GLO River Basin Flood Study
Central Region

Texas Integrated Flooding Framework
Brown Bag Series

Commissioner Dawn Buckingham, M.D.

Central Region Team

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Agenda

- Study Overview
- Central Region Baseline Model Coverage
- Modeling Methodology & Assumptions
  - Riverine
  - Coastal
- Key Findings/Limitations
- Data & Models Query Tool (DMQT)
  - Accessing RBFS Models in TDIS
- Hot Spot Analysis
- Alternative Analysis
- Next Steps

Study Overview

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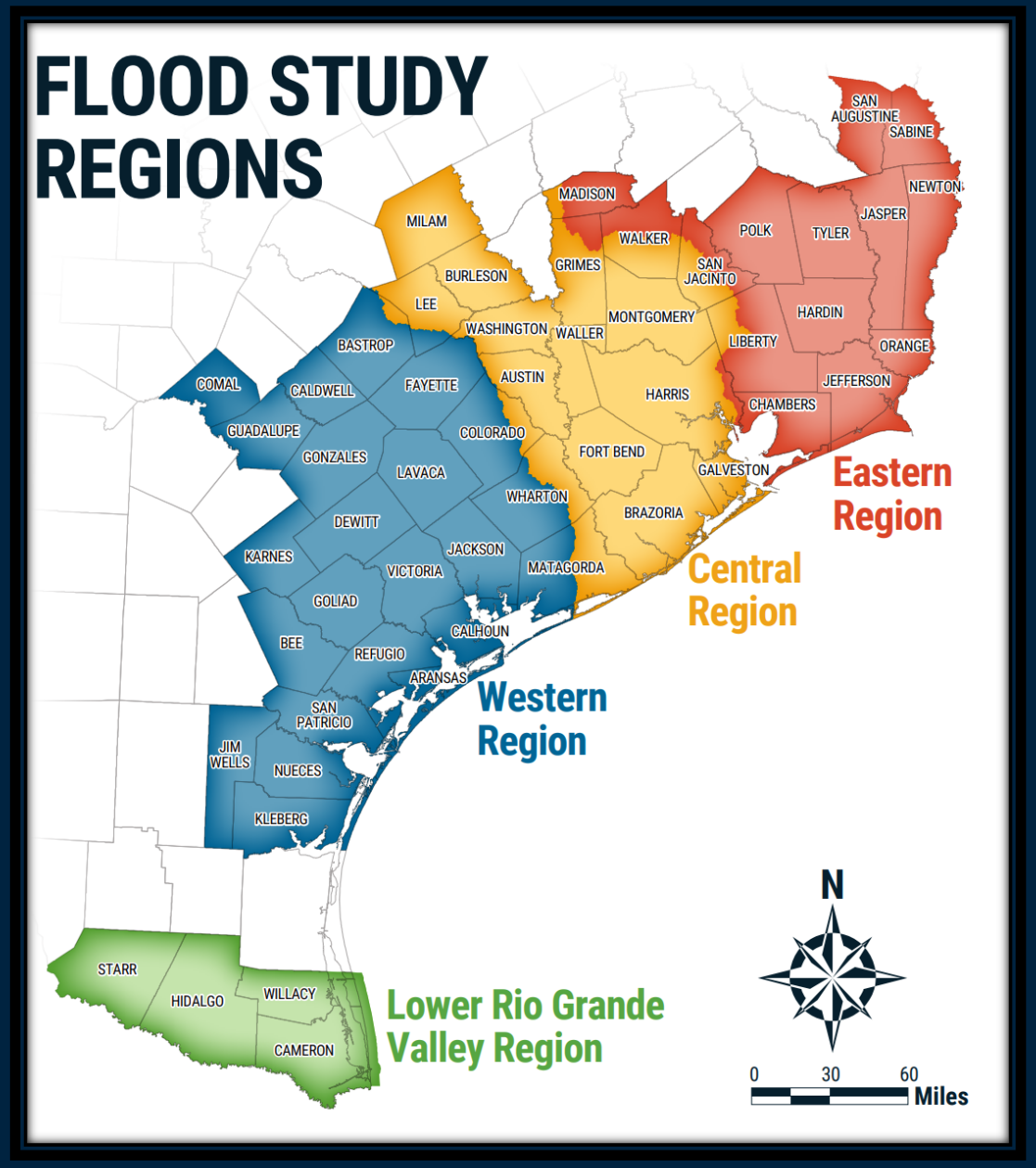
GLO's River Basin Flood Studies (RBFS)

The Texas General Land Office (GLO) initiated the RBFS to provide declared disaster-impacted counties with flood modeling that identifies flooding hotspots and supports project development. The goals for the flood study are to:

- Develop modeling to support flood mitigation and understanding of flood risk
- Identify large-scale or regional flood projects that strengthen the resilience of our communities
- Align identified projects with funding opportunities

This is a one-time planning effort, and the data produced by RBFS will also be used to support current and future Texas State Regional Flood Plans.



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Study Phases

Central Region
Baseline Model Coverage

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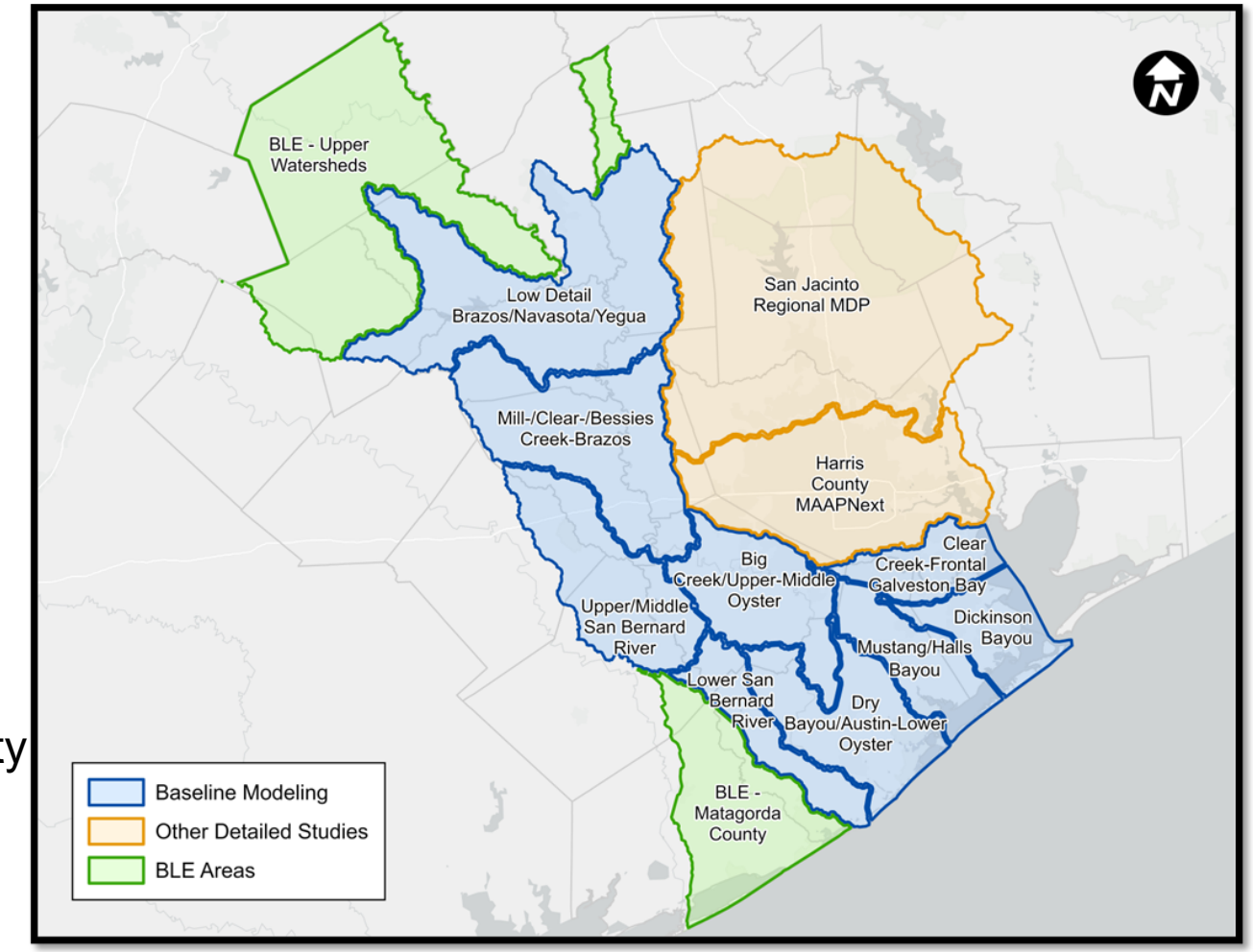
Model Coverage

- **Central Region RBFS Models**
  - Upper/Middle San Bernard
  - Lower San Bernard
  - Mill-/ Clear-/ Bessies Creek-Brazos River
  - Lower Brazos/Navasota/Yegua
  - Dry Bayou/Austin-Lower Oyster
  - Clear Creek-Frontal Galveston Bay
  - Dickinson Bayou
  - Big Creek/Upper-Middle Oyster
  - Mustang/Halls Bayou

- **Other Available Models**
  - BLE – Upper Watersheds and Matagorda County
  - San Jacinto Regional Master Drainage Plan
  - Harris County MAAPNext



Risk: Defensible & Credible Prioritization of Funding

Phase 2 Mitigation: Level of Detail commensurate with Level of Risk in Phase 3

Level of Risk *per watershed, refined in Phase 3*

Low Risk:

- Lower flood risk, rural areas, no gages, minimal RL/SRL, etc.

Detail:

- 2D BLE style model (rain-on-mesh) w/hydrologic losses in HEC-RAS
- HUC-10 scale or significant portion of watershed low level of detail

Medium Risk:

- Noticeable flood risk and major population centers or coastal areas
- Gages or risk on gaged streams
- Reservoirs, calibration, storm shifting

Detail:

- Includes most relevant structures, may still exclude low water crossings. May not include minor structures
- Calibrate to all gages, where available
- Reservoirs, calibration, storm shifting may be applicable

High Risk:

- Only in areas with previously identified USACE projects.

Detail:

- Additional uncertainty analysis
- Includes storm shifting

Level of Detail *per stream, refined per phase*

Modeling Methodology & Assumptions

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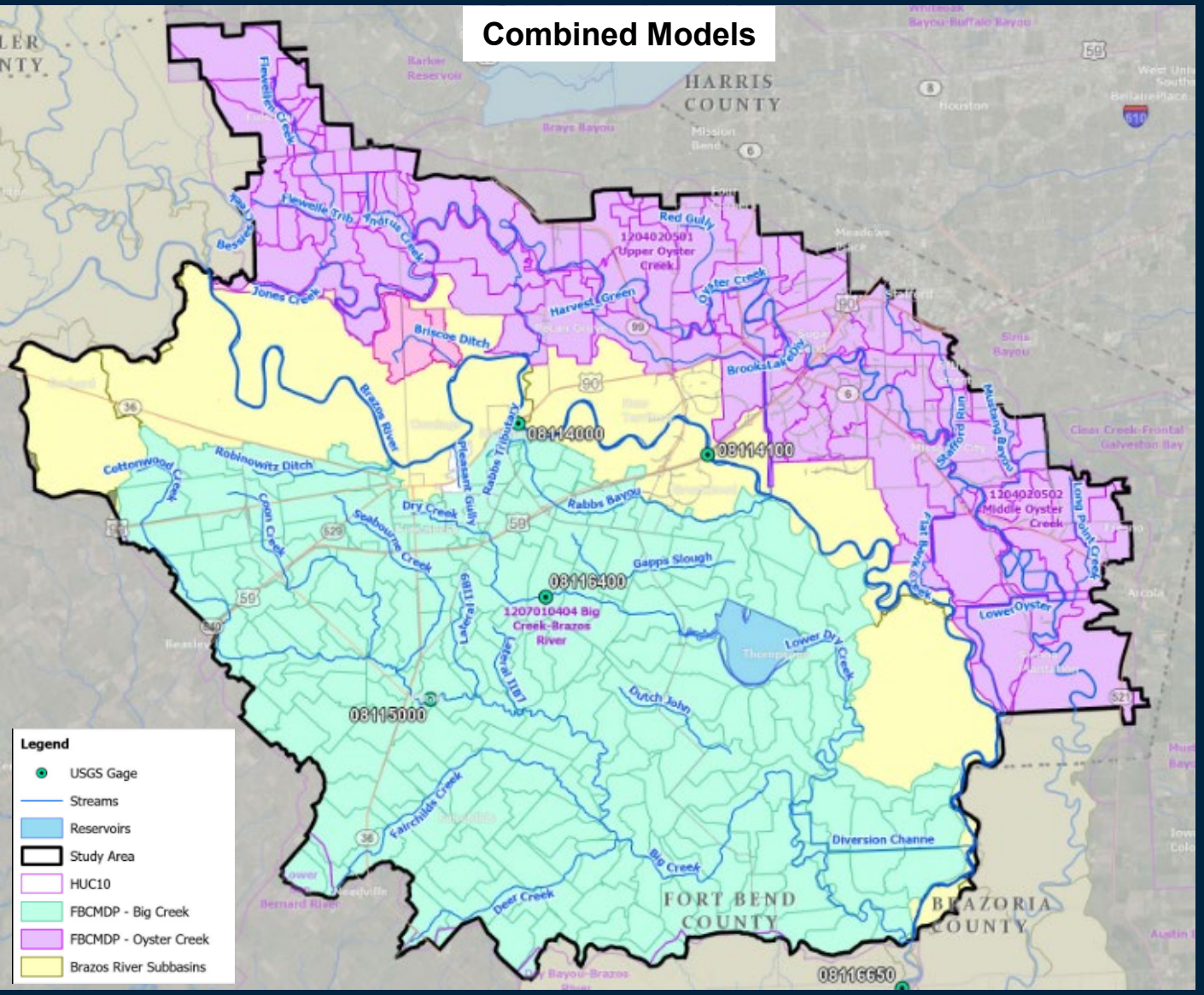
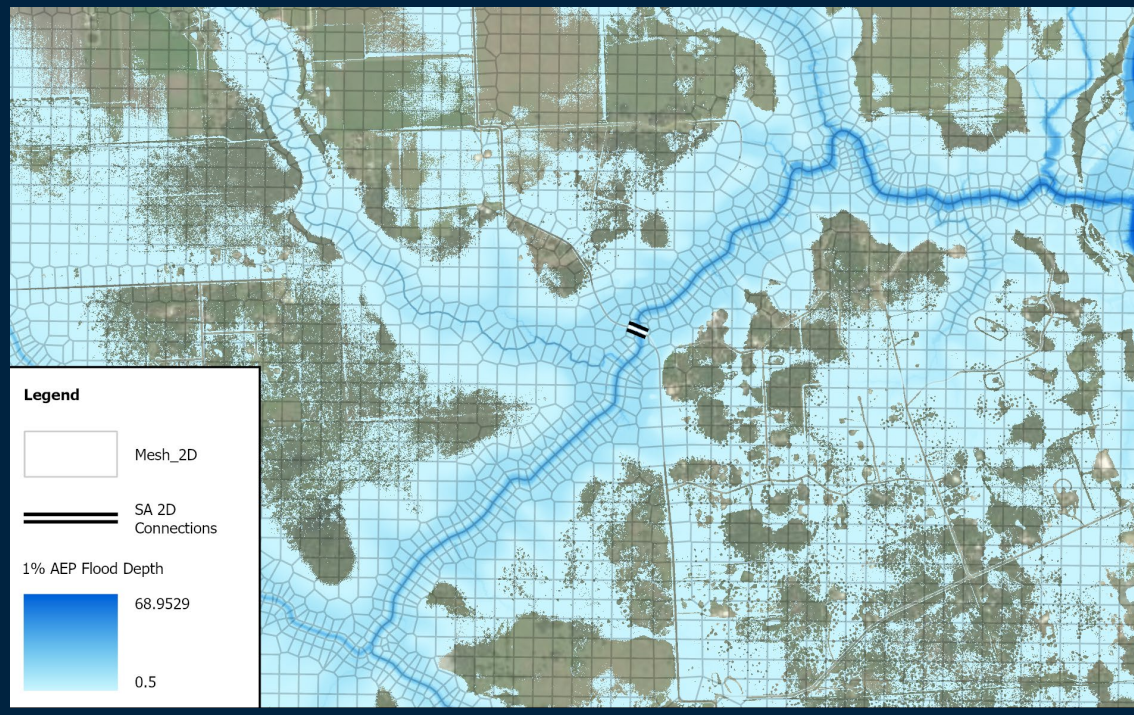
Hydrologic Model Setup

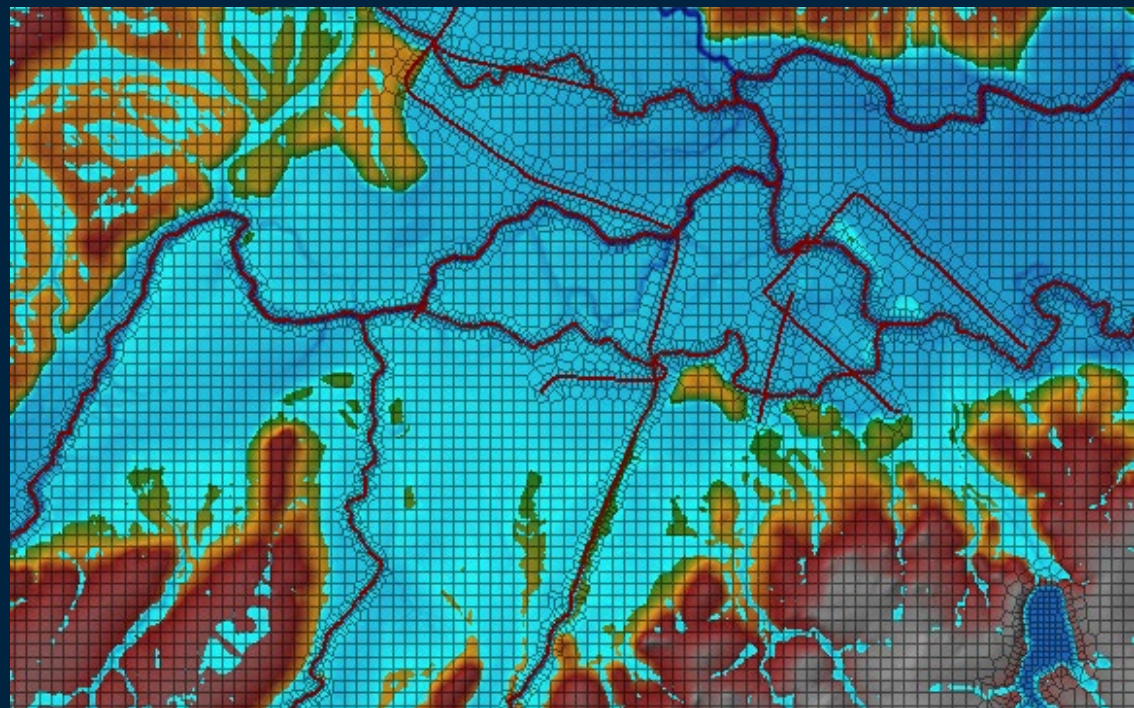


- Approach
  - Rain-on-mesh 2D for most areas (coastal, some riverine)
  - HMS + 2D RAS for some areas (riverine only)
  - Leveraged available existing models
  - Brazos River (elliptical storm) runs were run separately from local rainfall (Atlas 14) runs
- Methodology
  - Green & Ampt loss method
  - Clark Unit Hydrograph transform method
  - Mod. Puls routing (to align with RAS model)
- Data inputs
  - LiDAR from Texas GIO,USGS,developments
  - NLCD 2019
  - NOAA Atlas 14 (frequency rainfall)
  - NOAA Stage IV radar rainfall (historical rainfall)

Hydraulic Model Setup - Riverine

- Leveraged available existing 1D and 2D models
- Mesh geometry
  - LiDAR from Texas GIO, USGS, developments, available bathymetry
  - 200–300’ base cell size, with 50–100’ in refined areas and up to 600’ in coastal open water
  - Breaklines along streamlines and road networks
  - Roughness from NLCD 2019 + SLAMM plus manual refinements
- Bridges and culverts
  - Medium-detail: Included based on available as-builts or previous model data
  - Low-detail: Approximated using terrain modifications to establish hydrologic connectivity





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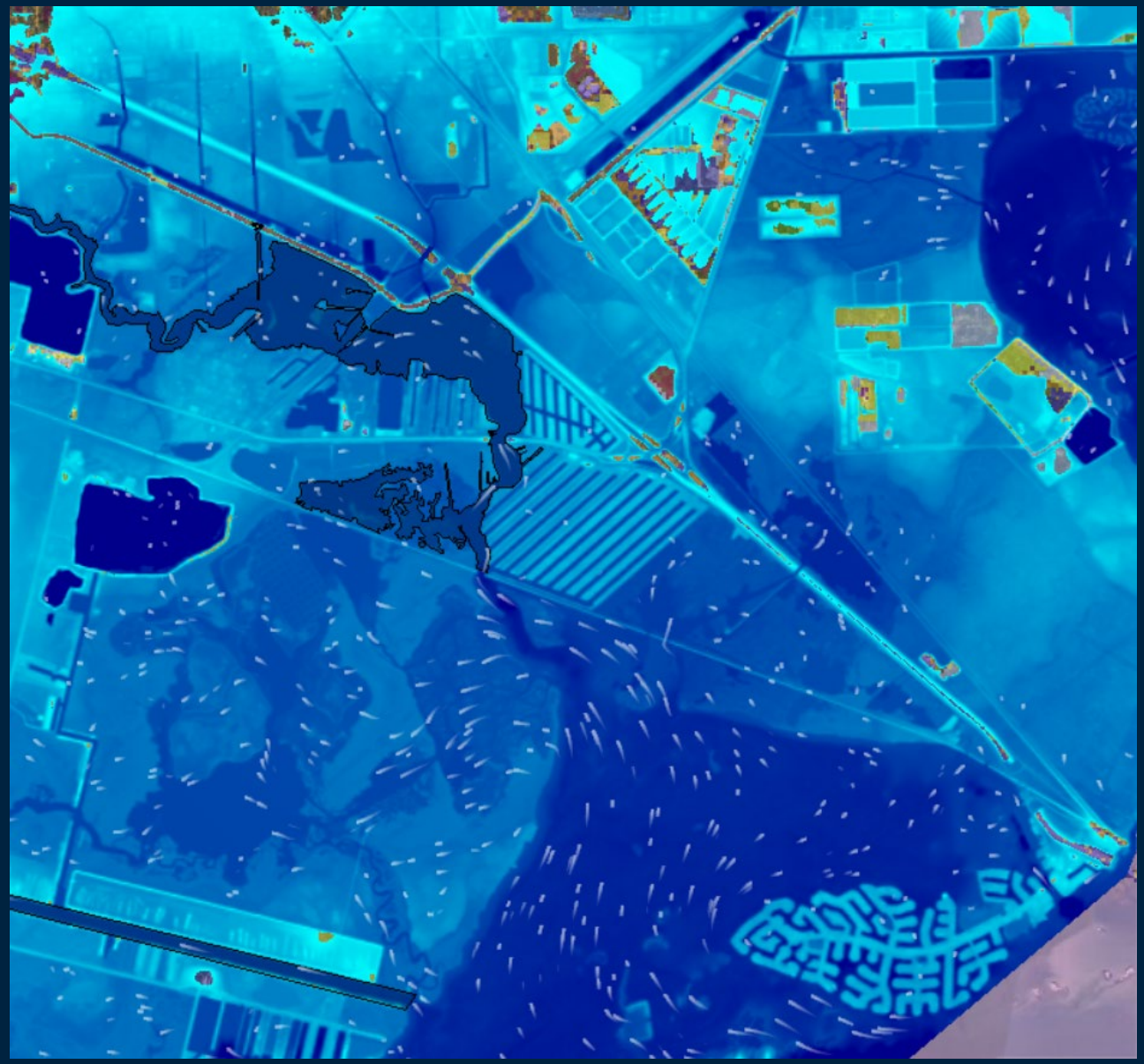
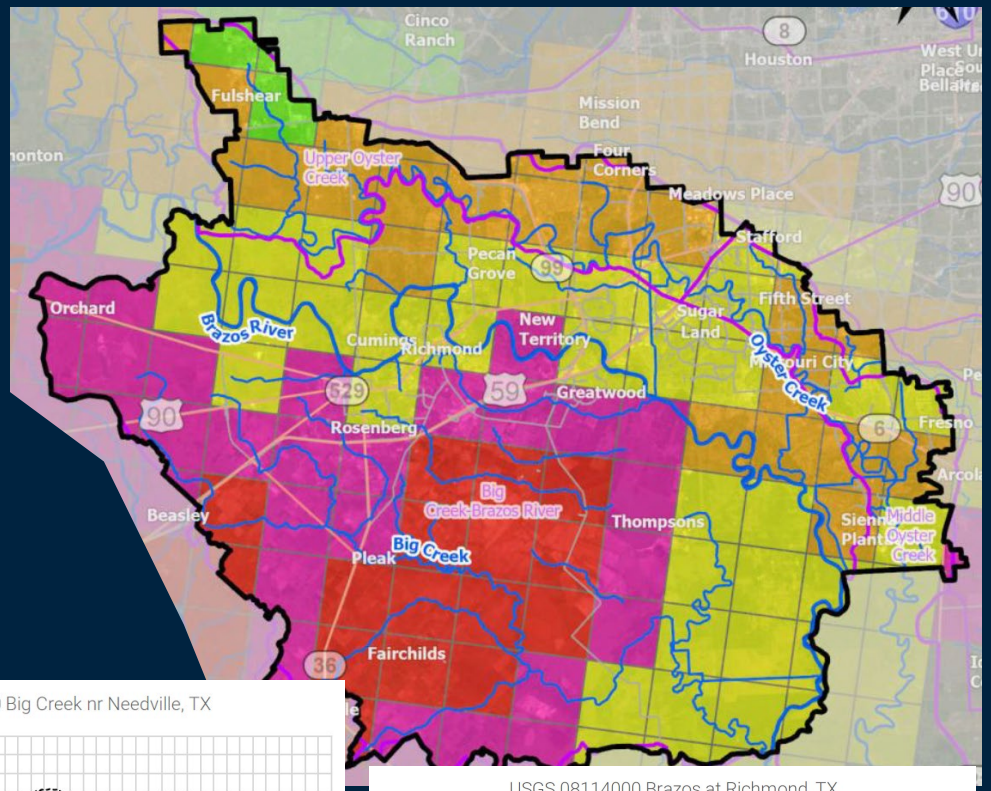
Coastal Modeling Considerations

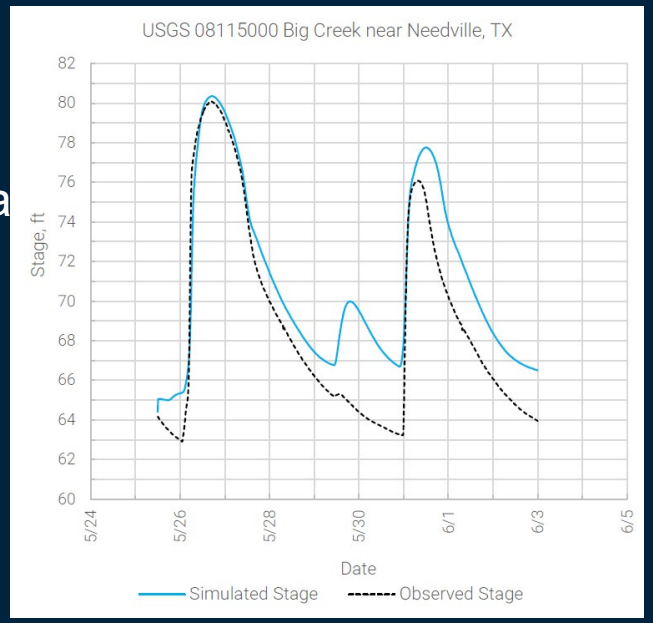
- **Multiple compound flooding scenarios** were modeled for each frequency storm (e.g. the 1% annual chance event)
  - Surge-dominated
  - Precipitation-dominated
  - Most likely
- Temporal patterns of rainfall and surge were taken from **Hurricane Harvey** or **Ike** and scaled to match **observed basin-averaged rainfall** and **observed non-tidal residual** at NOAA gages
- Additional historical storm patterns may be considered for future efforts

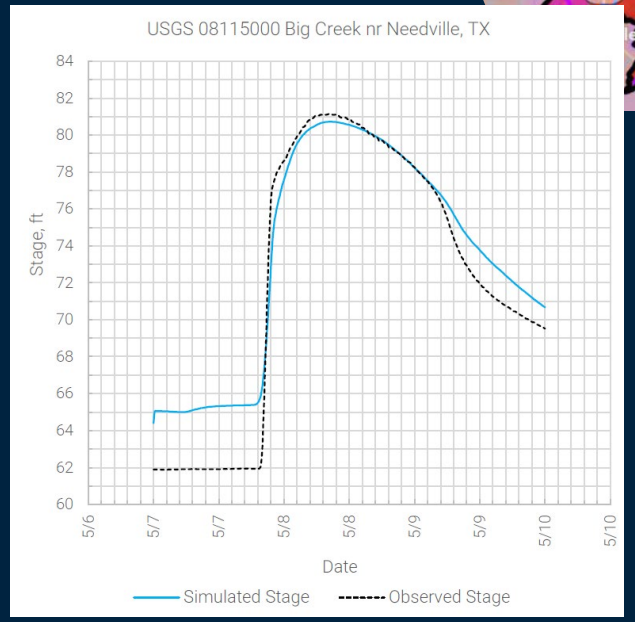


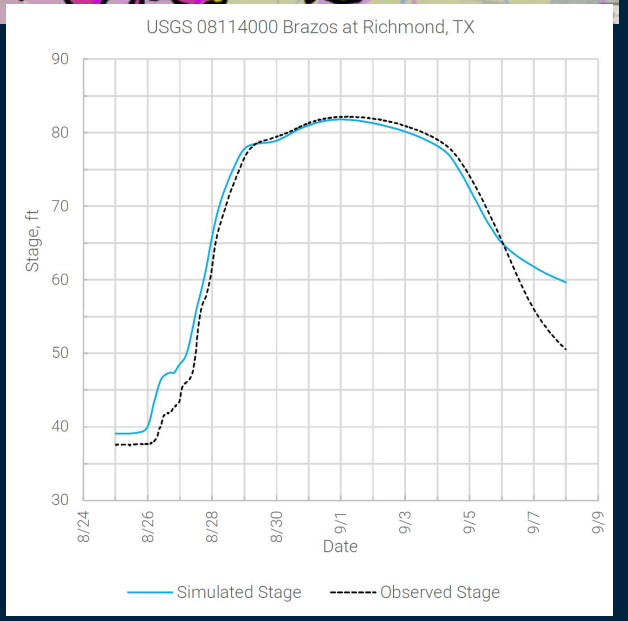
Calibration and Validation

- Models simulated with historical flow and precipitation data
- Calibrated to multiple storms based on observed stream gage data
- Historical events simulated generally include
  - Hurricane Harvey
  - Hurricane Ike
  - Hurricane Nicholas
  - Tropical Storm Imelda
  - Memorial Day 2015
  - Tax Day 2016
  - January 2019
  - May 2019
  - September 2020
  - May 2021









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Baseline Modeling Riverine Watersheds

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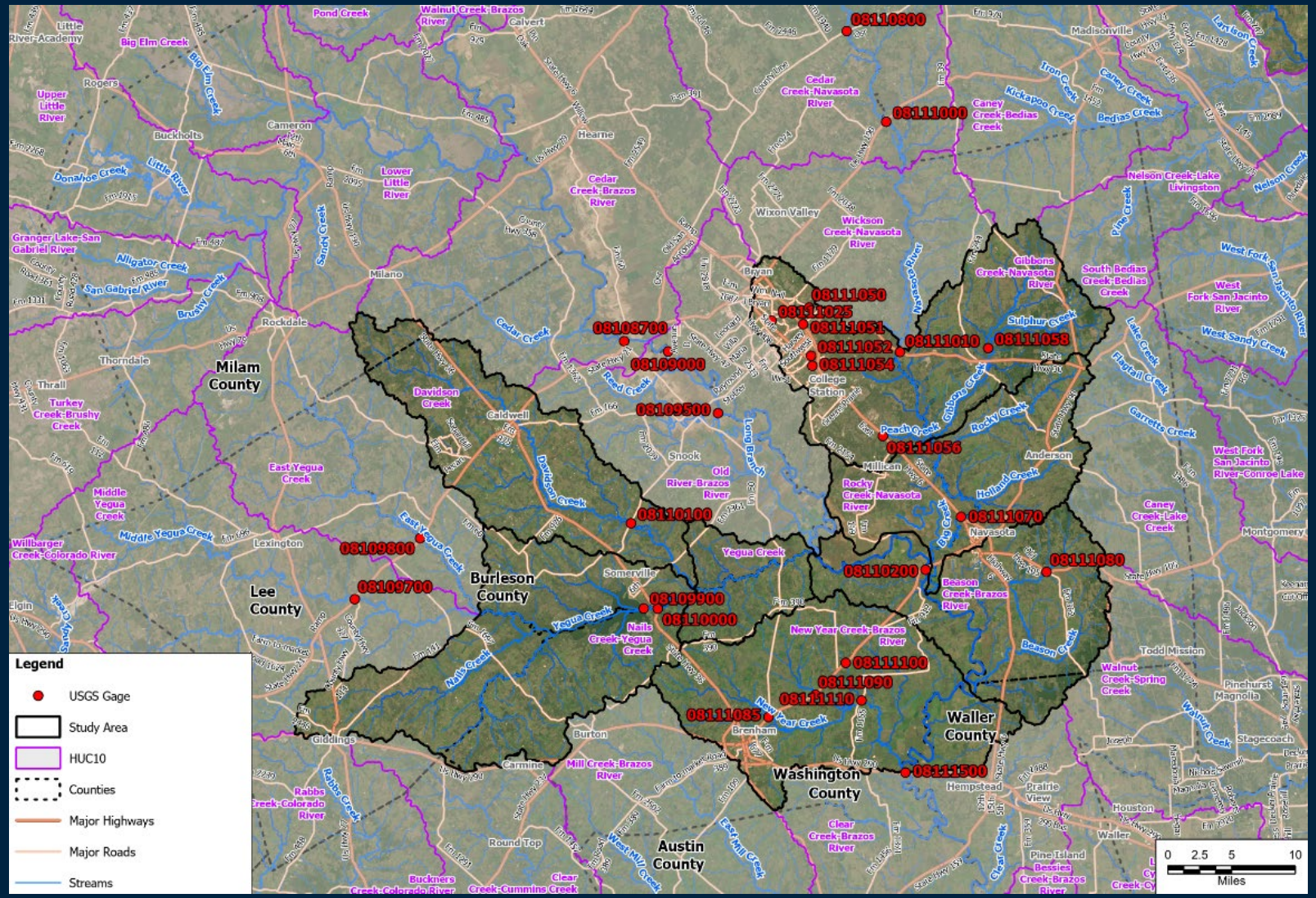
Study Area Overview - Lower Brazos/ Navasota/ Yegua



- Study Area includes six HUC10s – about 1,533square miles modeled in low detail
- Counties: Grimes, Washington, Brazos, Lee, and Burleson.
- Local and Brazos elliptical storms
  - 50, 20, 10, 4, 2, 1, and 0.2% events
- Validation events
  - Harvey, May 2017, April 2017, March 2016

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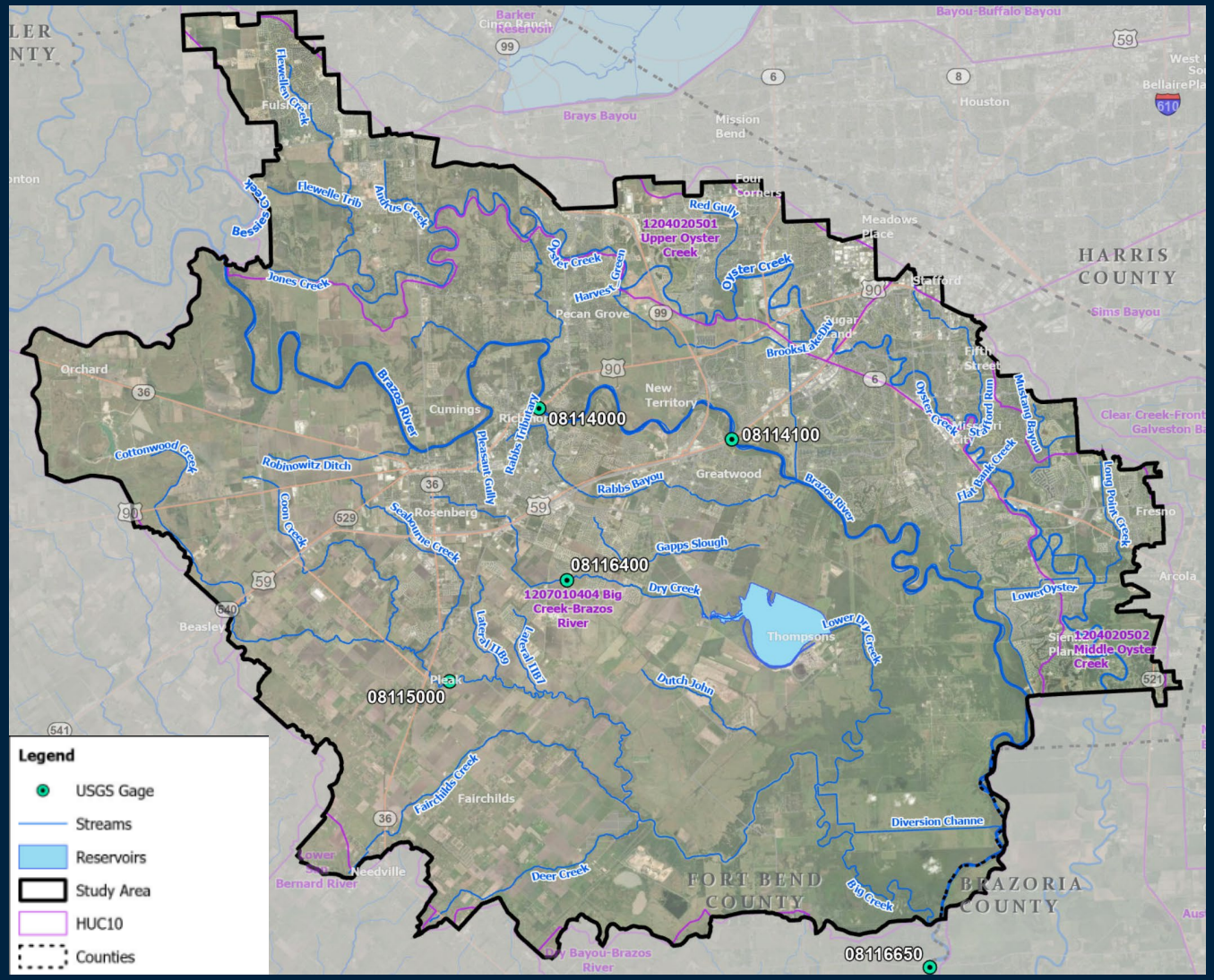
Study Area Overview - Big Creek/Upper -Middle Oyster



- Major streams: Brazos River, Oyster Creek, Jones Creek, Big Creek
- Mostly in Fort Bend County
- Many flood mitigation measures in place (levees, pump stations)
- Interior leveed areas not modeled
- Local and Brazos elliptical storms
  - 50, 20, 10, 4, 2, 1, and 0.2%
- Calibration/validation events
  - Harvey, Memorial Day 2015, Tax Day 2016, January 2019, and May 2019

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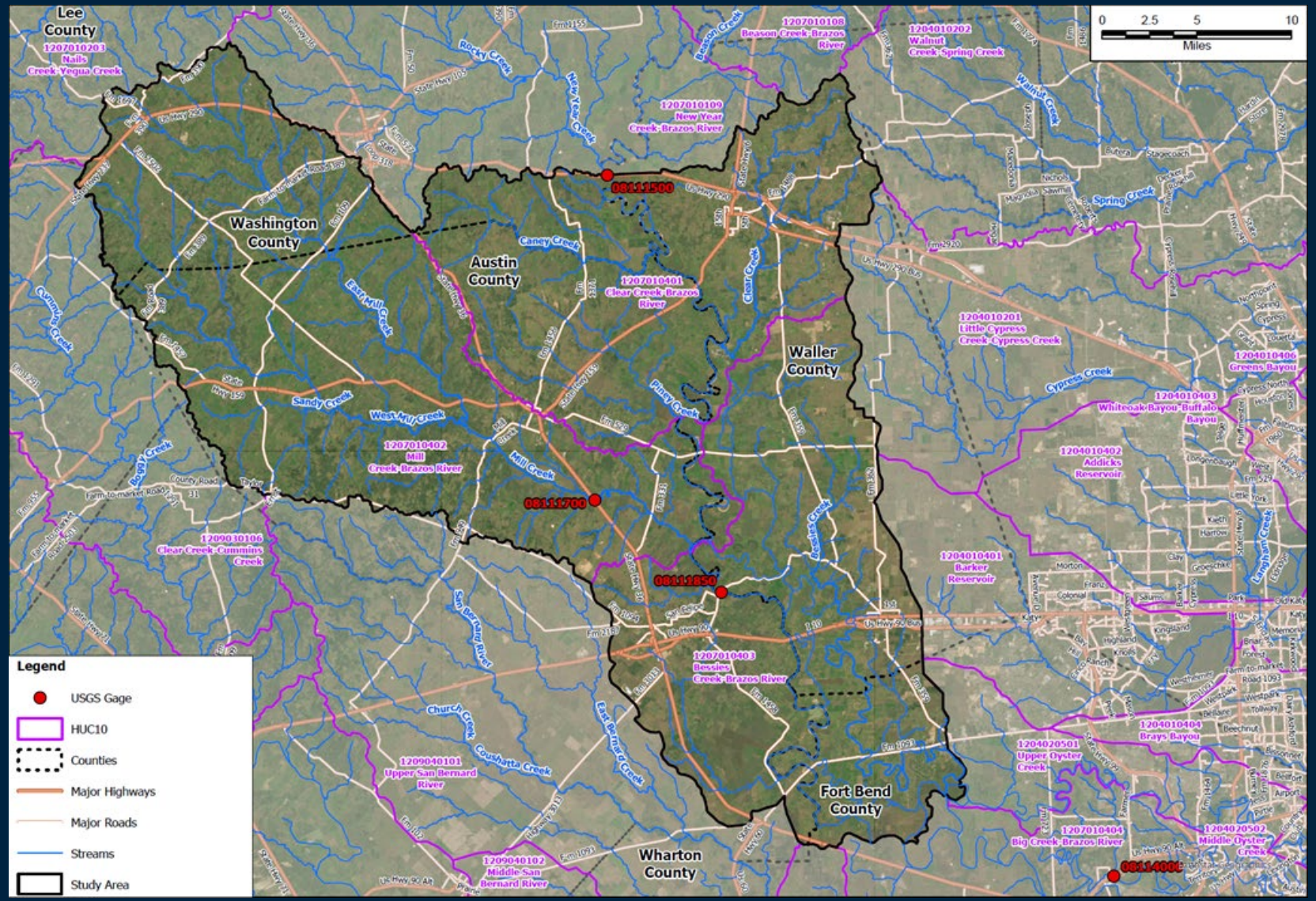
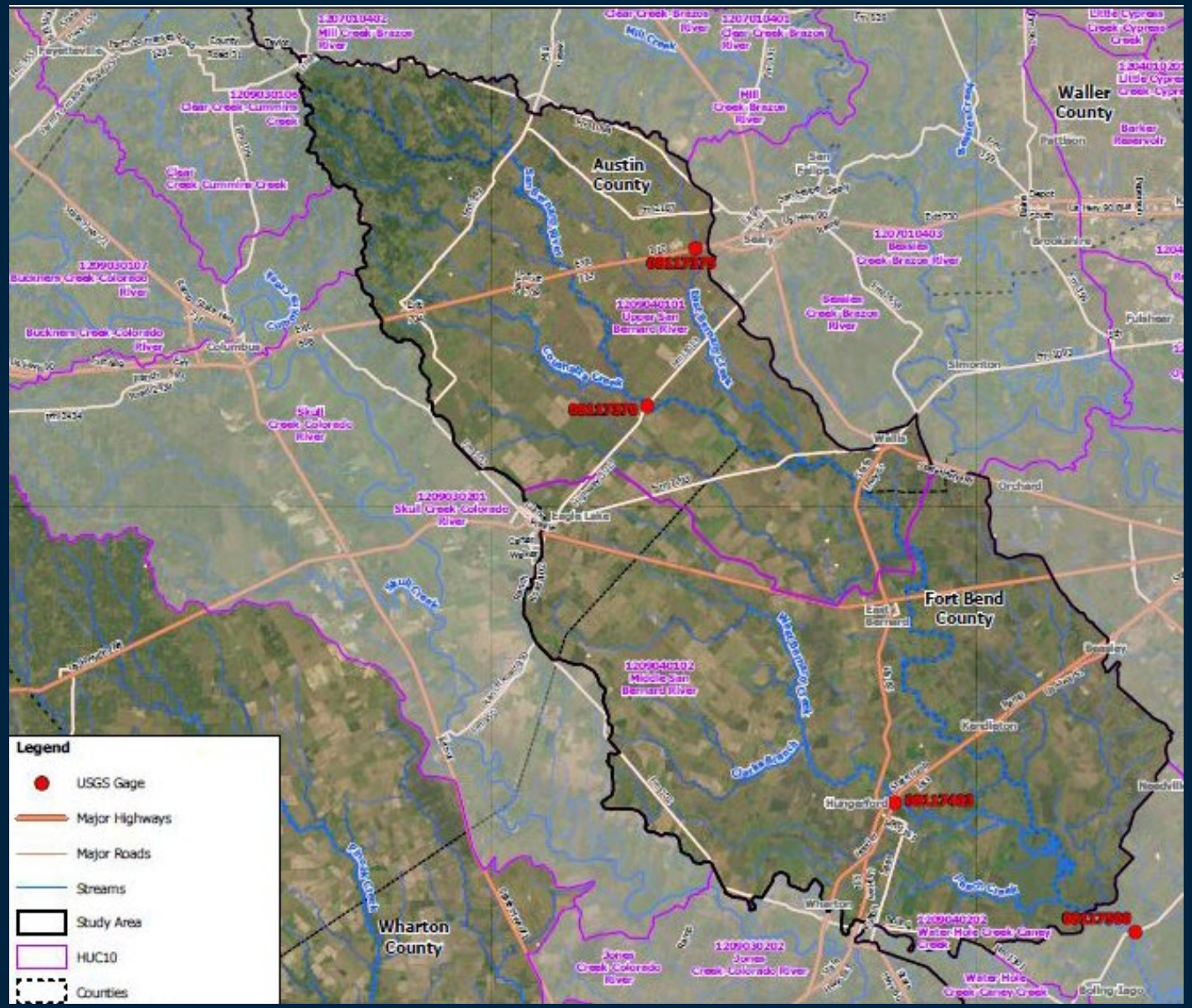
Study Area Overview - Mill-/Clear-/Bessies Creek-Brazos River



- Major Streams: Mill Creek, Brazos River, Clear Creek (low detail), Bessies Creek
- Counties: Washington, Austin, Waller, and Fort Bend
- Local and Brazos elliptical storms
  - 50, 20, 10, 4, 2, 1, and 0.2%
- Calibration/validation events
  - Harvey, May 2016, June 2021, May 2015, May 2019
  - Only two USGS gages in service for 10+ years

Study Area Overview - Upper/Middle San Bernard



- Major Streams: San Bernard River, West Bernard Creek, East Bernard Creek
- Counties: Colorado, Austin, Fort Bend, and Wharton
- Land Use is over 80% Pasture and Crops
- Colorado River overflow at Wharton during Harvey
- Calibration/validation events
  - Harvey, April 2016, May 2021, June 2015, June 2019
  - Only one USGS gage in service for 10+ years

Baseline Modeling Coastal Watersheds

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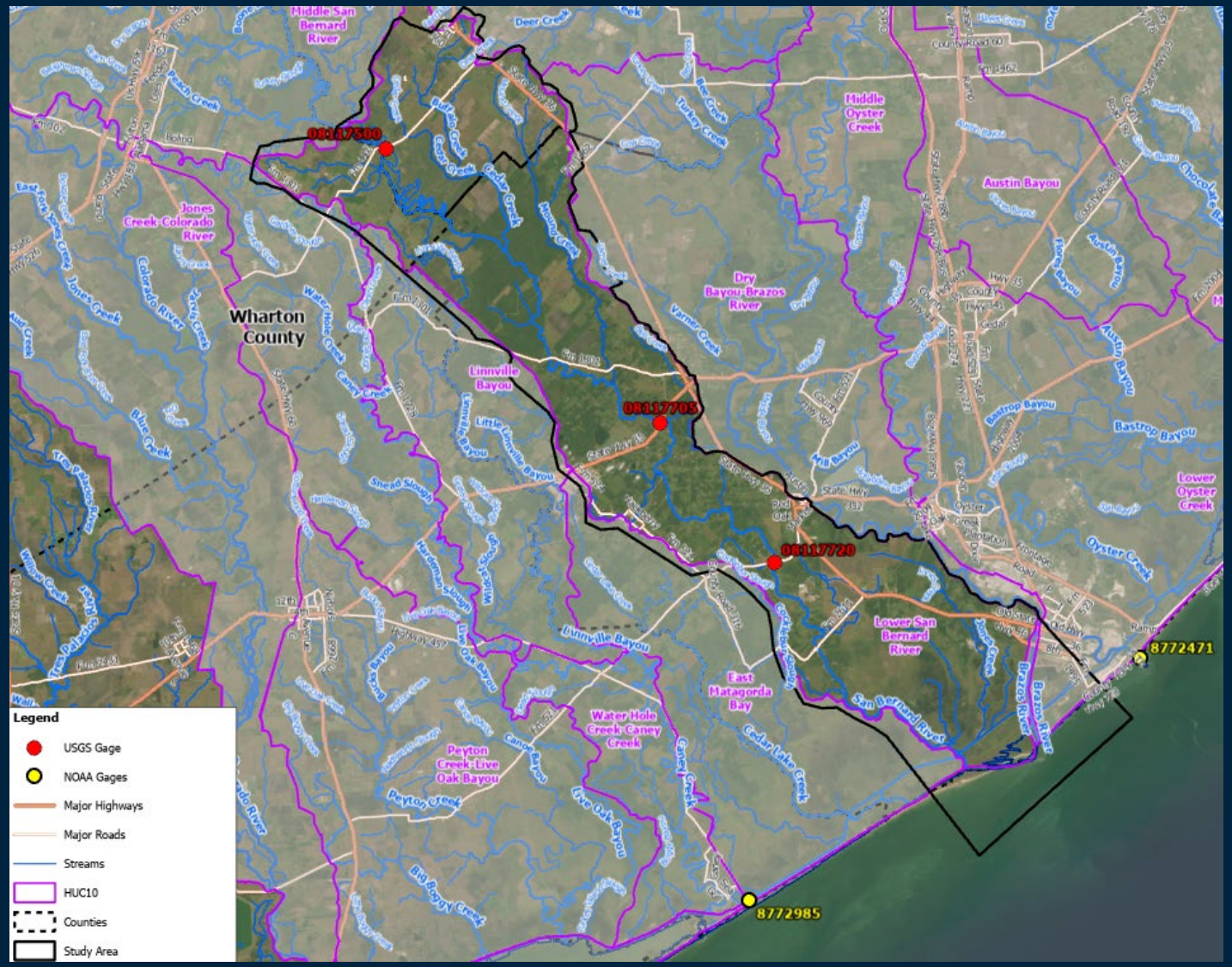
Study Area Overview Map



- Counties: Brazoria, Fort Bend, Wharton
- Watershed includes major streams: San Bernard River (SBR), Jones Creek, Ceda Creek, Buffalo Creek, Mound Creek
- Flood Risks:
  - Primarily riverine and precipitation-driven
  - Surge events within lower portion of HUC-10 and Jones Creek
  - Brazos River overflows

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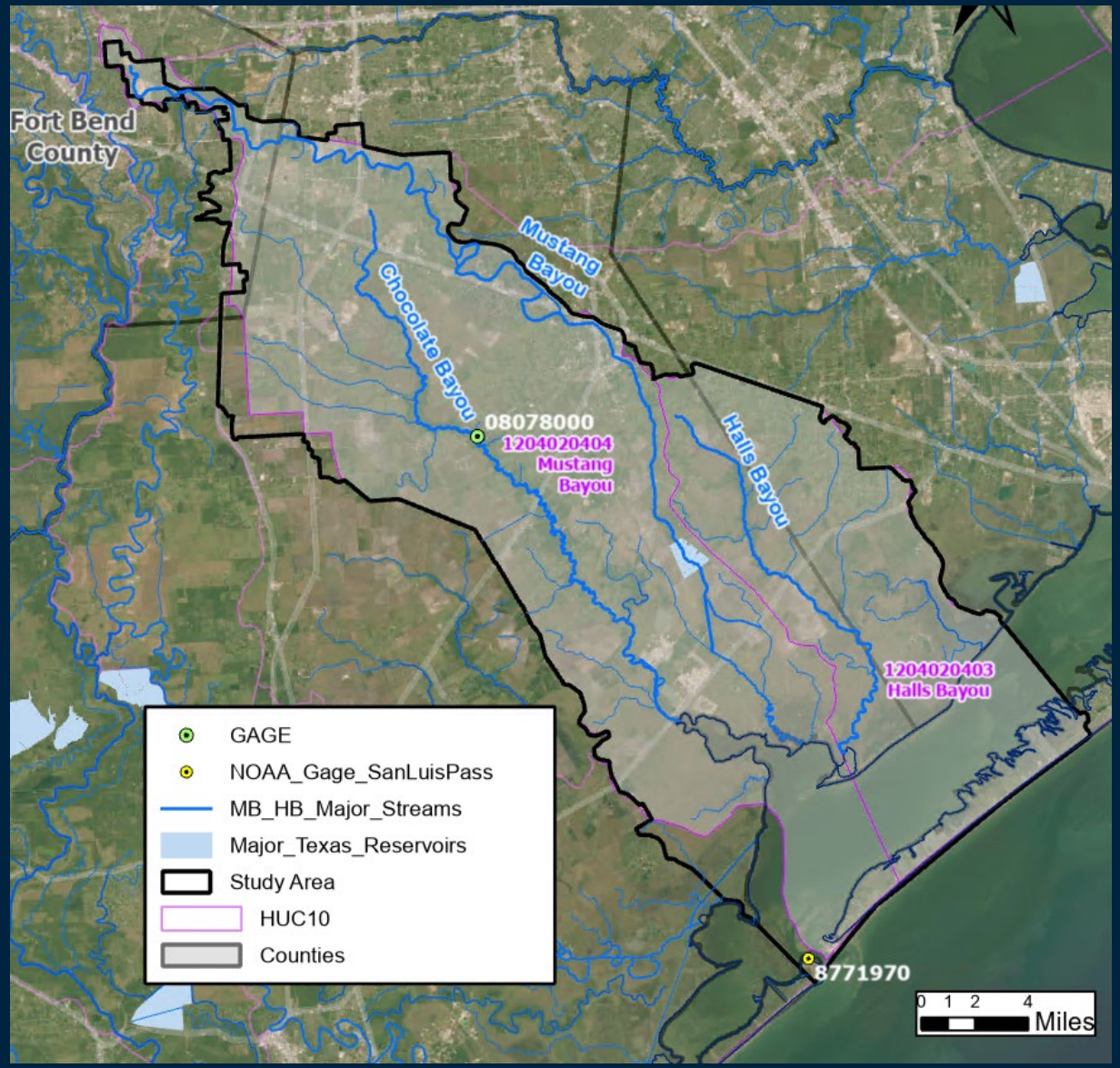
Study Area Overview - Mustang/Halls Bayou



- Major Rivers: Mustang Bayou, Chocolate Bayou, Halls Bayou
- Counties: Brazoria, Galveston, and Fort Bend
- Some flood mitigation measures in place (levees)
- Local and coastal storms
  - 10, 2, 1, and 0.2% (surge and precip dominated, most-likely, and Atlas 14)
- Calibration/validation events
  - Harvey, May 2016, June 2021, May 2015, May 2019
  - Runoff may be overestimated, likely due to radar rainfall uncertainty

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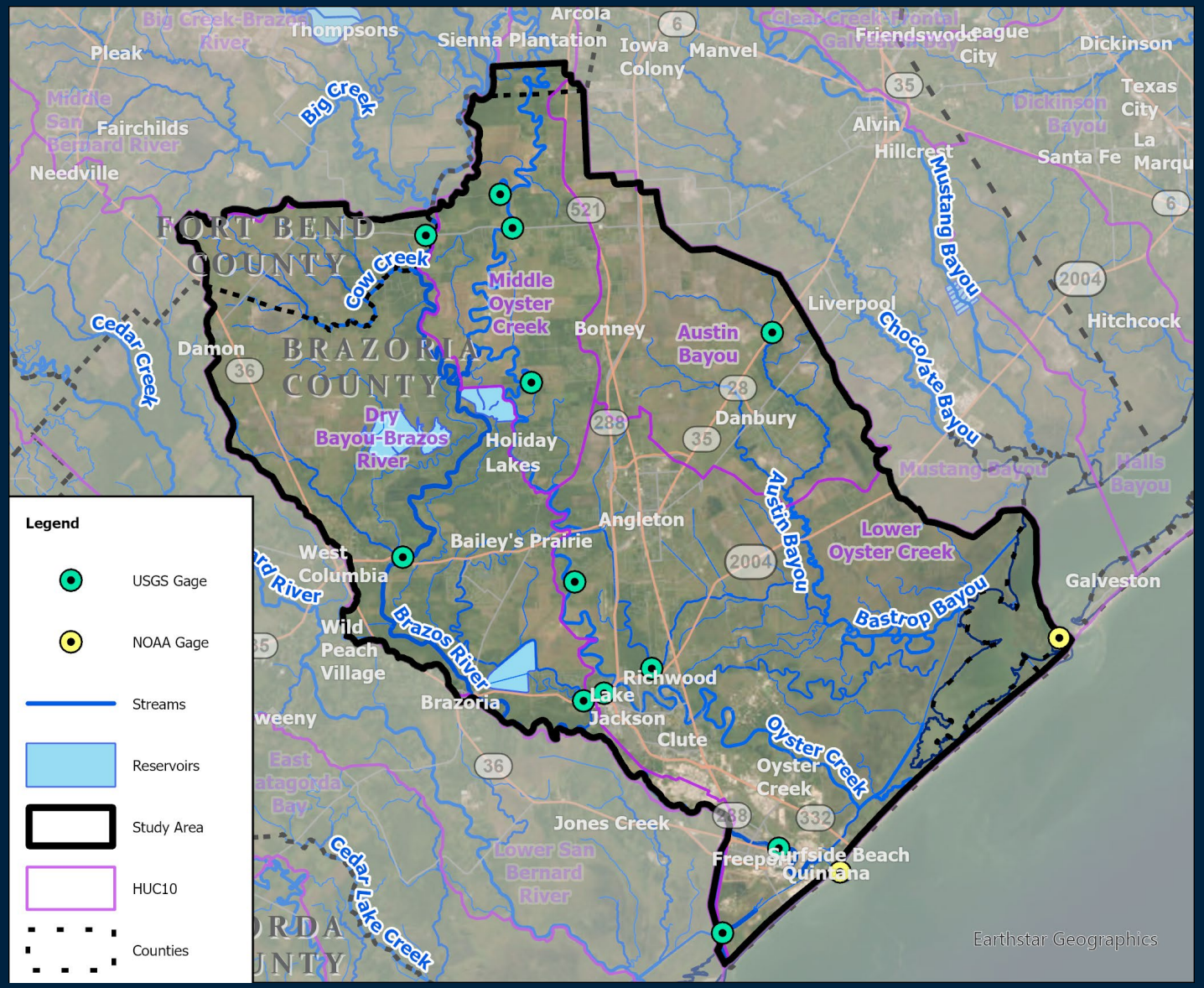
Study Area Overview - Dry Bayou/Austin -Lower Oyster



- Major streams: Brazos River, Oyster Creek, Austin Bayou
- Counties: Brazoria and Fort Bend
- Many significant features and existing mitigation measures (water supply reservoirs, levees, pump stations)
- Local and coastal storms
  - 10, 2, 1, and 0.2% (surge and precip dominated, most-likely, and Atlas 14)
- Calibration/validation events
  - Harvey, Ike, Beta, Nicholas, Imelda, June 2021

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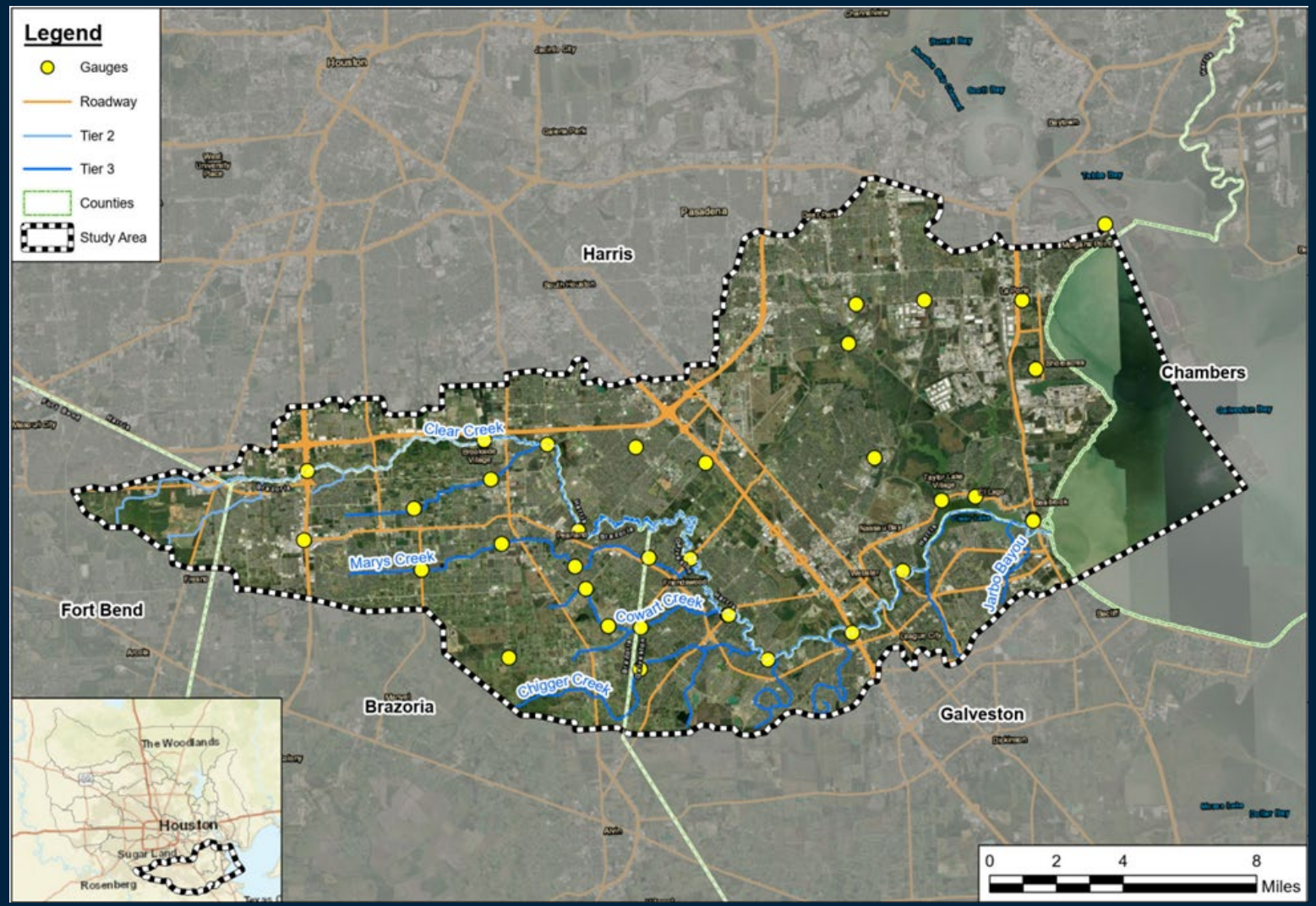
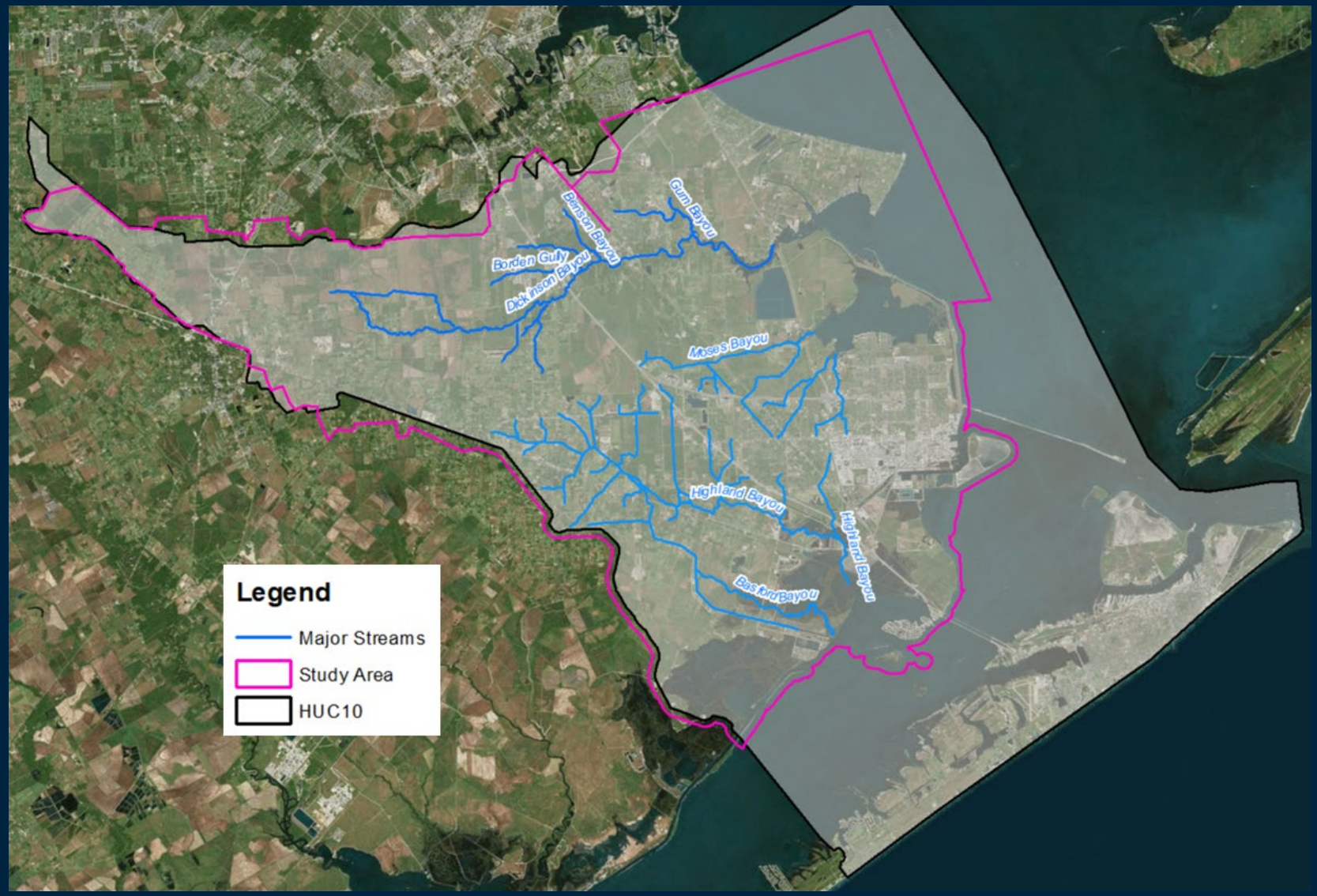
Study Area Overview - Clear Creek-Frontal Galveston Bay



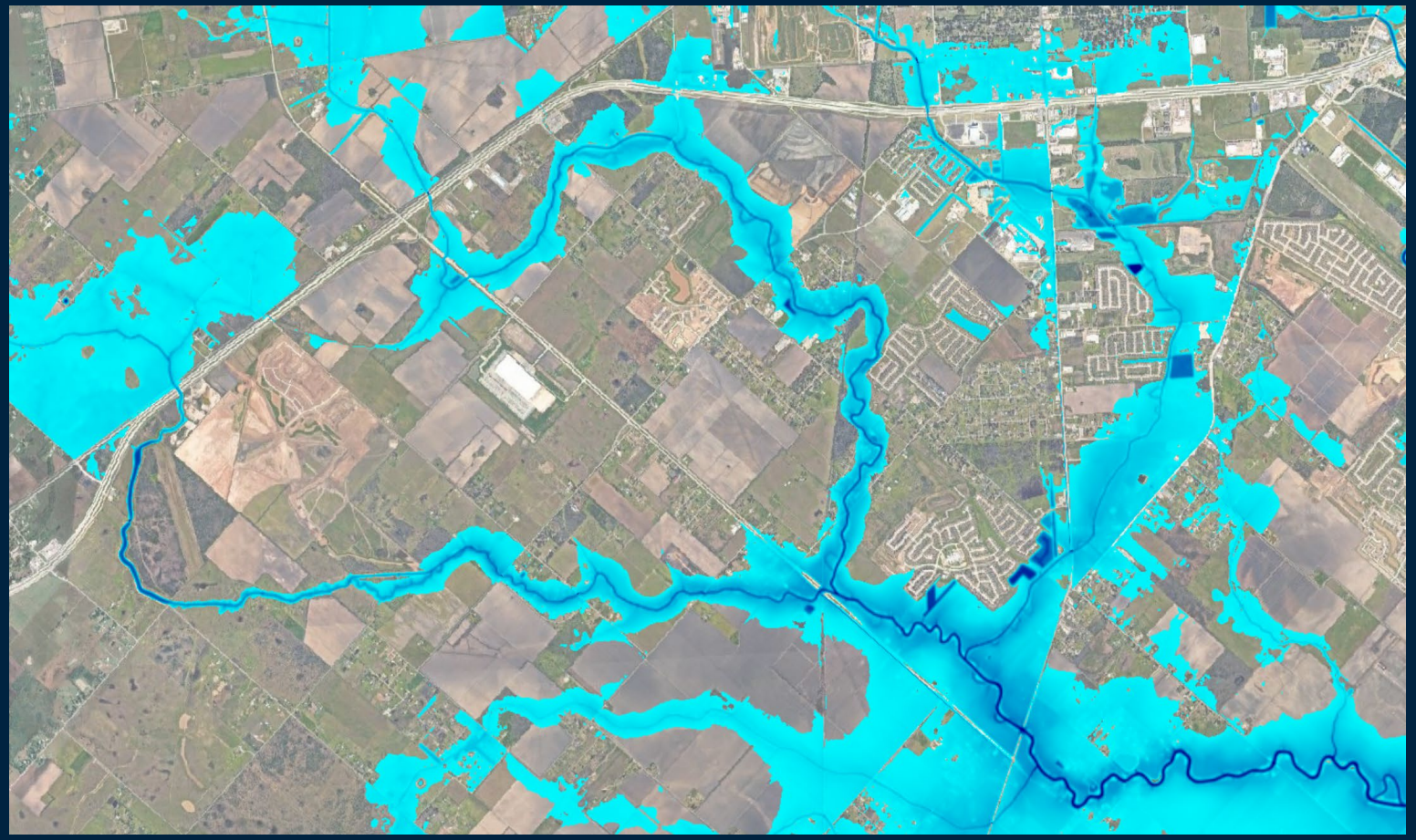
- Major Streams
  - Clear Creek & Tributary (Mary's Creek, Cowart Creek, Chigger Creek, Jarob Bayou)
  - Armand Bayou
- Counties: Harris, Galveston, Brazoria, Fort Bend
- Rapidly developing area
- Local and coastal storms
  - 10, 2, 1, and 0.2% (surge and precip dominated, most-likely, and Atlas 14)
- Calibration/validation events
  - Harvey, Ike, Beta, Nicholas, Imelda, June 2021

Study Area Overview - Dickinson Bayou



- Major Streams: Dickinson Bayou, Highland Bayou & Diversion Channel, Moses Bayou & Lake
- Counties: Galveston
- Local and coastal storms
  - 10, 2, 1, and 0.2% (surge and precip dominated, most-likely, and Atlas 14)
- Calibration/validation events
  - Allison, Ike, Imelda, Nicholas, Harvey
  - Uncertainty due to Moses Lake, pump station operations, bathymetry, lack of gages

Results – Riverine & Coastal



- 50%, 20%, 10%, 4% 2%, 1%, and 0.2% AEP inundation flood polygons developed for watershed
- Submittal contains
  - **Report** (PDF)
  - **Hydrologic models** (HEC-HMS)
  - **Hydraulic models** (HEC-RAS 2D)
  - **Spatial data** (Terrain, streams, model input data, and model output data including inundation boundaries, depth grids, water surface elevation grids)
  - **Supplemental data** (calculations and previous studies)
  - **QC documentation**

Key Findings/ Limitations

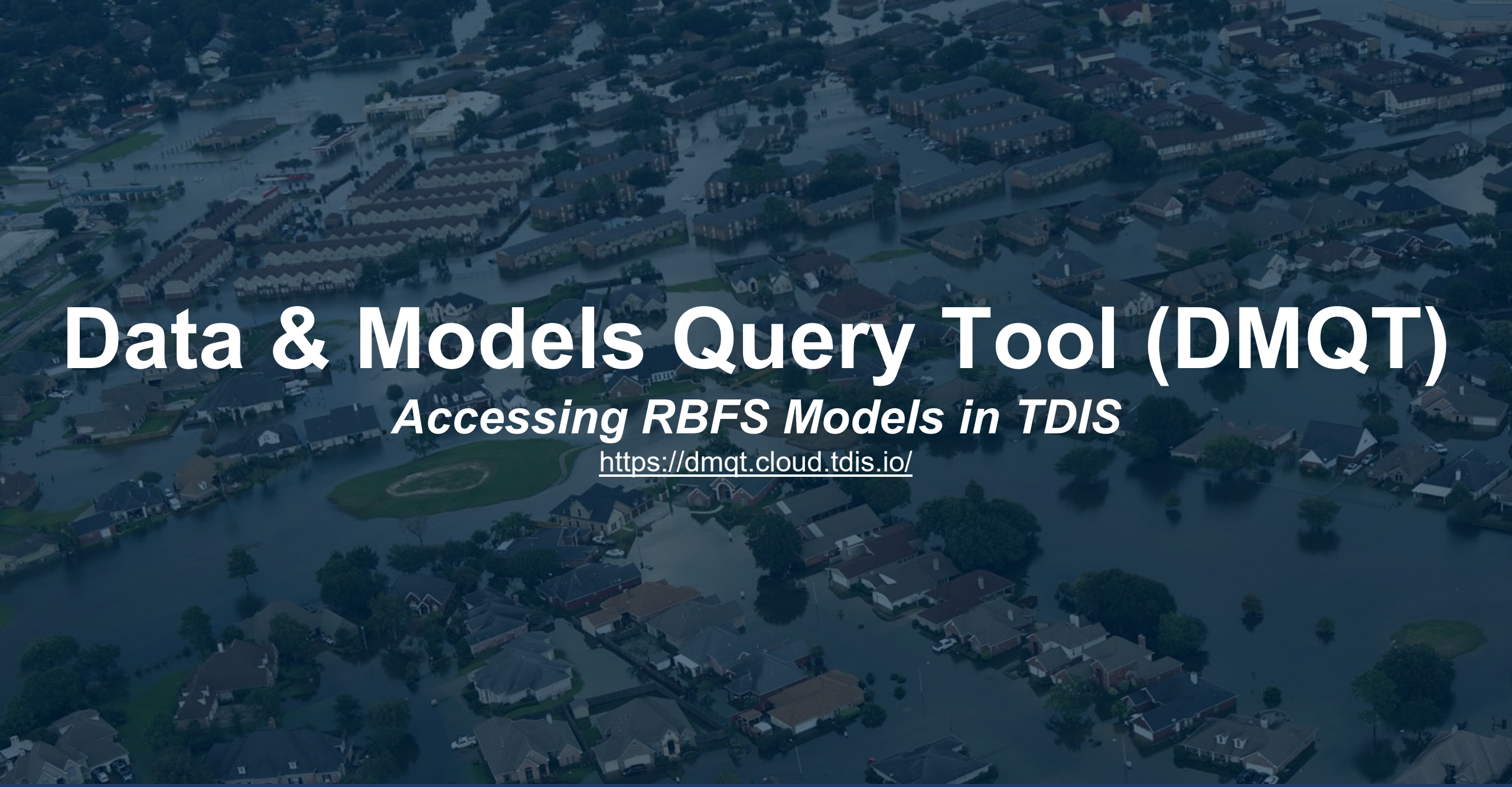
Key Findings & Limitations

Key Findings

- Achieved nearly full coverage of Central Region with flood risk models and maps
- Hot spots cluster along main streams and overflows
- 2D rain-on-mesh models capture pluvial, fluvial, and coastal flooding, leading to greater 1% AEP flooding vs. effective FEMA FIS in general
- Transition zones between surge- and rainfall-dominant areas are limited; most areas are clearly influenced by one dominant source

Limitations

- Rainfall uncertainty (differences between MRMS, NWS Stage IV QPE, gages)
- Limited calibration data and bathymetry in some areas
- Bridges and culverts are primarily taken from as-built plans or previous studies
- Interior leveed areas and storm sewers not modeled
- Overland waves in shoreline areas can't be modeled by HEC-RAS



Data & Models Query Tool (DMQT)

Accessing RBFS Models in TDIS

https://dmqt.cloud.tdis.io/

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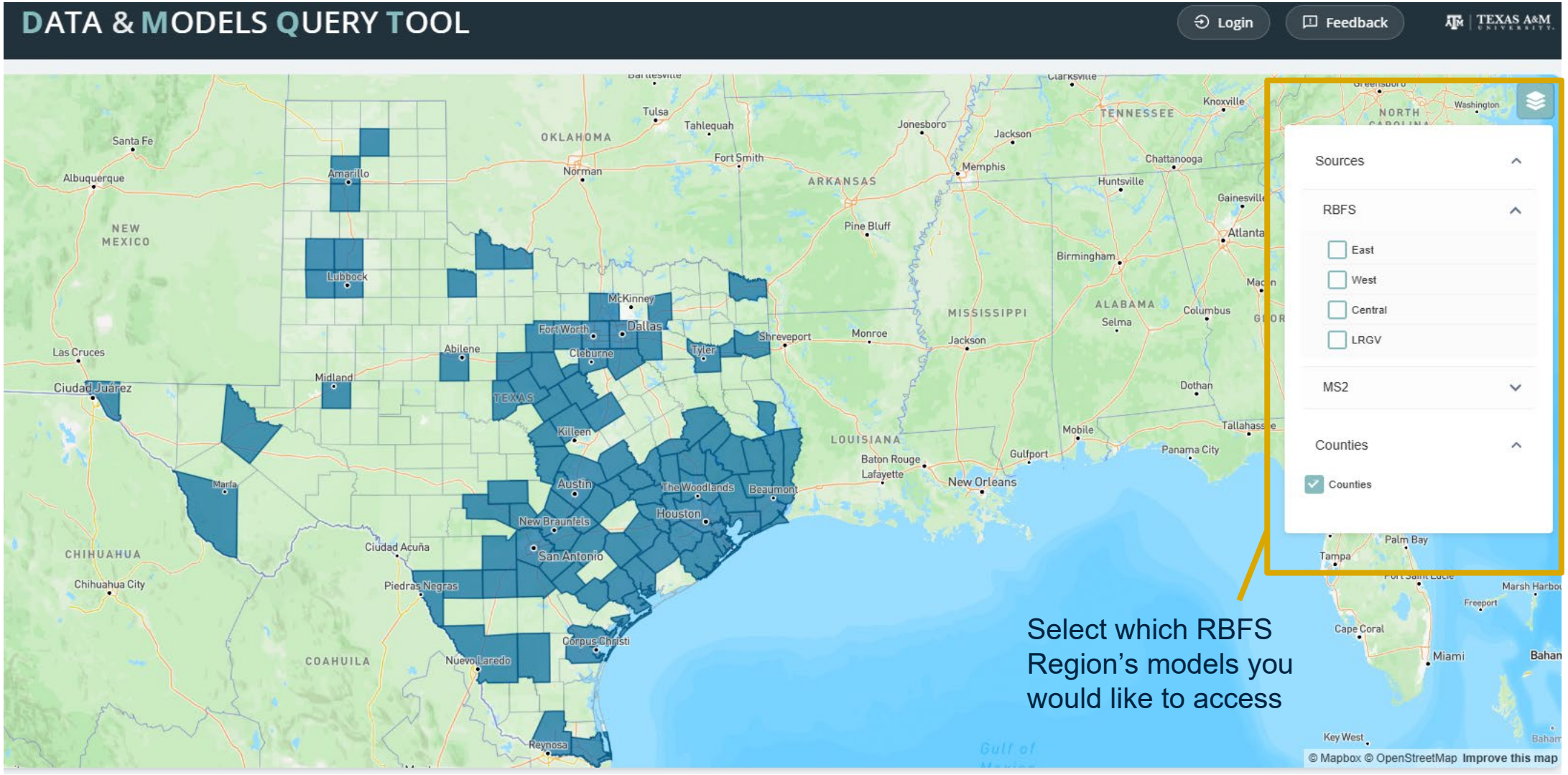
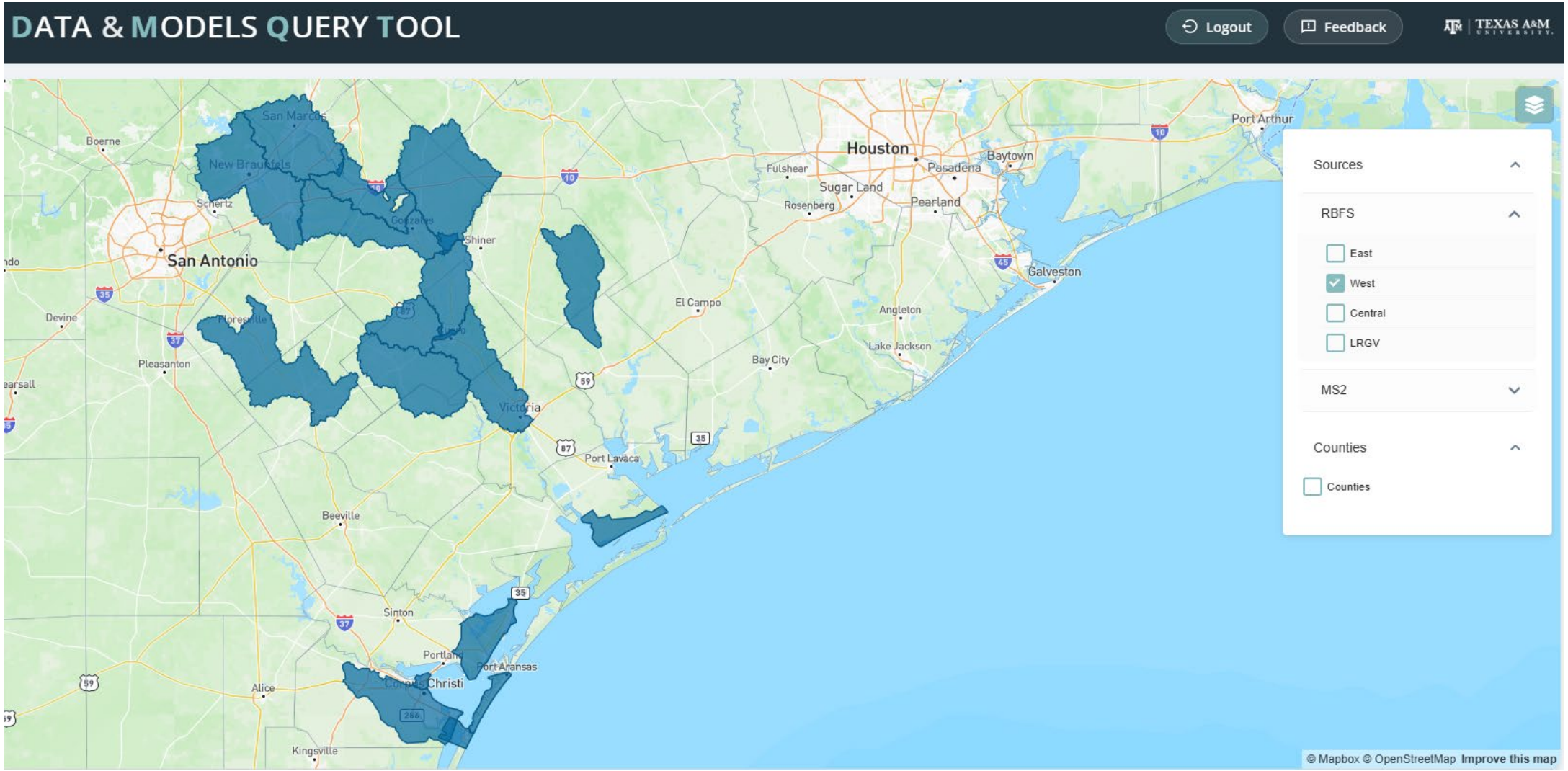
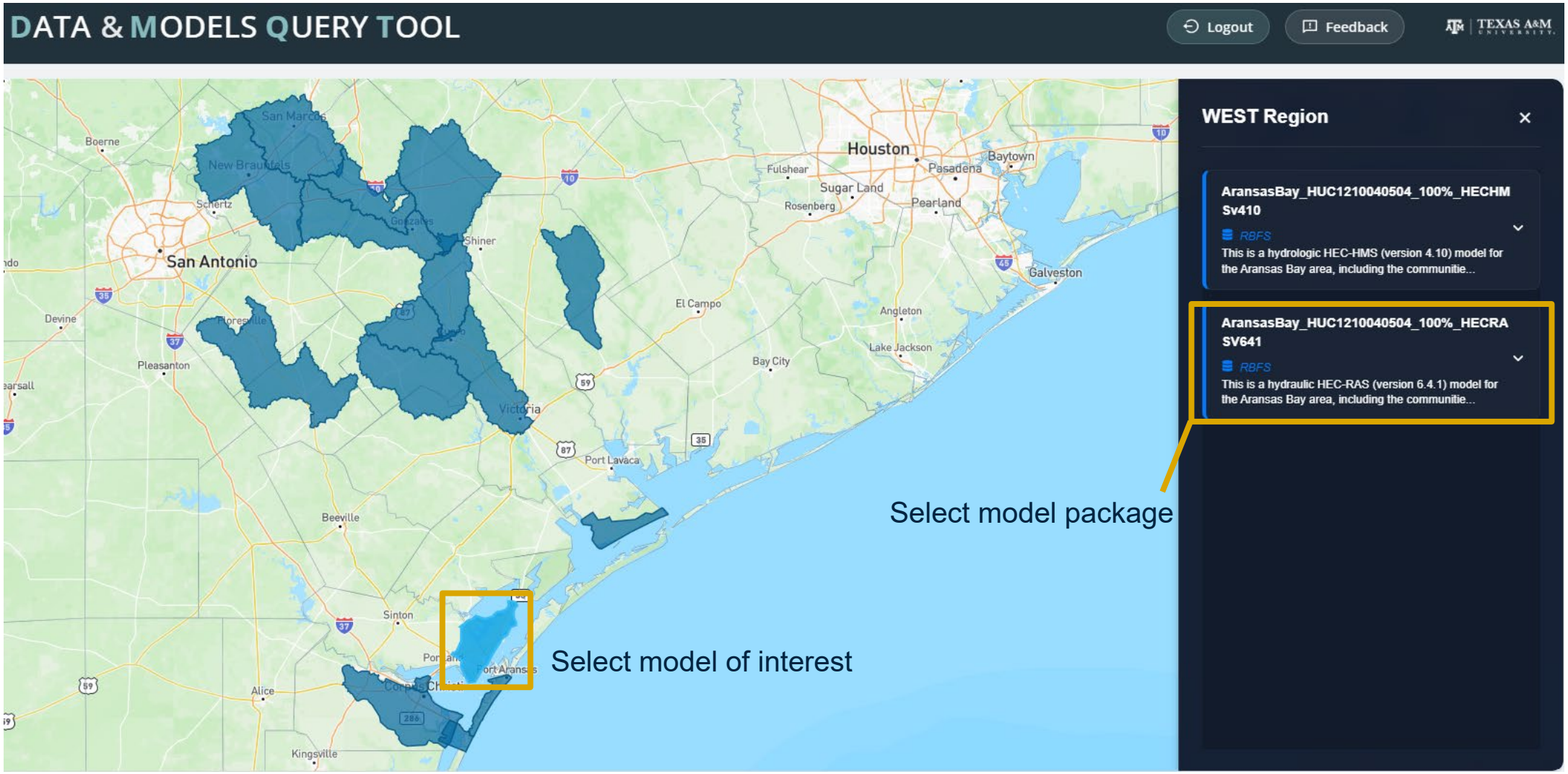
TDIS Data & Models Query Tool (DMQT)



TDIS Data & Models Query Tool (DMQT)



TDIS Data & Models Query Tool (DMQT)



TDIS Data & Models Query Tool (DMQT)

AransasBay_HUC1210040504_100%_HECRASV641

X

HUC:
1210040504

County:
Aransas, San Patricio

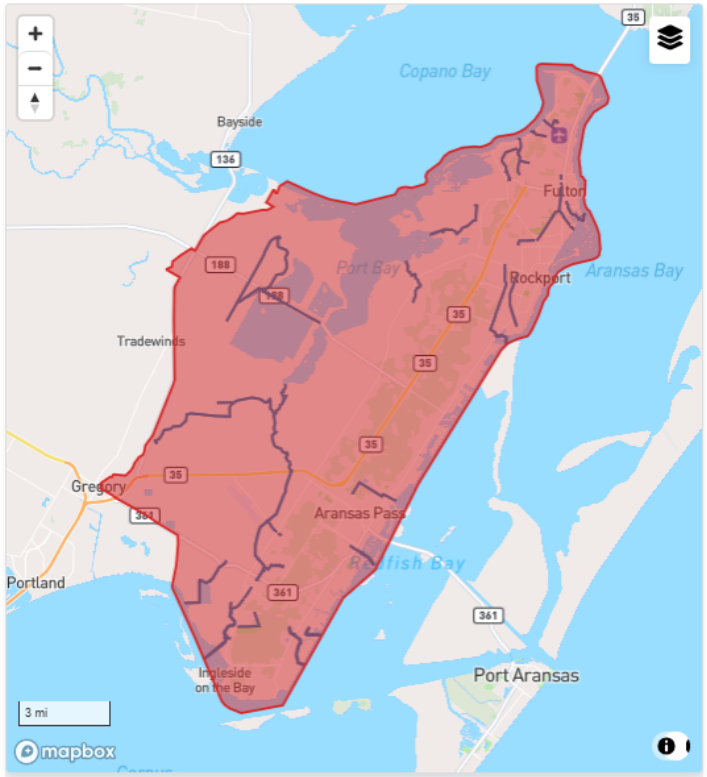
City:
Aransas Pass, Ingleside, Ingleside on the Bay, Rockport

Model Description:
This is a hydraulic HEC-RAS (version 6.4.1) model for the Aransas Bay area, including the communities of Aransas Pass, Ingleside, Ingleside on the Bay, and Rockport. This model was developed by West Region for the Texas General Land Office's River Basin Flood Study during Phase 3 of the study and includes assessment of both riverine and coastal flood risk.

Model Purpose:
The enclosed hydrologic and hydraulic models, final report, and GIS data were developed for the Texas General Land Office (GLO) for its Regional River Basin Flood Study project. The purpose of these models, final report, and associated GIS data is to better understand existing conditions for the GLO study. These products should not be used for construction or bidding purposes. For areas where FEMA effective FIRM maps do not include regulatory flood zones, or where Zone A is depicted, these maps could be considered best available data at the discretion of the local floodplain administrator. Enclosed

N/A* - Not Available/Not Applicable/Not Specified

Model metadata



Map of model boundary

Model Files Listing | Available Files for Download

Complete Model Package

HUC1210040504_AransasBay_100pct_Final.zip	103.02 GB
HUC1210040504_AransasBay_100%_Final_H&H_Report.pdf	182.1 MB
HUC1210040504_AransasBay_100%_Final_SlideDeck.pptx	21.8 MB
HUC1210040504_AransasBay_100%_Final_SlideDeck.pdf	6.4 MB
Manning_n_calibration_regions.zip	130 KB
Model_Boundary.zip	5 KB

Model Results

Results.zip	3.30 GB

Choose to download full package, results, boundary, or report

Close

Hot Spot Analysis

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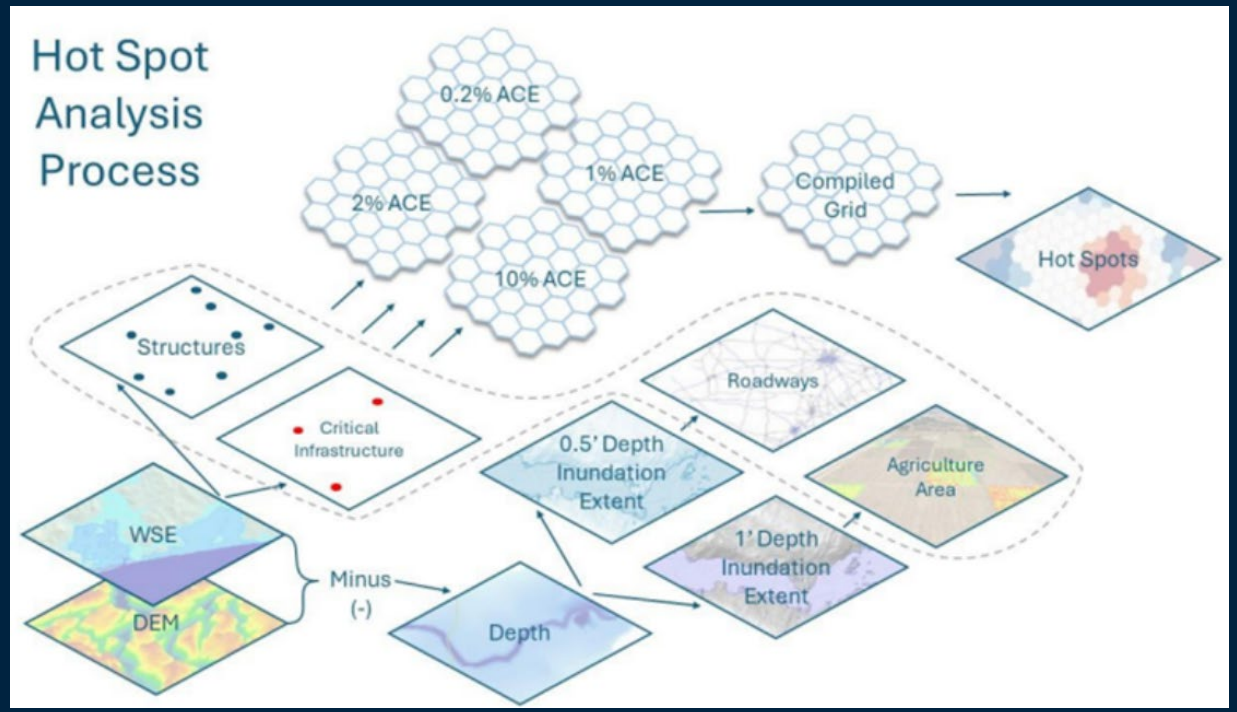
Hot Spot Analysis

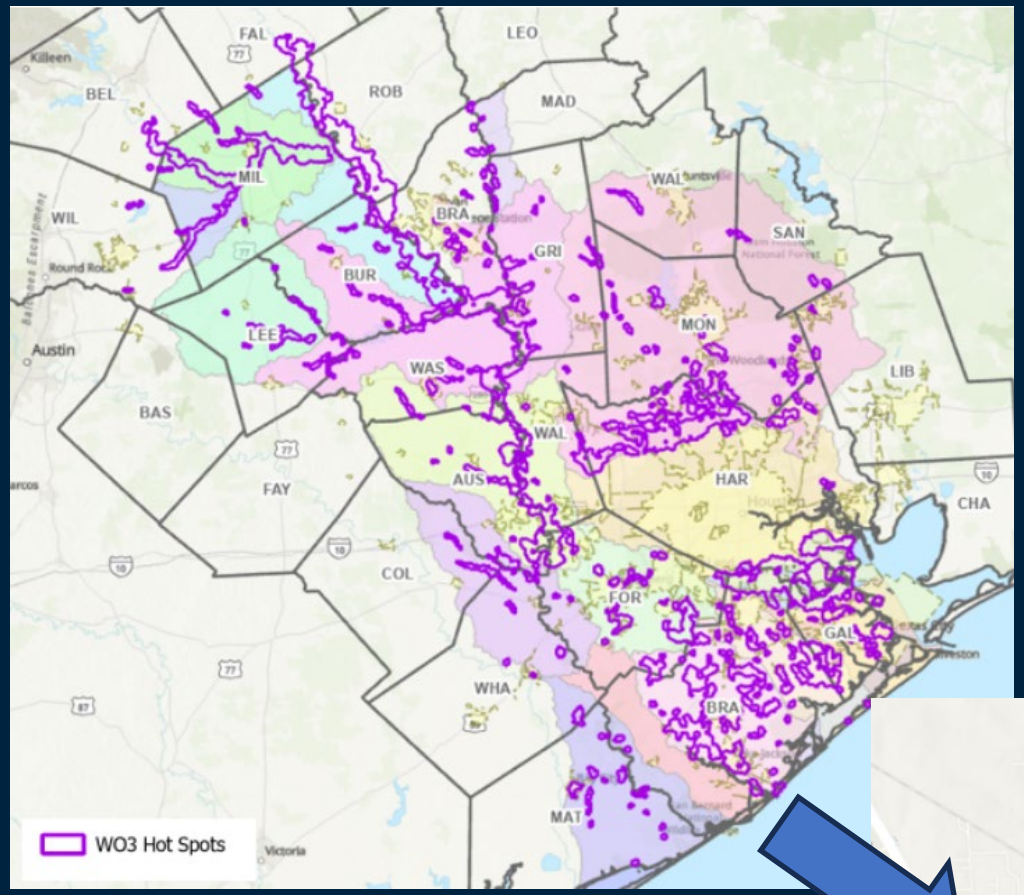
- Flood risk “hot-spots” determined throughout Central Region
- Based on several factors including:
  - Flood risk to structures
  - Flood risk to critical infrastructure
  - Flood risk to agricultural land
  - Flood risk to roadways
  - Flooding extent

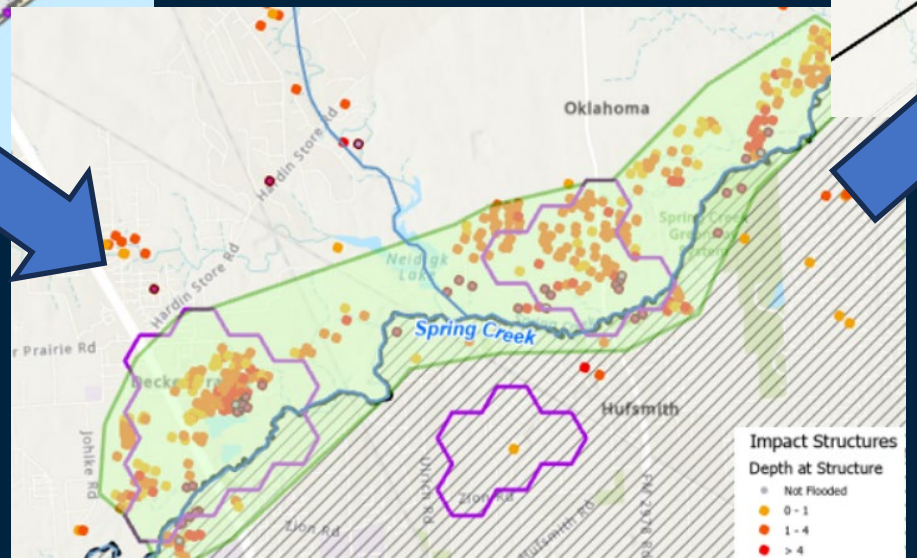


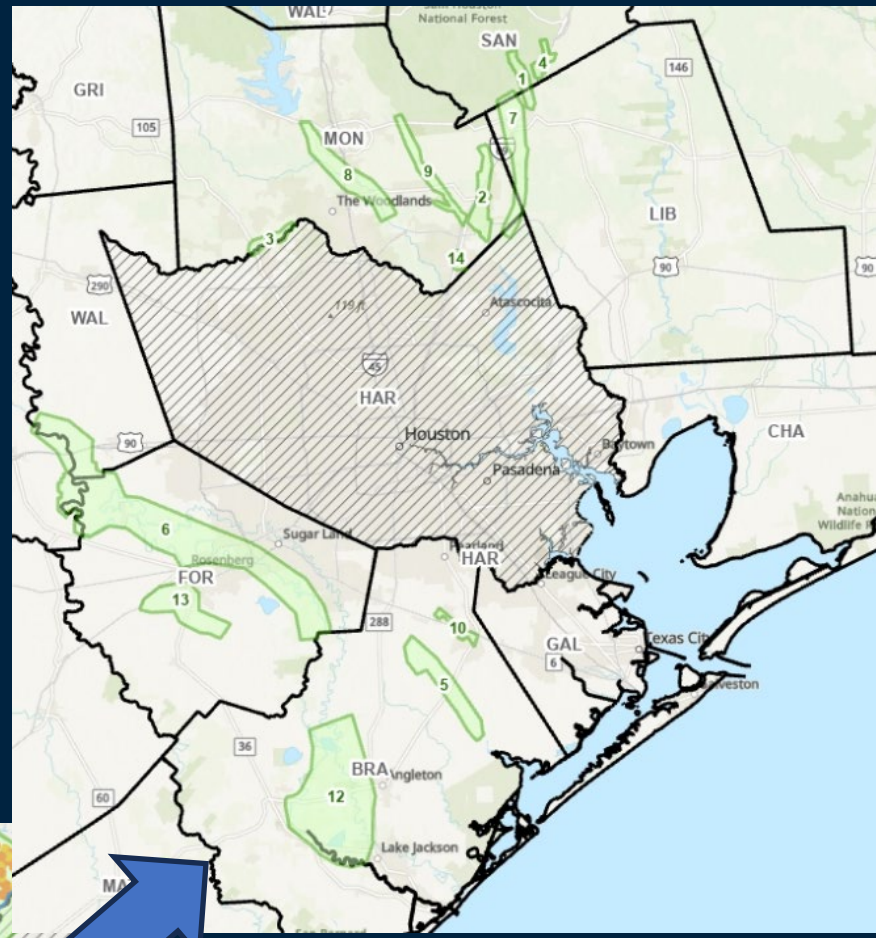
Hot Spot Analysis

- 243 Hot Spots Initially Identified
- Filtered, grouped, and prioritized based on numerous factors:
  - Benefit to General Public
  - Scale of Benefit (Local vs. Regional)
  - Overlaps with Similar Studies
  - Complexity of Area
  - Impact on vulnerable populations (SoVI, LMI)
  - Anticipated ability to identify structural mitigation improvements
  - Other available funding sources
- 14 “mitigation areas” selected to advance to WO4- Alternatives

Hot Spot to Mitigation Area Process







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Alternative Analysis

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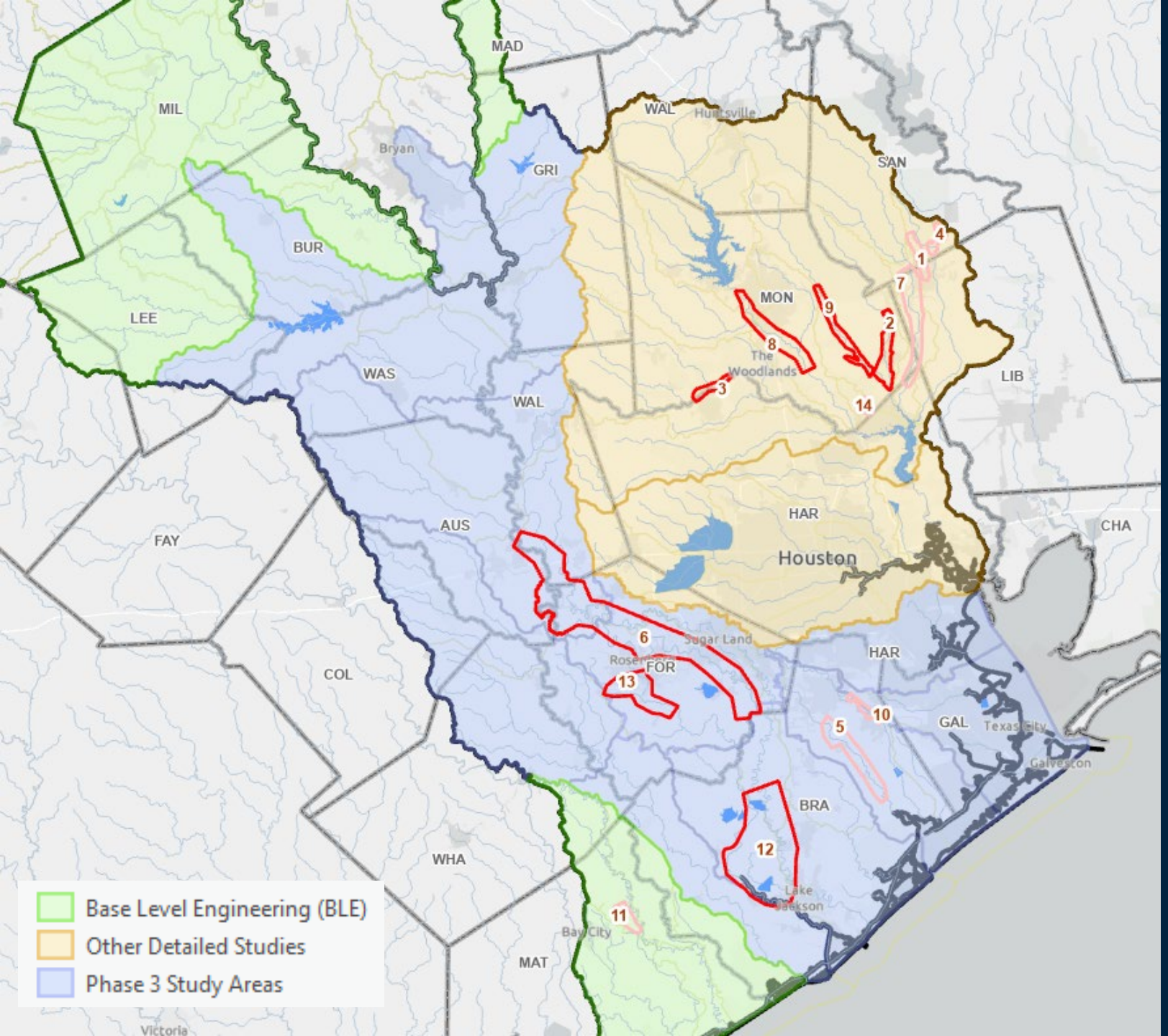
Alternative Analysis

- Regional-scale alternatives developed and modeled in detail
  - Baseline models or best-available data will be used as a starting point
  - Emphasis on multi-jurisdictional mitigation projects and strategies
  - Coordination with ongoing studies/projects to manage duplication of effort and maximize benefit to communities in Central Region

WO4 Mitigation Areas



Map Key Label No	Mitigation Area Name	Area (sq mi)
1	Reese Bayou	8.7
2	Lower Peach Creek	17.8
3	Spring Creek Near Tomball	7.0
4	Luce Bayou Near Cleveland	5.4
5	Chocolate Bayou	30.6
6	Middle Brazos River	202.5
7	Lower East Fork San Jacinto	33.9
8	West Fork San Jacinto Near Conroe	32.8
9	Lower Caney Creek	17.0
10	Mustang Bayou Near Alvin	5.5
11	Lower Hardeman Slough	8.9
12	Lower Brazos River	135.3
13	Big Creek	33.3
14	Bens Branch	2.7

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Next Steps

Alternatives Analysis

25% Submittal

- Define Risk & Needs
- Identify Conceptual Alternatives
- Define Performance Targets
- Preliminary Costs
- Initial Screening
- Stakeholder Outreach

50% Submittal

- Without-Project Modeling
- With-Project Modeling
- Preliminary Comparison

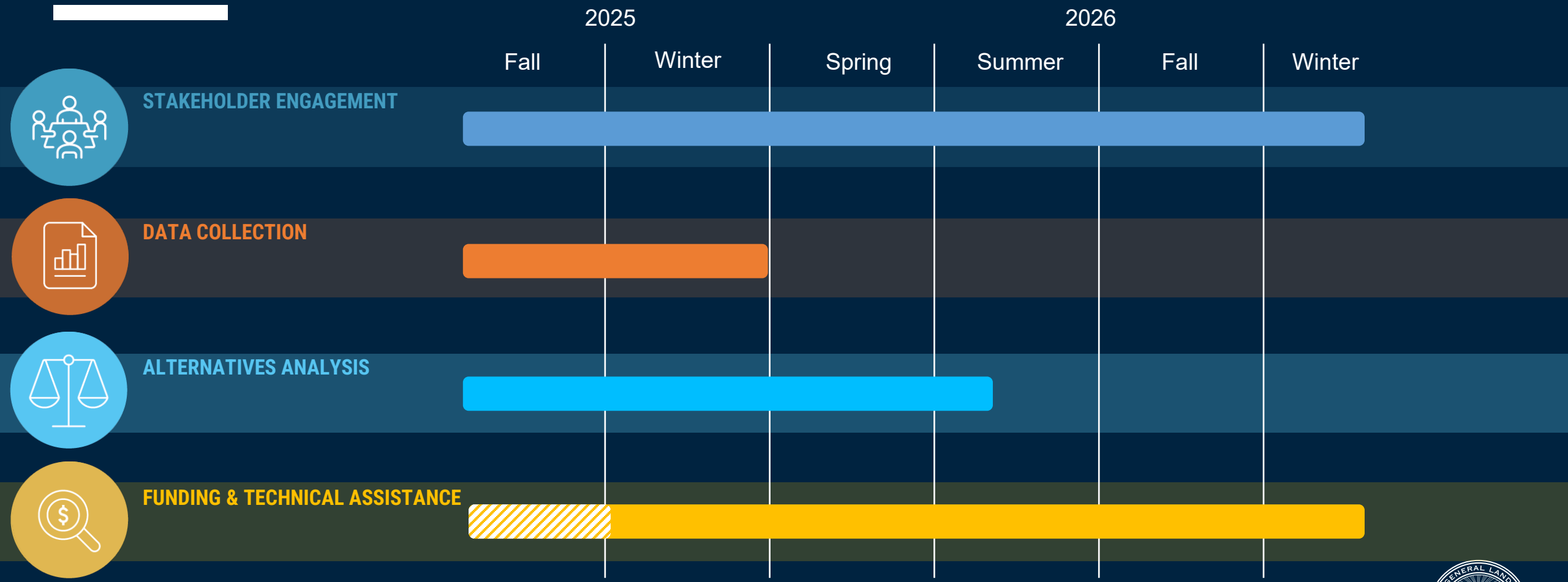
75% Submittal

- Refine Alternatives
- Incorporate Survey Data
- Benefit-Cost Analysis
- Stakeholder Outreach – Alternatives Analysis Workshops

100% Submittal

- Select Recommended Alternative Plan
- Final refinements of Alternative Plan

Central Region Study Timeline



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QUESTIONS?

Contact GLO-CDR by email at

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