



Geologists warn Houston's sinking

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HOUSTON — Despite decades of plugging water wells to keep land from sinking here, the Texas coast is still subsiding, scientists said Saturday, because of unseen geological forces that can't be controlled and aren't being measured.

The results, said Roy Dokka, a Louisiana State University engineering geologist, have rendered flood plain maps out of date and storm surge models inaccurate.

In other words, the most flood-prone state in the nation is more susceptible than ever to unpredictable torrents. And the problem stretches miles inland, via overflowing rivers and heavy rains.

Parts of Houston are sinking a half-inch annually, according to some estimates. It doesn't seem like a lot in laymen's terms, but in the muddy world of continental drift, plate tectonics and geologic time, it's a country mile.

No one knows how bad the problem is now, or how bad it's going to get. The system for measuring land elevation is out of date in many places, because some of the markers are themselves sinking with terra firma.

"Until you've got (a benchmark) to hang everything from," said geologist Art Berman, "you're just playing games."

The Gulf Coast Basin is one of the most dynamic geologic regions in the world, said Dokka, who heads LSU's Center for Geoinformatics, and that means the ground below Houston and the Gulf Coast is still moving, taking everything with it toward the sea.

"If you think that geological processes that created the Gulf of Mexico stopped at the beginning of the 20th century," he told the Association of Environmental and Engineering Geologists on Saturday, "then God help you."

Subsidence plagues the entire Gulf Coast, experts say, but it's acute where there's more development, in cities such as New Orleans and Houston.

Large parts of the Bayou City have been sinking for decades and officials have spent billions to address it. In 1975, the state created the Harris-Galveston Coastal Subsidence District, which stopped much of the sinking by limiting the groundwater pumping that caused it.

But decades of human-induced subsidence and eons of natural subsidence have left scars all over Harris County. There are parts of town that are 10 feet lower now than they were 50 years ago.

Baytown's Brownwood subdivision, along the Houston Ship Channel on the county's east side, began sinking into the mud shortly after it opened in 1956.

Built in an area that had always been immune from floods, storm surge unexpectedly struck the area in 1961. After that, floods continued and got worse with each major storm. Officials installed pumps and built levees to protect the 450-acre neighborhood but couldn't keep it dry.

Hurricane Alicia finished Brownwood off in 1983. The neighborhood was condemned, all homes were razed and the site is now the Baytown Nature Center.

Fractured and falling

On the county's west side, the Long Point fault runs parallel to Interstate 10, through the Spring Branch area, and has altered the face of that neighborhood.

In 30 years, it has buckled streets and foundations along its 3-mile-long, S-shaped path. Driveways twist, detached garages tower over homes, and backyards have turned into hillsides. On Moorhead Street, the fault has created an abrupt 3-foot drop-off in the pavement, as if the street were built to accommodate skateboarders.

Even with pumping limits, there will be more neighborhoods like Spring Branch and Brownwood, Berman said, because Harris County is collapsing into the earth and there's nothing that can be done to stop it.

The Gulf Coast Basin was created when continents drifted apart millions of years ago. The geological formation includes the Gulf of Mexico and encompasses parts of every Gulf Coast state and northern Mexico.

In Texas, Berman said, it extends about 200 miles inland, reaching the outskirts of the Hill Country.

As seawater evaporated and created dry land, Berman said, large layers of salt were left in its wake. The natural flow of sediment began accumulating on top of that, creating the topography that exists today.

The salt layer is soft, said Berman, who likened it to toothpaste. Layers of sediment cause the salt to move. Sometimes, that creates cracks, or faults. In other places, salt is pushed to the surface, creating salt domes, which are unstable formations like faults.

The Houston area is dotted with salt domes and faults, creating an ever-changing topography and situations such as the Moorhead Street skateboard ramps.

Although rock movement is slow, the results can be seen in a single generation. Two adjacent neighborhoods, for example, could avoid flooding for decades. But if one of them sinks even slightly, it could become inundated during rain, catching and holding the runoff from the other.

Reliable markers?

Much of the uncertainty, said Gary Jeffress, is because the state's height measurement system — which determines land elevation relative to the ocean — hasn't been maintained for decades.

"The state of topographical mapping in the United States is pretty abysmal," Jeffress said.

The National Spatial Reference System is a web of calibrated markers that stretches across the country to keep track of latitude, longitude, height, scale, gravity and orientation. Elevation is determined by measuring one marker's relationship to another.

The markers, also called monuments, are stainless steel poles driven 50 feet into the ground, or until they hit bedrock, by gas-powered hammers, said Jeffress, whose lab at Texas A&M-Corpus Christi maintains 30 offshore gauges that measure the tides on the Texas coast.

Comparing the water level to the land level paints a picture of what areas are prone to flood and which areas will stay dry, he said.

"It's not sexy," said Jeffress, a geographic information science professor," but it's very important."

Texas leads the nation in almost all flood-related categories: 612 flood deaths since 1960 and \$2.2 billion in flood insurance losses since 1978.

The tidal gauges tell Jeffress the ocean is rising at 6.6 millimeters per year in Galveston, or 2.13 feet in the past century. It's important information, but it's almost meaningless in terms of flood control, he said, because the land monuments aren't reliable.

Many of them are in areas that have subsided but haven't been recalibrated, Jeffress said. About 20 percent can't be found or can't be used.

The Texas Spatial Reference Center at A&M-Corpus Christi was created with a \$750,000 federal grant and charged with creation of a height modernization program, but that's only a fraction of the \$2,000 per mile it will take to do the job, Jeffress said.

He said \$40 million over 10 years could bankroll a height modernization system, but state and federal officials haven't opted to fund it.

"We need those elevation points," Jeffress said. "Without them, we don't know how to (protect hurricane evacuation routes) or what steps to take to make sure important structures aren't flooded."

Ron Neighbors, general manager of the Harris-Galveston Coastal Subsidence District, said the situation isn't as dire as Jeffress, Dokka and Berman say it is.

"I don't think the National Geodetic Survey agrees (with their claims about the unreliability of the elevation measurement system)," Neighbors said. "I don't agree with it. We measure the change in the land elevation at the surface. We don't measure part of the subsidence. We measure whatever happens at the measuring point."

Working with the U.S. Geodetic Survey, Neighbors said, Harris County has the most high-tech and extensive elevation monitoring system in the world. The monuments are monitored for movement with precise digital equipment. If there's subsidence and the marker moves, it's noted and adjustments are made to measuring system.

Inevitable sinking

The district has convinced most of the region's cities and most of the hundreds of small utility districts in the area to stop pumping groundwater and switch to surface water. That effort, combining politics and

hydrology, has eliminated most of the subsidence caused by pumping.

Neighbors acknowledges that geological subsidence occurs, but said the impact of it won't be felt locally for centuries.

"There's very little history to go on," he said, noting that the measuring systems are less than 200 years old. "I'm not trying to oppose the point of view that the area has subsided over geological time and that it's going to continue. But we don't know what's going to happen."

But Dokka said Houston area homeowners, even without a scientific background or knowledge of geological phenomena, know something is going on under their feet.

"They're saying, 'Gee, my subdivision didn't flood before. Now it floods whenever it rains. What's going on?'"

Berman, who studies basins as an oil-field geologist, said the fate of the Gulf Basin is inevitable.

"People who aren't trained in geology don't comprehend the three-dimensional nature (of the Earth) or the fourth dimension, which is geological time."

"But this is a basin," he said, "and by definition, a basin is a place that's subsiding."

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