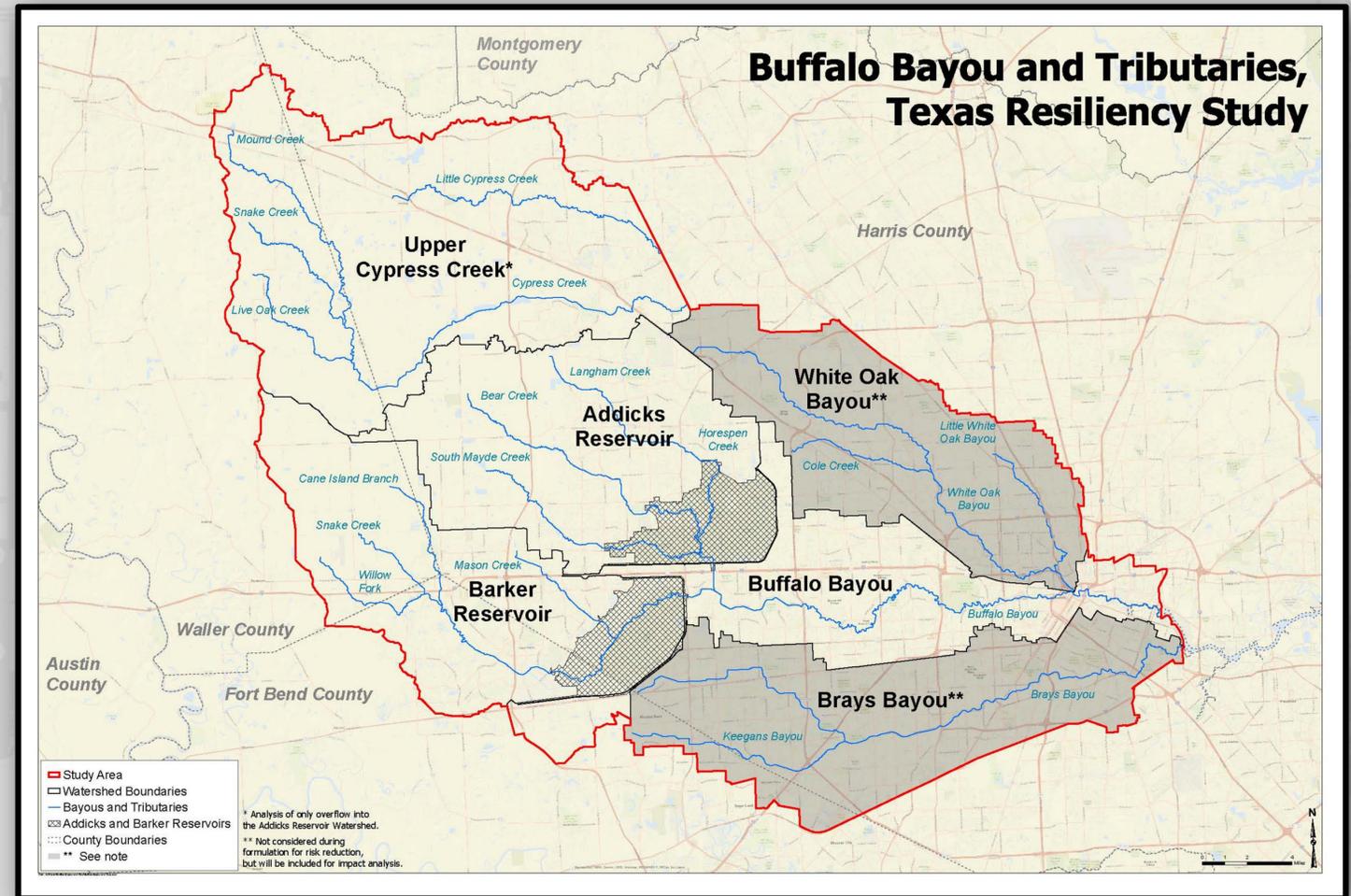


# Study Overview

**Purpose** The study has two goals

- **Flood Risk Management:** Identify and recommend an alternative that reduce the risk of flooding along Buffalo Bayou and its tributaries and upstream and downstream of Addicks and Barker Reservoirs due to changed physical and economic conditions since construction of the project in the 1940s.
- **Dam Safety:** Reassess the integrity of Addicks and Barker Dams in light of changed hydrologic conditions and determine if and what measures are needed to address dam safety concerns



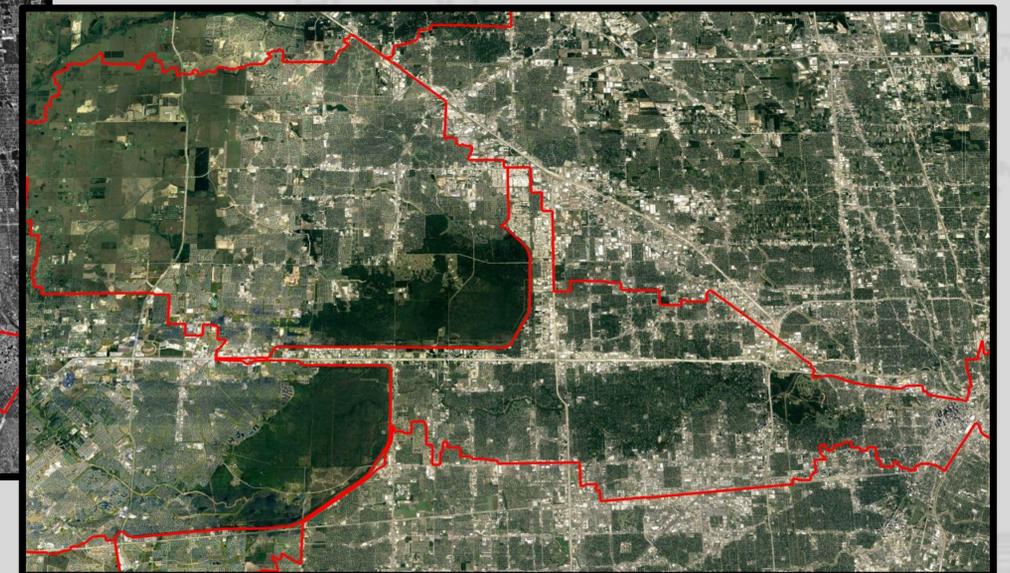
1953



1978



2017



A number of physical improvements and operational changes to the project have been implemented in response to steady growth of the Houston metropolitan area. However, the watershed continues to experience major flood events, including the most recent and most significant during Hurricane Harvey in 2017.

# Overview – Flood Risk Management



## Problem -- Flooding

Flood events have resulted in property damages, degradation of critical infrastructure, increase in overall regional flood risk and, in extreme events, loss of life.

Historic urban expansion has modified the way water moves throughout the watersheds.

- Less surface runoff can be absorbed than under historic conditions resulting in more water entering the bayous and reservoirs.
- When the capacity of the bayou or reservoirs is exceeded, flooding can occur in adjacent developed areas.

## Primary Study Objectives

Identify a plan that:

- Reduces the risk of flooding;
- Reduces the risk to health and life safety; and
- Reduces sediment and erosion.



## Problem -- Erosion

Sedimentation has been a persistent problem along the stream banks of Buffalo Bayou for decades. Erosion and the subsequent sediment transport in the bayou contributes to the flooding risk in several ways:

- During an event, erosion causes vegetation to fall into the channel potentially causing an obstruction to the flow path;
- Sedimentation reduces channel capacity; and
- Structural integrity of buildings adjacent to the bayou are threatened by eroding stream banks.



# Overview – Dam Safety Phase II

## What was done in Phase I?

The Phase I Dam Safety Modification Study (DSMS) was completed in 2013. The DSMS identified solutions to address the primary dam safety concerns:

- Seepage and piping beneath, around, and near the outlet structures

In 2015, USACE awarded a \$75 million contract to replace the outlet structures. Work should be completed in 2020.

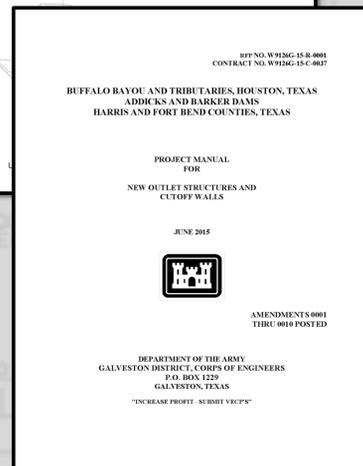
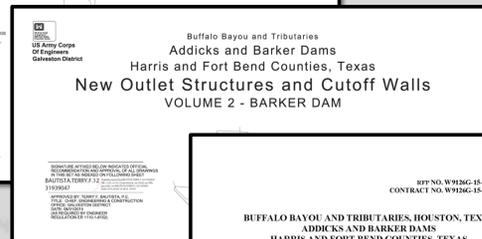
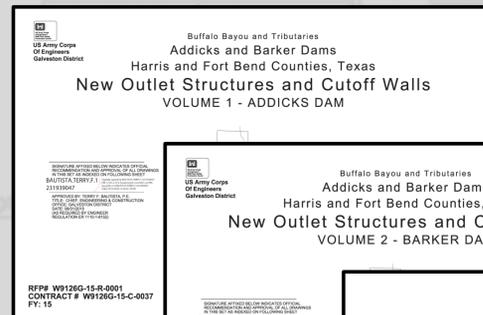
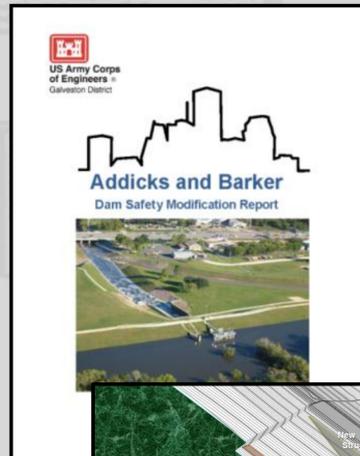


Flow around the end of the dams, and over untested auxiliary spillways can occur during extreme flood events. This could lead to a potential failure of a portion of the dam embankment.

## Current Dam Safety Rating

### DSAC 1: “Extremely High Risk”

This designation is based on a formula that accounts for the dam safety risks and potential consequences (life loss and property damages) downstream if something happened to the dam. **When a dam protects a significantly populated area like Houston, the consequences of failure are much greater than if the dam was protecting farm or ranch land.**



Like much of our national infrastructure, the dams have been around a long time. The original design was developed when technology was more limited and design standards were different. While safety issues associated with the water control structures are currently being addressed, issues associated with the auxiliary spillways still need to be investigated.



## What is Phase II?

The Phase II Dam Safety Modification Evaluation will identify solutions to secondary dam safety concerns including:

- How will the dams respond to flow around the ends of the dams and/or over the auxiliary spillway?
- How does changing precipitation patterns affect the frequency of flow around the end or over the auxiliary spillways of the dams?

**Addicks and Barker Dams are not in imminent danger of failing.**

**The two dams are continuously monitored by full-time staff to ensure their structural integrity.**

# Addicks and Barker Dams and Reservoirs

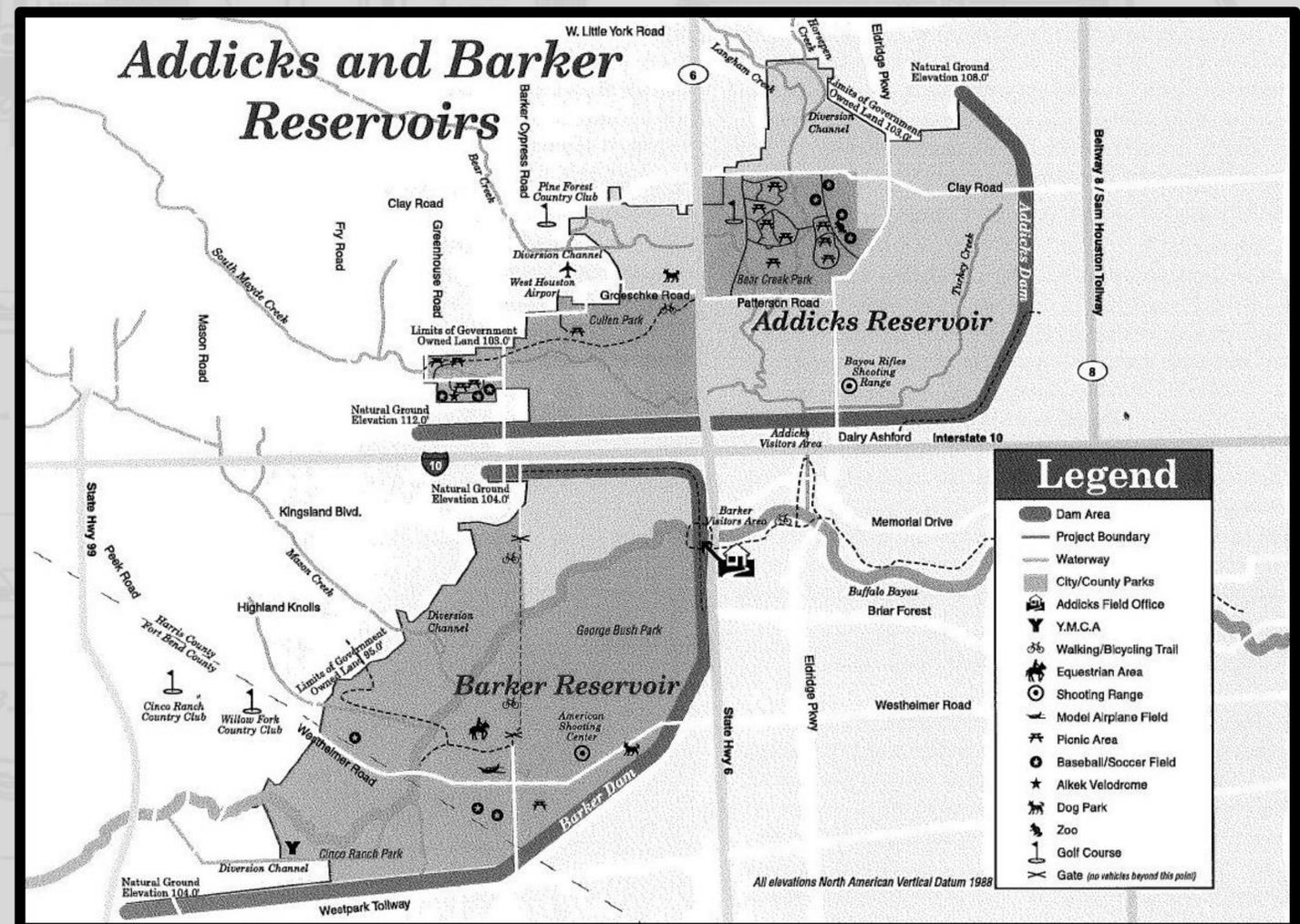
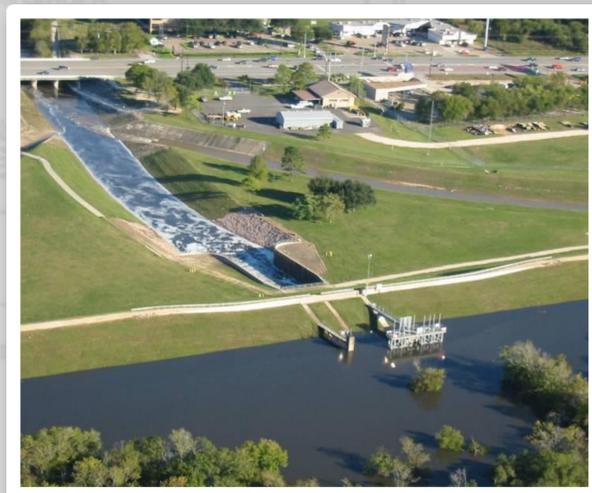
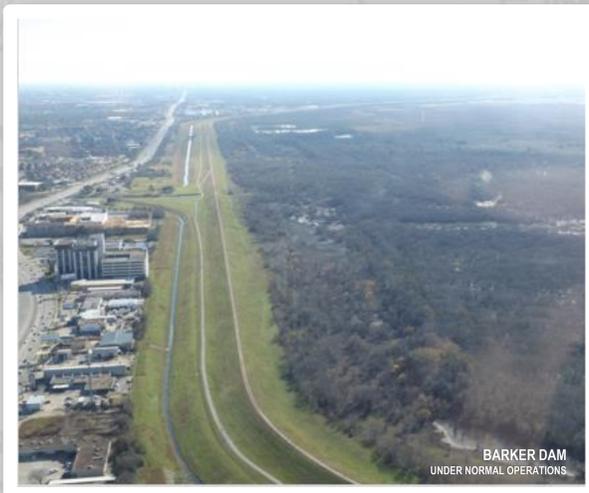
The purpose of the dams and reservoirs is to provide flood damage reduction along Buffalo Bayou downstream of the dams and through the center of the City of Houston.

- The dams detain water generated from rainfall runoff in the Addicks and Barker Watersheds. The water is then slowly released into Buffalo Bayou through the water control structures when the risk of downstream flooding is past.
- Under normal conditions, the reservoirs are dry and the gates remain open to allow the normal low flows of the creeks and bayous to pass through the dams and down Buffalo Bayou.

Since 1948, the dams have prevented flood damages estimated to be in excess of \$25 billion, along with countless lives saved, historical treasures preserved, and continued growth of a thriving metropolitan area.

## Dam Operations -- The gates are open until there is a threat of flooding.

- Under normal operations, the gates are closed when more than 2" of rain falls upstream of the dams and/or 1" of rain has fallen below the dam.
- Dam releases for both dams are regulated by the flow measured at the Piney Point Gage Station.
- If stored floodwaters are being released from the reservoirs when a rain event is threatening, the releases are adjusted based on the amount of rainfall predicted.
- It takes 8 hours for water released from the reservoirs to travel from the gates to Piney Point Gage Station and approximately 24 hours for the water to travel through downtown.



Addicks and Barker Reservoirs are located near the intersection of Interstate 10 and State Highway 6 in an area considered to be in the upper watershed of Buffalo Bayou.

# Plan Formulation

## Management Measures Considered During Plan Formulation

### Storm Water Storage

- New Reservoirs/Dams\*
- New Detention Basins
- Sedimentation Basins
- Increase Reservoir Storage\*
- Levees/Floodwalls

### Storm Water Conveyance

- Bypass Channels
- Diversion Channels\*
- Tunnels\*
- Channel Improvements\*

\* Anchor Measure

### Limit Exposure & Vulnerability

- Land Acquisition/Relocation
- Flood Proofing
- Warning Systems
- Raising a Structure in Place
- Update Emergency Action Plans and Hazard Maps

### Dam Safety

- Auxiliary Spillway Improvements
- Relocation of Auxiliary Spillway
- Modify Dam Operations
- Remove Dams

**Plan Formulation:** The process of building alternatives and eventual plans that meet study objectives while also avoiding any study constraints in order to achieve a complete and effective plan.

**Management Measure:** Generalized concept or approach that addresses one or more problems.

**Anchor Measure:** A management measure that serves as the basis for the alternative and contributes the greatest benefit to addressing a problem(s).

**Alternative:** Consists of either a stand-alone management measure or a combination of management measures as a means of addressing problems and objectives. For this study, alternatives would be either a stand-alone anchor measure or an anchor measure combined with other management measures.

## Alternatives Developed Around the Anchor Measure

No Action	Storage		Conveyance			Dam Safety	Comprehensive	Nonstructural
Alt #1	Alt #2 S1	Alt #3 S2	Alt #4 C1	Alt #5 C2	Alt #6 C3	Alt #7 Dam Safety	Alt #8	Alt #9
No Action	New Reservoir/Dam	Increase Reservoir Storage	Tunnels	Diversion	Channel Improvements	Change to Auxiliary Spillway	Best of Storage & Conveyance Alternatives Combined	Nonstructural

\* Note: Each alternative may have additional non-anchor measures added to the alternative to further reduce risk.

# Potential Measures that Limit Exposure and Vulnerability

Nonstructural Measures reduce human exposure or vulnerability to a flood hazard without altering the nature or extent of that hazard.

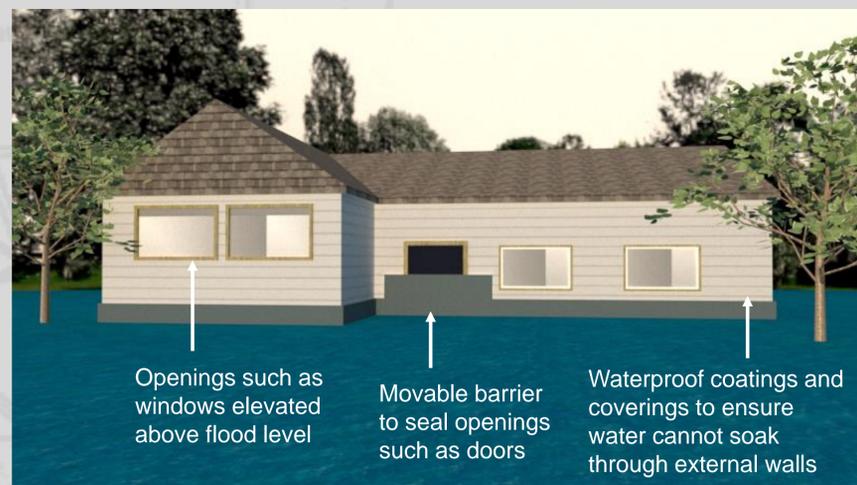
- A **hazard** for this study refers to water associated with flooding within the Buffalo Bayou Watershed.
- An **exposure** is who or what would be impacted by the hazard
- A **vulnerability** is how susceptible exposed people and properties are to damage or harm from the hazard.



Land is purchased, all structures are removed, and all utilities are capped. The land remains as open space.



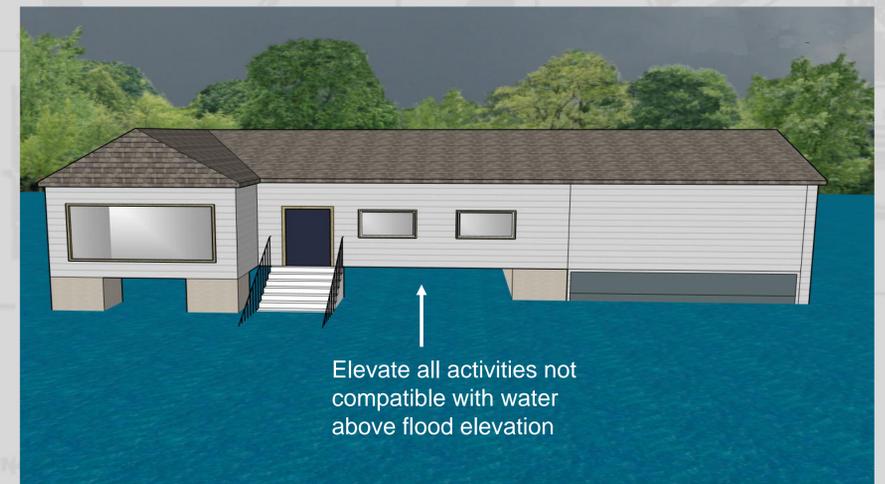
Land Acquisition



Flood Proofing

## Nonstructural Measures Being Considered

- Land Acquisition
- Relocation
- Flood Proofing
- Warning Systems
- Raise Structure in Place
- Update Emergency Action Plans and Hazard Maps



Raise Structure in Place



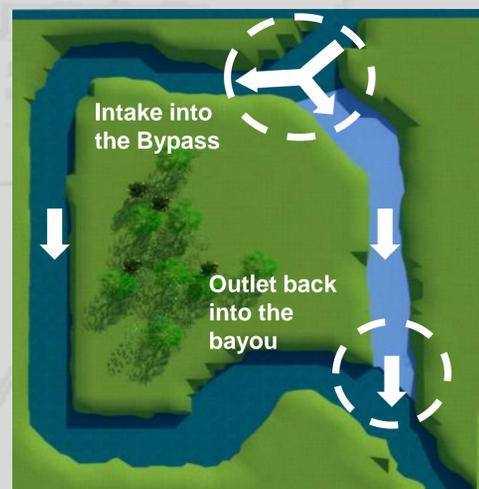
Warning Systems

# Potential Storm Water Conveyance Measures

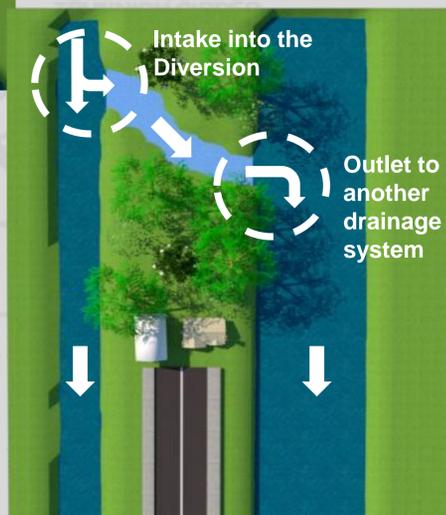
Structural measures that reduce the impacts of riverine flooding by improving how water moves through the drainage system.

## Bypass and Diversion Channels

A channel that redirects river flows at a point upstream of a particular area and then discharge the flow back into the same river (bypass) or a separate nearby drainage system (diversion).



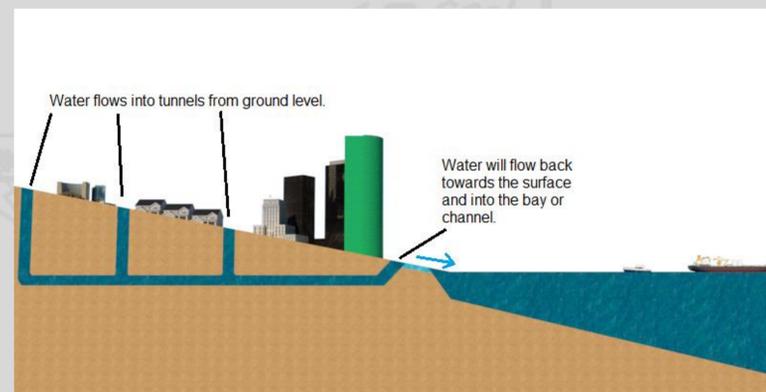
Bypass Channel



Diversion Channel

## Tunnels

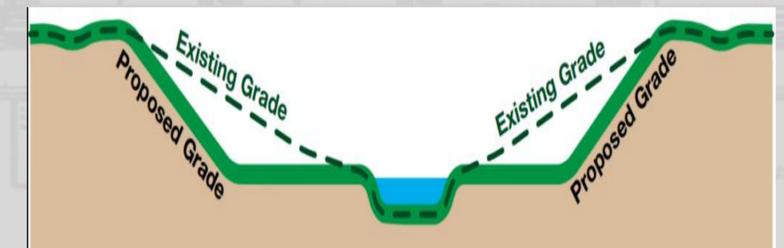
An underground floodway that diverts excess floodwaters from the surface into underground tunnel. The tunnels would then carry and discharge water around the flood prone areas.



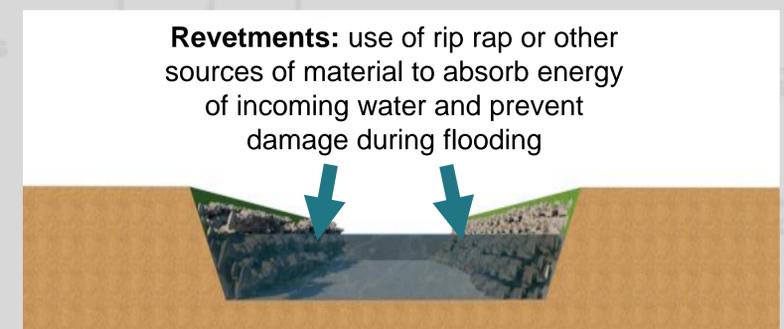
Tunneling

## Channel Improvements

Various measures that are undertaken to increase flow depths/widths and increase the overall carrying capacity and effectiveness.



Channelization

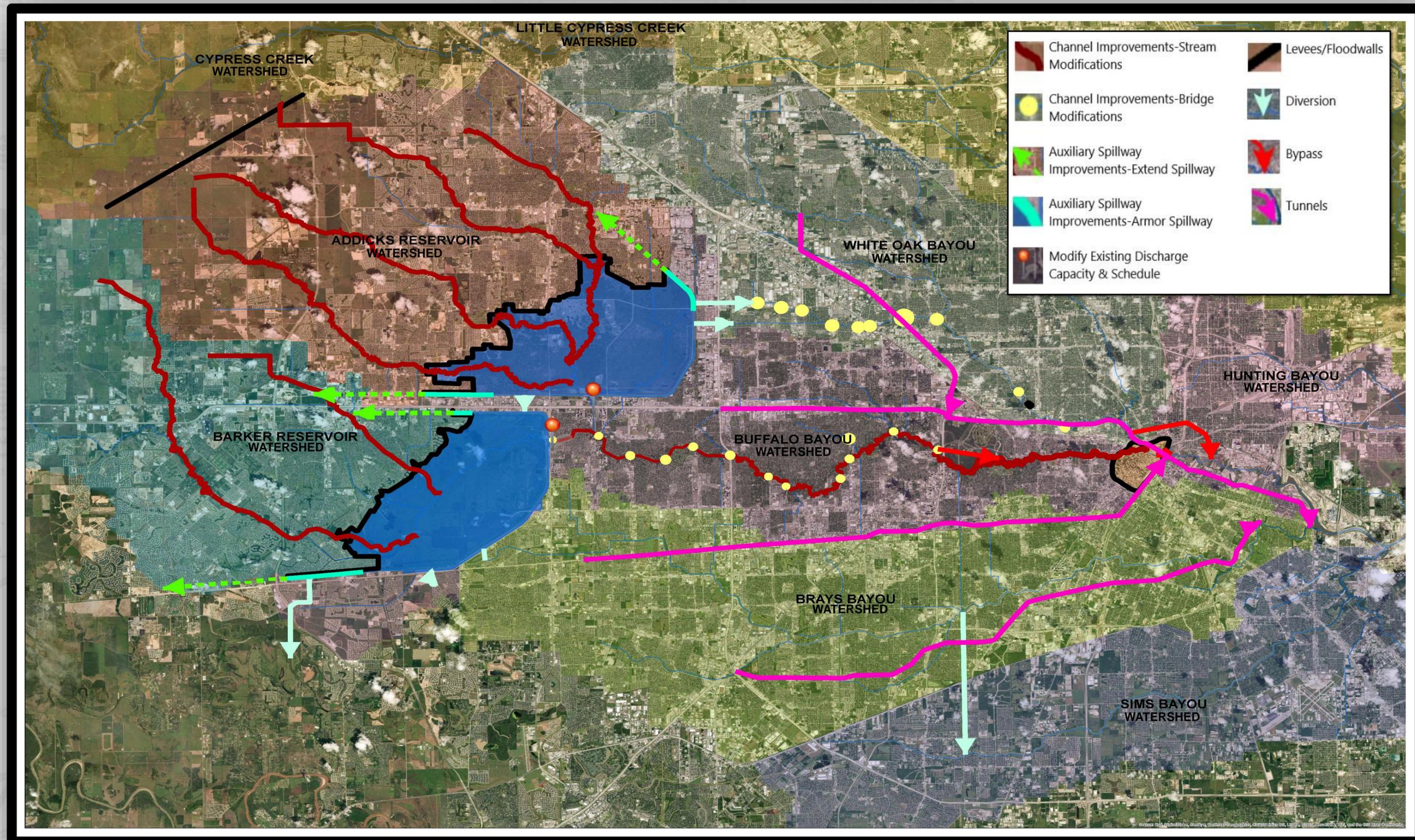


Revetments

## **Other Forms of Channel Improvement:**

- Bridge modifications
- Add/Remove/Modify Culverts
- Weirs

# Potential Storm Water Conveyance Measures



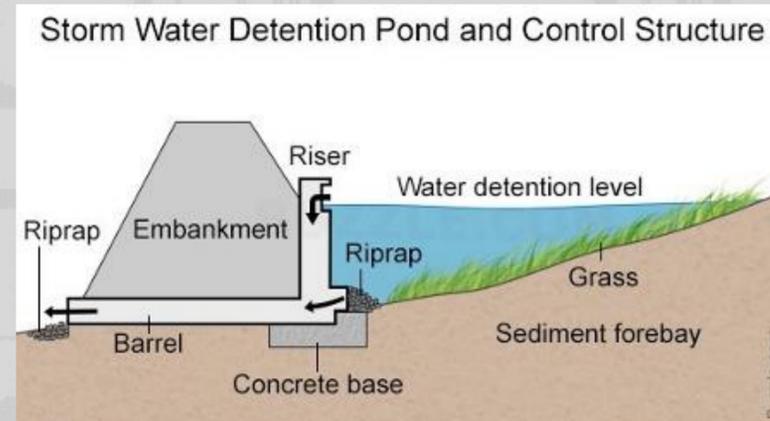
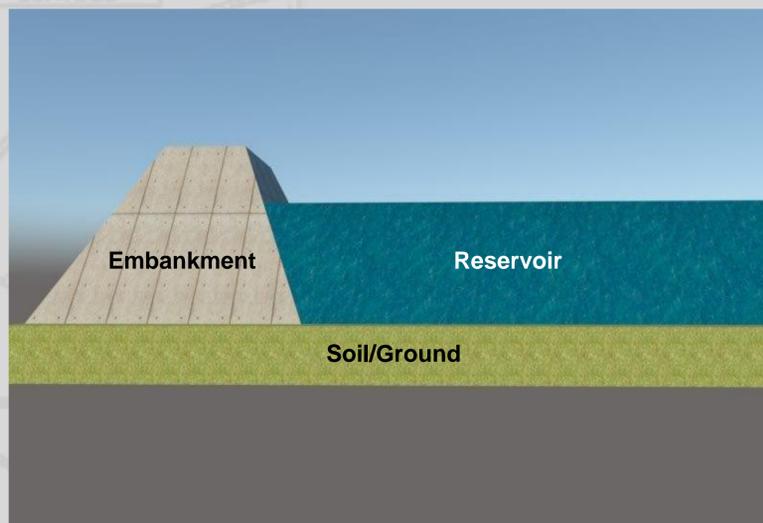
**Note: These measures and locations are conceptual and subject to change during the formulation and technical analyses phase. Any combination or subset of these measures could be included in the alternatives developed.**

# Potential Storm Water Storage Measures

Structural measures that store a portion of the flood waters so that the peak flows are minimized in downstream areas.

## New Dams and Reservoirs

Dams are constructed across waterways to regulate water levels and flooding downstream of the dam by temporarily storing the flood volume and releasing it in a regulated manner, like Addicks and Barker Reservoirs.

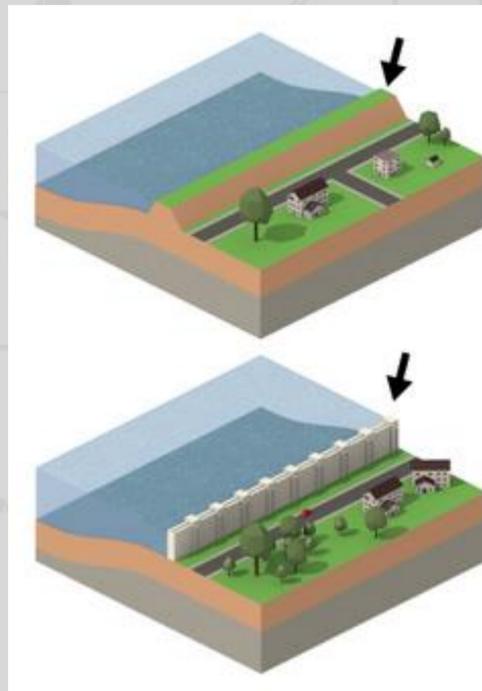


## Detention Basins

Excavations on the landscape used to receive and temporarily store surface flows. Flows are then slowly released at a predetermined rate into a natural or man-made drainage channel once the receiving channel has sufficient carrying capacity. Basins may not have a permanent pool of water.

## Levees/Floodwalls

Both floodwalls and levees provide a barrier between surging waters and built structures.



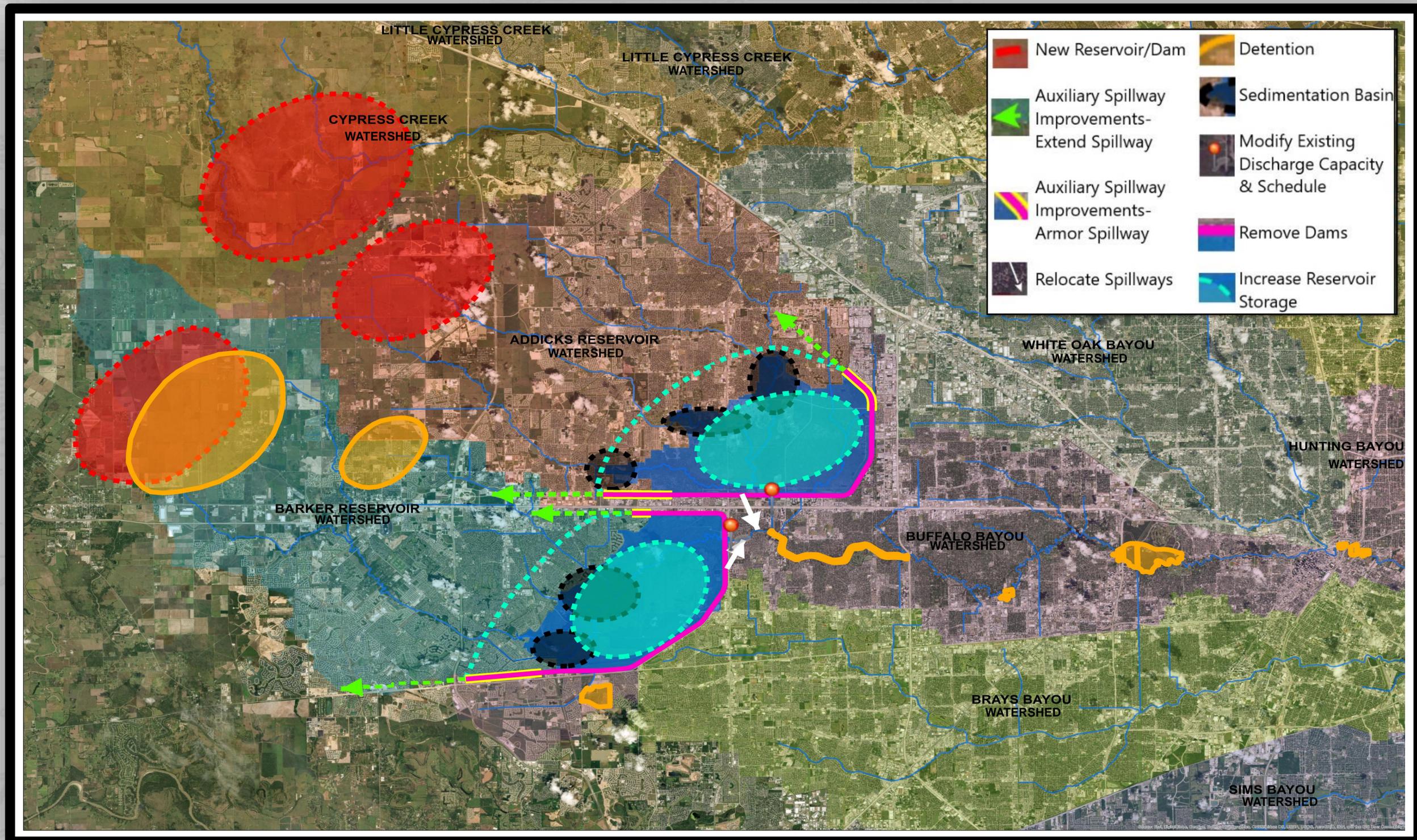
**Levees:** Artificial mounds of compacted soil with sloping sides and a wide crest.

**Floodwalls:** Engineered structures made of reinforced concrete

## Increase and/or Restore Reservoir Storage

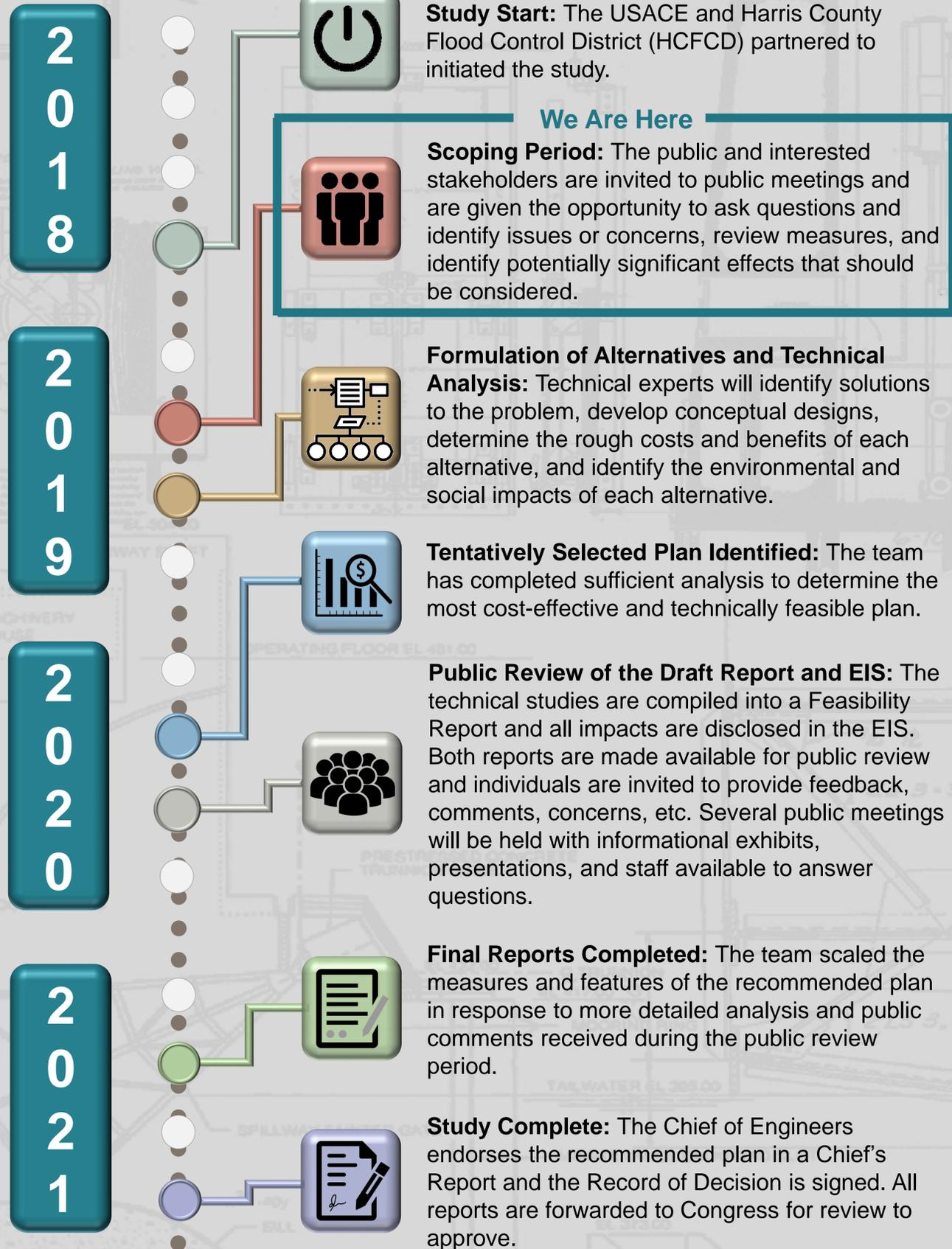
Regain storage space by removing sediments from the reservoir or raising the dam.

# Potential Storm Water Storage Measures



**Note: These measures and locations are conceptual and subject to change during the formulation and technical analyses phase. Any combination of a subset of these measures could be included in the alternatives developed.**

# Study Process



## What is NEPA?

### National Environmental Policy Act (NEPA) of 1969

- One of the nation's oldest environmental laws
- Requires Federal agencies to consider and disclose the environmental and social effects of their proposed actions in a publically available document.

## What type of document will be prepared?

An Environmental Impact Statement (EIS) will be prepared and fully disclose the:

- Purpose and Need,
- Alternatives Considered,
- Baseline Conditions,
- Environmental Effects,
- Social Effects.

An EIS results in a Record of Decision (ROD)

## What topics are being evaluated?

- Air Quality
- Climate Change
- Hydrology
- Water Quality
- Wetlands
- Fish and Wildlife Resources
- Recreation
- Traffic
- Land Use
- Cultural and Historic Resources
- Economics and Socioeconomics
- Noise

# How Can You Participate?

## ▪ Today's Scoping Meeting

- Review information on the display boards and handouts
- Ask the USACE and HCFCD Staff questions

## ▪ Provide Comments

- Place comment cards in comment box tonight
- E-mail comments to: [BBTRS@usace.army.mil](mailto:BBTRS@usace.army.mil)
- Mail comments to:

USACE, Galveston District

Attn: BBTRS

PO Box 1229

Galveston, TX 77553-1229

**3 Options to  
Submit Your  
Comments**

**Comments must  
be postmarked by:  
May 31, 2019**

# Where Can I Get Information?

**For additional information, please visit our website where you can find:**

- This Evening's Presentation
- A Copy of the Display Boards
- Meeting Handouts
- Latest Updates on the Study

**<https://www.swg.usace.army.mil/Missions/Projects/Buffer-Bayou-and-Tributaries-Resiliency-Study/>**