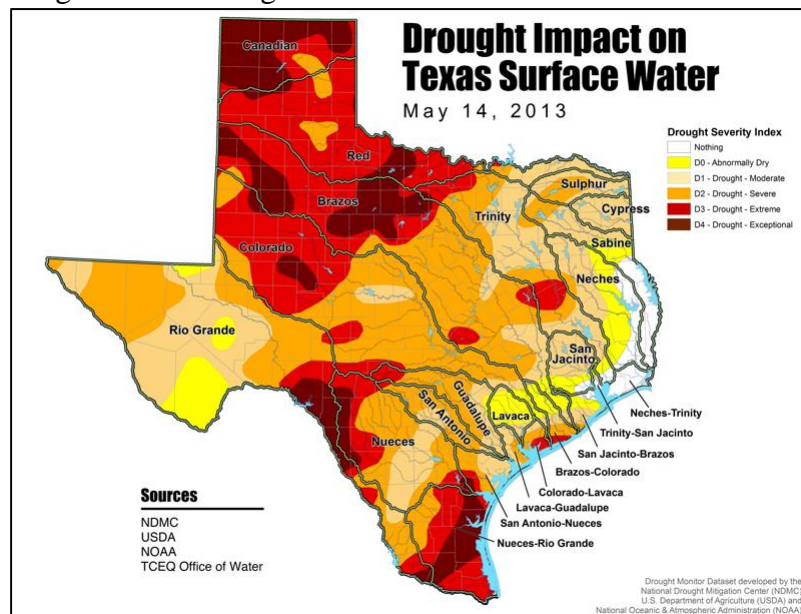


# Water Grand Challenges: Physical Processes

## Physical Effects of Drought

**Background** – Persistent periods of abnormally low levels of precipitation result in instances of prolonged drought in Texas that can cause a plethora of physical changes to a landscape. In 2011, unusually warm and dry weather resulting from the weather phenomenon known as La Niña resulted in the driest year for Texas yet.<sup>1</sup> Prolonged drought events such as this can physically effect the environment, resulting in wildfires, subsidence, parched farmlands, and damaged wetlands. Climatologists recognize four different types of drought: 1) meteorological drought, 2) hydrological drought, 3) agricultural drought, and 4) socioeconomic drought.<sup>2</sup> Meteorological drought occurs due to shifts in dominant weather patterns. Hydrological drought becomes apparent with low ground and surface water levels, which is usually a result of repeated months of meteorological drought.<sup>1</sup> Agricultural drought occurs when low water levels affect crops and agricultural production. The last form, socioeconomic drought, is a prolonged instance of drought, which adversely affects various commodities and industry.<sup>2</sup>



**Figure 1: Effect of Drought on Texas Watersheds<sup>3</sup>**

**Agriculture and Forestry** – During times of drought, farmers often see a loss in crops as dehydrated plants wilt and die in the intense heat and dry soil. Apart from the economic impact of crop loss, the lack of a root system to hold soil in place increases mass wasting and erosion into Texas waterways, thereby lowering surface water quality.<sup>4</sup> In 2011, the Texas Tree Service estimated approximately 500 million trees had been lost to drought, particularly in west Texas south of San Angelo.<sup>5</sup> Many species of native Texas trees are drought-tolerant and experts expect populations to make a recovery. However, indirect costs of the physical effects of drought such as [damage to infrastructure](#) and rising [food prices](#) resulting from desiccated pecan trees and nutrient poor soil may not be so easily corrected.



**Water Sources** – The impact to our water quality during drought is of great concern. When rainfall is less than normal for any given period of time, the surface water flow of stream and rivers decline, water levels in lakes and reservoirs fall, and the depth to water in wells increases. For our drinking water supply, it's important to recognize that the water level in an aquifer does not always stay the same. Droughts, seasonal variations in rainfall, and pumping all impact the amount of water in an aquifer at any given time.<sup>6</sup> However, drought greatly increases the need to tap into our groundwater resources and this puts an increased strain on an already fragile resource. Scientists are also starting to study the correlation between the depth of the water table and the impacts of drought. Due to the fact that the higher the water table, the greater the moisture content in the soil, recent modeling results show that the depth of the water table, which results from lateral water flow at the surface and subsurface, determines the relative susceptibility of regions to changes in temperature and precipitation, and therefore drought.<sup>7</sup> This information highlights the need to preserve our groundwater, not only for its storage capacity, but also for its ability to limit the impact of drought on the surface.

In Texas coastal areas, reduced freshwater discharges from aquifers coupled with increased groundwater pumping may cause seawater to move beyond previous limits and increase subsidence, or sinking, of the earth thereby greatly decreasing the value of nearby homes.<sup>8</sup> Subsidence can also lead to increased risk of flooding for coastal communities. Another critical impact of the drought is the disruption of migratory patterns for various species. Birds and butterflies seeking refuge in Texas will be faced with a lack of water, lack of food and limited nesting opportunities. For example, The Nature Conservancy's Mad Island preserve along the Texas coast has lost nearly 1,000 acres of wetlands due to the drought. Birds that would normally rest or winter here are forced to continue their migration further south, or return north. It is also expected that habitat provided by rice paddies will also decline, as farmers are not able to sustain the paddies due to the lack of freshwater.<sup>9</sup>

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<sup>1</sup> StateImpact. "Everything You Need to Know About the Texas Drought." Texas Reporting on policy, power, and the planet. May 22, 2013. <http://stateimpact.npr.org/texas/tag/drought/>.

<sup>2</sup> National Climatic Data Center. "Definition of Drought." National Climatic Data Center National Ocean and Atmospheric Administration. November 29, 2012. <http://www.ncdc.noaa.gov/climate-monitoring/dyk/drought-definition> (accessed March 1, 2013).

<sup>3</sup> Texas Commission on Environmental Quality. "Drought impact on Texas surface water." May 14, 2013. <http://www.tceq.gov/assets/public/response/drought/DM-130514.jpg> (accessed 22 2013, May)

<sup>4</sup> State Impact Texas, "Erosion Concerns West Texas Farmers During Drought." March 29, 2012. <http://www.xsorb.com/blog/130349/environment/erosion-concerns-west-texas-farmers-during-severe-drought/>. (accessed March 21, 2013).

<sup>5</sup> Henry, Terrence. "Hundreds of millions of trees could be lost to the drought." StateImpact. December 20, 2011. <http://stateimpact.npr.org/texas/2011/12/20/hundreds-of-millions-of-trees-could-be-lost-to-the-drought/>.

<sup>6</sup> United States Geological Survey. "Effects of Drought on Groundwater Resources." <http://ga.water.usgs.gov/edu/droughtandgw.html>. (accessed March 21, 2013).

<sup>7</sup> Science Daily. "Water Table Depths Tied to Droughts." October 1, 2008. <http://www.sciencedaily.com/releases/2008/09/080929133725.htm> (accessed March 21, 2013.)

<sup>8</sup> Alley, William M, Thomas E Reilly, and O Lehn Franke. "Sustainability of ground-water resources." U.S. Geological Circular, 1999.



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<sup>9</sup> Huffington Post. "Texas Drought Disrupts Bird Migrations." March 1, 2012.  
[http://www.huffingtonpost.com/2012/03/01/texas-drought-bird-migrations\\_n\\_1312393.html](http://www.huffingtonpost.com/2012/03/01/texas-drought-bird-migrations_n_1312393.html). (accessed March 21, 2013.)