6. Water Demand

This section focuses on the second regional water planning question: What is the region's current and projected future demand for water? To address this question, current and historical water uses within the Mora-San Miguel-Guadalupe Water Planning Region have been evaluated and are presented in Section 6.1. In order to estimate future water demand, it is important to understand demographic and economic trends in the region, and these are presented in Section 6.2. Projected future water demands for the region, based on current and historical uses and demographic and economic trends, are presented in Section 6.3.

6.1 Present Uses

Present and historical water use was determined based on information from the OSE, which tracks water use in New Mexico, supplemented with information contributed by water users within the region. Water use information includes information on total withdrawals or diversions from the systems, as well as on consumptive use (water that is completely used and does not return to the system). The OSE currently tracks water use in the following categories: public water supply, irrigated agriculture, self-supplied livestock, self-supplied commercial, industrial, mining, power, self-supplied domestic, and reservoir evaporation.

Over the years, the OSE has made a few changes in the way that water demand is categorized and reported:

- Fish and wildlife and recreation uses were previously (1975 through 1985) reported as separate categories, but now are included in the commercial category.

- Rural, urban, and military uses were separate categories until 1990, when they were replaced with the public water supply and self-supplied domestic categories.

- The OSE stopped reporting stockpond evaporation (which was previously a separate category) after 1985.

- Since 1990, the reservoir evaporation category has included only reservoirs that store at least 5,000 acre-feet.

The OSE water use inventories include only the amounts of water used by people or used through a man-made structure (i.e., reservoir evaporation) and thus do not include natural riparian consumption. Estimates for riparian consumption are provided in the water budget discussed in Section 7.

Table 6-1 and Figure 6-1 show water depletions in each category for the years 1975, 1980, 1985, 1990, 1995, and 2000 based on the OSE inventories for those years (Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003, respectively). Appendix F1 provides these data by county, as well as total withdrawals and return flows. The trends in historical demand, which were used in projecting future demand for each of the current OSE categories, are summarized and discussed in Sections 6.1.1 through 6.1.5.

Current depletions vary somewhat among the three counties. Whereas agriculture is by far the largest depletion in Mora County (Figure 6-2), evaporation from Santa Rosa and Conchas Lakes dominates depletion in Guadalupe and San Miguel Counties; nevertheless, irrigated agriculture is also a large component of water use in those counties (Figure 6-2).

6.1.1 Public Water Supply and Self-Supplied Domestic

These two OSE categories include domestic use from public water supplies that serve whole communities and from private domestic wells that serve only one or a few residences, as discussed in Sections 6.1.1.1 and 6.1.1.2, respectively.

6.1.1.1 Public Water Supply

This category includes community water systems that rely on surface water and/or groundwater diversions and consist of common collection, treatment, storage, and distribution facilities operated for the delivery of water to multiple service connections (Wilson et al., 2003). Water used for the irrigation of self-supplied golf courses, playing fields, and parks, as well as water used to maintain the water level in ponds and lakes owned and operated by a municipality or water utility, is also included in this category. Inclusion of these uses, when such data are available, allows comparison of the total amount of water used by the system to the water rights owned by these public water suppliers.

Table 6-1. Total Depletions in the Mora-San Miguel-Guadalupe Planning Region, 1975-2000

Use Category	Total Depletions (acre-feet)											
	2000		1995		1990		1985		1980		1975	
	Surface Water	Ground-water	Surface Water	Ground-water	Surface Water	Ground-water	Surface Water	Ground-water	Surface Water	Ground-water	Surface Water	Ground-water
Commercial (self-supplied)	164	200	170	95	97	135	0	110	0	44	NA	NA
Fish and wildlife	---	---	---	---	---	---	4,156	0	2,722	0	2,570	0
Recreation	---	---	---	---	---	---	26	186	83	260	0	100
Domestic (self-supplied)	0 [a]	1,351 [a]	0	533	0	363	---	---	---	---	---	---
Rural	---	---	---	---	---	---	0	898	0	759	0	473
Industrial (self-supplied)	0	0	0	0	0	0	0	8	0	0	NA	NA
Manufacturing	---	---	---	---	---	---	NA	NA	NA	NA	0	21
Irrigated agriculture	38,582	730	35,638	1,060	41,868	938	33,280	754	39,240	940	38,130	1,010
Livestock (self-supplied)	507	806	577	966	504	888	698	707	908	931	823	823
Mining (self-supplied)	0	0	0	4	0	4	---	---	---	---	---	---
Minerals	---	---	---	---	---	---	0	7	0	5	0	4
Power (self-supplied)	0	0	0	0	0	0	0	0	0	0	0	0
Public water supply	922	823	1,014	790	1,035	382	---	---	---	---	---	---
Urban	---	---	---	---	---	---	1,354	0	1,190	3	962	181
Military	---	---	---	---	---	---	0	0	0	0	0	0
Reservoir evaporation	60,541	0	61,477	0	28,441	0	47,160	0	34,630	0	20,900	0
Playa lake evaporation	---	---	---	---	---	---	NA	NA	NA	NA	0	0
Stockpond evaporation	---	---	---	---	---	---	1,931	0	1,931	0	1,950	0
Total	100,716	3,910	98,876	3,448	71,945	2,710	88,605	2,670	80,704	2,942	65,335	2,612

Sources: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

[a] DBS&A estimates 1,876 ac-ft/yr diversion from domestic wells in 2000

NA = Not available

--- = Not tracked as a separate category in this reporting year.

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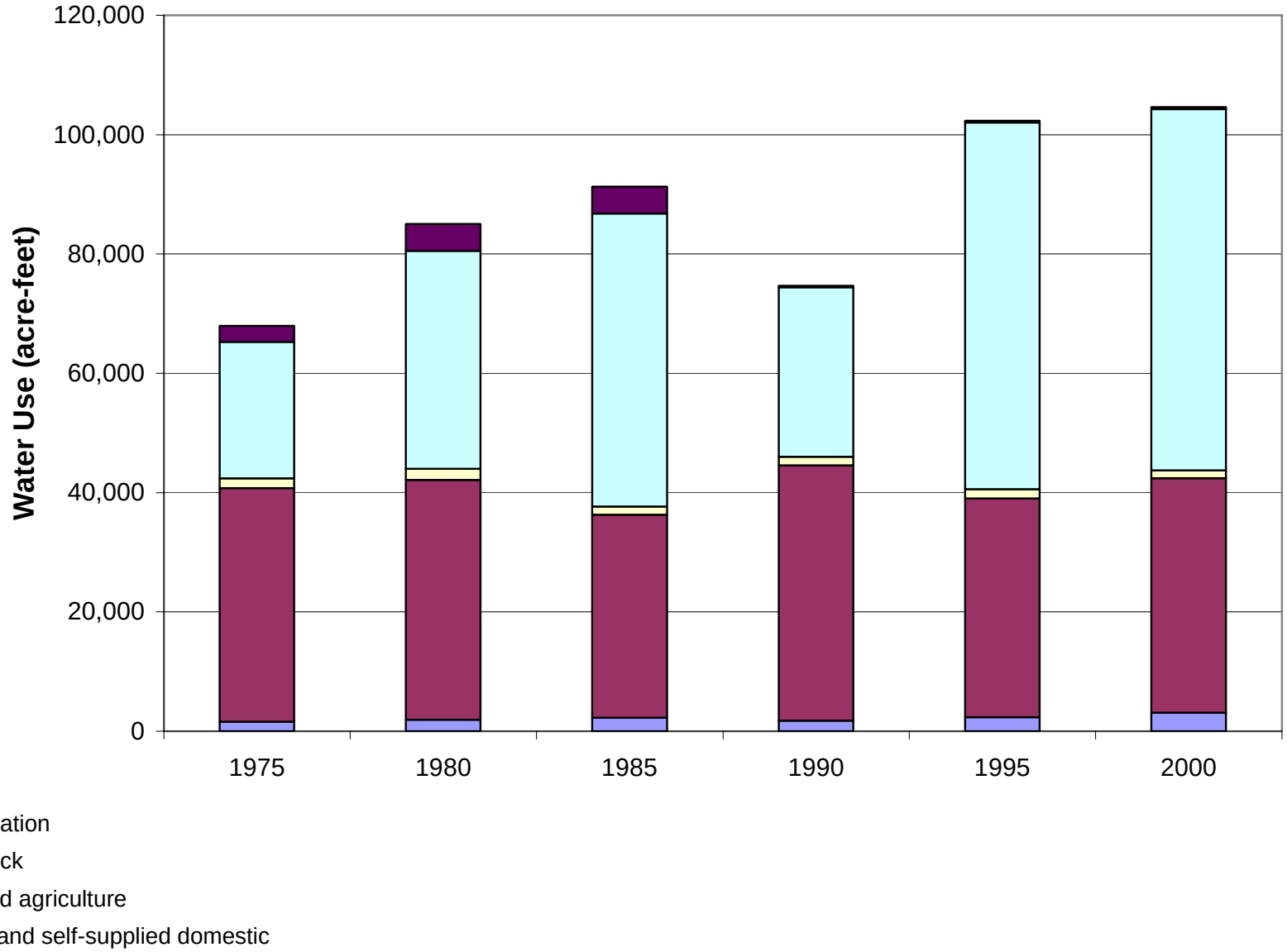

Figure 6-1

MORA-SAN MIGUEL-GUADALUPE WATER PLANNING REGION

Historical Depletions, 1975-2000

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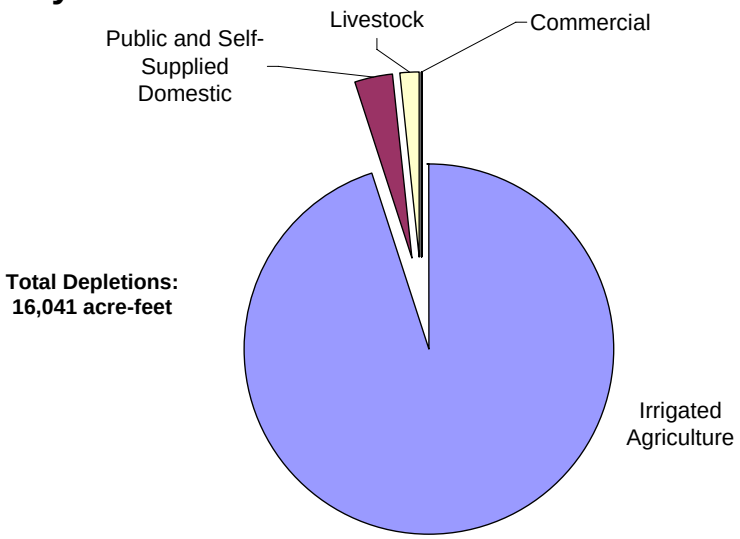
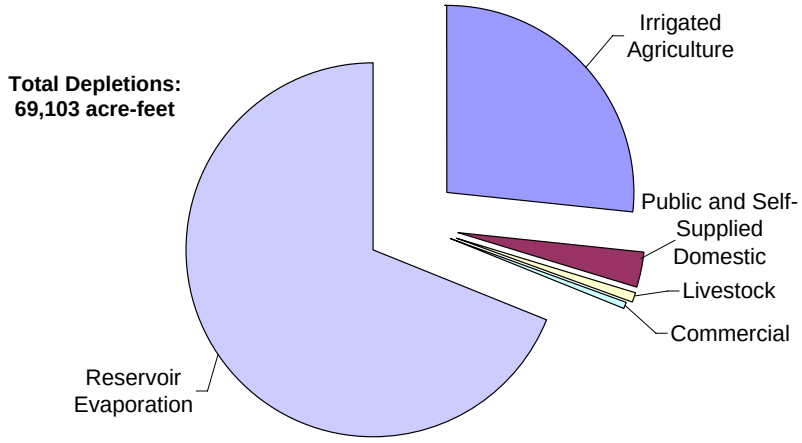
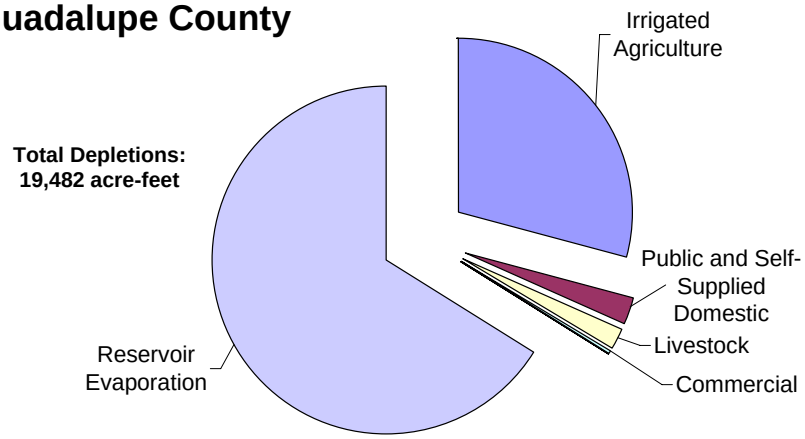
Mora County



San Miguel County



Guadalupe County



MORA-SAN MIGUEL-GUADALUPE
WATER PLANNING REGION

Depletions in the Planning Region in 2000

Figure 6-2

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Current information on public water systems in the three counties was compiled from the OSE inventory (Wilson et al., 2003) and is summarized in Appendix F2. As indicated on the table in Appendix F2, information on 32 public water systems in the planning region is available. The public water systems listed include both incorporated municipalities and smaller mutual domestic associations, such as mobile home communities.

Recent water diversions by the major municipalities, including per capita use, are summarized in Table 6-2 based on Wilson et al. (2003); details of each system for the year 2000 are provided in Appendix F2. While smaller system per capita demands may vary widely (from 40 to 250 gpcd), diversions by these systems were averaged (Table 6-2) for use in the future demand projections, to account for possible errors in metering or in estimating the population served by each small system. Large per capita demands may also be due to temporary leaks or breaks in the water lines, which can result in a large one-time deviation in per capita demand on a small system. Small per capita demands in some cases may be accurate, due to poor-quality water being used only minimally, and ideally, each system should evaluate its needs based on its own per capita usage. However, for purposes of developing regional estimates, the average per capita demand was used.

Table 6-2. Summary of Municipal/Community and Per Capita Water Diversions in 2000

Water System	Municipal Well or Surface Water Diversions (ac-ft/yr)	Population Served by Public Wells	Per Capita Demand	
			(ac-ft/yr)	(gpd)
Mora County				
Rural public supplied	305	1,351	0.23	202
San Miguel County				
Las Vegas	2,387	14,565	0.16	146
Village of Pecos	195	1,441	0.14	121
Rural public supplied	377	4,519	0.12	109
Guadalupe County				
Santa Rosa	621	2,744	0.23	202
Rural public supplied	278	1,392 [a]	0.20	178

Source: Wilson et al., 2003

[a] Includes 135 outside the planning region that are served by the Vaughn water system.

ac-ft/yr = Acre-feet per year
gpd = gallons per day

Most of the municipalities listed rely on groundwater; however, 5 of the 32 systems (the City of Las Vegas, Big Mesa Water Co-op, Conchas Dam, Pendaries Water System, and the San Jose Mutual Domestic Water Consumers Association) depend on surface water (Appendix F2). The Taylor Well Field supplies supplemental groundwater to the City of Las Vegas when surface water from the Gallinas River is insufficient to meet demands. Return flow from municipal diversion is estimated by Wilson et al. (2003) to range between 42 and 65 percent.

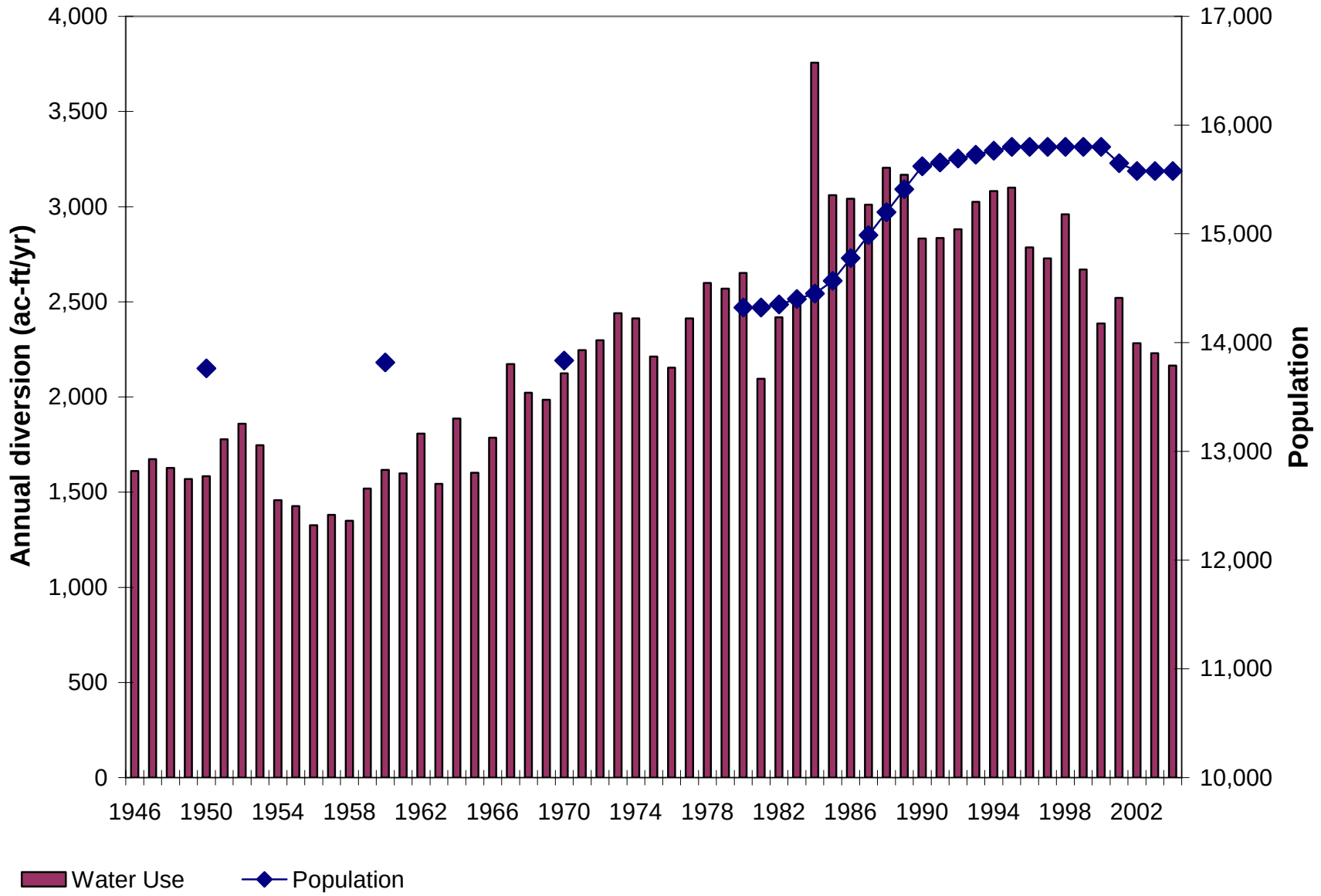
The population and historical use of water for the City of Las Vegas is shown in Figure 6-3. Per capita demand (Figure 6-4) has increased from just above 100 gpcd in the late 1940s to near 200 gpcd in the 1980s (a peak above 200 gpcd in 1984 may be due to an error in metering or a major leak, rather than to actual demand). Implementation of conservation measures in the late 1990s has been effective in reducing per capita demand to below 150 gpcd (to a low of 124 gpcd in 2004).

Las Vegas serves communities outside of the city limits, and the actual population served is therefore greater than the Census 2000 population of 14,565 cited by Wilson et al. (2003). All calculations of population served by domestic wells and municipal systems are based on Wilson et al. (2003), which may overstate the number of domestic wells in San Miguel County. Wilson and Lucero (1997) show a population supplied by Las Vegas of 15,800 people, 1,300 people more than in 2000, whereas the census for Las Vegas showed little change in population from 1990 to 2000.

6.1.1.2 Self-Supplied Domestic Wells

This category includes self-supplied residences, which may be single-family or multi-family dwellings, with wells permitted by the OSE under NMSA Section 72-12-1 (Appendix D, Section D.2.2.2).

The OSE WATERS database was used to estimate domestic well locations (Figure 6-5). The WATERS database is incomplete at present and therefore may not provide a complete representation of the wells present in the planning region. Nevertheless, the number of domestic wells in each county, as listed in WATERS (NM OSE, 2003), is outlined below:



MORA-SAN MIGUEL-GUADALUPE WATER PLANNING REGION

City of Las Vegas Population and Historical Annual Water Diversions

Figure 6-3

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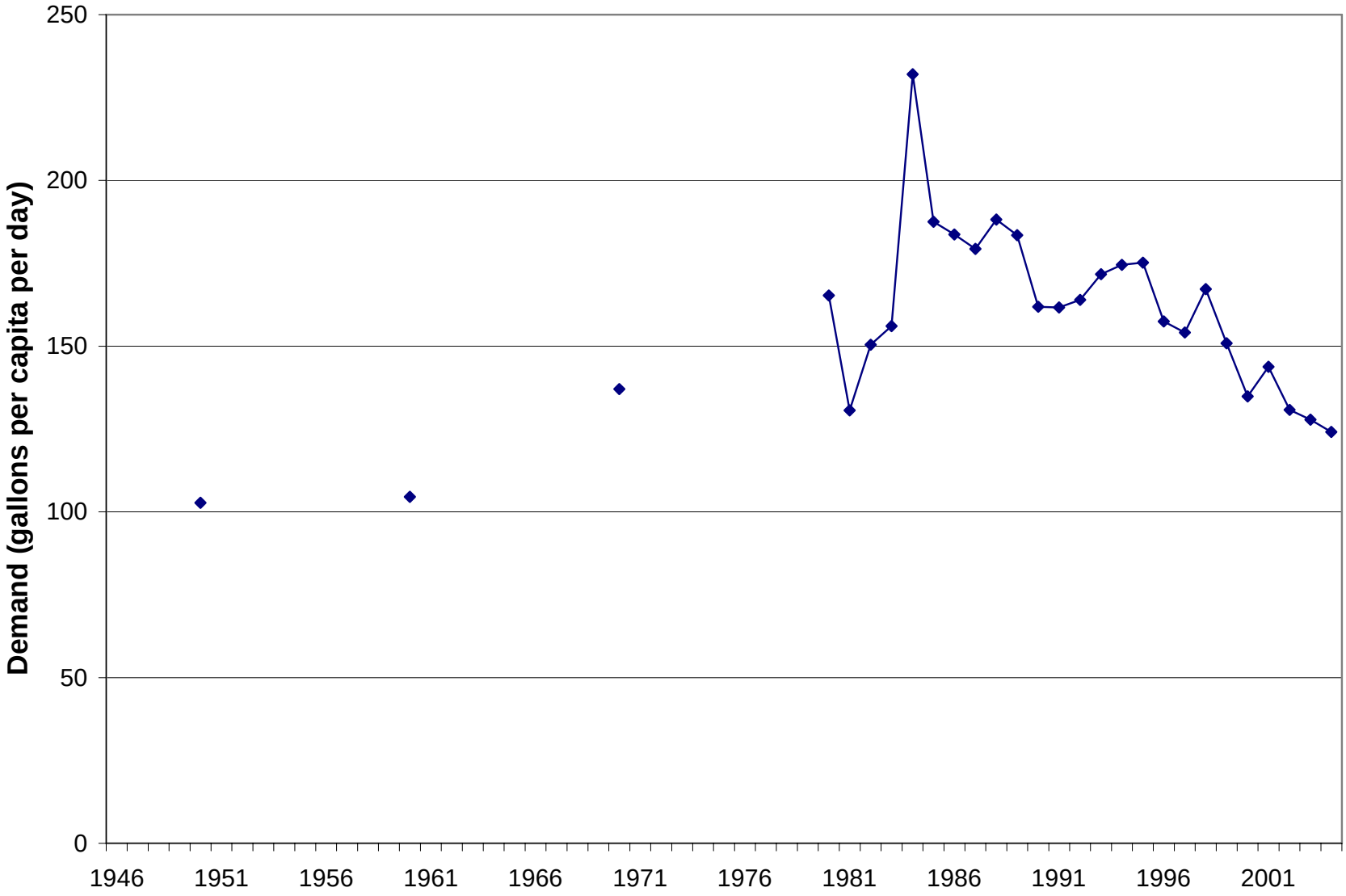

Figure 6-4

MORA-SAN MIGUEL-GUADALUPE WATER PLANNING REGION

City of Las Vegas Historical Per Capita Demand

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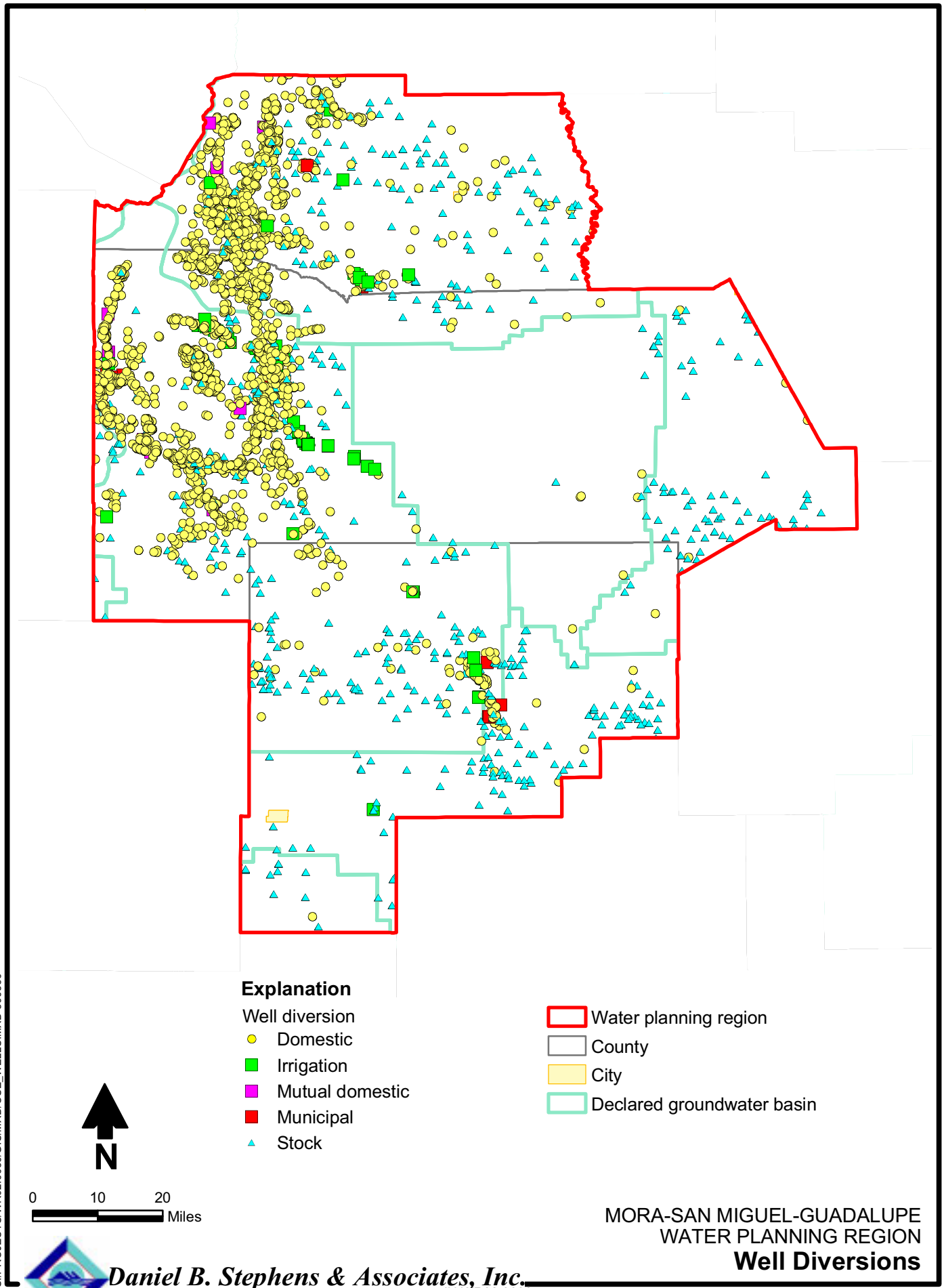

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MORA-SAN MIGUEL-GUADALUPE
WATER PLANNING REGION

Well Diversions

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3-29-05

JN WR02.0036

Figure 6-5

- Mora County: 1,115
- San Miguel County: 2,431
- Guadalupe County: 141

Because domestic wells are not metered, water use in the self-supplied category was estimated based on the procedure defined by Wilson et al. (2003), which is to subtract the population (and water diversions) served by public water supply systems from the total county population (and water diversions). For the three counties in the planning region, the total withdrawals in 2000 for the self-supplied domestic well category were so estimated at 1,876 ac-ft/yr.

DBS&A's estimate is about 40 percent higher than the one provided by Wilson et al. (2003) (Table 6-3, Appendix F1), even though the same procedure was used in developing the estimates. The discrepancy is due to refined estimates for the population served by community water systems. For instance, Wilson showed that the Vaughn water system served a population of 1,300, whereas the City of Vaughn reports serving 582 residents in 2000. Vaughn also serves the communities of Encina and Duran which brings the total population served by the Vaughn water system to 717, still significantly lower than the OSE estimate. This lower estimate of population served by the Vaughn water system results in a higher estimate served by self-supplied wells in Guadalupe County (70 ac-ft/yr estimated by DBS&A versus 18 ac-ft/yr estimated by Wilson et al.). DBS&A also used per capita demand rates based on rural community water system usage for each county, which ranged from 0.1 to 0.13 acre-foot per capita, whereas OSE uses 0.09 ac-ft/yr per capita. DBS&A's estimate is more consistent with OSE's estimates of diversions from Guadalupe County domestic wells of 97 acre-feet in 1995 and 87 acre-feet in 1990, both of which are much higher than their 2000 estimate.

An alternate estimate can be developed by assuming that (1) about 80 gallons per capita per day (gpcd) are withdrawn at each domestic well (Wilson et al., 2003) and (2) on average, each domestic well supplies 2.55 persons (based on 2000 Census). Based on these assumptions, the use at each domestic well would be 0.23 ac-ft/yr. The above estimates from the WATERS database indicate that about 3,700 wells exist in the three-county area, in which case, at 0.23 ac-ft/yr per well, self-supplied domestic use in the region would total about 850 ac-ft/yr (Table 6-3). However, there is considerable uncertainly in that method, because the number of

domestic wells listed in the WATERS database may not be accurate (particularly for Guadalupe County, for which the record seems particularly short) and because the "average" domestic well withdrawal rate is very hard to estimate. A more detailed accounting of domestic wells is necessary to accurately quantify their impact.

Table 6-3. Comparison of Estimates of Domestic Well Diversions in 2000 by County

	Estimated Domestic Well Diversions						
	Mora		San Miguel		Guadalupe		Total
Estimate Source	ac-ft/yr	ac-ft/cap	ac-ft/yr	ac-ft/cap	ac-ft/yr	ac-ft/cap	(ac-ft/yr)
DBS&A [a]	503	0.13	1,303	0.12	70	0.10	1,876
OSE [b]	343	0.09	989	0.09	18	0.09	1,350
WATERS [c]	255	0.09	559	0.09	32	0.09	846
Difference [d] (ac-ft/yr)	160		314		52		526
Difference [d] (%)	47		32		290		39

[a] Based on population balance and average water diversions in the county
[b] Wilson et al., 2003
[c] Assuming 0.27 ac-ft/yr per domestic well in OSE WATERS database
[d] Difference between DBS&A and OSE estimates

ac-ft/yr = Acre-feet per year
ac-ft/cap = Acre-feet per capita

6.1.2 Self-Supplied Commercial, Industrial, Mining, and Power

Wilson et al. (2003) define these categories as follows:

- Commercial includes self-supplied businesses (e.g., motels, restaurants, recreational resorts, and campgrounds) and institutions. Self-supplied golf courses that are not watered by a public water supply are also included, as are off-stream fish hatcheries engaged in the production of fish for release.

- Industrial includes self-supplied enterprises engaged in the processing of raw materials or the manufacturing of durable or non-durable goods. Water used for the construction of highways, subdivisions, and other construction projects is also included.

- Mining includes self-supplied enterprises engaged in the extraction of minerals occurring naturally in the earth's crust, including (1) solids, such as coal and smelting ores,

(2) liquids, such as crude petroleum, and (3) gases, such as natural gas. Water used for drilling and/or processing at a mine site is also included.

- Power includes all self-supplied power-generating facilities. Water used in conjunction with coal mining operations that are contiguous with a power-generating facility that owns and/or operates the mines is also included. The Hope Decree lists a water right for hydroelectric power in Santa Rosa from Rito de Agua Negra Chiquita in the Pecos River Basin, but no water use associated with this right has yet occurred.

As shown in Table 6-1, the self-supplied commercial and mining categories are a relatively small part of the planning region's water demand. Rock and gravel quarries are the only resource extraction activities that occur in the three-county area (Section 5.4.1.4), and quarries are not water-intensive. Power production and industrial activities have not occurred in the planning region in the past or recently, and no water has been used in these categories since 1975. However, water use in the power and industrial sector is expected to increase a minor amount in the future (Section 6.3).

6.1.3 Self-Supplied Livestock

Livestock use represents a relatively small proportion (about 2 percent) of the total depletions in the region. The total depletions for self-supplied livestock in the MSG region for the years 1990, 1995, and 2000 are provided in Table 6-4. During these three years, depletions for livestock use were equal to livestock withdrawals. About 40 percent of the water for livestock use is derived from surface water and 60 percent from groundwater.

Table 6-4. Livestock Water Use

Reporting Year	Total Depletion (acre-feet)		
	Mora	San Miguel	Guadalupe
1990	276	603	513
1995	303	696	543
2000	280	640	393

Sources: Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

Estimates of the total number of cattle and sheep in the three counties for 1990, 1995, and 2000 were obtained from NMASS (2003) (Table 6-5).

Table 6-5. Estimated Number of Livestock by County

Reporting Year	Mora			San Miguel			Guadalupe		
	Cattle	Sheep	Total	Cattle	Sheep	Total	Cattle	Sheep	Total
1990	23,000	1,000	24,000	49,000	1,500	50,500	38,000	27,000	65,000
1995	26,000	500	26,500	55,000	100	55,100	41,000	16,000	57,000
2000	24,000	400	24,400	53,000	200	53,200	31,000	12,000	43,000

Source: NMASS, 2003

Virtually all the livestock in Mora and San Miguel Counties are cattle, with small numbers of sheep as well (Table 6-5). A large number of cattle are also raised in Guadalupe County, though one-third to one-half of livestock in the county are sheep. Using the OSE livestock water depletion values for 2000 and the livestock numbers from the NMASS for the same year, the water consumption per animal in each county is estimated below, assuming that the numbers of other livestock such as horses are minimal compared to cattle and sheep:

- Mora: 10.2 gallons per day per head (gpd/head)
- San Miguel: 10.7 gpd/head
- Guadalupe: 8.2 gpd/head

These per-head or per-capita consumption rates are consistent with the values presented as typical in the OSE's 2000 water use report (Wilson et al., 2003, Section 5.6). Water use per head per day in Guadalupe County is probably less due to the fact that sheep are smaller than cattle and thus consume less water.

6.1.4 Irrigated Agriculture

Irrigated agriculture is the second largest water use, after reservoir evaporation, in the planning region. The water used for agriculture irrigates a variety of crops, primarily alfalfa and mixed hay along with minor amounts of wheat, vegetables, oats, and orchards (Table 6-6). Most of the

water used for irrigated agricultural in the planning region is obtained from surface water of the Upper Pecos and Upper Canadian Rivers and their tributaries. In the year 2000, groundwater accounted for less than 2 percent of all agricultural depletions in the region (Wilson et al., 2003).

Table 6-6. Irrigated Acreage by Crop and County for 2002

Crop	Irrigated Acres		
	Mora	San Miguel	Guadalupe
All hay (including alfalfa)	6,528	4,352	1,118
Corn	0	W	0
Oats	W	30	0
Sorghum	0	0	W
Wheat for grain	0	W	228
Vegetables	W	7	18
Orchards	27	53	16
Total cropland harvested	9,201	4,668	1,394

Source: USDA, 2005
W = Withheld to avoid disclosing data for individual farms.

The relative percentages of crops, as reported by Romero (1994), are outlined in Table 6-7.

Table 6-7. Crop Percentages by Basin

Crop	Percentage of Total Crops in Basin	
	Canadian River	Pecos River
Alfalfa	83.7	55.1
Permanent pasture	7.5	18.3
Mixed hays	5.8	14.5
Row crops	1.4	11.5
Orchards	1.3	0.6

Where legal decrees exist, the number of acres that can legally be irrigated is established in the decree (Section 4). However, recent hydrographic surveys and water use reports (NM OSE, 1991; Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003) indicate that the number of acres that are being or have recently been actually irrigated (referred to herein as irrigated land) is less than the reported total acreage that

legally can be irrigated (i.e., holds water rights). This deviation appears to be related to the lack of surface water for diversion due to drought conditions, to variable and poor agricultural market conditions, and to the conversion of agricultural land to residential subdivisions. As an example, Table 4-3 shows the acreage adjudicated in the Hope Decree and the acreage that has actually been irrigated over the years.

Sections 6.1.4.1 through 6.1.4.3 discuss the reported water use and irrigated acres by county in the planning region, as reported by OSE.

6.1.4.1 Mora County

Cropland in Mora County is irrigated almost exclusively by surface water supplied by the Canadian River and its tributaries. In the year 2000, less than 1 percent of irrigation water in Mora County was supplied by groundwater. The Mora and Upper Pecos Rivers and their tributaries are the main surface water sources in the county. Table 6-8 summarizes the irrigated acreage, total water withdrawals, and total water use (depletions) as reported by the OSE for Mora County.

Table 6-8. Irrigation Water Use in Mora County

Reporting Year	Total Acres Irrigated	Total Withdrawal (acre-feet)	Total Depletion (acre-feet)
1975	14,420	44,700	20,140
1980	13,760	42,660	19,550
1985	13,150	41,342	15,338
1990	13,990	38,174	17,715
1995	14,610	36,485	16,976
2000	14,880	32,671	15,234

Sources: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

The actual cropland that was apparently irrigated appears to vary somewhat, based on the dates reported. The OSE reported that the irrigated acreage ranged from 13,150 to 14,880 acres during the period of 1975 to 2000 (Table 6-8). Martinez (1990) shows a total of 26,122 acres irrigated in 1989.

The consumptive irrigation requirement for irrigated land in Mora County is reported to range from 0.598 to 1.021 acre-feet per acre along the Arkansas, White, and Red River Basins (Wilson et al., 2003).

6.1.4.2 San Miguel County

According to the OSE (Wilson et al., 2003), the only source of irrigation water in San Miguel County is surface water from the Pecos River and its tributaries and the Sapello River, tributary to the Mora River.

The total reported irrigated acreage ranges from 10,570 acres in 1980 to 12,380 acres in 1990 (Table 6-9). As shown in Table 4-3, a total of 23,116 acres were adjudicated in the Hope Decree in San Miguel County in 1933, whereas Wilson et al. (2003) shows only 11,145 acres irrigated, or about 48 percent of the total acreage with water rights, in 2000.

Table 6-9. Irrigation Water Use in San Miguel County

Reporting Year	Total Acres Irrigated	Total Withdrawal (acre-feet)	Total Depletion (acre-feet)
1975	11,120	23,730	11,100
1980	10,570	27,840	12,930
1985	10,665	26,393	11,217
1990	12,380	37,794	17,530
1995	11,730	29,512	11,388
2000	11,145	47,838	18,370

Sources: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

According to the OSE (Wilson et al., 2003), the consumptive irrigation requirements range from a low of 0.57 to a high of 1.584 acre-feet per acre, for the Storrie Irrigation Project and the Canadian River, respectively.

6.1.4.3 Guadalupe County

The Pecos River is the main source of water used for irrigation in Guadalupe County. In the year 2000, surface water provided 88 percent of irrigation water, and much of the groundwater pumped from shallow wells for irrigation in the Pecos floodplain is most likely water that has

been recharged by the river as it passes over the highly permeable San Andres Limestone. Table 6-10 summarizes the irrigated acreage, total water withdrawals, and total water use (depletions) as reported by the OSE for Guadalupe County.

Table 6-10. Irrigation Water Use in Guadalupe County

Reporting Year	Total Acres Irrigated	Total Withdrawal (acre-feet)	Total Depletion (acre-feet)
1975	3,140	15,610	7,900
1980	3,480	15,440	7,700
1985	3,375	17,555	7,479
1990	3,385	15,139	7,561
1995	3,765	20,236	8,334
2000	3,660	13,871	5,708

Sources: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

Although the Hope Decree indicates that the total acreage with water rights is about 1,603 acres, the land actually irrigated in Guadalupe County between 1975 and 2000 ranged from 3,140 to 3,765 acres. The reason for this discrepancy is that OSE includes acreage irrigated in Anton Chico, which is not included in the Hope Decree, as part of Guadalupe County. For the acreage listed in the Hope Decree from Dilia to Guadalupe Station (Table 4-3), OSE shows 973 acres and 1,113 acres in 1995 and 2000 respectively, or about 60 to 70 percent of the adjudicated water rights.

The consumptive irrigation requirement (the amount of water consumed by the crop, minus precipitation) for irrigated land in Guadalupe County is reported to range from 1.297 to 2.118 acre-feet per acre along the Pecos River Valley (Wilson et al., 2003).

6.1.5 Reservoir Evaporation

The OSE reports reservoir evaporation as calculated from pan evaporation (measured by various federal agencies that operate the reservoirs) multiplied by the surface area of the reservoirs under consideration. The calculated evaporation is corrected by the amount of

precipitation that falls on the reservoir(s), so this category actually reflects a net evaporation rather than a total evaporation. Table 6-11 summarizes the net reservoir evaporation reported by the OSE.

Table 6-11. Total Depletions Attributed to Evaporation

Reporting Year	Total Depletion (acre-feet)		
	Mora	San Miguel	Guadalupe
1975	2,097	19,847	906
1980	2,224	31,326	3,011
1985	2,224	27,591	19,276
1990	0	23,971	4,470
1995	0	47,406	14,071
2000	0	47,653	12,888

Sources: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

Over the years the OSE has modified the way in which it reports evaporation data. Whereas reservoir, stockpond and playa lake evaporation were formerly tabulated as individual categories, playa lake and stockpond evaporation were no longer inventoried by the OSE after 1975 and 1985, respectively. Additionally, since 1990 the OSE has reported reservoir evaporation only for reservoirs with 5,000 or more acre-feet of storage. Total OSE-reported depletions resulting from evaporation shown in Table 6-11 reflect these reporting changes as well as modifications to the surface water system in the planning region:

- In Mora County, the lack of evaporative losses starting in 1990 is actually the result of the fact that, in addition to the cessation of stockpond and playa lake evaporation reporting, the county has no reservoirs with more than 5,000 acre-feet of storage.

- In San Miguel County, it is likely that the decrease in total evaporative losses from 1985 to 1990 is also due to the small reservoirs not being reported by the OSE beginning in 1990. The near-doubling of evaporative losses from 1990 to 1995 is probably due to the fact that annual water yields for rivers in the county were much higher from 1994 through 1995 than from 1988 through 1990 (Appendix E2). The high streamflow in 1994 and

1995 would have increased storage in local reservoirs, resulting in larger surface areas available to facilitate evaporation, whereas the lower inflow to reservoirs immediately prior to 1990 would have resulted in less surface area available to evaporation during that time.

- In Guadalupe County, the dramatic increase in evaporative losses during the period of record can mostly be attributed to construction of Santa Rosa Reservoir, which was completed in 1980. The low evaporative loss reported in 1990 in Guadalupe County is probably due to the aforementioned low annual water yields from 1988 through 1990, which likely resulted in low Santa Rosa Reservoir levels and thus a small surface area to facilitate evaporation in 1990.

6.2 Projected Demographics

Future water demand in the planning region depends on the future growth of the region's population and economy. Accordingly, Southwest Planning & Marketing (SWPM) projected growth in 10-year increments from 2000 to 2040. The population projections were based on information from interviews with selected community representatives, historical population trends, and Bureau of Business & Economic Research (BBER) population projections. Based on this information, both high growth rate and low growth rate scenarios for future population development were determined.

The population projections developed by SWPM under both low and high growth scenarios are provided in Appendix F3 and summarized in Table 6-12. The population projections for the entire planning region show an increase of approximately 15,000 residents under the low growth scenario and 29,000 under the high growth projection (Table 6-12). San Miguel County currently has the majority of the population and will maintain that majority under both the high and low projections (Table 6-12).

Table 6-12. Population Projections
Mora-San Miguel-Guadalupe Water Planning Region

County	2000	2010	2020	2030	2040
Low growth					
Mora	5,205	5,609	5,896	6,045	6,136
San Miguel	29,723	34,190	38,218	41,512	43,939
Guadalupe	4,696	4,687	4,682	4,682	4,687
Total	39,624	44,486	48,796	52,238	54,762
High growth					
Mora	5,205	6,203	7,143	7,890	8,468
San Miguel	29,723	34,495	40,033	46,459	53,918
Guadalupe	4,696	5,304	5,748	5,989	6,059
Total	39,624	46,002	52,923	60,338	68,445

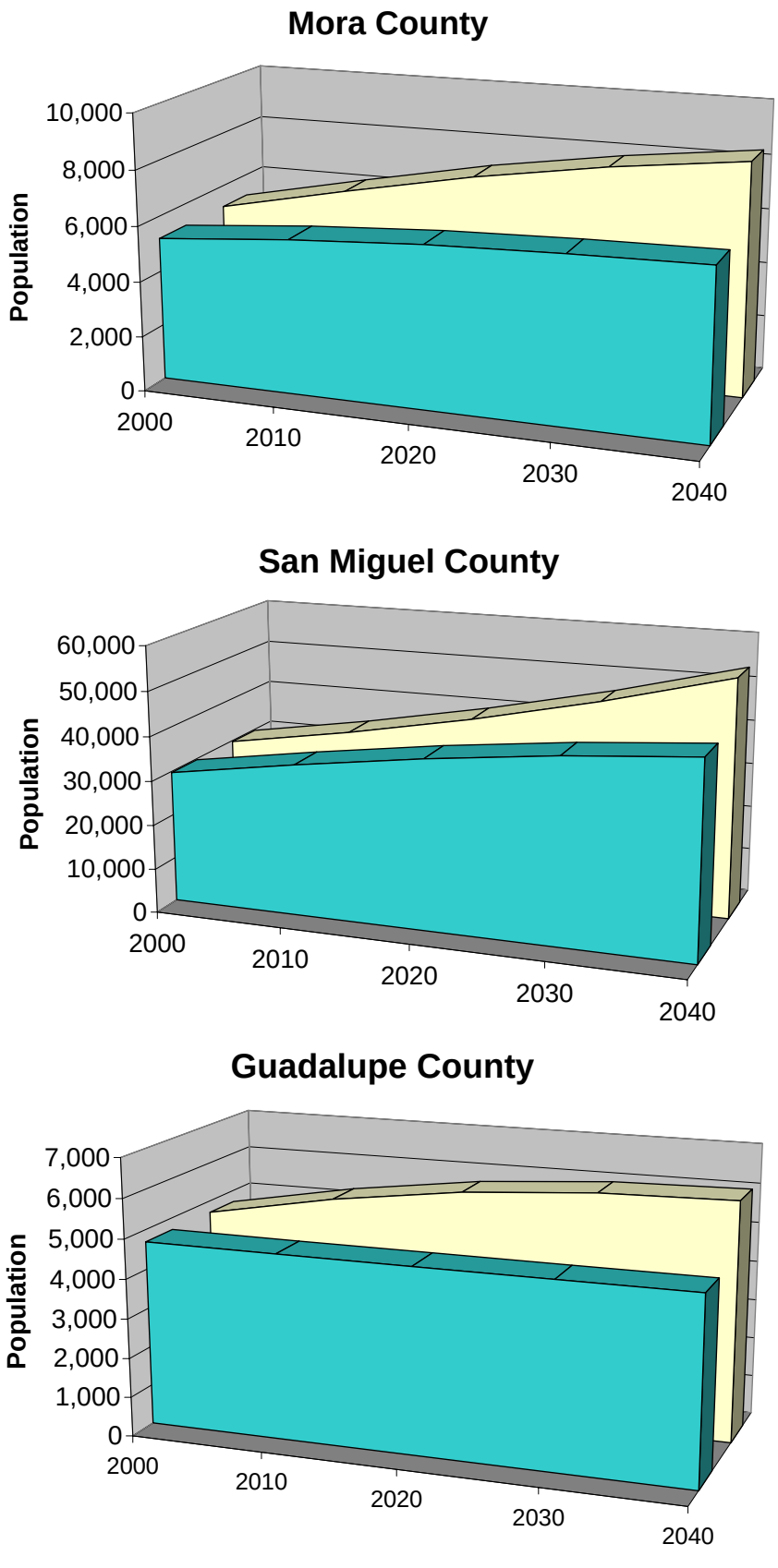
6.2.1 Mora County

The population of Mora County is projected to increase under both the high and low growth scenarios (Table 6-12, Figure 6-6). Under these forecasts, Mora County's 2000 population of about 5,200 will increase to between 6,000 residents and 8,500 residents in 2040. The increase is due to (1) the in-migration of new residents who are building vacation, second, and retirement homes on retired ranches and (2) a positive natural population increase.

6.2.2 San Miguel County

Population projections for San Miguel County show an increase for both the low and high scenarios (Table 6-12, Figure 6-6). San Miguel's 2000 population of approximately 30,000 will increase to about 44,000 residents in 2040 under the low scenario and 54,000 under the high scenario. The low projection assumes that the City of Las Vegas population will not increase.

The high projection assumes that the southern end of San Miguel County along the Interstate-25 (I-25) corridor will continue to gain population because it is located within the City of Santa Fe's commuter shed and offers more affordable and rural living options compared to adjacent Santa Fe County. In addition, the high scenario assumes that economic development efforts will be successful at attracting new businesses and new residents to Las Vegas.



MORA-SAN MIGUEL-GUADALUPE WATER PLANNING REGION

Projected Population Growth in the Planning Region

Figure 6-6

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The rural population of San Miguel County is projected to be about 67 percent of the total county population under the low growth scenario in 2040 (Appendix F3). Under the high growth scenario, the rural population would maintain the majority at 66 percent of the total county population (Appendix F3).

6.2.3 Guadalupe County

The population of Guadalupe County is expected to remain flat (low growth scenario) or grow by almost 1,400 people (Table 6-12, Figure 6-6). The City of Santa Rosa currently is home to about 58 percent of the County population and will increase that percentage to 71 percent in 2040 under the low growth projection (Appendix F3). The historically declining rural population trend may continue (low growth) or remain at the current levels (high), but the population of the county is not expected to increase. The high growth projection assumes a continued robust tourist economy, further economic diversification represented by industries such as the Guadalupe County Correctional Facility, and sustaining the current level of the region's agricultural economy.

6.3 Projected Water Use for 40-Year Planning Horizon

This section provides estimates of future water diversions in the region. To assist in bracketing the uncertainty of the projections, low and high water use estimates were developed for the various water use sectors, based on population growth projections (Section 6.2; Appendix F3) and input from the steering committee. Sections 6.3.1 through 6.3.8 describe the methods or assumptions used in projecting future water diversions for the various use sectors. Estimates of projected future water diversions in all sectors in the entire region are shown on Table 6-13. Projections of future water diversions for each sector, segregated by County and showing the growth rates and assumptions used to project future water use, are included in Appendix F4.

SWPM analyzed how the projected growth in population will affect water use in eight use sectors:

- Commercial (self-supplied)
- Industrial (self-supplied)

- Mining (self-supplied)
- Power (self-supplied)
- Irrigated agriculture
- Livestock (self-supplied)
- Municipal water supply
- Residential (self-supplied domestic)

The reservoir evaporation water use category is not driven by population growth and was therefore estimated based on historical use amounts.

Table 6-13. Projected Water Uses in the Mora-San Miguel-Guadalupe Region

Sector	2000 Total Withdrawal (acre-feet)	Growth Scenario	Projected Water Diversions (ac-ft/yr)			
			2010	2020	2030	2040
Commercial	363	Low	412	456	492	519
		High	421	486	560	644
Industrial	0	Low	0	0	0	0
		High	22	24	27	30
Mining	1	Low	1	1	1	1
		High	1	1	1	1
Power	0	Low	0	0	0	0
		High	12	12	12	12
Irrigated agriculture	94,380	Low	92,783	91,264	89,819	88,444
		High	95,328	96,286	97,253	98,230
Livestock	1,313	Low	1,313	1,313	1,313	1,313
		High	1,381	1,454	1,532	1,615
Municipal/public	4,163	Low	4,351	4,532	4,671	4,769
		High	4,554	5,009	5,497	5,987
Domestic	1,876	Low	2,292	2,659	2,953	3,169
		High	2,355	2,856	3,376	3,960
Reservoir evaporation	62,723	Low	44,251	44,251	44,251	44,251
		High	63,659	63,659	63,659	63,659

ac-ft/yr = Acre-feet per year

Future water demand in the residential, commercial, and municipal sectors depends largely on the degree of population growth and therefore varies throughout the planning region, from

stable population in Guadalupe County under the low growth projection to moderate growth in Mora and San Miguel Counties. Any growth will likely be driven by tourism and in-migration of residents due to the trend for businesses and self-employed individuals to relocate to rural communities with high quality of life. Communities along the I-25 corridor between Santa Fe and Las Vegas in San Miguel County are within the Santa Fe commuter shed, allowing people to live in rural mountain communities and still take advantage of employment opportunities and social and cultural amenities in Santa Fe. Santa Rosa in Guadalupe County is dependent on tourism from travelers on I-40.

For the most part, both the irrigated agriculture and livestock sectors in the planning region are projected to either remain constant or increase slightly. The industry, mining and power sectors may increase by a small amount. The projected water use in each sector is discussed in detail in Sections 6.3.1 through 6.3.8.

6.3.1 Public Water Supply and Self-Supplied Domestic

The public water supply projections are based on the county and municipal population growth estimates developed by SWPM (Section 6.2; Appendix F3). Based on pumping and population records, the per capita use (diversions) for individual communities varied from about 34 gpcd at Upper Hollman to more than 202 gpcd in Santa Rosa, where water use by the transient population along Interstate 40 is high. County average per capita use rates varied from 123 gpcd for San Miguel County to 186 gpcd for Guadalupe County (Table 6-14).

Table 6-14 shows the projected growth for the largest communities of Las Vegas and Santa Rosa based on their individual per capita demand. The growth in other communities is grouped into those on rural pubic systems and those that are self-supplied. This plan assesses future demand for the region as a whole, as compared with the available supply, to assess the overall demand gap in the planning region and alternatives to meet that gap. Because the actual growth rate of individual communities may vary from the overall average growth rate, communities should conduct their own water planning to evaluate their local future infrastructure and water rights needs.

Table 6-14. Public and Domestic Water Use Projections for the Mora-San Miguel-Guadalupe Water Planning Region, 2000-2004

County	City/Category	Per Capita Demand (gpcpd)	Per Capita Demand (ac-ft) [a]	Population Served in 2000 [a]	Water Demand in 2000	Scenario	Projected Water Diversions (ac-ft/yr) 2010	2020	2030	2040
Guadalupe	Santa Rosa	202	0.23	2,744	621	Low	748	794	819	826
						High	826	937	999	1,018
	Rural public (includes Vaughn [b])	178	0.20	1,392	278	Low	243	218	205	202
						High	281	282	280	279
	Self-supplied	90	0.10	695	70	Low	60	53	50	49
						High	71	71	71	70
	Total Guadalupe	179	0.20	4,831	969	Low	983	994	1,001	1,003
						High	1,105	1,205	1,260	1,277
San Miguel	Las Vegas	146	0.16	14,565	2,387	Low	2,381	2,381	2,381	2,381
						High	2,441	2,566	2,765	2,979
	Rural public	109	0.12	4,519	572	Low	718	865	985	1,073
						High	715	890	1,080	1,304
	Self supplied	109	0.12	10,639	1,303	Low	1,689	2,036	2,319	2,527
						High	1,684	2,094	2,542	3,071
	Total San Miguel	123	0.14	29,723	4,262	Low	4,788	5,281	5,684	5,982
						High	4,840	5,550	6,387	7,355
Mora	Public systems	202	0.23	1,351	305	Low	329	346	355	360
						High	364	419	463	497
	Self-supplied	117	0.13	3,854	503	Low	542	570	584	593
						High	600	690	763	819
	Total Mora	139	0.16	5,205	808	Low	871	916	939	953
						High	963	1,109	1,225	1,315
Three-county total/average		136	0.15	39,759	6,039	Low	6,643	7,191	7,624	7,938
						High	6,909	7,864	8,873	9,947

[a] Wilson et al., 2003
[b] Vaughn serves 135 people outside the planning region.

gpcpd = Gallons per capita per day
ac-ft = Acre-feet

ac-ft/yr = Acre-feet per year

Future water use was projected as follows:

- *High water use projection:* The current county average usage rate for non-municipal uses was multiplied by the high population projections for the rural areas. The population projections for the individual cities were multiplied by each city's per capita demand in 2000 to obtain the projected municipal water use. The rural self-supplied population was calculated as the remaining population not counted in municipal or public supply systems. The water use was based on the average demands of small public systems and the population growth projections for each county as presented by SWPM (Appendix F3).

- *Low water use projection:* The water usage rates described for the high water use projections were multiplied by the low population estimates to obtain the low water use projection. Alternatives such as water conservation or growth management, if adopted, would lower the projections (Section 8).

Under the high water use projection, the domestic and municipal demand for water (6,039 ac-ft/yr) would increase by 4,000 ac-ft/yr (to about 10,000 ac-ft/yr) by 2040, as compared to an increase of about 2,000 ac-ft/yr (to about 8,000 ac-ft/yr) under the low water use projection. More than half of the projected growth in demand is in San Miguel County, where the projected increase is 2,000 ac-ft/yr in 2040 under the high growth scenario.

6.3.2 Commercial

Generally, commercial water use represents a very small sector in the region. The low and high projections for this sector (Table 6-13) were developed based on growth rates that are proportional to the population projections (Section 6.2; Appendix F3). Wilson et al. (2003) shows depletions and diversions as virtually equivalent; thus, no return flow is expected from the commercial use sector, except for 4 acre-feet in Guadalupe County.

6.3.3 Industrial

No consumptive industrial water use is estimated in 2000. Under the low scenario, the industrial sector is projected to continue to use no water. Under the high scenario, water use for the

industrial sector would grow annually by 1 percent in Guadalupe and San Miguel Counties and remain unchanged in Mora County. In order to project growth in the industrial sector, SWPM assumed a current small use of 10 ac-ft/yr in both Guadalupe and San Miguel Counties (20 acre-feet total). By the year 2040, the water use for the industrial sector is projected under the high scenario to be 30 ac-ft/yr for the region.

6.3.4 Irrigated Agriculture

OSE records indicate that irrigated acreage has been stable in the region for the last 25 years. Under the low scenario, irrigated acreage is projected to remain at current levels, except in Mora County where it is projected to decline 0.5 percent (Appendix F4). For the high scenario, irrigated acreage is projected to increase by 0.1 percent in Guadalupe, San Miguel, and Mora Counties. The high projection results in an increase of 4.1 percent in irrigated acreage (1,211 acres) over a 40-year period in the three counties, and the resulting total water diversions in 2040 for irrigated agriculture are projected to be 98,230 ac-ft/yr on 30,896 acres of irrigated land. Irrigation return flows range from 40 to 62 percent of the diversions.

6.3.5 Livestock

Under the low water use scenario, no change in livestock use is projected (Appendix F4). For the high water use scenario, an annual increase of 0.75 percent in Mora and Guadalupe Counties and 0.25 percent in San Miguel County is projected. The growth in the cheese industry, which relies on dairy cows, will offset the decline in cattle ranching under the low scenario or exceed the decline under the high scenario, resulting in an increased depletion of about 300 acre-feet by the year 2040. Wilson et al. (2003) shows depletions and diversions as equivalent; thus no return flow from this water use sector is expected.

6.3.6 Power

According to the OSE, no water is currently used for power generation in the planning region (Wilson et al., 2003). For the high and low water use scenarios, no change is projected to occur in Mora and San Miguel Counties (Appendix F4). In Guadalupe County, an increase is projected based on the assumption of hydroelectric power generation at Power Dam Lake near

Santa Rosa. The potential increased power production from wind farms and solar arrays is not expected to significantly increase water consumption. If a current water diversion of 10 ac-ft/yr is assumed for power production, under the projected growth rate for the power industry, the water use would increase to 12 ac-ft/yr by the year 2040.

6.3.7 Mining

Under both the low and the high water use scenarios, no change is expected in the mining industry's use of water (Appendix F4). Currently, the water depletion by the mining sector is zero; however, mining of lead, copper and zinc has occurred in the vicinity of Pecos. About 1 ac-ft/yr of water is diverted for oil and gas drilling and sand and gravel washing in San Miguel County, but this water is not consumptively used.

6.3.8 Reservoir Evaporation

As with irrigated agriculture, reservoir evaporation is dependent on climatic conditions. Evaporation from Santa Rosa Reservoir in Guadalupe County and Conchas Reservoir in San Miguel County represents the majority of the evaporation from reservoirs; however, the exact amounts will fluctuate depending on the amount of water in storage. To show a range of possible evaporation amounts, the low use estimate represents conditions (i.e., lake levels) that result in moderate evaporation, while the high use estimate is based on conditions that result in higher evaporation:

- *Low water use:* This scenario assumed that reservoir evaporation over the planning period is equal to the average use for this category (44,251 ac-ft/yr), based on the six years of available OSE data (1975, 1980, 1985, 1990, 1995, and 2000) (Table 6-15).

- *High water use:* This scenario assumed that reservoir evaporation over the planning period is equal to the maximum use for this category (63,659 ac-ft in 1995), based on the six years of available OSE data (1975, 1980, 1985, 1990, 1995, and 2000) (Table 6-15).

Beginning in 1990, the OSE no longer estimated evaporation from reservoirs less than 5,000 acre-feet in size. Thus, the estimates for evaporation in Mora County for 1990 through 2000 shown in Table 6-15 (and used in the low water use projection) are based on the average reservoir evaporation for 1975 through 1985.

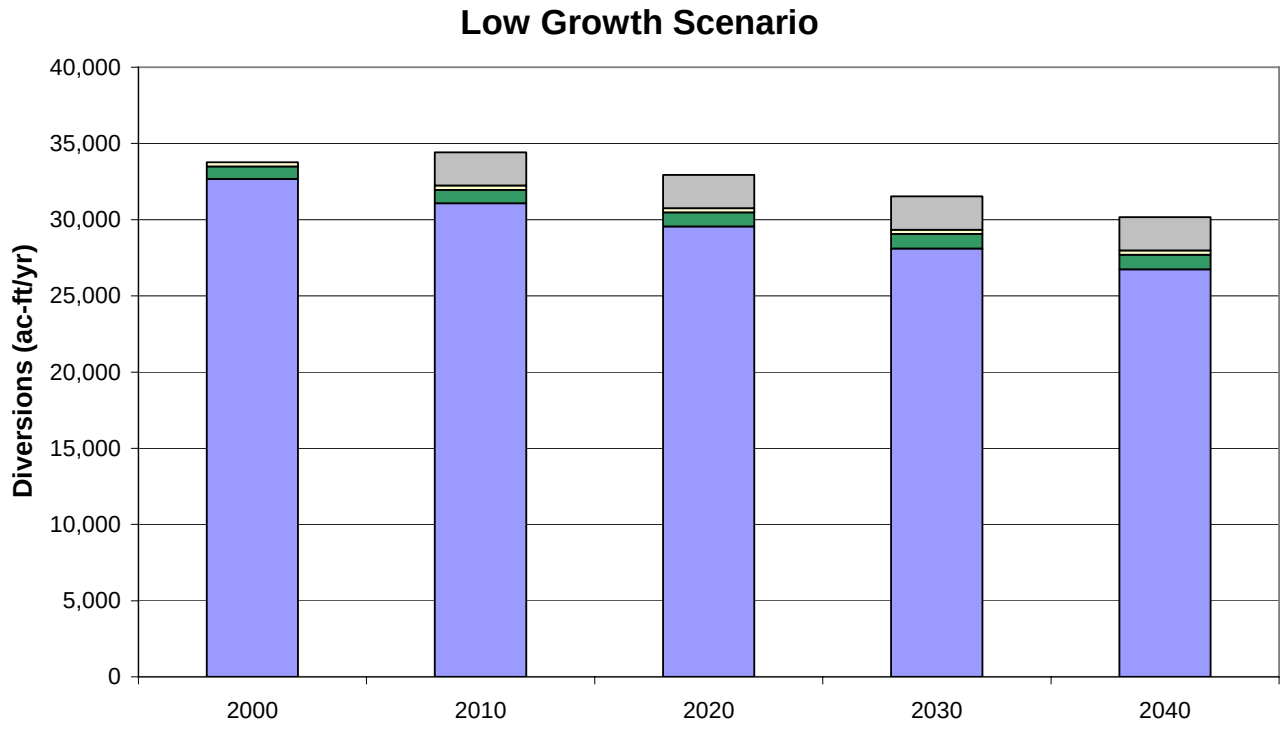
Table 6-15. Historical Reservoir Evaporation Estimates

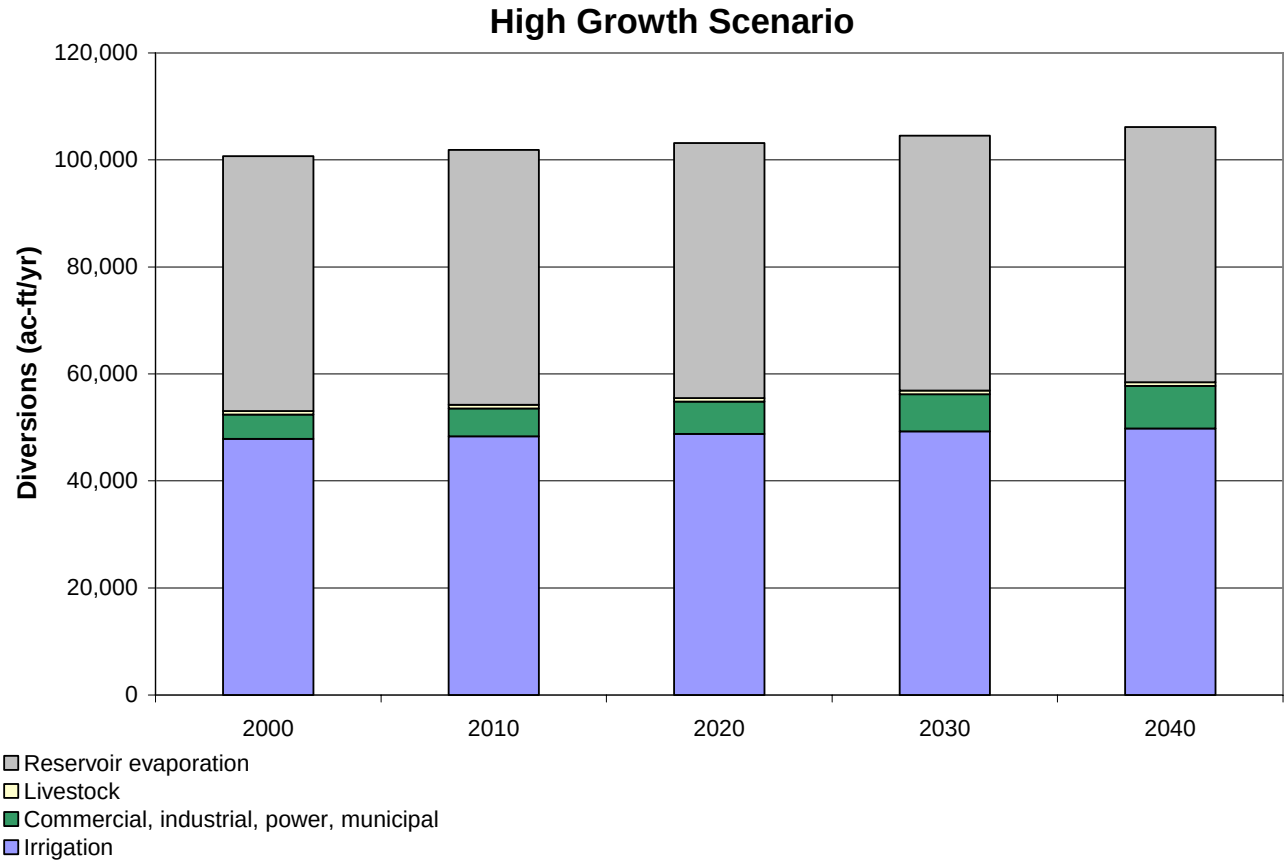
Reporting Year	Total Depletion (acre-feet)		
	Mora	San Miguel	Guadalupe
1975	2,097	19,847	906
1980	2,224	31,326	3,011
1985	2,224	27,591	19,276
1990	2,182	23,971	4,470
1995	2,182	47,406	14,071
2000	2,182	47,653	12,888

Sources: Sorensen, 1976; Sorensen, 1981; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

6.3.9 Summary of Present and Future Water Demand

As shown in Figures 6-7 through 6-9, agriculture and reservoir evaporation dominate water use in each county in the planning region. This water use is dependent on the availability of surface water to meet demands.





MORA-SAN MIGUEL-GUADALUPE WATER PLANNING REGION

Projected Water Diversions in Mora County

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Figure 6-7

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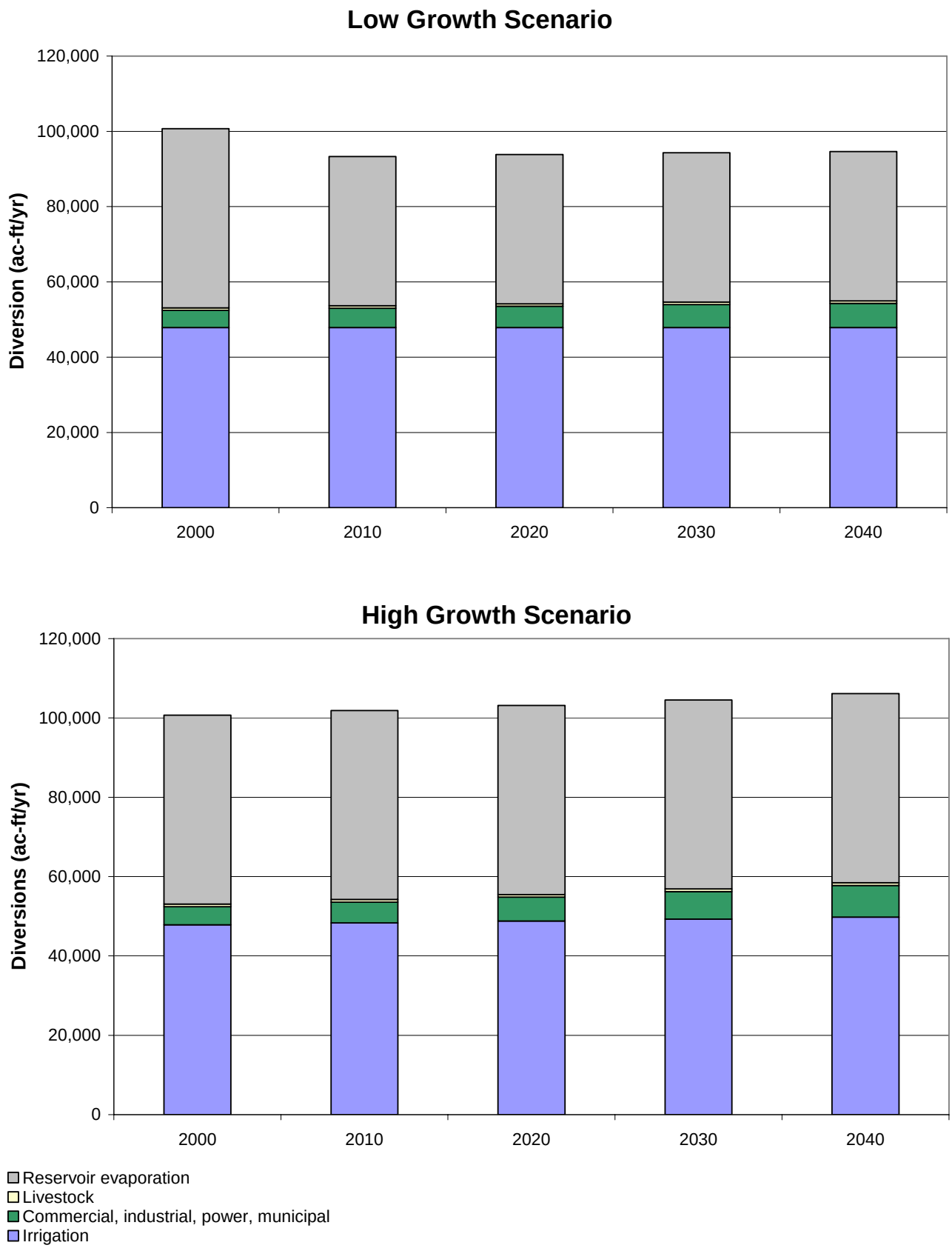

MORA-SAN MIGUEL-GUADALUPE WATER PLANNING REGION

Projected Water Diversions in San Miguel County

Figure 6-8

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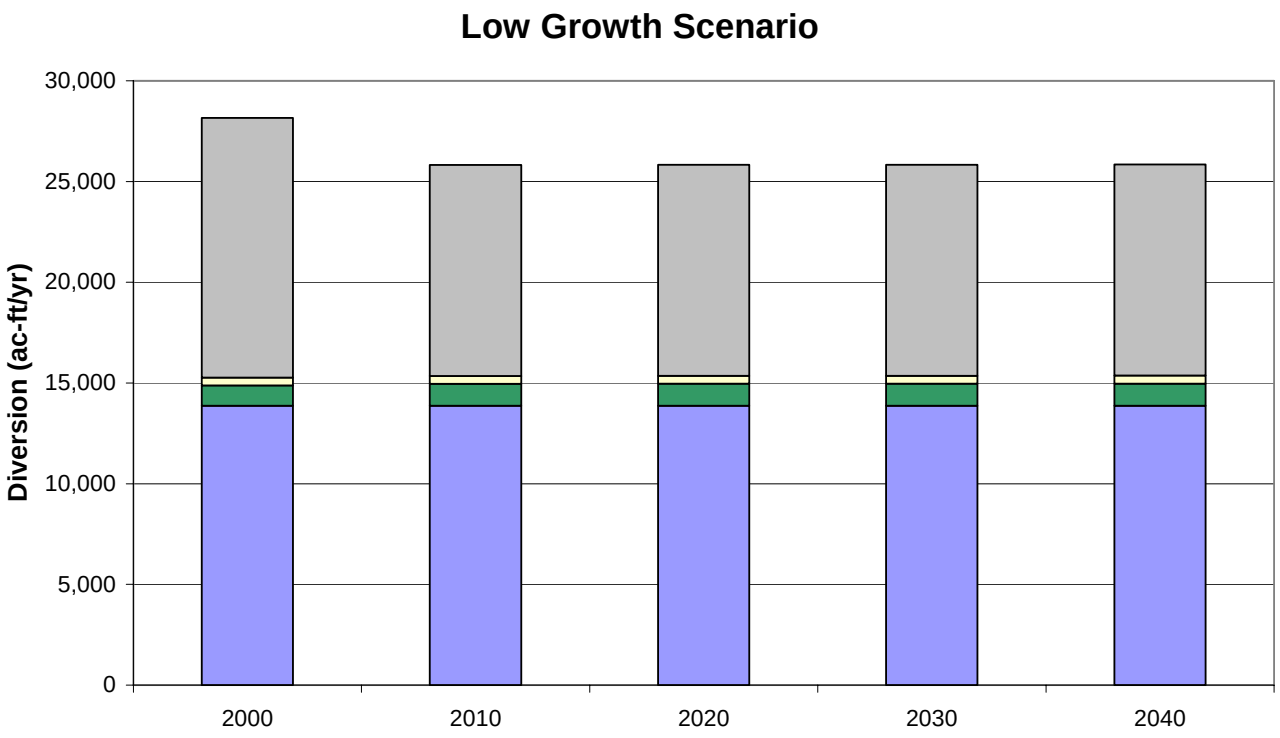

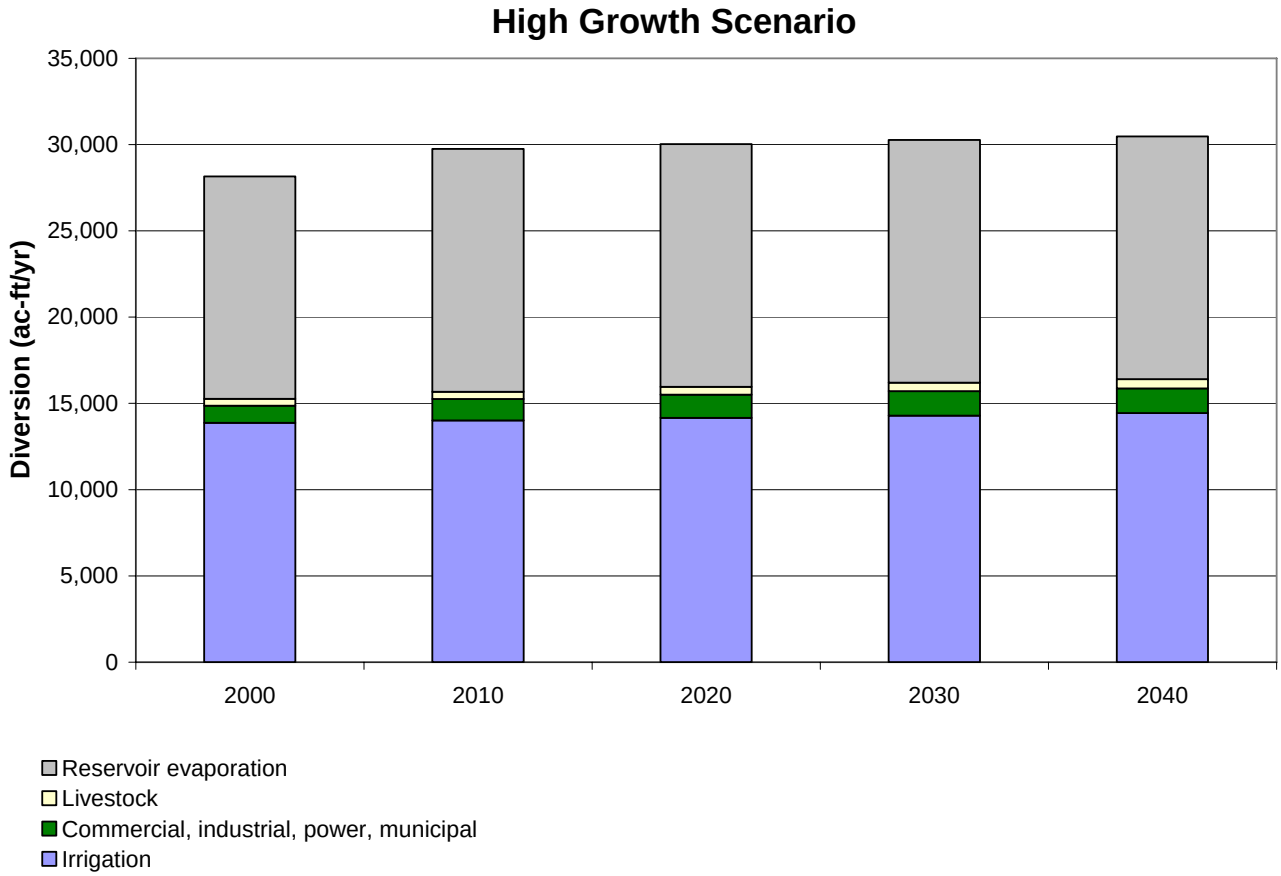

MORA-SAN MIGUEL-GUADALUPE WATER PLANNING REGION

Projected Water Diversions in Guadalupe County

Figure 6-9

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