HAZARD MITIGATION PLAN

CITY OF FRIENDSWOOD

SEPTEMBER 14, 2015

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“By failing to prepare, you are preparing to fail”.

Benjamin Franklin

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INTRODUCTION

Mitigation, a cornerstone of emergency management, is defined as taking sustained actions to reduce or eliminate the long-term risks to people and property from hazards. By taking steps to lower our risk across generations, we can ensure that our community recovers more quickly from natural disasters when they do occur.

The Code of Federal Regulations states:

"The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards."
(44 CFR Part 201.6, pp 8851)

Mitigation builds community resilience and community sustainability. This plan identifies hazards based on the history of disasters and localized events within the City of Friendswood and lists goals, objectives, strategies and actions for reducing future losses. The implementation of planned, pre-identified, and cost-effective mitigation measures not only helps reduce losses to lives, property, and the environment, but it streamlines the disaster recovery process.

Mitigation is commonly defined as sustained actions taken to reduce or eliminate long term risk to people and property from hazards and their effects. Hazard mitigation focuses attention and resources on community policies and actions that will produce successive benefits over time. Mitigation measures can include regulatory changes impacting development in natural hazard areas, infrastructure improvements, natural resource protection, education programs, and many others.

Hazard mitigation aims to make human development and the natural environment safer and more resilient. Hazard mitigation generally involves altering the built environment to significantly reduce risks and vulnerability to hazards so that life and property losses can be avoided or reduced. Mitigation can also include removing the built environment from disaster prone areas and maintaining natural mitigating features, such as wetlands or floodplains. Hazard mitigation makes it easier and less expensive to respond to and recover from disasters by breaking the damage and repair cycle.

The Federal Disaster Mitigation Act of 2000 requires all municipalities eligible to receive FEMA grant funding for hazard mitigation projects to adopt a local multi-hazard mitigation plan and update their plan in five-year intervals.

The City of Friendswood received approval to develop its first Hazard Mitigation Plan with a FEMA approved mitigation planning grant in 2002. The City Council formally adopted the 2003 Hazard Analysis and Mitigation Plan on January 6, 2003. The five-year review and update of the City's Hazard Analysis and Mitigation Plan was adopted by City Council on November 2, 2009. This plan review and update will play an important role in the City's objective of protecting its citizen's health, safety and welfare.

AUTHORITIES

44 CFR 201 AND 206 – Hazard Mitigation Planning and Hazard Mitigation Grant Program, February 2002

44 CFR 201.3 RESPONSIBILITIES

(d) Local governments. The key responsibilities of local governments are to:
  (1) prepare and adopt a jurisdiction-wide natural hazard mitigation plan as a condition of receiving project grant funds under the HMGP, in accordance with §201.6.
  (2) At a minimum, review and update the local mitigation plan every 5 years from date of plan approval of the previous plan in order to continue program eligibility.

TEXAS DISASTER ACT OF 1975, CHAPTER 481 OF THE TEXAS GOVERNMENT CODE
Subchapter F -- Disaster Mitigation

PUBLIC LAW 100-707 – Stafford Act (Public Law 93-288), as amended
PUBLIC LAW 106-390 – Disaster Mitigation Act of 2000

SECTION I
PLANNING PROCESS

The 2015 City of Friendswood Hazard Mitigation Plan is the second updated plan after adopting the city's first mitigation plan – *The Hazard Assessment and Mitigation Plan* - in January 2003, and the first updated plan adopted in October 2009.

PLANNING PROCESS

The planning process for the 2015 Hazard Mitigation Plan began shortly after FEMA approval was received for the 2009 Hazard Mitigation Plan. Since the adoption of the city's mitigation plan, mitigation team members also participated with the Galveston County Consolidated Drainage District in the development of their initial mitigation plan. The City of Friendswood is located in Galveston and Harris Counties. Requests for plan development assistance was extended via telephone requests and email to the Harris County Office of Emergency Management, Galveston County Office of Emergency Management, League City Office of Emergency Management, Pearland Office of Emergency Management, and the Galveston County Consolidated Drainage District. Presentations were also made through local community organizations; such as the Rotary Club, Friendswood Chamber of Commerce, State of the City Address by the Mayor to solicit individual participation. Solicitation for participants was also made through surveys on the city's website, at local community organization meetings, the local newspaper, the city's PEG channel. Although numerous requests have been made to solicit members of the community to participate in the mitigation planning process, only one resident has remained as a steadfast participating member throughout the mitigation planning process. However, participation is sporadic at best.

Members of the Hazard Mitigation Planning Committee consist of the Mayor, Mayor Pro Tem, City Manager and all Departmental Directors of the City of Friendswood. All members of the committee participated in the planning process by submitting data, recommendations, and ideas for mitigation projects. Members of participant agencies gave input and ideas in those areas where cooperation and coordination would be needed to successfully address hazards and mitigation projects.

2015 HAZARD MITIGATION PLAN REVIEW & UPDATE COMMITTEE

CITY OF FRIENDSWOOD -STAKEHOLDERS	
Terry Byrd	Fire Marshal/Emergency Management Coordinator
Brian Mansfield	Deputy Director, Fire Marshal's Office/Office of Emergency Management
Roger Roecker	City Manager
Morad Kabiri, PE, AICP	Assistant City Manager/Director of Community Development
Frank Manigold, CFM	Deputy Director, Community Development
Nick Haby	Planning Manager/PIO-Public Information Officer
Kaz Hamidian	Director, Public Works
James Toney	Director, Community Services
Kevin Holland	Mayor
Rene Ibarra	Deputy Director, Projects & Engineering
Cora Crews	Deputy Emergency Management Coordinator
Jim Hill	City Council Member
Steven Simmons	Deputy Fire Marshal
David Smith	Resident, City of Friendswood
PARTICIPANTS – NEIGHBORING COMMUNITIES	
Bill Wheeler	Deputy Emergency Management Coordinator, Harris County Office of Emergency Management
Joseph Anderson	Operations Manager, Galveston County Consolidated Drainage District

Niki Bender	Emergency Planning Coordinator, Galveston County Office of Emergency Management
David Popoff	Emergency Management Coordinator, Galveston County Office of Emergency Management
Joshua Glover	Harris County Office of Emergency Management
Dena Mahan	Emergency Management Coordinator, City of League City

The Annual Mayor State of the City Address, sponsored by the Friendswood Chamber of Commerce, makes available areas for city departments to display the status and progress of various projects. Educational materials regarding the mitigation process and status of the current plan are made available for attendees by the Office of Emergency Management/Fire Marshal's Office. The 2010 Mayor State of the City was held on March 4, 2010. Approximately 160 attendees, primarily members of the local Chamber of Commerce, attend this annual presentation.

The first meeting of the Hazard Mitigation Plan Committee was held on April 7, 2010. The group discussed the removal of maps and other information or data which may be sensitive in nature to protect the city's infrastructure and that data which may be relative to homeland security issues. Attorney General Rulings are to be researched and those items within the HMP which could be utilized in terrorist incidents will be excluded from the public copies. Copies of the HMP will be distributed as follows: 1 complete copy available for the City Secretary's Office. The committee preferred not to charge a fee for a copy of the Mitigation Plan; therefore, a copy of the "public copy" will be available for review in-house at the Friendswood Public Library and City Hall with copies on compact discs for residents to take with them. Also, copies of the 2003 and 2009 Hazard Mitigation Plans will be available on the City of Friendswood website. Discussion held regarding distribution of educational materials to residents to keep them informed with respect to hazards affecting the city. Resource materials were obtained from "Ready.Gov" and were distributed to senior living centers/facilities, child care centers, animal clinics, Chamber of Commerce, and all city facilities. Excess materials were then provided to the City of League City and Nassau Bay and Clear Lake Council of Cities for use in their respective jurisdictions.

Educational materials regarding the mitigation process and status of the current plan are made available for attendees by the Office of Emergency Management/Fire Marshal's Office. The 2011 Mayor State of the City was held on March 3, 2011.

The second meeting of the Hazard Mitigation Plan Committee was held on October 6, 2011. Update was given as to the status of availability of public copies of the Mitigation Plan. Research was conducted with the Attorney General regarding the removal of sensitive materials, and a final public copy was produced and made available at City Hall and the Public Library.

Educational materials regarding the mitigation process and status of the current plan are made available for attendees by the Office of Emergency Management/Fire Marshal's Office. The 2012 Mayor State of the City was held on March 1, 2012.

On May 17th, 2012, the Hazard Mitigation Planning Committee met. Discussion included the updated records for new housing construction and commercial new construction and build-outs. Capital improvement projects were updated with the committee. The Texas Water Development Board (TWDB) is conducting a CRS review. Critical facilities protection measures were updated to the committee. Those water wells and lift stations that are not located within a designated flood zone have been equipped with natural gas generators. City Hall and the Public Library have had generators installed to maintain continuity of government during emergency situations. Windows have been reinforced at all city facilities to minimize damage as a result of various disastrous events. Training was provided by the State Library regarding the necessity to develop a Records Emergency Action Plan. A draft plan is in the development phase. A Continuity of Operations Plan (COOP) has also been drafted. The city still maintains an "Advanced Level of Preparedness" with the Texas Department of Emergency Management (TDEM). The city's Emergency Operations Plan and all supporting annexes are current and have been approved by TDEM.

In January 2013, members of the Mitigation Planning Committee attended mitigation training provided through the State of Texas Division of Emergency Management. The courses presented included G-710: Mitigation Planning Course and G-393: Mitigation for Emergency Managers. The primary focus of Mitigation Planning Course was to address 44CFR 201.6 (Hazard Mitigation Planning and Hazard Mitigation Grant Program) with emphasis on requirements for mitigation plans and the revised crosswalk to ensure local mitigation plans address all issues of the regulation.

January 31, 2013, the Mitigation Planning Committee met with the primary focus of the review of the current plan to ensure that all requirements of 44 CFR 201 are addressed in the current plan. A presentation was made regarding the highlights of the new regulations and mandatory requirements, addressing deficiencies in the current plan, emphasis on public participation, participation of stakeholders within the community, and incorporation of the mitigation plan into other planning mechanisms utilized by the city (i.e., capital improvements plan, drainage plans, floodplain plans). The committee updated the city's risk assessment/vulnerability analysis. Those hazards receiving the highest ranking were severe thunderstorm/hail/lightning, flood events (flash and riverine) and hurricane – wind. Hazardous material events with regard to pipelines also received high ranking. The process used for the assessment utilized the vulnerability of the community to a hazard and the frequency of the occurrence of such event. Educational materials regarding the mitigation process and status of the current plan were made available for committee members by the Office of Emergency Management/Fire Marshal's Office.

A Hazard Mitigation Plan Survey was developed and posted on the city's webpage. Two surveys were developed, one directed at business owners and one directed to homeowners. This survey was capable of being completed on-line and submitted via email to the Office of Emergency Management. A copy of the posting on the City's website, questionnaire and the results can be found in **APPENDIX B**.

The 2013 Mayor State of the City was held on March 7, 2013. Along with the educational materials, copies of the business owner hazard mitigation survey were distributed and collected after the meeting.

A member of the Hazard Mitigation Committee delivered a mitigation awareness program at the Friendswood Rotary International organization on May 15, 2013. Copies of the hazard mitigation survey were distributed and collected from the 24 attendees.

The Hazard Mitigation Committee met again on January 20, 2014. Discussion was held around the draft submitted to the committee and development of mitigation action items.

During the development of the plan update, draft copies of the Hazard Mitigation Plan were distributed to committee members via email.

Members of the city's mitigation committee also participated in planning meetings during the development process of the Galveston County Consolidated Drainage District Hazard Mitigation Plan. City of Friendswood committee members participating with the Drainage District were Morad Kabiri, Rene Ibarra, Cora Crews and Niki Bender.

Copies of the Hazard Mitigation Committee meeting agendas, signature pages, and the hazard mitigation surveys are located in **APPENDIX A**.

COORDINATION WITH OTHER PLANS

During the plan update process, existing documents were referenced to ensure that the Hazard Mitigation Plan goals and activities are consistent with planning that has already occurred.

The following plans were utilized in the review process:

- City of Friendswood Capital Improvements Plan (CIP)
  The CIP was utilized to document the status of current and proposed improvements to city facilities and infrastructure to emphasize protection measures designed to alleviate the effects of future hazards.
- City of Friendswood, Master Drainage Plan-Phase II, 2007
  The Master Drainage Plan details the protection measures to be put into place to alleviate flooding hazards during minor and major weather events
- Vision 2020
  This plan was utilized to assist with the city's current status and growth projections to maintain the quality of life envisioned by the strategic planning committee. This plan details economic status and projections, land use (residential and commercial), population density, and future development.
- City of Friendswood, Drought Contingency Plan
  This plan details strategies to ensure continued water access and preservation.
- State of Texas, Hazard Mitigation Plan, 2013 Update
  This document was used as a reference to ensure that the city's mitigation planning process was compliant with the state example.
- Galveston County Consolidated Drainage District Hazard Mitigation Plan, September 24, 2013
  The Galveston County Consolidated Drainage District (GCCDD) is a partnering agency with the city assisting with drainage projects and mitigation efforts. The GCCDD and the city partner together to develop, design and complete drainage projects throughout the city.

PUBLIC PARTICIPATION

Approved copies of the 2015 Hazard Mitigation Plan will be made available to the public at the Friendswood Library and City Secretary's Office. The approved plan will also be placed on the city's website available for the public's review.

Public information fliers will be available at public emergency management presentations to educate the public about the importance of public and private mitigation practices.

EVALUATION AND UPDATING THE MITIGATION PLAN

Due diligence is warranted on a daily basis to ensure that all data located in the plan is maintained and updated through each year following adoption of the plan. Semi-annual to annual hazard mitigation committee meetings will be held to assess the progress and status of the current mitigation action items and to develop future mitigation action items.

SECTION II
HAZARD MITIGATION STRATEGY

The City of Friendswood Hazard Mitigation Committee identified a number of mitigation measures that would serve to reduce the city's vulnerability to natural or man-made hazardous events. These include infrastructure improvements such as continued maintenance and repairs which may arise with regard to generators on all public facilities, water wells, surface water stations, lift stations, and public education efforts relating to all natural hazards potentially impacting the city.

Overall, the hazard mitigation strategy recognizes that mitigating hazards for Friendswood will be an on-going process as our understanding of natural hazards and the steps that can be taken to mitigate their damages changes over time. Various factors impact the city's vulnerability, and local officials will need to work together across municipal lines and with state and federal agencies in order to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into other related plans and policies.

HAZARD MITIGATION STRATEGY AND GOALS

1. Ensure that critical infrastructure sites are protected from all hazards.

2. Reduce the vulnerability from flooding of existing residential and business structures.

3. Maintain previous mitigation projects to ensure continuity of services.

4. Continue to enforce existing zoning and building regulations.

5. Educate the public regarding zoning and building regulations which affect new construction, demolition, and flood hazards.

6. Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities, such as flooding.

7. Continue to develop capital improvements projects which address hazards identified in the mitigation plan.

8. Maintain the city's ability to respond to all types of hazards.

9. Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, CodeRed, Radio, etc.)

SECTION III
HAZARD IDENTIFICATION AND RISK ASSESSMENT

OVERVIEW OF HAZARDS

The City of Friendswood is exposed to many hazards, all of which have the potential to disrupt the community, cause casualties, and damage or destroy property.

The process of identifying hazards is two-fold.

FIRST

- A hazards analysis is developed. It is a stand-alone product consisting of maps, databases, charts, atlases, and other supporting documentation. The analysis provides a risk-based quantitative method to prioritize mitigation and preparedness needs for the jurisdiction as a whole. This analysis is reviewed and updated frequently.

SECOND

- A mitigation action plan is developed. The mitigation action plan outlines mitigation goals, identifies a risk reduction strategy for each of the significant hazards that threaten the area, and discusses the on-going risk reduction activities undertaken within the jurisdiction. The mitigation action plan further details what is to be done, how much it will cost, who will be responsible for the action, how it will be funded, and provides an implementation schedule.

The City of Friendswood recognizes that the community will continue to be exposed to and subject to the impact of hazards as described in this document as well as hazards that may develop in the future. The potential exists for a major disaster to occur at any time and at any place. In many cases dissemination of warning to the public and implementation of increased readiness measures may be possible, yet some emergency situations occur with little or no warning.

During the 2014 Plan update the Mitigation Committee updated the Risk Assessment/Vulnerability Analysis with reference to natural and man-made hazards. The Hazard Mitigation Committee reviewed the hazards included in the 2009 Mitigation Plan, along with the historical aspect of past events, and updated the Risk Assessment & Vulnerability Assessment. Although the 2009 Hazard Mitigation Plan did not rank or prioritize the potential hazards based upon historical data, frequency or vulnerability, the Hazard Mitigation Committee did complete a Risk Assessment/Vulnerability Analysis during the review process for the 2014 Mitigation Plan. The results of that analysis can be seen in Table 2 of this Section. Hazards were prioritized based upon the total vulnerability and frequency within the city, and then each hazard was explained, updated with information from the latest Mitigation Plan, and further analyzed. The listing in the following paragraph depicts the priority of hazard s based upon the Risk Assessment/Hazard Analysis.

The following hazards were assessed in the 2009 Mitigation Plan, and were reviewed again for the 2014 Mitigation Plan update:

- Flood events (flash and riverine)
- Hurricane (storm surge) & hurricane (wind)
- Tornado
- Severe thunderstorm/hail/lightning
- Drought
- Subsidence
- Winter storms
- Hazardous materials/pipeline and/or fixed facility

A variety of sources were utilized to identify past natural hazard events for the City of Friendswood. Some of these sources included the National Oceanic Atmospheric Administration (NOAA) National Climatic Data Center (NCDC) database, the Natural Hurricane Center's Hurricane Tracker database, and Hurricane Consulting. Review of past natural hazard events for the City of Friendswood noted for those events which were included in the 2009 Mitigation Hazard Plan, and those events which have occurred

since adoption of the latest version of the City's Mitigation Plan. The following tables and graphs show the data sets utilized to determine the city's vulnerability to hazards.

Table 1
HISTORICAL REVIEW OF PAST NATURAL HAZARD EVENTS

EVENT TYPE	NUMBER OF OCCURRENCES 1950-2008	NUMBER OF OCCURRENCES 2009-2013
Severe Thunderstorms/Hail/Lightning	9	0
Hail Storms	8	0
Tornadoes	4 (2 FO, 2 F1)	0
Floods (Riverine/Flash)	10	2
Hurricanes/Storm Surge	5	0
Hurricane/Wind	1	0
Drought	4	Mod to Extreme 2010-2013
Subsidence	0.02'	-0.05'
Winter Storms	2	0
Hazardous Materials/Pipeline (fixed facility)	10	
Wildland-Urban Fires	0	0

RISK ASSESSMENT/VULNERABILITY ANALYSIS

The Risk Assessment/Vulnerability Analysis is a rating system utilizing the vulnerability and frequency of a potential hazard and thus resulting in a numerical rating. The Tables below capture the analysis process and results.

HAZARD	VULNERABLITY (0-3)	FREQUENCY (0-3)	TOTAL (Vulnerability ×Frequency)
NATURAL			
Flood Events (Flash & Riverine)	**2**	**3**	**6**
Hurricane – Storm Surge	**1**	**3**	**3**
Hurricane – Wind	**2**	**3**	**6**
Tornado	**1**	**2**	**2**
Severe Thunderstorm/Hail/Lightning	**3**	**3**	**9**
Drought	**2**	**1**	**2**
Subsidence	**1**	**0**	**0**
Winter Storms	**1**	**1**	**1**
TECHNOLOGICAL			
Utility Outage (Gas, Water, Electricity)	**2**	**1**	**2**
Hazardous Materials – Pipeline	**2**	**2**	**4**
Hazardous Materials – Fixed Facility	**0**	**0**	**0**
Hazardous Materials – Hazardous Cargo Route	**1**	**0**	**0**
HUMAN CAUSED			
Large Scale Special Events	Not profiled in this plan review		
Terrorism			

TABLE 2
RISK ASSESSMENT / VULNERABILITY ANALYSIS

The following information was used to identify vulnerability and frequency for the events listed above under Natural.

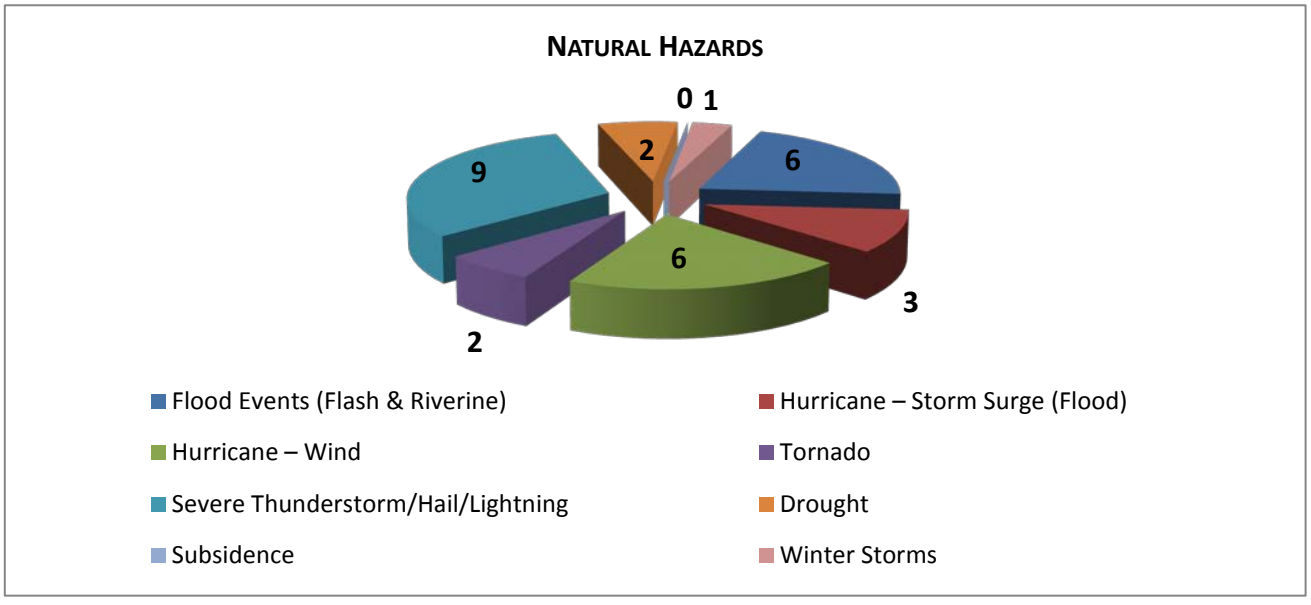
VULNERABILITY

STORM SURGE	Zone A	=	3
	Zone B	=	2
	Zone C	=	1
	Outside	=	0
	=		
WIND	< 50 miles to coast	=	3
	50-75 miles inland	=	2
	> 75 miles inland	=	1
FLOOD	Floodway	=	3
	100 year floodplain	=	2
	500 hear floodplain	=	1
HAZARDOUS MATERIALS	< 3000 feet	=	3
	< 1 mile	=	2
	< 5 miles	=	1
	> 5 miles	=	0

FREQUENCY

5 years or less	=	3
6 – 25 years	=	2
26 – 100 years	=	1
Rare	=	0

GRAPH 1
VULNERABILITY RATING OF NATURAL HAZARDS



GRAPH 2
VULNERABILITY RANKING OF POTENTIAL TECHNOLOGICAL HAZARDS

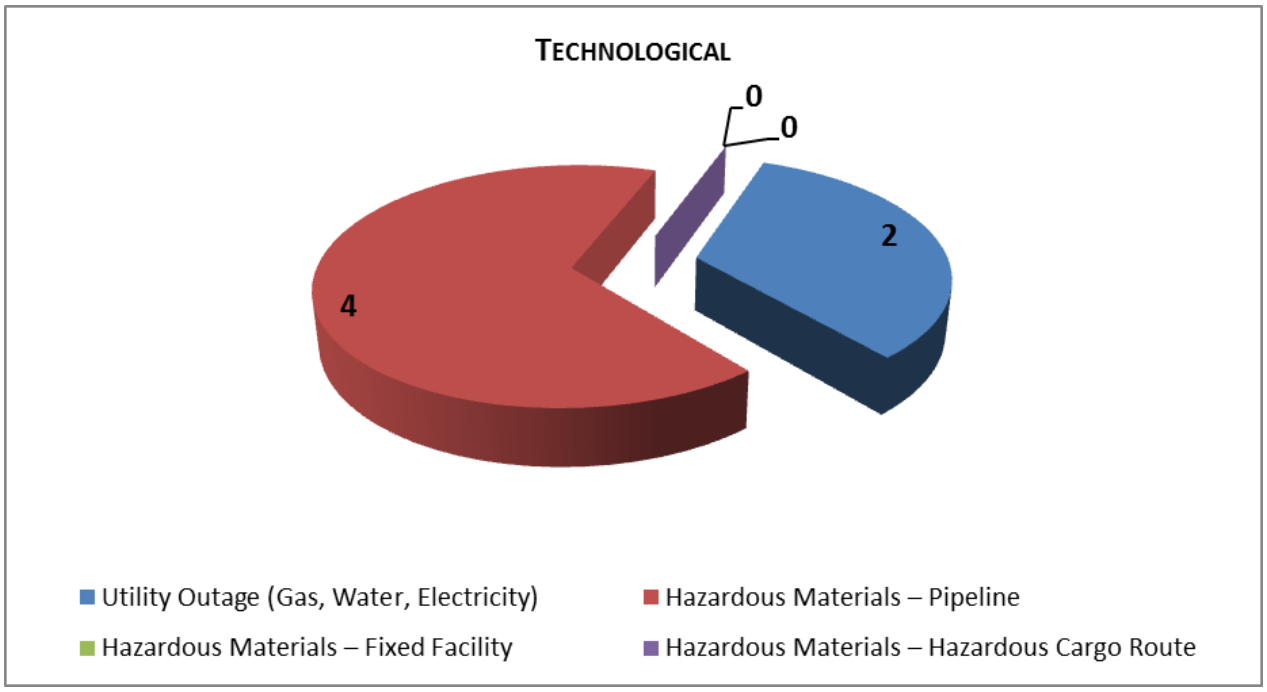


TABLE 3
CONCLUSION ON HAZARD RISK FOR THE CITY OF FRIENDSWOOD

High Risk	• Severe Thunderstorm/Hail/Lightning • Flood Events (Flash & Riverine) • Hurricane (Wind)
Moderate Risk	• Hazardous Materials – Pipeline • Hurricane – Storm Surge
Low Risk	• Tornado • Drought • Utility Outage (Gas, Water, Electricity) • Winter Storms

TABLE 4
TOTAL ASSESSED PROPERTY VALUE
(BY PROPERTY USE CATEGORY)

	Units	2014 Tax Year Property Valuation
Single Family Residential		$ 2,625,159,492
Multi-Family Residential		$ 60,987,782
Vacant		$ 38,080,485
❖ Agricultural Land- Acres		$ 29,526,676
❖ Farm & Ranch Improved		$ 7,870,600
Commercial/Industrial		$ 163,036,688
Oil & Mineral Gas		$ 14,883,635
Utilities		$ 40,512,865
Tangible Commercial		$ 41,092,339
Tangible Watercraft, Aircraft, Mobile Homes		$ 827,923
Inventory		$ 4,858,810
Dealer Inventory		$ 339,740
★ Governmental		$ 38,720,150

RESIDENTIAL

# Units	11,583
Assessed Value	$2,686,147,274
TOTAL ASSESSED PROPERTY VALUE (All Categories)	$3,065,897,185

Total Assessed Value –Public Works & Parks Equipment	$ 1,187,165
Historical Items (Fine Arts)	$ 173,500
Public Property* - Building	$ 41,835,494
- Contents	$ 18,806,580
TOTAL	**$ 61,902,739**

SCHOOL DISTRICT ASSESSED PROPERTY VALUE

Clear Creek ISD	
26 Elementary/10 Intermediate/7 High Schools	$1,023,796,628
Friendswood ISD	
3 Elementary/2 Intermediate/1 High School	$ 39,718,981

★ Public Property includes all city buildings, water wells, sewer lift stations, communications equipment, park facility structures, fencing, etc.

❖ Agricultural Lands and Farm/Ranch Improved as defined by the Galveston County Appraisal District as:

- The Texas agricultural exemption is not technically an exemption; it is a county appraisal district assessment valuation based on agricultural use (actually an agricultural appraisal);
- Land is assessed on land's productivity value rather than on what the land would sell for on the open market;
- Must be used for agriculture; uses include producing crops, livestock, poultry, fish or cover crops;
- The land must have been devoted to agricultural production for at least 5 of the past 7 years;
- Land within the city limits must have been devoted continuously for the preceding 5 years, unless the land did not receive substantially equal city services as other properties in the city.

VULNERABILITY ASSESSMENT

The data depicted in the following table provides a breakdown of the estimated number of buildings and dollar exposure in the city that will be used for the basis of the risk assessment for each hazard depicted throughout this section.

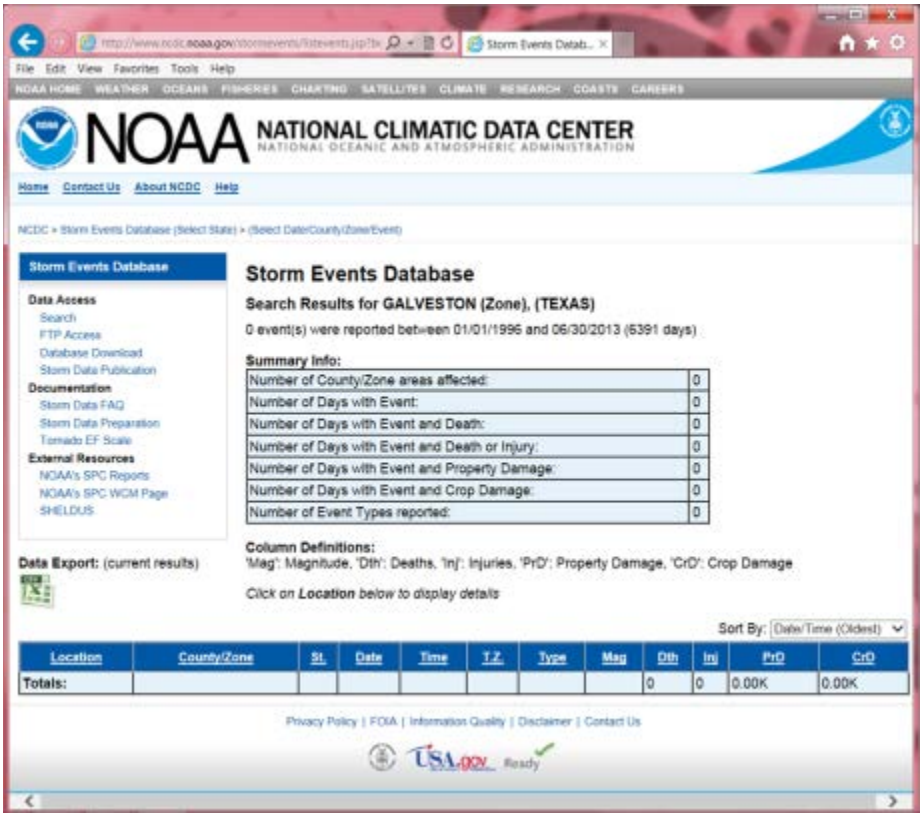
	Units	2014 Tax Year Property Valuation
Single Family Residential	11,550	$ 2,625,159,492
Multi-Family Residential	33	$ 60,987,782
Commercial/Industrial	307	$ 163,036,688
Tangible Commercial	996	$ 41,092,339
Governmental	69	$ 43,022,659
School (FISD only)	6	$ 39,718,981
TOTAL	**12,961**	**$ 2,973,017,941**

WILDLAND-URBAN INTERFACE/FIRE

Although the **WILDLAND-URBAN INTERFACE/FIRE** hazard was included in the 2009 Mitigation Plan to satisfy FEMA requirements during that process, this hazard will not be included for this update as no recorded events have occurred within Galveston County from January 1, 1950 through June 30, 2013.

According to Texas A&M Forest Service, the Wildfire Risk Assessment of 2010 indicates that the City of Friendswood wildfire threat is low to negligible.

Therefore, no further research and/or analysis will be done for purposes of this plan.



SEVERE THUNDERSTORM / HAIL / LIGHTNING

THUNDERSTORMS / HIGH WIND

Severe weather incidents which include thunderstorms, hail, lightning, and high winds have occurred within the community. Several meteorological conditions can result in winds severe enough to cause property damage. Winds have been associated with extreme hurricanes traveling inland, tornadoes, and locally strong thunderstorms. Thunderstorms are the by-products of atmospheric instability, which promotes vigorous rising of air particles. A typical thunderstorm may cover an area three miles wide. In Galveston County, most wind damage has been limited to downed trees, blocked roads, and disabled power lines.

Single cell thunderstorms are sometimes referred to as "airmass", “popcorn”, or “pulse" thunderstorms, and usually do not produce severe weather. They often form in regions of warm, moist air with no strong fronts in the area. Each thunderstorm follows the life cycle of a typical thunderstorm with development, maturity, and decay occurring over a period of 30 minutes to an hour. They may contain heavy rain and can also produce occasional downbursts, small hail, and (rarely) weak tornadoes, but these are fairly rare in single cell storms. Multi-cell clusters are basically what the title says; a cluster of thunderstorms that form and move together. When a single cell thunderstorm forms, it produces a downdraft that can create a gust front of cool air near the ground. The gust front contains denser air than its surroundings, and as it spreads out, it ‘lifts’ the surrounding warm air around it. That ‘lift’ may be just enough to create another updraft which would lead to the formation of one or more additional thunderstorms. This cycle can repeat itself for hours before the cluster of thunderstorms finally dies down.

LOCATION

Thunderstorms/high wind events have the potential to affect the entire planning area. Historically thunderstorm/wind events have been infrequent and sporadic in effect on the city. Thunderstorms associated with lightning, hail, tornado, and flash flooding are addressed separately.

PREVIOUS EVENTS & EXTENT

It is difficult to predict the area where a thunderstorm/high wind event may occur, or the duration of such a storm, therefore, all buildings and facilities are considered to be exposed to these hazards and could potentially be impacted.

PREVIOUS EVENTS

The NCDC database indicates that between 1950 and 2015, Galveston County experienced 313 thunderstorms. Of those 313 events, 97 had winds in excess of 57 mph or higher. Of the 23,920 days during the study period, 130 days experienced an event (.005%), with the highest wind speed of 62 mph. Of the three (3) events which affected the city (.0001%), total damages recorded are $118,000. The NCDC indicates that no thunderstorm/high wind events have occurred in the city since the 2009 Friendswood Hazard Mitigation Plan. Also note that the thunderstorm and winds category of the NCDC database excludes hurricane wind events.

EXTENT

Based upon data available for past events, it can be expected that the city will experience minimal damage in future thunderstorms. Assuming that wind speeds would be in the 57 to 62 mph range, damages are expected to be minimal. As noted above, the chance of damages from a severe thunderstorm/wind event to affect the city is .0001%. Although the potential exists that a severe thunderstorm/wind event could affect the entire city, approximately 12,961 structures are vulnerable to damage. However, damages could involve downed fences and uprooted trees which do not always cause damage to the built environment; missing roof shingles; damage to tar roofs, etc. Damages reported by the NCDC do not specify what damages were incurred, but include an estimate of the damage by reports received by the NWS. The Community Development Department for the city issues building permits for remodel and repair construction, but does not specify what caused the damage, therefore, it is difficult to anticipate estimated structural damages if such an event effected the city. Using an assumption that damages affect 1% to 5% of the structures, 130 to 648 structures could potentially receive damage. Damage estimates are difficult to anticipate based upon the type of material that would be required to make repairs to roofs (shingle, tile, torch-down, etc.), fencing material, debris removal of vegetation, current market cost of materials, and labor costs.

PROBABILITY

FREQUENCY OF OCCURRENCE

☐	Highly Likely	Event probably in next year
☐	Likely	Event probable in next 3 years.
■	Occasional	Event possible in next 5 years.
☐	Unlikely	Event possible in next 10 years.

HAIL

As with other severe weather events, hailstorms may occur year round. Duration of the hailstorm varies from periodic hailstones interspersed with a rain event to an extended hail event lasting up to several minutes.

The Tornado and Storm Research Organization (TORRO) developed the intensity scale for hail which extends from H0 to H10 with its increments of intensity or damage potential related to hail size, texture, numbers, fall speed, speed of storm translation and strength of the accompanying wind. An indication of equivalent hail kinetic energy ranges (in joules per square meter) has been added to the first six increments on the scale, and this may be derived from radar reflectivity or from hail pads. The International Hailstorm Intensity Scale recognizes that hail size alone is insufficient to accurately categorize the intensity and damage potential of a hailstorm, especially towards the lower end of the scale. Without additional information, an event in which hail of up to walnut size is reported (hail size code 3 with hail diameter of 21-30 mm) would be graded as a hailstorm with a minimum intensity of H2-3. Additional information, such as the ground wind speed or the nature of the damage the hail caused, would help to clarify the intensity of the event. For example, a fall of walnut-sized hail with little or no wind may scar fruit and sever the stems of crops but would not break vertical glass and so would be ranked H2-3. However, if accompanied by strong winds, the same hail may smash many windows in a house and dent the bodywork of a car, and thus may be graded an intensity as high as H5. Evidence indicates that maximum hailstone size is the most important parameter relating to structural damage, especially towards the most severe end of the scale.

LOCATION

Hail ranges in size from vanishing small particles to melon-sized dimensions. Hailstones may be spherical, conical or irregular in shape. The size and shape is governed by the violence of the storm cell. The lifting and falling of the freezing moisture pellet within the storm cell increases the size of the hailstone until it is ejected from the cloud.

PREVIOUS EVENTS & EXTENT

PREVIOUS EVENTS

The following table details the hail events which have been recorded, and it should be noted that the following hail events have been recorded near Friendswood, and does not necessarily indicate that the actual damages were recorded within the city exclusively. The NCDC database indicates that between 1950 and 2015, Galveston County experienced 111 storm events with hail. The nearest hail event was recorded in the vicinity of FM 518 and FM 528, with estimated property damage recorded at $2,000. Of the 23,920 days during the study period, 71 days experienced an event (.0029%), with one event of measurable hail diameter of 1¾". Of the five (5) events which affected the city, total damages recorded are $210,000.

Table 5
HAIL HISTORY WITH RECORDED DAMAGES

DATE		REPORTED DAMAGE AMOUNT
April 11, 1997		$5,000
April 27, 1997		$5,000
March 14, 2001		$10,000
March 30, 2002		$40,000
October 4, 2004		$150,000

(Source: NOAA Satellite and Information Service/National Climatic Data Center)

EXTENT

Historically, hail events that have affected the city have been in the H1 and H2 Intensity Category (http://www.torro.org.uk/site/hscale.php) and the city expects future events to occur with the same intensity.

Based upon data available for past events, it can be expected that the city will experience minimal damage in future thunderstorm/hail events. As noted above, the chance of damages from a thunderstorm/hail event to affect the city is .00021%. Although the potential exists that a severe thunderstorm/hail event could affect the entire city, approximately 12,961 structures are vulnerable to damage. However, damages could involve downed damaged roofs and vehicles. Since Friendswood is not classified as an agricultural area, crop damages expected to be negligible. Damages reported by the NCDC do not specify what damages were incurred, but include an estimate of the damage by reports received by the NWS. The Community Development Department for the city issues building permits for remodel and repair construction, but does not specify what caused the damage, therefore, it is difficult to anticipate estimated structural damages if such an event effected the city. Using an assumption that damages affect 1% to 5% of the structures, 130 to 648 structures could potentially receive damage. Damage estimates are difficult to anticipate based upon the type of roofing material that would be required (shingle, tile, torch-down, etc.), current market cost of materials, and current labor costs.

PROBABILITY

FREQUENCY OF OCCURRENCE

☐	Highly Likely	Event probably in next year
■	Likely	Event probable in next 3 years
☐	Occasional	Event possible in next 5 years
☐	Unlikely	Event possible in next 10 years

LIGHTNING

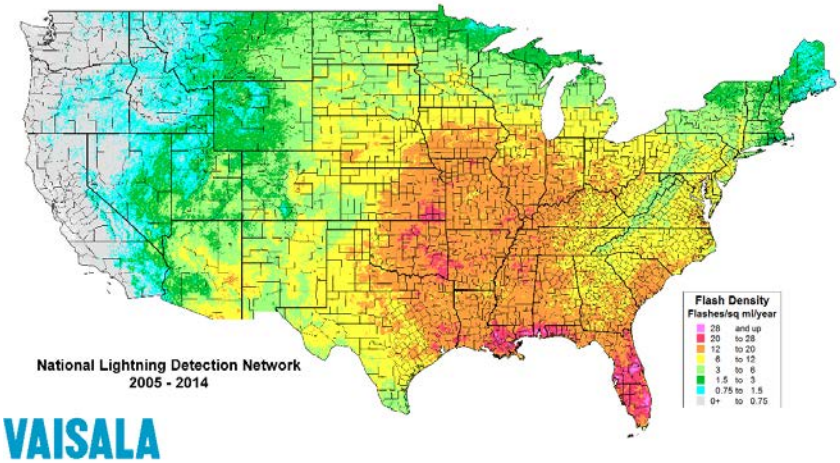
Lightning is a secondary effect of electrification within a thunderstorm cloud system. Lightning damage results from four effects of the lightning strike: electrocution of humans and animals, vaporization of materials along the path of the strike, fire caused by the high temperature produced by the strike, and a sudden power surge that can damage electrical and electronic equipment. Millions of dollars of direct and indirect damages result from lightning strikes on electric utility substations and distribution lines. While property damage is the major hazard associated with lightning, it should be noted that lightning strikes kill more people each year than either tornadoes or hurricanes. Since it is difficult to predict where lightning might strike, all buildings and facilities are considered to be exposed to these hazards and could potentially be impacted.

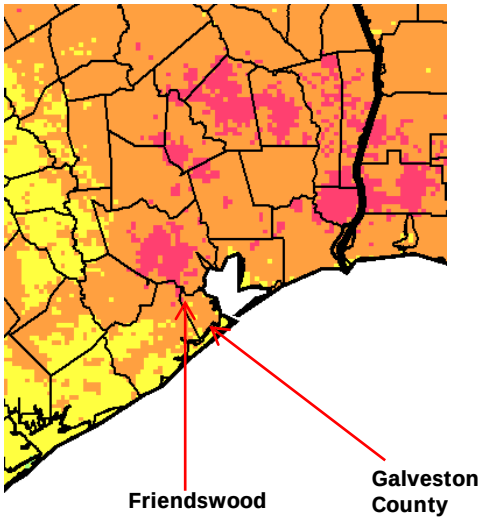
PREVIOUS EVENTS & EXTENT

According records available from the National Lightning Detection Network – NLDN (operated by Vaisala, Inc.), data of cloud-to-ground flash densities for the State of Texas indicates 11.4 flashes per square mile, with a total of 3,025,808 flashes per year.

PREVIOUS EVENTS

NCDC records indicate six (6) lightning strikes in Galveston County for the period of 2008 through October 31, 2013. Of these 6 reports, 5 were located in the southern portion of the county. The nearest recorded lightning strike to the city was located in west League City. No lightning strikes were recorded for the City of Friendswood during this period. As indicated by the figures below, the flash density for the city ranges in the 12-20 flash density per square mile in the lower portion of the city, with a flash density in the range of 20-28 in the northeastern portion of the city. With the City of Friendswood encompassing 23 square miles, the potential exists for up to a density of 262 strikes per year.





EXTENT

BUILT ENVIRONMENT

The entire city is vulnerable to thunderstorm/lightning events. The NCDC database shows that between 1950 and 2015, Galveston County experienced 13 thunderstorm/lightning events (.00054%). According to fire response records for the Friendswood Volunteer Fire Department, two (2) residential structures were struck by lightning resulting in a fire. Damages were estimated at $441,000 (based upon assessed valuation per the Galveston County Appraisal District). Assuming that one percent (1%) of structures per year could be affected by a lightning strike during such an event, damages may potentially amount to $2,973,018. Historical lightning events have ranged in the LAL 4 – LAL 5 level as explained by the Lightning Activity Level on the NOAA website listed below.

HUMAN ENVIRONMENT

No previous incidences have occurred in the city where people have been injured or killed when outside during a lightning storm. However, the City of Friendswood boasts 10 park areas with a total of 265.71 acres. This does not include the outdoor park areas located at the Friendswood school facilities. The city hosts numerous activities in the city's parks throughout the year and is diligent in cancelling events should the potential exist for lightning and/or hail storms. People are vulnerable to lightning strikes when they are outside, especially in wooded areas and open areas, such as soccer, football and baseball fields. Public information materials are available for lightning safety while outside and are posted on the city's website, via Twitter and Facebook. The Parks Department is also very diligent in working with the Office of Emergency Management to obtain updated weather conditions and will cancel all outdoor events should potential dangerous weather conditions exist, especially where the potential for lightning exists.

The **LIGHTNING ACTIVITY LEVEL** is a common parameter that is part of fire weather forecasts. LAL is a measure of the amount of lightning activity using values 1 to 6. (Reference http://www.prh.noaa.gov/hnl/pages/LAL.php for further information.)

PROBABILITY

FREQUENCY OF OCCURRENCE

☐	Highly Likely	Event probably in next year
■	Likely	Event probable in next 3 years
☐	Occasional	Event possible in next 5 years
☐	Unlikely	Event possible in next 10 years

SEVERE THUNDERSTORM / HAIL / LIGHTNING MITIGATION STRATEGY

The Fire Marshal/Emergency Management Office works in conjunction with a variety of organizations, departments, and agencies in effort to address the threats posed by severe weather within the community.

In an effort to mitigate the impact of severe weather within the community, the city provides public outreach programs aimed at increasing family disaster preparedness. The Emergency Management Office submits materials to be published in the annual ***Focus on Friendswood Hurricane Preparedness Newsletter*** which is distributed to all Friendswood residents. The Emergency Management Office participates in emergency management training, exercises, drills, Severe Weather Awareness Week in the spring of each year, and the annual TDEM Hurricane Exercise. Through participation in emergency management exercises, Emergency Management staff members are able to evaluate their capabilities and preparedness status. Constant examination and evaluation of the emergency management functions within the city are a valuable mitigation strategy. To protect the public utilizing the community swimming pool and the various designated sports areas, the Community Development Department conducts annual training sessions for all staff members to be cognizant of impending weather developments (severe thunderstorms, lightning, etc.) and to cease all activities when a potential danger exists.

Emergency Management Officials encourage citizens to purchase and utilize weather radios as a mitigation strategy for the individual. Weather radios are also placed in city facilities, educational facilities, and congregate care facilities within the city limits. Additional sources for obtaining weather information include local television stations, City of Friendswood PEG Channel 17, Friendswood Information Radio 1640 AM in addition to Houston radio broadcasts, e-mail alerts from the city, and the FirstCall Emergency Notification System.

2009 MITIGATION ACTION ITEMS

PUBLIC WARNING SYSTEM	
▪ Utilize available warning systems to inform the public of impending severe thunderstorms, hail storms and potential possible damage from lightning strikes The city utilizes the following systems to broadcast public service announcements: ▪ Radio: Friendswood Information Radio 1650 AM KTRH 740 AM (EAS) ▪ Television: City of Friendswood PEG Channel 17 & all Houston local stations ▪ E-mail Alerts available at www.friendswood.com ▪ Outdoor Warning Siren System (7 sirens) ▪ Storm Spotters (a requirement of "Storm Ready Community" classification), in conjunction with the National Weather Service and the city conducts Storm Spotters Classes on a bi-annual basis.	**STATUS** Ongoing

UPGRADE PUBLIC WATER SYSTEM	
Equipment to provide a consistent supply of safe water during extended power outages following hurricanes, flood events, severe weather events, etc.	
WATER PLANT #5 ▪ Replace elevated tank & ground storage tanks with concrete tanks + new generator	▪ Completed 2011
WATER PLANT #6 ▪ Install 500,000 gallon steel water tank, new pump house, emergency generator	▪ In final stages of construction
WATER PLANT #7 ▪ Replacement of control room, chemical room, conversion of pumps, all valves/piping, replace existing 210,000 existing tank with 500,000 gallon steel unit	▪ Projected completion in FY2014
▪ Purchased an additional 6 M gallons surface water from the City of Houston. ▪ The city has also added 30 fire hydrants to the system within the past five (5) years.	
▪ Installed PVC transmission lines to replace large sections of old water lines; strategic connections and increased certain line sizes to improve pressure and water quality.	

CRITICAL FACILITIES PROTECTION	
This is a updated mitigation item carried over from the 2003 Mitigation Plan to include procedures to maintain consistent service during extended power outages following hurricanes, flood events, severe weather events, etc.	
AUXILIARY POWER ▪ Lift Station #2: CIP 2009 ▪ Lift Station #2: ▪ Surface Water Pump #1: ▪ Blackhawk Regional Treatment Plant: Has partial back-up power for the building and the UV system; estimated cost for full back-up power for the entire plant is	**ACCOMPLISHMENTS** ▪ By utilizing hazard mitigation funds following Hurricane Ike, the city was able to provide natural gas back-up generators to 35 surface water stations and lift stations which are not located in a flood hazard area. ▪ Portable generators are available for use with those lift stations and water stations in the flood hazard areas. All stations have hook-up capabilities. ▪ Replaced large sections of old AC water lines with PVC piping, as well as made strategic connections or increased certain line sizes to improve the pressure/water quality. ▪ The city appropriated funding to the Gulf Coast Water Disposal Authority to be used to rehabilitate the Blackhawk Regional Treatment Plant
▪ Install/provide back-up generator to maintain operations of all city lift stations ▪ Install/provide back-up generator to maintain operations of water wells to provide additional source of water when transmission from the City of Houston is interrupted during natural disaster events	
Lift Station #27 and the Blackhawk Regional Treatment Plant auxiliary power projects have been included in the CDBG grant application. The projects have been approved; awaiting award of funding.	

FLOOD EVENTS

Historically floods are and continue to be one of the most frequent destructive and costly natural hazards. Floods are a natural and recurrent event. Floods take place every year and in all seasons. Flooding is a localized hazard that is generally the result of excessive precipitation.

Flooding events are usually broken down into three different categories: flash floods, riverine floods, and tidal floods. Given present knowledge, the size, time, and place of floods cannot be predicted more than a few hours in advance. Floods are generally the result of excessive precipitation, and can be classified in two broad categories: general and flash floods.

FLASH FLOODING

Flash floods are the product of heavy localized precipitation falling in a short time period over a given location. Flash floods occur within a few minutes or hours of heavy amounts of rainfall, from a dam or levee failure, or from a sudden release of water held by an ice jam. Flash floods can destroy buildings and bridges, uproot trees, and scour out new drainage channels. Most flash flooding is caused by slow-moving thunderstorms in a local area or by heavy rains associated with hurricanes and tropical storms.

GENERAL FLOODING

General floods are defined as precipitation over a given river basin. General floods are usually long-term events that may last for several days. The primary types of general flooding include riverine, coastal, and urban flooding.

RIVERINE FLOODING is a function of excessive precipitation levels and water runoff volumes within the watershed. Coastal flooding is typically a result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes, tropical storms, nor'easters, and other large coastal storms. Urban flooding occurs when development has obstructed the natural flow of water and decreased the ability of natural groundcover to absorb and retain surface water runoff. The recurrence interval of a flood is defined as the average time interval, in years expected to take place between the occurrence of a flood of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing interval.

COASTAL FLOODING is typically a result of storm surge, wind-driven waves, and heavy rainfall. These conditions are produced by hurricanes during the summer and fall, and nor'easters and other large coastal storms during the winter and spring. Storm surges may overrun barrier islands and push sea water up coastal rivers and inlets, blocking the downstream flow of inland runoff.

COMBINED RIVERINE AND COASTAL FLOODING

Certain areas are affected by both riverine and coastal flooding. As subsidence occurs in these areas, the depth of riverine flooding tends to remain constant, while the depth of coastal flooding increases. For floodplain management and flood insurance purposes, criteria used in coastal areas should be applied in areas of combined riverine and coastal flooding.

Clear Creek divides Harris and Galveston Counties. It is subject to combined probability flooding from riverine and coastal/tidal flooding. No home construction is allowed within Zone A areas until the property owner completes a study to determine the BFE (base flood elevation) of the parcel. Based upon the results of the BFE, the parcel is then zoned appropriately and construction elevation is then based upon that determination.

URBAN FLOODING entails the flooding of streets, underpasses, low lying areas, or storm drains. This type of flooding is mainly an inconvenience and is generally not life threatening.

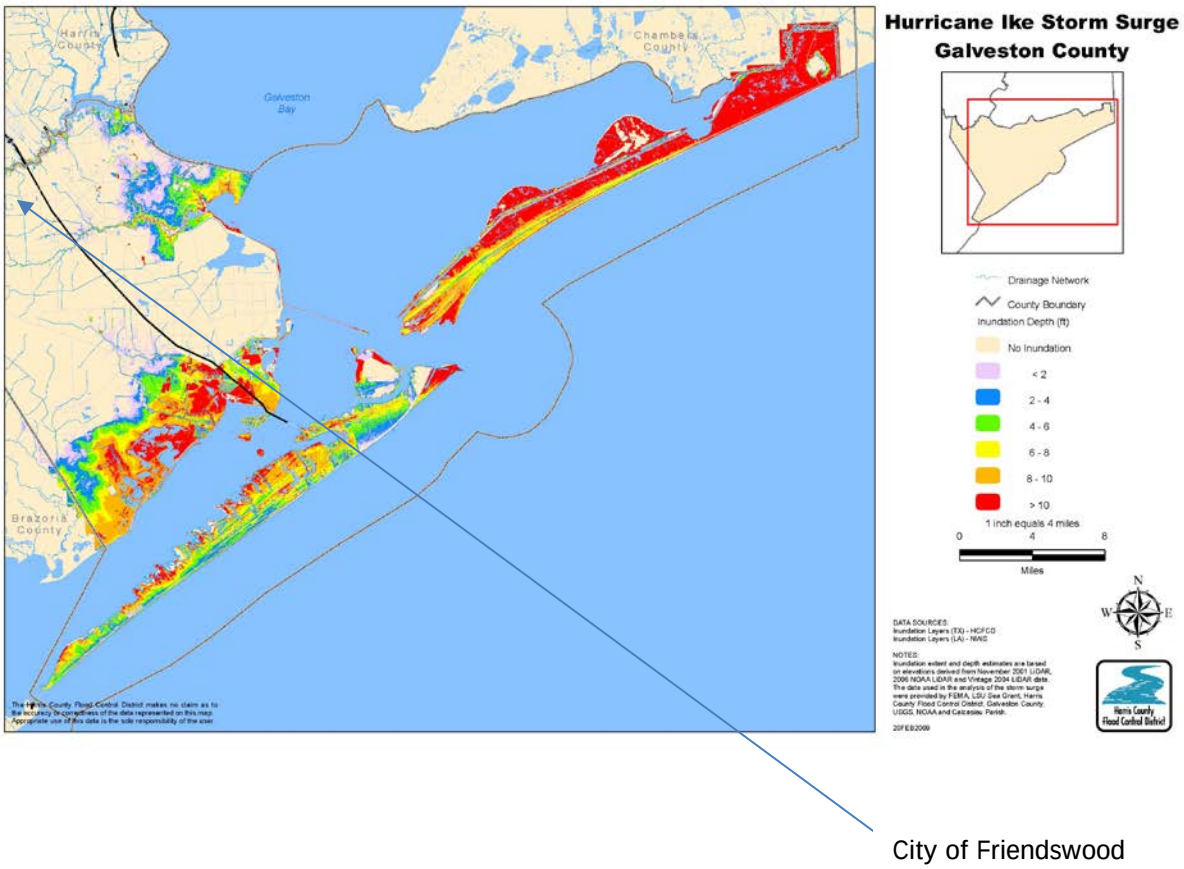
Flood hazard areas are determined using statistical analyses of records of river flow, storm tides, erosion, wave heights, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and coastal, hydrologic, and hydraulic analyses. The Flood Insurance Study covers those areas subject to flooding from rivers and streams, along coastal areas and lakeshores, and/or shallow flooding areas.

As described in the April 20, 2000, Harris County Flood Insurance Study, the City of Friendswood and Harris County are subject to intense local thunderstorms of short duration, general storms extending over periods of several days, and torrential rainfall associated with hurricanes and other tropical disturbances. The National Climatic Data Center (NCDC) of the National Oceanographic and Atmospheric Administration (NOAA) maintains historical data for numerous hazards facing the United States.

Records from the NCDC indicate that Galveston County experienced eight (8) flash flood events from January 1, 2008 through October 31, 2013. The City of Friendswood has experienced 4 Riverine/Flash floods prior to 2008. The two flash flooding events within the city since 2008 occurred April 18 and April 24, 2009. Heavy rainfall from thunderstorms produced widespread flooding of roads. Although Clear Creek at FM 528 was out of its bank, no report of flooding of homes in Friendswood was reported; however high water rescues were conducted in Dickinson to the south, and over 300 homes in League City to the east sustained flood damage in homes. Property damage estimates for this event were $4 million.

Flooding from storm surge (hurricane event) has been recorded five (5) times within the city prior to 2008, and no flooding events from storm surge have occurred within the city since 2008. Two storm surge/flooding events occurred within Galveston County on August 5, 2008, as a result of Tropical Storm Edouard and September 12-14, 2008, following Hurricane Ike. The storm surge was primarily located in the southern most portion of the county.

FIGURE 1
STORM SURGE – HURRICANE IKE



City of Friendswood

STORM SURGE SCALES AND FORECASTING

Prior to the 2009 hurricane season, the National Hurricane Center predicted storm surge levels based on the hurricane wind speed category. A storm surge is a large dome of water often 50 to 100 miles wide and rising from 4 to 5 feet upwards to 20 feet. In 2015 NOAA's National Hurricane Center will offer an experimental graphic to highlight those areas along the Gulf and Atlantic coasts of the United States most at risk for life-threatening inundation by storm surge from a tropical cyclone. The new graphic is designed to introduce the concept of a watch or warning specific to the storm surge hazard, displaying areas that would qualify for inclusion under a storm surge watch or warning system currently being developed by the National Weather Service. As part of a phased implementation plan, experimental storm surge watches and warnings are expected to debut in 2016. After incorporating both user and partner input, the NWS expects to make the new storm surge warning system fully operational in 2017. The storm surge arrives ahead of the storm's actual landfall and the more intense the hurricane is, the sooner the surge arrives. Water rise can be very rapid, posing a serious threat to those who have not yet evacuated flood-prone areas. The surge is always highest in the right-front quadrant of the hurricane. As the storm approaches shore, the greatest storm surge forms to the north of the hurricane eye. The surge of high water topped by waves driven by hurricane force winds can be devastating to coastal regions, causing severe beach erosion and property damage.

According to historical records from the National Climatic Data Center, the City of Friendswood has not experienced flooding related to storm surge. However, it should be noted that if the tropical storm has high storm surge along with heavy rainfall, flooding could be experienced in the city along all the creeks and drainage areas.

The Federal Emergency Management Agency (FEMA) has classified the city as a Category "C" Repetitive Loss Community; therefore, as a condition of participation in the Community Rating System (CRS) Program, FEMA requires a Category "C" community to adopt a floodplain management plan that addresses all hazards within the community and not limited to only repetitive loss areas. The Community Rating System (CRS) indicates the city received a Class Nine (9) CRS Community designation by FEMA on June 1, 1991; upgraded the rating to Class Eight (8) CRS Community on October 1, 1993; and received a Class Five (5) CRS Community rating on October 1, 2003, and maintained the CRS Class 5 rating per the Community Assistance Visit (CAV) visit on September 18, 2007. As of June 2013, the CRS rating is at 5.

The city has participated in the National Flood Insurance Program (NFIP) since June 5, 1970 (Emergency Program) and since March 3, 1972 (Regular Program). To remain in compliance with the NFIP, the city has adopted the following Flood Damage Prevention Ordinances:

TABLE 6
FLOODPLAIN ORDINANCES

FLOODPLAIN ORDINANCE #		ADOPTION DATE
No. 175		March 5, 1973
No. 304		June 5, 1978
3-83		April 4, 1983
87-10		May 4, 1987
90-19		September 20, 1990
90-26		October 15, 1990
91-27		February 26, 1991
98-36		December 7, 1998
99-30		September 27, 1999
03-08		July 7, 2003
07-20		December 17, 2007

The city is mitigating the impact of flooding within the community. The current impact has been greatly reduced from what it was ten years ago. Cooperative projects with the Galveston County Consolidated Drainage District and Harris County Flood Control District seek to reduce flood losses. Acquisition projects

such as the Hazard Mitigation Grant Program (HMGP) following Tropical Storm Allison have reduced the number of persons exposed to flood hazards. In April 2008, the city conveyed an easement to the GCCDD over a buy-out tract for the purpose of in-line detention on Mary's Creek. City officials continue to encourage the purchase of flood insurance as a mitigation measure for individuals in the community. Flood insurance policies are available to all residents of the City of Friendswood. Because the City of Friendswood participates in the CRS program, flood insurance policy holders pay reduced premiums.

It is important to note that flooding has damaged additional properties but exact records are not known because the properties and losses were not covered by flood insurance. Neither FEMA nor the TDEM has records that identify all flooded properties within the city.

DEFINITIONS OF FEMA FLOOD ZONE DESIGNATIONS

Flood zones are geographic areas that are defined according to varying levels of flood risk. Special Flood Hazard Areas (SFHA) zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map (FHBM). The SFHA is a high-risk area defined as any land that would be inundated by a flood having a 1% chance of occurring in a given year (also referred to as the base flood). The SFHA is the area where the National Flood Insurance Program's (NFIPs) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. The SFHA includes Zones A, AO, AH, A1-30, AE, A99, AR, AR/A1-30, AR/AE, AR/AO, AR/AH, AR/A, VO, V1-30, VE, and V. Each zone reflects the severity or type of flooding in the area. For further information regarding the description of each flood zone; see http://stdblearningcenter.com/uploads/fema-flood-zone-definitions.pdf

The public becomes aware of local hazards in various ways. For example, public awareness of flood hazards is enhanced during the following activities:

- Buying property in a floodplain triggers the federal requirement to obtain flood insurance. Federally insured and regulated mortgage lenders are required to inform the potential homeowner of the necessity of purchasing flood insurance if the building is located in a mapped flood hazard area.

- Applying for permits will lead to the determination that the property or construction site is within a mapped floodplain and is subsequently subject to floodplain management requirements.

- When flooding occurs the news media frequently advises the public of travel which is hampered by flooded roads and homes which may be damaged by floodwaters. Research has shown that many flood victims tend to discount the likelihood that flooding will occur again. This tendency is attributed to a general lack of understanding of probability. Often people interpret the phrase "100-year storm" to indicated it only occurs once every 100 years, rather than such an event has a 1-in-100 chance of happening each year.

- Flood warnings reach the public as regional warnings from the National Weather Service.

REPETITIVE LOSS PROPERTIES

Of primary concern to the City of Friendswood are the four major watersheds: Clear Creek, Chigger Creek, Cowards Creek and Mary's Creek. Several smaller drainage features also crisscross the city's 21.1 square miles.

FEMA DEFINITION

The Flood Mitigation Assistance (FMA) Grant Program provides grants to assist states and communities in implementing measures to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. The FMA Grant Program was created as part of the National Flood Insurance Reform Act (NFIRA) of 1994 with the goal of reducing or eliminating claims under the NFIP. The Biggert-Waters Flood Insurance Reform Act of 2012 changed the FMA Grant Program in 2013 to allow more federal funds for properties with repetitive flood claims and

severe repetitive loss properties, and the Repetitive Flood Claims and Severe Repetitive Loss Grant Programs were eliminated.

Repetitive Loss (RL) and Severe Repetitive Loss (SRL) data is based on flood insurance damage claims by property and by community.

SRL

An SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both of the criteria detailed above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

RL

Any residence or business that has received two or more claim payments greater than $1,000 from the National Flood Insurance Program within any rolling 10-year period, the property is considered a Repetitive Loss (RL) structure.

Repetitive flood loss data for the city reveals 307 residences with a history of severe and/or repetitive flood losses. The buyout process following Tropical Storm Allison (2001) mitigated (removed) 112 properties from the RL/SRL inventory, leaving a total of 195 properties remaining on the repetitive flood loss listing. In July 2011, Galveston County participated in the FEMA SRL Elevation grant Program. This is a voluntary mitigation program to provide funding to reduce or eliminate long-term risk of flood damage to SRL and RL structures insured under NFIP. The SRL Elevation Project criteria are to raise existing structures at or above the BFE (base flood elevation), must be cost-effective and prior flood loss determines benefit. This program was extended to homeowners in Friendswood, Galveston County, for participation. Friendswood has 14 RL/SRL participating properties. Once all the elevations have been completed, there will be a remainder of 181 RL/SRL properties in Friendswood. The 181 unmitigated RL/SRL properties represent .1.56% of the 11,583 households within the city.

FEMA Community Information System records indicate the city has 7,380 flood insurance policies in force with coverage totaling $2,245,449,000 and $3,273,504 in paid premiums. The city has reviewed FEMA records to determine which areas of the city have received flood insurance claims. Based upon FEMA Community Information System records 1,175 flood claims have been paid with losses totaling $48,644,765 (includes structure and contents losses). The average residential flood insurance claim paid in the city is $49,340. There are 7,380 flood insurance policies in force within the city, which represents 55% of the total structures.

Historically, flood events that have occurred within the city were the direct result of flash and riverine flooding. All of the significant flood events were precipitated by heavy rain events. Hurricane Ike, September 2008, produced significant tidal surge heights; however, only one (1) incident of flooding was documented within the city. The rising water did not inundate the living quarters of the residence, but the garage area only.

TABLE 7
SUMMARY OF RL AND SRL PROPERTY CLAIMS

	RL / SRL ALL RECORDS	MITIGATED PROPERTIES
Total Number of Properties	307	112
Number of Paid Claims	1,175	532
Building Payments	$32,585,977	$19,560,601
Contents Payments	$16,058,788	$10,743,528
TOTAL PAYMENTS	**$48,644,765**	**$30,304,130**
Average Payment	$28,524	$56,963
Building Value	$43,358,874	$19,442,020
PERCENTAGE MITIGATED AS OF 04/30/2014		**36.48%**

TABLE 8
GALVESTON COUNTY 2013 HMA GRANT ASSISTANCE PROGRAM / ELEVATION

	2013 HMA GRANT ASSISTANCE PROGRAM
Total Number of Properties	14
Number of Paid Claims	65
Building Payments	$1,964,463
Contents Payments	$923,919
TOTAL PAYMENTS	**$2,888,381**
Average Payment	$44,437
Building Value	$2,525,109
TOTAL PERCENTAGE MITIGATED (112 BUYOUTS + 14 ELEVATED)	**41%**

Of the 14 property owners who have executed contracts through the 2013 HMA Grant Assistance program through Galveston County, participation was voluntary. Financial costs are based on a 90/10 split with the homeowner covering 10% of the cost of the elevation. Four (4) of these residences qualified for ICC (Increased Cost of Compliance) through their private insurance carriers, which can be utilized toward their 10% financial obligation.

FIGURE 2
REPETITIVE FLOOD LOSS (RL)

MAP REMOVED

This map has been removed to achieve document brevity. If you would like to view this map, you can find a copy on the City of Friendswood's website at www.friendswood.com; **Online Services**, "GIS Interactive Mapping"

The City of Friendswood has identified facilities critical to the fulfillment of city services as well as facilities that are vulnerable to the impact of disaster. A map illustrating the location of critical and vulnerable facilities is located in **FIGURE 3**.

- The following locations are listed as vulnerable facilities with their approximate flood zone identified as in the 100-year floodplain (AE), 500-year floodplain (Shaded X -SHX), or outside of the floodplain (Unshaded X -UNX).
- The critical and vulnerable facilities are also identified as High Consequence Areas (HCAs) potentially at risk during a pipeline incident.

TABLE 9
CRITICAL AND VULNERABLE FACILITIES

INFORMATION REMOVED

As part of the Texas Homeland Security Act, Sections 418.176 through 418.182 were added to Chapter 418 of the Government Code.

§ 418.180. CONFIDENTIALITY OF CERTAIN INFORMATION PREPARED FOR UNITED STATES.

Information, other than financial information, in the possession of a governmental entity is confidential if the information:
(1) is part of a report to an agency of the United States;
(2) relates to an act of terrorism or related criminal activity; and
(3) is specifically required to be kept confidential:
(A) under Section 552.101 because of a federal statute or regulation;
(B) to participate in a state-federal information sharing agreement; or
(C) to obtain federal funding.
Added by Acts 2003, 78th Leg., ch. 1312, § 3, eff. June 21, 2003.

FIGURE 3
CRITICAL FACILITIES MAP

INFORMATION REMOVED

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Added by Acts 2003, 78th Leg., ch. 1312, § 3, eff. June 21, 2003.

PREVIOUS EVENTS & EXTENT

PREVIOUS EVENTS

The city has experienced ten (10) major flooding events since 1973. Prior to 2008, of the 7 major flooding events 6 were federally declared disaster events. Since 2008, three (3) flooding events have affected the city. Heavy rainfall occurred April 18-19, and again on April 24, 2009. Widespread street flooding occurred due to overwhelmed drainage systems. One report of residential flooding occurred with approximately $5,000 in damages. Hurricane Ike was a severe wind event with extensive debris in the form of downed trees and fences; however, one flood report was received regarding flooding in a detached garage.

EXTENT

Drainage systems within the city are constructed to handle the runoff of 2" of rain per hour. With this design, rain is expected to remain in the streets and prevent flooding of homes and other structures. However, whenever rainfalls which exceed the 2" per hour, the existing storm drainage system can become overwhelmed and result in street flooding which makes some roads impassable, and also cause water to rise into the yard areas of the structures. The Office of Emergency Management maintains a listing of all the streets located near Clear Creek, Chigger Creek, Mary's Creek, and Cowart Creek where water levels may cause the streets to become impassable during rain events when over 2" off rain falls within an hour or longer. During storm events where rainfall exceeds 2" per hour, members of the Friendswood Police Department and the Office of Emergency Management survey the status of all streets on the list. Currently there are 63 city blocks that are monitored during such rain events. In the event streets become impassable, the Public Works Department will place barriers to prevent motorists driving through the area. The city also monitors all Harris County Flood Control District flood gauges in Clear Creek when during heavy rain events and when runoff is expected from bayous in Houston and Harris County.

When rainfall and/or storm runoff exceeds the 2" per hour rate, flooding along the four watersheds will flow over their banks and threaten structures and roads will become impassable. With flooding along the designated flood zones as indicated on the map in **FIGURE 4**, it is estimated that approximately 1.56% of the houses within the city are vulnerable (181 homes) to potential flooding from a level of a few inches to several feet. Depth of flooding varies depending on the location of the residence; i.e., located in a floodway or a 100-year flood zone. Several flood mitigation projects completed by the city and projects completed in cooperation with the Galveston County Consolidated Drainage District have alleviated flooding problems in several areas of the city.

Completion of the following drainage projects as identified in the city's capital improvements plan has reduced flooding in the following areas:

DRAINAGE PROJECT	NUMBER OF RESIDENCES AFFECTED	DETENTION ACREAGE
Sunmeadow	504	
Annalea/Whitehall/Kings Park	516	
Clover Acres	23	
Glenshannon	142	
Woodlawn	17	
FM518 (Willowick to Cowards Creek)	71	
West Ranch	1141	54.7

All new commercial development within the city is required to provide detention/retention ponds on site. Residential developments are required to provide detention/retention areas, or open space areas which allows water along the creeks to spread out during flood events thus slowing the flow of the water, and prevents water from encroaching onto residential or commercial properties.

TABLE 10
FLOODING EVENTS 2008-2013

DATE	EVENT DESCRIPTION	ESTIMATED DAMAGE COSTS
April 18-19, 2009 Heavy Rainfall	Total rainfall for both days was 8"; of which 6" fell in a one hour time period around Clear Creek at FM 528. Tides were elevated due to persistent easterly and southeasterly winds, which resulted in slower than normal drainage in low lying coastal areas near Clear Lake and Galveston Bay. Widespread street flooding occurred mainly from drainage systems being overwhelmed by the intense rainfall.	Unknown None Reported
April 24, 2009 Heavy Rainfall	Flash Flood from a series of thunderstorms which produced heavy rainfall and strong winds across portions of Harris, Galveston and Chambers Counties. Numerous roads in and around Friendswood were impassable due to high water caused by heavy rainfall. Several high water rescues were required due to the flooding. Total rainfall was 6"; two house fires occurred as a result of lightning strikes. One home was flooded in the SE portion of the city.	$5,000

FIGURE 4
FLOODPLAIN MAP

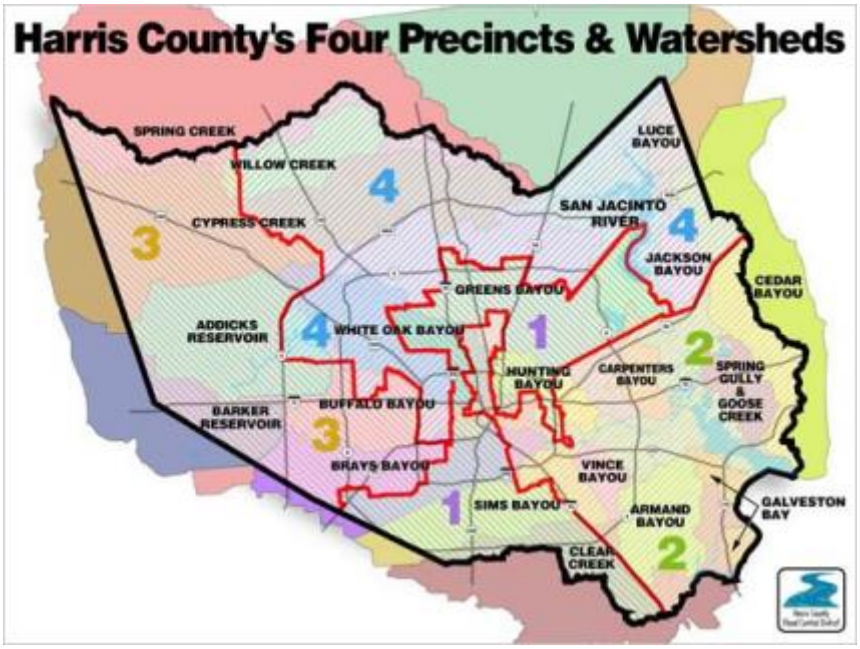
MAP REMOVED

This map has been removed to achieve document brevity. If you would like to view this map, you can find a copy on the City of Friendswood's website at www.friendswood.com; **Online Services**, "GIS Interactive Mapping"

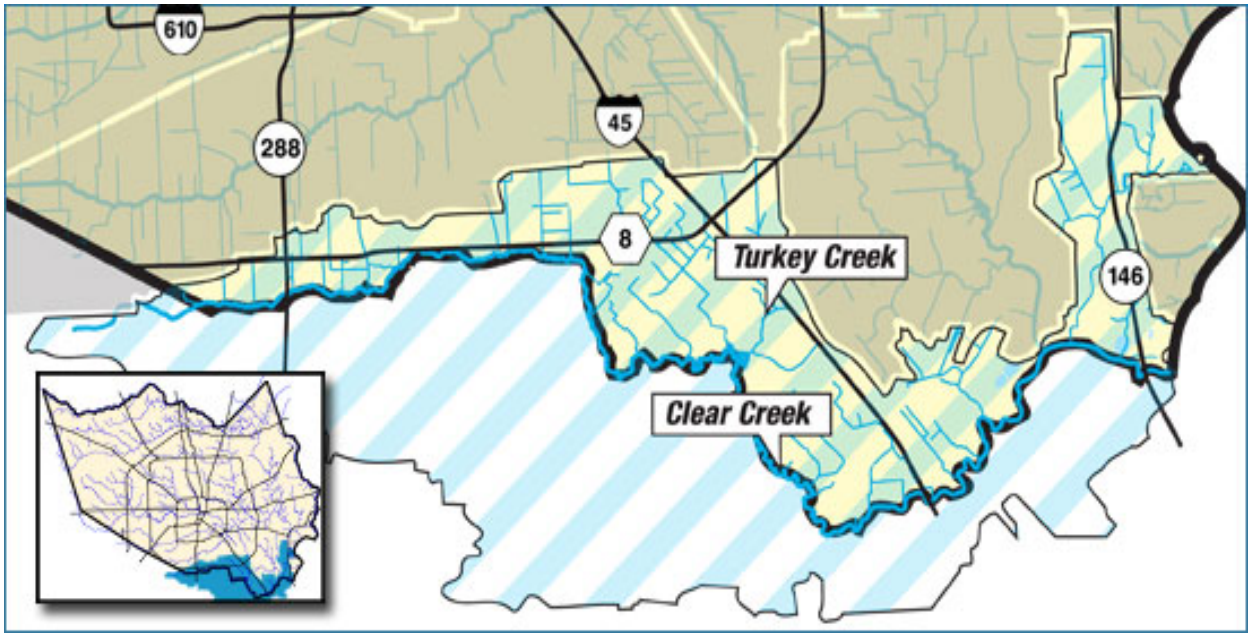
HARRIS COUNTY FLOOD CONTROL DISTRICT

After devastating floods of 1929 and 1935, the City of Houston issued a plea to Congress and secured a commitment for federal flood control assistance. In 1937, the Texas Legislature created the Harris County Flood Control District and designated the Harris County Commissioner's Court as the governing body. The Harris County Flood Control District has acted as the local sponsor for numerous federal flood control projects to protect the lives and property of local citizens. The city is an active partner with the Harris County Flood Control District and the U.S. Army Corps of Engineers. The partnership has resulted in numerous multi-objective projects that provide flood protection and maximize the use of public lands.

The Harris County Flood Control District does "not" have sole jurisdiction over flood-related matters in Harris County. In fact, there are many other entities involved that have special interests in their particular areas of responsibility. The City of Houston, for example, is one of the local floodplain administrators for the community's participation in the National Flood Insurance Program (NFIP). The city has its own criteria for design of its drainage systems - primarily the design of storm sewers and street drainage, but also stormwater detention storage for these systems.



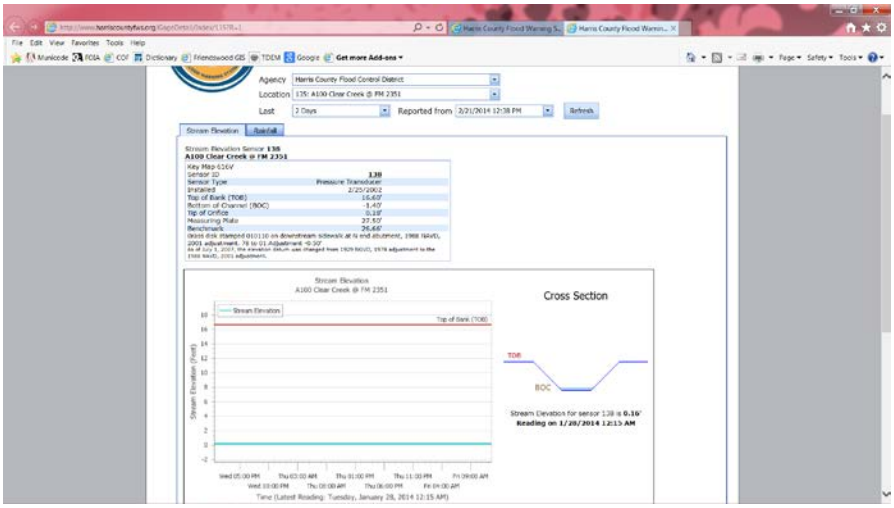
CLEAR CREEK WATERSHED

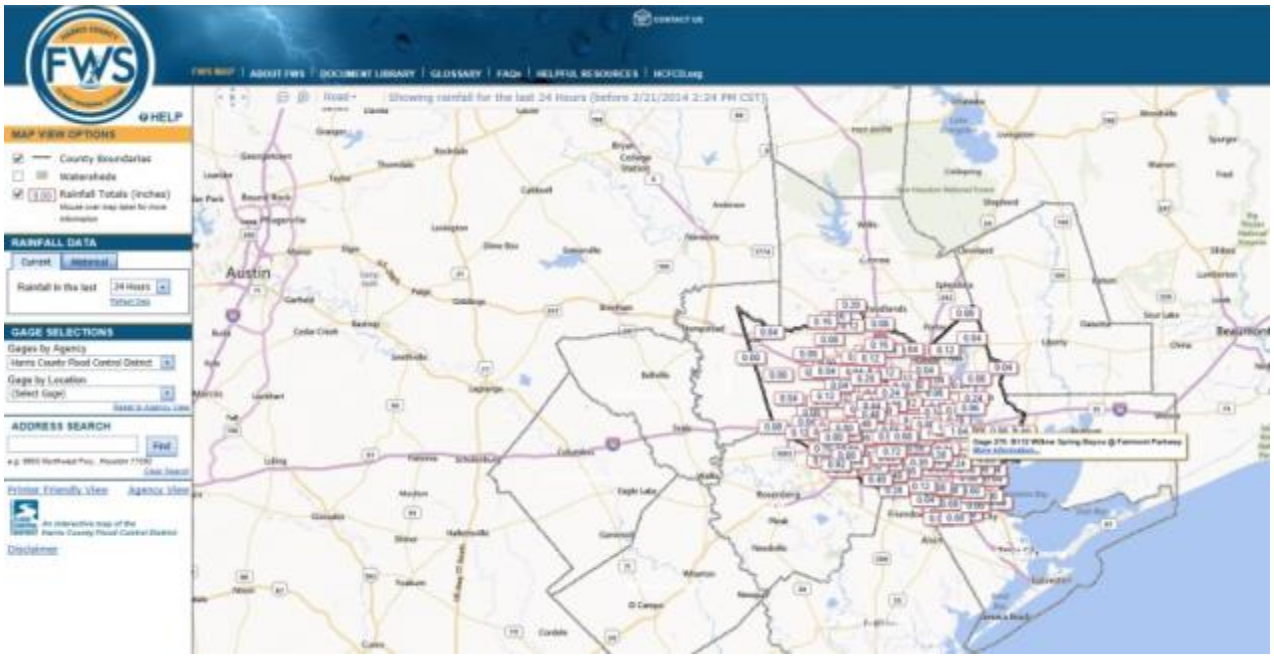


HARRIS COUNTY FLOOD WARNING SYSTEM

The Harris County Flood Control District's Flood Warning System measures rainfall amounts and monitors water levels in bayous and major streams on a real-time basis to inform of dangerous weather conditions. The system relies on 133 gage stations strategically placed throughout Harris County bayous and their tributaries. The stations contain sensors that transmit valuable data during times of heavy rainfall and during tropical storms and hurricanes. Some gages also measure wind speed and direction, barometric pressure, air temperature, road temperature and humidity.

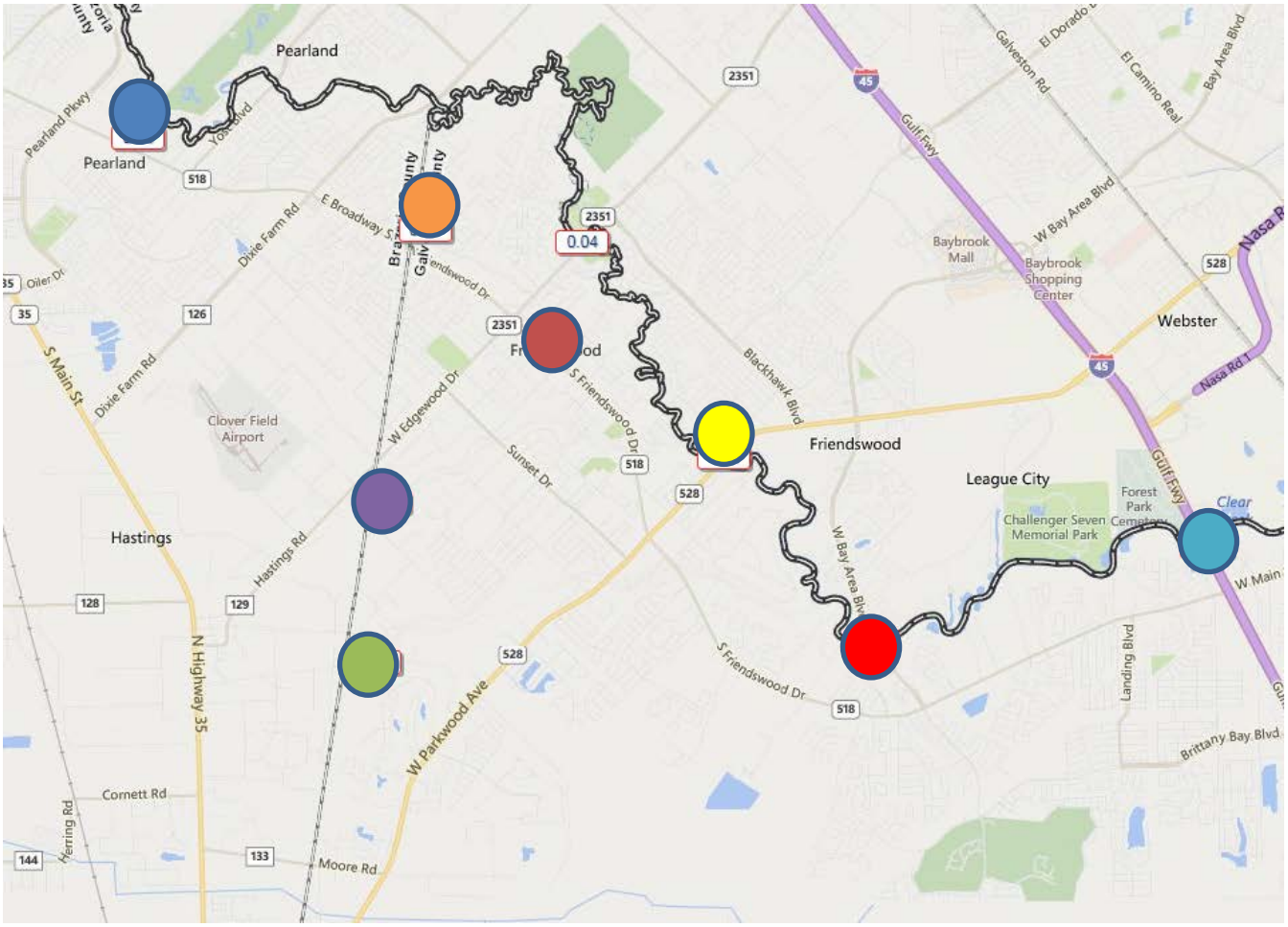
The purpose of the Flood Warning System website is to provide information collected by the gages in a user-friendly format. This information is used to inform of imminent and current flooding conditions along bayous. It also is used by the National Weather Service to assist in the issuing of flood watches and warnings. Accurate rainfall and bayou/stream level data help make critical decisions that ultimately can reduce the risk of property damage, injuries and loss of life. *(http://www.harriscountyfws.org/)*



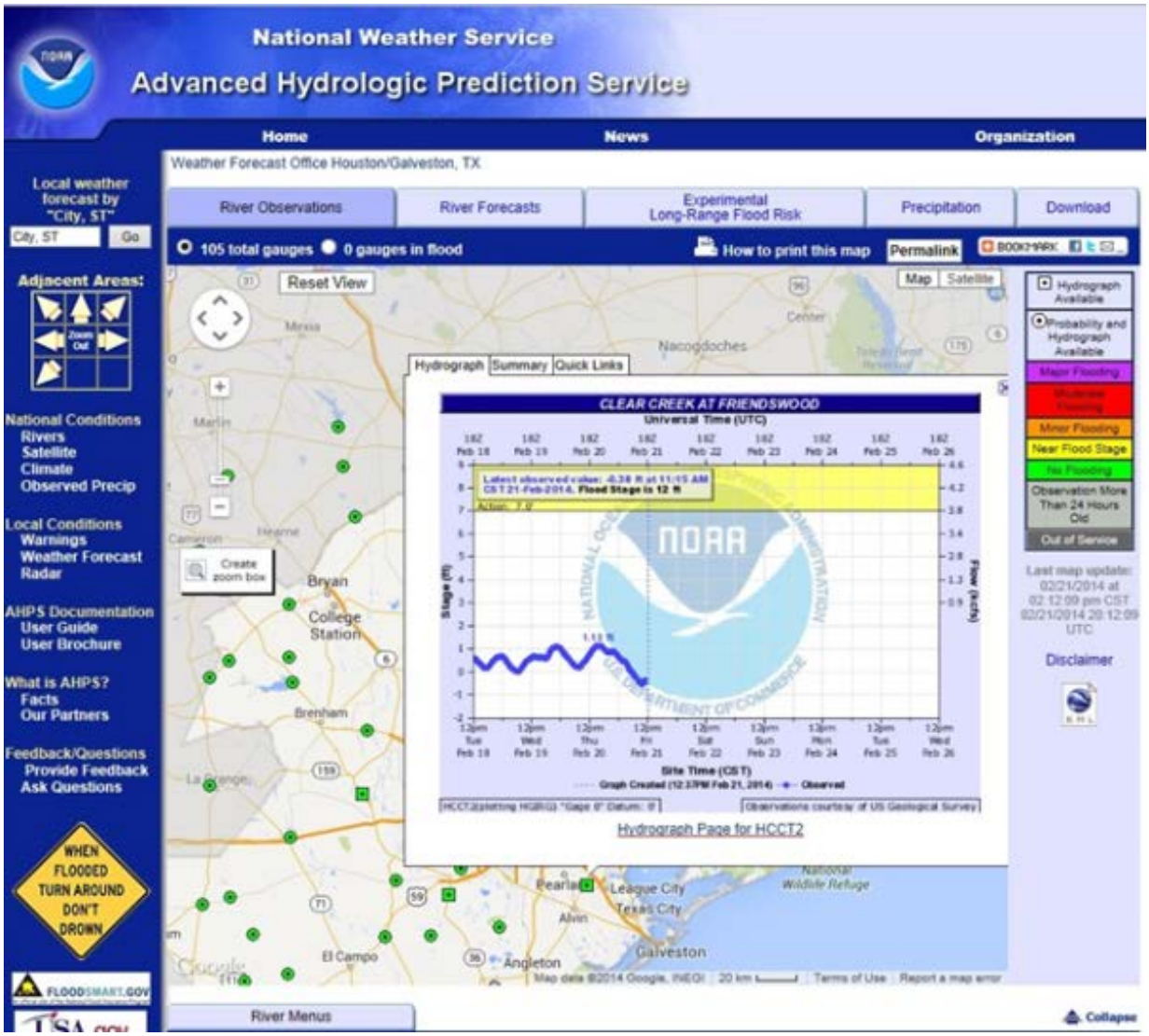


Harris County Flood Control gauge locations in the City of Friendswood.
Locations are:

- Gauge 105: Mary's Creek @ Winding Road
- Gauge 115: Coward Creek @ Baker Road
- Gauge 125: Chigger Creek @ Windsong Lane
- Gauge 135: Clear Creek @ FM 2351
- Gauge 120: Clear Creek @ FM 528
- Gauge 130: Clear Creek @ Bay Area Boulevard (League City)
- Gauge 110: Clear Creek @ IH-45 (League City)
- Gauge 150: Clear Creek @ Country Club Drive (Pearland)



An additional resource for current information regarding rainfall, flooding and current flood stages and severe weather as well as future forecasts is currently in the experimental stages and under the guidance of the National Oceanic and Atmospheric Administration. *(http://www.srh.noaa.gov/rfcexp)*



PROBABILITY

FREQUENCY OF OCCURRENCE	
☐ Highly Likely	Event probably in next year
■ Likely	Event probable in next 3 years
☐ Occasional	Event possible in next 5 years
☐ Unlikely	Event possible in next 10 years

FLOOD MITIGATION PROJECTS

FLOOD INSURANCE STUDY (FIS)

Flood Insurance studies are often developed in conjunction with FIRMs. The FIS typically contains a narrative of the flood history of the community and discusses the engineering methods used to develop the FIRMs. The most recent FIS for Galveston County is dated August 21, 2002. The FIS indicates that riverine flooding results primarily from overflow of the streams and drainage ditches caused by rainfall runoff, ponding, and sheet flow. Storms occurring during the summer months are often associated with tropical storms moving inland from the Gulf of Mexico. Thunderstorms are common throughout the spring, summer and fall months. Hurricanes and tropical storms interrupt the summer with high winds, heavy rainfall, and high storm surges.

COF DRAINAGE PROJECTS

The city continues to enforce its floodplain management ordinance and retain a CRS Rating of 5. Despite efforts to improve our Rating to that of a 4, changes by FEMA to the CRS Manual and grading criteria have made pursuit of a CRS Rating of 4 much costlier.

The city maintains $1,000,000 of General Reserve Funds to put toward the Mud Gully drainage and detention project. This project is a major component of the USACE's overall Clear Creek project. Design of the Mud Gully improvements is well underway with Phase 1 expected to break ground in early 2014.

COMPLETED PROJECTS THROUGH CAPITAL IMPROVEMENTS PLANNING

Sunmeadow Drainage
Annalea/Whitehall/Kings Park Drainage
Clover Acres Drainage
Glenshannon Drainage
Woodlawn Streets & Drainage
FM518 Drainage Improvements (Willowick to Coward's Creek)
Mud Gully Detention & Conveyance
Melody Lane Reconstruction & Drainage
Sunnyview/Skyview Streets & Drainage

FLOODPLAIN MANAGEMENT (MASTER DRAINAGE PLAN)

Although the city has not participated in any additional buyout programs, there have been efforts on the part of Harris and Galveston County to either buyout or elevate repetitive loss properties in Friendswood since 2009. The city continues to maintain listing of those properties to ensure compliance with our floodplain management ordinance.

Through an HMA Grant for SRL/RL properties, 14 homeowners have executed contracts to participate in a voluntary elevation mitigation project. This project will elevate these 14 residences above the BFE (base flood elevation). This program is a 90/10% cost share program coordinated through Galveston County.

FLOODPLAIN MANAGEMENT PLANNING

The Community Rating System (CRS) is an overall strategy of programs, projects, and measures that will reduce the adverse impact of a flood hazard on the community. The CRS does not specify what activities a plan must recommend, but recognizes plans that have been prepared according the standard planning process. Emphasis is based on Floodplain Management Planning (FMP), Repetitive Loss Area Analyses (RLAA), and Natural floodplain functions plan (NFP). Since the city is classified as a Category C repetitive loss community, it must prepare either a FPM or RLAA area analysis that covers at least all of its repetitive loss areas.

GALVESTON COUNTY CONSOLIDATED DRAINAGE DISTRICT - PROJECTS/EXTENT OF SERVICES PROVIDED

The District's mission remains the same: to reduce the probability of flooding throughout the Friendswood area by improving drainage while preserving the natural beauty of the creeks, resulting in increased safety, higher quality of life and

an environment fostering economic growth.

COMPLETED PROJECTS

Wegner Ditch/Tributary 2 – City of Friendswood and GCCDD
Replace ditch with box culvert and shallow surface swale; will improve drainage and reduce long term maintenance using inline detention and the Baker Road detention facility

Channel improvements to Chigger Creek
Conservation and reclamation of existing drainage channel using inline detention
- Phase 1 – Slope Improvements from Clear Creek to Oak Drive
- Phase 2 – Slope Improvements from Oak Drive to FM518
- Phase 3 – Slope Improvements from FM518 to FM528

BIGGERT-WATERS (BW-12) FLOOD INSURANCE REFORM ACT OF 2012

The Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12) was passed by the U.S. Congress in hopes of making the NFIP more financially stable by raising rates on certain properties to reflect the true cost of flood risk. FEMA is also in the process of updating all FIRM (Flood Insurance Rate Maps) maps usually adopted by those communities participating in the NFIP program.

The BW-12 Act hopes to achieve that insurance rates will more accurately reflect the flood risk. The BW-12 will phase out subsidized rates for non-primary/secondary residences, along with eliminating the subsidized rates for certain other classes of properties. Although only twenty percent (20%) of NFIP policies receive subsidies, rates will increase at a 25% annual rate for non-primary/secondary residences in a SFHA (begins January 1, 2013), subsidized policies on property that has experienced severe or repeated flooding until rates reflect true risk (begins October 1, 2013), and subsidized policies on business/non-residential properties in a SFHA until rates reflect true flood risk (October 1, 2013). Along with policy rate increases, property owners may have to obtain an elevation certificate to determine correct rates. Along with premium increases, policy holders will also be paying a 5% 'Reserve Fund Assessment' on the policy premium. This assessment will be used to create a reserve fund to reduce the NFIP's need to borrow money from the federal government to pay claims. There will also be an annual 'Federal Policy Fee' of $44.00 on each policy to cover the operational cost of the program. The ICC (Increased Cost of Compliance) fee of $34.00 provides policyholders who need extra funds to bring their property into compliance with local floodplain ordinances after it is damaged by a flood. The coverage provides up to $30,000 to elevate, relocate, flood-proof or demolish the property.

2009 MITIGATION ACTION ITEMS

FLOODPLAIN MANAGEMENT COMMUNITY RATING SYSTEM RECERTIFICATION	
▪ Review and update the city's floodplain regulations/ordinances as appropriate. ▪ Review and update the city's Regional Drainage Study. ▪ Coordinate and cooperate with USACE and Harris County Flood Control District with regard to Clear Creek Federal Flood Protection Project. ▪ Require elevation certificates on all construction plans submitted for development. ▪ Maintain annual progress records of all repetitive loss properties. ▪ Continue adherence to the open space requirements. ▪ Continue annual outreach projects for structures located within the SFHA. ▪ Continue to implement the drainage system maintenance program. ▪ Continue to encourage residents participate in the NFIP.	▪ The city continues to enforce its floodplain management ordinance (City of Friendswood, Code of Ordinances, Part II, Chapter 34-Floods) for all development in order to maintain the current CRS rating of 5. Despite efforts to improve the CRS rating to a 4, changes by FEMA and to the CRS manual and grading criteria have made pursuit of that rating costlier. ▪ Master Drainage Plan was updated in conjunction with the acceptance of the TSARP map. ▪ Elevation certificates are required for all new development, specifically in the SFHA with more emphasis since Tropical Storm Allison, 2001. ▪ Letters are sent to all property owners within the SFHA to ensure they are aware of any changes in the CRS Rating, FEMA updated information, NFIP program, hurricane preparedness materials, etc. ▪ The city adheres to open space requirements for all new development projects.
▪ Maintain detailed records for all repetitive flood loss properties	Ongoing

FLOODPLAIN MANAGEMENT MASTER DRAINAGE PLAN	
▪ The Community Development Department utilizes the Master Drainage Plans as a planning tool for future project development and budgeting. ▪ Five (5) projects are identified in the Phase II drainage study adopted in 2007. ▪ The city is coordinating work with the GCCDD on the Melody Lane and Willowick projects identified in the second phase of the 2007 Drainage Plan. ▪ The northern and southern panhandle of the regional detention project is a Capital Improvements Project to be included within the city's annual budget process with cooperation with Galveston County Bond package.	▪ The Sun Meadow Relief Storm Sewer, Phase I & II, are completed. ▪ Melody Lane and FM518 drainage, Phase I, has been completed as a joint effort with Galveston County. ▪ Mission Estates Outfall improvements were completed as part of the Sterling Creek residential development project. ▪ General reserve funds are being used toward the Mud Gully drainage and detention project in the northwest portion of the city. This project is a major component of the USACE overall Clear Creek project. Phase I ground breaking to begin early 2014.

ELEVATION, RELOCATION AND ACQUISITION DATABASE MAINTENANCE	
▪ All properties designated as RL and SRL are maintained in a database and updated on an annual basis. ▪	▪ The purpose of the activity is to offer buyout options in future events if the City of Friendswood opts to participate in a buyout program with FEMA grant monies.
▪ Conduct an annual evaluation of FEMA's Repetitive Loss Database to prioritize and identify potential properties that may qualify for acquisition, relocation and elevation projects	▪ 14 property owners have volunteered for the 2013 Galveston County HMA Grant Program for elevation of residences. As of this date, 4 of the residences have been elevated.
▪ Obtain Class 4 CRS Rating.	▪ Changes by FEMA to the CRS Manual and the grading criteria have made pursuit of a 4 Rating costlier.
▪ The adoption of floodplain management ordinances and more restrictive building codes with regard to building elevation, the city anticipates this will prevent severe flooding of homes identified as RL/SRL properties and ultimately eliminate the addition of homes to the current listing.	▪ The city has amended the existing deed restrictions for the buyout lots in the Imperial Estates Section 1 subdivision (this project was a result of TS Allison, 2001) to align them with FEMA requirements and set the framework for enhanced park facilities.

HURRICANE / TROPICAL STORM

Hurricanes and tropical storms combine size and intensity to become one of Earth's greatest and most awesome weather vehicles of disaster. In addition to hurricanes and tropical storms, damage may be caused by tornadoes that are created from the storms. The Texas coast is not immune to the damages from such storms. Hurricane season lasts from June 1 to November 30. The most active portion of hurricane season is August, September, and October.

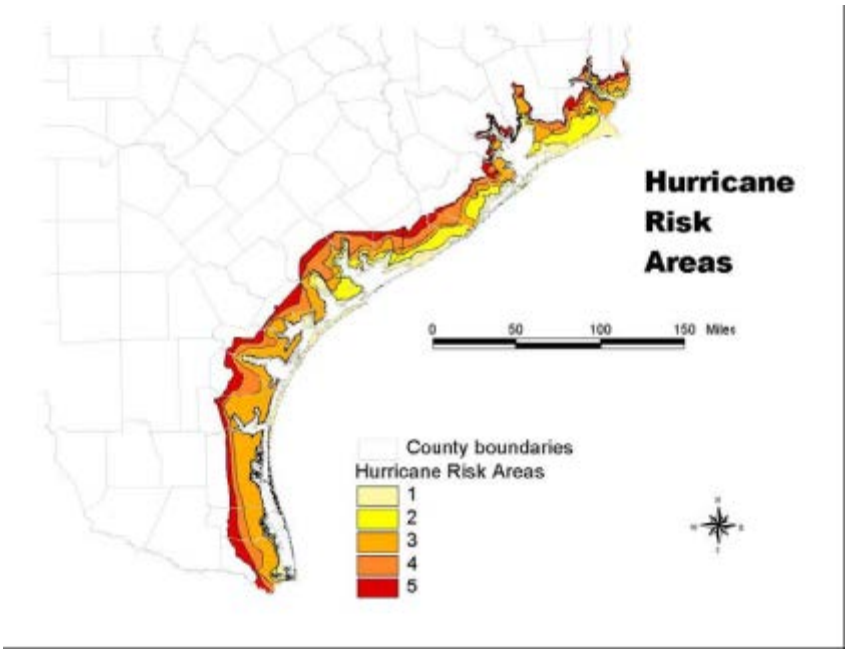
Hurricanes, tropical storms, nor'easters include any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise and whose diameter averages 10-30 miles across. While hurricane winds cause severe damage, the storm surge and torrential rains accompanying hurricane landfall are responsible for most deaths. The storm surge raises wave heights and increases tides. Torrential rain can cause both flash flooding and riverine flooding in the area.

As tropical storms develop, the barometric pressure at the center falls and the winds increase. If all conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated as a tropical storm, given a name, and closely monitored by the National Hurricane Center. When sustained winds reach or exceed 74 miles per hour, the storm is deemed a hurricane. Hurricane intensity is classified using the Saffir-Simpson Hurricane Wind Scale, which rates hurricane intensity on a scale of 1 to 5, with 5 being the most intense.

LOCATION

FIGURE 5 illustrates that the hurricane risk area for Texas includes the entire Gulf Coast.

FIGURE 5
STATE OF TEXAS
HURRICANE RISK AREAS



The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Category 1 and 2 storms are still dangerous, however, and require preventative measures.

TABLE 11
SAFFIR-SIMPSON HURRICANE WIND DAMAGE SCALE

CATE-GORY	SUSTAINED WINDS	TYPES OF DAMAGE DUE TO HURRICANE WINDS
1	74-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

PREVIOUS EVENTS & EXTENT

Previous hurricane and tropical storm events prior to 2008 can be found in **APPENDIX D – HISTORY OF NATURAL EVENTS.** The latest hurricane/tropical storm to affect the city was Hurricane Ike, September 12-14, 2008.

Sept. 13, 2008 **FEMA 1791-DR-TX HURRICANE IKE**	Hurricane Ike made landfall on September 13, 2008, over Galveston as a large Category 2 hurricane. An estimated 37 people lost their lives as a result of Hurricane Ike. Although Friendswood received only received one unverified report of flooding in a detached garage, damages within the city were primarily wind caused with extensive debris removal required from downed trees and fences.	$21.3 Billion

Most notable historical tropical events which have affected Friendswood are Hurricane Carla (06/11/1961), Hurricane Alicia (08/15-18/1983), Hurricane Rita (09/21/2005), and Hurricane Ike (09/13/2008). Time spans between Hurricane Carla and Alicia is 22 years; between Alicia and Rita is 22 years, and between Ike and Rita is 3 years.

HURRICANE CARLA - 1961

- Land fall in the area of Port O'Connor
- High winds for an extended period of time (100 mph)
- Storm surge in west Galveston Bay of 14-16 feet
- Rain amounts of 5-10" on east of the eyewall
- No storm surge affected the City of Friendswood
- Extensive wind damage to outbuildings, built environment, and vegetation

ALICIA – 1983

- Third depression, 1st tropical storm, and only hurricane of the Atlantic season (small Category 3)
- Traveled up IH-45 from Galveston to Houston
- Spawned 23 tornadoes (14 in Galveston/Hobby Airport area)
- Rainfall amounts of 10-11'
- Structures damages/destroyed: 2,297 destroyed, 30,000 major damage, over 10,000 minor damage
- Friendswood experienced extensive structural and vegetative debris

HURRICANE RITA – 2005

- Landfall in the Matagorda Bay area
- Galveston & Harris County ordered an evacuation
- Major gridlock on evacuation routes from coastal areas to Dallas and San Antonio
- Traffic congestion, lack of fuel, extreme heat, lack of access to food and water, and comfort stations led to discomfort and health problems for some.

HURRICANE IKE – 2008

- Diameter of storm was 425 miles
- Moved NNW, and east of IH-45
- 110 mph winds
- Storm surge was in upper SE coast
- Longevity of the storm over SE Texas contributed to extensive wind damage, not the intensity of the winds
- Tornadoes occurred in Liberty County on 9/13, 12-15 hours after landfall
- No storm surge experienced in Friendswood
- Friendswood experienced extensive vegetative debris

In addition to the 20 hurricanes over the past 110 years, Galveston County has also experienced numerous tropical storms. Results of the NCDC query shows that Harris and Galveston Counties have been impacted by 6 tropical storms between 1950 and 2008. The most significant tropical storm to affect the area was Tropical Storm Allison in June 2001. This storm was a major rain and flooding event, with minor damages from high winds. The surrounding area received up to 35 inches of rain over a period of five days.

With a total of 30 tropical storms between 1900 and 2008, Galveston and Harris Counties experience a tropical storm on average about slightly less than every 4 years. This equates to a 27% annual probability of a future tropical storm event occurring in Galveston and Harris Counties. Based on the high, medium and low ranges identified in Table 16, there is a high probability of future tropical storms occurring in both counties. The Table is based on data queried from the National Hurricane Center's Hurricane and Tropical Storm Tracker between 1900 and 2008. There is only a 4% annual probability for a major hurricane while a tropical storm has a 27% annual probability.

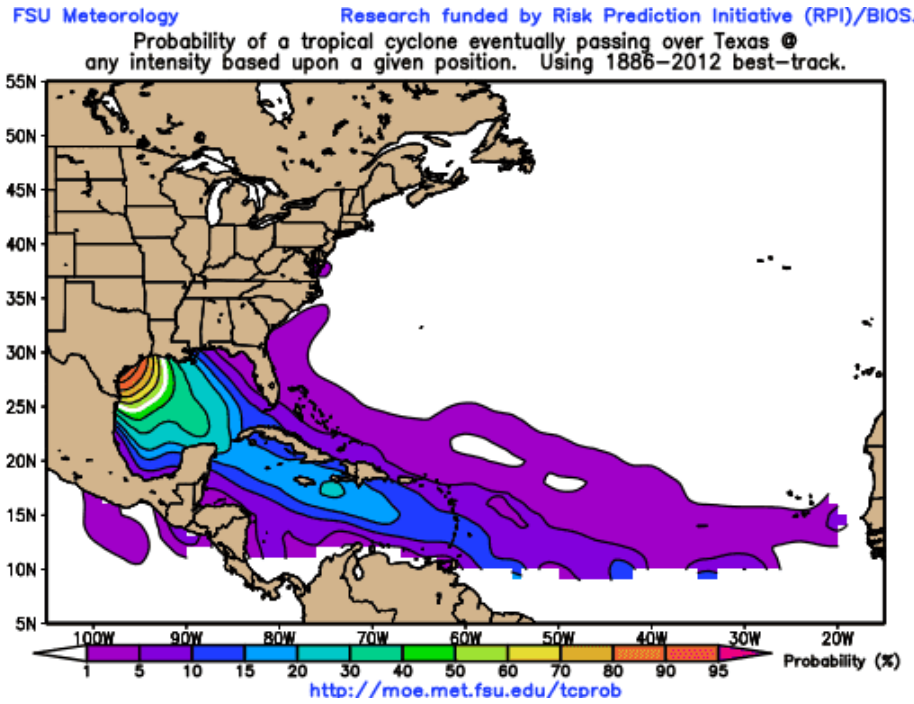
Numerous factors affect the development of tropical systems, making annual predictions difficult at best. History shows that the city is not affected by a tropical storm and/or hurricane each and every year, however, the potential still exists. During hurricane season (June 1 through November 30) the Office of Emergency Management is in a heightened stage of awareness and preparedness.

Regardless of the time span between hurricanes which may or may not affect the city, hurricane preparedness is a major priority for the OEM. The OEM conducts and annual Hurricane Preparedness program for all partners (includes neighboring communities; city departments, fire/EMS, grocery stores,

fuel suppliers, catering companies, utility companies, debris removal/monitoring companies, and school districts); annual preparedness meetings are also held with all local nursing/assisted living facilities and senior housing apartments and faith-based organizations. Public education materials are made available to public on the city's website, monthly newsletter, Chamber of Commerce and Rotary meetings, all city presentations and festivals, as well as homeowner associations.

PROBABILITY

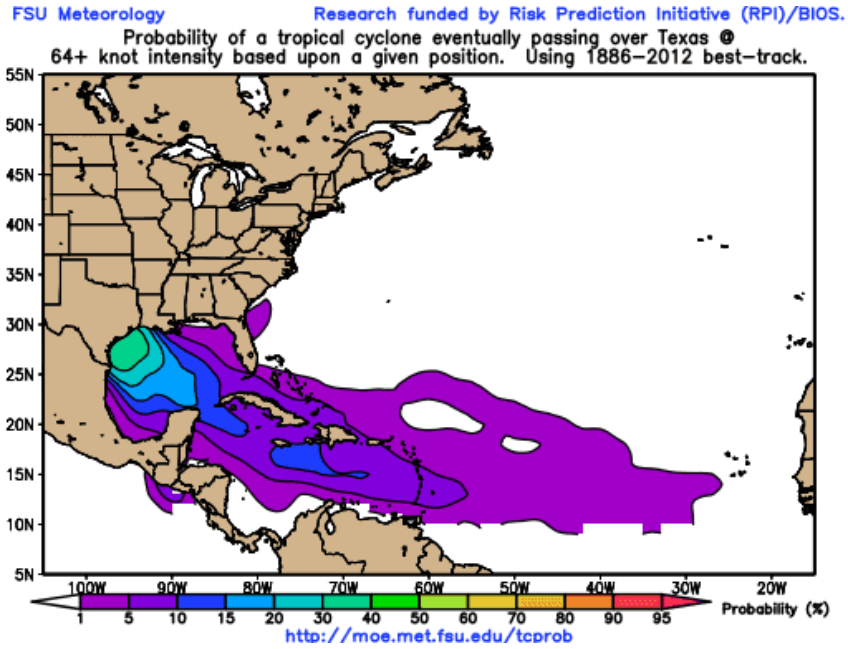
FIGURE 6
TROPICAL CYCLONE PROBABILITIES



Florida State University

FIGURE 7
TROPICAL CYCLONE PROBABILITIES

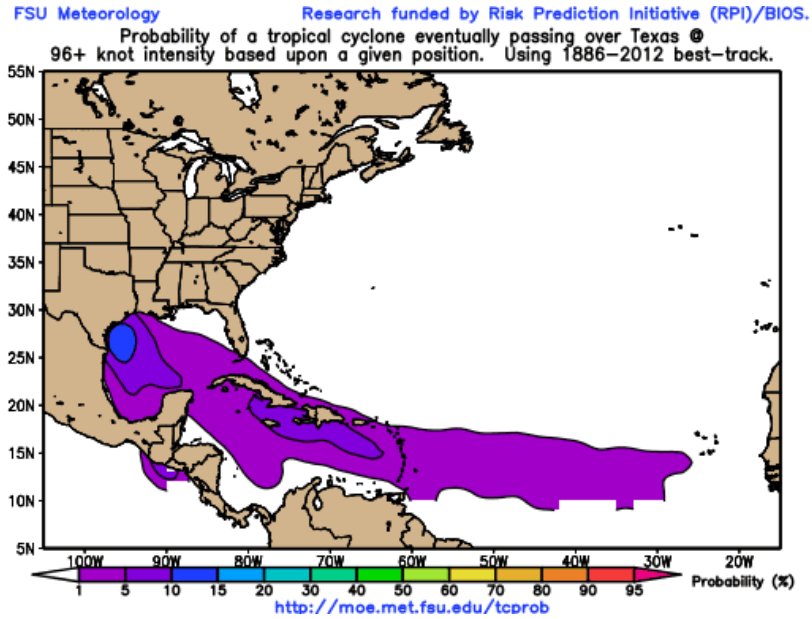
The annual chance (percentage) of a hurricane (wind greater than 73 mph).



Florida State University

FIGURE 8
TROPICAL CYCLONE PROBABILITIES - MAJOR HURRICANES

This is the chance at any particular location that a major hurricane (Category 3, 4 or 5) will affect the area sometime during Atlantic hurricane season (June 1 - November 30).



Florida State University

TABLE 12
ANNUAL PROBABILITY OF HURRICANES AND TROPICAL STORMS IMPACTING GALVESTON / HARRIS COUNTIES, 1900-2008

MAGNITUDE	NUMBER OF EVENTS	ANNUAL PROBABILITY	WIND IMPACTS
Tropical Storms	30	27%	Moderate
Hurricanes (Category 1 & 2)	13	12%	High
Major Hurricanes (Category 3, 4 & 5)	7	4%	High to Extreme

(Source: National Hurricane Center – Hurricane and Tropical Storm Tracker)

The maps shown in **FIGURE 8** include the following:

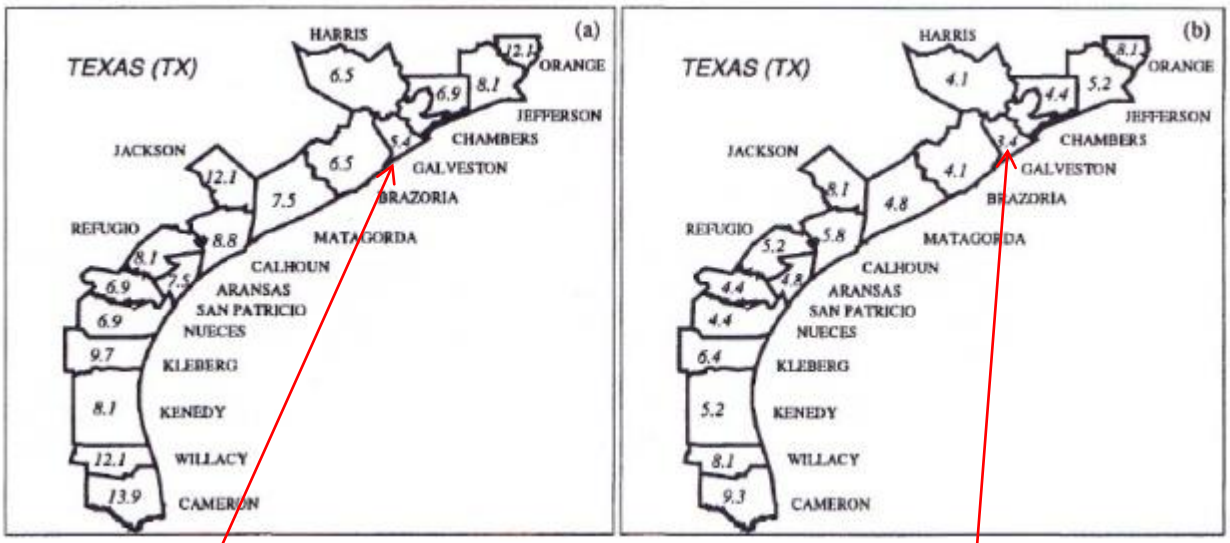
a. hurricane return periods (Categories 1-5)
b. wait times in coastal Counties (Categories 1-5)
c. major hurricane return periods
d. wait times in coastal Counties (major hurricanes)

The number in shown each county is the return period or wait time in years. The wait time is the average time in years between hurricanes.

Hurricane probability in southeastern Texas can also be assessed based on data from the 1999 study Hurricanes of the North Atlantic, Climate and Society. The study includes a series of maps showing the return periods and wait times for the counties along the Texas coastline over the time period 1900-1996.

FIGURE 9
SOUTHEAST TEXAS HURRICANE RETURN PERIODS AND WAIT TIMES

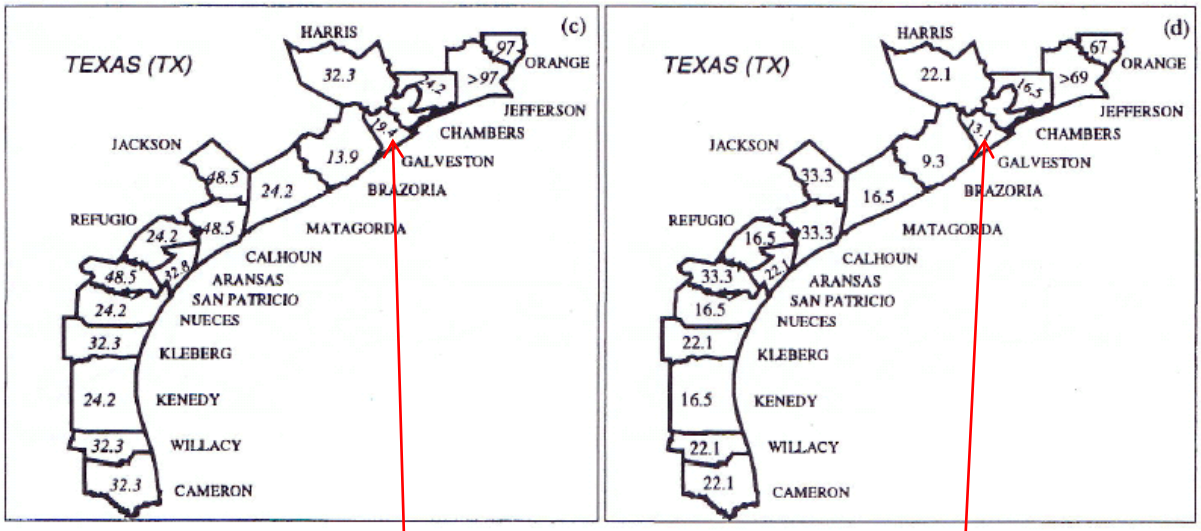
ALL HURRICANES (CATEGORIES 1-5)



GALVESTON -- 5.4 YEARS **GALVESTON -- 3.4 YEARS**

The left hand map (Map a) shows the return period for all hurricanes (Categories 1-5) in Galveston County is 5.4 years, which equates to an approximate 20% annual probability of future occurrences.

MAJOR HURRICANES (CATEGORIES 3-5)



GALVESTON – 19.4 YEARS **GALVESTON – 13.1 YEARS**

(Source: Hurricanes of the North Atlantic, Climate and Society, 1999)

Major hurricanes (Map c) have occurred every 19.4 years in Galveston County, indicating an approximate 6% annual probability. Based on high, medium, and low probability ranges in the hurricane probability is considered medium for Category 1 and 2 magnitude storms, and low for Category 3 and higher. *(Tropical Meteorology Research Project, Colorado State University & GeoGraphics Laboratory, Bridgewater State University)*

Map *a* in Figure 8 shows the return period for all hurricanes (categories 1-5) in Galveston County at 5.4 years, which equates to an approximate 20% annual probability of future occurrences. Major hurricanes (Map c) have occurred every 19.4 years in Galveston County, which translates to an approximate 6% annual probability. *(Hurricanes of the North Atlantic, Climate and Society, James Elsner and A. Birol Kara, New York, Oxford University Press, 1999)* Based on high, medium, and low probability ranges, the hurricane probability is considered medium for Category 1 and 2 magnitude storms, and low for Category 3 and higher (Table 16). As mentioned earlier, future probability is only one component of the risk calculation. Although the hurricane hazard is considered to have a medium to low probability, a hurricane (particularly a major hurricane) has potential for catastrophic impacts on life and property in the planning area. Potential impacts are high for all hurricane categories.

STORM SURGE

From 1971 until 2008, the NHC used the Saffir-Simpson Hurricane Scale, which also utilized pressure, storm surge and flooding measurements. After Hurricane Ike in 2008, which produced a storm surge undeserving to its Category 2 status, the NHC dropped all requirements except wind "to help reduce public confusion about the impacts associated with the various hurricane categories as well as to provide a more scientifically defensible scale." However, the National Hurricane Center does believe that storm surge scales would be helpful or effective at conveying the storm surge threat. As an example, if Hurricane Ike had made landfall in Palm Beach, Florida, the resulting storm surge would have only been 8', rather than the 20' that occurred where Ike actually made landfall on the upper Texas coast. These greatly differing surge impacts arise from differences in the local bathymetry (the shallow waters off of Texas enhance storm surge while the deep ocean depths off of southeastern Florida inhibit surge). The proposed storm surge scales that consider storm size do not consider these local factors that play a crucial role in determining actual surge impacts.

Potentially disastrous surges occur along coasts with low-lying terrain that allows inland inundation, or across inland water bodies such as bays, estuaries, lakes and rivers. For riverine situations, the surge is sea water moving up the river.

The storm surge depends greatly upon the size and intensity of a hurricane, the angle that it approaches the shore at, how deep the water is close to shore (the slope of the seabed at the coastline), and how fast the hurricane is moving. There are several factors that contribute to the amount of surge produced by storms at any given location:

- Central Pressure
- Storm Intensity
- Storm Forward Speed
- Angle of Approach to Coast
- Shape of the Coastline
- Width and Slope of the Ocean Bottom
- Local Features

As can be seen in the following maps, the majority of ground elevation in the Clear Creek Watershed in Friendswood lies within the 25-30 foot range.

The Hurricane Surge Map located in **FIGURE 11** indicates areas of the city with flooding potential from storm surges greater than twenty feet (20'), previously designated as classification of a Category 4 or 5 hurricanes. A storm surge of thirty feet (30') or greater could affect approximately twenty-five to forty-five percent (25%-45%) of the city. Either one of the above scenarios could inundate the area with salt water. Several critical facilities including schools, city facilities, day cares and senior care facilities may be affected by either of those levels of storm surge.

Any rainfall will be exacerbated by a surge of twenty feet (20') or more, resulting in flooding. A surge of any level coupled with heavy rain would also produce flooding. Excessive rainfall amounts, which normally drain into the Clear Creek watershed, will increase the level of water accumulation due to the inability for drainage into Galveston Bay via Clear Creek.

As noted earlier, size, forward speed, and landfall location of the hurricane eye will affect the amount of inundation from a storm surge. Hurricane Ike, September 2008, was classified as a Category 2 hurricane, with little or no rainfall, and made landfall between Galveston Island and the Bolivar Peninsula. The greatest amount of storm surge was across Bolivar Peninsula at twenty feet (20'); however, the surge level near Kemah at the entrance of Clear Lake was recorded at a level of ten to twelve feet (10-12'). Therefore, the city was not affected by storm surge during Hurricane Ike, and the major damages were due to wind.

A major planning factor for surge potential would be if a hurricane makes landfall west of Galveston Island, causing the greatest force of the hurricane to traverse over Galveston Island and inland, and also increasing the surge level in Galveston Bay.

SEA, LAKE, AND OVERLAND SURGES FROM HURRICANES (SLOSH)

The SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model is the computer model developed by the National Weather Service for coastal inundation risk assessment and the prediction of storm surge. It estimates storm surge heights resulting from historical, hypothetical, or predicted hurricanes. SLOSH computes storm surge by taking into account a storm's atmospheric pressure, size, forward speed, track, and winds. The calculations are applied to a specific locale's shoreline, incorporating the unique bay and river configurations, water depths, bridges, roads, levees, and other features.

The Operational Storm Surge Basins for SLOSH model accounts for astronomical tides (which can add significantly to the water height) by specifying a constant tide level to coincide with landfall, but does not include rainfall amounts, river flow, or wind-driven waves (those riding on top of the surge). The SLOSH model is the basis for the "hazard analysis" portion of coastal hurricane evacuation plans.

However, the SLOSH model does not explicitly model the impacts of waves on top of the surge; it does not account for normal river flow or rain flooding; nor does it explicitly model the astronomical tide (although operational runs can be made with different initial water level anomalies). Future advancements in the SLOSH model will allow for the resolution of some of these limitations.

SLOSH DISPLAY PROGRAM AIDS IN EVACUATION PLANNING

The SLOSH Display Program is software developed as a tool to aid emergency managers in visualizing storm surge vulnerability. The SLOSH model and the display program are two different tools. The National Weather Service uses the SLOSH model to forecast storm surge and model storm surge vulnerability; emergency managers and others use the display program to visualize the SLOSH data.

Graphical output from the model shows color-coded storm surge heights for a particular area in either feet above ground level (inundation) or feet above a specific reference level.

The SLOSH Display Program displays the results of the SLOSH model in order to assist emergency managers planning for evacuations and to educate decision-makers.

PROBABILISTIC HURRICANE STORM SURGE (P-SURGE)

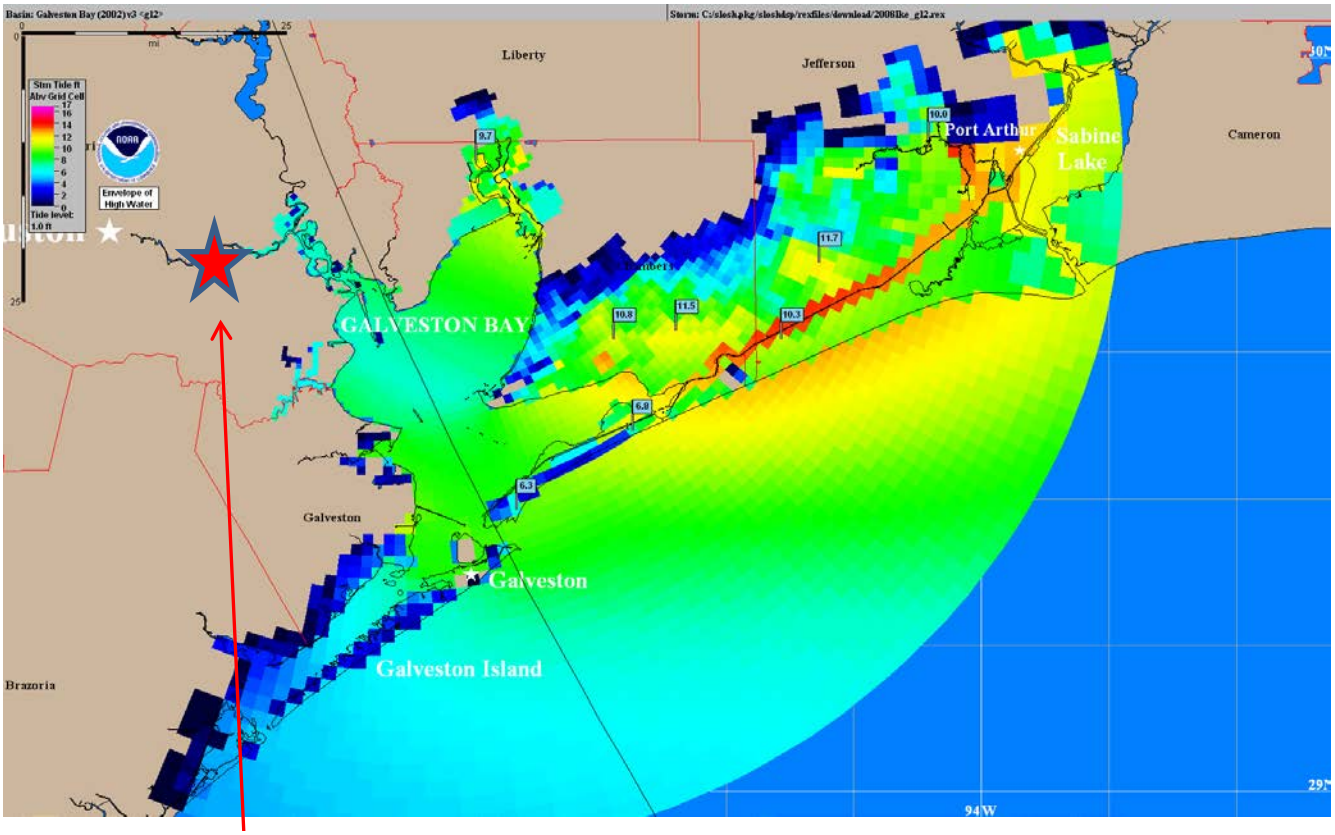
Numerical storm surge models depend on an accurate forecast of the hurricane’s track, intensity, and size. Even the best hurricane forecasts still have considerable uncertainty. The National Hurricane Center's forecast landfall location, for example, can be in error by tens of miles even during the final 12 to 24 hours before the hurricane center reaches the coast. These limitations can make the single, deterministic SLOSH surge forecasts incorrect. To help overcome these limitations, forecasters use probabilistic storm surge (P-surge) forecasts.

The Probabilistic Hurricane Storm Surge (P-Surge) model predicts the likelihood of various storm surge heights above a datum or above ground level based on an ensemble of SLOSH model runs using the official hurricane advisory. Graphical output shows:

- storm surge heights which have a certain probability of being exceeded
- the probability of storm surge exceeding a certain height

These storm surge heights and probabilities are based on the historical accuracy of hurricane track and wind speed forecasts, and an estimate of storm size. P-Surge also computes the probability of surge above ground to more clearly communicate where the surge will occur.

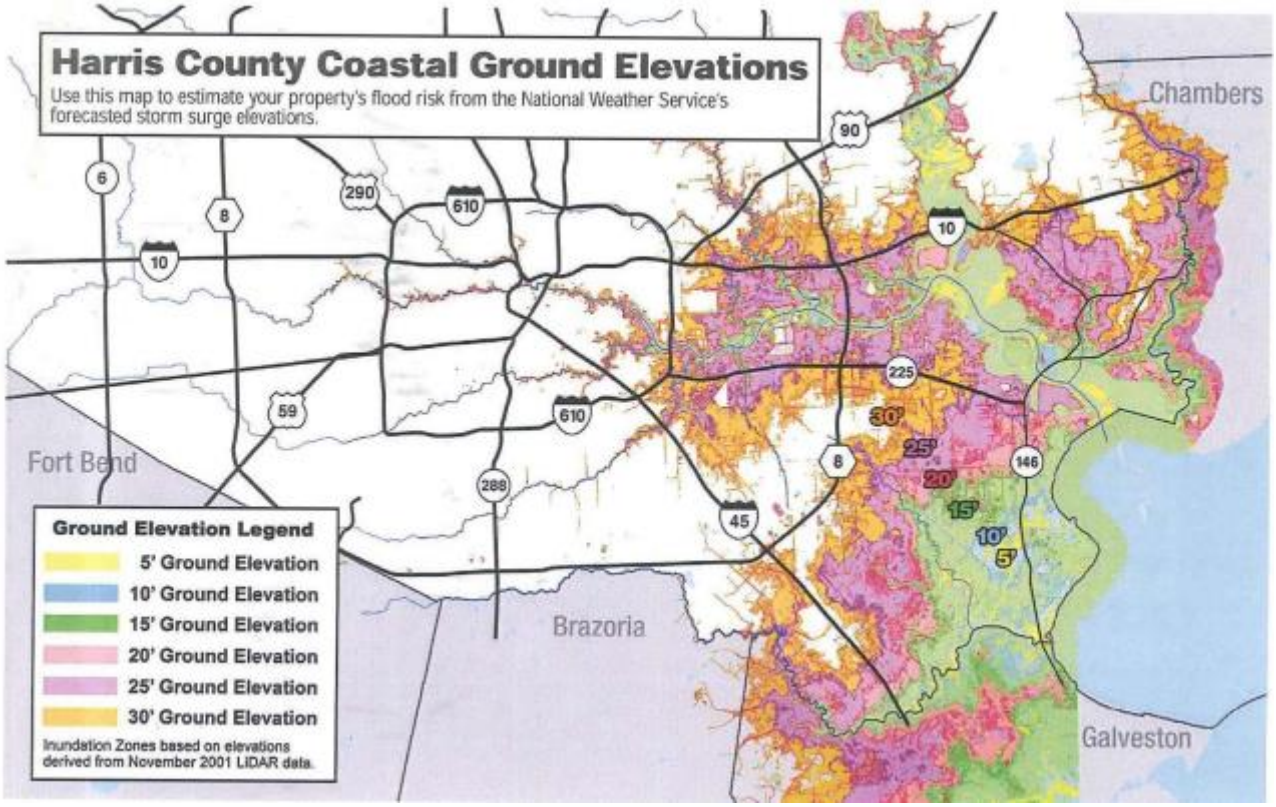
A sample output of the SLOSH model can be seen here for Hurricane Ike.

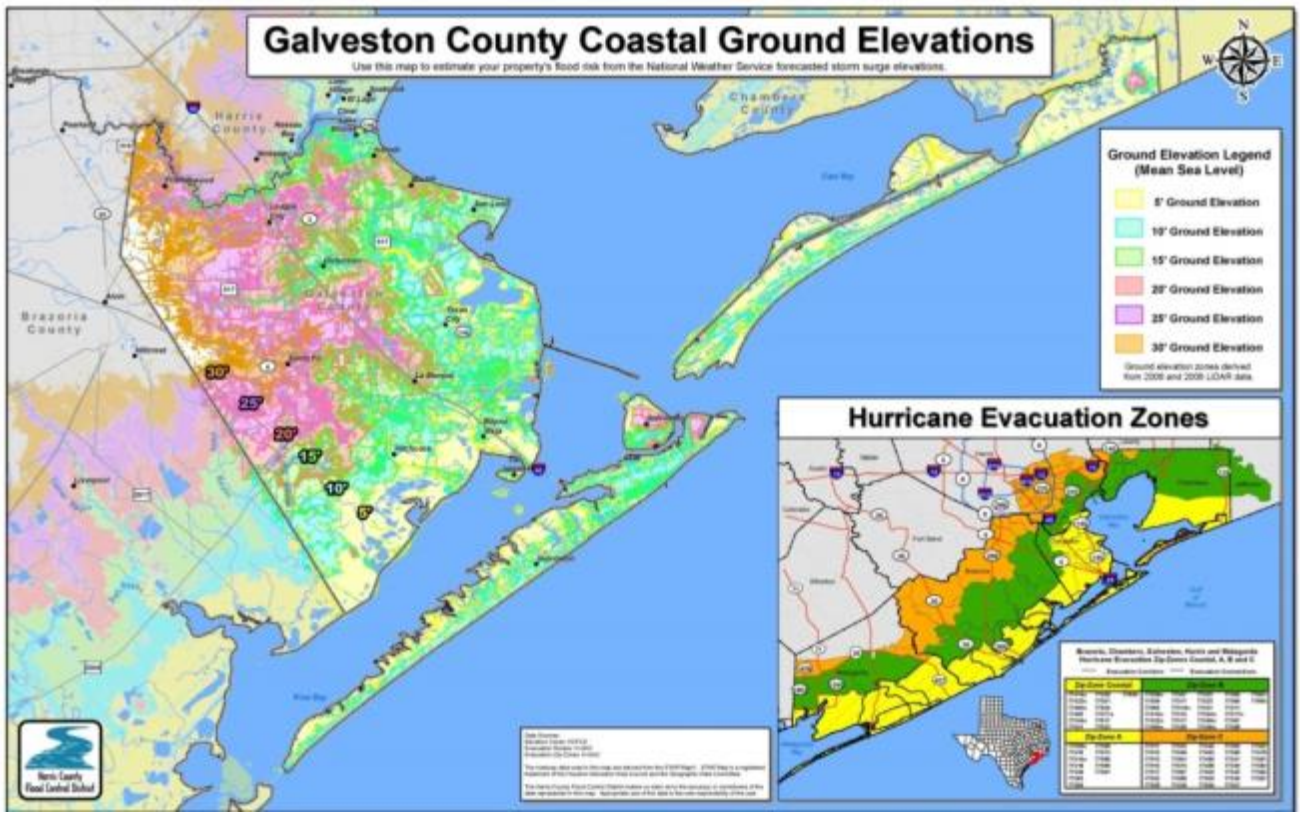


Approximate location of the City of Friendswood

Storm damage from Tropical Storm Allison – June 2001

FIGURE 10
COASTAL GROUND ELEVATIONS
HARRIS AND GALVESTON COUNTIES





LOCATION

FIGURE 11
HURRICANE STORM SURGE

MAP REMOVED

This map has been removed to achieve document brevity. If you would like to view this map, you can find a copy on the City of Friendswood's website at www.friendswood.com; **Online Services**, "GIS Interactive Mapping"

PREVIOUS EVENTS & EXTENT

PREVIOUS EVENTS

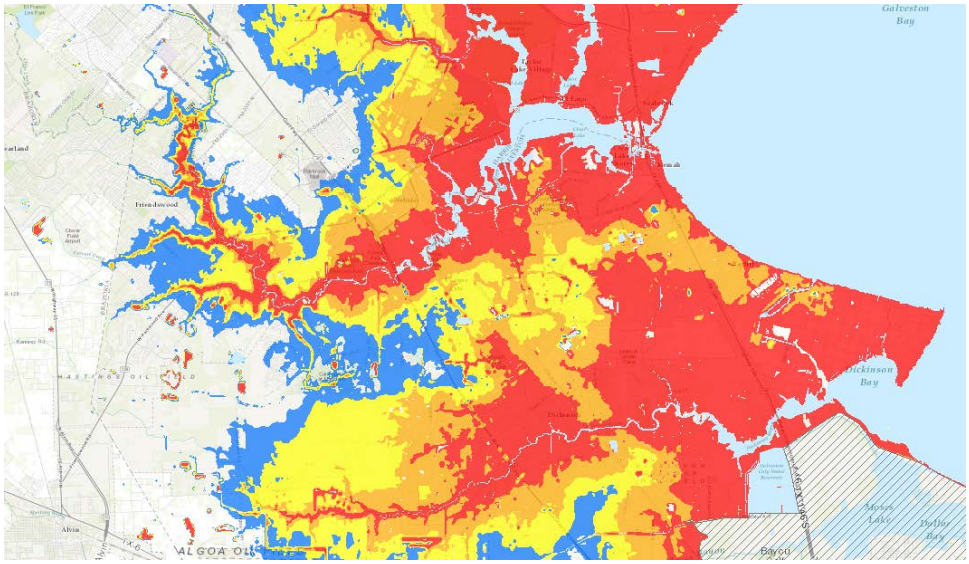
As found in the National Climatic Data Center (NCDC) documentation, two storm surge events have affected Galveston County since 2008. Tropical Storm Edouard moved ashore between High Island and Sabine Pass producing minimal damage of $100,000, and caused tidal flooding on portions of Bolivar Peninsula with damages reported at $95,000. The second event to cause storm surge flooding was Hurricane Ike which made landfall near Galveston September 12-13, 2008. Storm tidal surge ranged between 10-13 feet on most of Galveston Island and Galveston Bay. Approximately 37 deaths, directly or indirectly, were attributed to Hurricane Ike. One report of flood damage was made in Friendswood to a detached garage near Clear Creek; however, no other reports of flooding occurred within the city occurred.

EXTENT

The City of Friendswood sits on land approximately 10' to 35' feet above sea level, with the largest portion of the city located on land approximately 25-30' above sea level.

The National Hurricane Center provides two near worst case scenario planning products based on hypothetical storm tracks: Maximum Envelopes of Water (MEOWs) and Maximum of Maximums (MOMs). MEOWs are created by computing the maximum storm surge resulting from roughly 10,000 to 60,000 hypothetical storms simulated through each SLOSH grid of varying forward speed, radius of maximum wind, intensity (Categories 1-5), landfall location, initial water level, and storm direction. A MEOW product is created for each combination of category, forward speed, storm direction, and initial water level. SLOSH products do not include Category 5 storms north of the NC/VA border. For each storm combination, parallel storms make landfall in 5 to 10 mile increments along the coast within the SLOSH grid, and the maximum storm surge footprint from each simulation is composited, retaining the maximum height of storm surge in a given basin grid cell. No single hurricane will produce the regional flooding depicted in the MEOWs. SLOSH model MOMs are an ensemble product of maximum storm surge heights. MOMs are created for each SLOSH basin by compositing all the MEOWs, separated by category and initial water level, and selecting maximum storm surge value for each grid cell regardless of the forward speed, storm trajectory, or landfall location. MOMs represent the worst case scenario for a given category of storm and initial water level under ideal storm conditions. Here, a high tide initial water level is used in the analysis.

The following graphic depicts the worst case scenario for Friendswood based upon the MOMs as defined in the preceding paragraph. Using this scenario, a majority of the city would be inundated with water ranging from 3 feet above ground to greater than 9 feet above ground.



Historically, the city has not experienced storm surge from previous events, and would not expect this type of storm surge in future hurricanes.

PROBABILITY

FREQUENCY OF OCCURRENCE	
☐ Highly Likely	Event probably in next year
☐ Likely	Event probable in next 3 years
■ Occasional	Event possible in next 5 years
☐ Unlikely	Event possible in next 10 years

TABLE 11 below shows those critical facilities within the city which have the potential of being affected by storm surge, storm surge exacerbated with rainfall, or excessive rainfall.

TABLE 11
CRITICAL FACILITIES AFFECTED
13-17 FT AND OVER 18 FT STORM SURGE

INFORMATION REMOVED

As part of the Texas Homeland Security Act, Sections 418.176 through 418.182 were added to Chapter 418 of the Government Code.

§ 418.180. CONFIDENTIALITY OF CERTAIN INFORMATION PREPARED FOR UNITED STATES.

Information, other than financial information, in the possession of a governmental entity is confidential if the information:
(1) is part of a report to an agency of the United States;
(2) relates to an act of terrorism or related criminal activity; and
(3) is specifically required to be kept confidential:
(A) under Section 552.101 because of a federal statute or regulation;
(B) to participate in a state-federal information sharing agreement; or
(C) to obtain federal funding.
Added by Acts 2003, 78th Leg., ch. 1312, § 3, eff. June 21, 2003.

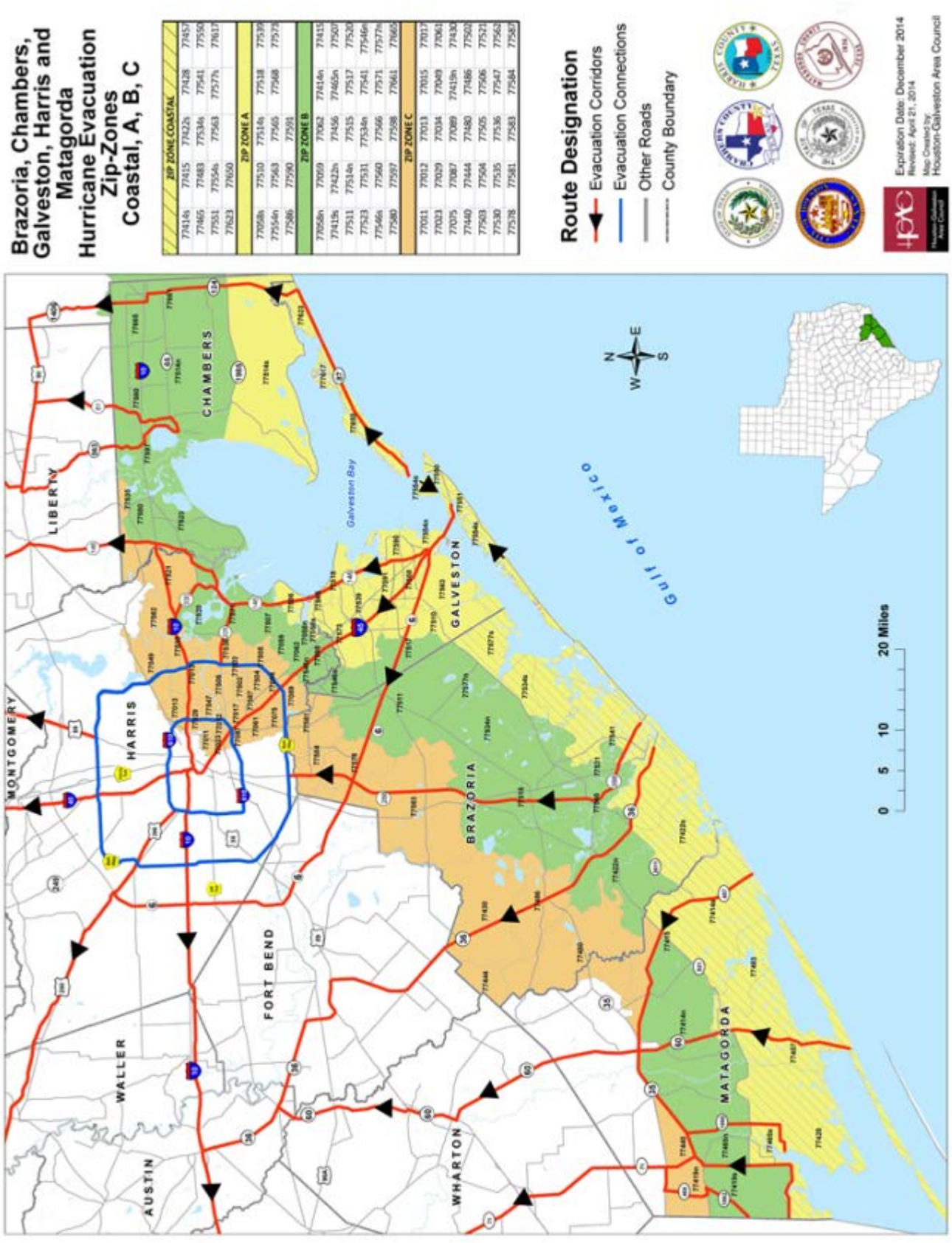
MITIGATION STRATEGY

The city is vulnerable to the damages associated with hurricane and tropical storm events. The Emergency Management Office works diligently to increase preparedness and improve mitigation efforts related to hurricanes and tropical storm events.

The *Focus of Friendswood Newsletter* devotes considerable space in the Spring and Summer issues providing hurricane safety and preparedness information. Emergency Management officials supply the bulk of materials featured in the newsletter. The Emergency Management Office staff also conducts several presentations throughout the year to help increase citizen awareness and preparedness for hurricanes, tropical storms, and other hazardous conditions. These presentations focus on property protection and protection of life. Included in the educational presentations and materials is the Hurricane Evacuation Zip-Zone for the coastal areas of southeast Texas developed by the Houston-Galveston Area Council. Following Hurricane Ike, September 2008, the Hurricane Evacuation Zip-Zone map was amended to reflect the north and south portions of zip code 77546, which encompasses the City of Friendswood. The north portion of the 77546 zip zone is located in the unincorporated area of Harris County. When an evacuation order was issued by the Harris County Judge prior to landfall of the hurricane, residents of Friendswood were under the assumption that the city was included in that evacuation order, although the Mayor of Friendswood had not issued such an order. Although residents of the north 77546 zip zone have Friendswood mailing addresses, they do not reside within the corporate limits of the City of Friendswood. **(SEE FIGURE 12)**

The city participates in a variety of exercises and disaster drills both locally and regionally to help increase preparedness. Disaster exercises and drills are a vital function of the emergency management program. Routine emergency drills and disaster exercises allow for city officials to interact with other local jurisdictions, regional emergency service providers, as well as state and federal agencies. Exercises assist to identify potential problems or weaknesses in emergency management activities, as well as identify strengths and strategic alliances between departments, organizations, and outside agencies.

FIGURE 12
HURRICANE EVACUATION ZIP-ZONES



2009 MITIGATION ACTION ITEMS

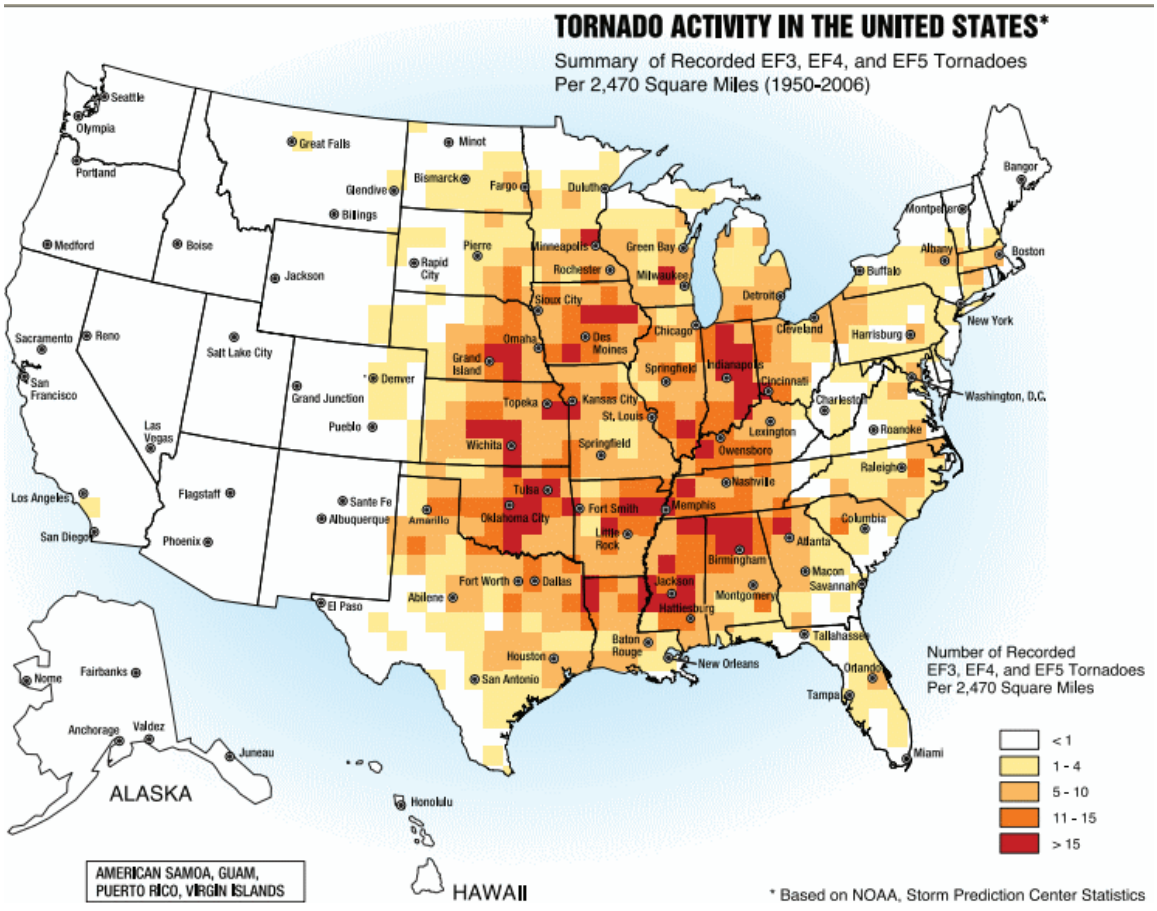
CRITICAL FACILITIES PROTECTION
▪ Stationary generators were installed at all lift stations and surface water stations which were not located in a designated flood zone. Hook ups were adapted to accept portable generators at the remaining surface water stations and lift stations that are located in special flood hazard areas. ▪ Through grant awards, generators were installed at City Hall, Library, and fire stations. ▪ Protective window film was installed at the Public Safety Building, City Hall, and the Library. Funding was obtained through SHSP grant funding.

HURRICANE PUBLIC EDUCATION CAMPAIGN	
▪ Design/develop Hurricane Guide which to include: o evacuation procedures/routes and re-entry procedures o preparing homes to withstand storm damage o preparing a survival kit o health safety guidelines o power outages o debris removal o permitting process ▪ Schedule presentations with all critical and vulnerable facilities ▪ Distribute the flyer to all residents within the city	Being conducted on an annual basis
▪ Review and update the preparedness program, educational materials, and data on an annual basis ▪ Conduct presentations for the public at the Friendswood Public Library ▪ Conduct presentations and provide educational materials for Mayor and City Council members on an annual basis ▪ Distribute the flyer to all residents city with utility bills ▪ Post educational materials on the city's website ▪ Post educational materials on the city's PEG Channel 17 ▪ Pre-record messages for broadcast over Friendswood Information Radio 1650 AM	Being conducted on an annual basis

TORNADO

A tornado is a violent rotating column of air extending from a thunderstorm to the ground. The most violent tornadoes are capable of tremendous destruction with wind speeds of up to 300 mph. Tornadoes come in many shapes and sizes, but are usually in the form of a visible condensation funnel, and when narrow end touches ground it is often encircled by a cloud of debris and dust. According to the National Weather Service, tornado wind speeds range from 40 to more than 300 miles per hour. The most violent tornadoes have rotating winds of 250 mph or more and are capable of causing extreme destruction. Tornadoes are related to larger vortex formations, and therefore often form in convective cells such as thunderstorms or in the right forward quadrant of a hurricane, far from the hurricane eye. ***(Multi-Hazard Identification and Risk Assessment, The Cornerstone of the National Mitigation Strategy, FEMA, 1997, p. 40)***

FIGURE 13
U.S. TORNADO ACTIVITY (1950-2006)



Intense tornado activity in the United States
The darker-colored areas denote the area commonly referred to as Tornado Alley.

Tornado damage severity is measured by the Enhanced Fujita Scale, which began operational use on February 1, 2007. The scale has the same basic design as the original Fujita Scale (implemented in 1971) with six categories from zero to five representing increasing degrees of damage. The Enhanced Fujita Scale includes 28 damage indicators categorized by building type and construction. According to NOAA, the Enhanced Fujita Scale is a set of wind estimates (not measurements) based on damage on a judgment of 6 levels of damage. The new scale takes into account the quality of construction and standardizes different types of structures. None of the tornadoes recorded on or before January 31, 2007, will be re-categorized. For detailed information on the Enhanced Fujita Scale and damage indicators, please see http://www.spc.noaa.gov/faq/tornado/ef-scale.html.

PREVIOUS EVENTS

During the period of 1950-2015, the National Weather Service recorded 2 tornadic events in the vicinity of Friendswood. Of these 2 tornadoes, 1 was categorized as EF0 and 1 was categorized as an EF1. Total damage for these events was reported to be $520,000. These tornadoes were approximately .2-.3 miles in length and 20-50 yards in width. Records from the NCDC, show no reported tornado sightings and/or touchdowns within the city since 2008.

LOCATION AND EXTENT

LOCATION

Tornadoes can result from severe thunderstorm activity, or may occur during a major tropical storm or hurricane. Based upon historical data, tornado activity was recorded in a 65 year period of .004%. Because it cannot be predicted where a tornado may strike, all buildings and facilities are considered to be exposed and could potentially be impacted. As noted in the table at the beginning of this section, vulnerability estimate for damages is $2,973,017,641. Damages will be variable and are dependent upon the location of touchdown in specific sections of the city.

EXTENT

Based upon the premise that the entire city is vulnerable to a tornadic event, if an EF0 or EF1 were to occur within the city, damages for debris could range up to 500,000 cubic yards of woody debris and construction & demolition debris. Debris removal expenses could reach into the $7-10 million dollar range. As stated above, total structural damages could reach $2,973,017,641 and does not include estimates for contents of all structures. Based upon historical occurrences, the city does not anticipate experiencing tornadoes stronger than an EF0 or EF1; however, the city is aware that a stronger tornado could potentially affect the area at any time in the future.

Due to the infrequency and minimal intensity of previous tornadic events, the city does not require tornado safe rooms to be constructed within new and/or remodeled residential, commercial or school facilities. However, building construction strength standards increase with each new edition of the IBC; i.e., structures are currently required to be built to withstand 120 mph winds.

PROBABILITY

FREQUENCY OF OCCURRENCE

☐	Highly Likely	Event probably in next year
☐	Likely	Event probable in next 3 years
☐	Occasional	Event possible in next 5 years
■	Unlikely	Event possible in next 10 years

MITIGATION STRATEGY

Due to the infrequency of tornado activity within the vicinity of the city, the primary preparedness strategy is public awareness and education.

2009 MITIGATION ACTION ITEMS

SHELTER-IN-PLACE PUBLIC EDUCATION CAMPAIGN	
▪ Design/develop a public awareness flyer for shelter-in-place procedures ▪ Schedule presentations with all critical and vulnerable facilities within the city ▪ Distribute the flyer to all residents within the city ▪ Provide detail listing of all residential, critical and/or vulnerable facilities within each evacuation zone for all pipeline corridors as outlined in the Pipeline Map (Appendix E) and ensure these zones are designated for the First Call Notification System Review and update the program on an annual basis ▪ Conduct presentations for the public at the Friendswood Public Library, Mayor and City Council members ▪ Post the flyer on the City of Friendswood's website and Friendswood PEG Channel 17 ▪ Pre-record messages for broadcast over Friendswood Information Radio 1650 AM	Ongoing

CRITICAL FACILITIES PROTECTION	
AUXILIARY POWER ▪ Fire Station #1 ▪ Fire Station #2 ▪ Fire Station #3 ▪ City Hall ▪ Library	**COMPLETED WITH HAZARD MITIGATION GRANT FUNDING** **ALL CITY CRITICAL FACILITIES ARE NOW EQUIPPED WITH BACK-UP AUXILIARY POWER**
▪ Ensure continuous operations of the city's critical facilities. ▪ Will allow for continuity of government, ensure continued communications during times of power outages and/or disastrous events, and assist with response and recovery operations. ▪ Equipping the Fire Stations with generators will assist the community with communications, search and rescue operations. ▪ The Activity Building was equipped with full back-up power coverage in December 2002. ▪ City Hall (constructed in 1995/96) back-up power for the mainframe computer system, telephones, certain electrical outlets and emergency lighting was included. ▪ Public Safety Building is equipped with full back-up power coverage. ▪ Fire Station #4 auxiliary power supply was included with construction plans for the facility with CIP funding.	▪ Funding has been received for a manual transfer switch installation for the Public Works Facility with Homeland Security Grant funding.

DROUGHT

Drought is often thought of as a condition of climatic dryness that is severe enough to reduce soil moisture and water supplies below the requirements necessary to sustain normal plant, animal, and human life. Drought can also be defined "as the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length". The term can be further divided into agricultural and hydrologic drought.

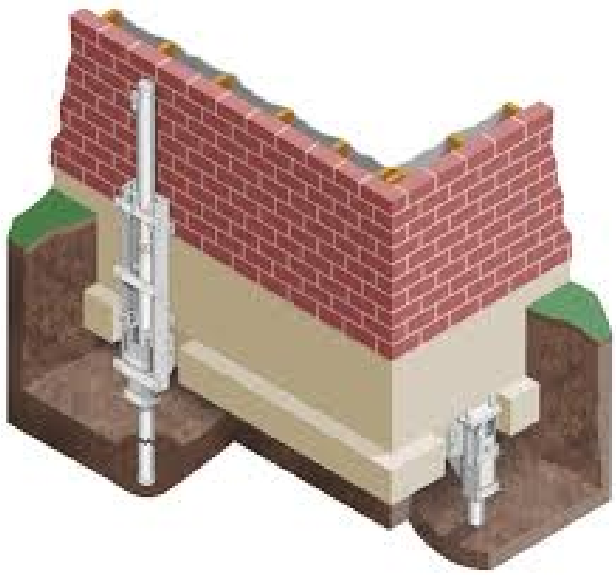
Agricultural drought is a dry period of sufficient duration and intensity that crop and animal agriculture are markedly affected.

Hydrologic drought is a long-term condition of abnormally dry weather that ultimately leads to the depletion of surface and ground water supplies. During hydrologic drought, a significant reduction in the flow of rivers, streams, and springs is noticed.

PREVIOUS EVENTS & EXTENT

PREVIOUS EVENTS

Within the past five years (2008-2013) no extended periods of drought have been recorded per data provided by the NCDC for Friendswood, Galveston County, or Harris County in Southeast Texas.



Although the area is vulnerable to drought, estimated losses are quite difficult to calculate because drought damage to the built environment is difficult to track.

Therefore, it is assumed that all buildings and facilities are exposed to drought and could experience foundation or structural damage.

EXTENT

The entire planning area may be affected by drought as no one portion is more at risk than any other part of the area. Friendswood is located in the Upper Coast Climactic division. As such, the city is subject to occasional periods of drought.

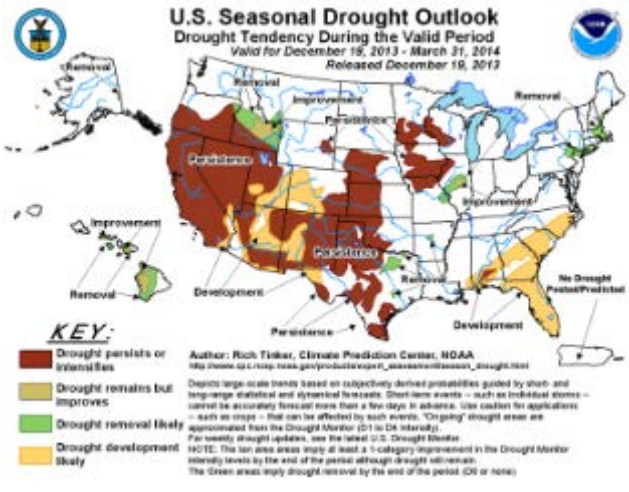
Assessing the potential damage costs to structures as a result of extended drought conditions is at best as difficult as predicting the duration of extreme drought conditions. Extended drought conditions affect the stability of a building foundation and causes damages to the structural integrity of homes. The average cost of foundation repairs for a 2,400-3,800 square foot home could range from $10,000 to $75,000. Of course, costs are related to whether or not all or a portion of the foundation has piers installed, and whether or not piers are installed only on the exterior of the structure or installed on the exterior and the interior. Foundation repairs are not covered by a homeowner's insurance policy. Between January 1, 2008 and December 31, 2014, 1,300 building permits were issued with total valuation of $7,880,632 (average cost of $6,062) for foundation repairs. It should be noted that the city does not require a "cause" of the damage when issuing building permits. Foundation damage can be a result of drought or extremely dry conditions (and the property owner does not 'water' the area around the foundation to minimize ground shrinkage, trees planted too closely to the structure, or the design and construction quality of the structure.

As indicated in the Table on page 11, 2,169 acres of land within the city are classified as "agricultural land" and 26 units classified as "farm and ranch improved". These descriptions define those parcels classified by the Galveston County Appraisal District as receiving an exemption with reference to the valuation associated with property taxation. By definition in the description of the agricultural appraisal, this is a special appraisal exemption afforded to property owners based on the land's productivity value rather than on what the land would sell for on the open market. Numerous parcels within the city limits are large enough to maintain small numbers of cows, horses, goats and chickens, and not utilized for the purpose of agricultural production.

Public education materials and programs are utilized to teach residents how to protect their foundations by installing slow drip watering hoses around the foundation of their homes, utilizing rain barrels to capture water for plants and lawn watering uses. The city has a drought contingency ordinance which designates varying stages of water conservation and limits outside watering days and times and water usage in order to maintain sufficient water supply for drinking and fire suppression.

PROBABILITY

After the summer flood of 2007, most of Texas was declared drought free for the first time since 1996. However, monitoring should continue as conditions can change from one calendar year to another, as can be seen in the annual graphics below. Forecasting future drought events can be difficult. The following map indicates improvement in the drought outlook for the first quarter of 2014.



Drought research data can be found at the following websites: www.drought.gov (National Integrated Drought Information System-NIDIS), www.drought.noaa.gov, www.drought.unl.edu, and www.ncdc.noaa.gov.

FREQUENCY OF OCCURRENCE

☐	Highly Likely	Event probably in next year
☐	Likely	Event probable in next 3 years
■	Occasional	Event possible in next 5 years
☐	Unlikely	Event possible in next 10 years

PALMER DROUGHT INDICES

The Palmer Index was developed by Wayne Palmer in 1965 which uses temperature and rainfall information in a formula to determine dryness. The Palmer Index is most effective in determining long term drought. The Advantage of the Palmer Index is that it is standardized to local climate, therefore can be applied to any part of the country to demonstrate relative drought or rainfall conditions. This Index is not as good for short term forecasts.

PALMER Z INDEX

- Measures short-term drought on a monthly scale

CROP MOISTURE INDEX (CMI)

- Measures short-term drought on a weekly scale to quantify a drought's impacts on agriculture during the growing season

PALMER DROUGHT SEVERITY INDEX (PDSI)

- Attempts to measure the duration and intensity of the long-term drought-inducing circulation patterns.
- Long-term drought is cumulative, so the intensity of drought during the current month is dependent on the current weather patterns plus the cumulative patterns of previous months.

PALMER HYDROLOGICAL DROUGHT INDEX (PHDI)

- Developed to quantify hydrological effects and is a long-term drought index; responds more slowly to changing conditions than the PDSI

STANDARDIZED PRECIPITATION INDEX

- A probability index that considers only precipitation. The SPI is an index based on the probability of recording a given amount of precipitation, and the probabilities are standardized so that an index of zero (0) indicates the median precipitation amount. This index is negative for drought and positive for wet conditions. The SPI is computed by NCDC for several time scales, ranging from one month to 24 months, capturing various scales of both short-term and long-term drought.

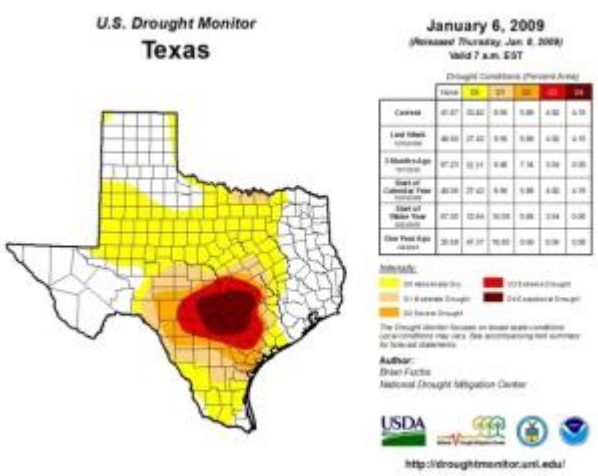
The objective of the Palmer Drought Severity Index (PDSI) provides measurements of moisture conditions that are standardized so comparisons using the index can be made between locations and between months. The PDSI is a meteorological drought index, and it responds to weather conditions that have been abnormally dry or abnormally wet. Palmer developed the PDSI to include the duration of a drought (or wet spell). His motivation was as follows: an abnormally wet month in the middle of a long-term drought should not have a major impact on the index, or a series of months with near-normal precipitation following a serious drought does not mean that the drought is over. Therefore, Palmer developed criteria for determining when a drought or a wet spell begins and ends, which adjust the PDSI accordingly. The Palmer Index is popular and has been widely used for a variety of applications across the United States. It is most effective measuring impacts sensitive to soil moisture conditions, such as agriculture. It has also been useful as a drought monitoring tool and has been used to trigger actions associated with drought contingency plans. Three positive characteristics of the Palmer Index provide decision makers with a measurement of the abnormality of recent weather for a region; provides an opportunity to place current conditions in historical perspective; and it provides spatial and temporal representations of historical droughts.

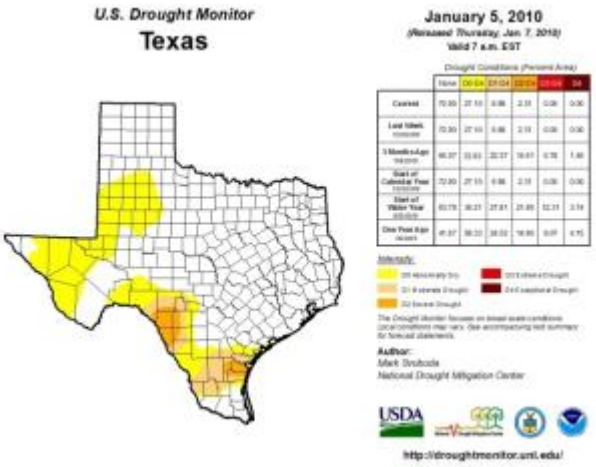
For further information, please see https://www.drought.gov/drought/content/products-current-drought-and-monitoring-drought-indicators/palmer-drought-severity-index

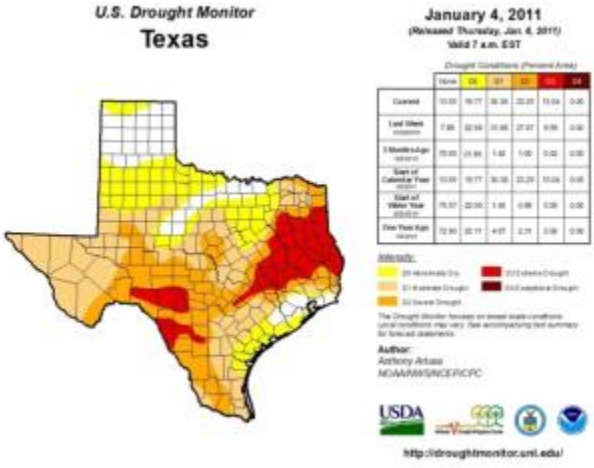
TABLE 12
RANGES OF DROUGHT

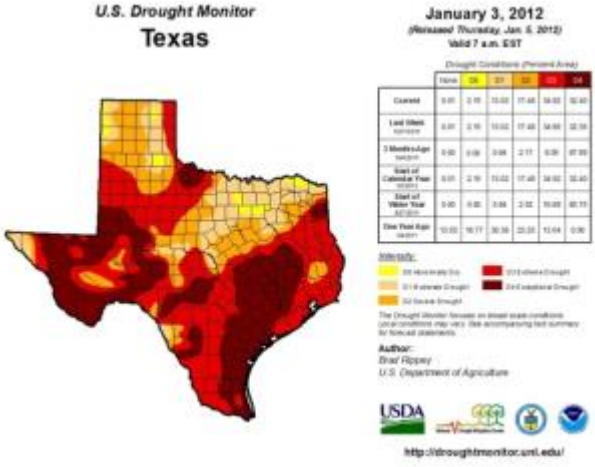
RANGES OF DROUGHT			
CATEGORY	**DESCRIPTION**	**POSSIBLE IMPACTS**	**PALMER DROUGHT INDEX**
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to 1.9
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to 2.9
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

The following maps from the U.S. Drought Monitor give a pictorial synopsis of the stages of drought experienced through the State of Texas as well as Galveston and Harris Counties for the last five years.









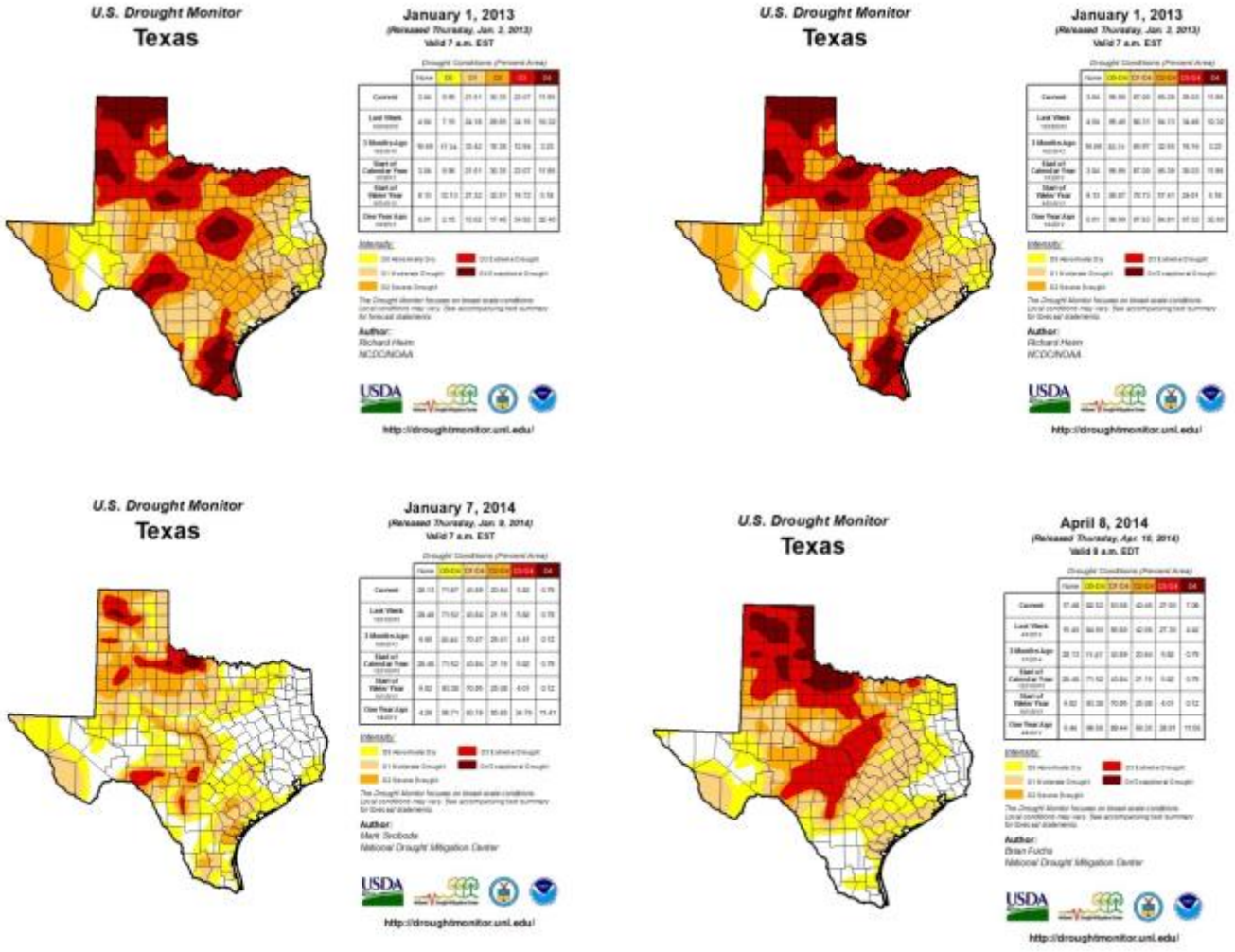
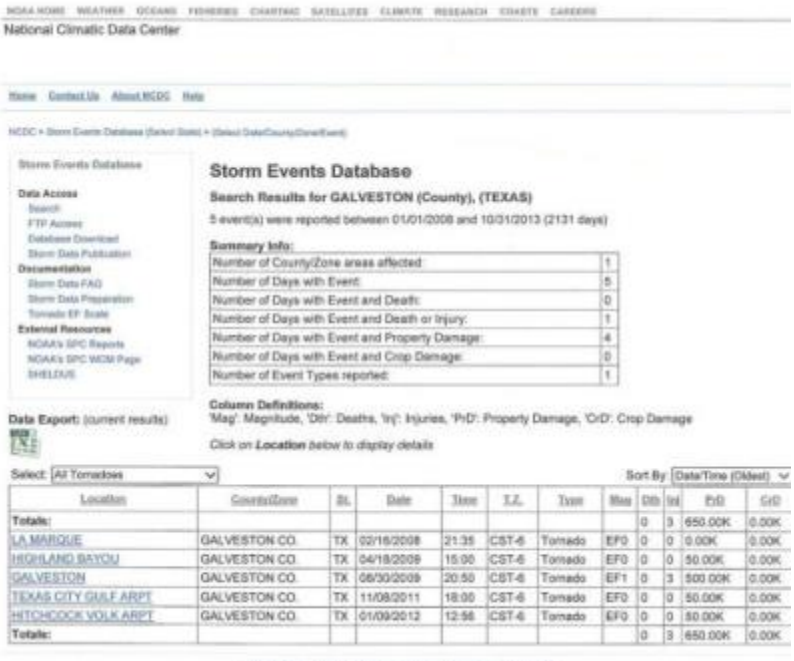


FIGURE 14
NCDC DROUGHT DATABASE



National Climatic Data Center

Storm Events Database

Search Results for GALVESTON (County), (TEXAS)

5 event(s) were reported between 01/01/2008 and 10/31/2013 (2131 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	5
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	1
Number of Days with Event and Property Damage:	4
Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

Column Definitions:
'Mag': Magnitude, 'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage, 'CrD': Crop Damage

Click on **Location** below to display details

Select: All Tornadoes — Sort By: Date/Time (Oldest)

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	3	650.00K	0.00K
LA MARQUE	GALVESTON CO.	TX	02/16/2008	21:35	CST-6	Tornado	EF0	0	0	0.00K	0.00K
HIGHLAND BAYOU	GALVESTON CO.	TX	04/18/2009	15:00	CST-6	Tornado	EF0	0	0	50.00K	0.00K
GALVESTON	GALVESTON CO.	TX	06/30/2009	20:50	CST-6	Tornado	EF1	0	3	500.00K	0.00K
TEXAS CITY GULF ARPT	GALVESTON CO.	TX	11/08/2011	18:00	CST-6	Tornado	EF0	0	0	50.00K	0.00K
HITCHCOCK VOLK ARPT	GALVESTON CO.	TX	01/09/2012	12:56	CST-6	Tornado	EF0	0	0	50.00K	0.00K
Totals:								0	3	650.00K	0.00K

MITIGATION STRATEGY

The city developed and approved an ordinance adopting a Drought Contingency Plan. The Drought Contingency Plan has been approved by TCEQ and is in place to meet periods of extreme drought conditions as they occur. The city's Drought Contingency Plan was amended March 20, 2006, through Ordinance No. 2006-07. A copy of the city's Drought Contingency Plan (Ordinance No. 2006-07) follows Action Item #12 in Section 5, Mitigation Action Items, of this document. A copy of the Drought Contingency Plan is available by request through the City Secretary's Office for the residents of the city.

The use of Public Service Announcements and informational brochures can be an effective tool to inform residents of existing conditions and potential damage to their residence by failing to keep foundations hydrated. Public Service Announcements have been developed and are available to be placed on the city's PEG Channel 17, local 1650 AM Radio station, the city's website (www.ci.friendswood.tx.us) and if necessary, on the reader board at Stevenson Park.

2009 MITIGATION ACTION ITEMS

DEVELOP A DROUGHT CONTINGENCY PLAN	
▪ Conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection. ▪ The provisions of the Drought Contingency Plan shall apply to all persons, customers, and property utilizing water provided by the City of Friendswood. ▪ Conduct annual review, and modify as necessary	▪ Ordinance #2006-07, adopted March 20, 2006 – Drought Contingency Plan ▪ Includes the opportunity to utilize alternative water sources and/or alternative delivery mechanisms with prior approval of the Executive Director of the Texas Commission on Environmental Quality (interconnection with another system, temporary use of a non-municipal water supply, or use of reclaimed water for non-potable use)

DEVELOP PUBLIC EDUCATION CAMPAIGN Public Service Announcements (PSA)	
▪ Emphasis is to ensure that the citizens of are informed of the potential danger of existing weather conditions, and to ensure they have information to protect themselves and their property. ▪ Ensure the public is aware of the potential dangers posed by drought conditions. ▪ Ensure water conservation methodologies are available to all residential and commercial properties within the corporate limits of the city. ▪ Ensure articles are available for publication in local newspapers, "Focus on Friendswood", PEG Channel 17, etc., beginning of summer season 2010. ▪ Monitor weather conditions to ensure the public is aware of existing drought conditions. ▪ Review and update current Public Service Announcements to ensure data is the most current and reflects any technological advances made with regard to prediction and protection of the public.	Ongoing

WINTER STORMS

Severe winter storms can include blizzards, freezing rain, sleet, or dangerous combinations of temperatures and wind. Winter storms can be deceiving. Even a small amount of precipitation can cause problems, especially in areas where snow and ice are unusual occurrences. The State of Texas, Mitigation Plan, states the Texas Panhandle and North Central Texas, around Dallas and Texarkana, are the most vulnerable areas to severe winter storms. Generally, the winter storm season in Texas runs from late November to mid-March.

The coldest recorded low temperature for this area was 7.5° at Galveston in February 1899 which also covered Galveston Bay with a thin sheet of ice. Friendswood enjoys a subtropical climate where the growing season extends well into November. Winter days are mild with a few temperature dips below the freezing mark. After an infrequent freeze event, it is not uncommon for the temperature to rise to a balmy 60° or 70° during the day.

The entire planning area may be affected by mild to moderate winter storms. We currently do not have enough data to adequately and truthfully determine either the percentage of damage or dollar amount of expected damage to the structures within the city as a result of winter storms. We have included an action item aimed at attempting to address this data gap.

PREVIOUS EVENTS AND EXTENT

PREVIOUS EVENTS

No severe or extreme winter weather events were recorded for the city from 2008 through 2014. Predicting the probability of cold waves and/or unusual winter storms with snow or ice, are difficult at best. Historically speaking, only three events of importance can be found. The damages from such events would also be as difficult to predict as the event itself. Therefore, public awareness through the city's various points of warning would be the optimal conduit of information regarding potential occurrences.

EXTENT

The entire city has the potential of being affected either by a cold front, cold wave, snow or other winter storm; however, the probability of extreme cold weather events and snow are extremely rare due to the subtropical climate in the region. Primary property losses during these rare occasions is the damage caused by unprotected pipes and plumbing that may freeze. Losses can be minimized by ensuring all pipes are properly insulated and protected.

In the event that bridge spans which cross the creeks become impassable, the Public Works Department will spread sand or put up barricades to prevent traffic from using the bridges. If prolonged periods of cold weather are predicted, traffic barriers are utilized to prevent automobiles from using the bridges.

No recommendations for structural changes for residential or commercial buildings have been incorporated into planning documents due to the infrequency of these winter events and the minimal effect on the built environment.

PROBABILITY

FREQUENCY OF OCCURRENCE

☐	Highly Likely	Event probably in next year
☐	Likely	Event probable in next 3 years
☐	Occasional	Event possible in next 5 years
■	Unlikely	Event possible in next 10 years

The Wind Chill is the temperature your body feels when the air temperature is combined with the wind speed. It is based on the rate of heat loss from exposed skin caused by the effects of wind and cold. As the speed of the wind increases, it can carry heat away from your body much more quickly, causing skin temperature to drop. The Wind Chill chart below shows the difference between actual air temperature and perceived temperature, and amount of time until frostbite occurs.

http://www.nws.noaa.gov/om/windchill/

NWS Windchill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

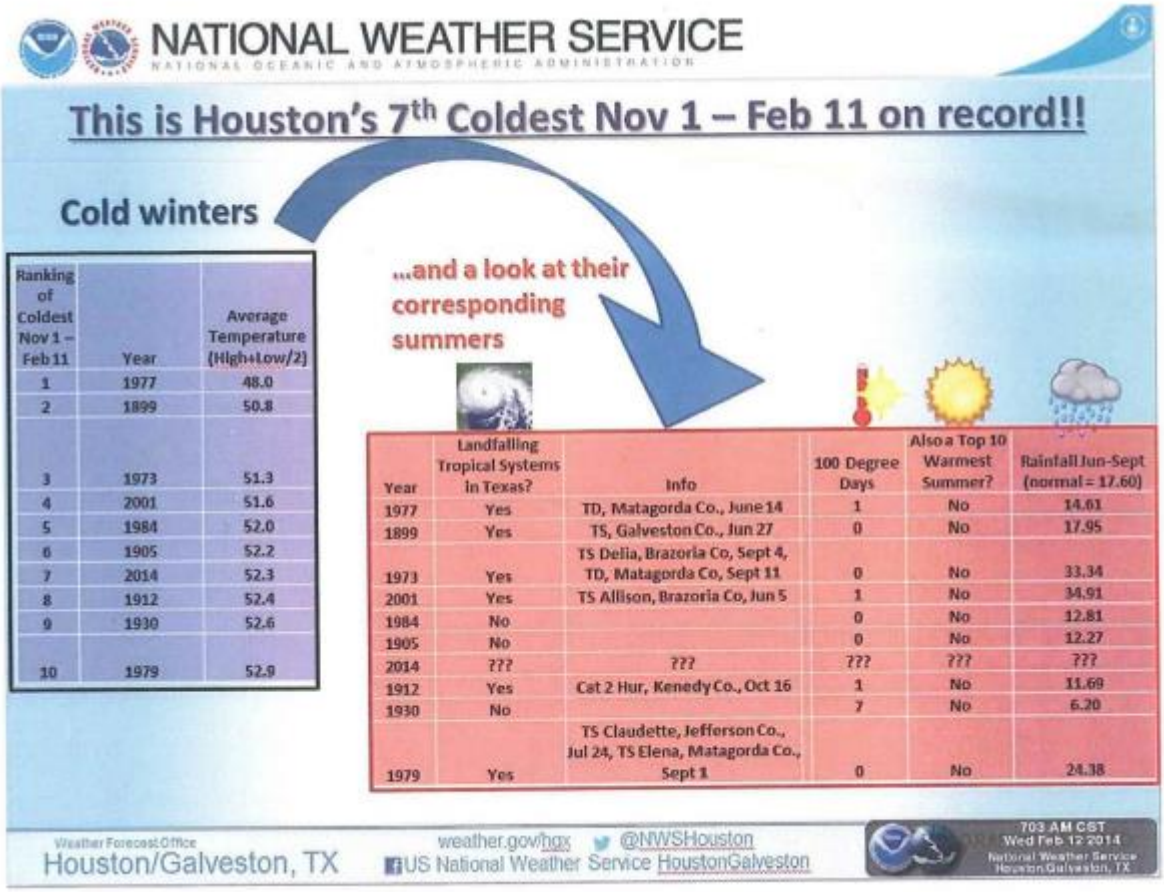
Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

FOOTNOTE

During the winter of 2013-2014, the National Weather Service announced that this has been the 7th coldest November 1-February 11 on record in the greater Houston area. The following graphic depicts those comparisons:



2009 MITIGATION ACTION ITEMS

WINTER STORM PUBLIC EDUCATION CAMPAIGN	

▪ Develop public service announcements to warn residents of impending inclement weather.
▪ Develop slides to be placed on the city's local PEG Channel 17 informing the public of predicted temperature fluctuations; the importance of protecting outside pipes from cold temperatures; and the need to bring pets indoors out of the inclement weather.
▪ Develop public service announcements to be utilized via the following modes of transmission:
  ▪ PEG TV Channel 17
  ▪ 1650 AM Radio Station
  ▪ Group Builder (city's email informational e-mail system)
  ▪ City's website: www.ci.friendswood.tx.us
	Ongoing

EMERGENCY POWER BACKUP WATER/WASTEWATER FACILITIES	

▪ Provide backup power supply to maintain consistent water service, wastewater disposal/lift station functions in the event of a power outage due to cooler weather.
▪ CIP projects
  ▪ Lift Station #2
  ▪ Surface Water Pump #2
  ▪ Lift Station #23
  ▪ Water Well #3, #4, #5, #6, #7
  ▪ Water Plant #1 Rehab
  ▪ Water Well #5 Rehab
  ▪ Water Well #7 Rehab
  ▪ Water Well #6 Rehab
  ▪ HMPG & CDBG 33 lift station generator installation
	▪ 9 projects included in FY09/19 CIP Plan
	▪ Water plant #5, work in process
	▪ Water plant #6, in final stage of project
	▪ Surface water plant #2, Phase 1, ground storage tank addition completed
	▪ Surface water plant #2, Phase 2, systems upgrade currently underway
	▪ Surface water plant #7 is in the design phase
	▪ Lift station #3 and #6 replacement are in process
	▪ HMPG, CDBG & TDRA generator installations are complete

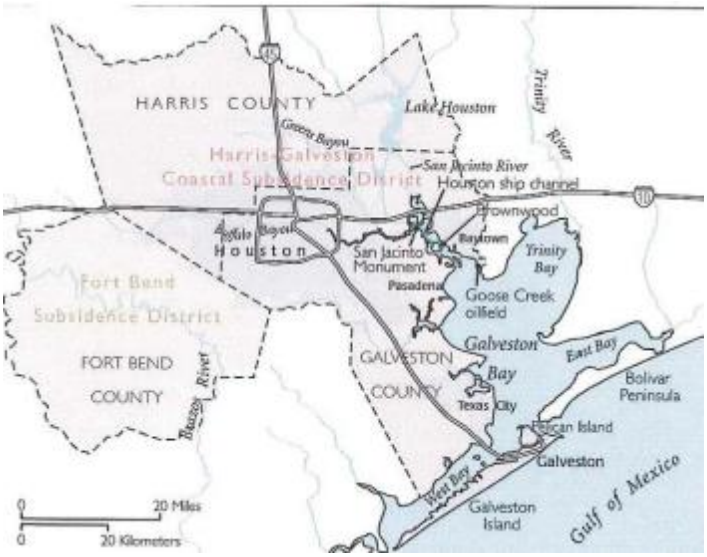
SUBSIDENCE

Land subsidence occurs when large amounts of groundwater have been excessively withdrawn from an aquifer. The clay layers within the aquifer compact and settle, resulting in the lowering of the ground surface in the area from which the groundwater is being pumped. Over time, as more water is removed from the area, the ground drops and creates a cone. Once the water has been removed from the sediment, it cannot be replaced. For example, only about 5.3 million acre-feet of the total rainfall "recharge" Texas aquifers each year. However, in 1996 approximately 9.9 million acre-feet of groundwater were pumped, resulting in a net loss of 4.6 million acre-feet of groundwater.

In the early 1900's, the Houston area began to see the first signs of human-induced land subsidence. This was initially attributed to the extraction of oil and gas beneath the surface of land immediately in and around the center of oil fields. In 1975, the Texas Legislature created the Harris-Galveston Subsidence District (HGSD), "...for the purpose of ending subsidence which contributes to, or precipitates, flooding, inundation, and overflow of any area within the District...." *(Houston-Galveston, Texas: Managing Coastal Subsidence, http://pubs.usgs.gov/circ/circ1182/pdf/07Houston.pdf).*

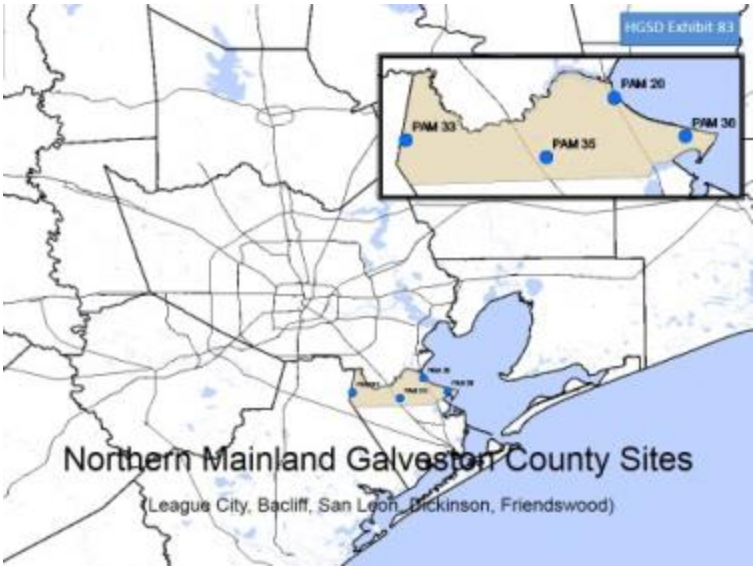
The District was authorized to issue or refuse well permits, promote water conservation and education, and promote conversion from ground-water to surface-water supplies. The primary objective of arresting subsidence in the coastal plain east of Houston has been successful; however, subsidence has accelerated in the inland areas north and west of Houston where the fastest development and growth are currently taking place.

HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT



NORTHERN MAINLAND GALVESTON COUNTY

This area includes Northern (Mainland) Galveston County encompasses Bacliff, Dickinson, Friendswood, Kemah, League City, and San Leon. There are four PAM (GPS measuring stations called Port-A-Measure units) sites in this area and all show very slight downward trends.

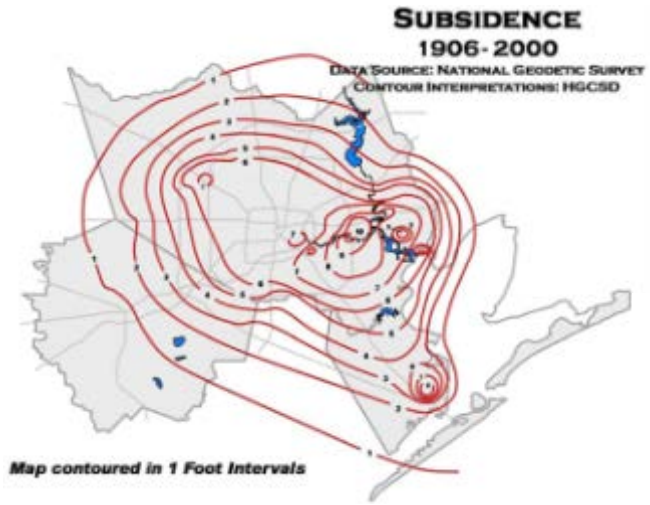


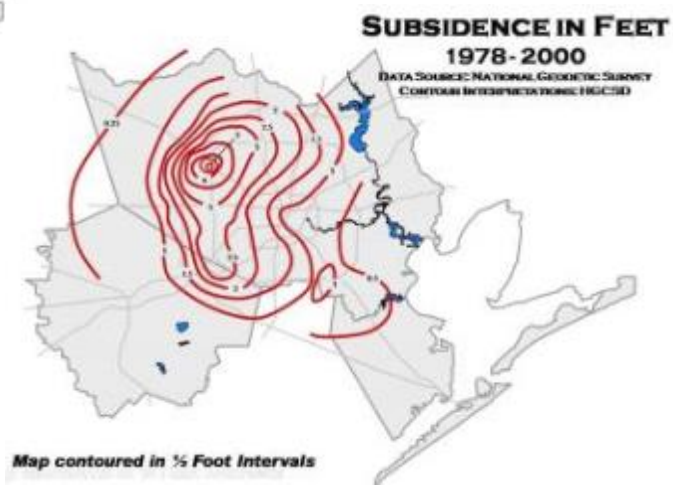
Friendswood, PAM 33 – installed 2/13/2007, recorded 0.02 feet in 2012, and a cumulative change of -0.05 feet in six years.
(+0.24 inches and -0.60 inches)

The Harris-Galveston Coastal Subsidence District (HGCSD) is the recognized expert in subsidence for this area. The HGCSD maintains the website www.subsidence.org and publishes annual reports that are utilized by communities and agencies in Harris and Galveston Counties.

State and local governments are already at work seeking to ensure that there will be enough water for the expected future population. The primary strategies aim to promote water conservation and acquire supplies from East Texas reservoirs. However, the region is better-positioned to deal with future problems than many other subsidence-affected areas, for several reasons: a raised public consciousness, the existence of well-established subsidence districts with appropriate regulatory authority, and the knowledge base provided by abundant historical data and ongoing monitoring.

Land subsidence is measured by the number of feet of land loss.





PREVIOUS EVENTS & EXTENT

PREVIOUS EVENTS

Regional land subsidence is subtle and difficult to detect. The Harris-Galveston Coastal Subsidence District (HGCSD) is the recognized expert in subsidence for this area. The HGCSD maintains a website www.subsidence.org and publishes annual reports that are utilized by communities and agencies in Harris and Galveston Counties.

June 2000	Houston-Galveston area	Early oil and gas production and a long history of ground water pumping in the Houston-Galveston area have created severe and costly coastal flooding hazards and affected a critical environmental resource – the Galveston Bay estuary.

Source: State of Texas Hazard Mitigation Plan, 2013 Update

EXTENT

The entire city or planning area is susceptible to subsidence. Land subsidence can lead to many problems, including changes in elevation; damage to structures such as storm drains, sanitary sewers, roads, railroads, canals, levees and bridges; structural damage to public and private buildings; and damage to wells. Most commonly, though, subsidence is known for causing an increase in the potential for flooding.

The entire planning area includes the following types of structures:

Single Family Structures	12,930
Multi-Family Units	1932
Commercial Facilities	309
Schools (Public and Private)	10
Day Cares	32
Churches	17
Government Facilities	21
Utilities	3
Public Infrastructure (sewer & water)	49

The City of Friendswood purchases water from the City of Houston, thus alleviating the need to obtain water from wells. Water usage from the city's water wells is only utilized as a backup when there are extended periods of power outages and water from the City of Houston cannot be conveyed to the city. No additional building restrictions and/or requirements have been initiated and/or adopted with regard to the effects of subsidence. No new irrigation water wells permits have been issued within the previous planning period.

In the eastern part of the greater Houston region, near the bay system, subsidence has been controlled by conversion from groundwater to imported surface-water. However, subsidence is accelerating to the west, where ground-water use has increased. Thus, the area of active subsidence has shifted from the low-lying, tide-affected areas towards higher elevations inland.

PROBABILITY

FREQUENCY OF OCCURRENCE

☐	Highly Likely	Event probably in next year
☐	Likely	Event probable in next 3 years
☐	Occasional	Event possible in next 5 years
■	Unlikely	Event possible in next 10 years

2009 MITIGATION ACTION ITEMS

WATER SYSTEM OPERATIONS	
▪ The City of Friendswood purchases treated water from the City of Houston. ▪ The city owns and operates two water booster stations and six ground water plants. ▪ The purchased water provides the majority of the demand and averages over 90% of the usage.	
▪ The city has purchased 12 million gallons/day surface water from the City of Houston to sustain the city to total build-out status. ▪ At this capacity, this supply will serve up to 57,000 people. ▪ Review and amend, if necessary, the "Water Conservation Plan", and the "Storm Water Management Program"	▪ Ordinance #2009-03 was amended by adopting a new section 86-30 "Water Conservation Plan" which adopts a water conservation plan to promote responsible use of water.

DETAILED DATA RESEARCH FOR AFFECTS OF SUBSIDENCE ON THE PLANNING AREA	
Annual reports and studies conducted by the Harris-Galveston Coastal Subsidence District (HGCSD) indicate that the effects of subsidence on the coastal area is negligible due to the conversion by communities from ground water to surface water. ▪ Research data regarding the effects of subsidence on the local planning area. ▪ Coordinate with the HGCSD for research on the effects of subsidence on the City, and seek potential avenues to alleviate those affects. ▪ Research potential the effects of subsidence and potential flooding.	The conversion to surface water has reduced the subsidence greatly. The result reported by Harris-Galveston Subsidence District for Friendswood was recorded 0.02' in 2012, and a cumulative change of -0.05' in six years.

HAZARDOUS MATERIALS

Hazardous materials are commonly used, transported, and produced in the area; hence, hazmat incidents may occur here. Roadway and pipeline transportation of hazardous materials presents a serious threat to the population. Eleven (11) pipeline companies operate twenty-eight (28) pipelines through the city. There are approximately forty-seven (47) linear miles of pipeline transmission lines within the city limits. Products such as ethane, natural gas, crude oil, gasoline, ethylene, propane, methane, and propylene are carried through pipelines ranging from six (6) to thirty (30) inches in diameter. Potential pipeline hazards include explosion, fire, toxic release, and contamination.

EXTENT

The following maps illustrate the location of pipelines within the community. Maps of the pipelines through the city and maps outlining the evacuation zones for each pipeline to include ruptures or leaks are located in ANNEX Q–HAZARDOUS MATERIALS, of the city's EMERGENCY OPERATIONS PLAN, and **APPENDIX E** of this **PLAN**. The evacuation zones are based on the 2008 Emergency Response Guidebook (ERG) developed in a joint effort by The U.S. Department of Transportation (DOT) and Transport Canada (TC). Road transportation of hazardous cargo occurs along the following routes: FM 518, FM 528, and FM 2351.

2007
Crude oil spill into Cowards Creek was a result of a damaged storage tank in a Pearland oil storage facility

PREVIOUS EVENTS

No hazardous materials events have been recorded within the city since 2008. Previous history of hazardous events can be found in *APPENDIX D*.

PROBABILITY

City of Friendswood officials recognize that hazardous materials incidents may occur within the community. In 2007 a complete inventory of all the pipelines traversing under the city was completed. This inventory included identifying all critical facilities within the city and their relation to pipeline hazards, and evacuation zones for materials contained within the pipelines were also mapped. The city's Emergency Management staff members regularly participate in training courses related to hazardous materials, and contact all the pipeline companies operating within the city on an annual basis to maintain an updated emergency contact list as well as identify all materials within the pipelines.

FREQUENCY OF OCCURRENCE

☐	Highly Likely	Event probably in next year
☐	Likely	Event probable in next 3 years
■	Occasional	Event possible in next 5 years
☐	Unlikely	Event possible in next 10 years

LOCATION

FIGURE 15
PIPELINES BY CORRIDOR

INFORMATION REMOVED

As part of the Texas Homeland Security Act, Sections 418.176 through 418.182 were added to Chapter 418 of the Government Code.

§ 418.180. CONFIDENTIALITY OF CERTAIN INFORMATION PREPARED FOR UNITED STATES.

Information, other than financial information, in the possession of a governmental entity is confidential if the information:
(1) is part of a report to an agency of the United States;
(2) relates to an act of terrorism or related criminal activity; and
(3) is specifically required to be kept confidential:
(A) under Section 552.101 because of a federal statute or regulation;
(B) to participate in a state-federal information sharing agreement; or
(C) to obtain federal funding.
Added by Acts 2003, 78th Leg., ch. 1312, § 3, eff. June 21, 2003.

2009 MITIGATION ACTION ITEMS

MAJOR THOROUGHFARE PLANNING	
▪ Implement the recommendations contained in the Major Thoroughfare Plan to improve evacuation options available within the community. ▪ Friendswood currently relies on FM 518, FM 528 and FM 2351 to provide access to Interstate 45 in the event of an evacuation. The Major Thoroughfare Plan includes improvements to League City Parkway (Brittany Bay Boulevard) to provide an additional evacuation route for residents. The proposed route parallels FM 518 connecting with Beltway 8 to the west and SH 146 to the east. ▪ The League City Parkway (Brittany Bay Boulevard) expansion is currently under design. The Friendswood Parkway (from FM 528 to League City Parkway) could provide an additional east/west mobility route to access IH-45 (designated evacuation route) o Brittany Bay Blvd – Phase I: CIP 2018 -- $6.5 million o Brittany Bay Blvd – Phase II: CIP 2018 -- $6.5 million ▪ Provide additional egress/ingress to enhance the residents' ability to access designated evacuation routes	▪ This is an amended/updated mitigation item carried over from the 2003 FEMA approved City of Friendswood Hazard Analysis and Mitigation Plan. ▪ This is a continuous project to be completed as CIP funding and/or grant funds are made available. ▪ Since 2009, the city has sought and secured Disaster Recovery Funds to expand Whispering Pines Avenue/Friendswood Link Road. o Currently under design ▪ Blackhawk Blvd. – Mobility enhanced providing alternative routes through the city o Large section improved from Friendswood Link to Thursa Lane Brittany Bay Blvd – Friendswood Parkway ▪ Ongoing project

GIS MAPPING & HAZUS	
▪ The main emphasis of this mitigation project is to enable the city to develop efficient damage assessments following hazard events which affect the city. This project will enhance the city's ability to identify flood prone properties, properties within the evacuation range in the event of a pipeline rupture or leak, conduct damage assessments in the event of a tornado touchdown or following a severe thunderstorm, hail or lightning event. ▪ HAZUS-MH mitigation software could be utilized to full capacity with in-house capabilities which would enhance 2013 City of Friendswood Hazard Analysis and Mitigation Plan. ▪ The city currently contracts with a private engineering firm for GIS mapping for the Community Development Department. ▪ Enhance the current mapping capabilities to allow for more detailed descriptions of properties with respect to identifying flood zones, evacuation routes, etc.	Through a contract with HDR Engineering, the city continues to maintain robust GIS system for mapping of critical facilities and other infrastructure. Budget restraints have affected the ability to purchase equipment for the utilization of HAZUS-MH.

SECTION IV
CAPABILITIES

PRE- AND POST-DISASTER HAZARD MITIGATION

BUILDING CODES

The City Code of Ordinances outlines buildings and building regulations, electrical code, plumbing code, mechanical code, fuel gas code, substandard buildings and structures, swimming pools, standard unsafe building codes. All construction, residential and commercial, must adhere to all building codes as well as land use and zoning regulations. The substandard structures laws were revised by ordinance to provide new methods, fees and appeals processes for handling substandard structures within the city.

FLOODPLAIN MANAGEMENT

Chapter 34, Floods, Article II Flood Damage Prevention, Division 2 Flood Hazard Reduction of the City Code of Ordinances details methods of reducing flood losses, general standards for building in special flood hazard areas, specific standards for residential and non-residential construction in SFHA, stormwater storage facilities, special lowest floor elevation requirements, and prohibiting construction into floodways. The city also participates in the National Flood Insurance Program utilizing maps which identify flood zones and special flood hazard areas. Annual CRS reviews are conducted to enhance the city's compliance and ability to maintain or lower the current CRS rating.

CAPITAL IMPROVEMENT PROJECTS COMPLETED

DRAINAGE PROJECTS

- Sunmeadow drainage
- Annalea/Whitehall/Kings Park drainage
- Clover Acres drainage
- Glenshannon drainage
- Woodlawn Streets and drainage
- FM 518 Drainage Improvements (Willowick to Cowards Creek)

WATER AND SEWER PROJECTS

- Blackhawk FM 2351 water line
- East Heritage 8" sanitary sewer
- 16" water line (Melody to Sunset)
- Autumn Creek sewer line
- City of Houston Raw Water System Buy-In (SEWPP) – pro-rata share
- Second surface water take point and system loop
- Moore/Mandale water line loop
- Bay Area Boulevard water line
- WWTP 8" water line loop
- Longwood Park water and sewer
- Surface Water Plant #1 - Rehabilitation
- Surface Water Plant #2, Phase 2 system upgrade with 1 million gallon storage tank
- Water Plan #3 rehabilitation
- Water Plant #4 rehabilitation
- Water Plant #5 – system upgrades, 500K gallon ground storage tank, 1M gallon elevated storage tank
- Water Plant #6 – System upgrades, 500K gallon ground storage tank
- Sunmeadow lift station
- South Friendswood force main
- Blackhawk water line
- Blackhawk Wastewater Treatment Plant Rehabilitation improvements; pro-rata share
- 16" transmission water line (Sunset to WW#4)
- Deepwood lift station & force main
- FM 2351/Beamer Road – Water line, gravity sewer, lift station/force main

FACILITIES

- **ANIMAL CONTROL FACILITY**
  - Replacement of structure previously located in a floodway)
- **FIRE STATION #3 REHABILITATION**
  - Funded through the state's disaster recovery dollars, Fire Station #3 was upgraded, expanded, and hardened to a much improved state of readiness.
  - Provision of auxiliary power

OIL AND GAS ORDINANCE

The city updated the oil and gas ordinance to address issues regarding new developments for pipelines and wells, updating the permitting and appeals process, and enhanced buffering and nuisance mitigation requirements.

EMERGENCY GENERATOR PROGRAM (TDRA)

Following Hurricane Ike in September 2008, the city utilized Hazard Mitigation Grant and State Homeland Security Grant funding to install generators at city critical facilities – city hall, library, water stations and lift stations (not located in flood zones). The city also ensured that other critical facilities, lift stations and water stations located in a flood zone were equipped with transfer switches to enable the use of portable generators.

EMERGENCY GENERATOR MAINTENANCE PROGRAM

- The city installed 37 emergency generators (2 water plants, 2 fire stations, 33 lift stations) with TDRA assistance of a disaster recovery grant following Hurricane Ike.
- The city entered into an agreement for an emergency generator maintenance program with a contractor to further ensure the city's constant state of emergency readiness.

BUYOUT LOTS AND PARKS

The city incorporated the buyout lots in the Imperial Gardens Estates subdivision with the 1776 Park, increasing the city's parkland acreage to about 33 acres, and allowing the city to utilize funds within the 1776 Trust for future operation and maintenance costs. These lots were part of the 2001 Tropical Storm Allison buyout program.

INTER-JURISDICTIONAL EMERGENCY MANAGEMENT PLAN

Friendswood ISD and the city designated an inter-jurisdictional emergency management plan together, providing Friendswood ISD that ability to meet state requirements and enhance joint planning and response efforts during times of disaster.

DISPATCH CONSOLES

FY11 Urban Area Security Initiative Program (UASI) grant funding was secured to upgrade the dispatch consoles in the police department to enhance communications throughout the Houston UASI region.

WARNING SYSTEMS

SIREN SYSTEM

A total of seven sirens are installed throughout the city to warn the public in case of a pipeline emergency or severe weather event. The Outdoor Warning Siren System is tested on the first Friday of every month at noon.

TELEPHONE-BASED SYSTEM

The city contracts with FirstCall Notification System to provide telephone-based community warnings for major emergencies within the city. This system allows the city to quickly alert citizens in the area affected or the entire city of an emergency, potential danger or hazardous condition. When directed, the system will begin calling all the telephone numbers in the affected area with a message alerting the residents.

E-MAIL ALERTS

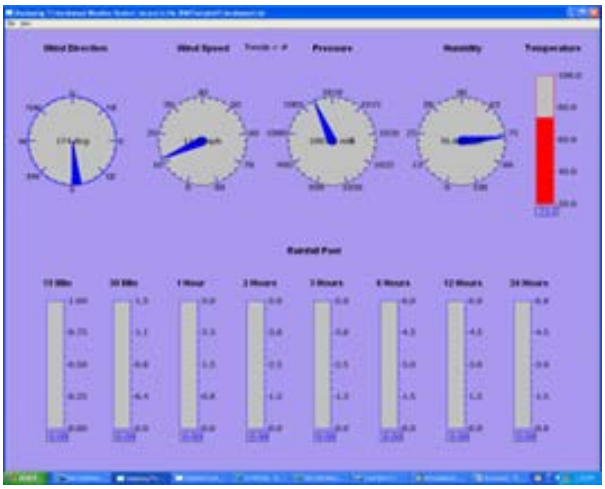
Citizens can register for E-mail alerts regarding emergency notices or other official city business. These notices are generated by the city and sent to E-mail address registered by the citizen.

RADIO AND TELEVISION

The city utilizes its local radio station, Friendswood Information Radio 1650 AM or KTRH-740 AM, and the Comcast Cable PEG (Public, Educational, Governmental Access) Channel 17 for local news, along with having access through EAS/PIES system to all Houston local television stations.

FRIENDSWOOD OEM WEATHER STATION

- The OEM Weather Station continues to monitor weather conditions within the city.
- Daily weather information can be found on the City of Friendswood's website in the EMERGENCY MANAGEMENT portion of PUBLIC SAFETY & EMERGENCY – (http://www.ci.friendswood.tx.us/Friendswood-Weather-Station)



CONTRACTS

The city enters into and maintains Agreements and Contracts for various services to be utilized before, during and following an emergency or disastrous event.

DEBRIS REMOVAL & MONITORING

- Crowder-Gulf Storm debris pickup & hazardous household waste
- CERES Storm debris pickup & hazardous household waste
- IESI Storm debris pickup

DEBRIS MONITORING

- SAIC Debris monitoring and other services

DEBRIS DISPOSAL

- Hill Sand Storm debris disposal site

ENVIRONMENTAL

- Garner Environmental Services, Inc. Environmental and disaster services

EMERGENCY FEEDING SERVICES – MEALS FOR EMERGENCY WORKERS

- Cardinal Culinary Services
- Joe's Bar-B-Q

EMERGENCY NOTIFICATION

- Code Red

CONTINUITY OF GOVERNMENT

- **ALTERNATE EOC**
  - Inter-local agreement with the City of Bryan to provide space for alternate EOC and relocation of city vehicles

INTER-LOCAL AGREEMENTS

▪ Clear Creek Drainage District	Supports city and emergency operations
▪ Galveston County Consolidated Drainage District	Supports city and emergency operations
▪ Friendswood ISD	Use of facilities and equipment
▪ Clear Creek ISD	Use of facilities and equipment
▪ Harris County	Emergency assistance, governmental functions & services
▪ Galveston County	Emergency assistance, governmental functions & services
▪ City of Pearland & Alvin	Fire and EMS assistance

SECTION V
2014 MITIGATION ACTION ITEMS

The Hazard Mitigation Committee conducted the Risk Assessment/Vulnerability Analysis to determine which hazards were of the greatest risk to the city. This analysis was based upon the historical data of occurrences of past events. The committee utilized the Risk Assessment/Vulnerability Analysis tool as shown in Table 2 on page 8 and 9 of this plan. This process showed that Severe Thunderstorms/Hail/Lightning rated the highest vulnerability with Flood Events and Hurricane (Wind) both receiving the second highest rating. The Hazard Mitigation Committee agreed by voice vote consensus that the hazards be prioritized to coordinate with the Risk Assessment/Vulnerability Analysis.

Action Items were prioritized to coincide with the Risk Assessment/Vulnerability Analysis as indicated below:

1. Severe Thunderstorms/Hail/Lightning
2. Flood Events
3. Hurricane (Wind)
4. Hurricane (Storm Surge)
5. Tornado & Drought
6. Winter Storms
7. Hazardous Materials

SEVERE THUNDERSTORMS / HAIL / LIGHTNING

ACTION #1	DEVELOP A PUBLIC EDUCATION CAMPAIGN WITH INFORMATION REGARDING PROPERTY & PEOPLE PROTECTION
• Develop public information materials and conduct outreach programs which include information regarding thunderstorms/hail/lightning to include how they develop, precautionary measures to take to protect property and lives, and developing a disaster plan. o Protective measures which can be utilized to protect against thunderstorms, lightning and hail events ✓ Remove dead or rotting trees & branches which could fall and cause damage or injury; ideal planting conditions for fruit trees is 16', ash 32' and oak 59' from a building structure to prevent damage to foundations and/or structural damage from the canopy ✓ Go indoors after seeing lightning and remain inside for at least 30 minutes after hearing last clap of thunder ✓ Postpone outdoor activities ✓ Secure outdoor objects which may be blow around or cause further damage ✓ Avoid corded telephones – cordless & cellular phones are safe to use. ✓ Unplug electrical appliances and other electrical items such as computers, TVs, radios, etc. ✓ Use NOAA Weather Radio for updates from local officials o Encourage the public to make a family disaster plan to include contacts and locations to reunite in the event they become separated o Assemble a 3 day disaster supply kit with food, water, medical supplies, battery powered NOAA radio, flashlights, batteries, extra clothing. o Gather important documents and store them in a fire and/or water-proof container.	
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • Fire Marshal's Office • City Manager o Public Information Officer
ESTIMATED COST	• Minimal – obtain brochures from FEMA free of charge; • Staff to deliver materials to Library, Activity Center, City Hall, and various public events
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #9** • Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, CodeRed Network, Radio, etc.)
IMPLEMENTATION SCHEDULE	Obtain FEMA materials and begin development of PSA materials in FY 2015 and continue through 2020.

ACTION #2	DEVELOP AND INITIATE A PUBLIC INFORMATION CAMPAIGN REGARDING THE LOCATION OF TREES IN RELATION TO POWER LINES & UTILITY EASEMENTS
• Work with Texas New Mexico Power Company to develop public information materials or a cooperative plan to encourage residents and/or business to trim and/or remove trees and other vegetation located within the utility easement and intermingling through the power lines which could potentially tear down power lines during severe thunderstorms with high winds. • Information can be disseminated through public service announcements (PSAs) via the city PEG channel, Twitter feed, Facebook, Focus on Friendswood newsletter, email messages, newspaper articles, and public presentations at civic organizations. • Effect on existing buildings would be to minimize damage to power lines by the removal of trees or trimming of canopies away from the power lines. • Effect on future buildings would be to ensure that electrical utility lines are buried and not affected by tree canopies and/or vegetation.	
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • Fire Marshal's Office • Community Development • City Manager o Public Information Officer
ESTIMATED COST	• Development of informational materials would be minimal; • Cost to businesses and homeowners is unknown
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #1** • Ensure that critical infrastructure sites are protected from all hazards.
IMPLEMENTATION SCHEDULE	Develop & obtain materials as soon as possible, and continue this program throughout the next 5 years.

ACTION #3	THUNDERSTORM & LIGHTNING SENSORS FOR CITY PARKS
PURCHASE AND INSTALL OUTDOOR ALERTING SYSTEMS AT ALL CITY PARKS UTILIZED FOR GROUPS GREATER THAN 20 PEOPLE.	Purchase and install lightning detection and early warning devices for all city park facilities. The devices will detect lightning activity to provide in-cloud and cloud-to-ground detection efficiency critical for advanced notification of severe weather. These devices will detect and warn by siren during severe thunderstorm/hail/lightning events and give attendees and participants at events held at various sports parks throughout the city sufficient time to prevent injury and possible loss of life.
PARK ACREAGES	• Baker Road 17.60 • Centennial Park 58.40 • Friendswood Sports Park 19.85 • Lake Friendswood 42.00 • Leavesley Park 2.90 • Lundy Lane Soccer Park 24.69 • Old City Park 14.70 • Renwick Sports Complex 16.48 • 1776 Memorial Park 2.90 • Stevenson Park 27.00 Total Park (in acres) 265.71
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Parks and Recreation Department • Office of Emergency Management
ESTIMATED COST	• $100,000 for warning units at 11 locations • $5,000 - annual maintenance of units
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #7** • Continue to develop capital improvement projects which address hazards identified in the mitigation plan. **MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards.
IMPLEMENTATION SCHEDULE	Purchase and install sensors within the next 5 to 10 years.

FLOOD EVENTS

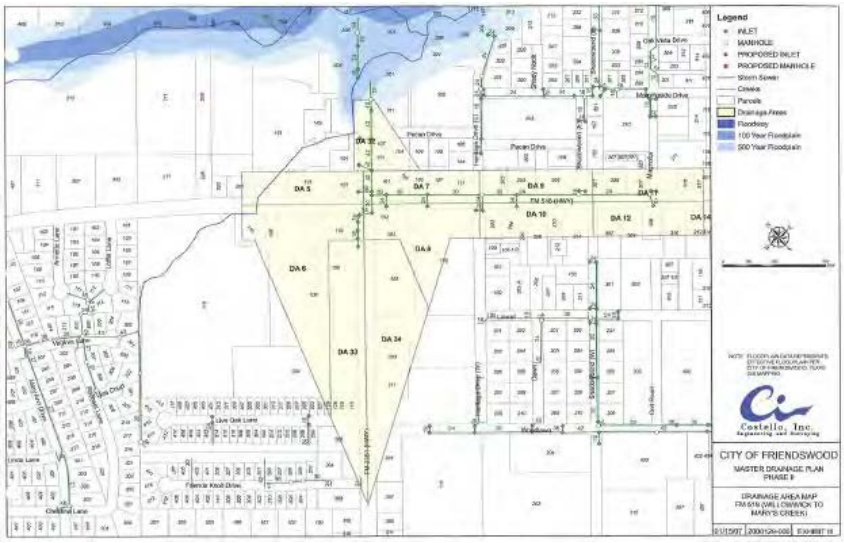
ACTION ITEM #1	DEVELOP A COMPREHENSIVE FLOOD MITIGATION PLAN
• Develop a Flood Mitigation Plan for the city and submit the plan to the Texas Water Development Board for guidance and review. • Review and update the city's floodplain ordinance. • Continue enforcement of the floodplain management ordinance and retain or improve the current CRS Rating of 5. • Strive to meet criteria necessary to achieve a lower CRS rating. • Initiate and implement additional floodplain requirements that are above the minimum floodplain compliance. • Update the city's current floodplain map to coordinate with the currently proposed FEMA Flood Insurance Rate Map relative to all floodplains as proposed. • Require elevation certificates on all construction plans submitted for development. • Require new developments to adhere to open space requirements with regard to floodplain management. • Continue to encourage residents to purchase flood insurance through the NFIP.	
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Floodplain Manager • Community Development Office • Office of Emergency Management • Assistance from the Hazard Mitigation Committee
EFFECT ON NEW & EXISTING BUILDINGS	• Maintain and/or increase affordability of flood insurance to residents and commercial owners by lowering the certification rating. • Protect the city's current CRS rating and possibly improve the current CRS rating.
ESTIMATED COST	• The cost of this project is low compared to the potential benefits of reducing the effects of flooding on residential and commercial structures. • This project can be achieved in coordination between the three departments identified.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #2** • Reduce the vulnerability from flooding of existing residential & business structures. • Decrease flood losses in designated flood hazard areas, and potentially decrease losses and damages to those properties classified as RL and SRL
IMPLEMENTATION SCHEDULE	To be developed and approved within the next five years.

ACTION ITEM #2	DATABASE DEVELOPMENT & MAINTENANCE FOR RL/SRL PROPERTIES DATABASE DEVELOPMENT FOR ELEVATION, RELOCATION AND ACQUISITION
• **DEVELOP A USER FRIENDLY DATABASE FOR ENTRY OF ALL DESIGNED RL AND SRL PROPERTIES AS WELL AS THOSE PROPERTIES LOCATED IN SFHA AREAS.** • **MAINTAIN ACCURATE INFORMATION REGARDING BFE.** • **DESIGNATE A COORDINATOR TO MAINTAIN INTEGRITY OF THE SYSTEM.** • Database development will ensure that documentation of flood losses is consistent and up-to-date. • The database will assist to ensure map coordinates and property identification is consistent. • Enhance inventory control of all structures in or out of SFHA designated areas (number of structures/parcels, improvement values; total land area) to assess loss liability following a disaster. • The city incorporated the buyout lots in the Imperial Estates subdivision (Tropical Storm Allison 2001) with the 1776 Park. This increased the city's designated park acreage by 33 acres and will allow the city to utilize funds in the 1776 Trust for future operation and maintenance costs. • Amended existing deed restrictions for buyout lots in Imperial Estates Section 1 subdivision to align them with FEMA requirements and setting the framework for enhanced park facilities.	
LEAD AGENCY/DEPARTMENT RESPONSIBLE	• Floodplain Manager • Community Development • Parks & Recreation Department • Office of Emergency Management
EFFECT ON NEW & EXISTING BUILDINGS	• Potentially remove RL and SRL properties identified in the NFIP database through future mitigation projects. • Control future development with compliance to all adopted floodplain management criteria and plans.
ESTIMATED COST	• The development of the RL/SRL database could be accomplished with the current staffing patterns. • Current database of mitigated buyout lots is currently being handled with current staffing pattern.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #2** • Reduce the vulnerability from flooding of existing residential & business structures. • The benefit of compliance is to remove those properties from located in the floodway or 100 year flood zone to prevent losses from future flood events. • In the event that elevation, relocation and acquisition projects would be necessary in the future, the adequate identification of properties could possibly limit the city's financial liability.
IMPLEMENTATION SCHEDULE	Within the next 5 years.

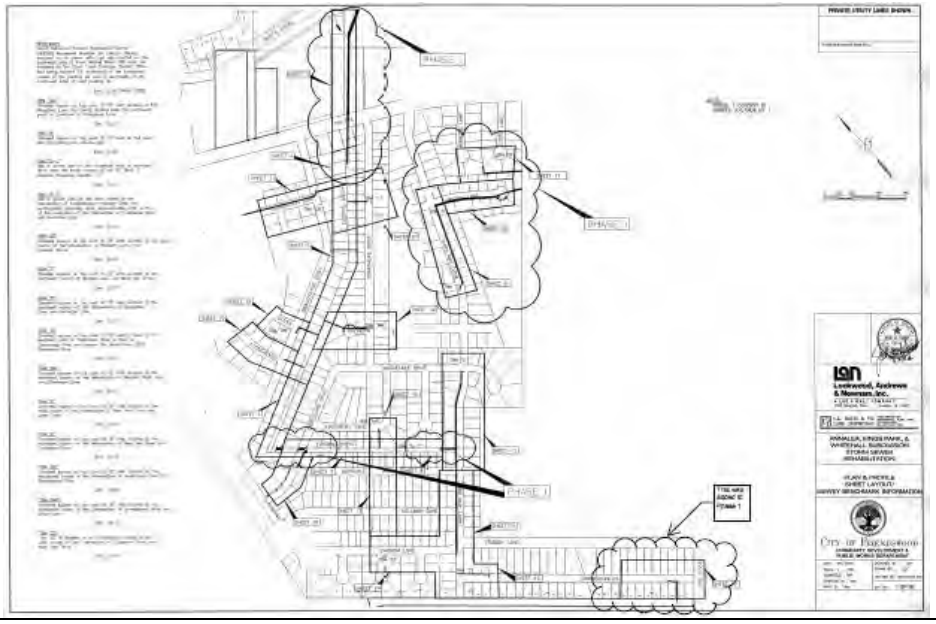
ACTION ITEM #3	DRAINAGE PROJECTS

DEVELOP DRAINAGE IMPROVEMENT PROJECTS AND OBTAIN FUNDING FOR COMPLETION OF DRAINAGE PROJECTS TO MITIGATE FUTURE FLOODING

- **FM518 DRAINAGE IMPROVEMENTS – PHASE 2**
  - FM 2351 to Willowick
  - Convey the 100 year flows into Clear Creek
  - Component of the 2007 Master Drainage Plan Phase 2
  - Estimated cost $2.7 million



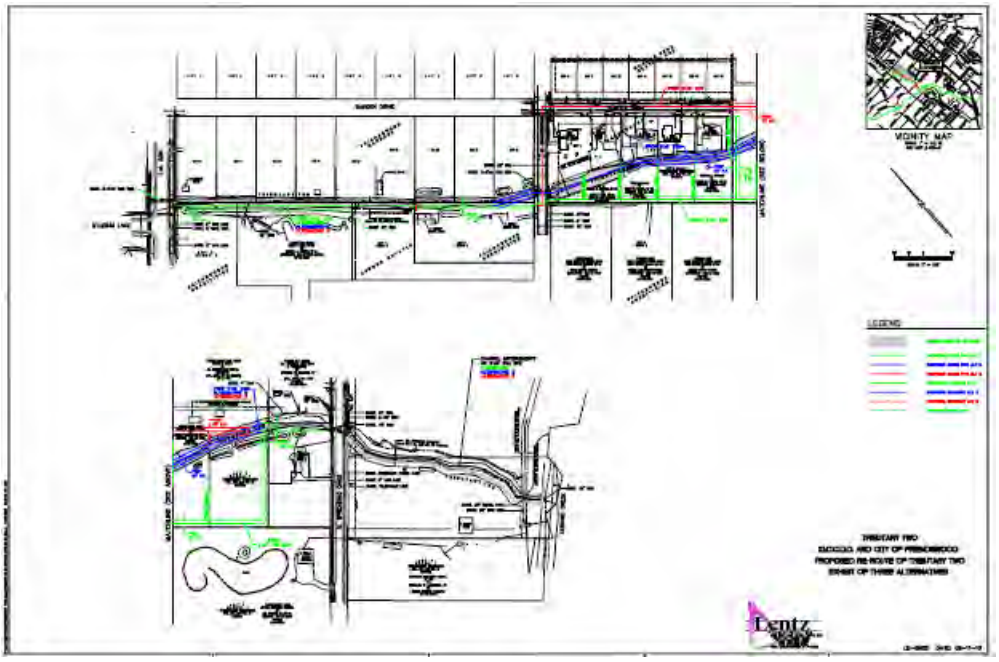
- **ANNALEA / WHITEHALL / KINGS PARK DRAINAGE – DRAINAGE IMPROVEMENTS PHASE 2**
  - Initial phase of project completed in 2005
  - Upsizing storm sewer system to reduce potential flooding
  - Estimated cost $862,000

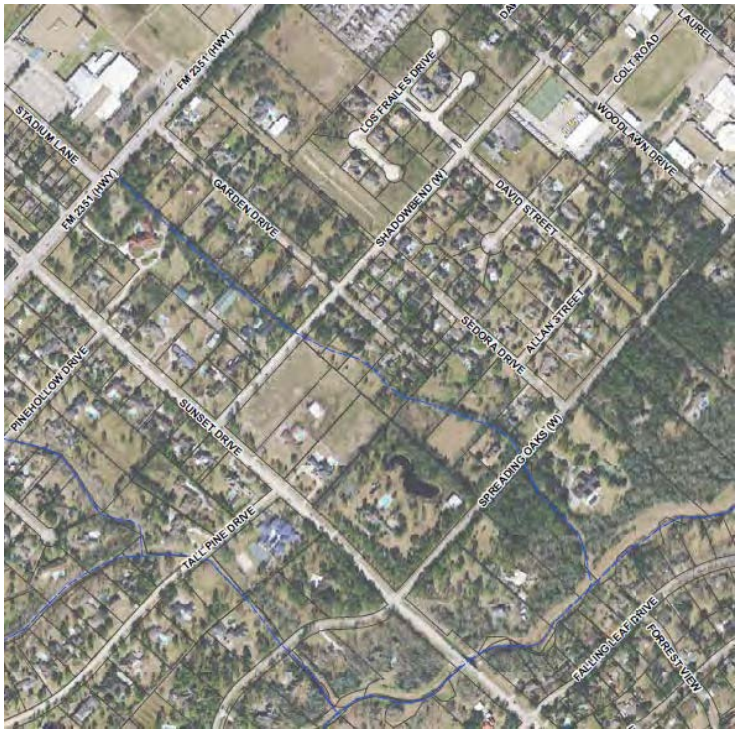


- **SHADOWBEND DRAINAGE IMPROVEMENTS PHASE 2**
  - Component of 1993 master Drainage Plan Phase 1
  - Upsizing storm sewer system to reduce potential flooding
  - Estimated cost $416,000

- **SUNMEADOW DRAINAGE IMPROVEMENTS PHASE 2**
  - Component of 1993 Master Drainage Plan Phase 1
  - Initial phase of project completed in 2005
  - Upsizing storm sewer system to reduce potential flooding
  - Estimated cost $3.1 million

- **TRIBUTARY 2 DRAINAGE / OUTFALL IMPROVEMENTS**
  - Component of 2004 TxDOT study
  - First 3 segments of project have been completed
  - From FM2351 to Cowards Creek
  - Placement of 3,300 linear feet of box culverts
  - Possible partnership with Galveston County Consolidated Conservation District
  - Estimated cost $3.6 million



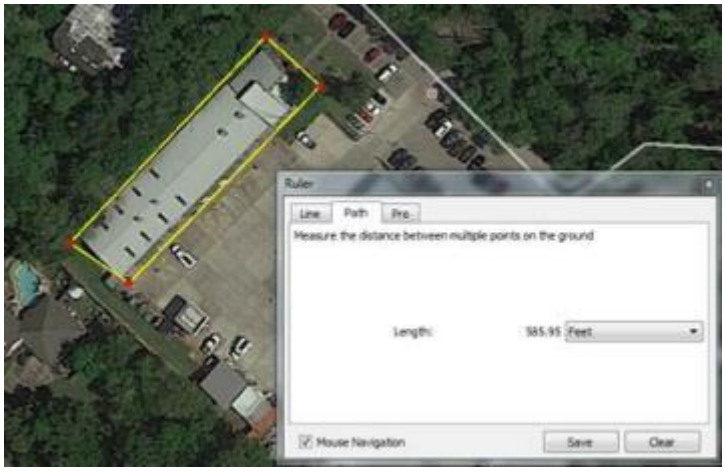


LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development • Public Works –Engineering & Capital Projects
EFFECT ON NEW & EXISTING BUILDINGS	• These projects are in areas that have already been built out and have experienced flooding in the past. These projects are designed to protect existing structures from future flooding losses.
ESTIMATED COST	• Estimated cost of all projects combined is $10,678,000 • Once funding sources have been identified and secured, these projects can proceed to completion.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY # 2** • Reduce the vulnerability from flooding of existing residential & business structures.
IMPLEMENTATION SCHEDULE	• Capital improvements are an ongoing program within the city. • Projects are proposed and prioritized though City Council. • Project completion is dependent upon the securing of funding either through the general operating budget or other avenues; i.e., bonds, grants, loans, etc.

ACTION #4	TIGER DAM PROTECTION OF CRITICAL INFRASTRUCTURE
PURCHASE AND MAINTAIN A TIGER DAM FOR USE AT PUBLIC WORKS FACILITY & PARKS & RECREATION STORAGE UNIT	• The public works complex of approximately 3 acres floods on average once every 5-6 years. • Access to the public works complex is inhibited during flood events. • Elevation of current office, lunchroom, equipment, fueling station and other outbuildings is not feasible as access to entire complex is blocked during flood events. • Because the entire facility is located in the floodway, the possibility of installation of a permanent backup generator is not feasible. • Office portion of current facility is insured by TML and NFIP is mandatory. **TIGER DAM SYSTEM INFORMATION** • The system consists of elongated flexible tubes which can be staked, joined end to end & filled with water (flood water, 2" pump, fire hydrant or garden hose. • Tubes can be stacked up to 32" high, and linked together seamlessly (triangular in shape) • They are flexible and can form any shape. • Water can be drained back into Clear Creek once the flood waters have subsided. • Reusable • Can possibly divert up to 70-100% of floodwaters. **TIGER DAM VS. FACILITY RELOCATION** • Estimated cost of relocating the Public Works Building, Parks & Recreation storage unit, and securing enough property to house all equipment is estimated to cost $5-6 million dollars (including property purchase). • Projected property size would be 3-5 acres. **LOCATION OF PROPERTY LARGE ENOUGH TO HOUSE SUCH A FACILITY IS GOING TO BE AN ISSUE:** • If located within the COD (Community Overlay District) where any portion of the property lies within 300' of the major thoroughfares; i.e., FM 518, FM 528, FM 2351, Bay Area Blvd, and Friendswood Lakes, the structures would have to include fenestrations which will increase cost of construction, etc. for the structures. • **Estimated cost for property purchase and relocation for all facilities is estimated at $4-6 million.**
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Public Works Department • Parks & Recreation Department • Office of Emergency Management
ESTIMATED COST	**ESTIMATED EXPENSE TO UTILIZE TIGER DAMS TO PROTECT THE FOLLOWING BUILDINGS AT THEIR CURRENT LOCATION BETWEEN 3 AND 4 FEET HIGH (3 – 42" HIGH TUBES)** • Public Works Facility (600'), Parks Facility (350'), & Public Works & Parks Department Fuel Station (200') **$450,000** **COST EFFECTIVENESS** Cost effectiveness for the purchase of the Tiger Dams as compared to relocating all the Public Works facilities and Parks & Recreation facility and equipment is considerable. The cost of purchasing the Tiger Dams is approximately .075% of the cost of relocation.

CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #1** • Ensure that critical infrastructure sites are protected from all hazards. **MITIGATION STRATEGY #2** • Reduce the vulnerability from flooding of existing residential and business structures. **MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards.
IMPLEMENTATION SCHEDULE	**FACILITY RELOCATION** • Potential time frame would be 10 years. • Latest bond elections were conducted in 2003 and 2013. • Current bond election projects detailed in three phases with projected completion expected by 2023. **TIGER DAMS** • Purchase within the next five years.
	PUBLIC WORKS & PARKS AND RECREATION FACILITIES LOCATION MAPS 

PUBLIC WORKS FACILITY



PUBLIC WORKS FUEL STATION

PARKS & RECRECATION FACILITY

HURRICANE - WIND

ACTION #1	PUBLIC INFORMATION EDUCATION PROGRAM
DEVELOP & INITIATE PUBLIC INFORMATION MATERIALS FOR A TREE MANAGEMENT PROGRAM WITH REGARD TO THE LOCATION OF TREES IN RELATION TO POWER LINES	• This is a preventative measure to alleviate power outages due to downed trees as a result of hurricane winds, tornadoes, and/or other high wind events. • Encourage property owners to remove diseased/dead trees from property and remove trees which have the potential to cause property damage if blown by the wind into structures. • Build a working relationship with power companies servicing the city and potentially develop a cooperative plan to assist residents with the removal of hazardous vegetation.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • Community Development • City Manager o Public Information Officer
EFFECT ON NEW & EXISTING BUILDINGS	Alleviate damages to structures and public utility systems as a result of downed trees.
ESTIMATED COST	Minimal cost/staff time
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards. **MITIGATION STRATEGY #9** • Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, FirstCall Network, Radio, etc.)
IMPLEMENTATION SCHEDULE	Develop & obtain materials as soon as possible, and continue this program throughout the next 5 years.

ACTION #2	PROTECT POWER LINES
BURYING POWER LINES **BURIED POWERS LINES CAN ENSURE UNINTERRUPTED POWER SUPPLIES FOLLOWING SEVERE WIND EVENTS**	• The Community Development Department requires all potential developers to submit their potential plans and participate in a review process which includes Community Development, Fire Marshal's Office, Public Works and Engineering. • All future developments are required to bury power lines to prevent disruption by protecting said lines from wind and flying debris.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development • Engineering • Fire Marshal's Office
EFFECT ON NEW & EXISTING BUILDINGS	• By requiring future developments to bury power lines, interruption of power can be minimized in more portions of the community.
ESTIMATED COST	• This requirement can be initiated early in the development phase and all power lines can be buried along with additional utilities (natural gas lines, water lines, streets and drainage) and could be accomplished prior to construction of residences.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #1** • Ensure that critical infrastructure sites are protected from all hazards. **MITIGATION STRATEGY #3** • Maintain previous mitigation projects to ensure continuity of services.
IMPLEMENTATION SCHEDULE	Begin and continue this program through the next five years.

HURRICANE – STORM SURGE

ACTION ITEM #1	ADOPT THE 2012 INTERNATIONAL BUILDING CODE (IBC) TO INCLUDE ASCE-24-10
Adopt the 2012 International Building Code (IBC) and 2012 International Fire Code (IFC). The city currently operates under the 2009 IBC which includes the ASCE-24-05 Flood Resistant Design and Construction and the 2009 IFC.	
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development • Fire Marshal's Office
EFFECT ON NEW & EXISTING BUILDINGS	• Establish design standards for buildings located in areas susceptible to storm surge. • Adoption of these codes will require higher elevations in structures in inundation zones. • Require deep foundations in order to avoid erosion and scour. • Plans for future storm surge heights due to potential rise in sea levels.
ESTIMATED COST	• Cost to implement the adoption of these codes is limited to staff review time of the 2012 IBC and IFC, and submitting suggested amendments to City Council for approval. • Additional staff time would be required if it was recommended that the city adopt the 2015 IBC and IFC.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #2** • Reduce the vulnerability from flooding of existing residential & business structures.
IMPLEMENTATION SCHEDULE	This process could begin in Fiscal Year (FY) 2015 and be completed within a year.

ACTION ITEM #2	UPGRADE & RENOVATE CURRENT PUBLIC WORKS BUILDING
• Renovate and upgrade the current Public Works facility. • The current facility is located in Hurricane Category 4 Storm Surge Zone. • Current facility was built in 1978. • Current facility has approximately 2400 square feet, and is not sufficient to accommodate current office staff members (public works, engineering, projects and design). • Current facility needs to be improved to adhere to current codes, i.e., IBC, IFR, ADA, etc.	
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development • Public Works Department o Engineering Department o Capital Projects Department
EFFECT ON NEW & EXISTING BUILDINGS	• The existing structure would be improved to ensure compliance with all codes currently in place in the city.
ESTIMATED COST	• Projected cost is $1.4 million
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #1** • Ensure that critical infrastructure sites are protected from all hazards. • Maintain continuity of operations by protecting public facilities prior to an emergency event and minimize potential damages and interruption of services.
IMPLEMENTATION SCHEDULE	Within the next 5 to 10 years.

ACTION ITEM #3	UPDATE CITY STORM SURGE MAPS TO REFLECT THE NWS PREDICTIONS
• The storm surge maps currently utilized to depict storm surge are based upon hurricane category wind speeds. • As indicated during Hurricane Ike (2008), the storm surge recorded at Bolivar Peninsula was 20', however, surge at Kemah (entrance of Clear Lake) was recorded at 10-12 feet, which did not affect any structures within the city. • Storm surge water depth is in direct relation to the path or track of the hurricane. A hurricane making landfall nearer the west portion of Galveston Bay or west portion of Galveston County will affect the city more than a hurricane tracking over the east portion of Galveston Bay (as occurred during Hurricane Ike).	
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development • Office of Emergency Management
EFFECT ON NEW & EXISTING BUILDINGS	• The updated maps will display potential storm surge by water depth based upon the NWS predicted storm surge and projected track for landfall. The new maps may more accurately display water depth in areas within the city.
ESTIMATED COST	• Projected cost is $5,000-10,000 (updated mapping provided by the current contracted engineering firm). Projected costs could potentially be covered by annual budget funding through the city's annual budgeting process.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #2** • Reduce the vulnerability from flooding of existing residential & business structures. • Updating the storm surge maps to reflect actual predicted water levels will provide a more accurate scenario which would be useful in issuing evacuation orders and in determining evacuation routes. • Assigning damage assessment teams to focus on areas where water levels had been predicted to rise will assist in the damage assessment process and pre-staging of resources. • Updated storm surge maps may assist in more accurately predicting potential woody debris and construction/demolition debris and in estimating potential costs and time needed for debris removal.
IMPLEMENTATION SCHEDULE	Within the next 5 years.

TORNADO

ACTION #1	DEVELOP CONSTRUCTION STANDARDS AND TECHNIQUES
DEVELOP CONSTRUCTION STANDARDS AND TECHNIQUES TO REDUCE IMPACT OF TORNADIC WINDS	Through the development process with private homebuilders and developers, encourage the following measures to minimize damage from wind: • structural bracing • straps and clips • anchor bolts • impact-resistant glass • reinforced garage doors • interlocking roof shingles
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development • Engineering
EFFECT ON NEW & EXISTING BUILDINGS	• Structural reinforcement requirements can be required when homeowners remodel or add additions onto existing structures, or make repairs to fire-damaged structures. • Structural reinforcement requirements can be required on all new construction of commercial and residential building.
ESTIMATED COST	• Projected costs would be absorbed by homebuilders and developers.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #5** • Educate the public regarding zoning and building regulations which affect new construction, demolition, and flood hazards.
IMPLEMENTATION SCHEDULE	Develop & obtain materials as soon as possible, and continue this program throughout the next 5 years.

ACTION #2	DEVELOP & CONDUCT TORNADO AWARENESS ACTIVITIES
DEVELOP PUBLIC AWARENESS MATERIALS	• Develop tornado awareness materials to educate the public as to how to protect themselves and property in the event a tornado would occur in the area. • Items to cover: o If no concrete safe room is located in the residence, use an internal room with no windows o Secure all items located outside the residence (patio furniture, flower pots, grilling accessories, etc.) so they do not become flying projectiles o Encourage installation of impact-resistant windows o Reinforce garage doors
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • City Manager o Public Information Officer
ESTIMATED COST	• Informational materials can be obtained at no cost from FEMA • If additional materials are needed, they can be developed in-house by staff members, and distributed through public education outreach programs with HOAs, civic organizations, etc.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #9** • Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, CodeRed Network, Radio, etc.)
IMPLEMENTATION SCHEDULE	Develop & obtain materials as soon as possible, and continue this program throughout the next 5 years.

DROUGHT

ACTION #1	MONITOR DROUGHT CONDITIONS
DEVELOP A REGULAR SCHEDULE TO MONITOR AND REPORT DROUGHT CONDITIONS TO DECISIONS MAKERS & DEPARTMENT HEADS	• Develop a regular schedule to monitor drought conditions; i.e., monthly or quarterly, through the U.S. Drought Monitor website. • Report drought conditions to Public Works Department. • Report drought conditions to Department Heads. • If necessary, implement the city's Drought Contingency Plan in coordination with the Decision Makers and Department Heads. • Notify public of status of the Drought Contingency Plan through PSAs.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • Public Works Department • City Manager o Public Information Officer
ESTIMATED COST	• Minimal; can be absorbed by staff
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards. **MITIGATION STRATEGY #9** • Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, CodeRed Network, Radio, etc.)
IMPLEMENTATION SCHEDULE	Develop PSAs and have drought informational materials prepared prior to initiating the Drought Contingency Plan.

ACTION #2	WATER CONSERVATION
ENHANCE LANDSCAPING AND DESIGN MEASURES	• Develop public informational materials to educate the public regarding water conservation measures during periods of drought conditions. o Encourage recapturing of water with buckets when showering or bathing to be used on outside vegetation areas o Educate public on restricted watering criteria; i.e., by house number/days of week; limiting watering of lawns to certain hours; establish only flower beds and gardens can be watered using only the end hose – no sprinklers; o Encourage xeriscaping property and lawns o Encourage installation of permeable driveways and sidewalks in new subdivision developments to reduce runoff and promote groundwater recharge
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • Public Works Department • Community Development • City Manager o Public Information Officer
ESTIMATED COST	• Development of informational materials can be accomplished in-house at minimal cost and absorbed by annual budget, • Research and obtain materials through various agencies at minimal cost or for free
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards. **MITIGATION STRATEGY #9** • Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, CodeRed Network, Radio, etc.)
IMPLEMENTATION SCHEDULE	• Develop PSAs and have preparedness materials on-hand as soon as possible and prior to need. • Develop and provide the Community Development Department materials to be utilized in the proposal and design phase of subdivision development.

WINTER STORMS

ACTION #1	ESTABLISH A WARMING CENTER AT THE PUBLIC LIBRARY FOR THE GENERAL PUBLIC
INSTALLATION OF A GENERATOR AT THE PUBLIC LIBRARY TO PROVIDE AUXILIARY POWER WHICH FACILITATE THE OPERATION OF A WARMING STATION FOR THE GENERAL PUBLIC	• Install a generator at the City Public Library at 416 South Friendswood Drive to provide auxiliary power which will facilitate the operation of a warming station for the general public • Develop public information materials for the general public regarding the location of a warming station at the Public Library.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • Community Development • Friendswood Public Library • City Manager o Public Information Officer
ESTIMATED COST	• Generator and installation $90,000
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** Maintain the city's ability to respond to all types of hazards. **MITIGATION STRATEGY #9** • Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, CodeRed Network, Radio, etc.)
IMPLEMENTATION SCHEDULE	• Generator installation project to begin in quarter 2 of FY 2016 • Develop PSAs and have preparedness materials on-hand as soon as possible and prior to need.

ACTION #2	ESTABLISH A WARMING STATION AT THE SENIOR ACTIVITY CENTER FOR SENIOR CITIZENS
DEVELOP PUBLIC INFORMATIONAL AND EDUCATIONAL MATERIALS TO EDUCATE THE SENIOR CITIZEN POPULATION REGARDING THE WARMING STATION LOCATED AT THE SENIOR CENTER	• Develop public educational materials and presentations to inform senior citizens of the availability of a warming station located at the Senior Citizen Center.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • Parks and Recreation Department
ESTIMATED COST	• Costs will be minimal for development of educational and informational pamphlets to be distributed to the Senior Citizen population at the Senior Activity Center and the Public Library. • Costs can be absorbed in the city's annual budget.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards. **MITIGATION STRATEGY #9** Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, CodeRed Network, Radio, etc.)
IMPLEMENTATION SCHEDULE	First quarter of FY 2016

SUBSIDENCE

ACTION #1	ADOPT THE 2012 INTERNATIONAL BUILDING CODE (IBC) TO INCLUDE ASCE-24-10
ADOPT THE 2012 INTERNATIONAL BUILDING CODE (IBC)	• Adopt the 2012 IBC to establish design standards for buildings located in areas susceptible to subsidence. • Amend the IBC to include the requirement for all new residential and commercial construction to have reinforced and stabilized foundations which will alleviate the effects of subsidence.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development o Design Review Committee (DRC)
ESTIMATED COST	• Adoption of these codes is limited to staff review time of the codes and submitting suggested amendments to City Council for approval. • Additional staff time would be required if it was recommended that the city adopt the 2015 IBC.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #7** • Continue to develop capital improvements projects which address hazards identified in the mitigation plan.
IMPLEMENTATION SCHEDULE	Begin the first quarter of FY2016

ACTION #2	DEVELOP AND CONDUCT PUBLIC EDUCATION PROGRAMS TO INFORM THE PUBLIC OF THE EFFECTS OF SUBSIDENCE
DEVELOP AND CONDUCT PUBLIC EDUCATION PROGRAMS	• In coordination with the Houston-Galveston Subsidence District, develop materials regarding the status of subsidence within the planning area, along with developing educational pamphlets for residents to alleviate the effects of subsidence on their properties. • Examples of mitigation projects would be foundation stabilization to alleviate structural damage to residences and pipes.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development o Floodplain Manager • Office of Emergency Management
ESTIMATED COST	Costs of materials and staff time to develop the materials and schedule presentations can be absorbed through the annual departmental budget.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #3** • Maintain previous mitigation projects to ensure continuity of services. **MITIGATION STRATEGY #6** • Work with surrounding communities to ensure regional cooperation and solutions for hazards affecting multiple communities, such as flooding.
IMPLEMENTATION SCHEDULE	Begin the first quarter of FY 2016

HAZARDOUS MATERIALS

ACTION #1	COOPERATE IN MAINTAINING THE PIPELINE INTEGRITY MANAGEMENT RESOURCE REPORTING IN HIGH CONSEQUENCE AREAS
HCA	• The Pipeline and Hazardous Materials Safety Administration (PHMSA) of the US Department of Transportation (DOT) has a rule requiring pipeline operators to develop an integrity management program for gas transmission lines where a leak or rupture could impact a HCA. • Pipeline operators are also required to identify the location of any "Identified Sites" located near their pipelines. • "Identified Site" o Outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12 month period (i.e., playgrounds, recreational facilities, camp grounds, outdoor theaters, stadiums, etc.) o A building that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12 month period (i.e., religious facilities, office buildings, community centers, general stores, etc.) o A facility occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate (i.e., hospitals, schools, day-care facilities, nursing homes, retirement facilities or assisted living facilities) • Every six months access the PHMSA site and verify the location of all "Identified Sites", and include any new facilities which meet the defined criteria.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management
ESTIMATED COST	Unknown
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards.
IMPLEMENTATION SCHEDULE	Implementation begins immediately, and will be an on-going project.

ACTION #2	DEVELOP A COMMODITY FLOW STUDY OF ALL HAZARDOUS MATERIALS TRANSPORTATION ROUTES
DEVELOP A COMMODITY FLOW STUDY OF ALL HAZARDOUS MATERIALS TRANSPORTATION ROUTES AND MATERIALS	• Develop a commodity flow study in participation with Galveston County LEPC (Local Emergency Planning Committee) to identify all routes and modes of transportation utilized to move hazardous materials within and through the county and all incorporated areas. o Identify the types of materials being transported o Identify all the routes being utilized for movement o Identify all the methodology of delivery of hazardous materials (i.e., barge, train, tankers, trucks, etc.)
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • Galveston County LEPC (Local Emergency Planning Committee)
ESTIMATED COST	$150,000
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards.
IMPLEMENTATION SCHEDULE	This project is a new project and will be conducted in cooperation with Galveston County LEPC.

ADDITIONAL MITIGATION ACTION ITEMS

ACTION #1	FLOOD EVENTS
PROPERTY PROTECTION – DRAINAGE PROJECTS **MITIGATE THE IMPACT OF FLOODING TO SAFEGUARD AGAINST THE LOSS OF LIFE AND/OR DAMAGE TO STRUCTURES**	• **FUNDING AVAILABLE THROUGH PUBLIC WORKS OPERATING BUDGET TO CLEAN & RECUT DRAINAGE DITCHES, COMPLETE WORK ORDERS RELATED TO CONVEYANCE SYSTEMS, REMEDY LOCALIZED PONDING ISSUES.** • **PURSUE SUB-REGIONAL DRAINAGE IMPROVEMENTS IN THE BUILT ENVIRONMENT TO REDUCE THE IMPACT OF FLOODING IN AREAS OUTSIDE THE DESIGNATION OF OFFICIAL CAPITAL PROJECTS**
LEAD AGENCY/DEPARTMENT RESPONSIBLE	• Public Works Department o Streets & Drainage o Engineering • Community Development o Floodplain Manager
ESTIMATED COSTS	• Costs unknown but to be addressed in the annual budget process and capital improvements program.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #2** • Reduce the vulnerability from flooding of existing residential & business structures.
IMPLEMENTATION SCHEDULE	This is an on-going project.

ACTION #2	HURRICANE SEVERE THUNDERSTORMS / HAIL / LIGHTNING
POWER OUTAGE **FRIENDSWOOD ACTIVITY CENTER BACK-UP GENERATOR**	**PURCHASE AND INSTALLATION OF A BACK-UP NATURAL GAS GENERATOR AT THE ACTIVITY CENTER** • The current facility is being utilized as the city's activity center and offers numerous and various activities to the senior population. • The current facility lacks a source for back-up power.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development Department o Capital Improvements • Fire Marshal's Office
ESTIMATED COST	• $50,000-$80,000 for generator and installation.
CONTRIBUTION TO MITIGATION STRATEGY	• During periods of extreme heat and/or power outages, with the addition of back-up power, the Library could be utilized as a cooling station for residents lacking the ability to cool their homes. • The Activity Center has also been identified as a feeding station for city staff members who are assigned as essential emergency staff prior to, during and following a severe emergency event. • The Activity Center would also be capable of providing a source for shelter arrangements for the essential emergency staff members. **MITIGATION STRATEGY #1** • Ensure that critical infrastructure sites are protected from all hazards. • Maintain continuity of operations by protecting public facilities prior to an emergency event and minimize potential damages and interruption of services. **MITIGATION STRATEGY #3** • Maintain previous mitigation projects to ensure continuity of services. • During periods of extreme heat and/or power outages, with the addition of back-up power, the Library could be utilized as a cooling station for residents lacking the ability to cool their homes.
IMPLEMENTATION SCHEDULE	Within the next 5 years or as soon as funding source is secured.

ACTION # 3	HURRICANE SEVERE THUNDERSTORMS / HAIL / LIGHTNING
POWER OUTAGE FRIENDSWOOD ANIMAL CONTROL FACILITY BACK-UP GENERATOR FRIENDSWOOD PUBLIC LIBRARY EXPANSION	PURCHASE AND INSTALLATION OF A BACK-UP NATURAL GAS GENERATOR AT THE FRIENDSWOOD ANIMAL CONTROL FACILITY • Wind events will likely cause damage to residential fences which will impede the ability to maintain and/or provide a safe environment for pets. • Flood events will displace wildlife and potentially force them into neighborhoods. • Hazardous material releases and/or spills has the potential to displace or contaminate wildlife and pets. PURCHASE AND INSTALLATION OF A BACK-UP NATURAL GAS GENERATOR AT THE NEW EXPANSION TO FRIENDSWOOD PUBLIC LIBRARY • November 2013 Tax Bond Proposition approved the 21,000 square foot expansion to the existing footprint of the Public Library. • Current facility has a natural gas back-up generator.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Community Development Department o Capital Improvements • Fire Marshal's Office
ESTIMATED COST	ANIMAL CONTROL FACILITY • $50,000-$80,000 for generator and installation. PUBLIC LIBRARY • Projected 211 KW expected total load (current load is 138 KW) • $80,000-$100,000 for generator and installation
CONTRIBUTION TO MITIGATION STRATEGY	MITIGATION STRATEGY # 1 • Ensure that critical infrastructure sites are protected from all hazards. • Maintain continuity of operations by protecting public facilities prior to an emergency event and minimize potential damages and interruption of services. MITIGATION STRATEGY # 3 • Maintain previous mitigation projects to ensure continuity of services. • During periods of extreme heat and/or power outages, with the addition of back-up power, the Library could be utilized as a cooling station for residents lacking the ability to cool their homes.
IMPLEMENTATION SCHEDULE	Within the next 5 years or completion of Library expansion.

ACTION #4	HURRICANE SEVERE THUNDERSTORMS / HAIL / LIGHTNING
PUBLIC INFORMATION & WARNING **EMERGENCY PREPAREDNESS APP FOR IPHONE / IPAD & ANDROID SYSTEMS** **PROMOTE THE USE OF EMERGENCY PREPAREDNESS APPS CURRENTLY AVAILABLE AT THE APPLE STORE**	**RESEARCH AND DEVELOP A MOBILE APPLICATION TO BE AVAILABLE FOR CITIZENS TO DOWNLOAD FOR IOS AND ANDROID OPERATING SYSTEMS** **IF COST IS TOO PROHIBITIVE, RESEARCH AND PROMOTE APPLICATIONS ALREADY DEVELOPED TO ENCOURAGE EMERGENCY PREPAREDNESS**
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management • IT Department
ESTIMATED COST	• Research has shown that costs associated with the development of an emergency management application – simple, table based app – for IOS systems range $500 to $4,000. All content & clear direction is provided by the organization. If GSP locators, social media integration, and additional add-ins are included, costs will raise accordingly. • If costs are maintained in the range of $5,000 to $10,000, proposals could be made during the budget development process to include this project in the annual operating budget. • If this project is rejected by the governing body, research and application for grants could provide an alternative funding source.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #9** • Develop, maintain, and update a viable public information network to ensure that residents and commercial interests are aware of the various sources of information regarding impending emergency and/or disaster events (i.e., Facebook, Twitter, E-mail, City Website, FirstCall Network, Radio, etc.)
IMPLEMENTATION SCHEDULE	If a funding source is secured, ideally development could be accomplished within 2-3 years.

ACTION #5	CONTINUITY OF OPERATIONS
INSTALLATION OF A FUEL STATION FOR CITY VEHICLES	**DESIGN AND INSTALL A COMPARTMENTALIZED FUEL TANK** • Design a 12,000 gallon combination diesel and no-lead fuel tank. • This would be compartmentalized tank with the capacity to provide 8,000 gallons no-lead fuel and 4,000 gallons diesel fuel. • AST – Above ground storage tank • The design will include the storage tanks, dispensing pumps, card management system, and covered awning over tank and fueling area
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Public Works • Community Development • Office of Emergency Management
ESTIMATED COST	• $100,000 • Feasible location would be at Public Safety Building -1400 Whitaker Drive
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards. • In past emergency events, the city has relied on local vendors for fuel for response vehicles. The fuel supply for local residential use had been diminished. • The city currently has a mutual aid agreement with FISD for fuel storage and usage. However, the FISD utilizes "Vendor A" and the city utilizes "Vendor B". Vendors will not fill tanks that are not under their contract. Therefore, fuel shortages have occurred in the past. • With the installation of a fuel station for city vehicle usage, this will ensure a steady supply of fuel during emergency situations. • The additional fuel station will also enhance fuel capacity as the city has a mutual aid agreement with Galveston County Consolidated Drainage District, and FISD is a participant in the city's EOP.
IMPLEMENTATION SCHEDULE	To be accomplished as soon as possible after funding is obtained; or within the next five years.

ACTION #6	DEVELOP A RESEARCH PROGRAM TO STUDY THE EFFECTS OF CLIMATE CHANGE
CLIMATE CHANGE RESEARCH	Develop a Research Program to determine the effects of climate change on the city's built environment and its citizens, and develop action items to mitigate those effects through public education campaigns, flood mitigation projects, water conservation projects, severe cold and heat effects on the residents Maintain the current research program of the identified hazards addressed in this plan, and continue to monitor and collect necessary data to establish the effects of climate change on the community and its residents.
LEAD AGENCY / DEPARTMENT RESPONSIBLE	• Office of Emergency Management
ESTIMATED COST	• Unknown at this time • Research data and available scientific datasets are minimal at this time.
CONTRIBUTION TO MITIGATION STRATEGY	**MITIGATION STRATEGY #8** • Maintain the city's ability to respond to all types of hazards.
IMPLEMENTATION SCHEDULE	Begin the research portion of this action item within the next 5 years, and continue throughout the next 10 years. Research datasets are limited at this time; however, maintaining continuity with the established mitigation action items will maintain awareness of the potential for the effects of climate change.

SECTION VI
PLAN MAINTENANCE

The Friendswood Hazard Analysis and Mitigation Plan is an official plan of the community and not an internal staff proposal. The Hazard Mitigation Plan is designed as a stand-alone document. The Hazard Mitigation Plan will be included as **APPENDIX 4** to **ANNEX P: HAZARD MITIGATION OF THE CITY'S EMERGENCY OPERATIONS PLAN.**

The Fire Marshal/Emergency Management Coordinator will be responsible for ensuring the Hazard Mitigation Plan is reviewed on an as needed or annual basis. The Mitigation Plan Review Committee will be responsible for coordinating implementation of the actions identified in the Mitigation Plan, and undertaking other activities to reduce vulnerability and risks. This committee will also be responsible for the annual review and adjustment of the Hazard Mitigation Plan.

MONITORING

The City of Friendswood Hazard Mitigation Committee recognizes the need to review and evaluate the effectiveness of this plan. Annual meetings of the Hazard Mitigation Committee will ensure that the plan is being properly implemented and achieving the objectives stated in the plan. The public will be notified when the review process begins and will be afforded the opportunity to review and comment on changes to the plan and the action items. Public participation may be solicited from a combination of informational public meetings, surveys and questionnaires, and City Council meetings.

The Friendswood Hazard Analysis and Mitigation Plan will be posted on the City's Web Site and accessible to the public, adjacent communities, and "other agencies". Copies of the Hazard Analysis and Mitigation Plan are available for public review at the following locations:

- Public Library
- Community Development Department
- City Secretary's Office
- City Manager's Office
- Fire Marshal/Emergency Management Office

EVALUATING

The FEMA approved Hazard Mitigation Plan will be posted on the City of Friendswood's website. The Fire Marshal/Emergency Management Coordinator will be responsible for scheduling annual review meetings and ensuring that the proper notifications are posted on the city's website as well as notices in the local newspaper. An announcement will be posted on the city's website advising the public that the Hazard Mitigation Committee has scheduled an annual review and solicits their input toward the process. The public may submit their comments and/or suggestions regarding the Hazard Mitigation Plan to eoc@friendswood.com.

Reports on the status of implementation, including obstacles to progress, will be submitted by assigned departments on an as needed basis, but no less than once annually. The Hazard Mitigation Planning Team will review each mitigation action item to determine appropriateness with respect to changing situations within the city. The Hazard Mitigation Planning Team will also review the risk assessment and capabilities portion of the plan and determine what data will need to be updated or modified.

UPDATING

The Hazard Mitigation Plan should be updated when a disaster (damage causing natural or man-made events) occurs in the community, whether or not it receives a Presidential Declaration. It is recommended that the update be completed as soon as possible following such an event, but by no later than one year following such an event. The risk assessment data should be update on an annual basis to reflect any changes with regard to commercial development, residential development, and other vulnerable structures.

Input from adjacent communities and "other agencies" will be requested for each annual plan review and update.

SECTION VII
ADOPTION AND IMPLEMENTATION

Upon receiving Approval Pending Adoption (APA) from FEMA Region VI, the Hazard Mitigation Plan will be submitted to the Friendswood City Council for formal adoption by Resolution.

Documentation of approval by City Council will be forwarded to Texas Department of Emergency Management and then onto FEMA Region VI for final approval.

RESOLUTION NO. R2015-20

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF FRIENDSWOOD, TEXAS, AUTHORIZING AND APPROVING THE 5-YEAR REVIEW AND UPDATED CITY'S HAZARD MITIGATION PLAN.

* * * * *

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF FRIENDSWOOD, TEXAS:

Section 1. That the City Council of the City of Friendswood, Texas, hereby authorizes and approves the City of Friendswood Hazard Mitigation Plan (August 5, 2015), as reviewed, amended, and updated, by the City's Hazard Mitigation Team, for and on behalf of the City. A copy of the Hazard Mitigation Plan is on file in the office of the City Secretary.

Section 2. That this Resolution shall be and become effective immediately upon and after its adoption and approval.

PASSED, APPROVED AND ADOPTED this 14th day of September, 2015.

Kevin M. Holland
Mayor

ATTEST:

Melinda Welsh, TRMC
City Secretary

CITY OF FRIENDSWOOD ★ STATE OF TEXAS ★

APPENDICES

APPENDIX A
HAZARD MITIGATION COMMITTEE MEETINGS AGENDA-MINUTES-SIGNATURE PAGES

MITIGATION PLANNING MEETING – APRIL 7, 2010

FRIENDSWOOD HAZARD MITIGATION PLAN

MINUTES
April 7, 2010

COMMITTEE MEMBERS:

- Roger Roecker
- Terry Byrd
- Tonya Hilton
- Frank Manigold
- Kaz Hamidian
- Morad Kabiri
- Brian Mansfield
- James Toney
- Mayor, David Smith
- Nick Haby
- Cora Crews

TOPICS FOR DISCUSSION:

1. ***Approval*** from FEMA and TDEM have been received
   - Copy of letter can be found on page 245.

2. Discuss ***items to be removed*** from in-house copy to develop a copy for public review
   - Remove items deemed "critical" or "privileged"
   - Remove pipeline maps
   - Remove critical and vulnerable facilities
   - Should all other maps be:
     - ■ included
     - ☐ excluded
   - other: _____

Discussion held regarding the removal of maps and other documents which may be sensitive in nature (i.e., critical facilities listing and map) to protect the city's infrastructure and that data which may be relative to homeland security issues.

- *The Mayor suggested we submit request to the state Attorney General for his opinion.*
  - *Identify what is to be removed*
- ***Research of Attorney General Rulings revealed the following:***
  - *Government Code, Section 552.101 accepts from disclosure "information considered to be confidential by law, either constitutional, statutory, or by judicial decision." (Gov't Code § 552.101) As part of the Texas Homeland Security Act, sections 418.176 through 418.182 were added to chapter 418 of the Government Code. These provisions make certain information related to terrorism confidential and which provides that "those documents or portions of documents in the possession of a governmental entity are confidential if they identify the technical details of particular vulnerabilities of critical infrastructure to an act of*

1

terrorism." (Gov't Code § 418.181). Additional reference: Gov't Code § 421.001.

3. ***Public copy*** of plan to be available at:
   Place paper copies of the LMP at City Hall and the Library for review "in house"
   - City Hall
   - Public Library

4. ***Executive Summary*** (see attached sample) to be posted on the city's website w/ instructions where public can find copies of the document.
   - Plan is TOO large to post an Adobe .pdf file on the website; use the Executive Summary instead w/ instructions to find "public" copy
   - Copies made available for "reading" only, not for check out
   - If residents want a copy of the "public" copy, should there be a fee attached?
     ☐ Yes ■ No
     - *Open Records: can't charge more than allowable by law; Mayor suggested the copies be put on CD and have available upon request.*

Discussion: Preference by the committee members to not charge a fee for a copy of the Mitigation Plan. A suggestion was made that if the public wanted a copy for their personal use, one could be provided on a CD upon request.

5. ***Update information***
   - Is there any updated information available that will need to be included in next plan review process:
     - ***New construction – housing/commercial starts***
       - Data included in the LMP is current through 12/2008
       - *Monthly building reports are sent to EOC*
     - ***Capital Improvements***
       - I have FY 2010 -5 year CIP
       - I have FY 2010 –beyond 5 year CIP
       - I have 2010 CIP 2010 Update-DRAFT (not adopted)
     - ***Updated drainage projects?*** *Not covered*
     - ***CRS update?*** *Not covered*
     - ***Other Information Needed*** *Nothing to report*

6. ***Other***
   Discussion held regarding:
   - *developing magnets & other public educational materials to keep the residents informed with respect to hazards affecting the city,*
   - *resources to assist with the development of personal emergency preparedness plans* ***(copy of Ready.Gov Emergency Supply List attached),***
   - *guidelines to assist in mitigation of personal property,*
   - *"why is it important as a citizen to get behind the LMP and support it",*

- *update emergency management page on city's website with links to additional informational sources* ***(completed May/June 2010)***
- *develop "survival kits" (plastic bags with preparedness materials)*
- *solicit girl/boy scouts to deliver door to door throughout the city.*

7. **TEST**

Notes:

- Order placed to Ready.Gov for free public informational materials on July 8, 2010, included copies of the following:
  - 500 "Preparing Makes Sense" -- booklet
  - 500 "Preparing Makes Sense" – tri-fold pamphlet
  - 500 "Ready Emergency Supply List" – small tri-fold pamphlet/copy attached
  - 200 "Ready Kids Activity Book"
  - 500 "Preparing Your Pets for Emergencies makes Sense"
  - 500 "Preparing Makes Sense for Older Americans"
  - 500 "Preparing Makes Sense for People with Disabilities and Special Needs"
  - 250 "Every Business Should Have a Plan"
  - 5,000 Every Business Should Have a Plan" – quad-fold pamphlet

Delivery of public informational materials delivered to- July 15, 2010

Senior Living Centers/Facilities

- The Bedford, Gardens at Friendswood Lakes, Emeritus at Friendswood, Stones Throw Apartments & Village on the Park
  - "Preparing Makes Sense" brochures & tri-folds
  - "Preparing Makes Sense for Older Americans" tri-folds
  - "Preparing Makes Sense for People with Disabilities & Special Needs" tri-folds
  - "Ready Emergency Supply List" small tri-fold
  - COF Preparedness Brochure

Child Care Centers

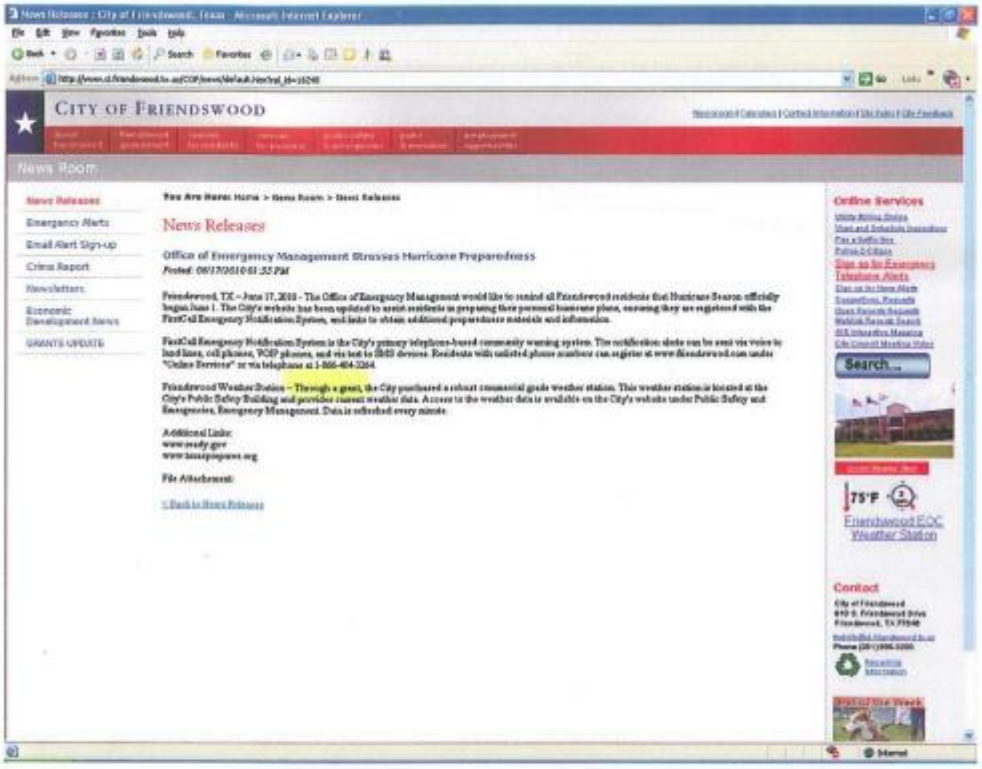
- Good Shepard Episcopal Church School, Kids R My Business, Korner Club 4 Kids, New Life Assembly Mother Day Out
  - "Ready Kids Activity Book"
  - "Preparing Makes Sense" tri-folds
  - "Emergency Supply List" tri-folds
  - COF Preparedness Brochure

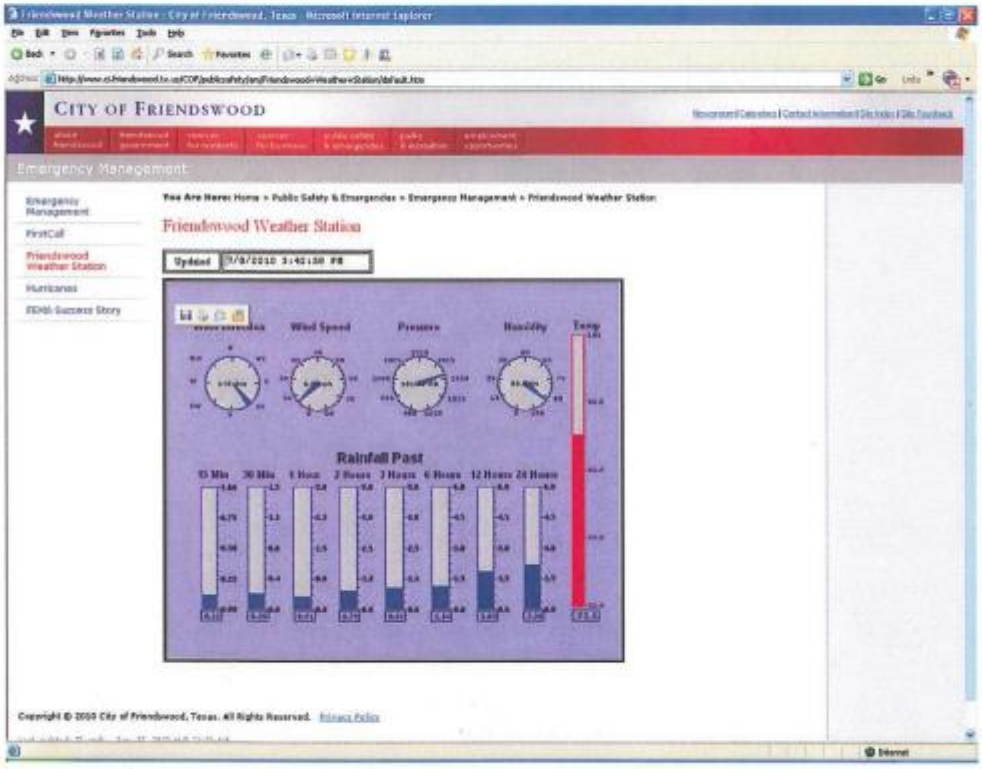
Animal Clinics

- Friendswood Animal Clinic, Heritage Animal Clinic, Parkwood Animal Hospital, Alvin-Friendswood Veterinary Clinic, Creekwood Veterinary Hospital,
  - "Preparing Your Pets for Emergencies Makes Sense"
  - COF Preparedness Brochure

Other Agencies/Facilities

- Chamber of Commerce - Business Planning Booklets/quad-folds
- COF Library – Sampling of all brochures
- COF City Hall – Sampling of all brochures


CITY OF FRIENDSWOOD
News Room
News Releases
Emergency Alerts
Email Alert Sign-up
Crime Report
Newsletters
Economic Development News
GRANTS UPDATE
News Releases
Office of Emergency Management Stresses Hurricane Preparedness
Online Services
Search...
75°F
Friendswood EOC Weather Station
Contact


CITY OF FRIENDSWOOD
Emergency Management
Emergency Management
FirstCall
Friendswood Weather Station
Hurricanes
FEMA Success Story
Friendswood Weather Station
Updated
Wind Speed
Pressure
Humidity
Temp
Rainfall Past
15 Min
30 Min
1 Hour
2 Hours
3 Hours
6 Hours
12 Hours
24 Hours
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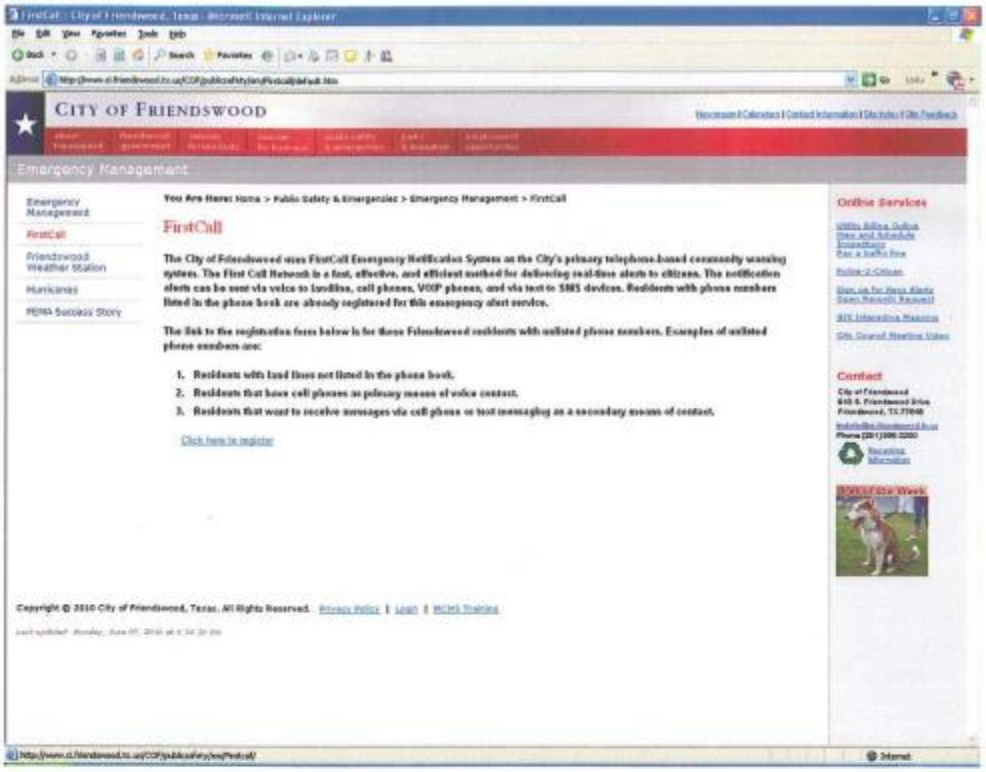
CITY OF FRIENDSWOOD
Emergency Management
Emergency Management
FirstCall
Friendswood Weather Station
Hurricanes
FEMA Success Story
You Are Here: Home > Public Safety & Emergencies > Emergency Management > FirstCall
FirstCall
The City of Friendswood uses FirstCall Emergency Notification System as the City's primary telephone-based community warning system. The First Call Network is a fast, effective, and efficient method for delivering real-time alerts to citizens. The notification alerts can be sent via voice to landline, cell phones, VOIP phones, and via text to SMS devices. Residents with phone numbers listed in the phone book are already registered for this emergency alert service.
The link to the registration form below is for those Friendswood residents with unlisted phone numbers. Examples of unlisted phone numbers are:
1. Residents with land lines not listed in the phone book.
2. Residents that have cell phones as primary means of voice contact.
3. Residents that want to receive messages via cell phone or text messaging as a secondary means of contact.
Click here to register
Online Services
Contact
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CITY OF FRIENDSWOOD
OFFICE OF EMERGENCY MANAGEMENT/FIRE MARSHAL
1600 Whitaker (910 S. Friendswood Drive)
Friendswood TX 77546

NAME OF GROUP: MITIGATION PLANNING COMMITTEE **DATE:** APRIL 7, 2010

NAME	TITLE	SIGNATURE
TERRY BYRD	FIRE MARSHAL EMERGENCY MANAGEMENT COORDINATOR	
DAVID J. H. SMITH	MAYOR	
ROGER ROECKER	CITY MANAGER	
NICK HABY	ASSISTANT TO CITY MANAGER	
BRIAN MANSFIELD	DEPUTY DIRECTOR FMO/EMC	
TONYA HILTON	ASSISTANT FMO/EMC	
MORAD KABIRI	DIRECTOR COMMUNITY DEVELOPMENT	
FRANK MANIGOLD	DEPUTY DIRECTOR COMMUNITY DEVELOPMENT	
KAZ HAMIDIAN	DIRECTOR PUBLIC WORKS	
JAMES TONEY	DIRECTOR COMMUNITY SERVICES	
CORA CREWS	DEPUTY EMC	

MITIGATION PLANNING MEETING – OCTOBER 6, 2011

FRIENDSWOOD HAZARD MITIGATION PLAN

AGENDA
October 6th, 2011
10:00 am – 12:00 pm

COMMITTEE MEMBERS:

- ■ Roger Roecker
- ■ Terry Byrd
- ■ Tonya Hilton
- ■ Frank Manigold
- □ Kaz Hamidian
- ■ Morad Kabiri
- ■ Brian Mansfield
- ■ James Toney
- ■ Mayor, David Smith
- ■ Nick Haby
- ■ Cora Crews

TOPICS FOR DISCUSSION:

1. Public Copy of the Mitigation Plan have been developed
   - Screen Shot of what is currently showing on COF website
   - Public copy of plan is 9,331 Kb (which I assume can be placed on the website and/or ftp location)
   - Copy of Public Plan is on disc and distributed to committee members (10 copies can be delivered to City Secretary and Library along with one printed "public copy") – committee approval needed
   - Executive Summary for COF website
   - Sensitive material to be removed
   - Legal sources to support removal of sensitive material

2. Refer to Item #4 from April 7th meeting notes: preference by committee members to not charge a fee for a copy of the Mitigation Plan. A suggestion was made that if the public wanted a copy for their personal use, one could be provided on a CD upon request
   - Each mitigation committee member has CD with copy of public MAP; 10 additional CDs available for City Secretary & Library
   - Will be distributed after the meeting

3. Updated information
   - ***New construction – housing/commercial starts***
     - ✖ Data included in the LMP is current through 12/2008
     - ✖ All monthly building reports are at FMO for 2009 through August 2011
     - ✖ Copies of building tallies attached
   - ***Capital Improvements***
     - ✖ What projects have been completed (page 91)
     - ✖ Updated drainage projects?
       - Have new projects been approved and on an updated plan?

1

- Action Items
  - #1: Floodplain Management (CRS) -Flood Events
    - What is status of CRS
  - #2: Floodplain Management -Master Drainage Plan
  - #3: Elevation, Relocation & Acquisition Database Maintenance -Flood Events
  - #4: Critical Facilities Protection -Hurricane/Tropical Storm
    - Retrofit Library and Activity Center
    - Generators for both facilities
    - Addition of restroom facilities
  - #5: Hurricane Public Education Campaign –Hurricane/Tropical Storm
    - Public education materials
    - Ordered materials from Ready.gov for booklets for general public, tri-folds, activity books for kids, preparedness for pets, preparedness for older citizens, preparedness for special needs/people with disabilities, business preparedness
    - Materials have been distributed to senior living centers, child care centers, animal clinics, Chamber of Commerce, Library, City Hall, Economic Development, Animal Control, PD, Community Development,
    - The materials from Ready.gov are free, and can be ordered in specified quantities and replenished as needed
    - Information and sources listed on the Emergency Management section of COF website (links included)
    - COF web page for Emergency Management has a few corrections that need to be made; will contact IT
    - Survival kits: has not been started as of this time
  - #6: Shelter-in-Place Public Education Campaign -Tornado
  - #7: Critical Facilities Protection -Tornado
    - Auxiliary power: FS#1, FS#2, FS#3, City Hall, Library
      - What is the status of these projects?
  - #8: Public Warning System -Severe Thunderstorm/Hail/Lightning
    - Annual contract with FirstCall Notification System
    - "Storm Ready Community" – Storm Spotter/NWS
  - #9: Upgrade Public Water System –Severe Thunderstorm/Hail/Lightning
    - Auxiliary power
      - Water Well #5

2

- Water Well #6
- Water Well #7
- Rehab of Water Plant #1, #5, #7, #6, #2

- #10: Develop Continuity of Operations Plans for Critical Facilities –Severe Thunderstorm/Hail/Lightning
  - Auxiliary power:
    - Lift Station #2 (CIP 2009)
    - Lift Station #2
    - Surface Water Pump #1
    - Blackhawk Regional Treatment Plant – full backup auxiliary Power

- #11: Major Thoroughfare Planning –Hazardous Materials Incidents
  - Status:

- #12: GIS Mapping & HAZUS –Hazardous Materials Incidents
  - Status:

- #13: Develop a Drought Contingency Plan –Drought
  - Status:

- #14: Develop Public Education Campaign/PSA –Drought
  - Status:

- #15: Water System Operations –Subsidence
  - Status:

- #16; Detailed Data research for Affects of Subsidence on the Planning Area –Subsidence
  - Status:

- #17: Develop Public Education Campaign -Subsidence
  - Status:

- #18: Winter Storm Public Education Campaign –Winter Storms
  - Status:

- #19: Develop Winter Storm Public Education Campaign –Winter Storms
  - Status:
- #20: Emergency Power Backup for Water/Wastewater Facilities –Winter Storms
  - Status:

4. Other Items of Discussion

CITY OF FRIENDSWOOD
OFFICE OF EMERGENCY MANAGEMENT/FIRE MARSHAL
1600 Whitaker (910 S. Friendswood Drive)
Friendswood TX 77546

Name of Group: Hazard Mitigation Review Committee Meeting **Date: October 6, 2011**

NAME	TITLE	SIGNATURE
CORA CREWS	Deputy EMC	Cora Crews
Tonia Hilton	ASST. Fire Marshal	
Brian Mac Lebb	Dep. Dir. FMO	
MORAD KABIRI	CD Director	
DAVID Smith	MAYOR	
FRANK MANIGOLD	DEP. DIR. CD	
Nat Haby	Asst to City Mgr	
Roger Roecker	CM	
Terry Byrd	EMC	
James Toney	CS Director	

MITIGATION PLANNING MEETING – MAY 17, 2012

FRIENDSWOOD HAZARD MITIGATION PLAN

AGENDA
May17th, 2012
10:00 am – 11:30 pm

COMMITTEE MEMBERS:

☐ Roger Roecker	☐ Kaz Hamidian	■ Mayor, David Smith
■ Terry Byrd	■ Morad Kabiri	■ Cora Crews
■ Brian Mansfield	■ James Toney	■ Joseph Anderson, GCCDD
■ Frank Manigold	■ Nick Haby	■ Rene Ibarra

TOPICS FOR DISCUSSION:

1. Public Copy of the Mitigation Plan has been developed
   - Located on COF website under the Public Safety & Emergency Tab/Emergency Management Tab

2. Public Education Materials
   - Severe Weather Awareness Week – April 22-28; public information data was developed for COF website, but was not posted
   - Hurricane Preparedness Week – May 27-June 2; public information data developed for COF website.
   - 2012 Hurricane Workshop sponsored by the Houston/Galveston National Weather Service; June 9th (Saturday) at George R. Brown Convention Center, 10am-3 pm. Free and open to the public. http://hurricaneworkshop.com/default.asp

2. Updated information
   - ***New construction – housing/commercial starts***
     - Data included in the LMP is current through 12/2008
     - All monthly building reports are at FMO for 2009 through March 2012
   - ***Capital Improvements***
     - Updated drainage projects?
       - Have new projects been approved and on an updated plan?
   - Action Items
     - #1: Floodplain Management (CRS) -Flood Events
       - What is status of CRS
     - #2: Floodplain Management -Master Drainage Plan

1

- #3: Elevation, Relocation & Acquisition Database Maintenance -Flood Events

- #4: Critical Facilities Protection -Hurricane/Tropical Storm
  - Addition of restroom facilities

- #5: Hurricane Public Education Campaign –Hurricane/Tropical Storm
  - Public education materials
  - Information and sources listed on the Emergency Management section of COF website (links are included)
  - Survival kits: has not been started as of this time
  - Emergency Preparedness information has been included in Spring Focus on Friendswood/new information included for extended

- #9: Upgrade Public Water System –Severe Thunderstorm/Hail/Lightning
  - Auxiliary power
  - Status?

- #11: Major Thoroughfare Planning –Hazardous Materials Incidents
  - Status?

- #13: Develop a Drought Contingency Plan –Drought
  - Status?

- #14: Develop Public Education Campaign/PSA –Drought
  - Status?

- #15: Water System Operations –Subsidence
  - Status?
- #16: Detailed Data research for Affects of Subsidence on the Planning Area –Subsidence
  - Status?
- #17: Develop Public Education Campaign -Subsidence
  - Status?

- #18: Winter Storm Public Education Campaign –Winter Storms
  - Status?
- #19: Develop Winter Storm Public Education Campaign –Winter Storms
  - Status?

3. REAP – Records Emergency Action Plan
   - Draft of plan has been developed
   - Training on Essential Records Retention/Protection obtained by 2 FMO/OEM staff members

4. COOP
   - Draft of plan has been developed

- Review/revisions are in process

5. Emergency Operations Plan (EOP)
   - COF maintains Advanced Level of Preparedness
   - FY2012 Annexes being reviewed:
     - ✓ Annex A-Warning; Annex B-Communications; Annex J-Recovery; Annex K-Public Works/Engineering; Annex L-Utilities; Annex N-Directions & Control; Annex O- Human Services; Annex S-Transportation; Annex T-Donations Management; Annex V-Terrorism
   - Annex E-Evacuation
     - ✓ Extensive review in process to include Galveston County Embarkation SOP, 2-1-1 registration; Pick-up Points; Transportation; City of Bryan Advance Team

6. THIRA – Threat & Hazard Identification and Risk Assessment
   - New requirements for all Hazard Mitigation Plan updates beginning with 2012.
   - National Strategy for Homeland Security/2007
   - National Preparedness System/November 2011

7. Other Items???

CITY OF FRIENDSWOOD
OFFICE OF EMERGENCY MANAGEMENT/FIRE MARSHAL
1600 Whitaker (910 S. Friendswood Drive)
Friendswood TX 77546

NAME OF GROUP: MITIGATION PLANNING COMMITTEE **DATE:** MAY 17, 2012

NAME	TITLE	SIGNATURE
TERRY BYRD	FIRE MARSHAL EMERGENCY MANAGEMENT COORDINATOR	
DAVID J. H. SMITH	MAYOR	
ROGER ROECKER	CITY MANAGER	
NICK HABY	ASSISTANT TO CITY MANAGER	
BRIAN MANSFIELD	DEPUTY DIRECTOR FMO/EMC	
MORAD KABIRI	DIRECTOR COMMUNITY DEVELOPMENT	
FRANK MANIGOLD	DEPUTY DIRECTOR COMMUNITY DEVELOPMENT	
KAZ HAMIDIAN	DIRECTOR PUBLIC WORKS	
JAMES TONEY	DIRECTOR COMMUNITY SERVICES	
CORA CREWS	DEPUTY EMC	
JOSEPH ANDERSON	Galveston County Consolidated Drainage District	
RENE IBARRA	COMMUNITY DEVELOPMENT	

MITIGATION PLANNING MEETING – JANUARY 31, 2013

FRIENDSWOOD HAZARD MITIGATION PLAN

AGENDA
January 31st, 2013
2:00 pm – 3:30 pm

COMMITTEE MEMBERS:

■ Roger Roecker	■ Kaz Hamidian	■ David Smith
■ Terry Byrd	■ Morad Kabiri	■ Cora Crews
■ Brian Mansfield	■ James Toney	■ Joseph Anderson, GCCDD
■ Frank Manigold	■ Nick Haby	■ Kevin Holland, Mayor
■ Rene Ibarra	■ Bill Wheeler, HCOEM	□ Dena Mahan, LCOEM
□ David Popoff, GCOEM	■ Jim Hill, Mayor ProTem	■ Niki Bender, GCOEM

Handouts
- Quiz
- FEMA Fact Sheet – Mitigation's Value to Society
- FEMA: Mitigation Planning
- TDEM Mitigation Planning Fact Sheet
- Hazard Profile Worksheet
- Developing a Mitigation Strategy
- Identify Alternative Mitigation Actions
- 44 CFR 201.6
- Local Mitigation Plan Review Guide
- Current Action Items from 2009 LMP

TOPICS FOR DISCUSSION:

FEMA updates for 2014 LMP submission (from DEM class)
- Plan is to be written for a target audience at an 8th grade level - NO FLUFF – make sure everything is short, sharp and to the point - KISS
- Goals must be measurable
- No reference can be made to first responders; has to be emergency services personnel
- All action items (if carrying over or creating new ones) must state they are an upgrade or improvement to the current system
- Outline of plan should follow the new checklist
- Analyze the community's planning efforts during each phase of the mitigation planning process
- Develop an action plan to address deficient in the community's mitigation plan (data deficiency, political will of elected officials) -- **POLITICAL WILL IS HIGH IMMEDIATELY FOLLOWING AN EVENT, AND EBBS AS TIME PASSES**
- Community involvement must be accomplished through various scenarios – public meetings, website, PSA in newspaper or local cable station

1

- Private non-profits are exempt from federal mitigation planning standards, can apply for HMGP funds, but the project site's jurisdiction must have an approved mitigation plan
- Document process of how mitigation committee made their decisions
- Incorporate the mitigation plan into other planning mechanisms, or incorporate other plans into the mitigation plan (CIP, Drainage, Flood, Pandemic, Debris, COOP, REAP, 20 Year Plans, etc.)
- School districts, public universities and special districts are defined as a local government and must develop own mitigation plans to apply for mitigation funds, however, they can be participants in the city's LMP
- Stakeholders are defined as businesses (Chamber of Commerce), residents, school districts, churches, non-profits
- Community infrastructure does not apply to government property; does include hospitals, schools, etc. but have to be a participant in LMP in order to apply for funding.

Top Texas threats by federal disaster declarations
- Flooding
- Hurricane & tropical storms
- High winds/tornadoes
- Wildfire & drought
- Winter ice storms

Not all mitigation results in brick & mortar projects
- Upgrade ordinances/building codes
- Create & implement public information campaigns that focus on mitigation techniques
- Create warning systems using social media

Mitigation is NOT
- Maintenance (cleaning culverts, clearing easements)
- Preparedness equipment (fire trucks, tree trimming equipment, install fire hydrants)
- Studies (investigations as to what type of project to build)
- Response strategies (evacuation routes, long-term sheltering)

General Information
- FEMA does not want demographic, historical, geography/geology, climate, economic data about the community (what was in the 2009 plan can be moved to appendices in the new plan).
- Emphasis is on the planning process (who was involved, how you reached decisions, how hazards were analyzed and preferences made, etc.)
- If a hazard does not exist (even though they were listed in the previous plans, and no instances have occurred or the hazard has been rated at a lower importance) it can be eliminated in updated plan. Have to be able to document and justify the decision
- Emphasis is on natural disasters only; we do not have to address man-made or technological hazards.

- Must have two actions items for each hazard identified – cannot be maintenance type of projects
- Must include a cost reviews (not cost-benefit)
- The plan MUST follow the new checklist (which follows 44CFR 201.6)
- Hazard areas, areas of concern, must be identified in greater detail than in previous plans
- Estimate losses – what's going to happen if special facilities go down
- GOAL: to become a Disaster Resilient Community – defined by the speed you can return to "new normal"

ADDITIONAL HANDOUTS FOR THE MEETING

1. Unit Three: Mitigation
   - From the FEMA Independent Study Course – The Emergency Manager

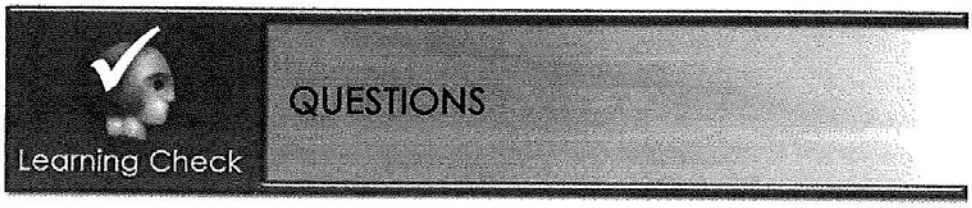
2. From the Student Manual – Mitigation for Emergency Managers, FEMA, G393, Student Manual
   - Hazard Profile Worksheet, pages SM IV-9 – SM IV-11
   - Individual Activity: Identifying Hazards in Your Community, page SM IV-6
   - Individual Activity: Assessing Your Community's Readiness to Plan, pages SM III-7 – SM III-8
   - Formulate Goals, SM V-5

3. Mitigation Planning Fact Sheet, Texas Department of Emergency Management

4. Identify Alternative Mitigation Actions, FEMA 386-3, Developing the Mitigation Plan, pages 2-4 to 2-5

5. 44 CFR Ch. 1 §201.6 – Local Mitigation Plans

6. FEMA Fact Sheet – Mitigation's Value to Society

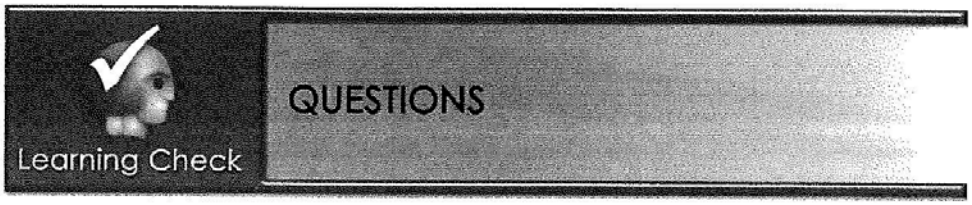


6. What is mitigation?

7. What are the tasks of the emergency manager in mitigation?

8. How does the emergency manager perform his or her role in mitigation?

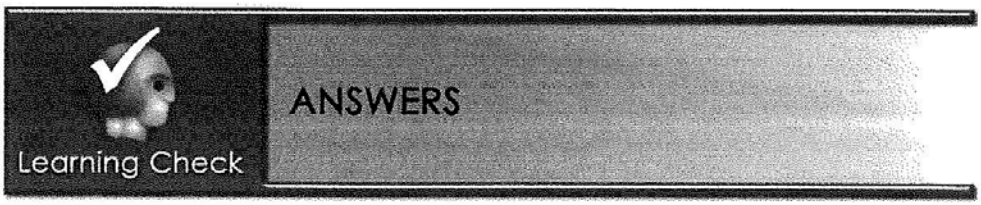
9. List three forms of mitigation than can be accomplished by local laws or ordinances.



10. List four tools other than laws that can be used for mitigation.

11. Which of the following is a structural measure for mitigation?
    A. Flood insurance
    B. Storage containers
    C. Preparedness plans
    D. Fire sprinkler systems

12. What is the role of public information as a tool for mitigation?



For every question that you answered incorrectly, review the page listed next to the answer to find out why your answer was incorrect.

1. What is the purpose of a hazard analysis? (See page 3-3)

   The purpose of a hazard analysis is to show what hazards can strike.

2. What is the purpose of a vulnerability analysis? (See page 3-6)

   The purpose of a vulnerability analysis is to show who or what will be affected by a disaster and how badly it will be affected.

3. What are the two major types of loss that occur in a disaster? (See page 3-6)

   Human loss and economic loss

4. What are some sources of information you should use while preparing a hazard analysis? (See page 3-3)

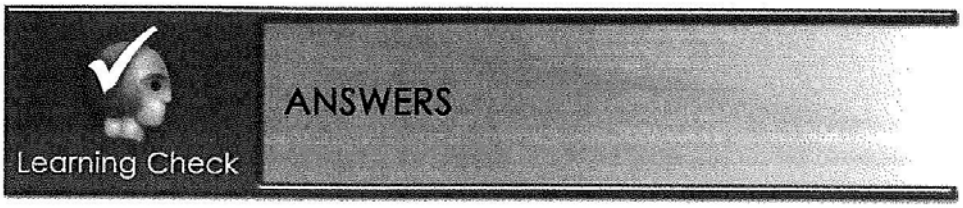
   Information sources include: reports on past disasters, local citizens, high school or college teachers, federal agencies, neighboring emergency managers, officials in your own jurisdiction.

5. Why should you identify special populations in the vulnerability analysis? (See page 3-7)

   Because these are the people who, in the event of an emergency, will require special provisions and attention, such as the elderly, those with disabilities, those in nursing homes or retirement communities, prison inmates, college students on a campus, and those speaking languages other than English. Your vulnerability analysis will help you in preparing the emergency plan and identifying the special tasks necessary to provide for their safety.

6. What is mitigation? (See page 3-1)

   Mitigation involves efforts to eliminate or reduce the damaging impact of hazards.



7. What are the tasks of the emergency manager in mitigation? (See page 3-10)

   The emergency manager's role in mitigation is to be the conscience of the community in matters related to emergencies. This translates into two major tasks: He/she must be alert to the various types of hazards that threaten the community, and he/she must constantly monitor opportunities to reduce and eliminate the risks from these hazards.

8. How does the emergency manager perform his or her role in mitigation? (See pages 3-11 thru 3-15)

   By motivating others to take mitigation actions and helping coordinate the available government and private-sector resources that can assist in mitigation.

9. List three forms of mitigation than can be accomplished by local laws or ordinances. (See page 3-11)

   Any of the following: Building and zoning codes, plumbing and electrical codes, public health ordinances, fire and life safety codes, hazardous materials regulations, dam inspection regulations, traffic codes

10. List four tools other than laws that can be used for mitigation. (See page 3-10)

    Financial incentives and disincentives, hazard disclosure reports, public information, risk mapping, monitoring and inspecting, professional training, and structural measures.

11. Which of the following is a structural measure for mitigation? (See page 3-11)

    B. Storage containers and
    D. Fire sprinkler systems

12. What is the role of public information as a tool for mitigation? (See pages 3-12 thru 3-14)

    Public information for mitigation is useful for sharing with citizens the possible alternatives for dealing with hazardous conditions and then applying pressure for implementing mitigation.

FEMA

NEW! Local Mitigation Plan Review Process

Since 2004, FEMA and States reviewed nearly 4,000 mitigation plans that included more than 23,000 jurisdictions. Based on lessons learned over time and input from State, local, and Tribal stakeholders, FEMA is changing the way mitigation plans are reviewed. New tools, guidance, training, and outreach materials have been developed to enhance the plan review process.

You Asked – We Listened

FEMA developed the new process with insightful feedback from internal and external stakeholders, including all FEMA HQ and Regional offices, State Hazard Mitigation Officers, local government officials, National Emergency Managers Association (NEMA), Association of State Floodplain Managers (ASFPM) and the National Hazard Mitigation Association (NHMA).

The *Local Mitigation Plan Review Guide* is available now, and it contains several significant changes from the current local mitigation planning guidance:

- Stronger emphasis on the Mitigation Strategy and Implementation;
- Simplified to require only the regulatory requirements;
- New Guiding Principles and Intent statements support regulatory requirements; and
- New *Plan Review Tool* to replace the existing Crosswalk in a simplified format and communicate implementation of the plan as well as improvements to the plan.

Plan Review Process Goals

- Increase the focus on risk reduction and plan implementation
- Simplify the plan review process to use less FEMA, State, local, and Tribal time and resources
- Improve consistency of plan reviews
- Promote alignment with intent of the law and regulations
- Foster responsiveness to communities

Have questions? Contact us:
mitigation_planning@accenture.co

Effective Date

The revised *Local Mitigation Plan Review Guide* is available for use as of October 1, 2011. Implementation will be phased over the course of a year and the *Local Mitigation Plan Review Guide* will become effective on October 1, 2012 to allow stakeholders at the state and local level to prepare for the change. Many communities are presently in the process of developing local mitigation plans, and all communities currently reference the *Local Multi-Hazard Mitigation Planning Guidance* (June, 2008) and the corresponding Plan Review Crosswalk. In FY12, new guidance will also be released for local plan developers. During this time, it is important to remember that the mitigation planning regulations have not changed; the plan requirements remain the same.

Plan Review Training

FEMA will present training on the *Local Mitigation Plan Review Guide* for State and FEMA staff that complete mitigation plan reviews. Training sessions will be held via online webinars on October 13th, 18th, and 26th. Training will be recorded and posted to the FEMA website for download by additional stakeholders that are unable to attend the live webinars.

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http://www.fema.gov/plan/mitplanning/index.shtm

DEVELOPING A MITIGATION STRATEGY

IDENTIFY AND PRIORITIZE MITIGATION ACTIONS

- Identify alternative mitigation actions
- Identify and analyze state and local mitigation capabilities
- Evaluate, select, and prioritize mitigation actions

CATEGORIES OF MITIGATION MEASURES

- Prevention (planning/zoning)
- Property protection
- Critical facilities protection
- Public education and awareness
- Natural resource protection
- Structural projects

PREVENTION

- Planning and zoning
- Open space preservation (cannot be developed)
- Land development regulations
- Storm water management
- Coastal barrier protection
- Capital improvement planning
- Building codes

PROPERTY PROTECTION

- Acquisition
- Relocation
- Rebuilding
- Retrofitting
- Flood-proofing

EMERGENCY SERVICES

- Warning systems
- Emergency response operations (upgrade/improve critical facilities)
- Public heal and safety
- Critical facilities

PUBLIC EDUCATION AND AWARENESS

- Outreach projects
- Real estate disclosure (NFIP; potential hazard disclosure)
- Hazard information centers
- Technical assistance
- School-age and adult education programs

NATURAL RESOURCE PROTECTION

- Erosion and sediment control
- Wetlands protection
- Dunes restoration
- Reforestation
- Terracing
- Beach nourishment

STRUCTURAL PROJECTS

- Dams and reservoirs
- Dikes, levees, floodwalls, ad seawalls
- High flow diversions and spillways
- Channel modifications
- Storm sewers (upgrade/improve current system)

IDENTIFY ALTERNATIVE MITIGATION ACTIONS

- Brainstorm mitigation measures to accomplish the objectives (FEMA 38-3 Worksheet)

FRIENDSWOOD ROTARY CLUB PRESENTATION – MAY 15, 2013

The Mitigation Plan Coordinator gave a presentation to the City of Friendswood Rotary Club on May 15, 2013. The Rotary Club is a local organization of business owners within the city. The main emphasis of the presentation was to provide information regarding what mitigation is and how it is beneficial to all members of the community, whether they are a business owner or a resident.

Copies of the Business and Homeowner Mitigation Questionnaires were provided for input from the group.

The following pages are indicative of the materials provided for those in attendance.

FEMA

Mitigation Planning

Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended, State, Tribal, and local governments are required to develop a hazard mitigation plan as a condition for receiving certain types of non-emergency disaster assistance, including funding for mitigation projects.

Mitigation Planning Process

The planning process promoted by the Federal Emergency Management Agency (FEMA) is as important as the resulting plan because it creates a framework for governments to reduce the negative impacts from future disasters on lives, property, and the economy. Mitigation planning includes the following elements:

Public Involvement – Planning creates a way to solicit and consider input from diverse interests. Involving stakeholders is essential to building community-wide support for the plan. In addition to emergency managers, the planning process involves other government agencies (e.g., zoning, floodplain management, public works, community and economic development), businesses, civic groups, environmental groups, and schools.

Risk Assessment – Mitigation plans identify natural hazards and risks based on history, estimate the potential frequency and magnitude of disasters, and assess the potential losses of life and property. The assessment considers the built environment, including the type and numbers of existing and future buildings, infrastructure, and critical facilities located in or near identified hazard areas.

Mitigation Strategy – Based on the risk assessment, communities develop mitigation goals and objectives, as part of a strategy for mitigating disaster losses. The strategy is a community's approach for implementing mitigation activities that are cost-effective, technically feasible, and environmentally sound as well as allowing strategic investment of limited resources.

Hazard Mitigation

Hazard mitigation is sustained action taken to reduce or eliminate long-term risk to people and their property from hazards. Hazard mitigation planning is the process State, Tribal, and local governments use to identify risks and vulnerabilities associated with natural disasters, and to develop long-term strategies for protecting people and property from future hazard events.

http://www.fema.gov/multi-hazard-mitigation-planning

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November 2012

www.fema.gov/rm-main · 1-877-FEMA MAP

Benefits of Mitigation Planning

- Increases public awareness and understanding of vulnerabilities as well as support for specific actions to reduce losses from future natural disasters.
- Builds partnerships with diverse stakeholders, thereby maximizing opportunities to leverage data and resources, which can help reduce workloads and achieve shared community objectives. For example, managing floodplain development may not only reduce flood losses, but also protect water quality by restoring natural functions.
- Expands understanding of potential risk reduction measures to include structural and regulatory tools, where available, such as ordinances and building codes. Implementation of local floodplain ordinances prevents an estimated $1.1 billion in flood damages annually.

Informs development, prioritization, and implementation of mitigation projects. Benefits accrue over the life of the project as losses are avoided from each subsequent hazard event.

Planning Guidance, Tools, and Training

To assist with mitigation planning, FEMA and its partners offer a variety of guidance, training, and informative publications, such as:

- Multi-Hazard Mitigation Planning Guidance, or "Blue Books," designed to increase State, Tribal, and local governments' understanding of the requirements for developing new or updated mitigation plans. They also help Federal and State reviewers fairly and consistently evaluate mitigation plans from different jurisdictions.
- Training sessions, including the following courses: Mitigation Planning Workshop for Local Governments (G318), HAZUS Multi-Hazard/DMA 2000 Risk Assessment (E296), and Protecting Tribal Communities and Acquiring Resources (E344).
- A series of "How-To" guides with information beyond FEMA's basic requirements. The guides focus on initiating and maintaining a planning process that will result in safer communities and are applicable to jurisdictions of all size, resource, and capability levels.

Hazard Mitigation Planning Results

History shows that the physical, financial, and emotional losses caused by disasters can be reduced significantly through hazard mitigation planning. A broad range of activities designed to reduce risk can result from the mitigation planning process. The examples listed below illustrate a range of possible long-term mitigation actions; however, they are not necessarily intended to serve as examples of eligible activities under the FEMA Hazard Mitigation Assistance programs:

- Consider adopting and enforcing regulatory tools, including ordinances, regulations, and building codes, to guide and inform land use, development, and construction decisions in areas affected by hazards. Where authorized, adopt more stringent criteria to provide greater protection for citizens, as conditions may change over time. For example, consider:
    - Exceeding the National Flood Insurance Program (NFIP) floodplain management regulations by elevating structures above the Base Flood Elevation (BFE) in high-risk areas.
    - Creating a buffer area by protecting natural resources, such as floodplains, wetlands, or sensitive habitats. Additional benefits to the community may include improved water quality and recreational opportunities.
- Develop mitigation projects to acquire and demolish flood damaged structures, such as homes or businesses, or to retrofit public buildings, schools, and critical facilities to withstand extreme wind events or ground shaking from earthquakes.

Hazard Mitigation Assistance (HMA)

FEMA's HMA programs fund eligible mitigation activities that reduce future disaster losses and protect life and property. Funding is available for mitigation plan development and updates as well as mitigation projects. For more information on FEMA's HMA programs, visit http://www.fema.gov/hazard-mitigation-assistance.

RiskMAP
Increasing Resilience Together

FEMA Fact Sheet

Federal Insurance and Mitigation Administration

Mitigation's Value to Society

Building Stronger and Safer

Mitigation is the effort to reduce the loss of life and property by lessening the impact of disasters. A recent study by the Multihazard Mitigation Council (MMC) shows that each dollar spent on mitigation saves an average of $4.00.*

Value to Society

Mitigation yields benefits to society and therefore:

- It creates safer communities by reducing loss of life and property;
- It enables individuals to recover more rapidly from floods and other disasters; and
- It lessens the financial impact on the Federal Treasury, States, Tribes, and communities.

FEMA's Federal Insurance and Mitigation Administration implements numerous Congressionally-authorized programs that address the effects of natural hazards through mitigation activities.

Mitigation Creates Safer Communities

In any disaster, buildings constructed to a higher standard not only reduce property damage but can also save lives. Homes constructed to National Flood Insurance Program (NFIP) standards incur 80 percent less damage from floods than structures not built to those standards.

Mitigation Speeds Recovery

Mitigation is key to decreasing the time it takes to rebuild and recover after a disaster. By using existing, proven plans and building standards, mitigation allows individuals and communities to lessen post-disaster disruption and rebuild more quickly. Long-term hazard mitigation planning and projects enable communities and individuals to break the cycle of disaster damage, reconstruction, and repeated loss.

Mitigation Saves Money

Mitigation activities have been proven to lessen the financial impact on individuals, communities, and society as a whole. Floodplain management actions save the country more than $1 billion in prevented damages each year.

Mitigation is Cost-Effective

In December 2005, the MMC of the National Institute of Building Sciences (NIBS) released *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities*. The report was the culmination of a 3-year, Congressionally-mandated independent study.

Key findings included:

- A dollar spent on mitigation saves society an average of $4.00, with positive benefit-cost ratios for all hazard types studied.
- In addition to savings to society, the Federal Treasury can redirect an average of $3.65 for each dollar spent on mitigation resulting from disaster relief costs and tax losses avoided.

Case Study: Grand forks, North Dakota

In 1997, the Red River flooded 8,600 homes in Grand Forks, North Dakota, causing $3.7 billion in flood losses. Following the disaster, the State of North Dakota, local governments, and FEMA worked together to buy out almost 700 of the most vulnerable homes in the State with FEMA mitigation grant program funds. The Red River flooded again in 2006, yet losses were kept to $6.5 million as a result of the mitigation projects and studies. Demonstrating mitigation's cost-effectiveness is critical to the continued success of FEMA mitigation

"FEMA's mission is to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards."

- In each of the eight communities studied in-depth, FEMA mitigation grants were a significant part of the community's mitigation history and often led to additional loss reduction activities.
- Mitigation is sufficiently cost-effective to warrant Federal funding both before disasters occur and during post-disaster recovery.

MMC Report Recommendations

The MMC report demonstrated through statistical and community analyses that positive net benefits result from hazard mitigation. In addition, the MMC report included three basic recommendations:

- Mitigation should continue to be Federally funded on an ongoing basis. It should encompass projects that relate to enforcing strong building codes and land use measures, and promote development of comprehensive plans to limit damage and reduce losses.
- Mitigation is most effective when carried out on a comprehensive, community-wide, and long-term basis. Implementing coordinated mitigation activities over time is the best way to ensure that communities will be physically, socially, and economically resilient to future hazard impacts.
- The effectiveness of mitigation activities must continue to be studied and analyzed. Systematic data collection and assessment of various mitigation approaches are required to ensure that lessons learned are incorporated into disaster public policy.

For More Information

The two-volume study report is available for free download at:
http://www.nibs.org/index.php/mmc/projects/nhms.

CITY OF FRIENDSWOOD
OFFICE OF EMERGENCY MANAGEMENT/FIRE MARSHAL
1600 Whitaker (910 S. Friendswood Drive)
Friendswood TX 77546

NAME OF GROUP: MITIGATION PRESENTATION-FRIENDSWOOD ROTARY **DATE:** MAY 15, 2013

NAME	TITLE	SIGNATURE
Gerald T. Haley	Imm P.P.	
Delores McKenzie	Imm/Imm P.P.	
Jeremy Harrison	President Elect	
Robert Dickerson	member	
Carolyn Gemmell	Secretary	
Linda Thomas	Club Administration	
	Treasurer	
Charisse Arney	message therapist	
ROBIN HALL	Vice President	
Anna Babinsky	member	
Mac Thornhill	MEMBER	
Phil Messina	OWNER	

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1600 Whitaker (910 S. Friendswood Drive)
Friendswood TX 77546

NAME OF GROUP: MITIGATION PRESENTATION-FRIENDSWOOD ROTARY **DATE:** MAY 15, 2013

NAME	TITLE	SIGNATURE
C. EMMERICH	R.E. BROKER	
C BAUMGARDNER	RETIRED	
J. Gibson	member	
Tom Grace		T.J. Grace
Richard Tindall	Esq.	
Allan Rasmussen	President	
SEL THINT	MEMBER	
Kam Hormukh	MEMBER	
Betty Stacy	Guest	E. Stacy
Trish Hanks	SUPERINTENDENT	Trish Hanks
Sally Branson	ADVISOR	Sally Branson
Kevin Holland	Mayor	

STATE OF THE CITY ADDRESS
MARCH 1, 2012

The Office of Emergency Management hosted a display table at the State of the City Address on Thursday, March 1 2012. Hazard mitigation informational materials were available for attendees as well as the Business and Home Owner Surveys were available for Completion.

FRIENDSWOOD FIRE MARSHAL'S OFFICE
MONTHLY ACTIVITY REPORT
MARCH 2012

ACTIVITY	Mar-2012	YTD FY 2012	Mar-2011	YTD FY 2011
Public Education: Classes	0	6	1	9
Number of Attendees	0	227	40	2,594
Instructional Hours	0	12.00	1	27.25
Plan Reviews	8	63	18	67
DRC Meetings Attended	2	24	5	20
Inspections	151	877	165	699
Incident Reports Processed	262	1,416	224	1,391
Citations Issued	1	14	0	7
Investigations	0	7	0	6
Alcohol Permits Reviewed	1	3	1	5
Fire Code Permit Applications	3	7	1	7
Life Safety/Fire Code Complaints Investigated	1	10	5	11
Open Records Requests	1	10	3	25

FIRE MARSHAL'S OFFICE STAFF ACTIVITIES:

1. FISD Propane Tank Training/Safety Procedures, Friendswood – March 1st
2. State of the City Address, Friendswood – March 1st
3. Coastal County Command Workshop, Galveston – March 5th & March 6th
4. National Weather Service Conference Call & Webinar – March 9th
5. Coordinated Activity for the FISD Propane Tank Flaring – March 12th
6. City/ISDs Joint Monthly Meeting, Friendswood – March 15th
7. Friendswood Volunteer Fire Department Meeting with the City Manager – March 20th
8. Public Information Act Seminar, Deer Park – March 21st
9. National Hurricane Conference, Orlando, FL – March 26th – March 29th
10. Council of Cities, Webster – March 30th

MITIGATION PLANNING MEETING – JANUARY 30, 2014

FRIENDSWOOD HAZARD MITIGATION PLAN

AGENDA
January 30th, 2014
2:00 pm – 3:30 pm

COMMITTEE MEMBERS

☐ Roger Roecker	■ Kaz Hamidian	☐ David Smith
■ Terry Byrd	■ Morad Kabiri	■ Cora Crews
■ Brian Mansfield	■ James Toney	■ Joseph Anderson, GCCDD
■ Frank Manigold	■ Nick Haby	■ Kevin Holland, Mayor
■ Rene Ibarra	☐ Bill Wheeler, HCOEM	☐ Dena Mahan, LCOEM
☐ David Popoff, GCOEM	■ Steven Simmons	☐ Niki Bender, GCOEM
☐ Joshua Glover, HCOEM	☐ Jim Hill, Mayor Pro-Tem	

PLAN REVIEW

ELEMENT A1

- Expand explanation of the planning process in beginning of document
  - neighboring jurisdictions
  - public involvement
  - Incorporation of existing plans, etc.
  - Continue public participation

ELEMENT B

- Hazard Analysis – is this adequate?
  - Previous occurrences/probability for future events
  - Impact of hazard on the community
  - NFIP – RL and SRL properties

ELEMENT C

- Existing authorities, policies, programs, resources – expand
- Participation in NFIP
- Goals to reduce/avoid long-term vulnerabilities
- Mitigation Actions/projects to reduce effects of each hazard
- Cost benefit review
- How is mitigation plan incorporated in other city planning documents

ELEMENT D

- Reflect changes in development
- Reflect progress in local mitigation efforts
- Reflect changes in priorities

SUGGESTIONS

1

TOPICS FOR DISCUSSION

- Goals must be measurable
- No reference can be made to first responders; has to be emergency services personnel
- All action items (if carrying over or creating new ones) must state they are an upgrade or improvement to the current system
- Outline of plan should follow the new checklist
- Analyze the community's planning efforts during each phase of the mitigation planning process
- Community involvement must be accomplished through various scenarios – public meetings, website, PSA in newspaper or local cable station
- Document process of how mitigation committee made their decisions
- Incorporate the mitigation plan into other planning mechanisms, or incorporate other plans into the mitigation plan (CIP, Drainage, Flood, Pandemic, Debris, COOP, REAP, 20 Year Plans, etc.)
- Community infrastructure does not apply to government property; does include hospitals, schools, etc. but have to be a participant in LMP in order to apply for funding.

Not all mitigation results in brick & mortar projects

- Upgrade ordinances/building codes
- Create & implement public information campaigns that focus on mitigation techniques
- Create warning systems using social media

Mitigation is NOT

- Maintenance (cleaning culverts, clearing easements)
- Preparedness equipment (fire trucks, tree trimming equipment, install fire hydrants)
- Studies (investigations as to what type of project to build)
- Response strategies (evacuation routes, long-term sheltering)

General Information

- FEMA does not want demographic, historical, geography/geology, climate, economic data about the community (what was in the 2009 plan can be moved to appendices in the new plan).
- Emphasis is on the planning process (who was involved, how you reached decisions, how hazards were analyzed and preferences made, etc.)
- If a hazard does not exist (even though they were listed in the previous plans, and no instances have occurred or the hazard has been rated at a lower importance) it can be eliminated in updated plan. Have to be able to document and justify the decision
- Emphasis is on natural disasters only; we do not have to address man-made or technological hazards.
- Must have two actions items for each hazard identified – cannot be maintenance type of projects
- Must include a cost reviews (not cost-benefit)
- The plan MUST follow the new checklist (which follows 44CFR 201.6)

- Hazard areas, areas of concern, must be identified in greater detail than in previous plans
- Estimate losses – what's going to happen if special facilities go down
- GOAL: to become a Disaster Resilient Community – defined by the speed you can return to "new normal"

3

AGENDA DISCUSSION

INTRODUCTION

- Pp 1-4: Move demographic information to Appendix 1
- Include "Authorities" (44 CFR 201) to this section

ELEMENT A: THE PLANNING PROCESS

- Document planning process
  - How was it prepared
  - Who was involved
  - Opportunity for neighboring communities to be involved
  - Document how public was involved
  - Review and incorporate existing city plans
  - Discuss how city will continue public participation
  - Description of method and schedule for keeping plan current

ELEMENT B: HAZARD IDENTIFICATION & RISK ASSESSMENT

- Discussion of events which have occurred since 2008 LMP
- Natural hazards profiled only (however, we did include pipelines) – THIRA
  - Description of type, location, extent of all natural hazards affecting city
- Previous occurrences of hazard events & probability
  - Include historical data in an Appendix
- Address NFIP insured structures/RL and SRL

ELEMENT C: MITIGATION STRATEGY

- Document existing authorities, policies, programs and resources & ability to expand on and improve
- Address the city's participation in the NFIP and continued compliance with NFIP requirements
- Include goals to reduce/avoid long-term vulnerabilities to the identified hazards
- Identify comprehensive range of mitigation actions and projects to reduce effects of hazards
  - Emphasis on new and existing buildings & infrastructure
- Action plan that describes how the actions identified will be prioritized (include cost benefit review), implemented and administered
- Process by which the requirements of the mitigation plan will integrate into other planning mechanisms (comprehensive or capital improvements plans)

ELEMENT D: PLAN REVIEW, EVALUATION AND IMPLEMENTATION (PLAN UPDATES ONLY)

- Was plan revised to reflect changes in development in hazard prone areas
- Increased or decreased vulnerability since last plan approved
- Was plan revised to reflect progress in local mitigation efforts
  - Must describe status of hazard mitigation actions in previous plan – identify which ones have been completed or not completed
  - Not completed action items: must either describe whether the action is no longer relevant or will be included in updated plan
- Was plan revised to reflect changes in priorities

ELEMENT E: PLAN ADOPTION

- Include documentation that the plan has been formally adopted by governing body

HAZARD MITIGATION COMMITTEE MEETING

Date of Meeting	1/30/2014
Start Time	10:00am
End Time	10:52am
Location of Meeting	1600 Whitaker

ATTENDEES

Terry Byrd, Brian Mansfield, Rene Ibarra, Kaz Hamidian, Morad Kabiri, James Toney, Nick Haby, Steven Simmons, Cora Crews, Joseph Anderson, Kevin Holland

ITEMS DISCUSSED

- Plan needs to be reorganized to meet planning guidance.
- Need more data on housing, risk areas, growth, and other information.
- Need cost benefit review.
- Need to develop new mitigation items to be conducted.
- Would like to have 1st draft submitted by end of February.
- Would like needed information submitted to Cora by Valentine's Day.

POSSIBLE MITIGATION ITEMS

- Upgrade of streets included in bond package.
- Include extension of water lines.
- Installation of a joint fueling station between the drainage district and COF.
- Include plans for a new parks building since it is in the flood way. Use any additional bond money coupled with grant funding.
- Include plans to elevate or other forms of mitigation for the Public Works building.
- Include plans to harden the Jones Hanger.
- Carry over warning systems.
- Carry over public awareness campaign.
- Consider a unified public information system. (phones, email, text messages, social media)

CITY OF FRIENDSWOOD
OFFICE OF EMERGENCY MANAGEMENT/FIRE MARSHAL
1600 Whitaker (910 S. Friendswood Drive)
Friendswood TX 77546

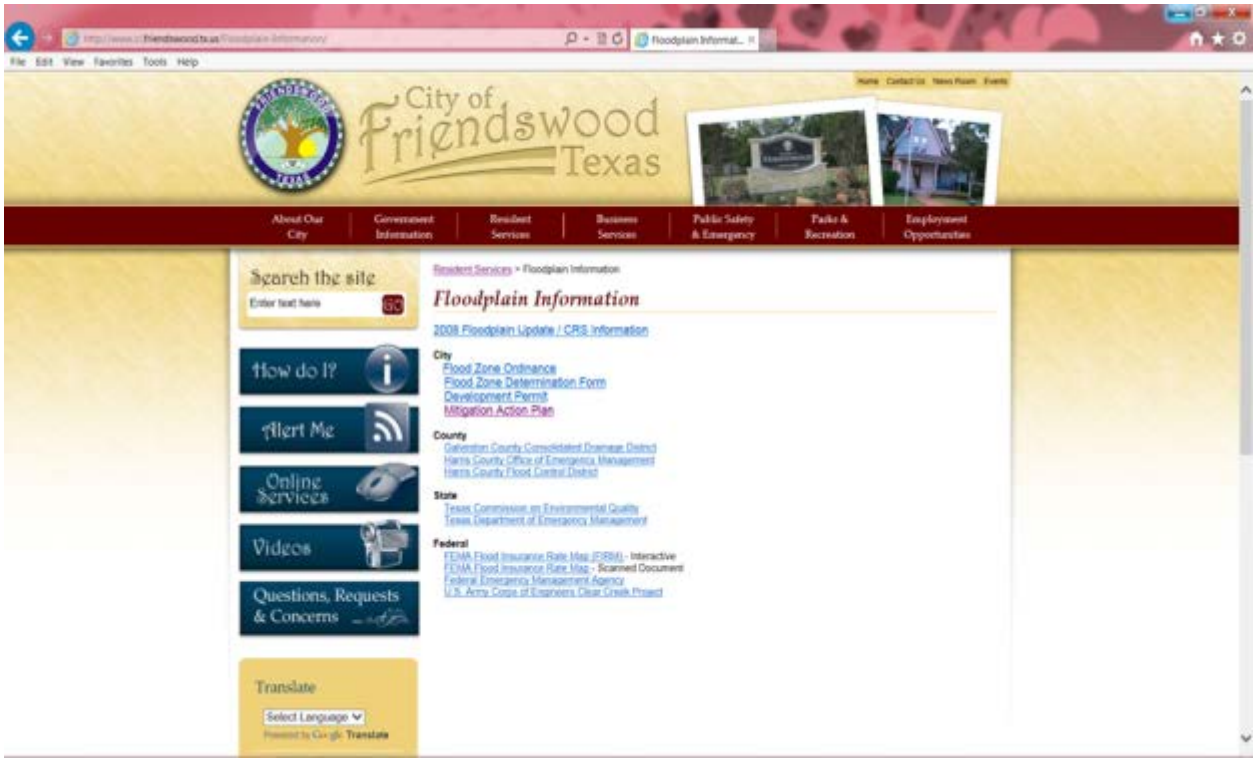
Name of Group: Hazard Mitigation Review Committee Meeting **Date: January 30, 2014**

NAME	TITLE	SIGNATURE
Kevin Holland	Mayor	
Terry Byrd	Fire Marshal Emergency Management Coordinator	
Brian Mansfield	Assistant Fire Marshal Assistant EMC	
Roger Roecker	City Manager	
Morad Kabiri, PE, AICP	Assistant City Manager Community Development Director	
Frank Manigold, CFM	Community Development Deputy Director	
Rene Ibarra	Project/Development Manager Community Development	
Nick Haby	Planning Manager & PIO	
Kaz Hamidian	Public Works Director	
James Toney	Community Services Director	
Joseph Anderson	Galveston County Drainage District	
David Smith	Citizen of Friendswood	
Steven Simmons	Deputy Fire Marshal/OEM	

Cora Crews	Deputy EMC, LMP Coordinator	Cora Crews
Dena Mahan	City of League City, EMC	
Bill Wheeler	Harris County OEM	
Joshua Glover	Harris County OEM	
David Popoff	Galveston County EMC	
Niki Bender	Galveston County OEM	
Jim Hill	City Council Member	

APPENDIX B
HAZARD MITIGATION SURVEY

A Hazard Mitigation Survey was developed for business owners and homeowners. A copy of the survey for homeowners was placed on the City's website on April 18, 2013.



HOMEOWNER SURVEY

A copy of the homeowner survey can be found on the following page. Although the survey has been available on the City's website since April, only seventeen (17) responses were received. Survey response results can be found in Section

HOMEOWNER'S HAZARD MITIGATION SURVEY

HAZARD MITIGATION SURVEY

While it is impossible to prevent a hazard or disastrous event from occurring, the impact of such hazards or disastrous events can be lessened in terms of their effect on people and property. This concept is known as hazard mitigation. Hazard mitigation is also defined as a means to reduce or alleviate the loss of life, injury, and property damage resulting from natural and man-made hazards through long term strategies. These strategies include, planning, policy changes, programs, projects, and other activities. Hazard mitigation is designed to break the cycle of repeated damages and reconstruction costs associated with recurrent disasters, such as flooding and hurricanes.

The City of Friendswood is in the process of the 5-year review of the Hazard Mitigation Plan. The current plan is available on the City's website.

1. **DO YOU OWN A HOME WITHIN THE CITY LIMITS OF FRIENDSWOOD?**
   □ Yes □ No

2. **HOW CONCERNED ARE YOU ABOUT THE POSSIBILITY OF OUR COMMUNITY BEING IMPACTED BY A DISASTER?**
   □ Extremely Concerned □ Somewhat Concerned □ Not Concerned

3. **PLEASE RANK THE FOLLOWING HAZARDS 1 THROUGH 6, WITH #1 BEING THE HIGHEST THREAT:**
   ___ Severe Thunderstorm/ Hail/ Lightning
   ___ Hurricane/Tropical Storm (Wind Damage)
   ___ Flood (Storm Surge)
   ___ Flood Events (Flash or Riverine)
   ___ Tornado
   ___ Hazardous Materials (Pipeline)

4. **HAVE YOU EVER EXPERIENCED OR BEEN IMPACTED BY ONE OF THE HAZARDS LISTED ABOVE?**
   □ Yes □ No

5. **IN YOUR OPINION, WHAT CAN THE CITY OF FRIENDSWOOD DO TO BETTER PREPARE THE COMMUNITY FOR EMERGENCY SITUATIONS? CHECK ALL THAT YOU THINK WOULD APPLY.**
   □ Public Education Programs & Information
   □ Building/Code Enforcement
   □ Improve Drainage & Detention
   □ Improved Warning/Notification Systems
   □ Other _____

6. **WHICH OF THE FOLLOWING WARNING SYSTEMS ARE YOU AWARE THAT THE CITY OF FRIENDSWOOD UTILIZES?**
   □ Sirens □ Text Messaging □ Phone Calls
   □ Radio Station □ Email □ TV

7. **HAVE YOU TAKEN ANY ACTIONS TO MAKE YOUR HOME MORE RESISTANT TO HAZARDS?**
   □ Yes □ No

   What have you done? _____

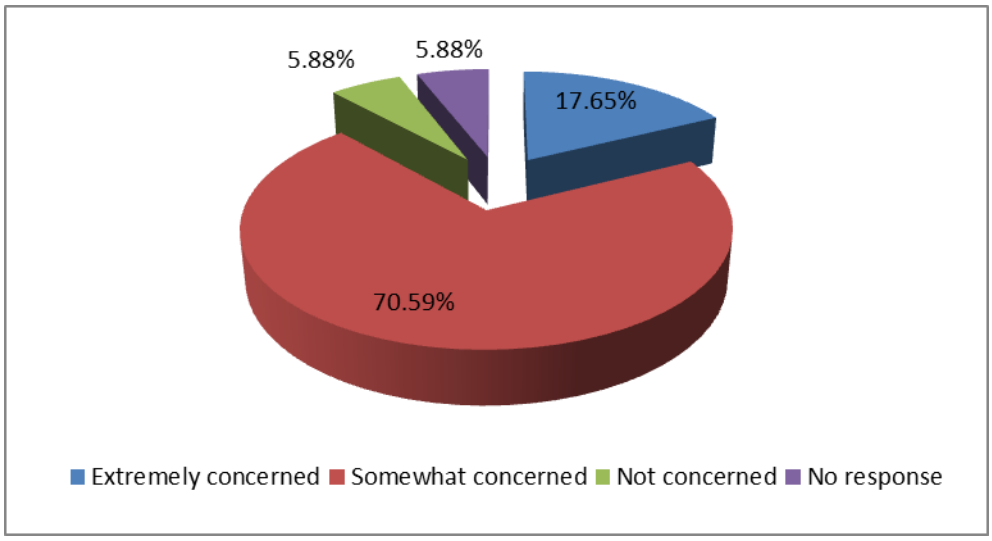
8. **ARE YOU INTERESTED IN MAKING YOUR HOME MORE RESISTANT TO HAZARDS?**
   □ Yes □ No

9. **WHAT IS THE MOST EFFECTIVE WAY FOR YOU TO RECEIVE INFORMATION ABOUT HOW TO MAKE YOUR HOME MORE RESISTANT TO HAZARDS?**
   □ Newspaper
   □ Television
   □ Radio
   □ Internet
   □ Mail
   □ Public Workshops/Meetings
   □ School Meetings
   □ Other

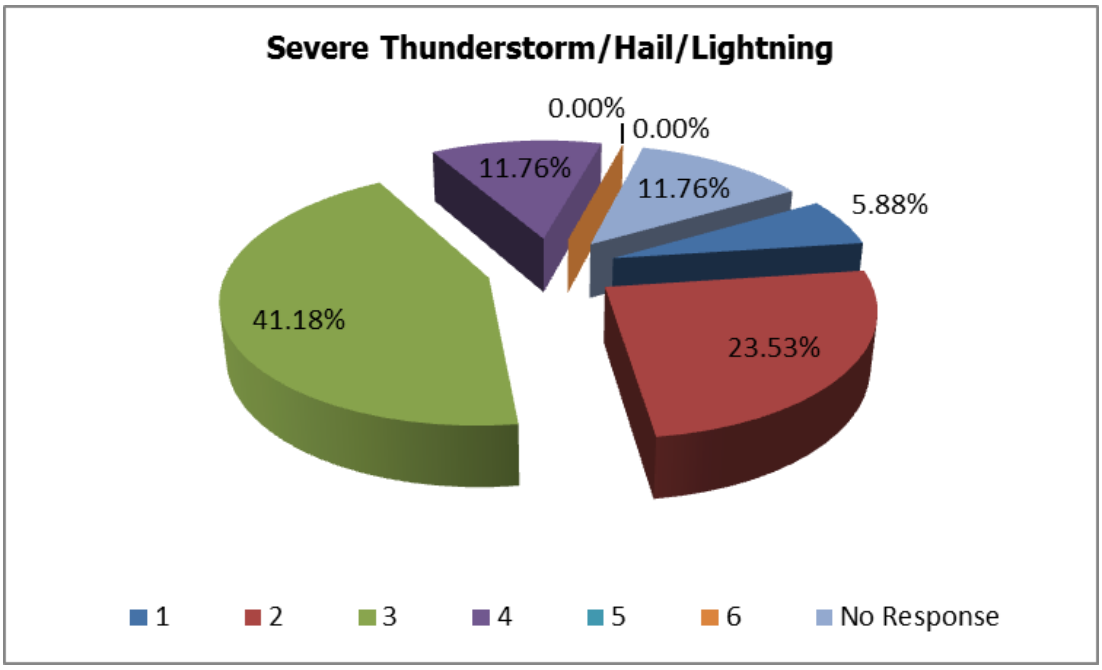
HAZARD MITIGATION SURVEY – HOMEOWNERS RESULTS

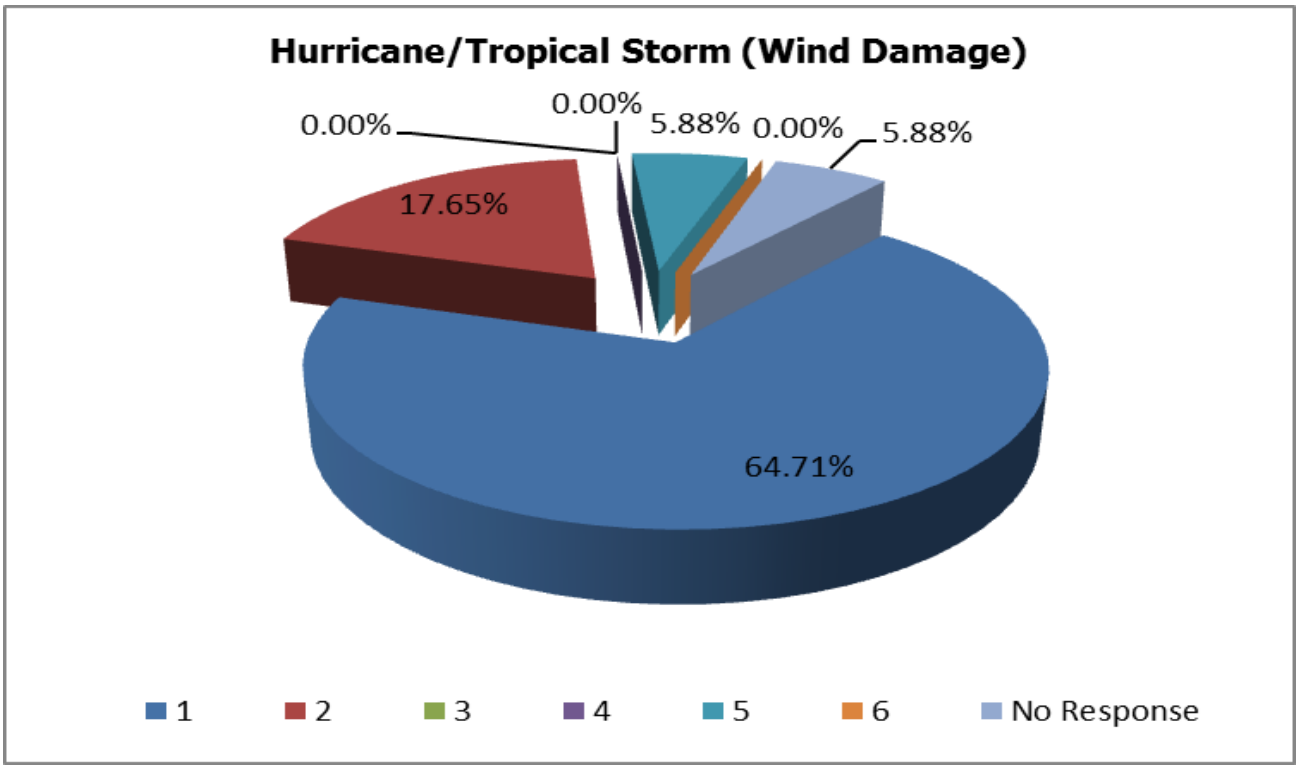
HAZARD MITIGATION SURVEY RESULTS
HOME OWNERS

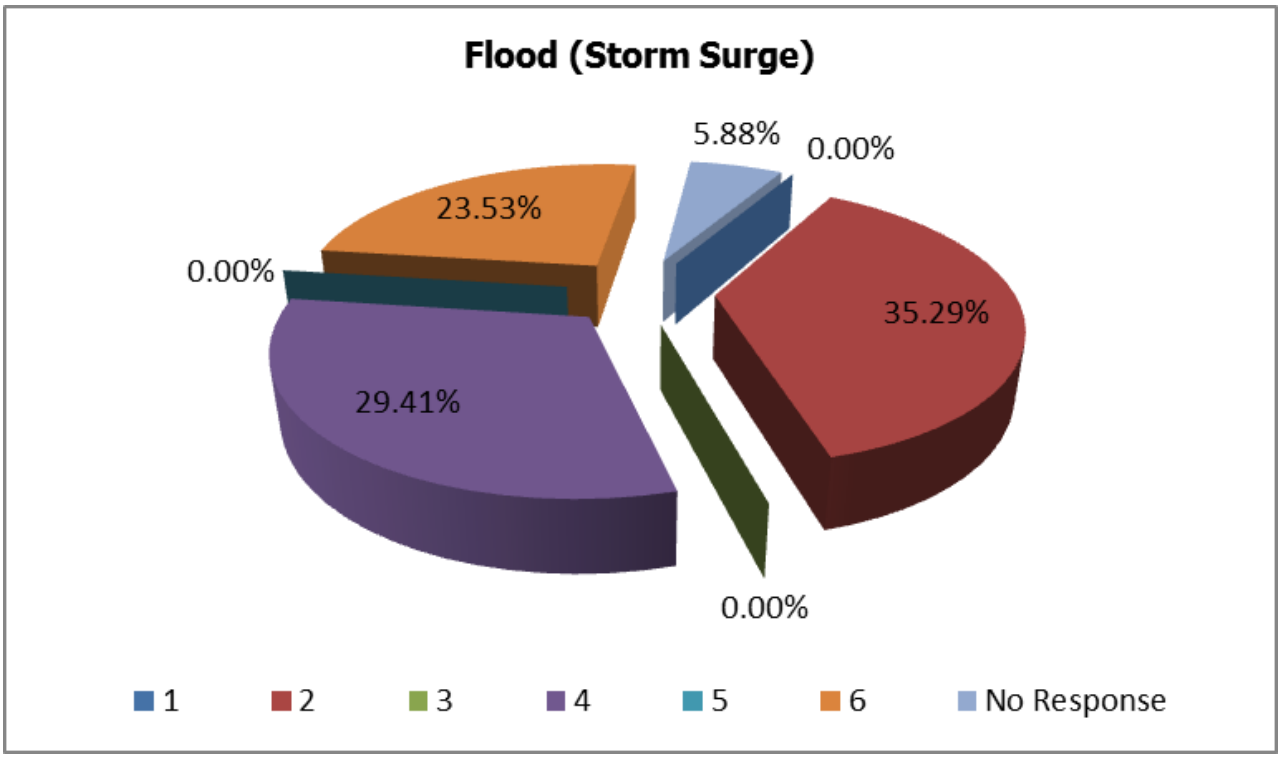
1. How concerned are you about the possibility of our community being impacted by a disaster?

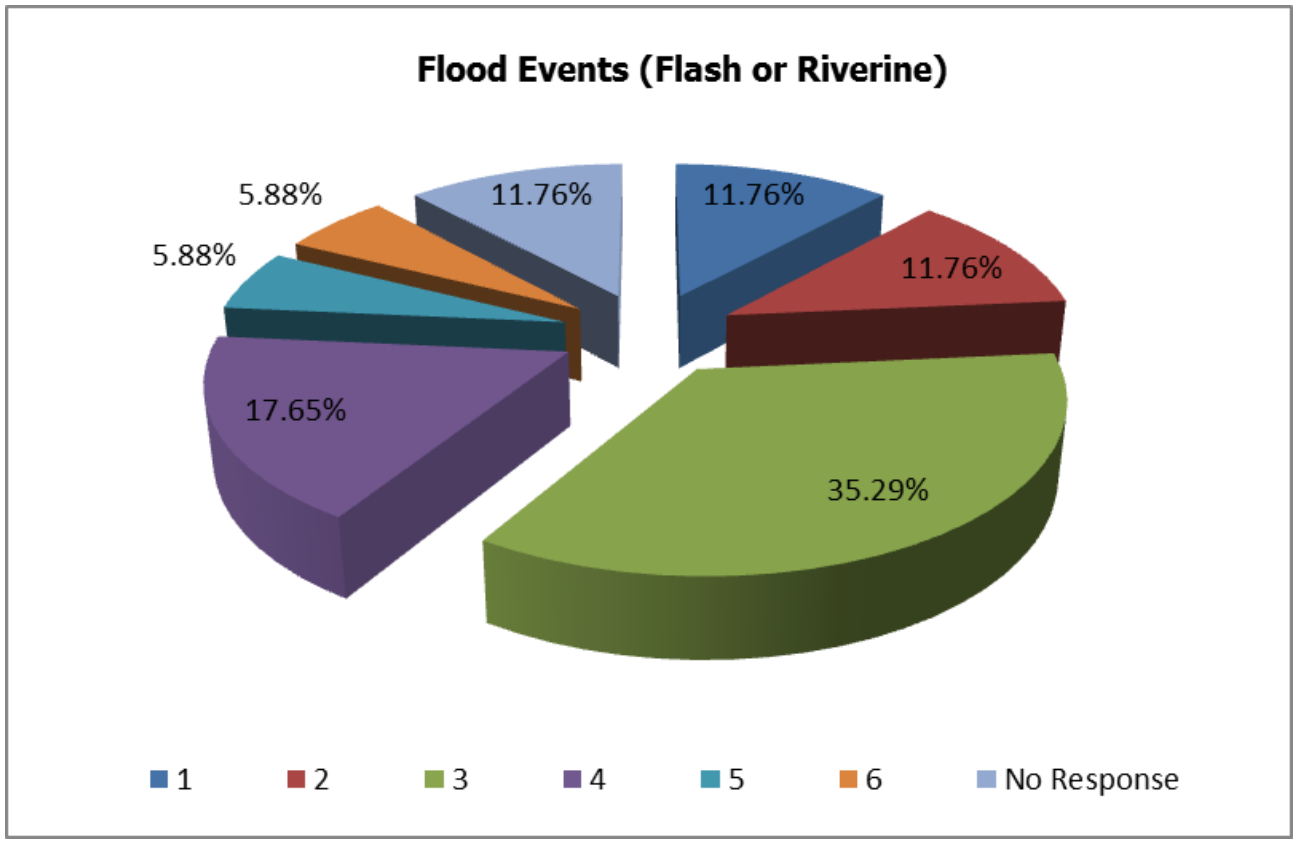


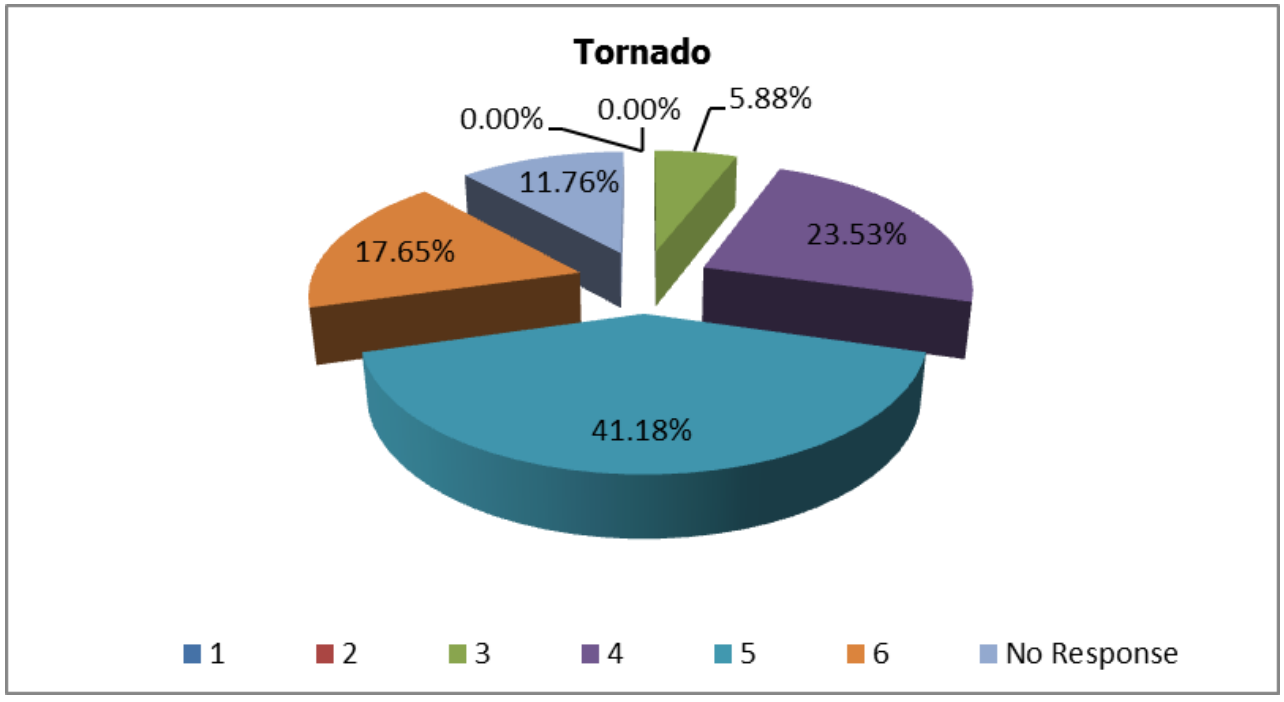
2. Please rank the following hazards 1 through 6, with #1 being the highest threat.

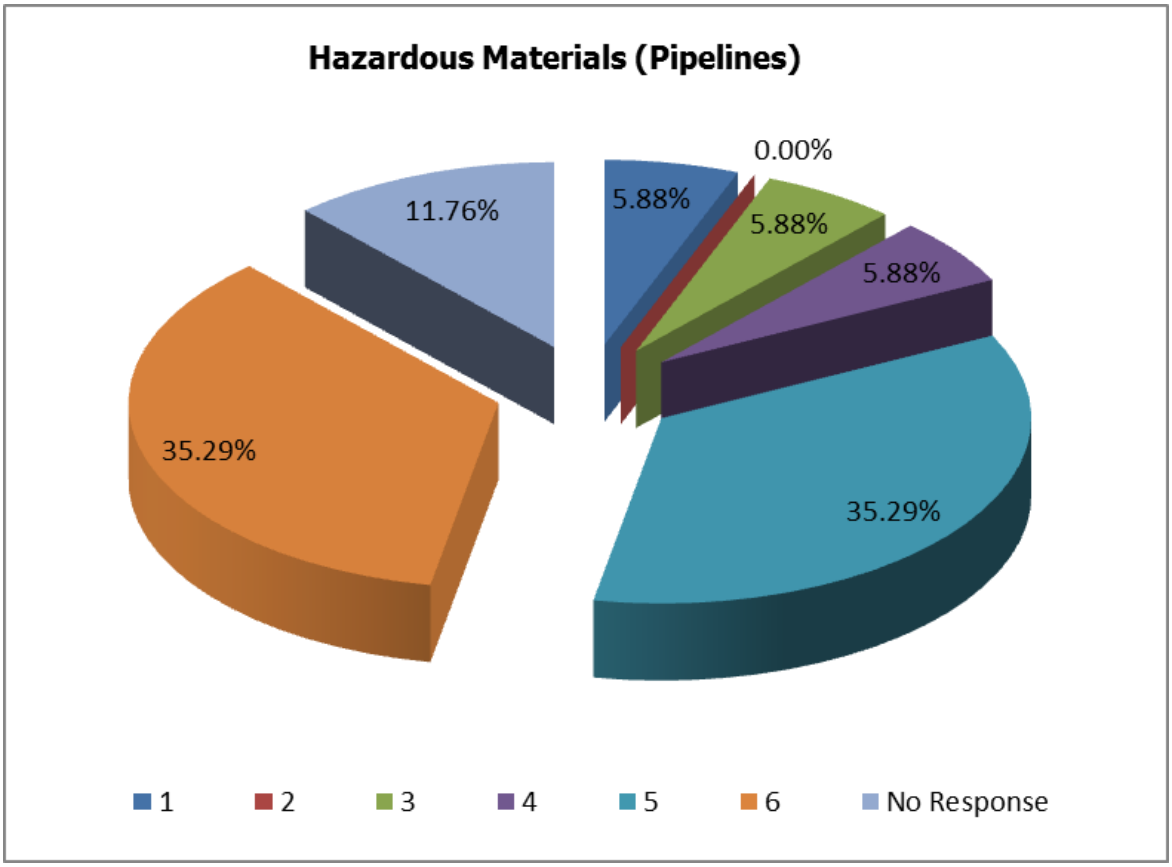



Hurricane/Tropical Storm (Wind Damage)
0.00%
0.00%
5.88%
0.00%
5.88%
17.65%
64.71%
1
2
3
4
5
6
No Response

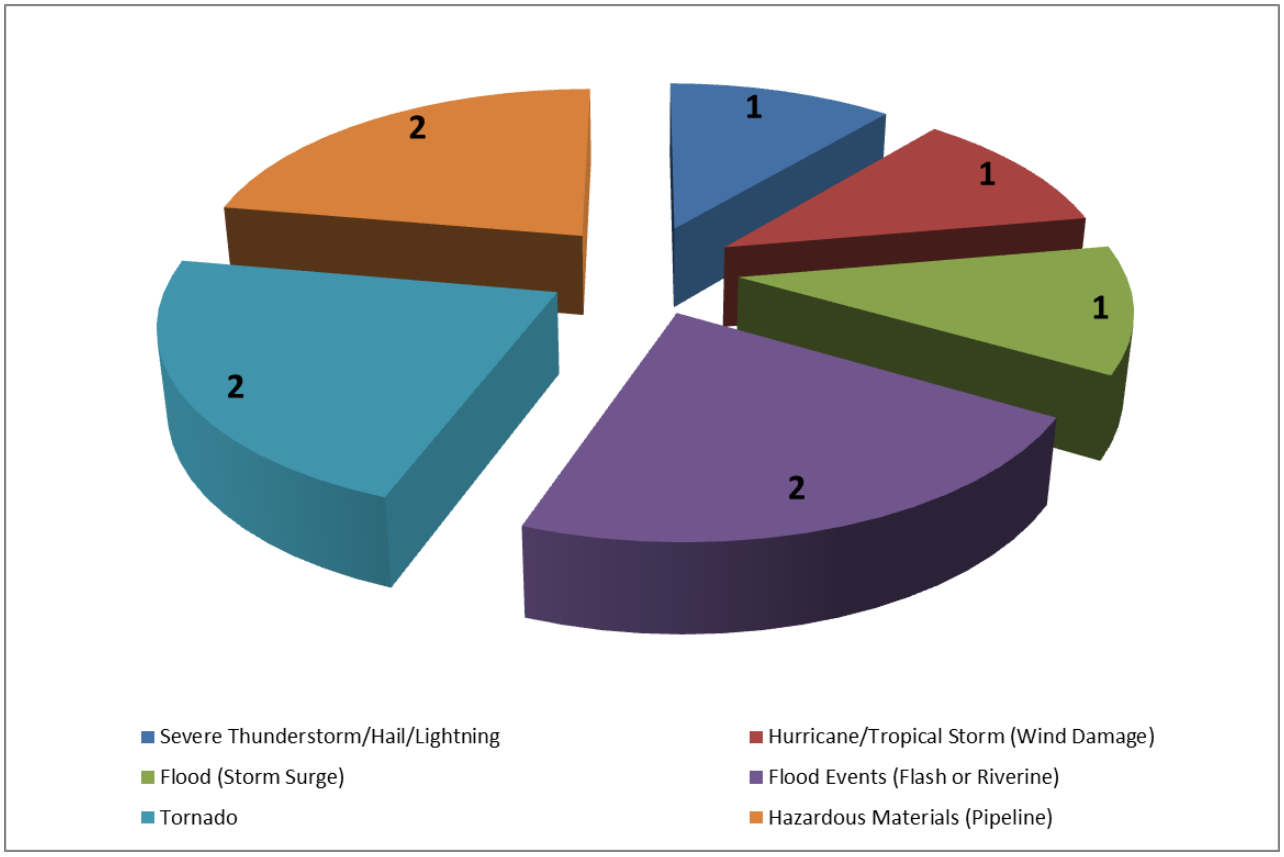

Flood (Storm Surge)
5.88%
0.00%
23.53%
0.00%
35.29%
29.41%
0.00%
1
2
3
4
5
6
No Response


Flood Events (Flash or Riverine)
5.88%
11.76%
11.76%
5.88%
11.76%
17.65%
35.29%
1
2
3
4
5
6
No Response

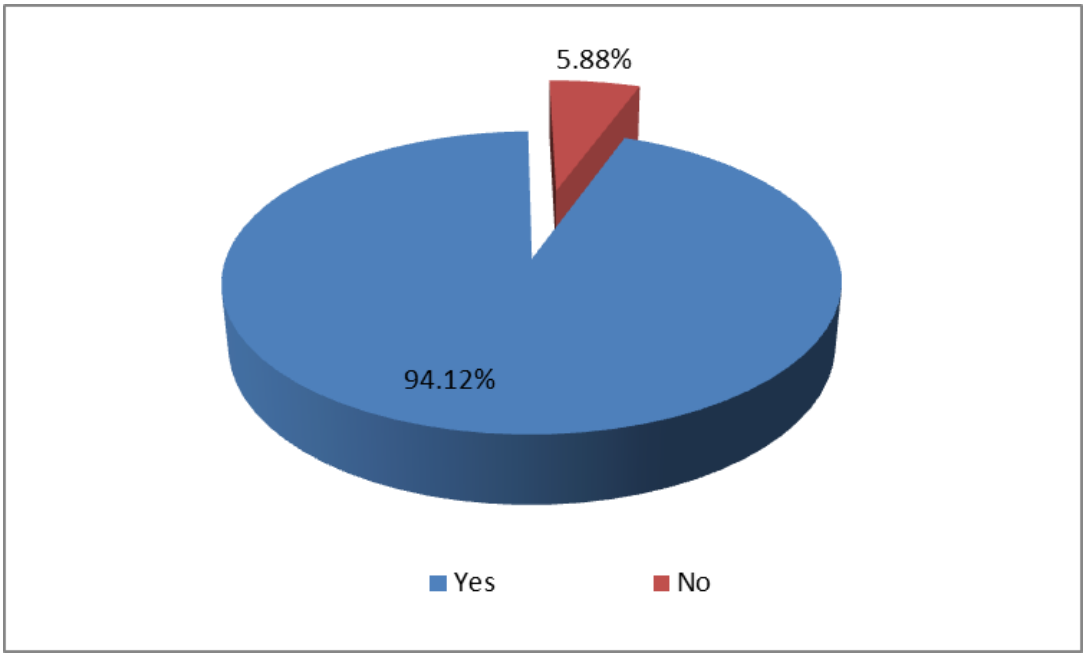

Tornado
0.00%
0.00%
5.88%
11.76%
17.65%
23.53%
41.18%
1
2
3
4
5
6
No Response



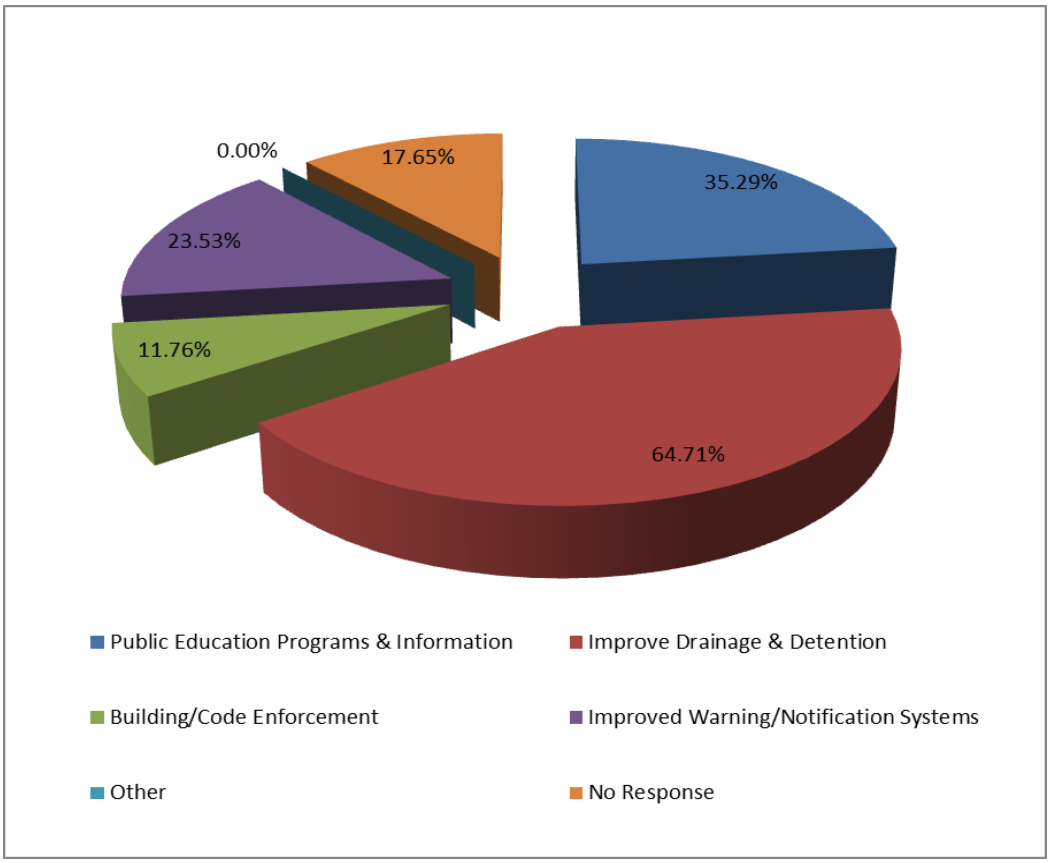
OVERALL RATING CONSENSUS OF HAZARDS (WITH 1 BEING THE HIGHEST RATED THREAT)



Have you ever experienced or been impacted by one of the hazards listed above?



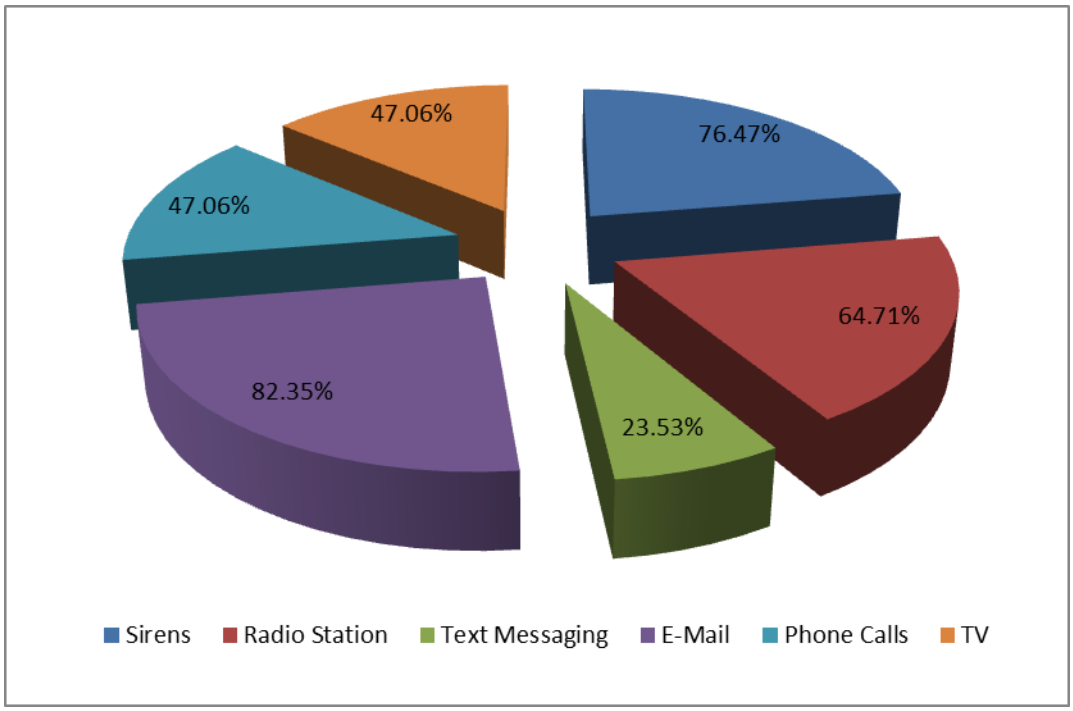
3. In your opinion, what can the City of Friendswood do to better prepare the community for emergency situations? Check all that you think would apply.



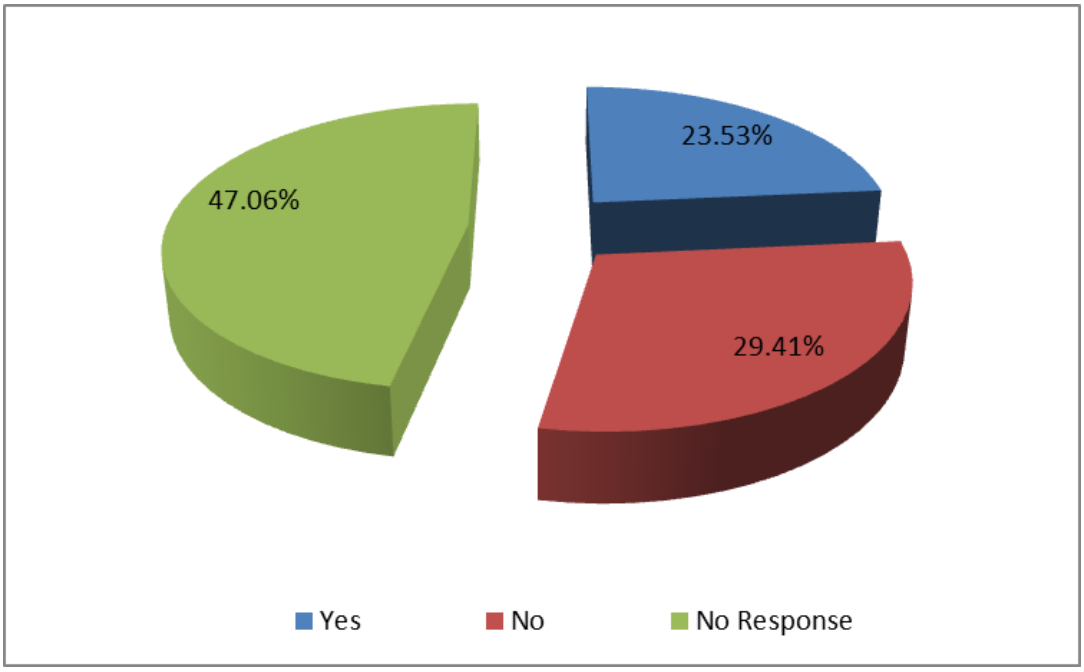
ADDITIONAL COMMENTS

- Nothing to improve.

4. Which of the following warning systems are you aware that the City of Friendswood utilizes?



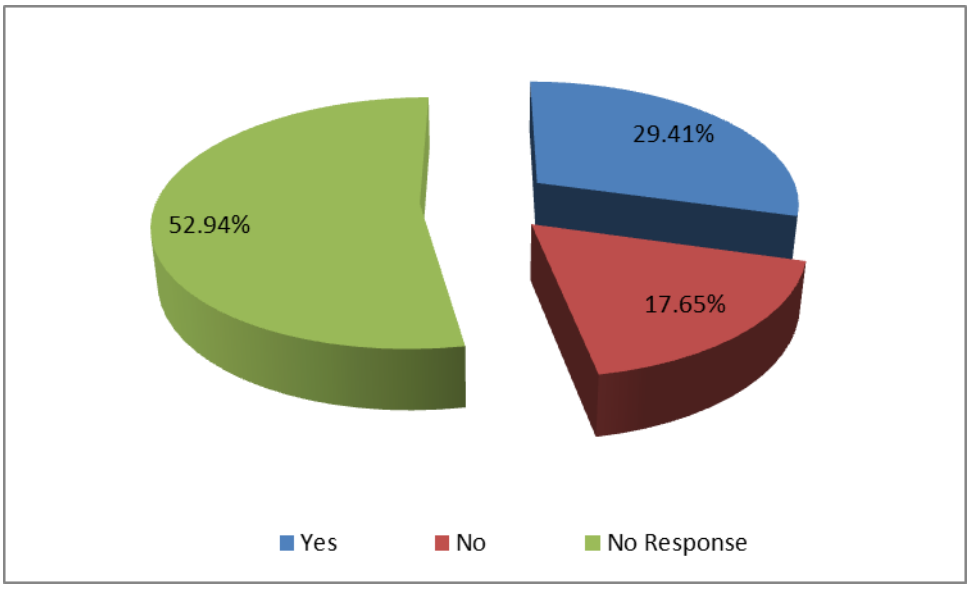
5. Have you taken any actions to make your business more resistant to hazards?



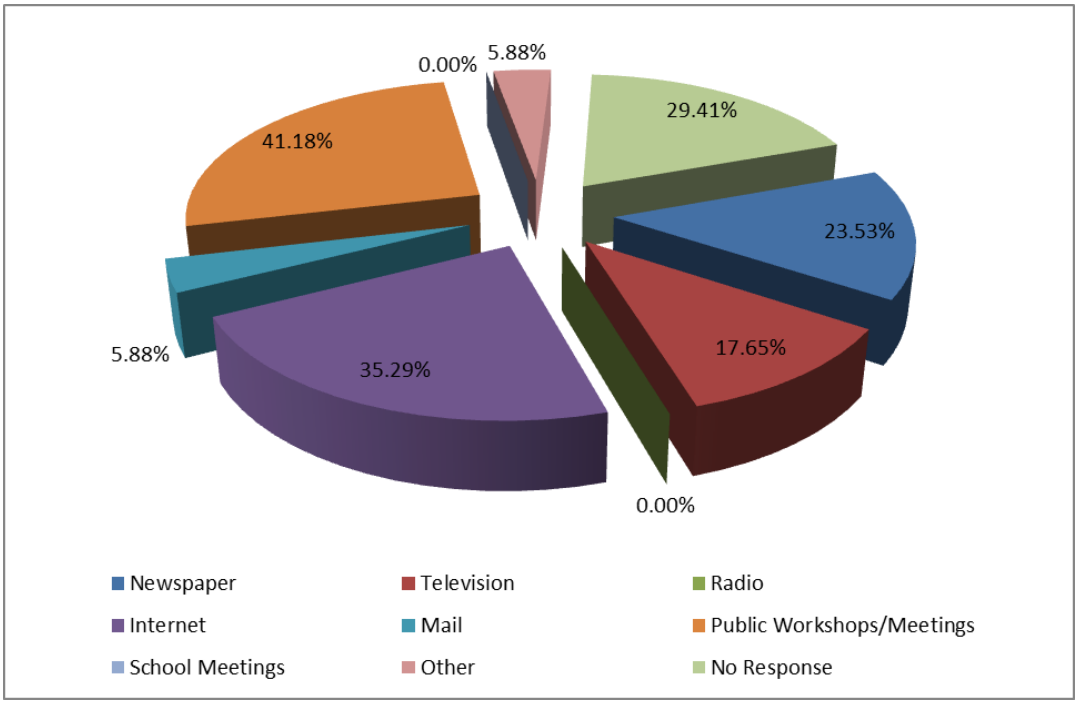
WHAT HAVE YOU DONE?

- Developed a plan to relocate in an emergency
- Boarded windows
- Alarm system
- New roof and windows
- Prepared covers for windows, discussed with family our actions in case of tornado or hurricane.
- Storm windows, hang able window shutters, trees trimmed away from roof, etc.

6. Are you interested in making your business more resistant to hazards?



7. What is the most effective way for you to receive information about how to make your business more resistant to hazards?



ADDITIONAL COMMENTS

- E-mail

BUSINESS OWNERS HAZARD MITIGATION SURVEY

HAZARD MITIGATION SURVEY

While it is impossible to prevent a hazard or disastrous event from occurring, the impact of such hazards or disastrous events can be lessened in terms of their effect on people and property. This concept is known as hazard mitigation. Hazard mitigation is also defined as a means to reduce or alleviate the loss of life, injury, and property damage resulting from natural and man-made hazards through long term strategies. These strategies include, planning, policy changes, programs, projects, and other activities. Hazard mitigation is designed to break the cycle of repeated damages and reconstruction costs associated with recurrent disasters, such as flooding and hurricanes.

The City of Friendswood is in the process of the 5-year review of the Hazard Mitigation Plan. The current plan is available on the City's website.

1. **DO YOU OWN A BUSINESS WITHIN THE CITY LIMITS OF FRIENDSWOOD?**
   □ Yes □ No

2. **HOW CONCERNED ARE YOU ABOUT THE POSSIBILITY OF OUR COMMUNITY BEING IMPACTED BY A DISASTER?**
   □ Extremely Concerned □ Somewhat Concerned □ Not Concerned

3. **PLEASE RANK THE FOLLOWING HAZARDS 1 THROUGH 6, WITH #1 BEING THE HIGHEST THREAT:**
   ___ Severe Thunderstorm/ Hail/ Lightning
   ___ Hurricane/Tropical Storm (Wind Damage)
   ___ Flood (Storm Surge)
   ___ Flood Events (Flash or Riverine)
   ___ Tornado
   ___ Hazardous Materials (Pipeline)

4. **HAVE YOU EVER EXPERIENCED OR BEEN IMPACTED BY ONE OF THE HAZARDS LISTED ABOVE?**
   □ Yes □ No

5. **IN YOUR OPINION, WHAT CAN THE CITY OF FRIENDSWOOD DO TO BETTER PREPARE THE COMMUNITY FOR EMERGENCY SITUATIONS? CHECK ALL THAT YOU THINK WOULD APPLY.**
   □ Public Education Programs & Information
   □ Improve Drainage & Detention
   □ Other _____
   □ Building/Code Enforcement
   □ Improved Warning/Notification Systems

   _____

6. **WHICH OF THE FOLLOWING WARNING SYSTEMS ARE YOU AWARE THAT THE CITY OF FRIENDSWOOD UTILIZES?**
   □ Sirens □ Text Messaging □ Phone Calls
   □ Radio Station □ Email □ TV

7. **HAVE YOU TAKEN ANY ACTIONS TO MAKE YOUR BUSINESS MORE RESISTANT TO HAZARDS?**
   □ Yes □ No

   What have you done? _____

   _____

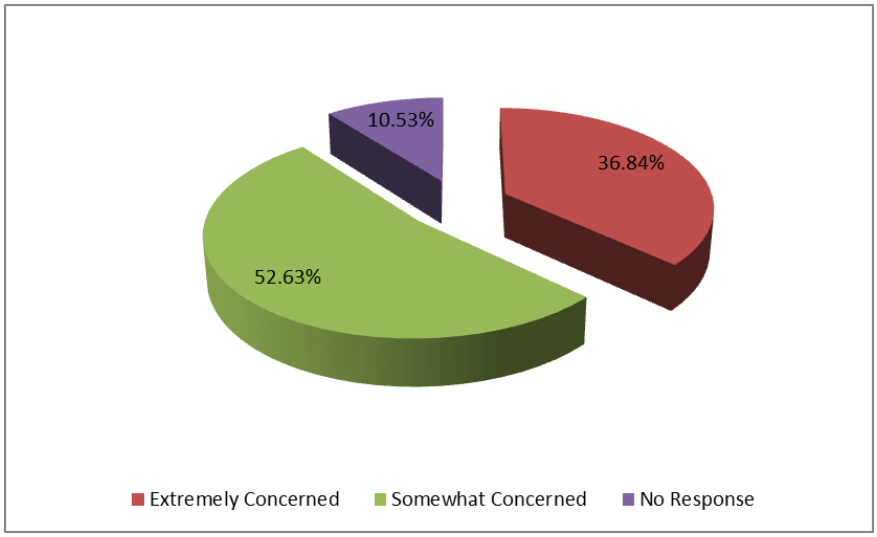
8. **ARE YOU INTERESTED IN MAKING YOUR BUSINESS MORE RESISTANT TO HAZARDS?**
   □ Yes □ No

9. **WHAT IS THE MOST EFFECTIVE WAY FOR YOU TO RECEIVE INFORMATION ABOUT HOW TO MAKE YOUR BUSINESS MORE RESISTANT TO HAZARDS?**
   □ Newspaper
   □ Television
   □ Radio
   □ Internet
   □ Mail
   □ Public Workshops/Meetings
   □ School Meetings
   □ Other

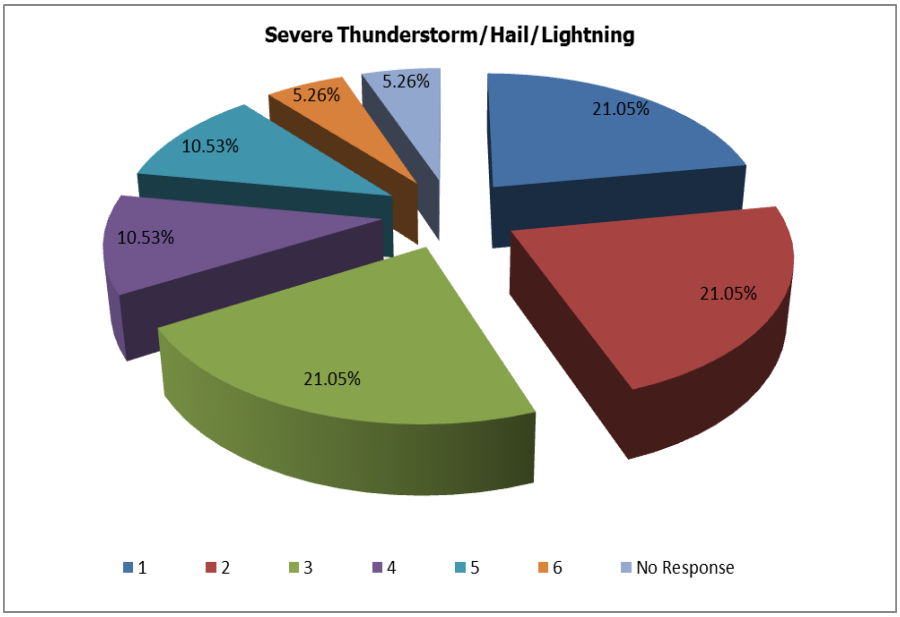
HAZARD MITIGATION SURVEY – BUSINESS OWNERS RESULTS

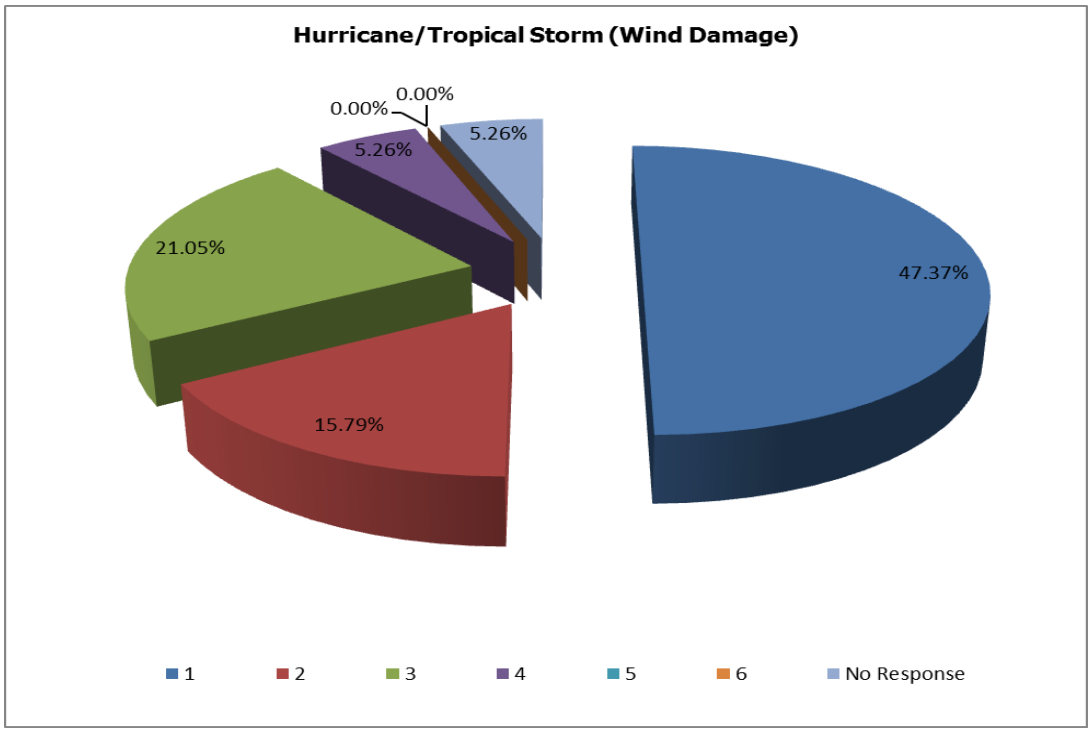
HAZARD MITIGATION SURVEY RESULTS
BUSINESS OWNERS

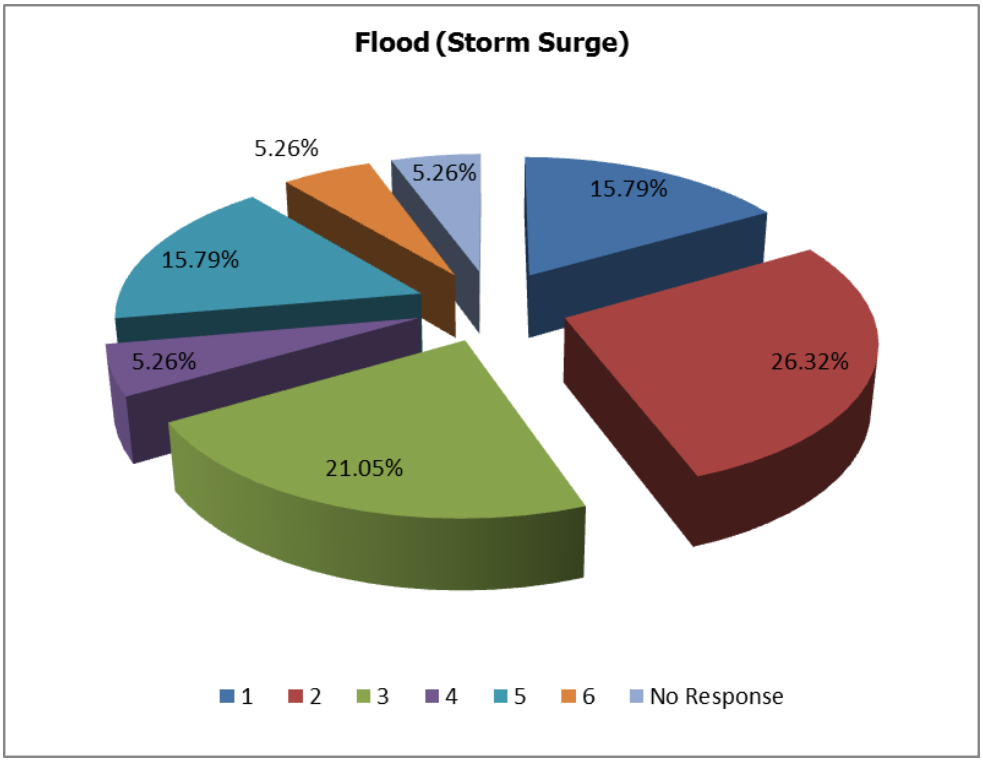
1. How concerned are you about the possibility of our community being impacted by a disaster?

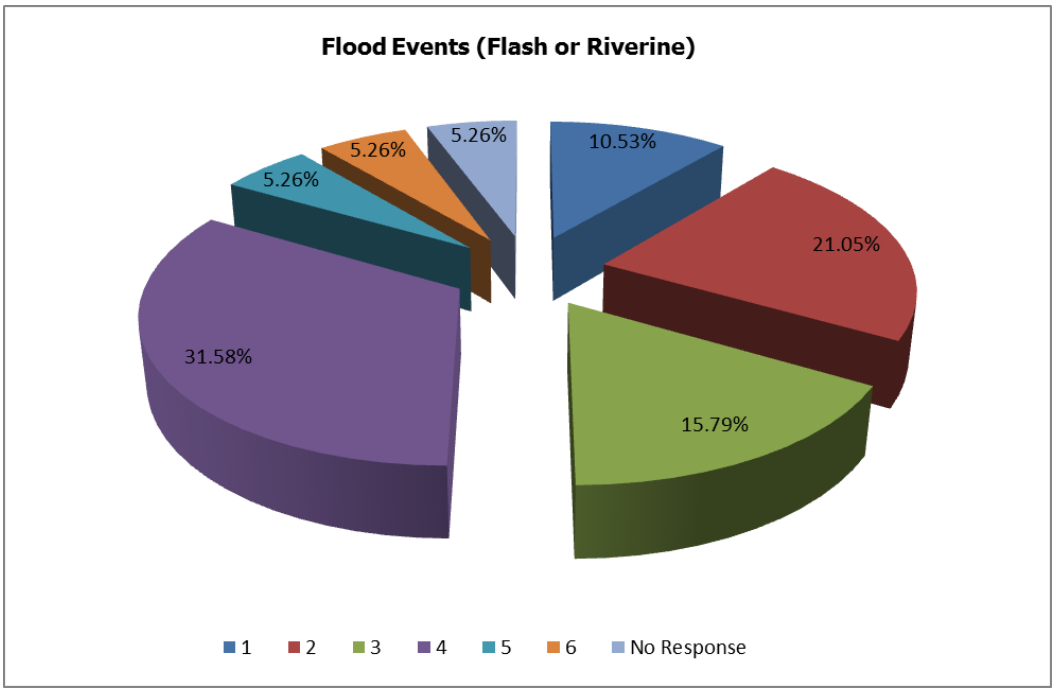


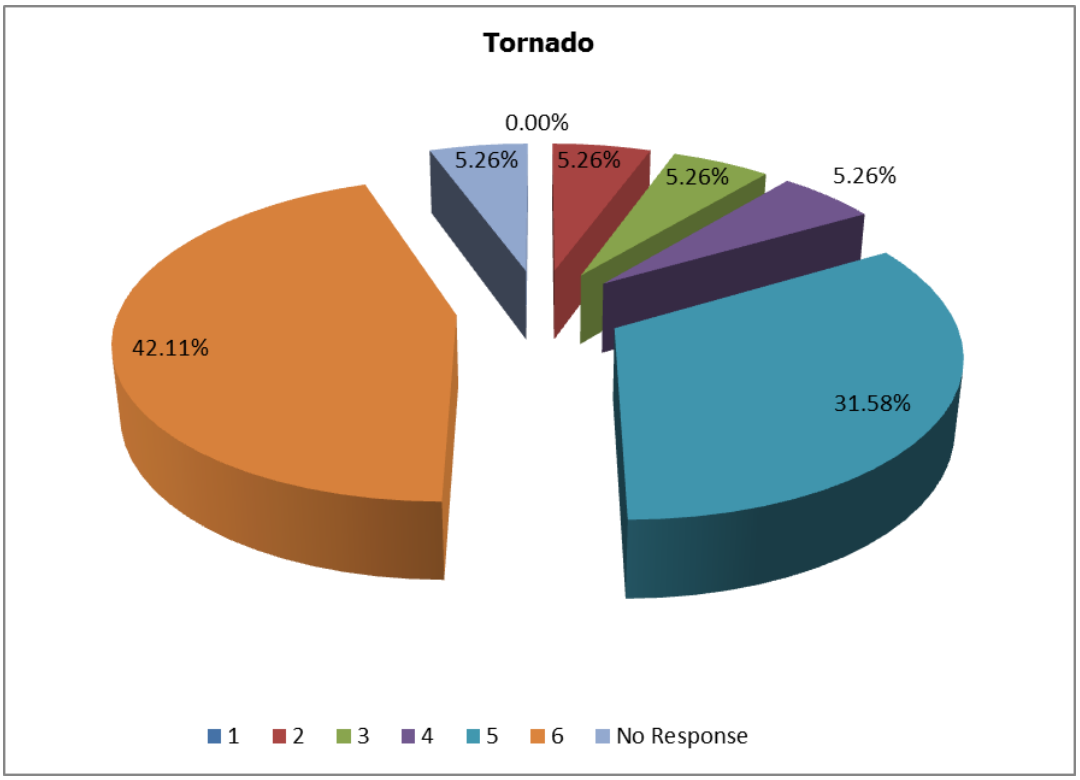
2. Please rank the following hazards 1 through 6, with #1 being the highest threat.

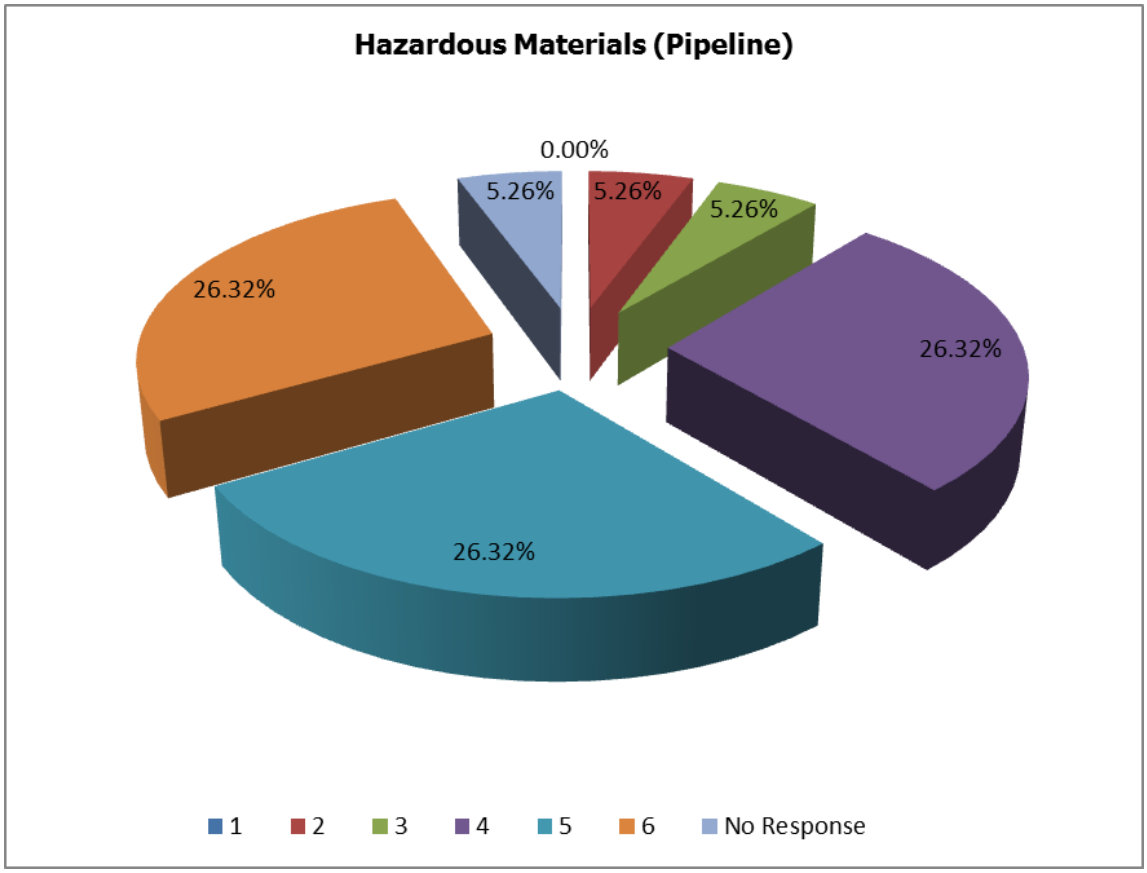



Hurricane/Tropical Storm (Wind Damage)
0.00%
0.00%
5.26%
5.26%
21.05%
47.37%
15.79%
1
2
3
4
5
6
No Response

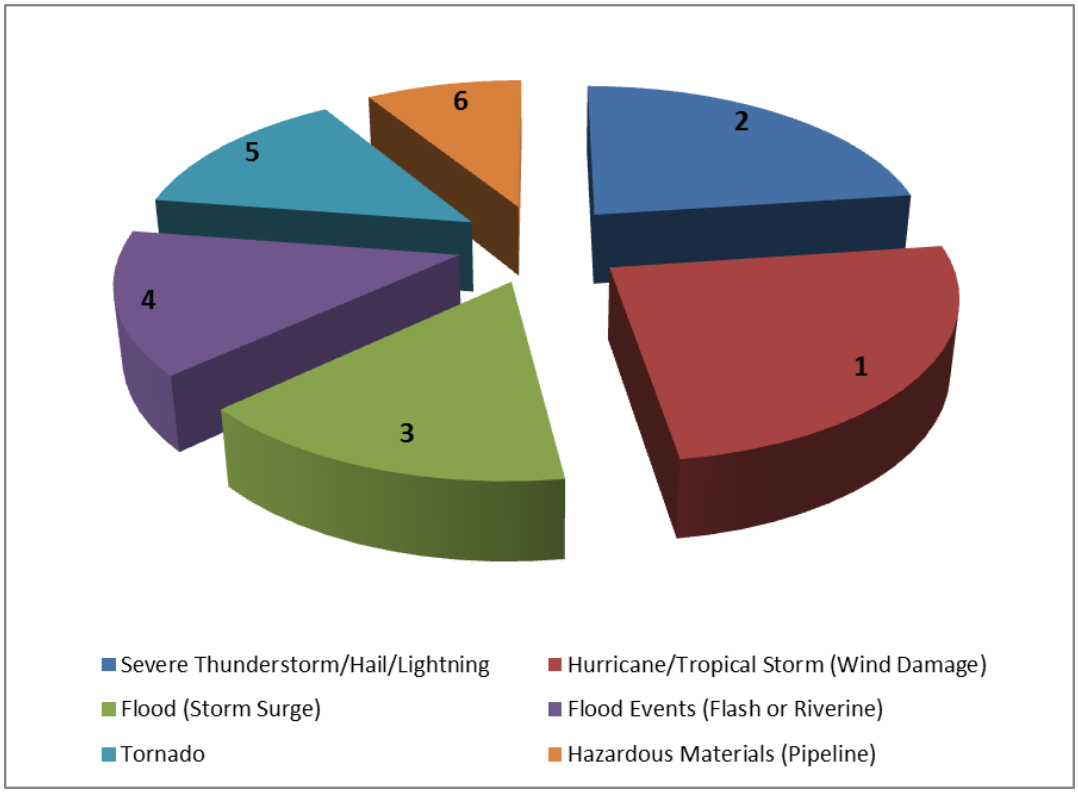

Flood (Storm Surge)
5.26%
5.26%
15.79%
15.79%
26.32%
5.26%
21.05%
1
2
3
4
5
6
No Response


Flood Events (Flash or Riverine)
10.53%
21.05%
15.79%
31.58%
5.26%
5.26%
5.26%
1
2
3
4
5
6
No Response

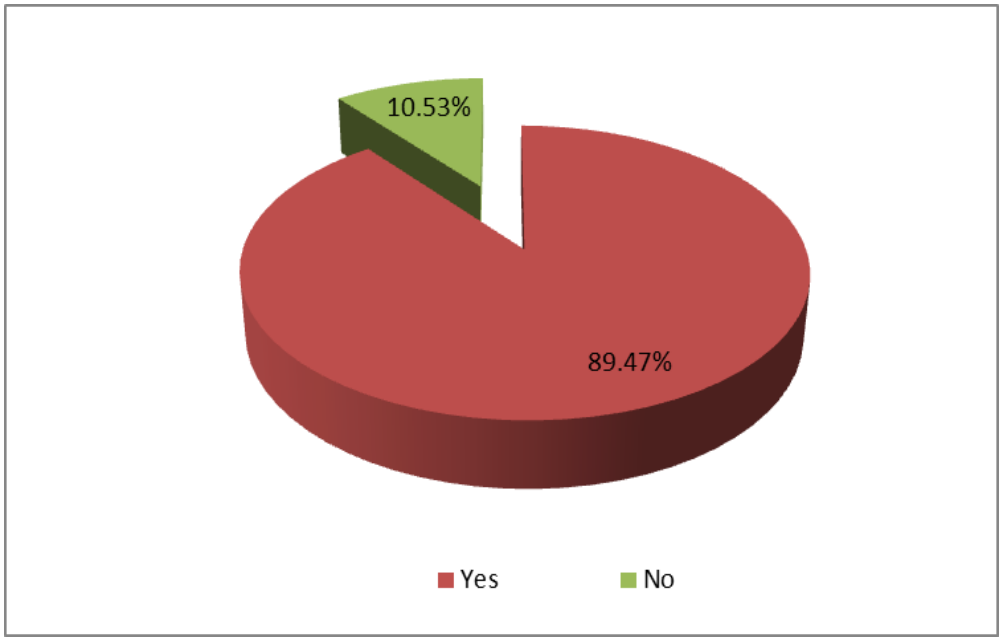

Tornado
0.00%
5.26%
5.26%
5.26%
5.26%
42.11%
31.58%
1
2
3
4
5
6
No Response



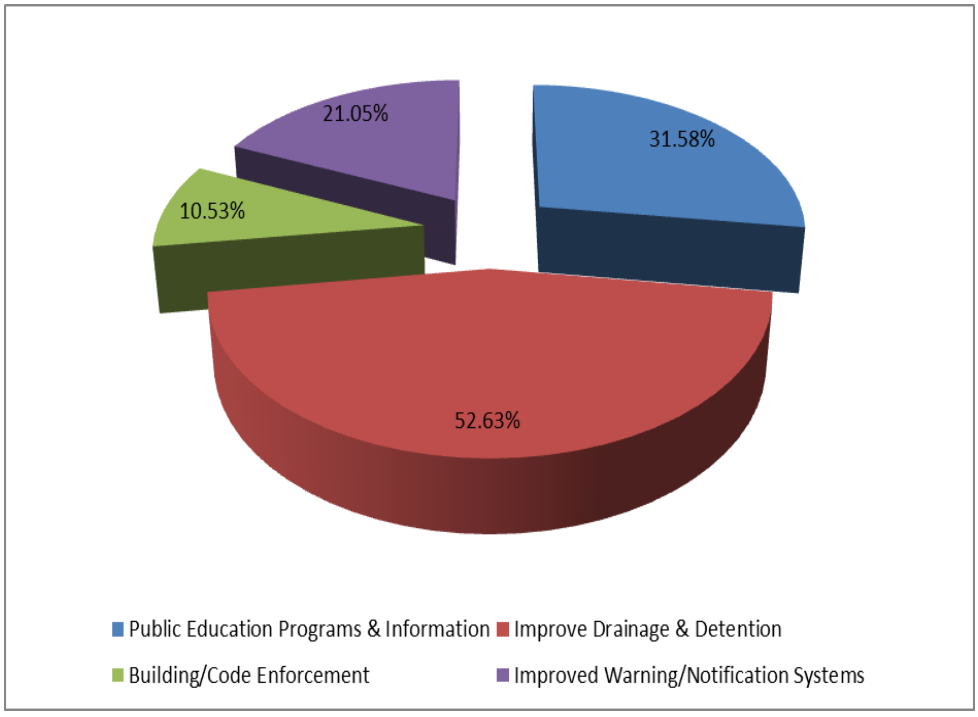
OVERALL RATING CONSENSUS OF HAZARDS (WITH 1 BEING THE HIGHEST RATED THREAT)



3. Have you ever experienced or been impacted by one of the hazards listed above?



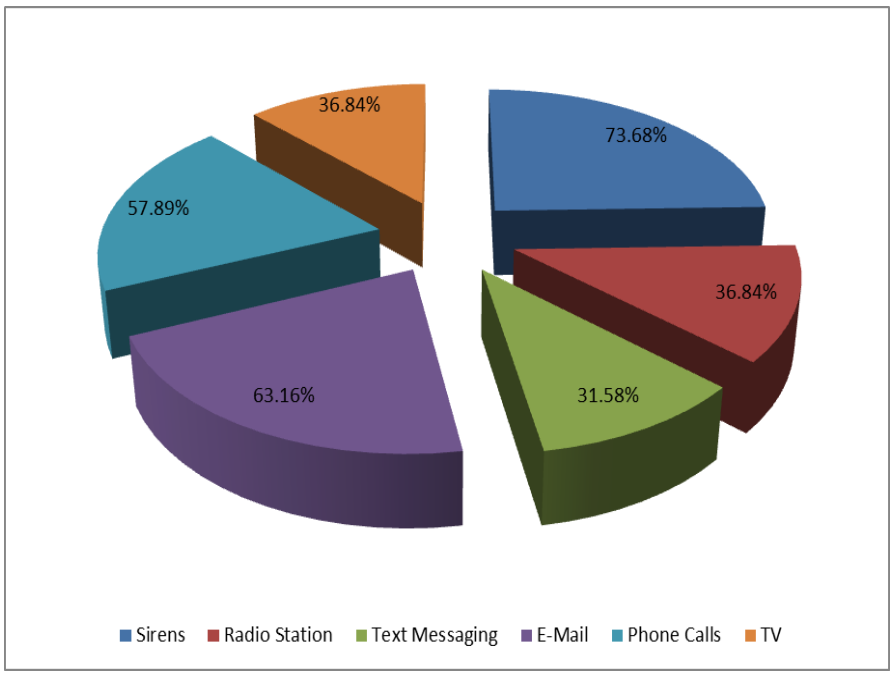
4. In your opinion, what can the City of Friendswood do to better prepare the community for emergency situations? Check all that you think would apply.



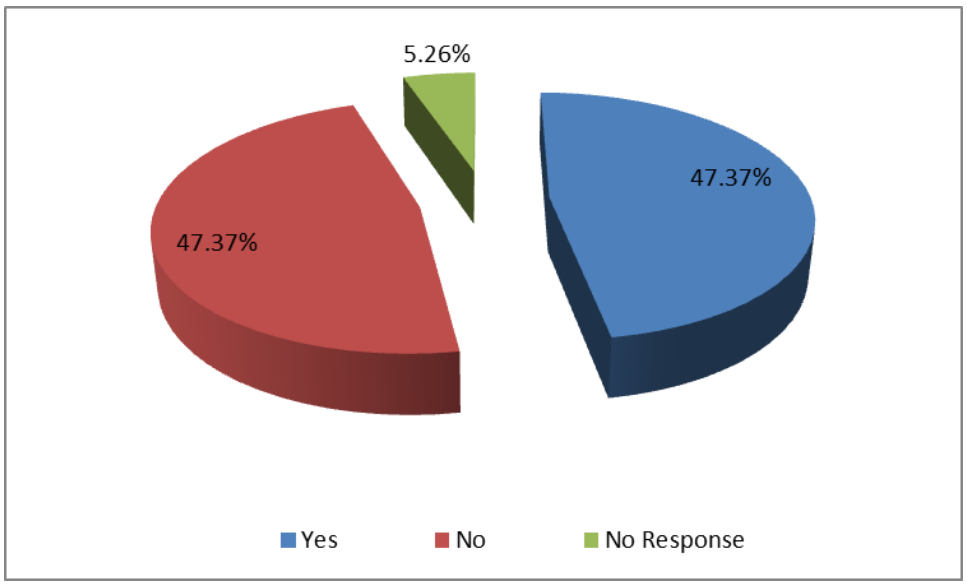
ADDITIONAL COMMENTS

- We have a strong city emergency management group.
- Not really sure, honestly.
- The City does a great job of preparing citizens for hurricane(s) and then if the event occurs; keeping citizens informed thru out.

5. Which of the following warning systems are you aware that the City of Friendswood utilizes?



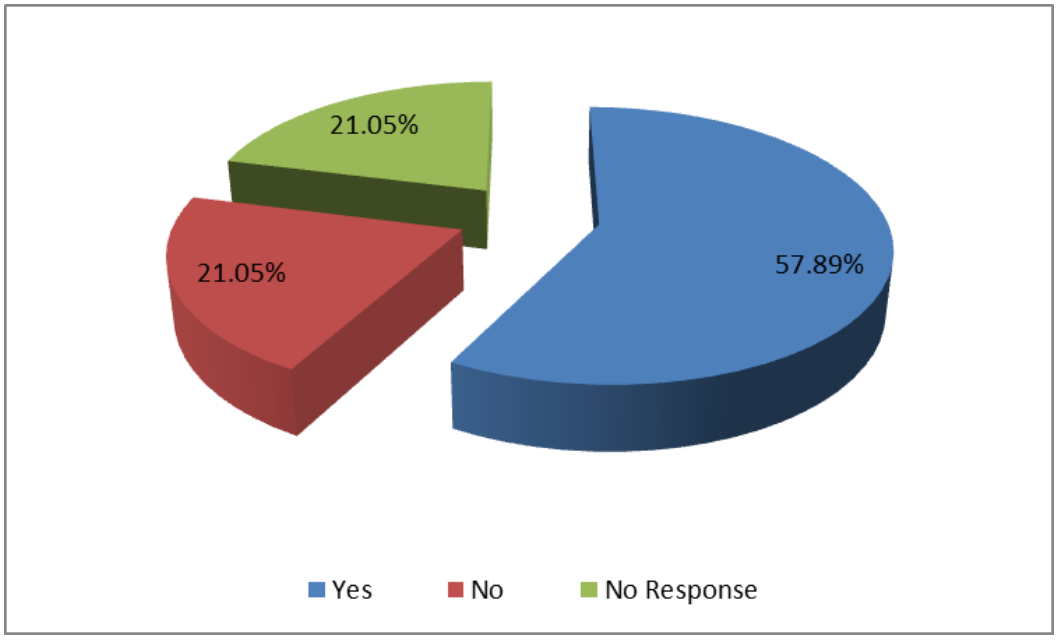
6. Have you taken any actions to make your business more resistant to hazards?



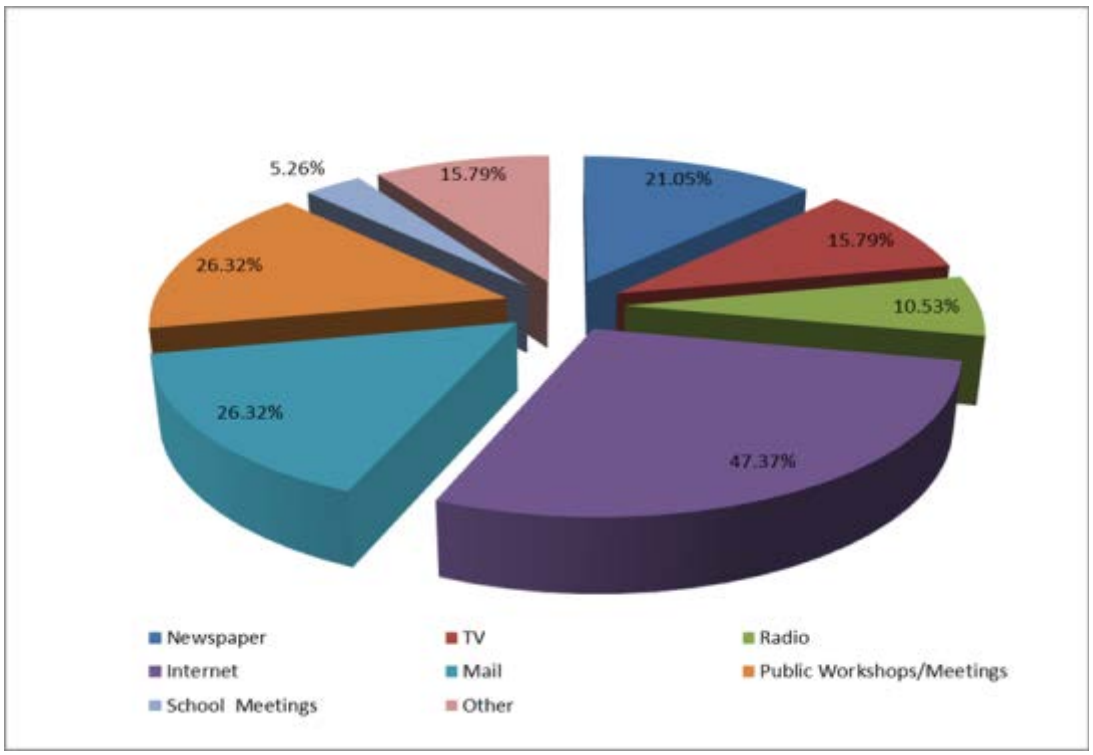
WHAT HAVE YOU DONE?

- EOP plans; city-wide drills
- Installed generators
- Having an evacuation plan/emergency plan in place and practicing it in case of an actual emergency.
- Training, outside audits, a plan developed in cooperation with the emergency management office.
- Redundant off-site back-up systems.
- Clean up prior to storms.
- Gotten an emergency box ready to take when needed.

7. Are you interested in making your business more resistant to hazards?



8. What is the most effective way for you to receive information about how to make your business more resistant to hazards?



ADDITIONAL COMMENTS

- Text messaging
- E-mail

APPENDIX C
CITY DEMOGRAPHICS

DESCRIPTION OF THE CITY

Friendswood is a medium-sized city with an estimated 2010 population of 33,396. The city was established in 1895 as a Quaker (Friends) Colony in northern Galveston County. The colony was originally a farming community of fig and Satsuma orange orchards, and rice fields.

GEOGRAPHY & GEOLOGY

Friendswood is a progressive suburban city located between downtown Houston and Galveston along the upper Texas Gulf Coast. The majority of Friendswood is in Galveston County and a portion of the city lies north of Clear Creek within southeast Harris County. The city encompasses 23 square miles a d is located in an area described on the Physiographic Map of Texas as the "Gulf Coastal Plain". The city is located on lands ranging from an elevation of ten feet (10') above sea level along Clear Creek, to approximately thirty-five feet (35') above sea level in the extreme northwestern section. Most of the city is located on land ranging from an elevation of twenty-five to thirty-feet (25' to 30') above sea level. The area is a nearly flat stratum with deltaic sand and mud soils. According to the City of Friendswood Flood Insurance Study, the soils within the city are clayey and loamy. Soils are characterized by low infiltration rates and high runoff potential.

WATERSHEDS

The Clear Creek Watershed, which includes Chigger Creek, Coward's Creek, Mary's Creek and Turkey Creek as tributaries, are of primary concern to the city.

CLEAR CREEK

Clear Creek is the major water way within the city. The Clear Creek Watershed has an area of approximately 260 square miles, and extends into Brazoria, Fort Bend, Galveston, and Harris Counties. Clear Creek is 45 miles in length and the watershed area varies in width from 2 miles at its upper end to 13½ miles in the mid-section. Clear Creek originates in Fort Bend County and forms the boundary between Harris, Brazoria, and Galveston Counties as it flows into Galveston Bay. Clear Creek crosses the northern and central sections of the city. Chigger Creek and Turkey Creek are major tributaries of Clear Creek and a major flooding source.

CHIGGER CREEK

Chigger Creek has a 16.6 square mile drainage area with the lower 8000+ feet affected by the backwater of Clear Creek. The character of flood events in the Chigger Creek watershed is more of a flash flood variety. Residential areas along Chigger Creek are subject to flooding with minimal notice and residents are not able to evacuate valuables out of harm's way. Flood damage claims including damage to both contents and structure have been filed as a result in this watershed.

COWARDS CREEK

Coward's Creek is an intermittent stream with perennial pools from the confluence with Clear Creek in Galveston County to SH 35 in Brazoria County. The stream length measures 8.1 miles. The character of flood events in the Coward's Creek watershed is of the flash flood variety. Water quickly rises in the area and then drains into Clear Creek.

MARY'S CREEK

Mary's Creek rises in two forks in northeastern Brazoria County and runs southeast for twelve miles to its mouth on Clear Creek, at Friendswood in Galveston County. The North Fork rises four (4) miles southwest of Pearland and runs for one and one-half (1½) miles to join the South Fork, which rises six (6) miles southwest of Pearland and runs for three (3) miles to their confluence.

TRANSPORTATION

The City of Friendswood is located three (3) miles west of IH-45. The city is served by three major Farm to Market Roads: FM 528, FM 518 and FM 2351. The east/west corridor is FM 528. FM 518 travels northwest to southeast, while FM 2351 travels northeast to southwest. No railroads run within the city's boundaries. Polly Ranch Airstrip is located within the community providing a private aviation location. In nearby Pearland, Pearland Regional Airport provides a hard surface, lighted general aviation runway with fuel service.

CLIMATE

The climate of the area is sub-tropical. Mild winters and warm summers best characterize the climate. The average summer temperature ranges from a high of 90°F to a low of 74°F. The average winter temperature ranges from a high of 62°F to a low of 42°F. The area receives an average of two hundred seventy-five (275) days per year of sunshine. Average rainfall per year is thirty-eight (38") inches. Rainfall is abundant and evenly distributed throughout the year. Hurricane season, spanning from June through November, usually produces the heaviest rainfall events.

ECONOMIC PROFILE AND OUTLOOK

POPULATION

The total population based on the 2000 Census figures was 29,037. The table below details the estimated population changes for the city from 2000 through 2014. These population estimates are based upon annual certificates of occupancy issued by the Community Development Department. Prior to the 2010 Census, the following formula was used to determine growth: number of households × 2.85 persons per household × 0.971 occupancy rate; i.e., 10405×2.85×.971 = 29,037; based on the 2010 Census, the following formula was used to determine growth: number of households × 2.802 persons per household × 0.971 occupancy rate.

POPULATION ESTIMATES 2000-2013

YEAR	RESIDENTIAL CERTIFICATE OF OCCUPANCY	NUMBER OF HOUSEHOLDS	POPULATION ESTIMATE	PERCENT CHANGE %
2000[1]		10,405	29,037	
2001	434	10,839	29,995	3.3%
2002	350	11,189	30,964	3.2%
2003	363	11,552	31,968	3.2%
2004	190	11,742	32,494	1.6%
2005	200	11,942	33,047	1.7%
2006	246	12,188	33,728	2.1%
2007	288	12,476	34,525	2.4%
2008	205	12,681	35,093	1.6%
2009	130	12,811	35,453	1.0%
2010[2]	147	12,958	35,255	-.56%
2011	165	13.128	35,705	1.3%
2012	192	13,315	36,227	1.5%
2013	168	13,483	36,684	1.1%
2014	189	13,672	37,198	1.4%
TOTAL PERCENT CHANGE 2000-2013				28.1%

[1] 2000 Census data
[2] 2010 Census data – Official population = 35,805

PROJECTED GROWTH

The City of Friendswood covers approximately 23 square miles, or 13,237 total acres. As of October 2013, a total of 7,818 acres are developed leaving 2,816 acres undeveloped. Public owned acreage totals 2,603. Existing residences cover 6,000 acres and commercial covers 1,218 acres. Approximately eighty-four percent (84%) of the improved land within the city is dedicated to single-family dwellings. Estimations are that the city will build-out around the year 2020 with a total population of 57,400.

The table below illustrates the number of structures located within the city which could be vulnerable to one or several of the hazard agents detailed in this plan. Data in the following tables were obtained from the U.S. Census 2010.

TYPES OF STRUCTURES

		UNITS
Single Family	13,339	
Multi-Family		
Apartment Complexes	12	1,511
Town Home/Condo	7	
Senior Care Facilities	4	421
Trailer Parks	2	30
Commercial Buildings	309	715
Schools/Public	8	
Schools/Private	2	
Day Cares	32	
Churches	17	
Government	21	
Utilities	3	
Lift Stations	38	
Water Wells	6	
Surface Water Station	2	
Elevated Water Tank	2	
Waste Water Treatment Facility	1	

HOUSING OCCUPANCY

	2000	2010	2015
Total Housing Units	10,405	13,254	13,399
Occupied Housing Units	10,107	12,726	12,850
Vacant Housing Units	298	528	549
All Other Vacants	18	97	N/A
Homeowner Vacancy Rate	1.1	1.8	1.2
Rental Vacancy Rate	6.1%	7.0%	7.1

AGE OF HOUSING

YEAR STRUCTURE BUILT		
Total housing units	13,399	
Built 2010 or later	722	32%
Built 2000 to 2009	3,532	
Built 1990 to 1999	2,262	16.9%
Built 1980 to 1989	2,128	15.9%
Built 1970 to 1979	3,951	38.1%
Built 1960 to 1969	1,158	
Built 1950 to 1959	120	1.2%
Built 1940 to 1949	34	
Built 1939 or earlier	18	0.1%

VALUE OF HOUSING

VALUE	
Owner-occupied units	10,412
Less than $50,000	229
$50,000 to $99,999	561
$100,000 to $149,999	2,296
$150,000 to $199,999	1,433
$200,000 to $299,999	2,669
$300,000 to $499,999	2,604
$500,000 to $999,999	481
$1,000,000 or more	139
Median (dollars)	$226,600
Housing Units with Mortgage	7,468
Housing Units without a mortgage	2,944

ESTIMATED HOUSEHOLD INCOME

2010 ESTIMATED FAMILY HOUSEHOLDS BY HOUSEHOLD INCOME	
2010 Estimated Mean Family Household Income	$114,319
2010 Estimated Median Family Household Income	$ 114,319
2010 Estimated Per Capita Income	$ 43,185

CHANGES IN DEVELOPMENT

Friendswood is a 'zoned' community, meaning that properties are zoned to determine what use is allowed on the property. For example, homes are allowed in residential zoning categories and businesses are allowed in commercial zoning categories. The city has six (6) residential zoning districts and seven (7) non-residential zoning districts. In addition to the types of uses on a zoned piece of property, each zoning district can have landscaping, lot size, building setback and design requirements. Building permits are required for all new construction, reconstruction and renovation.

Approximately 714 new residential structures have been added to the city's built environment, and 30 new commercial structures have also been added.

The following table depicts the trend in development of residential and commercial construction and renovations within the past six (6) years.

YEAR	RESIDENTIAL				COMMERCIAL			
	NEW CONST.	% CHANGE	RENOVATIONS	% CHANGE	NEW CONST.	% CHANGE	BUILD-OUT	% CHANGE
2009	101	N/A	0	N/A	12	N/A	35	N/A
2010	147	45.5%	12	45.5%	8	-33.3	38	8.6%
2011	165	12.2%	123	925%	6	-25%	47	23.7%
2012	192	16.4%	435	253.7%	3	-50%	74	57.4%
2013	168	-12.5%	468	7.6%	9	200%	66	-10.8%
2014	189	12.5%	487	4.1%	4	-55.6%	40	-39.4%

All structures within the city must be constructed to comply with the city's Flood Hazard Reduction Ordinance. Structures to be constructed in SFHA (special flood hazard areas) shall be constructed to the following guidelines:

- All new construction or substantial improvements shall be designed or modified and adequately an chored to prevent flotation, collapse or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyance;
- Shall be constructed by methods and practices that minimize flood damage;
- All new construction or substantial improvements shall be constructed with materials resistant to flood damage;

New residential construction and substantial improvements of any residential structures shall have the lowest floor, including basement, elevated to 24 inches (24") above the base flood elevation. A registered professional engineer, architect or land surveyor shall submit a certification to the floodplain administrator that the standard is satisfied.

Non-residential construction and substantial improvements of any commercial, industrial or other non-residential structure shall either have the lowest floor, including basement, elevated to 24 inches (24") above the base flood level or, together with attendant utility and sanitary facilities, be designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy. A regist4ered professional engineer or architect shall develop and/or review the structural design, specifications and plans for the construction and shall certify that the design and methods of construction are in accordance with accepted standards of practice as outlined. A record of

such certification, which includes the specific elevation in relation to mean sea level to which such structures are flood proofed, shall be maintained by the floodplain administrator.

All manufactured homes to be placed within Zone shall be installed using methods and practices which minimize flood damage. Manufactured homes must be elevated and anchored to resist flotation, collapse or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable state and local anchoring requirements for resisting wind forces.

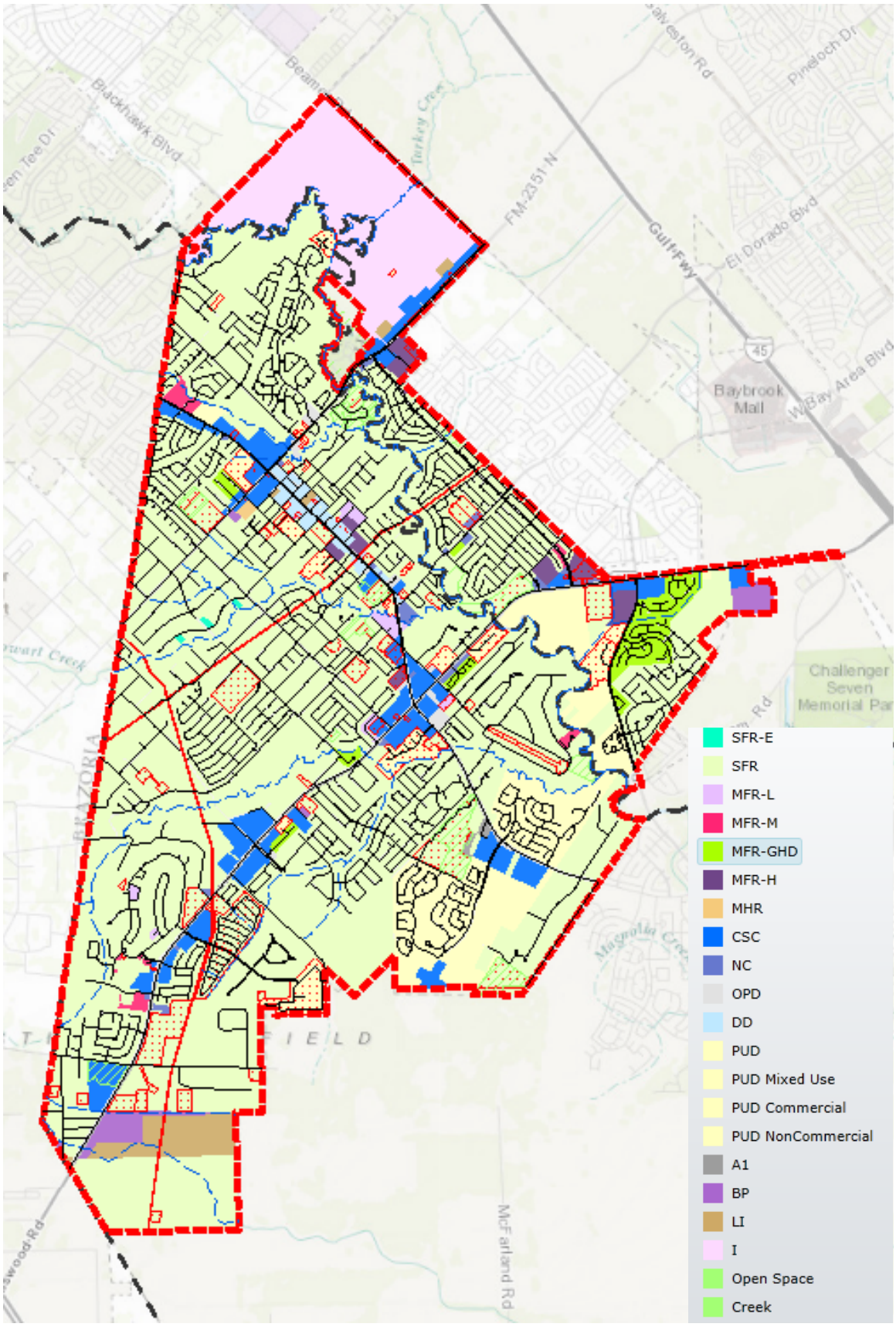
Special lowest floor elevation requirements:

- Zone Ae – the lowest floor elevations shall be a minimum of 24 inches (24") above the elevation given on the latest FEMA FIRM panel for the city;
- Zone AO – the lowest floor elevations shall be 36 inches (36:0 higher than the centerline of the road in curb and gutter streets, or the high bank of a roadside ditch on streets with open ditch drainage;
- Zone X shaded – lowest floor elevations shall be a minimum of 24 inches (24") higher than the adjacent natural grade;
- Zone X unshaded –
    - Curb & Gutter Streets – the lowest floor elevation shall be a minimum of 18 inches (18") above the top of curb or a minimum of 12 inches (12") above the adjacent natural grade, whichever is greater;
    - Streets with open ditches – slab elevations shall be a minimum of 18 inches (18") higher than the center of the street or a minimum of 12 inches (12") higher than the adjacent natural grade, whichever is greater.

Base flood elevation data shall be generated for subdivision proposals and other proposed development, including manufactured home parks and subdivisions, which is greater than 50 lots or five acres, whichever is lesser. All subdivision proposals, included manufactured home parks and subdivisions, shall have adequate drainage provided to reduce exposure to flood hazards.

Encroachments into the floodway shall be prohibited, including fill, new construction, substantial improvements and other development within the adopted regulatory floodway unless it has been demonstrated through a no-rise certificate using hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed encroachment would not result in any increase in flood elevations within the community during the occurrence of the base flood discharge.

CURRENT ZONING MAP



APPENDIX D
HISTORY OF NATURAL EVENTS

FLOODING

FLOODING EVENTS OCCURRING WITHIN THE CITY OF FRIENDSWOOD

DATE	EVENT DESCRIPTION	ESTIMATED DAMAGE COSTS
June 23, 1973 **FEMA 398-DR TX**	Clear Creek, Chigger Creek, Cowards Creek, and Mary's Creek flooded due to protracted rains. The storms responsible for the rains also triggered tornados within the area. The flooding event inundated roads within the city, backed up storm drains, caused erosion and road washouts.	$50 Million
July 13-31, 1979 **FEMA 595-DR-TX** **TS CLAUDETTE**	Torrential rains caused Clear Creek, Chigger Creek, Cowards Creek and Mary's Creek to overflow its banks. Many streets and homes within the city were flooded. The schools were closed and thousands of citizens went without telephone service.	$750 Million (SE Texas)
August 18, 1983 **FEMA 689-DR-TX** **HURRICANE ALICIA**	After forming just south of Louisiana on August 15, 1983, Alicia drifted westward and intensified and quickly into a Category 3 hurricane before making landfall on the west end of Galveston Island in the early morning hours of August 18. As a result, a total of 21 persons died with an additional 3,000 injuries.	$1 Billion
October 1994 **FEMA 1041-DR-TX** Severe Storms & Flooding	Flooding along Clear Creek, Chigger Creek, Mary's Creek and Cowards Creek from an intense rainstorm resulted in a Presidential declared disaster for 38 East Texas Counties that included Harris and Galveston Counties and the City of Friendswood. This event caused 22 flood related deaths.	$900 Million
October 17, 1998 **FEMA 1257-DR-TX** Severe Storms & Flooding	The ground was saturated in the Houston/Galveston area from two previous storms in the vicinity: Tropical Storm Charley (8/26) and Hurricane Georges (9/23). On October 17 a series of storms moved across the central and south regions of Texas, dropping up to 22" of rain in some areas and spawning several tornadoes. A total of 60 Texas counties reported flooding during October 17-19.	$184.7 Million
June 5-10, 2001 **FEMA 1379-DR-TX** **TROPICAL STORM ALLISON**	**TROPICAL STORM ALLISON** stalled over the Upper Gulf Coast and the five day rain event flooded numerous homes within the city. The city initiated a "fast track" acquisition and relocation of homes and businesses damaged by the flood. Flooding occurred along Clear Creek, Chigger Creek, Mary's Creek, and Cowards Creek. **534 HOMES DESTROYED** • 73 homes were completely destroyed; 128 homes had major damage; 333 homes had minor damage	$6+ Billion
October 2006	Heavy rains caused widespread flooding along Clear Creek, Mary's Creek, Cowards Creek, and Chigger Creek, with water in homes. The combination of very deep tropical moisture with a slow-moving warm front and the approach of a strong upper level trough resulted in excessive rainfall across Harris and various surrounding counties.	Damages within the City $250,000
April 18-19, 2009 Heavy Rainfall	Total rainfall for both days was 8"; of which 6" fell in a one hour time period around Clear Creek at FM 528. Tides were elevated due to persistent easterly and southeasterly winds, which resulted in slower than normal drainage in low lying coastal areas near Clear Lake and Galveston Bay. Widespread street flooding occurred mainly from drainage systems being overwhelmed by the intense rainfall.	Unknown None Reported
April 24, 2009 Heavy Rainfall	Flash Flood from a series of thunderstorms which produced heavy rainfall and strong winds across portions of Harris, Galveston and Chambers Counties. Numerous roads in and around Friendswood were impassable due to high water caused by heavy rainfall. Several high water rescues were required due to the flooding. Total rainfall was 6"; two house fires occurred as a result of lightning strikes. One home was flooded in the SE portion of the city.	$5,000

DETAILED LIST OF REPETITIVE LOSS PROPERTY CLAIMS

CURRENT RL / SRL PROPERTY INVENTORY

	MITIGATED	INSURED	OCCUPANCY	ZONE	FIRM	BUILDING VALUE	TOTAL BUILDING PAYMENT	TOTAL CONTENTS PAYMENT	NO. OF LOSSES	TOTAL PAID	AVERAGE PAY
1	NO	NO	SINGLE FMLY	C	N	37,000	3,020.18	915.00	2	3,935.18	1,967.59
2	NO	NO	SINGLE FMLY	X	Y	117,007	15,013.77	838.94	3	15,852.71	5,284.24
3	NO	YES	SINGLE FMLY	X	N	133,065	55,768.60	10,661.33	3	66,429.93	22,143.31
4	NO	NO	SINGLE FMLY	X	N	172,380	83,101.74	26,266.87	6	109,368.61	18,228.10
5	NO	NO	SINGLE FMLY	X	N	175,000	5,986.15	1,280.00	2	7,266.15	3,633.08
6	NO	NO	SINGLE FMLY	X	Y	103,552	3,667.09	0.00	2	3,667.09	1,833.55
7	NO	YES	SINGLE FMLY	C	N	60,000	14,855.12	12,799.46	2	27,654.58	13,827.29
8	NO	NO	SINGLE FMLY	C	N	55,074	15,942.47	7,512.23	3	23,454.70	7,818.23
9	NO	YES	SINGLE FMLY	A06	N	27,100	15,831.15	4,574.72	2	20,405.87	10,202.94
10	NO	NO	SINGLE FMLY	B	N	65,000	13,426.55	9,579.00	3	23,005.55	7,668.52
11	NO	NO	SINGLE FMLY	C	N	62,000	36,628.79	0.00	3	36,628.79	12,209.60
12	NO	NO	SINGLE FMLY	C	N	93,600	13,121.08	12,995.00	2	26,116.08	13,058.04
13	NO	NO	SINGLE FMLY	C	Y	79,000	4,545.18	1,523.91	2	6,069.09	3,034.55
14	NO	YES	SINGLE FMLY	C	Y	96,000	16,064.86	10,166.73	2	26,231.59	13,115.80
15	NO	NO	SINGLE FMLY	C	Y	2,600	1,629.40	10,378.99	2	12,008.39	6,004.20
16	NO	NO	SINGLE FMLY	X	Y	6,500,000	9,192.80	4,500.42	2	13,693.22	6,846.61
17	NO	YES	SINGLE FMLY	X	Y	120,086	38,239.12	18,285.25	4	56,524.37	14,131.09
18	NO	SDF	SINGLE FMLY	X	Y	211,501	63,852.10	16,152.23	4	80,004.33	20,001.08
19	NO	YES	SINGLE FMLY	X	Y	161,861	76,718.81	1,811.43	3	78,530.24	26,176.75
20	NO	YES	SINGLE FMLY	X	Y	157,218	11,606.47	4,580.66	2	16,187.13	8,093.57
21	NO	NO	SINGLE FMLY	X	N	173,156	26,118.67	27,848.71	3	53,967.38	17,989.13
22	NO	YES	ASSMD CONDO	B	N	N/A	146,601.10	53,118.36	2	199,719.46	99,859.73
23	NO	NO	ASSMD CONDO	C	N	N/A	12,967.05	9,511.12	3	22,478.17	7,492.72
24	NO	YES	SINGLE FMLY	A03	N	42,900	16,344.59	11,167.41	4	27,512.00	6,878.00
25	NO	YES	SINGLE FMLY	A	N	70,000	25,283.96	5,580.94	3	30,864.90	10,288.30
26	NO	YES	SINGLE FMLY	A06	N	68,600	12,602.14	649.50	3	13,251.64	4,417.21
27	NO	NO	SINGLE FMLY	C	N	37,600	21,050.05	37,548.06	2	58,598.11	29,299.06
28	NO	YES	SINGLE FMLY	AE	Y	235,806	3,965.86	9,190.94	2	13,156.80	6,578.40
29	NO	YES	SINGLE FMLY	A	N	148,500	94,129.95	27,222.02	3	121,351.97	40,450.66
30	NO	YES	SINGLE FMLY	C	N	193,690	103,813.11	51,193.56	3	155,006.67	51,668.89
31	NO	YES	SINGLE FMLY	A	N	116,700	75,550.25	11,086.00	3	86,636.25	28,878.75
32	NO	YES	SINGLE FMLY	AE	Y	200,000	194,633.39	38,767.90	3	233,401.29	77,800.43
33	NO	SDF	SINGLE FMLY	A04	Y	136,923	120,419.64	18,798.00	4	139,217.64	34,804.41
34	NO	NO	SINGLE FMLY	X	N	204,000	15,398.64	11,557.00	2	26,955.64	13,477.82
35	NO	YES	SINGLE FMLY	A	N	177,000	52,941.54	40,544.14	3	93,485.68	31,161.89
36	NO	NO	SINGLE FMLY	A	N	120,000	68,610.41	23,600.00	3	92,210.41	30,736.80
37	NO	YES	SINGLE FMLY	C	Y	60,000	33,371.65	0.00	2	33,371.65	16,685.83

	MITIGATED	INSURED	OCCUPANCY	ZONE	FIRM	BUILDING VALUE	TOTAL BUILDING PAYMENT	TOTAL CONTENTS PAYMENT	NO. OF LOSSES	TOTAL PAID	AVERAGE PAY
38	NO	NO	SINGLE FMLY	A08	N	37,500	65,323.78	21,130.67	7	86,454.45	12,350.64
39	NO	YES	SINGLE FMLY	AE	N	59,418	1,290.86	58,243.18	4	59,534.04	14,883.51
40	NO	SDF	SINGLE FMLY	A08	N	16,000	24,983.56	0.00	3	24,983.56	8,327.85
41	NO	SDF	SINGLE FMLY	AE	N	15,950	54,411.93	0.00	7	54,411.93	7,773.13
42	NO	YES	SINGLE FMLY	X	N	108,900	41,000.86	10,000.00	3	51,000.86	17,000.29
43	NO	NO	SINGLE FMLY	A08	N	300,000	17,400.00	10,000.00	2	27,400.00	13,700.00
44	NO	NO	NON RESIDNT	A06	N	80,000	61,557.14	10,130.00	3	71,687.14	23,895.71
45	NO	YES	SINGLE FMLY	X	Y	335,008	6,144.56	12,578.63	3	18,723.19	6,241.06
46	NO	SDF	SINGLE FMLY	X	Y	298,128	160,590.65	23,133.21	4	183,723.86	45,930.97
47	NO	YES	SINGLE FMLY	X	Y	289,756	108,565.42	37,108.31	4	145,673.73	36,418.43
48	NO	SDF	SINGLE FMLY	AE	Y	155,520	117,462.82	30,493.03	5	147,955.85	29,591.17
49	NO	NO	SINGLE FMLY	X	Y	48,239	100,778.69	22,689.90	2	123,468.59	61,734.30
50	NO	NO	SINGLE FMLY	C	N	120,000	22,086.59	0.00	2	22,086.59	11,043.30
51	NO	YES	SINGLE FMLY	A08	N	94,300	62,193.88	20,000.00	2	82,193.88	41,096.94
52	NO	NO	SINGLE FMLY	X	N	163,807	100,951.97	38,247.00	3	139,198.97	46,399.66
53	NO	NO	SINGLE FMLY	C	N	68,500	36,477.05	10,210.00	2	46,687.05	23,343.53
54	NO	NO	NON RESIDNT	C	N	541,580	74,747.80	4,895.15	2	79,642.95	39,821.48
55	NO	NO	SINGLE FMLY	C	N	95,000	46,417.00	36,160.00	2	82,577.00	41,288.50
56	NO	NO	NON RESIDNT	A03	N	101,000	40,876.04	15,000.00	2	55,876.04	27,938.02
57	NO	YES	SINGLE FMLY	X	Y	298,307	13,252.13	2,308.62	2	15,560.75	7,780.38
58	NO	SDF	SINGLE FMLY	C	N	240,116	270,925.62	163,582.68	5	434,508.30	86,901.66
59	NO	NO	OTHER RESID	C	N	230,000	105,629.85	0.00	2	105,629.85	52,814.93
60	NO	YES	SINGLE FMLY	A03	N	55,000	8,447.68	10,813.49	2	19,261.17	9,630.59
61	NO	NO	SINGLE FMLY	A03	N	44,700	25,404.30	15,423.25	3	40,827.55	13,609.18
62	NO	YES	SINGLE FMLY	A03	N	44,800	19,112.54	6,502.01	3	25,614.55	8,538.18
63	NO	NO	SINGLE FMLY	A03	N	60,500	22,811.40	1,350.50	2	24,161.90	12,080.95
64	NO	NO	SINGLE FMLY	C	N	60,500	10,766.90	0.00	2	10,766.90	5,383.45
65	NO	SDF	SINGLE FMLY	X	N	73,500	90,292.43	57,104.65	4	147,397.08	36,849.27
66	NO	NO	SINGLE FMLY	X	Y	112,504	29,471.38	4,094.68	3	33,566.06	11,188.69
67	NO	YES	SINGLE FMLY	AE	Y	226,000	71,761.70	17,292.04	4	89,053.74	22,263.44
68	NO	YES	SINGLE FMLY	AE	Y	275,950	48,536.96	8,393.72	2	56,930.68	28,465.34
69	NO	YES	SINGLE FMLY	B	N	49,000	5,252.63	3,554.50	2	8,807.13	4,403.57
70	NO	NO	SINGLE FMLY	C	Y	82,680	34,535.60	15,001.20	5	49,536.80	9,907.36
71	NO	NO	SINGLE FMLY	AE	Y	98,700	91,893.24	69,636.72	3	161,529.96	53,843.32
72	NO	SDF	SINGLE FMLY	X	N	130,933	247,468.51	86,334.60	7	333,803.11	47,686.16
73	NO	NO	SINGLE FMLY	X	N	152,165	204,628.71	85,282.38	10	289,911.09	28,991.11
74	NO	NO	SINGLE FMLY	A	N	32,200	11,909.43	10,000.00	2	21,909.43	10,954.72
75	NO	SDF	SINGLE FMLY	AE	N	161,200	89,941.54	149,836.35	4	239,777.89	59,944.47
76	NO	YES	SINGLE FMLY	C	N	176,800	14,519.82	3,240.98	3	17,760.80	5,920.27
77	NO	NO	SINGLE FMLY	A03	N	54,000	29,144.48	588.30	3	29,732.78	9,910.93
78	NO	YES	SINGLE FMLY	X	Y	222,201	21,097.22	610.00	2	21,707.22	10,853.61
79	NO	YES	SINGLE FMLY	X	N	175,000	117,100.11	40,801.01	3	157,901.12	52,633.71
80	NO	YES	SINGLE FMLY	X	Y	82,227	69,059.56	35,411.57	5	104,471.13	20,894.23
81	NO	YES	SINGLE FMLY	AE	Y	289,000	5,101.23	6,164.28	3	11,265.51	3,755.17

	MITIGATED	INSURED	OCCUPANCY	ZONE	FIRM	BUILDING VALUE	TOTAL BUILDING PAYMENT	TOTAL CONTENTS PAYMENT	NO. OF LOSSES	TOTAL PAID	AVERAGE PAY
82	NO	YES	SINGLE FMLY	X	N	800,000	40,342.02	20,643.00	4	60,985.02	15,246.26
83	NO	YES	SINGLE FMLY	AE	Y	118,180	100,410.27	52,235.30	4	152,645.57	38,161.39
84	NO	YES	SINGLE FMLY	A03	N	121,500	44,053.27	22,222.14	3	66,275.41	22,091.80
85	NO	YES	SINGLE FMLY	A03	N	73,200	30,879.11	8,503.12	3	39,382.23	13,127.41
86	NO	YES	SINGLE FMLY	A03	N	86,200	49,106.26	14,238.53	3	63,344.79	21,114.93
87	NO	YES	ASSMD CONDO	A	N	N/A	50,883.98	26,249.80	4	77,133.78	19,283.45
88	NO	YES	SINGLE FMLY	A03	N	58,300	35,543.70	7,552.00	3	43,095.70	14,365.23
89	NO	SDF	SINGLE FMLY	X	N	96,458	90,600.47	48,477.32	5	139,077.79	27,815.56
90	NO	NO	SINGLE FMLY	C	N	63,000	27,017.94	21,788.69	2	48,806.63	24,403.32
91	NO	NO	SINGLE FMLY	C	N	96,000	70,814.20	35,797.80	6	106,612.00	17,768.67
92	NO	YES	SINGLE FMLY	AE	Y	241,741	11,268.45	6,400.61	4	17,669.06	4,417.27
93	NO	YES	SINGLE FMLY	AE	Y	218,168	33,300.45	3,160.81	2	36,461.26	18,230.63
94	NO	NO	SINGLE FMLY	A03	N	60,000	25,706.00	2,145.00	2	27,851.00	13,925.50
95	NO	YES	SINGLE FMLY	A	N	185,200	112,748.25	65,609.28	3	178,357.53	59,452.51
96	NO	YES	SINGLE FMLY	C	N	48,900	15,027.79	8,091.20	2	23,118.99	11,559.50
97	NO	NO	SINGLE FMLY	X	Y	180,870	81,720.56	39,256.95	3	120,977.51	40,325.84
98	NO	YES	SINGLE FMLY	X	Y	710,421	43,296.55	1,090.00	2	44,386.55	22,193.28
99	NO	YES	SINGLE FMLY	X	Y	200,130	109,479.97	47,751.43	3	157,231.40	52,410.47
100	NO	NO	NON RESIDNT	A	N	25,000	8,450.00	6,000.00	2	14,450.00	7,225.00
101	NO	YES	SINGLE FMLY	X	Y	269,153	180,295.94	46,105.00	4	226,400.94	56,600.24
102	NO	YES	SINGLE FMLY	X	Y	242,000	22,724.52	8,579.71	4	31,304.23	7,826.06
103	NO	NO	SINGLE FMLY	AE	Y	213,719	113,167.99	32,087.50	3	145,255.49	48,418.50
104	NO	YES	SINGLE FMLY	AE	Y	25,298	11,101.57	423.78	3	11,525.35	3,841.78
105	NO	NO	SINGLE FMLY	C	N	64,700	25,058.46	26,275.00	2	51,333.46	25,666.73
106	NO	SDF	SINGLE FMLY	C	N	89,335	77,197.09	28,922.75	4	106,119.84	26,529.96
107	NO	YES	SINGLE FMLY	AE	Y	281,950	99,059.37	48,806.16	3	147,865.53	49,288.51
108	NO	YES	SINGLE FMLY	AE	Y	300,192	11,493.72	3,395.76	2	14,889.48	7,444.74
109	NO	YES	SINGLE FMLY	AE	N	173,305	118,740.43	59,979.71	4	178,720.14	44,680.04
110	NO	NO	SINGLE FMLY	C	Y	63,820	56,709.89	19,346.00	5	76,055.89	15,211.18
111	NO	YES	SINGLE FMLY	X	Y	8,800,000	24,172.80	10,342.50	5	34,515.30	6,903.06
112	NO	YES	SINGLE FMLY	X	N	92,610	30,285.27	47,363.25	3	77,648.52	25,882.84
113	NO	YES	SINGLE FMLY	X	Y	117,204	44,632.35	24,743.29	3	69,375.64	23,125.21
114	NO	NO	SINGLE FMLY	B	N	130,000	61,355.64	20,000.00	2	81,355.64	40,677.82
115	NO	NO	SINGLE FMLY	X	Y	178,500	30,929.64	17,640.12	4	48,569.76	12,142.44
116	NO	YES	SINGLE FMLY	A08	N	67,200	35,073.08	5,578.33	3	40,651.41	13,550.47
117	NO	YES	SINGLE FMLY	A07	N	42,000	12,171.45	5,249.10	2	17,420.55	8,710.28
118	NO	YES	SINGLE FMLY	X	N	153,520	107,013.34	47,231.12	3	154,244.46	51,414.82
119	NO	YES	SINGLE FMLY	AE	N	121,091	66,869.99	34,796.75	4	101,666.74	25,416.69
120	NO	YES	SINGLE FMLY	X	Y	277,496	65,178.97	30,000.00	2	95,178.97	47,589.49
121	NO	NO	SINGLE FMLY	X	Y	167,273	12,182.83	3,382.58	2	15,565.41	7,782.71
122	NO	YES	SINGLE FMLY	X	N	109,330	36,013.05	42,263.94	2	78,276.99	39,138.50
123	NO	NO	SINGLE FMLY	C	N	35,000	21,758.16	7,241.30	2	28,999.46	14,499.73
124	NO	YES	SINGLE FMLY	A03	N	47,500	37,738.30	9,733.34	3	47,471.64	15,823.88
125	NO	NO	SINGLE FMLY	A03	N	58,500	8,054.34	1,099.00	2	9,153.34	4,576.67

	MITIGATED	INSURED	OCCUPANCY	ZONE	FIRM	BUILDING VALUE	TOTAL BUILDING PAYMENT	TOTAL CONTENTS PAYMENT	NO. OF LOSSES	TOTAL PAID	AVERAGE PAY
126	NO	YES	SINGLE FMLY	A03	N	88,100	5,824.32	0.00	2	5,824.32	2,912.16
127	NO	YES	SINGLE FMLY	C	N	20,000	16,028.50	5,592.00	2	21,620.50	10,810.25
128	NO	NO	SINGLE FMLY	C	N	155,000	22,757.84	15,614.25	3	38,372.09	12,790.70
129	NO	YES	SINGLE FMLY	X	Y	115,500	16,743.10	3,187.57	3	19,930.67	6,643.56
130	NO	YES	SINGLE FMLY	C	N	72,000	8,559.70	0.00	2	8,559.70	4,279.85
131	NO	NO	SINGLE FMLY	X	Y	90,000	22,317.19	7,275.42	2	29,592.61	14,796.31
132	NO	YES	SINGLE FMLY	A	N	83,300	20,301.69	16,320.00	2	36,621.69	18,310.85
133	NO	YES	SINGLE FMLY	B	N	168,500	92,608.44	36,000.00	3	128,608.44	42,869.48
134	NO	SDF	SINGLE FMLY	A	N	84,500	60,098.87	40,952.25	4	101,051.12	25,262.78
135	NO	NO	SINGLE FMLY	X	N	135,179	49,655.76	22,916.05	5	72,571.81	14,514.36
136	NO	NO	SINGLE FMLY	C	N	78,500	8,954.51	0.00	2	8,954.51	4,477.26
137	NO	NO	SINGLE FMLY	X	N	178,010	96,484.64	38,582.60	2	135,067.24	67,533.62
138	NO	YES	SINGLE FMLY	X	Y	170,154	35,359.67	0.00	2	35,359.67	17,679.84
139	NO	NO	SINGLE FMLY	X	N	78,334	7,239.12	4,608.00	3	11,847.12	3,949.04
140	NO	YES	SINGLE FMLY	X	Y	126,720	28,124.30	500.00	2	28,624.30	14,312.15
141	NO	NO	SINGLE FMLY	X	Y	130,642	88,054.52	12,549.86	3	100,604.38	33,534.79
142	NO	NO	SINGLE FMLY	X	Y	96,304	19,435.61	11,396.82	2	30,832.43	15,416.22
143	NO	YES	SINGLE FMLY	A03	Y	87,900	6,511.20	4,068.98	2	10,580.18	5,290.09
144	NO	YES	SINGLE FMLY	X	Y	657,000	329,733.41	62,810.25	2	392,543.66	196,271.83
145	NO	SDF	SINGLE FMLY	X	N	143,563	61,074.44	21,649.97	6	82,724.41	13,787.40
146	NO	YES	SINGLE FMLY	B	N	49,000	16,092.12	13,464.80	2	29,556.92	14,778.46
147	NO	SDF	SINGLE FMLY	B	N	106,791	84,621.35	77,620.86	6	162,242.21	27,040.37
148	NO	SDF	SINGLE FMLY	X	N	146,493	110,988.40	38,220.33	6	149,208.73	24,868.12
149	NO	YES	SINGLE FMLY	X	N	185,693	11,701.08	0.00	2	11,701.08	5,850.54
150	NO	SDF	SINGLE FMLY	B	Y	321,529	206,051.29	115,000.89	5	321,052.18	64,210.44
151	NO	YES	SINGLE FMLY	C	N	102,000	26,088.76	750.00	2	26,838.76	13,419.38
152	NO	YES	SINGLE FMLY	B	N	130,000	62,337.26	14,085.00	2	76,422.26	38,211.13
153	NO	YES	SINGLE FMLY	X	N	220,650	115,143.01	12,600.00	4	127,743.01	31,935.75
154	NO	NO	SINGLE FMLY	C	N	87,000	198,975.73	0.00	2	198,975.73	99,487.87
155	NO	YES	SINGLE FMLY	AE	Y	134,596	74,740.31	65,142.93	3	139,883.24	46,627.75
156	NO	YES	SINGLE FMLY	AE	Y	183,810	93,573.37	49,247.36	4	142,820.73	35,705.18
157	NO	NO	SINGLE FMLY	X	N	292,766	107,537.66	70,117.73	10	177,655.39	17,765.54
158	NO	NO	SINGLE FMLY	C	N	72,878	3,770.42	0.00	3	3,770.42	1,256.81
159	NO	YES	SINGLE FMLY	X	N	330,349	34,645.40	7,959.29	2	42,604.69	21,302.35
160	NO	YES	SINGLE FMLY	AE	Y	179,774	7,996.38	5,463.54	2	13,459.92	6,729.96
161	NO	SDF	SINGLE FMLY	C	N	225,131	182,435.12	145,968.27	5	328,403.39	65,680.68
162	NO	YES	SINGLE FMLY	X	Y	223,740	392,552.37	201,257.49	10	593,809.86	59,380.99
163	NO	YES	SINGLE FMLY	X	Y	306,545	448,165.40	147,131.99	9	595,297.39	66,144.15
164	NO	NO	SINGLE FMLY	A	N	208,010	121,992.72	54,902.54	3	176,895.26	58,965.09
165	NO	NO	SINGLE FMLY	X	Y	168,000	113,305.84	10,000.00	3	123,305.84	41,101.95
166	NO	NO	SINGLE FMLY	X	N	393,400	184,959.26	80,281.00	3	265,240.26	88,413.42
167	NO	NO	SINGLE FMLY	X	Y	80,000	58,988.84	17,554.00	3	76,542.84	25,514.28
168	NO	NO	OTHER RESID	X	Y	227,664	113,460.70	0.00	3	113,460.70	37,820.23
169	NO	NO	SINGLE FMLY	AE	N	77,000	47,405.58	11,694.00	5	59,099.58	11,819.92

	MITIGATED	INSURED	OCCUPANCY	ZONE	FIRM	BUILDING VALUE	TOTAL BUILDING PAYMENT	TOTAL CONTENTS PAYMENT	NO. OF LOSSES	TOTAL PAID	AVERAGE PAY
170	NO	YES	SINGLE FMLY	A03	N	68,700	36,231.01	5,715.31	3	41,946.32	13,982.11
171	NO	YES	SINGLE FMLY	A03	N	96,000	67,042.81	18,430.06	3	85,472.87	28,490.96
172	NO	NO	SINGLE FMLY	A03	N	75,300	24,090.71	5,238.00	4	29,328.71	7,332.18
173	NO	NO	SINGLE FMLY	A03	N	84,000	106,244.89	15,755.00	4	121,999.89	30,499.97
174	NO	NO	SINGLE FMLY	C	N	85,300	90,556.51	43,533.87	5	134,090.38	26,818.08
175	NO	NO	SINGLE FMLY	X	N	176,290	100,814.88	76,483.09	6	177,297.97	29,549.66
176	NO	YES	SINGLE FMLY	A03	N	49,000	27,224.09	8,296.62	2	35,520.71	17,760.36
177	NO	YES	SINGLE FMLY	B	N	65,600	23,399.25	11,190.00	2	34,589.25	17,294.63
178	NO	YES	SINGLE FMLY	A03	N	61,500	12,837.56	3,642.16	2	16,479.72	8,239.86
179	NO	NO	SINGLE FMLY	X	Y	179,496	42,989.41	4,749.91	2	47,739.32	23,869.66
180	NO	YES	SINGLE FMLY	X	N	285,367	9,482.78	0.00	2	9,482.78	4,741.39
181	NO	YES	SINGLE FMLY	X	N	120,715	93,637.50	52,470.00	4	146,107.50	36,526.88

CURRENT RESIDENCES WHO HAVE EXECUTED CONTRACTS FOR GALVESTON COUNTY
2013 HMA GRANT ASSISTANCE FOR ELEVATION OF RESIDENCES.
THIS PROGRAM IS A 90/10% COST SHARE AND PARTICIPATION IS VOLUNTARY

	MITIGATED	INSURED	OCCUPANCY	ZONE	FIRM	BUILDING VALUE	TOTAL BUILDING PAYMENT	TOTAL CONTENTS PAYMENT	NO. OF LOSSES	TOTAL PAID	AVERAGE PAY
1	NO	SDF	SINGLE FMLY	AE	Y	302,782	157,184.67	160,682.03	5	317,866.70	63,573.34
2	NO	SDF	SINGLE FMLY	X	Y	40,000	71,930.93	22,894.81	7	94,825.74	13,546.53
3	NO	YES	SINGLE FMLY	B	N	482,231	225,864.12	95,377.00	4	321,241.12	80,310.28
4	NO	SDF	SINGLE FMLY	X	N	176,800	179,525.47	88,254.87	8	267,780.34	33,472.54
5	NO	SDF	SINGLE FMLY	X	N	201,300	171,052.32	84,420.71	4	255,473.03	63,868.26
6	NO	YES	SINGLE FMLY	X	Y	96,195	89,847.77	53,033.01	3	142,880.78	47,626.93
7	NO	SDF	SINGLE FMLY	C	N	126,360	105,299.08	35,655.25	4	140,954.33	35,238.58
8	NO	SDF	SINGLE FMLY	A05	N	202,022	145,584.06	66,086.55	4	211,670.61	52,917.65
9	NO	SDF	SINGLE FMLY	AE	Y	96,820	124,509.18	22,130.12	4	146,639.30	36,659.83
10	NO	SDF	SINGLE FMLY	AE	N	148,650	173,510.50	25,131.37	4	198,641.87	49,660.47
11	NO	YES	SINGLE FMLY	X	Y	210,700	51,754.16	46,576.59	3	98,330.75	32,776.92
12	NO	NO	SINGLE FMLY	A01	N	69,860	29,797.13	10,000.00	4	39,797.13	9,949.28
13	NO	SDF	SINGLE FMLY	X	N	359,689	288,757.66	174,688.33	5	463,445.99	92,689.20
14	NO	SDF	SINGLE FMLY	X	Y	11,700	149,845.52	38,987.88	6	188,833.40	31,472.23

PROPERTIES DEMOLISHED THROUGH THE HMGP ACQUISITION PROGRAM UNDER FEMA-1014-DR-TX FOLLOWING TROPICAL STORM ALLISON, JUNE 5-10, 2001

	MITIGATED	INSURED	OCCUPANCY	ZONE	FIRM	BUILDING VALUE	TOTAL BUILDING PAYMENT	TOTAL CONTENTS PAYMENT	NO. OF LOSSES	TOTAL PAID	AVERAGE PAY
1	YES	NO	NON RESIDNT	B	N	0	0.00	7,023.78	2	7,023.78	3,511.89
2	YES	NO	SINGLE FMLY	A08	N	32,494	98,102.15	30,000.00	2	128,102.15	64,051.08
3	YES	NO	SINGLE FMLY	X	Y	108,660	48,713.46	58,461.49	3	107,174.95	35,724.98
4	YES	NO	SINGLE FMLY	C	N	144,627	96,022.59	55,066.87	4	151,089.46	37,772.37
5	YES	NO	SINGLE FMLY	X	N	161,837	115,173.99	46,302.71	4	161,476.70	40,369.18
6	YES	NO	SINGLE FMLY	X	Y	185,000	423,282.62	130,604.78	5	553,887.40	110,777.48
7	YES	NO	SINGLE FMLY	B	N	281,955	230,358.71	136,242.73	5	366,601.44	73,320.29
8	YES	NO	SINGLE FMLY	X	Y	284,862	185,267.22	134,363.37	6	319,630.59	53,271.77
9	YES	NO	SINGLE FMLY	B	N	246,788	364,939.70	185,946.90	5	550,886.60	110,177.32
10	YES	NO	SINGLE FMLY	AE	Y	272,540	488,373.90	186,759.56	5	675,133.46	135,026.69
11	YES	NO	SINGLE FMLY	X	Y	222,568	316,803.26	151,477.25	5	468,280.51	93,656.10
12	YES	NO	SINGLE FMLY	X	N	250,000	114,980.49	41,339.34	4	156,319.83	39,079.96
13	YES	NO	SINGLE FMLY	AE	N	148,949	260,513.79	484,492.96	9	745,006.75	82,778.53
14	YES	NO	SINGLE FMLY	A08	Y	175,000	94,158.72	43,728.00	5	137,886.72	27,577.34
15	YES	NO	SINGLE FMLY	AE	N	146,400	118,184.99	18,300.00	4	136,484.99	34,121.25
16	YES	NO	SINGLE FMLY	AE	N	126,132	102,035.77	46,739.00	4	148,774.77	37,193.69
17	YES	NO	SINGLE FMLY	AE	N	63,800	66,689.10	40,079.00	2	106,768.10	53,384.05
18	YES	NO	SINGLE FMLY	X	N	121,684	62,201.19	42,557.80	3	104,758.99	34,919.66
19	YES	NO	SINGLE FMLY	C	Y	98,816	26,725.52	23,047.31	3	49,772.83	16,590.94
20	YES	NO	SINGLE FMLY	A06	N	168,533	154,249.81	47,442.37	5	201,692.18	40,338.44
21	YES	NO	SINGLE FMLY	AE	N	106,361	126,055.58	86,510.61	6	212,566.19	35,427.70
22	YES	NO	SINGLE FMLY	X	Y	208,109	212,183.63	100,000.00	3	312,183.63	104,061.21
23	YES	NO	SINGLE FMLY	X	N	171,835	130,143.21	74,050.98	4	204,194.19	51,048.55
24	YES	NO	SINGLE FMLY	B	N	106,681	123,137.22	47,249.19	4	170,386.41	42,596.60
25	YES	NO	SINGLE FMLY	X	N	251,281	184,455.30	90,597.16	4	275,052.46	68,763.12
26	YES	NO	SINGLE FMLY	AE	N	262,956	184,298.20	59,842.60	4	244,140.80	61,035.20
27	YES	NO	SINGLE FMLY	C	N	225,000	35,000.00	13,000.00	2	48,000.00	24,000.00
28	YES	NO	SINGLE FMLY	AE	Y	60,800	198,191.69	65,419.85	4	263,611.54	65,902.89
29	YES	NO	SINGLE FMLY	AE	N	131,148	146,724.00	97,061.50	4	243,785.50	60,946.38
30	YES	NO	SINGLE FMLY	A06	N	252,850	112,067.15	74,015.00	3	186,082.15	62,027.38
31	YES	NO	SINGLE FMLY	B	N	235,000	499,889.63	180,000.00	4	679,889.63	169,972.41
32	YES	NO	SINGLE FMLY	X	N	159,540	128,464.27	55,749.10	4	184,213.37	46,053.34
33	YES	NO	SINGLE FMLY	X	N	183,293	133,122.38	53,415.47	3	186,537.85	62,179.28
34	YES	NO	SINGLE FMLY	A	N	202,984	170,058.72	67,971.73	5	238,030.45	47,606.09
35	YES	NO	SINGLE FMLY	AE	N	120,000	147,683.75	84,106.14	5	231,789.89	46,357.98
36	YES	NO	SINGLE FMLY	AE	Y	151,000	193,325.68	107,296.64	5	300,622.32	60,124.46
37	YES	NO	SINGLE FMLY	AE	N	200,156	303,691.14	172,709.60	7	476,400.74	68,057.25
38	YES	NO	SINGLE FMLY	AE	Y	211,227	192,887.09	57,944.61	5	250,831.70	50,166.34
39	YES	NO	SINGLE FMLY	AE	N	281,174	259,555.72	204,073.35	3	463,629.07	154,543.02

40	YES	NO	SINGLE FMLY	AE	N	157,040	188,328.53	137,074.98	5	325,403.51	65,080.70
41	YES	NO	SINGLE FMLY	B	Y	192,995	304,499.00	210,902.33	5	515,401.33	103,080.27
42	YES	NO	SINGLE FMLY	X	N	121,000	266,296.79	186,138.80	5	452,435.59	90,487.12
43	YES	NO	SINGLE FMLY	AE	N	241,290	339,163.00	225,177.12	5	564,340.12	112,868.02
44	YES	NO	SINGLE FMLY	AE	N	165,839	213,222.13	84,151.86	4	297,373.99	74,343.50
45	YES	NO	SINGLE FMLY	AE	N	204,537	236,890.77	222,929.30	4	459,820.07	114,955.02
46	YES	NO	SINGLE FMLY	AE	N	184,546	291,658.41	190,414.15	5	482,072.56	96,414.51
47	YES	NO	SINGLE FMLY	AE	Y	222,160	133,627.92	47,338.66	4	180,966.58	45,241.65
48	YES	NO	SINGLE FMLY	B	N	244,524	232,729.61	172,070.86	5	404,800.47	80,960.09
49	YES	NO	SINGLE FMLY	AE	N	103,650	64,312.78	22,305.69	4	86,618.47	21,654.62
50	YES	NO	SINGLE FMLY	AE	N	140,370	228,912.33	77,734.86	6	306,647.19	51,107.87
51	YES	NO	SINGLE FMLY	A	N	87,300	105,647.68	16,930.35	4	122,578.03	30,644.51
52	YES	NO	SINGLE FMLY	AE	N	220,843	353,532.30	210,029.75	6	563,562.05	93,927.01
53	YES	NO	SINGLE FMLY	A08	N	106,420	152,046.29	150,530.65	6	302,576.94	50,429.49
54	YES	NO	SINGLE FMLY	AE	N	336,203	358,740.80	93,217.84	5	451,958.64	90,391.73
55	YES	NO	SINGLE FMLY	AE	N	185,760	342,104.00	322,671.73	7	664,775.73	94,967.96
56	YES	NO	SINGLE FMLY	AE	N	199,473	275,104.66	160,356.26	6	435,460.92	72,576.82
57	YES	NO	SINGLE FMLY	AE	N	144,000	230,368.57	169,659.66	5	400,028.23	80,005.65
58	YES	NO	SINGLE FMLY	AE	N	145,740	180,478.42	109,681.96	5	290,160.38	58,032.08
59	YES	NO	SINGLE FMLY	AE	N	219,843	347,999.41	181,852.46	6	529,851.87	88,308.65
60	YES	NO	SINGLE FMLY	AE	N	178,567	175,070.94	75,436.37	6	250,507.31	41,751.22
61	YES	NO	SINGLE FMLY	X	N	97,400	166,788.90	113,708.09	5	280,496.99	56,099.40
62	YES	NO	SINGLE FMLY	AE	N	223,205	370,354.06	142,974.39	6	513,328.45	85,554.74
63	YES	NO	SINGLE FMLY	X	N	135,636	166,438.95	40,533.22	5	206,972.17	41,394.43
64	YES	NO	SINGLE FMLY	AE	N	151,025	191,282.40	133,584.61	5	324,867.01	64,973.40
65	YES	NO	SINGLE FMLY	X	Y	167,913	168,705.81	90,436.85	5	259,142.66	51,828.53
66	YES	NO	SINGLE FMLY	X	N	200,000	195,489.88	112,027.53	5	307,517.41	61,503.48
67	YES	NO	SINGLE FMLY	A	N	178,510	137,595.01	60,394.49	5	197,989.50	39,597.90
68	YES	NO	SINGLE FMLY	X	Y	115,500	71,927.32	33,034.87	3	104,962.19	34,987.40
69	YES	NO	SINGLE FMLY	X	Y	243,000	241,055.69	105,400.00	5	346,455.69	69,291.14
70	YES	NO	SINGLE FMLY	B	Y	165,804	228,910.85	133,130.45	5	362,041.30	72,408.26
71	YES	NO	SINGLE FMLY	AE	Y	138,147	126,087.06	30,000.00	4	156,087.06	39,021.77
72	YES	NO	SINGLE FMLY	X	N	180,844	233,787.62	91,258.96	4	325,046.58	81,261.65
73	YES	NO	SINGLE FMLY	X	Y	101,692	46,296.21	25,113.00	5	71,409.21	14,281.84
74	YES	NO	ASSMD CONDO	AE	N	N/A	90,757.95	24,690.41	3	115,448.36	38,482.79
75	YES	NO	SINGLE FMLY	AE	N	124,000	171,001.95	54,875.68	15	225,877.63	15,058.51
76	YES	NO	SINGLE FMLY	AE	N	138,686	268,486.32	105,535.69	13	374,022.01	28,770.92
77	YES	NO	SINGLE FMLY	AE	N	176,825	127,244.93	75,610.24	3	202,855.17	67,618.39
78	YES	NO	SINGLE FMLY	AE	N	195,032	274,471.15	230,134.12	5	504,605.27	100,921.05
79	YES	NO	SINGLE FMLY	AE	N	239,360	143,816.81	131,668.31	3	275,485.12	91,828.37
80	YES	NO	SINGLE FMLY	B	N	205,848	210,142.38	100,532.07	5	310,674.45	62,134.89
81	YES	NO	SINGLE FMLY	X	N	143,175	162,781.75	67,738.67	5	230,520.42	46,104.08
82	YES	NO	SINGLE FMLY	A08	N	921,000	44,088.00	0.00	2	44,088.00	22,044.00
83	YES	NO	SINGLE FMLY	A08	N	172,020	165,809.53	112,188.16	5	277,997.69	55,599.54
84	YES	NO	SINGLE FMLY	AO	N	89,976	128,165.83	116,913.33	3	245,079.16	81,693.05
85	YES	NO	SINGLE FMLY	X	N	153,240	57,674.30	13,212.18	5	70,886.48	14,177.30

	MITIGATED	INSURED	OCCUPANCY	ZONE	FIRM	BUILDING VALUE	TOTAL BUILDING PAYMENT	TOTAL CONTENTS PAYMENT	NO. OF LOSSES	TOTAL PAID	AVERAGE PAY
86	YES	NO	SINGLE FMLY	X	Y	128,750	127,167.76	45,468.21	4	172,635.97	43,158.99
87	YES	NO	SINGLE FMLY	C	N	128,850	106,639.60	77,464.24	9	184,103.84	20,455.98
88	YES	NO	SINGLE FMLY	A	N	207,840	145,834.28	58,555.09	8	204,389.37	25,548.67
89	YES	NO	SINGLE FMLY	X	N	137,816	90,450.22	48,000.00	3	138,450.22	46,150.07
90	YES	NO	SINGLE FMLY	A	N	121,200	47,742.86	33,739.69	3	81,482.55	27,160.85
91	YES	NO	SINGLE FMLY	AE	N	121,920	105,256.60	41,483.00	5	146,739.60	29,347.92
92	YES	NO	SINGLE FMLY	A	N	190,638	262,994.32	209,156.63	7	472,150.95	67,450.14
93	YES	NO	SINGLE FMLY	X	Y	140,660	123,354.31	66,214.30	4	189,568.61	47,392.15
94	YES	NO	SINGLE FMLY	AE	N	115,628	163,867.79	123,652.87	8	287,520.66	35,940.08
95	YES	NO	SINGLE FMLY	AE	N	125,640	123,471.97	57,272.12	4	180,744.09	45,186.02
96	YES	NO	SINGLE FMLY	A15	N	60,113	46,910.19	31,578.77	4	78,488.96	19,622.24
97	YES	NO	SINGLE FMLY	A06	N	98,607	120,323.87	60,867.00	10	181,190.87	18,119.09
98	YES	NO	SINGLE FMLY	AE	N	59,464	79,766.56	53,094.31	4	132,860.87	33,215.22
99	YES	NO	SINGLE FMLY	AE	Y	177,563	148,603.46	67,479.70	4	216,083.16	54,020.79
100	YES	NO	SINGLE FMLY	X	Y	148,010	188,548.14	107,089.33	4	295,637.47	73,909.37
101	YES	NO	SINGLE FMLY	AE	N	127,100	139,107.58	86,422.19	4	225,529.77	56,382.44
102	YES	NO	SINGLE FMLY	A	N	104,400	116,294.07	93,066.09	3	209,360.16	69,786.72
103	YES	NO	SINGLE FMLY	AE	Y	145,439	141,839.25	41,237.94	5	183,077.19	36,615.44
104	YES	YES	SINGLE FMLY	AE	N	109,940	156,955.94	95,018.33	5	251,974.27	50,394.85
105	YES	YES	SINGLE FMLY	X	N	165,000	222,492.05	64,166.73	6	286,658.78	47,776.46
106	YES	YES	SINGLE FMLY	A	N	133,511	91,910.01	98,590.54	5	190,500.55	38,100.11
107	YES	YES	SINGLE FMLY	X	Y	197,150	27,599.80	3,116.70	2	30,716.50	15,358.25
108	YES	NO	SINGLE FMLY	B	N	171,202	235,335.14	133,660.89	5	368,996.03	73,799.21
109	YES	NO	SINGLE FMLY	A	N	130,000	167,089.23	53,445.60	4	220,534.83	55,133.71
110	YES	YES	SINGLE FMLY	A	N	38,800	23,544.38	5,348.01	2	28,892.39	14,446.20
111	YES	NO	2-4 FAMILY	AE	Y	260,301	206,313.23	91,678.92	4	297,992.15	74,498.04
112	YES	YES	SINGLE FMLY	AE	Y	674,500	93,582.35	84,371.31	5	177,953.66	35,590.73

FOOTNOTES

SDF Special Direct Facility - NFIP Insurance is obtained directly from FEMA/NFIP program and not through local insurance broker.

Current RL/SRL property inventory	307
Mitigated properties/2001	112
Mitigated properties/2013-2014	14
RL/SRL Inventory balance	181

HURRICANES

The following major tropical storm and hurricane events have produced severe flooding and structural damage along the Texas Gulf Coast:

- September 16-20, 1854
- June 1-5, 1871
- June 8-10, 1871
- September 8-18, 1875
- August 19-24, 1879
- June 21-25, 1880
- June 13-15, 1886
- June 16-18, 1888
- July 4-6, 1888
- July 3-8, 1891
- October 2-7, 1895
- September 10-13, 1897
- September 20-28, 1898
- September 7-10, 1900
- July 21, 1909
- August 16-17, 1915
- September 14, 1919
- August 12-15, 1932
- July 21-27, 1933
- August 26-September 1, 1934
- October 11-17, 1938
- September 19-25, 1940
- September 11-16, 1941
- September 16-25, 1941
- August 30, 1942
- July 25-29, 1943
- August 24-29, 1945
- August 18-27, 1947
- September 27–October 6, 1949
- July 27, 1957 – Hurricane Audrey
- July 24-25, 1959 – Hurricane Debra
- September 11, 1961 – Hurricane Carla
- September 16-20, 1963 – Hurricane Cindy
- August 5-8, 1964 – Tropical Storm Abby
- August 2-5, 1970 Hurricane Celia
- September 12-17, 1970 – Tropical Storm Felice
- September 1-7, 1973 – Tropical Storm Delia
- July 25, 1979 – Tropical Storm Claudette
- August 30 – September 2, 1979 – Tropical Storm Elena
- August 3-10, 1980 – Hurricane Allen
- September 1-7, 1980 – Tropical Storm Danielle
- August 15-18, 1983 – Hurricane Alicia
- June 23-28, 1986 – Hurricane Bonnie
- June 24- July 1, 1989 - Tropical Storm Allison
- July 30 – August 3, 1989 – Hurricane Chantal
- October 12-16, 1989 – Hurricane Jerry
- October 15-20, 1994 - Southeast Texas Flood
- July 28 – August 2, 1995 – Tropical Storm Dean
- September 1998 – Tropical Storm Frances
- June 5-10, 2001 – Tropical Storm Allison
- September 5-7, 2002 – Tropical Storm Fay
- July 14-16, 2003 – Hurricane Claudette
- August30-September2, 2003 – Tropical Storm Grace
- September 24, 2005 – Hurricane Rita
- September 12-13, 2007 – Hurricane Humberto
- July 3, 2008 – Hurricane Dolly
- August 5, 2008 – Tropical Storm Edouard

(Portions of the list were provided to the City of Friendswood as a courtesy from Hurricane Consulting)

TORNADO

National Weather Service records document Galveston County has experienced forty-four (44) tornadoes of F1 magnitude or greater from 1950 to 2002. Of the recorded storms in Galveston County, nine (9) deaths were reported and two hundred thirty-seven (237) injuries were reported. Damages from these storm events totaled $32.1 million. However, from 2003-2007, Galveston County only had two (2) recorded tornadoes (both in the City of Friendswood). There were no recorded deaths or injuries and damage estimates were reported at $475,000.

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

National Climatic Data Center
U.S. Department of Commerce

DOC >NOAA >NESDIS >NCDC Search Field: Search NCDC

Event Record Details

Event: **Tornado**
Begin Date: **17 Nov 2003, 08:55:00 PM CST**
Begin Location: **Friendswood**
Begin LAT/LON: **29°32'N / 95°25'W**
End Date: **17 Nov 2003, 09:00:00 PM CST**
End Location: **Friendswood**
End LAT/LON: **29°32'N / 95°25'W**
Length: **1 Mile**
Width: **20 Yards**
Magnitude: **F0**
Fatalities: **0**
Injuries: **0**
Property Damage: **$ 5.0K**
Crop Damage: **$ 0.0**

State: **Texas**
Map of Counties
County: **Galveston**

Description:
Tornado touch down at FM 528 and FM 518. Tornado crossed Clear Creek and moved 1/4 mile into Harris County. A total of 24 tornadoes touched down during this 15 hour period of severe weather in southeastern Texas on November 17, 2003. In addition to these tornadoes, a major flood developed over Harris and surrounding counties during the middle of this tornadic outbreak. Over 300 homes, along with hundreds of vehicles, were flooded. These tornadic storms developed over parts of Wharton and Matagorda counties shortly after sunrise with the first confirmed tornado occurring just east of El Campo around 9:00 am. Strong 500mb upper level troughing over the western U.S. moved from west to east across the Southern Plains. The polar jet stream associated with this 500 millibar trough surged into west Texas and then curved sharply northeastward into the Central Plains. The sub-tropical jet stream was oriented west to east across deep southern Texas. This jet stream pattern was the impetus to strong lower level convergence due to the enhanced upper level divergence. Low level moisture had substantially increased and was about 200 percent of normal by 6 AM. Vertical wind profiles also showed a great deal of low level wind shear with the greatest shear occurring in the lowest 2000 feet. In addition, these veering wind speeds rapidly increased with height. A focus for the thunderstorm development was provided by a weak low level boundary which was aligned southwest to northeast, or generally along the U.S. Highway 59 corridor. This feature was nearly-stationary and thunderstorms repeatedly developed and moved along this boundary. The axis of heaviest rain was coincident with this boundary.

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

National Climatic Data Center
U.S. Department of Commerce

DOC >NOAA >NESDIS >NCDC Search Field: Search NCDC

Event Record Details

Event: **Tornado**
Begin Date: **17 Nov 2003, 09:08:00 PM CST**
Begin Location: **Friendswood**
Begin LAT/LON: **29°32'N / 95°25'W**
End Date: **17 Nov 2003, 09:15:00 PM CST**
End Location: **Friendswood**
End LAT/LON: **29°32'N / 95°25'W**
Length: **0 Mile**
Width: **25 Yards**
Magnitude: **F1**
Fatalities: **0**
Injuries: **0**
Property Damage: **$ 200.0K**
Crop Damage: **$ 0.0**

State: **Texas**
Map of Counties
County: **Galveston**

Description:
Tornado struck a Friendswood church on FM 2351. Church's sanctuary received damage, church's bell tower completely torn off. A total of 24 tornadoes touched down during this 15 hour period of severe weather in southeastern Texas on November 17, 2003. In addition to these tornadoes, a major flood developed over Harris and surrounding counties during the middle of this tornadic outbreak. Over 300 homes, along with hundreds of vehicles, were flooded. These tornadic storms developed over parts of Wharton and Matagorda counties shortly after sunrise with the first confirmed tornado occurring just east of El Campo around 9:00 am. Strong 500mb upper level troughing over the western U.S. moved from west to east across the Southern Plains. The polar jet stream associated with this 500 millibar trough surged into west Texas and then curved sharply northeastward into the Central Plains. The sub-tropical jet stream was oriented west to east across deep southern Texas. This jet stream pattern was the impetus to strong lower level convergence due to the enhanced upper level divergence. Low level moisture had substantially increased and was about 200 percent of normal by 6 AM. Vertical wind profiles also showed a great deal of low level wind shear with the greatest shear occurring in the lowest 2000 feet. In addition, these veering wind speeds rapidly increased with height. A focus for the thunderstorm development was provided by a weak low level boundary which was aligned southwest to northeast, or generally along the U.S. Highway 59 corridor. This feature was nearly-stationary and thunderstorms repeatedly developed and moved along this boundary. The axis of heaviest rain was coincident with this boundary.

NOAA Satellite and Information Service
National Environmental Satellite, Data, and Information Service (NESDIS)

National Climatic Data Center
U.S. Department of Commerce

DOC >NOAA >NESDIS >NCDC Search Field: Search NCDC

Event Record Details

Event: **Tornado**
Begin Date: **17 Nov 2003, 09:15:00 PM CST**
Begin Location: **Friendswood**
Begin LAT/LON: **29°32'N / 95°25'W**
End Date: **17 Nov 2003, 09:18:00 PM CST**
End Location: **Friendswood**
End LAT/LON: **29°32'N / 95°25'W**
Length: **0 Mile**
Width: **50 Yards**
Magnitude: **F1**
Fatalities: **0**
Injuries: **0**
Property Damage: **$ 275.0K**
Crop Damage: **$ 0.0**

State: **Texas**
Map of Counties
County: **Galveston**

Description:
Tornado hit a Friendswood home subdivision. Numerous homes received roof damage, garage door damage, and tree damage. A total of 24 tornadoes touched down during this 15 hour period of severe weather in southeastern Texas on November 17, 2003. In addition to these tornadoes, a major flood developed over Harris and surrounding counties during the middle of this tornadic outbreak. Over 300 homes, along with hundreds of vehicles, were flooded. These tornadic storms developed over parts of Wharton and Matagorda counties shortly after sunrise with the first confirmed tornado occurring just east of El Campo around 9:00 am. Strong 500mb upper level troughing over the western U.S. moved from west to east across the Southern Plains. The polar jet stream associated with this 500 millibar trough surged into west Texas and then curved sharply northeastward into the Central Plains. The sub-tropical jet stream was oriented west to east across deep southern Texas. This jet stream pattern was the impetus to strong lower level convergence due to the enhanced upper level divergence. Low level moisture had substantially increased and was about 200 percent of normal by 6 AM. Vertical wind profiles also showed a great deal of low level wind shear with the greatest shear occurring in the lowest 2000 feet. In addition, these veering wind speeds rapidly increased with height. A focus for the thunderstorm development was provided by a weak low level boundary which was aligned southwest to northeast, or generally along the U.S. Highway 59 corridor. This feature was nearly-stationary and thunderstorms repeatedly developed and moved along this boundary. The axis of heaviest rain was coincident with this boundary.

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National Climatic Data Center
U.S. Department of Commerce

DOC >NOAA >NESDIS >NCDC Search Field: Search NCDC

Event Record Details

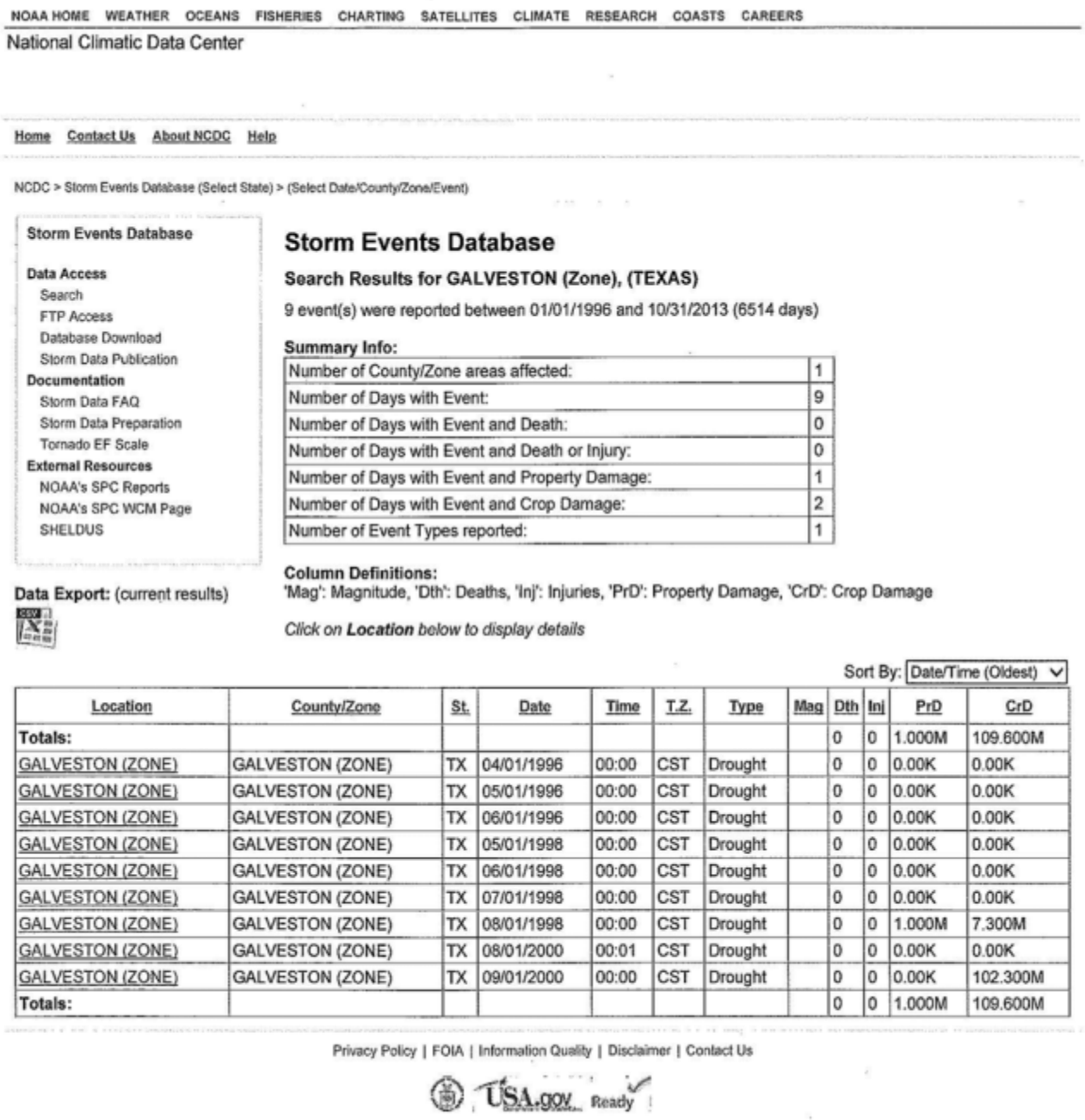
Event: **Tornado**
Begin Date: **04 Oct 2004, 04:00:00 PM CST**
Begin Location: **Friendswood**
Begin LAT/LON: **29°32'N / 95°25'W**
End Date: **04 Oct 2004, 04:00:00 PM CST**
End Location: **Friendswood**
End LAT/LON: **29°32'N / 95°25'W**
Length: **0 Mile**
Width: **25 Yards**
Magnitude: **F0**
Fatalities: **0**
Injuries: **0**
Property Damage: **$ 40.0K**
Crop Damage: **$ 0.0**

State: **Texas**
Map of Counties
County: **Galveston**

Description:
18 wheeler overturned at intersection of FM 518 and FM 2351. Trees snapped and numerous fences damaged with widespread power outages in and around city. 16 foot boat flipped over in residential yard.

DROUGHT

The National Climatic Data Center indicates three incidents of recorded drought in Galveston and Harris County for the periods of 1996 (91 days), 1998 (124 days), and 2000 (61 days). Peak years for drought throughout the state were 1996, 2000, and 2002. The worst year where drought affected the entire state was 2000.



NOAA HOME WEATHER OCEANS FISHERIES CHARTING SATELLITES CLIMATE RESEARCH COASTS CAREERS

National Climatic Data Center

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NCDC > Storm Events Database (Select State) > (Select Date/County/Zone/Event)

Storm Events Database

Data Access
- Search
- FTP Access
- Database Download
- Storm Data Publication

Documentation
- Storm Data FAQ
- Storm Data Preparation
- Tornado EF Scale

External Resources
- NOAA's SPC Reports
- NOAA's SPC WCM Page
- SHELDUS

Data Export: (current results)

Storm Events Database

Search Results for GALVESTON (Zone), (TEXAS)

9 event(s) were reported between 01/01/1996 and 10/31/2013 (6514 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	9
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	1
Number of Days with Event and Crop Damage:	2
Number of Event Types reported:	1

Column Definitions:
'Mag': Magnitude, 'Dth': Deaths, 'Inj': Injuries, 'PrD': Property Damage, 'CrD': Crop Damage

*Click on **Location** below to display details*

Sort By: Date/Time (Oldest)

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	1.000M	109.600M
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	04/01/1996	00:00	CST	Drought		0	0	0.00K	0.00K
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	05/01/1996	00:00	CST	Drought		0	0	0.00K	0.00K
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	06/01/1996	00:00	CST	Drought		0	0	0.00K	0.00K
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	05/01/1998	00:00	CST	Drought		0	0	0.00K	0.00K
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	06/01/1998	00:00	CST	Drought		0	0	0.00K	0.00K
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	07/01/1998	00:00	CST	Drought		0	0	0.00K	0.00K
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	08/01/1998	00:00	CST	Drought		0	0	1.000M	7.300M
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	08/01/2000	00:01	CST	Drought		0	0	0.00K	0.00K
GALVESTON (ZONE)	GALVESTON (ZONE)	TX	09/01/2000	00:00	CST	Drought		0	0	0.00K	102.300M
Totals:								0	0	1.000M	109.600M

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WINTER STORMS

COLD WAVE

The type of winter storms most coastal Texas residents are familiar with are cold waves with the passage of a winter cold front causing a dramatic drop in temperature, commonly referred to as a "blue north'er".

- 1983: A winter storm occurred in 1983. This storm struck during the holidays when many people were away from their homes. Excessive water damage was associated with broken plumbing and water mains as a result of this event.
- 2014: A winter freeze event occurred January 5 and 6, with temperatures dropping below freezing for several hours. A second winter freeze event occurred January 23-25, with snow near the Huntsville area, and freezing rain and temperatures stretching to Galveston. Roads iced over, a few school districts cancelled school, and the majority in Galveston County delayed opening for two hours.

SNOW

As stated in the State of Texas Mitigation Plan, snowfall of any amount is rare south of a line from Del Rio to Port Arthur.

- 2004: A rare and record breaking snowfall occurred Christmas Eve into early Christmas morning. Snowfall amount averaged about three (3") inches in the City of Friendswood. There were no injuries or property damage reported.

HAZARDOUS MATERIALS

Within the past twenty-five (25) years, several hazardous materials incidents have occurred within the city. The following is a list of the hazardous materials events that have been recorded:

TABLE 23
HAZARDOUS MATERIALS EVENTS

YEAR	TYPE OF INCIDENT
1977	Well blowout
1978	Large gasoline spill at a filling station
1980	8" Natural gas line seared
1981	Radioactive container found within the city
1983	Well blowout
1984	Brio Refining Site
1987	Well blowout
1988	Damaged pipeline/pipeline explosion
2002	Fire resulting in hazardous materials release
2007	Crude oil spill (3,612 gallons) in Cowards Creek from storage tank off of FM 2351

APPENDIX E
PIPELINE MAP WITH EVACUATION ZONES

INFORMATION REMOVED

As part of the Texas Homeland Security Act, Sections 418.176 through 418.182 were added to Chapter 418 of the Government Code.

§ 418.180. CONFIDENTIALITY OF CERTAIN INFORMATION PREPARED FOR UNITED STATES.

Information, other than financial information, in the possession of a governmental entity is confidential if the information:
(1) is part of a report to an agency of the United States;
(2) relates to an act of terrorism or related criminal activity; and
(3) is specifically required to be kept confidential:
  (A) under Section 552.101 because of a federal statute or regulation;
  (B) to participate in a state-federal information sharing agreement; or
  (C) to obtain federal funding.
Added by Acts 2003, 78th Leg., ch. 1312, § 3, eff. June 21, 2003.