# Quick Facts

In the event of severe drought conditions, the state faces an immediate need for additional water supplies of 3.6 million acre-feet per year.

If Texas does not implement new water supply projects or management strategies, then homes, businesses, and agricultural enterprises throughout the state are projected to need 8.3 million acre-feet of additional water supply by 2060.

Planning groups were unable to find economically feasible strategies to meet over 2 million acre-feet of annual needs, with the vast majority of the unmet needs in irrigation.

Annual economic losses from not meeting water supply needs could result in a reduction in income of approximately $11.9 billion annually if current drought conditions approach the drought of record, and as much as $115.7 billion annually by 2060, with over a million lost jobs.

# 6 Water Supply Needs

**Needs are projected water demands in excess of existing supplies that would be legally and physically available during a drought of record.**

Growing at a rate of approximately 1,100 people per day over the last decade, Texas is one of the fastest growing states in the nation. By 2060, the population of the state is projected to increase to over 46 million people. Rapid growth, combined with Texas' robust economy and susceptibility to drought, makes water supply a crucial issue. If water infrastructure and water management strategies are not implemented, Texas could face serious social, economic, and environmental consequences in both the large metropolitan areas as well as the vast rural areas of the state.

Unreliable water supplies could have overwhelming negative implications for Texas. For example, water shortages brought on by drought conditions would more than likely curtail economic activity in industries heavily reliant on water, which could result in not only job loss but a monetary loss to local economies as well as the state economy. Also, a lack of reliable water supply may bias corporate decision-makers against expanding or locating their businesses in Texas.

## TABLE 6.1. WATER NEEDS BY REGION (ACRE-FEET PER YEAR)

| Region | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| A | 454,876 | 454,118 | 487,316 | 501,830 | 462,230 | 418,414 |
| B | 23,559 | 28,347 | 34,074 | 35,802 | 37,485 | 40,397 |
| C | 69,087 | 399,917 | 686,836 | 953,949 | 1,244,618 | 1,588,236 |
| D | 10,252 | 14,724 | 18,696 | 31,954 | 60,005 | 96,142 |
| E | 209,591 | 213,091 | 215,624 | 210,794 | 216,113 | 226,569 |
| F | 191,057 | 200,868 | 204,186 | 211,018 | 214,792 | 219,995 |
| G | 131,489 | 196,761 | 228,978 | 272,584 | 334,773 | 390,732 |
| H | 290,890 | 524,137 | 698,776 | 833,518 | 1,004,872 | 1,236,335 |
| I | 28,856 | 83,032 | 83,153 | 106,900 | 141,866 | 182,145 |
| J | 1,494 | 1,878 | 2,044 | 2,057 | 2,275 | 2,389 |
| K | 255,709 | 303,240 | 294,534 | 309,813 | 340,898 | 367,671 |
| L | 174,235 | 265,567 | 308,444 | 350,063 | 390,297 | 436,751 |
| M | 435,922 | 401,858 | 362,249 | 434,329 | 519,622 | 609,906 |
| N | 3,404 | 14,084 | 27,102 | 41,949 | 57,994 | 75,744 |
| O | 1,275,057 | 1,750,409 | 2,107,876 | 2,364,996 | 2,405,010 | 2,366,036 |
| P | 67,739 | 67,739 | 67,739 | 67,739 | 67,739 | 67,739 |
| **Total** | **3,623,217** | **4,919,770** | **5,827,627** | **6,729,295** | **7,500,589** | **8,325,201** |

For all these reasons as well as others, it is important to identify potential future water supply needs to analyze and understand how the needs for water could affect communities throughout the state during a severe drought and to plan for meeting those needs. When developing regional water plans, regional water planning groups compare existing water supplies with current and projected water demands to identify when and where additional water supplies are needed for each identified water user group and wholesale water provider. TWDB provides assistance in conducting this task by performing a socioeconomic impact analysis for each region at their request.

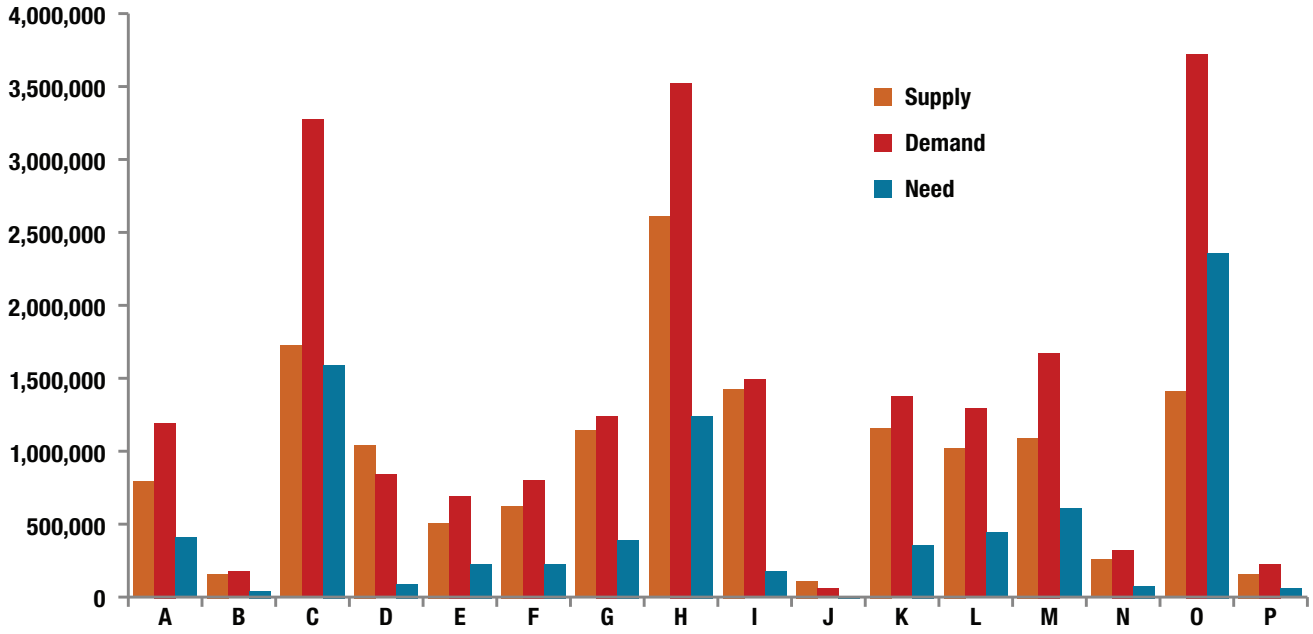
## 6.1 IDENTIFICATION OF NEEDS

When existing water supplies available to a specific water user group are less than projected demands, there is a need for water. In other words, once there is an identified water demand projection for a given water user group, this estimate is then deducted from identified existing supplies for that water user group, resulting in either a water supply surplus or a need. Planning groups have identified a statewide water supply need of 3.6 million acre-feet in 2010 and 8.3 million acre-feet by 2060, which is a slight reduction from the 2007 State Water Plan in which planning groups identified estimated needs of 3.7 million acre-feet in 2010 and 8.9 million acre-feet in 2060. Table 6.1 shows the total water supply needs identified for each region by the regional water planning groups for the current planning cycle.

Although in some regions it appears that there are sufficient existing water supplies region-wide to meet demands under drought conditions in the early planning decades, local existing water supplies are not always available to all users throughout the region. Therefore, water needs were identified as a result of this geographic "mismatch" of existing supplies and anticipated shortages (Figure 6.1).

The regional water planning groups were tasked with identifying needs for water user groups—municipal, county-other, manufacturing, steam-electric, livestock,

## FIGURE 6.1. EXISTING WATER SUPPLIES, PROJECTED DEMANDS, AND NEEDS BY REGION IN 2060 (ACRE-FEET PER YEAR).




irrigation, and mining—and wholesale water providers. Water uses for the following categories were estimated at the county level: county-other, manufacturing, mining, steam-electric, livestock, and irrigation.

The planning groups identified 982 total non-municipal water user groups; 174 (18 percent) of these would currently have inadequate water supply in drought of record conditions, with that number increasing to 260 (26 percent) by 2060. The planning groups also identified 1,587 total municipal water user groups and 173 total wholesale water providers. Of the municipal water user groups, 470 (30 percent) would currently have water supply needs if the state were facing drought conditions, increasing to 825 (52 percent of the total) in 2060. Of the wholesale water providers, the planning groups identified 83 (48 percent) that would currently face shortages; those with needs are projected to increase to 109 (63 percent) by 2060 (Table 6.2). If no action is taken to implement water management strategies, over 50 percent of the state's population in 2060 would face a water need of at least 45 percent of their projected demand during a repeat of drought conditions.

### 6.1.1 MUNICIPAL NEEDS

Municipal water use accounts for about 9 percent of total identified needs or roughly 315,000 acre-feet in 2010, increasing to 41 percent or 3.4 million acre-feet by 2060. These estimates are down from projections in the 2007 State Water Plan, where municipal water supply needs were projected to be about 610,000 and 3.8 million acre-feet in 2010 and 2060, respectively. This reduction is a result of implementing projects from the past plan.

If the state were to experience drought conditions like those in the 1950s, Region L would currently experience the largest identified municipal needs at

## TABLE 6.2. NUMBER OF WATER USER GROUPS WITH NEEDS BY REGION

| Region | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| A | 8 | 14 | 20 | 22 | 22 | 23 |
| B | 7 | 8 | 8 | 8 | 7 | 7 |
| C | 172 | 246 | 262 | 267 | 269 | 270 |
| D | 17 | 20 | 28 | 32 | 36 | 39 |
| E | 2 | 10 | 10 | 11 | 12 | 12 |
| F | 53 | 54 | 50 | 52 | 54 | 54 |
| G | 66 | 72 | 84 | 89 | 96 | 97 |
| H | 132 | 229 | 234 | 237 | 237 | 241 |
| I | 31 | 41 | 45 | 51 | 56 | 60 |
| J | 2 | 2 | 2 | 2 | 2 | 2 |
| K | 36 | 46 | 53 | 59 | 63 | 67 |
| L | 47 | 58 | 65 | 69 | 72 | 77 |
| M | 35 | 44 | 50 | 54 | 63 | 64 |
| N | 8 | 12 | 14 | 15 | 16 | 16 |
| O | 26 | 37 | 45 | 48 | 53 | 54 |
| P | 2 | 2 | 2 | 2 | 2 | 2 |
| **Total water user groups with needs** | **644** | **895** | **972** | **1,018** | **1,060** | **1,085** |
| **Total water user groups** | **2,569** | **2,569** | **2,569** | **2,569** | **2,569** | **2,569** |
| **Percent of water user groups with needs** | **25** | **35** | **38** | **40** | **41** | **42** |

about 96,000 acre-feet. However, by 2060, Regions C, H, and M account for the majority of these needs, with the Dallas-Fort Worth area responsible for a large portion of those needs. In fact, with the exception of Region P, every region in the state would be affected by future municipal water shortages.

### 6.1.2 WHOLESALE WATER PROVIDERS

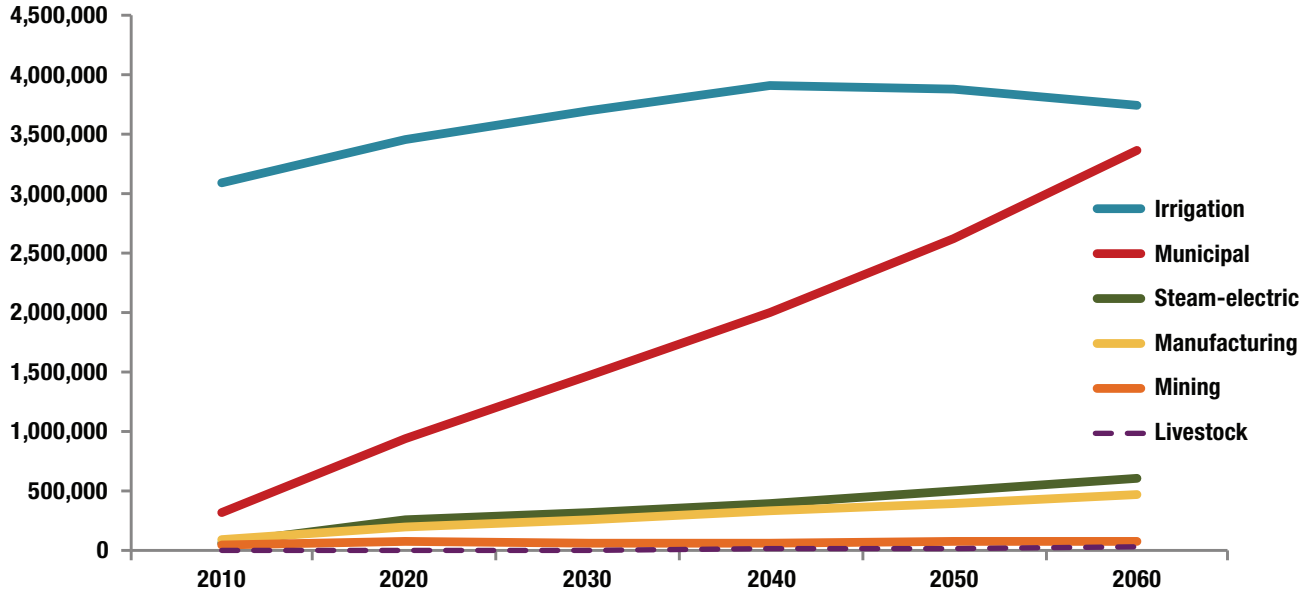
Wholesale water providers—entities such as some river authorities, municipal utility districts, and water supply corporations—deliver and sell large amounts of raw (untreated) or treated water for municipal and manufacturing use on a wholesale or retail basis. In many instances, the burden of their water needs is shared by both the water user group facing the projected shortage and the entity that provides water to them, since the needs for wholesale water providers are not additional to those of water user groups but made up of needs from several of those entities.

Wholesale water providers are projected to have total water supply needs under drought conditions of about 835,000 acre-feet in 2010 and 4.4 million acre-feet in 2060. Tarrant Regional Water District, the City of Dallas, North Texas Municipal Water District, and the City of Fort Worth are the wholesale water providers with the largest projected needs by 2060.

### 6.1.3 NON-MUNICIPAL NEEDS

*Irrigation:* Irrigation accounts for the largest share of the state's total current water demand, roughly 60 percent. It is projected to remain the state's largest water use category through 2050, although by 2060, TWDB projects its share of the total demand will decline to approximately 38 percent of total water demand. As expected, irrigation also accounts for the largest percentage of projected water supply needs under drought conditions at 3.1 million acre-feet, or 86 percent of the total in 2010; irrigation needs are projected to increase to 3.8 million acre-feet by 2060. However, this will only account for about 45 percent of the state's total water needs in 2060, due to the large increase in volume of municipal needs from 2010 to

## FIGURE 6.2. PROJECTED WATER NEEDS BY USE CATEGORY (ACRE-FEET PER YEAR).




2060 (Figure 6.2). The vast majority of irrigation needs occur in the most heavily irrigated parts of the state.

Irrigation needs represent an increase from those projected in the 2007 State Water Plan, which were 2.8 million acre-feet in 2010 and 3.7 million acre-feet by 2060. This increase is largely due to the transfer of water rights from irrigation to municipal and groundwater depletion in the more heavily irrigated parts of the state.

*Livestock:* Although livestock water use is quite small in comparison to other water uses, the inability to meet demands could prove costly for some parts of the state. Under drought conditions, Region I would account for almost all of the projected livestock needs for 2010, which are slightly over 1,000 acre-feet. By 2060, the state total is projected to increase to approximately 30,000 acre-feet, with Region O accounting for the majority of the total needs followed by Region I. This represents a decline from the projected livestock needs of about 11,000 acre-feet in 2010 and 39,000 acre-feet in 2060, identified in the 2007 State Water Plan. Region A accounted for a large percentage of livestock needs during the last round of planning; however, based on reduced livestock water use demands that resulted from a detailed study performed for this round of planning, no projected needs for livestock have been identified in Region A in the 2012 State Water Plan.

*Mining:* Planning groups identified 47,000 acre-feet of water needs for the mining industry statewide under drought conditions for 2010, with that total increasing to almost 85,000 acre-feet by 2060. This is an increase from needs identified in the 2007 State Water Plan, which were approximately 38,000 and 79,000 acre-feet in 2010 and 2060, respectively. In 2010, Regions I and K will have the largest percentage of mining needs, whereas by 2060 Regions C and H have the largest portion of identified mining needs. However, these projections were developed before the boom in natural gas extraction extended to some eastern and southern areas of the state late in the last decade.

## TABLE 6.3. PROJECTED WATER NEEDS BY USE CATEGORY BY REGION (ACRE-FEET PER YEAR)

| Region | Category | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|---|
| A | Irrigation | 454,628 | 452,144 | 477,338 | 482,226 | 433,155 | 381,180 |
| | Manufacturing | 173 | 800 | 1,317 | 2,845 | 4,212 | 5,866 |
| | Municipal | 0 | 1,075 | 8,544 | 16,631 | 24,727 | 31,214 |
| | Steam-electric | 75 | 99 | 117 | 128 | 136 | 154 |
| B | Irrigation | 22,945 | 23,926 | 24,909 | 25,893 | 26,876 | 29,058 |
| | Mining | 177 | 153 | 145 | 149 | 162 | 162 |
| | Municipal | 437 | 468 | 491 | 502 | 460 | 462 |
| | Steam-electric | 0 | 3,800 | 8,529 | 9,258 | 9,987 | 10,715 |
| C | Irrigation | 510 | 2,588 | 3,412 | 4,007 | 4,492 | 4,913 |
| | Manufacturing | 557 | 11,946 | 21,151 | 30,369 | 39,640 | 48,894 |
| | Mining | 414 | 4,909 | 10,036 | 14,782 | 19,445 | 23,779 |
| | Municipal | 67,606 | 367,257 | 622,541 | 869,956 | 1,140,044 | 1,459,327 |
| | Steam-electric | 0 | 13,217 | 29,696 | 34,835 | 40,997 | 51,323 |
| D | Irrigation | 56 | 0 | 14 | 115 | 238 | 388 |
| | Municipal | 1,557 | 2,358 | 3,245 | 4,443 | 8,938 | 18,285 |
| | Steam-electric | 8,639 | 12,366 | 15,437 | 27,396 | 50,829 | 77,469 |
| E | Irrigation | 209,591 | 201,491 | 195,833 | 183,734 | 176,377 | 169,156 |
| | Manufacturing | 0 | 813 | 1,511 | 2,186 | 2,760 | 3,674 |
| | Municipal | 0 | 6,981 | 13,300 | 18,464 | 28,823 | 43,460 |
| | Steam-electric | 0 | 3,806 | 4,980 | 6,410 | 8,153 | 10,279 |
| F | Irrigation | 157,884 | 154,955 | 152,930 | 149,472 | 146,995 | 144,276 |
| | Manufacturing | 3,537 | 4,138 | 3,747 | 4,403 | 4,707 | 5,152 |
| | Mining | 503 | 660 | 29 | 143 | 232 | 375 |
| | Municipal | 22,038 | 31,275 | 36,100 | 43,706 | 46,511 | 49,619 |
| | Steam-electric | 7,095 | 9,840 | 11,380 | 13,294 | 16,347 | 20,573 |
| G | Irrigation | 59,571 | 56,961 | 54,422 | 51,942 | 49,527 | 47,181 |
| | Manufacturing | 2,762 | 3,441 | 4,108 | 4,783 | 5,393 | 6,054 |
| | Mining | 9,670 | 10,544 | 10,963 | 11,301 | 11,704 | 12,158 |
| | Municipal | 20,944 | 54,332 | 76,594 | 110,959 | 150,533 | 192,467 |
| | Steam-electric | 38,542 | 71,483 | 82,891 | 93,599 | 117,616 | 132,872 |
| H | Irrigation | 151,366 | 141,232 | 137,995 | 137,113 | 140,733 | 144,802 |
| | Manufacturing | 75,164 | 131,531 | 168,597 | 202,219 | 231,118 | 255,604 |
| | Mining | 5,992 | 10,595 | 13,850 | 16,278 | 18,736 | 20,984 |
| | Municipal | 55,151 | 228,106 | 360,236 | 453,142 | 579,269 | 758,934 |
| | Steam-electric | 3,203 | 12,609 | 18,058 | 24,726 | 34,976 | 55,972 |
| | Livestock | 14 | 64 | 40 | 40 | 40 | 39 |
| I | Irrigation | 1,675 | 1,805 | 2,156 | 2,536 | 2,955 | 3,416 |
| | Manufacturing | 3,392 | 16,014 | 24,580 | 33,256 | 40,999 | 49,588 |
| | Mining | 14,812 | 29,744 | 9,395 | 10,075 | 10,748 | 11,276 |
| | Municipal | 4,412 | 7,351 | 9,314 | 11,633 | 15,366 | 20,509 |
| | Steam-electric | 3,588 | 25,922 | 33,615 | 43,053 | 62,778 | 85,212 |
| | Livestock | 977 | 2,196 | 4,093 | 6,347 | 9,020 | 12,144 |
| J | Municipal | 1,494 | 1,878 | 2,044 | 2,057 | 2,275 | 2,389 |
| K | Irrigation | 234,738 | 217,011 | 198,717 | 181,070 | 164,084 | 135,822 |
| | Manufacturing | 146 | 298 | 452 | 605 | 741 | 934 |
| | Mining | 13,550 | 13,146 | 12,366 | 6,972 | 5,574 | 5,794 |
| | Municipal | 6,894 | 19,592 | 29,636 | 44,548 | 88,381 | 135,891 |
| | Steam-electric | 193 | 53,005 | 53,175 | 76,430 | 81,930 | 89,042 |
| | Livestock | 188 | 188 | 188 | 188 | 188 | 188 |
| L | Irrigation | 68,465 | 62,376 | 56,519 | 50,894 | 45,502 | 41,782 |
| | Manufacturing | 6,539 | 13,888 | 20,946 | 27,911 | 34,068 | 43,072 |
| | Mining | 521 | 726 | 1,771 | 1,992 | 2,293 | 2,493 |
| | Municipal | 96,653 | 137,614 | 178,217 | 218,245 | 256,777 | 297,386 |
| | Steam-electric | 2,054 | 50,962 | 50,991 | 51,021 | 51,657 | 52,018 |
| | Livestock | 3 | 1 | 0 | 0 | 0 | 0 |
| M | Irrigation | 407,522 | 333,246 | 239,408 | 245,896 | 252,386 | 258,375 |
| | Manufacturing | 1,921 | 2,355 | 2,748 | 3,137 | 3,729 | 4,524 |
| | Municipal | 26,479 | 64,277 | 115,719 | 178,005 | 252,293 | 330,625 |
| | Steam-electric | 0 | 1,980 | 4,374 | 7,291 | 11,214 | 16,382 |
| N | Irrigation | 627 | 569 | 1,264 | 2,316 | 3,784 | 5,677 |
| | Manufacturing | 409 | 7,980 | 15,859 | 25,181 | 34,686 | 46,905 |
| | Mining | 1,802 | 2,996 | 4,471 | 6,166 | 6,897 | 7,584 |
| | Municipal | 566 | 557 | 753 | 827 | 2,440 | 2,395 |
| | Steam-electric | 0 | 1,982 | 4,755 | 7,459 | 10,187 | 13,183 |
| O | Irrigation | 1,264,707 | 1,735,399 | 2,084,569 | 2,331,719 | 2,361,813 | 2,318,004 |
| | Municipal | 10,349 | 14,247 | 20,116 | 23,771 | 28,489 | 30,458 |
| | Livestock | 1 | 763 | 3,191 | 9,506 | 14,708 | 17,574 |
| P | Irrigation | 67,739 | 67,739 | 67,739 | 67,739 | 67,739 | 67,739 |

## TABLE 6.4. UNMET NEEDS 2010–2060 (ACRE-FEET PER YEAR)

| Region | Category | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|---|
| A | Irrigation | 454,628 | 254,900 | 127,413 | 97,003 | 60,375 | 30,307 |
| B | Irrigation | 9,911 | 0 | 0 | 0 | 0 | 0 |
| C | Irrigation | 87 | 0 | 0 | 0 | 0 | 0 |
| D | Irrigation | 56 | 0 | 14 | 115 | 238 | 388 |
| E | Irrigation | 209,591 | 168,904 | 163,246 | 158,209 | 159,914 | 161,775 |
| F | Irrigation | 153,159 | 125,967 | 100,485 | 97,453 | 96,177 | 94,108 |
| F | Steam-electric | 1,219 | 3,969 | 5,512 | 7,441 | 10,608 | 14,935 |
| G | Irrigation | 49,973 | 45,234 | 40,664 | 38,358 | 36,113 | 33,932 |
| G | Mining | 1,800 | 2,001 | 2,116 | 2,281 | 2,446 | 2,567 |
| G | Municipal | 2,196 | 0 | 0 | 0 | 0 | 0 |
| G | Steam-electric | 36,086 | 0 | 0 | 0 | 0 | 0 |
| I | Mining | 7,772 | 8,620 | 9,191 | 9,760 | 10,333 | 10,772 |
| I | Steam-electric | 2,588 | 0 | 0 | 0 | 0 | 0 |
| L | Irrigation | 48,378 | 44,815 | 42,090 | 39,473 | 36,959 | 34,544 |
| M | Irrigation | 394,896 | 285,316 | 149,547 | 107,676 | 59,571 | 4,739 |
| N | Mining | 1,591 | 2,448 | 3,023 | 3,374 | 3,660 | 3,876 |
| O | Irrigation | 862,586 | 1,348,515 | 1,728,725 | 2,000,555 | 2,057,677 | 2,043,247 |
| O | Livestock | 1 | 763 | 3,191 | 9,506 | 14,708 | 17,574 |
| **Total** | | **2,236,518** | **2,291,452** | **2,375,217** | **2,571,204** | **2,548,779** | **2,452,764** |

*Steam-electric:* Planning groups identified 63,000 acre-feet of potential water shortages for the steam-electric category in 2010, increasing dramatically to over 615,000 acre-feet by 2060. Region G accounts for the largest share of these needs for both 2010 and 2060.

Regions K, I, and D, however, are also projected to have significant water supply needs by 2060 under drought conditions. This is a reduction from the steam-electric needs identified in the 2007 State Water Plan, which were approximately 76,000 acre-feet in 2010 and 675,000 acre-feet in 2060, statewide.

*Manufacturing*: Planning groups identified a potential shortage of 95,000 acre-feet for the manufacturing water use category in 2010, increasing to about 470,000 acre-feet by 2060. This represents a decline from those needs identified in the last round of planning, where planning groups estimated projected needs of 132,000 and 500,000 acre-feet in 2010 and 2060, respectively. The decline is due to a reduction in Region H's water supply needs in 2010 and reductions for Regions A, C, and K in 2060, which was a result of an increase in allocated supplies in these regions. The majority of potential manufacturing needs in the 2012 State Water Plan occur in Region H, most notably in Brazoria and Harris counties, in both 2010 and 2060.

## 6.2 UNMET NEEDS

During the current round of planning, planning groups identified some water needs that could not be met because no feasible water management strategy could be implemented in the identified decades of needs. The majority of unmet needs fall under the irrigation water use category, especially in Regions A, E, F, M, and O. For irrigation water needs, it is likely that under drought conditions, the return on the investment is not sufficient to support implementation of costly water management strategies.

The remainder of unmet needs are relatively small, with many of them occurring only in the 2010 decade when timing issues precluded strategy implementation. In the remaining decades, there are unmet steam-electric

needs in Region F, unmet mining needs in Regions G, I, and N, and unmet livestock needs in Region O. Identified unmet needs can be seen in Table 6.4.

## 6.3 SOCIOECONOMIC IMPACT OF NOT MEETING WATER NEEDS

As part of the regional planning process, planning groups are tasked with evaluating the social and economic impacts of not meeting identified water supply needs. TWDB provided assistance in conducting this task by performing a socioeconomic impact analysis for each region at their request. The impact analysis is based on the assumption of a physical shortage of raw surface or groundwater due to drought conditions. Under this scenario, impacts are estimates for a single year (2010, 2020, 2030, 2040, 2050, and 2060), and shortages are assumed to be temporary events resulting from drought conditions.

There are two major components to TWDB's socioeconomic analysis: (1) an economic impact component and (2) a social impact component. The economic component analyzes the impacts of water shortages on residential water consumers and losses to regional economies from reduced economic output in agriculture, industry, and commerce. The social component focuses on demographic effects, including changes in population and school enrollment, by incorporating results from the economic impact element and assessing how changes in a region's economy due to water shortages could affect patterns of migration.

Variables impacted by projected water shortages identified in this analysis include the following:

- **Regional income:** Total payroll costs, including wages and salaries plus benefits paid by industries; corporate income; rental income; and interest payments to corporations and individuals in a given region.
- **State and local business taxes:** Sales, excise, fees, licenses, and other taxes paid during normal operation of an industry.
- **Number of full- and part-time jobs:** Number of full and part-time jobs including self-employment.
- **Population losses:** Unrecognized gains in population due to water shortages.
- **Declines in school enrollment:** Potential losses to future enrollment due to population losses.

There are a variety of tools available for use in estimating economic impacts; however, the most widely used methods are input-output models combined with social accounting matrices. Impacts in this study were estimated using proprietary software known as IMPLAN PRO™. IMPLAN is a modeling system originally developed by the U.S. Forest Service in the late 1970s. Today, MIG Inc. (formerly Minnesota IMPLAN Group Inc.) owns the copyright and distributes data and software. IMPLAN is also utilized by the U.S. Army Corps of Engineers as well as many other federal and state agencies.

Once potential output reductions due to water shortages were estimated, direct impacts to total sales, employment, regional income, and business taxes were derived using regional level economic multipliers. Secondary impacts were derived using a similar methodology; however, indirect multiplier coefficients are used.

As with any attempt to measure human social activities, assumptions are necessary. Assumptions are needed to maintain a level of generality and simplicity so that models can be applied on several geographic levels and across different economic sectors. Some

of the assumptions made in this analysis include the following:

- Water supply needs as reported by regional planning groups are the starting point for socioeconomic analysis.
- Since plans are developed for drought conditions on a decadal basis, estimated socioeconomic impacts are point estimates for years in which water needs are reported (2010, 2020, 2030, 2040, 2050, and 2060). Given that the resulting impacts are not cumulative in nature, it is inappropriate to sum these impacts over the planning horizon; doing so would imply that the drought conditions will occur every 10 years in the future.
- Indirect impacts measure only linkages to supporting industries (those who sell inputs to an affected sector), not the impacts on businesses that purchase the sector's final product. Thus, the measured impacts of a given water shortage likely represent an underestimate of the losses to a region's economy.
- The analysis assumes the general structure of the economy remains the same over the planning horizon.
- Monetary figures are reported in constant year 2006 U.S. dollars.

### 6.3.1 SOCIOECONOMIC ANALYSIS RESULTS

Assuming drought conditions were experienced statewide and water management strategies identified in the 2012 State Water Plan were not implemented, planning areas could suffer significant economic losses (Table 6.5). Models show that Texas businesses and workers could lose approximately $11.9 billion in income in 2010, with that total increasing to an estimated $115.7 billion by 2060. Losses to state and local business taxes associated with commerce could reach $1.1 billion in 2010 and escalate to roughly $9.8 billion in 2060. If water management strategies identified in the 2012 State Water Plan are not implemented to meet these needs, Texans could face an estimated 115,000 lost jobs in 2010 and 1.1 million in 2060. The state could also fail to meet its true growth potential, losing an estimated 1.4 million in potential population growth and 403,000 fewer students by 2060. The 1950s drought of record was estimated to cost the Texas economy about $3.5 billion (adjusted to 2008 dollars) annually (TBWE, 1959).

In short, TWDB estimates of socioeconomic impacts show if the state were to experience drought conditions in any year in the planning horizon and strategies were not put in place, there would be severe social and economic consequences. Furthermore, if drought conditions were to recur, the duration would likely exceed a single year and possibly cause actual impacts to the state that would exceed the estimates included in the 2012 State Water Plan.

## REFERENCES

TBWE (Texas Board of Water Engineers), 1959, A Study of Droughts in Texas: Texas Board of Water Engineers Bulletin 5914, 76 p.

## TABLE 6.5. ANNUAL ECONOMIC LOSSES FROM NOT MEETING WATER SUPPLY NEEDS FOR 2010–2060 (MILLIONS OF 2006 DOLLARS)

| Region | Category | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|---|
| A | Regional income ($) | 183 | 309 | 472 | 509 | 538 | 906 |
| | State and local business taxes ($) | 11 | 30 | 53 | 57 | 62 | 116 |
| | Number of full- and part-time jobs | 2,970 | 3,417 | 4,067 | 4,459 | 4,806 | 4,879 |
| | Population losses | 3,693 | 4,234 | 4,670 | 5,548 | 6,338 | 6,864 |
| | Declines in school enrollment | 1,042 | 1,201 | 1,237 | 1,025 | 1,171 | 1,270 |
| B | Regional income ($) | 5 | 5 | 5 | 5 | 5 | 6 |
| | State and local business taxes ($) | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.4 |
| | Number of full- and part-time jobs | 85 | 88 | 92 | 96 | 100 | 108 |
| | Population losses | 13 | 522 | 1,156 | 1,254 | 1,354 | 1,451 |
| | Declines in school enrollment | 4 | 148 | 328 | 356 | 384 | 412 |
| C | Regional income ($) | 2,336 | 5,176 | 12,883 | 19,246 | 24,741 | 49,721 |
| | State and local business taxes ($) | 130 | 341 | 848 | 1,288 | 1,672 | 3,060 |
| | Number of full- and part-time jobs | 23,808 | 52,165 | 131,257 | 206,836 | 270,935 | 546,676 |
| | Population losses | 33,019 | 74,375 | 190,664 | 301,075 | 394,560 | 796,606 |
| | Declines in school enrollment | 10,348 | 24,340 | 64,415 | 102,345 | 134,283 | 271,468 |
| D | Regional income ($) | 357 | 515 | 620 | 871 | 1,341 | 1,960 |
| | State and local business taxes ($) | 51 | 73 | 88 | 123 | 189 | 267 |
| | Number of full- and part-time jobs | 1,224 | 1,780 | 2,150 | 2,998 | 4,639 | 6,784 |
| | Population losses | 1,472 | 2,144 | 2,590 | 3,611 | 5,588 | 8,171 |
| | Declines in school enrollment | 415 | 608 | 735 | 1,024 | 1,585 | 2,318 |
| E | Regional income ($) | 41 | 749 | 1,212 | 1,690 | 2,144 | 2,810 |
| | State and local business taxes ($) | 2 | 51 | 78 | 107 | 137 | 179 |
| | Number of full- and part-time jobs | 340 | 2,447 | 3,944 | 5,669 | 7,380 | 9,843 |
| | Population losses | 409 | 2,947 | 4,745 | 6,787 | 8,814 | 11,750 |
| | Declines in school enrollment | 115 | 836 | 1,257 | 1,254 | 1,628 | 2,173 |
| F | Regional income ($) | 1,444 | 1,715 | 2,195 | 2,729 | 3,061 | 3,470 |
| | State and local business taxes ($) | 145 | 176 | 236 | 288 | 330 | 380 |
| | Number of full- and part-time jobs | 19,225 | 21,784 | 26,293 | 34,853 | 37,661 | 40,877 |
| | Population losses | 25,050 | 26,239 | 31,670 | 41,980 | 45,362 | 49,236 |
| | Declines in school enrollment | 7,065 | 7,444 | 8,389 | 7,759 | 8,378 | 9,106 |
| G | Regional income ($) | 1,890 | 4,375 | 5,621 | 6,297 | 7,183 | 8,204 |
| | State and local business taxes ($) | 214 | 530 | 693 | 778 | 893 | 1,027 |
| | Number of full- and part-time jobs | 14,699 | 33,660 | 39,733 | 48,896 | 58,432 | 73,117 |
| | Population losses | 15,801 | 35,645 | 41,465 | 51,910 | 61,309 | 71,604 |
| | Declines in school enrollment | 4,457 | 10,112 | 11,764 | 14,727 | 17,393 | 20,314 |
| H | Regional income ($) | 3,195 | 5,189 | 10,012 | 12,910 | 15,759 | 18,637 |
| | State and local business taxes ($) | 326 | 536 | 1,024 | 1,375 | 1,689 | 2,036 |
| | Number of full- and part-time jobs | 20,176 | 37,849 | 82,478 | 100,622 | 126,412 | 149,380 |
| | Population losses | 24,433 | 45,514 | 99,071 | 122,686 | 152,028 | 175,839 |
| | Declines in school enrollment | 6,891 | 12,913 | 26,242 | 22,674 | 28,078 | 32,522 |
| I | Regional income ($) | 1,264 | 3,279 | 2,087 | 3,609 | 5,027 | 5,957 |
| | State and local business taxes ($) | 116 | 334 | 213 | 358 | 528 | 627 |
| | Number of full- and part-time jobs | 8,739 | 20,661 | 11,018 | 16,886 | 24,091 | 28,872 |
| | Population losses | 10,511 | 24,754 | 13,269 | 20,337 | 29,015 | 34,773 |
| | Declines in school enrollment | 2,965 | 7,023 | 3,764 | 5,770 | 8,232 | 9,865 |

## TABLE 6.5. ANNUAL ECONOMIC LOSSES FROM NOT MEETING WATER SUPPLY NEEDS FOR 2010–2060 (MILLIONS OF 2006 DOLLARS) - CONTINUED

| Region | Category | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|---|
| J | Regional income ($) | 2 | 2 | 2 | 2 | 2 | 2 |
| | State and local business taxes ($) | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 |
| | Number of full- and part-time jobs | 63 | 63 | 61 | 59 | 60 | 61 |
| | Population losses | 80 | 80 | 80 | 80 | 80 | 80 |
| | Declines in school enrollment | 20 | 20 | 20 | 20 | 20 | 20 |
| K | Regional income ($) | 138 | 1,326 | 1,396 | 2,246 | 2,407 | 2,933 |
| | State and local business taxes ($) | 15 | 179 | 186 | 305 | 326 | 393 |
| | Number of full- and part-time jobs | 1,989 | 8,447 | 9,860 | 14,651 | 16,273 | 21,576 |
| | Population losses | 2,393 | 10,174 | 11,876 | 17,647 | 19,601 | 25,988 |
| | Declines in school enrollment | 675 | 2,886 | 3,146 | 3,261 | 3,620 | 4,807 |
| L | Regional income ($) | 299 | 5,279 | 5,943 | 7,034 | 8,192 | 8,944 |
| | State and local business taxes ($) | 39 | 564 | 668 | 775 | 885 | 965 |
| | Number of full- and part-time jobs | 10,128 | 19,948 | 39,716 | 53,848 | 67,085 | 78,736 |
| | Population losses | 12,886 | 43,823 | 58,402 | 74,857 | 86,896 | 54,411 |
| | Declines in school enrollment | 3,635 | 12,433 | 15,470 | 13,835 | 16,049 | 10,064 |
| M | Regional income ($) | 324 | 325 | 382 | 909 | 1,568 | 2,935 |
| | State and local business taxes ($) | 27 | 34 | 43 | 104 | 179 | 337 |
| | Number of full- and part-time jobs | 5,081 | 5,609 | 6,664 | 17,658 | 32,124 | 62,574 |
| | Population losses | 6,112 | 6,756 | 8,027 | 21,269 | 38,597 | 75,252 |
| | Declines in school enrollment | 1,724 | 1,917 | 2,277 | 6,034 | 10,950 | 21,349 |
| N | Regional income ($) | 56 | 427 | 1,612 | 2,484 | 5,999 | 7,796 |
| | State and local business taxes ($) | 3 | 22 | 74 | 123 | 274 | 352 |
| | Number of full- and part-time jobs | 430 | 3,125 | 11,275 | 16,375 | 42,420 | 55,025 |
| | Population losses | 520 | 3,770 | 13,590 | 19,730 | 51,100 | 66,280 |
| | Declines in school enrollment | 130 | 890 | 2,990 | 3,030 | 7,840 | 10,180 |
| O | Regional income ($) | 356 | 714 | 949 | 1,214 | 1,415 | 1,437 |
| | State and local business taxes ($) | 18 | 38 | 53 | 71 | 83 | 86 |
| | Number of full- and part-time jobs | 5,546 | 10,843 | 14,760 | 19,532 | 23,761 | 23,966 |
| | Population losses | 7,160 | 13,910 | 18,670 | 24,590 | 29,830 | 30,030 |
| | Declines in school enrollment | 1,680 | 3,270 | 4,380 | 5,770 | 7,000 | 7,040 |
| P | Regional income ($) | 16 | 16 | 16 | 16 | 16 | 16 |
| | State and local business taxes ($) | 2 | 2 | 2 | 2 | 2 | 2 |
| | Number of full- and part-time jobs | 215 | 215 | 215 | 215 | 215 | 215 |
| | Population losses | 258 | 259 | 259 | 259 | 259 | 259 |
| | Declines in school enrollment | 73 | 73 | 73 | 73 | 73 | 73 |
| **Total** | **Regional income losses ($)** | **11,905** | **29,400** | **45,409** | **61,771** | **79,398** | **115,734** |
| | **State and local business taxes losses ($)** | **1,100** | **2,909** | **4,261** | **5,755** | **7,249** | **9,828** |
| | **Number of full- and part-time jobs losses** | **114,718** | **222,101** | **383,583** | **543,653** | **716,394** | **1,102,689** |
| | **Population losses** | **143,810** | **295,146** | **500,204** | **713,620** | **930,731** | **1,408,594** |
| | **Declines in school enrollment** | **41,239** | **86,114** | **146,487** | **188,957** | **246,684** | **402,981** |