

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

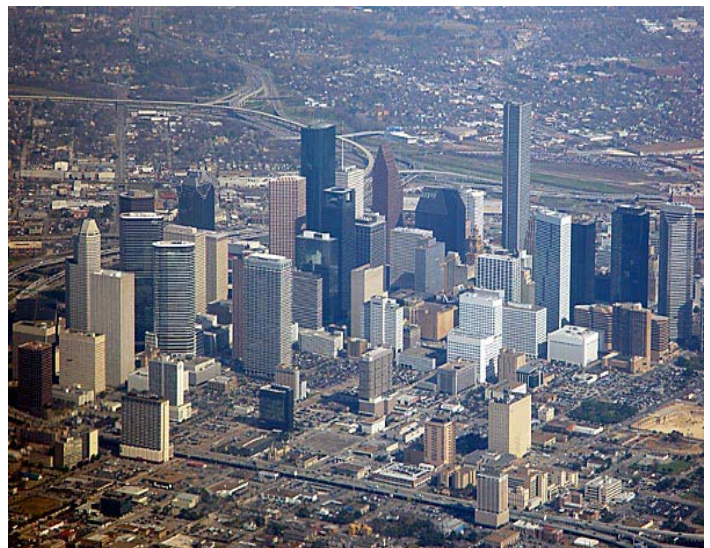


**Sub-si-dence** – the sinking down of land resulting from natural shifts or human activity, frequently causing structural damage to buildings.

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.

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.



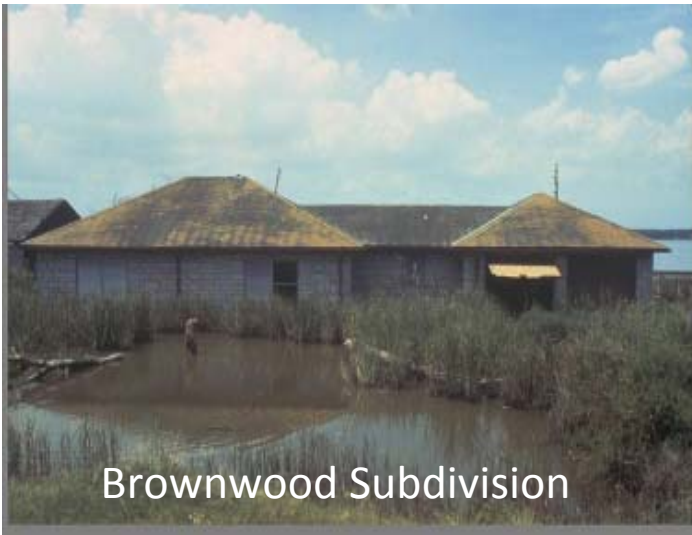
## ***That "sinking" feeling...***

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.)

*Continued next page*



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



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.



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

### **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 Harris-Galveston Coastal Subsidence District “for the purpose of ending subsidence which contributes to, or precipitates, flooding, inundation, and overflow of any area within the District...” This unique District 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, and the Fort Bend Subsidence District was created in 1989 to accomplish the same reduction of reliance on groundwater.

Surface water is managed at the state level; groundwater in the state of Texas is managed by local Groundwater Conservation Districts — over 95 of which have been created, that cover more than 150 counties across the state. The Lone Star Groundwater Conservation District was created by the 77th legislature in 2001 to protect and manage the groundwater resources of Montgomery County. As with the other Districts, Lone Star (LSGCD) works to maintain a balance between protecting the rights of private landowners and our responsibility to protect groundwater. The District focuses on preventing waste, collecting data, educating the public about water conservation and preventing irreparable harm to the aquifer.

Montgomery County faces similar groundwater withdrawal problems. Quite simply, we’re pumping groundwater faster than the aquifers can recharge. According to Kathy Turner Jones, general manager of LSGCD, “Virtually all of our current water supply is provided by groundwater. In 2009, the permitted demand in the county was 87,000 acre feet per year, exceeding the sustainable recharge rate by 50%. By 2040 the total water demand is expected to be 154,000 acre feet. What this means,” she continued, “is that in 2040, we will be exceeding the

sustainable recharge rate of the aquifer by almost 90,000 acre-feet per year!”

Over the years, there have been adequate supplies of groundwater to fuel and sustain significant economic growth and development in Montgomery County. In just the last decade, the County’s population had already experienced a staggering 52 percent increase, making it one of the fastest growing counties in the U. S. Obviously, more people mean increasing demand for water...at least that has always been true in the past. Since the early 1990’s however, some parts of the state have learned that by aggressively taking some common-sense measures to use water more efficiently, they were actually able to keep the level of demand relatively constant even though the population continued to increase.

“Obviously, it is necessary to reduce our reliance on groundwater, so the District sought the most fair and equitable regulatory process to accomplish this. As of January 1, 2016, groundwater withdrawals must be reduced,” Turner said, “and alternative sources of water will be required. This applies county-wide to all industrial, commercial and public water suppliers.”

“One of our major tasks,” Turner said, “is to communicate with area residents about the critical need for this transition, and to solicit everyone’s help in achieving a consensus that using our finite water resources more efficiently is absolutely necessary if we are to have an adequate future supply of water.”

For additional information about subsidence and the LSGCD groundwater reduction mandates, please visit [www.lonestargcd.org](http://www.lonestargcd.org).



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 is the largest municipal user (1997, Water For Texas). 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.

This aquifer recharge and reduction in subsidence is the objective of the Lone Star Groundwater Conservation District’s Regulatory Plan that mandates the conversion to surface water. 💧