Executive summary

- Why do we plan?
- How do we plan?
- How many Texans will there be?
- How much water will we require?
- How much water do we have now?
- Do we have enough water for the future?
- What can we do to get more water?
- Are all the water supply needs met?
- How much will it cost?
- What if we do nothing?
- How are strategies in the state water plan funded?
- What has the TWDB done to implement water management strategies in the 2017 State Water Plan?
- What were impediments to implementing the previous plan?
- What has the TWDB done already to implement water management strategies in this new plan?
- What more can we do?

QUICK FACTS

Texas' state water plans are based on future conditions in the event of a recurrence of the worst recorded drought in Texas' history—known as the "drought of record"—a time when, generally, water supplies are lowest and water demands are highest.

Texas' population is anticipated to increase 73 percent between 2020 and 2070, from 29.7 million to 51.5 million, with approximately half of this growth occurring in Regions C and H. Water demands are projected to increase less significantly, by approximately 9 percent between 2020 and 2070, from 17.7 million to 19.2 million acre-feet per year.

Texas' existing water supplies—those that can already be relied on in the event of drought—are projected to decline by approximately 18 percent between 2020 and 2070, from 16.8 million to 13.8 million acre-feet per year primarily due to depletion of aquifers, with relatively small losses in reservoir yield due to sedimentation.

Water user groups face a potential water shortage of 3.1 million acre-feet per year in 2020 and 6.9 million acre-feet per year in 2070 in drought of record conditions.

Approximately 5,800 water management strategies recommended in this plan would provide 1.7 million acre-feet per year in additional water supplies to water user groups in 2020 and 7.7 million acre-feet per year in 2070.

Conservation strategies represent approximately 29 percent, or 2.2 million acre-feet per year, of all recommended water management strategy volumes in 2070 and were recommended for more than half of the water user groups in the plan.

The estimated capital cost to design, construct, and implement the more than 2,400 recommended water management strategy projects by 2070 is $80 billion in 2018 dollars, without accounting for future inflation.

If strategies are not implemented, approximately one-quarter of Texas' population in 2070 would have less than half the municipal water supplies they will require during a drought of record.

If Texas does not implement the water supply strategies and projects in the state water plan, a severe drought could cause $110 billion of economic damages in 2020, increasing to $153 billion per year by 2070.

Through SWIFT and other financial assistance programs, the TWDB has closed on approximately $6.5 billion in financial assistance for 61 state water plan projects recommended in the 2017 State Water Plan.

Since inception, the SWIFT program has committed almost $9 billion to state water plan projects, of which almost $8.2 billion is toward recommended projects in this state water plan.

Why do we plan?

Planning is necessary to responsibly manage and develop the state's water resources for the benefit of future generations. Reliable water supply is essential to supporting Texas' robust economy, its agricultural and natural resources, and one of the fastest growing populations in the country. By 2070, 51.5 million people are anticipated to live in the state, all requiring water to work and thrive.

The goal of the state's water planning process is to ensure adequate water supplies for all Texans in times of drought. Texas has a long history of drought, and there is no indication of that pattern changing; in fact, recent droughts remind us that more severe drought conditions are likely to continue to occur at some point in the future. Although the drought of the 1950s is considered the *statewide* "drought of record" for Texas—and remains the statewide benchmark for the water planning process—there are much more recent *regional droughts of record*, the new 2007–2016 Colorado Basin drought of record being a recently documented example. As they continue to occur, each of those new regional droughts of record must be incorporated directly into the regional and state water plans to reflect the new regional planning benchmark.

Because the state water plan is based on providing water supplies under benchmark drought conditions when water demands are usually highest and supplies are lowest, its implementation will also generally support most of the same water demands under average or wetter hydrologic conditions. Significant portions of identified water needs in this state water plan, particularly certain irrigation needs, are not, however, entirely attributable to an onset of drought conditions. Even under average hydrologic conditions, irrigated agriculture requires significant water supplies to support it, and sizable portions of those irrigation demands will likely be unmet even under average hydrologic periods, due largely to the managed and unmanaged depletion of aquifers.

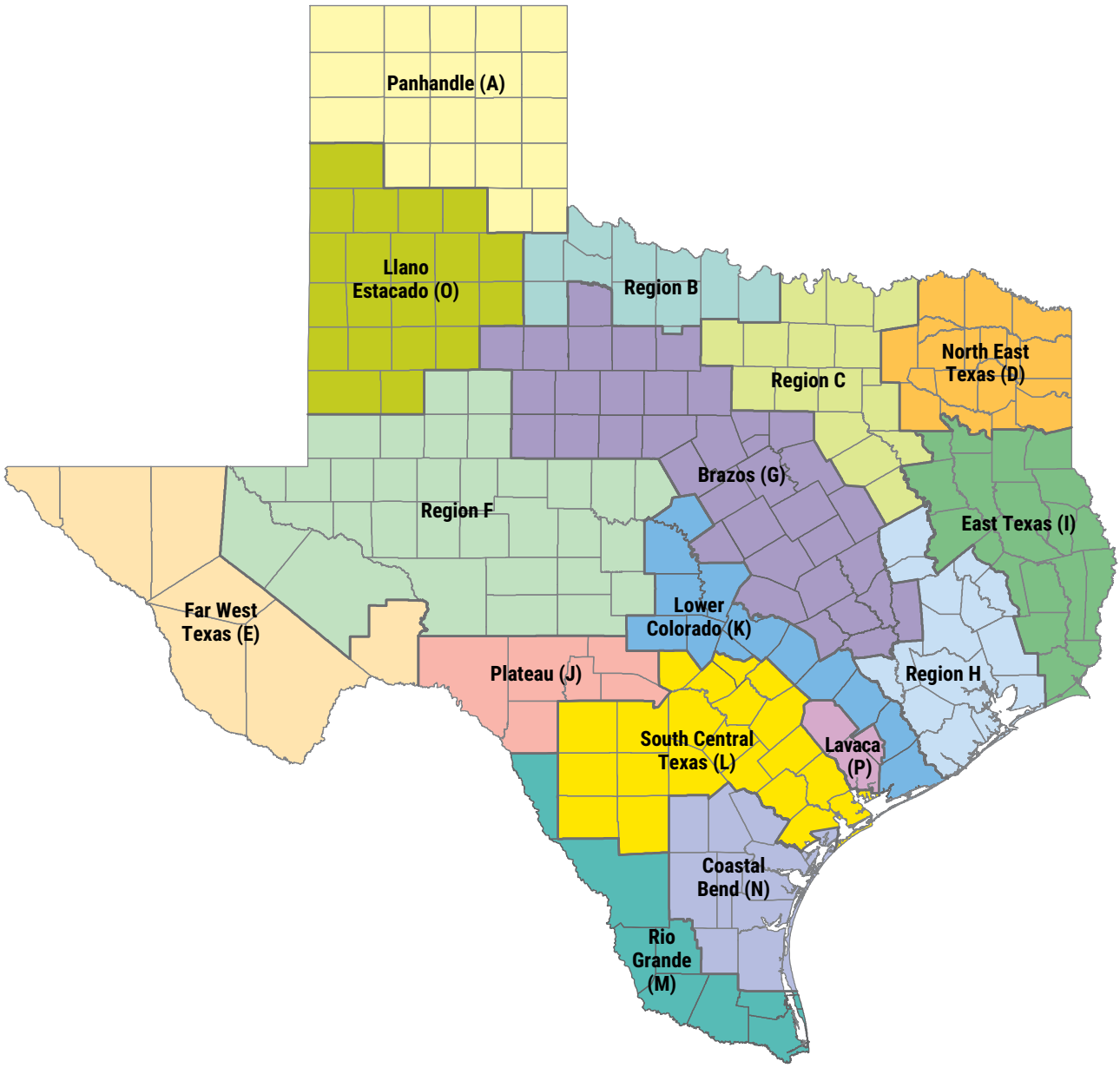
Ensuring adequate and affordable water supplies for all Texans to withstand future droughts requires both advance planning and implementation prior to the onset of drought. The Texas Water Development Board (TWDB) is the state's lead water planning and infrastructure financing agency and is statutorily responsible for administering the regional water planning process and preparing and adopting the state water plan every five years. Each new state water plan, which considers a 50-year horizon, must reflect and respond to changes in population, water supplies, technological improvements, economic shifts, project viability, and state policy. The Texas Legislature has long recognized that water is critical to the future of Texas and, in 1997, created a strong state and regional framework for responsibly planning to address both the short- and long-term water needs of the state. However, providing sufficient water supplies at reasonable costs continues to present new challenges with each planning cycle. Among those challenges are the continued increase in the estimated cost of developing water supply projects that often require many years to implement and adequately preparing in the face of continued uncertainty of future droughts that may be worse than the drought of record.

How do we plan?

Since 1997, water planning in Texas has been based on local involvement focused at the regional level. The state is divided into 16 regional water planning areas (Figure ES-1). Each planning area is represented by a planning group that, on average, consists of approximately 22 members representing at least 12 statutorily required interests: the public, counties, municipalities, industries, agriculture, environment, small businesses, electric-generating utilities, river authorities, water districts, water utilities, and groundwater management areas where applicable.

During each five-year planning cycle, regional water planning groups evaluate population projections, water demand projections, and existing

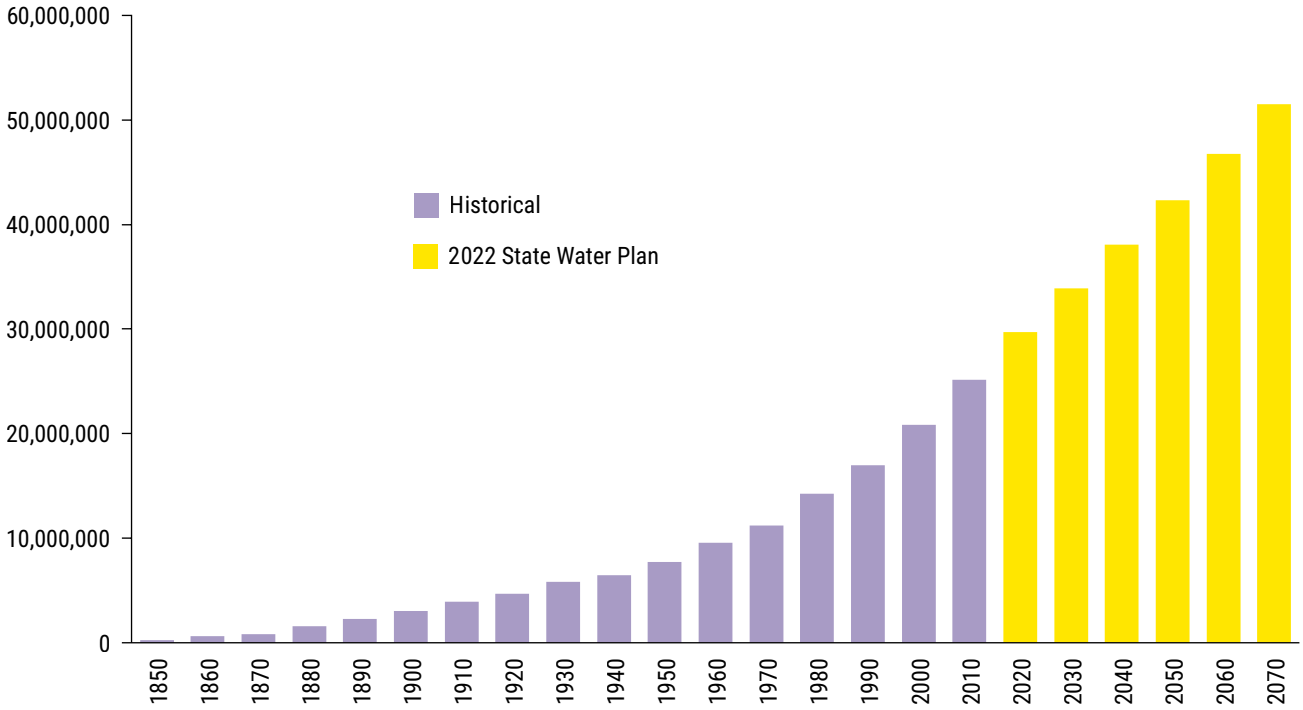
Figure ES-1. Regional water planning areas



water supplies. Each planning group then identifies potential water shortages under drought of record conditions (water needs) and recommends water management strategies (with cost estimates) to address those potential shortages. This bottom-up approach allows the planning groups to assess specific risks and uncertainties in their own regions and evaluate potential impacts of water management strategies on their region as well as on the state's water, agricultural, and natural resources. Importantly, Texas' planning framework directly involves the entities—regional water providers, cities, or water utilities—that will actually be responsible for developing and delivering those future water supplies.

Once the planning groups adopt their regional water plans, the plans are sent to the TWDB for review and approval. The TWDB then prepares the state water plan based on the regional water plans. The state water plan also serves as a guide for state water policy and includes the TWDB's policy recommendations to the Texas Legislature. Each step of the water planning process is open

Figure ES-2. Historical and projected population growth in Texas (1850–2070)



to the public and provides numerous opportunities for public input.

How many Texans will there be?

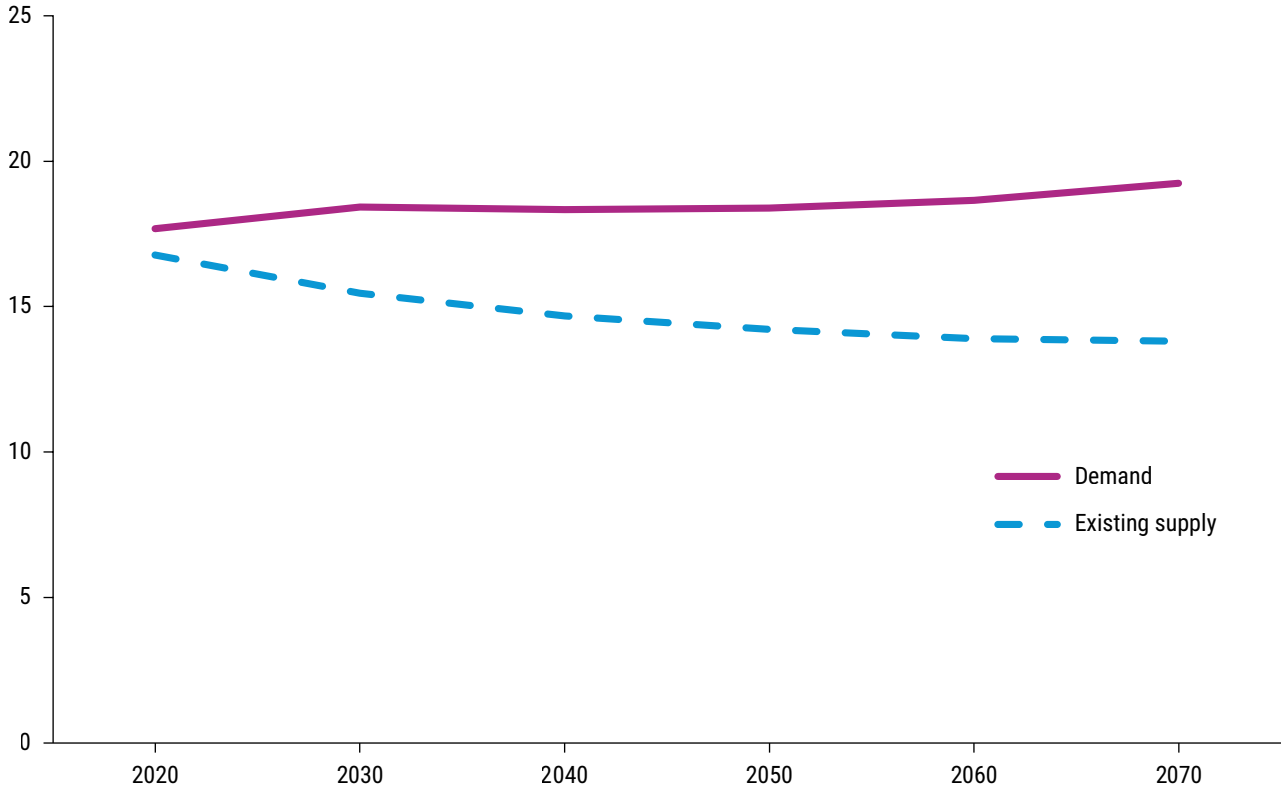
The population in Texas is projected to increase 73 percent between 2020 and 2070, from 29.7[1] million to 51.5 million people (Figure ES-2). Growth rates vary considerably throughout the state. For example, 31 counties are projected to at least double their population by 2070; the rest are projected to remain the same, decline, or experience modest growth. Approximately half of the statewide population growth between 2020 and 2070 is projected to occur within Regions C (which includes the Dallas-Fort Worth metropolitan area) and H (which includes the Houston metropolitan area).

How much water will we require?

While population is projected to increase 73 percent over the next 50 years, total water demand for all sectors in Texas is projected to increase by only 9 percent, from about 17.7 million acre-feet per year in 2020 to about 19.2 million in 2070 (Figure ES-3). Municipal demand is projected to increase in greater proportion and total volume over the next 50 years than any other water use category, from 5.2 million acre-feet per year in 2020 to 8.5 million in 2070. This projected demand includes passive conservation from plumbing codes that are similar in magnitude to the volume of recommended municipal conservation strategies in this plan as detailed in Chapter 8. Agricultural irrigation demand is projected to decrease, from 9.4 million acre-feet per year in 2020 to about 7.6 million in 2070, due to more efficient irrigation systems, reduced groundwater availability, and the transfer of surface water rights from agricultural to municipal users. Manufacturing and livestock demands are projected to increase, while mining demand is projected to decline. Water demand for steam-electric power generation is projected to remain constant over the next 50 years primarily due to a combination of anticipated factors, including a projected increase in wind and solar power generation and increased water efficiencies at existing facilities.

[1] Planning numbers presented throughout this plan have been rounded.

Figure ES-3. Projected total annual water demand and existing water supply for all sectors in Texas (millions of acre-feet)



How much water do we have now?

Existing water supply—categorized as surface water, groundwater, and reuse water—is projected to decrease approximately 18 percent, from 16.8 million acre-feet per year in 2020 to about 13.8 million in 2070. For planning purposes, existing supply represents water supplies that are physically and legally available to be produced and delivered with current permits, current contracts, and existing infrastructure immediately in the event of an onset of drought of record conditions.

Existing surface water supplies are projected to decrease by about 2 percent, from 7.2 million acre-feet per year in 2020 to 7.1 million in 2070 due to sedimentation and changes in water contracts.

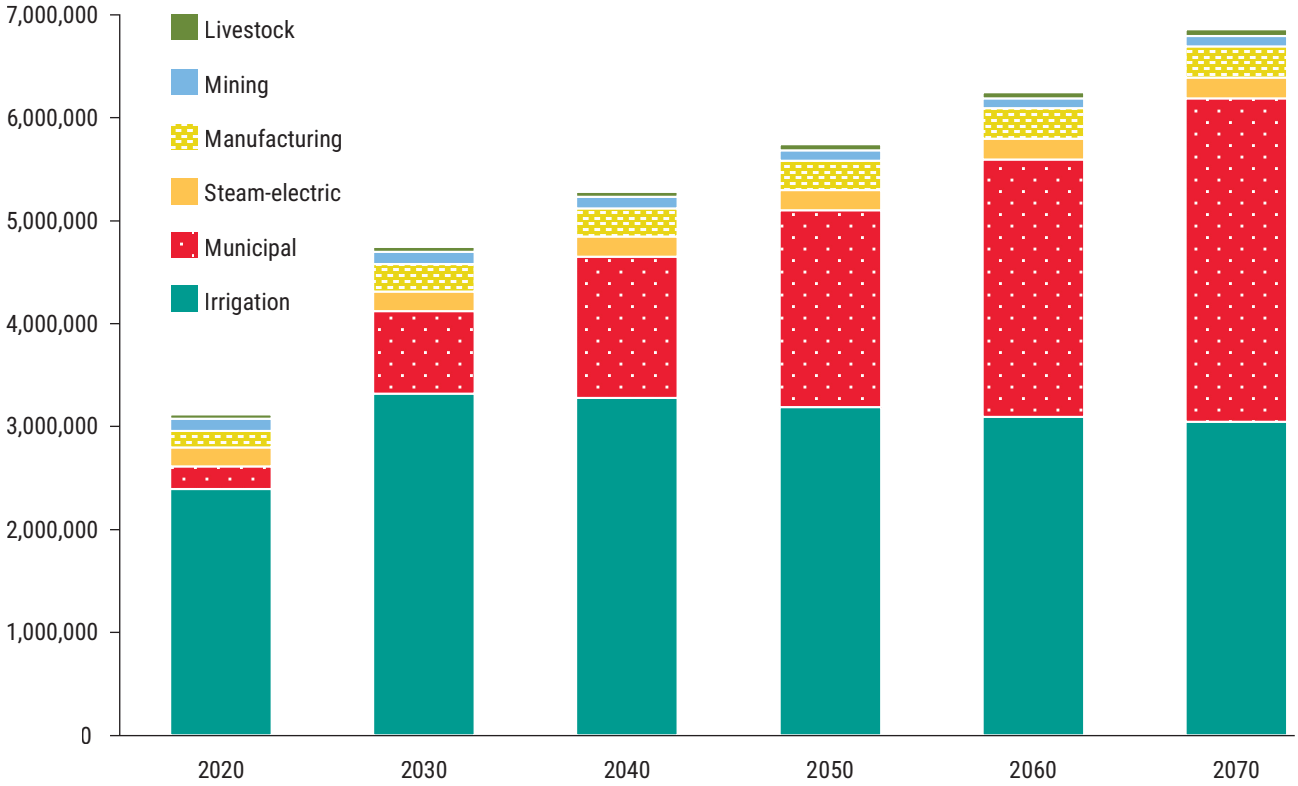
Groundwater supplies are projected to decrease 32 percent, from 8.9 million acre-feet per year in 2020 to 6 million in 2070. This decrease is primarily due to reduced groundwater availability from the Ogallala Aquifer (as a result of its managed depletion over time) and the Gulf Coast Aquifer (due to mandatory reductions in pumping to prevent land surface subsidence). Additionally, groundwater conservation districts made policy decisions through the groundwater management area joint planning process that also resulted in changes to groundwater availability.

Total annual reuse supply makes up nearly 4 percent of total supplies in 2020, with approximately half of this supply occurring in Region C. Reuse supplies are estimated to increase statewide about 15 percent from 2020 to 2070.

Do we have enough water for the future?

Because the existing water supply is not enough to meet the future demand for water during times of drought, Texas would need 6.9 million acre-feet of *additional* water supplies, including in the form of water savings through conservation, to meet the demand for water in 2070. If a recurrence of

*Figure ES-4. Annual water needs by water use category (acre-feet)**



** Water use categories are presented in the order listed in the legend.*

the drought of record had occurred in 2020, the state would have faced an immediate need for 3.1 million acre-feet per year in additional water supplies (Figure ES-4). Of that, 7 percent (215,000 acre-feet) would have been required for municipal water users, who face the largest water demand increase over the next 50 years. Total water needs (potential shortages) are projected to increase by 120 percent between 2020 and 2070, from 3.1 million to 6.9 million acre-feet per year. In 2070, 3.1 million acre-feet per year, or 46 percent of the total projected needs, is associated with municipal users.

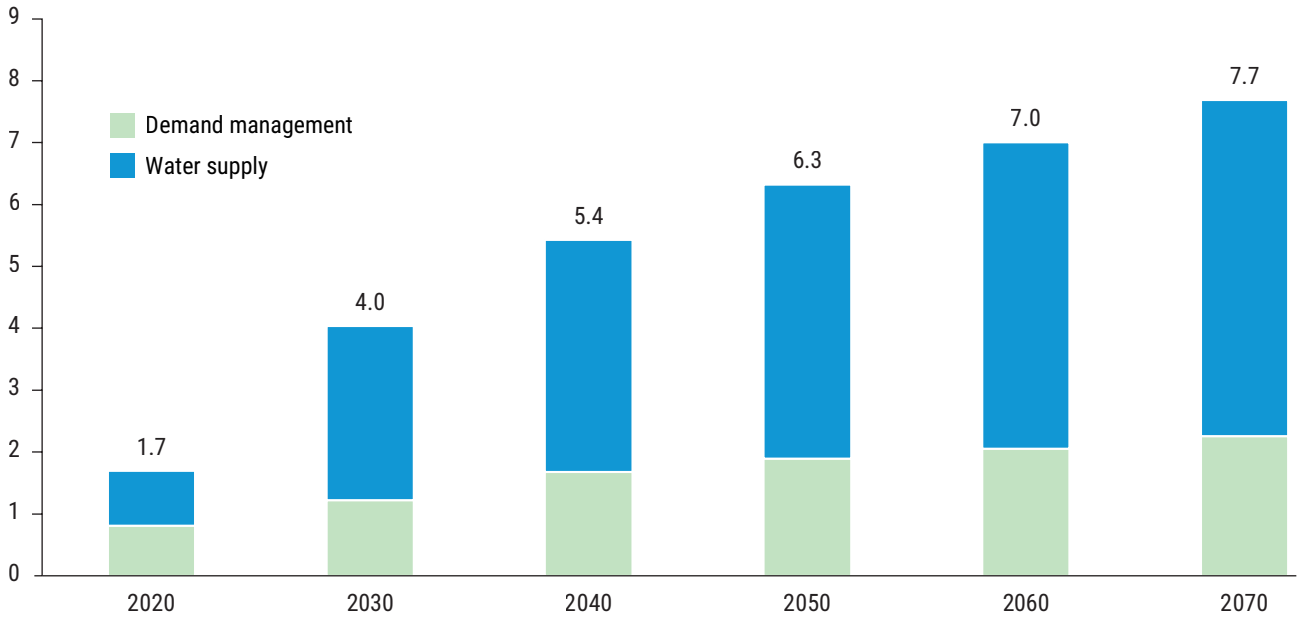
What can we do to get more water?

When projected demand for water exceeds existing supply, planning groups recommend water management strategies—specific plans and associated projects—to address the gap either by providing additional water supply or by reducing water demand. Water management strategies include reduction in water use through conservation or additional water supply from new reservoirs, groundwater wells, water reuse, seawater and groundwater desalination plants, and more.

In the 2022 State Water Plan, planning groups recommended approximately 5,800 water management strategies and more than 2,400 specific water management strategy projects to increase water supply. Strategies may or may not require new water infrastructure—referred to as water management strategy projects—to be developed. If implemented, these strategies would provide 7.7 million acre-feet per year in additional water supplies to water user groups by 2070 (Figure ES-5).

The full capacity of all recommended projects and strategies that are included in the approved regional water plans, including any associated capacities or volumes of water that may not be

Figure ES-5. Annual volume of recommended water management strategies (millions of acre-feet)



immediately assigned to a specific water user group, is also considered to be part of the state water plan.

By 2070, about 31 percent of the total volume of these strategies would be in the form of demand management. Demand management refers to measures that reduce the need for additional water, such as long-term conservation and short-term drought management measures. Drought management includes activities that temporarily restrict water use for certain types of activities and businesses.

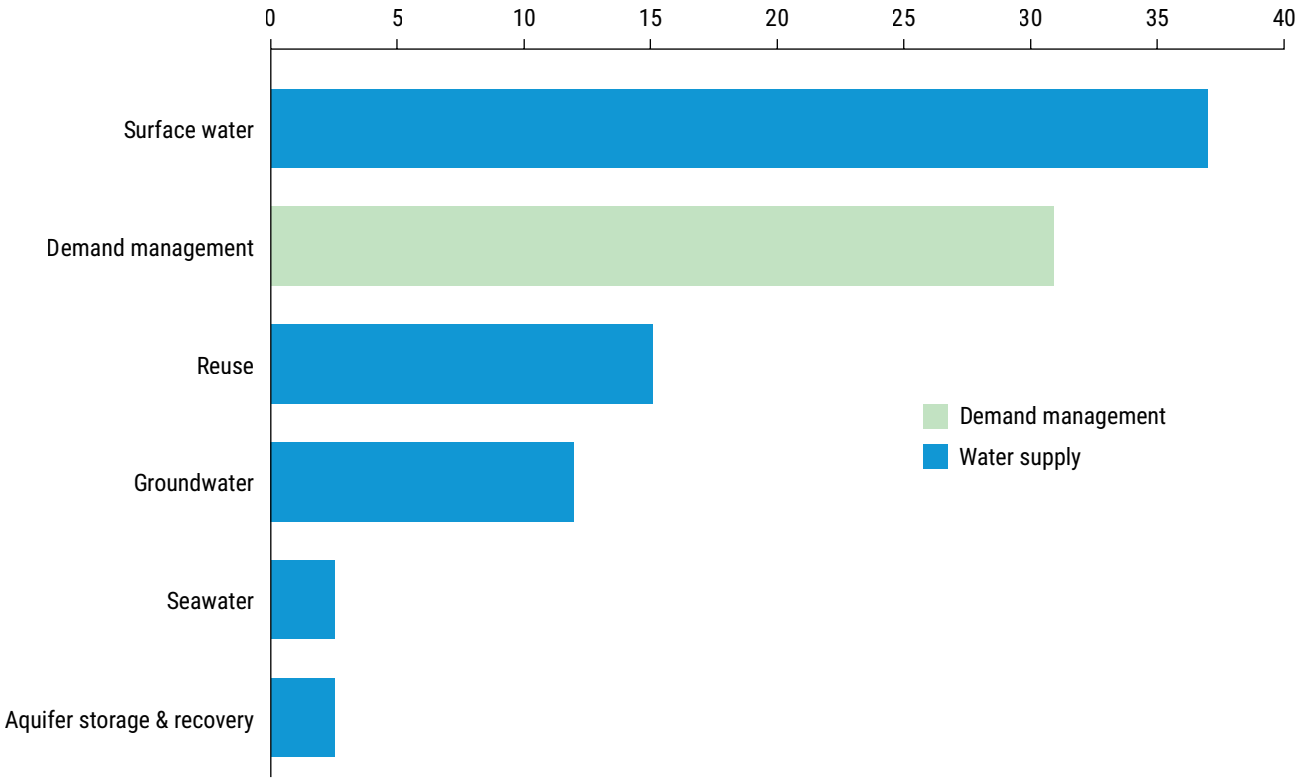
Surface water resources, including new reservoirs, compose the greatest portion of the recommended water management strategy supplies in 2070 at approximately 37 percent. Reuse is expected to provide approximately 15 percent, groundwater resources approximately 12 percent, aquifer storage and recovery resources approximately 3 percent, and seawater desalination about 3 percent of additional supplies to water user groups (Figure ES-6).

Planning groups recommended a wide variety of water management strategies, each of which relies on a specific combination of water source(s), infrastructure, and technology (Figure ES-7). The types and mixture of strategies recommended by each regional planning group were shaped by the regional geography, availability of water resources, and water needs.

Some planning groups recommended strategies that, if implemented, would provide more water than may be required to meet their region's water needs under drought of record conditions. This additional supply addresses risks and uncertainties that are inherent to the planning process and the operation and management of water systems, including

- higher population growth and/or water demands than projected;
- the occurrence of a drought worse than the drought of record;
- unanticipated reduction in existing water supplies;
- water system operation, treatment losses, and operational safety factors; and
- potential difficulties in financing and implementing water supply projects.

Figure ES-6. Share of recommended water management strategies by water resource in 2070 (percent)



Are all the water supply needs met?

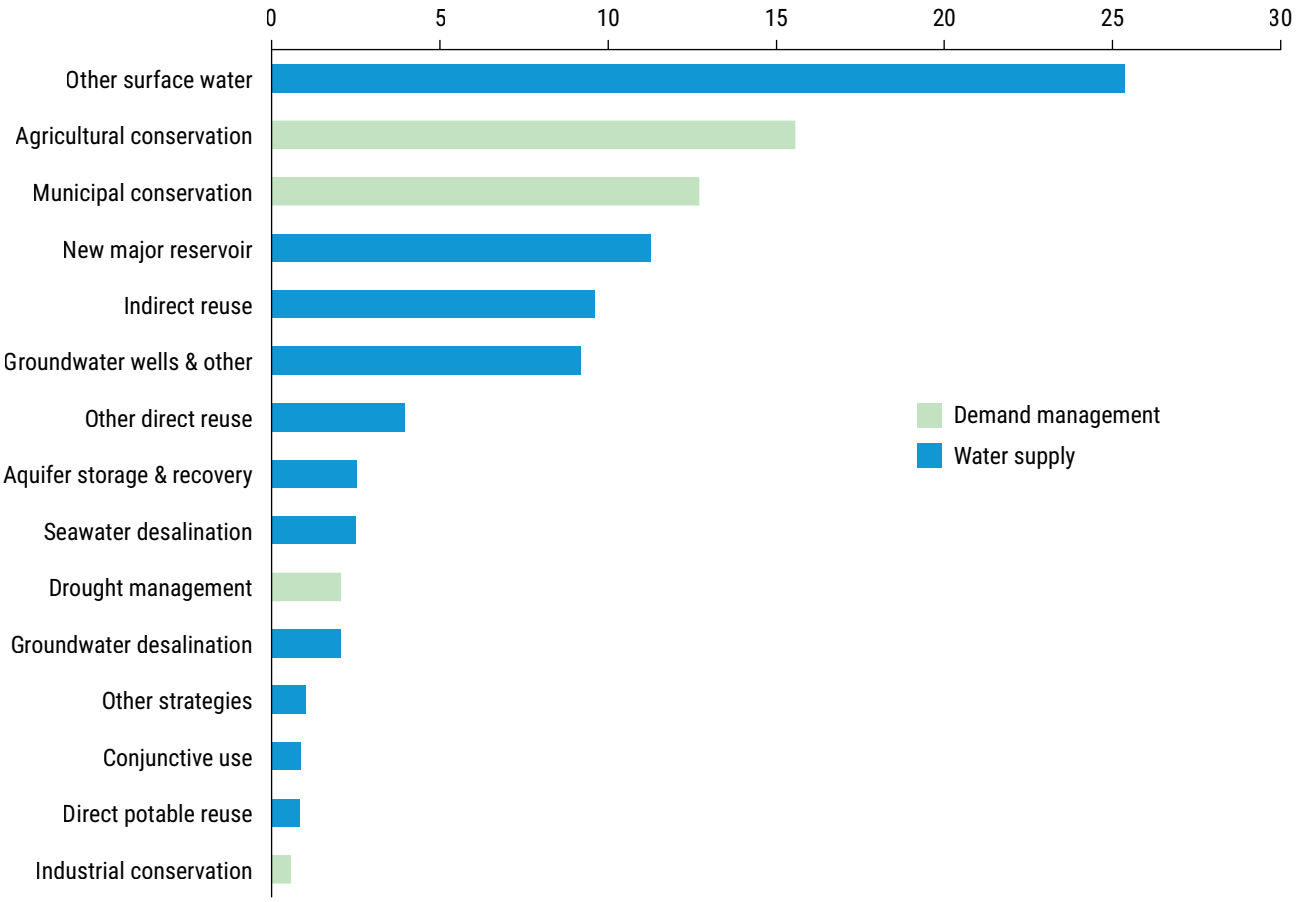
Two planning groups (Regions N and P) were able to recommend water management strategies that, if implemented, can fully meet the needs for all their water user groups. The remaining 14 planning groups were unable to identify sufficient feasible strategies that could meet both Texas' planning requirements and all the projected needs in their regions (Figure ES-8).

Statewide, the vast majority of projected water needs associated with municipal, manufacturing, livestock, and mining water user groups are met by the plan through 2070 (Figure ES-9). However, approximately 2.2 million acre-feet of water supply needs remain unmet by this plan in 2020, increasing to approximately 2.5 million acre-feet in 2070 (Table ES-1). Irrigation represents the vast majority (ranging from 86 percent to 94 percent) of these unmet needs in all decades. At least some volume of unmet water supply needs occur for all categories of water user groups in the plan. Often these unmet needs comprise a relatively small share of an entity's total water demands, meaning that they could be addressed through a drought contingency plan. The inability to meet a water user group's need in the plan is usually due to the lack of an economically feasible water management strategy, but this does not prevent an entity from pursuing additional water supplies.

How much will it cost?

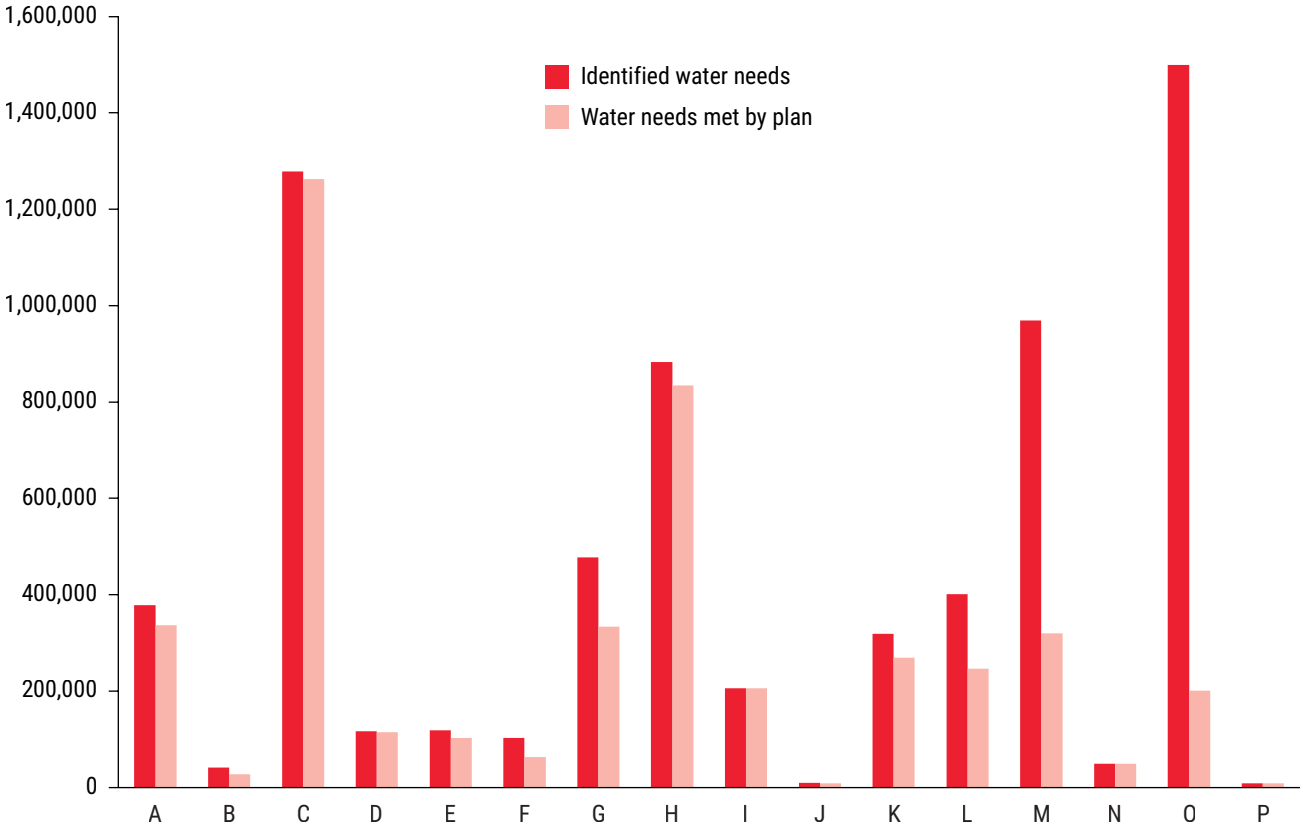
The estimated total capital cost of the 2022 State Water Plan, which represents the capital costs of all recommended water management strategies and projects in the 2021 regional water plans, is $80 billion in 2018 dollars, without accounting for future inflation. These costs include the funds needed to permit and design projects, acquire water rights and land, and construct projects necessary to implement the recommended strategies. The vast majority of the cost, approximately $77.1 billion, is associated with projects sponsored by municipal water user groups and wholesale water providers that provide water to municipal water users.

Figure ES-7. Share of recommended water management strategies by strategy type in 2070 (percent)



Center pivot irrigation system

Figure ES-8. Annual water supply needs and needs met by the plan by region in 2070 (acre-feet)



What if we do nothing?

Texas would suffer significant economic losses should the recommended water management strategies not be implemented and another drought of record, or worse, occur. Economic modeling indicates that Texas businesses and workers could have lost approximately $110 billion in income annually in 2020 and could lose $153 billion annually in 2070. Job losses could have totaled approximately 615,000 in 2020 and could total 1.4 million in 2070. This estimate is likely conservative and does not include additional drought impacts such as those to dry land farming and other activities not associated directly with water needs identified by the plan, nor does it attempt to quantify the potential for greater impacts that would result from a drought that is worse than the drought of record.

If we do nothing, approximately four out of five Texans would face at least a 10 percent water shortage in their cities and residences in 2070, and approximately a quarter of all Texas' municipal water users would have less than half of the water supplies that they require to live and work by 2070 (Figure ES-10).

How are strategies in the state water plan funded?

Strategy sponsors, such as cities or wholesale water providers, must take action, including obtaining financing, to develop water projects and conservation measures, many of which may require financial assistance. Water providers surveyed during the planning process reported an anticipated need of $47 billion in state financial assistance to implement strategies in their regions. Of this amount, approximately $46.6 billion is for strategies associated with municipal water suppliers or wholesale water providers. Cities, communities, and individuals can ask their water providers to apply for state financing for water projects.

Figure ES-9. Annual water supply needs and needs met by the plan by water use category in 2070 (acre-feet)

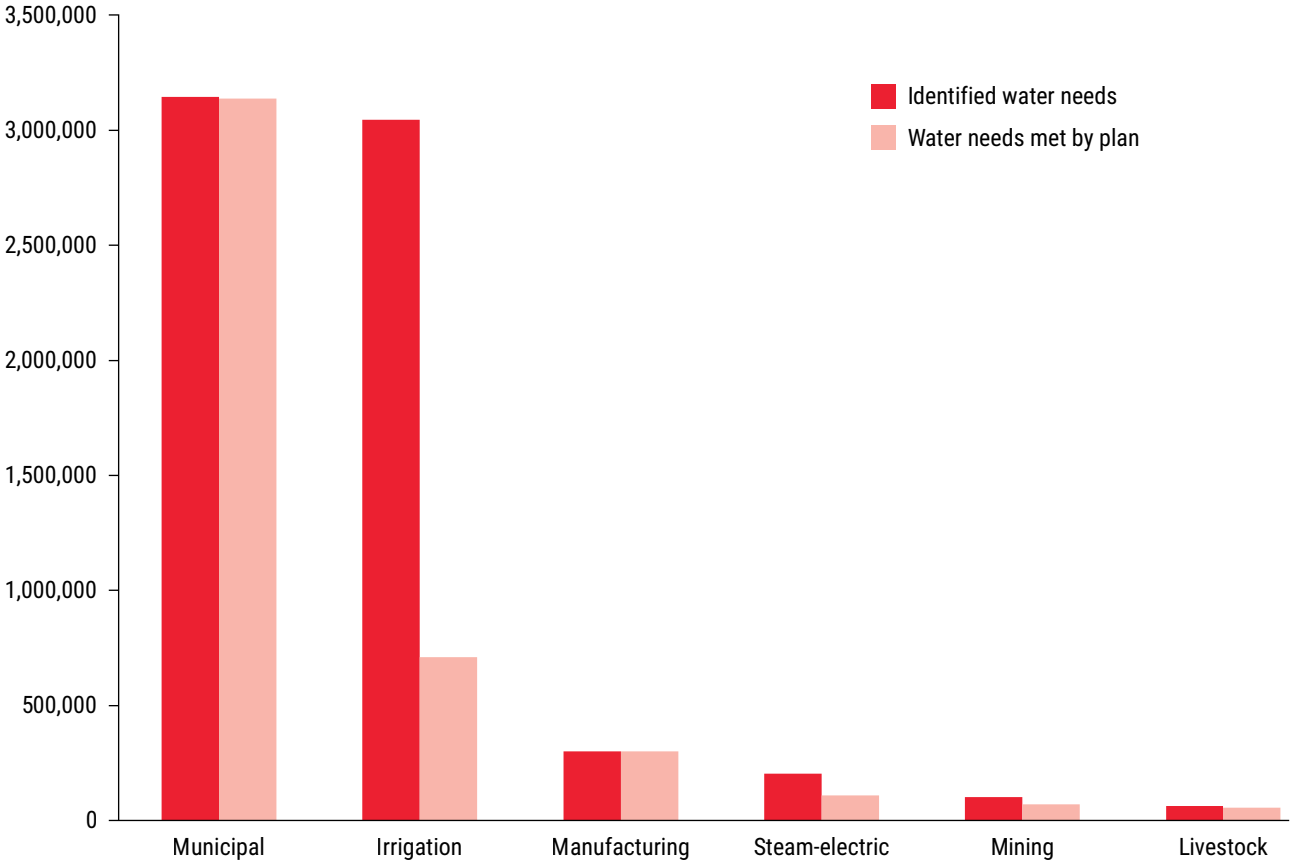


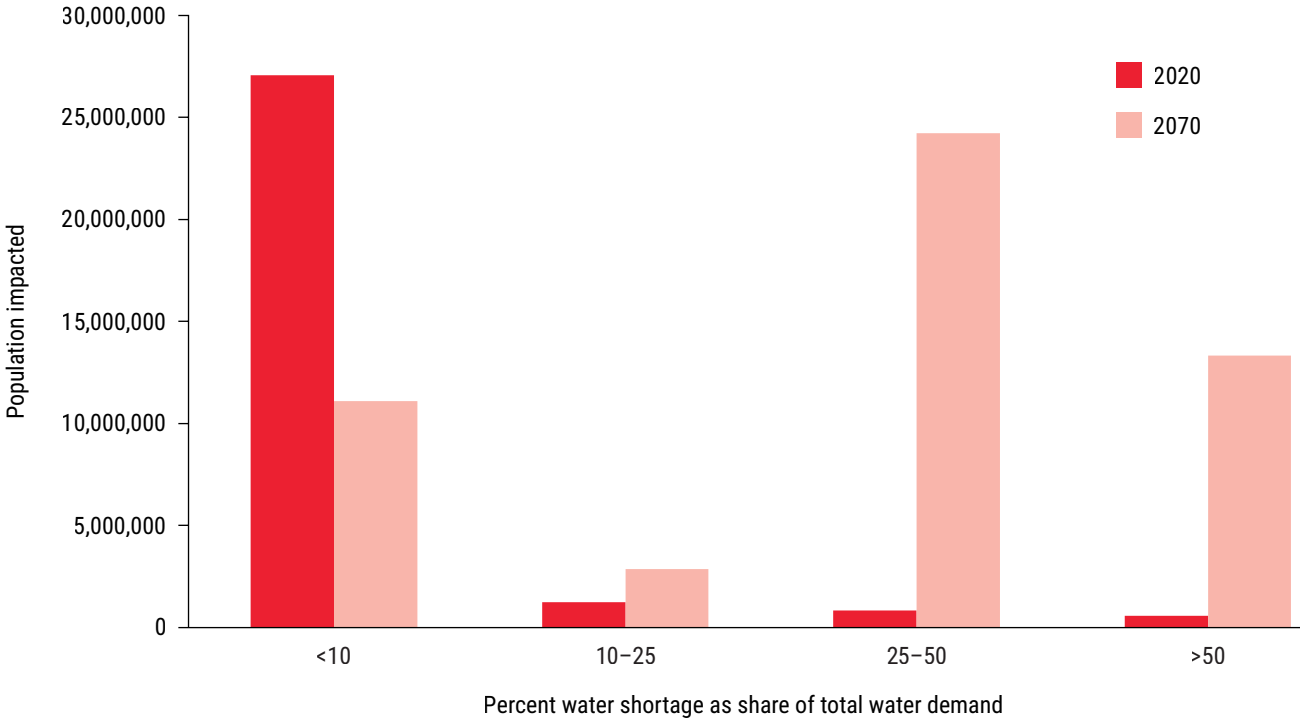
Table ES-1. Statewide annual water supply needs that are unmet by the plan (acre-feet)

Water use category	2020	2030	2040	2050	2060	2070
Irrigation	1,917,000	2,724,000	2,512,000	2,421,000	2,377,000	2,336,000
Steam-electric	122,000	94,000	94,000	94,000	95,000	95,000
Manufacturing	110,000	1,000	1,000	1,000	1,000	1,000
Mining	52,000	46,000	41,000	35,000	29,000	32,000
Municipal	18,000	1,000	2,000	3,000	4,000	6,000
Livestock	9,000	2,000	3,000	4,000	5,000	7,000
Total	**2,228,000**	**2,868,000**	**2,653,000**	**2,558,000**	**2,511,000**	**2,477,000**

In 2013, the Texas Legislature created the State Water Implementation Fund for Texas (SWIFT) and State Water Implementation Revenue Fund for Texas (SWIRFT) to provide affordable, ongoing state financial assistance for projects in the state water plan. Passed by the legislature and approved by Texas voters through a constitutional amendment, the SWIFT[2] program assists communities in developing and optimizing water supply projects at cost-effective rates. The

[2] The SWIFT *program* includes two funds, the State Water Implementation Fund for Texas (SWIFT) and the State Water Implementation Revenue Fund for Texas (SWIRFT). Revenue bonds for the program are issued through SWIRFT.

Figure ES-10. Projected statewide population impacted by municipal water needs in 2020 and 2070



program provides low-interest loans, extended repayment terms, deferral of loan repayments, and incremental repurchase terms for projects with state ownership aspects. To be eligible for the SWIFT program, a project and its associated capital costs must be included in the state water plan. In addition to SWIFT, the TWDB has several state and federally funded financial assistance programs that may be utilized to fund projects in the state water plan.

What has the TWDB done to implement water management strategies in the 2017 State Water Plan?

Since adopting the 2017 State Water Plan, the TWDB has closed[3] on more than $6.5 billion, including in SWIFT financing, for implementation of 61 projects recommended in the 2017 State Water Plan. Many of these water management strategy projects continue to be recommended strategies in this new plan and are in various stages of implementation across the state.

What were impediments to implementing the previous plan?

Planning groups listed several impediments to implementation, with access to funding and the permitting process being the most common impediments mentioned. Other impediments included lack of a project sponsor, land acquisition, and water availability constraints. However, the impediments reported do not necessarily indicate that a project will not be implemented; rather, it usually appears to indicate that it may take longer or more effort to implement. During each planning cycle, planning groups update their water management strategies and reflect any changes to when the projects are anticipated to be needed and/or fully operational.

[3] The TWDB first approves a commitment for financial assistance. After all appropriate reviews and requirements are met, funds are released at closing.

What has the TWDB done already to implement water management strategies in this new plan?

The TWDB has already committed almost $8.2 billion in SWIFT financing toward projects that are recommended in this 2022 State Water Plan. The projects include groundwater wells, conservation, brackish groundwater and seawater desalination, and reservoir projects.

What more can we do?

Planning groups made a variety of regulatory, administrative, and legislative recommendations that they believe are needed to better manage Texas' water resources and to prepare for and respond to droughts. Having considered their recommendations and other potential policy considerations, the TWDB recommends the following:

Legislative recommendation 1: Unique stream segment designation

The legislature should designate the five river or stream segments of unique ecological value recommended by the 2021 regional water plans (Alamito Creek, Black Cypress Bayou, Black Cypress Creek, Pecan Bayou, and Terlingua Creek) for protection under Texas Water Code § 16.051(f).

Legislative recommendation 2: Unique reservoir site designation

The legislature should designate for protection under Texas Water Code § 16.051(g) three sites of unique value for constructing reservoirs as recommended in the 2021 regional water plans: Coryell County Off-Channel Reservoir, Millers Creek Off-Channel Reservoir, and Parkhouse II (North).

Reverse osmosis membranes at a brackish groundwater desalination plant