GREATER HOUSTON FLOOD MITIGATION CONSORTIUM

Briefing Document #2

How do Addicks & Barker Reservoirs work?

Addicks Dam/Reservoir and Barker Dam/Reservoir are two federal flood control projects located in western Harris County that are designed to store water during large rainfalls to reduce downstream flooding along Buffalo Bayou within the City of Houston.

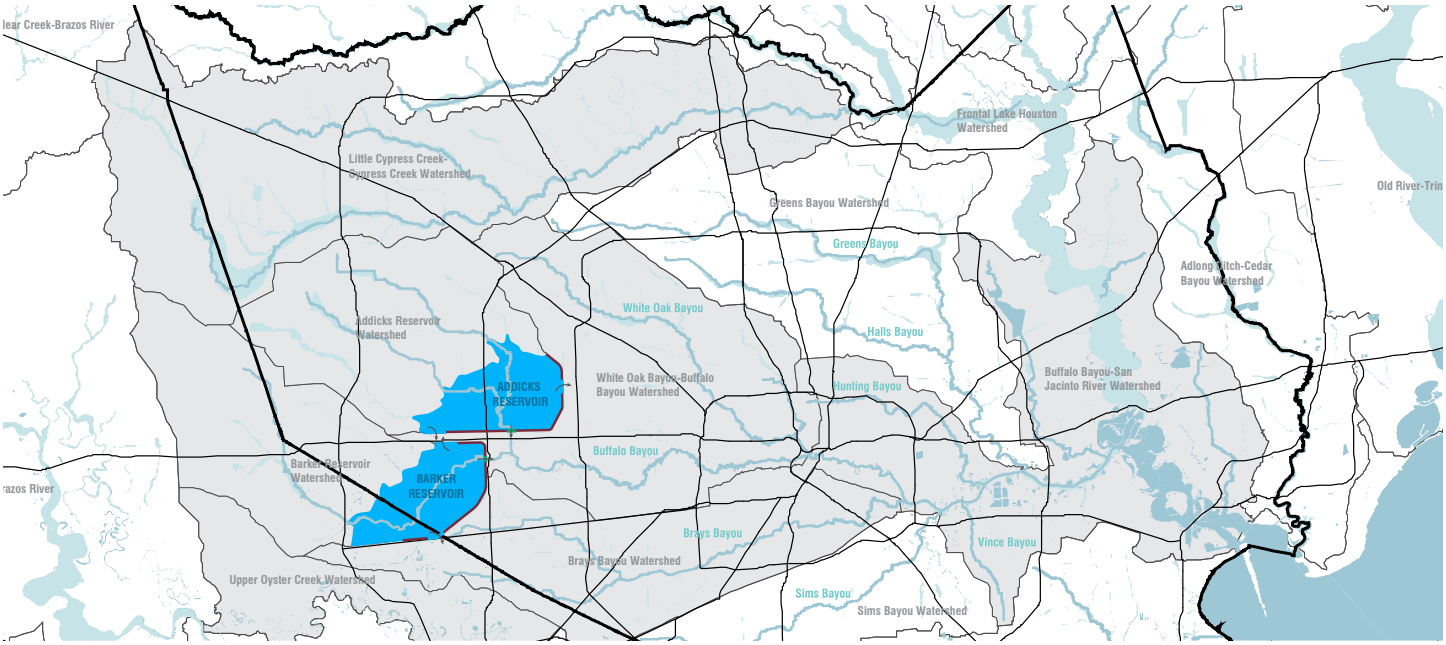

Figure 1 Watersheds impacting or impacted by Addicks and Barker (shaded in GREY)

History of Addicks and Barker

Addicks and Barker Dams were constructed between 1942 and 1948 as part of a larger U.S. Army Corps of Engineers 1940 flood protection plan for the City of Houston. At the time, around $4 million were spent on construction of these two dams, including land acquisition for the dams and for some of the land area behind the dams within the design flood pool of the reservoirs. The reservoirs were intended as part of a larger system that was never implemented:

1. A levee to prevent flood water from Cypress Creek watershed from overflowing into the Addicks Reservoir.
2. A reservoir on upper White Oak Bayou.
3. Bypass channels to direct high volumes of water being released from the dams out of Buffalo Bayou and around Houston.

The two dams were redesigned and reconstructed in the 1980s to meet updated safety criteria for federal dams.

Initially, these two dams and reservoirs were far from developed areas of Houston; however, today, development has occurred in and around both, including thousands of single-family homes built within the reservoirs' design flood pool for each dam, and within the pathway of floodwater releases from these dams along and outside the banks of Buffalo Bayou.

The reservoirs are designed to hold more rainfall than a 1% event, so land upstream of the reservoir is considered "safe" because it is protected from flooding due to rainfall in a 100-year event. Therefore, FEMA does not map these areas within the 100-year floodplain, but in an event larger than the 100-year, they will flood. Similarly, during events larger than the 1%, dam releases can occur, flooding areas downstream, along Buffalo Bayou, that are not mapped in the FEMA 100-year floodplain. This scenario occurred during Hurricane Harvey.

Benefits of Addicks and Barker Resevoirs

Addicks and Barker Reservoirs and Dams hold water during large rainfall events, reducing the flow of water into Buffalo Bayou and mitigating the risk of flooding along the bayou. This protects areas of significant economic impact in Houston, including Downtown, Memorial, River Oaks, Washington Avenue, Montrose, Fourth Ward, and the East End. Without the reservoirs, Harvey would likely have caused significantly more flooding in these areas.

Figure 2 Shows Congress and Milam intersection during a flood (1929)

Figure 3 Shows Congress and Milam intersection during Harvey (2017)

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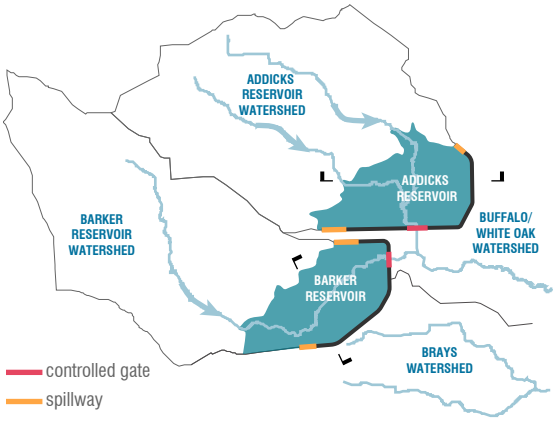
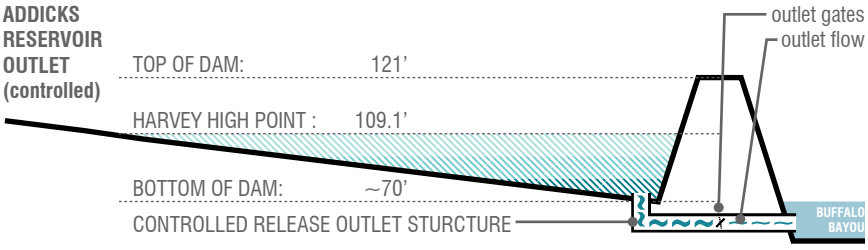
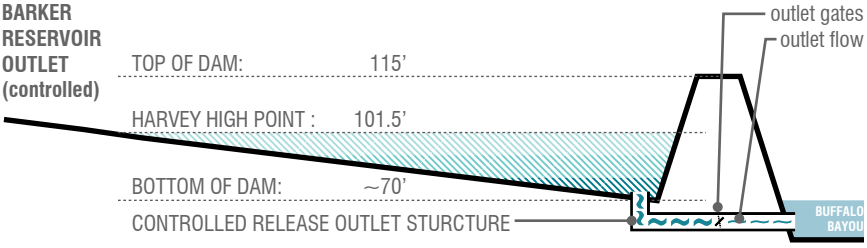
How do the dams/reservoirs work?

Addicks and Barker capture and store excess rainwater that runs off of the land upstream from the dams, creating a flood control reservoir, or pool, of water for an extended period of time until the stored water can be released through outlet pipes or conduits located at the bottom of each dam. Where Buffalo Bayou starts, both dams have **controlled outlet gates** that allow outflow to be released at a desired rate. The flood control reservoirs hold floodwater and then slowly release through gated outlet pipes. The gates at the ends of the pipes can be incrementally opened to regulate the amount of water released from these dams so as to mitigate flooding downstream. **Emergency spillways** are located at the far ends of both dams. Emergency spillways are built to allow water to flow out of reservoirs during extreme conditions in order to prevent dam failures, similar to an emergency overflow drain on a bathtub or sink. Thus, as the reservoirs start filling up, at a certain level some of the water stored behind the dams can begin to flow over the spillways. The spillways all have neighborhoods and commercial developments downstream of them. The reservoir levels have reached high enough to spill over, and it is not known what flooding might result from an overflow.

Normal Flow

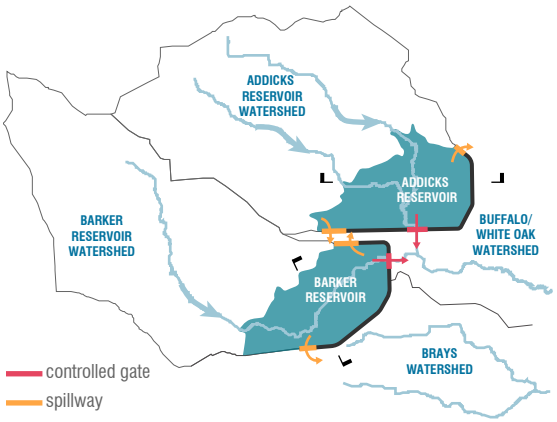


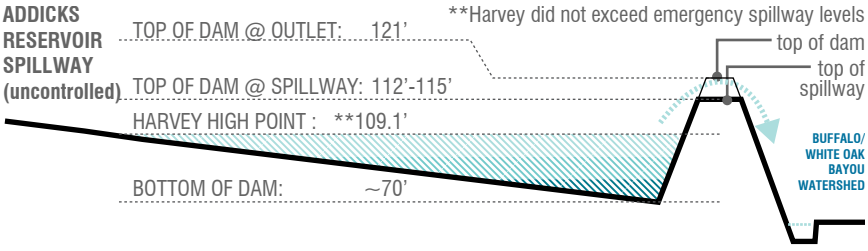


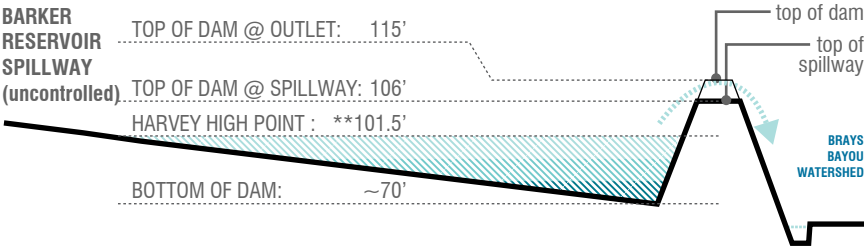


At its highest point near the outlet structure, Addicks Dam is 121 feet above mean sea level, while Barker Dam is about 115 feet. The top of the dams slope downward to a ground level approximately 70 feet above mean sea level, making the dams about 45-50 feet tall. For Addicks Dam, the spillways are at elevation 112 feet to 115 feet; for Barker, the spillways are at elevation 106 feet. Large areas behind each of the dams and within the reservoirs' footprints are inundated when the dams are filling up.

Spillway Flow







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Addicks and Barker During Harvey

Figure 4 North Addicks Before Harvey

Figure 5 North Addicks After Harvey

Upstream Flooding within the Reservoir Pool

During Harvey, unprecedented amounts of rainfall caused water levels to reach 109.1 feet above mean sea level inside Addicks Reservoir and 101.5 feet inside Barker Reservoir, both of which were record pool levels. In Addicks, the water level was high enough to flow out of the reservoir, going around the northern spillway that meets up with the natural ground at 108 feet elevation. More than 10,000 homes located inside of these two reservoirs are estimated to have experienced some level of flooding during Hurricane Harvey. As the water level in these reservoirs began to rise significantly, water was released through the gated flood control structures at the outlets of each dam.

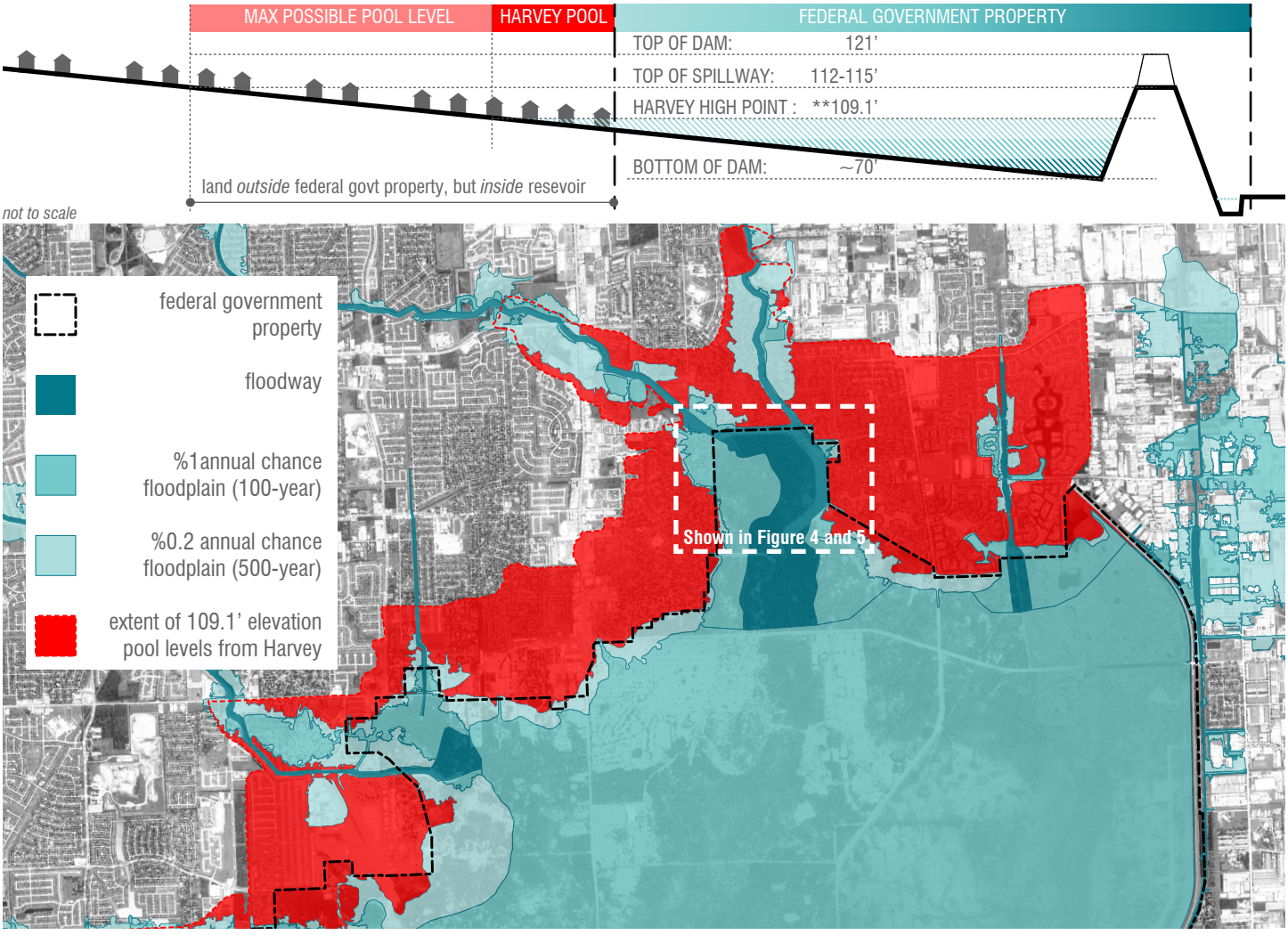

Figure 6 Diagram of 109.1' level pool in Addicks as a result of Harvey rainfall

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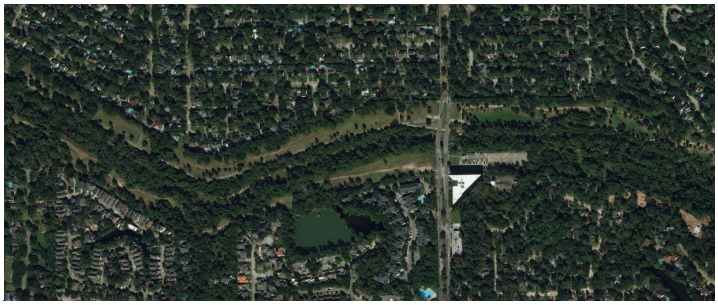

Figure 7 South Dairy Ashford Road @ Buffalo Bayou - before controlled release

Figure 8 South Dairy Ashford Road @ Buffalo Bayou - during controlled release

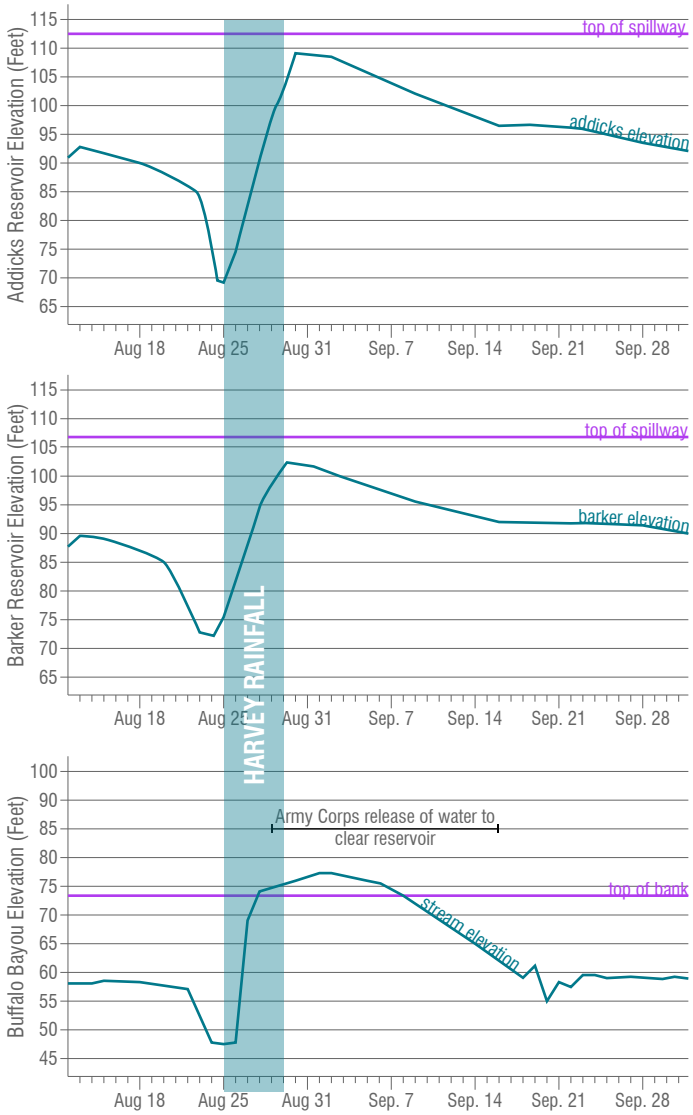

Figure 6 Stream gages 08/12/17-09/30

For more information visit

HCFCD on Flooding Impacts with the Reservoirs:
https://www.hcfcd.org/hurricane-harvey/flooding-impacts-in-connection-with-the-reservoirs/

USGS Stream Gages:
https://nwis.waterdata.usgs.gov/usa/nwis/uv/

Greater Houston Flood Mitigation Consortium:
http://houstonconsortium.com

Downstream Flooding due to Dam Releases

In order to minimize upstream flooding, risks of spillway overflows from the reservoirs, and the risk of further rainfall exceeding the reservoir capacity, the Army Corps of Engineers released water at a controlled rate through the outlet gates during and after Harvey. The combined amount of water released through the gates of both dams exceeded 15,000 cubic feet per second (cfs), well above the capacity of Buffalo Bayou, resulting in flooding in neighborhoods downstream of the dams. Such reservoir releases have never happened before. Typically, combined reservoir releases have not exceeded 2,000 cfs. Neighborhoods between State Highway 6 and Beltway 8 were especially affected by the releases and an estimated 4,000 homes were flooded.

What is the status of the reservoir projects?

New outlet gate structures will replace the existing ones at both Addicks and Barker Dams, expected completion in 2019. Like all dams, Addicks and Barker are at some risk of failing, and failure could be catastrophic. More information about this can be found in later fact sheets.

Risk of Future Dam Releases

Addicks and Barker Dams could again release large amounts of water downstream or flood homes upstream during extreme rain events like Harvey, or as a result of a number of smaller rains occurring over a short period of time.

Some solutions that have been suggested to avoid future releases include excavating and/or clearing vegetation in the reservoirs' storage areas to increase their volumes, expanding Buffalo Bayou to increase its capacity and allow more flow, adding more flood control structures upstream, and additional regulations for upstream development to reduce the amount of water entering these reservoirs.

KEY POLICY QUESTIONS

Could a new regional flood management strategy help use our current structures to their full ability and help target future funds for improvements?

Could regional policy restricting development inside the reservoir pool or overflow path help prevent damages in future events?

Could a policy requiring better water storage for developments lessen the demand for new storage structures in the future, or even prevent flooding in areas not near the reservoirs?