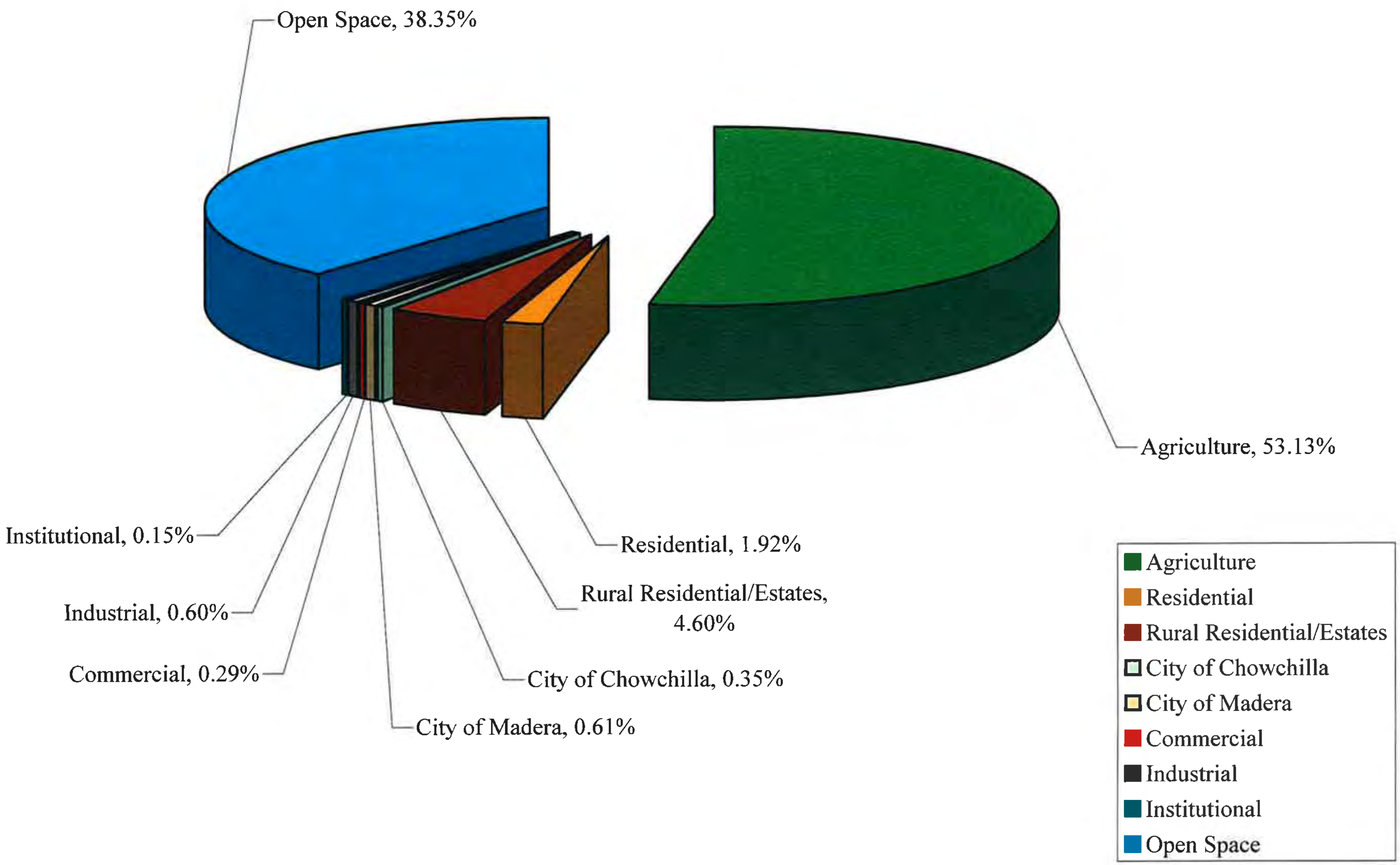
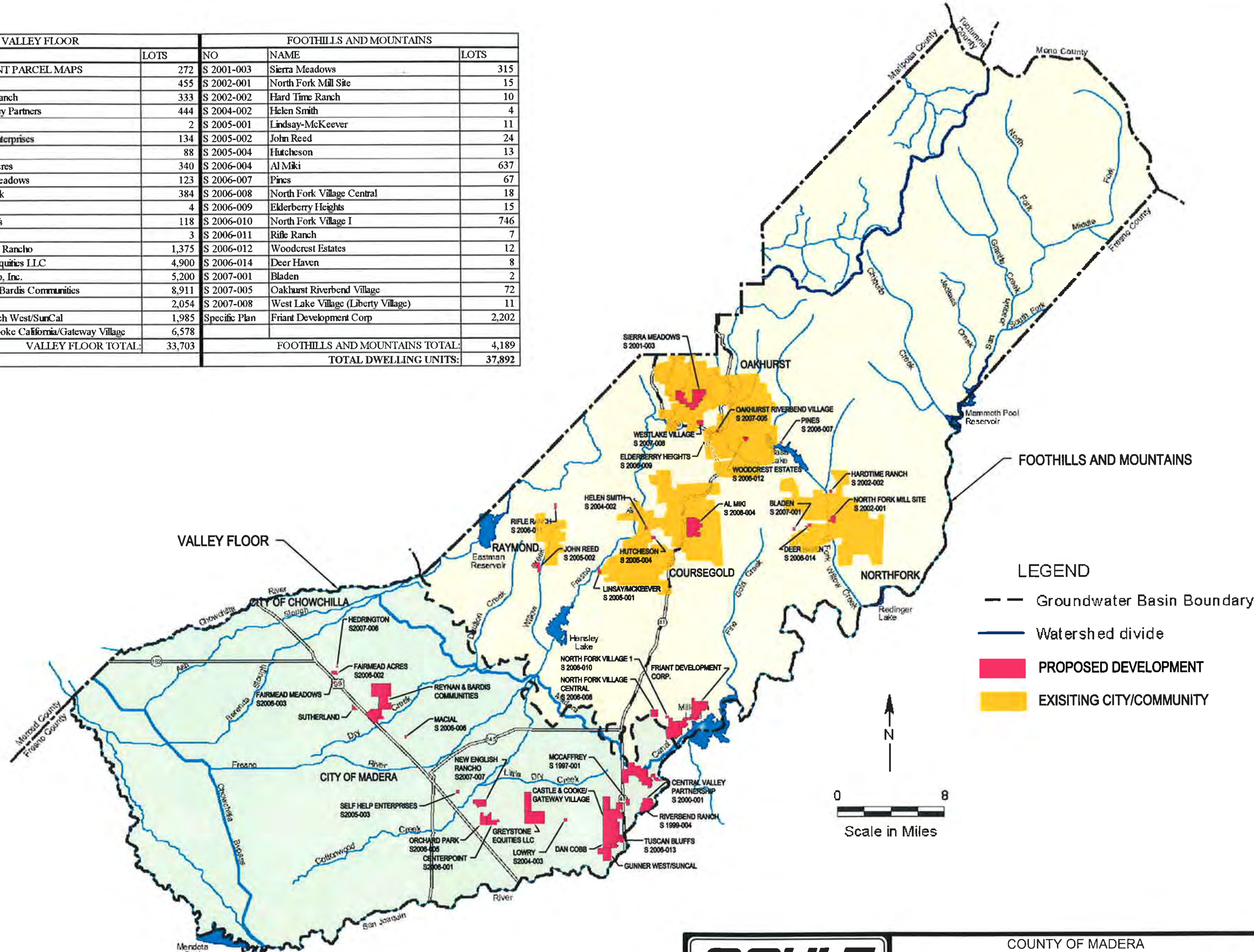
Figure 2-5
Madera County Integerated Regional Management Plan
2015 Land Use Breakdown



VALLEY FLOOR			FOOTHILLS AND MOUNTAINS		
NO	NAME	LOTS	NO	NAME	LOTS
PM	76 CURRENT PARCEL MAPS	272	S 2001-003	Sierra Meadows	315
S 1997-001	McCaffrey	455	S 2002-001	North Fork Mill Site	15
S 1999-004	Riverbend Ranch	333	S 2002-002	Hard Time Ranch	10
S 2000-001	Central Valley Partners	444	S 2004-002	Helen Smith	4
S 2004-003	Lowry	2	S 2005-001	Lindsay-McKeever	11
S 2005-003	Self-Help Enterprises	134	S 2005-002	John Reed	24
S 2006-001	Centerpoint	88	S 2005-004	Hutcheson	13
S 2006-002	Fairmead Acres	340	S 2006-004	Al Miki	637
S 2006-003	Fairmead Meadows	123	S 2006-007	Pines	67
S 2006-005	Orchard Park	384	S 2006-008	North Fork Village Central	18
S 2006-006	Macial	4	S 2006-009	Elderberry Heights	15
S 2006-013	Tuscan Bluffs	118	S 2006-010	North Fork Village I	746
S 2007-006	Hedrington	3	S 2006-011	Rifle Ranch	7
S 2007-007	New English Rancho	1,375	S 2006-012	Woodcrest Estates	12
Specific Plan	Greystone Equities LLC	4,900	S 2006-014	Deer Haven	8
Specific Plan	Tesoro Viejo, Inc.	5,200	S 2007-001	Bladen	2
Specific Plan	Reynen and Bardis Communities	8,911	S 2007-005	Oakhurst Riverbend Village	72
Specific Plan	Dan Cobb	2,054	S 2007-008	West Lake Village (Liberty Village)	11
Specific Plan	Gunner Ranch West/SunCal	1,985	Specific Plan	Friant Development Corp	2,202
Specific Plan	Castle & Cooke California/Gateway Village	6,578			
	VALLEY FLOOR TOTAL:	33,703		FOOTHILLS AND MOUNTAINS TOTAL:	4,189
				TOTAL DWELLING UNITS:	37,892



SOURCE: COUNTY OF MADERA PLANNING DEPT.

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COUNTY OF MADERA
INTEGRATED REGIONAL WATER MANAGEMENT PLAN

COUNTY OF MADERA
PROPOSED RESIDENTIAL DEVELOPMENTS

BEC PROJECT NO. 22203.00

FIGURE 2-6

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growth because no new water-consuming segments will be served. Schools in the study area range from elementary to junior college levels.

Generally, the cities in the Valley Floor maintain parks, landscaped medians, municipal golf courses, and landscaped public facilities, all of which require dependable water supplies. The effect of the recent and near-future rapid growth of park facilities may create a disproportionately large increase in water consumption for this sector.

The County Planning Department has received a large number of applications for developments incorporating significant residential, commercial/institutional, industrial, and landscape irrigation components, which are shown in Figure 2-6. The increased water demands associated with the proposed developments in the Valley Floor will significantly impact the water resources in the County.

2.5.2 Foothills and Mountains Land Uses

The predominant land uses in the Foothills and Mountains include agriculture (animal husbandry and cropping), residential and commercial (small towns and rural development), tourism, recreation, and natural resources such as the timber industry. However, the timber industry has been significantly reduced and impacted due to ever-increasing regulations. Most of the development in the Foothills and Mountains has occurred in the foothills with elevations ranging from 300 to 3,500 feet.

The foothills are used for animal grazing, animal husbandry, irrigated and native pasture, small towns, and rural development. Cultivated agriculture, including vineyards and orchards, has recently increased in the area due to advances in agricultural technology and market demands. Relatively significant areas of commercial and residential development are located near the unincorporated communities of Oakhurst (2000 population of 2,868), Raymond, North Fork, Ahwahnee, Coarsegold, Indian Lakes, and Yosemite Lakes Park (California Department of Conservation, 2000). Tourism and recreation are also important land uses in the foothills. For example, the economy of the Bass Lake community is dependent on the recreation industry (Madera County, 1995).

The Madera County General Plan includes Specific Plans in the foothills area including the North Fork/South Fork Community Center Area Plan (2003), the Ahwahnee Area Plan (2003), the Oakhurst Area Plan (2005), and the Coarsegold Plan (2006). A consistent theme in each plan is to maintain a rural setting. Urban development is limited to existing communities, and minimum lot sizes are usually recommended for both urban and rural development (Madera County, 1995).

The predominant land uses in the mountains are tourism, recreation, and natural resources such as timber logging. Forests under federal ownership cover more than one-third of the County and include portions of the Sierra and Inyo National Forests and Yosemite National Park. Timberlands of pine and fir forests cover approximately 400,000 acres but support only a limited wood products industry in the foothills due to ever-increasing regulations. The proposed residential developments in the Foothills and Mountains subarea are shown in Figure 2-6.

2.6 Watersheds

Runoff from rainfall and snowmelt feeds the rivers, lakes, and reservoirs in the County. Most of the County is drained by the San Joaquin River and its tributaries as shown in Figure 2-1. The San Joaquin River forms most of the southern and western boundaries of Madera County and ultimately serves as the discharge point for runoff from more than 90 percent of the County (including the Fresno River and Chowchilla River basins). Less than 10 percent of precipitation and stream flow originating in Madera County drains out of the County to another river system (Todd Engineers, 2002b). This occurs in the northwestern portion of the County where surface water drains westward into the Merced River system. The Fresno River basin drains much of the central part of the County. The Chowchilla River basin drains a narrow portion of the northwestern foothill region. Both of these rivers ultimately discharge to the San Joaquin River in the Valley Floor. However, water from both of these rivers reaches the San Joaquin River only in very wet years.

Major reservoirs in the lower portion of the Foothills and Mountains include Millerton Lake on the San Joaquin River, Hensley Lake on the Fresno River, and Eastman Reservoir on the Chowchilla River. Major reservoirs at higher elevations include Bass Lake on the Willow Creek tributary to the San Joaquin River and Mammoth Pool Reservoir on the upper San Joaquin River. Many small lakes and reservoirs are also present, particularly at higher elevations. Major areas of development are present within the upper Fresno River drainage (Oakhurst and Coarsegold) and the Willow Creek tributary to the San Joaquin River (Bass Lake and North Fork areas). The major reservoirs/lakes, their surface areas, and storage capacities are summarized in Table 2-4.

Table 2-4. Major Madera County Reservoirs and Lakes

Reservoir	Surface Area (acres)	Storage Capacity (AF)
Millerton Lake	4,850	520,000
Eastman Reservoir	1,750	150,000
Hensley Lake	1,550	90,000
Bass Lake	1,150	45,400
Mammoth Pool	1,000	122,700
Total	**10,300**	**928,100**

Chapter 3
Existing Water Resources Systems

This chapter describes existing water resources systems in the County including:

- Water supply, treatment, and distribution systems
- Wastewater collection, treatment, and disposal/reuse systems
- Flood control and associated groundwater recharge systems

These water resource systems provide the necessary background for evaluation of existing and future water resource usage in the County.

3.1 Water Supply, Treatment, and Distribution Systems

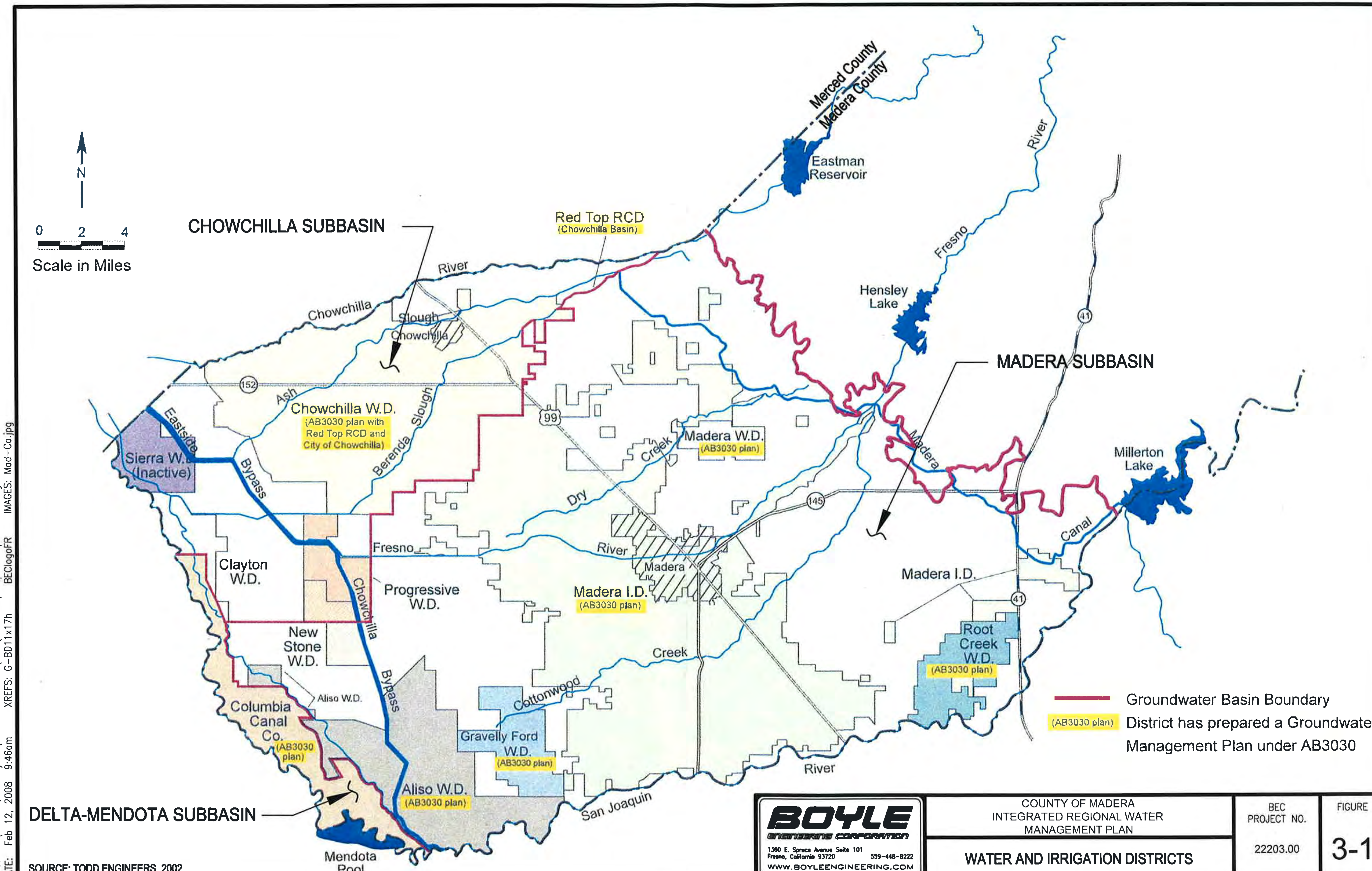
The water supply, treatment, and distribution systems in the County are described in the following sections based on their respective water providers. The major water service providers are shown in Figures 3-1, 3-2, and 3-3.

3.1.1 Irrigation and Water Districts

The five major irrigation and water districts that currently provide water to the agricultural community in the Valley Floor are Madera Irrigation District (MID), Chowchilla Water District (CWD), Gravelly Ford Water District (GFWD), Madera Water District (MWD), and Columbia Canal Company (CCC). There are no irrigation or water districts in the Foothills and Mountains subarea. Additional water districts, such as the Root Creek and Aliso Water Districts, have been formed to facilitate water deliveries/transfers and for groundwater management purposes. As of the date of this report, some water districts, including the Progressive, Sierra, Clayton, and New Stone Water Districts, are considered inactive by the Madera County Local Agency Formation Commission. The location of the irrigation and water districts are shown in Figure 3-1. Their operations, groundwater management activities, and monitoring programs are discussed as follows.

3.1.1.1 Madera Irrigation District

MID is the largest irrigation district in the County and covers approximately 128,300 acres. It delivers water to its customers through approximately 115 miles of pipelines, 225 miles of lined canals, 90 miles of unlined canals, and 102 miles of natural streambeds. The pipelines range from 12 inches to 84 inches in diameter with about half of them cast-in-place. The flows are delivered by gravity in the majority of the water distribution system with only a few small pump stations.



SOURCE: TODD ENGINEERS, 2002

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COUNTY OF MADERA
INTEGRATED REGIONAL WATER
MANAGEMENT PLAN

WATER AND IRRIGATION DISTRICTS

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FIGURE 3-1

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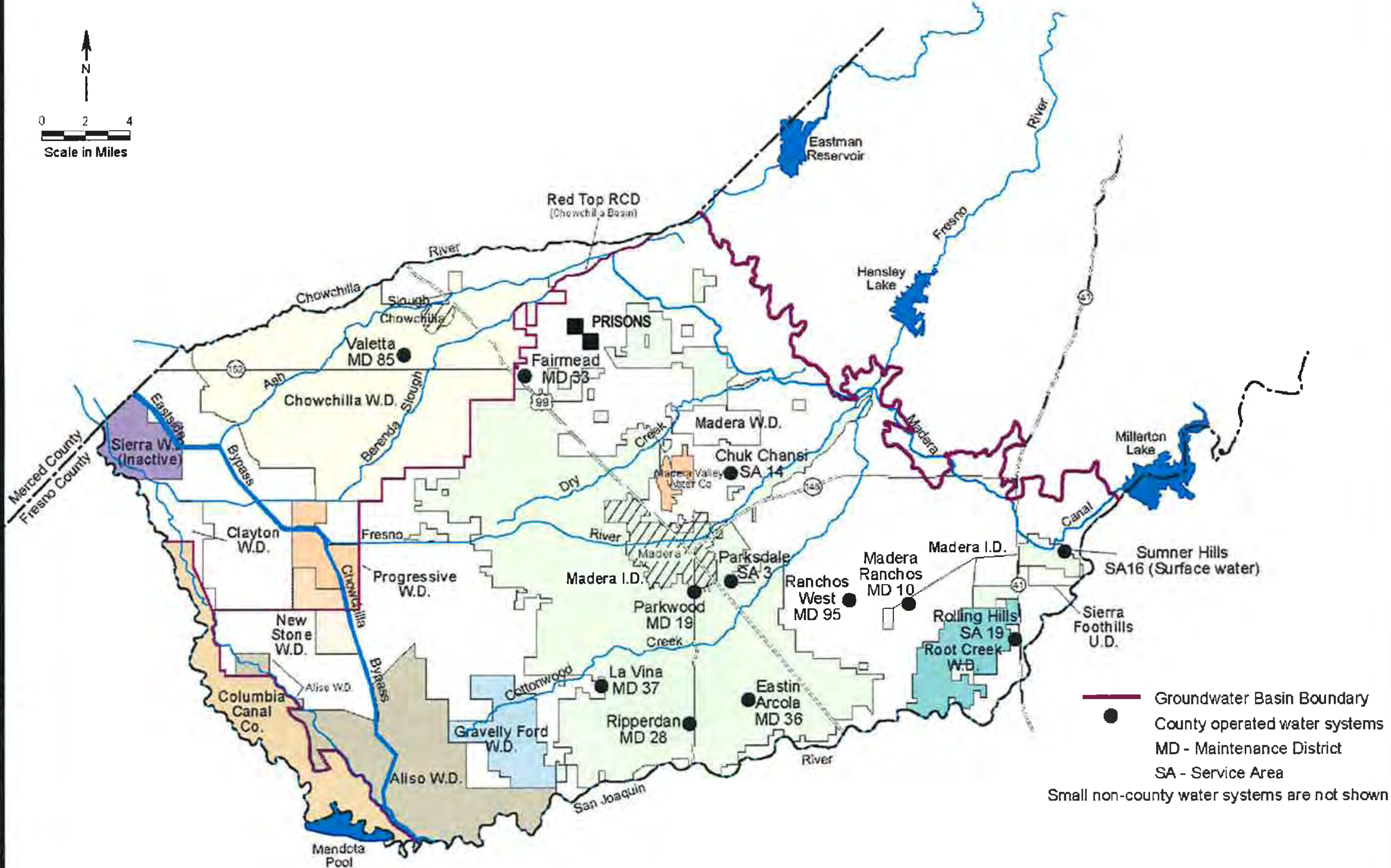

SOURCE: TODD ENGINEERS, 2002

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COUNTY OF MADERA
INTEGRATED REGIONAL WATER
MANAGEMENT PLAN

VALLEY FLOOR WATER SYSTEM PROVIDERS

BEC PROJECT NO. 22203.00

FIGURE 3-2

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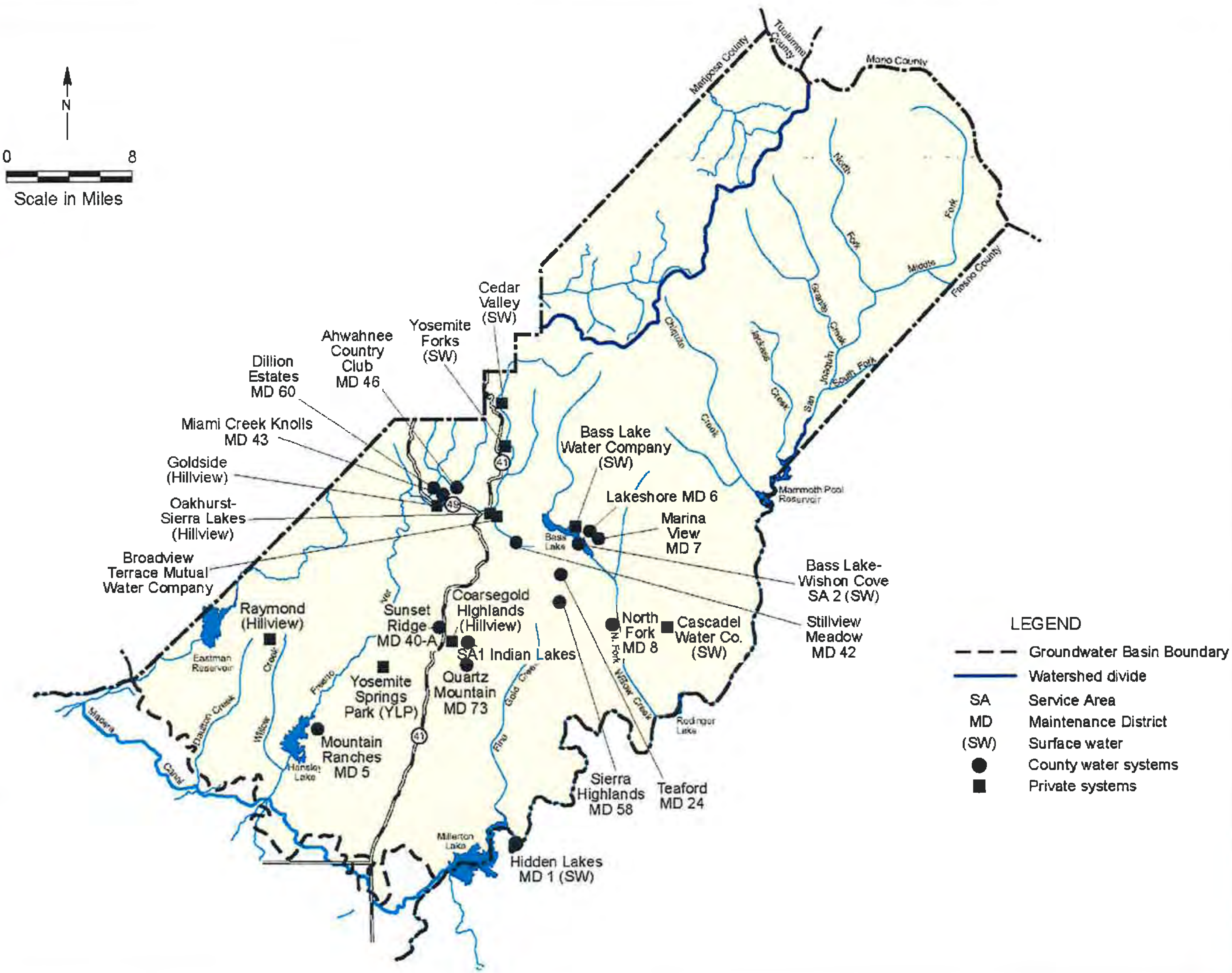

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COUNTY OF MADERA
INTEGRATED REGIONAL WATER MANAGEMENT PLAN

FOOTHILL / MOUNTAIN WATER PROVIDERS

BEC PROJECT NO. 22203.00

FIGURE 3-3

MID's main source of water is through water diversions from Friant Dam. Other sources of water for MID include USBR contract water from Hidden Dam as well as from water rights on the Fresno River, including the Big Creek Diversion from the Merced River watershed and the Soquel Diversion from the San Joaquin watershed.

In 1951, MID negotiated a contract with USBR for the water from Friant Dam. The contract provided for 85,000 AF of Class 1 water and 186,000 AF of Class 2 water. Class 1 is a relatively firm supply, whereas Class 2 is on an as-available basis and its quantity varies from year to year. All water supplied under this contract with USBR is conveyed to MID through the Madera Canal, which receives water from Friant Dam. CVP allocations during the period of 1996 through 2007 averaged 97 percent of Class 1 and 19 percent of Class 2 water.

Water supplied to MID under the Hidden Dam contract with USBR (up to 24,000 AFY) is for the conservation yield of the project. However, the project has stringent flood control criteria that preclude large carryover or early season storage.

The Big Creek and Soquel Diversions provide an average annual supply of 9,400 AF and 9,700 AF, respectively. The Fresno River adjudicated and appropriative average annual supply is approximately 20,000 AF and is inclusive of the Big Creek and Soquel Diversions. The average annual amount of water delivered to its growers during the period of 1996-2007 was approximately 120,000 AF, which included deliveries to growers classified "subordinates." MID growers pump groundwater to meet the remaining crop water demand.

Also, portions of the City of Madera are in MID and are assessed a monthly charge that is related to the recharge benefit created by the District.

3.1.1.2 Chowchilla Water District

CWD was formed in 1949 from a portion of the original MID. It covers approximately 80,000 acres in both Madera and Merced Counties. The estimated service area within Madera County is approximately 65,600 acres.

CWD delivers surface water to lands within its boundaries through a delivery system that includes approximately 160 miles of unlined canals and laterals and 46 miles of pipeline (CWD-Red Top RCD, 1997). Water has been transported into the CWD via the Madera Canal since 1945 (originally by MID, DWR, 1966). The CWD contract with USBR provides for 55,000 AF of Class 1 and 160,000 AF of Class 2 water from Friant Dam delivered via the Madera Canal. In addition, CWD receives approximately 24,000 AFY from Buchanan Dam releases on the Chowchilla River (CWD-Red Top RCD, 1997) under existing water rights and a USBR contract. It is estimated that CWD delivers an average of approximately 105,000 AFY to its growers including riparian deliveries (1996-2006). The remaining water demand is met by pumping of groundwater by its growers.

3.1.1.3 Gravelly Ford Water District

GFWD was formed in 1962 by the local agricultural community to obtain a permanent source of water supply. A water delivery system was constructed in 1984, allowing additional surface water to supplement the use of groundwater and water from Cottonwood Creek. The GFWD distribution system consists primarily of the Gravelly Ford Canal, which extends from the San Joaquin River to Cottonwood Creek, and small distribution pipelines used to deliver water to metered turnouts. The unlined canal allows for groundwater recharge by percolation of water into the underlying sandy soils (Bair and Westra, 1998). GFWD has contracts with USBR for 14,000 AFY of Class 2 water and a contract with MID to purchase spill waters in Cottonwood Creek (Bair and Westra, 1998). The GFWD covers approximately 8,300 acres.

3.1.1.4 Madera Water District

MWD was formed in 1987 to supply 3,740 acres of mature pistachio orchards with irrigation water (Provost and Pritchard, 1997b). MWD relies on both groundwater and surface water for irrigation. It purchases surface water from MID which is delivered via the Dry Creek Canal to lands that are within MID. It operates two pumping plants on the Dry Creek Canal to supplement irrigation with groundwater. MWD owns and operates wells to provide water for irrigation.

3.1.1.5 Columbia Canal Company

CCC covers approximately 15,750 acres in western Madera County and is one of four member agencies of the San Joaquin River Exchange Contractors Water Authority. Under an agreement with USBR, the Exchange Contractors receive 59,000 AFY of surface water from the Delta-Mendota Canal in exchange for USBR use of San Joaquin River water in the Friant Division of the Central Valley Project (CVP) from pre-1914 water rights held by the Exchange Contractors. In critically dry years, the allocation can be reduced to a minimum of 45,000 AFY. Water deliveries by CCC averaged 59,000 AFY from 1996 to 2007.

When surface water deliveries are insufficient to meet crop demands, groundwater is pumped into the CCC distribution system from wells within the service area. Groundwater is pumped during April, May, and June so that surface water can be “banked” for access during peak demand. Groundwater is also pumped during June, July, and August to supplement surface water. CCC is undergoing a modernization project which will include water distribution system improvements to increase delivery flexibility and efficiency and to capture/reuse operational spill water.

Installation of drip and microsprinkler irrigation systems to maximize irrigation water use uniformity and efficiency and to eliminate tailwater production is also part of the modernization project. CCC believes that overall water use efficiency will be increased to the point that use of groundwater will not be needed to meet crop water demand on CCC lands in most years.

3.1.1.6 Root Creek Water District

RCWD was formed in 1996 for the primary purpose of obtaining a reliable water supply for its service area of approximately 9,234 acres. The majority of the service area relies on groundwater, but RCWD plans to obtain some surface water to supplement the groundwater due to overdraft conditions. Water supply to the service area is currently served by private wells and irrigation systems. RCWD is, however, in the process of planning its surface water distribution system and has entered into an agreement with MID to construct a turnout on MID Lateral 6.2 to receive surface water from MID. RCWD is also working with USBR to become a Section 215 contractor to enable RCWD to receive 215 water from USBR when available. Further discussion of potential RCWD water supply projects is presented in Section 3.3.4.5.

3.1.1.7 Aliso Water District

AWD consists of approximately 25,723 acres in southwestern Madera County along the San Joaquin River. AWD has no surface water supply and currently does not deliver water to growers (AWD, 1996). This land is irrigated exclusively with groundwater. Its principal objective is to assist growers with the protection and management of the groundwater resources in the service area.

3.1.2 Valley Floor Urban and Rural Water Providers

Residents of Madera County rely on public and private water systems as well as individual domestic wells for their water supply. Almost all of the public and private water systems use groundwater. For the large water systems, defined as more than 199 connections, the Department of Public Health, Drinking Water Division (CDPH) inspects the facilities and monitors the quality of the water used for potable water supply. For systems with less than 200 connections, defined as small water systems, inspections and monitoring are conducted by the Madera County Department of Environmental Health. The following sections describe the urban and rural water systems in the Valley Floor.

3.1.2.1 City of Madera

The City of Madera has a current (2007) population of almost 56,000 and is the largest urban area in the County. The City covers approximately 12 square miles of incorporated area and relies solely on groundwater to serve its customers. The City's existing water system facilities include 16 groundwater wells, 150 miles of water distribution system pipelines, and a 1-MG elevated water storage tank.

The wells are scattered throughout the City and have depths ranging approximately from 300 to 700 feet. The total pumping capacity of the current water system is about 27,000 gpm. Specific capacities for the wells range from 17 gpm/ft to about 100 gpm/ft. The quality of the groundwater meets all regulatory standards with the exception of water produced at Well 27. Well 27 is equipped with a granular activated carbon (GAC) treatment system to remove DBCP and EDB. One new well (in the northeast part of the City) is to be treated for manganese.

The distribution system pipelines range from 4 to 14 inches in diameter. Wells 32, 33, 34, and 35 have been constructed and are at different stages of development. The City currently has approximately 12,500 water service connections, of which about 500 commercial and multifamily residential connections are metered. Annual pumping from 1999 through 2006 averaged approximately 12,260 AFY.

3.1.2.2 City of Chowchilla

The City of Chowchilla currently (2007) has a population of almost 18,000 (including the inmates of the Central California Women's Facility and Valley State Prison for Women) and is the second largest community in the County. The City relies solely on groundwater for its water supply. The City's water system is comprised of nine water wells and 37 miles of main distribution pipelines. There are currently seven groundwater wells (Wells 1, 3, 4, 6, 8, 10 and 11) in service. A new well (5A) is currently under construction. Each well site is equipped with a chlorine pump, metering chlorine dosage to the distribution system. The City pumped an average of approximately 2,900 AFY from 1999 to 2006. The quality of the groundwater currently meets all regulatory standards.

The City has approximately 3,000 customer connections, of which 140 are metered (primarily commercial customers). The two prisons have their own separate water systems.

3.1.2.3 County Special Districts in the Valley Floor

Madera County has 34 County Service Areas and Maintenance Districts that together operate 30 small water systems as shown in Table 3-1. Fourteen of these special districts are located in the Valley Floor, of which 13 include water systems. Water supply for these systems comes primarily from groundwater wells. Sumner Hill is the only Valley Floor district treating and delivering surface water to meet water demands. Sumner Hill is located between Friant Dam and Highway 41 on the north side of the San Joaquin River (its source of water). The larger systems, with a capacity of about 2,000 gpm, serve Parkwood, Parksdale, and Madera Ranchos. The remaining systems have capacities ranging from 15 to 900 gpm. The County-operated water systems in the Valley Floor produced an average of 3,570 AFY of water from 1999 to 2006.

3.1.2.4 Madera Valley Water Company

MVWC is a mutually-owned water company providing water to approximately 1,890 residential and 40 commercial customers in the Valley Floor area. MVWC relies solely on groundwater supply. It has seven wells distributed throughout its water distribution system. From 1999 to 2006, the MVWC has pumped an average of about 2,300 AFY to meet customer water demand.

3.1.2.5 Prisons

Central California Women's Facility. The Central California Women's Facility is a State prison located near the City of Chowchilla (about 5 miles southeast of the airport) and houses

Table 3-1. County Maintenance Districts and Service Areas

District Number	District Name	Region	Service Type	Total Units	Water Supply Source	Well/Plant Capacity (gpm)	Well Depth (ft)
MD-1	Hidden Lakes	Foothills/Mtns	Water	208	S	60	-
MD-5	Mtn Ranches	Foothills/Mtns	Water	49	G	25	600-800
MD-6	Lake Shore	Foothills/Mtns	Water/Sewer	51	G	46	450
MD-7	Marina View	Foothills/Mtns	Water/Sewer	92	G	57	200-550
MD-8A	North Fork	Foothills/Mtns	Water/Sewer	130	G	240	520
MD-10A	Madera Ranchos	Valley Floor	Water	1,001	G	2100	400
MD-19A	Parkwood	Valley Floor	Water/Sewer	288	G	1840	224-425
MD-19B	Parkwood	Valley Floor	Water	347	G	1840	224-425
MD-22A	Oakhurst	Foothills/Mtns	Sewer	2,044	-	-	-
MD-24	Teaford Meadows	Foothills/Mtns	Water/Sewer	72	G	37	240-640
MD-27	Goldside	Foothills/Mtns	Sewer/Drainage	142	-	-	-
MD-28	Ripperdan	Valley Floor	Water/Sewer	17	G	150	470-520
MD-33	Fairmead	Valley Floor	Water	241	G	600	390
MD-36	Eastin Arcola	Valley Floor	Water/Sewer	18	G	340	400
MD-37	La Vina	Valley Floor	Water/Sewer	178	G	665	297-393
MD-40A	Sunset Ridge	Foothills/Mtns	Water	31	G	112	520
MD-42	Still Meadows	Foothills/Mtns	Water	37	G	55	400-430
MD-43	Miami Creek Knolls	Foothills/Mtns	Water	26	G	15	200-400
MD-46	Ahwahnee Country Club - Miami Cr Estates	Foothills/Mtns	Water	110	G	184	900-1160
MD-58	Sierra Highlands	Foothills/Mtns	Water	29	G	86	380
MD-60A	Dillon Estates	Foothills/Mtns	Water	38	G	105	140-900
MD-63A	Coarsegold South	Foothills/Mtns	Water	101	G	200	525-1200
MD-73A	Quartz Mountain	Foothills/Mtns	Water	140	G	170	400-875
MD-85	Valeta	Valley Floor	Water	20	G	160	200
MD-95A	Ranchos West	Valley Floor	Water	29	G	200	550
SA-1	Indian Lakes	Foothills/Mtns	Water	518	G	900	300-1100
SA-2A	Bass Lake (Pines Tract)	Foothills/Mtns	Sewer	1,738	-	-	-
SA-2B	Bass Lake (Wishon Cove)	Foothills/Mtns	Water/Sewer	75	S	100	-

District Number	District Name	Region	Service Type	Total Units	Water Supply Source	Well/Plant Capacity (gpm)	Well Depth (ft)
SA-2C	Bass Lake (Molly Cabin)	Foothills/Mtns	Water	6	S	100	-
SA-3	Parksdale	Valley Floor	Water/Sewer	507	G	1,900	216-480
SA-5	Eastside Ac	Valley Floor	Sewer	85	G	-	-
SA-14	Chukchansi	Valley Floor	Water/Sewer	31	G	31	390
SA-16	Sumner Hill	Valley Floor	Water/Sewer	50	S	180	-
SA-19	Rolling Hills	Valley Floor	Water	360	G	400	240-700

S = Surface Water, G = Groundwater

approximately 3,800 inmates. The facility relies on groundwater from three wells for its water supply. Total water production in 2006 was about 900 AFY.

Valley State Prison for Women. Valley State Prison for Women was opened in April 1995 on a 640-acre site in the San Joaquin Valley and was designed to hold up to 1,980 inmates. It is now one of the largest women's prisons in the world, with approximately 3,810 inmates and nearly 1,000 staff. The water supply for this facility comes from two active wells with another well on standby. These wells produced a total of about 800 AFY of water in 2006.

3.1.3 Foothills and Mountains Urban and Rural Water Providers

3.1.3.1 County Special Districts in the Foothills and Mountains

Madera County has 20 County Service Areas and Maintenance Districts that together operate 17 small water systems as shown in Table 3-1 in the Foothills and Mountains subarea. Hidden Lakes and Bass Lake (SA-2B and SA-2C) have surface water treatment plants. The remaining service areas and maintenance districts rely solely on groundwater pumped from approximately 17 wells to meet residential, institutional, and commercial use. The County districts produced an average of approximately 670 AFY of water from 1999 to 2006.

3.1.3.2 Hillview Water Company

HWC is a privately owned water company providing water service to residential and commercial customers in the Foothills and Mountains subarea. It is the largest private water provider in the region and is regulated by the California Public Utilities Commission (CPUC). The CPUC authorizes customer water rates and establishes standards for water system design and customer service. HWC has four separate water systems as shown in Table 3-2. Each water system has its own source of water supply, storage, and distribution facilities.

The HWC water systems have been repeatedly cited by CDPH for noncompliance with permit requirements including failure to monitor and meet drinking water quality standards. Customers have been periodically notified per CDPH permit conditions that water in the system exceeds the maximum contaminant levels (MCL) for uranium and, in some cases, nitrate. HWC also has

Table 3-2. Hillview Water Company Water Systems[a]

Water System	Number of Connections	Number of Active Wells
Oakhurst-Sierra Lake	987	10
Goldside	296	7
Coarsegold	24	2
Raymond	83	5
Totals	1,390	24

[a]Source: Feasibility Study to Acquire Hillview Water Company, Task 100 – Data Collection by Boyle Engineering Corporation, May 2006.

been operating on summer water-use restrictions because of water supply deficiency. A service connection moratorium was imposed in Oakhurst by the CPUC in 2002 pending completion of water system improvements required for satisfactory customer service per CPUC and CDPH standards. The moratorium was lifted by CDPH in November 2007.

A Madera County Citizens Committee from the HWC service areas was organized to consider possible public ownership and operation of the HWC. County Maintenance District 22F (MD 22F), which covers the areas of the four HWC water systems, was also formed. The following paragraphs describe the individual HWC water systems.

Oakhurst-Sierra Lakes Water System. This water system serves the majority of residences and businesses in the Oakhurst area. It had 987 active connections in 2006 and served a population of 2,961. The water supply sources consist of ten active hardrock wells that produced 580 AFY in 2006. Some wells are among the most productive in the Foothills and Mountain areas. Treatment to remove iron and manganese is required for some of the wells, and gross alpha, uranium, and total dissolved solids (TDS) concentrations exceed the MCL in some wells. Water is stored in 14 tanks with a combined capacity of 1.1 MG.

Coarsegold Highlands Water System. This water system serves residences in the Coarsegold Highlands subdivision with 24 residential connections and a population of 72 as of 2006. The water supply is from one hardrock well with a pumping capacity of 37 gpm. The current production capacity is sufficient to meet the estimated peak-hour demand of 22 gpm. Water is stored in a 30,000-gallon storage tank. An occasional exceedance of the manganese MCL has been reported (CDPH, April 19, 2001).

Goldside Water System. This water system serves residences in the Hillview, Goldside, Goldside Estates, and Fresno River Estates subdivisions. There were 304 residential service connections with a population of 912 as of 2006. This water system has ten wells, seven of which are active. Peak-hour water demand of 162 gpm is not met by the active well production capacity of 129 gpm but is met with inclusion of storage. The two water storage tanks have capacities of 408,000 and 105,000 gallons. Water quality concerns include elevated chloride and TDS at Goldside Well No. 4, elevated nitrate at Goldside Well No. 1 (CDPH, June 13, 2001), and high iron and manganese concentrations in some wells.

Raymond Water System. This water system serves a small area including 79 connections and a population of 237 as of 2006. The Raymond water system has five active hardrock wells that, combined, produce 50 to 60 gpm. The water storage system has five 25,000-gallon storage tanks. Relatively low well yields characterize the system. Peak summer demands may equal or exceed well production capacity. Water quality concerns include elevated nitrate levels at active Wells 5 and 8 (CDPH, March 9, 2001).

3.1.3.3 Other Large Private Water Providers

Broadview Terrace Mutual Water Company. Broadview Terrace Mutual Water Company is located in Oakhurst. Its water system serves 163 residential connections, two small apartment buildings, and the Fresno Flats Historical Museum. The water supply sources include seven hardrock wells and a connection to the Hillview Water Company (which is currently not used due to limited water supply and high uranium concentrations). The seven wells produce approximately 182 gpm and are generally 200 to 300 feet deep. The deepest well (Well 5) is 900 feet deep but is not used due to high uranium levels. The highest producing well is Well 7 which is 525 feet deep and produces 125 gpm. Uranium concentrations are a concern with Well 7 having a level of 329 pC/L, which is well above the MCL of 20 pC/L. The water system has two storage tanks with 45,000- and 50,000-gallon capacities. Because the service area is unsewered, locations for wells are very limited.

Yosemite Springs Park Utility Company. The Yosemite Springs Park Utility Company (YLP) service area is located in the Fresno River drainage area between Hensley Lake and Coarsegold. The water system has approximately 1,850 connections serving a population of 5,900 people. The water system has 15 active and standby wells and nine storage tanks. The wells produced about 780 AFY in 2006. These are some of the best producing hardrock wells in the Foothills and Mountains area.

Bass Lake Water Company. The Bass Lake Water Company's (BLWC) water system consists of about 960 residential connections and 22 commercial connections serving a permanent population of approximately 1,100 and a seasonal population of 3,000. Water supply sources include surface water and groundwater. Surface water is obtained from Willow Creek and treated at a water treatment plant with a design capacity of 400 gpm (0.6 MGD). During peak summer months, the treatment plant operates at or above its design capacity. Groundwater is supplied by three active wells producing a combined 103 gpm based on a 3-day pumping test. An elevated iron concentration exceeding the secondary MCL was reported for one of the active wells. A fourth well (School Road well) was previously designated a "standby" well by CDPH and was limited in the number of days it could operate due to elevated levels of uranium. BLWC has completed the installation of a uranium removal treatment system on its School Road well, enabling BLWC to operate the 100-gpm well to meet peak summer demands.

3.1.3.4 Small Private Water Providers

Cascadel Water Company. The Cascadel Water Company's water system has over 130 connections and is located along Cascadel Drive east of the community of North Fork. The four sources of water supply include three wells and one spring. Historical spring flows range from a low of 5 gpm to over 100 gpm. The spring was originally the main source of water but was not able to meet Title 22 requirements for bacteriological quality and had high turbidity after rain events. It was considered to be under the influence of surface water as defined by the Surface Water Treatment Rule. Recent renovations to the spring appear to have solved the problems, and it is considered a potable source although it is still closely monitored. The spring may be under the influence of surface water as turbidity spikes occur after rain events. A 24-hour pumping test of Wells 1 (500 feet deep) and 1A produced 57 gpm combined, and Well 2 is 550 feet deep and produces 25 gpm. Assuming an average spring flow of 50 gpm and maximum well capacity of 82 gpm provides a 132-gpm capacity for the system, or about 1 gpm per connection. Determination of long-term yields of water system hardrock wells requires 15 to 20-day pump tests. Reservoir 1 was installed in 1995 and consists of two tanks having a 45,500-gallon capacity each and collects water from the spring and Well 1. Reservoir 2 consists of three 15,000-gallon capacity tanks and collects water from Well 2.

Yosemite Forks. Yosemite Forks' water system serves 114 homes. The three sources of water are Hackney Spring in Cedar Valley and two hardrock wells. The spring is described in the Cedar Valley section below and is estimated to produce 45 gpm. Well 1 was drilled in 1985 to 286 feet and produced 45 gpm based on the driller's airlift test at the time of drilling. Well 2 was drilled in 1996 to a depth of 500 feet and produced 55 gpm (also from a driller's airlift test). Water storage includes a 44,000-gallon underground tank.

Cedar Valley. Cedar Valley's water system is located along Highway 41 north of Oakhurst and serves a subdivision of small lots with on-site septic systems. The water source is Hackney Springs. There have been recent problems with positive bacteria tests and failure to sample for bacteria. Hackney Springs is located in a meadow northeast of the subdivision. The spring was initially developed several decades ago. Spring water flows to a 4,000-gallon underground storage tank which is pumped to a 1,500-gallon storage tank for gravity feed to Cedar Valley customers. Overflow water goes to the Yosemite Forks' storage tanks.

Millerton Lake SRA. Millerton Lake was created by the construction of the Friant Dam across the San Joaquin River in 1944. The State Parks recreational area and camping facilities include boat camping. It has a daily maximum population of 2,500 that are served treated surface water from the Millerton SRA Meadow Tank system. The water system has about 70 connections. The historical water quality concerns have been coliform and turbidity violations.

3.1.3.5 Other Small Community Systems

In addition to the water systems discussed above, approximately 20 additional small community water systems also provide water supply to customers in the Foothills and Mountains subarea. These water systems include mutually-owned water companies and typically provide water to well-defined areas such as mobile home parks. Although water demand is generally unknown for these small systems, water use based on population has been estimated by Todd Engineers (2002b). Using a small water system factor estimated from the County-operated systems, these small community water systems provide approximately 934 AFY of groundwater to their customers.

3.1.3.6 Noncommunity Water Systems

Additional water use in the Foothills and Mountains includes the noncommunity water systems and individual wells. The noncommunity water systems include commercial locations, such as gasoline stations, mini-marts, restaurants, churches, or schools, that are not tied into any community water system. Often these facilities have one well and a variable or seasonal population. The water demand of these systems has not been quantified. There are approximately 69 such noncommunity water systems in the Foothills and Mountains (Madera County, March 31, 2001).

Many individuals in rural developments rely on individual groundwater wells for water supply as indicated by Water Well Drillers' Reports (drillers' logs) filed with DWR. There are 4,609 logs for wells drilled in the Foothills and Mountains subarea that were obtained from DWR files (Todd Engineers, 2002b). Although the logs may provide a useful idea of the number and depths of wells drilled in the Foothills and Mountains, they do not provide a comprehensive evaluation of the number of currently active wells used for domestic purposes. Limitations of using drillers' logs to estimate current domestic production include the following:

- DWR does not field check locations, so exact locations of a number of wells cannot be determined.
- Some wells may be shared by several households.
- Some wells may now be abandoned.
- Some wells may have been tied into a community water system.
- Some wells may be used for nonpotable uses only.
- Logs are not available for every well, and County records have generally not been accessible.
- DWR files did not include wells drilled in 1999 or 2000, when Todd Engineers' logs were copied.

As part of this Plan, KDSA estimated the number of privately developed lots at 4,510 based on aerial photographs and County of Madera records as of 2006. KDSA also estimated the average annual water use of the wells in these private lots to be 2,425 AF. Details of water use in the Foothills and Mountains can be found in Appendices A through D.

3.2 Wastewater Collection, Treatment and Disposal/Reuse Systems

Wastewater collection, treatment and disposal services are provided by only a few service providers in the County. These service providers' wastewater systems and operations are described as follows.

3.2.1 City of Madera Wastewater System

3.2.1.1 Wastewater Collection System

Wastewater is collected throughout the City of Madera via a network of sanitary sewer collection pipelines ranging from 8 to 42 inches in diameter. With the aid of five sewer lift stations, the influent is gravity fed to the WWTP approximately 7 miles from the western boundary of the city limits. There are approximately 10,000 residential connections with typically a 4-inch sewer service connecting to the main. Commercial and industrial customers number less than 1,000 and are connected with service lines appropriate to handle their particular effluent load.

The average daily wastewater volume for 2005 was estimated to be approximately 5.7 MGD, yielding a yearly total of about 6,400 AF. The City of Madera has no facilities for extensive storage of the wastewater before treatment. Because the City of Madera's wastewater treatment plant has been designated as a regional collection point for septic disposal, septic haulers from outside the City service area bring in an additional volume of wastewater. The most recent data show that outside septic waste collection contributes about 11,000 gallons (less than 1 percent of total) per day to the treatment totals. The outside septic waste collection volume is assumed to remain constant over time because some of the areas currently served by septic tanks will eventually be served by public sewer systems, offsetting the projected growth in areas served by septic tanks. Table 3-3 provides projections for wastewater collected and treated in the service area. The projection in Table 3-3 assumes an average annual population growth rate of 3.6 percent.

Table 3-3. Wastewater Collected and Treated (AFY)[a]

City of Madera	2005	2010	2015	2020	2025
Wastewater collected and treated in service area	6,400	7,600	9,100	11,000	13,000

[a]Source: City of Madera 2005 Urban Water Management Plan.

3.2.1.2 Wastewater Treatment System

The Madera WWTP, when constructed in 1972, consisted of influent grinding, grit removal, primary clarification, secondary treatment using trickling filters, and secondary clarifiers. The WWTP also provides anaerobic digestion of biosolids generated in the treatment process.

The City is in the final stage of expanding the capacity of the WWTP from 7 MGD to 10.1 MGD and upgrading the current treatment process to reduce nitrogen levels in the effluent. The new treatment process replaced the trickling filters with oxidation ditches, a suspended growth process capable of removing nitrogen. After clarification, the anaerobically digested biosolids are dewatered by a sludge centrifuge. The dewatered cake is then hauled offsite for final disposal.

3.2.1.3 Wastewater Management

The treated wastewater (effluent) from the City of Madera's WWTP is disposed of by land application. The facilities consist of fourteen 20-acre percolation/evaporation ponds and a 40-acre irrigated farming area. The farming area currently uses effluent for irrigation purposes.

The WWTP Expansion Predesign Report by Boyle (July 2004) proposed a system of recovery wells that will pump groundwater from under the percolation ponds to an MID canal for agricultural irrigation. This pumping of percolated effluent is intended to reduce mounding under the WWTP and to control elevated concentrations of nitrate or other contaminants in the underlying groundwater. Phase 1 of the recovery well system is currently being designed.

3.2.2 City of Chowchilla Wastewater System

The City of Chowchilla collects wastewater from its customers via approximately 26 miles of sanitary sewers. There are seven sewage pump stations in Chowchilla. The collected wastewater is treated at a 1.8-MGD wastewater plant. The existing wastewater treatment plant has only primary treatment facilities. The City is currently working on design of a new wastewater treatment that would incorporate secondary treatment and handle all domestic sewage. The City plans to direct all industrial waste to the current plant when the new plant goes online. Currently, the treated water is discharged to percolation ponds at the wastewater treatment plant.

3.2.3 County-Operated Wastewater Systems

Madera County Service Areas and Maintenance Districts operate 16 small sewer systems as shown in Table 3-1. Seven of these are located in the Valley Floor and the remaining nine are in the Foothills and Mountains subarea. The following descriptions of the wastewater systems are based on information from the County's website and County staff.

The smaller wastewater systems generally have sanitary sewer systems with asbestos cement, clay, or plastic pipe collection systems; one raw sewage pumping station; an extended aeration treatment process; chlorine disinfection; and treated water pumping. Wastewater is handled by percolation ponds and sprayfields. Many of these wastewater systems are in poor condition and need repair.

The larger, County-operated wastewater systems (with more than 500 connections) are located in the communities of Oakhurst, Bass Lake, and Parksdale.

3.2.3.1 Oakhurst Wastewater System

Oakhurst's wastewater system consists of gravity and force main collection systems, nine pumping stations, an oxidation ditch, chlorine disinfection, effluent storage pond, irrigation pumping stations, approximately 85 acres of effluent sprayfields, and sprayfield irrigation runoff return pumping stations. The collection system recently underwent major rehabilitation including pipe repairs, new force main to the treatment plant, new gravity main river crossing, new main lift station, and replacement or repair of several manholes.

Two original sewage pumping stations near the Fresno River at Road 426 and Chapel Hill are in fair condition now but will eventually need to be rehabilitated. The old main lift station at State Highway 41 has been abandoned as part of the collection system upgrade project. The new main pumping station, which pumps approximately 90 percent of the plant inflow, has the capacity to pump approximately 1 MGD of wastewater.

Of the three small pumping stations that serve apartment complexes along Victoria Lane, two are in need of rehabilitation due to the corrosive effects of sewer gases. The pumping station serving Enterprise Center is in fair condition. Also in fair condition is the pumping station on Redbud Drive at the river. Requirements to modify the force main and lift station along the Redbud collection line are anticipated to be placed on developers to accommodate the anticipated increase in flows as growth occurs.

Reconstruction of the wastewater treatment plant was completed in February 2005. The new facility provides for more advanced treatment capable of removing nitrates from the wastewater. It has a septage receiving station to treat septic tank pumping from eastern Madera County. Part of the overall plan for this facility includes the ability to return treated and reclaimed wastewater to the community for reuse in the irrigation of large, open space parcels.

3.2.3.2 Bass Lake's Wastewater System

Bass Lake's wastewater system was built in 1974 and consists of a collection system made of asbestos cement and plastic pipe, 16 raw sewage pumping stations, grit removal, an activated sludge treatment process, a chlorine contact tank, a treated water pumping station, a treated water booster pumping station, and a sprayfield. Some of the collection system is actually buried in the lakebed and is submersed when the lake level is high. The system operates well, with the exception of some major holidays when an influx of visitors causes a tremendous increase in sewage flows.

The treatment plant and high-use raw sewage pumping stations have generator backup. The four raw sewage pumping stations serving the campgrounds do not. However, the campgrounds are empty during the winter and the flow is minimal. There are approximately 100 alarm settings that are monitored at all times. Autodialers are used to call in alarm conditions as they occur.

3.2.3.3 Parksdale Wastewater Collection System

Parksdale's wastewater system consists of a plastic pipe collection system, a raw sewage pumping station, and one metering station. After flowing through the metering station, the wastewater becomes the responsibility of the City of Madera. City fees for sewage disposal are passed on to each resident connected to the sewer system.

3.3 Flood Control and Associated Groundwater Recharge Systems

3.3.1 City of Madera Groundwater Management and Storm Water System

The City of Madera is actively managing its water system and water use in an attempt to efficiently use its limited water supply and minimize overdraft. Although the City does not have a Groundwater Management Plan, it is almost wholly contained within MID, which also actively manages its groundwater supplies and is implementing its Groundwater Management Plan that was adopted in 1999.

Water levels in area wells are monitored by the City as well as DWR and MID. Water quality monitoring is also conducted by the City and is reported annually to its citizens and CDPH. Water level declines led to a series of recommendations in the City's 1997 Water Master Plan (Montgomery Watson, 1997) to assist in reducing the continued decline. The recommendations included:

- Percolation of storm drainage water and, possibly, other sources of water via storm water retention basins.
- Conducting recharge along the Fresno River.
- Buying or exchanging water from MID.
- Reducing demand by installing residential water meters.

Much of the City's storm water runoff, especially in the older part of town, is disposed of in MID canals, where MID utilizes the water to the extent possible in making deliveries to its growers or directing it to its recharge facilities. This requires MID to reduce its water supply at the system head, which often results in unanticipated spilling of District supplies, usually resulting in a net loss of water to MID. Therefore, MID no longer accepts any new storm water into its system because of water quality concerns and lack of capacity in the system. Water quality concerns include oil and grease that plug drip and microsprinkler irrigation systems. This is especially a problem during and immediately after the first couple of rain events each year.

Percolation through storm drainage retention basins and negotiating with MID for water it can provide during surplus years are ongoing efforts being employed in the groundwater recharge effort, as well as continuing efforts to implement the other recommendations from the 1997 Water Master Plan.

Continued cooperation with MID, along with other water users in the Madera Basin, to manage the groundwater basin will be essential to maintaining the availability of high-quality groundwater resources in the area.

The City's Water System Master Plan recommended favorable recharge areas south and southwest of the City where coarse-grain sediments persist with depth. The report also assessed the availability of additional surface water supplies to replace groundwater for direct use.

3.3.2 City of Chowchilla Flood Control Systems

The City of Chowchilla operates and maintains a storm drain system to provide control and disposal of storm water runoff. The system consists of 4 miles of drainage ditches, seven reservoirs, three pump stations, and other storm drainage facilities.

The City operates eight storm water basins. Approximately 80 to 90 percent of the storm water runoff collected by the drainage system ends up in these storm water basins. The remainder of the storm water runoff flows into Ash Slough or privately-owned storm basins. Most of the storm water in the basins percolates to the groundwater.

Despite the storm drainage system, the City still has problems with flooding. This is because there are no storm drains in most parts of the City. Further, the City has a fairly flat terrain, which slopes about 2 feet per mile and is conducive to flooding.

Current groundwater management activities include plans to conduct source water assessment tests in compliance with State guidelines for their water supply wells. The City also implements an urban water conservation program that restricts landscape irrigation during the day from April 1 through October 31 of each year (City of Chowchilla, 2001). Also, the City has recently begun the process of developing an Urban Water Management Plan and plans to adopt it in 2008. The plan will include a list of demand management measures that the City will be implementing in the next 5 years. The City is working with CWD to require developers to bring surface water to supplement groundwater pumping.

3.3.3 County-Operated Flood Control Systems

Madera County operates only one storm drainage system, which is located in Goldside in the Foothills and Mountains subarea.

3.3.4 Irrigation and Water Districts Recharge Programs

The irrigation and water districts in the County currently engage in different groundwater recharge and management programs. The districts with available information include the Madera Irrigation District, Chowchilla Water District, Madera Water District, Columbia Canal Company, Root Creek Water District, and Aliso Water District.

3.3.4.1 Madera Irrigation District Water Recharge Program

MID engages in the replenishment of the groundwater system by diverting excess surface water into eight recharge facilities totaling more than 350 acres, as well as allowing percolation along unlined channels and canals. Water is routed through natural channels such as the Fresno River, the channel below the Franchi weir, and Cottonwood Creek (when available) even when there are no riparian diversions. MID works closely with DWR and USBR to monitor the groundwater levels in an average of 229 wells located throughout the district, with 15 wells selected as representative of water level conditions (Boyle, 1999). Static water levels are measured in October and February, representing the lowest water level (which occurs in the fall) and the highest water level (which occurs in the spring before the irrigation season).

MID has installed recharge basins at strategic locations within the district to store water underground. A list of the designated groundwater recharge basins is provided in Table 3-4. Recharge accomplished with these facilities averages approximately 3,000 AFY. In addition, MID is developing the Madera Ranch into a "groundwater bank" through its Water Enhancement Project. This project is discussed in greater detail in Section 8.

Table 3-4. Madera Irrigation District Recharge Basins

Name	Location Township/Range/Section	Area (acres)
Lake Madera	T10S/R18E/S34	300
Airport Pit	T11S/R17E/S10	12
Burgess Pond	T11S/R18E/S32	5
Russell Pond	T12S/R18E/S08	19
Dirt/Beeman Pond	T12S/R18E/S17	9
Hospital Pond	T11S/R18E/S30	3

3.3.4.2 Chowchilla Water District Groundwater Management Plan

CWD purchases water surplus to its needs when available to recharge groundwater. Natural and intentional recharge is accomplished in the unlined portions of the surface water conveyance system, nearby stream channels, two surface water retention reservoirs, and eight recharge basins located throughout the district. CWD measures water levels in approximately 143 wells each spring and fall. Plans are under way to improve groundwater monitoring and install additional recharge basins. CWD is working with the City of Chowchilla to mitigate the effects on groundwater from new developments.

3.3.4.3 Madera Water District Groundwater Management Plan

MWD, in its AB 3030 Groundwater Management Plan, dated 1997, expressed a commitment to increased use of surface water from the Dry Creek Canal in lieu of groundwater pumping, hoping to mitigate overdraft conditions. At the time of its AB 3030 Groundwater Management Plan, MWD did not conduct routine groundwater monitoring, although DWR measures water levels for some wells in the vicinity of MID (Provost and Pritchard, 1997b). However, MWD indicated in its plan that a water-level measuring program will be implemented within 1 year of the plan and coordinated with USBR and DWR.

3.3.4.4 Columbia Canal Company Groundwater Management Plan

CCC overlies a portion of the Delta-Mendota Groundwater Subbasin, which has not been identified by DWR as being in a critical condition of overdraft. However, the CCC service area is in a state of overdraft. In CCC's *Rules and Regulations Governing Transfers of Water Under* *the Central Valley Project Improvement Act of 1992*, CCC recognizes the negative impacts created by substituting groundwater for transferred surface water. To protect the underlying groundwater basin, CCC does not allow transfer of groundwater to areas outside its service area (SJREC, 1997). Also, CCC does not allow transfer of surface water without fallowing the land to which such surface water would have been delivered. Pilot recharge tests have been undertaken at selected sites in the CCC area through direct and/or in-lieu means. As discussed in Section 3.1.1.5, CCC is undergoing a modernization project that is designed to eliminate the need to pump groundwater in most years and thus eliminate any overdraft in CCC.

3.3.4.5 Root Creek Water District Water Recharge Program

In its 1997 Groundwater Management Plan, RCWD expressed the desire to increase groundwater recharge and was exploring various options for obtaining and recharging water. One plan component involved conducting groundwater recharge feasibility studies.

As previously mentioned, RCWD is planning on purchasing water from MID to help meet the needs of planned development within its boundaries and to alleviate the current overdraft condition in its area. In addition, RCWD plans to become a Section 215 contractor, allowing them to purchase Section 215 water from USBR when available, which can be used to recharge groundwater in its area.

In addition, Castle and Cooke, a landowner in RCWD, was approved for development of land to commercial, residential, and industrial use by Madera County with the understanding that they had an option to purchase new water from outside Madera County. This new water may have a positive impact on water supplies in Madera County.

3.3.4.6 Aliso Water District Water Recharge Program

AWD is pursuing the purchase of surplus surface water to minimize groundwater extractions using private canals within the service areas for distribution. It also intends to investigate cooperative efforts for groundwater management with neighboring water agencies, landowners, and water users. According to the Groundwater Management Plan, AWD is also tracking and evaluating water levels within its boundaries.

Chapter 4
Water Demand

This chapter presents water demand estimates for the County of Madera. Water production is used as a surrogate for water demand. Detailed and accurate estimates of current water demand in the County are necessary to evaluate the existing and future water supply requirements. Subsequent sections of this chapter describe the historical and projected water demands in the County.

4.1 Historical Water Production

Water production is the combined quantity of water produced by groundwater wells and surface water sources in the County. The historical water production evaluation in this section is based on data received from CDPH, DWR, Madera County special districts, and previous study reports. In this study, the historical water production is classified as agricultural or urban and rural. Urban and rural includes residential, commercial, industrial, and institutional water uses typical of urban and rural settlements.

4.1.1 Agricultural Water Use

Agricultural water use in the County was estimated using crop irrigation area and unit demand factors from the DWR because agricultural groundwater pumping is generally not metered. The annual agricultural water use was estimated for 1998 to 2003 because these were the only years with available cropping pattern data. The agricultural water use for each crop is the product of the irrigated area and the corresponding applied water requirements for the crop. Using this methodology, agricultural water use in the County was estimated to be 1,010,000 AF in 2003, as shown in Table 4-1 and Figure 4-1.

Agricultural water use was extrapolated to approximately 1,170,000 AF for 2006 and likely to remain at or near this level in the near future.

4.1.2 Urban and Rural Nonagricultural Water Use

Urban and rural water use includes all the water uses in the cities, unincorporated towns, and private residences in the County with the exception of agricultural water use. Historical urban and rural water use is shown in Table 4-2 and Figure 4-2. The data is derived from Annual Reports to the CDPH Drinking Water Program and water production records from water providers.

As shown in Figure 4-2, there is a general decline in total urban and rural water use in the County from 1999 to 2001 likely due to increased precipitation in those years. From 2001 to 2004, the County demand increases at a rate of 3.7 percent per year (the approximate population growth rate in the County).

Table 4-1. Irrigation Water Requirements for Madera County[a]

	1998			1999			2000			2001			2002			2003		
Crop	**Irrigated Crop Area (1,000 ac)**	**Applied Water Require-ments (AF/acre)**	**Estimated Annual Irrigation (1,000 AF)**	**Irrigated Crop Area (1,000 ac)**	**Applied Water Require-ments (AF/acre)**	**Estimated Annual Irrigation (1,000 AF)**	**Irrigated Crop Area (1,000 ac)**	**Applied Water Require-ments (AF/acre)**	**Estimated Annual Irrigation (1,000 AF)**	**Irrigated Crop Area (1,000 ac)**	**Applied Water Require-ments (AF/acre)**	**Estimated Annual Irrigation (1,000 AF)**	**Irrigated Crop Area (1,000 ac)**	**Applied Water Require-ments (AF/acre)**	**Estimated Annual Irrigation (1,000 AF)**	**Irrigated Crop Area (1,000 ac)**	**Applied Water Require-ments (AF/acre)**	**Estimated Annual Irrigation (1,000 AF)**
Grain	19.0	0.14	2.7	9.3	1.30	12.1	25.2	1.30	32.8	26.2	1.59	41.7	9.6	1.74	16.7	5.9	1.2	6.8
Rice	0.4	4.76	1.9	0.3	5.24	1.6	0.3	5.24	1.6	0.2	5.56	1.1	0.0	0.00	0.0	0.0	0.0	0.0
Cotton	27.1	2.40	65.0	25.5	2.93	74.7	27.3	2.93	80.0	24.7	3.47	85.7	16.6	3.60	59.8	18.2	3.2	58.2
Sugar Beet	0.4	0.65	0.3	0.5	1.95	1.0	0.6	1.82	1.1	0.6	2.08	1.2	0.0	0.00	0.0	0.0	0.0	0.0
Corn	15.3	2.01	30.8	17.8	2.30	40.9	16.5	2.30	38.0	17.1	2.87	49.1	20.5	2.88	59.0	20.6	2.7	56.4
Dry Bean	3.1	1.75	5.4	2.5	2.02	5.1	0.3	2.02	0.6	0.2	2.28	0.5	0.4	2.28	0.9	1.0	2.5	2.5
Safflower	0.9	0.60	0.5	0.5	1.80	0.9	0.4	1.20	0.5	0.6	1.50	0.9	0.6	1.60	1.0	0.0	0.0	0.0
Other Field	1.1	1.90	2.1	12.1	2.38	28.8	0.7	2.38	1.7	0.8	2.86	2.3	17.3	3.02	52.2	18.2	2.7	49.1
Alfalfa	37.3	3.19	119.0	36.3	4.35	157.9	35.9	4.20	150.8	33.4	4.93	164.7	39.1	4.93	192.8	38.8	4.5	174.2
Pasture	5.5	3.42	18.8	8.1	4.38	35.5	5.2	4.25	22.1	5.2	4.66	24.2	4.7	4.66	21.9	4.7	4.4	20.6
Process Tomato	0.7	2.93	2.1	1.1	3.27[c]	3.6	0.6	3.60	2.2	0.6	3.19	1.9	1.1	2.80	3.1	1.6	2.5	4.0
Fresh Tomato	0.3	2.05	0.6	0.2	2.26[c]	0.5	0.2	2.47	0.5	0.2	2.60	0.5	0.2	2.05	0.4	0.4	1.6	0.7
Cucumber	1.1	2.06	2.3	0.9	2.21[c]	2.0	0.7	2.35	1.6	0.7	2.65	1.9	0.7	1.76	1.2	0.4	1.2	0.5
Onion/Garlic	1.8	3.29	5.9	1.5	3.56[c]	5.3	1.3	3.82	5.0	1.1	3.95	4.3	0.8	1.84	1.5	0.4	1.5	0.6
Other Truck Crops	1.0	1.20	1.2	1.4	1.2[c]	1.7	1.2	1.20	1.4	2.0	1.20	2.4	1.0	1.06	1.1	1.1	1.2	1.3
Almond/Pistachio	69.0	2.52	173.9	77.1	3.39	261.4	71.8	3.32	238.4	71.8	3.72	267.1	81.1	3.86	313.0	81.1	3.5	280.6
Other Deciduous	18.7	2.55	47.7	18.5	3.45	63.8	16.5	3.44	56.8	16.2	3.83	62.0	20.1	3.96	79.6	18.4	3.7	68.1
Subtropical	5.4	1.86	10.0	6.1	2.80	17.1	5.7	2.66	15.2	5.4	3.06	16.5	6.7	3.19	21.4	6.4	2.9	18.8
Vine	94.0	1.42	133.5	96.5	2.27	219.1	95.0	2.13	202.4	94.1	2.70	254.1	95.9	2.84	272.4	94.0	2.6	240.6
Multiple Crop[b]	6.5	2.10	13.7	5.0	2.90	14.5	6.8	2.80	19.0	6.1	3.30	20.1	9.1	3.5	31.9	8.5	3.2	27.2
Total Acres	**308.6**			**321.2**			**312.2**			**307.2**			**325.5**			**319.7**		
Total Applied Water			**637.3**			**947.4**			**871.4**			**1,002.2**			**1,129.8**			**1,010.3**
Average Unit Applied Water		**2.1**			**2.9**			**2.8**			**3.3**			**3.5**			**3.2**	

[a]Based on Department of Water Resources Irrigated Crop Area & Crop Water Use-Applied Water for Madera County.

[b]No data available. Based on Boyle's experience.

[c]No data available. Average of 1998 and 2000 applied water requirements was used.

Figure 4-1. County of Madera Historic Agricultural Water Use, AFY

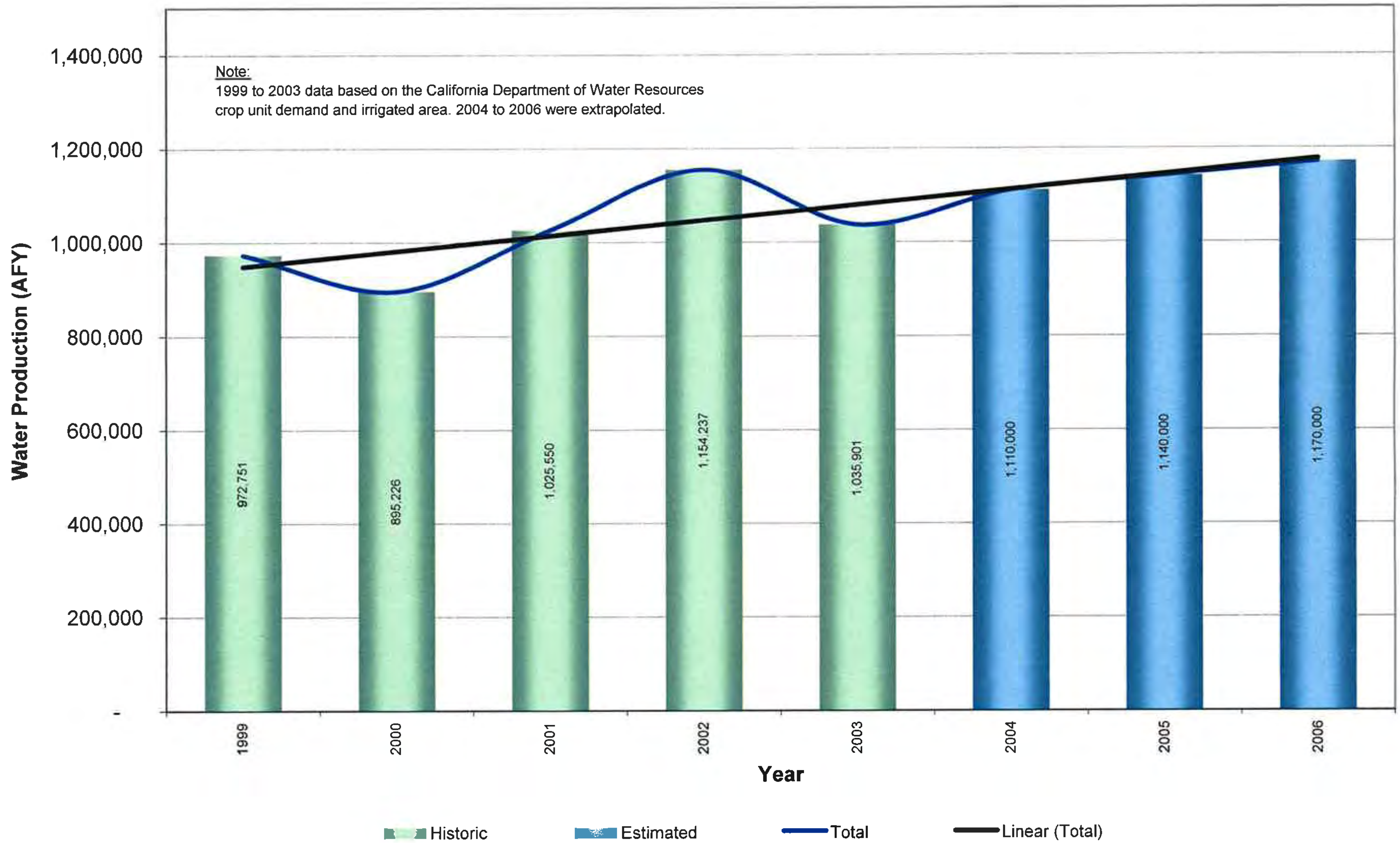


Table 4-2. Historical Municipal, Domestic, and Industrial Water Use (1999-2006)[a]

Water Purveyor	County Region	Water Production, AF							
		1999	2000	2001	2002	2003	2004	2005	2006
City of Madera	Valley Floor	12,156	11,834	11,196	11,867	12,473	12,886	12,473	13,165
City of Chowchilla	Valley Floor	2,753	2,673	2,722	2,761	2,761	3,117	3,169	3,200
Madera Valley Water Company	Valley Floor	2,832	2,082	2,274	2,249	2,162	2,385	2,194	2,130
County Special Districts	Valley Floor	3,615	3,411	3,203	3,586	4,219	3,725	3,446	3,368
Prisons[b]	Valley Floor	1,517	1,413	1,411	1,381	1,475	1,611	1,616	1,702
Subtotal		**22,873**	**21,413**	**20,806**	**21,843**	**23,090**	**23,724**	**22,899**	**23,565**
County Special Districts	Foothills and Mountains	614	612	644	699	668	774	705	669
Hillview Water Company	Foothills and Mountains	801	759	736	728	700	671	715	721
Small Private Water Providers [c]	Foothills and Mountains	1,291	1,270	1,377	1,393	1,371	1,447	1,385	1,400
Small Community Systems[d]	Foothills and Mountains	934	934	934	934	934	934	934	934
Noncommunity Water Systems[d]	Foothills and Mountains	2,250	2,250	2,250	2,250	2,250	2,250	2,250	2,250
Subtotal		**5,890**	**5,825**	**5,941**	**6,004**	**5,922**	**6,076**	**5,990**	**5,974**
Total		**28,763**	**27,238**	**26,747**	**27,848**	**29,013**	**29,800**	**28,888**	**29,540**

[a] Water production based on Annual Reports to the CDPH Drinking Water Program and from provider water production records.

[b] Water production from Central California Women's Facility and Valley State Prison for Women.

[c] Comprised of Bass Lake Water Company, Millerton Lake SRA, Yosemite National Parks, Yosemite Spring Park Utility Company, Cascadel Water Company, Yosemite Forks, Cedar Valley, Broadview Terrace.

[d] From Todd Engineers, 2002b.

Figure 4-2. County of Madera Historic Urban and Rural Water Use, AFY

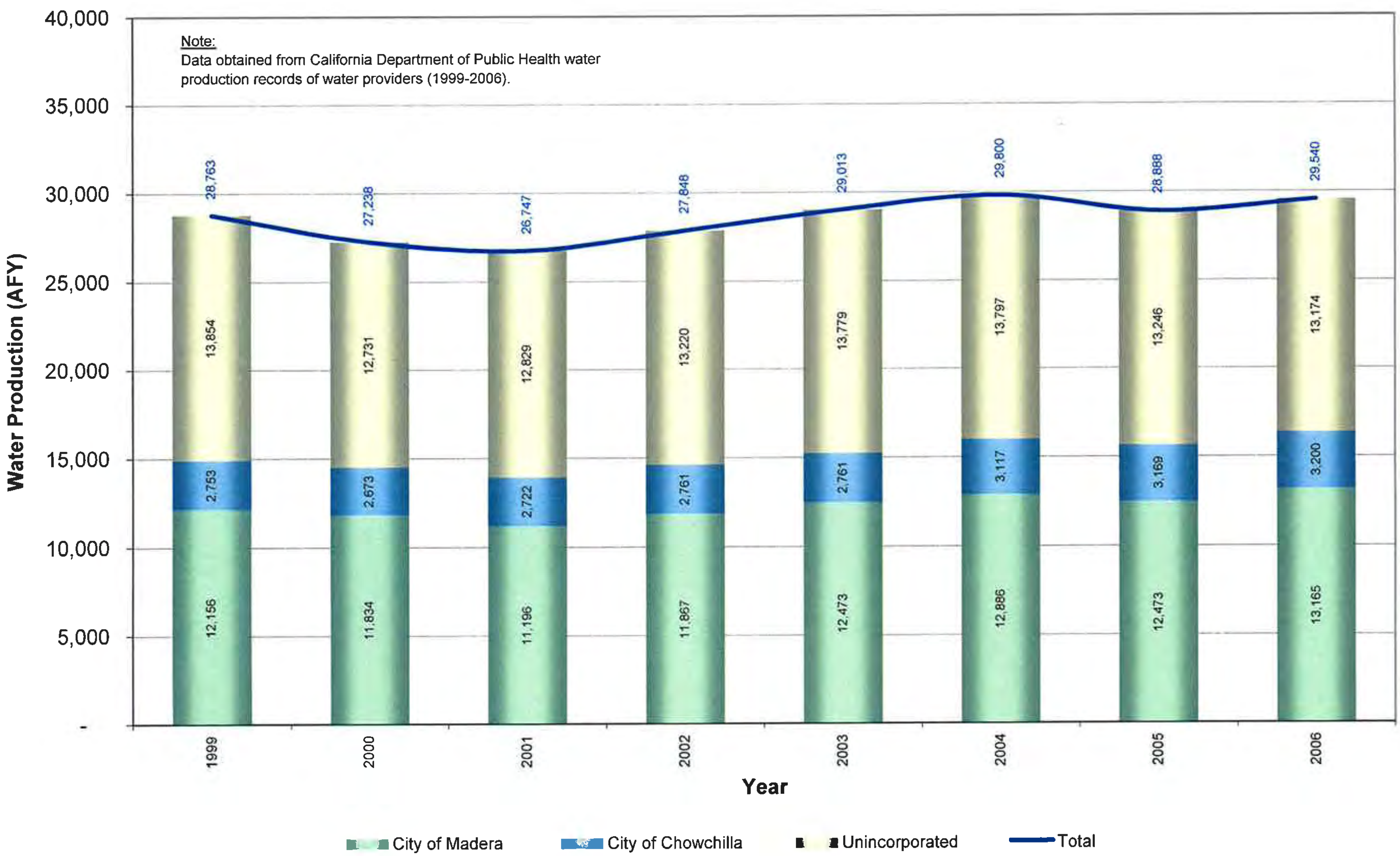


Figure 4-3 shows the historic per-capita water consumption in the County from 2000 to 2006. The highest per-capita water demand was recorded in the City of Chowchilla. The per-capita water demand for the City of Chowchilla averaged approximately 311 gpcd during the 2000 to 2006 period. This is approximately 35 percent higher than the City of Madera average of 230 gpcd for the same period. The unit demand in the unincorporated areas (168 gpcd) is significantly lower than the incorporated cities. The per-capita water demand for the entire County averaged 191 gpcd from 2000 to 2006.

4.1.3 Summary of Historical Water Use

Historical water use in the County is summarized in Table 4-3. The majority of water use in the County is for agricultural purposes, with approximately 3 percent being used for urban and rural use.

Table 4-3. Historical Water Use in Madera County (1999-2006)

Water Use Type	Annual Water Use (AF)							
	1999	2000	2001	2002	2003	2004	2005	2006
Agricultural[a]	947,400	871,400	1,002,200	1,129,800	1,010,300	1,110,000	1,140,000	1,170,000
Urban and rural	28,763	27,238	26,747	27,848	29,013	29,800	28,888	29,540
Urban and rural (% of total)	2.9	3.0	2.6	2.4	2.8	2.6	2.5	2.5
Total	976,000	899,000	1,029,000	1,158,000	1,039,000	1,140,000	1,169,000	1,200,000

[a] Data from Table 4-1. Estimated for 2004-2006.

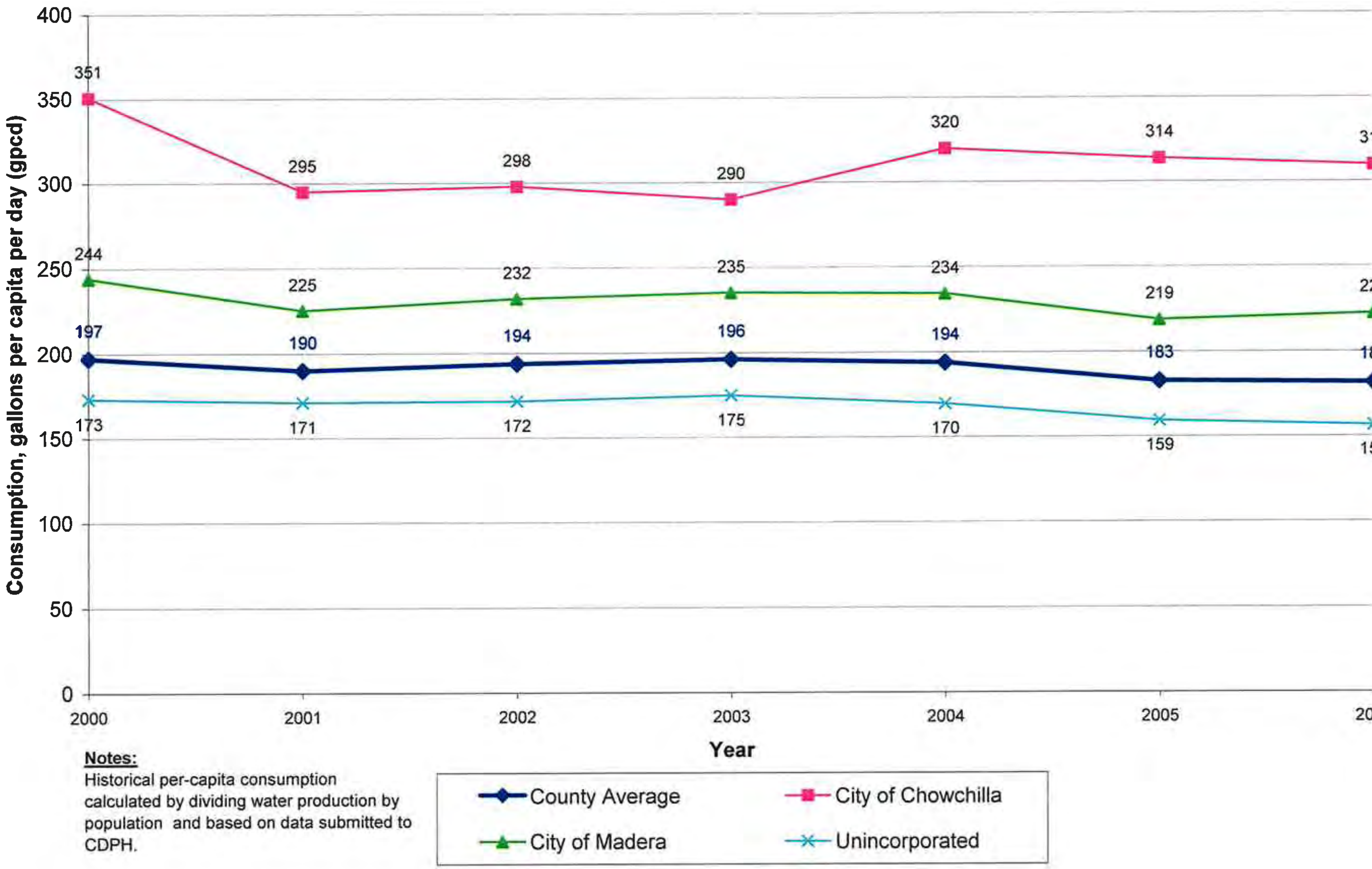
4.2 Water Demand Projections

Table 4-4 shows the additional future urban and rural water demands by location based on population estimates by the County Planning Department. The total urban and rural water demand of the County for 2030 was estimated by adding the product of the additional projected 2030 population for each of the growth areas and the projected per-capita water demand to the current estimated demand. A unit water demand of 270 gpcd was used for the Valley Floor and 191 gpcd was used for the Foothills and Mountains subarea. The historical average unit demand of the incorporated cities in Madera County is 270 gpcd. The City of Madera Water Master Plan assumed a unit water demand of 280 gpcd.

It is difficult to predict what future agricultural water use will be because of the many factors that impact the number, such as:

- Cropping patterns.
- Water use efficiency.
- Urbanization.

Figure 4-3. Madera County Historic Per-Capita Water Consumption, gpcd



Notes:
Historical per-capita consumption calculated by dividing water production by population and based on data submitted to CDPH.

- Cost of land.
- Cost of water.
- Possible controls on pumping to address groundwater overdraft.
- Transfers or purchase of agricultural surface water supplies for urban use.
- Irrigated land retirement.
- Reduction in agricultural surface water supplies due to increased regulations, and dedication of additional existing supplies to environmental purposes.

Table 4-4. Urban and Rural Projected Water Demand in Madera County

Community	Study Area	Water Demand (AFY)		
		2030 Population[(a)]	Population Difference (current vs. 2030)	Additional Water Required by 2030[(b)]
City of Chowchilla	Valley Floor	29,760	11,933	3,608
City of Madera		137,350	81,570	24,666
Unincorporated		127,500	86,946	26,292
Subtotal		**294,610**	**180,449**	**54,566**
Ahwahnee	Foothills and Mountains	6,252	3,351	717
Bass Lake		1,129	591	126
Coarsegold		24,965	13,955	2,985
North Fork		5,550	2,524	540
Oakhurst		13,274	7,502	1,605
O'Neals		6,150	3,066	656
Raymond		3,587	1,702	364
Subtotal		**60,907**	**32,691**	**6,993**
County Total (rounded)		356,000	207,000	62,000

[(a)]Population estimates taken from Table 2-2.
[(b)]Based on Valley Floor unit demand of 270 gpcd and Foothills and Mountains unit demand of 191 gpcd.

The California Water Plan Update 2005 (Update 2005) examined three different scenarios in an effort to describe possible future conditions and water demands in the state in the year 2030. Under all three scenarios, when all factors were accounted for, agricultural water use was estimated to decline.

In examining recent irrigated acreage and crop water use numbers for Madera County (Table 4-1 and Figure 4-1), it can be seen that both the number of irrigated acres and agricultural water use have been trending upward. These trends may continue in the near future; however, because of agriculture's heavy reliance on groundwater and the continued overdraft of the basin, the potential reductions in available surface water supplies due to reallocation of water for environmental uses, and conversion of agricultural land to urban uses, it is assumed that agricultural water use in Madera County will level off and be approximately 1.2 MAFY in 2030. This is approximately 2.5 percent greater than the estimated agricultural water use of 1.17 MAF in 2006. It is also assumed that continued technological advances in water use efficiencies will help offset cropping pattern changes to higher water demand crops, such as trees and vines. Update 2005 assumptions for decreased crop unit water use (increased irrigation efficiency) ranged from 5 to 8 percent in 2030 due to technological advances.

Table 4-5 summarizes the total existing and projected water demand for the County. The total demand in 2030 is projected to be approximately 1.3 MAFY, which is approximately 8 percent greater than the existing demand.

Table 4-5. Water Demand Summary

	Estimated Water Use (AFY)	
Water Purveyor/Use Type	**2006**	**2030[a]**
Agricultural	1,170,000	1,200,000
Urban and rural	29,540	91,500
Total	1,199,540	1,291,600
	Use 1,200,000	Use 1,300,000

[a]Based on water use shown in Table 4-4.

Chapter 5
Water Supply

A combination of groundwater and surface water is used to meet water demand in Madera County. This section characterizes the quantity of each of these water supplies and compares the existing water supplies to projected water demands. The potential impacts of relying solely on additional groundwater pumping to meet future demands are examined.

5.1 Existing Groundwater Supply

Groundwater is pumped in many parts of the County. Water for the Valley Floor is pumped from the Madera, Chowchilla, and Delta-Mendota groundwater subbasins (shown in Figure 5-1), which are hydraulically connected and are part of the greater San Joaquin Valley Groundwater Basin (SJV Basin). In the Foothills and Mountains, groundwater is drawn from wells and springs in weathered materials and fractures in the hard rock.

This section summarizes hydrogeologic information available for the Valley Floor and Foothills and Mountains. The two subareas are described in terms of location, extent, subsurface geology, water levels, groundwater flow, aquifer characteristics, pumpage, recharge, and available groundwater supply. This information is based on recent detailed studies conducted by KDSA as part of the IRWMP and AB303 studies as well as previous studies.

5.1.1 Valley Floor Groundwater Supply

Mitten, LeBlanc, and Bertoldi (1970) discussed regional groundwater conditions in the Madera area. The Madera area is bounded by the Chowchilla River on the north, the San Joaquin River on the west and south, and the edge of the valley floor on the northeast. Todd Engineers (2002) provided a Groundwater Management Plan for Madera County and described updated groundwater conditions in the Valley Floor. KDSA (1996) conducted a groundwater evaluation for the City of Madera sphere of influence for the City's Master Water Plan Update. Provost & Pritchard and KDSA (2001) conducted a comprehensive groundwater evaluation of the area northeast of the Santa Fe Railroad tracks, south of Highway 145, and west of Highway 41 for the Root Creek Water District. Fugro West, Inc. (2006) conducted a groundwater management study for the CWD, and their report contains updated and more specific information on groundwater conditions in and near the CWD. The following sections describe the groundwater supply in the Valley Floor based on the above references.

5.1.1.1 Subsurface Geologic Conditions

In most of the Valley Floor, the uppermost several hundred feet of deposits are coarser-grained than the underlying deposits. The coarser-grained deposits were termed the older alluvium by

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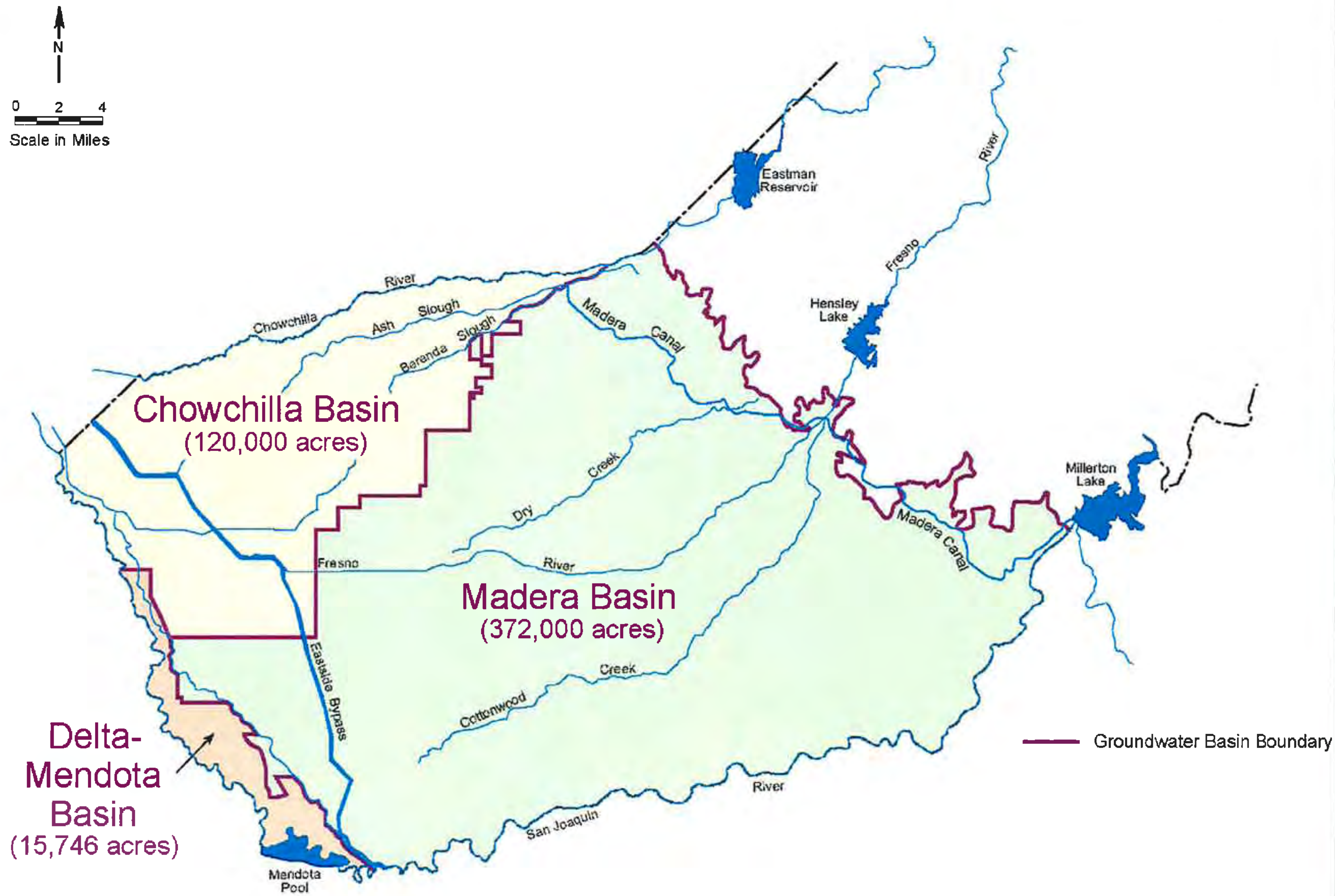

SOURCE: DWR BULLETIN 118 - 2003

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COUNTY OF MADERA INTEGRATED REGIONAL WATER MANAGEMENT PLAN	BEC PROJECT NO.	FIGURE
VALLEY FLOOR GROUNDWATER BASINS	22203.00	5-1

Mitten, LeBlanc, and Bertoldi (1970). The underlying primarily fine-grained deposits were termed the continental deposits. Shallow bedrock is present in the northeast part of the study area, primarily near the Madera Canal. The bedrock generally contains only small amounts of water, and yields of wells are generally too low to develop large-capacity wells. At the time of the report by Mitten, LeBlanc and Bertoldi (1970), many water supply wells in the Madera area were less than 400 feet deep. Since that time, many large-capacity wells have been drilled to more than 600 feet in depth. Some of the deepest known water wells in the area are about 1,300 feet deep.

Along the east side of the Valley Floor, clay layers are predominant in much of the interfan area, between the Fresno River and San Joaquin River and between the Chowchilla River and Fresno River. Two regionally extensive clay layers are present beneath the western part of the Valley Floor. The thickest and most widespread of these is the Corcoran Clay. The strata above this clay are termed the “upper aquifer,” and strata below are termed the “lower aquifer.” Few wells in the west part of the Valley Floor in Madera County are known to tap solely the lower aquifer. Rather, most of the deeper irrigation wells in the west part of this area are perforated both above and below the Corcoran Clay, and thus tap both aquifers. The east edge of the Corcoran Clay is indicated to be about 5 miles southwest of the City of Madera and to be slightly east of the City of Chowchilla. The top of this clay averages about 200 to 250 feet deep in the area west of Madera, and is about 400 feet deep near Mendota.

A shallower, less-extensive clay layer is present along the trough of the valley (i.e., near the San Joaquin River and northwest of Mendota). This clay is termed “A-clay” and is often overlain by shallow groundwater, particularly in the area west of the San Joaquin River where agricultural drainage problems are experienced. Near the Mendota Pool, relatively low-salinity groundwater is present above the A-clay, and numerous large-capacity wells have been drilled by the Mendota Pool Group to tap this water. This is one of the few locations in the San Joaquin Valley where groundwater above the A-clay is tapped by supply wells.

In several parts of the Madera area, deep wells have been drilled into highly productive black sands. Examples of locations are near Berenda and near Red Top. The black sands are part of the Mehrten formation, which is tapped by many large-capacity wells along the east edge of the valley north of Chowchilla.

5.1.1.2 Well Production and Aquifer Characteristics

Where more than 200 feet of saturated deposits are present, large-capacity wells in much of the Valley Floor can often yield over 500 gpm. In areas where more than several hundred feet of saturated deposits are present, well yields ranging from 1,000 to 2,500 gpm are possible. Specific capacities of wells are highly variable. Transmissivity has been determined from dozens of aquifer tests at well sites, including the City of Madera, the Columbia Canal Company service area, the Madera Ranch Water Bank, the Madera Community College, Madera Ranchos, S&J Ranch Rolling Hills, and Gunner Ranch. Transmissivities of deposits above a depth of 500 feet in areas where significant coarse-grained deposits are present normally range from 50,000 to 250,000 gpd/ft. Transmissivities of the underlying continental deposits normally range from about 10,000 to 30,000 gpd/ft.

5.1.1.3 Water Levels

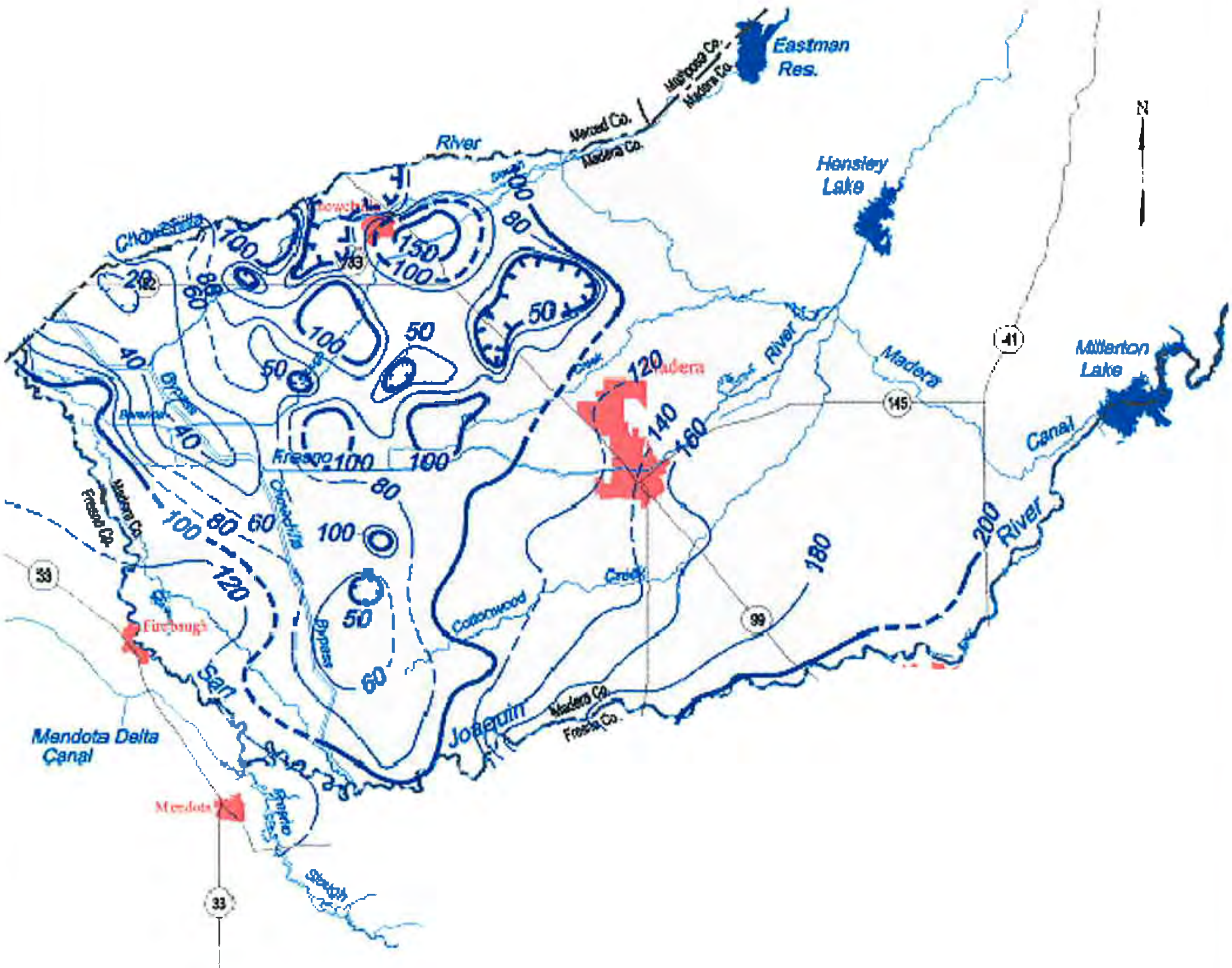
Annual maps showing water-level elevations in the Valley Floor area are prepared by DWR as shown in Figure 5-2. These maps are intended to primarily pertain to unconfined groundwater. However, in the western part of the Madera area, these maps are often based on measurements for composite wells (tapping both the upper and lower aquifers). Although it has been assumed by most investigators that all of the groundwater in the area east of the east edge of the Corcoran Clay is unconfined, drilling and testing of many deep wells in the east part of the Madera area during recent decades has provided contrary information. That is, relatively thick clay layers are often present below a depth of several hundred feet in the east part of the Valley Floor.

Although these clay layers are not regional in nature, they act to locally confine the underlying groundwater. New public supply wells in the City of Madera, the Madera Community College, the Avenue 13 School, Madera Ranchos, and Rolling Hills have tapped groundwater in deep deposits that are confined by an overlaying clay layer(s). Thus, an enhanced understanding of groundwater in the Valley Floor area is that groundwater within the uppermost several hundred feet is normally unconfined, whereas the deep groundwater is usually confined, whether or not the Corcoran Clay is present.

Historically, the direction of groundwater flow in much of the Madera area was to the southwest, toward the valley trough (San Joaquin River downstream of Mendota). However, as groundwater pumping increased, particularly after World War II, several large cones of depression developed. One of the largest depressions is located south of Highway 145 and northeast of the Santa Fe Railroad tracks. This depression coincides with an area with limited surface water use, thus groundwater pumping has been predominant. For many decades, instead of flowing uniformly to the southwest, groundwater has been flowing away from the San Joaquin River to the northwest. Seepage of streamflow in the San Joaquin River in the reach between Sumner Hill and Mendota is a major source of recharge to groundwater in Madera County.

Another cone of depression is located near and east of Fairmead. This coincides with another large area with little surface water deliveries. Groundwater pumping is predominant in this area, and water levels have been substantially lowered in recent decades. There are several additional cones of depression in the western part of the Madera Area. In general, these are west of CWD and MID, and north of the CCC, AWD, and GFWD service areas. Many modern-day irrigation wells in the area of these westerly cones of depression are perforated opposite both aquifers. The apparent lower levels are partly because the water levels in wells tapping the lower aquifer are lower than those tapping the upper aquifer. Experience indicates that water levels in composite wells are either between the water levels in each aquifer or are close to water levels in the lower aquifer.

Water-level hydrographs are available for the past five decades for hundreds of wells in the Valley Floor. Todd Engineers (2002) provided three dozen of these hydrographs in their report. Figure 5-3 shows Valley Floor hydrographs from 1920 to 2000, and Figure 5-4 shows historic average depth to groundwater for the CWD. Most of those hydrographs were for wells in districted areas where surface water has been available and conjunctive use has been practiced. Fewer water-level measurements are generally available for wells in the undistricted areas,



SOURCE: DWR

NOTE: UNCONFINED AQUIFER

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VALLEY FLOOR LINES OF EQUAL WATER ELEVATION IN WELLS, SPRING 2004

BEC PROJECT NO.
22203.00

FIGURE
5-2

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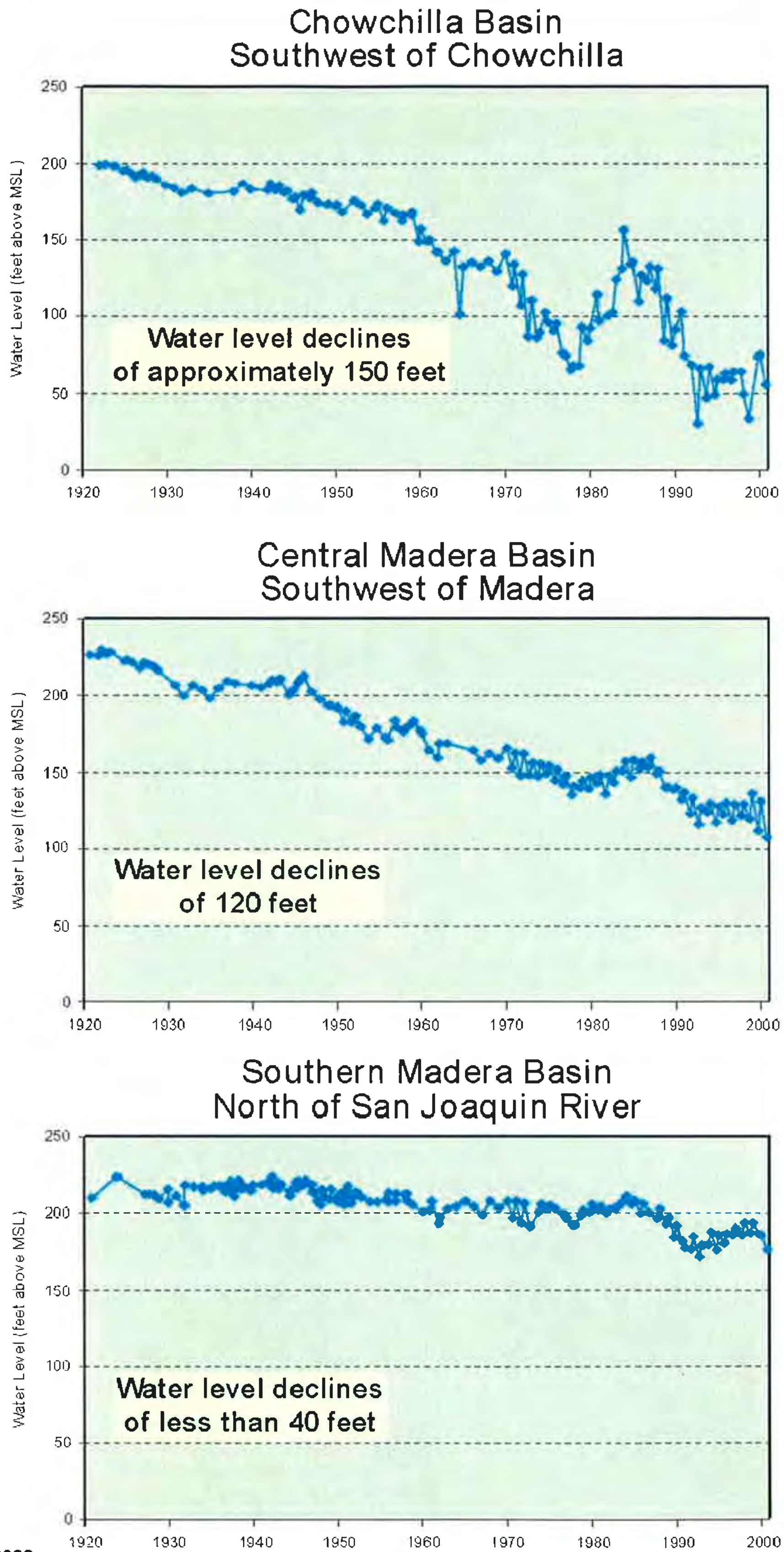

SOURCE: TODD ENGINEERS, 2002

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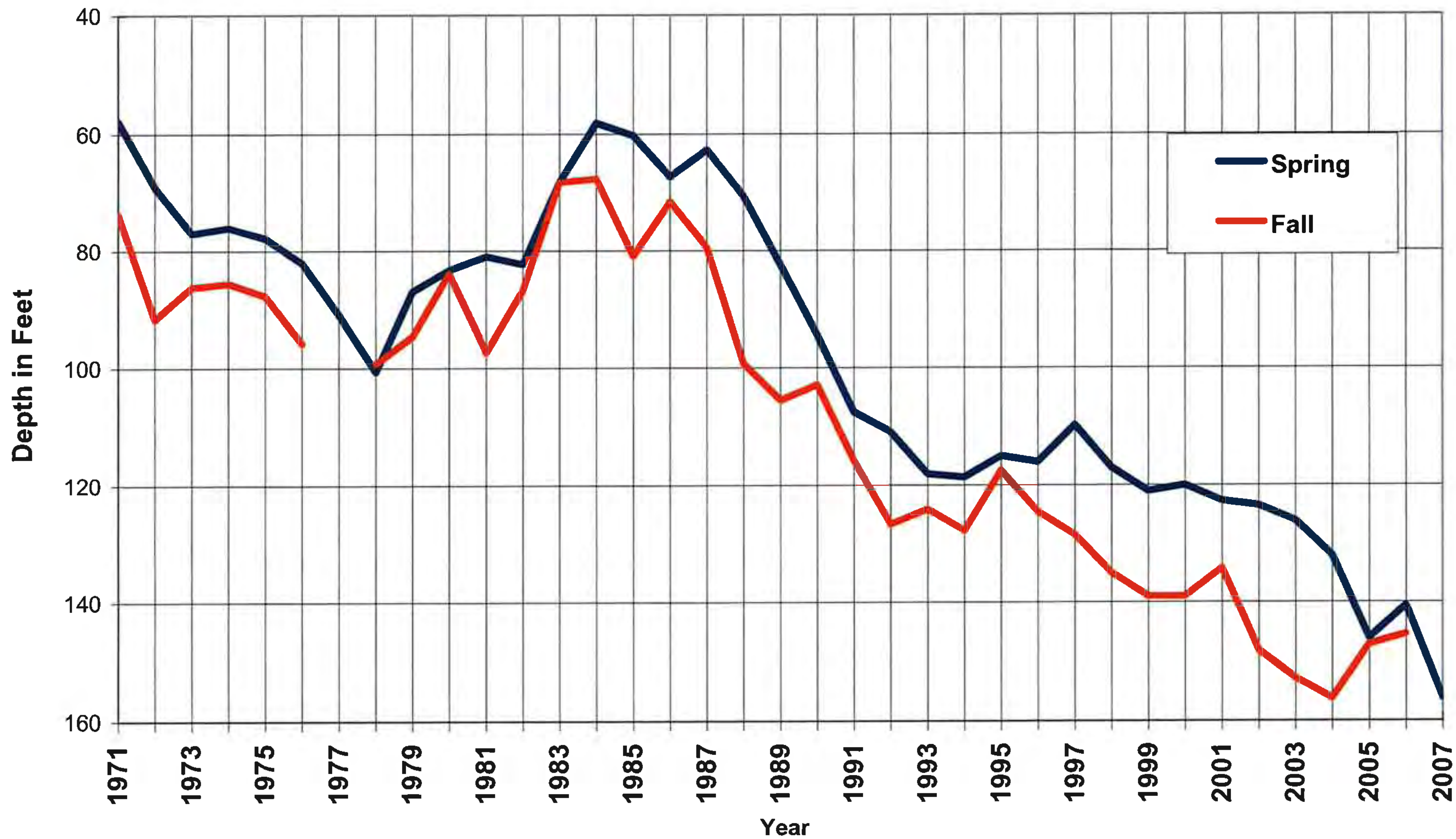
MANAGEMENT PLAN

VALLEY FLOOR HYDROGRAPHS
1920 - 2000

BEC PROJECT NO. 22203.00

FIGURE 5-3

Figure 5-4. Chowchilla Water District
Historic Average Depth to Groundwater



particularly in the southeastern part of the Madera area. The greatest water-level declines are occurring in these areas.

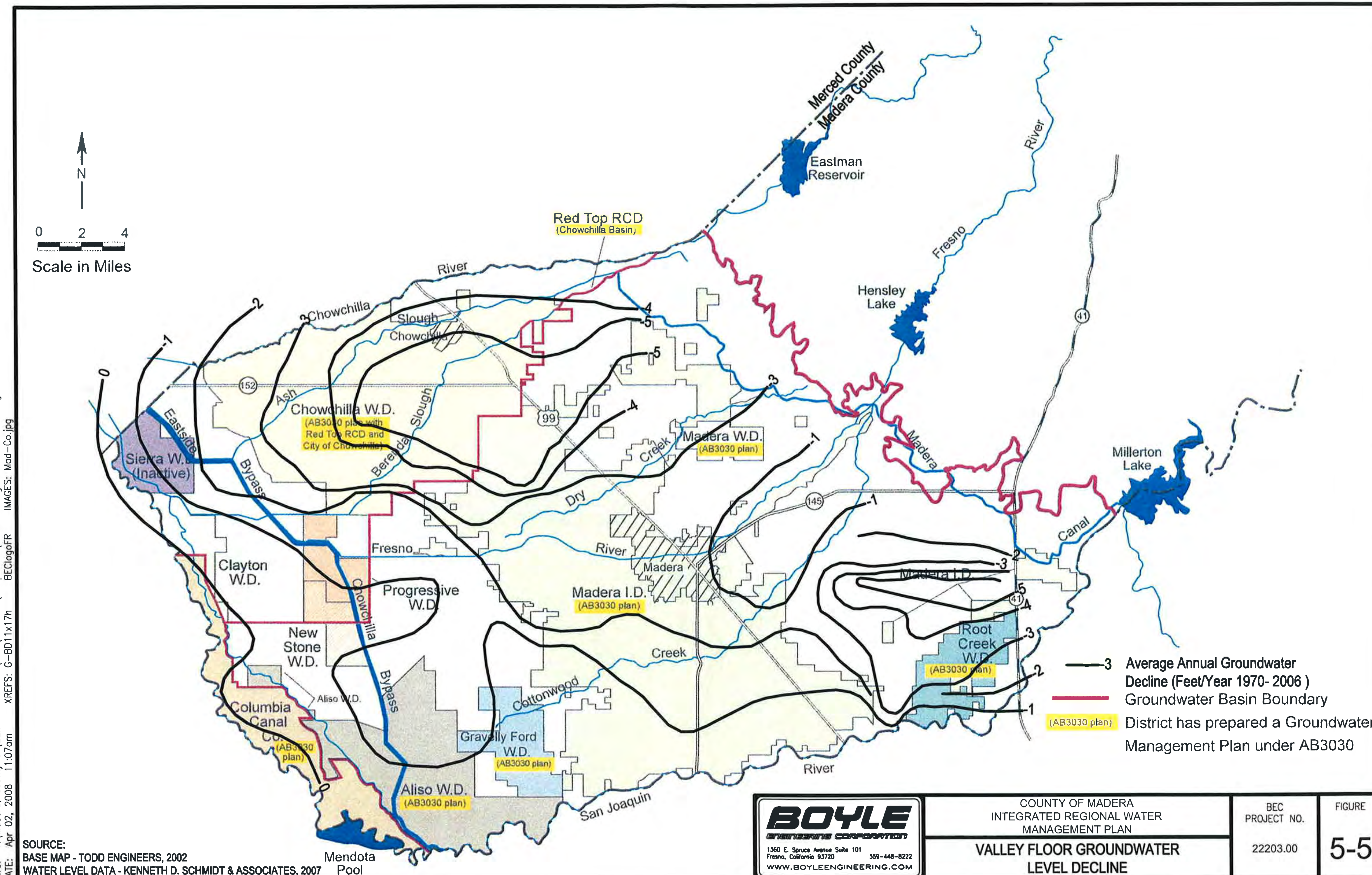
As part of this Plan, KDSA compiled water-level hydrographs for several hundred wells in the Valley Floor. These are primarily from DWR and from the RCWD. These hydrographs largely cover the past three decades, and water-level declines determined from them are more representative of recent conditions than hydrographs for earlier periods (i.e., prior to the mid-1970s). Figure 5-5 shows average rates of water-level decline in the Valley Floor based on these hydrographs. There has been virtually no water-level decline in recent decades near the San Joaquin River downstream of Mendota, near the west edge of the Valley Floor area in Madera County. Water-level declines have averaged about 1 foot per year farther east, primarily in the area between the Eastside Bypass and the San Joaquin River, and near the San Joaquin River upstream of Mendota. Rates of water-level decline generally increase with increasing distance from the Chowchilla River, the Fresno River, and the San Joaquin River. This confirms the importance of recharge from seepage of streamflow in these rivers. For example, near the Fresno River east of the City of Madera, the average rate of water-level decline has been less than 1 foot per year. In contrast, the greatest average water-level declines in the Madera area have exceeded 5 feet per year. These include areas east of the Santa Fe Railroad, such as Madera Ranchos, Rolling Hills, and nearby irrigated lands, that rely solely on groundwater pumpage.

Another area with very large water-level declines is in the eastern part of CWD and to the east, where irrigated lands and the City of Chowchilla rely solely on groundwater pumpage. The low precipitation in the Valley Floor, as shown in Figure 5-6, contributes little to groundwater recharge. Most of the precipitation contributes to evapotranspiration or is evaporated.

5.1.1.4 Groundwater Overdraft

A number of items in the groundwater budget, such as irrigation well pumpage, deep percolation of excess applied irrigation water, subsurface flows, and streamflow seepage, are not directly measured. Because of this, the most accurate method of estimating overdraft is by examining the historical rates of water-level declines and multiplying these by the estimated specific yield of the deposits. Specific yields have been provided in several reports by the U.S. Geological Survey.

Swanson (1992) evaluated unconfined water-level trends in the Valley Floor from 1970 to 1991. He estimated that the average annual groundwater overdraft in Madera County was about 74,000 AFY. Todd Engineers (2002) evaluated overdraft in the Valley Floor for the period 1990 to 1998. They estimated an average annual overdraft of about 68,000 AFY for that period. As part of this Plan, the Valley Floor was divided into six subareas to evaluate groundwater overdraft as shown in Figure 5-7. Overdraft was previously estimated in one of these areas by Provost & Pritchard and KDSA (2001). This was about 22,000 AFY in the area east of MID and south of the Fresno River. Overdraft in the area east of MID and CWD and north of the Fresno River has averaged about 30,000 AFY. In the area west of CWD and MID and north of the CCC, AWD, and GFWD service areas, the overdraft has averaged about 15,000 AFY. In MID, CWD, and the City of Madera, the overdraft has averaged about 28,000 AFY. An



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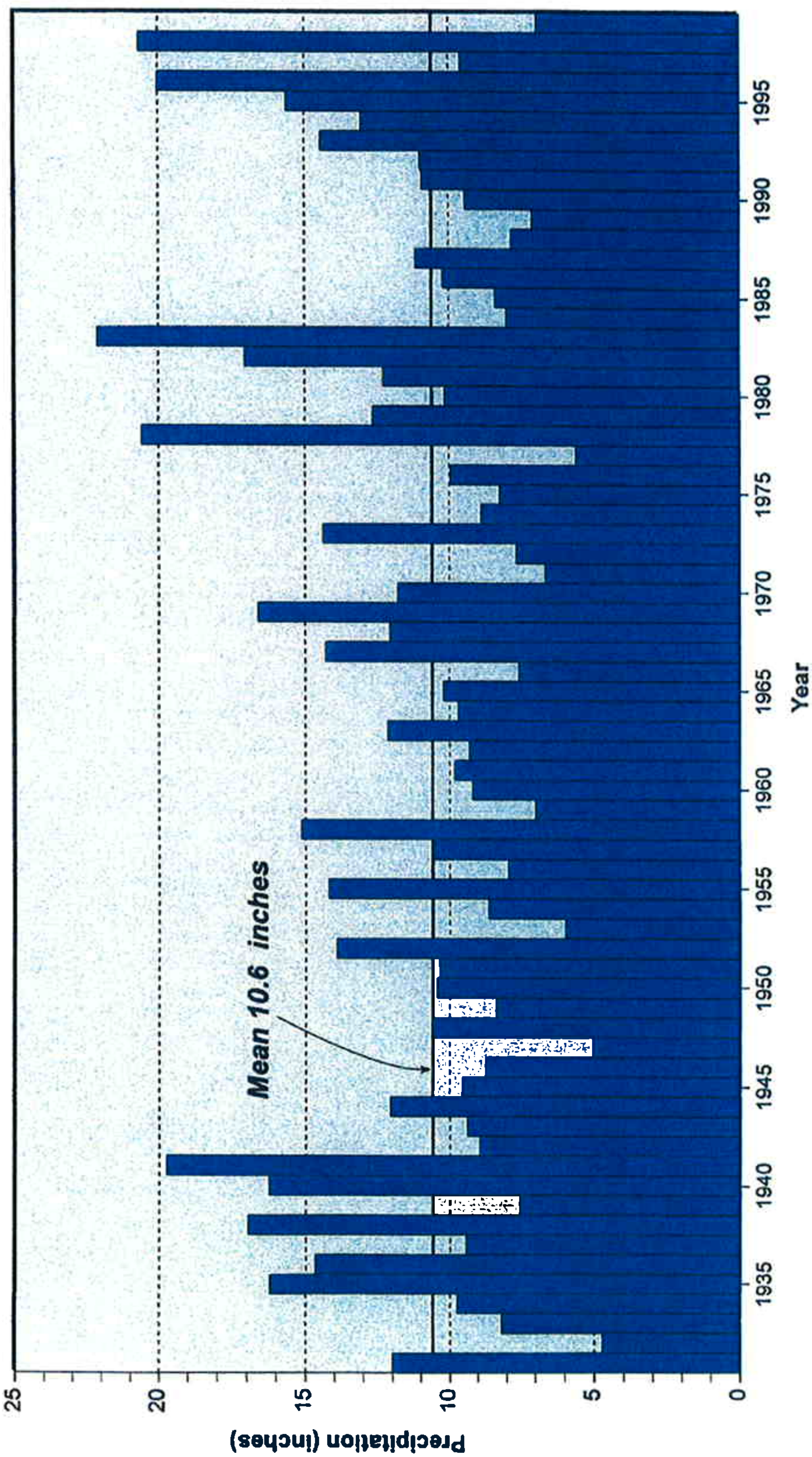

Based on monthly data from Madera Station No. 45233 NOAA

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ANNUAL PRECIPITATION AT MADERA FROM 1931-1999

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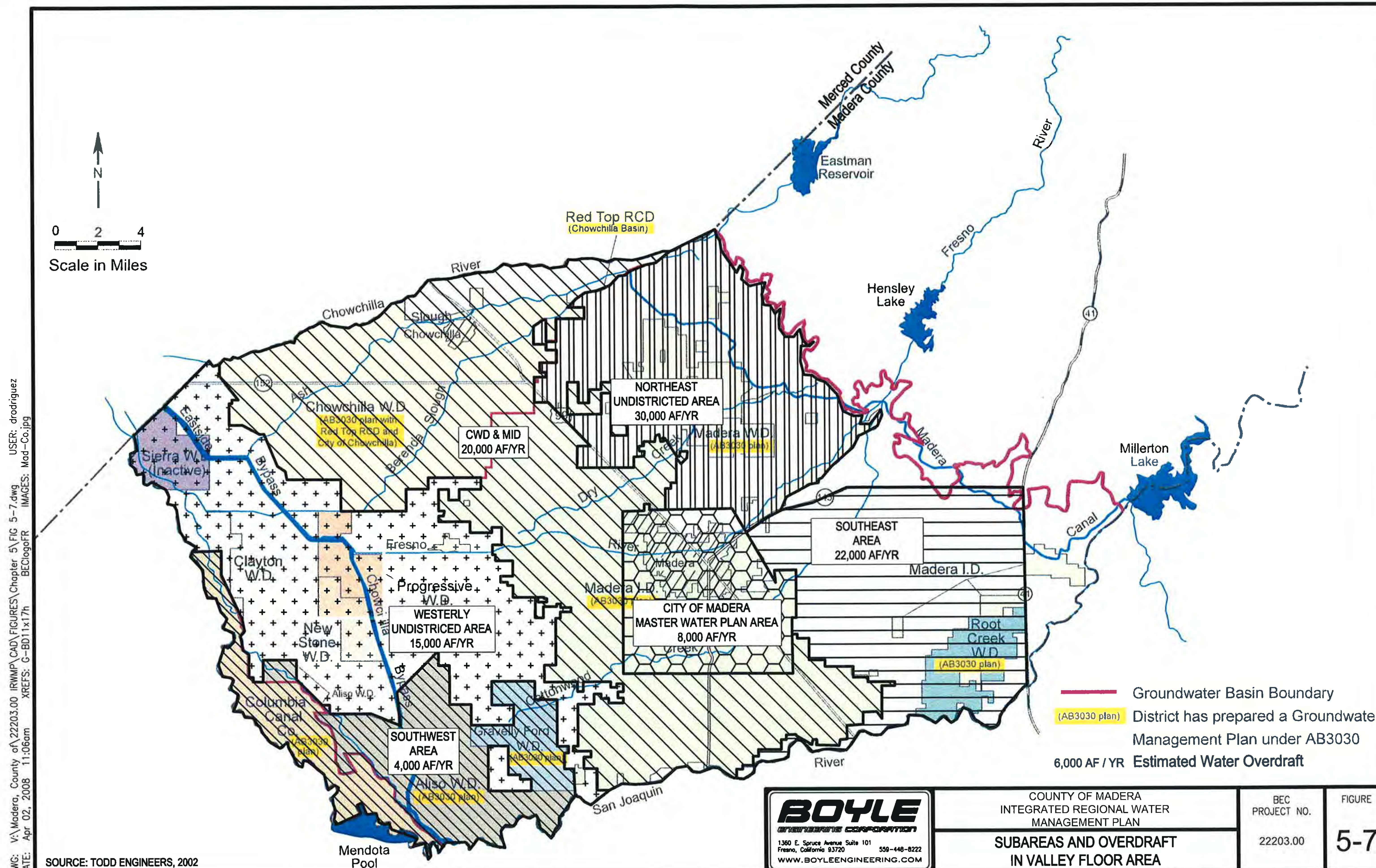
22203.00

FIGURE
5-6



COUNTY OF MADERA
INTEGRATED REGIONAL WATER MANAGEMENT PLAN

SUBAREAS AND OVERDRAFT IN VALLEY FLOOR AREA

BEC PROJECT NO. 22203.00

FIGURE 5-7

additional 4,000 AFY of overdraft has been present in the service areas of CCC, AWD, and GFWD.

The total amount of groundwater overdraft in the Valley Floor of Madera County, based on historical water-level declines for the past 30 years, is estimated to be about 100,000 AFY. The overdraft is continuing to increase with development of previously undeveloped land in the Valley Floor, including development of new irrigated land and additional urban and rural residential development relying solely on groundwater.

5.1.2 Foothills and Mountains Groundwater Supply

Some of the earliest information on groundwater in the Foothills and Mountains subarea was presented by DWR (1966) in Bulletin 135 (the Madera Area Investigation). Well depths and yields in the Oakhurst Basin were a topic of substantial discussion in that report. Unfortunately, modern-day hardrock drilling by the air-rotary method had just commenced at that time in the central Sierra Nevada. Earlier drilling methods, such as cable-tool, allowed only relatively shallow wells to be drilled, and they usually tapped weathered materials or shallow fractures above a depth of about 300 feet.

The development and perfection of the air-rotary method over the past four decades has allowed drilling to depths exceeding 1,400 feet in hardrock terrain. Deeper drilling has commonly indicated more deep water-producing fractures than was previously thought to be present. More groundwater can often be developed by drilling deeper in the Foothills and Mountains. This has been best illustrated in the Raymond area. Records on thousands of wells are now available for the Foothills and Mountains subarea.

Todd Engineers (2002) provided an updated evaluation of groundwater conditions in the Foothills and Mountains. Well depths and yields, water system wells, and groundwater quality were discussed. In 2004-05, KDSA conducted a comprehensive evaluation of groundwater in the Oakhurst Basin, pursuant to a DWR AB303 grant to Madera County. Included were discussions of geologic rock outcrops, fracture trends, large-scale linear features (lineaments), extensive water-level measurements and GPS surveys of wells and stream channels, preparation of the first water-level elevation maps and water-level hydrographs for supply wells in the area, evaluation of pumpage and recharge, and extensive water sampling. The technical report on the Oakhurst study can be found in Appendix A.

Precipitation, evapotranspiration, pumpage, and streamflow were evaluated in order to estimate potential groundwater recharge. Also in 2004-05, KDSA (2005b) conducted a comprehensive evaluation of groundwater in the Picayune Rancheria/Indian Lakes area pursuant to an agreement between Madera County and the Chukchansi Tribe of the Picayune Rancheria. This study evaluated similar features as for the Oakhurst Basin evaluation for the area near the Chukchansi Casino, and also focused on drawdowns in offsite wells associated with pumping for the casino. Additional areas in the Foothills and Mountains, as shown in Figure 2-2, were evaluated by KDSA during 2006-07, also pursuant to DWR grants to Madera County. The areas are North Fork, Coarsegold, and Raymond-Hensley Lake. The reports on these studies can be found in Appendices B through D.

5.1.2.1 Subsurface Geologic Conditions

The Foothills and Mountains are underlain by granitic and metamorphic rocks as shown in Figure 5-8. Groundwater in the Foothills and Mountains is normally developed from wells or springs tapping shallow weathered rock or underlying fractured hardrock. Generally, unfractured rock is present between fractures, and some fractures contain water and some do not. Groundwater occurs at variable depths at different locations. Substantial water production has been found at depths exceeding 700 feet at some locations in the Coarsegold, Raymond, North Fork, and Oakhurst areas.

5.1.2.2 Aquifer Characteristics

Aquifer tests have been conducted at several sites in Oakhurst, at one site in Raymond, at several sites in the North Fork area, at Yosemite Lakes Park, the Chukchansi Casino, and Meadow Springs in the Coarsegold area. Most of these tests can be used to estimate long-term well yields and determine drawdowns in other wells due to pumping of large-capacity wells. Transmissivities in hardrock areas commonly range from about 100 to 3,000 gpd/ft, which is much lower than typical values in alluvial deposits. Groundwater in fractured rock is often confined by overlying unfractured rock. Low storage coefficients, typical of confined aquifers, are usually found when aquifer tests are conducted on most hardrock wells.

5.1.2.3 Well Data

Important geologic features influencing the occurrence of groundwater are rock types, fracture patterns, and regional fractured zones that are termed lineaments. Depths of wells are variable but generally range from less than 100 to more than 1,000 feet. Large-capacity wells, commonly producing more than 50 gpm, are present in a number of water systems, including the Hillview Water Company systems in Oakhurst and Yosemite Lakes Park. Individual domestic wells, on the other hand, commonly produce in the range of several to more than 30 gpm. A characteristic of water system wells is that they are pumped at much higher rates and for much longer durations than are most individual wells.

5.1.2.4 Recharge

Recharge to groundwater in the Foothills and Mountains is derived from precipitation on the tributary watershed. Average precipitation is generally about 14 inches per year in the lowest foothill areas to more than 50 inches per year in the higher parts of the watersheds as shown in Figure 5-9 and 5-10. Evapotranspiration by plants ranges from about 13 inches per year in the lowest foothills to about 24 inches per year for conifer forest and meadows at higher elevations. Under the predevelopment condition, the difference between precipitation and evapotranspiration was streamflow. Development of groundwater in the Foothills and Mountains generally comes from a reduction in evapotranspiration or streamflow. In developed areas, groundwater is used for domestic purposes, and some is consumed by evapotranspiration. The remainder generally returns to the groundwater (i.e., septic tank effluent). There is little streamflow that originates in the low foothills because of the low precipitation, but the limited