby lands, or the trees, vines, or crops growing or to be grown thereon;
7. Adversely affecting the economy or environment of the county; or
8. Adversely affecting the storage ability on adjacent lands where passive recharge may take place.

J.

For groundwater banking projects all or a portion of which will be located within areas of the county of Madera which are outside of the boundaries of a local water agency or an incorporated city, it is essential that the county of Madera be the agency that determines whether a permit should be issued to allow groundwater banking within such areas (but without reflecting the right of such a local water agency or incorporated city to determine whether to issue a permit for groundwater banking within the boundaries of such agency or city). Without permit process which allows public notice, public hearings, and compliance with environmental and other appropriate requirements, there would be no or inadequate local control over such groundwater banking, nor a method to insure that groundwater banking will meet the requirements of subsection I of this section.

K.

In the absence of regulation by such local water agencies, the county of Madera should exercise its police power to protect the public health, safety, and welfare of the county and its various areas by adopting reasonable regulatory measures in relation to exportation of groundwater, groundwater banking, and the importation of foreign water for the purpose of groundwater banking. The purpose of this chapter is to provide Madera County with the regulatory controls over the exportation of groundwater, groundwater banking, and the importation of foreign water for the purpose of groundwater banking.

L.

Local water agencies (as defined below) within the county have a long term water supply (as defined below) to enable them to deliver a reliable supply of surface water to lands within their boundaries, and have adopted groundwater management plans which may include groundwater banking within their boundaries. Such local water agencies therefore control groundwater banking as a part of the integrated management of both groundwater and surface water resources within their boundaries. Such local agencies, being public agencies, are governed by various statutes and regulations, including CEQA, that assure that all decisions of the governing body regarding matters affecting groundwater will take into account the environmental effects, both within and outside of its boundaries, of any proposed project that is to take place within its boundaries. This insures that any groundwater banking permitted within the boundaries of those agencies will not adversely affect the groundwater supply or damage neighboring lands' groundwater extractions, or the environment. The decision of whether or not to permit groundwater banking within the boundaries of such agencies should be left in the hands of the elected officials thereof who have close knowledge of the surface and groundwater supplies within the boundaries of the respective agencies and are in the best position to allow groundwater banking within their boundaries. This chapter, therefore, shall apply only to lands within the county of Madera that overlay the Madera, Chowchilla, or Delta-Mendota Groundwater Basins, but which are outside of the boundaries of a local water agency or an incorporated city.

M.

The purpose and intent of this chapter is not to usurp, hinder, or infringe upon the authority of the local water agencies and their elected officials, to carry out their responsibilities to their constituents.

1.

Further, it is clearly understood that such local water agencies engage in groundwater recharge both directly and indirectly as a normal operational procedure. Nothing in this chapter shall be interpreted as allowing the county or anyone else to prohibit or hinder such local water agencies' groundwater recharge operations to benefit their constituents.

2.

Further, it is clearly understood that such local water agencies routinely import water into the county. Nothing in this chapter shall be interpreted as allowing the county or anyone else to prohibit or hinder the local water agencies' importation of water to benefit their constituents.

N.

The direct injection of water into an underground aquifer results in an unreasonable risk of contamination of such aquifer without adequate ability to safeguard the aquifer. Accordingly, the direct injection of water into an underground aquifer shall not be permitted.

(Ord. 573B § 1(part), 2001).

13.100.020 Title.

The title of this chapter shall be "Rules and Regulations Pertaining to Groundwater Banking—Importation of Foreign Water, for the Purpose of Groundwater Banking, to Areas of Madera County Which Are Outside of Local Water Agencies That Deliver Water to Lands Within Their Boundaries—Exportation of Groundwater Outside the County."

(Ord. 573B § 1(part), 2001).

13.100.030 Definitions.

The terms used in this chapter have the following meanings, unless otherwise expressly provided:

"Board" shall mean the Madera County board of supervisors.

"Damage prevention plan" means a written plan which specifically details the problems that may occur as a result of the operation of the project, how such anticipated problems were identified and analyzed, and details what actions will be taken by the applicant to mitigate or eliminate the problems in order to prevent damage to the site, surrounding properties, he public, and/or the water resources of Madera County.

"Emergency action plan" means a written plan which provides a complete and detailed evaluation of potential project failures that can occur during operation of the project and which details what actions the applicant will take to prevent or minimize damage to the project and protect the public and surrounding properties, and/or the water resources of Madera County. The plan will also provide details of corrective actions that applicant will take if any such damage occurs.

"Exportation of groundwater" means the extraction of groundwater from any well within the boundaries of the county and located on or under lands subject to this chapter and used on lands which are outside of the boundaries of the county, unless the lands on which the water is being used are contiguous to the lands where the water is extracted, and are owned by the same landowner. Exportation of groundwater also includes activities by which groundwater (or surface water or groundwater for which such groundwater is or may be exchanged or that may be used to replace such groundwater) will or may be, through one or more exchanges or transactions (including subsequent groundwater banking), directly or indirectly transferred out of the county.

"Foreign water" means water originating outside of Madera County, whether or not conveyed through or pooled with facilities located in or adjacent to Madera County, which is imported into Madera County for purposes of groundwater banking.

"Groundwater" means water located beneath the land surface that fills the pore spaces of the alluvium, soil, or rock formation in which it is situated.

"Groundwater banking" means the importation of a surface supply of water that is percolated into the subsurface for storage, or placed underground by means of in-lieu recharge, for later extraction by any person, unless the board, on application in such form and according to such procedures as shall be adopted by the county engineer, issues a certificate of exemption. A certificate of exemption shall be issued if the information and supporting documentation show to the reasonable satisfaction of the board that the water to be extracted shall only be delivered, and ultimately used, solely within Madera County. If the percolated or recharged groundwater (or surface water or groundwater for which such groundwater is or may be exchanged or that may be used to replace such groundwater) will or may be, through one or more exchanges or transactions (including subsequent groundwater banking), directly or indirectly transferred out of Madera County, then no certificate of exemption shall be issued. For purposes of determining whether extracted water is delivered and used solely within Madera County, the transfer out of Madera County of less than an amount equal to one percent of a person's annual surface water entitlement, due to the normal operating practices of such person, shall not be taken into account. Consideration of the application for a certificate of exemption shall be contingent upon:

1. The applicant's payment of such fees as are or may be established and/or modified by resolution of the board for processing the application for a certificate of exemption.

2.

The applicant's written agreement, in the form provided by the county engineer, to reimburse the county for all fees and costs of engineering, hydrogeological, legal, and other consultants engaged by the county for the purpose of assisting the county in reviewing, evaluating and processing the application for a certificate of exemption, and in monitoring the project to confirm that it is continuing to comply with the terms of the certificate of exemption.

3. The applicant's agreement, in the form provided by the county engineer, to provide such periodic reports, and such supporting data, as may be required by the county engineer to confirm compliance with the terms of the certificate of exemption.

Notwithstanding any of the foregoing, recharge attributable to normal and customary farming and irrigation practices, and the extraction of such recharged water solely for irrigation on overlying lands, is not groundwater banking and no certificate of exemption shall be required for such activities. A certificate of exemption is not evidence of a groundwater or other right, but only evidences exemption from the permit requirements of this chapter. The use of groundwater by a party holding a certificate of exemption remains subject to the state and other laws and regulations applicable to groundwater generally.

"Groundwater management plan" means a groundwater management plan adopted pursuant to California Water Code section 10750 et seq.

"Local water agency" means a district or other public agency, a majority of the acreage of which, as of July 11, 2000, was located within Madera County, that has as its primary function the supplying of water for domestic, agricultural, industrial, or municipal purposes to lands within their boundaries, that had, as of July 11, 2000, a long term water supply, and that had adopted as of July 11, 2000 a groundwater management plan (directly or through a joint powers owners authority of which it is a party, and whether or not such plan is subsequently modified, terminated, or rescinded). For purposes of this chapter, the boundaries of a local water agency shall mean, and all provisions applicable to any exemptions for the operations of such an agency shall be fully applicable within, the boundaries of such agency as they existed as of July 11, 2000. For purposes of this chapter, "long term water supply" means a contract between the local water agency and the United States Bureau of Reclamation for a Class I supply of irrigation water, or such other surface supply that the board may determine, on application by an affected district or other public agency, as having equivalent or better permanence and reliability.

"Operations and maintenance plan" means a written plan which provides complete details of how the applicant plans to operate and maintain the project, including any conveyance facilities, after construction is completed, including but not limited to the sources, quantities and qualities of water to be imported, used for recharge, extracted, and/or exported. This plan must show which entity or entities will assume the responsibility for the operation and maintenance of the project, how such responsibility will be shared; and for each such entity provide an organizational chart detailing the job responsibilities of each position shown.

"Person" means an individual, general or limited partnership, limited liability company, corporation, unincorporated association, public agency, or other form of public or business entity.

"Plans and specifications" means written and detailed plans and specifications, in such format and subject to such requirements as may be established and/or modified from time to time by the county engineer. All plans and specifications shall contain certification stamps of a California registered civil engineer and, where applicable, a California certified hydrogeologist.

"Project monitoring plan" means a written plan which details how the applicant will monitor the surface and subsurface of the project site and of properties outside of the project boundaries for possible-impacts from operation of the project, including but not limited to locations, frequencies, and methods for monitoring ground subsidence, groundwater levels and quality, and for monitoring quantity and quality of imported and extracted water.

"Project plans" means the damage prevention plan, emergency action plan, operations and maintenance plan, project monitoring plan, project water measurement and water loss accountability plan, rehabilitation plan, and safety action plan.

"Project water measurement and water loss accountability plan" means a written plan which details how water into and out of the project will be measured and how the applicant plans to calculate or otherwise account for project water losses. The plan must provide details of what types of measuring equipment will be used on the project, where it will be installed, and how it will be calibrated and maintained.

"Rehabilitation plan" means, and shall consist of, (1) a statement of planned rehabilitation after the project terminates including methods of accomplishment and timing and how rehabilitation of the site may affect future uses of the property and surrounding areas, (2) a detailed site plan showing the rehabilitation proposal including new contouring, (3) a soil salvage plan and, if refill is proposed, the sources thereof, (4) a schedule to accomplish the rehabilitation work, and if applicable the phases thereof, (5) the disposition of any equipment or structures, (6) the security to be provided by the applicant to the county to assure performance of the obligations under the rehabilitation plan.

"Safety action plan" means a written plan which provides details of all project safety requirements, including those needed to protect the public and surrounding properties. It shall also provide information on which entity or entities will be responsible for implementing the safety requirements for the project, how such responsibility will be shared, and for each such entity provide an organizational chart detailing the job responsibilities of each position shown.

(Ord. 573B § 1(part), 2001).

13.100.040 Lands subject to chapter.

This chapter shall be applicable to all unincorporated-area lands in the San Joaquin Valley floor of the county of Madera which overlay the Madera, Delta-Mendota and Chowchilla Groundwater Basins as delineated by the State Department of Water Resources and which are located outside of the boundaries of (1) a local water agency or (2) an incorporated city. If a portion of a groundwater banking project (or other project to which this chapter applies) lies within such an agency or city, and a portion lies outside the boundaries of such an agency or city, then this chapter shall apply to that portion that lies outside the boundaries of such an agency or city, and such agency or city shall have full authority as to that portion that lies within the boundaries of that agency or city.

(Ord. 573B § 1(part), 2001).

13.100.050 Permits required for exportation of groundwater beyond county boundaries, for groundwater banking, and/or for importation of foreign water for purposes of groundwater banking to areas of Madera County which are outside of local water agencies that deliver water to lands within their boundaries.

A.

Except as otherwise provided in this chapter, no person shall engage in (1) the exportation of groundwater, (2) groundwater banking, (3) importation of foreign water, for purposes of groundwater banking, or (4) any combination of these activities, on or under land subject to this chapter without first obtaining a permit to do so pursuant to the terms and procedures of this chapter.

B.

While engaging in their normal and/or historical operation of serving their constituents, local water agencies are specifically exempted from the requirements of subsection A of this section, with respect to such operations.

C.

A single permit may be issued under this chapter for one or more of the activities listed in subsection A of this section, provided that the permit holder shall be authorized to engage only those activities or combination of activities specifically authorized by the permit. A permit that authorizes the importation of foreign water shall be limited to importation from the sources entitled and any importation from other sources is prohibited unless a new or amended permit granted for such importation.

(Ord. 573B § 1(part), 2001).

13.100.060 Permitting process.

A.

Application for Permit. Applications for permits under this chapter shall be made to the county engineer on forms provided by the county engineer and shall contain all information and reports required therein. An application shall be accompanied by a hydrogeologic report ("report") and project plans prepared at the applicant's expense by a qualified California Registered Civil Engineer and a California Certified Hydrogeologist, versed in geologic, hydrogeologic, and hydrologic investigations, which describes hydrogeologic conditions at and in the vicinity of the project site as well as details regarding the proposed project. The report and project plans shall include detailed plans and specifications of all project facilities. The report and project plans shall contain the certification stamps of the California registered civil engineer and the California certified hydrogeologist responsible for their preparation. The report and project plans shall comply with all requirements, and shall be such format(s), as may be established and/or modified from time to time by the county engineer, and shall include, but not be limited to, the following items as deemed applicable by the county engineer:

1. The sources of all water to be explored;
2. The quantity and quality of all water proposed to be exported;
3. The locations to which and purposes for which all water is to be exported, including the reasonable and beneficial uses to which the water is to be put;
4. The geologic and hydrologic properties of the aquifers from which all extraction will be made and/or into which recharge will occur and from which extraction will be made, including possibilities or likelihood of subsidence problems;
5. Percolation tests to determine the ability of the aquifer(s) to recharge;
6. An investigation of the vadose zone that evaluates the geologic and hydrologic properties of the soils and subsurface sediments above the water table (including but not limited to clay layers and their effect on percolation), storage capacity, and soil chemistry (including but not limited to the potential for leaching of soil constituents or impacts to vadose zone soils from imported water);
7. The location, size, spacing and depths of all extraction wells;
8. Migration of groundwater from surrounding locations and anticipated changes in groundwater migration as a result of the project;
9. The effect on surrounding lands and their groundwater supplies, including but not limited to impacts on groundwater levels and flows, groundwater quality and quantity, and surface water/groundwater interactions and the water balance of potentially affected areas;
10. The location, plans, and specifications of the proposed project;
11.

The quantity of all water proposed to be imported, and the quality standards thereof, including potential for contamination or degradation problems and/or compatibility problems with the receiving waters or vadose zone soils;

12.

The quality and quantity of all groundwater to be extracted;

13.

Design of spreading areas;

14.

The methods of placement and storage of the water;

15.

The sources of all water to be imported;

16.

The quantity and quality of all water proposed to be imported;

17.

The manner in which all water is to be conveyed to the groundwater banking facility, including the specific location of all conveyance facilities, and copies of all permits and agreements showing consent for the use of such conveyance facilities (provided, however, that any consents that may not be granted without an EIR under the California Environmental Quality Act or an EIS under the National Environmental Protection Act may be provided after compliance with such requirements provided that in all events such consents shall be provided within sixty days after the EIR required under subsection C of this section is certified);

18.

The physical, and where applicable the geologic and hydrologic, properties of all conveyance facilities, including possibilities or likelihood of contamination or degradation problems;

19.

The effect on lands surrounding or neighboring all conveyance facilities and on their groundwater or surface water supplies;

20.

The effect on all other water supplies into which all proposed foreign water may be commingled while being conveyed, such as in a pool or reservoir;

21.

The applicant's damage prevention plan;

22.

The applicant's emergency action plan;

23.

The applicant's operations and maintenance plan;

24.

The applicant's project monitoring plan;

25.

The applicant's project water measurement and water loss accountability plan;

26.

The applicant's safety action plan;

27.

The applicant's rehabilitation plan;

28.

Such other matters as the county engineer may require in order to properly evaluate the project and its potential impacts;

29.

An agreement ("reimbursement agreement"), in the form as may be established and/or modified from time to time by the county engineer, executed by the applicant agreeing to reimburse the county for all consultant fees and other costs as provided in subsection B of this section;

30.

A letter of credit, bond, or other form of security, as specified by, and in such form and amount as shall be required by, the county engineer to secure the reimbursement of costs and expenses provided for in the reimbursement agreement.

All technical interpretations, analyses and/or conclusions shall be accompanied by all supporting data used in connection therewith. The applicant shall provide as many copies of the application, report, and other information submitted as may be requested by the county engineer.

The application shall not be deemed received by the county until each of the foregoing items is provided.

B.

Payment of Fees and Reimbursement of County Consultant and Other Costs. The applicant at the time of filing shall pay such fees as are or may be established and/or modified by resolution of the board for processing the application and the giving and publication of required notices. The applicant shall also reimburse the county for all fees and costs of engineering, hydrogeological, legal, and other consultants engaged by the county for the purpose of assisting the county in reviewing, evaluating and processing the application, and the fees and costs for any environmental investigations, reviews and reports done by or on behalf of the county in connection with the preparation of the EIR or otherwise in compliance with the California Environmental Quality Act.

C.

Environmental Impact Report. An application for a permit under this chapter is deemed to be a "project" under the California Environmental Quality Act ("CEQA") and its implementing regulations ("CEQA Guidelines"). In order to ensure that decision-makers have sufficient information on the potential impacts of such a project, the preparation and identification of an Environmental Impact Report ("EIR") is required for each such project application. The EIR must conform to CEQA, CEQA Guidelines, and all county requirements. The EIR shall be prepared in accordance with the county's CEQA implementation procedures and the county shall be the lead agency for the preparation thereof. As set forth in subsection B of this section, the fees and costs incurred in connection with the preparation of the EIR shall be paid by the applicant.

D.

Additional Studies and Requirements. If, after accepting the application referred to in subsection A of this section, the county engineer or the county planning director desires more information in order to comply with the requirements of the California Environmental Quality Act, he or she may require the applicant to provide that information, including, but not limited to, the preparation by or on behalf of applicant, applicant's expense, of any additional geologic, hydrogeologic, or hydrologic studies, or other information or studies, that he or she deems reasonably necessary to obtain information needed in order to make a recommendation on the application. Furthermore, at any time after accepting the application the county engineer may, in the course of processing the application, require the applicant to clarify, amplify, correct, or otherwise supplement the information

required for the application. At any time and from time to time, the county engineer may review the application with other potentially affected county departments, with the staff of applicable state and federal agencies and with all local agencies. The county engineer shall submit the application and all supporting documents to the water advisory commission for review and recommendations at a regular noticed hearing, before presenting the application for final review by the board as provided elsewhere in this section.

E.

Review of Application. Copies of the application, report, environmental impact report, and any additional studies and other information required under subsection D of this subsection, shall be forwarded by the county engineer to the county environmental health department, and to other affected county departments, including, but not limited to, the agricultural commissioner and planning director, and other permitting agencies, for review and comments. The county engineer shall coordinate his or her review of the project, to the extent practicable, with other permitting agencies having jurisdiction over any aspect of the project. After all reviews have been made, and all comments have been received, the county engineer shall prepare a written report with all comments attached thereto (the "county engineer's report"), in which he or she either shall recommend denial of the permit, or granting the permit. Any recommendation to grant the permit shall also contain any recommended conditions for the project and the permit. The county engineer's report also shall include recommendations from the planning director concerning the adequacy of the EIR. All documents shall be filed with the clerk of the board.

F.

Notice to Landowners. Upon the filing of an application with the county engineer, the county engineer shall give written notice to all owners of lands located within six miles of the exterior boundaries of the proposed project site, setting forth the name of the applicant, a description of the project, a description or map of the land involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the county engineer. In the case of an application for a permit to export groundwater, the project site shall mean the entire landholding (whether resisting of one or more parcels in common ownership) upon which any well or other extraction facility is to be located, and all conveyance facilities to be used to convey such water from the extraction site to the Madera County border. In the case of the importation of foreign water for purpose of groundwater banking, the project site consists of both the groundwater banking project site, and all conveyance facilities to be used to convey such imported water from the Madera County border to the groundwater banking project site. In addition thereto, the county engineer shall cause to be published pursuant to Government Code §§ 6060 and 6061.3 notice that the application has been filed, setting forth the name of the applicant, a description of the project, a description or map of the land involved, and a statement that all documents in connection with the application are public records subject to inspection at the office county engineer. The county engineer shall retain one copy of the application documents, EIR, and any comments or reports thereon and make them available for public inspection and copying in accordance with the public records act.

G.

Noticed Public Hearing. No permit shall be issued without a noticed public hearing before the board pursuant to Government Code §§ 6060 and 6061.3. The notice shall be given by the clerk of the board after completion and filing of the county engineer's report and the environmental review process. The notice shall specify the time and place of the hearing, a description of the project site (as determined under subsection F of this section) and a general description of the project, and a statement that any interested person may submit evidence at the hearing. At least fifteen days must elapse between filing the documents with the clerk of the board and the date of the hearing.

H.

Procedures for Conducting Hearing. At the hearing, the application, report, environmental impact report, additional submittals, comments from county departments and state, regional, or federal permitting agencies, and the county engineer's report shall become evidence. The applicant and members of the public, or their representatives, may testify and introduce evidence in favor of, or in opposition to, the project.

I.

Findings Required for Permit Approval or Denial by the Board. The permit may only be approved if the Madera County board finds that the proposed project will not have detrimental impacts on Madera County. For this purpose, a finding of no detrimental impact shall include but not be limited to the following specific findings:

1. The project will not cause or increase an overdraft on parts or all of the groundwater basins underlying the county.
2. The project will not adversely affect the ability of other groundwater users to use, store, recharge, or transmit groundwater within any aquifer(s) underlying the county (for example by utilizing storage that might otherwise be subject to natural or passive recharge and thus depriving other groundwater users of their use of the aquifer and the groundwater derived therefrom).
3. The project will not adversely affect the reasonable and beneficial uses of groundwater by other groundwater users within Madera County.
4. The project will not result in, expand, or exacerbate degradation of the quality or quantity of surface or groundwater within Madera County, or groundwater basin and aquifers within Madera County.
5. The project will not result in injury to a water replenishment, storage, restoration, or conveyance project or facility.
6. The project will not adversely affect the economy or environment of the county.
7. The project will not result in land subsidence, uncontrolled movement of contaminated or poor quality groundwater, or increased soil degradation.
8. The project will not adversely affect the surface or subsurface of neighboring or nearby lands, or the trees, vines, or crops growing or to be grown thereon.
9. The project will not adversely affect the storage or recharge capability on adjacent lands where passive recharge may take place.
10. The project will not adversely affect the existing qualities of any of the underground aquifers within Madera County. Due to the risk of groundwater contamination from direct injection of water into an underground aquifer, no permit may be issued to any project that will or may use direct injection.

If the board determines that one or more of the findings required by this section cannot be made, even after all reasonable mitigation measures are considered, then the board shall deny the permit application. The basis for any such denial shall be reflected in the board's official record of proceedings.

J.

Decision After Hearing. At the conclusion of the hearing, the board shall approve the application and grant the permit if the board makes the findings set forth in subsection I of this section, subject to the terms and provisions authorized in subsection K of this section. If the board is unable to make the findings set forth in said subsection I of this section, then the application shall be denied and no permit shall be issued. The board shall direct that written findings be prepared in conformity with its decision and shall adopt said findings when prepared.

K.

Terms and Conditions of Permit. If an application is approved, the board may impose such terms and conditions and mitigation measures thereon as the board deems necessary to prevent adverse effects on the aquifer(s); the quality and quantity of the groundwater supply, adjacent or neighboring lands, or the environment, including a reasonable time limit on the life of the permit and a requirement that the applicant provide such periodic reports to the county as the county engineer may reasonably require. The terms and conditions of any permit shall also include the following:

1.

All reports, data, and information to be provided by the permit holder shall be certified as true, accurate, and complete. If the county engineer determines, at any time, that reports, data, and/or information provided as part of the application, or provided to the county pursuant to the terms and conditions of the permit, were not true, accurate, and complete, or have been altered so as to misrepresent project impacts, the county may, following notice and hearing, revoke the permit.

2.

In addition to the monitoring and reporting requirements approved in the monitoring plan, the county engineer or other county representatives may, at any reasonable time, from time to time, and with or without notice, enter the project site to inspect monitoring procedures, equipment, data collection methodologies and frequencies, and other monitoring components. The county engineer or county representatives shall also conduct such independent monitoring and other activities as are necessary to reasonably verify compliance with the terms and conditions of the permit, including without limitation the monitoring plan.

3.

Upon request of the county engineer, the applicant shall deposit with the county engineer such amounts as may be requested from time to time in order to compensate the county for any onsite monitoring and/or inspection activities, including ongoing water sampling, that the county engineer may undertake or cause to be undertaken, whether by county employees or by contractors engaged by, and who shall report to, the county engineer.

4.

For a groundwater banking project, the permit may contain any appropriate limitations on extraction of banked water, whether characterized by a maximum ratio of permitted extractions to deposits or otherwise.

L.

Decision of Board Final. The decision of the board in any matter set forth herein, other than criminal penalties, shall be final upon its adoption of written findings. Any action of the county engineer that under the express provisions of this chapter requires a determination of what is "reasonable" shall be made in the first instance by such engineer, and if appealed to the board, the decision of the board likewise shall be final.

M.

Re-application After Board Denial. Re-application for a permit that has been denied by the board may not be filed until one year after the date of denial.

N.

Inspections—Notice by Permit Holder of Violations. If an application is approved and a permit granted, then the applicant's acceptance of the permit shall constitute the applicant's consent for the county engineer, or his or her representatives, at any reasonable time, and from time to time, and with or without notice, to enter the project site and make such observations and measurements as are deemed necessary to assure that the project is being carried out under the terms of the permit. The permit holder shall notify the county engineer in writing within forty-eight hours of any violation of the terms of any permit (including any permit conditions).

O.

Permit Reviews.

1.

The county engineer, or his or her designee, periodically shall review the operation of the project and its compliance with all applicable terms, conditions, and mitigation measures of the permit. This review, which shall be conducted at the expense of the permit holder, shall be conducted at such intervals as the board shall establish as a part of the permit's terms, conditions and mitigation measures, but in no case shall the intervals exceed five years in length. Such periodic review shall be conducted in accordance with the procedures adopted therefore by the board.

2.

During each periodic review, the permit holder shall be required to demonstrate compliance with the terms, conditions, and mitigation measures of the permit. By acceptance of the permit, the permit holder agrees to furnish such reasonable evidence of compliance as the county engineer (or his or her designee), in the exercise of reasonable discretion, may require.

3.

In addition to the periodic review, the board may at any time initiate a review of the permit holder's compliance with the terms, conditions, and mitigation measures applicable to the permit by giving written notice to the permit holder. Within thirty days following receipt of such notice, the permit holder shall submit evidence to the county engineer (or his or her designee) of the permit holder's compliance with the terms, conditions, and mitigation measures applicable to the permit.

P.

Revocation or Modification of Permit. Upon receiving knowledge of an alleged violation of this chapter, and/or the terms of any permit (including any permit conditions), the county will provide written notice of the alleged violation to the permit holder or other allegedly violating party. The notice shall detail the alleged violation and require the permit holder to cease and desist immediately upon receipt of the notice from continuing the alleged violations or within five working days demonstrate to the county engineer that the alleged violating activities in fact do not violate this chapter. No civil fines, as set forth below shall accrue during this notification process. Any violation of the terms, conditions, and/or mitigation measures of the permit not corrected during such five-day period will constitute grounds for revocation of the permit after a duly noticed public hearing thereon held by the board in the manner described in the preceding subsections; provided that nothing in this paragraph is intended to deprive the board of its authority to grant one or more extensions of time within which the permit holder shall be required to cure the violation.

Any change in circumstances which shows that the project as operated may result in any the kinds of detrimental impacts referred to in subsection I of this section constitutes independent grounds for revocation of the project's permit, or modification thereof as next set forth.

In lieu of revocation of the permit, the board may, after a duly noticed public hearing held in the manner described in the preceding paragraphs, modify the permit to include such different, and/or additional, terms, conditions, and/or mitigation measures as the board determines are necessary and appropriate in light of the change in circumstances then existing. "Change in circumstances" may include, but is not necessarily limited to, changes in the physical characteristics of the project site or surrounding properties, or changes in applicable statutes or regulations affecting the project.

Q.

Judicial Review. Any judicial action to set aside, annul, or vacate any decision or action taken by the board pursuant to this chapter shall be filed pursuant to California Code of Civil Procedure Section 1094.5 and within the time limits prescribed in California Code of Civil Procedure Section 1094.6.

(Ord. 573C § 1, 2008; Ord. 573B § 1(part), 2001).

13.100.070 Penalties for violation.

The county may elect to proceed with any or all of the following remedies for violation of this chapter, in addition to all other remedies provided in this chapter or provided by law:

A.

Civil action against the violator, including injunctive relief.

B.

Any person or entity who violates any provision of this chapter or any term or condition of any permit issued under this chapter, shall be subject to a civil fine up to five thousand dollars for each separate violation. A person or entity shall be deemed to have committed a separate violation for each and every day or portion thereof during which any such violation is committed continued, or permitted as well as for each and every separate groundwater well within or in connection with which any such violations are committed, continued or permitted.

C.

Any person who violates any provision of this chapter, or the terms and/or the conditions of any permit issued pursuant to this chapter, with intent to do so, shall be guilty of a misdemeanor, punishable by fine not exceeding one thousand dollars per violation, or imprisonment not exceeding six months, or by both such fine and imprisonment; and any person shall be deemed guilty of a separate offense for each and every day, or portion thereof, during which any such violation is committed, continued, or permitted; and for each such day shall be subject to the same punishment as for the original offense.

(Ord. 573B § 1(part), 2001).

13.100.080 Severability.

If any section, subsection, sentence, clause or phrase of this chapter is for any reason held to be illegal, invalid or unconstitutional by the decision of any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions hereof. The board hereby declares it would have passed this chapter and each section, subsection, sentence, clause or phrase hereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases are declared illegal, invalid or unconstitutional.

(Ord. 573B § 1(part), 2001).

MADERA IRRIGATION DISTRICT

RULES AND REGULATIONS PERTAINING TO GROUNDWATER BANKING AND GROUNDWATER EXPORTS

SECTION 5: GROUNDWATER EXPORTATION, GROUNDWATER BANKING, IMPORTATION OF FOREIGN WATER, AND USE OF DISTRICT FACILITIES FOR SUCH PURPOSES

Chapter .100
Rules and Regulations Pertaining to Groundwater Banking; Importation of Foreign Water For the Purpose of Groundwater Banking; Exportation of Groundwater Outside the District; and Use of District Facilities for such Purposes.

.100.010 PURPOSE AND INTENT.

A. The lands within Madera Irrigation District ("District") are heavily dependent upon groundwater. The groundwater basin(s) underlying the District and surrounding areas are severely overdrafted.

B. It is essential to the continued prosperity of the landowners and water users within the District that the quality and quantity of the groundwater supply be maintained to meet the demands of District landowners and water users.

C. Areas within the District are or could be or become subject to land subsidence due to the extraction of groundwater.

D. The direct or indirect transfer of groundwater outside the District may have significant environmental impacts on the area within the District including, but not limited to, increased groundwater overdraft; land subsidence; uncontrolled movement of contaminated groundwater; uncontrolled movement of poor quality or contaminated groundwater; the lowering of groundwater levels; increased groundwater or soil degradation; and loss of aquifer capacity due to land subsidence.

E. The direct or indirect transfer of groundwater outside the District may have significant economic impacts on areas within the District including, but not limited to, loss of arable agricultural land; increased pumping costs due to lowered groundwater levels; increased groundwater quality treatment costs due to movement of contaminated or poor quality groundwater; replacement of wells due to declining groundwater levels, and replacement of damaged wells, conveyance facilities, roads, bridges and other structures due to land subsidence.

F. The importation of water originating outside of Madera County (whether or not conveyed through or pooled with facilities located in or adjacent to Madera County) for the purpose of Groundwater Banking such water ("Foreign Water") could, if unregulated, introduce water of an inferior quality into District aquifers, resulting in significant economic and environmental impacts on areas within the District, including, but not limited to, those specified in Paragraphs D. and E., above .

G. As used herein the term "Groundwater Banking" means the percolation, injection, or other recharge of a supply of water for the purpose of later extraction and delivery of such water outside of the District. Groundwater Banking can be reasonable and beneficial if it can be accomplished without:

(1) causing or increasing an overdraft of groundwater underlying the District;

(2) adversely affecting the ability of other groundwater users to use, store, or transmit groundwater within any aquifer(s) underlying the District (for example by utilizing storage that might otherwise be subject to natural or passive recharge and thus depriving other groundwater users of their use of the aquifer and the groundwater derived therefrom) ;

(3) adversely affecting the reasonable and beneficial uses of groundwater by other groundwater users within the District;

(4) resulting in, expanding, or exacerbating degradation of the quality or quantity of surface or groundwater within the District, or groundwater basins and aquifers within the District;

(5) resulting in injury to a water replenishment, storage, restoration, or conveyance project or facility;

(6) adversely affecting the surface or subsurface of neighboring or nearby lands, or the trees, vines, or crops growing or to be grown thereon;

(7) adversely affecting the economy or environment of the area within the District; or

(8) adversely affecting the recharge and storage ability on adjacent lands where passive recharge may take place.

H. For Groundwater Banking projects all or a portion of which will be located within the District, it is essential that the District be the agency that determines whether a permit should be issued to allow groundwater banking, exportation of groundwater, or importation of foreign water, within such areas. Without a permit process which allows public notice, public hearings, and compliance with environmental and other appropriate requirements, there would be no or inadequate local control over such groundwater banking, exportation of groundwater, or importation of foreign water, nor a method to insure that groundwater banking will meet the requirements of Paragraph G., above.

I. The District, as the agency most familiar with local conditions affecting groundwater, should adopt reasonable regulatory measures in relation to exportation of groundwater, Groundwater Banking, and the importation of Foreign Water for the purpose of Groundwater Banking.

J. California Water Code section 1810(d) provides that use of a water conveyance facility to transfer water may be denied if the use of the water conveyance facility will injure any legal user of water, will unreasonably affect fish, wildlife or other in-stream beneficial uses, or will unreasonably affect the overall economy or the environment of the county from which the water is being transferred.

__.100.020 TITLE.

These provisions shall be known as "Rules and Regulations Pertaining to Groundwater Banking; Importation of Foreign Water For the Purpose of Groundwater Banking; Exportation of Groundwater Outside the District; and Use of District Facilities for such Purposes."

__.100.030 DEFINITIONS

The terms used in this Chapter have the following meanings, unless otherwise expressly provided:

A. "Damage Prevention Plan" means a written plan which specifically details the problems that may occur as a result of the operation of the project and details what actions will be

taken by the Applicant to mitigate or eliminate the problems in order to prevent damage to the site and surrounding properties.

B. "Emergency Action Plan" means a written plan which provides a complete and detailed evaluation of potential project failures that can occur during operation of the project and which details what actions the Applicant will take to prevent or minimize damage to the project and protect the public and surrounding properties.

C. "Exportation of Groundwater" means the extraction of groundwater from any well within the boundaries of the County and located on or under lands subject to this Chapter and used on lands which are outside of the boundaries of the County, unless the lands on which the water is being used are contiguous to the lands where the water is extracted, and are owned by the same landowner.

D. "Foreign Water" means water originating outside of Madera County, whether or not conveyed through or pooled with facilities located in or adjacent to Madera County, which is imported into Madera County for purposes of groundwater banking.

E "Groundwater" means water that occurs beneath the land surface and fills the pore spaces of the alluvium, soil, or rock formation in which it is situated.

F. "Groundwater Banking" means the importation of a surface supply of water that is percolated or injected to groundwater for storage, or placed underground by means of in-lieu recharge, for later extraction and delivery.

G. "Groundwater Management Plan" means a groundwater management plan adopted pursuant to California Water Code section 10750 et seq.

H. "Local water agencies" means public agencies, districts, or mutual water companies located wholly or partly within Madera County which have as their primary function the supplying of water for domestic, agricultural, industrial, or municipal purposes.

I. "Operations and Maintenance Plan" means a written plan which provides complete details of how the Applicant plans to

operate and maintain the project after construction is completed. This Plan must show who will assume the responsibility for the operation and maintenance of the project and provide an organizational chart detailing the job responsibilities of each position shown.

J. "Person" means an individual, partnership, company, corporation, unincorporated association, public agency, or other form of business entity.

K. "Project Monitoring Plan" means a written plan which details how the Applicant will monitor the project site and properties outside of the project boundaries for possible damage from operation of the project.

L. "Project Water Measurement and Water Loss Accountability Plan" means a written plan which details how water into and out of the project will be measured and how the Applicant plans to calculate or otherwise account for project water losses. The Plan must provide details of what types of measuring equipment will be used on the project and where it will be installed.

M. "Safety Action Plan" means a written plan which provides information on who will be responsible for implementing the safety requirements for the project and which also provides details of all project safety requirements, including those needed to protect the public and surrounding properties.

__.100.040 LAND SUBJECT TO ARTICLE.

This Chapter shall be applicable to all lands within the District boundaries. If a portion of a Groundwater Banking project lies within the District, and a portion lies outside the boundaries of the District, then this Chapter shall apply to that portion that lies within the boundaries of the District.

__.100.050 EXPORTATION OF GROUNDWATER BEYOND DISTRICT BOUNDARIES.

A. REQUIREMENT OF PERMIT:

Except under a permit granted pursuant to this Section, no groundwater extracted from any well within the boundaries of the District and located on or under lands subject to this Chapter, shall be used on lands which are outside of the boundaries of the District, unless the lands on which the water

is being used are contiguous to the lands where the water is extracted, and are owned by the same landowner. A permit is required under this Section whether or not such exportation is pursuant to Groundwater Banking that is also subject to a separate permit under Section __.100.060. A permit for exportation under this Section may cover all exportation of water to a specified water user in amounts specified in the permit for a period not to exceed five years from the granting of the permit, after which a new permit shall be required.

B. APPLICATION FOR PERMIT:

Applications for permits under this Section shall be made to the District on forms provided by the District and shall contain all information and reports required therein. An Application shall be accompanied by a report ("Report") prepared at the applicant's expense by a qualified Registered Civil Engineer or Geologist, versed in geologic and hydraulic testing, which shows:

a. The source of the water to be exported.

b. The quantity and quality of water proposed to be exported.

c. The location to which and purpose for which the water is to be exported, including the reasonable and beneficial use to which the water is to be put.

d. The geologic and hydrologic properties of the aquifers from which extraction will be made, including possibilities or likelihood of subsidence problems.

e. Percolation tests to determine the ability of the aquifer(s) to recharge.

f. Clay layers and their effect on percolation.

g. The applicant's Project Water Measurement and Water Loss Accountability Plan.

h. The applicant's Damage Prevention Plan.

i. The applicant's Project Monitoring Plan.

j. The applicant's Safety Action Plan.

k. The applicant's Emergency Action Plan.

l. The location, size, spacing and depths of extraction wells.

m. Horizontal migration of groundwater from surrounding locations.

n. The means and criteria for determining any effects on surrounding lands and their groundwater supplies.

o. Such other matters as the District may require.

Five copies of the Application, Report, and other information submitted shall be provided.

C. ENVIRONMENTAL IMPACT REPORT:
An Application for extraction permit under this Section is deemed to be a "project" under the California Environmental Quality Act ("CEQA") and its implementing regulations ("CEQA Guidelines"). In order to ensure that decision-makers have sufficient information on the potential impacts of such a project, the preparation and certification of an Environmental Impact Report ("EIR") is hereby required for each such project application. The EIR must conform to CEQA, CEQA Guidelines, and all District requirements. The EIR shall be prepared, and shall be paid for by the applicant, in accordance with the District's CEQA implementation procedures.

D. ADDITIONAL STUDIES AND REQUIREMENTS:
If, after receiving the Report as required by Paragraph B., above, and before or after receiving the EIR, the District Engineer desires more information, he or she may require preparation by applicant, at applicant's expense, of any additional geologic or hydrologic studies, or other information or studies, that he or she deems necessary to obtain information needed in order to make a recommendation on the application. The Engineer may review the application with potentially affected landowners and water users, with the staff of applicable local, state and federal agencies and with, and with the Madera County Water Oversight Committee.

E. REVIEW OF APPLICATION.

After reviewing the Application, Report, Environmental Impact Report, and any additional studies and other information required under Paragraph D., above, the District Engineer shall prepare a written report, with all comments attached thereto, in which he or she either shall recommend denial of the permit, or granting the permit with suggested conditions for the project. The written report also shall include recommendations concerning the adequacy of the EIR. All documents shall be filed with the Secretary of the Board.

F. FINDINGS REQUIRED FOR PERMIT APPROVAL OR DENIAL BY THE BOARD:

The permit may only be approved if the District finds that the proposed extraction and exportation will not have detrimental impacts on the District by determining that:

(1) The extraction and exportation will not cause or increase an overdraft on parts or all of the groundwater basins underlying the District.

(2) The extraction and exportation will not adversely affect the ability of other groundwater users to use, store, or transmit groundwater within any aquifer(s) underlying the District.

(3) The extraction and exportation will not adversely effect the reasonable and beneficial uses of groundwater by other groundwater users within the District.

(4) The extraction and exportation will not result in, expand, or exacerbate degradation of the quality or quantity of surface or groundwater within the District, or groundwater basins and aquifers within the District.

(5) The extraction and exportation will not result in injury to a water replenishment, storage, restoration, or conveyance project or facility;

(6) The extraction and exportation will not adversely affect the overall economy or environment of the area within the District.

If the Board determines that one or more of the findings required by this Section cannot be made, the Board shall deny the permit application. The basis for any such denial shall be reflected in the Board's official record of proceedings.

G. RE-APPLICATION AFTER BOARD DENIAL:
Re-application for a permit that has been denied by the Board may not be filed until one year after the date of denial.

H. PAYMENT OF FEES.
The applicant at the time of filing shall pay such fees as are or may be established by the Board for processing the application and the giving and publication of required notices.

I. NOTICE TO LANDOWNERS:
Upon the filing of an application with the District, the District shall give written notice to all owners of lands located within five miles of the exterior boundaries of the proposed extraction site, setting forth the name of the applicant, a description of the project, a description or map of the land involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the District. In addition thereto, the District shall cause to be published pursuant to Government Code §§ 6060 and 6061.3 a notice that the application has been filed, setting forth the name of the applicant, a description of the project, a description or map of the land involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the District. The District shall retain one copy of the application documents, EIR, and any comments or reports thereon and make them available for public inspection and copying in accordance with the Public Records Act.

J. NOTICED PUBLIC HEARING:
No permit shall be issued without a noticed public hearing before the Board pursuant to Government Code §§ 6060 and 6061.3. The notice shall be given by the Secretary of the Board after completion and filing of the Engineer's Report and the environmental review process. The notice shall specify the time and place of the hearing, the location from which the water is proposed to be extracted and exported, and a general description of the project and that any interested person may submit evidence at the hearing. At least fifteen days must

elapse between filing the documents with the Secretary of the Board and the date of the hearing.

K. PROCEDURES FOR CONDUCTING HEARING:
At the hearing, the Application, Report, Environmental Impact Report, additional submittals, comments from the public and the Engineer's Recommendation shall become evidence. The applicant and members of the public, or their representatives, may testify and introduce evidence in favor of, or in opposition to, the project.

L. DECISION AFTER HEARING.
At the conclusion of the hearing, the Board shall approve the application and grant the permit if the Board makes the findings set forth in Paragraph F., above, subject to the terms and provisions authorized in Paragraph M., below. If the Board is unable to make the findings set forth in Paragraph F., above, then the application shall be denied and no permit shall be issued. The Board shall direct that written findings are prepared in conformity with its decision and shall adopt said findings when prepared.

M. TERMS AND CONDITIONS OF PERMIT:
If an application is approved, the Board may impose such terms and conditions thereon as the Board deems necessary to prevent adverse effects on the aquifer(s), the quality and quantity of the groundwater supply, adjacent or neighboring lands, or the environment.

N. REVOCATION OF PERMIT:
Any violation of the terms and conditions of the permit will constitute grounds for revocation of the permit after a duly noticed public hearing thereon held in the manner described in the preceding Paragraphs.

O. INSPECTIONS:
If an application is approved and a permit granted, then the applicant's acceptance of the permit shall constitute the applicant's consent for the District Engineer, or his representatives, at any reasonable time, and from time to time, to enter the project site and make such observations and measurements as are deemed necessary to assure that the project is being carried out under the terms of the permit.

representatives, at any reasonable time, and from time to time, to enter the project site and make such observations and measurements as are deemed necessary to assure that the project is being carried out under the terms of the permit.

P. DECISION OF BOARD FINAL:
The decision of the Board in any matter set forth herein, other than criminal penalties, shall be final upon its adoption of written findings.

Q. JUDICIAL REVIEW:
Any judicial action to set aside, annul, or vacate any decision or action taken by the Board pursuant to this Chapter shall be filed pursuant to California Code of Civil Procedure Section 1094.5 and within the time limits prescribed in California Code of Civil Procedure section 1094.6.

__.100.060 GROUNDWATER BANKING.

A. REQUIREMENT OF PERMIT:
No person, who is subject to this Ordinance, other than the District, shall engage in Groundwater Banking on or under land subject to this Ordinance without first obtaining a permit from the District in accordance with this Section. A permit for Groundwater Banking under this Section may cover all Groundwater Banking for amounts of storage specified in the permit for a period not to exceed five years from the granting of the permit, after which a new permit shall be required. A permit for Groundwater Banking is not a permit for importation of Foreign Water to the Groundwater Bank (which importation shall require a separate permit under Section __.100.070), and it is not a permit for exportation of groundwater beyond District boundaries (which exportation shall require a separate permit under Section __.100.050).

B. APPLICATION FOR PERMIT:
Applications for permits under this Section shall be made to the District on forms provided by the District and shall contain all information and reports required therein. An Application shall be accompanied by a report ("Report") prepared at the applicant's expense by a qualified Registered Civil Engineer or Geologist, versed in geologic and hydraulic testing, which shows:

a. The location, plans, and specifications of the proposed project.

c. The method of placement of water to be banked

d. The quantities of groundwater to be extracted.

e. The geologic and hydrologic properties of the aquifers into which recharge will occur and from which extraction will be made, including possibilities or likelihood of subsidence problems.

f. Percolation tests to determine the ability of the aquifer(s) to recharge.

g. Clay layers and their effect on percolation.

h. Design of spreading areas.

i. The applicant's Operations and Maintenance Plan.

j. The applicant's Project Water Measurement and Water Loss Accountability Plan.

k. The applicant's Damage Prevention Plan.

l. The applicant's Project Monitoring Plan.

m. The applicant's Safety Action Plan.

n. The applicant's Emergency Action Plan.

o. The location, size, spacing and depths of extraction wells.

p. Horizontal migration of groundwater from surrounding locations.

q. The means and criteria for determining any effects on surrounding lands and their groundwater supplies.

r. Such other matters as the District may require.

Five copies of the Application, Report, and other information submitted shall be provided.

C. ENVIRONMENTAL IMPACT REPORT:
An Application for Groundwater Banking under this Section is deemed to be a "project" under the California Environmental Quality Act ("CEQA") and its implementing regulations ("CEQA Guidelines"). In order to ensure that decision-makers have sufficient information on the potential impacts of such a project, the preparation and certification of an Environmental Impact Report ("EIR") is hereby required for each such project application. The EIR must conform to CEQA, CEQA Guidelines, and all District requirements. The EIR shall be prepared, and shall be paid for by the applicant, in accordance with the District's CEQA implementation procedures.

D. ADDITIONAL STUDIES AND REQUIREMENTS:
If, after receiving the Report as required by Paragraph B., above, and before or after receiving the EIR, the District Engineer desires more information, he or she may require preparation by applicant, at applicant's expense, of any additional geologic or hydrologic studies, or other studies or information, that he or she deems necessary to obtain information needed in order to make a recommendation on the application. The Engineer may review the application with potentially affected landowners and water users, with the staff of applicable local, state and federal agencies, and with the Madera County Water Oversight Committee.

E. REVIEW OF APPLICATION.
After reviewing the Application, Report, Environmental Impact Report, and any additional studies and other information required under Paragraph D., above, the District Engineer shall prepare a written report, with all comments attached thereto, in which he or she either shall recommend denial of the permit, or granting the permit with suggested conditions for the project. The written report also shall include recommendations concerning the adequacy of the EIR. All documents shall be filed with the Secretary of the Board.

F. FINDINGS REQUIRED FOR PERMIT APPROVAL OR DENIAL BY THE BOARD:
The permit may only be approved if the District finds that the proposed Groundwater Banking project will not have detrimental impacts on the District by determining that:

(1) The project will not adversely affect the ability of other groundwater users to use, store, or transmit groundwater within any aquifer(s) underlying the District (for example by utilizing storage that might otherwise be subject to natural or passive recharge and thus depriving other groundwater users of their use of the aquifer and the groundwater derived therefrom).

(2) The project will not adversely affect the reasonable and beneficial uses of groundwater by other groundwater users within the District.

(3) The project will not result in, expand, or exacerbate degradation of the quality or quantity of surface or groundwater within the District, or groundwater basins and aquifers within the District.

(4) The project will not result in injury to a water replenishment, storage, restoration, or conveyance project or facility.

(5) The project will not adversely affect the surface or subsurface of neighboring or nearby lands, or the trees, vines, or crops growing or to be grown thereon.

(6) The project will not adversely affect the overall economy or environment of the District.

(7) The project will not cause or increase an overdraft of groundwater underlying the District.

(8) The project will not adversely affect the storage ability on adjacent lands where passive recharge may take place.

If the Board determines that one or more of the findings required by this Section cannot be made, the Board shall deny the permit application. The basis for any such denial shall be reflected in the Board's official record of proceedings.

G. RE-APPLICATION AFTER BOARD DENIAL:
Re-application for a permit that has been denied by the Board may not be filed until one year after the date of denial.

H. PAYMENT OF FEES.
The applicant at the time of filing shall pay such fees as are or may be established by the Board for processing the application and the giving and publication of required notices.

I. NOTICE TO LANDOWNERS:
Upon the filing of an application with the District, the District shall give written notice to all owners of lands located within the District which are located within five miles of project site, setting forth the name of the applicant, a description of the project, a description or map of the land involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the District. In addition thereto, the District shall cause to be published pursuant to Government Code §§ 6060 and 6061.3 a notice that the application has been filed, setting forth the name of the applicant, a description of the project, a description or map of the land involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the District. the District shall retain one copy of the application documents, EIR, and any comments or reports thereon and make them available for public inspection and copying in accordance with the Public Records Act.

J. NOTICED PUBLIC HEARING:
No permit shall be issued without a noticed public hearing before the Board pursuant to Government Code §§ 6060 and 6061.3. The notice shall be given by the Secretary of the Board after completion and filing of the Engineer's Report and the environmental review process. The notice shall specify the time and place of the hearing, a general description of the proposed importation and that any interested person may submit evidence at the hearing. At least fifteen days must elapse between filing the documents with the Secretary of the Board and the date of the hearing.

K. PROCEDURES FOR CONDUCTING HEARING:
At the hearing, the Application, Report, Environmental Impact Report, additional submittals, comments from the public and the Engineer's Recommendation shall become evidence. The applicant and members of the public, or their representatives, may testify and introduce evidence in favor of, or in opposition to, the project.

L. DECISION AFTER HEARING.
At the conclusion of the hearing, the Board shall approve the application and grant the permit if the Board makes the findings set forth in Paragraph F., above, subject to the terms and provisions authorized in Paragraph M., below. If the Board is unable to make the findings set forth in Paragraph F., above, then the application shall be denied and no permit shall be issued. The Board shall direct that written findings are prepared in conformity with its decision and shall adopt said findings when prepared.

M. TERMS AND CONDITIONS OF PERMIT:
If an application is approved, the Board may impose such terms and conditions thereon as the Board deems necessary to prevent adverse effects on the aquifer(s), the quality and quantity of the groundwater supply, adjacent or neighboring lands, or the environment. Since direct or other subsurface injection of water into an aquifer entails an inherent risk of irreparable contamination due to the lack of natural filtering resulting from percolation, the permit shall prohibit the use of direct or other subsurface injection.

N. REVOCATION OF PERMIT:
Any violation of the terms and conditions of the permit will constitute grounds for revocation of the permit after a duly noticed public hearing thereon held in the manner described in the preceding Paragraphs.

O. INSPECTIONS:
If an application is approved and a permit granted, then the applicant's acceptance of the permit shall constitute the applicant's consent for the District Engineer, or his representatives, at any reasonable time, and from time to time, to enter the project site(s) and make such observations and measurements as are deemed necessary to assure that the project is being carried out under the terms of the permit.

P. DECISION OF BOARD FINAL:
The decision of the Board in any matter set forth herein, other than criminal penalties, shall be final upon its adoption of written findings.

Q. JUDICIAL REVIEW:
Any judicial action to set aside, annul, or vacate any decision or action taken by the Board pursuant to this Chapter shall be filed pursuant to California Code of Civil Procedure Section 1094.5 and within the time limits prescribed in California Code of Civil Procedure section 1094.6.

__.100.070 IMPORTATION OF FOREIGN WATER FOR GROUNDWATER BANKING.

A. REQUIREMENT OF PERMIT:
Except under a permit granted pursuant to this Section, no person may import Foreign Water for the purpose of Groundwater Banking within the boundaries of the District and located on or under lands subject to this Chapter. A permit is required under this Section whether or not such importation is pursuant to Groundwater Banking that is also subject to a separate permit under Section __.100.060. A permit for importation under this Section may cover all importation of water from a specified water source (designated by specific location and type) in amounts specified in the permit for a period not to exceed five years from the granting of the permit, after which a new permit shall be required.

B. APPLICATION FOR PERMIT:
Applications for permits under this Section shall be made to the District on forms provided by the District and shall contain all information and reports required therein. An Application shall be accompanied by a report ("Report") prepared at the applicant's expense by a qualified Registered Civil Engineer or Geologist, versed in geologic and hydraulic testing, which shows:

a. The source of the water to be imported.

b. The quantity and quality of water proposed to be imported.

c. The manner in which the water is to be conveyed to the Groundwater Banking facility, including the specific location of conveyance facilities, and copies of all permits and agreements showing consent for the use of such conveyance facilities.

d. The proposed method of placement of water to be imported and banked

e. The physical, and where applicable the geologic and hydrologic, properties of the conveyance facilities, including possibilities or likelihood of contamination or degradation problems.

f. The applicant's Project Water Measurement and Water Accountability Plan.

g. The applicant's Damage Prevention Plan.

h. The applicant's Project Monitoring Plan.

i. The applicant's Safety Action Plan.

j. The applicant's Emergency Action Plan.

k. The means and criteria for determining any effects on lands surrounding or neighboring all conveyance facilities and on their groundwater or surface water supplies.

l. The means and criteria for determining any effects on all other water supplies into which the proposed Foreign Water may be commingled while being conveyed, such as in a pool or reservoir.

m. Such other matters as the District may require.

Five copies of the Application, Report, and other information submitted shall be provided.

C. ENVIRONMENTAL IMPACT REPORT:

An Application for Foreign Water Importation Permit under this Section is deemed to be a "project" under the California Environmental Quality Act ("CEQA") and its implementing regulations ("CEQA Guidelines"). In order to ensure that decision-makers have sufficient information on the potential impacts of such a project, the preparation and certification of an Environmental Impact Report ("EIR") is hereby required for each such project application. The EIR must conform to CEQA, CEQA Guidelines, and all District requirements. The EIR shall be prepared, and shall be paid for by the applicant,

in accordance with the District's CEQA implementation procedures.

D. ADDITIONAL STUDIES AND REQUIREMENTS:
If, after receiving the Report as required by Paragraph B., above, and before or after receiving the EIR, the District Engineer desires more information, he or she may require preparation by applicant, at applicant's expense, of any additional geologic or hydrologic studies, or other studies or information, that he or she deems necessary to obtain information needed in order to make a recommendation on the application. The Engineer may review the application with potentially affected landowners and water users, with the staff of applicable state and federal agencies, and with the Madera County Water Oversight Committee.

E. REVIEW OF APPLICATION.
After reviewing the Application, Report, Environmental Impact Report, and any additional studies and other information required under Paragraph D., above, the District Engineer shall prepare a written report, with all comments attached thereto, in which he or she either shall recommend denial of the permit, or granting the permit with suggested conditions for the project. The written report also shall include recommendations concerning the adequacy of the EIR. All documents shall be filed with the Secretary of the Board.

F. FINDINGS REQUIRED FOR PERMIT APPROVAL OR DENIAL BY THE BOARD:
The permit may only be approved if the District finds that the proposed importation of Foreign Water will not have detrimental impacts on the District by determining that:

(1) The importation will not adversely affect the ability of other groundwater users to use, store, or transmit groundwater within any aquifer(s) underlying the District.

(2) The importation will not adversely affect the reasonable and beneficial uses of groundwater by other groundwater users within the District.

(3) The importation will not result in, expand, or exacerbate degradation of the quality or quantity of surface or groundwater within the District, or groundwater basins and aquifers within the District.

(4) The importation will not result in injury to a water replenishment, storage, restoration, or conveyance project or facility.

(5) The project will not adversely affect the surface or subsurface of neighboring or nearby lands, or the trees, vines, or crops growing or to be grown thereon.

(6) The importation will not adversely affect the overall economy or environment of the District.

(7) The existing qualities of the underground aquifers will not be degraded by the importation.

(8) The importation will not adversely affect the storage ability on adjacent lands where passive recharge may take place.

If the Board determine that one or more of the findings required by this Section cannot be made, the Board shall deny the permit application. The basis for any such denial shall be reflected in the Board's official record of proceedings.

G. RE-APPLICATION AFTER BOARD DENIAL:
Re-application for a permit that has been denied by the Board may not be filed until one year after the date of denial.

H. PAYMENT OF FEES.
The applicant at the time of filing shall pay such fees as are or may be established by the Board for processing the application and the giving and publication of required notices.

I. NOTICE TO LANDOWNERS:
Upon the filing of an application with the District, the District shall give written notice to all owners of lands located within the District which are located within five miles of any conveyance facilities that are within or adjacent to the District, setting forth the name of the applicant, a description of the project, a description or map of the land involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the District. In addition thereto, the District shall cause to be published pursuant to Government Code §§ 6060 and 6061.3 a notice that the application has been filed, setting forth the name of the applicant, a description of the project, a

description or map of the land involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the District. The District shall retain one copy of the application documents, EIR, and any comments or reports thereon and make them available for public inspection and copying in accordance with the Public Records Act.

J. NOTICED PUBLIC HEARING:
No permit shall be issued without a noticed public hearing before the Board pursuant to Government Code §§ 6060 and 6061.3. The notice shall be given by the Secretary of the Board after completion and filing of the Engineer's Report and the environmental review process. The notice shall specify the time and place of the hearing, a general description of the proposed importation and that any interested person may submit evidence at the hearing. At least fifteen days must elapse between filing the documents with the Secretary of the Board and the date of the hearing.

K. PROCEDURES FOR CONDUCTING HEARING:
At the hearing, the Application, Report, Environmental Impact Report, additional submittals, comments from the public and the Engineer's Recommendation shall become evidence. The applicant and members of the public, or their representatives, may testify and introduce evidence in favor of, or in opposition to, the project.

L. DECISION AFTER HEARING.
At the conclusion of the hearing, the Board shall approve the application and grant the permit if the Board makes the findings set forth in Paragraph F., above, subject to the terms and provisions authorized in Paragraph M., below. If the Board is unable to make the findings set forth in Paragraph F., above, then the application shall be denied and no permit shall be issued. The Board shall direct that written findings are prepared in conformity with its decision and shall adopt said findings when prepared.

M. TERMS AND CONDITIONS OF PERMIT:
If an application is approved, the Board may impose such terms and conditions thereon as the Board deems necessary to prevent adverse effects on the aquifer(s), the quality and quantity of the groundwater supply, adjacent or neighboring lands, or the environment.

N. REVOCATION OF PERMIT:
Any violation of the terms and conditions of the permit will constitute grounds for revocation of the permit after a duly noticed public hearing thereon held in the manner described in the preceding Paragraphs.

O. INSPECTIONS:
If an application is approved and a permit granted, then the applicant's acceptance of the permit shall constitute the applicant's consent for the District Engineer, or his representatives, at any reasonable time, and from time to time, to enter the project site(s) and make such observations and measurements as are deemed necessary to assure that the project is being carried out under the terms of the permit.

P. DECISION OF BOARD FINAL:
The decision of the Board in any matter set forth herein, other than criminal penalties, shall be final upon its adoption of written findings.

Q. JUDICIAL REVIEW:
Any judicial action to set aside, annul, or vacate any decision or action taken by the Board pursuant to this Chapter shall be filed pursuant to California Code of Civil Procedure Section 1094.5 and within the time limits prescribed in California Code of Civil Procedure section 1094.6.

.100.080 DISTRICT CONVEYANCE FACILITIES:

A. REQUIREMENT OF PERMIT:
In order to avoid injury to any legal user of water, and to avoid unreasonably affecting the overall economy or the environment of Madera county, no person may use any District-owned conveyance facility as a part of, or in connection with, Groundwater Banking for which a permit is required under this Chapter, or the importation of Foreign Water for which a permit is required under this Chapter, or the exportation of groundwater for which a permit is required under this Chapter, except under a permit granted pursuant to this Section. A permit is required under this Section whether or not such use is in connection with groundwater banking, importation of foreign water, or exportation of groundwater for which a separate permit or permits are required under other Sections of this Chapter. A permit for use of a district conveyance facility under this Section may cover all importation of water from a specified water source (designated by specific location and type) in amounts specified in the

permit for a period not to exceed two years from the granting of the permit, after which a new permit shall be required.

B. APPLICATION FOR PERMIT:
Applications for permits under this Section shall be made to the District on forms provided by the District and shall contain all information and reports required therein. An Application shall be accompanied by a report ("Report") prepared at the applicant's expense by a qualified Registered Civil Engineer or Geologist, versed in geologic and hydraulic testing, which shows:

a. The source of the water to be conveyed through the conveyance facility.

b. The quantity and quality of water proposed to be conveyed.

c. The manner in which the water is to be delivered to and withdrawn from the District conveyance facility and how the water is to conveyed from its source to the District's conveyance facility.

d. The physical, and where applicable the geologic and hydrologic, properties of the conveyance facilities through which the water will be delivered into the District's conveyance facilities, including possibilities or likelihood of contamination or degradation problems.

e. The applicant's Project Water Measurement and Water Accountability Plan.

f. The applicant's Damage Prevention Plan.

g. The applicant's Project Monitoring Plan.

h. The applicant's Safety Action Plan.

i. The applicant's Emergency Action Plan.

j. The means and criteria for determining any effects on lands within the District and otherwise surrounding or neighboring all conveyance facilities and on their groundwater or surface water supplies.

k. The means and criteria for determining any effects on all other water supplies with which the water proposed to be conveyed may be commingled while being conveyed.

l. The means and criteria for determining any effects of the use of the District conveyance facility on any other legal user of water conveyed or to be conveyed through such facilities.

m. The means and criteria for determining any effects of the use of the District conveyance facility on fish, wildlife, other instream beneficial uses, or the environment within the District and within Madera County.

n. The means and criteria for determining any effects of the use of the District conveyance facility on the economy within the District and within Madera County.

o. Such other matters as the District may require.

Five copies of the Application, Report, and other information submitted shall be provided.

C. ENVIRONMENTAL IMPACT REPORT:
An Application for Use of District Conveyance Facility under this Section is deemed to be a "project" under the California Environmental Quality Act ("CEQA") and its implementing regulations ("CEQA Guidelines"). In order to ensure that decision-makers have sufficient information on the potential impacts of such a project, the preparation and certification of an Environmental Impact Report ("EIR") is hereby required for each such project application. The EIR must conform to CEQA, CEQA Guidelines, and all District requirements. The EIR shall be prepared, and shall be paid for by the applicant, in accordance with the District's CEQA implementation procedures.

D. ADDITIONAL STUDIES AND REQUIREMENTS:
If, after receiving the Report as required by Paragraph B., above, and before or after receiving the EIR, the District

Engineer desires more information, he or she may require preparation by applicant, at applicant's expense, of any additional physical, geologic or hydrologic studies, or other studies or information, that he or she deems necessary to obtain information needed in order to make a recommendation on the application. The Engineer may review the application with potentially affected landowners and water users, with the staff of applicable state and federal agencies, and with the Madera County Water Oversight Committee.

E. REVIEW OF APPLICATION.

After reviewing the Application, Report, Environmental Impact Report, and any additional studies and other information required under Paragraph D., above, the District Engineer shall prepare a written report, with all comments attached thereto, in which he or she either shall recommend denial of the permit, or granting the permit with suggested conditions for the project. The written report also shall include recommendations concerning the adequacy of the EIR. All documents shall be filed with the Secretary of the Board.

F. FINDINGS REQUIRED FOR PERMIT APPROVAL OR DENIAL BY THE BOARD:

The permit may only be approved if the District finds that the proposed use of District conveyance facility will not:

(1) Injure any legal user of water.

(2) Unreasonably affect the delivery of water to any District landowners.

(3) Unreasonably affect fish, wildlife, or other instream beneficial uses.

(4) Unreasonably affect the overall economy of the county from which the water is to be transferred.

(5) Unreasonably affect the environment of the county from which the water is to be transferred.

If the Board determines that one or more of the findings required by this Section cannot be made, the Board shall deny the permit application. The basis for any such denial shall be reflected in the Board's official record of proceedings.

G. RE-APPLICATION AFTER BOARD DENIAL:
Re-application for a permit that has been denied by the Board may not be filed until one year after the date of denial.

H. PAYMENT OF FEES.
The applicant at the time of filing shall pay such fees as are or may be established by the Board for processing the application and the giving and publication of required notices.

I. NOTICE TO LANDOWNERS:
Upon the filing of an application with the District, the District shall give written notice to all owners of lands located within the District which are located within five miles of any conveyance facilities that are within or adjacent to the District, setting forth the name of the applicant, a description of the applicant's proposal, a description or map of the District facility involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the District. In addition thereto, the District shall cause to be published pursuant to Government Code §§ 6060 and 6061.3 a notice that the application has been filed, setting forth the name of the applicant, a description of the applicant's proposal, a description or map of the District facility involved, and a statement that all documents submitted in connection with the application are public records subject to inspection at the office of the District. The District shall retain one copy of the application documents, EIR, and any comments or reports thereon and make them available for public inspection and copying in accordance with the Public Records Act.

J. NOTICED PUBLIC HEARING:
No permit shall be issued without a noticed public hearing before the Board pursuant to Government Code §§ 6060 and 6061.3. The notice shall be given by the Secretary of the Board after completion and filing of the Engineer's Report and the environmental review process. The notice shall specify the time and place of the hearing, a general description of the proposed importation and that any interested person may submit evidence at the hearing. At least fifteen days must elapse between filing the documents with the Secretary of the Board and the date of the hearing.

K. PROCEDURES FOR CONDUCTING HEARING:
At the hearing, the Application, Report, Environmental Impact Report, additional submittals, comments from the public and the Engineer's Recommendation shall become evidence. The applicant and members of the public, or their representatives, may testify and introduce evidence in favor of, or in opposition to, the project.

L. DECISION AFTER HEARING.
At the conclusion of the hearing, the Board shall approve the application and grant the permit if the Board makes the findings set forth in Paragraph F., above, subject to the terms and provisions authorized in Paragraph M., below. If the Board is unable to make the findings set forth in Paragraph F., above, then the application shall be denied and no permit shall be issued. The Board shall direct that written findings are prepared in conformity with its decision and shall adopt said findings when prepared.

M. TERMS AND CONDITIONS OF PERMIT:
If an application is approved, the Board may impose such terms and conditions thereon as the Board deems necessary to prevent adverse effects described in Paragraph F, above.

N. REVOCATION OF PERMIT:
Any violation of the terms and conditions of the permit will constitute grounds for revocation of the permit after a duly noticed public hearing thereon held in the manner described in the preceding Paragraphs.

O. INSPECTIONS:
If an application is approved and a permit granted, then the applicant's acceptance of the permit shall constitute the applicant's consent for the District Engineer, or his representatives, at any reasonable time, and from time to time, to enter the applicant's site(s) and make such observations and measurements as are deemed necessary to assure that the applicant's proposed use is being carried out under the terms of the permit.

P. DECISION OF BOARD FINAL:
The decision of the Board in any matter set forth herein, other than criminal penalties, shall be final upon its adoption of written findings.

Q. JUDICIAL REVIEW:
Any judicial action to set aside, annul, or vacate any decision or action taken by the Board pursuant to this Chapter shall be filed pursuant to Cal. Code of Civil Procedure Section 1094.5 and within the time limits prescribed in Cal. Code of Civil Procedure section 1094.6.

.100.090 PENALTIES FOR VIOLATION:
These rules and regulations are enacted to secure distribution of water in accordance with determined rights within the District pursuant to California Water Code Section 22085. Supervision and enforcement of these regulations shall be by District watermasters appointed under Water Code Section 22081. The District may elect to proceed with any or all of the following remedies for violation of this Chapter:

(a) A civil action against the violator for damages and/or injunctive relief.

(b) A misdemeanor criminal action against any violator who willfully and without authority closes, changes, or interferes with any headgate, waterbox, or measuring device while it is under the control of the watermaster, or who willfully takes, uses, or conveys water which has been denied him by the watermaster as not allowed under permit or in violation of the provisions of this Ordinance is guilty of a misdemeanor pursuant to Water Code Section 22088. Under Water Code Section 22089.5, a watermaster has the power to arrest any person violating any of the provisions of this article and to give him into the custody of the sheriff or other competent police officer within the county, and immediately thereafter make a complaint before a magistrate against the person so arrested. Every person who violates any of the provisions of this article is guilty of a misdemeanor and is punishable by a fine of not less than twenty-five dollars ($25), nor more than two hundred fifty dollars ($250), or by imprisonment in the county jail for not less than 10 days nor more than six months, or by both such fine and imprisonment pursuant to Water Code Section 22089.

(c) A referral to the Madera County District Attorney for prosecution of a misdemeanor criminal action against any violator without authority of the owner or managing agent, and with intent to defraud, take water from any canal, ditch, flume, or reservoir used for the purpose of holding or conveying is guilty of a misdemeanor under California Penal Code Section 592. If the total retail value of all the water taken is more than

four hundred dollars ($400), or if the defendant has previously been convicted of an offense under Penal Code Section 592 or any former section that would be an offense under Section 592, or of an offense under the laws of another state or of the United States that would have been an offense under this section if committed in this state, then the violation is punishable by imprisonment in the county jail for not more than one year, or in the state prison.

__.100.100 SEVERABILITY:

If any section, subsection, sentence, clause or phrase of this Chapter is for any reason held to be illegal, invalid or unconstitutional by the decision of any court of competent jurisdiction, such decision shall not affect the validity of the remaining portions hereof. The Board hereby declares it would have passed this Chapter and each section, subsection, sentence, clause or phrase hereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases are declared illegal, invalid or unconstitutional.

MADERA REGIONAL

GROUNDWATER MANAGEMENT PLAN

APPENDIX H – WELL CONSTRUCTION POLICIES

(CITY OF CHOWCHILLA AND COUNTY OF MADERA)

CITY OF CHOWCHILLA

WELL STANDARDS

Chapter 8.20 - WELL STANDARDS

Sections:

8.20.010 - Purpose and definitions.

8.20.020 - Permits.

8.20.030 - Well standards.

8.20.040 - Variances.

8.20.050 - Special groundwater protection.

8.20.060 - Inspections.

8.20.070 - Completion reports.

8.20.080 - Appeals.

8.20.090 - Right of entry and inspection.

8.20.100 - Abatement of abandoned wells.

8.20.110 - Criminal and civil enforcement.

8.20.120 - Reports to the regional board.

8.20.010 - Purpose and definitions.

A. Intent of Chapter. It is the purpose of this chapter to protect the health, safety and general welfare of the people of the state by ensuring that the groundwaters of this state will not be polluted or contaminated. To this end, minimum requirements are contained in this chapter for construction, reconstruction, repair, and destruction* of water wells, cathodic protection wells and monitoring wells.

B. Definitions and Interpretation.

1. As Defined in Other Documents. Except as otherwise required by the context of this chapter, the terms used in this chapter are those of Division 7 of the California Water Code and the Department of Water Resources Bulletin 74-81 and subsequent supplements or revisions.

2. "Board" means the city council of the city of Chowchilla.

3. "Enforcement agency" means the city administrator of the city of Chowchilla, or his designee.

4. "Person" means any person, firm, corporation or governmental agency, to the extent authorized by law.

5. Well or Water Well. The California Water Code, Section 13710, defines well or water well to mean " ;elipsis; any artificial excavation constructed by any method for the purpose of extracting water from, or injecting water into, the underground." None of the following shall be included

within this definition of welts: potholes, drainage trenches or canals, wastewater ponds, shallow root zone piezometers, stock ponds or similar excavations.

6. Tense or Gender. Words used in the present tense include the future as well as the present. Words used in the masculine gender include the feminine and neuter. The singular number includes the plural, and the plural the singular.

7. Section headings, when contained in this chapter, shall not be deemed to govern, limit, modify or in any manner affect the scope, meaning or intent of the provisions of any section.

(Ord. 370-90 (part), 1990)

* The California Water Code Section 13801(b) refers to well construction, maintenance and abandonment standards. Since the Department of Water Resources, "Water Well Standards" defines an abandoned well in terms of an undesirable condition, best remedied by destruction of the well, this usage is followed in this chapter.

8.20.020 - Permits.

A. Permit Applications.

1. When Required. No person shall dig, bore, drill, deepen, modify, repair or destroy a water well, cathodic protection well, observation well, monitoring well or any other excavation that may intersect groundwater without first applying for and receiving a permit as provided in this chapter unless exempted by law.

2. Penalty for Failure to Obtain Permit. Any person who shall commence any work for which a permit is required by this chapter without having obtained a permit shall be required, if subsequently granted a permit for this work, to pay double the standard permit fee.

3. Emergency Work. The above provisions shall not apply to emergency work required on short notice to maintain drinking water or agricultural supply systems. In such cases, the person responsible for the emergency work shall:

a. Urgency. Satisfy the enforcement agency that such work was urgently necessary;

b. Conformance with Standards. Demonstrate that all work performed was in conformance with the technical standards as designed in Section 8.20.030

B. Application Procedure. Applications for permits shall be made to the enforcement agency on forms approved by the agency and shall contain all such information the enforcement agency requires to accomplish the purposes of this chapter. The application shall be accompanied by the required filing fee. If the enforcement agency finds the application contains all necessary information, it shall issue to the applicant a comprehensive permit containing such conditions as are necessary to fulfill the purposes of this chapter.

C. Filing Fees. Filing fees may be set by the board from time to time by ordinance.

D. Permit Conditions.

1. Limitations. When the enforcement agency issues a permit pursuant to this chapter, it may condition the permit in any manner necessary to carry out the purposes of this chapter.

Conditions may include, but are not limited to such quantity and quality testing methods as the enforcement agency finds necessary.

2. Performance Bond. The enforcement agency may require a performance bond as a condition to the permit.

3. Persons Permitted to Work on Wells. All construction, reconstruction or destruction work on wells shall be performed by a person who possesses an active C-57 contractor's license in accordance with the provisions of the California Business and Professions Code, Section 7000, et. seq. and Water Code Section 13750.5.

4. Proper Disposal of Drilling Fluids. The permit shall contain a clause requiring the safe and appropriate handling and disposal of drilling fluids and other drilling materials used in connection with the permitted work.

5. Abandoned Wells. As a condition of a construction or reconstruction permit, any abandoned wells on the property shall be destroyed in accordance with standards provided in this chapter.

6. Posting of Permit. It shall be the responsibility of the permittee to maintain a copy of this permit on the drilling site during all stages of construction or destruction.

E. Permit—Denial. The enforcement agency shall deny an application for a permit if, in its judgment, issuance of a permit is not in the public interest.

F. Permit—Expiration. The permittee shall complete the work authorized by the permit within the time and before the date set out in the permit. If there have been exceptional circumstances, the enforcement agency may grant the applicant an extension. Upon the expiration of the permit, no further work shall be done unless and until the applicant has received an extension or a new permit.

G. Permit—Suspension and Revocation.

1. Circumstances for Such Action. The enforcement agency may suspend or revoke any permit issued pursuant to this chapter, whenever it finds that the permittee has violated any of the provisions of this chapter, or has misrepresented any material fact in his application or any supporting documents for such a permit. Prior to ordering any such suspension or revocation, the enforcement agency shall give the permittee an opportunity for a hearing thereon, after reasonable notice. The hearing shall be before the enforcement agency head or his designated representative. An appeal may be made as set forth below.

2. Consequences. No person whose permit has been suspended or revoked shall continue to perform the work for which the permit was granted until, in the case of suspension, such permit has been reinstated by the enforcement agency.

3. Ordered Additional Work. Upon suspending or revoking any permit, the enforcing agency may order the permittee to protect the underground waters from pollution or contamination, if any work already done by the permittee has left a well in such conditions as to constitute a hazard to the quality of the underground waters. No permittee or person who has held any permit issued pursuant to the chapter shall fail to comply with any such order.

(Ord. 370-90 (part), 1990)

8.20.030 - Well standards.

Except as otherwise specified, the standards for the construction, repair, reconstruction or destruction of wells shall be as set forth in:

A. Department of Water Resources Bulletin 74-81. The California Department of Water Resources Bulletin 74-81 "Water Well Standards, State of California," except as modified by subsequent revisions;

B. All Subsequent Supplements and Revisions. All subsequent Bulletin 74-81 supplements or revisions issued by the Department of Water Resources, once the revised standards have been reviewed at appropriate public hearing.

(Ord. 370-90 (part), 1990)

8.20.040 - Variances.

The enforcement agency shall have the power under the following specified conditions to grant a variance from any provision of the standards referenced above and to prescribe alternative requirements in their place.

A. Special Circumstances. There must be, in a specific case, a special circumstance where practical difficulties or unnecessary hardship would result from the strict interpretation and enforcement of any standard.

B. Intent of Chapter Not Compromised. There must be, in a specific case, a special circumstance where practical difficulties or unnecessary hardship would result from the strict interpretation and enforcement of any standard.

(Ord. 370-90 (part), 1990)

8.20.050 - Special groundwater protection.

The enforcement agency may designate areas where groundwater quality problems are known to exist and where a well will penetrate more than one aquifer. The enforcement agency may require in these designated areas special well seal(s) to prevent mixing of water from several aquifers. Where an applicant proposes well construction, reconstruction or destruction work in such an area, the enforcement agency may require the applicant to provide a report prepared by a registered geologist or registered civil engineer (California Business and Professions Code Sections 7850 and 6762 respectively) that identifies all strata containing poor quality water and recommends the location and specifications of the seal or seals needed to prevent the entrance of poor-quality water or its migration into other aquifers.

(Ord. 370-90 (part), 1990)

8.20.060 - Inspections.

The enforcement agency shall make an inspection of the annular seal construction work. It may make an initial inspection of each proposed drilling site, an inspection at the completion of the work, and inspections at such other times as it deems appropriate.

A. Initial Inspection. Upon receipt of an application, the enforcement agency may make an inspection of the drilling site prior to the issuance of a well permit. The purpose of this inspection is to determine whether there are any site conditions such that the enforcement agency shall do the following:

1. Relocation of Drilling Site. Require relocation of the drilling site should the location shown on the permit application be too close to potential sources of pollution;

2. Additional Conditions. Set additional conditions if needed to remediate any previously unknown groundwater quality protection problems.

B. Inspection of Well Seal. The enforcement agency shall inspect the annular space grout depth prior to the sealing.

1. Required Notice. The enforcement agency shall be notified by the well driller a minimum of twenty-four hours prior to sealing the annular space. Drillers who anticipate completing a well in less than one day shall notify the enforcement agency twenty-four hours prior to commencement of drilling and provide the anticipated time to commence the sealing of the annular space.

2. Should Enforcement Agency Fail to be Present. If the enforcement agency wishes to allow a seal to be tremied or placed without inspection, the driller shall seal the well in accordance with the standards of this chapter and any permit conditions. No seal shall be tremied or placed until permission to proceed is given.

C. Final Inspection. If requested by the enforcement agency, the driller shall notify the enforcement agency within seven days of the completion of their work at each drilling site. The enforcement agency may make a final inspection after completion of the work to determine whether the well was completed in accordance with this chapter.

D. Waiver of Inspections. The enforcement agency may waive inspections should any of the following conditions exist:

1. Well Inspected by Other Agencies. Inspections may be waived where the work will be inspected by the staff of the California Regional Water Quality Control Board or the California Department of Health Services if these designated agencies will inspect and report to the enforcement agency on all drilling features required by the standards.

2. Monitoring Wells under Specified Conditions. Inspections may be waived for monitoring wells that will penetrate only aquifers containing degraded waters or will penetrate only formations that normally contain no water.

3. Drilling Sites Known to Have No Threats to Groundwater Quality. Initial inspections may be waived when the drilling site is well known to the enforcement agency staff and it is known that no significant threats to groundwater quality exist in the area.

(Ord. 370-90 (part), 1990)

8.20.070 - Completion reports.

The driller shall provide the enforcement agency a completion report within thirty days of the completion of any well construction, reconstruction or destruction job.

A. Submittal of State "Report of Completion." A copy of the "Report of Completion" (Water Well Driller's Report, Department of Water Resources Form 188) required by California Water Code Section 13751 shall be submitted by the permittee to the enforcement agency within thirty days of construction, alteration or destruction of any well. This report shall document that the work was completed in accordance with the standards and all additional permit conditions.

This section shall not be deemed to release any person from the requirement to file said report with the State Department of Water Resources.

B. Confidentiality of Report. In accordance with California Water Code Section 13752, reports shall not be made available for inspection by the public but shall be made available for inspection by governmental agencies for use in making studies. Reports shall be made available to any person who obtains written authorization from the owner of the well.

C. Other Agency's Requirements. Nothing in this chapter shall be deemed to excuse any person from compliance with the provisions of California Water Code Sections 13750 through 13755 relating to notices and reports of completion or any other federal, state or local reporting regulations.

(Ord. 370-90 (part) , 1990)

8.20.080 - Appeals.

A. Right of Hearing. Any person whose application for a permit has been denied, or granted conditionally, or whose permit has been suspended or revoked, or whose variance request has been denied, may appeal to the board, in writing, within ten days after any such denial, conditional granting, suspension or revocation. Such appeal shall specify the ground upon which it is taken, and shall be accompanied by a filing fee as set forth herein. The clerk of the board shall set such appeal for hearing at the earliest practicable time, and shall notify the appellant and the enforcement agency, in writing, of the time so set at least five days prior to the hearing.

B. Action by the Board. After such hearing, the board may reverse, wholly or partly, or may modify the order or determination appealed from.

(Ord. 370-90 (part), 1990)

8.20.090 - Right of entry and inspection.

Representatives of the enforcement agency shall have the right to enter upon any premises at all reasonable times to make inspections and tests for the purpose of such enforcement and administration. If any such premises are occupied, he shall first present proper credentials and demand entry. If the same is unoccupied, he shall first make a reasonable effort to locate the owner or other person having charge or control of same and demand entry. If such entry is refused, he shall have recourse to such remedies as are provided by law to secure entry.

(Ord. 370-90 (part), 1990)

8.20.100 - Abatement of abandoned wells.

All persons owning an abandoned well as defined in the well standards shall destroy it before December 31, 1991, except those excluded by California Health and Safety Code Section 24440.

(Ord. 370-90 (part), 1990)

8.20.110 - Criminal and civil enforcement.

A. Violation a Misdemeanor. Any person who violates any of the provisions of this chapter is guilty of a misdemeanor, and upon conviction thereof is punishable by such penalties as the board shall from time to time set by ordinance.

B. Civil Enforcement—Notice of Violation.

1. Notice of Violation Recordation. Whenever the enforcement agency determines that a well (a) has not been completed in accordance with a well permit or the plans and specification relating thereto, (b) has been constructed without the required permit, or (c) an abandoned well has not been destroyed in accordance with the standards, the enforcement agency may record a notice of violation with the office of the county recorder. The owner(s) of the property, as revealed by the assessment roll, on which the violation is situated and any other person responsible for the violation shall be notified of the recordation, if their address is available.

   If the property owner(s) or authorized agent disagree with the determination, he may submit evidence to the enforcement agency indicating that there is no violation and then shall have a right to appeal an adverse decision of the enforcement agency to the board in accordance with the provisions of the following subsection.

2. Appeal—Action by the Board.

   a. Date of Hearing. Upon receipt of the notice of appeal, the board shall, within fifteen days following the filing of the appeal, set a date for public hearing thereon.

   b. Evidence. The evidence before the board shall consist of the records in the enforcement agency's files and any other relevant evidence which, in the judgment of the board, should be considered to effectuate and implement the policies of this chapter.

   c. Decision by Board. The board may reverse or affirm, wholly or in part, or modify the decision or the notice of violation and may make such order as should be made. Such action shall be final.

3. Removal of Violation Notice. The enforcement agency shall submit a removal of notice of violation to the county recorder when (a) it is determined by the enforcement agency or the board, after review, that no violation of this chapter exists; or (b) all required and corrective work has been completed and approved by the enforcement agency.

C. Civil Enforcement—Nuisance. Violations of this chapter may also be redressed in the manner hereinafter set forth by civil action. In addition to being subject to prosecution, any person who violates any of the provisions of this chapter may be made the subject of a civil action. Appropriate civil action includes, but is not limited to, injunctive relief and cost recovery.

D. Remedies Cumulative. The remedies available to the board to enforce this chapter are in addition to any other remedies available under ordinance or statute, and do not replace or supplant any other remedy but are cumulative thereto.

(Ord. 370-90 (part), 1990)

8.20.120 - Reports to the regional board.

Pursuant to California Water Code Section 13225 (c), the enforcement agency shall submit a report, not less than annually, to the California Regional Water Quality Control Board(s) having jurisdiction in their area. This report shall contain the following data, unless the regional board determines a lesser amount of information is necessary:

A. Wells Constructed or Destroyed. The number of wells constructed or destroyed;

B. Abatement Actions. Descriptions of all well destructions undertaken by the enforcement agency using its regulatory authority under nuisance abatement powers;

C. Variances Granted. A description of each specific case where variances were granted and the circumstances that made a variance necessary;

D. Inspection Waivers Granted. A description of each specific case where an inspection was waived and the circumstances that made the waiver necessary.

(Ord. 370-90 (part), 1990)

COUTY OF MADERA

WELL STANDARDS

Chapter 13.52 WELL STANDARDS

Sections:

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13.52.010 Purpose.

The purpose of this chapter is to protect the groundwater of the state and county for the health, welfare, safety, and enjoyment of the people in accordance with federal, state and local laws.

(Ord. 492B § 1, 2007: Ord. 492 (part), 1985).

13.52.020 Definitions.

All terms used in this chapter shall be defined as specified in the current editions of the California Health and Safety Code, California Water Code, California Code of Regulations, and California Department of Water Resources Bulletins (including revisions and addendums), or as stated in this section.

"Abandoned well" means a well that has not been used for a period of one year, unless the owner demonstrates the intention to use the well again for supplying water or other associated purpose (such as an observation well or injection well).

"Abatement" means the construction, reconstruction, repair or destruction of a well so as to eliminate a nuisance caused by a well polluting or contaminating groundwater.

"Abatement order" means both mandatory and prohibitory orders requiring or prohibiting the construction, reconstruction, repair or destruction of a well so as to eliminate a nuisance or potential hazard of a well polluting or contaminating the groundwater resource.

"Agricultural well" means a well used to supply water for irrigation or other agricultural purposes, including so-called "stock wells."

"Air conditioning well" means any well constructed to return to the groundwater any water which has been used as a coolant in air conditioning processes.

"Cathodic protection well" means any artificial excavation in excess of fifty feet deep, constructed by any method for the purpose of installing equipment or facilities for the protection electrically of metallic equipment in contact with the ground, commonly referred to as cathodic protection.

"Contamination" means the impairment of a quality of water to a degree which creates a hazard to the public health through poisoning or through spread of disease.

"Dairy well" means a water well used to supply water for a dairy farm where milk is produced. The water may also be used for domestic purposes.

"Director" means the director of environmental health of Madera County or his authorized representative.

"Domestic well" means a water well furnishing potable water for human consumption with four or fewer service connections and serving fewer than twenty-five individuals.

"Inactive well" means a well not operating but capable of being made operable with the placement of a pump.

"Observation and monitoring wells" means wells constructed for the purpose of observing or monitoring groundwater conditions.

"Out-of-service well" means a water well not presently in service but which the owner has declared is intended for future use.

"Person" means any person, firm, corporation, or governmental agency subject to the jurisdiction of the county.

"Pollution" means an alteration of the quality of water to a degree which unreasonably affects, as determined by reference to federal and state drinking water quality standards:

1. Such waters for beneficial uses; or
2. Facilities which serve such beneficial uses.

Pollution may include contamination.

"Public water system" means any system, publicly or privately owned that:

1. Has at least fifteen service connections which are used at least sixty days out of the year; or
2. Serves an average of at least twenty-five people at least sixty days out of the year.

Such a system shall be operated under the jurisdiction of the county or the California Public Utilities Commission.

"Public well" means a water well furnishing potable water for human consumption which has five or more service connections or regularly serves an average of at least twenty-five individuals daily at least sixty days of the year.

"Pump installation" means the setting of a pump on any domestic, industrial, commercial or agricultural well, but does not include the resetting of a pump on an agricultural well.

"Recharge or injection wells" means wells constructed to introduce water into the ground as a means of replenishing groundwater basins, repelling the intrusion of seawater or disposing of waste water.

"Repair or reconstruction of well" means the deepening of a well or the reperforation or replacement of a casing.

"Sanitary seal" means a grout, mastic, or mechanical device to make a watertight joint between the pump and casing or between the pump and concrete platform.

"Test hole" means a hole drilled for the specific purpose of determining geologic and hydrologic data, which is temporary in nature and is not cased.

"Test well" means a well constructed for the purpose of obtaining the information needed to design a well prior to its construction. Test wells are cased and can be converted to other uses such as observation and monitoring wells or, under certain circumstances, to production wells. Test wells are not the same as test holes.

"Well" or "water well" means any artificial excavation constructed by any method for the purpose of extracting water from, or injecting water into, the underground. This definition shall not include:

1. Oil and gas wells, or geothermal wells constructed under the jurisdiction of the Department of Conservation of the state of California, except those wells converted to use as water wells;
2. Wells used for the purposes of:
   a. Dewatering excavation during construction, or
   b. Stabilizing hillsides or earth embankments; or
3. Springs.

(Ord. 492B § 2, 2007: Ord. 492 (part), 1985).

13.52.030 Permits.

A. Permit Requirements.
   1. A well permit is required for all activities specified in the California Health and Safety Code (including its implementing regulations) and the Department of Water Resources' Well Bulletin(s) and standards. The application for a permit shall be in the form prescribed by the director. Every permit issued shall be contingent upon compliance with the requirements specified in this chapter and on the permit.
   2. A permit shall be required for the drilling of a test hole. If subsequent test holes are drilled at the same location within a period of thirty days, separate fees will not be

charged for each permit unless more than one completed well is constructed. Abandoned test holes shall be destroyed in accordance with the methods prescribed in the standards.

3. When the owner, the authorized representative, or a contractor makes an application for a permit, such applicant shall have on file a certificate of insurance which states that there is in existence a valid policy of workmen's compensation insurance in a form approved by the State Insurance Commissioner.
4. A contractor may make an application for a permit on behalf of the owner. If the contractor makes such application on behalf of the owner, he shall put their address and contractors' license number on such application.
5. A copy of the permit shall be posted at the work site prior to commencement of drilling operations. Any drilling contractor who fails to comply with this requirement and drills a water well for which a permit has not been secured shall be in violation of this chapter.

B. Permit Issuance.

1. No permit shall be issued on any parcel within a service area designated by the Public Utilities Commission or within five hundred feet of an existing public water system except:
   a. As required by the affected public water system; or
   b. When an existing well serving the parcel that is not currently connected to the affected public water system needs to be replaced or deepened and the applicable service area or public water system is under a connection ban. The parcel owner may apply for a permit from the director of environmental health to replace or deepen the existing well.
   c. When the public water system does not agree to provide service for domestic and/or fire flow purposes to the parcel within ten days of submittal of a written application for service.
2. The following conditions shall apply to the exceptions in subsection (B)(1):
   a. The parcel must have adequate area for private well and on-site sewage disposal system and reserve area, unless connected to a community sewer system.
   b. The applicant for a well shall make an effort to ensure that the operation of the well will not have an adverse effect on adjacent (private and public) wells by making a written offer of performing a pump test and drilling a monitoring well on adjacent parcels with wells within two hundred feet of the proposed well prior to drilling the new well.
   c. The applicant shall use drought-tolerant plant species and drip-type irrigation systems where appropriate.

C. Additional Permit Conditions.

1. Commercial landscaping wells on existing parcels served by a public water system are subject to the following additional conditions:
   a. The property owner shall install and test a backflow prevention device prior to the well being placed in service and comply with conditions as required by the water system.
   b. The well must be adequately protected from potential sources of contamination.
2.

Wells for commercial uses on parcels that are not connected to a water system shall be subject to applicable conditions placed on the public water system from applicable local, state and federal regulatory agencies.

D. Permit Term.

1. Each permit issued pursuant to this chapter shall expire and become null and void if the work authorized thereby has not been completed within one hundred eighty days following the issuance of the permit. An extension, not to exceed sixty days, may be granted by the director if requested prior to the expiration of a permit upon a finding that such work could not be completed for causes beyond the control of the permittee.

2. Upon expiration of any permit issued pursuant hereto, no further work may be done in connection with construction, repair, reconstruction or destruction of a well unless and until a new permit for such purpose is secured in accordance with the provisions of this chapter.

(Ord. 492B § 3, 2007: Ord. 492A § 1, 2002; Ord. 492 (part), 1985).

13.52.035 Revocation or suspension of permit.

A. A permit issued hereunder may be revoked or suspended by the director as hereinafter provided if it is determined that a violation of this chapter exists, and the permittee fails to correct such violations within thirty days after the date of mailing of the violation notice.

B. A permit may be revoked or suspended by the director if it is determined that the person to whom any permit was issued pursuant to this chapter has obtained the same by fraud or misrepresentation.

C. The suspension or revocation of any permit by the director shall not be effective until notice thereof in writing is mailed to the permittee, and the time for filing an appeal to the board of supervisors in accordance with Section 13.52.120 of this chapter has expired. The notice shall advise the permittee of their right to appeal and to stay the suspension or revocation pending such appeal.

D. Stop Work Order. Whenever any well construction, destruction, pump installation or well repair work is being done contrary to the requirements of this chapter, the director shall order work stopped by posting a notice to desist at the well site. No further work shall be done until the director deems that the necessary corrections have been made.

(Ord. 492B § 4, 2007).

13.52.040 Emergency exemption.

Should persons or property be threatened by a sudden unforeseen impairment in the quantity or quality of water available, so that it becomes necessary to obtain a new water supply when a permit cannot be obtained, work may begin without a permit. All work performed under such emergency conditions shall comply with the requirements of this chapter. In all such cases, the owner or the contractor shall, within two working days obtain a permit and file a statement with the director indicating the reason for the emergency work.

(Ord. 492 (part), 1985).

13.52.050 Well standards.

A. Standards Adopted. Excepted as otherwise specified, the standards for the construction, repair, reconstruction, or abandonment of wells published in the Department of Water Resources Bulletins 74-81 and 74-90, "Water Well Standards, State of California" and

subsequent revisions and addendums are incorporated and made a part of this chapter. Standards for monitoring wells shall be those adopted by the director in conformance with requirements of the Department of Water Resources.

B. Well Location. All wells shall be constructed to prevent the entrance of surface water and contaminated groundwater into the well or into the producing aquifer, and shall be separated a safe distance from potential sources of contamination and pollution. The following minimum horizontal distances shall be maintained for all wells furnishing potable water for human consumption:

	Agricultural Well (in feet)	Domestic Well (in feet)	Public Well (in feet)*
Agricultural wells		300	300
Areas of intense animal confinement	100	100	100
Leach line or disposal field	150	100	150
Seepage pit or cesspool	150	150	150
Septic tank	150	100	150
Sewer line	50	50	50

* The above separation distances are for wells with adequate annular seals drilled in dry upper consolidated formations that are less permeable than sand. Wells drilled in fractured rock formations need to have much greater separation distances.

C. Well Seals. Wells shall have a sanitary seal, surface seal, and an annular seal. An access opening in the well cap, well casing, or pump base for the purpose of disinfecting the well or measuring the water level shall be protected with a threaded, watertight plug or cap. Air vents shall be installed in an approved manner.

D. Casing Perforations. Perforation of monitoring well casings shall conform to standards and conditions common to the industry and prescribed by the director.

E. The well shall be located upstream of the groundwater gradient from potential sources of contamination. If this is not possible, additional permit conditions may apply.

F. The top of the casing shall be extended a minimum of twelve inches above ground level and/or twelve inches above the one hundred year floodplain to prevent flooding by drainage or runoff from the surrounding land. If the proposed well location appears to be within the one hundred year floodplain as shown on the appropriate Federal Emergency Management Agency (FEMA) flood maps, the applicant shall either provide documentation to show the site is above the floodplain or request an on-site inspection.

G. All wells shall be accessible for repair and maintenance.

H. All pump discharge pipes not discharging to the atmosphere shall be equipped with an approved check valve to prevent backflow or back-siphonage into the well when the pump shuts down. The check valve shall be installed between the pump head and the connection to the distribution system or standpipe.

I. Annular Seal. The annular space between the well casing and the wall of the drilled hole shall be effectively sealed with cement grout or other approved sealant material to protect against contamination or pollution by surface or shallow subsurface waters. The following minimum annular seal depths shall be required:

Type of Well	

	Minimum Depth of Annular Seal Below Ground Surface (in feet)
Agricultural wells	20
Air conditioning wells	20
Cathodic protection wells	20
Dairy wells	100
Domestic wells	20
Drainage wells	20
Industrial wells	50
Observation and monitoring wells	20
Public wells (community water supplies)	50

J. Sealing Conditions. The following are the requirements to be observed in sealing the annular space:

1. The sealing material shall consist of neat cement, cement grout, concrete, or bentonite clay, and shall conform to the specifications given in the standards (Department of Water Resources Bulletins 74-81 and 74-90) and subsequent revisions and addendums.
2. Gravel-Packed Wells. The width of the annular seal space between the wall of the drilled hole and the well casing, where applicable, shall be at least two inches. If gravel fill pipes are installed through the seal, the annular seal shall be of sufficient thickness to assure that there is a minimum of two inches between the gravel fill pipe and the wall of the drilled hole. If a temporary conductor casing is used, it shall be removed as the sealing material is placed. Where the well is to be gravel packed, a watertight cover shall be installed between the conductor pipe and the inner casing at the top of the well.

K. Surface Seal.

1. A concrete surface seal or slab shall be constructed on the ground surface around the top of the well casing and shall be free from cracks or other defects likely to detract from its weathertightness. The slab shall be monolithically poured on thoroughly compacted native earth and shall have a minimum thickness of four inches, and shall be extended at least two feet in all directions from the well casing and four feet or more in one direction if the storage tank is to be at the well location.
2. The surface of the concrete slab shall be smooth-troweled and shall be graded away from the well casing in all directions for a distance of at least one foot from the casing, at a fall of at least one-fourth inch per foot to provide sufficient fall to drain water away from the casing. The concrete slab shall be poured in contact with the sealant material in the annular space.

L. Sanitary Seal. A sanitary seal shall form a durable, weatherproof, and watertight seal on top of the well, between the pump base and the top of the well casing. When a pump is offset or submerged, the opening between the well casing and any pipes or cables which enter the well shall be closed by a watertight seal or cap.

M. Backflow Prevention. All pumping equipment shall be installed with protective devices to prevent the entrance of foreign matter or back siphonage into the well casing. A properly designed air gap may be considered an acceptable protective device for agricultural wells. No person shall install any equipment or mechanism, or use any water-treating chemical or substance, if such equipment, mechanism, chemical or substance may cause pollution or

contamination of the domestic water supply. Such equipment or mechanism may be permitted only when equipped with an approved backflow prevention device.

N. Building Code Compliance. All electrical, plumbing and appurtenant structural work relating to the water well installation or repair shall be performed in conformity with all applicable building code requirements.

O. Disinfection. All wells and associated equipment furnishing or in contact with potable water for domestic purposes, shall be disinfected after the construction, installation, or repair of the well, pump, or storage equipment and prior to its use or return to operation. The minimum concentration of the disinfectant solution shall be equivalent to at least one hundred ppm (parts per million) of available chlorine, with a minimum contact time of twelve hours.

P. Temporary Cover. During periods when no work is being done on the well, such as overnight, or while waiting for sealing material to set, the well and surrounding excavation, if any, shall be covered. The cover shall be strong and well enough anchored to prevent the introduction of foreign material into the well and to protect the public from a hazardous situation.

1. Whenever there is an interruption in work on the well (i.e., overnight shutdown during inclement weather, or waiting periods required for the setting up of sealing materials, testing or the installation of the pump), the well opening shall be closed with a cover to prevent the introduction of undesirable material into the well and to protect the public safety.
2. During interruptions of one week or more, a semipermanent cover shall be installed. For wells cased with steel, a steel cover tack-welded to the top of the casing is permitted.
3. Observation and monitoring wells must meet all standards with exception of the cement surface pad requirement.

Q. Inactive or Out-of-Service Well. The owner shall continuously maintain any well which is inactive or out of service, so as to be safe and to prevent pollution of any aquifer. A properly maintained inactive or out-of-service well shall not be considered to be an abandoned well. As evidence of intentions for future use, the owner shall properly maintain the well in such a way that:

1. The well has no defects which shall impair the quality of the water in the well or in the aquifers penetrated;
2. If the pump has been removed, the well casing shall be covered with a durable, weatherproof, and watertight seal to prevent unauthorized access and entrance of surface contaminants into the well;
3. The well is covered with a locked watertight cap or other secured means;
4. The well is marked so that it can be clearly seen;
5. The area surrounding the well is kept clear of brush or debris.

An inactive well shall not be used for the disposal of any liquid or solid waste.

R. Abandoned Well. Every abandoned well shall be considered the property owner's responsibility and shall be destroyed in accordance with the methods prescribed in the standards (Department of Water Resources Bulletin 74-81 and applicable revisions and addendums). Abandoned wells must be destroyed to promote and protect the public welfare by preventing pollution of the groundwater and physical injury to persons or damage to property. An abandoned well shall not be used for the disposal of any liquid or solid waste.

If the pump has been removed for repair or replacement, the well shall not be considered abandoned, provided that evidence of repair can be shown. During the repair period, the well shall

be adequately covered to prevent injury to people and to prevent the entrance of undesirable water or foreign matter. Observation or test wells used in the investigation or management of groundwater basins by governmental agencies or other appropriate engineering or research organizations are not considered abandoned so long as they are maintained for this purpose. However, such wells shall be covered with an appropriate cap, bearing the label, "Observation Well," and the name of the agency or organization. When these wells are no longer used for this purpose or for supplying water, they shall be considered abandoned.

S. Sampling Faucet. For domestic and public wells, a faucet shall be located on the discharge line ahead of the storage tank.

T. Water Level Measurements. A sounding tube of at least three-fourths inch in diameter or as approved by the environmental health director and material shall be installed in all public wells and extend from the surface to near the pump intake to allow water level measurements by electric sounder.

(Ord. 492B § 5, 2007: Ord. 492 (part), 1985).

13.52.060 Exceptions.

The director may authorize an exception to any provision of the standards in Section 13.52.050 when in his judgment the application of such provisions is unnecessary, or he may impose additional requirements if necessary to protect the quality of the underground water resource. Specific conditions or exceptions will be prescribed on the permit.

(Ord. 492 (part), 1985).

13.52.070 Well drillers and pump installers.

Wells shall be constructed and pumps installed only by contractors licensed in accordance with the provisions of the Contractors License Law of the state of California (Chapter 9, Division 3, Business and Professional Code).

(Ord. 492B § 6, 2007: Ord. 492 (part), 1985).

13.52.080 Inspection.

A. An inspection of the well site and surrounding property may be conducted and at any time during construction, reconstruction, repair or destruction of water wells to ensure compliance with the requirements of this chapter. The drilling contractor shall notify the department in advance as specified by the director prior to placement of seals.

B. The sanitary, surface, and annular seals on a well furnishing potable water for human consumption shall be installed prior to placing the well into service.

(Ord. 492B § 7, 2007: Ord. 492 (part), 1985).

13.52.090 Water analysis.

The property owner shall obtain water samples for chemical, radiological and bacteriological analyses following pump test procedures as required in Section 13.52.030(B)(2)(b) and as specified by the director. Sample results shall be submitted to environmental health department prior to the well being placed into service, or the property being sold or otherwise transferred, whichever comes first. Any new building proposing to use a previously unused well as a water source shall not receive a final building inspection until those results are submitted. The purpose of reporting water

quality analyses is to provide information to the property owner and the county regarding the presence or absence of constituents of concern.

(Ord. 492B § 8, 2007: Ord. 492 (part), 1985).

13.52.100 Replacement of new well.

If a new water well for which a valid permit was obtained should require abandonment and replacement within a period of one hundred eighty days after installation, an additional fee shall not be required. In the event of such an occurrence, the abandoned well shall be properly destroyed in accordance with the methods and requirements prescribed in the standards.

(Ord. 492 (part), 1985).

13.52.110 Reports.

A. Any person who intends to construct, deepen, reperforate, abandon, or destroy a well shall file the appropriate "Water Well Drillers Report" with the state of California, Department of Water Resources on their specified form and an official copy shall be furnished to the director within thirty days after completion of the permitted work.

B. Confidentiality of reports will be strictly enforced according to the California Water Code, Section 13752.

(Ord. 492B § 9, 2007: Ord. 492 (part), 1985).

13.52.120 Appeals.

A. Any person whose application for a permit or for an approval has been revoked, denied, modified or had additional standards imposed may, within thirty days after the date of such denial or revocation, appeal therefrom in writing, to the board of supervisors. The board shall set a date for hearing said appeal and the director, the appellant, and all affected public water systems shall be notified. This section does not authorize appeals to the board from any action of the director required by state law, regulation, or this chapter.

B. At the hearing of an appeal to the board of supervisors, any interested party may present oral or written evidence. Following the hearing, the board shall render a decision upon the appeal and may sustain, modify, or reverse any action of the director. The decision of the board shall be final.

(Ord. 492 (part), 1985).

13.52.130 Permit fees.

A fee schedule shall be established by resolution of the board of supervisors to cover the administrative costs of issuing a permit and performing installation and destruction inspections.

(Ord. 492B § 10, 2007: Ord. 492 (part), 1985).

13.52.140 Enforcement.

The director shall enforce this chapter and may perform all acts necessary or proper to accomplish the purposes of this chapter.

(Ord. 492 (part), 1985).

13.52.150 Violation.

A. Violation of this chapter is a misdemeanor, punishable by a fine not exceeding one thousand dollars or by imprisonment not to exceed six months or by both fine and imprisonment, together with any administrative costs. Each separate day or any portion thereof during which any violation occurs or continues constitutes a separate offense.

B. Any violation shall constitute a nuisance. The remedy to abate such nuisance shall be as prescribed in the Madera County Code and shall be in addition to any other remedy provided by this chapter or by law.

(Ord. 492B § 11, 2007: Ord. 492 (part), 1985).