

# WHAT IS SUBSIDENCE AND WHY SHOULD WE CARE ABOUT IT?



**Sub-si-dence** – the sinking down of land resulting from natural shifts or human activity, frequently causing structural damage to buildings.

Following a period of rapid and sustained growth and an influx of new residents triggered by the expansion of the petrochemical industry and allied businesses following World War II, six or more feet of subsidence had occurred in Harris and Galveston Counties by the mid-1970's along the Ship Channel. By 1979, up to 10 feet of subsidence was measured there, and over 3,000 square miles had 'sunk' by more than 1 foot. The elevation of the land surface is lowered when the many layers of clay beneath the land surface are compacted.

As people have been saying for centuries, "Nature abhors a vacuum." When large amounts of groundwater are drawn out of the aquifers, it should be no surprise that the clay layers would collapse under the weight of everything above them, and effectively decrease the storage capacity of the aquifer...never to return to previous levels. Some natural settling or shifting of sediments laid down millions of years ago may also cause subsidence, but not to the extent of that caused by the withdrawal of oil and gas, subsurface coal mining, and the pumpage of groundwater.



An example of what can happen when land loses elevation by subsidence. (USGS photo)

Most of the groundwater wells that supply drinking water to the Houston-Galveston area are completed in the upper 1,000 to 2,000 feet of the Chicot and Evangeline aquifers. As subsidence

increased inland – north and west of Houston – water levels have declined more than 100 feet in the Evangeline aquifer between 1977 and 1997. The area's steadily increasing population and decades of aggressive water usage have resulted in a corresponding decline of the aquifers and in subsidence.

## **That "sinking" feeling...**

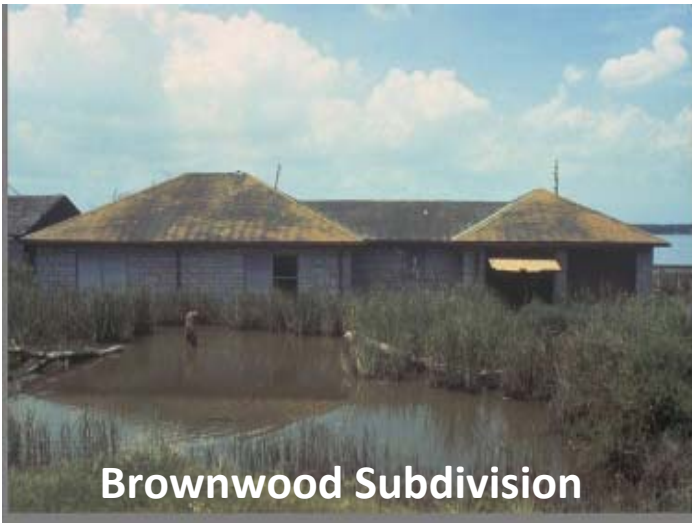
According to the United States Geological Service (USGS), the greater Houston area has been more adversely impacted by subsidence than any other metropolitan area in the U.S. Extensive subsidence – caused primarily by groundwater pumping (and to a lesser extent, by oil and gas extraction) has caused damage to the area's industrial and transportation infrastructure, increased the frequency of flooding, and has cost millions of dollars. (One conservative estimate places the average annual direct and indirect cost of subsidence to property owners at more than \$90 billion in 1998 dollars.)

Look at it this way. If the elevation of your house is only 10 feet above sea level and you lose 10 feet of elevation because of subsidence...your house is now under water. This actually happened to Brownwood, a subdivision in the City of Baytown that had to be abandoned – an extreme example of the effects of subsidence in coastal areas. While regional land subsidence can be subtle and difficult to detect, there are locations in and near Houston where the effects are quite evident. As much as 10 feet of subsidence has shifted the coastline and changed the distribution of important wetlands. One of the most obvious impacts of subsidence has occurred at the San Jacinto Battleground State Historical Park, where Texas won its independence, which is now partly submerged with 100 acres of the park under water.

## **In search of solutions...**

It was a growing awareness of subsidence and related problems that prompted community and business leaders to lobby for some relief. The 1975 Texas Legislature responded with the creation of the

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**Brownwood Subdivision**

Harris-Galveston Coastal Subsidence District (HGSD) “for the purpose of ending subsidence which contributes to, or precipitates, flooding, inundation, and overflow of any area within the Subsidence District...” The HGSD was authorized to control the issuance of well permits, promote water conservation and education, and promote conversion from groundwater to surface water supplies. It was largely successful in its efforts to arrest subsidence in the coastal plain east of Houston.

After addressing subsidence in areas south of Houston, in 2000 the HGSD required the phased conversion from groundwater (water wells) to surface water (lakes and reservoirs) in northwest Harris County. This mandate required that we reduce reliance on groundwater at least 30 percent by 2010; 70 percent by 2020; and by 80 percent in 2030. Failure to meet these deadlines would trigger huge Subsidence District penalties of \$7.00/1000 gallons. Since that time, there have been a number of increases and today, the Disincentive fee is \$9.24/ per 1,000 gallons.



*A road that provided access to the San Jacinto Monument was closed due to flooding caused by subsidence.*

By 2013, there were serious concerns about population projections and the ability to meet the HGSD’s 2020 mandate. At its January 2013 board meeting, the Subsidence District voted to delay the next conversion date from 2020 to 2025, and to reduce the percentage conversion from 70 percent to 60 percent of total water usage. The 2030 deadline was also extended to 2035. For ratepayers, that means a more gradual – but still substantial – increase in rates to pay for the construction of new waterlines and capacity throughout the West Harris County region, and allows a more logical, reasonable approach to the design, bid and construction process.

In addition to pursuing its Capital Improvement and construction programs to meet Subsidence District mandates, the WHCRWA continues to encourage water conservation by offering incentives to individual water districts that find creative ways to reuse water resources, or find other alternatives to groundwater pumping. And, as it has since its inception in 2001, the Authority aggressively promotes water efficiency by residents of all ages, through educational programs and community outreach efforts.

**WATER...WHAT WOULD WE DO WITHOUT IT?**

**West Harris County Regional Water Authority**

**Save Water Texas Coalition**

**West Harris County Regional Water Authority**

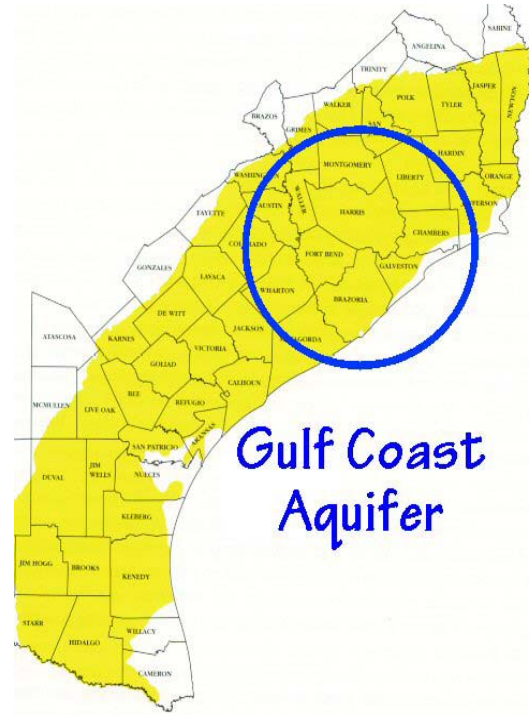
Member of the Save Water Texas Coalition

[www.SaveWaterTexas.org](http://www.SaveWaterTexas.org)





Measuring Subsidence



The **Gulf Coast Aquifer** forms an irregular shaped belt along the Gulf of Mexico from Florida to Mexico. In Texas, it provides water to all or parts of 54 counties, and the greater Houston metropolitan area. The aquifer is made up of a combination of clays, silts, sands, and gravels that are all connected to form a large, leaky artesian aquifer system comprised of four major components. The deepest of these water producing formations is the Catahoula. Above that is the Jasper Aquifer, followed by the Evangeline Aquifer, and topped by the Chicot Aquifer.

According to the Texas Water Development Board, years of heavy pumpage in portions of the aquifer have resulted in areas of significant water level decline. Declines of 200 to 300 feet have been measured in some areas of eastern and southeastern Harris and northern Galveston County. Although there is some continued decline in the Galveston area, conversion to surface water and a reduction in groundwater usage has slowed the rate of decline, and has actually allowed some recharge of the aquifer in at least one location.

