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# Rebuilding After Harvey: How the Flood Overtook Houston

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(AP Photo/David J. Phillip August 29, 2017 Houston)

Interstate Highway 10 runs from Los Angeles, CA to Tallahassee, FL. In the middle, it dips southward across the lower states and right through the middle of Houston, TX, running parallel to Buffalo Bayou.

On August 30, 2017, the only identification that a roadway was anywhere near was the signage visible just above the floodwater that covered the area. There is no image that better illustrates the inundation and flooding Houston suffered when Hurricane Harvey came ashore on August 25.

An estimated 20 trillion gallons of water came down across the area over the days Harvey remained. At Cedar Bayou, TX, 30 miles east of Houston, a record 51.88 inches of rain fell. Realistically, there is no way the area could have avoided the flood. However, it is possible it did not have to be so catastrophic.

## **Rapid Population Growth and Development**

Houston has become home to over 2.3 million people, over 600,000 of whom have become residents between 1990 and 2017. Houston was built on the coastal plains, concrete replacing the prairie pothole pimple-mound complexes that were capable of detaining an enormous amount of water.

In fact, between 1992 and 2010, Harris County (in which Houston lies) lost around 7,000 acre-feet<sup>1</sup> of wetlands. Just they could have provided 2.3 billion gallons of storm water detention, in addition to that of the native soils. Runoff was a major cause of the flooding Houston experienced. The amount of concrete and other surfaces impervious to water has increased by 25% in the past 15 years .

## **Overwhelmed Water Management Systems**

Houston is home to a broad network of bayous, slow-moving streams of water that eventually flows into Galveston Bay. Many of the bayous were widened and lined with concrete decades ago. The city also has two large federally-owned reservoirs that were created to alleviate flooding.

Unfortunately, the current system is unable to handle the high volume of runoff from the additional roof tops, parking lots, and roadways that have been built during the intervening years. Projects to widen the bayous and build thousands of retention ponds to hold excess water have not kept pace with the development.

Houston also developed a drainage system consisting of concrete channels, some of which were roads and streets built below grade. They were designed to take on excess water when the storm drains overflowed. An unintended consequence of this design is that when deep flooding occurred in these areas, it trapped people in their homes; there was no way to leave because their street was now underwater.

### **Lax Regulations**

The Houston metro area is not without building codes and regulations. Each of the 34 municipalities within Harris County has its own plan for addressing flooding. The lack of coordination between the municipalities and the absence of a comprehensive plan for the entire area is a problem.

Most codes require developers to offset wetlands they destroy with remedies like detention ponds. The Houston Chronicle analyzed a sampling of building permits issued by the US Army Corps of Engineers: Over half of them were out of compliance with this code.

### **The Damage**

By the latest estimates, over 136,000 structures were damaged or destroyed either during the hurricane or in the flooding that followed. Over \$36 billion will be required to rebuild.

Older homes and buildings were built on flat slabs nearly level with the surrounding ground. When the water overflowed the streets that were designed to hold it, the water entered the homes. Thousands of dollars of damage is done by an inch or two of water. Many single-story homes were flooded to their roofs. Newer homes were required to be built at least one foot above the level of a 100-year storm, which helped in the areas the flooding was minor.

A single inch of flood water ruins carpets, wood and vinyl floors, furniture, drywall, and insulation. After the waters recede or are removed, mold will grow in the damp materials, requiring complete removal and replacement to mitigate the health threat. Besides all that, chemicals, bacteria, and other toxic elements also flow in with the flood waters.

### **Moving Forward**

Certainly, some of the existing flood-mitigation measures kept some property from damage. However, more can be done to provide a higher level of safety and reduce property loss in future floods:

- “Sponge” concrete is capable of absorbing water rather than allowing it to run off.
- Compliance enforcement can ensure retention and detention ponds are built when required.
- Recovering open ground and wetlands will hold water and add it to the existing water table.

Future plans should include an analysis of where excess water would drain, particularly if a developer proposes to elevate structures by adding layers of soil beneath. Where will the water flow from there? Are there nearby homes that would be in danger of flooding that would not have been before the creation of the mound?

Future posts will take up the challenges of finding labor and materials in an already depleted market, a deeper look at safety concerns within a flood zone, and an analysis of what we have learned from Hurricane Harvey and previous disastrous storms such as Katrina, Rita, and Sandy.

<sup>1</sup>Houston-Area Freshwater Wetland Loss, 1992-2010, TAMU-SG-14-303 by Jacob, John s, et al. 2014.

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