

## **2. Population and Water Demand Projections**

This section presents the population and water demand projections for Region C and describes the development of those projections. For the purposes of water supply planning, projections of dry year water demands are used. Demands are generally greater in dry years than in normal years, and it is important to develop a water supply system that is able to meet those greater demands when they occur.

### **2.1 Previous Texas Water Development Board Projections**

The estimated 1996 population of Region C was 4,609,060. Table 2.1 shows TWDB's previous population projections for Region C counties developed for the 1997 Texas Water Plan<sup>(1)</sup>, which projected a 2050 population of 8,843,253. Figure 2.1 shows the historical population for Region C from 1900 through 1990 and the TWDB projection from the 1997 water plan.

The estimated 1996 water use in Region C was 1,126,518 acre-feet. Table 2.2 shows the projected water demand for Region C counties from the 1997 Texas Water Plan, with a total region-wide demand of 1,967,916 acre-feet per year projected by 2050. Figure 2.2 shows TWDB's projected water demand for Region C from the 1997 water plan by type of use.

### **2.2 Region C Population and Water Use Patterns**

The sixteen counties in Region C can be divided into four classifications from the standpoint of population and water use:

- Urbanized counties
- Partially urbanized counties
- Urban fringe counties
- Rural counties.

Figure 2.3 shows the classification of counties in Region C.

**Urbanized counties** are characterized by dense population and by residential, industrial, and commercial development covering most of the land area. Population growth will come from development of the remaining open land and from redevelopment. Increased water

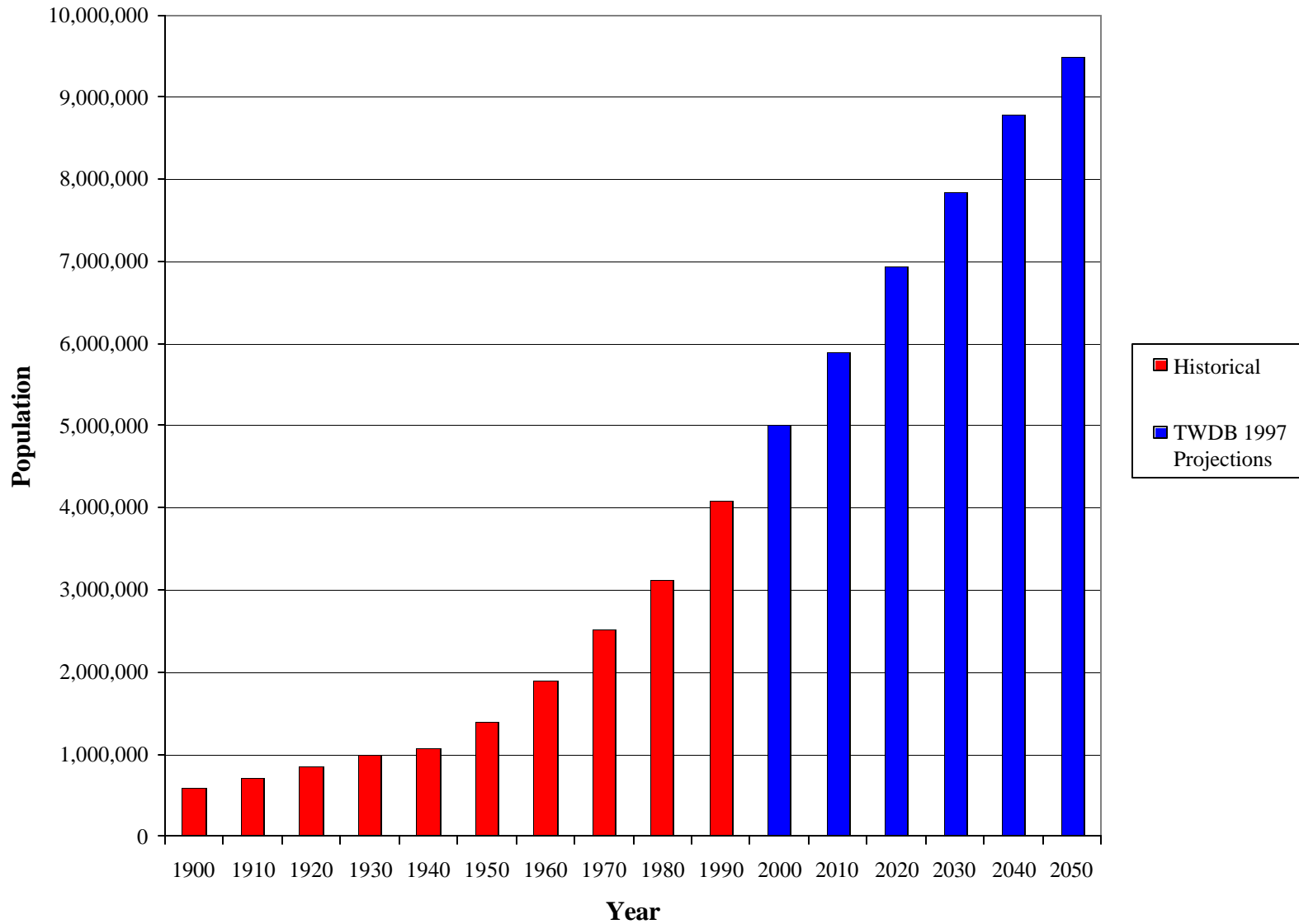
**Table 2.1**  
**Texas Water Development Board**  
**County Population Projections from the 1997 Texas Water Plan**

County	Historical 1996	Projected Population					
		2000	2010	2020	2030	2040	2050
Collin	373,095	387,598	527,712	706,997	873,323	1,019,350	1,162,482
Cooke	33,196	32,139	33,714	35,241	36,360	37,142	37,821
Dallas	1,999,926	2,074,858	2,286,828	2,556,793	2,784,704	3,045,931	3,259,995
Denton	349,566	385,876	523,205	679,279	845,595	985,370	1,135,566
Ellis	94,097	106,921	130,867	156,521	181,711	194,893	205,487
Fannin	27,435	26,692	26,966	27,408	27,835	28,173	28,396
Freestone	17,757	17,291	17,854	18,382	18,848	19,164	19,433
Grayson	100,611	102,119	106,277	110,643	114,702	117,864	120,982
Henderson (Partial)	45,761	46,562	51,261	55,514	57,704	58,689	60,476
Jack	7,435	7,148	7,530	7,896	8,358	8,865	9,352
Kaufman	61,646	63,741	76,272	89,203	100,144	107,283	112,964
Navarro	42,875	42,441	45,665	48,265	50,691	51,563	53,312
Parker	73,897	80,436	99,095	118,287	139,094	156,023	171,216
Rockwall	34,287	41,174	61,392	88,135	121,288	160,588	203,530
Tarrant	1,306,457	1,415,759	1,594,218	1,798,893	1,915,375	2,111,193	2,205,610
Wise	41,019	39,743	45,428	50,540	55,596	56,476	56,631
Region C Total	4,609,060	4,870,498	5,634,284	6,547,997	7,331,328	8,158,567	8,843,253

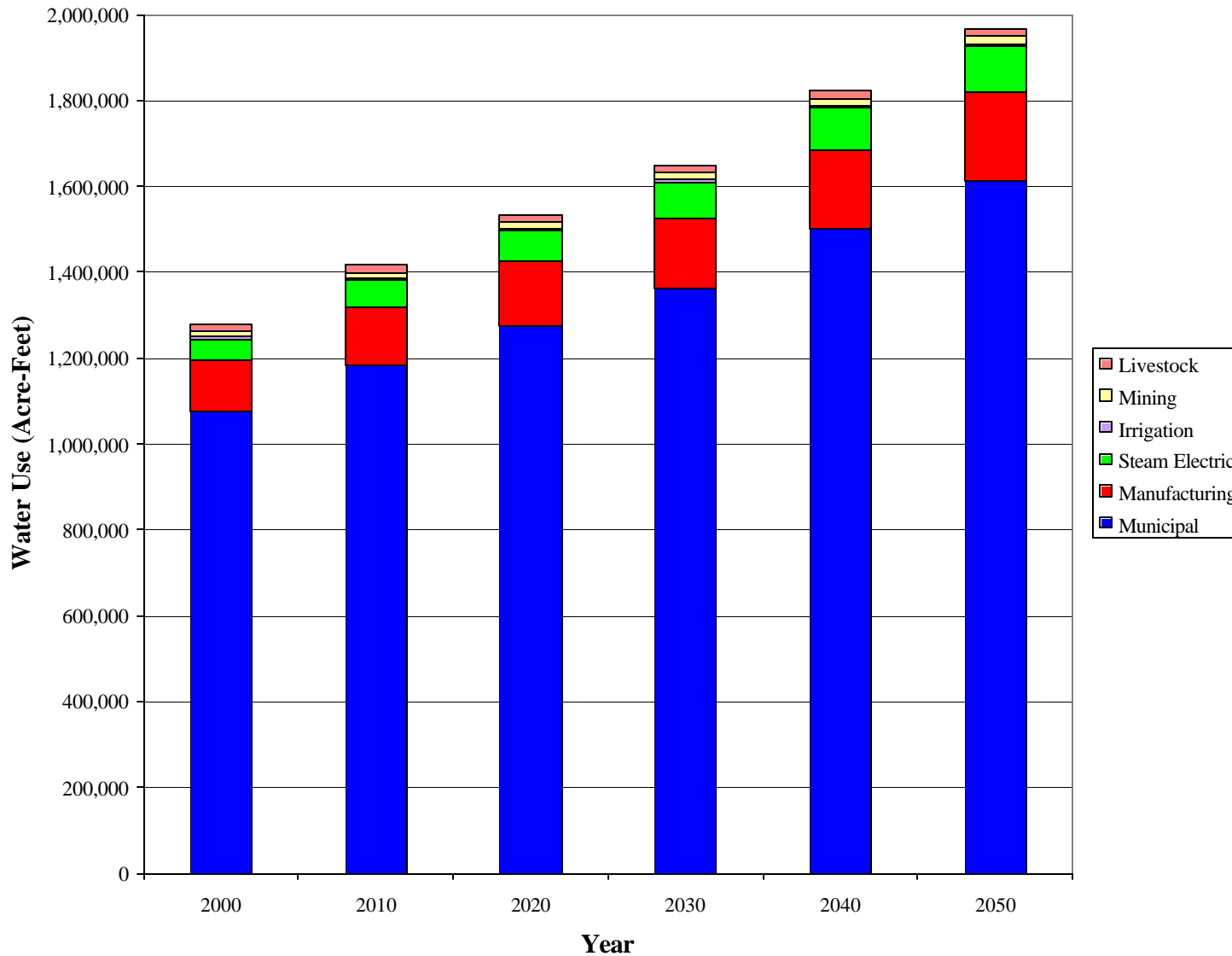
**Table 2.2**  
**Texas Water Development Board**  
**County Water Demand Projections from the 1997 Texas Water Plan**

County	Historical 1996	Projected Water Demand (Acre-Feet per Year)					
		2000	2010	2020	2030	2040	2050
Collin	89,230	91,275	109,344	134,062	159,642	183,209	202,680
Cooke	8,429	8,266	8,113	8,073	8,075	8,079	8,147
Dallas	505,423	597,945	649,055	700,728	729,819	802,988	860,588
Denton	65,075	80,037	98,815	117,821	132,349	151,155	172,338
Ellis	19,721	24,756	27,812	30,050	33,422	35,127	36,857
Fannin	17,515	13,199	15,896	15,582	20,398	25,247	30,147
Freestone	20,608	17,939	17,857	17,738	17,717	17,674	17,691
Grayson	29,152	25,738	25,981	26,139	26,719	27,354	28,553
Henderson (Partial)	10,785	11,550	18,771	28,791	33,945	38,881	44,014
Jack	3,337	2,365	2,290	2,259	2,265	2,294	2,346
Kaufman	10,653	12,434	13,503	14,503	15,669	16,359	17,035
Navarro	10,558	9,405	9,585	9,675	9,875	9,917	10,159
Parker	12,372	13,603	15,147	16,304	18,362	20,125	21,858
Rockwall	6,566	8,375	10,929	14,562	19,709	25,952	32,219
Tarrant	291,406	346,372	375,680	379,846	401,915	437,950	462,745
Wise	25,688	16,845	17,493	18,276	19,287	19,863	20,539
Region C Total	1,126,518	1,280,104	1,416,271	1,534,409	1,649,168	1,822,174	1,967,916

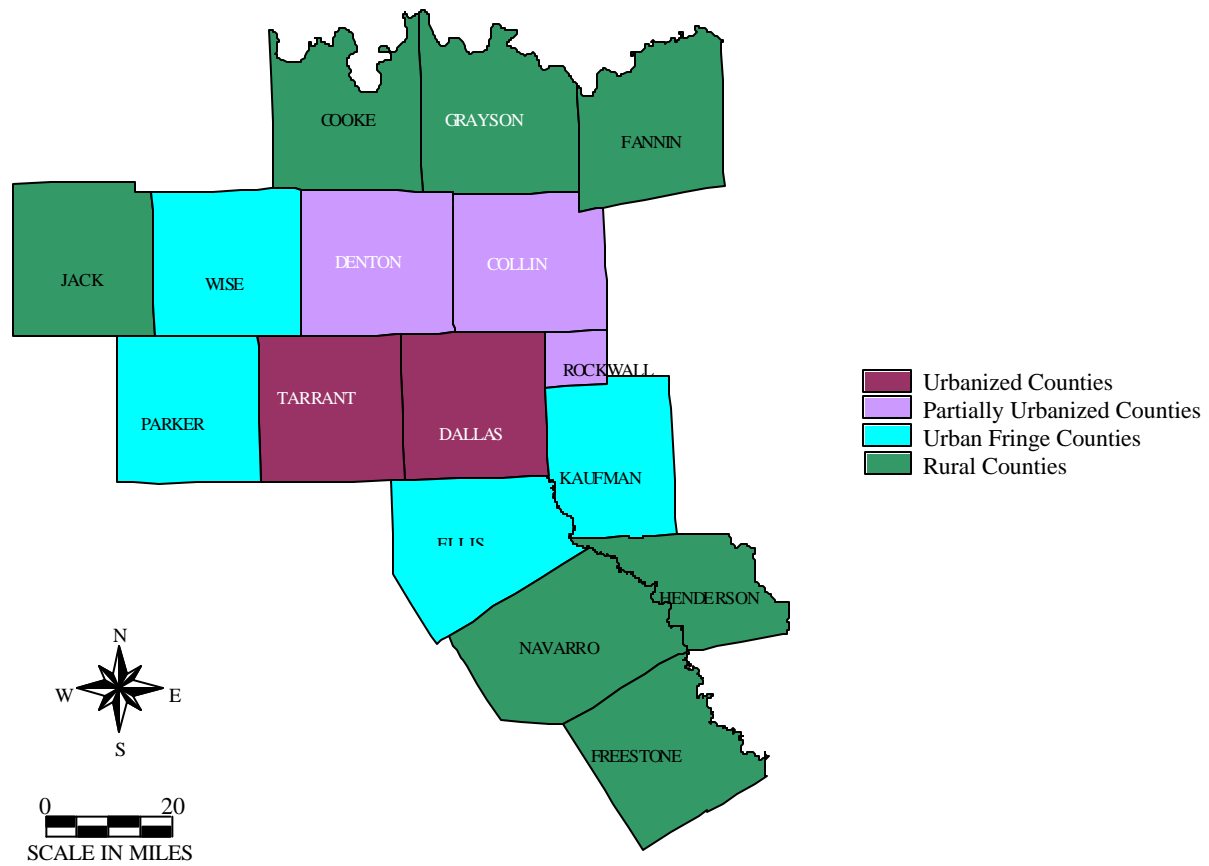
**Figure 2.1**  
**Texas Water Development Board Historical and Projected**  
**Population for Region C from the 1997 Water Plan**



**Figure 2.2**  
**Texas Water Development Board 1997 Water Plan Projections**  
**for Water Use by Category in Region C**



**Figure 2.3**  
**Region C County Classifications**



demand will come primarily from population and employment growth (partially offset by water conservation). Dallas and Tarrant Counties are the urbanized counties in Region C.

**Partially urbanized counties** have a significant land area that is highly developed, with dense population and industrial and commercial development. These counties also have significant undeveloped areas. Population growth in these counties is expected to be significant and to be driven primarily by new development. Increased water demand will also come primarily from new development. Growth rates in these counties cannot be predicted from historical trends alone. Per capita municipal water demand is likely to increase with population in developing areas, even though conservation measures are implemented. The increase in per capita municipal demand occurs as a result of changes in the type of housing. Newly constructed homes in developing areas are likely to have higher per capita demand than existing development because of irrigation systems, swimming pools, and water-using appliances. Collin, Denton, and Rockwall Counties are partially urbanized counties in Region C.

**Urban fringe counties** are located adjacent to urban counties, but they currently have minimal urbanized development. They generally have higher population density than rural counties, but most of the land area is undeveloped. These counties are expected to experience relatively high growth in the next fifty years as urban development expands from the urbanized counties. Population growth in the urban fringe counties can be expected to be significant and will be derived primarily from new development. Water demand will grow with the growing population, and per capita municipal demand will generally increase even with water conservation measures because of changes in housing type. The urban fringe counties in Region C are Ellis, Kaufman, Parker, and Wise.

**Rural counties** are located beyond the immediate influence of the urban counties. Growth in these counties will generally be generated from local expansion and be dependent on local economic factors. In most cases, historical trends are a reasonable indication of future population growth. In some cases, recent economic or demographic changes, such as prison construction, have altered population growth trends. The rural counties in Region C are Cooke, Fannin, Freestone, Grayson, Henderson, Jack, and Navarro.

### **2.3 Methodology for Projections of Population and Water Demand**

TWDB's Regional Water Planning Guidelines <sup>(1)</sup> require the regional water planning groups to use TWDB population and water demand projections from the 1997 Texas Water Plan <sup>(11)</sup> unless revisions are approved by TWDB. TWDB provided guidelines allowing for revisions based on changed conditions or new information <sup>(35)</sup>.

TWDB projects water demand in several categories, including municipal, manufacturing, steam electric power generation, mining, irrigation, and livestock. Municipal demand is developed separately for each community with a population of over 500 and includes commercial, institutional, and residential demands but does not include manufacturing water use. A "county other" group for each county covers municipal use in rural areas and communities with less than 500 people. The other demand categories are developed on a countywide basis for each county.

The basic data provided by TWDB included historical population and water use data and the projections from the 1997 Texas Water Plan <sup>(9, 11)</sup>. For the Senate Bill One planning process, these data were assembled in tables and figures that could be reviewed by counties, cities, water suppliers, industries, and other interested entities. The TWDB data and a questionnaire were sent to all Region C counties, cities with a population over 1,000, regional water suppliers, retail water suppliers (supplying over 0.2 mgd), and large industries. The questionnaires sought information on population and water use projections and other water supply issues. Copies of the questionnaires are included in Appendix C. The response rate for all questionnaire recipients was 51 percent, and 61 percent of the cities, counties, and regional water suppliers responded. Many cities and counties responded with suggestions for revisions to the previous projections, as did several major water providers.

In addition to data provided by TWDB and replies from the surveys, population data were gathered from the State Data Center <sup>(3)</sup> and the North Central Texas Council of Governments (NCTCOG) <sup>(36)</sup>. The State Data Center provided historical population estimates for each city and county and a 1998 population projection by county based on 1990-1996 migration rates. NCTCOG provided historical population estimates for cities and counties in its service area and projected populations for 1999 and 2000.

## Revisions to Population Projections

Figures showing historical and projected population were developed for each Region C county. The figures are included in Appendix D, which has back-up data for population and water demand projections. The figures show the following:

- Historical population estimates from the State Data Center
- TWDB population projections through 2050 developed for the 1997 water plan
- State Data Center population projections through 2030 based on 1990-96 migration rates
- Projections provided from responses to the surveys
- Projections adopted by the Region C committee and approved by TWDB.

The State Data Center and TWDB population projections are based on analysis of projected birth rates, death rates, and migration into and out of each county. In the 1997 water plan, the TWDB developed at least three different population projections for each county, based on different assumptions about future migration rates:

- Future migration rates equal to 100 percent of the rates that actually occurred in the 1980s
- Future migration rates equal to 50 percent of the rates in the 1980s
- No net future migration into or out of the county.

The TWDB then adopted one of these three population projections as the “most likely” for the county or ran a fourth projection as the most likely set. The State Data Center projection is a single projection showing future population if migration rates are the same as those from 1990 through 1996.

The existing population projections for each county were reviewed, and changes to projections were recommended where current populations deviate significantly from the previous TWDB projections. The 1998 State Data Center projections were considered carefully in this process since they are based on the most recent available migration information.

Once the county population projections were completed, city population projections were adjusted based on historical trends and knowledge of expected future development. The county population projections served as controls in this process, and all population not assigned to a particular city was included as “county other” for that county.



## Revisions to Water Demand Projections

As discussed in Section 1, municipal use is over 85 percent of the total water use in Region C. TWDB estimates of municipal demand are based on projections of population and per capita municipal water demand. The projected population is multiplied by the projected per capita municipal demand to determine the projected municipal water use. TWDB's projections of per capita municipal water demand from the 1997 Texas Water Plan<sup>(11)</sup> were compared with per capita water demand in the 1990s from TWDB data<sup>(9)</sup>. In addition, data were developed on 1998 per capita water use for many Region C water providers. Previous TWDB projections in per capita water demand were adjusted to reflect actual use in the 1990s, trends in water use, water conservation, reasonable minimum demands for water, knowledge of future development that might affect per capita needs, and other factors. Tables and graphs were developed for each city in the region. They are not included in this report due to space limitations, but they were provided to the Region C Technical Review Committee and the TWDB to assist in the review of the recommended projections.

Projections of water demand for steam electric power generation were revised based on input from TXU Electric. The revised projections are higher than previous TWDB projections because of the surge in power plant development that is presently occurring. Previous TWDB projections for manufacturing, mining, irrigation, and livestock use were left unchanged after comparison with recent historical data.

## Review of Initial Recommendations for Population and Water Use Projections

The Region C Water Planning Group formed a Technical Review Committee consisting of experienced water resource planners to review the recommendations of the consultants on population and water use and report to the planning group. The Technical Review Committee met with the Region C consultants five times for a total of 35 hours to review and finalize the population and water demand projections for the region. These meetings included a thorough review and discussion of the population and municipal demand projections for each water user group in the region. The report of the Technical Review Committee is included as Appendix E. The Region C Water Planning Group also held a public meeting to receive input on the water demand projections.

The TWDB staff conducted a thorough review of the revisions to projected population and water demand recommended by the Region C Water Planning Group. A number of additional changes were made as a result of TWDB input, and the TWDB board approved the revised projections in December of 1999.

#### **2.4. Population Projections**

Table 2.3 presents the population projections by county for Region C as recommended by the Region C water planning group and approved by TWDB. Figure 2.4 shows the historical and projected population for the region. Figure 2.5 is a map of the projected 2050 population and the projected change between 1996 and 2050 by county. All counties are projected to increase in population between now and 2050, and the new 2050 population projection for Region C is 9,481,157, which is 7.2 percent higher than the previous TWDB projection. The newly adopted 2050 population projections are higher than the previous TWDB projections for Collin, Cooke, Denton, Fannin, Freestone, Grayson, Kaufman, Navarro, and Wise Counties. They are lower than the previous projections for Ellis County, and they are the same for Dallas, Henderson, Jack, Parker, Rockwall, and Tarrant Counties. The reasons for the changes to county population projections are as follows:

**Collin.** The estimated 1998 population for Collin County exceeds TWDB's projected population for the year 2000. In the 1990s, population growth has been slightly above TWDB's highest projection and well above TWDB's most likely projection. The adopted projection follows TWDB's highest projection through 2020 and shows slower growth thereafter.

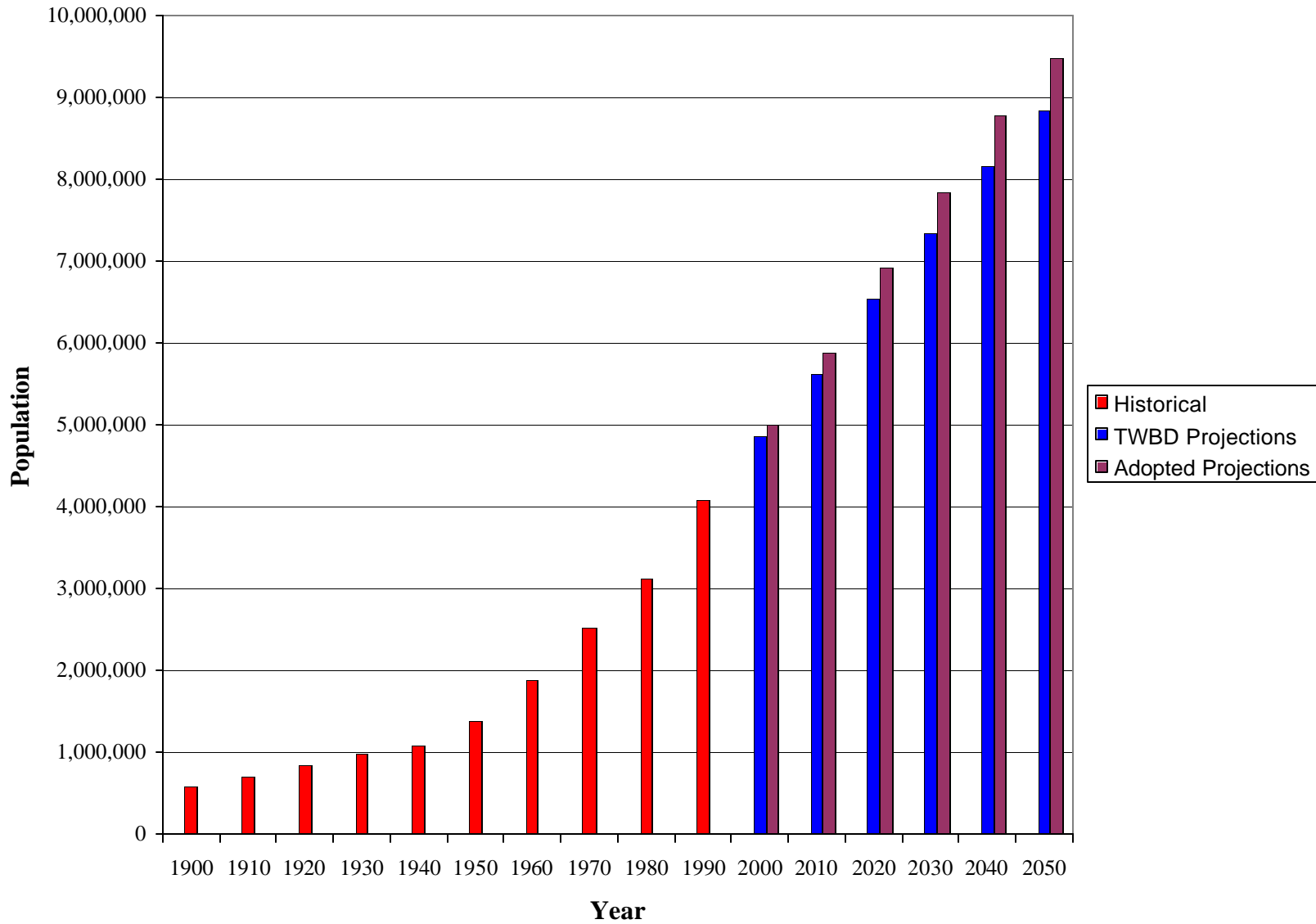
**Cooke.** The estimated 1998 population for Cooke County exceeds TWDB's projections for 2000 and 2010. The adopted projection follows the 1998 State Data Center projection through 2020 and continues slow growth thereafter.

**Denton.** Based on growth through 1998, the expected year 2000 population for Denton County will exceed TWDB's most likely projection. The adopted projection for 2000 is based on extending the 1990-98 growth trend. The adopted projection parallels the State Data Center projection for 2010 through 2030 and shows slower growth thereafter.

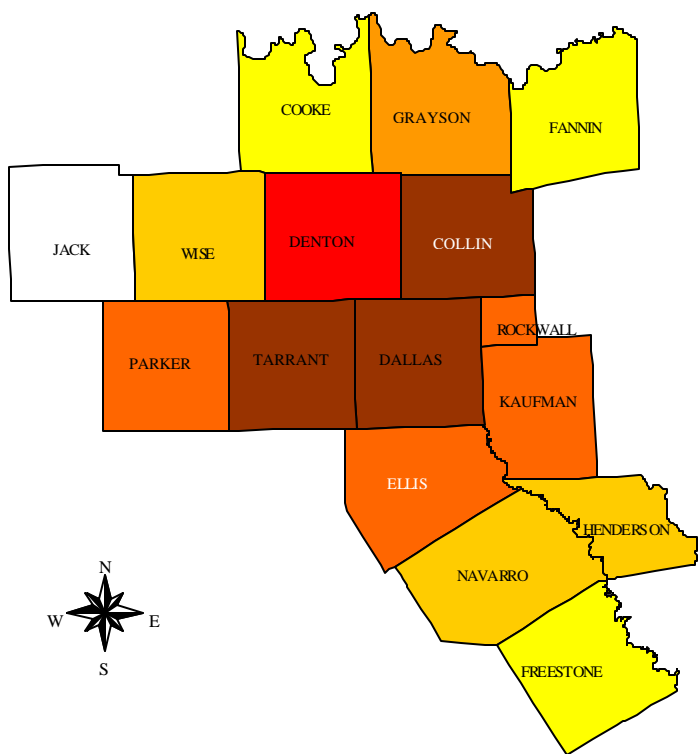
**Table 2.3  
Adopted County Population Projections for Region C**

<b>County</b>	<b>Historical 1996</b>	<b>2000</b>	<b>2010</b>	<b>2020</b>	<b>2030</b>	<b>2040</b>	<b>2050</b>	<b>Previous TWDB 2050</b>	<b>% Change from Previous</b>
Collin	373,095	443,000	635,455	923,309	1,150,001	1,351,000	1,501,395	1,162,482	29.2%
Cooke	33,196	34,209	36,967	38,816	40,000	41,250	42,500	37,821	12.4%
Dallas	1,999,926	2,104,858	2,326,828	2,556,793	2,784,704	3,045,931	3,259,995	3,259,995	0.0%
Denton	349,566	423,327	591,350	802,461	1,033,731	1,200,000	1,349,999	1,135,566	18.9%
Ellis	94,097	103,070	123,854	144,054	162,273	175,403	185,364	205,487	-9.8%
Fannin	27,435	30,000	33,601	37,000	39,501	40,499	41,001	28,396	44.4%
Freestone	17,757	18,167	18,800	19,300	19,600	20,000	20,300	19,433	4.5%
Grayson	100,611	106,119	110,226	114,702	117,865	120,981	122,000	120,982	0.8%
Henderson (Partial)	45,761	46,562	51,261	55,515	57,704	58,690	60,476	60,476	0.0%
Jack	7,435	7,819	8,139	8,591	8,934	9,175	9,353	9,352	0.0%
Kaufman	61,646	68,368	87,106	108,291	129,359	147,108	162,417	112,964	43.8%
Navarro	42,875	45,191	49,207	53,031	57,015	59,200	61,000	53,312	14.4%
Parker	73,897	80,436	99,095	118,287	139,094	156,023	171,216	171,216	0.0%
Rockwall	34,287	41,175	61,392	88,136	122,000	160,588	203,529	203,530	0.0%
Tarrant	1,306,457	1,415,759	1,594,218	1,798,894	1,915,375	2,111,193	2,205,610	2,205,610	0.0%
Wise	41,019	44,800	54,674	64,363	73,641	81,000	85,002	56,631	50.1%
Region C Total	4,609,060	5,012,860	5,882,173	6,931,543	7,850,797	8,778,041	9,481,157	8,843,253	7.2%
Previous TWDB Total		4,870,498	5,634,284	6,547,997	7,331,328	8,158,567	8,843,253		
% Change from Previous		2.9%	4.4%	5.9%	7.1%	7.6%	7.2%		

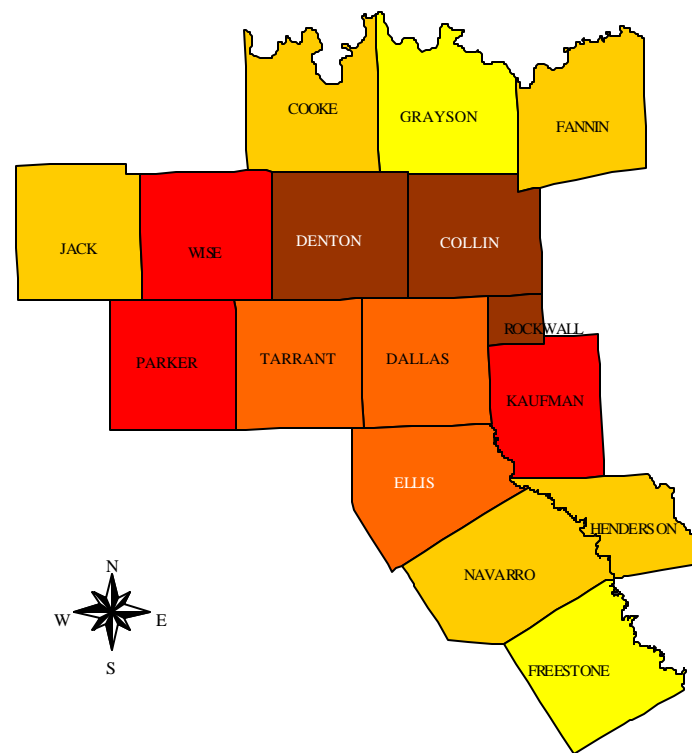
**Figure 2.4**  
**Historical and Projected Population for Region C**



**Figure 2.5**  
**Adopted Population Projections for 2050**



Approved Relative Population 2050



Approved % Increase 1996 - 2050

**Ellis.** Based on growth through 1998, the expected year 2000 population for Ellis County will be less than TWDB's most likely projection. The adopted projection follows the State Data Center projection, which is lower than TWDB's most likely projection, through 2030 and parallels TWDB's most likely projection from 2030 through 2050.

**Fannin.** The estimated 1998 population for Fannin County exceeds TWDB's projections for 2000, 2010, and 2020. The adopted projection follows information provided by the county through 2010 and shows slower growth thereafter.

**Grayson.** The estimated 1998 population projection for Grayson County exceeds TWDB's projection for 2000. The adopted population for 2000 is based on extending the 1990-98 growth trend. After 2000, the adopted projection shows slightly slower growth than TWDB's most likely scenario. The adopted projection for 2050 is almost the same as TWDB's previous most likely projection.

**Kaufman.** Based on growth through 1998, the expected year 2000 population for Kaufman will exceed the TWDB's most likely projection. The adopted projections through 2050 are the average of TWDB's 100 percent migration and most likely projections.

**Navarro.** The estimated 1998 population for Navarro County exceeds the TWDB's projection for 2000. The adopted projection follows a projection provided by the county (very close to the State Data Center projection) through 2030 and parallels TWDB's 100 percent migration projection thereafter.

**Wise.** Based on growth through 1998, the estimated 2000 population for Wise County will exceed TWDB's projection. The adopted projection follows a projection provided by the county (very close to the State Data Center projection) through 2030 and projects slower growth thereafter.

Although the adopted year 2050 population projections for Dallas and Jack Counties are the same as the previous TWDB projections, they are slightly different in the early decades. Dallas County requires a slight adjustment for 2000 and 2010 in order to balance the projections for the individual cities. Jack County's estimated 1998 population is greater than TWDB's projections for 2000 and 2010. The adopted projection uses 1990-98 growth to estimate 2000 population,

uses the State Data Center projection for 2010-2030 and uses TWDB's most likely projection for 2050.

In summary, changes were made to the previous TWDB county population projections for the following reasons:

- Estimated 1998 population exceeds TWDB's projected population for 2000 (Collin, Cooke, Fannin, Freestone, Grayson, Jack, Navarro).
- Projected 2000 population based on 1990-98 growth rate exceeds TWDB's projected population for 2000 (Denton, Kaufman, Wise).
- Projected 2000 population based on the 1990-98 growth rate is less than TWDB's projected population for 2000 (Ellis).
- Small adjustments made to balance city populations (Dallas County, 2000 and 2010).

Table 2.4 presents a summary of the change in the projected 2050 population for each Region C county and the reasons for the changes.

Once the county population projections were completed, city population projections were adjusted based on historical trends and knowledge of expected future development. The county populations served as controls in this process, and all population not assigned to a particular city was included as county other. Appendix F includes the adopted Region C population projections by county, water user group, and basin. Table D-2 in Appendix D shows the reasons for the changes from previous TWDB population projections for each city. Population changes for cities are based on one or more of the following factors:

**Current population exceeds TWDB year 2000 projection.** In some cities, recent population estimates by the State Data Center indicate that the current population exceeds TWDB projections for 2000. This indicates that the city is growing faster than previously projected by TWDB.

**Recent growth trends exceed TWDB's projected trends.** Some cities have experienced a change in growth trends in recent years. These are often areas in partially urbanized or urban fringe counties. In these cases, growth trends in the 1990s support a higher growth rate than was used in the previous TWDB projections.

**Urbanization.** Some cities are in transition from undeveloped rural areas into more urban areas. Others are expected to make such a transition between now and 2050. In these

**Table 2.4  
Summary of Changes to Population Projections and Reasons for Changes by County**

County	2050 Population		Change	Percent Change	Reasons (See key.)					
	Previous TWDB	Adopted			1	2	3	4	5	6
Collin	1,162,482	1,501,395	338,913	29.2%	X	X		X		
Cooke	37,821	42,500	4,679	12.4%	X	X				
Dallas	3,259,995	3,259,995	0	0.0%	No change from TWDB					
Denton	1,135,566	1,349,999	214,433	18.9%	X	X		X		
Ellis	205,487	185,364	-20,123	-9.8%						
Fannin	28,396	41,001	12,605	44.4%	X	X				X
Freestone	19,433	20,300	867	4.5%	X	X				
Grayson	120,982	122,000	1,018	0.8%	X	X				
Henderson (Partial)	60,476	60,476	0	0.0%	No change from TWDB					
Jack	9,352	9,353	1	0.0%	No change from TWDB					
Kaufman	112,964	162,417	49,453	43.8%	X	X		X		
Navarro	53,312	61,000	7,688	14.4%	X	X				
Parker	171,216	171,216	0	0.0%	No change from TWDB					
Rockwall	203,530	203,529	-1	0.0%	No change from TWDB					
Tarrant	2,205,610	2,205,610	0	0.0%	No change from TWDB					
Wise	56,631	85,002	28,371	50.1%	X	X				
Region C Total	8,843,253	9,481,157	637,904	7.2%						

Key to Reasons:

- 1 Estimated Current Population Exceeds TWDB Year 2000 Projections
- 2 Recent Growth Trends Exceed TWDB's Projected Trends
- 3 City Limit Growth Through Annexation
- 4 Urbanization
- 5 Buildout
- 6 Other (See Table D-2 in Appendix D)



situations, historical growth trends are not accurate indicators of future trends. The growth experienced by similar areas that have already gone through such urbanization is a better guide. For example, growth trends experienced by Plano from 1980 through 2000 can be used as a model for McKinney and Frisco. Growth trends experienced by Lewisville and Flower Mound can serve as models for adjacent communities in Denton County.

**Build Out.** For some cities, the expected build out population is less than the previous TWDB projection for 2050. The area available for development and the expected population density will limit population in these cities.

**Other.** Other reasons for changes in population projections are covered on a case-by-case basis in Table D-2.

## **2.5 Water Demand Projections**

Table 2.5 shows adopted water demand projections for Region C by county. Table 2.6 and Figure 2.6 show the projected water demand for the region by type of use. Figure 2.7 is a map of the projected 2050 water demand and the projected change between 1996 and 2050 by county. The projected 2050 water demand for Region C is 2,536,902 acre-feet per year, which is 28.9 percent higher than the previous TWDB projection. The projected year 2050 demand is more than double the 1996 use in the region. The newly adopted projections are higher than the previous TWDB projections for all counties except Fannin and Henderson. For both Fannin and Henderson Counties, the reduction in projected 2050 water demand is due to a reduction in projected water demand for steam electric power generation. Most of the change from previous TWDB projections is in projected municipal demands, with a smaller change in steam electric power demands. No changes were made to TWDB's previous projections for manufacturing, mining, irrigation, or livestock demands.

Table 2.7 presents a summary of the specific reasons for changes to projected water demand for each county. Specific reasons for the increases include the following:

**Population change.** As set forth in TWDB guidelines <sup>(35)</sup>, a change in projected population requires a change in projected water use. The adopted 2050 population projection for Region C is 7.2 percent higher than the previous TWDB guidelines, which

**Table 2.5  
Adopted County Water Demand Projections for Region C**

County	Historical 1996 (Acre-Feet per Year)	Projected Water Demand (Acre-Feet per Year)						Previous TWDB 2050 (Acre-Feet per Year)	% Change from Previous
		2000	2010	2020	2030	2040	2050		
Collin	89,230	129,015	199,964	262,520	312,307	363,821	401,007	202,680	97.9%
Cooke	8,429	9,054	9,133	9,238	9,304	9,581	9,879	8,147	21.3%
Dallas	505,423	594,937	683,097	751,767	810,356	883,850	940,289	860,588	9.3%
Denton	65,075	90,209	135,740	185,725	230,286	257,410	281,989	172,338	63.6%
Ellis	19,721	24,372	43,204	46,030	49,309	53,991	55,575	36,857	50.8%
Fannin	17,515	12,100	13,330	14,500	15,597	16,572	17,515	30,147	-41.9%
Freestone	20,608	20,074	31,058	33,000	33,036	37,260	37,290	17,691	110.8%
Grayson	29,152	29,060	29,760	30,242	31,347	32,508	33,688	28,553	18.0%
Henderson (Partial)	10,785	12,697	13,169	13,478	13,697	13,737	13,908	44,014	-68.4%
Jack	3,337	2,644	2,589	2,574	2,591	2,615	2,652	2,346	13.0%
Kaufman	10,653	21,219	24,401	27,392	32,361	34,832	42,017	17,035	146.7%
Navarro	10,558	10,301	10,845	11,210	11,850	12,303	12,735	10,159	25.4%
Parker	12,372	14,120	24,528	28,455	37,697	42,853	45,725	21,858	109.2%
Rockwall	6,566	9,160	19,805	26,027	33,061	41,320	50,249	32,219	56.0%
Tarrant	291,406	379,205	423,578	468,728	490,960	527,716	553,302	462,745	19.6%
Wise	25,688	18,206	31,460	34,007	36,067	37,819	39,082	20,539	90.3%
Region C Total	1,126,518	1,376,373	1,695,661	1,944,893	2,149,826	2,368,188	2,536,902	1,967,916	28.9%
Previous TWDB Total		1,280,104	1,416,271	1,534,409	1,649,168	1,822,174	1,967,916		
% Change from Previous		7.5%	19.7%	26.8%	30.4%	30.0%	28.9%		

**Table 2.6**  
**Adopted Water Demand Projections for Region C by Type of Use**  
 - Values in Acre-Feet per Year -

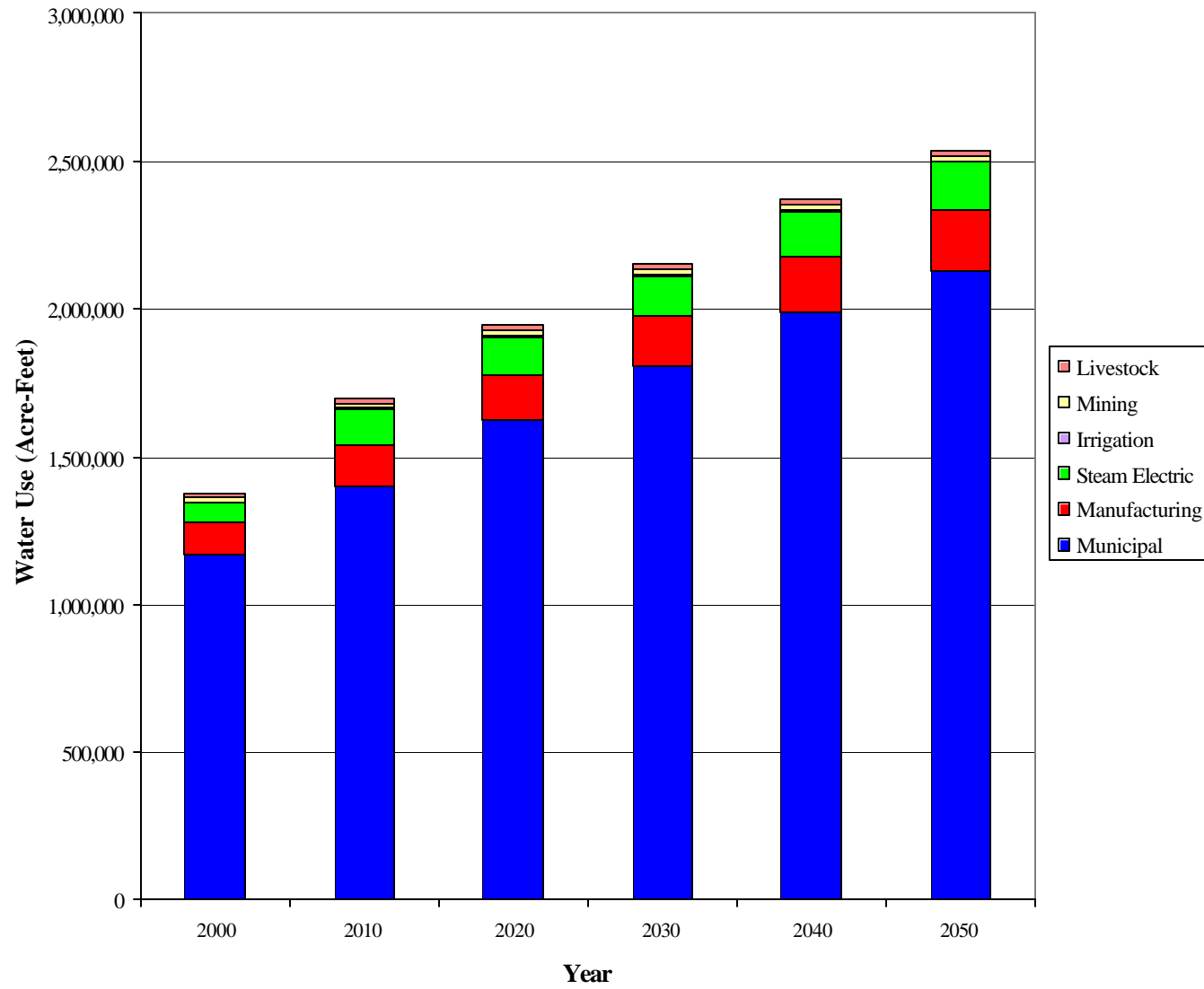
Use	Historical 1996	Projected Water Demand					
		2000	2010	2020	2030	2040	2050
Municipal	946,454	1,162,093	1,401,197	1,625,412	1,808,337	1,988,513	2,125,330
Manufacturing	71,366	117,577	135,114	148,798	162,714	183,188	207,637
Steam Electric Power	52,103	59,800	122,300	132,700	139,700	156,192	162,192
Mining	22,576	13,046	13,231	14,190	15,294	16,515	17,950
Irrigation	9,689	5,382	5,344	5,318	5,306	5,305	5,318
Livestock	24,330	18,475	18,475	18,475	18,475	18,475	18,475
<b>Total</b>	<b>1,126,518</b>	<b>1,376,373</b>	<b>1,695,661</b>	<b>1,944,893</b>	<b>2,149,826</b>	<b>2,368,188</b>	<b>2,536,902</b>

causes a 5.1 percent increase in water demand. (The increase in demand is less than the increase in population because the increased population affects only municipal demand. Manufacturing, steam electric, mining, irrigation, and livestock demands are not directly dependent on population.) The increase in water demand due to higher population projections is most significant in Collin, Denton, Kaufman, Navarro, and Wise Counties.

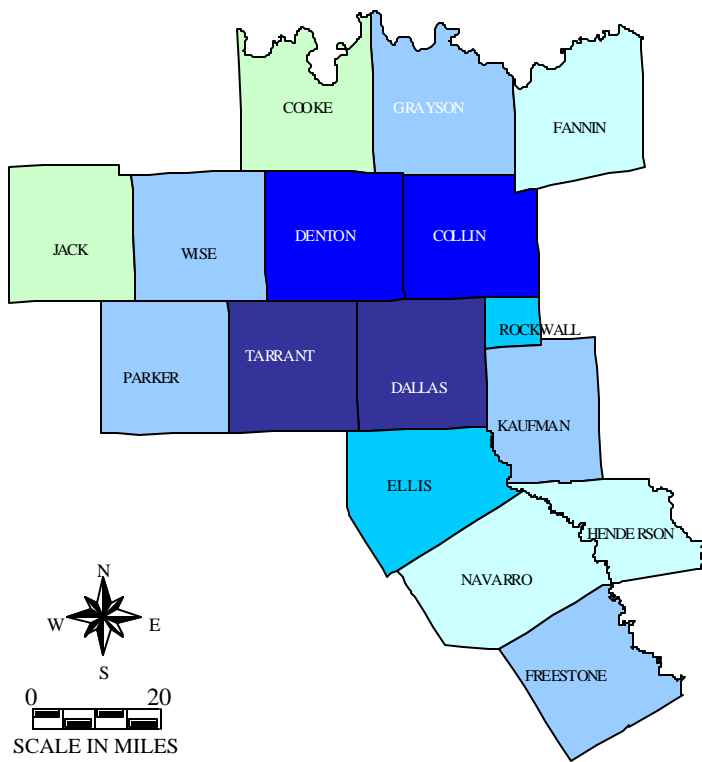
**Actual per capita use.** As set forth in TWDB guidelines<sup>(35)</sup>, actual per capita municipal use in excess of projections is a reason to revise municipal demand projections. The dry years in 1996 and 1998 caused many cities in Region C to experience record per capita municipal water use. Table D-1, in Appendix D, lists cities in Region C for which recent per capita municipal water use exceeds the TWDB projection for 2000. This list should be updated once 1998 per capita use figures are available for all cities in the region. For the whole region, actual per capita use in excess of TWDB projections caused a 9.7 percent increase in water demand. The biggest increases due to actual per capita use are in Collin, Cooke, Denton, Grayson, Kaufman, Rockwall, and Tarrant Counties.

**Continuing increase in per capita water use.** Many cities in Region C have a historical trend of increasing municipal per capita use. Such a trend is particularly common in cities undergoing rapid development. Water conservation decreases water use from what it would have been without conservation. However, there are many cities in which conservation is not projected to overcome a trend of increasing per capita use, at least in the near term. For most

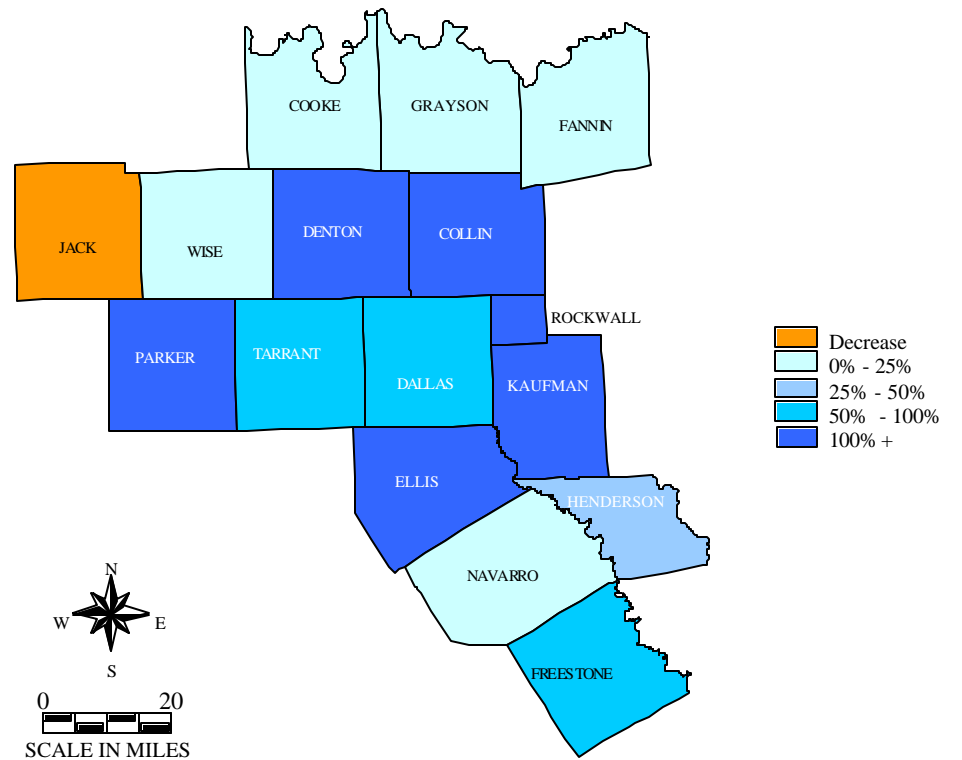
**Figure 2.6**  
**Adopted Projections**  
**for Water Use by Category in Region C**



**Figure 2.7**  
**Adopted Water Demand Growth 1996-2050**



Approved 2050 Water Demand Projection



Percent Change, 1996 To 2050 Recommended Projection

**Table 2.7**  
**Summary of Water Demand Changes and Reasons for Changes by County**  
 - Values in Acre-Feet per Year -

County	2050 Water Demand		Change	Reasons (See key.)						
	Previous TWDB	Adopted		1	2	3	4	5	6	7
Collin	202,680	401,007	198,327	50,798	78,424	57,466	15	4,271	6,500	853
Cooke	8,147	9,879	1,732	636	697	238	169	0	0	-8
Dallas	860,588	940,289	79,701	1,257	35,365	24,925	0	4,107	2,000	12,047
Denton	172,039	281,989	109,950	39,132	13,123	13,907	3,051	21,238	5,000	14,499
Ellis	36,674	55,575	18,901	-1,676	1,643	461	101	890	18,000	-518
Fannin	30,147	17,515	-12,632	1,628	432	187	21	0	-15,000	100
Freestone	17,691	37,290	19,599	95	206	47	93	0	19,192	-34
Grayson	28,553	33,688	5,135	276	3,468	416	29	939	0	7
Henderson (Partial)	44,014	13,908	-30,106	90	1,229	4	278	0	-31,000	-707
Jack	2,346	2,652	306	-1	187	64	17	0	0	39
Kaufman	17,035	42,017	24,982	4,801	2,791	2,132	33	233	15,000	-8
Navarro	10,342	12,735	2,393	1,575	739	0	58	0	0	21
Parker	21,858	45,725	23,867	1,889	2,413	2,963	1,098	3,605	11,900	-1
Rockwall	32,219	50,249	18,030	-1,697	5,804	7,264	0	0	6,000	659
Tarrant	462,903	553,302	90,399	-521	43,061	37,875	662	907	6,800	1,615
Wise	20,680	39,082	18,402	2,530	760	0	893	3,038	11,200	-19
Region C Total	1,967,916	2,536,902	568,986	100,812	190,342	147,949	6,518	39,228	55,592	28,545
Region C Total %			28.9%	5.1%	9.7%	7.5%	0.3%	2.0%	2.8%	1.5%

Key to Reasons for Change:

- 1 **Population change** is the change in projected water demand caused by changes to population projections.
- 2 **Actual per capita use** is the change in projected water demand caused by per capita use in the late 1990s being higher than projected for 2000 by TWDB.
- 3 **Continuing increase** is the change in projected water demand caused by an increase in per capita use in the future consistent with trends seen in the 1990s.
- 4 **Minimum per capita** is the change in projected water demand caused by assuming a minimum level of per capita use.
- 5 **Future development** is the change in projected water demand caused by assuming an increase in per capita use as cities change from rural to suburban in character.
- 6 **Steam electric** is the change in projected water demand caused by increased use for steam electric power production.
- 7 **Other** is the change in projected water demand caused by other factors, including anticipated commercial development.

Region C cities with increasing per capita use in the 1990s, the trend is assumed to continue through 2010, partially offset by conservation. For some cities expected to grow rapidly until 2020, per capita use is assumed to increase through 2020, again partially offset by conservation. For Region C as a whole, accounting for the continuing increase in per capita use causes a 7.5 percent increase in projected 2050 water demand, with the biggest change in rapidly growing areas such as Collin, Denton, Kaufman, Rockwall, and Tarrant Counties.

**Minimum per capita use.** In the process of determining projected water demands, Region C adopted a minimum dry year per capita municipal water use – a level designed to provide an adequate water supply and an adequate quality of life. Based on experience in the region, it was felt that most per capita municipal use less than 115 gallons per person per day occurs in systems with inadequate supplies and represents supply and delivery limitations rather than the true demand for water. With few exceptions, a minimum municipal water demand of 115 gallons per capita per day was adopted for Region C, reducing over 50 years to 95 gallons per capita per day. This change increases the overall regional projected 2050 water demand by about 0.3 percent, with the biggest increases in Denton, Parker, and Wise Counties.

**Future development.** As cities in Region C have changed from rural to suburban, the per capita municipal water use has historically risen. This occurs because the nature of the housing changes. The new suburban housing generally has irrigated lawns, swimming pools, water-using appliances and other features that tend to increase water use. Communities with low existing per capita water use expected to undergo rapid development are also expected to see a rise in per capita use, partially offset by water conservation. This assumption causes a 2.0 percent increase to the projected 2050 water demand for Region C, with the biggest impact in Denton, Parker, and Wise Counties.

**Steam electric.** TXU Electric provided revised steam electric power demands reflecting known development plans for TXU and other utilities. These revised numbers reflect the current trend toward development of new merchant power plants in Region C. The increase to the projected 2050 steam electric demand causes a 2.8 percent increase to total water demand for the region.

**Other factors.** Other factors that influence water demand projections include anticipated major commercial development, anticipated employment growth, changes in the rate at

which water conservation is achieved (slower or faster), and increased water demand due to the development of better supplies in some areas. These other factors increase the overall Region C water demand by 1.5 percent. They are discussed on a case-by-case basis in Table D-3 in Appendix D.

Appendix G includes the adopted water demand projections by county, water user group, and basin. Table D-3 in Appendix D shows the reasons for the changes from previous TWDB demand projections for each water user group. Appendix H includes the adopted demand projections by major water provider.

One of the most important factors determining the increase to projected per capita demand for Region C over previous TWDB projections is the high water use recorded for many Region C water suppliers in 1996 and 1998. This high water use occurred despite significant efforts to implement water conservation in the region and despite the impact of low flow plumbing fixtures. There are several factors that tend to increase per capita municipal water use in the region:

- In many communities, new development is large houses with large lots, sprinkler systems, swimming pools, and other water-using amenities.
- The number of people per household is decreasing in most of Region C. This tends to cause an increase in per capita use because household uses are spread over fewer people.
- Many Region C communities are experiencing rapid commercial development, which also drives up per capita water use.

Table D-4 in Appendix D shows 1997 unaccounted water data for Region C water suppliers. (The table is based on TWDB records and includes only entities for which TWDB had data available.) Unaccounted water is potable water put into the distribution system but not metered as sold. Causes of unaccounted water can include inaccurate metering, unmetered uses, fire flows, line flushing flows, and losses to leaks. In general, unaccounted water less than 10 percent is excellent in a municipal distribution system, and values in the 15 to 20 percent range are acceptable. Rural water suppliers, which tend to have more pipeline per customer, may experience somewhat higher losses. For Region C as a whole, unaccounted water was 10.1 percent in 1997, which is excellent. Some water suppliers show high values for unaccounted water. For the most part, these are smaller cities and rural water suppliers. A continual pattern



of high unaccounted water might indicate that the supplier should investigate the problem and make appropriate improvements.

In summary, the reasons for the 28.9 percent increase in projected 2050 water demands over previous TWDB projections, which would have been greater without the incorporated water conservation assumptions, are as follows:

- 5.1 percent due to increased population projections.
- 9.7 percent due to actual per capita municipal demand in recent years above the previous TWDB projection for 2000.
- 7.5 percent due to continuing recent trends of increasing per capita municipal demand through 2010 or 2020. (These trends have been reduced by conservation efforts, but per capita municipal demand is still increasing overall in many cities.)
- 0.3 percent due to adoption of a minimum per capita municipal demand.
- 2.0 percent due to increases in per capita municipal demand assumed to occur with rapid suburban development in rural areas.
- 2.8 percent due to increased projections for steam-electric power generation.
- 1.5 percent due to other factors, including commercial development and employment growth.