

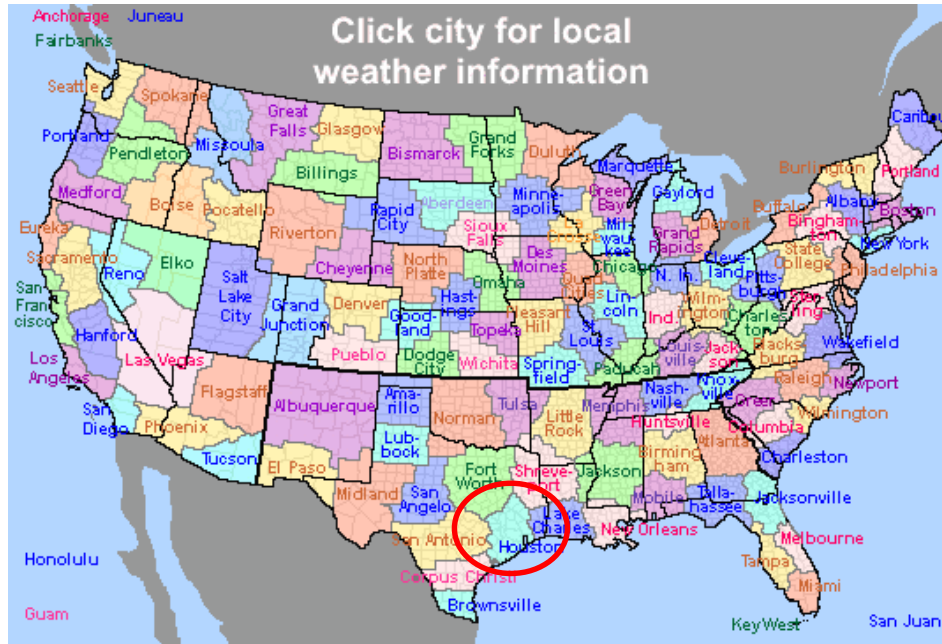


2018 FloodWarn Training

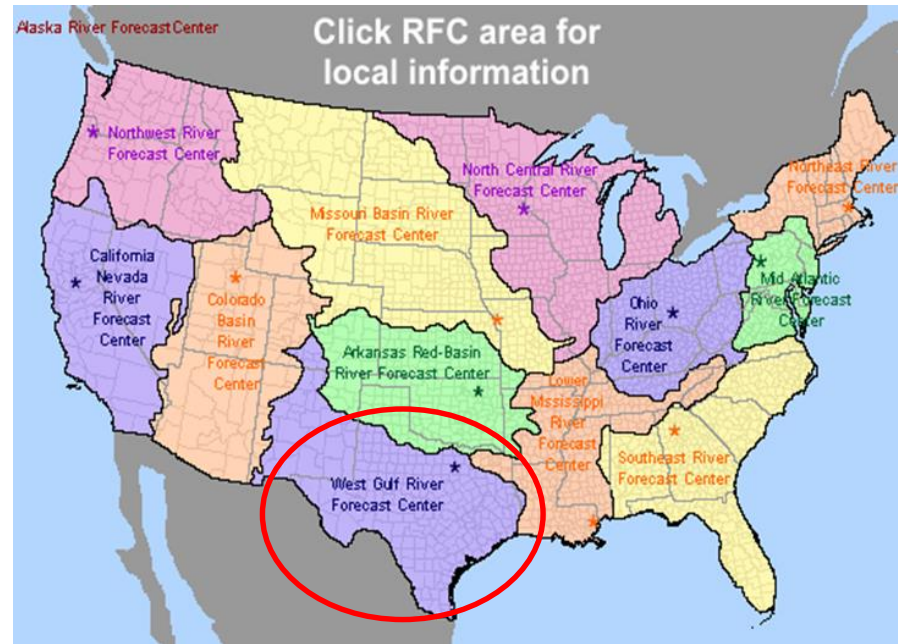
Katie Landry-Guyton
Senior Service Hydrologist/Meteorologist
National Weather Service- Houston/Galveston, TX

National Weather Service

Weather Forecast Offices



River Forecast Centers



Outline

Flooding Importance

Flooding Types and Causes

Flood Products

River Flooding

Partners

Flood Safety

Reporting Flooding

Flood Risk

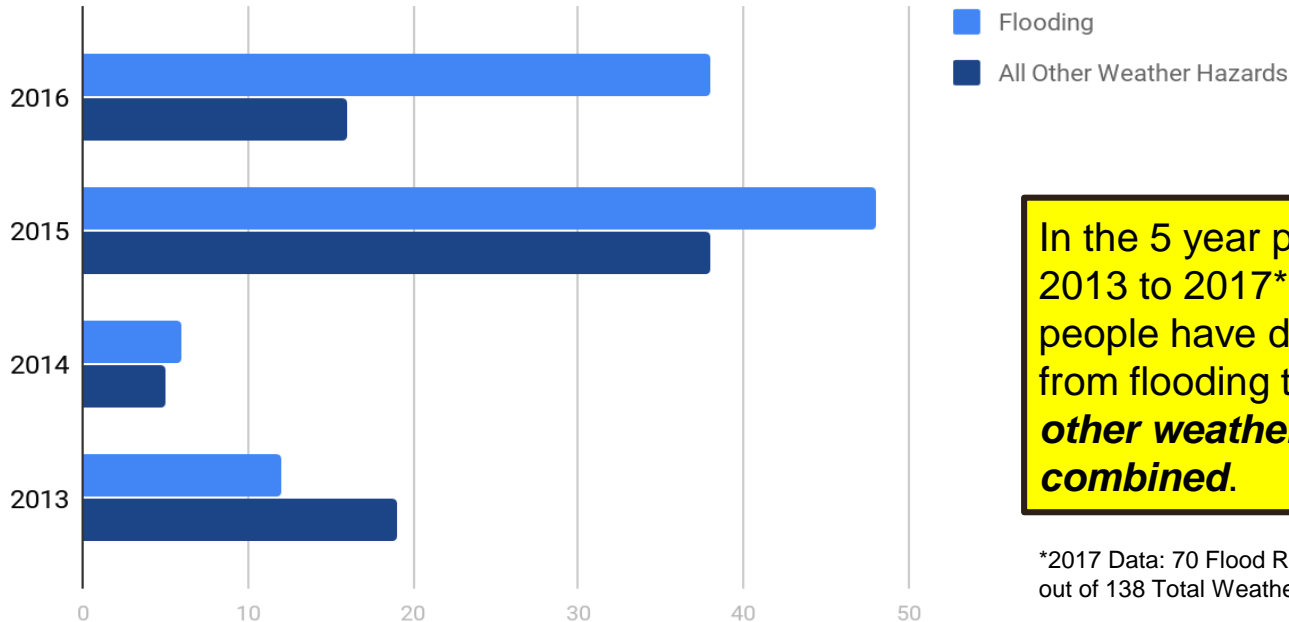




Flooding Importance

Flooding is Deadly!

Weather-Related Deaths in Texas

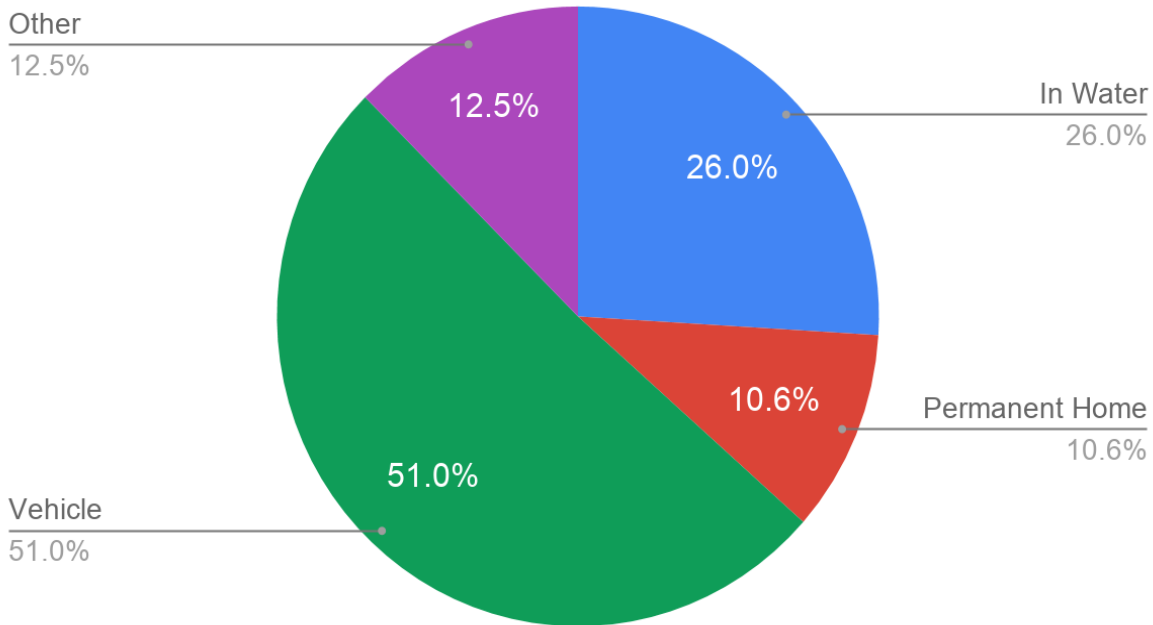


In the 5 year period from 2013 to 2017*, **more** people have died in Texas from flooding than ***all other weather hazards combined.***

*2017 Data: 70 Flood Related Deaths in TX out of 138 Total Weather-Related Fatalities

Flood Fatalities

Texas Flood Fatalities by Shelter from 2013-2016



Over half of the flood fatalities in Texas occurred while people were in their car.

Houston Floods: April 18, 2016



Recent Big Floods...

Memorial Day 2015

Tax Day 2016

Brenham 2016

Harvey 2017



Tax Day 2016



Brenham 2016



Harvey 2017

And other historic floods...

Tropical Storm Allison

1994 Flood

Tropical Storm Claudette



Flooding Types and Causes

What Causes Flooding?

- Intense rainfall
- Rain over several days
- Dam/levee failures
- High tides or storm surge
- Snowmelt
- Ice or debris jams



Types of Flooding

Ponding & Sheet Flow Flooding

Flooding that occurs gradually over time, usually 6 hours after the rain begins or longer (longer duration)

Flash Flooding

Flooding that develops quickly (typically 6 hours or less) either from heavy rainfall or dam/levee failure (shorter duration).

River Flooding

Flooding that occurs from water escaping river banks.

Coastal Flooding

Flooding along a coastline either from high tides or storm surge during a tropical storm or hurricane



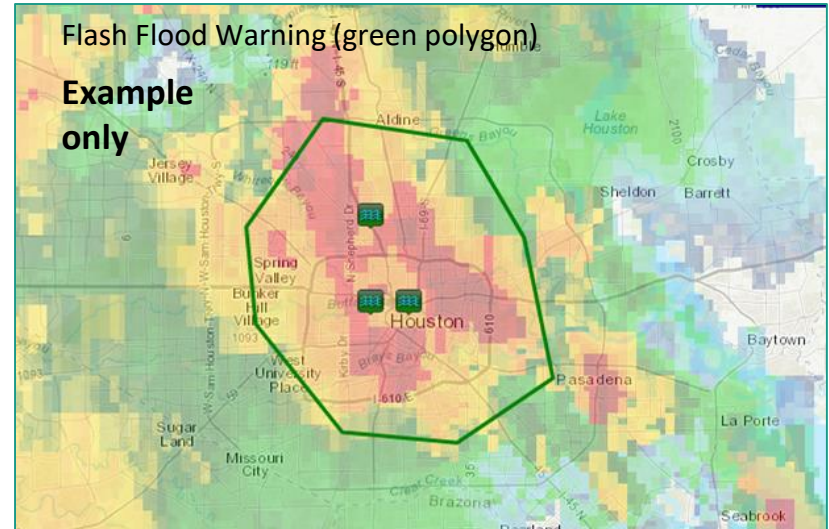
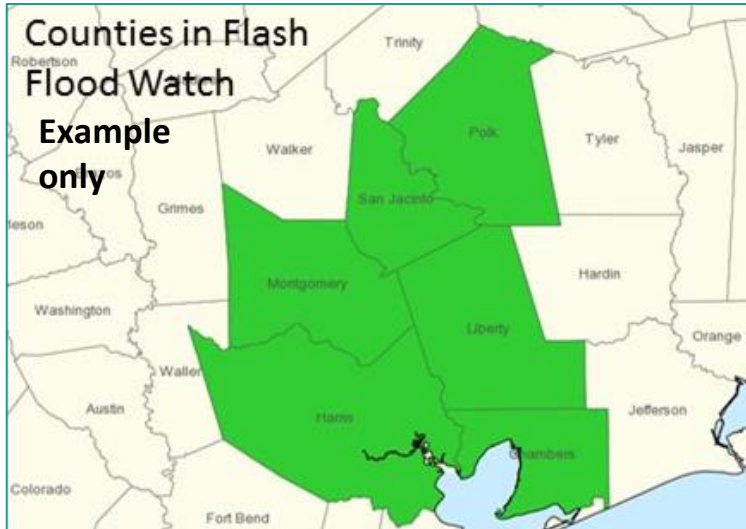


Flood Products

Watch vs Warning

A **Watch** is issued when conditions are favorable to occur.

A **Warning** is issued when the threat is *occurring or imminent*, threatening life or property.



Flood vs. Flash Flood



A **Flood** is an overflow of water onto normally dry land likely caused by rising water in a river/bayou or poor drainage. Flooding is a longer term event than flash flooding. It may last days or weeks.

A **Flash Flood** is a flood caused by heavy or excessive rainfall in a short period of time, typically 6 hours or less. Flash floods are defined as:

- ≥ 3 feet of standing water (less if threatening life or property), and/or
- ≥ 6 inches of fast flowing water across a road or bridge, or
- Water in a stream or bayou flowing rapidly out of its banks, or
- A dam break (even on a sunny day)

Understanding Flooding

Urban / Small Stream Advisory

WHAT IS IT?

Flooding of small streams, streets and low-lying areas.

WHAT TO DO?

Stay away from areas that are prone to flooding and stay clear of rapidly moving water

Flood Watch

WHAT IS IT?

Flooding is possible – typically within a 6 to 48 hours before rain is expected to reach the area.

WHAT TO DO?

Stay tuned to local river forecasts; prepare for areas near rivers to spread towards nearby roads and buildings

Flash Flood Watch

WHAT IS IT?

Flash flooding is possible – typically 6 to 48 hours before rain is expected to reach the area.

WHAT TO DO?

Have a way to receive local warnings, expect hazardous travel conditions and have alternate routes available

Flood Warning

WHAT IS IT?

Flooding impacts are occurring or imminent.

WHAT TO DO?

Stay *alert* for inundated roadways and follow all local signage! Additional impacts include homes and structures could become flooded and need to be evacuated

Flash Flood Warning

WHAT IS IT?

Flash flooding impacts are occurring or imminent.

WHAT TO DO?

Conditions will *rapidly* become hazardous! Do not cross flooded roadways or approach inundated areas as water may still be rising


Flash Flood Emergency

WHAT IS IT?

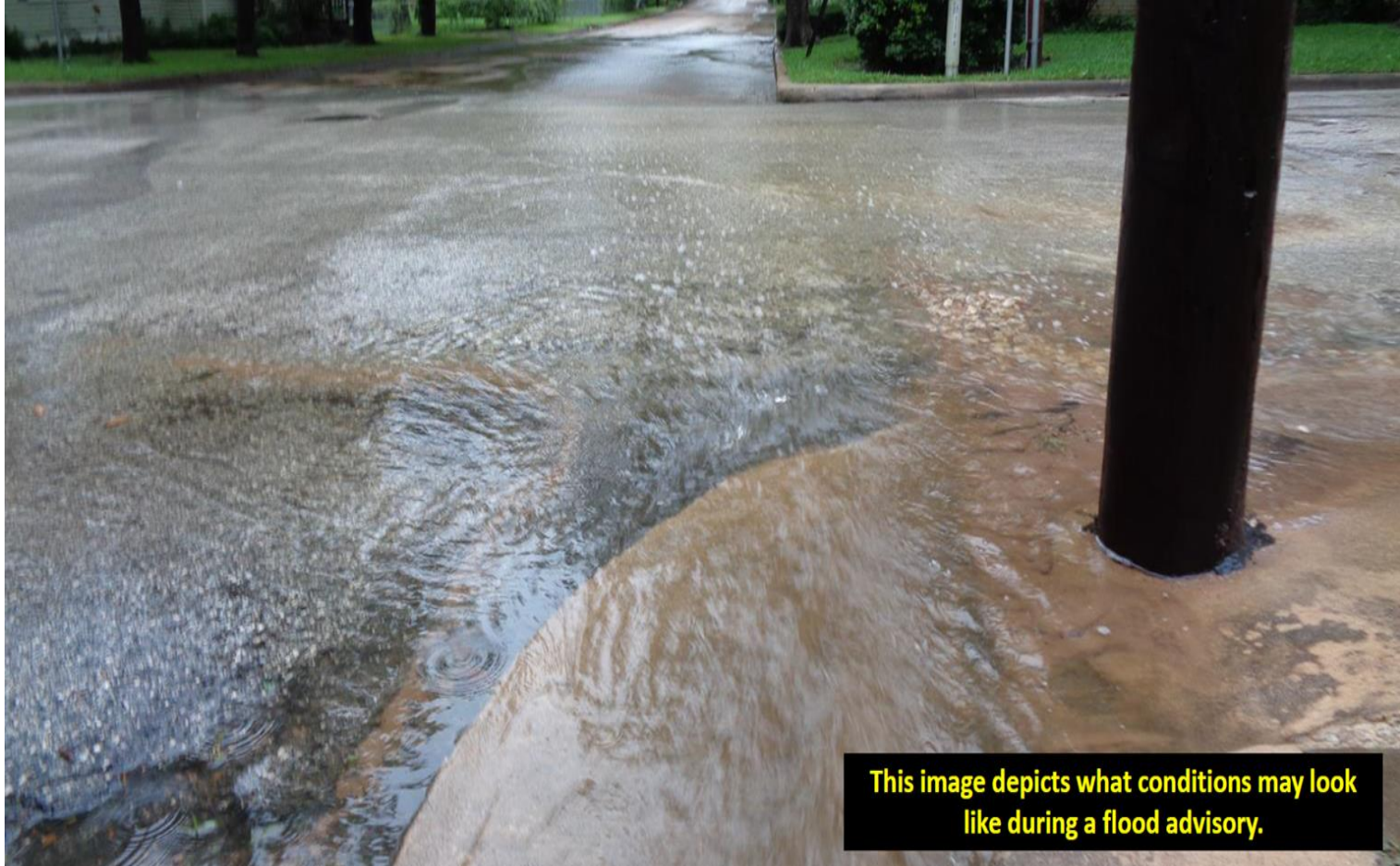
Flash flood situation that presents a clear threat to human life due to extremely dangerous flooding conditions

WHAT TO DO?

Immediately reach higher ground by any means possible



Urban / Small Stream Flood Advisory



This image depicts what conditions may look like during a flood advisory.

Flash Flood Warning



This image depicts what conditions may look like during a Flash Flood Warning.

Flash Flood Emergency



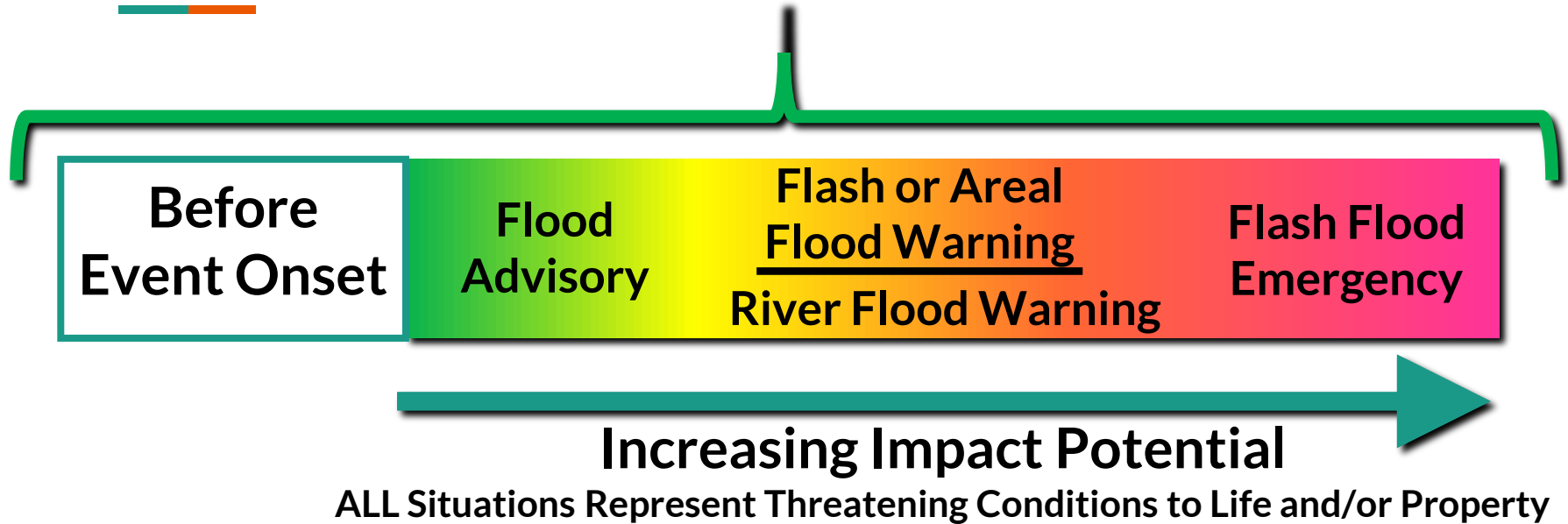
This image depicts what impacts may result from a Flash Flood Emergency. A rapidly moving flood wave resulted in this roadway being completely washed out.

Flood Warning (Areal/ River/ Bayou)



This image depicts what conditions may look like during an Areal Flood Warning.

Flood Timeline



Note: Flooding can (and does) occur without a Flash Flood Watch!

Ways to Receive a Warning

NOAA Weather Radio



NWS Website: <https://www.weather.gov/hgx/>

Wireless Emergency Alerts and Weather Apps



TV and Radio



Social Media





River Flooding

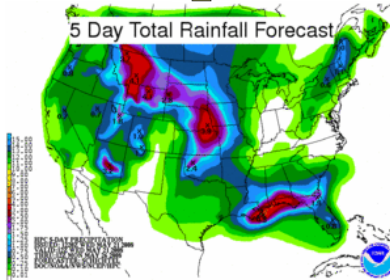
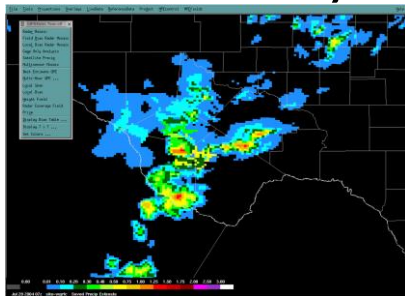
River Flooding



River flooding occurs when water escapes the river banks. There are different thresholds for river flooding: action, minor, moderate, major and record flooding. This image depicts what a river flooding looks like.

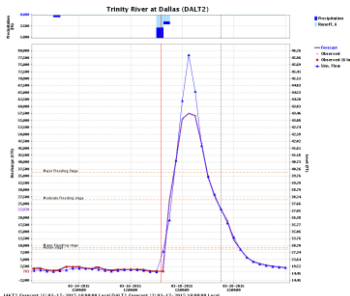
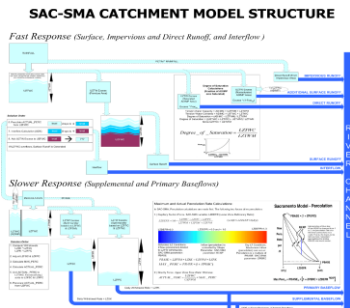
River Forecast Process

Rainfall Analysis



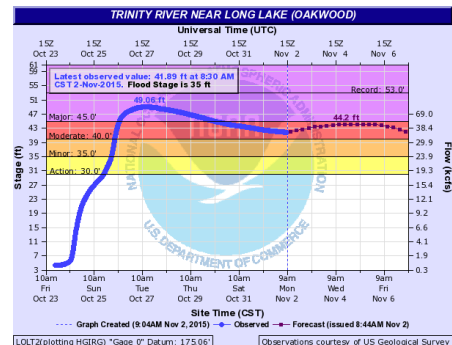
Rainfall estimates and forecasts merged into continuous dataset

Hydrologic Modeling



Rainfall ingested into hydrologic model.
Forecasters adjust model parameters in real time

Forecast



Warning

FLOOD WARNING
NATIONAL WEATHER SERVICE HOUSTON/GALVESTON, TX
926 PM CDT THU MAY 26 2016

...The National Weather Service in Houston/Galveston has issued a flood warning for the following rivers...

Brazos River in Richmond affecting the following counties in Texas...Austin and Fort Bend

/XC015-039-157-473-271425-
/O.NEW.KHGX.FL.W.0149.160529T0730Z-000000T0000Z/
/R/NOT2.1.ER.160529T0730Z.160531T0600Z.000000T0000Z.NO/
126 PM CDT THU MAY 26 2016

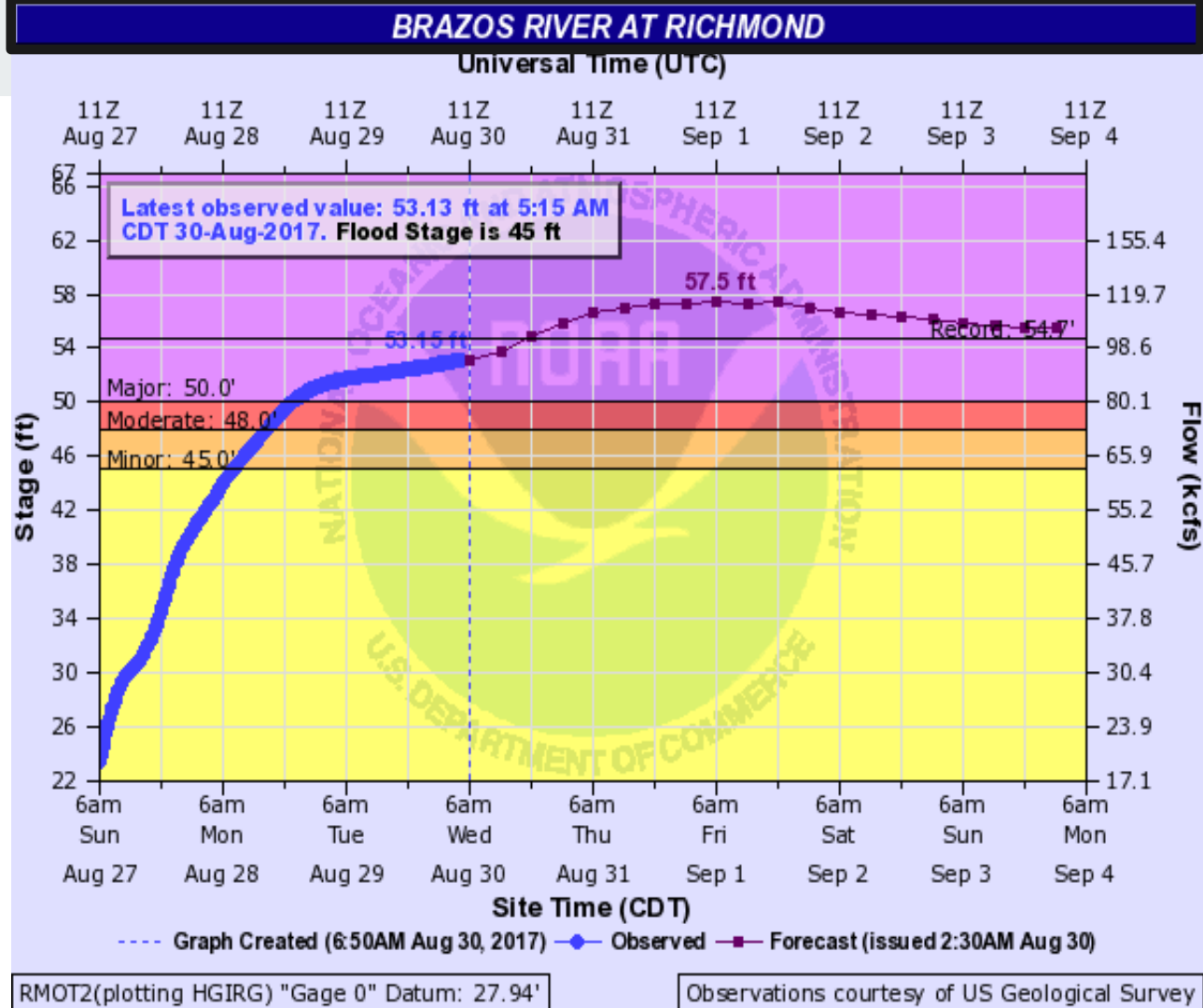
The National Weather Service in Houston/Galveston has issued a

Flood Warning for
The Brazos River in Richmond.
from late Saturday night until further notice...or until the warning is canceled.

Hydrograph Basics

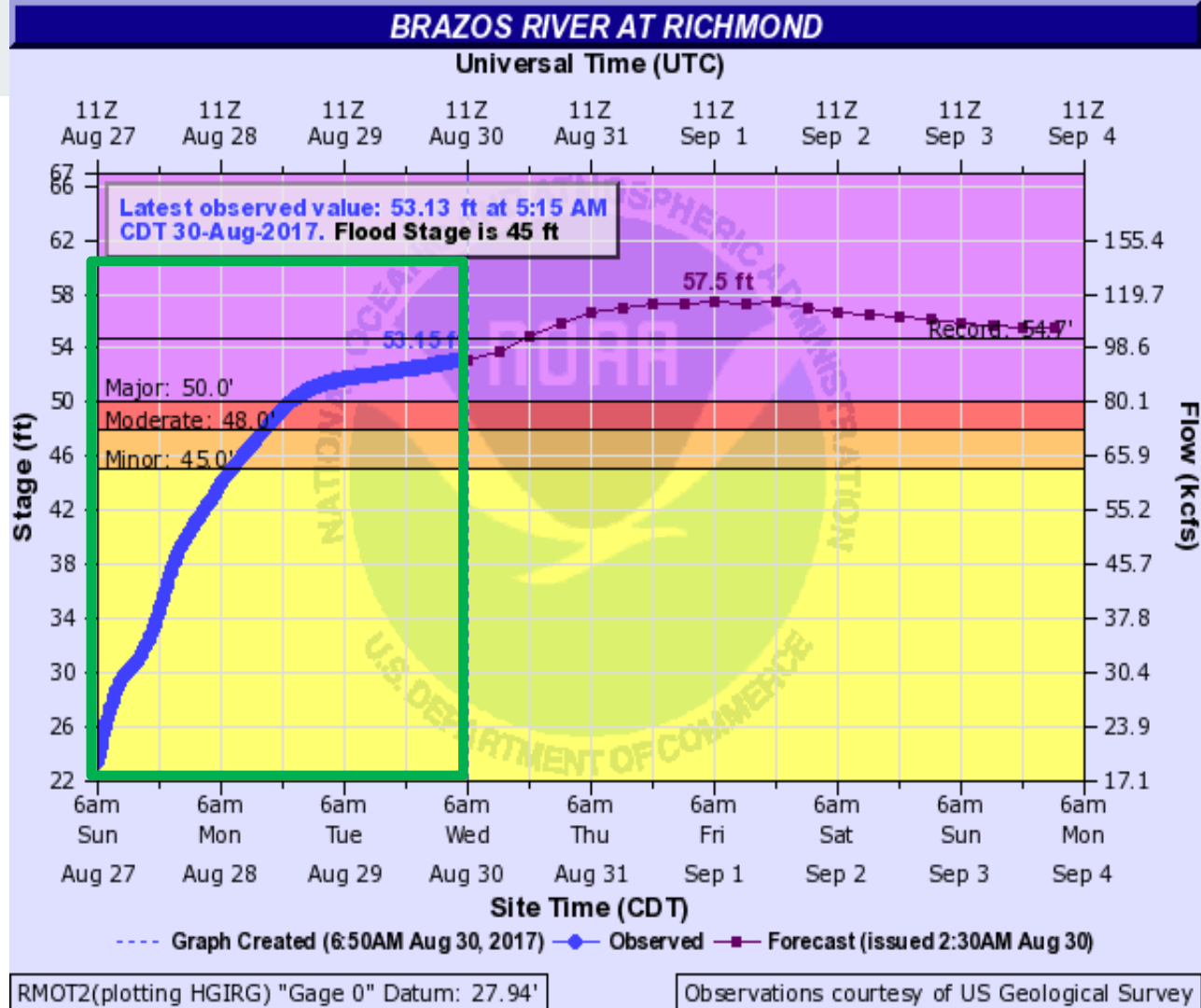
LOCATION:

Of the gage the forecast is made, AT means the gage is in the limits of the town/city, NEAR or NR means that town/city has the closest post office



Hydrograph Basics

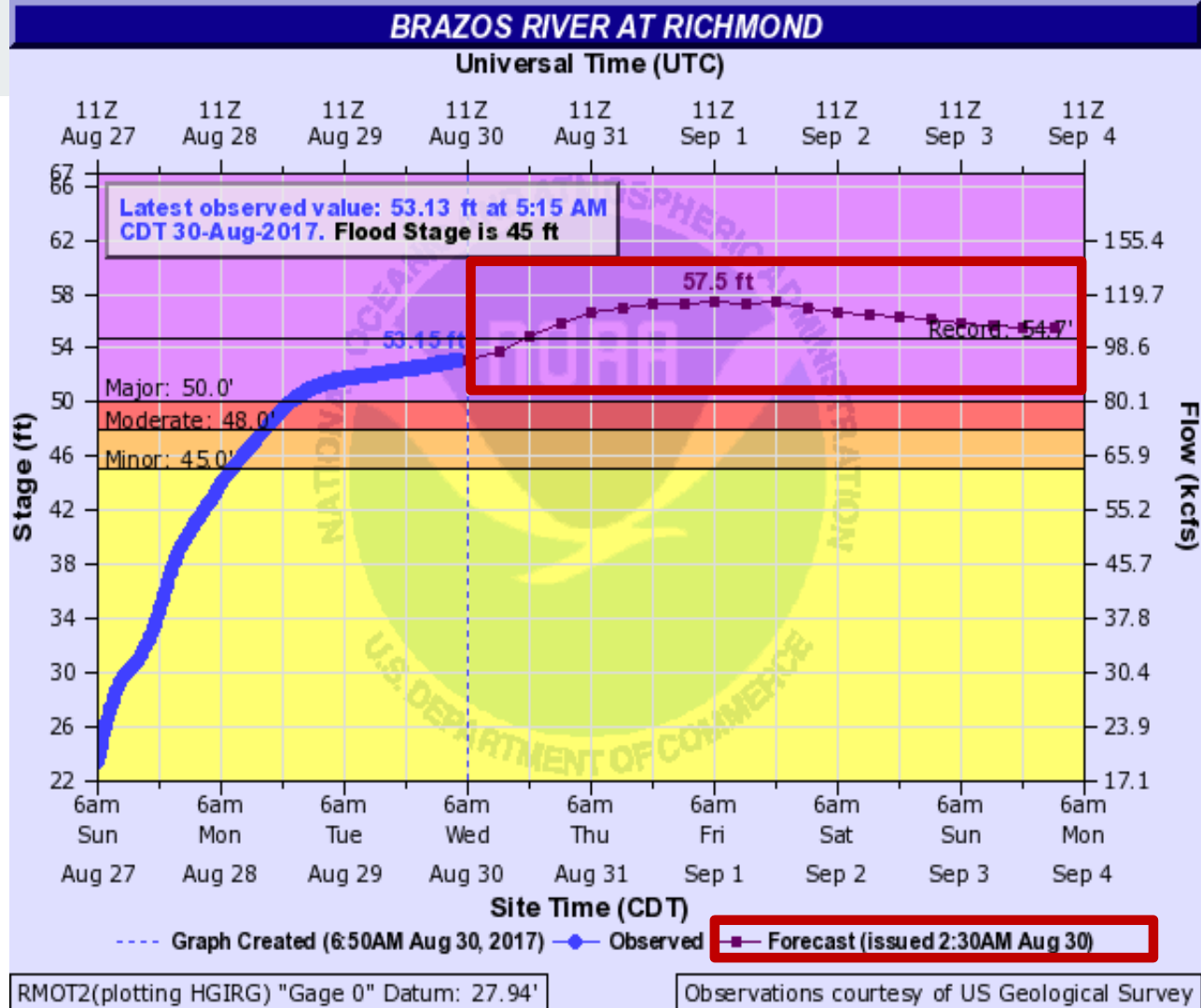
OBSERVATIONS:
Past river stages



Hydrograph Basics

FORECAST:
Forecast River
Stages

CREST:
Peak Stage

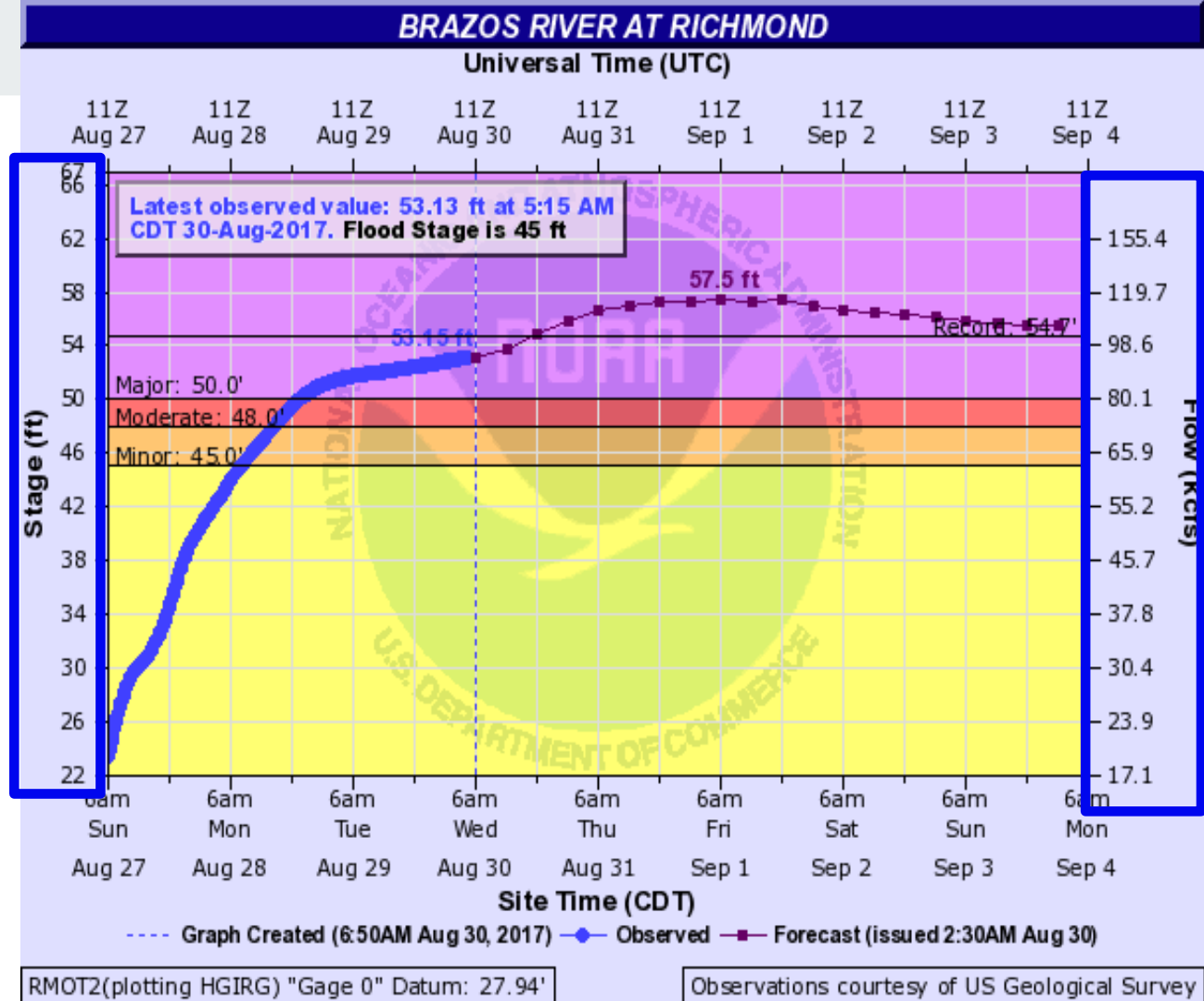


Hydrograph Basics

STAGE VS FLOW:

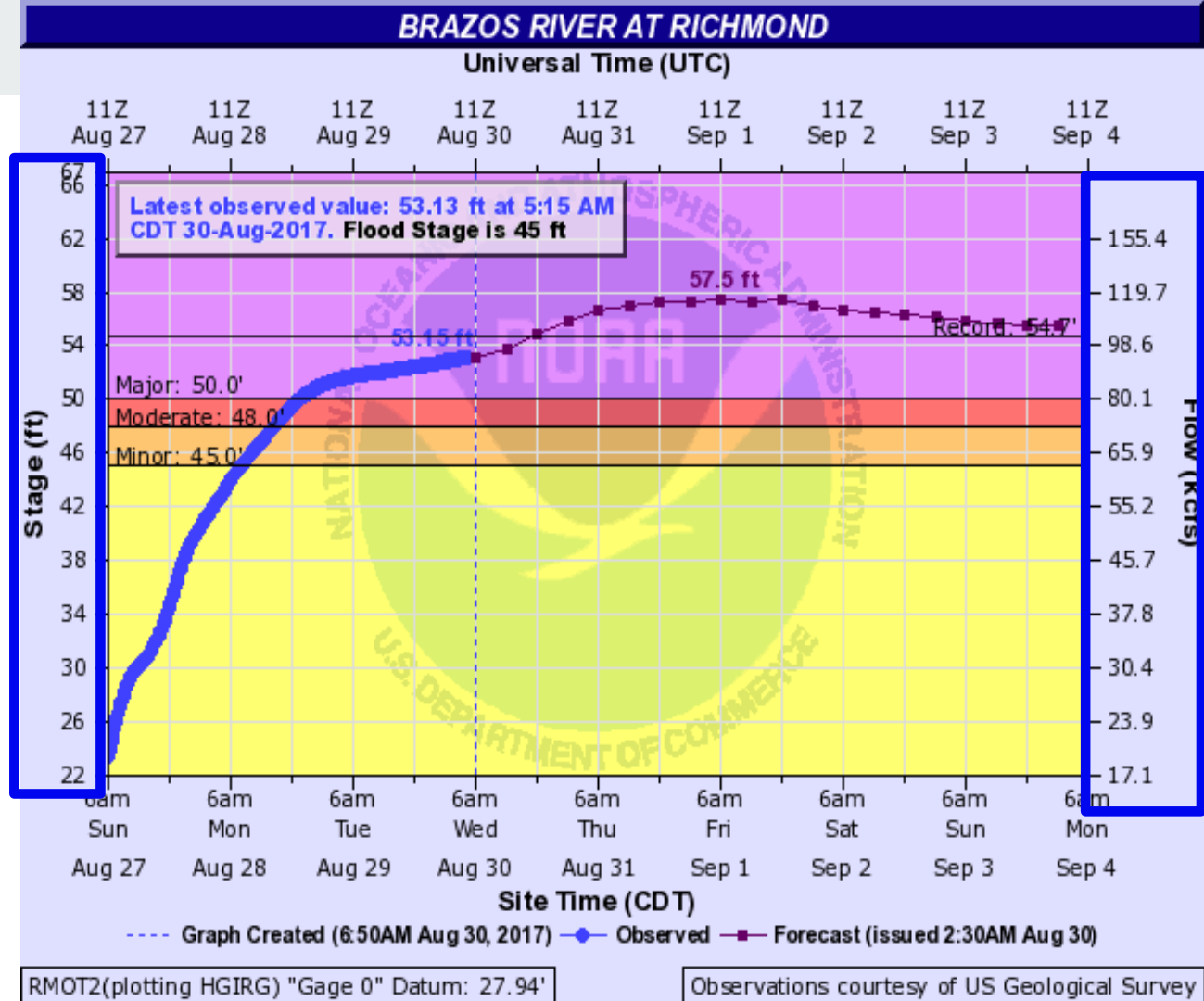
Hydrologists,
models, reservoirs
work in flow.
Emergency
managers, media,
general public work
in stage.

What is flow or a
cubic foot per
second?



Hydrograph Basics

A basketball is roughly a cubic foot, so 20,000cfs is 20,000 basketballs of water passing the gage every second.



Understanding River Criteria Levels



BELOW CRITERIA

Impact: Water is within the banks of the river with no impacts to the surrounding area. Flow speeds may still be high during rainfall or releases which could impact recreational activities

ACTION

Impact: Water is over the banks and into the flood plain, but not a threat to structures or roadways. Some action may be required such as moving farm equipment or increasing awareness

MINOR

Impact: Typically water is impacting areas inside of floodplain which can vary by location. Some low water crossings covered by water, agricultural flooding, water approaching public areas (parks, sidewalks etc.). Areas frequently flooded can expect to be impacted

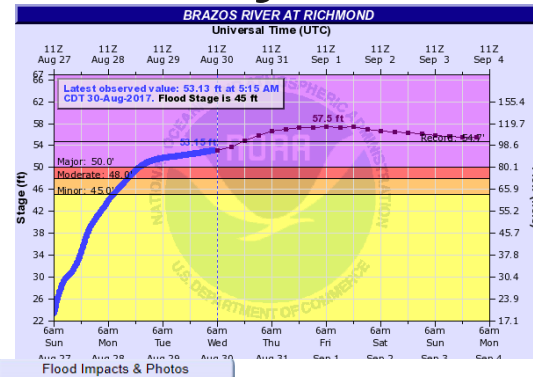
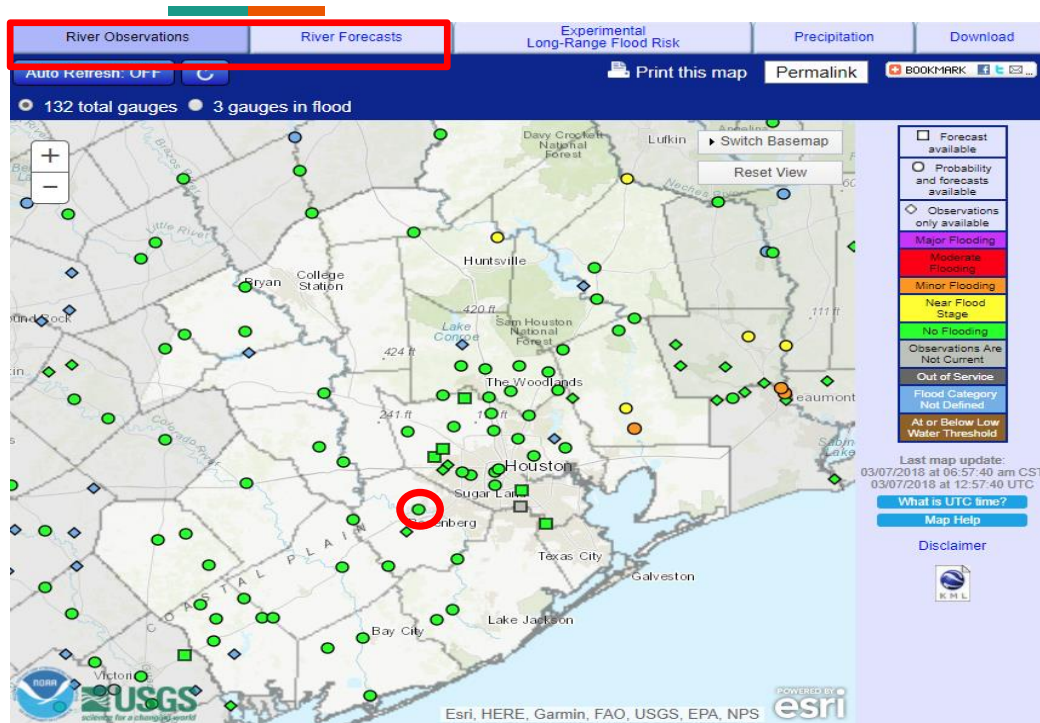
MODERATE

Impact: Water now reaching areas only impacted by significant rain events. Structures can be inundated, several roads covered with water, water may cut off certain areas, widespread agricultural flooding.

MAJOR

Impact: Water is near the highest it's ever been representing rare flooding and significant widespread impacts. Most roads will be covered by water in the area cutting off if not completely flooding subdivisions, rivers can be several miles wide in areas. Homes and structures underwater, bridges inundated and in danger of being hit by debris. Impacts may be greater than ever experienced.

Advanced Hydrologic Prediction System



Flood Categories (in feet)	
Major Flood Stage:	50
Moderate Flood Stage:	48
Flood Stage:	45
Action Stage:	20
Low Stage (in feet):	0

Historic Crests

- (1) 55.19 ft on 09/01/2017
 - (2) 54.74 ft on 06/02/2016
 - (3) 50.30 ft on 10/21/1994
 - (4) 50.01 ft on 06/03/2015
 - (5) 49.68 ft on 01/01/1992
- [Show More Historic Crests](#)

(P): Preliminary values subject to further review.

Recent Crests

- (1) 55.19 ft on 09/01/2017
- (2) 54.74 ft on 06/02/2016

[Collapse](#)

If you notice any errors in the below information, please contact our Webmaster

- Major flooding continues with significant home flooding in the following areas: Valley Lodge near Simonton, Bar Rd, Baker Rd/Cummings Rd/Rio Brazos area north of Rosenberg, Edgewood/Baudet Rd in Richmond, and FM 2759 near Thompsons. Low lying homes in Grand River, Rivers Edge, Pecan Estates in Thompson, and Pecan Bend flood as well.
- Major flooding continues with US90A eastbound lanes inundated and impassible between Harlem Rd and New Territory. Pitts Rd is impassible between US90A and Savannah Dr.
- Major lowland flooding continues with FM 359 impassible between US90A and the Pecan Grove levee near Southern Place Dr. The intersection of FM 359 and Mason Rd is impassible. FM 2759 is completely inundated east of Agnes Rd. Street flooding occurs along Sienna Parkway between McKeever Rd and Steep Bank Trace. Street flooding occurs along McKeever Rd between Sienna Parkway and SH6. Miller Rd near Arcola is inundated.
- Major lowland flooding continues with homes near intersection of Sixth St. and Avenue B in Rosenberg beginning to take on water. FM 1489 is inundated south of Simonton to Johnson Rd. FM 723 is inundated north of Rosenberg to FM 359, making the Kingdom Heights and Riverside ranch subdivisions inaccessible. FM 359 between US90A and Pecan Grove begins taking on water. Thompson Ferry Rd south of LJ Parkway is inundated outside of the leveed area.
- Major lowland flooding continues with homes flooding along Cummings/Baker Roads and in Rio Brazos north of Rosenberg. FM 1093 is inundated to Stansberry Rd in Simonton. Underpass at intersection of SH36/90A west of Rosenberg is inundated/impassible. Fort Bend County flood fight operations in Simonton are exceeded and cease. Low lying streets on west side of Quail Valley take on water. Feeder roads along SH6 near intersection of FM 521/McKeever Rd are inundated. Low lying areas along Knights Ct take on water.
- Major lowland flooding begins as homes in Richmond begin flooding and many homes in Simonton and Thompsons have water in them. FM 1458 near FM 1093 remains inundated and closed. Homes along Carroll and McKeever Roads near FM 2759 in southeast Fort Bend County are close to taking water. Strange Drive, Greenwood Drive, and Second Street in Richmond and Sixth Street, Avenue B, and River Road in Rosenberg and Pittman Road in Thompsons are inundated with over one foot of water.

<http://water.weather.gov/ahps2/index.php?wfo=hgx>

USGS Water Alerts

- Set alerts when a gauge reaches certain water surface elevations.
- Identify the gauge nearest you
- Click on the gauge

USGS
science for a changing world

WaterAlert

Sites Map

Select Location

News updated September 30, 2013

Search by Street Address:
Enter Street Address

Search by Place Name:
Enter Place Name

Search by Site Number(s):
Enter Site Number(s)

Search by State/Territory:
Select an Area

Search by Watershed Region:
Select a Region

Select Data Type

About WaterAlert

How To Use WaterAlert

Related Information

Sam Houston National Forest

The Woodlands

Houston

Pasadena

Baytown

Sugar Land

Missouri City

Pearland

League City

Reynoldsburg

Angleton

Brazoria Natl Wildlife Refuge

Lake Jackson

0 10 20mi

-95.597, 29.141

USGS Water Alerts:

<https://maps.waterdata.usgs.gov/mapper/wateralert/>

USGS Water Alerts

- Set alerts when a gauge reaches certain water surface elevations.
- Identify the gauge nearest you
- Click on the gauge and select "Subscribe to WaterAlert"

The screenshot displays the USGS WaterAlert website. At the top, the USGS logo and tagline "science for a changing world" are visible, along with a "WaterAlert" banner. Below the banner, there are tabs for "Sites" and "Map". A "Select Location" sidebar on the left contains search options: "News" (updated September 30, 2013), "Search by Street" (with an "Enter Street Address" field), "Search by Place" (with an "Enter Place Name" field), "Search by Site" (with an "Enter Site Number" field), "Search by State" (with a "Select an Area" dropdown), and "Search by Water" (with a "Select a Region" dropdown). A "Subscribe to WaterAlert" button is highlighted with a red box. A "Site Information" pop-up window is open, showing details for a specific gauge: "Site Number: 08069500", "Site Name: W Fk San Jacinto Rv nr Humble, TX", "Site Type: Stream", "Agency: USGS", and a link to "Access Data". The pop-up also displays "Streamflow: 7260 ft³/sec on 2018-04-02 at 22:15 CDT (TSID 229383)" and "Stage: 42.78 ft on 2018-05-07 at 06:45 CDT (TSID 140334)". The background map shows the Houston area with various gauges marked by black triangles. One gauge is circled in red. A scale bar at the bottom indicates distances up to 20 miles.

USGS
science for a changing world

WaterAlert

Sites Map

Select Location

News updated September 30, 2013

Search by Street
Enter Street Address

Search by Place
Enter Place Name

Search by Site
Enter Site Number

Search by State
Select an Area

Search by Water
Select a Region

Site Information

Site Number: 08069500
Site Name: W Fk San Jacinto Rv nr Humble, TX
Site Type: Stream
Agency: USGS
[Access Data](#)

Streamflow: 7260 ft³/sec
on 2018-04-02 at 22:15 CDT (TSID 229383)
Stage: 42.78 ft
on 2018-05-07 at 06:45 CDT (TSID 140334)

Subscribe to WaterAlert

Select Data Type

About WaterAlert

How To Use WaterAlert

Related Information

USGS Water Alerts:

<https://maps.waterdata.usgs.gov/mapper/wateralert/>



USGS Water Alerts

- Set alerts when a gauge reaches certain water surface elevations.
- Identify the gauge nearest you
- Click on the gauge and select "Subscribe to WaterAlert"
- Define how you want to receive the information:
 - Email or phone
 - Frequency
 - Stage or Discharge
 - Stream Elevation(s)
- Note: Use Internet Explorer

Subscription Form

The U.S. Geological Survey WaterAlert service sends e-mail or text (SMS) messages when [certain parameters](#), as measured by a USGS real-time data-collection station, exceed user-definable thresholds. The development and maintenance of the WaterAlert system is supported by the USGS and its partners, including numerous federal, state, and local agencies.

Real-time data from USGS gages are transmitted via satellite or other telemetry to USGS offices at various intervals; in most cases, 1 to 4 times per hour. Emergency transmissions, such as during floods, may be more frequent. *Notifications will be based on the data received at these site-dependent intervals.*

Site Info:

Number: 08069500
 Name: W Fk San Jacinto Rv nr Humble, TX
 Agency: USGS
 Transaction ID: stsCN

Send Notification To:

- [about this...](#)
- ☐ My mobile phone
☐ My email address

Notification Frequency:

- [about this...](#)
- Hourly ☐
 Daily ☒

Streamflow Parameter(s):

[about this...](#) Recent value:

Discharge, in ft³/s ☒ 7260 [\[peak chart\]](#)
 Gage height, in ft ☐ 42.78 [\[peak chart\]](#)

Alert Threshold Condition:

- [about this...](#)
- ☒ Greater than (>)
☐ Less than (<)
☐ Outside a range (< or >)
☐ Inside a range (> and <)

Real-time value is greater than: ft³/s

☐ I have read and acknowledge the [Provisional Data Statement](#) and [Disclaimer](#).

Submit

Reset

Cancel

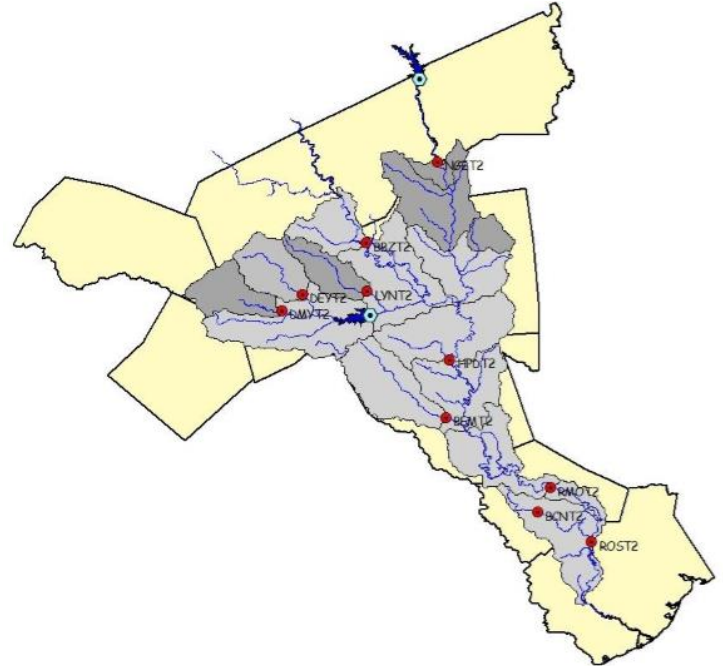


USGS Water Alerts:

<https://maps.waterdata.usgs.gov/mapper/wateralert/>

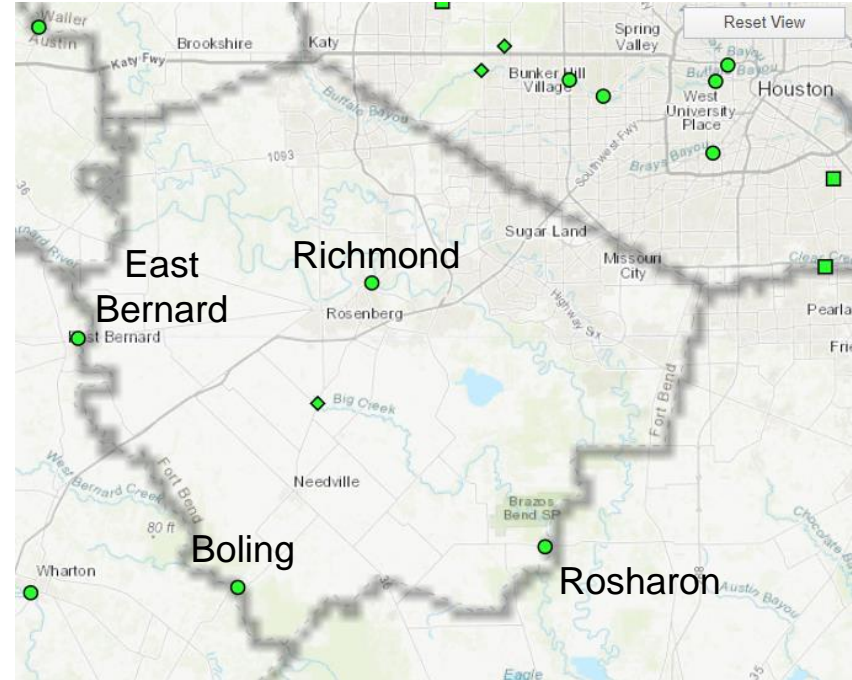
Watershed

- A watershed is an area of land that drains runoff from rainfall (stormwater) to a body of water, either a river, bayou, creek, or lake.
- A watershed can flow into another watershed.
- Watersheds vary in shape and size which ultimately lead to unique challenges.
- Topography plays a big role in how watershed boundaries are defined.



Watershed

- A watershed is an area of land that drains runoff from rainfall (stormwater) to a body of water, either a river, bayou, creek, or lake.
- A watershed can flow into another watershed.
- Watersheds vary in shape and size which ultimately lead to unique challenges.
- Topography plays a big role in how watershed boundaries are defined.
- Fort Bend County deals with 3 primary watersheds: Brazos River, San Bernard River and Upper Harris/Brazoria County.
- NWS issues river forecasts for 4 sites in Fort Bend County.





Partners



Brazos River Authority Operations 2018 FloodWarn Training

***Presented by
Brad Brunett, Regional Manager – Central & Lower Basins
Aaron Abel, Water Services Manager***



Brazos River Authority Overview

Our Mission

**To develop, manage, and protect
the water resources of the Brazos River basin**

- **Oldest river authority in Texas**
- **Created by the Texas Legislature in 1929**
- **First entity of its kind in the nation**
- **Self-funded (not appropriated), do not levy taxes**
- **21 member Board appointed by Governor**
- **Territory:**
 - **Extends from the Texas-New Mexico state line west of Lubbock to the Gulf of Mexico near Freeport**
 - **More than 42,000 square miles**
 - **All or part of 76 counties**





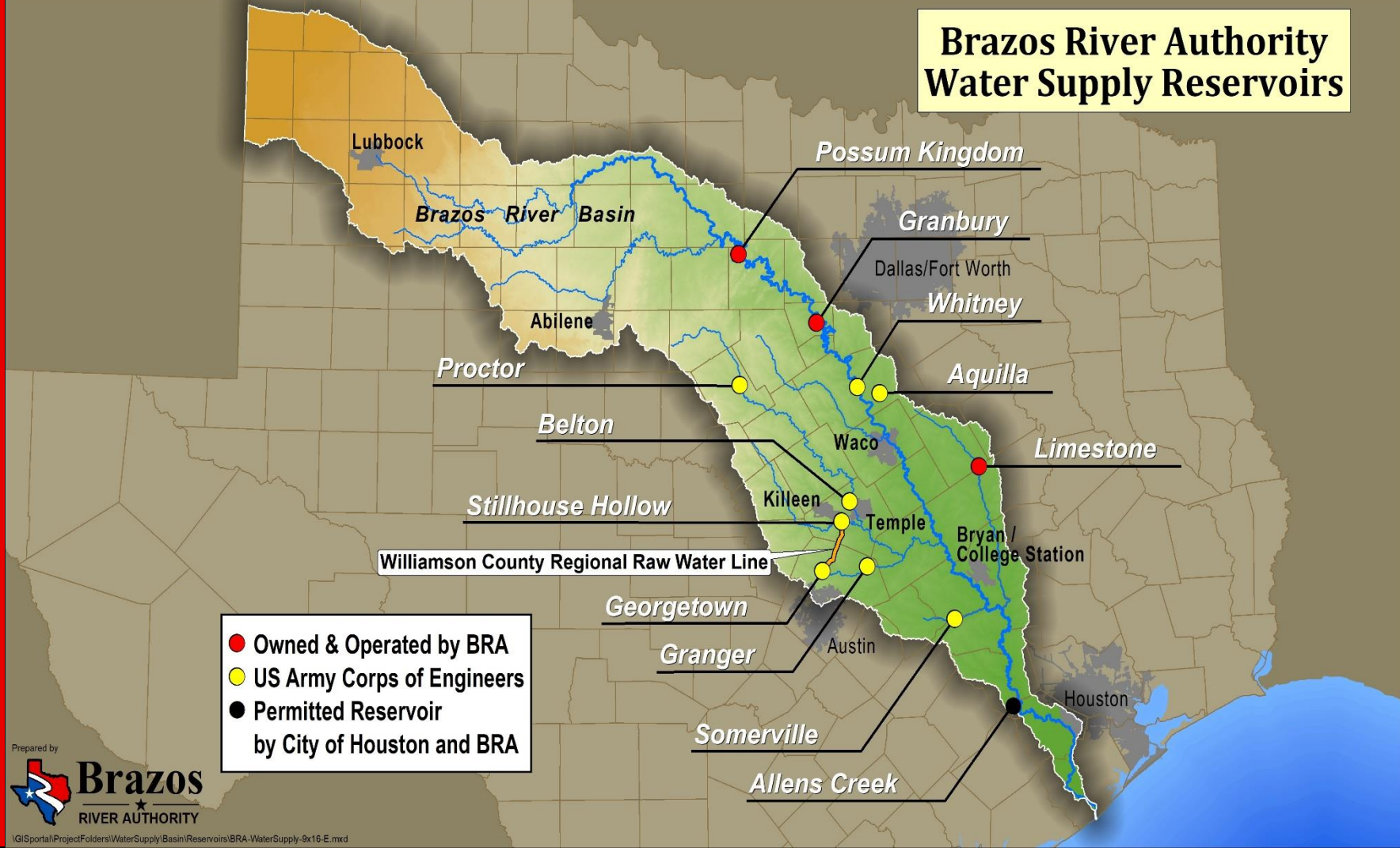
Our Business

- Raw Water Supply
- Water & Wastewater Treatment
- Water Quality & Environmental Stewardship





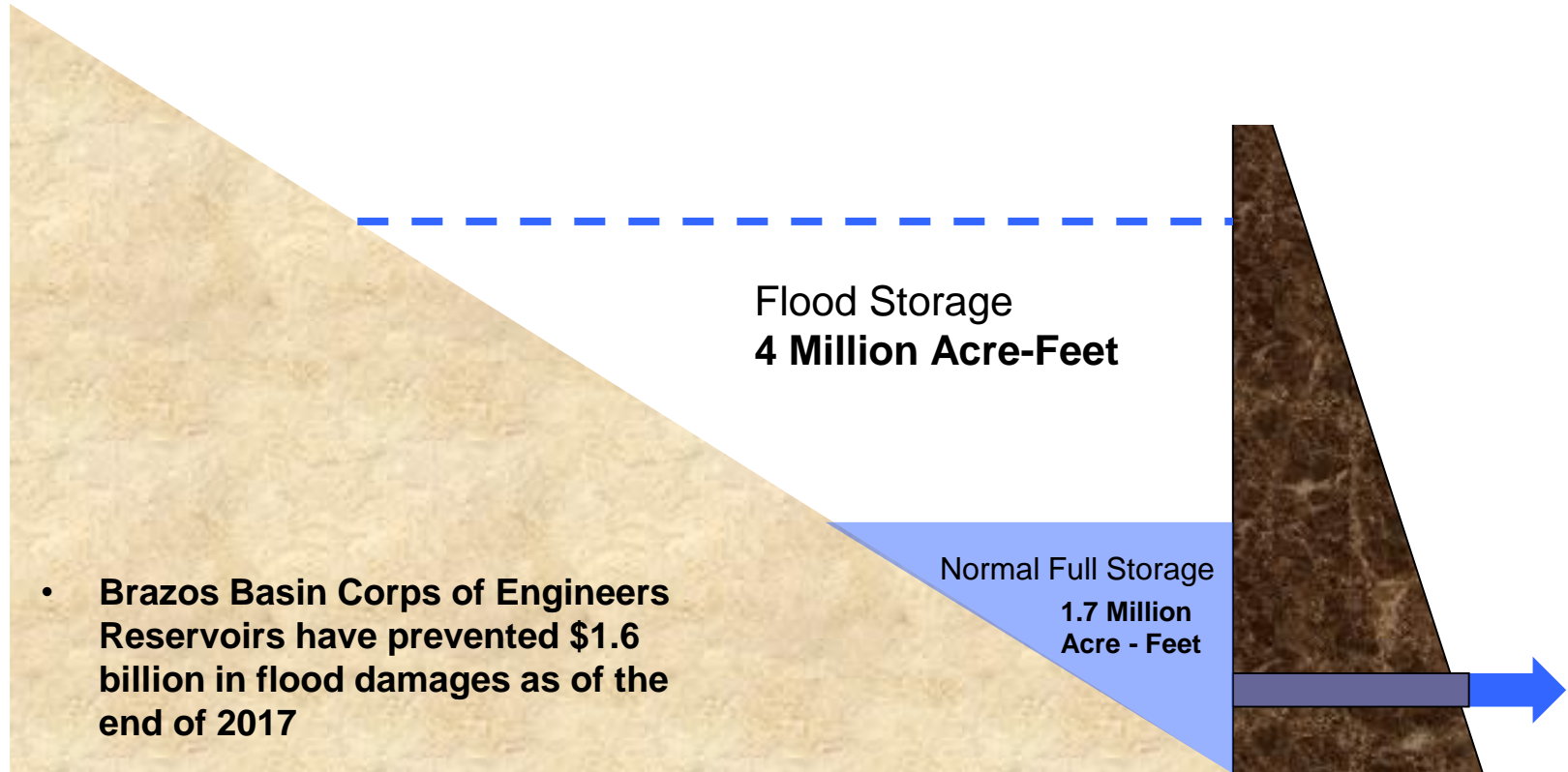
Brazos River Authority Water Supply Reservoirs



Prepared by



Storage in Brazos Basin Corps of Engineers Reservoirs





Brazos River Authority



*Lake Somerville Emergency Spillway,
Late May, 2016*

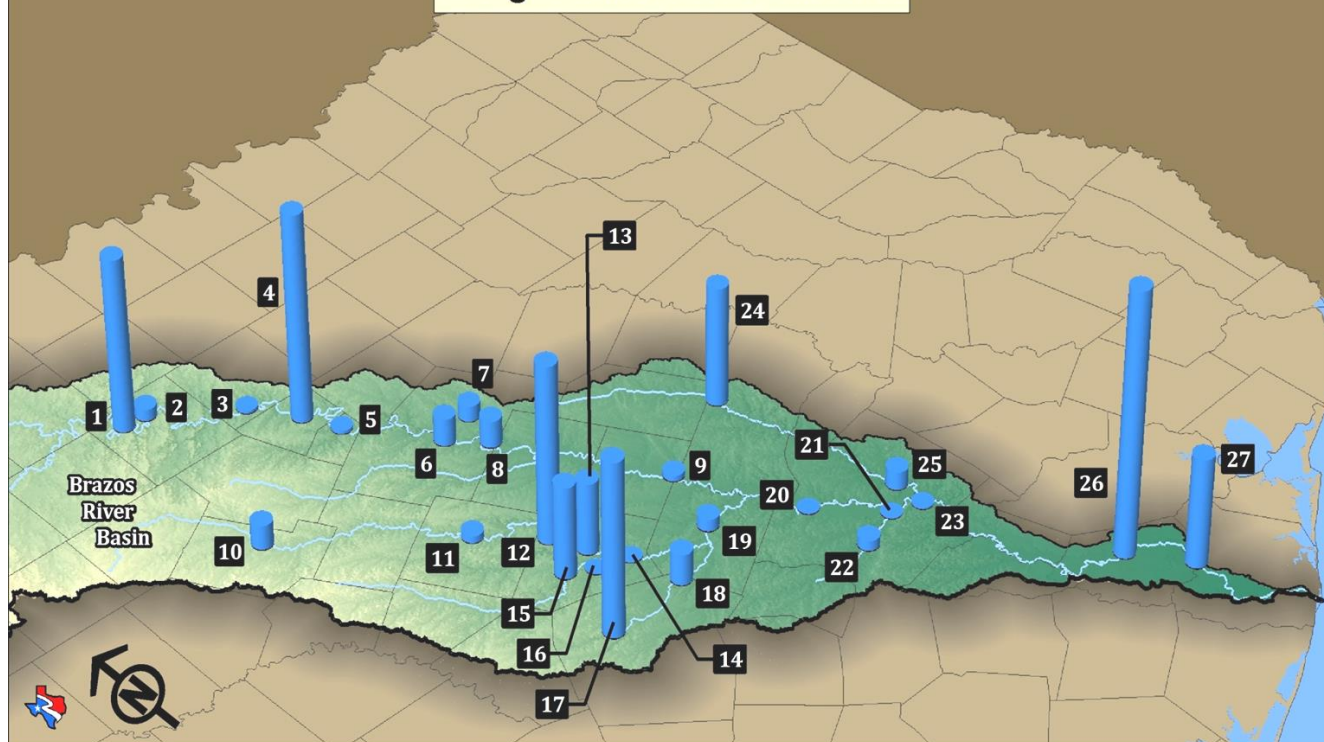


The Drought, 2011 – 2015...(RIP!)



Brazos River at Seymour – August 3, 2011

Long Term Water Contracts



TOTAL DIVERSIONS AUTHORIZED UNDER EXISTING CONTRACTS

*values are acre-feet per year
aggregated by stream segment reaches*

1. Possum Kingdom Lake	74,166	10. Lake Proctor	10,180	19. Little-San Gabriel conf. to Little Rv at Cameron	5,000
2. Possum Kingdom Lake dam to Palo Pinto gage	4,800	11. Lake Proctor dam to Leon Rv at Gatesville gage	2,909	20. Brazos-Little conf. to Bryan gage	200
3. Palo Pinto gage to Dennis gage	1,050	12. Leon Rv at Gatesville gage to Lake Belton dam	76,062	21. Bryan gage to Brazos-Yegua conf.	150
4. Dennis gage to Lake Granbury dam	89,244	13. Lake Belton dam to Leon Rv nr Belton gage	30,453	22. Lake Somerville	4,200
5. Lake Granbury dam to Glen Rose gage	1,200	14. Leon Rv nr Belton gage to Little Rv gage	200	23. Brazos-Yegua conf. to Brazos-Navasota conf.	540
6. Glen Rose gage to Lake Whitney dam	11,510	15. Stillhouse Hollow Lake	39,255	24. Lake Limestone	50,875
7. Lake Aquilla	6,500	16. Stillhouse Hollow Lake dam to Lampasas Rv nr Belton gage	8	25. Easterly gage to Brazos-Navasota conf.	7,600
8. Lake Whitney dam to Brazos nr Aquilla gage	11,403	17. Lake Georgetown	74,561	26. Hempstead gage to Richmond gage	113,070
9. Brazos-Aquilla conf. to Highbank gage	2,300	18. North San Gabriel gage to Lake Granger dam	13,015	27. Richmond gage to Gulf of Mexico	46,780

Reservoir Operations

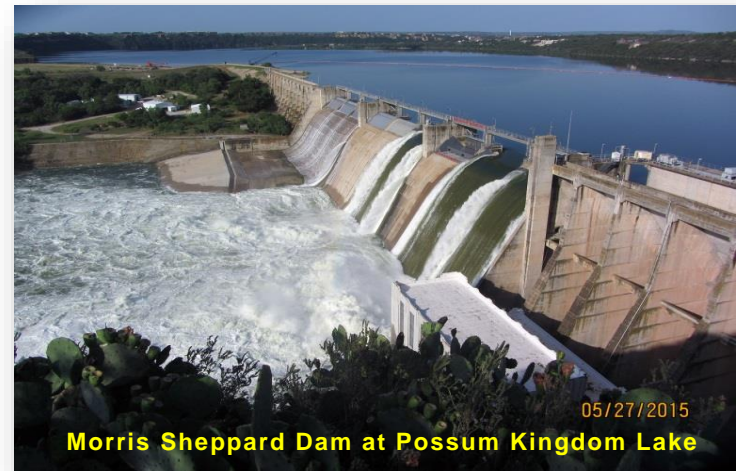


DeCordova Bend Dam at Lake Granbury

- **BRA reservoirs contain no flood storage space**
- **What comes in must go out real-time**

Significant Operating Rules

- Don't release based on weather forecasts
- Don't make flooding worse downstream than it would have been without the reservoir being present
- Prevent water overtopping flood gates
- Attempt to minimize flood potential on upper end of lakes
- Ensure good communication
 - BRA Central Office and Lake Office staff
 - Downstream Call Lists
 - West Gulf River Forecast Center
& Other Agencies
 - Emergency Management Officials
 - General Public
 - Media



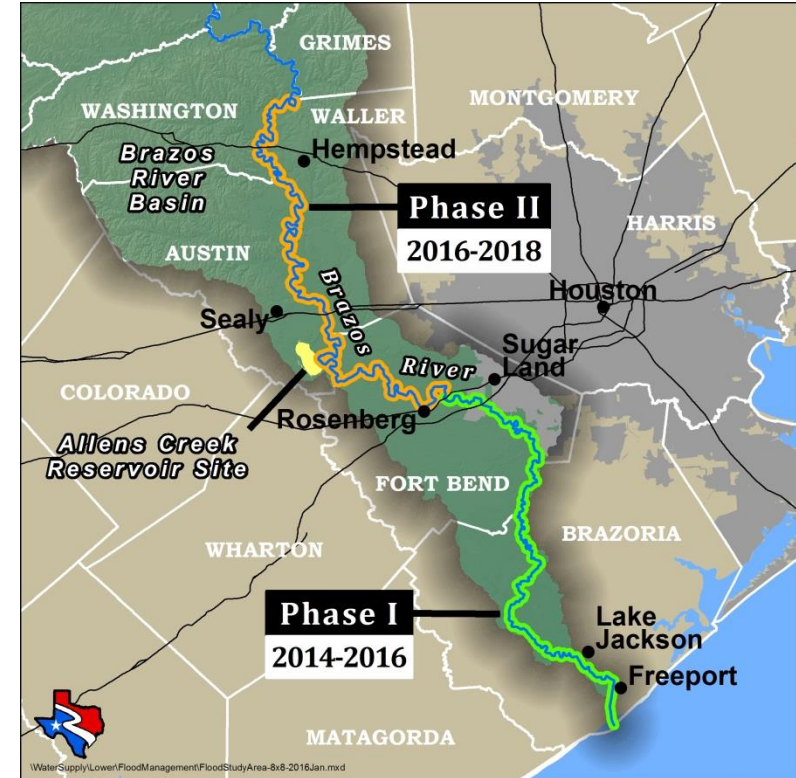
05/27/2015

Morris Sheppard Dam at Possum Kingdom Lake



Lower Brazos Flood Study

- **Why?**
 - High growth area with outdated and inconsistent Brazos River floodplain information
- **Who?**
 - Texas Water Development Board, lower basin entities, BRA, & Halff Associates, Inc.
- **What?**
 - New models
 - New estimates of how much water, how fast, and how high
 - New maps
 - Alternatives to reduce/mitigate future damages





Brazos

RIVER AUTHORITY
www.brazos.org



information@brazos.org

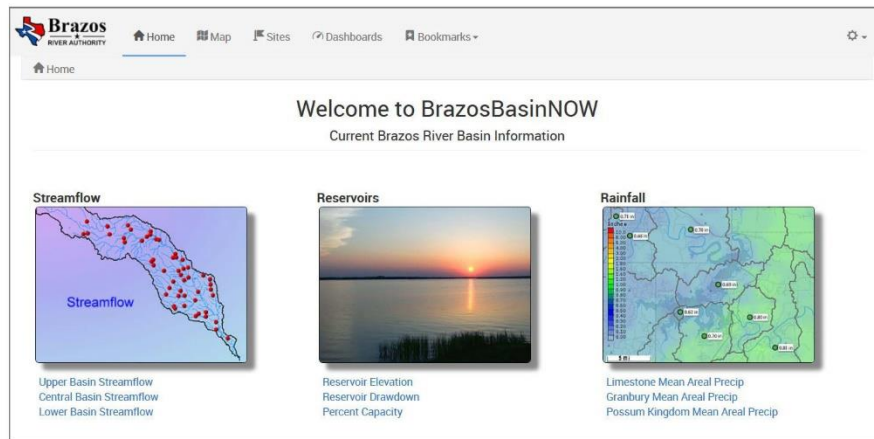
www.BrazosBasinNow.org



@BrazosWater



YouTube





**Brazos
River
Authority**

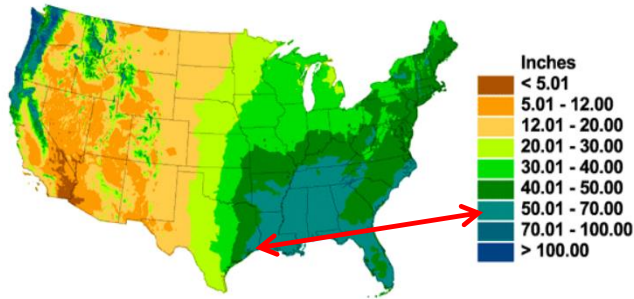
National Weather Service – FloodWarn

Fort Bend County Drainage District

October 17, 2018



Annual Mean Total Precipitation



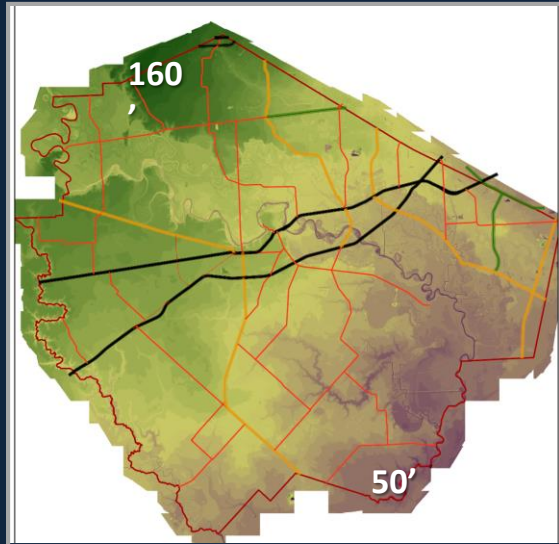
WHY ARE FLOOD EVENTS SO SIGNIFICANT IN FORT BEND?

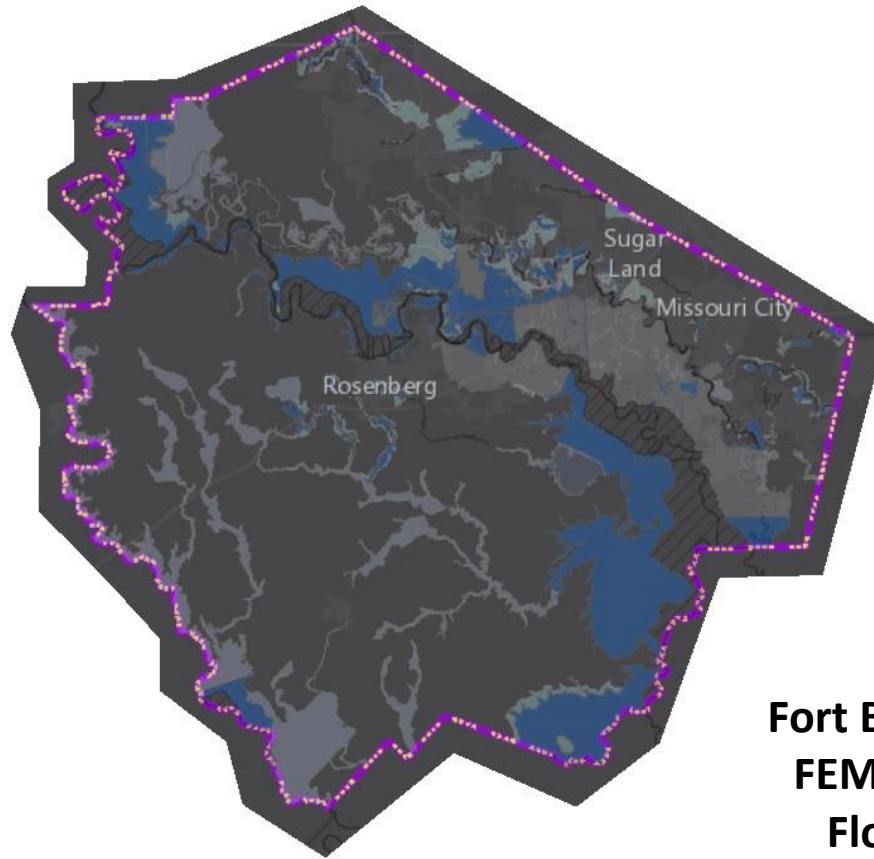
Very high precipitation totals

Relatively flat natural ground

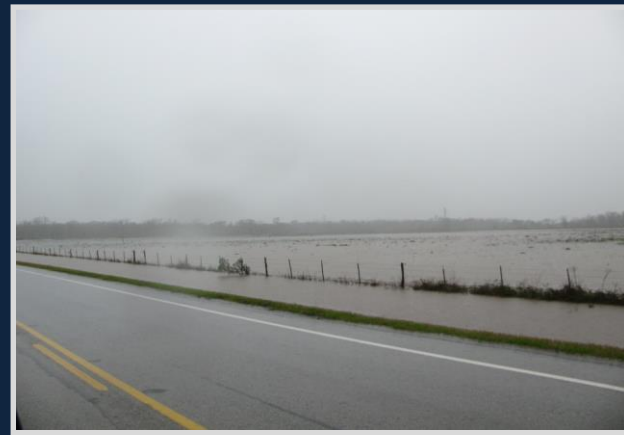
(Predominately drains in a NW to SE direction. Highest natural ground is west of Katy at approximately 160' above m.s.l. Lowest is near Brazos Bend State Park and approximately 50' above m.s.l.)

Predominately clay soils
produce greater runoff

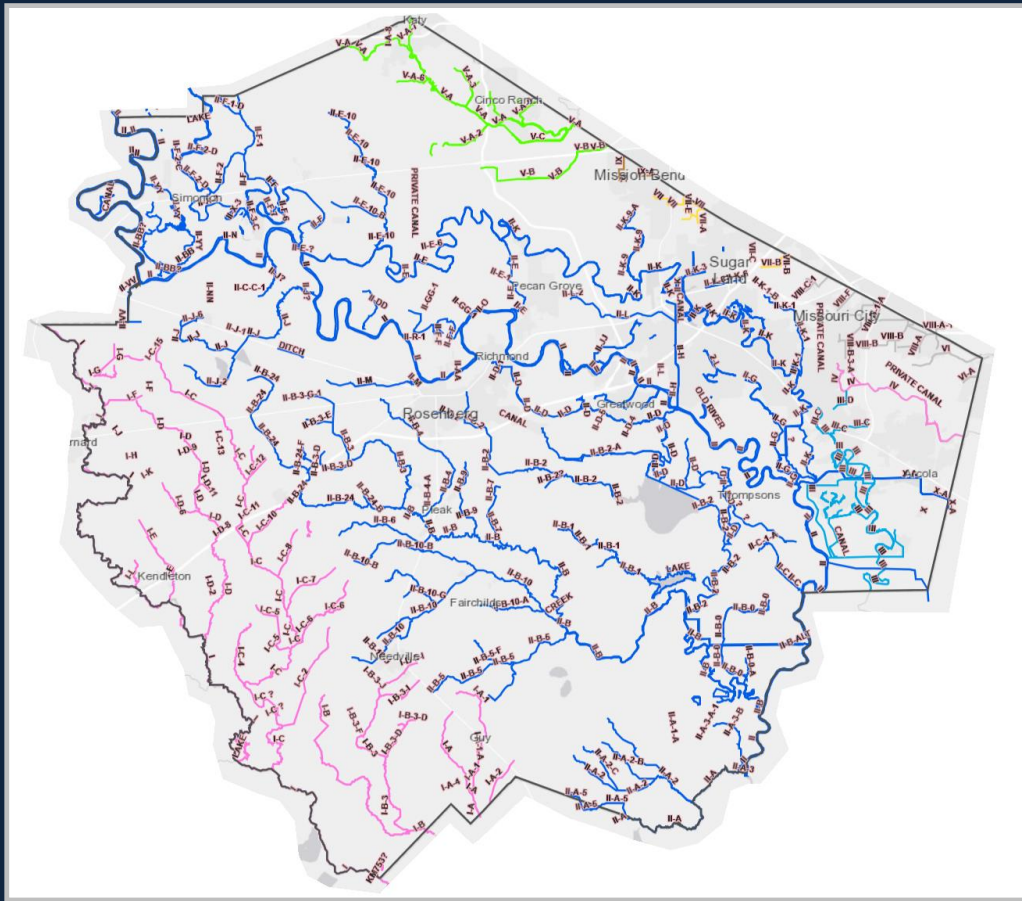




**Fort Bend County
FEMA Mapped
Floodplains**



**Fort Bend County – Examples of Flooding on
Undeveloped Tracts during Local Rainfall Events**



Fort Bend County Major Streams & Drainage Channels

San Bernard River

- **Mound Creek**
Guy Creek
- **Cedar Creek**
Buffalo Creek
- **Snake Creek**
Moody Creek
- **Turkey Creek**
Dry Branch
- **Means Ditch**
- **East Bernard Ditch**
- **Jackson Ditch**
- **San Bernard Lateral I-J**
- **Oldag Ditch**

Brazos River

- **Cow Creek**
Bee Creek
Turkey Creek
Hoggs Bayou
Parrot Creek
Cow Creek Lat. II-A-5
- **Big Creek**
Waters Lake Bayou
Dutch John Creek
Dry Creek
Gapps Slough
Theatre Ditch
Coon Creek

Brazos River (cont.)

- **Big Creek (cont.)**
Waters Lake Bayou
Dutch John Creek
Dry Creek
Gapps Slough
Theatre Ditch
Coon Creek
Seabourne Creek
Deer Creek
Big Creek Lat. II-B-7
Big Creek Lat. II-B-9
Fairchilds Creek
Cottonwood Creek
- **Rabbs Bayou**
Middle Bayou
Tara Lateral
- **Jones Creek**
Andrus Creek
Rosenbush Ditch
Flewellen Creek
Jones Lateral II-E-1
Brynmawr Lateral
Woods Edge Lateral
- **Fulshear Creek**
Brookshire Creek
Hady Creek
Orchard Creek
Pool Hill Ditch
- **Steepbank Creek**
- **Ditch H**
- **Duval Ditch**
- **Flat Bank Creek**
- **Bullhead Slough**

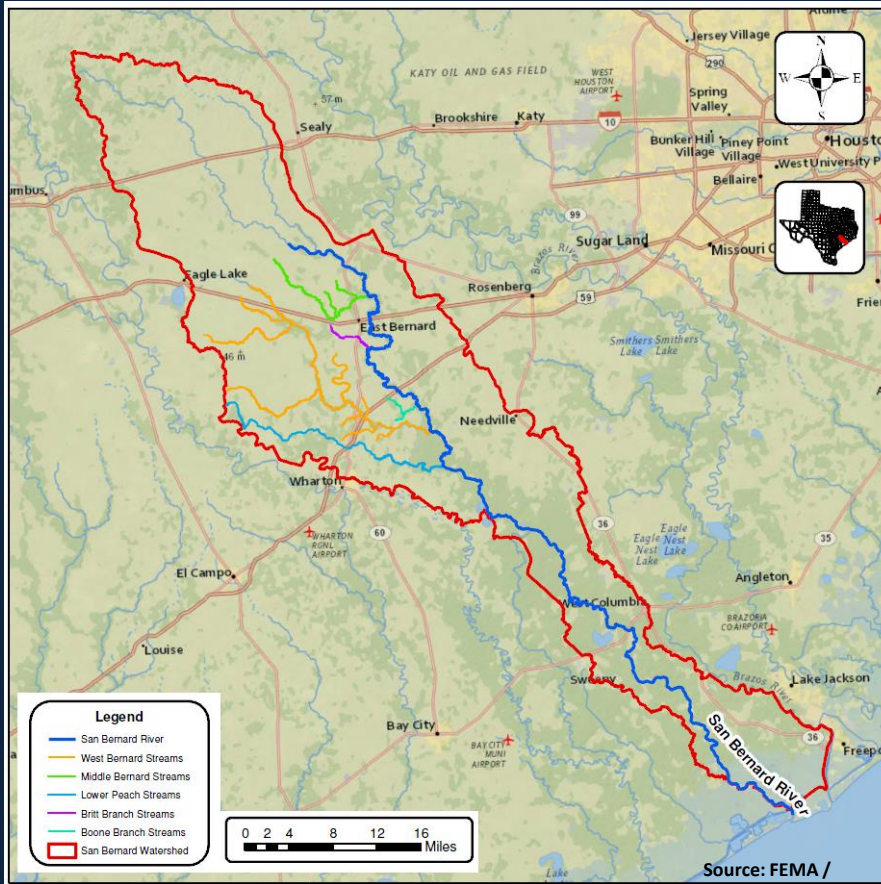
Brazos River (cont.)

- **Upper/Middle/Lower Oyster Creek**
Stafford Run
Red Gulley
- **Robinowitz Ditch**
- **Fulshear Farms Ditch**
- **Pleasant Gulley**
- **Guyler Ditch**
- **Moore Gulley**
- **Sugarland Ditch**
- **Briscoe Ditch**
- **Aylor Ditch**
- **Schuech Ditch**
- **County Line Ditch**
- **West Simonton Ditch**
- **Brazos Lateral II-0**

Upper Harris/Brazoria

- **Mustang Bayou**
- **Willow Fork of Buffalo Bayou**
Cane Island Branch
Little Prong Creek
Willow Fork Lateral V-A-3
Cinco Ranch Ditch
- **Long Point Slough / Clodine Ditch**
- **Clear Creek**
- **Keegans Bayou**
- **Sims Bayou**
Cangelosi Ditch
- **Brays Bayou**

San Bernard River Watershed



Headwaters located north of I-10 between Sealy & Columbus

Approximately 20% of Fort Bend County drains into the San Bernard River

Subject to overflows from the Colorado River near Wharton

Major Flood Events:

June 1960

November 1998

Hurricane Harvey (Aug. 2018)

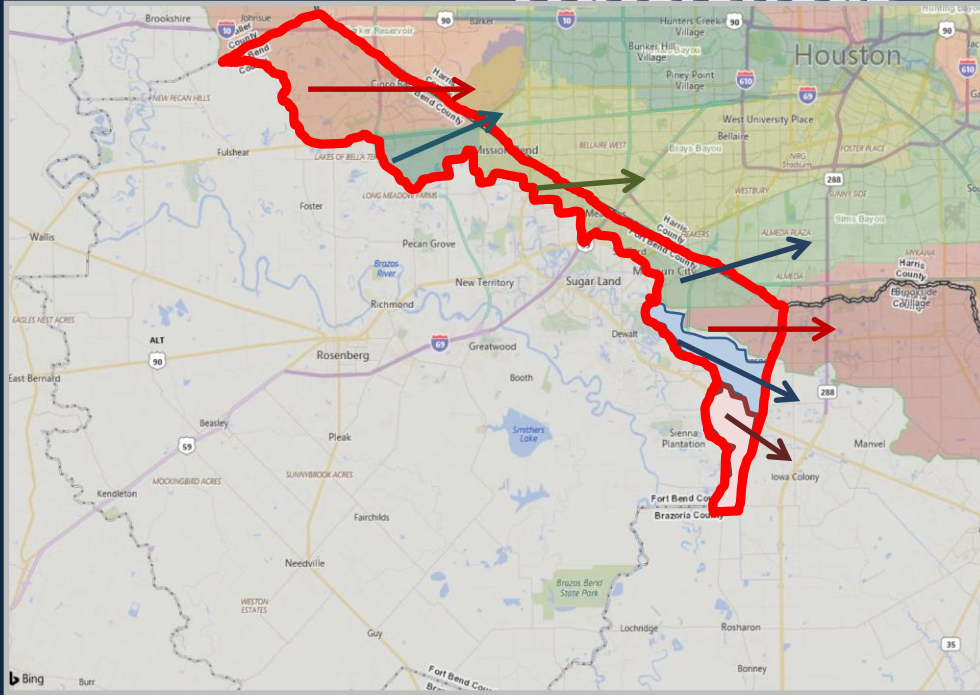
On-Line Flood Gages:

Chesterville at FM 3013

East Bernard at SH90A

Boling at FM442

Upper Harris / Brazoria Co. Watersheds



Approximately 15% of Fort Bend drains east into Harris and Brazoria County watersheds

Barker Reservoir owned and operated by US Army Corps of Engineers

Developed/urban watersheds within Houston, Stafford, Missouri City, Arcola city limits

On-Line Flood Gages available at HCFCF Flood Warning Website:

www.harriscountyfws.org

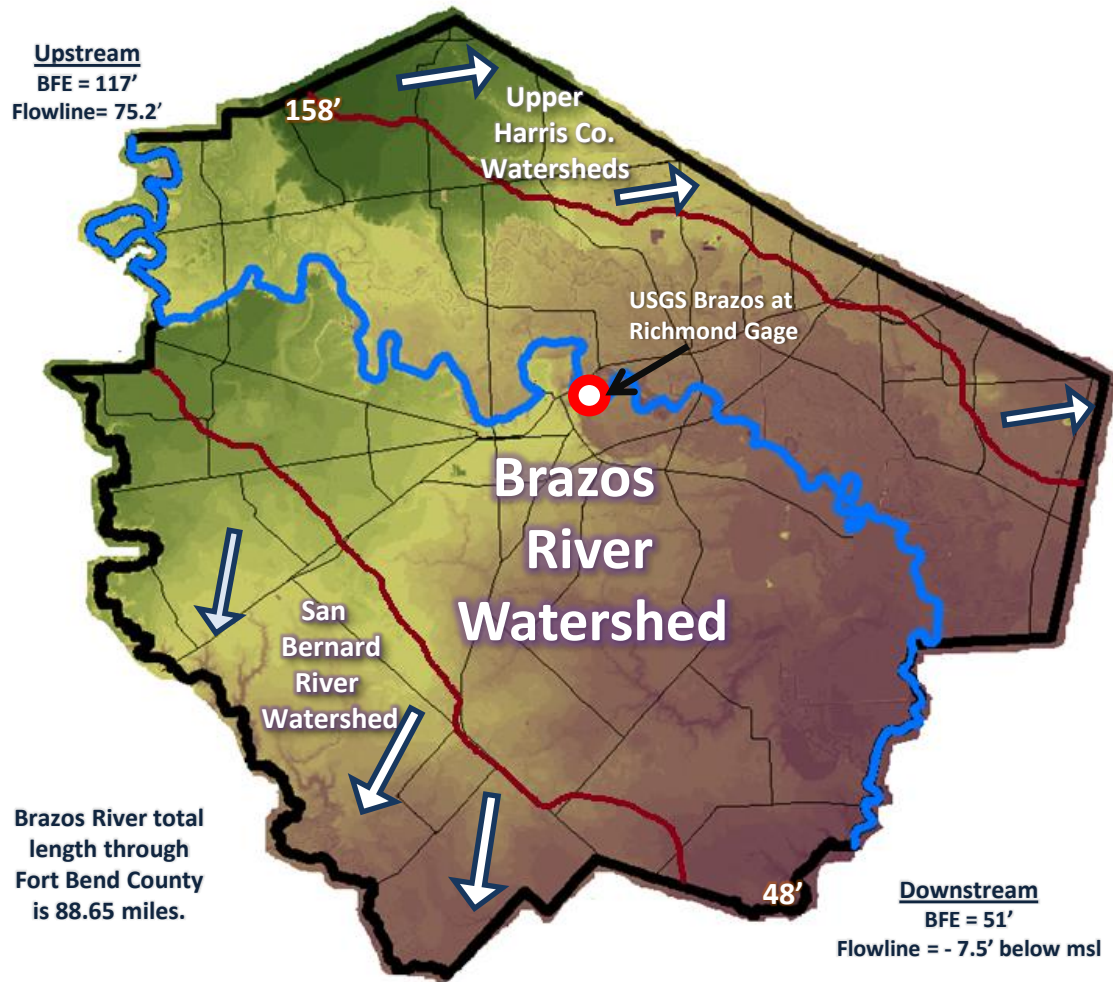
g

Willow Fork of Buffalo Bayou/Barker Reservoir Long Point Slough/Clodine Ditch

Brays Bayou Keegans Bayou Sims Bayou

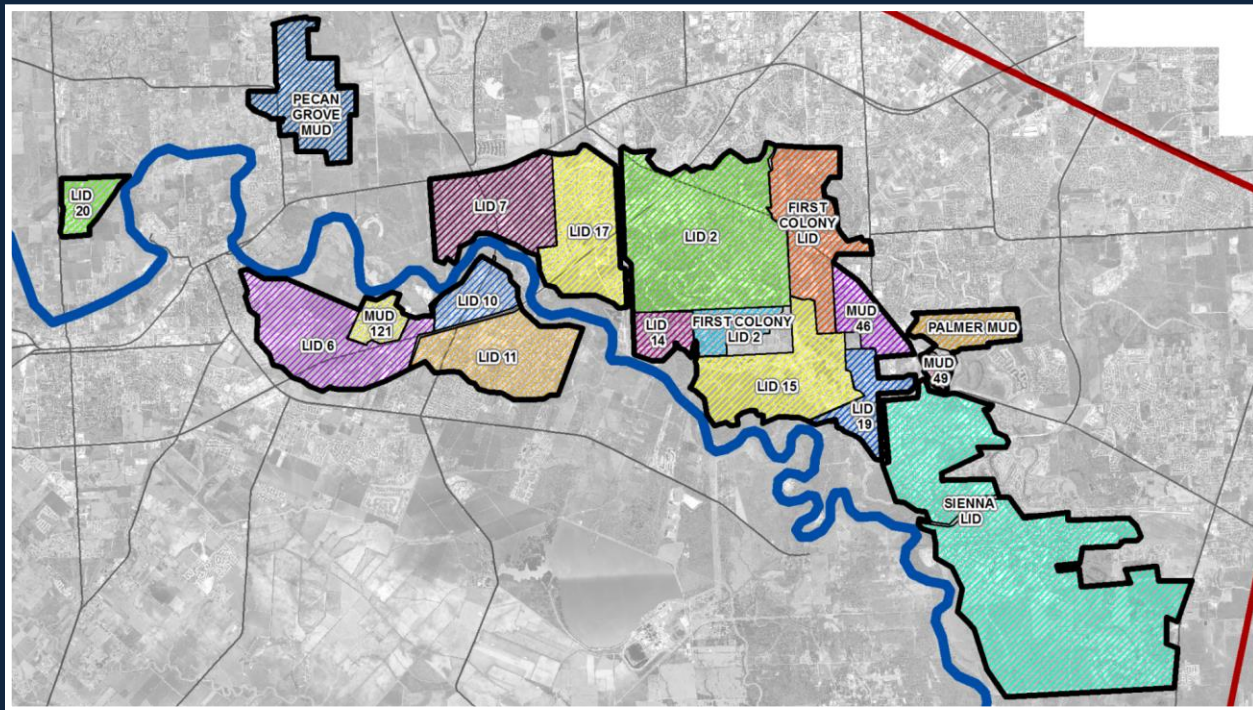
Clear Creek Chocolate Bayou Mustang Bayou

Upstream
BFE = 117'
Flowline= 75.2'



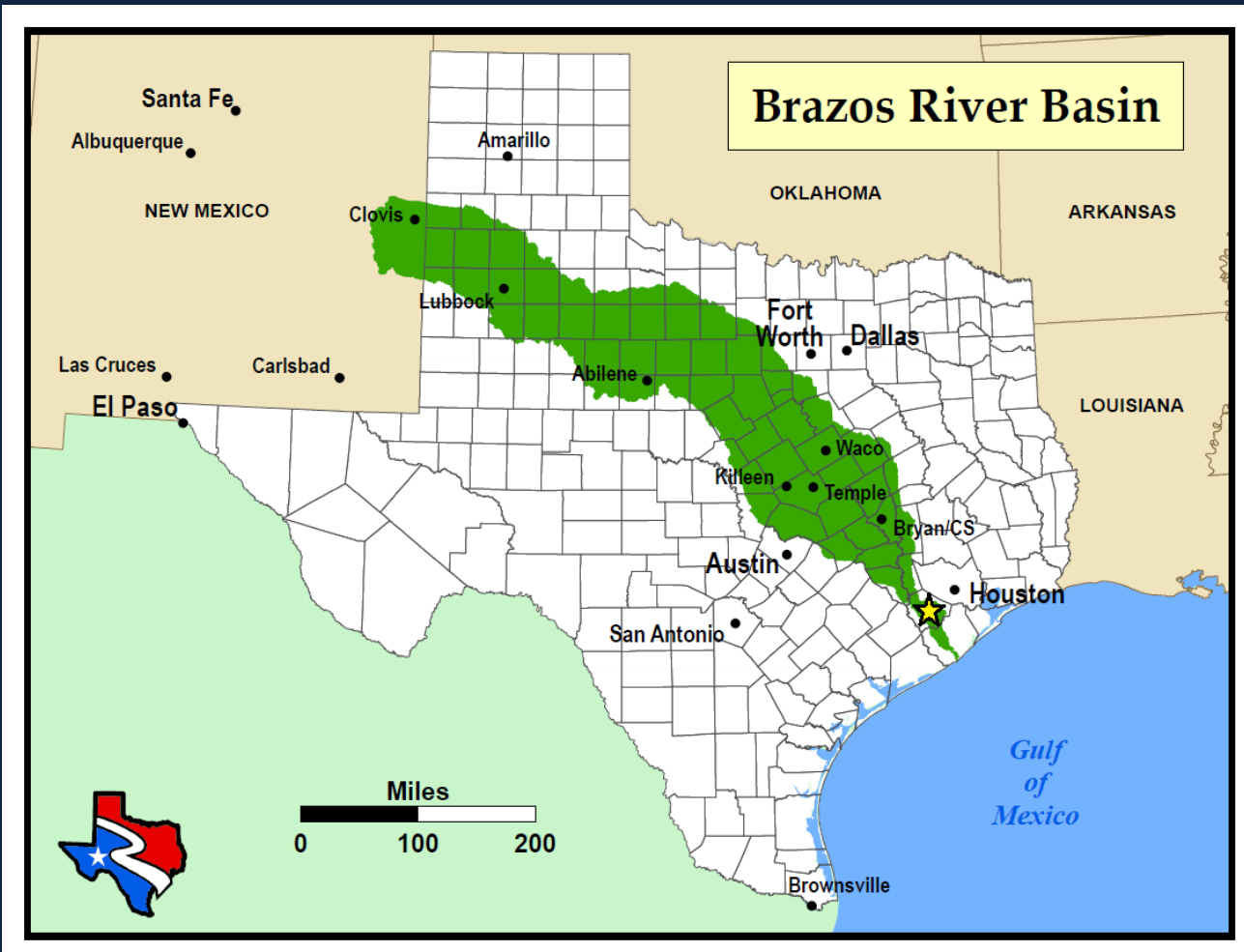
Brazos River total
length through
Fort Bend County
is 88.65 miles.

Downstream
BFE = 51'
Flowline = - 7.5' below msl



Fort Bend County Levees:

- 20 Individual Districts
- Appx. 100 miles of Levees
- Appx. 180,000 Residents
- Appx. \$20 Billion in Taxable Value

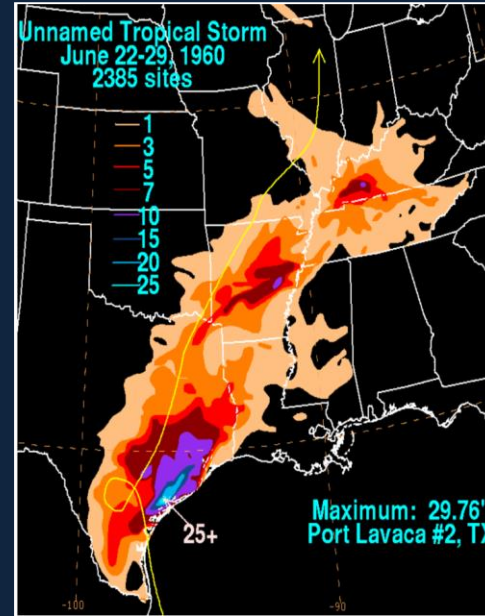


Historic Fort Bend Floods:



May 1957

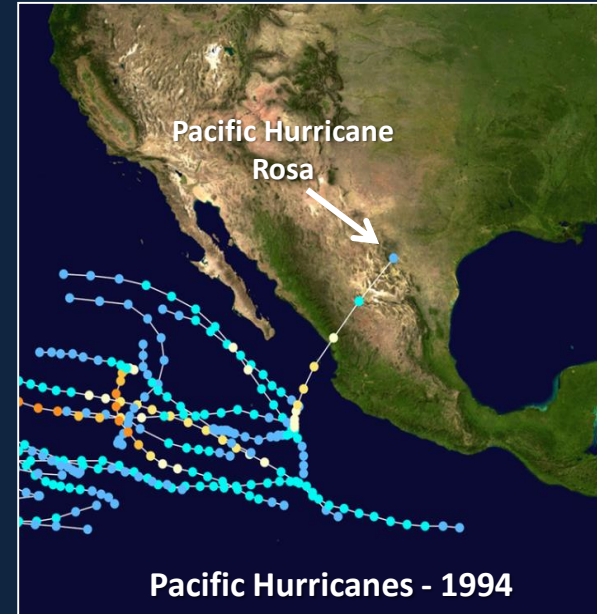
- “Drought-Buster”
- Exceptionally Wet Spring
- Major Brazos River Flood



June 1960

- Unnamed Tropical Storm
- Big Creek Flood of Record
- Third Highest San Bernard Flows

Historic Fort Bend Floods:



"Christmas 1991 Flood"

- Major Brazos River Flood over Christmas/New Year 91-92
- Substantial Volume, Event Extended well into Spring

Mid-October 1994 & 1998

- Remnants of Pacific Hurricanes (Both)
- Major Brazos Rise + Local Rainfall (94)
- Third Highest San Bernard Flows (98)

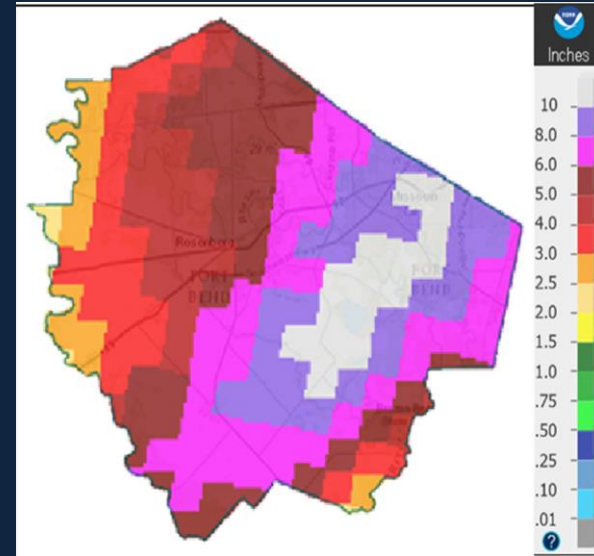
Historic Fort Bend Floods:

NOAA - NWS RICHMOND WEATHER STATION		
Top 10 Daily Maximum Precipitation Totals		
1	11.03"	8/27/2017
2	9.32"	5/12/2012
3	8.58"	1/10/2012
4	8.19"	11/12/1985
5	7.72"	11/1/1959
6	7.60"	8/31/1981
7	7.51"	5/26/2015
8	6.93"	8/28/2017
9	6.68"	8/26/2017
10	6.60"	10/29/2002



January & May 2012

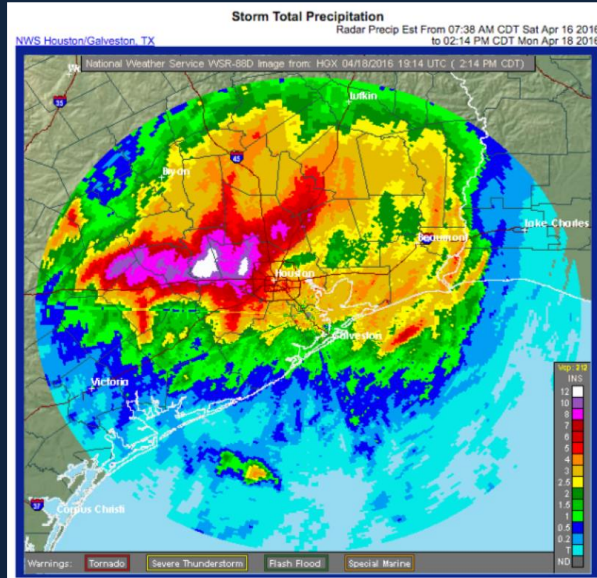
- Record Daily Rainfall Totals at Richmond
- Very intense, local events with most serve impacts along and south of FM 1093.



Memorial Day 2015

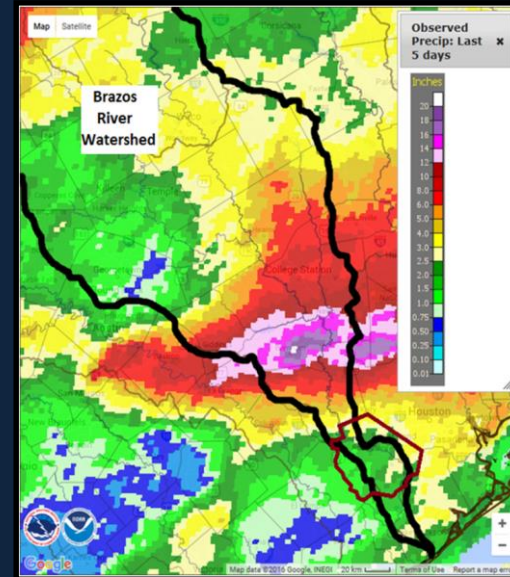
- Very intense local event, particularly between Needville & Sugar Land.
- Historic Flows on Dry & Big Creek
- Brazos at Richmond reached 50' for first time in 20+ years.

Historic Fort Bend Floods:



Tax Day 2016

- Most significant impacts occurred in north Fort Bend
- Record levels in Willow Fork of Buffalo Bayou & Barker Reservoir



Memorial Day 2016

- Brenham 20"+...Fort Bend only 2"
- Brazos River at Richmond peaked at 54.8', highest in 100+ years

Hurricane Harvey / Fort Bend County Impacts

Estimated all of Fort Bend County exceeded the 500-year
return frequency for a 4-Day Duration Event

Estimated % FBC Land Area Inundated by Floodwater: 20%

Total Number of Rescues : 9,945

Fatalities Reported within Fort Bend County: 3

Estimated Number of Homes Damaged: 6,824

Total Number of Tornado Warnings: 47

FBC Emergency Operations Total Phone Calls: 25,564

NOAA - NWS RICHMOND WEATHER STATION		
Top 10 Daily Maximum Precipitation Totals		
1	11.03"	8/27/2017
2	9.32"	5/12/2012
3	8.58"	1/10/2012
4	8.19"	11/12/1985
5	7.72"	11/1/1959
6	7.60"	8/31/1981
7	7.51"	5/26/2015
8	6.93"	8/28/2017
9	6.68"	8/26/2017
10	6.60"	10/29/2002

Source:

FBCDD Analysis of
NOAA Online Weather Data (NOW Data)
Calendar Day Summaries –
Daily Maximum Precipitation

(Not a continuous period of record but
estimated 20,000+ days worth of daily rainfall
records)

FLOOD EVENTS

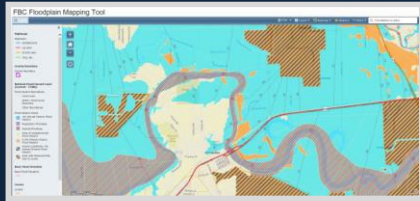
OCCUR:

- Any month of the year
- Short, intense storms or extended duration high volume events
- Upstream watersheds far way or local events
- In the midst of severe droughts or as part of a multi-year wet cycle
- In the floodplain or far away from a mapped flood zone

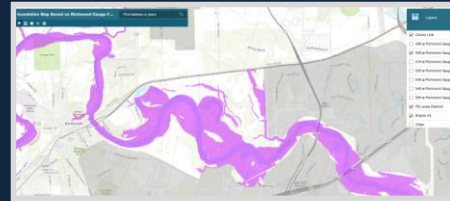
LOCAL RESOURCES:

www.fortbendcountytexas.gov

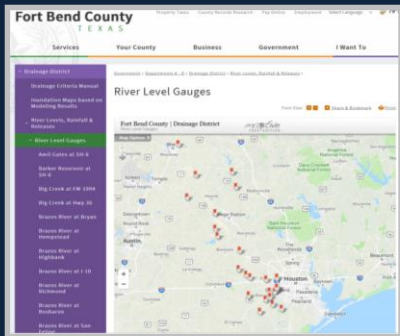
[/government/departments/county-services/drainage-district](http://www.fortbendcountytexas.gov/government/departments/county-services/drainage-district)



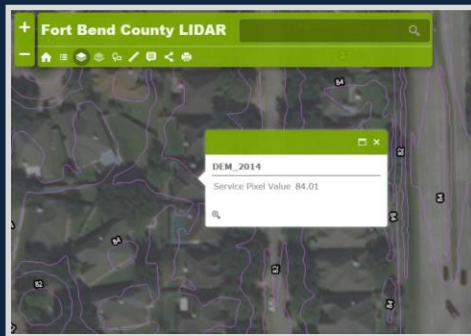
Floodplain Maps



Inundation Mapping (Brazos & Barker)



Links to Flood Gages

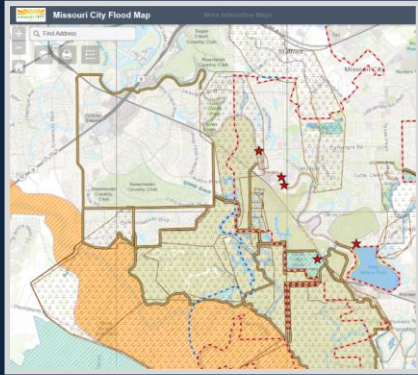


LiDAR Topographic Data



Search Levee Contacts

LOCAL RESOURCES:



City Resources



LID/MUD Resources



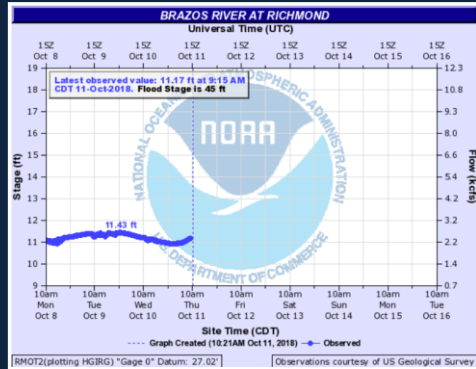
FORT BEND COUNTY OEM

FORT BEND COUNTY OFFICE OF EMERGENCY MANAGEMENT

WEBSITE: www.fbcoem.org

TWITTER: [@fbcoem](https://twitter.com/fbcoem)

In closing...

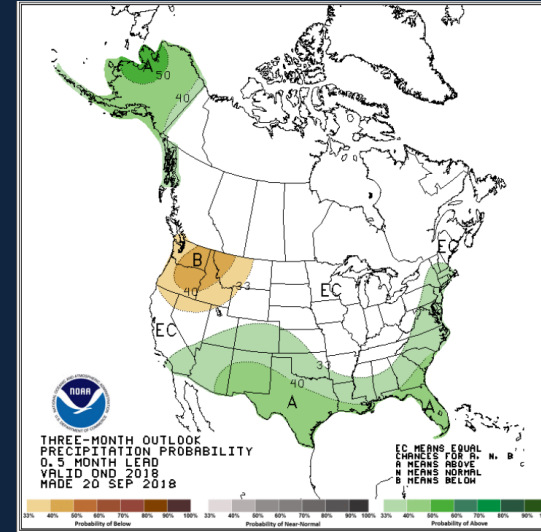


Rivers are currently down and reservoirs have storage...

NWS Total Observed Precipitation at Sugar Land Regional Airport (January - September)

YEAR	INCHES
2015	56.02
2016	50.40
2017	68.00
2018	32.56

...so far 2018 has been manageable...



...but always keeping an eye on what's ahead!

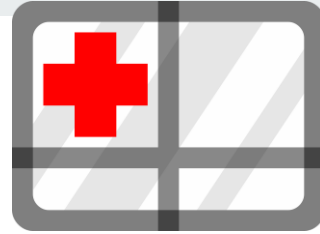
JEFFREY T. JANECEK, P.E.
FORT BEND COUNTY DRAINAGE DISTRICT
jeffrey.janecek@fortbendcountytexas.gov



Flood Safety

What to do before, during, and after a flood?

Safety Before a Flood



- Prepare a family disaster plan.
- Check if your insurance covers flood damages. If not, get flood insurance.
- Keep insurance and other important documents, such as copies of driver's licenses and credit cards, and other valuable items, in a safe deposit box.
- Assemble a disaster supplies kit. Be sure to include prescription medications, food, and water.
- Find out where you can go if ordered to evacuate.
- Arrange to keep in contact with relatives and friends.
- Know your resources.

Knowing what to do when a flood occurs will increase your family's safety and possibly its survival.

Safety During a Flash Flood



- Turn around, don't drown when encountering flooded roads.
- Be especially cautious at night when it is harder to recognize the dangers of flooding.
- Stay away or be swept away. River banks and culverts can become unstable and unsafe.
- You should monitor the latest forecasts and be prepared to take action should additional Flash Flood Warnings be issued.
- Have multiple ways to receive weather information (cell phone, NOAA weather radio, television, etc.)

Turn Around, Don't Drown!

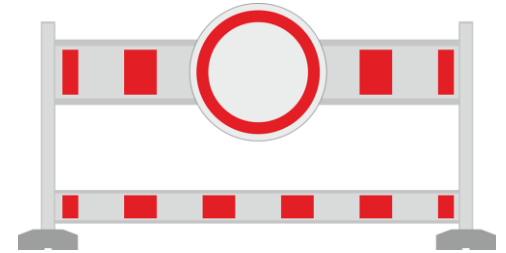
- Most flood deaths occur in vehicles.
- It only takes **six inches of water** for a vehicle to lose contact with the road surface.
- Most vehicles can be swept away in just 18 to 24 inches of water!
- Flooded roads may have hidden dangers, such as washed out road beds or underwater obstructions.
- If your vehicle is caught in rising water, leave it immediately and seek higher ground.



Minnesota road damaged by flood waters, courtesy of FEMA.

Safety During a Flood

- Have multiple ways to receive weather information (cell phone, NOAA weather radio, television, etc.)
- Do not sightsee!
- Evacuations are ongoing and first responders are working hard to get people to safety. Do not get in their way!
- Flood waters from creeks, bayous and rivers will be swiftly moving. *Do not go near the flood waters!* They will sweep you away if you go in the water.
- Roads may still be closed as they could be damaged or still under water. **Barricades are for your protection; do not drive around them!**



Safety During a Flood



- Stay out of the flood waters!
- Floodwaters can contain chemicals, sewage, disease, and animals
- Unseen underwater debris can be sharp and cause injury
- Downed power lines under the water could lead to death or injury from electrocution
- Water depth can change unexpectedly (storm drains, washed-out roads)

Safety After a Flood

- Don't put yourself in danger.
- Return home only when authorities indicate it is safe.
- Stay away from damaged areas unless your assistance has been specifically requested by police, fire, or a relief organization.
- Use extreme caution when entering buildings; there may be hidden damage, particularly in foundations.

Flooding Resources

Flood Safety

Turn Around Don't Drown

State Flood Information

Flood Hazards

NWS Flood Related Products

Forecasts and Observations

National Water Center

Education and Outreach Materials

Partner Agencies

weather.gov/flood

Safety After a Flood

- Don't leave lit candles unattended
- Cut power to flooded areas of your home
- Only use generators in well-ventilated areas—never in a closed garage!
- Take breaks and drink plenty of fluids
- Do not use power tools while standing in water
- If you smell or hear gas, call the Fire Department.





Reporting/Wrap Up

What to Report

Flash Flooding

- Underpasses filling with water
- Impassible roadways
- Any fast-moving water greater than 6 inches in depth

Any River or Bayou Flooding



Flooding, Washington County (2016)

Formatting Reports



Reports should include the following information:

WHO is calling

WHERE the flooding is located

WHAT type of flooding is occurring (flash, river, or bayou)

WHEN the flooding occurred (is it ongoing?)

HOW deep is the water (if you can *safely* evaluate this)



The Good

“I’m a storm spotter located in Sealy at the intersection of Meyer and FM 2187. Water is flowing over curbs; it’s at least 6-8 inches deep in some locations on the road.”

The Bad

“Hey, we got some flooding here a few minutes ago!”

The Ugly

“My sister-in-law said the bayou got really closer to her house, did you have a warning out for that?”

How to Report

Call us!

Spotter line: 1-800-846-1828

Report via amateur radio

Call sign WX5HGX

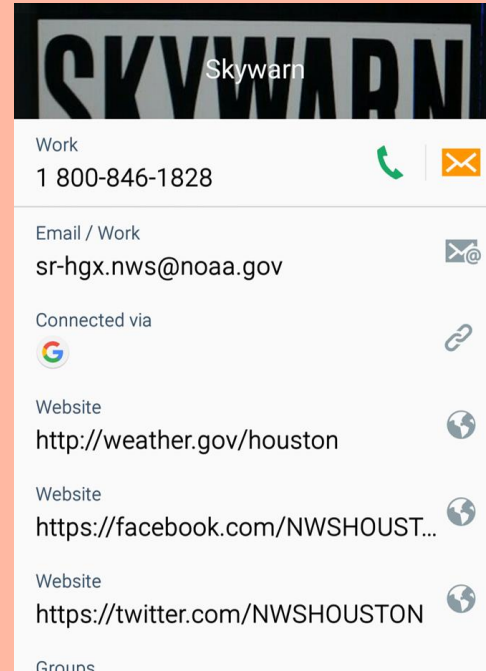
Email

sr-hgx.nws@noaa.gov

Social Media

Twitter: @NWSHouston

Facebook: NWSHouston



Spotter Tip

Set up SKYWARN as a contact
in your smartphone



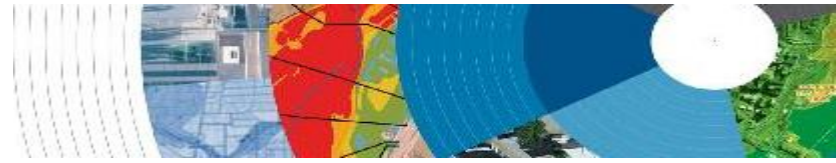
Flood Risk



FEMA
FEMA

FloodWarn Workshop

Topics



- NFIP – National Flood Insurance Program.
- What is Flood Risk?
- Flood Hazard Mapping and FIRMs

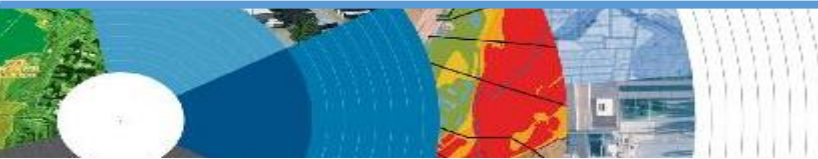
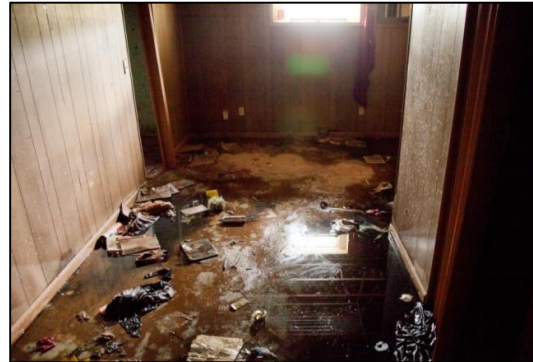


FEMA

Flood Insurance

A tool for individuals to manage risk.

- Everyone is at risk for flooding.
 - For most events 26% of NFIP claims are outside the SHFA.
- A few inches can cause tens of thousands in damage.
- If your mortgage company “forced” you to buy flood insurance, check that structure and CONTENTS are covered. Most cover structure only.

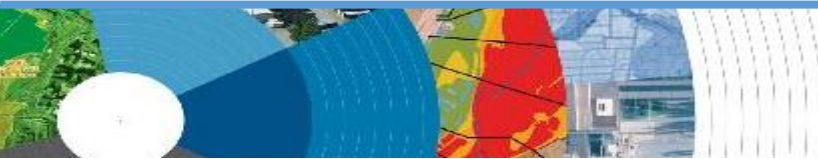


FEMA

What is the NFIP definition of A Flood Defined?

Inundation of 2 or more acres of normally dry land or of two or more properties (one of which is your property) from:

- Overflow of inland or tidal waters;
- Unusual, rapid accumulation or runoff of surface waters from *any source*;
- Mudflow; or
- Collapse or sinking of land along the shore of a lake or similar body of water as a result of erosion or undermining caused by waves or currents of water exceeding anticipated levels that result in a flood.



FEMA

NFIP Flood Insurance Coverages

- **Structure Coverage**

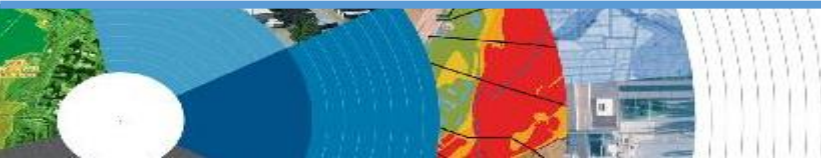
- Replacement Cost on single-family, primary residence (structure) if insured to at least 80% of replacement cost.
- Max coverage \$250,000

- **Contents coverage**

- Contents is an optional addition, except for Preferred Risk Policy.
- Max coverage \$100,000 coverage for Actual Cash Value (depreciation applies.)

- **Wait Period**

- Typically - 30-days from purchase until effective.
- Exceptions:
 - Flood Insurance required by a federally regulated and insured lender—0 days.
 - Wildfire 30-day waiting period exception—0 days.
 - Initial purchase of flood insurance as the result of a map revision—1 day.



FEMA

Misconception: Homeowners Insurance is Enough



- **Misconception:**

"I'm already covered—my homeowners policy covers flooding."

- **Fact:**

Most insurance policies do not cover flooding; only flood insurance covers flood damage.

Renters and Business owners should also consider flood insurance for contents.



FEMA

Group Flood Insurance Policy (GFIP)

IF in the 1% risk area (100yr floodplain)
AND received FEMA Individual Assistance(IA),
A GFIP policy was purchased
(if they did not have flood insurance.)

GFIP is a 3 yr. abridged Flood Insurance Policy. The policy is paid for from the IA funds.

You can purchase the standard NFIP policy to increase your coverage. *(GFIP cancels)*



Group Flood Insurance Policy (GFIP)



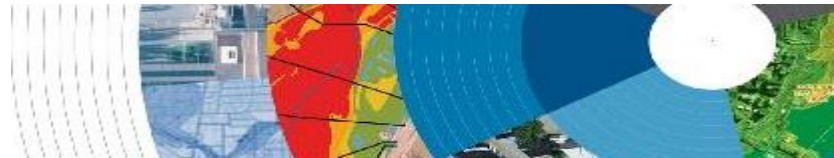
Requirement - *property owner MUST purchase and maintain a traditional NFIP policy when GFIP expires.*

If not...they are not eligible for IA that would cover the replacement of real or personal property for the damaged location with a future event.

The insurance requirement is forever – including new homeowners.



Flood Risk?



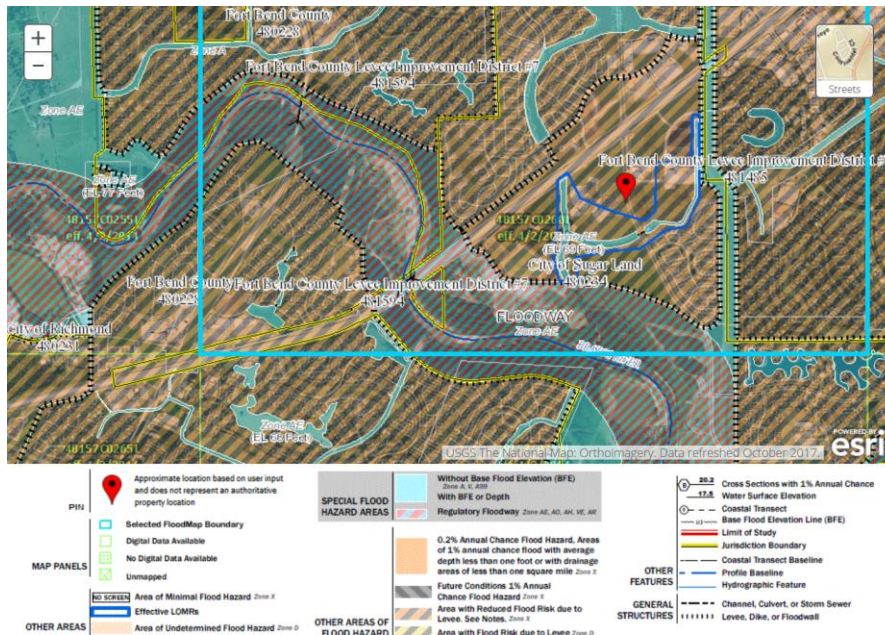
Any situation involving exposure to a Flood danger, harm or loss.

“While levees can help reduce flood risk...they do not eliminate the risk.”



FEMA

- Identifies the Special Flood Hazard Area (SFHA) and Non-SFHA's
- Used for rating flood insurance policies
- Mandatory purchase requirement if property is in SHFA **AND** is a federally backed mortgage.



FIRM's show Coastal and Riverine flood risk.

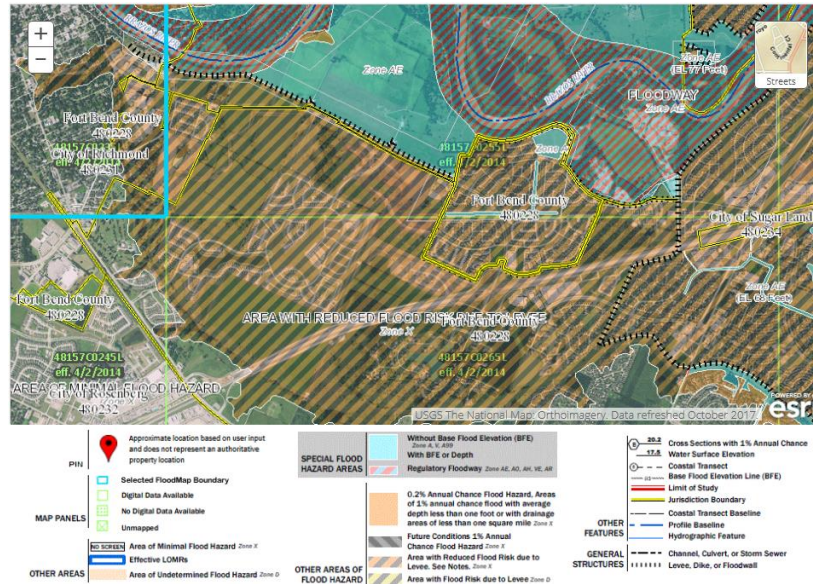


FEMA

What is a Flood Zone?

Zones on a FIRM:

- SFHA (high risk)
 - A, AE, AO, AH, VE, V etc. (Aqua)
 - 1% annual chance flood
 - 26% chance of flooding in a 30-yr mortgage
- Non-SFHA (low to moderate risk)
 - B, C and X (Shaded – orange or gray color & non-Shaded)
 - Orange/Gray area – outlines areas protected by Levees
 - Even the non-shaded is a flood zone – a minimal risk.



Find your zone at
<https://msc.fema.gov/portal/home>



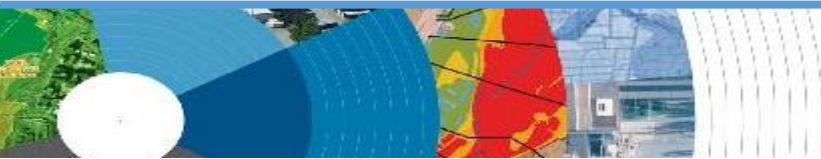
FEMA

Flood Hazard Mapping

- The maps are **NOT** a prediction or forecast.
- Flood waters are not confined to the at the 1% risk line (aka 100yr flood) on the FIRM.



"Yes, this is a beautiful river. But it wasn't here when we purchased the land. Maybe we should've checked to see if it was in a flood zone before investing in it."

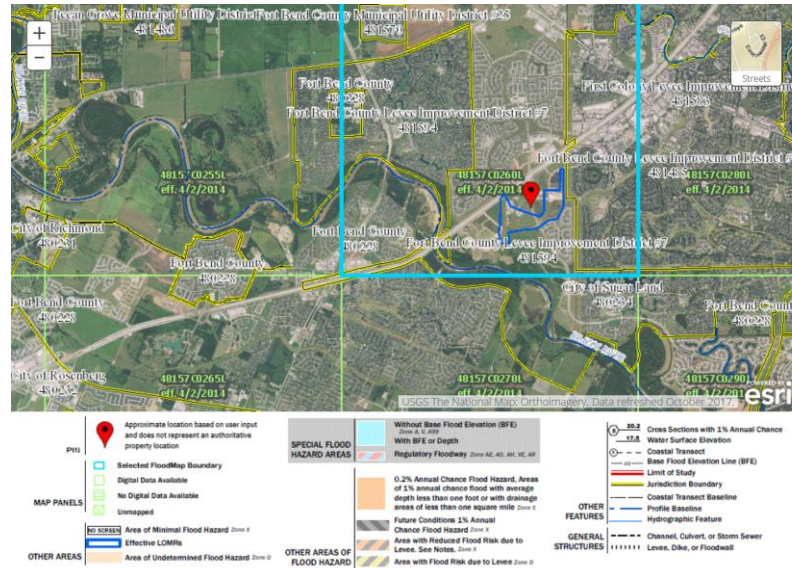


FEMA

Flood Hazard Mapping

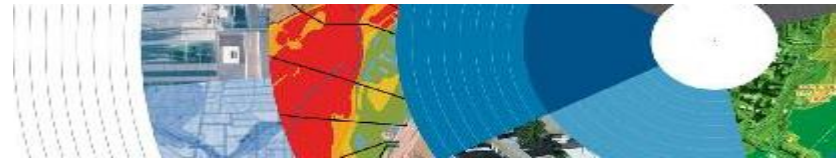
- FIRM panels are subdivided by panels to cover a jurisdictional boundary (each has a unique panel number.)

- Each panel has a specific code and effective date.
- FIRM panels are a single snapshot for one scenario.



FEMA

Flood Hazard Mapping



- Assumptions are made in the river modeling
 - Precipitation input the 100 year/24 hr. design storm (*actual events rain intensities vary - not consistent rate over a 24 hr. period.*)
 - Assumptions about the vegetation in the flood plain – do NOT differentiate dead vs growing vegetation (increased friction during growing season)
 - Snapshot of land use when the models were developed – a challenge in rapidly developing areas
- One event is never the same as another, FIRMs will not exactly match an individual event.



FEMA

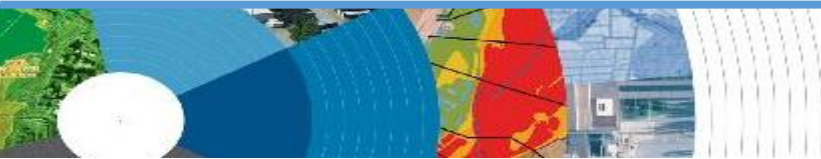
Misconception: Only 100yr Floodplain is at Risk

- **Misconception:**

"I don't live in a flood zone."

- **Facts:**

- Floods are the #1 natural disaster in the United States.
- If it can rain, it can flood.
- FIRMs do not show localized flooding from drainage ditches/sewers/road ponding.
- To some degree overland flooding...but not property to property drainage problems.

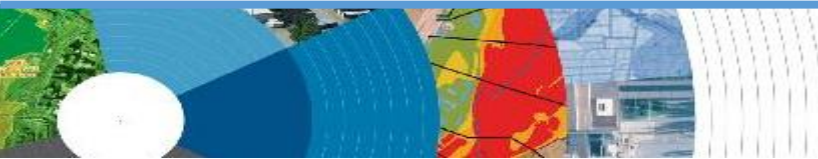


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Cost of Flood Damage?

2,500 sqft, one-story home with possessions worth \$50,000

Interior Water Depth (Inches)	Cost to Home	Cost to Personal Property	Combined Loss Potential
1"	\$23,635	\$3,172	\$26,807
2"	\$23,720	\$3,172	\$26,892
3"	\$24,370	\$4,917	\$29,287
4"	\$31,345	\$7,207	\$38,552
5"	\$31,425	\$13,914	\$45,339
6"	\$37,260	\$14,777	\$52,037
7"	\$37,691	\$17,700	\$55,391
8"	\$38,122	\$20,624	\$58,746
9"	\$38,553	\$23,547	\$62,100
10"	\$38,983	\$26,470	\$65,453
11"	\$39,414	\$29,394	\$68,808
12"	\$39,845	\$32,317	\$72,162
24"	\$44,325	\$43,001	\$87,326
36"	\$47,905	\$46,633	\$94,538
48"	\$53,355	\$50,000	\$103,355



FEMA

Structure Elevation Impact Insurance Rates



The elevation is just one factor, others include: when was the structure, has it flooded in the past, etc.

EVERY Structure has a risk...
generally the higher the structure the less the risk.

Harvey Numbers

Insurance claims

- Harris Co (includes cities such as Houston) – all claims 55,570**
- Fort Bend County (unincorporated only) – 15,193 (Losses over 125K)

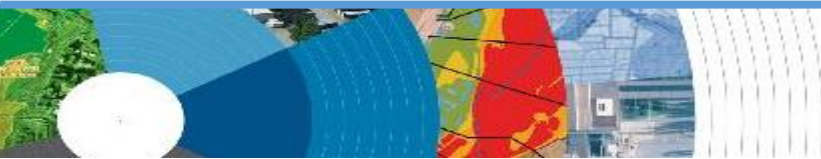
New GFIP's Due to Harvey

- Fort Bend –1832

Harris County Numbers**

- 154,170 Homes 48,850 in 1% Risk Area (100-yr)
- 34,970 in 0.2% (500-yr) floodplain
- **68% OUTSIDE of the 1% Risk Area.**

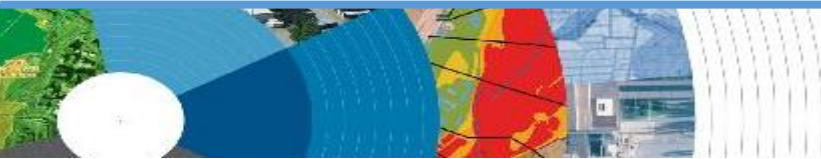
**Data HCFCFCD Finale Hurricane Harvey Storm and Flood Information –
<https://www.hcfcfd.org/media/2678/immediate-flood-report-final-hurricane-harvey-2017.pdf>



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Summary

- Living in Texas means we have a flood risk even with heavy rain.
 - Tax Day 2016 and Memorial Day 2015 – not with a tropical system
- Flood Risk is from multiple sources.
 - FIRMs focus on river flooding and some overland flow.
- Flood insurance allows individual property owners to manage their risk.
 - **Buy policies that cover the structure AND contents.**



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NFIP Hotline

1-800-427-4661

www.fema.gov/nfip

Lauren Schmied, PE, Floodplain Management

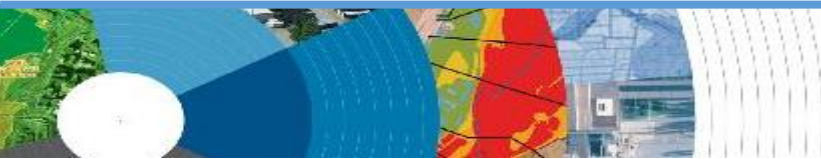
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Questions

National Weather Service
Brazos River Authority
Fort Bend County Drainage District
FEMA