

HOUSTON/GALVESTON National Weather Service

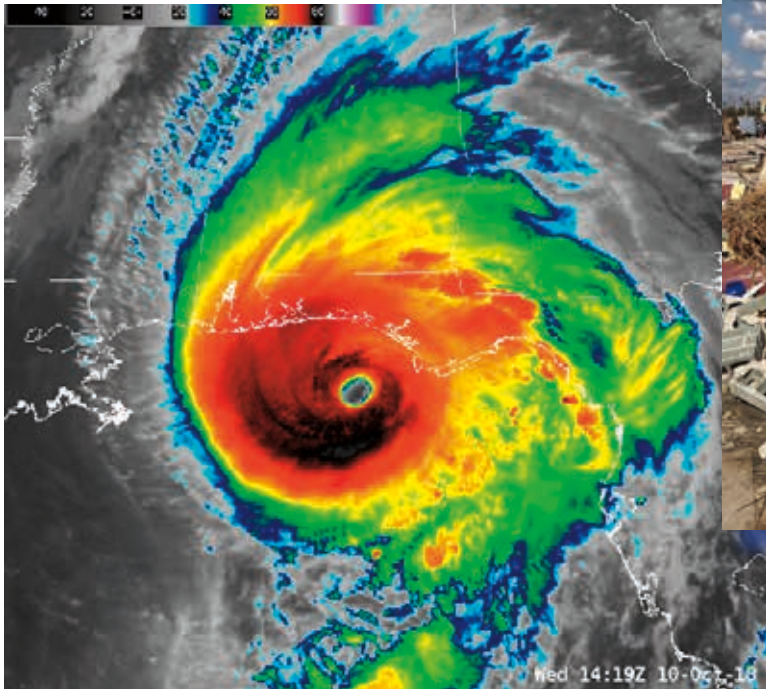
HURRICANE & SEVERE WEATHER GUIDE



*Tornado Damage, Houston Co., Apr 2019
Photo Credit: Dan Reilly*



Photo Credit: NOAA



Hurricane Michael: NOAA



*Damage from Hurricane Michael
Photo Credit: Jeff Lindner*

INTRODUCTION

Index of Pages

- **About the Hurricane**
Page 2
- **Storm Surge Flooding**
Page 3
- **Flooding from Heavy Rain**
Page 4
- **Zip Zone Evacuation**
Page 5 - 6
- **Damaging Winds and Tornadoes**
Page 7
- **Contacts and Disaster Supply Kit**
Page 8
- **Planning and Preparing**
Page 9 - 10
- **For Those Who Need Assistance**
Page 11
- **Preparing Pets and Livestock**
Page 12
- **Insurance Tips**
Page 13
- **Final Checklist**
Page 14
- **Hurricane Tracking Chart**
Page 15 - 16
- **Hurricane Forecast Resources**
Page 17
- **Review of 2019 Hurricane Season**
Page 18
- **Rapidly Intensifying Gulf Hurricanes**
Page 19 - 20
- **After the Storm**
Page 21 - 22
- **Flood Safety**
Pages 23
- **Tornado Safety**
Page 24
- **Other Thunderstorm Hazards**
Page 25
- **Weather Alerts to Cell Phone**
Page 26
- **Regional NWS Offices**
Page 27
- **EMC Contacts, Phone numbers**
Page 28 - 30

Severe thunderstorms can bring tornadoes, large hail, damaging winds, flooding rains and lightning. Hurricanes and tropical storms can bring many of the same hazards as well as storm surge flooding. This guide will cover how to prepare for different weather hazards and how to stay safe when facing them. There are numerous checklists on what to do before, during and after the storm. The guide contains contact information for your local emergency managers and numerous resources/links where to find information. In this years guide you'll also find an article on the dangers of rapidly intensifying Gulf hurricanes which can impact the area with relatively little notice. In recent years Michael (2018) and Harvey (2017) made landfall along the Gulf Coast as category-4 storms after a period of rapid intensification over just a few days time. These hurricanes make the point that the time for preparation is now. Don't wait until there is a storm in the Gulf. We hope you find this guide useful and will share the information with your family, friends and coworkers. An electronic version of this guide will be found on the National Weather Service Houston/Galveston Forecast Office web site weather.gov/houston and also at the Extreme Weather Expo page extremeweatherexpo.com. You are encouraged to place the link to the guide on your web site and/or share it out through email and social media.

Daniel Reilly
Warning Coordination Meteorologist
National Weather Service Houston/Galveston

ABOUT THE HURRICANE



Hurricanes Matthew and Nicole, 2016 Photo credit: NASA

A hurricane is the strongest type of tropical cyclone, a weather system that derives its energy from warm ocean waters and is characterized by a closed counterclockwise circulation in the Northern Hemisphere. It typically has a cluster of thunderstorms around the center of circulation and bands of thunderstorms spiraling outward. The tropical cyclone is called a tropical depression, tropical storm or hurricane depending on the strength of the maximum winds in the storm. The hurricane often has an eye, a rain free area in the center of the storm where the winds are very light. Every storm is different and contains some combination of the following hazards: damaging winds, storm surge flooding, tornadoes and flooding from heavy rainfall. The greatest chance of a hurricane landfall for Texas is during August and September although hurricanes have struck the Upper Texas coast during every month from June to October.

Definitions

TROPICAL DEPRESSION:
A tropical cyclone with maximum sustained winds of 38 mph or less.

TROPICAL STORM:
A tropical cyclone with maximum sustained winds between 39 and 73 mph.

HURRICANE:
An intense tropical cyclone with sustained winds of 74 mph or higher.

TROPICAL STORM WATCH/WARNING:
Tropical Storm force winds are possible/expected in the watch/warning area generally within 48/36 hours.

HURRICANE WATCH/WARNING:
Hurricane force winds are possible/expected within the watch/warning area within 48/36 hours.

STORM SURGE WATCH:
The possibility of life-threatening inundation from rising water moving inland from the shoreline (storm surge flooding) somewhere within the specified area, generally within 48 hours.

STORM SURGE WARNING:
The danger of life-threatening inundation from rising water moving inland from the shoreline (storm surge flooding) somewhere within the specified area, generally within 36 hours.

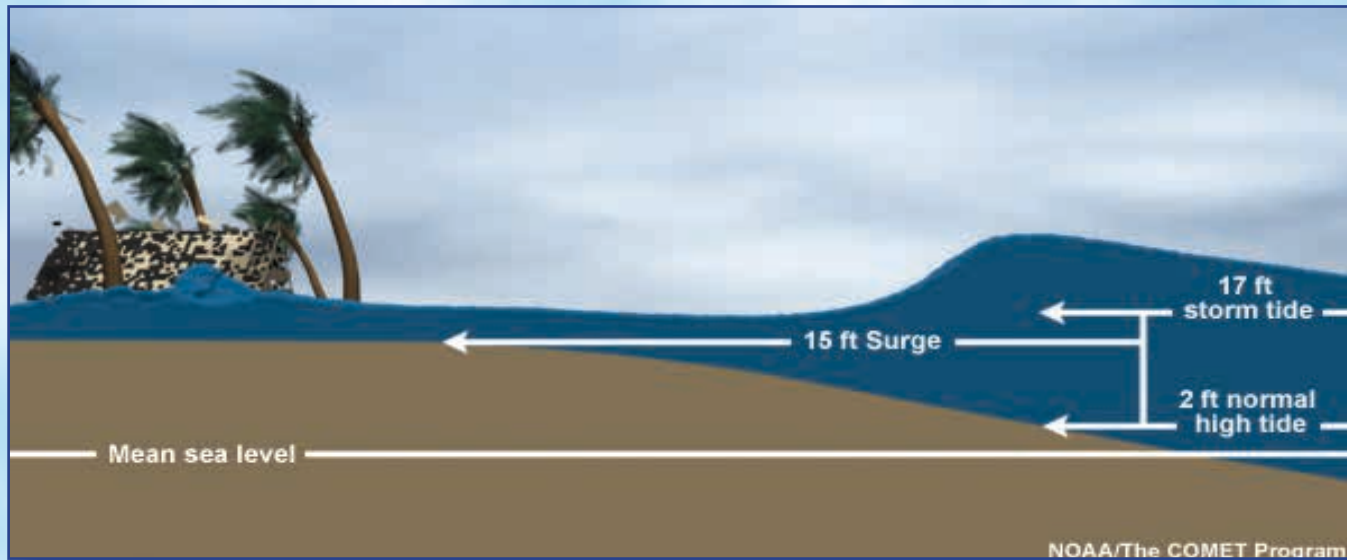
Saffir Simpson Hurricane Wind Scale

Category 1 - Winds	74 to 95 mph
Category 2 - Winds	96 to 110 mph
Category 3 - Winds	111 to 129 mph
Category 4 - Winds	130 to 156 mph
Category 5 - Winds	157 mph or higher

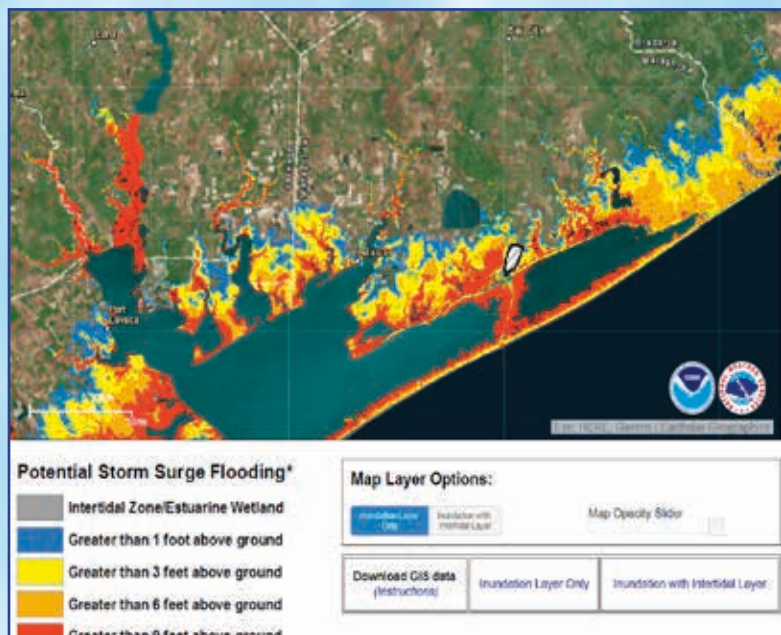
www.nhc.noaa.gov/prepare/wwa.php
www.nhc.noaa.gov/experimental/surgewarning
www.nhc.noaa.gov/aboutshws.php

Storm Surge Flooding

Storm surge is the abnormal rise of water generated by a storm, over and above the predicted astronomical tides. The storm tide is the height of water relative to a reference level or datum that includes storm surge and astronomical tide. The combination of storm surge flooding—and battering waves can be very destructive as seen with Hurricanes Ike (2008), Carla (1961), the 1900 Galveston Hurricane and many others.



When a hurricane or strong tropical storm approaches, the National Weather Service (NWS) will produce two maps to convey the storm surge flood threat. The first is the storm surge watch and warning map showing areas at risk for life threatening surge (see page 2 for watch/warning definitions). The other type of map, referred to shows the **reasonable worst case scenario** for depth of water above ground due to storm surge flooding for a given storm. The following are examples from Harvey in 2017.

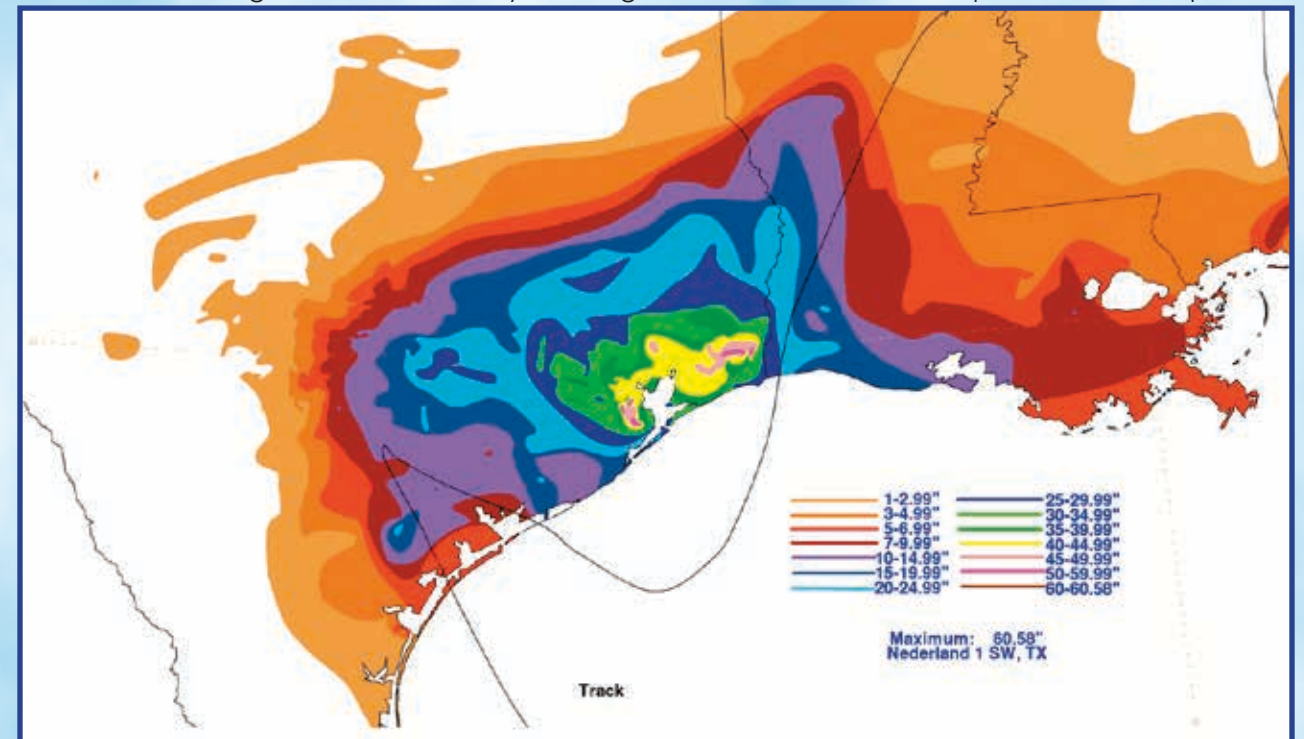


For more information on these storm surge related maps refer to the following links:
<https://www.nhc.noaa.gov/experimental/surgewarning>
<https://www.nhc.noaa.gov/surge/inundation>

Flooding from Heavy Rain

Flooding from Heavy Rain

There are numerous examples of significant flooding caused by slow moving hurricanes and tropical storms in Texas. Harvey in 2017 and Allison in 2001 are two recent examples. Extreme rainfall totals and rain rates in some cases over 4,5 or even 6 inches per hour produced devastating flooding in these cases. The figure below shows the amount of rainfall from Harvey and it's slow looping track. While the rainfall and associated flooding with Allison was extreme, the maximum rainfall and area covered was much greater with Harvey leading to even more catastrophic and widespread flooding.



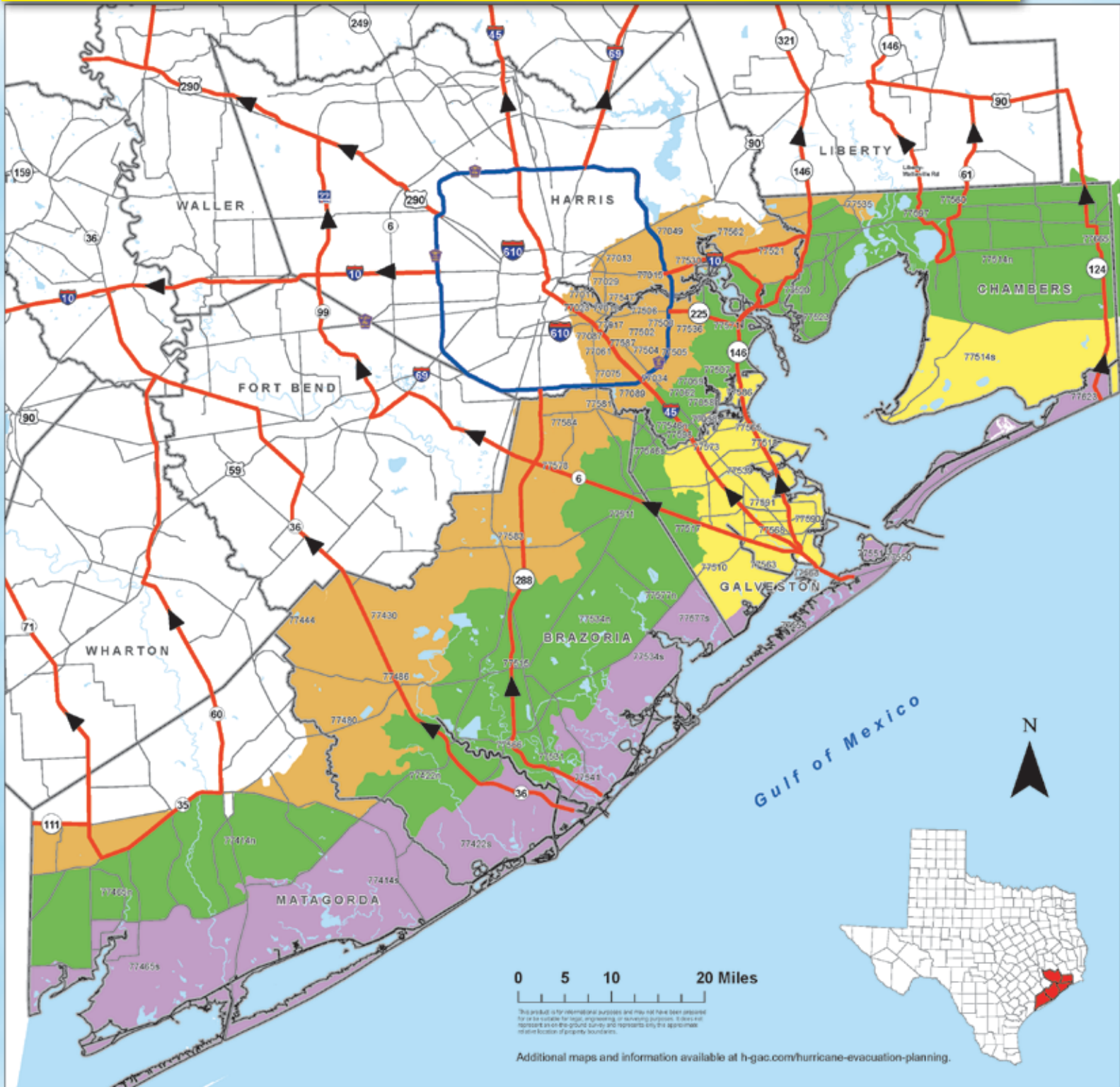
Tips to Prepare for Flooding

- Protect Your Personal Documents and Special Items
 - Store in plastic tubs with lockable tops on high shelves or in the attic
 - Consider storing critical documents in a safe deposit box if in a flood prone area
- Buy flood insurance even if not in the 100 year flood plain! Your homeowners policy will not cover your flood loss. A separate policy is needed through the National Flood Insurance Program (NFIP). For more information go to www.floodsmart.gov
- Know your risk. Is your home, business or school in a flood plain? Where is water likely to collect on the roadways you most often travel? What is the fastest way to get to higher ground?
- Most of the time it is safer to stay put than get on the roads. Is that true where you live? Knowing the answers to these questions ahead of time can save your life. Flood plain maps can be accessed here: <https://msc.fema.gov/portal>
- Never attempt to drive on flooded roads. If you encounter flood waters when driving, Turn Around, Don't Drown! Most flash flood fatalities occur in vehicles.
<http://www.weather.gov/tadd>



Additional flood safety information can be found on page 23

Zip Zone Evacuation



Brazoria, Chambers, Galveston, Harris, and Matagorda Hurricane Evacuation Zip-Zones Coastal, A, B, C

ZIP ZONE COASTAL				
77414s	77422s	77465s	77534s	77541
77550	77551	77554	77563	77577s
77623				
ZIP ZONE A				
77058s	77510	77514s	77518	77539
77563	77565	77568	77573	77586
77590	77591			
ZIP ZONE B				
77058n	77059	77062	77414n	77422n
77465n	77507	77511	77514n	77515
77517	77520	77523	77531	77534n
77546n	77546s	77580	77586	77571
77577n	77597	77598	77665	
ZIP ZONE C				
77011	77012	77013	77015	77017
77023	77029	77034	77049	77061
77075	77087	77089	77430	77444
77480	77486	77502	77503	77504
77505	77506	77521	77530	77535
77536	77547	77562	77578	77581
77583	77584	77587		

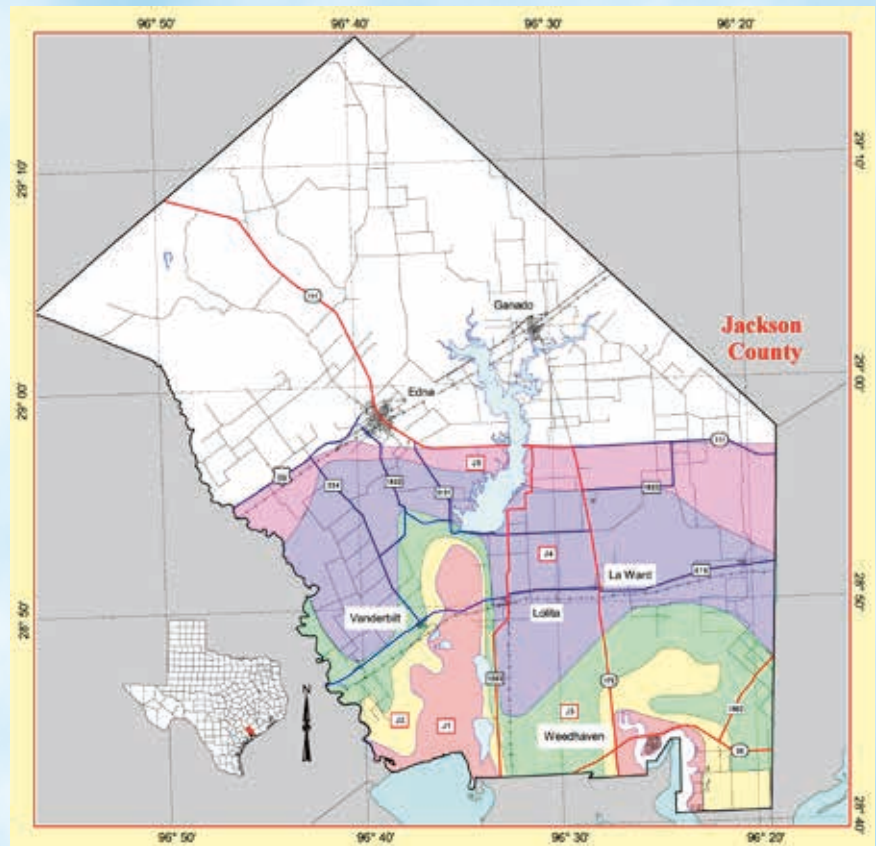
Some zip codes are split into north (n) and south (s) for evacuation purposes.

- ### Route Designation
- Evacuation Corridors (Red line with arrow)
 - Evacuation Connections (Blue line)
 - Other Roads (Grey line)
 - County Boundary (Dashed line)

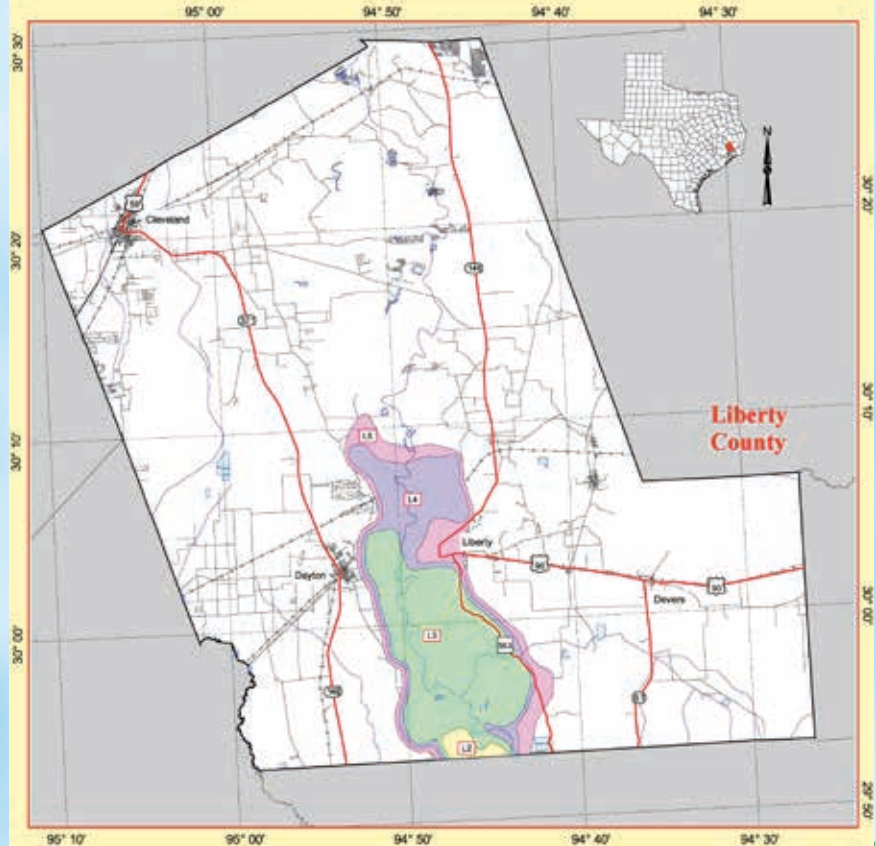


Revision Date: March 18, 2019
 Expiration Date: December 31, 2019
 Map Created by:
 Houston-Galveston Area Council

ZipZone evacuation zones roughly correspond to the following hurricane categories. However because surge depends on more than category, this is not always the case. Hurricane Ike was a category 2 but had a surge more like a typical 3 or a 4: Coastal-cat 1; Zone A-cat 1 or 2; Zone B-cat 3; Zone C-cat 4,5.



Different colors/zones roughly correspond to surge flooding for different hurricane categories (J1 corresponds to cat 1, etc). However because surge depends on more than category, this is not always the case.



Damaging Winds and Tornadoes



Above: Wind damage to home from Hurricane Alicia in August 1983.

Hurricane force winds of 74 mph or more can destroy buildings, mobile homes, trees and power poles. Debris such as signs, roofing material, siding, and small items left outside become flying missiles in a hurricane. The strongest winds occur in a region of the hurricane called the eyewall. Wind gusts in the right side of the eyewall are the most destructive. Hurricane force wind gusts can be felt well inland, far from the coast, especially for stronger fast moving hurricanes.

It is imperative to ensure your home or business is well constructed to minimize the damage from the wind. See the Planning and Preparing section in this guide for cost effective home improvement tips that can help you reduce your damage from a hurricane.

MOBILE HOME RESIDENTS MUST EVACUATE!

- No mobile home or manufactured home - no matter how new it is - can provide safe shelter from hurricane force winds.
- Straps or other tie-downs **will not** protect a mobile home from the high winds associated with a hurricane.
- Mobile home residents **must evacuate** when told to do so by local authorities.



Tornadoes

Tropical cyclones can also produce tornadoes which most often occur in thunderstorms embedded in outer rain bands on the right hand side of the track, away from the center of the hurricane. They can also occur in the eyewall. Tornadoes produced by tropical cyclones are usually relatively weak and short-lived but not always. A tornado that developed in Hurricane Carla's outer bands killed 6 in Galveston in 1961. Twenty-three tornadoes were confirmed with Harvey, all forming in the outerrainbands on the right side of the storm.



More information on tornado safety can be found on page 24

Contacts and Disaster Supply Kit

The Greater Houston Area Chapter of the American Red Cross recommends that you have the following items in your Hurricane Supply Kit. Do not forget to have a family meeting before hurricane season and review your communication information and evacuation plan. Make sure the contact information such as home, work, school, cell phone numbers, and your "Out of Town" contact person's information is current.



Emergency Contact Information

Out of Town Contact Address: _____

Out of Town Contact Phone Number: _____

Work Telephone Number: _____

Cell Number/Spouse Cell Number: _____

Children Cell Number: _____

School Telephone Number: _____

Doctor Telephone Number: _____

Bank/Credit Card Telephone Number: _____

Insurance Company Information: _____

HURRICANE SUPPLY KIT

- At least a 7-day supply of non-perishable food and a manual can opener
- At least a 7-day supply of water. One gallon per person per day is recommended
- Battery powered portable television or radio with extra batteries
- Flashlight with extra batteries
- First Aid kit and manual
- Sanitation and hygiene items such as instant hand sanitizing gel, moist towelettes, toilet paper, and feminine hygiene products
- Matches in a waterproof container
- Whistle
- Kitchen accessories and cooking utensils
- Cash
- Extra clothing, blankets, and sleeping bags
- Photocopies of identification, insurance, prescriptions, household inventory, credit cards, and your latest utility bill
- CD or photocopies of important documents such as birth/marriage certificates and titles
- Prescription medications, eyeglasses, contact lens solution, and hearing aid batteries
- Formula, baby food, diapers, and pacifiers
- Pet carriers, leashes, shot records, and food for each animal evacuating with you
- A good map showing county roads and highways
- Tire repair kit, booster cables, pump, and flares
- White distress flag
- Toys and games for children
- List of family phone numbers and addresses outside the area

Planning and Preparing

Preparing Your Home Before the Storm

Proper hurricane preparations made ahead of time will not completely protect your property from damage. However, following a few simple tips may greatly reduce the damage to your home and property.



Important Home Preparation Tips

Elevation Matters

- Know the elevation of your home! Are you in a surge, flood and/or evacuation zone?

Mobile Homes

- Check tie-downs for rust or breakage.
- Residents of mobile homes *must evacuate* when told to do so!

Landscaping

- Trim trees, shrubbery and dead limbs, especially ones close to your home.
- Repair or replace broken or damaged fences.
- Shredded bark is preferred instead of small gravel or stone bedding.

Roofing

- Inspect the roof for loose tiles, shingles or debris. Consider replacing old or damaged shingles with new ones rated for hurricane force winds.
- Check for and/or install hurricane clips to secure roof trusses to side walls.
- Clear loose and clogged rain gutters and downspouts.

Doors

- Reinforce garage doors and tracks or replace with a hurricane tested door. (See above image)
- Reinforce double entry doors with heavy duty foot and head bolts.
- Use a security dead bolt with a one inch minimum bolt length.
- Doors may be shuttered, but one entry must be left easily accessible.

Windows

- If possible, install tested/manufactured hurricane shutters.
- Inspect existing shutters to ensure they are in good working order.
- Alternative: Use 5/8" or greater exterior grade plywood secured by 2 1/2" screws and/or special clips.
- Obtain wood and fasteners, cut wood to size, pre-drill holes and place anchors on homes.
- Store shutters or plywood lying flat to avoid warping when not in use.

Planning and Preparing

Business and Employee Preparation



Tips for Businesses



- Establish a temporary location for business operations in case your facility is damaged.
- Give employees enough time to secure their homes and families.
- Consider paying employees before they leave to prepare their homes.

- Identify and protect vital records. Backup and store key files off site.
- Protect electronic equipment from possible water damage.
- Have extra cash and blank checks in case extra money is needed after the storm.
- Identify a safe room for employees who must remain in the building.
- Develop a 24-hour emergency contact list with phone numbers of key employees.
- Set up telephone numbers for employees to check in and receive company information.

Protecting Your Boat - Marine Preparations



Tips for Boat Owners

- Check your marina contract for policies and procedures for hurricanes.
- Check with the manufacturer for proper ways to secure your boat during a storm.
- Consider moving arrangements well in advance of an approaching storm.
- Trailer boats should be removed from the water and securely stored at least 48 hours before a hurricane is expected to make landfall.
- Purchase necessary hurricane materials such as additional mooring lines, crew anchors, fenders, fender boards, chafing gear, and anchors.
- Safe storm moorings should consist of good condition ropes of sufficient diameter and length, with at least three or four substantial anchor points.
- Do not moor parallel to bank. Receding tides often capsize boats in this type of anchorage.

<https://www.fema.gov/what-do-if-your-business-or-farm-was-damaged>

For Those Needing Assistance

Preparations for People with Medical, Functional or Access Needs



FEMA News Photo

If you or someone you know have medical, functional or access needs, such as impaired vision, hearing loss, or limited mobility, it is important to make sure there is a support structure in place to help that person respond to a hurricane threat. Such individuals can often benefit from a caretaker or "hurricane helper," someone who can look out for that individual and ensure they have the necessary resources to evacuate and/or shelter when the storm threatens. For more information: www.togetheragainstheweather.com



Important Tips

- Identify things you need every day such as food, medicines, water and other items you may rely on such as a walker, oxygen tanks or medical equipment. Start building up a supply before the hurricane season of non-perishable food items, bottled water, medicines, etc. that can be used in the event you lose power and/or water supply. Have at least two weeks' supply of food and water, and 1 month supply of medications. If you have vital medical equipment that you rely on that requires power, be sure to have a back-up source of power such as a battery or generator.
- Store important documents in a plastic bag such as prescriptions, emergency contact information for family and doctor, insurance cards, identification etc.
- If evacuation is necessary, identify where you will evacuate to, who you will stay with and how you will get there. If you cannot drive, make sure you have someone designated who will drive you where you need to go in advance of the hurricane. Make sure your transportation can accommodate any equipment or other supplies that need to be taken with you.

State of Texas

Emergency Assistance Registry (STEAR) - Dial 211

If you will need help evacuating from a hurricane or any other hazard, dial 2-1-1 to register in advance. You will be asked a series of questions which will allow emergency managers to identify those who need extra assistance evacuating. It is necessary to do this each calendar year. There is also an option to register online.

The City of Galveston has a separate "need a ride" number for their residents which is 409-797-3701. Once you register contact your emergency management office (pp.28-30) for more information on what type of assistance will be offered in your jurisdiction.

STEAR.dps.texas.gov

www.txdps.state.tx.us/dem/stear/public.htm

www.galvestontx.gov/561/Need-A-Ride-Program



Preparing Pets and Livestock

Preparing for Your Pet's Safety

Your pet should be part of your overall hurricane preparation plans. Below are a few important things to help you prepare:

- Make sure your pet's vaccinations are current and have proof they are current. **DO NOT** assume that a public shelter or hotel will accept your pet.
- Be sure to have a current photo of your pet.
- Each animal should have a properly sized pet carrier. The carrier should be large enough for the animal to stand up and turn around.
- Make sure your pet has a proper ID collar.
- Pack enough food and bottled water for the duration of your evacuation. **DO NOT** let your pet eat food or drink water from outside that may have become contaminated.
- Be sure to pack all medications your pet may need along with a muzzle, collar, leash, paper towels, and trash bags.



Preparations for Livestock



- Ensure all animals have some form of visible identification.
- Evacuate animals whenever possible. Arrangements for evacuation, including routes and host sites, should be made in advance.
- The evacuation sites should have or be able to readily obtain food, water, veterinary care, handling equipment and facilities.
- Obtain vehicles and trailers needed for transporting each type of animal. Also make available experienced handlers and drivers.
- If evacuation is not possible, a decision must be made whether to move large animals to available shelter or turn them outside. This decision should be determined based on soundness and location of the shelter (structure).
- When necessary, move livestock to higher ground and deny access to flood prone pastures, barns, and other structures.
- It is important that livestock have plenty of food and clean water.

<https://www.aspc.org/pet-care/general-pet-care/disaster-preparedness>

<https://www.ready.gov/animals>

Insurance Tips

Insurance Tips - Before the Storm

- Keep a written inventory of your possessions. Take photos or videotape of each room and the exterior of your home to keep with your inventory.
- Gather important documents and insurance cards and policies. Unless they are stored in a safe place, take them with you if you evacuate along with an inventory of your possessions, including receipts and photos or videos.
- Know what your policy covers. Check your auto policy to see if you have comprehensive coverage "other than collision." Comprehensive coverage pays if a storm, fire, or flood damages your car. Find out how much coverage you have for "additional living expenses" to cover lodging, food, and other expenses if you're forced to vacate your residence after suffering a covered loss.
- Know your policy limits. Your limits may be too low if replacement costs have risen because of new additions, improvements, or inflation.
- Review your health coverage. Find out if you'll be able to receive non-emergency care from out-of-network providers, if needed, without accruing additional out-of-pocket costs.
- Consider renters insurance if you don't have it. If you rent an apartment, duplex, house, or townhouse, you may need renters insurance to protect your belongings.
- Consider purchasing flood, wind and hail coverage. You may have to buy separate policies to cover wind, hail, and flood damage. Homeowners, farm and ranch, renters, windstorm, and condominium policies do not cover damage from rising waters.

National Flood Insurance Program (NFIP)

Homeowners and commercial property policies specifically exclude coverage for damage from flooding from rising waters. To protect yourself from losses caused by most flooding, you'll need to purchase a separate flood insurance policy from the National Flood Insurance Program (NFIP). For more information about flood insurance, contact the NFIP 1-800-427-4661. www.floodsmart.gov

Texas Windstorm Insurance Association (TWIA)

If your property is located in one of Texas' 14 coastal counties, or parts of southeastern Harris County, you will likely only be able to obtain insurance coverage for windstorm or hail damage from a special insurance pool called the Texas Windstorm Insurance Association (TWIA.) To qualify for TWIA coverage, your property must pass a windstorm inspection and must meet certain windstorm-resistant building standards. You cannot buy or change TWIA coverage once a hurricane has entered the Gulf of Mexico. For more information about windstorm coverage call TWIA or visit its website 1-800-788-8247. www.twia.org

Insurance Tips - After the Storm

Contact your insurance agent or company promptly. Keep a record of all contacts you have with your company. Be prepared to answer questions about the extent and severity of the damage.

If your home is not insured, contact your local Red Cross or FEMA Disaster Recovery Center for assistance. Call FEMA at 1-800-621-FEMA (3362).

Make a list of your damaged property. Photograph or videotape the damage if possible. Don't throw away damaged items until your insurance adjuster has had a chance to view them.

If there is partial damage to your home, take reasonable and necessary repairs to protect your home and property from further damage. Cover broken windows and holes to keep rain out. Don't make permanent repairs until instructed by your insurance company. Keep a record of your repair expenses and save all receipts.

Final Checklist

Actions to Take When a Storm is in the Gulf

- Listen frequently to radio, TV, or NOAA weather radio for bulletins and forecasts of the storm's progress.
- Double check items in your emergency supply kit.
- Fuel and service your vehicles.
- Inspect and secure mobile home tie-downs.
- Make sure you have supplies to survive on your own for at least one week if you plan on staying.
- Board up windows (if shutters do not exist) in case storm moves quickly and you have to leave. **TAPE PROVIDES NO PROTECTION!**
- Store lawn furniture and other loose, light weight objects, such as garbage cans and garden tools.
- Get plenty of extra cash in case power goes out and ATMs do not work.
- Garage or store vehicles that are not being used.
- Follow instructions issued by local officials. **EVACUATE IMMEDIATELY IF ORDERED TO DO SO!**

Final Actions to Take if Leaving

- Turn off propane tanks.
- Unplug small appliances.
- Turn refrigerator and freezer to lowest setting.
- Turn off utilities if ordered to do so.
- Notify family members of your evacuation plans.
- Lower water level in swimming pool by at least one foot.
- Lock home securely.
- Board up remaining doors and brace garage door.
- Take pets with you.

Final Actions to Take if Staying

- Close storm shutters, if available.
- Turn refrigerator or freezer to coldest setting and open only if necessary. (25 pounds of dry ice will keep a 10-cubic foot freezer below freezing for 3-4 days.)
- Follow instructions from emergency managers and be prepared to turn off utilities if ordered to do so.
- Board up remaining doors, brace garage door, and remain inside. Stay away from boarded up windows.
- Beware of the calm winds in the eye of the storm and do not venture outside. Some of the strongest winds may occur shortly after the eye passes. **DO NOT EXPECT EMERGENCY RESPONDERS TO BE OF ANY ASSISTANCE DURING A LANDFALLING HURRICANE!**





ATLANTIC HURRICANE TRACKING CHART

Always remember

If you live along the coast or in a low-lying area, if you live in a mobile home in an area subject to hurricane water or wind, or if authorities tell you to... Go!

Storm Surge

A storm surge is a dome of water often 50 miles wide that comes sweeping across the coastline near the area where the eye of the hurricane makes landfall. The surge, aided by the hammering effect of breaking waves, acts like a giant bulldozer sweeping away everything in its path. Nine out of ten hurricane deaths are caused by storm surge. That's why it's important to leave well before a hurricane may come your way.

Wind Damage

Hurricane winds can cause significant damage to homes and businesses far from the shore. If you live in an area anywhere near the path of a hurricane, you should take steps to protect property from high winds. Bring in anything from outside that may become airborne in high winds, including toys, lawn chairs, trash cans, coconuts, etc. Cover all windows of your home. If shutters are not installed, use 3/4" marine plywood panels. Tape does not work, so it is not recommended. Remain inside until authorities tell you the danger has passed.

Other Hurricane Effects

Hurricanes can produce flooding far inland, especially if the storm "stalls" or produces a lot of rain. Also, tornadoes can form when hurricanes come on shore. Ask your American Red Cross, National Weather Service, or emergency management office what to do in case of a flood or tornado.

More Information

More information about hurricanes, protection from wind damage, floods, and tornadoes is available from your local American Red Cross chapter, National Weather Service Office, or emergency management agency.

2019 Hurricane Names

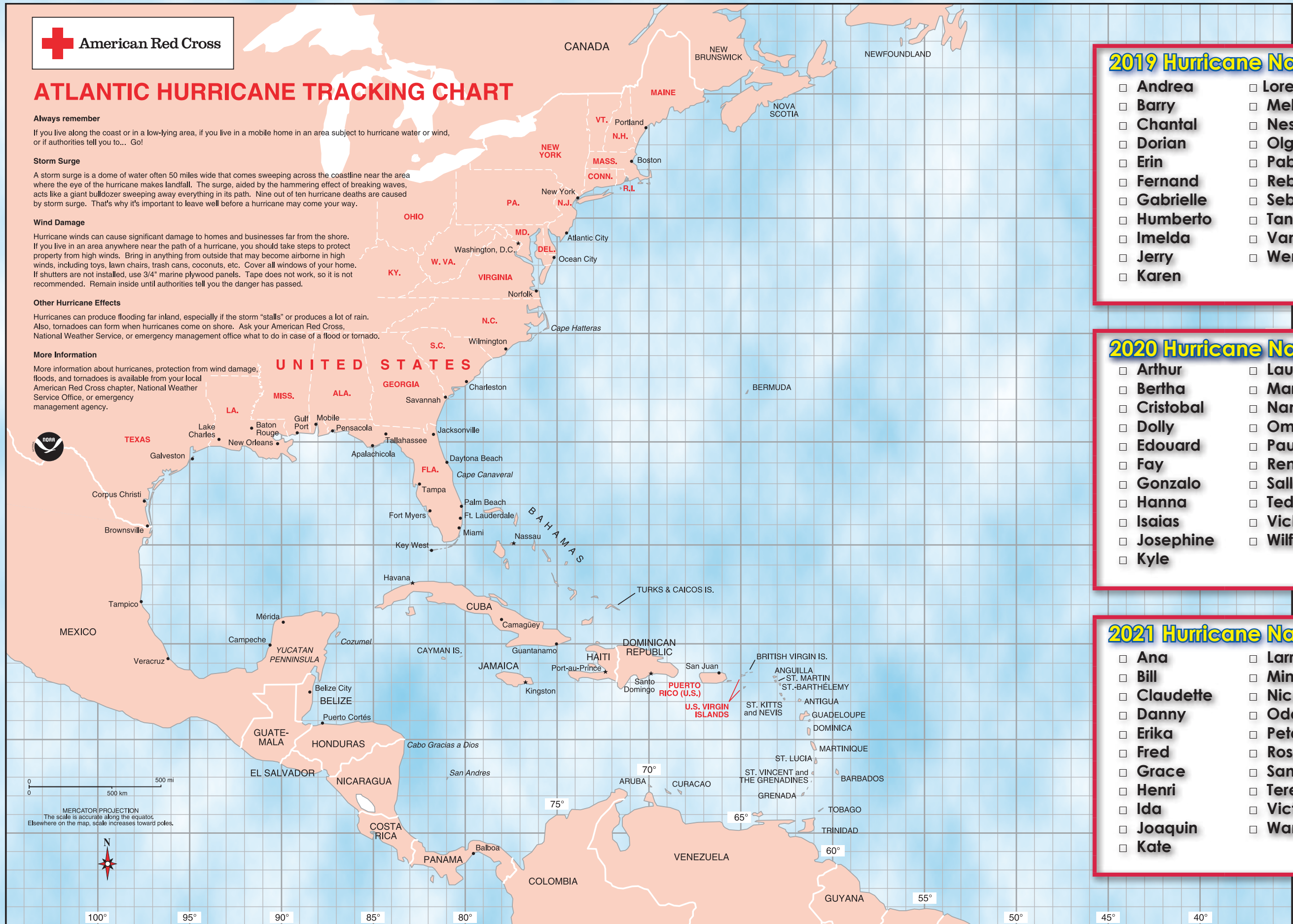
- Andrea
- Barry
- Chantal
- Dorian
- Erin
- Fernand
- Gabrielle
- Humberto
- Imelda
- Jerry
- Karen
- Lorenzo
- Melissa
- Nestor
- Olga
- Pablo
- Rebekah
- Sebastien
- Tanya
- Van
- Wendy

2020 Hurricane Names

- Arthur
- Bertha
- Cristobal
- Dolly
- Edouard
- Fay
- Gonzalo
- Hanna
- Isaias
- Josephine
- Kyle
- Laura
- Marco
- Nana
- Omar
- Paulette
- Rene
- Sally
- Teddy
- Vicky
- Wilfred

2021 Hurricane Names

- Ana
- Bill
- Claudette
- Danny
- Erika
- Fred
- Grace
- Henri
- Ida
- Joaquin
- Kate
- Larry
- Mindy
- Nicholas
- Odette
- Peter
- Rose
- Sam
- Teresa
- Victor
- Wanda



Hurricane Forecast Resources

The National Hurricane Center (NHC) in Miami, FL is the official source for tropical cyclone advisories and forecasts and is responsible for issuing tropical cyclone watches and warnings for the United States.

Weather Information
 National Weather Service
www.weather.gov/houston
 National Hurricane Center
www.hurricanes.gov



Graphical Tropical Weather Outlook

- Provides an overview of all tropical cyclone activity.
- Indicates areas of interest where tropical cyclones could develop over next 5 days. A percent chance that it will develop is assigned.
- Moving the cursor over the highlighted areas will provide a more detailed text description.

NHC Forecast Advisory

- Most recent position for a storm along with all coastline watches and warnings. Includes a 3 or 5 day track with error cone.
- Error cone represents a 5 year average error. The center of the storms only stays within the error cone 67% of the time.
- DO NOT focus too closely on the exact track forecast - the little black line. If you are in or near the cone, the center of the storm could head your way. Impacts are often felt well outside the cone.

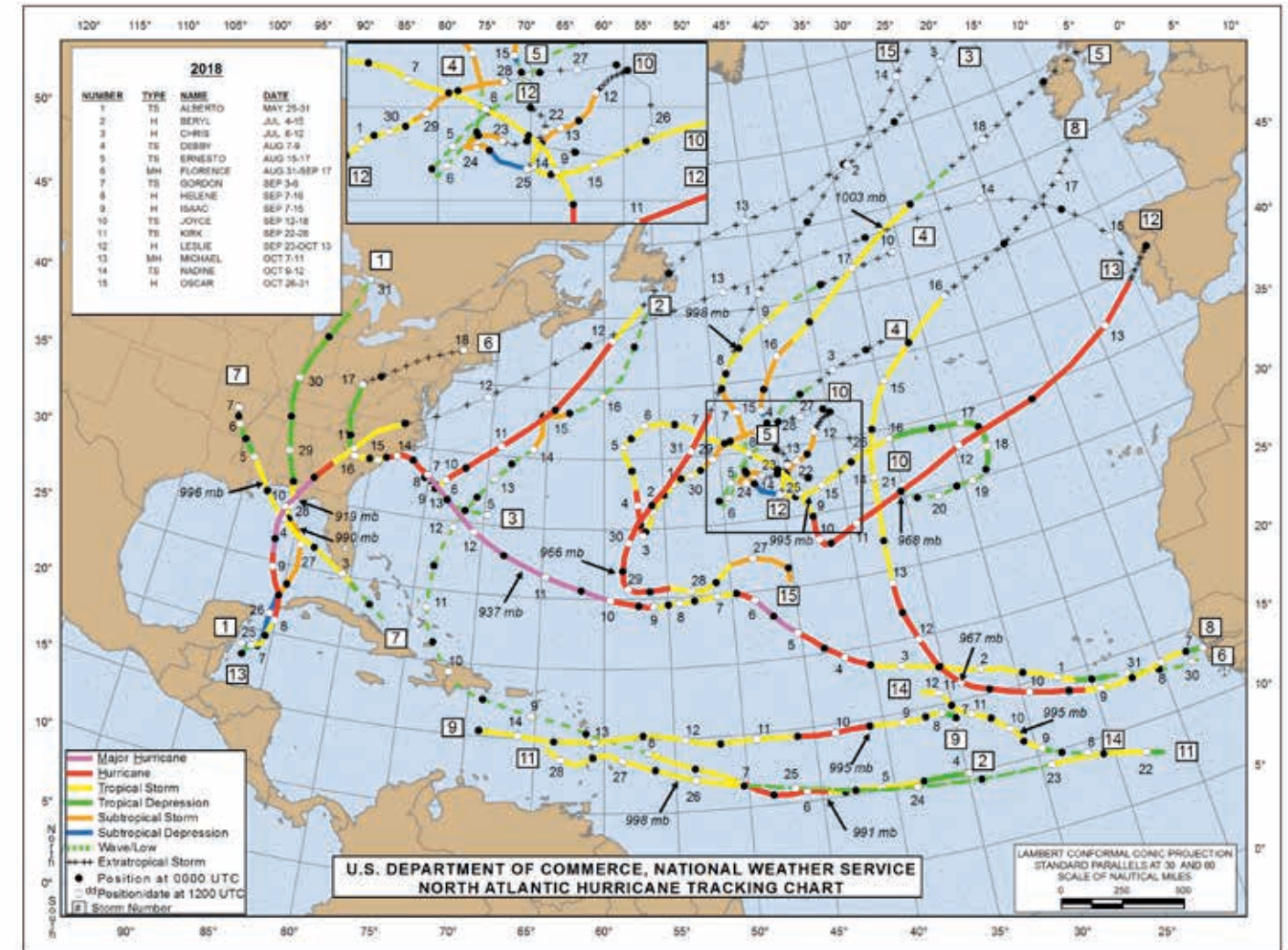
Tropical Storm Wind Time of Arrival Graphic

- Graphic shows estimated time of arrival of tropical storm force winds, both most likely time and earliest reasonable time.
- Designed to account for forecast uncertainty.
- May be useful for evacuation planning.

Potential Surge Inundation Graphic

- Issued by National Hurricane Center about 48 hours prior to impacts being felt at the coast.
- Shows reasonable worst case for the amount of flooding from ocean water surging over land. Data is plotted as depth of water above ground.
- Storm Surge watch/warning also may be issued.

Review of 2018 Hurricane Season



The 2018 Atlantic hurricane season was active with 15 named storms including 8 hurricanes of which 2 were major (category 3 or greater). This compares to the long term averages of 12 named storms, 6 hurricanes and 3 major. The most significant impacts to the United States were from Hurricanes Florence and Michael. Florence was a slow moving hurricane which dropped torrential rains and produced catastrophic flooding over the Carolinas. Hurricane Michael made landfall as a category 5 hurricane along the Florida Panhandle, the strongest hurricane on record to strike that region. Hurricane Michael is described in more detail on pages 19-20.

<https://www.noaa.gov/media-release/destructive-2018-atlantic-hurricane-season-draws-to-end>

Rapidly Intensifying Gulf Hurricanes: Need to Prepare Before the Season

In October 2018 Hurricane Michael struck the coast of the Florida Panhandle with 160 mph sustained winds making it just the 4th hurricane on record to make a U.S. landfall as a category 5 storm. It ranks only behind the Labor Day Hurricane of 1935, Camille in 1969 and Andrew in 1992 for maximum sustained winds at landfall. The destruction was devastating, especially in the Mexico Beach area which received the most intense winds in the eyewall region of the storm (figure 1). A combination of winds and surge produced mass devastation accounting for 49 deaths and 5.5 billion dollars in damage. Severe wind damage extended well inland following the track of the storm.

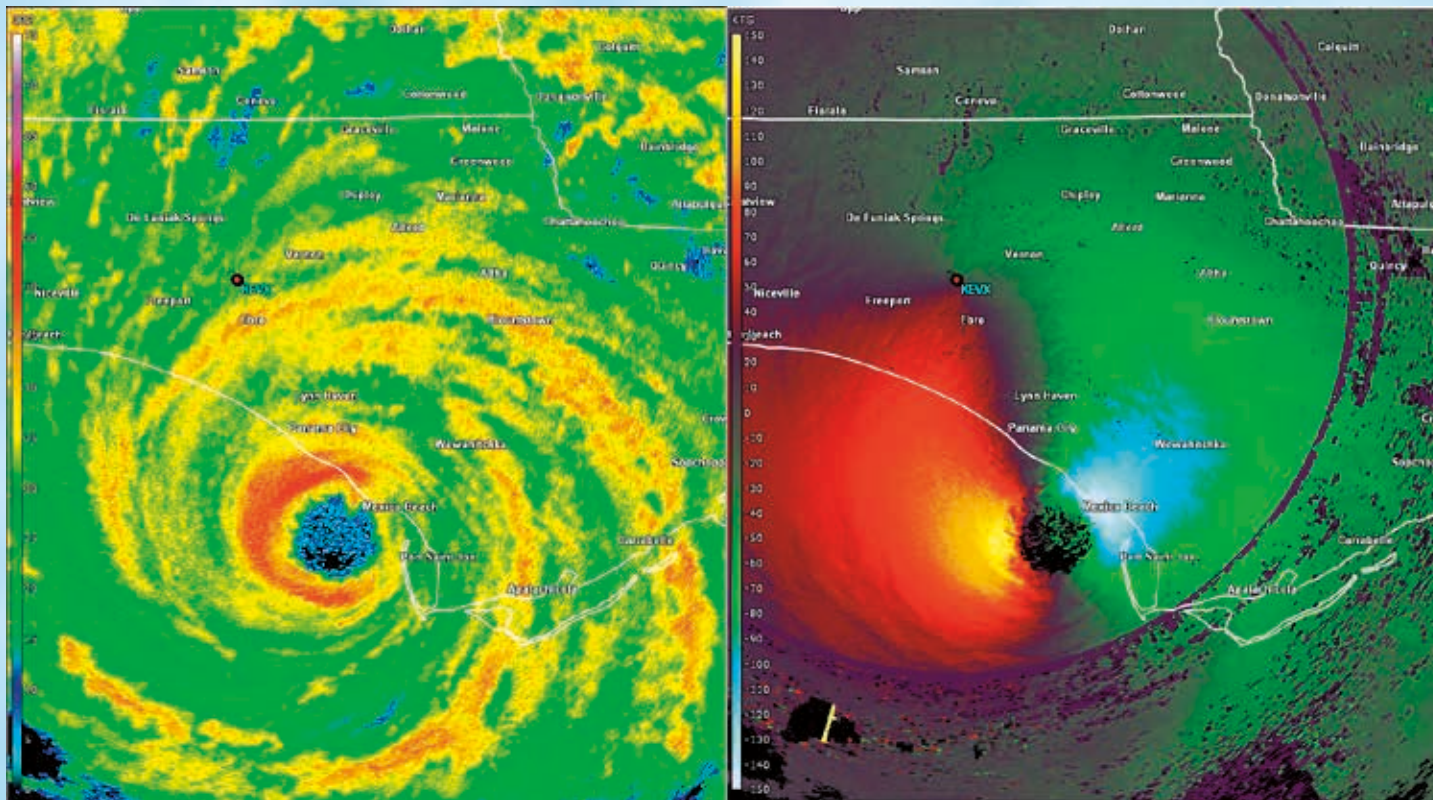


Figure 1. Base reflectivity and velocity as measured from EVX radar. Oct. 10th, 2018, 1254 pm EDT.

Michael reminds us that hurricanes which form and intensify over the Gulf of Mexico can strike coastal regions with devastating impacts as high-category, major hurricanes with only a few days notice. Michael strengthened rapidly as it lifted north across the eastern Gulf. It intensified from a 40-mph tropical storm to a 160-mph category 5 hurricane at landfall in just 3 days. Hurricane Harvey in 2017 strengthened even more rapidly from a minimal tropical storm to a category 4 hurricane at landfall in less than 48 hours (see figure 2). The main wind and surge impacts were felt along the Mid-Texas Coast close to where the center came ashore. The Houston-Galveston area was well removed from the significant wind impacts from Harvey but did experience extreme rainfall and flooding as the storm tracked slowly across the area.

Rapidly Intensifying Gulf Hurricanes: Need to Prepare Before the Season

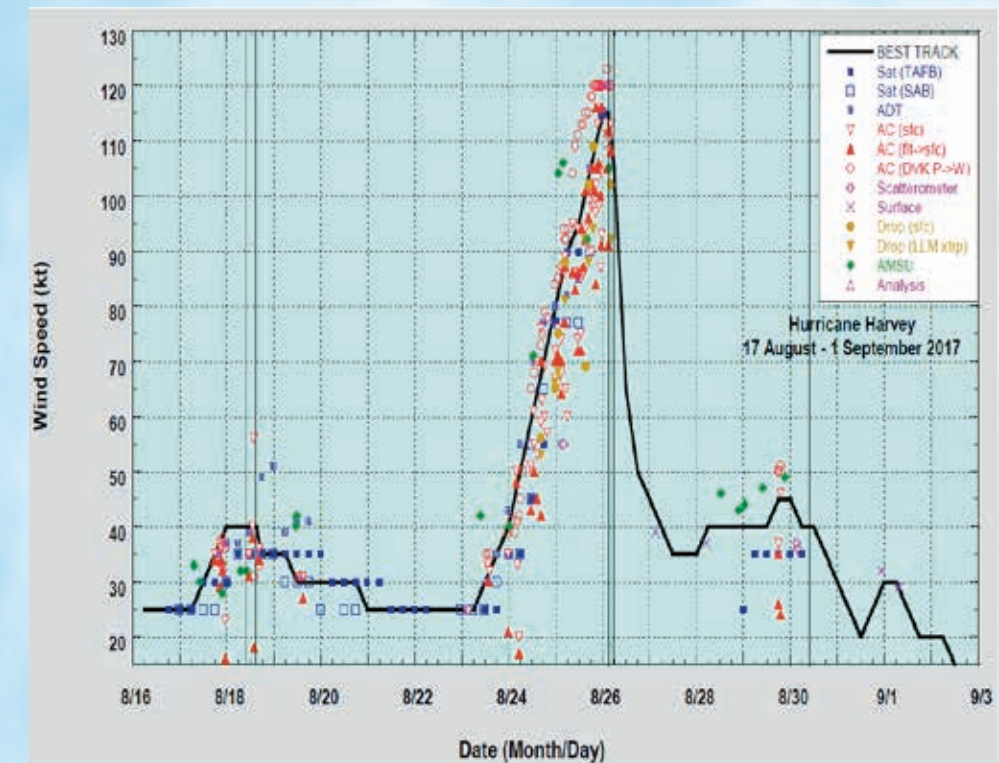


Figure 2. Maximum sustained wind speed for Harvey versus time. Note rapid intensification from 8/24 to 8/26. Source: National Hurricane Center.

In 1932 another rapidly intensifying Gulf storm struck Freeport area as a Category 4 within just a few days of formation. Hurricane Alicia in 1983 intensified from a tropical storm to a major category 3 storm hurricane in less than 48 hours before making landfall on the West End of Galveston Island. These past hurricanes show the need to prepare ahead of the hurricane season. By the time something starts to form in the Gulf it may be too late. Have a hurricane plan that includes where you would evacuate to (if necessary) and what you would take with you. Build your hurricane supply kit whether you plan to ride out the storm or leave. Detailed checklists on what to consider in your plan and what to include in your kit are found elsewhere in this guide.



Figure 3. Photo showing tree damage near Lake Seminole, Decatur County, GA (well inland of landfall). Photo credit: Jeffrey Evans.

After the Storm

- Listen to local officials for updates and instructions. Don't return until notified it is safe to do so. A list of emergency manager contacts is included in the back of this guide.
- Watch out for debris and downed power lines.
- Avoid walking or driving through flood waters. Just 6 inches of moving water can knock you down, and fast-moving water can sweep your vehicle away.
- Avoid flood water as it may be electrically charged from underground or downed power lines and may hide dangerous debris or places where the ground is washed away. Snakes, alligators, fire ants can also be found in and around flood waters.
- Photograph the damage to your property in order to assist in filing an insurance claim.
- Make sure to inspect your home after a hurricane. Do what you can to prevent further damage to your property, (e.g., putting a tarp on a damaged roof), as insurance may not cover additional damage that occurs after the storm.
- Continue listening to local news for updated information and instructions.
- Do not use water that could be contaminated to drink, wash dishes, brush teeth, prepare food, wash hands, make ice or make baby formula. Use only bottled, boiled or treated water until you know that the water is safe.



Photo Credit: FEMA

After the Storm



- Help people who require additional assistance—infants, elderly people, those without transportation, large families who may need additional help in an emergency situation, people with disabilities, and the people who care for them.
- Keep away from loose or dangling power lines. Report them immediately to the power company. Check for gas leaks. If you smell or hear gas leaking leave immediately and call the gas company or fire department.
- Wear protective clothing, including rubber gloves and rubber boots, and be cautious when cleaning up.
- DO NOT run generators indoors but only in well ventilated outdoor areas. Many deaths after the storm are due to carbon monoxide poisoning due to improper use of generators.
- Do not use open flames indoors. Be extremely cautious if using candles. Many fires have resulted post storm due to candles getting knocked over.
- Listen for instructions on debris clean up and pick up for your community. You may be instructed to sort the debris and put by curbside.
- If you suspect water and sewer lines are out do not use your plumbing (toilets, sinks, etc). Your toilet can be used by flushing until the bowl has no water. If you have filled your bath tub with water before the storm you can draw from this with a bucket and pour in the toilet to aid in flushing.
- If widespread sewer outages have occurred, instructions for disposal of human waste will be announced.

Flood Safety



Flash floods from heavy rains are the most dangerous hazard for Southeast Texas, especially inland from the coast. With the Gulf of Mexico providing abundant moisture, high rain rates are not uncommon, with greater than 4 inches per hour observed on occasion. When thunderstorms follow each other or “train” over one area, rainfall amounts of around a foot or more over a 12 hour period can occur. It is important to understand what actions to take to protect yourself from flash flooding hazards.

Flood Related Watches, Warnings, Advisories

- **Flash Flood Watch: Be Prepared, Stay Alert, Keep Watch.** A watch is issued when conditions are favorable for flash flooding but occurrence, timing, and location is still uncertain.
- **Flood Advisory: Be advised, be cautious.** A Flood Advisory is issued when flooding may cause significant inconvenience and if caution is not exercised, could lead to situations that may threaten life and/or property. Conditions are not quite as severe as with a warning.
- **Flash Flood Warning: Take Action!** A warning is issued when potentially life threatening flash flooding is imminent or occurring. A flash flood is a sudden violent flood that can develop quickly...within hours.

- **Flash Flood Emergency: Extreme Danger!** Rarely used. Reserved for rare cases of extreme danger to life and property from flash flooding, a historic event with an extreme threat to life and property.

During a Flood

- Avoid walking or driving through flood waters. Turn Around, Don't Drown! Just 6 inches of moving water can knock you down, and 2 feet of water can sweep your vehicle away. Most flash flood fatalities occur in vehicles.
- If floodwaters rise around your car, abandon the car immediately and move to higher ground. Best option is to get out through the windows. Force door open if necessary before becoming completely submerged.
- Avoid camping or parking along streams, rivers, and creeks during heavy rainfall. These areas can flood quickly and with little warning.
- If in a flood prone area from a nearby stream or creek you may be asked to evacuate and move to higher ground. Obey evacuation orders if given.
- Never drive around barricades.

After A Flood

- Return home only when authorities say it is safe.
- Be aware of areas where floodwaters have receded and watch out for debris, snakes, fire ants, alligators, etc. Floodwaters often erode roads and walkways.
- Do not attempt to drive through areas that are still flooded.
- Avoid standing water as it may be electrically charged from underground or downed power lines.
- Photograph damage to your property for insurance purposes.



www.floodsafety.noaa.gov
www.ready.gov/floods
www.redcross.org/get-help/prepare-for-emergencies/types-of-emergencies/flood

Tornado Safety

Tornadoes are fairly common in Southeast Texas. A tornado can strike very quickly with little warning. It's important to know what to do should a tornado approach so you can take quick protective action. First a few terms and then tips on what to do.

Tornado Watch - Conditions favor the development of tornadoes. Stay alert, be ready to act should a tornado threaten. Watch the sky and have a way to receive warnings (smart phone apps, NOAA Weather Radio, commercial radio or television).

Tornado Warning - A tornado has been sighted or indicated by weather radar. Take shelter immediately if in the warned area.

Tornado Emergency - Issued in exceedingly rare circumstances when there is a severe threat to human life and/or catastrophic damage is imminent or ongoing and reliable sources confirm tornado.

If you are in a structure (e.g. residence, small building, school, nursing home, hospital, factory, shopping center, high-rise building) go to the center of a small interior room or interior hallway on the lowest level, away from corners, windows, doors, and outside walls. Put as many walls as possible between you and the outside. Avoid large rooms with large span roofs (gymnasiums, cafeterias, etc). If in a high-rise building go to a small interior room or hallway on the lowest floor possible away from windows. Have a pair of sturdy shoes stored in your shelter room and put them on. Do not open windows.

If you are in a manufactured or mobile home get out immediately and go to a pre-identified location such as the lowest floor of a sturdy, nearby building or storm shelter. Mobile homes, even if tied down, offer little protection from tornadoes. It is important to identify such a sturdy shelter you can get to quickly as part of your severe weather plan.

If caught outside with no shelter make every effort to get to a safe shelter. If this is not possible your best course of action is to lie in a low spot or ditch and cover your head with your hands. It is not advisable to get under a bridge or overpass.



Other Thunderstorm Hazards: Hail, Damaging Winds, Lightning

Thunderstorms can bring a variety of hazards including tornadoes, flash flooding, hail, lightning and damaging winds. The National Weather Service issues Severe Thunderstorm Warnings for thunderstorms believed to contain large hail (greater than 1 inch in diameter) and/or damaging winds. Here are some guidelines on how to stay safe when dealing with thunderstorm hazards lightning, hail and high winds.

Lightning Safety:

- A good rule of thumb, if you can hear thunder you are close enough to be struck by lightning.
"When Thunder Roars, Go Indoors!"
"See a Flash, Dash Inside"
- Get inside a home, building, or closed automobile (not a convertible). You are much safer inside a vehicle than outside.
- Avoid open fields, the top of a hill or a ridge top.
- Stay away from tall, isolated trees or other tall objects (power poles, antennae). If you are in a forest, stay near a lower stand of trees.
- If you are in a group, spread out to avoid the current traveling between group members.
- Stay away from water, wet items, such as ropes, and metal objects, such as fences and poles.
- Unplug any electronic equipment well before the storm arrives.
- If planning an outdoor event, make sure you have a lightning safety plan; have a designated weather watcher; identify shelters that can be reached quickly.



www.lightningsafety.noaa.gov
www.ready.gov/thunderstorms-lightning
www.ncaa.org/health-and-safety/lightning-safety



Large Hail and High Winds:

- Seek shelter in a sturdy structure away from windows
- Before the storm close your drapes or blinds; this offers you extra protection from flying glass.
- Inspect your home and roof after a large hail storm. Cover any damaged areas to prevent leaks.

flash.org/peril_inside.php?id=75

Weather Alerts to Your Cell Phone

Wireless Emergency Alerts (WEA)

1. What are WEA messages?

Wireless Emergency Alerts (WEA) are emergency messages sent by authorized government alerting authorities through your mobile carrier. Government partners include local and state public safety agencies, FEMA, the FCC, the Department of Homeland Security, and the National Weather Service.

No signup is required! Alerts are sent automatically to WEA-capable phones during an emergency.

2. Why is this important to me?

Alerts received at the right time can help keep you safe during an emergency. With WEA, alerts can be sent to your mobile device when you may be in harm's way, without need to download an app or subscribe to a service.

3. What types of alerts will I receive?

- Extreme weather warnings
- Local emergencies requiring evacuation or immediate action
- AMBER Alerts
- Presidential Alerts during a national emergency

4. What types of weather warnings are included?

- Flash Flood, Tornado and Hurricane Warnings
- Less Common: Tsunami, Extreme Wind and Dust Storm Warnings

4. What does a WEA message look like?

WEA will look like a text message. The WEA message will typically show the type and time of the alert, any action you should take, and the agency issuing the alert. The message will be no more than 90 characters.

5. Will I receive a WEA message if I'm visiting an area where I don't live, or outside the area where my phone is registered?

Yes, if you have a WEA-capable phone.

6. How will I know the difference between WEA and a regular text message?

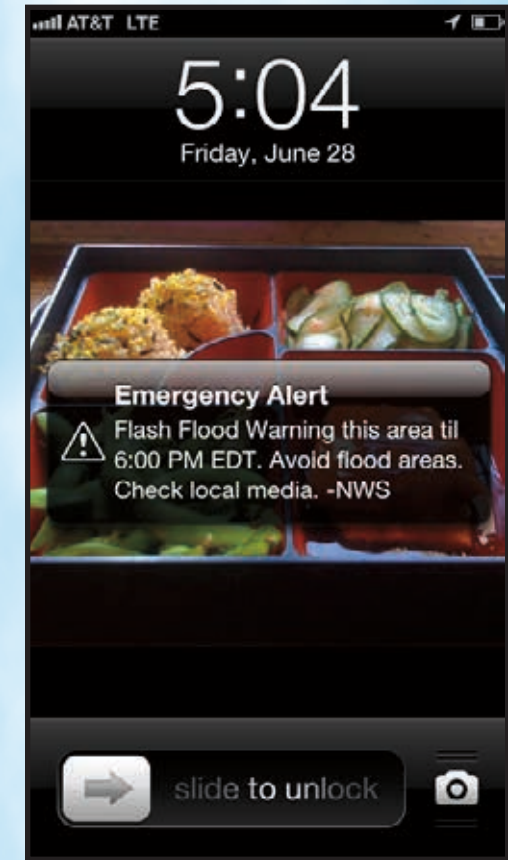
WEA messages include a special tone and vibration, both repeated twice.

7. What if I don't want to receive these emergency messages?

You can opt out of the Amber or Extreme Weather WEAs. Details on how to set your phone up for these alerts including opt out instructions can be found by searching your wireless carrier's website for WEA or wireless emergency alerts. The details on how to set these up are dependent on your carrier and smart phone model.

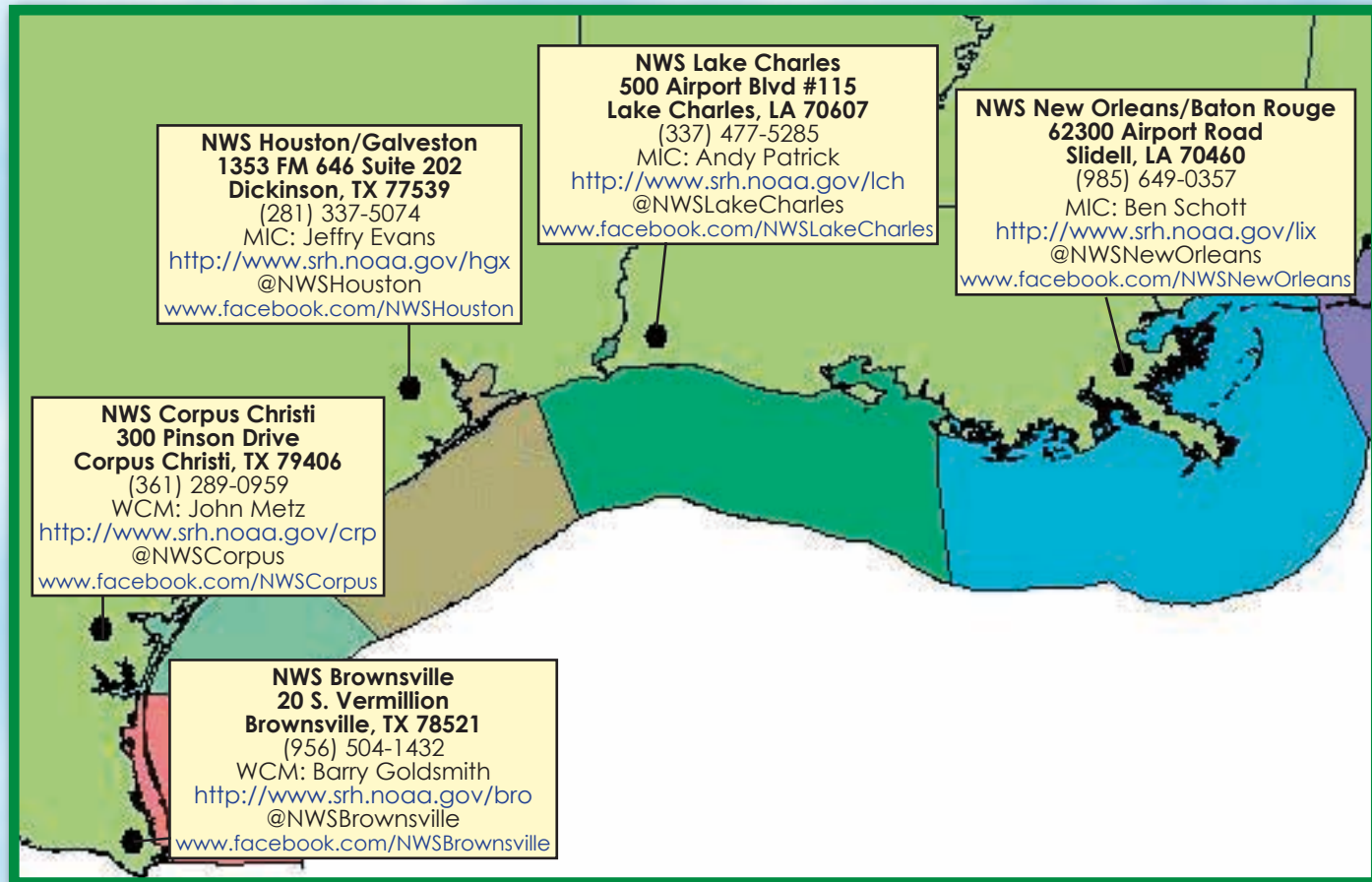
Other weather alert apps

There are many weather alert apps, many free, that have some of the same functionality as the WEA system in that they will send you a weather alert usually as a text message for your location and any others you specify. Do a search for "weather alerts" at the App Store or wherever you find apps on your phone.



www.nws.noaa.gov/com/weatherreadynation/wea.html
www.ready.gov/alerts
www.ready.gov/get-tech-ready

Regional National Weather Service Offices



The National Weather Service would like to acknowledge the Greater Houston LEPC for their assistance in the production of this severe weather guide. An LEPC (Local Emergency Planning Committee) is a gathering of representatives in your community that have an interest in hazardous materials safety. As a group, they are tasked with identifying potential risks that your community faces, from chemicals stored in and/or transported throughout your community. The LEPC seeks ways to help minimize the risk, prevent accidents and assist in the development of plans to deal with a chemical emergency. Education and community outreach is another core component of an LEPC. Through the LEPC, the public will be able to seek out information about chemicals in their communities and learn how to safely shelter in place. For more information on LEPCs in Texas go to this link:

www.tceq.texas.gov/assets/public/permitting/tier2/LEPC-contact-list.pdf



Emergency Management Contacts

AUSTIN

- **County Emergency Management**
979-865-5911
austincounty.com

BRAZORIA

- **County Emergency Management**
979-864-1201
brazoriacountytx.gov/departments/emergency-management

- **Alvin**
281-388-4363
www.alvin-tx.gov

- **Angleton**
979-849-2383

- **Bailey's Prairie**
979-849-0134

- **Brazoria**
979-798-2489

- **Brookside**
281-485-3048

- **Clute**
979-265-6194

- **Danbury**
979-922-1551

- **Freeport**
979-239-1211

- **Hillcrest Village**
281-748-7149

- **Holiday Lakes**
979-849-1136

- **Iowa Colony**
281-369-3444

- **Jones Creek**
979-233-3091

- **Lake Jackson**
979-415-2500

- **Liverpool**
281-581-2342

- **Manvel**
281-489-1212

- **Oyster Creek**
979-233-8481

- **Pearland**
281-997-4640
cityofpearland.com/preparedness

- **Richwood**
979-265-8157

- **Surfside Beach**
979-239-1151

- **Sweeny**
979-548-3321
979-548-4541
www.sweenytx.gov

- **Quintana**
979-233-0848

- **West Columbia**
979-345-5121

BRAZOS

- **County Emergency Management**
979-821-1011
www.bcdem.org

- **Bryan**
979-821-1030
www.bryantx.gov

- **College Station**
979-821-1000
www.cstx.gov/dem

BURLESON

- **County Emergency Management**
979-567-2001
co.burleson.tx.us/burleson-county-alert-system

CHAMBERS

- **County Emergency Management**
409-267-2445
www.chamberstx.gov

- **City of Mont Belvieu**
281-576-2021

COLORADO

- **County Emergency Management**
979-733-0184

FORT BEND

- **County Emergency Management**
281-342-6185
www.fbcoem.org

- **Arcola**
281-431-0606

- **Beasley**
979-387-2775

- **Fairchild**
281-341-4638

- **Fulshear**
281-346-1796

- **Kendleton**
979-532-8240

- **Meadows Place**
281-983-2900

- **Missouri City**
281-403-8500
www.missouricityready.com

- **Needville**
979-793-4255

- **Orchard**
979-478-6893

- **Pleak**
281-239-8504

- **Richmond**
281-342-5456
www.richmondtx.gov

- **Rosenberg**
835-595-3700
www.rosenbergtx.gov

- **Simonton**
281-533-9809

- **Stafford**
281-261-3950

- **Sugar Land**
281-275-2700

<http://www.sugarlandtx.gov/105/Emergency-Management>

- **Thompsons**
281-343-9929

- **Weston lakes**
281-533-0907

Emergency Management Contacts

GALVESTON

- **County Emergency Management**
281-309-5002 / 888-384-2000
www.gcoem.org
- **Bayou Vista**
409-935-0449
- **Clear Lake Shores**
281-334-1034
281-334-2799
- **Dickinson**
281-337-4700
www.ci.dickinson.tx.us
- **Friendswood**
281-996-3335
www.ci.friendswood.tx.us
- **Galveston**
409-765-3710
galvestontx.gov
- **Hitchcock**
409-986-5559
www.hitchcockpd.com
- **Jamaica Beach**
(920) 572-4073
www.ci.jamaicabeach.tx.us
- **Kemah**
281-334-5414
- **La Marque**
409-938-9269
www.cityoflamarque.org
- **League City**
281-554-1000
www.leaguecity.com
- **Santa Fe**
409-925-2000
- **Texas City**
409-643-5840
- **Tiki Island**
409-935-1427

GRIMES

- **County Emergency Management**
936-873-4404

HARRIS

- **County Office of Homeland Security & Emergency Mgt**
713-881-3100
www.readyharris.org
- **Baytown**
281-422-2311
www.oembaytown.org
- **Bellaire**
713-662-8206
www.bellairetx.gov
- **Deer Park**
281-478-7298
www.deerparktx.gov
- **El Lago**
281-326-5900
- **Galena Park**
713-672-2556
- **Houston**
713-884-4500
www.houstonoem.org
- **Jacinto City**
713-674-8424
- **Humble**
281-446-4928
<http://www.cityofhumble.com>
- **Jersey Village**
713-466-2130
- **Katy**
281-574-8633
281-391-3500
www.cityofkaty.com
- **La Porte**
281-470-0010
www.lpoem.org
- **Morgan's Point**
281-471-2171
- **Nassau Bay**
281-333-4211
www.nassaubay.com

- **Pasadena**
713-475-5588
www.pasadena.tx.gov

- **Seabrook**
281-291-5700
- **Shoreacres**
281-471-2244
- **South Houston**
713-947-7700
- **Taylor Lake Village**
281-326-2843
- **Tomball**
281-290-1301
- **Webster**
281-332-1826
- **West University Place**
713-662-5836

HOUSTON COUNTY

- **County Emergency Management**
(936) 544-7175
(936) 544-2862
Hyper-reach.com/txhoustonsignup.html

JACKSON

- **County Emergency Management**
361-782-3398
www.co.jackson.tx.us
- **Edna**
361-782-3122
- **Ganado**
361-771-2800

Emergency Management Contacts

LIBERTY

- **County Emergency Management**
936-334-3219
www.co.liberty.tx.us
- **Liberty**
936-336-8118

MADISON

- **County Emergency Management**
936-348-3810
www.co.madison.tx.us

MATAGORDA

- **County Emergency Management**
979-323-0707
www.co.matagorda.tx.us

MONTGOMERY

- **County Emergency Management**
936-523-3900
www.mctxoem.org
- **Conroe**
936-522-3080
- **Shenandoah**
281-367-8952

POLK

- **County Emergency Management**
936-327-6826
www.polkcountyem.com
- **Alabama-Coushatta**
936-563-1100

SAN JACINTO

- **County Emergency Management**
936-653-3395
sjc.oem@co.san-jacinto.tx.us

WALKER

- **County Emergency Management**
936-435-8740
www.facebook.com/WalkerCountyOEM/

WALLER

- **County Emergency Management**
979-826-8282

WASHINGTON

- **County Emergency Management**
979-353-7683

- **Brenham**
979-337-7300

WHARTON

- **County Emergency Management**
979-532-1123
co.wharton.tx.us
www.facebook.com/Wharton-County-Office-of-Emergency-Management-221712291190574/
- **El Campo**
979-543-5311
www.cityofelcampo.org
- **Wharton**
979-532-4811 x570
www.facebook.com/WhartonOEM

US Department of Homeland Security

www.ready.gov

Red Cross

www.redcross.org

National - 800-733-2767

Gulf Coast Assistance Line 866-526-8300

FEMA

www.fema.gov

**Community Resource Information:
Do Not Call 911 for Non-Emergencies!**





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Galveston County
Harris County
Montgomery County
Walmart
Houston Red Cross
The Church of Jesus Christ of Latter-day Saints
Mayor's Office for People with Disabilities
Harris County Flood Control District
Houston Commission on Disabilities
METRO Houston