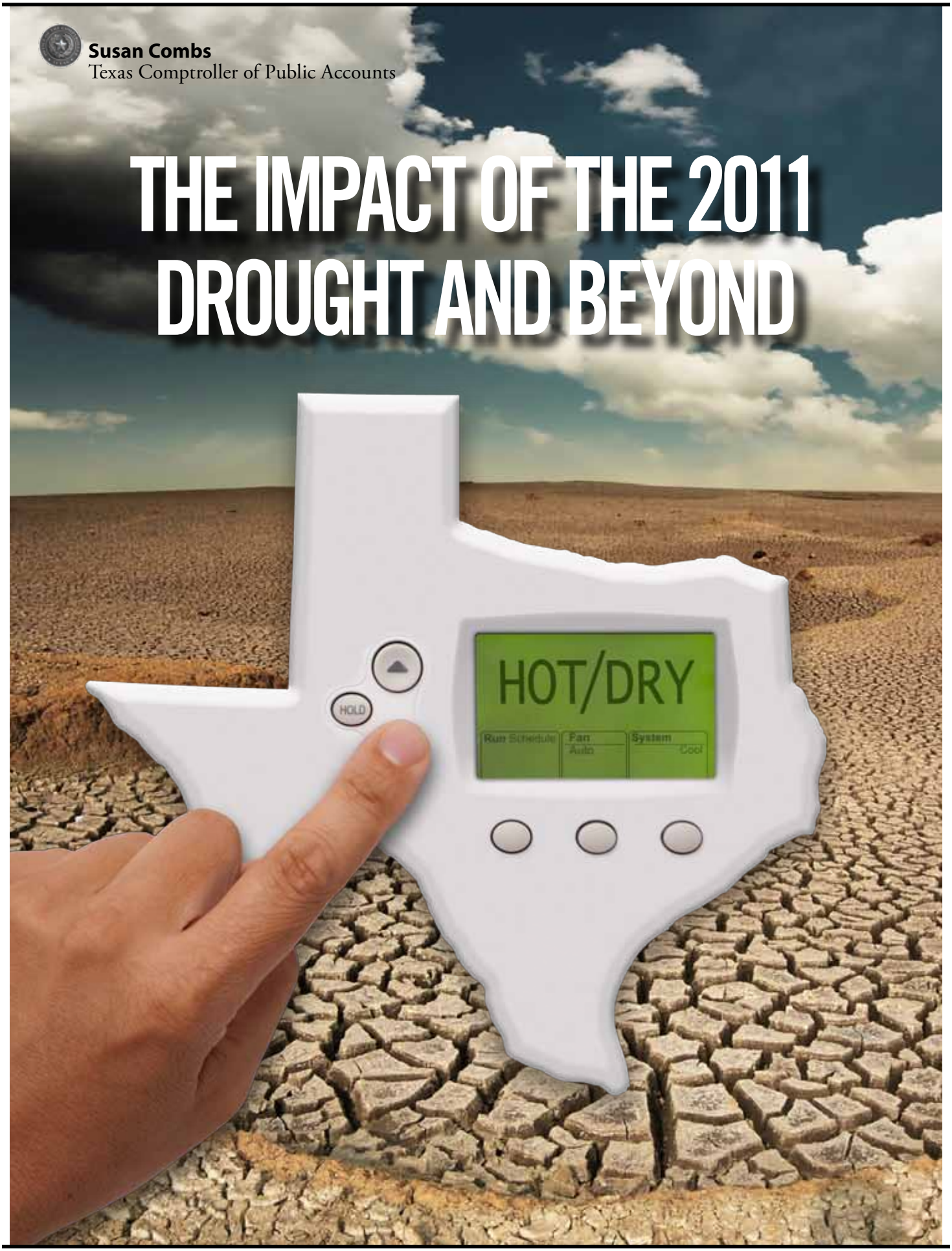
**Susan Combs**
Texas Comptroller of Public Accounts

# THE IMPACT OF THE 2011 DROUGHT AND BEYOND



## TABLE OF CONTENTS



February 6, 2012

Ladies and Gentlemen:

As Comptroller, one of my responsibilities is to analyze trends that affect the state's bottom line. And the terrible drought of 2011 underlined a particularly important factor that could have far-reaching impacts on Texas' growth and prosperity.

*Our water resources are finite. Planning for and managing our water use is perhaps the most important task facing Texas policymakers in the 21st century.*

My office is pleased to present *Gauging the Economic Impact of the 2011 Drought and Beyond,* which discusses the current drought and its impacts on the state; current and future water resources in Texas; and innovative solutions governments in Texas and elsewhere are using to solve the water crisis.

The current drought is the worst single-year Texas drought since recordkeeping began — and it may prove to be one of most devastating economic events in our history. Estimates by the Texas AgriLife Extension Service put Texas agricultural losses for the year at **$5.2 billion**. A December economic analysis by BBVA Compass Bank found that indirect drought losses to the state's agricultural industries could add another **$3.5 billion** to the toll.

Even after some welcome rainfall in the fall, two-thirds of our state remains in "extreme" or "exceptional" drought — the two most severe categories.

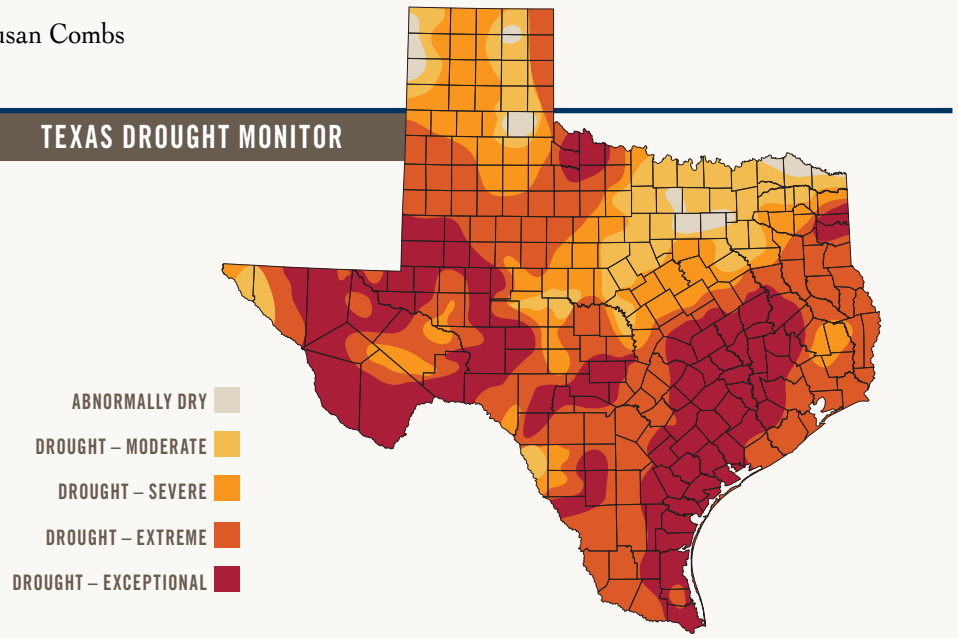
Drought is an ever-present concern in many parts of the state, leading to pressure on our water infrastructure. According to the Texas Water Development Board, demand for water will rise by 22 percent by 2060. The board says that, should we experience another multi-year "drought of record" such as that of the 1950s, it could cost Texas businesses and workers **$116 billion** in income by 2060.

Every Texan has a stake in the water issues we face, and we can all take steps to reduce our own water consumption. Our office stands ready to assist communities, businesses and lawmakers in their efforts to ensure that our water resources remain plentiful for future generations.

Sincerely,

Susan Combs

### TEXAS DROUGHT MONITOR




Source: U.S. Drought Monitor, NOAA Climate Prediction Center, as of January 5, 2012

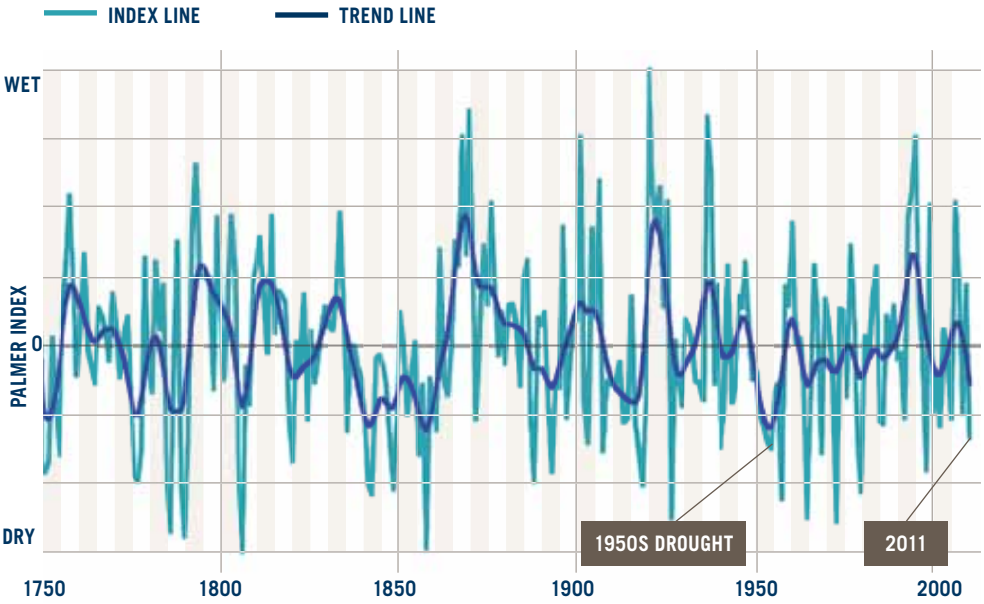
Severe drought is nothing new in Texas. Cycles of drought have plagued our region for millennia, devastating vegetation and wildlife and making survival difficult for human inhabitants as well.

In the 12th century CE, for instance, much of the Southwest suffered through a decades-long drought; another in the second century CE lasted *for nearly 50 years*.[1] These "megadroughts" appear to be infrequent but regular occurrences in our part of the world. A recent chart released by the Texas Water Resources Institute documents regular cycles of severe drought dating back to 1750 (**Exhibit 1**).

EXHIBIT 1

## TEXAS DROUGHT CYCLES OVER TIME

Studies of tree rings have made it clear that Texas is prone to cycles of drought — sometimes prolonged drought. The graph below tracks more than two-and-a-half centuries of drought conditions in South Central Texas. The line in lighter blue shows estimated values for the Palmer Drought Severity Index, often used to track the occurrence and severity of drought; the darker line tracks the overall trend.




Source: Texas Water Resources Institute

But even in the context of centuries, 2011 was special — the driest year Texas has seen since modern recordkeeping began in 1895.

Rains in October and beyond brought some relief to parts of the state, but the drought's toll for 2011 still runs into billions in damage. And it may well continue into 2012 — or longer.

In Texas, reliable water resources have always been the lifeblood of our economy and an entire way of life. And in today's fast-growing state, those resources are being tested as never before.

**Planning for and managing our water use is perhaps the most important task facing Texas policymakers in the 21st century.**

## I. THE GREAT DROUGHT OF 2011

As of October 1, 2011, Texas as a whole had received an average of about **11 inches** of rain in the previous year, about **16 inches less than normal** — and **less than Morocco and Tunisia generally see in a year**.[2] In the western half of the state, rainfall totals for the year were comparable with those typically seen in the world's desert regions (**Exhibit 2**).


Even after some welcome fall rains, as of January 3, 2012, **nearly 67 percent** of the state was still in **an "extreme" or "exceptional" drought** — the two most severe categories of a classification system maintained by the U.S. Department of Agriculture.[3]

- In early November, nearly **1,000** of Texas' 4,700 public water systems had imposed voluntary or mandatory water restrictions;
- **55** prohibited all outside watering; and
- **23** believed they were within 180 days of running out of water *completely*.[4]

EXHIBIT 2

### WEST TEXAS RAINFALL COMPARISONS

| WEST TEXAS CITIES | 2011 PRECIPITATION AS OF 12/15/11 (INCHES) | COMPARISON CITIES | AVERAGE ANNUAL PRECIPITATION (INCHES)* |
|---|---|---|---|
| Amarillo | 5.8 | Damascus, Syria | 5.3 |
| Del Rio | 9.6 | Tehran, Iran | 9.1 |
| El Paso | 4.9 | Baghdad, Iraq | 4.8 |
| Lubbock | 5.1 | Khartoum, Sudan | 4.8 |
| Midland/Odessa | 4.6 | Kuwait City, Kuwait | 4.6 |

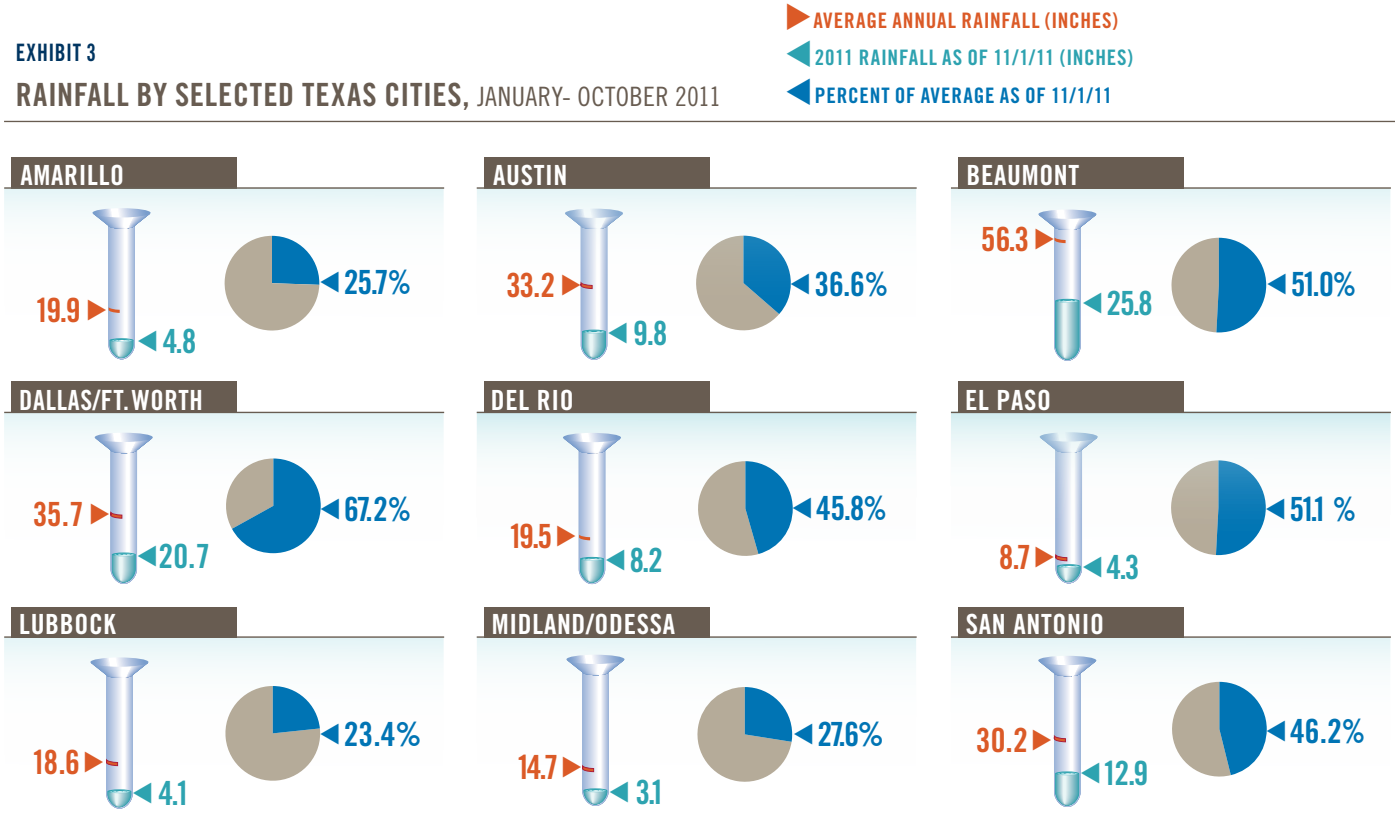
* Average annual precipitation for the years 1961 through 1990.

Sources: World Weather Information Service and National Weather Service Southern Regional Headquarters.

Even in "normal" years, Texas rainfall varies widely by region, growing steadily drier from east to west (**Exhibit 3**).

EXHIBIT 3

### RAINFALL BY SELECTED TEXAS CITIES, JANUARY- OCTOBER 2011



## DROUGHT METEOROLOGY

State Climatologist Dr. John Nielsen-Gammon, a professor of atmospheric sciences at Texas A&M University, says the current drought is due largely to the coincidence of three patterns that can bring dry weather to Texas:

- a long-term cycle of Atlantic Ocean temperature variation that climatologists call the **Atlantic Multidecadal Oscillation**, which turned warm in the mid-1990s;
- a similar long-term cycle in the Pacific, the **Pacific Decadal Oscillation**, which began cooling the tropical Pacific in 2009; and
- a shorter cycle, the **El Niño/La Niña Southern Oscillation** or ENSO. The current La Niña pattern, which also brings cooler conditions to the tropical Pacific, developed in mid-2010.[5]

In early November, nearly **1,000** of Texas' **4,700** public water systems had imposed **voluntary** or **mandatory** water restrictions

According to Nielsen-Gammon, "The last time [these] cycles lined up was in the 1950s and early 1960s, when we had not just the seven- to 10-year drought of the 1950s, but also a couple of drought years in the early 1960s."[6]

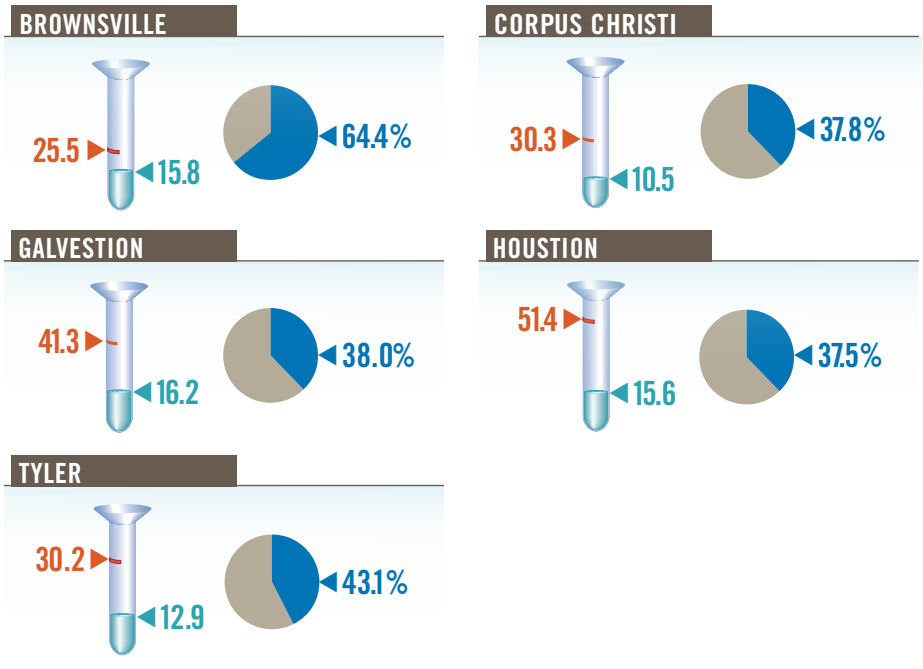
## WATER AND ENERGY

Extended drought may affect the price and availability of electrical power in Texas, due both to the demand for summer air conditioning and the fact that most power plants use large amounts of water for cooling.

On December 1, 2011, the Electric Reliability Council of Texas (ERCOT) warned that another hot, dry summer could push the state's power reserves below its minimum target next year.[7]

More than **11,000** megawatts of Texas power generation — about 16 percent of ERCOT's total power resources — rely on cooling water from sources at historically low levels. If Texas does not receive "significant" rainfall by May, more than **3,000** megawatts of this capacity could be unavailable due to a lack of water for cooling.[8]

More than **11,000 megawatts** of Texas power generation — about **16%** of ERCOT's total power resources — depend on cooling **water** from sources at historically **low levels.**

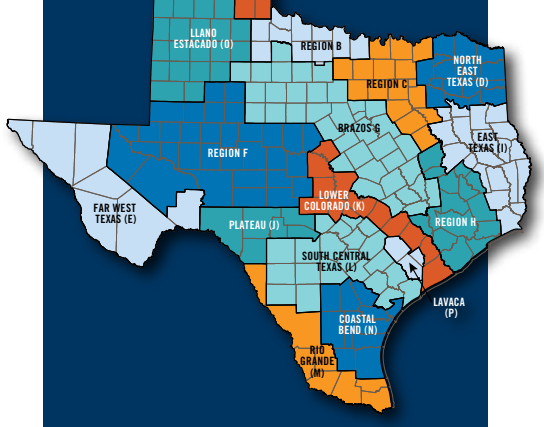



## II. TEXAS WATER PLANNING

The 1997 Texas Legislature established a state water planning process that assesses conditions in each of 16 regions, identifies solutions to water shortages and estimates their cost. The Texas Water Development Board (TWDB) synthesizes these plans into a single state plan that estimates the state's water needs over a 50-year horizon (**Exhibit 4**).

EXHIBIT 4

**TEXAS WATER PLANNING REGIONS**




Sources: Texas Water Development Board.

## NEW STATE WATER FUNDING

In November 2011, Texas voters approved Proposition 2, which authorizes TWDB to issue up to **$6 billion** in general obligation bonds. The proceeds will be used to make loans to Texas local governments for water, wastewater and flood control projects.[9]

Proposition 2 authorizes the issuance of no more than $6 billion of G.O. bonds *at any time*. This provision was called "evergreen," since it will allow TWDB to continually issue bonds for water projects so long as the amount of outstanding bonds remains below the $6 billion cap. It is likely that TWDB ultimately will issue much more than $6 billion in bonds in the coming years.[10]

The provision was called **"evergreen"** since it will allow **TWDB** to continually issue **bonds** for **water projects** so long asthe amount of the outsatanding bonds remains **below** the **$6 BILLION** cap.

## THE 2012 PLAN

**TDWB** released a draft version of its 2012 state water plan in September 2011; it became final in January 2012. According to the finalplan:

- Texas' water demand should rise by **22 percent** by 2060, from about 18 million acre-feet annually to about 22 million acre-feet (**Exhibit 5**). (An acre-foot is the amount of water needed to cover an acre of land to a depth of one foot, or nearly 326,000 gallons.)

### THE COST OF DOING NOTHING

The 2012 State Water Plan also estimates the losses the state would incur in another multi-year "drought of record," such as the 1950s drought.

According to TWDB, Texas businesses and workers could lose nearly **$12 billion** in income in 2010 and nearly **$116 billion** by 2060. State and local business tax losses could amount to **$1.1 billion** in 2010 and **$9.8 billion** in 2060.

Jobs losses could reach **115,000** in 2010 and **1.1 million** in 2060. And due to diminished employment prospects, the state's projected population could fall by about **1.4 million** people by 2060, with **403,000** fewer students in Texas schools.[11]

Texas' groundwater suppliesare expected to **FALL** by **30%** between **2010** and **2060.**

- Texas' rapidly growing **urban areas will lead water consumption**, with the largest anticipated increases in demand for municipal water systems, manufacturing plants and power generators.
- TWDB expects **irrigation**, by contrast, to see a **drop in demand** and **in its share of total demand.**
- Texas' groundwater supplies are expected to **fall by 30 percent** between 2010 and 2060, from 8 million acre-feet to 5.7 million acre-feet.[12]
- TWDB expects additional reservoirs and improved water management techniques to boost today's **8.4 million** available acre-feet of surface water to about **9 million** acre-feet in 2060.[13]

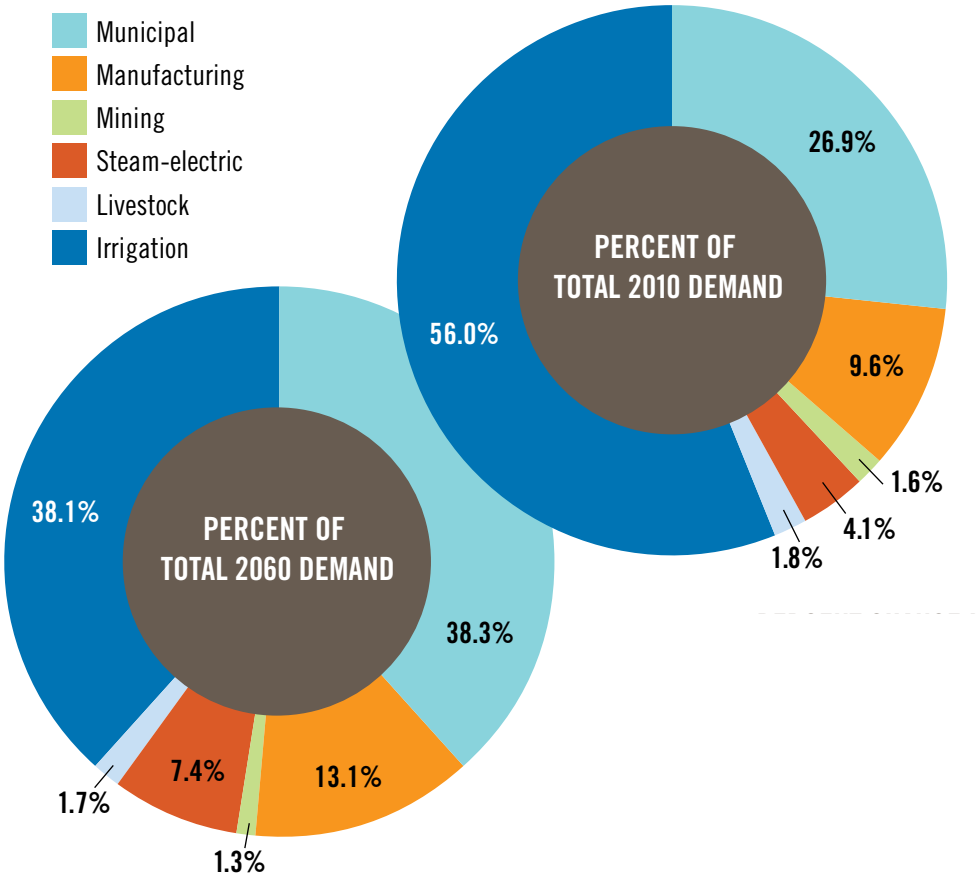
To ensure adequate water supplies during drought years, the State Water Plan recommends **562 water supply projects** as well as conservation measures, water reuse and other efforts.

- TWDB estimates its strategies would add 9 million acre-feet to Texas' water supplies by 2060, at a total cost of **$53 billion**, including **$27 billion** in state financial assistance.[14]

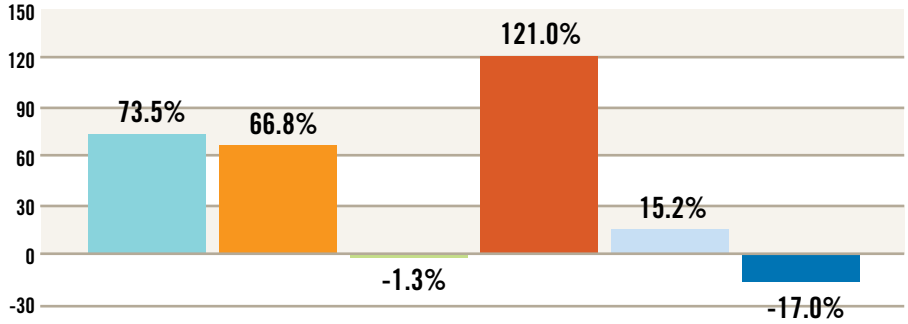
EXHIBIT 5

## TEXAS WATER DEMANDS BY CATEGORY, 2010-2060

(Amounts in Acre-Feet per Year)




### PERCENT CHANGE IN DEMAND, 2010-2060




Totals may not add due to rounding.

Source: Texas Water Development Board and Texas Comptroller of Public Accounts.

## THE 2011 DROUGHT'S TOLL

In August 2011, the Texas AgriLife Extension Service estimated Texas' direct agricultural losses from the year's drought at

**$5.2 BILLION**

That included —

**LIVESTOCK:**
**$2.06 BILLION**

**HAY PRODUCTION:**
**$750 MILLION**

**COTTON:**
**$1.8 BILLION**

**CORN:**
**$327 MILLION**

**WHEAT:**
**$243 MILLION**

**SORGHUM:**
**$63 MILLION**

. . . in addition to losses from fruit and vegetable producers, horticultural and nursery crops and other grain and row crops.[15]

A December 2012 economic analysis by BBVA Compass Bank found that **indirect losses** to Texas agriculture due to the drought could add **another $3.5 BILLION** to the toll.[16]


## WHAT HAPPENS WHEN A CITY RUNS OUT OF WATER?

We may find out soon. Robert Lee, a small town in Coke County just north of San Angelo, relies on Lake E.V. Spence for its water. The reservoir is all but gone — only **0.42 percent full** as of December 27, 2011.[17] Families that once consumed 20,000 gallons per month now are getting by with 3,000 to 4,000 gallons, **80 percent less**.[18]

According to Robert Lee Mayor John Jacobs, the city recently received a loan and grant combination for $1.2 million from TWDB that will allow it to build 12.2-mile pipeline to the water treatment plant of neighboring Bronte, Texas, which receives some water from Oak Creek Reservoir (which is **only 38 percent full**). The pipeline may take about four months to construct; Jacobs hopes that Robert Lee can hold out until then.[19]

# III. LIVING IN DRY TIMES

Human behavior and human economies are directly affected by water supplies. But what happens if we don't have enough water? How would Texas as we know it change? Three scenarios show what Texas could be like with varying rainfall amounts.

## SCENARIO 1: ADEQUATE WATER SUPPLIES

In a "normal" year Texas receives an average of about **27 inches** of rainfall across the state, with much more falling in the eastern part of the state than in the west. Average rainfall varies from about **55 inches** annually in the Beaumont-Port Arthur area to about **10 inches** around El Paso.[20]

### CONSEQUENCES:

- In general, such rainfall provides enough water for both rural and urban needs.
- Water management and planning focuses more on water rights and the need for wells and pipelines to move water where it is needed.
- Conservation efforts tend to be concentrated in the more arid parts of the state.
- Other than occasional disruptions due to broken pipes and mains, when the faucet is turned on there's plenty of water, no matter what the need.

## SCENARIO 2: SEVERE DROUGHT

In a severe drought such as the drought of record, Texas might average between **22.5** and **four** inches of rain annually, moving from east to west, for **five to 10 years**.

### CONSEQUENCES:

- Surface water supplies are strained, requiring more extensive use of both fresh and brackish groundwater.
- Texas' municipalities are forced to absorb millions of dollars in costs to fix water mains cracked and buckled by dried-out soils.
- Municipal water rates may rise dramatically.
- Texas agriculture takes billions of dollars in losses. Many farmers stop planting, and some leave the business entirely. Cattle herds are greatly reduced as forage becomes prohibitively expensive.
- As a result, food costs may rise substantially.
- Many businesses based on recreation on Texas lakes and streams dry up and disappear.
- Destructive wildfires may sweep through the tinder-dry state each summer, destroying millions of dollars' worth of homes, businesses and timber.
- Irrigation of trees, shrubs, flowering plants and lawns is restricted; many plants used in landscaping die.

- Lack of rainfall leads to increased salinity in Texas' bays and estuaries, damaging oyster, shrimp and crab yields.
- Low-flush and dual-flush toilets and other low-flow water appliances are required or strongly recommended and may receive significant tax and installation rebates.
- Texans face "convenience costs" as well — scarce and expensive water makes Texans think twice about using appliances they once took for granted, such as dishwashers and clothes washing machines.

## SCENARIO 3: MEGADROUGHT

Texas' water planning process uses the 1950s "drought of record" as a worst-case scenario. Unfortunately, scientific evidence from tree-ring studies indicates that the 1950s drought may be far from a true worst-case scenario.

Say that Texas receives half of its "normal" average annual rainfall, **13 inches or so, for two decades**. Our semi-tropical regions would become arid, while our semi-arid regions would become desert. This situation would create *tremendous* social changes.

### CONSEQUENCES:

- Texas agriculture would change dramatically, and might end in some areas. Drip irrigation and other techniques pioneered in desert areas would become essential.
- Remaining agriculture might become dependent on "water markets," in which the rights to draw groundwater are bought and sold.
- Food prices, particularly beef prices, would increase significantly.
- Turf grass lawns and all outside watering might be banned.
- Low-flow water appliances would become mandatory.
- Wastewater would become quite valuable, and would be reclaimed for reuse in irrigation and perhaps treated to make it suitable for human consumption.
- Desalination of brackish (salty) groundwater and seawater would become common, at first for industrial and agricultural uses and then for drinking water.
- Utility rates could be expected to skyrocket due to the increased expense of water obtained through desalination or reuse, and the higher costs faced by energy plants that rely on water for cooling.

### 2011: THE WILDFIRE YEAR

**Drought and unprecedented heat made 2011 the worst year for wildfires in Texas history. From Nov. 15, 2010 through Sept. 29, 2011, Texas saw 23,835 fires that burned more than 3.8 million acres and destroyed 2,763 Texas homes.[21]**

**See page 12 for how you can help the victims of these fires.**

CRACKED PAVEMENT, BROKEN PIPES

The 2011 drought caused considerable damage to infrastructure. Much of Texas is covered in clay-rich soils that swell when wet and shrink when soil moisture evaporates. That shrinkage can cause the soil to buckle, damaging foundations, roads and water and sewer lines.

Williamson County had around 100 road and bridge employees working full-time to fix pavement cracks in the summer.[22] Dallas closed more than two dozen athletic fields due to cracks in the soil up to two feet deep.[23]

The city of Austin repaired 103 leaking pipes in the last week of July alone. In July, Fort Worth reported more than 200 breaks in its water mains, including 20 discovered on a single day.[24] At the end of August, Houston had 1,033 active leaks in its water system.[25]

## IV. INNOVATIVE SOLUTIONS TO THE WATER CRISIS

Rising water demands — and the grim prospect of extended drought — require Texas water planners to look for innovative responses. The 2012 State Water Plan indicates that nearly **40 percent** of the water supplies to be developed by 2060 will be the result of conservation and unconventional water sources.[27] These include:

- **RAINWATER HARVESTING,** which typically involves funneling rainwater runoff from roofs or other surfaces into cisterns for storage. Some Texas municipal water systems already provide rebates toward the purchase of rain barrels for capturing runoff.[28] Such systems can lower residential water bills as well as the demand for municipal water.
- **AQUIFER STORAGE AND RECOVERY,** the storage of water in an aquifer for later use.[29] ASR allows providers to collect surface water and rainwater when it is abundant and store it underground until needed. The San Antonio Water System's ASR system is one of the nation's largest, delivering 40 million gallons a day at the peak of the 2011 drought.[30] TWDB proposes ASR projects to produce **81,000** acre-feet of water annually by 2060.[31]
- **WATER REUSE,** chiefly the use of treated wastewater. In West Texas, reclaimed water has been used in agricultural irrigation for many years. Other uses can include landscaping irrigation, industrial cooling, hydraulic fracturing in natural gas drilling and, with appropriate treatment, drinking water.[32] The 2012 State Water Plan proposes a major expansion in reuse, from **100,600** acre-feet in 2010 to **915,600** acre-feet in 2060.[33]

The San Antonio Water System's **ASR** system is one of the nation's largest, delivering **40 million** gallons a **day** at the peak of the **2011 drought**.

**The 2011 Legislature eliminated a legal provision stipulating that rainwater-harvesting systems could be used only for non-potable purposes. Now, captured rainwater can be used for drinking, cooking and bathing, provided the system is installed by a licensed plumber; has a backflow system to prevent contamination of water utility lines; and meets safe drinking-water standards.[26]**

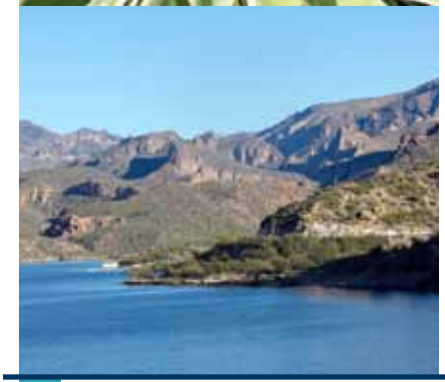

- **DESALINATION,** the conversion of this brackish groundwater into drinking water. Texas has an estimated **2.7 billion** acre-feet of brackish groundwater and **44** active groundwater desalination plants, including the world's largest inland facility, the Kay Bailey Hutchison Desalination Plant in El Paso, which produces almost 85 acre-feet of fresh water daily.[34] In all, Texas' current groundwater desalination plants have a current capacity of about **70,560** acre-feet annually; the Water Plan proposes expanding this total to **181,568** acre-feet by 2060.[35]

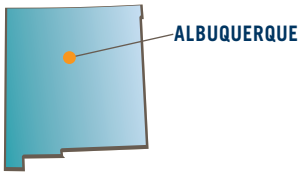
- **SEAWATER DESALINATION** is roughly two to three times expensive than groundwater desalination.[36] Although Texas does not yet have a municipal seawater desalination plant, in May 2011 voters in Port Isabel's Laguna Madre Water District voted to build one on South Padre Island. The plant is expected to cost $13.2 million and will generate about three acre-feet of fresh water daily.[37] TWDB proposes a major expansion of the state's seawater desalination capacity, to **125,514** acre-feet annually by 2060.[38]

Texas
has an estimated
**2.7 BILLION**
acre-feet of
**brackish groundwater**
and **44** active groundwater
**desalination** plants.


As is often the case with evolving technologies, the major barrier to desalination is cost. The Laguna Madre Water District, for instance, anticipates that building and operating its seawater desalination plant will cost three times as much as a similar plant to treat surface waters from the Rio Grande.[39] Nonetheless, desalination offers access to an essentially endless source of fresh water — as long as we can pay for it.

Texas is not alone in facing sustained drought conditions from time to time. Our neighbors in southwestern states have been forced to develop innovative strategies to combat chronic water shortages — strategies that may become common in Texas as well.






**Albuquerque, New Mexico** has a population of approximately 500,000 and average rainfall of 9.5 inches. In 1993, scientific studies showed that Albuquerque's aquifer was being drawn down twice as fast as nature could replenish it. At that time, Albuquerque's total daily per capita usage was 250 gallons.

In response, the Albuquerque/Bernalillo County Water Utility Authority (ABCWUA) adopted aggressive conservation and education policies. In 2010, the city's daily per capita usage had **fallen by nearly 38 percent**, to 157 gallons, and ABCWUA believes the city can reduce this to 150 gallons daily by 2014.

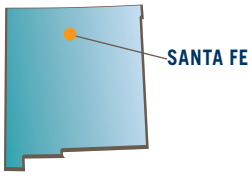
**STRATEGIES:**

- In 1995, Albuquerque adopted **strict requirements for landscaping** in new developments, such as prohibiting the use of high-water-use grasses on more than 20 percent of a landscaped area.
- Albuquerque provides **generous rebates for "xeriscaping"** — landscaping reliant on native, drought-tolerant plants. The rebates total 25 cents per square foot of converted landscape area, up to $500 ($700 for commercial landscapes).
- The city also conducts extensive **public education** on wise water use, including classes that pay customers $20 to learn about xeriscaping, the types of plants to use and how to care for them. According to the city, attendees reduce their water usage by an average of **28 percent**.
- Albuquerque also **requires high-efficiency toilets** in all new residential construction. The city offers **rebates of up to $100** for high-efficiency toilets and clothes washers.
- The city offers **free water audits** and **free installation** for high-efficiency plumbing devices.
- Albuquerque also **fines residential and commercial customers who waste water**. Offenses include allowing sprinklers to water streets or adjacent properties, and overwatering to an extent that causes excessive runoff. The city uses **"water cops"** to patrol the city, looking for water waste.
- In 1993, the city embarked on a $400 million project to **diversify the city's water portfolio.** Due to this project, completed in 1998, Albuquerque now obtains half of its water from the Colorado River, a share that ultimately may rise to 90 percent.[40]


**Phoenix, Arizona,** with 1.3 million residents and less than eight inches of rain per year, has been forced to adopt extensive water management policies. Since 1998, Phoenix's per capita water use has declined despite a 15 percent growth rate.

**STRATEGIES:**

- Phoenix has **diversified its water portfolio**, now drawing water from three surface-water sources, one groundwater source, two aquifer storage and recovery projects and water reuse and conservation efforts.
- Phoenix draws water from both city-run and state-run **ASR systems**. The city's has a capacity of **20,000 acre-feet** annually, while the state's ASR project, the Arizona Water Banking Authority (AWBA), has a capacity of more than **3 million acre-feet** of Colorado River water for municipal and industrial needs. At present, Phoenix uses **25,000 acre-feet** of ABWA water annually.
- Phoenix treats and **reuses about 40 percent** of the water it delivers to customers. Most of this water is used for agriculture and reactor cooling at the Palo Verde Nuclear Generating Station.
- The city relies primarily on **rebates and incentives** for compliance with its water management policies, but also penalizes water waste through measures such as **progressive water rates**, which raises the cost of water as you use more. **"Water cops"** are used to further compliance.[41]




**Santa Fe, New Mexico** has a population of approximately 100,000 and averages about 12.5 inches of rain annually. A severe two-year drought a decade ago prompted Santa Fe to perform a hydrological study that determined the city's reliance on groundwater was unsustainable.

**STRATEGIES:**

- The city began to **diversify its water portfolio** and now relies equally on two surface water and two groundwater sources. The two surface-water reservoirs the city added to its portfolio now provide **40 percent** of its water.
- To **protect its surface reservoirs**, the city engaged in a forest thinning and controlled burning project to help reduce water draws by trees and to prevent forest fires that could threaten the water's quality.
- Santa Fe also **heavily promotes water conservation** with initiatives including xeriscaping, the use of water-efficient appliances and other behavioral changes.
- The city requires new residential and commercial construction projects to estimate the amount of water they will need, acquire the appropriate water rights and provide them to the city. In other words, **allowable growth is directly tied to the amount of water available**.
- The city also relies on **water reuse** for the irrigation of public green spaces, golf courses and parks.
- An **ASR project** stores excess rainfall and surface water in an underground aquifer for future use.[42]


**Tucson, Arizona** has a population of approximately 520,000 and averages 12.5 inches of rain annually, and began conserving water in earnest in the mid-1980s. At that time, Tucson faced a significant problem with sinkholes, caused by the massive use of groundwater and the inability of aquifers to replenish fast enough.

**STRATEGIES:**

- Tucson **requires all new homes and commercial construction to use xeriscaping**.
- The city supplies **rebates** for xeriscaping, water-efficient appliances and rainwater and "grey water" harvesting. Coupled with **aggressive public education**, these measures have led to significant reductions in per capita usage. Tucson's per capita daily water usage went from **200 gallons** in 1985 to **130 gallons** in 2010.
- Tucson's **use of reclaimed water** satisfies **7 percent** of its water needs — about 18,000 acre-feet per year. Most golf courses, city parks, schools and some commercial green spaces use reclaimed water for irrigation. An ordinance approved two years ago requires that reclaimed water supply half of all commercial irrigation.[43]


## RESOURCES

- **Texas Water Development Board (TWDB)**
  http://www.twdb.state.tx.us/

  TWDB is the state's water supply and infrastructure planning agency, responsible for updating the State Water Plan every five .years.

- **Texas Water Development Board — 2012 State Water Plan**
  http://www.twdb.state.tx.us/wrpi/swp/.asp

- **National Weather Service — Climate Prediction Center**
  http://www.cpc.ncep.noaa.gov/products/predictions/90day/

  This site provides rolling three-month projections on temperature and precipitation throughout the U.S.

- **NOAA — La Niña Resource Page**
  http://www.elnino.noaa.gov/lanina.html

  This website provides scientific data and weather outlooks on the La Niña weather pattern that is controlling Texas's recent drought-plagued climate.

- **Texas Commission on Environmental Quality (TCEQ)**
  http://www.tceq.state.tx.us/

  As the agency responsible for the health of Texas' public water systems, air and soil, TCEQ is the best source for state environmental information.

- **TCEQ — Water Rights Database**
  http://www.tceq.texas.gov/permitting/water_supply/water_rights/wr_databases.html

  TCEQ maintains this downloadable Excel database of all permittees of state-owned surface waters, arranged by name, location, permitted amount and date of issuance.

- **National Drought Mitigation Center**
  http://droughtmonitor.unl.edu/

  The National Drought Mitigation Center, headquartered within the University of Nebraska at Lincoln, publishes weekly maps of drought conditions throughout the U.S.

## WHAT YOU CAN DO

**The impact of a drought as bad as last year's can seem overwhelming. But every Texan has a stake in the water issues we face.**

**You can take steps to reduce your own water consumption, of course. Your wallet and your state will both benefit.**

**On a broader level, you can familiarize yourself with the 2012 Water Plan and its associated presentations (http://www.twdb.state.tx.us/wrpi/swp.asp) at the Texas Water Development Board's website. The issues and policies discussed there will play an essential role in shaping our state's growth over the next 50 years.**

**Understanding them can help you hold your state and local policy-makers accountable in this all-important arena.**

## How You Can Help Texas Wildfire Relief:

Dozens of charities and aid organizations are helping the victims of the disastrous 2011 wildfires. Here is a  list to find out where and how you can help.

- The American Red Cross of Central Texas: www.centex.redcross.org.
- The Texas Forest Service: http://texasforestservice.tamu.edu/main/article.aspx?id=13348.
- The Texas Wildfire Relief Fund: http://txwildfirerelief.org.

# ENDNOTES

[1] Shelley Littin, "Scientists Find Evidence of Roman Period Megadrought," Physorg.com (November 4, 2011), http://www.physorg.com/news/2011-11-scientists-evidence-roman-period-megadrought.html. (Last visited November 9, 2011.)

[2] Office of the Texas State Climatologist, *The 2011 Texas Drought: A Briefing Packet for the Texas Legislature* (College Station, Texas, October 31, 2011), p. 26, http://atmo.tamu.edu/osc/library/osc_pubs/2011_drought.pdf (last visited November 8, 2011); and Nationmaster.com, "Precipitation (Most Recent) by Country," http://www.nationmaster.com/graph/geo_pre-geography-precipitation. (Last visited November 7, 2011.)

[3] National Drought Mitigation Center, "U.S. Drought Monitor: Texas," December 13, 2011, http://droughtmonitor.unl.edu/DM_state.htm?TX,S. (Last visited December 19, 2011.)

[4] Commissioner Carlos Rubenstein, Texas Commission on Environmental Quality, testimony before a joint hearing of the Senate Natural Resources and Agriculture and Rural Affairs committees, Austin, Texas, November 2, 2011.

[5] See also Atlantic Oceanographic and Meteorological Laboratory, "Frequently Asked Questions About the Atlantic Multidecadal Oscillation (AMO)," http://www.aoml.noaa.gov/phod/amo_faq.php; Northwest Fisheries Science Center, "Pacific Decadal Oscillation (PDO)," http://www.nwfsc.noaa.gov/research/divisions/fed/oeip/ca-pdo.cfm; and National Oceanic and Atmospheric Administration, "NOAA Still Expects Active Atlantic Hurricane Season; La Niña Develops," http://www.noaanews.noaa.gov/stories2010/20100805_hurricaneupdate.html. (Last visited December 6, 2011.)

[6] Interview with Texas State Climatologist John Nielsen-Gammon, September 30, 2011.

[7] Electric Reliability Council of Texas, "ERCOT 10-Year Outlook Indicates Need for Additional Generation," http://ercot.com/news/press_releases/show/459. (Last visited December 6, 2011.)

[8] Electric Reliability Council of Texas, *Grid Operations and Planning Report* (Austin, Texas, December 12-13, 2011), p. 22, http://www.ercot.com/content/meetings/board/keydocs/2011/1212/Item_06e_-_Grid_Operations_and_Planning_Report.pdf. (Last visited December 19, 2011.)

[9] Texas Water Development Board, "Proposed Constitutional Amendment for Water Financial Assistance Bonds," http://www.twdb.state.tx.us/newsmedia/constitutional/doc/Const_Amend_Fact.pdf. (Last visited November 22, 2011.)

[10] Texas Water Resources Institute, Propositions Up for Vote in November Could Affect Texas' Water Future," http://twri.tamu.edu/publications/new-waves/2011/october/propositions-up-for-vote-in-november. (Last visited November 22, 2011.)

[11] Texas Water Development Board, *Water for Texas 2012* (Austin, Texas, January 2012), http://www.twdb.state.tx.us/publications/state_water_plan/2012/2012_SWP.pdf. (Last visited January 9, 2012.).

[12] Texas Water Development Board, *Water for Texas 2012*, p. 3,

[13] Texas Water Development Board, *Water for Texas 2012*, p. 3.

[14] Texas Water Development Board, *Water for Texas 2012*, pp. 4-6.

[15] Texas Agrilife Extension Service, "Texas Agricultural Drought Losses Reach Record $5.2 Billion," http://agrilife.org/today/2011/08/17/texas-agricultural-drought-losses-reach-record-5-2-billion/. (Last visited December 19, 2012.)

[16] BBVA Research, "Texas Drought Impact," Houston, Texas, December 9, 2011, http://www.bbvaresearch.com/KETD/fbin/mult/111209_EconomicWatchEEUU_136_tcm348-282133.pdf?ts=19122011. (Last visited December 19, 2011.)

[17] Texas Water Development Board, Reservoir Storage Summary for Lake E. V. Spence, http://wiid.twdb.state.tx.us/ims/resinfo/BushButton/lakeStatus.asp?selcat=3&slbasin=36. (Last visited December 19, 2011.)

[18] Allan Turner, "Drought Threatens West Texas Town's Existence," *San Antonio Express-News* (August 15, 2011), http://www.mysanantonio.com/news/local_news/article/Opportunity-dries-up-with-water-in-Robert-Lee-1992471.php#photo-1526613. (Last visited November 18, 2011.)

[19] Interview with Robert Lee Mayor John Jacobs, December 16, 2011; and Texas Water Development Board, Reservoir Storage Summary for Oak Creek Reservoir, http://wiid.twdb.state.tx.us/ims/resinfo/BushButton/lakeStatus.asp?selcat=3&slbasin=86. (Last visited December 19, 2011.)

[20] Texas Water Development Board, *Water for Texas 2012*, p. 148.

[21] Texas Forest Service, "Dangerous Wildfire Conditions Predicted for Friday," http://txforestservice.tamu.edu/main/popup.aspx?id=14644. (Last visited December 19, 2011.)

[22] Ben Wear, "Parched Soil Takes Toll on Roads, Slabs, Pipes," *Austin American-Statesman* (October 14, 2011), http://www.statesman.com/news/local/parched-soil-takes-toll-on-roads-slabs-pipes-1914577.html?printArticle=y. (Last visited December 19, 2011.)

[23] Mike Drago, "Drought Related Cracks Prompt Dallas to Close Athletic Fields," *Dallas Morning News* (September 16, 2011), http://thescoopblog.dallasnews.com/archives/2011/09/drought-related-cracks-prompt.html. (Last visited December 19, 2011.)

[24] Ari Auber, "Drought Damages Texas Infrastructure," *The Texas Tribune* (August 5, 2011), http://www.texastribune.org/texas-environmental-news/environmental-problems-and-policies/drought-damages-texas-infrastructure/. (Last visited December 19, 2011.)

[25] Cindy Horswell, "When It Comes to Water, Houston Can't Catch a Break," *Houston Chronicle* (August 29, 2011), http://www.chron.com/news/houston-texas/article/WHEN-IT-COMES-TO-WATER-CITY-CAN-T-CATCH-BREAK-2146711.php. (Last visited December 19, 2011.)

[26] Texas House of Representatives, House Research Organization, "Bill Analysis: HB 3372," April 19, 2011, www.hro.house.state.tx.us/pdf/ba82r/hb3372.pdf. (Last visited November 12, 2011.)

[27] Texas Water Development Board, *Water for Texas 2012*, p. 189.

[28] See for instance City of San Marcos, "Rainwater Harvesting," http://www.ci.san-marcos.tx.us/departments/www/Rain_Water_Harvesting.html; Austin Water, "Rainwater Harvesting Rebate Program Guidelines," http://www.ci.austin.tx.us/water/conservation/downloads/rainh2orebate.pdf; and New Braunfels Utilities, "Rainwater Harvesting Rebate," http://www.nbutexas.com/Conservation/Rebates/WaterConservationRebates/RainwaterHarvestingRebate/tabid/1096/Default.aspx. (Last visited November 16, 2011.)

[29] Texas Water Development Board, *Water for Texas 2012*, p. 196.

[30] Texas Water Development Board, *An Assessment of Aquifer Storage and Recovery in Texas*, by Malcolm Pirnie, ASR Systems LLC, and Jackson, Sjoberg, McCarthy & Wilson LLP (Austin, Texas, February, 2011), p. 15, http://www.twdb.state.tx.us/innovativewater/asr/projects/pirnie/doc/2011_03_asr_final_rpt.pdf (last visited November 15, 2011); and San Antonio Water System, response to Comptroller survey, November 16, 2011.

[31] Texas Water Development Board, *Water for Texas 2012*, p. 189.

[32] Texas Water Development Board, *History of Water Reuse in Texas*, by Alan Plummer Associates, Inc. (Austin, Texas, February 2011), p. 6, http://www.twdb.state.tx.us/innovativewater/reuse/projects/reuseadvance/doc/component_a_final.pdf. (Last visited November 16, 2011.)

[33] Texas Water Development Board, *Water for Texas 2012*, p. 189.

[34] Texas Water Development Board, "Desalination FAQs" www.twdb.state.tx.us/innovaterwater/desal/faq.asp (Last visited January 9, 2012); and El Paso Water Utilities, "Setting the State for the Future," http://www.epwu.org/water/desal_info.html. (Last visited November 18, 2011.)

[35] Texas Water Development Board, *Water for Texas 2012*, p. 189; "Desalination Plant Database," http://www.twdb.state.tx.us/apps/desal/default.aspx (last visited November 14, 2011); and "Desalination: Brackish Groundwater," April 2011, http://www.twdb.state.tx.us/publications/shells/Desal_Brackish.pdf. (Last visited November 15, 2011.)

[36] Texas Water Development Board, *Cost of Water Desalination in Texas*, by Jorge Arroyo and Saqib Shirazi, Innovative Water Technologies, October 16, 2009, p. 5, http://www.twdb.state.tx.us/innovativewater/desal/doc/Cost_of_Desalination_in_Texas.pdf. (Last visited November 16, 2011.)

[37] Texas Water Development Board, "Desalination Facts," http://www.twdb.state.tx.us/innovativewater/desal/facts.asp (last visited November 14, 2011); and Jeannie Keaver, "Desalination a Big Part of Texas' Water Future," *Houston Chronicle* (November 14, 2011), http://www.chron.com/news/houston-texas/article/Desalination-a-big-part-of-Texas-water-future-2269050.php. (Last visited November 14, 2011).

[38] Texas Water Development Board, *Water for Texas 2012*, p. 189.

[39] Jeannie Keaver, "Desalination a Big Part of Texas' Water Future."

[40] Interview with Katherine Yuhas, conservation officer for the Albuquerque/Bernalillo County Water Utility Authority, December 27, 2011.

[41] Interview with Gerard Silvani, principal planner, Phoenix Water Services Department, December 22, 2011.

[42] Interview with Rick Carpenter, manager of Water Resources and Conservation, City of Santa Fe Water Division, December 21, 2011.

[43] Interview with Fernando Molina, public information and conservation officer, Tucson Water, December 21, 2011.

This document can be found on the Web:
http://www.window.state.tx.us/specialrpt/drought/Texas
Comptroller of Public Accounts

Data Services Division
P.O. Box 13528
Austin, Texas 78711-3528

Publication# 96-1704 • Printed February 2012