MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT
PLAN UPDATE
MERCED COUNTY, CA

Submitted to:

Merced Area Groundwater Pool Interests, Merced, CA

Submitted by:

AMEC Geomatrix, Inc., Fresno, CA

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Project No. 13651.001

AMEC Geomatrix

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TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

Page

TABLE OF CONTENTS
(continued)

TABLE

FIGURES

TABLE OF CONTENTS
(continued)

APPENDIXES

List of Acronyms

°C	temperature degrees Celsius
°F	temperature degrees Fahrenheit
1,2 DCA	1,2-dichloroethane
1,2,3-TCP	1,2,3-trichloropropane
AB	California Assembly Bill
ac-ft	acre-feet
ac-ft/d	acre-feet per day
ac-ft/y	acre-feet per year
bgs	below ground surface
BMO	Basin Management Objective
BShs	Koppen climate classification - Mediterranean Steppe
Csa	Koppen climate classification - Hot Mediterranean
CWC	California Water Code
DBCP	dibromochioropropane
DOHS	Department of Health Services
DPH	California Department of Public Health
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EDB	ethylene dibromide
EPA	United States Environmental Protection Agency
et. Seq.	and subsequent (Latin)
GMO	genetically modified organism
gpm	gallon per minute
GWMP	Groundwater Management Plan
IGSM	Integrated surface water / groundwater model
IWRIS	integrated water resources information system database
JPA	Joint Powers Authority
MAGPI	Merced Area Groundwater Pool Interests
MCDEH	Merced County Division of Environmental Health
MCL	maximum contaminant level
mg/L	milligrams per liter (also part per million)
MGWB	Merced Groundwater Basin
MID	Merced Irrigation District
MOU	Memorandum of Understanding
MTBE	methyl-tertiary-butyl-ether
PCE	perchloroethyene
ppm	parts per million
RWQCB	California Regional Water Quality Control Board
SB	California Senate Bill
SPI	Standardized Precipitation Index
SWRCB	California State Water Resources Control Board
TCE	trichloroethylene
TDS	total dissolved solids
TWG	Technical Working Group
UC Merced	University of California - Merced Campus
µg/L	micrograms per liter (also parts per billion)
USDA	United States Department of Agriculture
USGS	United States Geological Survey

List of Acronyms (continued)

UST	underground storage tank
VOC	volatile organic compound
WPA	wellhead protection area
WWP	wellhead protection program

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
Merced Area Groundwater Pool Interests
Merced County, California

1.0 INTRODUCTION

The Groundwater Management Act, California Water Code (CWC) Section 10753 et. seq., originally enacted as Assembly Bill (AB) 3030, was passed by the State legislature during the 1992 session and became law on January 1, 1993. AB 3030 identifies groundwater as a valuable resource that should be managed to ensure both its safe production and its quality. It also encourages local agencies to work cooperatively to manage groundwater resources within their jurisdiction.

Groundwater management encompasses the planned and coordinated monitoring, operation, and administration of a groundwater basin or portion of a groundwater basin with the goal of long-term sustainability of the resource (DWR, 2003). Groundwater management includes a number of integrated actions, both natural processes and managed activities, which relate to groundwater recharge and discharge. Those actions include a range of options to increase water supply reliability to achieve the long-term sustainability of groundwater resources. A groundwater management plan (GWMP) provides the framework to implement a groundwater management strategy for an area, basin, or a portion of a groundwater basin. In this case, the GWMP addresses the Merced Groundwater Basin (MGWB) which is located in the eastern half of Merced County, California (Figure 1).

1.1 PURPOSE OF THE GROUNDWATER MANAGEMENT PLAN

The purpose of the GWMP is to identify and implement a number of actions using modern technology and sound science to preserve and/or increase the quantity of groundwater resources in the MGWB to ensure adequate groundwater resources for future generations. The GWMP is a living document; progress in implementing the plan will be periodically reviewed with the current understanding of groundwater levels, quality, and trends. The GWMP is a guideline for the community to use for sustainable development of groundwater resources. It is intended to be consistent with Federal, State, and County regulations; however it is not intended to replace or ensure compliance with local General Plans or the California Environmental Quality Act. The burden of proving proposed project compatibilities with applicable plans and regulations is fully borne by the lead agencies.

1.2 PREVIOUS GROUNDWATER MANAGEMENT PLAN

The Merced Irrigation District (MID) and the City of Merced prepared a final draft GWMP in 1997 to comply with legislative requirements of AB 3030. In December 1997, water purveyors within the MGWB signed a Memorandum of Understanding (MOU) creating an association identified as the Merced Area Groundwater Pool Interests (MAGPI) (Appendix A). MAGPI adopted the GWMP in December 1997. The 1997 GWMP served as the initial framework for management of groundwater resources within the MGWB.

In 2002, State Senate Bills (SB) 1938 (Groundwater Management Planning Act of 2002) and SB 1672 (Integrated Regional Water Management Planning Act of 2002) were signed into law. These bills required various changes and additions to existing basin-wide groundwater management plans. The most significant changes were the adoption of an integrated approach to basin-wide groundwater management, the development of management objectives, and a basin-wide monitoring program by stakeholders. The California Department of Water Resources (DWR) outlined the new requirements of SB 1938 in Appendix C of the 2003 update to Bulletin 118 "California's Groundwater" and suggested additional components that should be included in a GWMP.

1.3 GROUNDWATER MANAGEMENT PLAN UPDATE

This document supersedes the 1997 GWMP and incorporates new components and updates existing components to address the legislative requirements of SB 1938 and SB 1672. This update incorporates data collected since 1997 and reflects analyses performed subsequent to preparation of the 1997 GWMP. In addition, the components suggested in Bulletin 118 have been added and the existing AB 3030 components were also updated to reflect: 1) expansion of the number of MAGPI members (i.e., Lone Tree Mutual Water Company), 2) revised characterization and understanding of the basin hydrogeology, 3) the addition of new monitoring data, 4) new or revised groundwater monitoring procedures, 5) changes to the basin management objectives, and 6) changes in groundwater management practices and philosophy.

The lead agencies for this GWMP update are the City of Merced and MID on behalf of MAGPI. The GWMP has been prepared with assistance from a Technical Working Group (TWG) consisting of members of MAGPI (Stevenson Water Company, Meadowbrook Water Company, the City of Merced, MID, Winton Water & Sanitation District, Le Grand-Athlone Water District, and Merced County Department of Health Services [DOHS]), non-MAGPI agencies (East Merced Resource Conservation District, DWR, San Joaquin Raptor Rescue Center), consulting engineers and hydrogeologists (Davids Engineering and AMEC Geomatrix, Inc.), and members of the general public.

A summary of the components of a GWMP required by applicable legislation (AB 3030, SB 1938, and SB 1672) and suggested in Bulletin 118 is included in Table 1. As shown, the GWMP addresses these items:

- the twelve required components of AB 3030 that describe technical issues that should be addressed in the GWMP to manage the basin optimally and protect against adverse conditions;
- the seven components of SB 1938 that are required for agencies to be eligible for funds administered by DWR for construction of groundwater projects;
- the five required components of SB 1672 that promote integrated regional groundwater management; and
- the seven voluntary components of Bulletin 118 that link Basin Management Objectives (BMOs) to specific actions within the GWMP.

These items are addressed throughout this GWMP. The GWMP consists of the following sections:

Section 1 Introduction – This section describes the legislative framework for the GWMP and the basis of the update.

Section 2 Groundwater Planning Process – This section describes the steps and procedures that were conducted to draft, review, and finalize this GWMP. Records of public participation, input received from the TWG, and the timeline of all events relating to the GWMP update process are included in this section.

Section 3 Existing Groundwater Basin Conditions – This section describes the current hydrogeologic conditions and issues related to the MGWB. It includes discussions of the MGWB boundaries, local hydrogeology and groundwater levels, existing water supplies and groundwater extractions, and groundwater quality.

Section 4 Water Resources Setting – This section describes existing surface water and groundwater supplies and municipal, industrial, and agricultural water demands within the MGWB.

Section 5 Basin Management Goals and Objectives – This section presents MAGPI's strategy for managing the MGWB in terms of states goals and associated BMOs. The goals are broad principals, and the BMOs are quantifiable or verifiable actions for achieving the goals.

Section 6 Groundwater Management Plan Elements – This section details the specific projects, programs, and policies that will be implemented to manage the MGWB; some new, and others existing.

Section 7 Groundwater Management Plan Implementation – This section outlines a schedule for implementation and assessment of this GWMP.

Section 8 References – This section provides a list of documents utilized to prepare this GWMP.

2.0 GROUNDWATER MANAGEMENT PLANNING PROCESS

Groundwater management is the planned and coordinated monitoring, operation, and administration of a groundwater basin or portion of a groundwater basin with the goal of achieving long-term sustainability of the resource (DWR, 2003). A GWMP is a document that provides a framework to implement a groundwater management strategy for an area, basin, or a portion of a groundwater basin. This GWMP presents the approach to implement a series of integrated water management actions to secure a sustainable source of groundwater in the MGWB.

The DWR has divided the state into 10 hydrologic regions, which have been further divided into basins and subbasins. As described in the 2003 update to Bulletin 118 "California's Groundwater," the MGWB is a subbasin within San Joaquin Valley Groundwater Basin of the San Joaquin River Hydrologic Region (Figure 2).

2.1 BASIN BOUNDARIES AND ASSEMBLY BILL 3030 STUDY AREA

The MGWB is located in the San Joaquin Valley, which is surrounded by the Coast Range on the west, the San Emigdio and Tehachapi Mountains on the south, the Sierra Nevada on the east, and the Sacramento-San Joaquin Delta (Delta) and Sacramento Valley on the north. The northern portion of the San Joaquin Valley drains toward the Delta by the San Joaquin River and its tributaries, including the Fresno, Merced, Tuolumne, and Stanislaus rivers. The southern portion of the valley is internally drained by the Kings, Kaweah, Tule, and Kern rivers that flow into the Tulare drainage basin including the beds of the former Tulare, Buena Vista, and Kern lakes (DWR, 2003).

The MGWB lies on the eastern side of the San Joaquin Valley, entirely within Merced County and is generally described as the eastern half of Merced County (Figure 3). For the purposes of this GWMP, the MGWB 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 MGWB boundary on the south stretches westerly along the Madera-Merced County line (Chowchilla River) to the northern boundary of the Sierra Water District, which is followed westerly to the San Joaquin River. Although this modified study area is about 54 square miles larger than the MGWB as described in Bulletin 118, it is more consistent with natural hydraulic boundaries surrounding the basin.

2.2 GROUNDWATER MANAGEMENT WITHIN THE MERCED GROUNDWATER BASIN

During 1997, several agencies within the groundwater basin adopted Resolutions of Intention to Adopt a Groundwater Management Plan pursuant to Water Code Section 10753 et seq. In addition, these agencies formed MAGPI for the purpose of developing a basin-wide groundwater management plan to guide the management of the groundwater resources in the MGWB.

The 1997 GWMP was the result of the planning effort of the City of Merced and MID on behalf of MAGPI. In June 2001, the DWR and MAGPI entered into a MOU to work cooperatively to promote conjunctive use of surface and groundwater projects within the MGWB. Since 2001, MID (on behalf of MAGPI) has implemented a number of in-lieu recharge programs to reduce groundwater pumping and decrease stress on the aquifer. Other activities completed by MAGPI include:

- Southeast Quadrant Data Assessment (2002; DWR funding), which described the regional hydrogeologic setting of Eastern Merced County, compiled available water resources data, and developed a data management plan for MAGPI members.
- Conjunctive Use Site Assessment (2003; DWR funding), which compared and evaluated alternative artificial recharge sites.
- Cressey Pilot Recharge Basin (ongoing; MID funding), which is providing promising results with respect to infiltration rates for spreading basins.
- Public Involvement (ongoing; DWR funding), which is aimed at improving coordination among MAGPI members and between MAGPI and other entities in the MGWB.
- Stream and Groundwater Monitoring (ongoing; AB 3030 funding), which is aimed at defining stream-aquifer interaction along Bear Creek in the vicinity of Merced.

2.2.1 Agencies/Water Purveyors within the Merced Groundwater Basin

There are numerous agencies that lie either wholly or partly within the MGWB and therefore are eligible to participate in an AB 3030 GWMP. These agencies 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

2.2.2 Merced Area Groundwater Pool Interests

The signatory agencies to the MAGPI MOU are shown on Figure 4. These agencies, which cover most of the MGWB, agree that the groundwater and surface water resources within the MGWB are vitally important resources in that they:

- Satisfy environmental, agricultural, domestic, municipal, industrial, and other water needs and
- maintain the economic viability and prosperity of eastern Merced County.

Eastern Merced County is a vital agricultural area with increasing importance in industry and education. Because of increasing demands for California's finite water resources, it is critical that those people and agencies making use of the region's limited water supplies do so in an efficient and knowledgeable manner to preserve the resources for all elements of a robust regional economy. The MAGPI parties acknowledge that long-term groundwater level declines due to pumping can diminish water quality and quantity; cause land subsidence; increase water costs; and eventually restrict economic development.

2.2.3 Public Participation

An extensive public involvement process was conducted to provide for broad input to development of the GWMP update, including formal public hearings conducted according to AB 3030 requirements, MAGPI board meetings, and formation of an ad hoc technical working group that represented selected MAGPI members and other interested members of the public. A chronology of the various activities carried out to support the update process is provided below:

- On January 16, 2008, the MAGPI Board published a notice informing the public of the intention of the MAPGI to hold a public hearing to determine whether to adopt a resolution to prepare the groundwater management plan update. These notices are included in Appendix B.
- The MAGPI Board, in a regularly scheduled meeting on January 30, 2008, held a hearing (after publication of notice) on whether to adopt a resolution of intent to prepare a GWMP Update. In this hearing, the public was invited to comment on

whether the agency should adopt the resolution and on the planning process. The public was informed on how to provide comments to the agency.

- At the conclusion of the hearing, the MAGPI Board adopted a resolution of intent to draft the GWMP update. The MAGPI Board also directed the staff to participate with members of MAGPI and the public to form a TWG to act as an advisory committee of stakeholders in development of the GWMP update.

- From February through May, the TWG met approximately monthly to review and comment on sections of the Draft GWMP. Notice of the TWG meetings were sent via e-mail to TWG members and the MAGPI Board. The Draft sections of the GWMP were published on the MAGPI website as they were prepared, and available for public review. The TWG meetings were open to the public.

- On May 31, 2008, the MAGPI Board published a notice informing the public of the intention of MAPGI to hold a public hearing to receive input from the public leading to adoption of the Draft GWMP, which would amend and supersede the existing plan adopted by the member agencies of MAGPI on December 29, 1997. These notices are included in Appendix B.

- The MAGPI Board, in a regularly scheduled meeting on June 16, 2008, held a hearing (after publication of notice) to present the Draft GWMP update to the Board and public and solicit public comment on the Draft. In this hearing, the MAGPI Board voted to keep the hearing open until July 1, 2008 and invited the public to provide written comments on the Draft GWMP (available on the MAGPI website since June 2, 2008) by July 1, 2008. The public was informed on how to provide comments to MAGPI.

- The MAGPI Board, on July 30, 2008, passed a resolution adopting the Draft GWMP update, superseding the December 29, 1997 plan.

3.0 EXISTING GROUNDWATER BASIN CONDITIONS

This section addresses the current hydrogeologic conditions and issues related to the MGWB. It includes discussions of the physical setting, local geology, local hydrogeology and groundwater levels, existing water supplies and groundwater extractions, and groundwater quality.

3.1 PHYSICAL SETTING

The MGWB is located in the San Joaquin Valley is a broad structural trough approximately 200 miles long and up to 70 miles wide. It is filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding mountains. Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is below and slightly west of the series of rivers, lakes, sloughs, and marshes that mark the current and historic axis of the surface drainage of the San Joaquin Valley (DWR, 2003).

The physiographic units in the MGWB area include the Sierra Nevada, dissected uplands, low alluvial plains and fans, river flood plains and channels, and overflow lands (Page and Balding, 1973). These physiographic units are presented on Figure 5. The Sierra Nevada unit, which can be found along the eastern border of the MGWB, consists of metamorphic and granitic mountains that have deep river-cut canyons and highly dissected foothills.

The dissected uplands unit has a width ranging between 5 and 18 miles and covers a significant portion of the MGWB. Local relief may be up to 200 feet. Within the uplands the Merced River has developed two terraces and a broad flood plain while the Chowchilla River is only slightly entrenched into the upland surface.

The low alluvial plains and fans unit, which consists primarily of coalescing alluvial fans, has a width ranging between 14 and 20 miles and covers a significant portion of the MGWB. Local relief may be up to 10 feet. Between Atwater and Turlock, northwest trending sand dunes underlie the surface of the plains and fans.

The river flood plains and channels unit flank the channels of the major rivers including the Merced and Chowchilla Rivers. In the dissected uplands unit, the flood plain of the Merced River ranges in width between 0.25 and 1 mile. In the Cressey area, natural levees are present. Near the valley trough, the Merced River flood plain becomes indistinguishable from the surrounding alluvial plains. The Chowchilla River, which is entrenched about 40 feet near where it leaves the Sierra Nevada, has developed a thin flood plain through the dissected uplands. The river has deposited natural levees throughout the low alluvial plains and fans unit.

The MGWB and San Joaquin Valley are classified as having a hot Mediterranean (Koppen climate classification *Csa*) to Mediterranean steppe (*BShs)* climate (McKnight & Hess, 2000). It is typically hot and dry during the summer and cool and damp in winter, leading to frequent ground fog known regionally as tule fog. Summer temperatures reach into the mid to upper

90s (degrees Fahrenheit [°F], 30s in degrees Celsius [°C]), and occasional heat waves might bring temperatures well over 100°F (38°C) with some locations topping out at around 115°F (46°C). Average precipitation ranges between 10 and 13 inches per year, increasing with elevation. Winter and spring comprise the rainy season, although during the late summer, southeasterly winds aloft can bring thunderstorms of tropical origin, mainly in the southern half of the San Joaquin Valley.

3.2 GEOLOGY

The MGWB is underlain by consolidated rocks, unconsolidated deposits, and shallow surface soils (Figure 6). The consolidated rocks, from bottom to top, include the Sierra Nevada basement complex, Ione Formation and other sedimentary rocks, the Valley Springs Formation, and the Mehrten Formation (Page and Balding, 1973). The unconsolidated deposits include continental deposits, lacustrine and marsh deposits, older alluvium, younger alluvium, and flood-basin deposits. The surface soils consist of 18 soil associations based on physiographic sections. The geology and soils are described in the following sections.

3.2.1 Consolidated Rock

The consolidated rocks include the Sierra Nevada basement complex, Ione Formation and other sedimentary rocks, the Valley Springs Formation, and the Mehrten Formation.

The Sierra Nevada bedrock complex consists largely of metasedimentary and metavolcanic rock of pre-Tertary age (Page and Balding, 1973). These rocks occur as foothill ridges along the eastern edge of the MGWB. Where the basement complex occurs near the surface, fracture sets and joints within the bedrock complex may contain sufficient groundwater for domestic or stock supplies.

The Eocene Ione Formation unconformably overlies the Sierra Nevada bedrock complex and is composed of marine to non-marine clay, sand, sandstone, and conglomerate (Figure 6). These rocks occur as foothill ridges along the eastern edge of the MGWB. The Ione is characterized by a white sandy clay (kaolinite) at its base and beds of conglomerate and yellow, red, and gray sandstone in it upper parts. In localized areas near the Sierra Nevada foothills, the formation contains fresh water; however, well yields are highly variable.

The Miocene Valley Springs Formation overlies the Ione Formation and is composed of a fluvial sequence of rhyolitic ash, sandy clay, and siliceous gravel in a clay matrix. These rocks occur as foothill ridges along the eastern edge of the MGWB (Figure 6). Because of the abundant ash and clay matrix, the Valley Springs has a relatively low groundwater yield, sufficient for domestic or stock supplies, but generally insufficient for irrigation.

The Miocene/Pliocene Mehrten Formation overlies the Valley Springs Formation and is composed of fluvial deposits of sandstone, breccia, conglomerate, tuff, siltstone and claystone. It contains a large amount of andesitic material, making it easy to distinguish. The Mehrten outcrops over a large area in eastern MGWB (Figure 6). It forms an important aquifer in the MGWB with relatively high yields.

3.2.2 Unconsolidated Deposits

The unconsolidated deposits, from bottom to top, include continental deposits, lacustrine and marsh deposits, older alluvium, younger alluvium, and flood-basin deposits. The Pliocene/Pleistocene continental deposits consist of a heterogeneous mixture of poorly sorted gravel, sand, silt and clay derived primarily from the Sierra Nevada. The sediments, which are found throughout the MGWB, dip gently to the southwest and have variable thickness up to 700 feet. The continental deposits have relatively large yields to wells and are an import part of the aquifer system.

The lacustrine and marsh deposits consist of two beds: the Corcoran Clay Member of the Pleistocene Tulare Formation and a shallow clay bed of Holocene age (Page, 1977). The Corcoran Clay is a bed of laterally extensive reduced (blue/grey) silt and clay that underlies about 770 square miles in the southeast portion of the MGWB (Figure 7). The Corcoran Clay is a significant confining layer up to 60 feet thick. The shallow clay bed of Holocene age is composed of oxidized (brown/red) sandy clay and clay with silica cemented intervals (hardpan). It is found throughout most of the MGWB at a shallow depth (~ 35 feet).

The older alluvium consists of a heterogeneous mixture of poorly sorted gravel, sand, silt and clay up to 400 feet thick derived primarily from the Sierra Nevada. The sediments, which are found throughout the MGWB, were deposited as a series of interbedded coarse-grained and fine-grained layers and form a leaky-aquifer system.

The flood-plain deposits consist of intercalated lenses of reduced to oxidized fine sand, silt, and clay. These deposits are found in the southwestern portion of the MGWB and generally are less than 30 feet thick (Figure 6).

The younger alluvium consists of well sorted gravel and sand derived primarily from the Sierra Nevada. The younger alluvium is found in a narrow band along the stream channels throughout the MGWB (Page and Balding, 1973).

3.2.3 Surface Soils

The United States Department of Agriculture (USDA) Soil Conservation Service conducted a soil survey in Merced County and identified more than 200 unique soil types within the MGWB

(USDA, 1962). These soil types can be grouped into 18 soil associations based on physiography and permeability (Figures 8 and 9).

3.3 HYDROGEOLOGY

This section provides a summary of the local hydrogeology, groundwater levels and trends, existing water supplies and groundwater extractions, and groundwater quality.

3.3.1 Occurrence of Groundwater

The base of fresh water in the MGWB is approximately 1,200 feet below ground surface (bgs, Page, 1977). Five aquifer systems have been identified in the MGWB including a fractured bedrock aquifer, the Mehrten Formation, a confined aquifer, an intermediate "leaky" aquifer, and a shallow unconfined aquifer. These are discussed below.

Fractured Bedrock - Along the eastern edge of the MGWB wells have been completed within the Valley Springs and Ione Formations (Page & Balding, 1973, Page, 1977). These wells appear to be completed in fractured bedrock with limited and variable yields. Because of the limited extent (and poor yields) of the fractured bedrock aquifer, the fractured aquifer is not a significant source of water in the MGWB.

The Mehrten Formation – The Mehrten Formation outcrops over a large area in the MGWB. Many water supply wells in the eastern portion of the MGWB penetrate the formation and it is a significant source of groundwater. Where the Mehrten occurs beneath the Corcoran Clay, it is considered a confined aquifer. Where the Mehrten does not underlie the Corcoran Clay, there is insufficient data to determine the degree of confinement of the formation.

Confined Aquifer – The confined aquifer occurs in older alluvium (and Mehrten Formation) deposits that underlie the Corcoran Clay (Figure 7). Many water supply wells in the western portion of the MGWB penetrate the Corcoran Clay into the confined aquifer and it is a significant source of groundwater.

Intermediate Leaky-Aquifer – The intermediate aquifer occurs in older alluvium deposits that overlie the Corcoran Clay or are east of the Corcoran Clay (Figure 7). Where the Corcoran Clay is absent the intermediate aquifer extends to the Mehrten Formation. In the eastern portion of the MGWB the intermediate aquifer consists of a series of interbedded coarse-grained (gravel and sand) layers separated by fine-grained (silt and clay) layers. The fine grained layers inhibit, but do not prevent vertical groundwater flow between layers and thus form a leaky-aquifer system. Many water supply wells in the MGWB are completed in the intermediate leaky-aquifer and it is a significant source of groundwater.

The Intermediate leaky-aquifer is the most extensively developed aquifer in MGWB. Measured well yields within the MGWB (Page & Balding, 1973) range from 670 to 4000 gallons per minute (gpm). Estimates of specific capacity of supply wells throughout the MGWB range from about 20 to 40 gallons per minute per foot of drawdown and indicate that the specific capacity increases from east to west (Figure 10).

Shallow Unconfined Aquifer – The shallow unconfined aquifer occurs in older and younger alluvium deposited above the shallow clay bed. Because of its shallow depth, few water supply wells are completed in the shallow unconfined aquifer. Where water levels in the intermediate leaky aquifer fall below the base of the shallow clay bed, groundwater in the intermediate aquifer becomes unconfined and water in the overlying shallow aquifer becomes perched.

3.3.2 Groundwater Levels and Historical Trends

Groundwater elevations in water supply and monitoring wells have been monitored by DWR, MID, and other entities since the 1950s. DWR monitors more than 305 wells on a semi-annual basis throughout the MGWB. MID currently measures static regional groundwater levels monthly in a total of 290 active wells within its service area (Figure 11). In addition, MID monitors shallow monitoring wells, which are located at the section corners, to evaluate localized areas of high groundwater (near ground surface) or perched groundwater table conditions. The municipalities within the MGWB also monitor groundwater levels frequently in their water supply wells. The City of Merced monitors water levels in more than 120 monitoring wells on a quarterly basis.

To simplify evaluation of the available groundwater level data in the MGWB, 34 monitoring wells (about 10 percent) with at least 30 years of history from 1970 to present were selected from the available data set. These wells are located relatively uniformly throughout the MGWB (Figure 12). Long-term hydrographs prepared for these wells show that throughout most of the MGWB, groundwater elevations are declining with time (Figure 13). Since 1980, average groundwater levels beneath the MGWB have decline approximately 14 feet (Figure 14). Most of this decline occurred between 1980 and 1996. The notable exception is beneath the El Nido area, where groundwater levels have shown a substantial increase since 1980 in response to increased delivery of surface water by MID. Individual hydrographs for the 34 selected wells are presented in Appendix C.

3.3.3 Groundwater Flow Directions

Groundwater conditions within the MGWB vary based on location. On the regional scale, groundwater flow beneath the MGWB is generally from northeast to southwest, from the foothill recharge areas toward the valley trough and the San Joaquin River. Locally, the

groundwater flow direction varies with time in response to local groundwater pumping and irrigation recharge. The response of the aquifers to changes in pumping and irrigation is relatively rapid, and localized flow directions are affected by these changes.

DWR routinely publishes potentiometric surface maps of the unconfined aquifer groundwater elevation in the San Joaquin Valley. The 1996 map indicates several major cones of depression in the potentiometric surface centered approximately on Chowchilla and El Nido (Figure 15). The DWR map for 2006 shows a highly convoluted potentiometric surface due to numerous localized pumping centers beneath Chowchilla, Merced, and Livingston (Figure 16).

The groundwater elevation data from the 34 selected monitoring wells were used to prepare simplified potentiometric surface maps on an annual basis (Appendix D). As shown on Figures 17 and 18, these maps show the same general features in the potentiometric surface as the DWR maps (Figures 15 and 16), but is more easily interpreted.

3.3.4 Groundwater Recharge and Discharge Areas

The groundwater elevations relative to the elevations of the major rivers and the interaction of the cones of depression with the rivers suggest that some reaches of the rivers lose water to groundwater while others gain water from groundwater discharge. Comparison of Chowchilla River elevations with groundwater levels indicates that the river is higher than the groundwater. Consequently, the river probably contributes some recharge to groundwater along the reach south of the study area. The pumping depressions near the Chowchilla River do not appear to be affected by the presence of the river.

The groundwater elevation data indicate that there is groundwater discharge along the San Joaquin River. There is a trough in the water table elevations that follow the San Joaquin River. Groundwater inflow to the river and surrounding areas occurs from both sides of the San Joaquin Valley. This river and the surrounding areas are the primary groundwater discharge area for the valley.

On the north side of the MGWB west of State Highway 99, the lower reaches of the Merced River appear to be a groundwater discharge area. East of the highway, the river may be acting as a constant head source and supplying water to the large cone of depression centered approximately 17 miles northwest of Merced, east of Oakdale Road (Township 5 South, Range 12 East, Section 36), the river is higher than the groundwater and probably provides some recharge to the groundwater.

3.3.5 Vertical Groundwater Gradients and Shallow Groundwater

The vertical groundwater gradient, and hence the direction of vertical groundwater flow, is downward from the shallowest groundwater to the deeper aquifers (Elliott, 1984). Consequently, degradation of shallow groundwater can potentially affect deeper water supply wells where downward flow is significant and where dilution and chemical/biological processes are insufficient to adequately reduce the concentrations of constituents of concern.

The area of the MGWB located generally between the cities of Atwater and Livingston, south of State Highway 99 and north of State Highway 140, has historically experienced localized high groundwater levels. Groundwater levels have varied from year to year and over the course of an irrigation season as a result of pumping, precipitation and applied irrigation water. If left uncontrolled, groundwater levels of less than six feet bgs would not be uncommon, resulting in potentially adverse impacts to local crop production.

To minimize these potentially adverse impacts, the MID provided groundwater control (referred to as "drainage pumping") in areas where groundwater levels were within six feet of the ground surface. Ninety-five wells specifically designed and located for drainage purposes were used for drainage pumping. This localized high groundwater condition within MID has declined steadily over the last 10 years. As a result, many of the drainage wells are now used exclusively for irrigation purposes during periods when insufficient surface water is available. Water pumped from these wells is typically discharged into the MID water distribution system where it is used, as much as possible, for irrigation purposes.

3.3.6 Subsidence

Subsidence of the land surface is not known to be occurring in the MGWB although subsidence has been detected in the vicinity of Los Banos within the Delta-Mendota Groundwater Basin west of the San Joaquin River (Merced County General Plan, 2000). In the Le Grand area, the ground surface around two wells is reported to have fallen a few feet, leaving the well heads above ground surface (Kole Upton, personnel communication). Although this subsidence appears to have occurred beneath a relatively small area and is not known to be occurring presently, it demonstrates that there is potential for subsidence in the MGWB if groundwater levels are not sustained. Monitoring of subsidence is not occurring in the MGWB at this time.

3.4 GROUNDWATER QUALITY

Many constituents, both man-made and naturally occurring, are present in the groundwater supply within the MGWB. The constituents identified in this section either currently impact groundwater usage within the basin or have the potential to impact groundwater usage in the future.

3.4.1 Salinity

Variability in soil conditions, soil type, geologic structure, irrigation practices, and irrigation water quality result in wide variability of the quality of groundwater, especially in the upper water-bearing zone. Because of these influences, groundwater salinity is generally lowest in the easterly portion of the MGWB and in the adjoining MID. Salinity increases westward toward the San Joaquin River and southward toward the Chowchilla River (Figure 19).

Salinity levels within the MGWB range from 90 to greater than 1,250 milligrams per liter (mg/L) as measured by total dissolved solids (TDS). TDS in groundwater in the eastern two-thirds of the Basin is generally less than 500 parts per million (ppm). TDS in groundwater increases westward and southwestward towards the San Joaquin River and southward towards the Chowchilla River. In these areas, high TDS water is found in wells deeper than 350 feet. Better quality groundwater (less than 1,000 ppm) in these areas is found at shallower depths.

Groundwater with high TDS concentrations in the MGWB is principally the result of the migration of a deep saline water body which originates in regionally deposited marine sedimentary rocks that underlie the San Joaquin Valley. The depth of this saline water body within the MGWB boundaries is very shallow compared to other parts of the San Joaquin Valley.

Groundwater with high concentrations of total dissolved solids is present beneath the entire MGWB at depths from about 400 feet in the west to over 800 feet in the east. The shallowest high 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.

Under natural pressure, the saline groundwater body is migrating upward. Brines move up through permeable sedimentary rocks and also through wells, faults and fractures. The chemistry of groundwater in the MGWB indicates that mixing is occurring between the shallow fresh groundwater and the brines, which produces the high TDS groundwater observed. Pumping of deep wells in the western and southern parts of the MGWB may be causing these saline brines to upwell and mix with fresh water aquifers more rapidly than under natural conditions.

The Corcoran Clay has provided a natural impediment to the migration of high TDS groundwater from the confined aquifer into the unconfined aquifer. High permeability pathways through the clay from the confined to the unconfined aquifer may be created by wells perforated in both the unconfined and confined aquifers.

3.4.2 Nitrates

Nitrate occurs from both natural and man-made sources and is widespread in groundwater in many parts of the San Joaquin Valley. High concentrations of nitrate in groundwater are primarily a concern for potable water supplies. The Meadowbrook Water Company has one well (of four) that, based on a 10-year trend analysis, is expected to reach the maximum contaminant level (MCL) in 10 to 12 years. The Planada Community Services District has two wells (of five) that are at or near the MCL. The MCL for nitrate in public drinking water supplies is 45 mg/L (as nitrate).

Nitrate in irrigation water is not a major concern for many crops, because it acts as fertilizer. However, permanent crop production, including grape vineyards, may be adversely affected by excess nitrate concentrations. High nitrate concentrations, typically found in shallower groundwater zones, has been attributed to various sources such as agricultural fertilizers, sewer effluent, septic tank effluent, and animal wastes.

3.4.3 Iron and Manganese

Groundwater in some areas within the MGWB has elevated iron and manganese concentrations. For example, manganese is found near the Merced Airport at relatively shallow depths. Generally "reducing conditions" (a lack of oxygen) may lead to elevated iron and manganese concentrations in groundwater. Also, shallow groundwater near streams often has high manganese and sometimes high iron concentrations.

3.4.4 Arsenic

Arsenic concentrations in water from public water supply wells in the MGWB are below the current MCL of 0.010 mg/L. The United States Environmental Protection Agency (EPA) is currently evaluating the MCL for arsenic, which if lowered significantly could have a decided impact on groundwater usage and cost within the MGWB.

3.4.5 Radionuclides

Radionuclides are primarily from natural sources and can affect drinking water supplies. Sampling in the MGWB for radiological constituents has generally been limited to public water systems. The MCL for gross alpha is 15 picocuries per liter, and the MCL for uranium has recently been increased from 5 to 20 picocuries per liter.

The EPA has discussed establishing a standard for radon in drinking water. Depending on how low this standard is set, the natural activity of radon in groundwater could be a significant concern in the future.

3.4.6 Bacteria

Bacteriological quality in the MGWB is generally acceptable in deep groundwater aquifers. Bacteriological quality of groundwater pumped by individual wells cannot be generalized and depends on many factors pertaining to the well and surrounding conditions. Inadequately constructed and improperly located, destroyed, or abandoned water wells may contribute to bacteriological contamination of groundwater. Some of the factors that may influence contamination of water wells include location with respect to sources of contamination, inadequate construction features, general deterioration, and/or inadequate maintenance of wells, and improper use of water wells for disposal of wastes.

Bacteriological contamination of groundwater is a health concern because groundwater is used for drinking water. State DOHS standards require periodic sampling and testing for pathogenic microorganisms. The minimum number of tests depends on the number of service connections in the system.

3.4.7 Petroleum Hydrocarbons

A number of unauthorized releases from underground storage tanks (USTs) have occurred in the MGWB. The State Water Resources Control Board and Merced County Division of Environmental Health (MCDEH) are involved in monitoring and regulating the cleanup of sites involving many volatile organic compounds (VOCs) and UST spills (Figure 20). Most of these cases are very localized in nature in terms of groundwater impacts, and public water supply wells are not known to have been affected. MCDEH has a contract with the State Water Resources Control Board to provide mitigation services for the definition and cleanup of releases resulting from underground storage tanks. Benzene, toluene, xylenes, methyl-tertiary-butyl-ether (MTBE), and 1,2-dichloroethane (1,2 DCA) are the constituents of concern in groundwater.

MTBE, a mandatory gasoline additive designed to reduce air emissions, has been detected in various locations, primarily shallow monitoring wells. MTBE is highly mobile and highly soluble in water, but it does not degrade naturally like other petroleum product constituents. MTBE is also resistant to the biological treatment methods commonly used to clean up hydrocarbon spills. The incidence of MTBE may be more common than many realize because it does not show up in the commonly used EPA test methods; however, it can be detected by EPA analytical methods 502.2 or 602.

3.4.8 Pesticides

Pesticide contamination is primarily the result of the widespread use of the agricultural nematicide dibromochloropropane (DBCP) on croplands for several decades before it was banned in 1977. DBCP in the groundwater is usually associated with vineyards or orchards

where the pesticide was used. DBCP is a carcinogen at very low concentrations in water, and is a concern for potable water supplies. It moves freely with the groundwater and persists for long periods. The MCL for DBCP is 0.2 micrograms per Liter (µg/L). DBCP has been found in public water supply wells in the Merced area at levels either at or below the MCL. For public water purveyors, the frequency of monitoring for DBCP, where it has been detected, is set by DOHS. Also, 1,2,3-trichloropropane (1,2,3-TCP), a common cleaning and degreasing solvent also used in the application of soil fumigants, has been detected in shallow groundwater in the Livingston area. The MCL for 1,2,3-TCP is 0.005 µg/L.

Another nematicide that has been detected in the MGWB is ethylene dibromide (EDB). Used primarily on vineyards, EDB was banned in the early 1980s, but it has been detected in at least one public water supply well and several domestic wells in the Atwater/Livingston area.

Pesticide and fertilizer formulators and distributor sites often have releases resulting from spills, residual materials, wash racks, etc. Sites with known releases, whether they impact groundwater or not, are monitored by the Department of Toxic Substances Control (DTSC) and the Regional Water Quality Control Board (RWQCB). Sites with known releases in the MGWB are shown on Figure 20.

3.4.9 Trichloroethylene

The VOC trichloroethylene (TCE) is a nonflammable, colorless liquid with a sweet odor and is used as a solvent for dyes, rug cleaners, as well as a degreaser for metal parts. Improper storage and disposal have made TCE a major contaminant of groundwater supplies in California. The California Drinking Water Action Level of 5 parts per billion (ppb; 5 ppb is equivalent to 5 µg/l) for TCE is based upon what is considered a negligible risk level for cancer (i.e. if one million people drank about 2 liters of water containing TCE at 5 µg/l every day over a 70-year lifetime, there would be no more than one additional case of cancer in the million people exposed).

Two locations in the MGWB, the Castle Airport Aviation and Development Center and the Merced's Eastern Industrial Park have known TCE plumes and have remediation activities in progress (Figure 20). At Castle Airport, a former United States Air Force Base, approximately 13,065 cubic yards of soil were removed and disposed of offsite. Twenty-three soil vapor extraction systems have removed 831,110 pounds of VOCs from the soil. Groundwater extraction systems were installed on and off base to protect nearby municipal wells and to remove the contaminants from the groundwater. As of 2007, 13.6 billion gallons of contaminated groundwater have been extracted and treated. All remediation has been completed or there are treatment systems in place and operating properly. (DTSC, 2007).

At the Merced Eastern Industrial Park, on-site and off-site groundwater extraction systems were installed. In addition, an impacted City of Merced supply well was replaced at an upgradient location. As of 2007, 7.2 billion gallons of contaminated groundwater have been extracted and treated, removing approximately 19,000 pounds of TCE. All groundwater remediation is completed or there are treatment systems in place and operating properly. (RWQCB, 2007).

3.4.10 Perchloroethylene

The VOC perchloroethyene (PCE) has been detected at sporadically in some of the MGWB's public water supply wells. Industrial wastes and dry cleaners are a recognized source of PCE in groundwater in many municipal areas, including the City of Merced (Figure 20). Beginning in the 1986, PCE was detected in three of the City of Merced's wells. As a result of the PCE contamination, three wells were replaced in the late 1980s and one well was rebuilt to seal off PCE contaminated aquifers. Five additional City of Merced wells are known to be at risk. Intensive monitoring and studies continue in an effort to manage the PCE problem in Merced. Improper use, improper storage, and accidental spills have resulted in unauthorized releases of PCE to groundwater.

3.4.11. Other Trace Organics

Other trace organic compounds have been detected in the MGWB including, but not limited to, carbon tetrachloride and hydrocarbon-based products. Improper use, improper storage, and accidental spills have resulted in unauthorized releases of these substances to groundwater.

Carbon tetrachloride is often attributed to auto repair shops, which have historically used it as a solvent or degreaser. There are no records of carbon tetrachloride being found in concentrations above the MCL of 0.5 µg/l in public water supply wells within the MGWB.

3.4.12. Emerging Contaminants

Many chemical and microbial constituents that have not historically been considered as contaminants are occasionally detected in groundwater. These newly recognized (or emerging) contaminants are commonly derived from municipal, agricultural, and industrial wastewater sources and pathways. These newly recognized contaminants are dispersed to the environment from domestic, commercial, and industrial uses of common household products and include such things as caffeine, artificial sweeteners, pharmaceuticals, cleaning products, etc. Residual waste products of genetically modified organisms (GMOs) are also of potential concern. A recently completed survey for pharmaceuticals at dairies in the MGWB by the UC Davis and the USGS resulted in a few detections of pharmaceuticals in shallow groundwater (Watanabe, Harter, and Bergamaschi, 2007).

4.0 WATER RESOURCES SETTING

The following sections describe the water resources setting in the MGWB, including review of water supply and demands within the MGWB and an evaluation of the sustainability of the water supply.

4.1 WATER SUPPLY

Water supplies within the MGWB consist of infiltration of precipitation, tributary inflow (surface water resulting from run-off of precipitation), surface water imported from the Merced River, and water stored in the subsurface as groundwater.

4.1.1 Precipitation

Precipitation is an important source of groundwater recharge in the MGWB. The average annual water year (July through June) precipitation in the MGWB is 12.25 inches (Figure 21) based on more than 100-years of monthly precipitation records from 1897 through 2006 collected by MID and its predecessors. Precipitation is highly seasonal with over 90 percent of precipitation occurring between the months of October and April (Figure 22).

Many quantitative measures of drought have been developed in the United States. One such index, the Standardized Precipitation Index (SPI), is useful for describing the many scales of drought. The SPI is an index based on the probability of recording a given amount of precipitation, and the probabilities are standardized so that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index value is negative for drought, and positive for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive. The SPI can be computed for several time scales, ranging from one month to 24 months, to capture the various scales of both short-term (1 to 2 months) and long-term (12 to 24 months) drought.

A SPI chart for the a 12-month interval representing a water year (July through June) for the 1897 to 2006 period indicates that the MGWB is likely to receive less than average annual precipitation approximately 52 percent of the time and greater than average annual precipitation approximately 47 percent of the time (Figure 23). Using an SPI value of +/- 1.0, the MGWB is likely to receive average annual precipitation approximately 68 percent of the time, experience drought conditions about 15 percent of the time, and experience wet conditions about 16 percent of the time,

A cumulative precipitation departure curve shows that precipitation in the MGWB during the past 100 years has generally been less than the annual average with several extended

periods of drought (Figure 24). Only three intervals had extended periods with above average precipitation.

An isoheytal map of the MGWB and watersheds that are tributary to the MGWB shows that annual average precipitation increases rapidly with increasing elevation (Figure 25). Much of the precipitation accumulates as snow pack in the higher elevations, which melts and runs off during the spring and early summer months.

4.1.2 Surface Water

The Merced River is the principal renewable surface water supply in the MGWB. The Merced River is impounded by New Exchequer Dam, forming Lake McClure. Lake McClure has a storage capacity of over 1 million acre-feet (ac-ft), and is used for flood control and storage of irrigation water. Under agreement with the United States Corp of Engineers, each spring the storage pool in Lake McClure is reduced to a maximum of 675,000 ac-ft for flood control purposes.

Since 1994, storage in Lake McClure has ranged from about 98,300 to 1,022,000 ac-ft and averaged about 610,400 ac-ft (Figure 26). Since 1994, inflow into Lake McClure has ranged between zero and about 133,000 ac-ft per day (ac-ft/d) and averaged about 2,560 ac-ft/d. Outflow has ranged between zero and about negative 23,400 ac-ft/d and averaged about negative 2,325 ac-ft/d. The maximum instantaneous release recorded was negative 95,000 cubic feet per second (negative 188,340 ac-ft/d) in January 1997 (MID, 2007).

Water is diverted from the Merced River into the MID distribution system through the Northside Canal from the Merced Falls Dam and through the Main Canal from the Crocker-Huffman Diversion Dam. Between 1994 and 2007, MID diversions have ranged between 430,600 and 571,400 ac-ft/y and averaged about 499,400 ac-ft/y (Figure 27).

Other sources of surface water within the MGWB include permanent and ephemeral streams including Bear Creek, Black Rascal Creek, Burns Creek, Canal Creek, Cottonwood Creek, Deadman Creek, Dutchman Creek, Fahrens Creek, Little Dutchman Creek, Mariposa Creek and Owens Creek. Gauging stations located at flood control structures on several of these creeks (Burns, Bear, Mariposa, and Owens) indicate that since 1993, annual outflow from the creeks has ranged between 15,000 and 238,700 ac-ft/y and averaged about 94,000 ac-ft/y (Figure 28). DWR has estimated that approximately half, or about 47,000 ac-ft/y of this water infiltrates and recharges groundwater (DWR, 2003).

4.1.3 Groundwater

The 2003 DWR Bulletin 118 indicates that the MGWB has a surface area of about 491,000 acres or about 767 square miles. The MGWB, as defined in this GWMP (Section 2.1) has a surface area of about 525,000 acres or about 821 square miles. DWR estimated the total storage capacity of the MGWB as of 1995 assuming an average specific yield of 9.0 percent. Based on 1995 water levels, DWR estimated the available groundwater in storage beneath the MGWB to be approximately 15.7 million ac-ft to a depth of 300 feet and 42.2 million ac-ft to the base of fresh water.

The potentiometric surface maps in Appendix D were used to estimate the change in groundwater storage over time. Between 1995 and 2007, the average decline in groundwater levels beneath the MGWB was approximately 3.7 feet (Figure 29). Based on an average specific yield of 9.0 percent, this is equivalent to decrease in storage of approximately 117,200 ac-ft. A plot of the annual change in storage from 1980 to 2007 shows that the MGWB experiences periods of long-term groundwater level decline and subsequent recovery (Figure 30). As of 2007, the MGWB is in a state of mild groundwater level decline with a cumulative decrease in storage of approximately 720,000 ac-ft from 1980 to 2007.

4.1.4 Reclamation

Waste water reclamation plants are operated by the municipalities to treat and discharge effluent back into the MGWB. For example, the City of Merced discharges a total of about 8,700 ac-ft/y of treated effluent (City of Merced, 2008). Approximately 900 ac-ft/y of treated effluent is discharged to about 600 acres of City owned cropland and reused. Another 1,400 ac-ft/y of treated effluent is discharged to about 385 acres of wetlands. The remaining treated wastewater (approximately 6,400 ac-ft/y) is discharged to the Hartley Slough where it is utilized for agricultural and environmental purposes within and downstream of the MGWB.

The Cities of Atwater and Winton treat and discharge approximately 4,500 acft/y of municipal and industrial effluent. This treated water is reclaimed for agricultural purposes. The Cities of Le Grand, Livingston, and Planada treat and discharge approximately 6,000 ac-ft/y of effluent.

4.2 Land and Water Use/Demand

Water demand within the MGWB consists primarily of agriculture, municipal, industrial, and environmental uses. These are described in the following Sections.

4.2.1 Agricultural

Most water within the MGWB continues to be utilized for agricultural purposes. Based on cropping patterns (DWR, 1995, 2002) and published crop demands (DWR, 1986), agricultural

demand 1995 was estimated to be 1.45 million ac-ft/y (Figure 31). Agricultural demand decreased in 2002 to an estimated 1.28 million ac-ft/y (Figure 32).

Agricultural demand within the MGWB is typically met with a combination of surface water and groundwater. MID provides surface water to neighboring water districts for agricultural application including average deliveries of about 26,400 ac-ft/y to the Stevinson Water District, 5,300 ac-ft/y to LeGrand Athlone Water District, and about 14,000 ac-ft/y to adjoining lands within the MID sphere of influence. Prior to incorporation into MID in 2004, the El Nido Water District received deliveries of about 15,000 ac-ft/y from MID. The remaining agricultural demand outside of MID (approximately 595,000 ac-ft/y) is met with groundwater solely.

Within the boundaries of MID, between 1994 and 2007, agricultural demand has ranged between 218,000 and 313,000 ac-ft/y and averaged approximately 275,000 ac-ft/y on approximately 110,000 irrigated acres (MID, 2007). To meet this demand, MID provides approximately 500,000 ac-ft/y of surface water from the Merced River and about 13,000 ac-ft/y of groundwater for irrigation in a typical year. Conveyance losses, most of which recharges the aquifer, account for approximately 80,000 to 110,000 ac-ft/y of water.

4.2.2 Municipal and Industrial

All municipal water purveyors within the MGWB rely solely on groundwater for water supply including the Cities of Atwater, Livingston, and Merced, the Black Rascal Mutual Water Company, the Le Grand and Planada Community Service Districts, the Meadowbrook Water Company, and the Winton Water and Sanitary District. Since 1996, total pumping by these municipal purveyors increased from approximately 36,100 ac-ft in 1996 to 46,250 ac-ft in 2007 (Figure 33). An estimated 4,000 ac-ft/y was produced in 2007 by small private residential water systems, commercial businesses, and industrial plants not served by the major municipal purveyors (MID, 2007).

Most of the municipal pumping is concentrated along the State Highway 99 corridor in the cities of Atwater and Merced. These two municipalities account for approximately 82 percent of municipal pumping with the City of Merced accounting for about 60 percent. Municipal water use varies seasonally with most of the municipal water demand occurring in the summer months (Figure 34).

4.2.3 Environmental

Water demand for environmental purposes is growing within the MGWB. Approximately 15,000 ac-ft/y are used at the Merced National Wildlife Refuge. Since 2000, Merced River releases by MID for the Vernalis Adaptive Management Plan to facilitate the migration of juvenile Chinook salmon have been approximately 60,000 ac-ft/y. During 2002 and again in

2007, MID released approximately 25,000 acre-feet of surface water from the Merced River to the Environmental Water Account for protection and restoration of at-risk fish species listed under the Federal and California Endangered Species Acts. MID pumped an equal amount of groundwater to replace the surface water supply to growers within the District.

4.3 GROUNDWATER YIELD AND SUSTAINABILITY

Safe yield or sustainable groundwater yield of an aquifer is defined as the amount of water that can be withdrawn annually without producing a permanent, undesired result, such as long-term groundwater level declines, groundwater quality degradation, and declines in river levels or discharge rates to wetlands resulting from increased pumping of the groundwater basin. An understanding of the sustainable groundwater yield of an aquifer, based on water availability, begins with understanding the hydrologic budget of the MGWB. A hydrologic budget is a mass balance expression that quantifies water inflow to and outflow from the MGWB.

Groundwater cannot be pumped in large quantities from the MGWB without experiencing impacts such as localized long-term groundwater level declines, which can create water quality degradation and increase pumping costs. It is not atypical in the San Joaquin Valley to have varying levels of water supply to different areas within a groundwater basin. This is the condition within the MGWB where the absence of surface supplies on the east side and southwest portions of the MGWB has resulted in concentrated pumping to support irrigated agriculture. Various methods of reducing long-term groundwater level declines to the Basin are discussed in Section 5.0 of this GWMP.

The simplified potentiometric surface maps (Appendix D) were used to estimate the change in MGWB storage on an annual basis, assuming a specific yield of 9.0 percent (Figure 30). As shown on Figure 30, there was a significant decrease in storage during the drought from 1986 through 1992 followed by a partial recovery from 1993 through 1999. As of 2007, the MGWB is in a state of mild long-term groundwater level decline, with a cumulative decrease in storage of approximately 720,000 ac-ft from 1980 to 2007, or about 26,000 ac-ft/y on average.

In response to the declining groundwater levels, MID implemented a series of programs in the 1990s to recharge the Merced subbasin aquifer system through in-lieu and direct recharge. MID has installed low-head booster pumps on several canals to provide surface water to higher lands and reducing annual pumping from about 24,000 ac-ft/yr to about 8,000 ac-ft/yr, resulting in an annual in-lieu recharge of about 16,000 ac-ft/yr. MID also implemented a program to provide more responsive service (delivery with 24 hours of demand) to its customers, which has reduced supplemental private pumping from an annual average of 42,000 ac-ft/yr to about 10,000 ac-ft/yr and resulted in an annual in-lieu recharge of about 32,000 ac-ft/yr. MID implemented a groundwater conservation incentive program, which has

resulted in the shifting of about 3,000 acres of groundwater irrigated land to surface water irrigation and resulted in the annual in-lieu recharge of about 9,000 ac-ft/yr. MID implemented the Highlands Pilot In-Lieu Recharge Project, which provides surface water to 450 acres of lands previously irrigated by groundwater only, thus replacing 12 wells and resulting in the annual in-lieu recharge of about 1,500 ac-ft/yr. MID also implemented a pilot direct recharge project at Cressey Basin, which has the potential to recharge up to 10,000 ac-ft/yr when surface water is available. In total, MID has implemented various recharge and conservation projects which combined provide an annual in-lieu recharge of about 60,000 ac-ft/yr and have resulted in the cumulative in-lieu recharge of about 300,000 ac-ft since 2001. Despite these efforts, the overall MGWB is in a state of mild long-term groundwater level decline (i.e. overdraft).

5.0 BASIN MANAGEMENT GOALS AND OBJECTIVES

MAGPI desires to identify, formulate, and implement sound groundwater management practices in order to maintain the available groundwater resources to meet the beneficial uses and needs of the MGWB. For the purposes of this groundwater management plan, Basin Management Goals (Goals) are statements of broad principles that express the desired state of the MGWB. BMOs are specific actions that are verifiable or quantifiable to achieve the Goals. Four groundwater management Goals have been established (no priority is implied). For each groundwater management goal, specific basin management objectives have been developed.

Goal 1 – Protect and maintain groundwater quality within the MGWB to satisfy current and future beneficial use.

BMOs

1.1 Monitor and evaluate groundwater quality within the MGWB.

1.2 Develop a high resolution numerical model of the groundwater system in the MGWB.

Goal 2 – Maintain groundwater quantities and eliminate conditions of long-term over draft in the MGWB to ensure water supply reliability to meet current and future beneficial use.

BMOs

2.1 Monitor groundwater elevations and evaluate the quantity of the MGWB's existing groundwater supplies.

2.2 Determine the MGWB's need for additional or improved water extraction, storage, conveyance, conservation, reuse, and intentional recharge facilities.

2.3 Promote in-lieu recharge of groundwater through conjunctive use of surface water.

2.4 Avoid subsidence through monitoring and prevention of overdraft.

Goal 3 – Protect and maintain groundwater recharge areas within the MGWB.

BMOs

3.1 Identify and evaluate natural recharge areas and potential intentional recharge areas within the MGWB.

3.2 Implement projects to intentionally recharge available surface water when surplus to needs.

Goal 4 – Manage the MGWB with local control.

BMOs

4.1 Provide information and guidance for the management, preservation, protection, and enhancement of the MGWB.

4.2 Assert local control of the region's groundwater resources.

4.3 Promote coordinated planning to make the best use of available water resources to meet the needs of all water users reliably and sustainably, and service territories in the mutual best interests of the inhabitants and resources of the MGWB.

4.4 Update the groundwater management plan for the MGWB periodically.

6.0 GROUNDWATER MANAGEMENT PLAN ELEMENTS

This section identifies the different groundwater management plan components that are included in this GWMP. The GWMP addresses these items:

- the twelve required components of AB 3030 that describe technical issues that should be addressed in GWMPs to manage the basin optimally and protect against adverse conditions;
- the seven components of SB 1938 that are required for agencies to be eligible for funds administered by DWR for construction groundwater projects;
- the five required components of SB 1672 that promote integrated regional groundwater management; and
- the seven voluntary components of Bulletin 118 that link BMOs to specific actions within the GWMP.

The correlation of the GWMP BMOs with the GWMP elements are presented in Table 2 and discussed in the following sections.

6.1 ELEMENT 1 – CONTROL OF SALINE WATER INTRUSION

Saline water can slowly degrade groundwater quality, limiting its range of potential beneficial use. Six potential sources of saline intrusion in the MGWB include:

- increase in salt content from dissolved materials (not a significant source of salts although some site-specific problems may exist),
- lateral or upward migration of saline water (not a significant source of salts, although there is some potential eastward migration of saline water from the Delta-Mendota Groundwater Basin),
- downward seepage of sewage, agricultural, or industrial waste (potential wide-spread problem associated with municipal waste water treatment plants, application of fertilizers, and dairies),
- downward seepage of mineralized surface water (potentially a wide-spread problem from infiltration of irrigation water containing salts), and
- seawater intrusion (not a potential risk in MGWB).

A program to minimize water quality degradation from saline water intrusion would include the following elements:

- Establish a network of monitoring wells completed to various depths throughout the management area using the existing monitoring well network.
- Monitor water quality periodically for salinity, nitrates, boron or other constituents of concern. Incorporate data from RWQCB, DTSC, DWR, and USGS, as appropriate.
- Identify and monitor areas where the groundwater flow patterns suggest a high probability of water quality degradation.
- Identify zones of marginal water quality that can be used in conjunction with surface water to increase the water supply for agricultural purposes and reduce migration of saline water into zones containing potable groundwater.
- Identify water management strategies that may be employed to minimize degradation.

Saline intrusion is not known to be a significant problem at this time; however, there is a potential for it to develop. For example, there is some evidence of migration of shallow saline water from west to east in the Stevinson area. At this time, the GWMP will emphasize groundwater monitoring. Groundwater monitoring, which is performed through existing activities of the individual parties of the GWMP, will allow the evaluation of saline water intrusion. If water quality changes begin to occur related to saline intrusion, the cause will be investigated and remedial actions will be considered to reverse the trend.

6.2 ELEMENT 2 – IDENTIFICATION AND MANAGEMENT OF WELLHEAD PROTECTION AREAS AND RECHARGE AREAS

The Federal Wellhead Protection Program (WPP) was established in 1986 by the Safe Drinking Water Act Amendments (Section 1428). The purpose of the WPP is to protect groundwater resources of public drinking water supplies from contamination to minimize the need for costly treatment to meet drinking water standards. The WPP is a preventative approach to protecting groundwater quality. Under the Act, the states are required to develop and EPA-approved WPP. To date, California does not have a formal state-mandated WPP program, but instead relies on public agencies to plan and implement programs under AB 3030. Merced County has developed and adopted a comprehensive countywide WPP (Appendix E).

The Merced County WPP for public water supply wells in the MGWB contains the following basic plan elements:

- Identification and description of all public water supply wells in the MGWB.
- Delineation of the wellhead protection area (WPA) for each well based on groundwater quality and flow information developed under Element 1 – Control of Saline Water Intrusion and Element 7 – Monitoring and Controlling Groundwater Levels, Quality, and Storage of this groundwater management plan.
- Identification of potential sources of contaminants within each WPA.
- Establishment of land use ordinances to preclude or control future land uses within each WPA that have the potential for groundwater contamination.
- Development of site specific well construction and abandonment programs to minimize contaminate migration (see Elements 4 and 9).
- Development of a contingency plan to implement if a WPA becomes contaminated.

A formal recharge area protection program for the MGWB does not exist at this time. Protection of recharge areas in the MGWB is realized by controlling or regulating surface contaminants before they migrate into the groundwater. This migration occurs either by percolation or via wells that have not been properly constructed or destroyed. The RWQCB, DTSC, and MCDEH regulate waste disposal.

To protected recharge areas, each MAGPI agency should provide assistance to the RWQCB, DTSC, and MCDEH by identifying areas that are most susceptible to groundwater contamination. Areas with good recharge potential should also be protected from development so that they may continue to be utilized for artificial and/or natural recharge. In addition, MAGPI agencies should closely review the applications for Waste Discharge Permits,

Tentative Waste Discharge Permits, and other environmental documents for facilities within and adjoining their boundaries with waste disposal systems that have the potential to degrade groundwater quality. Such waste disposal systems include disposal of dairy wastes, industrial wastes, sewage treatment plant effluent, and solid waste. Environmental documents and permits should be reviewed such that appropriate monitoring and mitigation measures are developed to preclude the possibility of migration of pollutants from disposal sites. Each participating agency should be observant for existing and proposed land use activities that have the potential to degrade groundwater quality so that appropriate action can be taken.

6.3 ELEMENT 3 – REGULATING CONTAMINANT MIGRATION IN GROUNDWATER

Section 10753.7c of the CWC addresses groundwater contaminants, which may originate from a number of sources such as leaking USTs or from the application, storage, and disposal of petroleum products, solvents, pesticides, fertilizers, sewage effluent, and other chemical used by businesses and in industry. These groundwater contaminants are distinguished from saline intrusion, which is addressed in Element 1 – Control of Saline Water Intrusion.

Agencies involved in mitigating groundwater contamination generally include the RWQCB, DTSC, EPA, and MCDEH. The MAGPI participant's role in protecting groundwater from contamination includes supporting each agency's efforts in monitoring and cleaning up point-source contamination sites. The RWCQB holds the primary responsibility for enforcing water quality regulations. The MCDEH oversees soil and groundwater cleanup activities associated with leaking USTs and sites. In addition, MAGPI participants should assist in understanding the hydrogeology of the MGWB, the vertical and lateral flow directions, and groundwater quality based on the groundwater monitoring activities carried out by each participating agency. Each participating agency should make the appropriate regulating agency aware of changes in groundwater quality, which may indicate that point source contamination is occurring.

6.4 ELEMENT 4 – ADMINISTRATION OF WELL ABANDONMENT AND WELL DESTRUCTION PROGRAMS

State regulations require that all unused or inactive wells be properly maintained (DWR bulletins 74-81 and 74-90) or destroyed (California Health and Safety Code Section 24400). Wells that are not properly maintained or destroyed may contribute to groundwater contamination as pollutants enter the well from the ground surface, as the well establishes vertical communication and allows poor quality water and pollutants to move from one aquifer to another, or if the well is used for illegal waste disposal.

It is the responsibility of the property owner or lessee to properly destroy their wells. Permits are required from the applicable County and/or City for destruction of wells within their

jurisdictions (See Elements 2 and 9). DWR bulletins 74-81 and 74-90 (Water Well Standards) provide the minimum standards for the destruction of wells, and Sections 13700 though 13806 of the CWC require proper destruction of wells. These standards apply to all water wells, cathodic protection wells, and monitoring wells. If a local agency does not have its own well standards, it must enforce the State Water Resources Control Board's Model Well Ordinance (Resolution 89-98). Local agency requirements may exceed California standards. For public supply wells, the DOHS may prescribe additional requirements.

Each participating MAGPI agency will continue to rely on administration of the well abandonment and destruction program by the permitting agencies. Each participating MAGPI agency's role in well abandonment and destruction should be to provide available groundwater data, assist in identifying locations of operating and abandoned wells, and provide support for a public awareness/outreach program to advise well owners why proper wells destruction is important for protection of water quality.

6.5 ELEMENT 5 – MITIGATION OF GROUNDWATER OVERDRAFT

Long-term uncontrolled groundwater level declines (overdraft) occur when the groundwater discharge rate exceeds the long-term recharge rate. Long-term groundwater level declines may result in land subsidence, degradation of groundwater quality, well dewatering, increased pumping costs, and other undesirable conditions.

At various locals within the MGWB, the amount of pumping has exceeded the recharge creating localized conditions of long-term groundwater level decline. As described in Sections 3.3.2 and 3.3.3, in general, groundwater elevations throughout the MGWB have declined approximately 14 feet since 1980 (Figure 13). Potentiometric surface maps of the unconfined aquifer indicate several major cones of depression in the potentiometric surface centered approximately on Chowchilla, El Nido, and Livingston (Figures 15 through 18).

In response to the declining groundwater levels, MID implemented a series of programs in the 1990s to recharge the Merced subbasin aquifer system through in-lieu and direct recharge. These programs are described in Section 4.4. These various recharge and conservation programs provide an annual in-lieu recharge of about 60,000 ac-ft/yr and have resulted in the cumulative in-lieu recharge of about 300,000 ac-ft since 2001. Despite these efforts, the overall MGWB is in a state of mild overdraft.

To avoid the negative impacts of groundwater long-term groundwater level decline, methods to recharge areas of decline need to be identified, evaluated, and implemented if they are economically and environmentally feasible. Restrictions on pumping should not be relied upon to mitigate long-term groundwater level decline until all possible and reasonable means of

recharge have been shown to be not viable. A conjunctive use program is one of the most cost effective ways to achieve aquifer recharge within the basin. Conjunctive use of surface water and groundwater is discussed in more detail in Element 8 – Facilitating Conjunctive Use Operations.

6.6 ELEMENT 6 – REPLENISHMENT OF GROUNDWATER EXTRACTED BY PRODUCERS

Groundwater replenishment may occur as:

- In-lieu recharge where surface water is substituted for groundwater supplies;
- natural percolation of surface water through the soil into the groundwater basin;
- intentional percolation of surface water in recharge basins that are created and maintained to maximize percolation; and
- injection of surface water or groundwater into the groundwater basin through injection wells.

Most groundwater recharge in the MGWB occurs from the application of irrigation water that is diverted from the Merced River. As the water is transported and distributed to the fields, seepage from canals and ditches percolates through the soil and recharges the groundwater basin. Annual seepage to groundwater is estimated by MID to be between 80,000 and 130,000 ac-ft/yr (Section 4.2.1). As irrigation water is applied to crops, a portion percolates past the root zone and continues downward also recharging the groundwater basin. This is most prevalent with the flood irrigation technique. As irrigation efficiency is increased through the adoption of advanced irrigation techniques like drip and micro sprinkler systems, applied water and deep percolation will decrease.

To increase groundwater replenishment, additional surface water must be recharged to the basin either by in-lieu or by direct recharge. During wet years, recharge of available surface water should be maximized. Through implementation of Element 8 – Facilitating Conjunctive Use Operations, MAGPI will be exploring methods of replenishing depleted groundwater supplies and optimizing use of available aquifer storage.

6.7 ELEMENT 7 – MONITORING AND CONTROLLING GROUNDWATER LEVELS, QUALITY, AND STORAGE

The purposes of a groundwater level and groundwater quality monitoring program are to identify areas of long-term groundwater level decline and provide information that will allow evaluation of the changes in groundwater quality and storage. Groundwater level monitoring is essential to understanding the impacts on the aquifer resulting from changes in water supply conditions and groundwater pumping activities. Such monitoring is also necessary for

administering any conjunctive water use program. Groundwater quality monitoring is essential to detect any adverse impacts on groundwater supply and to identify steps to protect groundwater quality in the MGWB.

Several participating local agencies (MID, the City of Merced, MCDEH) within the MGWB have established groundwater monitoring programs. The MID, for example, has recorded water levels in a network of shallow groundwater monitoring wells since 1942 and has recorded beginning and end-of-season water levels in its production wells since 1959. In addition, the cities are required to routinely test the groundwater quality in their supply wells. The MCDEH also maintains a groundwater monitoring program for individual domestic wells. These existing monitoring programs should be coordinated and expanded to develop a comprehensive basin-wide groundwater monitoring program.

Monitoring well networks should be established to monitor water levels both in the unconfined aquifer above and the confined aquifer below the Corcoran Clay where present. Water levels in the confined aquifer should be compared to water levels in the unconfined aquifer to evaluate the hydraulic gradient between the two zones. The hydraulic gradient is an important element in understanding how pumping affects the movement of water between the two aquifers. An adequate monitoring network should include representative wells that tap the two aquifers.

Basic elements should include:

- expanding the current network of monitoring wells to cover the entire basin;
- compiling the necessary data on the monitoring wells (e.g. location, depth, lithologic log, electric log, and casing and ground surface elevation);
- establishing the frequency of water level and quality monitoring;
- preparing an inventory of active wells and determining annual pumping amounts;
- developing a standardized data collection method;
- tabulating data and preparing groundwater maps; and
- interpreting and disseminating results.

Considering the substantial cost of implementing a comprehensive groundwater monitoring program, monitoring will largely continue to be accomplished through the existing, ongoing monitoring activities of the participating agencies. Each year, monitoring data collected by the individual agencies will be pooled and a report of groundwater conditions in the MGWB shall

be prepared. The report will address groundwater production, groundwater levels and storage changes, groundwater inflow and outflow, groundwater quality and other topics that are deemed appropriate.

To supplement the pooled effort, MAGPI participating agencies will implement routine groundwater monitoring in selected wells throughout the MGWB to collect water level data and groundwater quality samples on a consistent basin. This MGWB groundwater monitoring program is described in Section 6.13.

The MAGPI participating agencies have agreed that a numerical model of the MGWB will be useful as a means of consolidating available hydrologic and geologic data and preparing estimates of groundwater flow conditions. To that end, MAGPI has initiated a contract to prepare an integrated surface water/groundwater model (IGSM) of the MGWB. This work is anticipated to be completed within two years.

6.8 ELEMENT 8 – FACILITATING CONJUNCTIVE USE OPERATIONS

DWR Bulletin 118 defines the conjunctive operation of a groundwater basin as the "...operation of a groundwater basin in coordination with a surface water reservoir system. The basin is intentionally recharged in years of above average precipitation so groundwater can be extracted in years of below average precipitation when surface water supplies are below normal." Operation of a conjunctive use program requires the following features, all of which are present in the MGWB:

- a source of surface water during years with above normal precipitation and streamflow;
- conveyance facilities to import water;
- recharge facilities;
- usable storage capacity in the aquifer;
- extraction facilities; and
- distribution facilities for surface water and groundwater.

Conjunctive use of groundwater and surface water in a basin typically occurs when the surface water supply to the basin varies from year to year and basin water demand is relatively constant. In some years, the surface water supply is greater than the basin water demand; in other years, the surface water supply is less than the basin water demand. In the years of plentiful supply, surface water is utilized to recharge the groundwater aquifer. Recharge can occur either directly by surface recharge or injection well or by using surface water in-lieu of

groundwater when it is available. In effect, the groundwater basin is utilized as a storage reservoir and water is placed in the reservoir during wet years and withdrawn from the reservoir in dry years. This description (i.e. in-lieu recharge) generally portrays conditions in the MGWB.

In the MID portion of the MGWB, groundwater and surface water have historically been used conjunctively on an intentional but informal basis. For example, in view of the important part that canal seepage plays in recharging the MGWB aquifers, MID has elected not to line the vast majority of its canal system. Additionally, MID has implemented the in-lieu recharge project described previously. However, there has been no formalized plan for artificial recharge nor have recharge or extracted volumes been systematically inventoried.

During 2006, MID conducted a pilot recharge test of a small recharge basin north of Winton (Section 4.3). The results of this pilot test were promising, and this facility has been identified as a potential recharge project by MAGPI. Another potential recharge area has been identified in the El Nido area (Section 3.3.2). This area has been identified as a potential pilot recharge test project by MAGPI. MAGPI also intends to pursue cooperative arrangements with State and local agencies for the purpose of expanding the MGWB's conjunctive use capabilities.

6.9 ELEMENT 9 – WELL CONSTRUCTION

Improperly constructed wells can result in poor yields and may contribute to groundwater contamination by creating pathways for pollutants to enter the aquifer from surface drainage or by causing mixing of waters between aquifers of differing quality. CWC Sections 13700 through 13806 require proper construction of wells. DWR bulletins 74-81 and 74-90 specify minimum well construction standards that are adopted by local permitting authorities.

The Cities and County within the MGWB are responsible for adopting and enforcing well construction standards. Merced County and the City of Merced have adopted standards that are more strict than the minimum DWR standards. Permits are required from the applicable County and/or City for construction of a new well or to modify an existing well within their jurisdictions (See Elements 2 and 4). Well Driller's Reports must be filed with the DWR and Merced County. MCDEH is responsible for enforcing standards for construction and destruction of wells and for issuing drinking water permits for small public water systems; therefore, they maintains records on wells and groundwater. Since 1988, MCDEH has required at all new domestic wells be tested for bacteria, DBCP, EDB, and general minerals prior to issuing a use permit for the well.

The MAGPI participating agencies can augment efforts by the County and Cities by providing information on water levels and groundwater quality. These data can be used to identify

locations susceptible to intermingling of aquifer zones of varying water quality and to establish specifications for well construction and destruction to optimize well water quality and minimize mixing of water in these zones.

6.10 Element 10 – Construction and Operation of Recharge, Storage, Conservation, Water Recycling, and Extraction Projects

MAGPI member agencies share the responsibility for development and operation of recharge, storage, conservation, water recycling, and extraction processes. The role of MAGPI is to promote cooperation and sharing of information among the agencies sponsoring water management projects and other member agencies. To the extent feasible, MAGPI will also support measures to coordinate development and optimize operation of facilities to improve basin-wide effectiveness and efficiency of water management. Participating agencies will take the following actions:

- Encourage sharing of information on project planning, design, and operation among member agencies.
- Promote a coordinated approach toward development and operation to lower costs and increase benefits of water management efforts.
- Identify and promote projects and programs that will contribute to water conservation, recycling, storage, and recharge within the MGWB.

In the future, MAGPI intends to form a joint powers authority (JPA) and undertake a significant recharge project as outlined in the 1995 and 2000 Merced Water Supply Plans. Potential projects to contribute to water conservation, recycling, storage, and groundwater recharge could include:

- using use non-potable surface water (secondary water) for in-lieu of potable groundwater to irrigate public lands;
- using reclaimed wastewater for agricultural or landscape irrigation purposes, taking care to not adversely impact recharge areas;
- expanding surface water distribution facilities to increase the use of surface water in areas not currently serviced;
- constructing recharge facilities in areas of long-term groundwater decline (i.e. Cressey Basin and El Nido area);
- adding wetland buffer zones around drainages and recharges areas to promote infiltration rather than run-off; and
- constructing additional surface water storage facilities to increase surface water availability.

6.11 ELEMENT 11 – DEVELOPMENT OF RELATIONSHIPS WITH LOCAL, STATE, AND FEDERAL AGENCIES

Each MAGPI participant recognizes the benefit of close coordination between their efforts and work performed by various local, state, and federal agencies to monitor and protect groundwater in the MGWB. Some of these agencies include the DTSC, DWR, RWQCB, MCDEH, EPA, and USGS. The role that each of these agencies plays in the MGWB is described below.

- DTSC – under California EPA, is responsible for regulating hazardous waste facilities and overseeing cleanup of hazardous waste site in California. This includes oversight of the cleanup of contaminated soils, surface water, and groundwater.

- DWR – is responsible for managing the water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance the natural and human environments. Also to develop and assess strategies for managing the State's water resources, including supporting local planning and integrated regional water management through technical and financial assistance.

- RWQCB, under the SWRCB, has a responsibility to protect the waters of the state by reviewing projects and issuing waste discharge permits, as necessary, for disposal activities that threaten both surface and groundwater supplies. They are also responsible for oversight of the cleanup of contaminated water.

- MCDEH monitors the installation and destruction of wells to protect the groundwater from degradation caused by improper procedures. They also oversee the cleanup of contamination from leaking underground storage tanks.

- Federal regulations for the protection of groundwater are developed through the EPA, which looks to the states for implementation. The USGS provides technical studies and reports and maintains a database of surface and groundwater quality.

It is important for MAGPI agencies to establish and maintain an effective working relationship with local, state, and federal agencies. The CWC requires local agencies implementing an AB 3030 GWMP within the same groundwater basin to meet annually to coordinate groundwater management activities. MAGPI meets on a semi-annual basis to discuss the status of the MGWB and review implementation of the groundwater management plan.

6.12 ELEMENT 12 – REVIEW OF LAND USE PLANS AND COORDINATION WITH LAND USE PLANNING AGENCIES

In California, land use planning decisions are generally made by City or County government agencies, special districts (i.e. school districts, UC Merced, MID, etc.). Each MAGPI participating agency should review proposed development plans and associated environmental documentation to assess the potential groundwater impacts of land use

changes. Planning departments should refer development proposals to MCDEH for direction on potential impacts, studies, and mitigation. Each MAGPI participating agency should review initial studies, proposed negative declarations, draft environmental impact reports, and provide comments as appropriate to ensure that potential threats to groundwater can be addressed and avoided. In cases where the proposed land use involves disposal of wastes, storage of hazardous materials, or handling of petroleum products, solvents, or chemicals such as pesticides and fertilizers, each participating agency should coordinate with the appropriate state regulatory agencies to ensure that compliance with regulations for containment and disposal of wastes is obtained. During periodic land use plan preparation and updates, the county and cities in the MGWB should consult with the appropriate participating agency to avail themselves of the latest information on groundwater conditions that may be affected by the proposed activities, so that necessary mitigation measures can be included in the plans.

6.13 ELEMENT 13 – MERCED GROUNDWATER BASIN GROUNDWATER MONITORING PROGRAM

A GWMP should be capable of assessing the status of the basin and responses in the basin to future management activities. The groundwater monitoring program for the MGWB will consist of measuring groundwater levels and collecting groundwater quality data from selected wells within the MGWB on a consistent basis using the same protocols.

As previously mentioned, the groundwater levels in water supply and monitoring wells have been measured by DWR, MID, and other entities since the 1950s. To simplify evaluation of the groundwater level within the MGWB, MAGPI proposes to monitor groundwater levels in a select group of wells that are located relatively uniformly throughout the MGWB. Groundwater levels in each well will be monitored at minimum each spring and each fall during a short time period using a standard protocol. It is MAGPIs intent that these wells will be maintained as a consistent long-term network that represents overall groundwater elevation conditions in the MGWB. The approximate well locations for the proposed network are shown on Figure 35.

MAGPI has applied for grants to install pressure transducers and automated data logging equipment in approximately 40 monitoring wells (i.e. the proposed monitoring well network). The purpose of these data loggers is to allow for the continuous monitoring of water levels in the selected wells on an hourly basis so that the dynamic hydraulics of the basin can be evaluated and to provide a contemporaneous record of water levels for mapping purposes. The monitoring data may also be used to help calibrate a proposed IGSM model of the MGWB.

MID, the City of Merced, MCDEH, small water distribution systems, and mutual water companies public supply wells are monitored as required by the California Department of Public Health (DPH) under California Code of Regulations Title 22 (which includes organic

compounds, inorganic compounds, metals, microbial, and radiological analytes). The MCDEH has also monitored 18 domestic wells within Merced County (9 well within the MGWB) for general minerals, inorganics, DBCP, and EDB since 1988. These comprehensive programs will be supplemented with groundwater quality data collected from up to 20 selected water supply (i.e. agricultural) wells that are not already part of these programs. Groundwater samples will be collected on a 5-year frequency and analyzed for agricultural suitability including general minerals, nitrate, and arsenic. These data will be used to evaluate the groundwater geochemistry and monitor long-term changes in groundwater quality.

Water level and quality data collected by the various member agencies as part of the groundwater monitoring program will be uploaded into a centralized repository for storage and analysis. Data will also be uploaded in to the DWR integrated water resources information system (IWRIS). Data will be made available to member agencies and the public using an internet website including the links to the DWR IWRIS.

Subsidence is not known to be occurring in the MGWB at this time. MAGPI will seek funding to evaluate subsidence in the MGWB in the future.

6.14 Element 14 – Adoption of Monitoring Protocols

To improve the comparability, reliability, and accuracy of groundwater elevation data collected by MAGPI member agencies, the member agencies will adopt a standard protocol for collection of water level data. The protocol is presented in Appendix F. To collect comparable, reliable, and accurate groundwater quality data from agricultural wells to be sampled for general minerals and nitrate, a standard protocol will be used for collecting groundwater samples. The protocol is presented in Appendix F. The MGWB groundwater monitoring program described in Section 6.13 will be performed in accordance with these same protocols.

7.0 GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION

The following sections discuss the implementation of the groundwater management plan and metrics to evaluate the effectiveness of the implementation. References are provided where appropriate.

7.1 Integration of Water Resources Management Activities

Integration of groundwater resources management activities was accomplished through the creation of MAGPI (see Section 2.2; Section 7.3).

7.2 REGIONAL PLANNING AND MANAGEMENT

Regional planning and management was accomplished through the preparation of the GWMP. Implementation of regional groundwater management planning within the MGWB began with the 1997 GWMP, which served as the initial framework for management of groundwater resources within the MGWB, and will continue with this update to the GWMP. Other regional planning and management activities completed include the:

- 2003 Water Management Plan,
- 2005 Merced Water Supply Plan Update, and
- 2005 City of Merced Urban Water Management Plan

7.3 FORMATION OF A REGIONAL MANAGEMENT GROUP

MAGPI acts as the regional management planning group and its responsibilities are to:

- coordinate public awareness and participation in groundwater management planning,
- provide interagency coordination,
- develop regional priorities,
- assure that the BMOs are pursued in a reasonable and timely manner,
- prepare and assure the accuracy of an annual report associated with GWMP implementation,
- evaluate and modify the GWMP as needed to address issues within the MGWB,
- update the GWMP as necessary based on the state of the basin or to reflect changes in State law or in local conditions/programs, and
- coordinate with the storm water monitoring group.

MAGPI will meet at least semi-annually, at which time it will review the report on the status of the basin, review progress made to meet the basin management goals and objectives, discuss any work planned for the upcoming year, and consider any proposed amendments to the GWMP. It will be the responsibility of individual MAGPI members to complete activities or projects within their jurisdictions. Implementation of the GWMP does not preclude any agency from pursuing programs or projects related to groundwater management either independently or in cooperation with other agencies. In the future, MAGPI should form a JPA to facilitate regional planning and management of water resources within the MGWB.

7.4 PUBLIC INVOLVEMENT

MAGPI has developed a website (http://magpi-gw.org) to disseminate information about MAGPI and MAGPI activities. The website provides the public with access to MAGPI governing board meeting agendas and minutes, and electronic copies of various public documents concerning water resources in the MGWB. MAGPI will hold public meetings to inform the public on the progress of the groundwater management plan. MAPGI will also form, as necessary, ad hoc committees of technical and interested public (like the GWMP TWG) to assist MAGPI in review and/or implementation of elements of the GWMP.

7.5 DEVELOPMENT OF LOCAL, REGIONAL, AND STATEWIDE PRIORITIES

Local Priorities

Development of local priorities is the responsibility of each agency participating in the GWMP; however, the overriding local priority for implementation of the GWMP is satisfying regional and local water management objectives as identified in the BMOs. Through their involvement in MAGPI and the adoption of the BMP, participating agencies have demonstrated their conviction that the most effective approach to local water management is through regional actions.

Regional Priorities

The GWMP is an effort that recognizes that the most effective approach to managing the resources of the MGWB is an integrated plan that enlists the cooperation of the agencies whose political boundaries match the physical boundaries of the basin. The GWMP includes a number of BMOs (Section 5.0) that have been agreed upon by the MAGPI member agencies to promote wise management of regional groundwater resources.

Statewide Priorities

Implementation of the GWMP will enable MAGPI member agencies to respond to a range of statewide water management initiatives. Completion and adoption of the GWMP will allow participating agencies to satisfy one of the key prerequisites for grant funding through Chapter 8 of Proposition 50, the Integrated Regional Water Management Grant Program. The GWMP also places specific groundwater and surface water management projects in the context of an integrated regional water management strategy, which leads to a more comprehensive management of water supplies in a framework for compliance with state and federal water quality standards. By promoting effective water use within the MGWB, implementation of the GWMP will:

- increase California's water supply reliability;
- reduce conflict among water users;

- contribute to meeting water quality objectives; and
- assist in the implementation of the RWQCB's Watershed Management Initiative.

7.6 GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION REPORT

Periodically, MAGPI will prepare a GWMP implementation report which will summarize groundwater conditions within the MGWB, groundwater management activities; success in meeting the BMOs, and any proposed changes to plan components. This report will document conditions in the MGWB and GWMP activities completed since the previous update including a summary of:

- monitoring results, including historical trends;
- actual management actions;
- whether management actions are achieving progress in meeting management objectives, as supported by monitoring results;
- proposed management actions; and
- plan component changes, including addition or modification of management objectives.

7.7 PERIODIC EVALUATION OF GROUNDWATER MANAGEMENT PLAN

MAGPI will meet at least semi-annually, at which time it will review the status of the basin, review progress made to meet the basin management goals and objectives, discuss any work planned for the upcoming year, and consider any proposed amendments to the GWMP. The periodic evaluation of the GWMP will serve as a tool for MAGPI to organize its many activities to implement the plan, act as a driving force for plan implementation, and help interested parties understand the progress made by MAGPI in managing the groundwater resources of the MGWB.

8.0 REFERENCES

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TABLE 1

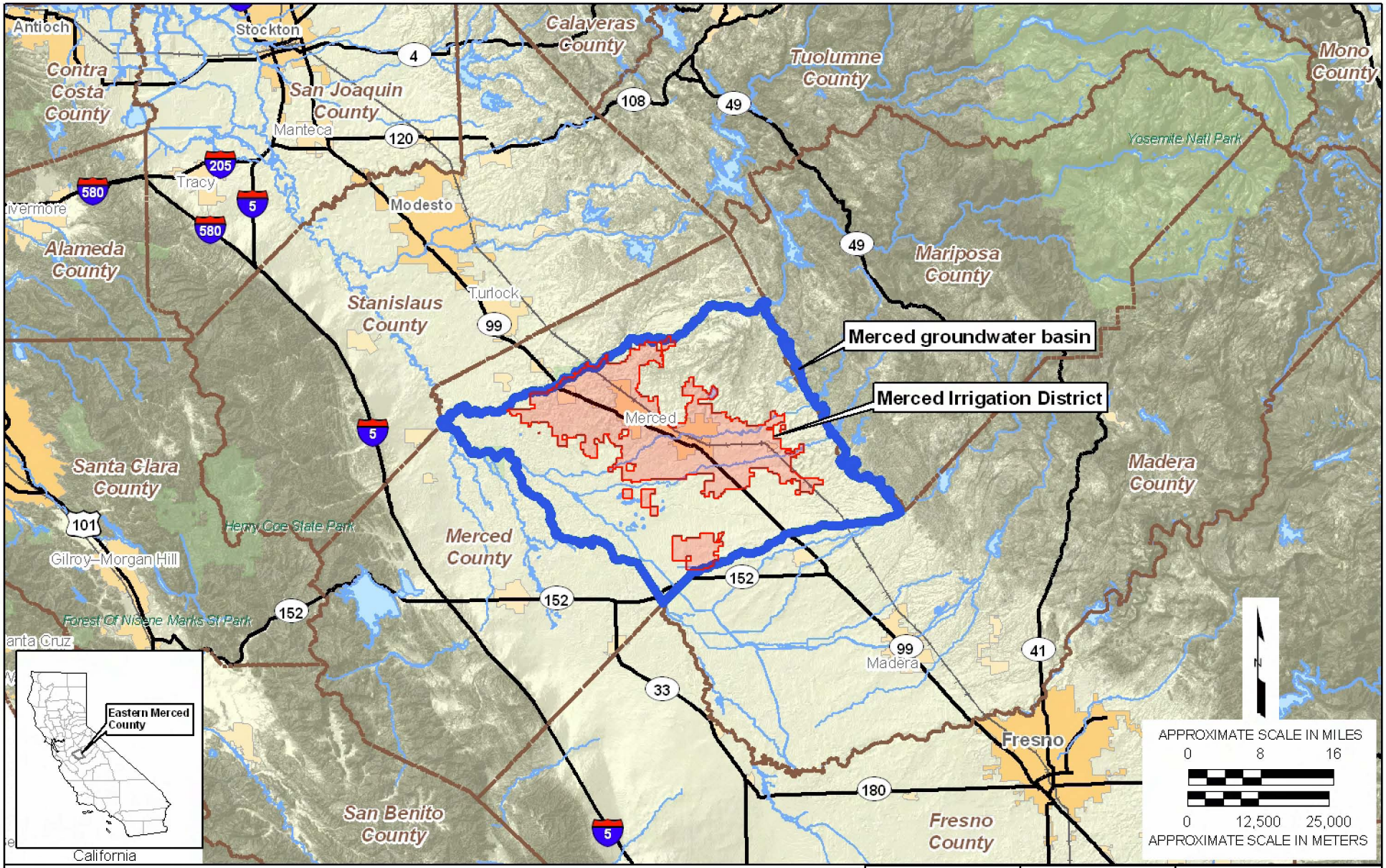
MERCED GROUNDWATER BASIN GROUNDWATER MANAGEMENT PLAN COMPONENTS REVIEW

Item	Summary of Compliance Requirements	DWR Bulletin 118 Append C Line Item	Updated GMP Report Section	Notes
A. California Water Code Section 10750 et seq., Required Components (SB1938)				
1	Documentation of public involvement statement	1	7.4	
2	Basin Management Objectives (BMOs)	6	5.0	
3	Monitoring and management of groundwater elevations, groundwater quality, inelastic land surface subsidence, and changes in surface water flows and quality that directly affects groundwater levels or quality or are caused by pumping.	7	6.7, 6.13	
4	Plan to involve other agencies located within groundwater basin.	2	2.2, 7.3	
5	Adoption of monitoring protocols by basin stakeholders	9	6.14	
6	Map of groundwater basin showing area of agency subject to GMP, other local agency boundaries, and groundwater basin boundary as defined in DWR Bulletin 118.	3	2.1, Figure 3	
7	For agencies not overlying groundwater basins, preparation of GMP using appropriate geologic and hydrologic principles.	14	Not Applicable	Not applicable to the Merced Basin
B. California Department of Water Resources Suggested Components, Bulletin 118				
1	Management with guidance of advisory committee	4	2.2, 7.3	
2	Description of area to be managed under GMP	5	2.1	
3	Creation of link between BMOs and goals and actions of BMP	8	.5.0, Table 2	
4	Description of GMP monitoring program	10	6.7, 6.13	Section 6.7 is still a little disjointed and the two sections don't coordinate all that well.
5	Description of integrated water management planning efforts	11	2.2, 7.1, 7.3	
6	Report on implementation of GMP	12,13	2.2; 7.6	
7	Periodic evaluation of GMP	12,13	7.7	
C. California Water Code Section 10750 et seq., Required Components (AB3030)				
1	Control of saline water intrusion		6.1	
2	Identification and management of wellhead protection areas and recharge areas.		6.2	
3	Regulation of the migration of contaminated groundwater		6.3	
4	Administration of well abandonment and well destruction programs		6.4	
5	Mitigation of conditions of overdraft		6.5	
6	Replenishment of groundwater extracted by water producers		6.6	
7	Monitoring of groundwater levels and storage		6.7	
8	Facilitating of conjunctive use operations		6.8	
9	Identification of well construction policies		6.9	
10	Construction and operation by local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects		6.10	
11	Development of relationships with state and federal regulatory agencies		6.11	
12	Review of land use plans and coordination with land use planning agencies to assess activities that create reasonable risk of groundwater contamination		6.12	
D. Integrated Regional Planning (SB 1672)				
1	Integration of water resource management activities		2.2, 7.1	What exists vs. what is planned for future implementation hasn't been addressed.
2	Regional planning and management		2.2, 7.2	
3	Formation of a regional management group		2.2, 7.3	
4	Public involvement		7.4	
5	Development of local, regional, and statewide priorities.		7.5	

TABLE 2

CORRELATION OF BASIN MANAGEMENT OBJECTIVES WITH ELEMENTS

Groundwater Management Goal	Element 1	Element 2	Element 3	Element 4	Element 5	Element 6	Element 7	Element 8	Element 9	Element 10	Element 11	Element 12	Element 13	Element 14	Section 7.1	Section 7.2	Section 7.3	Section 7.4	Section 7.5	Section 7.6	Section 7.8
	Control Saline Water Intrusion	Identification and Mangement of Wellhead Protection Areas and Recharge Areas	Regulating Contaminant Migration in Groundwater	Administratin of Well Abandonment and Well Destruction Programs	Mitigation of Groundwater Overdraft	Replenishment of Groundwater EXtracted by Producers	Monitoring and Controlling Groundwater Levels, Quality, and Storage	Facilitating Conjunctive Use Programs	Well Construction	Construction and Operation of Recharge, Storage, Conservation, Water Recycling, and EXtraction Projects	Development of Relationships with Local, State, and Federal Agencies	Review of Land Use Plans and Coordination with Land Use Planning Agencies	MGB Groundwater Monitoring Program	Adoption of Monitoring Protocols	Integration of Water Resources Management Activities	Regional Planning and Management	Formation of a Regional Management Group	Public Involvement	Development of Local, Regional, and Statewide Priorities	GMP Implementation Report	Periodic Evaluation of GMP
Goal 1																					
Protect and maintain groundwater quality with the MGB to meet current and future beneficial use.	X	X	X	X			X		X				X	X							
BMO 1.1 - Evaluate and monitor the quality of the MGB's eXisting groundwater supplies.	X		X				X						X	X							
BMO 1.2 - Develop a high resolution numerical model of the groundwater supply in the MGB							X														
Goal 2																					
Maintain groundwater quantities and eliminate conditions of long-term over draft in the MGB to ensure water supply reliability to meet current and future beneficial use.					X	X	X	X		X			X								
BMO 2.1 - Determine the eXtent and evaluate the quantity of the MGB's eXisting groundwater supply.							X						X								
BMO 2.2 - Determine the MGB's need for additional or improved water eXtraction, storage, conveyance, conservation, reuse, and intentional recharge facilities.		X			X	X				X											
BMO 2.3 - Promote in-lieu recharge of groundwater through conjunctive use of surface water.					X			X		X											
BMO 2.4 - Avoid subsidence through monitoring and use of alternative water resources.													X								
Goal 3																					
Protect and maintain the beneficial use of groundwater recharge areas within the MGB.		X	X	X																	
BMO 3.1 - Identify and evaluate natural recharge areas and potential intentional recharge areas within the MGB.		X																			
BMO 3.2 - Seek to change regulations to promote recharge of eXcess surface water.		X						X			X										
Goal 4																					
Manage the MGB with local control.												X			X		X				
BMO 4.1 - Provide information and guidance for the management, preservation, protection, and enhancement of the MGB.																	X	X		X	
BMO 4.2 - Provide a way to maintain local control of the region's groundwater resources.															X	X	X				
BMO 4.3 - Promote coordinated planning to make the best use of available water resources to meet the needs of the association's respective constituents and service territories in the mutual best interests of the inhabitants and resources of the MGB.											X	X			X	X	X		X		X
BMO 4.4 - Periodically update the the groundwater plan for the MGB for review and adoption by the appropriate agency or agencies.																					X



LONG-TERM HYDROGRAPHS IN SELECTED MONITORING WELLS
MERCED GROUNDWATER BASIN

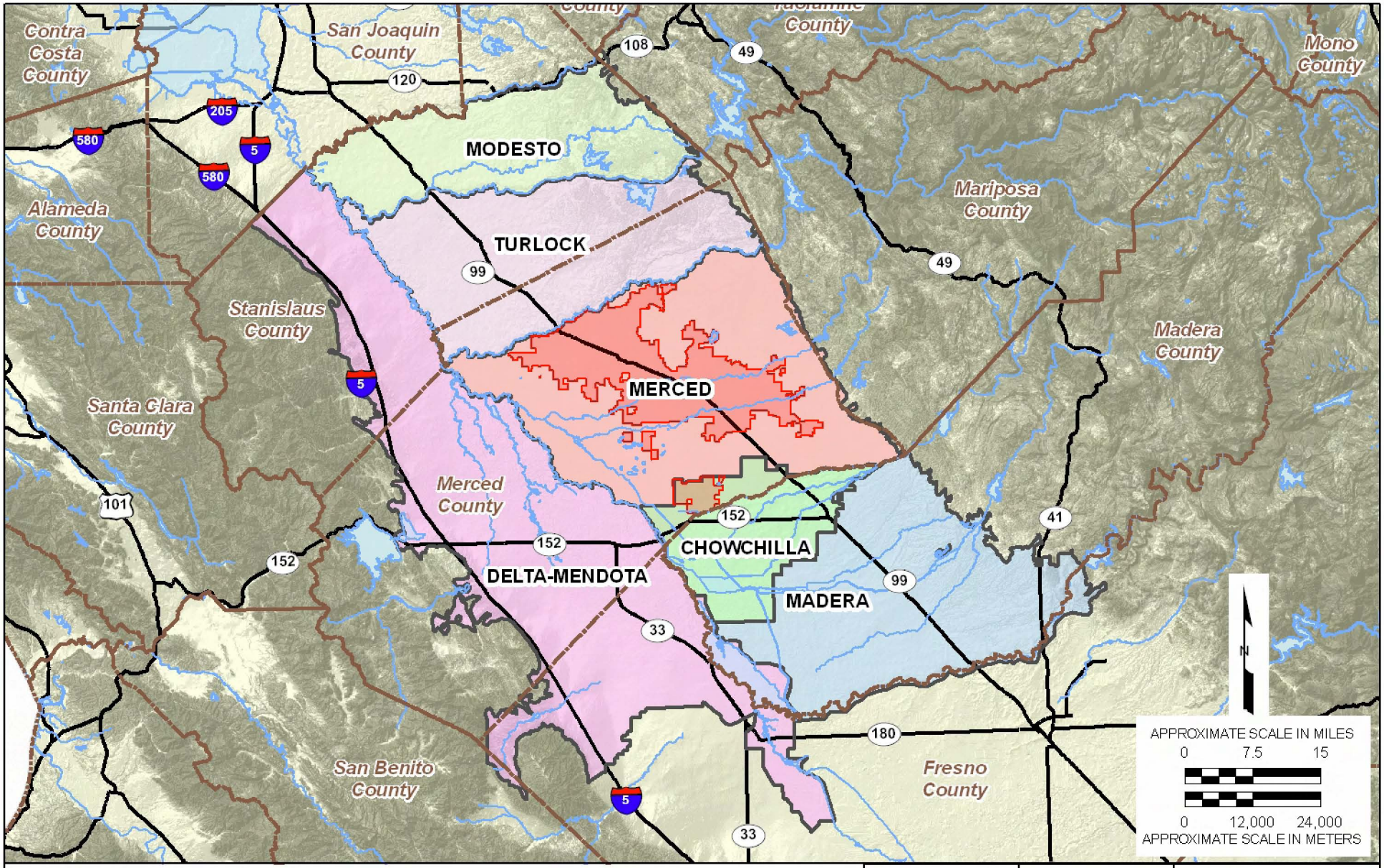
LOCATION MAP

Groundwater Management Plan Update
Merced, California

By: dmb | Date: 5/27/08 | Project No. 1365.1.000

Geomatrix

Figure 1



GROUNDWATER BASINS - SAN JOAQUIN BASIN HYDROLOGIC STUDY AREA

Groundwater Management Plan Update

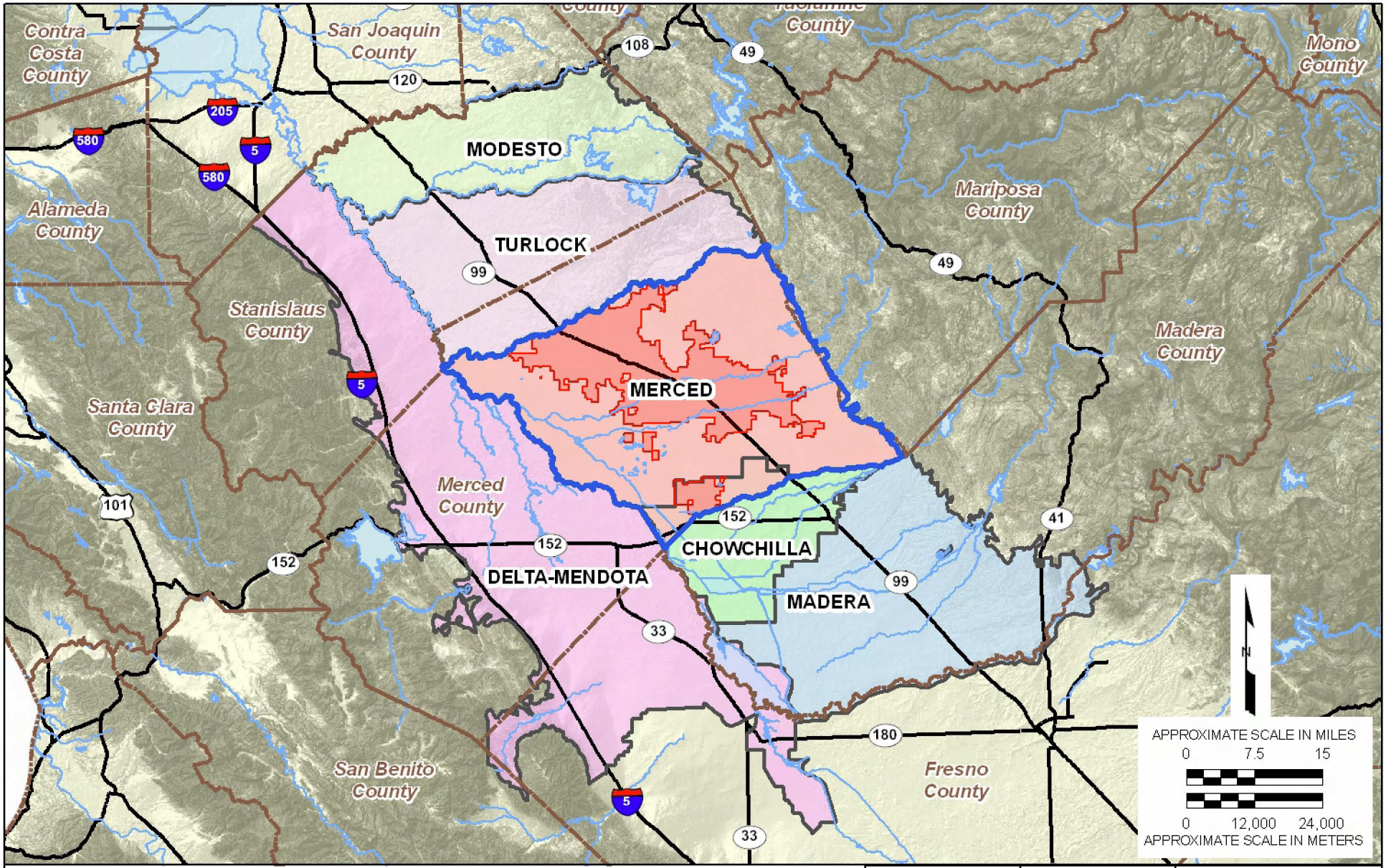
Merced, California

Groundwater Management Plan Update
Merced, California

By: dmb | Date: 5/27/08 | Project No. 13651.000

Geomatrix

Figure 2 13

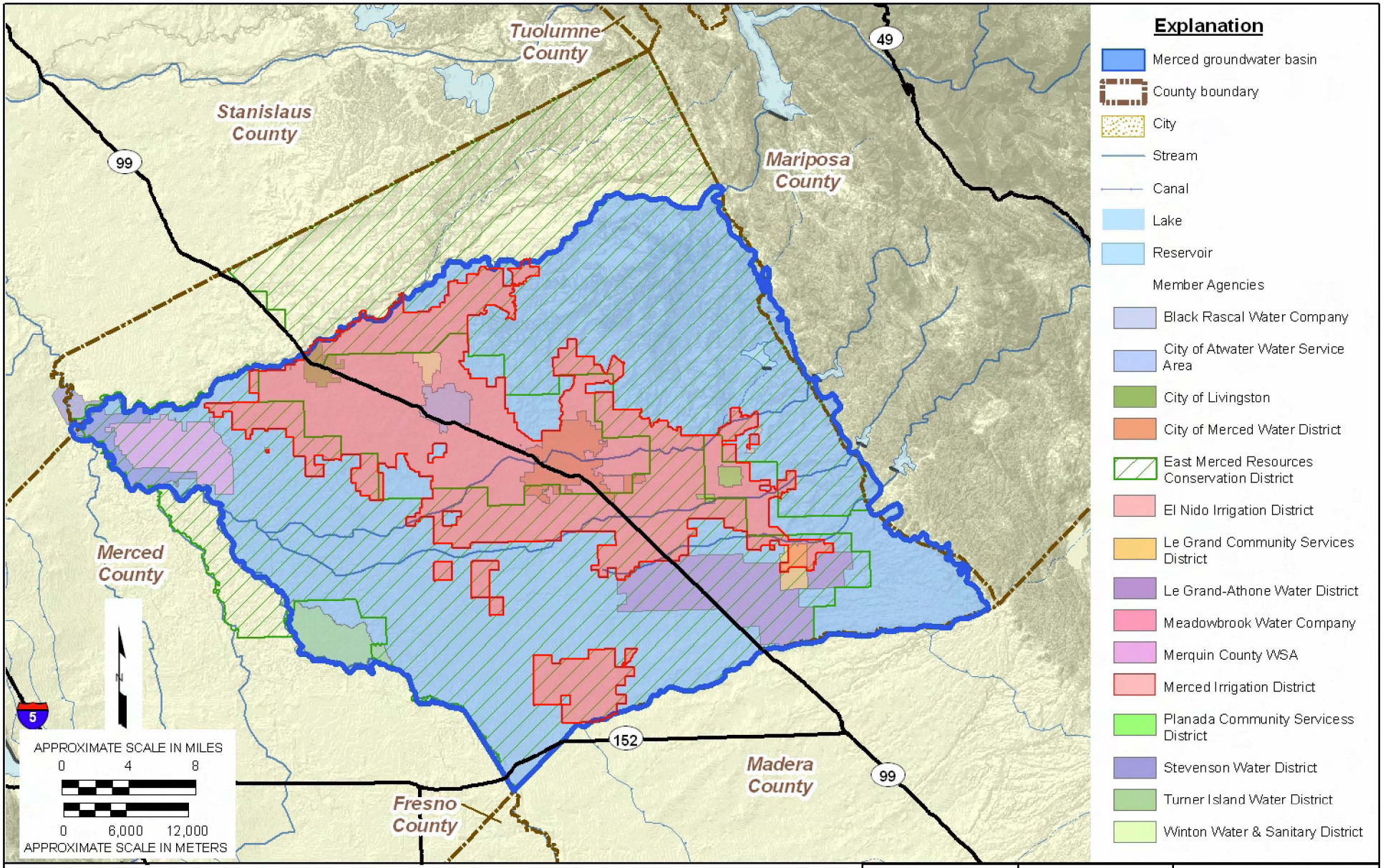


MODIFIED MERCED GROUNDWATER BASINS
SAN JOAQUIN BASIN HYDROLOGIC STUDY AREA
Groundwater Management Plan Update
Merced, California

By: dmb | Date: 5/27/08 | Project No. 13651.000

Geomatrix

Figure 3 13



MAGPI AGENCIES WITHIN THE MERCED GROUNDWATER BASIN

Groundwater Management Plan Update

Merced, California

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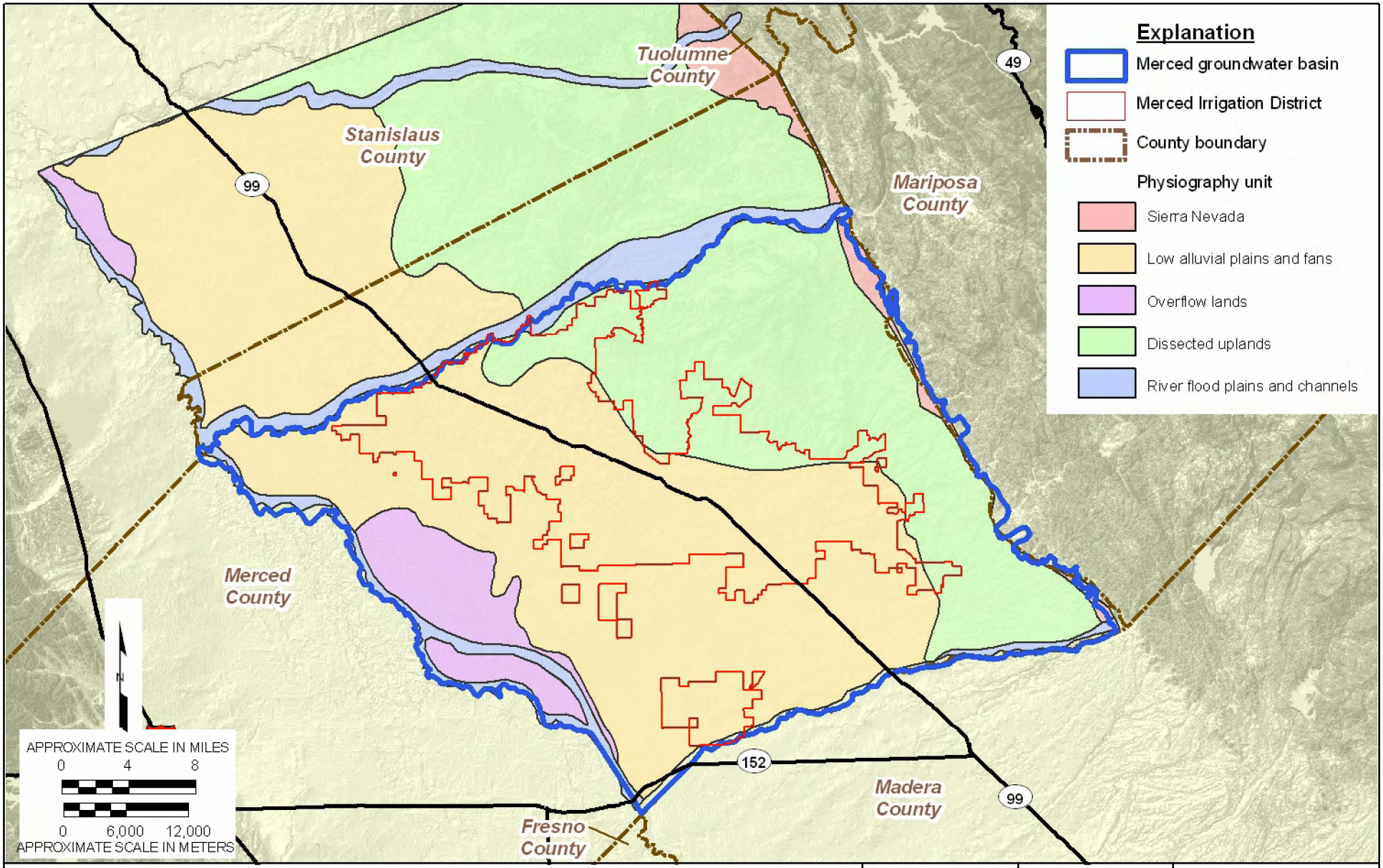
Geomatrix

Figure 4 13



PHYSIOGRAPHIC UNITS WITHIN THE MERCED GROUNDWATER BASIN

Groundwater Management Plan Update

Groundwater Management Plan Update
Merced, California

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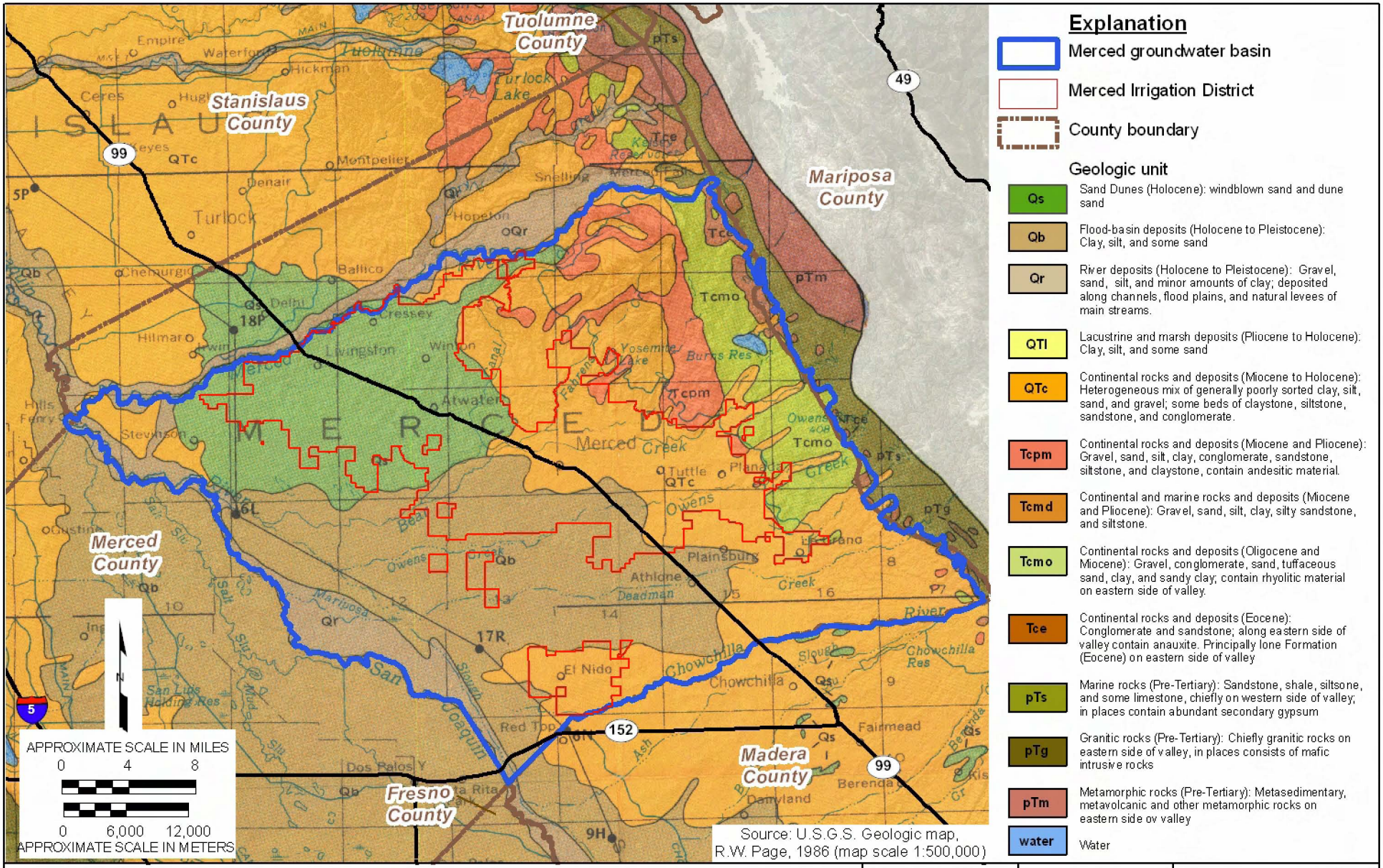
Figure 5 13



Explanation

- Merced groundwater basin
- Merced Irrigation District
- County boundary

Geologic unit

Qs	Sand Dunes (Holocene): windblown sand and dune sand
Qb	Flood-basin deposits (Holocene to Pleistocene): Clay, silt, and some sand
Qr	River deposits (Holocene to Pleistocene): Gravel, sand, silt, and minor amounts of clay; deposited along channels, flood plains, and natural levees of main streams.
QTl	Lacustrine and marsh deposits (Pliocene to Holocene): Clay, silt, and some sand
QTc	Continental rocks and deposits (Miocene to Holocene): Heterogeneous mix of generally poorly sorted clay, silt, sand, and gravel; some beds of claystone, siltstone, sandstone, and conglomerate.
Tcpm	Continental rocks and deposits (Miocene and Pliocene): Gravel, sand, silt, clay, conglomerate, sandstone, siltstone, and claystone, contain andesitic material.
Tcmd	Continental and marine rocks and deposits (Miocene and Pliocene): Gravel, sand, silt, clay, silty sandstone, and siltstone.
Tcmo	Continental rocks and deposits (Oligocene and Miocene): Gravel, conglomerate, sand, tuffaceous sand, clay, and sandy clay; contain rhyolitic material on eastern side of valley.
Tce	Continental rocks and deposits (Eocene): Conglomerate and sandstone; along eastern side of valley contain anauxite. Principally lone Formation (Eocene) on eastern side of valley
pTs	Marine rocks (Pre-Tertiary): Sandstone, shale, siltsone, and some limestone, chiefly on western side of valley; in places contain abundant secondary gypsum
pTg	Granitic rocks (Pre-Tertiary): Chiefly granitic rocks on eastern side of valley, in places consists of mafic intrusive rocks
pTm	Metamorphic rocks (Pre-Tertiary): Metasedimentary, metavolcanic and other metamorphic rocks on eastern side ov valley
water	Water

GENERALIZED GEOLOGY - MERCED GROUNDWATER BASIN
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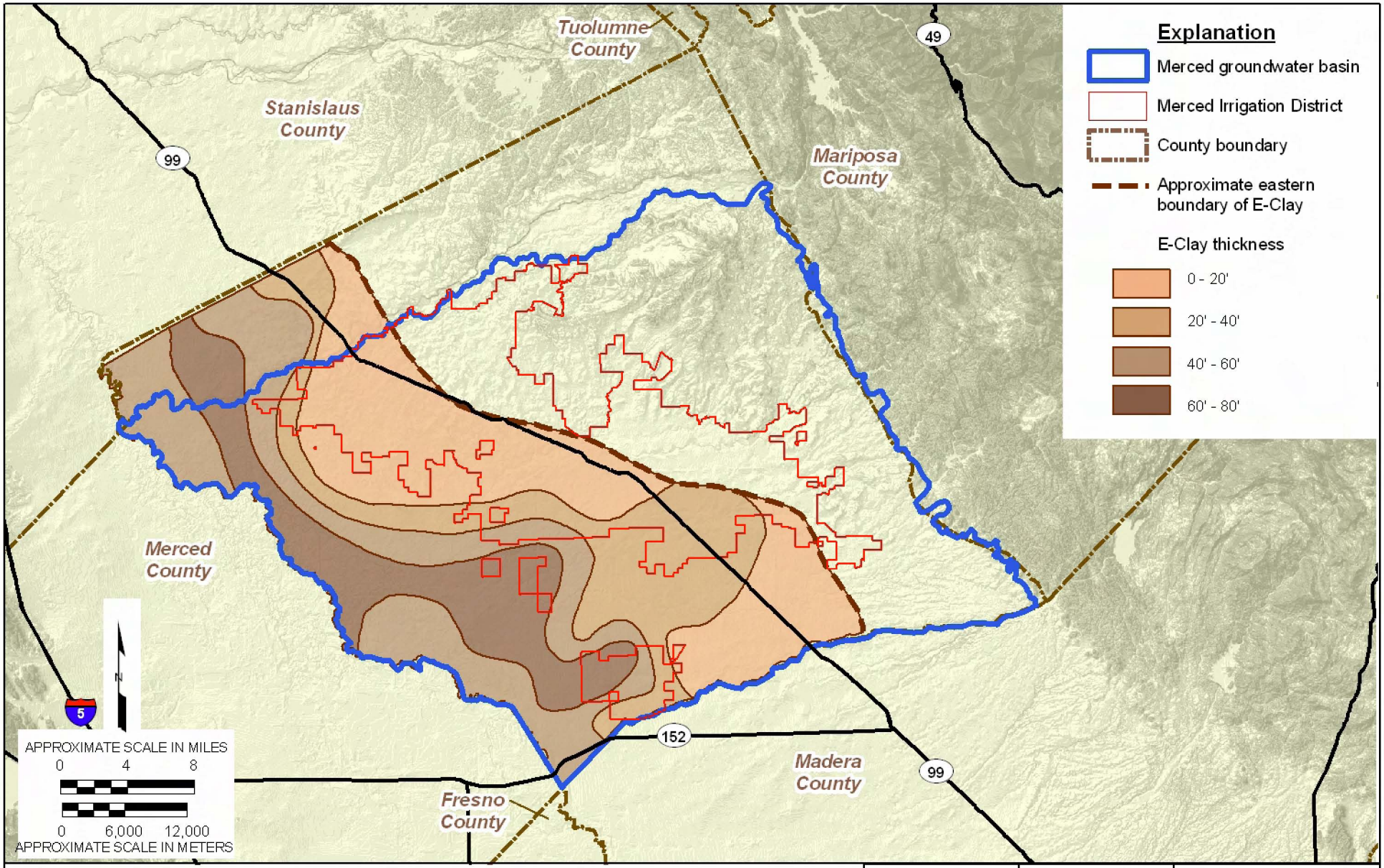
Figure 6 13



LATERAL EXTENT OF THE CORCORAN CLAY - MERCED GROUNDWATER BASIN

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Merced, California

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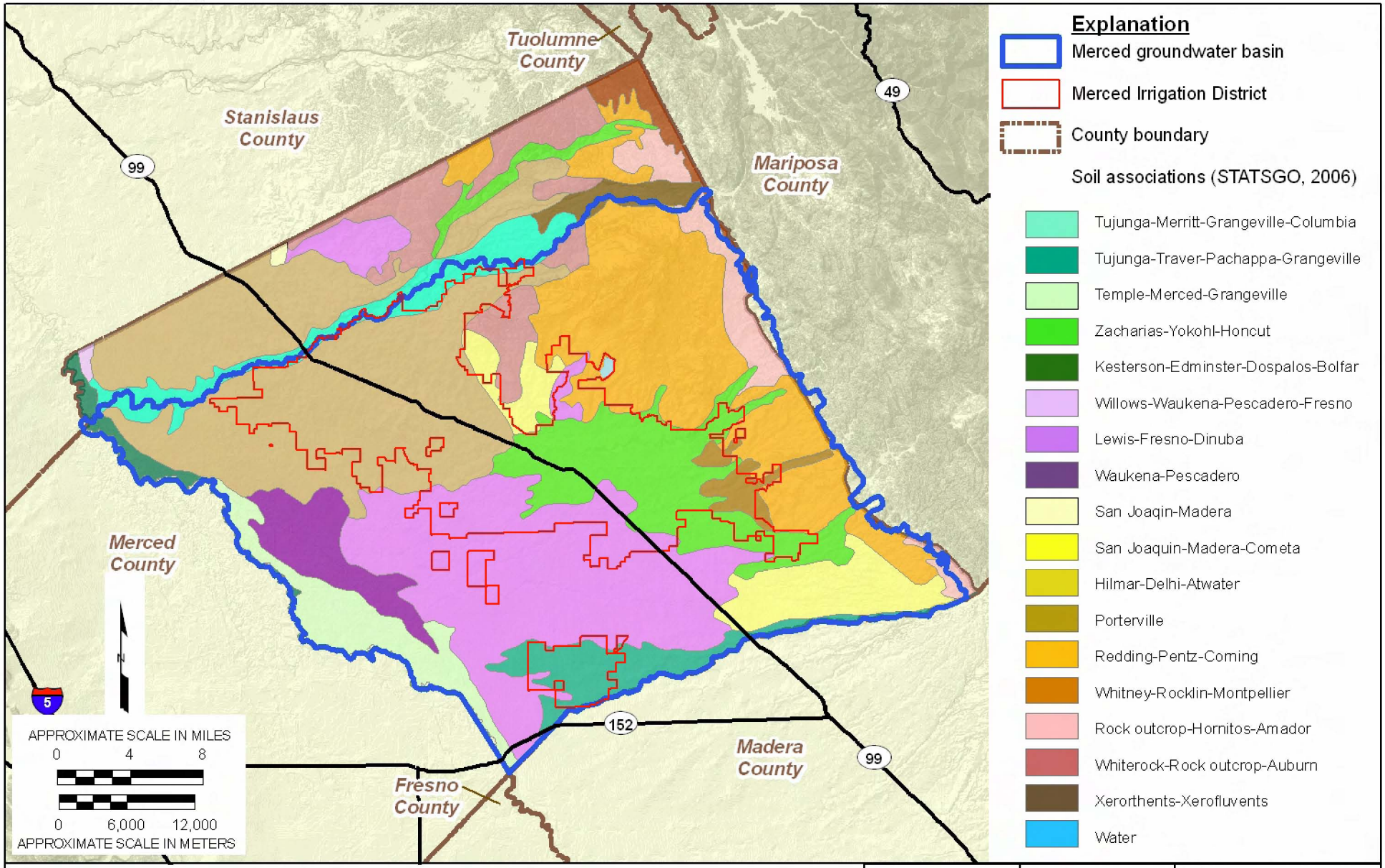
Figure 7 13



SOIL ASSOCIATIONS MAP - MERCED GROUNDWATER BASIN

Groundwater Management Plan Update

Merced, California

Groundwater Management Plan Update
Merced, California

By: dmb | Date: 5/27/08 | Project No. 13651.000

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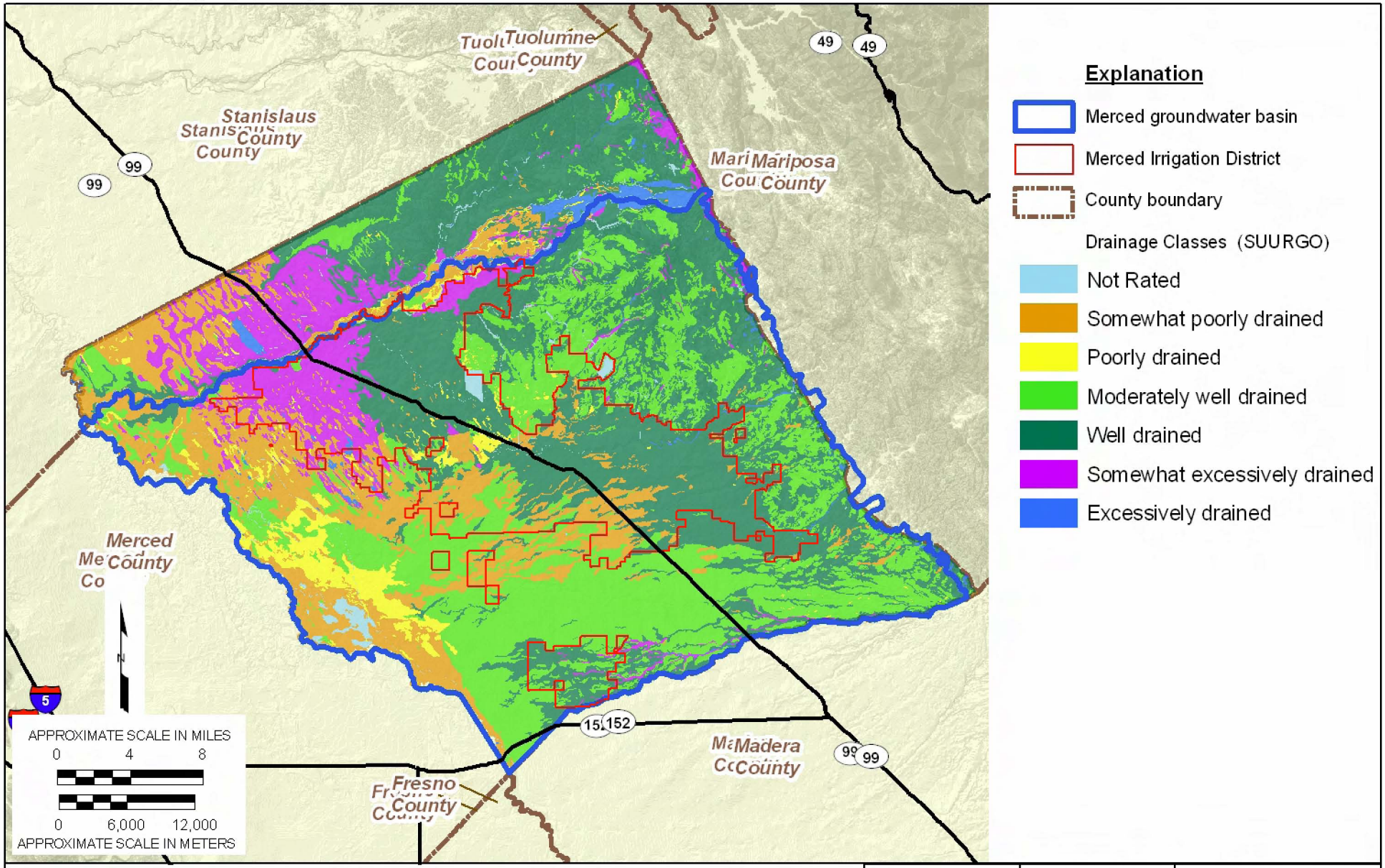
Figure 8 13



ESTIMATED SOIL PERMEABILITY MAP - MERCED GROUNDWATER BASIN

Groundwater Management Plan Update
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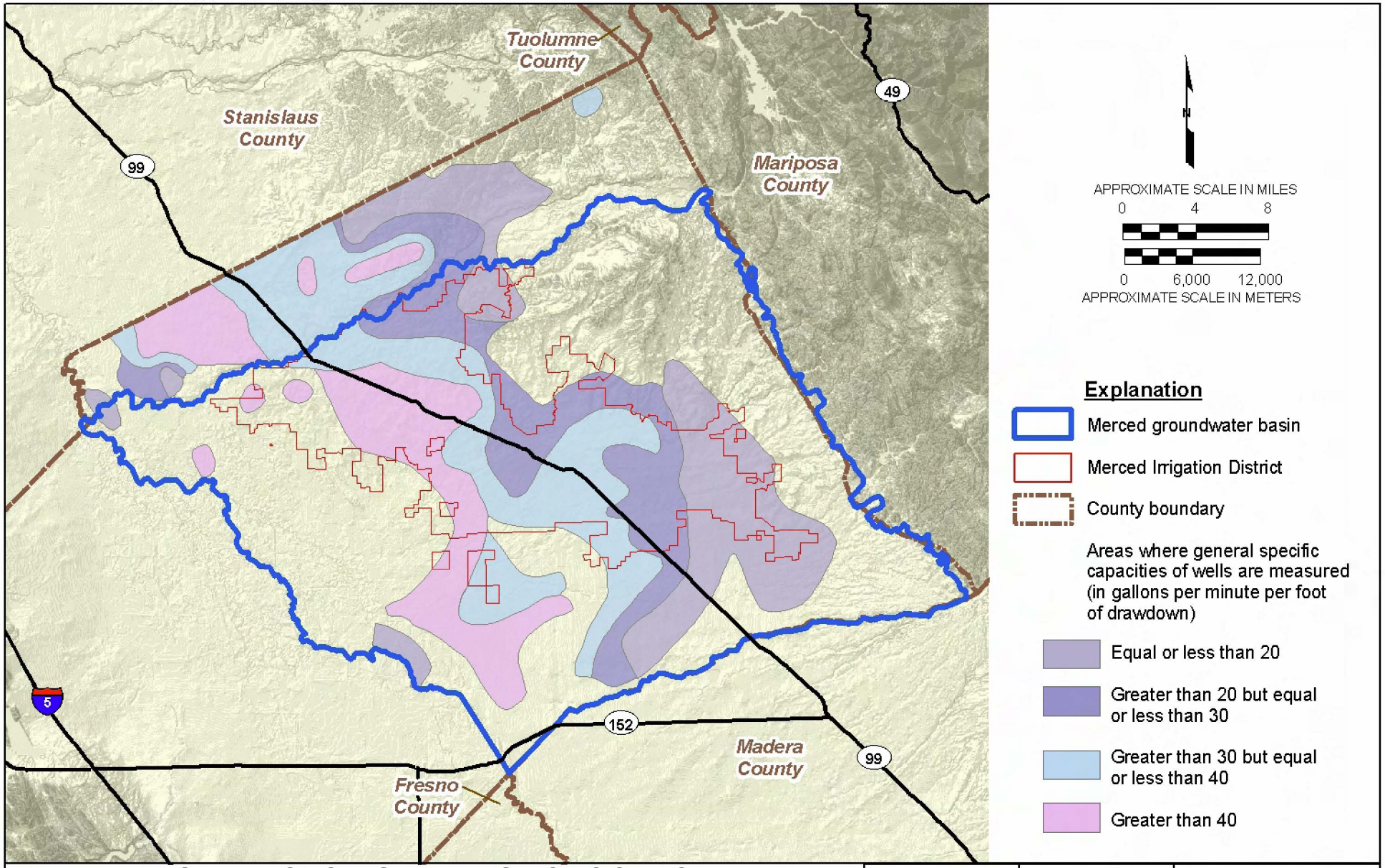
Geomatrix

Figure 9 13



DISTRIBUTION OF ESTIMATED SPECIFIC CAPACITY

ESTIMATED DISTRIBUTION OF SPECIFIC CAPACITY - MERCED GROUNDWATER BASIN

MERCED GROUNDWATER BASIN

Groundwater Management Plan Update

Groundwater Management Plan Update

Merced, California

Merced, California

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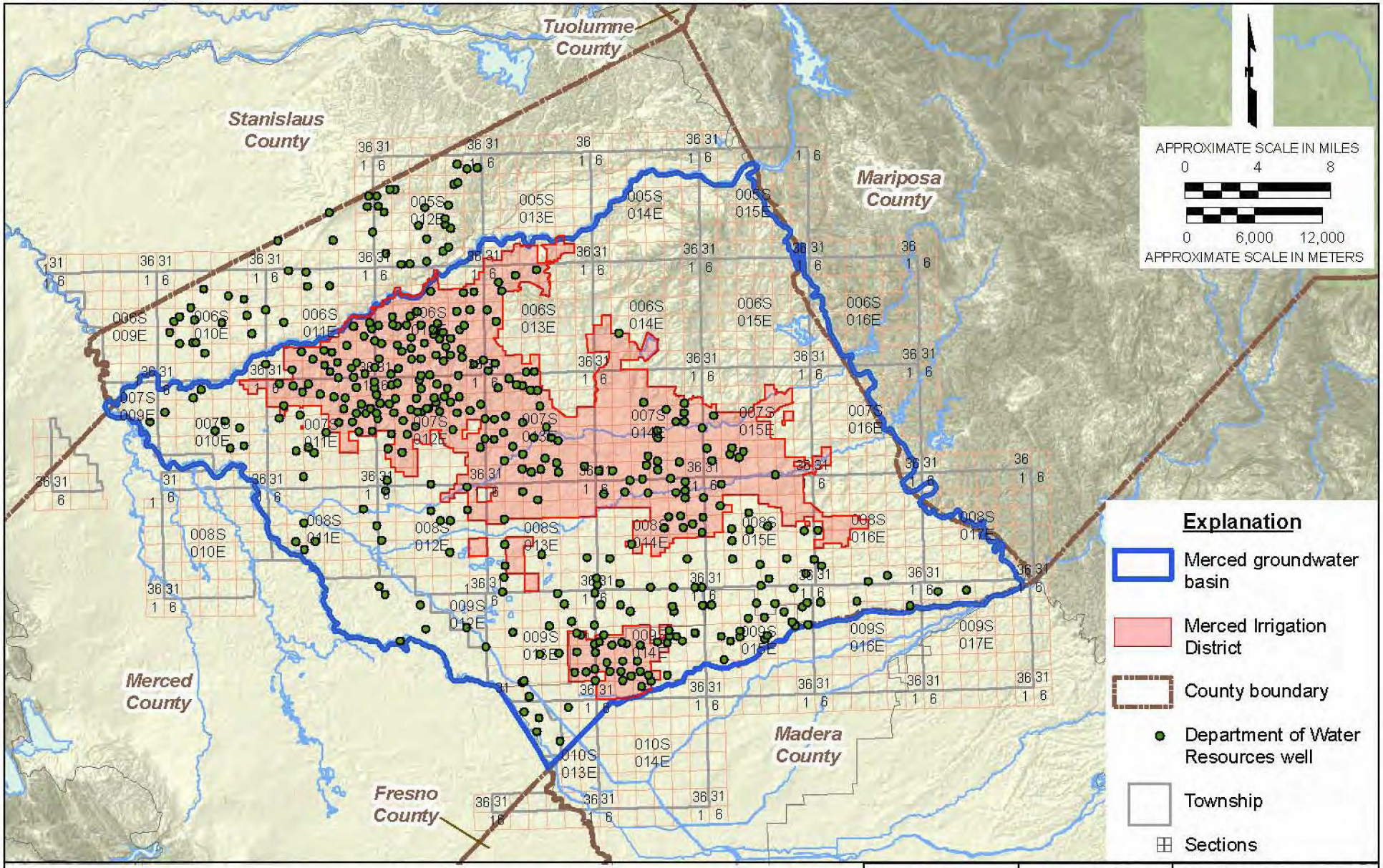
Figure 10



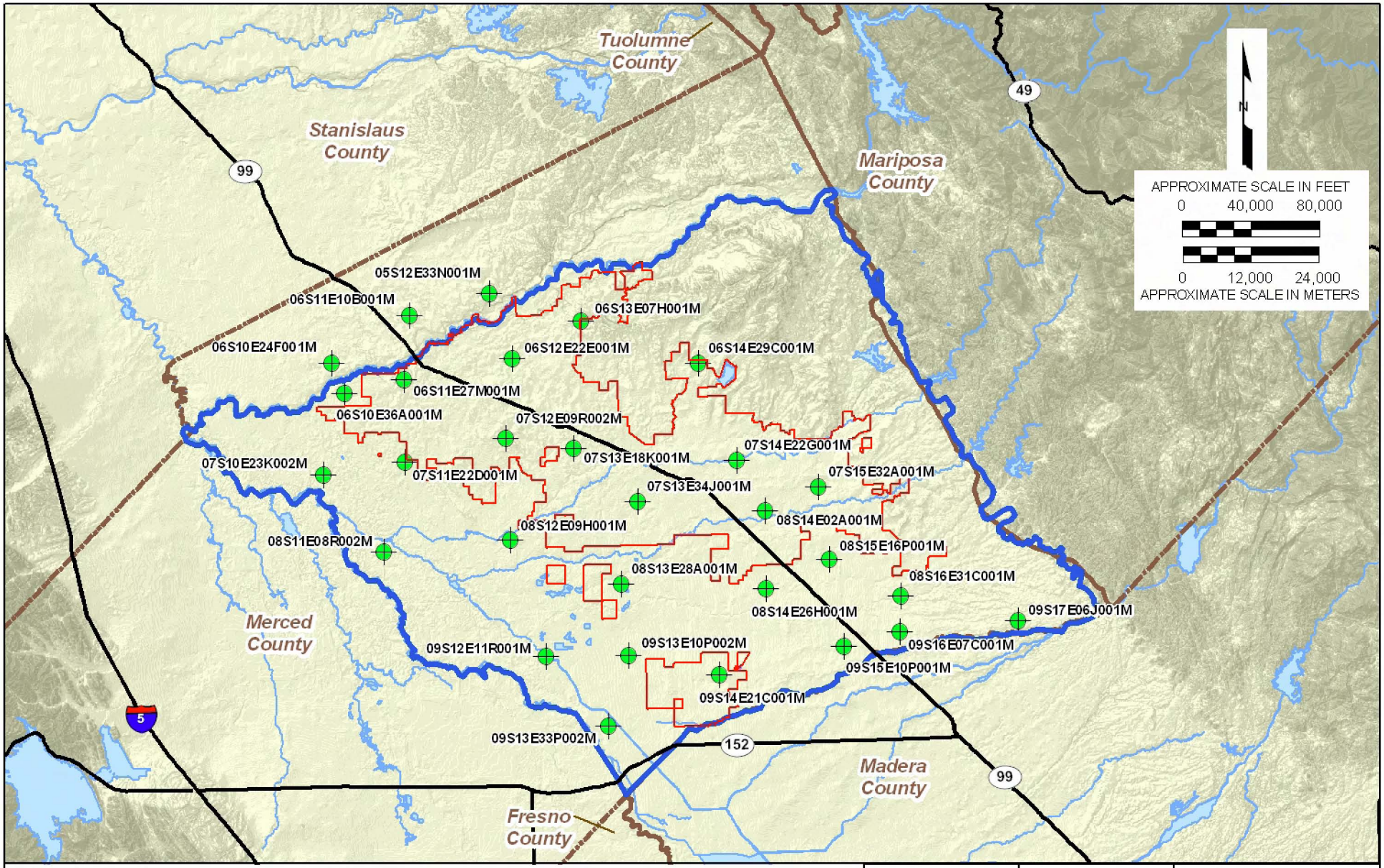
MONITORED WATER SUPPLY WELLS WITHIN THE MERCED GROUNDWATER BASIN

Merced Groundwater Basin
Groundwater Management Plan Update
Merced, California

By: dmb | Date: 5/27/08 | Project No. 13651.000

Geomatrix

Figure 1113



SELECTED WATER SUPPLY WELLS FOR LONG-TERM HYDROGRAPHS

Groundwater Management Plan Update
Merced, California

Groundwater Management Plan Update
Merced, California

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Figure 12

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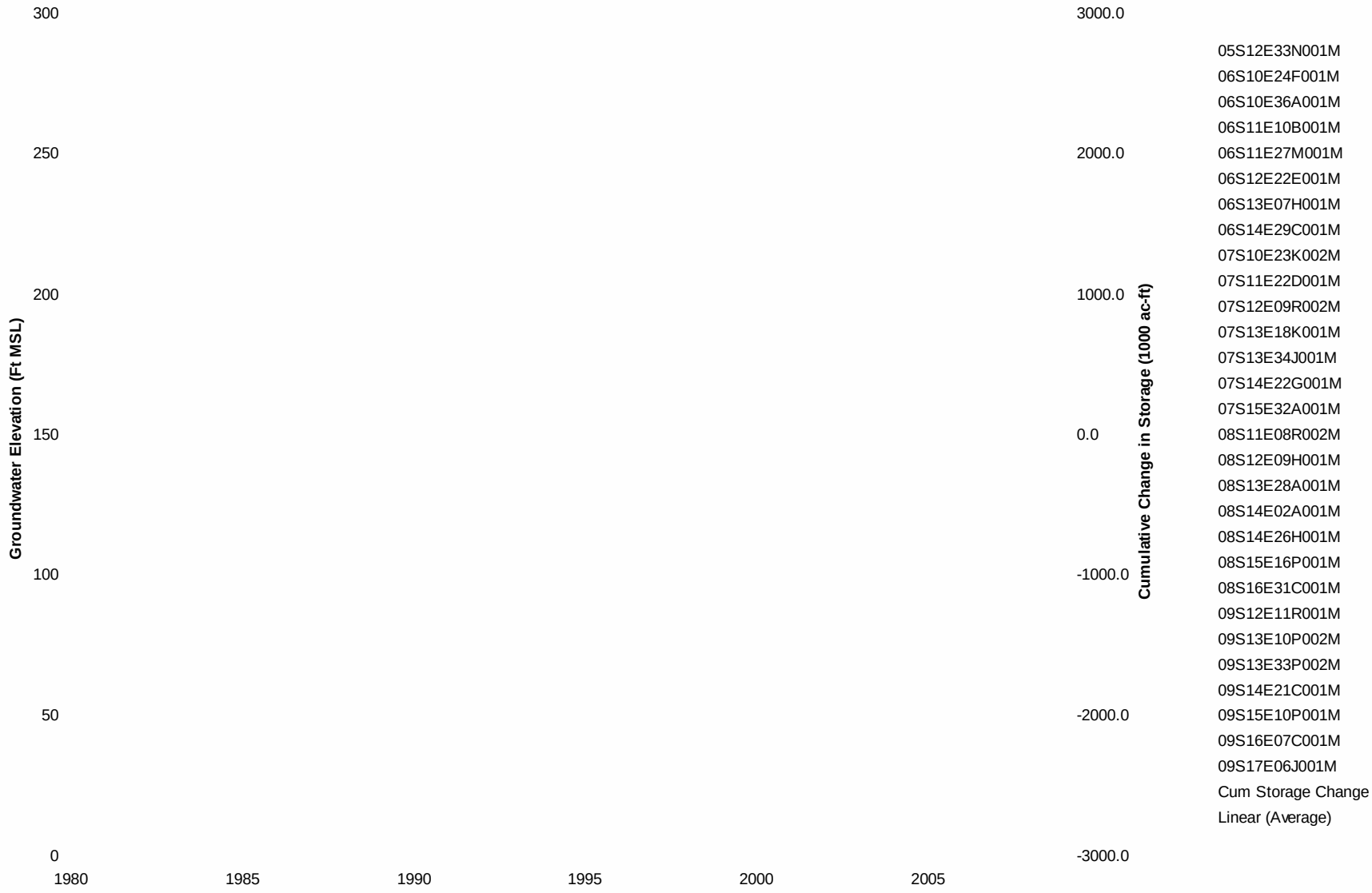

LONG-TERM HYDROGRAPHS IN SELECTED MONITORING WELLS
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Geomatrix

Figure **13**

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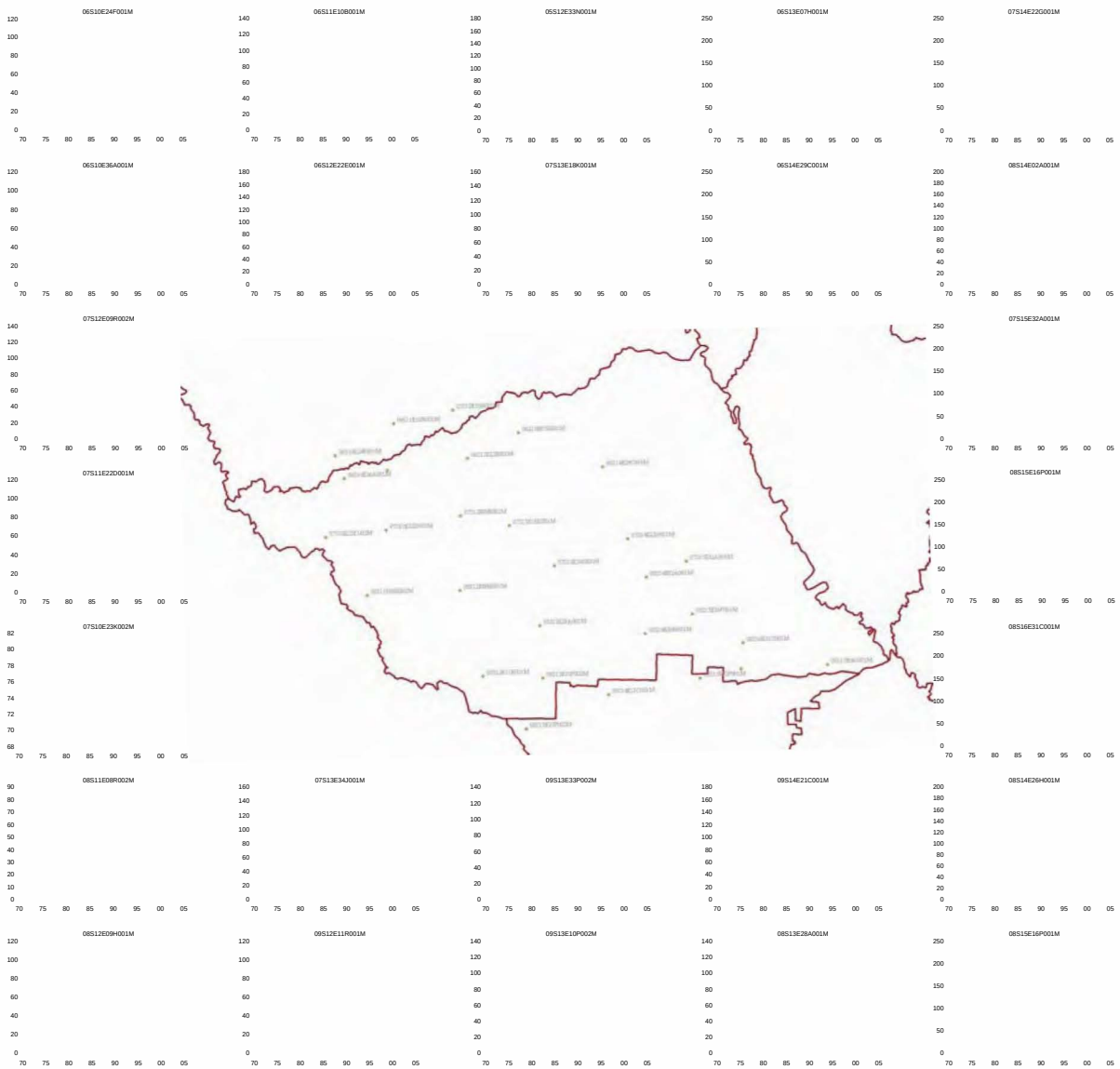

Explanation

Ground Surface Elevation

Groundwater Elevation

SPATIAL DISTRIBUTION OF LONG-TERM HYDROGRAPHS
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

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Figure **14**

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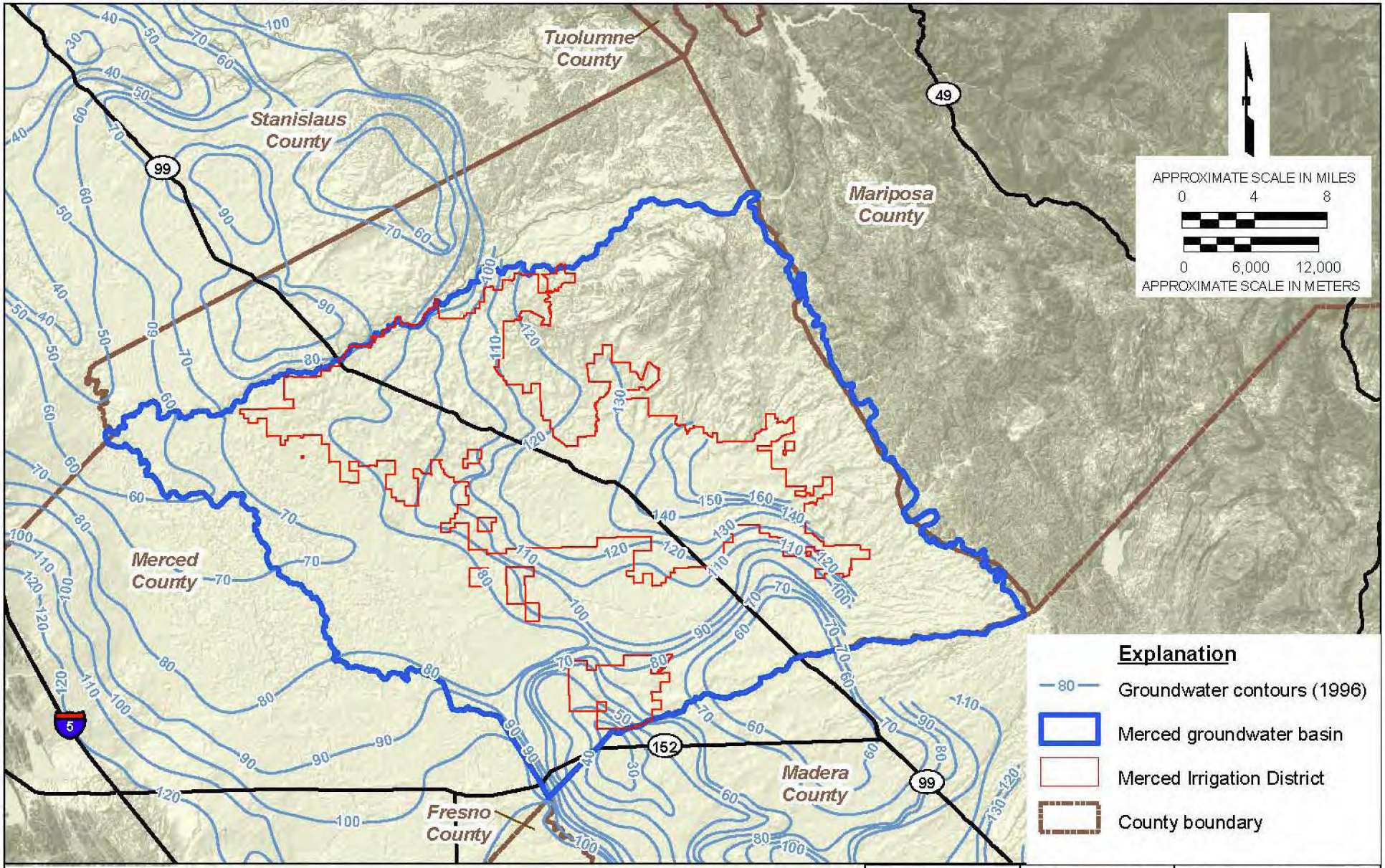
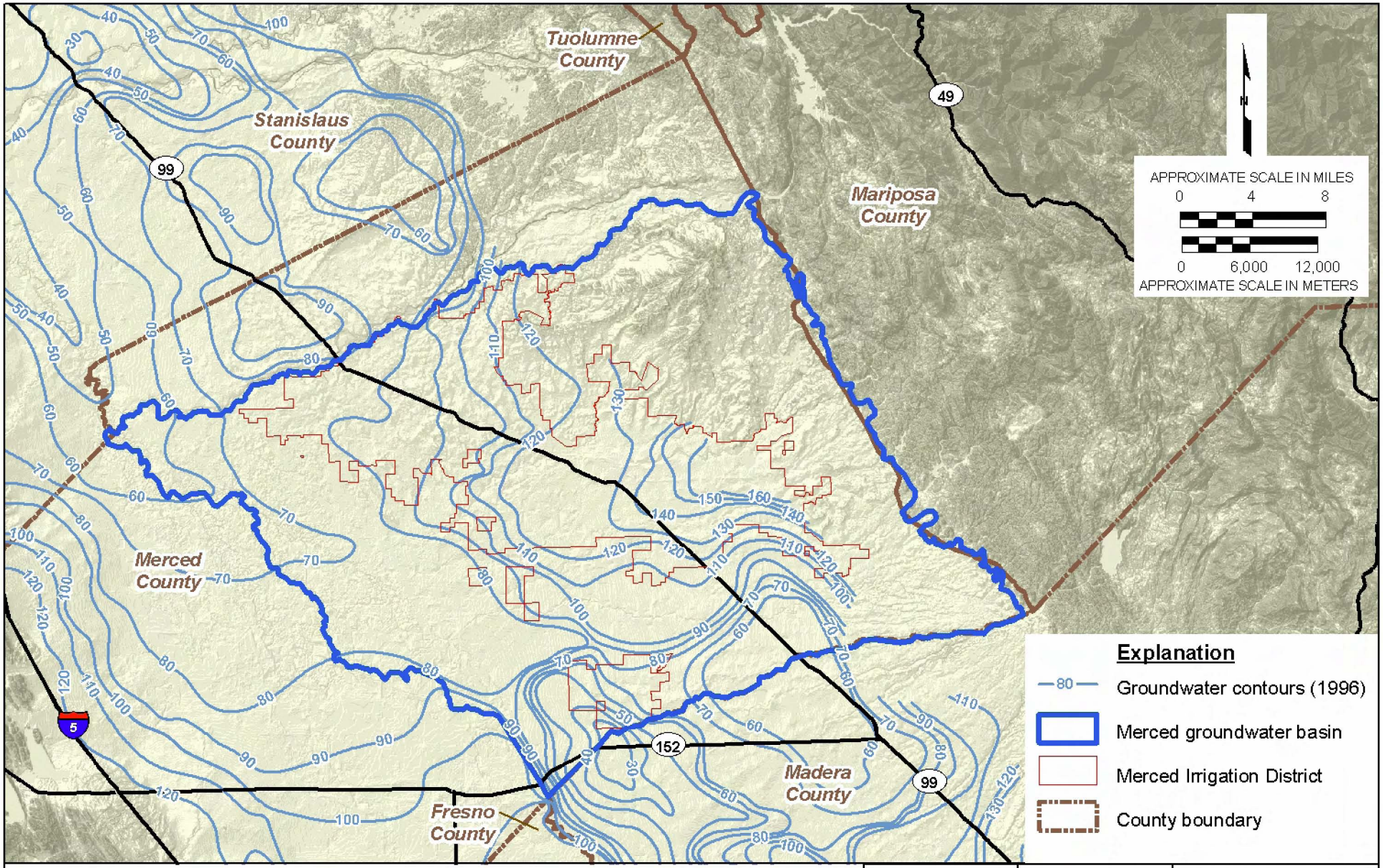


DWR 1996 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: dmb | Date: 5/27/08 | Project No. 13651.000

Geomatrix

Figure 15



DWR 2006 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER

Groundwater Management Plan Update

Merced, California

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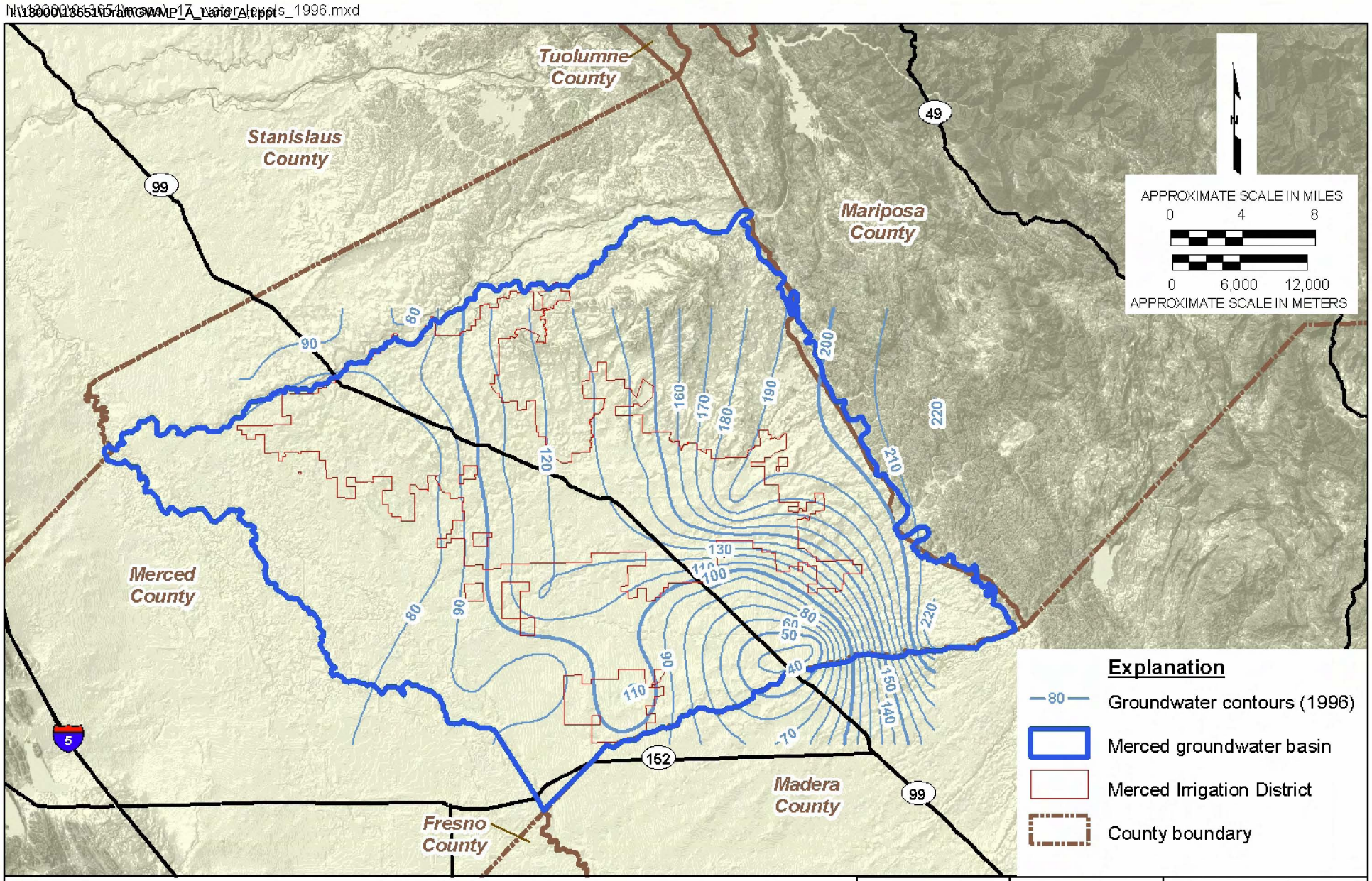
Geomatrix

Figure 16-13



SIMPLIFIED 1996 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER

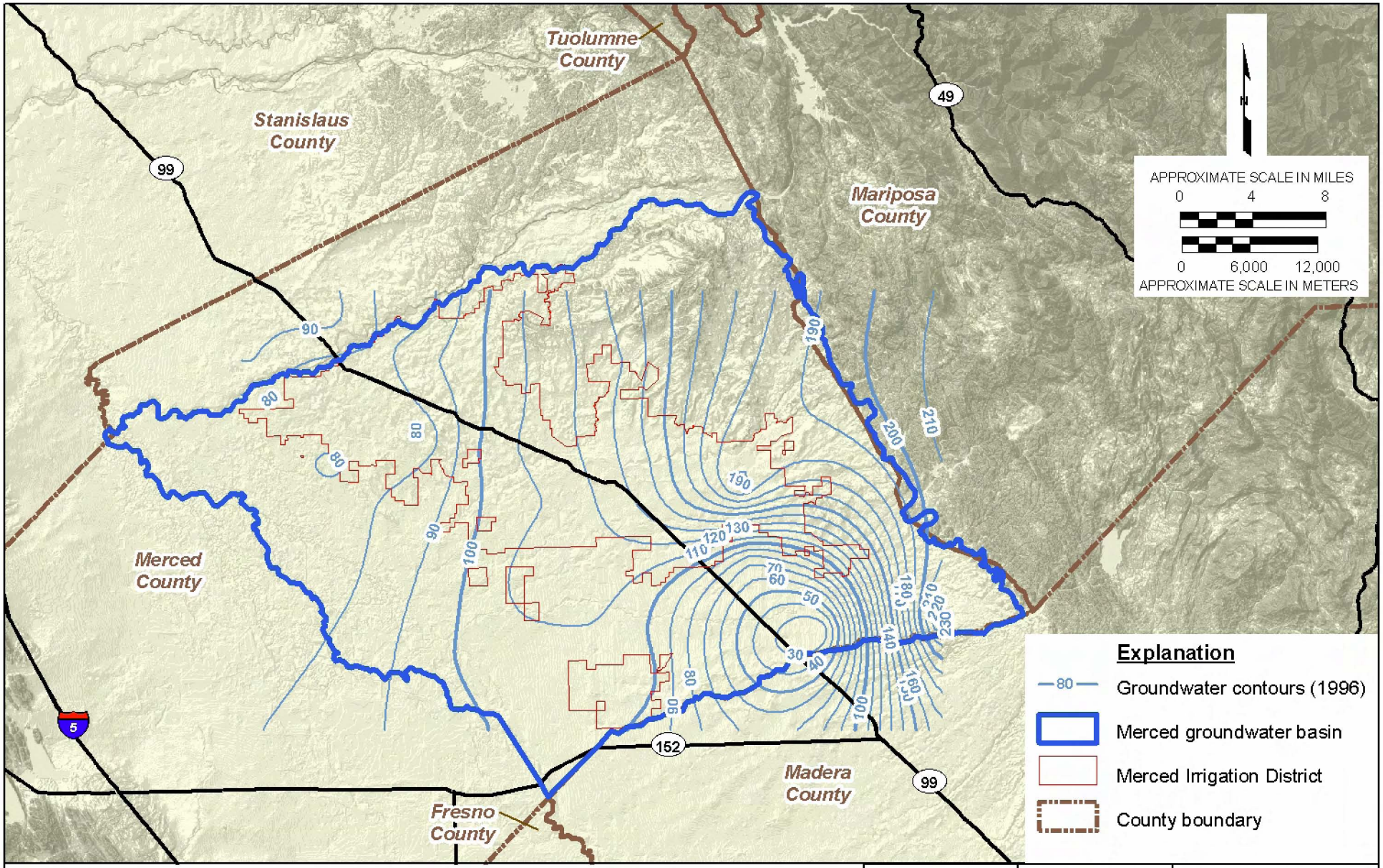
Groundwater Management Plan Update

Merced, California

By: dmb | Date: 5/27/08 | Project No. 13651.000

Geomatrix

Figure 17



SIMPLIFIED 2006 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER

Groundwater Management Plan Update
Groundwater Management Plan Update
Merced, California
Merced, California

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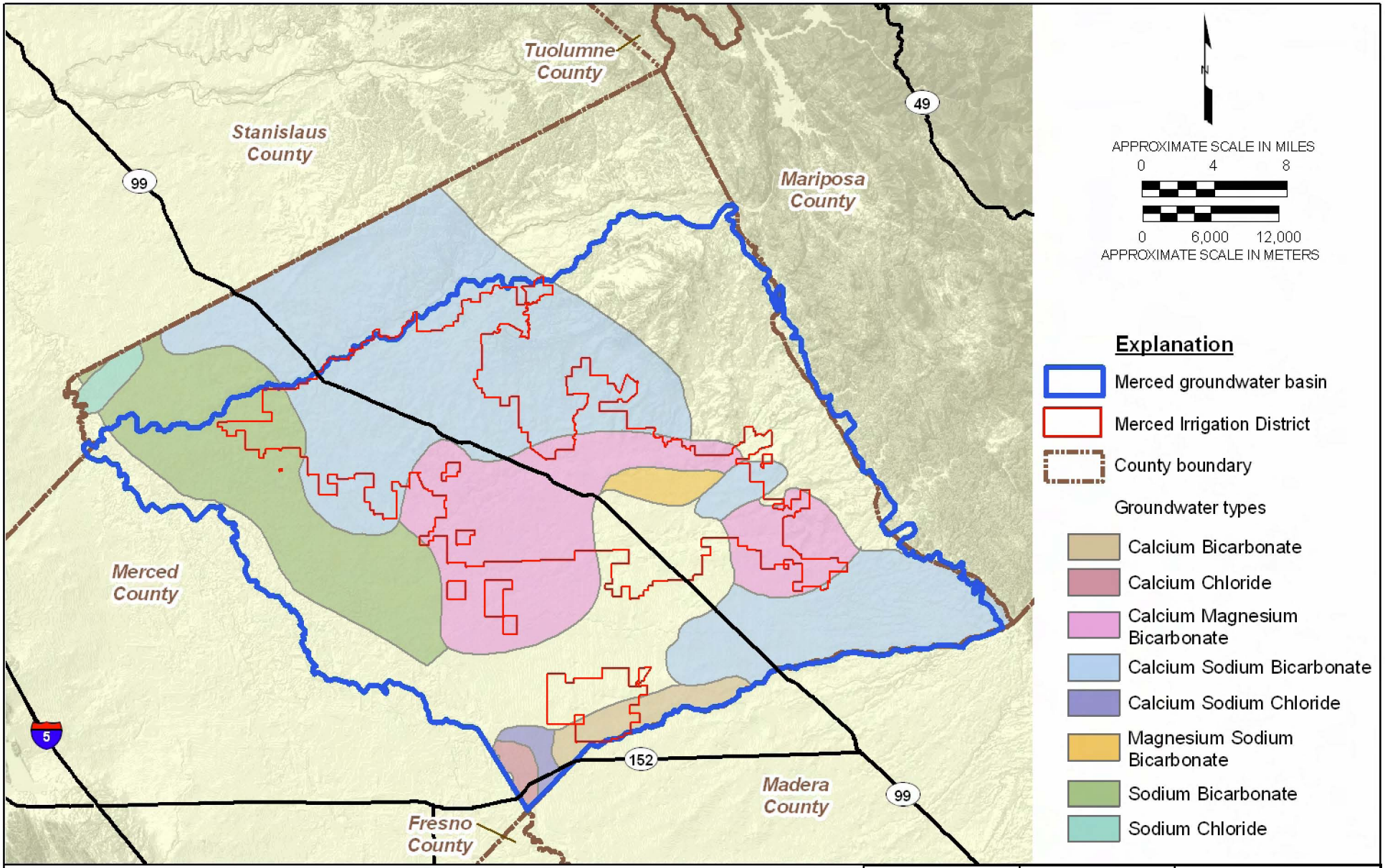
Geomatrix

Figure 13



DISTRIBUTION OF GROUNDWATER TYPES - MERCED GROUNDWATER BASIN

Groundwater Management Plan Update

Merced, California

Groundwater Management Plan Update
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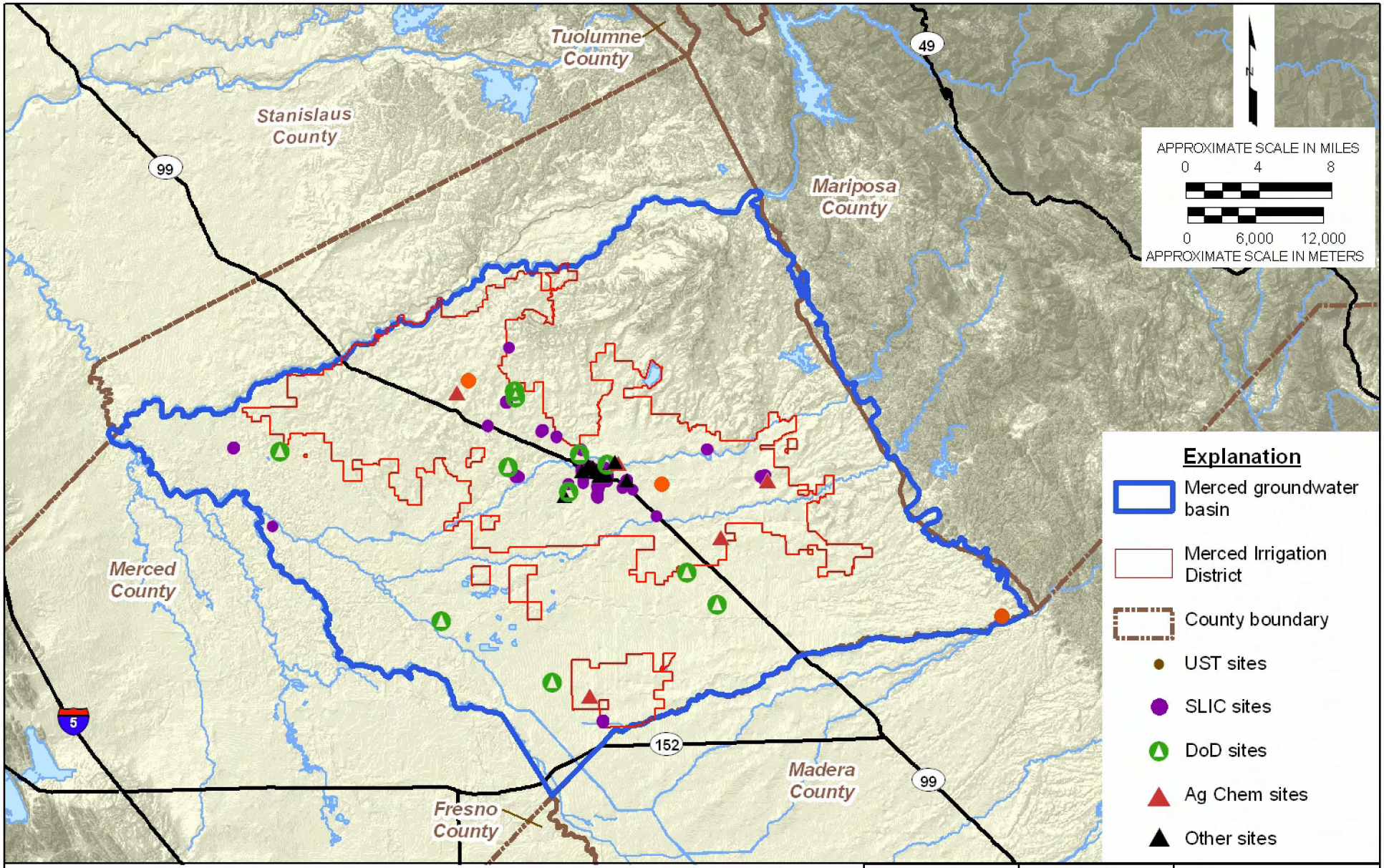
Geomatrix

Figure 1-3



LOCATIONS OF KNOWN LEAKY USTs AND CHEMICAL RELEASES

Groundwater Management Plan Update
Merced, California

Groundwater Management Plan Update
Merced, California

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Figure 2013

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HISTORICAL ANNUAL PRECIPITATION
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Geomatrix

Figure **21**

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HISTORICAL MONTHLY AVERAGE PRECIPITATION
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
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Figure **22**

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High SPI Values (~3) indicate wet periods

Medium SPI values (~0) indicate normal precipitation

Low SPI values (~-3) indicate periods of drought

STANDARDIZED PRECIPITATION INDEX
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

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Figure **23**

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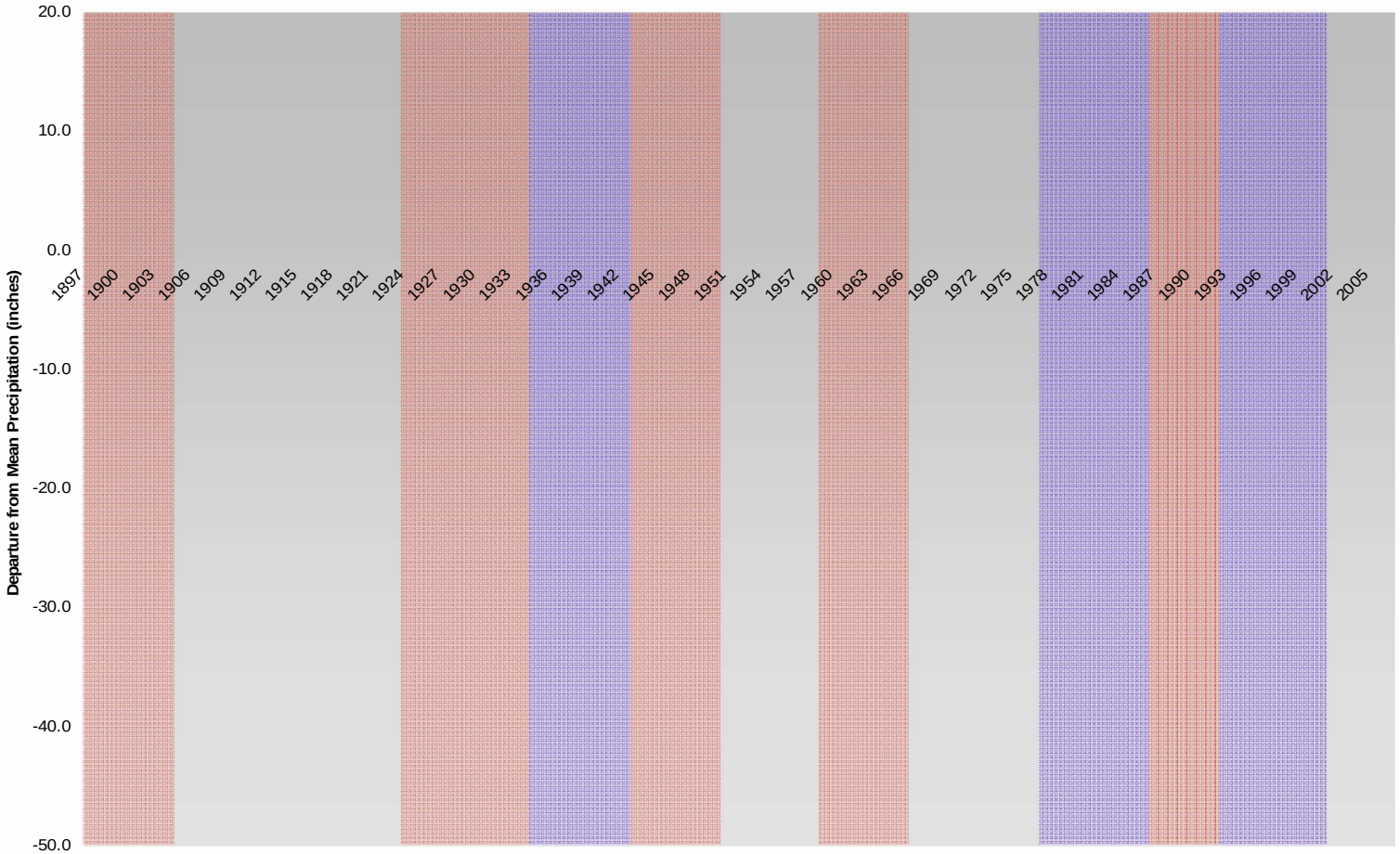

CUMULATIVE PRECIPITATION DEPARTURE CURVE
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

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Figure **24**

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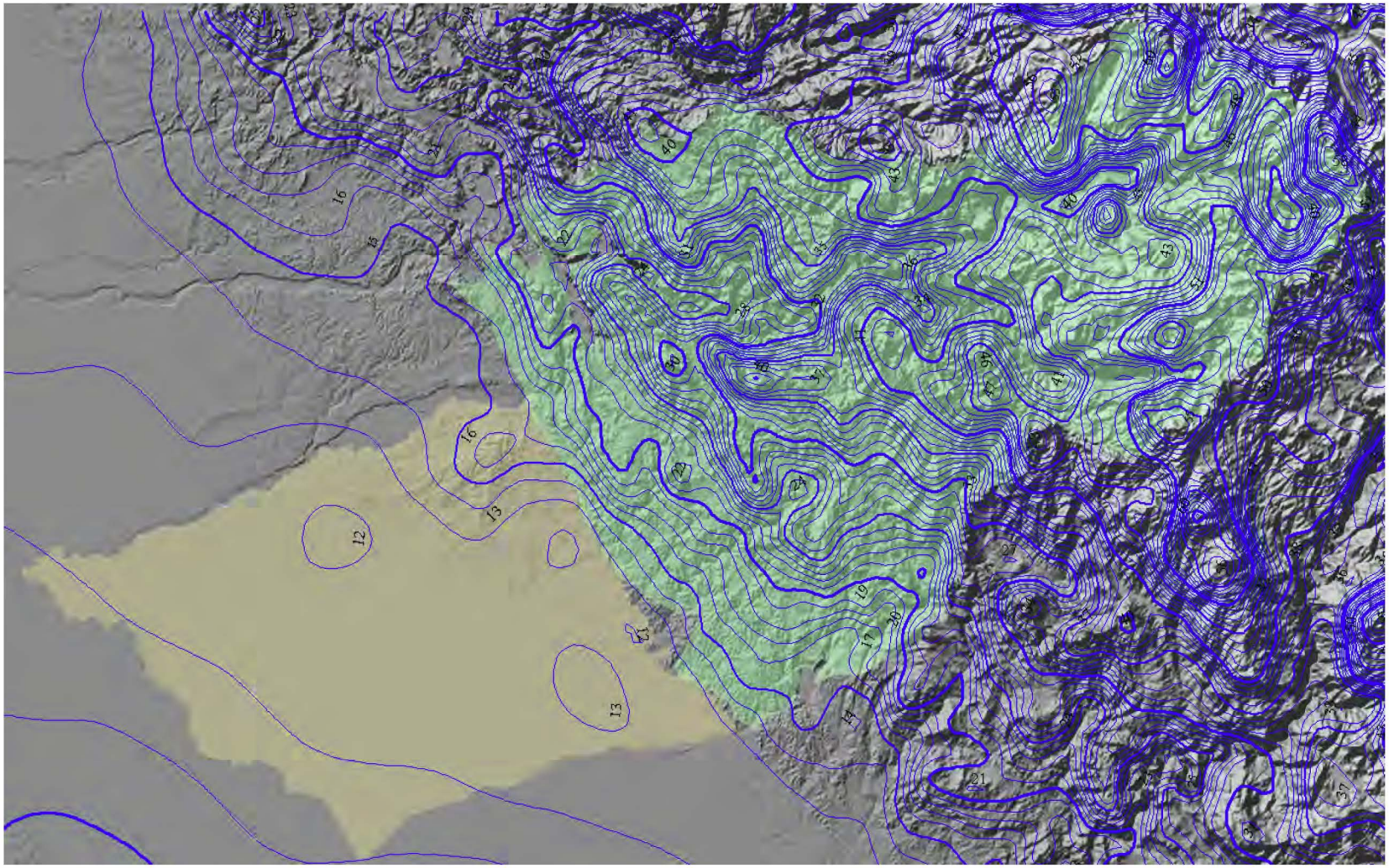

Merced Groundwater Basin Watersheds Tributary to Merced Groundwater Basin

1971-2000 Average Isoheytal Contours

1971 – 2000 AVERAGE ISOHEYTAL CONTOURS
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

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Figure **25**

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1990 – 2007 LAKE MCCLURE RESERVOIR STAGE
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

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Geomatrix

Figure **26**

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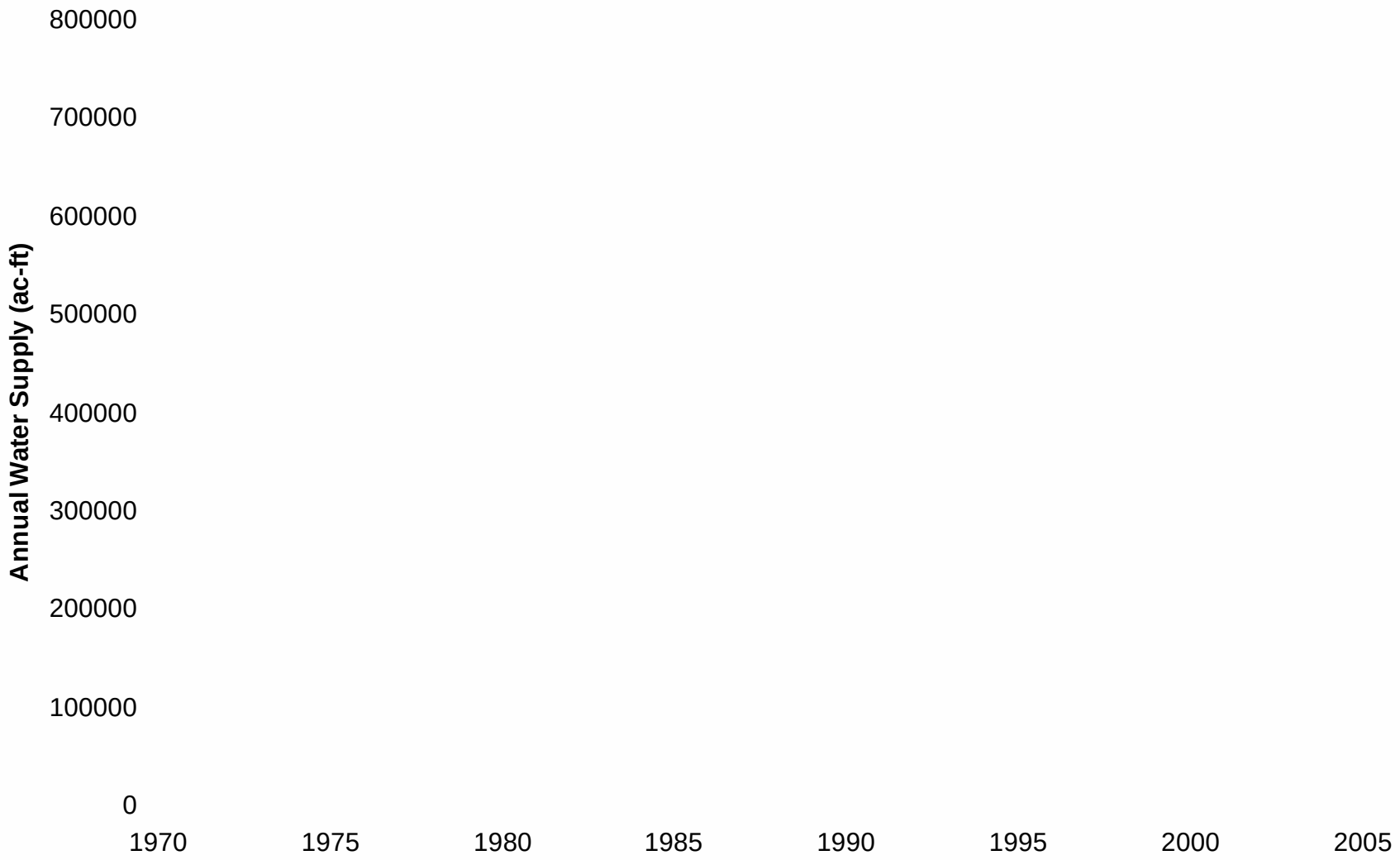

1970 – 2007 MERCED RIVER DERVERSIONS
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
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Figure **27**

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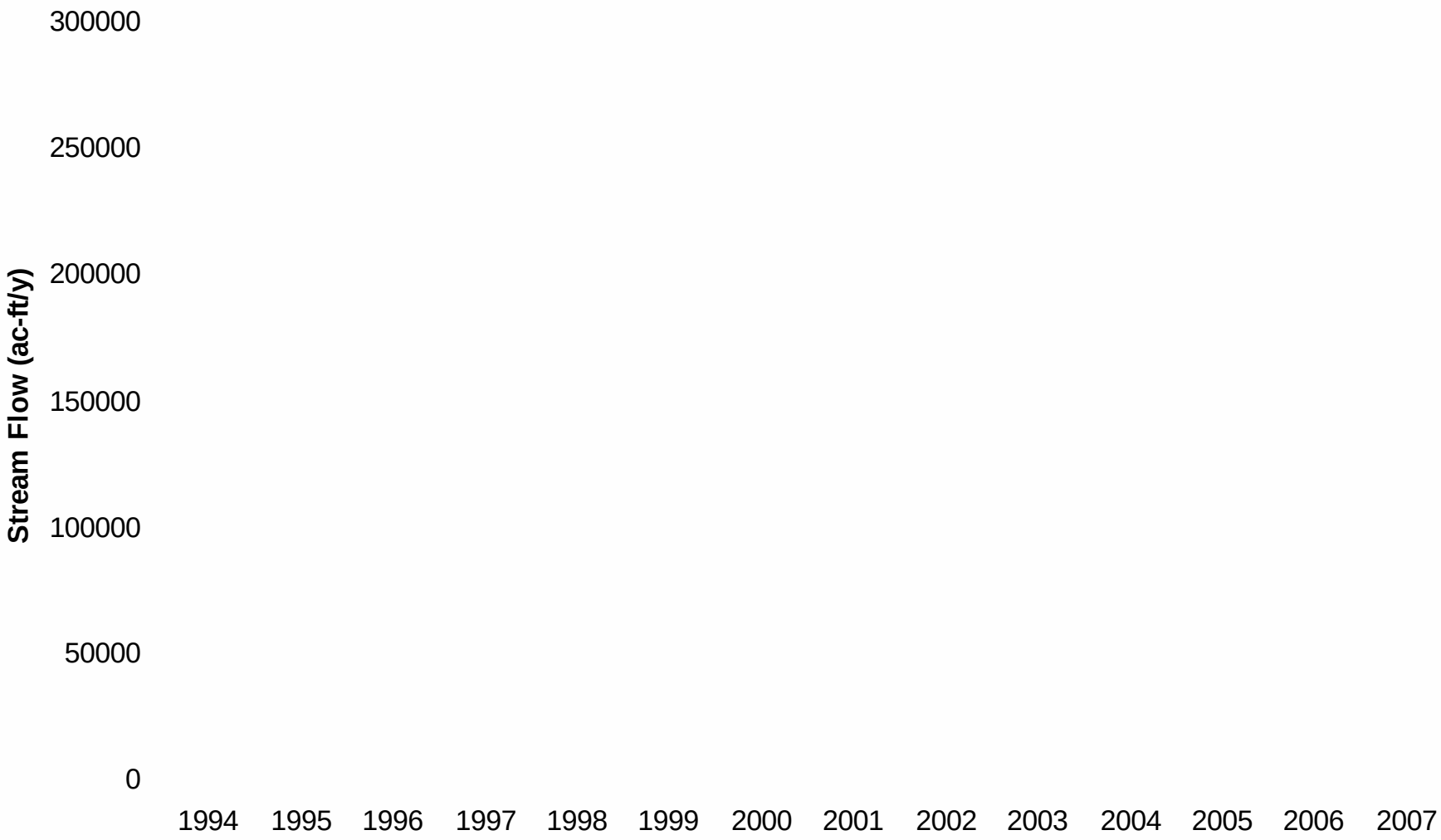

1994 – 2007 TRIBUTARY STREAM FLOW INTO THE MERCED GROUNDWATER BASIN

Groundwater Management Plan Update
Merced, California

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Geomatrix

Figure **28**

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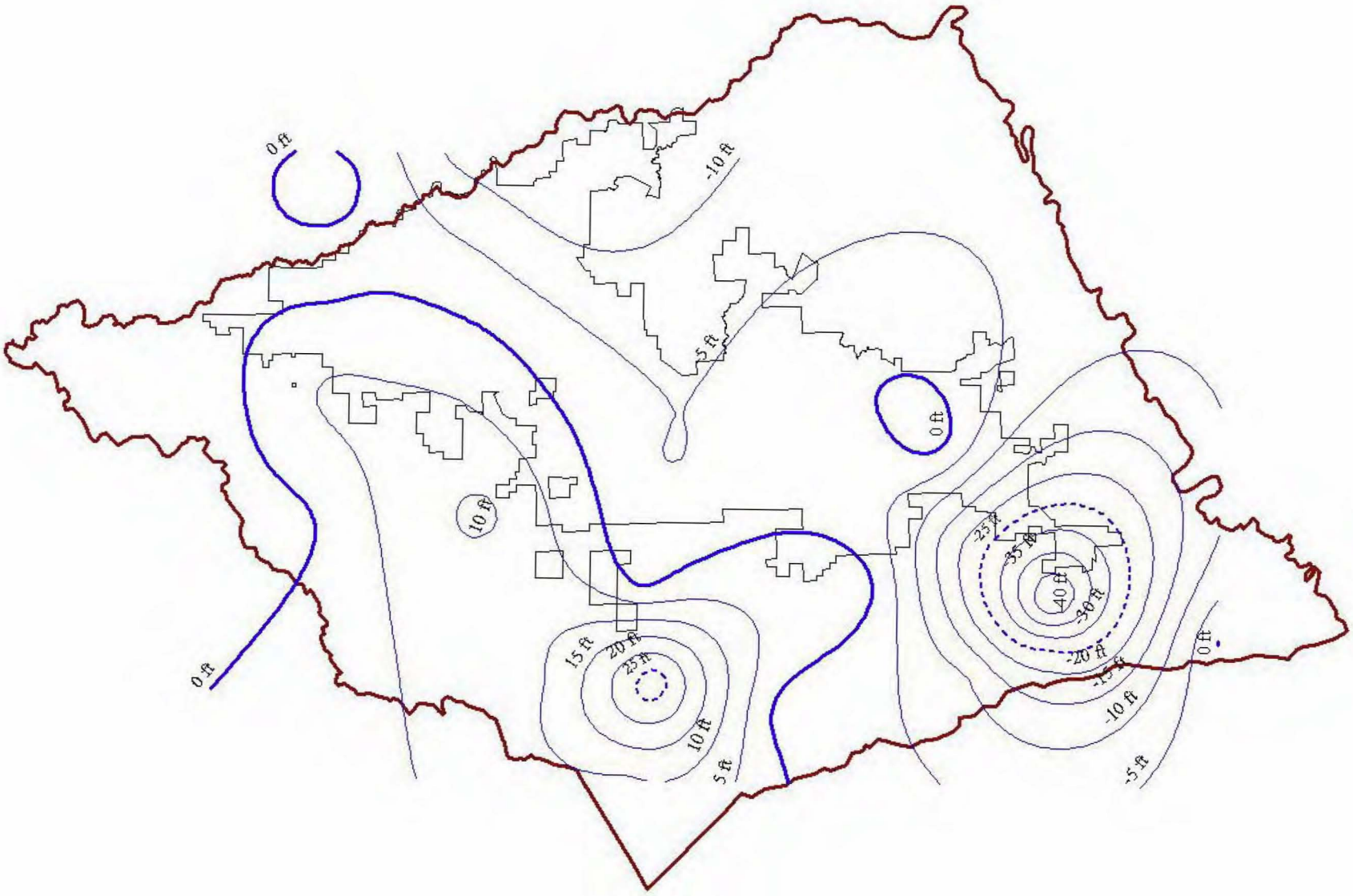

1996 – 2007 CHANGE IN UNCONFINED AQUIFER POTENTIOMETRIC SURFACE

Groundwater Management Plan Update
Merced, California

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Geomatrix

Figure **29**

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1980 – 2007 APPROXIMATE ANNUAL CHANGE IN STORAGE AND CUMULATIVE CHANGE IN STORAGE

Groundwater Management Plan Update
Merced, California

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Geomatrix

Figure **30**

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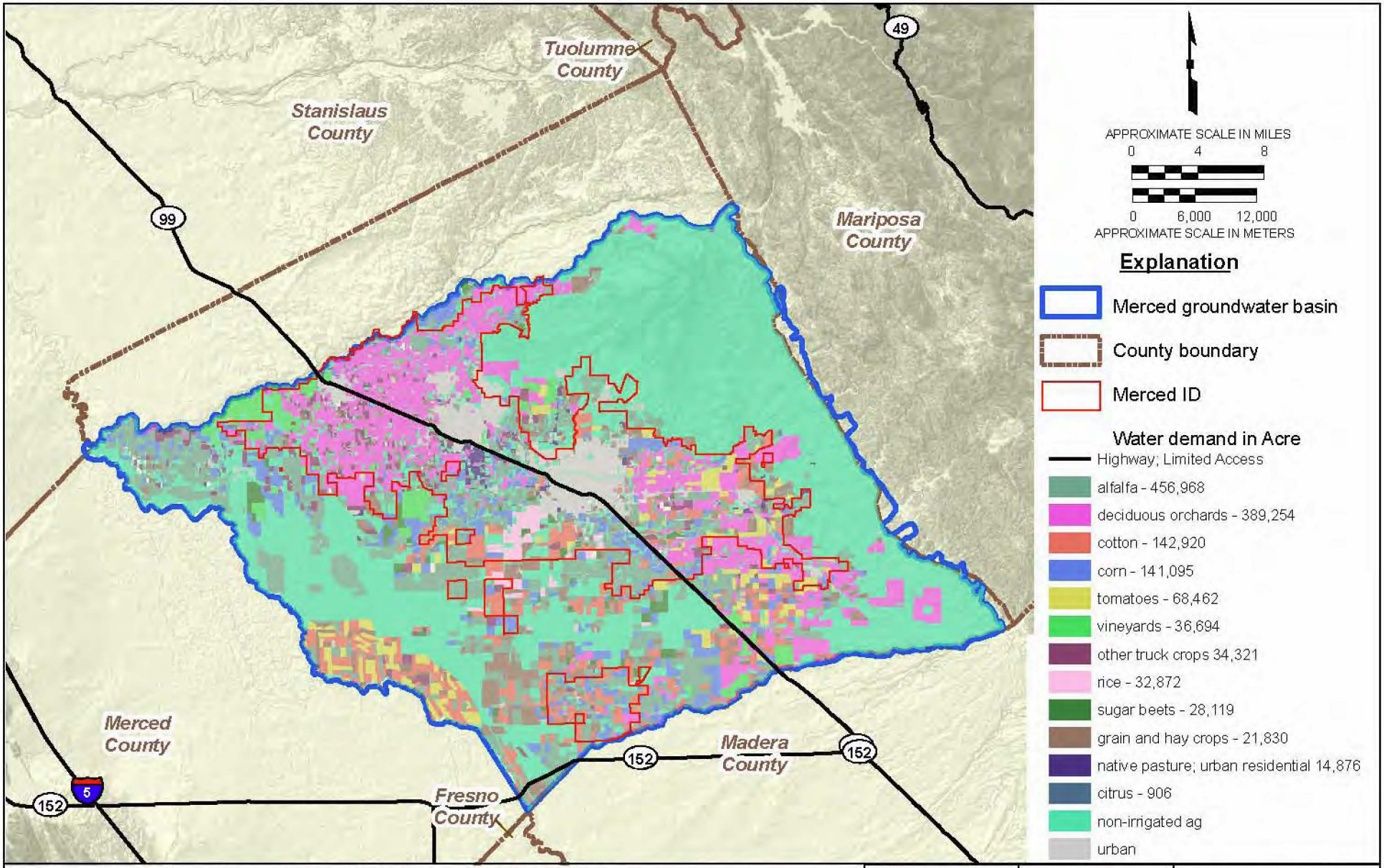


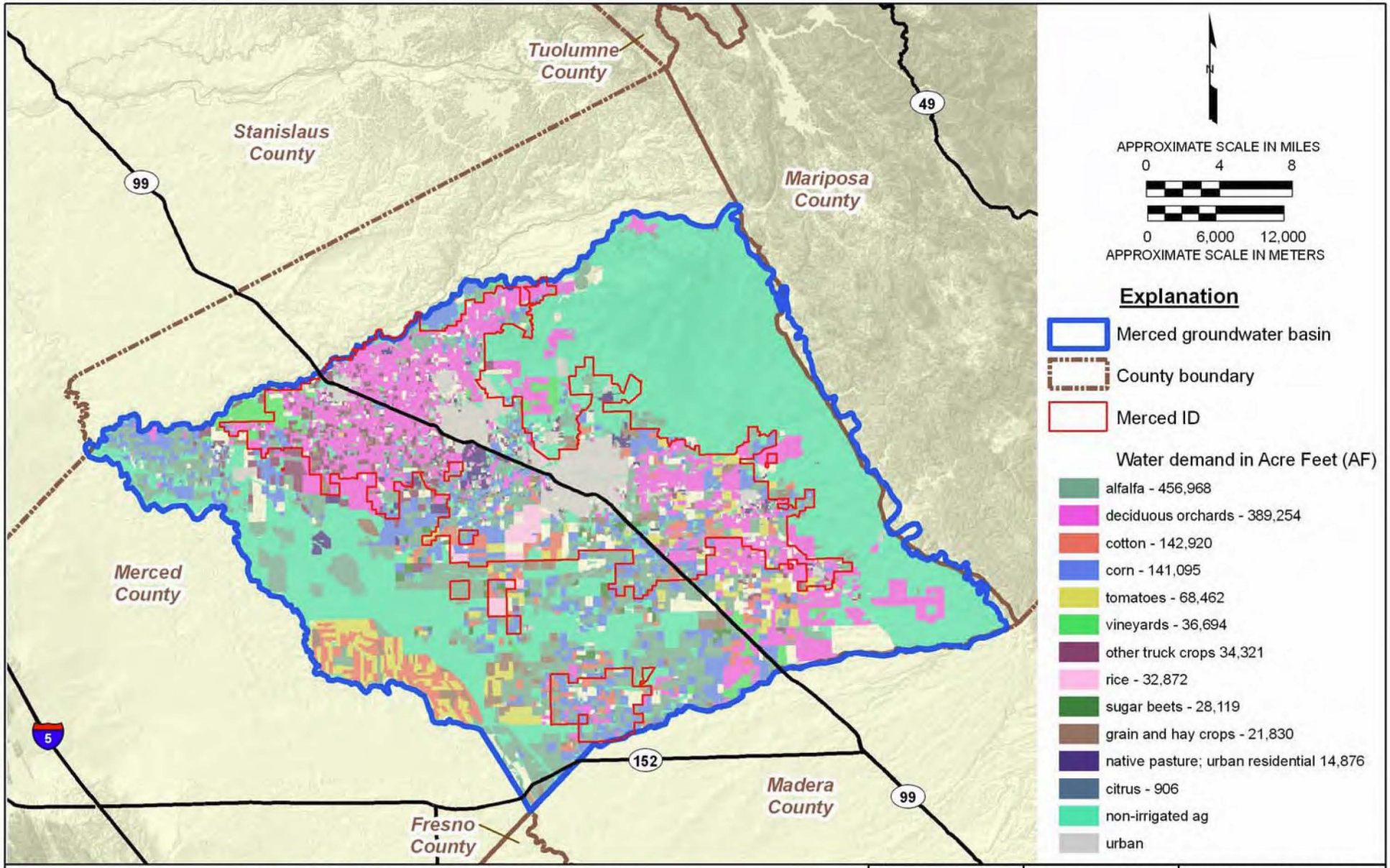
1995 ESTIMATED WATER DEMAND BASED ON LAND USE AND CROPPING PATTERNS

Groundwater Management Plan Update
Merced, California

By: dmb | Date: 5/27/08 | Project No. 13651.000

Geomatrix

Figure 3-1



2002 ESTIMATED WATER DEMAND BASED ON LAND USE AND CROPPING PATTERNS

Groundwater Management Plan Update
Merced, California

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Geomatrix

Figure 32

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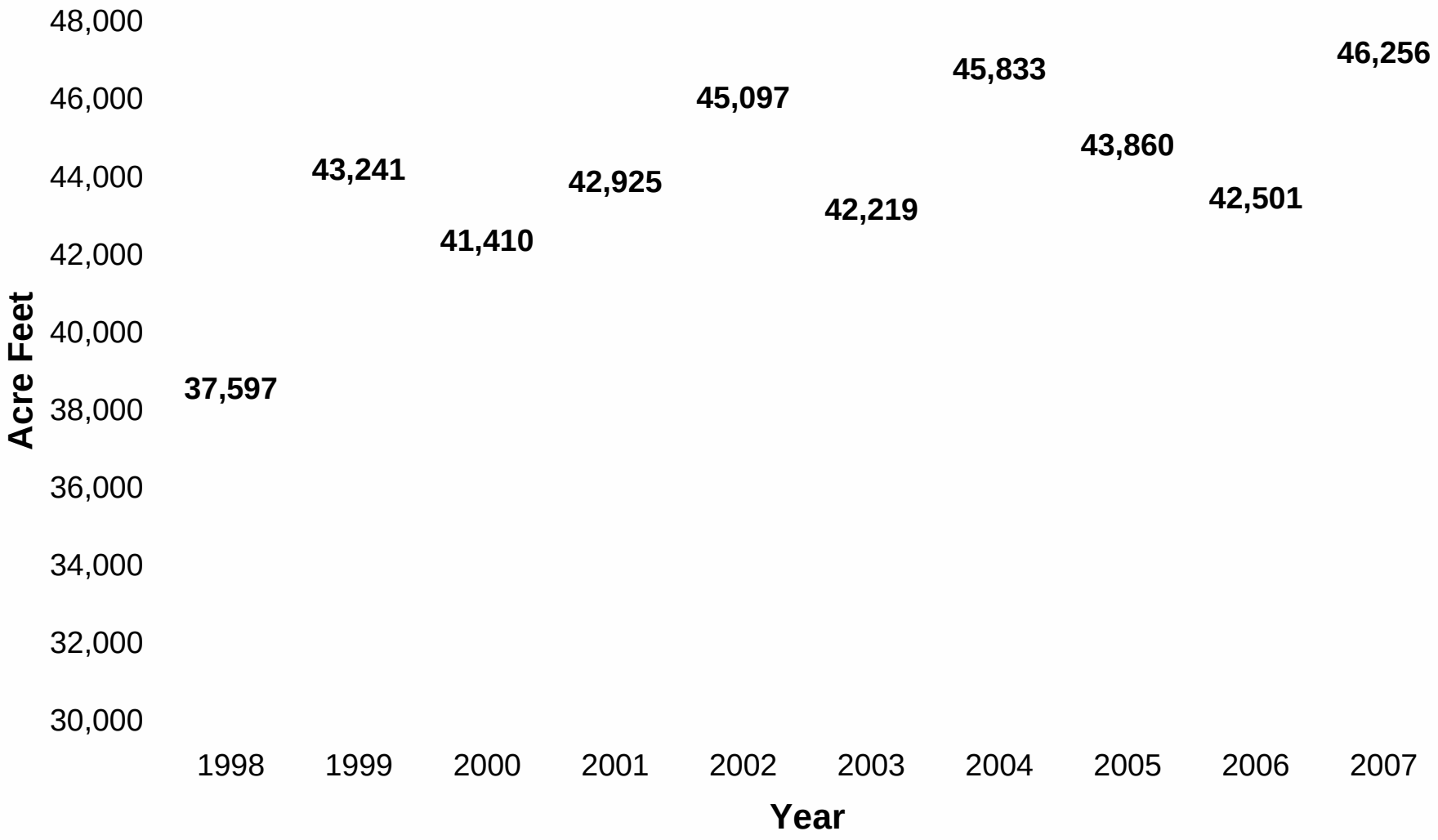

1998 – 2007 TOTAL MUNICIPAL PRODUCTION
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Geomatrix

Figure **33**

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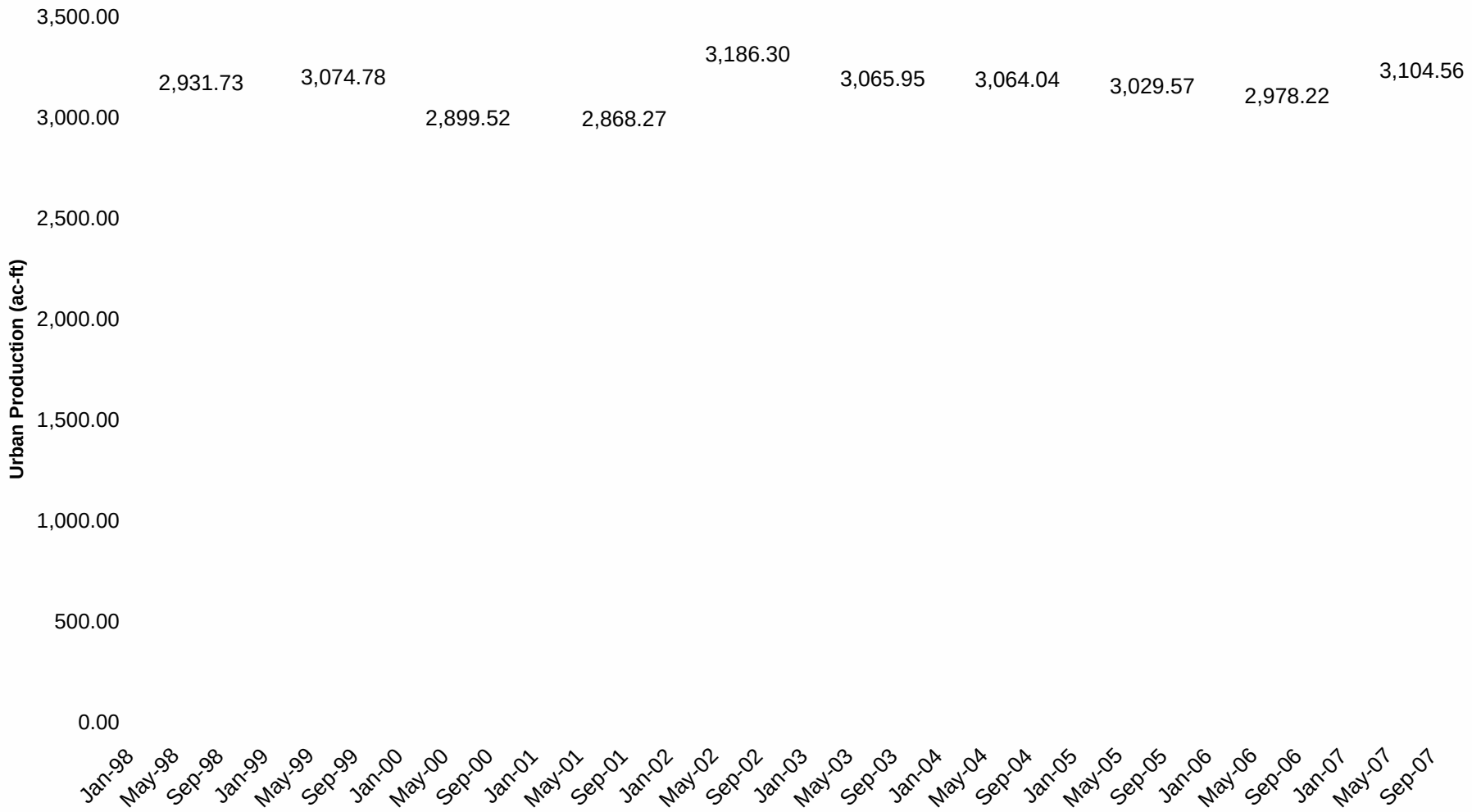


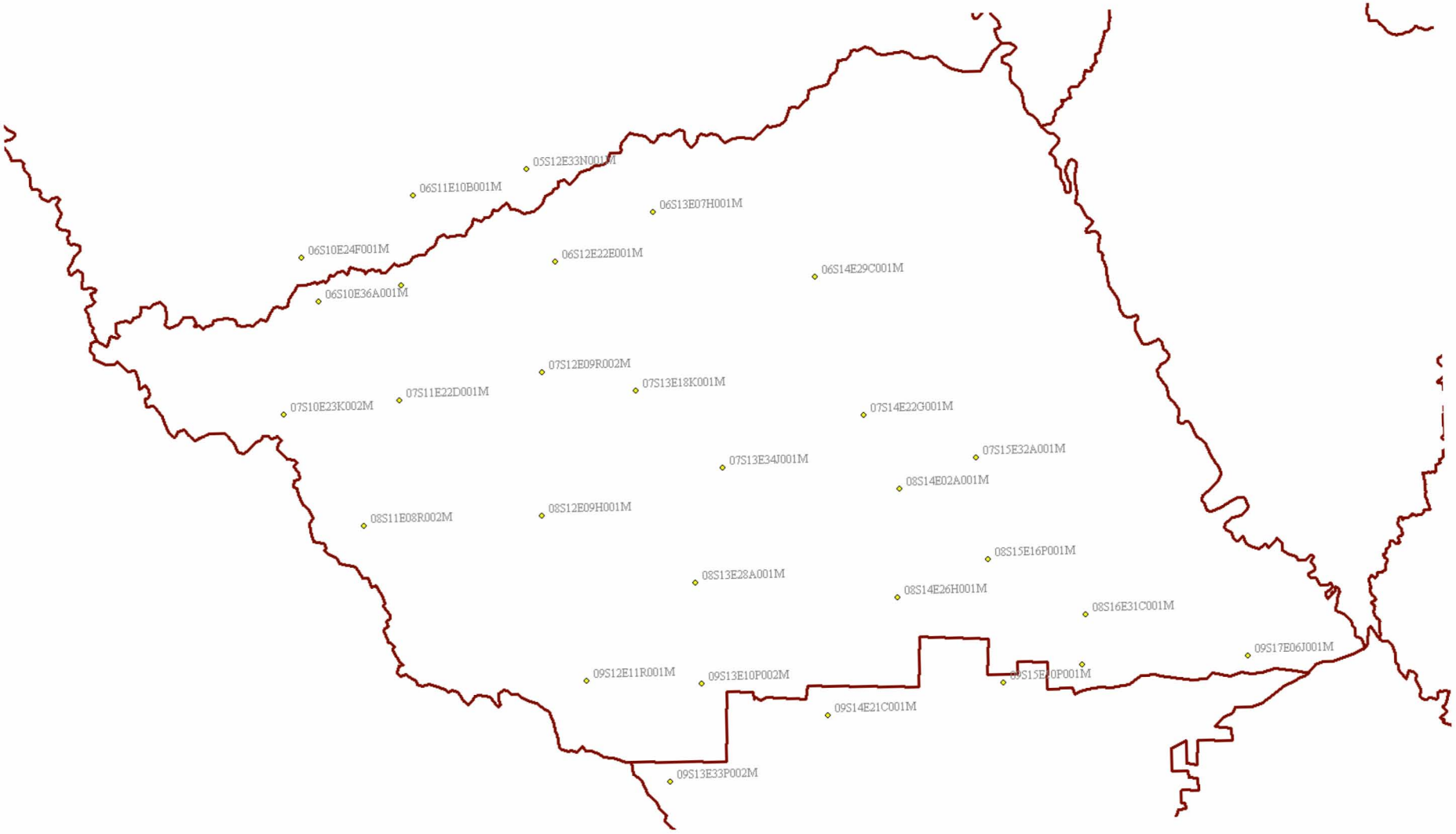
1998 – 2007 MONTHLY MUNICIPAL PRODUCTION
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Geomatrix

Figure **34**

I:\13000\13651\Draft\GWMP_A_Land_A;t.ppt



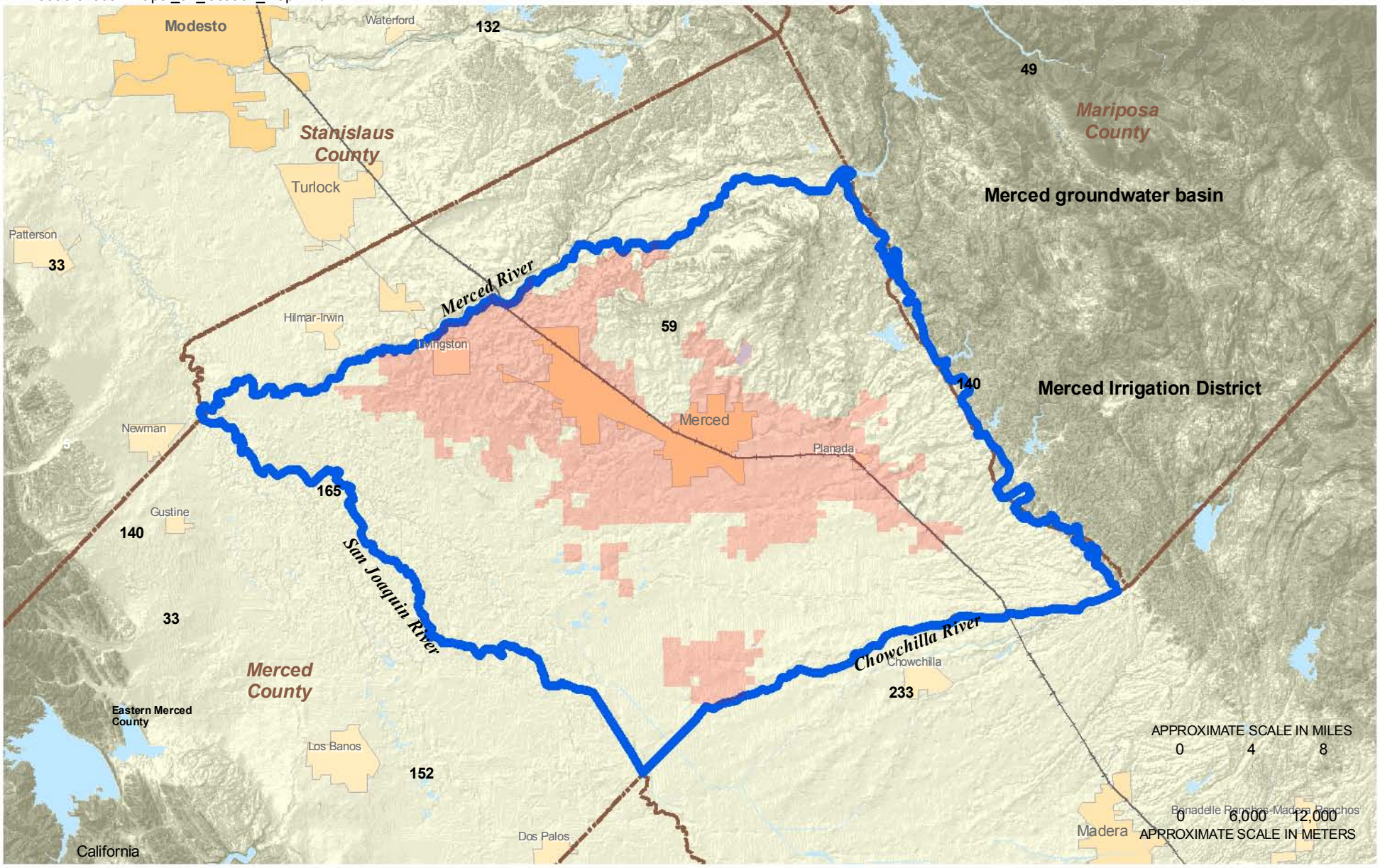
PROPOSED GROUNDWATER MONITORING WELL NETWORK
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Geomatrix

Figure **35**

N:\13000\013651\maps_01_location_map.mxd

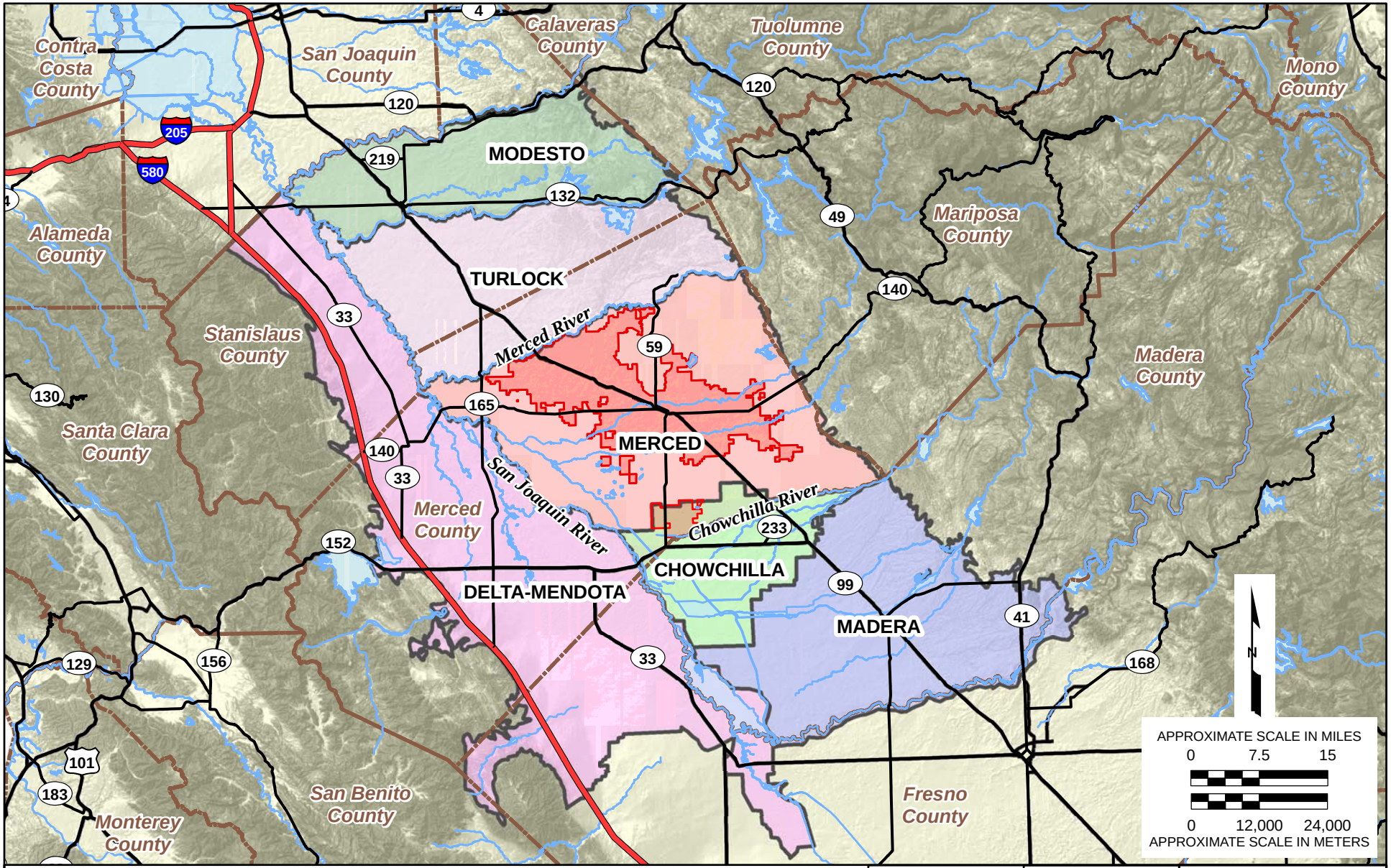


By: KLU Date: June 2008 Project No. 13651.000

LOCATION MAP
Groundwater Management Plan Update
Merced, California

Figure **1**

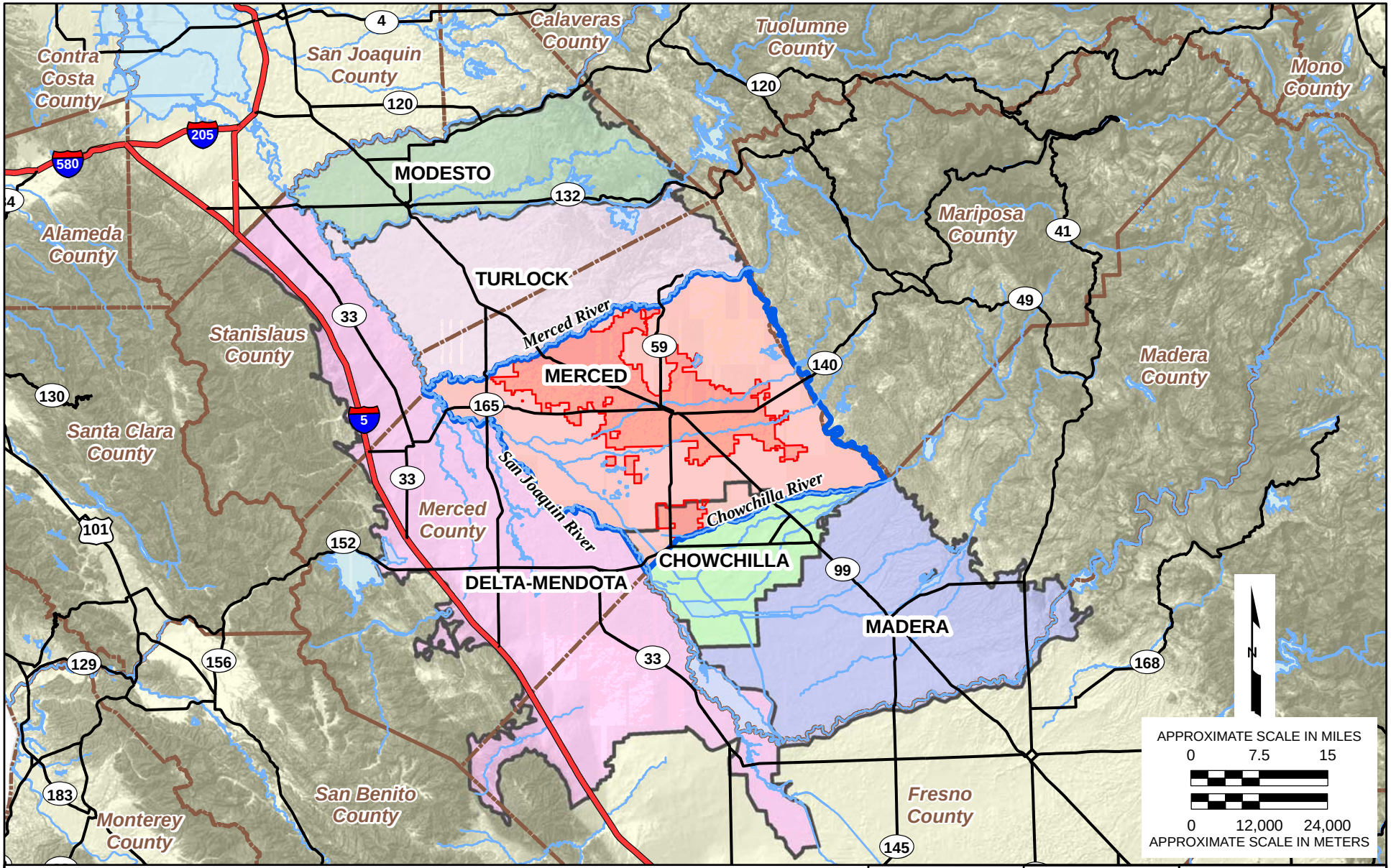
N:\13000\013651\maps_02_gw_basins.mxd



GROUNDWATER BASINS - SAN JOAQUIN RIVER HYDROLOGIC REGION
Groundwater Management Plan Update
Merced, California

By: KLU	Date: June 2008	Project No. 13651.000
AMEC Geomatrix		Figure 2

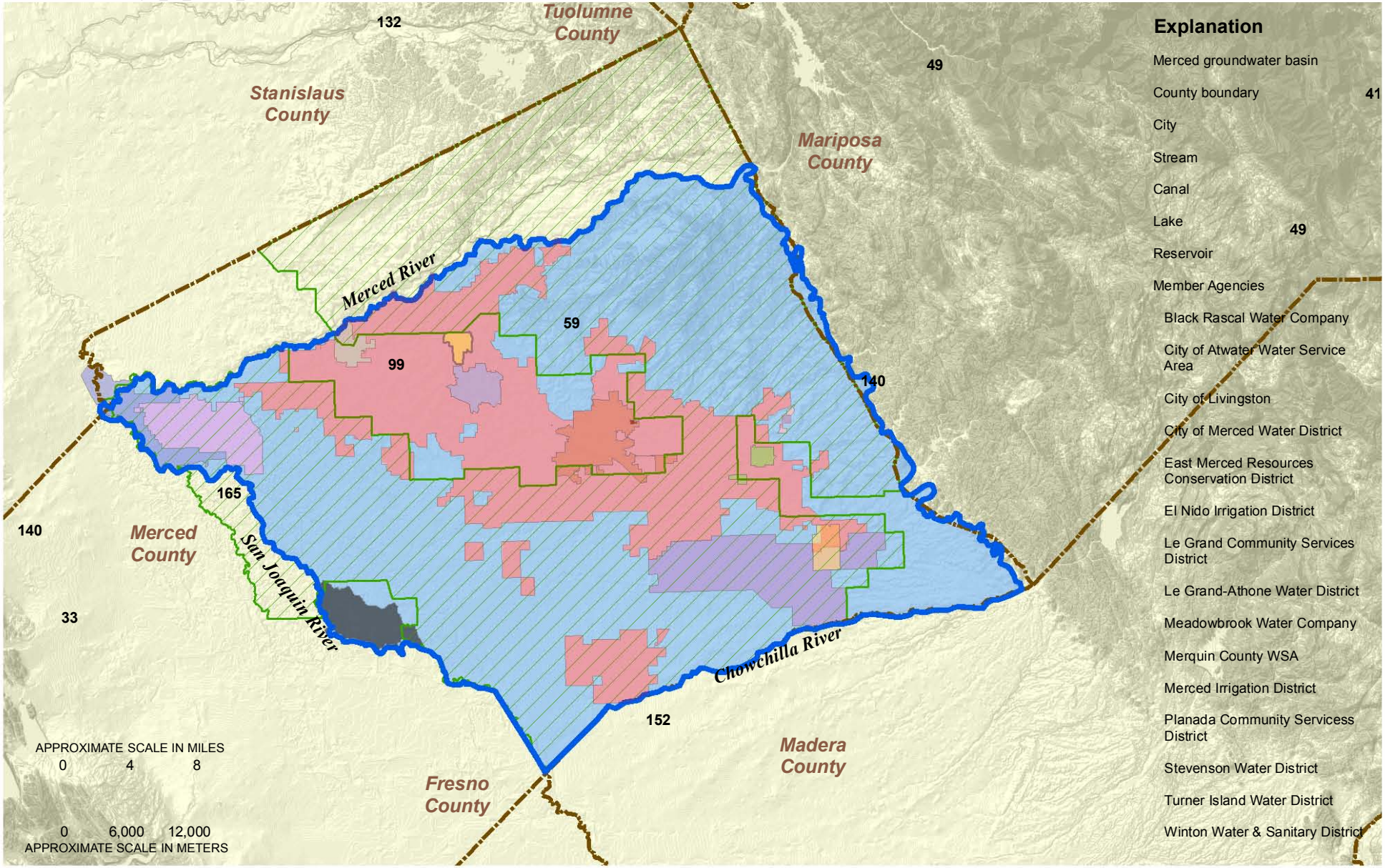
N:\13000\013651\maps_03_modified_gw_basins.mxd



MODIFIED MERCED GROUNDWATER BASIN - SAN JOAQUIN RIVER HYDROLOGIC REGION
Groundwater Management Plan Update
Merced, California

By: KLU	Date: June 2008	Project No. 13651.000
AMEC Geomatrix		Figure 3

N:\13000\013651\maps_04_MAGPI_districts.mxd

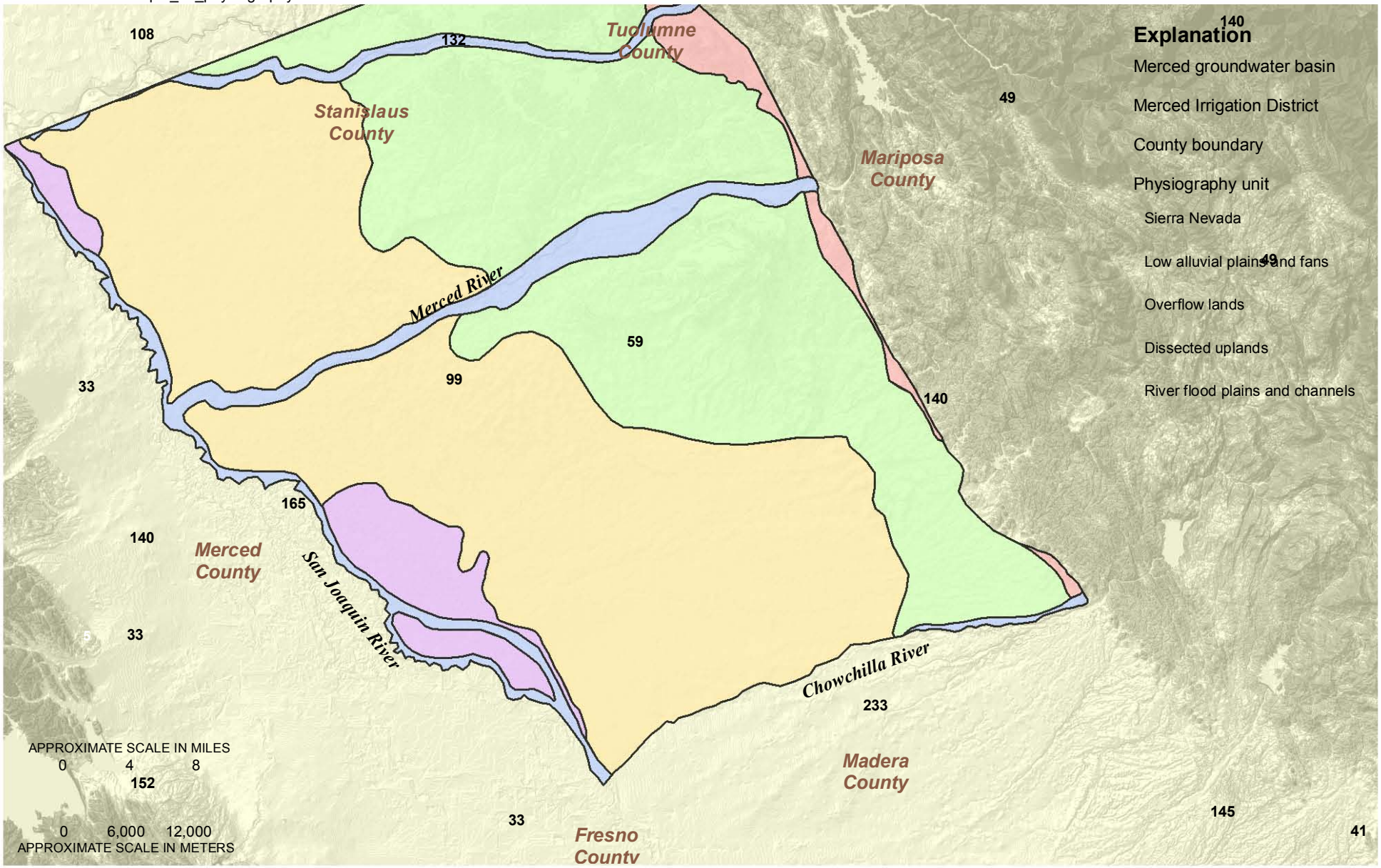


By: KLU Date: June 2008 Project No. 13651.000

MAGPI AGENCIES WITHIN THE MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

Figure **4**

N:\13000\013651\maps_05_physiography.mxd

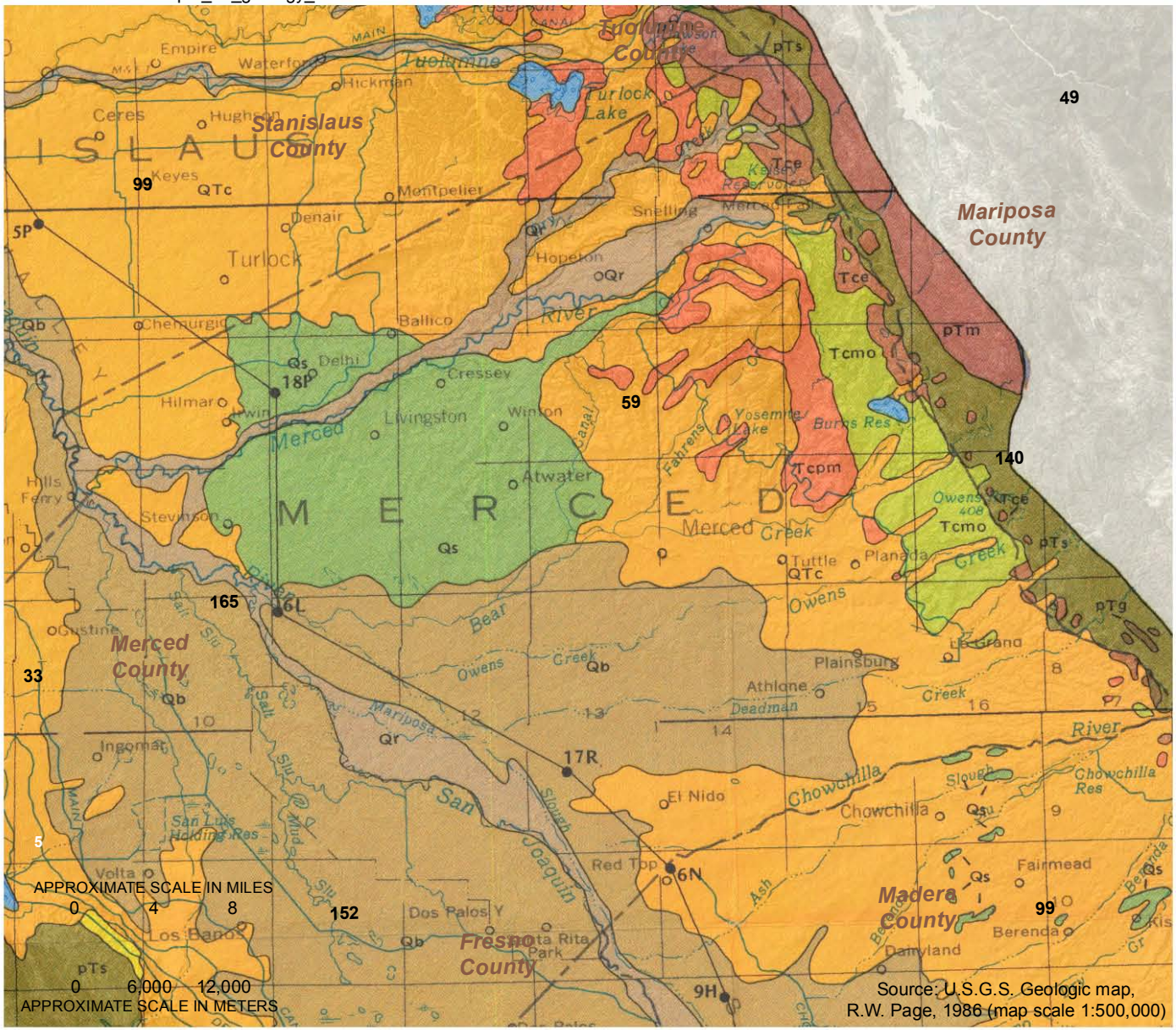


PHYSIOGRAPHIC UNITS WITHIN THE MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure **5**

N:\13000\013651\maps_06_geology_v02.mxd



APPROXIMATE SCALE IN MILES
0 4 8

0 6,000 12,000
APPROXIMATE SCALE IN METERS

Source: U.S.G.S. Geologic map,
R.W. Page, 1986 (map scale 1:500,000)

Explanation

Merced groundwater basin

Merced Irrigation District

County boundary

Geologic unit

Qs	Sand Dunes (Holocene): windblown sand and dune sand
Qb	Flood-basin deposits (Holocene to Pleistocene): Clay, silt, and some sand
Qr	River deposits (Holocene to Pleistocene): Gravel, sand, silt, and minor amounts of clay; deposited along channels, flood plains, and natural levees of main streams.
QTl	Lacustrine and marsh deposits (Pliocene to Holocene): Clay, silt, and some sand
QTc	Continental rocks and deposits (Miocene to Holocene): Heterogeneous mix of generally poorly sorted clay, silt, sand, and gravel; some beds of claystone, siltstone, sandstone, and conglomerate.
Tcpm	Continental rocks and deposits (Miocene and Pliocene): Gravel, sand, silt, clay, conglomerate, sandstone, siltstone, and claystone, contain andesitic material.
Tcmd	Continental and marine rocks and deposits (Miocene and Pliocene): Gravel, sand, silt, clay, silty sandstone, and siltstone.
Tcmo	Continental rocks and deposits (Oligocene and Miocene): Gravel, conglomerate, sand, tuffaceous sand, clay, and sandy clay; contain rhyolitic material on eastern side of valley.
Tce	Continental rocks and deposits (Eocene): Conglomerate and sandstone; along eastern side of valley contain anauxite. Principally lone Formation (Eocene) on eastern side of valley
pTs	Marine rocks (Pre-Tertiary): Sandstone, shale, siltsone, and some limestone, chiefly on western side of valley; in places contain abundant secondary gypsum
pTg	Granitic rocks (Pre-Tertiary): Chiefly granitic rocks on eastern side of valley, in places consists of mafic intrusive rocks
pTm	Metamorphic rocks (Pre-Tertiary): Metasedimentary, metavolcanic and other metamorphic rocks on eastern side ov valley
water	Water

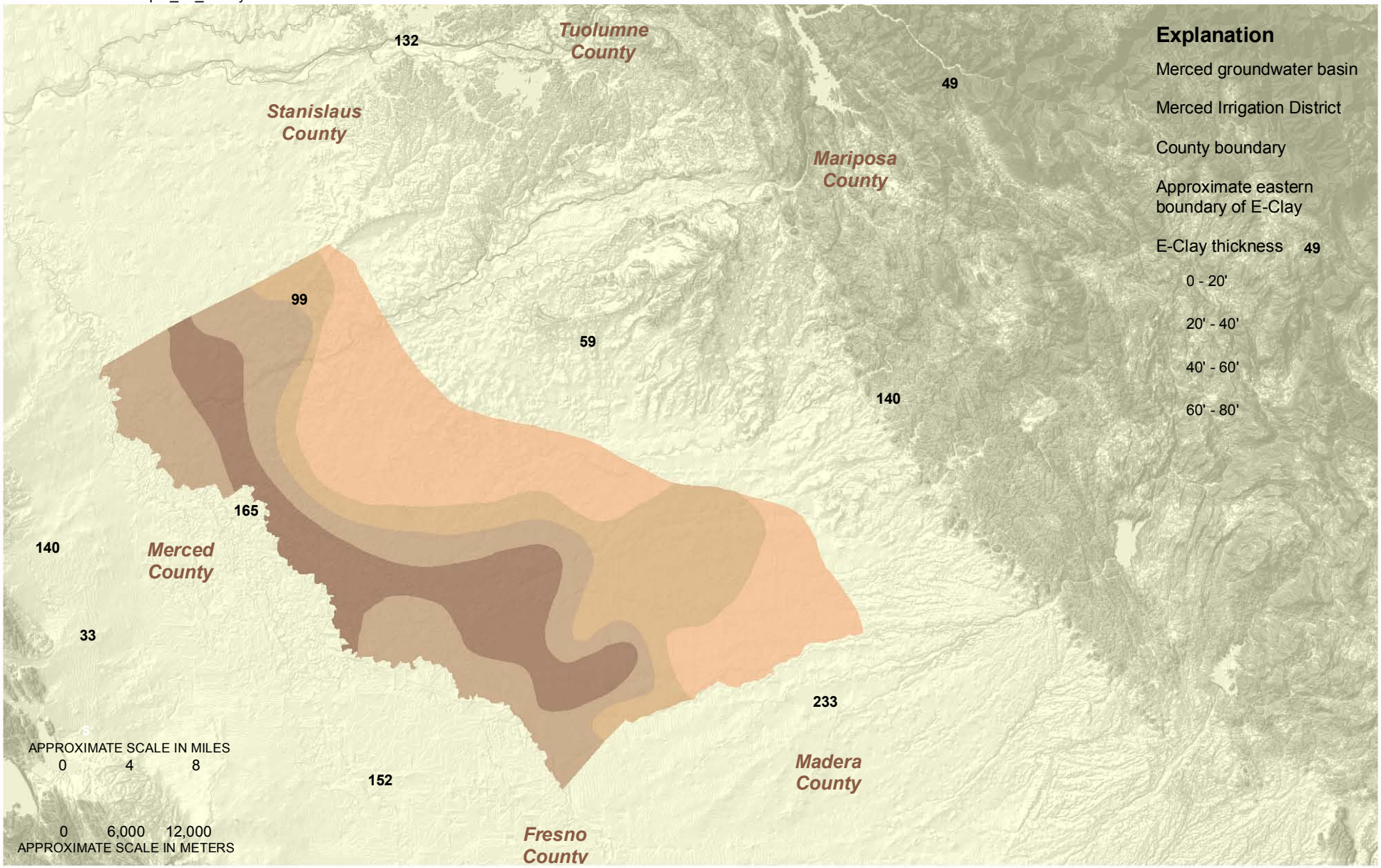
GENERALIZED GEOLOGY - MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: KLU

Date: June 2008 Project No. 13651.000

Figure **6**

N:\13000\013651\maps_07_E-clay.mxd

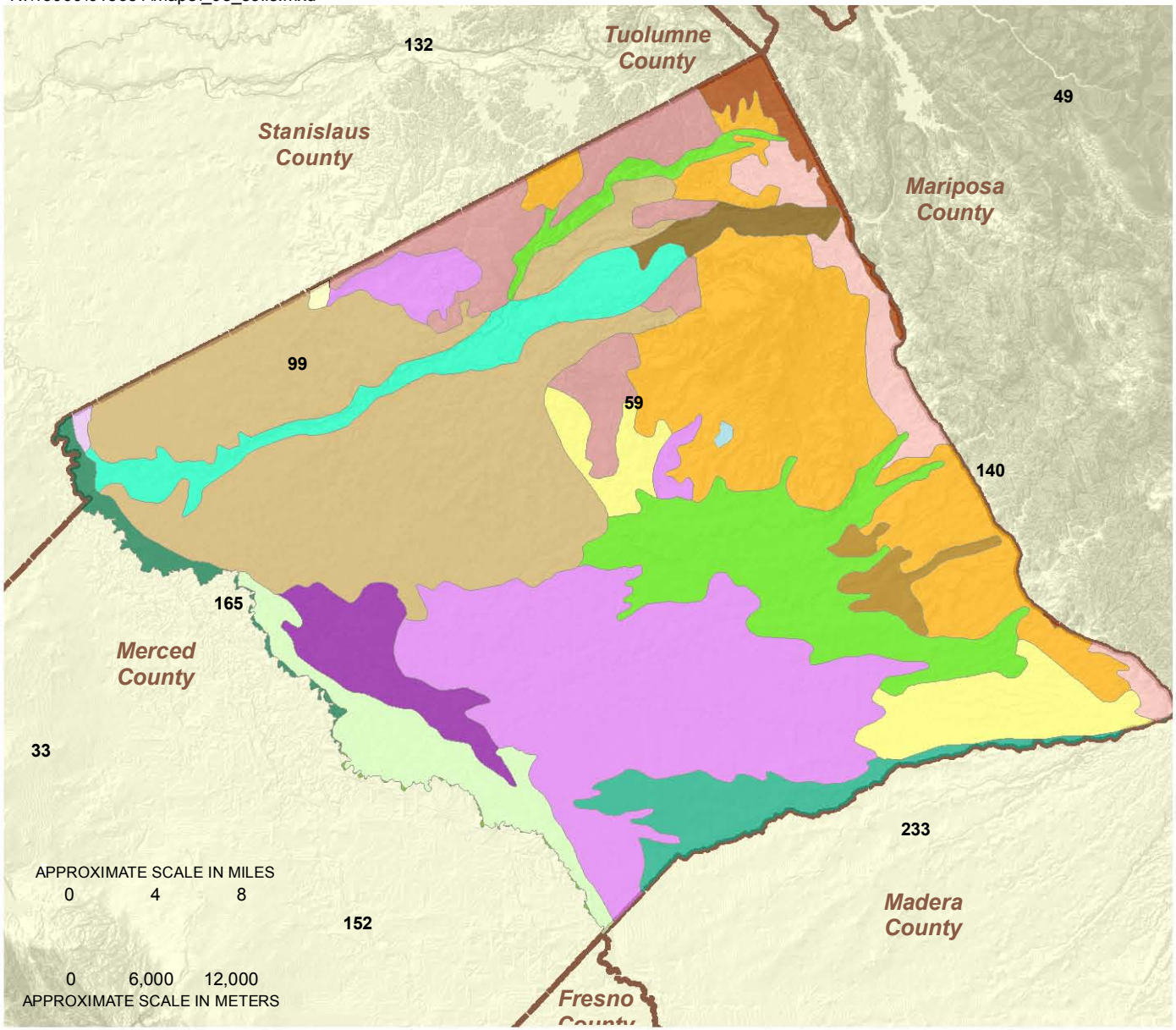


LATERAL EXTENT OF THE CORCORAN CLAY - MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure 7

N:\13000\013651\maps_08_soils.mxd



Explanation

Merced groundwater basin

Merced Irrigation District

County boundary

Soil associations (STATSGO, 2006)

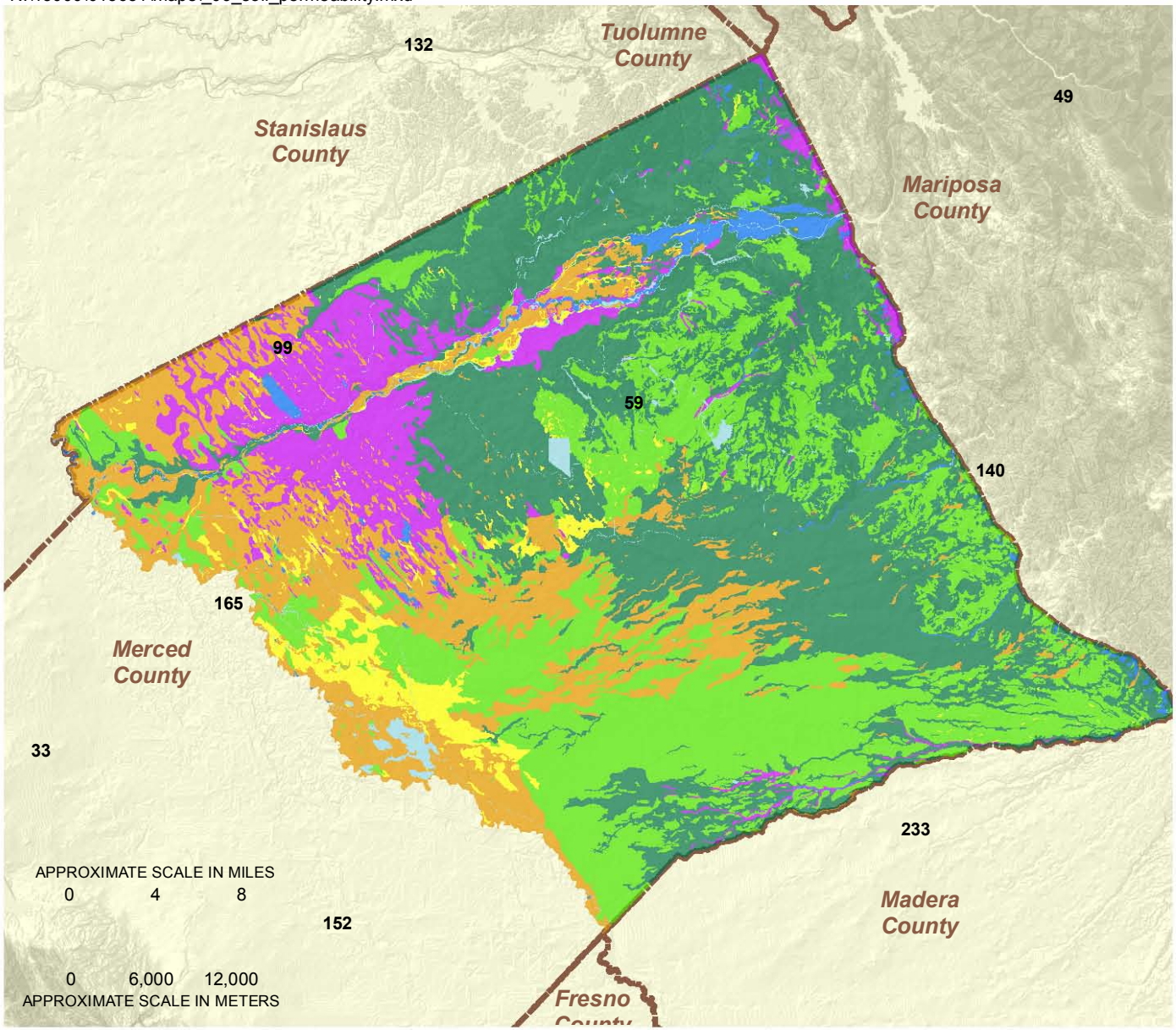
- Tujunga-Merritt-Grangeville-Columbia
- Tujunga-Traver-Pachappa-Grangeville
- Temple-Merced-Grangeville
- Zacharias-Yokohl-Honcut
- Kesterson-Edminster-Dospalos-Bolfar
- Willows-Waukena-Pescadero-Fresno
- Lewis-Fresno-Dinuba
- Waukena-Pescadero
- San Joaqin-Madera
- San Joaquin-Madera-Cometa
- Hilmar-Delhi-Atwater
- Porterville
- Redding-Pentz-Corning
- Whitney-Rocklin-Montpellier
- Rock outcrop-Hornitos-Amador
- Whiterock-Rock outcrop-Auburn
- Xerorthents-Xerofluvents
- Water

By: KLU Date: June 2008 Project No. 13651.000

SOIL ASSOCIATIONS MAP - MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

Figure **8**

N:\13000\013651\maps_09_soil_permeability.mxd



Explanation

Merced groundwater basin

Merced Irrigation District

County boundary

Drainage Classes (SUURGO)

Not Rated

Somewhat poorly drained

Poorly drained

Moderately well drained

Well drained

Somewhat excessively drained

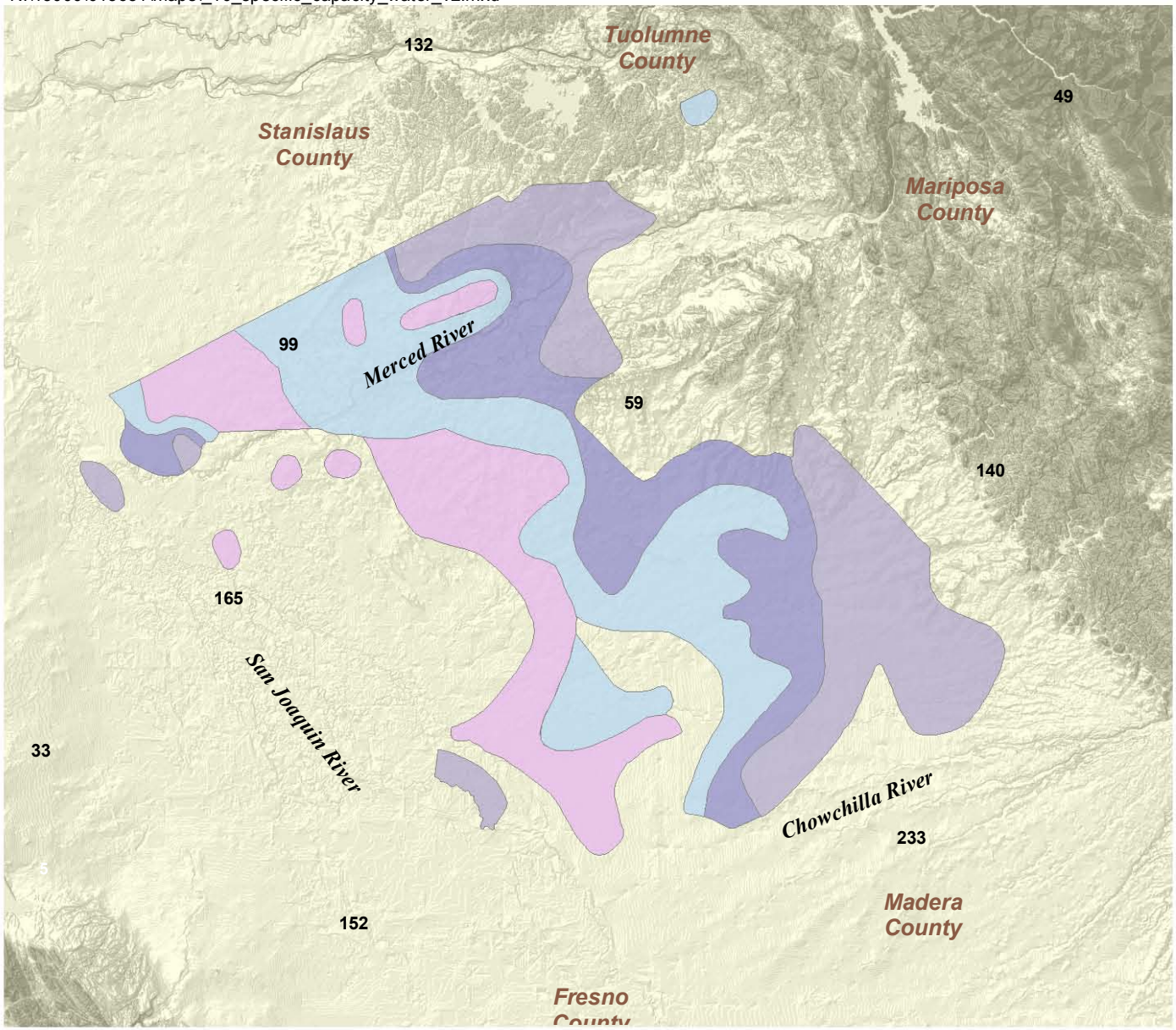
Excessively drained

ESTIMATED SOIL PERMEABILITY MAP - MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure **9**

N:\13000\013651\maps_10_specific_capacity_water_v2.mxd



APPROXIMATE SCALE IN MILES
0 4 8

0 6,000 12,000
APPROXIMATE SCALE IN METERS

Explanation

Merced groundwater basin

Merced Irrigation District

County boundary

Areas where general specific capacities of wells are measured (in gallons per minute per foot of drawdown)

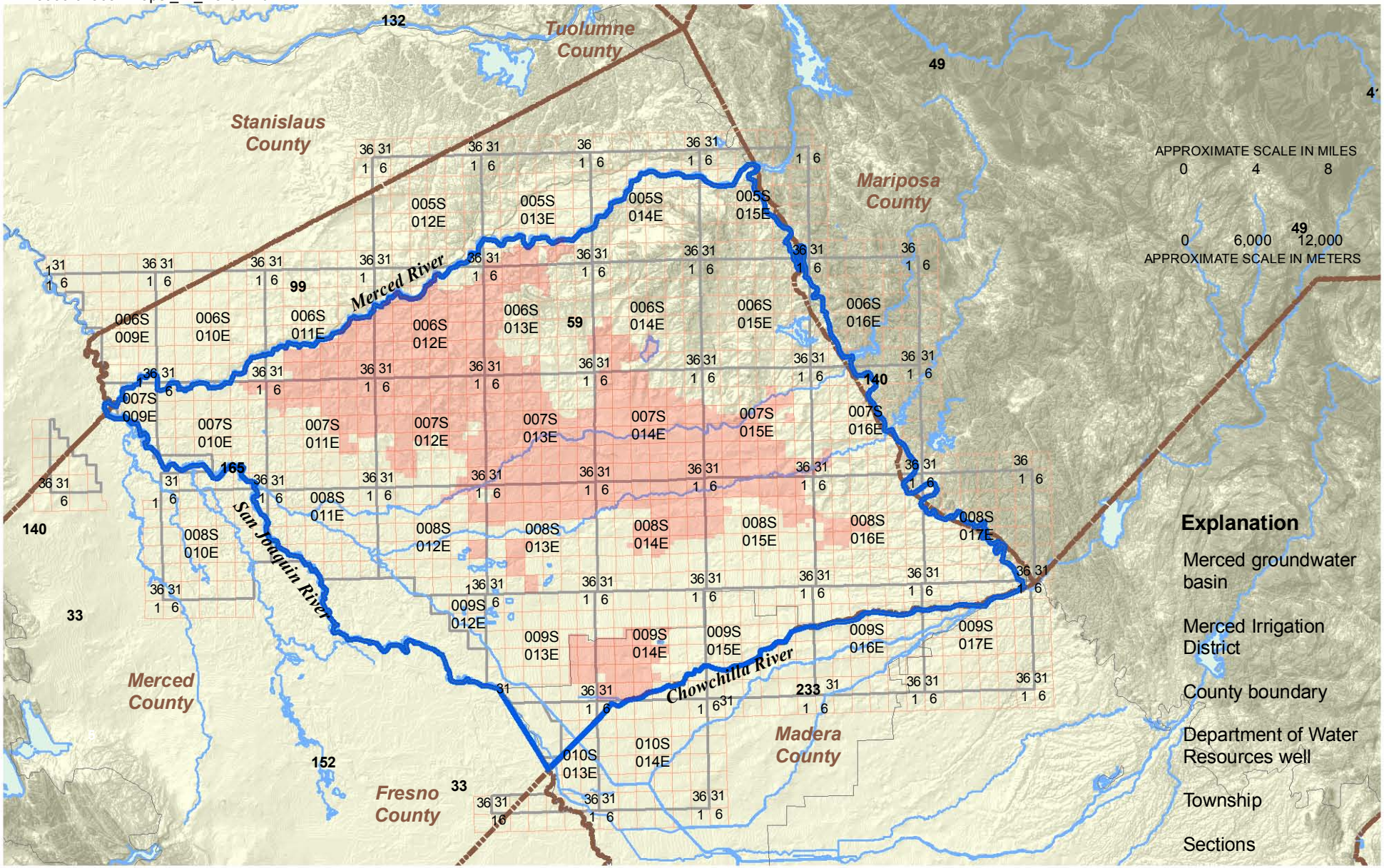
- Equal or less than 20
- Greater than 20 but equal or less than 30
- Greater than 30 but equal or less than 40
- Greater than 40

By: KLU Date: June 2008 Project No. 13651.000

ESTIMATED DISTRIBUTION OF SPECIFIC CAPACITY - MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

Figure **10**

N:\13000\013651\maps_11_wells.mxd

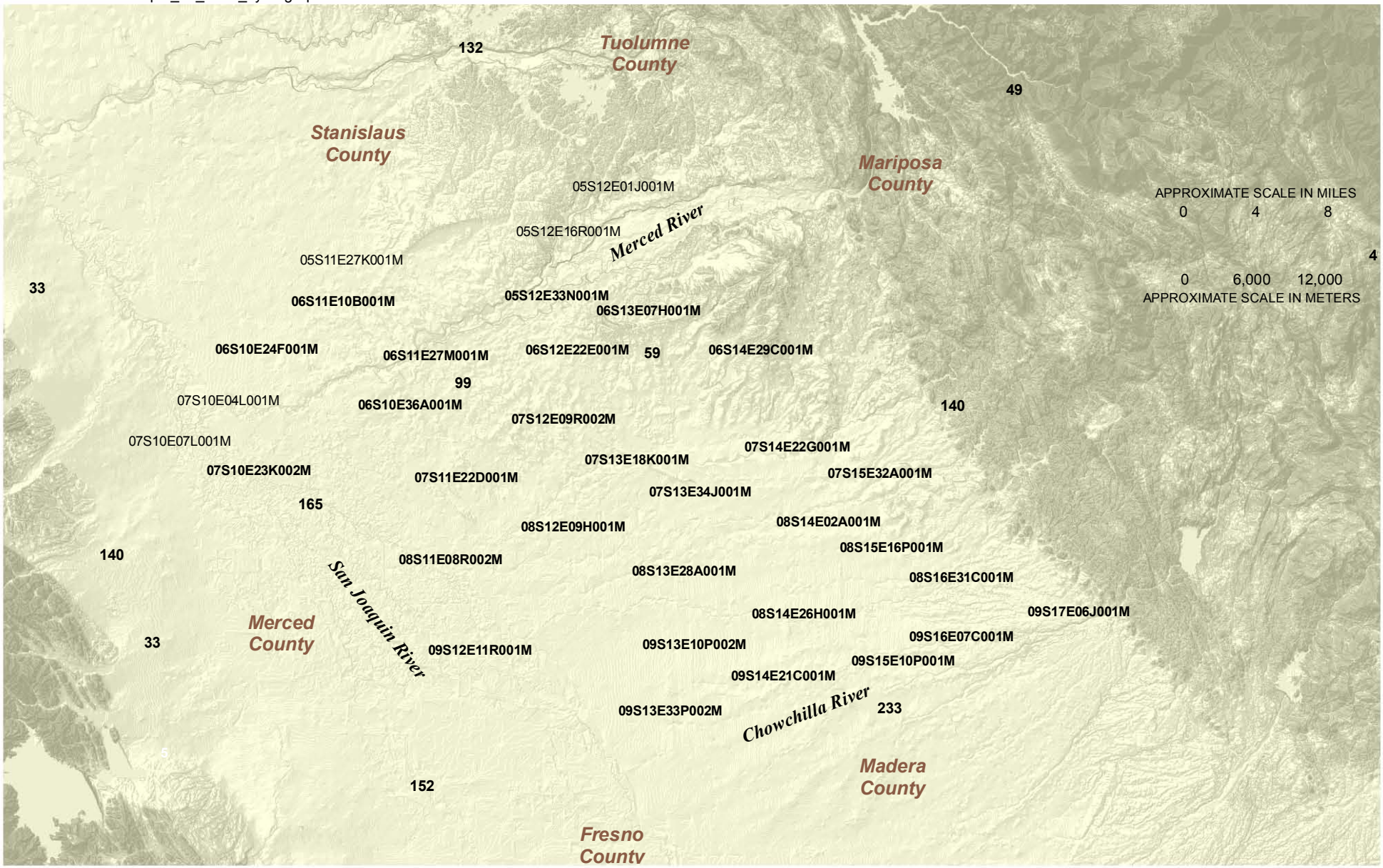


MONITORED WATER SUPPLY WELLS WITHIN THE MERCED GROUNDWATER BASIN
Merced Groundwater Basin
Merced, California

By: KLU Date: 04/14/2008 Project No. 13651.000

Figure **11**

N:\13000\013651\maps_12_wells_hydrogarphs.mxd



By: KLU Date: June 2008 Project No. 13651.000

SELECTED WATER SUPPLY WELLS FOR LONG-TERM HYDROGRAPHS
Groundwater Management Plan Update
Merced, California

Figure **12**

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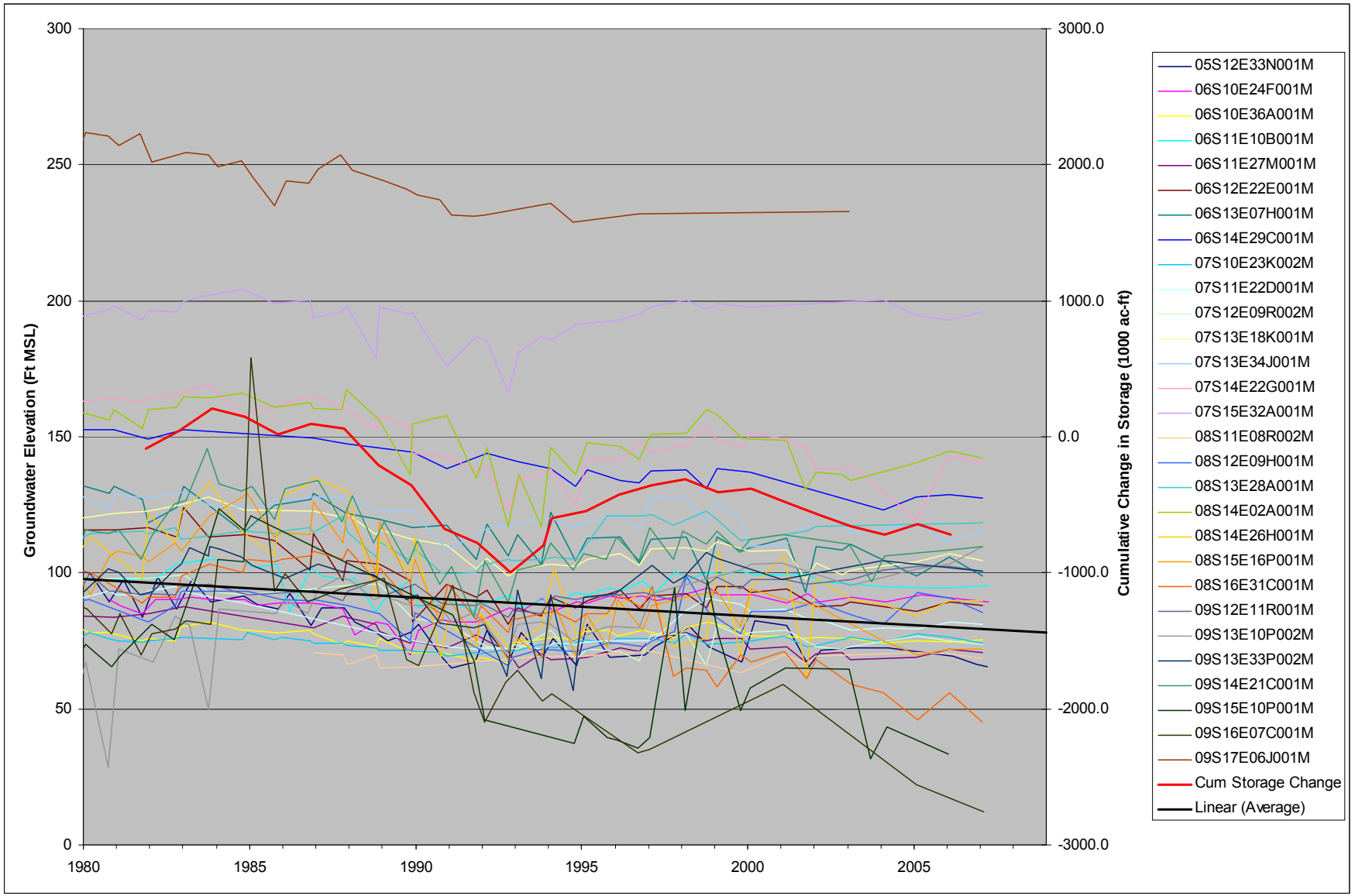
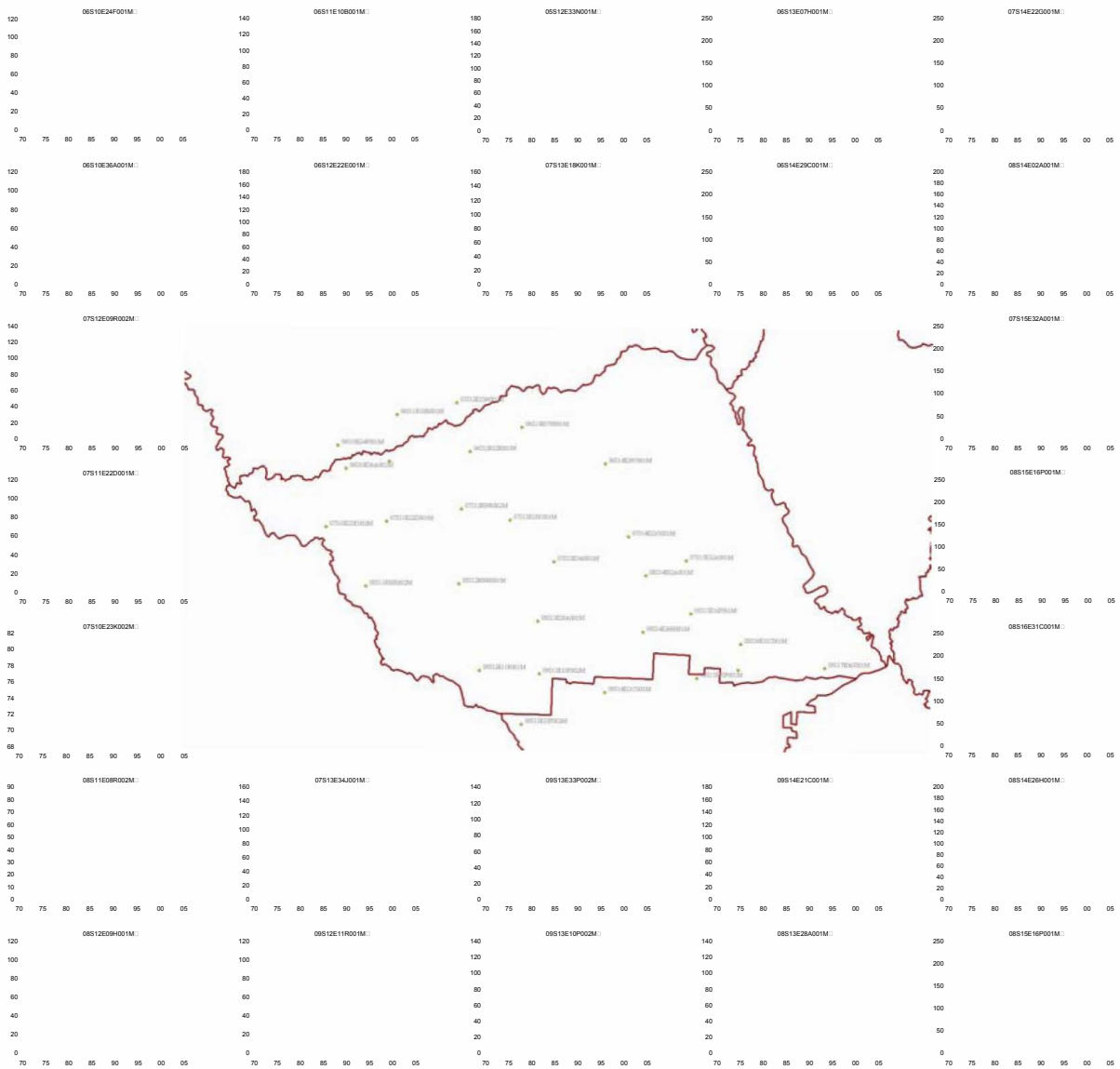


LONG-TERM HYDROGRAPHS IN SELECTED MONITORING WELLS
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure 13

I:\13000\13651\Draft\GWMP_Figures_A_Land_AMEC.ppt



Explanation

Ground Surface Elevation

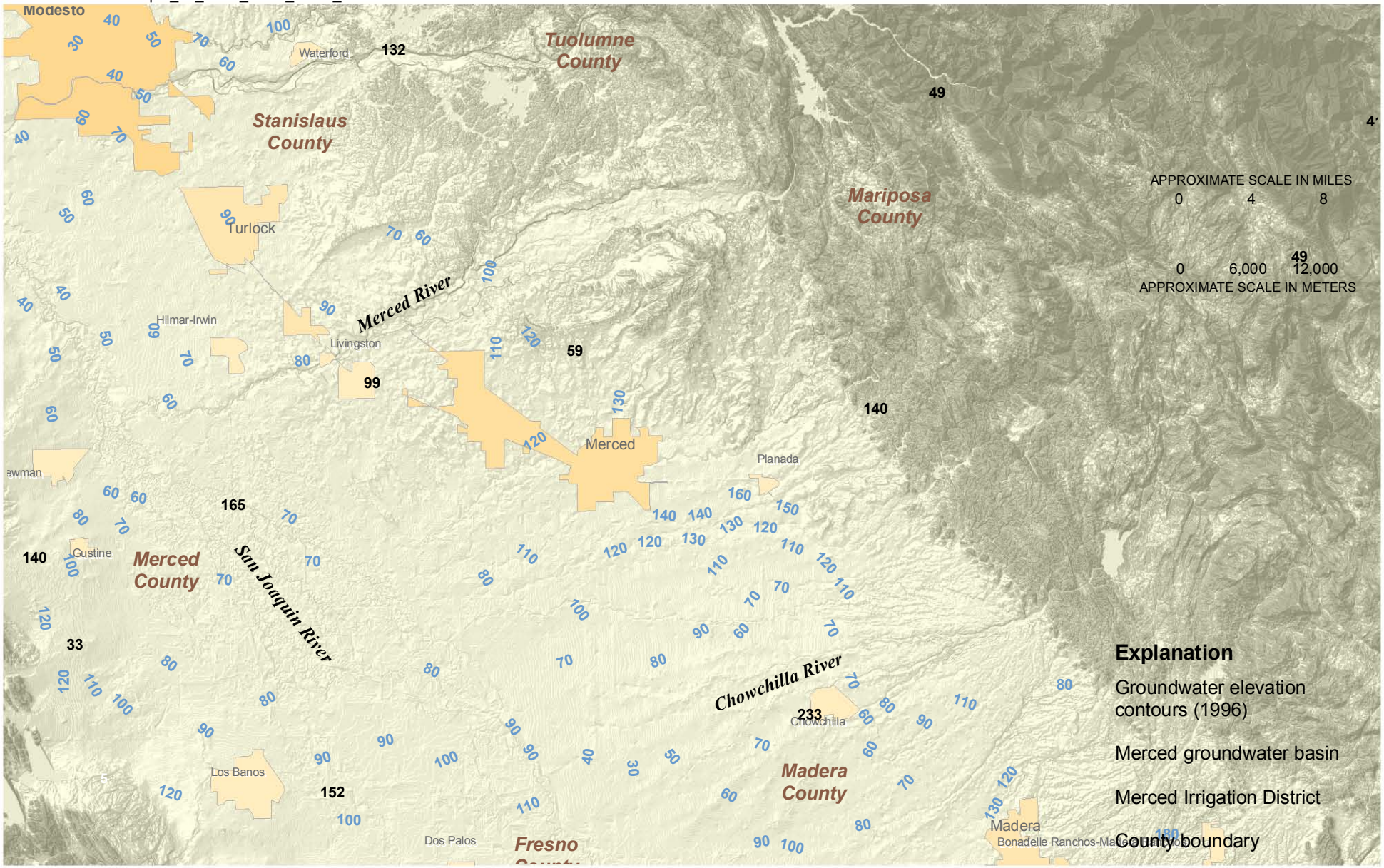
Groundwater Elevation

SPATIAL DISTRIBUTION OF LONG-TERM HYDROGRAPHS
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Figure **14**

N:\13000\013651\maps_15_DWR_water_levels_1996.mxd

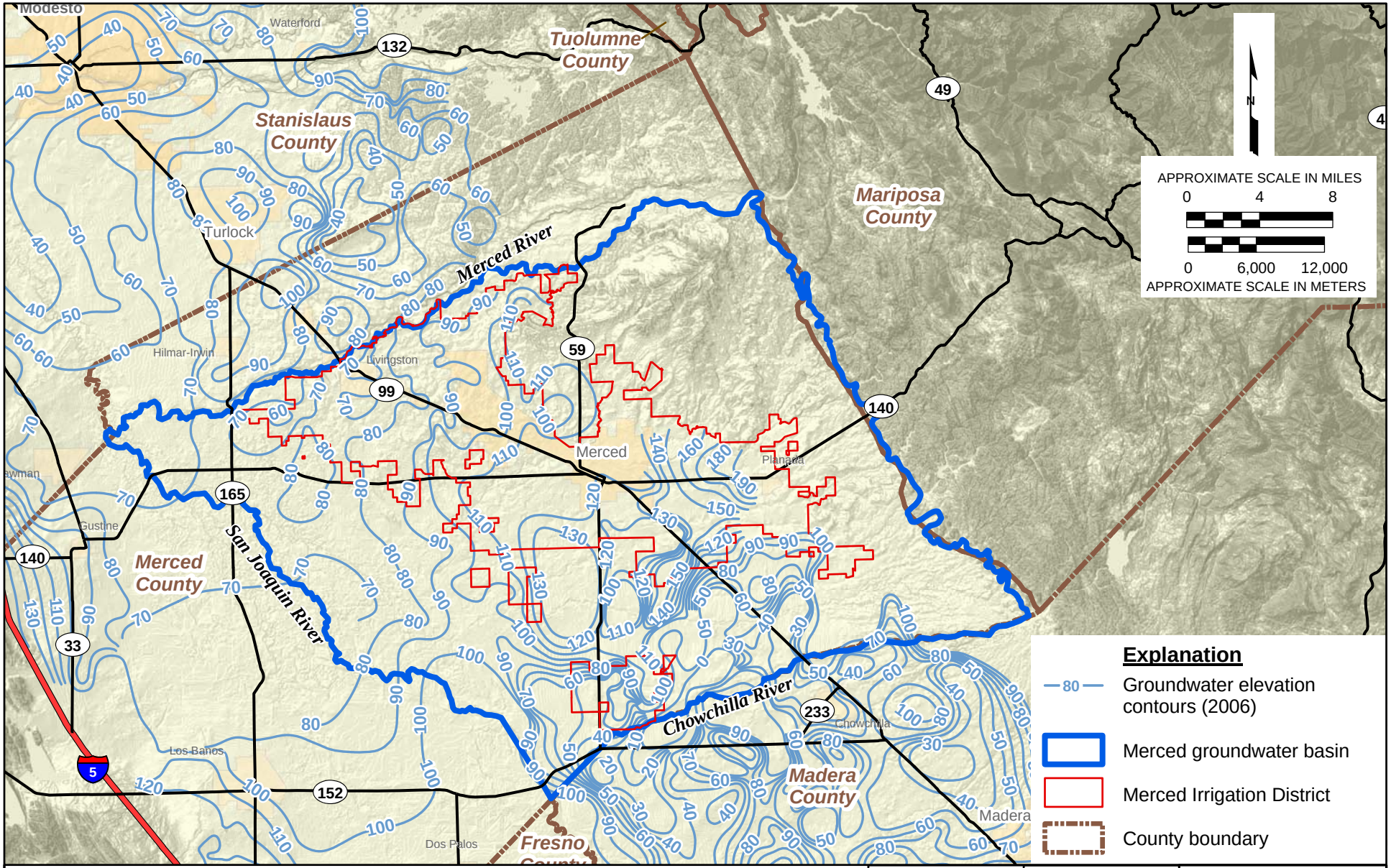


DWR 1996 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure **15**

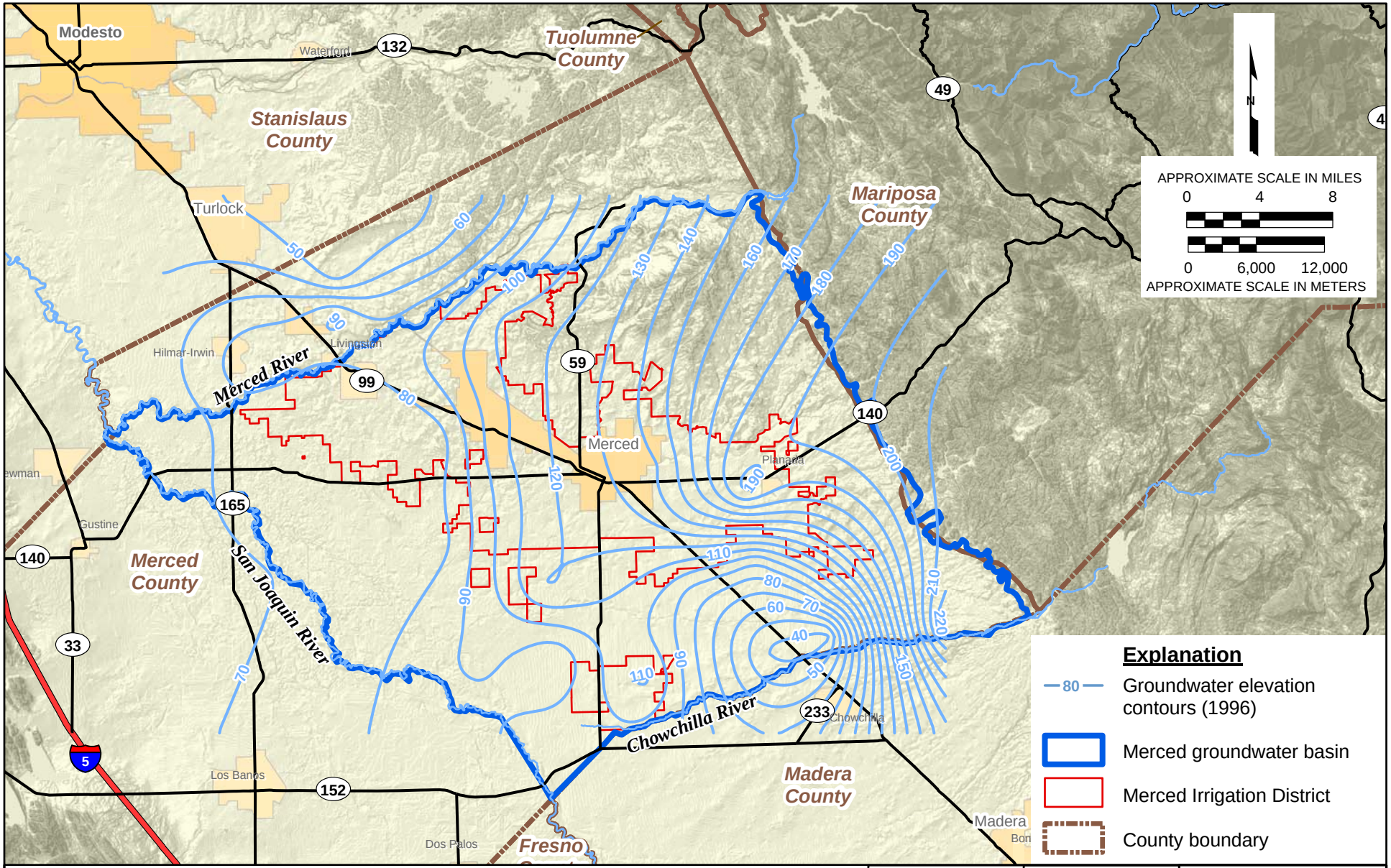
N:\13000\013651\maps_16_DWR_water_levels_2006.mxd



DWR 2006 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU	Date: June 2008	Project No. 13651.000
AMEC Geomatrix	Figure 16	

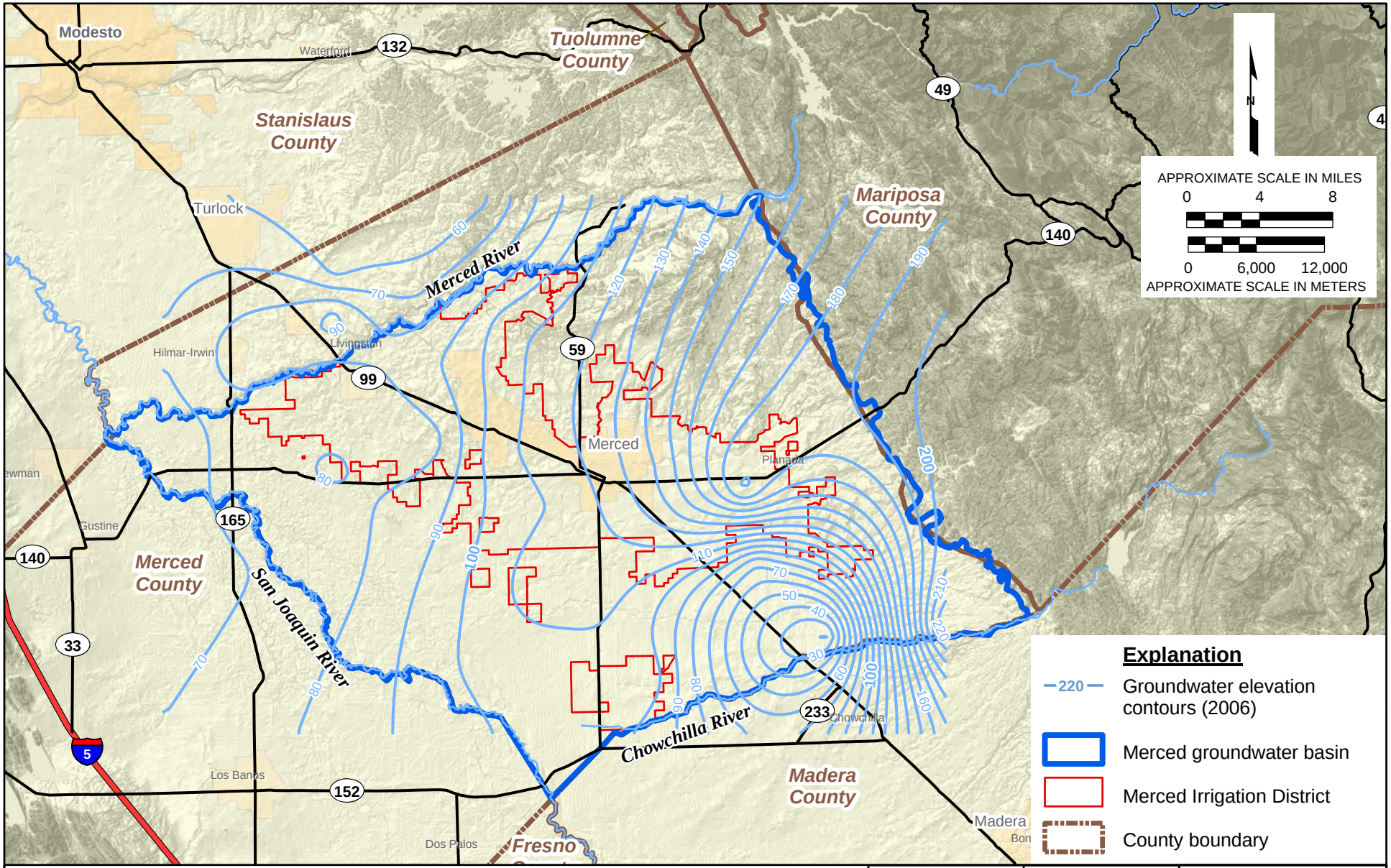
N:\13000\013651\maps_17_water_levels_1996.mxd



SIMPLIFIED 1996 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU	Date: June 2008	Project No. 13651.000
AMEC Geomatrix	Figure 17	

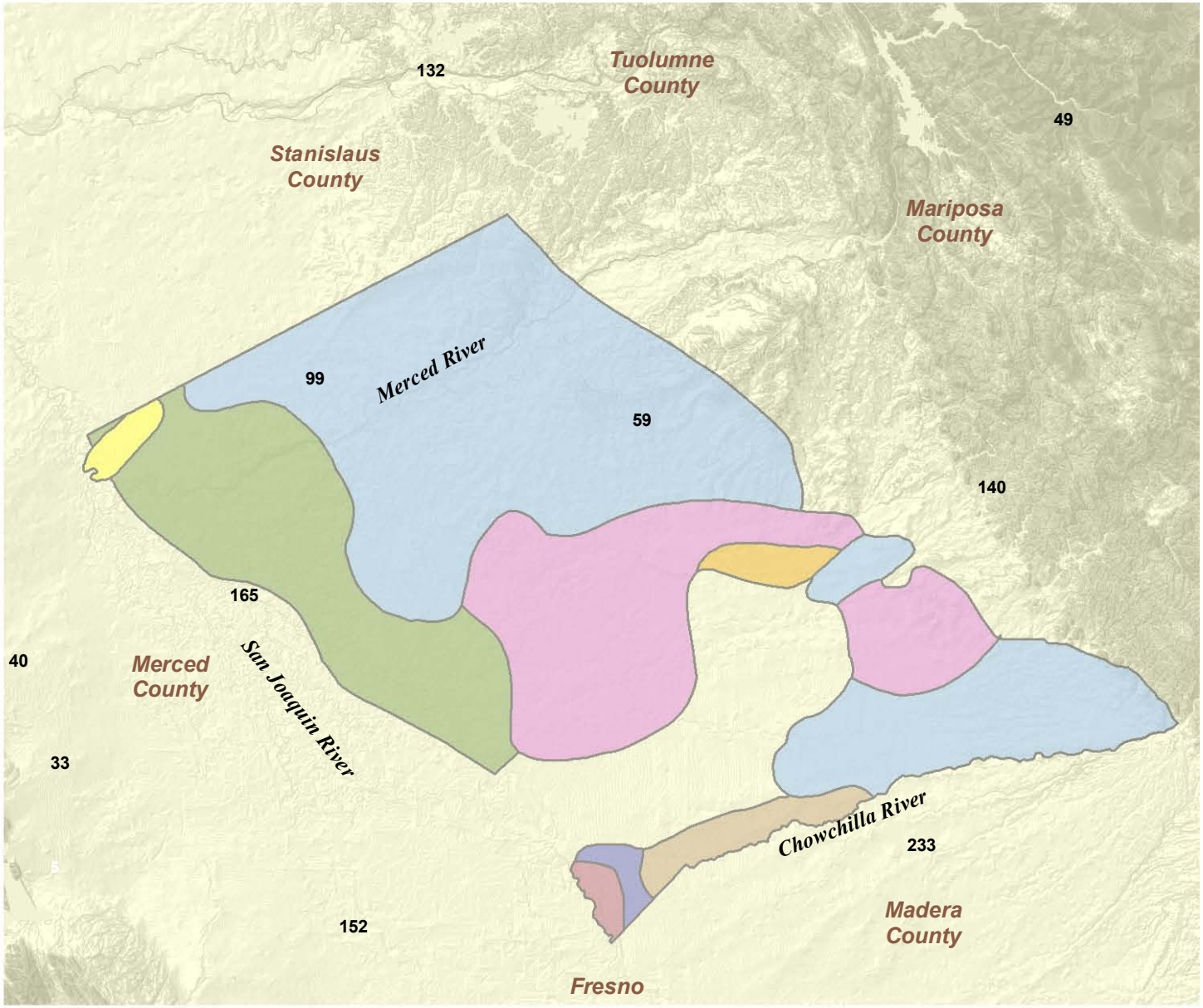
N:\13000\013651\maps_18_water_levels_2006.mxd



SIMPLIFIED 2006 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU	Date: June 2008	Project No. 13651.000
AMEC Geomatrix		Figure 18

N:\13000\013651\maps_19_salts.mxd



APPROXIMATE SCALE IN MILES
0 4 8

0 6,000 12,000
APPROXIMATE SCALE IN METERS

Explanation

Merced groundwater basin

Merced Irrigation District

County boundary

Groundwater types

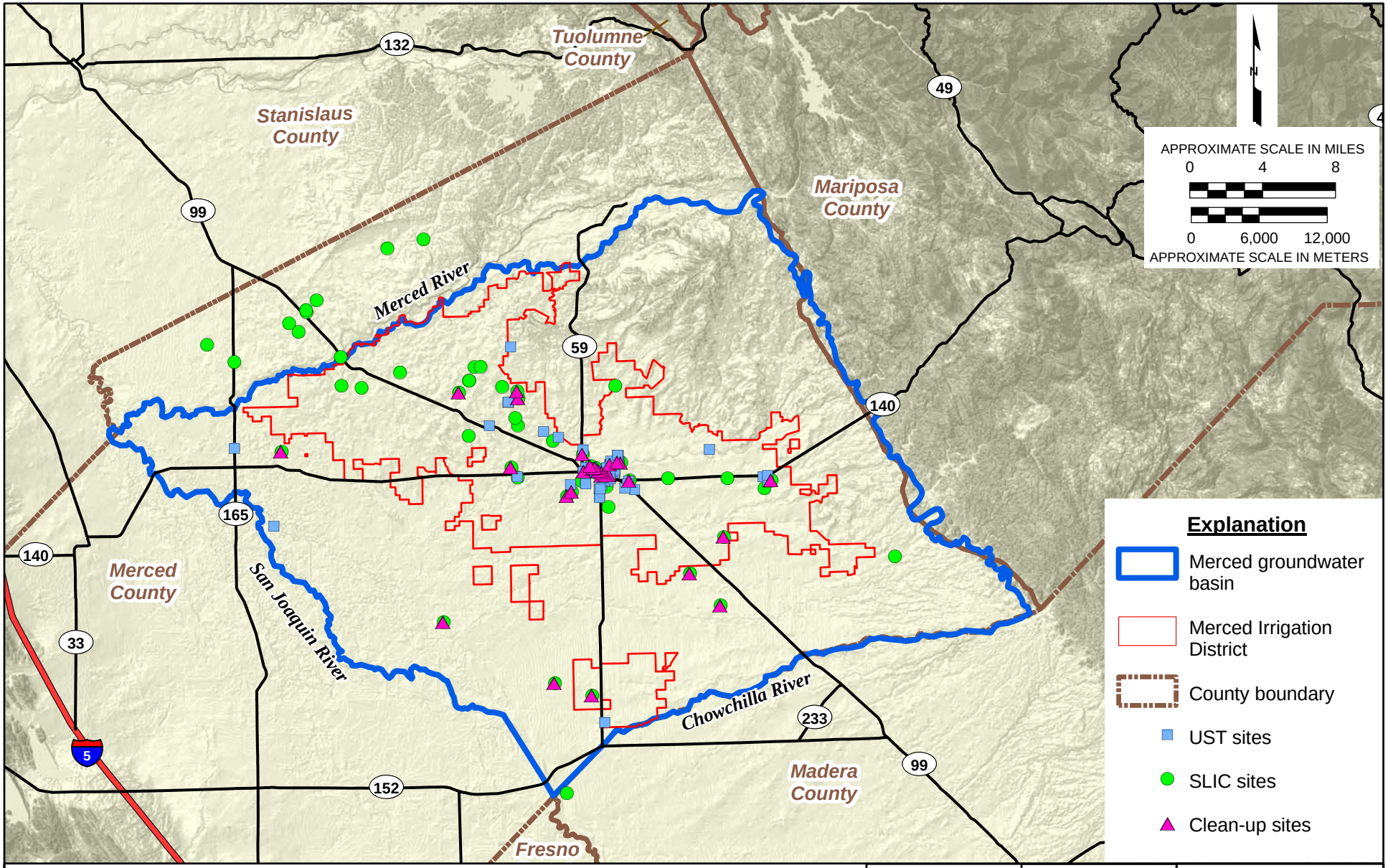
- Calcium Bicarbonate
- Calcium Chloride
- Calcium Magnesium Bicarbonate
- Calcium Sodium Bicarbonate
- Calcium Sodium Chloride
- Magnesium Sodium Bicarbonate
- Sodium Bicarbonate
- Sodium Chloride

DISTRIBUTION OF GROUNDWATER TYPES - MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure **19**

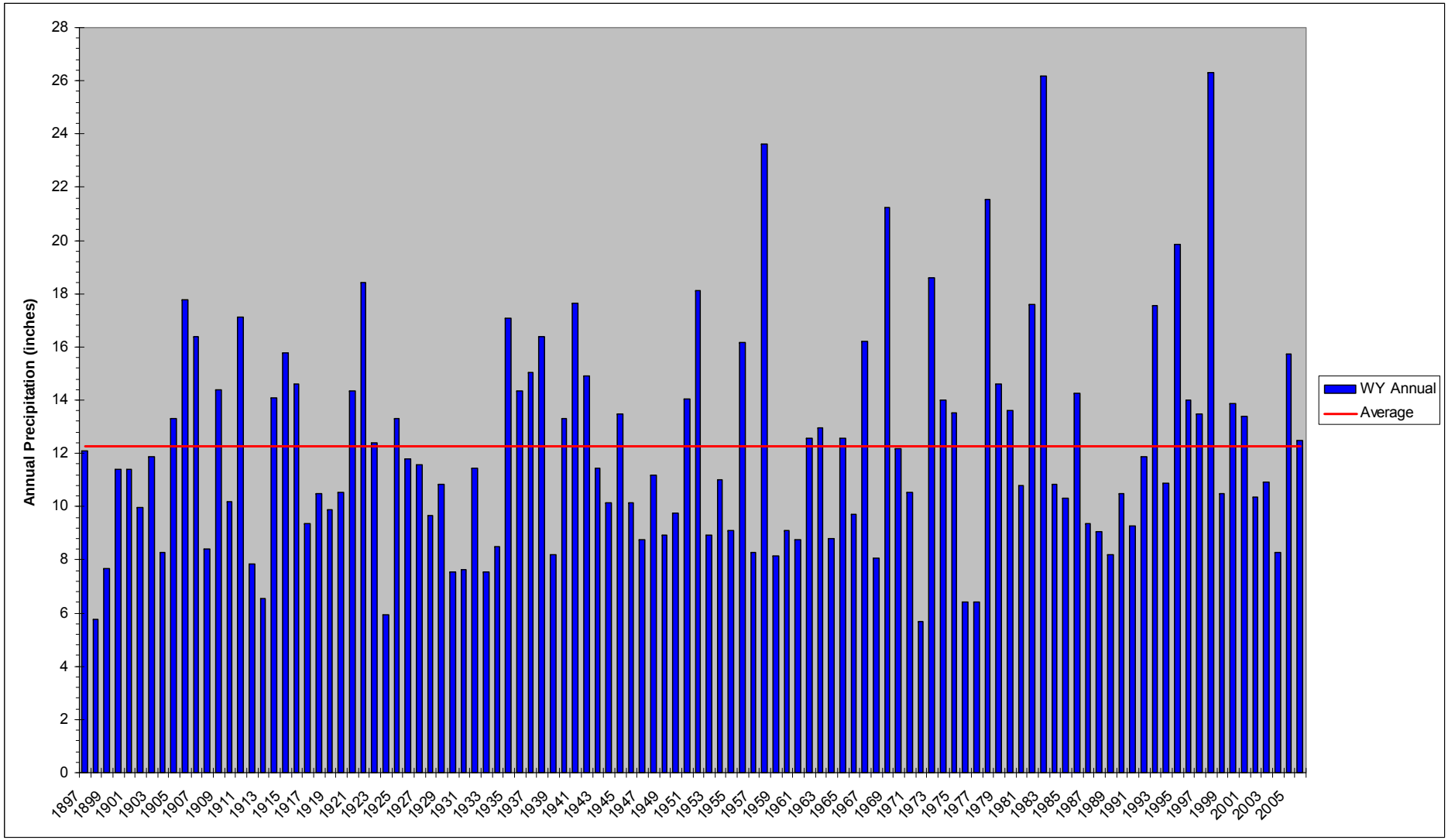
N:\13000\013651\maps_20_hazardous_waste_sites.mxd



LOCATIONS OF KNOWN LEAKY USTs AND CHEMICAL RELEASES
Groundwater Management Plan Update
Merced, California

By: KLU	Date: June 2008	Project No. 13651.000
AMEC Geomatrix		Figure 20

I:\13000\13651\Draft\GWMP_Figures_A_Land_AMEC.ppt



HISTORICAL ANNUAL PRECIPITATION
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure 21

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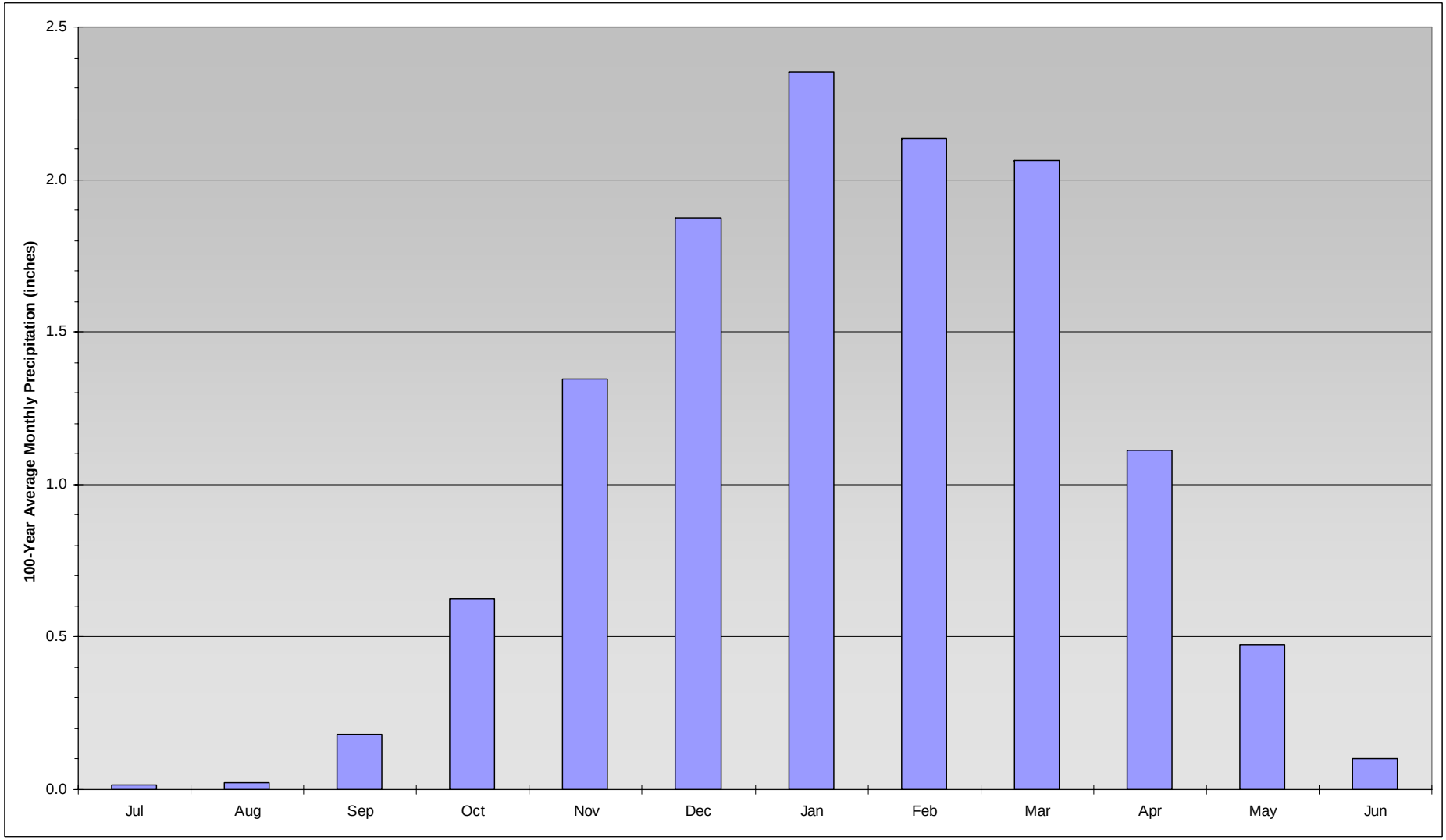
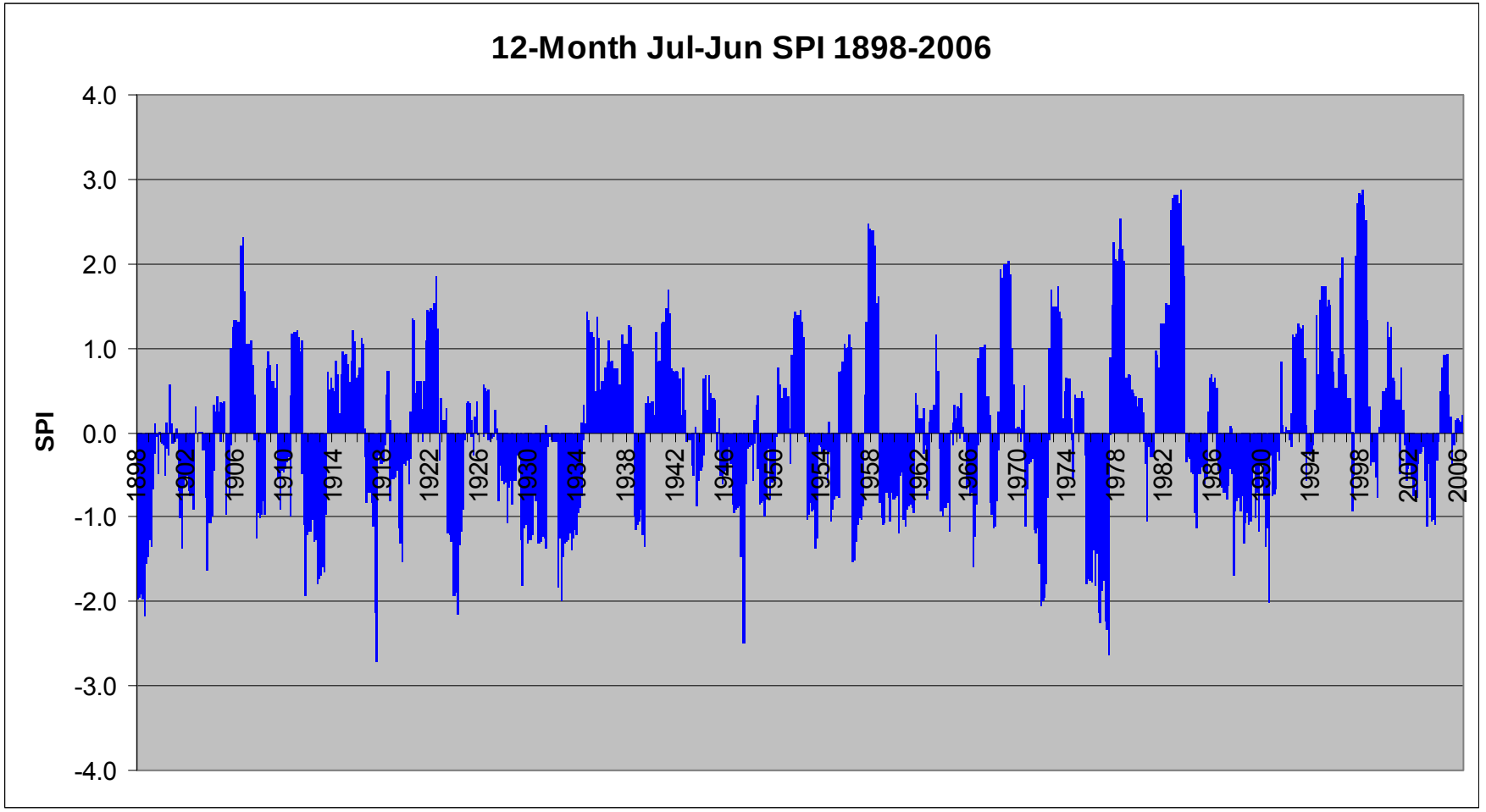


HISTORICAL MONTHLY AVERAGE PRECIPITATION
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: June 2008	Project No. 13651.000
AMEC Geomatrix		Figure 22



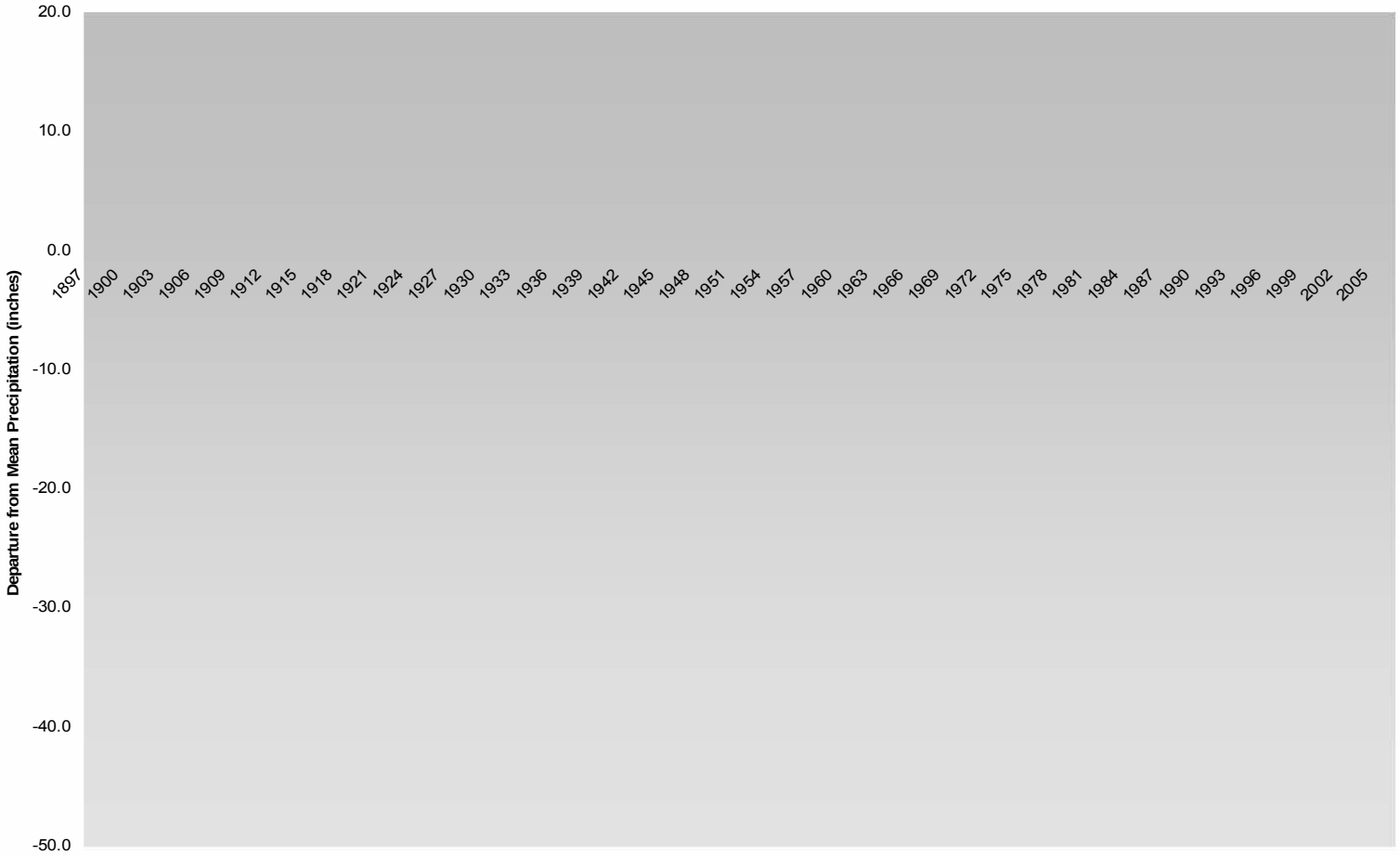
High SPI Values (~3) indicate wet periods

Medium SPI values (~0) indicate normal precipitation

Low SPI values (~-3) indicate periods of drought

STANDARDIZED PRECIPITATION INDEX MERCED GROUNDWATER BASIN Groundwater Management Plan Update Merced, California	By: dmb	Date: 5/27/08	Project No. 13651.000
	AMEC Geomatrix		Figure 23

I:\13000\13651\Draft\GWMP_Figures_A_Land_AMEC.ppt

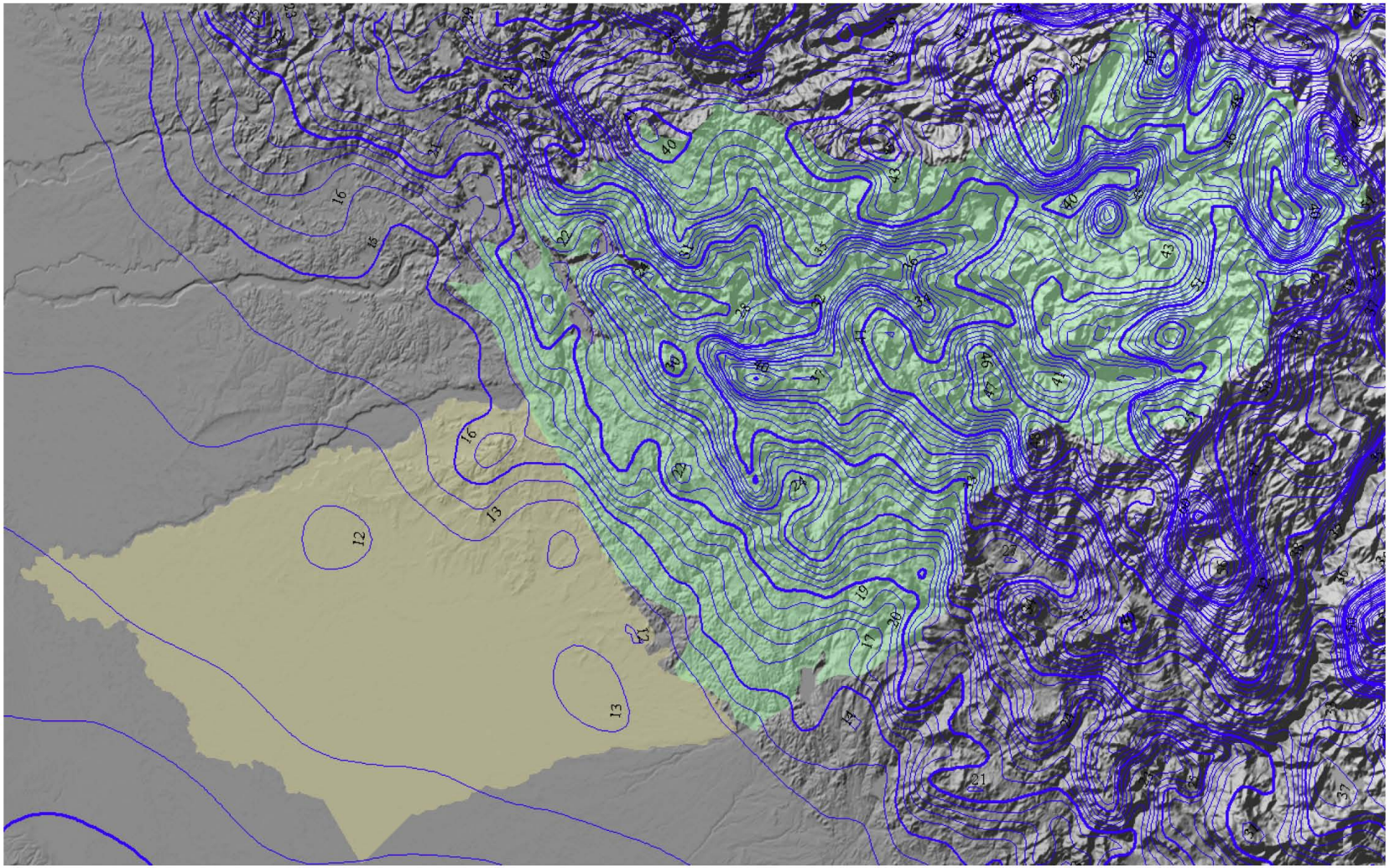


CUMULATIVE PRECIPITATION DEPARTURE CURVE
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Figure **24**

I:\13000\13651\Draft GWMP_Figures_A_Land_AMEC.ppt



Merced Groundwater Basin Watersheds Tributary to Merced Groundwater Basin

1971-2000 Average Isoheytal Contours

1971 – 2000 AVERAGE ISOHEYTAL CONTOURS
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Figure **25**

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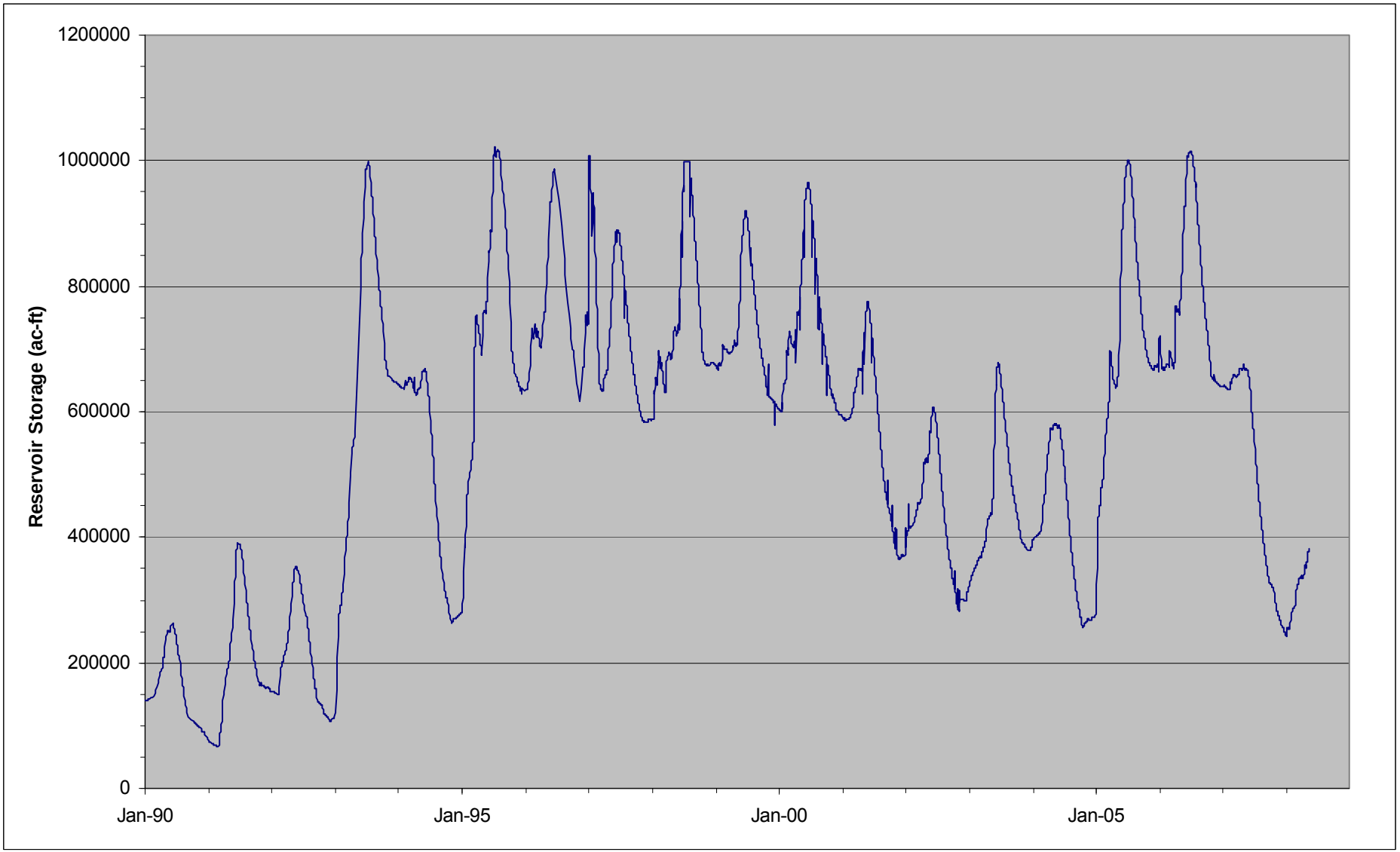

1990 – 2007 LAKE MCCLURE RESERVOIR STAGE
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure 26

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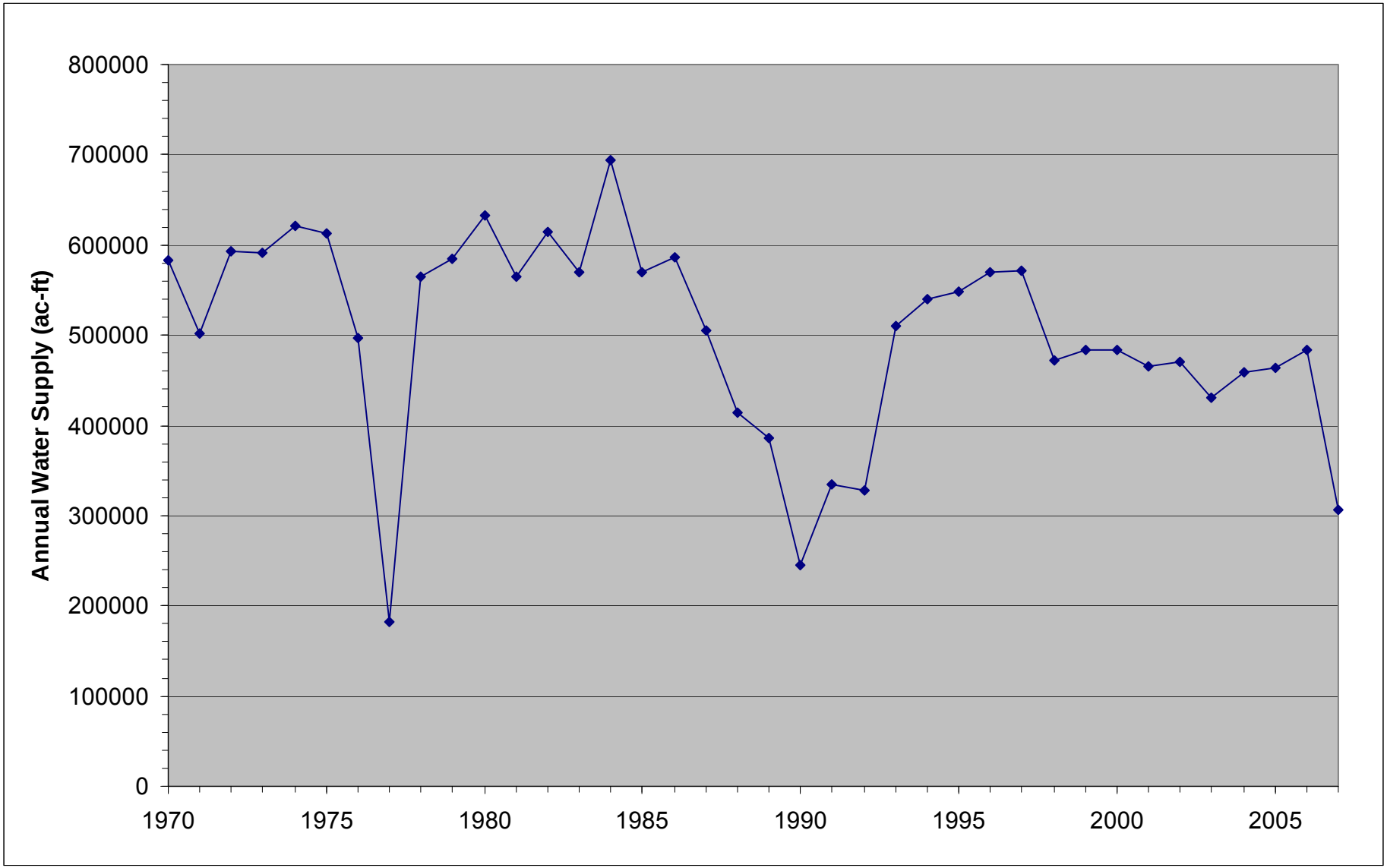
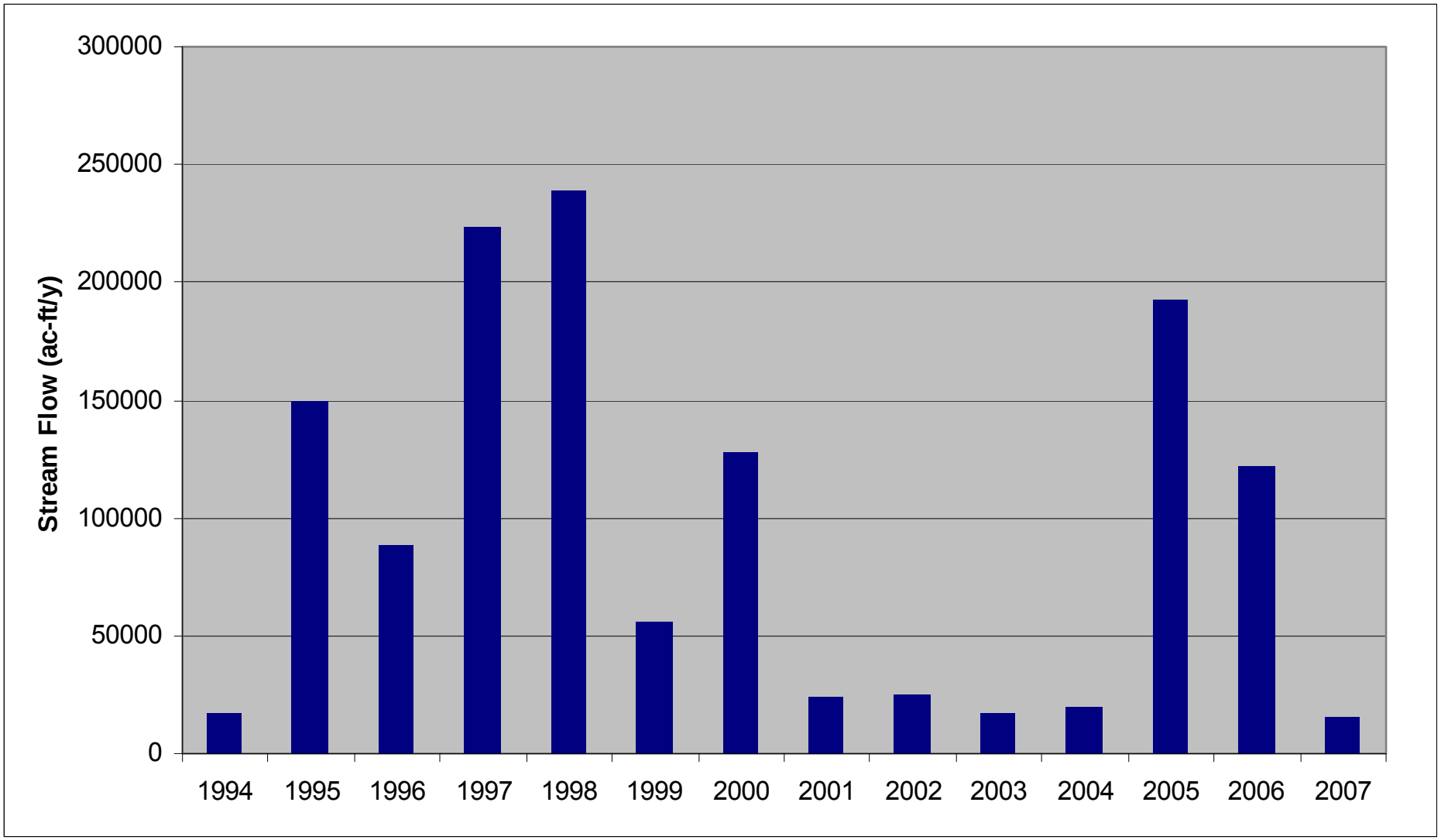


1970 – 2007 MERCED RIVER DERVERSIONS
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure 27

I:\13000\13651\Draft\GWMP_Figures_A_Land_AMEC.ppt

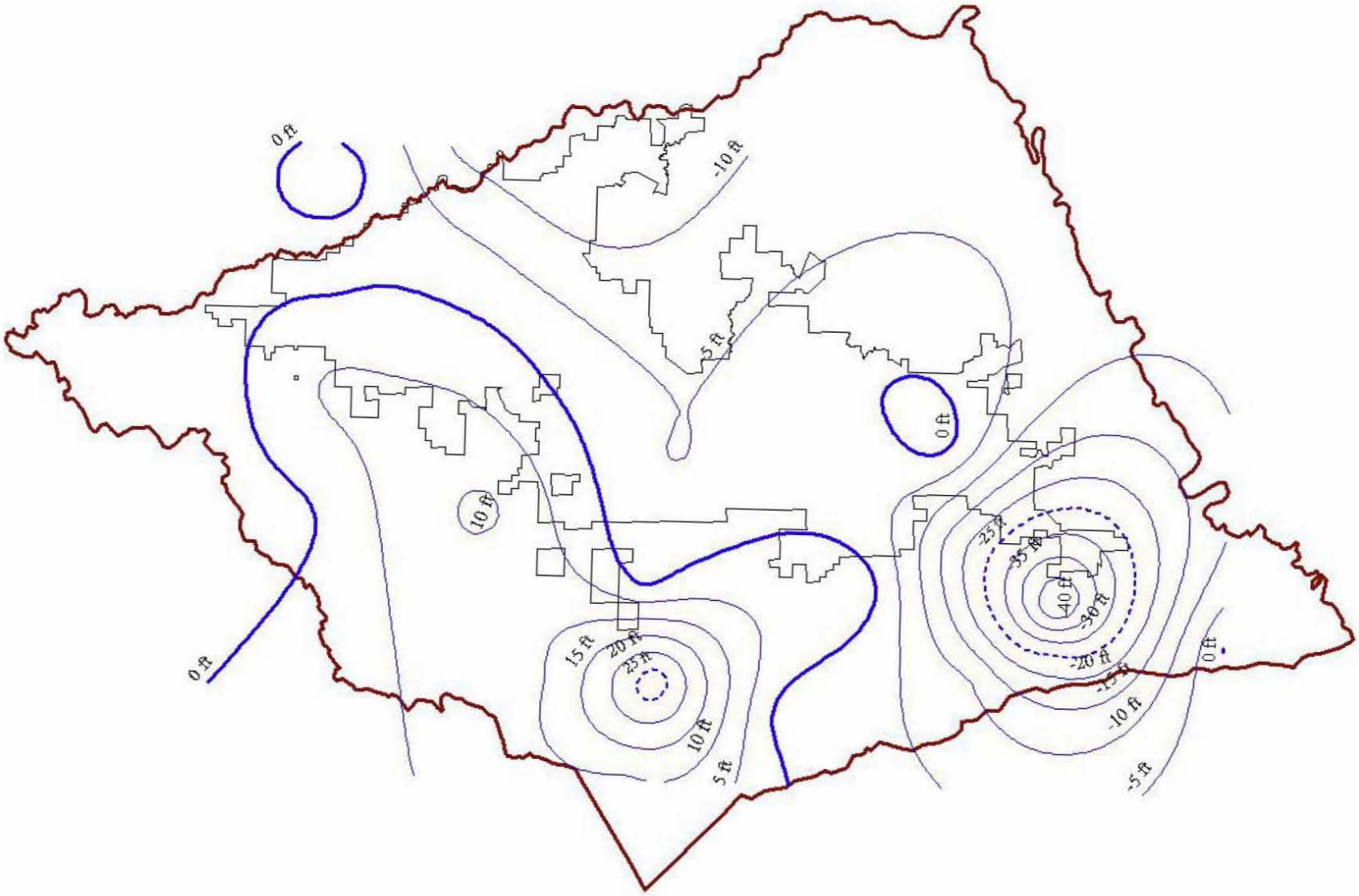


1994 – 2007 TRIBUTARY STREAM FLOW INTO THE MERCED GROUNDWATER BASIN

Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure 28

I:\13000\13651\Draft\GWMP_Figures_A_Land_AMEC.ppt



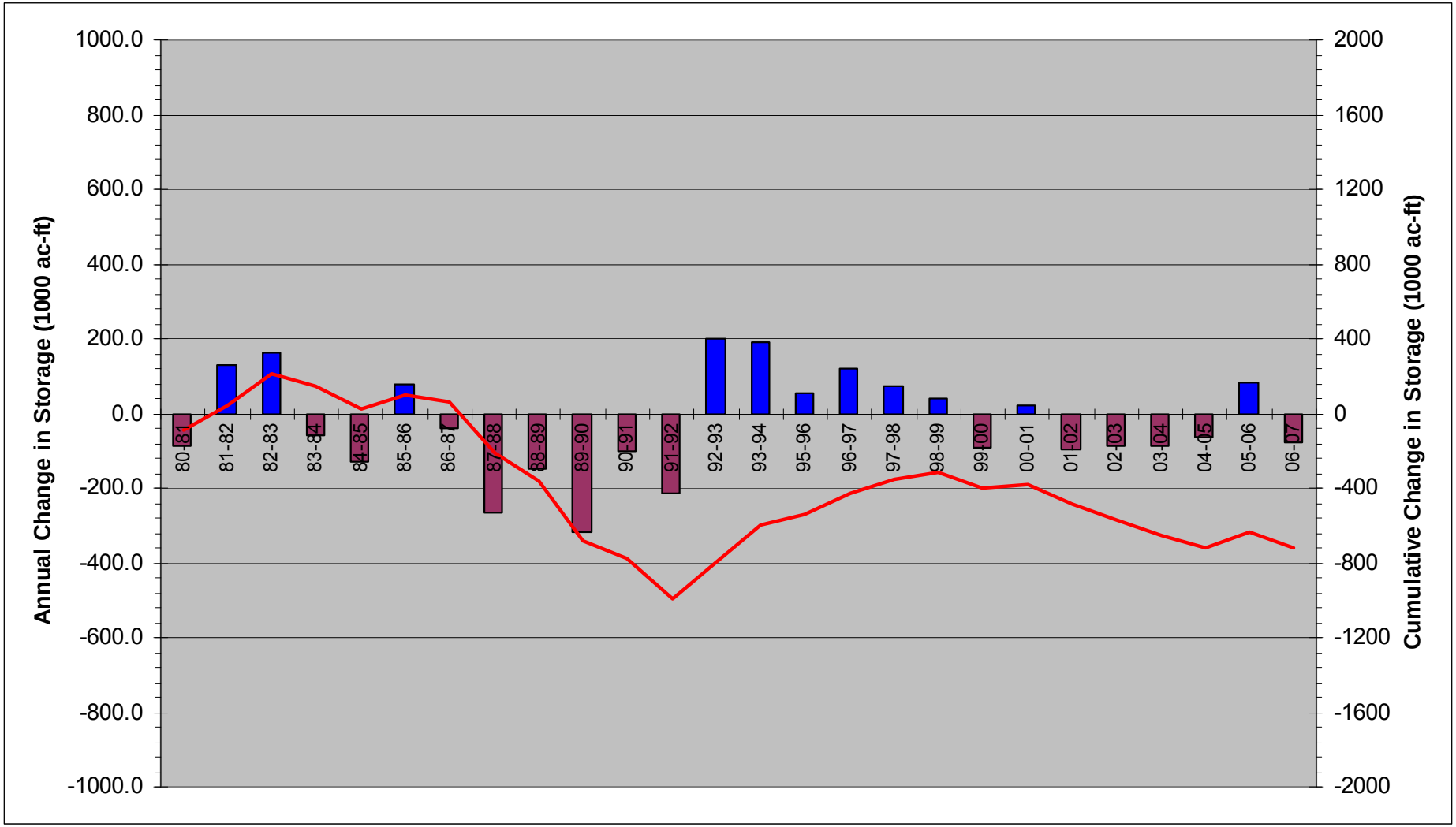
1996 – 2007 CHANGE IN UNCONFINED AQUIFER POTENTIOMETRIC SURFACE

Groundwater Management Plan Update
Merced, California

By: dmb Date: 5/27/08 Project No. 13651.000

Figure **29**

I:\13000\13651\Draft\GWMP_Figures_A_Land_AMEC.ppt

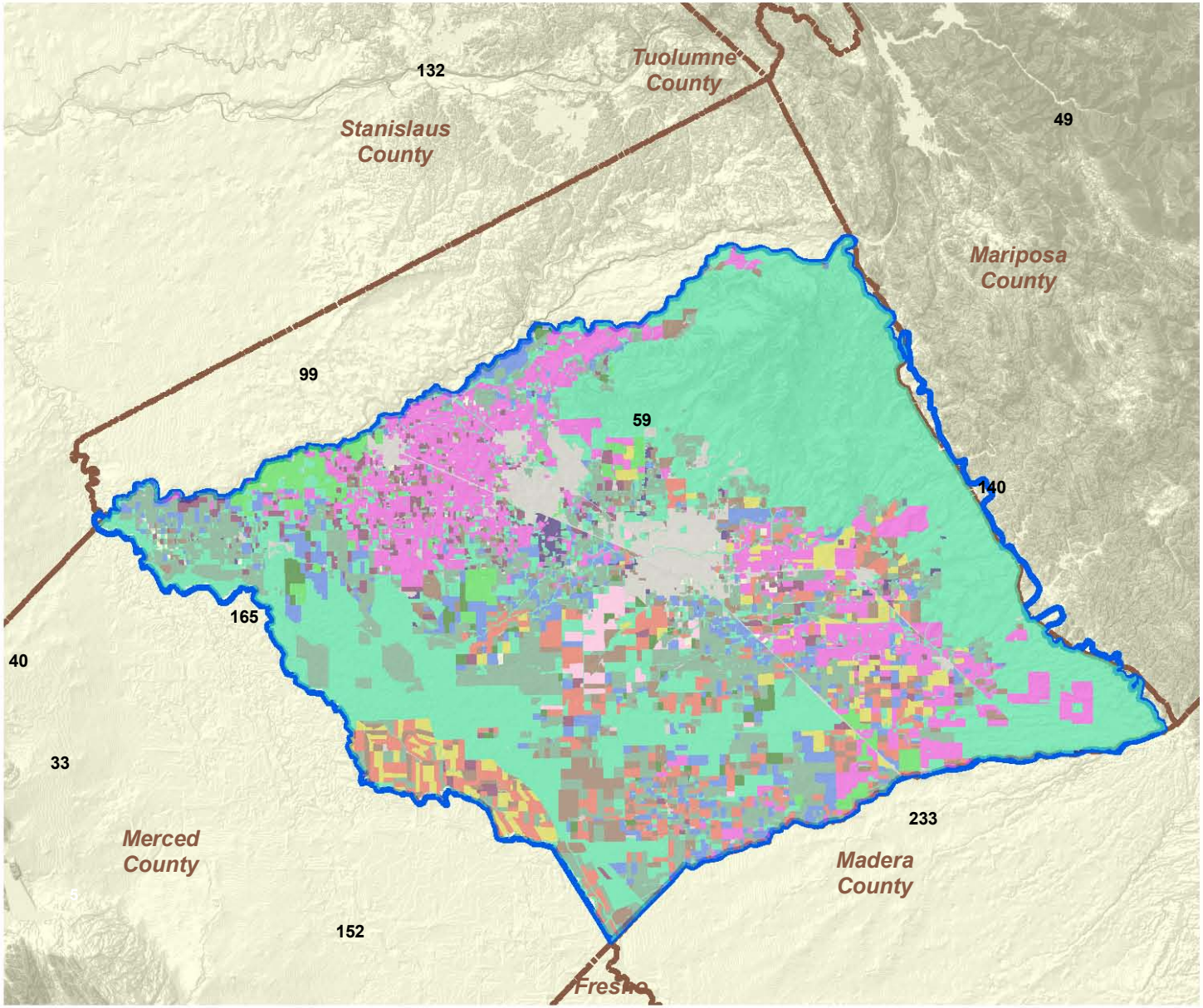


1980 – 2007 APPROXIMATE ANNUAL CHANGE IN STORAGE AND CUMULATIVE CHANGE IN STORAGE

Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure 30

\\FR4\Graphics\13000\013651\maps_crop_water_demand_1995.mxd



APPROXIMATE SCALE IN MILES
0 4 8

0 6,000 12,000
APPROXIMATE SCALE IN METERS

Explanation

Merced groundwater basin

County boundary

Merced ID

Water Demand in Acre Feet (AF)

alfalfa - 456,968

deciduous orchards - 389,254

cotton - 142,920

corn - 141,095

tomatoes - 68,462

vineyards - 36,694

other truck crops 34,321

rice - 32,872

sugar beets - 28,119

grain and hay crops - 21,830

native pasture; urban residential 14,876

citrus - 906

non-irrigated ag

urban

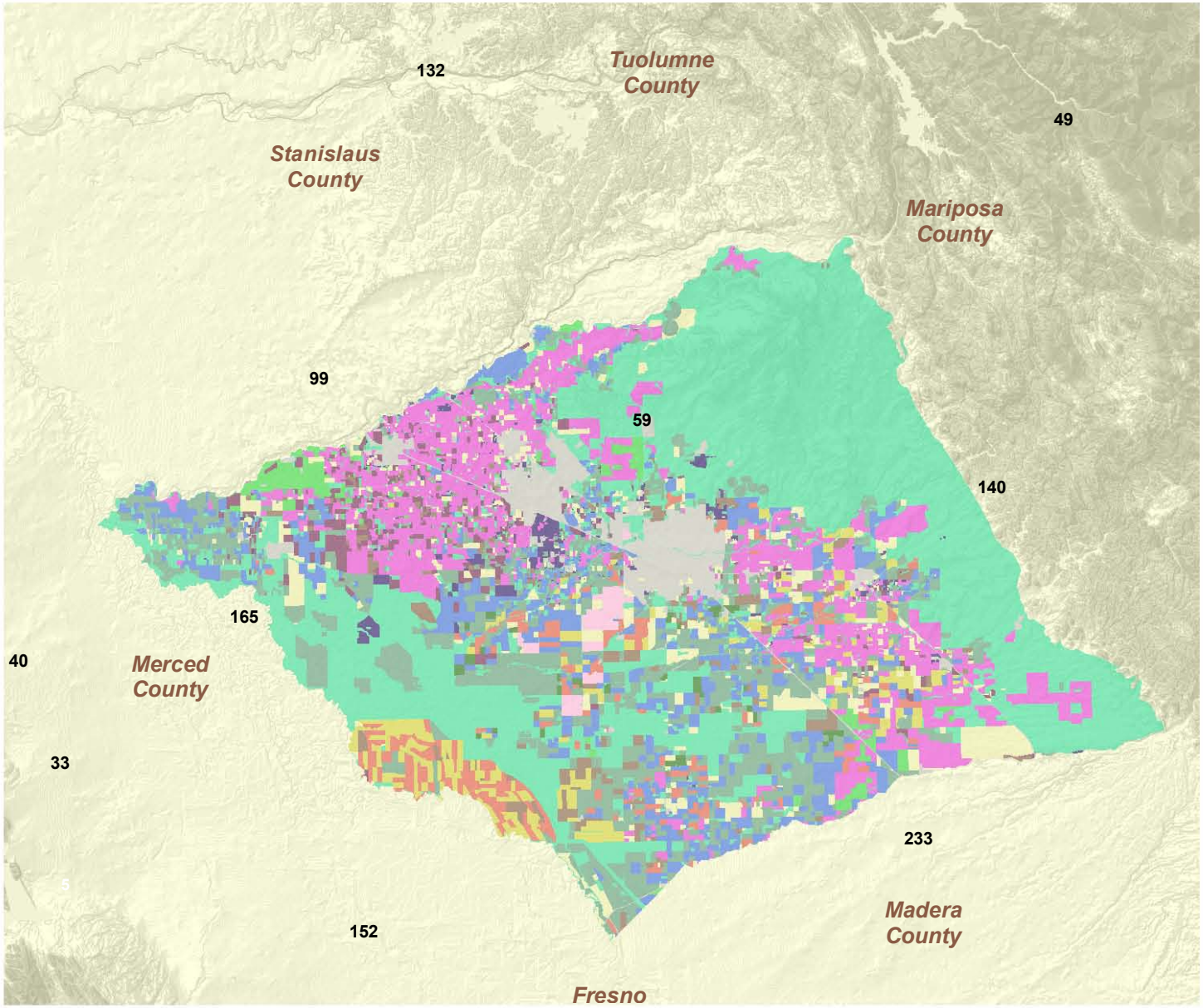
Total Crop Water Demand: 1,459,002 AF

1995 ESTIMATED WATER DEMAND BASED ON LAND USE AND CROPPING PATTERNS
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure **31**

\\FR4\Graphics\13000\013651\maps_32_2002_water_demand.mxd



APPROXIMATE SCALE IN MILES
0 4 8

0 6,000 12,000
APPROXIMATE SCALE IN METERS

Explanation

Merced groundwater basin

County boundary

Merced ID

Water Demand in Acre Feet (AF)

alfalfa - 447,925

deciduous orchards - 427,001

cotton - 83,688

corn - 218,942

tomatoes - 81,661

vineyards - 25,925

other truck crops 33,548

rice - 27,238

sugar beets - 14,260

grain and hay crops - 109,815

native pasture; urban residential 33,884

citrus - 502

non-irrigated ag

urban

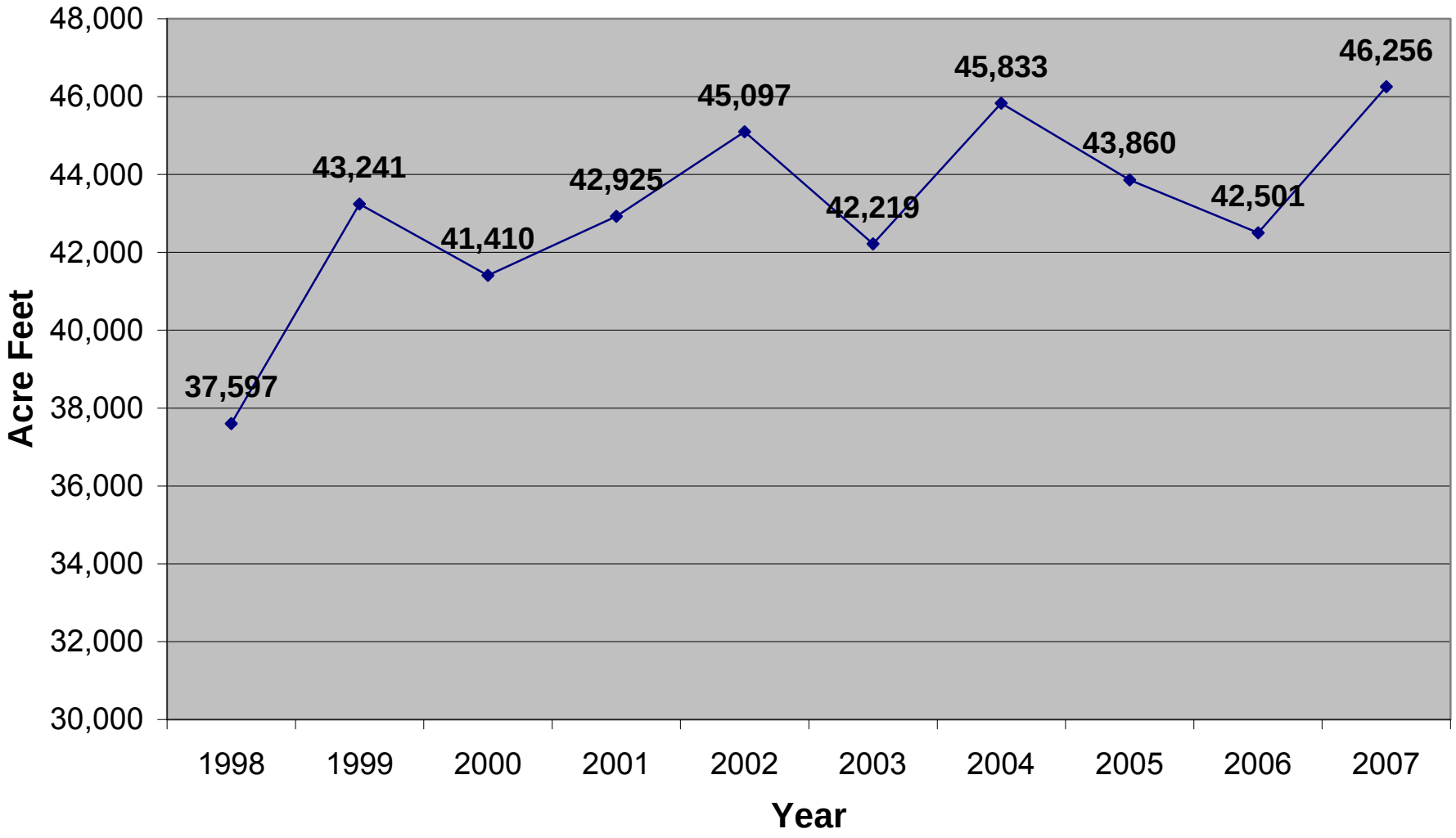
Total Crop Water Demand: 1,201,546 AF

2002 ESTIMATED WATER DEMAND BASED ON LAND USE AND CROPPING PATTERNS
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure **32**

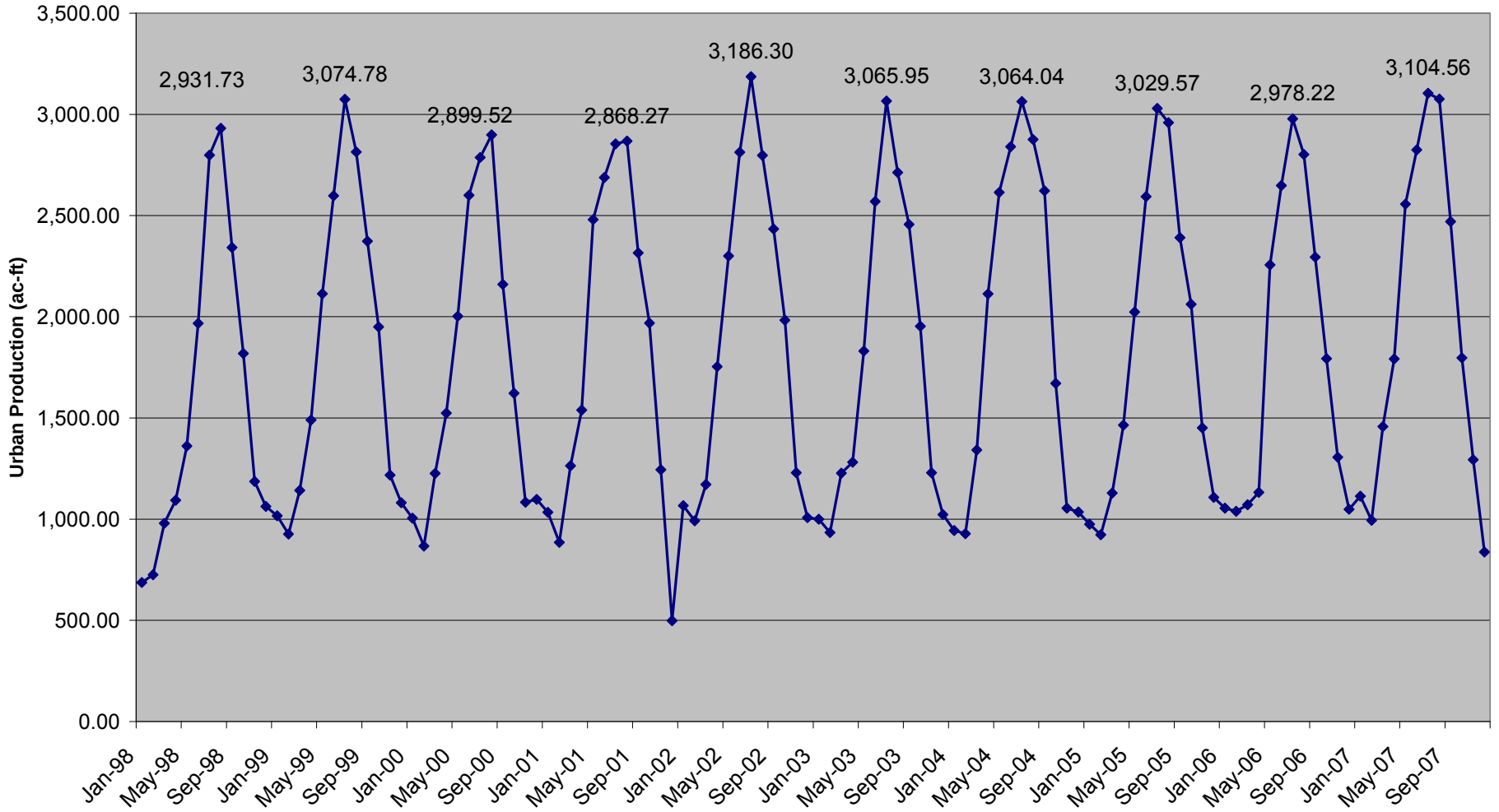
I:\13000\13651\Draft\GWMP_Figures_A_Land_AMEC.ppt



1998 – 2007 TOTAL MUNICIPAL PRODUCTION
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure 33

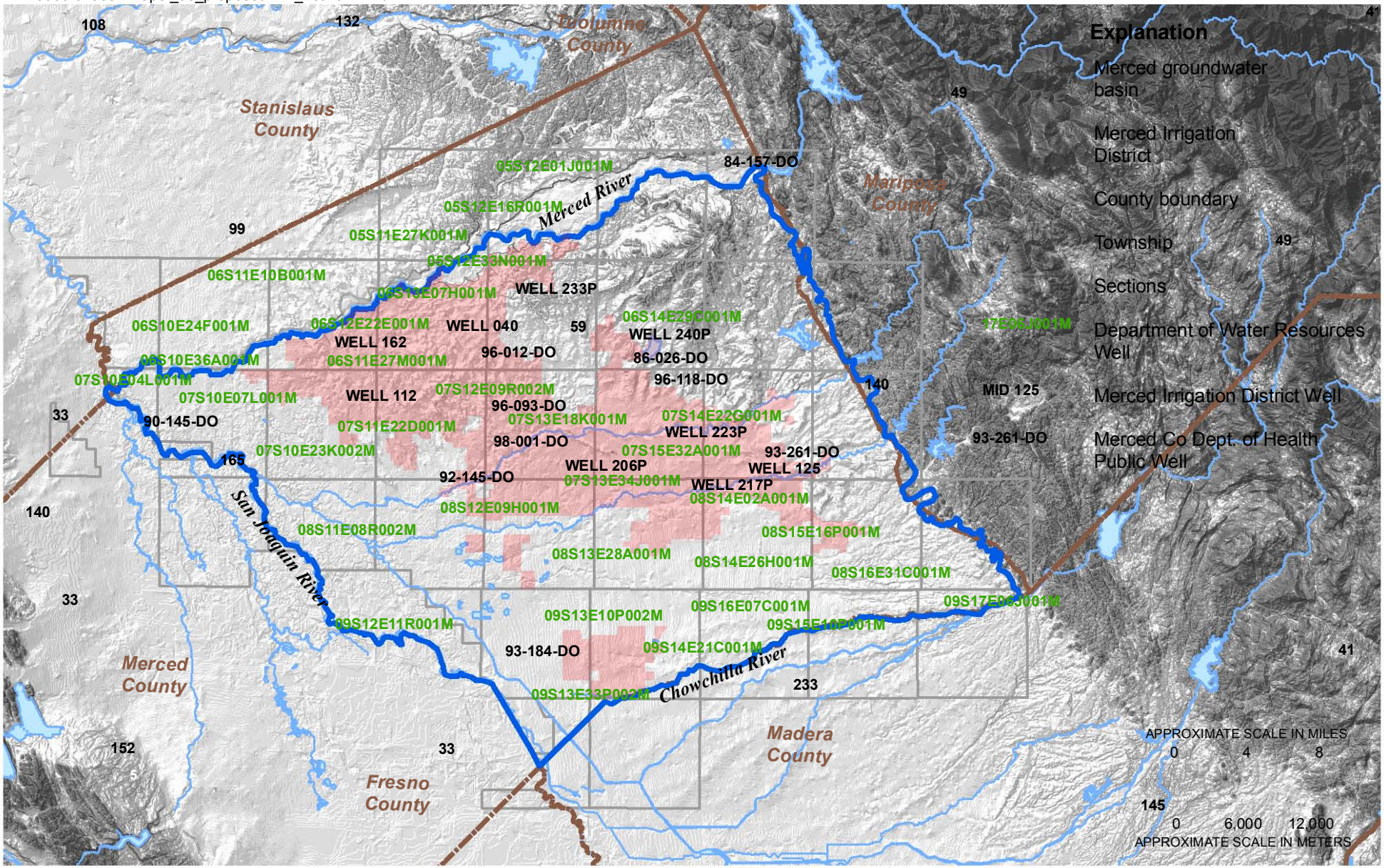
I:\13000\13651\Draft\GWMP_Figures_A_Land_AMEC.ppt



1998 – 2007 MONTHLY MUNICIPAL PRODUCTION
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure 34

N:\13000\013651\maps_35_proposed mw_network.mxd



By: KLU Date: 07/28/2008 Project No. 13651.000

APPROXIMATE LOCATIONS FOR PROPOSED MONITORING WELL NETWORK
Groundwater Management Plan Update
Merced, California

Figure **35**

MEMORANDUM OF UNDERSTANDING
FOR THE
ESTABLISHMENT AND OPERATION
OF THE
MERCED AREA GROUNDWATER POOL INTERESTS
(MAGPI)

RECITALS

The parties to this Memorandum of Understanding, hereafter "MOU", as set forth herein have entered this MOU based upon the following facts and principles:

A. The Merced Groundwater Basin, hereafter "Basin", is defined roughly and is herein understood to be bound on the east by the Merced County line, on the south by the Chowchilla River, on the west by the San Joaquin River, and on the north by the Merced River.

B. Groundwater and surface water resources within the Merced Groundwater Basin are vitally important resources, in that they provide the foundation for environmental, agricultural, domestic, municipal and industrial needs, as well as other needs, and to maintain the economic viability and prosperity of the Basin area.

C. The eastern Merced County area occupied by the Merced Groundwater Basin is a vital agricultural area with increasing importance in industry and education. Because of increasing demands for California's finite water resources, it is critical that those persons and agencies making use of the regions limited water supplies do so in an efficient and knowledgeable manner to preserve the resources for all elements of the local economy.

D. The permanent overdraft of groundwater supplies can result in water quality as well as quantity issues, cause land subsidence, increase costs to produce agricultural, industrial and domestic water supplies, and eventually restrict economic development.

In light of these matters the parties desire to form an association to be known as Merced Area Groundwater Pool Interests (MAGPI) on terms as follows:

1. Goals: The purposes and goals of MAGPI are:

   a. To determine and evaluate the Basin's existing groundwater supplies;

   b. Prepare and promote a draft groundwater management plan for the Basin, which could be adopted by the appropriate agencies, or in the event the parties deem appropriate to form a Joint Powers Authority (JPA) to adopt such a plan, which would then be ratified by the JPA members;

   c. Consider developing and/or adopting an existing hydrologic groundwater model of the Basin's groundwater supplies for association analysis of the Basin;

   d. Determine the Basin's need for additional or improved water extraction, storage, delivery, conservation, reuse and recharge facilities;

   e. Provide information and guidance for the management, preservation, protection and enhancement of the Basin; and

   f. To begin to determine the safe yield of the Basin.

2. Principles:

   a. The parties believe that non-coordinated action by water providers and users within the Basin could result in counter productive competition for finite resources resulting in adverse impacts to the groundwater and surface water supplies within the Basin.

b. The parties believe that a mutually acceptable groundwater management plan for water suppliers and users within the Basin is important to protect groundwater and surface water resources and will assist in meeting the needs of all current and future users of such resources within the Basin.

c. Because of the enactment of State legislation, it is now clear to the Parties that local management of water resources is desirable in order that local control be maintained over such resources.

d. The parties hereto desire to enter into this MOU in order to form an association to promote common goals and provide coordinated planning to make the best use of, and provide the most protection for, available water resources to meet the needs of their respective constituents and service areas in the mutual best interests of the people residing and working in the Basin.

e. In forming the Association, it is the parties' desire, at this time, that the Association not be formed as a separate governmental entity, nor have any enforceable regulatory authority over any party's facilities or any party's respective surface water or groundwater supplies or rights, nor duplicate any services, duties or authority of any other agency.

f. However, the parties recognize that achieving the goals and objectives of MAGPI may require certain activities in the future which may require a more formal organization in the nature of a Joint Powers Authority (JPA). Should such a need arise, each party hereto shall determine its continuing participation as it shall deem appropriate.

3. Definitions: The following terms shall have the meanings specified in this Section 3:

a. Board: That body, consisting of one representative from each of the parties, which governs the Association, as established pursuant to Section 5.2 of this MOU.

b. Chairperson: The presiding officer of the Association as elected by the Board. In the absence of the Chairperson, the Vice-Chairperson will perform all duties of the Chairperson.

c. Governing Bodies: The legislative bodies of the governmental parties to this MOU, and the Boards of Directors of the privately owned parties to this MOU.

d. Parties: Include County of Merced, Merced Irrigation District, City of Merced, together with all parties admitted to the MOU as hereafter set forth.

4. Organization:

a. The parties to this MOU hereby form an Association known as Merced Area Groundwater Pool Interests (MAGPI). This Association shall have no enforceable regulatory authority over any person or entity, including parties or parties' facilities property or rights.

b. Board: The Association shall be governed by a Board whose membership, duties and responsibilities are set forth herein.

(1) Each party shall designate one person to serve as a member of the Board, and one or more alternates and notify the Chairperson of those appointments. Each member of the Board, and each alternate, shall serve at the pleasure of the party appointing such member. A party's alternate may serve in the place of that party's member in the absence of such member and, in such case, the alternate shall have the powers of the member.

(2) The Board, at its first meeting, shall elect a Chairperson and Vice-Chairperson from its members. Such officers shall serve as the pleasure of the Board and in such capacities until the first meeting of the Board in 1998 at which time the Board shall elect new officers. Thereafter, the Board shall elect a Chairperson and Vice-Chairperson from its members at the first meeting of each calendar year. The Chairperson shall be responsible for presiding over meetings of the Board, and shall notify committee members of meetings of the Board. The Board shall establish a date, time and place for its regular meetings, and may hold special meetings when required for the proper transaction of business. All meetings of the Board shall be held in accordance with the provisions of the Brown Act, California Government Code §54950 et seq. The Board shall prescribe such procedures for the conduct of its business as it deems appropriate.

(3) A quorum shall consist of one more than fifty percent (50%) of the members of the Board, except that less than a quorum may adjourn meetings of the Board from time to time. Alternatively, the Chairperson may adjourn a meeting of the Board to a specified time, date and place if there is less than a quorum of members present for a meeting. Except for actions for which a different approval standard is set forth in this MOU, all actions of the Board shall be approved by a majority of the members present.

(4) The Board shall have the following duties and responsibilities:

(a) Develop and implement the activities, including work schedule, designated to achieve the objectives of the Association as set forth in Sections 1 and 2 of this MOU.

(b) Monitor work activities of the Association.

(c) Establish such committees as may be necessary or desirable to carry out the purposes of the Association, and to exercise general supervision over such committees.

c. Staff; Employees: The Association shall have no employees, but may obtain staff and support services through the parties.

d. New Parties: New parties may join the Association, provided that they meet the requirements as follows:

(1) Any local public agency, whose service area includes land located within the Basin, which is authorized to provide water service, flood control, groundwater quality management, or groundwater replenishment within its service area, and whose service area includes all or a portion of the Basin, may apply for membership in the Association.

(2) A water corporation regulated by the California Public Utilities Commission or a mutual water company, whose service area includes land located within the Basin, which is authorized to provide water service within its service area, and whose service area includes all or a portion of the Basin, may apply for membership in the Association.

(3) Application for membership shall be subject to approval by the Governing Bodies of the parties; approval shall require the affirmative vote of the Governing Bodies of two-thirds (2/3) of the parties. Each member sitting on the Board shall be responsible for placing on the agenda of his or her

Governing Body the application for membership of any applying party once requested by the Board.

(4) Any new party to this agreement shall, as a condition of admission to the Association, be required to first pay its proportionate share of back contributions, if any, as determined by the Board.

5. Technical Committee: A Technical Committee shall be established composed of staff of the participating member agencies, and will cause the preparation of a proposed draft groundwater management plan for the Basin.

6. Association Costs: Costs incurred by any party in connection with any functions of the Association, or any committee established by the Board, and expenses of a party's personnel including, without limitations, the regular and alternate members appointed by a party to any committee while performing such functions, shall not be reimbursed by the Association except upon approval of the Board.

7. Funding and Voting Percentages:

a. It is expected that the Parties will fund their own staff work, it is not anticipated that additional funding will be required. Any funding contribution by the parties for the preparation of a draft groundwater management plan monitoring activities, and/or restoration activities shall be approved by a unanimous vote of the Board members present.

b. Voting Rights: Each party's representative on the Board shall be entitled to one vote.

c. Modification by Party: Funding percentages and/or voting percentages as indicated in this Section, may be changed only upon the approval of the Governing Bodies of all of the parties.

8. Term of this MOU: The term of this MOU shall commence upon execution by three (3) parties, and continue until terminated by majority of the Board or withdrawal of members such that only two (2) or less remain. Upon termination of this MOU, the Board shall determine the assets and liabilities of the Association; make every effort to satisfy all obligations within sixty (60) days of the termination of the MOU; and distribute the remaining fund balance, if any, equitably to each party in proportion to each party's funding contribution to the Association.

9. General Provisions Governing MOU:

a. Construction of Terms: This MOU is for the sole benefit of the parties and shall not be construed as granting rights to any person other than the parties or imposing obligations on a party to any person other than another party.

b. Withdrawal or Termination of Membership: Except in the event of the termination of this MOU pursuant to Section 9, a party who withdraws or terminates its membership in the Association shall not be entitled to a refund of its funding contributions, if any. Any party may terminate membership and withdraw from this Association upon thirty-(30) days written notice of termination to the Association. If a party withdraws from the Association when the Party is in arrears as to its agreed funding contributions to the Association, that party's entitlement to use any groundwater model or other work product of the Association as provided for herein shall be determined by the Board.

c. Amendment: An amendment to this MOU must be approved by the affirmative vote of the Governing Bodies of two-thirds (2/3) of the Parties.

d. Counterpart Execution: This MOU may be executed in counterparts each of which shall be deemed an original but all of which together shall constitute one and the same instrument.

IN WITNESS WHEREOF, the parties have caused this MOU to be executed, each signatory hereto represents that he has been appropriately authorized to enter into this MOU on behalf of the party for whom he/she signs.

CITY OF MERCED

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
AND
MEMORANDUM OF UNDERSTANDING
MERCED AREA GROUNDWATER POOL INTERESTS
(Signature Page)

By: Mary Jo Knudsen 12/19/97
MARY JO KNUDSEN
Mayor

ATTEST

By: James G. Marshall 12/19/97
JAMES G. MARSHALL
City Manager

APPROVED AS TO FORM

By: 12/19/97
STEVEN F. NORD
City Attorney

BEFORE THE BOARD OF SUPERVISORS

OF THE COUNTY OF MERCED, STATE OF CALIFORNIA

In the matter of:

RESOLUTION ADOPTING THE MERCED GROUNDWATER BASIN, GROUNDWATER MANAGEMENT PLAN AND MEMORANDUM OF UNDERSTANDING FOR THE MERCED AREA GROUNDWATER POOL INTEREST

Resolution No. 97-261

WHEREAS, on November 4, 1997, the Merced County Board of Supervisors ("Board") adopted and published its Resolution of Intention to a Draft Groundwater Management Plan pursuant to California Code Sections 10750 et seq., commonly known as "AB 3030," following proceedings as prescribed by the Water Code; and

WHEREAS, the Board thereafter caused to be prepared the County's proposed Groundwater Management Plan, a copy of which is on file with Secretary hereof; and

WHEREAS, on November 25, 1997, the Board conducted a second hearing on the proposed plan after due notice and publication, all as required by Water Code Section 10750, et seq., including notice that copies of the Plan were available to the public; and

WHEREAS, at the second public hearing opportunity was provided for public input and questions, and the hearing was duly concluded; and

WHEREAS, at no time prior to or during said hearing process did the Board receive protest in writing from a majority of landowners of the County; and

WHEREAS, the Board has considered the Groundwater Management Plan and has determined that it is within the public affairs and in the best interest of the County to adopt the proposed plan.

NOW THEREFORE BE IT RESOLVED BY THE Board of Supervisors of the County of Merced, State of California as follows:

1. It is in the best interest of local agencies and Merced County, and its inhabitants, that the County approve and adopt the Merced Groundwater Basin, Groundwater Management Plan pursuant to Part 2.75 of Division 6 of the Water Code.

2. The Board approves the Memorandum of Understanding for the Merced Area Groundwater Pool Interest (MAGPI) and authorizes the Chairman to sign the Agreement.

3. The Director of the Division of Environmental Health is appointed as the county representative to the Merced Area Groundwater Pool Interests (MAGPI) and is hereby directed to coordinate issues with all applicable county departments and regularly report to the Board issues relating to groundwater management.

I, GREGORY B. WELLMAN, Clerk of the Board of Supervisors of the County of Merced, do hereby certify that the foregoing resolutions was regularly introduced, passed and adopted by said Board at a regular meeting thereof held on the 25th day of November 1997 by the following vote:

SUPERVISORS:

AYES: Joe Rivero, Gloria Cortez Keene, Deidre F. Kelsey, Jerry O'Banion

NOES: None

ABSENT: Kathleen M. Crookham

WITNESS my hand and the Seal of this Board this 25th day of November, 1997

GREGORY B. WELLMAN, CLERK

By _____
Deputy

MERCED IRRIGATION DISTRICT

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
AND
MEMORANDUM OF UNDERSTANDING
MERCED AREA GROUNDWATER POOL INTERESTS
(Signature Page)

Jack F. Hooper

JACK F. HOOPER
President

Timothy L. Pellissier

TIMOTHY L. PELLISSIER
Secretary

Approved as to Form:

KENNETH M. ROBBINS
Flanagan, Mason, Robbins & Gnass
General Counsel

CITY COUNCIL
OF THE
CITY OF ATWATER

RESOLUTION NO. 1397-97

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF ATWATER ADOPTING THE CITY OF ATWATER GROUNDWATER MANAGEMENT PLAN, FINDING THAT THE PLAN IS EXEMPT FROM THE CALIFORNIA ENVIRONMENTAL QUALITY ACT, AND AUTHORIZING FILING OF NOTICE OF EXEMPTION.

WHEREAS, the Merced Area Groundwater Pool Interests (MAGPI) of which the City of Atwater is a member, has developed a basin-wide groundwater management plan pursuant to Water Code Sections 10750 et. seq., and staff participated in the development of the plan;

WHEREAS, staff recommends that the City Council of the City of Atwater adopt the Atwater Groundwater Basin Groundwater Management Plan; and

WHEREAS, the California Environmental Quality Act ("CEQA") exempts certain projects from the environmental review process. Staff recommends that the Council consider making a finding that adoption of the Merced Groundwater Basin Groundwater Management Plan is eligible for a Statutory Exemption under the California Environmental Quality Act (CEQA); and

WHEREAS, staff has conducted a thorough review of the project and it's CEQA ramifications and has presented that review to the Council.

NOW, THEREFORE, BE IT RESOLVED as follows:

1. The findings and evidence set forth in attachment "A" are hereby adopted.

2. Pursuant to the findings of Attachment "A", the City Council finds that the project is statutorily exempt from CEQA and the City Clerk is authorized and directed to file a notice of exemption for the project pursuant to the requirements of CEQA.

3. The Mayor of the City Council is hereby authorized to sign the Memorandum of Understanding for the establishment and operation of the Merced Area Groundwater Pool

Interests. The Public Works Director/City Engineer is hereby appointed to be the City of Atwater's representative to the Merced Area Groundwater Pool Interests.

4. The plan is hereby adopted.

The foregoing resolution is hereby adopted this 8th day of December, 1997.

AYES: Anderson, Duddy, Krotik, DeVoe

NOES: None

ABSENT: Abercrombie

APPROVED:

Kenneth N. DeVoe

KENNETH N. DEVOE, MAYOR

ATTEST:

Frances M. Barrett

FRANCES M. BARRETT, CITY CLERK

"I, Frances M. Barrett, City Clerk of the City of Atwater and as such Ex-Officio Clerk of the City Council of the City of Atwater, hereby certify that the foregoing resolution is a true, correct, and complete copy of the original of such resolution, which is on file in my office.

Frances M. Barrett, City Clerk of the City of Atwater, and Ex-Officio Clerk of the City Council of the City of Atwater, State of California."

BLACK RASCAL WATER COMPANY

By: _____
President
Black Rascal Water Company
December 11, 1997

By: _____
Secretary
Black Rascal Water Company
December 11, 1997

Approved as to Form:

By: _____

CITY OF LIVINGSTON

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
AND
MEMORANDUM OF UNDERSTANDING
MERCED AREA GROUNDWATER POOL INTERESTS
(Signature Page)

By: _____

Mayor

ATTEST

By: _____
TIM KERR
City Manager

APPROVED AS TO FORM

By: _____

City Attorney

EAST MERCED RESOURCES CONSERVATION DISTRICT

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
AND
MEMORANDUM OF UNDERSTANDING
MERCED AREA GROUNDWATER POOL INTERESTS
(Signature Page)

By: _____ _____

Chairman of the Board of Directors

ATTEST

By: _____ _____

General Manager

APPROVED AS TO FORM

By: _____ _____

General Counsel

LE GRAND – ATHLONE WATER DISTRICT

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
AND
MEMORANDUM OF UNDERSTANDING
MERCED AREA GROUNDWATER POOL INTERESTS
(Signature Page)

By: David Serrano 12-30-97
DAVID SERRANO
President

By: Elmo Giampoli 12-30-97
ELMO GIAMPOLI
Vice President

By: Pauline Fudge 12-30-97
PAULINE FUDGE
Secretary

LE GRAND COMMUNITY SERVICES DISTRICT

Sewer Service Water Service

P.O. Box 82
Library Bldg.
13038 Jefferson St.
Le Grand, CA 95333

Phone:389-4173
FAX:(209) 389-0663

Resolution No. 97-11

Resolution Adopting the Memorandum of Understanding
Relating to the Formation and Operation of the Merced Groundwater Basin,
And the Merced Groundwater Basin Groundwater Management Plan,
Finding that the Plan is Categorically Exempt
From the California Environmental Quality Act,
And Authorizing Filing of Notice of Exemption

WHEREAS, the Merced Area Groundwater Pool Interests (MAGPI) of which the LeGrand Community Services District is a member, has developed a basin-wide groundwater management plan pursuant to Water Code Sections 10750 et. seq., and staff participated in the development of the plan;

WHEREAS, staff recommends that this Board of Directors adopt a Memorandum of Understanding relating to the formation and operation of the Merced Groundwater Basin (MOU, hereafter); and

WHEREAS, staff recommends that this Board of Directors of the LeGrand Community Services District ("Board") adopt the Merced Groundwater Basin Groundwater Management Plan ("plan" or "project"); and

WHEREAS, the California Environmental Quality Act ("CEQA") exempts certain projects from the environmental review process; and

WHEREAS, the County of Merced, as lead agency regarding CEQA matters, has determined or will determine that the project qualifies for Class 7 and Class 8 Categorical Exemption from the requirements of the California Environmental Quality Act; and

WHEREAS, the Board of Directors of the LeGrand Community Services District finds that the provisions of the County staff report attached hereto are true and correct;

NOW, THEREFORE, be it hereby resolved as follows:

1. The MOU is hereby adopted.

2. The findings and evidence set forth in attachment "A" are hereby adopted.

3. Pursuant to the Declaration of the County of Merced relative to 14 CCR Sections 15307 and 15308 that the Plan is determined to be categorically exempt from the requirements of CEQA. Posting of the notice of exemption for the project pursuant to the requirements of CEQA will be accomplished by the County of Merced. This action is taken subject to final approval and compliance by the County of Merced with such requirements.

4. The plan is hereby adopted.

LE GRAND COMMUNITY SERVICES DISTRICT
Sewer Service Water Service

P.O. Box 82
Library Bldg.
13038 Jefferson St.
Le Grand, CA 95333

Phone:389-4173
FAX:(209) 389-0663

AYES: DIRECTORS: Smith, Moroni, McPherson, Watts.

NOES: DIRECTORS: Ramirez.

I, SECRETARY TO THE BOARD OF DIRECTORS, do hereby certify the resolution was duly adopted by the Board of Directors of the Le Grand Community Services District, at a regular meeting held on November 6, 1997, with a full quorum present and acting throughout.

_____, SECRETARY/MANAGER

_____, PRESIDENT OF THE BOARD

MEADOWBROOK WATER COMPANY

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
AND
MEMORANDUM OF UNDERSTANDING
MERCED AREA GROUNDWATER POOL INTERESTS
(Signature Page)

Fred H. Walker
Fred H. Walker
President

RESOLUTION NO. 97-2

RESOLUTION AUTHORIZING THE PRESIDENT OF THE BOARD OF DIRECTORS AND THE GENERAL MANAGER TO EXECUTE THE MEMORANDUM OF UNDERSTANDING FOR THE ESTABLISHMENT AND OPERATION OF THE MERCED AREA GROUNDWATER POOL INTERESTS ASSOCIATION

WHEREAS, the Merced Groundwater Basin (the"Basin") is defined roughly and is understood to be bound on the east by the Merced County line, on the south by the Chowchilla River, on the west by the San Joaquin River, and on the north by the Merced River; and

WHEREAS, groundwater and surface water resources within the Merced Groundwater Basin are vitally important resources, in that they provide the foundation for environmental, agricultural, domestic, municipal and industrial needs, as well as other needs, and to maintain the economic viability and prosperity of the Basin area; and

WHEREAS, the eastern Merced County area occupied by the Merced Groundwater Basin is a vital agricultural area with increasing importance in industry and education, and because of increasing demands for California's finite water resources, it is critical that those persons and agencies making use of the region's limited water supplies do so in an efficient and knowledgeable manner to preserve the resources for all elements of the local economy; and

WHEREAS, the permanent overdraft of groundwater supplies can result in water quality as well as quantity issues, cause land subsidence, increase costs to produce agricultural, industrial and domestic water supplies, and eventually restrict economic development; and

WHEREAS, the goals of the Merced Area Groundwater Pool Interests Association are (1) to determine and evaluate the Basin's existing groundwater supplies, (2) to prepare and promote a draft groundwater management plan for the Basin, (3) to consider developing and/or adopting an existing hydrologic groundwater model of the Basin's groundwater supplies, (4) to determine the Basin's need for additional or improved water extraction, storage, delivery, conservation, reuse and recharge facilities, (5) to provide information and guidance for the management, preservation, protection, and enhancement of the Basin, and (6) to determine the safe yield of the Basin.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of the Merquin County Water District that it is in the best interests of the Merquin County Water District to enter into the Memorandum of Understanding for the Merced Area Groundwater Pool Interests Association, that the President of the Board of Directors and the General Manager be authorized to execute the Memorandum of Understanding on behalf of the District, and that the General Manager serve as the District's representative on the Merced Area Groundwater Pool Interests Association.

CITY OF MERCED By:_____ MARY JO KNUDSEN Mayor ATTEST By:_____ JAMES G. MARSHALL City Manager APPROVED AS TO FORM By:_____ STEVEN F. NORD City Attorney	**CITY OF ATWATER** By:_____ KEN DEVOE Mayor ATTEST By:_____ ANTHONY J. ALTFELD City Manager APPROVED AS TO FORM By:_____ GEORGE LOGAN City Attorney
WINTON WATER & SANITARY DISTRICT By:_____ SHIELLA SHAMBLIN President of the Board of Directors ATTEST By:_____ INA JOHNSON Administrator APPROVED AS TO FORM By:_____ DALE BACIGALUPI General Counsel	**LE GRAND-ATHLONE WATER DISTRICT** By:_____ DAVID SERRANO President of the Board of Directors ATTEST By:_____ __ General Manager APPROVED AS TO FORM By:_____ __ General Counsel

PLANADA COMMUNITY SERVICES DISTRICT By:_____ DANIEL CHAVEZ Chairman of the Board of Directors ATTEST By:_____ RUTH WATTS Office Manager APPROVED AS TO FORM By:_____ DAVE CAPRON Attorney	**BLACK RASCAL WATER COMPANY** By:_____ DAVID HAMM President ATTEST By:_____ TIM DICKSON Secretary
MERQUIN COUNTY WATER DISTRICT By:_____ John Cox Chairman of the Board of Directors ATTEST By:_____ Richard Chaparro General Manager APPROVED AS TO FORM By:_____ Arthur F. Godwin General Counsel	**STEVINSON WATER DISTRICT** By:_____ Robert D. Kelley, Jr. President ATTEST By:_____ Kevin F. Kelley Secretary

MERQUIN COUNTY WATER DISTRICT

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
AND
MEMORANDUM OF UNDERSTANDING
MERCED AREA GROUNDWATER POOL INTERESTS
(Signature Page)

By: _____ _____

Chairman of the Board of Directors

ATTEST

By: _____ _____

General Manager

APPROVED AS TO FORM

By: _____ _____

General Counsel

PLANADA COUMMUNITY SERVICES DISTRICT

MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN
AND
MEMORANDUM OF UNDERSTANDING
MERCED AREA GROUNDWATER POOL INTERESTS
(Signature Page)

By:_____

DANIEL CHAVEZ
Chairman of the Board of Directors

By:_____

RUTH WATTS
Office Manager

APPROVED AS TO FORM

By:_____

DAVE CAPRON
Attorney

PLANADA COMMUNITY SERVICES DISTRICT By:_____ DANIEL CHAVEZ Chairman of the Board of Directors ATTEST By:_____ RUTH WATTS Office Manager APPROVED AS TO FORM By:_____ DAVE CAPRON Attorney	**BLACK RASCAL WATER COMPANY** By:_____ DAVID HAMM President ATTEST By:_____ TIM DICKSON Secretary
MERQUIN COUNTY WATER DISTRICT By:_____ Chairman of the Board of Directors ATTEST By:_____ General Manager APPROVED AS TO FORM By:_____ General Counsel	**STEVINSON WATER DISTRICT** By: Robert D. Kelley Robert D. Kelley, Jr. President ATTEST By: Kevin F. Kelley Kevin F. Kelley Secretary

LE GRAND COMMUNITY SERVICES DISTRICT By:_____ Chairman of the Board of Directors ATTEST By:_____ General Manager APPROVED AS TO FORM By:_____ General Counsel	**TURNER ISLAND WATER DISTRICT** By:_____ Chairman of the Board of Directors ATTEST By:_____ General Manager APPROVED AS TO FORM By:_____ General Counsel
MEADOWBROOK WATER COMPANY By:_____ Chairman of the Board of Directors ATTEST By:_____ General Manager APPROVED AS TO FORM By:_____ General Counsel	**EAST MERCED RESOURCES CONSERVATION DISTRICT** By:_____ Chairman of the Board of Directors ATTEST By:_____ General Manager APPROVED AS TO FORM By:_____ General Counsel

Telephone
209/826-4935

TURNER ISLAND WATER DISTRICT

P.O. Box 311
LOS BANOS, CALIFORNIA 93635

December 9, 1997

Mr. Ted Selb
Merced Area Groundwater Pool Interests
c/o Merced Irrigation District
P.O. Box 2288
Merced, CA 95344-0288

RE: Merced Basin Groundwater Management Plan

Dear Mr. Selb:

As you are aware, the Turner Island Water District is a California water district located in Merced County which has been approached about participation in the Merced Basin Groundwater Management Plan now being finalized by the Merced Area Groundwater Pool Interests (the "Plan"). The purpose of this letter is to express our interest in participating in the Plan as soon as we can complete the required approval process under AB 3030, and we ask that you provide this letter to the California Department of Water Resources with any other materials you forward to the Plan in order to confirm our District's interest in participating.

Unfortunately, because we were unable to hear your presentation on the Plan until today (December 9), our Board was not previously in a position to act on participation. Due to the various requirements of AB 3030, we will not be able to adopt the Plan until January, but wish to make clear that we intend to do so.

We also wish to make clear that we have previously adopted our own AB 3030 plan (which is similar to the Plan), and have entered into a memorandum of understanding with a neighboring mutual water company (the Lone Tree Mutual Water Company) pursuant to our existing plan with the Plan, but until we have done so we commit to coordinate our actions with the Plan in order to achieve the regional goals of the Plan. Thank you for asking us to participate in the Plan.

Very truly yours,

Donald C. Skinner
President

DS/cjc

cc: Mr. Carl Hauge
Mr. George Park
Edward Amaral, Esq.
Gary W. Sawyers, Esq.

(don\tiwd-1)

ORDINANCE NO. 97-45

AN ORDINANCE OF THE WINTON WATER AND SANITARY DISTRICT ADOPTING A GROUNDWATER MANAGEMENT PLAN AND A MEMORANDUM OF UNDERSTANDING FOR THE ESTABLISHMENT AND OPERATION OF THE MERCED AREA GROUNDWATER POOL INTERESTS (MAGPI)

WHEREAS, the Board of Directors of the Winton Water and Sanitary District have adopted Resolution No. 97-465, A Resolution of Intent to Prepare a Groundwater Management Plan on October 9, 1997; and Resolution No. 97-466, A Resolution of Intent to Implement a Groundwater Management Plan on October 13, 1997; and

NOW, THEREFORE, the Board of Directors of the Winton Water and Sanitary District, by adoption of this ordinance, shall hereby administer the Groundwater Management Plan and the Memorandum and Operation of the Merced Area Groundwater Pool Interests (MAGPI).

SECTION 1: The Groundwater Management Plan is attached to this ordinance under Addendum A and the Memorandum of Understanding included in Appendix E of this Addendum.

SECTION 2: This ordinance shall take effect thirty (30) days from the date of its passage. Before the expiration of fifteen (15) days after its passage, this ordinance shall be published once in the Winton Times, a newspaper of general circulation printed and published in the Winton Water and Sanitary District.

* * *

The foregoing Ordinance was passed and adopted at a Regular Meeting of the Board of Directors of the Winton Water and Sanitary District held on the 27th day of October 1997 by the following vote:

AYES: SHAMBLIN, PITCHFORD, BONIN, BOWMAN, COX

NOES: NONE

ABSTAIN: NONE

ABSENT: NONE

Shiella Shamblin

SHIELLA SHAMBLIN, President
of the Board of Directors of
the Winton Water & Sanitary
District

Exhibit I

10/27/97.ms
ord\grwtr-mou.wwsd

ATTEST:

Marie Schipper

Marie Schipper, Secretary

CERTIFICATE

STATE OF CALIFORNIA)
COUNTY OF MERCED) ss.
COMMUNITY OF WINTON)

I, Marie Schipper, Secretary of the Board of Directors of the Winton Water and Sanitary District, do hereby certify the foregoing Ordinance, No. 97-45, was duly passed and adopted at a Special Meeting of the Board of Directors of the Winton Water and Sanitary District on the 27th day of October 1997.

DATED: October 27, 1997

Marie Schipper

Marie Schipper, Secretary

NOTICE OF PUBLIC HEARING OF THE MERCED AREA GROUNDWATER POOL INTERESTS (MAGPI) TO PREPARE AN UPDATE OF ITS DECEMBER, 1997 MERCED GROUNDWATER BASIN GROUNDWATER MANAGEMENT PLAN

NOTICE IS HEREBY GIVEN that the Merced Area Groundwater Pool Interests (MAGPI) will hold a public hearing to consider the preparation of an update of its existing groundwater management plan to be in compliance with California Senate Bill 1938. The hearing will be an opportunity for the public to provide input in this process. At the conclusion of the hearing, the MAGPI may consider adopting a resolution of intention to draft a groundwater management plan update. Should MAGPI adopt such a resolution, there will be additional opportunity to provide comment on the updated plan as it is developed, and prior to MAGPI adopting the plan.

NOTICE IS HEREBY FURTHER GIVEN that the public hearing will be held in the office of the Merced Irrigation District at 744 West 20th Street, Merced, California on the 30th day of January, 2008, at 10:00 AM. All interested persons are asked to attend. At the public hearing, MAGPI shall gather comments and suggestions from the public regarding the intent to draft a groundwater management plan update.

Legal 08 January 16, 23, 2008

MSS 1-16-08

NOTICE OF PUBLIC HEARING ON THE
MERCED GROUNDWATER BASIN
GROUNDWATER MANAGEMENT PLAN UPDATE

NOTICE IS HEREBY GIVEN that the Board of the Merced Area Groundwater Pool Interests (MAGPI) will hold a hearing to receive input from the public leading to adoption of the Merced Groundwater Basin Groundwater Management Plan Update ("plan") which would amend and supersede the existing plan adopted by the member agencies of MAGPI on December 29, 1997. The plan identifies and analyzes conditions within the Merced Groundwater Basin including water supply and demand, groundwater levels, and water quality. The plan also discusses areas of concern within the basin, including but not limited to groundwater overdraft, water quality, and saline intrusion. It also provides a variety of options for addressing these concerns, including continued monitoring of groundwater quality and quantity, evaluation of potential recharge projects, and coordination with other governmental agencies. The plan does not authorize or implement any specific action, but establishes avenues by which agencies can work together to preserve and protect local groundwater resources. A copy of the plan is available for review at Merced Irrigation District, 744 West 20th Street, Merced, CA 95340 or on the internet at **www.magpi-gw.org**. Copies of the plan may also be obtained, for the cost of reproduction, at Merced Irrigation District, 744 West 20th Street, Merced, CA 95340. Written comments may be submitted by 12:00 P.M. June 16, 2008, at Merced Irrigation District, 744 West 20th Street, Merced, CA 95340 or on the internet at **www.magpi-gw.org**. Written comments may be withdrawn at any time prior to the conclusion of the hearing.

FURTHER NOTICE IS HEREBY GIVEN that the public hearing will be held on said plan at Merced Irrigation District, 744 West 20th Street, Merced CA 95340, Merced County, California on June 16, 2008, at 2:00 P.M. All interested persons are asked to attend. At the public hearing, the Board of MAGPI shall consider comments to the adoption of the plan.

NOTICE OF PUBLIC HEARING ON THE MERCED GROUNDWATER BASIN GROUNDWATER MANAGEMENT PLAN UPDATE

NOTICE IS HEREBY GIVEN that the Board of the Merced Area Groundwater Pool Interests (MAGPI) will hold a hearing to receive input from the public leading to adoption of the Merced Groundwater Basin Groundwater Management Plan Update ("plan") which would amend and supersede the existing plan adopted by the member agencies of MAGPI on December 29, 1997. The plan identifies and analyzes conditions within the Merced Groundwater Basin including water supply and demand, groundwater levels, and water quality. The plan also discusses areas of concern within the basin, including but not limited to groundwater overdraft, water quality, and saline intrusion. It also provides a variety of options for addressing these concerns, including continued monitoring of groundwater quality and quantity, evaluation of potential recharge projects, and coordination with other governmental agencies. The plan does not authorize or implement any specific action, but establishes avenues by which agencies can work together to preserve and protect local groundwater resources. A copy of the plan is available for review at Merced Irrigation District, 744 West 20th Street, Merced, CA 95340 or on the internet at **www.magpi-gw.org**. Copies of the plan may also be obtained, for the cost of reproduction, at Merced Irrigation District, 744 West 20th Street, Merced, CA 95340. Written comments may be submitted by 12:00 P.M. June 16, 2008, at Merced Irrigation District, 744 West 20th Street, Merced, CA 95340 or on the internet at **www.magpi-gw.org**. Written comments may be withdrawn at any time prior to the conclusion of the hearing.

FURTHER NOTICE IS HEREBY GIVEN that the public hearing will be held on said plan at Merced Irrigation District, 744 West 20th Street, Merced CA 95340, Merced County, California on June 16, 2008, at 2:00 P.M. All interested persons are asked to attend. At the public hearing, the Board of MAGPI shall consider comments to the adoption of the plan.

Legal 08 May 31, June 7, 2008

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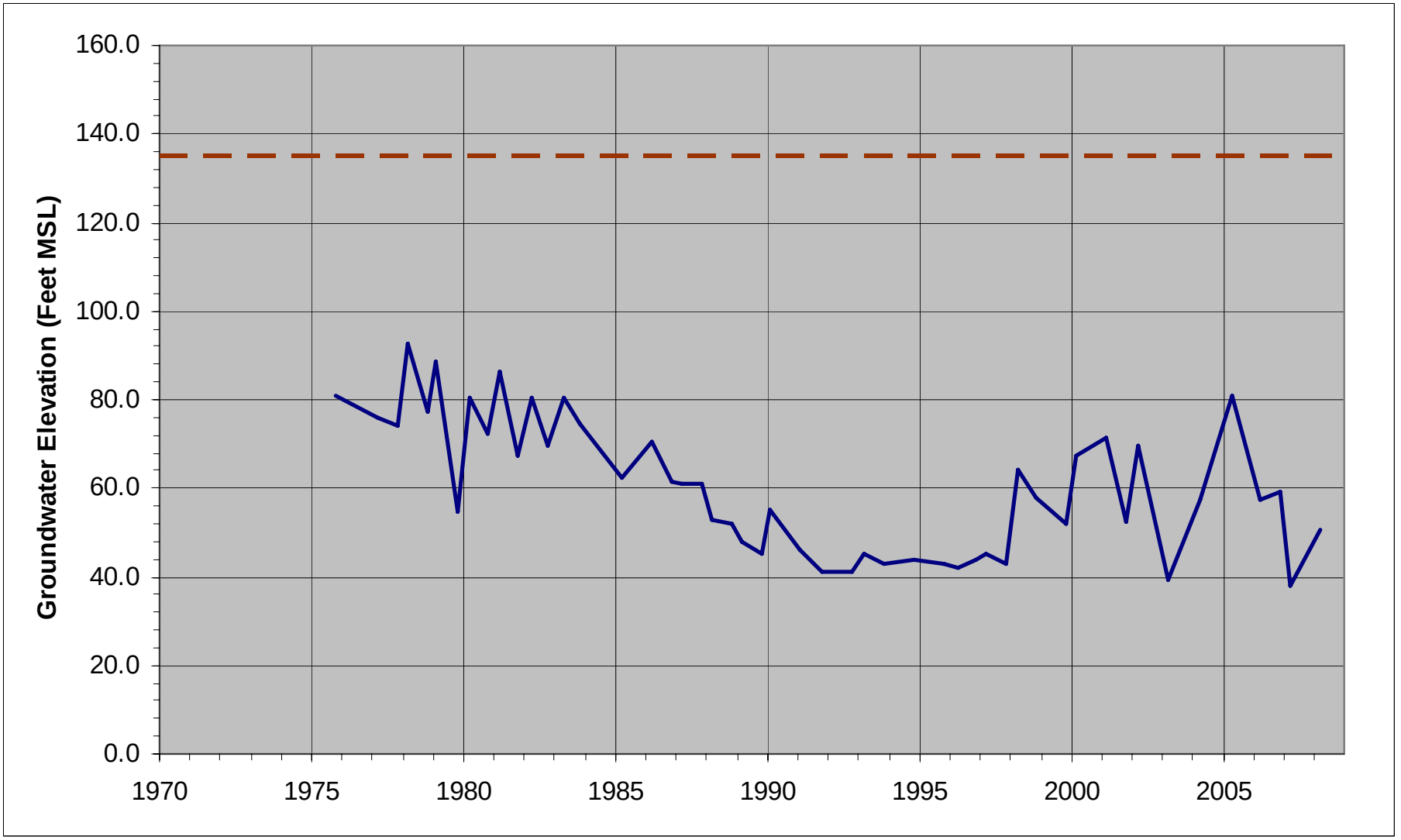

LONG-TERM HYDROGRAPH FOR MONITORING WELL 05S/11E-27K1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-1**

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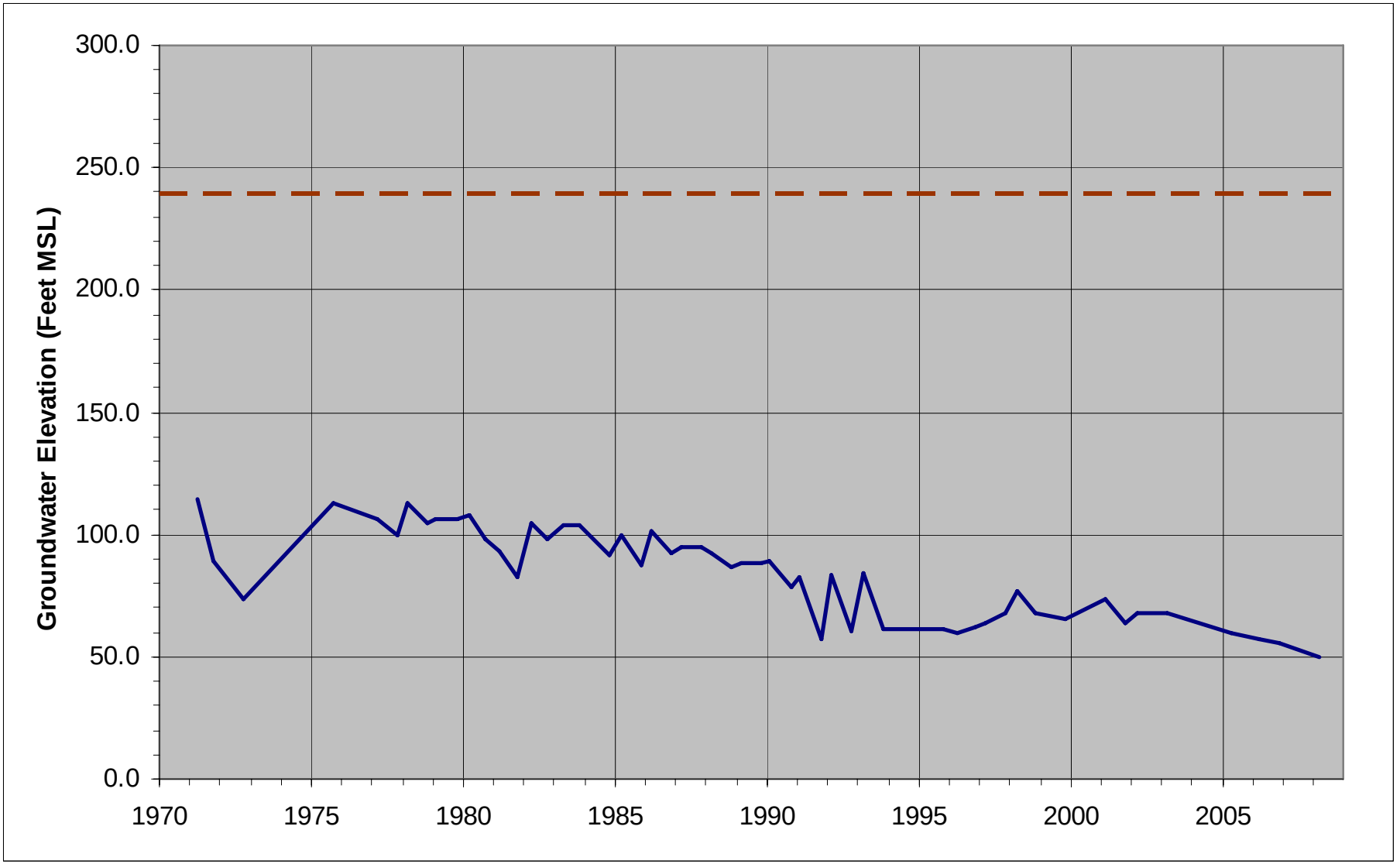

LONG-TERM HYDROGRAPH FOR MONITORING WELL 05S/12E-01J1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-2**

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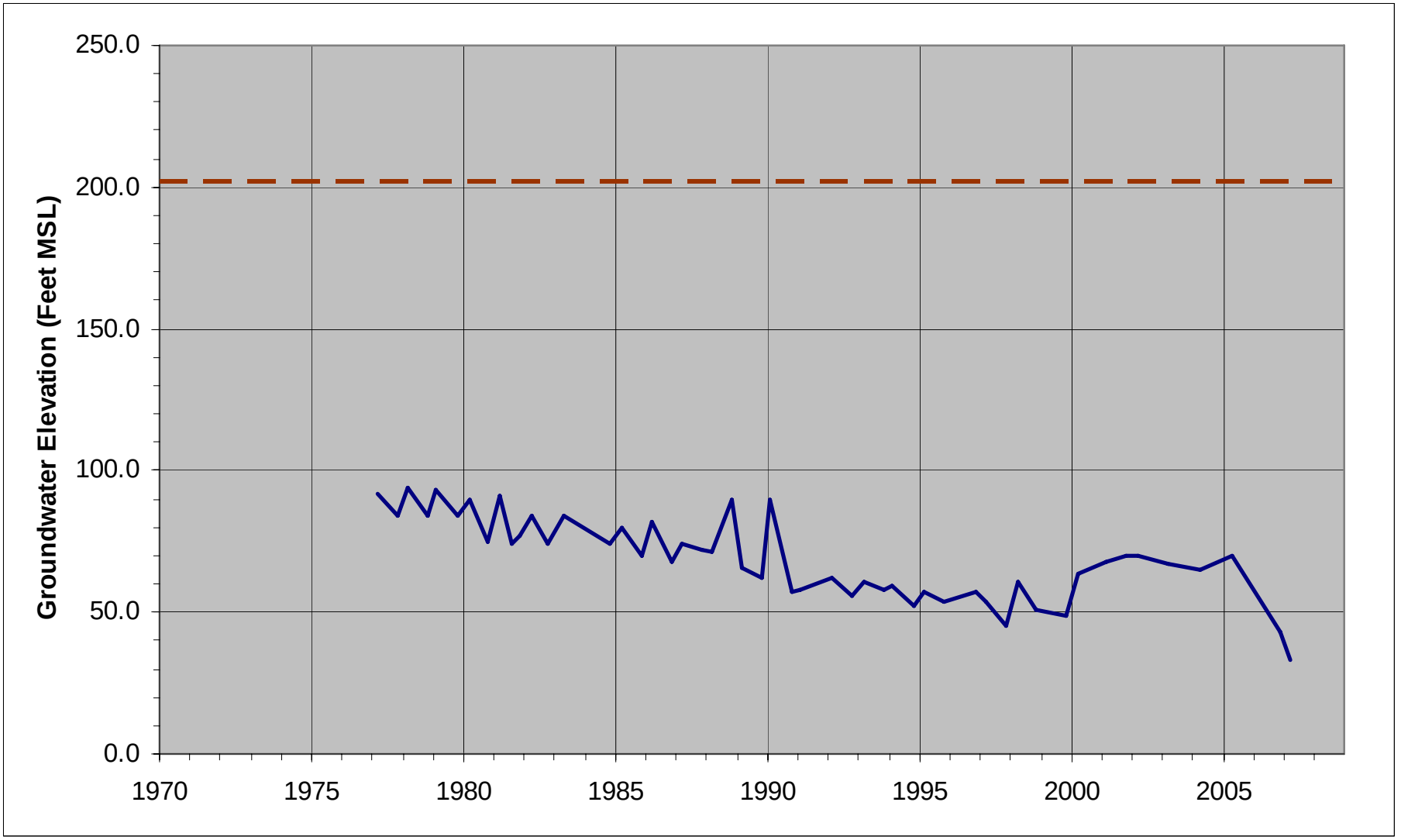

LONG-TERM HYDROGRAPH FOR MONITORING WELL 05S/12E-16R1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-3**

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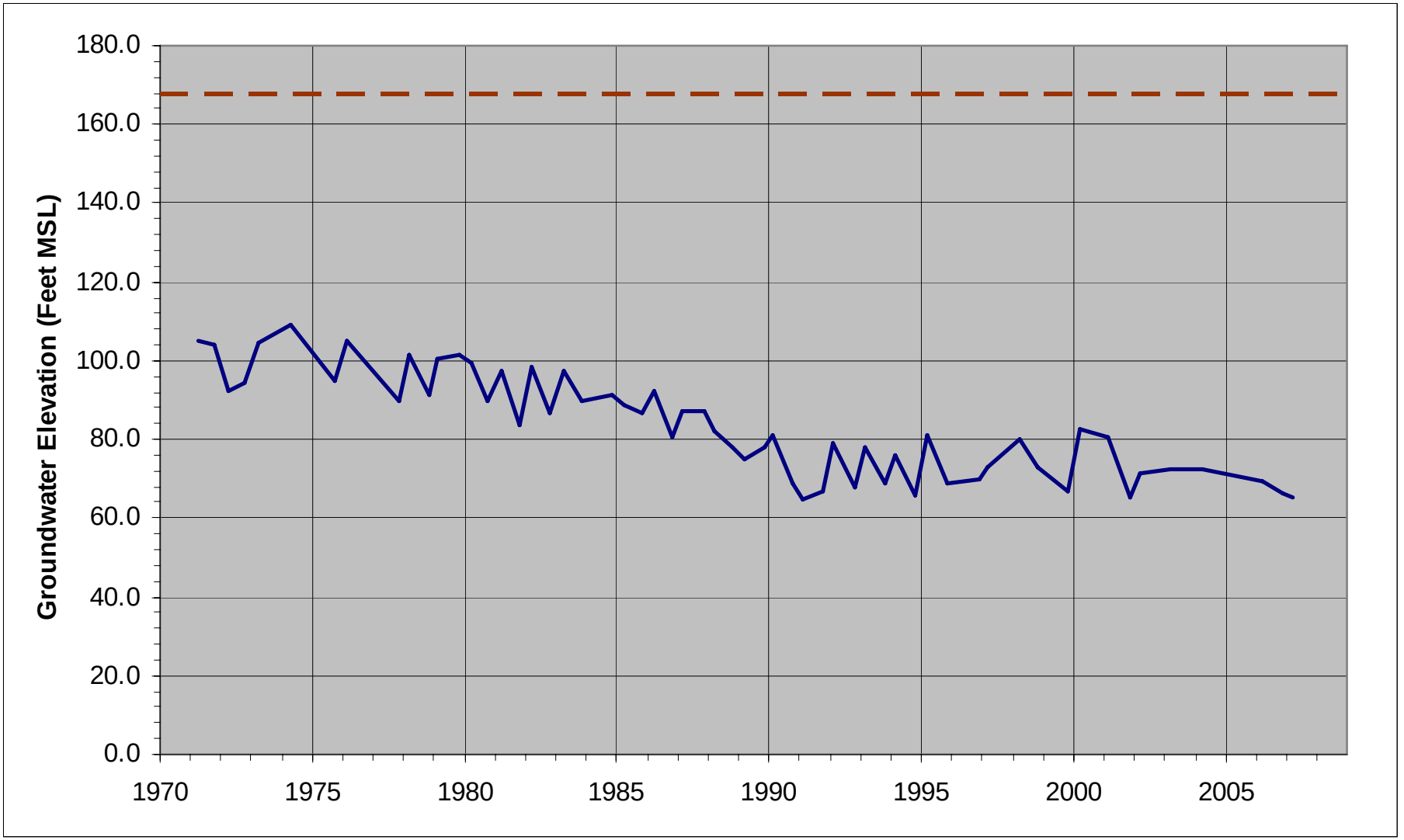
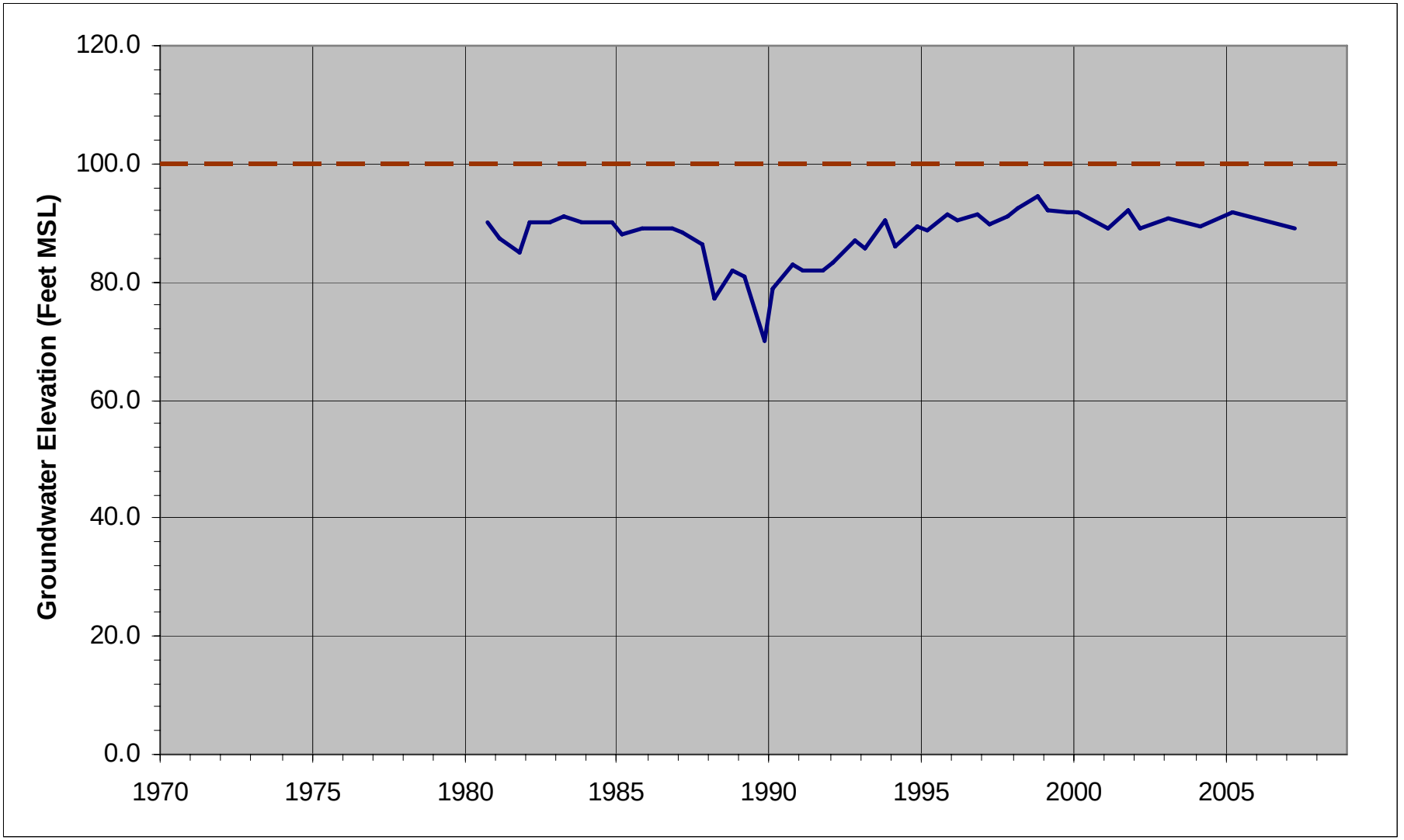


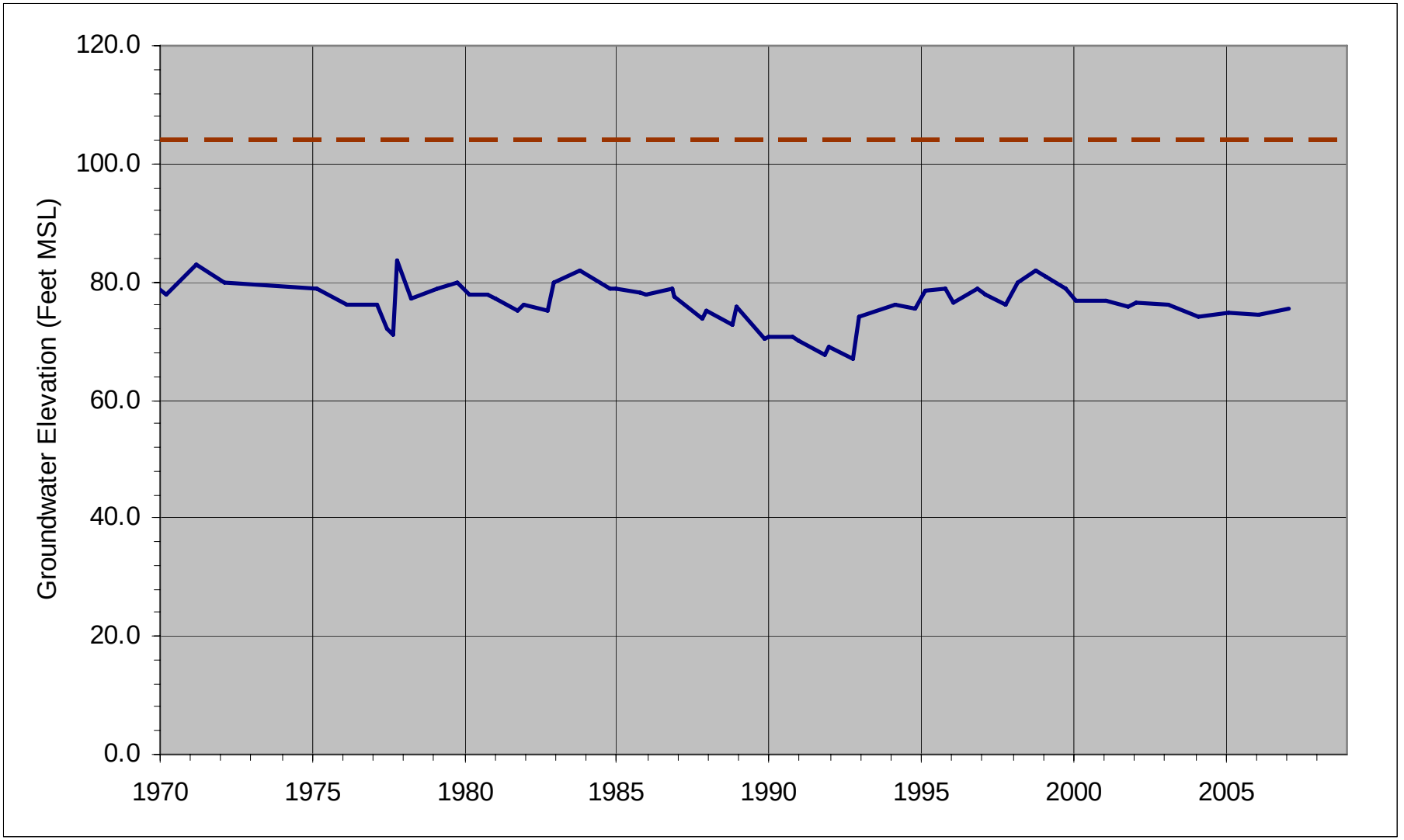
LONG-TERM HYDROGRAPH FOR MONITORING WELL 05S/12E-33N01
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-4**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 06S/10E-24F1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-5**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 06S/10E-36A1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-6**

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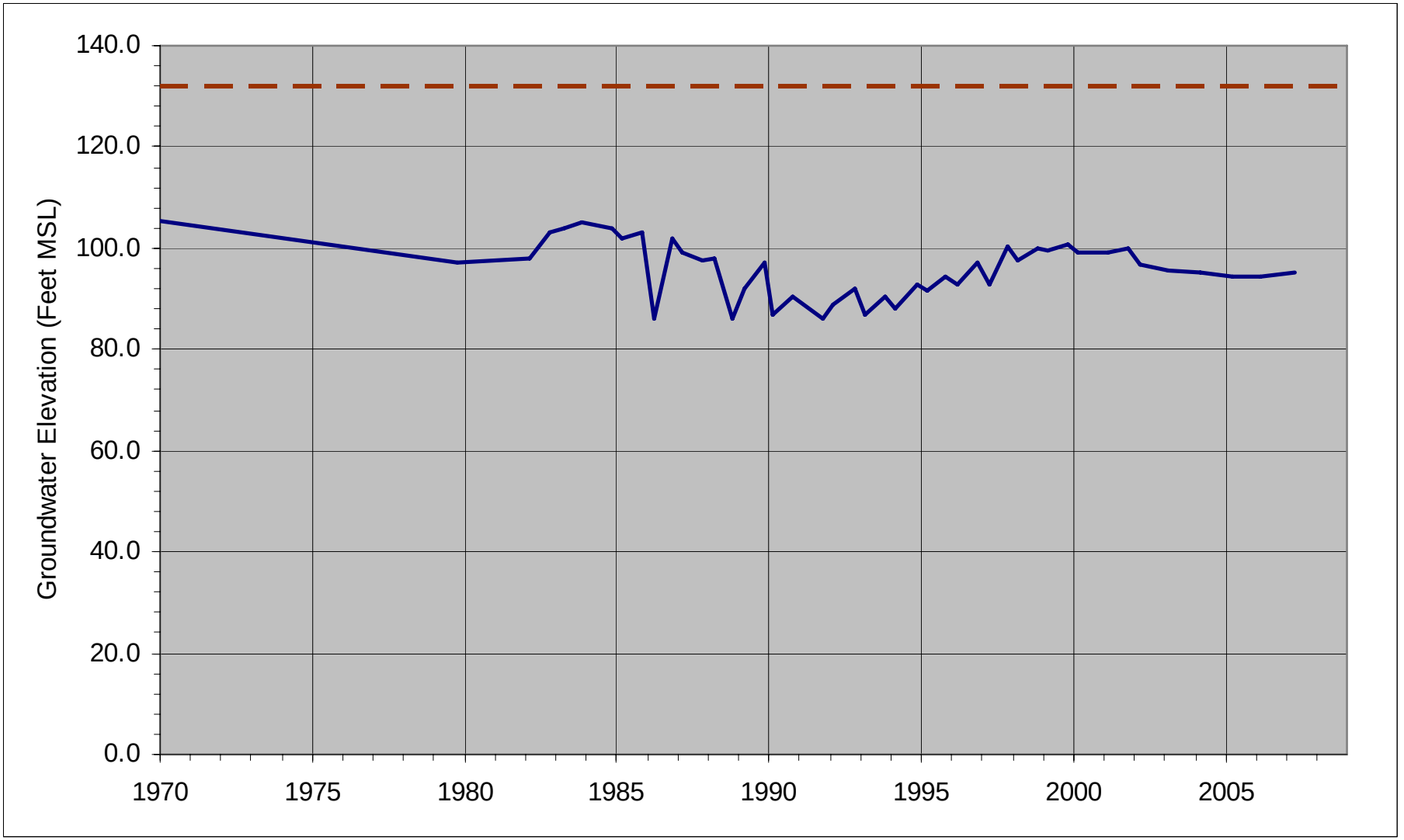
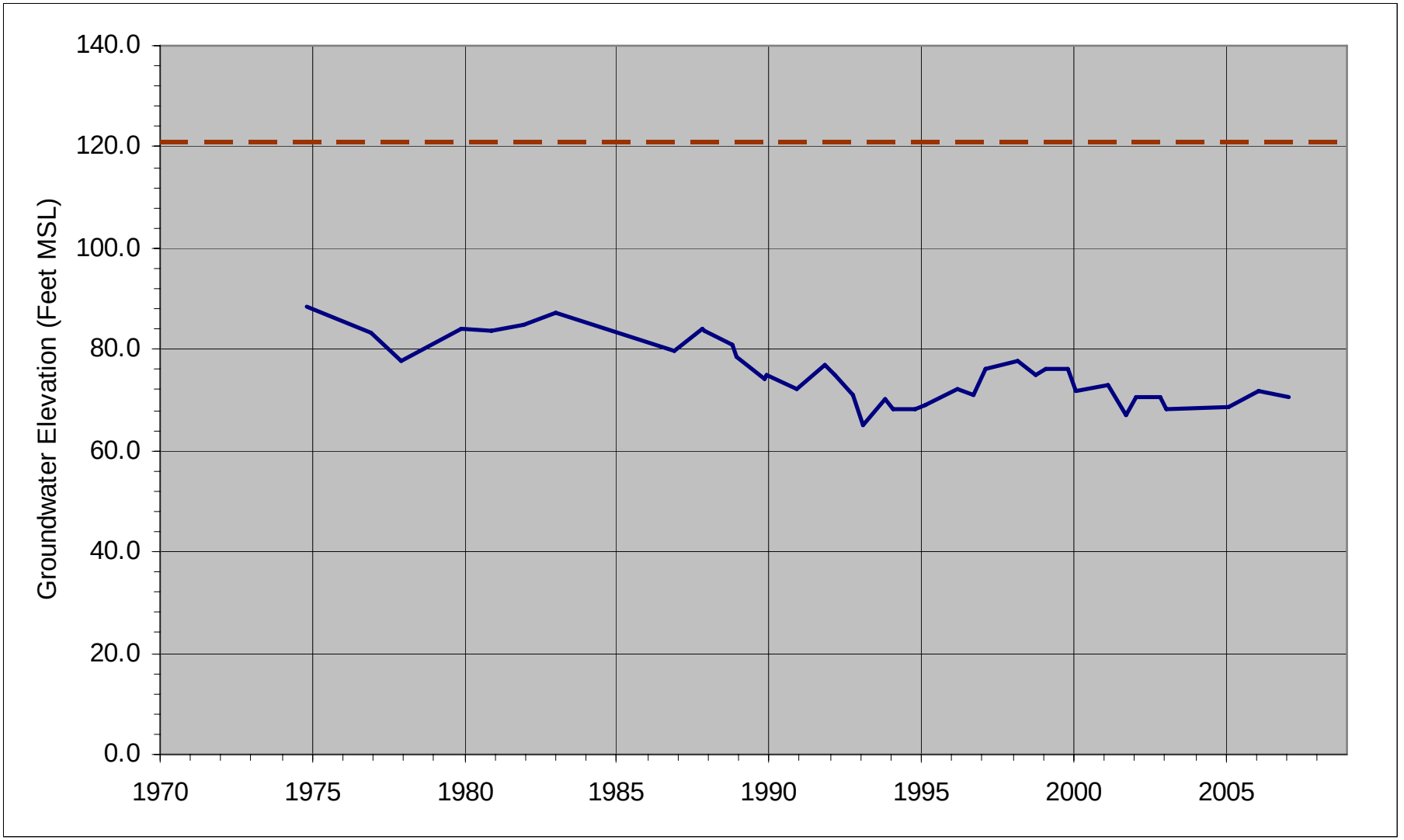


LONG-TERM HYDROGRAPH FOR MONITORING WELL 06S/11E-10B1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-7**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 06S/11E-27M1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-8**

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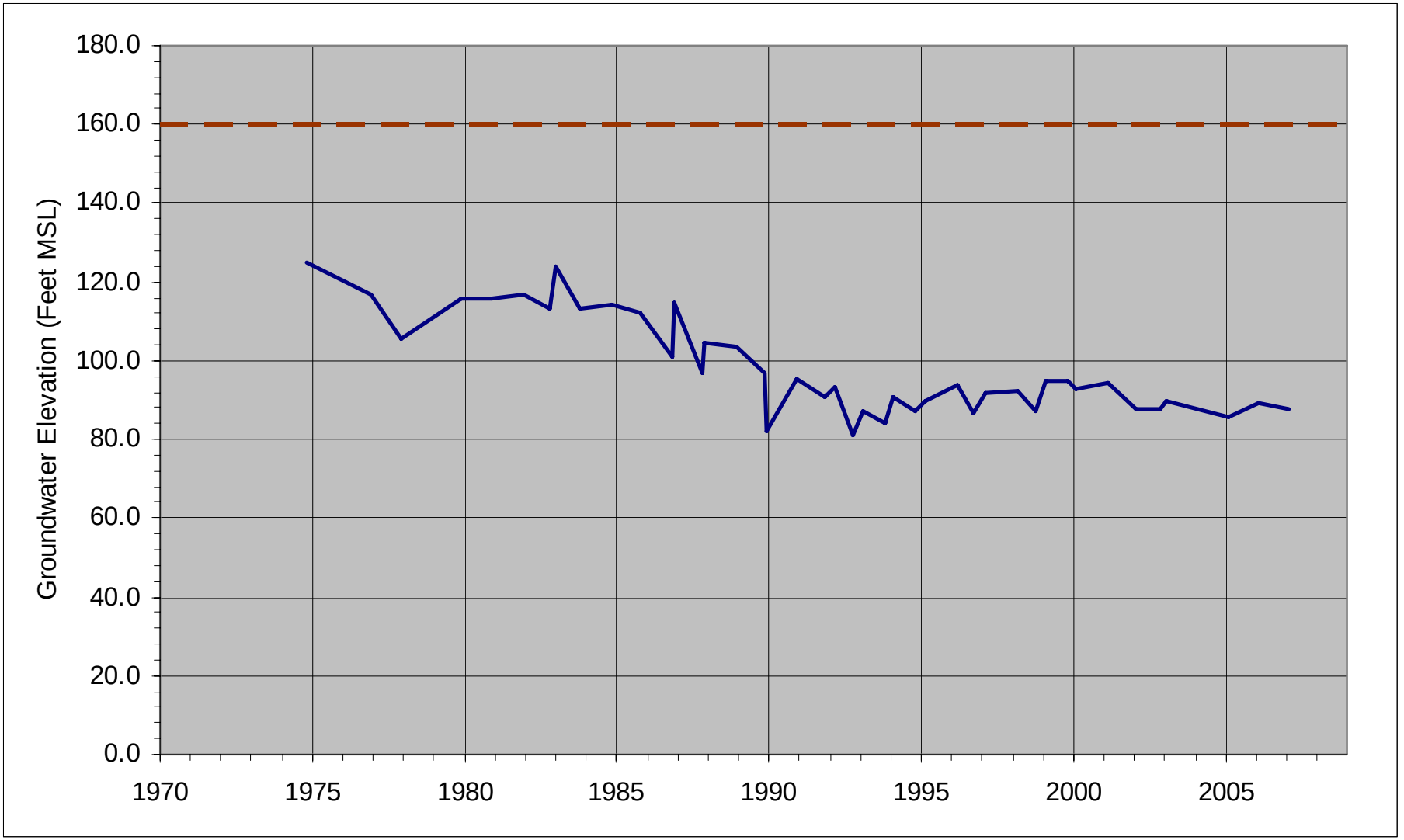
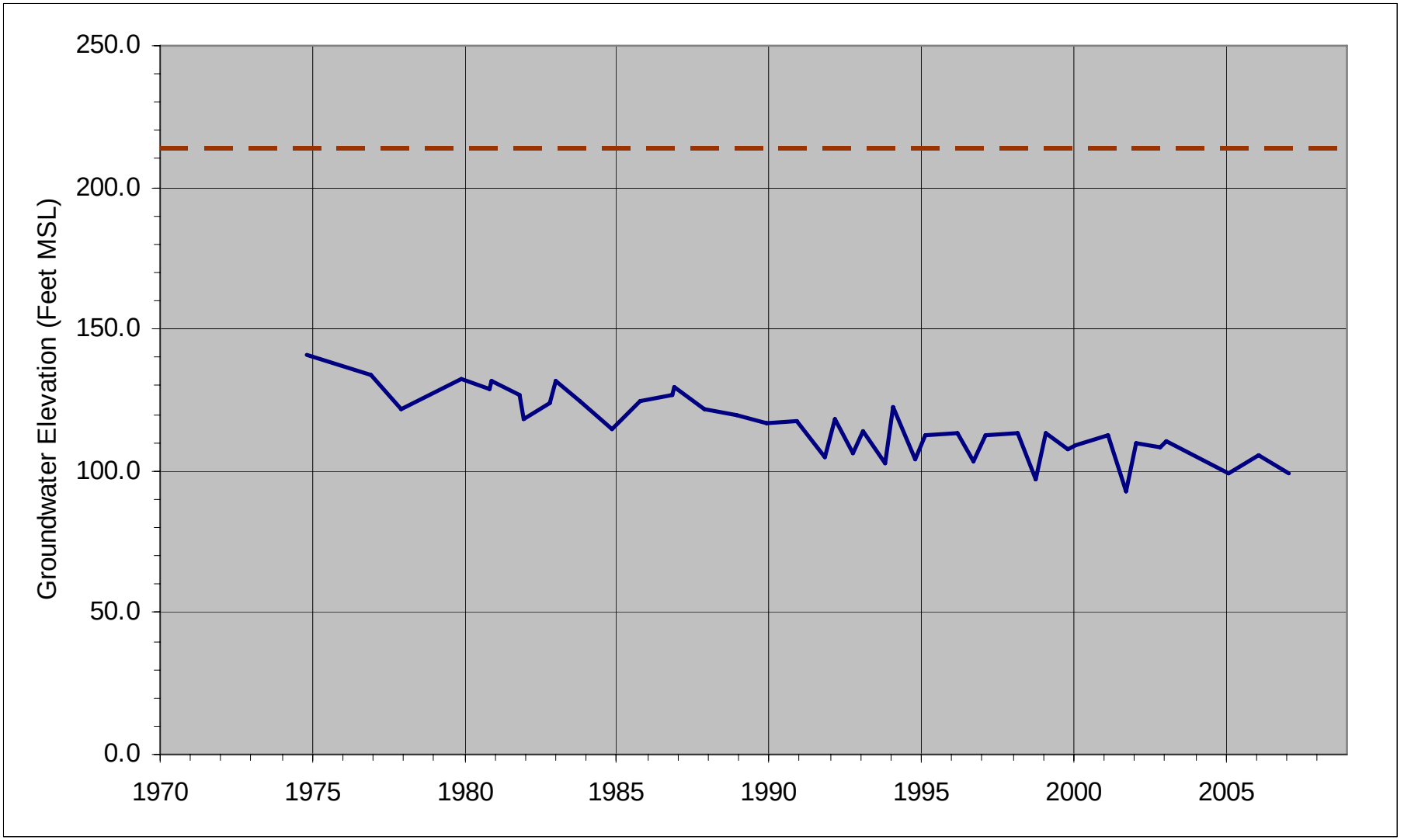


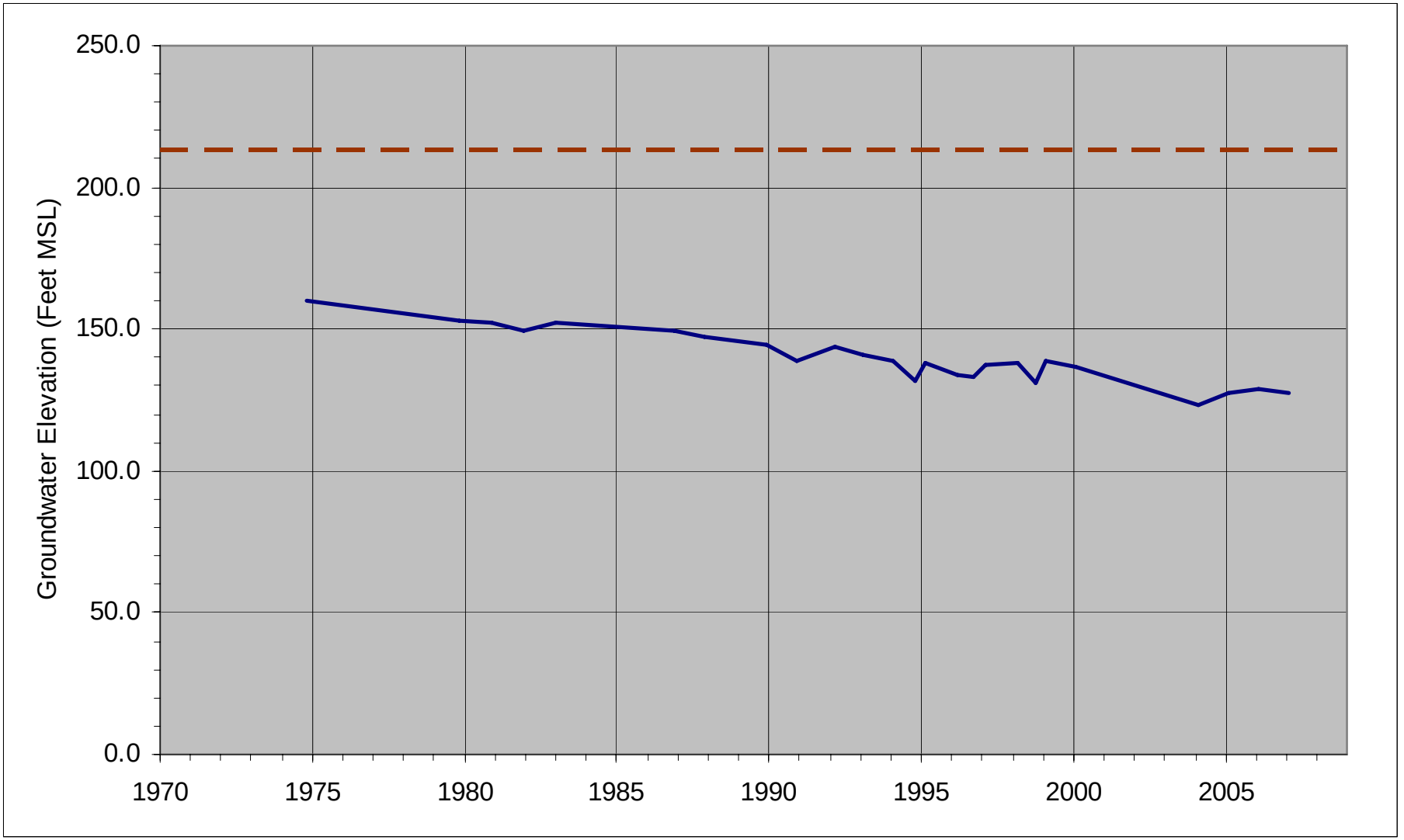
LONG-TERM HYDROGRAPH FOR MONITORING WELL 06S/12E-22E1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-9**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 06S/13E-07H1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-10**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 06S/14E-29C1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-11**

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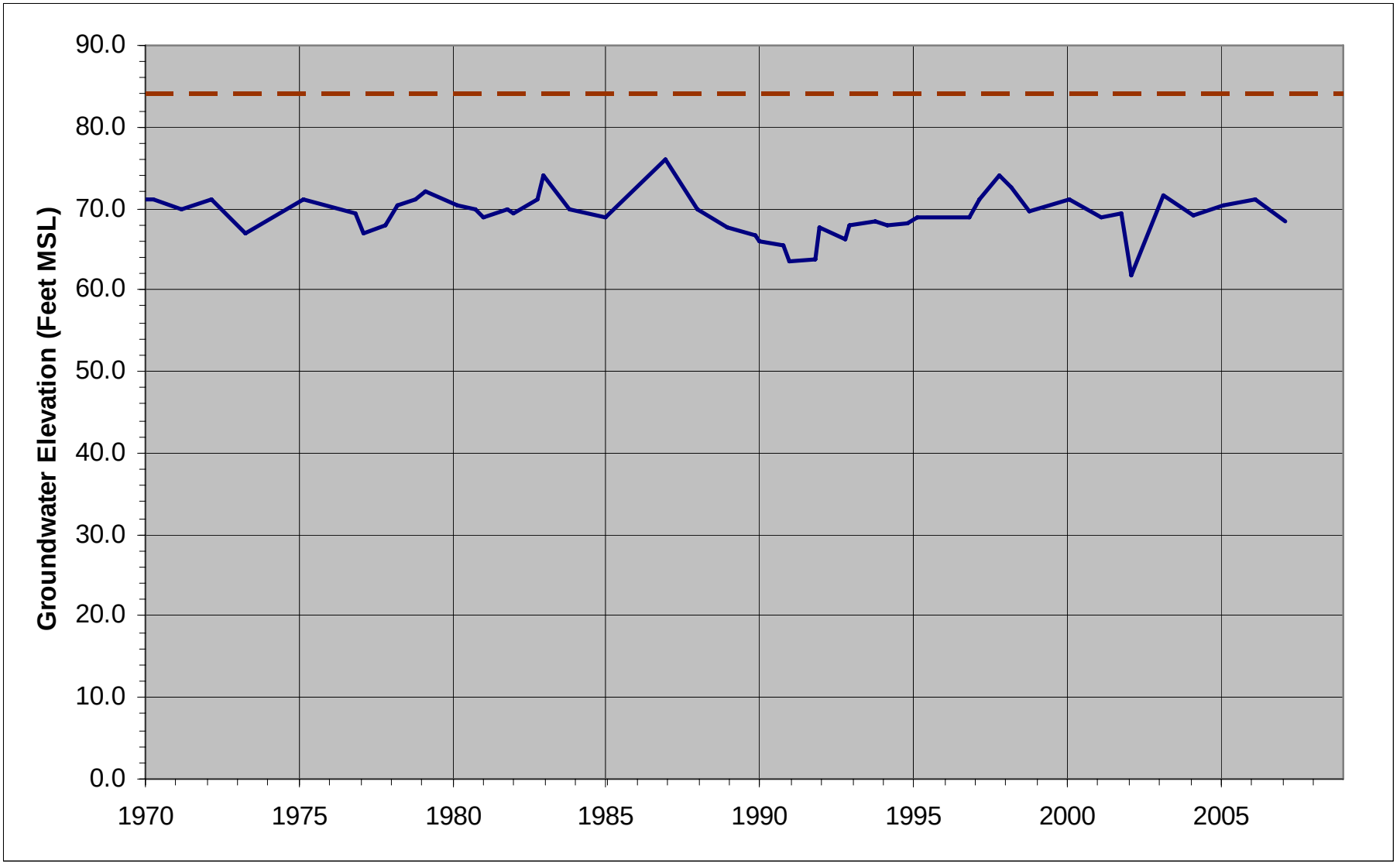

LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/10E-04L1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-12**

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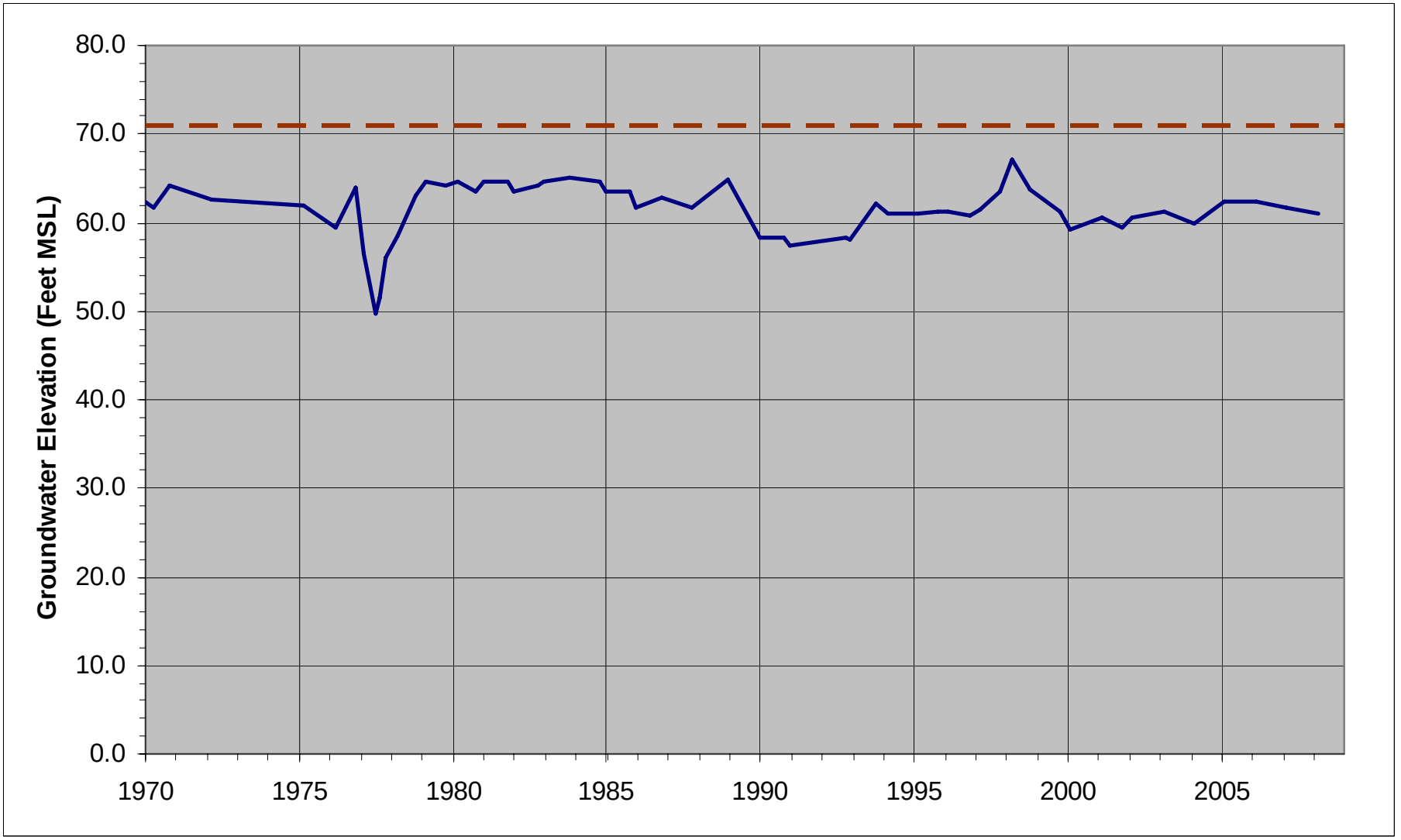
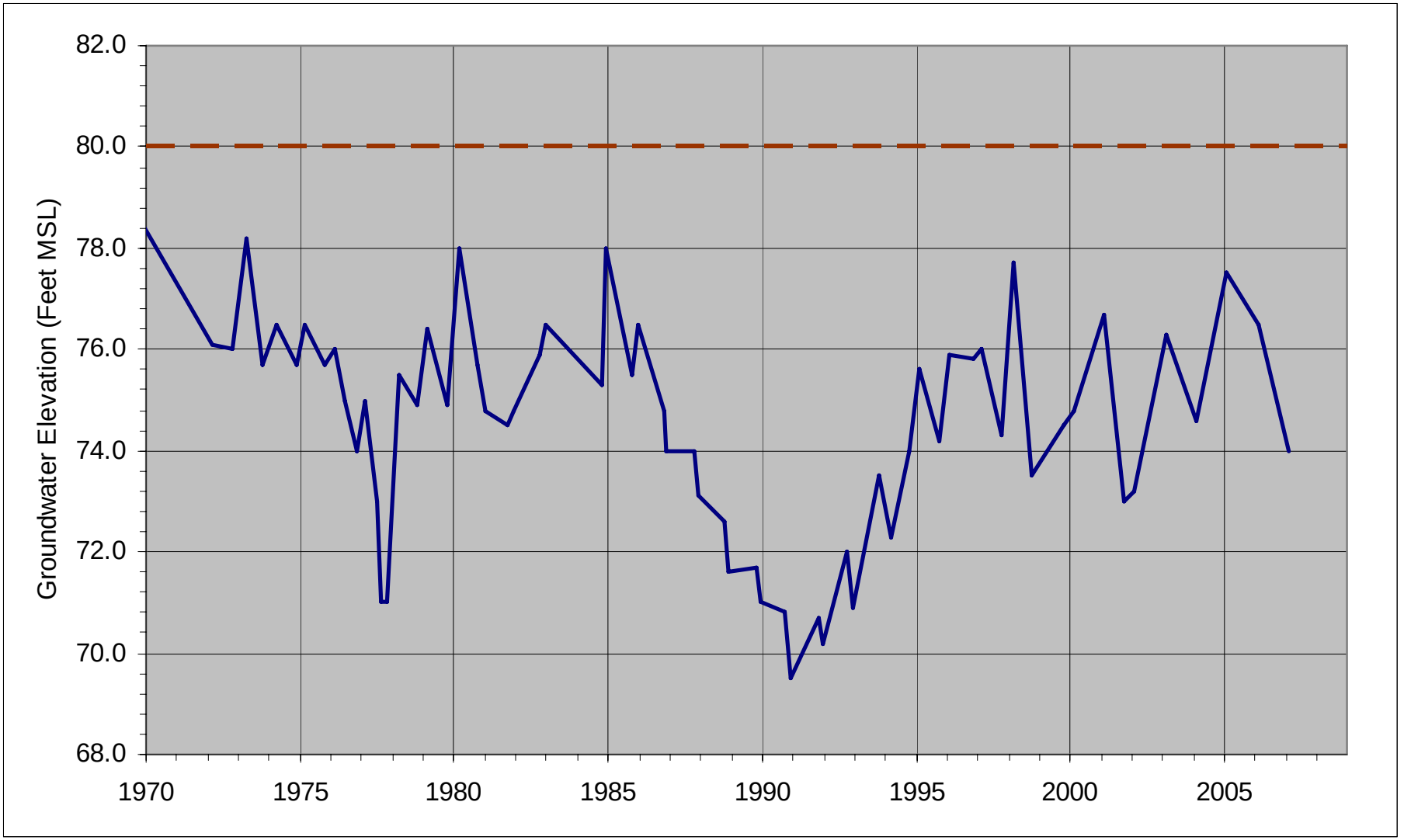


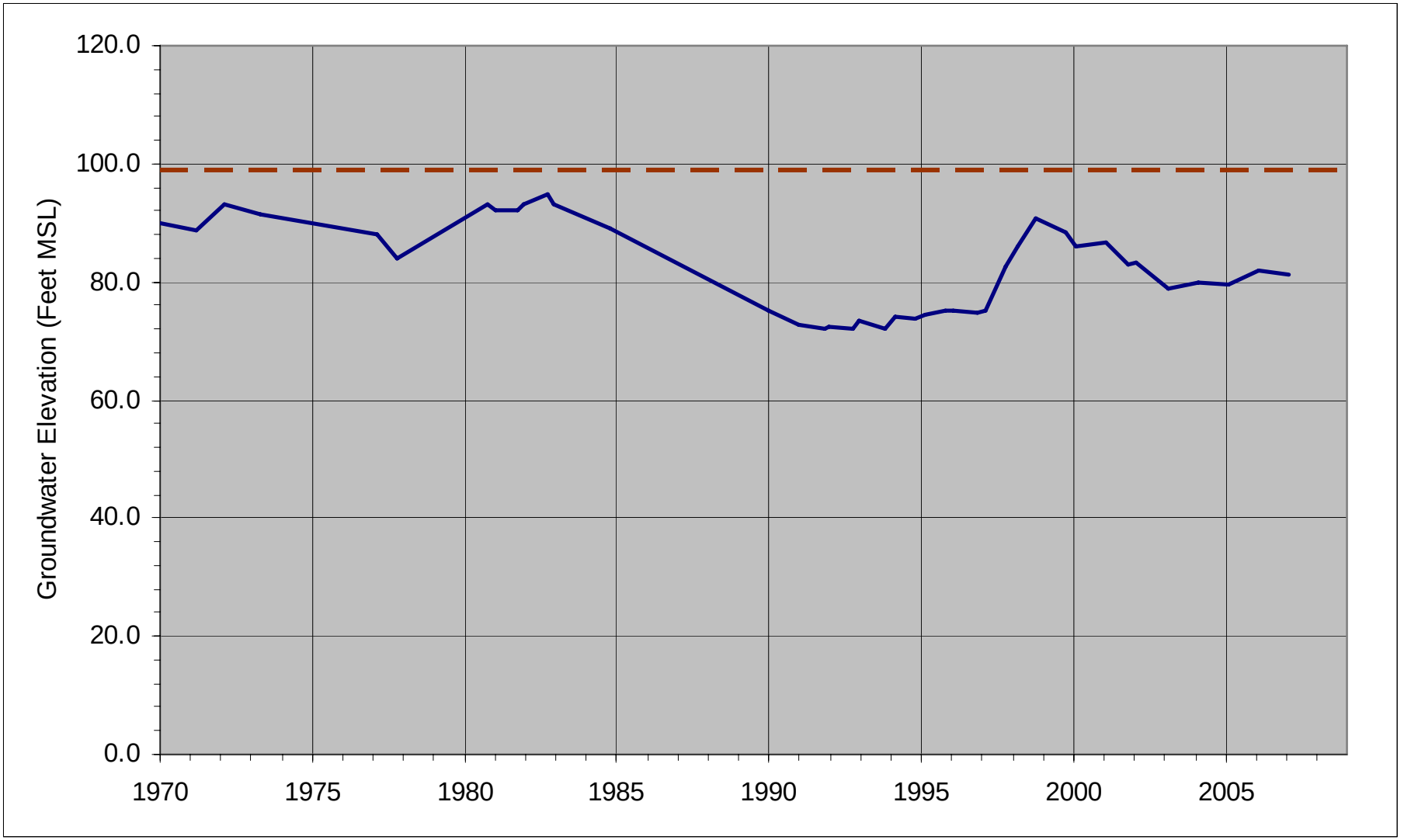
LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/10E-07L1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-13**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/10E-23K2
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-14**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/11E-22D1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-15**

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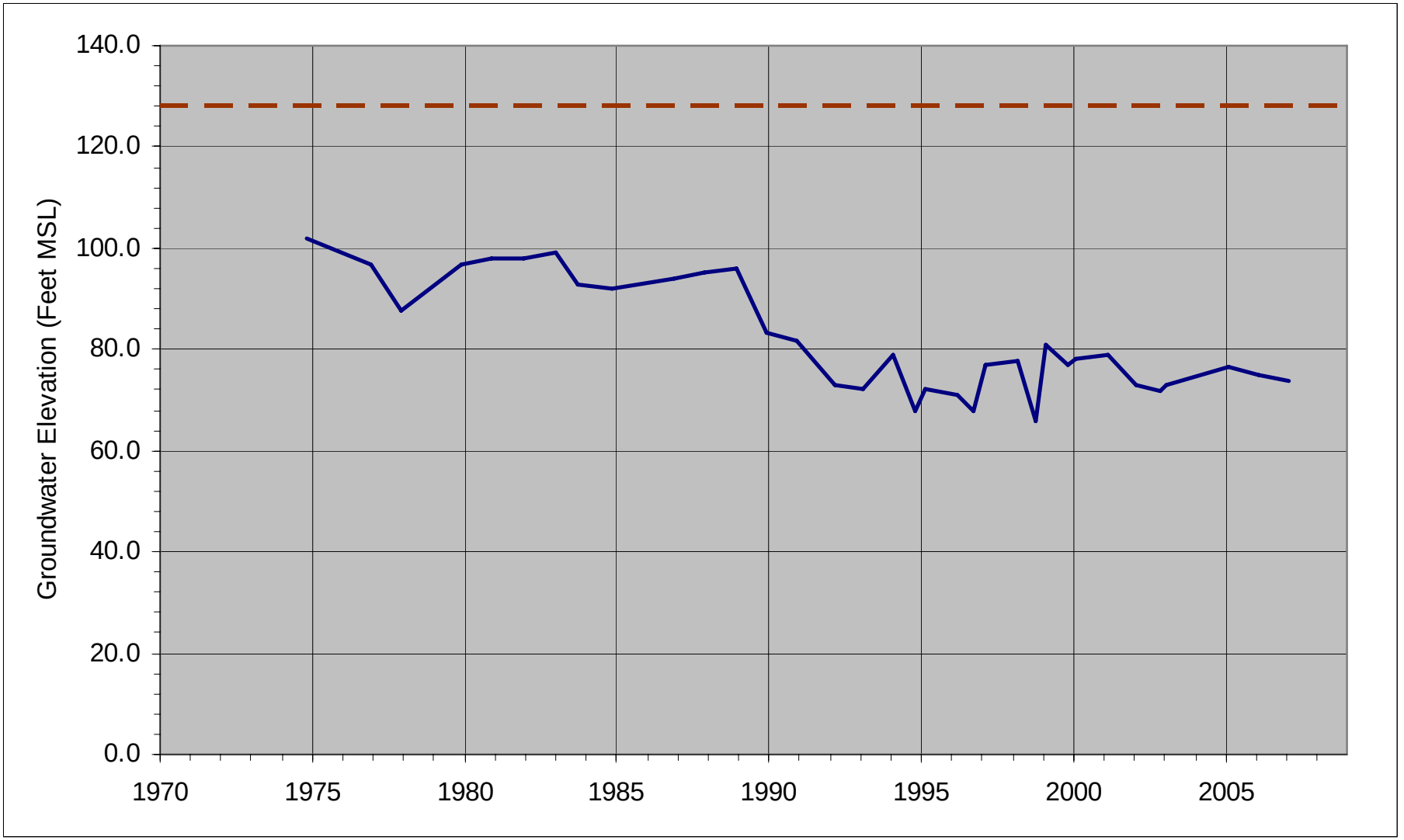

LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/12E-09R2
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-16**

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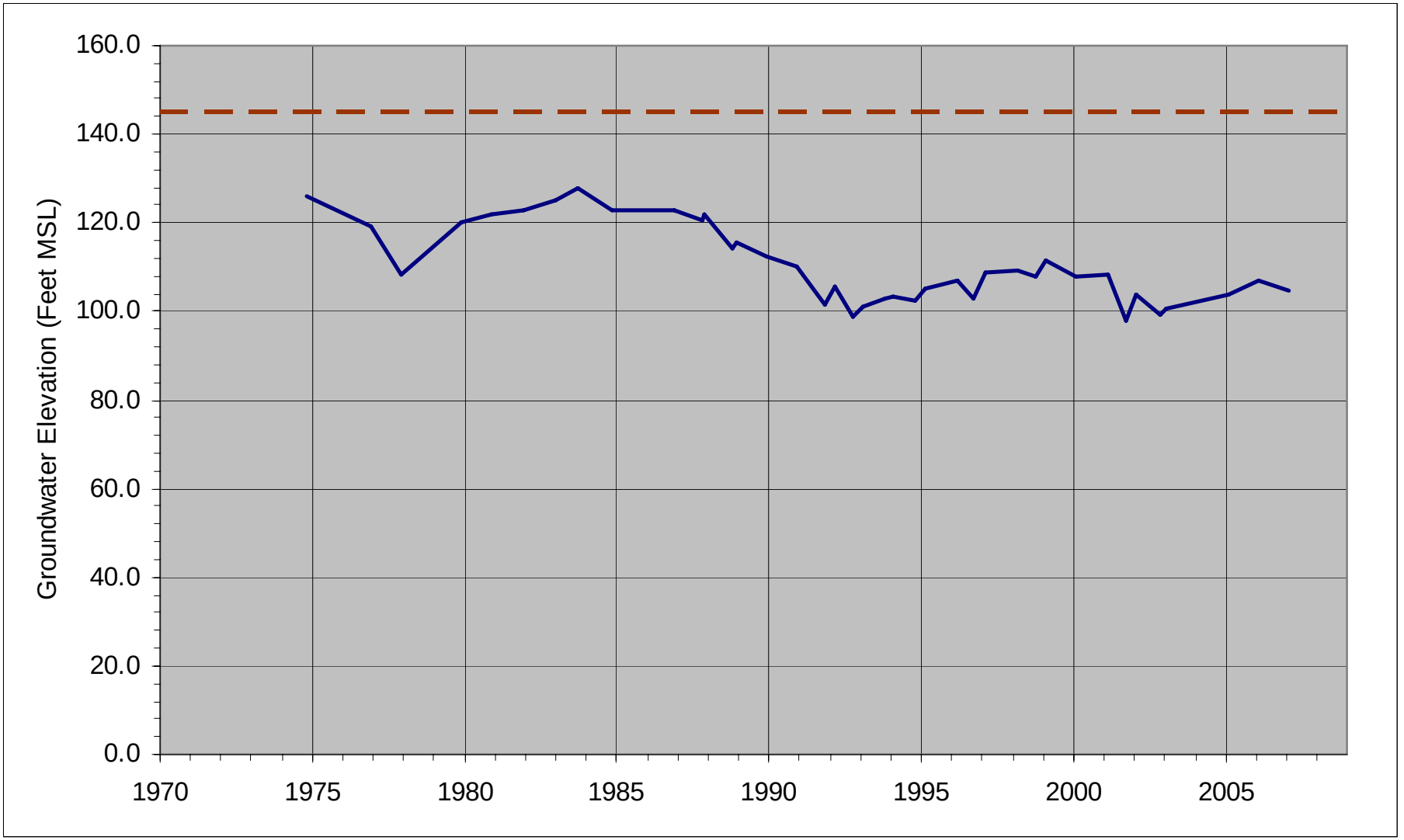

LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/13E-18K1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-17**

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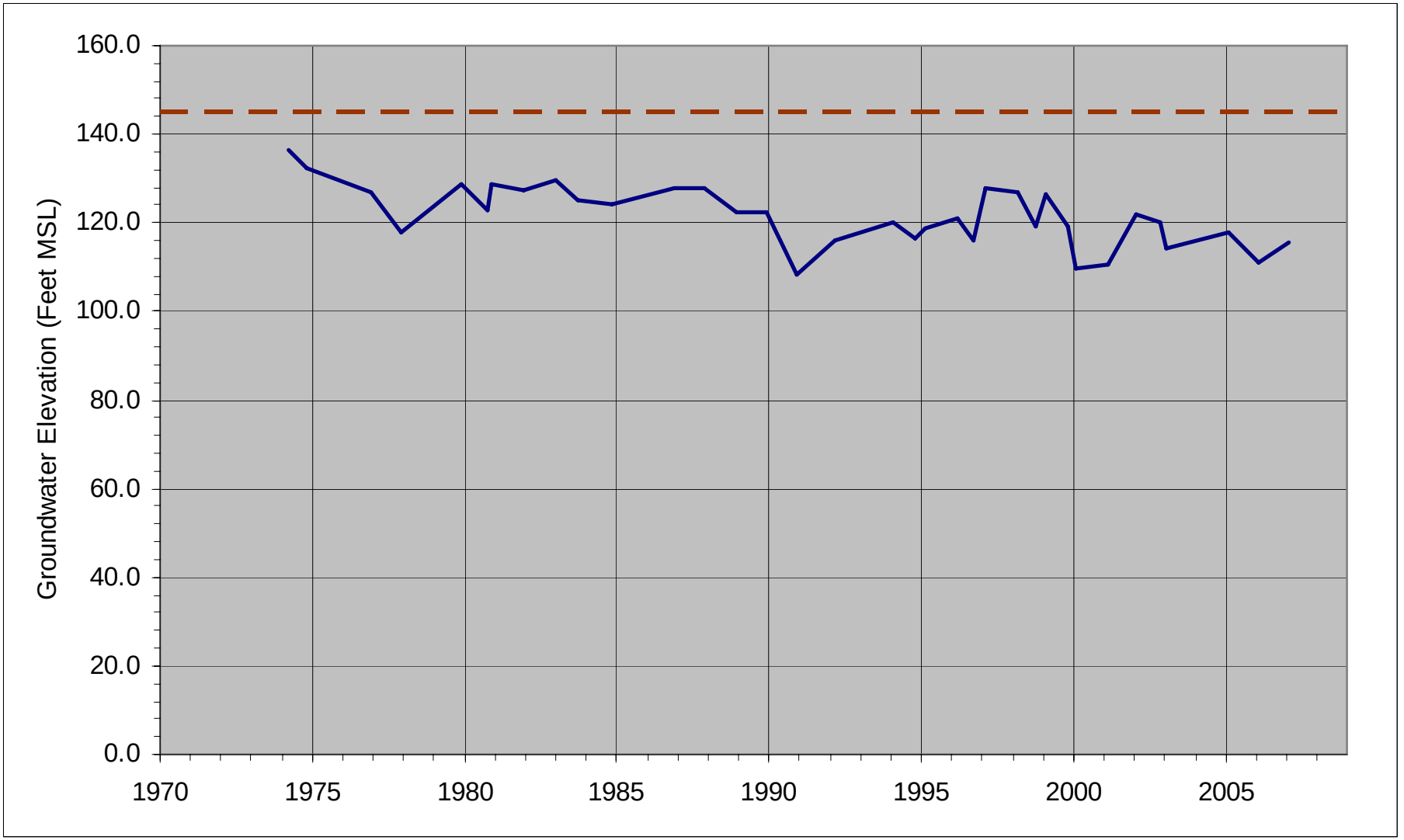

LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/13E-34J1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-18**

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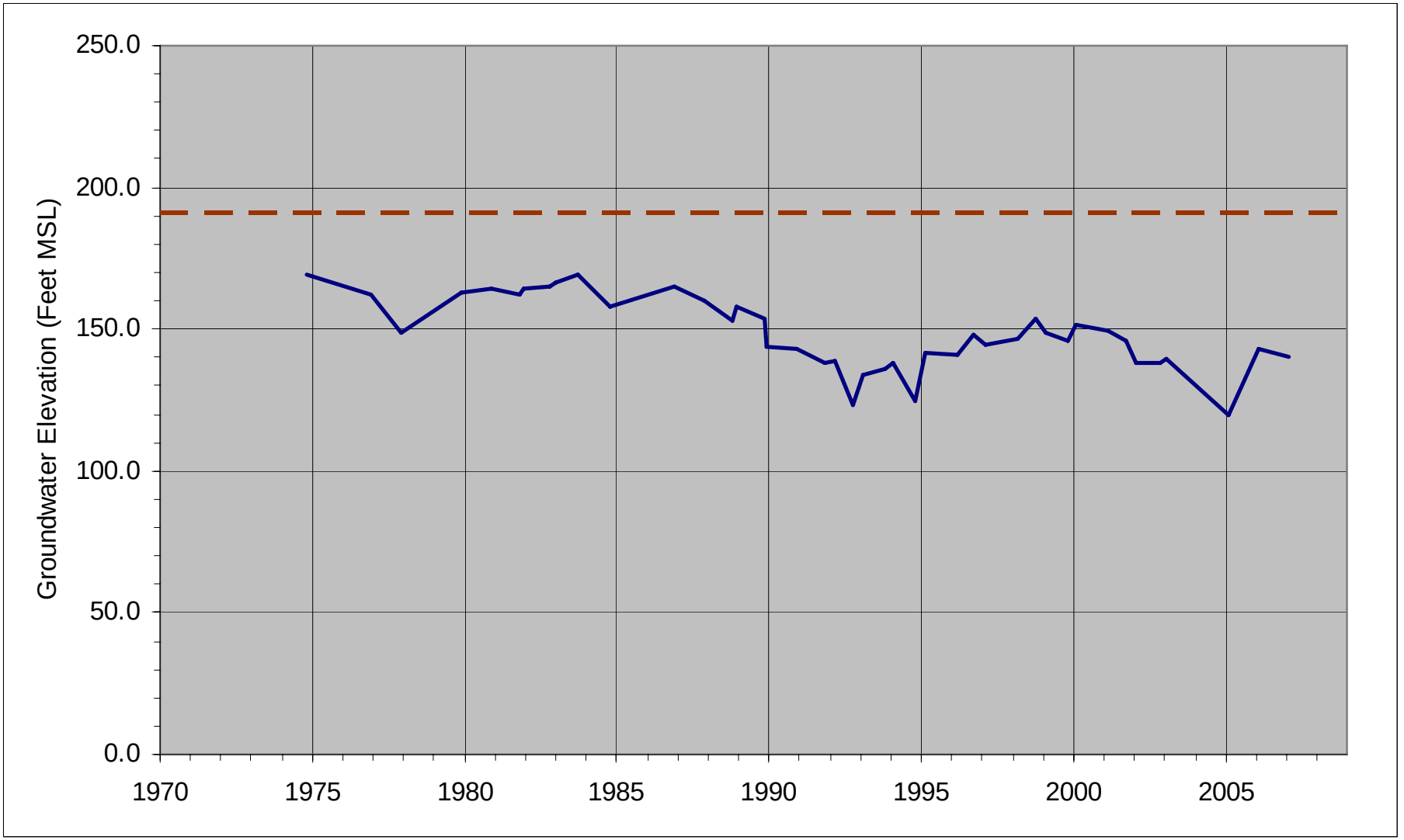

LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/14E-22G01
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-19**

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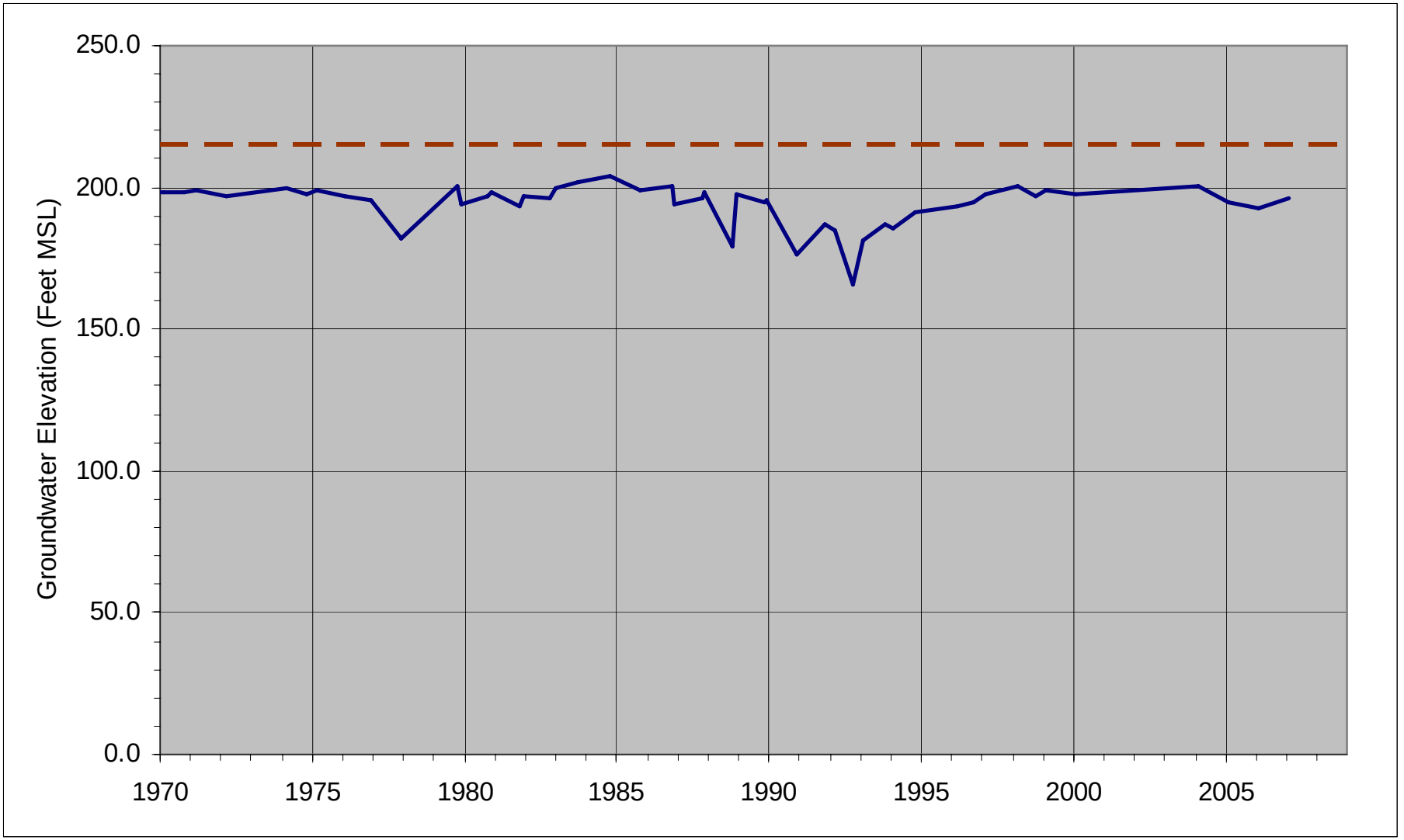

LONG-TERM HYDROGRAPH FOR MONITORING WELL 07S/15E-32A1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-20**

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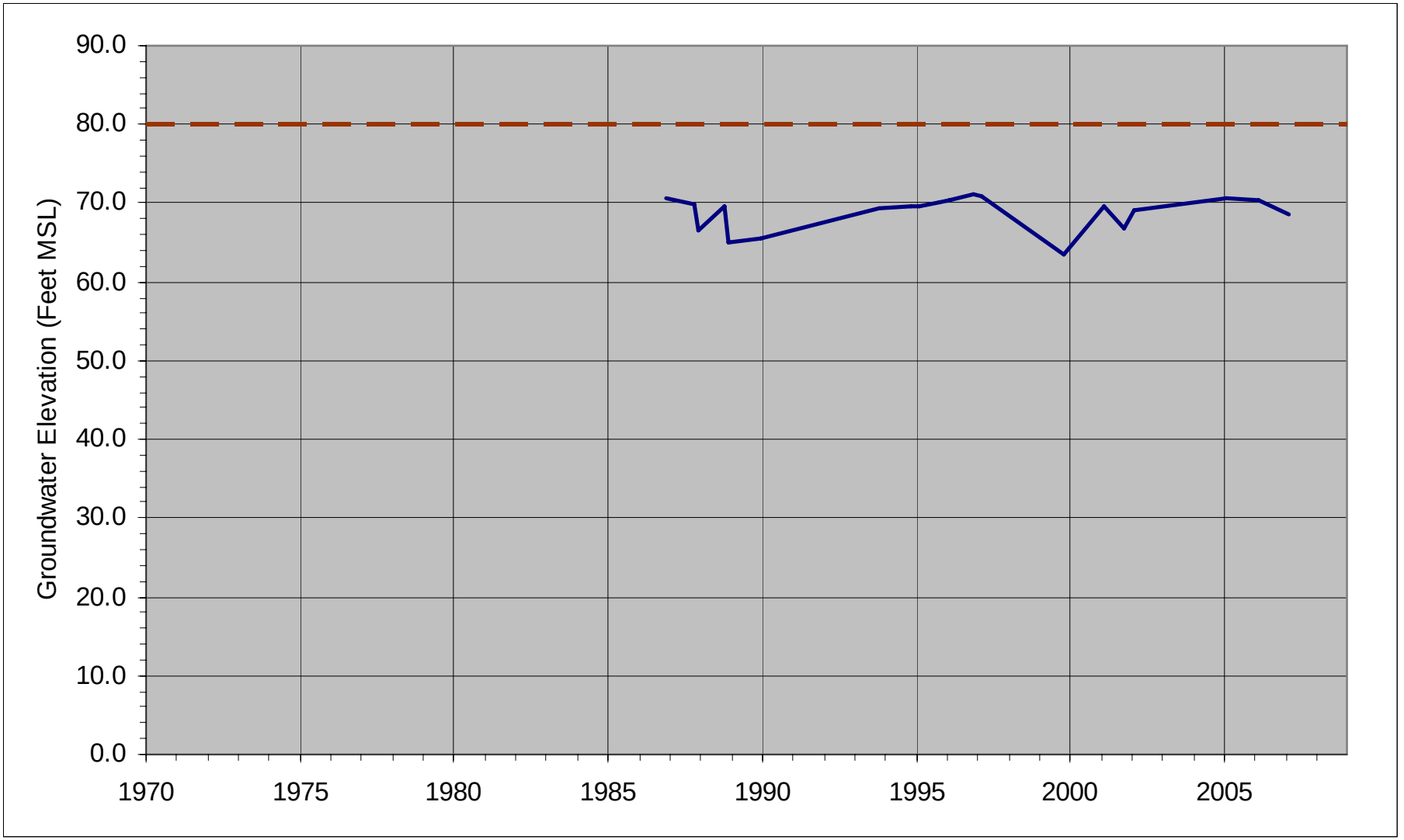

LONG-TERM HYDROGRAPH FOR MONITORING WELL 08S/11E-08R2
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-21**

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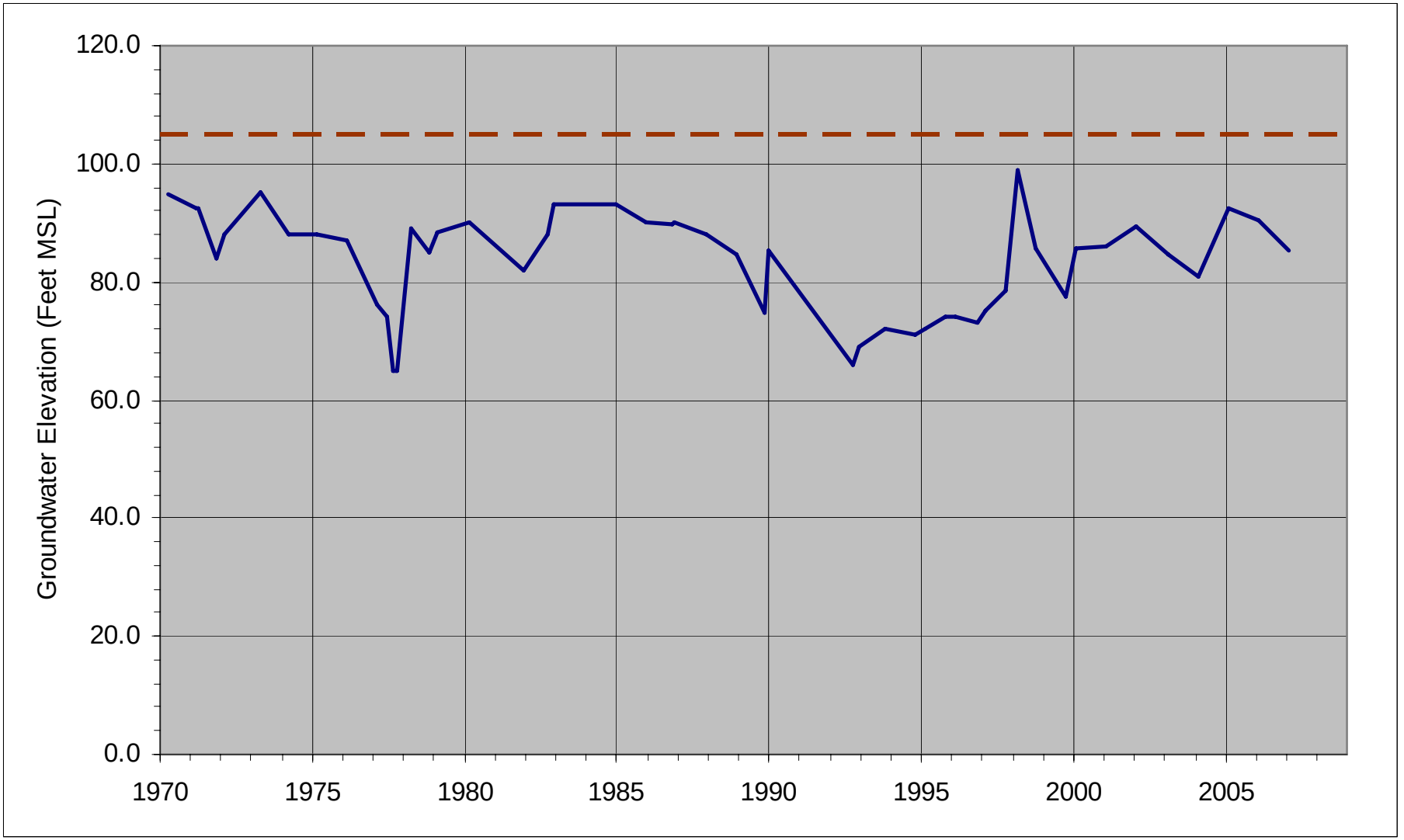

LONG-TERM HYDROGRAPH FOR MONITORING WELL 08S/12E-09H1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-22**

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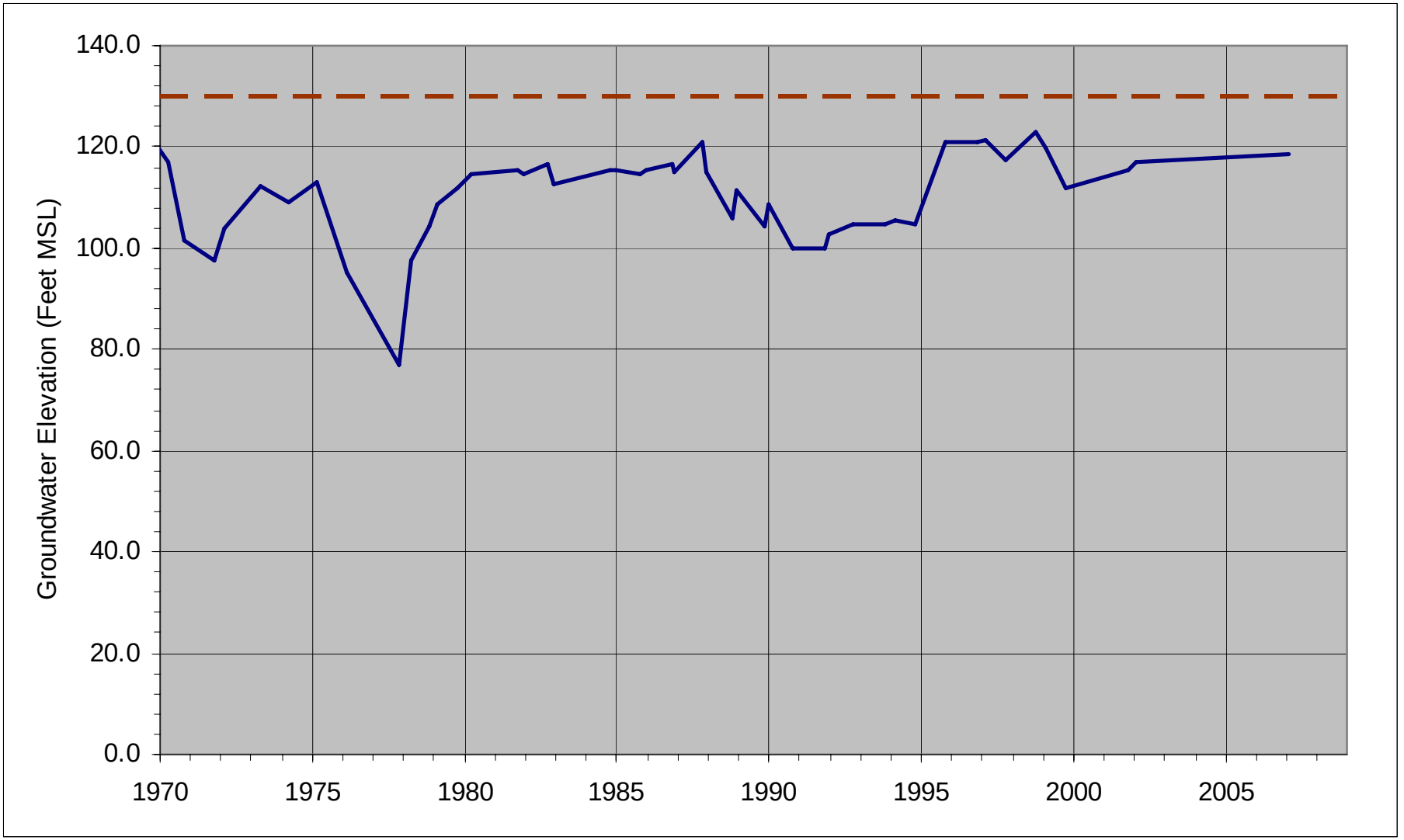

LONG-TERM HYDROGRAPH FOR MONITORING WELL 08S/13E-28A1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-23**

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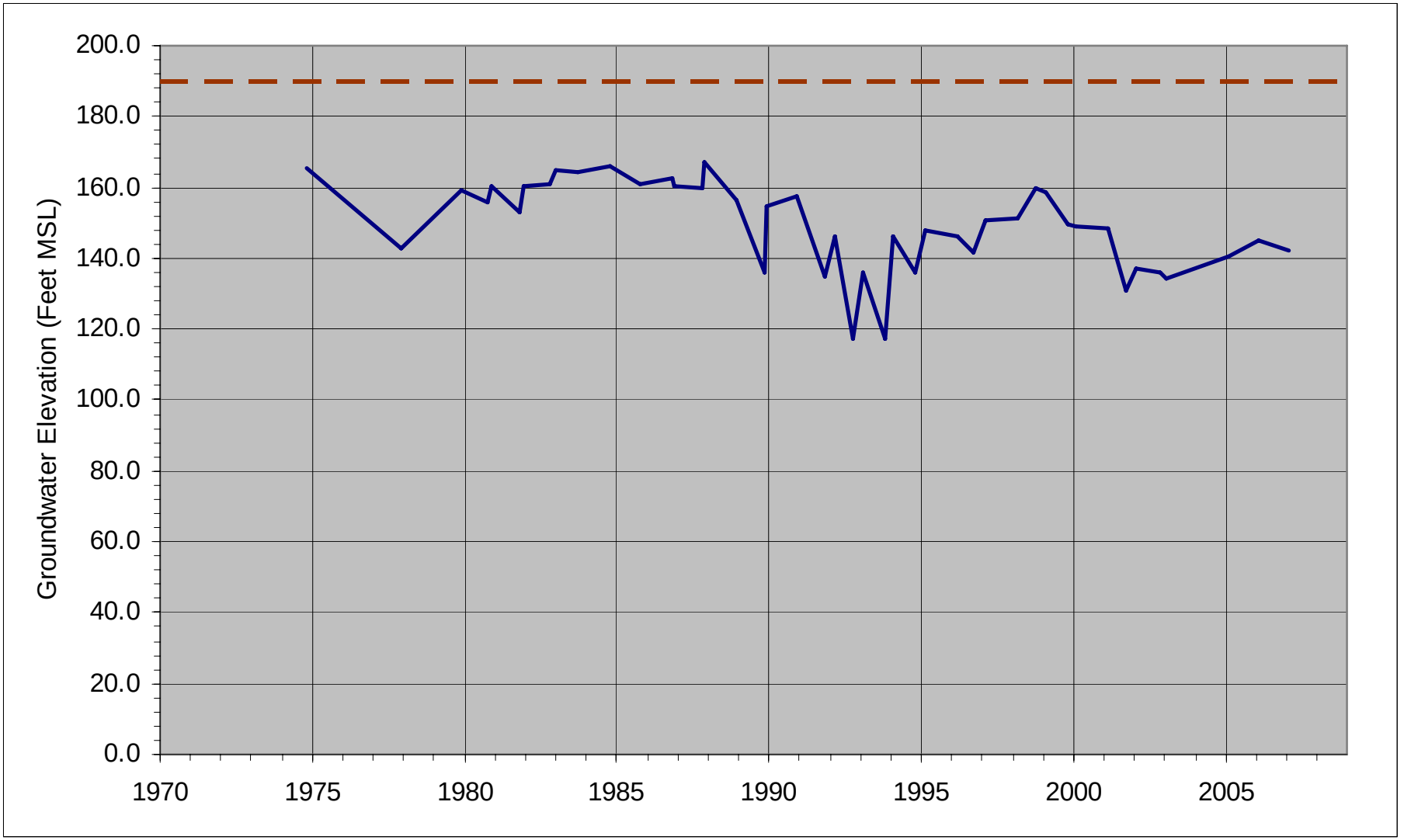

LONG-TERM HYDROGRAPH FOR MONITORING WELL 08S/14E-02A1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-24**

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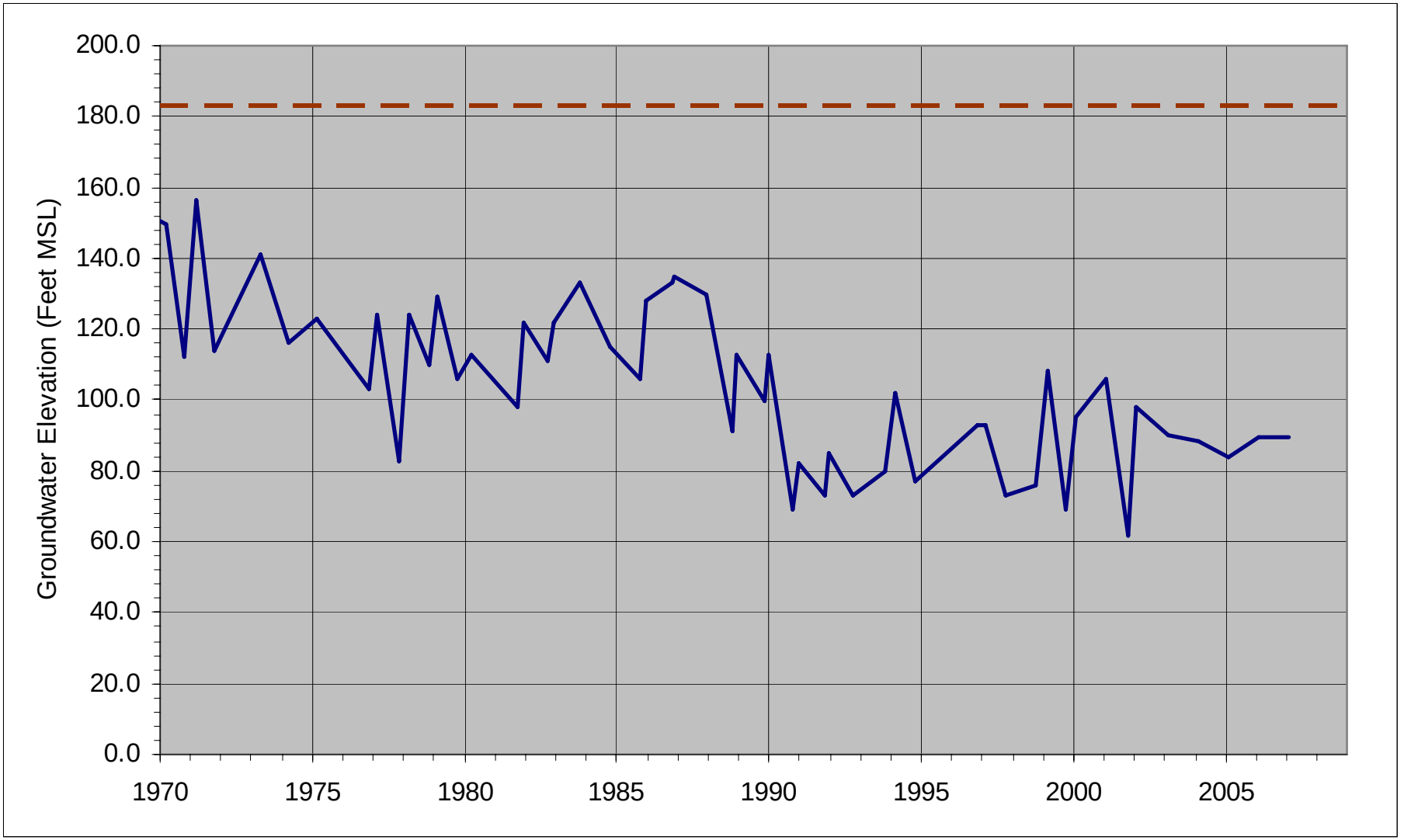

LONG-TERM HYDROGRAPH FOR MONITORING WELL 08S/14E-26H1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-25**

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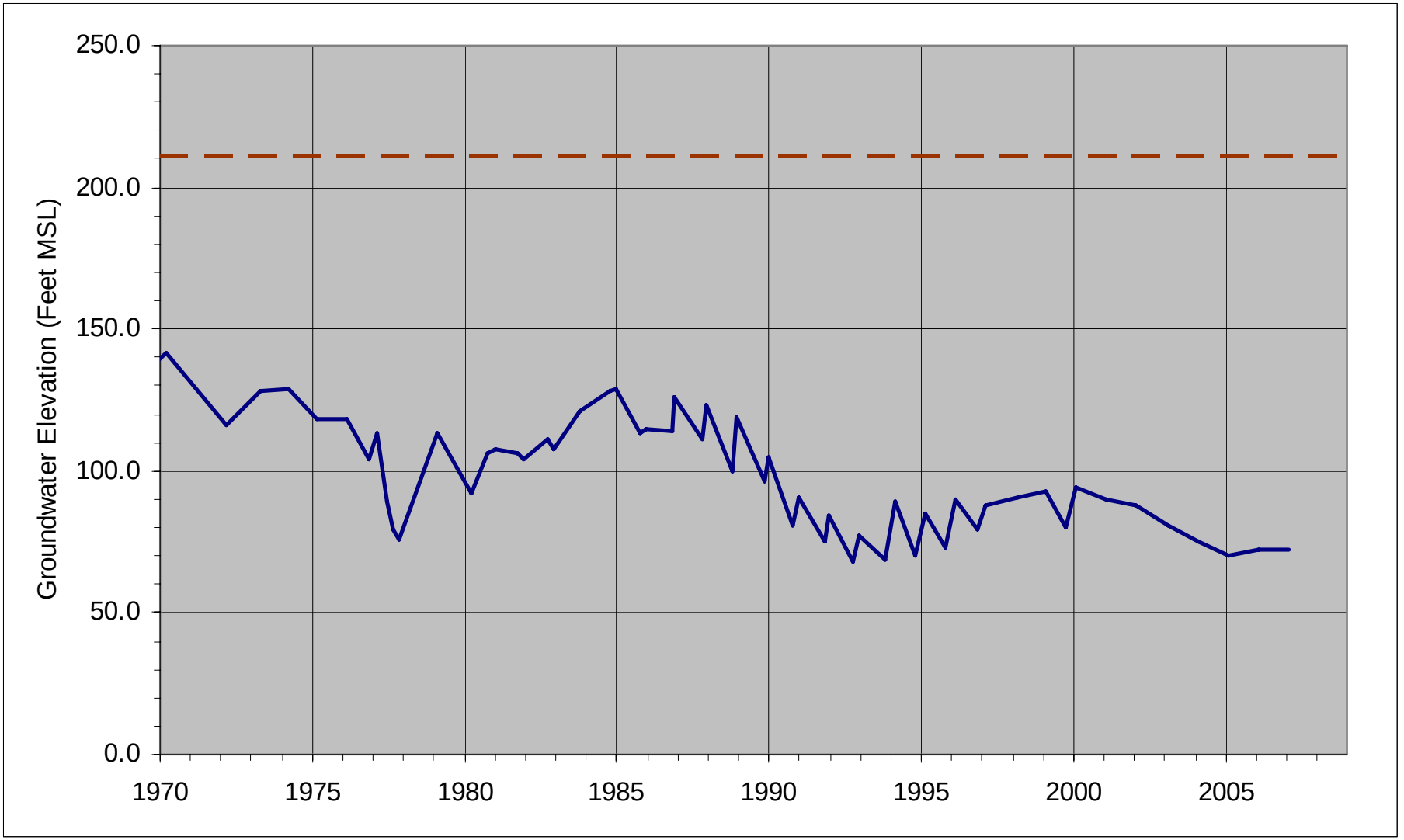

LONG-TERM HYDROGRAPH FOR MONITORING WELL 08S/15E-16P1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-26**

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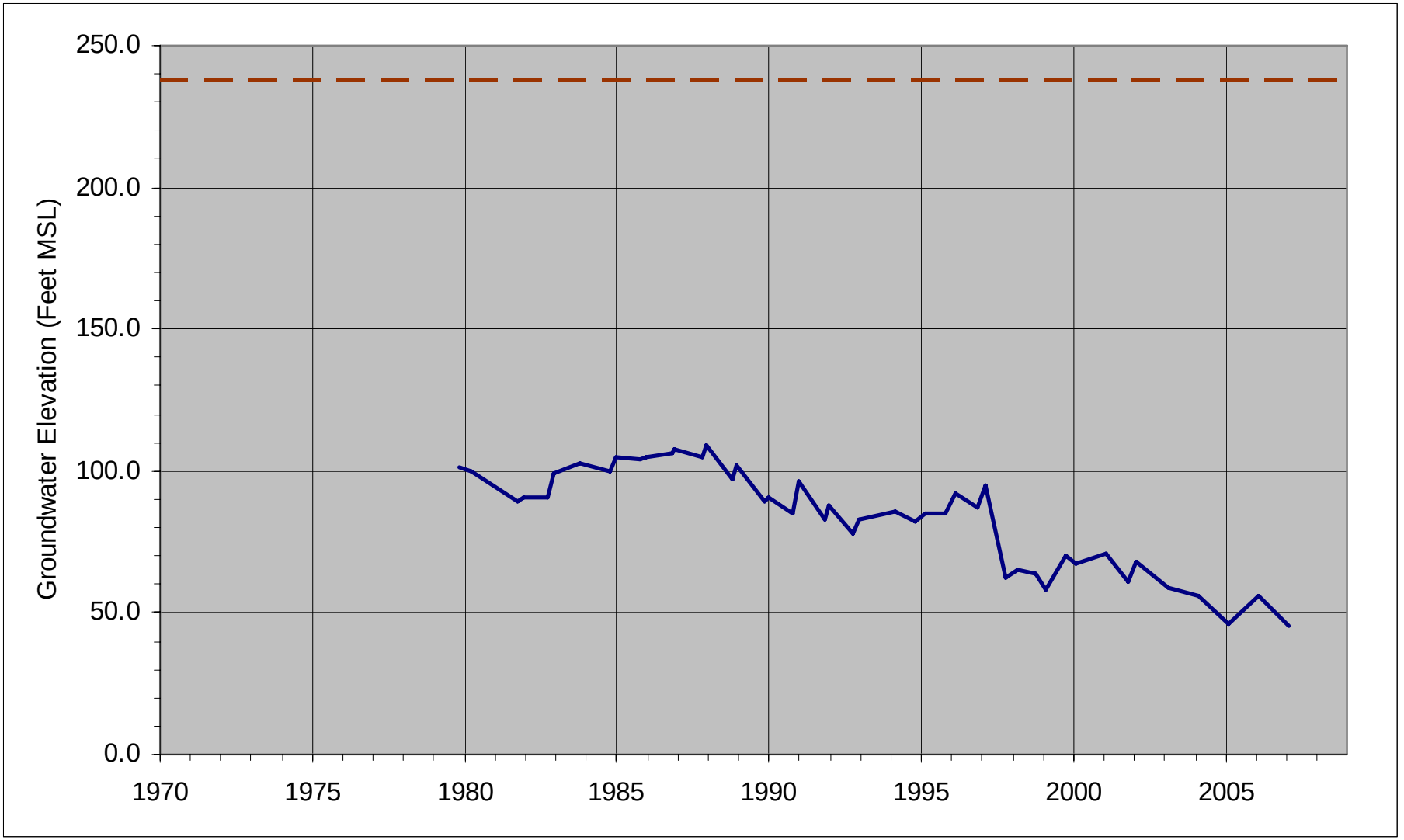
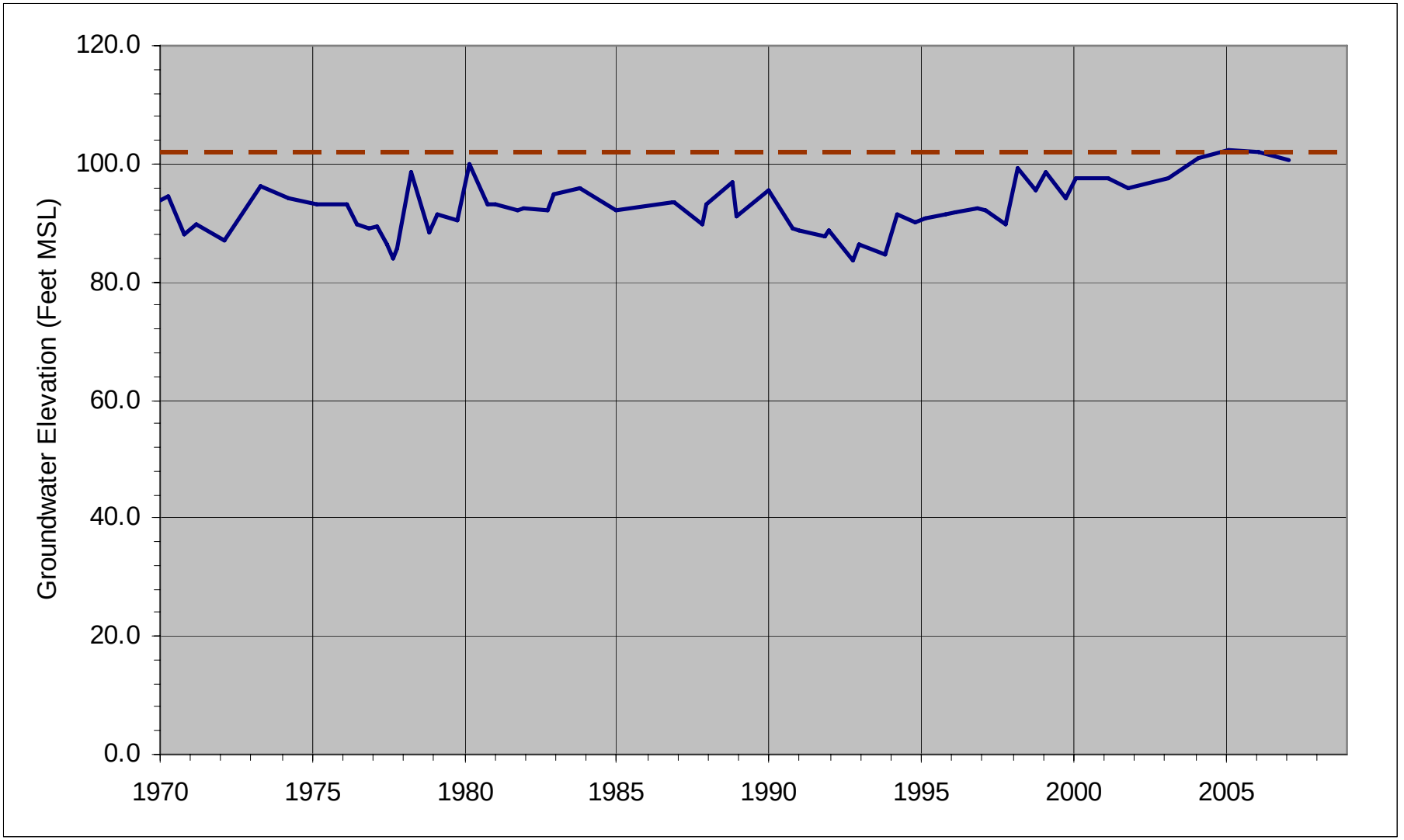


LONG-TERM HYDROGRAPH FOR MONITORING WELL 08S/16E-31C1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-27**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 09S/12E-11R1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-28**

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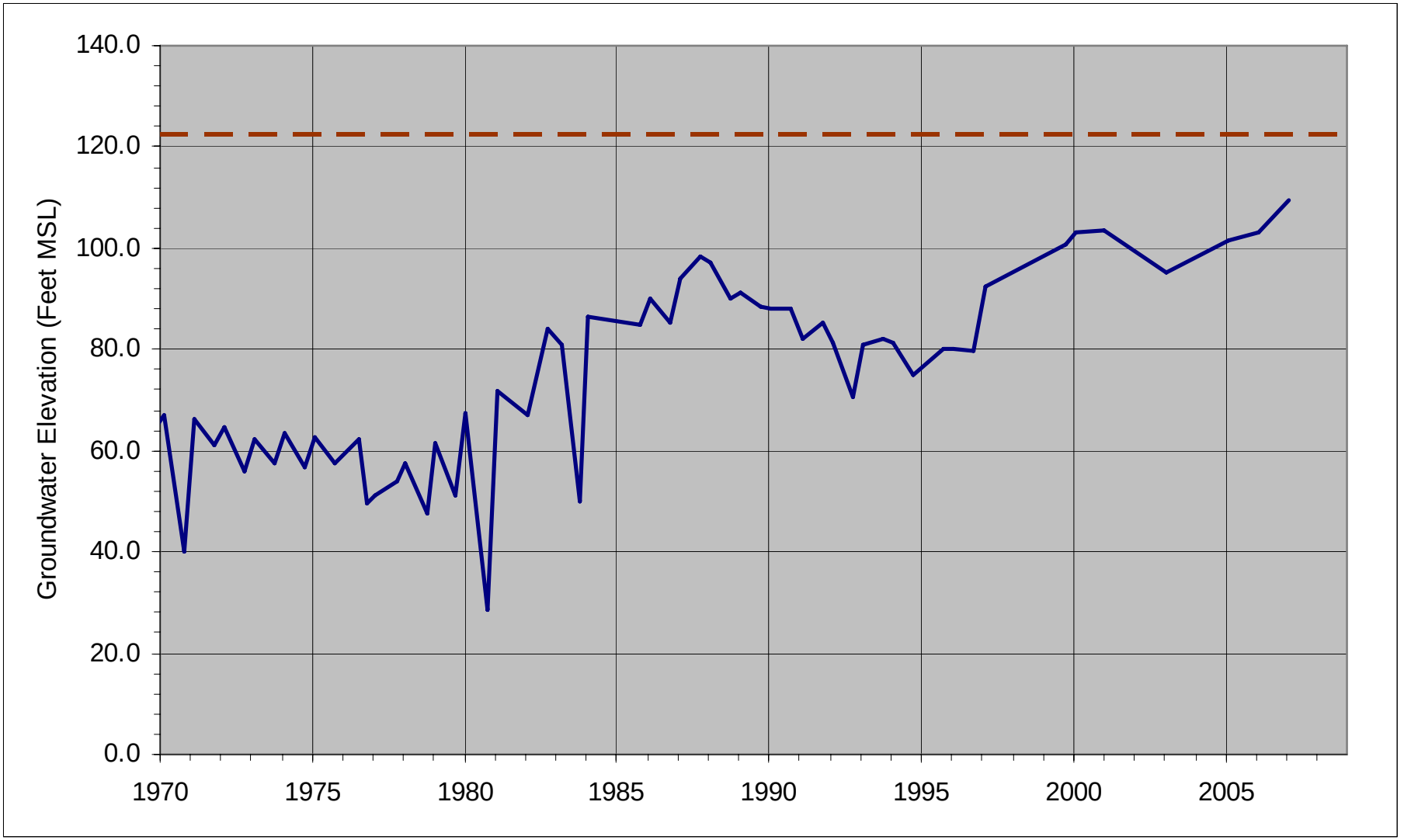
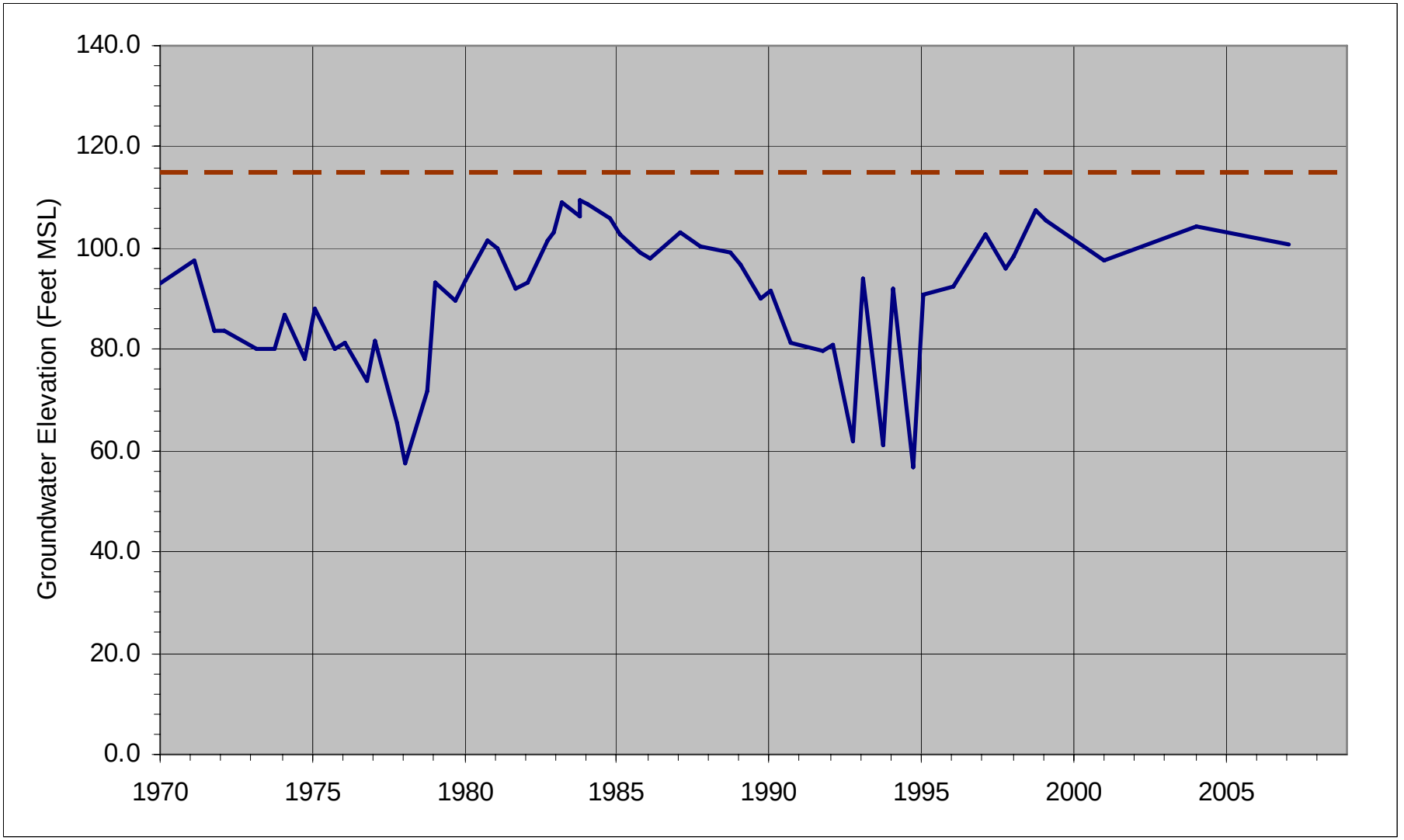


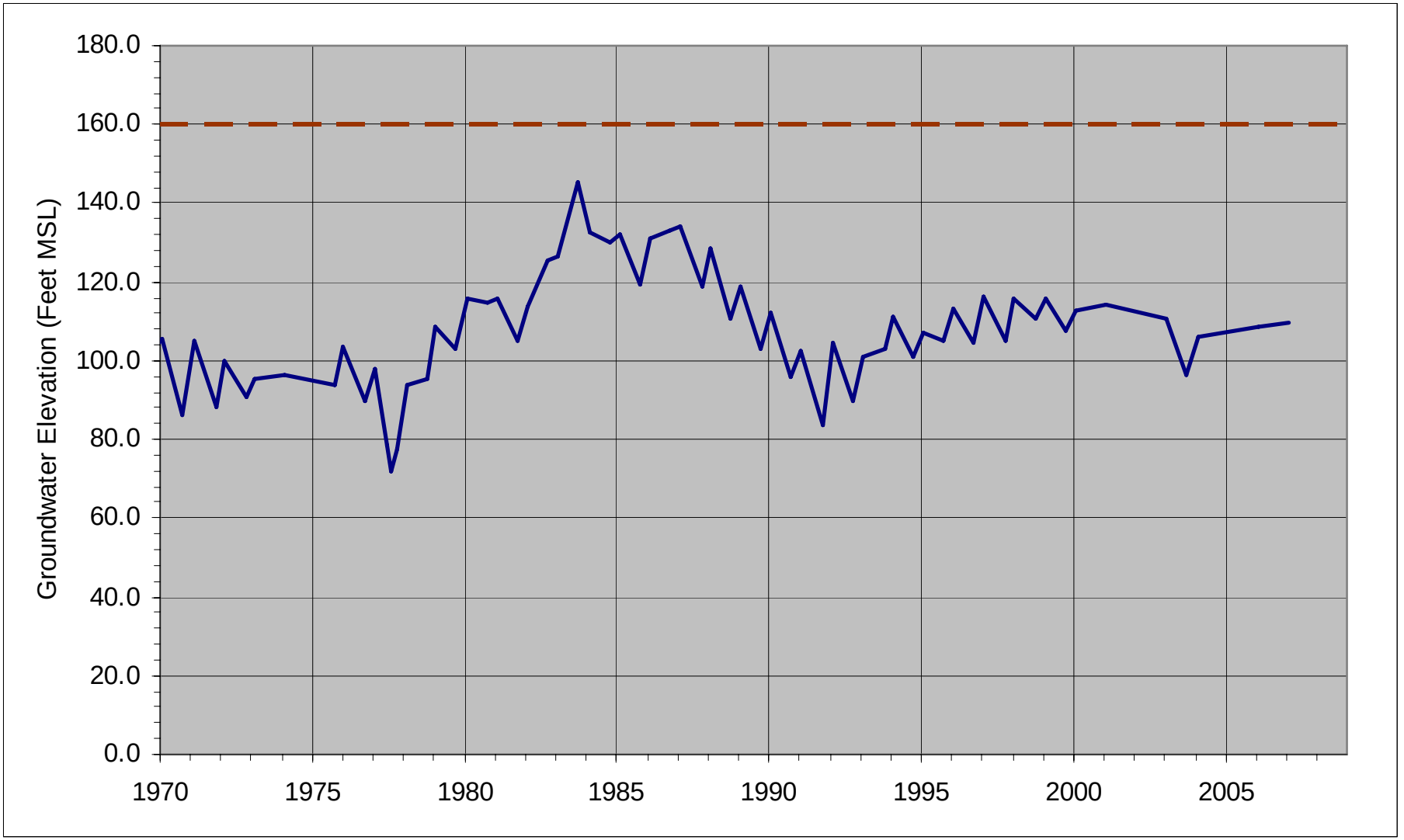
LONG-TERM HYDROGRAPH FOR MONITORING WELL 09S/13E-10P2
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-29**



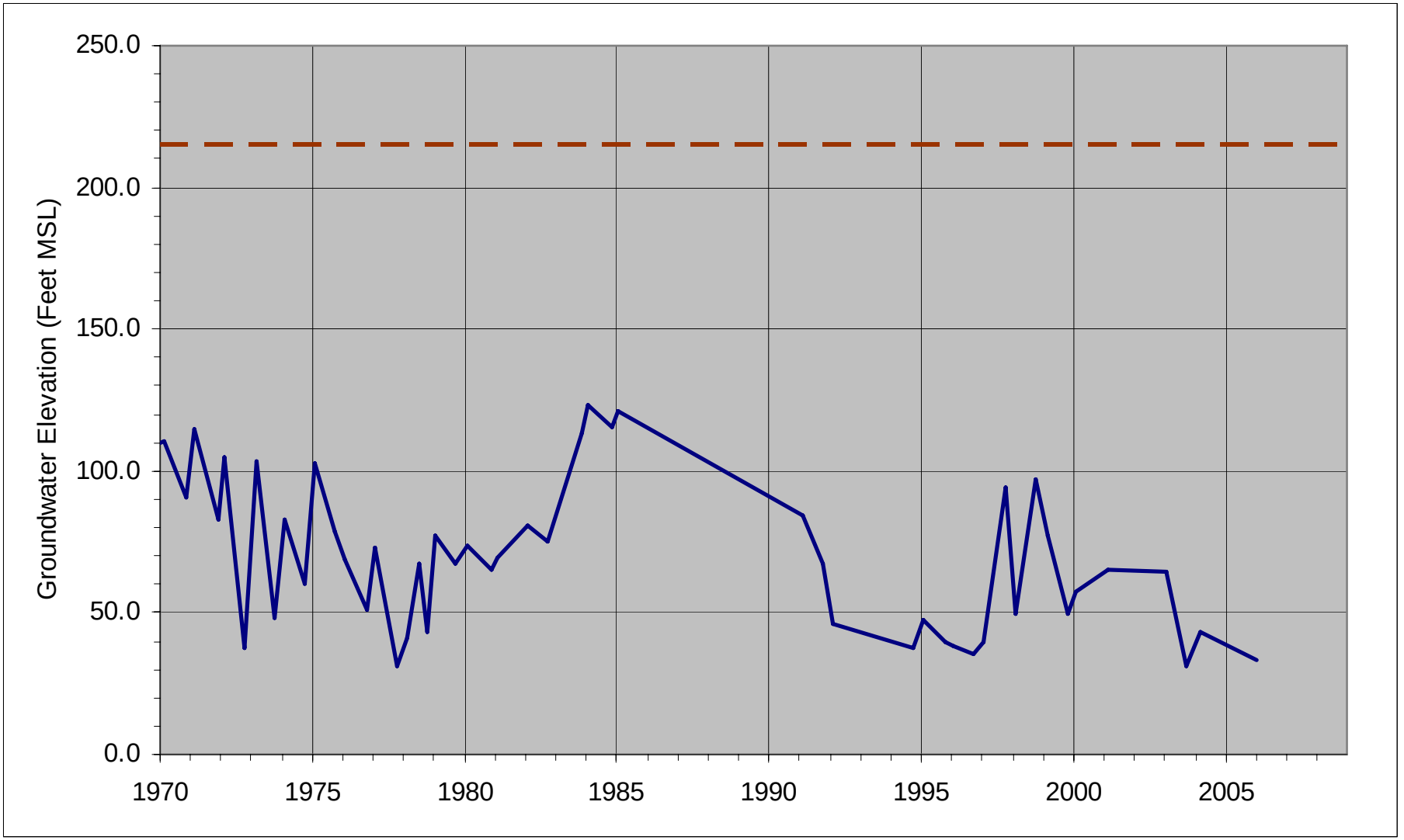
LONG-TERM HYDROGRAPH FOR MONITORING WELL 09S/13E-33P2
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-30**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 09S/14E-21C1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-31**



LONG-TERM HYDROGRAPH FOR MONITORING WELL 09S/15E-10P1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-32**

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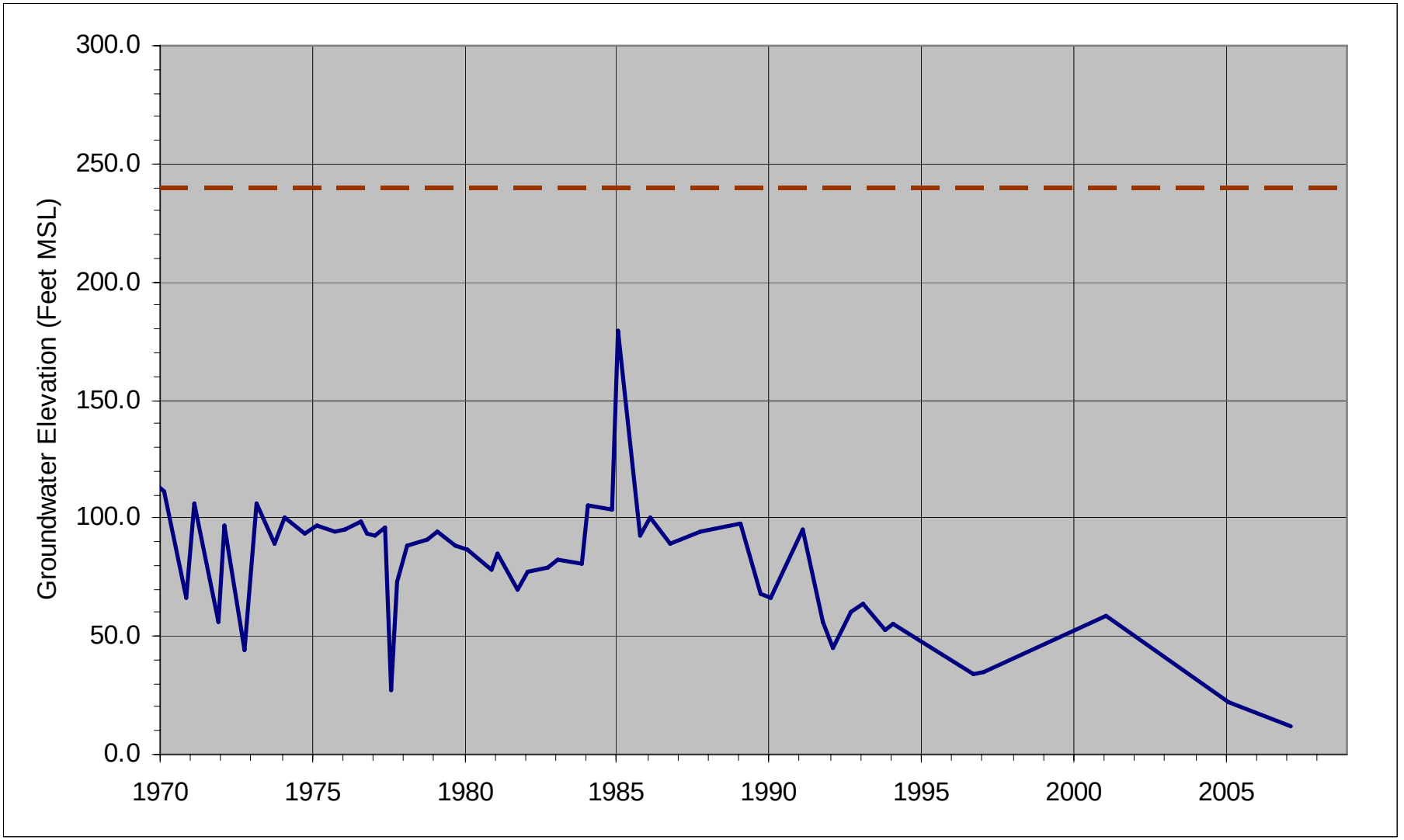

LONG-TERM HYDROGRAPH FOR MONITORING WELL 09S/16E-07C1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-33**

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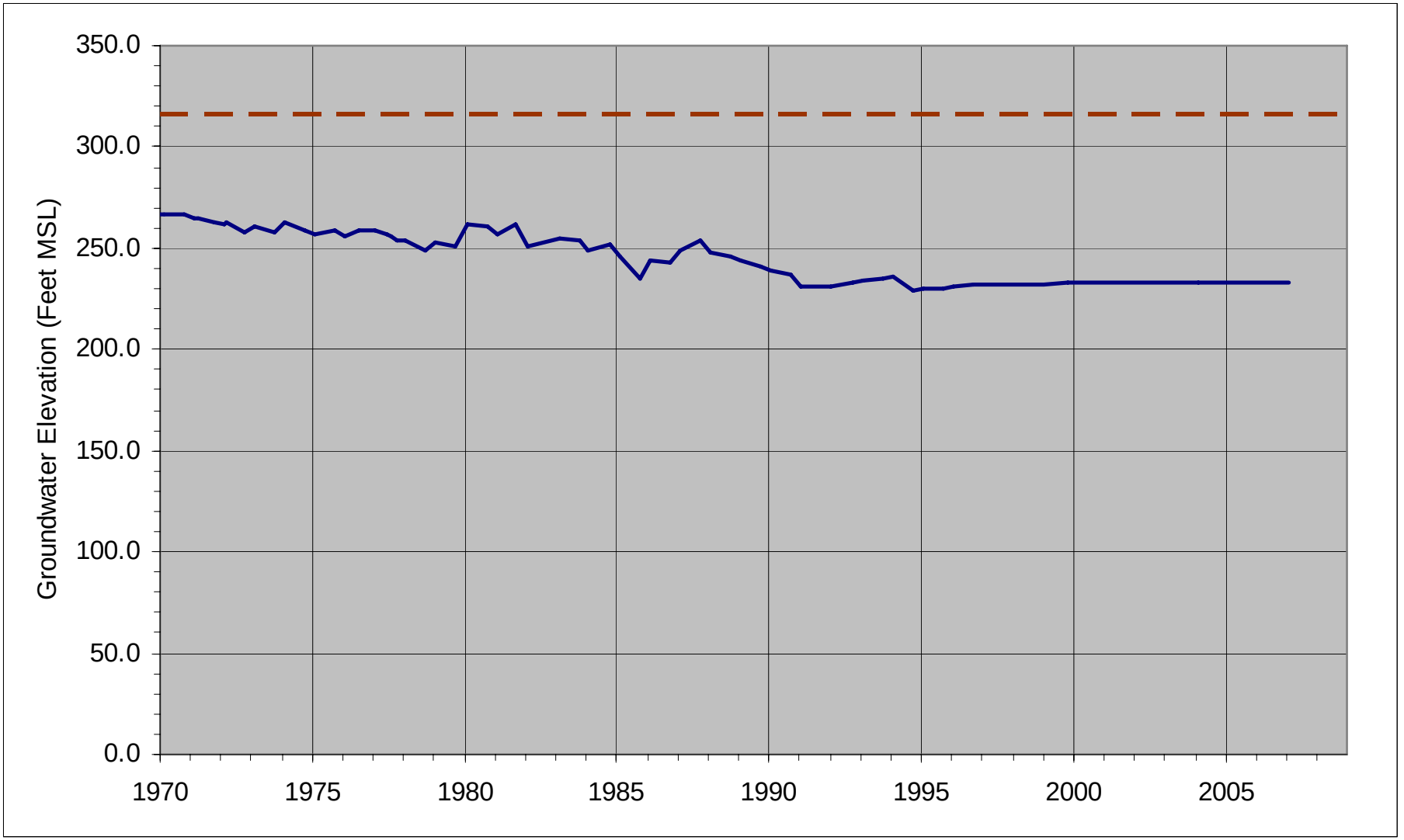
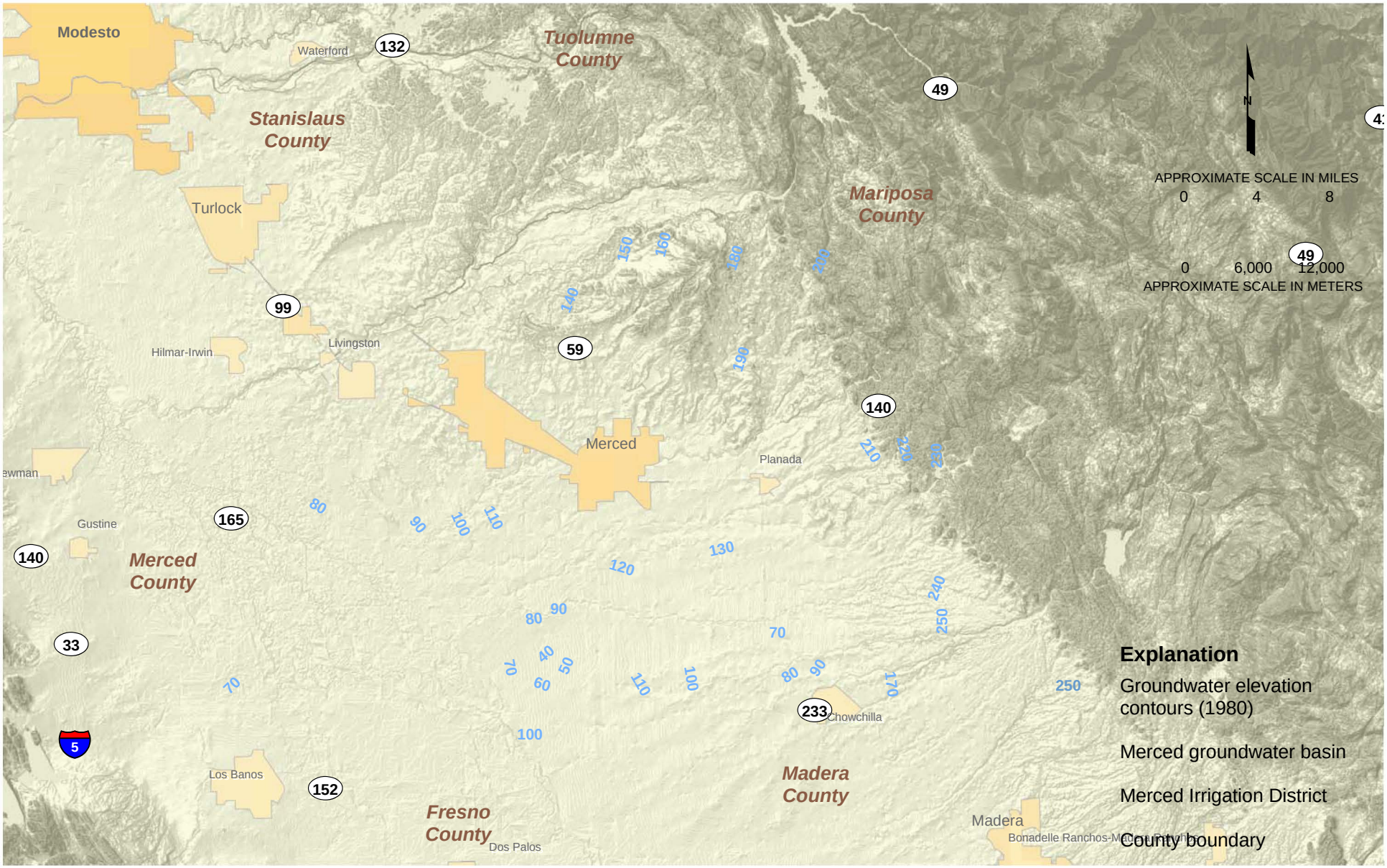


LONG-TERM HYDROGRAPH FOR MONITORING WELL 09S/17E-06J1
MERCED GROUNDWATER BASIN
Groundwater Management Plan Update
Merced, California

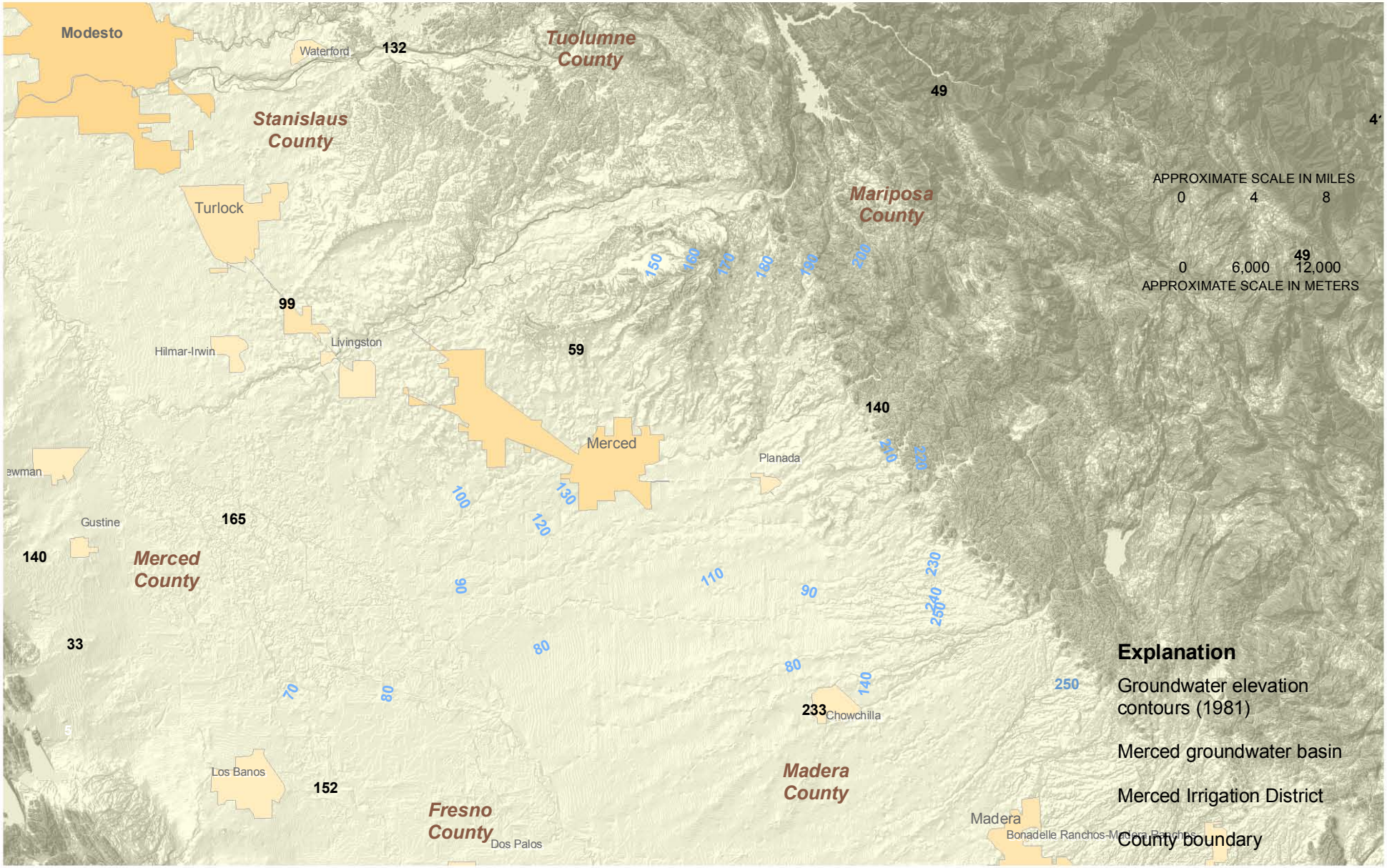
By: dmb	Date: 5/27/08	Project No. 13651.000
AMEC Geomatrix		Figure **C-34**



SIMPLIFIED 1980 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

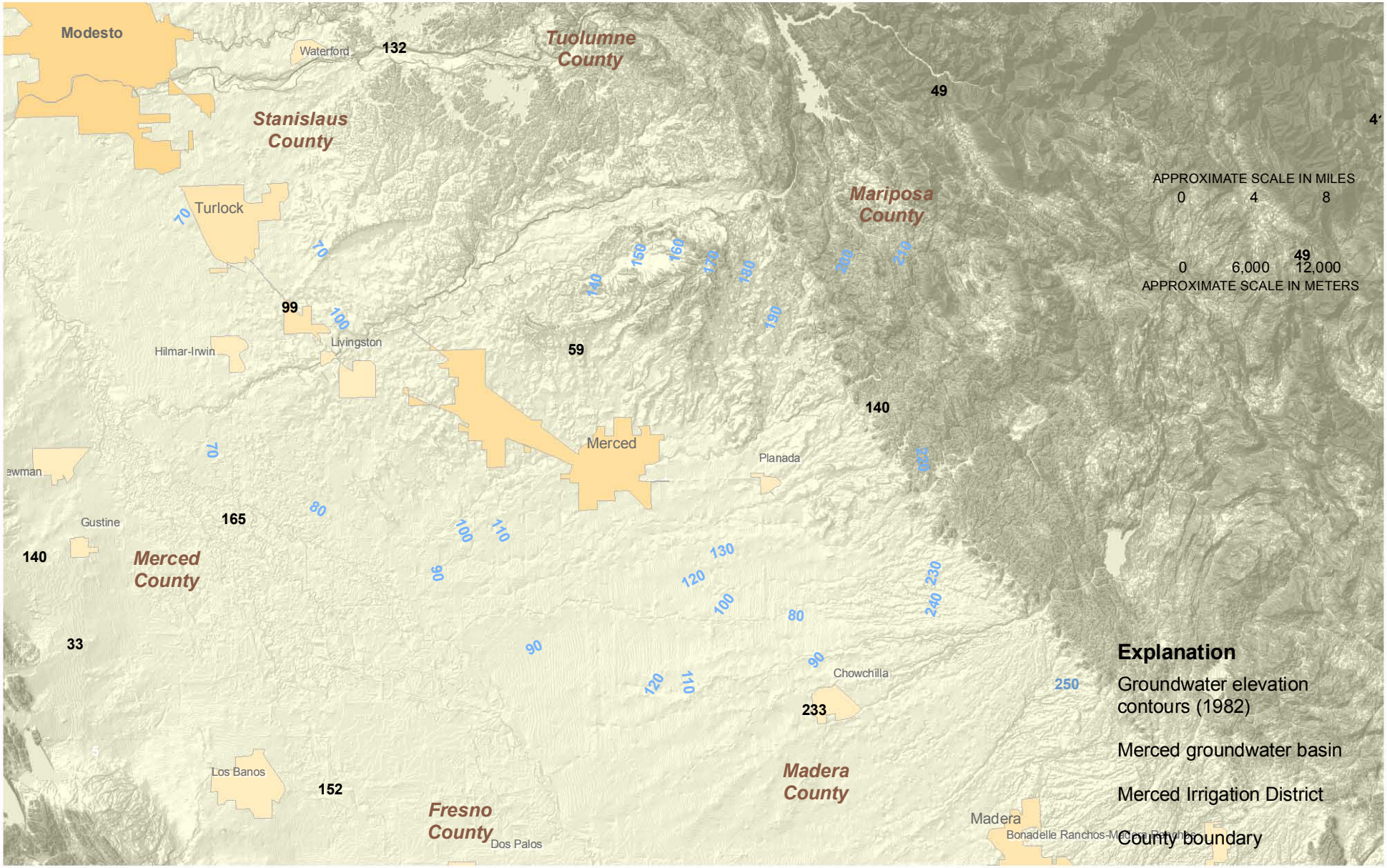
Figure **D-1**



SIMPLIFIED 1981 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

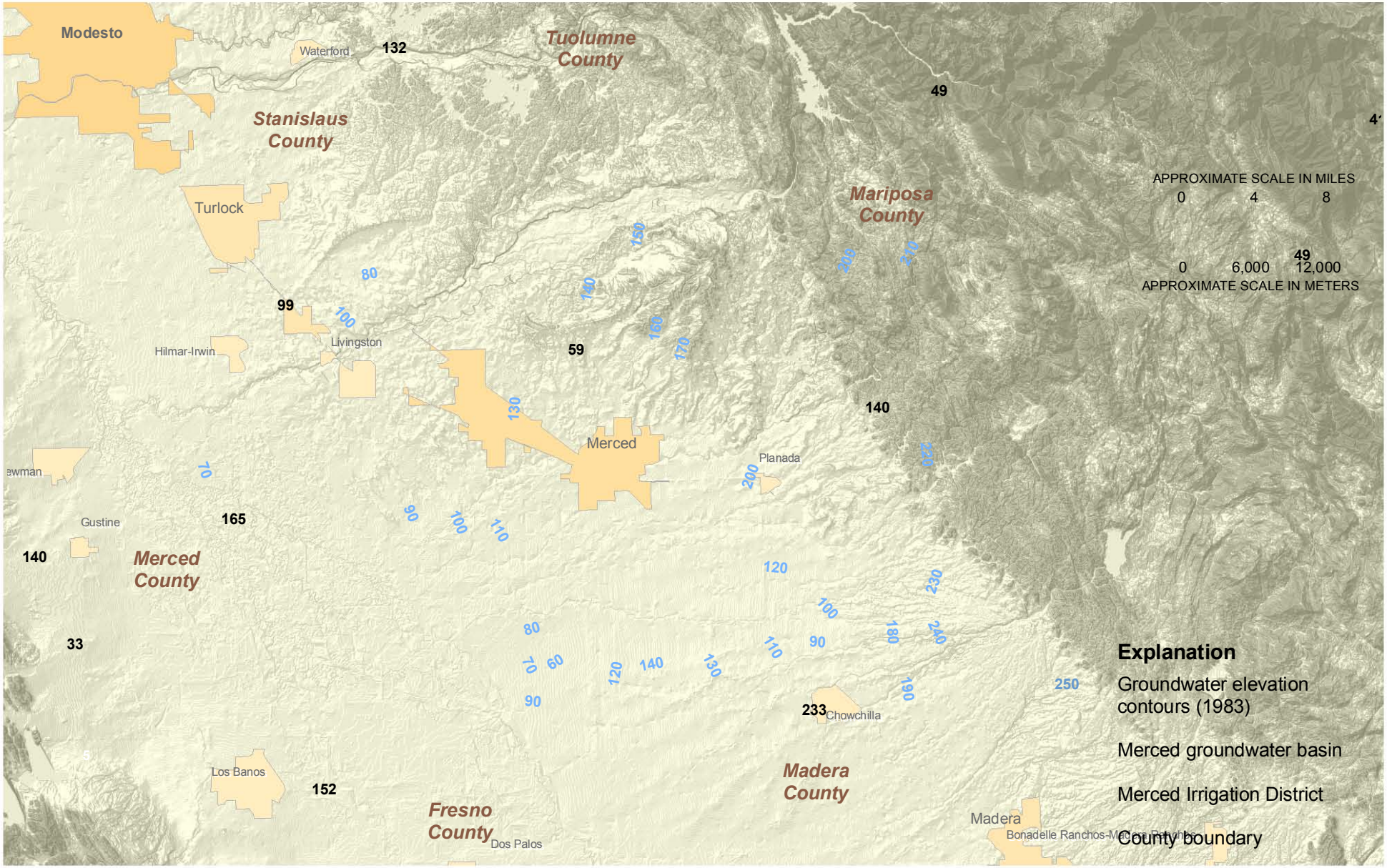
Figure **D-2**



SIMPLIFIED 1982 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

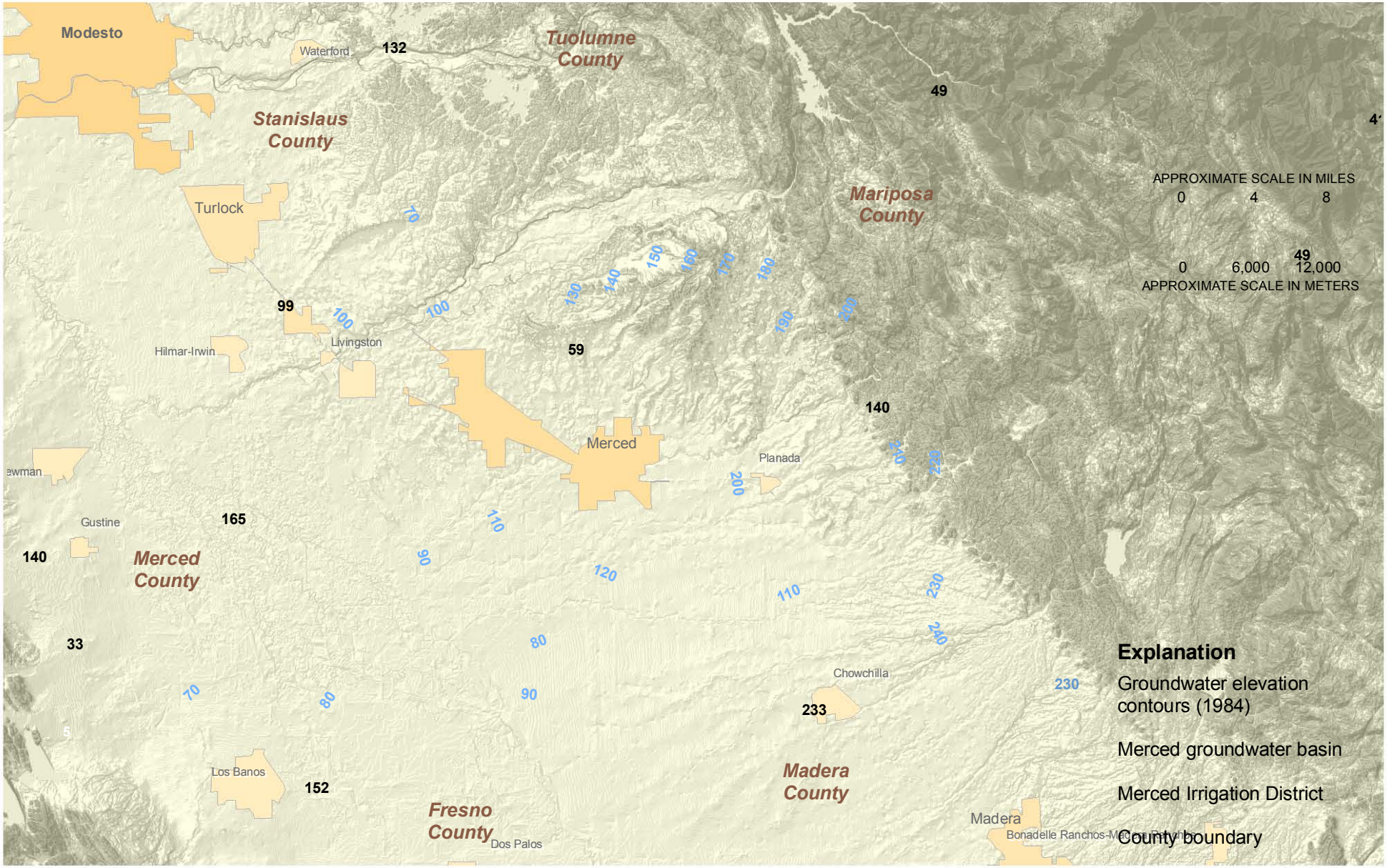
Figure **D-3**



SIMPLIFIED 1983 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

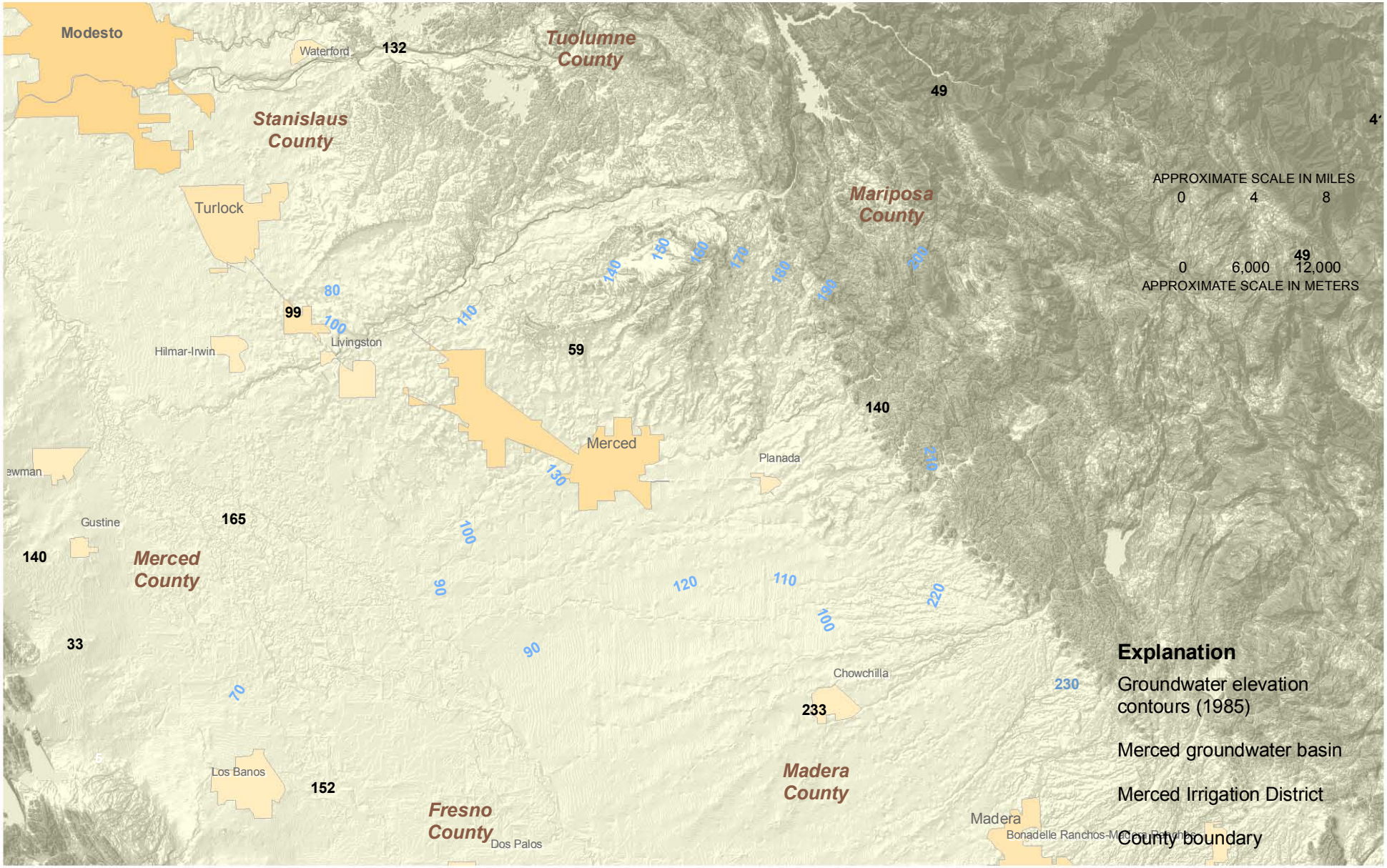
Figure **D-4**



SIMPLIFIED 1984 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

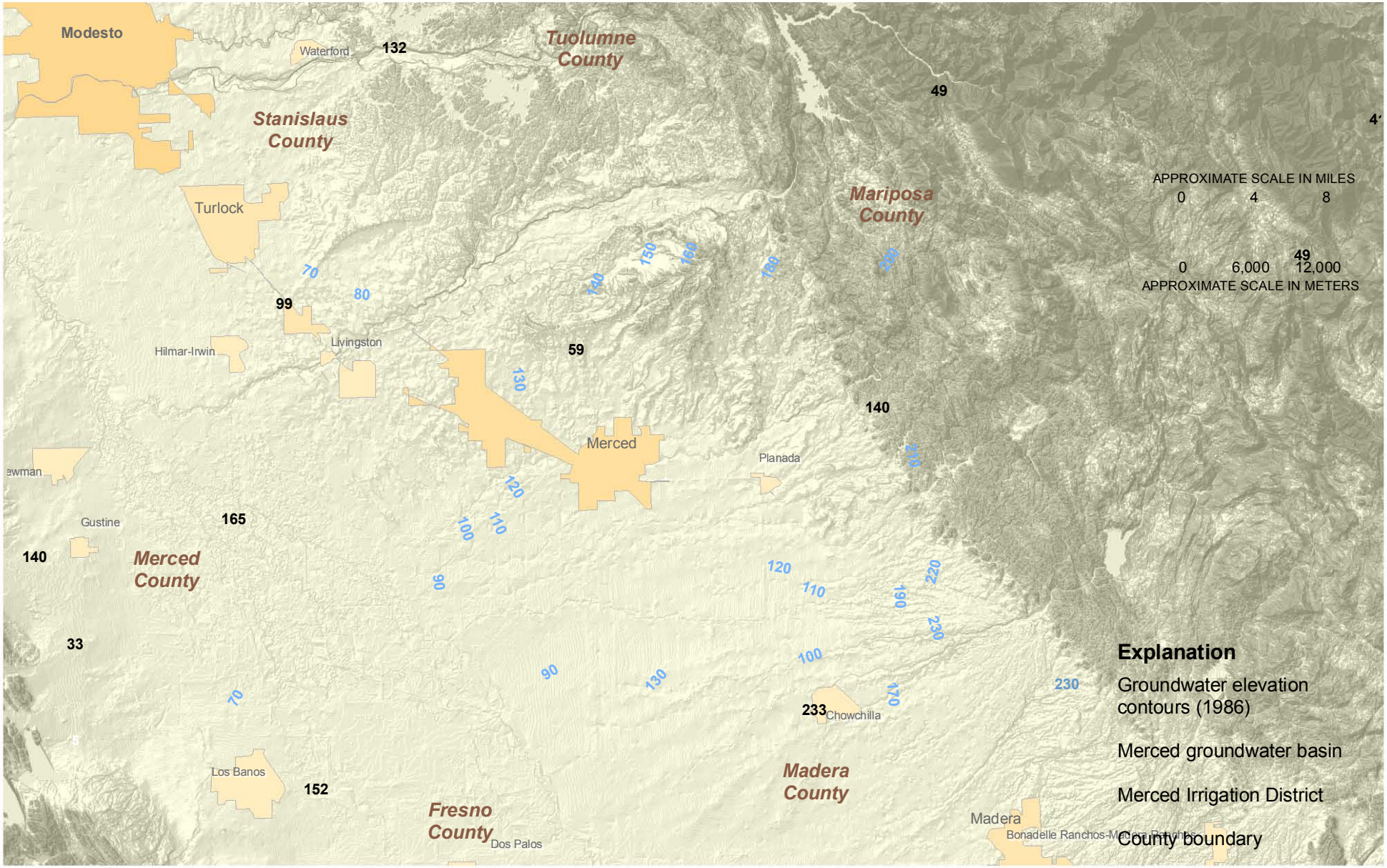
Figure **D-5**



SIMPLIFIED 1985 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

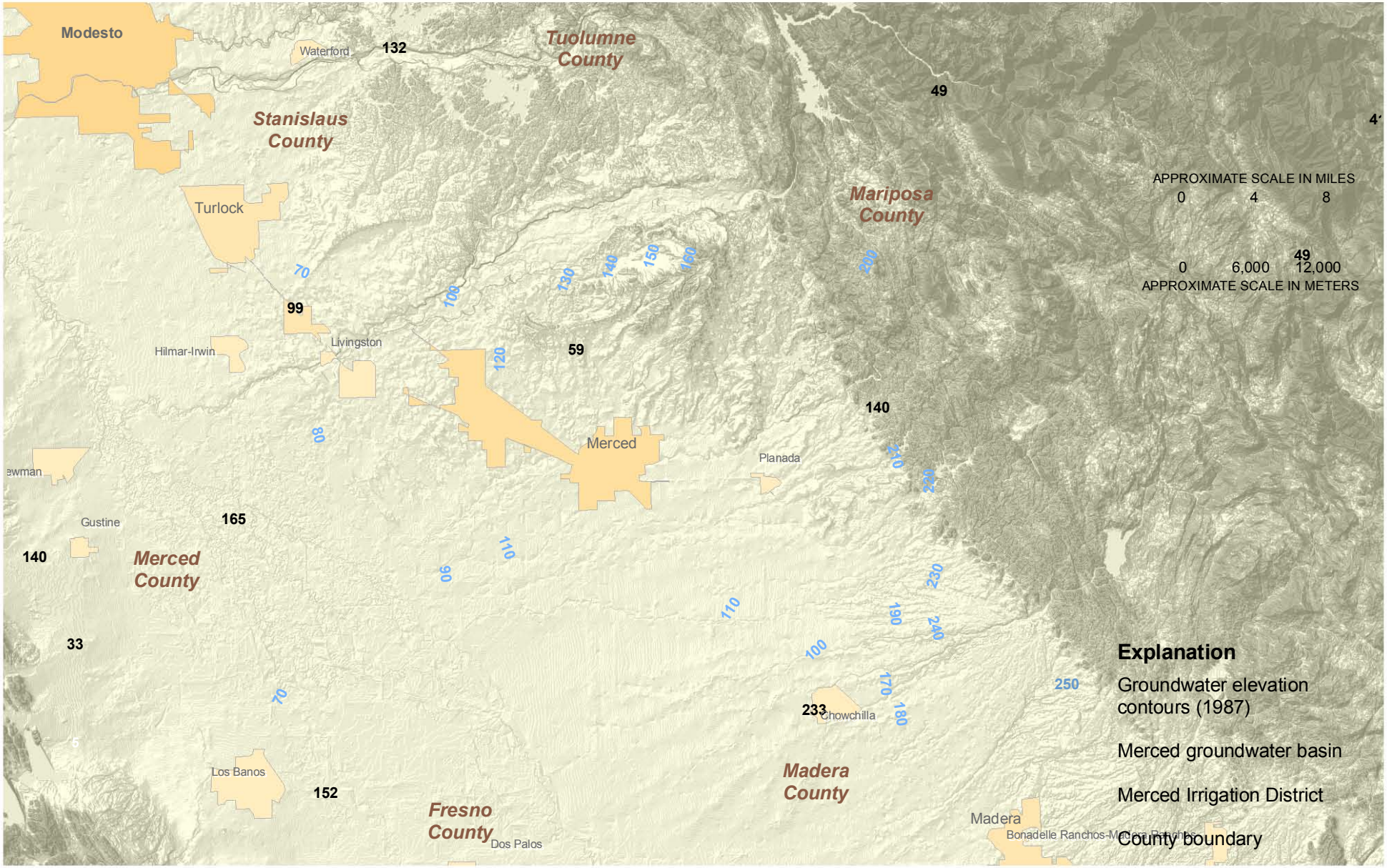
Figure **D-6**



SIMPLIFIED 1986 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

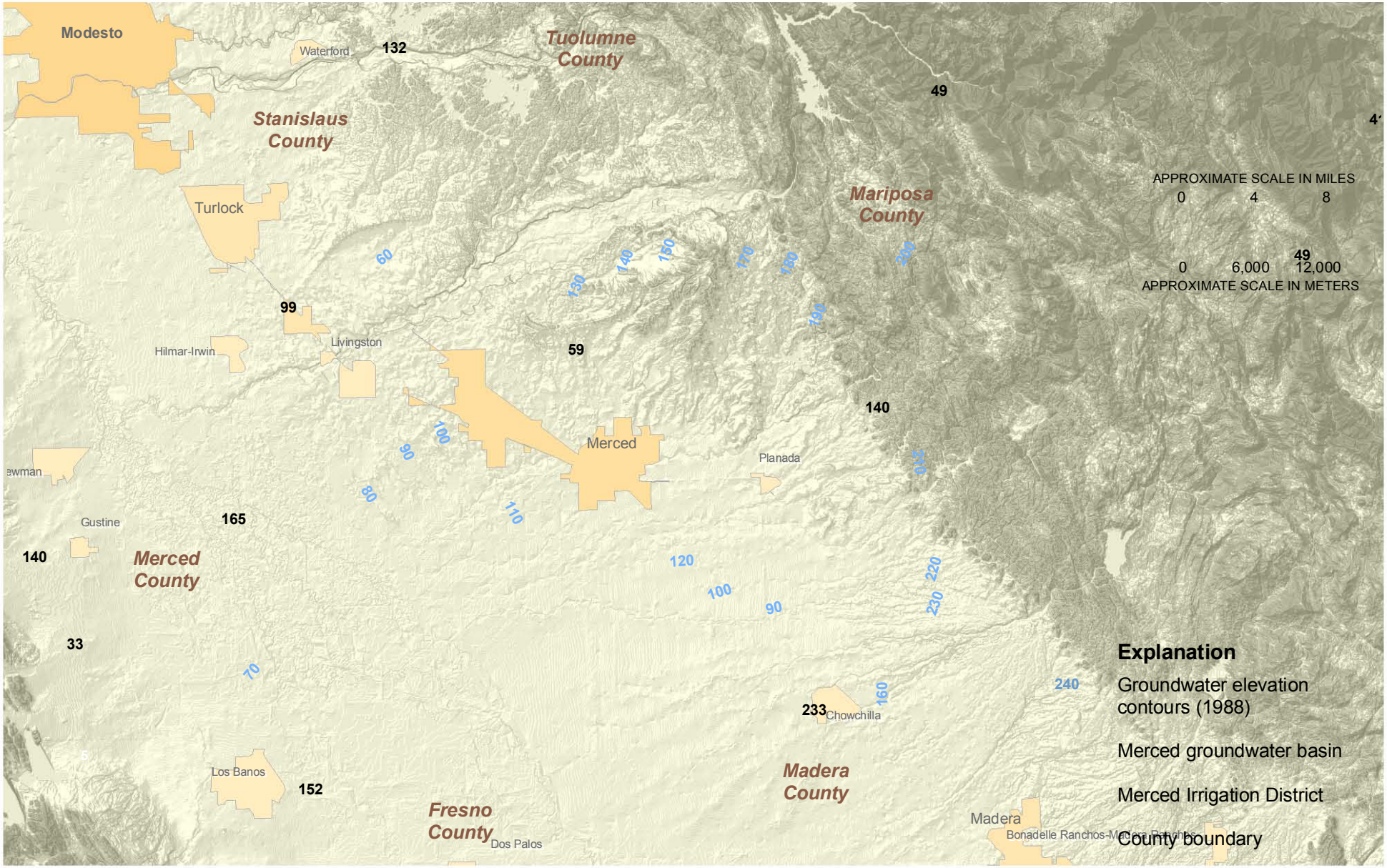
Figure **D-7**



SIMPLIFIED 1987 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

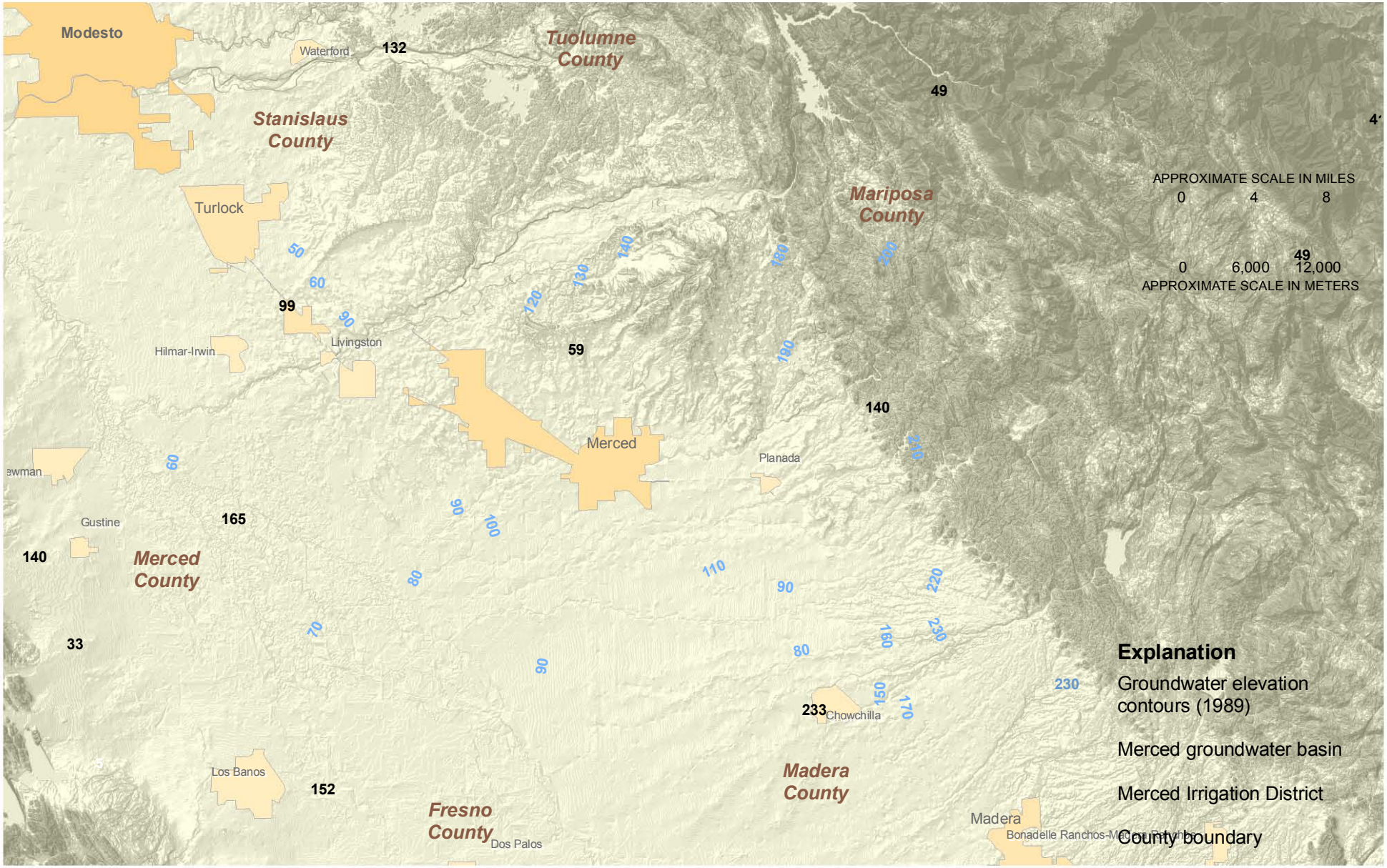
Figure **D-8**



SIMPLIFIED 1988 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

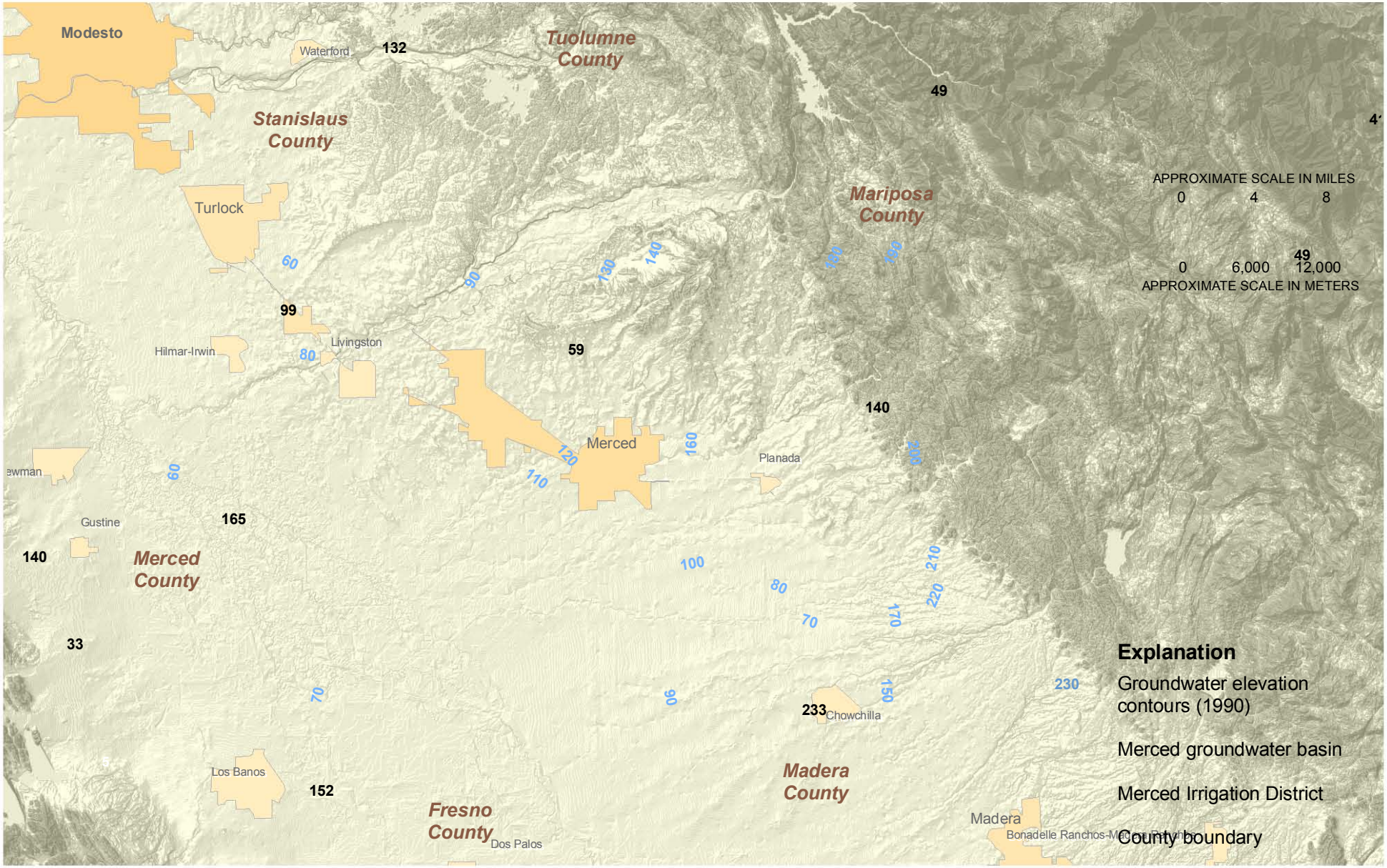
Figure **D-9**



SIMPLIFIED 1989 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

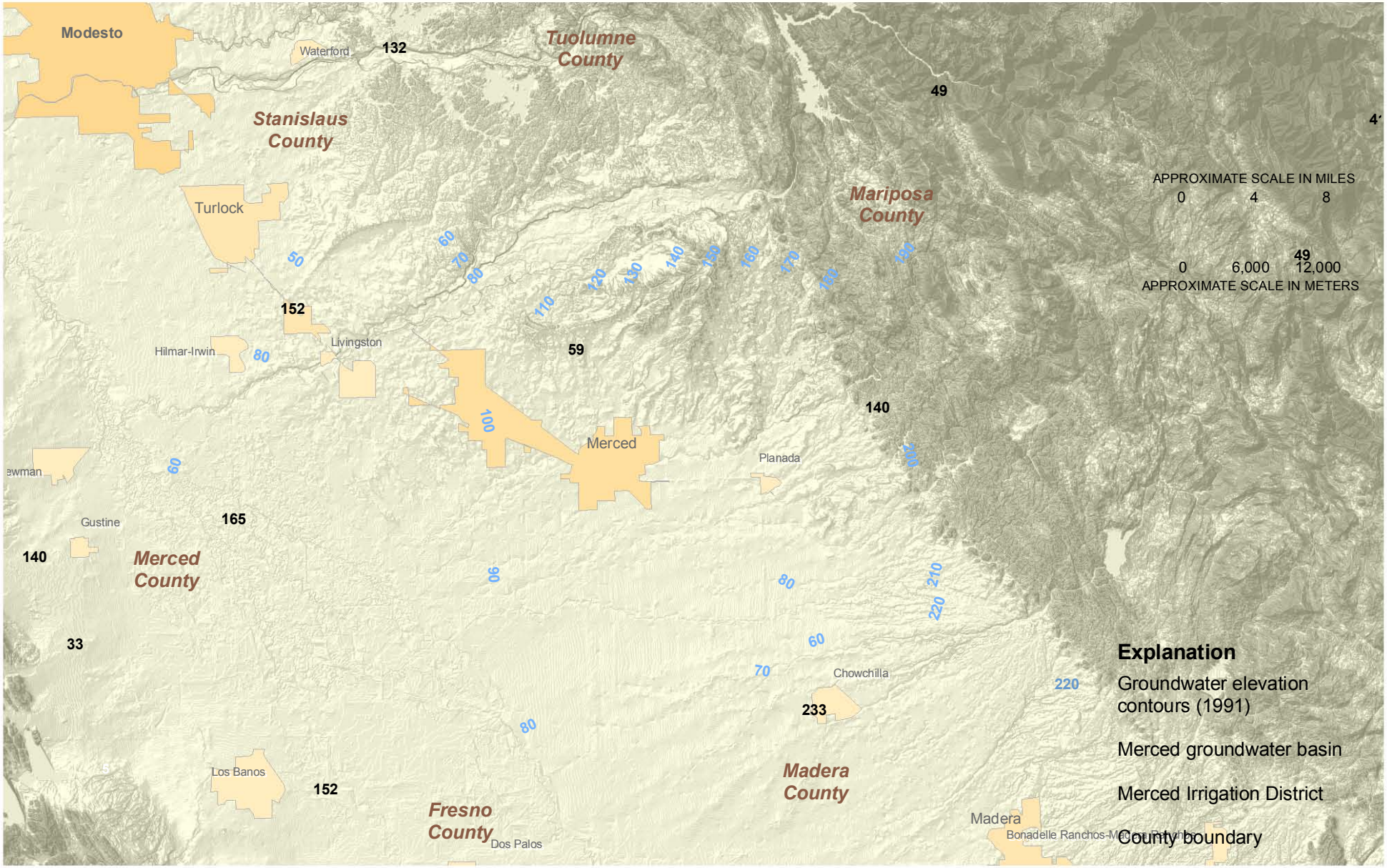
Figure **D-10**



SIMPLIFIED 1990 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

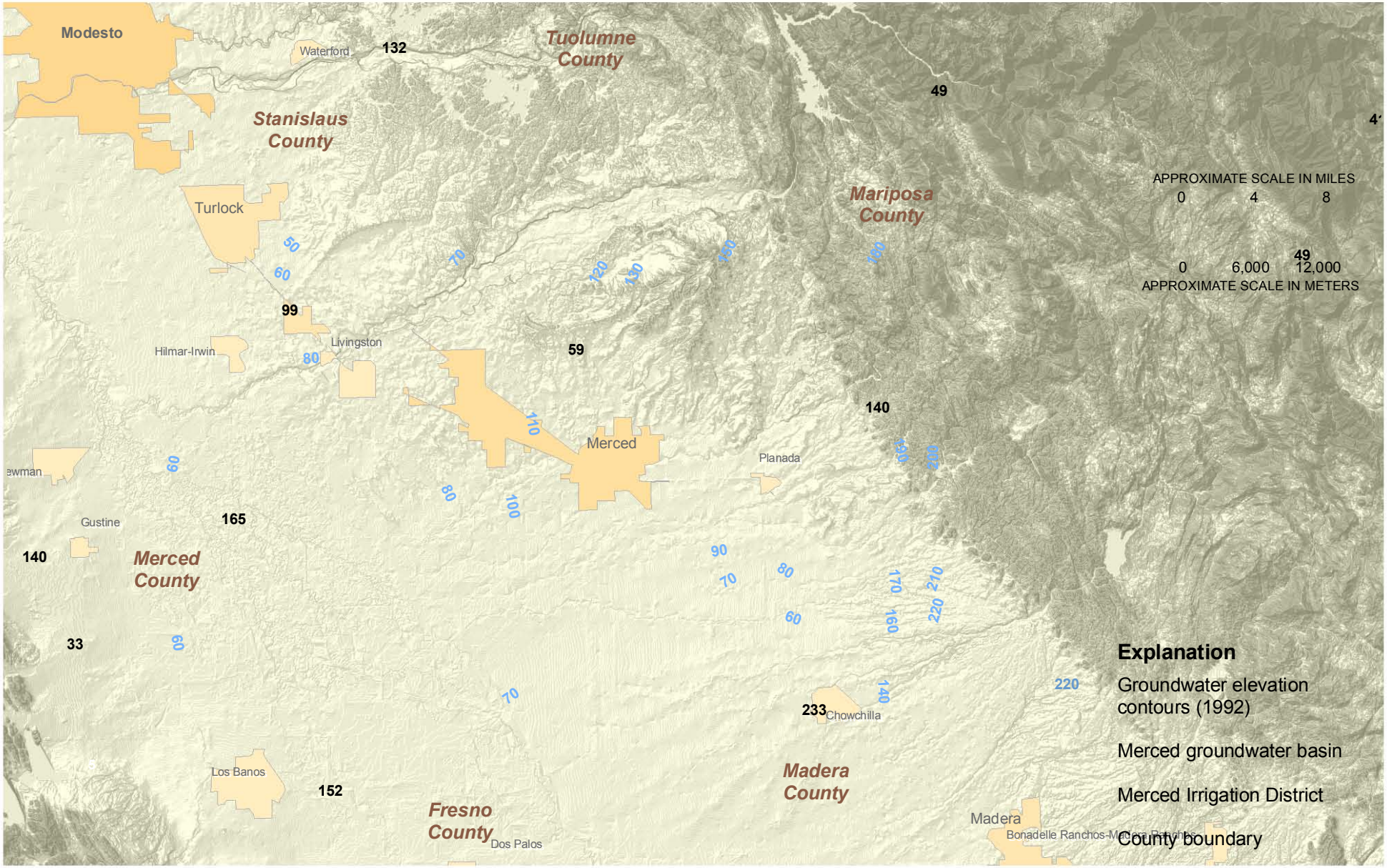
Figure **D-11**



SIMPLIFIED 1991 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

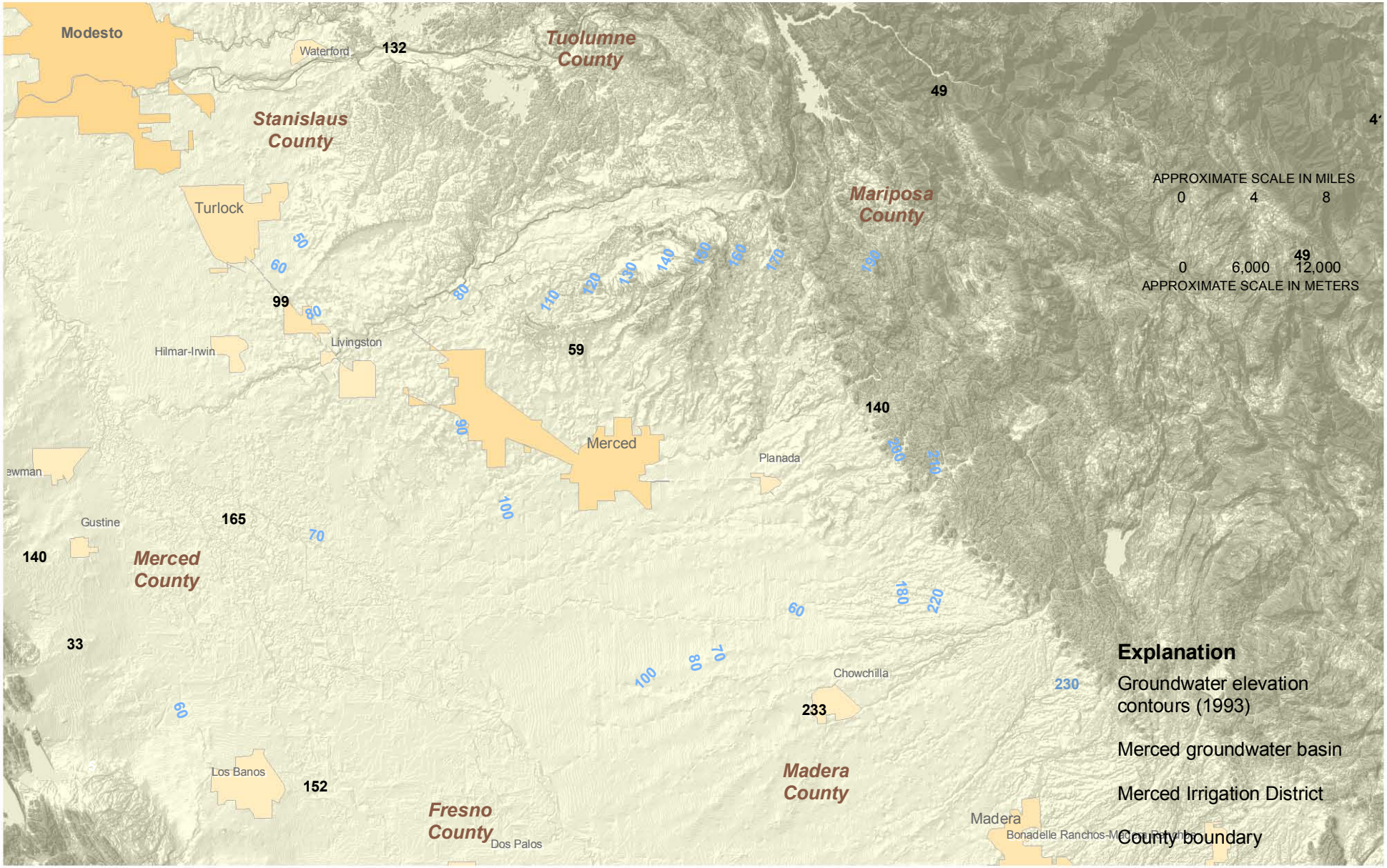
Figure **D-12**



SIMPLIFIED 1992 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

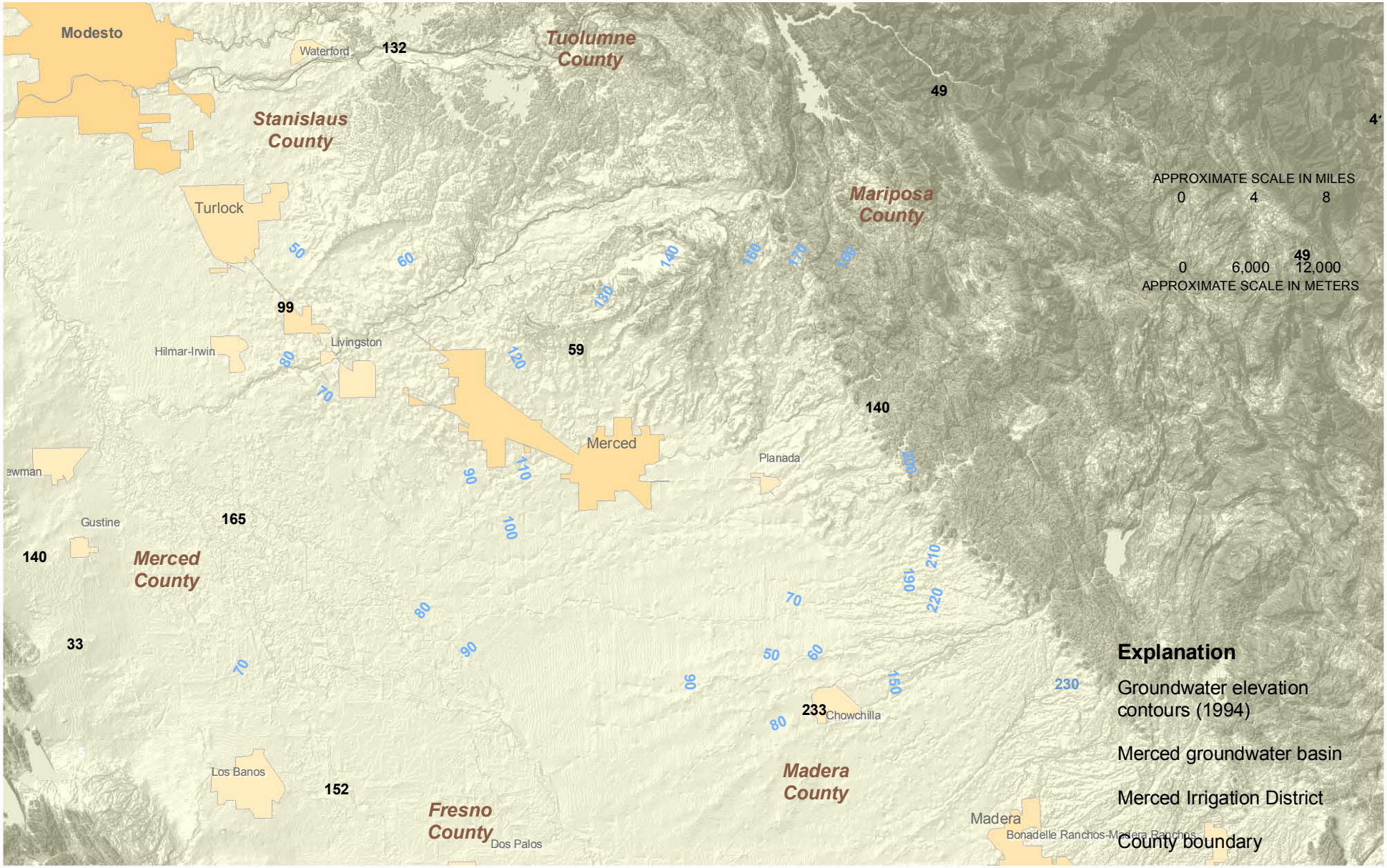
Figure **D-13**



SIMPLIFIED 1993 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

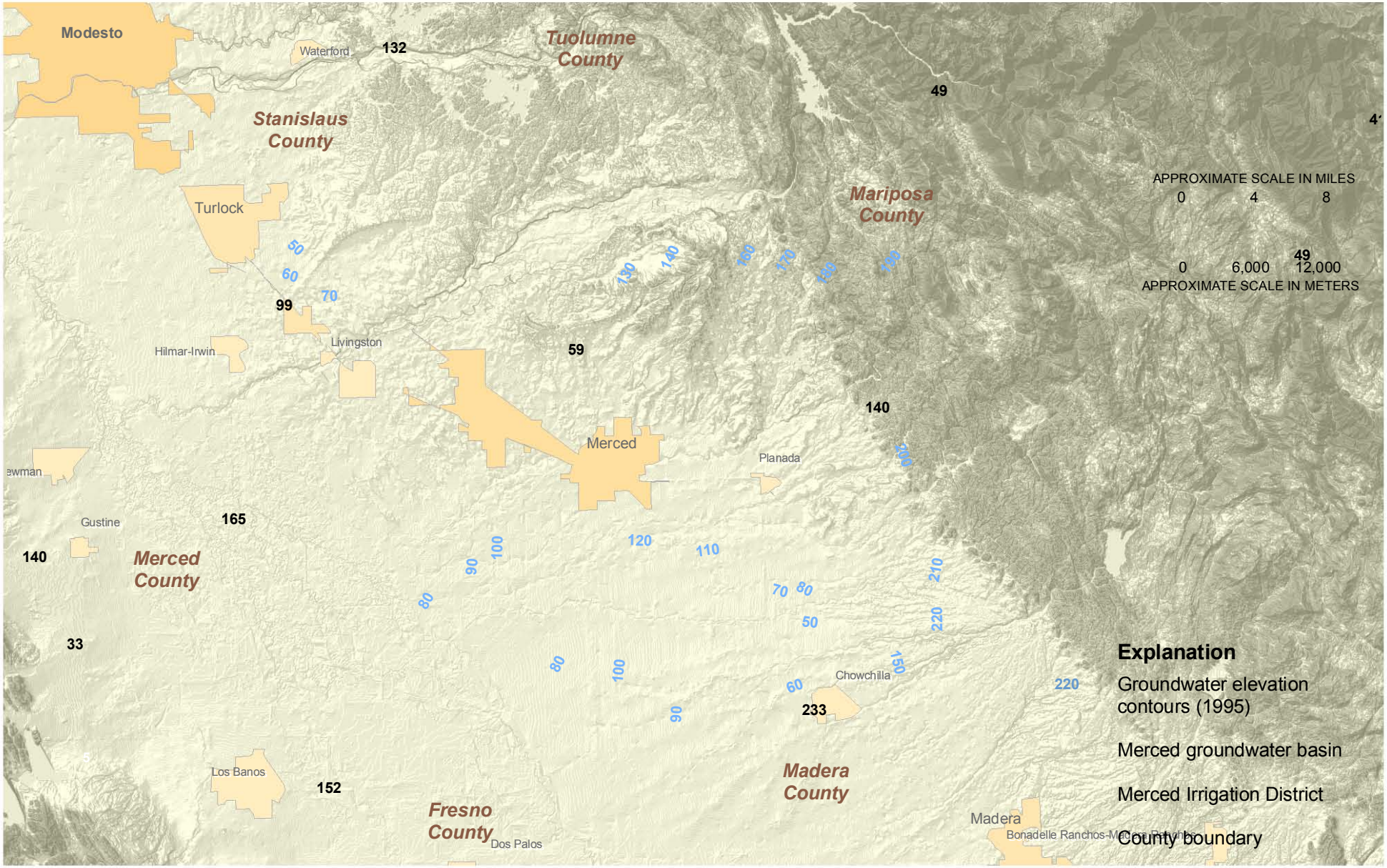
Figure **D-14**



SIMPLIFIED 1994 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

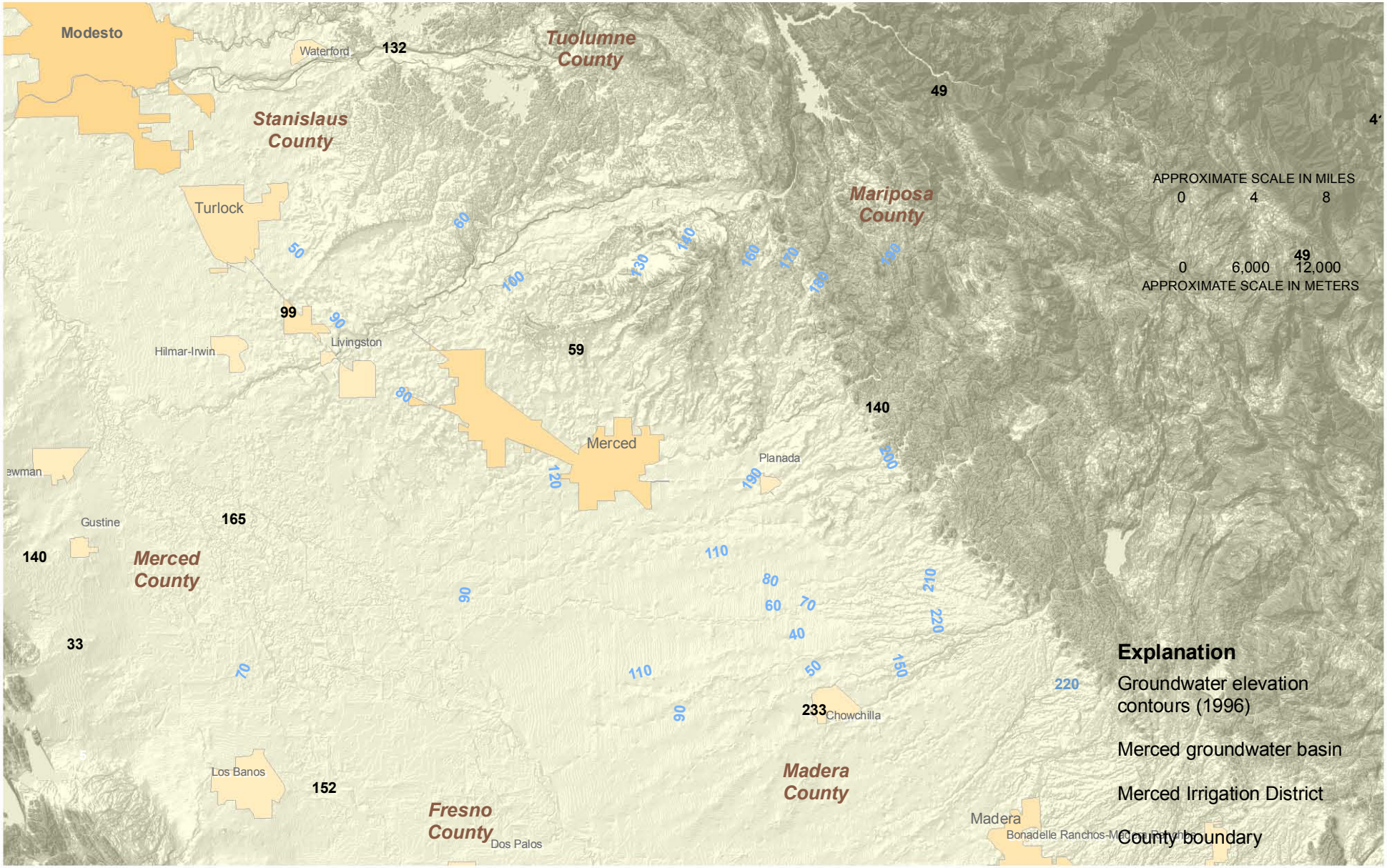
Figure **D-15**



SIMPLIFIED 1995 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

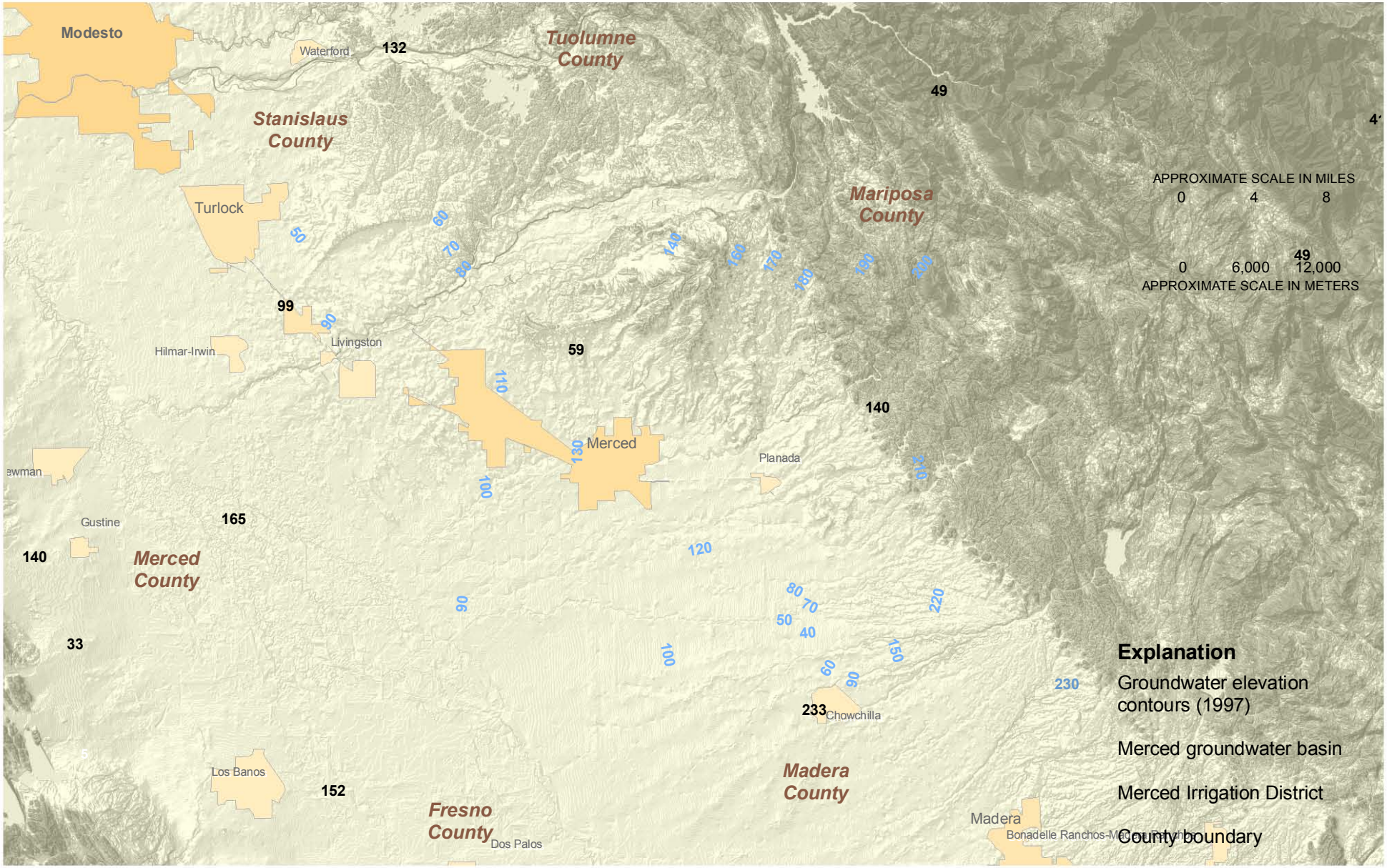
Figure **D-16**



SIMPLIFIED 1996 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

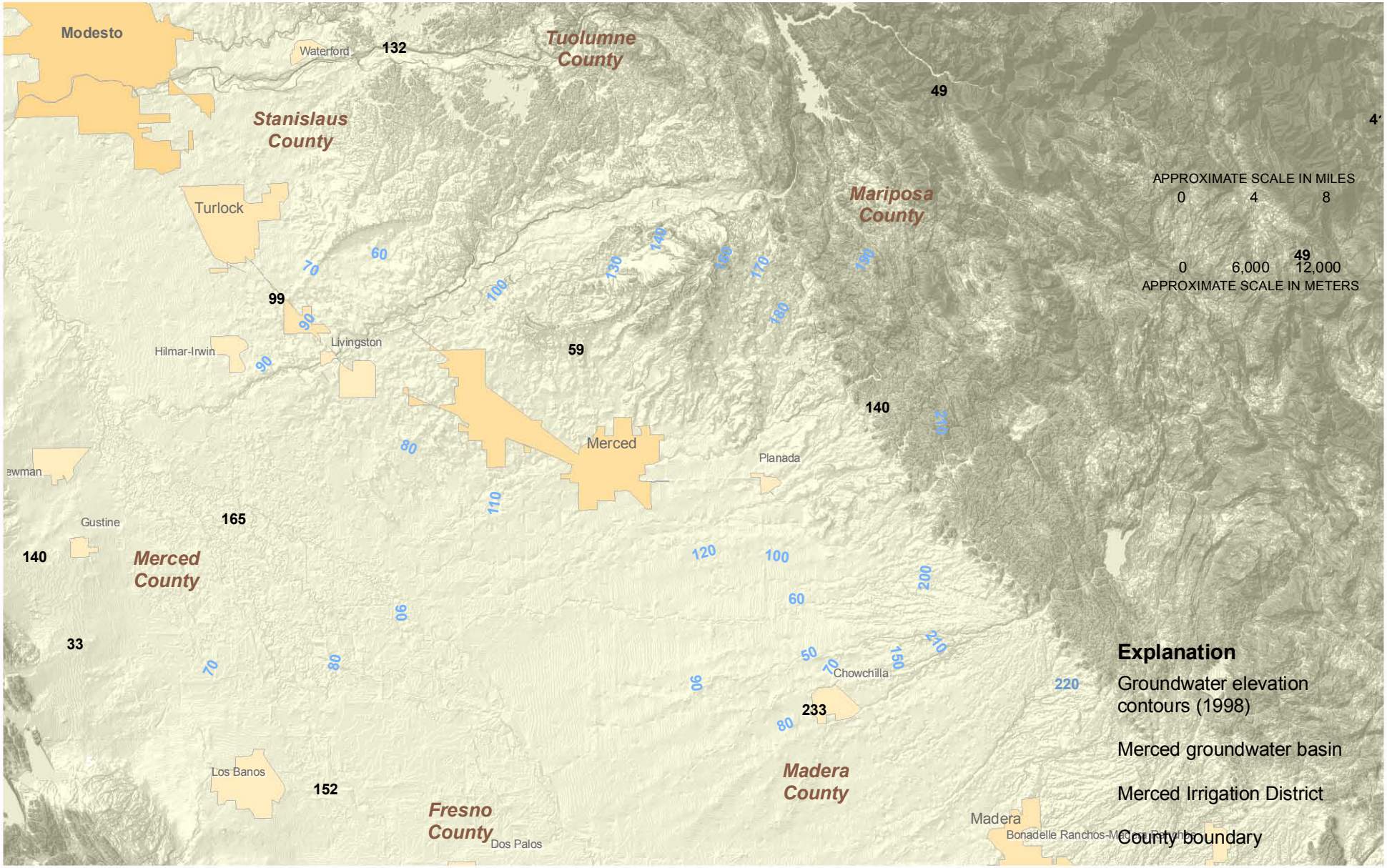
Figure **D-17**



SIMPLIFIED 1997 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

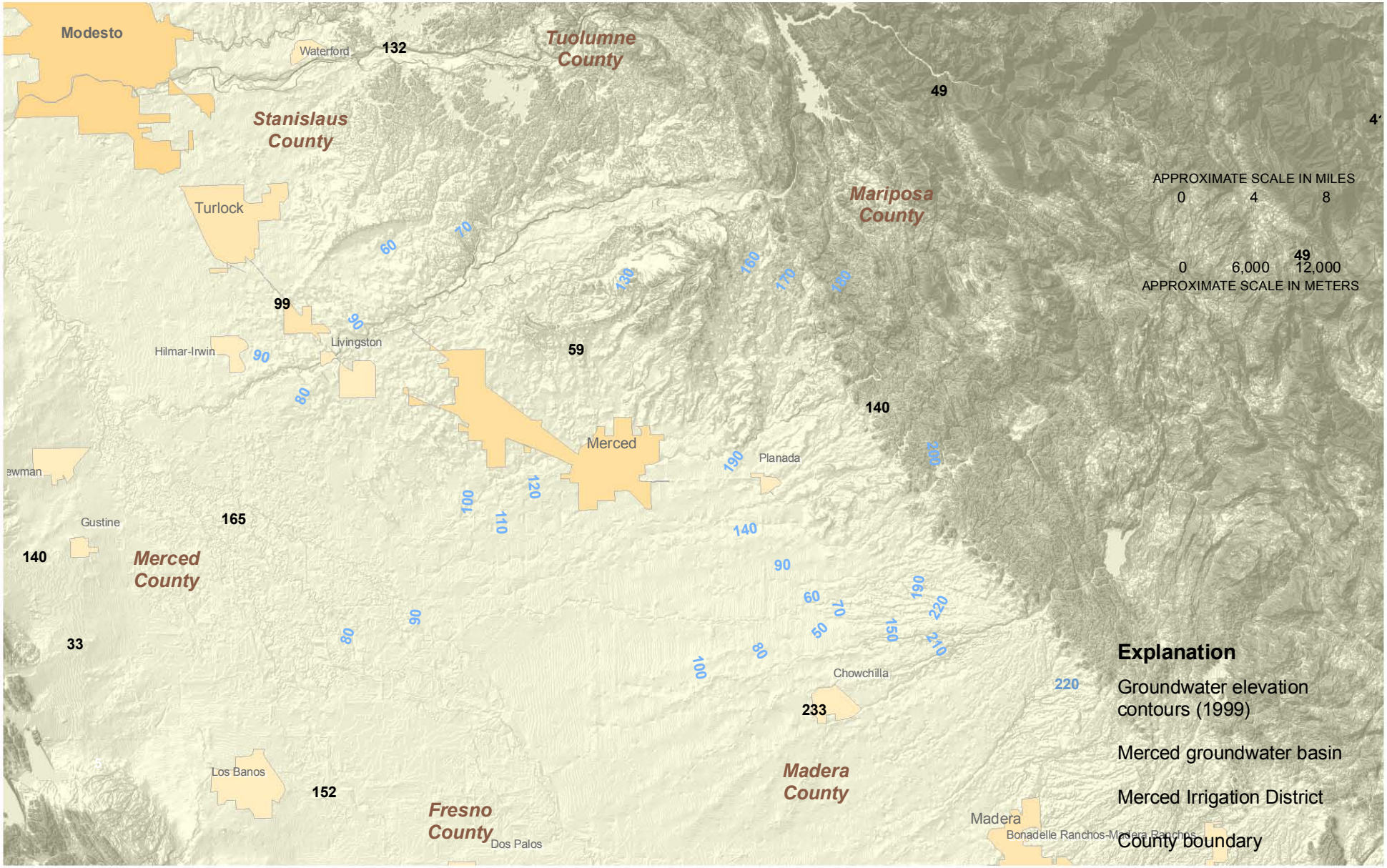
Figure **D-18**



SIMPLIFIED 1998 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

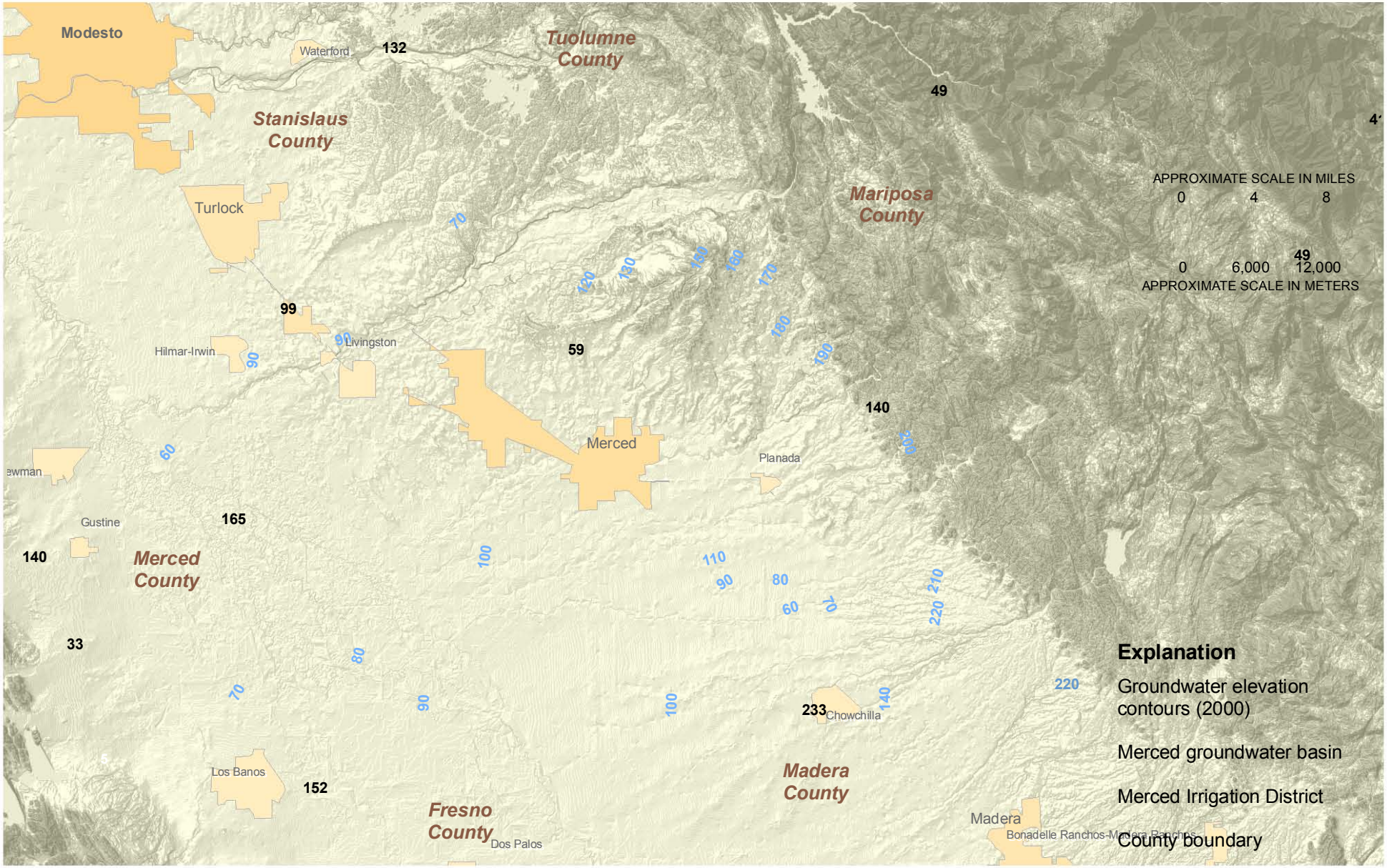
Figure **D-19**



SIMPLIFIED 1999 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

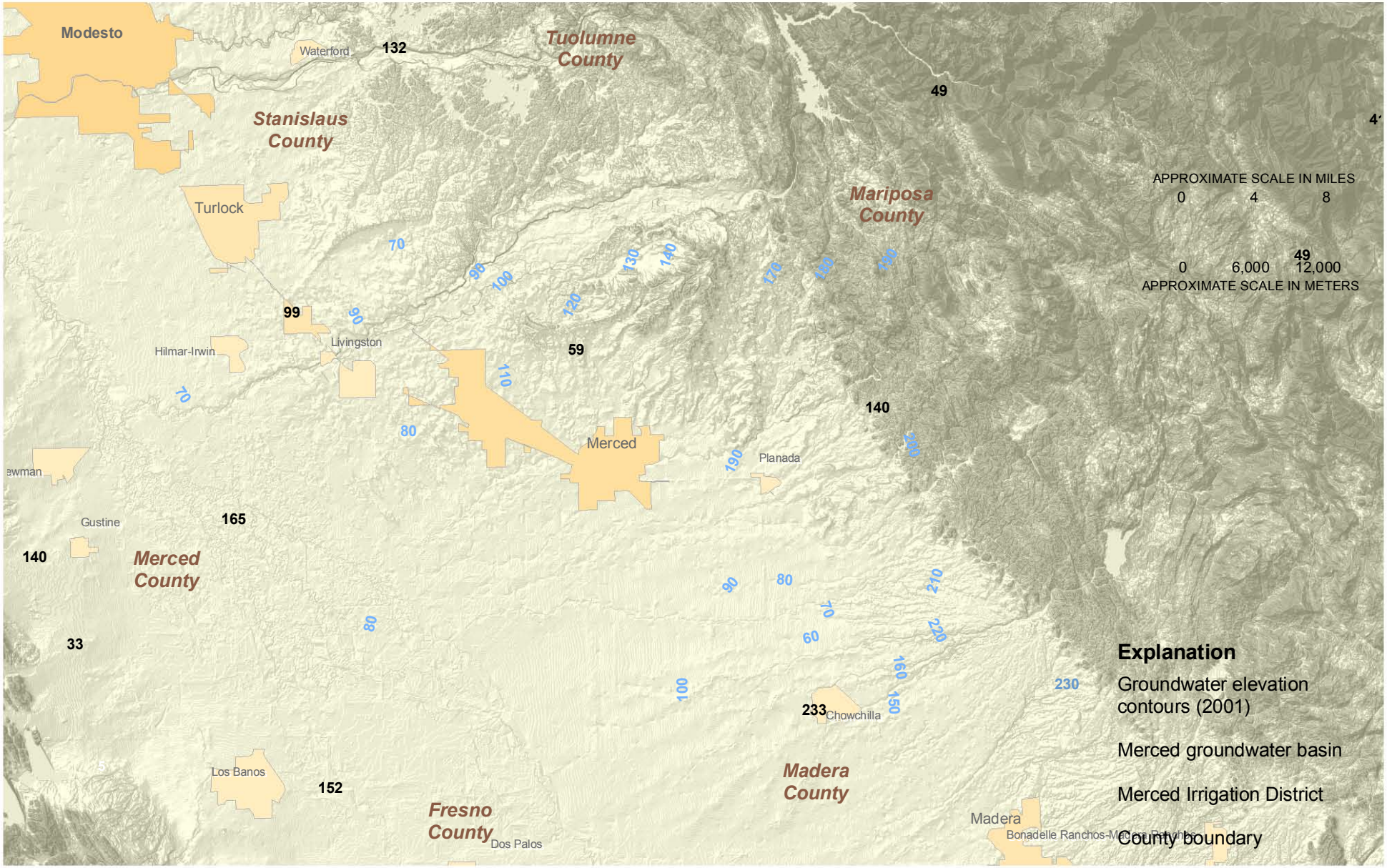
Figure **D-20**



SIMPLIFIED 2000 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

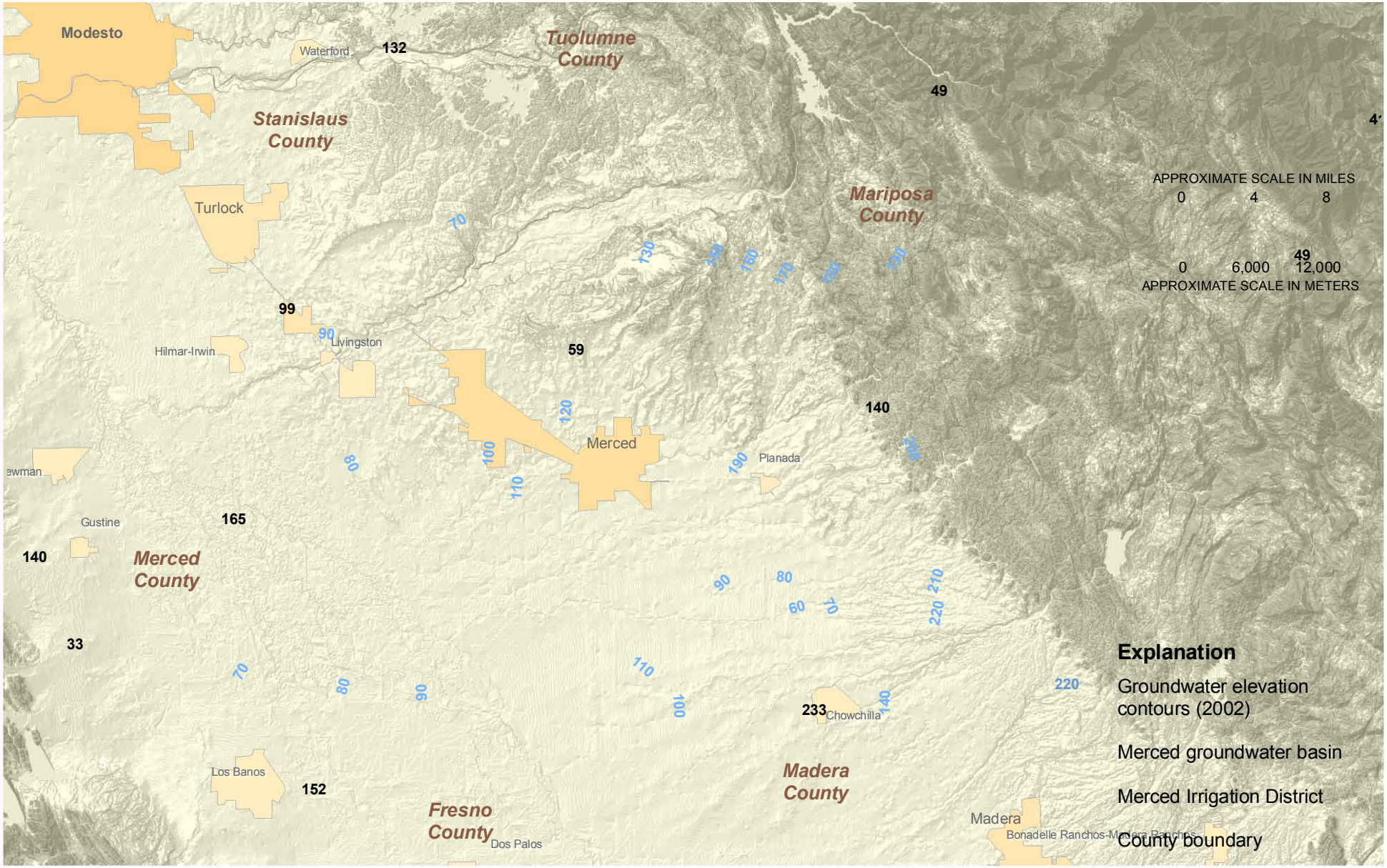
Figure **D-21**



SIMPLIFIED 2001 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

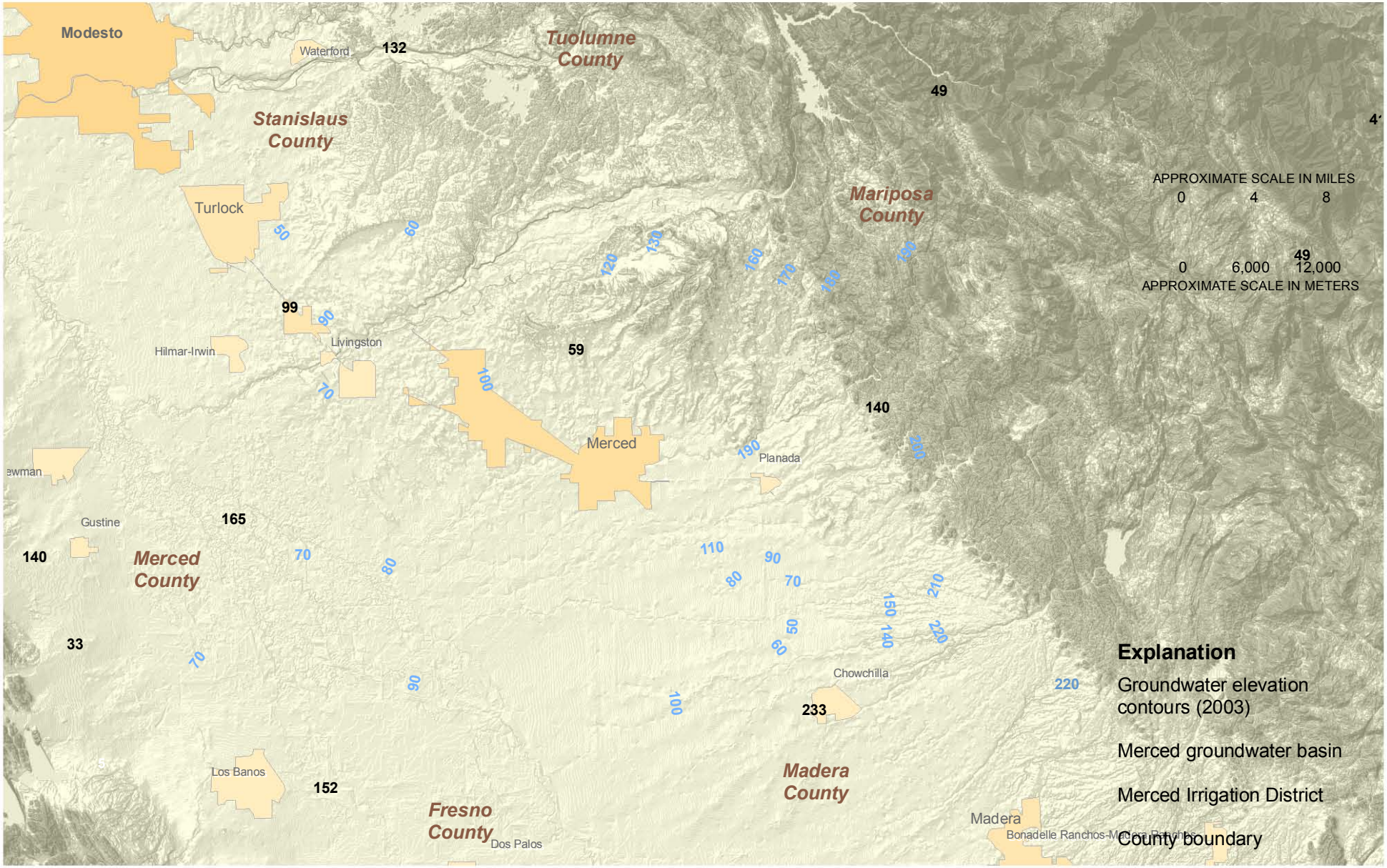
Figure **D-22**



SIMPLIFIED 2002 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

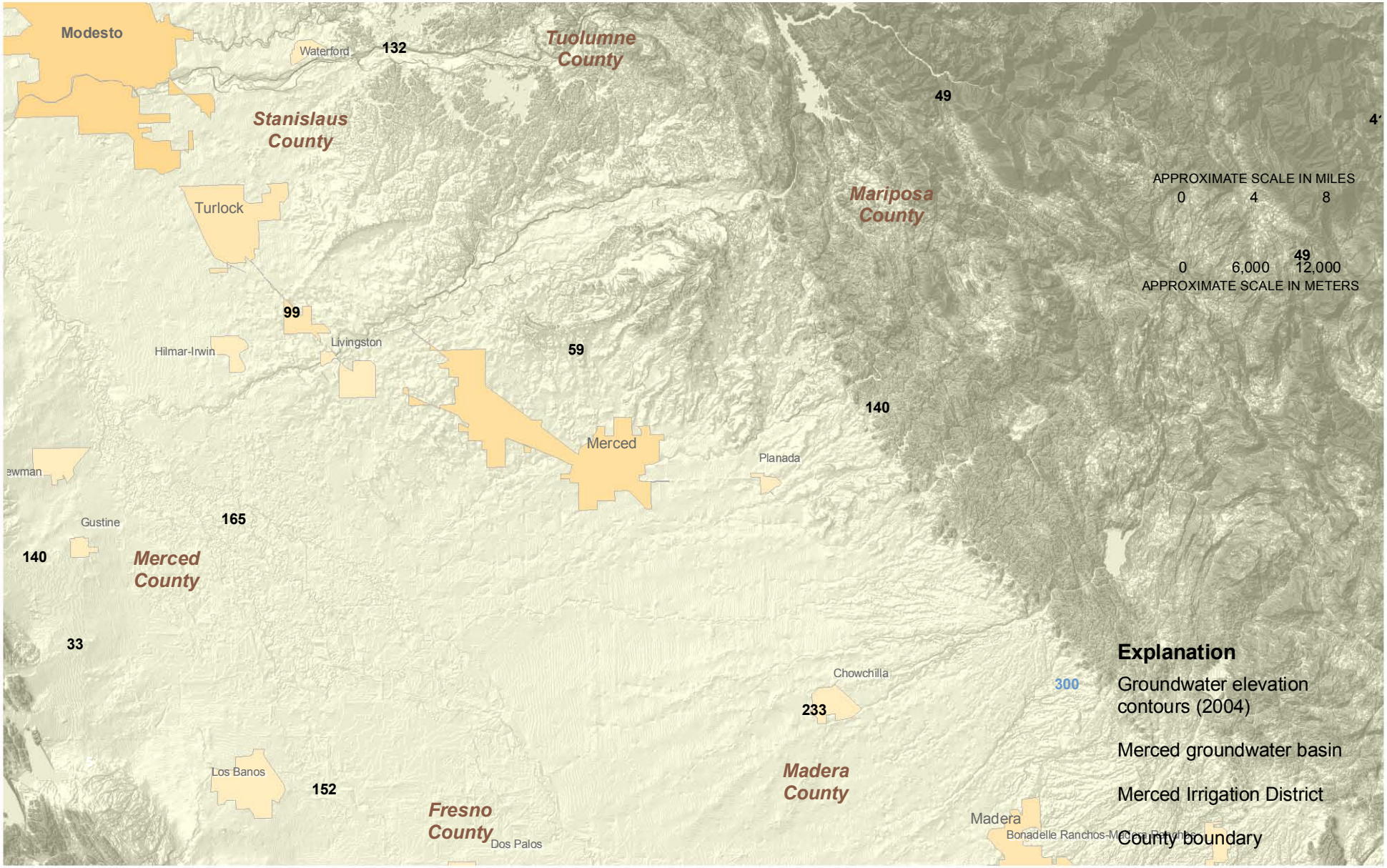
Figure **D-23**



SIMPLIFIED 2003 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

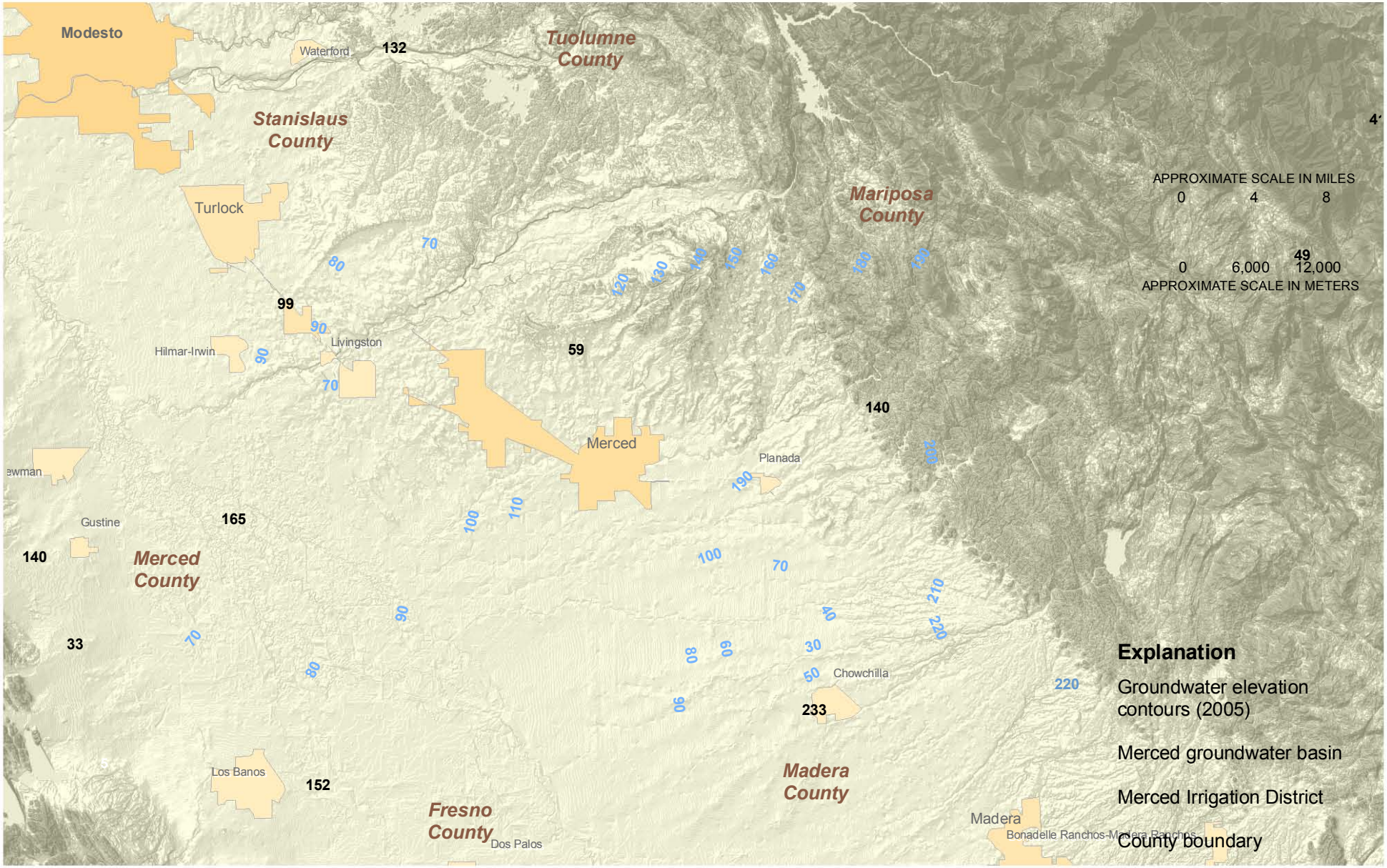
Figure **D-24**



SIMPLIFIED 2004 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

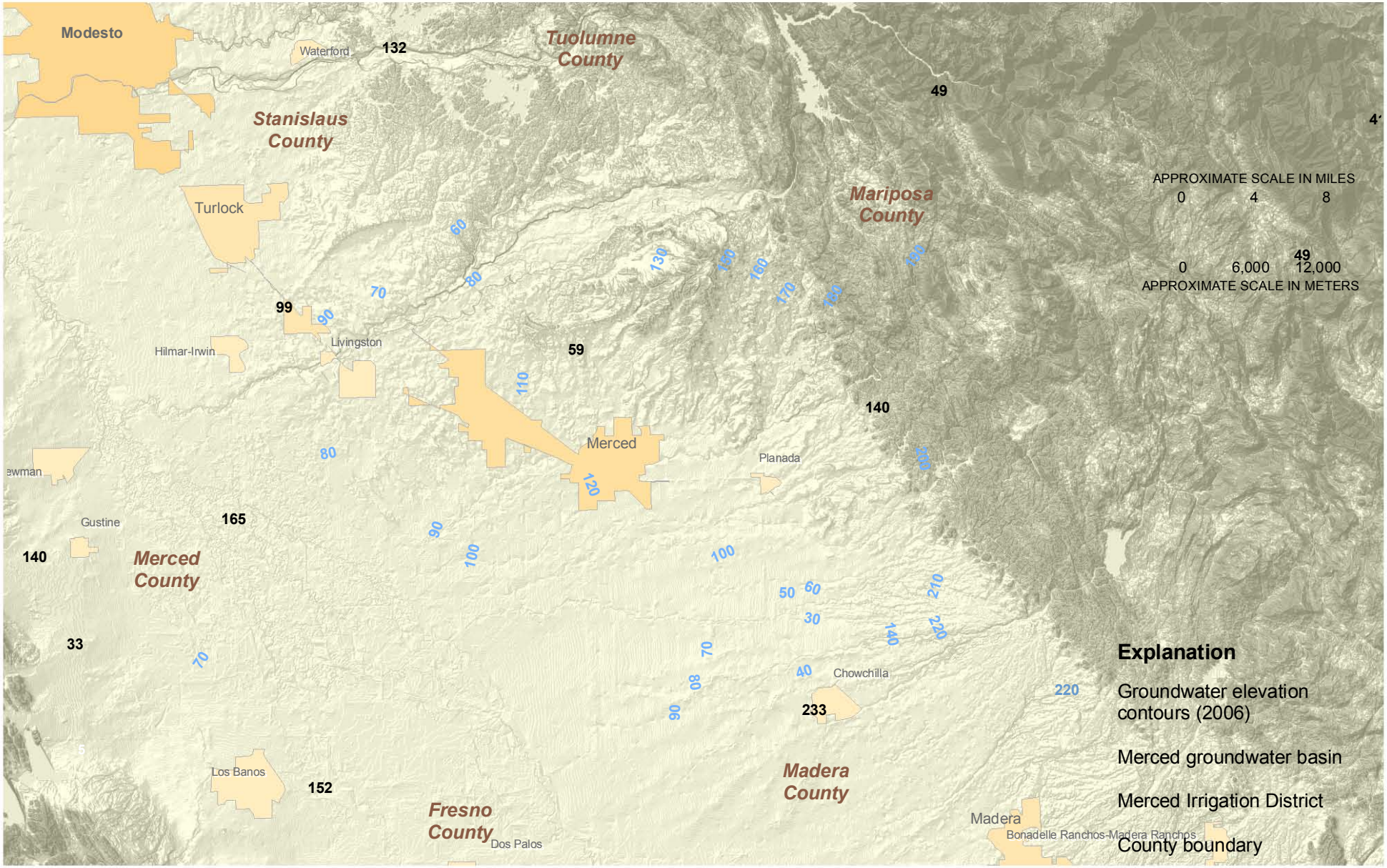
Figure **D-25**



SIMPLIFIED 2005 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

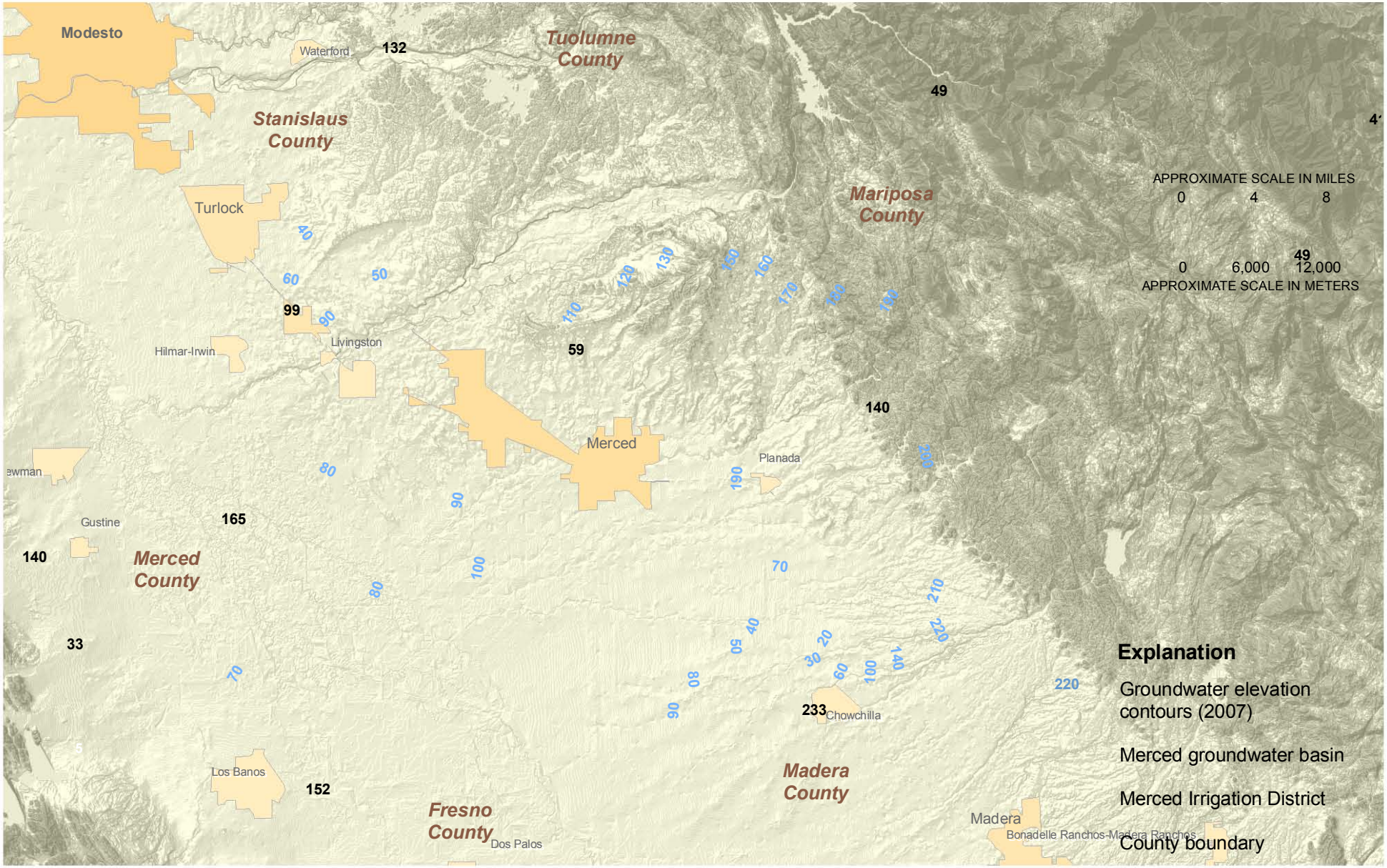
Figure **D-26**



SIMPLIFIED 2006 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure **D-27**



SIMPLIFIED 2007 POTENTIOMETRIC SURFACE MAP OF THE UNCONFINED AQUIFER
Groundwater Management Plan Update
Merced, California

By: KLU Date: June 2008 Project No. 13651.000

Figure **D-28**

Chapter 9.28 WELLS

9.28.010 Declaration and purpose.

A. The board of supervisors of Merced County finds that the majority of water used in the county is obtained from underground sources and that such waters are subject to impairment in quality and purity, causing detriment to the health, safety, and welfare of the people of the county. The board of supervisors therefore declares that the people of the county have a primary interest in the location, construction, maintenance, abandonment, and destruction of water wells, monitoring wells, and cathodic protection wells.

B. The board of supervisors finds and declares the following:

1. Improperly constructed, abandoned, and destroyed water, cathodic protection, and monitoring wells can allow contaminated water on the surface and in subsurface strata to flow down the well casing, thereby contaminating the useable groundwater.

2. Contamination of groundwater poses serious public health and economic problems in many areas of the county.

3. The Health Officer is responsible for regulating all aspects of well permitting, construction, inspection, and standard enforcement in all areas of Merced County subject to ordinance adoption by Resolution by incorporated cities, based on the following:

a. The health implications of contaminated groundwater and the inherent responsibilities of the County Health Officer to address health matters in incorporated areas not served by their own health authority.

b. Groundwater cannot be contained within incorporated or unincorporated boundaries. Varying standards and enforcement of standards within individual incorporated areas impact the quality of groundwater in the county as a whole.

c. Regulation and monitoring of hazardous material storage in underground tanks within Merced County is the responsibility of the County Health Officer. Construction of monitoring and recovery wells is required under this program. It is important that the regulatory agency and the involved private parties not be encumbered by duplication of effort or conflict in regulations.

d. Under Title 17 of the California Administrative Code, the health agency has the overall responsibility for preventing water from unapproved sources from entering potable water systems. (Ord. 1271, 1988; Ord. 1128, 1983; Ord. 752, 1975).

9.28.020 Definitions.

A. "Abandoned well" means a well whose use has been permanently discontinued or which is in such a state of disrepair that no water can be produced.

B. "Abatement order" means both mandatory and prohibitory orders requiring or prohibiting the construction, reconstruction, repair or destruction of a well so as to eliminate a nuisance or potential hazard of a well polluting or contaminating the groundwater resource.

C. "Agricultural well" means a water well used exclusively to supply water for irrigation, livestock or other agricultural purposes, not for domestic use.

D. "Air conditioning well" means a well constructed for the purpose of returning air conditioning coolant water to the ground.

E. "Annular seal" means a watertight seal of cement grout or other approved material placed between the well casing and the side wall of the excavation.

F. "Cathodic protection well" means "any artificial excavation constructed by any method for the purpose of installing equipment or facilities for the protection electrically of metallic equipment in contact with the ground, commonly referred to as cathodic protection."

G. "Contamination" means an impairment of the quality of water to a degree which creates a hazard to the public health through poisoning or the spread of disease.

H. "Dairy well" means a water well used to supply water for a dairy farm where milk is produced. The water may also be used for domestic purposes.

I. "Domestic well" means a water well furnishing potable water for human consumption with four (4) or less service connections and serving less than twenty-five (25) individuals.

J. "Dry/Drainage Well" means a well constructed for the purpose of disposing of waste water, hazardous material, or drainage water.

K. "Health officer" means the Health Officer of Merced County or an authorized representative of the Health Officer.

L. "Industrial Well" means a water well used to supply water for an industrial plant or operation or agricultural processing plant. The water may also be used for domestic purposes.

M. "Monitoring Well" means an artificial excavation by any method for the purpose of monitoring the fluctuations in groundwater levels, the quality of underground waters, the presence or concentration of contaminants in subsurface soil and water, and for the purpose of vapor monitoring.

N. "Out-of-service well" means a water well not presently in service for which the owner has declared his intention for future use. An out-of-service well will be considered abandoned if after one (1) year from the date it is taken out of service it has not been placed in service.

O. "Person" means any individual, firm, corporation, or governmental agency subject to the jurisdiction of the county of Merced.

P. "Pollution" means an alteration of the quality of water to a degree which unreasonably affects (1) such waters for beneficial uses; or (2) facilities which serve such beneficial uses. Pollution may include contamination.

Q. "Public well" means a water well furnishing potable water for human consumption which has five (5) or more service connections or regularly serves an average of at least twenty-five (25) individuals daily at least sixty (60) days out of the year.

R. "Quality of water" refers to chemical, physical, biological, bacteriological, radiological, and other properties and characteristics of water which affect its use.

S. "Recharge/injection well" means a well constructed to introduce water into the ground as a means of replenishing groundwater basins, repelling the intrusion of sea water, or to introduce water, nutrients and/or microbes for the purpose of subsurface contamination treatment.

T. "Sanitary seal" means a grout, mastic or mechanical device to make a watertight joint between the pump and casing or between the pump base and the concrete platform.

U. "Soil boring" means an artificial excavation by any method for the purpose of obtaining lithology or for the purpose of determining the presence or extent of contamination in subsurface soils.

V. "Surface seal" means a monolithically poured concrete platform constructed around the top of the well casing on thoroughly compacted earth.

W. "Test well" means a well constructed for the specific purpose of determining geologic and hydrologic data prior to the construction of a well.

X. "Well or water well" as defined in § 13710 of the Water Code, well or water well means "any artificial excavation constructed by any method for the purpose

of extracting water from, or injecting water into, the underground. This definition shall not include: (a) oil and gas wells, or geothermal wells constructed under the jurisdiction of the Department of Conservation, except those wells converted to use as water wells; or (b) wells used for the purpose of (1) dewatering excavation during construction, (2) stabilizing hillsides or earth embankments, or (3) monitoring wells."

Y. "Well construction" means creation of an artificial excavation by any method for the purpose of obtaining water, providing cathodic protection, or monitoring subsurface water, soil, or vapors. Construction shall include excavation, placement of the annular, surface, and sanitary seals and installation of the sample faucet, as appropriate.

Z. "Well pit" means an installation in which the top of the well casing terminates below the ground surface. (Ord. 1271, 1988; Ord. 1128, 1983; Ord. 752, 1975).

9.28.030 Permit—Requirement.

A. The well contractor shall apply for and obtain a permit from the Health Officer prior to commencing construction, reconstruction, deepening, abandonment, or destruction of any well or soil boring within the unincorporated areas of Merced County and incorporated areas where authorized. The application for a permit shall be in the form prescribed by the Health Officer and contain such information as the Health Officer may require. Every permit issued shall be contingent upon compliance with the requirements specified in this chapter and on the permit. For the purpose of this section the term "well" shall include cathodic protection wells, monitoring wells, and soil borings.

B. When one or more wells are existing on a parcel, an application for permit to construct a water well on the same parcel must be accompanied by a "Letter of Intent" for each well, signed by the property owner which elects one of the following options concerning the future of the existing well(s):

1. Immediate destruction at the time the new well is placed in service (required under the conditions in § 9.28.110); or

2. Continued use coinciding with the use of the new well; or

3. Taking the well out of service and maintaining it in accordance with the provisions of this chapter for a period of one year. At the end of one year the well will be restored to service or be destroyed in accordance with this chapter. A permit and inspection are required when an out-of-service well is placed into service.

C. When the well contractor makes an application for a permit said contractor shall have on file or file a copy of a valid C-57 license and a certificate of insurance which states that there is in existence a valid policy of workments compensation insurance in a form approved by the Insurance Commissioner. Said certificate shall show the following:

1. The expiration date;

2. Coverage is provided for construction permits in accordance with Labor Code § 3800;

3. The insurer shall give the county at least ten (10) days' notice of the cancellation of the policy. No permit shall be issued without the above insurance information.

D. It shall be the responsibility of the well contractor to post the permit at the work site prior to commencement of work for which the permit is required. Any drilling contractor who fails to comply with this requirement and commences work for which a permit is required but has not been secured, and without twenty-four (24) hours notification prior to commencing work (as reflected in § 9.28.080 herein), shall be in violation of this chapter.

E. A permit shall be required for the construction of a test well. If subsequent test wells are constructed at the same location within a period of thirty (30) days, separate fees will not be charged for each permit, unless more than one completed water well is constructed. All abandoned test wells shall be destroyed in accordance with the methods prescribed in § 9.28.060 of this chapter.

F. An application for a well permit may be submitted to the Merced County Department of Health by mail, but construction of the proposed well shall not be commenced until the permit application has been approved by the Health Officer and the contractor is in receipt of the approved permit.

G. An application for a water well permit shall be accompanied by a nonrefundable permit fee (when a fee is required).

H. A permit issued under this chapter shall be valid for a period of six (6) months from the date of issuance. Completion of the permitted work in accordance to this ordinance shall be within twelve (12) months from the date of issuance of the permit.

I. Any person operating a public water system shall obtain a permit to operate from the Health Officer.

J. The construction of a water well within the service area of a public water system where water is available is prohibited. Exemptions may be granted for

industries which require water in quantities greater than that which can be provided by the public water system or when it can be shown by the business that connection to the public water system would cause undue financial hardship. (Ord. 1271, 1988; Ord. 1197, 1985; Ord. 1128, 1983; Ord. 752, 1975).

9.28.035 Permit—Fees.

Fees will be established by the board of supervisors of Merced County pursuant to resolution. When the State Department of Health Services issues an amended permit to a public water system constructing a well, the permit and fee will be waived. (Ord. 1271, 1988; Ord. 1128, 1983; Ord. 752, 1975).

9.28.040 Permit—Emergency exemption.

Should persons or property be threatened by a sudden, unforeseen impairment in the quantity or quality of water available, so that it becomes necessary to obtain a new water supply or increase the existing supply and a permit cannot be obtained because county offices are not open, a water well may be constructed, deepened or reconstructed without a permit. All work performed under such emergency conditions shall comply with the requirements of this chapter. In all such cases, the person who performed the work shall, within forty-eight (48) hours after such work is begun, excluding weekends and holidays, obtain a permit and file a statement with the Health Officer indicating the reason for the emergency work. (Ord. 1271, 1988; Ord. 1128, 1983; Ord. 752, 1975).

9.28.050 Permit—Appeals.

A. Any person whose application for a permit or for an approval has been revoked, denied, modified or additional standards imposed may, within thirty (30) days after the date of such denial, or revocation, appeal therefrom in writing, to the board of supervisors. The board shall set a date for hearing said appeal and the applicant and the health officer shall be notified thereof. This section does not authorize appeals to the board from any action of the health officer authorized or required by state law or regulation.

B. At the hearing of an appeal to the board of supervisors, any interested party may present oral or written evidence. Following the hearing, the board shall render a decision upon the appeal and may sustain, modify, or reverse any action of the health officer. The decision of the board shall be final. (Ord. 1271, 1988; Ord. 1128, 1983; Ord. 752, 1975).

9.28.060 Water well standards.

A. Standards adopted. Except as may be otherwise specified in this chapter, the standards for the construction, repair, reconstruction, abandonment, or destruction of wells published in the department of Water Resources Bulletin 74-81, "Water Well Standards," State of California and Bulletin 74-1, "Cathodic Protection Well Standards" or as may be subsequently revised or supplemented, are hereby incorporated in and made an applicable section of this chapter.

B. Prohibited Construction.

1. The construction of dry/drainage wells, recharge/injection wells, and air conditioning wells as defined in this chapter is prohibited. The Health Officer may make exceptions to this prohibition if it can be shown that: (a) the quality of the water being introduced into the well will not have an undesirable impact on the ground-water; and/or (b) the well's construction will not permit the intermixing of aquifers or provide a conduit for the vertical movement of known or potential contaminants.

2. The construction of well pits is prohibited except in dewatering agricultural areas when discharge is into surface irrigation facilities only.

C. Well Construction.

1. Well location. All wells shall be so constructed as to prevent the entrance of surface water and contaminated ground water into the well or into the producing aquifer, and shall be separated a safe distance from potential sources of contamination and pollution. The following minimum horizontal distances shall be maintained for all wells furnishing potable water for human consumption:

	Domestic Well	Public Well
Septic tank or sewer line	30 feet	100 feet
Leach line or disposal field	100 feet	100 feet
Seepage pit or cesspool	150 feet	150 feet
Elevated sewage disposal field	150 feet	150 feet
Areas of intense animal confinement	100 feet	100 feet
Agricultural wells	300 feet*	300 feet*
Unlined canals, surface water course or drainage water retention ponds	100 feet	100 feet

* An exception may be authorized when an existing agricultural well meets or exceeds the sanitary, surface and annular seal requirements specified for the proposed water well.

a. The Health Officer may authorize an exception to these requirements in specific instances.

2. Property line setback. All wells shall be located with a minimum setback of fifteen (15) feet from a property line. The Health Officer may authorize an exception to this requirement where space restrictions on existing small lots necessitate, but in no case shall the minimum setback of the well from the property line be less than five (5) feet.

3. Casing perforations. All wells supplying potable water for human consumption shall be constructed with a fifty (50) foot minimum, continuous, unperforated casing, except in areas where the only potable water is at a depth of less than fifty (50) feet. In such instances, the depth to the first perforations in the well may be reduced to less than fifty (50) feet below ground surface if prior approval is granted by the Health Officer. In no case shall the depth of the annular seal or the depth of the first perforations be reduced to less than twenty (20) feet below ground surface.

a. Corcoran clay. All wells penetrating Corcoran clay shall be constructed in a manner such as to prevent the intermixing of waters above and below the Corcoran clay layer. There shall be no perforations above and below the Corcoran clay layer in the same casing.

4. Gravel packing. In gravel packed wells that furnish potable water for human consumption, the gravel packing shall not extend above fifty (50) feet below ground surface, except in areas where the only potable water is at a depth of less than fifty (50) feet. In such instances, the gravel packing shall not extend more than five (5) feet above the first perforations.

a. Gravel packed wells with a conductor casing shall be exempted from this requirement provided that the annular space between the conductor pipe and the wall of the drilled hole is filled with sealing material fulfilling the specifications and depth requirements of Parts G and H of this section.

5. Well seals. All wells shall have a sanitary seal, surface seal and an annular seal. An access opening in the well cap, well casing, or pump base for the purpose of disinfecting the well or measuring the water level shall be protected with a threaded, watertight plug or cap. Wells requiring air vents shall be installed in an approved manner.

a. Annular seal. On all wells the annular space between the well casing and the wall of the drilled hole shall be effectively sealed with cement grout or other approved sealant material to protect against contamination or pollution by surface or shallow subsurface waters. The annular seal shall begin no more than 20 feet above the most shallow perforation. The following minimum annular seal depths shall be required*:

Type of Well	Depth of Annular Seal Below Ground Surface
Domestic wells	50 feet
Public wells	50 feet
Dairy wells	50 feet
Industrial wells	50 feet
Agricultural wells	50 feet
Cathodic protection wells	20 feet
Observation and monitoring wells	20 feet

(1) Sealing conditions. The following are the requirements to be observed in sealing the annular space: The sealing material shall consist of neat cement grout, sand-cement grout, concrete, or Bentonite clay, and shall conform to the specifications given in the Standards (Bulletin 74-81). Sealing materials and their uses shall be in accordance with manufacturer's recommendations.

(2) Gravel packed wells - The width of the annular seal space between the wall of the drilled hole and the well casing or the conductor casing, where applicable, shall be at least two (2) inches. If gravel fill pipes are installed through the seal, the annular seal shall be of sufficient thickness to assure that there is a minimum of 2 inches between the gravel fill pipe and the wall of the drilled hole. If a temporary conductor casing is used, it shall be removed as the sealing material is placed. The sealing material shall be applied in the annular space in one continuous operation from the bottom.

(3) Cable tool wells - Wells constructed by the cable tool method of drilling are exempt from the annular seal requirements specified in Part 5.a of this section, provided:

(a) A slurry of Bentonite clay is maintained around and in contact with the casing at all times during construction.

(b) The well casing is without perforations.

(c) The casing shoe or collar is landed in an impermeable clay interval.

(d) If a conductor casing is used, the space between the well casing and the conductor casing is effectively sealed with a watertight welded cover or filled with approved sealant material.

b. Surface seal.

(1) A concrete surface seal or slab shall be constructed on the ground surface around the top of the well casing and shall be free from cracks or other defects likely to detract from its water tightness. The slab shall be monolithically poured on

thoroughly compacted native earth and shall be a minimum thickness of six (6) inches, extending four (4) inches above and two (2) inches below surrounding ground level, and shall be extended at least two (2) feet in all directions from the well casing. The surface of the concrete slab shall be smooth troweled and shall be graded away from the well casing in all directions for a distance of at least one (1) foot from the casing, with sufficient fall to drain water away from the casing.

(2) The concrete slab shall be poured in contact with the sealant material in the annular space.

(3) The top of the well casing shall extend a minimum of one (1) inch above the concrete surface slab.

c. Sanitary seal. A sanitary seal shall form a durable, weatherproof and watertight seal on top of the well, between the pump base and the concrete slab, or between the pump base and the top of the well casing. Sanitary seals that are manufactured and sold specifically for this purpose are required. "Home made" sanitary seals are not permitted unless plans for its construction, signed by an engineer, are submitted and approved by the Health Officer. When a pump is offset or submerged, any pipes or electrical cables which enter the well shall do so above ground and from the top of the casing and shall be completely surrounded by the sanitary seal so as to be water tight. Ropes for holding pipes or the submersible pump must be installed completely inside of the casing. Objects and materials that are not necessary for the operation of the well shall not enter the casing. Holes shall not be made in the casing. This requirement shall not restrict the proper installation of perforated casing below the annular seal or the proper installation of tubes for chlorination or sounding of the well. All proposed construction that varies from the requirements of this section must be approved by the Health Officer.

6. Backflow prevention. All pumping equipment shall be installed with protective devices to effectively prevent the entrance of foreign matter for back siphonage into the well casing. A properly designed air gap may be considered an acceptable protective device for agricultural wells. No person shall install any equipment or mechanism, or use any water treating chemical or substance, if it is found that such equipment, mechanism, chemical or substance may cause pollution or contamination of the domestic water supply. Such equipment or mechanism may be permitted only when equipped with an approved backflow prevention device.

7. Building code compliance. All electrical, plumbing and appurtenant structural work relating to the well installation or repair shall be performed in conformity with all applicable building code requirements of the jurisdiction in which the well is constructed.

8. Disinfection. All wells and associated equipment furnishing or in contact with potable water for domestic purposes, shall be disinfected after the construction, installation or repair of the well, pump, or storage equipment and prior to its use or

return to operation. The minimum concentration of the disinfectant solution shall be equivalent to at least one hundred (100) P.P.M. (parts per million) of available chlorine, with a minimum contact time of 12 hours.

9. Sampling Faucet (Hose Bib). A sampling faucet shall be installed on all new domestic and dairy wells. Sampling faucets are required on all public wells. The sampling faucet shall be located:

(a) So that it is accessible;

(b) On the discharge line between the pump and the pressure tank in such a manner that a sample may be taken when the pump is not in operation;

(c) A minimum of 18 inches above the surrounding grade; and

(d) So that the opening of the faucet is facing downward.

10. Temporary cover. During periods when no work is being performed on a well under construction, the well and appurtenant excavation if any, shall be adequately covered to preclude creation of a safety hazard.

11. Storage and Pressure Tanks. Tanks used for storage of potable water or to provide pressure for delivery of potable water shall conform to the minimum guidelines established by the Health Officer. Tanks used for potable water storage or to provide pressure must have been manufactured specifically for this purpose. Tanks which have previously contained materials other than potable water may not be used. Flexible tank liners shall be National Sanitation Foundation (NSF) approved. Interior tank coatings must meet AWWA Standard D102-78 and appear on the U.S. Environmental Protection Agency (E.P.A.) list of approved tank coatings.

D. Out-of-service well. The owner shall continuously maintain, in accordance with the provisions of this chapter, any well which is in or out of service, so as to be safe and to prevent pollution of any aquifer. A properly maintained out-of-service well shall not be considered to be an abandoned well for a period of one (1) year. When placed into service, all above-ground well construction must comply with current requirements, to be verified by on-site inspection. As evidence of his intentions for future use, the owner shall within thirty (30) days of taking the well out of service, submit to the Health Officer a signed "Letter of Intent" to place the well in service within one year. Furthermore, the owner shall properly maintain the well in such a way that:

1. The well has no defects which shall impair the quality of the water in the well or in the aquifers penetrated.

2. If the pump has been removed, the well casing shall be covered with a durable, weatherproof and watertight seal to prevent unauthorized access and entrance of surface contaminants into the well.

3. The well is clearly marked and the surrounding area is kept clear of brush or debris.

E. Abandoned well. Every abandoned well shall be considered the property owner's responsibility and shall be destroyed in accordance with the methods prescribed in this chapter.

F. Well destruction.** The objective of destruction is to restore as nearly as possible those subsurface conditions which existed before the well was constructed. Destruction of a well shall consist of the following:

1. The soil around the casing must be excavated to a minimum depth of four (4) feet and the casing removed from that point upward.

2. When a completed water well drillers report is available and, if reported subsurface conditions make it practical, the well may be destroyed by alternating clean native fill or sand with the sealing material inside the casing so as to seal each non-clay strata ten (10) feet above and ten (10) feet below its reported depth.***

3. When no water well drillers report is available, the well casing shall be filled entirely with the sealing material.

4. In all cases the upper most twenty (20) feet of casing shall be filled with the sealing material.

5. Borings made for the purpose of obtaining a single soil sample shall be destroyed in accordance with this chapter if any of the following apply:

a. Ground water is encountered;

b. A clay layer is penetrated;

c. The boring exceeds twenty (20) feet;

d. The presence of a contaminant is confirmed or suspected.

6. The sealing material and its installation shall conform with the requirements for annular seals listed in this chapter.

G. Exception to standards. An exception to any provision of these standards may be authorized when in the judgment of the Health Officer, the application of such provisions is unnecessary or impose additional requirements if necessary to protect the quality of the underground water resource. Specific conditions or exceptions will be prescribed on the variance permit. (Ord. 1271, 1988; Ord. 1197, 1985; Ord. 1128, 1983; Ord. 752, 1975).

* The Health Officer may change the required depth of the annular seal when adverse or special conditions warrant.
** Well destruction is required when a property where a well is located is connected to a public water system.
*** The Health Officer may change the destruction requirements when adverse or special conditions warrant.

9.28.070 Well Contractors.

The person responsible for the construction, alteration, destruction, or abandonment of a water well, cathodic protection well, or monitoring well shall possess a C-57 Water Well Contractor's License Law of the State of California. A copy of the current and valid C-57 license shall be submitted to the Health Officer prior to undertaking any well construction, alteration, destruction, or abandonment. (Ord. 1271, 1988; Ord. 1128, 1983; Ord. 752, 1975).

9.28.080 Inspection.

A. A well site and surrounding property may be inspected by the Health Officer at any time prior to or during the construction or destruction of any well. The Health Officer shall be notified by the well contractor at least twenty-four (24) hours prior to commencement of the work authorized by the permit.

B. Except when a valid, verifiable emergency exists, the sanitary surface and annular seals on a well furnishing water for human consumption shall be installed prior to placing the well into service. (Ord. 1271, 1988; Ord. 1128, 1983; Ord. 752, 1975).

9.28.090 Water analyses.

After new domestic and dairy water wells are placed into service, the Health Officer shall obtain water samples for chemical and bacteriological analysis. (Ord. 1271, 1988; Ord. 1128, 1983).

9.28.100 Replacement of new well.

If a new water well, for which a valid permit was obtained, should require abandonment and replacement within a period of one hundred eighty (180) days after installation, an additional permit and fee shall not be required. In the event of such an occurrence, the property owner shall comply with the following provisions:

A. The Health Officer shall be notified before work on the replacement well is started and an inspection shall be made during the course of the construction.

B. The abandoned well shall be properly destroyed in accordance with the methods and requirements prescribed in this chapter. (Ord. 1271, 1988; Ord. 1128, 1983).

9.28.110 Replacement of existing well.

If a new well must be constructed as a result of the failure of an existing well, mandatory destruction of the existing well will be a condition for issuance of a permit for the new construction. Well failure may be determined by, but not limited to, the following criteria:

A. When groundwater drops to a level below the useful depth of the well;

B. When the well yields sand or soil in quantities so as to make it unusable for domestic or agricultural purposes;

C. When contamination is present;

D. When the well is inside of the established minimum setback requirements from potential sources of contamination;

E. When established setback requirements do not exist and when, in the judgment of the Health Officer degradation of the groundwater is likely to occur or continue as a result of failure to destroy the well, the Health Officer may order its destruction. (Ord. 1271, 1988).

* The existing well shall be properly destroyed in accordance with the methods and requirements of this chapter.

9.28.120 Reports.

A. A contractor who has constructed, deepened or reconstructed a water well shall, within thirty (30) days after completion of the work, furnish the Health Officer

with an official copy of the "Water Well Driller's Report" (State of California, department of Water Resources, Form #DWR-188).

B. Confidentiality of reports will be strictly enforced according to the California Water Code, § 13752. (Ord. 1271, 1988; Ord. 1128, 1983).

9.28.130 Enforcement.

The health officer is authorized to enforce this chapter, and may perform all acts necessary or proper to accomplish the purposes of this chapter and is authorized to adopt and enforce such guidelines as is necessary to enforce the provisions of this chapter. (Ord. 1197, 1985; Ord. 1128, 1983; Ord. 752, 1975).

9.28.140 Violation—Penalty.

Each violation of this chapter is an infraction subject to the penalties set forth in chapter 1.28 § 1.28.030, and 1.28.040, of the Merced County Code. (Ord. 1128, 1983; Ord. 752, 1975).

PROTOCOL

SAMPLING OF GROUNDWATER MONITORING WELLS AND WATER SUPPLY WELLS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during sampling of groundwater monitoring wells and water supply wells for laboratory chemical analysis. The laboratory must be certified by the appropriate regulating agency for the analyses to be performed.

The procedures presented herein are intended to be of general use. During the review of the Groundwater Management Plan, if warranted, appropriate revisions may be made by the Merced Area Groundwater Pool Interests member agencies. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

2.0 SAMPLING

2.1 SAMPLE COLLECTION

2.1.1 Monitoring Wells

Methods for purging and sampling monitoring wells with dedicated and non-dedicated equipment are described in this Section. When practical, the purging and sampling technique adopted for a given site will remain consistent from one sampling event to the next.

2.1.1.1 Purging Monitoring Wells

A submersible pump, diaphragm pump, positive displacement pump, which may contain a bladder, or a bailer will be used for evacuating (purging) the monitoring well casing. If the well is to be sampled using equipment that must be separately introduced into the well, the purge intake will be located near the top of the water column for removal of at least one casing volume to remove stagnant water above the screened interval in the well casing; the pump may then be moved to the midscreen interval to complete the purging progress, if required. If a bailer is used to purge the monitoring well, it will be gently lowered into the well to reduce the potential for aeration of water. Purging will progress at a rate intended to minimize differential drawdown between the interior of the well screen and the filter material to limit cascading water along the inside of the well casing. Procedures for purging slowly recharging wells are discussed in Section 2.1.1.3.

A minimum of four well casing volumes or one saturated borehole volume, whichever is greater, will be removed to purge the well prior to collection of groundwater samples if the well will be

purged with non-dedicated equipment. If a low-flow capacity pump is dedicated in the well, the micropurge method described in 2.1.1.4 may be used to reduce the purge volume. If the well goes dry before four casing volumes are removed, the procedure discussed in Section 2.1.1.3 will be followed. The saturated borehole volume is the volume of water in the well casing plus the volume of water in the filter pack. For a well with a dedicated pump and packer, a casing volume is defined as the volume of water in the well casing below the inflated packer.

Periodic observations of turbidity and measurements of temperature, pH, and specific electrical conductance (SEC) will be made with field equipment during purging to evaluate whether the water samples are representative of the target zone. Samples will be collected when: (1) a minimum of four sets of parameter readings have been taken; and (2) the temperature, pH, and SEC reach relatively constant values, and the turbidity has stabilized.

2.1.1.2 Sampling Monitoring Wells

The sampler will wear clean gloves appropriate for the chemicals of concern while collecting the sample. Samples will be collected directly in laboratory-prepared bottles from the sampling device.

Each sampling episode or day should generally begin with the well having the least suspected concentrations of target compounds. Successive wells should generally be sampled in sequence of increasing suspected concentration.

A Teflon® bailer, new disposable bailer, stainless steel positive displacement Teflon® bladder pump with Teflon® tubing, or a clean electric submersible pump with low-flow sampling capacity will be used to collect the water samples for laboratory chemical analysis.

If a bailer is being used to collect the sample, it will be gently lowered into the well below the point where the purge device was located. Samples will collected in the following order: (1) volatile organic compounds; (2) semi-volatile organic compounds; (3) metals; (4) other analytes.

If a bladder pump or electric submersible pump is being used to sample the well for volatile compounds, the flow rate will be adjusted to either 1) approximately 100 milliliters per minute; 2) a rate specifically selected for the well based on groundwater flow rates and well hydraulic conditions; or 3) as low as possible. This rate will be maintained until the discharge line has been purged and the sample collected.

2.1.1.3 *Purging and Sampling Wells With Slow Recharge*

Wells that recharge very slowly may be purged dry once, allowed to recharge, and then sampled as soon as sufficient water is available. In this case, at least two sets of parameter readings of field water quality should be taken, one initially and one after recharge.

2.1.1.4 *Purging and Sampling Wells Using "Micropurge" Sampling Method*

Based on current research, a low-flow-rate, reduced purge method may be used to purge and sample a well with a dedicated pump (Barcelona et al., 1994; Kearl et al., 1994). This method may be used if acceptable to applicable agencies. This method assumes the water within the screened interval is not stagnant, and a small change to the natural flow rate in the screened interval will result in samples with particulates and colloidal material representative of groundwater. The pump should be preset in the screen interval at least 24 hours before the sampling event. A minimum of two pump plus riser pipe volumes should be purged at a flow rate of approximately 100 milliliters per minute or as low as possible based on groundwater flow and well hydraulic conditions. Purging should progress until water quality parameters (pH, SEC, temperature) have reached relatively constant values. Dissolved oxygen readings are recommended, if practical.

2.1.2 Water Supply Wells

Water supply wells will be sampled by purging the wells for a period of time adequate to purge the pump riser pipe. Alternatively, if the volume of the riser pipe is unknown, the pressure tank will be drained until the pump cycles on, or the well may be purged until three successive field measurements performed 5 to 10 minutes apart have stabilized. If the well is currently pumping, the sample can be taken without purging the well. Water samples will then be collected from the discharge point nearest the well head. Samples will be collected directly into laboratory-prepared bottles.

2.1.3 Extraction Wells

Extraction wells will be sampled while extraction is occurring. Samples will be collected from an in-line sampling port after purging the sampling line. Samples will be collected directly into laboratory-prepared bottles.

A WELL SAMPLING AND/OR DEVELOPMENT RECORD will be used to record the following information:

- Sample I.D.
- Duplicate I.D., if applicable
- Date and time sampled

- Name of sample collector
- Well designation (State well numbering system for water supply wells, and unique sequential number for other wells)
- Owner's name, or other common designation for water supply wells
- Well diameter
- Depth to groundwater on day sampled
- Casing volume on day sampled
- Method of purging (bailing, pumping, etc.)
- Amount of water purged
- Extraordinary circumstances (if any)
- Results of instrument calibration/standardization and field measurements (temperature, pH, specific electrical conductance) and observed relative turbidity
- Depth from which sample was obtained
- Number and type of sample container(s)
- Purging pump intake depth
- Times and volumes corresponding to water quality measurement
- Purge rate

2.2 SAMPLE CONTAINERS AND PRESERVATION

Appropriate pre-cleaned sample containers and preservatives for the analyses to be performed will be obtained from the subcontracted analytical laboratory. Frequently requested analyses and sample handling requirements are listed in Table 1.

2.3 SAMPLE LABELING

Sample containers will be labeled before or immediately after sampling with self-adhesive tags having the following information written in waterproof ink:

- Geomatrix
- Project number
- Sample I.D. number
- Date and time sample was collected
- Initials of sample collector

2.4 QUALITY CONTROL SAMPLES

In order to evaluate the precision and accuracy of analytical data, quality control samples, such as duplicates and blanks, will be periodically prepared. These samples will be collected or prepared and analyzed by the laboratory, as specified in the project Quality Assurance Project Plan (QAPP) or by the project manager.

2.5 HANDLING, STORAGE, AND TRANSPORTATION

Efforts will be made to handle, store, and transport supplies and samples safely. Exposure to dust, direct sunlight, high temperature, adverse weather conditions, and possible contamination will be avoided. Immediately following collection, samples will be placed in a clean chest that contains ice or blue ice (if cooling is required), and will be transported to the subcontracted laboratory as soon as practical, or in accordance with the project QAPP.

3.0 FIELD MEASUREMENTS

Field measurements of temperature, pH, and SEC will be performed on aliquots of groundwater that will not be submitted for laboratory analysis. Field water quality measurements and instrument calibration details will be recorded on the WELL SAMPLING AND/OR DEVELOPMENT RECORD.

3.1 TEMPERATURE MEASUREMENTS

Temperature measurements will be made with a mercury-filled thermometer or an electronic thermistor, and all measurements will be recorded in degrees Celsius.

3.2 PH MEASUREMENT

The pH measurement will be made as soon as possible after collection of the sample, generally within a few minutes. The pH will be measured by immersing the pH probe into an aliquot of groundwater.

The pH meter will be calibrated at the beginning of and once during each sampling day and whenever appropriate, in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the specific pH meter used. Two buffers (either pH-4 and pH-7, or pH-7 and pH-10, whichever most closely bracket the anticipated range of groundwater conditions) will be used for instrument calibration.

3.3 SPECIFIC ELECTRICAL CONDUCTANCE MEASUREMENT

SEC will be measured by immersing the conductivity probe into an aliquot of groundwater. The probes used should automatically compensate for the temperature of the sample.

Measurements will be reported in units of micro-Siemens (S) per square centimeter (equivalent to micromhos or mhos) at 25 degrees Celsius.

The SEC meter will be calibrated at the beginning and once during each sampling day in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the SEC meter used. The SEC meter will be calibrated with the available standardized potassium chloride (KCl) solution that is closest to the SEC expected in groundwater below the site.

4.0 DOCUMENTATION

4.1 FIELD DATA SHEETS

A DAILY FIELD RECORD will be completed for each day of fieldwork. A WELL SAMPLING AND/OR DEVELOPMENT RECORD will be used for each well to record the information collected during water quality sampling. Samples may also be recorded on a SAMPLE CONTROL LOG SHEET or in the DAILY FIELD RECORD as a means of identifying and tracking the samples. Following review by the project manager, the original records will be kept in the project file.

4.2 CHAIN-OF-CUSTODY PROCEDURES

After samples have been collected and labeled, they will be maintained under chain-of-custody procedures. These procedures document the transfer of custody of samples from the field to the laboratory. Each sample sent to the laboratory for analysis will be recorded on a CHAIN-OF-CUSTODY RECORD, which will include instructions to the laboratory for analytical services.

Information contained on the triplicate CHAIN-OF-CUSTODY RECORD will include:

- Project number
- Signature of sampler(s)
- Date and time sampled
- Sample I.D.
- Number of sample containers
- Sample matrix (water)
- Analyses required
- Remarks, including preservatives, special conditions, or specific quality control measures

- Turnaround time and person to receive laboratory report
- Method of shipment to the laboratory
- Release signature of sampler(s), and signatures of all people assuming custody.
- Condition of samples when received by laboratory

Blank spaces on the CHAIN-OF-CUSTODY RECORD will be crossed out between the last sample listed and the signatures at the bottom of the sheet.

The field sampler will sign the CHAIN-OF-CUSTODY RECORD and will record the time and date at the time of transfer to the laboratory or to an intermediate person. A set of signatures is required for each relinquished/reserved transfer, including transfer within AMEC Geomatrix, Inc. The original imprint of the CHAIN-OF-CUSTODY record will accompany the sample containers. A duplicate copy will be placed in the project file.

If the samples are to be shipped to the laboratory, the original CHAIN-OF-CUSTODY will be sealed inside a plastic bag within the ice chest, and the chest will be sealed with custody tape which has been signed and dated by the last person listed on the chain-of-custody. U.S. Department of Transportation shipping requirements will be followed and the sample shipping receipt will be retained in the project files as part of the permanent chain-of-custody document. The shipping company (e.g., Federal Express, UPS, DHL) will not sign the chain-of-custody forms as a receiver; instead the laboratory will sign as a receiver when the samples are received.

5.0 EQUIPMENT CLEANING

Bailers, sampling pumps, purge pumps, and other non-dedicated purging or sampling apparatus will be cleaned before and after sampling each well. Factory new and sealed disposable bailers may be used for sampling, but may not be reused. Thermometers, pH electrodes, and SEC probes that will be used repeatedly will be cleaned before and after sampling each well and at any time during sampling if the object comes in contact with foreign matter.

Purged waters and solutions resulting from cleaning of purging or sampling equipment will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

Cleaning of reusable equipment that is not dedicated to a particular well will consist of the following:

- Bailers - the inside and outside of bailers will be cleaned in a solution of laboratory-grade detergent and potable water, followed by a rinse with deionized (DI) water. They may also be steam-cleaned, followed by a DI water rinse. If samples are to be collected for metals analysis, the Teflon□ bailer may be rinsed with a pH2 nitric acid solution followed by a double DI rinse.

- Purge Pumps - All downhole, reusable portions of purge pumps will be steam-cleaned on the outside. If the pump does not have a backflow check valve, the inside of the pump and tubing also should be steam-cleaned. For a purge pump with a backflow check valve, the interior of the pump and tubing may be cleaned by pumping a laboratory-grade detergent and potable water solution through the system followed by a potable water rinse, or by steam-cleaning.

- Water Quality Meters - All meters will be cleaned by rinsing the probe portions in DI water, and allowing to air dry.

- Bailer Tripod - The tripod cable will be steam-cleaned or rinsed with DI water.

Sample bottles and bottle caps will be cleaned by the subcontracted laboratory using standard EPA-approved protocols. Sample bottles and bottle caps will be protected from contact with solvents, dust, or other contamination. Sample bottles will not be reused.

6.0 REFERENCES

Barcelona, M.J., et al., 1994, Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground-Water Sampling: *Groundwater*, January-February.

Kearl, P.M., et al., 1994, Field Comparison of Micropurging vs. Traditional Ground Water Sampling: *Ground Water Monitoring Review*, Fall.

ADD
Water and Soil Analytical Methods and Sample Handling
Well Sampling and/or Development Record
Daily Field Record
Chain-of-Custody Record
Sample Control Log Sheet

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TABLE 1

WATER AND SOIL ANALYTICAL METHODS AND SAMPLE HANDLING

Parameter	Method	Water Containers[1]	Preservation[1]	Maximum Holding Time[1]
Total Petroleum Hydrocarbons: – as diesel – as gasoline	 GCFID (3550)[2] GCFID (5030)[2]	 2 - 1 liter amber glass 2 - 40 ml VOA glass	 cool on ice HCL to pH 2 in water samples: cool on ice	 14 days (unacidified water, 7 days) 14 days (unacidified water, 7 days)
Benzene, Toluene, Xylene, and Ethylbenzene	EPA 8020	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Volatile Organics with BTEX	EPA 8021[3]	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Oil and Grease	5520 E & F (soil)[4] 5520 C & F (water)[4]	2 - 1 liter amber glass	H_2SO_4 to pH <2 in water samples: cool on ice	28 days
Volatile Organics	EPA 8010 EPA 8240[5]	2 - 40 ml VOA glass 2 - 40 ml VOA glass	cool on ice[6] HCl to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days) 14 days (unacidified water, 7 days)
Semi-volatile Organics	EPA 8270	2 - 1 liter amber glass	cool on ice	7 days for extraction, water 14 days for extraction, soil 40 days for analysis
Polynuclear Aromatic Hydrocarbons	EPA 8310	2 - 1 liter amber glass	cool on ice	7 days, water 14 days, soil
Metals (dissolved)	EPA 7000 series for specific metal	1 - 500 ml plastic	Water Samples: field filtration (0.45 micron filter) and field acidify to pH 2 with HNO_3 except: Cr^{+6} - cool on ice	6 months, except: Hg - 28 days Cr^{+6} - 24 hours, water; 24 hours after prep, soil

Notes:

[1] All soil samples should be collected in full, clean brass liners, capped with aluminum foil or Teflon and plastic caps, and sealed with tape. If soil samples are to be analyzed for metals, they may be placed in laboratory-prepared clean glass jars. Soil should be cooled as indicated under Apreservation≅ and maximum holding times apply to both soil and water unless otherwise noted.

[2] For analysis in California, use California DHS recommended procedure as presented in LUFT manual using gas chromatography with a flame ionization detector. In other states, local requirements should be followed. Method 3660M is silica gel cleanup.

[3] EPA Method 8021 is equivalent to 8010/8020 in series.

[4] Method to be used in California Regional Water Quality Control Board North Coast and Central Valley Regions. In other areas, local requirements should be followed. Method 5520F is silica gel cleanup.

[5] Chloroethylvinylether may be detected at concentrations below 50 parts per billion due to degradation of HCl. EPA Method 8260B was formerly 8240.

[6] If EPA Methods 8010 and 8020 are to be run in sequence, HCl may be added. Check with the project manager before adding acid.

References:

U.S. EPA, 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW-846, Third Edition, July, and final amendments.

California State Water Resources Control Board, 1989, Leaking Underground Fuel Tank (LUFT) Field Manual, Tables 3-3 and 3-4, October.

California Regional Water Quality Control Boards, North Coast, San Francisco Bay, and Central Valley Regions, 1990, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, 10 August.

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WELL SAMPLING AND/OR DEVELOPMENT RECORD

Well ID: _____

Sample ID: _____ Duplicate ID: _____

Sample Depth: _____

Project and Task No.: _____

Project Name: _____

Date: _____

Sampled By: _____

Method of Purging: _____

Method of Sampling: _____

Initial Depth to Water: _____

Depth to Water after Sampling: _____

Total Depth to Well: _____

Well Diameter: _____

1 Casing/Borehole Volume: _____
(Circle one)

4 Casing/Borehole Volumes: _____
(Circle one)

Total Casing/Borehole Volumes Removed: _____

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment)

pH CALIBRATION (choose two)					Model or Unit No.:
Buffer Solution	pH 4.0	pH 7.0	pH 10.0		
Field Temperature °C					
Instrument Reading					

SPECIFIC ELECTRICAL CONDUCTANCE (SEC) – CALIBRATION				Model or Unit No.:
KCl Solution (µS/cm=µmhos/cm)	1413 at 25°C	12880 at 25°C		
Field Temperature °C				
Instrument Reading				

NOTES

DAILY FIELD RECORD

Geomatrix

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	Company	Time In	Time Out

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	DESCRIPTION OF CONTENTS AND QUANTITY	LOCATION

TIME	DESCRIPTION OF WORK PERFORMED

DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

Project and Task Number:	Date:

TIME	DESCRIPTION OF WORK PERFORMED

CHAIN-OF-CUSTODY RECORD

Nº | Date: | Page of

Project No.:

Samplers (Signatures):

Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8020 (BTEX only)	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel												Cooled	Soil (S), Water (W), or Vapor (V)	Acidified	Number of containers

ANALYSES

REMARKS

Additional Comments

Turnaround time:

Results to:

Total No. of containers:

Relinquished by (signature):	Date:	Relinquished by (signature):	Date:	Relinquished by (signature):	Date:
Printed Name:	Time:	Printed Name:	Time:	Printed Name:	Time:
Company:		Company:		Company:	
Received by (signature):	Date:	Received by (signature):	Date:	Received by (signature):	Date:
Printed Name:	Time:	Printed Name:	Time:	Printed Name:	Time:
Company:		Company:		Company:	

Method of Shipment:

Laboratory Comments and Log No.:

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Forms(PF).012b (Revised 12/95)

WATER LEVEL MONITORING RECORD

Geomatrix

Project Name: _____ Project and Task Number: _____

Date: _____ Measured by: _____ Instrument Used: _____

Note: For you convenience, the following abbreviations may be used.

P = Pumping I = Inaccessible D = Dedicated Pump

ST = Steel Tape ES = Electric Sounder MP = Measuring Point WL = Water Level

Well No.	Time	MP Elevation (feet)	Water Level Below MP (feet)	Water Level Elevation (feet)	Previous Water Level Below MP	Remarks

PROTOCOL
WATER LEVEL MEASUREMENTS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during water level measurement. The procedures presented herein are intended to be of general use. During review of the Groundwater Management Plan, if warranted, appropriate revisions may be made by the Merced Area Groundwater Pool Interests member agencies. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

2.0 WATER LEVEL MEASUREMENTS

A DAILY FIELD RECORD (Figure 6-1) will be completed for each day of fieldwork. Water levels will be recorded on a WATER LEVEL MONITORING RECORD. Following review by the project manager, the original records will be kept in the project files.

Water level measurements at a site will be taken as quickly as practical, to best represent the potentiometric surface across the site at a single time. If pressure is suspected or has developed inside the well casing, the well will be allowed to stand without a cap for a few minutes or until the water level stabilizes before taking the water level measurement. Water level measurements will be recorded to the nearest hundredth (0.01) foot, and well depth measurements will be noted to at least the nearest half (0.5) foot. Equipment placed in the wells for water level and well depth measurements will be cleaned prior to reuse, as discussed in Section 4.0. Care will be taken not to drop foreign objects into the wells and not to allow the tape or sounding device to touch the ground around the well during monitoring.

Water level measurements will be performed by one of the following methods:

A. Wetted-Tape Method

A steel surveyor's tape will be prepared by coating several feet of the lower end of the tape with chalk or water-finding paste. A weight is attached to the lower end of the steel tape to keep it taut. The tape is lowered into the well until a foot or two of the chalked portion is submerged.

A tape without weight can be used if the well opening or pump casing clearance is too small and restricts the passage of the weight. The proper length to lower the tape may have to be determined experimentally. Measurement will be done as follows:

1. Lower and hold the tape at an even foot mark at the measuring point (MP) and note this tape reading.

2. Remove the steel tape from the well. Add or subtract the wetted length from the even foot mark noted in Step 1, as appropriate for your tape, and record this as water level below MP on the WATER LEVEL MONITORING RECORD.

B. Electric Sounder Method

An electric sounder consists of a contact electrode suspended by an insulated electric cable from a reel that has an ammeter, a buzzer, a light, or other closed circuit indicator attached. The indicator shows a closed circuit and flow of current when the electrode touches the water surface. Electric sounders will be calibrated periodically by measuring each interval and remarking them where necessary.

The procedure for measuring water levels with an electric sounder is as follows:

1. Turn sounder on, and check that it is working.

2. Lower the electric sounder cable into the well until the ammeter or buzzer indicates a closed circuit. Raise and lower the electric cable slightly until the shortest length of cable that gives the maximum response on the indicator is found.

3. With the cable in this fixed position, note the length of cable at the MP.

4. If the electric cable is not graduated between foot markings, use a pocket steel tape measure (graduated in hundredths of a foot) to interpolate between consecutive marks. Care must be taken to ensure that the tape measurements are subtracted from the graduated mark footage value when the water level hold point (determined in Step 3) is below the graduated mark and added when it is above the mark. Record the resulting value as water level below MP on the WATER LEVEL MONITORING RECORD.

ADD Daily Field Record
ADD Water Level Monitoring Record

DAILY FIELD RECORD

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Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	Company	Time In	Time Out

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	DESCRIPTION OF CONTENTS AND QUANTITY	LOCATION

TIME	DESCRIPTION OF WORK PERFORMED

DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

Project and Task Number:	Date:

TIME	DESCRIPTION OF WORK PERFORMED

WATER LEVEL MONITORING RECORD

Geomatrix

Project Name: _____ Project and Task Number: _____

Date: _____ Measured by: _____ Instrument Used: _____

Note: For you convenience, the following abbreviations may be used.

P = Pumping I = Inaccessible D = Dedicated Pump

ST = Steel Tape ES = Electric Sounder MP = Measuring Point WL = Water Level

Well No.	Time	MP Elevation (feet)	Water Level Below MP (feet)	Water Level Elevation (feet)	Previous Water Level Below MP	Remarks