

Harris County and the City of Houston

Flood History and Policy

The City of Houston was founded in 1836 on the banks of Buffalo Bayou, a water route to the Gulf of Mexico. Houston became a major outlet for agricultural and petroleum products after the Houston Ship Channel was built in 1915 by the U.S. Army Corps of Engineers (USACE). Destructive flooding had been reported as early as 1843, but was not considered a large problem because of the low population density of Houston and Harris County before the 1950's.

The Brays Bayou watershed as one of the highly urbanized watersheds in Houston drains approximately 128 sq. mi. towards the Ship Channel, and is home to approximately 700,000 people. It is located in southwest Harris County and runs through Houston, Missouri City, Stafford, Bellaire, West University, and Southside Place. Brays Bayou flows eastward for 31 miles. Its headwaters lie in Fort Bend County, from where it flows into the Houston Ship Channel. Significant organizations within Brays Bayou include Texas Medical Center, the Houston Zoo, Houston Baptist University, Rice University, and the intensely developed commercial corridor along the Loop 610 and the U.S. 59 interchange.

Flooding

The bayous within Harris County exist as alternatives to groundwater absorption. The coastal recharge areas in Texas are structured such that rainwater is introduced slowly into the aquifer systems. Unless the rain falls directly upon the recharge area of an aquifer, the storage capacity of the soil eventually becomes exhausted, and the water added by the storm can no longer be absorbed by the ground surface. The runoff is then diverted to the bayou system or a reservoir.

The size of Harris County streams and bayous are primarily influenced by the size of the area into which they flow and the ability of the land surface to absorb the precipitation that it receives. Flooding in urban watersheds is primarily due to the unintended alteration of the natural hydrologic system by rapid, large-scale urban development. When urbanization renders soil impervious, the net result severely limits the storage capacity of the soil. Furthermore, the volume of water stored in the drainage channels accumulates more quickly; yet, the same volume of water must drain out of the system. In an altered urban system, this accumulation effect will happen in a matter of hours instead of days or weeks. Due to this quick response, watersheds become more susceptible to flooding from relatively short, intense rainfall events rather than longer, sustained events.

The Harris County Flood Control District (HCFCD) was established in 1937. The HCFCD did not become effectual until 1939, despite several large flooding events that caused severe damage in the early 20th century. After the development of a master plan in 1939, the 13,100-acre Barker Reservoir was completed in 1945, and the 11,600-acre Addicks Reservoir was completed later that decade to serve the Buffalo Bayou watershed.

During this time, the independent drainage districts (Armand Bayou, Brays Bayou, Clear Creek, Cypress Creek, Greens Bayou, Halls Bayou, Hunting Bayou, Sims Bayou, Vogel Bayou and White Oak Bayou) of Harris County were merged under the HCFCDD so that drainage issues would be handled in the best interest of the Houston area as a whole.

Brays Bayou was channelized and concrete lined from 1955 to 1960 after a destructive flood proved that Buffalo Bayou was not the only area of concern. In 1969, the Houston Post reported that during the previous month, Brays Bayou carried three times as much water as the 1949 flood without resulting in serious damage. This led to the conclusion that the renovations made to Brays Bayou were effective and successful. After these channel improvements were made on Brays Bayou, White Oak Bayou was also lined and was the last bayou in Harris County to be completely concrete-lined.

Flood Policy: 60's, 70's and 80's

Flood control activities in Harris County in the 1960's became more complex and had further reaching effects than ever before. Harris County experienced unprecedented growth during the 1950's as Houston doubled the area within its boundaries each decade. Substantial amounts of development occurred outside the city limits during the 1960's, and the trend accelerated during the 1970's. Beginning in 1973, measures were taken to restrict development in the floodplain, which had previously gone unchecked.

In June 1976, approximately 10 inches of rain fell in a six-hour period in southern Harris County, in the Brays and Sims Bayou watersheds. Flooding and damage was extensive, but the most heavily effected area was the Texas Medical Center, where damages exceeded \$20 million. Rice University, the University of Houston, and the Museum of Fine Arts suffered over one million dollars in damage. Flooding occurred when water backed up through sewer pipes and flowed overland through homes and institutions in the lower Brays Bayou watershed. Brays Bayou never overflowed its banks, and thus the cause of the flooding was attributed to the lack of capacity in the storm sewer system to contain the flow resulting from the significant rainfall event.

This storm identified a previously unrecognized problem regarding urbanization and channelization of streams. When the \$26 million Brays Bayou channelization project was undertaken, certain assumptions were made with regard to urbanization in the watershed, and the stream was channeled to accommodate the flow predicted from a 100-year storm event. However, the urbanization that occurred exceeded the design estimates, and as of 1979, Brays Bayou could only hold a 33-year return frequency storm. This statistic for Brays Bayou continues to decrease as Houston continues to develop at unprecedented rates.

In 1980, the HCFCDD initiated a formal "no downstream impact" policy for new developments. This policy required that when a watershed is developed upstream from existing communities, the development should accommodate for rainfall runoff and return the water at previous conditions. This resulted in widespread use of onsite detention facilities in urban developments to retain storm-water from flowing

downstream and flooding other communities within the watershed. This practice was further developed in the HCFCFCD design criteria manual, adopted by Commissioners Court in 1984.

In 1985, the HCFCFCD commissioned a study to evaluate alternatives for controlling flood peak discharges along Brays Bayou. The study set forward a goal to eliminate over-bank flooding for storms up to and including the 100-year event. Pate Engineers, Inc. developed a final report which recommended the construction of four regional detention facilities (two each on the upper Brays and Sims Bayou), along with the construction of flow diversion channels to route a portion of the Keegans Bayou storm water flow into Sims Bayou. For economic and political reasons, these measures were not implemented.

Project Brays

Since the late 80's, large scale flood protection plans along Brays Bayou have been initiated by the HCFCFCD and the USACE which include plans to increase channelization and upstream detention and raise over 30 bridges. This flood protection effort is known as the **Brays Bayou Flood Damage Reduction Plan** or **Project Brays**.

The upstream study was completed in 1988. It suggested the excavation of three major storm water detention ponds upstream of the Sam Houston Tollway, which will provide approximately 8,100 acre-feet of storage on 520 acres of land. It also includes 3.7 miles of channel enlargements between Old Westheimer Road and State Highway 6.

Construction on the upstream project began in 1994, and was scheduled to be completed in 2008. The projected cost is estimated to reach \$195 million, one half of which will be reimbursed by the USACE. It will provide 100-year flood protection along Brays Bayou between the Sam Houston Tollway and Highway 6. As of July 2001, about 98% of the land had been acquired and the excavation was in progress.

The downstream study sought a more effective alternative to the diversion element that was proposed in 1985. The plan involves enlarging the channel for a 17 mile length, from the mouth of Brays Bayou at the Ship Channel to Fondren Road. All channel widenings necessitate the modification of roadway, railroad, pipeline, and utility crossings. Fourteen bridges spanning Brays Bayou will be replaced, including State Highway 288. Additional 17 bridges will be extended. It also includes a large detention pond along Willow Waterhole, a tributary of Brays Bayou, whose simulated peak flow coincides with the peak of Brays Bayou. The detention pond will hold 1,865 acre-feet. Construction on the downstream part of Brays Bayou will cost about \$242 million, providing 50-year flood protection between the Ship Channel and the West Sam Houston Tollway.

Community input played a large part in the planning stages of the project. As a result, the project will incorporate extensive aesthetic, environmental, and recreational improvements. The upstream element includes attractive detention layouts, including playing fields, trails, landscaping, and the planting of 20,000 trees and shrubs. Some detention areas will include wet bottom marshes to improve water quality and create

wetland habitats. The detention area just upstream of West Sam Houston Tollway will be a Harris County Precinct Three Park. During the planning of the downstream element, several public meetings and coordination with the Brays Bayou Citizens Advisory Committee provided a substantial voice to community concerns. In the downstream reach, the Willow Waterhole Detention Basin will also incorporate wetlands and park and recreation features.

The entire project should be completed around 2012. It will significantly reduce flood elevations along Brays Bayou, bringing the number of homes in the 100-year floodplain down from 30,000 to 1,700. The total cost is projected to be \$437 million, reducing flood damages by about \$98 million per year. This amounts to a net benefit of \$62 million per year. After the project is completed, it is estimated that typical flood depth reductions in the Texas Medical Center area will be 5.5 - 6.5 feet in a 25-year storm, and 3 - 4.5 feet in a 100-year storm.

The Aftermath of Tropical Storm Allison and Today's Flood Prevention Measures

In June 2001, Tropical Storm Allison caused extensive damage in the Texas Medical Center and along Brays Bayou. The final total rainfall at Rice University was 14.8 inches, with over 8.5 inches recorded in two hours. These rates of rainfall are some of the highest ever recorded over the Texas Medical Center. High water marks in the area indicated that Brays rose to about 4.8 feet over the top of the Harris Gully Box culverts, near bankfull conditions. Maximum flood elevations around the Texas Medical Center and Rice University indicated as much as 5 feet on Fannin and 5 feet in Rice Boulevard, north of Rice Stadium.

Highway 59, under Hazard St., collected about 300 acre-feet (almost 100 million gallons) of flood water in a short period of time. More information about Allison may be found [here](#). More intense flood protection measures have been taken in the Houston area under the direction of HCFCD and the USACE. In the Texas Medical Center alone, flood walls and gates have been installed at incredible costs to prevent the reoccurrence and extent of the flooding in 2001.

Due to the Allison storm event, the funding capabilities of the Capital Improvement Program (CIP) were greatly increased, allowing for the examination of all watersheds within the Houston area. Prevention initiatives have been taken against flooding primarily due to increased urbanization in and around Houston. In 11 of the Harris County watersheds, attempts at increasing flood capacity using storm water detention areas, rebuilding bridges, channeling, widening and deepening parts of existing channels, as well as, introducing native plants to create parks and the buyout of homes, businesses, and land within the 100-year floodplain have been made. The flood prevention measures are estimated to cost a total of \$975 million under the CIP, funded by FEMA and the USACE.