6. Historical and Current Water Demand in the Socorro-Sierra Water Planning Region

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, a detailed summary of historical and current water demand in the Socorro-Sierra Water Planning Region is 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 discussed in Section 6.2. Section 6.3 presents projected future water demands for the region.

6.1 Current Water Use

This section defines water use categories, describes procedures used to quantify the water uses for each category, and summarizes surface and groundwater withdrawals (diversions) and depletions (consumptive use) for each water-use category. (As defined here, consumptive use does not pertain to consumptive use water rights unless specifically noted.) Appendix G provides detailed data and analyses to support the information summarized in this section. Two sources of information are presented: (1) previously published water demand estimates by the OSE in 5-year intervals from 1975 to 2000 and (2) an independent assessment of water demand by Hydrosphere for specific years in the 1990s.

Categories inventoried in this report are the OSE-defined categories of public water supply, self-supplied domestic, irrigated agriculture, livestock, commercial, industrial, mining, power, and reservoir evaporation. Because of the preponderance of riparian areas in the planning region, an additional category, riparian evapotranspiration, was evaluated for this regional water plan.

Periodically, the OSE inventories water use in the state and publishes the results in formal water-use technical reports (e.g., Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003). These reports also describe in detail the inventory procedures used to obtain these estimates. For this regional water plan, historical uses for the Socorro-Sierra planning region were summarized from these OSE reports.

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

- Fish and wildlife was previously (1975 through 1985) reported as a separate category, but is now included in the appropriate irrigated agriculture, commercial, or reservoir evaporation 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.

- Recreation was previously (1975 through 1985) reported as a separate category, but is now included in either the public water supply or commercial category.

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

For this study, historical water uses were adjusted, to the extent possible, to be consistent with the current categories; the basis and approach for each adjustment is described in the discussions of the affected water use categories.

Historical water use by category according to the OSE (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson 1992; Wilson and Lucero, 1997, Wilson et al., 2003) is summarized in Table 6-1 (a breakdown by county is included in Appendix G2, Tables G2-1 and G2-2). Additionally, independent estimation procedures were used to characterize current demand for the public water supply, self-supplied domestic, irrigated agriculture, livestock, and reservoir evaporation categories, and the results were compared with the most recent OSE estimates. Sections 6.1.1 through 6.1.5 summarize historical and current water use, based on both the OSE and independent estimates, for each of these water use categories.

Table 6-1. Socorro-Sierra Planning Region Water Use 1975 Through 2000
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Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Total Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	SW	GW	SW	GW	SW	GW			
2000 Water Year									
Commercial (self-supplied)	0	1,711	0	1,285	0	426	1,711	1,254	426
Domestic (self-supplied)	0	559	0	559	0	0	559	559	0
Industrial (self-supplied)	0	2	0	2	0	0	2	2	0
Irrigated agriculture	167,385	44,872	51,480	26,118	115,905	18,754	212,257	77,598	134,659
Livestock (self-supplied)	131	1,645	131	1,645	0	0	1,776	1,776	0
Mining (self-supplied)	0	7	0	3	0	4	7	3	4
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public water supply	0	4,490	0	2,020	0	2,470	4,490	2,020	2,470
Reservoir evaporation	226,895	0	226,895	0	0	0	226,895 [a]	226,895 [a]	0
Totals	394,411	53,284	278,506	31,632	115,905	21,652	447,695	310,138	137,557
1995 Water Year									
Commercial (self-supplied)	0	1,595	0	1,104	0	491	1,595	1,104	491
Domestic (self-supplied)	0	442	0	199	0	243	442	199	243
Industrial (self-supplied)	25	16	25	16	0	0	41	41	0
Irrigated agriculture	151,188	52,722	49,728	31,221	101,460	21,501	203,910	80,949	122,961
Livestock (self-supplied)	146	1,375	146	1,309	0	66	1,521	1,455	66
Mining (self-supplied)	0	34	0	12	0	22	34	12	22
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public water supply	0	4,651	0	2,214	0	2,437	4,651	2,214	2,437
Reservoir evaporation	300,131	0	300,131	0	0	0	300,131	300,131	0
Totals	451,490	60,835	350,030	36,075	101,460	24,760	512,325	386,105	126,220

Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003) unless otherwise noted.

SW = Surface water
GW = Groundwater

[a] Wilson, 2003

Table 6-1. Socorro-Sierra Planning Region Water Use 1975 Through 2000
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Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Total Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	SW	GW	SW	GW	SW	GW			
1990 Water Year									
Commercial (self-supplied)	0	475	0	308	0	167	475	308	167
Domestic (self-supplied)	0	478	0	214	0	264	478	214	264
Industrial (self-supplied)	25	27	25	27	0	0	52	52	0
Irrigated agriculture	128,826	42,278	47,382	27,840	81,444	14,438	171,104	75,222	95,882
Livestock (self-supplied)	139	1,045	139	1,009	0	36	1,184	1,148	36
Mining (self-supplied)	0	181	0	39	0	142	181	39	142
Power (self-supplied)	0	0	0	0	0	0	0	0	0
Public water supply	0	4,050	0	2,218	0	1,832	4,050	2,218	1,832
Reservoir evaporation	172,544	0	172,544	0	0	0	172,544	172,544	0
Totals	301,534	48,534	220,090	31,655	81,444	16,879	350,068	251,745	98,323
1985 Water Year									
Commercial	0	807	0	404	0	403	807	404	403
Urban	0	3,356	0	1,678	0	1,678	3,356	1,678	1,678
Rural	0	633	0	318	0	315	633	318	315
Industrial	0	0	0	0	0	0	0	0	0
Irrigated agriculture	107,216	23,335	27,778	13,688	79,438	9,647	130,551	41,466	89,085
Livestock	429	641	429	599	0	42	1,070	1,028	42
Minerals	0	230	0	125	0	105	230	125	105
Power	0	0	0	0	0	0	0	0	0
Stockpond evaporation	1,506	0	1,506	0	0	0	1,506	1,506	0
Military	0	0	0	0	0	0	0	0	0
Fish and wildlife	9,108	0	7,213	0	1,895	0	9,108	7,213	1,895

SW = Surface water GW = Groundwater

Table 6-1. Socorro-Sierra Planning Region Water Use 1975 Through 2000

Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Total Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	SW	GW	SW	GW	SW	GW			
1985 Water Year (continued)									
Recreation	0	541	0	378	0	163	541	378	163
Reservoir evaporation	218,971	0	218,971	0	0	0	218,971	218,971	0
Totals	337,230	29,543	255,897	17,190	81,333	12,353	366,773	273,087	93,686
1980 Water Year									
Urban	0	4,015	0	2,008	0	2,007	4,015	2,008	2,007
Rural	0	490	0	245	0	245	490	245	245
Irrigated agriculture	125,680	39,990	41,800	24,510	83,880	15,480	165,670	66,310	99,360
Livestock	552	712	552	680	0	32	1,264	1,232	32
Stockpond evaporation	1,506	0	1,506	0	0	0	1,506	1,506	0
Commercial	0	18	0	11	0	7	18	11	7
Industrial	0	0	0	0	0	0	0	0	0
Minerals	0	175	0	81	0	94	175	81	94
Military	0	0	0	0	0	0	0	0	0
Power	0	0	0	0	0	0	0	0	0
Fish and wildlife	6,719	384	6,200	192	519	192	7,103	6,392	711
Recreation	15	1,076	15	504	0	572	1,091	519	572
Reservoir evaporation	168,170	0	168,170	0	0	0	168,170	168,170	0
Totals	302,642	46,860	218,243	28,231	84,399	18,629	349,502	246,474	103,028
1975 Water Year									
Urban	0	2,798	0	1,400	0	1,398	2,798	1,400	1,398
Rural	0	533	0	266	0	267	533	266	267
Irrigated agriculture	111,890	47,030	34,620	28,070	77,270	18,960	158,920	62,690	96,230

SW = Surface water GW = Groundwater

Table 6-1. Socorro-Sierra Planning Region Water Use 1975 Through 2000
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Use Category	Withdrawal (acre-feet)		Depletion (acre-feet)		Return Flow (acre-feet)		Total Withdrawal (acre-feet)	Total Depletion (acre-feet)	Total Return Flow (acre-feet)
	SW	GW	SW	GW	SW	GW			
1975 Water Year (continued)									
Manufacturing	0	108	0	65	0	43	108	65	43
Minerals	70	60	7	12	63	48	130	19	111
Military	0	0	0	0	0	0	0	0	0
Livestock	516	516	516	516	0	0	1,032	1,032	0
Stockpond evaporation	1,254	0	1,254	0	0	0	1,254	1,254	0
Power	0	0	0	0	0	0	0	0	0
Fish and wildlife	5,124	6,622	3,250	3,311	1,874	3,311	11,746	6,561	5,185
Recreation	0	100	0	100	0	0	100	100	0
Reservoir evaporation	76,500	0	76,500	0	0	0	76,500	76,500	0
Playa lake evaporation	0	0	0	0	0	0	0	0	0
Totals	195,354	57,767	116,147	33,740	79,207	24,027	253,121	149,887	103,234

SW = Surface water GW = Groundwater

6.1.1 Public Water Supply Current Demand

Wilson and Lucero (1997) define this category as follows:
Includes community water systems which rely upon surface and/or ground water diversions (other than wells permitted by the NMOSE under Section 72-12-1 NMSA, 1978), and which consist of common collection, treatment, storage and distribution facilities operated for the delivery of water to multiple service connections.

Hydrosphere estimated the current demands from public water supply by first determining the total number of providers in the region. Of the 38 water systems shown on Table 6-2, 12 would be considered public water supply providers by OSE's definition. All of them derive their supply from groundwater resources. These systems are of various types:

- Incorporated municipal water systems (Socorro, Truth or Consequences, and Magdalena)

- Mutual domestic water consumer associations (MDWCAs) (La Joya, San Acacia, Polvadera, San Antonio, and Hillsboro)

- Private water utilities (National Utilities and Desert Aire Water Company, both at Elephant Butte)

- A water and sanitation district (Lakeshore Sanitation District)

- The water supply system for the Alamo Band Navajo Reservation.

To determine current demand for public water supplies, a questionnaire was sent to each of the public water supply providers in the planning region (Table 6-2), as determined from a list of public water supply providers compiled from an on-line U.S. EPA database (www.epa.gov/safewater/dwinfo/nm.htm) and information received from the New Mexico Environment Department (NMED). The questionnaire asked for data and information regarding current and future water use relative to the individual systems. A copy of the questionnaire is included in Appendix G1.

Table 6-2. List of Water Providers In Socorro-Sierra Planning Region
Page 1 of 2

Water System Name	OSE Category [a]	Response [b]	Contact Name	City
Public water supply systems				
Hillsboro MDWCA	PS	Q	Mary Westland	Hillsboro
Lakeshore Sanitation District	PS	T	Dean Banks	Elephant Butte
National Utilities (Elephant Butte)	PS	Q	Thomas Sailley	Elephant Butte
Desert Aire Water Company	PS	T	David & Dana Chavez	Albuquerque
Truth or Consequences	PS	Q	Jesus Salayandia	Truth or Consequences
La Joya MDWCA	PS	Q	Ken Hansen	La Joya
Magdalena Water Supply System	PS	T	Brad Cass	Magdalena
Polvadera MDWCA	PS	NR	Rick Griego	Lemitar
San Acacia MDWCA	PS	NR	Val Green	San Acacia
San Antonio MDWCA	PS	Q	Walter Ulibarri	San Antonio
Socorro Water System	PS	Q	Richard M. Sanchez	Socorro
Alamo Band Navajo Reservation	PS/DO	NR	NS	Alamo
Other community systems				
Caballo Lake State Park - Leased Lots	CO	T	Philip Mcclelland	Caballo
Caballo Lakeside Campground	CO	T	Philip Mcclelland	Caballo
Caballo Riverside Camp Ground	CO	T	Philip Mcclelland	Caballo
Elephant Butte State Park	CO	NR	Rolf Hechler	Elephant Butte
Bosque Del Apache National Wildlife Refuge	CO/IR/RE	Q	Michael Browne / Leroy Saavedra	Socorro
Bureau of Reclamation	DO	Q	Rick Williams	Truth or Consequences
Caballo Dairy LLC	LS	Q	Dale Antresian	Arrey
Center Court RV Park	CO	NR	Fred Brown	Truth or Consequences
Cuchillo Cafe	CO	NR	Hermilla Romero	Truth or Consequences

MDWCA = Mutual domestic water consumers association

[a] PS = Public water supply
DO = Self-supplied domestic
CO = Commercial
IR = Irrigated agriculture
RE = Reservoir evaporation
LS = Livestock

[b] NR = No response
T = Telephone contact
Q = Questionnaire returned

Table 6-2. List of Water Providers In Socorro-Sierra Planning Region
Page 2 of 2

Water System Name	OSE Category [a]	Response [b]	Contact Name	City
Didio's Store	CO	Q	Tony Salas	Bosque
Escondida Lake	CO	NR	Tiny Anaya	Socorro
Fort Craig	CO	Q	John P. Hooper	Socorro
Fort Craig Rest Area - East Side	CO	Q	Francisco Sanchez	Socorro
Fort Craig Rest Area - West Side	CO	Q	Francisco Sanchez	Socorro
Lakeside Bait and Tackle	CO	NR	Jim Rocco	Arrey
Lakeview Koa	CO	NR	Mike Roberts	Caballo
Monticello North Park	CO	NR	Jim Green	Elephant Butte
Monticello Rv Park	CO	NR	Chuck Mcquire	Albuquerque
New Mexico Boys Ranch	DO	NR	Jim Weir	Boys Ranch
New Mexico Tech	CO/PS	Q	Jim Shaffner	Socorro
Northern Socorro County Senior Center	DO	NR	Tiny Anaya	Socorro
Percha Dam State Park	CO	T	Philip Mcclelland	Caballo
Rock Canyon Marina	CO	NR	Green	Elephant Butte
Santa Fe Diner and Truck Stop	CO	NR	Salem Sager	Socorro
Stallion Range Center	CO	NR	Fred Hollis	Socorro
Very Large Array (VLA)	CO	NR	Steve Troy	Socorro
Walking Sands Rest Area	CO	Q	Jan Bennett	Socorro

MDWCA = Mutual domestic water consumers association

[a] PS = Public water supply
DO = Self-supplied domestic
CO = Commercial
IR = Irrigated agriculture
RE = Reservoir evaporation
LS = Livestock

[b] NR = No response
T = Telephone contact
Q = Questionnaire returned

Responses were received from all of the public water supply providers contacted except the Alamo Band Navajo Reservation. Feedback provided on the responses was entered into a water provider database, and a summary of the water suppliers' responses is included in Appendix G1.

In order to estimate potential needs of the Alamo Band Navajo Reservation in the public water supply and domestic categories, data and information presented in the 1994 and 1998 Socorro-Sierra water plans (Ramsey, 1994; Socorro SWCD, 1999) were relied upon to estimate the number of individuals served by the water system. The total public water supply use for the planning region (Table 6-3) was then obtained by summing the reported water use from the questionnaire responses with the estimated water use for the non-respondents.

As discussed in Section 4, the Alamo Chapter of the Navajo Tribe may be able to claim water for additional water uses that are not quantified here. With improved infrastructure, water use by the Alamos may increase.

These current use figures were compared with the historical information summarized in the OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson 1992; Wilson and Lucero, 1997; Wilson et al., 2003). Appendix G2 (Figure G2-1) presents historical and current water use for the public water supply systems in the region, and Table 6-4 summarizes the consumptive use and withdrawal values. The historical public water supply data for 1975 through 1985 (Appendix G2) include data from the former urban and military categories used by OSE. (Given the lack of information regarding the self-supplied domestic and MDWCA components of the rural category, the entire rural depletion was assigned to the self-supplied domestic category.)

Hydrosphere estimated consumptive use for 1999 from public water supplies at 966 ac-ft/yr for Socorro County and 1,653 ac-ft/yr for Sierra County (Table 6-4). The Socorro estimates compare favorably to the OSE estimates, but the Hydrosphere independent estimate of Sierra County diversions, which relied on supplier input, is higher than the OSE value for 2000.

Table 6-3. Current Water Use By Public Water Supply Providers and Other Community Systems in Socorro-Sierra Planning Region
Page 1 of 3

System	Population [a]	Water Right Diversion (ac-ft)	Most Recent Total Consumptive Use (acre-feet)	Basis for Consumptive Use Estimate
Public water supply systems				
Hillsboro MDWCA	192	224	13.9	Supplier response to questionnaire.
Lakeshore Sanitation District	1,100 [b]	192 [b]	108.6	Supplier response to questionnaire.
National Utilities (Elephant Butte)	2,980	1,120	156.4	Supplier response to questionnaire.
Desert Aire Water Co	55	---	9.4	NMED population and 152 gpcd.
Truth or Consequences	7,816 [b]	2,742 [c]	2,056.6	Supplier response to questionnaire (1838.58 ac-ft) plus an estimated 218 ac-ft for Oasis Golf Course (Wilson and Lucero, 1997).
La Joya MDWCA	132	17	10.7	Supplier response to questionnaire.
Magdalena Water Supply System	1,100 [b]	---	181.3	Supplier response to questionnaire.
Polvadera MDWCA	1,700	200 [d]	(268) 87.1	Personal communication with Jon Mortenson, Socorro Engineering, 2001; estimate from 525 meters, ~3 people per meter, 152 gpcd, and 67.5% return flow credit. Value in ( ) represents diversion without return flow credit.
San Acacia MDWCA	225	28	16.3	Supplier response to questionnaire.
San Antonio MDWCA	1,900 [b]	162 [b]	159.6	Population times 75 gpcd (Smith, 2000).
Socorro Water System	9,200	2,057 [e]	(2138.4) 1069.2	Supplier response to questionnaire for consumptive use includes 50% return flow credit. Average diversion is 1600 to 1800 ac-ft/yr. Value in ( ) represents amount delivered to customers' meters. Updated based on personal communication with Jay Santillanes, City of Socorro, 2001.

--- = Available information insufficient to estimate diversion

MDWCA = Mutual domestic water consumers association

Information sources:

[a] NMED database, unless otherwise noted

[b] Supplier response to questionnaire

[c] City of Truth or Consequences draft 40-year plan (personal communication with Neil Knott, City of Truth or Consequences, 2001. The City also has the following additional water rights: 50 ac-ft/yr geothermal heating, 518 ac-ft/yr irrigation, and 3 ac-ft/yr domestic and sanitation for the Municipal Airport.

[d] Personal communication with Jon Mortenson, Socorro Engineering, 2001

[e] Supplier response to questionnaire. Value does not include historical water rights from Sedillo Spring (~500 ac-ft/yr).

[f] Calculations of population growth rate using data from Ramsey (1994) and White (1998)

[g] Personal communication with New Mexico Tech Residential Life, 2000 (maximum number of campus-housed students)

[h] WATERS database information plus declared pre-basin water rights plus declared prior 1907 irrigation rights

Table 6-3. Current Water Use By Public Water Supply Providers and Other Community Systems in Socorro-Sierra Planning Region
Page 2 of 3

System	Population [a]	Water Right Diversion (ac-ft)	Most Recent Total Consumptive Use (acre-feet)	Basis for Consumptive Use Estimate
Alamo Band Navajo Reservation	2,097 [f]	---	131.1	Calculations of population growth rate and 56 gpcd using data from Ramsey (1994) and White (1998).
Total	28,497	6,741	4,000.2	
Other community systems (accounted for in OSE categories listed in Table 6-2)				
Caballo Lake State Park - Leased Lots	120	---	9.0	Supplier response to questionnaire.
Caballo Lakeside Campground	25	---	6.2	Supplier response to questionnaire.
Caballo Riverside Camp Ground	25	---	9.8	Supplier response to questionnaire.
Elephant Butte State Park	50	---	2.0	35 gpcd (Wilson and Lucero, 1997,Table 6.2) and 100% depletion.
Bosque Del Apache National Wildlife Refuge	50	12,417 [b]	7155.8	Supplier response to questionnaire.
Bureau of Reclamation	25	---	0.8	28 gpcd (Clark et al., 1977, Table 4-2) and100% depletion.
Caballo Dairy LLC	90	---	217.3	Supplier response to survey for period 1/17/00 through 10/3/00 + calculated pro rated value for remainder of year.
Center Court RV Park	100	---	3.9	35 gpcd (Wilson and Lucero, 1997,Table 6.2) and 100% depletion.
Cuchillo Cafe	26	---	0.8	28 gpcd (Clark et al., 1977, Table 4-2) and 100% depletion.
Didio's Store	100	---	0.9	Supplier response to questionnaire.
Escondida Lake	25	---	0.8	28 gpcd (Clark et al., 1977, Table 4-2) and 100% depletion.
Fort Craig	2	3 [b]	0.1	Supplier response to questionnaire.

--- = Available information insufficient to estimate diversion

Information sources:

[a] NMED database, unless otherwise noted

[b] Supplier response to questionnaire

[c] City of Truth or Consequences draft 40-year plan (personal communication with Neil Knott, City of Truth or Consequences, 2001. The City also has the following additional water rights: 50 ac-ft/yr geothermal heating, 518 ac-ft/yr irrigation, and 3 ac-ft/yr domestic and sanitation for the Municipal Airport.

[d] Personal communication with Jon Mortenson, Socorro Engineering, 2001

MDWCA = Mutual domestic water consumers association

[e] Supplier response to questionnaire. Value does not include historical water rights from Sedillo Spring (~500 ac-ft/yr).

[f] Calculations of population growth rate using data from Ramsey (1994) and White (1998)

[g] Personal communication with New Mexico Tech Residential Life, 2000 (maximum number of campus-housed students)

[h] WATERS database information plus declared pre-basin water rights plus declared prior 1907 irrigation rights

Table 6-3. Current Water Use By Public Water Supply Providers and Other Community Systems in Socorro-Sierra Planning Region
Page 3 of 3

System	Population [a]	Water Right Diversion (ac-ft)	Most Recent Total Consumptive Use (acre-feet)	Basis for Consumptive Use Estimate
Fort Craig Rest Area - East Side	500	3 [b]	1.7	Supplier response to questionnaire.
Fort Craig Rest Area - West Side	500	3 [b]	1.0	Supplier response to questionnaire.
Lakeside Bait and Tackle	25	---	0.8	28 gpcd (Clark et al., 1977, Table 4-2) and 100% depletion.
Lakeview Koa	120	---	4.7	35 gpcd (Wilson and Lucero, 1997,Table 6.2) and 100% depletion.
Monticello North Park	25	---	1.0	35 gpcd (Wilson and Lucero, 1997,Table 6.2) and 100% depletion.
Monticello Rv Park	100	---	3.9	35 gpcd (Wilson and Lucero, 1997,Table 6.2) and 100% depletion.
New Mexico Boys Ranch	70	---	7.8	NMED population and 152 gpcd.
New Mexico Tech	634 [g]	5,434 [h]	697.3	Supplier response to questionnaire.
Northern Socorro County Senior Center	25	---	2.8	NMED population and 152 gpcd.
Percha Dam State Park	25	---	1.5	Supplier response to questionnaire.
Rock Canyon Marina	33	---	1.0	28 gpcd (Clark, et al., 1977, Table 4-2) and 100% depletion.
Santa Fe Diner and Truck Stop	100	---	3.1	28 gpcd (Clark, et al., 1977, Table 4-2) and 100% depletion.
Stallion Range Center	200	---	6.3	28 gpcd (Clark, et al., 1977, Table 4-2) and 100% depletion.
Very Large Array (VLA)	60	---	1.9	28 gpcd (Clark, et al., 1977, Table 4-2) and 100% depletion.
Walking Sands Rest Area	1000	3 [b]	1.6	Supplier response to questionnaire.

--- = Available information insufficient to estimate diversion

Information sources:

[a] NMED database, unless otherwise noted

[b] Supplier response to questionnaire

[c] City of Truth or Consequences draft 40-year plan (personal communication with Neil Knott, City of Truth or Consequences, 2001. The City also has the following additional water rights: 50 ac-ft/yr geothermal heating, 518 ac-ft/yr irrigation, and 3 ac-ft/yr domestic and sanitation for the Municipal Airport.

[d] Personal communication with Jon Mortenson, Socorro Engineering, 2001

MDWCA = Mutual domestic water consumers association

[e] Supplier response to questionnaire. Value does not include historical water rights from Sedillo Spring (~500 ac-ft/yr).

[f] Calculations of population growth rate using data from Ramsey (1994) and White (1998)

[g] Personal communication with New Mexico Tech Residential Life, 2000 (maximum number of campus-housed students)

[h] WATERS database information plus declared pre-basin water rights plus declared prior 1907 irrigation rights

Table 6-4. Public Water Supply Consumptive Use and Withdrawal

County	Water Use / Withdrawal [a] (ac-ft/yr)						
	1975 [b]	1980 [b]	1985 [b]	1990	1995	1999 [c]	2000
Consumptive Use							
Sierra	638	704	719	1,220	1,398	1,653	1,062
Socorro	762	1,304	959	998	816	966	958
Total	1,400	2,008	1,678	2,218	2,214	2,619	2,020
Withdrawal							
Sierra	1,275	1,408	1,438	2,054	2,467	---	1,914
Socorro	1,523	2,607	1,918	1,996	2,184	---	2,576
Total	2,798	4,015	3,356	4,050	4,651	---	4,490

[a] Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et. al., 2003), unless otherwise noted

--- = Not calculated

[b] Includes urban and military uses

[c] Calculated by Hydrosphere as described in text

6.1.2 Self-Supplied Domestic Current Demand

Wilson and Lucero (1997) define this category as follows:

Includes self-supplied residences that may be single-family or multi-family dwellings with wells permitted by the NMOSE under section 72-12-1 NMSA, where water is used for normal household purposes including drinking, food preparation, bathing and washing, flushing toilets, evaporative cooling, yard landscape watering, and livestock watering (provided that this is not the sole purpose).

To estimate current demand for self-supplied domestic water systems, Hydrosphere subtracted the population served by public water systems from the total population, on the assumption that this remaining population is served by self-supplied domestic systems. The population numbers for the public systems were determined from the NMED water supplier database or the questionnaire responses (Section 6.1.1), and the total population figures for Socorro and Sierra Counties were obtained from the Sites Southwest population estimates and the U.S. Census Bureau. This population was then multiplied by an assumed 100 gpcd (Wilson and Lucero, 1997) to determine current demand for the self-supplied domestic category.

These current use estimates were compared with historical information summarized in the OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson 1992; Wilson and Lucero, 1997; Wilson et al., 2003). Figure G2-2 (Appendix G2) presents the historical and current water use for the self-supplied domestic category in the Socorro-Sierra planning region, and Table 6-5 summarizes withdrawal and consumptive use values for this category.

Table 6-5. Self-Supplied Domestic Consumptive Use and Withdrawal

County	Water Use / Withdrawal [a] (ac-ft/yr)						
	1975	1980	1985	1990	1995	1999 [b]	2000 [c]
Consumptive Use							
Sierra	168	98	117	71	54	53	102
Socorro	98	147	201	143	145	327	457
Total	266	245	318	214	199	380	559
Withdrawal							
Sierra	336	195	233	159	119	---	102
Socorro	197	295	400	319	323	---	457
Total	533	490	633	478	442	---	559

[a] Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et. al., 2003), unless otherwise noted

--- = Not calculated

[b] Calculated by Hydrosphere as described in text

[c] Procedure for estimating consumptive use changed to a more conservative approach where consumptive use equals withdrawals

6.1.3 Irrigated Agriculture

Wilson and Lucero (1997) define irrigated agriculture as follows:
Includes all diversions of water for the irrigation of crops grown on farms, ranches, and wildlife refuges.

In the planning region, the majority of irrigated agriculture relies on surface water supplies, with a large acreage of grapes in Sierra County and a smaller acreage in Socorro County supplied by groundwater. In Socorro County, more than 90 percent of the 24,000 surface-water-irrigated acres are served by the MRGCD and the remainder by the La Joya Acequia Association. In Sierra County, roughly half of the 6,000 surface-water-irrigated acres are served by EBID and

the remainder by five incorporated ditch (acequia) associations located along the drainages on the east slopes of the Black Range. The distribution of irrigated agricultural land in the region is illustrated in Appendix B, Figure B-2.

Agricultural demand for both diversions and consumptive use are generally not directly measured; instead they are estimated based on a model of crop water needs. For the Socorro-Sierra regional water plan, Hydrosphere independently developed the demand by irrigated agriculture by combining crop use information provided by the OSE (Blaney and Hanson, 1965) with irrigated acreage figures obtained from the New Mexico Agricultural Statistics Service (NMASS, 1995, 1996, 1997, and 1998) and the USDA Census of Agriculture (USDA, 1999).

New Mexico agricultural statistics (NMASS, 1995, 1996, 1997, and 1998) indicate that irrigated acreages and cropping quantities vary from year to year. The USDA data show similar variability, although they differ from the NMASS data. Additionally, the USDA and NMASS data sets were categorized differently in some cases (for instance, the USDA data included categories for orchards and fruits and nuts, whereas the NMASS data did not). To account for this variability, irrigated agricultural demands were computed using the following approach.

First, consumptive use by crops was evaluated by multiplying the crop consumptive use requirements (less growing season precipitation) by the acreage for each crop. In cases where the USDA and NMASS values were not consistent, the larger of the two values was used, and when the total acres for all crops did not equal the total acres of irrigated land, an additional, unspecified category was added to account for the difference. Consumptive use requirements vary from crop to crop (Blaney and Hanson, 1965). The three primary crops grown in the planning region are alfalfa, chile, and corn, with smaller acreages of grapes grown outside the inner Rio Grande Valley. Irrigation demand since 1992, estimated using this procedure (HRC1), is presented for Sierra and Socorro Counties in Table 6-6a and Figures G2-3 and G2-4 (Appendix G2). Appendix G3 summarizes the method and results of this independent approach.

OSE water use estimates are provided in Table 6-6b, which indicates a large degree of year-to-year variability in water use by irrigated agriculture in the planning region. A correlation analysis of various components that may contribute to the variability (e.g., irrigated acreage,

Table 6-6a. Irrigation Consumptive Use Based on USDA and Farm Reports of Irrigated Acreage

County	Water Use [a, b] (ac-ft/yr)								
						1999 [c]			
	1994	1995	1996	1997	1998	HRC1	HRC2	2000	2001
HRC Consumptive Use									
Sierra	33,684	34,255	34,773	34,051	34,565	24,235	20,168	24,045	27,220
Socorro	60,751	60,962	61,315	58,748	60,911	60,901	51,385	67,684	42,634
Total	94,435	95,217	96,088	92,799	95,476	85,136	71,553	91,729	69,854

[a] Includes both surface water and groundwater use

[b] Calculated by Hydrosphere as described in text and Appendix G3

[c] HRC1 = Based on USDA and NMDA data
HRC2 = Based on information provided by irrigation entities

Table 6-6b. Irrigated Agriculture Consumptive Use and Withdrawal

County	Water Use [a] / Withdrawal [b] (ac-ft/yr)					
	1975	1980	1985	1990	1995	2000 [c]
OSE Consumptive Use						
Sierra	17,060	17,720	15,993	19,021	23,097	18,218
Socorro	46,175 [d]	49,135 [d]	26,018 [d]	56,201	57,852	59,380
Total	63,235	66,855	42,011	75,222	80,949	77,598
OSE Withdrawal						
Sierra	35,500	36,710	35,182	36,786	43,663	35,211
Socorro	123,420	128,960	95,369	134,318	160,247	177,046
Total	158,920	165,670	130,551	171,104	203,910	212,257

[a] Includes both surface water and groundwater use

[b] Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003

[c] Data are from 1999 because 2000 data were determined to not be representative of typical conditions due to the drought that occurred that year (Wilson et al., 2003)

[d] Consumptive use for these years includes 545 ac-ft/yr that was reported by OSE in the fish and wildlife category for 200 acres irrigated at the Bosque del Apache National Wildlife Refuge.

precipitation, evaporation) found that the strongest correlation to water use was with precipitation. Some of the variability is due to changes in the methodology used by OSE to estimate irrigation consumptive use; these changes were based on improved technology for incorporating actual climatological conditions and resulted in improved estimates starting in 1985. Also starting in 1985, irrigation efficiencies were updated to better reflect actual field conditions, and off-farm conveyance efficiencies, which had often been ignored in earlier inventories, were incorporated into the calculations.

To provide an additional check of OSE-published estimates for agricultural water use (HRC2), all the irrigation districts, acequia associations, and ditch associations in the planning region were directly contacted and surveyed. These entities provided sufficient information to allow an independent estimate of irrigated acreage. These estimated acreages were then used to compute irrigation diversion and consumptive use demands using default per-acre values consistent with OSE standards. The diversion and consumptive use demands estimated in this manner are included in the totals presented in Table 6-6a. Additional detailed information regarding the individual irrigation districts is provided in Appendix G3 (Table G3-5). For these estimates, the La Joya Acequia Association in Socorro County and the Animas Ditch Association, the Cuchillo Valley Water Users Association, and the Elephant Butte Irrigation District (EBID) in Sierra County provided direct estimates of irrigated acreage in their service areas. For the other entities, a variety of approaches were used to estimate irrigated acreages, as described in Appendix G3.

Values for consumptive use and withdrawals as reported by the OSE (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003) are plotted in Figures G2-5 and G2-6 respectively. A comparison of these graphs indicates that withdrawals significantly exceed consumptive use, by a factor of roughly 2.5. For comparison, Figure G2-5 also includes the Socorro and Sierra County current demands estimated using the two independent approaches described above. These estimates closely match the long-term average of the OSE published values (Figure G2-5, Tables 6-6a and 6b). Whereas Hydrosphere estimated consumptive use for Sierra County at more than 35,000 ac-ft/yr, OSE estimates are less than 20,000 ac-ft/yr in all but one year (1995). Estimates of consumptive use by farms in Socorro County range between 42,000 ac-ft/yr to more than 67,000 ac-ft/yr compared to OSE estimates ranging from 46,000 ac-ft/yr to almost 58,000 ac-ft/yr. The total

diversions and consumptive use in the region are estimated in 1999 to be 212,257 ac-ft/yr and 77,598 ac-ft/yr, respectively.

6.1.4 Livestock Current Demand

Wilson and Lucero (1997) define the livestock use as follows:
Includes water used to raise livestock, maintain self-supplied livestock facilities, and provide on-farm processing of poultry and dairy products. (Diversions from wells owned by dairies are placed entirely within this category, even if it is possible that some of the water is used for domestic purposes.)

OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003), New Mexico Agricultural Statistics (NMASS, 1995, 1996, 1997, 1998), and the USDA Census of Agriculture (USDA, 1999) were all used to estimate livestock water use. The OSE reports provide a direct estimate of water depletion within the livestock category, and the OSE reports prior to 1990 (Sorenson, 1977; Sorenson, 1982; Wilson, 1986) show an average total stockpond evaporative depletion in the planning region of 1,424 ac-ft/yr. Although the OSE stopped reporting stockpond evaporation in 1990, the relatively large size of these depletions suggests that a realistic analysis of water demands should continue to include stockpond evaporation. Therefore, the average stockpond evaporation from the 1975, 1980, and 1985 OSE reports was added to the direct livestock consumptive use listed in the OSE water use reports to obtain the historical livestock demand profiles presented in Figure G2-7. Table 6-7a summarizes withdrawal and consumptive use values for this category.

An independent estimate of water demands by livestock was derived based on data provided by the New Mexico Agricultural Statistics and the USDA Census of Agriculture, who estimate numbers of livestock (cattle [both dairy and beef], sheep, hogs, horses, and poultry) on a county by county basis. To estimate water depletion by the livestock, the livestock numbers were multiplied by species-specific per capita water consumption (Wilson and Lucero, 1997). In cases where the NMDA and USDA values were not consistent, the higher of the two values was used. Livestock demand since 1995, estimated using this procedure, is presented for Sierra and Socorro Counties in Table 6-7b and Figures G2-8 and G2-9, respectively. The “Total”

Table 6-7a. Livestock Consumptive Use and Withdrawal

County	Water Use / Withdrawal [a] (ac-ft/yr)					
	1975	1980	1985	1990	1995	2000
OSE Consumptive Use						
Sierra	1,001	1,375	1,253	1,195	1,273	1,435
Socorro	1,285	1,363	1,281	1,375	1,603	1,763
Total	2,286	2,738	2,534	2,570	2,876	3,198
OSE Withdrawal						
Sierra	1,001	1,400	1,274	1,208	1,292	1,435
Socorro	1,285	1,370	1,302	1,397	1,650	1,763
Total	2,286	2,770	2,576	2,605	2,942	3,198

[a] Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et. al., 2003. For the years 1975, 1980, and 1985, the OSE estimates include stock pond evaporation; for consistency, average stock pond evaporation for these three years were added to the OSE estimates for 1990, 1995, and 2000.

Table 6-7b. Livestock Consumptive Use Based on USDA and Farm Reports of Irrigated Acreage

County	Water Use [a] (ac-ft/yr)							
	1995	1996	1997	1998	1999	2000	2001	2002
HRC Consumptive Use								
Sierra	1,466	1,484	1,461	1,589	1,608	1,608	1,255	1,155
Socorro	1,888	1,981	1,995	1,907	2,002	1,957	2,208	2,127
Total	3,354	3,465	3,456	3,496	3,610	3,565	3,463	3,282

[b] Calculated by Hydrosphere as described in the text; average OSE-reported stock pond evaporation for 1975, 1980, 1985 added to estimates.

livestock demand in Figures G2-8 and G2-9 was obtained by summing all of the species use together with the average stockpond evaporation from the 1975 through 1985 OSE reports (732 ac-ft/yr for Sierra County and 690 ac-ft/yr for Socorro County). As shown in Figure G2-7, water demand estimated by this independent approach is higher.

6.1.5 Commercial Current Demand

Wilson and Lucero (1997) define commercial use as follows:
Includes self-supplied businesses (e.g., motels, restaurants, recreational resorts, and campgrounds) and institutions (e.g., schools, churches, and hospitals), public and private, involved in the trade of goods or delivery of services. Self-supplied golf courses that are not otherwise included in the PS category are included here. Off-stream fish hatcheries engaged in the production of fish for releases are also included here.

Data for commercial water users were collected from two sources:

- For historical use, the OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003)

- For current use (and comparison to the most recent OSE report [Wilson et al., 2003]), information provided as part of the EPA on-line database and followup inquiries to commercial entities listed in the database

The historical water demand by the commercial sector is shown in Figure G2-10. Table 6-8 summarizes consumptive use and withdrawal values.

By far the largest commercial entity in the planning region is New Mexico Tech (NMT). The NMT physical plant provided a copy of a report that summarized water withdrawals back to 1966 (Trueline Engineering, 1999). The water withdrawn at NMT is used in on-campus facilities, residential student housing, and irrigation of the NMT golf course. A combination of approaches from Wilson and Lucero (1997) were used to determine a depletion factor for water at NMT. The NMT golf course includes approximately 80 irrigated acres (Jim McLain, personal communication, 2000) of warm-season grasses. Based on Wilson and Lucero (1997,

Section 6.4.3) and Blaney-Criddle consumptive use coefficients (K) of 0.80 inside the frost-free period and 0.50 outside the frost-free period, an assumed irrigation efficiency of 70 percent and an incidental depletion value of 12 percent, a depletion of 82 percent was calculated. Once the amount of water used for the golf course was determined, a depletion factor of 50 percent for the remainder of the water withdrawn was assumed, based on the 45 percent suggested for a day facility with cafeteria, gymnasiums, and showers (Wilson and Lucero, 1997) plus an additional 5 percent to account for the full-time residents who live on campus as well as other facility uses. These data are presented in Figure G2-10 along with the OSE historical data.

Table 6-8. Self-Supplied Commercial Consumptive Use and Withdrawal

County	Water Use / Withdrawal (ac-ft/yr)					
	1975	1980	1985	1990	1995	2000
Consumptive Use						
OSE Sierra [a]	NR	0	17	243	428	388
OSE Socorro [a]	NR	11	387	65	676	896
NM Tech [b]	679	582	476	798	599	NR
Total [c]		582	493	1,041	1,104 [d]	1,284 [d]
Withdrawal						
OSE Sierra [a]	NR	0	34	331	546	436
OSE Socorro [a]	NR	18	773	144	1,049	1,274
NM Tech [b]	1,178	984	772	1,416	1,018	NR
Total [c]		984	806	1,747	1,595 [d]	1,710 [d]

[a] Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et. al., 2003)

[b] Data provided by New Mexico Tech physical plant

[c] Unless otherwise noted, sum of OSE Sierra County estimate and New Mexico Tech physical plant data, which are considered more representative of Socorro County commercial use than the OSE estimates

[d] Sum of OSE estimates for Sierra and Socorro Counties

NR = Not reported

As evident on the figure, the OSE data for Socorro County are not entirely consistent with the NMT data. Therefore, the historical use profile for the planning region total (Figure G2-10) was obtained by summing the NMT data with the OSE reported commercial use for Sierra County. Comparison of the OSE Socorro County data and the NMT data in the years where the two values seem consistent would suggest that other commercial use in Socorro County was on the order of 1 acre-foot in 1985 and 30 acre-feet in 1995. These values are fairly uncertain and not

complete because of errors in the 1990 data (Brian Wilson, 2000, personal communication) so they are not included in the total planning region consumptive use calculations (Figure G2-10, Table 6-8).

6.1.6 Industrial Current Demand

Wilson and Lucero (1997) define industrial use as follows:
Includes self-supplied enterprises engaged in the processing of raw materials (organic or inorganic solids, liquids, or gasses) or the manufacturing of durable and non-durable goods. Self-supplied water used for construction of highways, subdivisions, or other construction projects is also included here.

Activity that fits this definition is very limited in the planning region. None of the water suppliers listed in Table 6-2 can be categorized as industrial water users. The OSE water use reports provide a historical profile of the limited and sporadic industrial water use in the planning region (Figure G2-11). Withdrawal and consumptive use values are summarized in Table 6-9.

Table 6-9. Self-Supplied Industrial Consumptive Use and Withdrawal

County	Water Use / Withdrawal [a] (ac-ft/yr)					
	1975	1980	1985	1990	1995	2000
Consumptive Use						
Sierra	6.0	0.0	0.0	49.8	25.1	0.1
Socorro	59.0	0.0	0.0	2.2	15.5	1.9
Total	65.0	0.0	0.0	52.0	40.6	2.0
Withdrawal						
Sierra	10.0	0.0	0.0	49.8	25.2	0.1
Socorro	98.0	0.0	0.0	2.2	15.5	1.9
Total	108.0	0.0	0.0	52.0	40.7	2.0

[a] Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et. al., 2003)

6.1.7 Mining Current Demand

Wilson and Lucero (1997) define mining use as follows:
Includes self-supplied enterprises engaged in extraction of minerals naturally occurring in the earth's crust. This includes solids (coal and ores), liquids (crude oil), and gasses (natural gas

and CO2). It does not included water for processing these minerals (those waters are included in the industrial category), unless the processing is an integral part of and is contiguous with the extraction operation.

The water use questionnaire sent to public water systems in the planning region was revised to address mining use and was submitted to all mine operators in the planning region listed in the 1998 inventory of mines in New Mexico (Hatton et al., 1998). The 1998 inventory lists 18 mines, mills, or quarries in Socorro and Sierra Counties, with 7 of those listed as under development, on standby, or temporarily closed. Because the status of mines can change rapidly, however, the questionnaire was sent to all 18. To date, completed questionnaires have been received for 3 of the 18 originally sent out, and 2 were returned unopened, stamped "Not Deliverable as Addressed, Unable to Forward," indicating that those mines may be currently closed. In addition, a verbal response was received on the status of the Waldo Mine, which is operated as a research facility by New Mexico Tech and uses very little water (Mojtabai, 2000, personal communication).

The completed questionnaires were from Ribble Contracting, Inc. and St. Cloud Mining Company, which operated two of the mines that questionnaires were sent to. Ribble Contracting operates the Armijo aggregate pit in Socorro, which uses City of Socorro water. The St. Cloud Mining Company runs the Midnight St. Cloud Mine and Mill, which is currently on standby but was formerly used for mining copper and zinc concentrates and silica flux, and the Stone House Zeolite Mine, which is currently active.

Pumping by St. Cloud from 1983 through 1998 varied from a low of about 6.6 ac-ft/yr in 1984 to a high of 173.9 ac-ft/yr in 1989 with an average of about 50 ac-ft/yr. Since 1993, when the mill was last operated full-time, the average has been less than 20 ac-ft/yr. The water use varies widely depending on metal prices and markets for mined products and can change quickly and unpredictably. The active zeolite operations by St. Cloud use much less water than flotation milling, which is used for silver, copper, and gold mining.

Pat Freeman of the St. Cloud Mining Company also provided some information for other Sierra County mining operations with which he was familiar. Copper Flats, near Hillsboro, last ran in 1983 and has the capacity to use about 1,000 ac-ft/yr. Copper prices are currently low and the

status is uncertain, but the owner has applied and is seeking permits to resume operations. Smaller operations, such as the Sanders Brothers Mill in Caballo and a small test plant near Arrey, operate intermittently and may use 2 to 20 ac-ft/yr from private wells. Given the general downturn in the mining industry since 1990, it is likely that many of the non-respondents are out of business.

Figure G2-12 presents historical mining water depletions from the OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997, Wilson et al., 2003). Values for withdrawal and consumptive use are summarized in Table 6-10. The downward trend (to nearly zero water use in 1995) in the OSE data is consistent with the lack of response received to the questionnaires. An independent estimate of water use in the mining category is not provided.

Table 6-10. Self-Supplied Mining Consumptive Use and Withdrawal

County	Water Use / Withdrawal [a] (ac-ft/yr)					
	1975	1980	1985	1990	1995	2000
Consumptive Use						
Sierra	11	4	48	33	4	1
Socorro	8	77	77	6	8	2
Total	19	81	125	39	12	3
Withdrawal						
Sierra	90	20	75	166	18	5
Socorro	40	155	155	15	16	2
Total	130	175	230	181	34	7

[a] Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et. al., 2003)

6.1.8 Power Current Demand

Wilson and Lucero (1997) define the power use category as follows:
Includes all self-supplied power generating facilities.

The only power-generating facility operating in the planning region is a hydroelectric power plant associated with Elephant Butte Dam. However, this facility provides power dependent upon the

water needs of downstream irrigators rather than on electricity demand. Therefore, the water used by the power plant is not a water demand for power, but a secondary use of water that is provided based on other demands. In addition, no water is depleted by this secondary demand.

6.1.9 Riparian Evapotranspiration

Riparian evapotranspiration (RPET) is comprised of water consumed by riverine (non-agricultural) plant communities in the vicinity of surface water features and areas with very shallow water tables. For the analyses of water demand for this regional water plan, the RPET results presented by SSPA (Appendix E1) in their Middle Rio Grande Water Supply Study (MRGWSS) were used. The MRGWSS used RPET estimates developed by the Bureau of Reclamation as part of the *Middle Rio Grande Water Assessment* (Hansen, 1997) for the reach of the Rio Grande above San Acacia and USBR-developed RPET estimates from the "ET Toolbox" (http://www.usbr.gov/rsmg/nexrad/) for the San Acacia to Elephant Butte reach. The RPET estimates include evapotranspiration from the Rio Grande floodway channel, as well as from canals and drains that make up the MRGCD irrigation system. Current consumptive use estimates from the Socorro County line to San Acacia are 44,829 ac-ft/yr, and an additional 112,792 ac-ft/yr from San Acacia to Elephant Butte Reservoir, for a total of 157, 621 ac-ft/yr. Figure G2-13 and Table 6-11 present historical RPET estimates for the planning region.

Table 6-11. Riparian Evapotranspiration Consumptive Use

Year [a]	Total RPET Socorro [b] (ac-ft/yr)	Year [a]	Total RPET Socorro [b] (ac-ft/yr)
1985	98,219	1992	93,847
1986	90,057	1993	94,351
1987	93,357	1994	94,049
1988	93,222	1995	101,486
1989	93,224	1996	97,327
1990	90,643	1997	101,572
1991	93,687	1998	91,029

[a] More recent estimates are provided in Appendix E1

[b] Calculated by Hydrosphere as described in the text from SSPA, 2000

6.1.10 Open Water Evaporation

Open water evaporation is defined as follows:
Includes open water evaporation from man-made and natural channels, and man made and natural reservoirs. Does not include ephemeral channels, nor does it include reservoirs with a storage capacity less than 5,000 acre-feet.

Historical and current water uses for this category were obtained from three sources: the OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et al., 2003), Rio Grande Compact reservoir evaporation reports, and engineering evaporation calculations:

- The OSE reports provide estimates of reservoir evaporation for Sierra County, presumably comprised entirely of Elephant Butte Reservoir and Caballo Reservoir evaporation.

- As part of Rio Grande Compact accounting, evaporation off Elephant Butte reservoir is computed by multiplying pan evaporation rates by a lake depth correction factor and the reservoir surface water area. These estimates were obtained from the ISC (Kevin Flanigan, personal communication, May 2000).

- Caballo Reservoir evaporation was obtained directly from the USBR (Burt Cortez, 2000, personal communication)

The open water evaporation historical demand is presented in Figure G2-14, with the OSE estimates presented as one set and Elephant Butte and Caballo Evaporation summed as an independent estimate for Sierra County. Table 6-12a summarizes the OSE values. Table 6-12b summarizes ISC and USBR estimates of reservoir evaporation, which are in close agreement in most years.

Table 6-12a. Open Water Evaporation Consumptive Use and Withdrawal

County	Water Use / Withdrawal [a] (ac-ft/yr)					
	1975	1980	1985	1990	1995	2000
OSE Consumptive Use						
Sierra	76,500	168,170	218,971	164,974	292,561	219,325
Socorro	6,016 [b]	5,847 [b]	6,668 [b]	7,570	7,570	7,570
Total	82,516	174,017	225,639	172,544	300,131	226,895
OSE Withdrawal						
Sierra	76,500	168,170	218,971	164,974	292,561	219,325
Socorro	6,016	5,847	6,668	7,570	7,570	7,570
Total	82,516	174,017	225,639	172,544	300,131	226,895

[a] Source: OSE water use reports (Sorenson, 1977; Sorenson, 1982; Wilson, 1986; Wilson, 1992; Wilson and Lucero, 1997; Wilson et. al., 2003)

[b] Data for these years are from the fish and wildlife category, less the 545 ac-ft included in irrigated agriculture (Table 6-6a).

In addition to these estimates, SSPA independently estimated open water consumptive use as 7,787 ac-ft/yr between the Socorro County line and San Acacia, and 27,863 ac-ft/yr between San Acacia and Elephant Butte Reservoir.

6.1.11 Summary of Historical and Current Water Demand

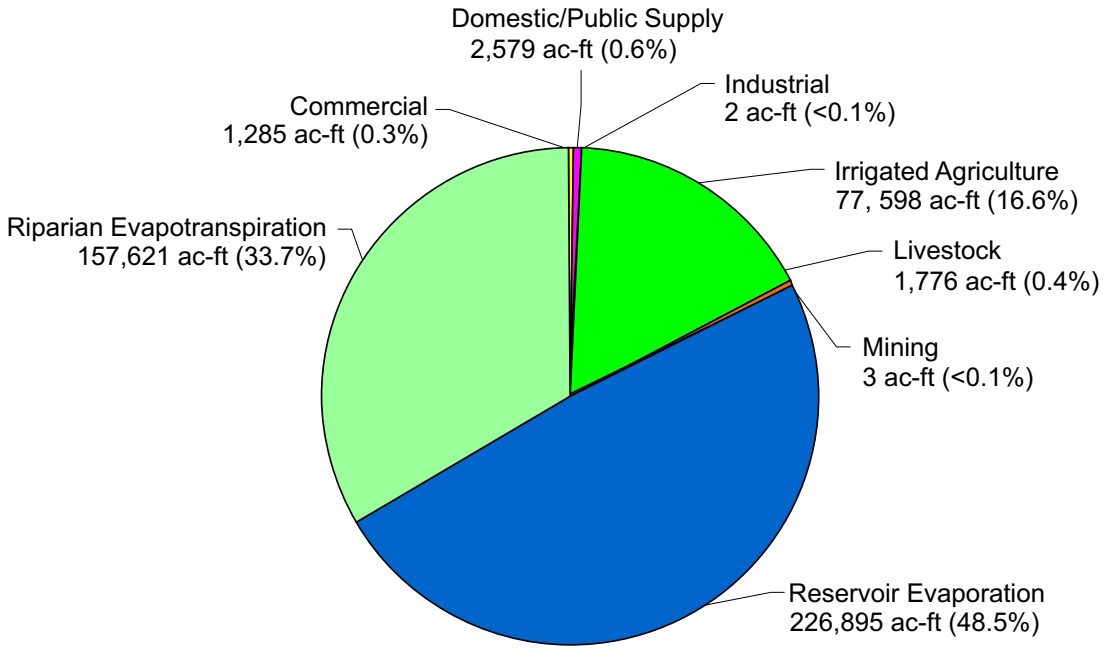
The results discussed in Section 6.1.1 through 6.1.10 are totaled and combined in several charts. Figures G2-15 and G2-16 present the total surface water depletion and groundwater depletion, respectively, broken down according to water use category. A more visual perspective of the relative magnitude by categories and sources is presented in Figure 6-1 with and without reservoir evaporation from Elephant Butte and Caballo Reservoirs. The total (surface water plus groundwater) depletion in the planning region, broken down by county, is presented in Figure G2-17.

These data indicate the following:

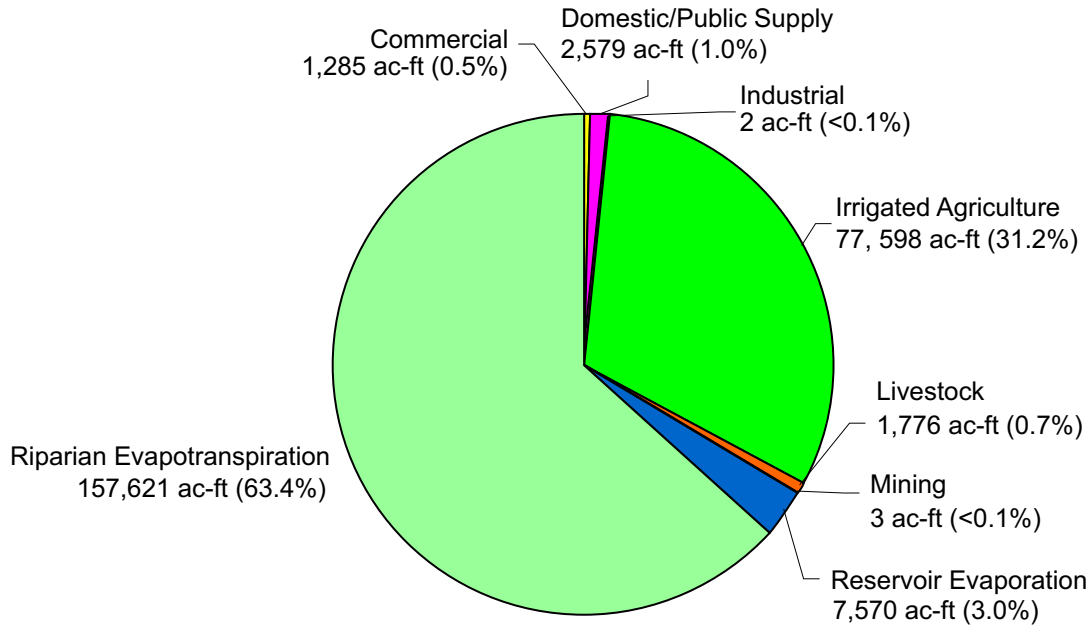
Table 6-12b. Open Water Evaporation Consumptive Use Based on USDA and Farm Reports of Irrigated Acreage

Year	Water Use [a] (ac-ft/yr)		
	Elephant Butte Total	Caballo	Sierra County Total
HRC Consumptive Use			
1970	74,081	25,622	99,703
1971	47,334	22,138	69,472
1972	44,907	20,626	65,533
1973	98,815	35,808	134,623
1974	94,434	31,144	125,578
1975	84,374	34,029	118,403
1976	70,029	30,243	100,272
1977	46,069	24,835	70,904
1978	41,101	19,037	60,138
1979	73,741	30,957	104,698
1980	139,036	33,179	172,215
1981	116,295	32,421	148,716
1982	107,408	29,584	136,992
1983	129,448	37,927	167,375
1984	147,519	33,889	181,408
1985	182,365	58,289	240,654
1986	160,959	65,829	226,788
1987	174,867	65,111	239,978
1988	178,793	55,596	234,389
1989	208,858	39,477	248,335
1990	145,970	23,777	169,747
1991	126,771	20,226	146,997
1992	161,166	23,045	184,211
1993	197,677	43,381	241,058
1994	228,114	48,013	276,127
1995	240,518	59,163	299,681
1996	228,114	43,808	271,922
1997	174,555	28,398	202,953
1998	227,057	28,741	255,798

[a] Calculated by Hydrosphere as described in the text.



With Elephant Butte and Caballo Reservoir Evaporation
Total Consumptive Use: 467,759 ac-ft



Without Elephant Butte and Caballo Reservoir Evaporation
Total Consumptive Use: 248,434 ac-ft

SOCORRO - SIERRA REGIONAL WATER PLAN

2000 OSE Water Use and Riparian Evapotranspiration for Socorro-Sierra Water Planning Region

Daniel B. Stephens & Associates, Inc.
12-2-03 JN 9469

Figure 6-1

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- Public-supplied water use in the planning region has risen approximately 85 percent between 1975 and 1999 (Figure G2-1), suggesting an annual growth rate of approximately 2.5 percent.

- Self-supplied domestic water use has remained relatively stable between 1975 and 1999 (Figure G2-2), with decreases in Sierra County somewhat offset by increases in Socorro County.

- Irrigated agricultural water depletions (Figure G2-5) and water diversions (Figure G2-6) have remained relatively stable for the past 25 years. The dip in diversion and depletions in 1985 coincides with the especially wet period from 1984 through 1985 and the change in OSE accounting methods. Irrigated agriculture represents the third largest depletion in the region, behind reservoir evaporation and riparian evapotranspiration.

- Livestock water use has remained relatively stable in the planning region (Figure G2-7) between 1975 and 2000.

- Total commercial water use (Figure G2-10) has risen approximately 60 percent in the planning region between 1975 and 1995. New Mexico Tech is by far the largest commercial user, and its use has remained relatively stable in the 1,000- to 1,300-ac-ft/yr range. Thus, commercial use by entities other than New Mexico Tech has increased 10-fold between 1975 and 1995.

- Industrial and mining water depletions in the planning region (Figures G2-11 and G2-12) are relatively small and have varied slightly since 1975, never exceeding 200 ac-ft/yr in aggregate.

- Reservoir evaporation has varied over a 3-fold range between 1970 and 1998. Essentially all of the reservoir evaporation depletion in Sierra County emanates from Elephant Butte and Caballo Reservoirs, whereas most of Socorro's open water evaporative depletions arise from La Joya and Bosque del Apache Wildlife Refuges and direct losses from the Rio Grande. The loss due to evaporation from Elephant Butte and

Caballo Reservoirs is substantially larger than the loss from La Joya, Bosque del Apache, and the Rio Grande. Nevertheless, as indicated by Figures 6-1 and G2-15, reservoir evaporation represents by far the largest water depletion in the planning region.

- Riparian evapotranspiration is very high in the region, representing approximately 34 percent of the total depletions (Figure 6-1). It is the second largest depletion in the region, behind reservoir evaporation.

- The largest "beneficial use" (as defined by New Mexico State Water Law [Appendix D]) water depletion has been irrigated agriculture, which has remained relatively stable. The beneficial use categories of public supplied and commercial use are relatively small compared to reservoir evaporation and irrigation, but these uses are growing at very high rates.

Although it is no longer tracked by the OSE as a separate category, recreational use is a significant factor in the region:

- In Socorro County, recreational activities account for approximately 26 percent of the total commercial demand (due to the New Mexico Tech golf course) and approximately 10 percent of the irrigated agriculture demand (to grow feed crops at Bosque del Apache National Wildlife Refuge).

- In Sierra County, recreational activities account for approximately 10 percent of the total public supply use (due to the City of Truth or Consequence's Oasis golf course) and approximately 10 percent of the commercial demand (due to supply water systems at campgrounds, state parks, and similar facilities).

In addition to the quantified demands, recreational use of water in Elephant Butte Reservoir is an important component of the economy of Truth or Consequences and Sierra County. Though the water stored in Elephant Butte is used primarily for downstream irrigation and to meet Compact requirements, the Elephant Butte reservoir pool has a secondary benefit to tourism-

related businesses in Truth or Consequences, including motels, restaurants, and recreational facilities.

Another demand that is not quantified is instream flow to support wildlife habitat and endangered species needs. The need for instream flow affects storage and release of water in the Rio Grande and could potentially affect the ability of agricultural users to divert water.

6.2 Projected Population Growth

In order to have an understanding of future water needs in the region, it is important to first have an understanding of demographic trends in the region. Accordingly, Sites Southwest projected population growth in the region over the next 40 years. Full documentation of their work is provided in Appendix G4 and is summarized below.

To develop population projections, Sites-Southwest used a computer model to project the future population in Socorro and Sierra Counties from 2000 to 2040. The model started with the 2000 U.S. Census count in each county, split out by sex and 5-year age intervals. It then took into account the historical and projected trends of several factors:

- The fertility rate, or number of babies born per 1,000 women of child-bearing age
- Life expectancy at birth
- Net migration (number of persons who move to an area in a given time period minus those who move out)

Fertility and mortality rates tend to change slowly over time, rendering them easier to predict. Migration rates can vary more over time, making them harder to forecast into the future.

Using slightly different assumptions for each scenario, the model produced high, middle, and low population projections for Socorro and Sierra Counties in 5-year intervals from 2000 to 2040 (Figure 6-2).

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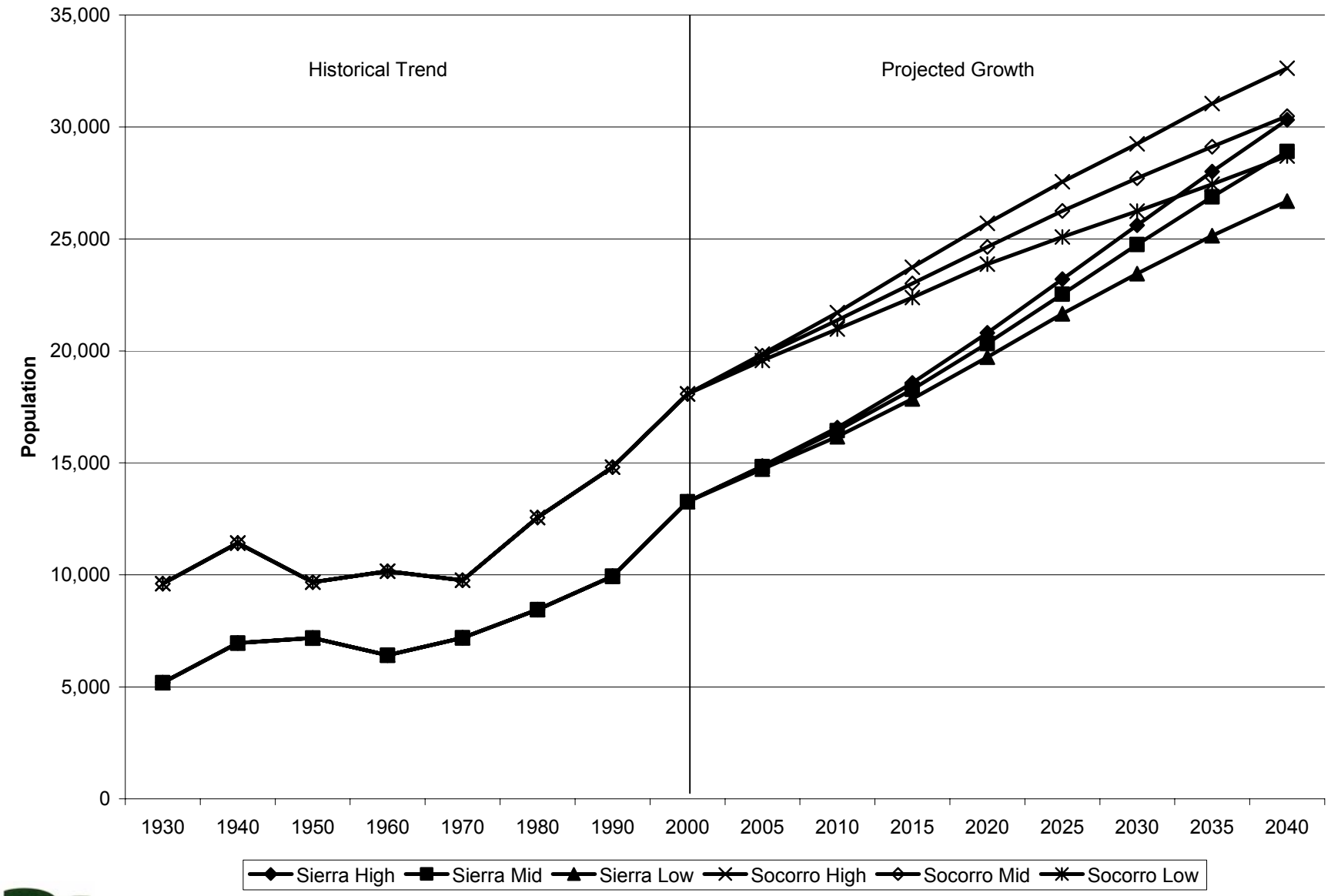


Figure 6-2

SOCORRO-SIERRA REGIONAL WATER PLAN

Historical and Projected Population Growth

Historically, the population in Sierra County grew at an average yearly rate of 1.05% from 1930 to 1990. It grew faster from 1960 to 1990 (1.44 percent average yearly rate) than throughout the rest of the period and rose to an average yearly growth of 2.9 percent between 1990 and 2000. Based on these trends, the Sierra County (Figure 6-2) population by 2040 for the low, middle, and high scenarios was projected to be 30,320 (2.2 percent average annual growth), 28,907 (2.0 percent average annual growth), and 26,687 (1.8% average annual growth), respectively.

For Socorro County (Figure 6-2), the 2040 population for the low, middle, and high scenarios was projected to be 32,626 (1.4 percent average annual growth), 30,481 (1.3 percent average annual growth), and 28,700 (1.2 percent average annual growth), respectively. This compares with an average annual growth rate of 0.71 percent from 1930 through 1990. The rate, however, accelerated to 2.05 percent a year between 1970 and 1990 and fell off only slightly to 2.01 percent between 1990 and 2000.

Several interesting population trends for each county emerged from the study:

- *Sierra County:*
  - The fertility rate increased from a low of 67.3 births per 1,000 women ages 15 to 44 in 1970 to a high of 80.7 births in 1997.
  - Because fewer women are in the child-bearing ages than in Socorro County, Sierra County has only 0.6 births for every death. All of the population increase comes from net migration into the county, particularly from retirement-age groups.
  - A high proportion of the population ages 20 to 24 (more than 50 per 1,000) and 25 to 29 (25 per 1,000), particularly males, tends to leave the county, presumably in search of economic opportunities elsewhere.
  - In addition to the regular population, approximately 1,700 seasonal visitors reside in the county and should be considered in calculating water use.

- *Socorro County:*
  - The fertility rate has declined from a high of 131.8 births per 1,000 women in 1970 to a low of 70.7 births in 1997. The exceptions were the rates for women ages 20 to 29, which increased to 76.6.

  - Overall there were 2.1 births for every death in the county from 1995 through 1997. Most of Socorro's population increase between 1980 and 1990 came from natural increase (births minus deaths).

  - Young people, particularly males, ages 20 to 34 also tend to leave Socorro County, although at a much lower rate then in Sierra County. The true rate, however, may be partially masked by incoming students to New Mexico Tech.

6.3 Future Demand

As prescribed by the ISC (1994), future water demand by category of use was projected as part of this regional water plan. Future water use was projected for the categories defined by the OSE and described in Section 6.1:

- Public water supply
- Self-supplied domestic
- Irrigated agriculture
- Livestock
- Commercial
- Industrial
- Mining
- Power generation
- Riparian evapotranspiration
- Reservoir evaporation

6.3.1 Methods

The methods used to project future water use in each of these categories are described in Sections 6.3.1.1. and 6.3.1.2

6.3.1.1 Public Supply, Domestic, and Commercial Water Use Categories

Future water demands for the public water supply, self-supplied domestic, and commercial categories were projected based on current demand (Section 6.1) and projected population growth through the year 2040 (Section 6.2, Appendix G4). The future water demand projections for the public water supply and self-supplied domestic categories were calculated by comparing the public water suppliers' questionnaire responses (Appendix G1) or NMED water supplier database values for the current population (Section 6.1; Table 6-2) and the 1999 estimated population by zip code provided by Sites Southwest (Appendix G4). The number of people on self-supplied domestic systems was assumed to be the difference between total population and that portion served by a public water supply system. The future population projections provided by Sites Southwest (Appendix G4) were then multiplied by per capita use rates to calculate future water consumptive use.

The per capita use rates for the public water supply category future projections were based on the weighted average of per capita use for public water suppliers in each county:

- For Sierra County, a consumptive use rate of 77 gallons per capita per day (gpcd), which is based on a 0.5 depletion factor, was used.

- For Socorro County, a rate of 98 gpcd, which is based on a 0.5 depletion factor except for the City of Socorro, which had a historical depletion factor of 0.6, was used.

The 0.5 depletion factor is based on recommendations given by Wilson (2003).

The future projections for the self-supplied domestic category are based on a rate of 100 gpcd with a depletion factor of 1.0. These values are also based on recommendations given by Wilson (2003).

At present, the majority of the water demand in the commercial category can be attributed to NMT, which is seeking to expand in the future based on a recently completed strategic planning process (NMT, 1999). The commercial future demand projection was calculated by applying the population growth rates for Socorro and Truth or Consequences to the current estimates of water consumption for Socorro County (NMT) and Sierra County, respectively. Although all future commercial category development in Socorro County likely will not be due to NMT, water used by NMT provides a basis for the potential amount of water needed as development in the commercial sector occurs.

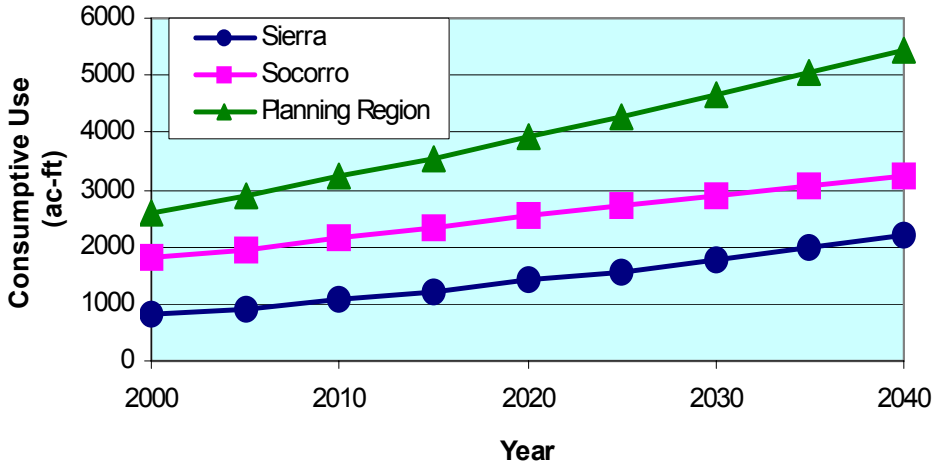
6.3.1.2 Other Water Use Categories

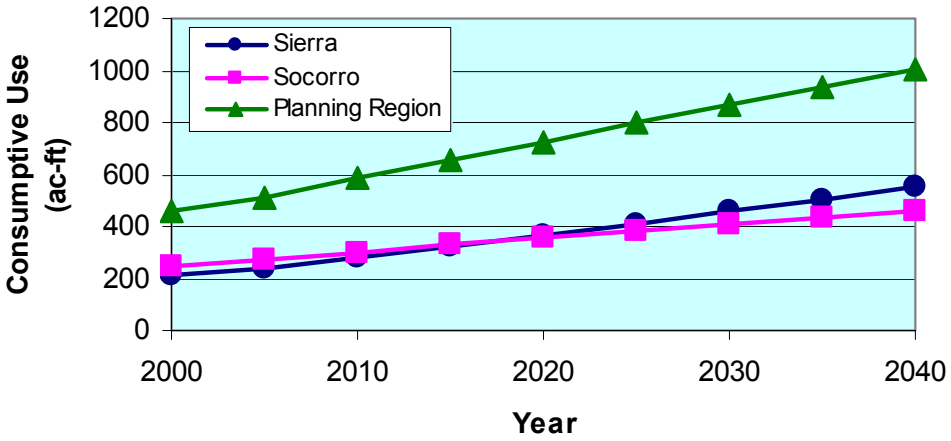
Changes in the irrigated agriculture, livestock, mining, and industrial categories within the planning region may occur as the regional economy evolves in the future, but predicting those changes is impossible at this time as they have shown no predictable trends in the past. For this study, therefore, the mining and industrial categories were assumed to continue at their average historical rate into the future, and the irrigated agriculture, livestock, and riparian evapotranspiration categories were assumed to continue at their current rates into the future. Reservoir evaporation, which varies from year to year based on climatological conditions and the size of the storage pool, was set to equal the long-term average based on SSPA modeling (Appendix E1). To account for the variability observed in the historical record, future demands for the reservoir evaporation and irrigated agriculture categories were projected as ranges that span their minimum and maximum historical values.

6.3.2 Results and Conclusions

The results of the future demand projections (Figure 6-3, Table 6-13) show that water demands in the public water supply, self-supplied domestic, and commercial categories will more than double over the next 40 years. As noted in Section 6.3.1.2, total future demand in the planning region for the industrial, irrigated agriculture, livestock, mining, reservoir evaporation, and riparian evapotranspiration were projected to remain at their past average levels (Table 6-13). A total increase in demand of 4,372 ac-ft/yr is projected from the year 2000 to 2040.

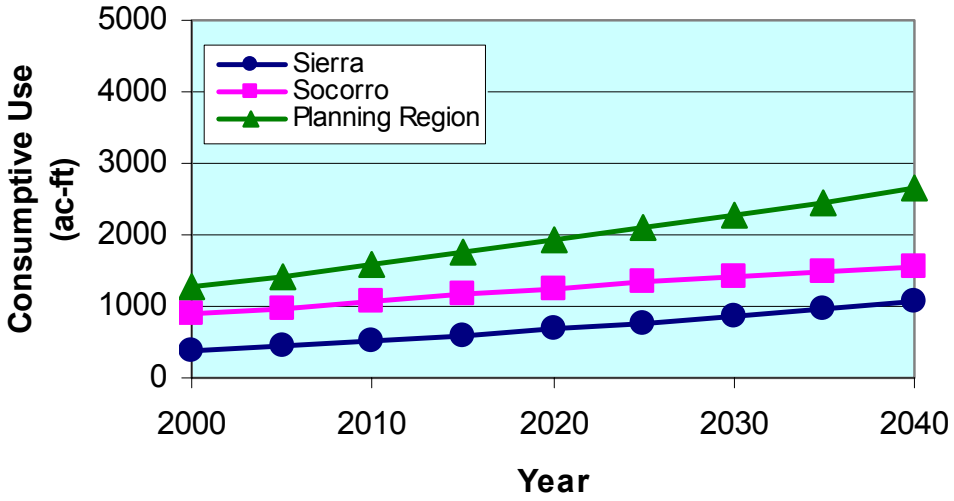
Public Water Supply





Self-Supplied Domestic

Commercial



SOCORRO-SIERRA REGIONAL WATER PLAN

Future Demand in the Public Water Supply, Domestic, and Commercial Categories

Figure 6-3

HYDROSPHERE Resource Consultants

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Table 6-13. Estimated Future Water Use in the Socorro-Sierra Water Planning Region

Category	Projected Future Water Use							
	2005	2010	2015	2020	2025	2030	2035	2040
Public water supply	2,871	3,231	3,558	3,949	4,291	4,673	5,066	5,435
Self-supplied domestic	512	586	651	722	796	866	938	1,008
Commercial	1,416	1,594	1,754	1,942	2,099	2,280	2,463	2,638
Irrigated agriculture [a]	77,598	77,598	77,598	77,598	77,598	77,598	77,598	77,598
Livestock	3,198	3,198	3,198	3,198	3,198	3,198	3,198	3,198
Industrial	27	27	27	27	27	27	27	27
Mining	47	47	47	47	47	47	47	47
Reservoir evaporation [b]	171,000	171,000	171,000	171,000	171,000	171,000	171,000	171,000
Riparian evapotranspiration [c]	157,621	157,621	157,621	157,621	157,621	157,621	157,621	157,621
Total [d]	414,290	414,902	415,454	416,104	416,677	417,310	417,958	418,572

[a] Projected depletion ± 36,000 (Year 2000 depletion minus lowest historical depletion).

[b] Based on average from 10,000 model runs (Appendix E1) of 163,580 ac-ft/yr at Elephant Butte plus mean Socorro County reservoir evaporation of 7,570 (Table G2-1)

[c] Based on SSPA estimate (Appendix E). These amounts are based on current conditions and could be lowered with removal of riparian vegetation.

[d] Projected depletion ± 150,000 (Year 2000 depletion minus lowest historical depletion)

Given that the water budget for the region (Section 7) suggests that essentially all existing supplies along the Rio Grande are already being used, future growth in demand must be carefully planned for to ensure that required supplies are available. Selected alternatives for meeting this future demand are evaluated in Section 8.