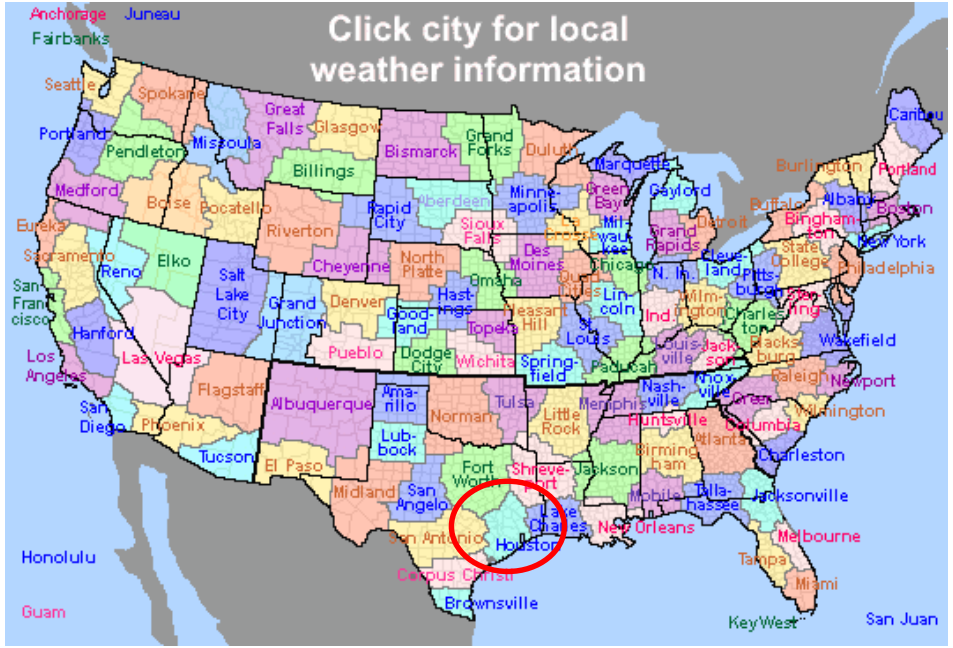
2019 FloodAware Training

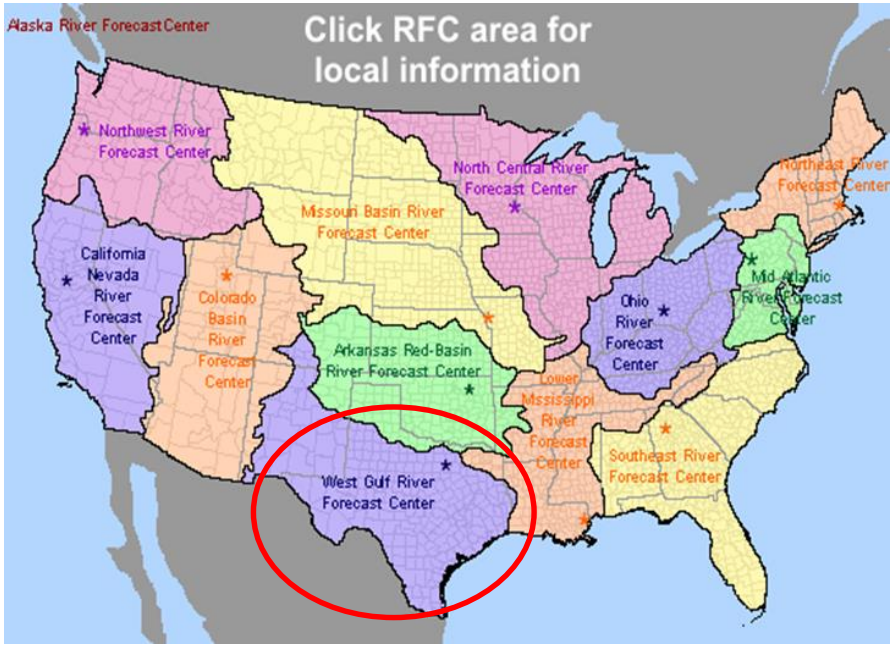
Katie Landry-Guyton
Senior Service Hydrologist/Meteorologist
National Weather Service- Houston/Galveston, TX

National Weather Service

Weather Forecast Offices



River Forecast Centers



Outline

Flooding Importance

Flooding Types and Causes

Flood Products

River Flooding

Partners

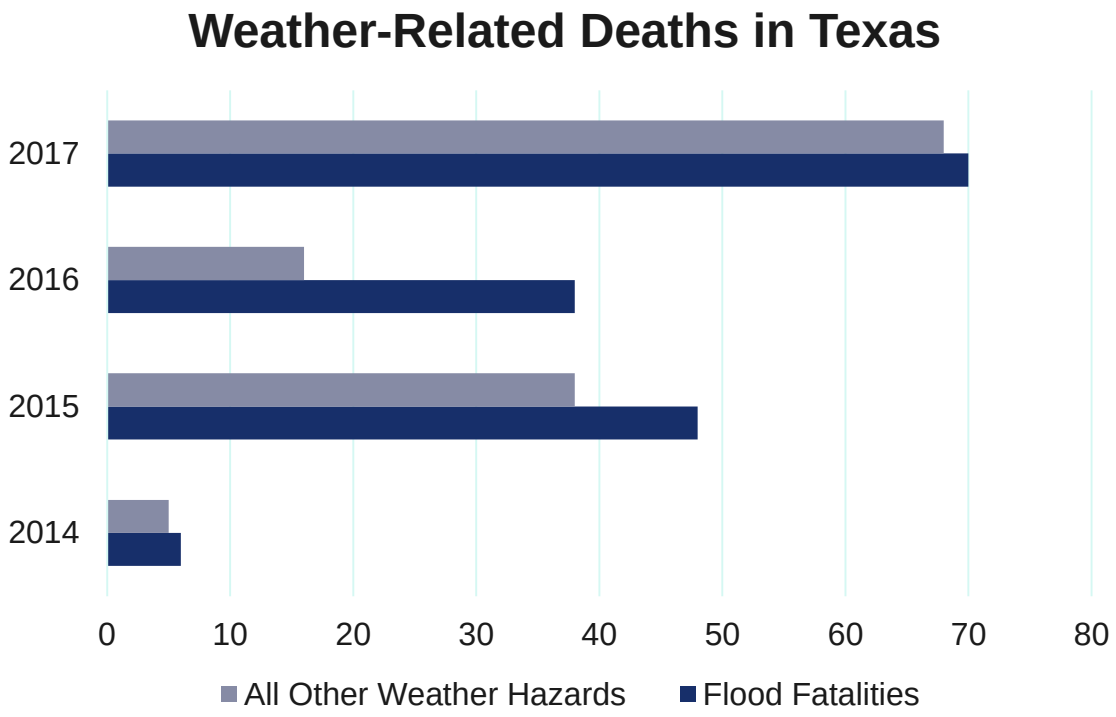
Flood Safety

Reporting Flooding

Flood Risk

Flooding Importance

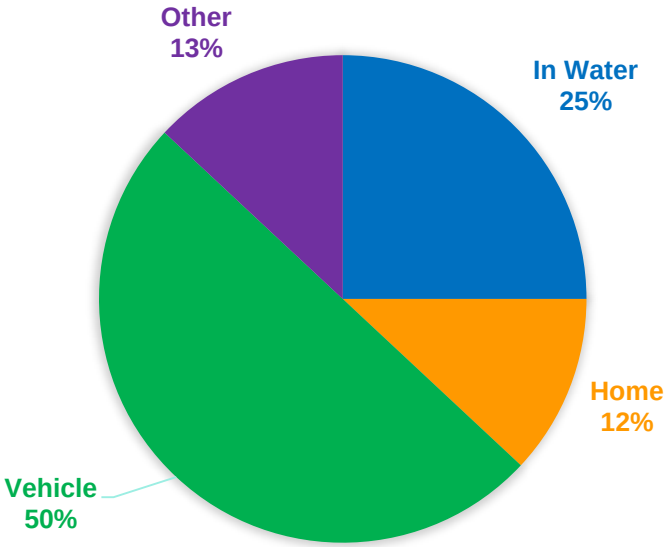
Flooding is Deadly!



In the 4 year period from 2014 to 2017, **more** people have died in Texas from flooding than ***all other weather hazards combined***.

Data from NWS National Hazard Statistics

Flood Fatalities



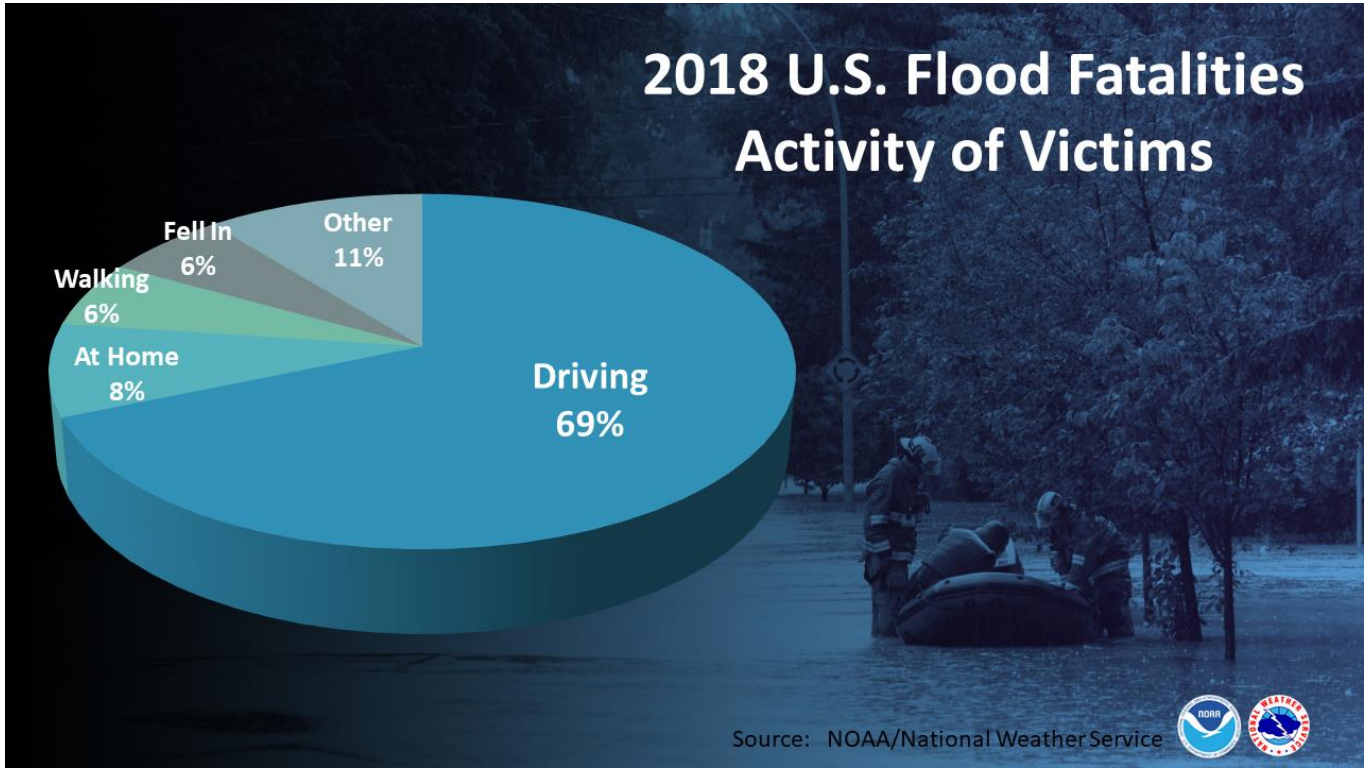
Half of the flood fatalities in Texas occurred while people were in their car.

2017 was skewed due to Hurricane Harvey. In 2017, there were 33 flood fatalities in the water and 19 in vehicles.

Data from NWS National Hazard Statistics

Houston Floods: April 18, 2016

Flood Fatalities



Recent Big Floods…

Memorial Day 2015

Tax Day 2016

Brenham 2016

Harvey 2017

Harvey 2017

Brenham 2016

Tax Day 2016

And other historic floods…

Tropical Storm Allison

1994 Flood

Tropical Storm Claudette

Flooding Types and Causes

What Causes Flooding?

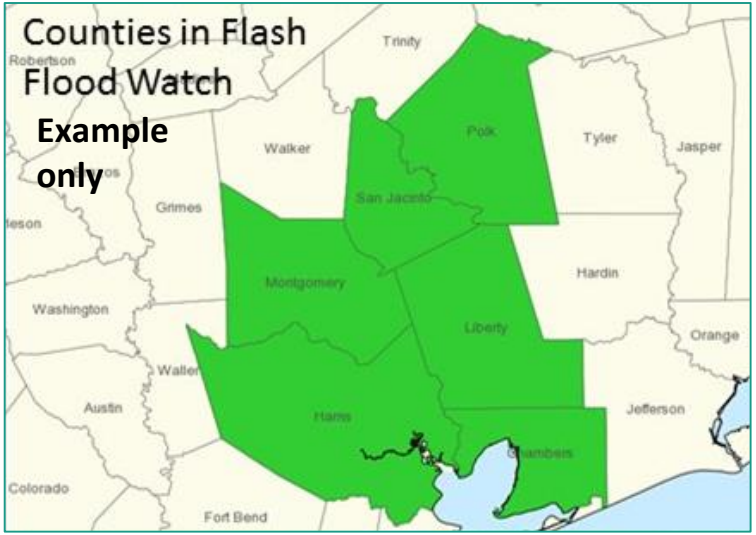
- Intense rainfall
- Rain over several days
- Dam/levee failures
- High tides or storm surge
- Snowmelt
- Ice or debris jams

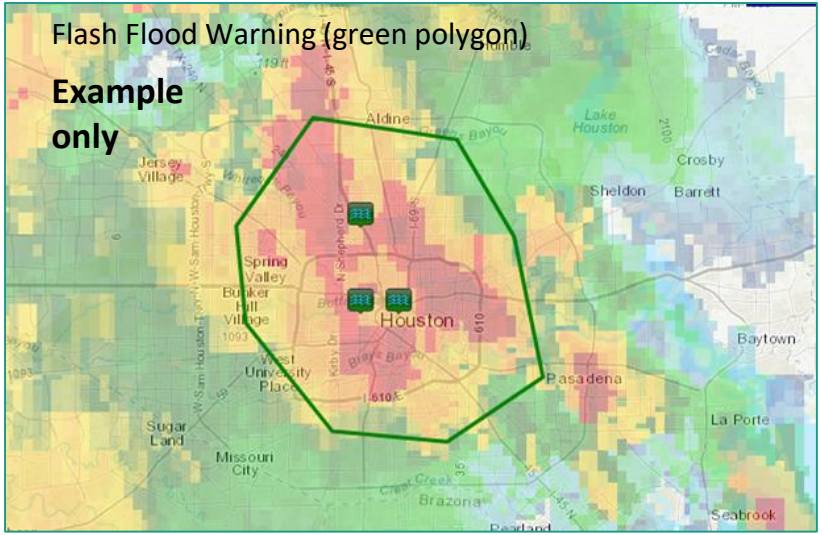
Flood Products

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, poor drainage, or high tides/surge. 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	*Flood Watch*	*Flash Flood Watch*	*Flood Warning*	*Flash Flood Warning*	*Flash Flood Emergency*
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	**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	**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	**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	**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	**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

You make the call…

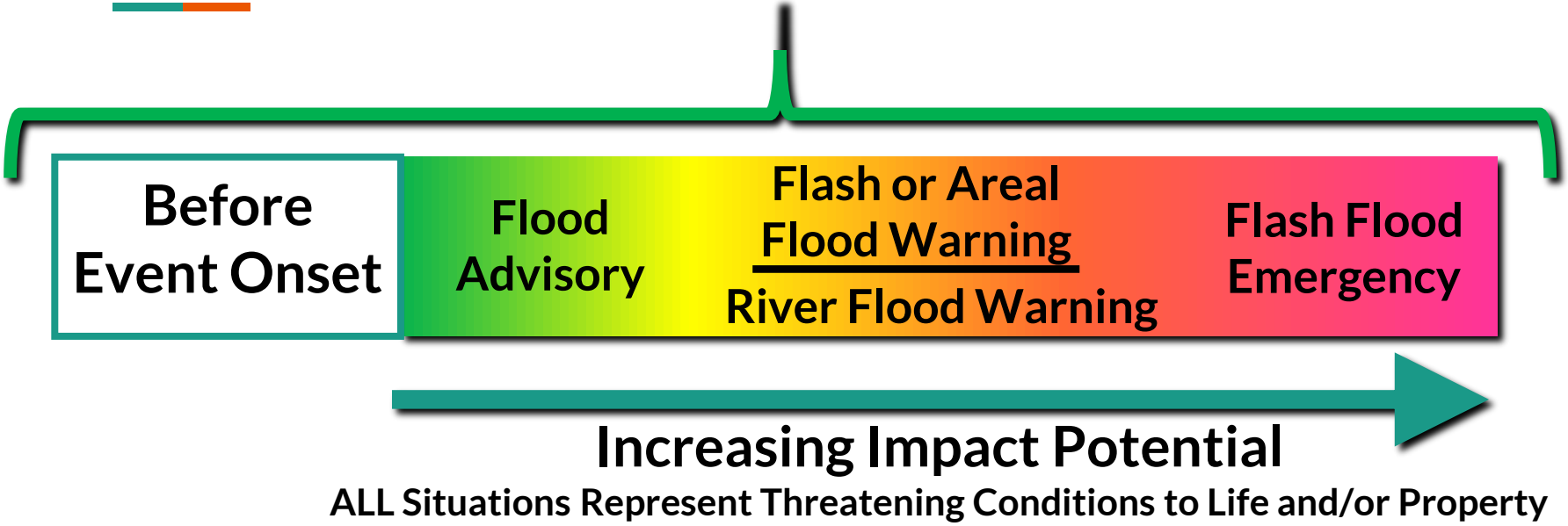
Urban / Small Stream Flood Advisory

Flash Flood Warning

Flash Flood Emergency

Flood Warning (Areal/ River/ Bayou)

Flood Timeline



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

Be sure to have multiple ways to receive warnings.

Ways to Receive a Warning

NOAA Weather Radio

Wireless Emergency Alerts and Weather Apps

TV and Radio

Social Media

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

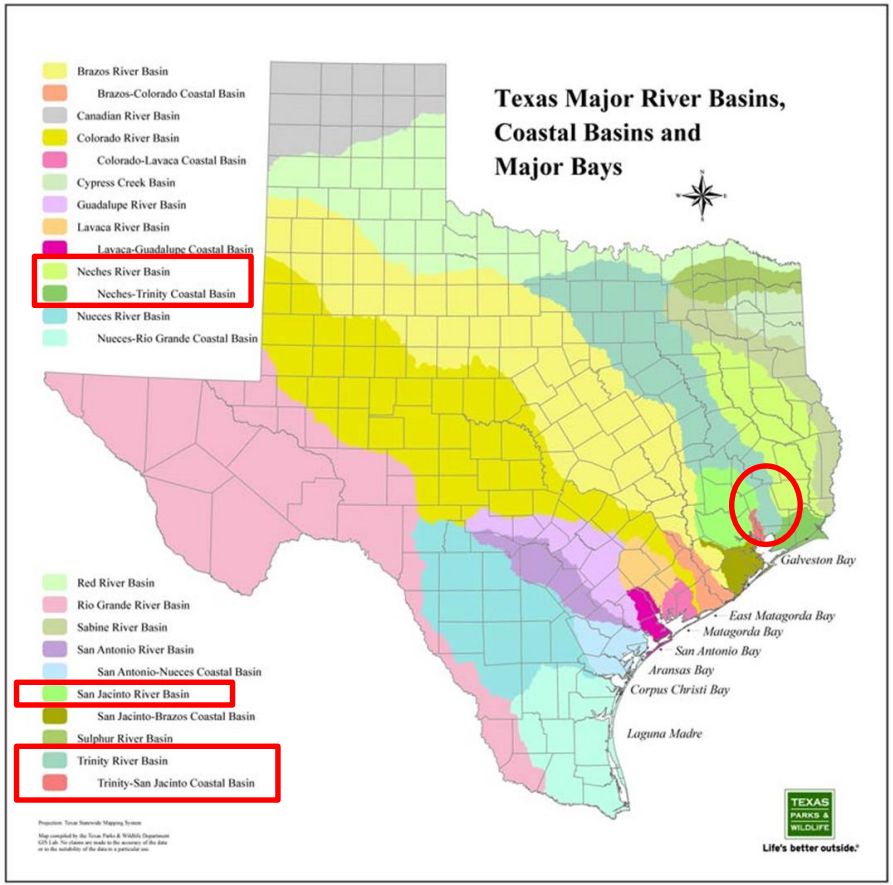
River Flooding

River Flooding

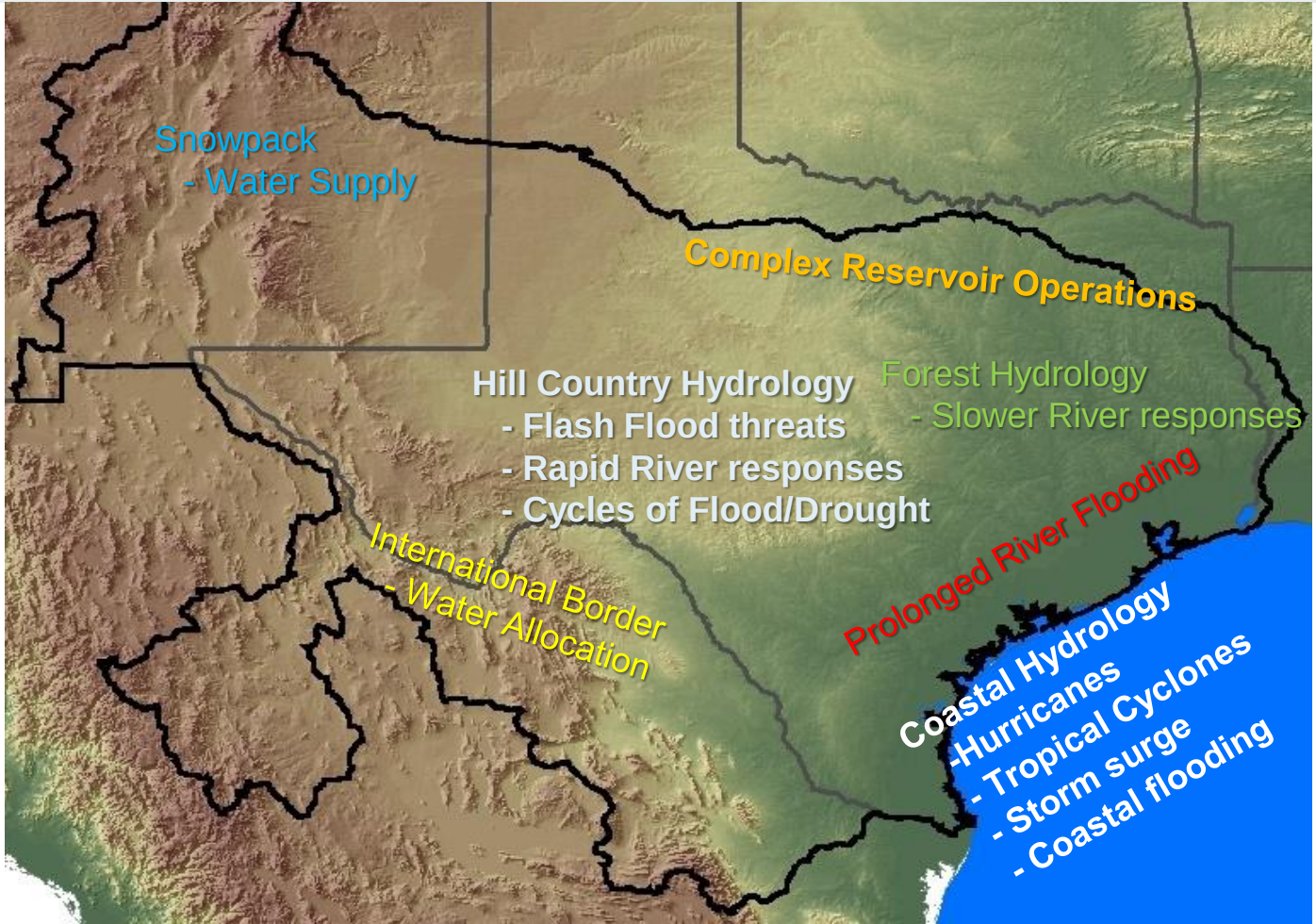
River flooding occurs when water escapes the river banks. There are different thresholds for river flooding: action, minor, moderate, major and record flooding. This image depicts what a river flooding looks like.

Watershed

- A watershed, or basin, 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.
- Liberty County deals with 3 primary watersheds: Trinity, San Jacinto, and Neches basins.



Diverse Watershed Characteristics in Texas



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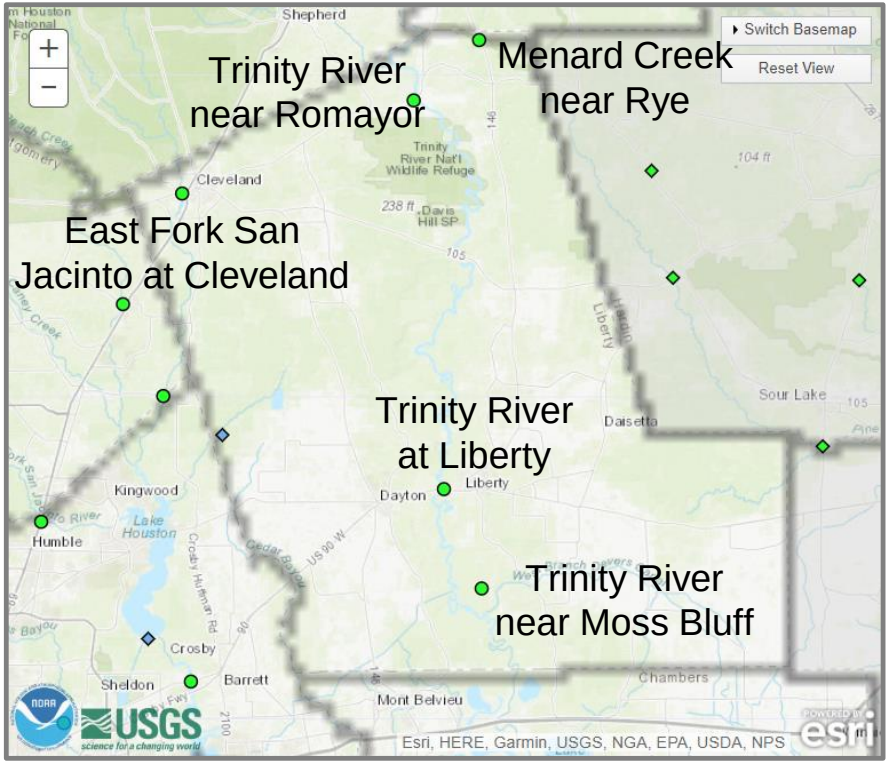
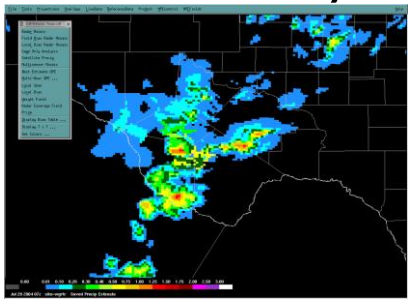
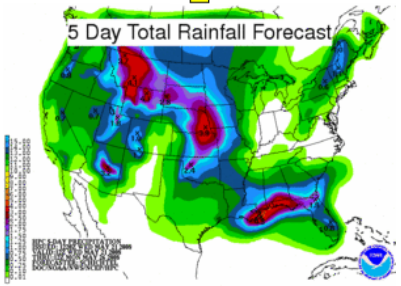
- Liberty County deals with 3 primary watersheds: Trinity, San Jacinto, and Neches basins.
- NWS issues forecasts for 5 gauges in Liberty County.



River Forecast Process

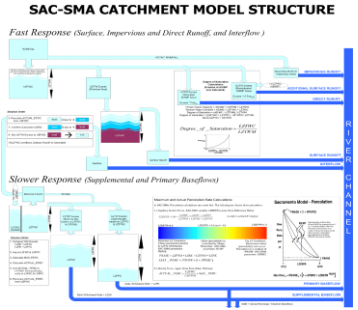
Rainfall Analysis

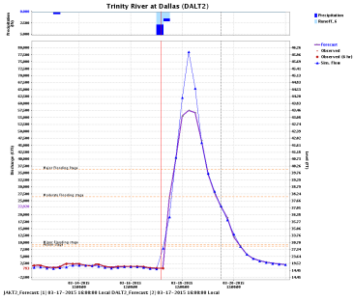




Rainfall estimates and forecasts merged into continuous dataset

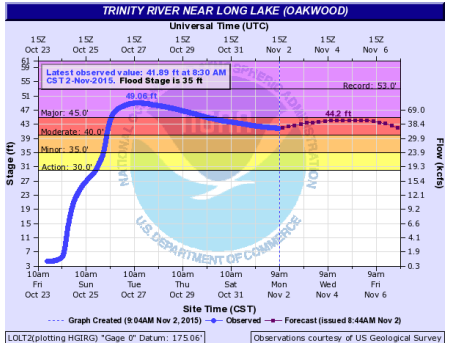
Hydrologic Modeling





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

Forecast



Warning

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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

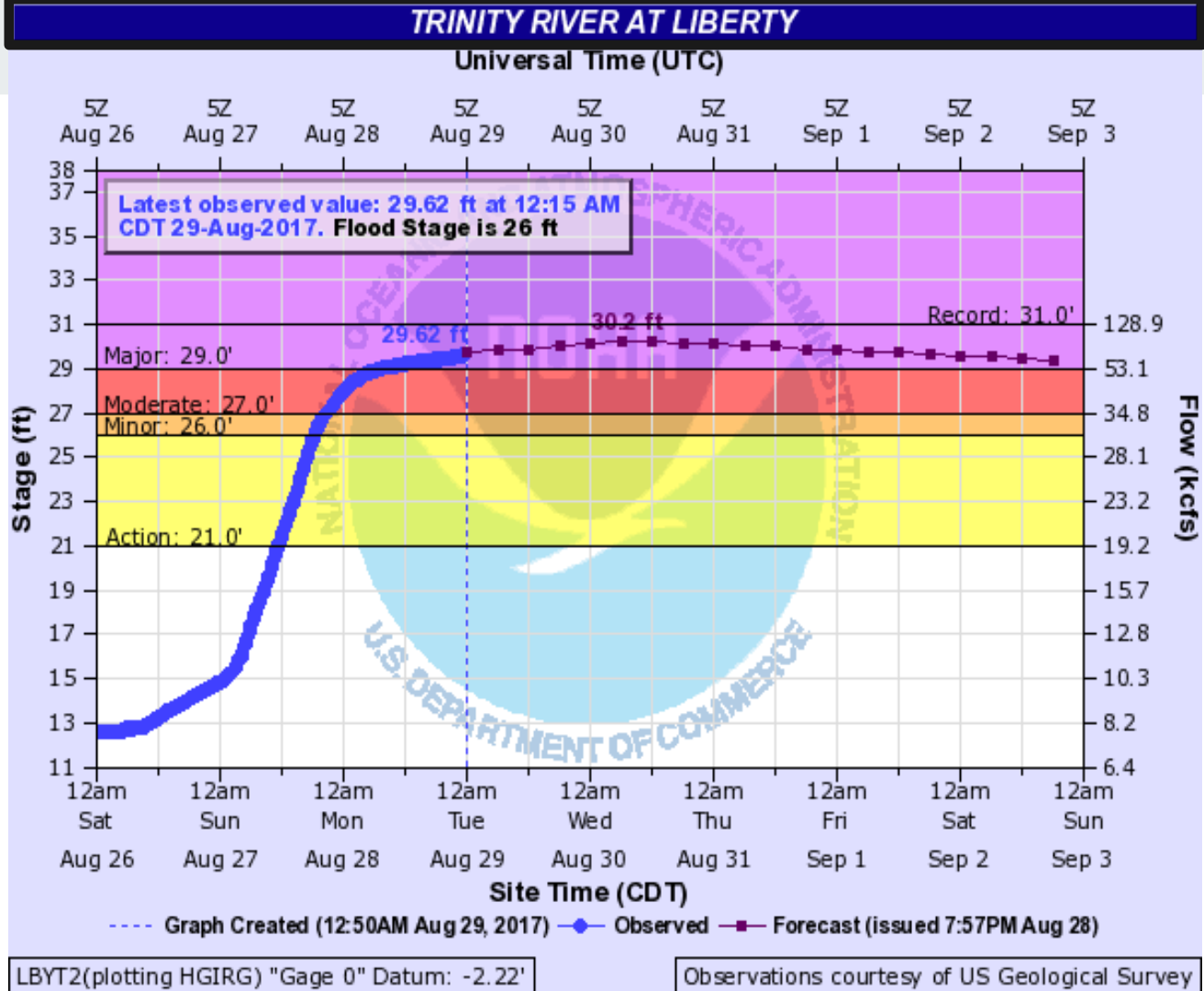
TXC015-039-157-473-271425-
/O.NEW.KHGX.FL.W.0149.160529T0730Z-000000T0000Z/
/RMOT2.1.ER.160529T0730Z.160531T0600Z.000000T0000Z.NO/
926 PM CDT THU MAY 26 2016

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

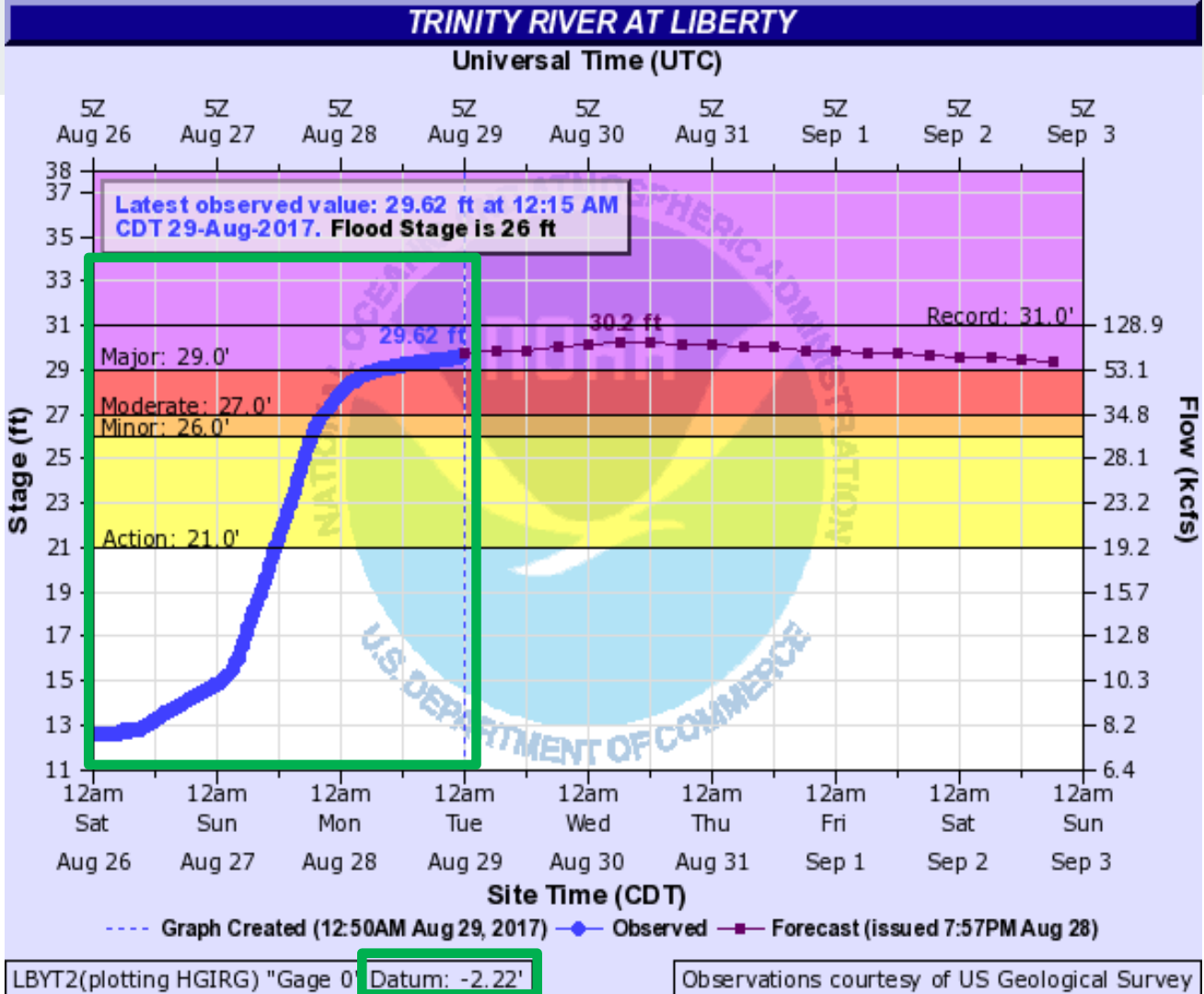
LOCATION:
Of the gage the forecast is made, AT means the gage is in the limits of the town/city, NEAR or NR means that town/city has the closest post office



Hydrograph Basics

OBSERVATIONS:
Past river stages

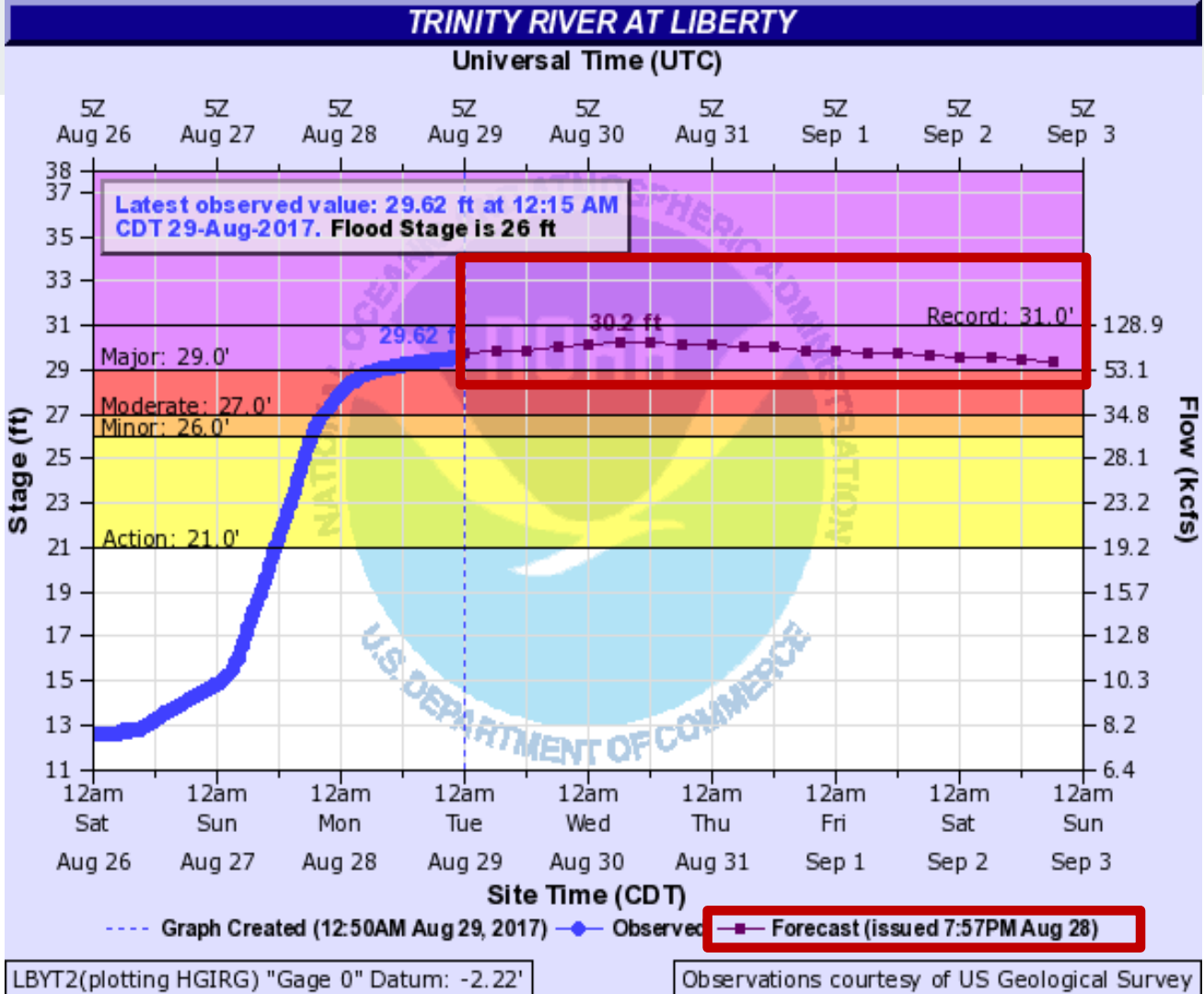
DATUM:
Adjustment to mean sea level



Hydrograph Basics

FORECAST:
Forecast River Stages

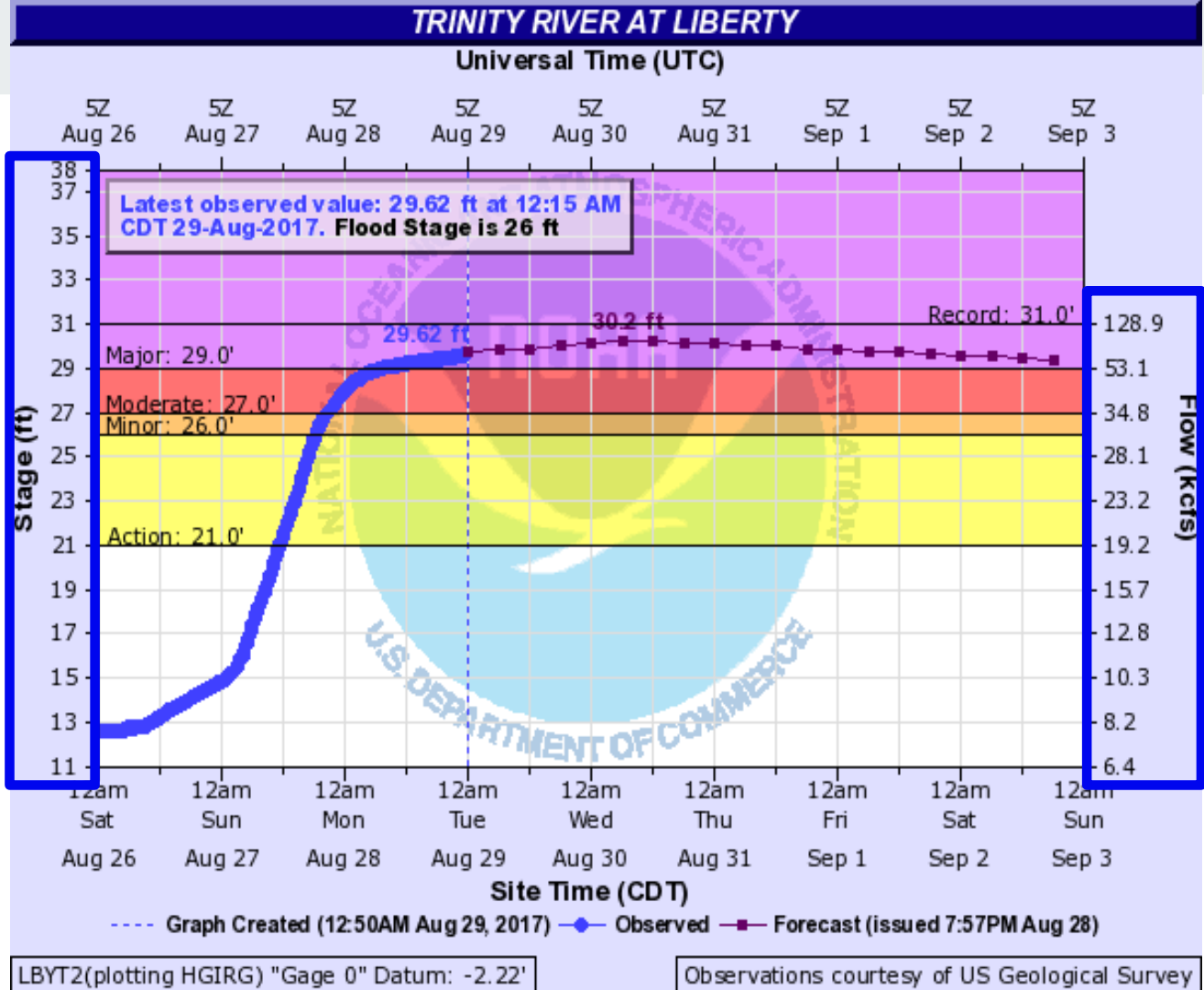
CREST:
Peak Stage



Hydrograph Basics

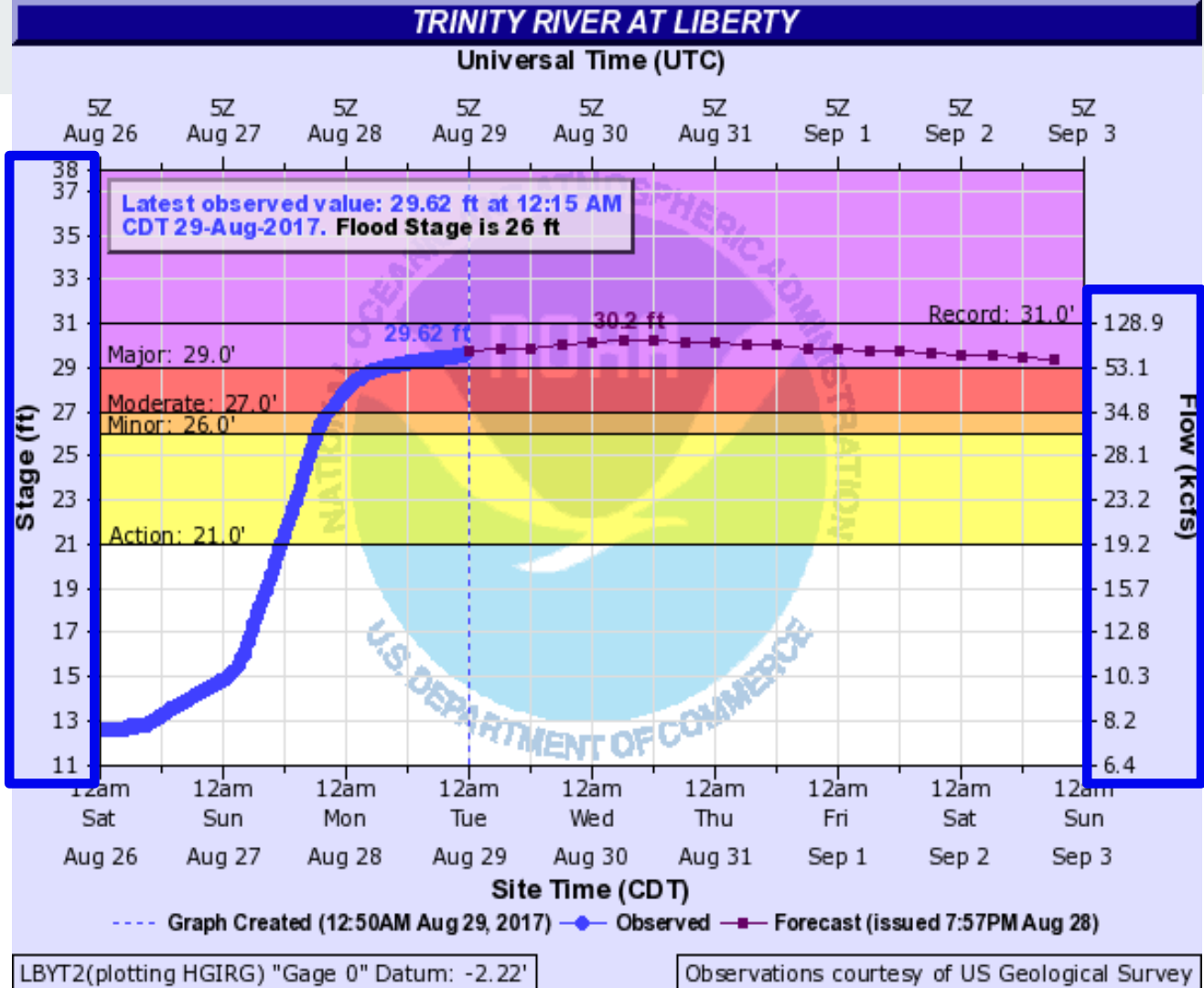
STAGE VS FLOW: Hydrologists, models, reservoirs work in flow. Emergency managers, media, general public work in stage.

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

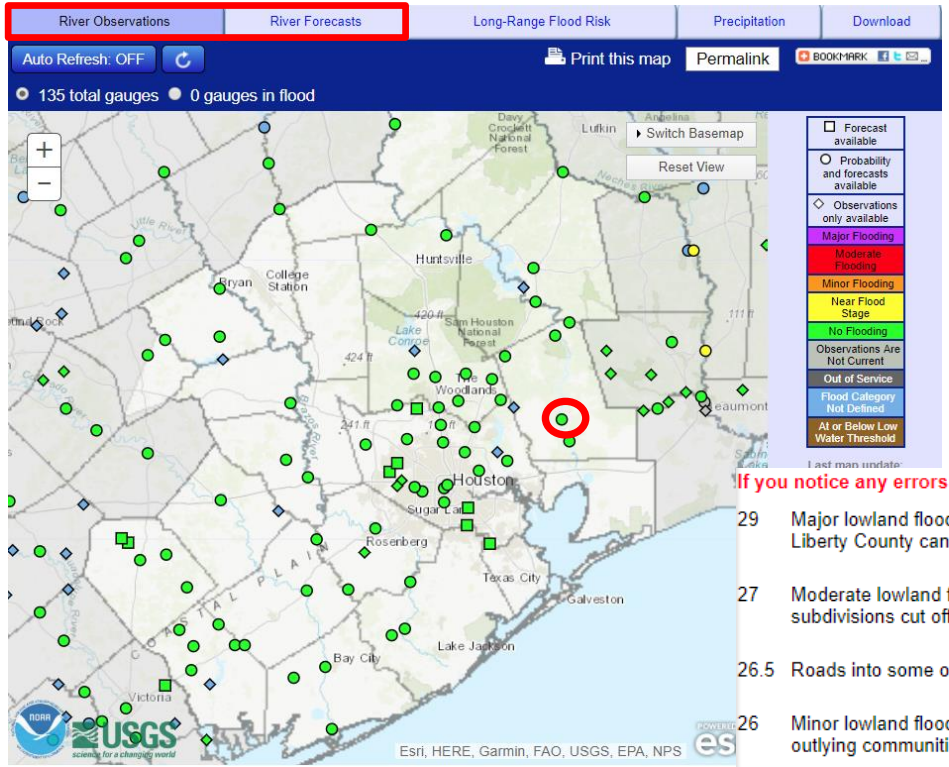
MODERATE

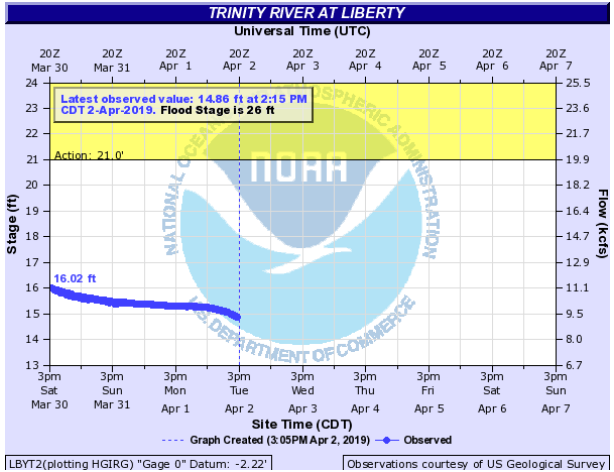
Impact: Water now reaching areas only impacted by significant rain events. Structures can be inundated, several roads covered with water, water may cut off certain areas, widespread agricultural flooding.

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:	29
Moderate Flood Stage:	27
Flood Stage:	26
Action Stage:	21
Low Stage (in feet):	0

Historic Crests

(1) 32.70 ft on 09/01/2017
(2) 31.00 ft on 10/21/1994
(3) 30.03 ft on 05/23/1990
(4) 29.96 ft on 05/31/2015
(5) 29.95 ft on 06/01/2016
Show More Historic Crests

(P): Preliminary values subject to further review.

Recent Crests

(1) 29.45 ft on 01/19/2019 (P)
(2) 29.39 ft on 01/06/2019 (P)
(3) 29.58 ft on 12/14/2018 (P)
(4) 29.95 ft on 10/22/2018 (P)
(5) 29.40 ft on 04/02/2018
Show More Recent Crests

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

29 Major lowland flooding begins as homes in several subdivisions above Liberty begin flooding. Extensive flooding over much of Liberty County can be expected with each incremental rise in the river.

27 Moderate lowland flooding begins as roads into several outlying communities above Liberty are closed with residents in 5 or 6 subdivisions cut off if not evacuated.

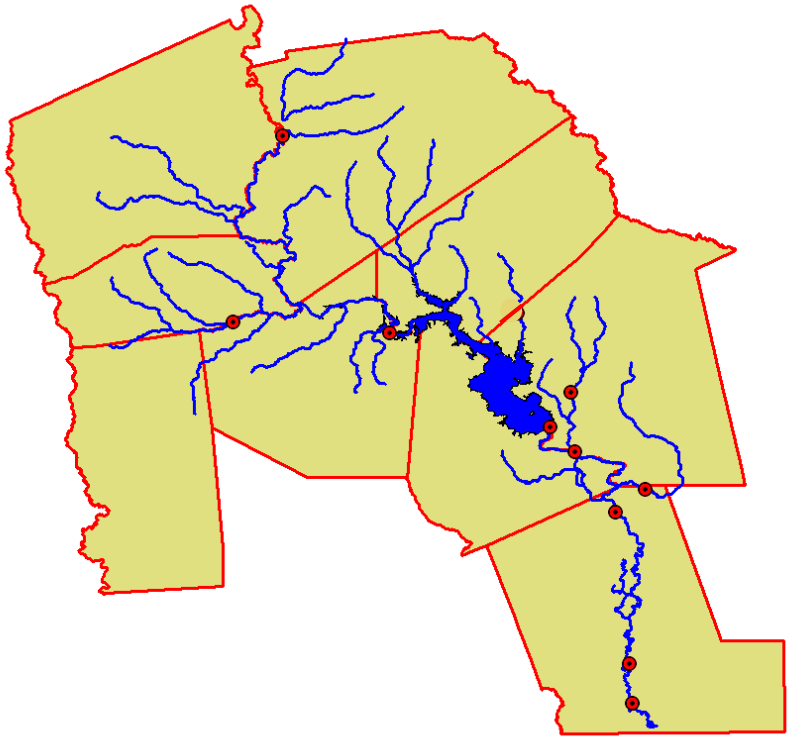
26.5 Roads into some outlying communities above the gage can have up to one foot of water over them.

26 Minor lowland flooding begins and significant lowland flooding in the vicinity of the gage can be expected as roads into some outlying communities above the gage begin to flood.

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

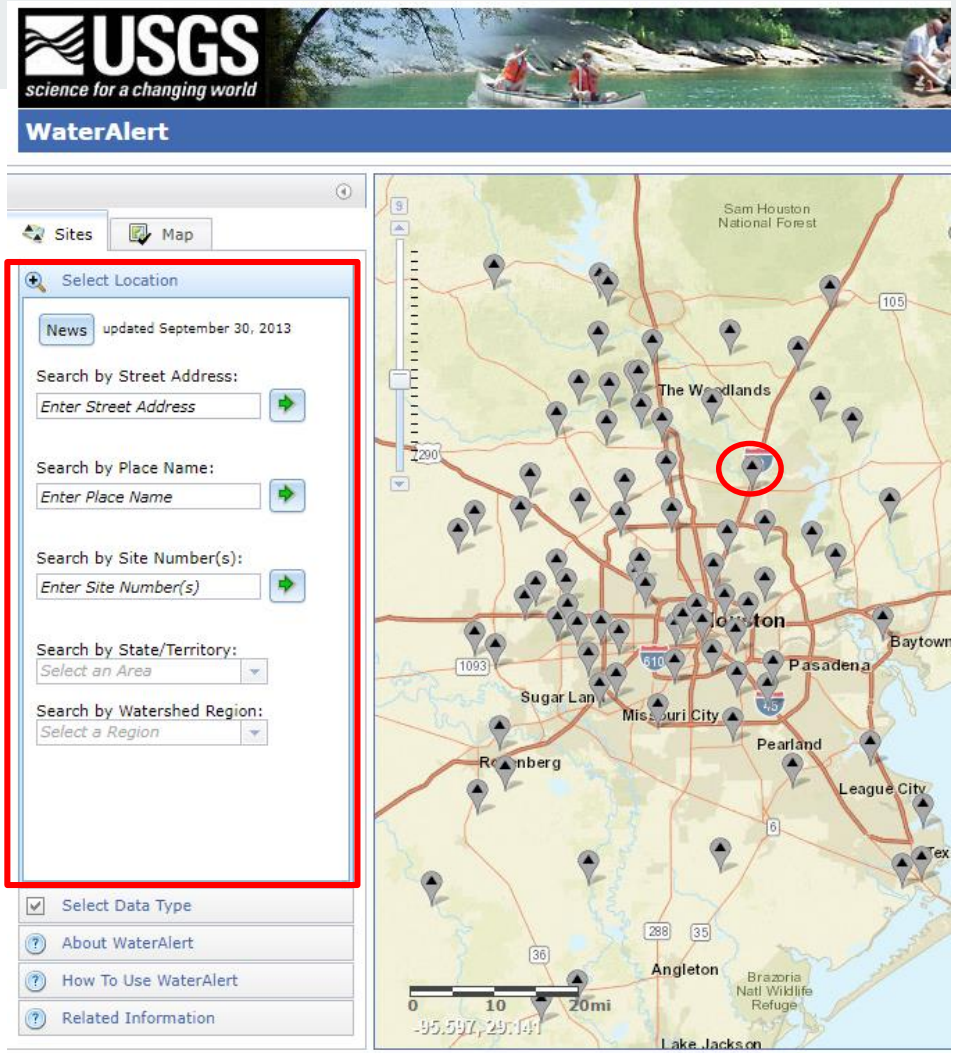
Forecasting the Trinity River

- 9 Forecast Points
  - 6 on Trinity River:
    - Crockett
    - Riverside
    - Goodrich
    - Romayor
    - Liberty
    - Moss Bluff
  - 1 on Bedias Creek
  - 1 on Long King Creek
  - 1 on Menard Creek
- 1 Reservoir
  - Lake Livingston



USGS Water Alerts

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



USGS Water Alerts:
https://maps.waterdata.usgs.gov/mapper/wateralert/

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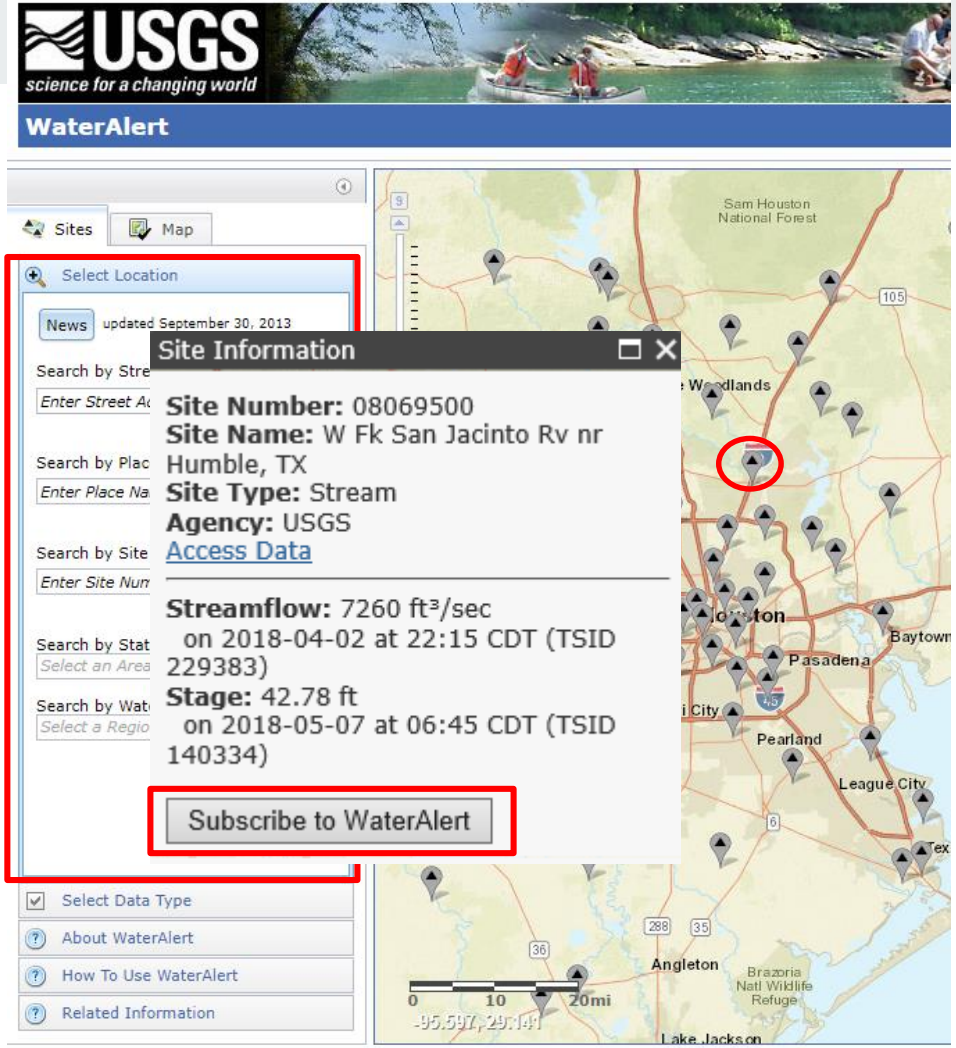
- Click on the gauge and select "Subscribe to WaterAlert"



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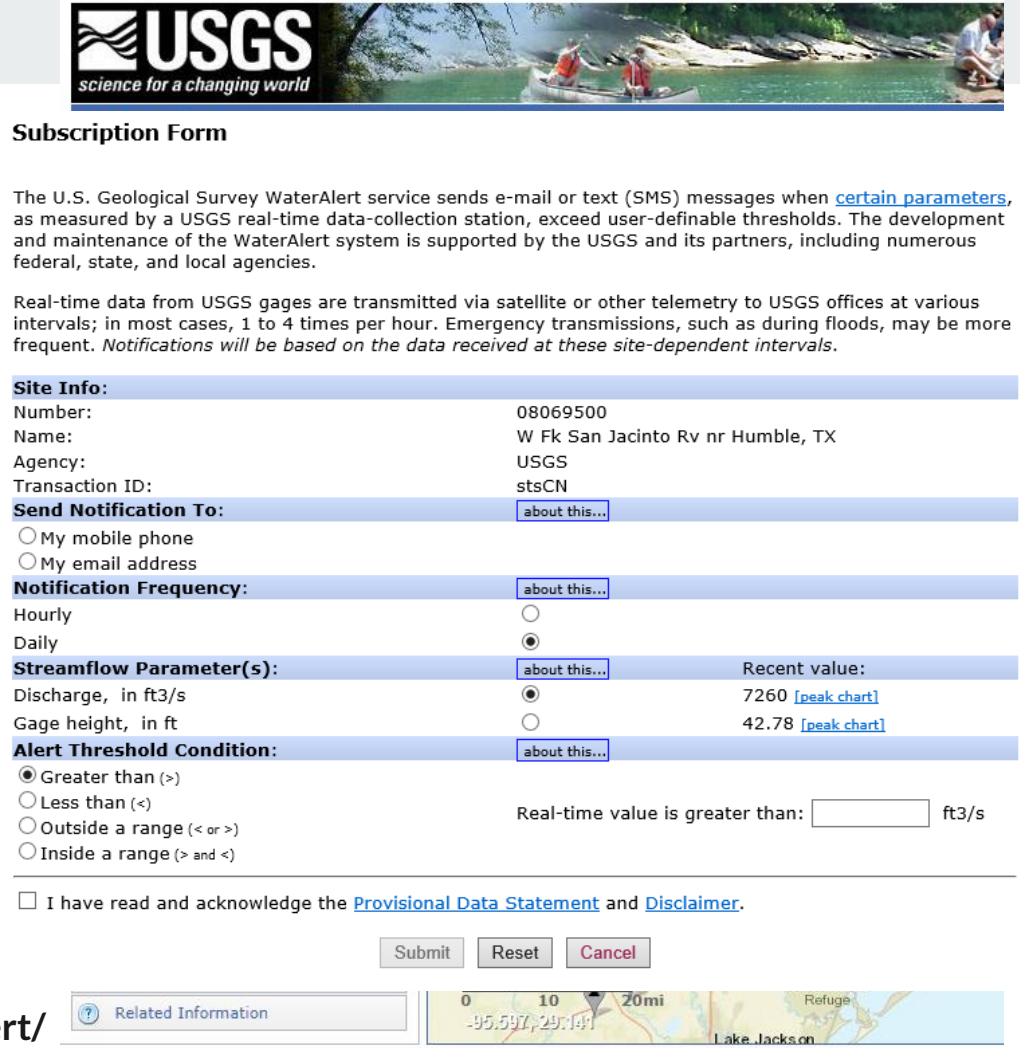
USGS Water Alerts

- 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

USGS Water Alerts:
https://maps.waterdata.usgs.gov/mapper/wateralert/



Partners

Partners

Roles of Primary River Forecast Partners

US Army Corps of Engineers

- Operate Flood Control Reservoirs
- Manage Other WR Projects

USGS science for a changing world

- U.S. Stream Gage Network
- Water Science Studies

National Weather Service

- Issue Weather & Water Forecasts, Watches, Warnings & Data

Shared Data and Resources

US Army Corps of Engineers

- Assist w/Gage Maintenance
- Assist w/Stream Measurements
- Assist w/Funding Data Networks

USGS science for a changing world

- Gage Maintenance
- Stream Measurements
- Focus Stream Gage Network

National Weather Service

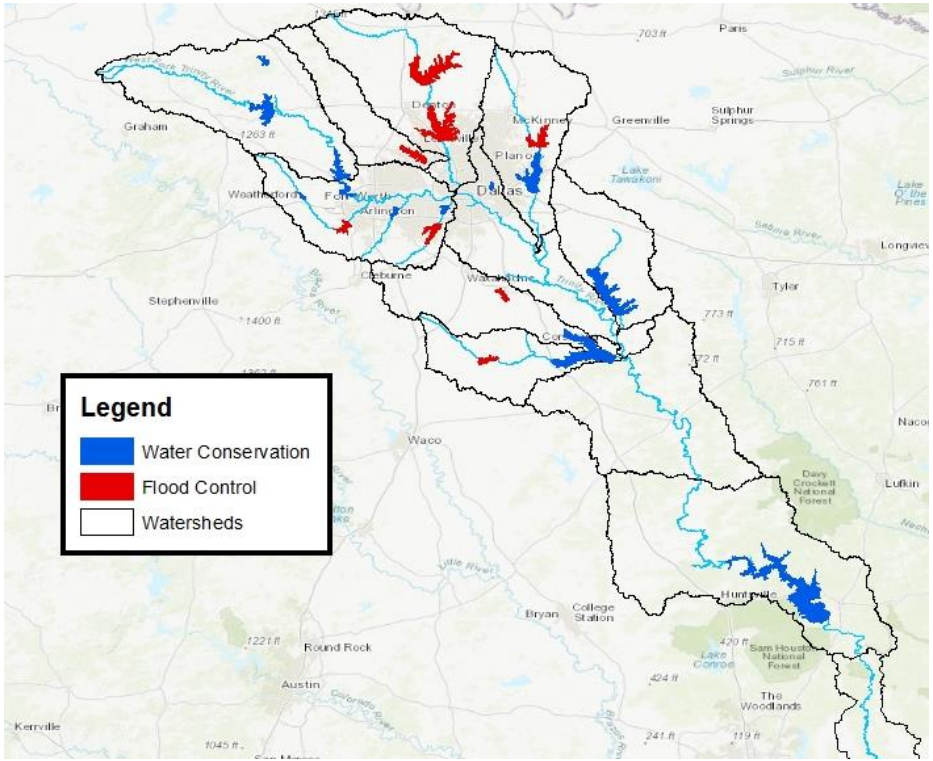
- Cooperative Data Network
- NOAA/NWS Satellite Transmission
- Forecasts/Data for Operations

Trinity River Basin Over View

Basin Facts

- Nearly 18,000 square miles
- More water storage than any other river system in Texas

Basin Facts



20 reservoirs ranging from 1,000 to 83,000 acres

- 12 Water Conservation
- 8 Flood Control

Basic Components of a Dam

Flood Control Reservoir

Flood Control Reservoir

- Built to regulate flood waters
- Examples:

1. Lake Grapevine
   - Storage-535 MSL
   - Flood Pool-560 MSL
   - Surcharge-582 MSL
2. Lake Lewisville
   - Storage-522 MSL
   - Flood Pool-532 MSL
   - Surcharge-552 MSL

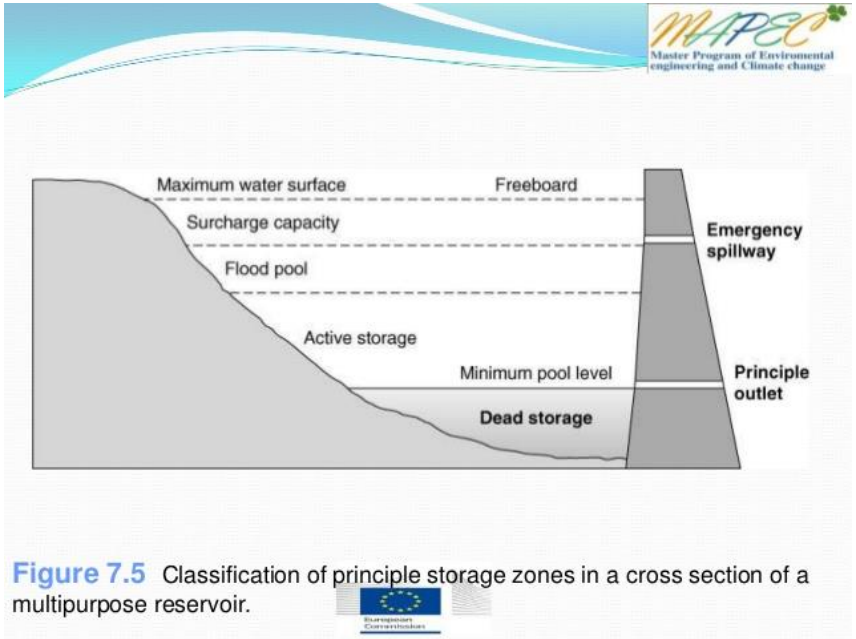


Figure 7.5 Classification of principle storage zones in a cross section of a multipurpose reservoir.

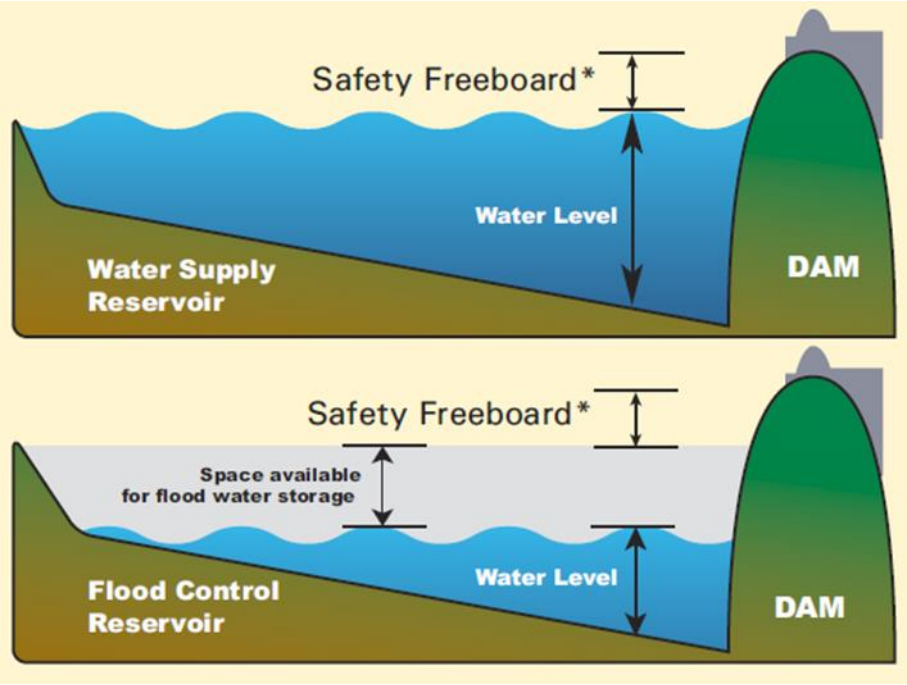
COE Release Schedule

PROJECT	ELEVATIONS	% FLOOD STORAGE	CLEAR FK TRINITY R.	WEST FK TRINITY R.	WEST FK TRINITY R.	MOUNTAIN CREEK	DENTON CREEK	ELM FORK TRINITY R.	ELM FORK TRINITY R.	TRINITY RIVER	EAST FK TRINITY R.	TRINITY RIVER	RICHLAND CREEK	WAXAHACHIE CREEK	CHANMBERS CREEK	LONG LAKE
Location			FWHT2	Ft Worth FWOT2	Grand Prairie GPRT2	Grand Prairie GPAT2		Above Lewisville Lake	Carrollton CART2	Dallas DALT2	Crandall CNLT2	Rosser RSRT2	Dawson DWST2	Bardwell BRDT2	Rice RCET2	LOLT2
Benbrook BNBT2	694.0 - 696.0	0 - 10	600		6000					13000		15000				24000
	696.0 - 697.1	10 - 16		3000	6000					13000		15000				24000
	697.1 - 710.0	16 - 100			6000					13000		15000				24000
Joe Pool JPLT2	522.0 - 524.0	0 - 10			6000	1000				13000		15000				24000
	524.0 - 536.0	10 - 100				4000				13000		15000				24000
										13000		15000				24000
Ray Roberts RRLT2	632.5 - 633.5	0 - 11						2000	4000	13000		15000				24000
	633.5 - 636.0	11 - 41						4000	5500	13000		15000				24000
	636.0 - 640.5	41 - 100						6000	7000	13000		15000				24000
Lewisville LEWT2	522.0 - 523.0	0 - 10	1 days						4000	13000		15000				24000
	523.0 - 526.0	10 - 35							5500	13000		15000				24000
	526.0 - 532.0	35 - 100							7000	13000		15000				24000
Grapevine GPVT2	535.0 - 538.2	0 - 10					2000		4000	13000		15000				24000
	538.2 - 542.0	10 - 23					2000		5500	13000		15000				24000
	542.0 - 560.0	23 - 100					2000		7000	13000		15000				24000
Lavon LVNT2	492.0 - 503.5	0 - 100									8000	15000				24000
Navarro Mills DAWT2	424.5 - 427.3	0 - 10											1200			24000
	427.3 - 443.0	10 - 100											2000			24000
Bardwell BDWT2	421.0 - 423.3	0 - 10												600	4000	24000
	423.3 - 427.4	10 - 30												1200	4000	24000
	427.4 - 439.0	30 - 100												2000	4000	24000

Water Conservation Reservoir

Water Supply Reservoir

- Designed to stay near full
- Have very limited capacity to capture storm inflows
- Designed to pass inflows from storms (with some reduction in peak flow)
- Structurally, the gates must open gradually as lake rises
- Still reduces flooding downstream



Lake Livingston

WATER CONSERVATION RESERVOIR is responsible for the safe storage of water and providing drinking water to more than two million southeast Texans.

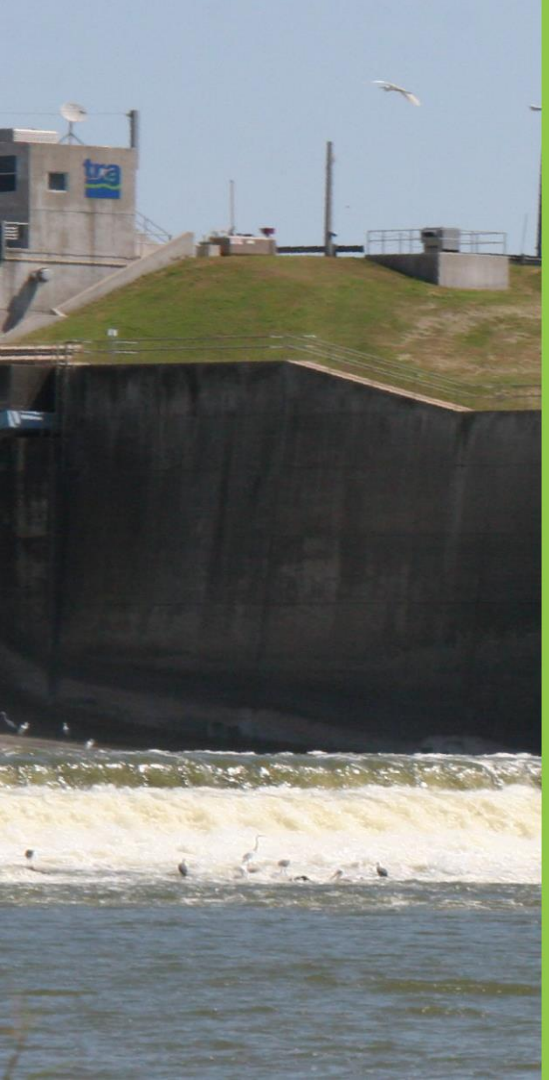
- 83,000 surface acres
- 1,750,000 acre feet
- More than 350,000 CFS spillway discharge capacity
- Conservation Pool – 131 MSL
- Flowage Easement –135 to 140 MSL

Gate Operations

- Manage outflow in order to mimic river flows
- Calculate releases adequate to keep pace with increasing inflows without causing sudden surges and without exceeding computed inflows until the peak inflow has been reached.
- Once reservoir elevation has peaked, excess inflow will be released from surcharge storage in an orderly fashion to reduce pool to conservation pool of 131 MSL.

Lake Livingston Emergency Action Plan

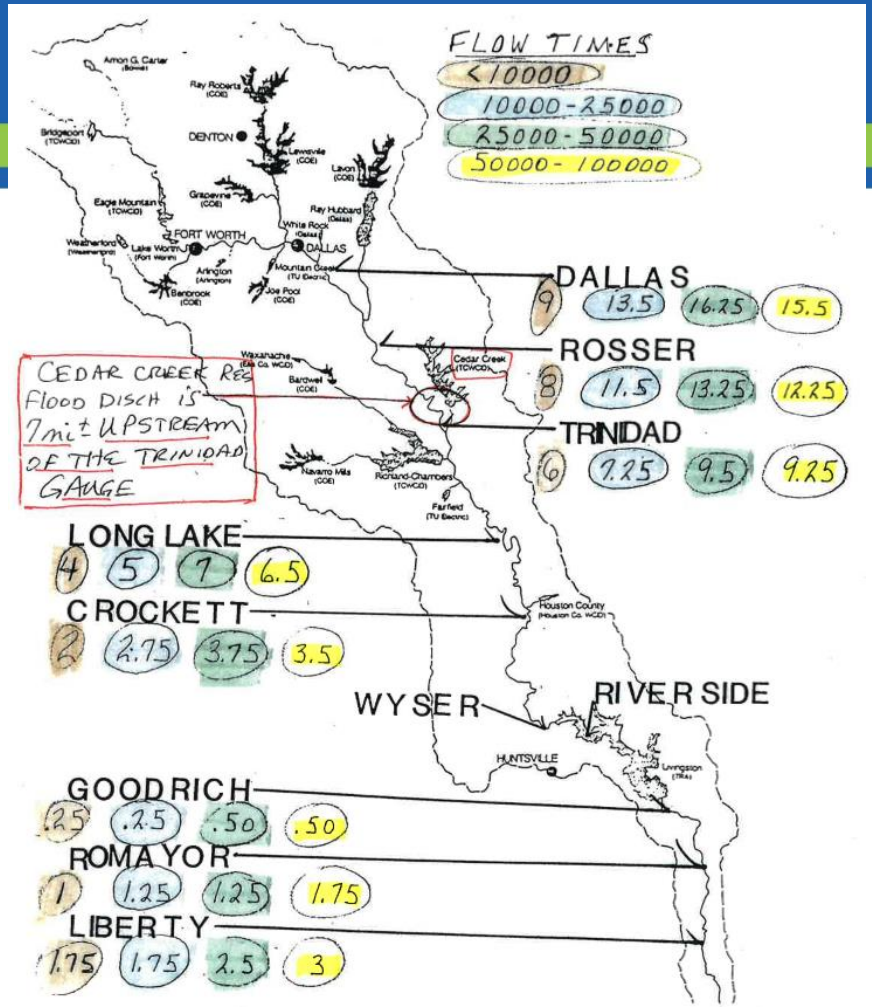
- Implemented at discharge of 20,000 cubic feet/second (CFS)
- Who do we contact?
  - ✓ Emergency Management Coordinator for Walker, Polk, San Jacinto, Trinity, Liberty and Chambers counties
  - ✓ NWS and WGRFC
  - ✓ DPS-Lufkin
  - ✓ Liberty radio
- Methods of notification
  - ✓ Phone
  - ✓ Email
  - ✓ Twitter



Hydrology and History of the Trinity River

Trinity River Travel Times

- Travel times are to/from Lake Livingston



Historic Flood Stages at Riverside

RANK	YEAR	STAGE
1	1942	142.61
2	1945	141.69
3	1957	139.61
4	1908	139.56
	1968	GATES AT DAM CLOSED
5	1990	139.08

Riverside 1942

No Two Floods Are The Same

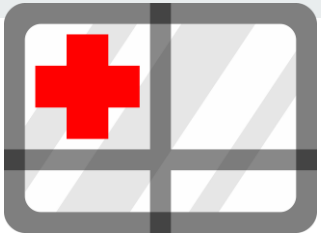
- What part of the watershed is the flood event originating?
  - Rain event in Dallas
  - Local Rain
- How much of the watershed was covered by precipitation?
- What are the current conditions?

- Link: http://lakedata.traweb.net/home.php
- Twitter Releases: @LivingstonDam

Flood Safety

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

Safety Before a Flood

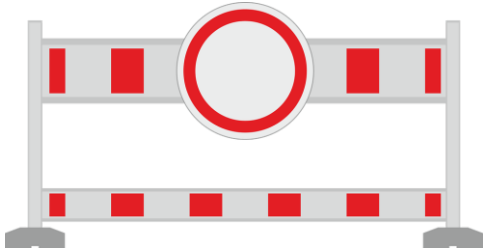


- Prepare a family disaster plan.
- Check if your insurance covers flood damages. If not, get flood insurance.
- Keep insurance and other important documents, such as copies of driver's licenses and credit cards, and other valuable items, in a safe place.
- Assemble a disaster supplies kit. Be sure to 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 Flood

- Monitor warnings and be prepared to take action.
- Have multiple ways to receive weather information.
- Turn around, don't drown!
- Stay away or be swept away. Flood waters will be moving swiftly and river banks/culverts can become unstable.
- Barricades are for your protection; do <u>not</u> drive around them!
- Do not sightsee!
- If evacuations are ongoing, don't get in the way of first responders.
- Stay out of the flood waters!



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.
- Be especially cautious when traveling at night .
- 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 After a Flood

- Stay away from damaged areas unless your assistance has been specifically requested by police, fire, or a relief organization.
- Return home only when authorities indicate it is safe.
- Use extreme caution when entering buildings; there may be hidden damage, particularly in foundations.
- Cut power to flooded areas of your home
- Only use generators in well-ventilated areas—never in a closed garage!

weather.gov/flood

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

Any Coastal 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

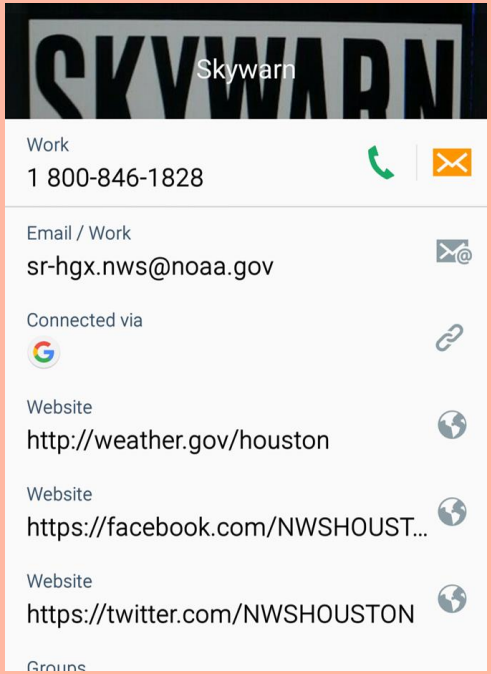
Call sign WX5HGX

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

Flood Risk?

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

Everyone is at a risk for flooding.

FEMA

Insurance Misconception

- **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.

- **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.

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

Flood Insurance Basics

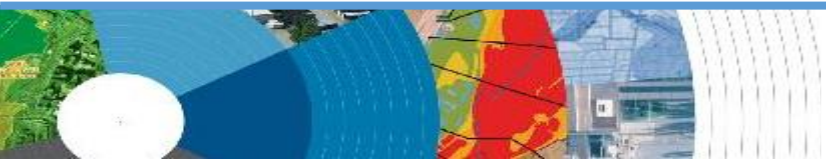
- **Brief definition of flooding – Any form of rising water in which 2 properties are affected.**
- **It doesn't have to be presidential declared event for a flood claim to be filed on a flood policy.**

Individual Flood Insurance

- **Structure Coverage**
  - Max coverage $250,000
  - Higher limits for commercial risk
- **Contents coverage**
  - Contents is an optional addition (except for Preferred Risk Policy)
  - Max coverage $100,000 coverage.
  - Renters can purchase flood insurance for contents.
- **Wait Period**
  - Typically - 30-days from purchase until effective.

Group Flood Insurance

- Available during a Presidential Declared event
- If qualified for a IA grant a GFIP will be purchased in the amount of $600
- Policy is good for 3 years
- Must maintain insurance on the property forever
- Max amount on the policy is 33,500 this includes structure and dwelling



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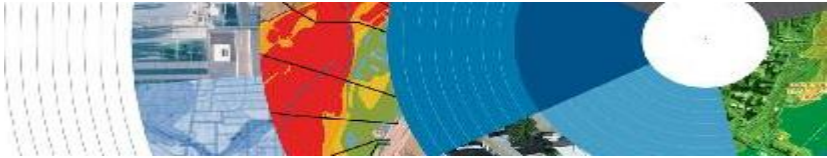
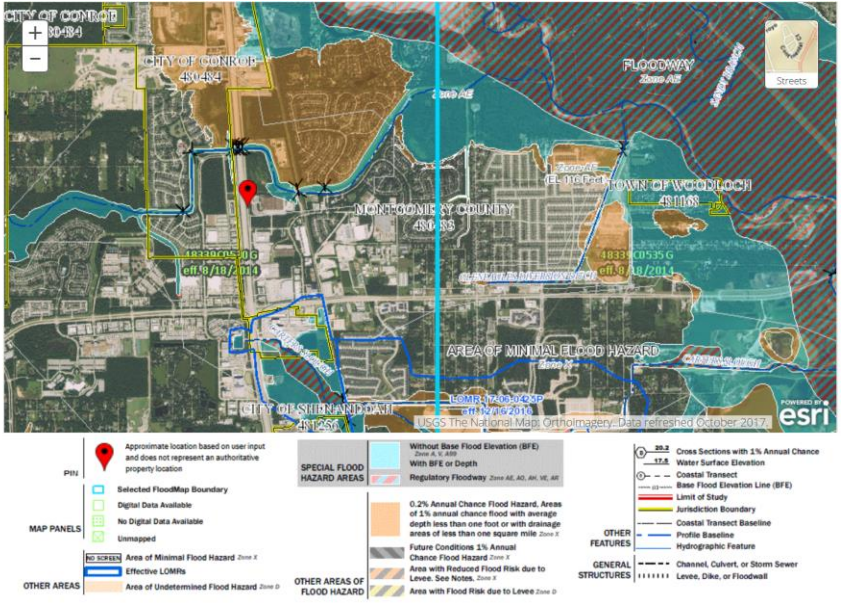
What is a FIRM?



Flood Insurance **Rate** Map

- Identifies the flood zones
- SFHA (high risk)
  - A, AE, AO, AH, VE, V etc. (Aqua)
    - 1% annual chance flood
- 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.
- Used for rating flood insurance policies
- Are subdivided by panels to cover jurisdictional boundary.
- Shows what the BFE within the zones
- FIRM's only show Costal and Riverine flood risk



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

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Structure Elevation Impact Insurance Rates

High Risk = $$$

Medium Risk = $$

Lower Risk = $

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.

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.
- Flood insurance allows individual property owners to manage their risk.
  - **Buy policies that cover the structure <u>AND</u> contents**.

FEMA

Contact Information

NFIP Hotline
1-800-427-4661
www.fema.gov/nfip

Angela Harrison, Insurance
Cell 470-557-2794 | Angela.Harrison@fema.dhs.gov

Yho-Meka Conway, Insurance
Cell 470-572-0803 | Yho-Meka.Conway@fema.dhs.gov

Lauren Schmied, PE, Floodplain Management
Cell 202-812-6164 | Lauren.Schmied@fema.dhs.gov

Gilbert Giron, ANFI, CFM, ACA
Senior Regional Insurance Specialist, FEMA Region 6
Phone: 940-898-5412 | Gilberty.giron@fema.dhs.gov

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Questions

National Weather Service
Trinity River Authority