East San Joaquin
WATER QUALITY COALITION
1201 L Street Modesto, CA 95354
www.esjcoalition.org

July 29, 2016

Pamela Creedon, Executive Officer
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive, #200
Rancho Cordova, CA 95670-6114

Dear Ms. Creedon,

The East San Joaquin Water Quality Coalition (ESJWQC) is resubmitting its revised Groundwater Quality Management Plan (GQMP) which incorporates responses to comments from Central Valley Regional Water Quality Control Board staff on the original submission on February 23, 2015. The submission of a GQMP is required by the Waste Discharge Requirements General Order for Growers within the Eastern San Joaquin Watershed that are Members of the ESJWQC (R5-2012-0116-R3). The GQMP incorporates the required elements in the Appendix MRP-1 and provides the ESJWQC's strategy for achieving compliance with the WDR.

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for knowingly submitting false information, including the possibility of fine and imprisonment for violations."

Submitted respectfully,

Parry Klassen
Executive Director
East San Joaquin Water Quality Coalition

Groundwater Quality

Management Plan

East San Joaquin
WATER QUALITY COALITION

Submitted February 23, 2015

Revised July 29, 2016

Irrigated Lands Regulatory Program

Central Valley Regional Water Quality Control Board

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LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

AB	Assembly Bill
BOD	Board of Directors
CASGEM	California Statewide Groundwater Elevation Monitoring
CDPH	California Department of Public Health
COC	Constituent of Concern
CTR	California Toxics Rule
CURES	Coalition for Urban Rural Environmental Sterwardship
CVHM	Central Valley Hydrologic Model
CVRWQCB	Central Valley Regional Water Quality Control Board
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability
DAC	Disadvantaged Community
DACT	Diaminochlorotriazine
DBCP	1,2-dibromo-3-chloropropane
DEA	Diethyl-atrazine
DEM	Digital Elevation Model
DOI	United States Department of the Interior
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
EC	Electrical Conductivity
EPA	U.S. Environmental Protection Agency
ESJHVA	East San Joaquin Water Quality Coalition High Vulnerability Area
ESJWQC	East San Joaquin Water Quality Coalition
ESRI	Environmental Systems Research Institute
FEP	Farm Evaluation Plan
GAR	Groundwater Assessment Report
GAMA	Geotracker database
GBA	Groundwater Basin Authority, Eastern San Joaquin County
GIS	Geographic Information System
GQMP	Groundwater Quality Management Plan
GQTM	Groundwater Quality Trend Monitoring
HHVA	Hydrogeologic High Vulnerability Area
I	Irrigated
ILP	Irrigated Lands Program
ILRP	Irrigated Land and Regulatory Program
IPNI	International Plan Nutrition Institute
IRWM	Integrated Regional Water Management Plan
LSCE	Luhdorff and Scalmanini Consulting Engineers
MAGPI	Merced Area Groundwater Pool Interests
MCL	Maximum Contaminant Level
MID	Merced (or Modesto) Irrigation District

MLJ-LLC	Michael L. Johnson, LLC
MPEP	Management Practice Evaluation Program
NA	Not Applicable
NI	Non-irrigated
NOA	Notice of Applicability
NMP	Nitrogen Management Plan
NRCS	Natural Resource Conservation Service
NWIS	National Water Information System
OID	Oakdale Irrigation District
PAM	Polyacrylamide
PCA	Pesticide Control Adviser
pH	Power of Hydrogen
PLSS	Public Land Survey System
SC	Specific Conductance
SJR	San Joaquin River
SNMP	Salt and Nitrate Management Plan
SWRCB	State Water Resources Control Board
TAF	Thousand Acre Feet
TDS	Total Dissolved Solids
TID	Turlock Irrigation District
TRS	Township Range Section, Public Land Survey System
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WDL	Water Data Library
WDR	Waste Discharge Requirements General Order r5-2012-0116-R2
WQO	Water Quality Objective
WQTL	Water Quality Trigger Limit

LIST OF UNITS

af	acre feet
°C	degrees Celcius
cm	centimeter
ft	foot
L	Liter
mg	milligram
µg	microgram
µmhos	microsiemens

INTRODUCTION AND BACKGROUND

This revision of the Comprehensive Groundwater Quality Management Plan (GQMP) addresses the requirements of the Waste Discharge Requirements General Order for Growers within the Eastern San Joaquin River Watershed (No. R5-2012-0116-R3). In addition, this revision includes some of the information requested by the Central Valley Regional Water Quality Control Board (the Regional Water Board or CVRWQCB) in their June 17, 2016 letter review of the Coalition's GQMP.

The GQMP presents the Coalition's approach to eliminating/reducing impairments of beneficial uses of groundwater. The Management Plan approach involves three activities: 1) identification of whether or not constituents of concern are related to agricultural practices, 2) outreach to all members whose parcels lay above groundwater identified as exceeding water quality parameters, providing recommendations of management practices with the potential to be effective in managing discharges, and 3) monitoring to evaluate the efficacy of those implemented management practices.

BACKGROUND

The Regional Water Board initiated the Irrigated Lands Program (ILP) in 2003 (and renewed in 2006) with the adoption of a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands. The ILP, later the Irrigated Lands Regulatory program (ILRP), was developed to regulate discharges from irrigated agriculture to surface waters. The Waste Discharge Requirements General Order for Growers within the Eastern San Joaquin River Watershed (WDR or the Order; No. R5-2012-0116-R3), along with other orders to be adopted for the irrigated lands within the Central Valley, constitute the long- term ILRP, an expansion of the initial ILRP.

The East San Joaquin Water Quality Coalition (ESJWQC or Coalition) has been selected as the third-party group representing Coalition Members in the East San Joaquin River Watershed. The ESJWQC is one of the 13 coalition groups in the Central Valley of California. Members of the ESJWQC are those landowners and/or operators of irrigated lands who have enrolled an irrigated land parcel(s) under the Order within the area represented by the ESJWQC. By enrolling an irrigated land parcel under the Order, members obtain regulatory coverage for operational discharges and agree to comply with the terms and conditions of the Order.

Following the Regional Board's adoption of the WDR on December 7, 2012 (revised October 3, 2013 and March 14, 2014), the Notice of Applicability (NOA) was approved on January 11, 2013 for ESJWQC. The approval date associated with the NOA started the timeline for several requirements, including submittal of an NOI from entities wishing to join the Coalition and for the Coalition to submit an outline of the Groundwater Assessment Report (GAR) (The Order, Section IV. A). The GAR provides the basis for the Groundwater Quality Management Plan, the Groundwater Quality Trend Monitoring Program and the Management Practices Evaluation Program.

The GAR outline was submitted April 11, 2013 (approved May 6, 2013) and the GAR was submitted January 13, 2014. The Coalition's GAR was 'conditionally' approved by the Regional Board on June 6, 2014, with a revised GAR to be submitted by August 11, 2014. A request from ESJWQC for an extension to the submittal date of the revised

GAR was approved by the Regional Board's Executive Director on August 8, 2014. An ESJWQC GAR Addendum was submitted November 5, 2014. The CVRWQCB gave final approval of the GAR in combination with the GAR Addendum on December 23, 2014. The CVRWQCB's final approval established the Comprehensive GQMP's required submittal date to be February 23, 2015, 60 days after review and approval of the revised GAR and GAR Addendum. A review of the ESJWQC's GQMP was provided by the CVRWQCB on June 17, 2016, establishing a second submittal date of July 29, 2016.

The GQMP was developed following the requirements listed in the ESJWQC's Order using existing groundwater data and a review of current regional management plans. The overarching goal of the GQMP is to improve the groundwater quality within the designated region of the Coalition in as timely a manner as possible. Requirements of the Order and where they can be found within the GQMP are listed in Table 1.

Table 1. WDR requirements for groundwater quality monitoring plans and their corresponding sections within the ESJWQC GQMP.

REQUIRED ELEMENT (APPENDIX MRP-1)	GROUNDWATER QUALITY MANAGEMENT PLAN SECTIONS
A. Introduction and Background	**Introduction and Background**
Previous work conducted to identify occurrence of COCs	
B. Physical Setting and Information	**Physical Setting and Geographical Characteristics**
B.1.a. Land use maps	Land Use
B.1.b. Identification of potential agricultural sources of COCs	Groundwater Constituents of Concern
B.1.c. Beneficial uses	Groundwater Beneficial Uses
B.1.d. Baseline of management practices	Existing Agricultural Management Practices
B.1.e. Summary, discussion, and compilation of surface water quality data	Previous Work to Identify Constituents of Concern in Groundwater
B.3. a. Soil information	Geology and Hydrology
B.3.b. Geology and hydrology	Geology and Hydrology
B.3.b.i. Regional geology	Geology and Hydrology
B.3.b.ii. Groundwater basins and sub-basins in area	Coalition Boundaries/Groundwater Hydrology
B.3.b.iii. Known water bearing zones	Groundwater Hydrology/Geology, Hydrogeology, and Groundwater Hydrology (within individual GQMP Zones)
B.3.b.iv. Identify water bearing zones used for domestic, irrigation, and municipal water	Geology and Hydrology
B.3.b.v. Aquifer characteristics	Geology and Hydrology
B.3.c. Identification of water chemistry	Geology and Hydrology
B.3.c. Identification of irrigation water sources	Land Use (Irrigated Land)
C. Management Plan Strategy	**Management Plan Strategy**
C.1. Description of approach	Description of Approach
C.2. Actions to meet goals and objectives	Management Plan Strategy
C.2.a. Compliance with receiving water limitations	Identify COCs in the GQMP Zones
C.2.b. Educate members	Adoption of Management Practices by Members / Outreach Methods
C.2.c. Identify, validate and implement management practices	Current Level of Management Practice Implementation / Management Practices to Control COCs
C.3 (a-c) Duties and responsibilities of individuals	Duties and Responsibilities
C.4. Strategies to implement the management plan tasks	Strategies to Implement Management Plan Tasks
C.4.a. ID entities or agencies	Agencies Contacted for Data and/or Assistance
C.4.b. ID management practices	Management Practices to Control COCs
C.4.c. ID outreach	Outreach Methods
C.4.d. Specific schedule and milestones	Specific Schedule and Milestones for Implementing Management Practices
C.4.e. Measurable performance goals with specific targets	Performance Goals and Performance Measures
D. Monitoring Methods	**Monitoring Methods**
D.3 Management Practice Evaluation Program and Groundwater Quality Trend Monitoring	Identify Management Practices that are Protective of Groundwater
E. Data Evaluation	**Data Evaluation**
F. Records and Reporting	**Records and Reporting**
G. Source Identification Study Requirements	**Strategies to Implement Management Plan Tasks**

COALITION BOUNDARIES

The East San Joaquin Water Quality Region encompasses an area of approximately 5.7 million acres (8,900 square miles), including approximately 1 million acres of irrigated land within the Eastern San Joaquin River Watershed. The Coalition region is bounded to the north by the Stanislaus River, to the south and west by the San Joaquin River, and to the east by the Sierra Nevada crest (Figure 1).

Groundwater Basin(s) within Coalition Region

Groundwater within the ESJWQC region lies within the San Joaquin Valley Groundwater Basin of the San Joaquin River Hydrologic Region as defined in Bulletin 118 from the Department of Water Resources (DWR) (Figure 2). From north to south, all or portions of seven groundwater subbasins lie within the Coalition region: Eastern San Joaquin, Modesto, Turlock, Merced, Chowchilla, Delta-Mendota, and Madera. The Modesto, Turlock, Merced, Chowchilla, and Madera subbasins are entirely within the Coalition boundaries while portions of the Eastern San Joaquin and Delta-Mendota subbasins lie to the north and southwest of the Coalition boundary, respectively. The Stanislaus River serves as the northern boundary of the Coalition with the exception of a relatively small sliver of land along the northern border which includes a portion of the Eastern San Joaquin subbasin north of and roughly parallel to the Stanislaus River. The San Joaquin River serves as the western and southern boundaries of the Coalition. The San Joaquin River is also the western boundary to the Modesto, Turlock, Merced, and Chowchilla subbasins. A portion of the Delta-Mendota subbasin extends from west to east across the San Joaquin River, bordering the Madera subbasin. The eastern portion of the San Joaquin Valley watershed and the Coalition is bounded by the crest of the Sierra Nevada. The groundwater subbasins within the Coalition, as defined by Bulletin 118, only reach the base of the foothills to the Sierra Nevada Mountains.

Figure 1. East San Joaquin Water Quality Coalition location within California.

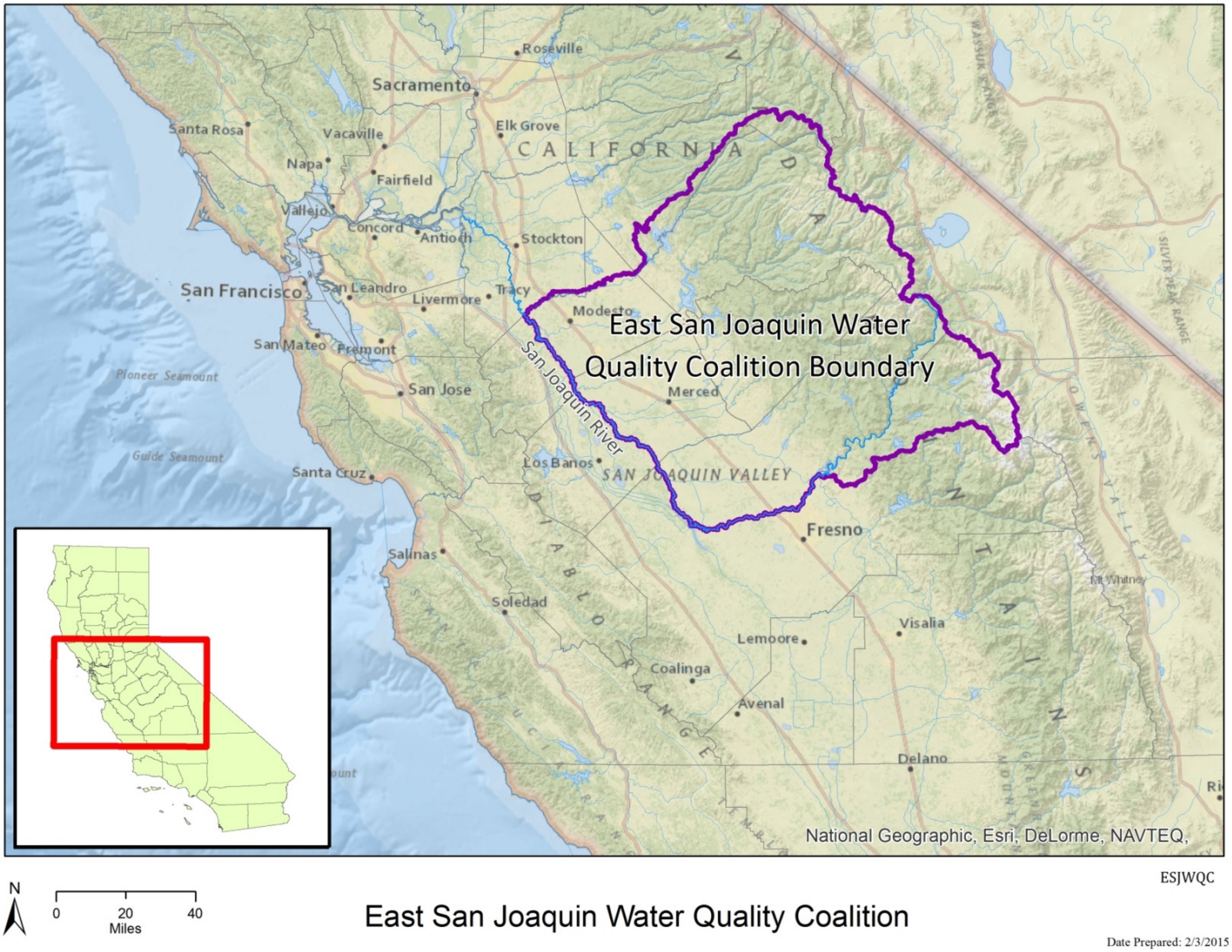
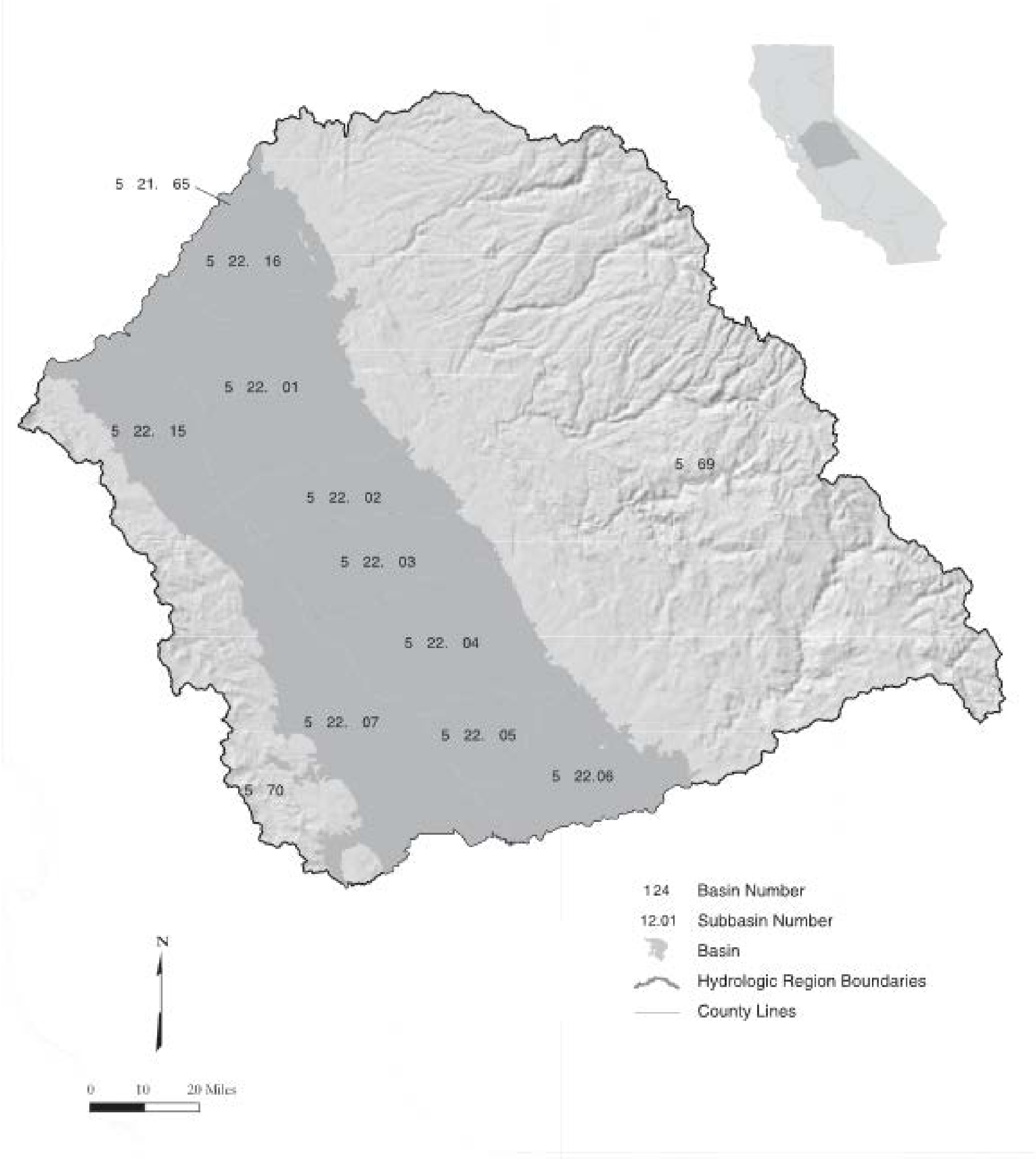


Figure 2. DWR Designated Groundwater Basins and Subbasins within the Coalition region (reproduced from Figure 35 from Bulletin 118, DWR 2003).



Groundwater Vulnerability Area Boundaries

The Coalition performed an analysis of groundwater vulnerability to contamination from agricultural discharge in the Coalition region. As part of the determination of groundwater vulnerability, the Department of Pesticide Regulations (DPR's) and the SWRCB's designations of high vulnerability areas were analyzed but ultimately rejected as suitable models of groundwater vulnerability for the Coalition's purposes. Results of the analysis were presented in the Groundwater Quality Assessment Report (GAR) (ESJWQC, 2015). Areas designated as High Vulnerability Areas (HVAs) in the GAR are shown in Table 6-10 and Figure 46 of the GAR (Figure 3 and Figure 4) in relation to DPR's Groundwater Protection Areas and SWRCB's Hydrogeologically Vulnerable Areas and acreages. As indicated in Figure 3, sections with known pesticide exceedances are consistently represented at a higher percentage within ESJWQC's HVAs than by both SWRCB's and DPR's high vulnerability designations. Furthermore, the GAR is to be updated every five years (due in 2019) and the footprint of the HVAs will be reevaluated based on the most recent water quality data, including those data sets provided by the DPR.

The HVA was further broken down into HVA Priority Areas 1-3 (Figure 54) within the "Groundwater Constituents of Concern" section of this document. The rational for the prioritization scheme includes consideration of the variables listed in Table 6-11 of the GAR and illustrated in Figure 4 of the GAR Addendum (Figure 5). The recalculated priority values presented in the GAR Addendum were used in this document when analyzing data in relation to the HVA and its Priority Areas.

Figure 3. Table 6-10 as presented in the ESJWQC's GAR comparing different groundwater vulnerability designations.

Table 6-10
Comparison of Pesticide Exceedances Within the Central Valley Floor by Vulnerability of Location

Area Description	Percent of Total Area of Sections with a Pesticide Exceedance that is Within Vulnerability Designation		Wells with a Pesticide Exceedance that are in Sections that are 50% Within Vulnerability Designation (all wells within sections are assigned to the high/low vulnerability category for the section based on the category that covers a dominant fraction [>50%] of the section)		Wells with a Pesticide Exceedance that are in Sections Where Any Part of the Section is Within the High Vulnerability Designation (all wells within sections are assigned to the high vulnerability category if any part of the section is within the relevant designated high vulnerability area)	
	High Vulnerability	*Low Vulnerability*	*High Vulnerability*	*Low Vulnerability*	*High Vulnerability*	*Low Vulnerability*
ESJ High Vulnerability Area	**96%**	**4%**	**97% (357 wells)**	**3% (10 wells)**	**100% (367 wells)**	**0% (0 wells)**
SWRCB Hydrogeologically Vulnerable Areas	60%	40%	62% (226 wells)	38% (141 wells)	69% (253 wells)	31% (114 wells)
DPR Groundwater Protection Areas	65%	35%	66% (244 wells)	34% (123 wells)	66% (244 wells)	34% (123 wells)
Leaching Potential	*62%*		*64% (236 wells)*		*64% (236 wells)*	*64% (236 wells)*
Runoff Potential	*3%*		*2% (8 wells)*		*2% (8 wells)*	*2% (8 wells)*
Leaching or Runoff Potential	*0%*		*0% (0 wells)*		*0% (0 wells)*	*0% (0 wells)*
Combined DPR and SWRCB Areas	90%	10%	89% (327 wells)	11% (40 wells)	92% (339 wells)	8% (28 wells)

Figure 4. Sections with pesticide exceedances in relation to the SWRCB Hydrogeologically Vulnerable Areas, the Department of Pesticide Regulation Groundwater Protection Areas, and the ESJWQC High Vulnerability Areas within the Coalition region (Figure 6-27, GAR).

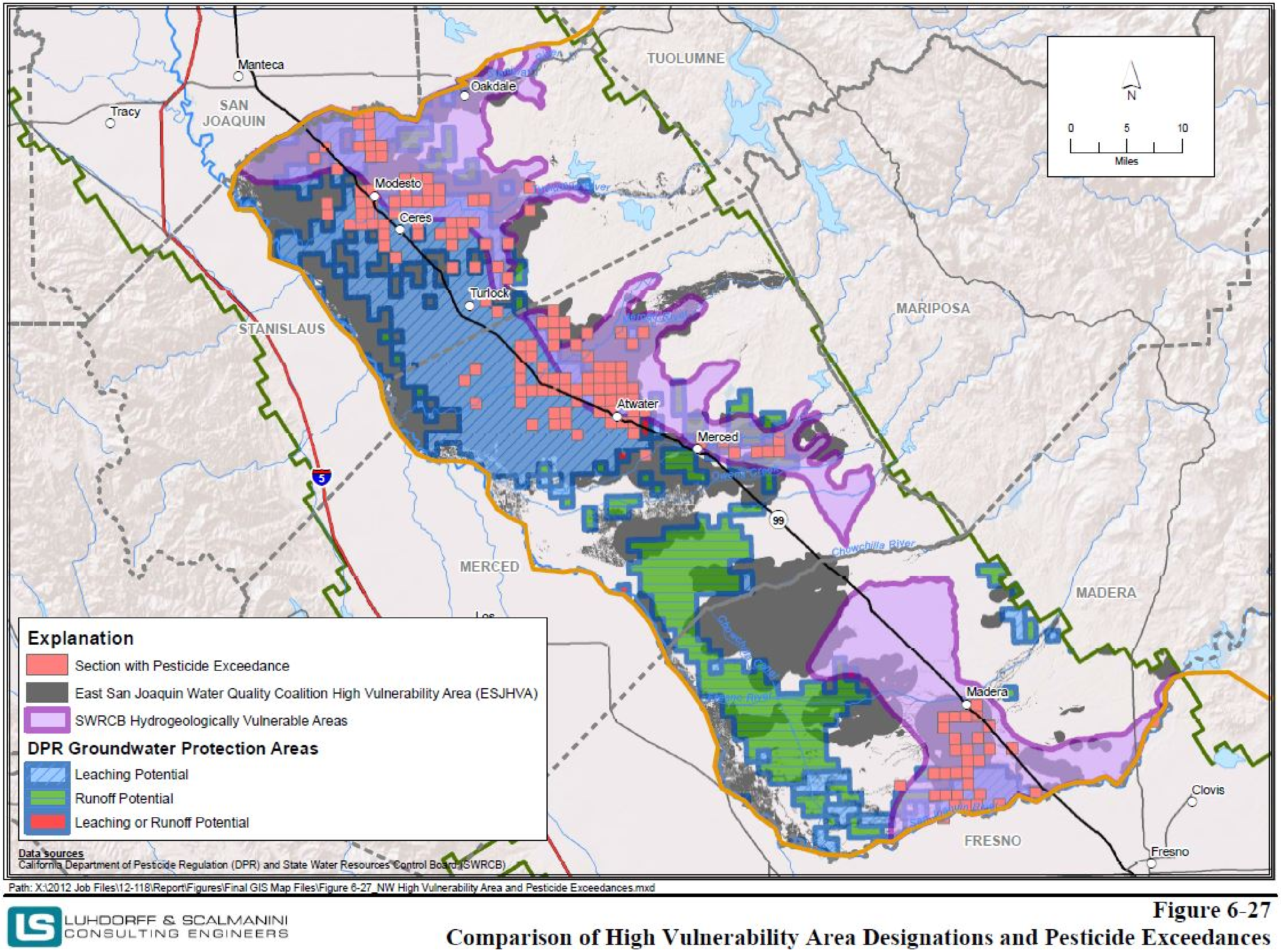
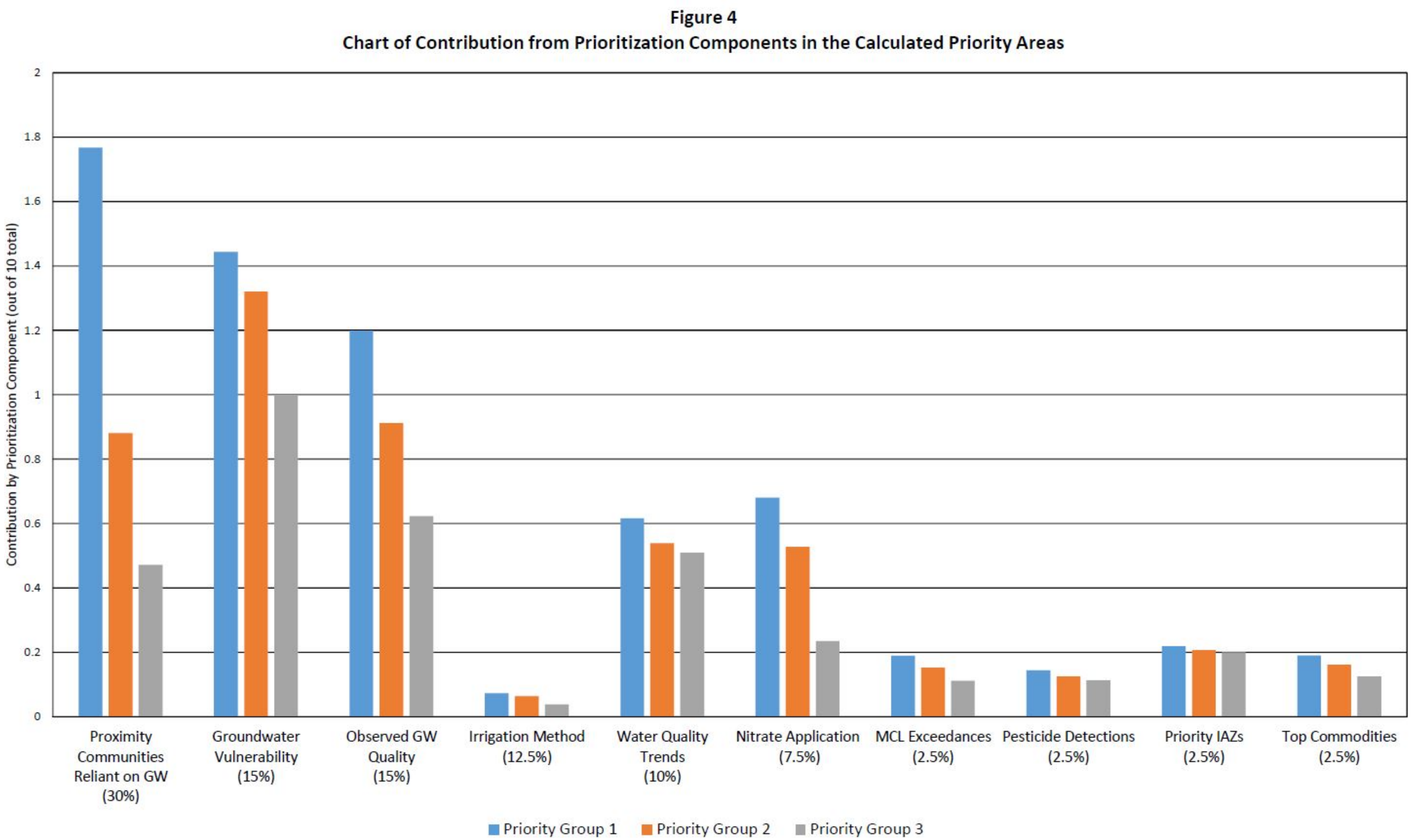


Figure 6-27
Comparison of High Vulnerability Area Designations and Pesticide Exceedances

Figure 5. Contribution of components used to determine the Priority Areas of the HVA as presented in Figure 4 of the GAR Addendum.



Groundwater Quality Management Plan Area

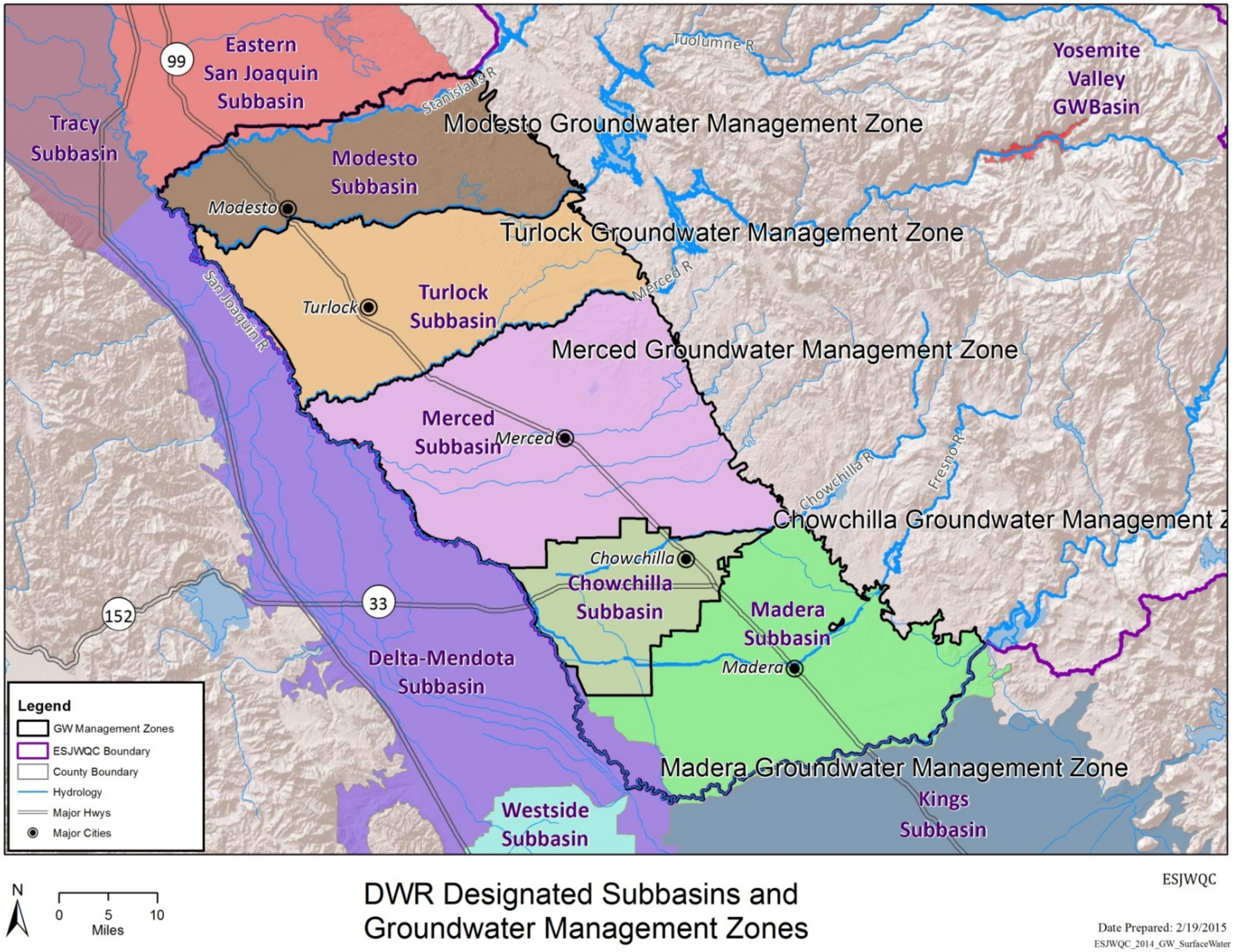
The Coalition area is divided into five groundwater management plan zones to facilitate the systematic monitoring of constituents of concern (COCs) and the implementation of an overall GQMP (Figure 6). The zone boundaries are based primarily on the underlying San Joaquin basin and subbasin boundaries within the San Joaquin River Hydrologic Region as estimated by Bulletin 118, page 168 (Figure 2). Zone names are based on the primary underlying subbasins from north to south: Modesto (including a portion of the Eastern San Joaquin subbasin), Turlock, Merced, Chowchilla, and Madera (including a portion of the Delta-Mendota subbasin; Table 2, Figure 6). The five zones overlay the western portion of the Coalition region, where the vast majority of agricultural land use occurs. Portions of the Delta-Mendota and Eastern San Joaquin subbasins are within the footprint of the Coalition boundaries and have been included within adjacent zones. The vast majority of agricultural activities (aside from ranching) occur within the Valley floor. Therefore, the GQMP Zones do not include the South American or Tracy subbasins of the San Joaquin Valley nor the Yosemite Valley or Los Banos Creek Valley basins (Table 2). The calculated High Priority Areas of the HVAs are illustrated relative to the Groundwater Quality Management Zones in Figure 55 of this document in the "Constituents of Concern" section.

Table 2. Basins and subbasins within the San Joaquin River Hydrologic Region located of the Coalition area.

BASIN	BASIN-SUBBASIN NUMBER	SUBBASIN NAME	GQMP ZONE	WITHIN COALITION REGION
San Joaquin Valley	5-21.65	South American	NA	NA
San Joaquin Valley	5-22.01	Eastern San Joaquin	Modesto	Partial
San Joaquin Valley	5-22.02	Modesto	Modesto	Entire
San Joaquin Valley	5-22.03	Turlock	Turlock	Entire
San Joaquin Valley	5-22.04	Merced	Merced	Entire
San Joaquin Valley	5-22.05	Chowchilla	Chowchilla	Entire
San Joaquin Valley	5-22.06	Madera	Madera	Entire
San Joaquin Valley	5-22.07	Delta-Mendota	Madera	Partial
San Joaquin Valley	5-22.15	Tracy	NA	NA
Yosemite Valley	5-69	NA	NA	NA
Los Banos Creek Valley	5-70	NA	NA	NA

NA – Not applicable

Figure 6. GQMP Zones based on DWR Designated Groundwater Basins and Subbasins within the Central Valley portion of the Coalition.



Other Groundwater Management Plans within the ESJWQC Region

In 1992, the State Legislature provided structure for more formal groundwater management with the passage of Assembly Bill (AB) 3030, the Groundwater Management Act (Water Code §10750 et seq.). Groundwater management, as defined in DWR's Bulletin 118 Update 2003, is the planned and coordinated monitoring, operation, and administration of a groundwater basin, or portion of a basin, with the goal of long-term groundwater resource sustainability. Under AB 359, introduced in 2011, local agencies are required to provide a copy of their groundwater management plan to DWR and for DWR to provide public access to those plans.

Several entities (other than agricultural landowners/operators) whose management practices could affect groundwater quality are located within the Coalition area boundaries including portions of several irrigation districts, numerous federal and state water districts, municipal water companies, and sanitation districts. Oakdale, Modesto, Turlock, and Merced Irrigation Districts are now members of the ESJWQC. Table 3 lists the water agencies within the GQMP area, the subbasin(s) within which they fall and whether there is an existing groundwater management plan that is associated with the agency.

Table 3. Water agencies and associated groundwater basin and subbasins (partial or entire) within the GQMP area. Subbasins are listed as they appear from north to south according the DWR's Bulletin 118.

Water Agencies	Eastern San Joaquin	Modesto	Turlock	Merced	Chowchilla	Madera	Delta-Mendota	Yosemite Valley[1]	Participating in an Existing Groundwater Management Plan[2]
River Junction Rec. Dist. #2064	X	X					X		
South Delta Water Agency	X	X					X		
City of Riverbank W.S.A.	X	X							X
Oakdale Irrigation District	X	X							X
South San Joaquin Irrigation District	X	X							
Turlock Irrigation District		X	X	X			X		X
City of Ceres W.S.A.		X	X						X
Eastside Water District		X	X						X
Modesto Irrigation District		X	X						X
Calaveras County Water District		X							X
City of Modesto		X							
City of Oakdale		X							
County of Stanislaus		X							
Del Este Water Company (acquired by the City of Modesto)		X							X
Stanislaus and Tuolumne Rivers' Groundwater Subbasin Association		X							
Tuolumne Utilities District		X							
Merced Irrigation District			X	X					X
Ballico Community Service District			X						X
Ballico-Cortez Water District (inactive)			X						X
City of Hughson			X						X
City of Turlock W.S.A.			X						X
Delhi County Water District			X						X

Water Agencies	Eastern San Joaquin	Modesto	Turlock	Merced	Chowchilla	Madera	Delta-Mendota	Yosemite Valley[1]	Participating in an Existing Groundwater Management Plan[2]
Denair Community Service District			X						X
Hilmar County Water District			X						X
Keyes Community Services District			X						X
Chowchilla Water District				X	X	X			X
Merced Area Groundwater Pool Interests				X	X		X		X
Sierra Water District (inactive)				X	X		X		
El Nido Irrigation District				X	X				X
Le Grand-Athlone Water District				X	X				X
Mariposa County Water Agency				X		X			
San Luis Canal Co.				X			X		X
Black Rascal Water Company				X					X
City of Atwater W.S.A.				X					X
City of Livingston				X					X
City of Merced Water District				X					X
County of Merced				X					X
Eagle Field Water District				X					X
East Merced Resource Conservtion District				X					X
Le Grand Community Service District				X					X
Lone Tree Mutual Water Company				X					
Meadowbrook Water Company				X					X
Merquin County Water District				X					X
Pacheco Water District				X					X
Plainsburg Irrigation District				X					
Planada Community Services District				X					X
San Luis Water District				X					X
Stevinson Irrigation Water District				X					X
Turner Island Water District				X					X
Winton Water and Sanitation District				X					X
Columbia Canal Company					X	X	X		X
Madera Irrigation District					X	X			X
Central California Irrigation District					X		X		X
Clayton Water District					X		X		
California Water Service Company					X				
Chowchilla-Red Top Resource Conservation District					X				X
New Stone Water District					X				
Aliso Water District						X	X		X
City of Fresno Service Area						X			
City of Madera W.S.A.						X			X[3]
County of Fresno Service Area						X			X
Fresno Co. Waterworks #18						X			
Fresno Irrigation District						X			X
Gravelly Ford Water District						X			X

Water Agencies	Eastern San Joaquin	Modesto	Turlock	Merced	Chowchilla	Madera	Delta-Mendota	Yosemite Valley[1]	Participating in an Existing Groundwater Management Plan[2]
Madera Water District						X			X
Mesa Water District						X			
Pinedale County Water District						X			
Root Creek Water District						X			X
Farmers Water District							X		
Patterson Water District							X		X
Bear Valley Community Services District								X	X
Fish Camp Mutual Water Company								X	
Groveland Community Service District								X	
Hidden Lake Estates								X	
Lake Don Pedro Community Services District								X	
Leland Meadows Water District								X	
Ponderosa Basin Mutual Water Company								X	
Sierra Cedars Community Services District								X	
Tuolumne County Water District No. 1								X	
Yosemite Alpine Community Services District								X	

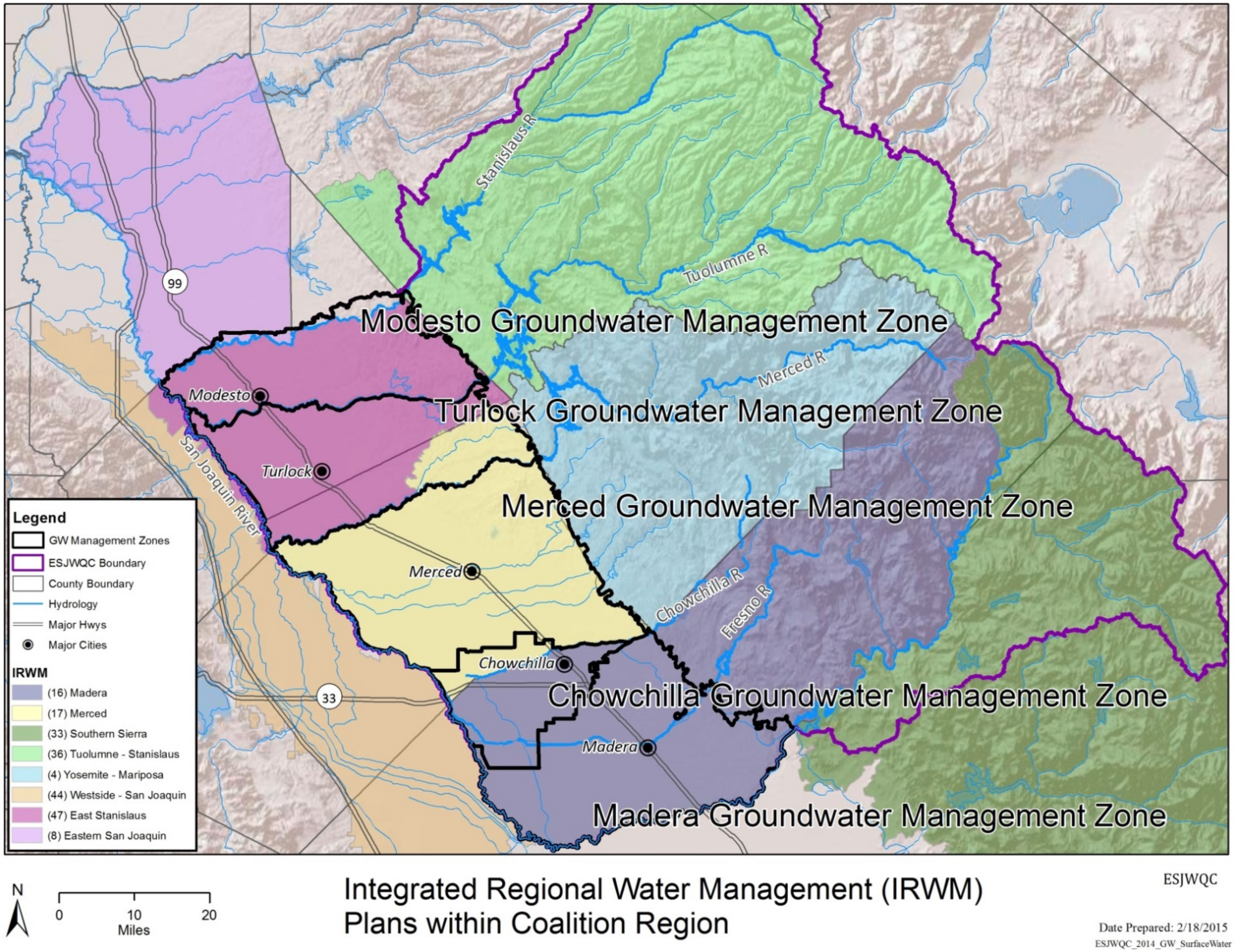
[1] Yosemite Valley groundwater basin is located east of and outside of the Central Valley and the Study area of this report.
[2] According to *California Water Plan Update 2013 (Draft)*, DWR; *Status of Groundwater Management in California, 2004*, DWR (http://www.water.ca.gov/pubs/groundwater/bulletin_118/california's_groundwater__bulletin_118_-_update_2003_/cagwmgmt10jan05-final.pdf); and DWR, *Bulletin 118*, updates.
[3] With the exclusion of 800 acres, the City is included in the Madera ID AB3030.

In 2002, the Integrated Regional Water Management Act was created when Senate Bill 1672 was passed. With the passing of Proposition 50 in 2002 (the Water Security, Clean Drinking Water, Coastal and Beach Protection Act), funding for the preparation of Integrated Regional Water Management Plans (IRWMPs) was in place. IRWMPs define planning regions and identify strategies that allow for the regional management of water resources (supply, quality, management, and ecosystem restoration). The IRWM program is currently administered by DWR. IRWMs in the GQMP area are Madera, Merced, and East Stanislaus (Table 4, Figure 7).

Table 4. GQMP Zones, underlying subbasins (partial or entire), counties and Integrated Regional Water Management Plans (IRWMs) overlaying the Zone (partial or entire) within the irrigated land in ESJWQC.

GQMP Zones	Subbasins	Associated County(s)	Associated IRWM(s)
Modesto	Eastern San Joaquin	San Joaquin/Calaveras/Stanislaus	Eastern San Joaquin
	Modesto	Stanislaus	East Stanislaus
Turlock	Turlock	Merced/Stanislaus	East Stanislaus
Merced	Merced	Merced	Merced
Chowchilla	Chowchilla	Madera/Chowchilla	Madera
Madera	Madera	Madera	Madera
	Delta-Mendota	Fresno/Madera/Merced/Stanislaus	Madera

Figure 7. Integrated Regional Water Management regions overlaying the GQMP Zones of the Coalition region.



PHYSICAL SETTING AND GEOGRAPHICAL CHARACTERISTICS

The ESJWQC GQMP area includes the portions of Stanislaus and Merced counties east of the San Joaquin River, Madera County, the portion of Fresno County that drains directly into the San Joaquin River, and the portion of San Joaquin County that drains directly into the Stanislaus River (Table 5). The eastern counties within the boundary include Tuolumne, Mariposa, and the portions of Calaveras and Alpine Counties that drain into the Stanislaus River. Within the Coalition region, the major population centers include Madera, Merced, Modesto, and Turlock with smaller communities spread throughout the Central Valley Floor and in to the Sierra foothills. The ESJWQC consists of 3,971 Members who are landowners/growers of approximately 720,000 acres of land.

Table 5. GQMP Zones, underlying subbasins (partial or entire), and counties overlaying the GQMP Monitoring Zones (partial or entire, in alphabetical order) within the irrigated land in ESJWQC.

GQMP Zones	Subbasins	Associated County(s)
Modesto	Eastern San Joaquin	Calaveras/San Joaquin/Stanislaus
	Modesto	Stanislaus
Turlock	Turlock	Merced/Stanislaus
Merced	Merced	Merced
Chowchilla	Chowchilla	Madera/Merced
Madera	Madera	Madera
	Delta-Mendota	Fresno/Madera/Merced/Stanislaus

[1] Table contents from DWR's Bulletin 118

Elevations in the Coalition region range from less than 100 feet above mean sea level to over 10,000 feet along the Sierra crest as shown in Figure 8 in this document (Figure 2-1, GAR). The topography in the Coalition region ranges from flat to rolling land within the Central Valley Floor area to steep alpine terrain at higher elevations. Within the Central Valley Floor area, the topography flattens to the west with much of the area having a slope of less than 0.5 degrees (1 %). Topographic slope within the Central Valley Floor area of the Coalition region is shown in Figure 9 in this document (Figure 2-2, GAR).

The climate of the Coalition region ranges greatly from the Central Valley Floor to the higher elevations. Annual precipitation ranges from less than 10 inches in areas of the Central Valley Floor to more than 60 inches at high elevations. A map showing the spatial distribution of average annual precipitation in the Coalition area is included as Figure 10 (Figure 2-3, GAR). Most of the Central Valley Floor area receives less than 14 inches of annual precipitation with many areas having less than 12 inches of annual precipitation. Figure 11 (Figure 2-4, GAR) shows average monthly precipitation at Modesto, Merced, and Madera within the Central Valley Floor. Precipitation in the Central Valley Floor occurs mainly during winter months with almost 90 percent of precipitation occurring between November and April (GAR, page 5).

Figure 8. Elevation map within the Coalition region (Figure 2-1, GAR).

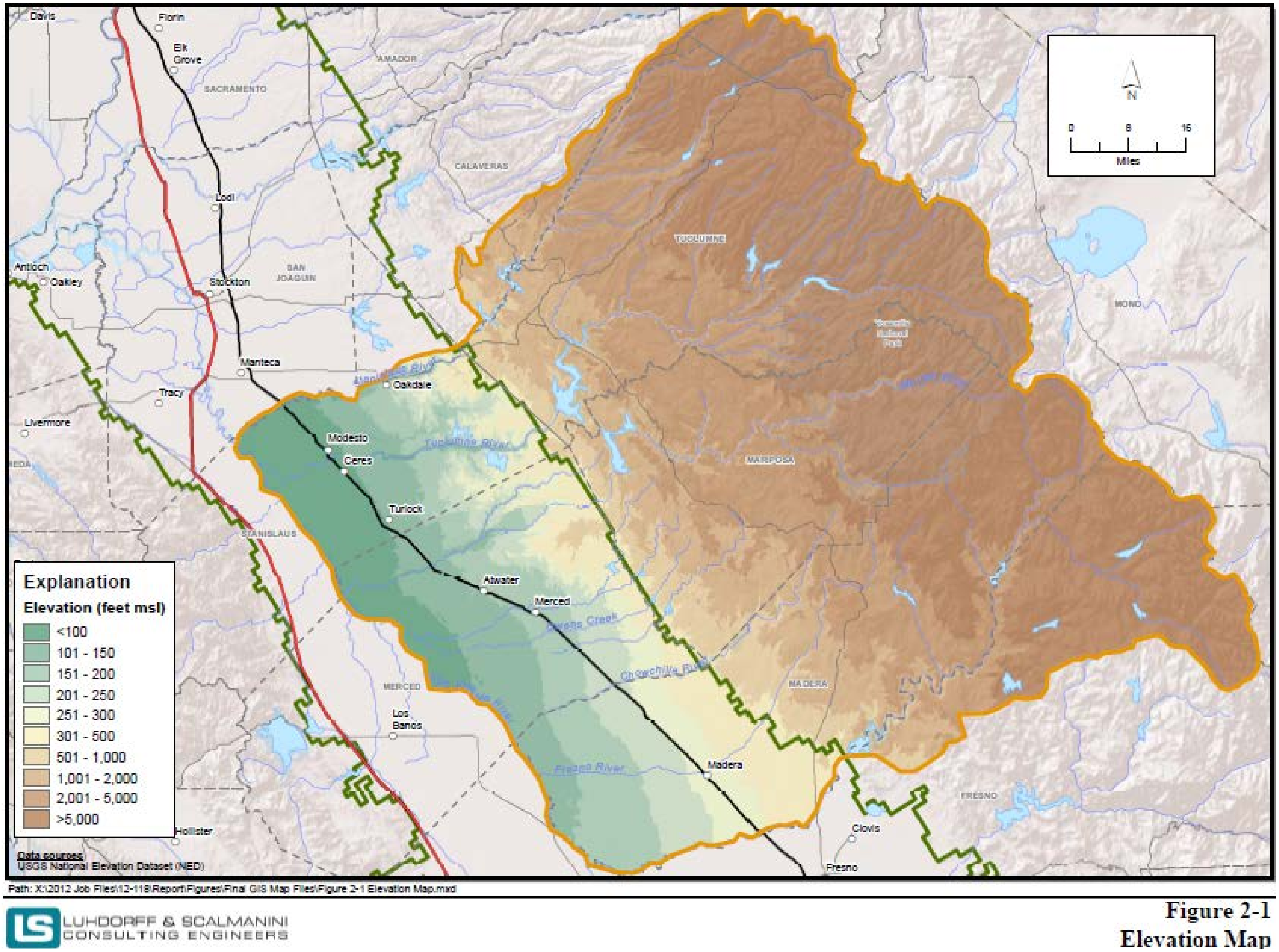


Figure 9. Slope map of the irrigated lands within the Coalition region (Figure 2-2, GAR).

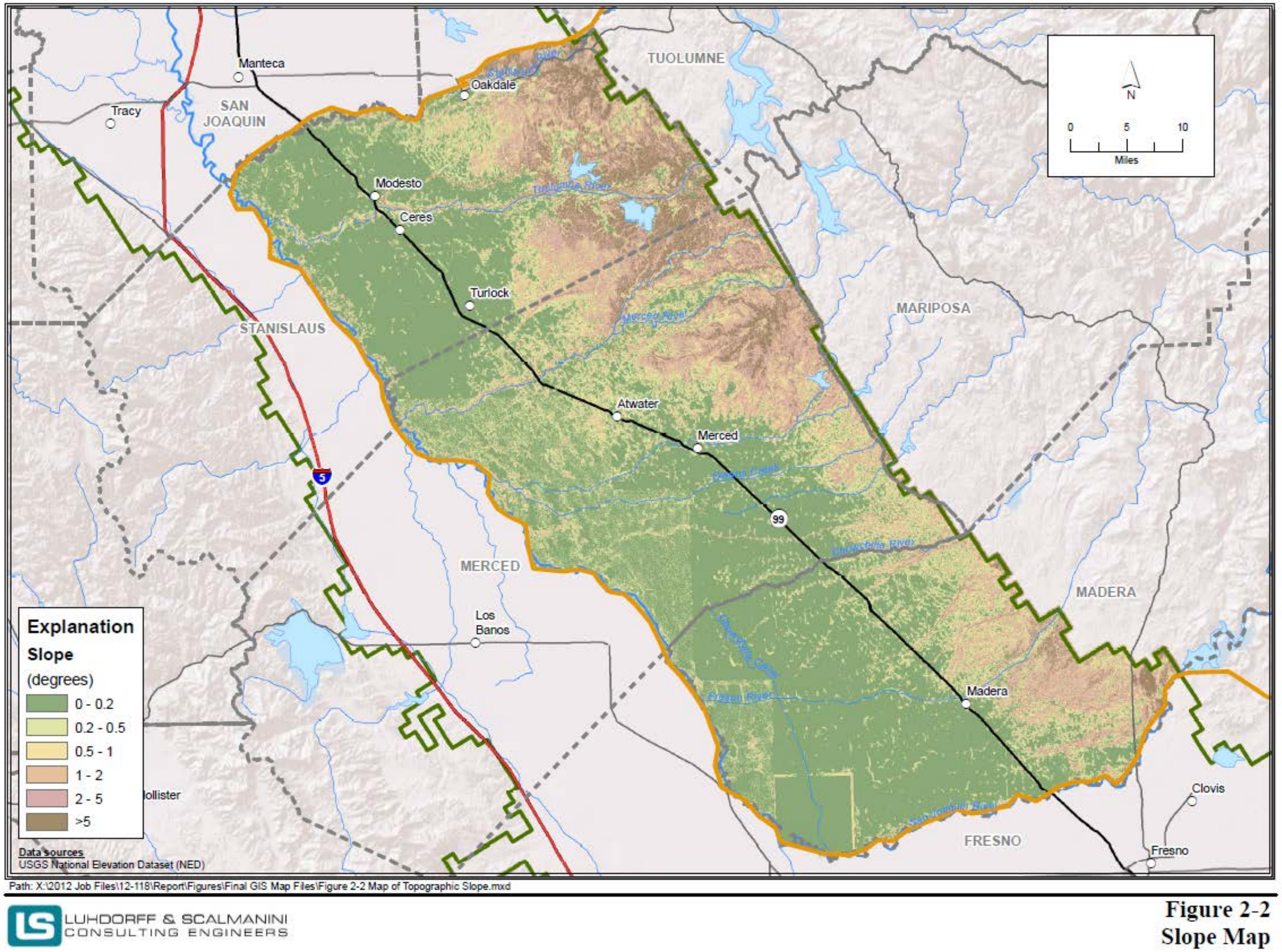


Figure 10. Annual average precipitation within the Coalition region (Figure 2-3, GAR).

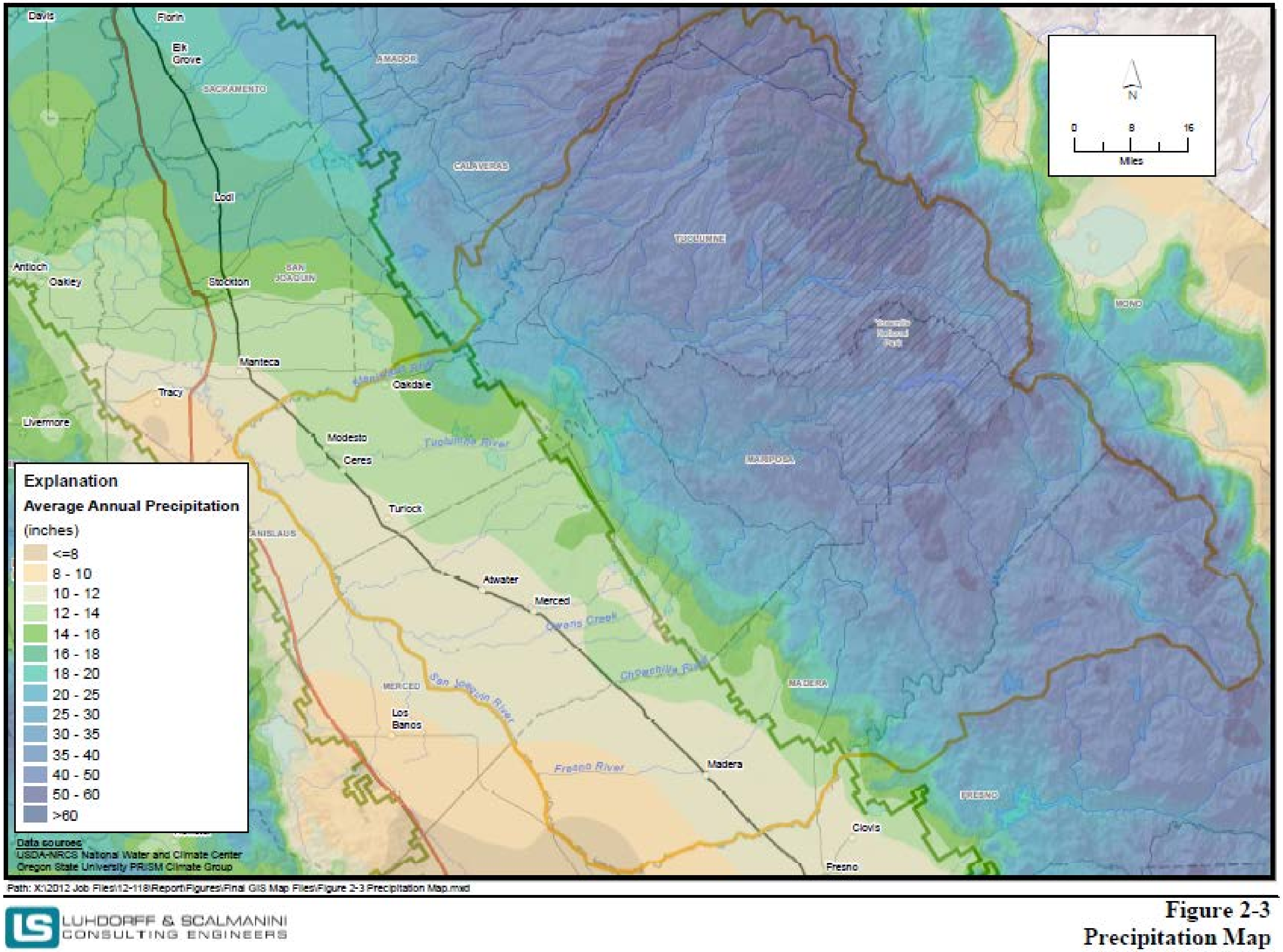
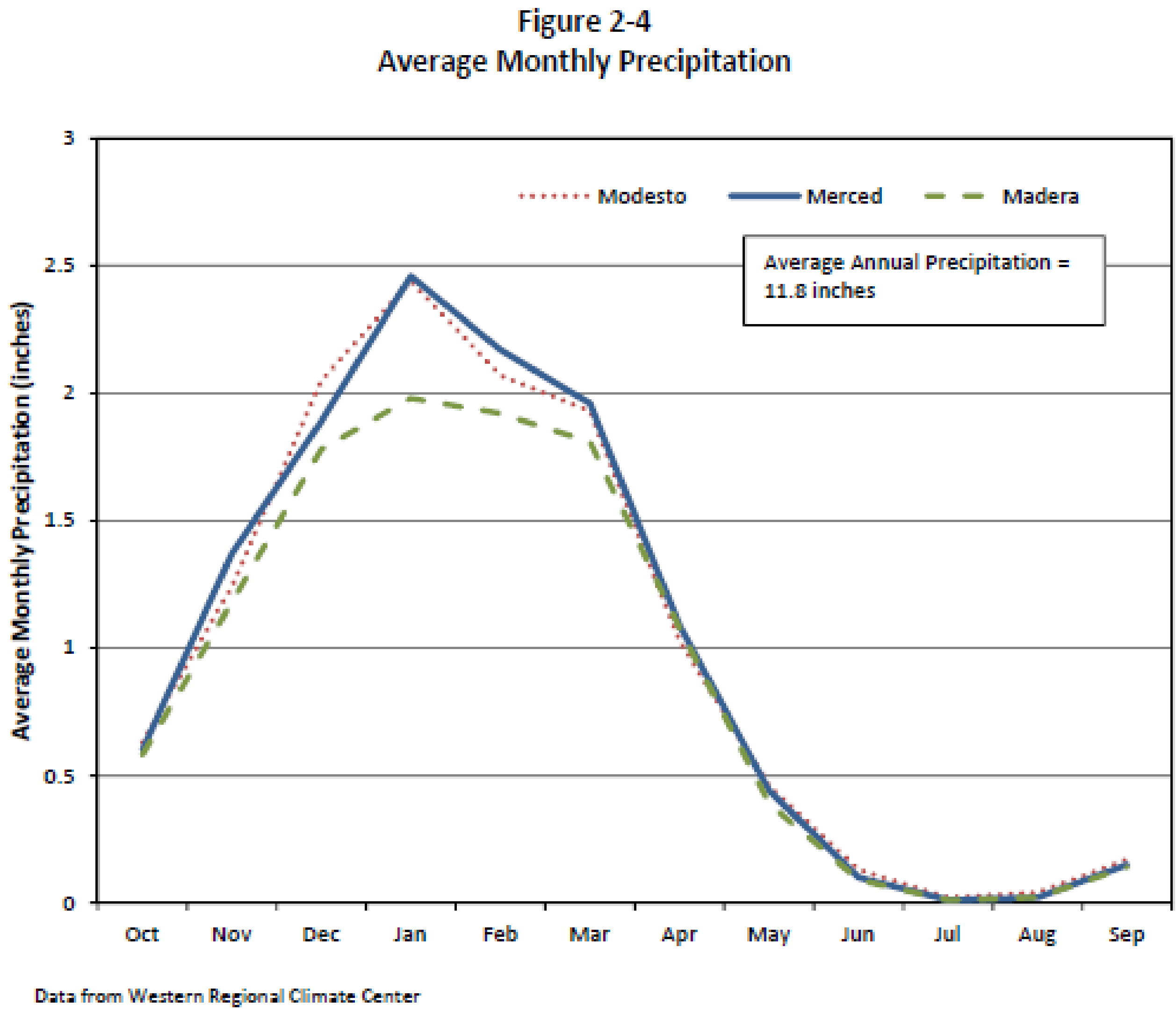


Figure 11. Average monthly precipitation values in the cities of Modesto, Merced, and Madera, CA (Figure 2-4, GAR).



GEOLOGY AND HYDROGEOLOGY

Descriptions of GQMP Zone-specific soil characteristics, hydrology, and land use are included within the individual GQMP Zone sections. The general description of the geology, hydrogeology, and soils of the Central Valley Floor within the Coalition region is provided in the GAR (pp 7-18) and summarized here.

The Coalition region is located within the San Joaquin Valley, near the southern end of the Central Valley of California in the Great Valley Geomorphic Province. The trough-shaped Central Valley has been filled with interlayered sediments of sand, gravel, silt, and clay derived from erosion of the Sierra Nevada and Coast Range mountains. Figure 12 (Figure 3-1, GAR) shows the geology within the Coalition region as generalized from Jennings (1977). Figure 13 and Figure 14(Figure 3-2, GAR) show more detailed geologic mapping focusing on the Central Valley Floor area of the Coalition region. The fill deposits mapped throughout much of the valley extend vertically for thousands of feet and the texture of sediments varies in the east-west direction across the valley. Coalescing alluvial fans have formed along the sides of the valley, primarily from the Sierra Nevada with a lesser extent coming from the Coastal Range. Alluvial fans with course textured material generally extend from the edges of the valley, gradually becoming finer towards the axis of the valley. Lacustrine and flood plain deposits also exist closer to the valley axis as thick silt and clay layers. Clay sediments referred to as the Corcoran Clay extend along parts of the San Joaquin Valley floor and generally are located along the western portion of the Coalition region. Resistant sedimentary, metamorphic, volcanic, and crystalline rocks define the foothills and mountains that border the eastern edge of the Central Valley Floor. The regional dip of strata is generally to the southwest.

Figure 12. Generalized geologic map of the Coalition region (Figure 3-1, GAR).

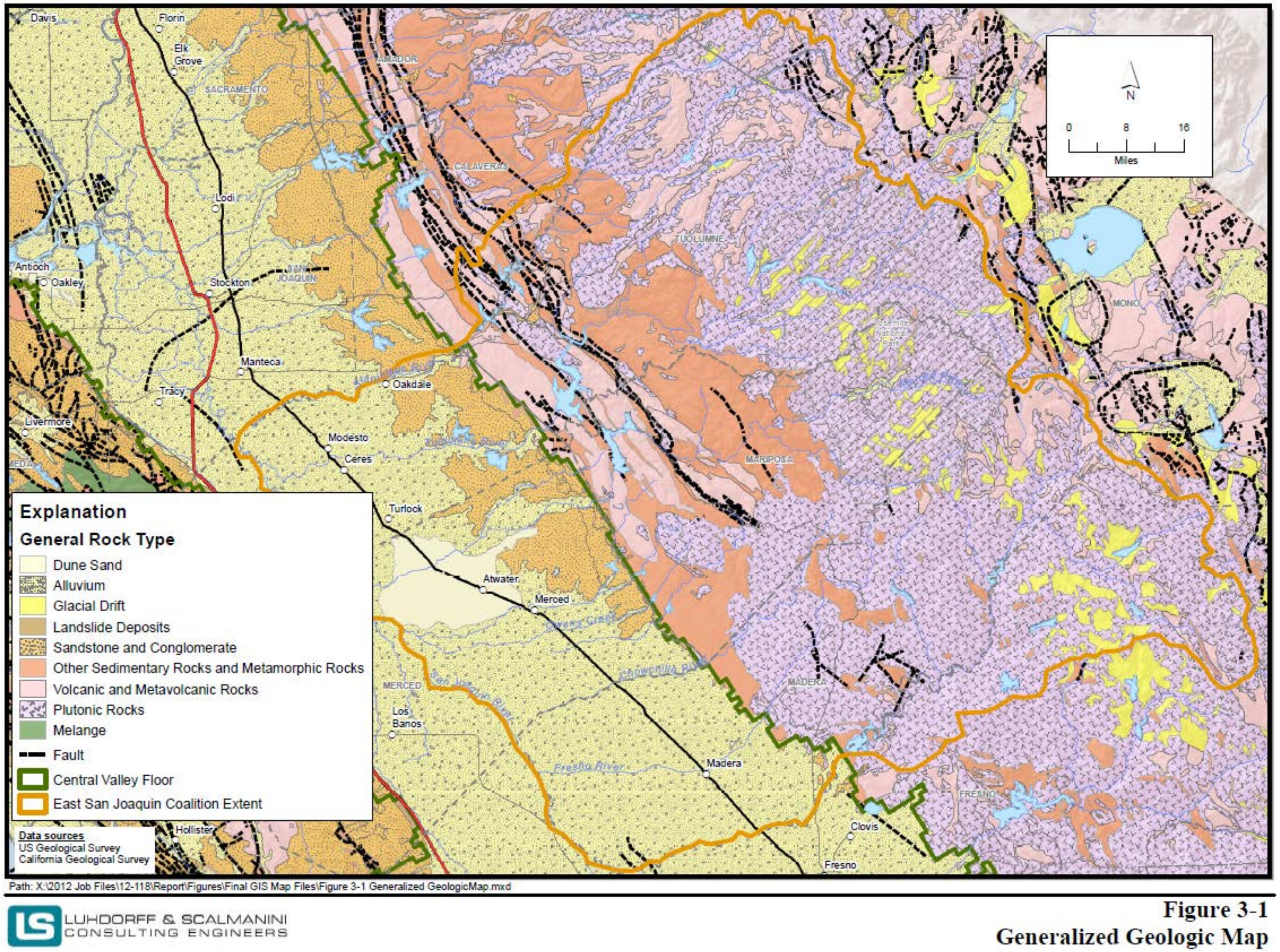


Figure 13. Geologic Map of the Central Valley floor area (Figure 3-2, GAR).

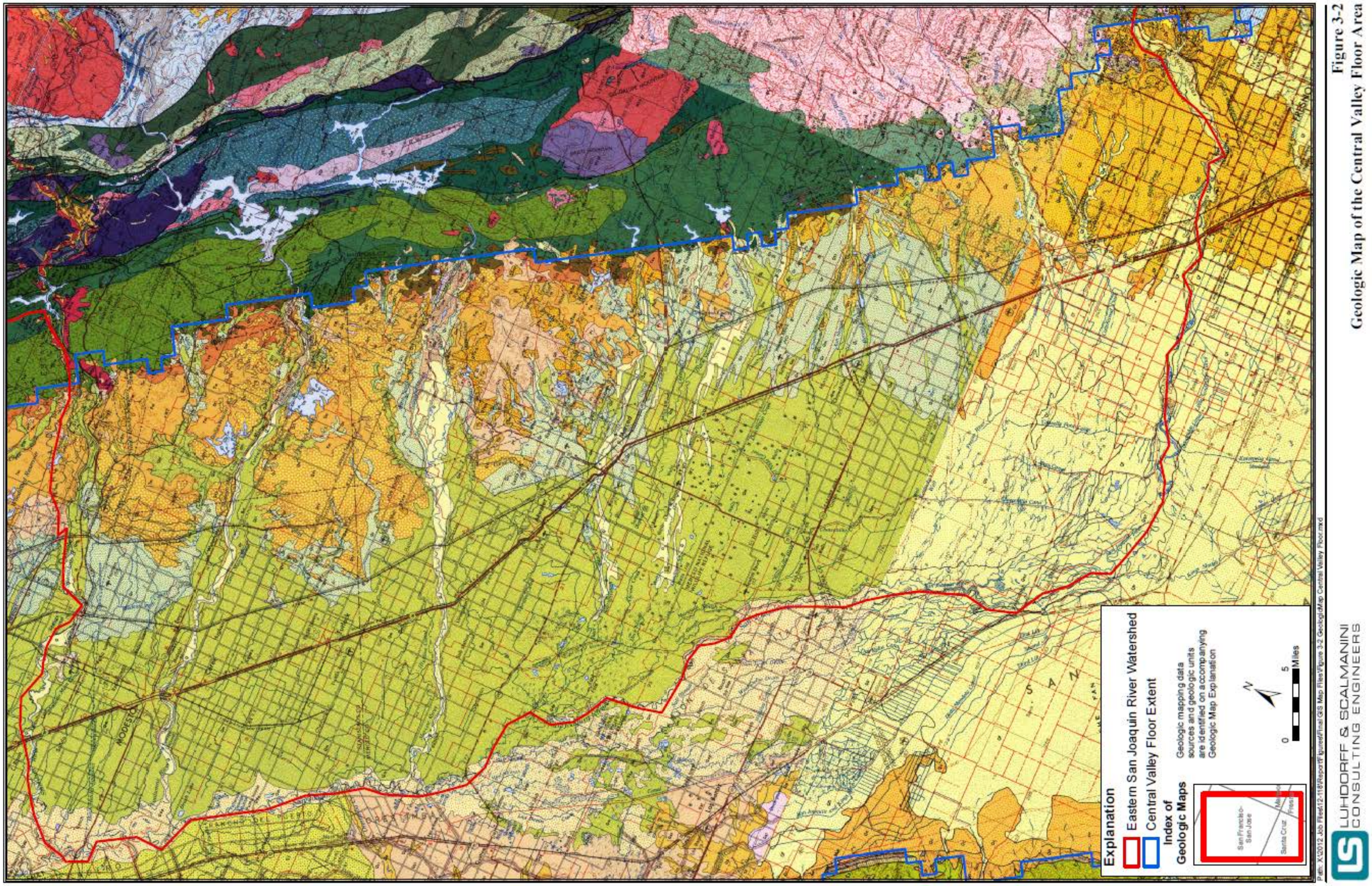
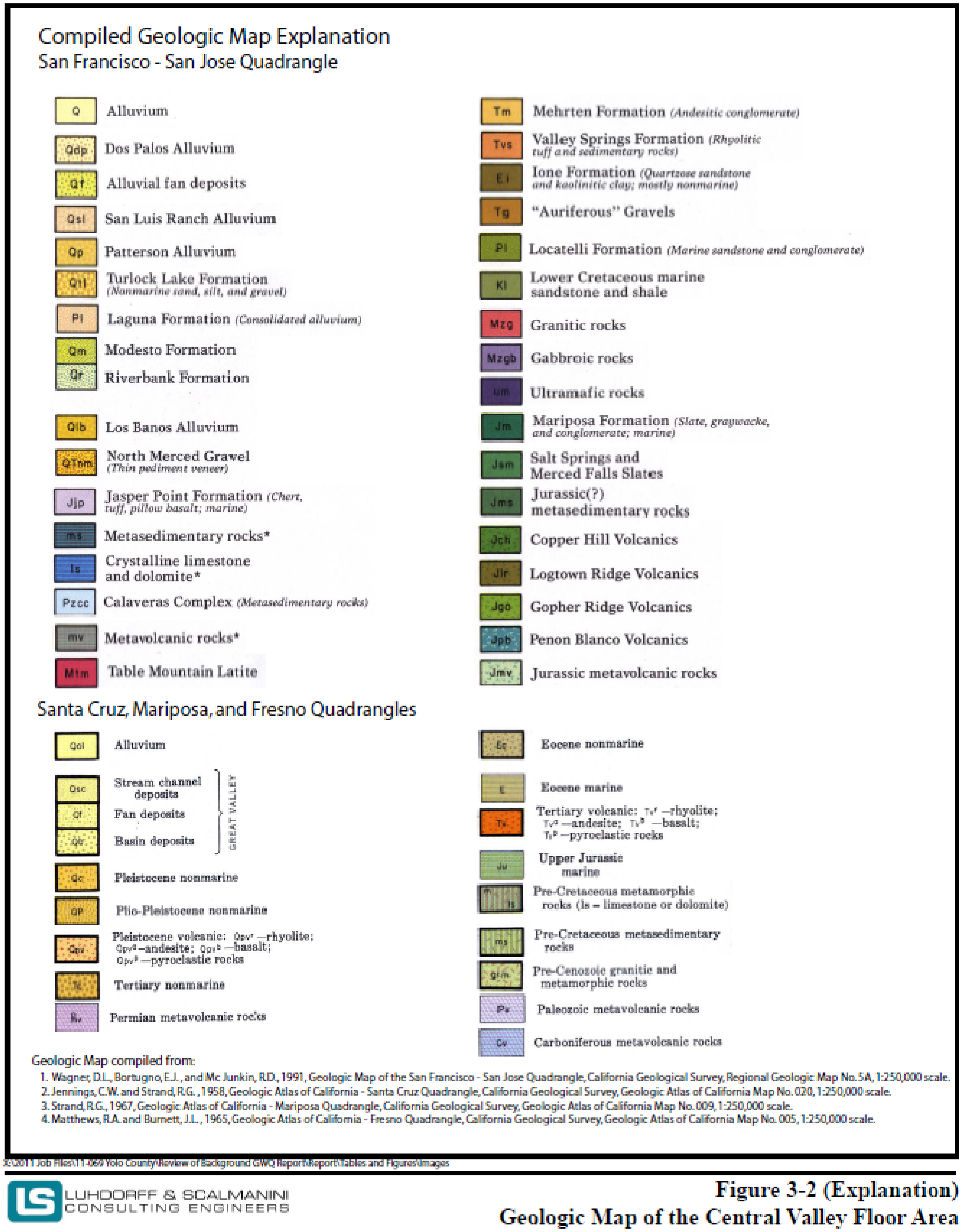


Figure 14. Geologic Map of the Central Valley floor area (Figure 3-2 [Explanation], GAR).



General Hydrogeological Setting

Within the Central Valley Floor, the primary units consist of Quaternary-aged unconsolidated continental deposits and older alluvium that are present across most of the western portion of the Coalition region. The continental and older alluvial deposits consist of layers of sand, gravel, silt, and clay that increase in thickness away from the margins of the valley. The continental deposits are generally mapped as the Turlock Lake Formation, North Merced Gravel, and Pleistocene non-marine sedimentary units which occur along the eastern edge of the Central Valley Floor as shown in Figure 12 (Figure 3-1, GAR). The extent of the older alluvium is generally represented by geologic units mapped as alluvium, Riverbank Formation, Modesto Formation, and Great Valley deposits (Figure 12 through Figure 14).

The Corcoran Clay is an extensive clay unit and prominent stratigraphic layer in parts of the Central Valley and is believed to separate shallow and deep groundwater systems where it is present. The Corcoran Clay is generally present only in the western portion of the Central Valley Floor area. Depth to the top of the Corcoran Clay generally increases towards the center of the valley.

Groundwater in the area generally occurs under confined, semi-confined, and unconfined conditions within primary water-yielding zones. Consolidated sedimentary rocks of lower water-bearing capacity include the Mehrten Formation, Valley Springs Formation, and Ione Formation which occur along the eastern edge of the Central Valley Floor and have lesser importance as a groundwater resource, although the Mehrten Formation, which consists primarily of sandstone, breccia, and conglomerate, is an important aquifer in the area (DWR, 2003).

Surface and Shallow Subsurface Sediments Characterization

For the purposes of completing the GAR, sources of data used to characterize the surface and subsurface sediments in the Coalition area consisted primarily of county soil surveys completed by the Natural Resource Conservation Service (NRCS), subsurface sediment texture model data from the USGS Central Valley Hydrologic Model (CVHM), and thickness and depth characteristics of the Corcoran Clay as represented in the CVHM (Faunt et al., 2009). The texture data of the CVHM was estimated using 50-foot-thick vertical increments. The model layers (1-10) range from 50-400 feet thick with the thickness of each layer 50 feet thicker than the layer above (Figure 15, Table 6).

Figure 16 depicts the groupings of basins and subbasins with the Central Valley used for the textural soils analysis in the CVHM. Modesto, Turlock, and Merced GQMP Zones are located in the southern half of the Northern San Joaquin spatial province and domain (22) of Figure 16. The Chowchilla and Madera GQMP Zones are located in Chowchilla-Madera spatial province and domain (23) of Figure 16. Layers 1-3 of the texture model are provided below (Figure 17s and **Figure** 18) to represent the texture of soils surrounding wells typically defined as shallow (less than 200 feet deep) in the GAR.

Table 6. Central Valley, California groundwater flow model layer thicknesses and depths listed by layers (Table A3, Faunt, et. al., 2009).

Layers 4 and 5 represent Corcoran Clay where it exists; elsewhere a 1 foot thick phantom layer; they are kept only to keep track of layer numbers.

LAYER	THICKNESS (FEET)	DEPTH TO BASE OUTSIDE CORCORAN CLAY (FEET)	TEXTURE FIGURE
1	50	50	A9(a)
2	100	150	-
3	150	300	A9(b)
4	Variable	301	A9(c)
5	Variable	302	A9(c)
6	198	500	A9(d)
7	250	750	-
8	300	1050	-
9	350	1400	**A9(c)**
10	400	1800	-

Figure 15. Generalized hydrogeologic section of the Central Valley according the CVHM. Layers 1-10 indicate the discreet vertical layers described in the CVHM (Fig. A11, Faunt, et. al., 2009).

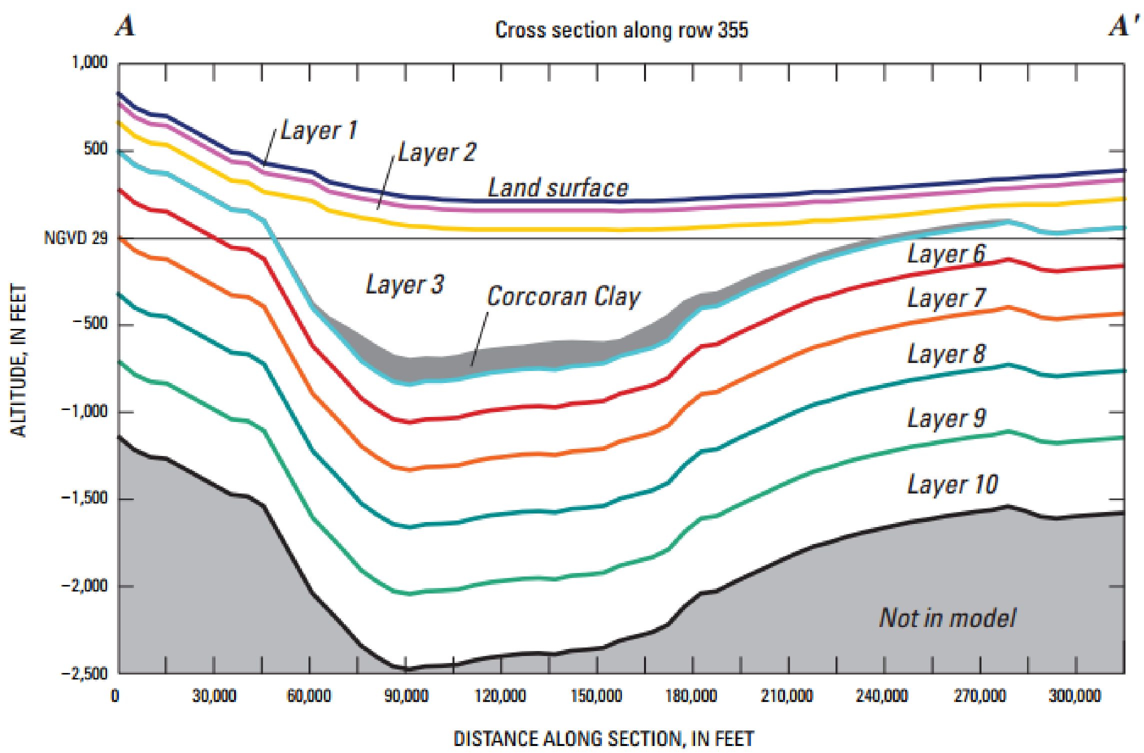


Figure A11. Generalized hydrogeologic section (*A–A'*) indicating the vertical discretization of the numerical model of the groundwater-flow system in the Central Valley, California. Line of section shown on *figure A1* (altitudes are along row 355; layer numbers indicate model layer).

Figure 16. Groupings of basins and subbasins within the Central Valley used for textural soils analysis in the CVHM (Figure A10, Faunt, et. al., 2009).

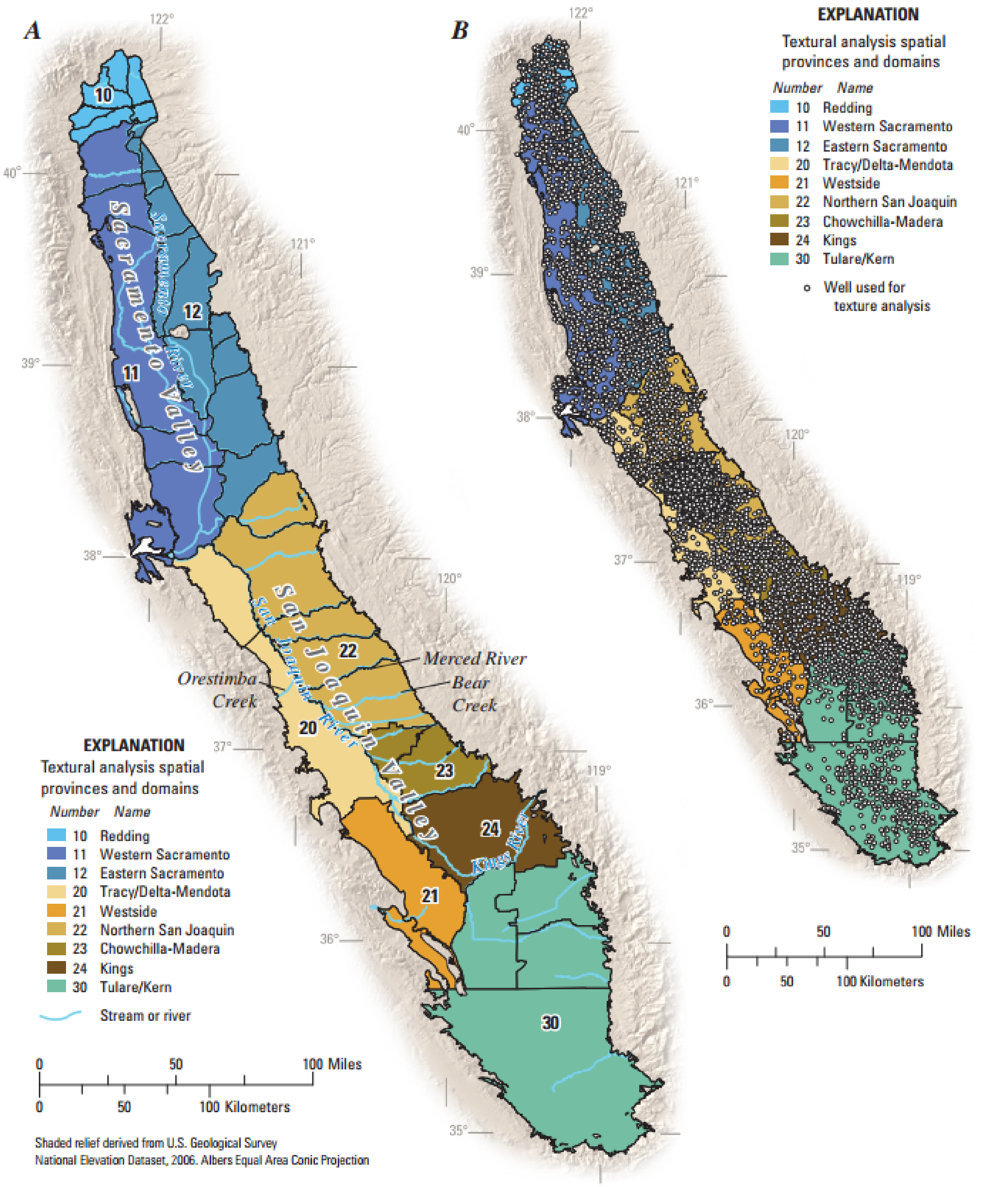


Figure A10. *A*, Central Valley showing groundwater basins and subbasins, groupings of basins and subbasins into spatial provinces and domains for textural analysis. *B*, Distribution of wells used for mapping texture. *C*, Count of wells for each depth increment by domains through 1,200 feet. Because less than 1 percent of the logs extend past 1,200 feet, increments below 1,200 feet were not shown. Detailed description of the spatial provinces and domains are in *table A2*.

Figure 17. Layer 1 of the CVHM depicting the percentage of coarse-grained material within the top 50 feet of the Central Valley.

Modesto, Turlock, and Merced GQMP Zones are located in the southern half of the Northern San Joaquin spatial province and domain (22). The Chowchilla and Madera GQMP Zones are located in Chowchilla-Madera spatial province and domain (23). (Fig. A12, Faunt, et. al., 2009).

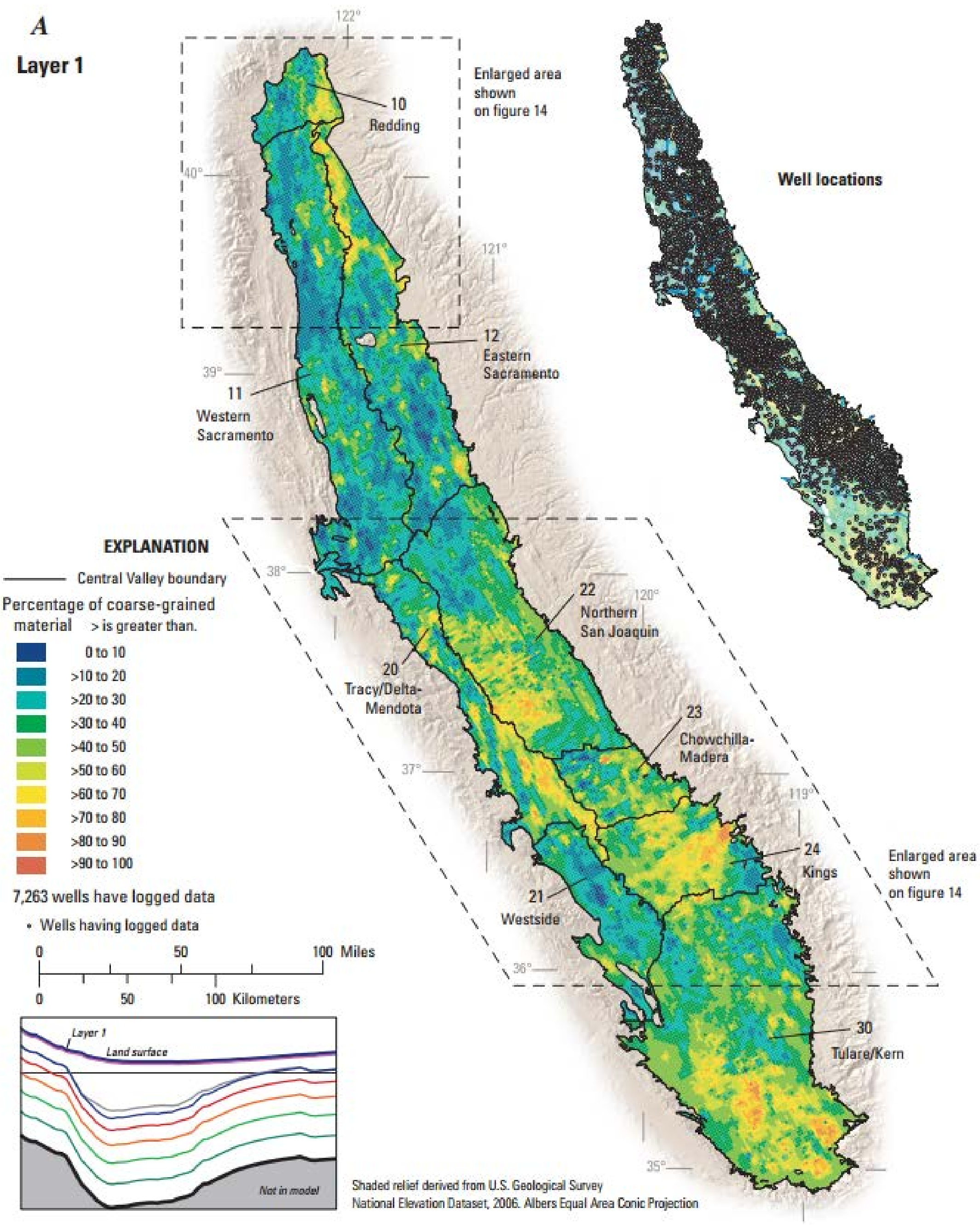
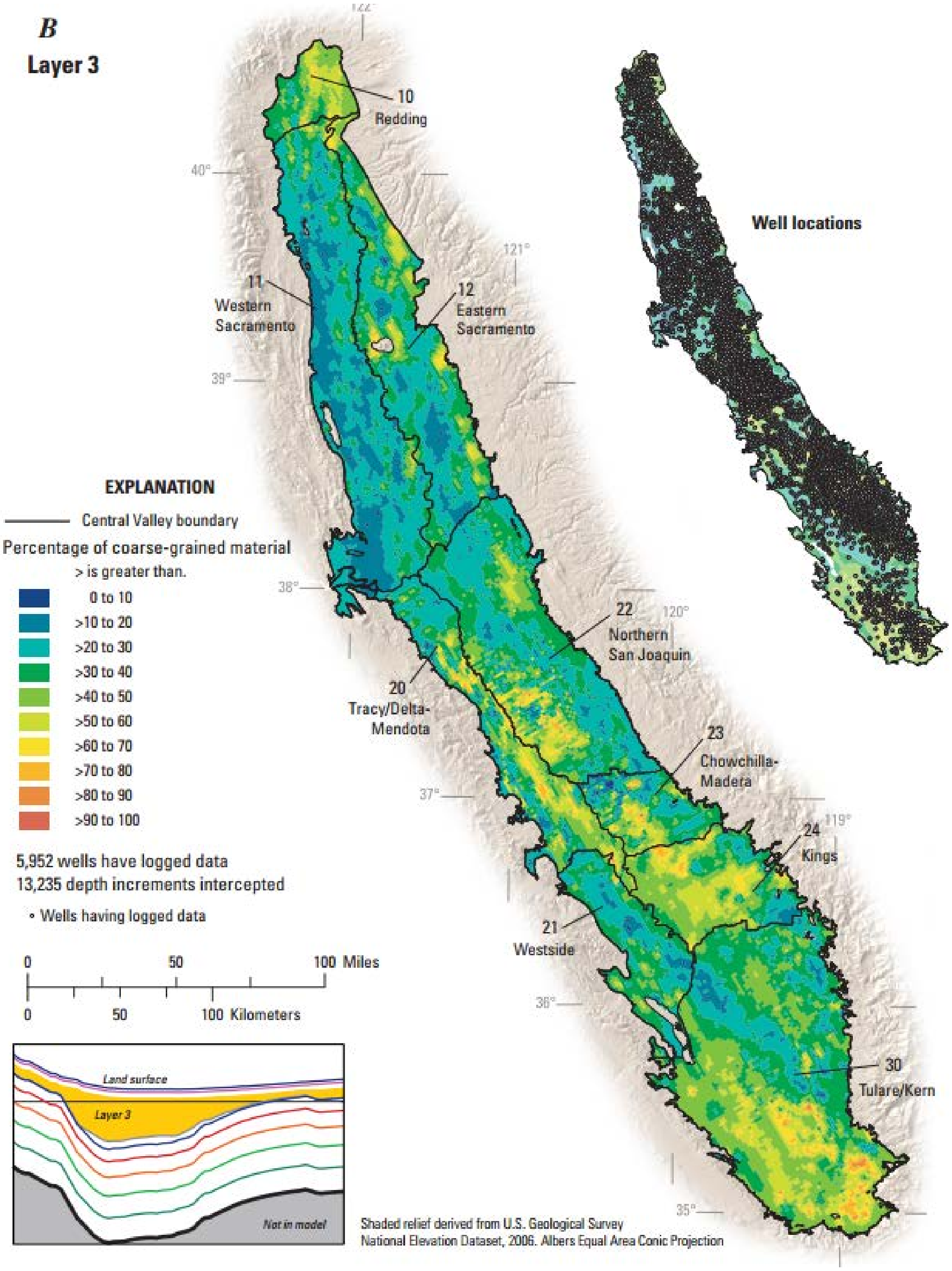


Figure 18. Layer 3 of the CVHM depicting the percentage of coarse-grained material within the top 150 feet of the Central Valley.

Modesto, Turlock, and Merced GQMP Zones are located in the southern half of the Northern San Joaquin spatial province and domain (22). The Chowchilla and Madera GQMP Zones are located in Chowchilla-Madera spatial province and domain (23). (Fig. A12 continued, Faunt, et. al., 2009).



Soil Hydraulic Conductivity

Hydraulic conductivity is a measure of the ability of a material to transmit water; the greater a material's hydraulic conductivity, the faster water moves through the matrix of the material. Figure 19(Figure 3-3, GAR) shows the hydraulic conductivity of soils as derived from NRCS soil surveys within the Central Valley Floor area of the Coalition region. Notably, the NRCS soil survey data presented in Figure 19show the presence of numerous long and narrow coarser-textured deposits of higher conductivity and the presence of alluvial channels which have formed large fans of high conductivity soils, particularly in those areas adjacent to the Merced, Tuolumne, Stanislaus, Chowchilla, and Fresno Rivers. Similar patterns of coarser textured material can also been seen within the Northern San Joaquin spatial province and domain (22) and Chowchilla-Madera spatial province and domain (23) in Layer 1 of the CVHM (Figure 17).

Soil Chemistry

The soil chemistry description below is taken almost exclusively from the GAR. Figure 20(Figure 3-4, GAR) shows the spatial distribution of soil salinity within the Central Valley Floor area of the Coalition region, as derived from NRCS soil surveys. The GAR evaluates high salinity as electrical conductivity (EC) greater than 4 dS/m which may lead to an impact on crop productivity. Areas of soil salinity above 4 dS/m are largely limited to the western portion of the Central Valley Floor area of the Coalition region, and particularly in the southwest. Large areas of high salinity soils are also located south of Atwater and Merced, and to the west of Madera, while a smaller area of soils with high salinity is present west of Turlock.

The spatial distribution of soil pH, as derived from NRCS soil surveys, is shown in Figure 21(Figure 3-5, GAR) for the Central Valley Floor area of the Coalition region. Highly alkaline soils (pH > 7.8) can affect plan health and appear to follow a similar spatial pattern as soils with high salinity. The western portion of the Central Valley Floor contains a majority of the alkaline soils, particularly to the south of Atwater and Merced and to the west of Madera. Throughout a large part of the Central Valley Floor of the Coalition region, soils are generally in the neutral pH range from 6.6 to 7.5. Crops vary in their ability to tolerate levels of soil pH; however, most crops grow best when the soil pH is slightly acidic at a value between 6 and 7. More acidic soils (lower pH) are generally located in the northern and eastern portions of the Central Valley Floor area of the Coalition region. Areas of greatest soil acidity exist to the northeast of Merced and along the eastern margins of the Central Valley Floor within the Coalition region.

Figure 19. Soil hydraulic conductivity in the Central Valley portion of the Coalition (Figure 3-3, GAR).

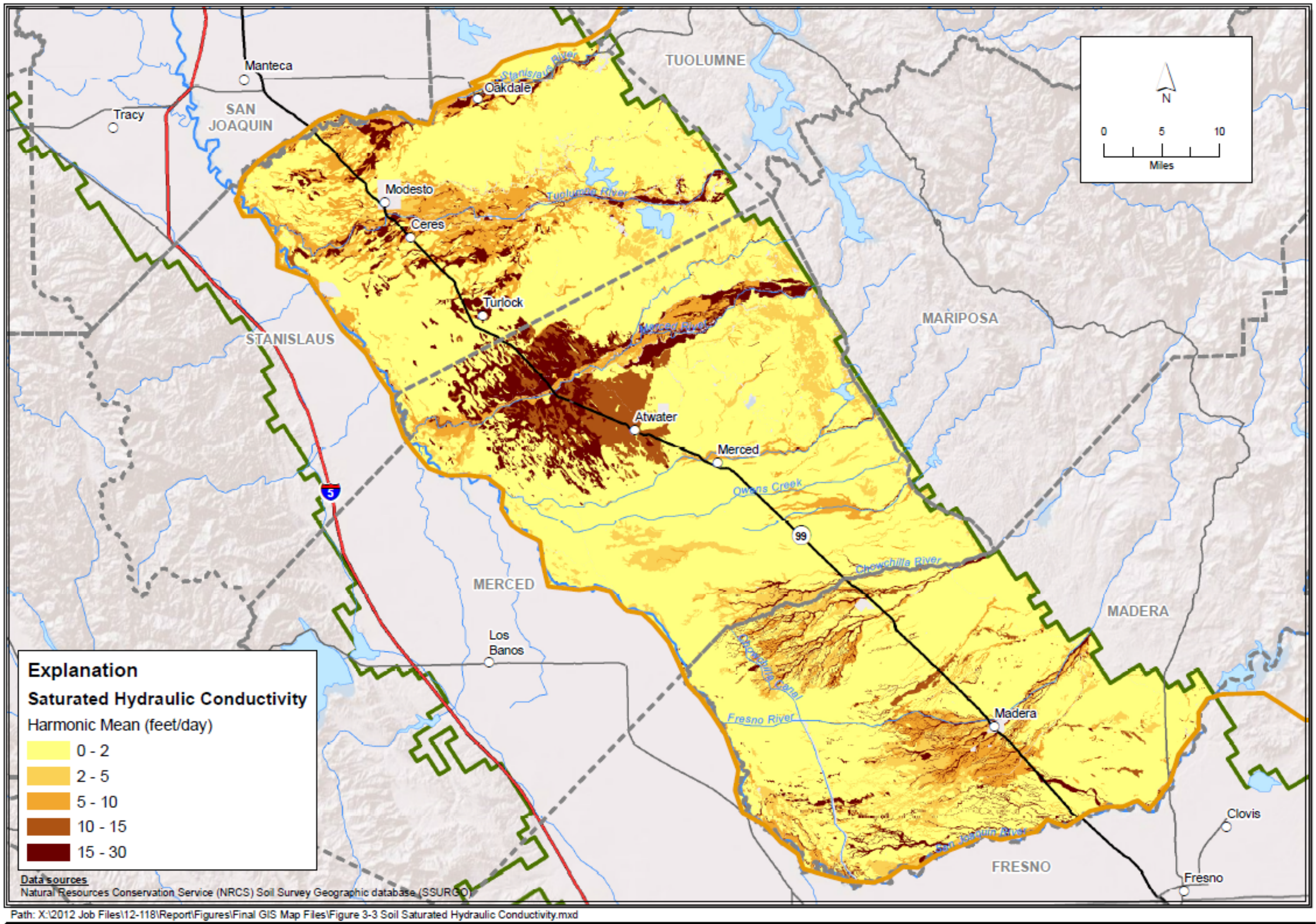


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Figure 3-3
Soil Hydraulic Conductivity

Figure 20. Soil salinity in the Central Valley portion of the Coalition (Figure 3-4, GAR).

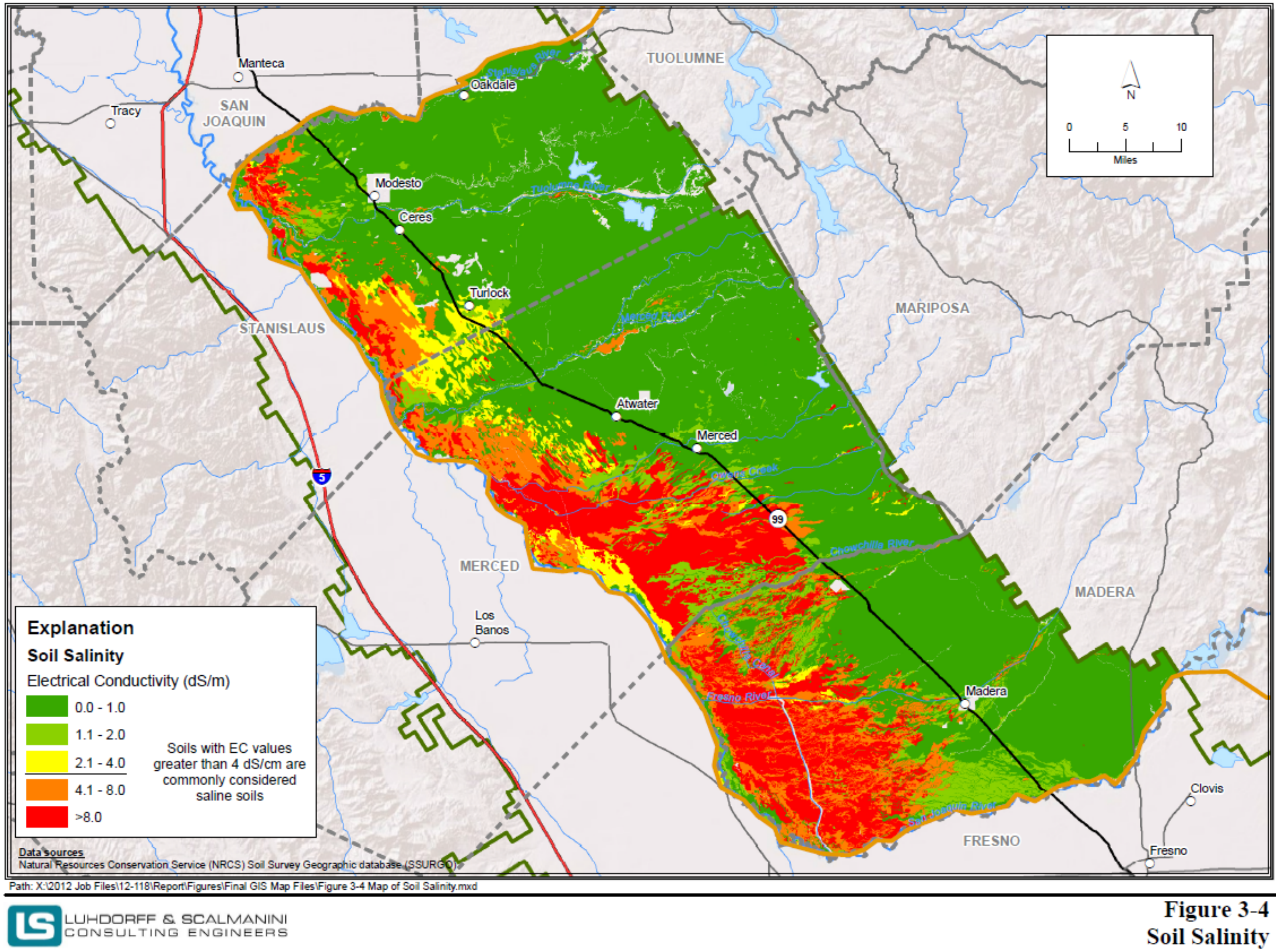
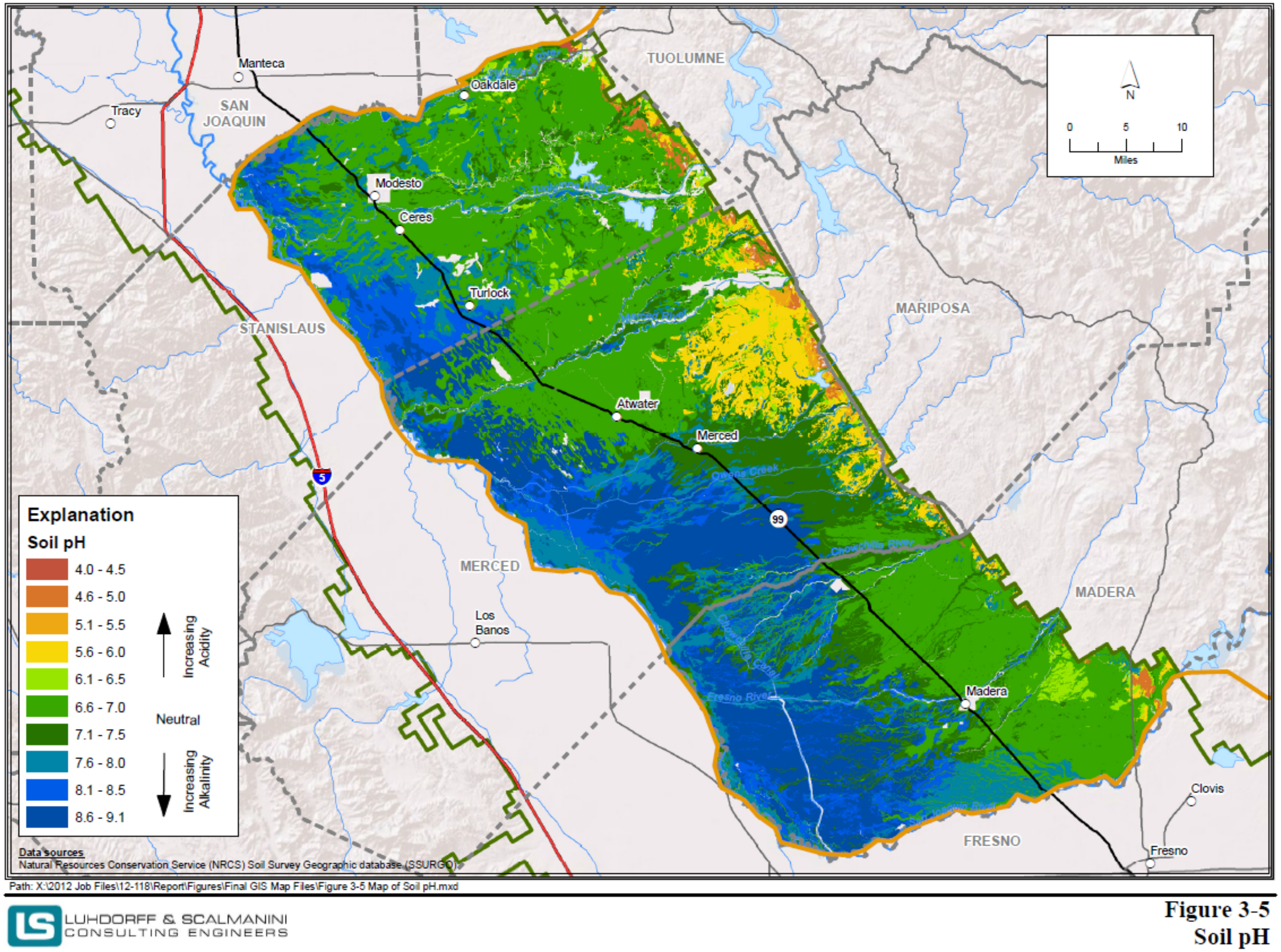


Figure 21. Soil pH in the Central Valley portion of the Coalition (Figure 3-5, GAR).



Subsurface Sediments

The subsurface sediment description below is taken directly from the GAR. Reproductions of the figures presented in the GAR are included here for ease of reference.

CVHM Hydraulic Conductivity

The CVHM (Faunt et al., 2009) (Figure 17 and **Figure** 18) incorporates available lithologic data from numerous well drillers' logs and other available data in a three-dimensional sediment texture model characterizing the valley-fill deposits within the Central Valley Floor area. The CVHM presents a layered spatial representation of subsurface hydraulic conductivity and texture at a horizontal grid scale of one-square mile and approximately 50-foot thickness intervals. For the purposes of understanding the relationship between irrigated agriculture management practices and groundwater quality, particularly in regards to the hydrogeologic vulnerability, the characteristics of the uppermost layer of the CVHM are of greatest interest (Figure 17). In the Coalition region, Layer 1 of the CVHM generally extends to a depth of 50 feet, and Figure 22(Figure 3-6, GAR) shows the vertical hydraulic conductivity as represented in Layer 1 of the CVHM.

Corcoran Clay

The spatial extent, thickness, and depth to the top of the Corcoran Clay in the Coalition region, as depicted in the CVHM, are shown in Figure 23 and Figure 24(Figures 3-7a and 3-7b, GAR) and is generally present only in the western portion of the Central Valley Floor area, approximately west of Highway 99 as shown. Depth to the top of the Corcoran Clay generally increases towards the center of the valley and ranges from less than 50 feet along parts of its eastern extent to more than 300 feet below ground in the southwest portion of the Central Valley Floor area as illustrated in Figure 23(Figure 3-7a, GAR). The thickness of the Corcoran Clay also increases towards the axis of the valley as shown in Figure 24(Figure 3-7b, GAR). Two areas where the Corcoran Clay is thickest are located generally to the west of Turlock and also to the south of Turlock where the thickness is generally greater than 60 feet with some thicker areas of 100 feet or more. Although the lateral extent of the Corcoran Clay is generally greater farther south, the unit tends to thin with many areas of less than 40 feet thickness, particularly across most of the eastern part of its southern extent.

Known Tile Drains

The presence of shallow or perched groundwater in parts of the San Joaquin Valley has led to the installation of tile drains in some areas. In preparation of the GAR, readily available data sources were researched in an attempt to identify locations of known tile drains within the Coalition region. Figure 25 (Figure 3-8, GAR) shows the locations of identified tile drains based on DWR water quality sampling points. This map shows the presence of tile drains throughout much of the Sacramento Delta area and in areas west of the San Joaquin River. However, these data do not show the existence of any tile drains within the Coalition region, although the presence of shallow groundwater conditions and shallow wells used by irrigation districts to drain the shallow groundwater is discussed below as it relates to groundwater level data. Tile drains apparently exist along the western edge of the Coalition region, although specific locations for these features are not known. Coalition members are not required to list tile drain locations as part of the Farm Evaluation survey and no additional data is available beyond the information provided in the GAR.

Figure 22. Vertical hydraulic conductivity of the CVHM Layer 1within in the Central Valley portion of the Coalition (Figure 3-6, GAR).

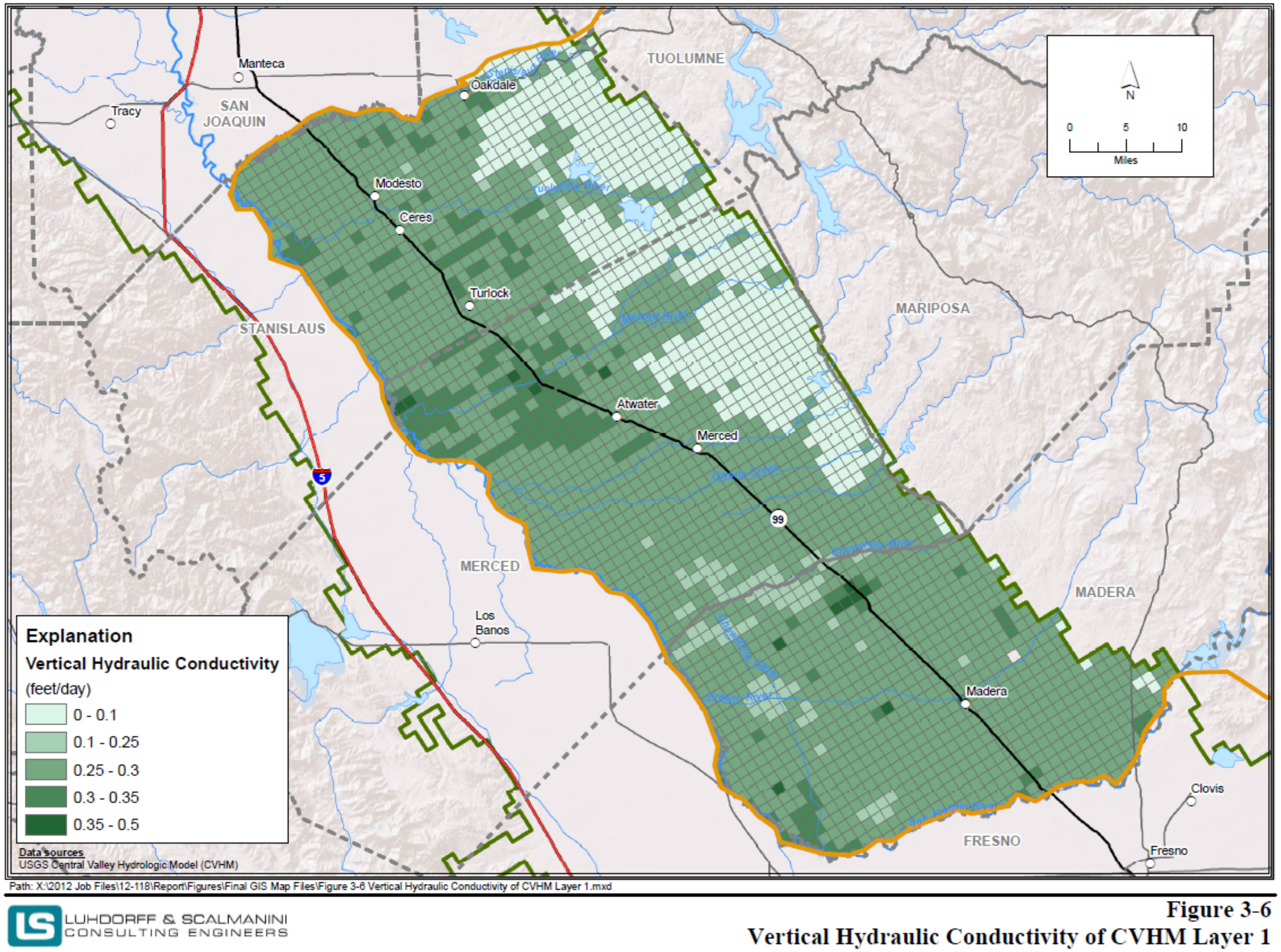


Figure 23. Corcoran Clay characteristics (extent and depth) in the Central Valley portion of the Coalition (Figure 3-7a, GAR).

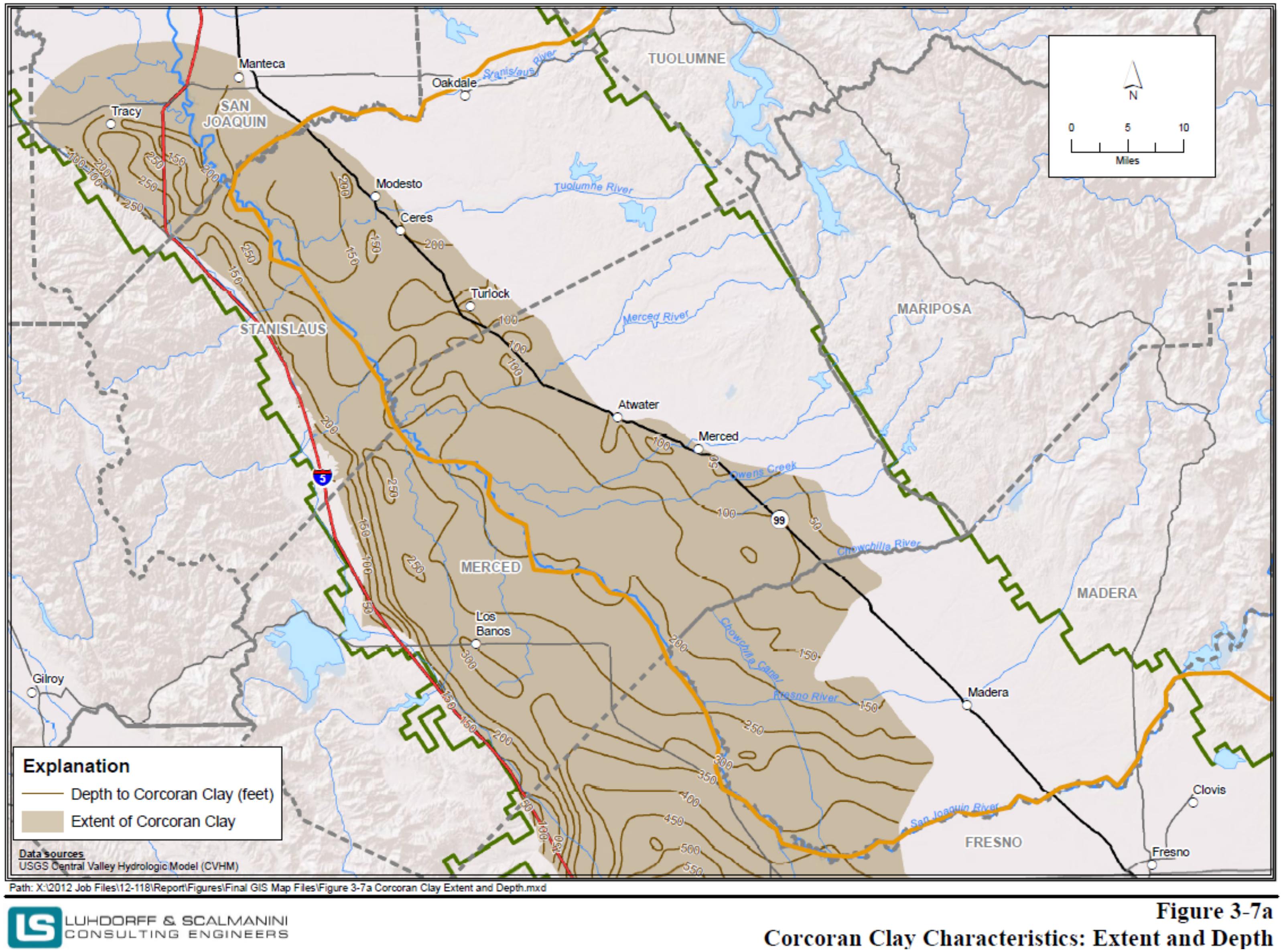


Figure 24. Corcoran Clay characteristics (thickness) in the Central Valley portion of the Coalition (Figure 3-7b, GAR).

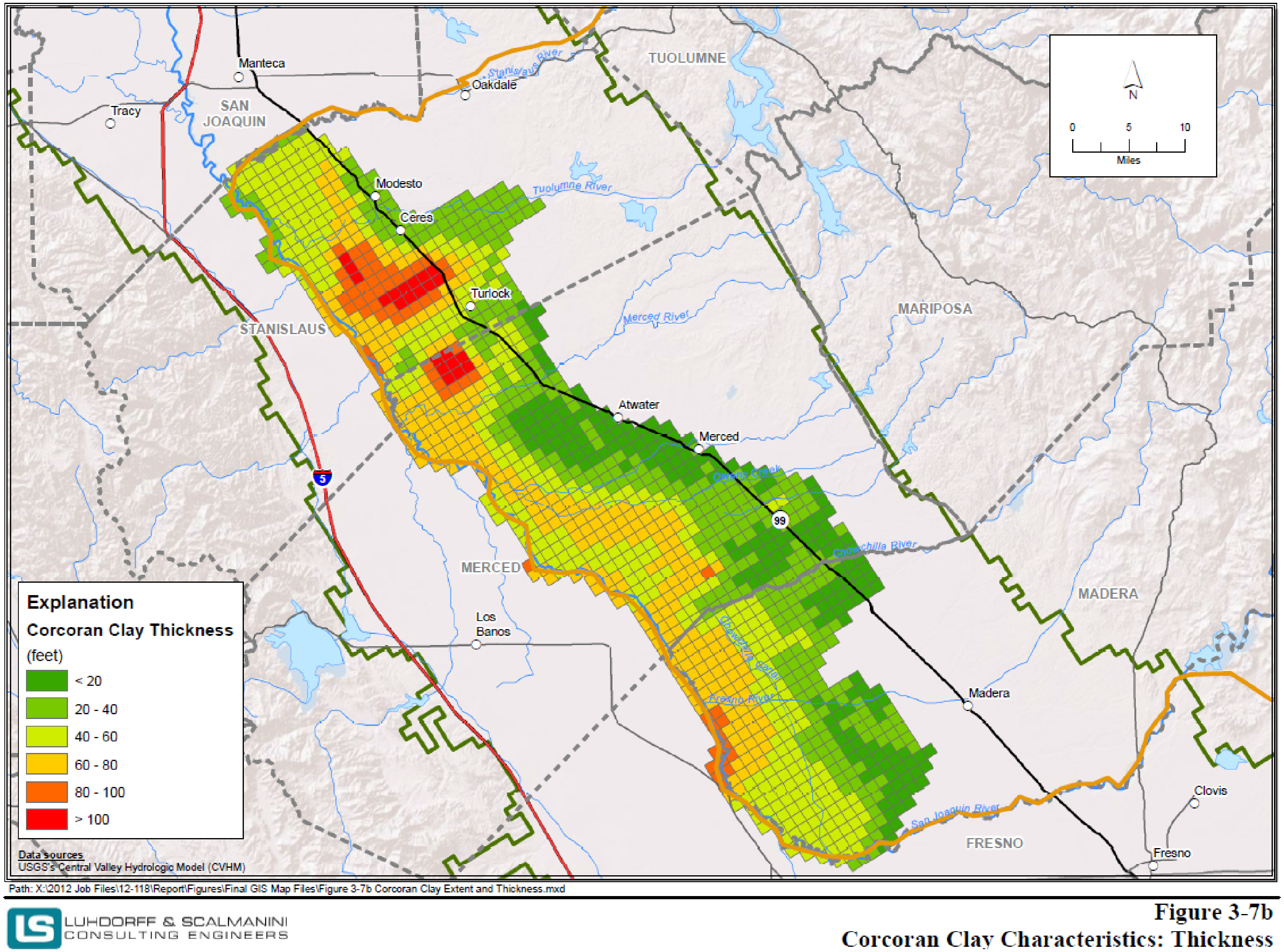
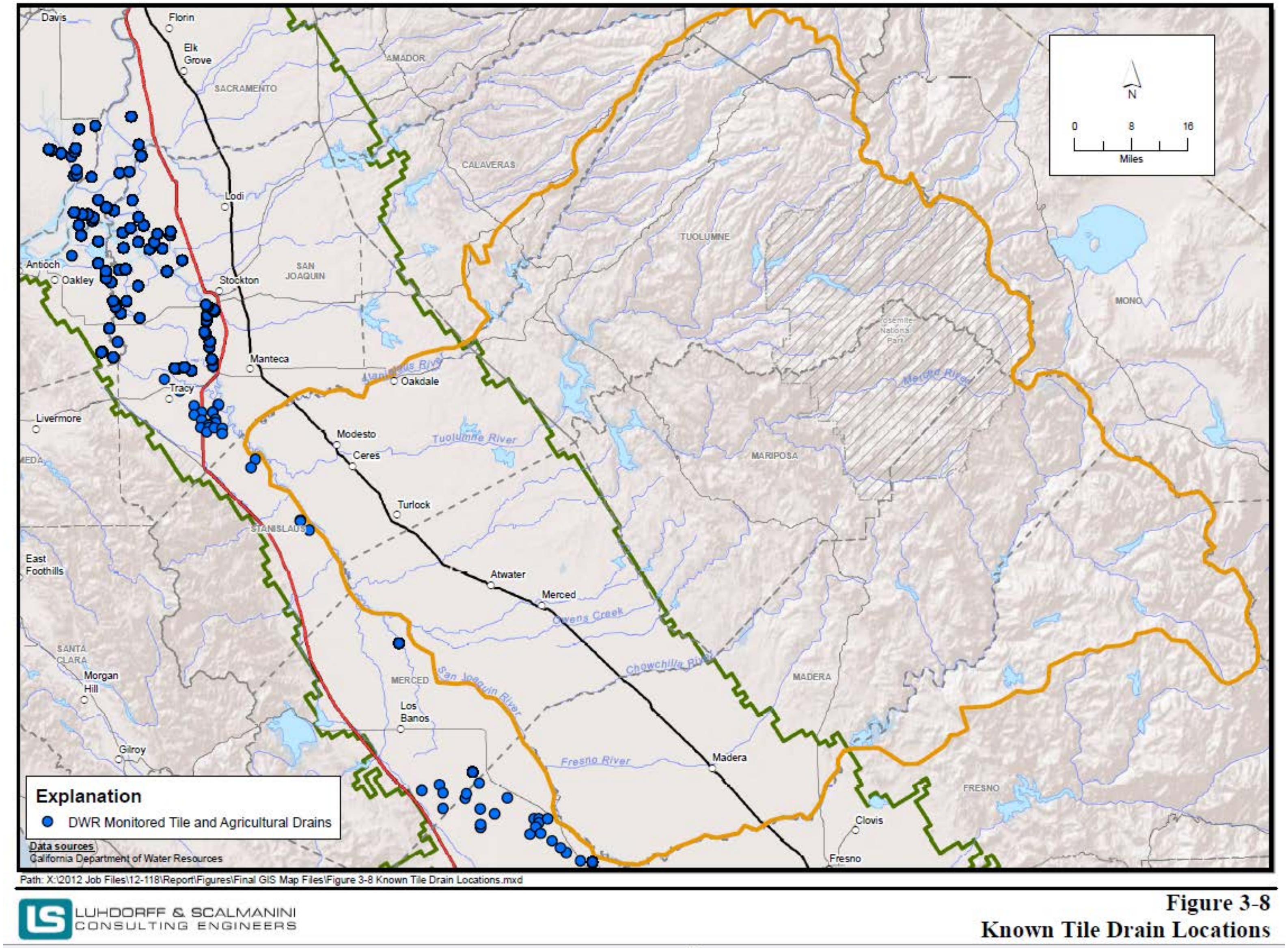


Figure 25. Known tile drain locations in the Central Valley portion of the Coalition (Figure 3-8, GAR).



GROUNDWATER HYDROLOGY

The groundwater hydrology description below is taken exclusively from the GAR. Reproduction of the figures presented in the GAR is included here for ease of reference. A discussion of the extent and various restrictions of the well data are presented at length in the GAR in Section 3.3.1.1.

Groundwater Levels

In order to characterize historical and present groundwater conditions for the GAR, groundwater level data for the Coalition region were gathered from available data sources including DWR's Water Data Library (WDL), California Statewide Groundwater Elevation Monitoring (CASGEM), United States Geological Survey (USGS's) National Water Information System (NWIS), the State Water Resources Control Board's (SWRCB) Geotracker database (GAMA), Merced Irrigation District and Turlock Irrigation District.

In addition to water level measurement data, spatial datasets representing groundwater levels as developed by the California Department of Pesticide Regulation (DPR), and DWR were also reviewed and evaluated. These included interpolated groundwater level data from the DPR Environmental Hazards Assessment Program, Depth to Groundwater Database (DPR, 2000) and from DWR contour maps for select areas of available data, primarily in the western part of the Central Valley Floor area within the Coalition region.

In the GAR, wells were grouped into three general well depth categories: shallow, deep, and unknown. Shallow wells were defined to be wells with known depths less than 200 feet and also included well use categories of domestic wells, monitoring wells, and Turlock Irrigation District (TID) drainage wells (because of anecdotally provided information about general well depth) when well depth was not provided. Deep wells included wells with depths greater than 200 feet and also municipal wells, irrigation wells, or other well uses indicating a greater likelihood of a well that is deeper than 200 feet. Wells without any further information with which to assign them into either the shallow or deep category were designated unknown.

Spatial Patterns in Depth to Groundwater

Central Valley Floor

The spring depth to groundwater contours in Figure 26(Figure 3-11, GAR) show extensive shallow groundwater levels (<20 feet below ground surface [bgs]) in the northwestern part of the Coalition region near Turlock and westwards toward the San Joaquin River. Another area of considerable shallow groundwater exists in the general vicinity of Merced and along Owens Creek and its tributaries. Figure 26 also highlights other more localized areas of shallow groundwater evident along waterways, most notably along the Stanislaus River, Merced River, and San Joaquin River. Depth to groundwater tends to be deeper to the east and away from San Joaquin River. Two notable pockets of deeper groundwater are apparent to the east of Turlock, in the vicinity of Chowchilla, and between Merced and Madera in the more southerly portion of the area. Similar spatial patterns are evident in the contours of fall depth to groundwater as shown in Figure 27(Figure 3-12, GAR). However, as expected, the depth to groundwater is generally greater in the fall than in the spring indicating seasonal lowering of groundwater levels. The depth to groundwater contour maps developed in the GAR show similar spatial patterns to those developed by DPR shown in Figure 28(Figure 3-13, GAR).

Figure 29(Figure 3-14, GAR) shows areas of potential groundwater discharge where the current depth to groundwater contours indicate shallow groundwater conditions (<10 feet bgs). Particularly notable areas where groundwater is within 10 feet of the ground surface are evident from Figure 29in the vicinity of Turlock and along lower reach sections of many tributary rivers to the San Joaquin River, including the Stanislaus, Tuolumne, Merced, and Fresno Rivers. As a result, some of these tributary reaches may experience gaining conditions during some times. A number of sections of the San Joaquin River also have shallow groundwater conditions which may result in groundwater discharge areas along or near the river. These general patterns are similar to those depicted by DWR groundwater level contour maps (2010a; 2010b).

Peripheral Area

Because of the relatively sparse spatial distribution of available water level data, and the different hydrogeologic environment of the Peripheral Area in which groundwater commonly occurs in and moves through networks of fractures, interpreting spatial patterns can be challenging and misleading since groundwater conditions can be highly localized. Therefore, groundwater levels outside of the Central Valley Floor were not contoured. However, available recent water level data points in the Peripheral Area are shown in Figure 30(Figure 3-15, GAR) to illustrate some of the general groundwater level conditions in the area. Because of the hydrogeologic environment of the Peripheral Area, differentiation of groundwater resources into shallow and deep zones is also not as meaningful. Figure 30 shows the average depth to groundwater value within the Peripheral Area for wells of all depth, regardless of time of year. This map shows a wide range of average depth to groundwater values ranging from shallow to greater than 700 feet below ground surface. The shallowest groundwater levels generally occur in valleys and deeper water levels are generally in upland areas away from waterways.

Groundwater Flow Directions

The continuous depth to groundwater spatial dataset and associated contours generated in the GAR were used to calculate groundwater elevations across the Central Valley Floor area and for estimating groundwater flow direction.

Figure 31 and Figure 32(Figures 3-16 and 3-17, GAR) show a steeper groundwater surface with greater hydraulic gradients in the eastern part of the Central Valley Floor area with the presence of some notable local groundwater depressions, particularly in the vicinity of Chowchilla, between Merced and Madera, and east of Turlock. The hydraulic gradient of the groundwater surface generally flattens to the west, particularly in the northern and western part of the Coalition region. Arrows on Figure 31 and Figure 32 show the interpreted directions of groundwater flow under spring and fall conditions based off of the contour maps. Both spring and fall groundwater elevation contours indicate that groundwater generally flows in a southwestern direction away from the hills and mountains to the northeast.

Figure 26. Spring depth to groundwater contours: Central Valley portion of the Coalition (Figure 3-11, GAR).

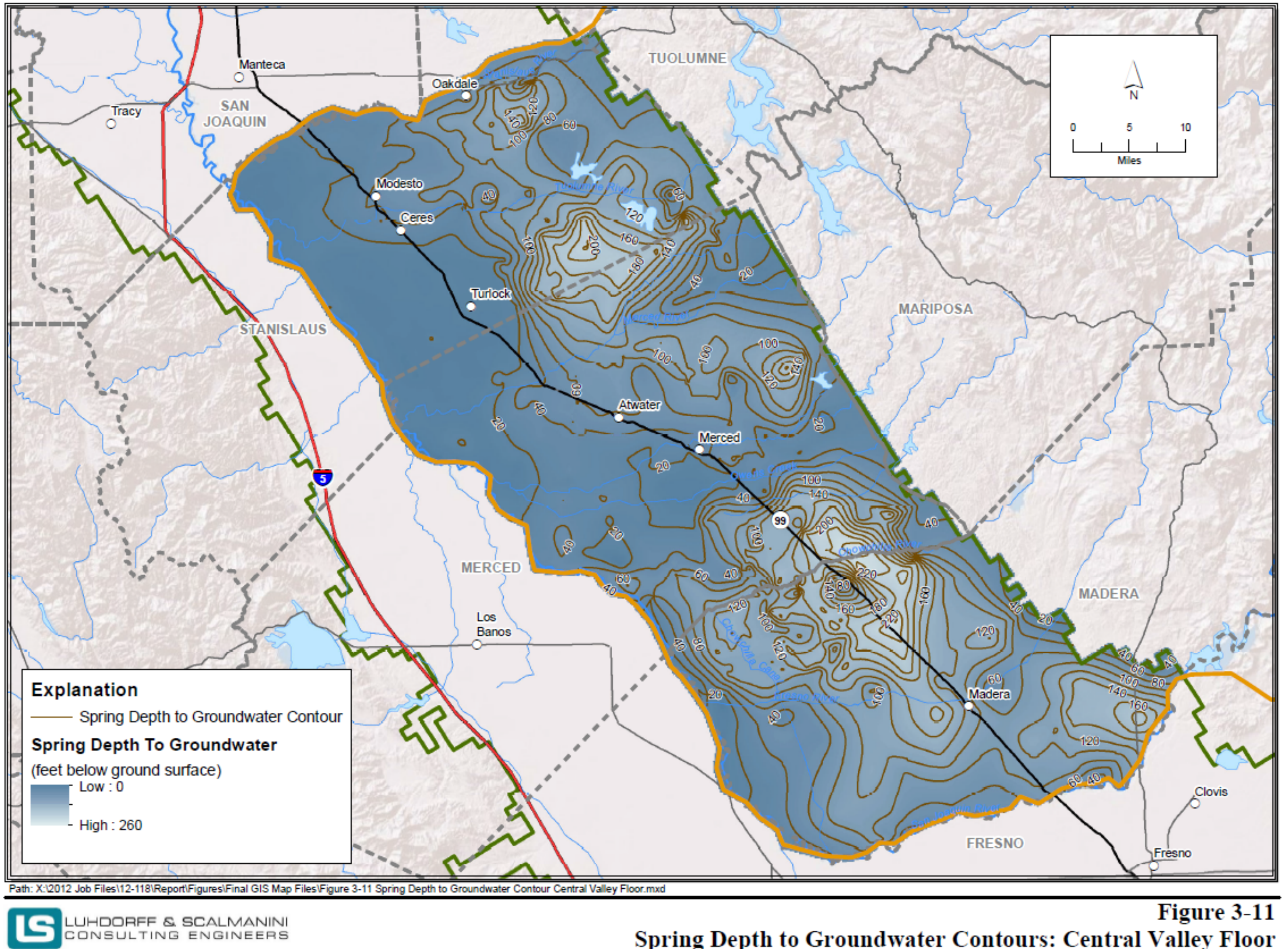
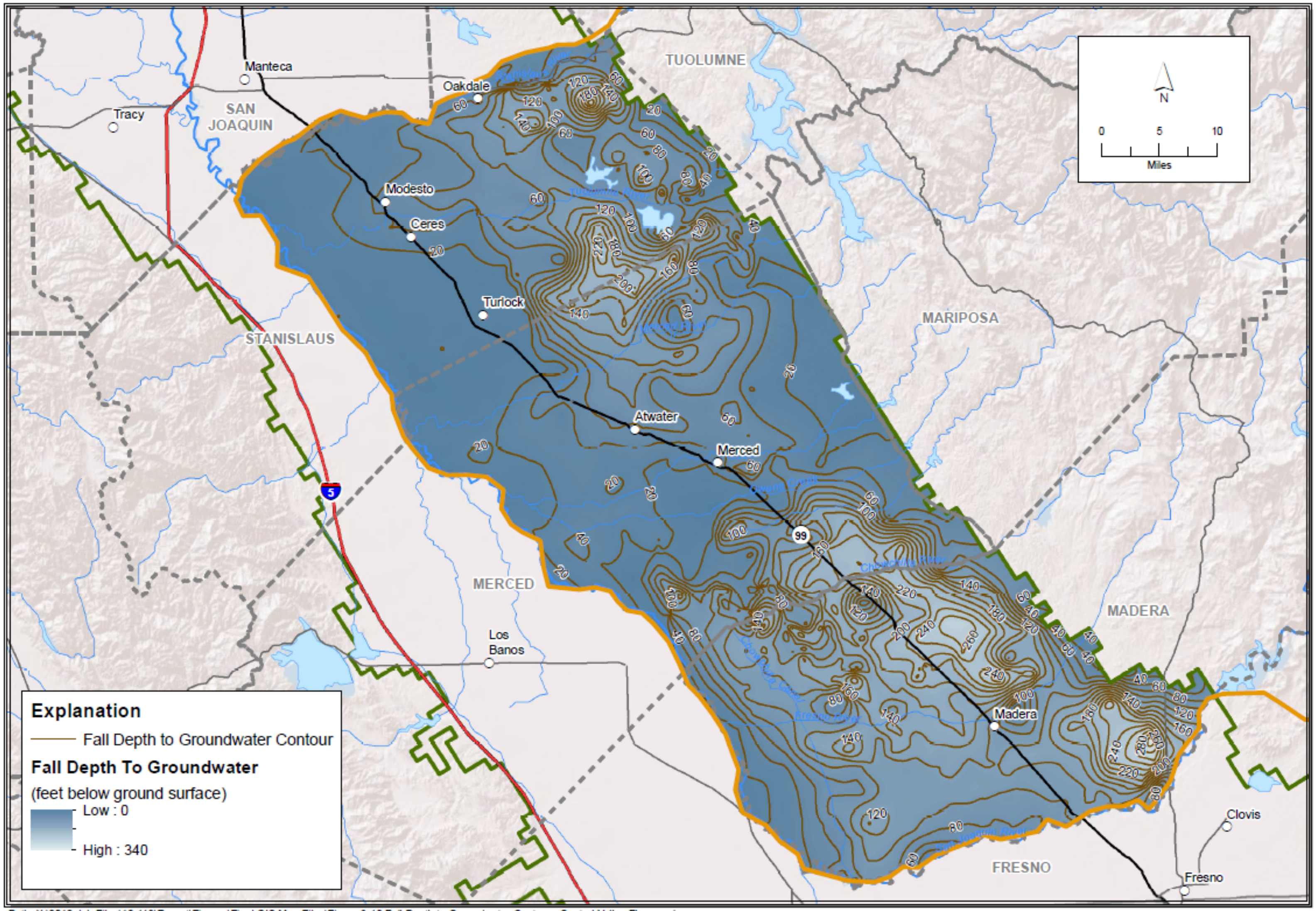


Figure 27. Fall depth to groundwater contours: Central Valley portion of the Coalition (Figure 3-12, GAR).



Path: X:\2012 Job Files\12-118\Report\Figures\Final GIS Map Files\Figure 3-12 Fall Depth to Groundwater Contours Central Valley Floor.mxd

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Figure 3-12
Fall Depth to Groundwater Contours: Central Valley Floor

Figure 28. DWR depth to groundwater contours of the Central Valley portion of the Coalition (Figure 3-13, GAR).

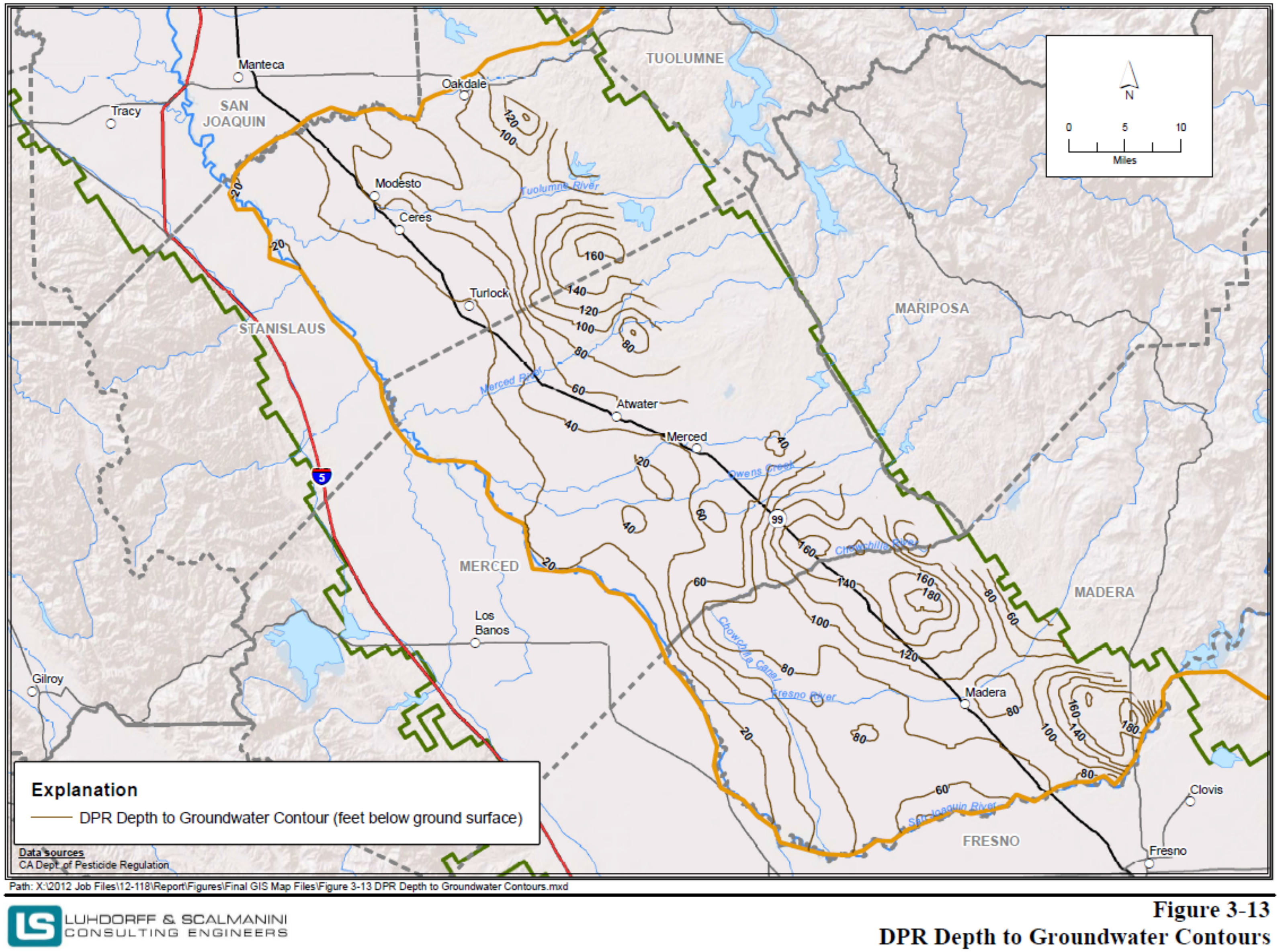


Figure 29. Potential groundwater discharge areas of the Central Valley portion of the Coalition (Figure 3-14, GAR).

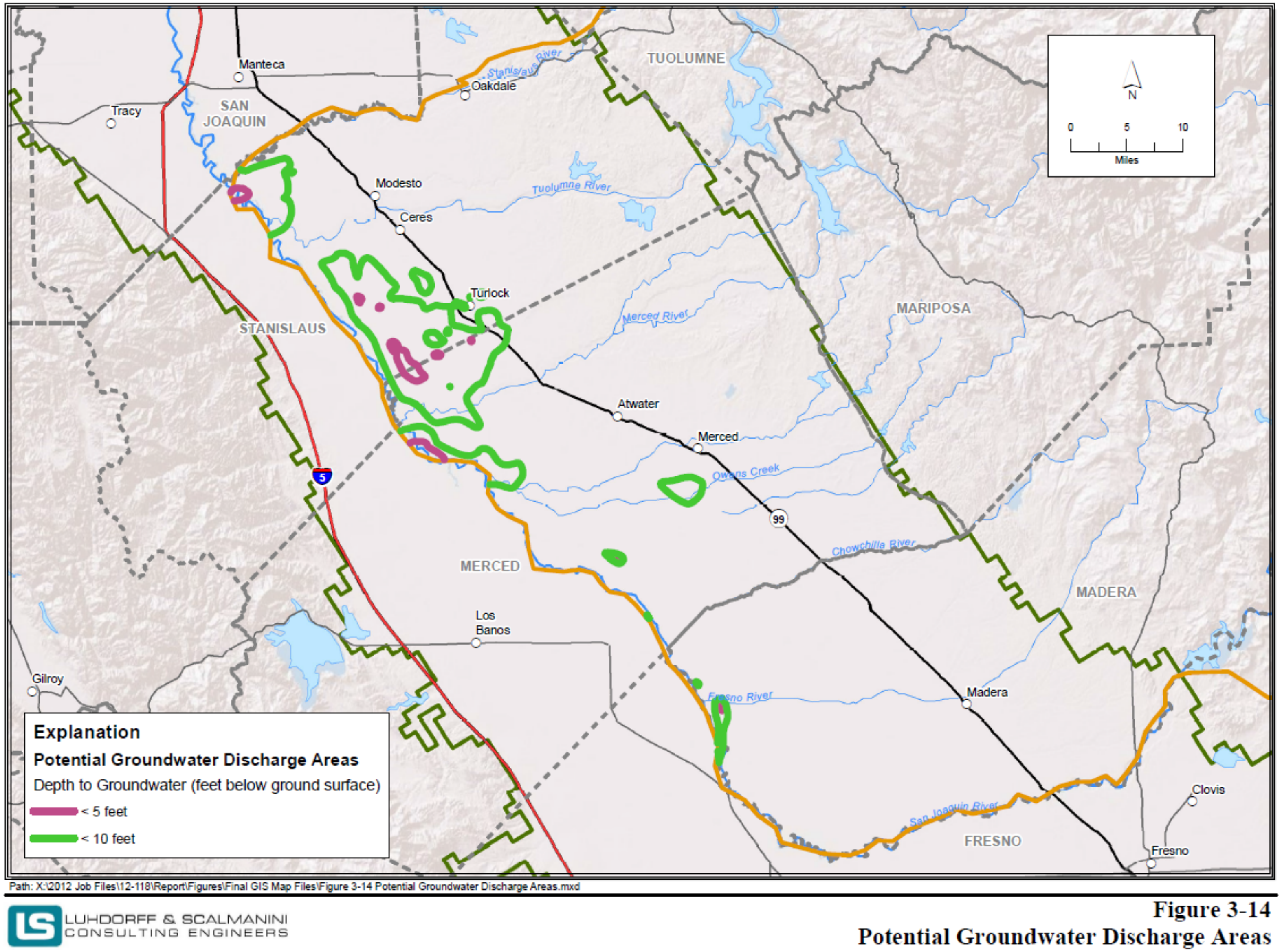


Figure 30. Depth to groundwater measurements: Peripheral portion of the Coalition (Figure 3-15, GAR).

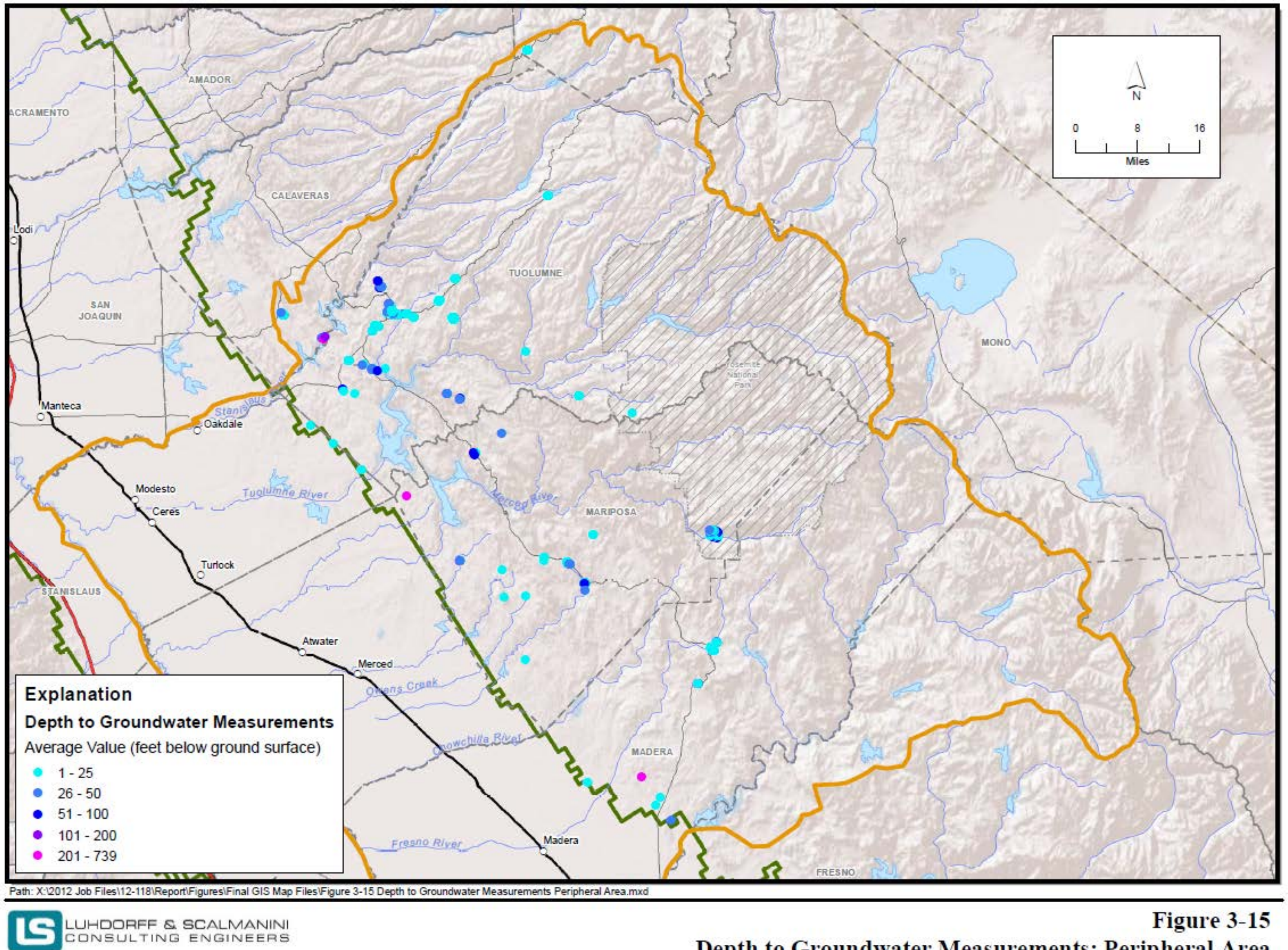


Figure 3-15
Depth to Groundwater Measurements: Peripheral Area

Figure 31. Spring groundwater elevation contours: Central Valley portion of the Coalition (Figure 3-16, GAR).

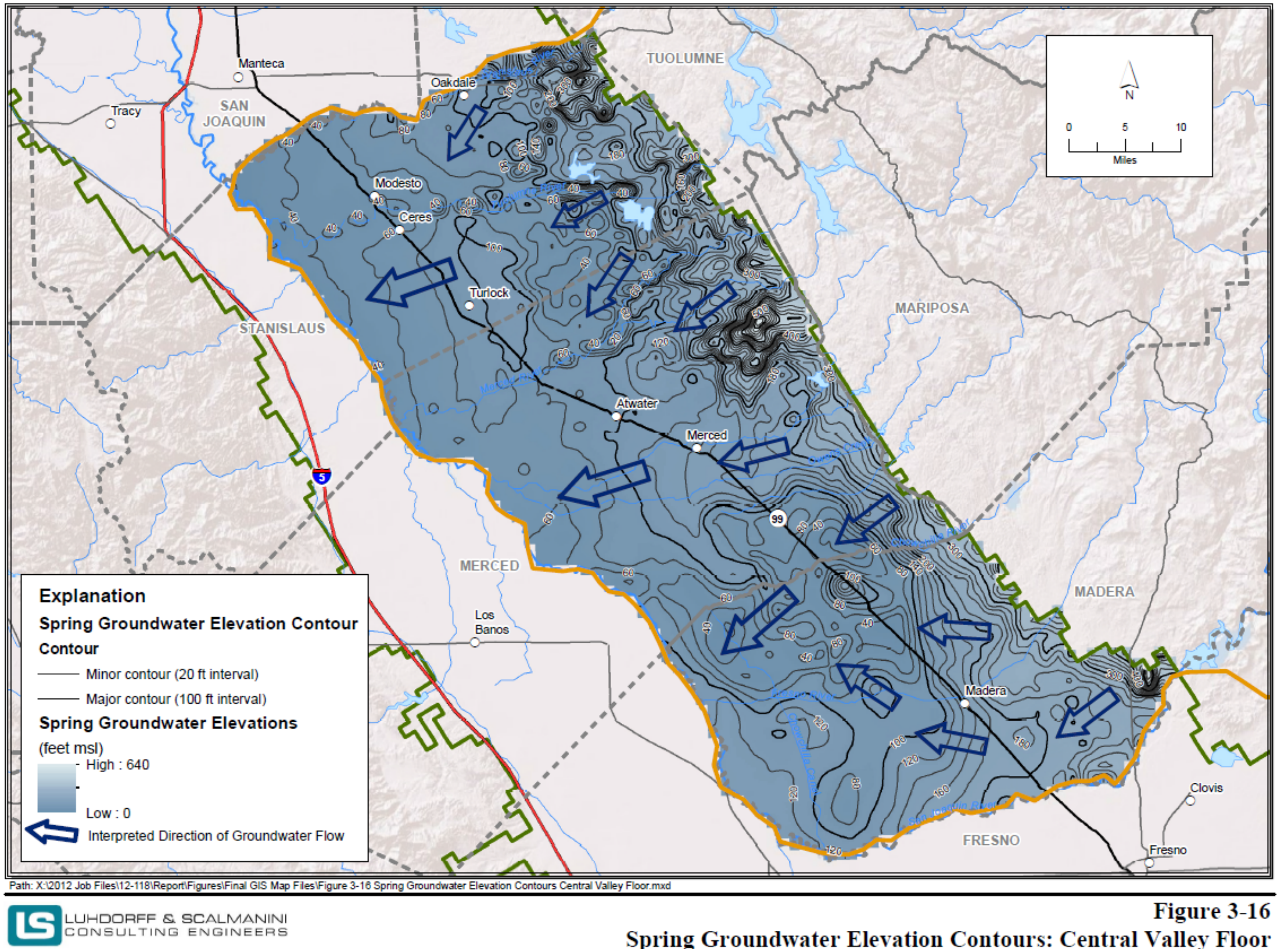
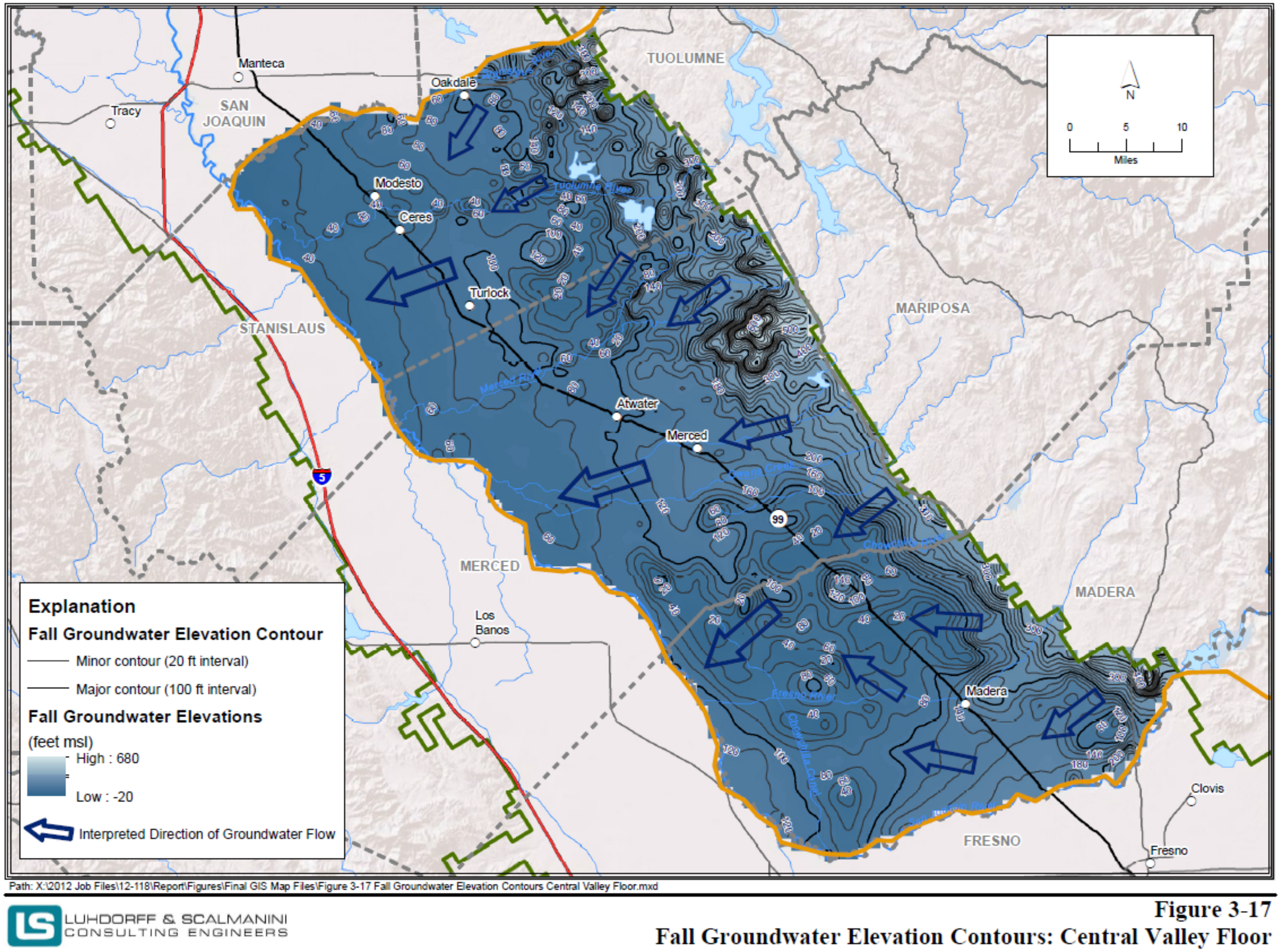


Figure 32. Fall groundwater elevation contours: Central Valley portion of the Coalition (Figure 3-16, GAR).



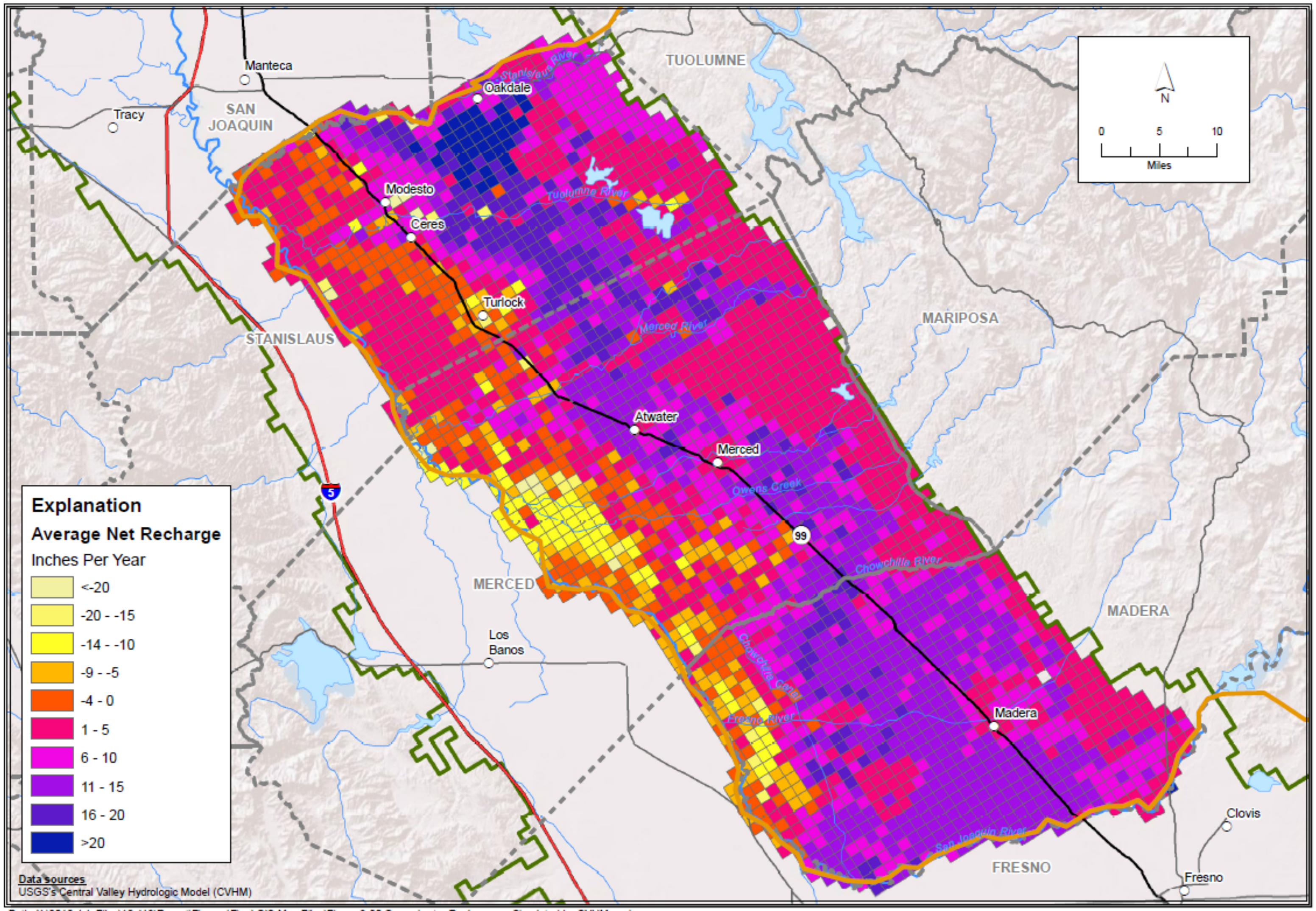
Recharge to Groundwater

The primary process for groundwater recharge within the Central Valley Floor area is from percolation of applied irrigation water. Groundwater recharge estimates made by DWR (2003) for each of the five main groundwater subbasins within the Coalition region indicate that natural groundwater recharge represents a relatively small fraction of total recharge when compared with estimates of recharge from applied water. Annual natural recharge estimates made by DWR for the five main groundwater subbasins within the Coalition region total 274,000 acre-feet (af) (Modesto: 86,000 af, Turlock: 33,000 af, Merced: 47,000 af, Chowchilla: 87,000 af, Madera: 21,000 af). In contrast, estimates of average annual recharge from applied water for these subbasins totals 1,231,000 af (Modesto: 92,000 af, Turlock: 313,000 af, Merced: 243,000 af, Chowchilla: 179,000 af, Madera: 404,000 af).

The modeled net recharge within the Central Valley Floor area from the CVHM output is shown in Figure 33(Figure 3-20, GAR). This map depicts model-simulated annual net recharge in units of inches at a one square mile grid scale with values ranging from below negative 20 inches per year to greater than 20 inches per year. The areas of highest net recharge correspond with areas of high vertical hydraulic conductivity in CVHM model layers (as shown for CVHM Layer 1 on Figure 17) and also areas where depth to groundwater is generally deeper (as shown in Figure 26 and Figure 27). Conversely, negative net recharge values are generally in areas where groundwater is shallow resulting in greater evapotranspiration of water within the root zone and potential discharging of groundwater.

Areas with high potential for groundwater recharge within the Central Valley Floor area of the Coalition region are shown in Figure 34(Figure 3-21, GAR). The areas of potential groundwater recharge are based on mapped areas of high soil hydraulic conductivity (harmonic mean of saturated soil vertical hydraulic conductivity >2 feet/day) which overlie mapped unconsolidated geologic units, mainly alluvium. High conductivity soils are shown in blue in Figure 34 and occur along many of the main tributary river channels and as the result of distributary channel and fan deposition. The areas where the greatest potential for groundwater recharge exists are areas where these high conductivity soils overlie unconsolidated alluvium which functions as the primary aquifer system in the area. Where the Corcoran Clay exists, groundwater recharge is more likely to be limited to shallow groundwater zones (Figure 34). As a result, the areas with potential for deep groundwater recharge are more likely to be located in the eastern part of the Central Valley Floor where the Corcoran Clay is not present.

Figure 33. Groundwater recharge as simulated by the CVHM (Figure 3-20, GAR).



Path: X:\2012 Job Files\12-118\Report\Figures\Final GIS Map Files\Figure 3-20 Groundwater Recharge as Simulated by CVHM.mxd

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Figure 3-20
Groundwater Recharge as Simulated by CVHM

Figure 34. Areas with higher potential for groundwater recharge (Figure 3-21, GAR).

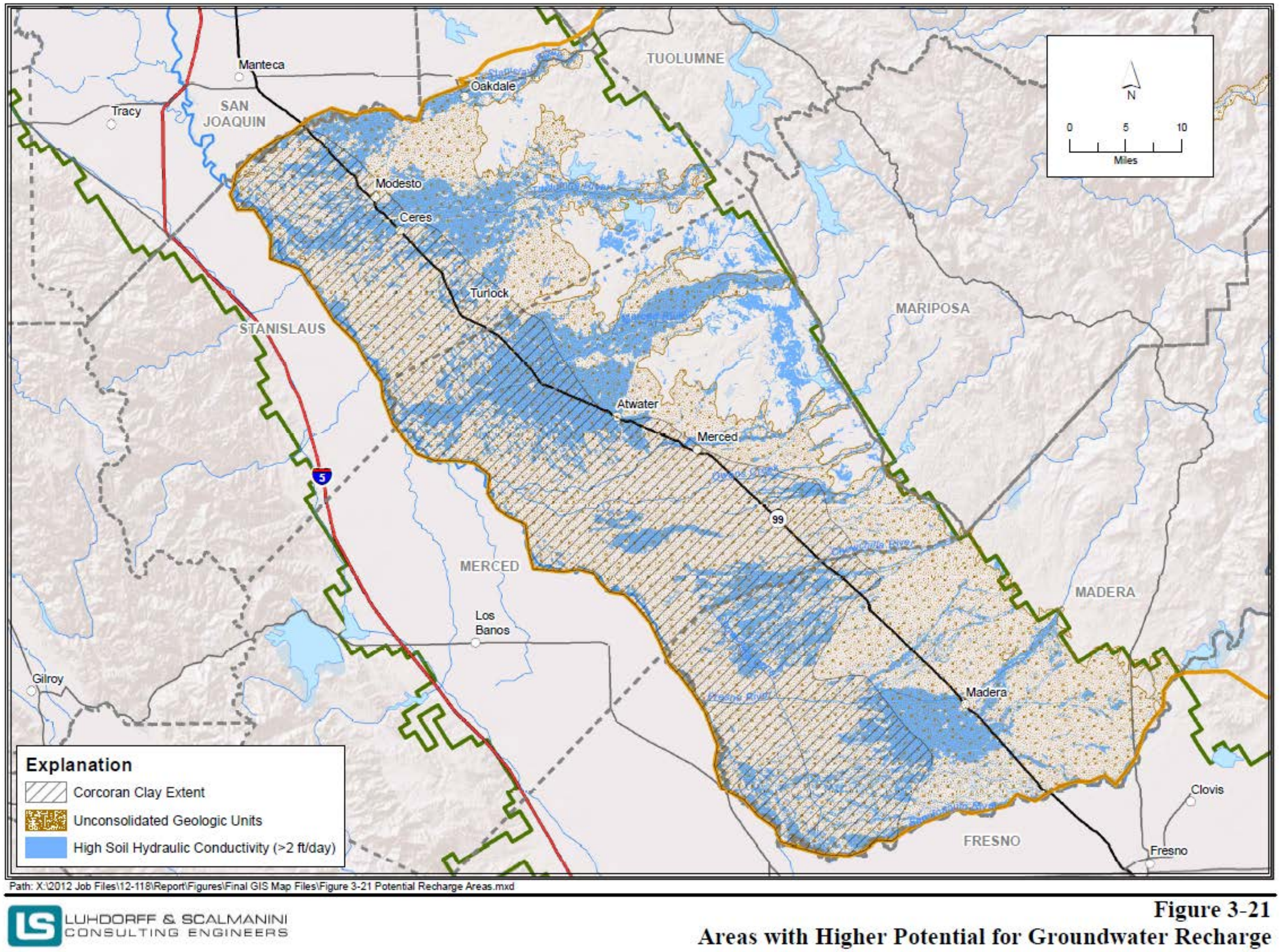


Figure 3-21
Areas with Higher Potential for Groundwater Recharge

General Groundwater Chemistry

The cation-anion balance of groundwater monitored in USGS' Central–Eastside San Joaquin Basin Study Unit is depicted in a Piper Diagram below (Figure 35). California Department of Public Health (CDPH) data used in the Piper diagram describes a charge imbalance of less than 10 percent. USGS' Central–Eastside San Joaquin Basin Study Unit is bounded by the San Joaquin River to the west, the Sierra Nevada Mountains to the east, the Stanislaus River to the north, and the Chowchilla groundwater subbasin to the south (USGS, *Status and Understanding of Groundwater Quality, Central–Eastside San Joaquin Basin, 2006: GAMA Priority Basin Project, Scientific Investigations Report 2009-5266*, page 5). For the purposes of the management units laid out in this GQMP, the USGS' Central–Eastside San Joaquin Basin Study Unit includes most of the Modesto GQMP Zone (excluding the northern most sliver along the Stanislaus River), part of the Eastern San Joaquin subbasin, and the entire Turlock and Merced GQMP Zones (Figure 36).

The Merced Area Groundwater Pool Interests (MAGPI) published a map of groundwater types (cation/anion) within the Merced groundwater subbasin in the Merced Groundwater Basin Groundwater Management Plan Update Merced County, CA, 2008 (Figure 37). "Groundwater with high concentrations of total dissolved solids is present beneath the entire Merced groundwater basin at depths from about 400 feet in the west to over 800 feet in the west. The shallowest high Total Dissolved Solids (TDS) groundwater occurs in zones five to six miles wide adjacent and parallel to the San Joaquin River and the lower part of the Merced River west of Hilmar, where high TDS groundwater is upwelling. The chemistry of groundwater in the Merced groundwater basin indicates that mixing is occurring between the shallow fresh groundwater and the brines, which produces the high TDS groundwater observed" (Merced Groundwater Basin Groundwater Management Plan Update Merced County, CA, 2008, page 15).

The cation-anion balance of groundwater monitored in USGS' Madera- Chowchilla Study Unit is depicted in a Piper Diagram below (Figure 38). USGS' Madera- Chowchilla Study Unit is bounded partially on the north by the Chowchilla River, approximately on the west and south by the San Joaquin River, and on the east by foothills of the Sierra Nevada (USGS, Status and Understanding of Groundwater Quality in the Madera-Chowchilla Study Unit, 2008: California GAMA Priority Basin Project*, Scientific Investigations Report 2012–5094*, page 5). For the purposes of the monitoring units laid out in this GQMP, the USGS' Madera- Chowchilla Study Unit includes the entire Chowchilla groundwater monitoring zone and most of the Madera groundwater monitoring zone, only excluding the eastern sliver of the Delta-Mendota subbasin as it follows the San Joaquin.

Madera County overlies most of the Madera subbasin and parts of the Chowchilla and Delta-Mendota subbasins. Madera County published a Stiff diagram in Figure 2-12 of their AB3030 Groundwater Management Plan Madera County Final Draft produced in January 2002 (Madera County, 2002). The Stiff diagram, reproduced in Figure 39, is a geochemical plot which allows for a visual comparison between water quality types based on concentrations of specific cations and anions in the water. The Madera County Stiff diagram indicates that the East and Central Basin are shallow with smaller concentrations of TDS. The Eastern Basin is considered deep with higher TDS concentrations and the presence of detectable metals and the Western Basin is shallow with a wide diagram dominated by sodium and chloride. According to the Madera County

Groundwater Management Plan, "the geochemical plot graphically illustrates the changes in water quality with depth and in particular the poorer water quality in the west" (Madera County, 2002).

Figure 35. Piper diagram of ion balance for USGS grid and understanding wells and all wells in the CDPH database that have a charge imbalance of less than 10 percent, Central Eastside, California, USGS study unit.

USGS, Status and Understanding of Groundwater Quality, Central–Eastside San Joaquin Basin, 2006: GAMA Priority Basin Project, Scientific Investigations Report 2009-5266, Figure B2, page 96.

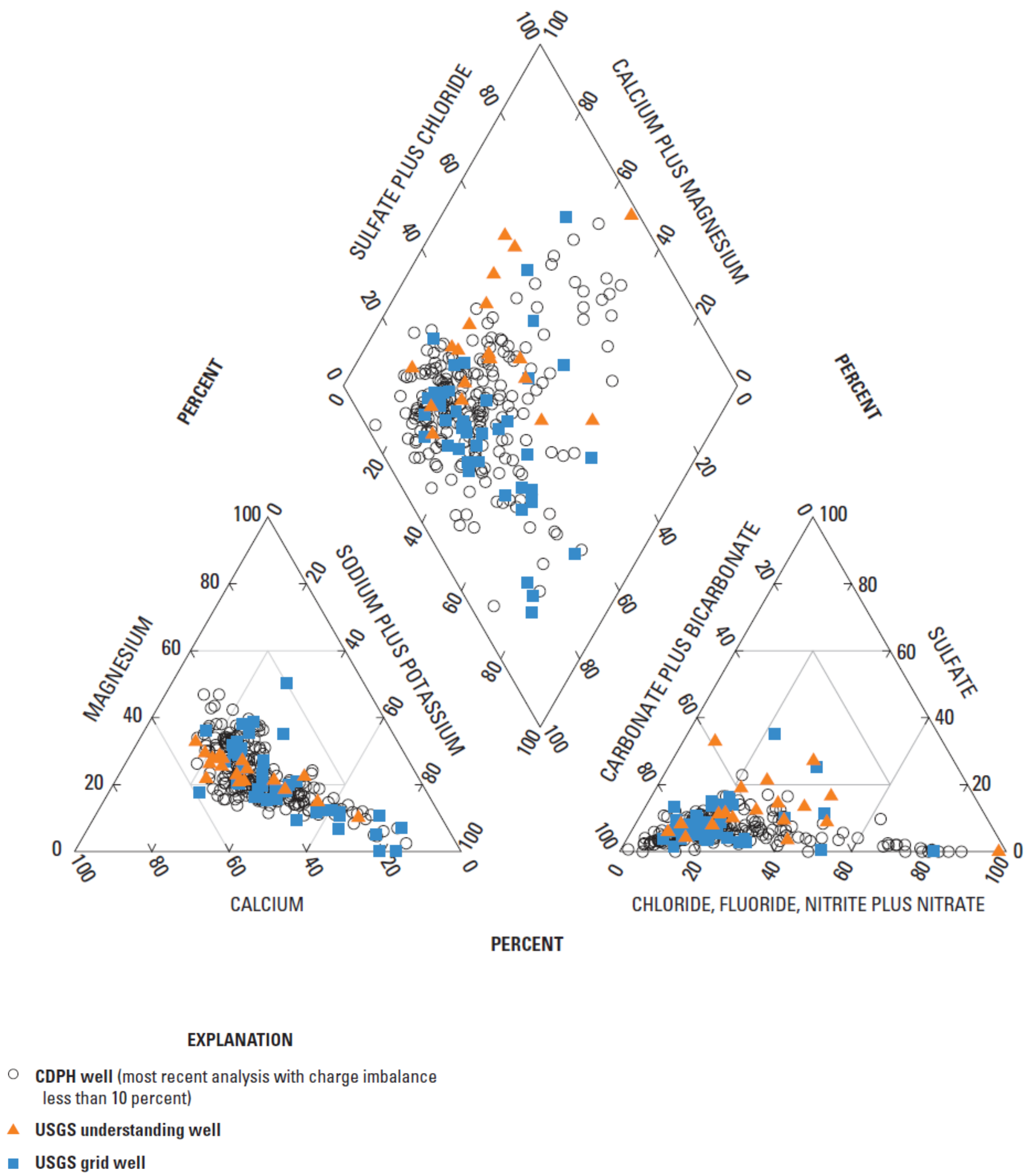


Figure 36. USGS' Central–Eastside San Joaquin Basin Study Unit.

USGS, Status and Understanding of Groundwater Quality, Central–Eastside San Joaquin Basin, 2006: GAMA Priority Basin Project, Scientific Investigations Report 2009-5266, page 5.

6 Status and Understanding of Groundwater Quality, Central–Eastside San Joaquin Basin, 2006: GAMA Priority Basin Project

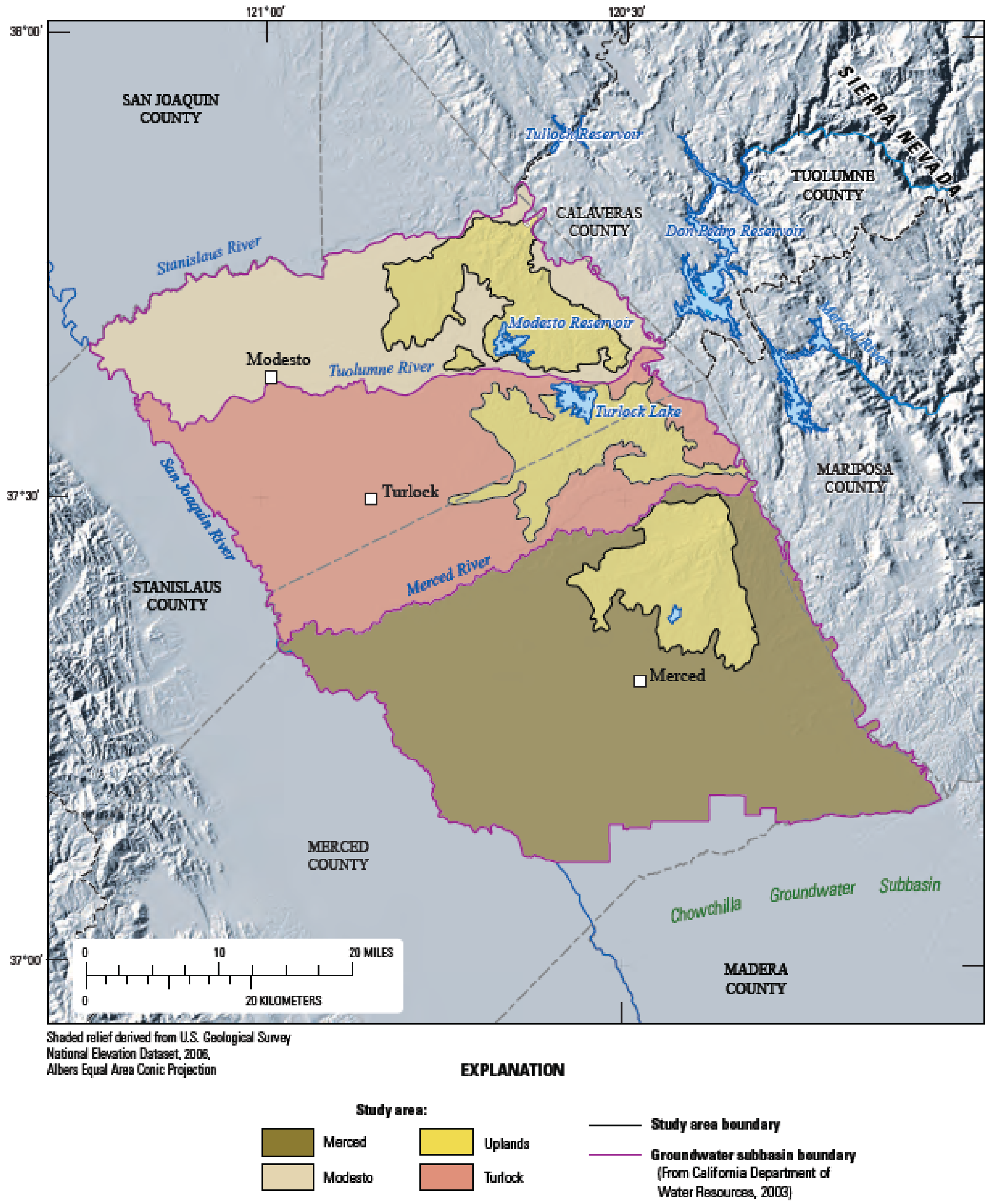


Figure 2. Geographic features of the Central Eastside, California, Groundwater Ambient Monitoring and Assessment (GAMA) study unit.

Figure 37. Distribution of groundwater types within the Merced groundwater basin (Geomatrix, Merced Groundwater Basin Groundwater Management Plan Update Merced County, CA, Figure 19, 2008).

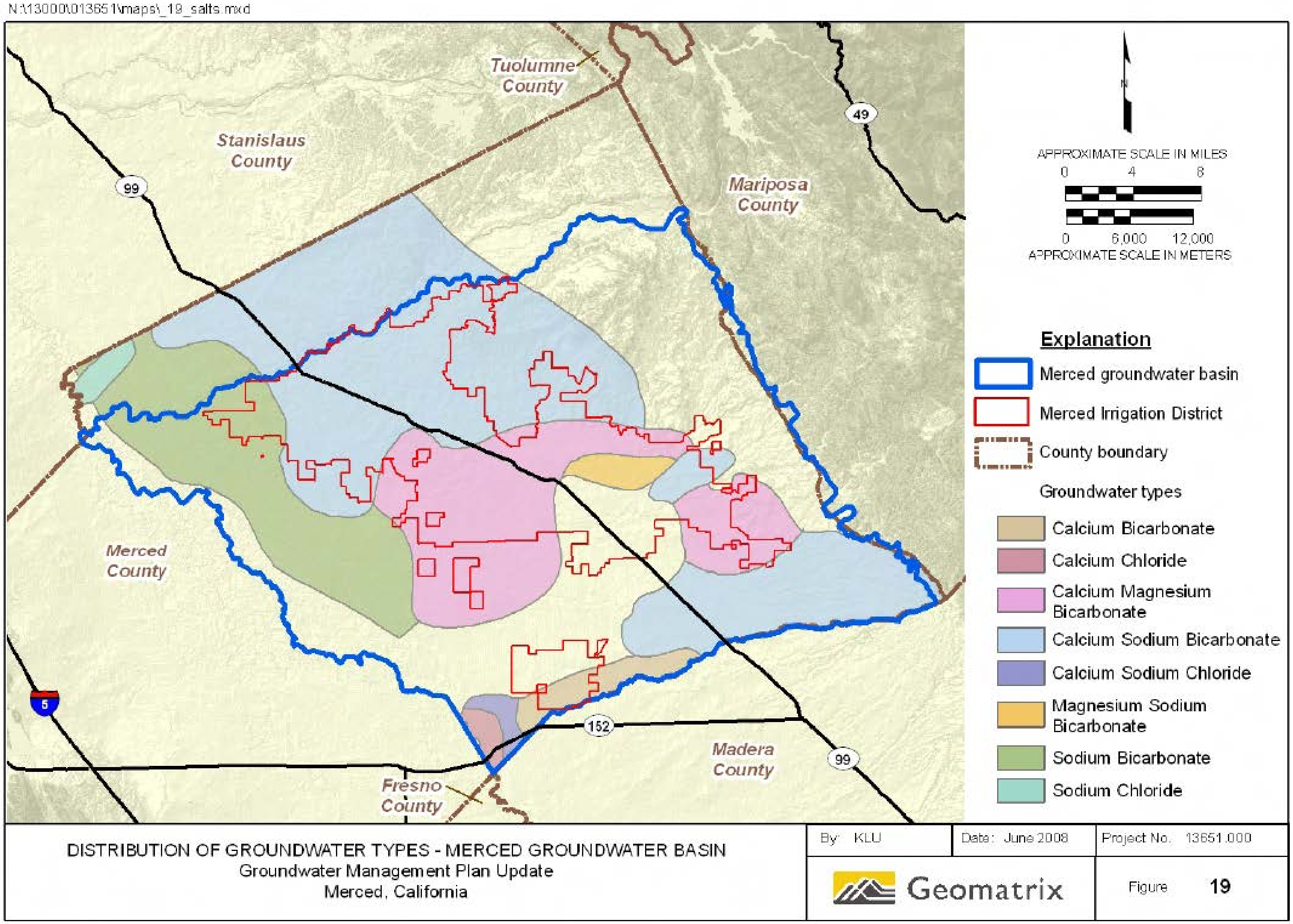


Figure 38. Reproduced piper diagram for the Madera-Chowchilla study unit (USGS 2008). Well data are from the CDPH database using data from February 12, 2005 – February 12, 2008.

USGS, Status and Understanding of Groundwater Quality in the Madera- Chowchilla Study Unit, 2008: California GAMA Priority Basin Project, Scientific Investigations Report 2012–5094, Figure B2, Appendix B, page 83.

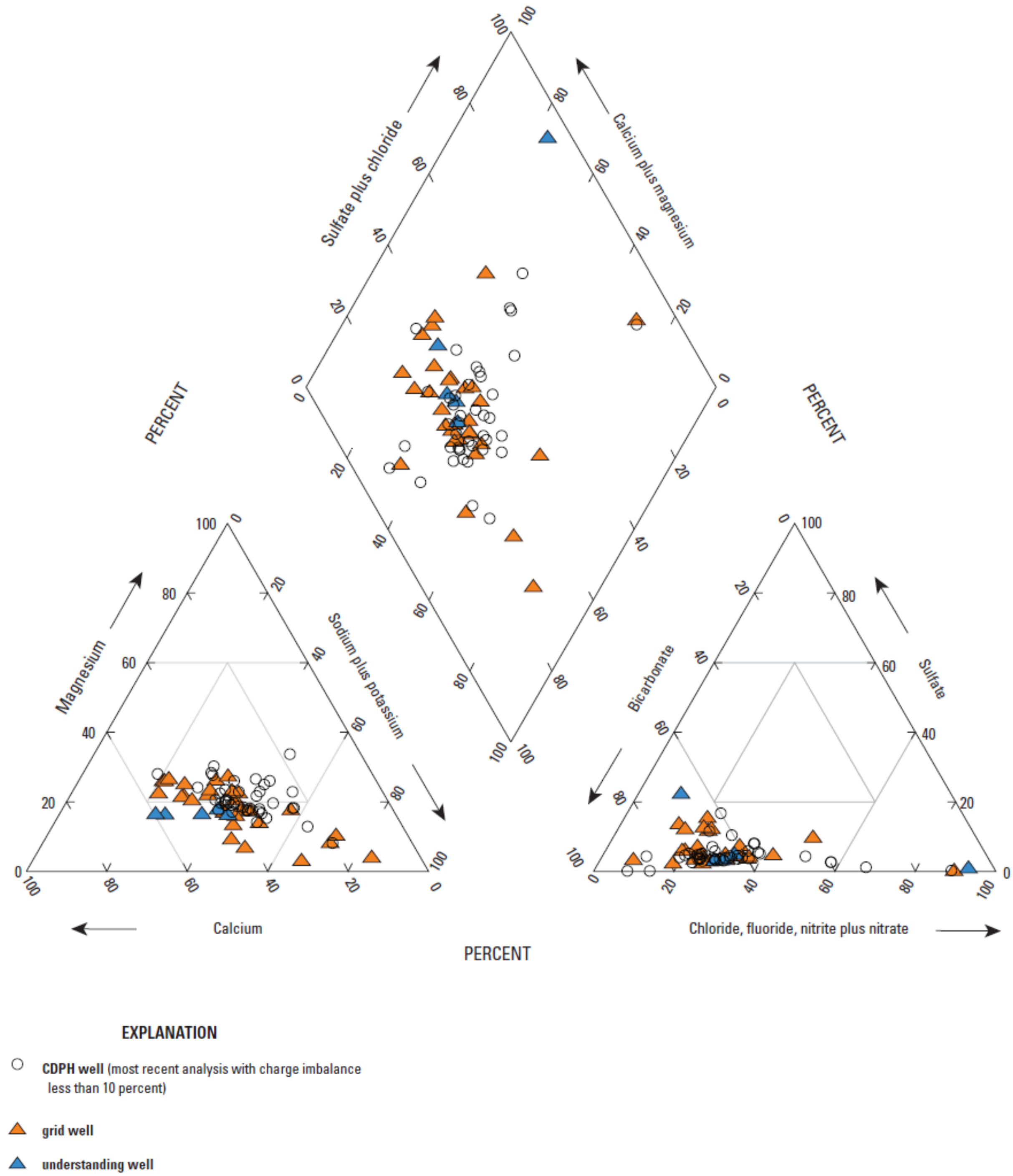
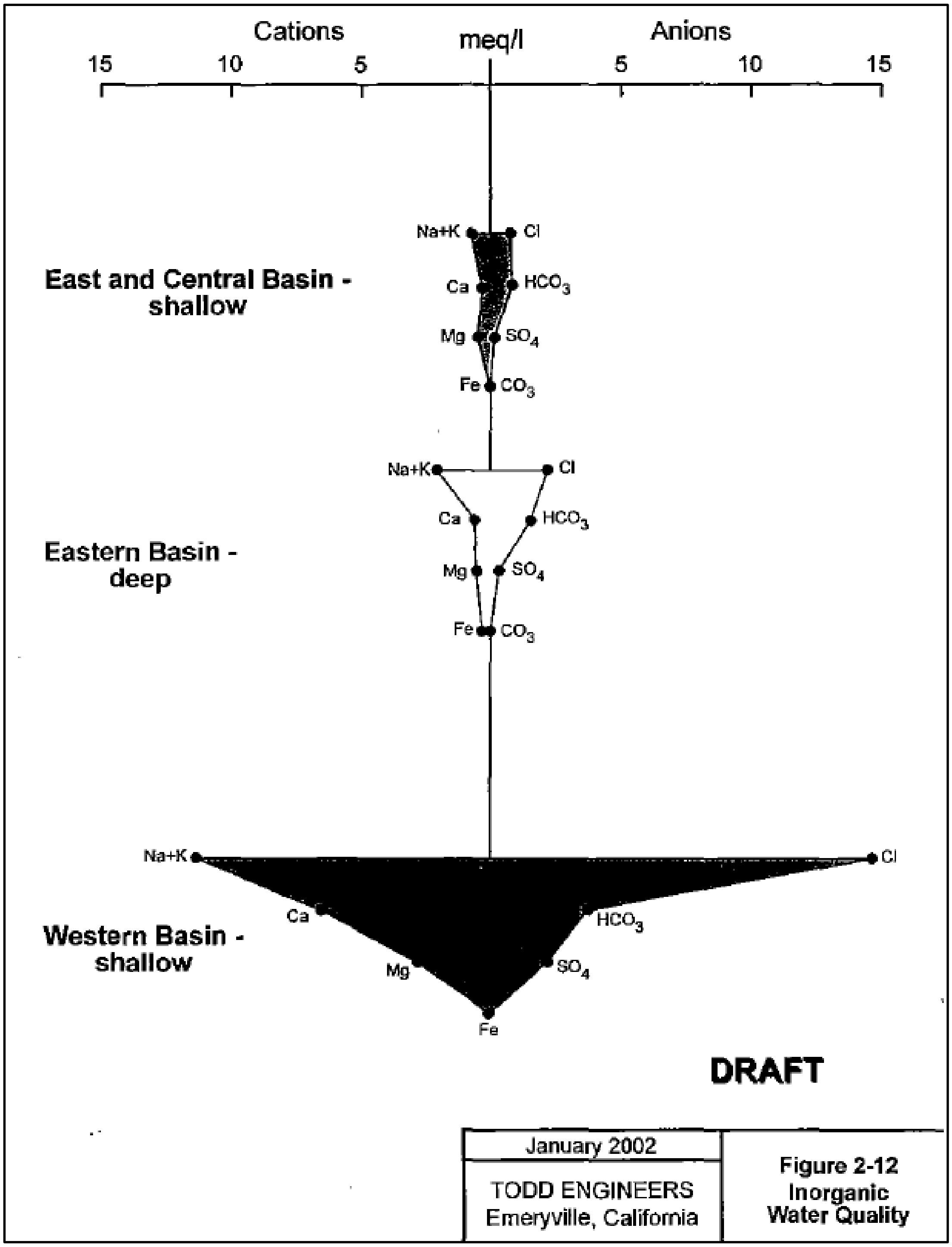


Figure 39. Stiff Diagram representing geochemical properties of both deep and shallow groundwater aquifers within Madera County (AB3030 Groundwater Management Plan, Madera County, 2002).



LAND USE

Irrigated agriculture is the predominant land use in the Coalition area although the growing urban areas in the Central Valley are also a significant land use. According to 2015 USDA data, approximately 4,676,191 acres are used for non-agricultural purposes and/or are simply undeveloped (Table 7). Other non-irrigated land uses include dairies with some acreage in feedlots.

Table 7. 2015 USDA land use acreage for non-agricultural lands within the entire Coalition region.

USDA (Non-agricultural) Land Use Category	Acreage
Evergreen Forest	1,849,171
Shrubland	1,077,992
Grassland/Pasture	1,035,689
Barren	293,922
Developed/Open Space	111,408
Open Water	69,257
Deciduous Forest	65,778
Developed/Low Intensity	47,475
Fallow/Idle Cropland	46,409
Developed/Med Intensity	44,279
Herbaceous Wetlands	19,966
Developed/High Intensity	9,764
Woody Wetlands	3,500
Mixed Forest	1,078
Perennial Ice/Snow	503
Grand Total	**4,676,191**

Irrigated Land

The Coalition area contains approximately 5,743,147 acres. Exact irrigated acreage is difficult to estimate due to rapidly changing land use and therefore two estimates are provided here. The acreage within the GQMP area (Table 8) is approximately 1,711,555 with a total irrigated acreage of 983,470 acres (57%), as provided by DWR, or 939,184 acres (55%), using 2015 USDA data, with the assumption that all crop land was irrigated land.

Table 8. Approximate total acreages of GQMP Zones for the Coalition area.

GQMP Zones	Total Acres[1] (from ArcGIS)
Modesto	273,477
Turlock	362,267
Merced	499,225
Chowchilla	160,963
Madera	415,623
Total	**1,711,555**

[1]Total zone acreages calculated using ArcGIS.

Irrigated acreages from two DWR data sources: 1) DWR Agricultural Land and Water Use data, and 2) DWR Land Use Survey are illustrated in Figure 40. Land use data illustrating 2015 USDA data are provided in Figure 41. Agricultural Land and Water Use data (DWR, http://www.water.ca.gov/landwateruse/anaglwu.cfm) estimates the acreage of irrigated crops for the entirety of each county. Land Use Survey data (http://www.water.ca.gov/landwateruse/lusrvymain.cfm) includes more detailed information regarding specific crop uses (both irrigated and non-irrigated) than the Agricultural Land and Water Use data but is updated less often. Because Land Use Survey data are available in Geographic Information System (GIS) shape files, the information was mapped to the Coalition area and used for estimates of irrigated crop acreage. The data source used depends on: 1) whether or not the entire county is within the Coalition boundary, and 2) which data were developed most recently.

For San Joaquin, Stanislaus, Merced, Madera, Fresno, Alpine and Calaveras Counties, the Coalition utilized DWR Land Use Survey data to determine irrigated land area as only portions of these counties are included in the Coalition boundary or the data were more current. For Tuolumne and Mariposa Counties, data from Agricultural Land and Water Use were used since these counties are included in their entirety within the Coalition boundary. Although the entire county of Madera is represented by the Coalition, the DWR Land Use Survey is more current. For calculations of total acreage, measurements were made using ArcGIS.

Crop Analysis in the GQMP

Land use analyses in the GAR reported the temporal change of crop and land use in the area using DWR land used data, from the mid-1990s to the early 2000s, and the United States Department of Agriculture (USDA) cropland data from 2012, when the GAR was written, the most recent data available. Based on the DWR land use data up until the early 2000s, the largest agricultural crop was nut trees. Based on the USDA data from 2012 (dataset used in the GAR), the top agricultural crop categories within the GQMP area of the Coalition were almonds, alfalfa, winter wheat, grapes, and corn totaling over 75% of cropland, when including values for double crops with corn (Table 9, Figure 41). Based on the USDA data from 2015 (the most recent dataset available at the time of this revision), the top agricultural crop categories within the GQMP area of the Coalition are almonds, grapes, alfalfa, and winter wheat, totaling over 78% of cropland (Table 10, Figure 42).

Table 9. USDA 2012 land use acreage within the entire GQMP area (dataset used in the ESJWQC's GAR).
Land use information obtained from data provided by USDA, 2012 California Cropland Data Layer: http://www.nass.usda.gov/research/Cropland/SARS1a.html. Land use in some areas of the ESJWQC may have changed since that time.

Crop Type	Acreage	Percent acreage of total GQMP*
Almonds	344,690	36.18%
Alfalfa	120,899	12.69%
Grapes	118,449	12.43%
Winter Wheat	47,705	5.01%
Double Crop Oats/Corn	42,882	4.50%
Oats	42,037	4.41%
Other Hay/Non Alfalfa	39,727	4.17%
Fallow/Idle Cropland	30,244	3.17%
Pistachios	28,387	2.98%
Double Crop Winter Wheat/Corn	24,990	2.62%
Corn	21,796	2.29%
Walnuts	21,168	2.22%
Cotton	16,024	1.68%
Tomatoes	12,245	1.29%
Sweet Potatoes	11,506	1.21%
Grand Total for Agricultural Crops	922,747	96.85%

*Percent of cropped area includes all agricultural fields, whether fallow or active. Land use categories such as barren, developed, and native or wetland vegetation were not included in acreage totals. Crops contributing 1% or more of the overall land use within the GQMP area were included.

Figure 40. Land use by GQMP Zone within the Coalition based on DWR data.

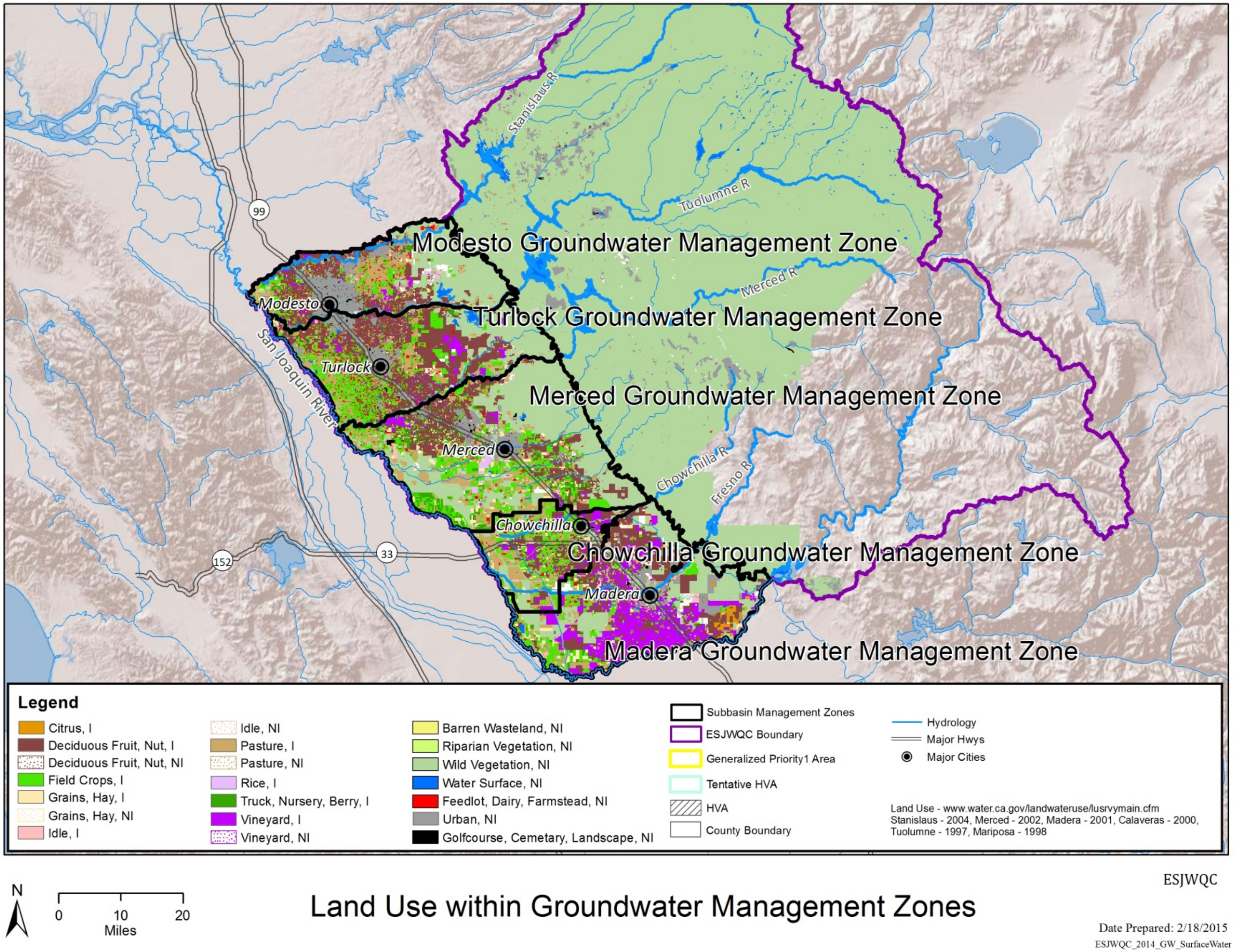


Figure 41. Land Use based on USDA 2012 data from the ESJWQC's GAR (Figure 4-5, GAR).

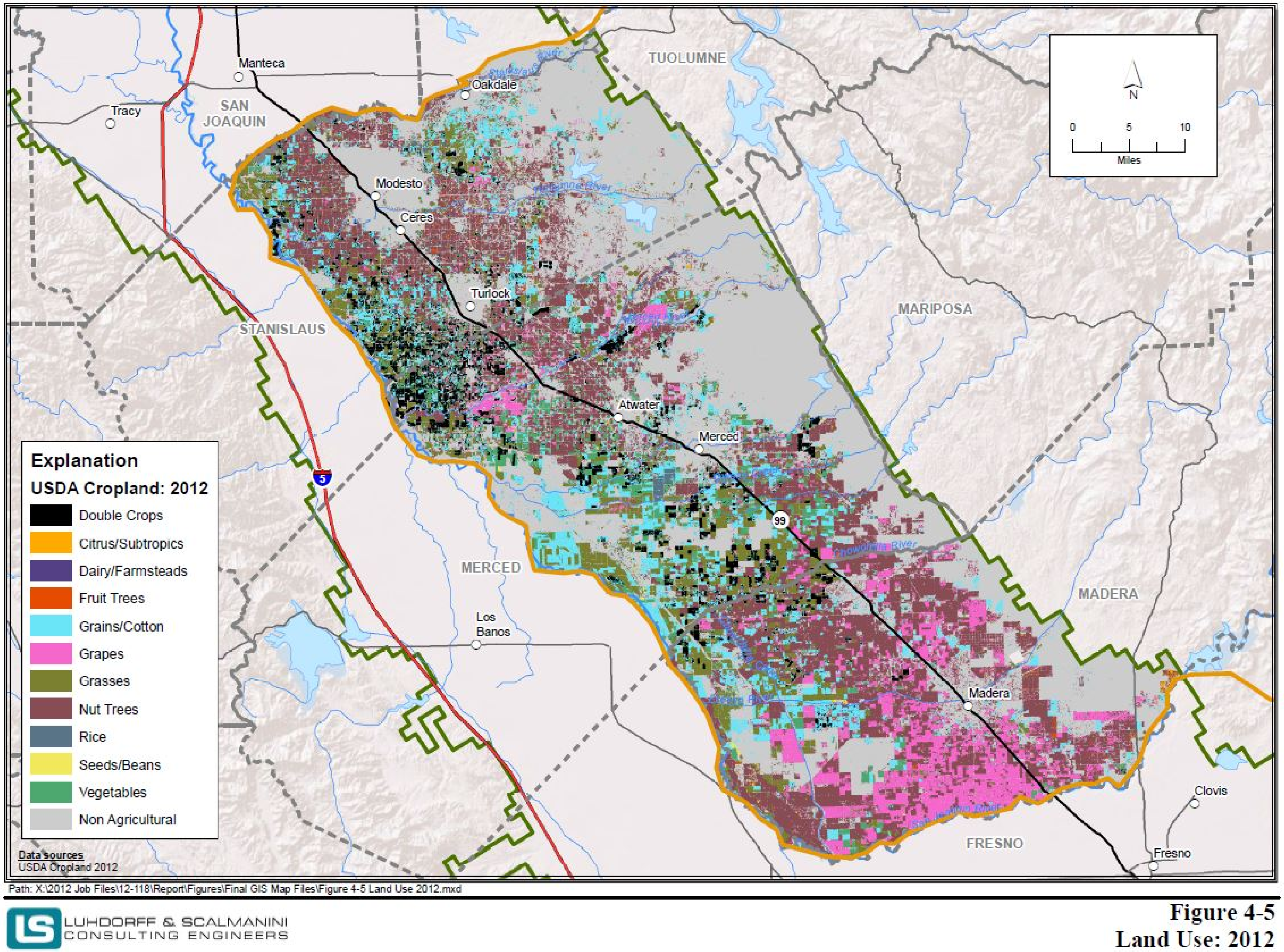
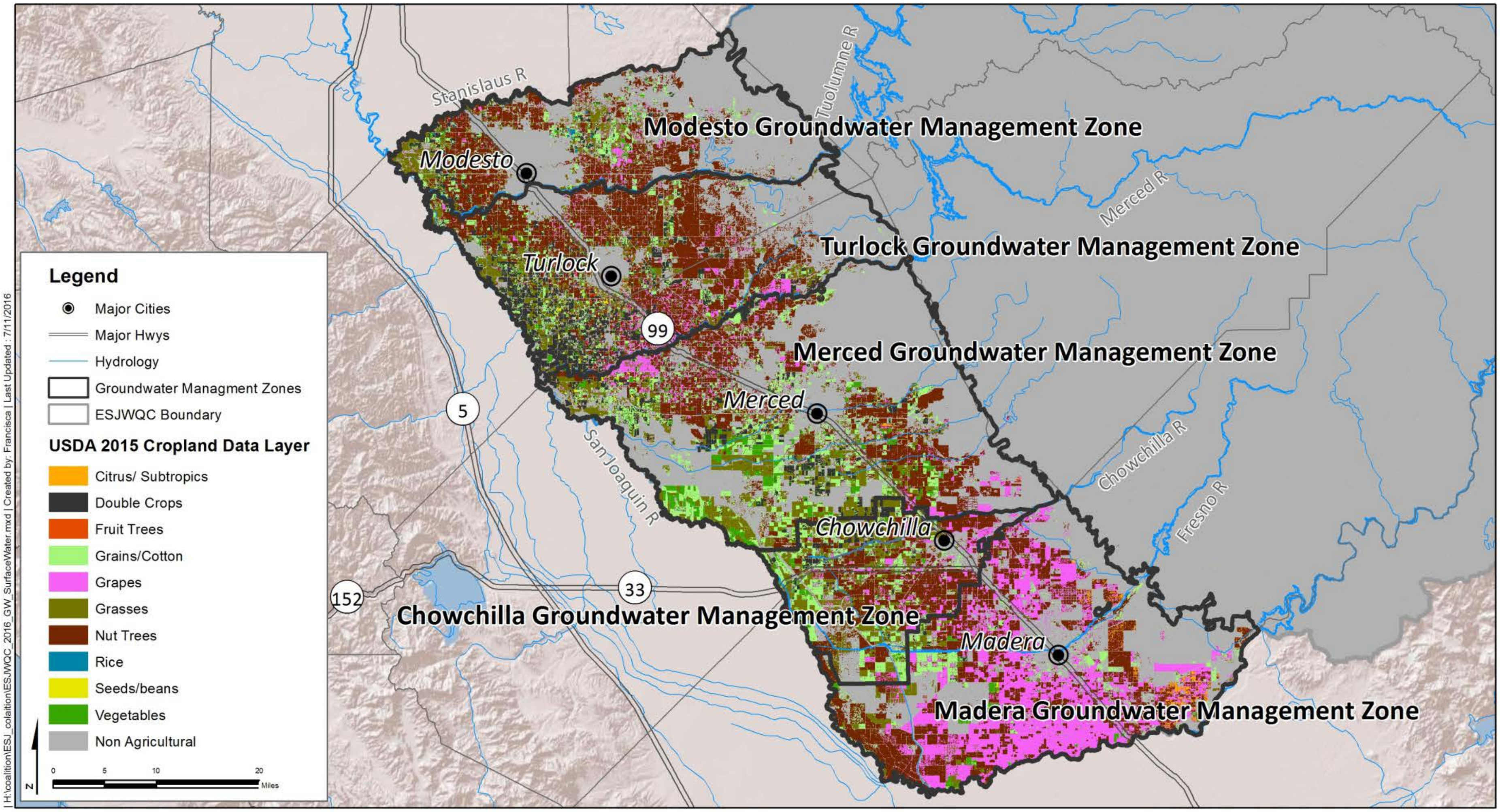


Figure 42. Land Use based on USDA 2015 data.



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2015 USDA Land Use within Groundwater Management Zones

ESJWQC

Coordinate System: NAD 1983 StatePlane California III FIPS 0403 Feet
Projection: property=Lambert Conformal Conic
Units: Foot US

Service Layer Credits: Shaded Relief: Copyright:© 2009 ESRI
Hydrology - NHD hydrodata, 1:24,000-scale, http://nhd.usgs.gov/
Roads, highways, railroads - ESRI
USDA Land Use:https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php, 2015 data

Table 10. USDA 2015 land use acreage within the entire GQMP area.

Land use information obtained from data provided by USDA, 2015 California Cropland Data Layer: http://www.nass.usda.gov/research/Cropland/SARS1a.html. Land use in some areas of the ESJWQC may have changed since that time.

Crop Type	Acreage	Percent acreage of total GQMP*
Almonds	730,281	38.29%
Grapes	433,627	22.74%
Alfalfa	233,715	12.25%
Winter Wheat	96,682	5.07%
Dbl Crop Oats/Corn	81,995	4.30%
Fallow/Idle Cropland	75,634	3.97%
Other Hay/Non Alfalfa	49,934	2.62%
Dbl Crop WinWht/Corn	45,558	2.39%
Pistachios	29,011	1.52%
Tomatoes	26,637	1.40%
Oats	26,286	1.38%
Walnuts	23,116	1.21%
Grand Total for Agricultural Crops	1,852,476	97%

*Percent of cropped area includes all agricultural fields, whether fallow or active. Land use categories such as barren, developed, and native or wetland vegetation were not included in acreage totals. Crops contributing 1% or more of the overall land use within the GQMP area were included.

Crop Analysis in the HVA and Priority 1-3 Areas

As described in the GAR Addendum, the top acreage crops within the Coalition are almonds (362,302 acres), grapes (136,409 acres), and corn (94,095 acres). The GAR analysis of crop type for the ESJHVA prioritization is based on USDA 2012 cropland data (Table 9, Figure 41). In order to evaluate spatial and temporal patterns and perform a groundwater vulnerability assessment throughout the Central Valley, authors of the GAR grouped similar land uses into categories (Figure 43) for both DWR and USDA data sets. Table 11 provides a breakdown of agricultural land use relative to HVA Priority Areas 1-3, based on 2015 USDA and grouped into categories listed in the GAR and provided in Figure 43.

Figure 43. Land use categories for both DWR and USDA data sets as presented in the GAR (Table 4-1, GAR).

Table 4-1

Land Use Classification System

LSCE	DWR				USDA			Applied Nitrogen[d]	
			Mid-1990s[a]	Early 2000s[a]			2012	(lbs nitrogen/ac/year)	
Group Description	Land Use Codes	Land Use Description	% of Valley Floor Land Cover[b]	% of Valley Floor Land Cover[b]	Codes	Land Use Description	% of Valley Floor Land Cover[b]	1973	2005
Non Agricultural	All "U" codes, #, L, NV, NR, NS, NV, NW	**Native vegetation (36%), urban (7%)**, water surface, riparian vegetation, other.	39.9%	38.3%	61, 111, 121, 122, 123, 124, 131, 141, 142, 143, 152, 171, 190, 195	**Grasslands herbaceous (30.22 %), Developed (9%),** barren, forest, water, wetlands, shrubland	44.6%	-	-
Nut Trees	D12, D13, D14	**Almonds (13%)**, walnuts, pistachios	15.5%	17.5%	74, 75, 76, 204	**Almonds (20%)**, pecans, walnuts, pistachios	23.3%	120-148	138-179
Grasses	All "P" codes	**Alfalfa (6%)**, pasture (mixed and native), clover, turf farms	12.4%	11.9%	27, 36, 58, 59	**Alfalfa (7%)**, rye, , clover/wildflowers, sod/grass seed,	7.9%	20[e]	11[e]
Vegetables	F6 (corn) and all "T" codes	**Corn (7%)**, tomatoes, sweet potatoes, artichokes, beans (green), broccoli, bush berries, cabbage, cauliflower, celery, cucumbers, flowers, nursery, Christmas tree farms, lettuce, melons, squash, onions, garlic, peppers, strawberries	8.7%	10.4%	1, 12, 41, 43, 44, 46, 47, 48, 49, 50, 53, 54, 57, 206, 207, 208, 209, 213, 214, 216, 219, 221, 227, 242	**Corn (1.3%)**, tomatoes, sweet potatoes, asparagus, blueberries, broccoli, cantaloupes, carrots, cucumbers, garlic, greens, herbs, honeydew melons, lettuce, misc vegs & fruits, onions, peas, peppers, potatoes, strawberries, sugar beets, sweet corn, watermelons	3.0%	*Corn*[c]: 145 *Tomatoes*[c]: 142 *Sweet Potatoes*[c]: 107[e]	*Corn*[c]: 213 *Tomatoes*[c]: 180 *Sweet Potatoes*[c]: 147[e]
Grapes	All "V" codes	Vineyards	7.5%	7.8%	69	Grapes	7.1%	53-57	27-44
Grains/Cotton	All "G" codes and also F1 (Cotton)	**Cotton (2.4%), grain and hay crops (2.3%)**, barley, wheat, oats, misc.	8.2%	5.7%	2, 21, 22, 23, 24, 28, 37, 205	**Cotton (1.1%)**, barley, **wheat (3%)** (Durum, Spring, Winter), oats, other hay/non alfalfa, triticale	9.3%	88-109	174-177
Double Crops	-	-		-	225, 226, 235-238	**Oats/Corn (2.6%), Winter Wheat/Corn (1.5%)**, Barley/Corn, Barley/Sorghum, Winter Wheat/Cotton, Winter Wheat/Sorghum	4.1%		
Seeds/beans	All "F" codes except F1 (Cotton) and F6 (Corn)	Field crops, dry beans, safflower, sugar beets, grain sorghum, sudan	2.1%	2.9%	4, 5, 6, 42, 33	Dry beans, safflower, sorghum, soybeans, sunflower	0.1%	51	91
Fruit Trees	D1, D2, D3, D5, D6, D7, D8, D9, D10, D, D**	**Peaches and nectarines (0.1%)**, apples, apricots, cherries, , pears, plums, prunes, figs, misc. deciduous, deciduous fruit and nuts	2.9%	2.6%	66, 67, 68, 71, 77, 218, 220, 223	**Cherries (0.1%)**, apples, apricots, nectarines, other tree crops, peaches, pears, plums	0.2%	95-133	102-130
Dairy/ Farmsteads	All "S" codes	**Dairies (0.89%)**, farmsteads, Poultry farms, livestock feed lot operations	2.0%	2.2%	-	-	-	-	-
Citrus/ Subtropics	All "C" codes	**Oranges (0.3%)**, grapefruit, eucalyptus, , olives, kiwis	0.4%	0.4%	72, 211, 212, 217	Citrus, olives, oranges, pomegranates	0.1%	65-166	95-123
Rice	All "R" codes	Rice	0.4%	0.3%	3	Rice	0.2%	86	130
Total:			100%	100%			100%		

[a] Mid-1990s DWR land use combines data for Stanislaus County (1996), Merced County (1995), and Madera County (1995); Early 2000s DWR land use combines data for Stanislaus County (2004), Merced County (2002), and Madera County (2001).

[b] Land cover values are shown as percent of the Central Valley Floor portion of the Coalition study area.

[c] From DWR Early-2000s land use data, approximately 92% of the total area of Group 7 crops is made up of corn (75%), tomatoes (12%), and sweet potatoes (5%).

[d] Source of applied nitrogen rates: Rosenstock, T.S. and others, 2013, Nitrogen fertilizer use in California: assessing the data, trends and a way forward, California Agriculture, Vol 67 No. 1. pgs 68-79. Online: http://californiaagriculture.ucant.edu/landingpage.cfm?article=ca.E.v067n01p68&fulltext=yesDPI:10.3733/ca.E.v067n01p68

[e] Source of applied nitrogen rates for sweet potatoes and alfalfa, 1975 and 2005: Viers, J.H. and others, 2012, Nitrogen Sources and Loading to Groundwater, Technical Report 2, Assessing Nitrate in California's Drinking Water with a focus on Tulare lake Basin and Salinas Valley Groundwater, Center for Watershed Sciences, University California, Davis, prepared for California State Water Resources Control Board.

Table 11. ESJWQC land use acreage listed in descending order of overall acreage. Acreages based on 2015 USDA data sets within ESJHVA Priority 1-3 areas across the GQMP area and grouped into categories provided by the GAR*.

LAND USE	PRIORITY 1	PRIORITY 2	PRIORITY 3	NOT IN ESJHVA	TOTAL
Nut Trees	56,446	216,227	286,126	223,699	782,498
Grapes	55,393	86,713	120,901	170,620	433,627
Grasses	8,116	63,427	92,196	71,852	235,591
Grains/Cotton*	8,352	51,997	68,776	62,531	191,656
Double Crops	5,072	47,886	57,035	20,817	130,810
Vegetables	2,106	11,017	13,420	17,059	43,602
Citrus/ Subtropics	106	777	1,567	4,948	7,397
Seeds/beans*	78	1,205	1,314	273	2,870
Fruit Trees	86	1,010	1,122	146	2,363
Rice	5	237	264	707	1,214
Christmas Trees*	-	-	2	28	30
Grand Total	**135,760**	**480,494**	**642,724**	**572,680**	**1,831,658**

*Crop types christmas trees, millet,and canola were not in the 2012 USDA dataset used in the GAR analysis. When analyzing acreage by category for the 2015 USDA crop data, millet was grouped with grains/cotton and canola in seeds/beans, based on the criteria described in the GAR. Crop type of christmas trees was not grouped with any other crop type.

Source of Irrigation Water

Data were not found pertaining to specific irrigation water ratios (groundwater vs. surface water) used by Coalition members. However, the DWR's California Draft Water Plan (Ca DWR, 2013) listed agricultural water use met by groundwater for various counties (Table 12). Thousand acre foot (TAF) values are given by county in Table 12 and therefore are presented simply as an approximate reference to the percentage of irrigation needs that are met by groundwater within any given Zone, as GQMP Zones may or may not be included entirely within any given county. Table 3 lists the Zones in reference to the underlying subbasins and associated counties.

Table 12. San Joaquin River Hydrologic Region (and Tulare Lake Hydrologic Region [Fresno County]) Average Annual Groundwater Supply by County and by Type of Use (2005-2010).[1]

COUNTY	WATER USE TYPE MET BY GROUNDWATER							
	AGRICULTURE		URBAN		MANAGED WETLANDS		TOTAL WATER	
	TAF	%	TAF	%	TAF	%	TAF	%
Amador	3.0	20%	1.8	17%	0.0	0%	4.8	19%
Calaveras	1.3	16%	1.6	13%	0.0	0%	2.8	14%
Contra Costa	0.8	1%	25.0	9%	0.0	0%	25.8	6%
Fresno[2]	1,705.2	46%	272.4	80%	1.1	4%	1,978.6	48%
Madera[2]	673.1	66%	40.7	100%	0.0	0%	713.7	68%
Mariposa	3.1	0%	4.6	1%	0.0	0%	7.7	0%
Merced[2]	764.6	38%	84.6	97%	189.2	40%	1,038.3	40%
San Joaquin[2]	354.1	22%	79.9	42%	0.0	0%	434.0	24%
Stanislaus[2]	512.4	30%	162.8	85%	1.4	13%	676.6	36%
Tuolumne	0.4	7%	1.3	10%	0.0	0%	1.7	9%
2005-2010 ANNUAL AVERAGE TOTAL	**2,312.8**	**36%**	**402.1**	**48%**	**190.6**	**39%**	**2,905.5**	**37%**

[1] Table contents from DWR's Draft Water Plan, 2013 (Tables SJR-17 and Table TL-19)
[2] Counties in the GQMP area (partial or entire county)
Percent (%) use is the percentage of the total water supply (for the county) that is met by groundwater, by type of use.

EXISTING AGRICULTURAL MANAGEMENT PRACTICES

Since 2007 the Coalition has surveyed its member grower/operators regarding their management practices. From 2008 to 2013 surveys were sent to landowners who were identified as having fields directly adjacent to or near any waterbody in a surface water management plan; the Coalition developed an inventory of surface water management practices of growers from these surveys including an assessment of irrigation management, pesticide application management and sediment management. Detailed results of the 2007 surveys can be found in the December 31, 2007 Semi Annual Monitoring Report. An inventory of management practices of growers with direct discharge to a management plan waterbody can be found in the Management Plan Update Reports submitted by the Coalition for each year between 2008 and 2013.

Starting in 2014, the Coalition obtains additional management practice information from members within high vulnerability areas (surface or groundwater) from the Farm Evaluation Plan surveys. Farm Evaluations Plans are designed to collect the following information from each grower:

1. Crops grown and acreage of each crop,
2. Location of the member's farm,
3. Identification of on-farm management practices implemented to achieve the WDR farm management performance standards,
4. Potential for erosion during storm events and/or during irrigation (sediment and erosion risk areas) and a description of where within the property this occurs,
5. Identification of whether water leaves the property and is conveyed downstream and a description of where within the property this occurs,
6. Location of active wells and abandoned wells, and
7. Identification of whether wellhead protection and installation of backflow prevention devices have been implemented.

The Coalition includes an assessment of member management practices from the previous year in its Annual Report (submitted May 1 of each year). Table 13 and Figure 44 through Figure 48 summarize the management practices implemented by members in 2013 to protect surface and groundwater quality.

Table 13. ESJWQC member management practices implemented in 2013; listed by Management Practice Category.

Management Practice Category		Management Practices
Irrigation Management Practices	Irrigation Efficiency Practices	Laser Leveling
		Pressure Bomb
		Soil Moisture Neutron Probe
		Use of ET in scheduling irrigations
		Use of moisture probe
		Water application scheduled to need
	Primary (and/or secondary)	Border Strip

Management Practice Category		Management Practices
	Irrigation Practices	Drip
		Flood
		Furrow
		Sprinkler
		Micro Sprinkler
Sediment Management Practices	Cultural Practices to Manage Sediment and Erosion	Berms are constructed at low ends of fields to capture runoff and trap sediment.
		Cover crops or native vegetation are used to reduce erosion.
		Creek banks and stream banks have been stabilized.
		Crop rows are graded, directed and at a length that will optimize the use of rain and irrigation water.
		Field is lower than surrounding terrain.
		Hedgerows or trees are used to help stabilize soils and trap sediment movement.
		Minimum tillage incorporated to minimize erosion.
		Sediment basins / holding ponds are used to settle out sediment and hydrophobic pesticides such as pyrethroids from irrigation and storm runoff.
		Soil water penetration has been increased through the use of amendments, deep ripping and/or aeration.
		Storm water is captured using field borders.
		Subsurface pipelines are used to channel runoff water.
		Vegetated ditches are used to remove sediment as well as water soluble pesticides, phosphate fertilizers and some forms of nitrogen.
		Vegetative filter strips and buffers are used to capture flows.
	Irrigation Practices for Managing Sediment and Erosion	In-furrow dams are used to increase infiltration and settling out of sediment prior to entering the tail ditch.
		PAM (polyacrylamide) used in furrow and flood irrigated fields to help bind sediment and increase infiltration.
		Shorter irrigation runs are used with checks to manage and capture flows.
		Tailwater Return System.
		The time between pesticide applications and the next irrigation is lengthened as much as possible to mitigate runoff of pesticide residue.
		Use drip or micro-irrigation to eliminate irrigation drainage.
		Use of flow dissipaters to minimize erosion at discharge point.
Pesticide & Nutrient Management	Pesticide Application Practices	Avoid Surface Water When Spraying
		Chemigation
		End of Row Shutoff When Spraying
		Follow County Permit
		Follow Label Restrictions
		Monitor Rain Forecasts
		Monitor Wind Conditions
		Reapply Rinsate to Treated Field
		Sensitive Areas Mapped
		Target Sensing Sprayer used
		Use Appropriate Buffer Zones
		Use Drift Control Agents
		Use PCA Recommendations
		Use Vegetated Drain Ditches
	Nitrogen Management Methods to Minimize Leaching Past the Root Zone	Cover Crops
		Fertigation
		Foliar N Application
		Irrigation Water N Testing
		Soil Testing

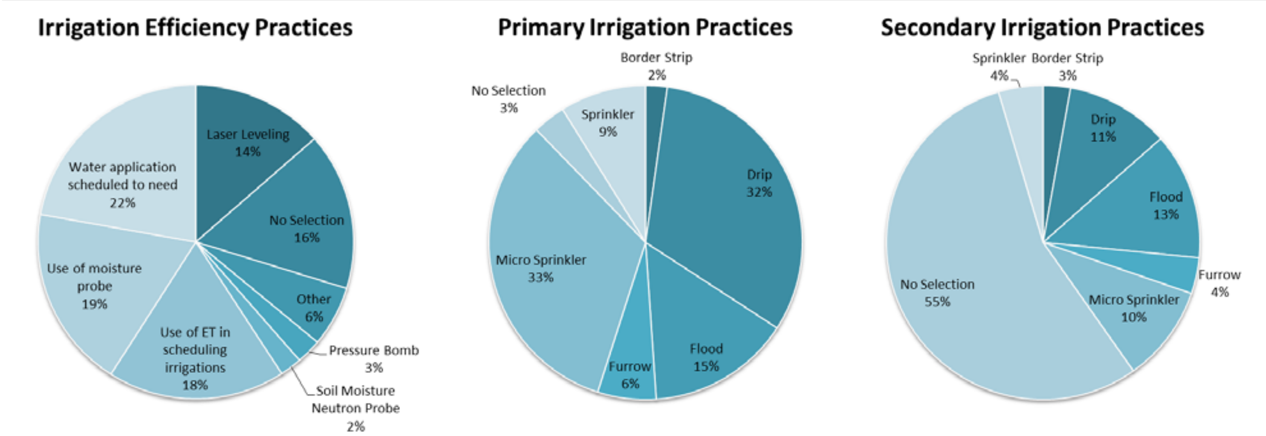
Management Practice Category		Management Practices
		Split Fertilizer Applications
		Tissue/Petiole Testing
		Variable Rate Applications using GPS
Well Management Practices	Wellhead Protection Practices	Air Gap (for non-pressurized systems
		Backflow Preventive / Check Valve
		Good “Housekeeping” Practices*
		Ground Sloped Away from Wellhead
		Standing water avoided around wellhead
	Abandoned Wells Practices (if abandoned well is known to be present on site)	Destroyed – certified by county
		Destroyed - Unknown method
		Destroyed by licensed professional

*Good housekeeping practices include keeping the area surrounding the wellhead clean of trash, debris and any empty containers

IRRIGATION MANAGEMENT PRACTICES

A large portion of the Coalition region has parcels with implemented practices associated with the management of irrigation. The largest acreages were associated with pressurized irrigation. A combination of flood, furrow, and sprinkler irrigation was used on fewer acres than drip irrigation alone. Most members utilize only one irrigation method (Figure 44).

Figure 44. Percent of acreage for irrigation management practices.



PESTICIDE & NUTRIENT MANAGEMENT

Several management practices are associated with pesticide and nutrient management in order to reduce the movement of pesticides and nutrients to surface waters. Nutrient management practices target measures designed to achieve the desired crop yield, but prevent excess nutrients from passing through the root zone and enter groundwater. Pesticide management practices apply to groundwater by targeting the minimum amount of pesticide required to achieve the desired crop yield, preventing overspray from entering recharge areas, and by timing the application of the pesticide far enough in advance of irrigation to prevent pesticides from travelling beyond the targeted area through irrigation waters to recharge areas and entering the groundwater (Figure 45 and Figure 46).

Figure 45. Acreage associated with pesticide application practices.

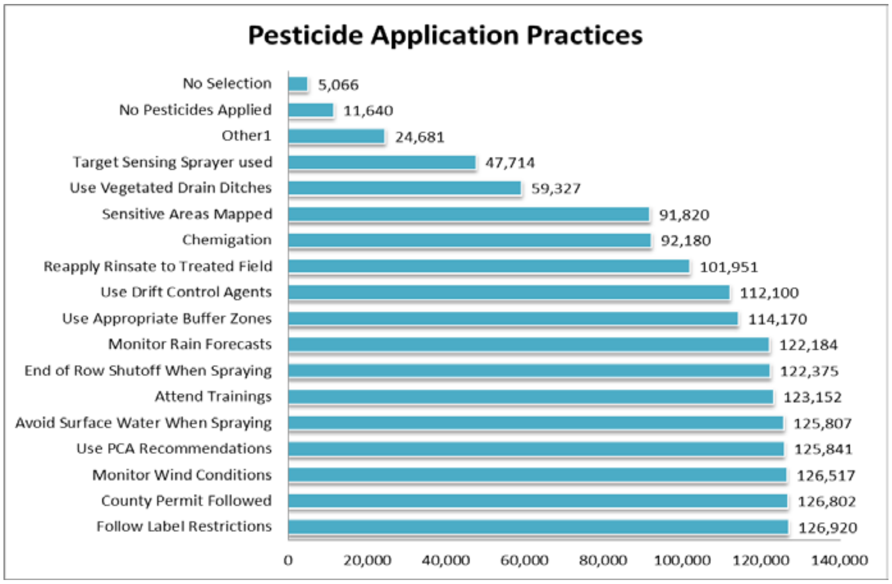
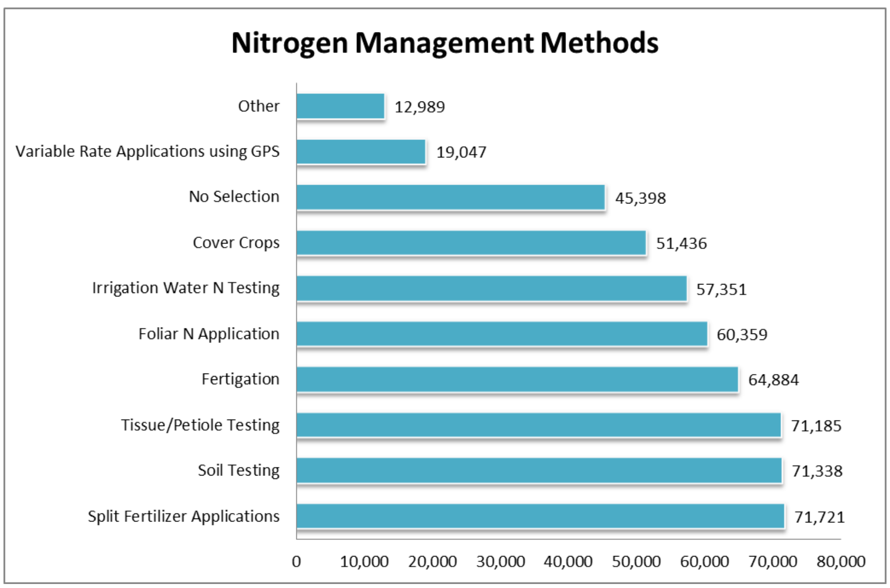


Figure 46. Acreage associated with nitrogen management methods.

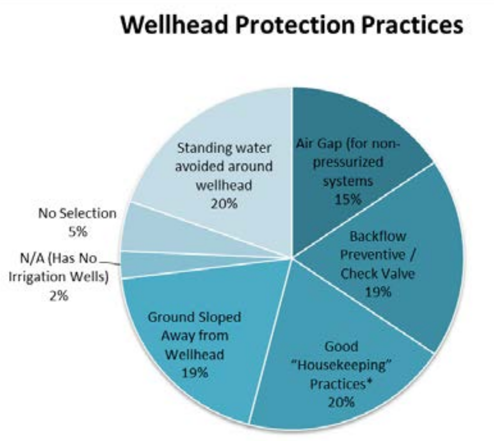


WELL MANAGEMENT PRACTICES

Irrigation Wells

Seventy-eight percent of those owners/operators who returned a Farm Evaluation Survey indicated there was an irrigation well on the agricultural parcel(s). Of those owners/operators utilizing the irrigation well, various wellhead protection practices were employed (**Figure** 47).

Figure 47. Percent acreage associated with members who have irrigation wells and members implementing wellhead protection practices.

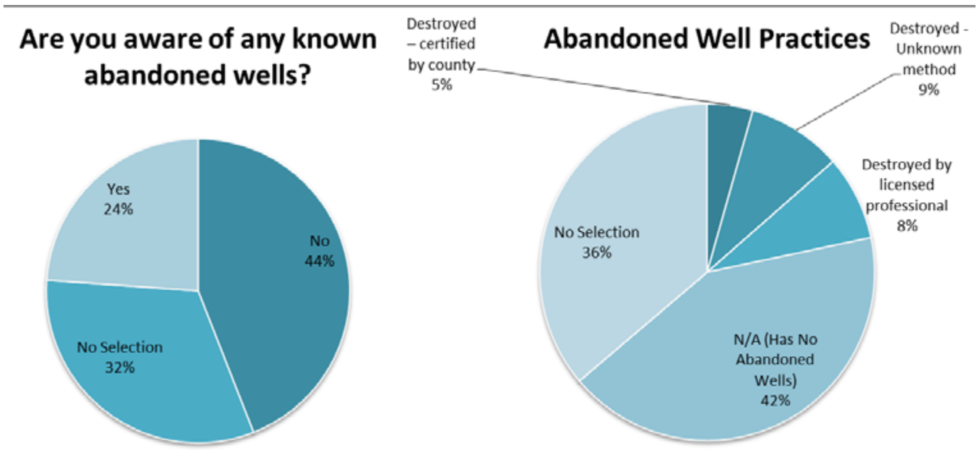


*Good housekeeping practices include keeping the area surrounding the wellhead clean of trash, debris and any empty containers

Abandoned Wells

The Coalition region contains abandoned wells, a large portion of these abandoned wells have been properly destroyed (Figure 48). The number of wells abandoned over the years has fluctuated and appears to bear no relationship to any variable the Coalition currently tracks, although a thorough analysis was not conducted.

Figure 48. Percentage of acreage with abandoned wells and practices associated with those wells.



"…potential constituents of concern (in shallow groundwater) include any material applied as part of the agricultural operation, including constituents in irrigation supply water (e.g., pesticides, fertilizers, soil amendments, etc.) that could impact beneficial uses or cause degradation" (WDR, Attachment B, pg. 13).

Constituents of concern in groundwater are those materials that could impact beneficial uses and that have been applied during agricultural operations (including constituents in irrigation supply water (e.g., pesticides, fertilizers, soil amendments, etc.). Typically, shallow groundwater is that water most recently entering the groundwater recharge cycle and is representative of more recent overlaying land use activities. Due to the extended transport time of downward-moving irrigation return water (years) to even shallow groundwater aquifers, any management practice applied to land use during a given year could take years to result in improvements in groundwater quality. Because groundwater samples taken currently will in most cases include constituents applied several years in the past, identifying the source of a constituent in groundwater is impractical. Agricultural management practices recommended by this GQMP are designed to prevent future degradation of groundwater quality by agricultural operations.

The Groundwater Monitoring Advisory Workgroup for the Regional Board determined "that the most important constituents of concern related to agriculture's impacts to the beneficial uses of groundwater are nitrate (NO_3-N) and salinity" (WDR, Attachment A, page 16).

According to Bulletin 118 (DWR 2003), in general, the primary constituents present in the San Joaquin River Hydrologic Region with the potential to impact or cause degradation state waters are salts (TDS), nitrate, boron, chloride and organic compounds such as pesticides. High salts can be attributed to marine sediments in the Coast Range in the west side of the San Joaquin Valley and a culmination of evaporation and poor drainage resulting in increased salt concentrations within the Valley floor. Nitrates may occur naturally or as a result of anthropogenic sources such as human/animal waste or fertilizers. Concentrations between 0 mg/L and to 3 – 5 mg/L nitrate (measured as N) can be considered to be due to natural sources. Concentrations above these amounts are generally assumed to be the result of anthropogenic activities, e.g. fertilizer applications, septic systems. Boron/chloride are likely to be a result of evaporation leading to increased concentrations. As described in Bulletin 118, agricultural pesticides and herbicides have been detected in groundwater throughout the San Joaquin River Hydrologic Region especially where soil permeability is higher and depth to groundwater is shallower.

In the identification of constituents of concern (COCs) for the GQMP area, the Coalition relied on the findings of the GAR and GAR Addendum which presented previous studies, and monitoring programs conducted throughout GQMP area. Several sources were used for water quality data including: California Department of Public Health's (CDPH) Water Quality Analyses Database Files, DWR's Water Data Library (WDL), USGS's National Water Information System (NWIS), SWRCB's Geotracker database (GAMA), data from wells on dairy permitted lands acquired from the CVRWQCB, and the DPR pesticide sampling database. The following constituents are identified in the GAR as having exceeded a threshold for the Drinking Water Standards Maximum Contaminant Levels (MCLs): nitrate, TDS, and the pesticides aldicarb sulfone, DBCP (dibromochloropropane), diazinon, ethylene dibromide, ethylene dichloride, naphthalene, simazine, and tetrachloroethane (Table 16). Per the GAR, selection of the threshold value to indicate an exceedance is based on a hierarchy consisting of the following order of preference: California Primary MCL, United States Environmental Protection Agency (EPA's) Federal Primary MCL, and California Notification Level (Table 14 through Table 16). One notable exception is for TDS; in this document because of the assigned beneficial use of agricultural irrigation supply, the threshold used to indicate an exceedance is based on the 450 mg/L limit for Agricultural Water Quality Goals (Food & Agriculture Organization of United Nations) versus the 500 mg/L threshold of the CDPH and EPA's Secondary MCLs. Only those constituents with concentrations above the MCLs or notification level or concentration of TDS above 450 mg/L were retained as potential COCs.

PREVIOUS WORK TO IDENTIFY CONSTITUENTS OF CONCERN IN GROUNDWATER

The Coalition's GAR summarizes current and historic groundwater quality data (dating back to 1910) in the Eastern San Joaquin River Watershed area using data from local, state, and federal agencies (CDPH Water Quality Analyses Database Files, DWR Water Data Library, USGS National Water Information System, GAMA, data acquired from the Regional Water Control Board from wells on dairy permitted lands, the DPR pesticide sampling database, MID, and TID). The GAR lists groundwater quality data relevant to irrigated agricultural practices (Table 14 through Table 16), provides a spatial and temporal assessment of constituents in the groundwater, and serves as the survey of current, available groundwater quality data necessary to develop an effective GQMP for the Coalition region. The GAR contains data obtained in 2011 from public data sources and is due to be updated every five years (next update due in 2019). A review of GAMA's Geotracker database (http://geotracker.waterboards.ca.gov/gama/data_download.asp) will be included in the annual Groundwater Management Plan Progress Report (due May 1) in order to determine if additional management plans are required and as part of the groundwater quality trend monitoring effort.

Nitrate and TDS – Spatial Distribution

According to groundwater quality data compiled from a variety of well depths throughout the Central Valley Coalition region, nitrogen concentrations were reported to be above both the 5 and 10 mg/L levels (Figure 49) and TDS concentrations exceeded the 450, 500, and 1,000 mg/L levels (Figure 50). According to the GAR, high concentrations of nitrate are found in shallow groundwater throughout much of the western part of the Coalition region, with a large area of very high in nitrate levels in the northwestern part of the Coalition region, particularly in the vicinity of and to the west of Turlock (Figure 49). Several shallow wells in the area west of Turlock exhibit nitrate concentrations above the drinking water MCL of 10 mg/L (nitrate as nitrogen). Nitrate concentrations in shallow groundwater within the southwestern portion of the Coalition region appear to be generally lower, however, much of the available data for this area date back to the 1970s and earlier.

Recent nitrate concentrations in deep wells show a somewhat similar spatial pattern as seen in shallow wells with higher nitrate concentrations occurring in the western part of the Central Valley Floor, again with a clustering of high nitrate concentrations around the Turlock area. Overall, nitrate concentrations in deep wells appear to be lower than those exhibited in the shallow wells and do not exhibit the same lateral spread as in shallow wells.

According to the GAR, some areas of locally high TDS concentrations exist in shallow wells, particularly in the vicinity of Modesto and also in some general locations west of Turlock. However, the most recent data indicate TDS concentrations in many shallow wells are below 500 mg/L, which represents the recommended MCL for Secondary Drinking Water Standards; agricultural beneficial use WQO is 450 mg/L. Figure 50 provides the distribution of wells exhibiting TDS concentrations above 450 mg/L in the Coalition region. The pattern of distribution appears to be similar to that of nitrates in Figure 49, with a cluster of wells with TDS concentrations above 450 mg/L between Turlock and the San Joaquin River. A number of wells with higher TDS concentrations are in close proximity to the San Joaquin River along the western edge of the Coalition region where groundwater is generally very shallow. According to the GAR, the available data from deep wells show most TDS concentrations are below 500 mg/L although some deep wells with high concentrations are scattered throughout the Central Valley Floor area. Most the wells with the highest TDS concentrations (above 1,000 or 1,500 mg/L) are in the western part of the Coalition region.

Pesticides – Spatial Distribution

Data assembled in the GAR to evaluate the distribution of pesticide detections in the Coalition region were from DPR. Corresponding well sampling location data are only available at the spatial resolution of the Public Land Survey System (PLSS) section in which the well is located. Overall, out of 2,732 unique wells sampled for pesticides, 872 had detectable concentrations of a pesticide and 369 wells had a pesticide found at a concentration exceeding a water quality objective (Table 16, Figure 51). Of the 997 sections for which pesticide data are available, 375 sections have pesticide detections and 167 sections have exceedances. A total of 48 different pesticides have been detected within the Coalition region with exceedances reported for 8 different pesticides. The pesticides most often tested for were DBCP, atrazine, simazine, and 1,2-dichloropropane, and the most commonly detected pesticides were DBCP, simazine, DEA (diethyl-atrazine), and atrazine.

Of those pesticides with reported exceedances, only diazinon and simazine are currently registered with the DPR and/or are the only chemicals currently used in agricultural practice. Table 17 provides the distribution of pesticides, both legacy and active, with concentrations detected above zero within the Coalition. Diazinon was detected in two wells within 442 sections, both wells had concentrations above the California Notification Level of 1.2 µg/L, however, since no MCL currently exists for diazinon in groundwater, diazinon concentrations, while not considered exceedances, will be tracked for trend analysis. Simazine was detected in 75 wells within 62 sections, but only one well had a concentration above the primary MCL of 4 µg/L. Figure 52 and Figure 53 illustrate the distribution of all legacy and active pesticides concentration level data (non-detect, detect, or exceedance), respectively, for wells sampled within a given PLSS section. Although the legacy pesticides aldicarb sulfone, DBCP, EDB, ethylene dichloride, naphthalene, and tetrachloroethane are no longer ingredients in any active, registered pesticides within the state of California and therefore are theoretically no longer being applied, Coalition members will be informed of their presence in groundwater where exceedance levels exist.

Table 14. Summary of Assembled Groundwater Quality Data for nitrate as N (all data since 1940; Table 5-1, GAR).

NITRATE DATA																					
Monitoring Entity	Number of wells	Number of samples	Number with known depth	Irrigation Wells	Monitoring Wells	Residential Wells	Public Supply Wells	Other Well Types	Unknown Well Type	Shallow Zone	Deep Zone	Unknown Depth Zone	Wells with results over 5 mg/L (as N)	Wells with results over 10 mg/L (as N)	Wells with results over 20 mg/L (as N)	Samples Pre-1970s	Samples in 1970s	Samples in 1980s	Samples in 1990s	Samples in 2000s	Samples in 2010s
Dairy	1,775	2,236	0	441	35	1,299	0	0	0	1,334	441	0	1,107	845	513	0	0	0	0	2,236	0
CDPH	1,235	27,404	0	0	0	0	1,235	0	0	0	1,235	0	438	146	21	0	0	754	3,388	16,910	6,352
DWR	836	1,651	0	0	0	0	29	11	796	0	29	807	240	56	5	1,246	278	127	0	0	0
GAMA	2,049	17,475	0	0	483	0	1,566	0	0	483	1,566	0	615	260	83	611	70	399	1,159	10,463	4,773
MID	29	32	0	0	0	0	0	0	29	0	0	29	16	9	2	0	0	0	0	32	0
TID	108	323	0	0	0	0	0	108	0	108	0	0	106	105	68	0	0	0	55	268	0
USGS	540	1,574	521	0	0	0	0	0	540	320	201	19	166	58	19	631	72	88	73	701	9
Total	**6,572**	**50,695**	**521**	**441**	**518**	**1,299**	**2,830**	**119**	**1,365**	**2,245**	**3,472**	**855**	**2,688**	**1,479**	**711**	**2,488**	**420**	**1,368**	**4,675**	**30,610**	**11,134**

Table 15. Summary of Assembled Groundwater Quality Data for TDS (all data since 1940; Table 5-1, GAR).

TOTAL DISSOLVED SOLIDS DATA																					
Monitoring Entity	Number of wells	Number of samples	Number with known depth	Irrigation Wells	Monitoring Wells	Residential Wells	Public Supply Wells	Other Well Types	Unknown Well Type	Shallow Zone	Deep Zone	Unknown Depth Zone	Wells with results over 500 mg/L	Wells with results over 1,000 mg/L	Wells with results over 1,500 mg/L	Samples Pre-1970s	Samples in 1970s	Samples in 1980s	Samples in 1990s	Samples in 2000s	Samples in 2010s
Dairy	34	156	0	0	34	0	0	0	0	34	0	0	25	8	0	0	0	0	0	156	0
CDPH	915	7,175	0	0	0	0	915	0	0	0	915	0	130	35	16	0	0	437	920	4,537	1,281
DWR	1,054	2,466	0	0	0	0	29	0	1,025	0	0	1,054	213	76	51	2,046	289	131	0	0	0
GAMA	1,654	6,555	0	0	254	0	1,400	0	0	254	0	1,400	466	183	122	1,400	124	262	406	3,467	896
MID	29	32	0	0	0	0	0	0	29	0	0	29	5	0	0	0	0	0	0	32	0
TID	108	323	0	0	0	0	0	108	0	108	0	0	102	18	1	0	0	0	55	268	0
USGS	722	3,215	696	0	0	0	0	0	722	429	267	26	167	61	43	842	74	454	364	1,464	17
Total	**4,516**	**19,922**	**696**	**0**	**288**	**0**	**2,344**	**108**	**1,776**	**825**	**1,182**	**2,509**	**1,108**	**381**	**233**	**4,288**	**487**	**1,284**	**1,745**	**9,924**	**2,194**

Table 16. Summary of pesticide detections (Table 5-2, GAR).

Constituents associated with exceedances have been **bolded** here.

Pesticide	Wells Sampled	Wells with Detection	Wells with Exceedance	Sections Sampled	Sections with Detection	Sections with Exceedance	Concentration in Samples with Detections (µg/L)			Exceedance Threshold Used (µg/L)	Basis for Exceedance Threshold
							Average	Minimum	Maximum		
1,2-Dichloropropane (Propylene Dichloride)	1107	13	0	567	12	0	0.4	0.03	1.4	5	CA Primary MCL
2,4-DP (Isooctyl Ester)	40	2	0	31	2	0	0.01	0	0.01	-	Chemical not in database
3,4-Dichloro Aniline	160	12	0	146	12	0	0.005	0.004	0.01	-	Chemical not in database
ACET (Deisopropylatrazine)	233	41	0	185	37	0	0.14	0	0.53	-	Chemical not in database
Alachlor	832	1	0	488	1	0	0.1	0.1	0.1	2	CA Primary MCL
Alachlor ESA	18	2	0	11	2	0	0.494	0.077	0.91	-	Chemical not in database
Aldicarb Sulfone	**414**	**23**	**21**	**250**	**2**	**2**	**46**	**1**	**1281**	**3**	**EPA Primary MCL**
Aldicarb Sulfoxide	366	4	0	249	2	0	2.9	2.9	2.9	4	EPA Primary MCL
Atrazine	1292	49	0	712	47	0	0.077	0.004	0.599	1	CA Primary MCL
Bentazon, Sodium Salt	369	4	0	220	4	0	1.72	0.26	3.74	18	CA Primary MCL
Bromacil	941	9	0	531	9	0	0.096	0.01	0.303	-	No value in database
Carbon Disulfide	226	4	0	183	4	0	0.05	0.03	0.07	160	CA Notification
Chlorothalonil	348	1	0	239	1	0	0.02	0.02	0.02	-	No value in database
Chlorthal-Dimethyl	241	2	0	205	1	0	0.46	0.37	0.54	-	No value in database
Coumaphos	2	1	0	2	1	0	1	1	1	-	Chemical not in database
DBCP (Dibromochloropropane)	**1786**	**632**	**331**	**675**	**250**	**154**	**0.831**	**0.001**	**166**	**0.2**	**CA Primary MCL**
Deethyl-Atrazine (DEA)	346	58	0	280	56	0	0.028	0.004	0.429	-	No value in database
Demeton	128	1	0	89	1	0	1	1	1	-	No value in database

Pesticide	Wells Sampled	Wells with Detection	Wells with Exceedance	Sections Sampled	Sections with Detection	Sections with Exceedance	Concentration in Samples with Detections (µg/L)			Exceedance Threshold Used (µg/L)	Basis for Exceedance Threshold
							Average	Minimum	Maximum		
Desmethylnorflurazon	79	15	0	65	13	0	0.36	0.066	1.86	-	Chemical not in database
Desulfinyl Fipronil	160	1	0	146	1	0	0.005	0.005	0.005	-	Chemical not in database
Diaminochlorotriazine (DACT)	126	46	0	93	38	0	0.243	0.051	1.23	-	Chemical not in database
Diazinon	**732**	**2**	**2**	**442**	**2**	**2**	**127.5**	**0.1**	**507**	**1.2**	**CA Notification**
Dicamba	331	1	0	228	1	0	0.01	0.01	0.01	-	No value in database
Dinoseb	388	1	0	243	1	0	0.04	0.04	0.04	7	CA Primary MCL
Diuron	618	32	0	394	29	0	0.16	0.01	1	-	No value in database
Ethylene Dibromide	**590**	**21**	**14**	**330**	**16**	**12**	**0.24**	**0.01**	**1**	**0.05**	**CA Primary MCL**
Ethylene Dichloride	**29**	**1**	**1**	**29**	**1**	**1**	**2.9**	**2.9**	**2.9**	**0.5**	**CA Primary MCL**
Fipronil	160	1	0	146	1	0	0.011	0.011	0.011	-	Chemical not in database
Fipronil Sulfone	160	1	0	146	1	0	0.008	0.008	0.008	-	Chemical not in database
Hexazinone	429	12	0	328	10	0	0.078	0.008	0.27	-	No exceedance value
Imazethapyr	47	1	0	45	1	0	0.01	0.01	0.01	-	Chemical not in database
Merphos	45	1	0	36	1	0	1	1	1	-	No value in database
Methyl Bromide (Bromomethane)	1047	6	0	538	5	0	2.37	0.54	7.7	-	No value in database
Metolachlor	637	11	0	382	11	0	0.011	0.004	0.036	-	No value in database
Metolachlor ESA	18	9	0	11	7	0	0.527	0.06	1.155	-	Chemical not in database
Metolachlor OXA	18	4	0	11	4	0	0.14	0.072	0.279	-	Chemical not in database
Naled (Dibrom)	33	1	0	28	1	0	5	5	5	-	No value in database

Pesticide	Wells Sampled	Wells with Detection	Wells with Exceedance	Sections Sampled	Sections with Detection	Sections with Exceedance	Concentration in Samples with Detections (μg/L)			Exceedance Threshold Used (μg/L)	Basis for Exceedance Threshold
							Average	Minimum	Maximum		
Naphthalene	**684**	**6**	**1**	**398**	**5**	**1**	**6.4**	**0.4**	**29**	**17**	**CA Notification**
Norflurazon	217	9	0	175	8	0	0.152	0.01	0.468	-	No value in database
Ortho-Dichlorobenzene	848	2	0	454	2	0	0.69	0.56	1	-	No value in database
Prometon	732	6	0	484	6	0	0.432	0.005	1.7	-	No value in database
Propoxur	156	1	0	127	1	0	5	5	5	30	CA Notification
Simazine	**1288**	**75**	**1**	**711**	**62**	**1**	**0.335**	**0.003**	**6.6**	**4**	**CA Primary MCL**
Tetrachloroethane	**590**	**2**	**1**	**339**	**2**	**1**	**26.12**	**0.84**	**51.4**	**1**	**CA Primary MCL**
Tetrachloroethylene	30	2	0	30	2	0	0.2	0.2	0.2	5	CA Primary MCL
Tetrachlorvinphos (Stirofos)	24	1	0	16	1	0	1	1	1	-	No value in database
TPA (2,3,5,6-Tetrachloroterephthalic Acid)	7	3	0	4	2	0	0.817	0.419	1.5	3500	CA Notification
TOTAL UNIQUE LOCATIONS	**2732**	**872**	**369**	**997**	**375**	**167**					

Pesticide data are for the period 1979-2011 provided by DPR.
*Exceedance thresholds used are based on values reported in the SWRCB Water Quality Goals Online Database (http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/search.shtml), when available. Selection of the threshold value for use to indicate an exceedance is based on a hierarchy consisting of the following order of preference: CA Primary MCL = California Primary MCL; EPA Primary MCL = EPA's Federal Primary MCL; CA Notification = California Notification Level. No value in database = Chemical is in the database but no possible threshold value reported, Chemical not in database = Chemical was not located in the SWRCB database.

Table 17. All pesticides with concentrations above zero (0) from those sections sampled within the Coalition region. Pesticides with at least one exceedance within the Coalition have been **bolded**.

PESTICIDE	LEGACY/ ACTIVE	OUTSIDE OF A GQMP ZONE OR BASIN	CHOWCHILLA SUBBASIN MANAGEMENT ZONE	MADERA SUBBASIN MANAGEMENT ZONE	MERCED SUBBASIN MANAGEMENT ZONE	MODESTO SUBBASIN MANAGEMENT ZONE	TURLOCK SUBBASIN MANAGEMENT ZONE	YOSEMITE VALLEY GROUNDWATER BASIN
ALACHLOR	ACTIVE	ND	ND	ND	D	ND	ND	ND
ATRAZINE	ACTIVE	D	D	D	D	D	D	ND
BENTAZON, SODIUM SALT	ACTIVE	ND	ND	ND	D	D	ND	-
BROMACIL	ACTIVE	ND	D	D	D	ND	D	ND
CHLOROTHALONIL[1]	ACTIVE	D	ND	ND	ND	ND	ND	ND
CHLORTHAL-DIMETHYL	ACTIVE	D	ND	ND	ND	ND	ND	ND
COUMAPHOS	ACTIVE	-	-	-	D	-	-	-
DIAZINON[2]	**ACTIVE**	**E[3]**	**ND**	**ND**	**ND**	**ND**	**E**	**ND**
DICAMBA	ACTIVE	ND	ND	D	ND	ND	ND	-
DIURON	ACTIVE	D	D	D	D	D	D	-
FIPRONIL[1]	ACTIVE	D	ND	ND	ND	ND	ND	ND
HEXAZINONE	ACTIVE	D	D	D	D	ND	D	ND
METHYL BROMIDE (BROMOMETHANE)	ACTIVE	D	ND	D	D	D	D	ND
METOLACHLOR	ACTIVE	ND	ND	ND	D	D	D	ND
NALED	ACTIVE	-	-	ND	D	-	ND	-
NORFLURAZON	ACTIVE	ND	ND	D	D	D	D	-
PROMETON	ACTIVE	ND	ND	ND	D	D	D	ND
PROPOXUR	ACTIVE	ND	ND	ND	ND	ND	D	
SIMAZINE	**ACTIVE**	**D**	**D**	**D**	**D**	**D**	**E**	**ND**
TETRACHLORVINPHOS (STIROFOS)	ACTIVE	ND	ND		D			
1,2-DICHLOROPROPANE (PROPYLENE DICHLORIDE)	LEGACY	ND	ND	D	D	D	D	ND
2,4-DP, ISOOCTYL ESTER	LEGACY	-	ND	ND	ND	D	D	
3,4-DICHLORO ANILINE	LEGACY	D	D	D	D	D	ND	ND
ACET (DEISOPROPYL-ATRAZINE)	LEGACY	D	D	D	D	D	D	-
ALACHLOR ESA	LEGACY	-	-	-	-	ND	D	-
ALDICARB SULFONE	**LEGACY**	**ND**	**ND**	**ND**	**E**	**ND**	**E**	**-**
ALDICARB SULFOXIDE[1]	LEGACY	ND	ND	ND	D	ND	ND	-
CARBON DISULFIDE	LEGACY	D	ND	ND	D	D	ND	ND
DBCP	**LEGACY**	**D**	**D**	**E**	**E**	**E**	**E**	**ND**
DEETHYL-ATRAZINE (DEA)	LEGACY	D	D	D	D	D	D	ND
DEMETON	LEGACY	ND	ND	ND	D	ND	ND	ND
DESMETHYLNORFLURAZON	LEGACY	D	ND	ND	ND	D	D	-
DESULFINYL FIPRONIL[1]	LEGACY	D	ND	ND	ND	ND	ND	ND
DIAMINOCHLOROTRIAZINE (DACT)	LEGACY	D	D	D	D	D	D	-
DINOSEB	LEGACY	ND	ND	D	ND	ND	ND	-
ETHYLENE DIBROMIDE	**LEGACY**	**ND**	**ND**	**E**	**E**	**E**	**E**	**ND**
ETHYLENE DICHLORIDE	**LEGACY**	**-**	**ND**	**ND**	**ND**	**ND**	**E**	**-**

PESTICIDE	LEGACY/ ACTIVE	OUTSIDE OF A GQMP ZONE OR BASIN	CHOWCHILLA SUBBASIN MANAGEMENT ZONE	MADERA SUBBASIN MANAGEMENT ZONE	MERCED SUBBASIN MANAGEMENT ZONE	MODESTO SUBBASIN MANAGEMENT ZONE	TURLOCK SUBBASIN MANAGEMENT ZONE	YOSEMITE VALLEY GROUNDWATER BASIN
FIPRONIL SULFONE[1]	LEGACY	D	ND	ND	ND	ND	ND	ND
IMAZETHAPYR[1]	LEGACY	ND	D	ND	ND	ND	ND	-
MERPHOS	LEGACY	ND	ND	ND	D		ND	-
METOLACHLOR ESA	LEGACY	-	-	-	-	D	D	-
METOLACHLOR OXA	LEGACY	-	-	-	-	D	D	-
NAPHTHALENE	**LEGACY**	**ND**	**ND**	**ND**	**E**	**D**	**D**	**ND**
ORTHO-DICHLOROBENZENE	LEGACY	D	ND	ND	ND	ND	D	ND
TETRACHLOROETHANE	**LEGACY**	**E**	**ND**	**ND**	**ND**	**D**	**ND**	**ND**
TETRACHLOROETHYLENE	LEGACY	-	ND	D	ND	ND	ND	-
TPA (2,3,5,6-TETRACHLOROTEREPHTHALIC ACID)	LEGACY	D	-	ND	-	-	-	-
XYLENE	LEGACY	D	ND	D	D	D	D	ND

1. Concentrations of these pesticides were reported as above "0" but below the Method Detection Limit.
2. There is no MCL for diazinon. The exceedance displayed here indicates an exceedance above the California Notification Level. Concentrations of diazinon above the California Notification Level in this instance do not require a management plan.
3. DPR found the diazinon signal of 507 µg/L near Shaver Lake in Fresno County was a lab transcription error. DPR reported this error in their 2005 well inventory report available at http://www.cdpr.ca.gov/docs/emon/pubs/ehapreps/eh0506.pdf.

D = Pesticide Detection; reported concentrations were below the MCL
E = Exceedance of Pesticide beyond the MCL
ND = Non-detection of Pesticide

Figure 49. Distribution of nitrogen as nitrate at concentrations at or above 5 mg/L within the GQMP Zones of the Coalition region.

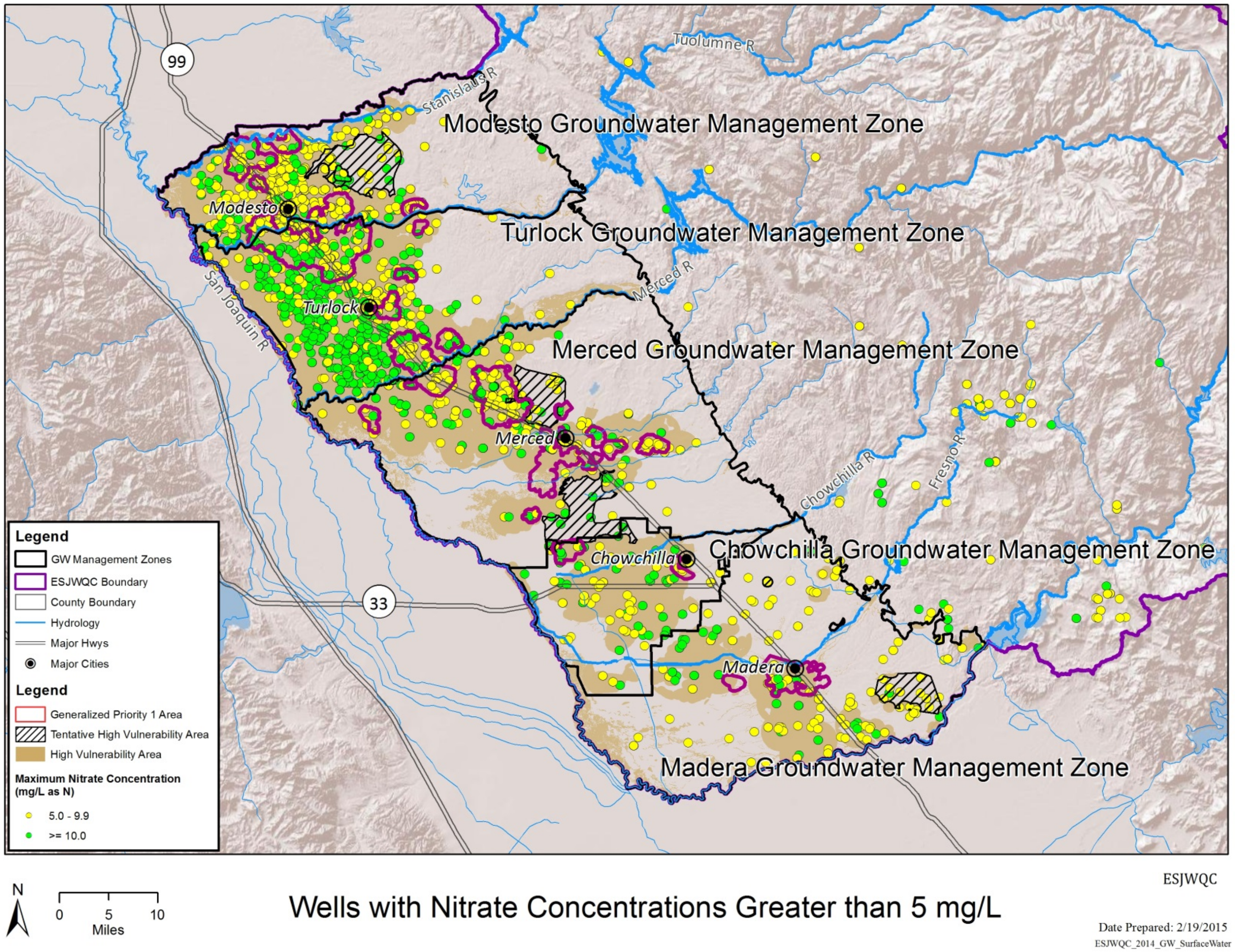


Figure 50. Distribution of TDS at concentrations at or above 450 mg/L within the GQMP Zones of the Coalition region.

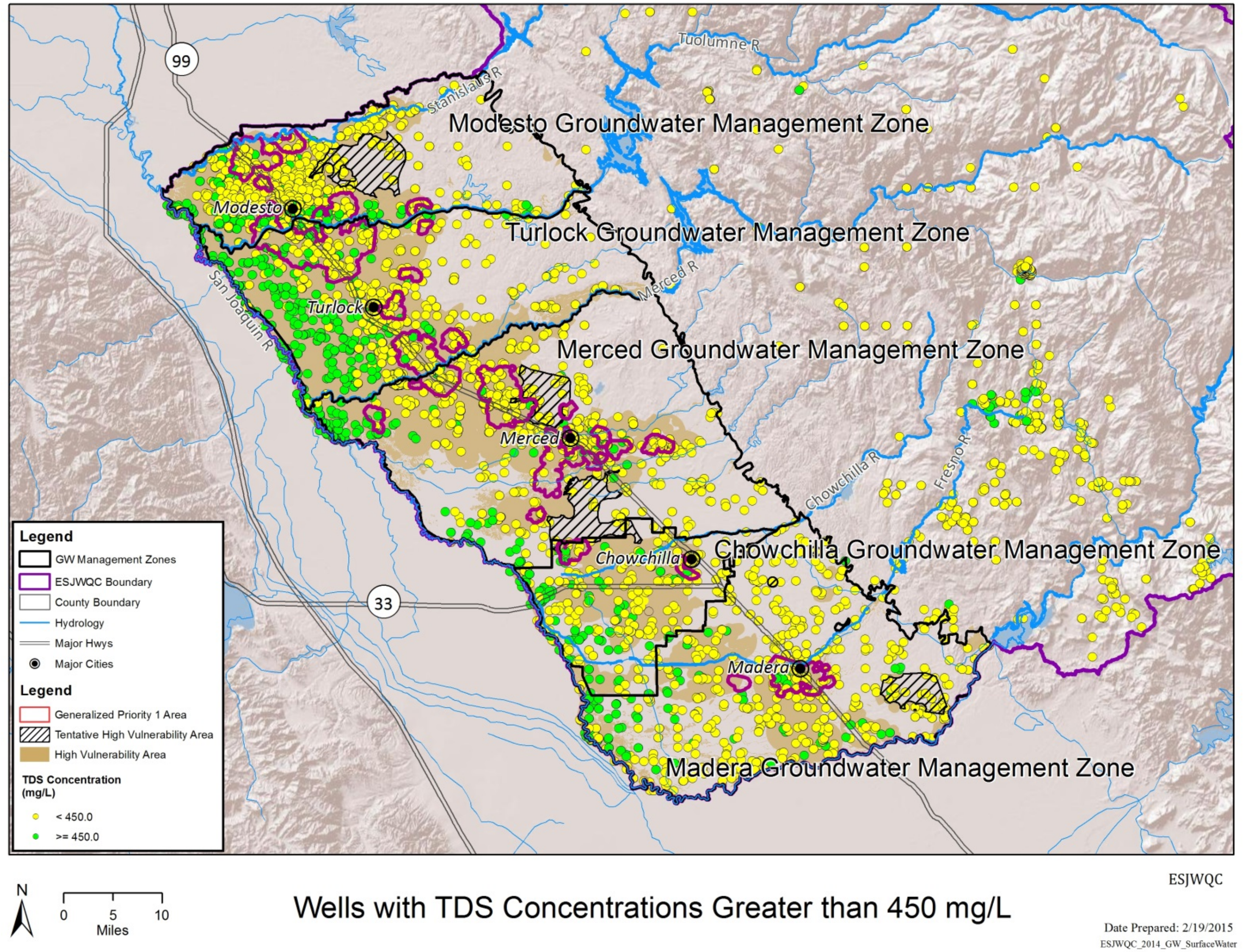


Figure 51. Distribution of all pesticide concentrations (detection, exceedance, or non-detect) by TRS within the GQMP Zones of the Coalition region.

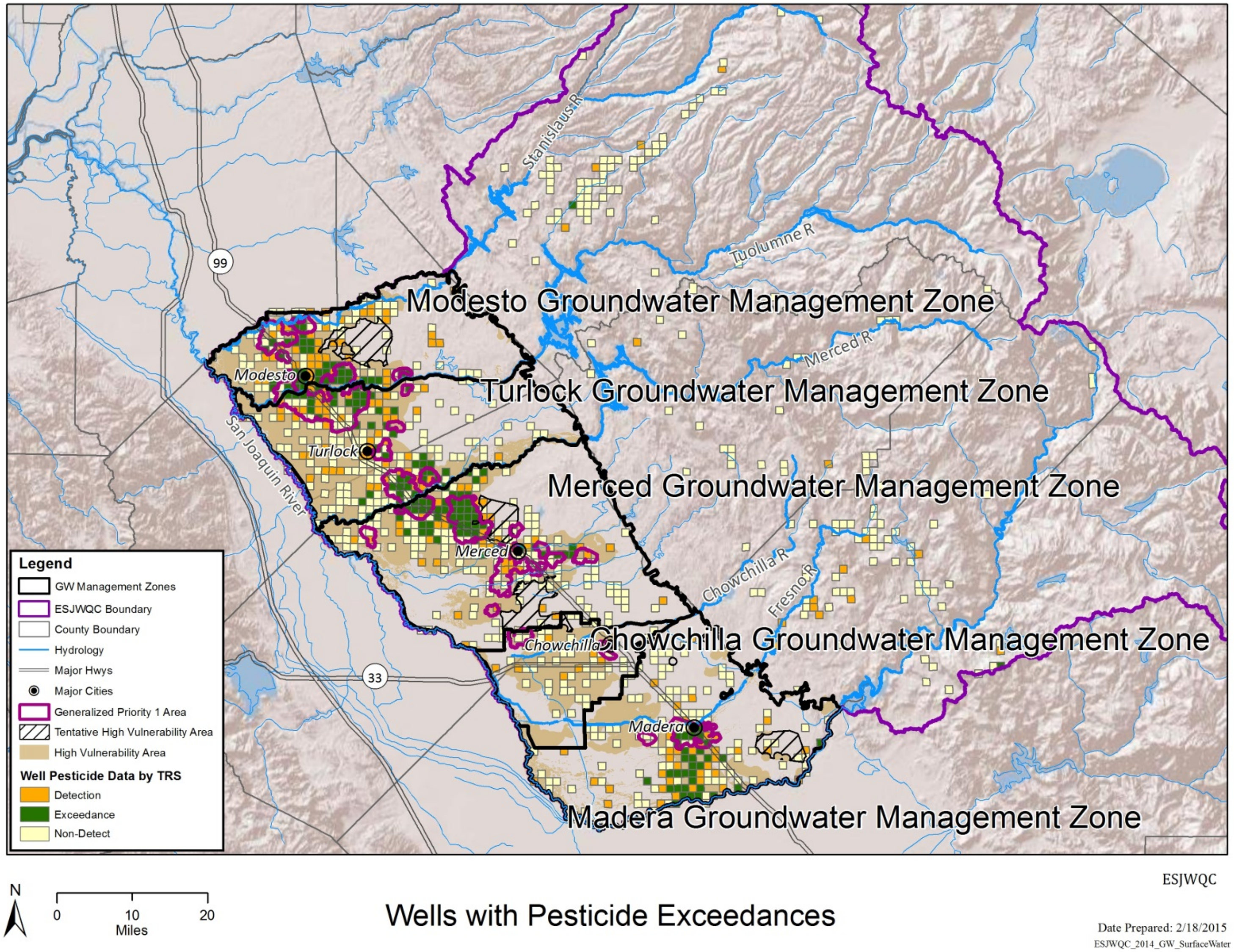


Figure 52. Distribution of legacy pesticide concentrations (detection, exceedance, or non-detect) by TRS within the GQMP Zones of the Coalition region.

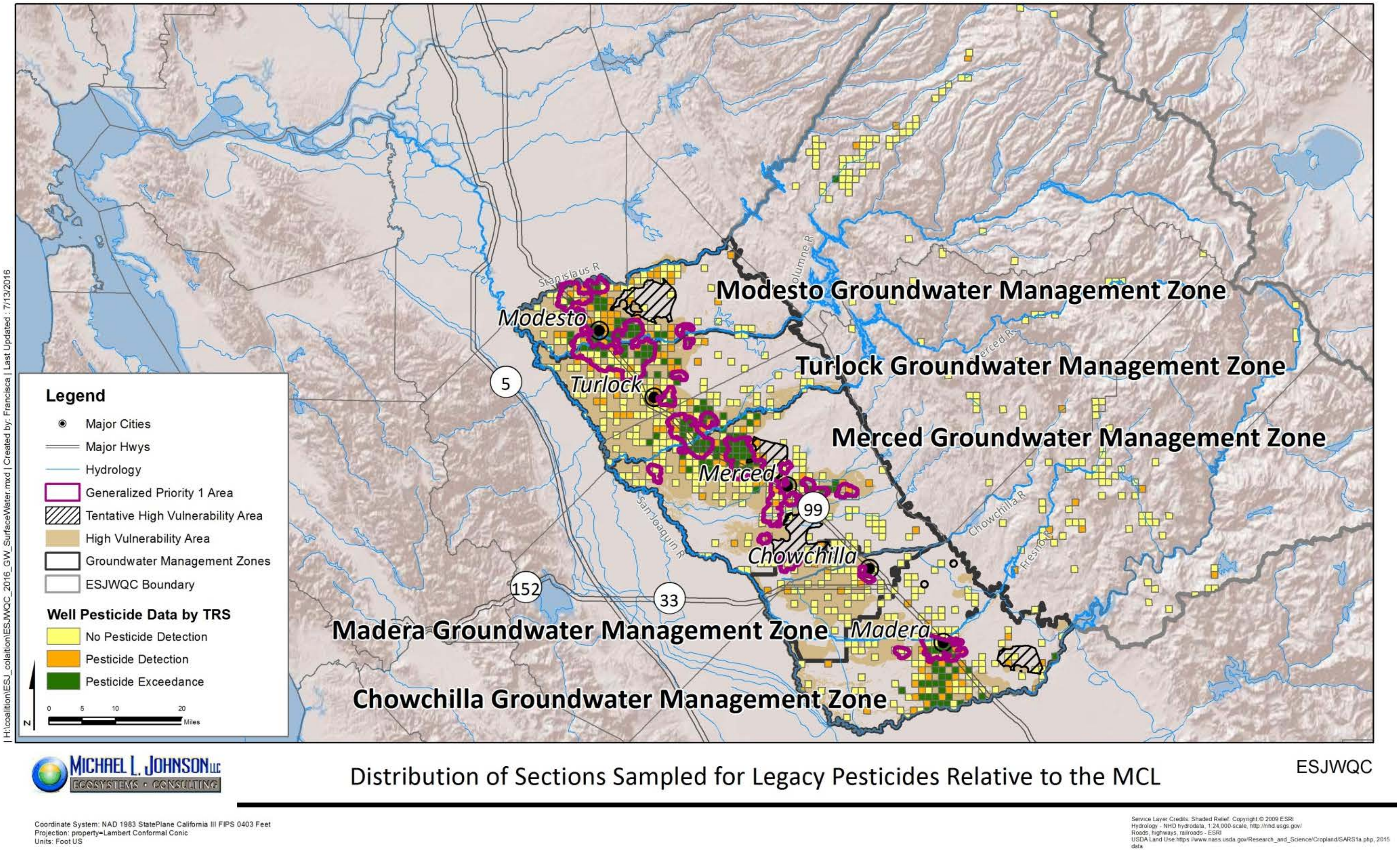
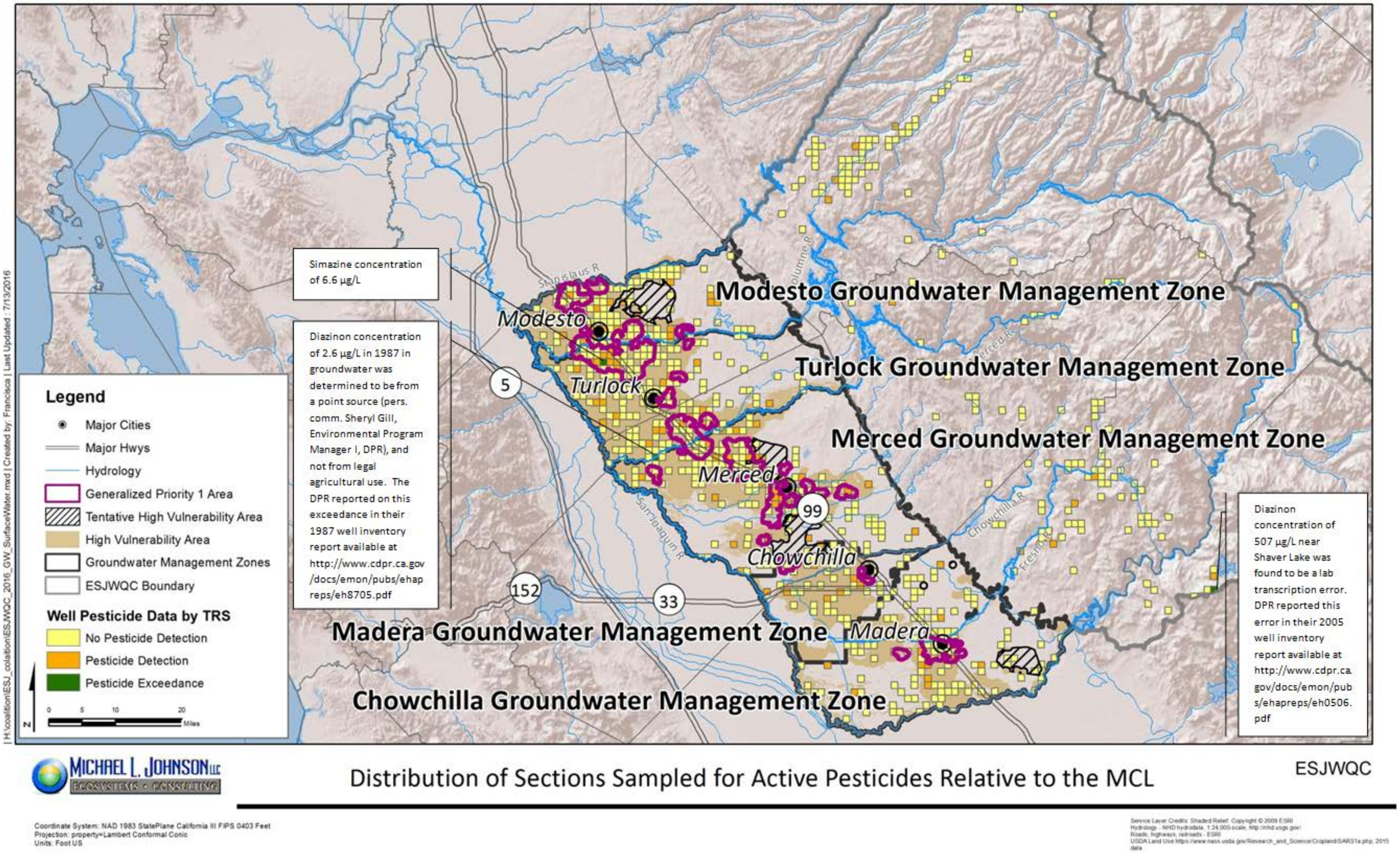


Figure 53. Distribution of active pesticide concentrations (detection, exceedance, or non-detect) by TRS within the GQMP Zones of the Coalition region.



ESJWQC High Vulnerability Area

"The GAR shall designate high/low vulnerability areas for groundwater in consideration of high and low vulnerability definitions provided in Attachment E of the Order" (WDR, Attachment B, pg. 13).

One of the objectives of the GAR was to "provide a basis for establishing groundwater quality management plans in high vulnerability areas and priorities for implementation of those plans" (WDR, Attachment B, page 13). As part of the focus on protection of regional groundwater quality, the relative vulnerability of groundwater to irrigated land practices was assessed in the GAR based on hydrogeologic sensitivity, overlying land uses and practices and groundwater quality data, historic and recent (Figure 54).

Determination of High Vulnerability Area

The Hydrogeologic High Vulnerability Area (HHVA) within the Coalition was developed in the GAR utilizing a statistical model incorporating observed groundwater quality and hydrogeologic characteristics. The HHVA defines areas within the Coalition region where groundwater is most likely to be vulnerable to contamination based on current exceedances of the nitrate MCL, or select hydrogeologic characteristics identified in a groundwater vulnerability model. A 0.5-mile buffer was added around the HHVA in the vicinity of wells where an observed nitrate exceedance occurred. With the addition of the 0.5-mile buffer around the HHVA and a few additional, select areas (GAR, ES-15), 98 percent of the wells with nitrate exceedances are accounted for. The combined extents of the HHVA and buffer represent the East San Joaquin Water Quality Coalition High Vulnerability Area (ESJHVA) (Figure 54). The ESJHVA identified in the GAR covers approximately 55 percent of the irrigated lands within the Coalition region and represents approximately 577,000 acres.

Determination of Prioritization of ESJHVAs

Because of the large size of the ESJHVA, the WDR allows the Coalition to identify high priority regions within the HVA. The WDR requires several factors be considered when prioritizing the high vulnerability areas of the ESJHVA:

- Identified exceedances of water quality objectives
- Proximity to areas contributing recharge to urban and rural communities that rely on groundwater as a source of supply
- Existing field and operational practices identified to be associated with irrigated agricultural waste discharges that are the cause or source of groundwater quality degradation
- The largest acreage commodity types comprising up to at least 80 percent of irrigated agriculture in the high vulnerability areas
- Legacy or ambient groundwater conditions
- Groundwater basins currently proposed to be under review by Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS)
- Identified constituents of concern

The prioritization process developed in the GAR included these factors when identifying the three prioritization levels. In addition, Disadvantaged Communities (DACs) and corresponding recharge areas were incorporated in the prioritization matrix and priority ranking (1-3) of the ESJHVA (Figure 54). Because the relative amount of fertilizer applied to the high acreage commodities in the HVA, the priority areas provide a spatial focus but outreach will be targeted initially to the high acreage commodities in those high priority areas. Figure 55 illustrates the ESJHVA Priority Areas relative to the GQMP Zones. At the GAR Addendum was published, using 2012 USDA data, the commodities within the Coalition region and surrounding the top Priority 1 Area were almonds (38,660 acres), corn (6,804 acres), and grapes (4,901 acres) (ESJWQC, 2014[2]) (Figure 56).

Figure 54. East San Joaquin Water Quality Coalition High Vulnerability Areas (ESJHVA) and Priority Areas (1-3) (ESJWQC[2], 2014).

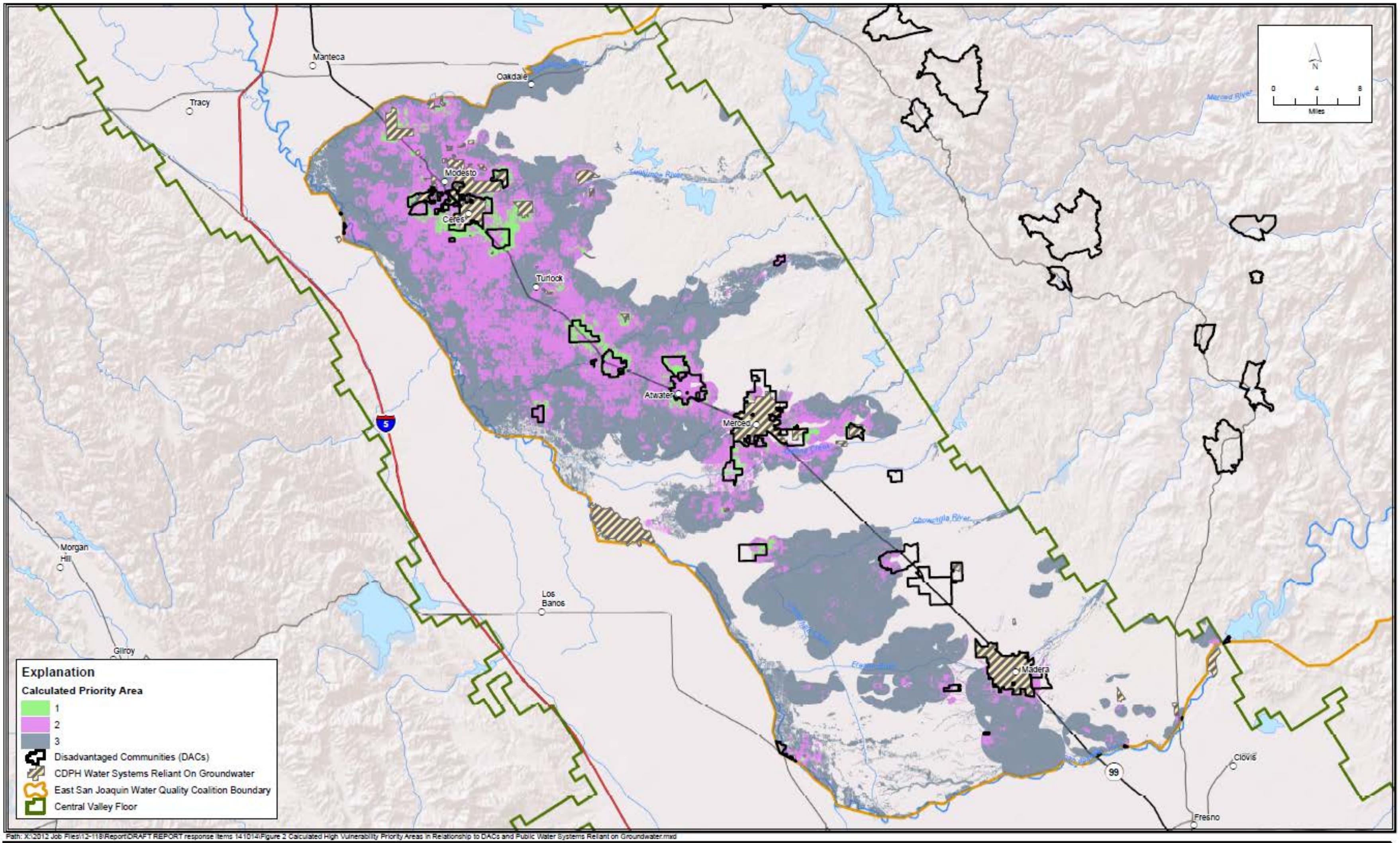


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Figure 2
Calculated High Vulnerability Priority Areas in Relationship to DACs and Public Water Systems Reliant on Groundwater

Figure 55. East San Joaquin Water Quality Coalition High Vulnerability Areas (ESJHVA) and Priority Areas (1-3) relative to GQMP Zones.

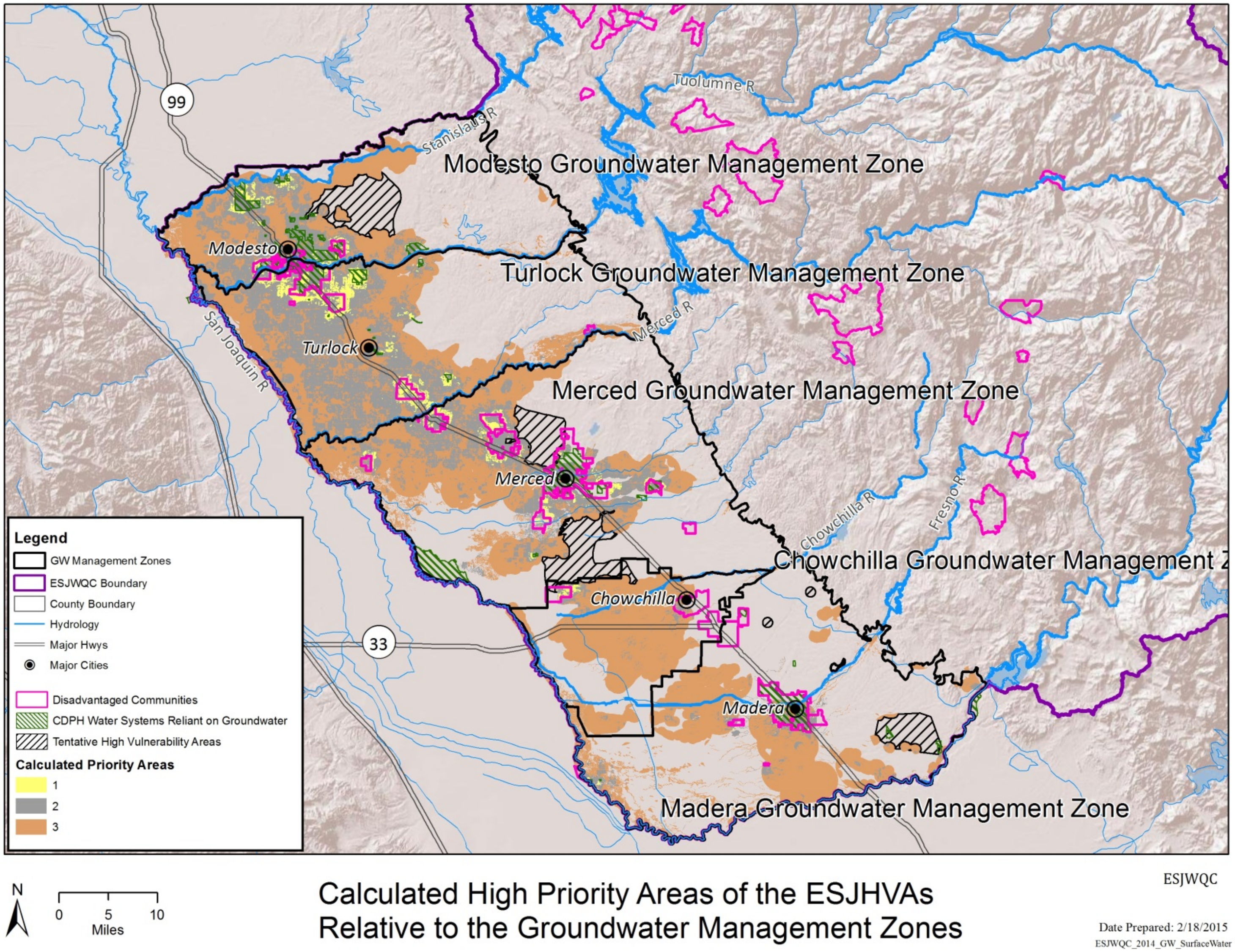

Figure 56. Top 3 crops within the East San Joaquin Water Quality Coalition in relation to the Generalized Priority 1 Area (GAR, Figure 8).

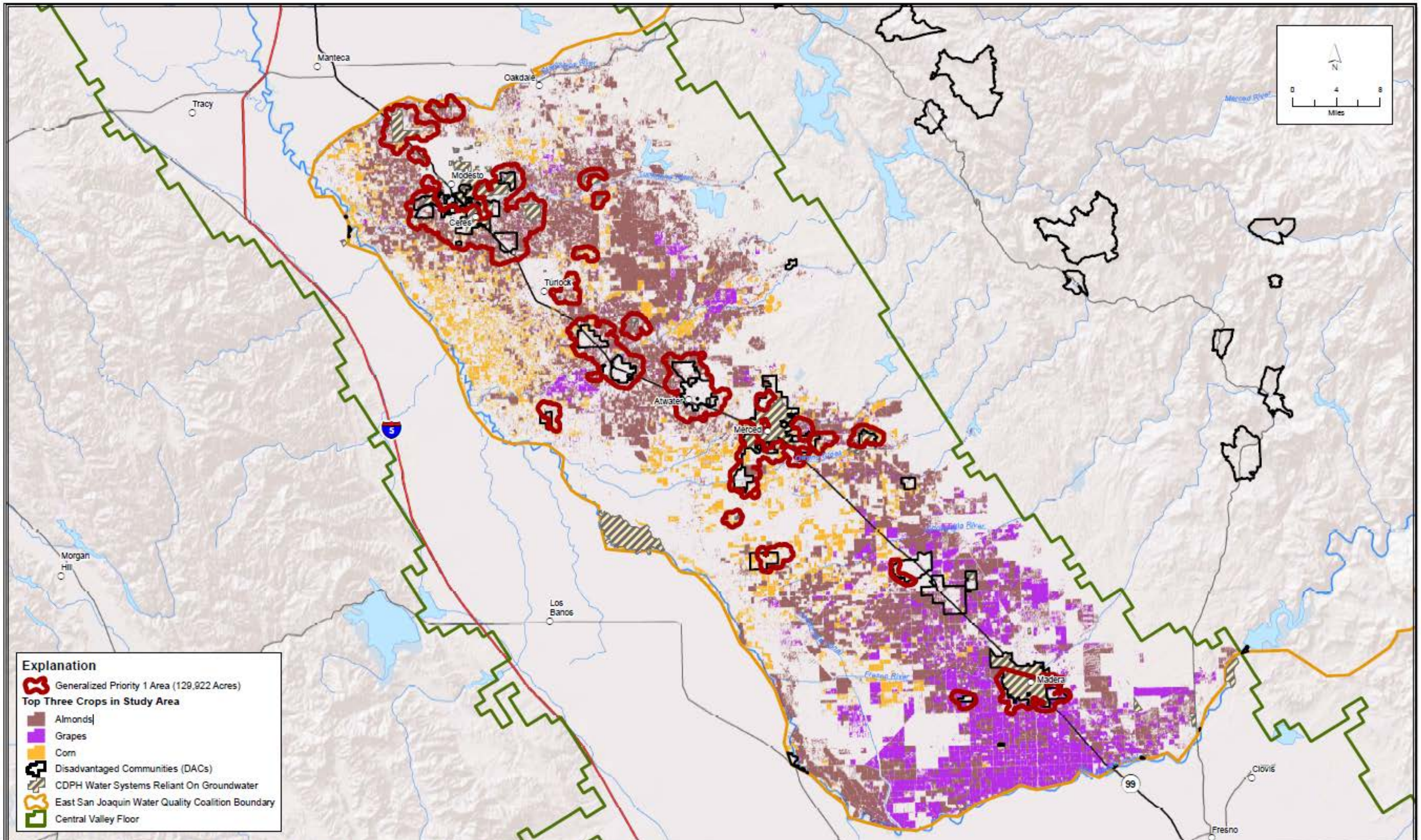

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Figure 8
Top Crops in Relation to Priority 2 Areas and Communities Reliant on Groundwater

SURFACE WATER DATA INDICATING CONSTITUENTS OF CONCERN IN GROUNDWATER

The ESJWQC began surface water quality monitoring as part of the ILRP in 2004 and on behalf of its members currently submits to the Regional Water Board, Annual Monitoring Reports of surface water quality monitoring and management. In general terms, data collected from surface water monitoring will be used to evaluate applications in agricultural operations and to better encourage the adoption of specific management practices to protect future groundwater quality. It is beyond the scope of the GQMP to identify surface water sources of constituents of concern identified in groundwater samples collected over previous decades.

GROUNDWATER BENEFICIAL USES

The Water Quality Trigger Limits (WQTLs) in Table 14 are applied based on the protection of beneficial uses assigned to groundwater according to the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan). According to the Basin Plan, "unless otherwise designated by the Regional Water Board, all ground waters in the Region are considered as suitable or potentially suitable, at a minimum, for municipal and domestic water supply, agricultural supply, industrial service supply, and industrial process supply" (Basin Plan, page II-3.00). These beneficial uses are described as:

- Municipal and Domestic Supply (MUN) – Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
- Agricultural Supply (AGR) – Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
- Industrial Service Supply (IND) – Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.
- Industrial Process Supply (PRO) – Uses of water for industrial activities that depend primarily on water quality.

Groundwater provides almost the entire urban and rural water supply and about 75 percent of the agricultural water supply in the Central Valley Floor (Madera IRWMP 2008). Groundwater accounts for about 30 percent of the annual supply used for agricultural and urban purposes in the entire San Joaquin River Hydrologic Region (DWR, 2013). However, agricultural irrigation water supplied by surface water and groundwater accounts for about 95 percent of the total water use in the Modesto, Turlock and Merced subbasins (USGS, 2006).

MANAGEMENT PLAN STRATEGY

DESCRIPTION OF APPROACH

The approach of the ESJWQC to its management plans involves three processes; 1) identifying potential sources of discharges that impair beneficial uses, 2) providing education to those growers on management practices to minimize/eliminate their discharge, and 3) monitoring to verify that water quality is improved. These processes in the context of the management of groundwater quality present some unique challenges. Because all crops need nitrogen, almost all growers apply nitrogen in some form and consequently, all growers are potential sources of discharges of nitrogen to groundwater. However, because growers apply different amounts at different times and in different places, there is the potential for some growers to have greater discharges to groundwater or, no discharges at all. The Coalition is concerned about those growers that have a greater chance of discharging nitrogen to groundwater. The challenge is identifying those potential sources and determining the cause of the increased risk for discharge. Groundwater monitoring to verify improved water quality is also a challenge because the potentially decadal time lag between implementation of management practices on the farm and changes in groundwater quality.

The ultimate goals of the ESJWQC GQMP process are to motivate growers to adopt management practices that are protective of groundwater quality, and minimize the discharge of nitrate below the root zone. The ESJWQC developed four objectives to achieve the GQMP goals.

The objectives of the ESJWQC GQMP are:

- Understand current level of management practice implementation by growers to prevent discharge to groundwater.
- Identify additional management practices to be implemented that are protective groundwater quality.
- Develop a management practice implementation process and schedule for growers (based on priority).
- Evaluate the effectiveness of existing or new management practices.

To facilitate achieving these objectives, the Coalition will implement performance goals with corresponding performance measures. These are presented in detail. A compliance schedule and milestones are also provided.

IDENTIFY COCS IN THE GQMP ZONES

To understand which management practices need to be implemented, the constituents of concern (COCs) for leaching to groundwater must be identified. The ESJWQC identified COCs based on analyses for constituents known to have the potential to be found in groundwater. As identified in the GAR there have been exceedances of water quality objectives for nitrate, TDS, pesticides (aldicarb sulfone, DBCP [dibromochloropropane], diazinon, ethylene dibromide, ethylene dichloride, and simazine), and additional compounds (naphthalene and tetrachloroethane) (Table 16). Naphthalene is the active ingredient in moth balls and is used for indoor storage, not irrigated agriculture, and tetrachloroethane is a degreasing agent, again not used for crop production by irrigated agriculture. Because naphthalene, tetrachloroethane, aldicarb sulfone, DBCP, ethylene dibromide, and ethylene dichloride are not ingredients in any currently registered pesticide in California, these constituents are not applied in agricultural operations and therefore cannot be managed directly with current management practices. They will not be the focus of this management plan. Rather, these compounds are considered legacy constituents and information regarding their presence in groundwater and recommended management practices to prevent the spread of contaminated groundwater will be included in annual outreach activities provided by the Coalition. The diazinon exceedances have been reviewed by the Department of Pesticide Regulation and have been found not to be a result of irrigated agriculture (Figure 53). An exceedance of the simazine MCL (4 µg/L MCL) is listed in the GAR as a concentration of 6.6 µg/L (Table 16). Associated data for this simazine exceedance indicate sample results were reported by the SWRCB for a sampling event on December 21, 1988, in Stanislaus County. All available water quality data were reviewed for simazine in Stanislaus County from the SWRCB's Geotracker GAMA (http://geotracker.waterboards.ca.gov/gama/data_download.asp). Data were reviewed to analyze for trends of simazine concentrations in groundwater in Stanislaus County. The available sampling events listed for simazine span from March 1985 to November 2015 with concentrations ranging from 0 -1.3 µg/L (below the 4 µg/L MCL) and no sampling events were listed in 1988. The lack of subsequent exceedances in Stanislaus County indicates that simazine should not be included as a COC in this management plan. The remaining constituents are TDS and nitrate. TDS is the focus of the CV-SALTS process and a management plan for salt is being developed for the entire Central Valley region. The Coalition participates in CV-SALTS and is involved in the development of the Salt and Nitrate Management Plan. When management practices are established, the Coalition will initiate outreach on salt management to members. The other COC is nitrate. Nitrate is the primary driver behind the specification of the HVAs in the Coalition region and will be the focus of this GQMP. Table 18 lists the WQTLs for the GQMP COCs.

Table 18. GQMP COC WQTLs

Constituent	Water Quality Trigger Limit (WQTL)	Standard Type	Beneficial Use (BU) with most protective limit	Reference for the Trigger Limit	Category (see footnotes)
Active COCs					
Total Dissolved Solids	450 mg/L	Narrative	Agricultural Supply	Water Quality for Agriculture (Ayers & Westcott)	3
Nitrate as NO_3 Nitrate as N	45 mg/L as NO_3; 10 mg/L as N	Numeric	Municipal and Domestic Supply	Sacramento/San Joaquin Basin Plan Chemical Constituents Objective: California Primary MCL	1

Category 1: Constituents that have numeric water quality objectives in the Sac-SJR Basin Plan or other WQO listed by reference such as MCLs (Page III-3.0)* , CTRs (Page III-10.1)*,

Category 3: Constituent does not have numeric WQO, and does not have a primary MCL. WQTL exceedance is based on implementation of narrative objective. All detections should be tracked. None are default exceedances.

(*)-Water Quality Control Plan for the Sacramento and San Joaquin River Basins. Revised on October 2007.

CURRENT LEVEL OF MANAGEMENT PRACTICE IMPLEMENTATION

Growers can implement numerous practices that are known to prevent movement of nitrate to groundwater, e.g. adequate wellhead protection, backflow prevention on pressurized irrigation systems, and the proper timing of nitrogen applications (see below). Many, although not all of these practices are captured on the Farm Evaluation Plans (FEPs) that must be completed and submitted to the ESJWQC by growers in HVAs every year. The Coalition will evaluate each member's FEP to determine if they are implementing practices that are considered to be protective of groundwater. In particular, information on destruction of abandoned wells and wellhead protection will be one of the points of emphasis. Prior Coalition outreach has focused on abandoned wells and wellhead protection, and all growers should be aware of practices that can be used to keep nitrate and other chemicals away from their current and abandoned wells, and eliminate the possibility of backflow or transport along the outside of the well casing down to groundwater.

The Coalition has reported these FEP data to the Regional Water Board yearly since 2014. The Coalition maintains a database with individual grower responses and can identify growers the Coalition believes could improve wellhead protection with the implementation of additional practices. Because growers from the entire Coalition region submit FEPs, this review can occur for all growers, not just those in HVAs. For those growers in HVAs, the review of their wellhead protection practices will occur in the first year of the program or as new farms or systems are installed. If the Coalition believes that growers in HVAs can improve their wellhead protection, they will be encouraged to adopt additional practices and the Coalition will follow-up with them the next year to determine if those practices were implemented, and if not, why. For growers outside HVAs, the review will occur with each FEP submission, every five years. If after reviewing the FEP submission, the Coalition believes that growers outside of HVAs can improve their wellhead protection, they will be encouraged to adopt additional practices. The Coalition will follow-up with these growers the next year to determine if those practices were implemented, and if not, why.

At a macro scale, the Coalition tracks management practices for irrigation, pesticide, and fertilizer management practices in the FEP. Growers can be identified through their FEPs as to whether they irrigate with a pressurized system, flood, or furrow system, if they fertigate, and wellhead sanitation practices. Changes in practices are tracked for individual members.

Identify Additional Management Practices that are Protective of Groundwater

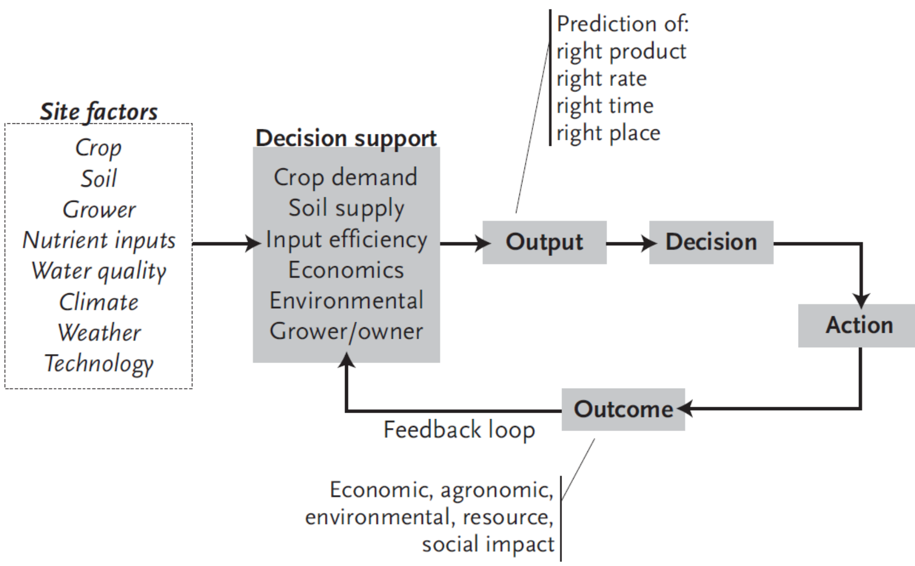
The transport paths/mechanisms resulting in movement of nitrate to groundwater include: leaching with infiltrating rain water or irrigation water, direct injection to operational wells lacking proper backflow prevention, and improperly abandoned or improperly cased wells that are located near to where crop inputs are applied. To date, the Coalition has focused on the last two potential transport pathways for which management practices are well understood. Practices to prevent transport of nitrate due to backflow and improperly destroyed and abandoned wells have been communicated to growers at numerous outreach events. The Coalition believes that no additional practices (beyond those documented on the FEPs) need to be identified to adequately prevent wellheads and abandoned wells from being conduits for the transport of nitrate to groundwater.

The Coalition will utilize the 4Rs (see below) to guide its general approach for managing nutrients in the field. The 4Rs were developed in the late 1980's at the Potash and Phosphate Institute, which is the predecessor of the International Plant Nutrition Institute. The original authors included a fertilizer industry agronomist and a university scientist who developed the concept to promote agricultural sustainability. Although developed specifically for fertilizers, these practices are also applicable to the management of other soluble constituents.

The International Plant Nutrition Institute (IPNI) is a leader in developing practices to optimize fertilizer applications and efficient use of nitrogen. The IPNI recognizes that there is not one set of universal fertilizer

BMPs. By definition, BMPs are site and crop-specific and vary depending on soils, climate, cropping history, and management expertise. There are many uncontrollable factors such as light, temperature, moisture, soils, and cultivar. Controllable factors include fertilizer, soil amendments, pesticide applications, tillage, and other cultural practices. Uncontrollable factors introduce uncertainty into the system which can make management of nutrients difficult. Only when controllable factors are controlled and uncontrollable factors are measured can reliable information on the efficacy of management practices be generated. Once the information is developed, it can be used as part of a larger decision support system (DSS) to guide the selection and implementation of appropriate management practices. An example of a DSS is provided in Figure 57 which is promoted by IPNI. The Coalition will use this general framework for communicating with growers about implementing fertilizer BMPs.

Figure 57. Decision support system for managing nutrient inputs to irrigated crops. Taken from Fixen (2007).



The 4Rs include right time, right place, right rate, and right source (product):

- Right time – nutrients are made available when the plant needs them, can be accomplished by providing when the plant needs them by synchronizing their application with crop demand, properly managing applications e.g. pre-plant or split applications, controlled release technologies, and product stabilizers
- Right rate – match the amount of fertilizer applied to the crop need to reduce losses to leaching or surface water runoff; BMPs include realistic yield goals, soil testing, crop nutrient budgets, tissue testing, plant analysis, applicator calibration, good record keeping and nutrient management plans
- Right place – keep nutrients where the crop can use them. Incorporation or fertigation are usually the best methods of doing this
- Right source (product) – match the fertilizer source and product to crop need and soil properties. Be aware of nutrient interactions and balance nitrogen, phosphorus, potassium, and other nutrients

Leaching of nitrate by either rainfall or irrigation water requires management of both fertilizer applications and irrigation water. Consequently, the Coalition will focus on management practices that address both of these aspects that determine discharge of nitrate to groundwater. Although not all of the methods by which growers can manage nitrogen are well vetted, some practices can be recommended now. The confidence to recommend other practices will require additional research conducted through the Management Practice Evaluation Program (MPEP) to fully understand which management practices are most effective and under what conditions (movement to groundwater resulting from surface applications of nitrate).

The Coalition is currently partnering with four other Central Valley coalitions to implement the MPEP. The first phase of that program is a literature review to identify practices that are known to be protective of groundwater. Although the efficacy of these practices may not be known under all conditions (e.g. soil types, rainfall regimes), there is certainly a sufficient amount known to recommend specific management practices to a subset of growers. MPEP field studies will be initiated in late 2016 and the efficacy of additional management practices will be evaluated within the first two years of the MPEP Work Plan approval based on the crop and growing conditions. Modeling the effectiveness of other practices is expected to begin by year two of the MPEP, providing additional early information on protective management practices. The Coalition will use the results of the literature review and the MPEP studies/modeling to compile a list of management practices with descriptions. The list will grow as more becomes known about protective practices. A matrix will be developed that addresses the 4Rs and crop specific information on nitrogen application rates, and the timing and placement of nitrogen fertilizer.

Growers will start receiving information on protective management practices in the first year after the GQMP is approved; within two years the Coalition will provide information to all members on management practices that are considered to be protective of groundwater. In the longer term, the emphasis of the Coalition's outreach will be expanded to include the outcome of the MPEP studies which will provide information that is specific to crops, soils, and climatic regions within the Coalition region.

ADOPTION OF MANAGEMENT PRACTICES BY MEMBERS

The GQMP strategy prioritizes growers in HVAs who have the greatest potential to impair groundwater quality. All growers within HVAs must return NMP Summary Reports which record the amount of nitrogen applied compared to the crop yield (A/Y). If data are available, the Coalition will multiply the crop yield by a nitrogen removed coefficient to create the ratio of nitrogen applied to nitrogen removed (A/R). The Coalition conducts an analysis of the NMP Summary Reports to determine statistical outliers by crop and township/range as well as the statistical distribution of A/Y values (mean, median, and upper and lower 90th percentiles). If a management unit has an A/Y that is greater than the 90th percentile of the mean, that management unit will be designated as a statistical outlier. This designation indicates that this management unit could be receiving more nitrogen then the crop needs relative to other management units growing the same crop in the same area. For the statistical outliers, both the amount applied (A) and the amount of crop yield (Y) are evaluated to determine the cause behind the statistical outlier status. The Coalition can evaluate the current nitrogen management practices for these growers based on their FEPs, but will also request additional information.

Members with management units that are A/Y outliers will be contacted and required to attend a NMP Focused Outreach seminar on crop specific nitrogen needs and management practices. At the seminar, the growers will be asked to report on more specific management practices such as what types of nitrogen fertilizer are applied (e.g. synthetic fertilizer, compost, manure, irrigation water), whether they use split applications, and timing of applications, and more details about irrigation practices such as when during an irrigation set fertigation takes place. During the NMP Focused Outreach meetings, the GQMP Strategy and progress of the MPEP will be discussed in addition to information about nitrogen fertilizer use and efficiency, nitrogen removed information for their specific crop (if known), and crop specific nitrogen management practices that are protective of groundwater.

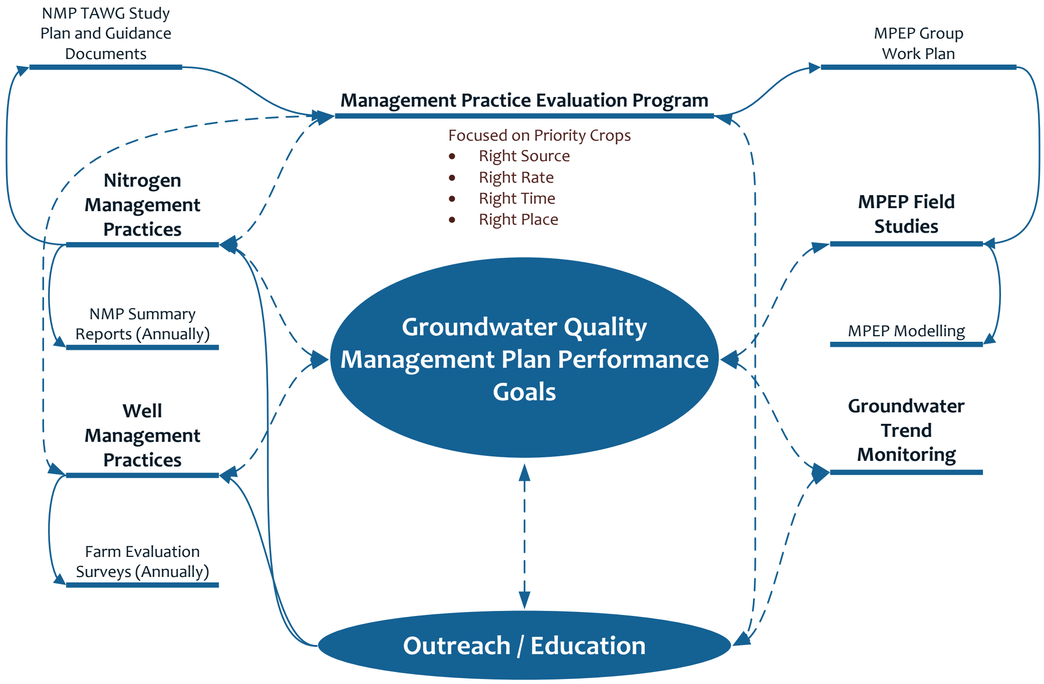
Based on the additional management practice information obtained from growers during these NMP Focused Outreach seminars, the Coalition will re-evaluate each member's A/Y to determine if the statistical outliers are verified as a member who may need to improve practices by either reducing A, increasing Y, or both. In some instances, members with an elevated A/Y may not be able to reduce the applied nitrogen because the majority, or all of the nitrogen, is applied in their irrigation water. Other members may be applying a recommended rate of nitrogen but because of their irrigation practices, the nitrogen may be leaching before it can be taken up by the crop. Practices will be recommended that help the grower save money (less nitrogen applied), increase their nitrogen use efficiency, maintain or increase their yield, and reduce the potential for leaching of nitrogen to groundwater.

Growers will be asked to indicate which practices they plan to implement during the next crop year based on the information obtained during the NMP Focused Outreach meetings (see further description below). Follow-up surveys will be sent the next year to determine if additional practices were implemented. If practices were not implemented the grower will indicate why the practice were not implemented and whether they will be implemented in the future. The NMP Focused Outreach management practice information will be recorded in a database maintained by the Coalition in addition to the annual FEP information recorded each year.

EVALUATE EFFECTIVENESS OF NEW MANAGEMENT PRACTICES

The Coalition will evaluate the effectiveness of the GQMP strategy by 1) documenting nitrate and wellhead management practices by members, 2) use of the NMP Summary Report information to assess nitrogen use by growers, 3) evaluating the need for implementation of additional practices by individual growers, and 4) assessing groundwater quality improvements using monitoring data generated by the Groundwater Quality Trend Monitoring Program (Figure 58).

Figure 58. Conceptual diagram of the GQMP strategy to evaluate effectiveness.



FEPs and NMPs - Tracking of Management Practices

Farm Evaluation Plan surveys (FEPs) are required of members to report the management practices implemented on their farming operation. Completed yearly by members farming in HVAs, the FEPs address constituents of concern in both surface and groundwater. For groundwater, the FEPs provide information on wellhead protection, irrigation practices, and nitrogen applications. More specific information on nitrogen management is provided in the Nitrogen Management Plan (NMP) which is completed yearly by members in HVAs. The NMP requests very specific information about the amount of nitrogen applied, additional sources of nitrogen available (e.g. irrigation water) to the crop, and anticipated yield. Growers in HVAs submit NMP Summary Reports annually which includes information from the previous crop year's NMP. The Coalition will use a combination of the FEPs and NMP Summary Reports to track implementation of management practices in HVAs from year to year.

NMP Summary Reports - Outlier's Improvement Targets and Time Schedule

Growers with management units identified as verified outliers will each receive their A/Y and A/R (if available) information compared to other growers of the same crop, an assessment of their nitrogen use, the potential improvement in nitrogen use efficiency that can occur without loss of yield, management practices that can be used to achieve the improvement, a survey and follow-up to determine which practices were implemented, and the time frame over which the improvement should occur. Each grower is unique and will have an individualized improvement target and schedule. Some growers will be outliers because they apply too much nitrogen fertilizer, some because they irrigate with groundwater that has an extremely high nitrate concentration, and others because their irrigation practices push nitrate past the root zone and their yield suffers. The first scenario is corrected provided the grower can be convinced that their fertilizer application rate is unnecessarily high, the second scenario can't be corrected with any management practice, and the third scenario is corrected if the cause of the leaching can be eliminated with appropriate education about the timing of the fertilizer application relative to irrigation, e.g. fertigating toward the middle of the irrigation set rather than at the beginning of the set. However, if the cause of the leaching is poor distribution uniformity, developing the funding to improve the system may take some time. Each of these is a unique scenario and until additional information is received from all statistical outliers, the management practices recommended and the time necessary for implementation are unknown. In some circumstances, recommendations about appropriate management practices will need to await the outcome of the MPEP field and modeling studies.

Understanding all of the various scenarios that result in verified outlier status will provide input to the MPEP process; however, providing the correct nitrogen management advice to growers may take a few years to initiate and complete the appropriate MPEP study. A delay in recommending protective management practices is not expected to occur in a significant percentage of growers identified as verified outliers and all management units identified as verified outliers are expected to reduce the A/R (or A/Y) associated with that management unit by a significant amount within 5 years.

Progress toward achieving the improvement targets will be tracked by reviewing various metrics including follow-up surveys documenting additional practices implemented, changed in overall nitrogen applied, and changes in A/Y or A/R ratios. Statistics detailing progress will be compiled and reported to the Regional Water Board each year in the Groundwater Quality Management Plan Update section of the Annual Report. Members whose management units do not make sufficient progress will be flagged for additional outreach and eventual communication with the Regional Water Board.

GQTMP - Evaluating Groundwater Quality Trend Monitoring Results

Changes in groundwater quality, even first encountered groundwater which may be shallow, are very difficult to document for several reasons including infiltration rate, depth to groundwater, seasonal variation in groundwater quality and depth, yearly variation due to changes in weather (drought years vs. above normal rainfall years), volume of the aquifer, flow rate and path, and the spatial and temporal sample sizes (potentially years) needed to demonstrate a trend. However, the Coalition's Groundwater Quality Trend Monitoring Program will generate groundwater quality data that can be used to evaluate groundwater quality for COCs as tracked over an extended period of time. Even in shallow groundwater, reductions in nitrate leaching to groundwater may not be identifiable for many years. The nitrate in the vadose zone may take several years to reach groundwater, and the volume of groundwater and concentration of nitrate in that groundwater may make any changes difficult to document. Consequently, the first few years of monitoring will establish a baseline from which future trends can be determined and linked to the implementation of management practices as reported in the FEPs and NMPs. The time needed to measure changes in groundwater quality is expected to vary across the Coalition region and therefore it is not known how long it will take to detect trends in groundwater quality. Once changes are detectable, it will be possible to analyze for any correlations between changes in groundwater quality, changes in the crop-specific A/Y and A/R statistics, and management practices implemented by growers. The results of the A/R analyses are reported in the Coalition's NMP Summary Report update in the Annual Report.

GAR Updates - Reporting Trends in Groundwater Quality

The Coalition will submit an update to the Groundwater Assessment Report in five-year intervals. Although the content of the updates is not fully detailed in the Order, the Coalition expects that reporting on trends in groundwater quality will be the focus of the updates. A summary of the changes measured in the years between GAR updates will be developed from the information provided in the Annual Reports.

ACTIONS TO MEET GOALS AND OBJECTIVES

The Coalition conducts outreach meetings regularly throughout the year at various locations in the Coalition region. At these meetings, Coalition monitoring results including exceedances of water quality objectives are discussed as well as management practices that can be implemented to reduce surface water runoff, sediment discharge, and leaching of COCs to groundwater. These practices include but are not limited to wellhead protection, irrigation system maintenance and calibration, and nitrogen management planning.

In addition to the annual grower meetings, the Coalition will present information about management practices at crop-specific meetings targeted to growers with verified A/Y outlier management units. The MPEP will provide substantial information about crop-specific management practices that can be provided to growers. The Coalition will provide information to growers of specific commodities at meetings in the Coalition region focused on conclusions from the MPEP studies. The Coalition will work with the MPEP GCC to secure funding for studies on priority crops in HVAs as well as funds for creating additional outreach materials and tools that can be utilized by members to assist with nitrogen application planning relative to the 4Rs.

DUTIES AND RESPONSIBILITIES

The responsible parties are provided in organizational chart provided below (Figure 59).

ESJWQC policy is determined by a Board of Directors. The ESJWQC Board of Directors (BOD) also oversees all Coalition business. The BOD works closely with the Executive Director to ensure effective management of Coalition activities. Parry Klassen is the Executive Director of the ESJWQC and the project lead for management plan activities. Mr. Klassen is responsible for implementing policy as directed by the Board of Directors including budgeting and financial management, management of the Coalition's membership, member outreach, oversight of consultant contracts, and management of consultant work products. Wayne Zipser is the Coalition Manager of Member Relations. Mr. Zipser is the lead for stakeholder involvement and is responsible for outreach to members, primarily in individual meetings with growers in management plan site subwatersheds. Technical consultants are contracted by the Coalition as needed to complete tasks and activities required by the Regional Water Board. Currently, the technical consultants to the ESJWQC are Michael L. Johnson, LLC; Luhdorff and Scalmanini Consulting Engineers (LSCE), and the Coalition for Urban Rural Environmental Stewardship (CURES). Michael L. Johnson, LLC (MLJ-LLC) will be responsible for conducting the groundwater monitoring and reporting program. LSCE is responsible for developing the Groundwater Trend Monitoring Report, updating the GAR every 5 years and providing technical support for groundwater issues. CURES assists in developing BMP literature and conducting member outreach events.

Data developed for the GQMP include information obtained from the FEPs, additional surveys completed by members with outlier management units, follow-up survey information, and NMP summary information. Because no groundwater monitoring is proposed as part of this program, there are no analytical data to manage. Groundwater monitoring will be conducted as part of the GTMP, and the MPEP in selected studies performed in areas with shallow groundwater. Data management for the GTMP will be discussed in the GTMP QAPP to be submitted to the Regional Water Board prior to the initiation of monitoring. The data management for the MPEP was discussed in the MPEP QAPP submitted to the Regional Water Board in June 2016. Because contractors are not yet selected for the MPEP studies, the individuals who will serve as the data manager, sample collection lead, and QA manager have not yet been identified. Those positions will be identified in the MPEP QAPP amendment submitted to the Regional Water Board prior to the initiation of the first MPEP field study.

The data collected for the GQMP, i.e. FEPs, NMP Summary Reports, and additional survey information, will be managed by MLJ-LLC. The data manager will be Ms. Melissa Turner. Ms. Turner currently manages the data obtained through the submission of the FEPs and NMP Summary Reports, and manages a database containing survey information focused on management practices in the surface water program. Databases have already been developed in Access, and data are housed in those databases. The Regional Water Board can request a detailed description of the databases if interested.

Coalition Contact Information

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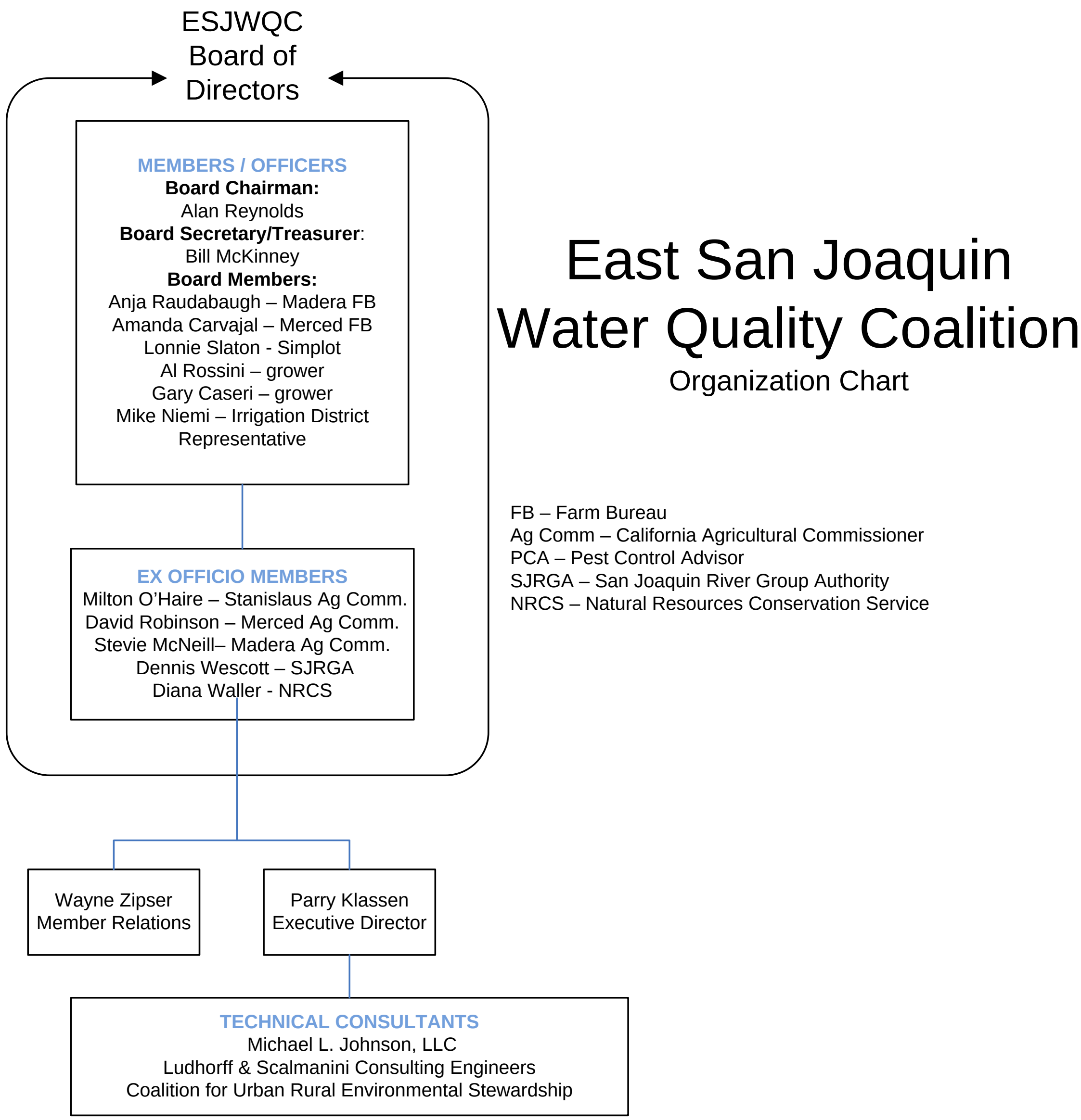
Figure 59. Identification key of responsible parties involved in major aspects of the GQMP.



STRATEGIES TO IMPLEMENT MANAGEMENT PLAN TASKS

Agencies Contacted for Data and/or Assistance

The Coalition receives input from NRCS in Modesto regarding county wide NRCS assistance to growers to implement new management practices is summarized in the Management Plan Progress Report. The Coalition encourages members to apply for NRCS funds to implement structural BMPs.

The Coalition is participating in a joint effort to conduct MPEP studies. Other coalitions participating are the Sacramento Valley Water Quality Coalition, San Joaquin County and Delta Water Quality Coalition, the Westside San Joaquin River Watershed Coalition and the Westlands Water Quality Coalition. The Coalitions have met and developed an administrative structure to manage the MPEP studies, and have convened a technical advisory group consisting of several representatives from UC Cooperative Extension, the fertilizer industry, and commodity groups. The Coalitions selected CURES as the administrative contractor, and have developed grant proposals to fund MPEP studies. One proposal was funded to evaluate nitrate leaching past the root zone in walnut orchards on sandy soil and the study was initiated in spring of 2016.

In addition, the Coalitions worked with CDFA to develop a nitrogen management curriculum that allows members who successfully complete the course to certify their Nitrogen Management Plans. CURES submitted a grant proposal to CDFA to fund the development of the curriculum of the self-certification course. The proposal was funded and the courses will continue to be delivered through the winter of 2016 – 17.

The Central Valley Salinity Alternatives for Long Term Solutions (CV-SALTS) process and the Central Valley Salinity Coalition are in the process of developing a Basin Plan Amendment (BPA) for salt and nitrate that will involve the development of a Salt and Nitrate Management Plan (SNMP). This SNMP will include implementation options that may result in the use of specific management practices in some or the entire Coalition region. The CV-SALTS process is anticipated to be completed by 2017 and when that BPA is finalized, the Coalition will re-evaluate its GQMP to determine its compatibility with the requirements of the BPA and the SNMP(s) developed for the Coalition region.

Management Practices to Control COCs

The Coalition uses the information provided by different state and federal agencies when making recommendations to growers about how to eliminate discharges from their farming operation. Recommended practices include a range of actions from reducing the amount of nitrogen fertilizer applied to installation of pressurized irrigation systems. Some of the management practices are not technically feasible on some crops. Some practices may be technically feasible but for some members, the practices may not be economically feasible. For these members, the Coalition provides additional practices that can be implemented to reduce leaching as well as information about programs that provide a cost share of the purchase and installation improving the affordability of these more expensive systems.

Outreach Methods

Grower meetings

Meetings in each of the major counties (Stanislaus, Merced, and Madera Counties) in the Coalition region are typically the held three times each year. Additional meetings can be called at any time during the year if circumstances warrant. At these meetings, the Coalition discusses the water quality results for the year, new management plans that can improve water quality, and any changes in requirements due to updates of the WDR by the Regional Water Board.

Meetings within a smaller geographic area are held periodically. These meetings are arranged as needed and can involve the participation of individuals with specialized training, e.g. NRCS or UC Extension personnel. If the Coalition determines that meeting with a subgroup of members (e.g. almond growers) in the high priority areas within the HVAs will provide information that can lead to increased implementation of practices known to be protective of groundwater quality, the Coalition will organize a meeting with members who grow a specific crop such as almonds or operate of a groundwater basin of specific interest.

Other entities within the Coalition region hold meetings where water quality results and management practices are discussed. Meetings are conducted by the County Agricultural Commissioner to satisfy education requirements involved in receiving a pesticide application permit. Although not the focus of these meetings, presentations focusing on water quality and management practices are given specifically addressing pesticides and pesticide applications.

Outside of a formal meeting setting, the Coalition provides information to growers throughout the year through mailings, emails, newsletters and an annual report. Through these media the Coalition presents information to members concerning the Coalition's progress in achieving water quality goals, monitoring results and management practices proven to be effective to reduce the discharge of nutrients and pesticides to groundwater. All outreach and education activities are reported in the ESJWQC Annual Report submitted by May 1 of each year.

The Coalition also hosts a website (http://www.esjcoalition.org/home.asp), which serves as a clearing house for Coalition activities and outreach on management practices. Information provided through the website is utilized as a supplement to regular grower contacts and meetings.

Pest Control Advisors, Agricultural Commissioners, Registrants, and Fertilizer Manufacturers

Agricultural Commissioners from Stanislaus, Merced, and Madera Counties are active participants as non-voting members of the ESJWQC Board of Directors. The Coalition collaborates with County Agricultural Commissioners, Pest Control Advisors (PCAs), and pesticide registrants to provide information on effective management practices to growers within the ESJWQC region. As the focus or water quality expands to groundwater, the Coalition has enlisted assistance from fertilizer manufacturers and their CCAs to work with members to optimize their nitrogen applications to achieve the maximum yield and eliminate discharge to groundwater.

Performance Goals and Performance Measures

The Coalition's Performance Goals are built on actions essential for successful completion of the Management Plan strategy. The Performance Goals reflect the steps necessary to guarantee that the objectives of the Management Plan program are met and that groundwater quality improves in the ESJWQC region.

The following section describes the Performance Measures associated with each Performance Goal (Table 19). These Performance Measures are the actions the Coalition will perform to meet the Performance Goals. Included in the table of Performance Goals and Performance Measures are the parties responsible for performing the actions described by the Performance Measures. A more detailed description of the Performance Goals and Performance Measures has been provided above.

Performance Goal 1.

Review each member's Farm Evaluation Plan (FEP) to determine number/type of management practices in place

Performance Measures

1.1 Analyze FEPs to track implementation of wellhead protection practices on member irrigation supply wells
1.2 Analyze FEPs to track destruction of abandoned wells on member management units
1.3 Analyze FEPs to track changes in well, irrigation, pesticide, and nitrogen fertilizer management practices

The ESJWQC will review information about member parcels reported in the FEPs from growers in groundwater high vulnerability areas and trend monitoring results (if applicable). Information on wellhead protection, destruction of abandoned wells, and management practices will be reported on in the annual Management Plan Progress Report.

Performance Goal 2.

Develop a list of practices associated with the 4Rs.

Performance Measures

2.1 Within two years, provide to 100% of Coalition members information on management practices that are considered to be protective of groundwater
2.2 Within two years, develop and distribute to members a summary of appropriate nitrogen application rates, timing, and placement for crops that cover 90% of the acreage in the HVAs

The Coalition is currently funding a literature review to compile a summary of management practices currently considered to be protective of groundwater. Within two years the Coalition will compile a matrix of crop-specific nitrogen application rates, appropriate timing of applications, and appropriate placement of fertilizer applications. The matrix will be based on guidelines developed by CDFA, UCCE, and/or commodity groups. Although this information is available through numerous sources online, many Coalition members do not have computers or do not have the time to search all of these sources for the right information. The Coalition will bring the information together in a single location which can then be a resource for growers and their CCAs when nitrogen management is discussed. The Coalition will update the information over time as more studies are reported.

Performance Goal 3.

Members adopt additional management practices when appropriate to reduce potential leaching of nitrate to groundwater

Performance Measures

3.1 *Analyze distribution of crop-specific A/Y and A/R (when available) values to evaluate performance of growers*
3.2 *Identify individual management units that are statistical outliers in the crop-specific distribution of A/R values*
3.3 *Conduct crop-specific meetings for members with outlier parcels in HVAs to obtain additional information on management practices*
3.4 *Develop management unit-specific A/Y or A/R (when available) improvement targets, a timeline to achieve targets, and identify appropriate actions/management practices to achieve targets*

Using data collected through return of the NMP Summary Reports, the Coalition will develop box and whisker plots and supporting statistics (mean, 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles) for A, Y, A/Y, and A/R for each crop (N removed information may not be available for all crops). Management units that are statistical outliers will be identified. The Coalition will provide all members, regardless of their outlier status, with their A/Y and A/R (if available) information relative to all other members who grow the same crop in the Coalition region. Included in these packets will be information regarding crop specific 4Rs, nutrient uptake information and published fertilizer recommendations. Each year within the Groundwater Management Plan Progress Report, the Coalition will evaluate changes in A/Y and A/R values to evaluate the performance of growers. It is expected that multiple year averages will need to be evaluated to get a better understanding of performance (see Performance Goal 4).

All members associated with an NMP Summary Report statistical outlier will be contacted and asked to attend a seminar during which additional management practice information will be obtained. Once additional information is received, the Coalition will 1) determine if the management unit is a verified outlier as well as a statistical outlier, and 2) develop a Nitrogen Use Assessment for each grower. The Nitrogen Use Assessment will identify the potential cause(s) for the verified outlier status for each management unit (A is too large, Y is too small), and appropriate management practices that assist the member in reaching their reduction target will be provided. Depending on the situation, a reduction target may include reducing the overall amount of nitrogen applied during the crop year (e.g. applying rates according to CDFA or UCCE recommendations) and/or reducing the overall A/Y ratio (either by reducing A or increasing Y). In some cases, these two metrics cannot be reduced. In these cases, the documentation of management practices may be all that is required as part of the Nitrogen Use Assessment. Each Nitrogen Use Assessment and reduction target will include a grower specific timetable for reaching the target. Based on the reduction targets for verified outliers, a crop-specific A/R improvement target will be developed for the Coalition region.

As the A/Y values are reduced for management units that are verified outliers, the overall mean and median A/Y and A/R values for all management units will decrease and new management units could be identified as outliers. Additionally, simply because a management unit is not identified as an outlier does not imply that the A/Y or A/R is appropriate for that crop. Even management units at or near the median could require additional management practices if the median A/Y or A/R is considered too high based on nitrogen application rates developed by CDFA, UCCE, or commodity groups or studied through MPEP. The crop-specific statistics will be reviewed to determine where management units are performing relative to the accepted nitrate applications guidelines. Those growers farming on management units that are above the accepted nitrogen application rates will be identified, contacted, and provided an improvement target based on accepted nitrogen application rates.

Performance Goal 4. *Evaluate the effectiveness of new management practices*

Performance Measures

4.1 *Reduce the 3-year running average A/Y or A/R for all management units to the level established by the crop-specific improvement rates*

4.2 *Reduce the 3-year running average A/Y or A/R for verified outlier management units to the value established by their individual targets according to the specified timetable*

4.3 *Evaluate groundwater quality monitoring results from the Groundwater Trend Monitoring Program on an annual basis*

4.4 *Evaluate trends in groundwater quality every five years in the Groundwater Assessment Report*

The Coalition will use the information from the FEPs, NMP Summary Reports, and surveys completed during the NMP Focused Outreach meetings to track implementation of management practices and progress towards changing A, Y, A/Y, and A/R. Three-year running averages for A/Y and A/R (when available or when an annual crop is in a multiyear rotation schedule) will be used to evaluate long-term progress towards reducing the amount of nitrogen applied compared to the amount of nitrogen removed with crop harvest. Groundwater quality results from the GTMP will be reviewed on an annual basis to assess nitrate concentrations in wells sampled from year to year. Every 5 years, trends in groundwater quality will be assessed for nitrate and documented in the GAR. Annual updates will be summarized in the Groundwater Management Plan Progress Report submitted annually to the Regional Water Board, and will also be disseminated to members.

Table 19. Performance Goals for the ESJWQC GQMP.

PERFORMANCE GOAL/PERFORMANCE MEASURE	OUTPUTS	WHO
Performance Goal 1: Review each member's Farm Evaluation Plan (FEP) to determine number/type of management practices in place		
Performance Measure 1.1 - *Analyze FEPs to track implementation of wellhead protection practices on member irrigation supply wells*	Report in Management Plan Progress Report the wellhead protection practices on member irrigation supply wells.	MLJ-LLC
Performance Measure 1.2 - *Analyze FEPs to track destruction of abandoned wells on member management units*	Report in Management Plan Progress Report the number of abandoned wells that are destroyed.	MLJ-LLC
Performance Measure 1.3 - *Analyze FEPs to track changes in well, irrigation, pesticide, and nitrogen fertilizer management practices*	Report in Management Plan Progress Report the changes in member practices that are more protective of groundwater quality.	MLJ-LLC
Performance Goal 2: Develop a list of management practices associated with the 4Rs		
Performance Measure 2.1 – *Within two years, provide to 100% of Coalition members information on practices are considered to be protective of groundwater*	A compilation of information on management practices that is provided to growers.	Parry Klassen/ MLJ-LLC
Performance Measure 2.2 – *Within two years, develop and distribute to members a summary of appropriate nitrogen application rates, timing, and placement for crops that cover 90% of the acreage in the HVAs*	A matrix of crop-specific nitrogen application rates, timing, and placement based on guidelines developed by CDFA, UCCE, and commodity groups.	Parry Klassen/ MLJ-LLC
Performance Goal 3: Members adopt additional management practices when appropriate to reduce potential leaching of nitrate to groundwater		
Performance Measure 3.1 – *Analyze distribution of crop-specific A/Y and A/R (when available) values to evaluate nitrogen management performance of growers for all crops*	The mean and supporting statistics of the crop-specific distributions of A, Y, A/Y, and A/R.	MLJ-LLC
Performance Measure 3.2 – *Identify 100% of individual management units that are statistical outliers in the crop-specific distribution of A/R values*	Member-specific nitrogen use assessment that provides their management unit-specific A/Y and A/R values, identifies all statistical outliers of the crop-specific distribution of A/R.	Parry Klassen/ MLJ-LLC
Performance Measure 3.3 - *Conduct crop-specific meetings for 100% of members with outlier parcels in HVAs to obtain additional information on management practices*	Supplemental information from 100% of outliers on A, Y, A/Y including fertilizer and irrigation management practices, and identify true outliers.	Parry Klassen/ MLJ-LLC
Performance Measure 3.4 – *Develop management unit-specific A/Y or A/R (when available) improvement targets, a timeline to achieve targets, and identify appropriate actions/management practices to achieve targets for 100% of managements unit identified as a true outliers*	Management unit-specific improvement targets for 100% of management units identified as true outliers and document crop-specific A/Y and A/R improvement goals and timelines for achieving the goals.	Parry Klassen/ MLJ-LLC
Performance Goal 4: Evaluate the effectiveness of new management practices		
Performance Measure 4.1 – *Reduce the 3-year running average A/Y or A/R for all management units to the level established by the crop-specific improvement rates*	Documented reduction in crop-specific A/Y and A/R statistics.	MLJ-LLC
Performance Measure 4.2 – *Reduce the 3-year running average A/Y or A/R for true outlier management units to the value established by their individual targets according to the specified timetable*	Number of management units meeting their management unit-specific A/R improvement targets within the timetable.	MLJ-LLC
Performance Measure 4.3 – *Evaluate groundwater quality in wells monitored during the Groundwater Trend Monitoring Program*	Groundwater quality monitoring results in the Groundwater Trend Monitoring Update Report	MLJ-LLC
Performance Measure 4.4 – *Evaluate trends in groundwater quality every five years in the GAR Update*	Trend in groundwater quality in Coalition HVAs	MLJ-LLC

Specific Schedule and Milestones for Implementing Management Practices

As detailed by the Outputs in Table 19, each year the Coalition will evaluate and report on the management practices implemented the previous year by members within the HVAs. During the year, the Coalition will conduct outreach and education to members regarding effective management practices that can be implemented to reduce the transport of COCs to groundwater. As data gaps regarding the 4Rs for specific crops are filled, this information will be included in the Coalition's outreach and education efforts. The following milestones were developed based on this strategy and supplemented with target dates based on the objectives of this GQMP.

Milestone 1: Within two years of the approved GQMP, provide to 100% of all members, information on practices that are considered protective of groundwater.

Milestone 2: Within three years of the approved GQMP, develop and distribute to members a summary of appropriate nitrogen application rates, timing, and placement for crops that cover 90% of the acreage in the HVAs.

Milestone 3: Within the first year (and annually thereafter), meet with members whose management units have been identified as verified outliers to obtain additional information about nitrate applications, management practices and yields.

Milestone 4: Within 5 years, demonstrate verified outliers are reducing the 3-year running average A/Y and A/R and meeting their target.

Milestone 5: Within 5 years, demonstrate that the 3-year running average crop-specific A/Y and A/R targets are being met for crops making up 90% of the acreage in the Coalition HVAs.

Staggering the work associated with Performance Goals and Measures over the next 2 – 5 years will allow the Coalition to keep their dues low, provide excellent service to its members, and will result in improved groundwater quality.

Despite staggering the work associated with the GQMP over the next 5 years, the milestones and the schedule to reach the milestones is very aggressive. The Coalition is currently working with four other Coalitions through the MPEP process to conduct a literature review that will identify some practices that are currently thought to be protective of groundwater quality. The Coalition expects that the results of the literature review will be available within the next several months but will provide the list to a selected group of technical experts from the MPEP Technical Advisory Committee and the University of California to confirm that the practices can be recommended to growers as protective. This process is expected to take at least a year and as soon as the practices receive endorsement from the technical experts, the information will be distributed to all Coalition members.

Similarly, the Coalition will initiate the compilation of practices on appropriate nitrogen application rates, timing, and placement for 90% of the crop acreage in the HVAs. A large amount of this information is readily available but needs to be compiled and placed into a format that is easily understandable by growers. Compilation and formatting is expected to take 12 months, and delivery to the members in the HVAs will be accomplished within the second year. The Coalition does not have staff to accomplish this task and it will become the responsibility of the technical consultants for the Coalition. Spreading the work over a year will help maintain the economic feasibility of the entire program.

The Coalition has initiated actions that will jump start the work needed to accomplish the Performance Goals and Performance Measures, but to develop 3-year running averages of nitrate applications and yields, it is not possible to reach the initial milestones until Year 5. Providing useful feedback to members on the implementation of additional management practices and the effectiveness of those practices will take at least five years. Additionally, after examining a grower's management practices that are in place, it may be difficult or impossible to recommend additional practices until the MPEP process is farther along. If the Coalition understood all management practices that will allow all members to reach their A/R targets, there would be no need for the MPEP. The GQMP and the MPEP are parallel process that are interlinked.

Technical and Economic Feasibility

The Coalition is implementing several new processes concurrently; the NMP Summary Report and FEP reporting processes, the GQMP, the MPEP, and the GTMP. All are interconnected and important components that will result in improved surface and groundwater quality. However, the expense and workload associated with all of these required elements has greatly impacted the Coalition. The Coalition's budget has grown substantially over the last few years and the workload on Coalition staff has required the hiring of additional personnel. The increased financial impact has been offset to date, with the increase in membership due to the addition of new members who discharge to groundwater. However, the acreage enrolled in the ILRP over the last two years has decreased slightly and the Coalition does not anticipate a large amount of additional acreage will enroll with the Coalition. Consequently, the additional costs associated with the initiation of the MPEP, the implementation of the GQMP, and the GTMP will require increases in the fees associated with Coalition membership. Increases in membership fees provide a disincentive to Coalition membership as well as a financial hardship for many growers of minor crops. In addition, the costs associated with the implementation of the practices may not be economically feasible for many growers, especially small growers. In these instances, the Coalition will work with the growers to find a suite of lower cost, but effective, management practices to minimize the discharge of nitrate to groundwater. The Coalition will also help growers identify opportunities to obtain funding to offset the cost of expensive systems that can facilitate achieving the member's A/Y target.

Performance Goals and Disadvantaged Communities (DACs)

The Coalition used a large set of parameters when developing its HVAs. These parameters were provided in the GAR (Table 6-11) and again in the GAR Addendum, with the addition of the DACs and the areas contributing recharge to those communities, as part of the matrix for prioritization of the HVAs. Communities that rely on groundwater for their source of drinking water were also considered within matrix for prioritization of the HVAs (Figure 54). Consequently, improvements in groundwater quality expected from the GQMP will immediately benefit residents of the DACs and those communities reliant on groundwater for drinking water. In addition, those DACs not readily included within the HVA, and that are not reliant on groundwater, will also benefit from outreach activities provided by the Coalition as growers of those crops adjacent to their communities will receive education on the BMPs for the protection of groundwater (Figure 56).

The top six crops by acreage in the HVAs in the Coalition region are almonds, wine grapes, pistachios, corn, walnuts, and processing tomatoes. Fertilizer guidelines are available for all of these crops through CDFA allowing the Coalition to establish targets for fertilizer applications and individual targets for growers for reduction of their A/Y and A/R. Of the next 6 highest acreage crops, potatoes, alfalfa, oats, wheat, peaches, and hay-grain, fertilizer guidelines are available for all except oats and hay-grain (although guidelines are available for barley). Consequently, the Coalition believes that A/Y improvement targets can be developed for the overwhelming majority of the acreage in the HVAs which can be evaluated and monitored for progress in achieving reduced target goals. The GQTMP strategy is designed to have the greatest impact on groundwater improvement as a result of focusing first on large acreage crops with documented fertilizer recommendations and nitrogen removed values to establish practical and effective reduction targets. As growers achieve their reduction targets, a reduction is expected to occur in the amount of nitrate leaching from the root zone for crops grown across the HVAs. As a result of decreased leaching, the groundwater supply of DACs and surrounding communities reliant on groundwater for drinking water will improve.

MONITORING METHODS

MONITORING DESIGN

The Coalition's groundwater monitoring strategy is currently being developed through the Groundwater Trend Monitoring Program and the Management Practices Evaluation Program. The Groundwater Trend Monitoring Program Work Plan will be submitted in the near future (the date as yet is unspecified) and will include a comprehensive monitoring program for groundwater quality. In addition, the MPEP will generate several studies of management practices to determine if they are protective of groundwater, some of which will involve groundwater monitoring. The final MPEP Work Plan will be submitted on July 29, 2016.

Minimum Groundwater Monitoring Requirements

According to the Order, "Trend monitoring wells will be sampled, at a minimum, annually at the same time of the year for the indicator parameters identified in Table 20 below."

Table 20. Groundwater monitoring parameters (WDR, Attachment B, pg. 19).

CONSTITUENTS, PARAMETERS, AND TESTS	
ANNUAL MONITORING	
Dissolved Oxygen* (mg/L)	**Physical Parameters and General Chemistry**
Electrical Conductivity* (µmhos/cm)	
pH* (in pH units)	
Temperature* (˚C)	
Nitrate* as nitrogen (mg/L)	
TREND MONITORING	
Total Dissolved Solids (SC, field measure)	**Physical Parameters and General Chemistry**
Carbonate	Anions
Bicarbonate	
Chloride	
Sulfate	
Boron	Cations
Calcium	
Sodium	
Magnesium	
Potassium	

*Field parameters

DATA EVALUATION

INFORMATION TO QUANTIFY PROGRAM EFFECTIVENESS

To quantify the Management Plan program effectiveness over the long term, there are several types of data collected each year including:

- Current, publically available groundwater quality data
- Current level of management practice implementation by growers (FEP)
- Identification of additional management practices to be implemented that are protective groundwater quality (associated with the 4Rs)
- Tracking the implementation of management practices by growers
- Tracking the amount of nitrogen applied (A), and the ratio of the amount of nitrogen applied to the crop yield (A/Y)

The Coalition currently maintains databases for water quality monitoring data, management practices reported in the FEP Reports, data on nitrogen applications and yields from the NMP Reports, and management practices that growers are encouraged to adopt by Coalition representatives. Water quality data and well sampling annual reports from Geotracker GAMA and DPR, respectively, are reviewed for spatial analysis of new impairments to groundwater quality due to agricultural activities. Water quality results from the GQTMP will be used to determine temporal trends in groundwater quality.

Tracking the effectiveness of management plans involves:

1. Identifying management practices that are potentially enabling constituents to impair groundwater quality,
2. Understanding what practices those growers currently have in place,
3. Providing information on additional practices if appropriate,
4. Verifying that additional practices are being implemented, and
5. Monitoring A/Y and water quality to determine constituent concentrations in groundwater are being reduced to acceptable levels.

Independent of water quality monitoring results, the Coalition maintains a relational database that holds member information including the results of the Farm Evaluation Plans and Nitrogen Management Summary Reports. The member is requested to complete a separate FEP or NMP for every field that is managed differently. All survey responses are placed into the database and the Coalition is able to associate every response and every management practice reported with a specific parcel and field. When all growers complete their FEPs and NMPs, the Coalition will have a record of all management practices implemented on every field in the Coalition region. Each year's FEP and NMP will be added to the database providing the Coalition with a record of management practices implemented over time. If growers receive a visit from a Coalition representative to receive information about practices that can be implemented, the specific field/location and the additional practices are also recorded in the database. If it is determined that the FEP or NMP does not adequately capture the practices used by members, the Coalition will request additional information be provided by the member. This information will also be placed into the database. Each year during the process of preparing the Management Plan Progress Report, the Coalition will review the practices currently used by members, the practices recommended by the Coalition to members, and the practices implemented by members. The review involves simple queries of the relational database that the technical consultants have generated while developing this practice tracking system.

As growers complete and submit their yearly FEPs and NMPs to the Coalition, a record is developed of the practices used on their farming operation which can then be associated with water quality data. Results from MPEP studies and modelling will be used to inform which management practices are protective of groundwater and will be included in education and outreach to growers.

Verification of the management practices information will be performed for those members employing management practices identified as not protective of groundwater quality. Meetings with members at their farming operation will allow the Coalition representatives to determine if the practices listed on the FEP or NMP are actually being implemented by the member. Although verification will occur, it is the experience of the Coalition that members are extremely honest about their farming operation and the practices they employ. Verification of the management practices information provided by members will not occur for those members in low vulnerability areas.

METHODS OF DATA EVALUATION

The data to be evaluated will be entered into an Access database and associated with a member, township, range and section, crop and acreage. The Coalition expects that graphical and tabular presentations of data such as management practices in place, recommended, and implemented will be sufficient to convey results of the evaluation of the tracking of the management practices implementation. Water quality data will be summarized with simple descriptive statistics for presentation in the Management Plan Progress Report submitted as part of the Annual Report (May 1).

RECORDS AND REPORTING

The Coalition will submit a Management Plan Progress Report as part of the Annual Monitoring Report submitted by May 1. The report will contain the 13 components listed in Appendix MRP-1 of the WDR. All reports are submitted electronically and shapefiles are either submitted with the reports, or available upon request.

GROUNDWATER MANAGEMENT PLAN ZONES

MODESTO SUBBASIN MANAGEMENT ZONE

Introduction and Background

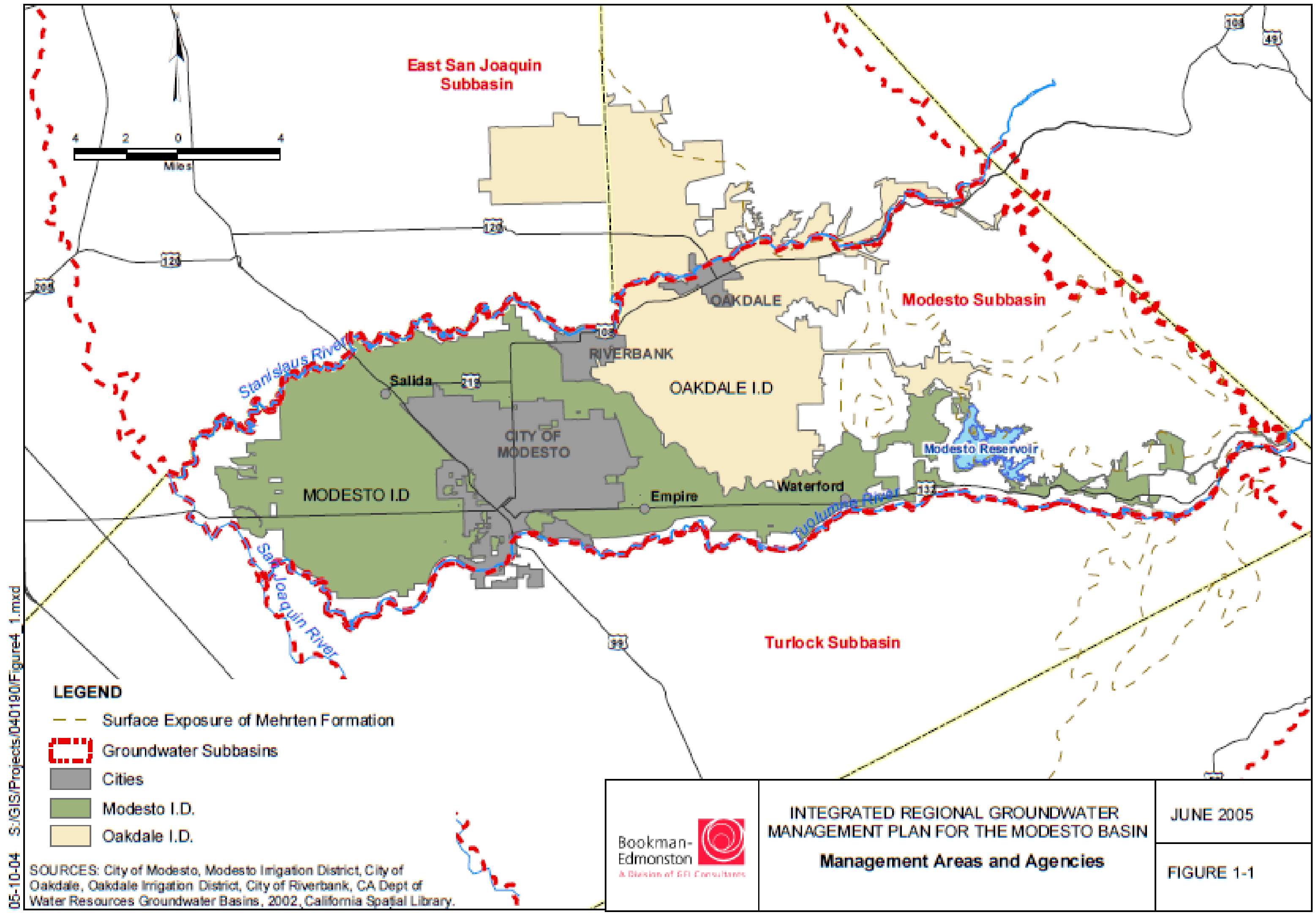
The Modesto GQMP Zone is the northern most zone within the Coalition including the entire Modesto Groundwater Subbasin and the southernmost border of the Eastern San Joaquin Groundwater Subbasin. The entire Modesto subbasin is within the Stanislaus County.

Existing Groundwater Management Plans/Entities

Figure 60illustrates the six agencies covering the Modesto Groundwater Subbasin. These six agencies formed the Stanislaus and Tuolumne Rivers Groundwater Basin Association in 1994 to provide a forum for coordinated planning and management of the Subbasin. These six agencies are: the City of Modesto, the Modesto Irrigation District (MID), the City of Oakdale, The Oakdale Irrigation District (OID), the City of Riverbank, and Stanislaus County" (Bookman-Edmonston, 2005). The Integrated Regional Groundwater Management Plan for the Modesto Subbasin includes a table of "Current Level of Monitoring Efforts". This table lists a number of member agencies, including MID, OID, a number of small communities and also DWR and CDPH. "Altogether, the table shows a total of 113 wells monitored for water levels and 104 wells monitored annually for water quality" (ESJWQC[1], 2014).

Figure 60. Integrated Regional Groundwater Management Plan Area for the Modesto Subbasin and participating agencies.

(Bookman-Edmonston, Integrated Regional Groundwater Management Plan for the Modesto Subbasin, Stanislaus & Tuolumne Rivers Groundwater Basin Association, Figure 1-1, 2005).



Basin Boundaries and Surface Hydrology

"The Modesto subbasin lies between the Stanislaus River to the north and Tuolumne River to the south and between the San Joaquin River on the west and crystalline basement rock of the Sierra Nevada foothills on the east. The northern, western, and southern boundaries are shared with the Eastern San Joaquin Valley, Delta-Mendota, and Turlock Groundwater Subbasins, respectively. The subbasin comprises land primarily in the Modesto Irrigation District (MID) and the southern two-thirds of the OID. The City of Modesto is in the southwestern portion of the subbasin. Average annual precipitation for this subbasin is 11 to 15 inches, increasing eastward" (DWR, Bulletin 118).

Geology, Hydrogeology, and Groundwater Hydrology

The characteristics of the Modesto, Turlock, and Merced groundwater subbasins which underlay the Modesto, Turlock, and Merced GQMP Zones are described as study areas within the Central Eastside Study Unit in the USGS' Status and Understanding Groundwater Quality in the Central-Eastside San Joaquin Basin Study Unit, 2006: California GAMA Priority Basin Project (Figure 61). The main water-bearing units of the Modesto, Turlock, and Merced study areas include the unconsolidated alluvial-fan deposits of the Pleistocene-age Riverbank Formation, the deeper unconsolidated Pleistocene-age Turlock Lake and Pliocene-age Laguna Formations, and the semi-consolidated Miocene-Pliocene-age Mehrten Formation.

Groundwater conditions are unconfined, semi-confined, and confined in different zones of the groundwater system in the Central Eastside study unit. The base of freshwater, where estimated, generally is more than 700 feet (ft) below land surface, but may be as shallow as 300 ft in parts of the study unit. Unconfined conditions are present in unconsolidated deposits above and east of the Corcoran Clay Member of the Turlock Lake Formation, which underlies the southwestern half of the study unit at depths ranging from 50 to 250 ft. Confined conditions are present below the Corcoran Clay. Semi-confined conditions are present at depth east of the Corcoran Clay, because of many discontinuous clay lenses (Landon, et al., 2010).

Figure 61. Geologic setting of the Central-Eastside San Joaquin Basin study unit.

(US Department of the Interior and US Geologic Survey, Status and Understanding Groundwater Quality in the Central-Eastside San Joaquin Basin Study Unit, 2006: California GAMA Priority Basin Project, Figure 5, pg. 10, 2006).

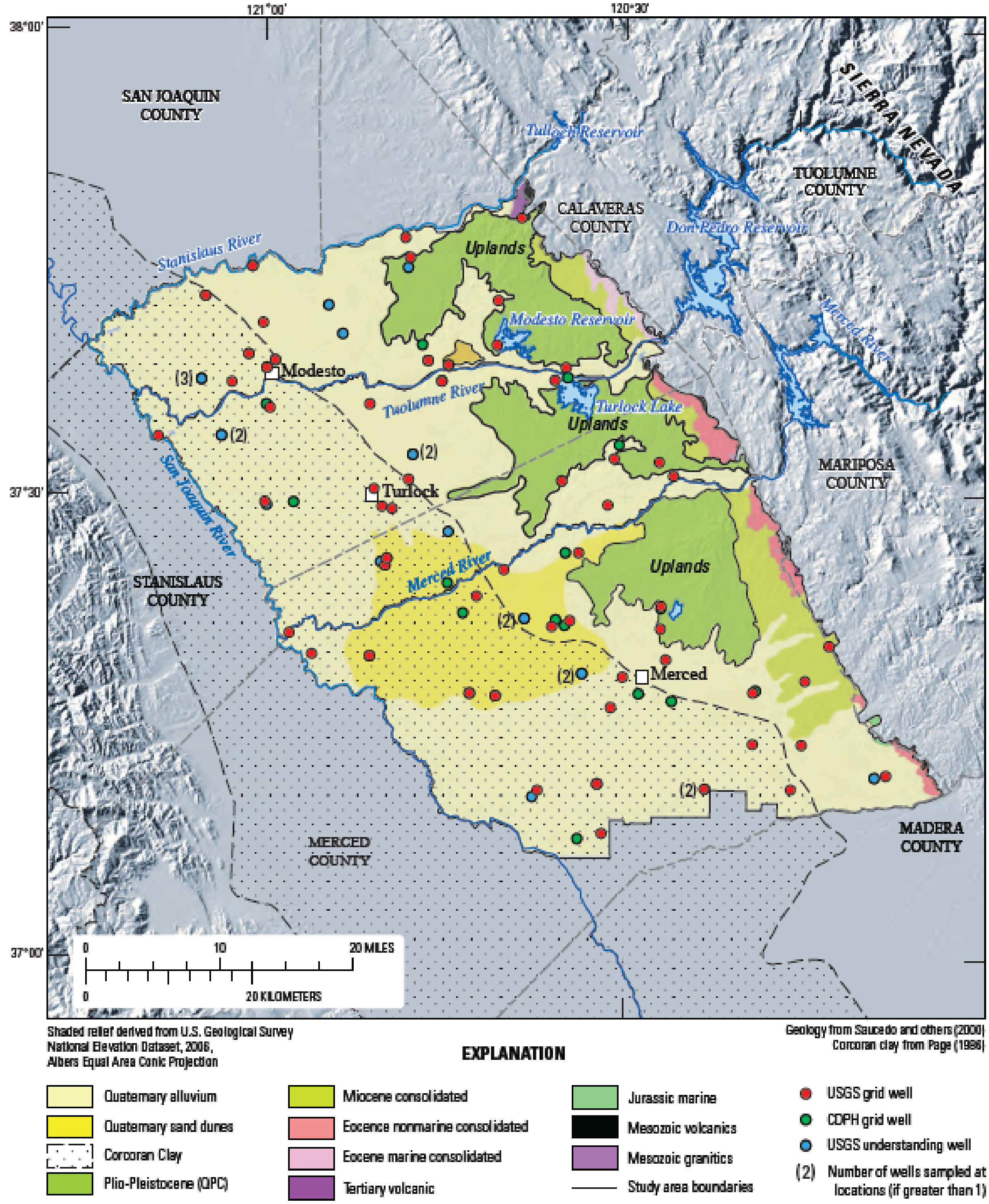


Figure 5. Geologic map of the Central Eastside, California, Groundwater Ambient Monitoring and Assessment (GAMA) study unit.

The geology, hydrogeology and groundwater hydrology description for the Modesto subbasin is taken almost exclusively from Bulletin 118 (DWR 2003).

Water Bearing Formations

The primary hydrogeologic units in the Modesto Subbasin include both consolidated and unconsolidated sedimentary deposits. The consolidated deposits include the Ione Formation of Miocene age, the Valley Springs Formation of Eocene age, and the Mehrten Formation, which was deposited during the Miocene to Pliocene Epochs. The consolidated deposits lie in the eastern portion of the subbasin and generally yield small quantities of water to wells except for the Mehrten Formation, which is an important aquifer. In the Subbasin, the Mehrten Formation is composed of up to 300 feet of sandstone, breccia, conglomerate, tuff siltstone and claystone (Page 1973).

The unconsolidated deposits were laid down during the Pliocene to present and, from oldest to youngest, include continental deposits lacustrine and marsh deposits, older alluvium, younger alluvium, and flood-subbasin deposits. The continental deposits and older alluvium are the main water-yielding units in the unconsolidated deposits. The lacustrine and marsh deposits (which include the Corcoran, or “E-” Clay), and the flood-subbasin deposits yield little water to wells, and the younger alluvium in most places probably yields only moderate quantities of water to wells (page 1973).

The continental deposits consist of poorly sorted gravel, sand, silt and clay varying in thickness from 0 to 450 feet occurring at the surface on the eastern side of the subbasin to over 400 feet deep in the western portion. These deposits are the equivalent of the North Merced Gravels and the lower Turlock Lake Formation (Davis and others 1959). The older alluvium consists of intercalated beds of gravel sand, silt, and clay with some hardpan. This alluvium is up to 400 feet thick and is generally present near or at the surface of the western one-half of the subbasin. The older alluvium is largely equivalent to the Riverbank and Modesto Formations (Davis and others 1959).

Ground water occurs under unconfined, semi-confined, and confined conditions. The unconfined waterbody occurs in the unconsolidated deposits above and east of the Corcoran Clay, which underlies the southwestern portion of the subbasin at depths ranging from 150 to 250 feet (DWR 1981). Where clay lenses restrict the downward flow of groundwater, semi-confined conditions occur. The confined waterbody occurs in the unconsolidated deposits below the Corcoran Clay and extends downward to the base of fresh water.

The estimated average specific yield of this subbasin is 8.8 percent (based on DWR San Joaquin District internal data and Davis and others 1959).

Restrictive Structures

Groundwater flow is primarily to the southwest, following the regional dip of basement rock and sedimentary units. The lower to middle reaches of the Stanislaus and Tuolumne Rivers in the Subbasin appear to be gaining streams with groundwater flow into both, especially the Tuolumne River (DWR 2000). No faults have been identified that affect the movement of fresh groundwater (Page and Balding 1973).

Recharge Areas

Groundwater recharge is primarily from deep percolation of applied irrigation water and canal seepage from MID and OID facilities. Seepage from Modesto Reservoir is also significant (STRGBA 1995). Lesser recharge occurs as a result of subsurface flows originating in the mountains and foothills along the east side of the subbasin, losses from minor streams, and from percolation of direct precipitation.

'The irrigation supply is provided primarily by surface water draining from the Sierra Nevada, and stored in reservoirs. The surface-water supplies are managed by irrigation districts and delivered to agricultural users through hundreds of miles of lined canals. Primary sources of discharge are pumping withdrawals for irrigation and municipal water supply, evaporation from areas with a shallow depth to water, and discharge to streams. Agricultural irrigation supplied by surface water and groundwater accounts for about 95 percent of the total water use in the region' (Landon, et al., 2010).

Groundwater Level Trends

Changes in groundwater levels are based on annual water level measurements by DWR and cooperators. Water level changes were evaluated by quarter township and computed through a custom DWR computer program using geostatistics (kriging). On average, the subbasin water level has declined nearly 15 feet from 1970 through 2000. The period from 1970 through 1978 showed steep declines totaling about 12 feet. The six-year period from 1978 to 1984 saw stabilization and rebound of about 7 feet. 1984 through 1995 again showed steep declines, bottoming out in 1995 at nearly 20 feet below the 1970 level. Water levels then rose about 5 feet from 1996 to 2000. Water level declines have been more severe in the eastern portion of the subbasin, but have risen faster in the eastern subbasin between 1996 and 2000 than in any other portion of the subbasin.

Groundwater Storage

Estimations of the total storage capacity of the subbasin and the amount of water in storage as of 1995 were calculated using an estimated specific yield of 8.8 percent and water levels collected by DWR and cooperators. According to these calculations, the total storage capacity of this subbasin is estimated to be 6,500,000 af to a depth of 300 feet. According to published literature, the amount of stored groundwater in this subbasin as of 1961 is 14,000,000 af to a depth of < 1000 feet (Williamson 1989).

Groundwater Budget (Type B)

Although a detailed budget was not available for this subbasin, an estimate of groundwater demand was calculated based on the 1990 normalized year and data on land and water use. A subsequent analysis was done by a DWR water budget spreadsheet to estimate overall applied water demands, agricultural groundwater pumpage, urban pumping demand and other extraction data.

Natural recharge into the subbasin is estimated to be 86,000 af. Artificial recharge and subsurface inflow values are not determined. There is approximately 92,000 af of applied water recharge. Annual urban and agricultural extractions are estimated to be 81,000 and 145,000 af, respectively. There are no other extractions, and values for subsurface outflow are not determined.

Groundwater Quality Characterization

The groundwater in this basin is of a calcium bicarbonate type in the eastern subbasin to a calcium-magnesium bicarbonate or calcium-sodium bicarbonate type in the western portion. The TDS values range from 60 to 8,300 mg/L, with a typical range of 200 to 500 mg/L. The Department of Health Services, which monitors Title 22 water quality standards, reports TDS values in 88 wells ranging from 60 to 860 mg/L, with an average value of 295 mg/L.

Groundwater Quality Impairments

There are areas of hard groundwater and localized areas of high chloride, boron, DBCP, nitrate, iron, and manganese. Some sodium chloride waters of high TDS values are found along the east side of the subbasin. There are also some areas of shallow groundwater in the subbasin that require dewatering wells.

Land Use/Irrigated Land

Management Practices/Crops in Zone

Table 21 and Table 22describe land uses within the Modesto GQMP Zone from two different data sets, USDA (2012) and DWR (early 2000s), respectively. Table 21 indicates almonds, other-hay/non-alfalfa, walnut, alfalfa, clover/wildflower, and oats as the crops capturing over 85% of the land use in the Modesto GQMP Zone, regardless of irrigated or non-irrigated status. DWR data indicates the top irrigated crop as deciduous fruits and nuts, which also include almonds.

Table 21. Land use acreage within the entire Modesto GQMP Zone1.

Row Labels	Acreage	Percent acreage of Zone*
Almonds	40818	37.22%
Other Hay/Non Alfalfa	16316	14.88%
Walnuts	13391	12.21%
Alfalfa	11714	10.68%
Clover/Wildflowers	6115	5.58%
Oats	5589	5.10%
Double Crop Oats/Corn	3950	3.60%
Winter Wheat	2447	2.23%
Grapes	2184	1.99%
Double Crop Winter Wheat/Corn	1537	1.40%
Fallow/Idle Cropland	1229	1.12%
Grand Total for Agricultural Crops	105290	96.01%

[1]Land use information obtained from data provided by USDA, 2012 California Cropland Data Layer: http://www.nass.usda.gov/research/Cropland/SARS1a.htm. Land use in some areas of the ESJWQC may have changed since that time.
*Percent of cropped area includes all agricultural fields, whether fallow or active. Land use categories such as barren, developed, and native or wetland vegetation were not included in acreage totals. Crops contributing 1% or more of the overall land use within the GQMP area were included.

Table 22. Land use acreage as associated with irrigation data within the Modesto GQMP Zone by ESJHVA Priority 1-3 areas.

Land uses derived from DWR data in order to incorporate irrigation data designated as irrigated/non-irrigated (I/NI); numbers are rounded to nearest whole number.

Land Use	I/NI	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Citrus & Sub-Tropical	I	0	5	33	0
Citrus & Sub-Tropical	N	0	0	1	29
Deciduous Fruits & Nuts	I	2898	16084	18416	16706
Field Crops	I	641	5944	6556	7245
Grain & Hay	I	161	368	501	186
Grain & Hay	N	2	23	76	2171
Idle	I	12	369	419	457
Native Riparian	N	36	288	4170	3135
Native Vegetation	N	103	801	4724	78791
Open Water	N	35	591	1650	2773
Pasture	I	264	1521	12806	19397
Pasture	N	17	63	147	1898
Rice	I	0	127	93	1465
Semi-agricultural	N	123	1375	2421	3759
Truck, Nursery, Berry	I	211	717	1104	268
Urban	N	528	19841	17996	3142
Vineyard	I	66	945	2458	1119

* Land use information obtained from data provided by DWR, http://www.water.ca.gov/landwateruse/anaglwu.cfm. Data compiled in 2001, land use in some areas of the ESJWQC may have changed since that time.

Constituents of Concern in Zone

Nitrates

Table 23 and Table 24 describe nitrogen as nitrate within the Modesto GQMP Zone. Table 21indicates that of those wells sampled in the Modesto GQMP Zone, approximately 24% exceeded the MCL of 10mg/L. Table 24indicates that of those wells with nitrate exceedances from 2005-2013, the majority (107) are located in the Priority 3 area of the ESJHVA.

Table 23. Count of nitrate (NO3) detections from 5-10mg/L and exceedances >10mg/L by well from 2005-2013 for the Modesto GQMP Zone.

	Count of Wells			Percent of Wells		
	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L
Modesto GQMP Zone	391	234	199	47%	28%	24%

Table 24. Number of individual wells with nitrate exceedances (greater than 10 mg/L) by well from 2005-2013 for the Modesto Groundwater Management Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, nitrate, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

ZONE	ESJHVA PRIORITY AREAS			
	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Modesto GQMP Zone	4	81	107	7

TDS

Table 25 and Table 26 describe TDS levels within the Modesto GQMP Zone. Table 25 indicates that of those wells sampled in the Modesto GQMP Zone, approximately 43% exceeded the agricultural MCL of 450 mg/L. Table 26indicates that of those wells with TDS exceedances from 2005-2013, the majority (28) are located in the Priority 3 area of the ESJHVA.

Table 25. Count of wells with detections of TDS (less than 450 mg/L) and exceedances of TDS (equal to or greater than 450 mg/L) by well from 2005-2013 within the Modesto GQMP Zone.

Well and TDS data used here are the same as those data compiled in the GAR.

ZONE	COUNT OF WELLS			% WELLS TDS>450
	TDS<450	TDS>=450	Total wells	
Modesto GQMP Zone	273	208	481	43%

Table 26. Number of individual wells with TDS exceedances (greater than 450 mg/L) by well from 2005-2013 for the Modesto GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, TDS, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

ZONE	ESJHVA PRIORITY AREAS			
	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Modesto GQMP Zone	10	24	28	6

Pesticides

As stated in previous sections, of the eight pesticides recorded as having exceeded WQTLs in the GAR, only diazinon and simazine are currently registered for application and use with the DPR. No exceedances of active pesticides occurred in the Modesto GQMP Zone. The below data (Table 27 and Table 28) indicate detections only.

Table 27. Summary of pesticide detections (below MCL threshold) and exceedances (at or above MCL threshold) for the Modesto GQMP Zone by individual well and TRS. Active pesticides in this GQMP are bolded.

Well and pesticide data used below are those data compiled in the GAR.

Pesticide	Individual Wells with Detections	Individual Wells with Exceedances	Individual TRS with Detections	Individual TRS with Exceedances	Concentration in Samples with Detections (μg/L)		Exceedance Threshold Used (μg/L)	Basis for Exceedance Threshold
					Minimum	Maximum		
DBCP	107	73	55	37	0.002	166.000	0.2	CA Primary MCL
Ethylene Dibromide	7	5	4	4	0.010	0.210	0.05	CA Primary MCL
Naphthalene	1	0	1	0	0.700	0.700	17	CA Notification
Simazine	**9**	**0**	**9**	**0**	**0.004**	**0.120**	**4**	**CA Primary MCL**
Tetrachloroethane	1	0	1	0	0.840	0.840	1	CA Primary MCL

Pesticide data are for the period 1979-2011 provided by the California Department of Pesticide Regulation (DPR)
TRS-Township Range Section
*Exceedance thresholds used are based on values reported in the SWRCB Water Quality Goals Online Database (http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/search.shtml), when available. Selection of the threshold value for use to indicate an exceedance is based on a hierarchy consisting of the following order of preference: CA Primary MCL = California Primary MCL; EPA Primary MCL = EPA's Federal Primary MCL; CA Notification = California Notification Level. No value in database = Chemical is in the database but not possible threshold value reported, Chemical not in database = Chemical was not located in the SWRCB database

Table 28. Number of individual wells and TRS sections with pesticide exceedances for the Modesto GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, TRS, pesticide, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Pesticide	ESJHVA Priority Areas							
	Priority 1		Priority 2		Priority 3		Outside ESJHVA	
	Individual	Individual	Individual	Individual	Individual	Individual	Individual	Individual
DBCP	1	1	56	27	12	7	4	2
Ethylene Dibromide	0	0	4	3	1	1	0	0

TURLOCK GROUNDWATER MANAGEMENT ZONE

Introduction and Background

The Turlock GQMP Zone is south of the Modesto GQMP Zone and north of the Merced GQMP Zone within the Coalition. The Turlock GQMP Zone includes the entire Turlock Groundwater Subbasin. The Turlock subbasin is within the eastern portion of Stanislaus and Merced counties.

Existing Groundwater Management Plans/Entities

Figure 62depicts the various water agencies within the footprint of the Turlock groundwater subbasin. Agencies eligible to participate in the Turlock Groundwater Basin Groundwater Management Plan for the include: the Turlock and Merced irrigation districts; the cities of Ceres, Turlock, Modesto and Hughson; the Hilmar and Delhi county water districts; the Keyes, Denair and Ballico community services districts; the Eastside and Ballico-Cortez water districts; as well as Stanislaus and Merced counties (Turlock Groundwater Basin Association, 2008).

The 2008 Turlock Groundwater Subbasin Groundwater Management Plan for the Turlock Subbasin includes a table of “Current Level of Monitoring Efforts”. “The table shows a total of 68 wells monitored monthly for water levels (and also an additional 307 wells monitored for levels by DWR) and 69 wells sampled from monthly to triennially for water quality (and an additional 163 wells sampled to meet CDPH requirements for water quality)” (ESJWQC[1], 2014).

Figure 62. Locations of the various local water agencies and their respective political boundaries for the Turlock Subbasin. (Turlock Groundwater Basin Association, Turlock Groundwater basin, Groundwater Management Plan, Figure 2, 2008).

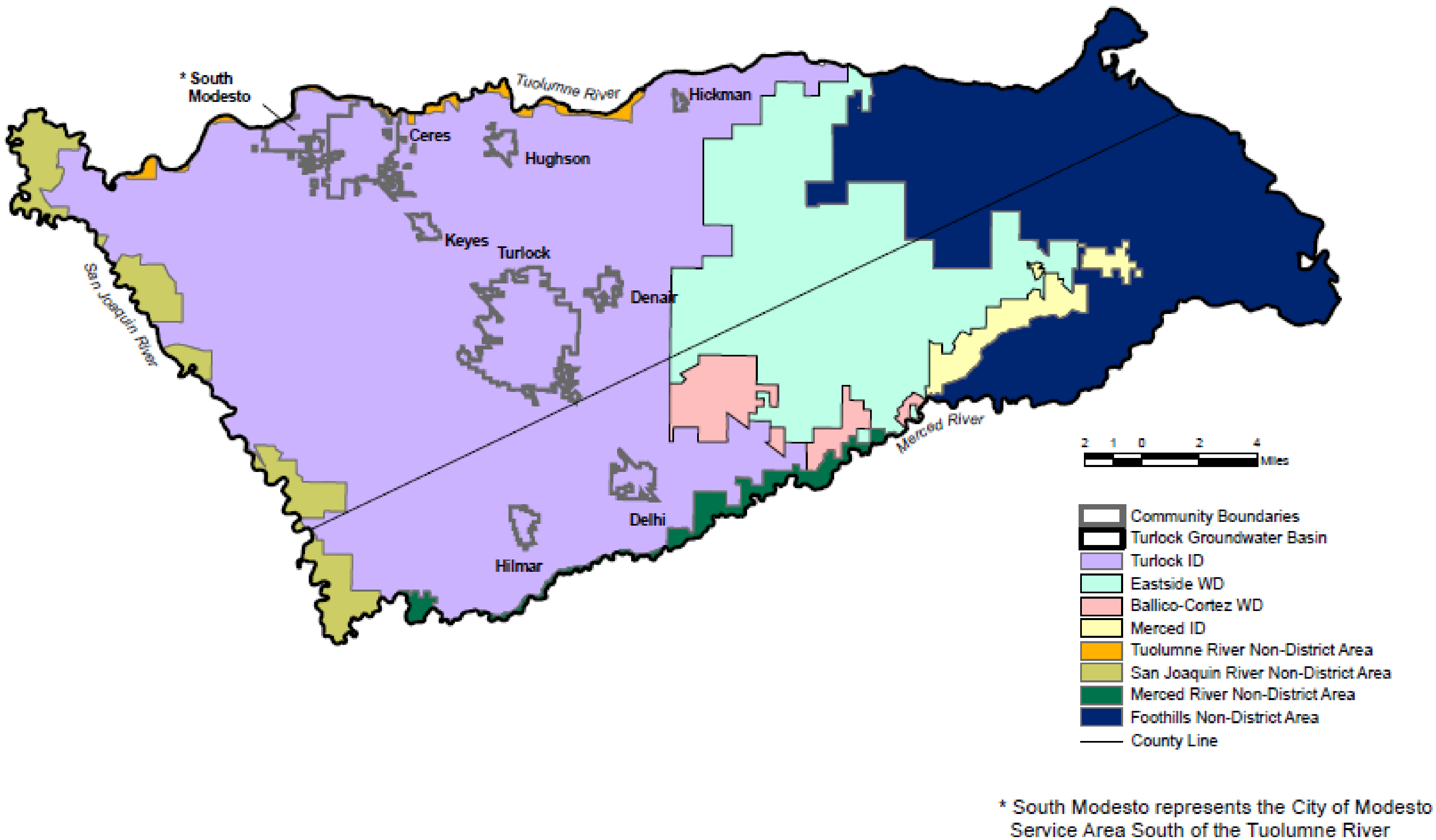


Figure 2. Urban Areas, Irrigation Districts, and Non-District Areas within the Turlock Groundwater Basin

Basin Boundaries and Surface Water Hydrology

"The Turlock Subbasin lies between the Tuolumne and Merced Rivers and is bounded on the west by the San Joaquin River and on the east by crystalline basement rock of the Sierra Nevada foothills. The northern, western, and southern boundaries are shared with the Modesto, Delta-Mendota, and Merced Groundwater Subbasins, respectively. The subbasin includes lands in the Turlock Irrigation District, the Ballico-Cortez Water District, the Eastside Water District, and a small portion of Merced I.D. Average annual precipitation is estimated as 11 to 13 inches, increasing eastward, with 15 inches in the Sierra foothills" (Bulletin 118).

Geology, Hydrogeology, and Groundwater Hydrology

As mentioned above, the characteristics of the Turlock groundwater subbasin is described as one of the study areas within the Central Eastside Study Unit in the USGS' Status and Understanding Groundwater Quality in the Central-Eastside San Joaquin Basin Study Unit, 2006: California GAMA Priority Basin Project (Figure 61). The main water-bearing units of the Modesto, Turlock, and Merced study areas include the unconsolidated alluvial-fan deposits of the Pleistocene-age Riverbank Formation, the deeper unconsolidated Pleistocene-age Turlock Lake and Pliocene-age Laguna Formations, and the semi-consolidated Miocene-Pliocene-age Mehrten Formation.

Groundwater conditions are unconfined, semi-confined, and confined in different zones of the groundwater system in the Central Eastside study unit. The base of freshwater, where estimated, generally is more than 700 ft below land surface, but may be as shallow as 300 ft in parts of the study unit. Unconfined conditions are present in unconsolidated deposits above and east of the Corcoran Clay Member of the Turlock Lake Formation, which underlies the southwestern half of the study unit at depths ranging from 50 to 250 ft. Confined conditions are present below the Corcoran Clay. Semi-confined conditions are present at depth east of the Corcoran Clay, because of many discontinuous clay lenses (Landon, et al., 2010).

The geology, hydrogeology and groundwater hydrology description for the Turlock subbasin is taken almost exclusively from Bulletin 118 (DWR 2003).

Water Bearing Formations

The primary hydrogeologic units in the Turlock Subbasin include both consolidated and unconsolidated sedimentary deposits. The consolidated deposits include the Ione Formation of Miocene age, the Valley Springs Formation of Eocene age, and the Mehrten Formation, which was deposited during the Miocene to Pliocene Epochs. The consolidated deposits lie in the eastern portion of the subbasin and generally yield small quantities of water to wells except for the Mehrten Formation, which is an important aquifer. The Mehrten Formation is composed of up to 800 feet of sandstone, breccia, conglomerate, tuff siltstone and claystone (Page 1973). Unconsolidated deposits include continental deposits, older alluvium, younger alluvium, and flood-basin deposits. Lacustrine and marsh deposits, which constitute the Corcoran or E-clay aquitard, underlie the western half of the subbasin at depths ranging between about 50 and 200 feet (DWR 1981). The continental deposits and older alluvium are the main water-yielding units in the unconsolidated deposits. The lacustrine and marsh deposits and the flood-subbasin deposits yield little water to wells. The younger alluvium, in most places, probably yields only moderate quantities of water. There are three groundwater bodies in the Turlock Subbasin: the unconfined waterbody; the semi-confined and confined waterbody in the consolidated rocks; and the confined waterbody beneath the E-clay in the western Subbasin. The estimated average specific yield of the subbasin is 10.1 percent (based on DWR San Joaquin District internal data and Davis 1959).

Restrictive Structures

Groundwater flow is primarily to the southwest, following the regional dip of basement rock and sedimentary units. Based on recent groundwater measurements (DWR 2000), a paired groundwater mound and depression appear beneath the city of Turlock and to its east, respectively. The lower to middle reaches of the Tuolumne River and the reach of the San Joaquin River in the subbasin appear to be gaining streams during this period also. No faults have been identified that affect the movement of fresh groundwater (Page 1973).

Groundwater Level Trends

Changes in groundwater levels are based on annual water level measurements by DWR and cooperators. Water level changes were evaluated by quarter township and computed through a custom DWR computer program using geostatistics (kriging). On average the subbasin water level has declined nearly 7 feet from 1970 through 2000. The period from 1970 through 1992 showed a generally steep decline totaling about 15 feet. Between 1992 and 1994, water levels stayed near this low level. From 1994 to 2000, the water levels rebounded about 8 feet, bringing them to approximately 7 feet below the 1970 levels. Water level declines have been more severe in the eastern portion of the subbasin after 1982. From 1970 to 1982, water level declines were more severe in the western portion of the subbasin.

Groundwater Storage

Estimations of the total storage capacity of the subbasin and the amount of water in storage as of 1995 were calculated using an estimated specific yield of 10.1 percent and water levels collected by DWR and cooperators. According to these calculations, the total storage capacity of this subbasin is estimated to be 15,800,000 af to a depth of 300 feet and 30,000,000 af to the base of fresh groundwater. These same calculations give an estimate of 12,800,000 af of groundwater to a depth of 300 feet stored in this subbasin as of 1995 (DWR 1995). According to published literature, the amount of stored groundwater in this subbasin as of 1961 is 23,000,000 af to a depth of < 1000 feet (Williamson 1989).

Groundwater Budget (Type B)

Although a detailed budget was not available for this subbasin, an estimate of groundwater demand was calculated based on the 1990 normalized year and data on land and water use. A subsequent analysis was done by a DWR water budget spreadsheet to estimate overall applied water demands, agricultural groundwater pumpage, urban pumping demand and other extraction data. Natural recharge of the subbasin was estimated to be 33,000 af. Artificial recharge and subsurface inflow were not determined. Applied water recharge was calculated to be 313,000 af. Annual urban extraction and annual agricultural extraction were calculated at 65,000 and 387,000 af, respectively. Other extractions and subsurface inflow were not determined.

Groundwater Quality Characterization

The groundwater in this subbasin is predominately of the sodium-calcium bicarbonate type, with sodium bicarbonate and sodium chloride types at the western margin and a small area in the north-central portion. TDS values range from 100 to 8,300 mg/L, with a typical range of 200 to 500 mg/L. The Department of Health Services, which monitors Title 22 water quality standards, reports TDS values in 71 wells ranging from 100 to 930 mg/L, with an average value of 335 mg/L. EC values range from 168 to 1,000 µmhos/cm, with a typical range of 244 to 707 µmhos/cm.

Groundwater Quality Impairments

There are localized areas of hard groundwater, nitrate, chloride, boron, and DBCP. Some sodium chloride type water of high TDS is found along the west side of the subbasin. Two wells in the city of Turlock have been closed, one for nitrate and one for carbon tetrachloride (Dan Wilde 2001).

Land Use/Irrigated Land

Management Practices/Crops in Zone

Table 29 and Table 30 describe land uses within the Turlock GQMP Zone from two different data sets, USDA (2012) and DWR (early 2000s), respectively. Table 29 indicates almonds, double crop oats/corn, alfalfa, oats, other hay/non alfalfa, and grapes as the crops capturing over 85% of the land use in the Modesto GQMP Zone, regardless of irrigated or non-irrigated status. DWR data indicates the top irrigated crop as deciduous fruits and nuts, which also include almonds.

Table 29. Land use acreage within the entire Turlock GQMP Zone1.

Row Labels	Acreage	Percent acreage of Zone
Almonds	78305	40.49%
Double Crop Oats/Corn	24289	12.56%
Alfalfa	21442	11.09%
Oats	15261	7.89%
Other Hay/Non Alfalfa	13949	7.21%
Grapes	8710	4.50%
Walnuts	6245	3.23%
Double Crop Winter Wheat/Corn	5996	3.10%
Corn	5095	2.63%
Winter Wheat	2408	1.24%
Fallow/Idle Cropland	1954	1.01%
Grand Total for Agricultural Crops	183654	95%

[1]Land use information obtained from data provided by USDA, 2012 California Cropland Data Layer: http://www.nass.usda.gov/research/Cropland/SARS1a.htm. Land use in some areas of the ESJWQC may have changed since that time.
*Percent of cropped area includes all agricultural fields, whether fallow or active. Land use categories such as barren, developed, and native or wetland vegetation were not included in acreage totals. Crops contributing 1% or more of the overall land use within the GQMP area were included.

Table 30. Land use acreage associated with irrigation data within the Turlock GQMP Zone by ESJHVA Priority 1-3 areas. Land uses derived from DWR data in order to incorporate irrigation data designated as irrigated/non-irrigated (I/NI); numbers are rounded to nearest whole number.

Land Use	I/NI	Priority 1	Priority 2	Priority 3	Not in ESJHVA
Citrus & Sub-Tropical	I	5	28	61	133
Citrus & Sub-Tropical	NI	0	1	10	0
Deciduous Fruits & Nuts	I	9558	36758	25499	41346
Deciduous Fruits & Nuts	NI	7	0	0	0
Field Crops	I	2105	34386	19235	10694
Field Crops	NI	0	0	0	139
Grain & Hay	I	42	818	1963	327
Grain & Hay	NI	14	97	252	808
Idle	I	80	632	895	138
Idle	NI	0	0	0	4
Native Riparian	NI	2	108	815	250
Native Vegetation	NI	176	1714	14766	52055
Open Water	NI	140	322	1806	3814
Pasture	I	666	9189	23871	5433
Pasture	NI	8	42	368	187
Semiagricultural	NI	732	5535	5515	1796
Truck, Nursery, Berry	I	310	1984	1378	688
Urban	NI	3824	13,553	12,081	79
Vineyard	I	622	2221	3184	5840

* Land use information obtained from data provided by DWR, http://www.water.ca.gov/landwateruse/anaglwu.cfm. Data compiled in 2001, land use in some areas of the ESJWQC may have changed since that time

Constituents of Concern in Zone

Nitrates

Table 31 and Table 32describe nitrogen as nitrate within the Turlock GQMP Zone. Table 31indicates that of those wells sampled in the Turlock GQMP Zone, approximately 51% exceeded the MCL of 10mg/L. Table 32indicates that of those wells with nitrate exceedances from 2005-2013, the majority of wells (428) are located in the Priority 2 area of the ESJHVA.

Table 31. Count of nitrate (NO3) detections from 5-10mg/L and exceedances >10mg/L by well from 2005-2013 for the Turlock GQMP Zone.

Zone	Count of Wells			Percent of Wells		
	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L
Turlock GQMP Zone	475	220	712	34%	16%	51%

Table 32. Number of individual wells with nitrate exceedances (greater than 10 mg/L) for the Turlock GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, nitrate, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Zone	ESJHVA Priority Areas			
	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Turlock GQMP Zone	27	428	257	0

TDS

Table 33 and Table 34 describe TDS levels within the Turlock GQMP Zone. Table 33indicates that of those wells sampled in the Turlock GQMP Zone, approximately 62% exceeded the agricultural MCL of 450 mg/L. Table 34 indicates that of those wells with TDS exceedances from 2005-2013, the majority of wells (107) are located in the Priority 3 area of the ESJHVA.

Table 33. Count of wells with detections of TDS (less than 450 mg/L) and exceedances of TDS (equal to or greater than 450 mg/L) within the Turlock GQMP Zone.

Well and TDS data used here are the same as those data compiled in the GAR.

Zone	Count of Wells			% wells TDS>450
	TDS<450	TDS>=450	Total wells	
Turlock GQMP Zone	158	255	413	62%

Table 34. Number of individual wells with TDS exceedances (greater than 450 mg/L) by well from 2005-2013 for the Turlock GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, TDS, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Zone	ESJHVA Priority Areas			
	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Turlock GQMP Zone	3	88	107	10

Pesticides

As stated in previous sections, of the eight pesticides recorded as having exceeded WQTLs in the GAR, only diazinon and simazine are currently registered for application and use with the DPR. Only diazinon and simazine are to be considered active pesticides for current groundwater quality management purposes. The below data (Table 35 and Table 36) indicate exceedances of diazinon and simazine in one individual well each in the Turlock GQMP Zone.

Table 35. Summary of pesticide detections (below MCL threshold) and exceedances (at or above MCL threshold) for the Turlock GQMP Zone. Active pesticides in this GQMP Zone are bolded.

Well and pesticide data used below are those data compiled in the GAR.

Pesticide	Individual Wells with Detections	Individual Wells with Exceedances	Individual TRS with Detections	Individual TRS with Exceedances	Concentration in Samples with Detections (µg/L)		Exceedance Threshold Used (µg/L)	Basis for Exceedance Threshold
					Minimum	Maximum		
Aldicarb Sulfone	3	9	1	1	1.000	1281.000	3	EPA Primary MCL
DBCP (Dibromochloropropane)	86	79	46	42	0.001	31.900	0.2	CA Primary MCL
Diazinon	**1**	**1**	**1**	**1**	**0.100**	**2.600**	**1.2**	**CA Notification**
Ethylene Dibromide	2	3	2	1	0.020	0.070	0.05	CA Primary MCL
Ethylene Dichloride	0	1	0	1	2.900	2.900	0.5	CA Primary MCL
Naphthalene	1	0	1	0	0.400	0.400	17	CA Notification
Simazine	**26**	**1**	**19**	**1**	**0.004**	**6.600**	**4**	**CA Primary MCL**

Pesticide data are for the period 1979-2011 provided by the California Department of Pesticide Regulation (DPR)

*Exceedance thresholds used are based on values reported in the SWRCB Water Quality Goals Online Database (http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/search.shtml), when available. Selection of the threshold value for use to indicate an exceedance is based on a hierarchy consisting of the following order of preference: CA Primary MCL = California Primary MCL; EPA Primary MCL = EPA's Federal Primary MCL; CA Notification = California Notification Level. No value in database = Chemical is in the database but not possible threshold value reported, Chemical not in database = Chemical was not located in the SWRCB database

Table 36. Number of individual wells and TRS sections with pesticide exceedances for the Turlock GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3. Well, TRS, pesticide, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Pesticide	ESJHVA Priority Areas							
	Priority 1		Priority 2		Priority 3		Not in ESJHVA	
	Individual	TRS	Individual	TRS	Individual	TRS	Individual	TRS
Aldicarb Sulfone	0	0	0	0	9	1	0	0
DBCP	10	7	51	27	18	8	0	0
Diazinon	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
Ethylene Dibromide	0	0	1	1	0	0	0	0
Ethylene Dichloride	0	0	1	1	0	0	0	0
Simazine	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**

MERCED GROUNDWATER MANAGEMENT ZONE

Introduction and Background

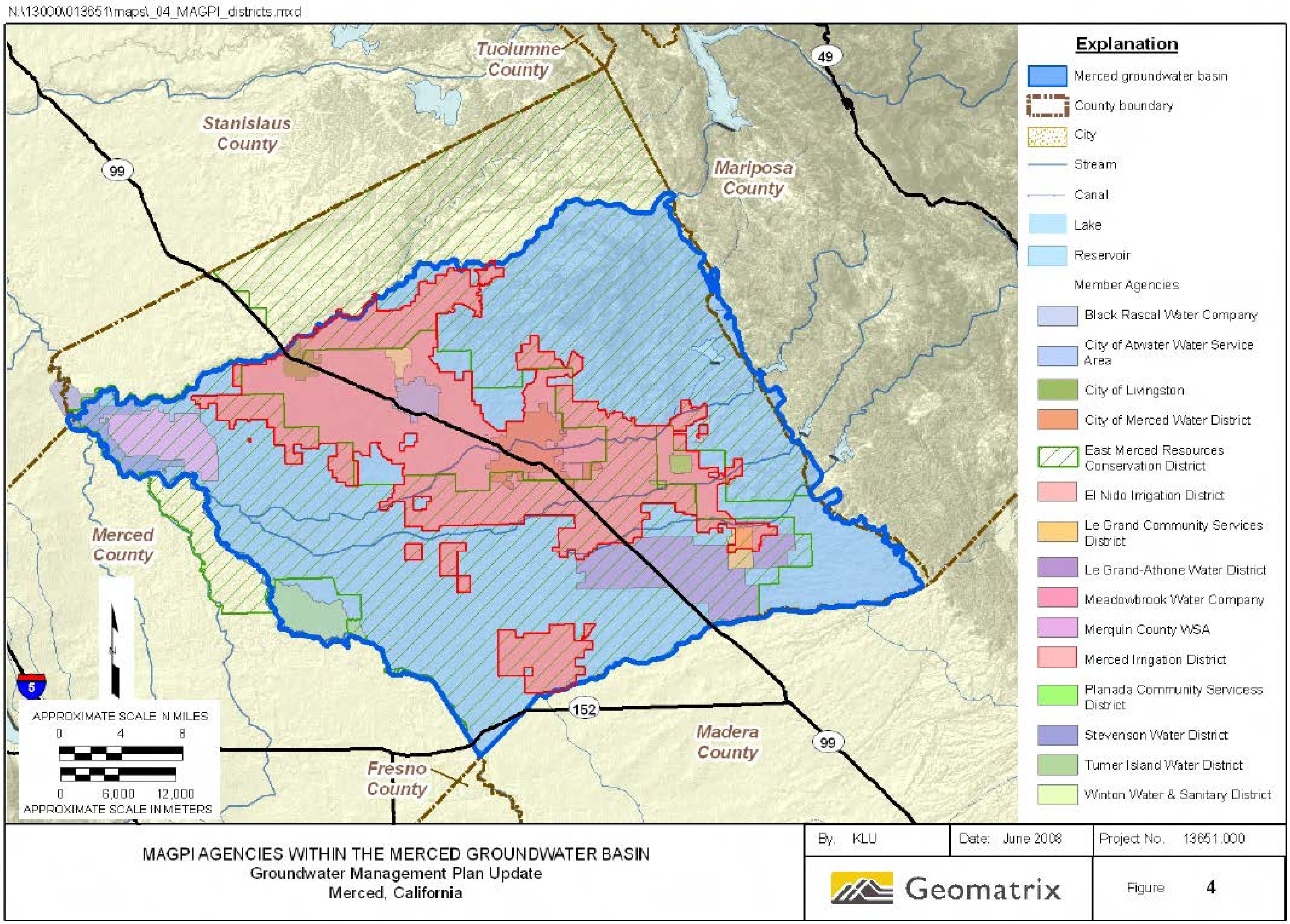
The Merced GQMP Zone is south of the Turlock GQMP Zone and north of the Chowchilla GQMP Zone within the Coalition. The Merced GQMP Zone includes the entire Merced Groundwater subbasin. The Merced subbasin is entirely within the Merced County.

Existing Groundwater Management Plans/Entities

Figure 62depicts the various water agencies within the footprint of the Merced groundwater subbasin. Agencies eligible to participate in the Merced Groundwater Basin Groundwater Management Plan include: the City of Atwater, Black Rascal Water District, East Side Water District, Le Grand Community Service District, Le Grand-Athlone Water District, City of Livingston, Lone Tree Mutual Water Company, Meadowbrook Water Company, City of Merced, Merced County Environmental Health Department, Merced Irrigation District, Merquin County Water District, Planada Community Service District, Stevinson Water District, Turner Island Water District, Winton Water and Sanitary District (Merced County, 2008).

The 2008 Merced Groundwater Basin Groundwater Management Plan Update, Merced County, CA (Merced County, 2008) mentions other entities that monitor in the basin and the plan includes a figure (Figure 63) with a "Proposed Groundwater Monitoring Well Network, Merced Groundwater Basin"; there are 27 wells shown on the map with state well numbers (ESJWQC[1], 2014).

Figure 63. Locations of Merced Area Groundwater Pool Interests (MAGPI) agencies and their respective political boundaries for the Merced Subbasin (Geomatrix, Merced Groundwater Basin Groundwater Management Plan Update Merced County, CA, Figure 4, 2008).



Basin Boundaries and Surface Water Hydrology

The Merced subbasin includes lands south of the Merced River between the San Joaquin River on the west and the crystalline basement rock of the Sierra Nevada foothills on the east. The subbasin boundary on the south stretches westerly along the Madera-Merced County line (Chowchilla River) and then between the boundary of the Le Grand-Athlone Water District and the Chowchilla Water District. The boundary continues west along the northern boundaries of Chowchilla Water District and El Nido Irrigation District. The southern boundary then follows the western boundary of El Nido I.D. south to the northern boundary of the Sierra Water District, which is followed westerly to the San Joaquin River. Average annual precipitation is 11 to 13 inches, increasing eastward (Bulletin 118).

Geology, Hydrogeology, and Groundwater Hydrology

As mentioned above, the characteristics of the Merced groundwater subbasin is described as one of the study areas within the Central Eastside Study Unit in the USGS' Status and Understanding Groundwater Quality in the Central-Eastside San Joaquin Basin Study Unit, 2006: California GAMA Priority Basin Project (Figure 61). The main water-bearing units of the Modesto, Turlock, and Merced study areas include the unconsolidated alluvial-fan deposits of the Pleistocene-age Riverbank Formation, the deeper unconsolidated Pleistocene-age Turlock Lake and Pliocene-age Laguna Formations, and the semi-consolidated Miocene-Pliocene-age Mehrten Formation.

Groundwater conditions are unconfined, semi-confined, and confined in different zones of the groundwater system in the Central Eastside study unit. The base of freshwater, where estimated, generally is more than 700 ft below land surface, but may be as shallow as 300 ft in parts of the study unit. Unconfined conditions are present in unconsolidated deposits above and east of the Corcoran Clay Member of the Turlock Lake Formation, which underlies the southwestern half of the study unit at depths ranging from 50 to 250 ft. Confined conditions are present below the Corcoran Clay. Semi-confined conditions are present at depth east of the Corcoran Clay, because of many discontinuous clay lenses (Landon, et al., 2010).

The geology, hydrogeology, and groundwater hydrology description for the Modesto subbasin is taken almost exclusively from Bulletin 118 (DWR 2003).

Water Bearing Formations

Geologic units in the Merced Subbasin consist of consolidated rocks and unconsolidated deposits. The consolidated rocks include the Ione Formation, the Valley Springs Formation, and the Mehrten Formation. In the eastern part of the area, the consolidated rocks generally yield small quantities of water to wells except for the Mehrten Formation, which is an important aquifer.

The unconsolidated deposits were laid down during the Pliocene to present. From oldest to youngest, these deposits include continental deposits, lacustrine and marsh deposits, older alluvium, younger alluvium, and flood basin deposits. The continental deposits and older alluvium are the main water-yielding units in the unconsolidated deposits. The lacustrine and marsh deposits (which include the Corcoran, or "E-" Clay), and the flood basin deposits yield little water to wells, and the younger alluvium in most places probably yields only moderate quantities of water to wells (page 1973.)

There are three groundwater bodies in the area: an unconfined waterbody, a confined waterbody, and the waterbody in consolidated rocks. The unconfined waterbody occurs in the unconsolidated deposits above and east of the Corcoran Clay, which underlies the western half of the subbasin at depths ranging between about 50 and 200 feet (DWR 1981), except in the western and southern parts of the area where clay lenses occur and semi-confined conditions exist. The confined waterbody occurs in the unconsolidated deposits below the Corcoran Clay and extends downward to the base of fresh water. The waterbody in consolidated rocks occurs under both unconfined and confined conditions. The estimated average specific yield of this subbasin is 9.0 percent (based on DWR, San Joaquin District internal data and that of Davis 1959).

Restrictive Structures
Groundwater flow is primarily to the southwest, following the regional dip of basement rock and sedimentary units. DWR (2000) data show two groundwater depressions south and southeast of the city of Merced during 1999.

Groundwater Level Trends
Changes in groundwater levels are based on annual water level measurements by DWR and cooperators. Water level changes were evaluated by quarter township and computed through a custom DWR computer program using geostatistics (kriging). On average, the subbasin water level has declined nearly 30 feet from 1970 through 2000. The period from 1970 through 1978 showed steep declines totaling about 15 feet. The ten-year period from 1978 to 1988 saw stabilization and a rebound of about 10 feet. 1988 through 1995 again showed steep declines, bottoming out in 1996 with water levels rising from 1996 to 2000. Water level declines have been more severe in the eastern portion of the subbasin.

Groundwater Storage
Estimations of the total storage capacity of the subbasin and the amount of water in storage as of 1995 were calculated using an estimated specific yield of 9.0 percent and water levels collected by DWR and cooperators. According to these calculations, the total storage capacity of this subbasin is estimated to be 21,100,000 af to a depth of 300 feet and 47,600,000 af to the base of fresh groundwater. These same calculations give an estimate of 15,700,000 af of groundwater to a depth of 300 feet stored in this subbasin as of 1995 (DWR 1995). According to published literature, the amount of stored groundwater in this subbasin as of 1961 is 37,000,000 af to a depth of < 1000 feet (Williamson 1989).

Groundwater Budget (Type B)
Although a detailed budget was not available for this subbasin, an estimate of groundwater demand was calculated based on the 1990 normalized year and data on land and water use. A subsequent analysis was done by a DWR water budget spreadsheet to estimate overall applied water demands, agricultural groundwater pumpage, urban pumping demand and other extraction data. Natural recharge into the subbasin is estimated to be 47,000 af. Values for artificial recharge and subsurface inflow are not determined. There is approximately 243,000 af of applied water recharge into the subbasin. Annual urban and agricultural extractions are 54,000 af and 492,000 af, respectively. Other extractions equal approximately 9,000 af. Subsurface inflow values are not determined.

Groundwater Quality Characterization
The groundwater in this subbasin is characterized by calcium-magnesium bicarbonate at the basin interior, sodium bicarbonate to the west, and calcium-sodium bicarbonate to the south. Small areas of sodium chloride and calcium-sodium chloride waters exist at the southwest corner of the basin (Page 1973). TDS values range from

100 to 3,600 mg/L, with a typical range of 200 to 400 mg/L. The Department of Health Services, which monitors Title 22 water quality standards, reports TDS values in 46 wells ranging from 150 to 424 mg/L, with an average value of 231 mg/L. For 10 wells, EC values range from 260 to 410 µmhos/cm, with an average value of 291 µmhos/cm.

Groundwater Quality Impairments

There are localized areas of high hardness, iron, nitrate, and chloride in this subbasin.

Land Use/Irrigated Land

Management Practices/Crops in Zone

Table 37 and Table 38 describe land uses within the Merced GQMP Zone from two different data sets, USDA (2012) and DWR (early 2000s), respectively. USDA data in Table 37indicate almonds, alfalfa, winter wheat, grapes, corn, cotton, double crop oats/corn, oats, sweet potatoes, and double crop winter wheat/corn as the crops capturing over 85% of the land use in the Merced GQMP Zone, regardless of irrigated or non-irrigated status. DWR data in Table 38indicate the top irrigated crop as deciduous fruits and nuts, followed by field crops .

Table 37. Land use acreage within the entire Merced GQMP Zone[1].

Row Labels	Acreage	Percent acreage[2] of Zone
Almonds	66544	26.96%
Alfalfa	45711	18.52%
Winter Wheat	18341	7.43%
Grapes	14051	5.69%
Corn	12843	5.20%
Cotton	12702	5.15%
Double Crop Oats/Corn	12023	4.87%
Oats	11612	4.70%
Sweet Potatoes	9748	3.95%
Double Crop Winter Wheat/Corn	8649	3.50%
Fallow/Idle Cropland	8341	3.38%
Tomatoes	6873	2.78%
Pistachios	5777	2.34%
Other Hay/Non Alfalfa	4978	2.02%
Barley	2470	1.00%
Grand Total for Agricultural Crops	240663	97.5%

[1]Land use information obtained from data provided by USDA, 2012 California Cropland Data Layer: http://www.nass.usda.gov/research/Cropland/SARS1a.htm. Land use in some areas of the ESJWQC may have changed since that time.
[2]Percent of cropped area includes all agricultural fields, whether fallow or active. Land use categories such as barren, developed, and native or wetland vegetation were not included in acreage totals. Crops contributing 1% or more of the overall land use within the GQMP area were included.

Table 38. Land use acreage within the Merced GQMP Zone by ESJHVA Priority 1-3 areas.

Land uses derived from DWR data in order to incorporate irrigation data designated as irrigated/non-irrigated (I/NI); numbers are rounded to nearest whole number.

Land Use	I/NI	Priority 1	Priority 2	Priority 3	Not in ESJHVA	Total
Citrus & Sub-Tropical	I	6	29	19	79	133
Citrus & Sub-Tropical	NI	3	1	0	0	4
Deciduous Fruits & Nuts	I	3457	19538	20533	23934	67462
Field Crops	I	1994	14465	19917	29628	66004
Grain & Hay	I	641	3084	3102	6594	13421
Grain & Hay	NI	73	404	898	2000	3375
Idle	I	154	573	1866	1719	4312
Idle	NI	0	0	152	490	642
Native Riparian	NI	5	32	43	363	443
Native Vegetation	NI	438	4391	30271	168241	203341
Open Water	NI	17	290	627	962	1896
Pasture	I	440	5137	23725	31987	61289
Pasture	NI	21	130	1429	680	2260
Rice	I	209	2051	629	750	3639
Semi-agricultural	NI	115	1545	3658	2333	7651
Truck, Nursery, Berry	I	1231	6189	5753	14806	27979
Urban	NI	993	14728	4178	8181	28080
Vineyard	I	30	881	4203	2522	7636
Totals		**9827**	**73468**	**121003**	**295269**	**499567**

* Land use information obtained from data provided by DWR, http://www.water.ca.gov/landwateruse/anaglwu.cfm. Data compiled in 2001, land use in some areas of the ESJWQC may have changed since that time.

Constituents of Concern in Zone

Nitrates

Table 39 and Table 40 describe nitrogen as nitrate within the Merced GQMP Zone. Table 39indicates that of those wells sampled in the Merced GQMP Zone, approximately 26% exceeded the MCL of 10mg/L. Table 40indicates that of those wells with nitrate exceedances from 2005-2013, the highest number of wells with nitrate exceedances greater than 10 mg/L are located in the Priority 2 and 3 areas (both with 68 wells) of the ESJHVA.

Table 39. Count of nitrate (NO_3) detections from 5-10mg/L and exceedances >10mg/L by well from 2005-2013 for the Merced GQMP Zone.

	COUNT OF WELLS			PERCENT OF WELLS		
	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L
Merced GQMP Zone	366	137	178	54%	20%	26%

Table 40. Number of individual wells with nitrate exceedances (greater than 10 mg/L) for the Merced GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, nitrate, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

ZONE	ESJHVA PRIORITY AREAS			
	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Merced GQMP Zone	27	68	68	15

TDS

Table 41 and Table 42 describe TDS levels within the Merced GQMP Zone. Table 41 indicates that of those wells sampled in the Merced GQMP Zone, approximately 31% exceeded the agricultural MCL of 450 mg/L. Table 42 indicates that of those wells with TDS exceedances from 2005-2013, the majority of wells (13) are located in the Priority 3 area of the ESJHVA.

Table 41. Count of wells with detections of TDS (less than 450 mg/L) and exceedances of TDS (equal to or greater than 450 mg/L) within the Merced GQMP Zone.

Well and TDS data used here are the same as those data compiled in the GAR.

ZONE	COUNT OF WELLS			% WELLS TDS>450
	TDS<450	TDS>=450	Total wells	
Merced GQMP Zone	153	68	221	31%

Table 42. Number of individual wells with TDS exceedances (greater than 450 mg/L) by well from 2005-2013 for the Merced GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, TDS, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

ZONE	ESJHVA PRIORITY AREAS			
	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Merced GQMP Zone	0	10	13	9

Pesticides

As stated in previous sections, of the eight pesticides recorded as having exceeded WQTLs in the GAR, only diazinon and simazine are currently registered for application and use with the DPR. Only diazinon and simazine are to be considered active pesticides for current groundwater quality management purposes. No exceedances of active pesticides occurred in the Merced GQMP Zone; Table 43 and Table 44indicate detections only.

Table 43. Summary of pesticide detections (below MCL threshold) and exceedances (at or above MCL threshold) for the Merced GQMP Zone. Active pesticides in this GQMP Zone are bolded.

Well and pesticide data used below are those data compiled in the GAR.

Pesticide	Individual Wells with Detections	Individual Wells with Exceedances	TRS Sections with Detections	TRS Sections with Exceedances	Concentration in Samples with Detections (µg/L)		Exceedance Threshold Used (µg/L)	Basis for Exceedance Threshold
					Minimum	Maximum		
Aldicarb Sulfone	7	12	1	1	1.000	78.000	3	EPA Primary MCL
DBCP	136	143	53	51	0.001	32.000	0.2	CA Primary MCL
Ethylene Dibromide	4	7	3	6	0.020	0.320	0.05	CA Primary MCL
Naphthalene	3	1	3	1	2.000	29.000	17	CA Notification
Simazine	**22**	**0**	**19**	**0**	**0.003**	**1.140**	**4**	**CA Primary MCL**

Pesticide data are for the period 1979-2011 provided by the California Department of Pesticide Regulation (DPR)

*Exceedance thresholds used are based on values reported in the SWRCB Water Quality Goals Online Database (http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/search.shtml), when available. Selection of the threshold value for use to indicate an exceedance is based on a hierarchy consisting of the following order of preference: CA Primary MCL = California Primary MCL; EPA Primary MCL = EPA's Federal Primary MCL; CA Notification = California Notification Level. No value in database = Chemical is in the database but not possible threshold value reported, Chemical not in database = Chemical was not located in the SWRCB database

Table 44. Number of individual wells and TRS sections with pesticide exceedances for the Merced GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, TRS, pesticide, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Pesticide	ESJHVA Priority Areas							
	Priority 1		Priority 2		Priority 3		Not in ESJHVA	
	Individual Well	TRS Section	Individual Well	TRS Section	Individual Well	TRS Section	Individual Well	TRS Section
Aldicarb Sulfone	0	0	12	1	0	0	0	0
DBCP	21	5	110	37	12	0	0	0
Ethylene Dibromide	1	1	5	4	1	1	0	0
Naphthalene	0	0	1	1	0	0	0	0

CHOWCHILLA GROUNDWATER MANAGEMENT ZONE

Introduction and Background

The Chowchilla GQMP Zone is the south of the Merced GQMP Zone and northwest of the Madera GQMP Zone within the Coalition. The entire Chowchilla Groundwater subbasin is included within the Chowchilla GQMP Zone. The Chowchilla subbasin is underlays portions of both the Madera and Merced Counties.

Existing Groundwater Management Plans/Entities

The Chowchilla groundwater subbasin is largely, although not entirely, located within Madera County (Figure 64). Those agencies located within Madera County are eligible to participate in the Madera Regional Groundwater Management Plan. The Madera Regional Groundwater Management Plan (Madera County, 2014) lists several entities within the plan's boundaries which perform mostly groundwater level monitoring (Figure 65). These groundwater entities include the City of Chowchilla, City of Madera, Chowchilla Water District, Gravelly Ford Water District (not as a participant of the Madera Regional Groundwater Management Plan but as a member of the California State Groundwater Elevation Monitoring Program), Madera Irrigation District, and Madera County. The total number of wells monitored for groundwater elevation listed within the Madera Regional Groundwater Management Plan approximately 415. The Madera Regional Groundwater Management Plan mentions the water quality data collected by DWR and the CDPH, and local city and county water agencies were used to analyze water quality trends for the Madera 2008 Integrated Regional Water Management Plan but the Madera Regional Groundwater Management Plan does not list other local monitoring agencies or any monitoring schedule.

In 2010, DWR approved the Madera-Chowchilla Basin Groundwater Monitoring Group as the local monitoring entity including: Madera Irrigation District, Chowchilla Water District, Gravelly Ford Water District, and Madera County, Madera Water District, and Root Creek Water District. 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 describes a variety of groundwater monitoring programs that exist throughout the county and suggests a meeting of all parties currently collecting groundwater data (Madera County, 2014).

Figure 64. Water agencies and groundwater subbasins (partial and entire) located within the Draft Madera Regional Groundwater Management Plan area.

Madera County, Draft Madera Regional Groundwater Management Plan, Figure 2.1, 2014.

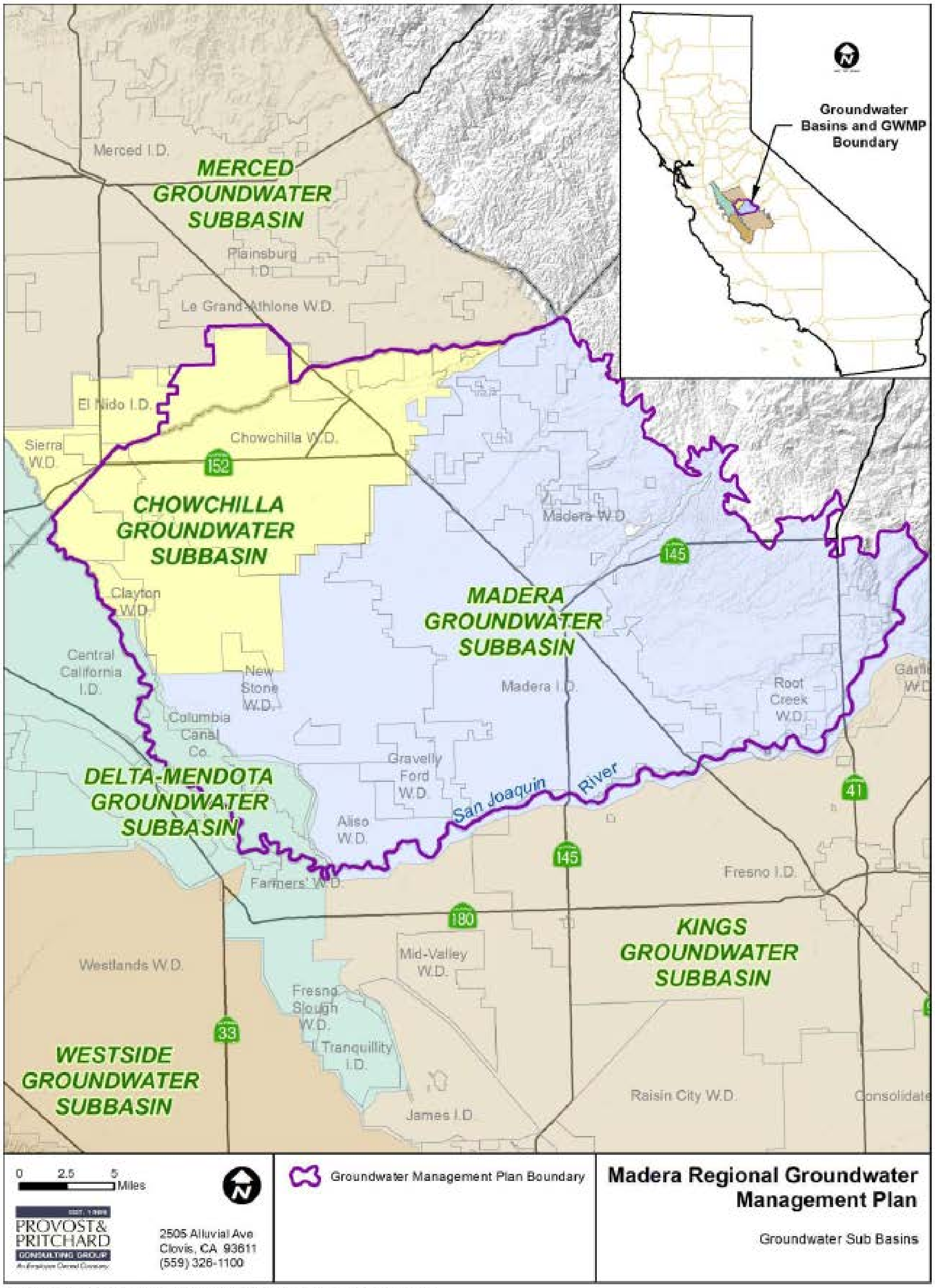


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Figure 2.1 – Groundwater Sub-basins

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Figure 65. Section of Madera County (that area within the Central Valley) covered in the Draft Madera Regional Groundwater Management Plan, the locations of participating agencies, and their respective political boundaries for the Chowchilla/Madera Subbasins.

The Draft Madera Regional Groundwater Management Plan area excludes those cities and irrigation/water districts with previously adopted groundwater management plans (Madera County, Draft Madera Regional Groundwater Management Plan, Figure 1.1, 2014).

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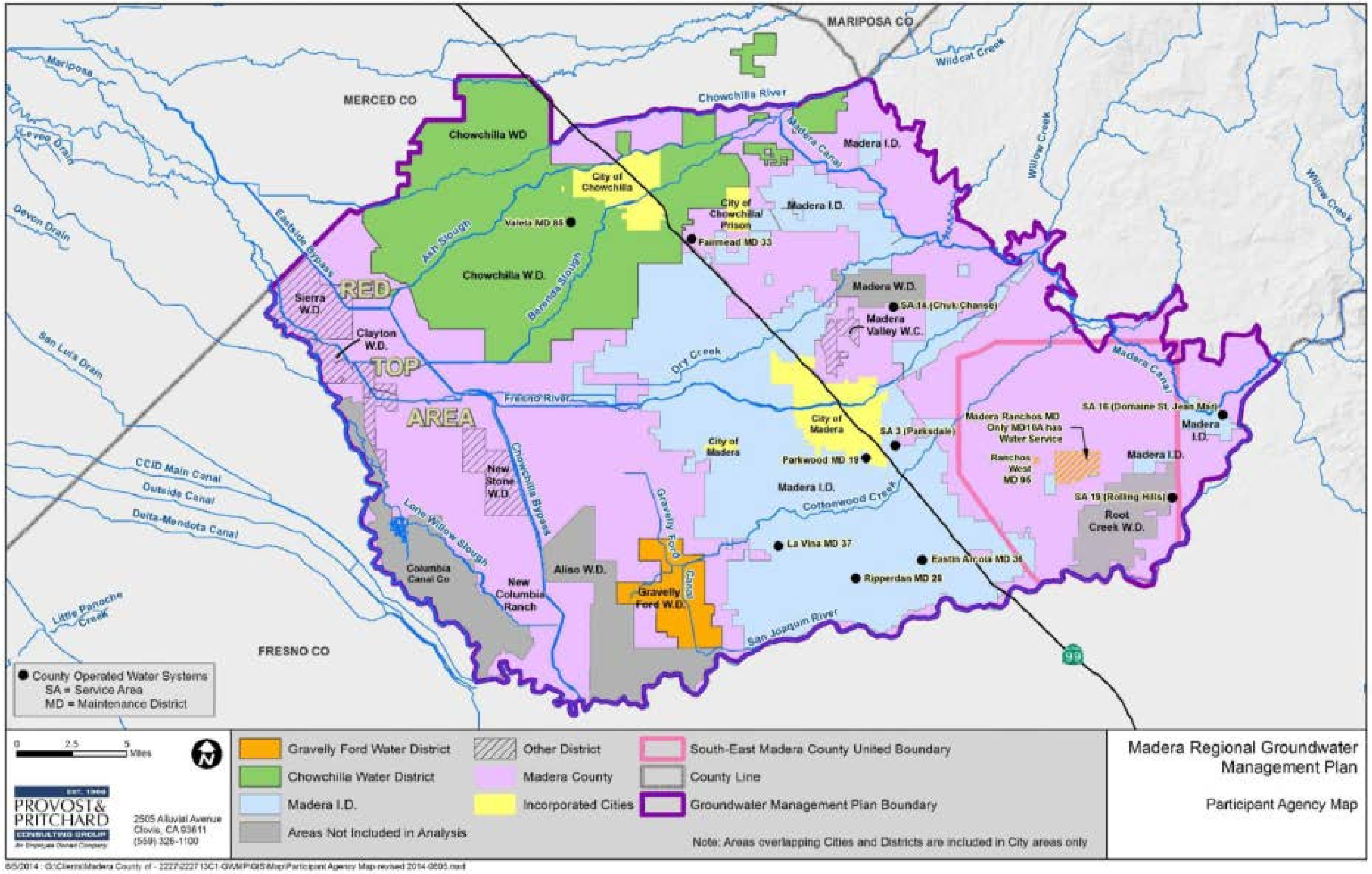

Figure 1.1 – Participating Agency Map

Basin Boundaries and Surface Hydrology

The basin boundaries, surface hydrology, geology, hydrogeology, and groundwater hydrology description for the Chowchilla subbasin is taken almost exclusively from Bulletin 118 (DWR 2003).

The Chowchilla subbasin includes lands in Madera and Merced Counties. The subbasin is bounded on the west by the San Joaquin River and the eastern boundary of the Columbia Canal Company Service Area and on the north by the southern boundary of the Merced Subbasin. The southern boundary from the west to its connection with the northern boundary runs along the southern boundary of Township 11 South, Ranges 14 East and 15 East, northerly along the eastern boundaries of sections 9, 20, 27, and 33 of Township 11S, Range 15 East, and northeasterly along the southern and eastern boundaries of Chowchilla Water District, then northeasterly following Berenda Slough and Ash Slough to the Chowchilla River. Major rivers in the subbasin are the Fresno and Chowchilla Rivers. Average annual precipitation is estimated to be 11 inches.

Geology, Hydrogeology, and Groundwater Hydrology

The characteristics of the Chowchilla and Madera groundwater subbasins which underlay the Chowchilla and Madera GQMP Zones are described as study areas within the Madera- Chowchilla Study Unit in the USGS' Status and Understanding of Groundwater Quality in the Madera- Chowchilla Study Unit, 2008: California GAMA Priority Basin Project. The study unit is bounded partially on the north by the Chowchilla River, approximately on the west and south by the San Joaquin River, and on the east by foothills of the Sierra Nevada (Figure 66; Shelton, et. al., 2008). In general, the Late Tertiary and Quaternary continental deposits increase in thickness from north to south and are up to 3,000 ft thick in the Madera-Chowchilla study unit. The Madera-Chowchilla study unit includes eastern alluvial fan, with derivatives from the Sierra Nevada, and basin areas. The Corcoran Clay Member of the Tulare Formation, underlies large parts of the basin and the distal end of parts of the eastern alluvial fans at depths dipping from 50 ft on the eastern edge of the Clay to 300 ft along the margin of the Coast Ranges and divides the San Joaquin Valley freshwater aquifer systems into an unconfined to semi-confined upper system and a largely confined lower system.

Figure 66. Geologic setting of the Madera-Chowchilla study unit (DOI and USGS, Status and Understanding Groundwater Quality in the Madera-Chowchilla Study Unit, 2008: California GAMA Priority Basin Project, Fig. 3, pg. 7, 2008).

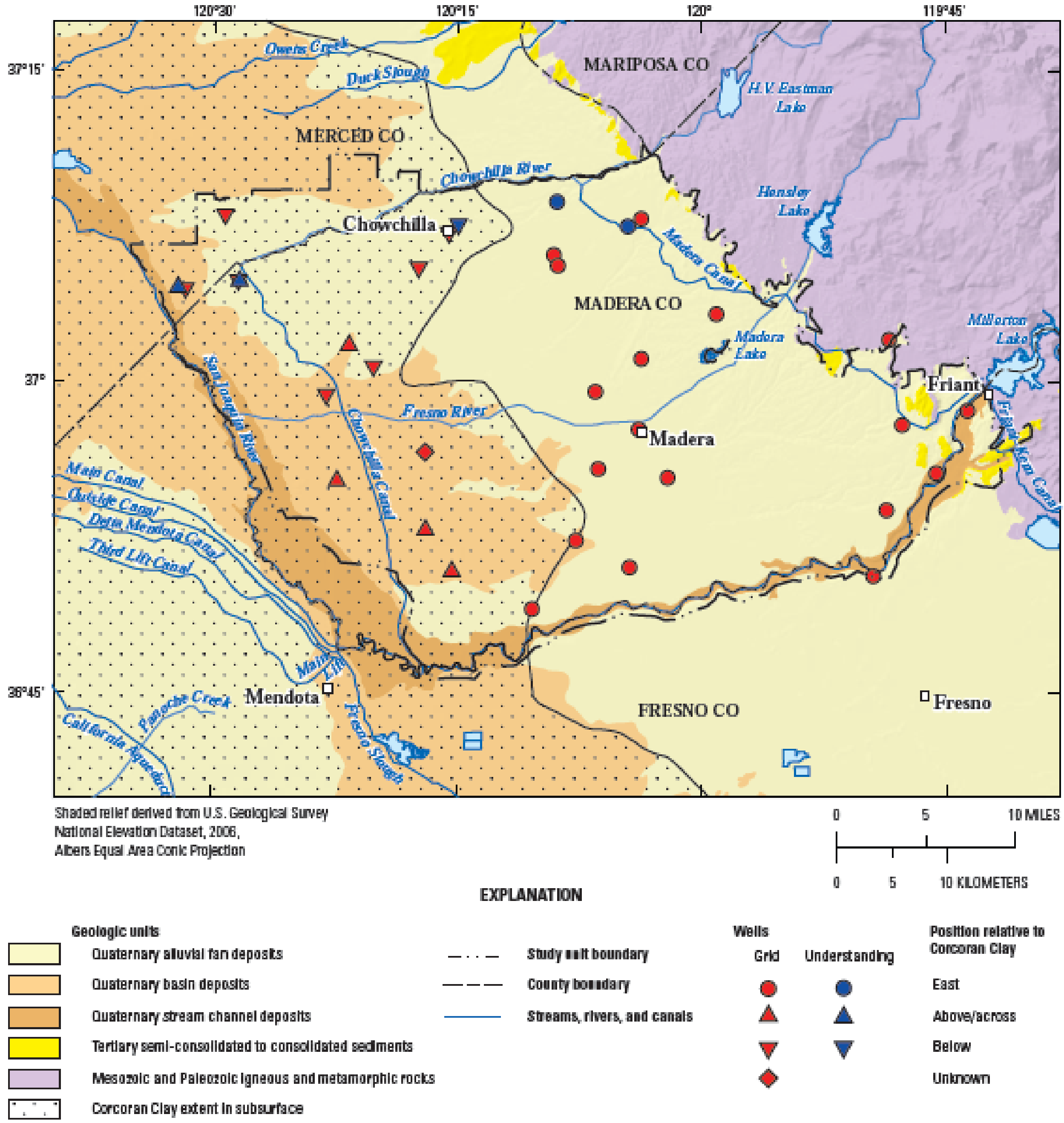

Figure 3. Madera-Chowchilla study unit, California GAMA Priority Basin Project.

Water Bearing Formations

Hydrogeologic units in the Chowchilla Subbasin consist of unconsolidated deposits of Pleistocene and Holocene age. These deposits are divided into continental deposit of Tertiary and Quaternary age, and continental deposits of Quaternary age. Continental deposits of Quaternary age include older alluvium, lacustrine and marsh deposits and younger alluvium. The continental deposits of Quaternary age crop out over most of the area and yield probably more than 95 percent of the water pumped from wells. Although younger alluvium and flood-basin deposits yield small quantities of water to wells, the most important aquifer in the area is the older alluvium. It consists mostly of intercalated lenses of clay, silt, sand, and some gravel. The Corcoran Clay or E-Clay (a lacustrine and marsh deposit), which underlies most of the subbasin at depths ranging between 50 and 250 feet (DWR 1981), restricts the vertical movement of groundwater and divides the water bearing deposits into confined and unconfined aquifers. The estimated average specific yield of this subbasin is 8.6 percent (based on DWR San Joaquin District internal data and that of Davis 1959).

Restrictive Structures

Groundwater flow is generally southwestward but with groundwater mounds occurring at the subbasin center and pumping depressions in the western portion during 1999 (DWR 2000). Based on current and historical groundwater elevation maps, groundwater barriers do not appear to exist in the subbasin.

Recharge Areas

Groundwater recharge is primarily from deep percolation of applied irrigation water (DWR 1995).

Groundwater Level Trends

Changes in groundwater levels are based on annual water level measurements by DWR and cooperators. Water level changes were evaluated by quarter township and computed through a custom DWR computer program using geostatistics (kriging). On average, the subbasin water level has declined nearly 40 feet from 1970 through 2000. The period from 1970 through 1978 showed steep declines totaling about 30 feet. The nine-year period from 1978 to 1987 saw stabilization and rebound of about 25 feet, taking the water levels close to where they were in 1970. 1987 through 1996 again showed steep declines, bottoming out in 1996 at about 45 feet below 1970 levels. Water levels rose about 8 feet from 1996 to 2000. Water level declines have been more severe in the eastern portion of the subbasin from 1980 to the present, but the western basin showed the strongest declines before this time period.

Groundwater Storage

Estimations of the total storage capacity of the subbasin and the amount of water in storage as of 1995 were calculated using an estimated specific yield of 8.6 percent and water levels collected by DWR and cooperators. According to these calculations, the total storage capacity of this subbasin is estimated to be 8,000,000 af to a depth of 300 feet and 13,900,000 af to the base of fresh groundwater. These same calculations give an estimate of 5,500,000 af of groundwater to a depth of 300 feet stored in this subbasin as of 1995 (DWR 1995). According to published literature, the amount of stored groundwater in this subbasin as of 1961 is 15,000,000 af to a depth of < 1000 feet (Williamson 1989).

Groundwater Budget (Type B)

Although a detailed budget was not available for this subbasin, an estimate of groundwater demand was calculated based on the 1990 normalized year and data on land and water use. A subsequent analysis was done by a DWR water budget spreadsheet to estimate overall applied water demands, agricultural groundwater pumpage, urban pumping demand and other extraction data. Natural recharge of the subbasin is estimated to be 87,000 af. Artificial recharge and subsurface inflow are not determined. There is approximately 179,000 af of applied water recharge. Annual urban and agricultural extractions are 6,000 af and 249,000 af, respectively. There are no other extractions, and subsurface outflow has not been determined.

Groundwater Quality Characterization

The water in this subbasin is of a calcium-sodium bicarbonate type in the eastern part of the subbasin. This turns into calcium bicarbonate, sodium-calcium bicarbonate, and sodium chloride water types towards the western part of the subbasin (Mitten 1970). TDS values range from 120 to 6,400 mg/L, with a typical range of 200 to 500 mg/L. The Department of Health Services, which monitors Title 22 water quality standards, reports TDS values in eight wells ranging from 120 to 390 mg/L, with an average value of 228 mg/L. EC values range from 150 to 3,380 µmhos/cm, with an average value of 508 µmhos/cm.

Groundwater Quality Impairments

There are local areas of high nitrate, hardness, iron, and chloride in the subbasin.

Land Use/Irrigated Land

Management Practices/Crops in Zone

Table 45 and Table 46 describe land uses within the Chowchilla GQMP Zone from two different data sets, USDA (2012) and DWR (early 2000s), respectively. USDA data in Table 45indicate almonds, alfalfa, winter wheat, grapes, double crop winter wheat/corn, fallow/Idle cropland, and pistachios as the crops capturing over 85% of the land use in the Chowchilla GQMP Zone, regardless of irrigated or non-irrigated status. DWR data (Table 46) indicate the top irrigated crop as field crops followed by deciduous fruits and nuts.

Table 45. Land use acreage within the entire Chowchilla GQMP Zone1.

Row Labels	Acreages	Percent of acreage in Zone
Almonds	46814	34.10%
Alfalfa	30472	22.19%
Winter Wheat	15032	10.95%
Grapes	10015	7.29%
Double Crop Winter Wheat/Corn	8173	5.95%
Fallow/Idle Cropland	6143	4.47%
Pistachios	4824	3.51%
Other Hay/Non Alfalfa	3705	2.70%
Cotton	2671	1.95%
Double Crop Oats/Corn	2152	1.57%
Oats	1760	1.28%
Tomatoes	1695	1.23%
Corn	1654	1.20%
Barley	1382	1.01%
Grand Total for Agricultural Crops	136493	99.4%

[1]Land use information obtained from data provided by USDA, 2012 California Cropland Data Layer: http://www.nass.usda.gov/research/Cropland/SARS1a.htm. Land use in some areas of the ESJWQC may have changed since that time.
*Percent of cropped area includes all agricultural fields, whether fallow or active. Land use categories such as barren, developed, and native or wetland vegetation were not included in acreage totals. Crops contributing 1% or more of the overall land use within the GQMP area were included.

Table 46. Land use acreage within the Chowchilla GQMP Zone by ESJHVA Priority 1-3 areas.
Land uses derived from DWR data in order to incorporate irrigation data designated as irrigated/non-irrigated (I/NI); numbers are rounded to nearest whole number.

Land Use	I/NI	Priority 1	Priority 2	Priority 3	Not in ESJHVA
Citrus & Sub-Tropical	I	0	4	3	12
Deciduous Fruits & Nuts	I	31	600	18230	9825
Field Crops	I	698	2608	26492	11187
Grain & Hay	I	215	271	2992	2618
Grain & Hay	NI	11	109	424	1110
Idle	I	1	64	319	522
Native Riparian	NI	0	0	255	176
Native Vegetation	NI	7	293	7271	12691
Open Water	NI	4	2	403	279

Land Use	I/NI	Priority 1	Priority 2	Priority 3	Not in ESJHVA
Pasture	I	70	1067	20754	17344
Pasture	NI	0	4	1	0
Semi-agricultural	NI	40	326	2514	989
Truck, Nursery, Berry	I	0	44	900	105
Urban	NI	39	801	1274	1949
Vineyard	I	0	85	5213	6827

* Land use information obtained from data provided by DWR, http://www.water.ca.gov/landwateruse/anaglwu.cfm. Data compiled in 2001, land use in some areas of the ESJWQC may have changed since that time.

Constituents of Concern in Zone

Nitrates

Table 47 and Table 48 describe nitrogen as nitrate within the Chowchilla GQMP Zone. Table 47 indicates that of those wells sampled in the Chowchilla GQMP Zone, approximately 36% exceeded the MCL of 10mg/L. Table 48 indicates that of those wells with nitrate exceedances from 2005-2013, the highest number of wells with nitrate exceedances greater than 10 mg/L are located in the Priority 3 area (69 wells) of the ESJHVA.

Table 47. Count of nitrate (NO3) detections from 5-10mg/L and exceedances >10mg/L by well from 2005-2013 for the Chowchilla GQMP Zone.

	Count of Wells			Percent of Wells		
	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L
Chowchilla GQMP Zone	108	55	92	42%	22%	36%

Table 48. Number of individual wells with nitrate exceedances (greater than 10 mg/L) for the Chowchilla GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, nitrate, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Zone	ESJHVA Priority Areas			
	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Chowchilla GQMP Zone	0	19	69	4

TDS

Table 49 and Table 50 describe TDS levels within the Chowchilla GQMP Zone. Table 49 indicates that of those wells sampled in the Chowchilla GQMP Zone, approximately 34% exceeded the agricultural MCL of 450 mg/L. Table 50indicates that of those wells with TDS exceedances from 2005-2013, the majority of wells (17) are located in the Priority 3 area of the ESJHVA.

Table 49. Count of wells with detections of TDS (less than 450 mg/L) and exceedances of TDS (equal to or greater than 450 mg/L) within the Chowchilla GQMP Zone.

Well and TDS data used here are the same as those data compiled in the GAR.

Zone	Count of Wells			% wells TDS>450
	TDS<450	TDS>=450	Total wells	
Chowchilla GQMP Zone	35	18	53	34%

Table 50. Number of individual wells with TDS exceedances (greater than 450 mg/L) by well from 2005-2013 for the Chowchilla GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3. Well, TDS, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Zone	ESJHVA Priority Areas			
	Priority 1	Priority 2	Priority 3	Outside ESJHVA
Chowchilla GQMP Zone	0	1	17	0

Pesticides

As stated in previous sections, of the eight pesticides recorded as having exceeded WQTLs in the GAR, only diazinon and simazine are currently registered for application and use with the DPR. Only diazinon and simazine are to be considered active pesticides for current groundwater quality management purposes. No exceedances of active pesticides occurred in the Chowchilla GQMP Zone. The below data (Table 51 and Table 52) indicate detections only.

Table 51. Summary of pesticide detections (below MCL threshold) and exceedances (at or above MCL threshold) for the Chowchilla GQMP Zone.

The TRS, well, and pesticide data used below are those data compiled in the GAR.

Pesticide	Individual Wells with Detections	Individual Wells with Exceedances	TRS Sections with Detections	TRS Sections with Exceedances	Concentration in Samples with Detections (µg/L)		Exceedance Threshold Used (µg/L)	Basis for Exceedance Threshold
					Minimum	Maximum		
DBCP	2	0	2	0	0.003	0.003	0.2	CA Primary MCL
Simazine	2	0	2	0	0.006	0.062	4	CA Primary MCL

Pesticide data are for the period 1979-2011 provided by the California Department of Pesticide Regulation (DPR)

*Exceedance thresholds used are based on values reported in the SWRCB Water Quality Goals Online Database (http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/search.shtml), when available. Selection of the threshold value for use to indicate an exceedance is based on a hierarchy consisting of the following order of preference: CA Primary MCL = California Primary MCL; EPA Primary MCL = EPA's Federal Primary MCL; CA Notification = California Notification Level. No value in database = Chemical is in the database but not possible threshold value reported, Chemical not in database = Chemical was not located in the SWRCB database

Table 52. Number of individual wells and TRS sections with pesticide exceedances for the Chowchilla GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, TRS, pesticide, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Pesticide	ESJHVA Priority Areas							
	Priority 1		Priority 2		Priority 3		Not in ESJHVA	
	Individual	TRS	Individual	TRS	Individual	TRS	Individual	TRS
DBCP	0	0	0	0	0	0	0	0
Simazine	0	0	0	0	0	0	0	0

MADERA GROUNDWATER MANAGEMENT ZONE

Introduction and Background

The Madera GQMP Zone is the southernmost GQMP Zone, south of the Chowchilla GQMP Zone. The entire Madera Groundwater subbasin and a portion of the Delta-Mendota groundwater subbasin are included within the Madera GQMP Zone. The Madera subbasin in entire included within Madera County. The eastern portion of the Delta-Mendota subbasin within the Madera GQMP Zone is located within Madera County.

Existing Groundwater Management Plans/Entities

As stated previously, the Madera Regional Groundwater Management Plan (Madera County, 2014) lists several entities within the plan's boundaries (Figure 64 and Figure 65) which perform mostly groundwater level monitoring. These groundwater entities include the City of Chowchilla, City of Madera, Chowchilla Water District, Gravelly Ford Water District (not as a participant of the Madera Regional Groundwater Management Plan but as a member of the California State Groundwater Elevation Monitoring Program), Madera Irrigation District, and Madera County. The total number of wells monitored for groundwater elevation listed within the Madera Regional Groundwater Management Plan approximately 415. The Madera Regional Groundwater Management Plan mentions the water quality data collected by DWR and the CDPH, and local City and County water agencies were used to analyze water quality trends for the Madera 2008 Integrated Regional Water Management Plan but the Madera Regional Groundwater Management Plan does not list other local monitoring agencies or any monitoring schedule.

In 2010, DWR approved the Madera-Chowchilla Basin Groundwater Monitoring Group as the local monitoring entity including: Madera Irrigation District, Chowchilla Water District, Gravelly Ford Water District, and Madera County, Madera Water District, and Root Creek Water District. 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 describes a variety of groundwater monitoring programs that exist throughout the county and suggests a meeting of all parties currently collecting groundwater data (Madera County, 2014).

Basin Boundaries and Surface Water Hydrology

"The Madera subbasin consists of lands overlying the alluvium in Madera County. The subbasin is bounded 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 bedrock of the Sierra Nevada foothills. Major streams in the area include the San Joaquin and Fresno Rivers. Average annual precipitation is 11 inches throughout the majority of the subbasin and 15 inches in the Sierra foothills" (DWR, Bulletin 118).

Geology, Hydrogeology, and Groundwater Hydrology

As stated previously, the characteristics of the Chowchilla and Madera groundwater subbasins which underlay the Chowchilla and Madera GQMP Zones are described as study areas within the Madera-Chowchilla Study Unit in the USGS' Status and Understanding of Groundwater Quality in the Madera-Chowchilla Study Unit, 2008: California GAMA Priority Basin Project. The study unit is bounded partially on the north by the Chowchilla River, approximately on the west and south by the San Joaquin River, and on the east by foothills of the Sierra Nevada (Figure 66; Shelton, et. al., 2008). In general, the Late Tertiary and Quaternary continental deposits increase in thickness from north to south and are up to 3,000 ft thick in the Madera-Chowchilla study unit. The Madera-Chowchilla study unit includes eastern alluvial fan, with derivatives from the Sierra Nevada, and basin areas. The Corcoran Clay Member of the Tulare Formation, underlies large parts of the basin and the distal end of parts of the eastern alluvial fans at depths dipping from 50 ft on the eastern edge of the Clay to 300 ft along the margin of the Coast Ranges and divides the San Joaquin Valley freshwater aquifer systems into an unconfined to semi-confined upper system and a largely confined lower system.

The geology, hydrogeology and groundwater hydrology description for the Madera subbasin is taken almost exclusively from Bulletin 118 (DWR 2003).

Water Bearing Formations

Hydrogeologic units in the Madera Subbasin consist of unconsolidated deposits of Pleistocene and Holocene age. These deposits are divided into continental deposit of Tertiary and Quaternary age, and continental deposits of Quaternary age. Continental deposits of Quaternary age include older alluvium, lacustrine and marsh deposits and younger alluvium. The continental deposits of Quaternary age crop out over most of the area and yield probably more than 95 percent of the water pumped from wells. Although younger alluvium and flood-basin deposits yield small quantities of water to wells, the most important aquifer in the area is the older alluvium. It consists mostly of intercalated lenses of clay, silt, sand, and some gravel. The lacustrine and marsh deposits (which contain the E-clay) do not crop out in the area but occur within the older alluvium and underlie the western portion of the subbasin at depths ranging between 150 and 300 feet (DWR 1981). These deposits restrict the vertical movement of groundwater and divide the water-bearing deposits into confined and unconfined aquifers. Continental deposits of Tertiary and Quaternary age include the Ione Formation which outcrops on the Subbasin's eastern margin. This unit may yield small quantities of water to wells but is not an important aquifer. The estimated average specific yield of this groundwater subbasin is 10.4 percent (based on DWR San Joaquin District internal data and that of Davis 1959).

Restrictive Structures

Groundwater flow is generally southwestward in the eastern part of the subbasin and to the northwest in the southern portion, away from the recharge area along the San Joaquin River. During 1999, a groundwater mound occurred in the northwest portion of the subbasin with accompanying depressions to the north and south, and a large depression in the subbasin's southeast corner (DWR 2000). Based on current and historical groundwater elevation maps, groundwater barriers do not appear to exist in the subbasin.

Groundwater Level Trends

Changes in groundwater levels are based on annual water level measurements by DWR and cooperators. Water level changes were evaluated by quarter township and computed through a custom DWR computer program using geostatistics (kriging). On average, the subbasin water level has declined nearly 40 feet from 1970 through 2000. The period from 1970 through 1978 showed steep declines totaling about 30 feet. The nine-year period from 1978 to 1987 saw stabilization and rebound of about 25 feet, taking the water levels close to where they were in 1970. 1987 through 1996 again showed steep declines, bottoming out in 1996 at about 45 feet below 1970 levels. Water levels rose about 8 feet from 1996 to 2000. Water levels declines have been more severe in the eastern portion of the subbasin from 1980 to the present, but the western subbasin showed the strongest declines before this time period.

Groundwater Storage

Estimations of the total storage capacity of the subbasin and the amount of water in storage as of 1995 were calculated using an estimated specific yield of 10.4 percent and water levels collected by DWR and cooperators. According to these calculations, the total storage capacity of this subbasin is estimated to be 18,500,000 af to a depth of 300 feet and 40,900,000 af to the base of fresh groundwater. These same calculations give an estimate of 12,600,000 af of groundwater to a depth of 300 feet stored in this subbasin as of 1995 (DWR 1995). According to published literature, the amount of stored groundwater in this subbasin as of 1961 is 24,000,000 af to a depth of < 1000 feet (Williamson 1989).

Groundwater Budget (Type B)

Although a detailed budget was not available for this subbasin, an estimate of groundwater demand was calculated based on the 1990 normalized year and data on land and water use. A subsequent analysis was done by a DWR water budget spreadsheet to estimate overall applied water demands, agricultural groundwater pumpage, urban pumping demand and other extraction data. Natural recharge was estimated to be 21,000 af. Artificial recharge and subsurface inflow were not determined. Applied water recharge was calculated to be 404,000 af. Annual urban extraction and annual agricultural extraction were estimated as 15,000 af and 551,000 af, respectively. There were no other extractions, and subsurface outflow was not determined.

Groundwater Quality Characterization

The majority of this subbasin is generally a calcium sodium bicarbonate type, with sodium bicarbonate and sodium chloride at the western margin of the subbasin along the San Joaquin River (Mitten 1970). TDS values range from 100 to 6,400 mg/L, with a typical range of 200 to 400 mg/L. The Department of Health Services, which monitors Title 22 water quality standards, reports TDS values in 40 wells ranging from 100 to 400 mg/L, with an average value of 215 mg/L. EC values range from 180 to 600 µmhos/cm, with an average value of 251 µmhos/cm (based on 15 wells).

Groundwater Quality Impairments

There are localized areas of high hardness, iron, nitrate, and chloride. One well is currently undergoing GAC filtration for the removal of EDB/DBCP (Glos 2001).

Land Use/Irrigated Land

Table 53 and Table 54describe land uses within the Madera GQMP Zone from two different data sets, USDA (2012) and DWR (early 2000s), respectively. USDA data in Table 53indicate almonds, grapes, pistachios, and fallow/idle cropland as the crops capturing over 85% of the land use in the Madera GQMP Zone, regardless of irrigated or non-irrigated status. DWR data in Table 54indicate the top irrigated crop as deciduous fruits and nuts followed closely by vineyards.

Table 53. Land use acreage within the entire Madera GQMP Zone1.

Row Labels	Acreage	Percent acreage of Zone
Almonds	112208	42.27%
Grapes	83488	31.45%
Pistachios	17638	6.64%
Fallow/Idle Cropland	12576	4.74%
Alfalfa	11560	4.35%
Winter Wheat	9477	3.57%
Oats	7814	2.94%
Grand Total for Agricultural Crops	254763	96%

[1]Land use information obtained from data provided by USDA, 2012 California Cropland Data Layer: http://www.nass.usda.gov/research/Cropland/SARS1a.htm. Land use in some areas of the ESJWQC may have changed since that time.
*Percent of cropped area includes all agricultural fields, whether fallow or active. Land use categories such as barren, developed, and native or wetland vegetation were not included in acreage totals. Crops contributing 1% or more of the overall land use within the GQMP area were included.

Table 54. Land use acreage within the Madera GQMP Zone by ESJHVA Priority 1-3 areas.

Land uses derived from DWR data in order to incorporate irrigation data designated as irrigated/non-irrigated (I/NI); numbers are rounded to nearest whole number.

Land Use	I/NI	Priority 1	Priority 2	Priority 3	Not in ESJHVA
Citrus & Sub-Tropical	I	26	151	761	5979
Deciduous Fruits & Nuts	I	67	2791	21070	58409
Field Crops	I	176	3209	14625	20649
Field Crops	NI	0	0	4	311
Grain & Hay	I	45	1056	4216	7017
Grain & Hay	NI	0	49	1045	6812
Idle	I	0	8	915	3238
Idle	NI	0	0	1	0
Native Riparian	NI	1	96	1055	972
Native Vegetation	NI	23	885	12612	88805
Pasture	I	88	1245	9348	14204
Pasture	NI	0	0	0	28
Rice	I	1	115	2	12
Semi-agricultural	NI	7	299	1800	1897
Truck, Nursery, Berry	I	6	228	1051	2280
Urban	NI	160	3619	4331	18629
Vineyard	I	214	3534	39807	50762

* Land use information obtained from data provided by DWR, http://www.water.ca.gov/landwateruse/anaglwu.cfm. Data compiled in 2001, land use in some areas of the ESJWQC may have changed since that time.

Constituents of Concern in Zone

Nitrates

Table 55 and Table 56 describe nitrogen as nitrate within the Madera GQMP Zone. Table 55indicates that of those wells sampled in the Madera GQMP Zone, approximately 13% exceeded the MCL of 10mg/L. Table 56indicates that of those wells with nitrate exceedances from 2005-2013, the highest number of wells with nitrate exceedances greater than 10 mg/L are located in the Priority 3 area (21 wells) of the ESJHVA.

Table 55. Count of nitrate (NO3) detections from 5-10mg/L and exceedances >10mg/L by well from 2005-2013 for the Madera GQMP Zone.

	COUNT OF WELLS			PERCENT OF WELLS		
	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L	NO_3 <5 mg/L	NO_3 5-10 mg/L	NO_3 > =10 mg/L
Madera GQMP Zone	174	49	32	68%	19%	13%

Table 56. Number of individual wells with nitrate exceedances (greater than 10 mg/L) for the Madera GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, nitrate, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

ZONE	ESJHVA PRIORITY AREAS			
	Priority 1	**Priority 2**	**Priority 3**	**Outside ESJHVA**
Madera GQMP Zone	0	7	21	4

TDS

Table 57 and Table 58 describe TDS levels within the Madera GQMP Zone. Table 57 indicates that of those wells sampled in the Madera GQMP Zone, approximately 19% exceeded the agricultural MCL of 450 mg/L. Table 58 indicates that of those wells with TDS exceedances from 2005-2013, the majority (17) are located in the Priority 3 area of the ESJHVA.

Table 57. Count of wells with detections of TDS (less than 450 mg/L) and exceedances of TDS (equal to or greater than 450 mg/L) within the Madera Groundwater Management Zone.

Well and TDS data used here are the same as those data compiled in the GAR.

ZONE	COUNT OF WELLS			% WELLS TDS>450
	TDS<450	**TDS>=450**	**Total wells**	
Madera GQMP Zone	136	32	168	19%

Table 58. Number of individual wells with TDS exceedances (greater than 450 mg/L) by well from 2005-2013 for the Madera Groundwater Management Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, TDS, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

ZONE	ESJHVA PRIORITY AREAS			
	Priority 1	**Priority 2**	**Priority 3**	**Outside ESJHVA**
Madera GQMP Zone	0	1	17	0

Pesticides

As stated in previous sections, of the eight pesticides recorded as having exceeded WQTLs in the GAR, only diazinon and simazine are currently registered for application and use with the DPR. Only diazinon and simazine are to be considered active pesticides for current groundwater quality management purposes. No exceedances of active pesticides occurred in the Madera GQMP Zone. The below data (Table 59 and Table 60) indicate detections only.

Table 59. Summary of pesticide detections (below MCL threshold) and exceedances (at or above MCL threshold) for the Madera GQMP Zone.

Active pesticides in this GQMP Zone are bolded. Well and pesticide data used below are those data compiled in the GAR.

Pesticide	Individual Wells with Detections	Individual Wells with Exceedances	TRS Sections with Detections	TRS Sections with Exceedances	Concentration in Samples with Detections (µg/L)		Exceedance Threshold Used (µg/L)	Basis for Exceedance Threshold
					Minimum	Maximum		
DBCP	57	49	40	32	0.003	60.000	0.2	CA Primary MCL
Ethylene Dibromide	1	1	1	1	0.010	1.000	0.05	CA Primary MCL
Simazine	**5**	**0**	**5**	**0**	**0.006**	**0.200**	**4**	**CA Primary MCL**

Pesticide data are for the period 1979-2011 provided by the California Department of Pesticide Regulation (DPR)

*Exceedance thresholds used are based on values reported in the SWRCB Water Quality Goals Online Database (http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/search.shtml), when available. Selection of the threshold value for use to indicate an exceedance is based on a hierarchy consisting of the following order of preference: CA Primary MCL = California Primary MCL; EPA Primary MCL = EPA's Federal Primary MCL; CA Notification = California Notification Level. No value in database = Chemical is in the database but not possible threshold value reported, Chemical not in database = Chemical was not located in the SWRCB database

Table 60. Number of individual wells and TRS sections with pesticide exceedances for the Madera GQMP Zone relative to ESJHVA Priority Areas 1, 2, or 3.

Well, TRS, pesticide, and ESJHVA priority designation data used here are the same as those data compiled in the GAR.

Pesticide	ESJHVA Priority Areas							
	Priority 1		Priority 2		Priority 3		Not in ESJHVA	
	Individual	TRS	Individual	TRS	Individual	TRS	Individual	TRS
DBCP	0	0	9	7	32	20	8	5
Ethylene Dibromide	0	0	1	1	0	0	0	0

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