# 10 Challenges and Uncertainty

**The five-year cycle of adopting regional and state water plans allows the state to respond to challenges and uncertainties in water supply planning. To reduce risks associated with planning for and providing sufficient water supplies, every five years TWDB and regional water planning groups evaluate changes in population, demand, and supply projections, new climate information, improvements in technologies, and policy and statutory changes.**

Regional water planning groups must develop plans to meet needs for water during a drought within the context of an uncertain future, both near and far. Water planning would be simpler if it were known when the next drought is going to happen and how severe it will be. But in reality, water planning has to be conducted in the context of uncertainty. The cyclical design of water planning in Texas, with regional water plans and the state water plan developed every five years, helps planning groups and the state monitor and respond to uncertainties. This chapter discusses some of the sources of uncertainty relevant to state and regional water planning, the challenges presented by uncertainty, and some strategies that planning groups use to deal with these challenges.

## 10.1 RISK AND UNCERTAINTY

The two related concepts of risk and uncertainty are fundamental to water planning. A risk is any negative outcome that might occur. In Texas, there is a risk that some demands for water may exceed availability under some conditions. The purpose of state and regional water planning is to minimize the negative effects of drought by planning to meet the needs for water during a repeat of the drought of record that occurred during the 1950s. Uncertainty is the unavoidable fact of not knowing what the future will bring, such as when the next drought may occur. The number of people that will live in Texas in the next 50 years, the amount of water that they will require, and the amount of water supplies that will be available are all future uncertainties. Good planning means being prepared for risks in spite of uncertainty.

The National Research Council (a nonprofit institution that provides science, technology, and health policy advice to improve government decision making) recommends responding to risk with a cycle of analysis and deliberation, where analysis is the gathering and assessment of technical facts and deliberation is the dialogue that leads to a plan of action (NRC, 1996). The council advocates that stakeholder participation in the deliberation stage is critical because stakeholders have unique knowledge and perspectives, because they have a right to contribute to plans that will involve them, and because plan execution depends on everyone working together. A coordinated plan is more important than perfect foresight, so the most important planning strategy for reducing risk is stakeholder participation. The regional water planning process is fundamentally based on stakeholder participation by the inclusion of 11 stakeholder interests groups as required by Texas statute.

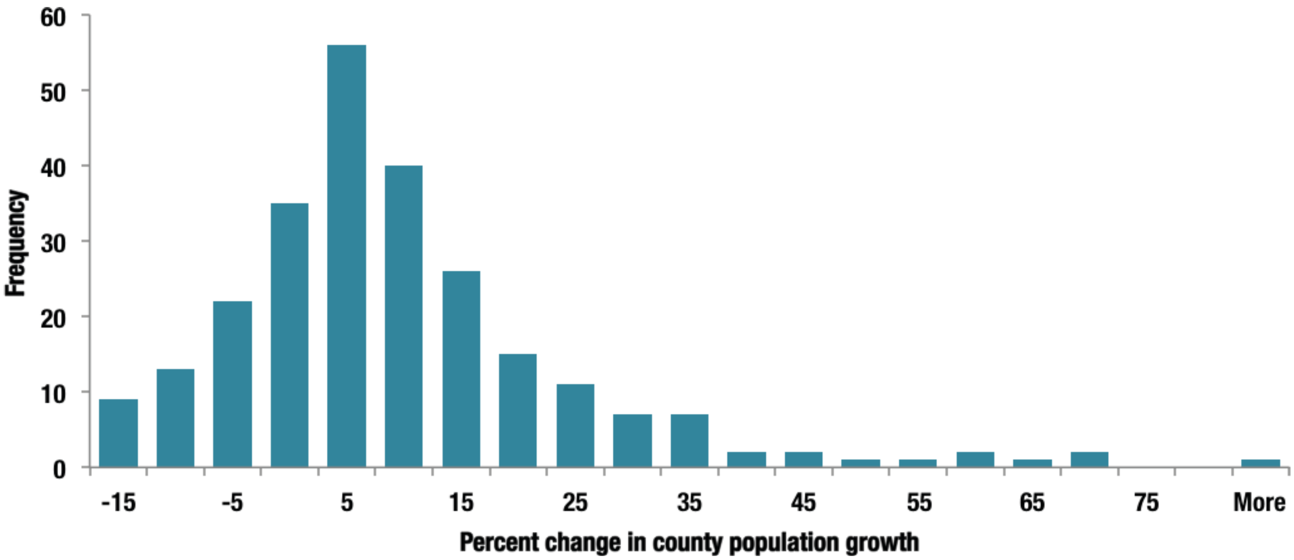
The risk analysis stage is necessary because it is much more effective to plan for risks that are clearly understood. Measurements, readings, reports, and surveys are all used to get a clearer picture of present conditions so that more certain future projections can be made. TWDB considers state and national data sources, as well as local information from each region, in making these projections. Nevertheless, unforeseeable events occasionally happen, with distant future conditions more difficult to predict than immediate future conditions. The solution to future uncertainty is updating, which is why the state and regional water plans are developed every five years. The dynamic updating built into the water planning process by Texas statute is the regional and state water plan's strongest defense against uncertainty.

Even with the latest information and the best predictive models, some uncertainty will always remain, complicating the task of planning a focused, coordinated risk response. Rather than preparing for every possible outcome, it is more efficient to focus on a benchmark risk. In Texas water planning, the benchmark is the drought of record of the 1950s. The drought of record is better understood than other projected drought risks because it actually happened. If we prepare for the drought of record, then the state will be better positioned to respond to future droughts. Using the drought of record as a benchmark also coincides with the concept of firm yield—the maximum water volume a reservoir can provide each year under a repeat of the drought of record—which engineers use to calculate reservoir yield.

While all planning groups are required to plan based on firm yield, some regions are even more cautious when addressing climate variability and other uncertainties. Several planning regions planned for a drought worse than the drought of record by making changes to the assumptions in the availability of surface water during development of their regional water plans. Regions D and G modified the water availability models that they use in their planning process to include hydrology from later, more severe droughts that occurred within their particular regions. Regions A, B, C, F, and G assumed safe yield (the annual amount of water that can be withdrawn from a reservoir for a period of time longer than the drought of record) for some reservoirs in their regions, also to address the possibility of a drought that is more severe than the drought of record. Since the planning process is repeated every five years, planning groups have the opportunity to update their planning assumptions each cycle as needed to address risk and uncertainty.

Beyond participation, updating, and benchmarking, the best response to uncertainty is simply to be aware

## FIGURE 10.1. VARIABILITY IN COUNTY POPULATION GROWTH, 2000-2010.




of it. Population growth, water demands, and the weather are all naturally variable and can lead to uncertainty.

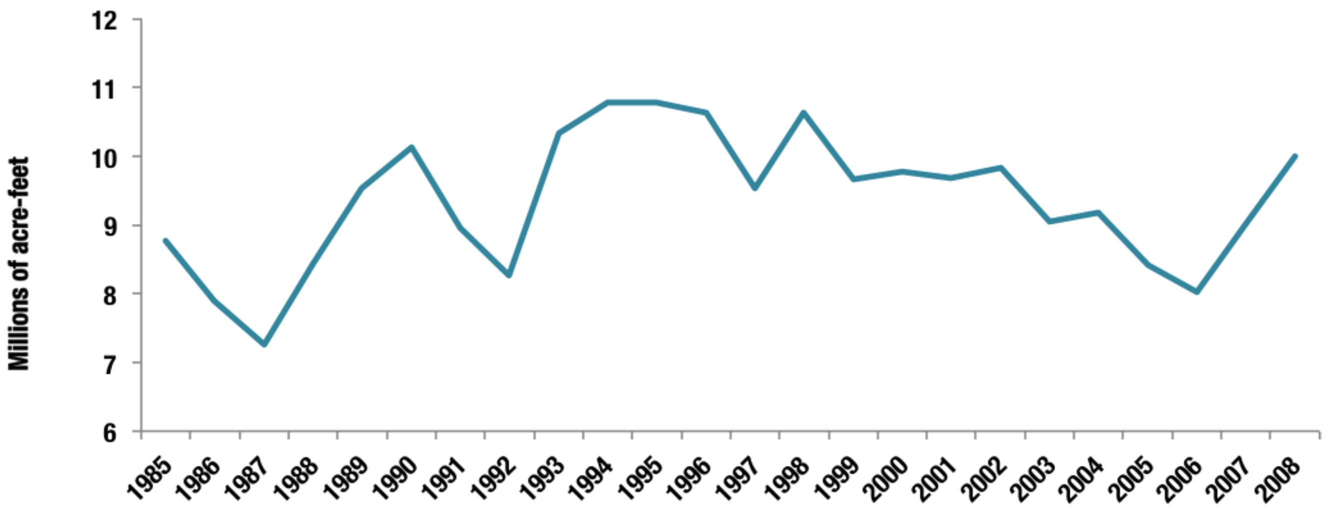
## 10.2 UNCERTAINTY OF DEMAND

Every category of water demand—municipal, manufacturing, irrigation, steam-electric, mining, livestock—is naturally variable. Municipal demand depends on how many residents are using water and how much water they are using. Population growth depends on social and economic factors including individual preferences. Per capita, or per person, water use depends on preferences, habits, and water-using appliances, all of which are influenced by the economy and the weather. 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 these underlying factors that influence water use are difficult to predict and result in uncertainty in water demand projections.

The population of Texas increased over 20 percent between 2000 and 2010; however, this growth was not distributed evenly through the state. The median Texas county grew by only 4.2 percent during the last decade. Some counties have less population now than they did in 2000, while others grew by as much as 82 percent. One way of representing this type of variability is in the form of a histogram, a bar chart representing a frequency distribution. Figure 10.1 is a histogram of the population growth for each county in Texas between 2000 and 2010, showing the number of counties whose growth was in each percentage range. The tallest bar in the middle of the histogram represents all of the counties whose growth was between zero and +5 percent (about 55 counties). Since the bars representing growth are taller and more numerous than the bars representing population decline, it is evident that most counties experienced positive population growth over the past decade.

Because population growth is so variable, projections have to be adjusted every decade when each new U.S. census is released. Between censuses, TWDB

## FIGURE 10.2. IRRIGATION WATER DEMAND, 1985-2008 (ACRE-FEET PER YEAR).



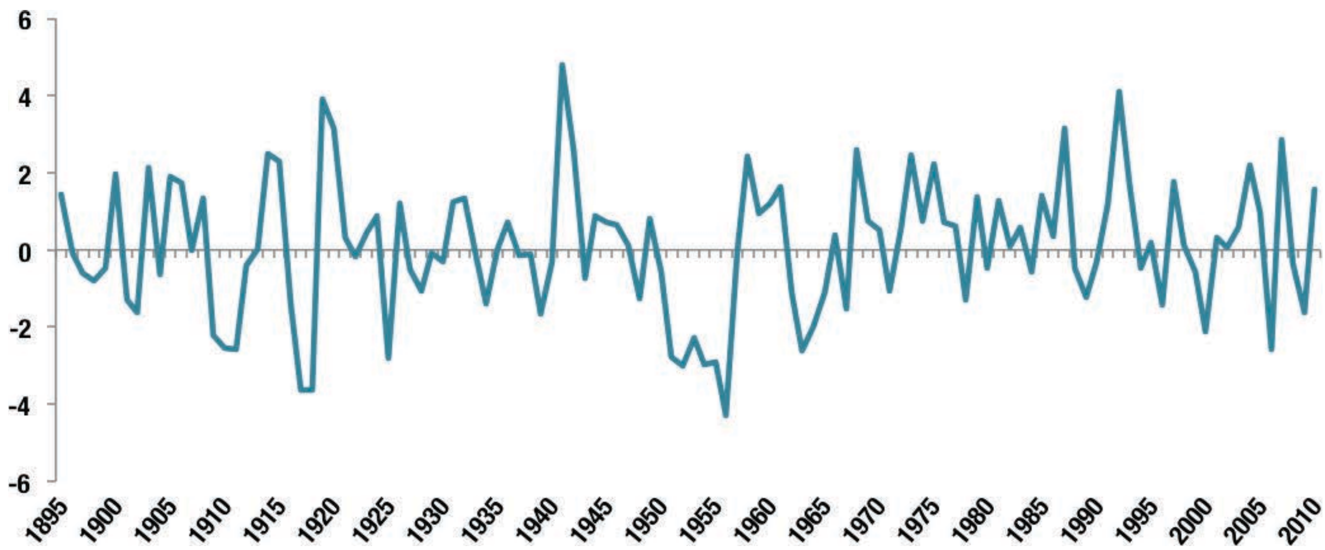

relies on estimates from the Texas State Data Center. For example, population projections for some water user groups in the 2007 State Water Plan were revised upward for the next planning cycle, based on information from the State Data Center that indicated growth in excess of the original projections. The state population projected for 2010 in the 2007 State Water Plan turned out to be about 1 percent lower than the actual 2010 census. The revisions made for the 2012 State Water Plan resulted in projected Texas population about 1 percent above the census (Chapter 3, Population and Water Demand Projections). Since communities often want to plan for the highest potential growth scenario, such projections may prove to be slight overestimates. However, planning for a high-growth scenario is a way to manage risk.

Irrigation demand depends on how many acres of each crop are planted, the water needs of each crop type, and the weather. Neither an upward nor a downward overall trend is evident in irrigation demand over the years 1985 through 2008 (Figure 10.2).

Irrigation for agriculture has historically been the category of greatest water use in Texas. Variability in irrigation demand therefore translates to variability in total state water demand. Irrigation demand depends on farmers' decisions on how much acreage and what crops to plant. These decisions depend on prices of both agricultural commodities and inputs like fuel and fertilizer. Government policies can also be influential. For example, the combination of an ethanol subsidy and an ethanol import tariff has encouraged corn production.

Rather than attempt to guess at future policies and commodity prices, TWDB projects irrigation water use based on current levels. Important future developments then can be reflected through adjustments in the assumptions in future planning cycles. For example, recent crop prices have been relatively high by historical standards. If these prices decrease, projected irrigation water demand may require a downward adjustment, while the lower cost of feed might require projected demand for water for livestock to be adjusted upward. More recently,

**FIGURE 10.3. STATEWIDE AVERAGE PALMER DROUGHT SEVERITY INDEX, 1895-2010.**




studies have explored the potential for expanded production of biofuels using "energy cane" and algae as feedstocks, which could also result in increased water demand.

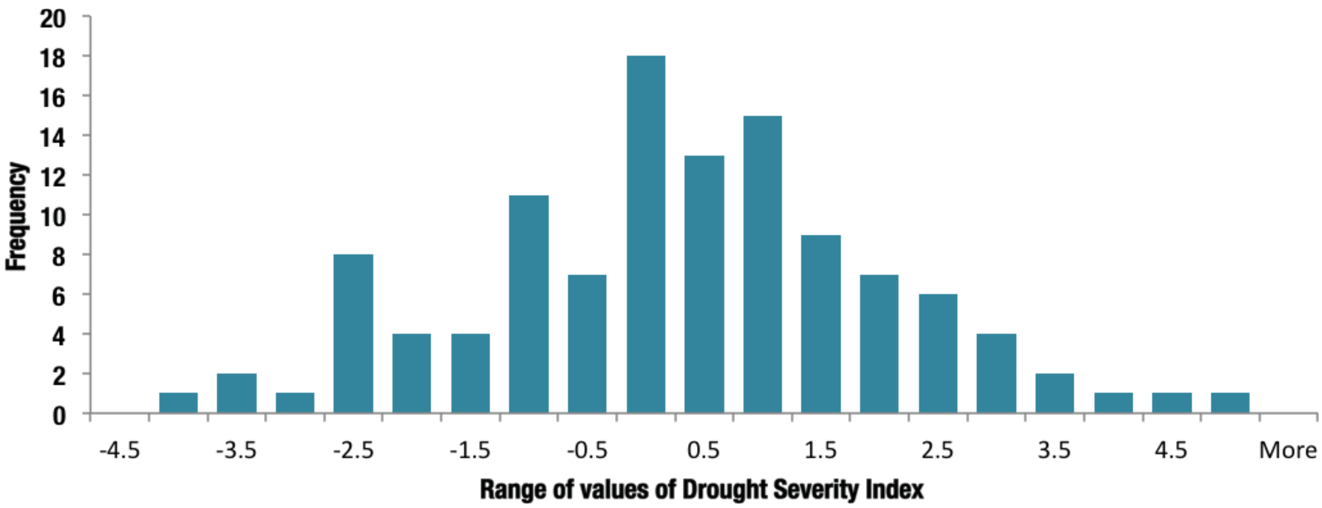
Manufacturing, mining, and power production also depend on price levels of their inputs and outputs, or the resources needed for production and the products or results of that production. Because practically all industrial processes are energy intensive, the prices of energy sources such as gasoline, natural gas, and coal are of particular importance. The hydrocarbon mining industry produces energy and uses it at the same time. Higher energy prices could shift water use away from manufacturing and toward mining and power production. The new technology of hydraulic fracturing is a method of producing hydrocarbon energy that experienced a boom during this planning cycle; thus, new developments in the hydraulic fracturing industry that could result in increased water use in the mining water use category will be monitored closely in the next regional water planning cycle.

## 10.3 UNCERTAINTY OF SUPPLY AND NEED

The regional water plans recommend water management strategies to increase future water supplies to meet needs during a severe drought. The actual water volume that will result from any recommended strategy is always uncertain, but it is also uncertain whether or not each strategy will be implemented, and when implementation will occur. Each water supply strategy requires some amount of funding and often political consensus to accomplish, both of which are ultimately uncertain. Projected yield of a strategy might not be realized. To avoid this possibility, regional planning groups may prioritize their recommended strategies, generally planning to execute cheaper, simpler, or more important strategies first.

Hydrology, the study of water movements in the natural environment, is also a source of uncertainty because it is so complex. Hydrologic drought is a condition of below average water content in aquifers and reservoirs, which results in reduced water supplies. It usually follows agricultural drought—an

## FIGURE 10.4. VARIABILITY IN STATEWIDE PALMER DROUGHT SEVERITY INDEX, 1895-2010.




adverse impact on crop or range production—where soil and surface moisture are reduced, stressing natural ecosystems and crops. Agricultural drought increases irrigation water demands. Both hydrologic and agricultural droughts are consequences of meteorological drought, which is the occurrence of abnormally dry weather, usually less precipitation than is seasonally normal for the region.

Levels of precipitation and evaporation are naturally variable, along with the amount of water that flows to a reservoir or recharges an aquifer. Exchanges between groundwater and surface water are not only variable but incompletely understood. Hydrologic modeling has advanced rapidly in recent years, but no model of a system so complex can completely address all uncertainty.

Hydrological drought can be measured by the Palmer Drought Index, which rates dry conditions on a scale relative to the normal conditions for each location. A Palmer Index of "zero" indicates a normal year; negative numbers indicate drought, whereas positive numbers indicate above-normal moisture. The National Oceanographic and Atmospheric Administration records the Palmer Index annually for each of the ten climatic divisions in Texas. The Palmer Index is constructed so that the mean will be zero as long as the climate maintains its historical pattern. Figure 10.4 shows a histogram of the same series of averaged Palmer Indexes, illustrating its variability.

Figure 10.3 illustrates the 1950s as a cluster of negative values that correspond to the drought of record. Even though Palmer Index values in this period are noticeably low, no single value constitutes an outlier, or a value far apart from the rest of the data set. The lack of an outlier implies that there was nothing hydrologically unusual about any one year of the record drought, meaning that it could happen again. The most unusual feature of the drought of record is that so many dry years occurred consecutively. Annual Palmer Index values as low as they were during the drought of record occur about 10 percent of the time, but they occurred 6 years in a row during the 1950s with water supplies unable to recover from the preceding drought before the next drought started. If each year's weather conditions were totally independent of the previous year's conditions, the chance of the drought of record recurring would literally be one in a million. Unfortunately, we do not understand weather patterns well enough to have confidence in this very low probability.

Agricultural drought can appear suddenly, causing almost instantaneous damage to agriculture and encouraging wildfires. Most recently, Texas experienced severe agricultural droughts in 1996, 1998, 2009, and 2011. Prolonged agricultural drought is often an indicator of impending hydrologic drought. Since 1997, public water suppliers and irrigation districts in Texas have been required to develop drought contingency plans to respond to the early warnings of hydrologic drought. Contingency plans help to manage risk by promoting preparation and coordination before a drought emergency appears.

## 10.4 UNCERTAIN POTENTIAL FUTURE CHALLENGES

Although the processes discussed so far all exhibit natural variability, historical distributions indicate what values they will probably take most of the time. Some risks, called ambiguous risks, are so uncertain that it is not known when they will happen, what their impacts will be, or even whether they will occur at all. Natural disasters, terrorism, and climate change are examples of ambiguous risks. Developments in new technology, as well as future state and federal policy decisions, can also be ambiguous, with unforeseeable implications. Awareness may be the only defense against this kind of uncertainty. This section discusses some of the challenges to water planning that may arise in the future from ambiguous risks.

### 10.4.1 NATURAL DISASTERS

Natural disasters include floods, hurricanes, tornados, and fires. The worst natural disaster in the history of the United States occurred in Galveston in 1900, when a hurricane killed more than 6,000 people. Hurricanes and floods generally increase water availability, so they do not usually pose a serious challenge for drought planning; however, they can degrade water infrastructure and water quality and can result in the redistribution of populations. An example is Hurricane Katrina, which forced many people to evacuate to Texas from Louisiana and Mississippi, adding to population variability. Hurricane Ike caused tremendous devastation to the Bolivar Peninsula, damaging a new water treatment plant's distribution system in addition to much of the residential housing, leaving a considerably smaller population to pay for the investment already incurred. Wildfires generally occur during drought conditions, so they may inflict additional damages on communities already suffering from drought. Fires also cause erosion that may affect streamflow positively or negatively.

Although less frequent than either flood or fire, earthquakes also occur occasionally in Texas. A magnitude 5.7 earthquake hit Marathon in 1995. Earthquakes are a serious risk to dams and infrastructure in some states, but it is unlikely that Texas will experience an earthquake significant enough to damage water infrastructure. A terrorist attack, much like a natural disaster, could damage infrastructure, degrade water quality, or result in only minimal impacts.

### 10.4.2 CLIMATE CHANGE

Chapter 4 (Climate of Texas) presents evidence that mean temperatures across the state have increased over the past three decades. A similar trend has been noticed in many regions around the world. Scientists on the Intergovernmental Panel on Climate Change believe this warming trend is "unequivocal" (IPCC, 2007). At the same time, extreme precipitation events in Texas have become more frequent, meaning that variability is increasing. Climate change and climatic variability both pose challenges to water planning because they add uncertainty. Additional challenges, primarily to agriculture, could arise if the climate of Texas becomes permanently warmer.

If precipitation decreases or evaporation increases as a result of climate change, farmers and ranchers will be forced to pump more groundwater, change their crop mix, or plant less. In one possible scenario, Texas could experience a 20 percent decline in cropped acreage. At the same time, cotton and grain sorghum could replace broilers, cattle, corn, rice, and wheat (McCarl, 2011). In areas of declining water availability, a change towards more cotton is plausible because cotton may be grown with deficit irrigation. On the other hand, research in the Northern High Plains has focused on producing corn with only 12 inches of supplemental irrigation, so the projected changes in production due to climate change may be overstated. Improvements in water use efficiency and adoption of new technologies or crop varieties may allow farmers the ability to grow more crops with less irrigation water applied. While technological advancements may further extend the useful life of the Ogallala Aquifer in the Panhandle and moderate changes to the climate may benefit rain-fed agriculture, future climate change impacts could increase the vulnerability of unsustainable practices in agricultural systems in the High Plains (IPCC, 2007).

Even though surface water would be the most vulnerable to projected climatic changes through increased evaporation and decreased streamflows, some groundwater sources would also be vulnerable. Aquifers with relatively fast recharge, such as those in the Edwards Aquifer in central Texas, are fed directly from the surface. For these types of aquifers, low runoff translates to low water recharge. More intense rainfall or flooding could impact recharge as well, by altering soil permeability or simply by forcing water courses away from recharge zones. Climate change resulting in higher temperatures in the Edwards Aquifer region could be especially damaging for agriculture, since increased irrigation pumping may not be legal or feasible.

TWDB has taken a number of steps to address uncertainty related to climate variability in the regional planning process. The agency monitors climate science for applicability to the planning process, consults with subject experts, and solicits research. TWDB also co-hosted the Far West Texas Climate Change Conference in 2008 (Chapter 4, Climate of Texas).

## 10.5 WATER AND SOCIETY

The greatest uncertainty pertaining to water planning is the future of human society. Economic cycles can affect the use of water inputs in productive processes like agriculture and industry. In the long run, these processes adapt to water availability and the needs of society. For example, most industrial users have dramatically increased their reuse of water in recent years. These users respond to the price and reliability of water as a signal of increased water scarcity, motivating them to develop new technology, which can improve the efficiency of water use, locate new supplies, and provide new supplies more efficiently. Desalination and reuse are two examples.

Society's values change as well. Over the past 40 years, public interest in protecting natural resources has increased dramatically. Water-based recreation is also much more popular now than it was 40 years ago. These new values have translated into new behaviors, new industries, and even new laws. Predicting which new values will emerge in the future is probably futile; the only solution to changing values is to recognize them early and to adapt plans accordingly.

Whether new challenges come from the values of society, the weather, or the economy, the regional water planning groups are prepared to deal with challenges and uncertainty through the five-year regional water planning cycle. Most importantly, they meet regularly to coordinate their activities and to assimilate new information. They plan for worst-case scenarios by employing conservative measures like firm yield and safe yield and by including model drought contingency plans. Although the challenge of uncertainty can never completely be overcome, it can managed through vigilance and adaptive planning.

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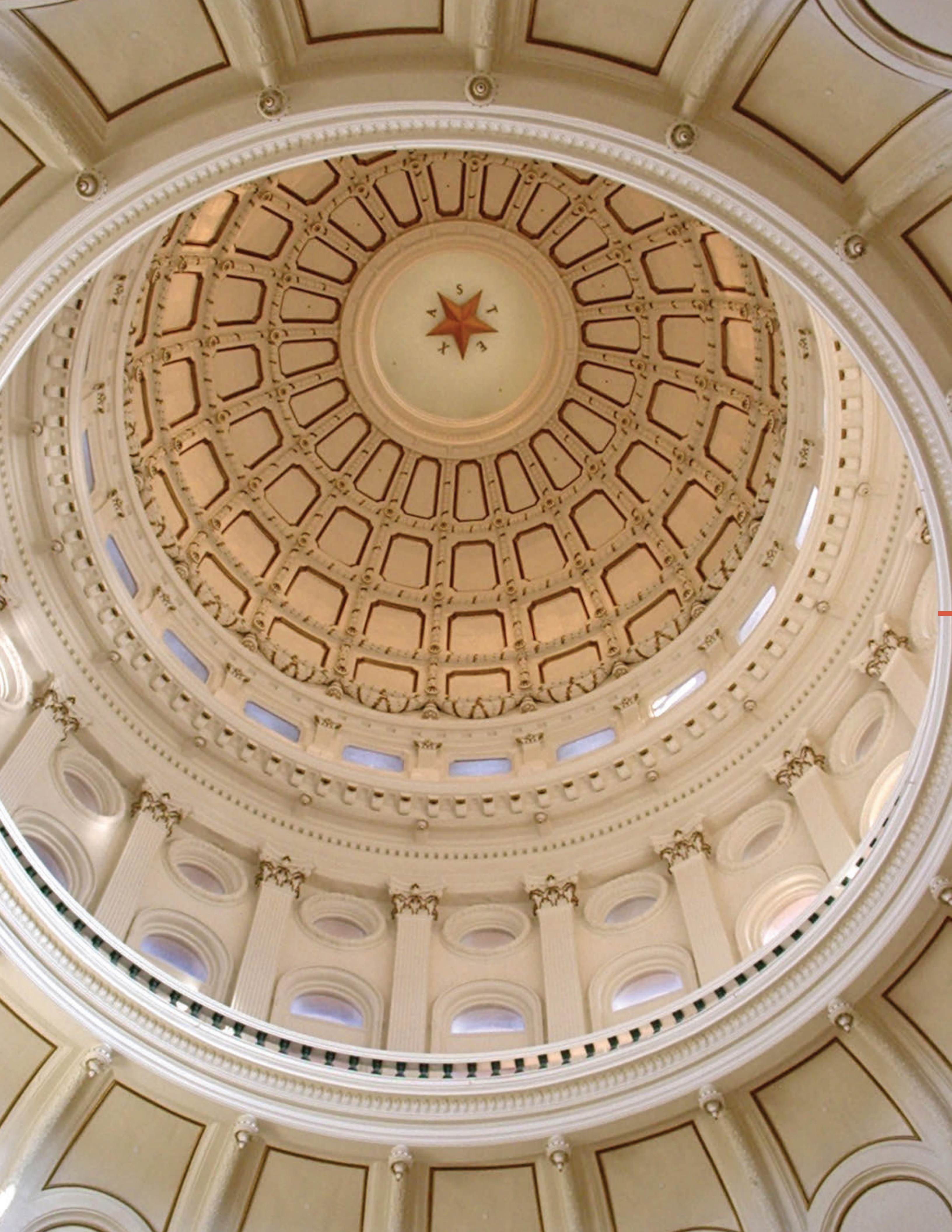
### UNCERTAINTY IN THE WEATHER

It is often said that Texas' weather can best be described as drought punctuated by floods. Our climate is certainly marked by extremes in temperature, precipitation, and catastrophic weather events such as droughts, floods, and hurricanes. While our daily weather is compared to precipitation and temperature "averages," these averages can obscure the sometimes impressive day-to-day, season-to-season and year-to-year extremes that are imbedded within them (TWDB, 1967).

The variability in Texas' weather is largely due to the state's location and topography. When moisture-laden air from the Gulf of Mexico collides with cooler, drier air masses moving southeast from the interior of the continent, storms and flooding can result. The Texas Hill Country is particularly susceptible to heavy thunderstorms when moist air rises over the Balcones Escarpment of the Edwards Plateau. Central Texas holds some of the highest rainfall rates in the state and the nation. In 1921, when the remnants of a hurricane moved over Williamson County, the town of Thrall received almost 40 inches of rain in 36 hours. The storm resulted in the most deadly flooding in Texas history (Jones, 1990).

This "flashiness" of the state's precipitation is an important consideration in water supply planning, particularly when addressing uncertainty. Constant variability means that much of the time, river and streamflows are an undependable source of water supply in Texas (Ward, 2011). This problem is dealt with through the construction of reservoirs, which impound rivers and capture some high flows for use during dry periods (Ward, 2011). So not only are reservoirs needed for the control of flooding, but they also help replenish surface water resources when the state receives intense rains and resulting floods.


T E X A S

# 11 Policy Recommendations

TWDB's statutory requirement to develop a state water plan every 5 years includes provisions that the plan should be a guide to state water policy that includes legislative recommendations that TWDB believes are needed and desirable to facilitate more voluntary water transfers. TWDB based the following recommendations, in part, on recommendations from the regional water planning process.

During the development of their regional water plans, planning groups make regulatory, administrative, and legislative recommendations (Appendix D) that they believe are needed and desirable to

- facilitate the orderly development, management, and conservation of water resources;
- facilitate preparation for and response to drought conditions so that sufficient water will be available at a reasonable cost to ensure public health, safety, and welfare;
- further economic development; and
- protect the agricultural and natural resources of the state and regional water planning areas.

Along with general policy and statutory recommendations, planning groups also made recommendations for designating unique reservoir sites and stream segments of unique ecological value; however, the Texas Legislature is responsible for making the official designations of these sites.

Planning groups may recommend the designation of sites of unique value for construction of reservoirs within their planning areas. The recommendations include descriptions of the sites, reasons for the unique designation, and expected beneficiaries of the water supply to be developed at the site. A planning group may recommend a site as unique for reservoir construction based upon several criteria:

- site-specific reservoir development is recommended as a specific water management strategy or in an alternative long-term scenario in an adopted regional water plan; or
- location; hydrology; geology; topography; water availability; water quality; environmental, cultural, and current development characteristics; or other pertinent factors make the site uniquely suited for: (a) reservoir development to provide water supply for the current planning period; or (b) to meet needs beyond the 50-year planning period.

Planning groups may also recommend the designation of all or parts of river and stream segments of unique ecological value located within their planning areas. A planning group may recommend a river or stream segment as being of unique ecological value based upon several criteria:

- biological function
- hydrologic function
- riparian conservation areas
- high water quality
- exceptional aquatic life
- high aesthetic value
- threatened or endangered species/unique communities

The recommendations include physical description of the stream segments, maps, and other supporting documentation. The planning groups coordinate each recommendation with the Texas Parks and Wildlife Department and include, when available, the Texas Parks and Wildlife Department's evaluation of the river or stream segment in their final plans.

Based on planning groups' recommendations and other policy considerations, TWDB makes the following recommendations that are needed to facilitate the implementation of the 2012 State Water Plan:

## ISSUE 1: RESERVOIR SITE AND STREAM SEGMENT DESIGNATION

*The legislature should designate the three additional sites of unique value for the construction of reservoirs recommended in the 2011 regional water plans (Turkey Peak Reservoir, Millers Creek Reservoir Augmentation, and Coryell County Reservoir) for protection under Texas Water Code, Section 16.051(g) (Figure 11.1).*

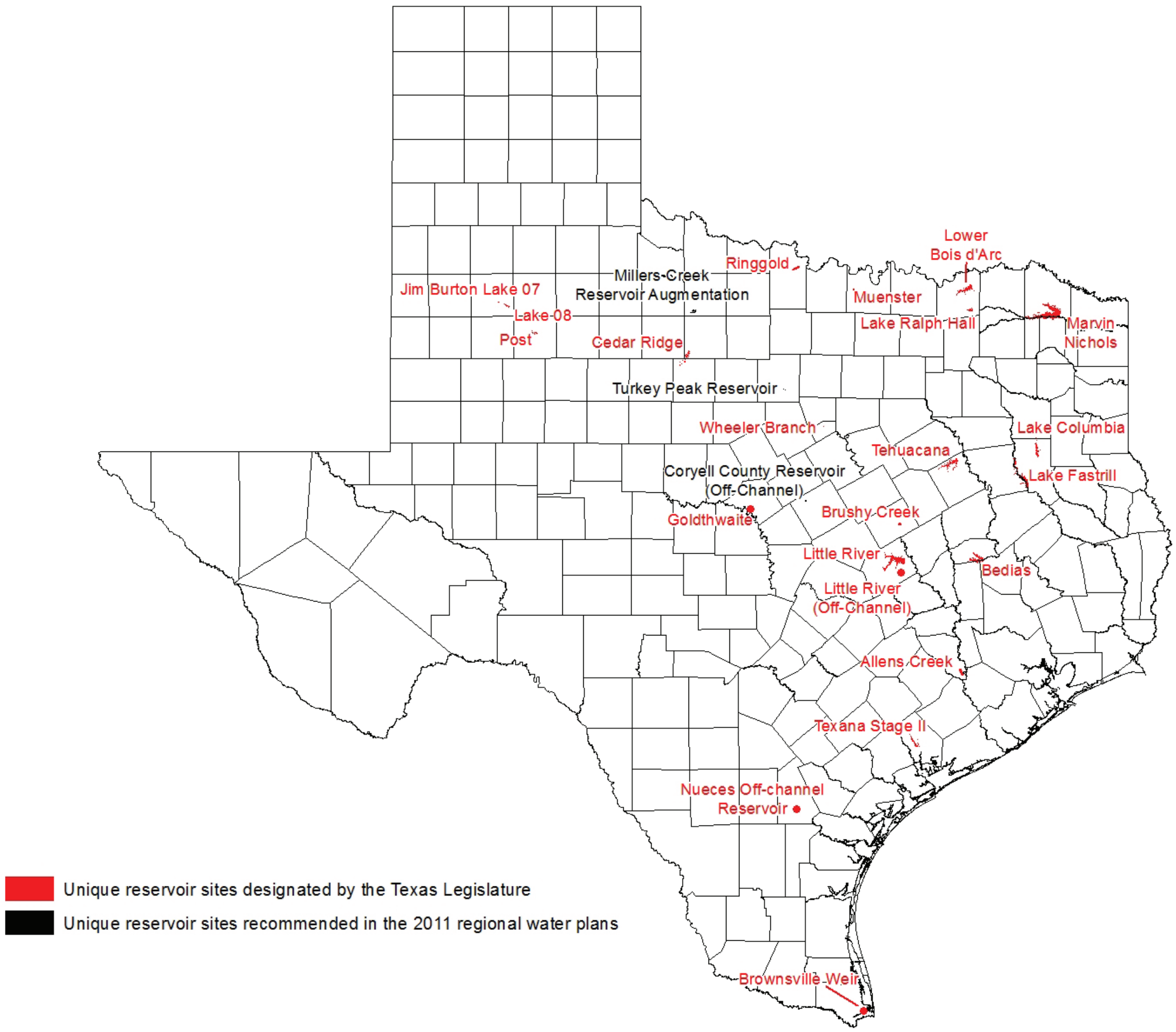
*The legislature should designate the nine river stream segments of unique ecological value recommended in the 2011 regional water plans (Pecan Bayou, Black Cypress Creek, Black Cypress Bayou, Alamito Creek, Nueces River, Frio River, Sabinal River, Comal River, and San Marcos River) for protection under Texas Water Code, Section 16.051(f) (Figure 11.2).*

### SUMMARY OF THE RECOMMENDATION

Recent regional water plans reflect the recognition that major reservoir projects absolutely must remain a strong and viable tool in our water supply development toolbox if the state is to meet its future water supply needs. The 2011 regional water plans include recommendations to develop 26 major reservoirs, which by 2060 would provide nearly 1.5 million acre-feet of water annually (16.7 percent of the total water management strategy volume).

In response to the drought of record of the 1950s, Texas embarked on a significant program of reservoir construction. In 1950, Texas had about 60 major reservoirs, with conservation storage amounting to less than one-half acre-foot per resident of the state. By 1980, the state had 179 major reservoirs, and conservation storage per capita (Chapter 1, Introduction) had increased to nearly 2.5 acre-feet. However, reservoir construction and storage capacity have slowed considerably. Texas currently has 188 major water supply reservoirs, storing just over 1.5 acre-feet per capita. If nothing is done to implement the strategies in the regional water plans, population growth will result in per capita storage declining to less than 1 acre-foot per resident, the lowest since immediately following the drought of record.

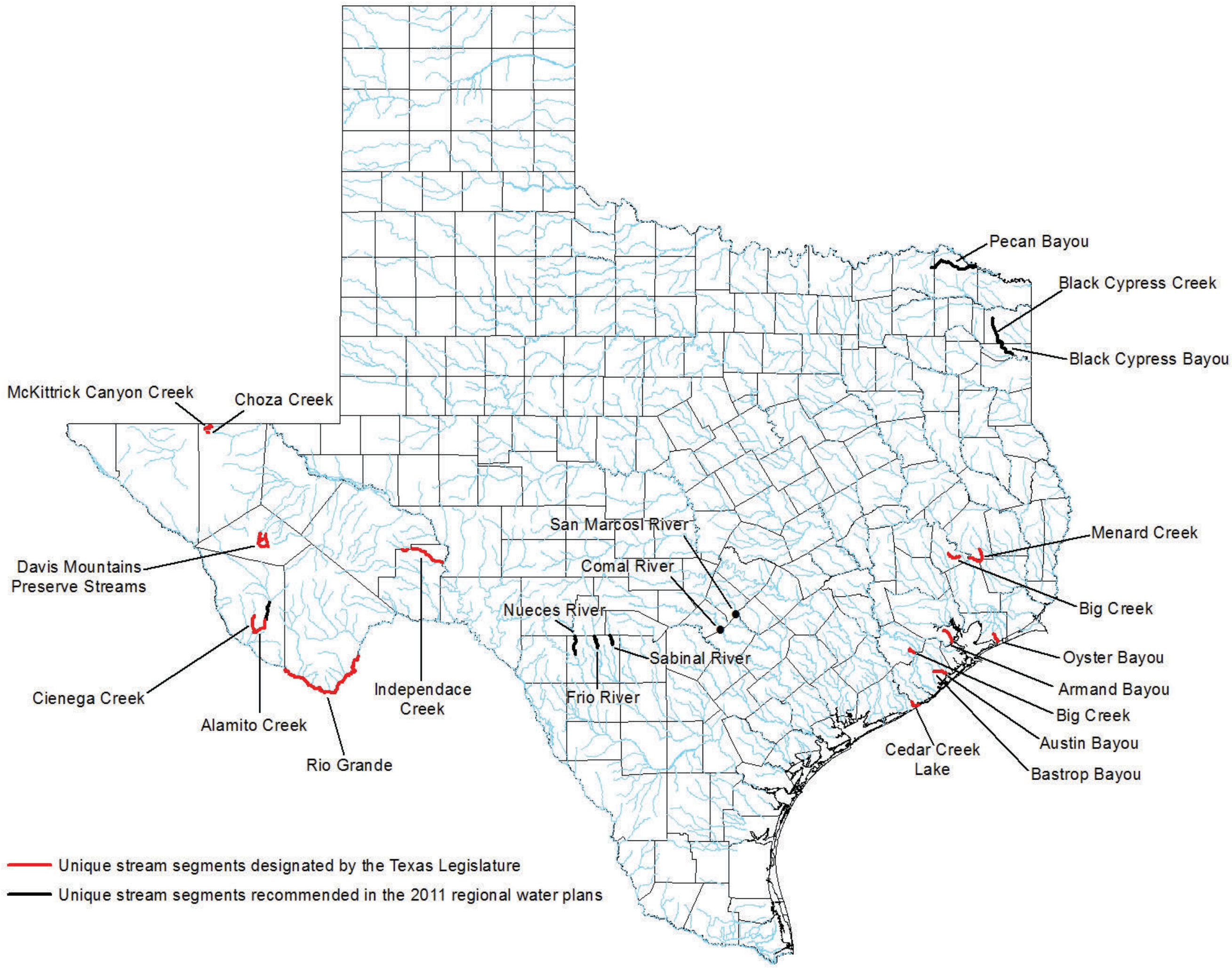
## FIGURE 11.1. DESIGNATED AND RECOMMENDED UNIQUE RESERVOIR SITES.




A number of factors have contributed to the slowdown in reservoir development. The earlier period of construction captured many of the most logical and prolific sites for reservoirs. However, increased costs and more stringent requirements for obtaining state and federal permits for reservoir construction have also been major factors. A significant factor in whether or not the major reservoirs recommended in the 2011 regional water plans can actually be developed involves the reservoir site itself and the manner in which the state addresses issues associated with preserving the viability of the reservoir site for future reservoir construction purposes.

Actions by federal, state, or local governments to protect natural ecosystems located within the reservoir footprint can significantly impact the viability of a site for future construction of a proposed reservoir. Development of Waters Bluff Reservoir on the main stem of the Sabine River was prevented in 1986 by the establishment of a private conservation easement. In addition, the proposed Lake Fastrill, which was included in the 2007 State Water Plan as a recommended water management strategy to meet the future water supply needs of the City of Dallas, was effectively precluded from development by the U.S. Fish and Wildlife Service's designation of the

## FIGURE 11.2. DESIGNATED AND RECOMMENDED UNIQUE STREAM SEGMENTS.




Neches River National Wildlife Refuge on the basis of a 1-acre conservation easement. Lack of action by the state legislature in protecting reservoir sites has been cited as a problem in precluding federal actions that could otherwise be considered to be in contravention of the state's primacy over water of the state.

Texas Water Code, Sections 16.051(e) and 16.053(e)(6), provide that state and regional water plans shall identify any sites of unique value for the construction of reservoirs that the planning groups or TWDB recommend for protection. Texas Water Code, Section 16.051(g) provides for legislative designation of sites of unique value for the construction of a reservoir. By statute, this designation means that a state agency or political subdivision of the state may not obtain a fee title or an easement that would significantly prevent the construction of a reservoir on a designated site.

Designation by the Texas Legislature provides a limited but important measure of protection of proposed reservoir sites for future development and provides a demonstration of the legislature's support for protection of potential sites.

The 80th Texas Legislature in 2007 designated all reservoir sites recommended in the 2007 State Water Plan as sites of unique value for the construction of a reservoir (Senate Bill 3, Section 4.01, codified at Texas Water Code Section 16.051 [g-1]). Senate Bill 3 (Section

3.02, codified at Texas Water Code Section 16.143) also added provisions providing certain protections to owners of land within a designated reservoir site. A former owner of land used for agricultural purposes within a designated reservoir site whose property is acquired either voluntarily or through condemnation is entitled to lease back the property and continue to use it for agricultural purposes until such time that the use must be terminated to allow for physical construction of the reservoir. In addition, a sunset provision was included which terminates the unique reservoir site designation on September 1, 2015, unless there is an affirmative vote by a project sponsor to make expenditures necessary to construct or file applications for permits required in connection with construction of the reservoir under federal or state law.

Texas Water Code, Sections 16.051(e) and 16.053(e)(6) also provide that state and regional water plans shall identify river and stream segments of unique ecological value that the planning groups or TWDB recommend for protection. Texas Water Code Section 16.051(f) also provides for legislative designation of river or stream segments of unique ecological value. By statute, this designation means that a state agency or political subdivision of the state may not finance the actual construction of a reservoir in a specific river or stream segment that the legislature has designated as having unique ecological value. Senate Bill 3, passed by the 80th Texas Legislature, also provided that all river or stream segment sites recommended in the 2007 State Water Plan were designated as being of unique ecological value.

### ISSUE 2: RESERVOIR SITE ACQUISITION

*The legislature should provide a mechanism to acquire feasible reservoir sites so they are available for development of additional surface water supplies to meet the future water supply needs of Texas identified in the 2011 regional water plans and also water supply needs that will occur beyond the 50-year regional and state water planning horizon.*

#### SUMMARY OF THE RECOMMENDATION

If the major reservoir sites recommended for construction in the 2011 regional water plans are not developed, the state will be short 1.46 million acre-feet of water in 2060, about 16.2 percent of the total water supply needed. Without additional water supplies, the state is facing a total water deficit of 8.3 million acre-feet in 2060. Failure to meet the state's water supply needs in drought conditions could cost Texas businesses and workers up to $115.7 billion in 2060.

The cost of acquiring the remaining sites recommended as water management strategies is estimated to be $558.2 million, based on 2011 regional water planning data. The advantages of acquiring these reservoir sites include the following:

- Provides for more efficient and economical long-term infrastructure planning
- Provides certainty to project sponsors that recommended reservoirs could be constructed on designated sites for future water supplies
- Provides some protection from actions by federal agencies that could prohibit the development of reservoirs
- Ensures these sites would be available to meet future water supply needs
- Demonstrates the state's commitment to provide sufficient water supply for Texas citizens to ensure public health, safety and welfare and to further economic development
- Allows the state to lease sites, prior to reservoir construction, to existing landowners or others for land use activities, such as crops and livestock, wildlife, or recreation, thereby also generating income for the state through lease revenue

Although prior legislative designation helps with preserving reservoir sites, purchasing future sites would provide significant additional protection, including much better protection from unilateral actions by federal agencies that could preempt major water supply projects. If the state owned the sites, it would be highly unlikely that a federal agency could take an action related to those sites, such as the U.S. Fish and Wildlife Service action establishing the Neches Wildlife Refuge at the location of the proposed Fastrill Reservoir.

## ISSUE 3: INTERBASIN TRANSFERS OF SURFACE WATER

*The legislature should enact statutory provisions that eliminate unreasonable restrictions on the voluntary transfer of surface water from one basin to another.*

### SUMMARY OF THE RECOMMENDATION

Interbasin transfers of surface water have been an important, efficient, and effective means of meeting the diverse water supply needs of an ever-increasing population in Texas. Interbasin transfers that have already been permitted are or will be used to meet a wide variety of water demands, including municipal, manufacturing, steam-electric power generation, and irrigated agriculture demands.

Prior to the passage of Senate Bill 1, 75th Legislative Session (1997), Texas Water Code, Section 11.085, was entitled Interwatershed Transfers and contained the following provisions:

- Prohibited transfers of water from one watershed to another to the prejudice of any person or property within the watershed from which the water is taken.
- Required a permit from the Texas Commission on Environmental Quality to move water from one watershed to another.
- Required the Texas Commission on Environmental Quality to hold hearings to determine any rights that might be affected by a proposed interwatershed transfer.
- Prescribed civil penalties for violations of these statutory requirements.

In Senate Bill 1, 75th Texas Legislative Session, Texas Water Code, Section 11.085, was amended to replace the above provisions with significantly expanded administrative and technical requirements for obtaining an interbasin transfer authorization. Since the amendments to the Texas Water Code requirements for interbasin transfers in 1997, there has been a significant drop in the amount of interbasin transfer authorizations issued and a significant amount of public discussion about whether the 1997 amendments to Texas Water Code, Section 11.085, have had a negative effect on issuing interbasin transfer authorizations.

Any impediments to obtaining interbasin transfer permits will severely impact the implementation of the projects included in the 2011 regional water plans. There are 15 recommended water management strategies which would rely on an interbasin transfer and will still require a permit to be granted.

## ISSUE 4: THE PETITION PROCESS ON THE REASONABLENESS OF DESIRED FUTURE CONDITIONS

*The legislature should remove TWDB from the petition process concerning the reasonableness of a desired future condition except for technical review and comment.*

### SUMMARY OF THE RECOMMENDATION

Prior to the passage of House Bill 1763 in 2005, regional water planning groups decided how much groundwater was available for use in the water planning process after considering groundwater conservation districts' management plans and rules. Groundwater conservation districts also decided how much groundwater was available for use for purposes of their management plans and permitting rules but with the requirement that their number not be inconsistent with the implementation of the state water plan. The passage of House Bill 1763 granted groundwater conservation districts the sole role of deciding how much groundwater was available for use for both regional water planning and groundwater conservation districts' purposes. Regional water planning groups are now required to use numbers called managed available groundwater, which will be called modeled available groundwater due to statutory changes effective September 1, 2011 (Chapter 5, Supplies). These availability numbers are determined by TWDB on the basis of the specific desired future conditions adopted by the groundwater districts.

Current statute allows a petition to be filed with TWDB challenging the reasonableness of a desired future condition. A person with a legally defined interest in a groundwater management area, a groundwater conservation district in or adjacent to a groundwater management area, or regional water planning group with territory in a groundwater management area can file the petition.

If TWDB finds that a desired future condition is not reasonable, it recommends changes to the desired future condition. The groundwater conservation districts then must prepare a revised plan in accordance with the recommendations and hold another public hearing, but at the conclusion of the hearing the districts may adopt whatever desired future condition they deem appropriate. The final decision by the districts is not reviewable by TWDB, and at the conclusion of the process districts are free to retain the same desired future condition that existed before a petition was filed.

TWDB's Legislative Priorities Report for the 82nd Texas Legislative Session (TWDB, 2011) recommended that the legislature repeal the petition process concerning the reasonableness of desired future conditions or modify the process to provide a judicial remedy exclusive of TWDB, except for the agency's technical review and comment. This recommendation was made because the process, as is, allows districts to make the final decision on their desired future condition regardless of TWDB's determination of reasonableness. TWDB recommended a judicial remedy exclusive of TWDB because the agency is not regulatory and is therefore ill-suited for a regulatory process.

The Sunset Advisory Commission (2010) recommended that the petition process with TWDB be repealed and that district adoption of a desired future condition be appealed to district court in the same manner as any challenge to a district rule under substantial evidence review. Although the petition process was discussed and debated during the 82nd Texas Legislative Session, the legislature ultimately did not pass legislation to change the process. Because the same concerns remain on the petition process, TWDB continues to recommend that the legislature should remove TWDB from the petition process except for technical review and comment.

## ISSUE 5: WATER LOSS

*The legislature should require all retail public utilities to conduct water loss audits on an annual basis, rather than every five years.*

### SUMMARY OF THE RECOMMENDATION

System water loss refers to the difference between how much water is put into a water distribution system and how much water is verified to be used for consumption. Water loss includes theft, under-registering meters, billing adjustments and waivers, main breaks and leaks, storage tank overflows, and customer service line breaks and leaks. High values of water loss impact utility revenues and unnecessarily increase the use of water resources, especially during drought. During reviews of loan applications, TWDB has seen water losses as high as 50 percent for some water systems. Smaller municipal water systems tend to have higher percentage water losses than larger systems. Based on information collected in 2005, statewide water losses were estimated at 250,000 to 460,000 acre-feet per year (Alan Plummer Associates, Inc. and Water Prospecting and Resource Consulting, LLC, 2009).

The first step toward addressing high water losses is measuring where the water is going in a system with a water loss audit. An audit shows a utility how much of its water is lost and where they may need to focus efforts to reduce those losses. Water loss audits done over time help a utility identify progress with minimizing water losses as well as identifying any new water loss issues.

Currently, the Texas Water Code requires all retail public utilities (about 3,600 in all) to submit a water loss audit to TWDB every five years. During the 82nd Legislative Session, based, in part, on TWDB's Legislative Priorities report for the 81st Legislative Session, the legislature required annual reporting for retail public utilities that receive financial assistance from TWDB (about 200). While this is a step in the right direction, TWDB believes that all retail public utilities would benefit from annual water loss surveys. Municipal water conservation is expected to account for about 7 percent of new water supplies (about 650,000 acre-feet per year) by 2060 in the state water plan. Measuring—and ultimately addressing—water loss will help achieve those conservation goals.

## ISSUE 6: FINANCING THE STATE WATER PLAN

*The legislature should develop a long-term, affordable, and sustainable method to provide financing assistance for the implementation of the state water plan.*

### SUMMARY OF THE RECOMMENDATION

Following publication of the 2007 State Water Plan, TWDB conducted an Infrastructure Finance Survey to evaluate the amount of funding needed from state financial assistance programs to support local and regional water providers in implementing water management strategies recommended in the 2007 State Water Plan. The survey reported an anticipated need of $17.1 billion in funds from TWDB financial assistance programs. Steps toward meeting these needs were made in the form of subsidized funding for state water plan projects provided during each of the previous two biennia to provide incentives for state water plan projects to be implemented. The 80th Legislature appropriated funds to subsidize the debt service for $762.8 million in bonds, and the 81st Legislature appropriated funds to subsidize the debt service for $707.8 million in bonds. The 82nd Legislature approved the issuance of up to $200 million in Water Infrastructure Funds bonds for state water plan projects; however, the funds appropriated to subsidize the debt service will provide for approximately $100 million to be issued.

To date, incentives for state water plan projects have included reduced interest rates and deferral of payments and some grants, depending on the program. While these incentives have proven successful, they are a steady draw on general revenues of the state as long as there is debt outstanding.

During the 82nd Legislative session a new model of funding state water plan projects was discussed. This model would involve a deposit of funding, either from general revenue, a fee, or another appropriate source designated by the legislature. This funding, one-time or ongoing over a period of time, could be utilized to make loans to entities for state water plan projects. As the loan payments are received by TWDB, these funds would be available to be lent out again. In this way, the original funding would provide "capital" for the fund. Once established, this model could be expanded to include bond funding and reduced interest rates without being a draw on general revenue.

The latest estimate of funding needed to implement the 2012 State Water Plan is $53 billion, with financial assistance needed from the state estimated to be $26.9 billion, based on the planning groups' financing survey. With a need of this size identified, it is imperative that the state determine a sustainable, long-term methodology to provide funding necessary to implement state water plan projects.

## DROUGHT AND PUBLIC POLICY

Droughts and other natural disasters have often served as the impetus behind significant changes in public policy. A severe drought in the mid-1880s resulted in the state's first disaster relief bill and set off a public policy debate on how the federal government should respond to disasters.

Many of the settlers that arrived in Texas in the mid-1800s had little knowledge of the variability of the state's climate. As a result, they were often ill-prepared to respond to droughts. While struggling to survive the effects of a drought that began in 1885, local leaders in Albany, Texas, selected John Brown, a local minister, to solicit donations of wheat for farmers in nearby counties. Believing it was just as appropriate to ask for drought relief as it was to seek aid following hurricanes, Brown appealed to financial institutions and churches throughout the eastern United States. He persisted despite attacks from Texas newspaper editors and land promoters, who feared that the negative publicity would harm the state's economic development (Caldwell, 2002).

In response to Brown's efforts and those of Clara Barton, founder and first president of the American Red Cross, Congress passed the Texas Seed Bill of 1887. The bill appropriated $10,000 for the purchase of seed grain for distribution to farmers in Texas counties that had suffered from the drought. The legislation was quickly vetoed by President Grover Cleveland, citing his belief that the government should not provide assistance, "to individual suffering which is in no manner properly related to the public service or benefit" (Bill of Rights Institute, 2011). It is still widely known as the most famous of President Cleveland's many vetoes.

Despite the defeat of federal aid, the Texas Legislature appropriated $100,000 for drought relief, providing a little over 3 dollars to each needy person. The Red Cross and other donors also sent clothing, household goods, tools, and seed to drought-stricken areas. This type of response to disasters—government aid, combined with private charitable donations—is a template that is still in use today (Caldwell, 2002).

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# Glossary

### ACRE-FOOT
Volume of water needed to cover 1 acre to a depth of 1 foot. It equals 325,851 gallons.

### AQUIFER
Geologic formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs. The formation could be sand, gravel, limestone, sandstone, or fractured igneous rocks.

### AVAILABILITY
Maximum amount of water available during the drought of record, regardless of whether the supply is physically or legally available.

### BRACKISH WATER
Water with total dissolved solids between 1,000 and 10,000 milligrams per liter.

### CAPITAL COST
Portion of the estimated cost of a water management strategy that includes both the direct costs of constructing facilities, such as materials, labor, and equipment, and the indirect expenses associated with construction activities, such as costs for engineering studies, legal counsel, land acquisition, contingencies, environmental mitigation, interest during construction, and permitting costs.

### CONJUNCTIVE USE
The combined use of groundwater and surface water sources that optimizes the beneficial characteristics of each source.

### COUNTY-OTHER
An aggregation of residential, commercial, and institutional water users in cities with less than 500 people or utilities that provide less than an average of 250,000 gallons per day, as well as unincorporated rural areas in a given county.

### DESALINATION
Process of removing salt from seawater or brackish water.

### DROUGHT
Term is generally applied to periods of less than average precipitation over a certain period of time. Associated definitions include *meteorological drought* (abnormally dry weather), *agricultural drought* (adverse impact on crop or range production), and *hydrologic drought* (below average water content in aquifers and/or reservoirs).

### DROUGHT OF RECORD
Period of time during recorded history when natural hydrological conditions provided the least amount of water supply. For Texas as a whole, the drought of record is generally considered to be from about 1950 to 1957.

### ESTUARY
Bay or inlet, often at the mouth of a river, in which large quantities of freshwater and seawater mix together.

### EXISTING WATER SUPPLY
Maximum amount of water available from existing sources for use during drought of record conditions that is physically and legally available for use.

### FIRM YIELD
Maximum water volume a reservoir can provide each year under a repeat of the drought of record.

### FLOOD CONTROL STORAGE
Storage in a lake or reservoir, between two designated water surface elevations, that is dedicated to storing floodwater so that flood damages downstream are eliminated or reduced.

### FRESHWATER INFLOW NEEDS
Freshwater flows required to maintain the natural salinity and nutrient and sediment delivery in a bay or estuary that supports their unique biological communities and ensures a healthy ecosystem.

### GROUNDWATER AVAILABILITY MODEL
Numerical groundwater flow models used by TWDB to determine groundwater availability of the major and minor aquifers in Texas.

### GROUNDWATER MANAGEMENT AREA
Area designated and delineated by TWDB as an area suitable for management of groundwater resources.

### INFRASTRUCTURE
Physical means for meeting water and wastewater needs, such as dams, wells, conveyance systems, and water treatment plants.

### INSTREAM FLOW
Water flow and water quality regime adequate to maintain an ecologically sound environment in streams and rivers.

### INTERBASIN TRANSFER
Physical conveyance of surface water from one river basin to another.

### MAJOR RESERVOIR
Reservoir having a storage capacity of 5,000 acre-feet or more.

### MODELED AVAILABLE GROUNDWATER
The total amount of groundwater, including both permitted and exempt uses, that can be produced from the aquifer in an average year, that achieves the desired future condition for the aquifer.

### NEEDS
Projected water demands in excess of existing water supplies for a water user group or a wholesale water provider.

### PLANNING GROUP
Team of regional and local leaders of different backgrounds and various social, environmental, and economic interests responsible for developing and adopting a regional water plan for their planning area at five-year intervals.

### RECHARGE
Amount of water that infiltrates to the water table of an aquifer.

### RECOMMENDED WATER MANAGEMENT STRATEGY
Specific project or action to increase water supply or maximize existing supply to meet a specific need.

### REUSE
Use of surface water that has already been beneficially used once under a water right or the use of groundwater which has already been used.

### RUN-OF-RIVER DIVERSION
Water right permit that allows the permit holder to divert water directly out of a stream or river.

### SAFE YIELD
The annual amount of water that can be withdrawn from a reservoir for a period of time longer than the drought of record.

### SEDIMENTATION
Action or process of depositing sediment in a reservoir, usually silts, sands, or gravel.

### STORAGE
Natural or artificial impoundment and accumulation of water in surface or underground reservoirs, usually for later withdrawal or release.

### SUBORDINATION AGREEMENT
Contracts between junior and senior water right holders where the senior water right holder agrees not to assert its priority right against the junior.

### UNMET NEEDS
Portion of the demand for water that exceeds water supply after inclusion of all recommended water management strategies in a regional water plan.

### WATER AVAILABILITY MODEL
Numerical surface water flow models to determine the availability of surface water for permitting in the state.

### WATER DEMAND
Quantity of water projected to meet the overall necessities of a water user group in a specific future year.

### WATER USER GROUP
Identified user or group of users for which water demands and water supplies have been identified and analyzed and plans developed to meet water needs. Water user groups are defined at the county level for the manufacturing, irrigation, livestock, steam-electric power generation, and mining water use categories. Municipal water user groups include (a) incorporated cities and selected Census Designated Places with a population of 500 or more; (b) individual or groups of selected water utilities serving smaller municipalities or unincorporated areas; and (c) rural areas not included in a listed city or utility, aggregated for each county.

### WHOLESALE WATER PROVIDER
Person or entity, including river authorities and irrigation districts, that had contracts to sell more than 1,000 acre-feet of water wholesale in any one year during the five years immediately preceding the adoption of the last regional water plan.


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# Appendices

## APPENDIX A.1. ACRONYMS

| Region | Acronym | Key |
|---|---|---|
| A | CRMWA | Canadian River Municipal Water Authority |
| B | None | None |
| C | DWU | Dallas Water Utilities |
| C | GTUA | Greater Texoma Utility Authority |
| C | NTMWD | North Texas Municipal Water District |
| C | TRA | Trinity River Authority |
| C | TRWD | Tarrant Regional Water District |
| C | UTRWD | Upper Trinity Regional Water District |
| D | None | None |
| E | EPWU | El Paso Water Utility |
| E | LVWD | Lower Valley Water District |
| F | None | None |
| G | BRA | Brazos River Authority |
| H | BRA | Brazos River Authority |
| H | CHCRWA | Central Harris County Regional Water Authority |
| H | CLCND | Chambers-Liberty Counties Navigation District |
| H | GCWA | Gulf Coast Water Authority |
| H | LNVA | Lower Neches Valley Authority |
| H | MUD | Municipal Utility District |
| H | NCWA | North Channel Water Authority |
| H | NFBWA | North Fort Bend Water Authority |
| H | NHCRWA | North Harris County Regional Water Authority |
| H | SJRA | San Jacinto River Authority |
| H | TRA | Trinity River Authority |
| H | WCID | Water Control and Improvement District |
| H | WHCRWA | West Harris County Regional Water Authority |
| I | None | None |
| J | UGRA | Upper Guadalupe River Authority |
| K | LCRA | Lower Colorado River Authority |
| K | SAWS | San Antonio Water System |
| L | CRWA | Canyon Regional Water Authority |
| L | GBRA | Guadalupe-Blanco River Authority |
| L | LCRA | Lower Colorado River Authority |
| L | LNRA | Lavaca Navidad River Authority |
| L | LGWSP | Lower Guadalupe Water Supply Project |
| L | SAWS | San Antonio Water System |
| L | SSLGC | Schertz-Seguin Local Government Corporation |
| L | TWA | Texas Water Alliance |
| M | None | None |
| N | None | None |
| O | CRMWA | Canadian River Municipal Water Authority |
| O | WRMWD | White River Municipal Water District |
| P | None | None |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| **Region A** | | | | | | | | | |
| CRMWA acquisition of water rights | $88,200,000 | na | - | - | - | - | - | - | na |
| CRMWA Roberts County well field | $21,824,000 | $239 | - | - | 15,000 | 15,000 | 15,000 | 15,000 | $112 |
| Drill additional groundwater well | $98,400,920 | $288 - $2,911 | 2,718 | 8,718 | 12,013 | 16,472 | 20,519 | 23,000 | up to $1,311 |
| Irrigation conservation | $0 | $19 - $25 | - | 297,114 | 485,080 | 540,861 | 549,383 | 552,385 | $18 - $27 |
| Municipal conservation | $0 | $490 | - | 1,963 | 3,641 | 3,979 | 4,278 | 4,529 | $490 |
| Palo Duro reservoir | $114,730,000 | $2,976 | - | - | 3,875 | 3,833 | 3,792 | 3,750 | $408 |
| Potter County well field | $128,511,300 | $1,518 | - | 9,467 | 10,292 | 11,182 | 11,141 | 10,831 | $293 |
| Precipitation enhancement | $0 | $6 | - | 15,206 | 15,206 | 15,206 | 15,206 | 15,206 | $6 |
| Roberts County well field - Amarillo | $287,377,200 | $1,447 | - | - | - | 11,210 | 11,210 | 22,420 | $889 |
| Voluntary transfer from other users | $0 | na | - | - | 100 | 100 | 1,100 | 1,100 | na |
| Voluntary transfer from other users[1] | $0 | na | 200 | 800 | 2,458 | 3,579 | 5,311 | 6,563 | na |
| ***Region A Subtotal*** | **$739,043,420** | | **2,718** | **332,468** | **545,207** | **617,843** | **631,629** | **648,221** | |
| **Region B** | | | | | | | | | |
| Construct Lake Ringgold | $382,900,000 | $1,408 | - | - | - | - | 27,000 | 27,000 | $1,408 |
| Develop other aquifer supplies | $957,975 | $615 | 245 | 245 | 245 | 245 | 245 | 245 | $274 |
| Develop Trinity Aquifer supplies | $1,059,638 | $615 | 271 | 271 | 271 | 271 | 271 | 271 | $274 |
| Develop Trinity Aquifer supplies (includes overdrafting) | $265,887 | $615 | 68 | 68 | 68 | 68 | 68 | 68 | $274 |
| Enclose canal laterals in pipe | $7,658,469 | $52 | 13,034 | 13,034 | 13,034 | 13,034 | 13,034 | 13,034 | $1 |
| Increase water conservation pool at Lake Kemp | $130,000 | na | - | 24,834 | 24,776 | 24,718 | 24,660 | 24,600 | na |
| Municipal conservation | $0 | $0 - $1,667 | 197 | 764 | 799 | 841 | 857 | 1,668 | $0 - $556 |
| Nitrate removal plant | $647,000 | $1,363 - $2,550 | 50 | 50 | 50 | 50 | 50 | 50 | $388 - $800 |
| Purchase water from local provider | $2,798,700 | $1,059 - $2,266 | 1,508 | 1,046 | 1,046 | 1,046 | 1,046 | 1,046 | $936 - $1642 |
| Wastewater reuse | $1,206,500 | $950 | - | - | - | 171 | 171 | 171 | $950 |
| Wichita River diversion | $5,380,000 | $73 | - | - | - | 8,850 | 8,850 | 8,850 | $20 |
| Emergency interconnect Millers Creek Reservoir[1] | $714,000 | $1,252 | 250 | 250 | 250 | 250 | 250 | 250 | $1,000 |
| Purchase water from local provider[1] | $0 | $1,059 | - | 462 | 462 | 462 | 462 | 462 | $1,059 |
| Wichita Basin chloride control project[1] | $95,450,000 | $286 | 26,500 | 26,500 | 26,500 | 26,500 | 26,500 | 26,500 | $47 |
| ***Region B Subtotal*** | **$499,168,169** | | **15,373** | **40,312** | **40,289** | **49,294** | **76,252** | **77,003** | |
| **Region C** | | | | | | | | | |
| Additional dry year supply | $1,750,000 | na | 25,000 | - | - | - | - | - | na |
| Additional pipeline from Lake Tawakoni (more Lake Fork supply) | $496,243,000 | $558 | - | 77,994 | 75,777 | 73,563 | 71,346 | 69,128 | $108 |
| Collin-Grayson Municipal Alliance System | $77,366,000 | $3,045 | - | 3,255 | 8,614 | 14,192 | 20,604 | 27,412 | $982 |
| Cooke County project | $50,280,000 | $1,658 | - | 2,240 | 2,240 | 3,360 | 4,480 | 4,480 | $394 |
| Dallas Water Utilities reuse | $82,920,000 | $233 | - | 34,902 | 41,326 | 39,907 | 47,001 | 50,382 | $42 |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Direct reuse | $264,783,000 | $691 | 1,552 | 14,327 | 29,283 | 38,649 | 43,184 | 46,250 | $139 |
| Direct reuse - Frisco | $31,448,606 | $1,359 | - | 2,240 | 3,359 | 5,650 | 5,649 | 5,650 | $134 |
| Ennis reuse | $31,779,000 | $14,739 | - | - | - | 333 | 2,199 | 3,696 | $1,328 |
| Facility improvements | $2,314,558,600 | na | - | - | - | - | - | - | na |
| Facility improvements - reuse sources | $590,686,000 | na | - | - | - | - | - | - | na |
| Fannin County project | $38,471,000 | $3,838 | - | 1,254 | 2,400 | 3,862 | 4,439 | 5,113 | $395 |
| Fastrill replacement (Region C component)[2] | $1,980,278,000 | $1,724 | - | - | - | - | - | 112,100 | $1,724 |
| Golf course conservation | $0 | $279 | 56 | 942 | 1,808 | 2,261 | 2,690 | 3,121 | $278 |
| Grayson County project | $136,016,000 | na | 200 | 7,560 | 10,920 | 13,440 | 19,040 | 24,640 | $141 |
| Indirect reuse | $0 | na | - | 4,368 | 4,368 | 4,368 | 4,368 | 4,368 | na |
| Indirect reuse - Jacksboro for Jack County mining | $200,000 | na | 385 | 385 | 385 | 385 | 385 | 385 | na |
| Lake Palestine connection (integrated pipeline with TRWD) | $887,954,000 | $773 | - | 111,776 | 110,670 | 109,563 | 108,455 | 107,347 | $204 |
| Lake Ralph Hall | $286,401,000 | $727 | - | 34,050 | 34,050 | 34,050 | 34,050 | 34,050 | $116 |
| Lake Ralph Hall - indirect reuse | $0 | na | 0 | 6,129 | 12,258 | 18,387 | 18,387 | 18,387 | na |
| Lake Texoma - authorized (blend) | $336,356,000 | $496 | - | - | 69,200 | 68,500 | 113,000 | 113,000 | $87 |
| Lake Texoma - interim purchase from GTUA | $0 | na | - | 21,900 | 21,900 | 21,899 | - | - | na |
| Lake Wright Patman - reallocation of flood pool | $896,478,000 | $762 | - | - | - | 112,100 | 112,100 | 112,100 | $762 |
| Lower Bois d'Arc Creek Reservoir | $615,498,000 | $972 | - | 54,796 | 117,800 | 114,138 | 111,361 | 108,487 | $79 |
| Main stem pump station (additional East Fork) NTMWD | $0 | na | - | 34,900 | 15,100 | - | - | - | na |
| Main Stem Trinity pump station (Lake Ray Hubbard indirect reuse - DWU) | $142,567,000 | $730 | - | 17,168 | 15,004 | 20,010 | 13,700 | 11,105 | $196 |
| Manufacturing conservation | $0 | na | 1 | 131 | 1,530 | 2,259 | 2,457 | 2,618 | $211 |
| Marvin Nichols Reservoir | $3,345,052,000 | $364 | - | - | 227,400 | 227,400 | 472,300 | 472,300 | $83 |
| Municipal conservation - basic | $1,151,575 | $200 | 41,967 | 97,040 | 137,705 | 175,858 | 216,941 | 264,429 | $85 |
| Municipal conservation - expanded | $480,774 | $169 | 4,756 | 9,862 | 13,907 | 16,910 | 18,824 | 20,541 | $396 |
| New wells - Carrizo Wilcox Aquifer | $1,853,000 | $345 | 154 | 181 | 183 | 465 | 466 | 467 | $446 |
| New wells - Trinity Aquifer | $7,778,150 | $410 | 1,882 | 2,042 | 2,306 | 2,306 | 2,306 | 2,306 | $229 |
| New wells - Woodbine Aquifer | $14,543,000 | $663 | 763 | 1,932 | 1,932 | 1,932 | 1,932 | 1,932 | $339 |
| Oklahoma water to Irving | $194,825,000 | $810 | - | - | 25,000 | 25,000 | 25,000 | 25,000 | $244 |
| Oklahoma water to NTMWD, TRWD, UTRWD | $756,044,500 | $290 | - | - | - | - | - | 115,000 | $290 |
| Overdraft Trinity Aquifer - existing wells | $0 | $105 | 2,168 | - | - | - | - | - | na |
| Overdraft Trinity Aquifer - new wells | $269,000 | $493 | 75 | - | - | - | - | - | na |
| Purchase from water provider (1) | $0 | na | 46 | - | - | - | - | - | na |
| Redistribution of supplies | $0 | na | 530 | 13,979 | 18,526 | 24,028 | 33,981 | 58,031 | na |
| Subordination agreement - future-only sources | $8,217,000 | $2,561 | - | 280 | 220 | 219 | 217 | 215 | $558 |
| Supplemental wells | $495,381,934 | na | - | - | - | - | - | - | na |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| | | | Water Supply Volume (acre-feet/year) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
| Toledo Bend project (Region I entities responsible for 20 percent of cost) | $2,406,236,000 | na | 363 | 329 | 272 | 232 | 400,229 | 400,217 | $1,072 |
| TRA 10-Mile Creek reuse project | $14,895,000 | $259 | - | - | 6,760 | 6,760 | 6,760 | 6,760 | $99 |
| TRA Denton Creek wastewater treatment plant reuse | $9,506,000 | na | - | 3750 | 3,750 | 3,750 | 3,750 | 3,750 | $229 |
| TRA Ellis County reuse | $10,384,000 | $505 | - | - | - | - | - | 2,200 | $505 |
| TRA Freestone County reuse | $17,266,000 | $323 | - | - | - | - | 6,760 | 6,760 | $323 |
| TRA Kaufman County reuse | $9,761,000 | $901 | - | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | $192 |
| TRA Las Colinas reuse | $14,530,000 | $284 | - | 7,000 | 7,000 | 7,000 | 7,000 | 7,000 | $134 |
| TRA Tarrant County project | $59,008,000 | na | - | - | - | - | - | - | na |
| TRWD third pipeline and reuse | $914,424,000 | $1,016 | - | 105,500 | 105,500 | 105,500 | 105,500 | 105,500 | $324 |
| Water treatment plant - expansion | $19,970,000 | na | - | 1,260 | 1,081 | 3,180 | 2,786 | 2,268 | $1,090 |
| Water treatment plant - new | $308,309,400 | na | - | 192 | 523 | 587 | 613 | 807 | $19,346 |
| Conveyance project (1)[1] | $413,884,000 | $11,561 | 194 | 10,417 | 17,255 | 19,490 | 23,046 | 25,178 | $679 |
| Conveyance project (2)[1] | $69,299,100 | na | - | 1,672 | 1,299 | 1,234 | 1,226 | 1,237 | $3,154 |
| Conveyance project (3)[1] | $6,465,400 | $6,531 | - | 213 | 1,009 | 1,717 | 1,957 | 2,016 | $1,027 |
| Grayson County project[1] | $146,071,000 | $3,693 | - | 5,600 | 8,400 | 8,400 | 14,000 | 19,600 | $514 |
| Purchase from water provider (1)[1] | $164,114,900 | na | 402 | 27,039 | 32,425 | 31,243 | 30,709 | 30,103 | $1,067 |
| Purchase from water provider (2)[1] | $3,538,000 | $5,950 | - | 52 | 50 | 50 | 50 | 86 | $609 |
| Purchase from water provider (3)[1] | $65,481,250 | $2,384 | - | 4,004 | 4,493 | 6,083 | 5,626 | 6,417 | $1,706 |
| Water treatment plant - expansion - reuse sources[1] | $32,750,000 | na | - | - | - | - | - | - | na |
| Water treatment plant - expansion[1] | $2,708,430,000 | na | - | 484 | 828 | 2,279 | 2,545 | 2,618 | $106,249 |
| ***Region C Subtotal*** | **$21,481,952,189** | | **79,898** | **674,664** | **1,131,057** | **1,303,003** | **2,045,260** | **2,360,302** | |
| **Region D** | | | | | | | | | |
| Drill new well | $32,260,219 | $2,342 | 1,094 | 1,636 | 1,969 | 3,100 | 4,888 | 6,757 | $336 |
| Increase existing contract | $0 | $591 | 1,576 | 2,001 | 3,345 | 13,199 | 34,692 | 59,478 | $476 |
| New surface water contract | $6,247,886 | $311 | 8,660 | 12,523 | 14,866 | 17,678 | 22,512 | 32,231 | $144 |
| Increase existing contract[3] | $0 | na | - | 340 | 558 | 711 | 1,280 | 1,471 | na |
| ***Region D Subtotal*** | **$38,508,104** | | **11,330** | **16,160** | **20,180** | **33,977** | **62,092** | **98,466** | |
| **Region E** | | | | | | | | | |
| Additional one well | $702,770 | $10 | - | 500 | 500 | 500 | 500 | 500 | $10 |
| Additional wells | $1,006,762 | $29 | - | 175 | 175 | 350 | 350 | 350 | $29 |
| Additional wells and desalination plant expansions | $34,344,000 | $1,114 | - | 1,607 | 3,304 | 4,764 | 6,245 | 7,726 | $564 |
| Arsenic treatment facility | $1,996,232 | $34 | - | 276 | 276 | 276 | 276 | 276 | $34 |
| Integrated water management strategy - conjunctive use with additional surface water | $0 | $525 | - | - | - | 3,600 | 3,600 | 3,600 | $525 |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Integrated water management strategy - conservation | $0 | $333 | - | 3,000 | 7,000 | 11,000 | 16,000 | 22,000 | $45 |
| Integrated water management strategy - desalination of agricultural drain water | $16,675,000 | $930 | - | 2,700 | 2,700 | 2,700 | 2,700 | 2,700 | $476 |
| Integrated water management strategy - direct reuse | $25,257,000 | $538 | - | 2,000 | 4,000 | 6,000 | 6,000 | 6,000 | $334 |
| Integrated water management strategy - import from Dell Valley | $214,113,000 | $1,529 | - | - | - | - | 10,000 | 20,000 | $1,309 |
| Integrated water management strategy - import from Diablo Farms | $245,506,000 | $2,353 | - | - | - | 10000 | 10,000 | 10,000 | $2,353 |
| Integrated water management strategy - recharge of groundwater with treated surface water | $14,625,000 | $542 | - | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | $330 |
| Irrigation scheduling | $0 | $70 | - | 5,275 | 5,275 | 5,275 | 5,275 | 5,275 | $70 |
| Purchase water from EPWU | $0 | varies | 3,376 | 16,939 | 21,512 | 18,156 | 14,074 | 13,569 | varies |
| Purchase water from LVWD | $0 | $451 | - | 1,441 | 2,812 | 3,883 | 5,050 | 6,218 | $1,470 |
| Tailwater reuse | $0 | $478 | - | 2,312 | 2,312 | 2,312 | 2,312 | 2,312 | $478 |
| Water district delivery systems | $147,635,869 | $8 | - | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 | $8 |
| Integrated water management strategy - conjunctive use with additional surface water[1] | $140,238,000 | $1,671 | - | 5,000 | 15,000 | 16,400 | 16,400 | 16,400 | $525 |
| Purchase water from EPWU[1] | $0 | varies | - | 605 | 1,161 | 9,193 | 18,231 | 24,706 | varies |
| ***Region E Subtotal*** | $842,099,633 | | 3,376 | 66,225 | 79,866 | 98,816 | 112,382 | 130,526 | |
| **Region F** | | | | | | | | | |
| Advanced treatment | $2,582,000 | na | - | - | - | - | - | - | na |
| Bottled water program | $3,000 | $1,400 - $28,400 | 1 | 1 | 1 | 1 | 1 | 1 | $1,400 - $28,400 |
| Brush control | $23,020,000 | na | 8,362 | 8,362 | 8,362 | 8,362 | 8,362 | 8,362 | na |
| Desalination | $213,760,990 | $1,163 | - | 950 | 950 | 16,050 | 16,050 | 16,050 | $346 |
| Develop Cenozoic Aquifer supplies | $244,775,000 | $251 - $342 | - | - | 19,600 | 19,600 | 19,600 | 19,600 | $251 - $342 |
| Develop Dockum Aquifer supplies | $17,855,000 | $445 | - | 2,200 | 2,200 | 2,200 | 2,200 | 2,200 | $445 |
| Develop Ellenburger Aquifer supplies | $5,148,000 | $370 | - | 200 | 200 | 200 | 200 | 200 | $370 |
| Develop Hickory Aquifer supplies | $174,991,000 | $610 - $1670 | 160 | 6,860 | 10,160 | 12,160 | 12,160 | 12,160 | $610 - $1670 |
| Irrigation conservation | $68,650,668 | $69 | - | 36,125 | 72,244 | 72,244 | 72,244 | 72,244 | $69 |
| Municipal conservation | $0 | $498 | 3,197 | 6,988 | 8,307 | 8,897 | 9,525 | 10,179 | $154 |
| New water treatment plant and storage facilities | $2,436,000 | na | - | - | - | - | - | - | na |
| New/renew water supply | $8,964,000 | $477 | 392 | 5,622 | 15,629 | 16,180 | 17,073 | 16,866 | $477 |
| Rehabilitation of pipeline | $7,521,900 | $315 | - | - | 2,281 | 2,267 | 2,254 | 2,240 | $448 |
| Replacement well | $13,941,000 | na | - | - | - | - | - | - | na |
| Reuse | $130,906,000 | $1,072 | - | 12,380 | 12,380 | 12,490 | 12,490 | 12,490 | $383 |
| Subordination | $0 | na | 78,832 | 77,555 | 66,391 | 65,436 | 63,241 | 62,606 | na |
| ***Region F Subtotal*** | $914,554,558 | | 90,944 | 157,243 | 218,705 | 236,087 | 235,400 | 235,198 | |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| **Region G** | | | | | | | | | |
| Additional Carrizo Aquifer development (includes overdrafting) | $23,676,071 | $585 | 1,481 | 1,884 | 2,184 | 5,084 | 6,963 | 6,963 | $182 |
| Additional Edwards-Trinity (Plateau) Aquifer development (includes overdrafting) | $679,000 | $588 | 114 | 114 | 114 | 114 | 114 | 114 | $70 |
| Additional Gulf Coast Aquifer development | $31,630,000 | $638 | - | - | - | 5,600 | 5,600 | 5,600 | $146 |
| Additional Trinity Aquifer development (includes overdrafting) | $19,278,000 | $264 | 723 | 322 | 522 | 1,357 | 1,708 | 2,025 | $553 |
| Aquifer storage and recovery (Brazos River to Seymour Aquifer) | $38,625,000 | $701 | 6,208 | 6,208 | 6,208 | 6,208 | 6,208 | 6,208 | $159 |
| Belton to Stillhouse pipeline | $36,038,000 | $133 | - | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | $45 |
| Bosque County regional project | $5,150,000 | $2,895 | - | - | 190 | 190 | 190 | 190 | $532 |
| BRA supply through the East Williamson County Regional Water Treatment System | $44,706,000 | $1,680 | 4,601 | 6,260 | 6,260 | 6,958 | 6,958 | 6,958 | $430 |
| BRA surface water and treatment system expansion | $39,971,000 | $2,933 | 375 | 3,545 | 3,545 | 3,545 | 3,545 | 3,545 | $573 |
| BRA system operations permit | $204,281,000 | $2,808 | 750 | 77,020 | 82,242 | 84,742 | 84,742 | 84,899 | $314 |
| Brushy Creek Reservoir | $18,553,000 | $484 | 2,090 | 2,090 | 2,090 | 2,090 | 2,090 | 2,090 | $67 |
| Cedar Ridge Reservoir | $285,214,000 | $1,168 | - | 23,380 | 23,380 | 23,380 | 23,380 | 23,380 | $241 |
| City of Groesbeck off-channel reservoir | $10,412,000 | $565 | - | - | - | - | 1,755 | 1,755 | $565 |
| Conjunctive management of Champion well field and Oak Creek Reservoir with subordination agreement | $0 | na | 688 | 755 | 878 | 948 | 953 | 963 | na |
| Coryell County Reservoir (BRA System) | $37,489,000 | $1,007 | - | 3,365 | 3,365 | 3,365 | 3,365 | 3,365 | $193 |
| Expansion of Champion well field | $15,015,000 | $1,643 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | $334 |
| Future phases of Lake Whitney water supply project | $110,843,000 | $926 | - | 7,572 | 7,572 | 7,572 | 7,572 | 7,572 | $926 |
| Groundwater/ surface water conjunctive use (Lake Granger Augmentation) | $643,928,000 | $838 | 26,505 | 26,001 | 25,496 | 47,435 | 70,751 | 70,246 | $1,154 |
| Increase treatment capacity | $195,654,000 | $546 | 15,176 | 28,176 | 36,016 | 40,047 | 51,330 | 58,435 | $294 |
| Interconnection of City of Waco system with neighboring communities | $14,652,000 | $3,387 | 837 | 837 | 837 | 1,564 | 1,664 | 1,814 | $1,136 |
| Irrigation water conservation | $0 | $235 | 3,390 | 5,519 | 7,550 | 7,376 | 7,206 | 7,041 | $228 |
| Limestone County Carrizo-Wilcox Aquifer development | $18,458,000 | $562 | 2,500 | 3,000 | 3,000 | 3,600 | 3,600 | 3,600 | $115 |
| Manufacturing water conservation | $0 | na | 140 | 275 | 440 | 494 | 545 | 594 | na |
| Midway pipeline project (West Central Brazos distribution system) | $13,524,731 | $2,046 | 843 | 843 | 843 | 843 | 843 | 843 | $648 |
| Millers Creek augmentation | $46,948,000 | $217 | 17,582 | 17,582 | 17,582 | 17,582 | 17,582 | 17,582 | $217 |
| Mining water conservation | $0 | na | 340 | 611 | 885 | 913 | 941 | 973 | na |
| Municipal water conservation | $0 | $475 | 4,873 | 13,572 | 14,379 | 15,865 | 18,497 | 21,347 | $475 |
| New water treatment plant | $3,522,000 | $2,179 | 224 | 224 | 224 | 224 | 224 | 224 | $808 |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| New West Loop reuse line | $5,495,500 | $591 | 680 | 680 | 680 | 680 | 680 | 680 | $120 |
| Oak Creek Reservoir with subordination agreement | $0 | na | 1,679 | 1,671 | 1,557 | 1,435 | 1,301 | 1,154 | na |
| Phase I Lake Whitney water supply project | $41,453,000 | $2,852 | 2,128 | 2,128 | 2,128 | 2,128 | 2,128 | 2,128 | $1,153 |
| Purchase water from City of Bryan | $1,201,000 | $262 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | $192 |
| Raise level of Gibbons Creek Reservoir | $12,140,600 | $237 | - | 3,870 | 3,870 | 3,870 | 3,870 | 3,870 | $29 |
| Reallocation of source | $0 | na | 9,081 | 35,928 | 35,928 | 40,028 | 45,728 | 52,628 | na |
| Regional surface water supply to Williamson County from Lake Travis | $391,533,000 | $1,308 | 600 | 34,148 | 41,187 | 41,187 | 44,459 | 44,459 | $938 |
| Rehabilitate existing wells | $350,000 | $30 | - | 1,100 | 1,100 | 1,100 | 1,100 | 1,100 | $30 |
| Restructure contract | $0 | na | 502 | 470 | 437 | 406 | 373 | 341 | na |
| Somervell County water supply project (phases 1-4) | $29,923,000 | $2,841 | 840 | 840 | 840 | 840 | 840 | 840 | $508 |
| Somervell County water supply project (phases 5-13) | $74,228,000 | $1,147 | - | - | 960 | 960 | 960 | 960 | $174 |
| Steam-electric conservation | $0 | na | 2,114 | 4,896 | 8,219 | 9,109 | 10,822 | 11,803 | na |
| Stonewall, Kent, and Garza chloride control project | $163,226,000 | na | - | - | - | - | - | - | na |
| Storage reallocation of federal reservoirs - Lake Aquilla | $11,447,000 | $406 | - | - | - | 2,050 | 2,050 | 2,050 | $406 |
| Turkey Peak Reservoir | $50,227,000 | $924 | - | 7,600 | 7,600 | 7,600 | 7,600 | 7,600 | $441 |
| Voluntary redistribution | $6,391,000 | $312 | 11,251 | 11,942 | 13,564 | 14,425 | 15,236 | 16,558 | $469 |
| Wastewater reuse | $115,432,500 | $340 | 17,043 | 38,653 | 40,523 | 51,114 | 64,830 | 70,087 | $317 |
| Coryell County Reservoir (BRA system)[1] | $14,399,000 | $2,867 | - | - | 3,365 | 3,365 | 3,365 | 3,365 | $1,522 |
| Groundwater/surface water conjunctive use (Lake Granger augmentation)[1] | $229,822,000 | $865 | - | - | - | 33,814 | 37,839 | 39,710 | $864 |
| Increase current contract[1] | $0 | $401 | 43 | 43 | 543 | 1,043 | 1,543 | 2,143 | $831 |
| Increase treatment capacity[1] | $13,951,000 | $648 | - | 2,800 | 2,800 | 2,800 | 2,800 | 2,800 | $213 |
| Limestone County Carrizo-Wilcox Aquifer development[1] | $0 | $562 | 148 | 146 | 144 | 142 | 141 | 141 | $115 |
| New water treatment plant[1] | $35,822,000 | $627 | - | 8,400 | 8,400 | 8,400 | 8,400 | 8,400 | $255 |
| Storage reallocation of federal reservoirs - Lake Aquilla[1] | $0 | na | - | - | - | 375 | 745 | 999 | na |
| Turkey Peak Reservoir[1] | $0 | $924 | - | 7,600 | 7,600 | 7,600 | 7,600 | 7,600 | $441 |
| Voluntary redistribution[1] | $91,940,000 | $860 | 3,529 | 19,162 | 28,296 | 29,099 | 29,903 | 30,757 | $472 |
| Wastewater reuse[1] | $39,128,901 | $436 | 9,232 | 10,831 | 11,760 | 11,760 | 11,760 | 11,760 | $107 |
| ***Region G Subtotal*** | $3,186,357,303 | | 137,858 | 405,581 | 436,895 | 496,528 | 562,803 | 587,084 | |
| **Region H** | | | | | | | | | |
| Allens Creek reservoir | $222,752,400 | $326 | - | 57,393 | 55,096 | 87,781 | 99,650 | 99,650 | $39 |
| BRA system operations permit | $0 | na | - | 6,621 | 18,870 | 25,350 | 25,350 | 25,350 | na |
| Brazoria County interruptible supplies for irrigation | $0 | na | 104,977 | 86,759 | 64,000 | 64,000 | 64,000 | 64,000 | na |
| Brazoria off-channel reservoir | $173,898,602 | $1,206 | - | - | - | - | - | 24,000 | $1,206 |
| Brazos saltwater barrier | $44,470,739 | na | - | - | - | - | - | - | na |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Cities of Richmond-Rosenberg Groundwater Reduction Plan - West Fort Bend surface water treatment plant | $117,220,150 | $887 | - | 7,500 | 7,500 | 7,500 | 7,500 | 7,500 | $2,325 |
| City of Houston bayous permit | $20,956,000 | na | - | - | - | - | - | - | na |
| City of Houston Groundwater Reduction Plan participation | $58,235,873 | $378 | 3,762 | 11,417 | 16,809 | 19,870 | 22,399 | 24,990 | $214 |
| City of Houston indirect reuse | $721,822,850 | $725 | - | - | - | 66,420 | 114,679 | 128,801 | $799 |
| City of Missouri City Groundwater Reduction Plan - aquifer storage and recovery | $58,967,437 | na | - | 4,147 | 4,147 | 4,147 | 4,147 | 4,147 | na |
| City of Missouri City Groundwater Reduction Plan - reuse | $9,100,352 | na | - | 640 | 640 | 640 | 640 | 640 | na |
| City of Missouri City Groundwater Reduction Plan participation | $6,618,706 | $378 | - | 1,004 | 1,860 | 1,896 | 1,896 | 1,896 | $248 |
| City of Sugar Land Groundwater Reduction Plan - reuse | $78,783,825 | na | - | 560 | 5,040 | 5,040 | 5,040 | 5,040 | na |
| City of Sugar Land Groundwater Reduction Plan participation | $6,360,101 | $379 | - | 480 | 1,763 | 2,380 | 2,381 | 2,155 | $223 |
| CLCND West Chambers System | $20,380,000 | $1,171 | - | 1,691 | 1,978 | 2,235 | 2,511 | 2,804 | $73 |
| Contract with Brazosport Water Authority | $22,363,694 | $193 | 7,750 | 7,750 | 7,750 | 7,750 | 7,750 | 7,750 | $94 |
| Contract with CHCRWA | $2,048,820 | $196 | - | 977 | 862 | 720 | 631 | 546 | $50 |
| Contract with City of Galveston | $10,542,328 | $172 | - | 7,262 | 7,262 | 7,262 | 7,262 | 7,262 | $46 |
| Contract with City of Houston | $63,420,357 | $596 | - | 6,128 | 4,816 | 4,742 | 5,400 | 6,027 | $428 |
| Contract with Fort Bend County WCID #1 | $1,815,739 | $259 | - | 148 | 824 | 940 | 1,016 | 1,016 | $60 |
| Contract with Galveston County WCID #1 | $1,807,960 | $207 | - | 766 | 909 | 940 | 975 | 1,014 | $60 |
| Contract with GCWA | $132,634,164 | $406 | - | 29,718 | 30,708 | 31,618 | 32,719 | 34,057 | $223 |
| Contract with LNVA | $405,835 | $1,392 | 16 | 23 | 26 | 29 | 33 | 37 | $642 |
| Contract with NHCRWA | $42,207,965 | $68 | - | 56,453 | 83,041 | 64,491 | 34,726 | 27,478 | $50 |
| Contract with SJRA | $264,926,229 | $829 | 23,008 | 27,754 | 37,090 | 54,777 | 54,805 | 54,849 | $206 |
| Contract with TRA | $249,479,472 | $1,044 | 13,823 | 17,083 | 19,972 | 22,888 | 25,732 | 28,672 | $620 |
| Dow off-channel reservoir | $124,468,000 | $481 | - | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | $389 |
| Expanded use of groundwater | $165,928,999 | $238 | - | 40,159 | 62,297 | 68,916 | 80,337 | 90,617 | $175 |
| Fort Bend County MUD #25 Groundwater Reduction Plan - reuse | $776,145 | $568 | - | 589 | 589 | 589 | 589 | 589 | $453 |
| Fort Bend off-channel reservoir | $202,514,788 | $484,074 | - | - | - | - | 90 | 45,943 | $948 |
| Freeport desalination plant | $255,699,000 | $854 | - | - | - | - | 33,600 | 33,600 | $854 |
| Fulshear reuse | $566,625 | $568 | - | 287 | 430 | 430 | 430 | 430 | $453 |
| GCWA off-channel reservoir | $197,448,012 | $827 | - | - | 39,500 | 39,500 | 39,500 | 39,500 | $827 |
| Industrial conservation | $0 | na | - | 558 | 558 | 558 | 558 | 558 | na |
| Interim strategies | $1,155,965 | $369 | 503 | - | - | - | - | - | na |
| Interim strategies - temporary overdraft | $85,545,570 | $303 | 45,009 | - | - | - | - | - | na |
| Irrigation conservation | $757,436 | $100 | 71,275 | 71,275 | 71,275 | 71,275 | 77,881 | 77,881 | $100 |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Montgomery MUD #8/9 indirect reuse | $12,245,687 | $1,387 | - | 657 | 816 | 1,120 | 1,120 | 1,120 | $436 |
| Municipal conservation | $0 | $213 | 1,680 | 3,635 | 3,954 | 4,269 | 4,716 | 5,232 | $213 |
| Municipal conservation - large water user group | $0 | $213 | 31,612 | 38,940 | 42,664 | 46,276 | 50,073 | 54,484 | $213 |
| Municipal conservation - medium water user group | $0 | $311 | 2,658 | 4,377 | 5,062 | 5,684 | 6,384 | 7,189 | $311 |
| Municipal conservation - small water user group | $0 | $202 | 9,655 | 18,366 | 24,016 | 28,274 | 33,219 | 38,589 | $202 |
| New groundwater wells for livestock | $18,635 | $61 | - | 41 | 41 | 41 | 41 | 41 | $21 |
| NFBWA Groundwater Reduction Plan participation | $1,638,063 | $380 | - | 106 | 258 | 295 | 466 | 687 | $241 |
| NHCRWA Groundwater Reduction Plan participation | $17,814,585 | $377 | 761 | 2,933 | 4,243 | 5,573 | 6,664 | 8,088 | $206 |
| NHCRWA indirect reuse | $66,778,694 | $822 | - | - | - | 7,300 | 16,300 | 16,300 | $589 |
| Reallocation of existing supplies | $275,269,912 | $351 | 59,614 | 56,931 | 54,011 | 66,006 | 76,391 | 152,895 | $148 |
| River Plantation Groundwater Reduction Plan - reuse | $484,926 | $568 | 168 | 368 | 368 | 368 | 368 | 368 | $453 |
| SJRA Water Resources Assessment Plan participation | $89,604,231 | $235 | - | 21,441 | 27,020 | 30,247 | 28,720 | 26,896 | $282 |
| TRA to City of Houston contract | $0 | na | - | - | 116,738 | 123,524 | 123,524 | 123,524 | na |
| TRA to SJRA contract | $302,781,597 | $4,676 | - | - | - | 7,935 | 39,096 | 76,476 | $140 |
| Wastewater reclamation for municipal irrigation | $48,043,249 | $568 | - | - | 7,272 | 15,425 | 25,561 | 36,388 | $520 |
| Wastewater reuse for industry | $332,051,761 | $893 | - | - | - | - | - | 67,200 | $893 |
| WHCRWA Groundwater Reduction Plan participation | $35,268,970 | $378 | 2,488 | 7,689 | 10,105 | 11,683 | 13,340 | 15,104 | $219 |
| BRA to Brazosport Water Authority contract[1] | $0 | na | - | 232 | 248 | 3,114 | 6,366 | 10,870 | na |
| BRA to Cities of Richmond-Rosenberg contract[1] | $0 | na | - | - | - | 2,182 | 6,120 | 11,290 | na |
| BRA to City of Sugar Land contract[1] | $0 | na | - | 2,054 | 5,894 | 7,232 | 7,750 | 9,512 | na |
| BRA to GCWA contract[1] | $0 | na | - | 35,558 | 80,016 | 100,410 | 112,400 | 131,128 | na |
| BRA to NRG Energy contract[1] | $0 | na | - | - | - | - | - | 17,000 | na |
| CHCRWA Groundwater Reduction Plan[1] | $0 | na | 2,375 | 4,146 | 4,789 | 4,806 | 4,806 | 4,806 | na |
| CHCRWA internal distribution[1] | $0 | na | 2,375 | 4,146 | 4,789 | 4,806 | 4,806 | 4,806 | na |
| CHCRWA transmission line[1] | $0 | na | 2,375 | 4,146 | 4,789 | 4,806 | 4,806 | 4,806 | na |
| City of Houston distribution expansion[1] | $261,040,000 | $80 | - | 280,000 | 128,000 | 64,000 | 48,000 | 48,000 | $54 |
| City of Houston to Baytown Area Water Authority contract[1] | $0 | na | - | 26 | 262 | 398 | 535 | 692 | na |
| City of Houston to BRA contract[1] | $0 | na | - | 54,996 | 50,402 | 115,772 | 139,510 | 139,510 | na |
| City of Houston to CHCRWA contract[1] | $0 | na | - | 1,771 | 2,414 | 2,431 | 2,431 | 2,431 | na |
| City of Houston to City of Pasadena contract[1] | $0 | na | 1,865 | 2,278 | 2,665 | 3,153 | 3,579 | 4,068 | na |
| City of Houston to NCWA contract[1] | $0 | na | 1,954 | 2,392 | 2,869 | 3,511 | 4,157 | 4,912 | na |
| City of Houston to NFBWA contract[1] | $0 | na | - | 888 | 35,942 | 62,322 | 82,344 | 100,884 | na |
| City of Houston to NHCRWA contract[1] | $0 | na | - | 56,453 | 83,041 | 83,041 | 78,041 | 83,041 | na |
| City of Houston to SJRA contract[1] | $0 | na | - | 36,377 | 55,538 | 54,582 | 53,581 | 52,534 | na |
| City of Houston to WHCRWA contract[1] | $0 | na | 1,241 | 31,837 | 46,324 | 52,759 | 55,549 | 58,402 | na |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| City of Houston treatment expansion[1] | $2,045,672,161 | $479 | 16,000 | 280,000 | 128,000 | 64,000 | 48,000 | 48,000 | $1,867 |
| City of Huntsville water treatment plant[1] | $61,023,906 | $904 | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 | 11,200 | $429 |
| City of Missouri City Groundwater Reduction Plan[1] | $24,003,201 | $1,110 | - | 395 | 4,644 | 8,362 | 8,362 | 12,775 | $131 |
| City of Pearland surface water treatment plant[1] | $265,000,000 | $1,656 | 6,720 | 6,720 | 6,720 | 13,420 | 13,420 | 13,420 | $544 |
| City of Sealy groundwater treatment expansion[1] | $6,450,000 | $2,176 | - | 360 | 360 | 360 | 360 | 888 | $269 |
| City of Sugar Land Groundwater Reduction Plan[1] | $82,576,224 | $11,066 | - | 1,027 | 2,947 | 3,616 | 3,875 | 4,756 | $357 |
| Contract with Baytown Area Water Authority | $900,444 | $180 | - | - | 191 | 349 | 496 | 496 | $122 |
| Contract with BRA[1] | $652,480,634 | $704 | - | 49,416 | 35,211 | 62,308 | 100,156 | 145,264 | $514 |
| Contract with Brazosport Water Authority | $2,102,169 | na | - | 116 | 124 | 1,557 | 3,183 | 5,435 | na |
| Contract with CHCRWA[1] | $1,867,449 | $196 | - | 794 | 1,129 | 1,500 | 1,668 | 1,668 | na |
| Contract with Cities of Richmond-Rosenberg[1] | $0 | na | - | - | - | 1,091 | 3,060 | 5,645 | na |
| Contract with City of Houston[1] | $183,896,349 | na | - | 14,981 | 31,413 | 30,449 | 34,995 | 34,995 | $361 |
| Contract with City of Missouri City[1] | $4,807,747 | $100 | - | 713 | 6,330 | 10,661 | 10,911 | 15,435 | $12 |
| Contract with City of Pasadena[1] | $2,918,547 | $65 | - | 967 | 1,941 | 2,765 | 3,317 | 3,317 | $72 |
| Contract with City of Sugar Land[1] | $4,982,927 | na | - | 1,027 | 2,947 | 3,616 | 3,875 | 4,756 | na |
| Contract with CLCND[1] | $30,827,919 | $1,383 | - | 1,691 | 1,978 | 2,235 | 2,511 | 2,804 | $635 |
| Contract with Dow[1] | $155,206,615 | $745 | - | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | $646 |
| Contract with Fort Bend County WCID #2[1] | $2,049,847 | $233 | - | 491 | 1,092 | 1,092 | 1,092 | 1,092 | $49 |
| Contract with GCWA[1] | $144,117,128 | na | - | 135 | 54,513 | 58,116 | 60,587 | 65,213 | na |
| Contract with NCWA[1] | $3,632,614 | $55 | - | - | 2,088 | 3,078 | 3,852 | 3,852 | $84 |
| Contract with NFBWA[1] | $44,964,481 | $176 | - | 444 | 13,085 | 27,315 | 38,155 | 38,155 | $85 |
| Contract with NRG Energy[1] | $0 | na | - | - | - | - | - | 8,500 | na |
| Contract with SJRA[1] | $43,842,177 | na | - | - | - | 7,935 | 39,096 | 76,476 | na |
| Contract with WHCRWA[1] | $44,753,636 | $90 | - | 31,837 | 46,324 | 40,241 | 43,031 | 38,961 | $55 |
| Fort Bend County WCID #2 Groundwater Reduction Plan[1] | $24,828,857 | $571 | - | 2,296 | 5,753 | 5,753 | 5,753 | 5,753 | $200 |
| GCWA to City of Galveston contract[1] | $0 | na | - | 7,262 | 7,262 | 7,262 | 7,262 | 7,262 | na |
| GCWA to City of Missouri City contract[1] | $0 | na | - | 713 | 6,330 | 10,661 | 10,911 | 15,435 | na |
| GCWA to Fort Bend County WCID #2 contract[1] | $0 | na | - | 491 | 1,092 | 1,092 | 1,092 | 1,092 | na |
| GCWA to Galveston County WCID #1 contract[1] | $0 | na | - | 766 | 909 | 940 | 975 | 1,014 | na |
| Harris County MUD #50 water treatment plant[1] | $6,131,600 | $1,382 | 560 | 560 | 560 | 560 | 588 | 632 | $427 |
| Lake Livingston Water Supply and Sewer Service Corporation surface water project[1] | $3,087,974 | $561 | 954 | 954 | 954 | 954 | 954 | 954 | $279 |
| Luce Bayou transfer[1] | $253,916,914 | $248 | - | 128,259 | 206,276 | 207,629 | 205,171 | 270,742 | $36 |
| NFBWA Groundwater Reduction Plan[1] | $0 | na | 35,009 | 61,021 | 70,363 | 84,943 | 96,103 | 106,402 | na |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| NFBWA internal distribution[1] | $225,000,000 | $184 | 35,009 | 61,021 | 70,363 | 84,943 | 96,103 | 106,402 | $16 |
| NFBWA shared transmission line[1] | $213,000,000 | $56 | - | 21,878 | 39,405 | 52,595 | 62,606 | 71,876 | na |
| NHCRWA Groundwater Reduction Plan[1] | $0 | na | 34,714 | 91,167 | 117,755 | 99,625 | 81,126 | 117,755 | na |
| NHCRWA internal 2010 distribution[1] | $153,149,640 | $429 | 34,714 | 34,714 | 34,714 | 34,714 | 34,714 | 34,714 | $44 |
| NHCRWA internal 2020 distribution[1] | $345,292,192 | $368 | - | 91,167 | 91,167 | 91,167 | 91,167 | 91,167 | $38 |
| NHCRWA internal 2030 distribution[1] | $37,439,584 | $31 | - | - | 117,755 | 117,755 | 117,755 | 117,755 | $3 |
| NHCRWA transmission 2010[1] | $80,690,624 | $226 | 34,714 | 34,714 | 34,714 | 34,714 | 34,714 | 34,714 | $23 |
| NHCRWA transmission 2020[1] | $172,558,512 | $184 | - | 91,167 | 91,167 | 91,167 | 91,167 | 91,167 | $19 |
| NHCRWA transmission 2030[1] | $0 | na | - | - | 117,755 | 117,755 | 117,755 | 117,755 | na |
| Pecan Grove Groundwater Reduction Plan[1] | $15,960,000 | $2,150 | 866 | 866 | 1,731 | 1,731 | 1,731 | 1,731 | $544 |
| SJRA to City of Houston contract[1] | $0 | na | - | - | 1,356 | 5,300 | 3,875 | 2,428 | na |
| SJRA Water Resources Assessment Plan partipation[1] | $128,252,622 | $136 | - | 36,377 | 55,538 | 54,582 | 53,581 | 52,534 | $125 |
| SJRA Water Resources Assessment Plan[1] | $900,000,000 | $1,172 | - | 36,377 | 55,538 | 62,517 | 92,677 | 129,010 | $269 |
| WHCRWA Groundwater Reduction Plan[1] | $0 | na | 21,678 | 52,274 | 66,761 | 73,196 | 75,985 | 78,839 | na |
| WHCRWA internal distribution[1] | $552,472,000 | $607 | 21,678 | 52,274 | 66,761 | 73,196 | 75,985 | 78,839 | $70 |
| WHCRWA transmission line[1] | $290,084,193 | $202 | 21,678 | 52,274 | 66,761 | 73,196 | 75,985 | 78,839 | $37 |
| ***Region H Subtotal*** | $12,019,061,335 | | 378,759 | 622,426 | 863,980 | 1,040,504 | 1,202,010 | 1,501,180 | |
| **Region I** | | | | | | | | | |
| Angelina County Regional Project | $53,164,000 | $1,577 | - | - | - | 11,210 | 11,210 | 11,210 | $1,164 |
| Expand local surface water supplies | $1,983,800 | $164 | 50 | 150 | 707 | 990 | 1,000 | 1,190 | $78 |
| Fastrill replacement (Region I component)[2] | $0 | na | - | - | - | - | - | 22,400 | na |
| Forest Grove Reservoir project | $26,619,000 | $1,173 | - | - | - | 2,240 | 2,240 | 2,240 | $310 |
| Indirect reuse* | $0 | $33 | - | 2,872 | 2,872 | 2,872 | 2,872 | 2,872 | $33 |
| Infrastructure improvements | $1,000,000 | $97 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | $97 |
| Lake Kurth Regional System | $56,488,600 | $1,233 | 6,800 | 18,400 | 18,400 | 18,400 | 18,400 | 18,400 | $314 |
| Lake Noconiche Regional Supply System | $24,890,050 | $1,686 | - | 800 | 1,200 | 1,200 | 1,700 | 1,700 | $796 |
| Lake Palestine infrastructure | $79,389,250 | $830 | - | - | 16,815 | 16,815 | 16,815 | 16,815 | $418 |
| Municipal conservation | $0 | $579 | 111 | 480 | 811 | 1,085 | 1,381 | 1,701 | $81 |
| New source - Lake Columbia | $231,865,000 | $215 | - | 75,700 | 75,700 | 75,700 | 75,700 | 75,700 | $12 |
| New wells - Carrizo Wilcox Aquifer | $39,623,385 | $332 | 11,787 | 13,493 | 15,656 | 17,006 | 20,433 | 21,403 | $175 |
| New wells - Gulf Coast Aquifer | $6,818,213 | $515 | 804 | 1,992 | 2,199 | 3,033 | 3,038 | 3,043 | $159 |
| New wells - Queen City Aquifer | $5,646,042 | $761 | 137 | 231 | 318 | 455 | 650 | 1,097 | $3,313 |
| New wells - Yegua Jackson Aquifer | $2,581,793 | $253 | 710 | 730 | 971 | 1,110 | 1,302 | 1,376 | $216 |
| Overdraft Carrizo Wilcox Aquifer | $4,209,789 | $49 | 100 | 1,400 | 1,400 | 1,500 | 1,500 | 1,540 | $176 |
| Overdraft Gulf Coast Aquifer | $2,359,067 | $426 | 844 | 996 | 996 | 996 | 1,149 | 1,149 | $236 |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Permit amendment - Houston County Lake | $0 | na | 3,500 | 3,500 | 3,500 | 3,500 | 3,500 | 3,500 | na |
| Permit amendment for Sam Rayburn Reservoir | $0 | $154 | - | 28,000 | 28,000 | 28,000 | 28,000 | 28,000 | $154 |
| Purchase water from provider (1) | $17,495,246 | $186 | 5,396 | 42,367 | 46,133 | 51,148 | 51,167 | 54,200 | $90 |
| Purchase water from provider (2) | $109,419,358 | $769 | 2,152 | 29,995 | 38,839 | 42,939 | 86,040 | 89,365 | $188 |
| Purchase water from provider (3) | $0 | $978 | 27 | - | - | - | 5,175 | 5,175 | na |
| Reallocation of flood storage (Rayburn) | $0 | $25 | - | - | - | - | 122,000 | 122,000 | $25 |
| Saltwater barrier conjunctive operation with Rayburn/Steinhagen | $2,000,000 | $5 | - | 111,000 | 111,000 | 111,000 | 111,000 | 111,000 | $5 |
| Wholesale customer conservation | $1,400,000 | $2 | 20,000 | 30,000 | 33,000 | 35,000 | 40,000 | 40,000 | $1 |
| Angelina-Neches River Authority Treatment and Distribution System[1] | $35,127,250 | na | - | - | - | - | - | - | na |
| Indirect reuse[1] | $0 | $35 | - | 1,377 | 1,589 | 1,784 | 1,993 | 2,198 | $41 |
| New water treatment plant[1] | $12,387,000 | $560 | - | - | - | - | - | 2,240 | $560 |
| Purchase water from provider (1)[1] | $0 | $651 | 1,080 | 2,508 | 2,633 | 2,908 | 3,308 | 3,708 | $642 |
| Purchase water from provider (2)[1] | $113,947,150 | $586 | 13,350 | 45,201 | 33,051 | 34,351 | 45,751 | 56,251 | $371 |
| Purchase water from provider (3)[1] | $56,415,750 | $955 | - | 10,251 | 10,251 | 10,251 | 10,251 | 10,251 | $475 |
| ***Region I Subtotal*** | $884,829,743 | | 53,418 | 363,106 | 399,517 | 427,199 | 607,272 | 638,076 | |
| **Region J** | | | | | | | | | |
| Additional groundwater wells | $240,350 | $7 | 222 | 222 | 222 | 222 | 222 | 222 | $7 |
| Conservation: brush management[4] | $3,937,790 | $14 | 10,500 | 10,500 | 10,500 | 10,500 | 10,500 | 10,500 | $14 |
| Conservation: public information | $0 | $234 | 65 | 69 | 71 | 71 | 76 | 77 | $251 |
| Conservation: system water audit and water loss audit | $0 | $43 | 514 | 553 | 570 | 572 | 593 | 604 | $36 |
| Groundwater wells | $247,250 | $7 | 172 | 172 | 172 | 172 | 172 | 172 | $7 |
| Increased water treatment and aquifer storage and recovery capacity | $6,650,000 | $364 | 2,240 | 2,240 | 2,240 | 2,240 | 2,240 | 2,240 | $150 |
| Purchase water from UGRA | $0 | $1,000 | - | - | 3,840 | 3,840 | 3,840 | 5,450 | $1,000 |
| Replace pressure tank | $7,000 | na | - | - | - | - | - | - | na |
| Surface water acquisition, treatment and aquifer storage and recovery | $36,660,000 | $1,620 | - | 1,624 | 1,624 | 2,124 | 2,124 | 2,624 | $518 |
| Surface water storage | $7,050,000 | $581 | - | 1,121 | 1,121 | 1,121 | 1,121 | 1,121 | $581 |
| ***Region J Subtotal*** | $54,792,390 | | 13,713 | 16,501 | 20,360 | 20,862 | 20,888 | 23,010 | |
| **Region K** | | | | | | | | | |
| Additional municipal conservation | $0 | $548 | - | - | - | 522 | 1,027 | 1,844 | $243 |
| Amend LCRA contract | $0 | $98 | 3,708 | 5,265 | 6,165 | 8,503 | 10,955 | 12,911 | $125 |
| Aquifer storage and recovery | $168,711,000 | $3,802 | - | - | - | 10,000 | 10,000 | 10,000 | $3,802 |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Blend brackish surface water in South Texas Project Nuclear Operating Company Reservoir | $0 | na | - | 17,505 | 17,505 | 17,505 | 17,505 | 17,625 | na |
| City of Austin conservation | $0 | $215 | 11,030 | 18,795 | 24,036 | 25,385 | 30,401 | 36,370 | $47 |
| City of Austin direct reuse (municipal and manufacturing) | $302,250,510 | $851 | 5,143 | 13,620 | 22,077 | 30,268 | 36,218 | 40,468 | $851 |
| City of Austin direct reuse (steam-electric) | $302,250,510 | $851 | 2,315 | 3,315 | 7,315 | 8,315 | 12,315 | 13,315 | $851 |
| City of Austin return flows | $0 | na | 46,853 | 45,641 | 49,862 | 62,330 | 64,645 | 74,366 | na |
| Conjunctive use of groundwater - includes overdraft | $0 | na | - | 62,000 | 62,000 | 62,000 | 62,000 | 62,000 | na |
| Development of Carrizo-Wilcox Aquifer | $12,242,071 | $771 | - | 1,687 | 1,687 | 1,687 | 2,662 | 2,933 | $748 |
| Development of Ellenburger-San Saba Aquifer | $5,601,523 | $1,542 | 478 | 478 | 478 | 478 | 519 | 542 | $1,869 |
| Development of Gulf Coast Aquifer | $164,000 | $376 | - | - | - | - | - | 82 | $376 |
| Development of Hickory Aquifer | $4,697,200 | $1,711 | 512 | 488 | 406 | 331 | 261 | 196 | $3,815 |
| Development of new rice varieties | $0 | na | - | 40,800 | 40,800 | 40,800 | 40,800 | 40,800 | na |
| Development of other aquifer | $3,104,788 | $23 | 4,291 | 4,291 | 4,370 | 4,582 | 4,839 | 5,180 | $104 |
| Development of Queen City Aquifer | $4,190,135 | $1,082 | - | - | - | - | - | 580 | $1,082 |
| Development of saline zone of Edwards-Balcones Fault Zone Aquifer | $19,753,964 | $979 | - | 250 | 2,750 | 2,850 | 5,500 | 7,100 | $979 |
| Development of Trinity Aquifer | $4,084,198 | $8,140 | - | - | 75 | 200 | 301 | 400 | $1,657 |
| Downstream return flows | $0 | na | - | - | 460 | 1,836 | 3,443 | 4,590 | na |
| Drought management | $0 | na | 461 | 461 | 461 | 461 | 461 | 1,912 | $38 |
| Enhanced municipal and industrial conservation | $0 | $400 | - | - | 2,000 | 10,000 | 20,000 | 20,000 | $400 |
| Expand supply from South Texas Project Nuclear Operating Company Reservoir | $0 | na | 193 | - | - | - | - | - | na |
| Expansion of Carrizo-Wilcox Aquifer | $16,872,960 | $357 | 4,350 | 5,815 | 8,476 | 9,779 | 12,950 | 12,920 | $484 |
| Expansion of Ellenburger-San Saba Aquifer | $14,482,800 | $1,989 | 681 | 756 | 788 | 1,229 | 1,633 | 2,076 | $1,827 |
| Expansion of Gulf Coast Aquifer | $1,475,140 | $85 | 4,486 | 4,261 | 3,659 | 2,573 | 1,185 | 1,409 | $350 |
| Expansion of Hickory Aquifer | $611,320 | $4,943 | 62 | 62 | 62 | 62 | 62 | 62 | $4,943 |
| Expansion of other aquifer | $1,721,920 | $626 | - | 416 | 777 | 1,366 | 2,017 | 2,814 | $118 |
| Expansion of Queen City Aquifer | $0 | $20 | 98 | 40 | 40 | 31 | 24 | 17 | $20 |
| Expansion of Sparta Aquifer | $0 | $37 | 188 | 208 | 129 | 129 | 129 | 129 | $37 |
| Expansion of Trinity Aquifer | $3,609,180 | $789 | 428 | 431 | 988 | 937 | 1,147 | 1,124 | $745 |
| Expansion of Yegua-Jackson Aquifer | $0 | $37 | - | - | - | - | - | 9 | $37 |
| Firm-up run-of-river with off-channel reservoir - LCRA/SAWS project (Region K Component) | $0 | na | - | - | - | - | - | 47,000 | na |
| Goldthwaite Channel Dam | $1,841,800 | $1,383 | 300 | 300 | 300 | 300 | 300 | 300 | $1,383 |
| House Bill 1437 on-farm conservation | $3,817,897 | $13 | 4,000 | 4,000 | 4,000 | 4,000 | 14,800 | 25,000 | $13 |
| Irrigation district conveyance improvements | $0 | na | - | 65,000 | 65,000 | 65,000 | 65,000 | 65,000 | na |
| LCRA Water Management Plan interruptible water supply | $0 | na | 255,493 | 196,568 | 137,643 | 78,718 | 19,793 | - | na |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Municipal conservation | $0 | $567 | 3,468 | 6,462 | 9,644 | 12,684 | 15,444 | 18,380 | $90 |
| New LCRA contracts | $17,556,000 | $138 | - | 35,564 | 36,782 | 59,422 | 60,177 | 69,910 | $181 |
| On-farm conservation | $0 | na | - | 34,150 | 34,150 | 34,150 | 34,150 | 34,150 | na |
| Purchase water from City of Austin | $2,280,200 | $963 | 1,100 | 1,100 | 1,100 | 1,100 | 1,100 | 1,100 | $963 |
| Purchase water from West Travis County Regional Water Supply | $0 | $138 | 846 | 925 | 989 | 1,015 | 990 | 958 | $138 |
| Reuse by Highland Lakes communities | $15,920,000 | $550 | - | 500 | 2,000 | 5,000 | 5,000 | 5,000 | $550 |
| Temporary drought period use of Gulf Coast Aquifer | $0 | $37 | - | - | - | - | - | 47 | $37 |
| Temporary drought period use of Queen City Aquifer | $0 | $20 | 21 | 10 | - | - | - | - | na |
| Water allocation | $0 | na | 67 | 110 | - | - | - | - | na |
| Water right permit amendment | $0 | na | - | 5,500 | 5,500 | 5,500 | 5,500 | 5,500 | na |
| Water transfer | $0 | na | 11 | 21 | 30 | 37 | 43 | 48 | na |
| House Bill 1437 for Williamson County[1] | $0 | $173 | 126 | 246 | 349 | 426 | 536 | 645 | $173 |
| New LCRA contracts[1] | $0 | $138 | 300 | 300 | 300 | 300 | 300 | 300 | $138 |
| ***Region K Subtotal*** | **$907,239,116** | | **350,583** | **576,795** | **554,504** | **571,085** | **565,296** | **646,167** | |
| **Region L** | | | | | | | | | |
| Aquifer storage and recovery project and phased expansion | $0 | na | 3,800 | 16,000 | 16,000 | 16,000 | 16,000 | 16,000 | na |
| Brackish groundwater desalination (Wilcox Aquifer) | $378,330,000 | $1,245 - $1,823 | - | 12,000 | 28,600 | 35,120 | 40,720 | 42,220 | $465 - $766 |
| Construction of Lavaca River off-channel reservoir diversion project (Region L component) | $85,429,083 | $701 | - | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | $100 |
| CRWA Siesta project | $53,481,000 | $1,421 | - | - | 1,000 | 5,042 | 5,042 | 5,042 | $497 |
| CRWA Wells Ranch project Phase I | $0 | na | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | na |
| CRWA Wells Ranch project Phase II (including Gonzales County) | $34,910,000 | $725 | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 | 5,800 | $200 |
| Drought management | $0 | na | 41,240 | - | - | - | - | - | na |
| Edwards Aquifer recharge - Type 2 projects | $527,643,000 | $2,005 | - | 13,451 | 13,451 | 13,451 | 13,451 | 21,577 | $340 |
| Edwards transfers | $0 | $454 | 45,896 | 47,479 | 48,931 | 49,870 | 50,855 | 51,875 | na |
| Facilities expansion | $142,282,000 | na | - | - | - | - | - | - | na |
| Firm-up- run-of-river with off-channel reservoir - LCRA/SAWS project (Region L component) | $1,986,684,000 | $2,394 | - | - | 90,000 | 90,000 | 90,000 | 90,000 | $829 |
| GBRA Exelon project | $280,598,000 | $646 | - | 49,126 | 49,126 | 49,126 | 49,126 | 49,126 | $224 |
| GBRA lower basin storage | $33,800,000 | $104 | - | - | 28,369 | 28,369 | 28,369 | 28,369 | $60 |
| GBRA mid basin (surface water) | $546,941,000 | $1,879 | - | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 | $370 |
| GBRA new appropriation (lower basin) | $246,849,000 | $1,910 | - | - | 11,300 | 11,300 | 11,300 | 11,300 | $223 |
| GBRA Simsboro project (overdraft) | $330,782,000 | $982 | - | 30,000 | 30,000 | 30,000 | 49,777 | 49,777 | $386 |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Hays/Caldwell Public Utility Authority Project (including Gonzales County) | $307,717,752 | $1,245 | - | 7,289 | 14,597 | 19,418 | 25,868 | 33,314 | $439 |
| Industrial, steam-electric power generation, and mining water conservation | $0 | na | 521 | 726 | 1,771 | 1,992 | 2,293 | 2,493 | na |
| Irrigation water conservation | $0 | $143 | 20,087 | 17,561 | 14,429 | 11,421 | 8,543 | 7,238 | $136 |
| Livestock water conservation | $0 | na | 3 | 1 | - | - | - | - | na |
| Local groundwater (Gulf Coast Aquifer) | $2,194,000 | $1,823 | - | - | - | 161 | 161 | 161 | $637 |
| Local groundwater (Trinity Aquifer) | $30,224,000 | $644 | 2,016 | 3,145 | 3,468 | 3,629 | 3,952 | 4,436 | $440 |
| Local groundwater Carrizo-Wilcox Aquifer (includes overdrafts) | $166,718,000 | $577 | 6,773 | 11,610 | 15,441 | 17,256 | 23,946 | 33,874 | $464 |
| Medina Lake firm-up (aquifer storage and recovery) | $146,237,000 | $1,696 | 9,933 | 9,933 | 9,933 | 9,933 | 9,933 | 9,933 | $450 |
| Municipal water conservation | $0 | $648 | 13,232 | 22,744 | 31,618 | 40,531 | 53,925 | 72,566 | $572 |
| Purchase from New Braunfels Utilities/redistribution of supplies | $0 | varies | 1,443 | 552 | 552 | 552 | 552 | 552 | varies |
| Purchase from wholesale water provider (GBRA) | $0 | varies | 8,940 | 4,805 | - | - | - | - | na |
| Purchase from wholesale water provider (LNRA)/redistribution of supplies | $0 | varies | 46 | 145 | 322 | 499 | 489 | 489 | varies |
| Purchase from wholesale water provider (SSLGC)/redistribution of supplies | $0 | varies | 581 | 719 | 876 | 1,034 | 1,197 | 1,376 | varies |
| Recycled water programs | $465,339,000 | varies | 21,666 | 26,046 | 30,151 | 34,178 | 37,706 | 41,737 | varies |
| Regional Carrizo for SAWS (including Gonzalas County) | $136,550,000 | $1,343 | - | 11,687 | 11,687 | 11,687 | 11,687 | 11,687 | $324 |
| Regional Carrizo for SSLGC project expansion (including Gonzales County) | $28,189,000 | $568 | - | 10,364 | 10,364 | 10,364 | 10,364 | 10,364 | $331 |
| Seawater desalination | $1,293,827,000 | $2,284 | - | - | - | - | - | 84,012 | $2,284 |
| Storage above Canyon Reservoir (aquifer storage and recovery) | $37,326,000 | $1,772 | - | 3,140 | 3,140 | 3,140 | 3,140 | 3,140 | $587 |
| TWA Regional Carrizo (including Gonzales County) | $313,060,000 | $1,523 | - | 27,000 | 27,000 | 27,000 | 27,000 | 27,000 | $512 |
| Western Canyon water treatment plant expansion | $11,727,436 | $315 | - | - | - | - | 5,600 | 5,600 | $315 |
| Wimberley and Woodcreek water supply project | $33,771,000 | $2,429 | 1,120 | 4,480 | 4,480 | 4,480 | 4,480 | 4,480 | $4,480 |
| Brackish groundwater desalination (Wilcox Aquifer)[1] | $0 | na | - | - | 3,596 | 3,596 | 9,196 | 9,196 | na |
| CRWA Siesta Project[1] | $0 | na | - | - | 1,000 | 5,042 | 3,711 | 4,211 | na |
| CRWA Wells Ranch Project Phase I[1] | $0 | $725 | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | 5,200 | $200 |
| CRWA Wells Ranch Project Phase II (including Gonzales County)[1] | $0 | $725 | 1,296 | 4,626 | 5,800 | 5,800 | 5,800 | 5,800 | $200 |
| Edwards transfers[1] | $0 | na | 5,259 | 6,220 | 8,297 | 12,483 | 20,823 | 21,138 | na |
| Facilities expansion[1] | $2,277,000 | na | - | - | - | - | - | - | na |
| GBRA lower basin storage[1] | $0 | na | - | - | 7,786 | 10,755 | 13,416 | 16,391 | na |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| GBRA mid-basin (surface water)[1] | $0 | na | - | 12,855 | 13,554 | 13,988 | 14,424 | 14,794 | na |
| GBRA new appropriation (lower basin)[1] | $0 | na | - | - | - | 81 | 193 | 310 | na |
| GBRA Simsboro project (overdraft)[1] | $0 | na | - | 9,268 | 14,174 | 20,954 | 28,024 | 35,786 | na |
| Hays/Caldwell Public Utility Authority project (including Gonzales County)[1] | $0 | na | - | 1,370 | 7,521 | 5,344 | 5,986 | 7,502 | na |
| Local groundwater (Trinity Aquifer)[1] | $0 | na | 296 | 283 | 403 | 705 | 963 | 1,216 | na |
| Local groundwater Carrizo-Wilcox Aquifer (includes overdrafts)[1] | $0 | na | 120 | 120 | 120 | 120 | 120 | 120 | na |
| Medina Lake firm-up (aquifer storage and recovery)[1] | $0 | na | 500 | 500 | 500 | 500 | 500 | 500 | na |
| Recycled water programs[1] | $0 | na | 4,240 | 7,367 | 15,127 | 15,127 | 15,127 | 15,127 | na |
| Regional Carrizo for SSLGC project expansion (including Gonzales County)[1] | $0 | $568 | - | 616 | 2,302 | 4,082 | 5,764 | 7,573 | na |
| Storage above Canyon Reservoir (aquifer storage and recovery)[1] | $0 | na | - | 3,140 | 3,140 | 3,140 | 3,140 | 3,140 | na |
| TWA Regional Carrizo (including Gonzales County)[1] | $0 | na | - | 6,828 | 13,717 | 17,591 | 21,556 | 25,575 | na |
| Western Canyon water treatment plant expansion[1] | $0 | $315 | - | - | - | - | - | 650 | $315 |
| Wimberley and Woodcreek water supply project[1] | $0 | na | 1,120 | 4,480 | 4,480 | 4,480 | 4,480 | 4,480 | $1,772 |
| ***Region L Subtotal*** | $7,622,886,271 | | 188,297 | 376,003 | 542,606 | 571,553 | 631,476 | 765,738 | |
| **Region M** | | | | | | | | | |
| Acquisition of water rights through contract | $16,263,877 | $430 | 312 | 738 | 1,665 | 2,352 | 3,198 | 4,671 | $430 |
| Acquisition of water rights through purchase | $631,081,709 | $294 | 9,611 | 19,461 | 41,602 | 70,944 | 110,913 | 151,237 | $424 |
| Acquisition of water rights through urbanization | $56,167,089 | $430 | 299 | 3,433 | 6,467 | 9,496 | 12,868 | 16,406 | $430 |
| Advanced water conservation | $22,583,710 | varies | 2,917 | 6,339 | 11,986 | 16,512 | 24,867 | 32,793 | varies |
| Banco Morales Reservoir | $25,790,900 | $2,542 | - | 238 | 238 | 238 | 238 | 238 | $2,542 |
| Brackish water desalination | $267,290,631 | $465 | 56,553 | 63,239 | 67,221 | 73,984 | 86,708 | 92,212 | $468 |
| Brownsville weir and reservoir | $98,411,077 | $183 | - | 20,643 | 20,643 | 20,643 | 20,643 | 23,643 | $183 |
| Expand existing groundwater wells | $27,474,302 | $215 | 3,772 | 8,572 | 17,139 | 20,492 | 22,284 | 24,520 | $254 |
| Irrigation conveyance system conservation | $131,899,803 | $3 | 11,204 | 37,711 | 63,762 | 89,347 | 114,465 | 139,217 | $15 |
| Laredo low water weir | $294,400,000 | na | - | - | - | - | - | - | na |
| Non-potable reuse | $174,944,916 | $101 | 2,417 | 9,891 | 16,425 | 28,087 | 42,938 | 64,116 | $130 |
| On-farm water conservation | $194,569,720 | $128 | 1,622 | 10,419 | 26,299 | 49,073 | 78,550 | 114,619 | $29 |
| Potable reuse | $7,519,850 | $150 | 1,120 | 1,120 | 1,120 | 1,120 | 1,150 | 1,290 | $180 |
| Proposed elevated storage tank and infrastructure improvements for City of Elsa | $8,325,386 | $102 | 105 | 105 | 105 | 105 | 105 | 105 | $102 |
| Resaca restoration | $52,000,000 | $2,542 | 877 | 877 | 877 | 877 | 877 | 877 | $2,542 |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| Seawater desalination | $185,940,937 | $1,051 | 125 | 125 | 143 | 6,049 | 6,421 | 7,902 | $1,051 |
| ***Region M Subtotal*** | **$2,194,663,908** | | **90,934** | **182,911** | **275,692** | **389,319** | **526,225** | **673,846** | |
| **Region N** | | | | | | | | | |
| Construction of Lavaca River off-channel reservoir diversion project (Region N component) | $138,753,917 | $1,027 | - | - | - | - | - | 16,242 | $1,027 |
| Garwood Pipeline | $112,798,000 | $685 | - | 35,000 | 35,000 | 35,000 | 35,000 | 35,000 | $402 |
| Gulf Coast Aquifer Supplies | $13,413,000 | $100 - $144 | 1,975 | 2,535 | 11,535 | 11,535 | 13,551 | 13,551 | $24 - $100 |
| Gulf Coast Aquifer Supplies (regional) | $59,245,000 | $853 | - | - | 11,000 | 11,000 | 11,000 | 18,000 | $566 |
| Irrigation water conservation | $0 | $228 | 17 | 52 | 103 | 169 | 248 | 342 | $228 |
| Manufacturing water conservation | $0 | na | 1,260 | 1,418 | 1,576 | 1,734 | 1,892 | 2,050 | na |
| Mining water conservation | $0 | na | 281 | 626 | 998 | 1,410 | 1,863 | 2,343 | na |
| Municipal water conservation | $0 | $423 - $448 | 106 | 353 | 721 | 1,153 | 1,763 | 2,415 | $423 - $448 |
| O.N. Stevens Water Treatment Plant improvements | $31,324,000 | $178 | 42,329 | 40,048 | 38,102 | 36,366 | 34,817 | 32,996 | $146 |
| Off-channel reservoir near Lake Corpus Christi | $300,577,000 | $715 | - | - | 30,340 | 30,340 | 30,340 | 30,340 | $578 |
| Reclaimed wastewater supplies | $0 | $826 | 250 | 250 | 250 | 250 | 250 | 250 | $826 |
| Voluntary redistribution | $0 | $685 - $798 | 736 | 738 | 914 | 1,060 | 2,706 | 2,797 | $685 - $798 |
| ***Region N Subtotal*** | **$656,110,917** | | **46,954** | **81,020** | **130,539** | **130,017** | **133,430** | **156,326** | |
| **Region O** | | | | | | | | | |
| CRMWA Region O local groundwater development | $56,574,000 | $358 | - | - | 15,500 | 14,130 | 12,717 | 11,445 | $412 |
| Irrigation water conservation | $345,824,000 | $63 | 479,466 | 431,517 | 388,366 | 349,528 | 314,577 | 283,118 | $106 |
| Lake Alan Henry Pipeline for the City of Lubbock | $294,329,000 | $1,310 | 21,880 | 21,880 | 21,880 | 21,880 | 21,880 | 21,880 | $1,310 |
| Lake Alan Henry Supply for Lake Alan Henry Water Supply Corporation | $7,334,502 | $3,349 | 270 | 270 | 270 | 270 | 270 | 270 | $3,349 |
| Local groundwater development | $21,438,369 | na | 10,034 | 12,711 | 15,253 | 15,871 | 16,841 | 16,175 | na |
| Lubbock brackish groundwater desalination | $13,167,000 | $663 | - | 3,360 | 3,360 | 3,360 | 3,360 | 3,360 | $663 |
| Lubbock Jim Bertram Lake 7 | $68,288,400 | $451 | - | 17,650 | 17,650 | 17,650 | 17,650 | 17,650 | $451 |
| Lubbock North Fork diversion operation (A) | $153,040,000 | $6,340 | - | 3,675 | 3,675 | 3,675 | 3,675 | 3,675 | $6,340 |
| Municipal water conservation | $0 | $668 | 5,809 | 10,583 | 10,729 | 10,264 | 10,206 | 10,424 | $550 |
| Post Reservoir - Delivered to Lake Alan Henry Pipeline | $110,307,000 | $695 | - | - | 25,720 | 25,720 | 25,720 | 25,720 | $695 |
| Reclaimed water - White River Municipal Water District | $38,089,684 | $1,593 | - | 2,240 | 2,240 | 2,240 | 2,240 | 2,240 | $1,593 |
| ***Region O Subtotal*** | **$1,108,391,955** | | **517,459** | **503,886** | **504,643** | **464,588** | **429,136** | **395,957** | |

## APPENDIX A.2. RECOMMENDED WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Recommended Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| **Region P** | | | | | | | | | |
| Conjunctive use of groundwater (temporary overdraft) - Jackson County | $0 | $42 | 5,053 | 5,053 | 5,053 | 5,054 | 5,053 | 5,053 | $42 |
| Conjunctive use of groundwater (temporary overdraft) - Wharton County | $0 | $42 | 62,686 | 62,686 | 62,686 | 62,686 | 62,686 | 62,686 | $42 |
| ***Region P Subtotal*** | $0 | | 67,739 | 67,739 | 67,739 | 67,740 | 67,739 | 67,739 | |

1 - Denotes strategies with supply volumes included in other strategies

2 - Estimated planning costs and water supply associated with this strategy are based on the Neches River Run-of River strategy. This project, however is only one of several water management strategies being considered to meet these 2060 needs, and through action by the Region C Water Planning Group, any of those other strategies may be substituted into the plan to represent the 'Fastrill Reservoir Replacement' strategy. Those other strategies include: additional water conservation, Lake Texoma, Toledo Bend Reservoir, Lake O' the Pines, Lake Livingston, Ogallala groundwater in Roberts County (Region A), Marvin Nichols Reservoir, Lake Columbia, George Parkhouse Reservoir (North), George Parkhouse Reservoir (South), and Oklahoma Water.

3 - Denotes strategies with supply volumes included in Region C Strategies (including supply from Bois D'Arc reservoir)
4 - Supply would not available during drought of record conditions
"na" = not available/applicable

## APPENDIX A.3.: ALTERNATIVE WATER MANAGEMENT STRATEGIES AND COST ESTIMATES

| Alternative Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| **Region A** | | | | | | | | | |
| Palo Duro Reservoir Transmission System | $107,839,700 | $2,891 | 0 | 0 | 3,758 | 3,758 | 3,758 | 3,750 | $390 |
| Precipitation enhancement | $0 | $6 | 0 | 87,558 | 87,558 | 87,558 | 87,558 | 87,558 | $6 |
| Voluntary transfers from other users | $3,116,400 | $1,870 | 0 | 0 | 300 | 500 | 800 | 1,000 | $871 |
| **Region B** | | | | | | | | | |
| Develop Trinity Aquifer supplies | $1,650,000 | $1,200 | 171 | 171 | 171 | 171 | 171 | 171 | $357 |
| Develop Trinity Aquifer supplies (including overdrafting) | $654,000 | $446 | 177 | 177 | 177 | 177 | 177 | 177 | $125 |
| Purchase water from local provider (alternative 1) | $364,500 | $1,200 | 584 | 584 | 584 | 584 | 584 | 584 | $1,145 |
| Purchase water from local provider (alternative 2) | $239,671 | $1,200 | 384 | 384 | 384 | 384 | 384 | 384 | $1,145 |
| Purchase water from local provider (alternative 3) | $848,000 | $3,050 | 40 | 40 | 40 | 40 | 40 | 40 | $1,200 |
| Wastewater reuse | $57,100,000 | $770 | 0 | 0 | 0 | 11,000 | 11,000 | 11,000 | $317 |
| **Region C** | | | | | | | | | |
| Brazos groundwater project to DWU | $801,451,000 | $1,222 | 0 | 0 | 0 | 100,000 | 100,000 | 100,000 | $1,222 |
| Brazos groundwater project to NTMWD | $913,344,000 | $1,416 | 0 | 0 | 100,000 | 100,000 | 100,000 | 100,000 | $752 |
| Cooke County project | $3,254,000 | $2,110 | 0 | 200 | 200 | 200 | 200 | 200 | $930 |
| Indirect reuse | $195,183,000 | na | 0 | 0 | 26,000 | 26,000 | 26,000 | 26,000 | $380 |
| Lake Columbia to DWU | $179,945,000 | $536 | 0 | 0 | 0 | 35,800 | 35,800 | 35,800 | $536 |
| Lake George Parkhouse North for DWU | $521,281,000 | $4,650 | 0 | 0 | 0 | 112,100 | 112,100 | 112,100 | $4,650 |
| Lake George Parkhouse North for NTMWD | $1,029,185,000 | $580 | 0 | 0 | 203,960 | 203,960 | 203,960 | 203,960 | $156 |
| Lake George Parkhouse South for DWU | $692,921,000 | $568 | 0 | 0 | 0 | 115,260 | 115,260 | 115,260 | $568 |
| Lake George Parkhouse South for NTMWD | $1,282,503,000 | $758 | 0 | 0 | 193,480 | 193,480 | 193,480 | 193,480 | $177 |
| Lake Livingston to DWU | $1,855,538,000 | $982 | 0 | 0 | 0 | 200,000 | 200,000 | 200,000 | $982 |
| Lake Livingston to NTMWD | $2,115,111,000 | $1,103 | 0 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | $334 |
| Lake Livingston to TRWD | $2,084,210,000 | $1,120 | 0 | 0 | 200,000 | 200,000 | 200,000 | 200,000 | $363 |
| Lake O' the Pines to DWU | $541,534,000 | $705 | 0 | 0 | 0 | 89,600 | 89,600 | 89,600 | $705 |
| Lake O' the Pines to NTMWD | $402,431,000 | $576 | 0 | 0 | 87,900 | 87,900 | 87,900 | 87,900 | $244 |
| Lake Ralph Hall | $143,201,000 | $847 | 0 | 0 | 29,219 | 29,219 | 29,219 | 29,219 | $135 |
| Lake Tehuacana | $746,345,000 | $1,118 | 0 | 0 | 56,800 | 56,800 | 56,800 | 56,800 | $163 |
| Lake Texoma - authorized (desalinate) | $796,532,000 | $994 | 0 | 105,000 | 105,000 | 105,000 | 105,000 | 105,000 | $443 |
| Lake Texoma - not authorized (blend) | $673,749,300 | $463 | 0 | 8,400 | 146,400 | 146,400 | 146,400 | 146,400 | $112 |
| Lake Texoma - not authorized (desalinate) | $925,918,000 | $1,099 | 0 | 0 | 105,000 | 105,000 | 105,000 | 105,000 | $459 |
| Lake Texoma to DWU (blend) | $56,334,000 | $306 | 0 | 20,000 | 20,000 | 20,000 | 20,000 | 20,000 | $101 |
| Marvin Nichols Reservoir with DWU | $322,326,000 | $455 | 0 | 0 | 50,000 | 50,000 | 50,000 | 50,000 | $127 |
| New wells - other aquifer | $7,000,000 | $219 | 0 | 4,480 | 4,480 | 4,480 | 4,480 | 4,480 | $106 |

## APPENDIX A.3.: ALTERNATIVE WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Alternative Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| NTMWD interim purchase from DWU (alternative strategies) | $1,777,000 | $464 | 0 | 11,200 | 11,200 | 0 | 0 | 0 | na |
| Oklahoma water to DWU | $343,934,000 | $702 | 0 | 0 | 0 | 0 | 0 | 50,000 | $702 |
| Purchase water from local provider (alternative 1) | $20,133,000 | $1,084 | 0 | 0 | 6,726 | 6,726 | 6,726 | 6,726 | $866 |
| Roberts County project to DWU | $2,435,534,000 | $1,109 | 0 | 0 | 0 | 200,000 | 200,000 | 200,000 | $1,109 |
| Roberts County project to NTMWD | $2,434,529,000 | $1,127 | 0 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | $243 |
| Toledo Bend Project | $1,433,774,000 | $813 | 0 | 0 | 0 | 0 | 200,000 | 200,000 | $813 |
| Water treatment plant - expansion | $14,548,000 | na | 0 | 0 | 0 | 0 | 0 | 0 | na |
| Water treatment plant - new | $17,000,000 | $259 | 0 | 8,960 | 8,960 | 8,960 | 8,960 | 8,960 | $121 |
| Water treatment plant - new (alternative strategies) | $48,972,000 | $1,204 | 0 | 0 | 6,726 | 6,726 | 6,726 | 6,726 | $675 |
| Wright Patman - reallocation of flood pool NTMWD | $1,433,524,000 | $797 | 0 | 0 | 230,000 | 230,000 | 230,000 | 230,000 | $227 |
| Wright Patman - reallocation of flood pool TRWD (180K) | $1,694,140,000 | $954 | 0 | 0 | 180,000 | 180,000 | 180,000 | 180,000 | $270 |
| Wright Patman - Texarkana sale to NTMWD | $1,192,489,000 | $1,090 | 0 | 0 | 150,000 | 150,000 | 150,000 | 150,000 | $390 |
| Wright Patman - Texarkana sale to TRWD | $1,081,475,000 | $1,167 | 0 | 0 | 100,000 | 100,000 | 100,000 | 100,000 | $382 |
| Wright Patman system operation | $2,954,940,000 | $1,057 | 0 | 0 | 298,000 | 298,000 | 298,000 | 298,000 | $337 |
| Marvin Nichols Reservoir with DWU[1] | $634,154,000 | $661 | 0 | 0 | 95,931 | 95,931 | 95,931 | 95,931 | $181 |
| Wright Patman system operation[1] | $403,387,000 | $2,023 | 0 | 0 | 50,000 | 50,000 | 50,000 | 50,000 | $582 |
| **Region D** | | | | | | | | | |
| Alternative Grand Saline Reservoir | $54,613,652 | $225,204 | 0 | 0 | 29 | 57 | 104 | 161 | $11,402 |
| Alternative reuse City of Canton | $3,761,806 | $18,397 | 0 | 0 | 29 | 57 | 104 | 161 | $1,617 |
| **Region F** | | | | | | | | | |
| Advanced treatment | $78,000 | $664 | 113 | 113 | 113 | 113 | 113 | 113 | $566 |
| Steam-electric alternative generation technology | $626,502,088 | $1,032 - $1,660 | 4,077 | 5,524 | 8,533 | 12,210 | 17,468 | 24,306 | $1,962 |
| Aquifer storage recovery | $1,752,000 | $1,271 | 240 | 240 | 240 | 240 | 240 | 240 | $633 |
| Bottled water program | $176,000 | $24,522 | 1 | 1 | 1 | 1 | 1 | 1 | $24,522 |
| Desalination | $14,494,000 | $1,740 - $1,879 | 500 | 850 | 850 | 850 | 850 | 850 | $314 - $349 |
| Develop Edwards Trinity Aquifer supplies | $57,062,000 | $660 - $1,080 | 1,000 | 1,000 | 1,000 | 13,000 | 13,000 | 13,000 | $288 - $311 |
| Develop other aquifer supplies | $287,925,000 | $2,060 - $2,643 | 150 | 650 | 650 | 12,650 | 12,650 | 12,650 | $173 - $626 |
| New/renew water supply - new infrastructure | $6,795,000 | $3,361 | 220 | 220 | 220 | 220 | 220 | 220 | $670 |
| Off-channel reservoir | $25,273,000 | $4,430 | 500 | 500 | 500 | 500 | 500 | 500 | $758 |
| Reuse | $2,567,000 | $1,473 | 0 | 220 | 220 | 220 | 220 | 220 | $455 |

## APPENDIX A.3.: ALTERNATIVE WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Alternative Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| **Region G** | | | | | | | | | |
| Additional Carrizo Aquifer development (includes overdrafting) | $212,042,000 | $842 | 0 | 35,000 | 35,000 | 35,000 | 35,000 | 35,000 | $314 |
| BRA system operations permit | $14,086,000 | $943 | 0 | 1,530 | 1,530 | 1,530 | 1,530 | 1,530 | $140 |
| Interconnection from Abilene to Sweetwater | $46,964,000 | $2,365 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | $1,342 |
| Lake Aquilla Augmentation | $64,749,000 | $552 | 0 | 5,000 | 5,000 | 5,000 | 5,000 | 5,000 | $232 |
| Lake Palo Pinto off-channel reservoir | $25,399,000 | $804 | 0 | 3,110 | 3,110 | 3,110 | 3,110 | 3,110 | $92 |
| Possum Kingdom supply[1] | $189,947,000 | $2,077 | 0 | 12,400 | 12,400 | 12,400 | 12,400 | 12,400 | $741 |
| **Region H** | | | | | | | | | |
| Little River Reservoir, off-channel | $137,356,000 | $436 | 0 | 0 | 27,225 | 27,225 | 27,225 | 27,225 | $317 |
| Montgomery MUD 8 and 9 brackish desalination | $12,000,000 | $1,171 | 2,240 | 2,240 | 2,240 | 2,240 | 2,240 | 2,240 | $1,171 |
| Sabine to Region H transfer | $760,813,320 | $203 | 0 | 0 | 486,500 | 486,500 | 486,500 | 486,500 | $67 |
| **Region I** | | | | | | | | | |
| New wells - Carrizo-Wilcox Aquifer | $299,452 | $285 | 0 | 0 | 0 | 212 | 212 | 212 | $162 |
| Purchase water from provider (1) | $1,021,000 | $1,482 | 100 | 100 | 100 | 100 | 100 | 100 | $592 |
| Purchase water from provider (2) | $1,389,500 | $285 | 700 | 700 | 700 | 700 | 700 | 700 | $112 |
| Purchase water from provider (3) | $114,418,981 | $2,049 | 0 | 0 | 0 | 0 | 5,175 | 5,175 | $2,049 |
| Purchase water from provider (1)[1] | $0 | $1,140 | 0 | 688 | 688 | 688 | 688 | 688 | $1,140 |
| **Region K** | | | | | | | | | |
| Alternative conjunctive use of groundwater - includes overdrafts | $14,432,000 | $964 | 0 | 0 | 0 | 0 | 15,000 | 15,000 | $964 |
| Alternative irrigation division delivery system improvements | $4,944,000 | $39 | 0 | 20,000 | 25,000 | 40,000 | 48,000 | 48,000 | $39 |
| Alternative on-farm conservation | $5,425,000 | $51 | 0 | 20,000 | 20,000 | 35,000 | 35,000 | 35,000 | $51 |
| Desalination of Ellenburger-San Saba Aquifer | $6,285,000 | $3,168 | | | 384 | 384 | 384 | 384 | $3,168 |
| Desalination of Brackish Gulf Coast Aquifer | $177,600,000 | $1,260 | 0 | 0 | 0 | 22,400 | 22,400 | 22,400 | $1,260 |
| Enhanced recharge of groundwater (Gulf Coast Aquifer) | $41,049,000 | $354 | 0 | 0 | 0 | 0 | 17,200 | 17,200 | $354 |
| Expansion of Gulf Coast Aquifer | $0 | $80 | 0 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | $80 |
| Groundwater importation | $395,900,000 | $1,330 | 0 | 0 | 0 | 35,000 | 35,000 | 35,000 | $1,330 |
| Off-channel storage in additional reservoirs | $53,388,000 | $345 | 0 | 0 | 30,000 | 40,000 | 40,000 | 40,000 | $345 |

## APPENDIX A.3.: ALTERNATIVE WATER MANAGEMENT STRATEGIES AND COST ESTIMATES - CONTINUED

| Alternative Water Management Strategy | Total Capital Costs | First Decade Estimated Annual Average Unit Cost ($/acre-foot/year) | Water Supply Volume (acre-feet/year) 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | Year 2060 Estimated Annual Average Unit Cost ($/acre-feet/year) |
|---|---|---|---|---|---|---|---|---|---|
| **Region L** | | | | | | | | | |
| Calhoun County brackish groundwater project | $24,887,000 | $2,679 | 0 | 1,344 | 1,344 | 1,344 | 1,344 | 1,344 | $1,063 |
| GBRA Lower Basin storage (500 acre site) | $77,876,000 | $109 | 0 | 0 | 59,569 | 59,569 | 59,569 | 59,569 | $73 |
| GBRA Mid-Basin project (conjuctive use) | $282,072,000 | $1,779 | 0 | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 | $425 |
| LGWSP for upstream GBRA needs | $1,003,219,000 | $1,921 | 0 | 60,000 | 60,000 | 60,000 | 60,000 | 60,000 | $476 |
| LGWSP for upstream GBRA needs at reduced capacity | $750,352,000 | $2,565 | 0 | 35,000 | 35,000 | 35,000 | 35,000 | 35,000 | $726 |
| Local groundwater Carrizo-Wilcox Aquifer (includes overdrafts) | $5,813,000 | $517 | 1,210 | 1,210 | 1,210 | 1,210 | 1,210 | 1,210 | $99 |
| Local groundwater supply (Barton Springs Edwards) | $4,321,000 | $203 | 0 | 0 | 0 | 1,358 | 1,358 | 1,358 | $84 |
| Medina Lake firm-up (off-channel reservoir) | $121,751,000 | $1,197 | 9,078 | 9,078 | 9,078 | 9,078 | 9,078 | 9,078 | $199 |
| Regional Carrizo for Guadalupe Basin (GBRA) | $239,245,000 | $1,280 | 0 | 25,000 | 25,000 | 25,000 | 25,000 | 25,000 | $454 |
| **Region N** | | | | | | | | | |
| Brackish groundwater desalination | $108,331,000 | $977 | 0 | 0 | 0 | 18,000 | 18,000 | 18,000 | $977 |
| Desalination | $260,914,000 | $1,696 | 0 | 0 | 0 | 28,000 | 28,000 | 28,000 | $1,696 |
| Pipeline from Choke Canyon Reservoir to Lake Corpus Christi | $48,324,000 | $588 | 0 | 0 | 0 | 21,905 | 21,905 | 21,905 | $588 |
| Stage II of Lake Texana/construction of Palmetto Bend Phase II on the Lavaca River | $131,126,000 | $1,213 | 0 | 0 | 0 | 0 | 0 | 12,963 | $1,213 |

## APPENDIX B. PROJECTED POPULATION OF TEXAS COUNTIES

| County | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| ANDERSON | 59,390 | 62,720 | 65,230 | 67,838 | 69,873 | 71,619 |
| ANDREWS | 14,131 | 15,078 | 15,737 | 16,358 | 16,645 | 16,968 |
| ANGELINA | 91,399 | 104,853 | 120,936 | 140,497 | 165,783 | 197,878 |
| ARANSAS | 26,863 | 30,604 | 32,560 | 32,201 | 30,422 | 28,791 |
| ARCHER | 9,689 | 10,542 | 11,237 | 11,449 | 11,054 | 10,649 |
| ARMSTRONG | 2,171 | 2,240 | 2,163 | 2,074 | 2,053 | 1,994 |
| ATASCOSA | 45,504 | 52,945 | 59,598 | 64,844 | 69,320 | 72,578 |
| AUSTIN | 27,173 | 30,574 | 32,946 | 34,355 | 35,031 | 35,958 |
| BAILEY | 7,060 | 7,558 | 7,875 | 8,207 | 8,238 | 8,086 |
| BANDERA | 26,373 | 37,265 | 48,577 | 54,829 | 56,642 | 60,346 |
| BASTROP | 84,449 | 120,740 | 151,364 | 199,548 | 239,588 | 288,683 |
| BAYLOR | 3,865 | 3,735 | 3,534 | 3,353 | 3,230 | 3,066 |
| BEE | 34,298 | 36,099 | 37,198 | 37,591 | 37,598 | 36,686 |
| BELL | 289,672 | 327,610 | 364,632 | 396,478 | 424,255 | 449,460 |
| BEXAR | 1,631,935 | 1,857,745 | 2,059,112 | 2,222,887 | 2,369,950 | 2,500,731 |
| BLANCO | 9,946 | 11,756 | 13,487 | 15,002 | 16,641 | 18,544 |
| BORDEN | 792 | 820 | 782 | 693 | 644 | 582 |
| BOSQUE | 19,831 | 22,646 | 24,622 | 25,364 | 25,667 | 26,032 |
| BOWIE | 96,953 | 103,397 | 108,397 | 113,397 | 113,397 | 113,397 |
| BRAZORIA | 305,649 | 354,708 | 401,684 | 444,981 | 490,875 | 538,795 |
| BRAZOS | 178,187 | 205,099 | 229,850 | 248,962 | 271,608 | 279,182 |
| BREWSTER | 9,468 | 9,944 | 10,155 | 10,297 | 10,684 | 10,770 |
| BRISCOE | 1,862 | 1,899 | 1,865 | 1,779 | 1,747 | 1,700 |
| BROOKS | 8,607 | 9,303 | 9,909 | 10,288 | 10,399 | 10,349 |
| BROWN | 39,324 | 40,602 | 40,959 | 40,959 | 40,959 | 40,959 |
| BURLESON | 18,477 | 20,663 | 22,249 | 23,465 | 24,358 | 25,146 |
| BURNET | 47,160 | 61,191 | 78,133 | 94,716 | 105,095 | 115,056 |
| CALDWELL | 45,958 | 59,722 | 71,459 | 83,250 | 95,103 | 106,575 |
| CALHOUN | 23,556 | 26,610 | 29,964 | 33,046 | 34,642 | 36,049 |
| CALLAHAN | 12,829 | 12,980 | 12,750 | 12,492 | 12,206 | 11,968 |
| CAMERON | 424,762 | 510,697 | 599,672 | 688,532 | 777,607 | 862,511 |
| CAMP | 12,586 | 13,735 | 14,798 | 15,639 | 16,291 | 17,006 |
| CARSON | 6,541 | 6,610 | 6,557 | 6,345 | 5,767 | 5,237 |
| CASS | 30,990 | 32,240 | 33,490 | 34,740 | 34,740 | 34,740 |
| CASTRO | 9,070 | 9,762 | 10,224 | 10,587 | 10,567 | 10,381 |
| CHAMBERS | 34,282 | 40,786 | 46,838 | 52,083 | 57,402 | 62,850 |
| CHEROKEE | 50,093 | 54,024 | 57,393 | 60,492 | 63,563 | 67,191 |
| CHILDRESS | 7,847 | 7,977 | 8,090 | 8,129 | 8,133 | 7,925 |
| CLAY | 11,376 | 11,699 | 11,628 | 11,147 | 10,462 | 9,778 |
| COCHRAN | 4,086 | 4,338 | 4,449 | 4,375 | 4,193 | 3,989 |
| COKE | 3,748 | 3,750 | 3,750 | 3,750 | 3,750 | 3,750 |
| COLEMAN | 9,141 | 9,149 | 9,149 | 9,149 | 9,149 | 9,149 |
| COLLIN | 790,648 | 1,046,601 | 1,265,373 | 1,526,407 | 1,761,082 | 1,938,067 |
| COLLINGSWORTH | 3,134 | 3,139 | 3,029 | 2,880 | 2,767 | 2,578 |
| COLORADO | 21,239 | 22,591 | 23,311 | 23,424 | 23,900 | 24,324 |
| COMAL | 108,219 | 146,868 | 190,873 | 233,964 | 278,626 | 326,655 |
| COMANCHE | 14,273 | 14,721 | 14,860 | 14,816 | 14,503 | 14,045 |
| CONCHO | 4,467 | 4,628 | 4,628 | 4,628 | 4,628 | 4,628 |
| COOKE | 40,674 | 46,141 | 51,749 | 56,973 | 65,099 | 71,328 |
| CORYELL | 87,707 | 102,414 | 116,741 | 126,878 | 135,749 | 142,886 |

## APPENDIX B. PROJECTED POPULATION OF TEXAS COUNTIES - CONTINUED

| County | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| COTTLE | 1,857 | 1,853 | 1,769 | 1,674 | 1,590 | 1,543 |
| CRANE | 4,469 | 4,990 | 5,272 | 5,487 | 5,718 | 5,961 |
| CROCKETT | 4,482 | 4,840 | 4,966 | 5,022 | 5,139 | 5,244 |
| CROSBY | 7,678 | 8,174 | 8,514 | 8,856 | 8,873 | 8,731 |
| CULBERSON | 3,351 | 3,596 | 3,703 | 3,738 | 3,738 | 3,738 |
| DALLAM | 6,851 | 7,387 | 7,724 | 7,808 | 7,645 | 7,291 |
| DALLAS | 2,512,352 | 2,756,079 | 2,950,635 | 3,128,628 | 3,365,780 | 3,695,125 |
| DAWSON | 15,523 | 16,010 | 16,421 | 16,665 | 16,268 | 15,652 |
| DEAF SMITH | 20,533 | 22,685 | 24,568 | 26,152 | 26,716 | 26,911 |
| DELTA | 5,728 | 6,244 | 6,744 | 7,244 | 7,244 | 7,244 |
| DENTON | 674,322 | 889,705 | 1,118,010 | 1,347,185 | 1,573,994 | 1,839,507 |
| DEWITT | 20,460 | 20,964 | 21,251 | 21,341 | 21,021 | 20,648 |
| DICKENS | 2,712 | 2,661 | 2,547 | 2,375 | 2,304 | 2,221 |
| DIMMIT | 10,996 | 11,733 | 12,187 | 12,234 | 11,966 | 11,378 |
| DONLEY | 3,764 | 3,694 | 3,536 | 3,375 | 3,238 | 3,026 |
| DUVAL | 13,881 | 14,528 | 14,882 | 14,976 | 14,567 | 13,819 |
| EASTLAND | 18,336 | 18,382 | 18,061 | 17,566 | 16,989 | 16,226 |
| ECTOR | 132,759 | 144,073 | 154,160 | 163,141 | 170,307 | 177,026 |
| EDWARDS | 2,322 | 2,421 | 2,364 | 2,291 | 2,264 | 2,170 |
| EL PASO | 833,640 | 1,000,651 | 1,141,414 | 1,262,817 | 1,384,220 | 1,505,623 |
| ELLIS | 169,514 | 233,654 | 293,665 | 351,919 | 411,721 | 471,317 |
| ERATH | 36,666 | 40,609 | 44,160 | 47,734 | 57,200 | 63,155 |
| FALLS | 19,600 | 20,884 | 22,196 | 23,350 | 24,267 | 25,346 |
| FANNIN | 38,129 | 42,648 | 49,775 | 60,659 | 74,490 | 86,970 |
| FAYETTE | 24,826 | 28,808 | 32,363 | 35,259 | 38,933 | 44,120 |
| FISHER | 4,264 | 4,259 | 4,097 | 3,972 | 3,910 | 3,717 |
| FLOYD | 8,173 | 8,580 | 8,723 | 8,793 | 8,491 | 8,053 |
| FOARD | 1,614 | 1,630 | 1,584 | 1,507 | 1,457 | 1,384 |
| FORT BEND | 550,121 | 719,737 | 893,875 | 1,090,710 | 1,348,851 | 1,643,825 |
| FRANKLIN | 11,533 | 13,363 | 14,613 | 15,863 | 15,863 | 15,863 |
| FREESTONE | 19,701 | 21,826 | 23,704 | 25,504 | 27,148 | 28,593 |
| FRIO | 18,160 | 20,034 | 21,628 | 22,952 | 23,913 | 24,412 |
| GAINES | 16,130 | 17,663 | 18,774 | 19,560 | 19,434 | 19,169 |
| GALVESTON | 268,714 | 284,731 | 294,218 | 298,057 | 300,915 | 302,774 |
| GARZA | 5,072 | 5,265 | 5,158 | 4,961 | 4,733 | 4,416 |
| GILLESPIE | 25,258 | 29,117 | 30,861 | 30,861 | 30,861 | 30,861 |
| GLASSCOCK | 1,582 | 1,783 | 1,891 | 1,921 | 1,915 | 1,954 |
| GOLIAD | 8,087 | 9,508 | 10,648 | 11,395 | 11,964 | 12,324 |
| GONZALES | 19,872 | 21,227 | 22,260 | 23,003 | 23,219 | 23,151 |
| GRAY | 22,163 | 21,988 | 21,371 | 20,542 | 19,286 | 18,064 |
| GRAYSON | 126,099 | 152,028 | 179,725 | 203,822 | 227,563 | 253,568 |
| GREGG | 118,770 | 126,421 | 134,330 | 143,481 | 155,871 | 173,587 |
| GRIMES | 26,635 | 30,073 | 32,785 | 34,670 | 36,176 | 37,657 |
| GUADALUPE | 114,878 | 146,511 | 180,725 | 214,912 | 252,857 | 293,736 |
| HALE | 39,456 | 42,103 | 44,034 | 45,204 | 44,940 | 44,069 |
| HALL | 3,750 | 3,832 | 3,884 | 3,841 | 3,859 | 3,783 |
| HAMILTON | 7,790 | 7,681 | 7,596 | 7,624 | 7,512 | 7,504 |
| HANSFORD | 5,699 | 6,148 | 6,532 | 6,948 | 7,191 | 7,406 |
| HARDEMAN | 4,665 | 4,626 | 4,496 | 4,329 | 4,144 | 3,792 |
| HARDIN | 54,504 | 59,115 | 61,211 | 63,381 | 65,627 | 67,954 |
| HARRIS | 4,078,231 | 4,629,335 | 5,180,439 | 5,731,543 | 6,282,647 | 6,833,751 |

## APPENDIX B. PROJECTED POPULATION OF TEXAS COUNTIES - CONTINUED

| County | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| HARRISON | 67,547 | 72,930 | 76,824 | 79,759 | 83,191 | 88,241 |
| HARTLEY | 5,697 | 5,889 | 5,989 | 6,026 | 5,950 | 5,646 |
| HASKELL | 5,860 | 5,741 | 5,580 | 5,496 | 5,345 | 5,089 |
| HAYS | 166,342 | 242,051 | 302,795 | 363,678 | 436,388 | 493,320 |
| HEMPHILL | 3,496 | 3,511 | 3,394 | 3,269 | 3,181 | 3,024 |
| HENDERSON | 80,019 | 91,456 | 104,323 | 116,918 | 131,949 | 150,317 |
| HIDALGO | 775,857 | 987,920 | 1,225,227 | 1,481,812 | 1,761,810 | 2,048,911 |
| HILL | 33,416 | 34,947 | 36,679 | 38,407 | 40,252 | 42,300 |
| HOCKLEY | 24,432 | 25,495 | 26,114 | 26,141 | 25,129 | 23,896 |
| HOOD | 49,207 | 58,364 | 66,888 | 75,814 | 87,058 | 100,045 |
| HOPKINS | 35,934 | 39,882 | 42,951 | 45,528 | 45,528 | 45,528 |
| HOUSTON | 23,947 | 24,555 | 25,539 | 26,559 | 27,622 | 28,727 |
| HOWARD | 34,574 | 35,438 | 35,719 | 35,719 | 35,719 | 35,719 |
| HUDSPETH | 3,815 | 4,146 | 4,314 | 4,314 | 4,314 | 4,314 |
| HUNT | 82,948 | 94,401 | 110,672 | 137,371 | 196,757 | 289,645 |
| HUTCHINSON | 24,320 | 24,655 | 24,311 | 23,513 | 22,209 | 21,087 |
| IRION | 1,888 | 1,938 | 1,892 | 1,774 | 1,680 | 1,606 |
| JACK | 9,567 | 10,275 | 10,915 | 11,415 | 11,915 | 12,415 |
| JACKSON | 15,441 | 16,515 | 17,183 | 17,567 | 17,713 | 17,716 |
| JASPER | 38,445 | 40,897 | 42,344 | 42,712 | 42,712 | 42,712 |
| JEFF DAVIS | 2,935 | 3,249 | 3,449 | 3,649 | 3,849 | 4,049 |
| JEFFERSON | 259,700 | 270,686 | 280,590 | 288,225 | 295,924 | 310,478 |
| JIM HOGG | 5,593 | 5,985 | 6,286 | 6,538 | 6,468 | 6,225 |
| JIM WELLS | 42,434 | 45,303 | 47,149 | 47,955 | 47,615 | 46,596 |
| JOHNSON | 159,451 | 200,381 | 238,590 | 268,082 | 304,454 | 346,999 |
| JONES | 21,211 | 21,729 | 21,695 | 21,366 | 20,738 | 19,933 |
| KARNES | 17,001 | 18,830 | 20,759 | 22,305 | 23,256 | 23,774 |
| KAUFMAN | 103,249 | 162,664 | 208,009 | 254,609 | 297,391 | 349,385 |
| KENDALL | 35,720 | 50,283 | 65,752 | 78,690 | 89,312 | 99,698 |
| KENEDY | 467 | 495 | 523 | 527 | 529 | 537 |
| KENT | 840 | 821 | 733 | 602 | 535 | 472 |
| KERR | 49,250 | 54,886 | 57,565 | 58,662 | 61,204 | 62,252 |
| KIMBLE | 4,660 | 4,702 | 4,702 | 4,702 | 4,702 | 4,702 |
| KING | 385 | 424 | 424 | 389 | 369 | 332 |
| KINNEY | 3,403 | 3,462 | 3,529 | 3,601 | 3,653 | 3,662 |
| KLEBERG | 36,959 | 40,849 | 43,370 | 44,989 | 47,118 | 47,212 |
| KNOX | 4,197 | 4,305 | 4,310 | 4,321 | 4,316 | 4,272 |
| LA SALLE | 6,599 | 7,278 | 7,930 | 8,578 | 9,048 | 9,407 |
| LAMAR | 52,525 | 56,536 | 60,286 | 64,036 | 64,036 | 64,036 |
| LAMB | 15,515 | 16,500 | 17,355 | 17,995 | 17,900 | 17,668 |
| LAMPASAS | 20,114 | 22,596 | 24,396 | 25,731 | 26,606 | 27,160 |
| LAVACA | 18,750 | 18,731 | 18,219 | 17,314 | 16,264 | 15,061 |
| LEE | 17,789 | 20,362 | 22,483 | 24,194 | 25,685 | 26,946 |
| LEON | 18,231 | 21,137 | 22,863 | 22,971 | 22,809 | 23,028 |
| LIBERTY | 81,930 | 94,898 | 107,335 | 119,519 | 132,875 | 147,845 |
| LIMESTONE | 23,322 | 24,944 | 25,828 | 26,505 | 27,177 | 28,050 |
| LIPSCOMB | 3,084 | 3,149 | 3,054 | 2,966 | 2,925 | 2,784 |
| LIVE OAK | 13,735 | 14,929 | 15,386 | 15,018 | 13,808 | 12,424 |
| LLANO | 21,284 | 23,007 | 23,471 | 23,932 | 24,393 | 24,855 |
| LOVING | 67 | 67 | 67 | 67 | 67 | 67 |
| LUBBOCK | 265,547 | 280,449 | 289,694 | 294,476 | 299,218 | 303,857 |

## APPENDIX B. PROJECTED POPULATION OF TEXAS COUNTIES - CONTINUED

| County | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| LYNN | 6,969 | 7,280 | 7,243 | 7,216 | 6,891 | 6,413 |
| MADISON | 13,905 | 14,873 | 15,644 | 16,364 | 17,002 | 17,560 |
| MARION | 11,295 | 11,420 | 11,420 | 11,420 | 11,420 | 11,420 |
| MARTIN | 5,203 | 5,696 | 5,935 | 6,082 | 5,934 | 5,633 |
| MASON | 3,817 | 3,856 | 3,876 | 3,886 | 3,891 | 3,896 |
| MATAGORDA | 40,506 | 43,295 | 44,991 | 45,925 | 45,925 | 45,925 |
| MAVERICK | 58,252 | 67,929 | 77,165 | 85,292 | 92,831 | 99,091 |
| MCCULLOCH | 8,235 | 8,377 | 8,377 | 8,377 | 8,377 | 8,377 |
| MCLENNAN | 231,882 | 250,398 | 266,002 | 282,177 | 292,449 | 307,378 |
| MCMULLEN | 920 | 957 | 918 | 866 | 837 | 793 |
| MEDINA | 46,675 | 54,815 | 62,416 | 68,987 | 75,370 | 81,104 |
| MENARD | 2,493 | 2,528 | 2,528 | 2,528 | 2,528 | 2,528 |
| MIDLAND | 124,710 | 134,022 | 140,659 | 145,595 | 148,720 | 151,664 |
| MILAM | 26,053 | 28,086 | 29,396 | 30,201 | 30,405 | 30,496 |
| MILLS | 5,466 | 5,815 | 6,107 | 5,930 | 6,329 | 6,497 |
| MITCHELL | 9,736 | 9,714 | 9,545 | 9,332 | 9,069 | 8,521 |
| MONTAGUE | 19,863 | 20,596 | 20,892 | 21,009 | 21,040 | 21,119 |
| MONTGOMERY | 453,369 | 588,351 | 751,702 | 931,732 | 1,169,199 | 1,444,999 |
| MOORE | 23,049 | 26,241 | 29,057 | 31,293 | 32,655 | 33,474 |
| MORRIS | 13,039 | 13,039 | 13,039 | 13,039 | 13,039 | 13,039 |
| MOTLEY | 1,409 | 1,359 | 1,262 | 1,143 | 1,060 | 1,008 |
| NACOGDOCHES | 67,357 | 75,914 | 84,183 | 92,628 | 108,753 | 124,453 |
| NAVARRO | 52,752 | 58,919 | 65,331 | 72,374 | 80,168 | 89,638 |
| NEWTON | 16,008 | 16,731 | 16,825 | 17,329 | 17,849 | 18,385 |
| NOLAN | 16,550 | 17,177 | 17,464 | 17,412 | 16,747 | 15,954 |
| NUECES | 358,278 | 405,492 | 447,014 | 483,692 | 516,265 | 542,327 |
| OCHILTREE | 9,685 | 10,440 | 11,001 | 11,380 | 11,566 | 11,803 |
| OLDHAM | 2,322 | 2,373 | 2,204 | 1,942 | 1,689 | 1,364 |
| ORANGE | 90,503 | 94,274 | 95,818 | 96,473 | 97,843 | 98,836 |
| PALO PINTO | 28,895 | 31,147 | 33,048 | 34,897 | 37,074 | 39,589 |
| PANOLA | 23,903 | 24,402 | 24,800 | 25,141 | 25,419 | 25,600 |
| PARKER | 121,653 | 193,559 | 262,053 | 301,760 | 324,546 | 342,887 |
| PARMER | 10,641 | 11,302 | 11,585 | 11,666 | 11,301 | 10,674 |
| PECOS | 17,850 | 18,780 | 19,300 | 19,580 | 19,630 | 19,246 |
| POLK | 48,072 | 54,897 | 60,401 | 64,478 | 68,247 | 71,928 |
| POTTER | 127,580 | 142,703 | 156,846 | 172,950 | 190,526 | 204,933 |
| PRESIDIO | 8,825 | 10,184 | 11,508 | 12,421 | 12,872 | 13,130 |
| RAINS | 11,173 | 13,221 | 14,687 | 15,400 | 15,755 | 15,991 |
| RANDALL | 117,420 | 131,546 | 144,757 | 159,800 | 176,218 | 189,811 |
| REAGAN | 3,791 | 4,182 | 4,381 | 4,367 | 4,213 | 4,010 |
| REAL | 3,063 | 3,111 | 3,042 | 2,993 | 3,070 | 3,132 |
| RED RIVER | 14,251 | 14,251 | 14,251 | 14,251 | 14,251 | 14,251 |
| REEVES | 14,281 | 15,451 | 16,417 | 17,219 | 17,949 | 18,527 |
| REFUGIO | 8,217 | 8,505 | 8,609 | 8,799 | 8,915 | 8,877 |
| ROBERTS | 930 | 955 | 857 | 719 | 622 | 561 |
| ROBERTSON | 17,164 | 18,704 | 19,674 | 20,335 | 20,419 | 20,353 |
| ROCKWALL | 89,144 | 141,386 | 171,373 | 199,044 | 215,312 | 232,186 |
| RUNNELS | 11,610 | 12,025 | 12,339 | 12,686 | 12,956 | 13,298 |
| RUSK | 49,874 | 52,241 | 53,585 | 54,255 | 56,120 | 60,705 |
| SABINE | 11,280 | 11,743 | 12,095 | 12,457 | 12,832 | 13,216 |
| SAN AUGUSTINE | 9,715 | 9,911 | 10,164 | 10,470 | 10,785 | 10,999 |

## APPENDIX B. PROJECTED POPULATION OF TEXAS COUNTIES - CONTINUED

| County | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| SAN JACINTO | 27,443 | 32,541 | 36,617 | 39,159 | 40,630 | 41,299 |
| SAN PATRICIO | 80,701 | 95,381 | 109,518 | 122,547 | 134,806 | 146,131 |
| SAN SABA | 6,387 | 6,746 | 7,059 | 7,332 | 7,365 | 7,409 |
| SCHLEICHER | 3,159 | 3,387 | 3,491 | 3,533 | 3,594 | 3,658 |
| SCURRY | 16,998 | 17,602 | 17,923 | 18,092 | 18,203 | 18,203 |
| SHACKELFORD | 3,456 | 3,638 | 3,603 | 3,406 | 2,997 | 2,516 |
| SHELBY | 26,531 | 28,248 | 29,597 | 30,602 | 31,467 | 32,414 |
| SHERMAN | 3,469 | 3,770 | 3,886 | 4,005 | 4,110 | 4,164 |
| SMITH | 194,223 | 208,737 | 223,251 | 237,766 | 262,454 | 295,252 |
| SOMERVELL | 7,542 | 8,393 | 9,094 | 9,554 | 9,740 | 9,804 |
| STARR | 69,379 | 83,583 | 98,262 | 113,102 | 127,802 | 141,961 |
| STEPHENS | 9,873 | 10,030 | 10,102 | 10,005 | 9,624 | 9,321 |
| STERLING | 1,529 | 1,680 | 1,744 | 1,766 | 1,717 | 1,739 |
| STONEWALL | 1,687 | 1,634 | 1,555 | 1,455 | 1,365 | 1,279 |
| SUTTON | 4,479 | 4,737 | 4,780 | 4,762 | 4,773 | 4,725 |
| SWISHER | 8,772 | 9,103 | 9,329 | 9,423 | 9,250 | 8,849 |
| TARRANT | 1,800,069 | 2,061,887 | 2,337,390 | 2,646,559 | 2,964,622 | 3,353,509 |
| TAYLOR | 136,370 | 142,645 | 145,634 | 146,529 | 143,772 | 139,309 |
| TERRELL | 1,156 | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| TERRY | 13,804 | 14,778 | 15,704 | 16,608 | 16,700 | 16,607 |
| THROCKMORTON | 1,851 | 1,793 | 1,713 | 1,584 | 1,483 | 1,407 |
| TITUS | 31,158 | 34,430 | 37,593 | 40,462 | 43,064 | 45,497 |
| TOM GREEN | 112,138 | 118,851 | 123,109 | 125,466 | 127,333 | 127,752 |
| TRAVIS | 1,003,253 | 1,201,256 | 1,402,153 | 1,583,068 | 1,770,347 | 1,918,135 |
| TRINITY | 15,361 | 16,572 | 16,972 | 16,951 | 16,581 | 16,243 |
| TYLER | 24,744 | 28,513 | 30,937 | 31,866 | 31,866 | 31,866 |
| UPSHUR | 38,372 | 41,496 | 43,619 | 44,953 | 46,003 | 47,385 |
| UPTON | 3,757 | 4,068 | 4,185 | 4,278 | 4,400 | 4,518 |
| UVALDE | 28,616 | 31,443 | 33,802 | 35,650 | 36,876 | 37,810 |
| VAL VERDE | 51,312 | 57,500 | 63,265 | 68,175 | 71,761 | 74,348 |
| VAN ZANDT | 55,423 | 63,079 | 69,539 | 74,392 | 80,547 | 87,414 |
| VICTORIA | 93,073 | 102,487 | 110,221 | 116,368 | 121,416 | 125,865 |
| WALKER | 70,672 | 77,915 | 81,402 | 80,547 | 80,737 | 80,737 |
| WALLER | 41,137 | 51,175 | 62,352 | 74,789 | 89,598 | 106,608 |
| WARD | 11,416 | 11,710 | 11,846 | 11,846 | 11,846 | 11,846 |
| WASHINGTON | 32,559 | 35,253 | 36,973 | 37,908 | 38,747 | 39,426 |
| WEBB | 257,647 | 333,451 | 418,332 | 511,710 | 613,774 | 721,586 |
| WHARTON | 43,560 | 46,045 | 47,648 | 48,567 | 48,590 | 48,074 |
| WHEELER | 5,132 | 5,133 | 5,112 | 5,149 | 5,139 | 5,080 |
| WICHITA | 138,058 | 143,805 | 147,606 | 149,595 | 150,981 | 152,102 |
| WILBARGER | 15,279 | 15,928 | 15,993 | 15,672 | 14,908 | 14,027 |
| WILLACY | 22,763 | 25,212 | 27,455 | 29,276 | 30,542 | 31,205 |
| WILLIAMSON | 408,743 | 553,412 | 701,334 | 880,370 | 1,056,891 | 1,240,276 |
| WILSON | 44,078 | 58,621 | 74,641 | 90,187 | 106,373 | 123,135 |
| WINKLER | 7,603 | 7,956 | 8,023 | 8,041 | 7,890 | 7,638 |
| WISE | 66,366 | 89,347 | 108,711 | 127,068 | 148,020 | 170,071 |
| WOOD | 42,727 | 48,200 | 51,236 | 51,565 | 51,565 | 51,565 |
| YOAKUM | 8,183 | 8,966 | 9,470 | 10,006 | 9,738 | 9,408 |
| YOUNG | 18,116 | 18,513 | 18,541 | 18,328 | 18,059 | 17,889 |
| ZAPATA | 14,025 | 16,217 | 18,415 | 20,486 | 22,354 | 23,733 |
| ZAVALA | 12,796 | 14,130 | 15,227 | 16,086 | 16,774 | 17,133 |
| Grand Total | 25,388,403 | 29,650,388 | 33,712,020 | 37,734,422 | 41,924,167 | 46,323,725 |

## APPENDIX C. MAJOR RESERVOIRS OF TEXAS

| Reservoir Name | River Basin | Year of Completion | Year 2010 Firm Yield (acre-feet) from 2011 Regional Water Plans | Original Conservation Pool Capacity (acre-feet) |
|---|---|---|---|---|
| Abilene, Lake | Brazos | 1921 | 1,141 | 7,900 |
| Alan Henry Reservoir | Brazos | 1994 | 22,500 | 115,937 |
| Alcoa Lake | Brazos | 1952 | 14,000 | 15,650 |
| Amistad Reservoir, International | Rio Grande | 1969 | 1,011,976 | 3,505,400 |
| Amon G Carter, Lake | Trinity | 1956 | 2,107 | 20,050 |
| Anahuac, Lake | Trinity | 1954 | 17,700 | 29,500 |
| Anzalduas Channel Dam | Rio Grande | 1960 | 0 | 13,910 |
| Aquilla Lake | Brazos | 1983 | 13,746 | 52,400 |
| Arlington, Lake | Trinity | 1957 | 9,850 | 45,710 |
| Arrowhead, Lake | Red | 1966 | 26,000 | 262,100 |
| Athens, Lake | Neches | 1963 | 6,064 | 32,790 |
| Austin, Lake | Colorado | 1939 | Sys. Op. | 21,000 |
| B. A. Steinhagen Lake | Neches | 1951 | Sys. Op. | 100,595 |
| Ballinger, Lake / Moonen, Lake | Colorado | 1984 | 30 | 6,850 |
| Balmorhea, Lake | Rio Grande | 1917 | 21,844 | 7,707 |
| Bardwell Lake | Trinity | 1965 | 9,600 | 54,877 |
| Bastrop, Lake | Colorado | 1964 | Sys. Op. | 16,590 |
| Baylor Lake | Red | 1950 | 0 | 9,220 |
| Belton Lake | Brazos | 1954 | 112,257 | 456,884 |
| Benbrook Lake | Trinity | 1950 | 6,833 | 88,250 |
| Bob Sandlin, Lake | Cypress | 1978 | 60,430 | 213,350 |
| Bonham, Lake | Red | 1969 | 5,340 | 11,976 |
| Brady Creek Reservoir | Colorado | 1963 | 0 | 30,430 |
| Brandy Branch Cooling Pond | Sabine | 1983 | 0 | 29,513 |
| Brazoria Reservoir | Brazos | 1954 | Pass-through | 21,970 |
| Bridgeport, Lake | Trinity | 1931 | Sys. Op. | 386,420 |
| Brownwood, Lake | Colorado | 1933 | 47,200 | 149,925 |
| Bryan Utilities Lake | Brazos | 1974 | 85 | 15,227 |
| Buchanan, Lake | Colorado | 1938 | 402,172 | 992,000 |
| Caddo Lake | Cypress | 1968 | 10,000 | 129,000 |
| Calaveras Lake | San Antonio | 1969 | 36,900 | 63,200 |
| Canyon Lake | Guadalupe | 1964 | 87,629 | 386,200 |
| Casa Blanca Lake | Rio Grande | 1951 | 0 | 20,000 |
| Cedar Bayou Generating Pond | Trinity-San Jacinto | 1972 | Cooling | 19,250 |
| Cedar Creek Reservoir Colorado | Colorado | 1977 | Sys. Op. | 74,080 |
| Cedar Creek Reservoir Trinity | Trinity | 1966 | 175,000 | 679,200 |
| Champion Creek Reservoir | Colorado | 1959 | 10 | 42,500 |
| Cherokee, Lake | Sabine | 1948 | 28,885 | 49,295 |
| Choke Canyon Reservoir | Nueces | 1982 | 165,000 | 691,130 |
| Cisco, Lake | Brazos | 1923 | 1,138 | 26,000 |
| Clyde, Lake | Colorado | 1970 | 500 | 5,748 |
| Coleman, Lake | Colorado | 1966 | 5 | 40,000 |
| Coleto Creek Reservoir | Guadalupe | 1980 | 12,500 | 31,040 |
| Colorado City, Lake | Colorado | 1949 | 0 | 31,805 |
| Conroe, Lake | San Jacinto | 1973 | 79,800 | 430,260 |
| Corpus Christi Reservoir, Lake | Nueces | 1958 | Sys. Op. | 308,700 |
| Cox Lake / Raw Water Lake / Recycle Lake | Colorado-Lavaca | 1956 | 0 | 5,034 |
| Creek Lake, Lake | Brazos | 1952 | 10,000 | 8,400 |

## APPENDIX C. MAJOR RESERVOIRS OF TEXAS - CONTINUED

| Reservoir Name | River Basin | Year of Completion | Year 2010 Firm Yield (acre-feet) from 2011 Regional Water Plans | Original Conservation Pool Capacity (acre-feet) |
|---|---|---|---|---|
| Crook, Lake | Red | 1923 | 7,290 | 11,487 |
| Cypress Springs, Lake | Cypress | 1971 | 10,737 | 72,800 |
| Daniel, Lake | Brazos | 1948 | 230 | 9,515 |
| Davis, Lake | Brazos | 1959 | 220 | 5,454 |
| Delta Lake | Nueces-Rio Grande | 1939 | 0 | 25,000 |
| Diversion, Lake | Red | 1924 | Sys. Op. | 40,000 |
| Dunlap, Lake | Guadalupe | 1928 | Hydro | 5,900 |
| E. V. Spence Reservoir | Colorado | 1969 | 6,170 | 488,760 |
| Eagle Lake | Colorado | 1900 | Sys. Op. | 9,600 |
| Eagle Mountain Lake | Trinity | 1932 | 109,833 | 189,523 |
| Eagle Nest Lake / Manor Lake | Brazos | 1949 | 1,800 | 18,000 |
| Electra, Lake | Red | 1950 | 462 | 8,730 |
| Ellison Creek Reservoir | Cypress | 1943 | 13,857 | 24,700 |
| Fairfield Lake | Trinity | 1969 | 870 | 50,600 |
| Falcon Reservoir, International | Rio Grande | 1954 | Sys. Op. | 2,830,000 |
| Farmers Creek Reservoir | Red | 1960 | 1,260 | 26,000 |
| Forest Grove Reservoir | Trinity | 1980 | 8,767 | 20,038 |
| Fork Reservoir, Lake | Sabine | 1980 | 173,035 | 675,819 |
| Fort Phantom Hill, Lake | Brazos | 1938 | 11,816 | 74,310 |
| Georgetown, Lake | Brazos | 1982 | 11,803 | 37,080 |
| Gibbons Creek Reservoir | Brazos | 1981 | 9,740 | 28,363 |
| Gilmer, Lake | Cypress | 1999 | 6,180 | 12,720 |
| Gladewater, Lake | Sabine | 1952 | 2,125 | 6,950 |
| Gonzales (H-4), Lake | Guadalupe | 1931 | Hydro | 6,500 |
| Graham, Lake | Brazos | 1958 | 5,335 | 53,680 |
| Granbury, Lake | Brazos | 1969 | 64,712 | 155,000 |
| Granger Lake | Brazos | 1979 | 18,007 | 56,961 |
| Grapevine Lake | Trinity | 1952 | 19,067 | 188,553 |
| Greenbelt Lake | Red | 1968 | 8,297 | 60,400 |
| Gulf Coast Water Authority Reservoir | San Jacinto-Brazos | 1948 | 0 | 7,308 |
| Halbert, Lake | Trinity | 1921 | 0 | 7,420 |
| Hords Creek Lake | Colorado | 1948 | 0 | 8,640 |
| Houston County Lake | Trinity | 1966 | 3,500 | 19,500 |
| Houston, Lake | San Jacinto | 1954 | 187,000 | 146,769 |
| Hubbard Creek Reservoir | Brazos | 1962 | 27,708 | 317,750 |
| Hubert H. Moss Lake | Red | 1966 | 7,410 | 23,210 |
| Imperial Reservoir | Rio Grande | 1915 | 0 | 6,000 |
| Inks Lake | Colorado | 1938 | Sys. Op. | 17,545 |
| J. B. Thomas, Lake | Colorado | 1952 | 20 | 203,600 |
| Jacksonville, Lake | Neches | 1957 | 6,200 | 30,500 |
| Jim Chapman Lake | Sulphur | 1991 | 127,983 | 310,312 |
| Joe Pool Lake | Trinity | 1991 | 15,192 | 176,900 |
| Johnson Creek Reservoir | Cypress | 1961 | 0 | 10,100 |
| Kemp, Lake | Red | 1923 | 100,983 | 319,600 |
| Kickapoo, Lake | Red | 1945 | 19,800 | 106,000 |
| Kirby, Lake | Brazos | 1928 | 533 | 7,620 |
| Kurth, Lake | Neches | 1961 | 18,421 | 16,200 |
| Lavon Lake | Trinity | 1953 | 112,033 | 456,526 |

## APPENDIX C. MAJOR RESERVOIRS OF TEXAS - CONTINUED

| Reservoir Name | River Basin | Year of Completion | Year 2010 Firm Yield (acre-feet) from 2011 Regional Water Plans | Original Conservation Pool Capacity (acre-feet) |
|---|---|---|---|---|
| Leon, Lake | Brazos | 1954 | 5,938 | 27,290 |
| Lewis Creek Reservoir | San Jacinto | 1969 | 0 | 16,400 |
| Lewisville Lake | Trinity | 1955 | 7,918 | 640,986 |
| Limestone, Lake | Brazos | 1978 | 65,074 | 225,400 |
| Livingston, Lake | Trinity | 1969 | 1,344,000 | 1,750,000 |
| Loma Alta Lake | Nueces-Rio Grande | 1963 | Storage | 26,500 |
| Lost Creek Reservoir | Trinity | 1991 | 1,597 | 11,961 |
| Lyndon B. Johnson, Lake | Colorado | 1951 | Sys. Op. | 138,500 |
| Mackenzie Reservoir | Red | 1974 | 0 | 46,545 |
| Marble Falls, Lake | Colorado | 1951 | Sys. Op. | 8,760 |
| Martin Lake | Sabine | 1974 | 25,000 | 77,619 |
| McQueeney, Lake | Guadalupe | 1928 | Hydro | 5,000 |
| Medina Lake | San Antonio | 1913 | 0 | 254,000 |
| Meredith, Lake | Canadian | 1965 | 69,750 | 864,400 |
| Mexia, Lake | Brazos | 1961 | 1,320 | 10,000 |
| Millers Creek Reservoir | Brazos | 1974 | 50 | 33,000 |
| Mineral Wells, Lake | Brazos | 1920 | 2,508 | 6,760 |
| Mitchell County Reservoir | Colorado | 1991 | Sys. Op. | 27,266 |
| Monticello Reservoir | Cypress | 1973 | 2,439 | 40,100 |
| Mountain Creek Lake | Trinity | 1936 | 6,400 | 22,840 |
| Mud Lake No. 4 | Colorado-Lavaca | 1974 | 0 | 11,048 |
| Murvaul, Lake | Sabine | 1958 | 21,792 | 45,815 |
| Mustang Lake East/Mustang Lake West | San Jacinto-Brazos | 1969 | 0 | 6,451 |
| Nacogdoches, Lake | Neches | 1977 | 17,067 | 41,140 |
| Nasworthy, Lake | Colorado | 1930 | 0 | 12,390 |
| Navarro Mills Lake | Trinity | 1963 | 19,342 | 63,000 |
| New Terrell City Lake | Trinity | 1955 | 2,283 | 8,712 |
| North Fork Buffalo Creek Reservoir | Red | 1964 | 840 | 15,400 |
| North Lake | Trinity | 1957 | 0 | 17,000 |
| O. C. Fisher Lake | Colorado | 1951 | 0 | 119,200 |
| O. H. Ivie Reservoir | Colorado | 1989 | 85,150 | 554,340 |
| O' the Pines, Lake | Cypress | 1958 | 174,960 | 274,443 |
| Oak Creek Reservoir | Colorado | 1952 | 5 | 39,360 |
| Olney, Lake / Cooper, Lake | Red | 1935 | 960 | 6,650 |
| Palestine, Lake | Neches | 1971 | 207,458 | 411,840 |
| Palo Duro Reservoir | Canadian | 1991 | 3,958 | 61,239 |
| Palo Pinto, Lake | Brazos | 1964 | 9,658 | 44,100 |
| Pat Cleburne, Lake | Brazos | 1964 | 5,075 | 25,560 |
| Pat Mayse Lake | Red | 1967 | 59,670 | 124,500 |
| Pauline, Lake | Red | 1905 | 1,200 | 7,000 |
| Peacock Site 1A Tailings Reservoir | Cypress | 1983 | Sys. Op. | 11,248 |
| Pinkston Reservoir | Neches | 1977 | 3,800 | 7,380 |
| Possum Kingdom Lake | Brazos | 1941 | 230,750 | 724,739 |
| Proctor Lake | Brazos | 1963 | 19,467 | 59,400 |
| Randell Lake | Red | 1909 | 1,400 | 5,400 |
| Ray Hubbard, Lake | Trinity | 1969 | 57,427 | 490,000 |
| Ray Roberts, Lake | Trinity | 1987 | 211,364 | 796,875 |
| Red Bluff Reservoir | Rio Grande | 1936 | 41,725 | 310,000 |

## APPENDIX C. MAJOR RESERVOIRS OF TEXAS - CONTINUED

| Reservoir Name | River Basin | Year of Completion | Year 2010 Firm Yield (acre-feet) from 2011 Regional Water Plans | Original Conservation Pool Capacity (acre-feet) |
|---|---|---|---|---|
| Red Draw Reservoir | Colorado | 1985 | Sys. Op. | 8,538 |
| Richland-Chambers Reservoir | Trinity | 1987 | 223,872 | 1,181,866 |
| River Crest Lake | Sulphur | 1953 | 8,624 | 7,000 |
| Sam Rayburn Reservoir | Neches | 1965 | 820,000 | 2,898,500 |
| Santa Rosa Lake | Red | 1929 | 3,075 | 11,570 |
| Sheldon Reservoir | San Jacinto | 1943 | 0 | 5,420 |
| Smithers Lake | Brazos | 1957 | 34,300 | 18,700 |
| Somerville Lake | Brazos | 1967 | 42,120 | 160,100 |
| South Texas Project Reservoir | Colorado | 1981 | 0 | 202,600 |
| Squaw Creek Reservoir | Brazos | 1977 | 9,238 | 151,008 |
| Stamford, Lake | Brazos | 1953 | 5,667 | 57,632 |
| Stillhouse Hollow Lake | Brazos | 1968 | 66,205 | 235,700 |
| Striker, Lake | Neches | 1957 | 20,183 | 29,000 |
| Sulphur Springs Draw Storage Reservoir | Colorado | 1993 | 0 | 7,997 |
| Sulphur Springs, Lake | Sulphur | 1973 | 9,800 | 14,160 |
| Sweetwater, Lake | Brazos | 1930 | 1,051 | 11,900 |
| Tawakoni, Lake | Sabine | 1960 | 229,807 | 936,200 |
| Texana, Lake | Lavaca | 1981 | 74,500 | 165,918 |
| Texoma, Lake | Red | 1944 | 314,850 | 3,132,000 |
| Toledo Bend Reservoir | Sabine | 1969 | 750,000 | 4,477,000 |
| Tradinghouse Creek Reservoir | Brazos | 1968 | 4,958 | 37,800 |
| Travis, Lake | Colorado | 1942 | Sys. Op. | 1,170,752 |
| Trinidad Lake | Trinity | 1925 | 3,050 | 7,450 |
| Twin Buttes Reservoir | Colorado | 1963 | 0 | 186,200 |
| Twin Oak Reservoir | Brazos | 1982 | 2,892 | 30,319 |
| Tyler, Lake | Neches | 1967 | 30,925 | 80,900 |
| Upper Nueces Lake | Nueces | 1948 | 0 | 7,590 |
| Valley Acres Reservoir | Nueces-Rio Grande | 1947 | 0 | 7,840 |
| Valley Lake | Red | 1961 | 0 | 16,400 |
| Victor Braunig Lake | San Antonio | 1962 | 12,000 | 26,500 |
| Waco, Lake | Brazos | 1965 | 79,098 | 152,500 |
| Wallisville Lake | Trinity | 1999 | Sys. Op. | 58,000 |
| Walter E Long, Lake | Colorado | 1967 | 0 | 33,940 |
| Waxahachie, Lake | Trinity | 1956 | 2,905 | 13,500 |
| Weatherford, Lake | Trinity | 1957 | 2,967 | 21,233 |
| Welsh Reservoir | Cypress | 1975 | 4,476 | 23,587 |
| White River Lake | Brazos | 1963 | 2,431 | 38,650 |
| White Rock Lake | Trinity | 1911 | 3,500 | 10,740 |
| Whitney, Lake | Brazos | 1951 | 18,336 | 627,100 |
| Wichita, Lake | Red | 1901 | Sys. Op. | 14,000 |
| William Harris Reservoir | Brazos | 1947 | 0 | 10,200 |
| Winters, Lake / New Winters, Lake | Colorado | 1983 | 0 | 8,374 |
| Worth, Lake | Trinity | 1914 | Sys. Op. | 37,066 |
| Wright Patman Lake | Sulphur | 1954 | 363,000 | 145,300 |

## APPENDIX C. MAJOR RESERVOIRS OF TEXAS - CONTINUED

| Reservoir Name | River Basin | Year of Completion | Year 2010 Firm Yield (acre-feet) from 2011 Regional Water Plans | Original Conservation Pool Capacity (acre-feet) |
|---|---|---|---|---|
| **Major Reservoirs with no water supply function** | | | | |
| Addicks Reservoir | San Jacinto | 1948 | No WS | 200,840 |
| Alders Reservoir | Trinity | 1950s | No WS | 7,064 |
| Barker Reservoir | San Jacinto | 1945 | No WS | 207,000 |
| Barney M. Davis Reservoir | Nueces-Rio Grande | 1973 | No WS | 6,600 |
| Bivins Lake | Red | 1927 | No WS | 5,122 |
| Buffalo Lake | Red | 1938 | No WS | 18,150 |
| Camp Creek Lake | Brazos | 1949 | No WS | 8,550 |
| Coffee Mill Lake | Red | 1938 | No WS | 8,000 |
| Hawkins, Lake | Sabine | 1962 | No WS | 11,890 |
| Holbrook, Lake | Sabine | 1962 | No WS | 7,990 |
| J. D. Murphree Wildlife Impoundment | Neches-Trinity | 1964 | No WS | 13,500 |
| Kiowa, Lake | Trinity | 1970 | No WS | 7,000 |
| Lower Running Water Draw WS SCS Site 2 Dam | Brazos | 1977 | No WS | 5,429 |
| Lower Running Water Draw WS SCS Site 3 Dam | Brazos | 1982 | No WS | 8,213 |
| Naconiche, Lake | Neches | 2005 | No WS | 15,031 |
| Natural Dam Lake | Colorado | 1989 | No WS | 54,560 |
| Quitman, Lake | Sabine | 1962 | No WS | 7,440 |
| Rita Blanca, Lake | Canadian | 1939 | No WS | 12,100 |
| San Esteban Lake | Rio Grande | 1911 | No WS | 18,770 |
| Tailing Ponds | San Antonio-Nueces | 1971 | No WS | 6,400 |
| Tailing Ponds No. 2 | San Antonio-Nueces | 1971 | No WS | 6,400 |
| Truscott Brine Lake | Red | 1983 | No WS | 111,147 |
| Winnsboro, Lake | Sabine | 1962 | No WS | 8,100 |
| | | | 9,367,813 | 42,900,519 |

Hydropower: Used to generate hydropower.
Cooling: Used as cooling pond for power plants.
Storage: Used as a water storage facility only.
Pass-through: Temporary storage facility only.
System Operation: Reservoir operated in system operation mode with several reservoirs contributing to one yield number.
(Note: When quantified separately, the sum of individual yields will not equal a system yield.)

Note: The capacity numbers for Amistad, Falcon, Toledo Bend, and Texoma are for total capacity, not Texas' share;
yields are firm as reported by the regional water planning groups and are for the Texas share only.

## AGRICULTURE
### (EIGHT REGIONS: A, B, E, H, J, K, L, AND P)

#### WATER DATA - FIVE REGIONS: A, B, E, J, AND L

- Develop irrigation demand numbers on a regional basis - A
- Provide funding for agricultural water use data collection - B
- Improve accuracy of TWDB historical irrigation pumpage reports - E
- Develop more accurate means of estimating actual irrigation use - J
- Continue supporting evaluations of exotic animal water use to improve demand estimates - J
- Improve accuracy of water use and demand information for irrigation and livestock - L

#### CONSERVATION - FIVE REGIONS: A, H, K, L, AND P

- Create a water conservation reserve program to convert irrigated acreage to dry land - A
- Encourage the federal government to continue to support Conservation Reserve Program participation - A
- Provide funding to expand the High Plains Potential Evapotranspiration network into a statewide network - A
- Fund grants or subsidies to stimulate irrigation conservation practices - H
- Increase funding for TWDB agricultural water conservation programs - H, L
- Collaborate with the Natural Resources Conservation Service state conservationist in identifying projects to fund - K
- Support adequate funding of the Environmental Quality Incentives Program and its water conservation efforts - K
- Support funding of the Natural Resources Conservation Service - K, P
- Leverage federal agricultural conservation grants by providing local matching share - P
- Continue supporting state and federal programs that improve irrigation efficiency and agricultural water conservation - P
- Support adequate funding of State Soil and Water Conservation Board and local soil and conservation districts - P

#### OTHER - THREE REGIONS: K, L, AND P

- Develop water polices that enable agriculture and rural Texas to achieve parity with other users - K
- Provide additional funding to the Irrigation Technology Center at Texas A&M University - L
- Protect groundwater sources for agricultural production - P

## CONJUNCTIVE USE
### FOUR REGIONS: F, G, L, AND N

- Expand definition of conjunctive use - F
- Encourage conceptual modeling for conjunctive use projects - G
- Include conjunctive use projects as management strategies - G
- Develop incentives for conjunctive use projects - L
- Develop policy to manage all water resources on conjunctive use basis - N

## CONSERVATION
### FIFTEEN REGIONS: A, B, C, D, F, G, H, I, J, K, L, M, N, O, AND P

#### REUSE - NINE REGIONS: A, C, F, G, H, I, K, L, AND N

- Encourage Texas Commission on Environmental Quality to evaluate rules governing reuse of wastewater and quantify incentives for its use - A
- Recommend reducing legal obstacles to indirect reuse of treated wastewater - C
- Recommend Texas Commission on Environmental Quality clearly define permitting process for large-scale reuse projects - C

- Encourage legislation for safe and economical water reuse - F
- Work with federal agencies/representatives to develop safe procedures for disposing of reject water - F
- Encourage municipalities to manage return flows through direct and indirect reuse - G
- Encourage river authorities to manage return flows not under others' jurisdictions - G
- Clarify Texas Pollutant Discharge Elimination System after Elimination rules for wastewater permitting to eliminate double-counting of waste loads - H
- Advocate statewide reuse - H
- Resolve permitting issues for indirect reuse, including clarifying Texas Water Code Sections 11.042 and 11.046 - H, I
- Encourage Texas Commission on Environmental Quality to continue thorough review of indirect reuse applications, including environmental and water rights concerns - K
- Fund reuse technologies - L
- Promote water reuse and return flows wherever practical, after evaluating environmental needs - N

### CONSERVATION FUNDING - FOUR REGIONS: F, H, K, AND O

- Fund grants or low-interest loans as incentives to use conservation technologies - F
- Leverage federal conservation grants by providing matching funds - H
- Continue and expand TWDB funding for retail utility water loss projects - K
- Fund conservation incentives for all user groups - O

### WATER CONSERVATION ADVISORY COUNCIL - FOUR REGIONS: A, C, K, AND L

- Adopt definitions and methodology for gallons per capita per day proposed by Water Conservation Advisory Council - A, K
- Maintain the functionality and viability of the Water Conservation Advisory Council - A
- Fund activities of the Water Conservation Advisory Council and a statewide awareness campaign - C, L

### WATER CONSERVATION IMPLEMENTATION TASK FORCE - FOUR REGIONS: C, F, L, AND O

- Follow the Water Conservation Implementation Task Force recommendation to institute voluntary, rather than mandatory, per capita water use goals - C, F
- Fund and implement programs recommended by the Water Conservation Implementation Task Force - L
- Update the 2004 Best Management Practices Guide - O

### VOLUNTARY CONSERVATION - FOUR REGIONS: B, D, F, AND O

- Allow regions to establish voluntary water conservation goals - B, D
- Encourage conservation through technical assistance rather than mandatory goals - F
- Support landowner's voluntary protection of springs and seeps - O

### WATER PROVIDERS - FIVE REGIONS: D, F, G, K, AND M

- Train water utilities to reduce water losses and improve their accountability - D, M
- Encourage retail water providers to use inclining block rate structure - F, G
- Support required use of conservation coordinator by all public water suppliers - K
- Encourage Texas Commission on Environmental Quality to amend 30 Texas Administrative Code Chapter 288 to require designated water conservation coordinators - K

### CONSERVATION MANAGEMENT - FIVE REGIONS: J, K, L, M, AND N

- Develop conservation-oriented management plans for areas particularly susceptible to drought - J

- Encourage legislation to allow water providers to have dedicated funding for longer term water conservation - K
- Encourage legislation to allow property owners' associations to adopt restrictive covenants consistent with their water providers drought and conservation recommendations - K
- Encourage water users to develop and implement conservation plans that meet or exceed legal requirements - L, M
- Encourage municipal providers to develop and implement drought contingency plans that meet or exceed legal requirements - L, M
- Encourage legislation to support conservation strategies that manage water supplies more efficiently - N

#### OTHER - TEN REGIONS: A, B, D, F, H, J, K, L, M, AND O

- Evaluate policy barriers to using playa lakes for conservation purposes - A
- Base calculation of gallons per capita per day on residential water use only - B
- Recommend the legislature standardize the measurement of gallons per capita per day - D
- Systems with use greater than 140 gallons per capita per day should perform water audits - D
- Recommends legislature continue to address and improve water conservation in the state - H
- Require conservation on all state-owned lands - J
- Encourage conservation partnerships between water groups - K
- Recommend consideration of drought management as an interim strategy to meet near-term needs - L
- Recommend the state more actively monitor compliance with conservation and drought plans - M
- Recommend conservation and drought plans be consistent with the regional water plan - M
- Regional water planning groups should have a more active role in evaluating conservation and drought plans - M
- Develop a tiered recognition program for conservation achievements - O
- Control aquatic vegetation as water conservation practice - O

## DATA COLLECTION AND RESEARCH

### FOURTEEN REGIONS: A, B, D, E, F, H, I, J, K, L, M, N, O, AND P

#### GROUNDWATER AND SURFACE WATER AVAILABILITY MODELING - NINE REGIONS: A, D, E, F, H, J, K, M, AND N

- Fund updates of water availability models - A, M, N
- Continue funding ground-water availability models - D, E, H, J, K, M, N
- Continue water availability modeling for minor Panhandle aquifers - A
- Recommend agencies coordinate with one another and planning groups in developing water availability and groundwater availability models - A
- Fund improvements to groundwater modeling and research in West Texas - E
- Request data from water agencies in Mexico to extend the Presidio Bolson groundwater availability model - E
- Allow more flexibility in the use of water availability models in the planning process - F
- Revise Hill Country Trinity Aquifer ground-water availability model - J
- Fund feasibility study linking groundwater and surface water in next generation of groundwater and water availability models - J, K
- Encourage public and private sector technical review of groundwater and water availability models - K
- Update the Central Gulf Coast Aquifer groundwater availability model - N

### GROUNDWATER STUDIES - EIGHT REGIONS: E, F, J, K, L, N, O, AND P

- Finish study of Presidio Bolson Aquifer - E
- Study and characterize limestone formation in southern Brewster County - E
- Collect groundwater data to carry out Senate Bill 1 and Joint Planning for Groundwater - F
- Continue funding monitoring studies - J
- Study and characterize the Edwards-Trinity (Plateau) Aquifer and associated aquifers - J
- Provide groundwater conservation districts with technical assistance in gathering aquifer data - J
- Study the Frio River alluvium - J
- Study surface water/groundwater interaction in the upper Guadalupe River for springflow analysis - J
- Complete study of Trinity Aquifer use in Hays County and use results in next regional water plan - K
- Encourage legislation requiring economic and environmental studies for any groundwater project - L
- Encourage Railroad Commission to provide better information for identifying aquifer characteristics - N
- Provide additional funds to expand groundwater data program - N
- Encourage TWDB, Texas Commission on Environmental Quality, and Railroad Commission to expand and intensify ground-water data gathering and disseminating - N
- Fund computer models that quantify groundwater resources in each aquifer and project future availability based on historical net changes - O
- Continue monitoring static water levels and groundwater pumpage - P

### ENVIRONMENTAL STUDIES - FOUR REGIONS: D, F, H, AND L

- Study mitigation effects as early as possible in reservoir planning - D
- Fund studies to identify and quantify environmental values to be protected and stream flows necessary to maintain priority environmental values - F
- Involve local groups in studies that evaluate streamflow issues - F
- Increase funding for research to determine freshwater inflow needs - H
- Complete the Texas Instream Flow Program - L
- Fund and improve freshwater inflow studies for bays and estuaries - L
- Examine applicability of report by Study Commission on Water for Environmental Flows - L
- Perform studies to evaluate effects of water management strategies on basin ecosystems - L

### AQUIFER RECHARGE - FIVE REGIONS: A, B, J, L, AND O

- Consider the minimal recharge rate in assessments of the Ogallala Aquifer - A
- Study means to improve groundwater recharge - A
- Study the applicability of aquifer recharge programs and their impact to surface water rights - B
- Study quantity of increased groundwater from enhanced recharge structures - B
- Study aquifer recharge with harvested rainwater - J
- Fund research on Edwards (Balcones Fault Zone) Aquifer recharge and recirculation systems water management strategy - L
- Identify and quantify recharge mechanisms for Ogallala Aquifer - O
- Study and describe impact of playas on recharge - O

### AGRICULTURE/RURAL - FIVE REGIONS: E, H, J, L, AND O

- Establish an integrated Rio Grande data management system to better manage irrigation releases and flood control - E
- Provide real time monitoring on the Rio Grande Project delivery system via information systems analysis and hydrologic operations modeling - E
- Fund research on more efficient irrigation practices - H
- Increase funding to research drought-resistant crop species - H, O
- Encourage riparian landowners to implement land stewardship practices - J
- Study impact of transient populations on rural water demand - J
- Undertake economic studies of water management strategies that meet irrigation needs - L

### CONSERVATION - FOUR REGIONS: F, H, K, AND O

- Continue participating in conservation research and demonstration projects - F
- Fund research for advanced conservation technologies - H
- Fund research on developing and implementing conservation goals and successful water management strategies to update the 2004 Best Management Practices Guide - K
- Update the 2004 Best Management Practices Guide - O

### BRUSH CONTROL - THREE REGIONS: D, J, AND K

- Monitor water pollution from Giant Salvinia and research and develop best management practices for its control - D
- Fund multidisciplinary research for defining watersheds with greatest potential for increasing water yields through brush management; quantify costs - J
- Fund voluntary brush control studies - K

### RIVERS - ONE REGION: E

- Study effects of possible rechannelization of Rio Grande below Fort Quitman - E

### GENERAL - ELEVEN REGIONS: A, B, E, F, I, J, K, L, M, N, AND O

- Improve monitoring and quantifying of small communities, manufacturers, livestock operators, and county-other categories - A
- Analyze economic effects of implementing water management strategies - A
- Remove provisions from Open Records Act restricting access to water data on private property - E
- Recommend TWDB meet with regions and consultants to discuss data collection and quality control - F
- Fund study on oral ingestion of radium before enforcing maximum containment load - F
- Fund improved data for next planning cycle - I
- Conduct studies on specific water resource issues - J
- Fund all levels of data collection and analysis - K, L, O
- Fund roles of TWDB and Texas Commission on Environmental Quality in providing data for regional planning - L
- Review the Texas Water Code regarding transfers of water out of groundwater conservation districts and provide sufficient revenue for technical studies - L
- Evaluate the effect of groundwater withdrawals on surface water availability - M
- Evaluate true impact and treaty compliance factors of aqueduct construction from Falcon Reservoir to Matamoros, Mexico - M
- Fund and establish regional research centers at local universities to focus on Coastal Bend water issues - N
- Provide funds to establish and maintain a regional water resources information

management system - N
- Recommend TWDB consider local projects when developing mining water demand projections, specifically the Eagle Ford shale - N
- Fund a basic data network that maintains current inventory of surface water and groundwater resources - O
- Develop standardized, comprehensive methodologies for characterizing and computing per capita water use - O

## EDUCATION
## NINE REGIONS: D, F, G, J, K, L, M, N, AND O

### CONSERVATION EDUCATION - EIGHT REGIONS: D, F, G, J, K, L, M, AND O
- Fund and implement conservation education programs for the public - D, F, J, M
- Create and fund a water conservation awareness program through TWDB - G, O
- Fund the Water IQ public education program - K, L
- Supports regional coordination and resource pooling for uniform conservation messaging - K
- Encourage TWDB to assist communities to coordinate on conservation education efforts - K

### GENERAL EDUCATION - FOUR REGIONS: J, K, L, AND O
- Fund education on conservation and about water supplies programs for public sector - J, O
- Fund education on water management and rainwater harvesting programs for private sector - J
- Address sustainability through education - K
- Fund statewide education program and coordinate with Texas Cooperative Extension - L

### AQUATIC WEED CONTROL - ONE REGION: D
- Develop awareness campaign and provide extension and education services to urban and industry stakeholders on giant salvinia threat and mitigation - D

### REGIONAL GROUPS - ONE REGION: N
- Make funds available to planning groups and groundwater conservation districts to educate public on water issues - N

## ENVIRONMENT
## TWELVE REGIONS: A, B, C, D, E, F, G, H, K, L, O, AND P

### UNIQUE STREAM SEGMENTS - FIVE REGIONS: A, B, C, D, AND L
- Clarify intent and uncertainties of unique stream segment designation - A, B, C, D, L
- Examine ancillary issues regarding unique stream segments - C
- Establish a working group on unique stream segments to review legislative intent, agency rules, and impacts of designations - C

### INSTREAM FLOWS - THREE REGIONS: F, G, AND K
- Protect existing water rights when considering instream flows - F
- Oppose adaptive management requirements concerning instream flows - F
- Evaluate return flows to determine impact on instream flows - G
- Provide direction to protect instream/freshwater inflows - K
- Monitor and provide adequate funding for environmental flows - K
- Encourage Colorado and Lavaca Stakeholder Group to develop recommendations protective of long-term ecological productivity - K
- Recommend state evaluate ways to convert existing water rights to environmental uses - K

### RESERVOIRS - TWO REGIONS: D AND P
- Consider environmental and economic impacts of reservoir development - D
- Recommend entities proposing new reservoirs through the planning process include a map of proposed mitigation acreage - D

- Support efforts to mitigate environmental impacts of Palmetto Bend Stage II - P

### OTHER - SEVEN REGIONS:, E, F, G, H, K, L, AND O

- Establish policy to protect aquifers and springs to preserve "the rural way of life" - E
- Support recognition of the importance of springs and spring-fed stream - F
- Encourage responsible land management practices to protect water sources - G, L
- Clarify agency rules on quantitative environmental analysis - H
- Support planning process structure that evaluates environmental needs to determine available water supply - K
- Evaluate land use and ecosystem health in light of sustaining future quality of life - L
- Encourage collaboration of scientists, policy makers, and agricultural representatives in managing threatened species - O

## GROUNDWATER

## FIFTEEN REGIONS: A, C, D, E, F, G, H, I, J, K, L, M, N, O, AND P

### GROUNDWATER CONSERVATION DISTRICTS - TWELVE REGIONS: A, C, F, G, H, I, J, K, L, M, O, AND P

- Manage groundwater resources through local groundwater conservation districts - A, F, G, H, J, K, M, P
- Create or expand groundwater conservation districts in areas not currently served - A, F, I, J, K, M
- Encourage cooperation between groundwater conservation districts - C, F
- Recommend TWDB or Texas Commission on Environmental Quality oversee groundwater districts to standardize regulations - C, F
- Support groundwater conservation districts as local authority on groundwater issues - G, K
- Respect property rights and right to capture when adopting rules and regulations - F
- Base groundwater supply availability on management goals and rules - F
- Restrict export from a district until there is a plan to ensure adequate supplies are available for the district or region - F
- Ensure all state lands are subject to groundwater district rules and limits - F
- Train groundwater conservation districts in use of groundwater availability modeling - J
- Form groundwater conservation districts to administer sound, scientifically based groundwater management objectives - J
- Advocate that groundwater conservation districts consider developing management rules for Edwards (Balcones Fault Zone) Aquifer to sustain spring flows of upper Guadalupe River - J
- Strengthen groundwater conservation districts' abilities to protect groundwater supplies - K
- Encourage TWDB to continue assisting groundwater districts - K
- Support referral of any groundwater district reorganization to the local election process - K
- Recommends groundwater districts manage groundwater as necessary to meet desired future conditions rather than use the Managed Available Groundwater as a permitting cap - K
- Review Texas Water Code to ensure groundwater conservation districts are funded and equipped for comprehensive analysis tasks - L
- Create and operate groundwater conservation districts under Texas Water Code, Chapter 36 - O

### GROUNDWATER MANAGEMENT AREAS - SIX REGIONS: D, E, F, J, K, AND L

- Recommend voting representation for areas without groundwater districts be based upon the areas population, groundwater use, or number of aquifers - D
- Reschedule due dates in the Joint Planning

process so Managed Available Groundwater data can be better integrated into the water plans - E, F

- Examine interaction of regional water planning and groundwater management areas processes to improve the resulting economic impacts - J
- Support use of groundwater management area-wide average desired future conditions to expedite establishment of managed available groundwater values - K
- Revise Texas Water Code Chapter 36 to allow groundwater districts to either manage groundwater to achieve the desired future condition or use TWDB-provided managed available groundwater to restrict permitting - K
- Support determinations of Managed Available Groundwater based on Desired Future Conditions Joint Planning process - L

## REGIONAL COLLABORATION - SIX REGIONS: E, F, G, J, K, AND L

- Encourage groundwater conservation districts to collaborate in planning process - E, F, G, K
- Recommend groundwater management councils coordinate efforts with planning groups - E
- Require state lands to abide by ground-water district regulations and submit water withdrawal plans to relevant planning group - F
- Notify planning groups when significant amounts of groundwater are being exported - F
- Assess groundwater availability for regional plans based on groundwater conservation district's goals and requirements - F
- Recommend planning groups J, K, and L collaborate on Trinity Aquifer evaluation - J
- Recommend TWDB-sponsored workshops for regions sharing aquifers - J
- Encourage collaboration between regions sharing aquifers - L

## RULE OF CAPTURE - FIVE REGIONS: F, H, K, O, AND P

- Support rule of capture - F, P
- Maintain rule of capture in areas not subject to defined subsidence or groundwater conservation districts - H, K
- Support rule of capture as modified by rules and regulations of existing ground-water conservation districts - K, O
- Oppose legal recognition of groundwater ownership in place as vested right of surface property owner - K

## OIL AND GAS - FOUR REGIONS: D, F, M, AND N

- Recommend Railroad Commission of Texas review and enforce regulations protecting aquifers from oil well contamination - D, F
- Levy fines for oil and gas producers who violate rules governing aquifer contamination - F
- Support the industry-funded program to plug abandoned wells - F
- Encourage adequate funding for the Railroad Commission of Texas to protect water supplies - F
- Encourage restoring funding to well-plugging account - F
- Appropriate sufficient funds to Railroad Commission of Texas for capping abandoned wells - M, N

## SUSTAINABILITY - THREE REGIONS: G, L, AND P

- Advocate adoption of water management strategies that do not substantially deplete aquifers - G
- Suggest the state continue developing policy that protects historical use and future sustainability - G
- Support management strategies that achieve groundwater sustainability - L
- Support sustainable yield of the Gulf Coast Aquifer as the limit for water development - P
- Recommend sustainable yield as upper limit for all groundwater conservation districts in region - P

### STATE AGENCIES - TWO REGIONS: K AND N

- Encourage funding of TWDB groundwater programs - K
- Expand efforts of TWDB, Texas Commission on Environmental Quality, and Railroad Commission of Texas in managing groundwater - N

### OTHER - THREE REGIONS: F, J, AND L

- Encourage groundwater legislation that is fair to all users - F
- Oppose historical use limits in granting water rights permits - F
- Oppose groundwater fees for wells used exclusively for dewatering - F
- Encourage state to review groundwater resources on state-owned land and determine appropriate management - F
- Standardize groundwater evaluations statewide - J
- Advocate groundwater management based on science, equity, and rationality - L
- Determine water management strategies for Edwards (Balcones Fault Zone) Aquifer during drought of record - L

## INNOVATIVE STRATEGIES

## TWELVE REGIONS: A, B, C, D, E, F, J, K, L, M, N, AND O

### BRUSH CONTROL - NINE REGIONS: A, B, D, F, J, K, L, M, AND O

- Provide funding to implement brush control and land stewardship - B, O
- Encourage funding for new technical resources to combat giant salvinia, saltcedar, and aquatic weeds - D, M
- Request TWDB guidance on including brush control projects as source of new surface water- A
- Support brush control as funding priority - F
- Recommend completing final phase of North Concho River brush control program - F
- Continue funding Twin Buttes brush control project until completed - F
- Fund brush control for region's reservoirs - F
- Give priority funding to land conservation and management practices, including brush and burn management and follow-up grazing - F
- Continue cooperating with federal agencies to secure brush control funds - F
- Fund programs to eradicate nuisance vegetation - J
- Fund a long-term, cost-sharing program for landowners participating in brush management similar to the Natural Resources Conservation Service's Great Plains Conservation Program - J
- Encourage funding for saltcedar eradication and long-term brush management strategies in Rio Grande watershed - J, M
- Fund programs to eradicate saltcedar - J, O
- Provide pro rata funds to landowners for brush control assistance - K
- Fund brush management technologies - L

### DESALINATION - SIX REGIONS: A, C, F, L, M, AND N

- Continue funding salinity control projects in Canadian and Red River basins - A
- Support research to advance desalination and reuse - C
- Provide funding to small communities for desalination projects - C
- Provide funds for desalination - F, L
- Continue funding brackish groundwater projects and seawater desalination demonstration projects - M
- Encourage Texas Commission on Environmental Quality, TWDB, and Texas Parks and Wildlife Department to investigate environmental impacts of seawater desalination discharge and allow it where no damage will occur - N
- Recommend changing regulations governing desalination brine to coincide with those governing petroleum brine - N

### STORMWATER - ONE REGION: E

- Future planning should include stormwater, including aquifer recharge and optimization of surface water resources - E

### WEATHER MODIFICATION - TWO REGIONS: F AND L

- Support funding for researching, evaluating, creating, and operating weather modification programs - F
- Fund weather modification technologies - L

### AQUIFER RECHARGE - TWO REGIONS: J AND L

- Fund recharge structures and provide technical assistance - J
- Fund small aquifer recharge dams - L

### PLAYAS - ONE REGION: O

- Create and preserve native grass buffers to protect playa basins - O

### OTHER - THREE REGIONS: F, J, AND L

- Support state/federal funding for demineralization, reclamation, and aquifer storage and recovery - F
- Encourage and fund rainwater harvesting - J, L
- Increase funds for projects demonstrating alternative water supply strategies - L

## INTERBASIN TRANSFERS
## EIGHT REGIONS: C, D, F, G, H, I, K, AND N

### JUNIOR RIGHTS - THREE REGIONS: F, I, AND N

- Oppose modifying the junior rights provision until basin of origin needs are ensured by reviewing water availability models to determine there are no detrimental impacts - F
- Support legislation to allow junior water rights exemptions from contracts reserving sufficient supply to meet 125 percent of demand in basin of origin - I
- Repeal junior rights provision and additional application requirements for interbasin transfers - N

### BASIN OF ORIGIN - TWO REGIONS: D AND K

- Review the definition of "need" in basin of origin to ensure that needs are met before transfers are permitted - D
- Evaluate compensation to basin of origin - D
- Protect basins of origin in interbasin transfers - K

### OTHER - FOUR REGIONS: C, F, H, AND K

- Recommend that unnecessary, counterproductive barriers to interbasin transfers be removed from Texas Water Code - C, H
- Support interbasin transfers as most efficient method for meeting state water needs - F
- Protect current water rights holders in interbasin transfers - F
- Verify that interbasin transfers are consistent with regional water plans - K
- Complete the Lower Colorado River Authority/ San Antonio Water System study to verify that water transport meets regional water plan guidelines - K

## FUNDING FOR PLAN IMPLEMENTATION
## NINE REGIONS: A, C, E, F, G, H, L, M, AND O

- Fund region-specific water supply strategies - A, E
- Change TWDB regulations to allow Water Infrastructure Funds to be used for acquisition of reservoir sites prior to permitting process - C
- Increase appropriations to the Water Infrastructure Fund - F
- Create statewide mechanism for funding state water plan projects - G, L
- Increase funding of State Participation Program to develop water supply projects meeting long-term demands - H

- Establish financing mechanisms to develop new water supply projects in adopted regional plans - H
- Provide sufficient funding to TWDB and Texas Commission on Environmental Quality for administering state water plan programs - L
- Fund water management strategies identified in regional water plans - M, O

## PROVIDING AND FINANCING WATER AND WASTEWATER SYSTEMS
### SEVEN REGIONS: A, F, H, K, L, M, AND O

#### FEDERAL MONIES - THREE REGIONS: E, H, AND L
- Continue federal and state financial programs for substandard water and wastewater systems (colonia areas) - E
- Investigate opportunities for increased U.S. Army Corps of Engineers funding - H
- Encourage more active state solicitation of federal monies - L

#### STATE FUNDING PROGRAMS - FOUR REGIONS: C, H, I, AND K
- Establish more flexible deferred financing programs for large projects which allow repayment as portions of projects are brought online - C
- Increase funding of the State Loan Program for near-term infrastructure cost projections - H
- Continue state and federal support of Texas Community Development Program - H
- Increase funds for Small Towns Environment Program - H
- Increase funding of Regional Water Supply and Wastewater Facilities Planning Program; expand to include engineering design and cost estimates - H
- Increase future funding of State Revolving Fund to cover system capacity increases - H
- Make State Participation Program available to public/private partnerships and nonprofit water supply corporations - H
- Allow Water Infrastructure Funds to be used for replacement of water supply infrastructure - I
- Increase flexibility in determining categorical exclusions for Environmental Information Documents - I
- Revise Economically Disadvantaged Areas Program requirements to reduce difficult eligibility requirements, including model subdivision planning - I
- Provide low-interest loans and grants to reduce system water loss - K

#### OTHER - SEVEN REGIONS: A, F, H, I, K, M, AND N
- Develop or improve grant and loan programs to replace and repair aging infrastructure - A, I
- Provide grants to small and rural drinking water treatment systems to meet federal drinking water standards - F
- Increase funds for the Galveston Bay and Estuary program - H
- Provide funds for water treatment and radioactive waste disposal threatening rural water supplies - K
- Encourage regionalization of water and wastewater utility service – M
- Fund and support efforts of Groundwater Management Areas – N

## REGIONAL WATER PLANNING
### ALL SIXTEEN REGIONS

#### FUNDING/SUPPORT - ELEVEN REGIONS: B, E, H, I, J, K, L, M, N, O, AND P
- Continue adequate funding of regional water planning process - B, E, H, K, L, M, N, O
- Provide additional state funding for regional planning administrative costs - B, E, J, K,
- Fund technical studies necessary to support the work of the planning groups - H

- Advocate that regions fund administrative costs of planning process - I
- Reimburse planning group members for reasonable expenses - J
- Consider factors other than population in funding the planning process - M
- Request public entities provide their share of funding for regional planning activities - N
- Establish funding for planning groups through TWDB - P

### STATE AGENCIES - SIX REGIONS: C, F, G, J, K, AND M

- Recommend that TWDB and Texas Commission on Environmental Quality collaborate on determining which water availability modeling data to use in regional planning - C, F
- Recommend all state agencies adhere to state water plan - G
- Recommend nonvoting state agencies attend regional planning meetings or relinquish authority to alter adopted plan - J
- Encourage Texas Commission on Environmental Quality to provide technical reviews and draft permits to planning groups to ensure consistency with regional plans - K
- Suggest Texas Commission on Environmental Quality assist Rio Grande area in converting water rights from one use to another - M

### ALTERNATIVE STRATEGIES - FOUR REGIONS: A, D, F, AND I

- Allow small systems to develop alternative near-term scenarios - A
- Allow alternative scenarios in population growth and economic development in determining future water demands - D
- Allow alternative water management strategies in regional plan - F, I

### CONSISTENCY - SIX REGIONS: B, D, E, F, H, AND I

- Recommend waivers for surface water projects that will not significantly impact regional supplies and do not involve new water sources - B
- Recommend TWDB consider entire regional plan when determining consistency - D
- Apply consistent economic principles to water project and strategy evaluation - E
- Allow maximum flexibility in determining consistency with regional plans - F, I
- Recommend Texas Commission on Environmental Quality and TWDB collaborate on consistency determinations and waivers to allow for maximum flexibility - F, I
- Recommend TWDB publish clear criteria for consistency determinations before adopting regional water plans - F
- Recommend waivers for consistency issues for small projects - F
- Clarify rules to address consistency within regional plans - H
- Allow entities smaller than planning criteria that do not have specific needs identified in water plans to be eligible for state funds - I
- Remove willing buyer/seller transactions from consistency requirements - I
- Advocate removing consistency requirements from Senate Bill 1 - I

### WATER DEMAND FIGURES - FIVE REGIONS: D, E, H, J, AND L

- Revise procedure for water demand reductions to recognize areas with low per capita consumption - D
- Allow more time for final demand figures - E
- Recommend more real life analysis of demand figures during drought conditions - E
- Recommend State Demographer explore potential changes in population distribution due to information technology advancements - H
- Develop better methodologies for estimating population and water demand - J
- Modify planning process so that water demand projections allow for regional input - L

- Modify regional planning process to allow for more flexibility in developing growth and water demand methodologies - L

### PLANNING GROUP AUTHORITY - ONE REGION: O

- Oppose legislature empowering planning groups with any regulatory authority - O

### TRAINING - ONE REGION: J

- Provide training for new planning group members - J

### OTHER - TEN REGIONS: A, C, E, F, H, K, L, M, O, AND P

- Clarify relationship between drought contingency planning and regional water supply planning - A
- Include project for future groundwater quality in the region - A
- Ensure eligibility for small cities and entities included as county-other - A
- Allow flexibility in applying water availability models for planning - C, F
- Avoid constraining planning process with technical requirements - E
- Set deadlines for regional plans that avoid legislative sessions - E
- Consider all water resources available to a region including those outside of the state - E
- Recommend rule simplification before next round of planning - F
- Allow planning groups to adopt an existing water plan if there are no significant changes to the recommended water management strategies - F
- Clarify rules on quantitative environmental analysis - H
- Review the administrative provisions of SB1 and subsequent policies to determine if appropriate organizational structure exists - H
- Coordinate regional planning process with Texas Clean Rivers Program - K
- Improve representation of women and minorities on planning groups - K
- Oppose development of new water management strategies to accommodate export of supplies to another county and planning region of state - K
- Oppose use of water availability model Run 3 in regional water planning as being unreasonably restrictive - K
- Include in plan water supplies over and above those required to meet the projected need - L
- Establish contract requirements before grant proposals are submitted - L
- Oppose changes to planning process except through formal rulemaking procedure - L
- Urge prompt and full implementation of these plans - L
- Include wildlife and environmental needs as a category of water use - M
- Recommend shifting to a utility-centric method of planning rather than city-centric - M
- State should consider impacts of climate change on regional water planning and future water supplies - M
- Allow for additional region-specific planning options and forecast scenarios - O
- Review the planning process with a group of stakeholders and identify any revisions to the planning process by the end of 2010 - O
- Support a greater role for inter-regional coordination in future planning - P

## RURAL WATER

### THREE REGIONS: G, H, AND L

- Encourage regionalization, education, and proactive planning of small water systems - G
- Support increased funding of federal Rural Utilities Service programs and funding of the state Rural Water Assistance Fund - H
- Study implications of water export, considering its implications on rural environment and economy - L

## SURFACE WATER
### TEN REGIONS: A, B, C, D, F, G, H, L, M, AND P

#### RESERVOIRS - SIX REGIONS: A, B, D, H, I, AND P

- Recommend TWDB submit reservoir feasibility study plans and results to Compact Commissions - A
- Change definition of water availability in reservoirs to match owner's operational criteria - A
- Include possible reservoir sites and flood control/aquifer recharge structures in future water plans - A
- Extend designations for unique reservoir sites beyond 2015 - B, I
- Designate Toledo Bend Reservoir as a supply strategy for upper Sabine Basin in Region D and supply option for Region C - D
- Consider potential economic and environmental impacts to reservoir development - D
- Consider raising the level for Lake Wright Patman prior to development of new reservoirs in Region D - D
- Consider development of reservoirs in the Sulphur Basin in Region D as violation of the quantitative evaluations of water management strategies under 31 Texas Administrative Code 357.7(a)(8)(A) and a conflict with the Region D plan - D
- Oppose development of reservoirs in the Sulphur Basin in Region D prior to development of environmental flow standards through Senate Bill 3 process - D
- Establish flood damage liability limits for reservoirs - H
- Develop Lake Texana Stage II as supply strategy - P

#### WATER PERMITS - FOUR REGIONS: C, F, L, AND N

- Encourage TWDB and Texas Commission on Environmental Quality work with U.S. Environmental Protection Agency to revise Section 361(b) regulations on power plant cooling water - C
- Notify all basin water rights holders when a request to amend a water right increases quantity or changes purpose or place of use - F
- Fund Texas Commission on Environmental Quality adequately to ensure appropriate use of permitted surface water rights - L
- Urge Texas Commission on Environmental Quality to enforce existing rules and regulations regarding impoundments - N

#### U.S. ARMY CORPS OF ENGINEERS - FOUR REGIONS: B, D, H, AND I

- Recommend U.S. Army Corps of Engineers transfer flood storage to conservation storage - B
- Recommend the Wetlands Compensatory Mitigation Rule of "avoid, minimize, and compensate" be closely followed - D
- Allow U.S. Army Corps of Engineers to increase water supply storage in new reservoirs - H
- Include TWDB and regional water planning agencies on mitigation bank review teams - I

#### SEDIMENT CONTROL - THREE REGIONS: B, C, AND D

- Support efforts, including land management, to rehabilitate existing sediment control structures and construct new ones - B
- Seek additional federal funding to improve and maintain Natural Resources Conservation Service sediment and flood control structures - C, D

#### UNCOMMITTED WATER - TWO REGIONS: C AND F

- Recommend changing Texas Water Code to exempt from cancellation nonuse associated with developing and managing reservoirs - C
- Oppose canceling uncommitted water contracts/rights - F

#### WATERMASTER PROGRAM - ONE REGION: M

- Authorize Watermaster Program to manage the Rio Grande water availability model - M
- Direct all appropriate Rio Grande water rights fees to Watermaster operations - M

### OTHER - SIX REGIONS: B, C, F, G, K, AND M

- Recommend all surface water uses, regardless of size, be consistent with regional plan - B
- Continued and increased state support of efforts to develop water supplies in Oklahoma - C
- Review state surface water policy to ensure its appropriateness for next 50 years - F
- Amend state water law to incorporate river basin subordinations in regional water plans - F
- Support long-term contracts for future projects and droughts - F
- Support long-term contracts for reliable water supply planning and shorter-term "interruptible" contracts to meet needs before long-term water rights are fully used - F
- Support coordinated operation of two or more water supply sources - G
- Give priority to water policies that increase surface water availability - K
- Encourage development of an operating plan for Mexican tributary reservoirs that ensures full compliance with 1944 Water Treaty while optimizing supply available to Mexico - M
- Continue considering allocation of Rio Grande Flows upstream of Ft. Quitman for treaty compliance - M

## WATER MARKETING
### FOUR REGIONS: A, F, L, AND P

- Assess potential of transporting water into or out of the Panhandle - A
- Assess potential for transferring groundwater to counties within region - A
- Oppose additional regulations in willing buyer/willing seller water transactions - F
- Require all water export plans to be submitted to regional planning groups - F
- Recommend legislative review of Water Code to consider changes in light of increasing number of water export proposals - F
- Oppose export of surface water outside of region, except for existing contracts until a comprehensive plan is in place - F
- Allow property owners to capture and market water - F
- Fund development of a standard method for evaluating water export proposals - L
- Clarify that water planning regions are not intended to be barriers to water transport - L
- Consider export fee to offset negative impacts of transferring water out of basin - P
- Allow water transfer out of basin that does not interfere with exempt, existing, or previously permitted wells - P

## WATER QUALITY
### SEVEN REGIONS: A, B, D, F, G, K, AND N

### STANDARDS - THREE REGIONS: B, D, AND F

- Allow flexibility in drinking water standards for small systems, such as use of bottled water programs - B, F
- Recommend TWDB and Texas Commission on Environmental Quality standardize rules for minimum water supply requirements - D
- Recommend that Texas Commission on Environmental Quality revise its policy requiring use of secondary water standards, particularly total dissolved solids, when granting permits - F

### WATER PLANNING - TWO REGIONS: A AND K

- Require Texas Commission on Environmental Quality to attend regional planning meetings and assist with water quality issues - A
- Support integrating water quality into water supply planning - K

### RADIOACTIVE WASTES - TWO REGIONS: F AND K

- Recommend Texas Commission on Environmental Quality develop disposal

procedures for the safe handling of radioactive wastes in water treatment process - F, K
- Develop disposal procedures for radioactive wastes threatening water supplies - K

### MINING - ONE REGION: N

- Amend rules to require routine, nonpartisan water quality monitoring of mining operations - N
- Oppose in-situ mining (a process that circulates acidic water through injection and recovery wells to remove minerals) where drinking water will be contaminated - N
- Monitor water quality from mining activities - N

### OTHER - THREE REGIONS: B, D, AND G

- Recognize chloride control project as regional priority - B
- Recommend Texas Commission on Environmental Quality expedite effort to replace methyl tertiary butyl ether in gasoline - D
- Encourage policies and business practices that give priority to water quality - G

## OTHER

### SIX REGIONS: A, J, K, L, M, AND N

- Establish guidelines differentiating between groundwater and surface rights - A
- Recommend basing drought management plans on peak use rather than annual production - J
- New electric generation facilities should utilize the most efficient technologies and conservation practices and assure water is available or can be obtained during the planning and permitting process - K
- Give counties additional authority for regulating land development to protect water resources - L
- Supports providers obtaining land for project through willing buyer-willing seller and using limited condemnation as a last resort - L
- Renew efforts to ensure Mexico's compliance with 1944 Treaty to eliminate water delivery deficits - M
- Amend state laws governing procurement of professional services to allow more flexibility in public works projects - N

# Photo Citations

**COVER**
Water tower, Tanvir Hussain (Wikimedia Commons)

**CHAPTER 1**
Cover: Stream near San Angelo (TWDB)

**CHAPTER 2**
Cover: Windmill in Big Bend National Park (TWDB)

**CHAPTER 3**
Cover: Corn irrigation near Vick (TWDB)
Last page: Robert Lee Dam morning glory structure, E.V. Spence Reservoir

**CHAPTER 4**
Cover: Dry stream near Uvalde (TWDB)
Last page: Headwaters of the Frio River (TWDB)

**CHAPTER 5**
Cover: Llano dam (TWDB)

**CHAPTER 6**
Cover: Sugarcane in the Lower Rio Grande Valley (TWDB)

**CHAPTER 7**
Cover: George W. Shannon Wetlands Water Reuse Project (Tarrant Regional Water District)

**CHAPTER 8**
Cover: Guadalupe River in Kerrville (TWDB)

**CHAPTER 9**
Cover: Trinity Bay area wastewater treatment plant (TWDB)

**CHAPTER 10**
Cover: Pedernales Falls (TWDB)

**CHAPTER 11**
Cover: Texas Capitol ceiling dome (Istockphoto.com/Suzie Jurado)

**GLOSSARY**
Cover: Pedernales Falls (TWDB)

**APPENDICES**
Cover: Anzalduas Dam (TWDB)

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