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Sinking , $$$$ into Sinking Land

By Lee Pilgrim, Editor, Texas Water Resources
Subsidence was a relatively unknown, unnoticed ecological condition until it recently took on a new spelling: ubidence.

An economic report, revealing that subsidence had cost the Houston-Pasadena area $113 million in damage and property losses, gave definition and dimension to the semi-ignored phenomenon. Subsidence is the sinking of coastal land surface due to withdrawal of underground water.

In 1972 an Associated Press column by Paul Recer capsuled the condition in prose that evoked emotional response, but failed to carry an economic thrust. It follows:

"Inch by inch, like a leaky balloon slowly collapsing, the ground in Houston and the area surrounding Galveston Bay is sinking. And as it does, bay waters rush in to claim acreage once high and dry. The word for the phenomenon is 'subsidence' and the result of it is expensive and even disastrous. Streets are being slowly flooded, homes are being cut off, trees die in salt water, docks and levees must be raised and park lands turn into lakes.

"The cause is well known. Industries, cities and individuals are using too much water from the wrong place. But only in recent years have residents begun to notice that as the water use increases, so does the subsidence. On the average now, about 600 million gallons per day are pumped out of the Beaumont Clays. Over half of it is pumped out by municipalities, principally, Houston. Most of the rest of the pumping is by industry, especially the huge paper and petrochemical complex along the Houston Ship Channel.

"Even if the pumping was stopped today, the subsidence might continue for months or perhaps years because it could take that long for subsurface pressure to become balanced again. Until then, a little more of Texas is disappearing every day beneath the relentless attack of invading sea water."

The economic report--results of which were published on page one of the Houston Post in October--was a study titled "Costs of Land Subsidence Due to Groundwater Withdrawal" conducted by an economic research team for the Texas Water Resources Institute, Texas A&M University.

The Gulf Coast Aquifer underlies the Houston-Galveston-Gulf Coast complex, where tremendous withdrawals of groundwater are necessary for municipal, industrial, and irrigation purposes. When water is withdrawn from the sands, hydrostatic pressure in the sands is reduced, causing water to move from the clays and silts. The earth becomes compacted, reducing its volume, and land subsidence results. R. K. Gabrysch of U.S. Geological Survey in Houston says most of the compaction is permanent because the clays are mostly inelastic. Less than 10 percent rebound can be expected to result from total recovery of artesian pressure.

Keeps Sinking

Underground water pumpage in the ever-booming Houston area has now reached more than 595 million gallons daily, half of it going for industrial uses. Gabrysch says that as the water pressure drops, so does the land. In the past 30 years the Houston Ship Channel area has sunk by as much as 7.5 feet. The San Jacinto Monument is now 6.5 feet lower than 30 years ago, a drop of 3.5 occurring from the past 10 years. During that 30 year period, Texas City, Webster, and downtown Houston have experienced a drop of 4 feet; Pasadena, 7 feet; Baytown, 5.5 feet; and other coastal towns, 3 feet and up.

Translating the subsidence rate into dollars was the mission of the Texas A&M research team. Three hundred square miles of the affected 3,000 square mile area were analyzed in the study, covering residential, commercial, public, and industrial areas. Little evidence was found that subsidence causes direct damage such as structural faulting. In almost all cases, damages and property losses resulted from either tidal or freshwater flooding-the greatest damages caused by tidal flooding. It was estimated that the six-foot tide that occurred with tropical storm Delia in 1973 caused subsidence-related property damages and losses of over $53 million. Projections indicated that a similar tide--and such can be expected about every five years--could cause $54.4 million in damages and losses if the land sinks two more feet and $63.5 million if it drops five feet.

Gone With the Flood

What are some of the property damages and losses?

A visit to Baytown's once-beautiful Brownwood residential area, located on a lush peninsula, gives a stark answer. Of the 435 homes, priced between $25,000 and $75,000 when built, twenty have been abandoned; 60 percent have become rental property; and the rest are a source of constant care and cost to the owners. No longer do the proud old oak trees and exotic tropical plants on acre and half-acre lawns catch the eye of the passerby. Instead, concrete riprap-and-earthen levees, private bulkheads stacked three deep, and abandoned boat houses are familiar sights in this prime property area.

Vegetation is dead or dying. Money spent on the property is aimed at survival, not beauty. The encroachment of bay water has brought death to a community. Mrs. Jean Shepherd, Brownwood Civic Association president, says, "Property owners are financially chained to sinking real estate."

Ruinous effects are not confined to bayfront home owners' property. In Kemah and Seabrook costly steps have been taken by business people to drain off flood water or to stay dry. One store owner spends $5,000 a year on dirt and fill materials. In Clear Lake, only the roofs of 10-foot high picnic shelters in the park are visible. Bulkheads around boat berths at a marina and at a seafront apartment have been raised several times. Some perimeter roads at San Jacinto Monument are often underwater, and the reflection pool sometimes resembles an ancient ruin.

To cope with flooding there must be continuous effort to raise roads, repair damages, and construct dikes and drainage facilities. Local tax money, private capital, and funds from organizations like the Brownwood Civic Association are plowed into repair work and preventive maintenance.

Water, Salt Water, Everywhere

A perimeter road built in Baytown in 1973 was supposed to turn back 7-foot tides; however, many homes are inundated at 3.5 feet and others at 4 and 5 feet. Once the tide sweeps over, electric pumps must be used to rid the area of the destructive water. Brownwood Civic Association paid $35,000 for five pumps for general use, and many home owners have their own $3500 pumps.

Freshwater damages are minor compared to the effects of tidal flooding. Changes in surface slopes introduce or aggravate drainage problems in streams, canals and watersheds during heavy rains. In some cases, lift pumps have been installed to cope with destruction of old sewer lines.

A few cases of damage to structures such as well casings and pipe lines-also some surface faulting-are caused by subsidence, the study indicated.

Professor Lonnie L. Jones, head of the research team, told a Water for Texas Conference in October, 1974, that the annual withdrawal rate of 118 billion gallons per year is increasing. He said a switch to surface water will be economically justified, even with the large difference in direct costs because of the large indirect cost caused by land subsidence.

For example, if all the 1972 water needs for the area under study had been pumped from groundwater sources, the total cost would have been about $20.5 million, counting direct pumping and subsidence-related costs. In contrast, if all water had been purchased from surface sources, total costs would have been about $18.9 million. This represents a saving of about $1.6 million to the area.

"Substitution of surface water for groundwater would result in higher direct costs to users, and at least initially, some form of inducement might be needed to encourage consumption of surface water," Jones stated, adding that "equitable distribution of increased costs is a problem that will demand the attention of legal and social planners."

Up or Down: Which Way to Go?

The rate of underground water pumping keeps going up. Land surface inches down. Which direction for the people: UP or DOWN?

At present, there seem to be no up-or-down directions--no black-and-white guidelines--for decision makers involved in the ruinous subsidence issue in the Houston-Galveston area. There is indeed one direction: To convert from underground water to surface water to supply that thirsty giant its 118 billion gallons of water per year.

The big problem is money. To import surface water would cost about 16 cents per 1,000 gallons undergound water is costing now, according to Dr. Jones. Furthermore, there are the initial costs of hooking on to surface water sources.

As a result, municipalities and industries are, for the most part, holding off. No community or municipality wants to take the plunge while its neighbors continue to use groundwater.

"There is no one trying to pull this whole thing together," Mayor Gene Smith of Nassau Bay recently told the Houston Post. He named several neighboring municipalities that have made no steps toward conversion. Nassau Bay recently agreed to a 20 year contract for surface water--over Smith's objection.

Texas City faces a deadline decision on a proposal which Mayor Emmett Lowry says "will cost the water users of Texas City a lot of money."

Even so, Lowry isn't certain that it is the use of groundwater by Texas City users that has caused that city to drop 4 feet in the past 30 years. "It's been my contention that our friends to the north and west of us are pumping out the water from the same sands before it gets to us and are really causing the subsidence."

That is a good example of the myriad unknown factors that confront the Gulf Coast planners and block their decision to pay the price.

While most community leaders are looking at the hard realities and considering concrete approaches, they allow themselves to dream of an equitable solution embracing the whole area. Something like effective legislation.