SUBSIDENCE IN THE HOUSTON REGION

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Subsidence District Mission

• The Subsidence District was created to prevent land subsidence in Harris and Galveston counties through the management of groundwater.
• Land subsidence contributes to flooding threatening the economic health of the area.
• Efforts to prevent subsidence by the District and the regulated community create a more resilient infrastructure to mitigate flooding while securing reliable water sources for future needs.
Subsidence

- Subsidence is the lowering of the elevation of land surface over time.
- In the Gulf Coast, aquifer clay and silt compaction resulting from groundwater withdrawal is the primary cause for land surface subsidence.
- Subsidence can have a wide range of consequences depending on the location of the occurrence and its proximity to surface drainage and coastal zones.
Estimated Total Subsidence 1906-2016

- Total subsidence over the period of development has been estimated based on traditional benchmark surveying from 1906-2000 and the calculated subsidence rates from measured GPS vertical movement data from sites active in 2016 with more than three years of vertical movement data.

- The largest magnitude of historical subsidence has occurred in the ship channel area of Eastern Harris County.
Texas Gulf Coast Groundwater and Land Subsidence
Over Forty Years of Research in the Houston-Galveston Region

In cooperation with Harris-Galveston Subsidence District, the City of Houston, Fort Bend County Subsidence District, Lone Star Groundwater Conservation District, and Brazoria County Groundwater Conservation District, the U.S. Geological Survey Texas Water Science Center Gulf Coast Program collects, processes, and interprets groundwater-level and aquifer-sediment-compaction data to understand the effects of groundwater withdrawal on land subsidence in the Houston-Galveston region, Texas.

Land Subsidence

Land subsidence is the gradual lowering of land-surface elevation. In the Houston-Galveston region, land subsidence is caused by compaction of fine-grained aquifer sediments (silt and clays) below the land surface due to groundwater withdrawals. Removing water from fine-grained aquifer sediments compresses the aquifer leaving less pore space available to store water resulting in the lowering (sinking or settling) of the land-surface. Most compaction that occurs as a result of groundwater withdrawals is irreversible; even if groundwater levels rise, compacted sediments and the associated land-surface lowering would remain as-is.

Consequences of land subsidence in the Houston-Galveston Region

- Reduces the ability to store water in an aquifer.
- Partially or completely submerges land.
- Collapses water well casings.
- Disrupts collector drains and irrigation ditches.
HGSD Subsidence Monitoring Station

• HGSD operated stations exist within and around the District.
• The District operates over 100 stations in cooperation with numerous agencies.
• Collaboration with the University of Houston - HoustonNet expands network to over 225 stations throughout the Texas Gulf Coast Region.
• USGS Operates Extensometers at 12 locations.
Annual subsidence rate, in centimeters per year (cm/yr.), estimated from three or more years of periodic or continuous GPS data measured at GPS monitoring sites in Harris and Surrounding Counties, Texas, 2015-2019.
GPS monitoring site P013, located in The Woodlands, has measured 26.7 cm of subsidence since 2000.
Current Activities and Projects

• **Joint District Regulatory Plan Review** - In Progress
  • Update the Regulatory Plan to account for future water needs and subsidence risk
  • Address specific policy questions regarding the regulatory plan and rules
  • Joint effort between the two Subsidence Districts
  • Collaboration with the Texas Water Development Board
  • Stakeholder input
  • Expected completion Fall 2023

• **Research and Monitoring Programs**
Joint Regulatory Plan Review

• Development of 2020 to 2100 Projected Water Needs
• Alternative Water Supply Availability
• Model Assessment and Update
• Conversion Scenario Development
• Project Coordination

https://hgsubsidence.org/planning/regulatory-plan-review/
Recent and Upcoming District Science and Research

- Determination of Subsidence Risk from Brackish Groundwater Development
- Determination of the Subsidence Neutral Yield of Aquifer Storage and Recovery
- Annual Subsidence Measurement – Regional Network
- Retrospective Interferometric Synthetic Aperture Radar Regional Subsidence Analysis
- Evaluation of subsidence impacts on flooding in Spring Creek Watershed
InSAR Research in the Houston Region

• In 2020, the HGSD and FBSD sponsored research at Southern Methodist University to utilize satellite technology to monitor land surface deformation across Harris, Galveston, Fort Bend and the surrounding counties.

• This new project was spawned from their research that was published 2019.

• The project is expected to be completed in 2021, preliminary results confirm the data recorded at PAM 13 and the impact of source water management on subsidence in the region.
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Spring Creek Subsidence Study

• The HGSD is working collaboratively with the Harris County Flood Control District to better understand the impact of subsidence on the watershed scale.

• This study will utilize measured subsidence rate data from within the watershed to develop scenarios that will be run through the latest H&H models of Spring Creek.

• Several scenarios will be run through the model to evaluate the impact of surface deformation on flooding.

• Results are planned to be evaluated for flood inundation, known fault movement, infrastructure and economic impact.

• Project is expected to begin in January of 2021 with a completion during the first half of 2022.

• This project is funded entirely by the HGSD.