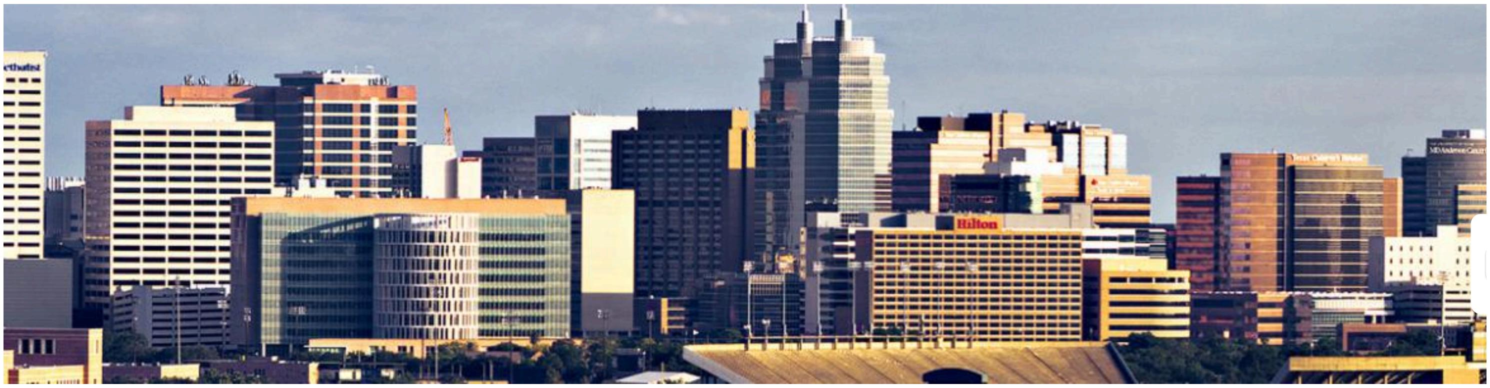

After Record-Breaking Rains, a Major Medical Center's Hazard Mitigation Plan Improves Resilience

Widespread damage from flooding at the Texas Medical Center in Houston revealed the complex's vulnerabilities. Implementing a long-term hazard mitigation plan is reducing future risks.

Climate stressors and impacts

Climate scientists predict that climate change will significantly affect rainfall patterns in the United States. They note that the frequency of heavy downpours has already increased, resulting in an increased risk of flooding in some areas. Such flooding is a great risk to medical facilities: in 2001, downtown Houston, Texas, faced an historic 1,000-year flood as a result of Tropical Storm Allison. Though the city is more than 80 miles inland, Allison hovered over the region for days, dumping more than three feet of rain on the Houston metro area. Allison left 22 dead and caused almost $5 billion in damage to Harris County alone.

The flooding caused by Allison virtually shut down the 700-acre Texas Medical Center complex, the largest aggregated medical campus in the United States. Flood waters crippled the infrastructure of the Center, which at the time included 13 hospitals, two specialty institutions, two medical schools, four nursing schools, and other schools for various health-related professions. The Center's emergency generators, electrical switchgear, and boiler and chiller plants all sustained water damage. Worse still, about 30,000 research animals housed in the basement of Baylor College of Medicine drowned. Altogether, the loss of lab animals, computer data, records, and tissue samples meant that medical researchers saw years of their work destroyed.

Planning ahead and engaging others

In the aftermath of the flooding, the Texas Medical Center organization, which acts as a sort of "city government" for the institutions that make up Texas Medical Center, realized that the Center's infrastructure needed a major overhaul in order to withstand future floods. As a result, all of the Center's institutions relocated their critical infrastructure and program areas above projected flood elevations, a process that took years to complete.

To accompany this infrastructure upgrade, the Texas Medical Center organization also developed a long-term hazard mitigation plan. The plan, which is still being implemented, incorporates 42 proactive, sustainable design measures to reduce the impact of future extreme weather events. In designing this plan, Texas Medical Center consulted with hydrology experts, officials from the city of Houston, the Federal Emergency Management Agency (FEMA), the Harris County Flood Control District, the Harris County Subsidence District, Reliant Energy, Southwestern Bell, and others. To be effective, the organization realized that the plan would require the engagement of a broad range of stakeholders.

Powering resilience

Immediately after the storm, many systems were non-operational: electrical power; emergency electrical power; heating, ventilation, and air conditioning (HVAC); laboratory and fume hood exhaust systems; domestic cold and hot water; compressed air and vacuum systems; fire detection and suppression systems; and basement sanitary and storm sewer systems all failed. Such systemic failure was possible because the interconnected basements linking the Center's more than 100 buildings contained vital systems, such as the incoming service from Houston Light and Power (5kV), as well as several unit substations. Motor control centers, distribution panels, and transformers had also been installed in basements, where they were extremely vulnerable to flooding. Although many of the basement tunnels had been equipped with flood control devices after a storm in the 1960s, no one remembered that the devices existed, given the time that had elapsed between events.

To avoid a repeat of the Allison disaster, a new 48-megawatt combined heat and power utility plant (managed by an independent medical campus power company) was placed above anticipated flood elevation on the central campus. Because severe flooding poses a much greater threat to the Texas Medical Center than does wind, power service is delivered via an elevated utility raceway that also serves as a pedestrian walkway. The plant eliminates dependence on the Houston utility grid for power during both normal and emergency operations, and reduces carbon emissions by bringing electrical generation on-site.

Reducing subsidence

Texas Medical Center has also installed a solar-powered system to monitor subsidence in the area. Subsidence, or the sinking of land, can occur when more water is withdrawn from the ground than is replaced through absorption of rainwater. The extent of impermeable surfaces such as streets and parking lots is one factor that can prevent water from being absorbed back into the ground. Since 1976, the Center has subsided more than three and a half feet. To keep new buildings at elevations high enough to be safe from future flooding, architects and planners must take this process into account.

Restoring or improving an area's ability to absorb water may reduce subsidence. Thus, Texas Medical Center ha implemented a stormwater management plan that increases green space and improves water absorption through advanced landscaping techniques and permeable paving systems. Every new development on campus, as well as improvement projects that involve streets and sidewalks, must follow stormwater management guidelines. Designs based on these guidelines will improve absorption by integrating landscape features and water drainage across the campus.

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Steps to Resilience

This content supports the highlighted step.

- (tarted
- U rstand Exposure
- A s Vulnerability & Risk
- I tigate Options
- F tize & Plan
- 1 Action

Hazards

Flooding – Rainfall-induced ›

Assets

Critical Facilities ›

Tools

Sustainable and Climate-Resilient Health Care Facilities Toolkit ›

Partners

Texas Medical Center ›

Federal Emergency Management Agency ›