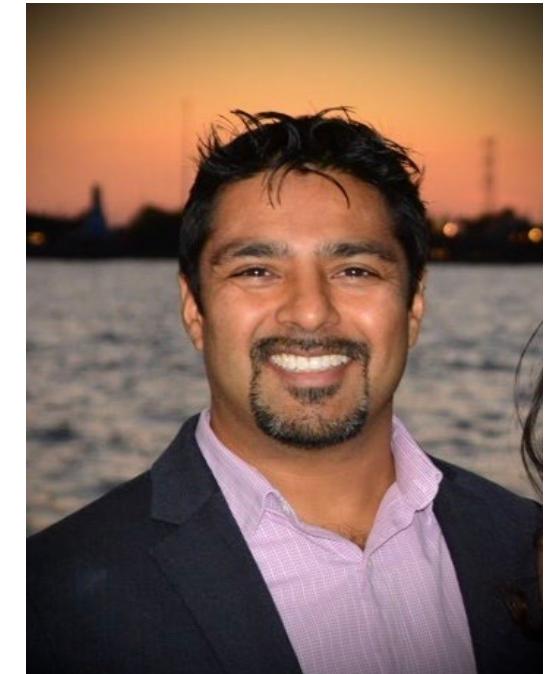




City of Houston Stormwater Master Plan

Paresh Lad

Division Manager
Transportation & Drainage Operations





STORMWATER MASTER PLAN AND MODEL

PARESH LAD, ENV SP
TRANSPORTATION AND DRAINAGE
OPERATIONS PLANNING





OUTLINE

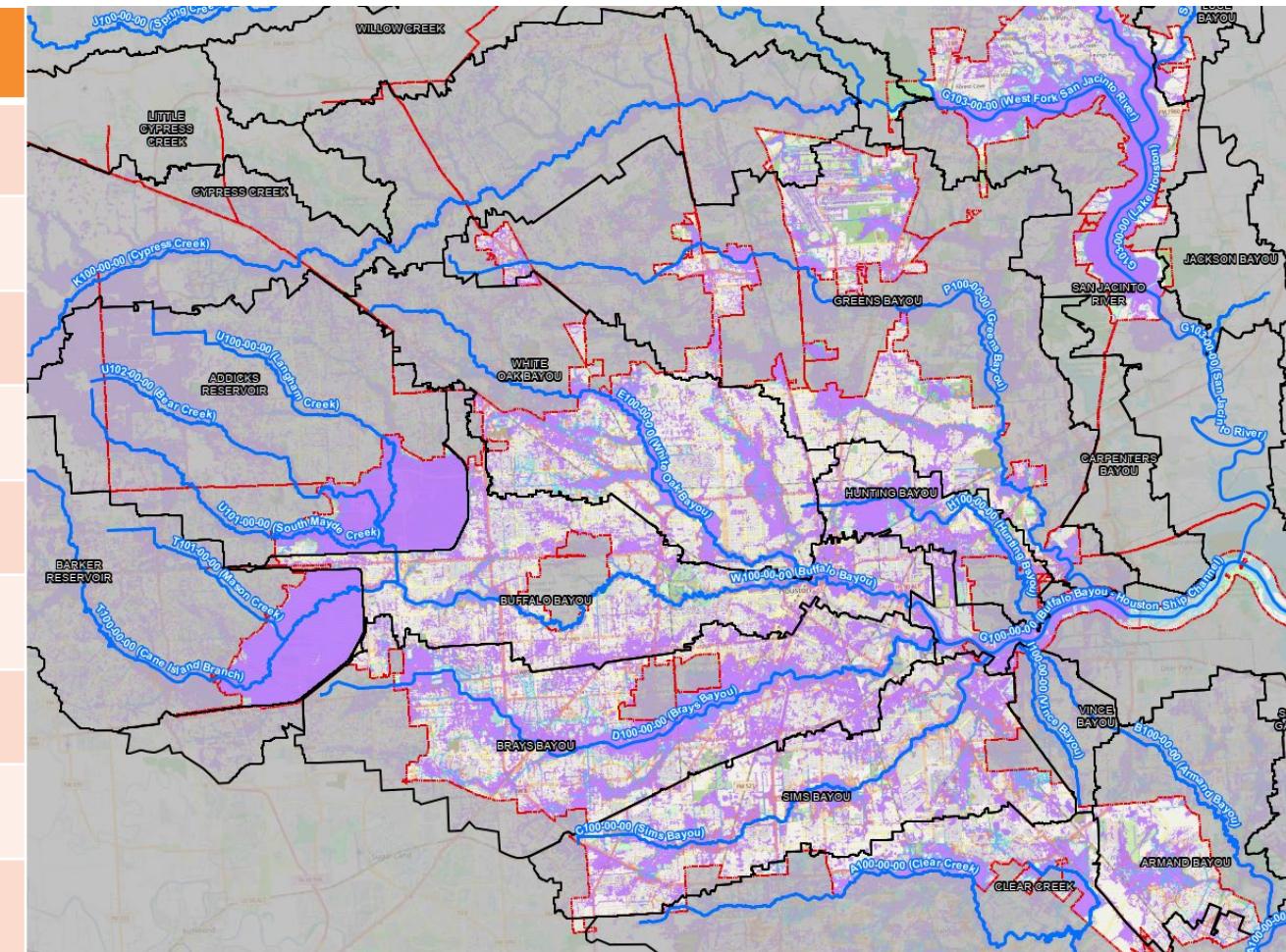
- **Project Goal**
- **Purpose**
- **Prioritization**
- **Focus Area**



DRAINAGE INFRASTRUCTURE

City Infrastructure Statistics

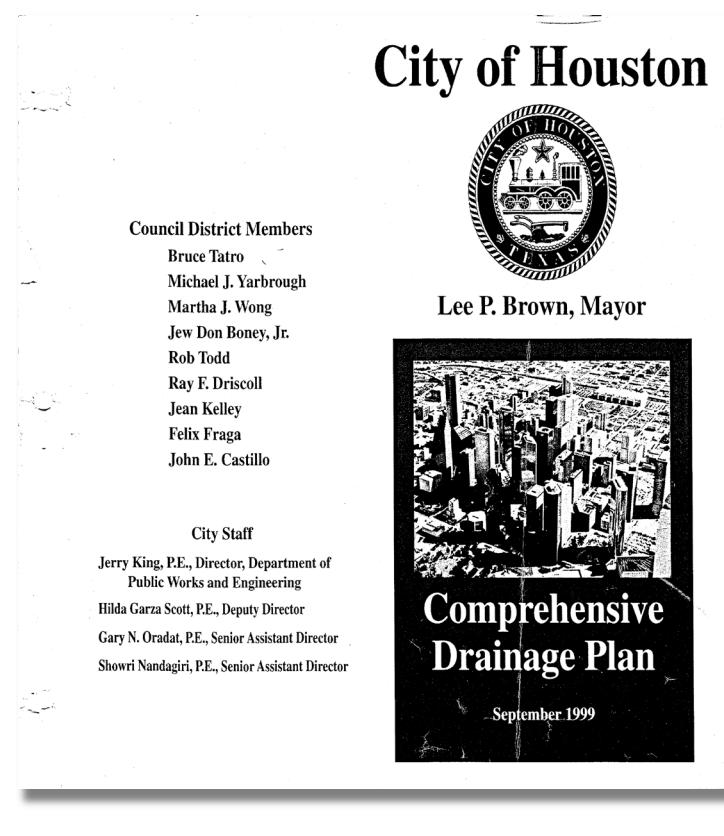
Area	609 sq. miles
Manholes	47,000
Pipe > 24"	3,000 miles
Pipe > 36"	1,700 miles
Roadside Ditches	2,500 miles
Unstudied Channels	310 miles
Studied Channels	776 miles
Area in 500-year Floodplain	479 sq. miles
FEMA Flood Claims (since 2015)	55,000





PAST EFFORTS

- Comprehensive Drainage Plan -1999
- GIS analysis of the City's storm sewer
- Pre-Atlas 14 rainfall
- Identification of adequate/inadequate systems
- Used to develop CIP's for the drainage infrastructure
- City surveyed the roadside ditch system in 2016
- Updated the CDP by combining the storm sewer system with the roadside ditch coverage
- Used current LiDAR to burn in the terrain which help create new outfall delineations
- Effort provided a view of the entire City and its infrastructure capacity



City of Houston



Lee P. Brown, Mayor

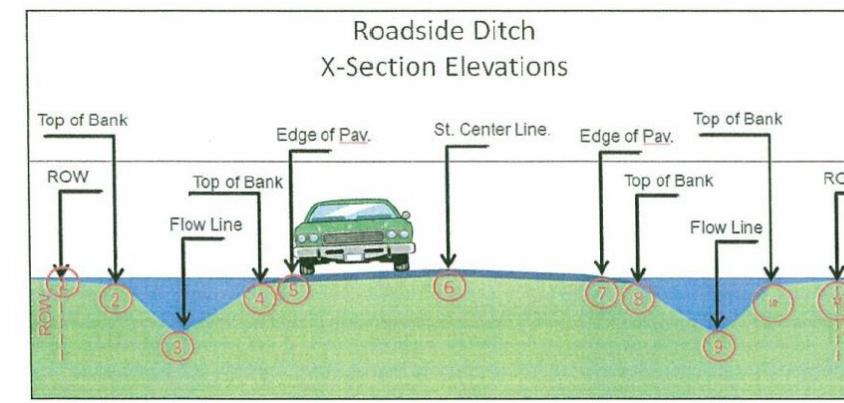
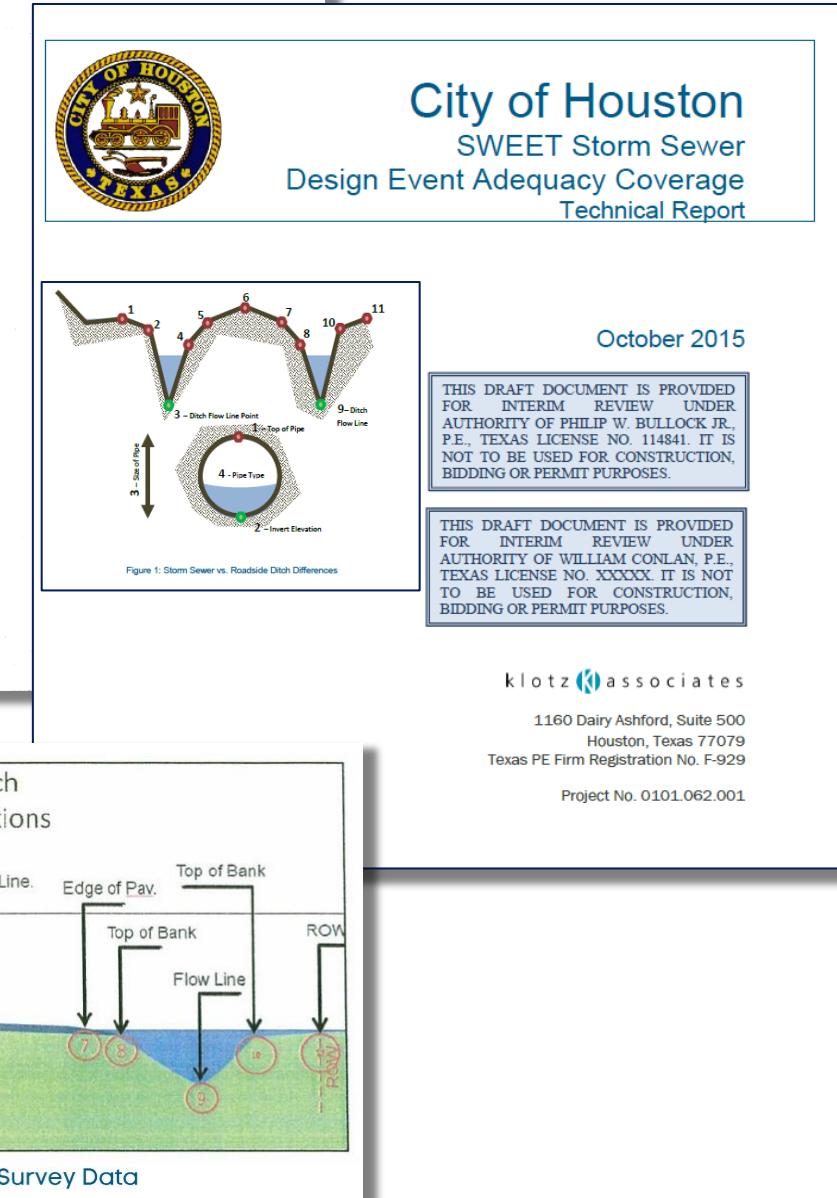
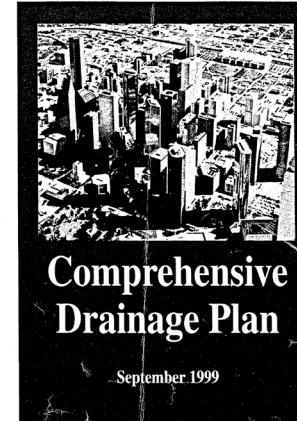
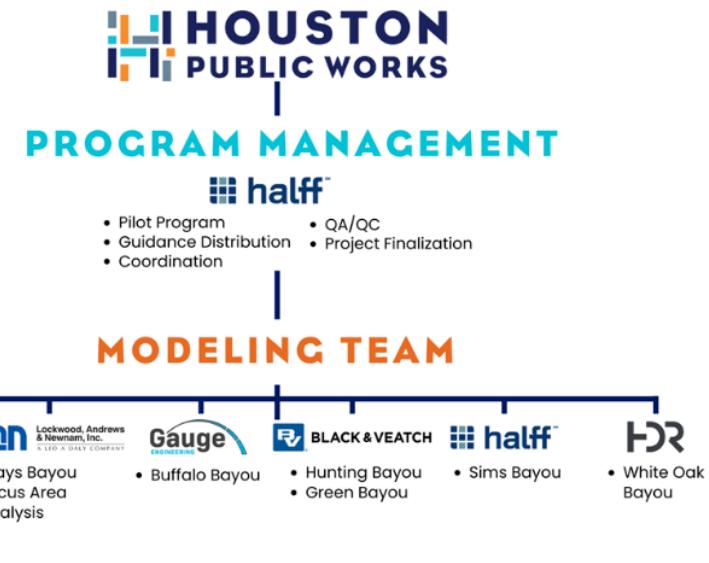


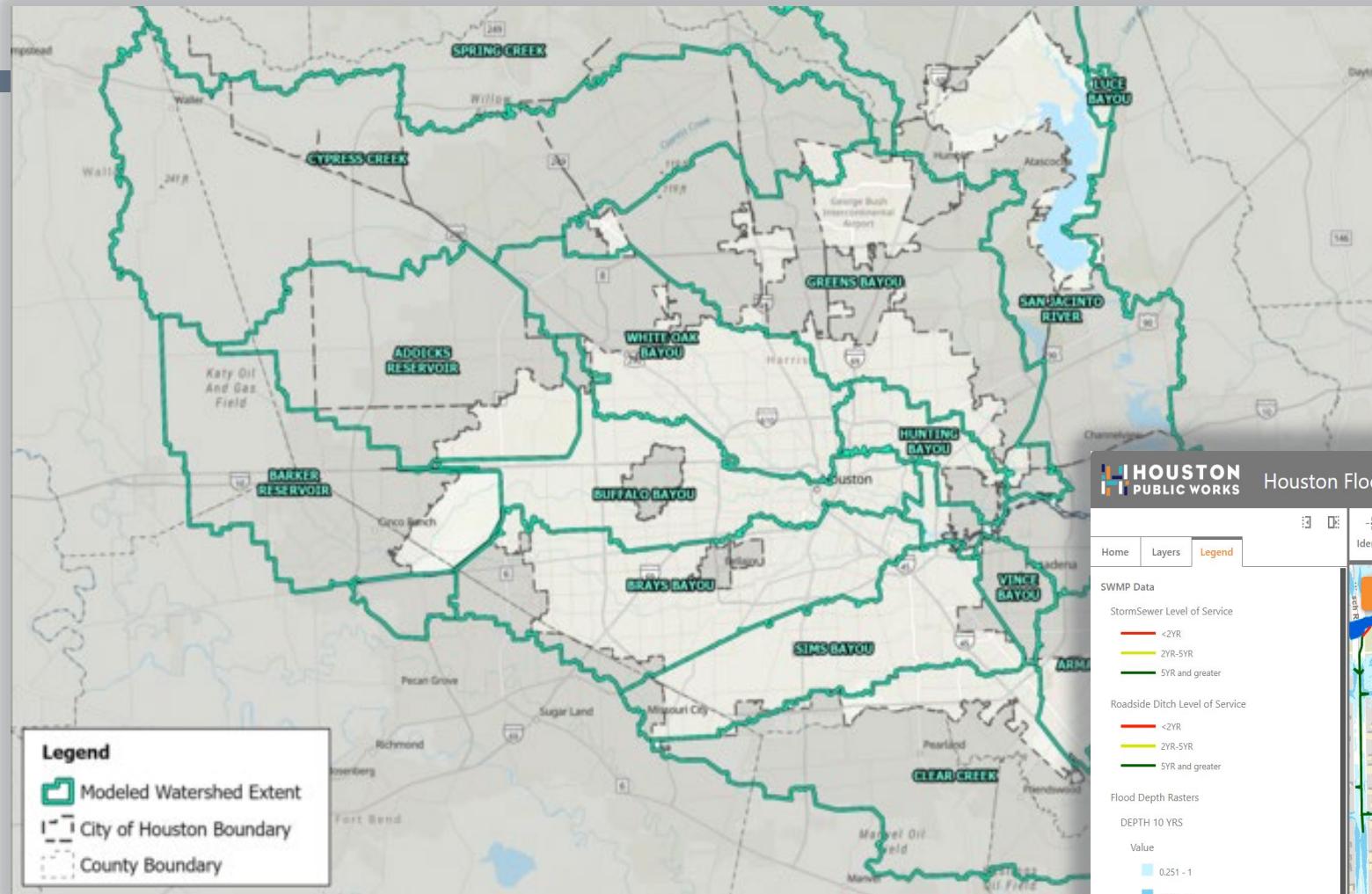
Figure 3: Cross Sectional Survey Data

STORMWATER MASTER PLAN STARTUP

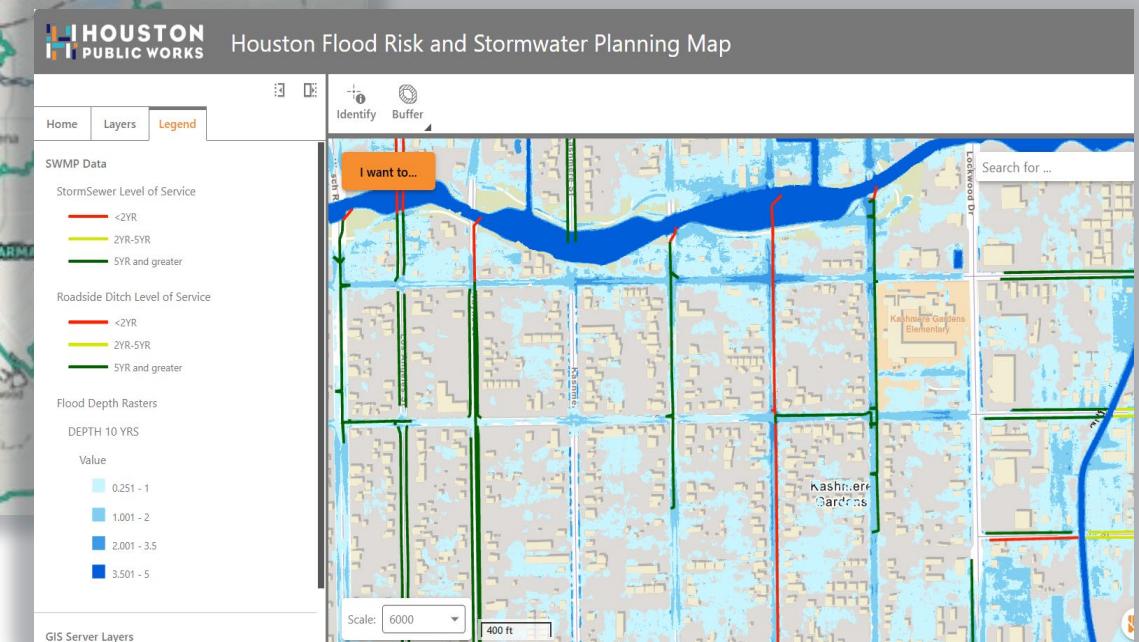
- **2018**
 - Funding release from CDBG-DR 17 and application submitted by COH
- **Funding:**
 - CDBG-MIT 2017 – 5 Consultants, 11 Watersheds
 - TWDB – Sims Bayou Watershed (Pilot) and Project Technical Management
- **Project Organization:**
 - Reviewed infrastructure similarities and differences between watersheds, highlighted components of each to inform data collection and model development challenges.
 - Divided City into 6 watershed groups due to watershed characteristics and familiarity.



CITY WATERSHEDS



- Each Watershed Analyzed
- Model shows water movement and areas of flood risk





HOUSTON STORMWATER MASTER PLAN



Houston Stormwater Master Plan

Supporting Documents

- Executive Summary
- Technical White Papers

Watershed Plans

- Armand Bayou
- Brays Bayou
- Buffalo Bayou
- Clear Creek
- Greens Bayou
- Hawthorne Bayou (AH Greens)
- Lake Bayou
- San Jacinto
- Santa Fe Bayou
- White Oak

Study Goals

- Provide a comprehensive drainage analysis of the city
- Understand existing flood risk throughout the city
- Identify focus areas for future planning for projects and studies

History and Overview

The City of Houston is prone to flooding due to its flat topography, dense development, and proximity to the coast. This flooding causes safety and economic ramifications that impact the region, the state, and the nation. Since the 1990s, Houston has completed drainage planning efforts to understand the impacts of flood events better and develop plans to reduce that flood risk for its residents. This study analyzes the influence of the City's local storm sewer and roadside ditch, alongside the drainage patterns caused by channels, bayous and rivers that convey stormwater to the bay. With this approach, the Houston SWMP initiative provides the first comprehensive look at flooding and drainage issues in the City.

Previous Planning Efforts

Year	Effort	Description
1999	Comprehensive Drainage Plan	<ul style="list-style-type: none"> City-wide analysis of storm sewer infrastructure Used GIS and national method Determined storm sewer capacity Used for CIP identification
2010	Rebuild Houston	<ul style="list-style-type: none"> Developed drainage impact fee to fund drainage project Created prioritization factor to conduct storm drainage planning studies Conducted various neighborhood planning studies
2016	Roadside Ditch Drainage Planning	<ul style="list-style-type: none"> Updated 1999 CDP to combine storm sewer analysis with open ditches Created new outlet boundaries and later assessment of drainage infrastructure Incorporated into the prioritization framework for a comprehensive analysis
2019 - Present	HCFCD MAPP/NEXT	<ul style="list-style-type: none"> Improving understanding of flood risk in Harris County to allow communities to make more informed decisions Developed new models for the bayous and channels throughout the county using the latest information and technology
2024 - Present	Stormwater Master Plan	<ul style="list-style-type: none"> Created a comprehensive, citywide assessment of drainage throughout the City of Houston Provides understanding of flood risk based on storm sewers, open ditches, channels, and roadside ditches Conducted focus area analysis to identify areas for projects and future studies

City-Wide Information

The City of Houston drainage infrastructure consists of two components: primary drainage systems such as the major bayous, rivers, and channels which receive flows from both local runoff as well as contributing watersheds upstream of the City; and secondary drainage systems such as storm sewer and roadside ditch that collect and convey local runoff flows to the primary drainage systems. Both of these types of infrastructure were included within the Houston SWMP.

City Statistics

Size	Storm Sewer*	1,900 mi
Population	Roadside Ditch*	2,800 mi
Structures*	Channels*	500 mi
870 sq mi	1,900 mi	
2.3 million	2,800 mi	
550,200	500 mi	

*Representative of modeled infrastructure

Diagram

BRAYS BAYOU WATERSHED

Size	127 sq mi
Area within City	99 sq mi
Developed Area within City	97 sq mi
Modeled Structures	140,130

The Brays Bayou watershed is located in the southwest portion of the City of Houston. Most of the watershed is located within City of Houston limits, with small portions falling in the cities of Bellaire, West University, Missouri City, Stafford, Missouri City Park, and Sugar Land. The Bayou flows from the eastern end of the Bayou to the west into the Buffalo Bayou – Houston Ship Channel. The watershed within City limits is mostly developed, consisting primarily of small-lot, single-family residences. There are areas of heavy commercial development near Interstate 45 and I-69 as well as along I-10 where NRG Stadium and the Texas Medical Center are located.

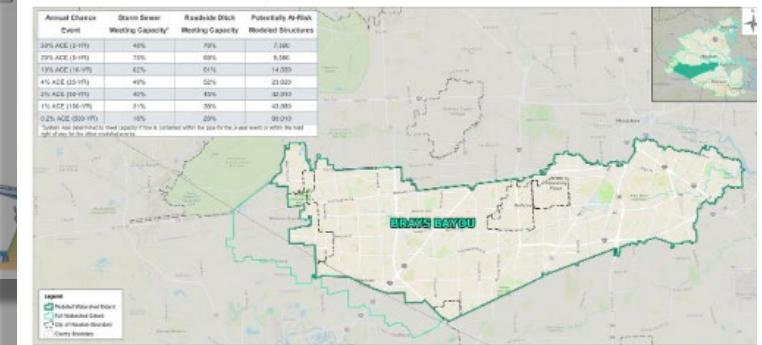
[View the Brays Bayou Watershed Report \(2024\)](#)



FEMA Floodplain Classification	Area within City (sq mi)	Structures within City (sq mi)	Conveyance Type	Length (mi)	Percent of Total
Within 1% ACE Floodplain (Zone AE)	29.3	34,250	24" & Pipe Diameter < 36"	875	48%
Additional Within 0.2% ACE Floodplain	25.2	105,640	36" & Pipe Diameter < 60"	459	25%
Outside 0.2% ACE Floodplain	72.8	74,320	Pipe Diameter ≥ 60"	181	10%
			Roadside Ditch	182	10%
			Studied Channels	76	4%
			Unstudied Channels	54	3%

Modeling results indicate that structural flooding in frequent events is largely confined to low-lying neighborhoods, including Alief and east Almeda Road. In more severe events, such as the 100- and 500-year events, widespread flooding can be seen along Brays Bayou as well as in nearby areas affected by the bayou's watershed.

During frequent events, flooding is primarily seen in the Alief neighborhood as well as in several areas east of Almeda Road. Flooding is due to underlined local infrastructure such as storm sewer and roadside ditch systems as well as low-lying terrain that prevents water from reaching outlet locations. Depths of 1 to 5 feet can be seen starting in the 2-year event with these neighborhoods. Elevated structures and road drainage mitigate some structural impacts; however, in more severe events, residents and businesses throughout Alief and areas west of Almeda Road experience widespread structural flooding.



STORMWATER MASTER PLAN VIEWER

 HOUSTON
PUBLIC WORKS

Stormwater Management Plan

Home Layers Legend

Stormwater Management Plan

Layer Information:

Flood Risk Index (Focus Areas)

This layer highlights areas of **Low**, **Medium**, or **High Flood Risk**. Risk levels are based on a combination of:

- How often flooding is likely to happen
- How many people and structures could be affected

For more information, visit the [Flood Risk Index technical overview](#).

Sub-Basin Watersheds (Modeled Boundaries)

This layer outlines **sub-basins**, which are smaller drainage areas used in the stormwater modeling. These boundaries may be different from official watershed boundaries because they are based on updated topography and flow patterns.

Data Directory: [View](#)

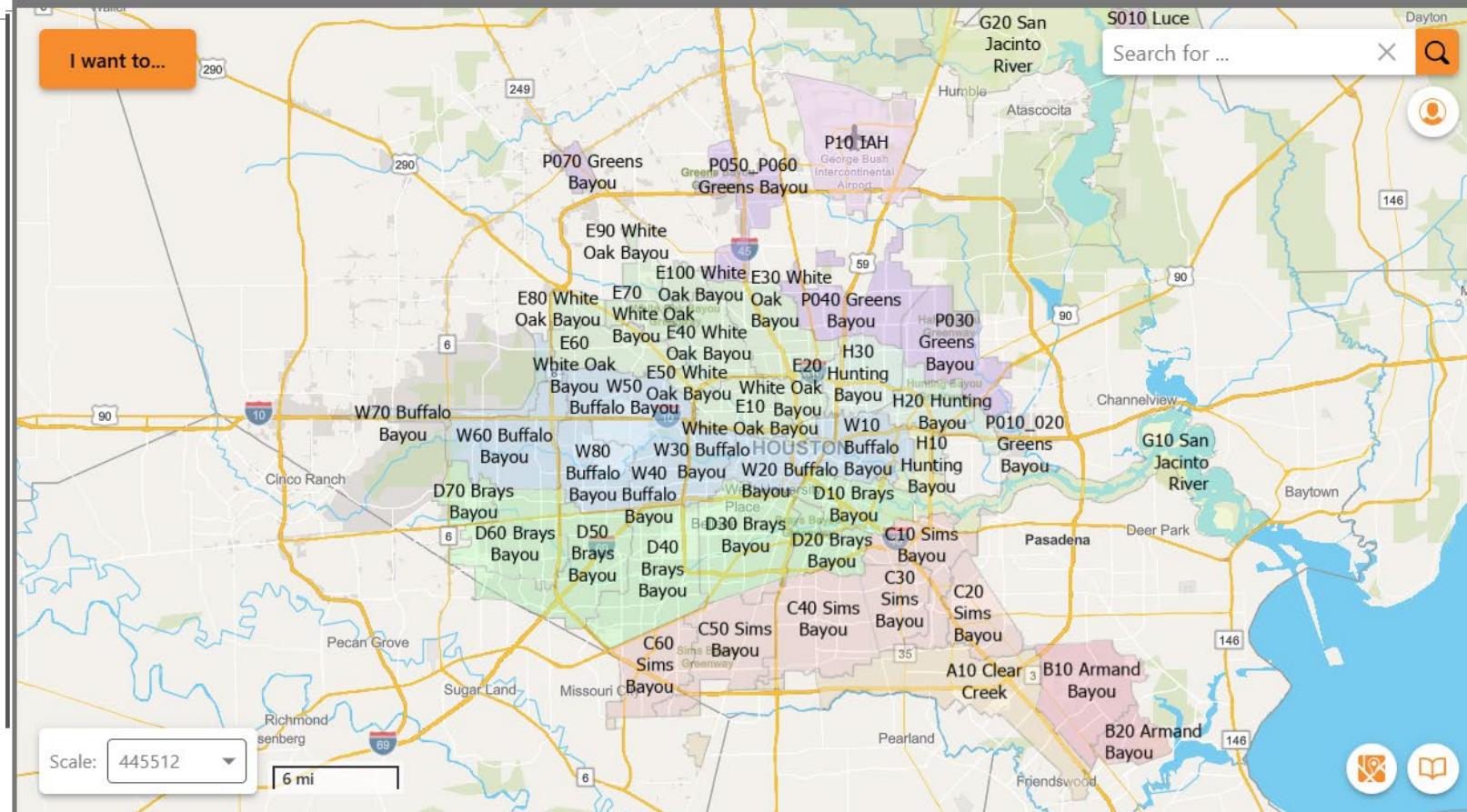
Identify Buffer

I want to...

Search for ...

Scale: 445512

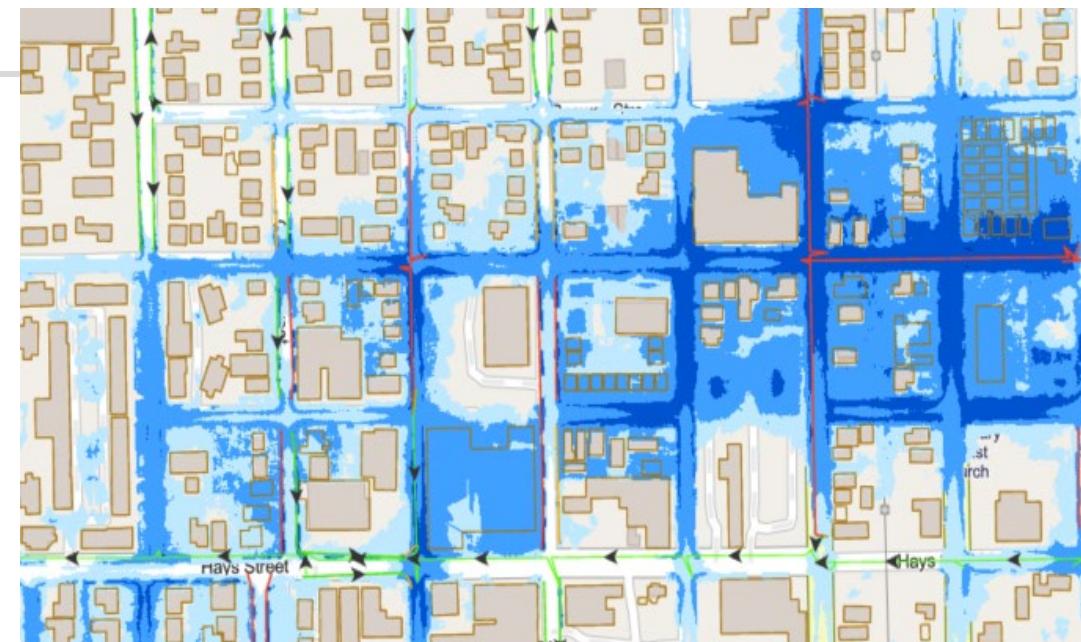
6 mi





DATA AND PRIORITIZATION

- Raster for Various Flood Frequencies
- Population Associated to Structure
- Critical Facilities
- Mobility and Access



• **550,000**

- Structures Modeled

• **500**

- Miles of Channel Modeled

1,900

Miles of Storm
Sewer Modeled

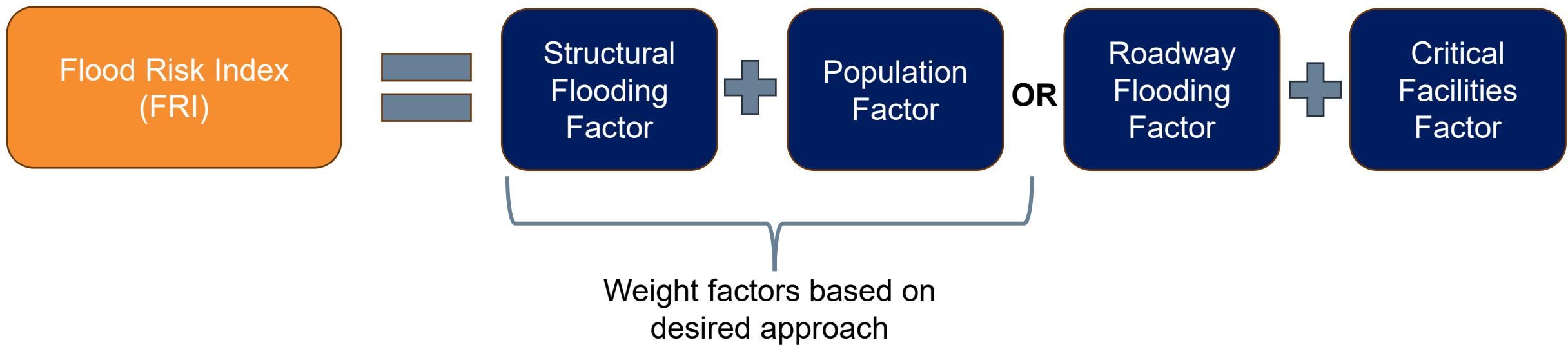
• **2,800**

- Miles of Roadside
Ditch Modeled



INSTANCE FACTOR AND FLOOD RISK INDEX

- Compares impacts of flooding across the City
- Provides one general number for each hexagon
- Factors can vary based on agency recommendations

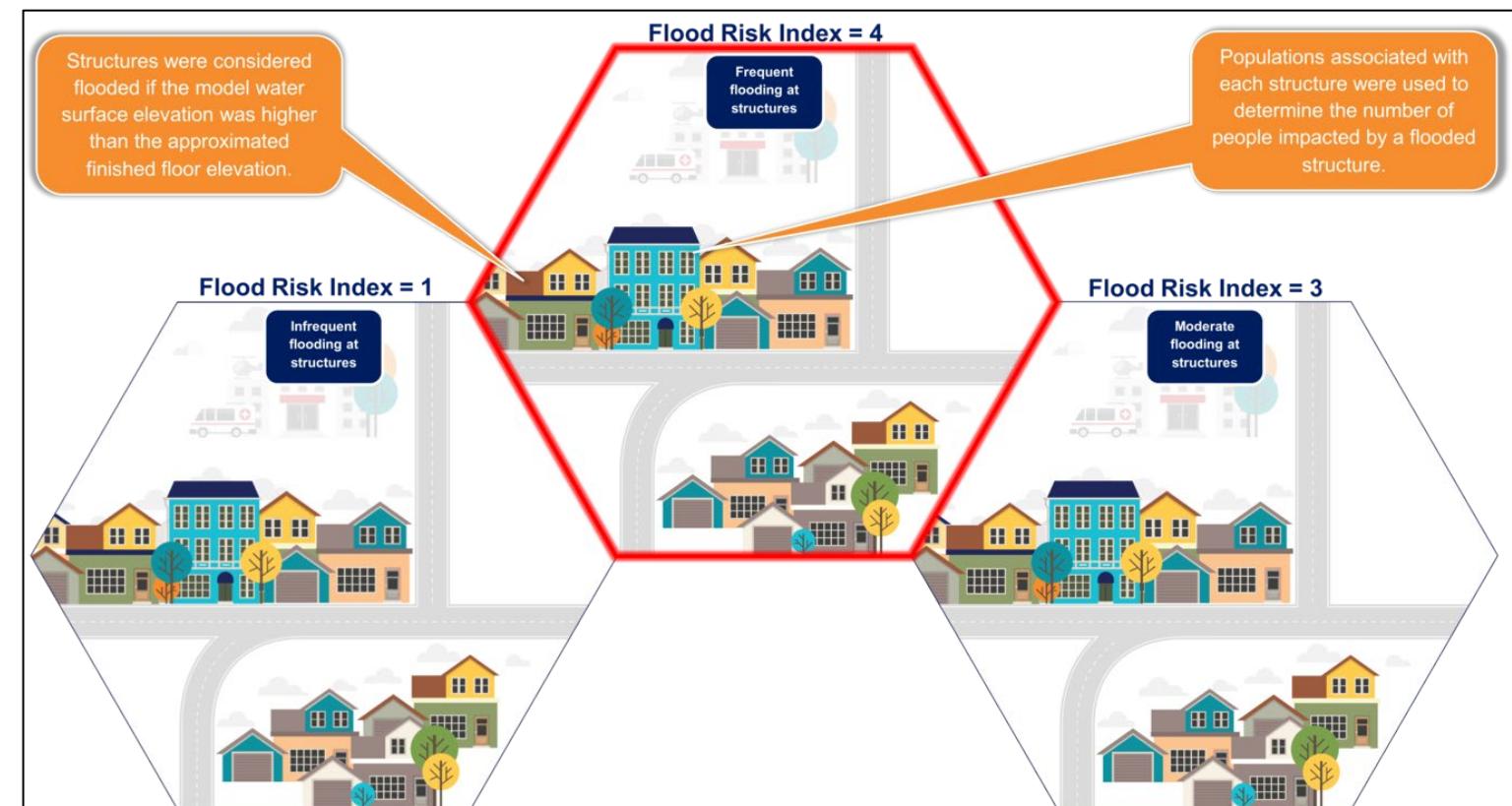




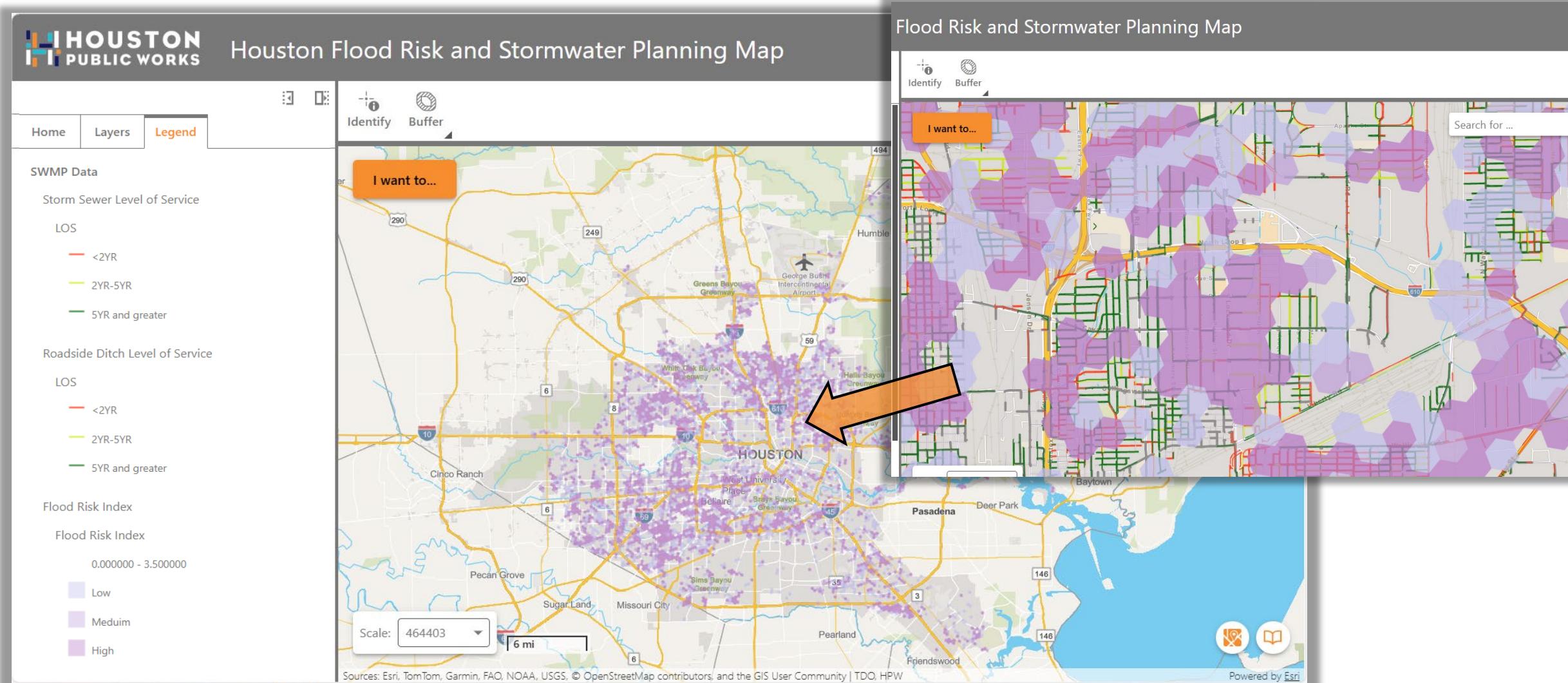
INSTANCE FACTOR AND FLOOD RISK INDEX

Available Data

- Structural Instances
 - FFE
 - Population
 - Critical Facilities
- Roadway Instances
 - Centerline Elevations
 - $\geq 6''$ of Ponding



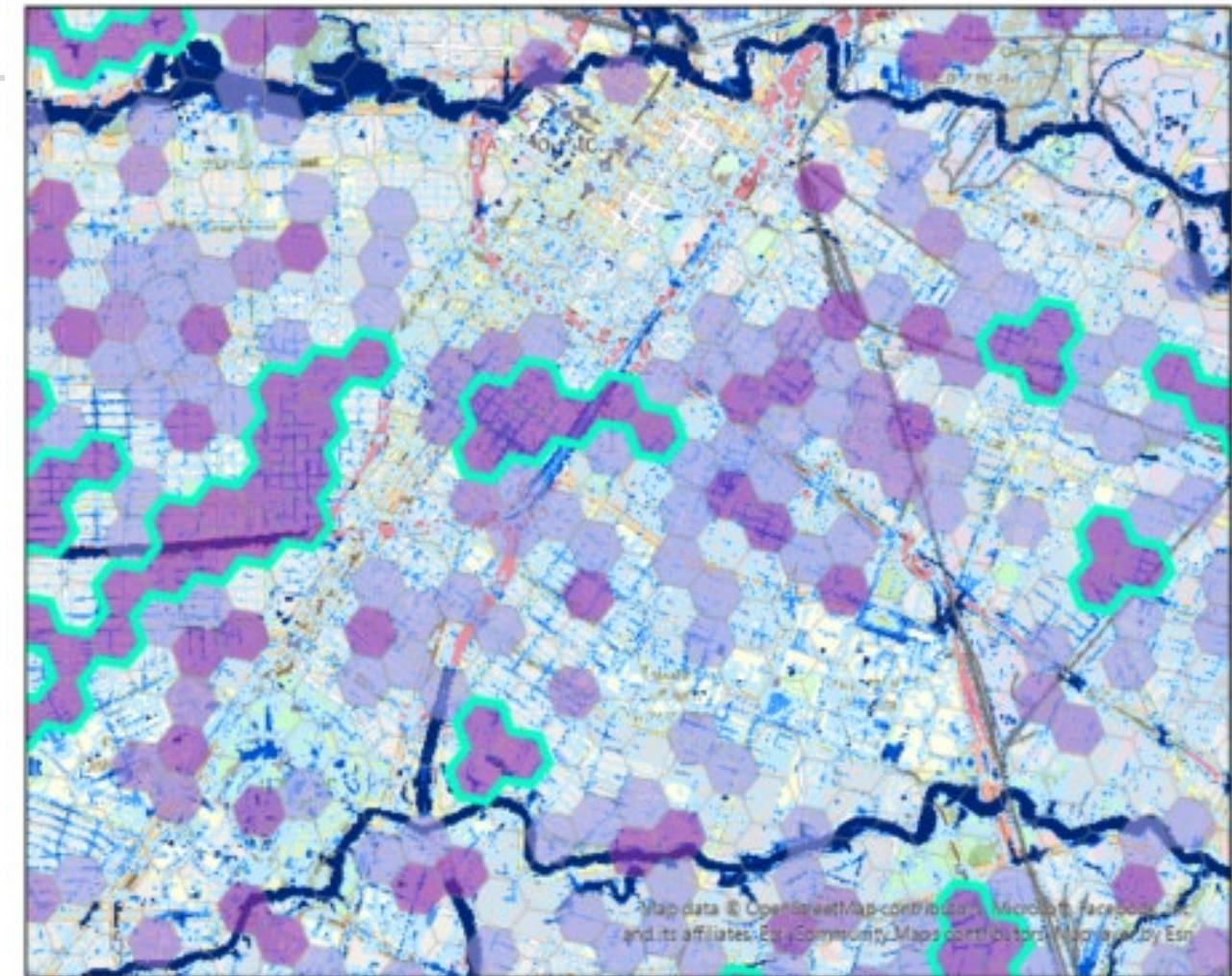
FLOOD RISK INDEX



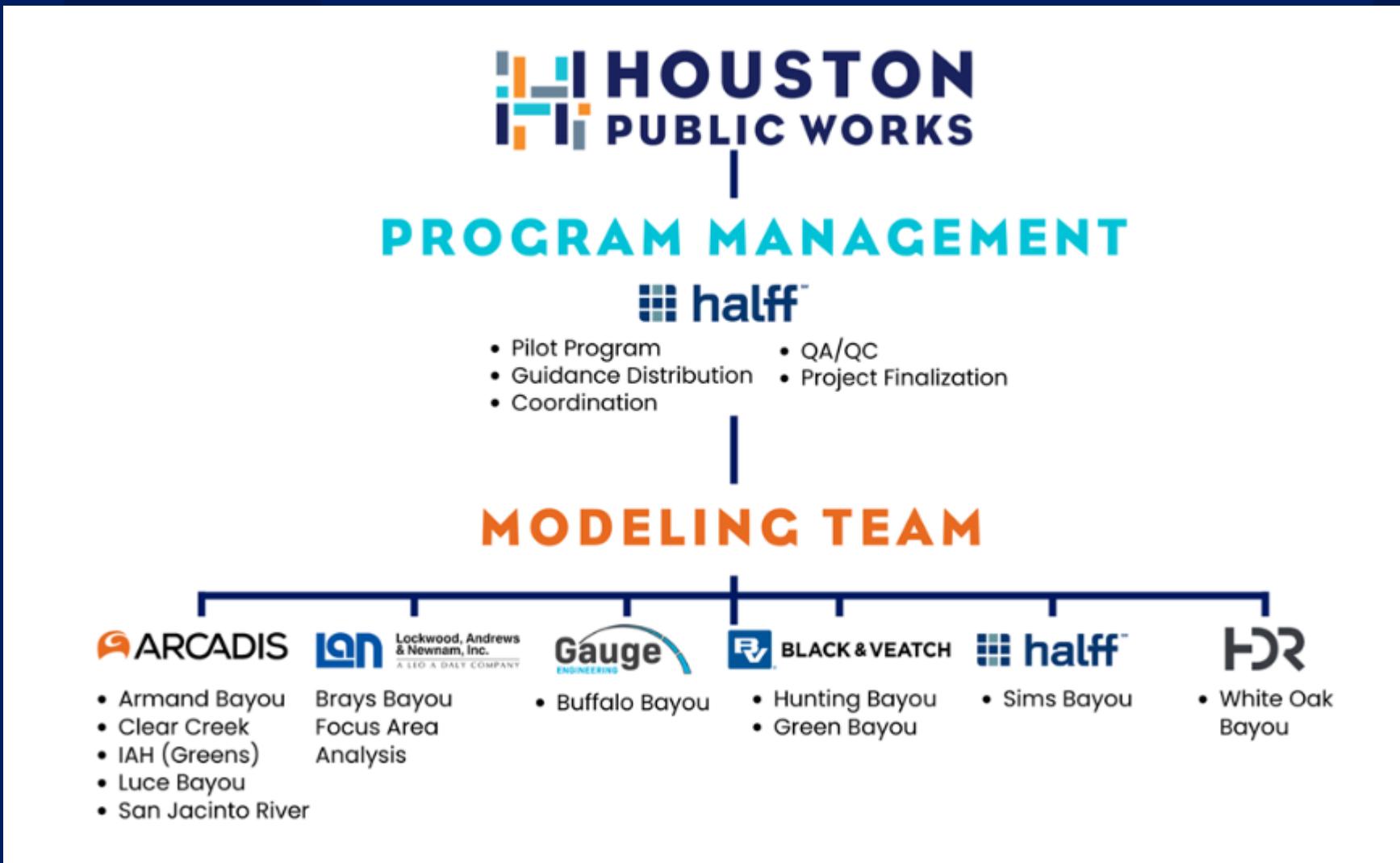
WHAT'S NEXT

Prioritization

- Fous Areas
 - Cluster FRI based on set threshold
- Additional Factors:
 - Socioeconomic Variables (SVI, LMI, etc.)
 - Review Public Works Critical Facilities
 - Open Channel Floodplain Influence



PROJECT TEAM



THANK YOU

www.houstonpublicworks.org/houston-stormwater-master-plan