



# **Flooding from Hurricane Harvey during August and September 2017 in southeastern Texas and southwestern Louisiana**

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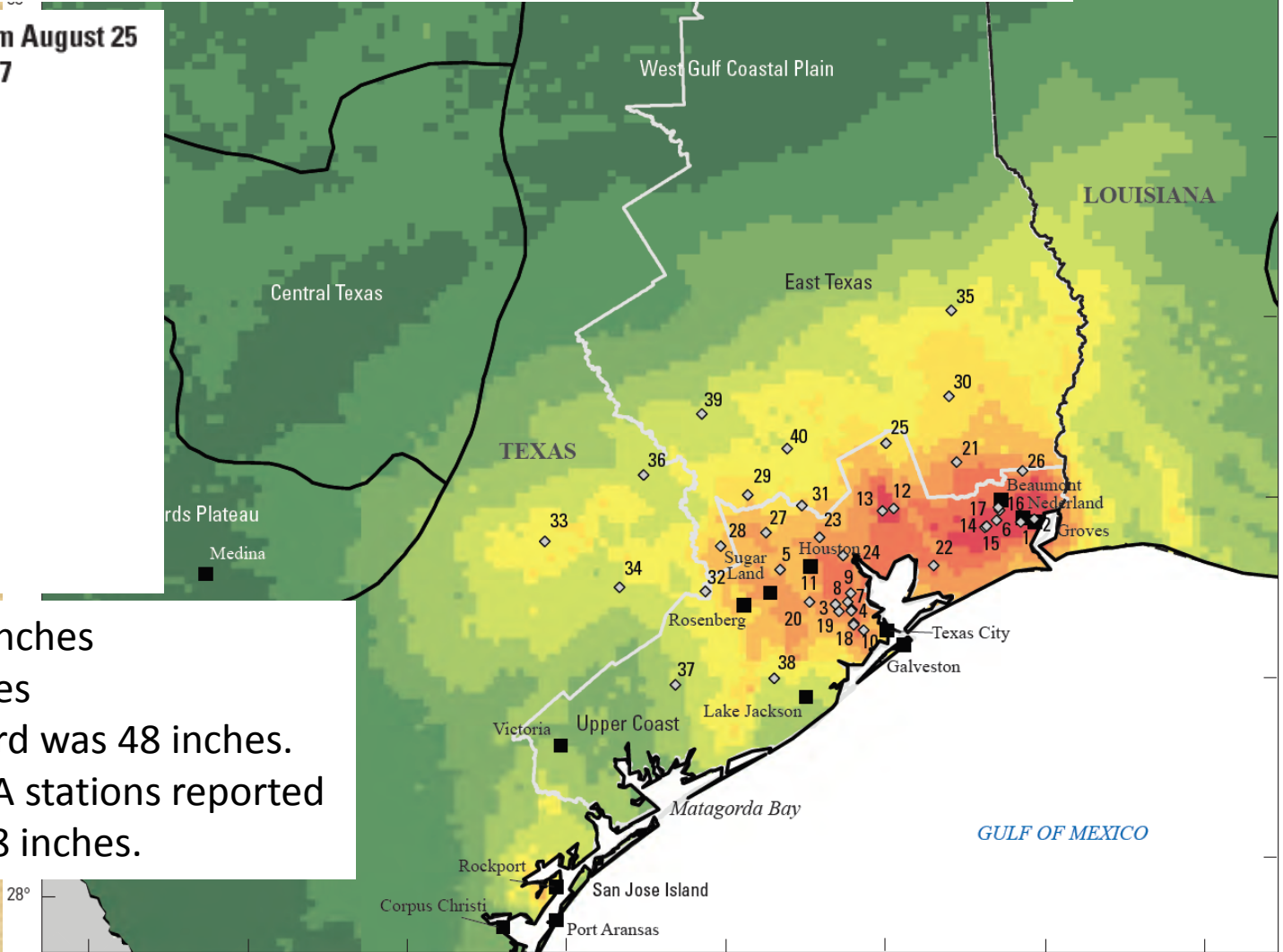
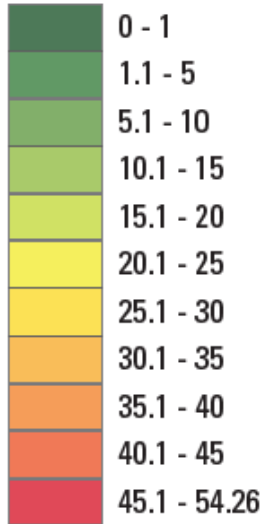
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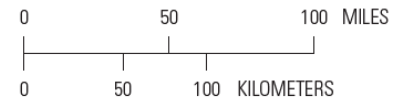
# Hurricane Harvey Rainfall Totals

Rainfall totals, in inches, from August 25 through September 1, 2017



Nederland = 60.58 inches  
 Groves = 60.54 inches  
 Previous event record was 48 inches.  
 For Harvey, 20 NOAA stations reported totals in excess of 48 inches.

Base modified from National Weather Service, Advanced Hydrologic Prediction Service  
<http://water.weather.gov/precip/download.php>, accessed February 28, 2018  
 Albers Equal Area Projection, Texas Centric Mapping System  
 North American Datum of 1983 (2011)



# Streamflow Measurements

- During August and September 2017 USGS personnel made more than 180 streamflow measurements in the study area by direct methods
- Indirect streamflow measurements were made in the study area at 97 locations
- Record peak streamflows at 54 percent (40 out of 74 stations) with at least 15 years of record and for which the Harvey-related streamflow ranked within the top five of all annual peaks. Thirty-four percent (25 out of 74) of the peak streamflows ranked second or third and 12 percent (9 out of 74) ranked fourth or fifth



USGS streamflow-gaging station 08072600, Buffalo Bayou at State Highway 6 near Addicks, Texas looking south on State Highway 6



# USGS/FEMA Interagency Agreement

- Collect high-water marks (HWMs)
- Indirect measurements if needed
- Flood inundation mapping
- Flood frequency analysis
- Documentation
  - Scientific Investigations Report
  - ScienceBase Data release

# High-Water Mark Data Collection



- Best identified immediately following the peak stage
- After identification, a more permanent mark is established such as a Parker-Kalon nail with a disk, a stake, a chiseled mark, or a paint line
- GPS used to obtain location and photos taken
- Marks surveyed to standard vertical datum, NAVD88, for elevation above land surface
- Stain lines on buildings, fences, and other structures provide excellent marks

# High-Water Mark Data Collection cont.

- USGS field crews began work on September 2 and continued through October 5, 2017 identifying and surveying HWMs
- USGS field work consisted of 73 staff members from 9 Water Science Centers including Texas, New Mexico, Oklahoma, Arizona, Missouri, Florida, New York, Nebraska, Mississippi
- USGS field crews surveyed 2,123 HWMs, resulting in 1,258 water-surface elevations



Hydrologic Technician with the USGS North Texas Program Office in Fort Worth, Texas, flagging a debris line on a telephone pole approximately 14.3 feet above the ground and located about 245 feet east of bridge on Keith Road over Boggy Creek.



# USGS STN Flood Event Viewer

**USGS** Flood Event Viewer

EVENT: **Harvey Aug 2017**  
24 Aug 2017 thru 24 Sep 2017

BASEMAPS >  
FILTERS >  
CHANGE FILTERS

**Current Filters**  
EVENT **Harvey Aug 2017**  
**GET DATA >**

POWERED BY WIM

**Current Filters**  
EVENT **Harvey Aug 2017**  
**GET DATA >**

Use buttons to access event-based data, reflecting the filters chosen above.

Sensor Data ▾  
High-water Mark Data ▾  
Peak Summary Data ▾

Visit the [STN Data Portal](#) for broader data retrieval capability.

MAP LAYERS

Real-Time Data  
Real-time stream gage layer only available at zoom level 9 and above. Please zoom in to view.

- Real-time Stream Gage
- Rapid Deployment Gage

Observed Data

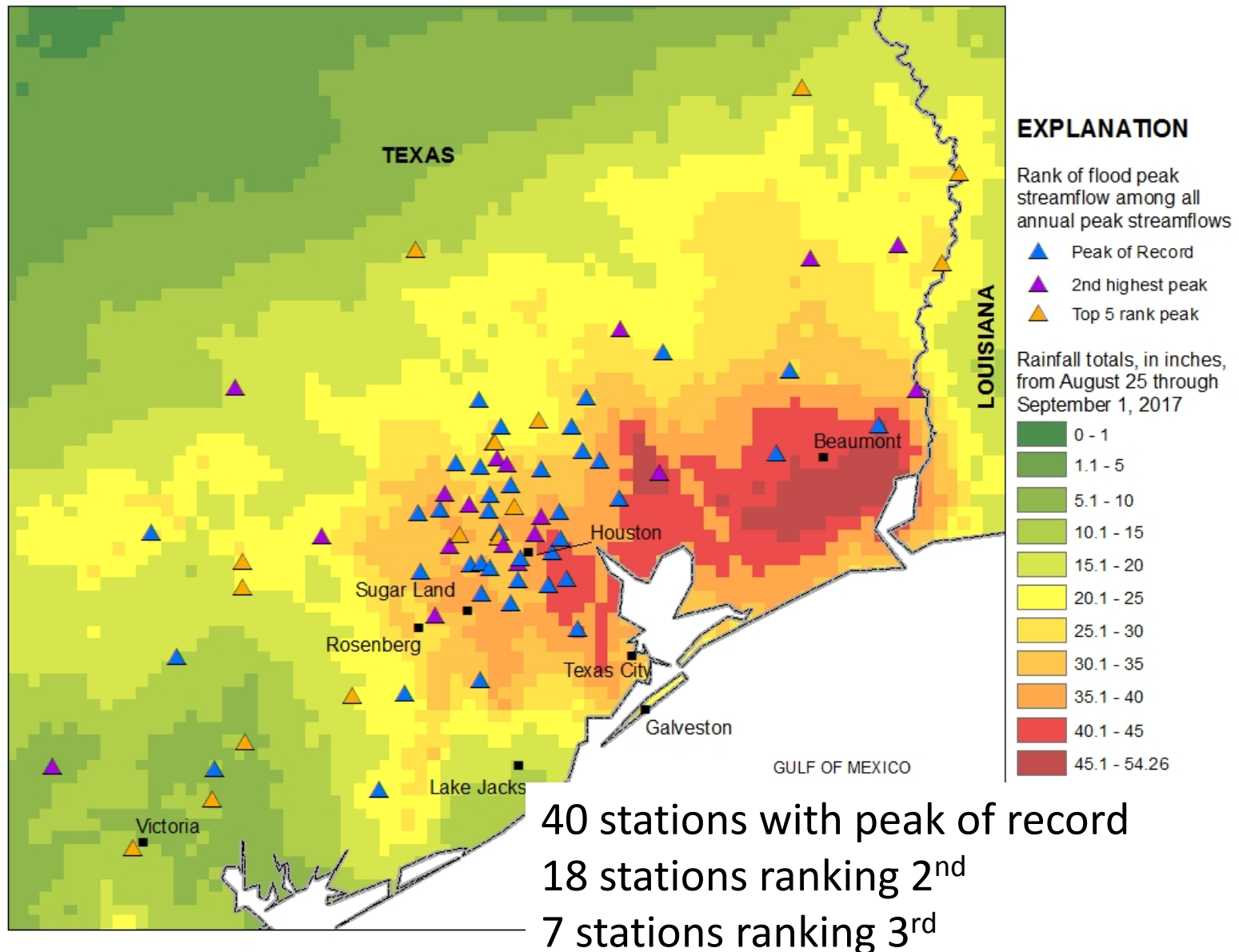
- Barometric Pressure Sensor
- Storm Tide Sensor
- Meteorological Sensor
- Wave Height Sensor
- High Water Mark

Interpreted Data

- Peak Summary

<https://water.usgs.gov/floods/FEV/>

# Streamflow Rank

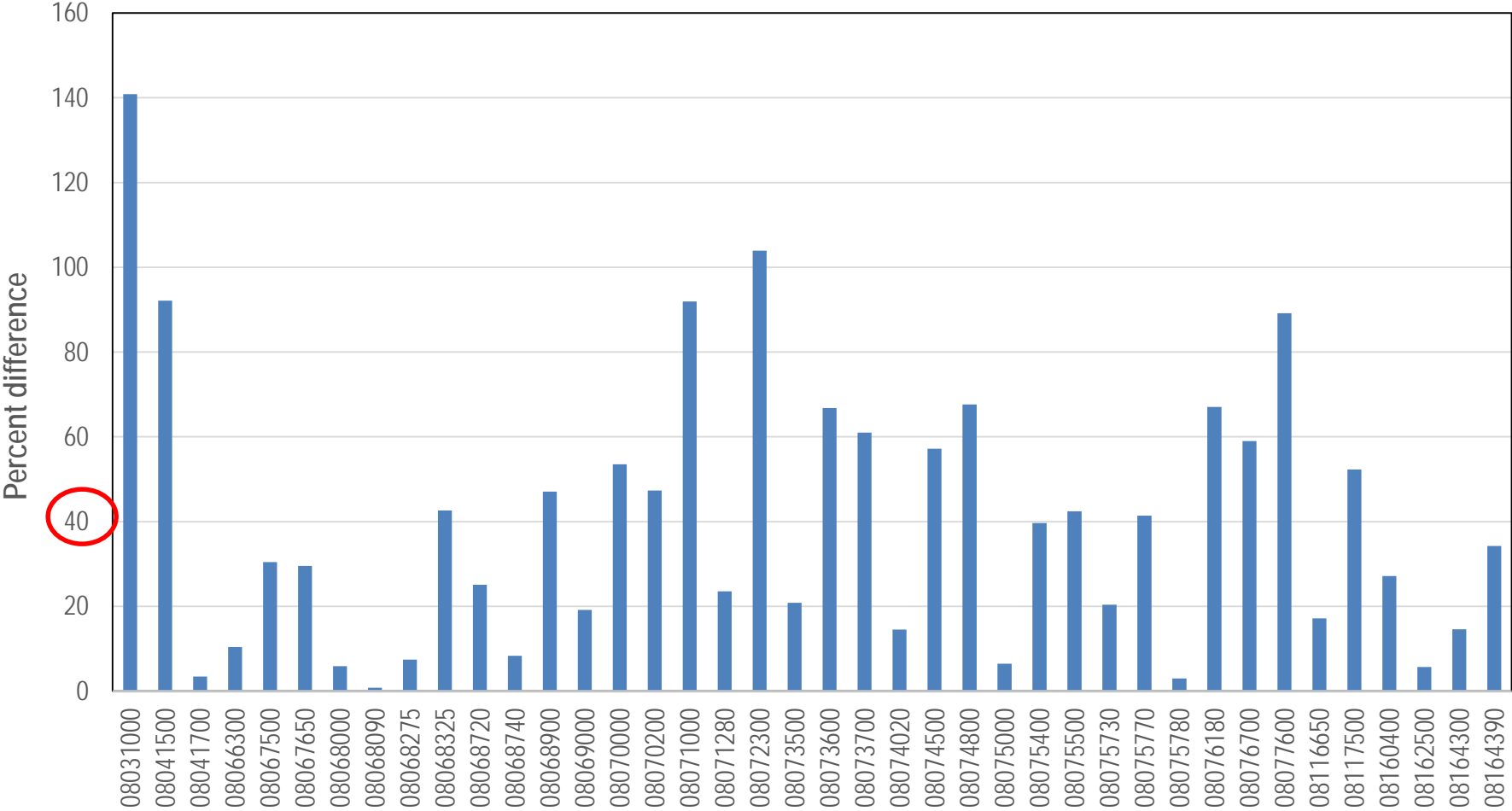


# Annual Exceedance Probability

- Period of record ranged from 18 to 105 years, average of 55 years
- AEP estimates for the analyzed streamflow-gaging stations ranged from less than 0.2 to 14.0 percent with a median of 1.4 percent
- 30 streamgages had an AEP of 1.0 percent or smaller for observed peak streamflow from August and September 2017 flood
  - 100 year recurrence interval
- 2 streamgages had an AEP of 0.2 percent or smaller
  - 500 year recurrence interval

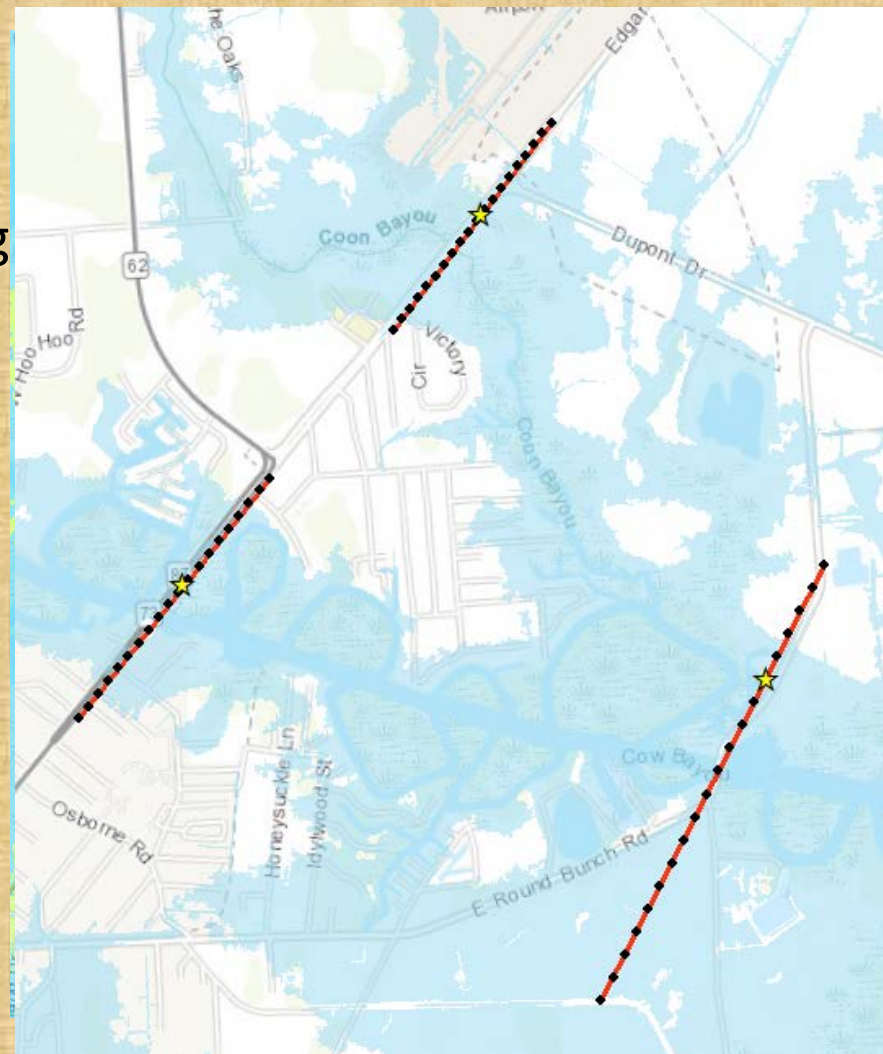
# Percent Differences

Percent difference between 2017 Harvey-related peak and previous peak of record



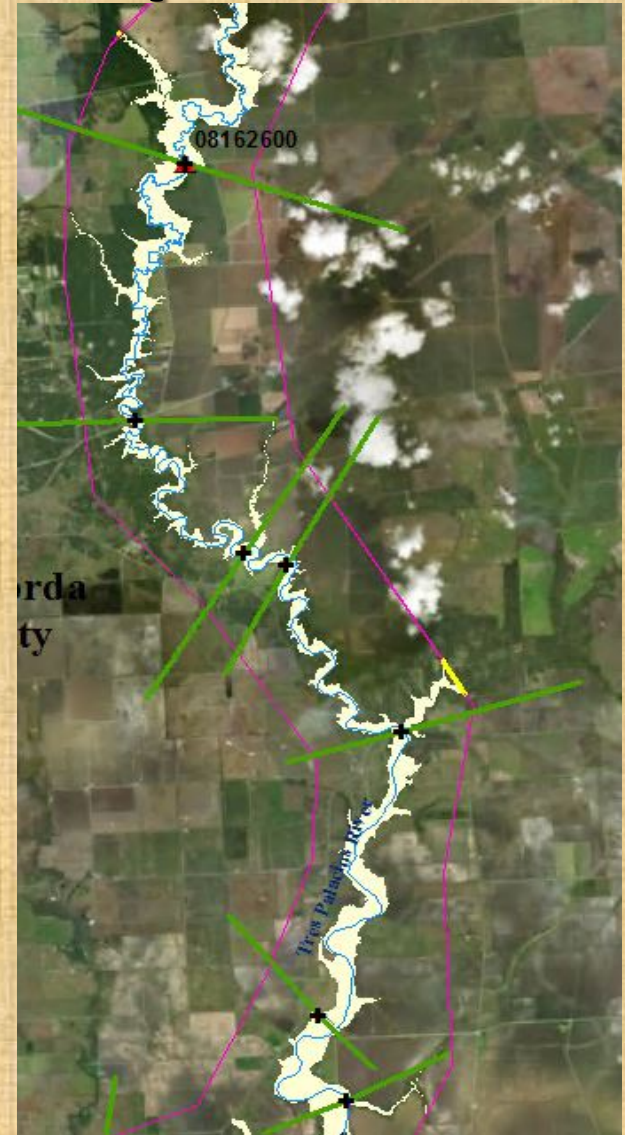
# High-Water Mark Derived Flood Documentation Map

- Use collected HWM elevation data to interpolate water-surface elevation
  - ArcGIS Topo to Raster tool using cross section lines or point data
- Create depth estimates for inundated areas
- Use the best lidar DEM layer available
- Layers created and published include:
  - Depth raster, inundation polygon, model boundary, and HWMs



# High-Water Mark Derived Flood Documentation Map

- Use USGS streamgage data if available along reach
- Geographic limit placed on extent of reach
  - Based on distribution of HWMs
  - Lidar data availability
  - Understanding natural hydrologic flow in the area

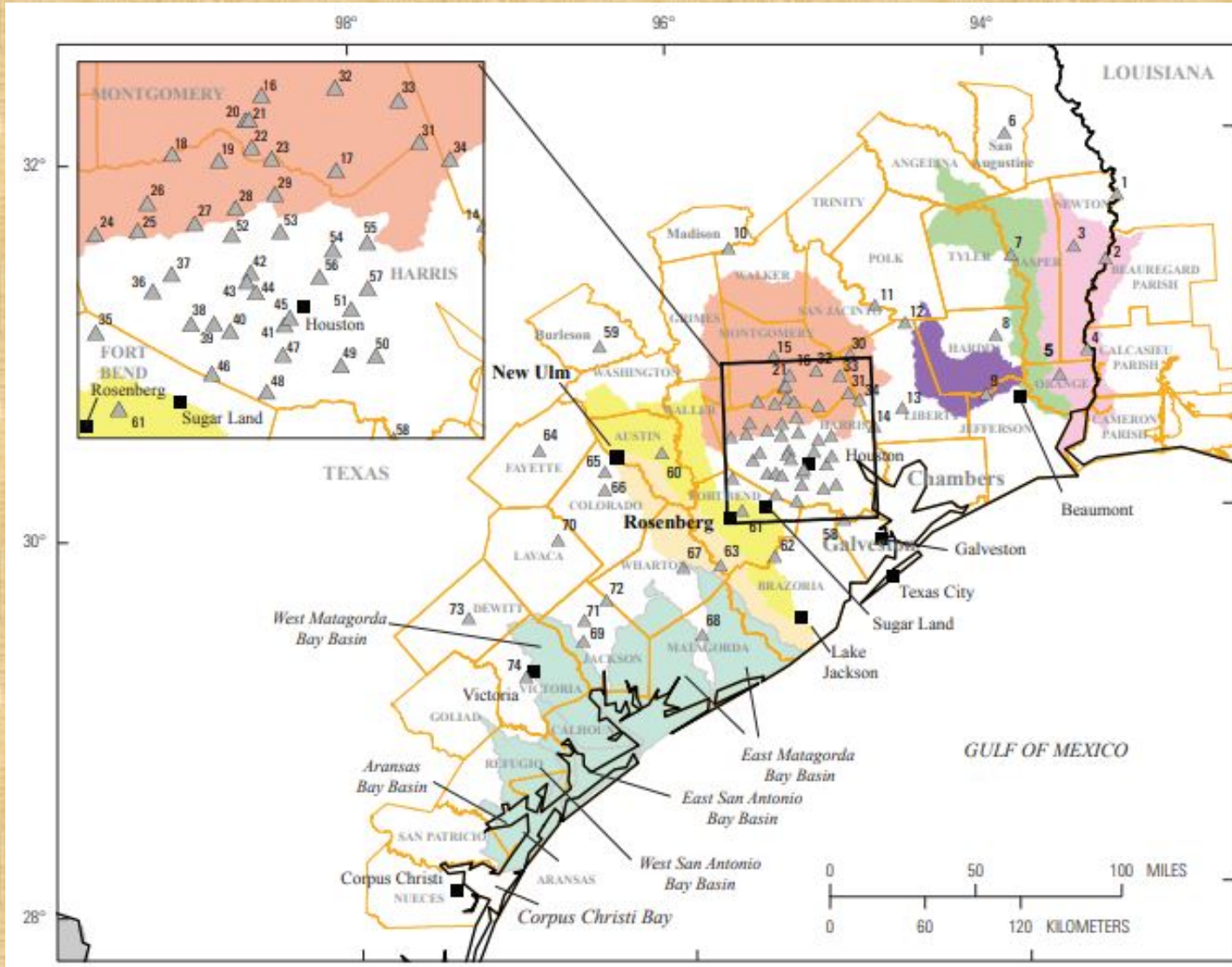


# Issues Observed

- DEM issues
  - Some areas lacked full lidar digital elevation model (DEM) data
- HWM coverage
  - Mapped boundaries were cut in locations lacking HWM coverage
- Coastal/low-lying flood areas
  - Use point interpolation with Topo to Raster
  - Limit overland flood water extent with model boundary
- Multiple tributaries along a reach
  - Separate each tributary for processing, then merge

# Inundation mapping locations

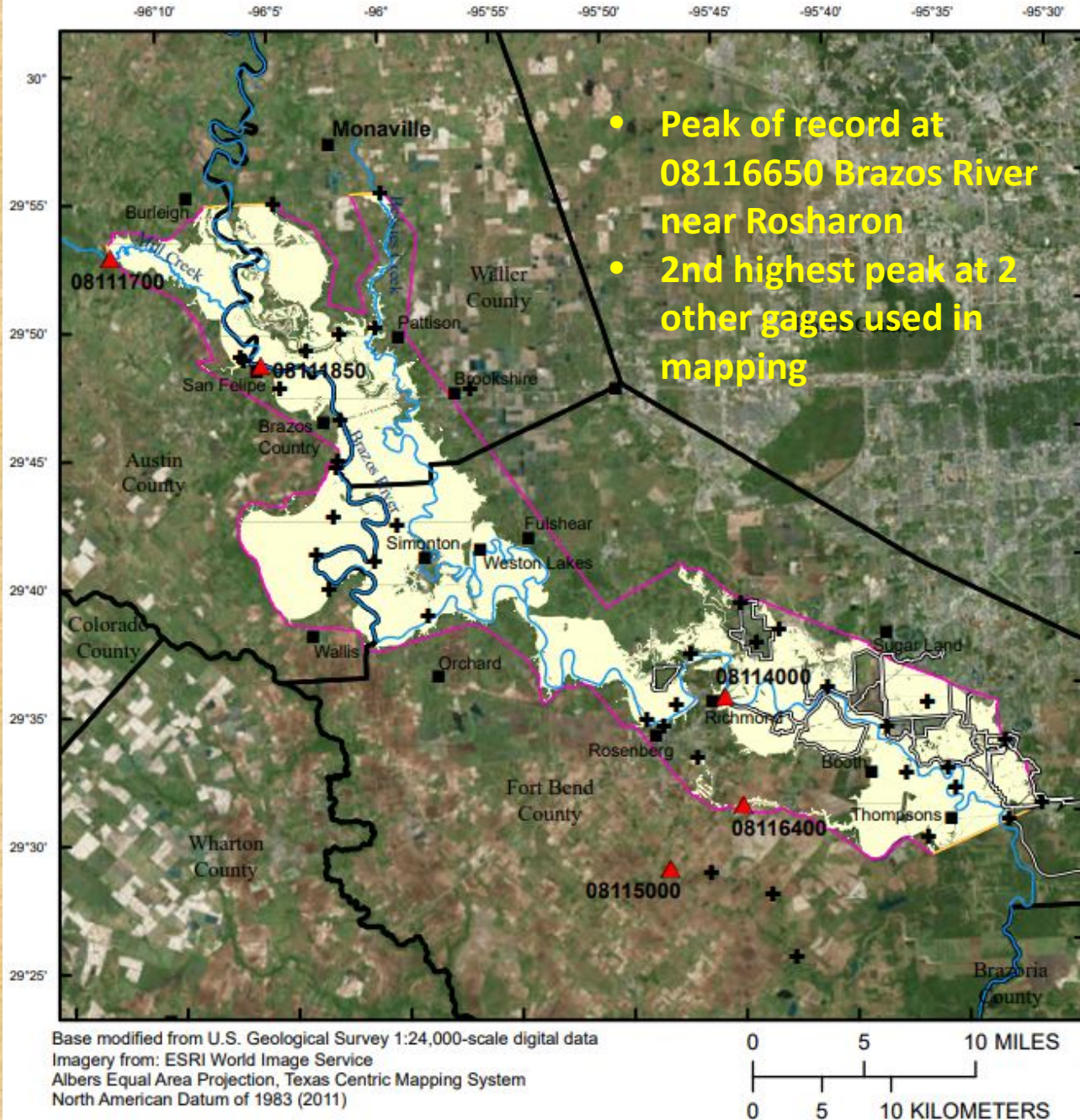
- 6 watersheds and coastal area basins





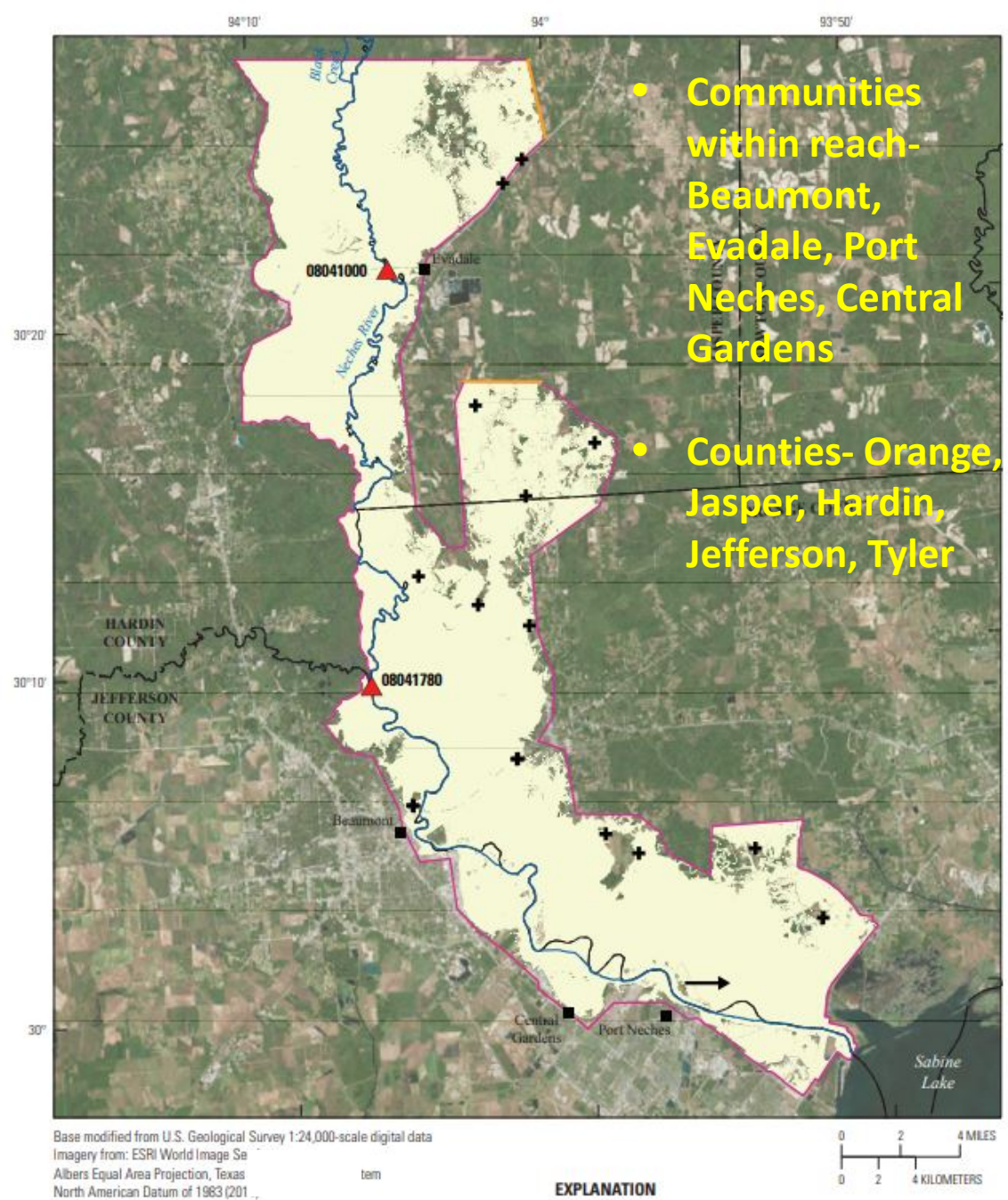
# Brazos River Mapping

- Divided into 2 maps- upper and lower
- 99-mile reach Brazos River, 43-mile reach Bessies Creek, 9-mile reach Mill Creek
- 46 HWMs used
- HWM height above ground ranged from 0 to 8.6 ft.
- Precipitation range 13-39 inches within the watershed



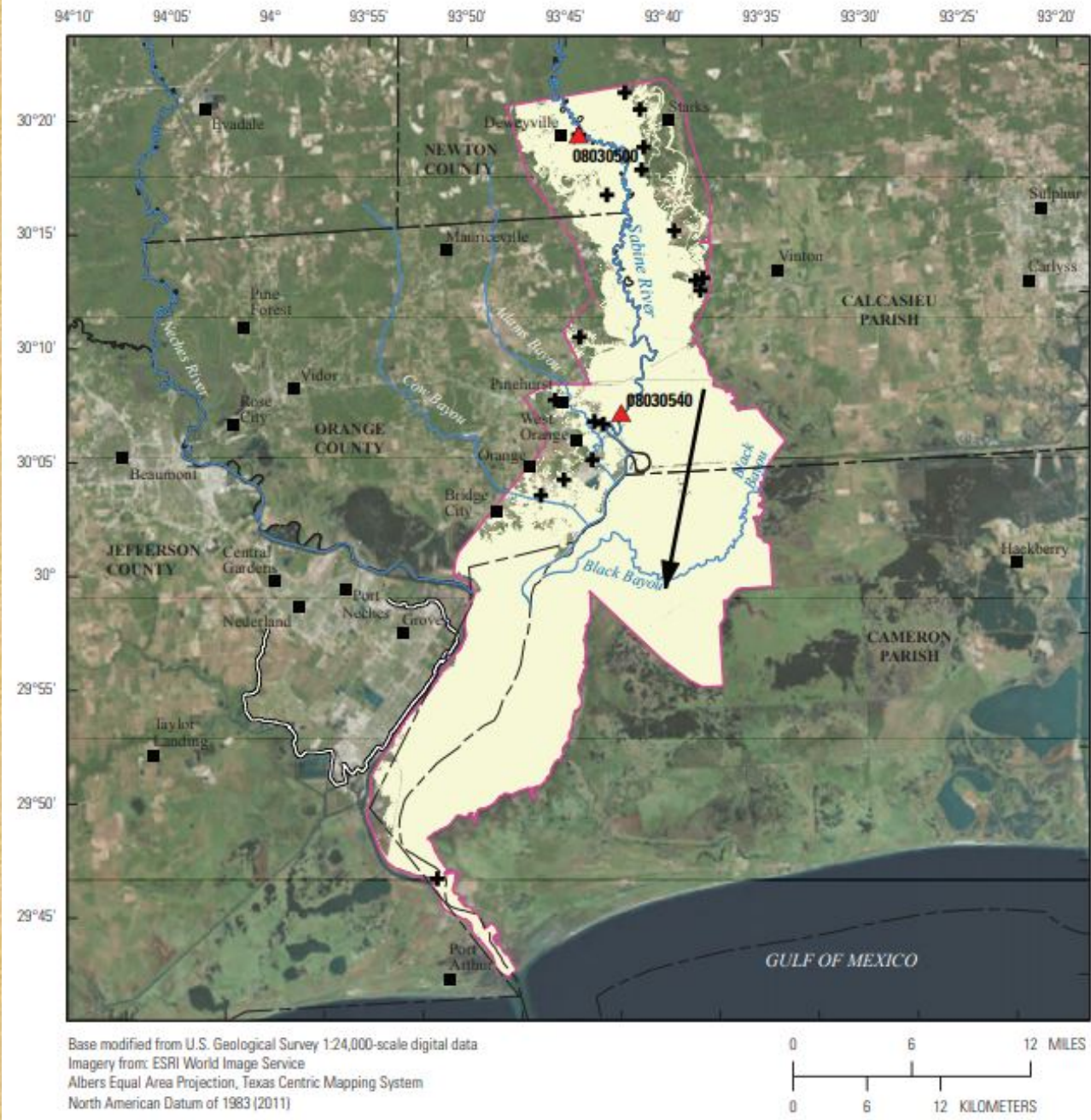
# Neches River Mapping

- Divided into 2 maps- upper and lower
- 131-mile reach Neches River
- 33 HWMs used
- HWM height above ground ranged from 0 to 11.6 ft.
- Precipitation range 18-52 inches within the watershed

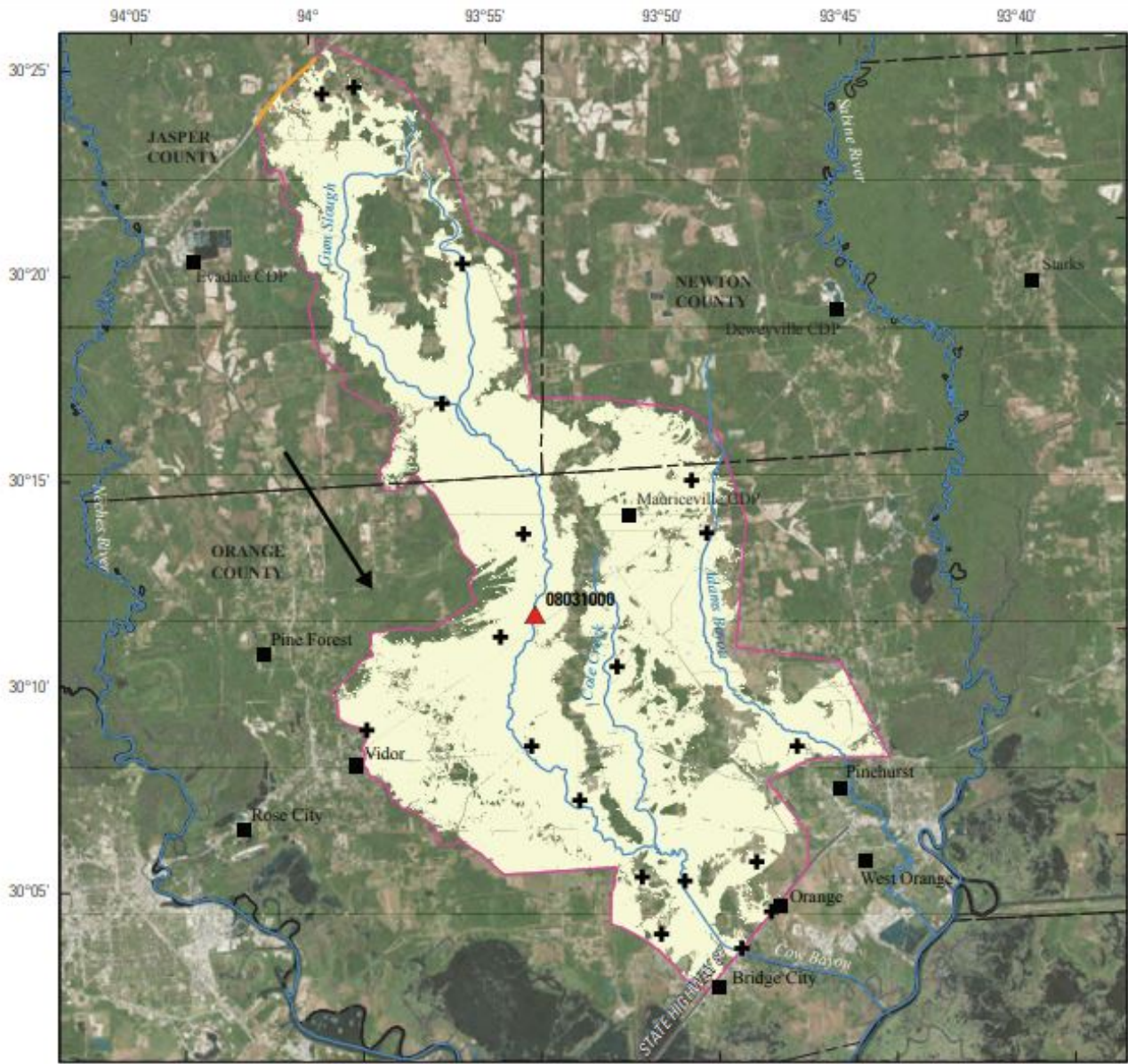


# Sabine River Mapping

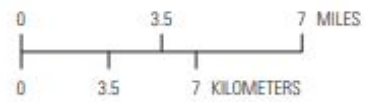
- Divided into 5 separate maps
- 131-mile reach along the Sabine River- upper, middle, and lower
- Cow Bayou
- Big Cow Creek
- 70 HWMs used to map
- HWM height above ground ranged from 0 to 7 ft
- Precipitation range 19-48 inches within the watershed



Lower Sabine River, August and September 2017



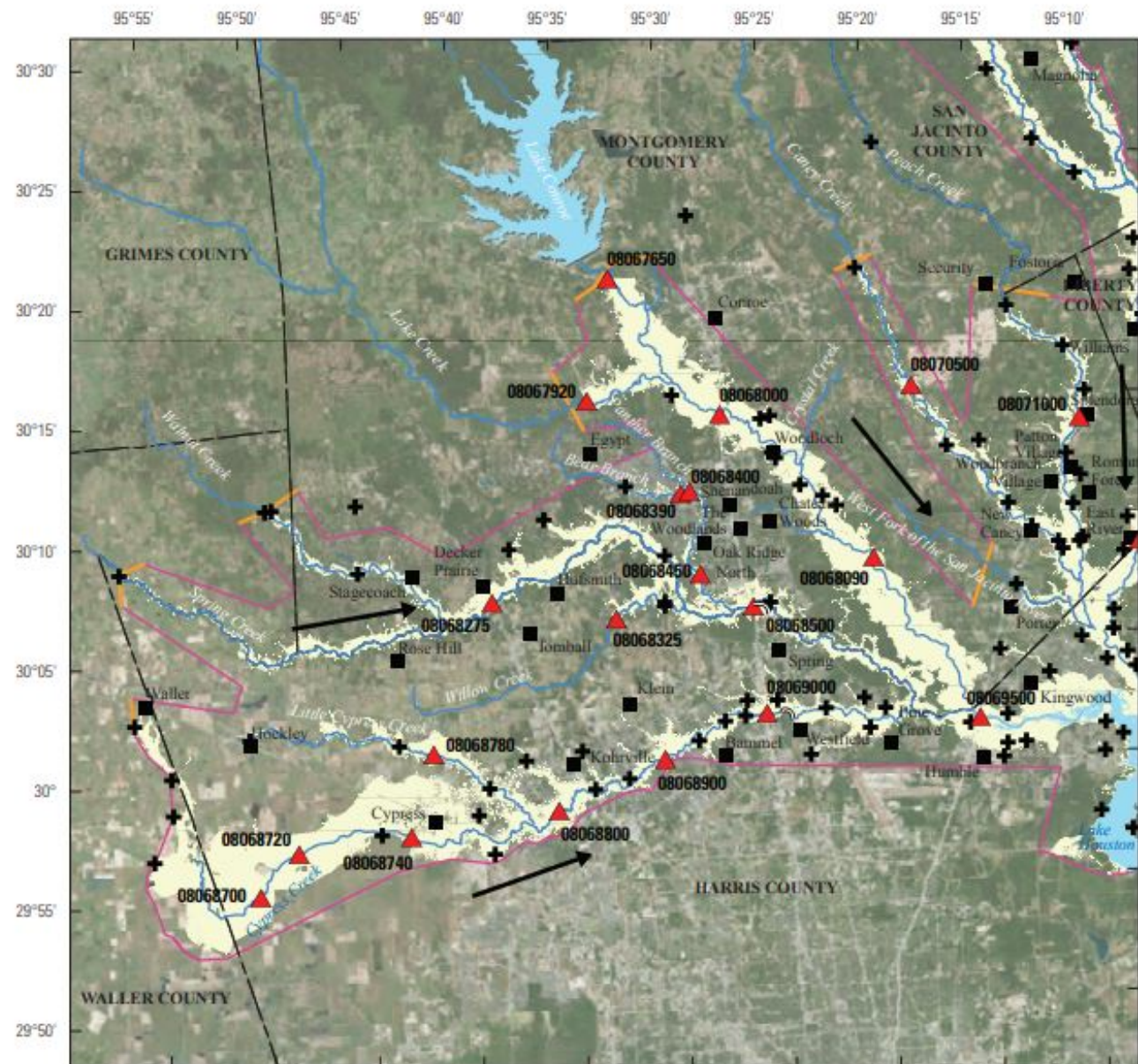
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 Imagery from: ESRI World Image Service  
 Albers Equal Area Projection, Texas Centric Mapping System  
 North American Datum of 1983 (2011)



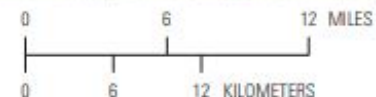
### Cow Bayou, August and September 2017

# San Jacinto River Mapping

- Divided into 2 separate maps
- West Fork and East Fork San Jacinto River
- 106 HWMs used to map
- HWM height above ground ranged from 0 to 9.6 ft
- Precipitation range 17-43 inches within the watershed



Base modified from U.S. Geological Survey 1:24,000-scale digital data  
Imagery from: ESRI World Image Service  
Albers Equal Area Projection, Texas Centric Mapping System  
North American Datum of 1983 (2011)



West Fork San Jacinto River, August and September 2017

# West Fork San Jacinto River



Townsen Boulevard intersects US Highway 59 about 0.65 miles southwest of USGS streamflow-gaging station 08069500, West Fork of the San Jacinto River near Humble, Texas.





# USGS Science Base- Data Release

- Data cataloging and collaborative data management platform
- Central repository for project data files
- Historically this data kept of local office servers
- Files provided from the Texas flood report:
  - Inundation polygon
  - Depth raster
  - Boundary
  - HWMs



# USGS Science Base- Data Release

- Flood Inundation, Flood Depth, and High-Water Marks for Selected Areas in Texas from the Hurricane Harvey, August 2017 Flood:


<https://doi.org/10.5066/F7VH5N3N>

# USGS Science Base- Data Release



## Attached Files

Click on title to download individual files attached to this item or [download all](#) files listed below as a compressed file.

<a href="#">Brazos_lower.zip</a>		2018-03-21 10:13	kmwatson@usgs.gov	628.12 KB
<a href="#">Brazos_upper.zip</a>		2018-03-21 10:13	kmwatson@usgs.gov	1.99 MB
<a href="#">Depth_Brazos_lower.zip</a>		2018-03-21 10:18	kmwatson@usgs.gov	160.44 MB
<a href="#">Depth_Brazos_upper.zip</a>		2018-03-21 10:21	kmwatson@usgs.gov	359.96 MB
<a href="#">Readme Brazos River.txt</a>		2018-04-10 23:17	kmwatson@usgs.gov	2.91 KB

## Related External Resources

**Type: Publication that references this resource**

Characterization of Peak Streamflows and Flood Inundation of Selected Areas in Southeastern Texas and Southwestern Louisiana from the August and September 2017 Flood Resulting from Hurricane Harvey

<https://doi.org/10.3133/ofr2018xxxx>

## Purpose

The mapped area boundary, flood inundation extents, and depth rasters were created to support the development of flood inundation maps for the Federal Emergency Management Agency's (FEMA) response and recovery operations following the August and September, 2017 Hurricane Harvey flood event in the communities of southeastern Texas and southwestern Louisiana.

# Addicks Reservoir



August 29, 2017



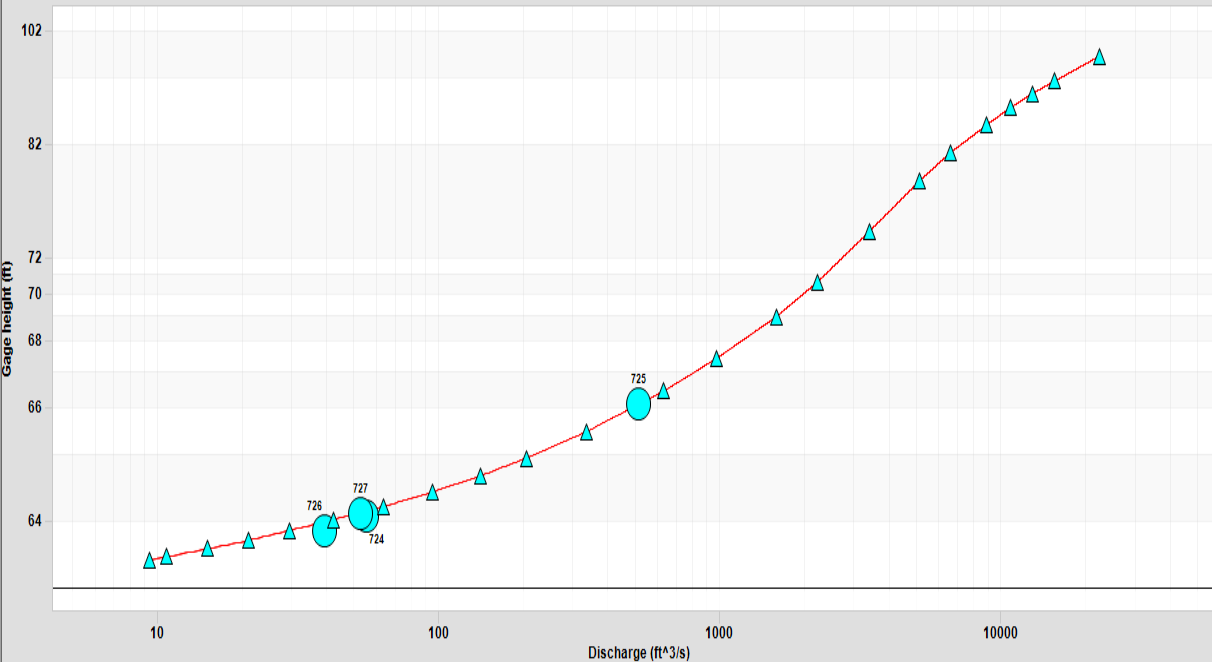
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April 6, 2018



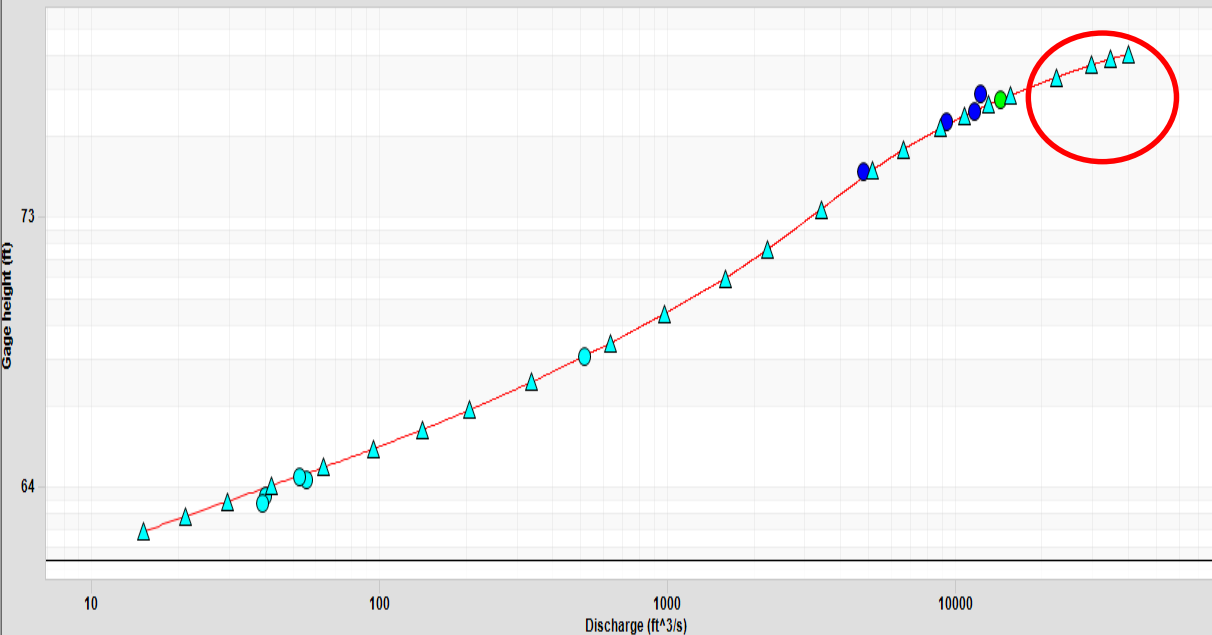
08069000 - Cypress Ck nr Westfield, TX - DD: 1 Rating: 26.0

Rating period from 2017-02-08 to 2017-08-25

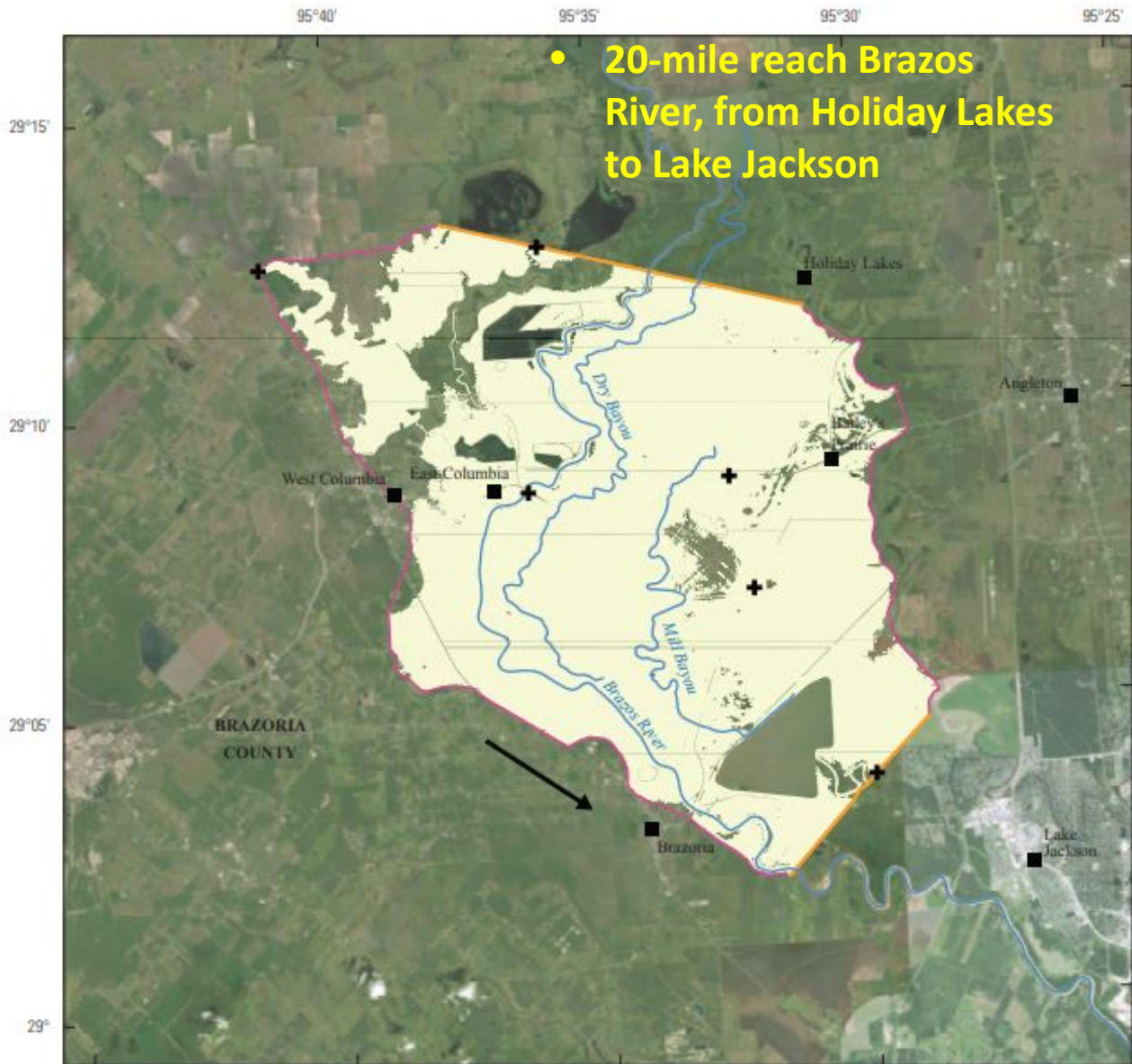


**Original Rating No. 26 stopped at Gage Height of 96.2 feet and Discharge of 22,400 cfs**

08069000 - Cypress Ck nr Westfield, TX - DD: 1 Rating: 26.1



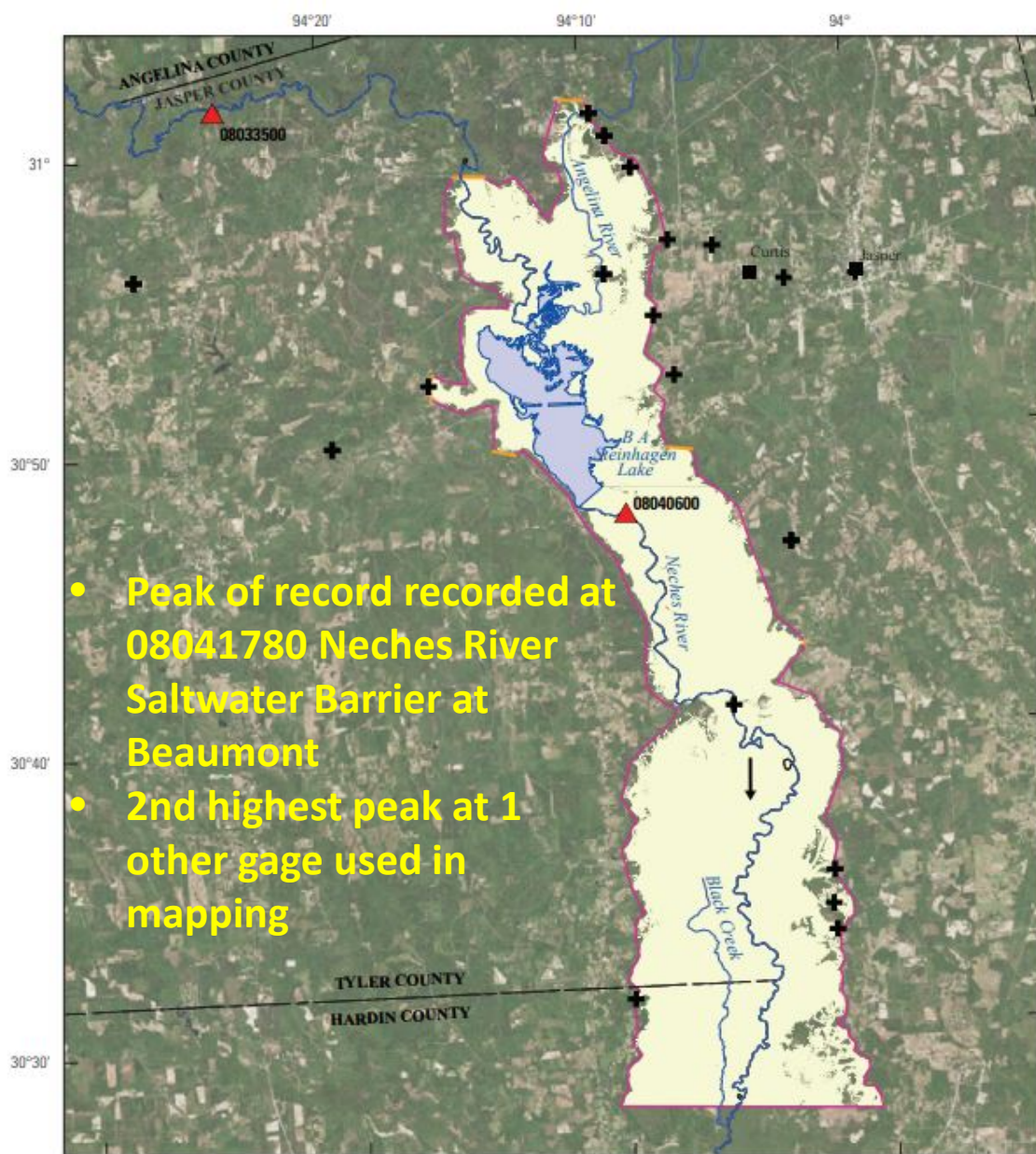
**Rating No. 26.1 extended to Gage Height of 103.4 feet and about 40,000 cfs**



Base modified from U.S. Geological Survey 1:24,000-scale digital data  
Imagery from: ESRI World Image Service  
Albers Equal Area Projection, Texas Centric Mapping System  
North American Datum of 1983 (2011)



Lower Brazos River, August and September 2017



- Peak of record recorded at 08041780 Neches River Saltwater Barrier at Beaumont
- 2nd highest peak at 1 other gage used in mapping

Base modified from U.S. Geological Survey 1:24,000-scale digital data  
 Imagery from: ESRI World Image Service  
 Albers Equal Area Projection, Texas Centric Mapping System  
 North American Datum of 1983 (2011)

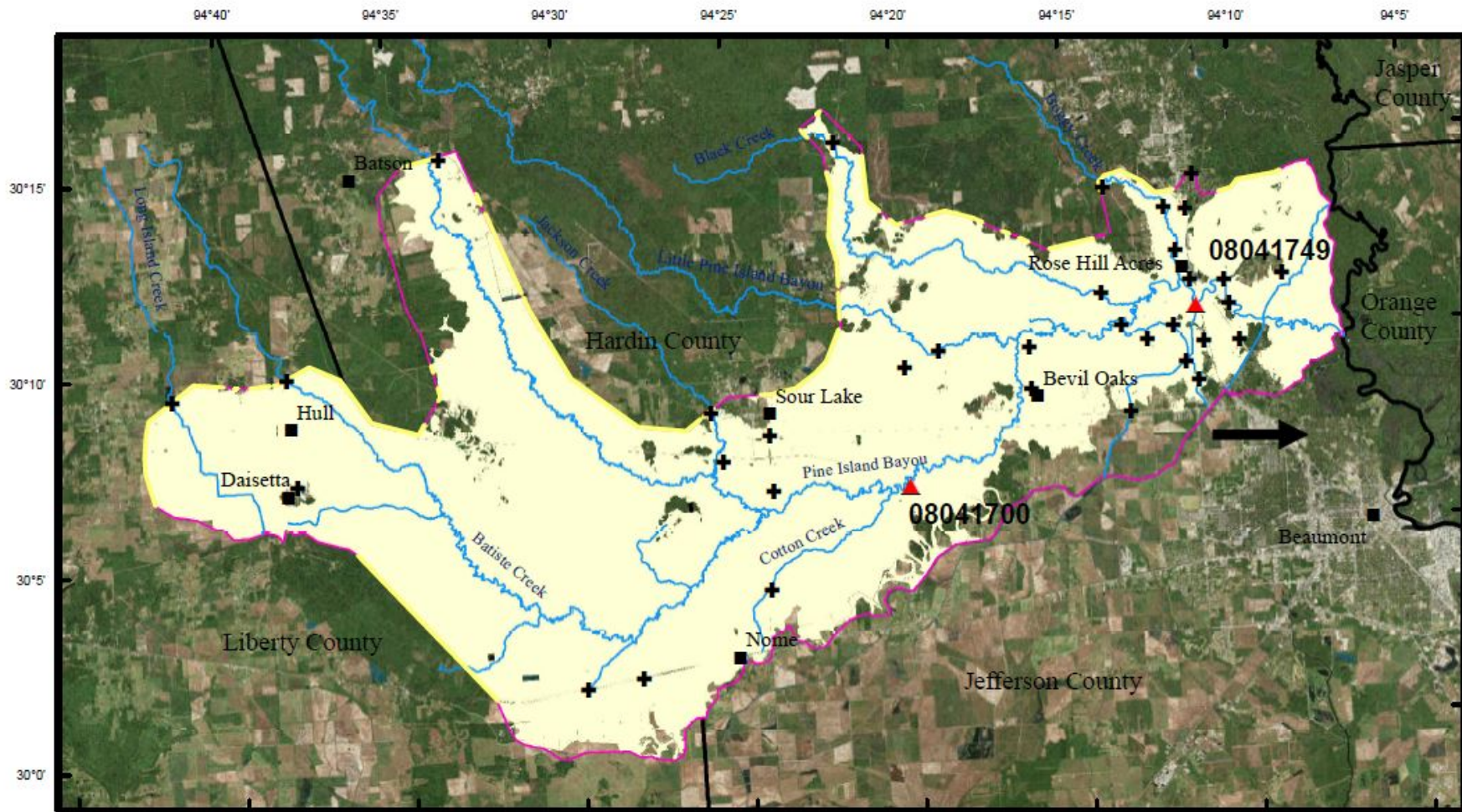
0 2 4 MILES  
 0 2 4 KILOMETERS



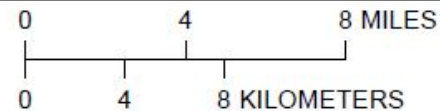
Upper Neches River, August and September 2017

# Pine Island Bayou Mapping

- 68-mile reach Pine Island Bayou
- 34 HWMs used
- HWM height above ground ranged from 0 to 14.3 ft
- Precipitation range 24-44 inches within the watershed
- Communities- Hull, Daisetta, Sour Lake, Nome, Bevil, Oaks, Rose Hill Acres, and outskirts of Beaumont



Base modified from U.S. Geological Survey 1:24,000-scale digital data  
 Imagery from: ESRI World Image Service  
 Albers Equal Area Projection, Texas Centric Mapping System  
 North American Datum of 1983 (2011)



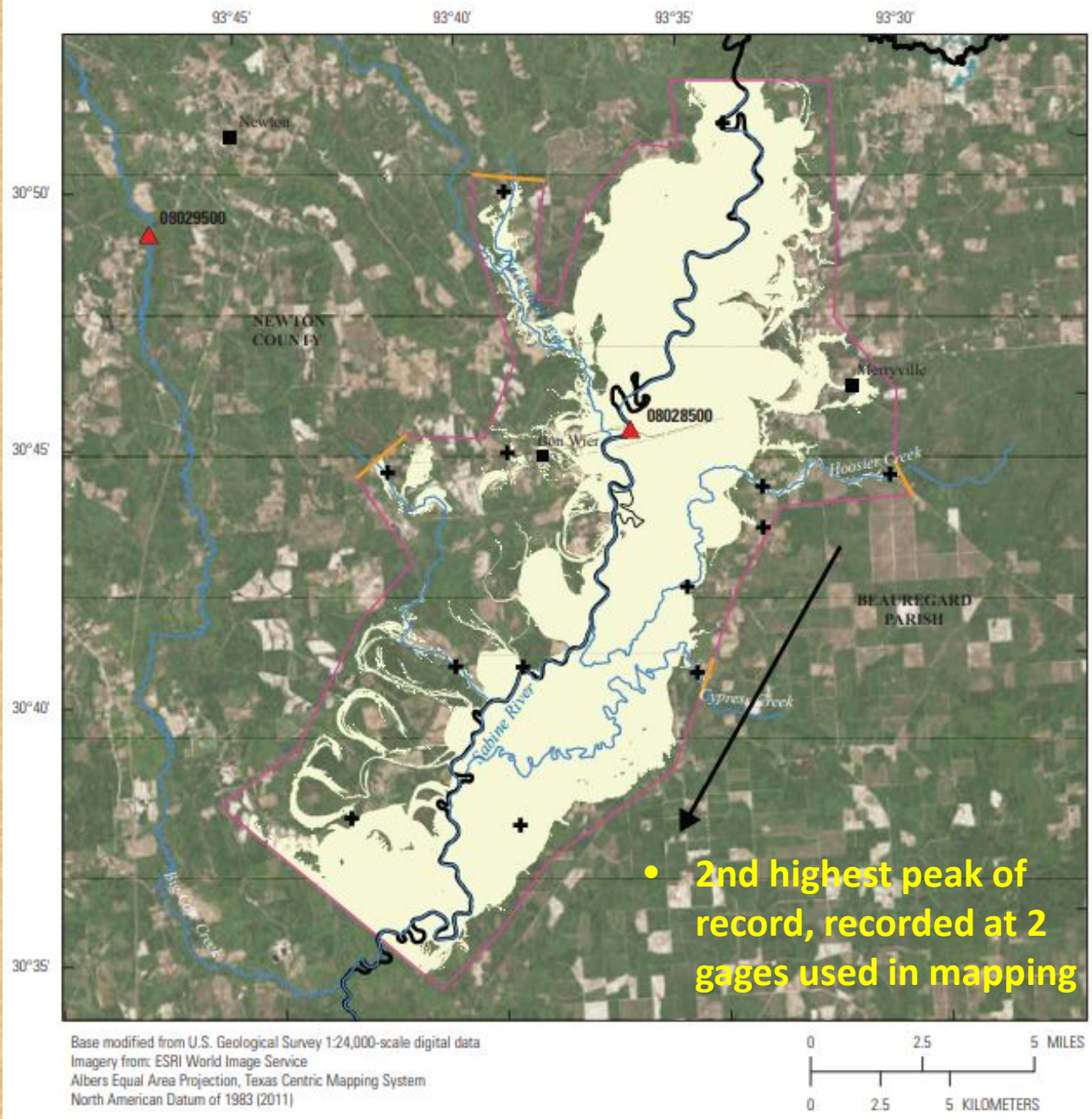
- Peak of record recorded at 08041700 Pine Island Bayou near Sour Lake



Pine Island Bayou, August and September 2017



Communities:  
Newton,  
Merryville,  
Bon Wier

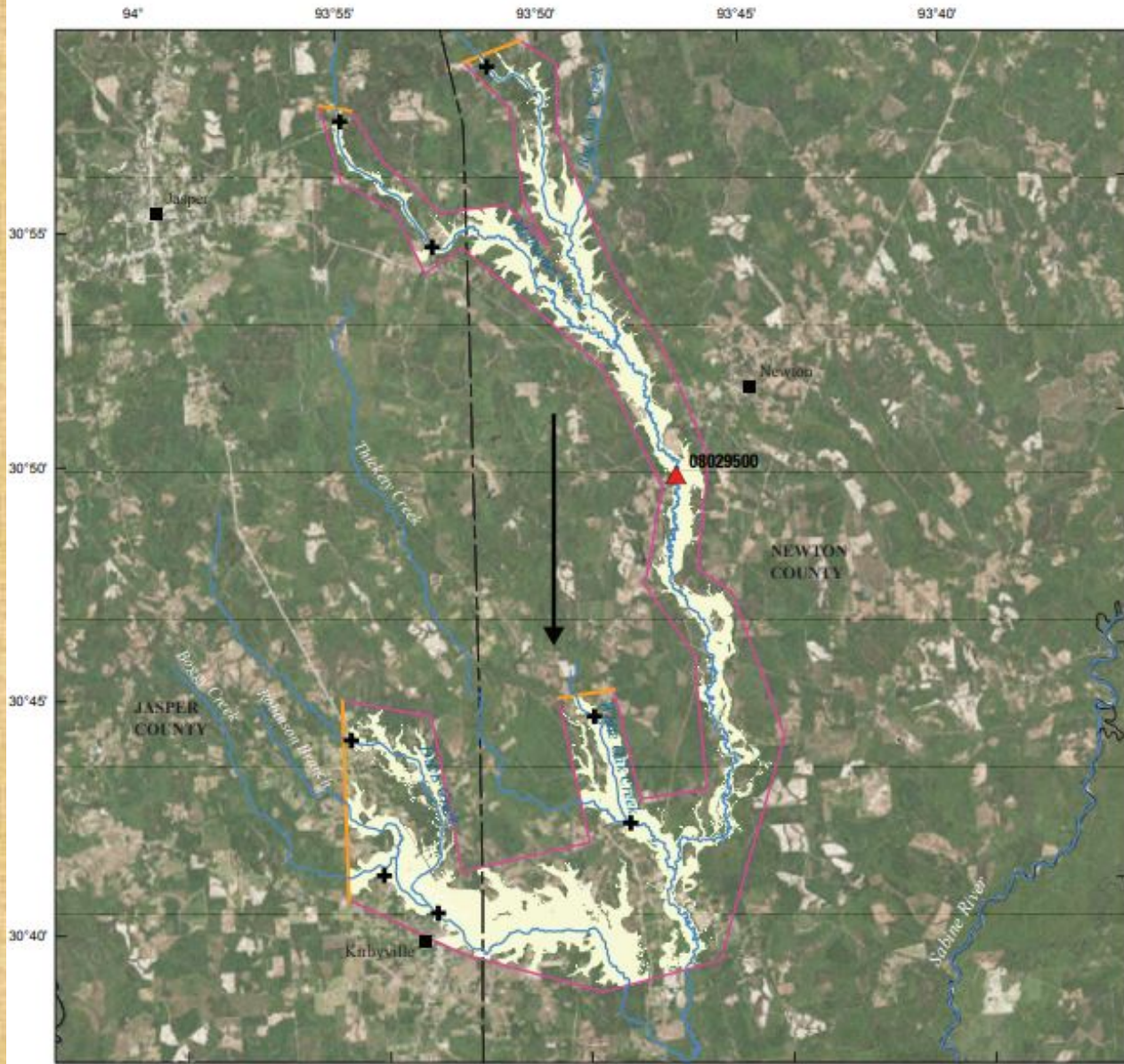


Upper Sabine River, August and September 2017

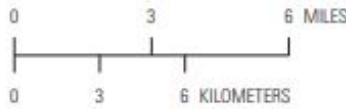
Communities:  
Kirbyville,  
Buna,  
Deweyville,  
Starks



Middle Sabine River, August and September 2017



Base modified from U.S. Geological Survey 1:24,000-scale digital data  
 Imagery from: ESRI World Image Service  
 Albers Equal Area Projection, Texas Centric Mapping System  
 North American Datum of 1983 (2011)



Communities:  
 Newton,  
 Kirbyville

Reach length:  
 37 miles



Big Cow Creek, August and September 2017

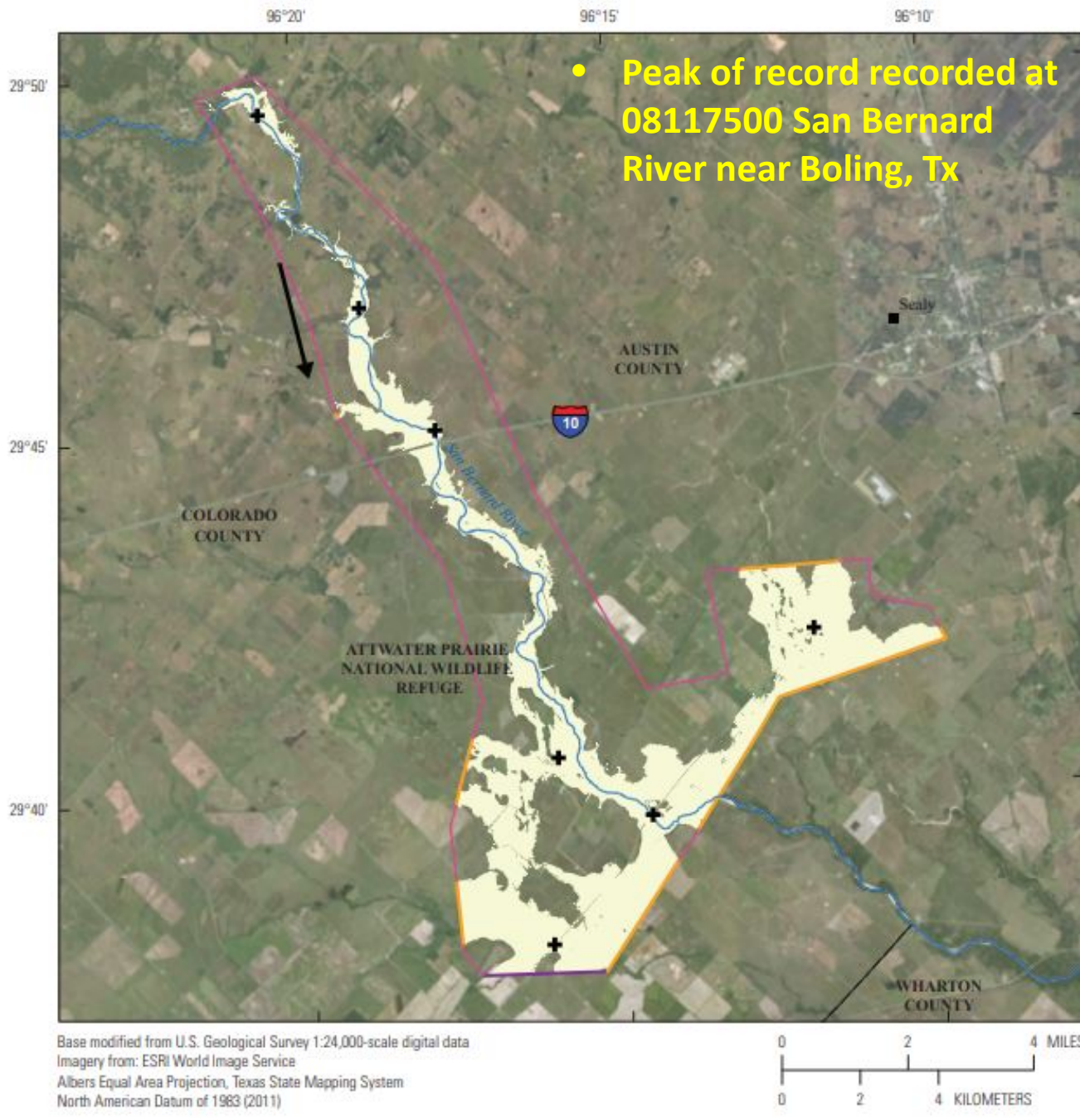
# San Bernard River Mapping

- Divided into 3 separate maps
- Along the San Bernard River- upper, middle, and lower
- 34 HWMs used to map
- HWM height above ground ranged from 0 to 6.8 ft
- Precipitation range 11-33 inches within the watershed

Community:  
Sealy

Reach length:  
20 miles

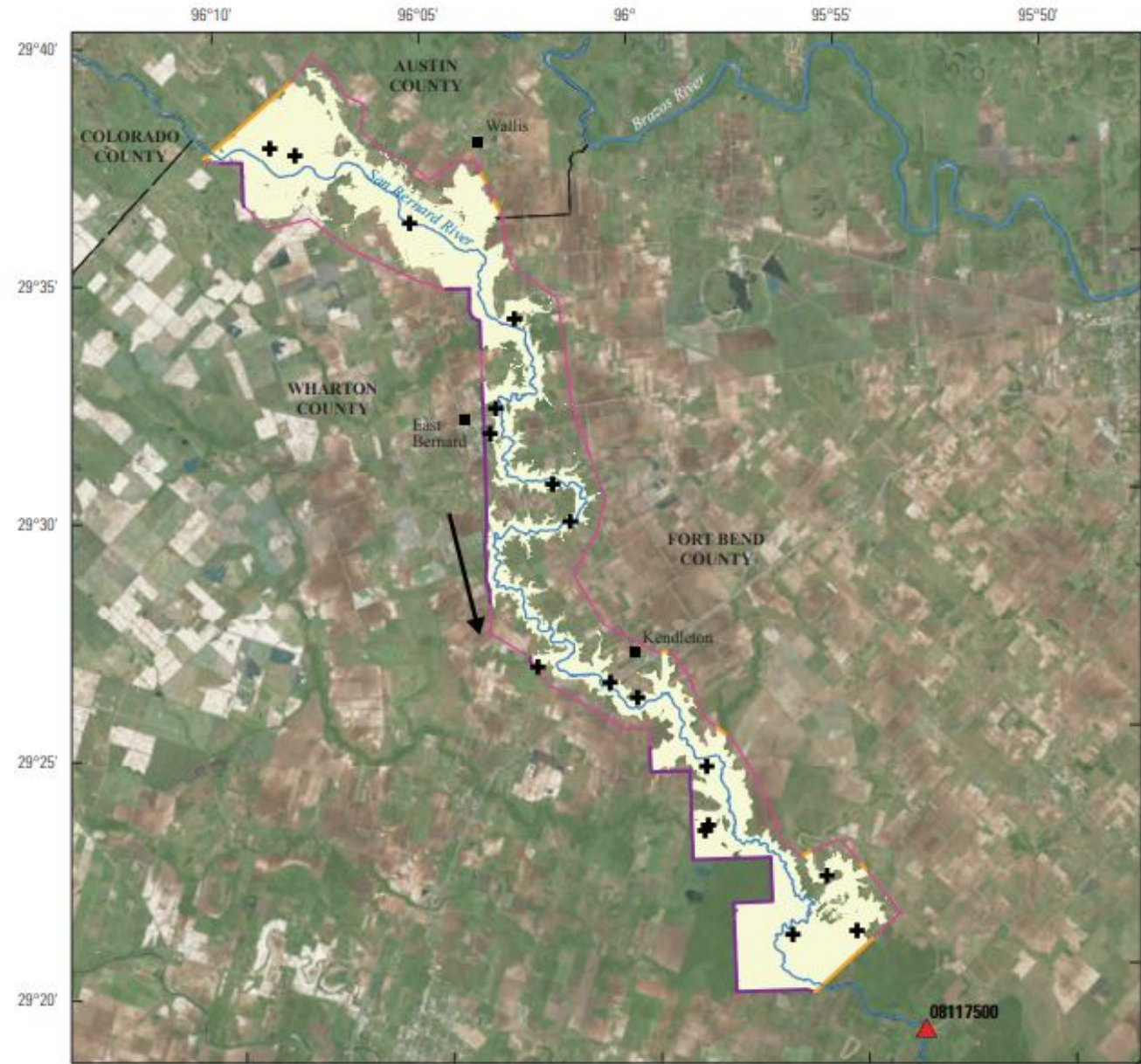
- Peak of record recorded at 08117500 San Bernard River near Boling, Tx



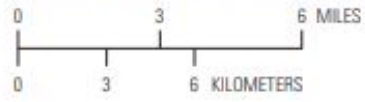
Upper San Bernard River, August and September 2017

Communities:  
Wallis, East  
Bernard,  
Kendleton

Reach length:  
46 miles



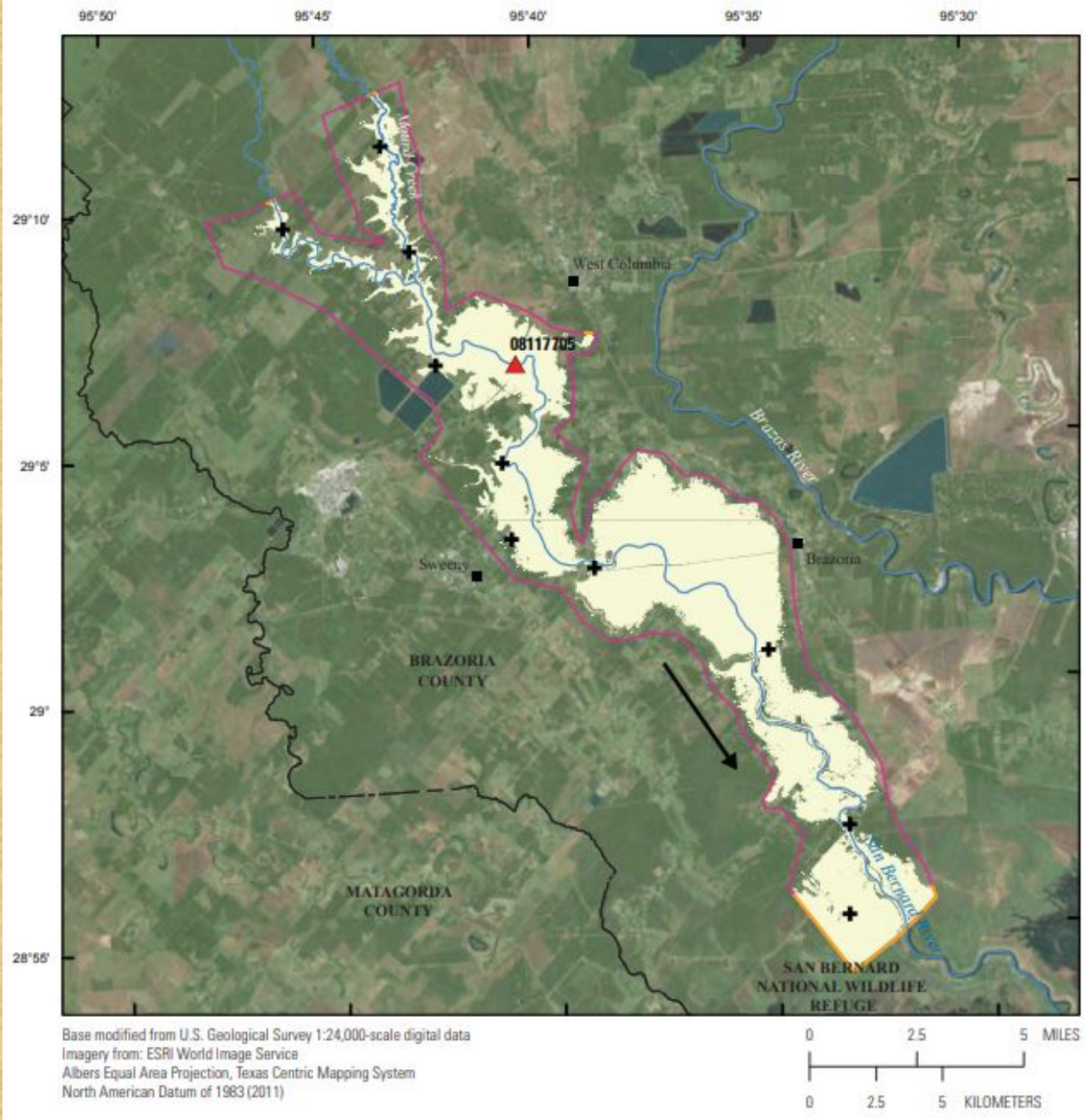
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Imagery from: ESRI World Image Service  
Albers Equal Area Projection, Texas State Mapping System  
North American Datum of 1983 (2011)



Middle San Bernard River, August and September 2017

Communities:  
Sweeny,  
Brazoria

Reach length:  
33 miles



Lower San Bernard River, August and September 2017

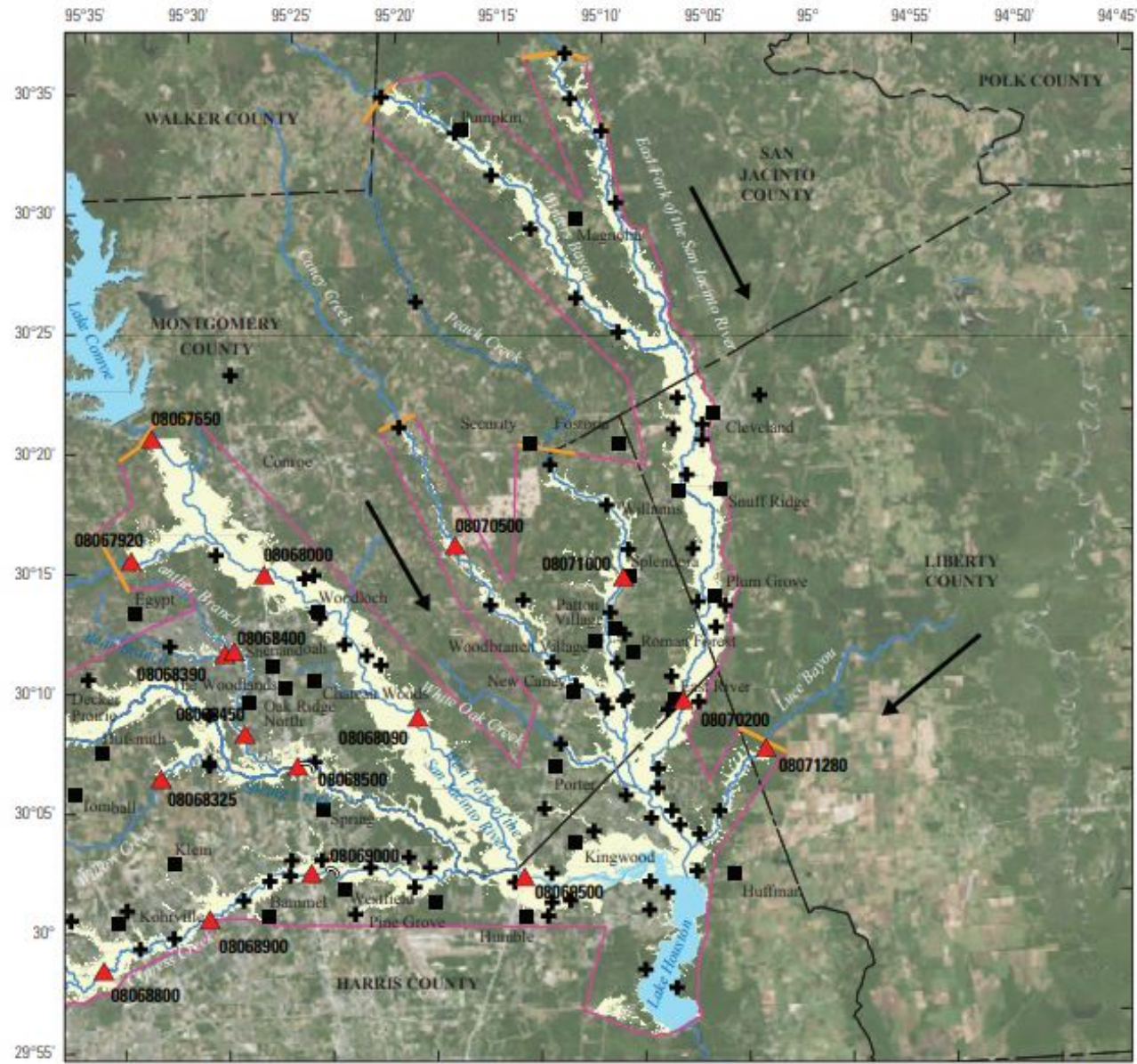
- Peak of record recorded at 4 streamgages

08070000 East Fork San Jacinto River near Cleveland

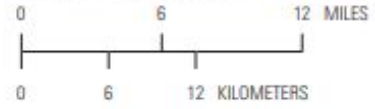
08071000 Peach Creek at Splendora

08070200 East Fork San Jacinto River near New Caney

08071280 Luce Bayou above Lake Houston near Huffman



Base modified from U.S. Geological Survey 1:24,000-scale digital data  
 Imagery from: ESRI World Image Service  
 Albers Equal Area Projection, Texas Centric Mapping System  
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East Fork San Jacinto River, August and September 2017



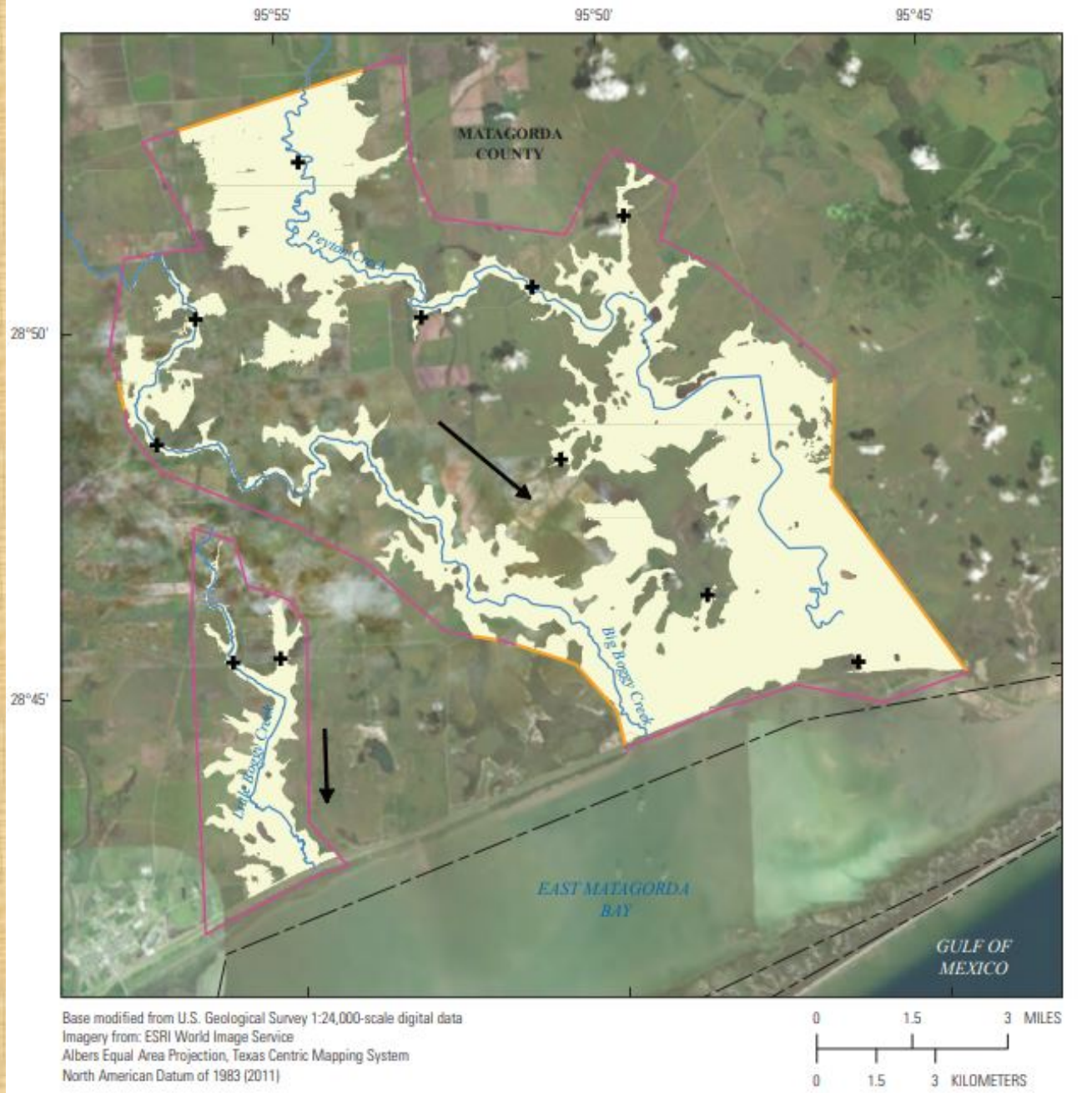
# Coastal Basins Mapping

- Divided into 3 separate riverine inundation maps
- One map along coastline showing peak water-surface elevation
- 129 HWMs used to map
- HWM height above ground ranged from 0 to 7.7 ft
- Precipitation range 6.6 -33 inches within the watershed

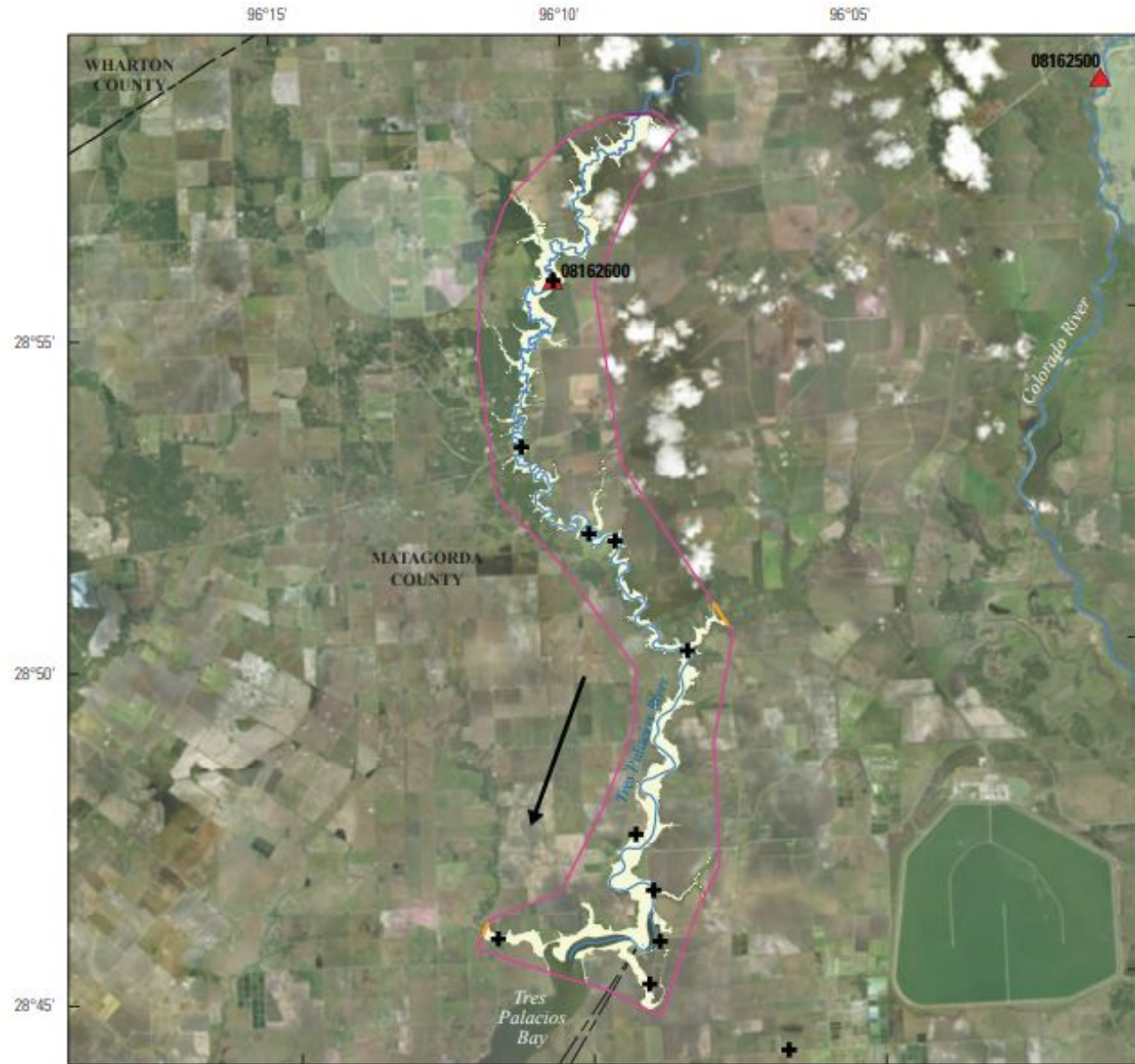
# East Matagorda Bay Basin Mapping

- Divided into 3 maps
- 1 includes 17-mile reach of Peyton Creek, 16-mile reach of Big Boggy Creek, and a 6-mile reach of Little Boggy Creek
- 2 includes 21-mile reach of Tres Palacios River
- 3 includes 13.5-mile reach of West Carancahua Creek, 14.5-mile reach of East Caranchua Creek, and 9.6-mile reach of Keller Creek

Peyton Creek  
Big Boggy Creek  
Little Boggy Creek



East Matagorda Bay Basin, August and September 2017



Base modified from U.S. Geological Survey 1:24,000-scale digital data  
Imagery from: ESRI World Image Service  
Albers Equal Area Projection, Texas Centric Mapping System  
North American Datum of 1983 (2011)

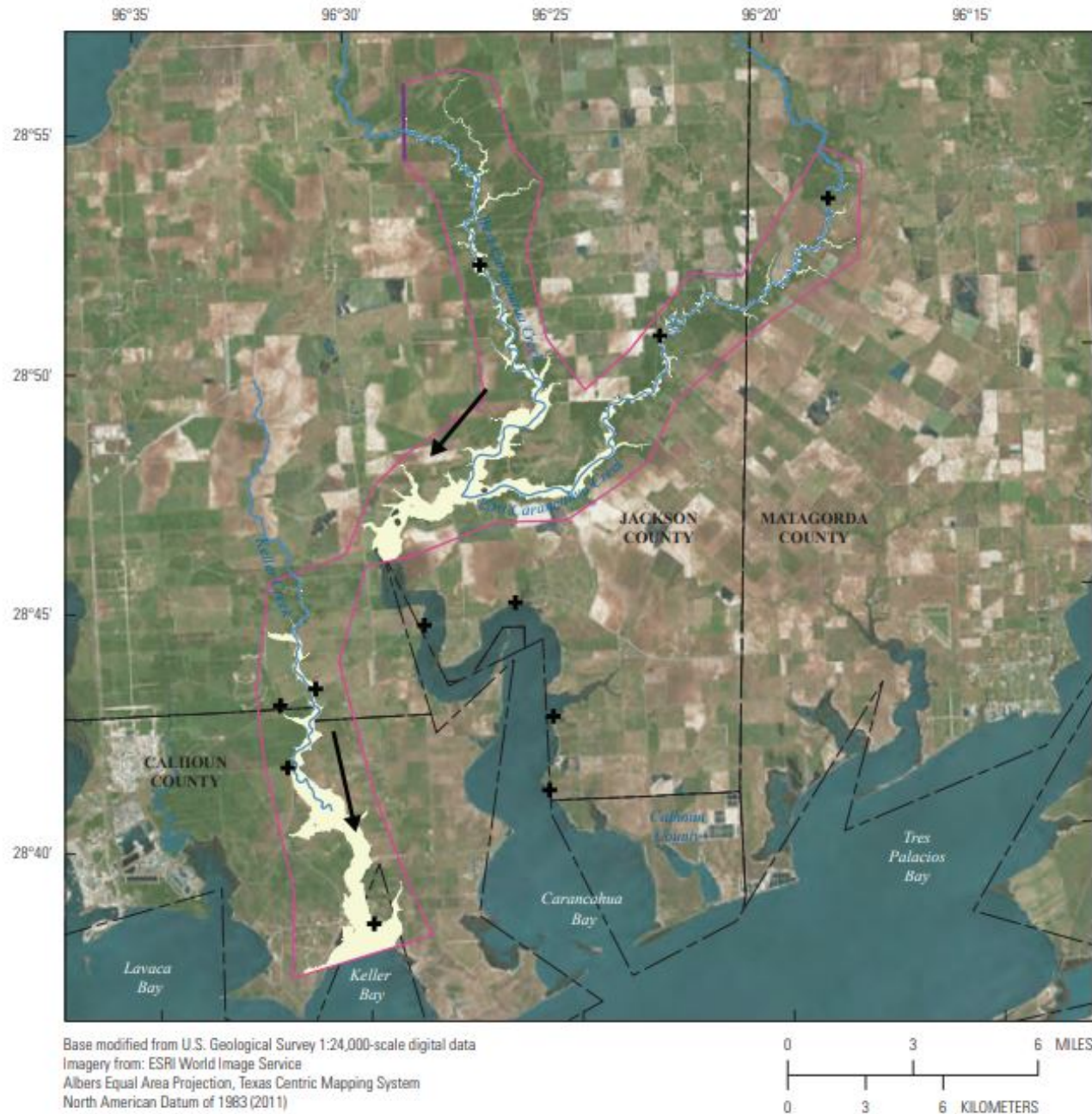


Tres Palacios River, August and September 2017

West Carancahua  
Creek

East Carancahua  
Creek

Keller Creek



East Matagorda Bay Basin, August and September 2017