



I-45 North Houston Highway Improvement Project

ADDRESSING FLOODING



What is TxDOT Doing to Address Flooding Concerns?

A primary objective of the North Houston Highway Improvement Project (NHHIP) is to construct a resilient highway system that functions during extreme weather events. Therefore, the drainage system for the NHHIP is important and will be designed to account for potential flooding risks. Another key objective is to ensure that the project does not adversely impact the adjacent community, but rather does its part to improve the status quo by reducing flooding in the project area.

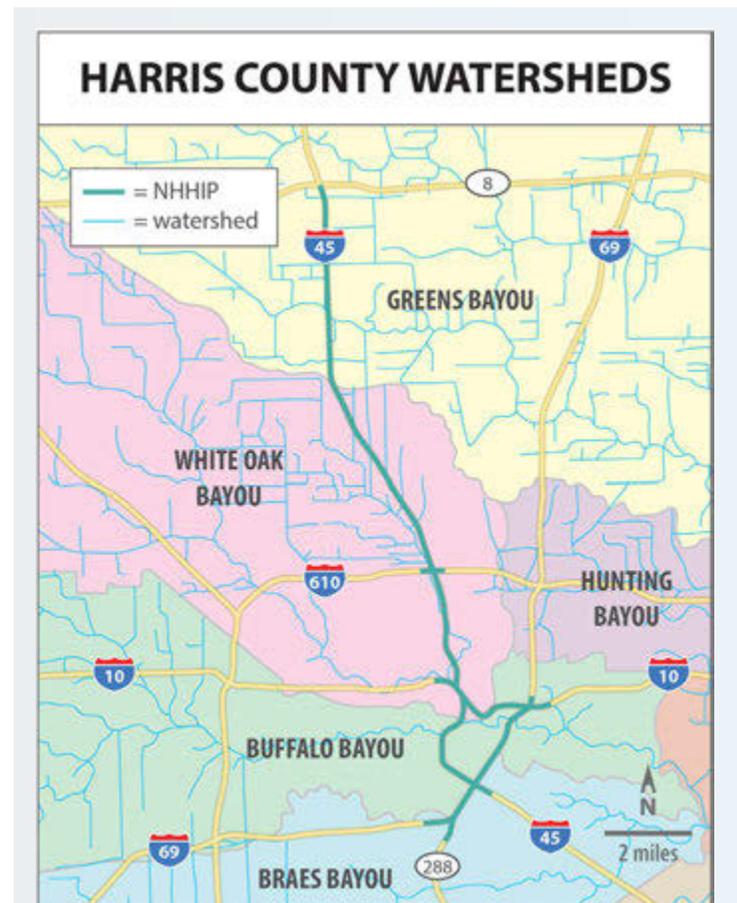
Storm Events - What Can This Roadway Handle?

Drainage studies are being performed for the project. The studies take into consideration the new National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall data and the most recent three major flood events in Houston: Memorial Day (2015), Tax Day (2016), and Hurricane Harvey (2017).

The highways within this project will be designed to be passable in a rain event similar to these three recent major storms.

Regarding the Atlas 14 rainfall data, while the data itself is currently available, the models that are used to design drainage systems throughout the region are still being updated to incorporate this data. While these models are being updated over the next few years, the Harris County Flood Control District (HCFCD) recommends using the current 500-year storm event model instead of using the 100-year storm event model. This is due to the similarity in rainfall intensity between the current 500-year storm event and the new Atlas 14 100-year storm event, with the current 500-year event being slightly higher.

As a result, the main lanes and managed lanes on this project (including the depressed sections) are designed to accommodate the current 500-year storm event model. The drainage systems for this project (including the depressed sections) will meet or exceed the most recent drainage system guidelines and criteria set out by the HCFCD.



Each separate watershed within project limits is included and analyzed as part of the drainage studies for this project. The Texas Department of Transportation (TxDOT) is working closely with the Harris County Flood Control District (HCFCD) to develop improvements to the bayous.

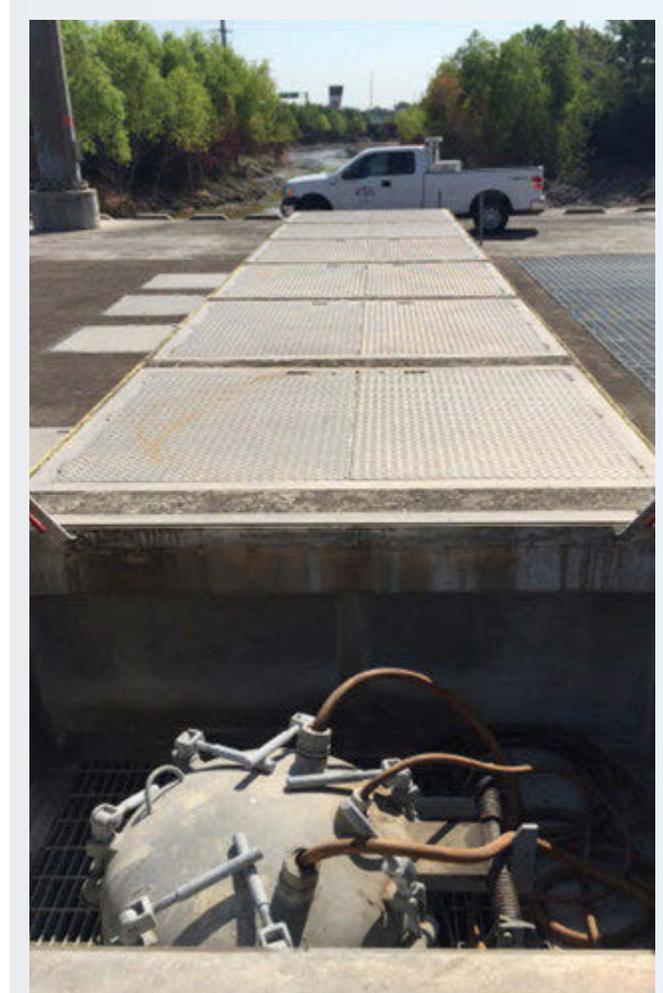
Depressed Sections/Pump System

Depressed sections of the proposed project will be designed to handle extreme weather events with rainfall levels similar to the region's three most recent flood events: Memorial Day (2015), Tax Day (2016), and Hurricane Harvey (2017). Additionally, the project will be designed to meet and/or exceed the most recent guidelines set by the HCFCD. In some cases, there may be water over the roadway during an extreme rainfall event, but the road is designed to still be passable. This will be achieved through a pumped drainage system that will collect rainwater falling inside the depressed sections and discharge it to an adjacent detention basin or receiving channel. For example, the rainwater that falls within the depressed section along US 59/I-69 between Main Street and Alabama will be conveyed to a detention facility where it will be held and then discharged at a controlled rate to Braes Bayou. The detention facilities are sized to accommodate extreme rain events so that the water pumped out of the depressed sections does not overwhelm the receiving bayous.

To further protect the depressed sections, the entrance points to these areas will be constructed above the new 500-year water surface elevation such that adjacent floodwaters do not enter the depressed sections and overwhelm the pumps. Regulatory agencies, such as Harris County Flood Control District, U.S. Army Corps of Engineers and the U.S. Coast Guard, will review TxDOT's final design to confirm that the project does not increase the risk of flooding to adjacent properties. In the unlikely event of flooding on the highway, an alert system will be utilized to block access at strategic highway locations prior to flooding levels that would pose a danger to commuters, ensuring that people will not be trapped in dangerous flood waters.

What Happens if a Pump Fails?

Safety is TxDOT's primary concern. The pump stations for the depressed sections of highway will be designed with backup pumps and backup generators to reduce the likelihood of a pump system failure. TxDOT is currently exploring the development of an alert system that will close access to depressed sections of the highways in the event of a pump failure.



Discharge Pump Cover Overlooking Detention.



Upper Wet Well.



Pump Discharge Pipes.

Will this Highway Project Make Flooding Worse?

No. This project will collect, convey and detain, where necessary, the storm water runoff not only from the highways but also from adjacent properties that are currently draining to the highways. This new infrastructure will help address many drainage issues in the vicinity of the project. However, it is not feasible for this project to solve flooding problems beyond the project's limits.

TxDOT understands that the highway infrastructure is integrated into the overall drainage pattern of the city. We are working closely with the City of Houston and the HCFCF to identify opportunities to develop partnerships that will leverage the roles and responsibilities, as well as the resources of each entity to deliver drainage improvements throughout the system. Working with our local partners, we are developing improvements that will reduce water elevations within the bayous so that more runoff can be accommodated and resiliency is built into the system. As an example, two bypasses along Buffalo Bayou in the central business district are being developed that would accommodate more runoff during high intensity rainfall events.

Details on Detention Facilities

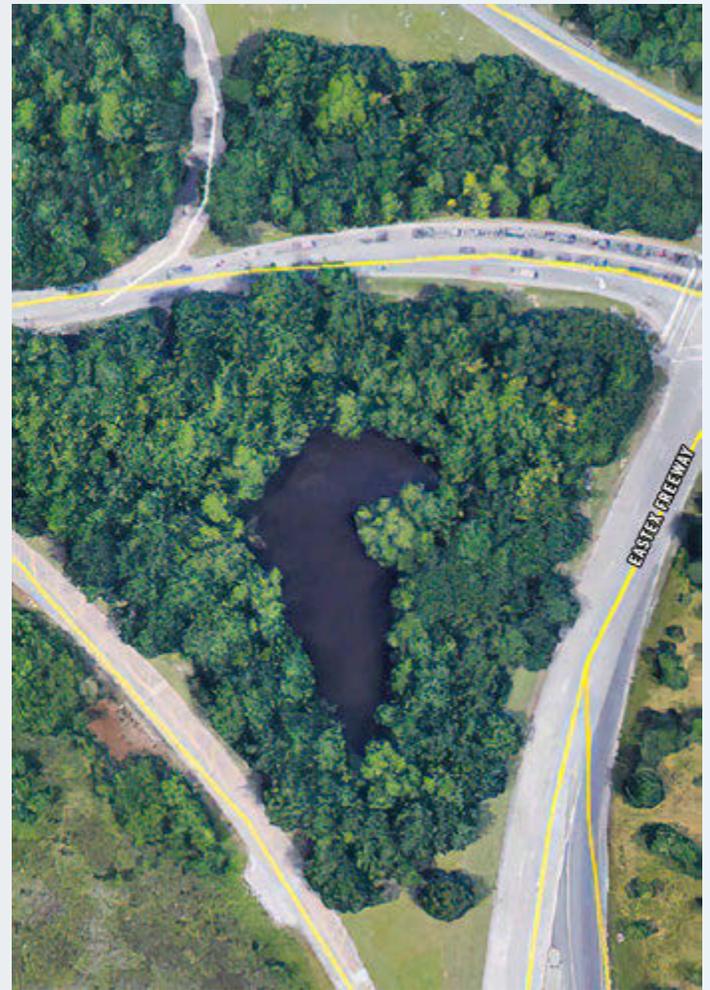
The purpose of detention facilities is to capture storm water runoff, store it during the peak rainfall period of a storm event and release it at a controlled rate to avoid overwhelming downstream facilities, such as receiving bayous and existing infrastructure. Detention facilities are designed to meet or exceed the most recent guidelines and criteria set out by local flood control entities.

Proposed detention areas are being evaluated as potential open spaces to enhance the quality of life for communities. The project will be developed under TxDOT's Green Ribbon Program, which enhances the visual character of highway corridors using landscape and hardscape elements including native trees, shrubs and plantings within the project's right of way. A detailed landscaping plan will be developed as part of the final design process.

TxDOT is coordinating with local groups and agencies to accommodate enhancements to standard landscaping and recreational open space in and around storm water detention areas, where feasible. Wet bottom detention basins will be considered if a partnering entity agrees to maintain them. As stewards of public funds, TxDOT is responsible for providing the storm water facilities necessary for the safe collection and conveyance of runoff within project limits. Enhancing the facilities above and beyond this requirement will need to be evaluated on a case-by-case basis to determine funding options and eligibility.

Developing Meaningful Partnerships

In addition to the work TxDOT is doing with the City of Houston and the HCFCF to enhance resiliency in the drainage system, TxDOT is evaluating opportunities to expand hike and bike trails along the bayous and will work directly with the HCFCF and interested stakeholders for the implementation of these opportunities. For more information, please see the NHHIP papers on *Pedestrian & Bicyclist Accommodations* and *Visual & Aesthetic Treatments*.



State funded roadway project with Green Ribbon reforestation.



Landscape improvements and upgrades done through partnership with local management district.

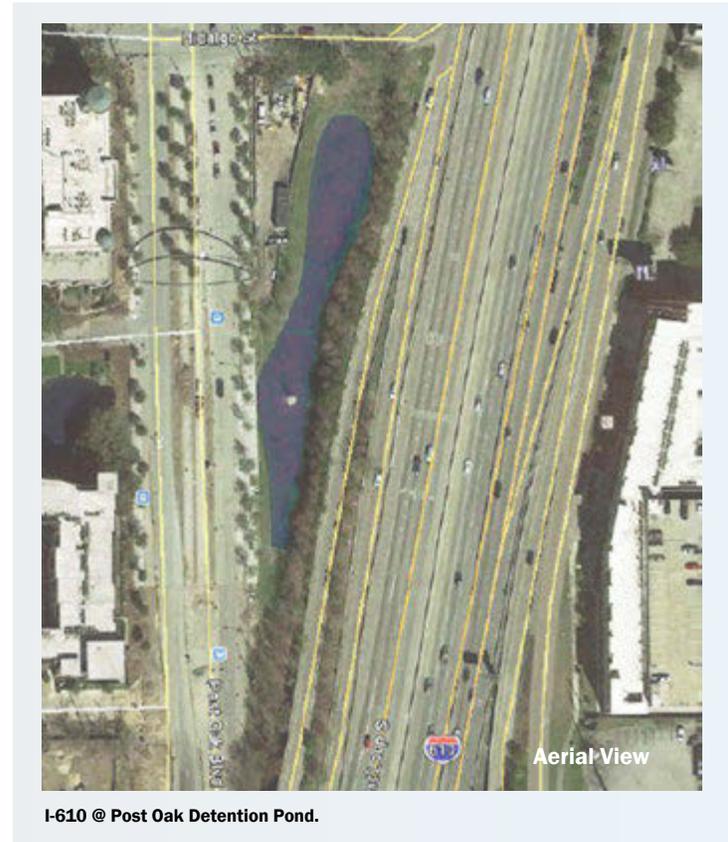
What will Happen During Construction?

Specifications are currently under development that will require temporary drainage measures and facilities during construction. It is the intent of these specifications that the construction will not increase the flood risk and will maintain positive drainage during storm events. Although the full impact of the new facilities will not be realized until construction is complete, it is the intent of TxDOT to ensure that construction facilities will not worsen existing flood risk.

Additionally, maintenance crews routinely check drainage outlets and clear debris along the roadway system to make sure runoff drains properly during major rainfall events.

Why is TxDOT Proposing to Lower Portions of the Highways Near and Around Downtown?

The decision to depress or elevate a highway is based on several factors. The primary considerations include how to effectively improve mobility by reducing congestion, improve roadway safety, and enhance connectivity of the local street network while working within design criteria and constraints. For more information, please see the NHHIP paper on *Lower the Highways*.



I-610 @ Post Oak Detention Pond.

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To learn more about NHHIP, scan or click the QR code and watch the Change for the Better video.

