5

Future population and water demand

Quick facts

Texas' population is expected to increase more than 70 percent between 2020 and 2070, from 29.5 million to 51 million.

Over half of all the statewide population growth between 2020 and 2070 is expected to occur within Regions C and H.

Water demand is projected to increase by 17 percent, from 18.4 million acre-feet per year in 2020 to 21.6 million acre-feet per year in 2070.

The five-year water planning cycle begins with projecting the population of Texas over the next 50 years and the water supply that the population will need to live and work in both cities and rural areas. Determining projections and water demand is a lengthy process designed to develop a consensus between state agencies, regional water planning groups, and local entities. The TWDB, the Texas Commission on Environmental Quality, the Texas Department of Agriculture, the Texas Parks and Wildlife Department, representatives from the planning groups, and members of the public helped determine the final projections using initial projections developed by the Office of the State Demographer and the Texas State Data Center.

5.1 Population projections

Texas' population is the second largest in the United States and has increased more than any other state since 2000 (U.S. Census Bureau, 2011, 2014). With its population expected to increase more than 70 percent between 2020 and 2070, from 29.5 million to 51 million (Figure 5.1, Table 5.1), Texas will continue to be one of the fastest growing states in the nation. Although the statewide population will increase over those 50 years, not all regions will grow equally.

This plan projects the population for over 1,600 population centers, including cities with more than 500 residents, utilities in unincorporated areas with annual water use in 2010 of 280 acre-feet or more, and unincorporated populations residing in sparsely populated rural areas within each county. Of the 16 regional water planning areas, 9 are expected to grow by more than 50 percent between 2020 and 2070, including those with many of the state's major metropolitan areas (Table 5.1).

Figure 5.1 - Projected population in Texas

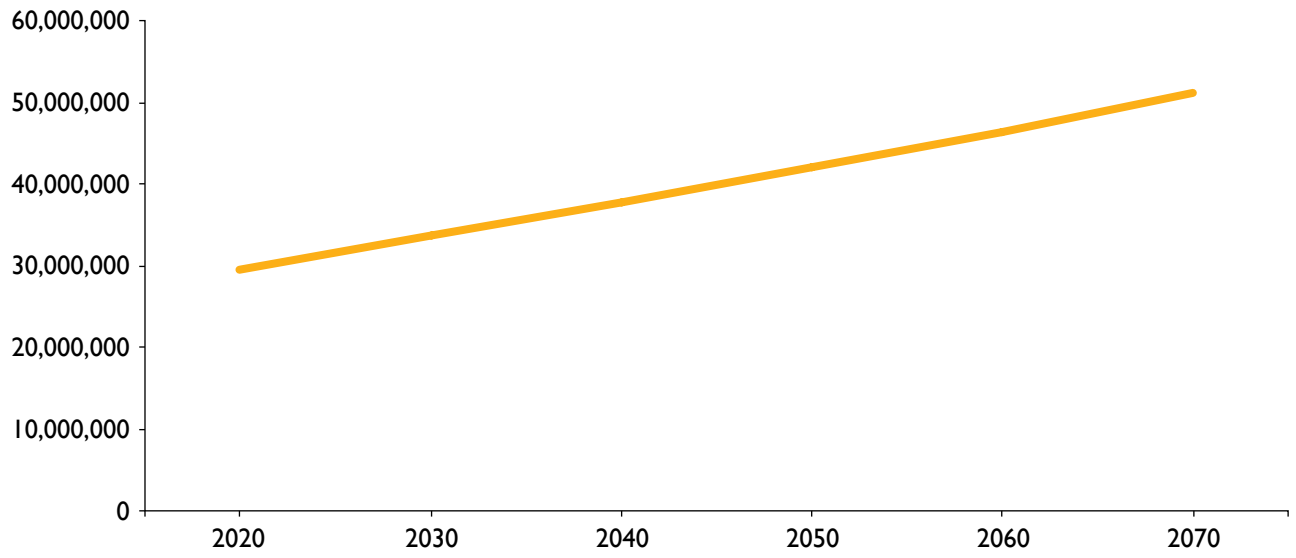


Table 5.1 - Projected population by region

Region	2020	2030	2040	2050	2060	2070	Percent growth
A	419,000	461,000	504,000	547,000	592,000	639,000	53
B	206,000	214,000	219,000	223,000	226,000	229,000	11
C	7,504,000	8,649,000	9,909,000	11,260,000	12,742,000	14,348,000	91
D	831,000	908,000	989,000	1,089,000	1,212,000	1,370,000	65
E	954,000	1,086,000	1,208,000	1,329,000	1,444,000	1,551,000	63
F	701,000	767,000	825,000	885,000	944,000	1,003,000	43
G	2,371,000	2,721,000	3,097,000	3,495,000	3,918,000	4,351,000	84
H	7,325,000	8,208,000	9,025,000	9,868,000	10,766,000	11,743,000	60
I	1,152,000	1,234,000	1,310,000	1,389,000	1,470,000	1,554,000	35
J	141,000	154,000	163,000	171,000	178,000	185,000	31
K	1,737,000	2,065,000	2,382,000	2,658,000	2,928,000	3,243,000	87
L	3,001,000	3,477,000	3,920,000	4,336,000	4,770,000	5,192,000	73
M	1,961,000	2,379,000	2,795,000	3,212,000	3,626,000	4,029,000	105
N	615,000	662,000	693,000	715,000	731,000	745,000	21
O	540,000	594,000	646,000	698,000	751,000	802,000	49
P	50,000	52,000	53,000	54,000	55,000	56,000	12
Texas	**29,508,000**	**33,631,000**	**37,738,000**	**41,929,000**	**46,353,000**	**51,040,000**	**73**

Population growth is concentrated in the eastern portion of Texas and along the Interstate Highway-35 corridor (Figure 5.2). Of Texas' 254 counties, 30 are projected to at least double in population between 2020 and 2070. The same is true for 328 population centers. Nine counties are expected to triple in population between 2020 and 2070. One, Bastrop County, is expected to quadruple in population over that time. Regions C (which includes the Dallas-Fort Worth metropolitan area) and H (which includes the Houston metropolitan area) account for more than half of the total projected statewide population growth between 2020 and 2070 (Figure 5.3). Region M, which stretches along the Rio Grande, has the highest regional growth rate and is expected to more than double its population. Conversely, 22 counties and 111 population centers in Texas are expected to lose residents or have no population growth.

5.1.1 Population methodology

Population projections for the 2017 State Water Plan were created using a standard demographic methodology known as a cohort-component model. This procedure uses separate cohorts (combinations of age, gender, and racial-ethnic groups) and components of cohort change (birth, survival, and migration rates) to estimate future county populations. The cohort-component model and demographic assumptions used as the basis for the regional population projections were developed by the State Demographer at the Texas State Data Center, which provided the TWDB with initial, 30-year projections for each county as a whole. The TWDB then extended these 30-year projections to the state water plan's 50-year planning horizon.

Of the three components of cohort change (birth, survival, and migration rates), migration rates, which calculate how many people move in and out of the counties, are the most critical. While birth and survival rates tend to closely follow historical trends, migration rates tend to be heavily influenced by the state of the economy, reflecting movement that results from economic opportunity. Migration can also be influenced by other unforeseen events, such as catastrophic weather events.

To determine the most appropriate migration projection for each region, the TWDB and the planning groups together evaluated three sets of projections based on different migration patterns:

- Zero migration
- One-half of the migration rates from 2000 to 2010
- 2000–2010 migration rates

The one-half migration scenario was used for the vast majority of counties, based on historical precedence and recommendations by the State Demographer for long-term projections.

Because detailed cohort-component data is available only for the population projections of whole counties, the TWDB had to determine subcounty level projections for cities, other utility service areas, and the remaining rural areas within each county.

The TWDB based these initial subcounty projections on the estimated share each entity had

Figure 5.2 - Projected population growth in Texas counties

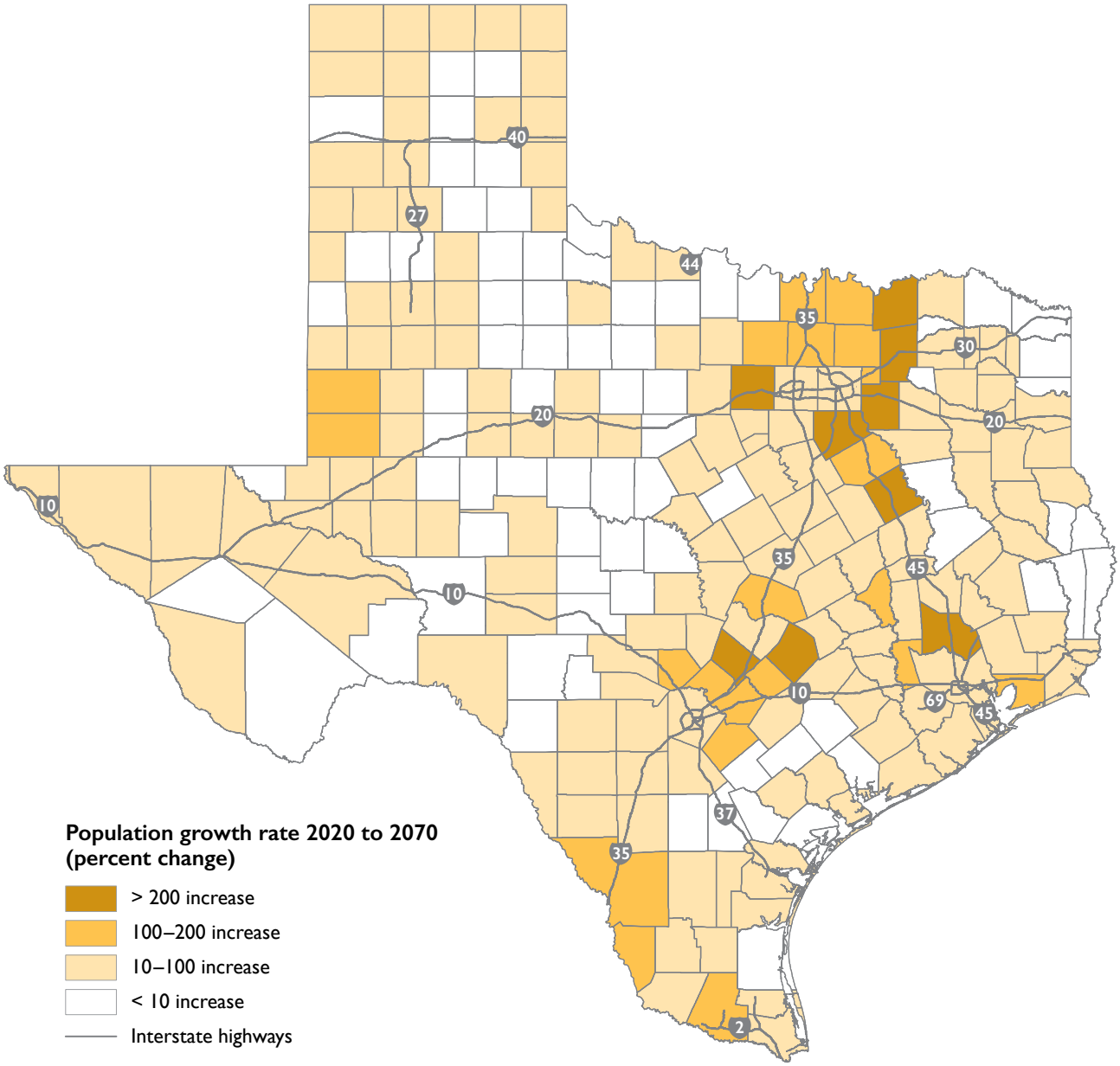
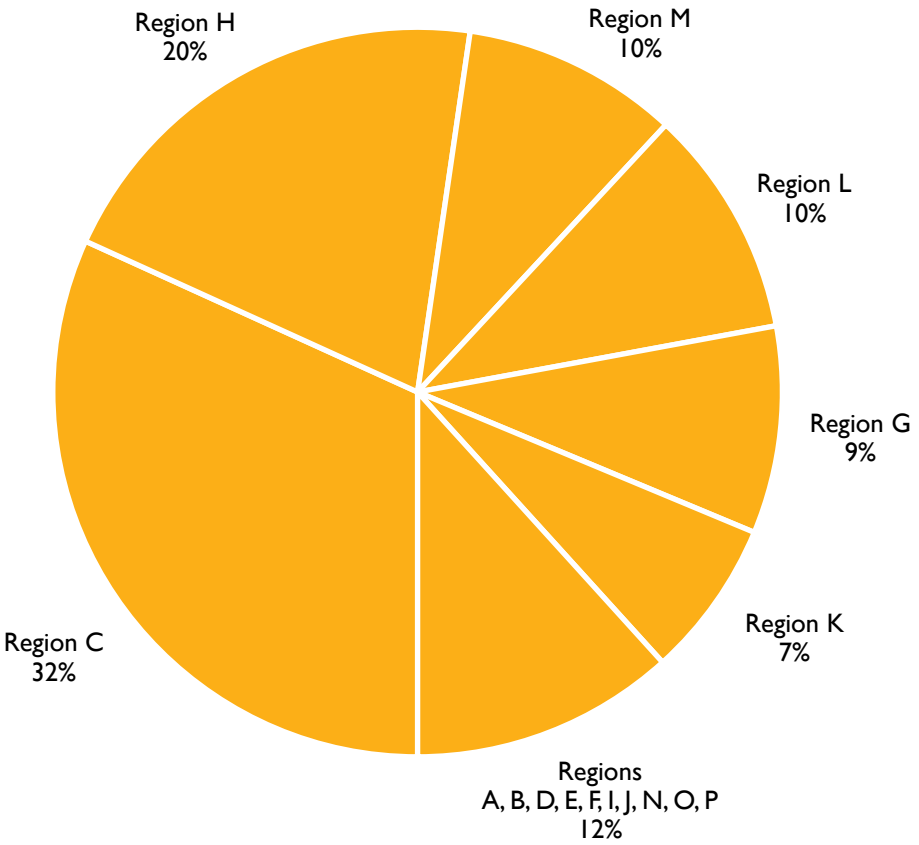


Figure 5.3 - Regional shares of statewide population growth (2020–2070)



during an entire county's growth from 2000 to 2010. The TWDB then applied that same percentage to growth projections. However, when the growth trend for a county and a city went in opposite directions, other methods of projections more specific to the situation were used. Because census populations were not available for utility service areas, the TWDB used the number of water connections and populations served that were reported in the TWDB's annual Water Use Survey to represent the baseline population figures.

These draft projections were then sent to the planning groups for review by planning group members and the public. After requests from the planning groups, the TWDB made more than 600 population projection revisions at the county and subcounty levels.

Table 5.2 - Projected annual water demand by water use category (acre-feet)

Category	2020	2030	2040	2050	2060	2070	Percent change
Irrigation	9,438,000	9,138,000	8,800,000	8,431,000	8,067,000	7,778,000	-18
Municipal	5,200,000	5,791,000	6,404,000	7,042,000	7,719,000	8,433,000	62
Manufacturing	2,177,000	2,489,000	2,644,000	2,778,000	2,900,000	3,030,000	39
Steam-electric	953,000	1,108,000	1,225,000	1,388,000	1,561,000	1,740,000	83
Livestock	296,000	305,000	309,000	315,000	320,000	325,000	10
Mining	343,000	354,000	327,000	303,000	287,000	292,000	-15
Texas[a]	**18,407,000**	**19,185,000**	**19,709,000**	**20,257,000**	**20,854,000**	**21,598,000**	**17**

[a] *Statewide totals may vary between tables due to rounding.*

5.2 Water demand projections

Projecting water demand is the second task undertaken to begin the water planning process. The TWDB projects water demand for municipal and non-municipal sectors of the Texas economy, including manufacturing, mining, steam-electric, livestock, and irrigation. Water demand in all water use categories is projected to increase by 17 percent, from 18.4 million acre-feet in 2020 to 21.6 million acre-feet in 2070 (Figure 5.4).

Steam-electric, municipal, and manufacturing categories show the greatest projected increases in water demand, ranging from approximately 83 percent to 39 percent. Mining is expected to decline, and livestock is expected to grow slightly. While irrigation is the largest water demand category for 2020, it is expected to decrease 18 percent by 2070. Municipal demand is projected to exceed irrigation demand in that decade (Table 5.2, Figure 5.5).

Water demand projections exclude water demands that are associated with purely saline supplies, much of which is associated with industrial uses located along the coast.

5.2.1 Projected water demand by region and water use category

As with population projections, total water demand varies significantly by planning area (Table 5.3). Significant increases in water demand are projected in Regions C, D, G, H, I, L, and N, each with more than 30 percent growth in projected water demand between 2020 and 2070.

Because of declining irrigation demand, four regions show a projected decrease in total water demand from 2020 to 2070: Regions A, B, O, and P. More than half of the projected water demand in 2020 is associated with irrigation use, while less than a third is associated with municipal demand (Figure 5.6). By 2070, the share of statewide water demand associated with irrigation declines to just more than one-third of the total, offset by increases in municipal, steam-electric, and manufacturing demand (Figure 5.7).

5.2.2 Water demand methodology

In a process similar to projecting future population, the TWDB, the Texas Commission on Environmental Quality, the Texas Department of Agriculture, and the Texas Parks and Wildlife Department drafted

Figure 5.4 - Projected annual water demand in Texas (acre-feet)

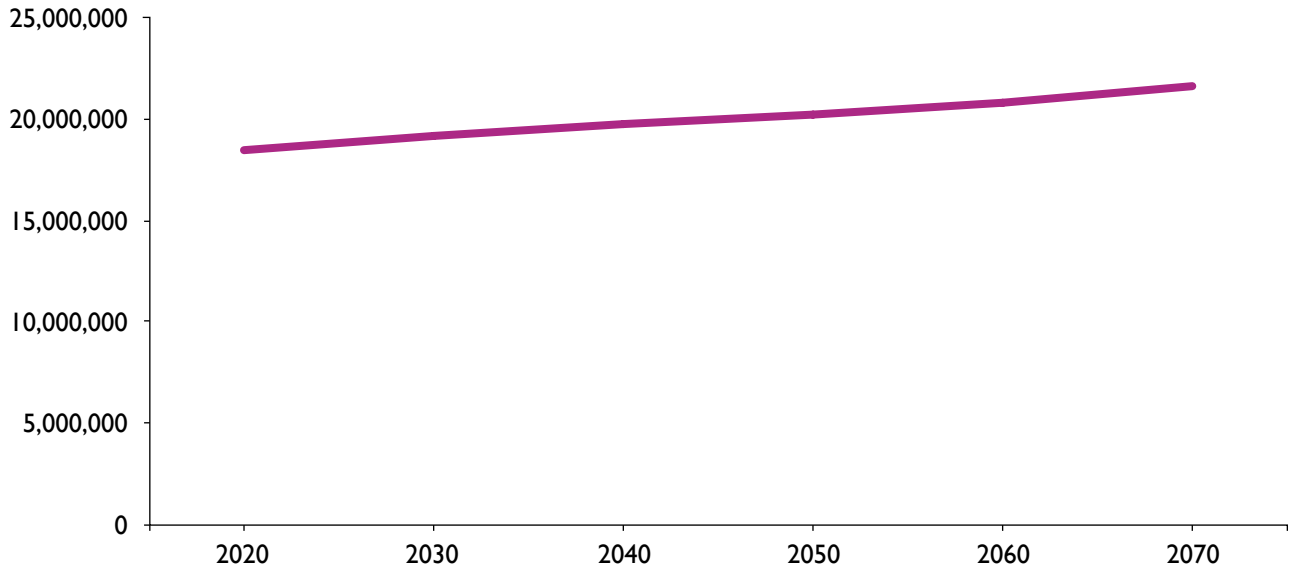
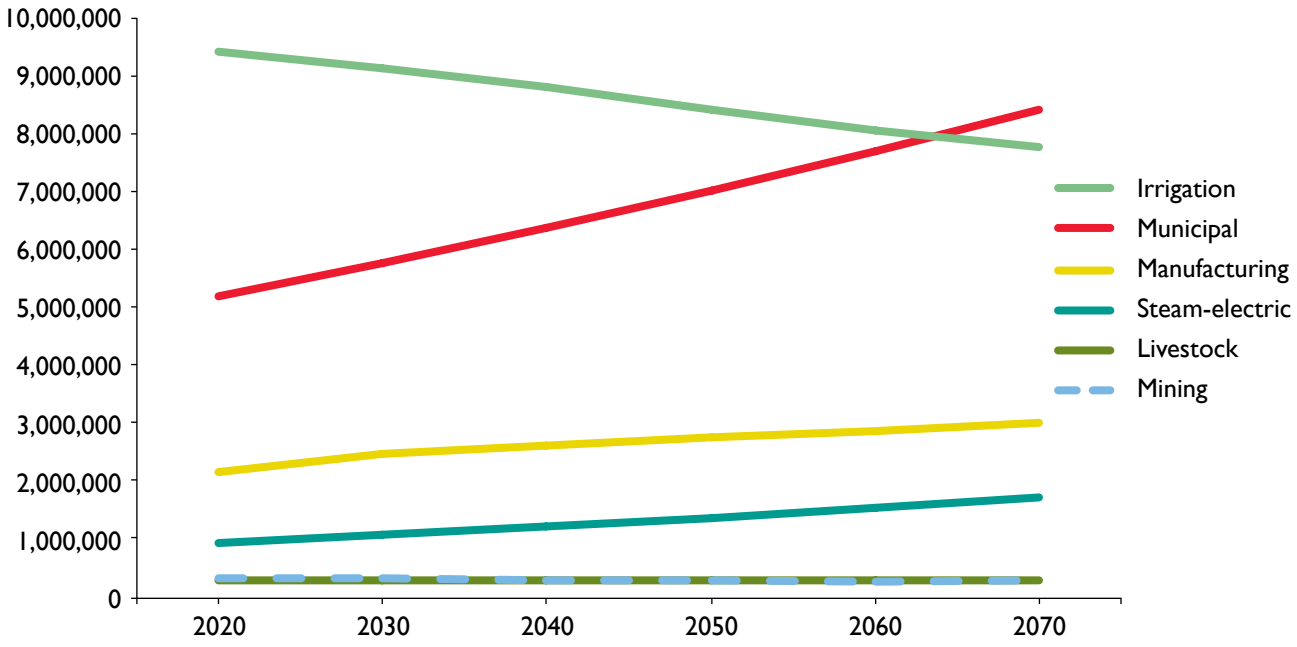


Figure 5.5 - Projected annual water demand by water use category (acre-feet)



water demand projections for the municipal, manufacturing, steam-electric, mining, livestock, and irrigation water use categories. The draft projections were provided to the planning groups for review. As a result of their review, the planning groups requested changes for more than 800 of the water user groups listed in the plan. More than 95 percent of these requested changes were recommended by the four agencies and adopted by the TWDB.

5.2.3 Municipal water demand

Municipal water demand includes water used by a variety of consumers in Texas communities, including single-family residences, multi-family residences, and nonresidential establishments (commercial, institutional, and light industrial). It includes water utilities, individual cities, and aggregated rural areas (referred to as "county-other" for planning purposes).

Residential and nonresidential consumers use water for similar purposes, such as drinking, cooking, sanitation, cooling, and landscape watering. In addition, residential and nonresidential establishments are generally intertwined in their long-term development, which supports the methodology of including both in the municipal water demand projections. Water-intensive industrial customers, such as large manufacturing plants, steam-electric power generation facilities, and mining operations, are not included in municipal water demand but instead have their own categories.

To estimate total annual water demands, the TWDB multiplied the projected per capita water use (also described as gallons per capita daily or GPCD) during a historical dry year by the projected populations. The per capita water use is based on annual Water Use Survey data for each water user group. The per capita water use values exclude wastewater reuse, sales to other water systems, and sales to large manufacturing, mining, or steam-electric power generating customers. Such exclusions in the water use calculations are made to avoid double counting water use. For the majority of municipal water user groups, the 2011 per capita water use was used in estimating demand because of the severity of the 2011 drought. In a few cases, based

on local circumstances, an average of other dry years was used as the basis for estimating demand.

In all regions, the municipal water demand projections incorporated the anticipated future water savings from the installation of more efficient toilets, shower heads, dishwashers, and clothes washers that are already required by state and federal laws determining water use efficiency in fixtures and appliances. These savings are projected to be 295,000 acre-feet per year in 2020, increasing to 887,000 acre-feet per year in 2070. Water savings due to existing legal requirements are embedded in the municipal water demand projections because they require no additional action on the part of cities and water utilities. Planning groups incorporated additional future water savings from municipal conservation programs in the regional and state water plans as adopted water management strategies to be implemented by water providers (see Chapter 8).

5.2.4 Manufacturing water demand

Manufacturing water demand consists of the future water necessary for large facilities including those that process chemicals, oil and gas, food, paper, and other materials. Projections for this category were based on a combination of previous projections from the 2012 State Water Plan (Waterstone Environmental Hydrology and Engineering, Inc. and The Perryman Group, 2003). Projections in this planning cycle were also adjusted to reflect local input, information provided by the planning groups, and water use in 2011 as reported in the TWDB's annual Water Use Survey. A base water use amount for each county was projected for the future, taking into consideration economic projections for the manufacturing industry as well as incorporated efficiency improvements from new technology. Future growth in manufacturing water demand was generally predicted to be located in the same counties in which manufacturing facilities currently exist.

Table 5.3 - Projected annual water demand by region (acre-feet)

Region	2020	2030	2040	2050	2060	2070	Percent change
A	1,734,000	1,658,000	1,555,000	1,421,000	1,293,000	1,166,000	-33
B	163,000	160,000	157,000	154,000	154,000	154,000	-5
C	1,723,000	1,945,000	2,183,000	2,426,000	2,677,000	2,940,000	71
D	634,000	682,000	734,000	790,000	866,000	957,000	51
E	645,000	657,000	661,000	671,000	682,000	694,000	7
F	838,000	847,000	846,000	844,000	846,000	853,000	2
G	1,068,000	1,152,000	1,215,000	1,303,000	1,387,000	1,478,000	38
H	2,489,000	2,675,000	2,853,000	3,039,000	3,218,000	3,415,000	37
I	1,109,000	1,331,000	1,395,000	1,464,000	1,533,000	1,607,000	45
J	40,000	41,000	42,000	43,000	44,000	45,000	13
K	1,183,000	1,245,000	1,302,000	1,352,000	1,401,000	1,462,000	24
L	1,070,000	1,156,000	1,219,000	1,291,000	1,366,000	1,434,000	34
M	1,505,000	1,515,000	1,524,000	1,530,000	1,538,000	1,606,000	7
N	262,000	280,000	295,000	307,000	324,000	343,000	31
O	3,711,000	3,608,000	3,496,000	3,391,000	3,293,000	3,211,000	-13
P	234,000	233,000	233,000	232,000	232,000	232,000	-1
Texas[a]	**18,408,000**	**19,185,000**	**19,710,000**	**20,258,000**	**20,854,000**	**21,597,000**	**17**

[a] *Statewide totals may vary between tables due to rounding.*

Figure 5.6 - Water use category shares of projected annual water demand in 2020

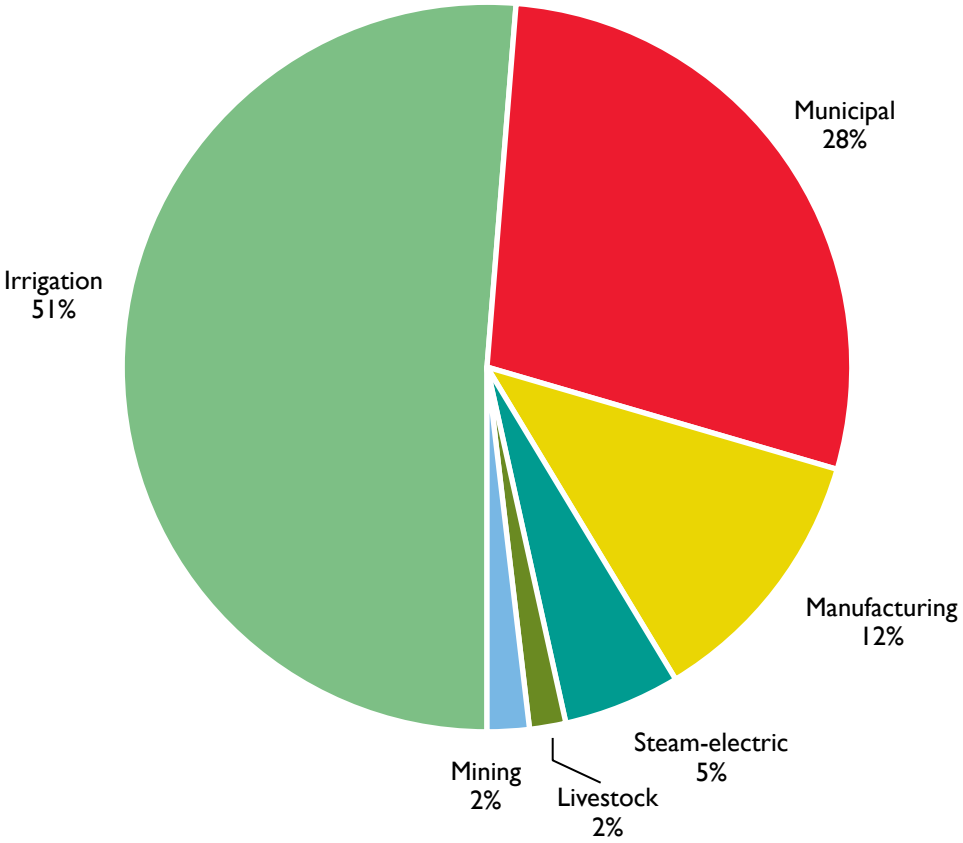
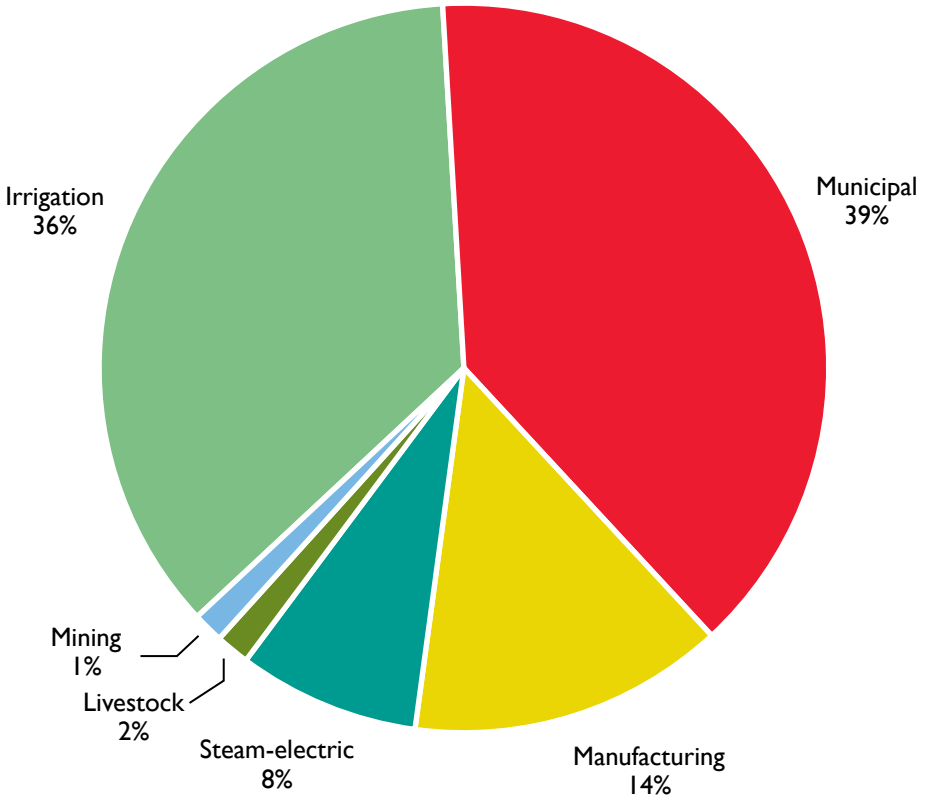


Figure 5.7 - Water use category shares of projected annual water demand in 2070



5.2.5 Mining water demand

Mining water demand consists of water used in the exploration, development, and extraction of oil, gas, coal, aggregates, and other materials. Mining demand projections were based on external research (BEG, 2011, 2012). Due to the rapidly changing hydraulic fracturing, or fracking, activity in the oil and gas industry, the TWDB contracted with the Bureau of Economic Geology in 2009 to re-evaluate the current and project the future water used in mining operations (BEG, 2011). In 2012, the Bureau of Economic Geology released an updated estimate of mining water use in response to the changes occurring in the oil and gas industry. This information was used in developing the mining water demand projections. In all planning decades except 2060, the projections of mining water use are greater than in the 2012 State Water Plan. However, mining demand is projected to decline slightly from 2020 to 2070 while remaining between 1 and 2 percent of total water use in all decades. Water use associated specifically with fracking is expected to be less than 1 percent of total water use in Texas in each decade.

5.2.6 Steam-electric water demand

Steam-electric water demand consists of water used for the purpose of generating power. A generation facility usually diverts surface water, uses it for cooling purposes, and then returns a large portion of the water to a body of water. The water use for the facility is only the volume consumed in the cooling process and not returned. Projections are based on a TWDB-funded study performed by the Bureau of Economic Geology (2008) to develop water demand projections for the steam-electric sector in Texas. Beyond the specific future steam-electric power generation facilities on file with the Public Utility Commission of Texas, most future water demand growth for steam-electric is expected to take place in the same counties in which current steam-electric facilities exist.

5.2.7 Irrigation water demand

Irrigation water demand includes water used in irrigated field crops, vineyards, orchards, and self-supplied golf courses. Projections for irrigation water demand were based on the rate of future change in demand and the previous projections used in developing the 2012 State Water Plan. Each planning cycle, the previous cycle's irrigation projections are adjusted by factors and trends including

- changes in the amount of crops under irrigation,
- increases in irrigation application efficiency,
- changes in canal losses for surface water diversions, and
- changes in cropping patterns.

Irrigation demand is expected to decline as a result of more efficient irrigation systems, reduced groundwater supplies, the economic difficulty of pumping water from increasingly greater depths, and the transfer of water rights from agricultural to municipal uses.

5.2.8 Livestock water demand

Livestock water demand includes water used in the production of various types of livestock, including cattle (beef and dairy), hogs, poultry, horses, sheep, and goats. Livestock water use for each county was based on the average livestock water use between 2005 and 2009 and on the estimated "dry year" water use per animal unit. In most cases, it was predicted that livestock use would remain fairly constant over the 50-year planning horizon.

5.3 Comparison to the 2012 State Water Plan

The overall population and water demand projections for the 2017 State Water Plan are similar to those in the 2012 State Water Plan, with a few notable exceptions. Focusing on the planning decades of 2020 and 2060 as common comparison points, some of the important similarities and differences are summarized below:

- The projected statewide population estimates are very close to those in the 2012 State Water Plan, with no more than one-half of a percent difference in any planning decade.

- The largest nominal decreases to population projections are for approximately 468,000 less people in Region C in 2020 and approximately 580,000 less people in Region H in 2060. The decrease in projected population is due to a number of factors, including a slightly slower overall growth rate during the 2007–2010 economic recession and numerous demographic shifts incorporated into the projection models that are based on 2010 census information that became available after the previous projection estimates.
- The largest relative increases in projected population from the 2012 State Water Plan were for approximately 30 and 36 percent increases in 2060 for Regions F and O, respectively. These increases are mostly associated with increased oil and gas activities in the regions.
- Statewide municipal water demand projections are projected to be approximately 8 percent lower in 2060 than the projections in the 2012 State Water Plan. This is due to lower population projections and because lower per capita water use rates (based on the drought year 2011) were used to develop the municipal water demand projections for some areas within Regions C and H. The lower per capita use may also reflect some conservation achieved since the previous state water plan.

5.4 Uncertainty of population growth and water demands

Because population growth is so variable, projections used to develop the regional and state water plans are adjusted every decade when each new U.S. Census is released. Between each census, the TWDB relies on input from planning groups to allocate the residents to population centers within each county.

As evidenced by the changes in the projections used to develop each state water plan, every category of water demand—municipal, manufacturing, irrigation, steam-electric, mining, and livestock—will vary over time. Population growth

Center-pivot irrigation near Uvalde, Texas

depends on social and economic factors including individual preferences. Municipal demand depends on how many and how residents are using water and where they choose to reside. Per capita water use depends on preferences, habits, and water-using appliances, all of which are influenced by the economy and/or the weather. In addition, irrigation and livestock demands are also strongly influenced by the economy and the weather. Manufacturing and mining demands are influenced by economic factors and government regulation but are less sensitive to the weather than other water uses. All of the underlying factors that influence water use are difficult to accurately predict, especially over the long term, and result in uncertainty in water demand projections.

Historically, irrigation has been the category of greatest water use in Texas. Irrigation demand is contingent upon many variables such as the number of acres of each crop, the water needs of each crop type, and the weather. In addition, economic factors equally contribute to irrigation demand, including prices of agricultural commodities and agricultural production inputs like fuel and fertilizer. Government policies can also be influential.

Rather than attempt to predict future policies and commodity prices, the TWDB projects irrigation water demand based on current water use levels. This allows important future developments to be revised every five years through adjustments from each planning cycle.

Manufacturing, mining, and steam-electric demands also depend on numerous factors such as price levels of their inputs and outputs, the resources needed for production, and the products of that production. Because most industrial processes are energy intensive, the prices of energy sources such as gasoline, natural gas, and coal are of particular importance.

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