Glossary

Water for Texas
2017 State Water Plan
Texas Water Development Board

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 from a source during the drought of record, regardless of whether the supply is physically or legally available to water user groups.

Brackish water
Water containing 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 costs associated with construction activities, such as engineering studies, legal counsel, land acquisition, contingencies, environmental mitigation, interest during construction, and permitting.

Conjunctive use
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.

Desired future condition
The desired, quantified condition of groundwater resources (such as water levels, spring flows, or volumes) within a management area at one or more specified future times as defined by participating groundwater conservation districts within a groundwater management area as part of the joint planning process.

Drought
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
The period of time when natural hydrological conditions provided the least amount of water supply.

Environmental flows
An amount of water that should remain in a stream or river for the benefit of the environment of the river, bay, and estuary, while balancing human needs.

Estuary
A bay or inlet, often at the mouth of a river and may be bounded by barrier islands, where freshwater and seawater mix together providing for economically and ecologically important habitats and species and which also yield essential ecosystem services.

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 by a water user group.

Firm yield
Maximum water volume a reservoir can provide each year under a repeat of the drought of record using reasonable sedimentation rates and assuming that all senior water rights will be totally utilized.

Groundwater availability model
A regional groundwater flow model approved by the executive administrator.

Groundwater management area
Geographical region of Texas designated and delineated by the 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 of surface water
Defined and governed in Texas Water Code §11.085 (relating to Interbasin Transfers) as the diverting of any state water from a river basin and transfer of that water to any other river basin.

Major reservoir
Reservoir having a storage capacity of 5,000 acre-feet or more.

Modeled available groundwater
The amount of water that the TWDB executive administrator determines may be produced on an average annual basis to achieve a desired future condition.

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

Regional water planning group
Group designated pursuant to Texas Water Code §16.053.

Performing instream flow surveys of the Brazos River near Marlin, Texas

Numerous Texas cities use reclaimed water for landscape irrigation

Recharge
Water that infiltrates to the water table of an aquifer.

Relevant aquifer
Aquifers or parts of aquifers for which groundwater conservation districts have defined desired future conditions.

Reuse
Use of surface water that has already been beneficially used once under a water right or the use of groundwater that has already been used (for example, using municipal reclaimed water to irrigate golf courses).

Run-of-river diversion
Water right permit that allows the permit holder to divert water directly out of a stream or river.

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.

Unmet needs
Amount of water demand that will still exceed the water supply after applying all recommended water management strategies in a regional water plan.

Water availability model
Numerical computer program used to determine the availability of surface water for permitting in the state.

Water management strategy
A plan or specific project to meet a need for additional water by a discrete water user group, which can mean increasing the total water supply or maximizing an existing supply.

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. These include: Incorporated Census places of a population greater than 500, including select Census Designated Places, such as significant military bases or cases in which the Census Designated Place is the only Census place in the county; retail public utilities providing more than 280 acre-feet per year for municipal use; collective Reporting Units, or groups of retail public utilities that have a common association; municipal and domestic water use, referred to as county-other; and non-municipal water use including manufacturing, irrigation, steam-electric power generation, mining, and livestock watering for each county or portion of a county in a regional water planning area.

Wholesale water provider
Any person or entity, including river authorities and irrigation districts, that has 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. The regional water planning groups shall include as wholesale water providers other persons and entities that enter into contracts or that the regional water planning group expects or recommends to enter contracts to sell more than 1,000 acre-feet of water wholesale during the period covered by the plan.

Appendices

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Appendix A.1 Background on Texas' water planning history, institutions, and laws

A.1.1 Early Texas water planning history

While formal statewide water planning did not begin in earnest until the 1950s, the Texas Legislature began assigning responsibility for managing and developing the state's water resources to various entities starting in the early 20th century. Partly as a result of a series of devastating droughts and floods, the early 1900s saw a flurry of activity. In 1904, a Texas constitutional amendment was adopted authorizing the first public development of water resources. The legislature authorized the creation of drainage districts in 1905, the Texas Board of Water Engineers in 1913, conservation and reclamation districts (later known as river authorities) in 1917, freshwater supply districts in 1919, and water control and improvement districts in 1925.

The creation of the Texas Board of Water Engineers, a predecessor agency to both the Texas Commission on Environmental Quality and the Texas Water Development Board (TWDB), played a significant role in the early history of water management in the state. The major duties of the Board of Water Engineers were to approve plans for the organization of irrigation and water supply districts, approve the issuance of bonds by these districts, issue water right permits for storage and diversion of water, and make plans for the storage and use of floodwater. Later, the legislature gave the agency the authority to define and designate groundwater aquifers, authorize underground water conservation districts, conduct groundwater and surface water studies, and approve federal projects, including those constructed by the U.S. Army Corps of Engineers.

The idea of a dedicated water planning agency came to fruition not long after the state experienced the worst drought in recorded history. For Texas as a whole, the drought began in 1950; by the end of 1956, all but one of Texas' 254 counties were classified as disaster areas. The drought ended in the spring of 1957 with massive rains flooding every major river and tributary in the state. This drought represents the driest seven-year period in the state's recorded history and is still considered as Texas' statewide "drought of record," upon which most water planning in the state is based.

The drought of record was unique in that a majority of Texans felt the impacts of it at some point. Small and large cities alike faced dire situations. By the fall of 1952, Dallas faced a severe water shortage and prohibited all but necessary household use of water. In 1953 alone, 28 municipalities were forced to use emergency sources of water supply, 77 were rationing water, and 8 resorted to hauling in water from neighboring towns or rural wells. The development of additional water infrastructure during the course of the drought reduced the number of communities with shortages during later years of the drought, but still more municipalities were forced to haul in water before it was over (TBWE, 1959). The drought of the 1950s cost the state hundreds of millions of dollars and was followed by floods that caused damages estimated at $120 million (TBWE, 1958).

A.1.2 State water planning history, 1957 to 1997

The Texas Legislature responded to the drought of record by establishing the Texas Water Resources Committee in 1953 to survey the state's water problems (UTIPA, 1955). As a result of some of the committee's recommendations, the legislature passed a resolution authorizing $200 million in state bonds to help construct water conservation and supply projects and created the TWDB to administer the funds from the bond sale. Then, in a special legislative session called by Governor Price Daniel, the legislature passed the Water Planning Act of 1957, which created the Texas Water Resources Planning Division of the Board of Water Engineers, which was assigned the responsibility of water resources planning on a statewide basis. The voters of Texas subsequently approved a constitutional amendment authorizing the TWDB to administer a $200 million water development fund to help communities develop water supplies.

In June of 1960, Governor Daniel called a meeting in Austin to request that the Board of Water Engineers prepare a planning report with projects to meet the projected municipal and industrial water requirements of the state in 1980. Work quickly began on statewide studies to develop the first state water plan. The first plan—*A Plan for Meeting the 1980 Water Requirements of Texas*—was published in 1961. It described historical and present uses of surface water and groundwater by municipalities, industries, and irrigation; summarized the development of reservoirs; estimated the 1980 municipal and industrial requirements of each area of the state; provided a plan for how to meet those requirements by river basin; and discussed how the plan could be implemented.

Later plans were developed by the state and adopted in 1968, 1984, 1990, 1992, and 1997. All of the plans have recognized the growth of the state's population and the need to develop future water supplies. Earlier plans placed more reliance on the federal government, while later plans developed at the state level increasingly emphasized the importance of conservation and natural resource protection. The 1968 State Water Plan recommended the federal government continue to fund feasibility studies on importing surplus water from the lower Mississippi River (a later study found that the project was not economically feasible). The 1984 State Water Plan was the first to address water quality, water conservation and water use efficiency, and environmental water needs in detail.

While previous plans were organized by river basin, the 1990 State Water Plan projected water demand, supply, and facility needs for eight regions in the state. The 1997 State Water Plan—developed by the TWDB through a consensus process with the Texas Parks and Wildlife Department and the Texas Commission on Environmental Quality—was the first to organize the state into 16 regional planning areas.

A.1.3 Regional and state water planning since 1997

Drought conditions in the mid-1990s spurred action in Texas water planning efforts, just as they had in the 1950s. In 1996, Texas suffered an intense, 10-month drought. Reservoirs and aquifer levels declined sharply and farmers suffered widespread crop failure, with estimated economic losses in the billions of dollars. Some cities had to ration water for several months and others ran out of water entirely.

The drought of 1996 was relatively short-lived, but it lasted long enough to remind Texans of the importance of water planning. When the legislature met in 1997, Lieutenant Governor Bob Bullock declared water the primary issue for the 75th Texas Legislative Session. After lengthy debate and numerous amendments, Senate Bill 1 was passed to improve the development and management of the water resources in the state. Among other provisions relating to water supplies, financial assistance, water data collection and dissemination, and additional water management issues, the bill established the regional water planning process, which directed water planning to be conducted from the ground up.

A.1.4 State and federal water supply institutions

While the TWDB is the state's primary water planning agency, a number of state and federal agencies in Texas have responsibility for managing water resources and participate in the regional planning process. The Texas Parks and Wildlife Department, the Texas Commission on Environmental Quality, and the Texas Department of Agriculture all have non-voting representatives on each regional water planning group. They participate in developing population projections and are consulted in the development and amendment of rules governing the planning process. Other state and federal entities also participate indirectly in the regional water planning process.

State entities

The TWDB is the state's primary water supply planning and financing agency. It supports the development of the 16 regional water plans and is responsible for developing the state water plan every five years. The TWDB provides financial assistance to local governments for water supply and wastewater treatment projects, flood protection planning and flood control projects, agricultural water conservation projects, and groundwater district creation expenses. It collects data and conducts studies of the fresh water needs of the state's bays and estuaries and is responsible for all aspects of groundwater studies. The TWDB also maintains the **Texas Natural Resources Information System**, which archives, maintains, and distributes the largest collection of current and historical geographic data in the state, including more than 1 million aerial photographs. Additionally, the TWDB provides technical support to the environmental flows process and is a member of the Texas Water Conservation Advisory Council, the Drought Preparedness Council, and the Emergency Drinking Water Task Force.

The State Parks Board, originally created in 1923, was later merged with other state entities and renamed the **Texas Parks and Wildlife Department**. Today, the agency is primarily responsible for conserving, protecting, and enhancing the state's fish and wildlife resources. It maintains a system of public lands, including state parks, historic sites, fish hatcheries, and wildlife management areas; regulates and enforces commercial and recreational fishing, hunting, boating, and nongame laws; and monitors, conserves, and enhances aquatic and wildlife habitats. It reviews and makes recommendations to minimize or avoid impacts on fish and wildlife resources resulting from water projects. Additionally, the Texas Parks and Wildlife Department works with regional and state water planning stakeholders and regulatory agencies to protect and enhance water quality and to ensure adequate environmental flows for rivers, bays, and estuaries. It also provides technical support to the environmental flows process.

In 1992, to make natural resource protection more efficient, the legislature consolidated several programs into one large environmental agency now known as the **Texas Commission on Environmental Quality**. The Texas Commission on Environmental Quality is the environmental regulatory agency for the state, focusing on water quality and quantity through various state and federal programs. It issues permits for the treatment and discharge of industrial and domestic wastewater and storm water, reviews plans and specifications for public water systems, and conducts assessments of surface water and groundwater quality. The Texas Commission on Environmental Quality regulates retail water and sewer utilities and administers a portion of the Nonpoint Source Management Program. In addition, it administers the surface water rights permitting program and a dam safety program, delineates and designates Priority Groundwater Management Areas, creates some groundwater conservation districts, and enforces the requirements of groundwater management planning. It also regulates public drinking water systems and is the primary agency for enforcing the federal Safe Drinking Water Act. The Texas Commission on Environmental Quality provides support to the environmental flows process and adopts rules for environmental flow standards.

The **Texas Department of Agriculture**, established by the Texas Legislature in 1907, is led by the Texas Commissioner of Agriculture. It supports protection of agricultural crops and livestock from harmful pests and diseases, facilitates trade and market development of agricultural commodities, provides financial assistance to farmers and ranchers, and administers consumer protection, economic development, and healthy living programs.

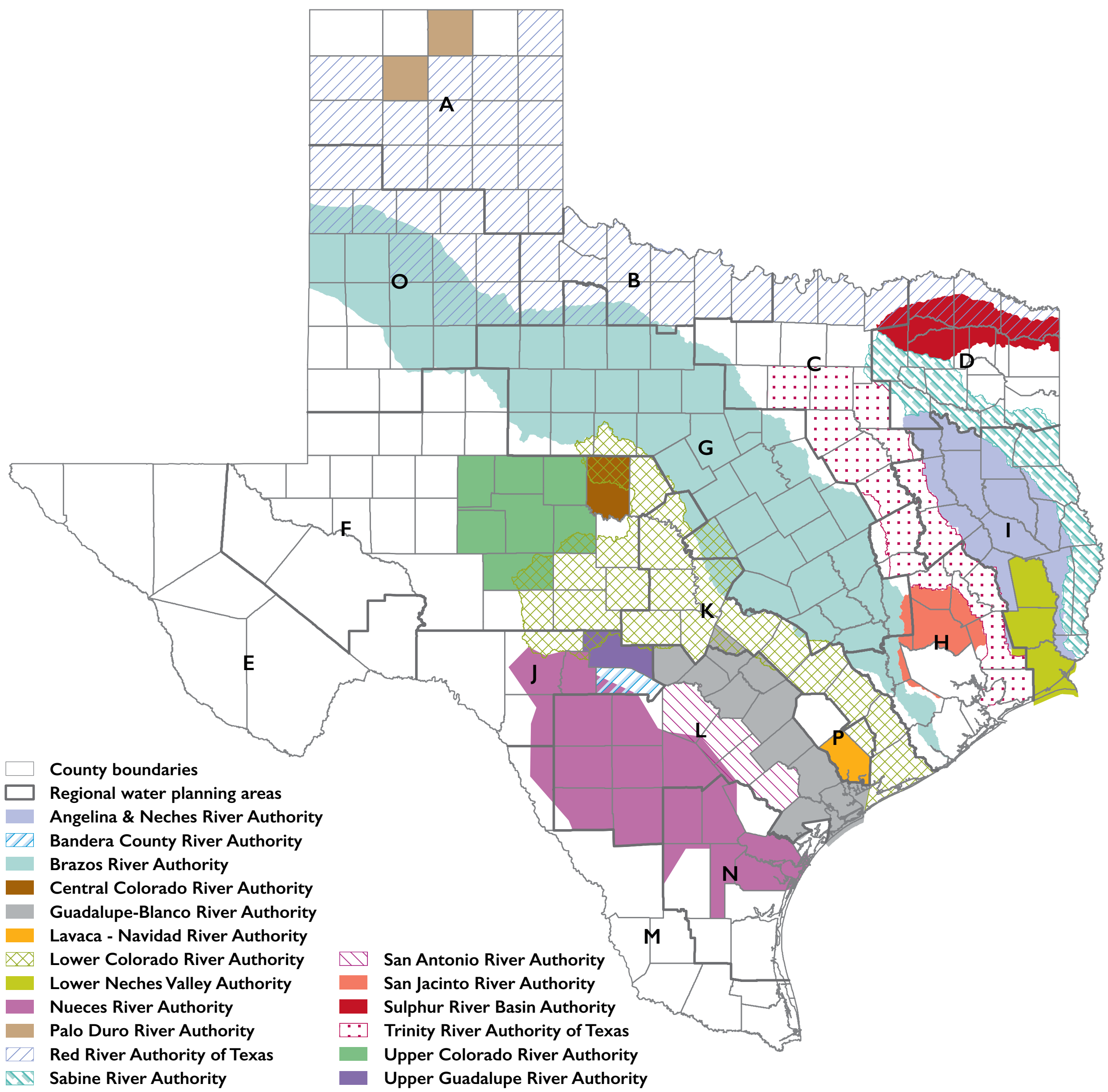
The **Public Utility Commission of Texas**, established in 1975, is led by three appointed commissioners and regulates the state's electric, telecommunication, and water and sewer utilities. In 2013, the Texas Legislature transferred the economic regulation of water and sewer utilities from the Texas Commission on Environmental Quality to the Public Utility Commission. The agency regulates water and sewer rates and services, Certificates of Convenience and Necessity, and sales/transfers/mergers.

Created in 1939, the **Texas State Soil and Water Conservation Board** administers Texas' soil and water conservation laws and coordinates conservation and nonpoint source pollution abatement programs. It also administers water quality and water supply enhancement programs.

First authorized by the legislature in 1917, **river authorities** are assigned the conservation and reclamation of the state's natural resources, including the development and management of water. They generally operate on utility revenues generated from supplying energy, water, wastewater, and other community services. There are 18 river authorities in Texas (Figure A1.1), along with similar special law districts authorized by the legislature.

The formation of **groundwater conservation districts** was first authorized by the legislature in 1949 to manage and protect groundwater at the local level. Groundwater conservation districts are governed by a local board of directors, which develops a management plan for the district with technical support from the TWDB, the Texas Commission on Environmental Quality, and other state agencies. Because most groundwater conservation districts are based on county lines and do not manage an entire aquifer, one aquifer may be managed by several groundwater districts. Each district must plan with the other districts within their common groundwater management areas to determine the desired future conditions of the aquifers within the groundwater management

Figure A1.1 - Locations of river authorities and regional water planning area boundaries



areas. As of 2015, 99 groundwater conservation districts have been established in Texas covering all or part of 174 counties, a map of which may be found on the TWDB website.

Other entities at the regional and local levels of government construct, operate, and maintain water supply and wastewater infrastructure. These include municipalities; water supply, irrigation, and municipal utility districts; flood and drainage districts; subsidence districts; and nonprofit water supply and sewer service corporations.

Federal agencies

Federal civil works projects played a major role in the early development of the state's water resources (TBWE, 1958). Historically, Texas relied heavily on federal funds to finance water development projects, with local commitments used to repay a portion of the costs. Federal agencies such as the **Soil Conservation Service**, the **U.S. Bureau of Reclamation**, and the **U.S. Army Corps of Engineers** constructed a number of surface water reservoirs in Texas. These reservoirs were built for the primary purpose of flood control but provide a large portion of the state's current water supply. The pace of federal spending on reservoir construction has declined considerably since the 1950s and 1960s, and current federal policy recognizes a declining federal interest in the long-term management of water supplies.

Several federal agencies are responsible for managing our nation's water resources. The U.S. Army Corps of Engineers investigates, develops, and maintains the nation's water and related environmental resources. Historically, the U.S. Army Corps of Engineers has been responsible for flood protection, dam safety, and the planning and construction of water projects, including reservoirs. Pursuant to the Clean Water Act and the Rivers and Harbors Act, the Corps operates a program that regulates construction and other work in the nation's waterways.

Within the **U.S. Department of the Interior**, the **U.S. Geological Survey** conducts natural resources studies and collects water-related data, and the **U.S. Bureau of Reclamation** conducts water resource planning studies and manages water resources primarily in the western United States. The **U.S. Fish and Wildlife Service**, also part of the Department of the Interior, protects fish and wildlife resources through various programs and carries out provisions of the Endangered Species Act.

The **Natural Resources Conservation Service**, part of the U.S. Department of Agriculture and successor to the Soil Conservation Service, implements soil conservation programs and works at the local level through conservation planning and assistance programs. The **U.S. Environmental Protection Agency** regulates and funds federal water quality, solid waste, drinking water, and other programs pursuant to the Clean Water Act, the Safe Drinking Water Act, and other federal laws and regulations. The **International Boundary and Water Commission** manages the waters of the Rio Grande between the United States and Mexico.

A.1.5 Management of water in Texas

Texas water law divides water into several categories for the purpose of regulation. Different rules apply to each category, determining how the water is used. This system stems from Spanish and English common law, the laws of other western states, and state and federal case law and legislation.

Surface water

In Texas, all surface water is held in trust by the state, which grants permission to use the water to different groups and individuals. Texas recognizes two basic doctrines of surface water rights: the riparian doctrine and the prior appropriation doctrine.

Under the riparian doctrine, landowners whose property is adjacent to a river or stream have the right to make reasonable use of the water. The riparian doctrine was introduced in Texas more than 200 years ago with the first Spanish settlers. In 1840, the state adopted the common law of England, which included a somewhat different version of the riparian doctrine (Templer, 2011).

In response to the scarcity of water in the western United States, Texas began to recognize the need for a prior appropriation system (Kaiser, n.d.). The prior appropriation system, first adopted by Texas in 1895, has evolved into the modern system used today. Landowners who live on many of the water bodies in the state are allowed to divert and use water for domestic and livestock purposes (not to exceed 200 acre-feet per year), but these are some of the last riparian rights still in place.

In 1913, the legislature extended the prior appropriation system to the entire state. It also established the Texas Board of Water Engineers, the agency that had original jurisdiction over all applications for appropriated water. Because different laws governed the use of surface waters at different times in Texas history, claims to water rights often conflicted with one another. In 1967, as a result of these historic conflicts, the state began to resolve claims for water rights. A "certificate of adjudication" was issued for each approved claim, limiting riparian and other unrecorded rights to a specific quantity of water. The certificate also assigned a priority date to each claim, with some dates going back to the time of the first Spanish settlements (TCEQ, 2009).

The adjudication of surface water rights gave the state the potential for more efficient management of surface waters (Templer, 2011). With only a few exceptions, surface water users today need a permit in the form of an appropriated water right from the Texas Commission on Environmental Quality. The prior appropriations system recognizes the "doctrine of priority," which gives superior rights to those who first used the water, often known as "first in time, first in right." In most of the state, water rights are prioritized only by the date assigned to them and not by the purpose for which the water will be used. Only water stored in Falcon and Amistad reservoirs in the middle and lower Rio Grande Basin is prioritized by the purpose of its use, with municipal and industrial rights having priority over irrigation rights during times of drought.

When issuing a new water right, the Texas Commission on Environmental Quality assigns a priority date, specifies the volume of water that can be used each year, and may allow users to divert or impound the water. Water rights do not guarantee that water will be available, but they are considered property interests that may be bought, sold, or leased. The agency also grants term permits and temporary permits, which do not have priority dates and are not considered property rights. The water rights system works hand in hand with the regional water planning process; the Texas Commission on Environmental Quality may not issue a new water right unless it addresses a water supply need that is consistent with the regional water plans and the state water plan.

Texas relies on the honor system in most parts of the state to protect water rights during times of drought. But in some areas, the Texas Commission on Environmental Quality has appointed a "watermaster" to oversee and continuously monitor streamflows, reservoir levels, and water use. There are three watermasters in Texas: the Rio Grande Watermaster, who among other things, coordinates releases from the Amistad and Falcon reservoir system; the Brazos Watermaster, who serves the lower portion of the Brazos River Basin; and the South Texas Watermaster, who serves the Nueces, San Antonio, Guadalupe, and Lavaca river and coastal basins. The South Texas Watermaster also serves as the Concho Watermaster, who oversees the Concho River and its tributaries in the Colorado River Basin.

Groundwater

Groundwater in Texas is managed differently than surface water. Historically, Texas has followed the English common law rule that landowners have the right to capture or remove all of the water that can be captured from beneath their land. In part, the rule was adopted because the science of quantifying and tracking the movement of groundwater was so poorly developed at the time that it would have been practically impossible to administer any set of legal rules to govern its use. The 1904 case and later court rulings established that landowners, with few exceptions, may pump as much water as they choose without liability. Today, Texas is the only western state that continues to follow the rule of capture.

In 1949, in an attempt to balance landowner interests with limited groundwater resources, the legislature authorized the creation of groundwater conservation districts to manage groundwater locally. Although the science of groundwater is much better developed (the TWDB has groundwater availability models for all of the major aquifers and most of the minor aquifers in the state), groundwater is still governed by the rule of capture, unless under the authority of a groundwater conservation district. Senate Bill 1 in 1997 reaffirmed state policy that groundwater conservation districts are the state's preferred method of groundwater management.

Since the original legislation creating groundwater districts in 1949, the legislature has made several changes to the way groundwater is managed in the state while still providing for local management. Most significantly, legislation in 2005 required groundwater conservation districts to meet regularly and to define the "desired future conditions" of the groundwater resources within designated groundwater management areas. Based on these desired future conditions, the TWDB delivers modeled available groundwater values to groundwater conservation districts and planning groups for inclusion in their plans.

Groundwater districts can be created by four possible methods: action of the Texas Legislature, petition by property owners, initiation by the Texas Commission on Environmental Quality, or addition of territory to an existing district. Districts may regulate both the location and production of wells, with certain voluntary and mandatory exemptions. They are also required to adopt management plans that include goals to provide the most efficient use of groundwater. The goals must also address drought, other natural resource issues, and adopted desired future conditions. The management plan must include estimates of modeled available groundwater based on desired future conditions and must address water supply needs and water management strategies in the state water plan.

Texas groundwater law continues to evolve through recent court cases and ongoing litigation. It is unclear exactly how these recent cases will affect the broad scope of groundwater law as appeals are decided and new litigation is brought.

The TWDB and the Texas Commission on Environmental Quality are the primary state agencies involved in supporting groundwater conservation districts to implement the groundwater management plan requirements. Along with determining values for modeled available groundwater based on desired future conditions of the aquifer, the TWDB provides technical and financial support to districts, reviews and administratively approves management plans, performs groundwater availability and water-use studies, and is responsible for the delineation and designation of groundwater management areas.

The Texas Commission on Environmental Quality provides technical assistance to districts and is responsible for enforcing the adoption, approval, and implementation of management plans. The agency also evaluates designated priority groundwater management areas—areas that are experiencing or are expected to experience critical groundwater problems within 50 years, including shortages of surface water or groundwater, land subsidence resulting from groundwater withdrawal, and contamination of groundwater supplies.

Surface water quality

The Texas Commission on Environmental Quality is charged with managing the quality of the state's surface water. Guided by the federal Clean Water Act and state law and regulations, the agency classifies water bodies and sets water quality standards. Water quality standards consist of two parts: the purposes for which surface water will be used (aquatic life, contact recreation, water supply, or fish consumption) and criteria that will be used to determine if the use is being supported. Water quality data are gathered regularly to monitor the condition of the state's surface waters and to determine if standards are being met. Through the Texas Clean Rivers Program, the Texas Commission on Environmental Quality works in partnership with state, regional, and federal entities to coordinate water quality monitoring, assessment, and stakeholder participation to improve the quality of surface water within each river basin.

Every two years, Texas submits a report to the U.S. Environmental Protection Agency that lists the status of all the waters in the state and identifies those that do not meet water quality standards. When water bodies do not meet standards, the Texas Commission on Environmental Quality may develop a restoration plan, evaluate the appropriateness of the standard, or collect more data and information. For water bodies with significant impairments, the agency must develop a scientific allocation called a "total maximum daily load" to determine the maximum amount of a pollutant that a water body can receive from all sources, including point and nonpoint sources, and still maintain water quality standards set for its use.

Drinking water

The Texas Commission on Environmental Quality is also responsible for protecting the quality and safety of drinking water through primary and secondary standards. In accordance with the federal Safe Drinking Water Act and state law and regulations, primary drinking water standards protect public health by limiting the levels of certain contaminants, and secondary drinking water quality standards address taste, color, and odor. Public drinking water systems must comply with certain construction and operational standards, and they must continually monitor water quality and file regular reports with the Texas Commission on Environmental Quality.

Interstate waters

Texas is a member of five interstate river compacts with neighboring states to manage the Rio Grande, Pecos, Canadian, Sabine, and Red rivers. The compacts, as ratified by the legislature of each participating state and the U.S. Congress, represent agreements that establish how water should be allocated. Each compact is administered by a commission of state representatives and, in some cases, a representative of the federal government appointed by the president. Compact commissions protect the states' rights and work to prevent and resolve any disputes over water. The compact commissions are authorized to plan for river operations, monitor activities affecting water quantity and quality, and engage in water accounting and rule-making. To administer the five compacts in Texas, the Texas Commission on Environmental Quality provides administrative and technical support to each commission and maintains databases of river flows, diversions, and other information.

A.1.6 Key state water planning statutes and rules

Texas Water Code §§16.022, 16.051, 16.053, 16.054, and 16.055.

31 Texas Administrative Code Chapters 355, 357, and 358.

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Appendix B.1 Annual surface water availability by river and coastal basin (acre-feet)

Surface water basin	2020	2030	2040	2050	2060	2070	Percent change
Brazos	1,380,355	1,375,437	1,370,505	1,365,548	1,360,593	1,355,302	-2
Brazos-Colorado	12,946	12,946	12,946	12,946	12,946	12,946	0
Canadian	17,133	17,091	17,049	17,008	16,966	16,924	-1
Colorado	998,891	992,217	985,533	978,343	970,653	963,471	-4
Colorado-Lavaca	4,852	4,852	4,852	4,852	4,852	4,852	0
Cypress	306,648	304,974	303,438	301,932	300,323	298,683	-3
Guadalupe	206,660	206,520	206,380	206,240	206,100	205,960	0
Lavaca	79,710	79,710	79,710	79,710	79,710	79,710	0
Lavaca-Guadalupe	319	319	319	319	319	319	0
Neches	2,344,766	2,342,204	2,339,778	2,337,623	2,335,690	2,333,680	0
Neches-Trinity	95,440	95,440	95,440	95,440	95,440	95,440	0
Nueces	164,666	163,266	161,867	160,467	159,068	157,668	-4
Nueces-Rio Grande	8,471	8,471	8,471	8,471	8,471	8,471	0
Red	507,065	502,923	498,777	494,643	490,513	486,307	-4
Rio Grande	1,228,488	1,227,132	1,225,775	1,224,419	1,223,063	1,221,706	-1
Sabine	1,706,628	1,701,787	1,696,937	1,691,770	1,686,448	1,682,147	-1
Sabine-Louisiana	336	336	336	336	336	336	0
San Antonio	62,823	62,824	62,824	62,825	62,834	62,834	0
San Antonio-Nueces	991	991	991	991	991	991	0
San Jacinto	271,322	268,622	265,922	263,222	260,522	257,822	-5
San Jacinto-Brazos	38,826	38,826	38,826	38,826	38,826	38,826	0
Sulphur	447,273	416,132	382,992	350,154	315,150	272,012	-39
Trinity	2,443,343	2,431,229	2,418,982	2,406,698	2,394,474	2,382,646	-2
Trinity-San Jacinto	35,316	35,316	35,316	35,316	35,316	35,316	0
Texas	**12,363,268**	**12,289,565**	**12,213,966**	**12,138,099**	**12,059,604**	**11,974,369**	**-3**

Appendix B.2 Annual groundwater availability by aquifer (acre-feet) *(page 1 of 2)*

Aquifer	2020	2030	2040	2050	2060	2070	Percent change
Austin Chalk	7,863	7,863	7,863	7,863	7,863	7,863	0
Blaine	346,180	346,180	346,180	346,180	344,878	343,593	-1
Blossom	2,273	2,273	2,273	2,273	2,273	2,273	0
Bone Spring-Victorio Peak	101,429	101,429	101,429	101,429	101,429	101,429	0
Brazos River Alluvium	107,960	107,960	107,960	107,960	107,960	107,960	0
Buda Limestone	758	758	758	758	758	758	0
Capitan Reef Complex	29,021	29,021	29,021	29,021	29,021	29,021	0
Carrizo-Wilcox	881,948	896,875	917,443	935,524	943,637	943,601	7
Dockum	116,685	116,685	116,685	116,685	116,685	116,685	0
Edwards (Balcones Fault Zone)	342,700	342,700	342,700	342,700	342,700	342,700	0
Edwards-Trinity (High Plains)	56,766	40,707	33,270	26,783	22,924	11,480	-80
Edwards-Trinity (Plateau)	473,455	473,455	473,455	473,455	473,455	473,455	0
Ellenburger-San Saba	46,896	46,896	46,896	46,896	46,896	46,896	0
Guadalupe River Alluvium	215	215	215	215	215	215	0
Gulf Coast	1,766,661	1,696,170	1,696,151	1,696,230	1,696,513	1,696,513	-4
Hickory	33,634	33,634	33,634	33,634	33,634	33,634	0
Hueco-Mesilla Bolsons	496,000	496,000	496,000	496,000	496,000	496,000	0
Igneous	11,333	11,333	11,332	11,329	11,327	11,327	0
Leona Gravel	31,402	31,402	31,402	31,402	31,402	31,402	0
Lipan	45,579	45,579	45,579	45,579	45,579	45,579	0
Marathon	7,327	7,327	7,327	7,327	7,327	7,327	0
Marble Falls	16,389	16,389	16,389	16,389	16,389	16,389	0
Nacatoch	13,774	13,774	13,774	13,774	13,774	13,774	0
Navasota River Alluvium	2,216	2,216	2,216	2,216	2,216	2,216	0
Nueces River Alluvium	5,719	5,719	5,719	5,719	5,719	5,719	0
Ogallala	4,790,905	4,361,654	3,929,605	3,508,380	3,112,588	2,753,590	-43
Ogallala/Rita Blanca[a]	742,022	646,077	561,411	485,779	419,589	362,421	-51
Other	294,136	294,136	294,136	294,136	294,136	294,136	0

[a] The Ogallala/Rita Blanca and the Pecos Valley/Edwards-Trinity (Plateau) are aquifer combinations that reflect specific and mutual aquifer properties, undifferentiated groundwater usage, and groundwater availability model characteristics. In these cases, the modeled available groundwater and existing supply values have likewise been developed to honor these aquifer combinations.

Appendix B.2 Annual groundwater availability by aquifer (acre-feet) (page 2 of 2)

Aquifer	2020	2030	2040	2050	2060	2070	Percent change
Pecos Valley	55,588	55,588	55,588	55,588	55,588	55,588	0
Pecos Valley/ Edwards-Trinity (Plateau)[a]	354,412	354,412	354,412	354,412	354,412	354,412	0
Queen City	263,925	265,354	263,215	262,541	262,202	262,202	-1
Rustler	15,222	15,222	15,222	15,222	15,222	15,222	0
San Bernard River Alluvium	520	520	520	520	520	520	0
San Jacinto River Alluvium	1,450	1,450	1,450	1,450	1,450	1,450	0
Seymour	169,375	159,281	151,401	147,751	149,652	148,728	-12
Sparta	33,334	39,625	37,890	39,015	38,968	38,968	17
Trinity	414,898	414,805	414,503	414,170	414,125	414,125	0
Trinity River Alluvium	3,913	3,913	3,913	3,913	3,913	3,913	0
West Texas Bolsons	79,045	78,844	78,553	78,349	78,220	78,220	-1
Woodbine	44,885	44,885	44,885	44,885	44,885	44,885	0
Yegua-Jackson	100,988	100,988	100,988	100,988	100,605	100,605	0
Texas	**12,308,801**	**11,709,314**	**11,193,363**	**10,704,440**	**10,246,649**	**9,816,794**	**-20**

[a] The Ogallala/Rita Blanca and the Pecos Valley/Edwards-Trinity (Plateau) are aquifer combinations that reflect specific and mutual aquifer properties, undifferentiated groundwater usage, and groundwater availability model characteristics. In these cases, the modeled available groundwater and existing supply values have likewise been developed to honor these aquifer combinations.

Appendix B.3 Annual surface water existing supplies by river and coastal basin (acre-feet)

Surface water basin	2020	2030	2040	2050	2060	2070	Percent change
Brazos	1,120,993	1,118,742	1,116,839	1,111,664	1,108,955	1,103,767	-2
Brazos-Colorado	10,225	10,225	10,225	10,225	10,225	10,225	0
Canadian	13,216	13,216	13,216	13,216	13,216	13,216	0
Colorado	832,901	832,566	831,819	827,893	820,917	815,303	-2
Colorado-Lavaca	4,353	4,353	4,353	4,353	4,353	4,353	0
Cypress	188,532	187,839	187,170	186,614	187,141	187,158	-1
Guadalupe	194,982	194,961	192,885	192,758	192,624	192,488	-1
Lavaca	78,517	78,517	78,517	78,517	78,517	78,517	0
Lavaca-Guadalupe	319	319	319	319	319	319	0
Neches	660,920	765,093	784,057	802,068	821,037	840,951	27
Neches-Trinity	90,617	90,617	90,617	90,617	90,617	90,617	0
Nueces	127,977	139,319	149,002	155,414	156,026	155,903	22
Nueces-Rio Grande	949	949	949	949	949	949	0
Red	242,852	238,974	233,993	229,320	225,218	221,248	-9
Rio Grande	897,351	896,504	895,163	894,781	893,621	892,999	0
Sabine	506,627	478,236	475,466	475,013	469,817	466,842	-8
Sabine-Louisiana	336	336	336	336	336	336	0
San Antonio	62,823	62,824	62,824	62,825	62,834	62,834	0
San Antonio-Nueces	991	991	991	991	991	991	0
San Jacinto	189,676	190,824	191,533	190,825	190,089	189,305	0
San Jacinto-Brazos	35,860	35,929	35,998	36,068	36,137	36,206	1
Sulphur	260,074	258,748	255,668	254,442	253,054	217,880	-16
Trinity	1,906,762	1,885,047	1,857,794	1,836,776	1,816,072	1,799,146	-6
Trinity-San Jacinto	35,316	35,316	35,316	35,316	35,316	35,316	0
Texas[a]	**7,463,169**	**7,520,445**	**7,505,050**	**7,491,300**	**7,468,381**	**7,416,869**	**-1**

[a] *Does not reflect some portions of existing supplies that are associated with purely saline water sources such as untreated seawater*

Appendix B.4 Annual groundwater existing supplies by aquifer (acre-feet) *(page 1 of 2)*

Aquifer	2020	2030	2040	2050	2060	2070	Percent change
Austin Chalk	2,663	2,663	2,663	2,663	2,663	2,663	0
Blaine	29,108	28,492	27,554	25,922	24,282	22,646	-22
Blossom	723	679	351	351	351	351	-51
Bone Spring-Victorio Peak	63,929	63,929	63,929	63,929	63,929	63,929	0
Brazos River Alluvium	52,467	52,467	52,467	52,467	52,467	52,467	0
Buda Limestone	525	525	525	525	525	525	0
Capitan Reef Complex	12,685	12,685	12,685	12,685	12,685	12,685	0
Carrizo-Wilcox	591,099	592,343	593,974	595,377	594,052	593,758	0
Dockum	43,906	44,869	45,081	46,029	45,860	45,740	4
Edwards (Balcones Fault Zone)	308,168	308,168	308,168	308,168	308,168	308,168	0
Edwards-Trinity (High Plains)	4,881	4,881	4,881	4,881	4,777	4,673	-4
Edwards-Trinity (Plateau)	255,991	254,540	250,267	245,545	240,637	238,004	-7
Ellenburger-San Saba	17,274	17,264	17,242	17,211	16,880	16,276	-6
Guadalupe River Alluvium	215	215	215	215	215	215	0
Gulf Coast	1,234,093	1,169,936	1,175,026	1,179,715	1,183,329	1,186,458	-4
Hickory	20,304	20,101	19,728	19,460	19,229	19,022	-6
Hueco-Mesilla Bolsons	146,555	146,555	146,555	146,555	146,555	146,555	0
Igneous	7,311	7,311	7,311	7,311	7,311	7,311	0
Leona Gravel	10,767	10,967	11,270	11,551	11,851	12,094	12
Lipan	45,439	45,463	45,452	45,395	45,417	45,439	0
Marathon	127	127	127	127	127	127	0
Marble Falls	6,151	6,151	6,151	6,151	6,151	6,151	0
Nacatoch	6,527	6,563	6,565	6,510	6,471	6,388	-2
Navasota River Alluvium	-	-	-	-	-	-	na
Nueces River Alluvium	748	748	748	748	748	748	0
Ogallala	2,865,940	2,581,492	2,246,007	1,985,484	1,766,241	1,474,056	-49
Ogallala/Rita Blanca[a]	564,727	495,177	433,544	377,961	328,607	279,322	-51
Other	203,540	203,562	202,022	201,107	200,708	200,509	-1

[a] The Ogallala/Rita Blanca and the Pecos Valley/Edwards-Trinity (Plateau) are aquifer combinations that reflect specific and mutual aquifer properties, undifferentiated groundwater usage, and groundwater availability model characteristics. In these cases, the modeled available groundwater and existing supply values have likewise been developed to honor these aquifer combinations.

na = not applicable

Appendix B.4 Annual groundwater existing supplies by aquifer (acre-feet) *(page 2 of 2)*

Aquifer	2020	2030	2040	2050	2060	2070	Percent change
Pecos Valley	19,210	19,786	19,632	19,372	19,109	18,924	-1
Pecos Valley/ Edwards-Trinity (Plateau)[a]	127,310	128,302	127,515	126,110	124,738	123,523	-3
Queen City	23,252	23,564	23,837	24,161	24,303	24,776	7
Rustler	2,521	2,521	2,521	2,521	2,521	2,521	0
San Bernard River Alluvium	-	-	-	-	-	-	na
San Jacinto River Alluvium	-	-	-	-	-	-	na
Seymour	152,886	144,959	137,738	134,121	135,379	133,548	-13
Sparta	18,930	20,367	20,446	20,498	20,523	20,577	9
Trinity	256,804	258,511	260,628	262,414	264,763	267,363	4
Trinity River Alluvium	-	-	-	-	-	-	na
West Texas Bolsons	44,216	44,216	44,216	44,216	44,216	44,216	0
Woodbine	33,726	33,635	33,649	33,572	33,608	33,561	0
Yegua-Jackson	16,462	16,553	16,624	16,714	16,411	16,437	0
Texas[b]	**7,191,180**	**6,770,287**	**6,367,314**	**6,047,742**	**5,775,807**	**5,431,726**	**-24**

[a] The Ogallala/Rita Blanca and the Pecos Valley/Edwards-Trinity (Plateau) are aquifer combinations that reflect specific and mutual aquifer properties, undifferentiated groundwater usage, and groundwater availability model characteristics. In these cases, the modeled available groundwater and existing supply values have likewise been developed to honor these aquifer combinations.

[b] Does not reflect some portions of existing supplies that are associated with purely saline water sources

na = not applicable

Appendix C.1 Annual water needs by region and water use category (acre-feet) *(page 1 of 3)*

Region	Water use category	2020	2030	2040	2050	2060	2070
A	Irrigation	156,704	185,043	192,876	180,151	165,133	148,519
	Manufacturing	4,017	6,986	10,048	14,243	18,369	22,538
	Municipal	10,074	24,142	38,521	52,624	66,847	81,559
A Total		**170,795**	**216,171**	**241,445**	**247,018**	**250,349**	**252,616**
B	Irrigation	22,518	23,214	24,287	25,717	28,281	30,841
	Livestock	130	130	130	130	130	130
	Manufacturing	1,254	1,361	1,518	1,710	1,771	1,829
	Mining	1,570	583	476	131	67	67
	Municipal	8,060	8,607	9,092	9,652	10,252	10,848
	Steam-electric	1,289	2,140	2,990	3,841	4,691	5,541
B Total		**34,821**	**36,035**	**38,493**	**41,181**	**45,192**	**49,256**
C	Irrigation	460	484	509	526	539	548
	Manufacturing	2,649	11,322	20,899	29,076	36,694	44,363
	Mining	6,204	5,756	7,089	9,635	12,198	15,956
	Municipal	106,718	319,284	539,183	750,997	981,697	1,227,956
	Steam-electric	9,006	30,361	36,336	44,038	55,098	67,549
C Total		**125,037**	**367,207**	**604,016**	**834,272**	**1,086,226**	**1,356,372**
D	Irrigation	30,763	30,696	30,479	30,021	29,589	29,402
	Manufacturing	61,557	72,166	87,466	100,894	120,136	175,740
	Mining	2,888	3,265	2,935	2,274	1,700	1,363
	Municipal	22,341	25,306	29,850	32,424	39,003	51,390
	Steam-electric	32,643	45,291	64,237	88,459	117,157	152,800
D Total		**150,192**	**176,724**	**214,967**	**254,072**	**307,585**	**410,695**
E	Irrigation	170,012	162,417	148,458	138,978	130,982	123,894
	Manufacturing	8,841	9,968	11,058	11,985	13,461	15,050
	Mining	740	1,577	1,694	1,521	1,885	2,440
	Municipal	5,623	10,265	14,734	28,319	43,442	58,011
	Steam-electric	3,651	4,825	6,255	7,998	10,124	12,651
E Total		**188,867**	**189,052**	**182,199**	**188,801**	**199,894**	**212,046**
F	Irrigation	113,745	113,158	111,096	111,365	111,501	109,960
	Livestock	368	397	403	420	446	445
	Manufacturing	3,528	3,718	4,202	4,663	5,277	5,917
	Mining	15,516	15,180	10,334	5,402	2,629	1,480
	Municipal	36,262	45,204	56,120	66,651	77,674	88,349
	Steam-electric	13,568	15,847	18,560	22,029	26,317	30,786
F Total		**182,987**	**193,504**	**200,715**	**210,530**	**223,844**	**236,937**

Appendix C.1 Annual water needs by region and water use category (acre-feet) *(page 2 of 3)*

Region	Water use category	2020	2030	2040	2050	2060	2070
G	Irrigation	83,218	83,258	83,455	77,447	70,261	67,066
	Manufacturing	7,179	7,263	8,620	9,771	11,040	12,319
	Mining	41,731	50,127	50,494	53,675	57,802	64,121
	Municipal	32,314	61,776	102,132	149,644	202,496	259,402
	Steam-electric	70,834	88,264	99,300	128,694	144,204	162,658
G Total		**235,276**	**290,688**	**344,001**	**419,231**	**485,803**	**565,566**
H	Irrigation	108,121	107,656	110,704	113,170	115,336	117,339
	Livestock	2,397	2,664	2,919	3,065	3,248	3,418
	Manufacturing	88,084	122,722	150,674	186,714	199,735	212,904
	Mining	4,817	5,619	5,114	5,160	5,388	5,746
	Municipal	141,908	310,606	420,866	523,604	635,865	760,957
	Steam-electric	1,707	5,325	9,115	14,707	24,383	61,400
H Total		**347,034**	**554,592**	**699,392**	**846,420**	**983,955**	**1,161,764**
I	Irrigation	3,518	4,011	4,452	4,812	5,076	5,427
	Livestock	3,011	4,212	5,663	7,419	9,541	9,983
	Manufacturing	195,313	286,821	308,893	329,416	348,617	368,917
	Mining	9,586	7,160	2,794	2,338	2,048	1,916
	Municipal	121	534	1,476	4,582	8,871	13,629
	Steam-electric	25,422	32,807	43,269	56,482	80,437	108,136
I Total		**236,971**	**335,545**	**366,547**	**405,049**	**454,590**	**508,008**
J	Irrigation	143	143	142	142	141	141
	Livestock	214	214	214	214	214	214
	Mining	38	98	112	76	47	43
	Municipal	3,462	3,768	3,925	4,033	4,143	4,228
J Total		**3,857**	**4,223**	**4,393**	**4,465**	**4,545**	**4,626**
K	Irrigation	335,489	319,584	304,106	289,044	274,387	260,124
	Manufacturing	570	692	810	913	1,059	1,216
	Mining	4,260	8,618	9,747	10,719	12,153	14,164
	Municipal	7,881	28,176	45,883	67,359	119,888	182,173
	Steam-electric	25,363	26,751	26,775	31,974	42,212	54,627
K Total		**373,563**	**383,821**	**387,321**	**400,009**	**449,699**	**512,304**
L	Irrigation	105,799	97,325	89,057	81,302	73,968	67,383
	Manufacturing	6,308	9,897	13,453	18,929	28,871	40,034
	Mining	10,822	10,481	8,694	5,138	2,073	666
	Municipal	72,636	108,068	148,627	197,279	249,846	304,164
	Steam-electric	4,506	29,778	37,178	53,599	70,696	70,696
L Total		**200,071**	**255,549**	**297,009**	**356,247**	**425,454**	**482,943**

Appendix C.1 Annual water needs by region and water use category (acre-feet) *(page 3 of 3)*

Region	Water use category	2020	2030	2040	2050	2060	2070
M	Irrigation	658,049	608,580	557,158	502,526	447,439	448,029
	Manufacturing	2,529	3,388	4,243	4,994	5,992	7,067
	Mining	5,290	4,641	5,488	5,565	5,758	6,337
	Municipal	48,534	86,393	132,173	190,834	251,976	312,410
	Steam-electric	2,984	5,635	8,866	12,805	17,608	23,501
M Total		**717,386**	**708,637**	**707,928**	**716,724**	**728,773**	**797,344**
N	Irrigation	40	42	44	545	2,112	4,242
	Manufacturing	6,451	8,804	11,126	15,077	26,735	38,132
	Mining	2,733	3,269	3,219	1,087	315	0
	Municipal	1,583	1,575	1,567	1,607	1,646	1,683
	Steam-electric	0	0	0	0	2,846	6,893
N Total		**10,807**	**13,690**	**15,956**	**18,316**	**33,654**	**50,950**
O	Irrigation	1,683,573	1,795,897	1,948,130	2,003,648	2,024,629	2,139,648
	Livestock	12,134	14,505	12,889	16,273	18,793	17,631
	Manufacturing	5,224	4,968	4,462	4,935	6,769	7,316
	Mining	9,921	11,705	11,291	10,314	8,626	7,337
	Municipal	13,233	24,556	30,937	38,977	47,923	56,371
	Steam-electric	7,747	6,617	3,189	4,185	5,474	11,793
O Total		**1,731,832**	**1,858,248**	**2,010,898**	**2,078,332**	**2,112,214**	**2,240,096**
P	Irrigation	50,285	50,285	50,285	50,285	50,285	50,285
P Total		**50,285**	**50,285**	**50,285**	**50,285**	**50,285**	**50,285**
	Texas	**4,759,781**	**5,633,971**	**6,365,565**	**7,070,952**	**7,842,062**	**8,891,808**

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