

JEFFERSON COUNTY DRAINAGE DISTRICT NO. 7
2018 HAZARD MITIGATION PLAN UPDATE

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EXECUTIVE SUMMARY

Jefferson County Drainage District No. Seven (DD7) undertook development of this Mitigation Plan to protect public health, safety and welfare. The purpose of this Plan is to reduce or avoid the impacts of hazards by identifying and analyzing hazards and outlining mitigation actions that will help the District reach this goal. This Mitigation Plan is a single jurisdiction Plan. This Mitigation Plan also enables DD7 to apply for disaster mitigation funding sources that are otherwise unavailable without an approved Mitigation Plan.

DD7 staff has shown their commitment to hazard mitigation by writing a Hazard Mitigation Plan in 2005 and updating that plan in 2013. The 2013 Plan was approved by FEMA on August 27, 2013. DD7 staff further demonstrated their commitment to hazard mitigation by applying for and administering FEMA grants to complete numerous projects as well as self-funding projects that help protect public health, safety and welfare.

For this Mitigation Plan update, DD7 hired a private firm to guide the planning process and Plan development. DD7 organized a Mitigation Planning Committee (MPC) consisting of members from DD7.

The majority of this Plan is focused on the flood hazard because DD7's mission and jurisdictional authority are explicitly limited to activities related to controlling floods (although DD7 does have the authority to complete actions to protect and mitigate damage to its own facilities, assets and protect personnel).

The Plan has been prepared in compliance with Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended; The National Flood Insurance Act of 1968 (NFIA), as amended; and Title 44 Code of Federal Regulations Section 201.6 (44 CFR 201.6).

SECTION 1 – THE PLANNING PROCESS

INTRODUCTION

Jefferson County Drainage District No. Seven (DD7) undertook development of the original Hazard Mitigation Plan because of increasing awareness that natural, especially flood hazards, may affect people and property in the area. The Hazard Mitigation Plan was written to identify District vulnerabilities to hazards and outline mitigation actions that help to reduce or avoid the impacts of hazards. To help reach those goals, mitigation funds are made available to jurisdictions with updated Hazard Mitigation Plans.

In accordance with 44 Code of Federal Regulations (CFR) 201.6(d)(3), local mitigation plans must be “reviewed, revised if appropriate, and resubmitted for approval within five years in order to continue to be eligible for... grant project funding.”

In this update, the Mitigation Planning Committee looked at what has changed in the District since the last version of the plan was approved and what new actions need to be taken based on those changes.

AUTHORITY

Jefferson County Drainage District No. Seven (DD7) is one of three Drainage Districts within Jefferson County, Texas. It is a conservation and reclamation district and a political subdivision of the State of Texas that was established in February 1946. It was created primarily to provide drainage of overflow lands within the southern part of Jefferson County. DD7 is governed by a five-member Board of Directors, elected at large to represent specific regions within the District.

Authority for the preparation of the Hazard Mitigation Plan is derived from Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended; The National Flood Insurance Act of 1968 (NFIA), as amended; and Title 44 Code of Federal Regulations Section 201.6 (44 CFR 201.6). These laws and regulations require state and local governments to develop and formally adopt Hazard Mitigation Plans in order to be eligible for certain disaster mitigation grant funding sources.

The District covers an area of 107.42 square miles and encompasses the cities of Port Arthur, Groves, Nederland and Port Neches and unincorporated areas of Jefferson County. Two thirds of the District is below five (5) feet above mean sea level. Sixty (60) to Seventy (70) percent of the District drains to Taylor's Bayou. Rainfall for this area averages 53 inches per year.

In 1962, as a joint venture between DD7 and the U.S. Army Corps of Engineers, a Hurricane Flood Protection System was incorporated into the District at a cost of \$84 million; the District paid 30% of the cost, U.S. Government 70%.

At present 281 miles of concrete and earthen outfall ditches, 36 miles of levee and seawalls, and 20 Pump Stations serve the District with a combined pumping capacity of 8.2 million gallons per minute.

Emergency response is the responsibility of the incorporated Cities and Jefferson County. The Cities own and maintain the roadside ditches, however, the ditches that are owned by DD7 routinely maintenance. After an event, it is standard procedure that DD7 identifies ditches that need cleaning (as well as crossings). There are known problem areas that are regularly checked during and after an event.

Both the Cities and the County have early warning capability. Citizens in the area rely mostly on local weather, which is reported to be very capable. DD7 has 13 rain gauges at some of the pump stations intake bays.

Further discussion on existing policies and programs are addressed in the section Review and Incorporation of Existing Plans, Studies, Reports and Technical Information.

THE PLANNING PROCESS

The process used to develop this Plan was guided by a Mitigation Planning Committee (MPC), which carried out most of the planning duties. The MPC determined that in addition to the small committee that would steer the planning process, a larger group of interested individuals called Stakeholders would be included in the planning process to review drafts and provide comments at critical points in the plan development. At the first Plan update meeting held on June 7, 2017, the MPC finalized who would comprise the MPC (below). The MPC Meeting Minutes can be found in Appendix 1 of this Plan. The MPC was responsible for data collection and update, review and update each section of the plan, provide status of the mitigation actions from the previous plan and provide any new actions for review by the Stakeholders and the public. The Stakeholders group was larger and comprised of individuals and organizations from both inside and outside Jefferson County DD7. The MPC was comprised of the following individuals:

Table 1 – Mitigation Planning Committee

Team Member	Job Title	Organization	MPC Member Responsibility
Phil Kelley	General Manager	Jefferson County DD7	Data collection, data review, lead on actions, review each section and participate in the approval of information incorporated
Ronnie Holler	Supervision Department and Emergency Management Coordinator	Jefferson County DD7	Data collection, data review, support on actions, review each section and participate in the approval of information incorporated

Diane Smith	Administrative Assistant	Jefferson County DD7	Data collection, data review, support on actions, review each section and participate in the approval of information incorporated
Allen Sims	Engineering Consultant	LJA	Data collection, data review, support on actions, review each section and participate in the approval of information incorporated
Jeff Ward	Mitigation Planning Consultant	JSWA	Review each section, determine information needs, draft plan, distribute and receive changes for final plan.
Kristen Thatcher	Mitigation Planning Consultant	JSWA	Review each section, determine information needs, draft plan, distribute and receive changes for final plan.
Dan Ward	Mitigation Planning Consultant	JSWA	Review each section, determine information needs, draft plan, distribute and receive changes for final plan.

As drafts of the Updated Plan were prepared, the MPC used email to distribute them to Stakeholders, and requested that they provide comments. Stakeholders were also invited to public meetings and were requested to provide feedback through email or by telephoning Jefferson County DD7 or a member of the consultant team. When the final draft was completed by the MPC, the Stakeholders were notified by mail and provided a website to download and review the plan for any updates or comments. The consultant was responsible for archiving the comments and including them in edited versions of the Plan update. The Stakeholders Group was comprised of the following individuals and entities:

Table 2 – Stakeholders Group Members

Group Member	Title	Organization	Invited By
Mr. Matthew Kaufman	Assistant General Manager	Sabine Neches Navigation District	Letter
Mr. Richard LeBlanc	General Manager	Jefferson County DD6	Letter
Mr. Don Rao	Superintendent – Engineering	Jefferson County	Letter
Ms. Kathy Hopkins	Flood Mitigation - Planning	Texas Water Development Board	Letter
Honorable Jeff Branick	County Judge	Jefferson County	Letter
Dr. Betty J. Reynard	President	Lamar State College Port Arthur	Letter
Dr. Robin Perez	Superintendent	Nederland ISD	Letter

Dr. Mark Porterie	Superintendent	Port Arthur ISD	Letter
Dr. Rodney Cavness	Superintendent	Port Neches Groves ISD	Letter
Mr. Mike White	Jefferson County EMC	Jefferson County	Letter
Mr. Gary Collins	Fire Chief/EMC	Nederland	Letter
Mr. Dale Jackson	Fire Chief/EMC	Groves	Letter
Mr. Paul Nelson	Fire Chief/EMC	Port Neches	Letter
Mr. Louie Havens	Deputy Fire Chief/EMC	Port Arthur	Letter
Mr. Michael Fratus	Deputy Police Chief/Deputy EMC	Port Arthur	Letter
Ms. Diana LaBorde	President/CEO	Nederland Chamber of Commerce	Letter
Ms. Debbie Plaia	Executive Director	Port Neches Chamber of Commerce	Letter
Mr. Ronnie Boneau	Executive Manager	Groves Chamber of Commerce	Letter
Mr. Bill McCoy	President	Port Arthur Chamber of Commerce	Letter
Mr. Ryan Miller	Administrator	Christus St. Mary Hospital	Letter
Mr. Richard Gonzalez	CEO	Medical Center of Southeast Texas	Letter
Mr. Gregory Lucchesi	Plant Manager	Motiva Refinery	Letter
Mr. Greg Gentry	Plant Manager	Valero Refinery	Letter
Mr. Bryan Canfield	Plant Manager	TOTAL Refinery	Letter
Mr. Greg Masica	Plant Manager	BASF Chemical Plant	Letter
Mr. Mike Nemeth	Plant Manager	Chevron-Phillips Chemical Plant	Letter
Mr. Chad Anderson	Plant Manager	Huntsman Chemical	Letter
Mr. Richard Creamer	Plant Manager	Flint Hills Chemical	Letter

PUBLIC INVOLVEMENT

Consistent with DD7's standard objective to inform and involve citizens, and to fulfill the public involvement requirements of the mitigation planning programs, during the plan development process, DD7 notified and invited residents to review the document and attend a public meeting and also posted a survey on the District website in an effort to get more public involvement. The public survey was announced at the public District board meetings and a public notice was published informing the public about the Hazard Mitigation Planning process and urged the public to be involved in this process.

The public survey was posted on July 19, 2017 and the public was encouraged to participate. In accordance with legal requirements, DD7 published public notices about the survey in the Port Arthur News prior to posting it online (See Appendix 2, Public Notice Documents). The notice explained the purpose of the survey and provided the links for the public to participate.

The District developed a Public Survey in an attempt to get public input, assess household preparedness for natural hazards and determine the public's perceived impact from those hazards. There were 21 responses to the survey, which is attached in Appendix 6. The public had an opportunity to review the final draft Plan when the document was posted on the Jefferson County DD7 website at <http://www.dd7.org/special-notice.asp> and placed at DD7's office on Ninth Ave. Prior to placing the document online, DD7 announced the availability of the final draft plan for review and provided a way for the public to provide comments. The public notice in the Port Arthur Newspaper and the letters to all stakeholders explaining that the District's Hazard Mitigation Plan update was in the final draft stages and available for review are attached in Appendix 2. The stakeholder and public comments were incorporated and the plan was presented at the public meeting on XXXXXXX, XX, 2018 for final review and comment before submission. (Summarize Meeting Results).

REVIEW AND INCORPORATION OF EXISTING PLANS, STUDIES, REPORTS AND TECHNICAL INFORMATION

A wide variety of existing plans, studies, reports and technical information were reviewed and incorporated into this Hazard Mitigation Plan including: the 2002 Comprehensive Study and Drainage Plan of the Jefferson County Drainage District No. 7 System and Service Area; the 2006 Jefferson County DD6 Drainage and Flood Damage Reduction Plan (Master Drainage Plan); the Drainage Regulations; Port Arthur Hurricane Flood Protection Levee FEMA Accreditation Report (2014), the 2017 Jefferson County Drainage District No. 6 Hazard Mitigation Plan, 2007 Drainage Criteria Manual for Drainage District No. 6 (Public Review Draft;), the Jefferson County Hazard Mitigation Plan and Update (2005, 2011 and 2017) and Texas State Mitigation Plan Update (2007, 2010 and 2013). In addition, any changes or updates to the, Flood Insurance Rate Maps (FIRM), and Flood Insurance Study are reflected in the HMP as part of the Plan. The specific Plans, Studies and Reports are listed below along with a discussion on how they were incorporated into the Plan.

- **2002 Comprehensive Study and Drainage Plan of the Jefferson County Drainage District No. 7 System and Service Area.** In 2002, DD7 commissioned the development of a comprehensive drainage plan for the DD7 service area. The major objectives of the study was to develop a Geographic Information System (GIS); develop a hydrologic model of watersheds for existing conditions which would simulate the flows resulting from the occurrence of a 10 and 25 year recurrence interval rainfall event; and develop a hydraulic model of each water course investigated to simulate the resulting water surface profiles utilizing the flows developed from the hydrologic analysis.
- **2006 Jefferson County DD6 Drainage and Flood Damage Reduction Plan (Master Drainage Plan).** In 2006 Jefferson County DD6 prepared the Flood Damage Reduction Plan to examine how development is reviewed and to satisfy the requirements of HB 919 so that DD6 could develop, adopt, implement, and enforce regulations relating to its

review and approval of development proposals. The Plan was reviewed by the MPC to determine if any information could be used in the HMP.

- **Port Arthur Hurricane Flood Protection Levee Fema Accreditation Report.** In 2014, DD7 received accreditation by FEMA for the Port Arthur Hurricane Flood Protection Levee. DD7 is responsible for maintaining this levee and utilizing it to protect the Port Arthur area from floods. This Report was used directly in formulating the levee failure portion of this HMP.
- **Drainage Regulations;** Jefferson County Drainage District No. 6, Public Review Draft (November 19, 2007). In November, 2007 Jefferson County DD6 completed Drainage Regulations within DD6. The regulations were adopted by DD6 to protect, maintain and enhance public health, safety and general welfare, and to minimize the impacts of increases in stormwater runoff and flooding. This document was reviewed by the MPC to determine if any information could be used in the HMP.
- **Drainage Criteria Manual for Drainage District No. 6,** Public review Draft (December, 2007). In December of 2007, DD6 completed the Drainage Criteria Manual. This manual was completed to support the Master Drainage Plan and Drainage Regulations that were adopted by Jefferson County DD6 pursuant to the authority set forth in the Texas Water Code §49.211. The purpose of the Drainage Criteria Manual is to outline criteria and guidance to be used by developers, engineers, and land surveyors in the design of drainage measures to manage runoff. This document was reviewed by the MPC to determine if such a report should be an action item for the District.
- **2007, 2010 and 2013 State of Texas Mitigation Plan Update.** The State HMP updates were reviewed and summarized in Section 2.7 of this Plan. The mitigation strategies from the State Plan are also summarized in Section 2.7 for the flood, tornado, and hurricane and tropical storm hazards. The goals from the State Plan update were also reviewed and included in Section 3.3 of DD7's HMP. The Flood Occurrences in Texas map was used in Section 5.1 to highlight Jefferson County as one of five counties in Texas that has experienced between 25-41 flood events between 1961 and 2003.
- **Jefferson County Flood Insurance Rate Map (FIRM).** The Flood Insurance Rate Maps (FIRMs) prepared by FEMA offer the best overview of flood risks. FIRMs are used to regulate new development and to control the substantial improvement and repair of substantially damaged buildings. The Jefferson County FIRM was reviewed and included in the Plan to develop a floodplain map identifying the 100-year floodplain within DD7.
- **Jefferson County Insurance Study (FIS).** The most recent FIS for Jefferson County is dated August 6, 2002. This study was reviewed as part of the Plan. Information describing the flood hazard was added to Section 6.
- **Jefferson County Drainage District 6 Hazard Mitigation Plan.** DD6 and DD7 support Jefferson County and typically are impacted by the same hazards. The review of this Plan helped the MPC consider additional goals, mitigation actions and strategies.

- **Jefferson County Hazard Mitigation Plan.** DD7 is located within Jefferson County, so the review of this Plan helped the MPC consider additional goals, mitigation actions and strategies.

INCORPORATION OF THE HAZARD MITIGATION PLAN INTO OTHER PLANNING MECHANISMS

As part of the original HMP development, DD7 integrated components of the Plan into other planning mechanisms. DD7 is currently working on their Master Drainage Plan and will incorporate some of the Plan information into the DD7 Master Drainage Plan. Elements of the previous versions of this Plan have been incorporated into the Flood Protection Planning Study; as well as The Jefferson County DD6 and Jefferson County Texas hazard mitigation plans. The MPC is currently reviewing the plans listed above and looking for opportunities where components of this HMP update can be integrated into these other plans and studies as well as new plans or studies. Mitigation Plan requirements have been incorporated into DD7's annual project planning and budgeting process.

PLAN MAINTENANCE AND CONTINUED PUBLIC INVOLVEMENT

Upon adoption of this Plan update, in the event change is necessary, the public will be notified of any substantial changes to the document between 2018 and the next scheduled Plan update in 2023. Any changes proposed by the MPC considered significant will be distributed to the list of Stakeholders. The Stakeholders will be encouraged to review the changes and provide comments on any proposed plan revisions.

DD7 will involve the public in the plan maintenance process and during the next Plan Update in 2023, using the same methods as the plan development. The public will be notified when the revision process is started and provided the opportunity to review and comment on changes to the plan and priority action items. It is expected that a combination of informational public meetings, public surveys, draft documents posted on the website, and public Board of Director meetings will be undertaken.

The DD7 Hazard Mitigation Plan update will be posted on the District's Website and notices of its availability will be distributed to the stakeholders and the public will be notified to participate in Plan development, including Jefferson County, City of Port Arthur, adjacent counties and cities, Citizens who attended public meetings and provided contact information; and the organizations, agencies, and elected officials who received notices of public meetings.

PLAN MONITORING, EVALUATING AND UPDATING

The Mitigation Planning Committee determined that progress would be best monitored by annual meetings of the MPC. Upon adoption in 2018, the MPC will meet on an annual basis

to discuss the status of the Plan and determine if any significant changes are warranted. As part of the meeting, the General Manager of DD7 will note progress made on the prior mitigation action items listed in Table 29. To this end, the General Manager may convene a meeting of the appropriate District, Cities and Jefferson County Departments to discuss and determine progress, and to identify obstacles to progress, if any. In addition to annual meetings, the General Manager will convene meetings after damage-causing natural hazard events to review the effects of such events. Based on those effects, adjustments to the mitigation priorities listed in Table 30 may be made or additional event-specific actions identified.

DD7 will initiate Plan reviews and updates based on the following:

1. On the recommendation of the General Manager or on its own initiative, DD7 Board may initiate a Plan review at any time.
2. At approximately the one-year anniversary of the Plan's re-adoption, and every year thereafter.
3. After natural hazard events that appear to significantly change the apparent risk to District assets, operations and/or citizens.
4. When activities of DD7, County, or the State significantly alter the potential effects of natural hazards on District assets, operations and/or citizen. Examples include completed mitigation projects that reduce risk, or actions or circumstances that increase risk.
5. When new mitigation opportunities or sources of funding are identified.

In addition to the circumstances listed above, revisions that warrant changing the text of this Plan or incorporating new information may be prompted by a number of circumstances, including identification of specific new mitigation projects, completion of several mitigation actions, or requirements for qualifying for specific funding. Major comprehensive review of and revisions to this Hazard Mitigation Plan update will be considered on a five-year cycle. To be adopted in 2018, the Plan will enter its next review cycle sometime in 2023. The Mitigation Planning Committee will be convened to conduct the comprehensive evaluation and revision.

The 2023 Update of this plan will begin one year prior to expiration of this plan. The Mitigation Planning Committee will begin by reviewing the meeting notes from the annual review and evaluation meetings that will be taking place throughout the next four years. The planning committee will also review any changes in development and disasters that have occurred within the District since the last version of this Plan. This information will help determine hazards to be included in the Update of this plan and possibly identify mitigation actions needed to address hazards based on the changes in new development. The next Update will follow the same planning process to allow the public input on hazards and prioritization of actions.

SECTION 2 – HAZARD ASSESSMENT

INTRODUCTION

Jefferson County Drainage District No. Seven (DD7) is one of three Drainage Districts within Jefferson County, Texas. It is a conservation and reclamation district and a political subdivision of the State of Texas that was established in February, 1946.

At present DD7 maintains 281 miles of concrete and earthen outfall ditches, 36 miles of levee and seawalls, and 20 Pump Stations with a combined pumping capacity of 8.2 million gallons per minute.

Although DD7 is subject to a range of hazards typical of the northern Gulf Coast, for the reasons outlined below, DD7 has determined that the most appropriate and useful approach to developing its mitigation plan is to eliminate certain hazards from detailed risk assessment in its Hazard Mitigation Plan. There are three reasons for this: (1) DD7's mission and jurisdictional authority is explicitly limited to activities related to controlling floods (although the organization does have the authority to complete actions to protect and mitigate damage to its own facilities); (2) non-DD7 assets and populations that are potentially exposed to hazards are part of another mitigation plan, and hence including them in the present document would be redundant and serve no meaningful purpose – Jefferson County and the City of Port Arthur have both the authority and the responsibility to sponsor mitigation activities for their constituent populations and communities, and; (3) the hazards were determined not to affect District Facilities. DD7 will continue to coordinate with the County and City to ensure that mitigation actions are developed and implemented in a rational manner, reducing or eliminating conflict and overlap between the jurisdictions.

During the Crosswalk review process in the 2011 version of this Plan, the FEMA reviewer highlighted the confusion and inconsistency of addressing a hazard and completing a risk assessment for a hazard that DD7 had no jurisdictional authority to mitigate against and that has no impact on DD7 owned facilities. As opposed to removing any discussion of the hazard, which would have warranted an entire re-write of the plan, it was agreed to provide a narrative discussion for each of these hazard indicating that there is no negative impact to DD7 operations or facilities. As such, it has been determined that the planning area, based on DD7 jurisdictional authority, and DD7 owned facilities will not be negatively impacted from the below hazards. For this reason, the hazards listed below have been eliminated from further consideration and there are no mitigation action items associated with them.

- Extreme Heat – This hazard does not affect District-owned facilities and DD7 has no authority to mitigate against this hazard.
- Drought – This hazard does not affect District owned facilities and DD7 has no authority to mitigate against this hazard.

- Winter Storm – While winter storm can cause pipes to freeze, the need for ice and snow to be removed, and downed power lines, the District facilities have been built to insulate the pipes, have backup generators for downed power lines and have the necessary equipment to remove ice and snow. This hazard does not affect District owned facilities and DD7 has no authority to mitigate against this hazard.
- Earthquake – Due to the extremely low probability of an earthquake within the planning area, and the fact that there is no record of any historical building damage as a result of seismic activity in the planning area, this hazard does not affect District owned facilities and DD7 has no authority to mitigate against this hazard.
- Land Subsidence – Due to the extremely low probability of a land subsidence within the planning area and the fact that there is no record of any historical occurrences of land subsidence in the planning area, this hazard does not affect District owned facilities and DD7 has no authority to mitigate against this hazard.
- Wildfire – Due to the low probability of Wildfire in the Planning area and the fact that DD7 owned facilities are located in an urban area, this hazard does not affect District owned facilities and DD7 has no authority to mitigate against this hazard.
- Coastal Erosion – Jefferson County, not DD7, maintains beaches and dune systems and the District has no authority to mitigate against this hazard.
- Expansive Soils – Due to the lack of documentation and low probability of expansive soils in the planning area, this hazard does not affect District owned facilities and DD7 has no authority to mitigate against this hazard.
- Hailstorms – DD7 buildings are built to withstand hail damage.
- Lightning – DD7 facilities are all built to be protected from lightning and therefore, lightning does not affect District owned facilities and DD7 has no authority to mitigate against this hazard.

The hazards that DD7 will address as part of this plan update are:

- Tornado
- Thunderstorm/High Wind
- Hurricane and Tropical Storm
- Flood
- Levee Failure

GEOGRAPHY, CLIMATE, AND POPULATION

The area covered by Jefferson County Drainage District No. Seven (DD7) is located in southeast Texas. Ground surface elevations across DD7 vary from 23 feet above mean sea level to slightly below mean sea level. The topography is described as nearly flat prairie and the geologic structure is nearly flat strata. The bedrock types are comprised of deltaic sands and muds. Data from the Bureau of Economic Geology, at the University of Texas at Austin, identifies the land

as “expansive clay and mud – locally silty, locally calcareous, flat to low; hilly prairie; commonly tilled”.

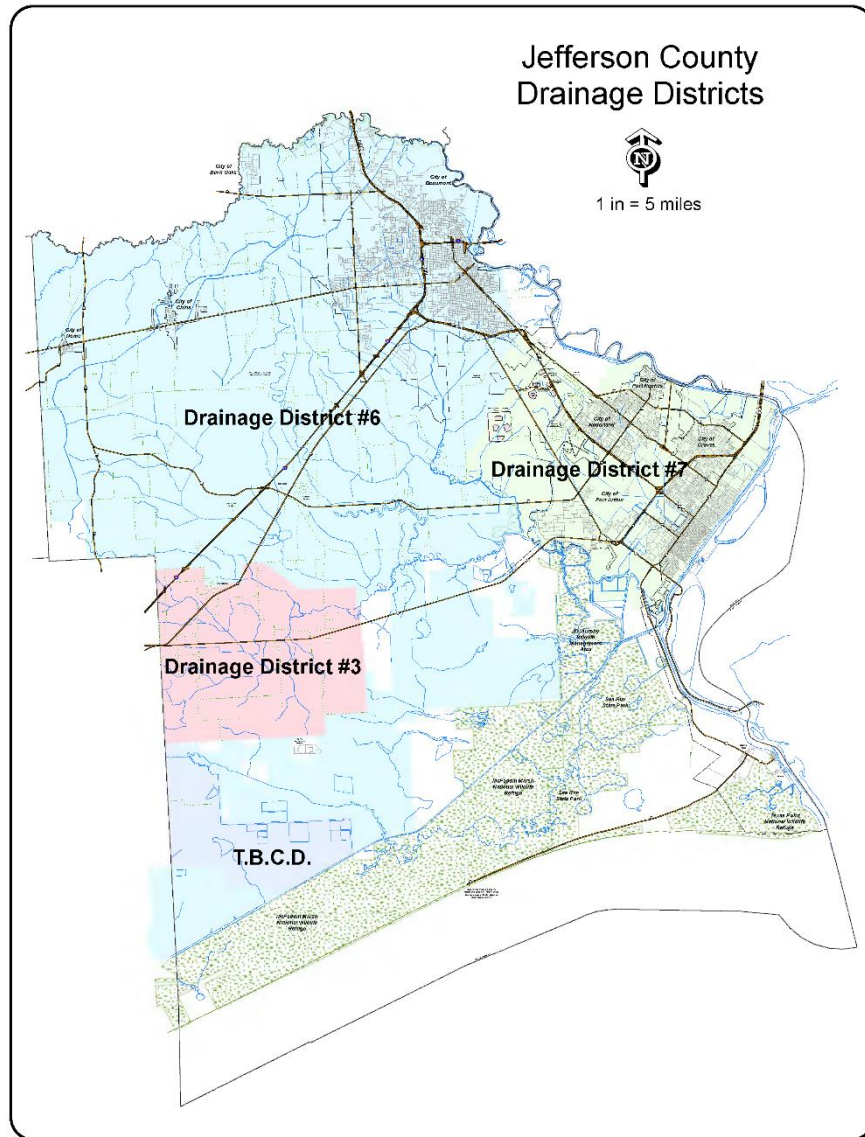
Figure 1 - Vicinity Map: State of Texas (Source: Mapquest)



The climate of the region is humid subtropical, with warm summers and moderate winters. Rainfall is abundant and on the average, evenly distributed throughout the year. The heaviest rains usually occur during the hurricane season, which extends from June through October. Average annual precipitation for the area is approximately 56 inches and the average annual temperature is about 69 degrees.

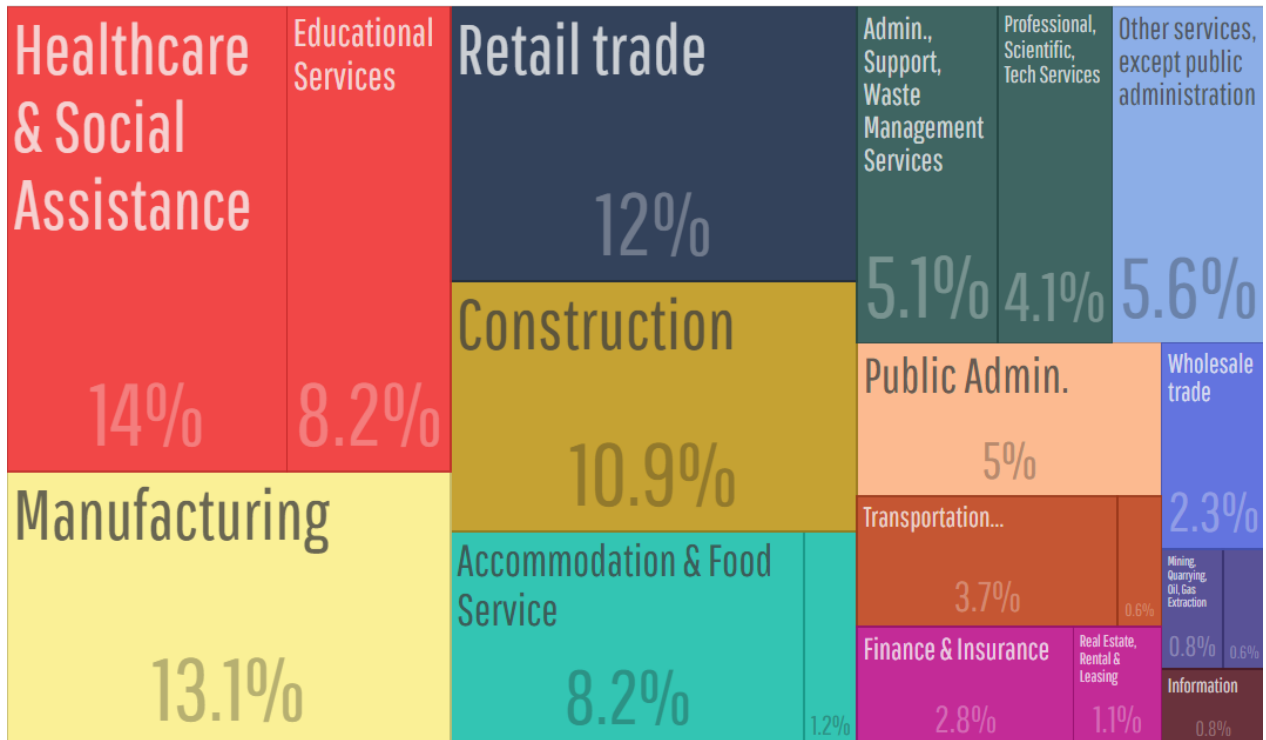
The District covers an area of 107.42 square miles and encompasses the cities of Port Arthur, Groves, Nederland and Port Neches and unincorporated areas of Jefferson County. Two thirds of the District is below five (5) feet above sea level. Sixty (60) to Seventy (70) percent of the District drains to Taylor's Bayou. Rainfall for this area averages 53 inches per year. Figure 2 is a map of Jefferson County, showing the three drainage districts in the county.

Figure 2 – Map of Jefferson County Drainage Districts



According to the United States Census Bureau, Jefferson County as a whole had an estimated total population of 254,679 in 2016. This is a 1.0 percent increase from the 2010 census data, which estimated the Jefferson County population at 252,273. In 2014, the population of the labor force in Jefferson County was 106,495, approximately a 2.9 percent increase from the estimated labor force in year 2014. The original Plan indicated the top three industries in the County were education, health, and social services. As of 2015, the top three industries were Healthcare and Social Assistance, Manufacturing and Retail as indicated by Figure 3.

Figure 3 – Most Common Industries, Jefferson County, Texas (Source: <https://datausa.io/profile/geo/jefferson-county-tx/>)



Jefferson County includes both incorporated and unincorporated areas. The population totals for the eight incorporated areas within the County are identified in Table 3. As indicated in the table, the cities of Groves, Nederland, Port Arthur and Port Neches are located within Jefferson County DD7. The population of the four cities within the planning area consists of a little less than half of the County population. The remaining incorporated areas are located outside of the planning area. The population of unincorporated Jefferson County totals 31,562.

Table 3 - Incorporated Areas of Jefferson County (Source: US Census Bureau, 2016 - Estimates)

City	Overall Population	Within DD7 Planning Area	Population within Planning area
Groves	15,758	Yes	15,758
Nederland	17,294	Yes	17,294
Port Arthur	55,427	Yes	55,427
Port Neches	12,809	Yes	12,809
Beaumont	118,299	No	N/A
Bevil Oaks	1,244	No	N/A
China	1,127	No	N/A
Nome	561	No	N/A
Total	222,519		101,288

The City of Port Arthur is the largest municipality in the planning area and as of 2016 had an estimated population of 55,427.

Table 4 identifies the total number and estimated value of buildings/infrastructure within Jefferson County DD7. The table indicates there are 37,554 residential buildings and 3,077 commercial buildings. As shown in Table 3 of the Plan update, the total population of the incorporated areas within DD7 is 101,288. The total population in DD7 is slightly higher than this figure when considering the additional residents living within the unincorporated areas. The data in Table 3 is used periodically throughout this section to identify the overall District-wide exposure for certain hazards that equally impact the entire planning area such as hurricanes/tropical storms.

Table 4 – Buildings/Infrastructure within Jefferson County Drainage District Seven (Sources: Jefferson County Central Appraisal District)

Type	Number of Structures	Estimated Value
Residential Buildings*	37,554	\$3,787,834,229
Commercial Buildings*	3,077	\$6,616,744,224
District-owned Buildings or structures**	34	\$43,121,010
Total	40,655	\$10,447,699,463

* – Value and number of structures based on percent of County population in the Planning Area.

** –Value based on insured value of District owned structures

CHANGES IN DEVELOPMENT AND REVIEW OF LOCAL REGULATION AND DD7 RESOURCES

DD7 has no direct responsibility for oversight of development in the floodplain. The Cities have strong development and permitting requirements for development in and out of the floodplain.

Construction permits. Table 5 lists the amount of building permits received by jurisdiction, by type of building (commercial/residential) demolition or construction.

Table 5 Building and Demolition Permits by Type and by Year for Each Incorporated Area Within DD7 (Source: City Building Departments)

Port Arthur Permits	2013	2014	2015	2016	2017	Total
Type						
Residential Buildings*	37	164	104	54	90	449
Commercial Building Permit	14	29	35	27	22	127
Demolition Residential Permit	113	310	409	161	94	1087
Demolition Commercial Permit	26	40	14	26	15	121

Nederland Permits	2013	2014	2015	2016	2017	Total
Type						
Residential Building Permit	66	45	46	59	71	287
Commercial Building Permit	4	7	3	3	1	18
Demolition Residential Permit	7	5	9	10	14	45
Demolition Commercial Permit	1	1	0	0	0	2

Groves Permits	2013	2014	2015	2016	2017	Total
Type						
Residential Building Permit	9	11	20	33	26	99
Commercial Building Permit	4	2	5	0	2	13

Demolition Residential Permit	4	6	10	7	8	35
Demolition Commercial Permit	3	0	0	0	4	7

Port Neches Permits	2013	2014	2015	2016	2017	Total
Type						
New Construction Single Family Homes	29	19	31	28	24	131
New Construction Residential Duplex	0	0	0	4	0	4
New Construction Commercial Building	2	1	1	1	2	7
Demolition Single Family Homes	9	6	5	12	13	45
Demolition Residential Duplex	1	0	1	0	0	2
Demolition Commercial Building	2	0	1	0	0	3

DD7 has no inspectors and has no jurisdiction over inspection. However, DD7 relies on the Cities to provide the necessary inspections. To manage development in the floodplain, DD7 relies on the City engineers.

Per the US Census Bureau Quick Facts, the population percent change from 2010 until 2017 has gone up 2.1% in Port Arthur, down 1.1% in Port Neches, down 2.3% in Groves, up 2.8% in Nederland and up 1.6% in Jefferson County as a whole. The planning area is slightly growing with the two larger Cities showing an increase in population. The Cities have strong development and permitting requirements for development in and out of the floodplain.

DD7 has a close working relationship with the Cities and Counties to help get needed resources and projects complete to help protect the residents, infrastructure, businesses and property from future flooding.

These small changes in development along with the Jurisdictions' permitting processes and the many projects that DD7 has engaged in, have led to a decrease in the overall flood vulnerability to the Jurisdiction. The majority of these projects have been drainage projects including detention basins, ditch improvements and floodwater diversions. Many of these projects have already reduced the 100-year flood levels in the project areas.

OVERVIEW OF RISKS

Numerous federal agencies maintain a variety of records regarding losses associated with natural hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. FEMA maintains records on federal expenditures associated with declared major disasters. The U.S. Army Corps of Engineers (USACE) and the Natural Resources Conservation Service collect data on losses during some of their ongoing projects and studies. National Oceanic and Atmospheric Administration's (NOAA) National Center for Environmental Information (NCEI) database is another source where data statistics such as injuries, deaths, and damage estimates are maintained for a variety of natural hazards. The data is maintained at the county-wide level, with more recent entries listing the specific location within the county. Although not always specific to DD7, this county-wide hazard data from the NCEI is often the best available resource for documenting historical events. For the hazards profiled, the query results from the NCEI database are provided in the hazard specific subsections.

In the absence of definitive data on some of the natural hazards that may occur in DD7, illustrative examples are useful. Table 6 provides brief descriptions of particularly significant natural hazard events occurring in DD7's recent history. This list is not meant to capture every event that has affected the area, rather lists one or two examples of the types of events that have affected the area in the past.

Data on Presidential Disaster Declarations characterize some natural disasters that have affected the area. In 1965, the federal government began to maintain records of events determined to be significant enough to warrant declaration of a major disaster by the President of the United States. Presidential Disaster Declarations are made at the county level and are not specific to any one city or sub-area, such as DD7. Given that DD7 is responsible for drainage in a large portion of Jefferson County, it is likely that a disaster declaration for Jefferson County affected DD7 in some way. Between 1965 and 2017 15 such disasters have been declared in Jefferson County and are identified in Table 6. In addition to the declared events, the table also includes several incidents which did not receive a Presidential Disaster Declaration. Since the last update, while the State of Texas has received nine more Presidential Disaster Declaration, with only Hurricane Harvey impacting Jefferson County.

**Table 6 –Natural Hazard Events and Declared Major Disasters in Jefferson County
(Sources: Public Entity Risk Institute (PERI) website, FEMA, NCEI database)**

Date & Disaster (DR)	Nature of Event
November 7, 1957	TORNADO (F3) – An F3 tornado touched down in Jefferson County. This tornado was 200 yards wide and stayed on the ground for 4 miles causing \$2.5M in damages, 2 deaths, and 59 injuries.
June 29, 1973 (DR-393)	SEVERE STORMS AND FLOODING – a massive storm hit the Houston Texas area dumping 10 – 15 inches of rain. In total the storm resulted in 10 deaths and over \$50M in damage.
April 26, 1979 (DR-580)	SEVERE STORMS, TORNADOES, AND FLOODING – (Nearly 300 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$2.8 M in payments). Rainfall reported in amounts between 9.56 to 10.7 inches in the Beaumont area and 11.5 inches in Bevil Oaks are, flooded many communities along the Neches river and Taylor, Pine Island, and Hillebrandt Bayous. Pine Island crested at 34.29 feet at Sour Lake, surpassing a record 31 feet set in 1917. Many homes, businesses and roads in the area were damaged.
July 28, 1979 (DR-595)	STORMS AND FLASH FLOODS - (Over 100 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$700K in payments). Tropical Storm Claudette formed in the Central Atlantic the morning of July 15, 1979. It never reached hurricane intensity as it wandered across the northern Caribbean, and the Gulf of Mexico 10 days, making landfall near Port Arthur the evening of the 24th. Rainfall was estimated at 11 inches in the Beaumont area. The area suffered severe wind damage to utilities.
September 26, 1980 (DR-632)	TROPICAL STORM DANIELLE - (Over 200 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$1.5M in payments). Rains of 8-9 in. fell on most of Texas. Particularly hard hit were Fisher, Mitchell, Nolan, and Scurry Counties.

Date & Disaster (DR)	Nature of Event
May 31, 1989 (DR-828)	SEVERE STORMS, TORNADOES AND FLOODING - (28 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$500K in payments). Widespread rains caused flooding that resulted in five deaths and total damages of about \$50 million. The storm dumped between 10 and 15 inches of rain in the southeast Texas area. Homes in Bevil Oaks flooded.
July 18, 1989 (DR-836)	TROPICAL STORM ALLISON - (Over 400 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$3.8M in payments). Tropical Storm Allison caused torrential rains of 10-15 in. from Houston to Beaumont. Houston Intercontinental Airport recorded 10.34 in. during 24 hours. The storm resulted in three deaths and over \$60M in damages.
November 15, 1994 (DR-1041)	SEVERE THUNDERSTORMS AND FLOODING - (Over 200 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$5.5M in payments). A tropical, mid-latitude rainfall of unusual proportion on a 30- to 35-county area of southeast Texas resulted in catastrophic flooding. The intense rainfalls totaled more than 25 in. at several locations and more than 8 in. on much of southeast Texas. The storm resulted in 18 deaths and an estimated \$700M in damages.
May, 1996	DROUGHT - Drought conditions continued across southeast Texas. Rainfall totals from January through May averaged 10 to 15 inches below normal. The main areas affected include farming and fire protection. Crop damage across the entire region exceeded 1 million dollars.
August 12, 1996	SEVERE LIGHTNING - As many as 9,000 lightning strikes this evening resulted in one man injured, one house fire, and several telephone poles damaged.

Date & Disaster (DR)	Nature of Event
January 14, 1997	ICE STORM - A record ice storm paralyzed southeast Texas and southwest Louisiana. Around 90,000 electric customers across southeast Texas were without power for up to six days. Emergency shelters were opened for several nights due to the cold weather following the ice storm. More trees and power lines were knocked down in this ice storm than what came down during Hurricane Bonnie in 1986. Hundreds of homes received minor damage due to trees or tree limbs falling on roofs. Several house fires were directly or indirectly related to the ice storm, but fortunately there were only no injuries. Numerous traffic accidents attributed to icy roads led to several minor injuries. One death was indirectly attributed to the ice storm. Two men were electrocuted on Tuesday, January 21st, while doing cleanup work for a local electric company. One 48 year old man died, and a 19 year old man was seriously injured in the accident
August, 26 1998 (DR-1239)	TROPICAL STORM CHARLEY – (Limited damage in Jefferson County) Up to 16 in. of rainfall in south-central Texas caused flooding in many counties, to include Jefferson
October, 14 1998 (DR-1245 & 1257)	HURRICANE GEORGES - (23 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$200K in payments). Tropical Storm Frances, and a localized thunderstorm that followed later in the same month, resulted in widespread flooding.
August 31, 2000	EXTREME HEAT - Record heat occurred in late August across southeast Texas. At the Southeast Texas Regional Airport, the all-time record high of 108 was tied on August 31st. Previously it had been achieved on July 14 1902.
June 9, 2001 (DR-1379)	TROPICAL STORM ALLISON - (Nearly 500 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$12 M in payments). Tropical Storm Allison produced flooding throughout Southeast Texas, Louisiana, and across the eastern United States. Damages were estimated at \$5 Billion and prompted a Presidential disaster declaration for 30 counties in Texas.
October 29, 2002 (DR-1439)	SEVERE STORMS, TORNADOES AND FLOODING – (Over 400 Jefferson County/City of Beaumont policy holders filed flood claims resulting in over \$8.7M in payments). This unnamed storm produced heavy rains, causing flooding throughout Jefferson County.

Date & Disaster (DR)	Nature of Event
September, 24, 2005 (DR-1606)	HURRICANE RITA – Hurricane Rita made landfall just east of the Texas-Louisiana border. Along the coast of Jefferson County, storm surges near 10 feet occurred near Sabine Pass, where over 90 percent of the homes were severely damaged or destroyed. The storm surge backed up the Sabine River, and flooded a small section of downtown Orange with around four to five feet of storm surge. High winds estimated at over 100 mph snapped and uprooting trees, and damaged over 125,000 homes and businesses.
September 13, 2008 (DR-1791)	HURRICANE IKE - Ike delivered a 17.5-foot storm surge on Jefferson County’s coastal plain and dropped anywhere from 6 to 20 inches of rain, depending on where in the County it was measured. The surge caused flooding in the county’s sparsely developed coastal areas, though no flooding occurred as a result of heavy rain. In total, at least 4,000 homes were flooded in Jefferson County.
August 25, 2017 (DR-4332)	HURRICANE HARVEY – Harvey made landfall as a Category 4 Hurricane with winds of 130 mph near Rockport, Texas. Harvey stalled around southern Texas for days as a weakening hurricane and tropical storm. As a tropical storm, Harvey dropped 40-61 inches of rainfall in southeast Texas and southwest Louisiana. 41 Counties in Texas were part of DR-4332, including Jefferson County. At the time of this Plan writing over \$1.5 Billion were approved for individual and household programs and over \$500 Million was approved in Public Assistance Grants. DD7 had damages to the office, the mechanic shop, District vehicles, the warehouse, various electronics and the electrician shop. Damage estimates are still coming in.

Jefferson County Drainage District 7 has the authority to mitigate against tornadoes, hurricanes and tropical storms winds and thunderstorm/high winds when they threaten DD7 buildings and assets. They also have the authority to mitigate against the flood hazard in all aspects. The National Oceanic and Atmospheric Administration’s (NOAA) National Center for Environmental Information (NCEI) collects and maintains certain hazard data in summary format, indicating injuries, deaths, and estimated damages.

For each hazard profiled in the present section, the planning team assigned a highly likely, likely, occasional or unlikely probability of future occurrences. The hazard probability was assigned in accordance with Table 7 below.

Table 7 – Frequency of Hazard Occurrence

<p>Frequency of Occurrence:</p> <p><input type="checkbox"/> Highly likely; Event probable in next year.</p> <p><input type="checkbox"/> Likely; Event probable in next three years</p> <p><input type="checkbox"/> Occasional; Event possible in next five years</p> <p><input type="checkbox"/> Unlikely; Event possible in next ten years</p>
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To deduce which hazards leave DD7 most vulnerable, the MPC ranked each hazard the potential to cause damage, disrupt continuity of operations or shutdown facilities by providing a classification. Definitions for overall vulnerability are subjective based primarily on future probability, impact and severity, with additional considerations for potential impacts locations of buildings, critical facilities and infrastructure. Vulnerability classification criteria are general and involve some degree of overlap amongst classes. Definitions for overall vulnerability classifications used are listed in Table 8.

Table 8 – Level of Vulnerability

Level of Vulnerability	Description
Very High	High probability of future occurrence and potential catastrophic severity
High	Moderate/high probability of future occurrence and potential critical severity
Moderate	Moderate probability of future occurrence and limited potential severity
Low	Low/moderate probability of future occurrence and limited/negligible potential severity

TORNADO

A tornado is defined as a rapidly rotating vortex or funnel of air extending ground-ward from a cumulonimbus cloud. Most of the time, vortices remain suspended in the atmosphere and are visible as a funnel cloud. However, when the lower tip of a vortex touches the ground, the tornado becomes a force of destruction.

TORNADO LOCATION

Figure 4 shows the planning area within the green boundary. A tornado effects the entire planning area equally.

Figure 4 – Vicinity Map: Jefferson County Drainage District 7

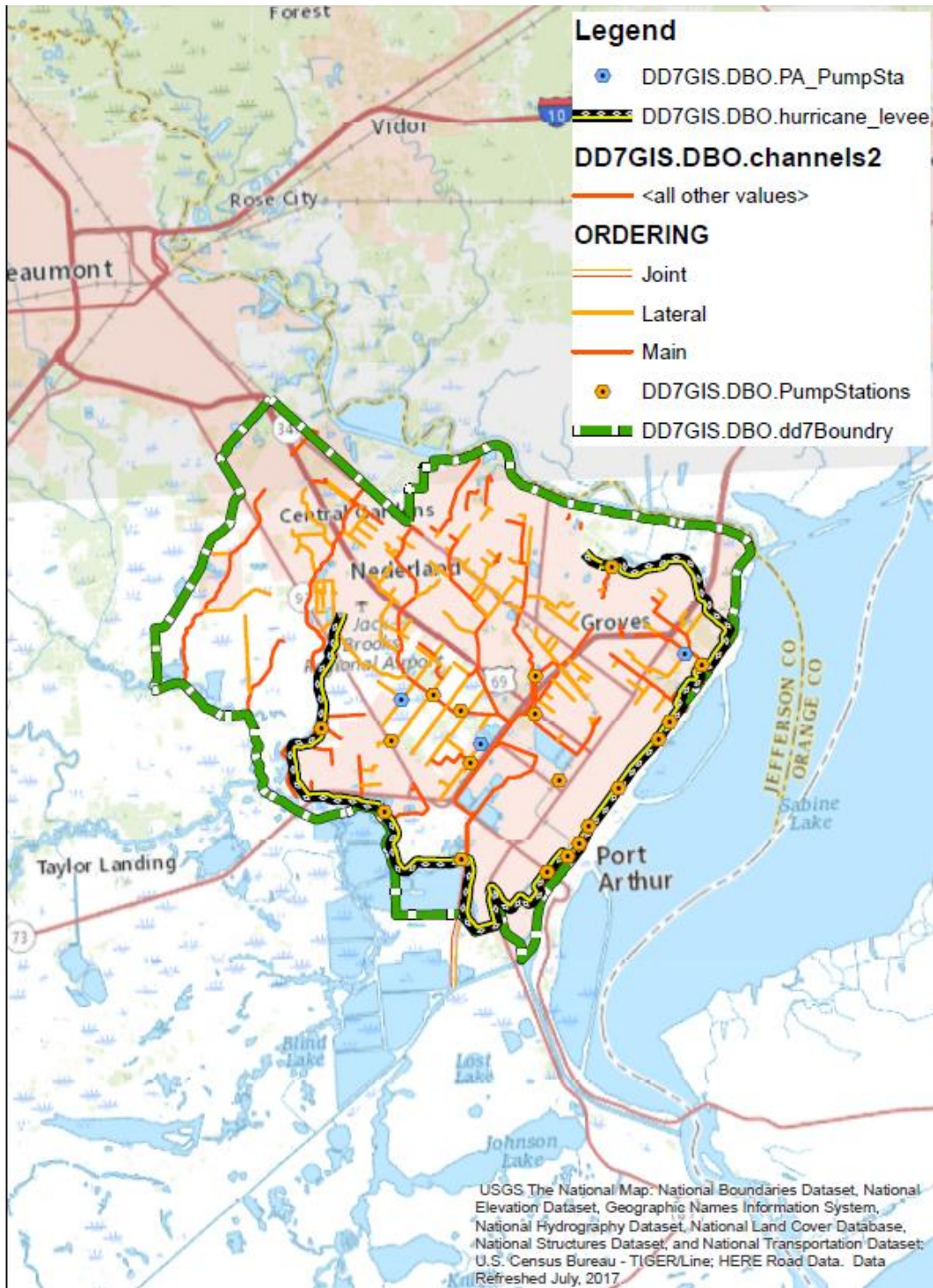
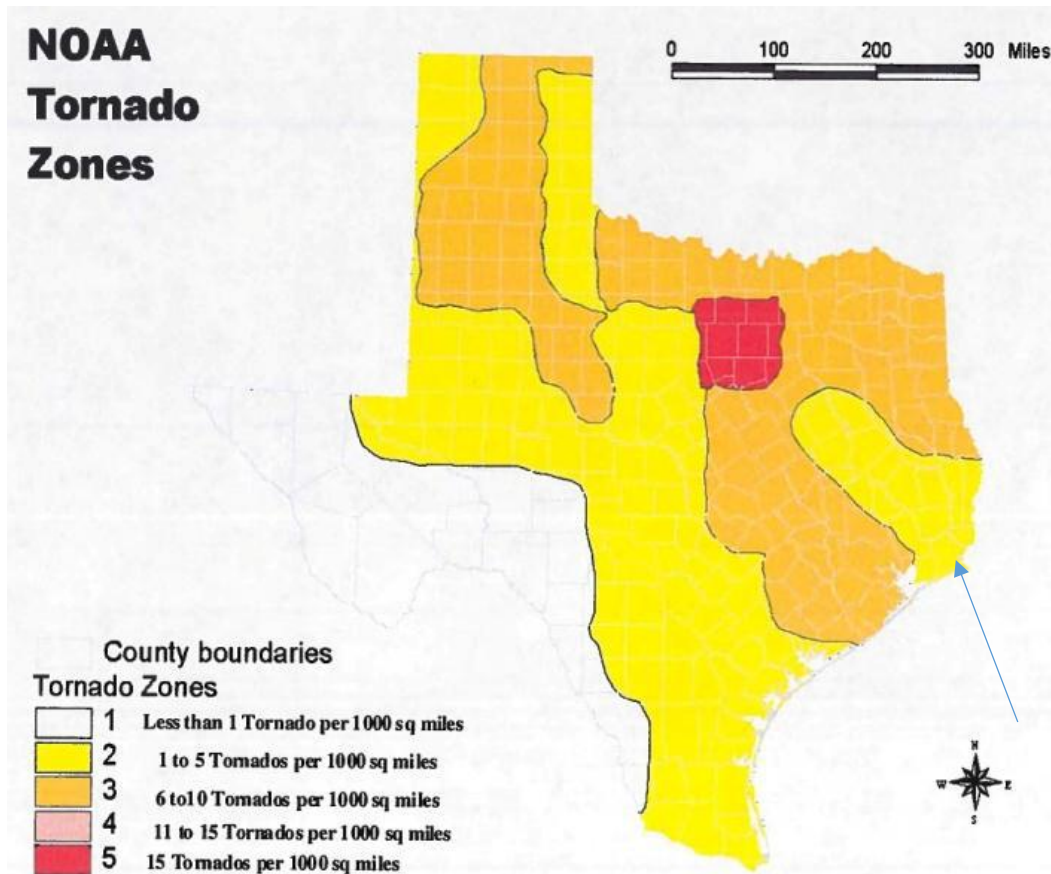


Figure 5 illustrates the frequency of tornado strikes in Texas per 1,000 square miles. Texas is considered the U.S. “tornado capital.” While Texas tornadoes can occur in any month and at all hours of the day or night, they occur with greatest frequency during the late spring and early summer months during late afternoon and early evening hours. Northern Texas is most vulnerable, but the area around DD7 experiences 1 – 5 tornadoes per 1,000 square miles. The tornado hazard affects the entire planning area equally.

Figure 5 – Tornado Activity in the U.S. (Source: NOAA – Storm Prediction Center)



TORNADO EXTENT

Tornado damage severity is measured by the Enhanced Fujita Tornado Scale (EF-Scale). The Enhanced Fujita Scale assigns numerical values based on wind speed and categorizes tornadoes from zero to five representing increased degrees of damage. 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 or tropical storm, far from the hurricane eye. Table 9 describes the categories for the Enhanced Fujita Tornado Scale. We can expect to experience a tornado ranging from EF0 to EF5 in the planning area.

Table 9 – Enhanced Fujita (EF) Scale

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	Wind Speed (mph)	Potential Damage
EF0	65-85	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136-165	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200	Devastating damage. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.

PREVIOUS OCCURRENCES OF TORNADO

According to the NCEI database, Jefferson County Drainage District 7 has experienced 41 tornadoes (18 F0s, 11 F1s, 10 F2s, and two F3s) between 1950 and 2017 (experiencing no events since the last planning effort was underway). The NCEI has recently updated the Storm Events Database, either showing tornado paths or descriptions for all recorded tornadoes, allowing the events to be narrowed down to just those that affected the District. There were 61 events outside of the Planning area, but in Jefferson County. It is possible that some of those tornadoes affected the planning area, but were listed incorrectly in a database. Note that prior to 2007, the Fujita (F) Scale was used. For these 41 events, the NCEI database reported three deaths, 86 injuries and \$10,218,000 in damages. Table 10 summarizes the 41 tornadoes that impacted DD7.

Table 10 – Tornado Events in DD7 (Source: NCEI Storm Events Database)

Location	Date	Mag	Dth	Inj	PrD
Nederland	02/14/1956	F2	0	0	\$25,000
Port Arthur	10/04/1956	F1	0	2	\$25,000
Port Arthur	11/05/1956	F2	0	0	\$2,500
Nederland	03/17/1957	F2	0	0	\$2,500
Groves	11/07/1957	F3	2	59	\$2,500,000

Port Arthur	11/07/1957	F3	0	1	\$250,000
Nederland	06/14/1959	F0	0	0	\$2,500
Port Arthur	07/02/1959	F2	0	0	\$25,000
Nederland	08/19/1960	F1	0	0	\$2,500
Port Arthur/ Groves	05/05/1964	F2	0	6	\$250,000
Port Arthur	07/05/1965	F1	0	0	\$250
Nederland	09/21/1967	F1	0	1	\$250
Groves	02/01/1968	F2	0	0	\$50,000
Port Arthur	07/15/1969	F1	0	0	\$250,000
Port Arthur	07/30/1969	F1	0	0	\$25,000
Groves	08/27/1969	F0	0	0	\$0
Nederland	07/13/1970	F0	0	0	\$0
Port Arthur	10/06/1970	F0	0	0	\$0
Port Arthur	10/11/1970	F0	0	0	\$250,000
Nederland	05/24/1971	F0	0	0	\$2,500
Port Arthur	05/12/1972	F2	0	2	\$250,000
Nederland	07/29/1972	F1	0	0	\$200,000
Port Arthur	09/05/1972	F1	0	0	\$0
Port Arthur	11/13/1972	F2	0	0	\$500,000
Groves	04/17/1973	F0	0	0	\$0
Port Arthur	08/09/1973	F0	0	0	\$2,500
Nederland	09/28/1973	F0	0	0	\$0
Port Arthur	06/21/1974	F0	0	0	\$2,500
Nederland/ Port Neches	06/06/1976	F1	0	0	\$25,000
Port Arthur	07/07/1976	F0	0	0	\$0
Port Neches	05/22/1979	F0	0	0	\$0
Nederland	06/06/1980	F2	0	0	\$25,000
Nederland	07/07/1982	F0	0	0	\$0
Jefferson County*	05/20/1983	F0- F2	1	12	\$2,500,000
Port Arthur	04/10/1984	F0	0	0	\$250,000
Nederland	06/30/1992	F0	0	0	\$0
Nederland	10/08/1994	F1	0	0	\$0
Port Arthur	04/10/1995	F0	0	0	\$0
Port Neches/ Groves	09/21/1995	F0	0	0	\$0
Port Arthur	07/14/1997	F0	0	3	\$50,000
Groves	04/03/2000	F1	0	0	\$3,000,000
			3	86	\$10,218,000

*There were 21 tornadoes across South East Texas on 5/20/83. The exact damages in the planning area are unknown, however, one of those tornadoes caused one death and nine injuries near Nederland and a separate tornado injured three in Port Arthur.

TORNADO PROBABILITY

Jefferson County DD7 has experienced 41 tornadoes between 1950 and 2017. Most of the tornado events are from EF0 to EF2, with the catastrophic tornado events occurring with far less chance. An average of tornadoes across the planning area provides the probability. With 41 events over 67 years, the frequency of an event is:

Table 11 – Frequency of Tornado Occurrence

<p>Frequency of Occurrence:</p> <p><input type="checkbox"/> Highly likely; Event probable in next year</p> <p><input checked="" type="checkbox"/> Likely; Event probable in next three years</p> <p><input type="checkbox"/> Occasional; Event possible in next five years</p> <p><input type="checkbox"/> Unlikely; Event possible in next ten years</p>
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TORNADO IMPACT AND VULNERABILITY

DD7's missions and jurisdictional authority being explicitly limited to activities related to controlling floods, they only have the authority to mitigate the effect of tornadoes on District-owned facilities and personnel. DD7 facilities, including 20 pump stations, pump station storage, pump station generator buildings, a vehicle shed, a warehouse, an electrical shop, a meeting room and two offices have an insured value of \$43,121,010. The current DD7 office building is made of brick and not reinforced, but does meet basic wind loads. It is reasonable to assume that District facilities, assets and employees are vulnerable to the impacts of severe tornadoes. DD7 plans to build a new office building with a safe room which will meet tornado wind loads, serve as a secondary EOC and will be able to shelter employees. DD7 will likely apply for grant funds to assist with the construction of the building.

HURRICANES AND TROPICAL STORMS

Hurricanes, tropical storms, and typhoons, collectively known as tropical cyclones, are among the most devastating naturally occurring hazards in the United States. They present flooding, storm surge, and high wind hazards to the communities that they impact.

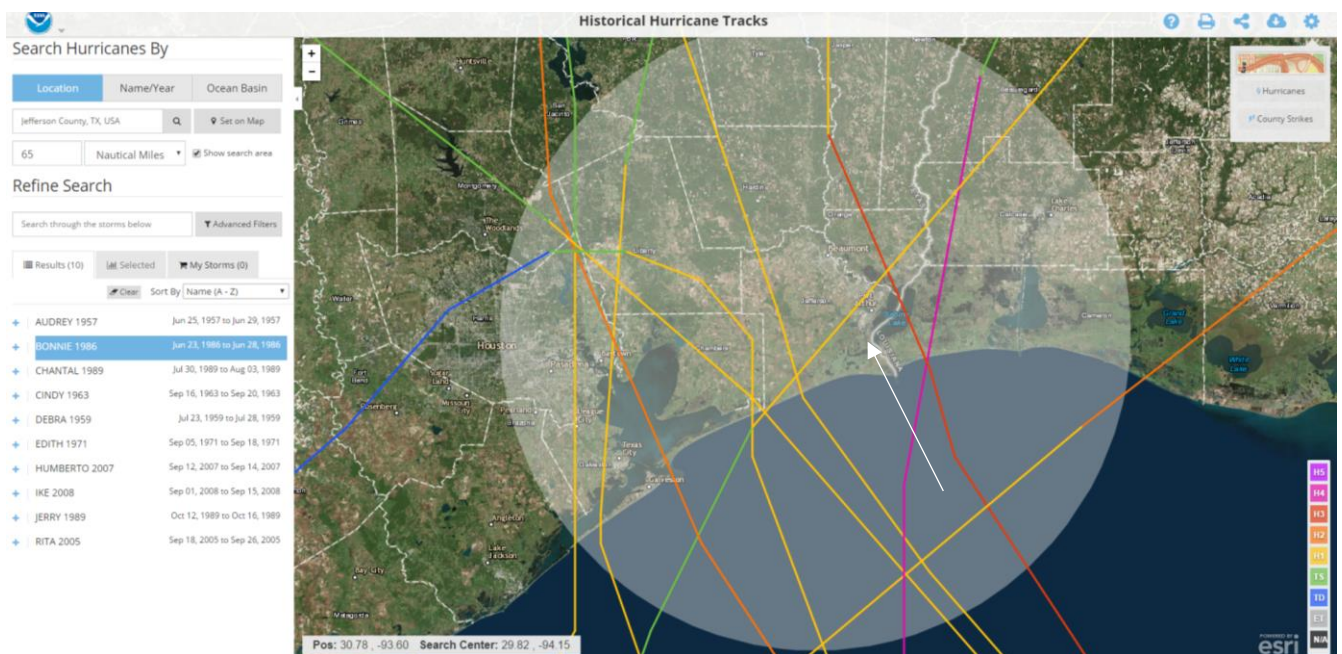
A hurricane is defined as a low-pressure area of closed circulation winds that originates over tropical waters.

Hurricanes bring high winds and heavy rains and are usually accompanied by high storm surge; a rapid rise of offshore water elevation primarily caused by the combination of extremely high winds over a large stretch of open water and low barometric pressure which accompany a hurricane, together working to create a dome of water near the eye of the hurricane. As the hurricane nears land, its winds push the dome toward the shore while the slope of the sea floor blocks the water's escape and it comes ashore as a rising surge.

HURRICANE AND TROPICAL STORM LOCATION

A hurricane or tropical storm occurs every year during hurricane season which begins in May and ends in November. Some of these storms dissipate before making landfall, but have the chance of striking anywhere on the Gulf Coast or eastern seaboard. The entire planning area is equally susceptible to hurricanes and tropical storms. According to the National Hurricane Center's Historical Hurricane Tracker, from 1950 to 2017, there have been 11 hurricanes and 11 tropical storms within a 65 nautical mile radius of Jefferson County Texas. Figure 6 shows the planning area, indicated by the white arrow, and ten of the hurricanes that came within 65 nautical miles. As shown by the figure, there were six H1s, two H2s, one H3 and one H4. The Historical Hurricane Tracks does not list Hurricane Harvey, which occurred during the writing of this Plan.

Figure 6 – Historical Hurricane Tracks for Jefferson County TX (National Hurricane Center)



HURRICANE AND TROPICAL STORM EXTENT

A hurricane begins as a tropical depression with wind speeds below 39 mph. As it intensifies, it may develop into a tropical storm, with further development producing a hurricane. Hurricane winds blow in a large spiral around a relative calm center known as the "eye." The "eye", the storm's core, is an area of low barometric pressure and is generally 20 to 30 miles wide. The storm may extend outward 100 - 400 miles in diameter. As a hurricane approaches, the skies will begin to darken and winds will grow in strength. As a hurricane nears land, it can bring torrential rains, high winds, storm surges, and severe flooding. Table 12 and Table 13 below identify the criteria for each stage of development. The Saffir / Simpson Hurricane Scale is used to classify storms by numbered categories. Hurricanes are classified as Categories 1 through 5

based on central pressure, wind speed, storm surge height, and damage potential. We can expect to experience a storm ranging from a tropical depression to a category 5 hurricane in the planning area.

Table 12 – Classification of Tropical Cyclones

Stage of Development	Criteria
Tropical Depression (development)	Maximum sustained surface wind speed is < 39 mph
Tropical Storm	Maximum sustained wind speed ranges 39 - <74 mph
Hurricane	Maximum sustained surface wind speed 74 mph+
Tropical Depression (dissipation)	Decaying stages of a cyclone in which maximum sustained surface wind speed has dropped below 39 mph

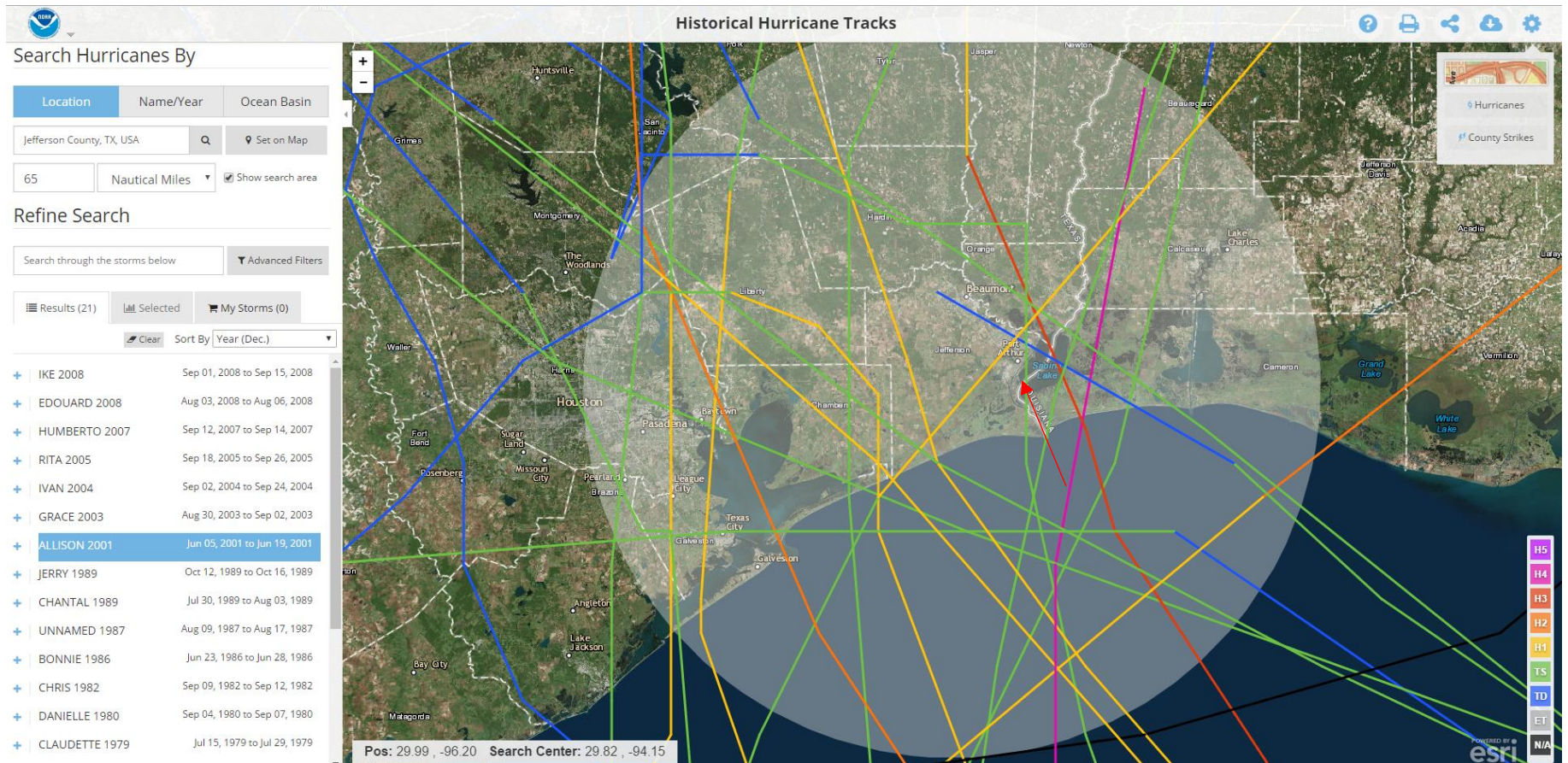
Table 13 – Saffir/Simpson Hurricane Scale

Storm Category	Central Pressure	Sustained Winds	Storm Surge	Potential Damage
1	> 980 mbar	74 - 95 mph	4 – 5 ft	Minimal
2	965 – 979 mbar	96 - 110 mph	6 – 8 ft	Moderate
3	945 – 964 mbar	111 – 130 mph	9 – 12 ft	Extensive
4	920 – 944 mbar	131 – 155 mph	13 – 18 ft	Extreme
5	< 920 mbar	> 155 mph	> 18 ft	Catastrophic

PREVIOUS OCCURRENCES OF HURRICANES AND TROPICAL STORMS

The NCEI database was queried for previous events, but only six were shown, so the National Hurricane Center’s (NHC) Historical Hurricane Tracker was used. This hurricane tracker showed ten hurricanes and 11 tropical storms within 65 nautical miles of Jefferson County between 1950 and 2017. Since the last version of this Plan, Jefferson County and the District were hit by Hurricane Harvey, a category 4 storm. Data is still coming in on Hurricane Harvey, but many areas received 40-61 inches of rainfall, combined with strong winds and storm surge. There is not specific data for just DD7, but it is reasonable to assume that if a hurricane or tropical storm affected the county, it would also affect DD7 because of the size and magnitude of the hazard. DD7 had damages to their office, mechanic shop, District vehicles, the warehouse, various electronics and the electrician shop. Damage estimates are still coming in. The six events shown on the NCEI database were from 1998 to 2008 and caused \$1.255 Billion in property damage. The 21 events from the NHC are shown below in Figure 7.

Figure 7 – Historical Hurricane Tracks for Jefferson County TX (National Hurricane Center)



HURRICANE AND TROPICAL STORM PROBABILITY

DD7 has experienced 22 tropical storms and hurricanes between 1950 and 2017. It is reasonable to assume that another such storm will affect the planning area experiencing an event approximately once every three years.

Table 14 – Frequency of Tropical Storm and Hurricane Occurrence

<p>Frequency of Occurrence:</p> <p><input type="checkbox"/> Highly likely; Event probable in next year</p> <p><input checked="" type="checkbox"/> Likely; Event probable in next three years</p> <p><input type="checkbox"/> Occasional; Event possible in next five years</p> <p><input type="checkbox"/> Unlikely; Event possible in next ten years</p>
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HURRICANE AND TROPICAL STORM IMPACT AND VULNERABILITY

DD7's missions and jurisdictional authority being explicitly limited to activities related to controlling floods, they only have the authority to mitigate the effect of hurricane winds on District owned facilities and personnel. DD7 facilities, including 20 pump stations, pump station storage, pump station generator buildings, a vehicle shed, a warehouse, an electrical shop, a meeting room and two offices have an insured value of \$43,121,010. The current DD7 office building is made of brick and not reinforced, but does meet basic wind loads. It is reasonable to assume that District facilities, assets and employees are vulnerable to the impacts of severe hurricane winds. DD7 plans to build a new office building with a safe room which will meet hurricane wind loads, serve as a secondary EOC and will be able to shelter employees. DD7 will likely apply for grant funds to assist with the construction of the building. The flood portion of the hurricane and tropical storm hazard will be address in the flood section of this Plan.

SEVERE THUNDERSTORMS AND HIGH WINDS

Several meteorological conditions can result in winds severe enough to cause property damage. High 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. The National Weather Service considers a thunderstorm "severe" if it produces tornadoes or winds of 58 miles per hour or more. Structural wind damage may imply the occurrence of a severe thunderstorm.

SEVERE THUNDERSTORM AND HIGH WIND LOCATION

Figure 8 shows the planning area within the green boundary. A severe thunderstorms and high wind effect the entire planning area equally.

Figure 8 - Vicinity Map: District Boundary Map

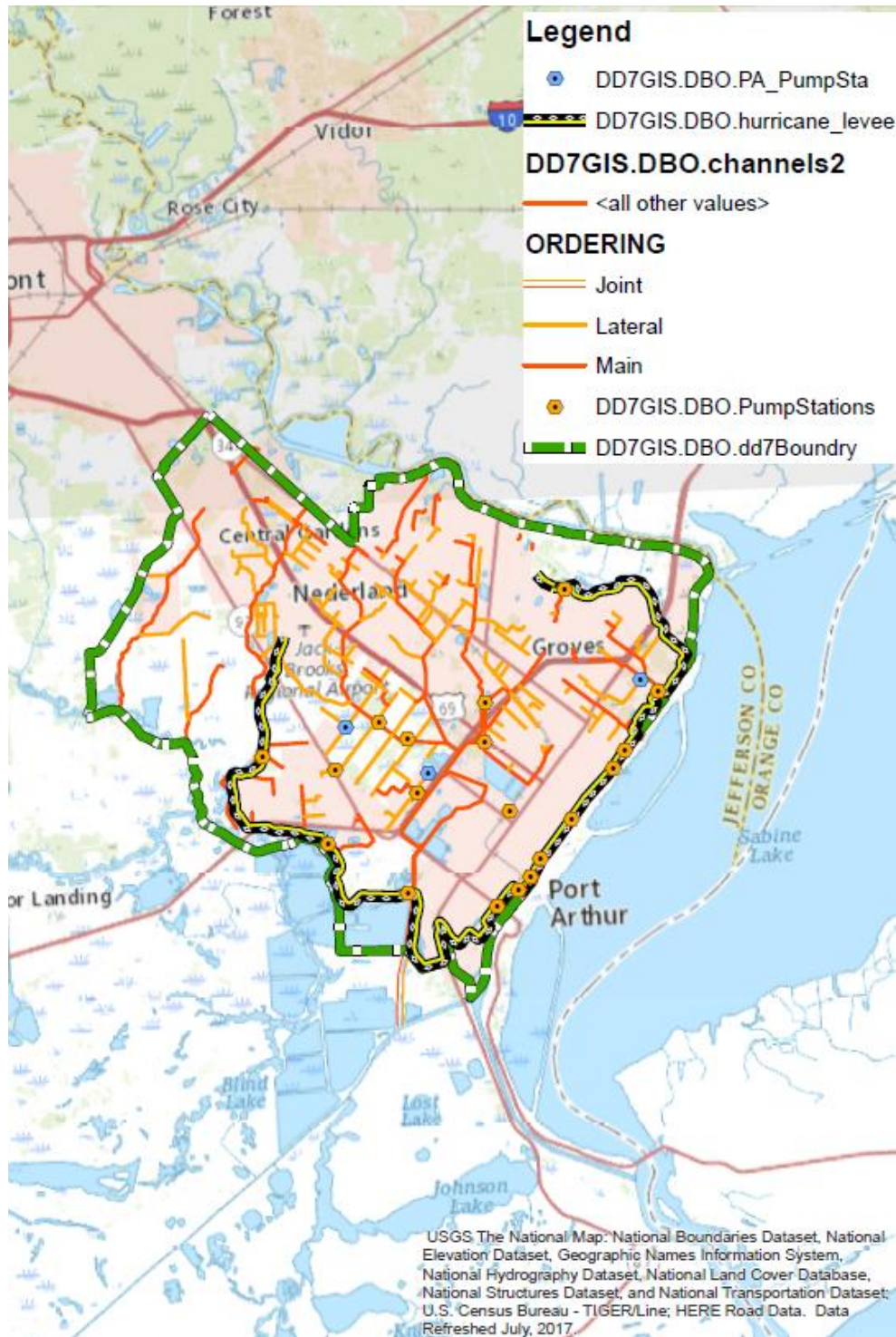
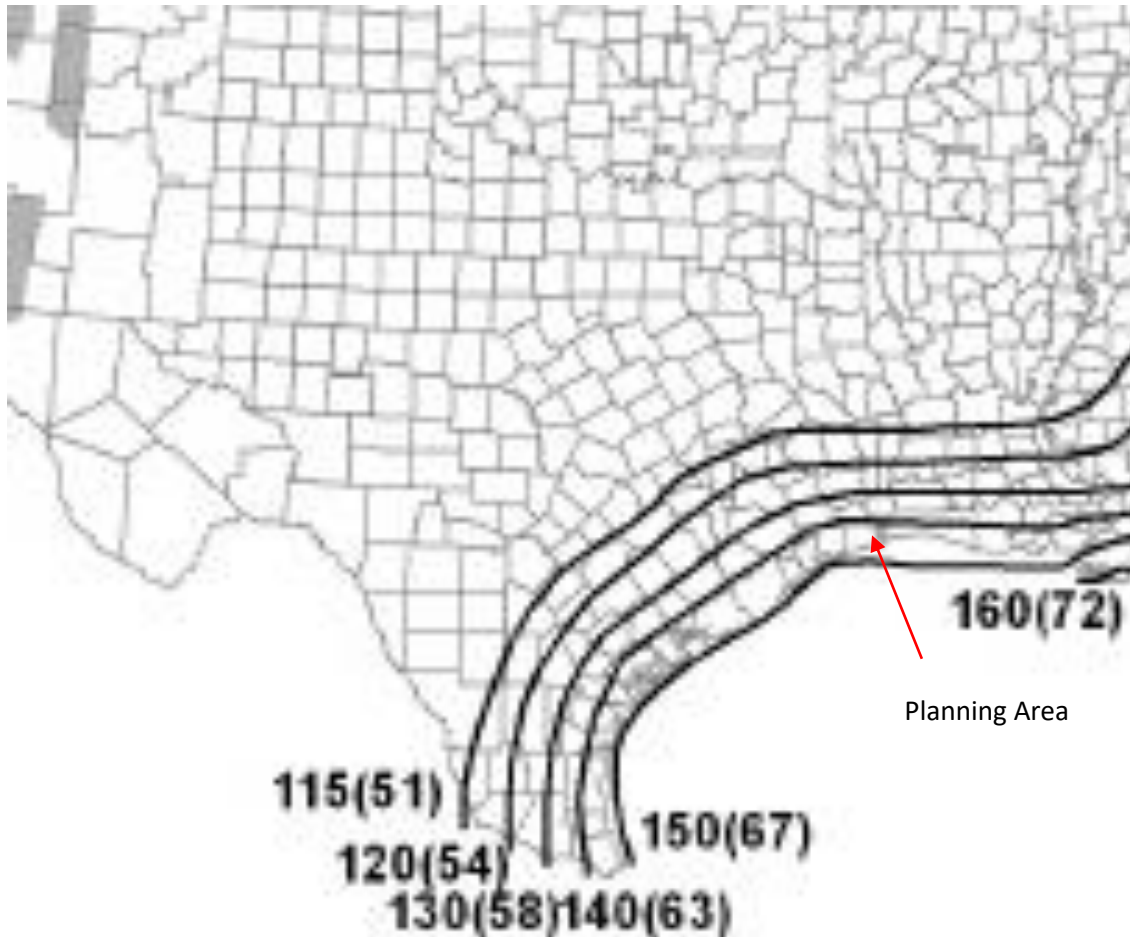


Figure 9 illustrates the minimum wind speed that buildings should be designed to withstand for buildings in Texas according to the International Building Code. As you can see below, new construction in DD7 should be built to withstand three-second gusts up to at least 140 MPH in some places and 150 MPH in others.

Figure 9 – Basic Design Wind Speed (Source: International Building Code)



Notes:

1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10m) above ground for Exposure C category.
2. Linear interpolation between contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.
5. Wind speeds correspond to approximately a 7% probability of exceedance in 50 years (Annual Exceedance Probability = 0.00143, MRI = 700 Years).

SEVERE THUNDERSTORM AND HIGH WIND EXTENT

The most widely accepted extent scale for wind is the Beaufort Wind Scale. The table below shows the force of the storm and the wind speed, classification and appearance that that is associated with each force. In the planning area we can expect to experience wind events ranging from light winds to hurricane force winds.

Table 15 – Beaufort Wind Scale (Source: National Oceanic and Atmospheric Administration)

Force	Wind (Knots)	WMO Classification	On the Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-19 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (18-25 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress
9	41-47	Strong Gale	High waves (23-32 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (29-41 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (37-52 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft., sea completely white with driving spray, visibility greatly reduced	

SEVERE THUNDERSTORM AND HIGH WIND PREVIOUS OCCURRENCE

According to the NCEI database, the planning area experienced 39 severe thunderstorm and high wind events with winds above 50 Knots between 1950 and 2017, (experiencing five such events since the last planning effort was underway). The NCEI has recently updated the Storm Events Database, either giving descriptions or locations for all recorded thunderstorm and high wind events, allowing the events to be narrowed down to just those that affected the District. Many of the earlier events show \$0 in damages, but where descriptions are available, some descriptions show damages occurred. Some of the events listed at \$0 in damages in the table below did not have event descriptions so it is possible that those events caused more damages than what is shown in the table. These events injured 18 people and caused \$2,119,000 in reported damages within the District. This hazard is reasonably predicted to have uniform probability of occurrence across the entire planning area. The table below summarizes the 39 events that occurred within the District.

Table 16 – Severe Thunderstorm and High Wind Events in Jefferson County DD7(Source: NCEI Storm Events Database)

Location	Date	Mag	Dth	Inj	PrD
Totals:			0	18	\$2,119,000
Nederland	07/26/63	58 Kts	0	0	\$8,000
Port Arthur	11/09/63	52 Kts	0	0	\$0
Nederland	03/19/64	60 Kts	0	14	\$70,000
Port Arthur	08/05/64	55 Kts	0	2	\$100,000
Nederland	02/24/65	50 Kts	0	0	\$0
Port Arthur/ Nederland	12/30/70	70 Kts	0	0	\$300,000
Nederland	05/12/72	52 Kts	0	0	\$0
Port Arthur	04/26/73	87 Kts	0	0	\$0
Port Arthur	12/19/73	53 Kts	0	0	\$0
Port Arthur	07/05/74	56 Kts	0	0	\$0
Port Arthur	07/27/74	50 Kts	0	0	\$0
Nederland	10/13/77	50 Kts	0	0	\$0
Nederland	03/19/79	52 Kts	0	0	\$0
Nederland	11/19/83	52 Kts	0	0	\$0
Nederland	05/23/85	54 Kts	0	0	\$0
Port Arthur	05/17/86	52 Kts	0	0	\$0
Nederland	05/21/88	54 Kts	0	0	\$0
Port Arthur	04/14/90	51 Kts	0	0	\$0
Nederland	07/30/90	51 Kts	0	0	\$0
Port Arthur	03/13/95	70 Kts	0	2	\$70,000
Nederland	07/29/95	52 Kts	0	0	\$0
Port Arthur	02/10/98	57 Kts	0	0	\$10,000

Port Arthur	02/26/98	52 Kts	0	0	\$0
Port Neches	03/07/98	50 Kts	0	0	\$0
Port Arthur	03/07/98	50 Kts	0	0	\$0
Port Arthur	04/03/00	56 Kts	0	0	\$20,000
Groves	07/16/02	65 Kts	0	0	\$1,500,000
Groves	11/27/04	50 Kts	0	0	\$20,000
Port Arthur	06/18/05	50 Kts	0	0	\$0
Nederland	06/02/09	63 Kts	0	0	\$0
Port Arthur	07/18/09	56 Kts	0	0	\$0
Port Arthur	10/09/09	50 Kts	0	0	\$0
Port Arthur	08/16/10	52 Kts	0	0	\$1,000
Nederland	08/23/10	52 Kts	0	0	\$0
Groves	10/31/13	61 Kts	0	0	\$5,000
Nederland	02/20/14	50 Kts	0	0	\$0
Nederland	07/03/14	57 Kts	0	0	\$0
Groves	04/27/16	50 Kts	0	0	\$5,000
Nederland	06/24/17	50 Kts	0	0	\$10,000
Totals			0	18	\$2,119,000

SEVERE THUNDERSTORM AND HIGH WIND PROBABILITY

Jefferson County DD7 has experienced 39 severe thunderstorm and high wind events with wind speeds of at least 50 kts between 1950 and 2017. With 39 events occurring in 67 years, a severe thunderstorm or high wind event is:

Table 17 – Frequency of Severe Thunderstorms and High Wind

<p>Frequency of Occurrence:</p> <p><input checked="" type="checkbox"/> Highly likely; Event probable in next year</p> <p><input type="checkbox"/> Likely; Event probable in next three years</p> <p><input type="checkbox"/> Occasional; Event possible in next five years</p> <p><input type="checkbox"/> Unlikely; Event possible in next ten years</p>
--

SEVERE THUNDERSTORM AND HIGH WIND IMPACT AND VULNERABILITY

DD7's missions and jurisdictional authority being explicitly limited to activities related to controlling floods, they only have the authority to mitigate the effect of severe thunderstorms and high wind on District owned facilities and personnel. DD7 facilities, including 20 pump stations, pump station storage, pump station generator buildings, a vehicle shed, a warehouse, an electrical shop, a meeting room and two offices have an insured value of \$43,121,010. The current DD7 office building is made of brick and not reinforced but does meet basic wind loads. It is reasonable to assume that District facilities, assets and employees are vulnerable to the

impacts of severe tornadoes. DD7 plans to build a new office building with a safe room which will meet tornado and hurricane force wind loads, serve as a secondary EOC and will be able to shelter employees. DD7 will likely apply for grant funds to assist with the construction of the building.

The following section, Levee Failure, has been redacted due to homeland security concerns by TCEQ and local jurisdictions.

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FLOOD

Flooding is the accumulation of water within a water body (e.g., stream, river, lake, or reservoir) and the overflow of excess water onto adjacent floodplains. Floodplains are usually lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected. Nationwide, hundreds of floods occur each year, making them one of the most common hazards in the U.S.

Floods result from rain events, whether short and intense, or long and gentle. Flood hazards are categorized as follows:

- Flash floods not only occur suddenly, but also involve forceful flows that can destroy buildings and bridges, uproot trees, and scour out new channels. Most flash flooding is caused by slow-moving thunderstorms, repeated thunderstorms in a local area, or heavy rains from hurricanes and tropical storms. Although flash flooding occurs often along mountain streams, it is also common in urban areas, where much of the ground is covered by impervious surfaces and drainage ways are designed for smaller flows. Flood Insurance Rate Maps typically show the 1%-annual-chance (100-year) floodplain for waterways with at least 1 square mile of drainage area. The flood hazard areas for waterways with less than one square mile of drainage area typically are not shown.
- Riverine floods are a function of precipitation levels and water runoff volumes, and occur when water rises out of the banks of the waterway. Flooding along waterways that drain larger watersheds often can be predicted in advance, especially where it takes 24 hours or more for the flood crest (maximum depth of flooding) to pass. In Jefferson County, riverine flooding is caused by large rainfall systems and thunderstorm activity associated with seasonal cold fronts. These systems can take as long as a day to pass, giving ample opportunity for large amounts of rain to fall over large areas. The Flood Insurance Rate Maps show the 1%-annual-chance floodplains.
- Urban drainage flooding occurs where development has altered hydrology through changes in the ground surface and modification of natural drainage ways. Urbanization increases the magnitude and frequency of floods by increasing impervious surfaces, increasing the speed of drainage collection, reducing the carrying capacity of the land, and, occasionally, overwhelming sewer systems. Localized urban flooding is not usually shown on the Flood Insurance Rate Maps in areas with less than one square mile of contributing drainage area.

The Flood Insurance Rate Maps (FIRMs) prepared by FEMA offer the best overview of flood risks. FIRMs are used to regulate new development and to control the substantial improvement and repair of substantially damaged buildings. Flood Insurance Studies (FISs) are often developed in conjunction with FIRMs. The FIS typically contains a narrative of the flood history of a community and discusses the engineering methods used to develop the FIRMs. The

study also contains flood profiles for studied flooding sources and can be used to determine Base Flood Elevations for some areas.

The revised FIS' for both the City of Port Arthur and Jefferson County are dated August 6, 2002, however, there is a preliminary FIS dated August 2012. These FIS' compile all previous flood information and include data collected on numerous waterways. Both FIS' indicate 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. The frequent hurricanes and tropical storms interrupt the summer with high winds, heavy rainfalls, and high storm surges. FIRMs for the City of Port Arthur and Jefferson County show flood zones:

- AE Zones along rivers and streams for which detailed engineering methods were used to determine Base Flood Elevations (BFEs). AE Zones (or A1-30 Zones) are shaded in gray.
- A Zones, which are areas inundated by the 100-year flood for which BFEs and Flood Hazard Factors (FHF) have not been determined
- AH Zones, which are areas inundated by types of 100-year shallow flooding where depths are between one and three feet, and for which BFEs are shown, but no FHF are determined.
- V Zones are areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.
- VE Zones are areas subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action. Base Flood Elevations (BFEs) derived from detailed hydraulic analyses are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.
- Shaded X Zones, which are areas of "moderate" flood hazard, typically associated with the 500-year flood (or 0.2% annual chance).
- Unshaded X Zones are areas of "minimal" flood hazard, typically considered to be "out of the floodplain." Although local drainage problems and ponding may still occur, these minor flood problems typically are not shown on the FIRM.

FLOOD LOCATION

Figure 12 identifies the 100-year floodplain (shaded dark blue) and the 500-year floodplain (shaded light blue) and the VE zone (shaded purple) for Jefferson County DD7. The map shows the 100-year floodplain is predominately found along the southern half of DD7 near the Gulf of Mexico, the western edge of Sabine Lake and the tributaries leading into the Gulf.

Figure 12 – Jefferson County DD7 – 100-year Floodplain Map (Source: LJA Engineering)

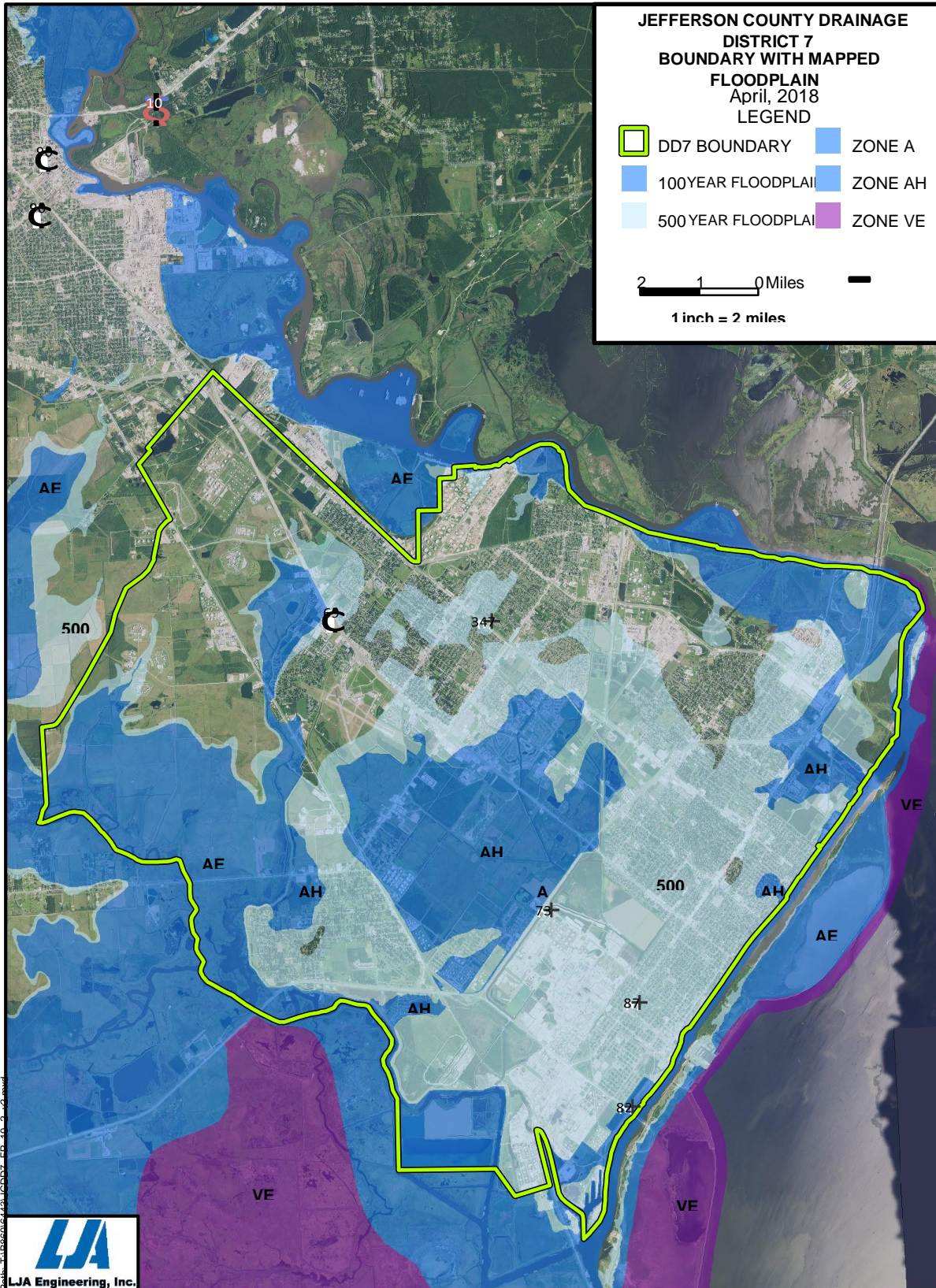
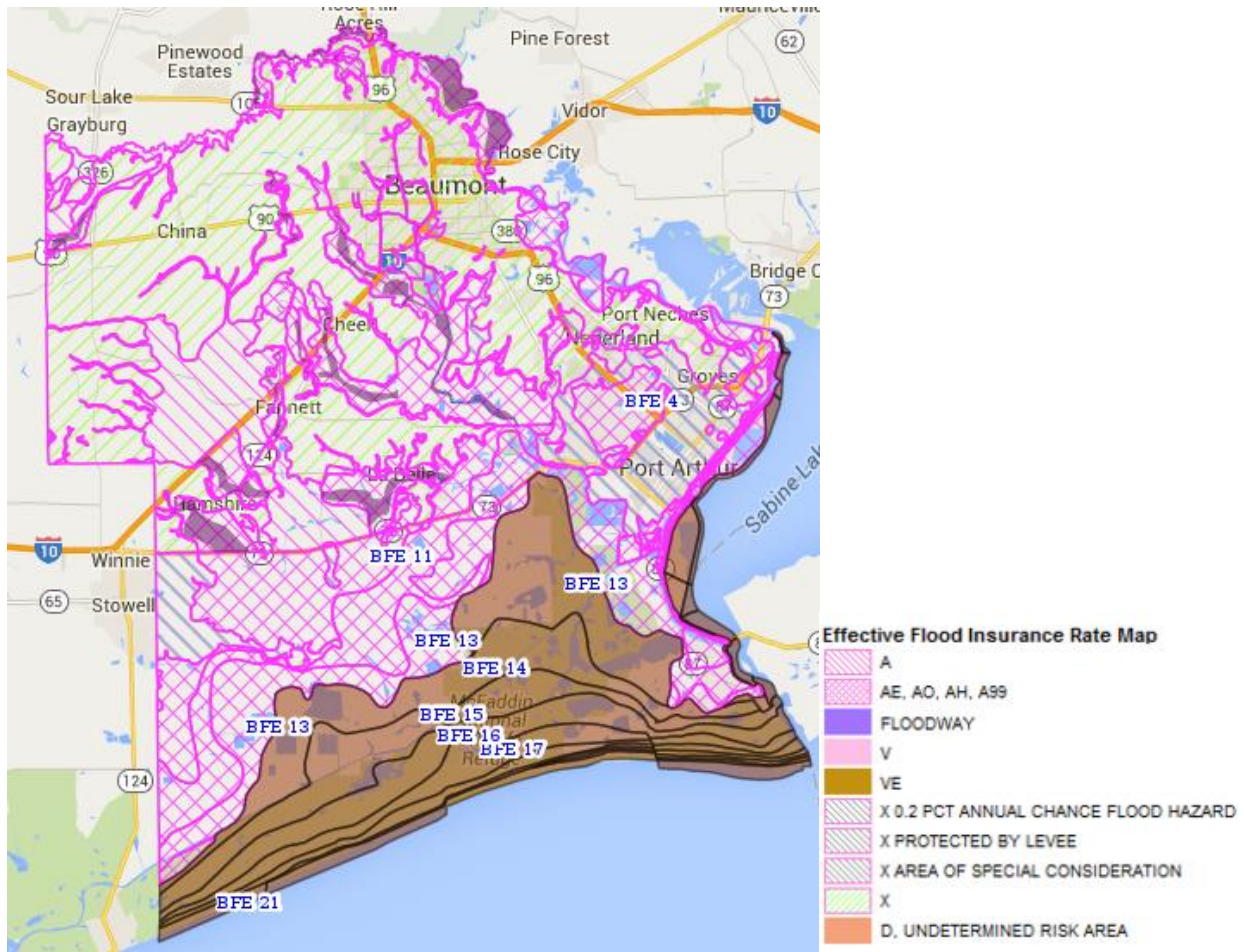


Figure 13 – Jefferson County TX Effective Flood Insurance Rate Map (Source: RiskMap6 Effective FIRM)



FLOOD EXTENT

Flood severity is measured in various ways, including frequency, depth, velocity, duration and contamination, among others. In DD7, characterizing the severity of the flood hazard depends on what part of the District is being considered, but generally speaking the issues relate to how often floods occur. Historically, floods are and continue to be the most frequent, destructive, and costly natural hazard facing the State of Texas. This is also the case within the District.

In DD7, the kind of rainfall that causes flash flooding almost always comes from hurricanes and tropical storms. This area receives the second greatest frequency of thunderstorms in the United States and is also favorable to frequent heavy rainfall, supporting an annual rainfall of approximately 60 inches. The flooding problems in the County are considered severe in some areas. The flat terrain and clay soils (which do not readily absorb water) found in this area contribute to the flood problem. In incorporated areas of the District, there are nearly 13,000 active flood insurance policies, many of which are within the floodplain. There are over 3,000

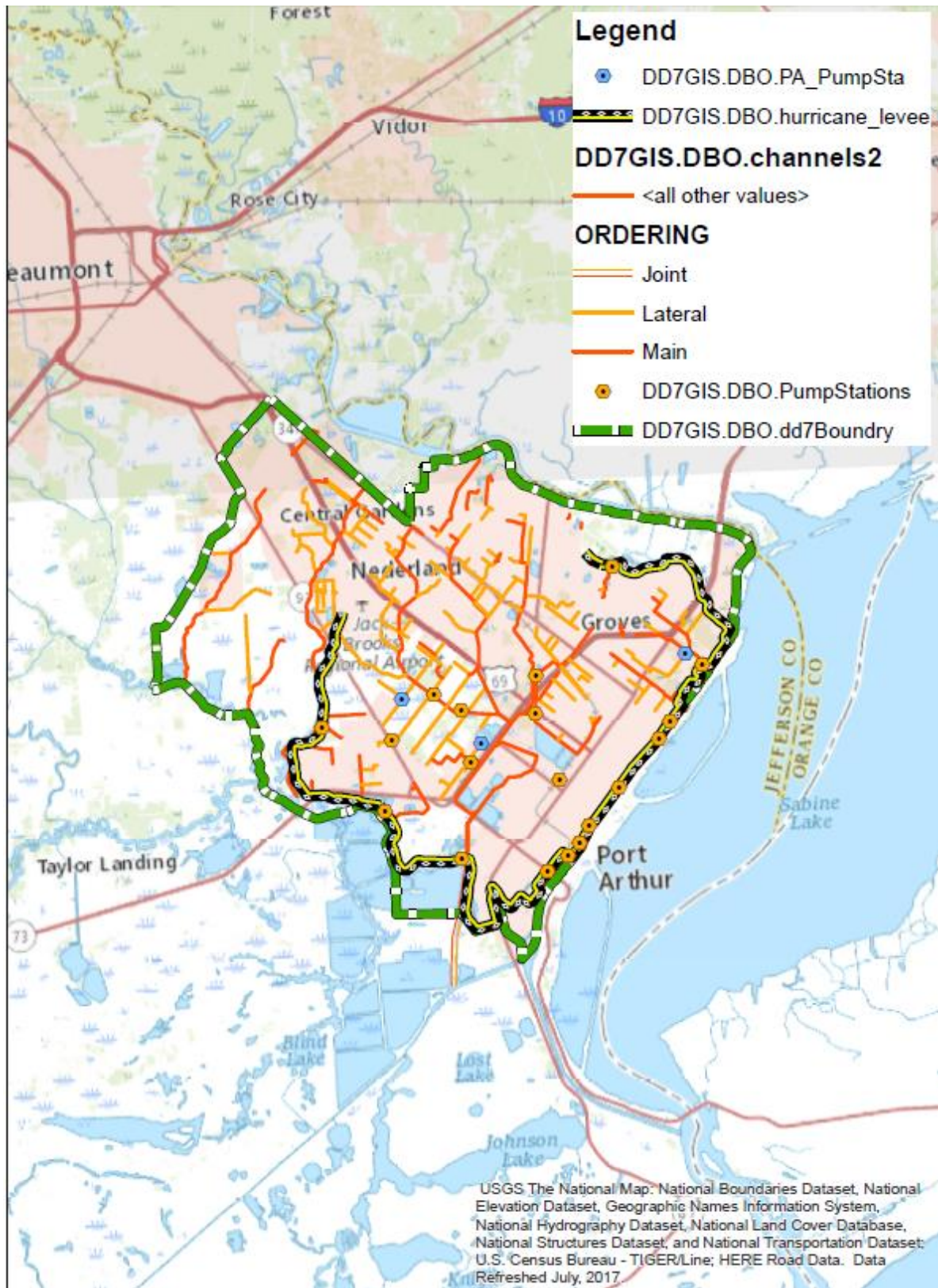
policies within unincorporated areas of Jefferson County, some of which are likely within the District.

Flooding can occur during any month of the year in DD7; however, the greatest likelihood of the occurrence is mid-summer to early winter. Mid-summer flooding (July, August, and September) is most likely to result from tropical storm and hurricane development. Flooding in the fall to early winter (October, November and December) usually results from stationary weak cold fronts.

DD7 has been actively pursuing projects to reduce the severity of flooding in the area. The majority of these projects have been drainage projects including detention ponds, ditch and channel improvements and floodwater diversions. Many of these projects have already reduced the 100-year flood levels in the project areas.

There are 13 rain gauges in the District located at some of the pump stations (the orange and blue hexagons below). The relevant rain gauges are shown in Figure 14 below.

Figure 14 – DD7 Boundary Map and Rain Gauge Location (Source: LJA Engineering)



These gauges offer the District real time data including water levels each hour which can be mapped out per storm as shown in the figure below. The figures below show rainfall per hour at each gauge as well as the total rainfall measured from Hurricane Harvey.

Figure 15 – Rainfall Per Hour During Hurricane Harvey at DD7 Rain Gauges (Source: DD7)

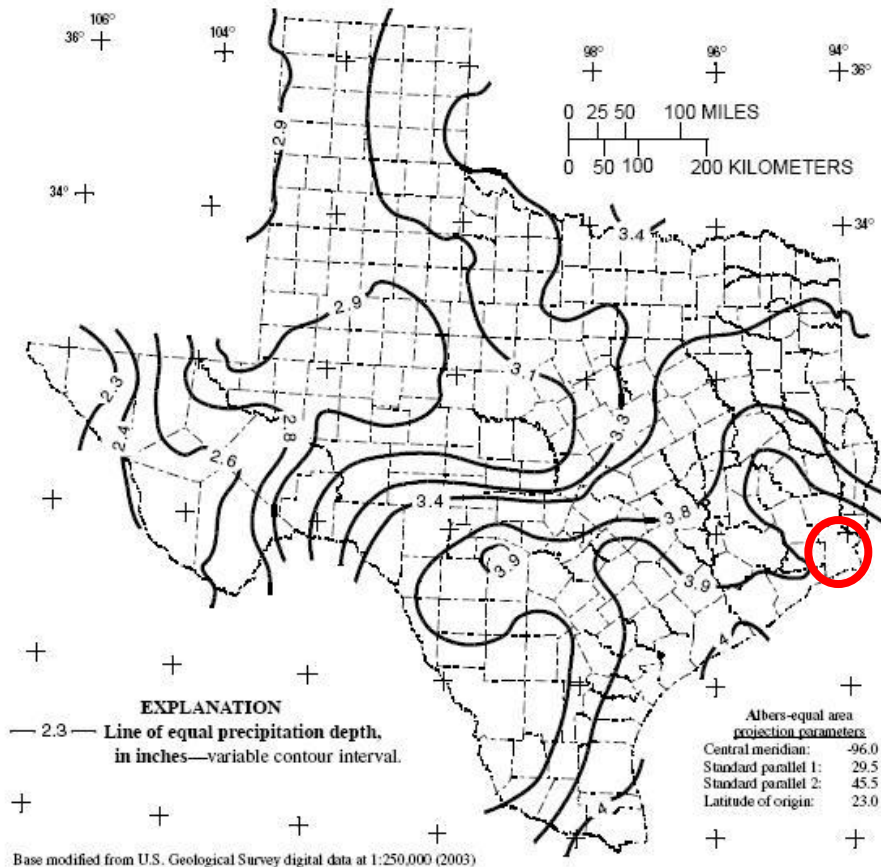
Date_Time	8901_Total Rain_Hour	8903_Total Rain_Hour	8906_Total Rain_Hour	8907_Total Rain_Hour	8910_Total Rain_Hour	8912_Total Rain_Hour	8915_Total Rain_Hour	8916_Total Rain_Hour	8918_Total Rain_Hour	8920_Total Rain_Hour	8921_Total Rain_Hour	8922_Total Rain_Hour	8923_Total Rain_Hour
08/29 8:00	0.20	0.30	0.40	0.19	0.00	0.21	0.14	0.17	0.33	0.46	0.25	0.17	0.28
08/29 9:00	0.10	0.06	0.14	0.03	0.00	0.04	0.02	0.03	0.11	0.18	0.12	0.09	0.12
08/29 10:00	0.44	0.12	0.04	0.02	0.00	0.21	0.18	0.18	0.20	0.11	0.06	0.09	0.02
08/29 11:00	0.69	0.63	0.32	0.18	0.00	0.33	0.28	0.37	0.74	0.82	0.43	0.51	0.26
08/29 12:00	0.23	0.22	0.94	0.21	0.00	0.11	0.04	0.03	0.34	0.68	0.35	0.26	0.53
08/29 13:00	0.11	0.90	0.84	1.05	0.00	1.38	1.04	0.93	1.08	0.88	0.66	1.97	0.48
08/29 14:00	1.25	1.30	2.06	1.47	0.00	1.50	1.08	0.86	1.40	1.68	1.41	1.78	1.26
08/29 15:00	1.53	1.63	3.70	1.92	0.00	2.07	2.26	1.24	1.82	2.93	1.97	1.62	2.69
08/29 16:00	0.83	0.68	1.06	0.67	0.00	0.50	0.44	0.27	0.81	1.84	1.02	1.91	1.50
08/29 17:00	0.22	0.58	0.32	0.25	0.00	0.31	0.36	0.53	0.91	0.65	0.57	0.82	0.87
08/29 18:00	0.80	0.62	0.77	0.36	0.00	0.26	0.20	0.19	0.80	1.66	0.96	0.87	0.68
08/29 19:00	0.54	0.84	0.88	0.45	0.00	0.56	0.50	0.30	1.32	1.38	0.85	0.87	0.35
08/29 20:00	1.70	2.42	2.54	1.25	0.00	1.95	1.28	1.08	2.23	2.44	1.42	2.15	1.72
08/29 21:00	1.68	1.80	2.70	0.99	0.00	0.71	0.13	0.61	1.00	2.19	2.18	1.03	2.03
08/29 22:00	1.71	1.97	1.90	1.46	0.00	1.98	1.70	1.07	1.74	1.68	1.22	1.63	1.10
08/29 23:00	0.97	0.79	1.57	0.72	0.00	0.62	0.55	1.05	2.10	2.41	1.02	1.51	1.11
08/30 0:00	1.36	1.01	1.91	1.05	0.00	1.12	1.76	1.29	1.26	3.40	1.27	1.40	1.57
08/30 1:00	1.11	0.09	3.54	1.93	0.00	2.32	0.08	0.24	1.26	1.13	1.65	1.06	2.29

Figure 16 – Rainfall Per Hour During Hurricane Harvey at DD7 Rain Gauges (Source: DD7)

Date_Time	8901_Total Rain_Hour	8903_Total Rain_Hour	8906_Total Rain_Hour	8907_Total Rain_Hour	8910_Total Rain_Hour	8912_Total Rain_Hour	8915_Total Rain_Hour	8916_Total Rain_Hour	8918_Total Rain_Hour	8920_Total Rain_Hour	8921_Total Rain_Hour	8922_Total Rain_Hour	8923_Total Rain_Hour
08/31 14:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 16:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 17:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 18:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 19:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 21:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 22:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
08/31 23:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
09/01 0:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Totals:	36.01	37.79	60.54	33.42	0.00	37.50	31.75	26.90	45.26	60.58	41.19	43.57	42.37

The bulk of the rain fell from August 29th to August 30th and dropped record amounts throughout the district, with two of the gauges measuring over 60 inches of rainfall during the storm. The figures below show what the depth of precipitation that a 50 year and 100 year storm drop in one hour. The planning area is circled in red.

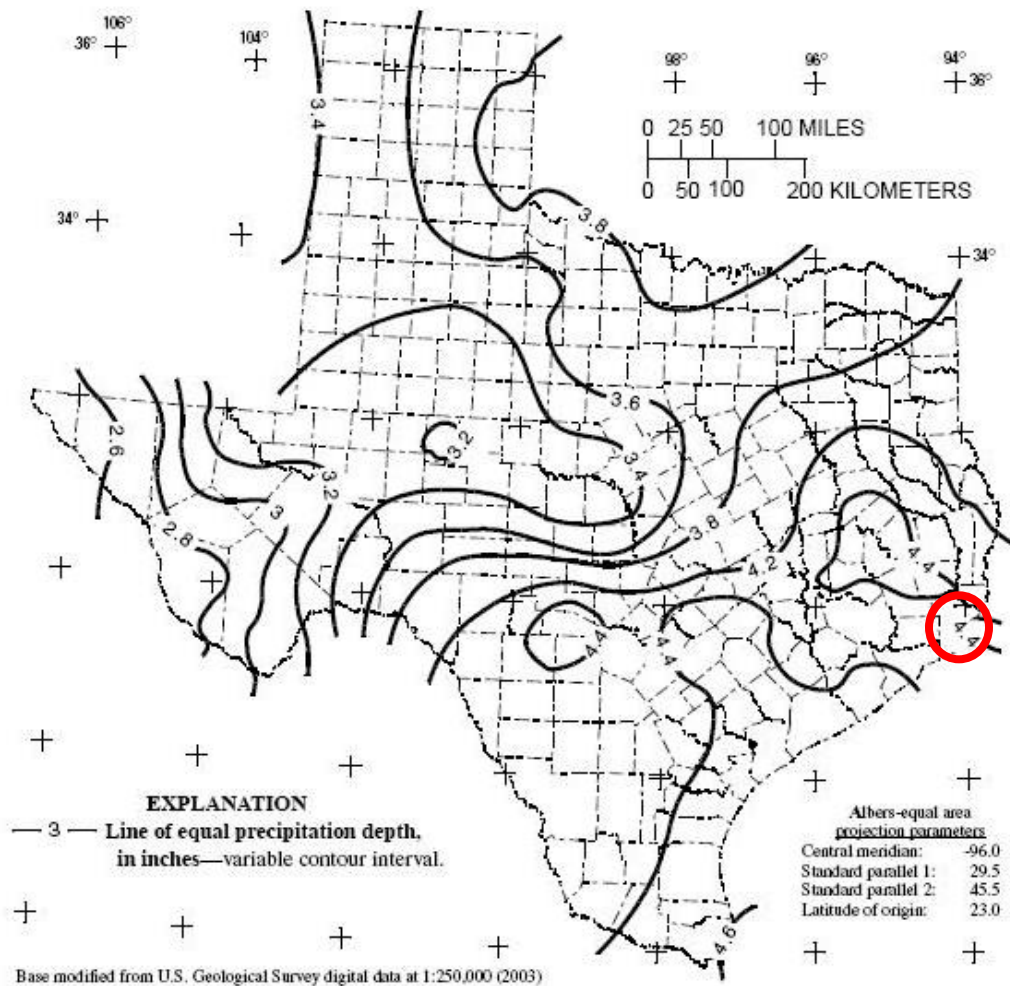
Figure 17 – Depth of Precipitation for 50-year Storm for 1-hour duration in Texas (Source: United States Geological Survey (USGS))



Depth of precipitation for 50-year storm for 1-hour duration in Texas.

Based on the above USGS map, the planning (in the red circle) area can expect, on average, an increase of 4.0" of water in one hour on the ground in a 50-year event.

Figure 18 – Depth of Precipitation for 100-year Storm for 1-hour duration in Texas (Source: USGS)



Depth of precipitation for 100-year storm for 1-hour duration in Texas.

Based on the above USGS map, the planning area (in the red circle) can expect, on average, an increase of 4.4” of water in one hour on the ground in a 100-year event.

FLOOD PREVIOUS OCCURRENCE

The NCEI indicates that Jefferson County and DD7 have experienced 23 flood events between 1996 and 2017. Of this total, six flood events have occurred since the last planning effort was underway. The NCEI database provides no indication as to why there are no events prior to 1996, although presumably occurrences follow the same pattern and frequency as shown in the NCEI list. Property damages for these events totaled \$3,500,742,000. It should be noted that two events, hurricanes Harvey and Ike contributed \$3,000,000,000 and \$500,000,000 respectively. The damages for those two events are on a countywide total as damages are not broken out to just those areas within the District. The NCEI reported seven deaths and one

injuries from the 64 flood events. The 23 flood events that have occurred since the last planning effort was under way are listed below.

Table 19 – Jefferson County Flood Events since Last Planning Effort (Source: NCEI Storm Events Database)

LOCATION	DATE	Property Damage	Injuries	Deaths	Description
BEAUMONT/PORT ARTHUR	9/27/1996	\$90,000	0	0	Over 100 homes and business had 6 inches to 2 ft of water in the region
PORT ARTHUR/ GROVES	7/30/1997	\$20,000	0	0	Street flooding
PORT ARTHUR	9/23/1997	\$10,000	0	0	Street Flooding and car accidents
NEDERLAND/ PORT ARTHUR	1/21/1998	\$40,000	0	0	Street flooding
NEDERLAND	4/12/2000	\$250,000	0	0	Several homes, businesses and a hotel had over a foot of water enter them
COUNTYWIDE*	9/1/2001	\$25,000	0	0	Street flooding across the county
COUNTYWIDE*	9/2/2001	\$75,000	0	0	Street flooding across the county
NEDERLAND/PORT ARTHUR	8/15/2002	\$20,000	0	0	Street and garage flooding
PORT ARTHUR	12/4/2002	\$50,000	0	0	Several homes flooded
PORT NECHES	10/25/2003	\$100,000	0	0	Homes and streets flooded
PORT ARTHUR	5/11/2004	\$2,000	0	0	Street flooding
NEDERLAND	5/13/2004	\$5,000	0	0	Water entered a garage
NEDERLAND	9/23/2004	\$10,000	0	0	Water entered one home
PORT ARTHUR	10/16/2006	\$5,000	0	0	Street flooding
COUNTYWIDE*	9/12/2008	\$500,000,000	0	0	4000 homes flooded county wide; at least 100 in Port Arthur
NEDERLAND/ PORT ARTHUR	4/27/2009	\$5,000	0	0	Street flooding
FT ACRES/ PORT ARTHUR	10/22/2009	\$10,000	0	0	Street flooding
GROVES/PORT NECHES	7/18/2014	\$0	0	0	Street flooding
PORT NECHES	3/21/2015	\$ 15,000	0	0	Street flooding; stalled cars
FT ACRES/ PORT NECHES	4/16/2015	\$0	0	0	Street flooding

PORT ARTHUR/ FT ACRES	11/7/2015	\$0	0	0	Street flooding
PORT ARTHUR	6/25/2017	\$10,000	0	0	Street flooding; stalled cars
COUNTYWIDE*	8/30/2017	\$3,000,000,000	1	5	The highest rainfall totals in Jefferson County were 60.58 inches 1.5 mile southwest of Nederland and 60.54 inches 1.3 mile north of Groves. This resulted in over 64,000 homes being flooded. The hardest hit areas were Port Arthur, Groves, Bevil Oaks, Hampshire, Fannet, China, and northeast Beaumont. Several refineries in the county also received floodwaters and were offline for an extended period. City and county infrastructure was also damaged with water pumps and treatment plants being inundated. DD7 had damages to the office, the mechanic shop, District vehicles, the warehouse, various electronics and the electrician shop. Damage estimates are still coming in. Record crests were observed along Pine Island and the lower Neches. 5 deaths were reported by flooding.
Total		\$3,500,742,000	1	5	

*the four events listed with a “COUNTYWIDE” location, include damages, injuries and deaths recorded across the county, not just those in the planning area.

FLOOD PROBABILITY

Jefferson County DD7 has experienced 23 floods between 1996 to 2017, a 21 year period. With so many events occurring, future probability of a flood is:

Table 20 – Flood Frequency of Occurrence

<p>Frequency of Occurrence:</p> <p><input checked="" type="checkbox"/> Highly likely; Event probable in next year</p> <p><input type="checkbox"/> Likely; Event probable in next three years</p> <p><input type="checkbox"/> Occasional; Event possible in next five years</p> <p><input type="checkbox"/> Unlikely; Event possible in next ten years</p>
--

FLOOD IMPACT AND VULNERABILITY

To develop more specific data about flood-prone buildings, as part of the Plan development, DD7 worked with LJA Engineering, who has access to a Geographic Information System (GIS) database. The tool that makes this possible is the GIS computer software application that relates physical features on the ground in mapping applications and analyses. The number of flood-prone residential and commercial buildings was re-evaluated in April 2018. Updated figures are included in the building characterizations described below.

Flood insurance policies and claims information can be used to identify buildings in mapped floodplains (where lenders require insurance) and where flooding has occurred (where owners are sufficiently concerned that they purchase flood insurance even if not required). This characterization of flood risk is described below.

Data provided by FEMA indicate that as of January 1, 2018, federal flood insurance policies were in-force on 12,787 buildings in the Cities of Port Arthur, Groves, Port Neches and Nederland. Unincorporated Jefferson County has another 3,248 policies in force, some of which are likely within the District. These insurance policies are administered by the National Flood Insurance Program (NFIP). Of those 12,787 buildings with NFIP policies still in force (active policies), 276 are Repetitive Loss structures and 32 are Severe Repetitive Loss structures (there are 48 SRLs in total but only 32 are currently insured; there are also 13 properties that are listed as pending being added to the SRL list, eight of those are currently insured). The District's vulnerability to flood is considered very high according to Table 8.

NFIP REPETITIVE LOSS PROPERTIES

In recent years, FEMA has focused considerable attention on the Repetitive Loss (RL) subset of insured buildings. These properties have received two or more claim payments of at least \$1,000 over a ten-year period. FEMA's database identifies 593 properties as Repetitive Loss properties in DD7 (this number includes properties with active flood insurance policies as well as those with inactive policies). Note that the RL properties below do not include those listed as mitigated on FEMA's Database. Collectively, they had received claim payments of over \$56.3 million (includes payments for building damage and contents damage).

As of January 1, 2018, repetitive loss statistics for areas within DD7 showed 593 Repetitive Loss properties. Of this total, 549 were categorized as residential properties and 44 were non-residential.

The RL data for Jefferson County was broken down by eliminating the properties located in the incorporated areas outside of DD7. Although it is not possible to extract only the Jefferson County DD7 RL properties, by removing the incorporated areas outside DD7 this leaves only the properties located within the incorporated areas of DD7 and the unincorporated areas for all of Jefferson County. The data was broken down further by taking those properties in

unincorporated areas that had mailing addresses of either Groves, Nederland, Port Arthur or Port Neches. Table 21 summarizes the residential and non-residential properties for each municipality within DD7.

Table 21 - Summary of Residential and Non-Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by Municipality (Source: FEMA NFIP query January 1, 2018)

Municipality	Properties	Building	Contents	Total	# of claims	Average
Groves	47	\$1,766,140.69	\$488,860.89	\$2,255,001.58	122	\$18,483.62
Nederland	116	\$7,696,489.44	\$2,416,207.49	\$10,112,696.93	355	\$28,486.47
Port Arthur	396	\$30,458,389.34	\$11,331,120.67	\$41,789,510.01	990	\$42,211.63
Port Neches	34	\$1,702,058.88	\$483,145.30	\$2,185,204.18	93	\$23,496.82
Grand Total	593	\$41,623,078.35	\$14,719,334.35	\$56,342,412.70	1,552	\$36,303.10

As indicated above, it is estimated there are 549 residential RL properties in Jefferson County DD7. Table 22 summarizes the RL claims data by municipality. The table shows that the majority of the residential RL properties are located within the City of Port Arthur. As of January 1, 2018, claim payments for all 549 residential properties totaled over \$49.3 Million.

Table 22 – Summary of Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by Municipality (Source: FEMA NFIP query January 1, 2018)

Municipality	Properties	Building	Contents	Total	# of claims	Average
Groves	45	\$1,596,410.99	\$495,709.06	\$2,082,120.05	108	\$19,278.89
Nederland	107	\$6,859,596.52	\$2,205,225.19	\$9,064,821.71	325	\$27,891.76
Port Arthur	365	\$26,780,205.93	\$9,629,082.47	\$36,409,288.40	906	\$40,186.85
Port Neches	32	\$1,443,722.76	\$381,051.48	\$1,824,774.24	87	\$20,966.11
Grand Total	549	\$36,679,936.20	\$12,701,068	\$49,381,004.40	1426	\$34,629.04

Table 23 – Summary of Non-Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by Municipality (Source: FEMA NFIP query January 1, 2018)

Municipality	Properties	Building	Contents	Total	# of claims	Average
Groves	2	\$169,729.70	\$3,151.83	\$172,881.53	4	\$43,220.39
Nederland	9	\$836,892.92	\$210,982.30	\$1,047,875.22	30	\$34,929.17
Port Arthur	31	\$3,678,183.41	\$1,702,038.20	\$5,380,221.61	86	\$62,560.72
Port Neches	2	\$258,336.12	\$102,093.82	\$309,781.74	6	\$51,630.29
Grand Total	44	\$4,943,142.15	\$2,018,266.15	\$6,961,408.30	126	\$55,249.27

The RL claims can be further broken down from listing by municipality to focusing on individual street level data. Table 24 provides a summary of residential repetitive flood insurance claims for individual streets within Jefferson County DD7 that include two or more repetitive loss properties. The data displayed in the table summarizes the NFIP repetitive loss data for 103 individual streets in DD7 that include two or more repetitive loss properties. For each street, the building, contents, and total claims data has been combined. Note that by selecting only streets with two or more repetitive loss properties, the table only includes 413 of the 549 residential RL properties estimated within Jefferson County DD7.

The table shows that for these 413 RL properties, claim payments totaled over \$41 million as of January 1, 2018. Address data about individual sites is omitted for reasons of confidentiality.

Table 24 – Summary of Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by number of Properties on Each Street (Source: FEMA NFIP query January 1, 2018)

Street Name*	Municipality	# of RL Properties	# of Claims	Total Paid
****	PORT ARTHUR	31	65	\$4,322,179.64
****	PORT ARTHUR	19	71	\$1,869,095.06
****	PORT ARTHUR	15	43	\$2,497,094.83
****	NEDERLAND	14	43	\$1,408,453.42
****	PORT ARTHUR	13	35	\$2,071,354.98
****	PORT ARTHUR	12	25	\$2,594,330.63
****	PORT ARTHUR	10	20	\$251,169.90

Street Name*	Municipality	# of RL Properties	# of Claims	Total Paid
****	PORT ARTHUR	10	20	\$815,246.35
****	PORT ARTHUR	9	20	\$1,094,054.16
****	PORT ARTHUR	8	18	\$190,869.16
****	PORT ARTHUR	7	15	\$1,111,951.77
****	PORT ARTHUR	7	18	\$241,306.07
****	NEDERLAND	6	17	\$587,744.55
****	NEDERLAND	6	19	\$715,864.16
****	NEDERLAND	6	16	\$643,214.98
****	PORT ARTHUR	6	16	\$559,214.81
****	PORT ARTHUR	6	16	\$1,261,686.53
****	PORT ARTHUR	6	13	\$171,829.38
****	PORT ARTHUR	5	11	\$246,036.83
****	NEDERLAND	5	11	\$245,011.92
****	PORT ARTHUR	5	10	\$878,617.34
****	PORT ARTHUR	5	14	\$287,642.47
****	GROVES	4	9	\$282,725.52
****	NEDERLAND	4	15	\$427,480.92
****	NEDERLAND	4	25	\$499,734.99
****	PORT ARTHUR	4	14	\$324,499.32
****	PORT ARTHUR	4	9	\$508,874.75
****	PORT ARTHUR	4	8	\$211,313.98
****	PORT ARTHUR	4	9	\$156,953.72
****	PORT ARTHUR	4	8	\$530,841.75
****	PORT ARTHUR	4	12	\$331,814.03
****	PORT ARTHUR	4	11	\$442,342.60
****	PORT ARTHUR	3	9	\$216,453.43

Street Name*	Municipality	# of RL Properties	# of Claims	Total Paid
*****	NEDERLAND	3	7	\$145,930.47
*****	NEDERLAND	3	10	\$907,441.85
*****	NEDERLAND	3	11	\$259,275.83
*****	NEDERLAND	3	7	\$162,529.98
*****	NEDERLAND	3	9	\$329,674.13
*****	NEDERLAND	3	6	\$245,354.01
*****	PORT ARTHUR	3	6	\$335,799.36
*****	PORT ARTHUR	3	6	\$229,070.46
*****	PORT ARTHUR	3	9	\$82,814.54
*****	PORT ARTHUR	3	8	\$353,860.21
*****	PORT ARTHUR	3	8	\$991,775.36
*****	PORT ARTHUR	3	6	\$482,758.07
*****	PORT ARTHUR	3	9	\$408,504.74
*****	PORT ARTHUR	3	6	\$1,055,935.05
*****	PORT ARTHUR	3	7	\$145,256.86
*****	PORT ARTHUR	3	6	\$223,079.21
*****	PORT ARTHUR	3	7	\$151,393.31
*****	PORT ARTHUR	3	8	\$168,650.41
*****	PORT NECHES	3	10	\$180,895.80
*****	GROVES	2	5	\$58,779.03
*****	PORT ARTHUR	2	4	\$80,038.50
*****	PORT ARTHUR	2	4	\$133,044.54
*****	GROVES	2	4	\$20,308.48
*****	GROVES	2	5	\$24,507.52
*****	GROVES	2	5	\$109,235.46
*****	GROVES	2	4	\$56,472.22

Street Name*	Municipality	# of RL Properties	# of Claims	Total Paid
*****	GROVES	2	7	\$70,132.74
*****	GROVES	2	5	\$38,701.50
*****	NEDERLAND	2	4	\$125,440.75
*****	NEDERLAND	2	5	\$161,779.30
*****	NEDERLAND	2	5	\$240,691.86
*****	NEDERLAND	2	5	\$188,830.59
*****	NEDERLAND	2	10	\$133,411.01
*****	NEDERLAND	2	13	\$66,655.54
*****	NEDERLAND	2	9	\$114,071.92
*****	NEDERLAND	2	6	\$87,429.95
*****	PORT ARTHUR	2	5	\$50,156.31
*****	PORT ARTHUR	2	10	\$305,613.47
*****	PORT ARTHUR	2	4	\$114,597.78
*****	PORT ARTHUR	2	6	\$95,639.35
*****	PORT ARTHUR	2	4	\$47,529.24
*****	PORT ARTHUR	2	4	\$59,462.96
*****	PORT ARTHUR	2	5	\$132,642.03
*****	PORT ARTHUR	2	4	\$27,123.52
*****	PORT ARTHUR	2	4	\$64,062.88
*****	PORT ARTHUR	2	4	\$34,889.25
*****	PORT ARTHUR	2	6	\$112,370.96
*****	PORT ARTHUR	2	5	\$61,093.28
*****	PORT ARTHUR	2	4	\$19,369.35
*****	PORT ARTHUR	2	6	\$185,062.72
*****	PORT ARTHUR	2	4	\$114,477.19
*****	PORT ARTHUR	2	5	\$123,602.25

Street Name*	Municipality	# of RL Properties	# of Claims	Total Paid
*****	PORT ARTHUR	2	5	\$210,973.50
*****	PORT ARTHUR	2	4	\$306,332.68
*****	PORT ARTHUR	2	5	\$388,423.32
*****	PORT ARTHUR	2	4	\$27,070.06
*****	PORT ARTHUR	2	4	\$164,038.21
*****	PORT ARTHUR	2	4	\$179,619.73
*****	PORT ARTHUR	2	5	\$43,412.02
*****	PORT ARTHUR	2	5	\$97,754.58
*****	PORT ARTHUR	2	6	\$20,948.50
*****	PORT ARTHUR	2	6	\$78,540.83
*****	PORT ARTHUR	2	5	\$194,069.06
*****	PORT ARTHUR	2	5	\$256,003.67
*****	PORT ARTHUR	2	5	\$78,297.22
*****	PORT ARTHUR	2	4	\$65,598.17
*****	PORT NECHES	2	4	\$44,233.19
*****	PORT NECHES	2	6	\$101,253.05
*****	PORT NECHES	2	5	\$325,435.70
*****	PORT NECHES	2	4	\$335,625.18
		413	1077	\$41,031,855.72

* Address data about individual sites is omitted for reasons of confidentiality.

FLOOD RISK TO RESIDENTIAL REPETITIVE LOSS PROPERTIES

Jefferson County DD7 has an extensive history of repetitive loss flood claims, so it is possible to perform a relatively simple statistical risk assessment using average annual losses and a present value coefficient calculation to project losses over a planning horizon. Residential flood risk is calculated by a simple methodology that uses the FEMA default present-value coefficients from the benefit-cost analysis software modules. To perform this calculation, the repetitive loss data were reviewed to determine an approximate period over which the claims occurred. This method should not be used for risk assessments for individual properties because of the generalizations that are used, but the method is appropriate for larger numbers of properties

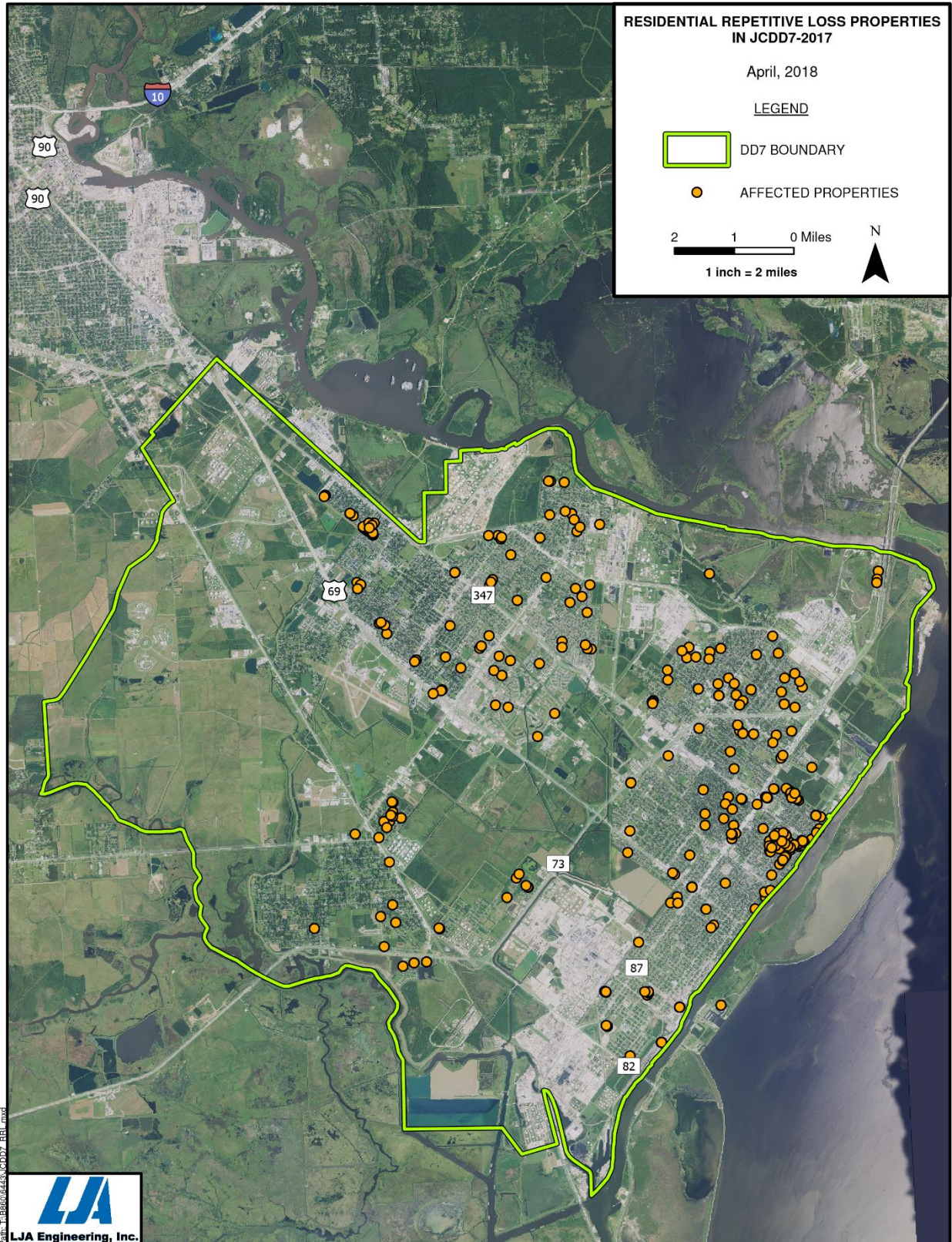
and policies that are spread over an entire jurisdiction. It is presumed that more accurate figures would be somewhat higher because the underlying statistics are for properties that had flood insurance, were flooded, and had paid claims. There are nearly always some properties in a jurisdiction that are flooded in big events, and do not have flood insurance (or did not make claims) and are thus not represented in the sample.

Most of the flood claims in this query occurred between 1979 and 2018, a period of 39 years. As shown in Table 25, there have been 1,426 claims in the 39-year period, for an average number of 37.53 claims per year. Based on a 100-year horizon and a present value coefficient of 14.27 (the coefficient for 100 years using the mandatory Office of Management and Budget (OMB) discount rate of 7.0 percent), the projected flood risk to these properties is shown at the bottom of the table. It must be understood that individuals can obtain and cancel flood insurance policies, and the flood hazard depends on many variables, including the weather, so this projection is simply an estimate of potential damages. Nevertheless, it offers a useful metric that can be used in assessing the potential cost effectiveness of mitigation actions.

Table 25 – Projected 100-year Flood Risk in Jefferson County DD7 Residential Repetitive Loss Areas (Source: FEMA NFIP query January 1, 2018)

Data	Value
Period in years	39
Number of claims	1,426
Average claims per year	37.53
Total value of claims	\$49,381,004.40
Average value of claims per year	\$1,266,179.60
Projected risk, 100-year horizon	\$18,068,382.89

Figure 19 – Number of NFIP Flood Insurance Claims Per Residential Repetitive Loss Property in Jefferson County DD7 (Source: FEMA/NFIP, Query January 1, 2018; Plotted by DD7)



NON-RESIDENTIAL REPETITIVE LOSS PROPERTIES

As noted earlier, as of January 1, 2018, Jefferson County DD7 had an estimated 44 non-residential repetitive loss properties in the NFIP database. Table 26 provides a summary of non-residential repetitive loss claims for individual streets in Jefferson County with at least five claims. The building, contents, and total claims data has been combined for streets that include more than one repetitive loss property. Similar to the residential repetitive loss data, address data about individual sites is omitted for reasons of confidentiality.

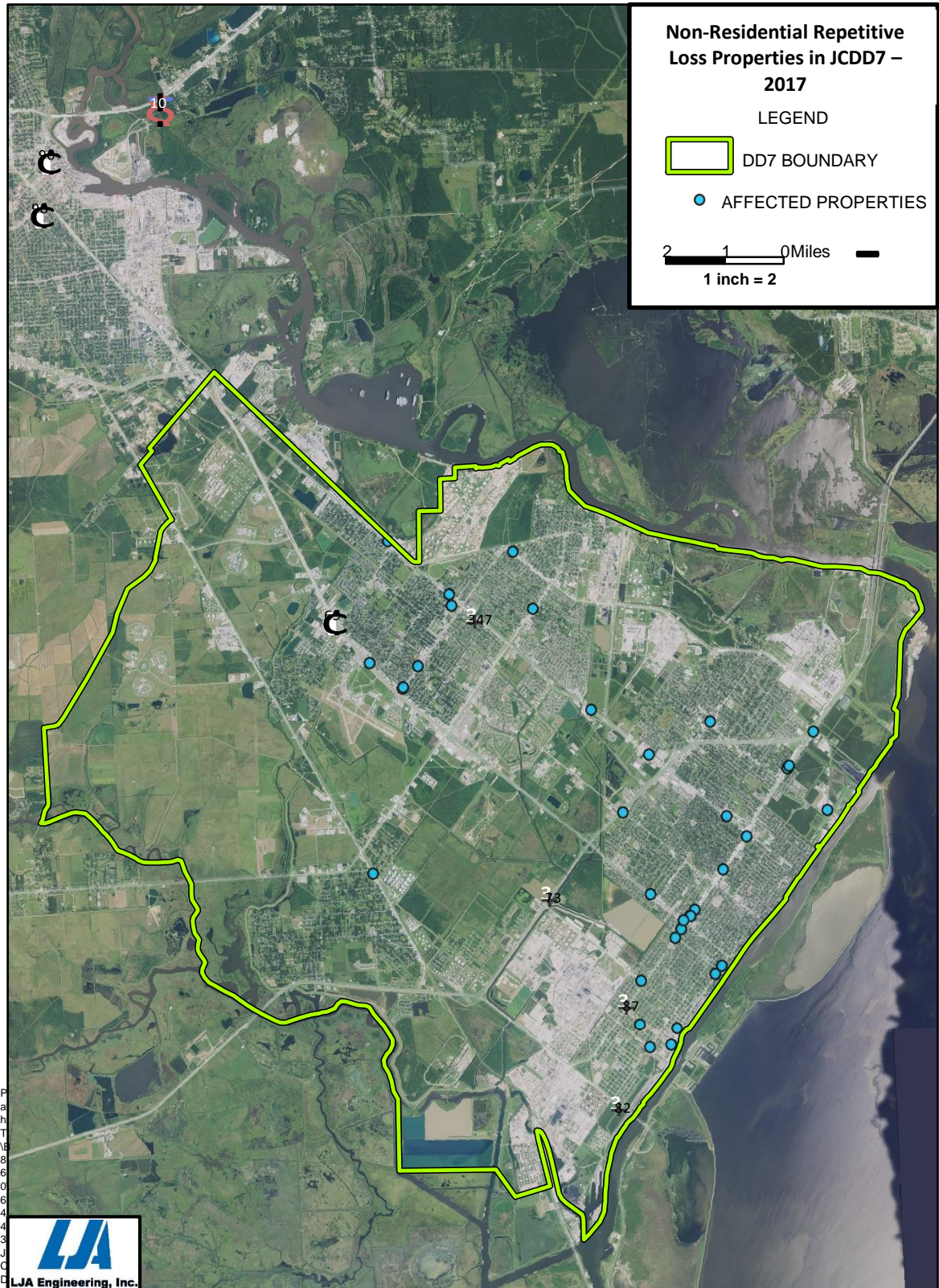
Table 26 – Projected 100-year Flood Risk, Non-Residential Repetitive Loss Properties in Jefferson County DD7 (Source: FEMA NFIP query January 1, 2018)

Street Name	Municipality	Commercial RL Properties	Claims	Total Claims	Annual Risk	100-Year Risk
*****	Port Arthur	11	42	\$1,902,353.80	\$48,778.30	\$696,066.38
*****	Nederland	3	11	\$298,095.54	\$7,643.48	\$109,072.39
*****	Port Arthur	3	7	\$198,252.48	\$5,083.40	\$72,540.07
*****	Nederland	1	5	\$291,995.43	\$7,487.06	\$106,840.38
Total		18	60	\$2,398,701.82	\$61,505.17	\$877,6789.78

It should be noted that some of the non-residential properties on this list may be at far greater flood risk than indicated, because there may have been periods where the owner(s) did not carry flood insurance, with the result that they may have been damaged but there is no record of it. This type of analysis is not totally conclusive. It would be possible to perform relatively simple engineering studies to better assess risks for properties with just a few claims, but where data suggests that sites may be vulnerable to additional flood-related losses.

The information in this section should be used for planning purposes only, i.e. as the basis for additional steps in risk assessment, and eventually (where warranted) targeted mitigation actions to reduce the risk. For example, a property that has received a number of claim payments not much higher than \$1,000 would be considered an unlikely candidate for mitigation using public funds. It may, however, be an excellent candidate for damage-reduction actions taken by the owner.

Figure 20 – Number of NFIP Flood Insurance Claims Per Non-Residential Repetitive Loss Property in Jefferson County DD7 (Source: FEMA/NFIP, January 1, 2018; Plotted by DD7)



NFIP SEVERE REPETITIVE LOSS PROPERTIES

In 2004 FEMA began to develop the Severe Repetitive Loss (SRL) Grant Program in an effort to reduce or eliminate flood damages to residential properties that met certain minimum requirements. FEMA initiated the program early in 2008. The SRL Grant Program has since been included in the FMA Grant Program, with SRL properties being a top priority. An SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- 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.

SRL properties are a subset of the RL list and include only residential structures. As of January 1, 2018, Jefferson County DD7 had 48 properties on the SRL list, 32 of which are currently insured. There are also another 13 properties that are listed as pending to be added to the SRL list and were not included in the below table. Table 27 provides loss estimates for SRL properties in DD7 summarized at the street level, as calculated by FEMA and the NFIP. The table shows that within DD7, Port Arthur has the highest number of SRL properties.

Table 27 – Projected 100-year Flood Risk, Severe Repetitive Loss Properties in Jefferson County DD7 by Street (Source: FEMA/NFIP, Query January 1, 2018)

Street Name	Municipality	Claims	Properties	Total Claims (\$)	Annual Risk	100-year risk
*****	Port Arthur	35	6	\$968,808.76	\$24,841.25	\$354,484.64
*****	Nederland	15	3	\$582,922.37	\$14,946.73	\$213,289.80
*****	Nederland	22	3	\$363,581.14	\$9,322.59	\$133,033.41
*****	Nederland	8	2	\$368,619.59	\$9,451.78	\$134,876.96
*****	Port Arthur	4	2	\$301,887.67	\$7,740.71	\$110,459.92
*****	Nederland	8	2	\$879,143.78	\$22,542.15	\$321,676.45
*****	Port Arthur	4	2	\$616,021.46	\$15,795.42	\$225,400.67
*****	Nederland	8	2	\$259,159.37	\$6,645.11	\$94,825.75
*****	Port Neches	8	2	\$374,702.17	\$9,607.75	\$137,102.56
Remaining 24 SRL Properties (all on different streets)	DD7	117	24	\$3,037,447.30	\$77,883.26	\$1,111,394.18
Total		229	48	\$7,752,293.61	\$198,776.76	\$2,836,544.35

It should be noted that some of the properties on this list may be at far greater flood risk than indicated, because there may have been periods where the owner(s) did not carry flood insurance, with the result that they may have been damaged but there is no record of it. This type of analysis is not totally conclusive. It would be possible to perform relatively simple engineering studies to better assess risks for properties with just a few claims, but where data suggests that sites may be vulnerable to additional flood-related losses.

The information in this section should be used for planning purposes only, i.e. as the basis for additional steps in risk assessment, and eventually (where warranted) targeted mitigation actions to reduce the risk.

The SRL properties can also be mapped to identify the floodprone areas of DD7. Figure 21 highlights the total number of NFIP severe repetitive loss flood insurance claims per property in Jefferson County DD7. The map shows that the SRL properties in DD7 are mainly concentrated within the Cities of Port Arthur and Nederland.

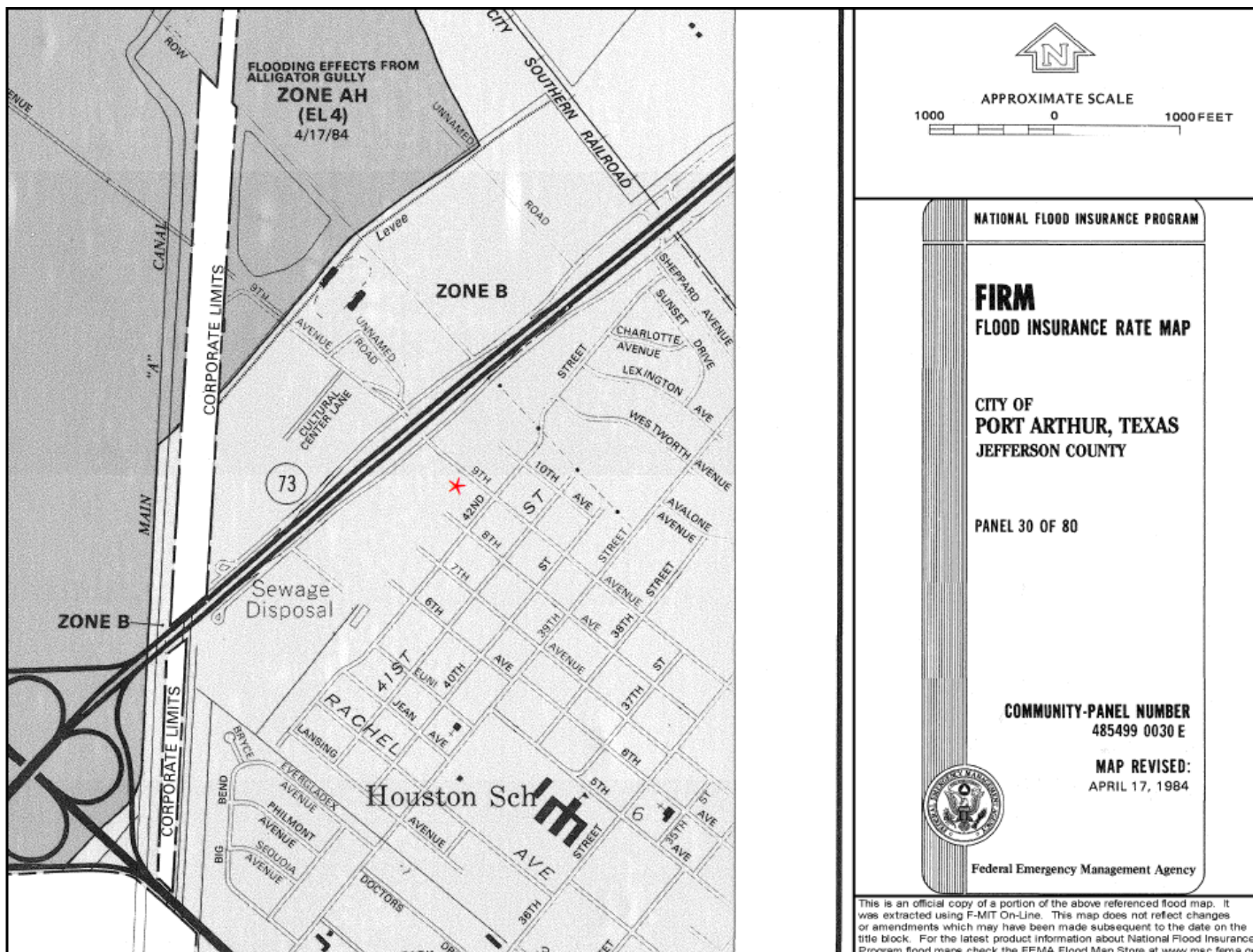
Figure 21 – Number of NFIP Flood Insurance Claims Per Severe Repetitive Loss Property in Jefferson County DD7 (Source: FEMA/NFIP, Query January 1, 2016; Plotted by DD7)



FLOOD RISKS – PUBLIC BUILDINGS

DD7 owns one complex of buildings in the planning area. As shown in Figure 22, these buildings are not located in the Special Flood Hazard Area and have never experienced flooding until Hurricane Harvey. In Harvey, DD7 had damages to the office, the mechanic shop, District vehicles, the warehouse, various electronics and the electrician shop. Damage estimates are as follows; the electrician shop and meeting room are each estimated at \$5,000 to \$20,000 in repairs and will begin in 2018. The warehouse repairs have been completed at a cost of \$53,495.27. The main office received an insurance payment for \$395,000 and repairs will begin soon.

Figure 22 – DD7 Owned Facilities FIRM (Source: FEMA Map Service Center)



Public Schools. The Port Arthur Independent School District (PAISD) owns 14 public schools. A review of the FIRM indicates none of these schools are in the mapped floodplain. As part of the 2018 Plan update, the FIRM maps were again reviewed and verified that none of the 14 schools within the PAISD are located within the floodplain.

FLOOD RISKS – DISTRICT ASSETS

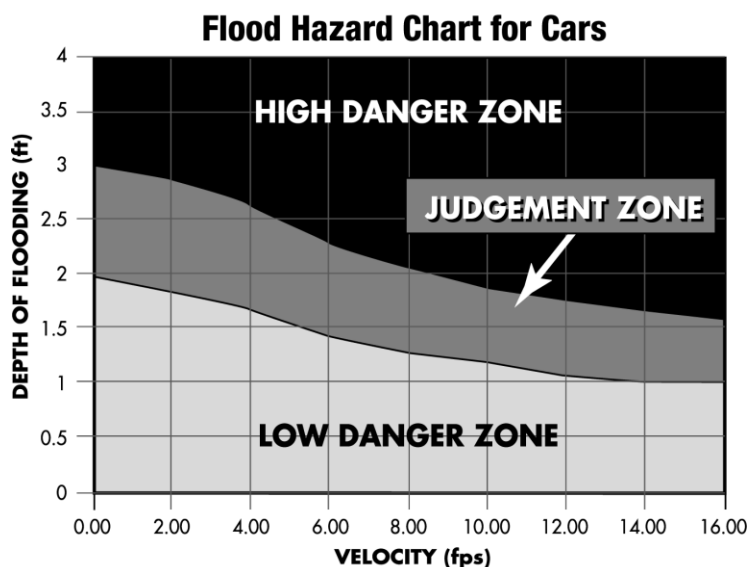
Aside from District facilities and contents, DD7 also owns other assets such as mobile equipment and contractor equipment and other vehicles totaling to \$1,045,171 in insured value. Those vehicles are mainly stored on District property, far from the floodplain. However, some of these vehicles are often in use and at various project sites that may be in a floodprone area. DD7 closely monitors the weather and takes proactive steps, when possible, to move vulnerable equipment to higher ground when equipment is being operated or staged in a floodprone area.

FLOOD RISKS – ROADS

Nationwide, flooded roads pose the greatest threat to people during floods. Most of the more than 200 people who die in floods each year are lost when they try to drive across flooded roads. Driving into water is the number one weather-related cause of death in Central Texas. Statewide, between 1960 and 1996, 76% of flood-related deaths were vehicle-related.

As illustrated in Figure 23, flood hazards for cars vary with both velocity and depth of floodwaters. Many cars will float in less than 24 inches of water. Fast-moving water can quickly wash cars off the road or wash out a low section of road.

Figure 23 – Flood Hazard Chart for Cars (Source: Downstream Hazard Classification Guidelines)



SOURCE: USBR, "Downstream Hazard Classification Guidelines," 1988

Although most roads in the area are unlikely to have deep or fast-moving water during flood conditions up to the level of the 100-year flood, many are still known to flood regularly. Within the City of Port Arthur and Jefferson County there are approximately 938 miles of roads.

The Texas Department of Transportation (TXDOT) maintains the freeways that run through the City and County. These major roadways include the following:

- Highway 73
- Twin City Highway
- Memorial Boulevard
- Highway 366
- Highway 365
- Martin Luther King Jr Drive
- Highway 69
- W Port Arthur Road (Spur 93)
- Gulfway Drive (Highway 87)
- Highway 87

Due to the extensive and common road flooding in the DD7 planning area, it would be nearly impossible to generate a list of flood-prone roads. Due to this reason, the City and County do not close roads due to flooding. However, the City does close major underpasses where water tends to get much deeper. This is accomplished by waiting until the water is deep enough to warrant the closure. There are water depth signs at these major underpasses.

When building new State roads or upgrading existing roads, TxDOT considers the NFIP's floodplain and floodway requirements to evaluate the impact of new and replacement structures. The City and County consider floodplain and floodway impacts in its planning and design for area roads. Within the City of Port Arthur, developers must satisfy the City's drainage criteria and other aspects of road designs in order for the City to accept ownership.

Replacing roads and bridges damaged or washed out by floods costs millions of dollars each year. If the damage is caused by a Presidentially-declared disaster, FEMA may pay up to 75% of the repair or replacement costs, with the remaining 25% covered by the State and local governments. The full costs of a damaging event that is not declared a major disaster must be borne by the State and local communities.

TXDOT inspects State bridges for structural integrity and to determine if erosion is a risk. Where erosion has been identified, stabilization measures have been put into place.

Roads and drainage structures in the area have sustained limited erosion damage due to flooding. Damage has occurred to two bridges in area, the bridge on Phelan, and the Bridge on Longhorn Rd. Staff interviews resulted in the following characterizations of past road flooding:

- Most roads in the area are designed to carry water and, therefore, flood even in small events.
- The worst street flooding tends to be on feeder roads.

FLOOD RISKS – LOCAL DRAINAGE

Many areas and streets experience accumulations of rainfall that are slow to drain away, which may cause disruption of normal traffic, soil erosion, and water quality problems. Local drainage problems contribute to the frequency of flooding, increased ditch maintenance costs, and are perceived to adversely affect the quality of life in some neighborhoods.

Many areas prone to shallow, local drainage flooding are not shown on the City or County's Flood Insurance Rate Maps. One measure of the magnitude of this problem is the number of flood insurance policies in-force on buildings that are outside of the mapped floodplain. Local drainage flooding throughout some subdivisions in DD7 is a problem, even during frequent rainstorms. It is a concern because access for emergency services (fire, emergency medical) can be limited. While the depth of water generally is relatively shallow, a number of homes have been flooded repetitively and are identified by FEMA as repetitive loss properties.

CONTINUED COMPLIANCE WITH THE NFIP

County and City participation in the National Flood Insurance Program (NFIP) is important to DD7 and its residents. This is evidenced by the Cities in the planning area, and the County's commitment to regulating development and redevelopment, by adoption of provisions that exceed the minimum requirements, and by its active pursuit of mitigation opportunities. The Cities and Jefferson County, with support from DD7, are firmly committed to continued compliance with the NFIP. It is important to note that DD7 cannot participate in the NFIP as Cities and Counties do. It cannot not apply for NFIP (Cities and County do) or CRS (Cities and County do) status. However, it supports the communities within its planning area in any way it can to keep its standing in the NFIP and CRS.

DD7 is a conservation and reclamation district and a political subdivision of the State of Texas. Considering DD7 is a separate entity and does not directly participate in the NFIP, specific actions will be determined by representatives and officials with the incorporated areas and Jefferson County within DD7. With this in mind, DD7 did not identify and prioritize NFIP actions as part of the planning process. DD7 will continue to work closely with the cities and Jefferson County to identify and recommend actions that will ensure continued compliance with the NFIP. DD7 is actively working on a Master Drainage Plan that will allow the District to establish and enforce regulations and to control development within existing flood zones.

The City of Groves, Nederland, Port Arthur and Port Neches all satisfied requirements for initial participation in the NFIP and joined the Emergency Program and ultimately the regular program in 1970.

Jefferson County satisfied requirements for initial participation in the NFIP and joined the Emergency Program. Upon issuance and final approval of the Flood Insurance Rate Map in June of 1983, the County joined the Regular Program. The effective Flood Insurance Rate Map for the County has been revised a number of times to reflect more detailed information and changes to the floodplain and is now used as the minimum flood hazard area within which development must conform to floodplain management regulations.

SECTION 3 – MITIGATION STRATEGY

DD7’S MITIGATION GOALS

State and federal guidance and regulations pertaining to mitigation planning require the development of a mitigation goal statement that is consistent with other goals, mission statements and vision statements. To do so, the MPC reviewed FEMA’s national mitigation goals, several examples of goal statements from other states and communities, and the State of Texas’ Mitigation Goal. The committee also considered information about natural hazards that may occur in the area and their potential consequences and losses.

As part of the Plan update, DD7’s mitigation goal statement from the previous HMP was reviewed by the MPC during the initial meeting held on June 7, 2017. The MPC determined that the mitigation goal statement remains current as is with no changes or modifications. The mitigation goal statement remains as follows:

DD7’S MITIGATION GOAL STATEMENT

The mitigation goals of DD7 are:

- To protect public health, safety, and welfare;
- To reduce losses due to hazards by identifying hazards, minimizing exposure of citizens and property to hazards, and increasing public awareness and involvement;
- To facilitate the development review and approval process to accommodate growth in a practical way that recognizes existing stormwater and floodplain problems while avoiding creating new problems or worsening existing problems; and
- To seek solutions to existing problems.

STATE OF TEXAS MITIGATION GOALS

The Texas Division of Emergency Management (TDEM) is designated by the Governor as the state’s coordinating agency for disaster preparedness, emergency response, and disaster recovery assistance. TDEM also is tasked to coordinate the state’s natural disaster mitigation initiatives and administer grant funding provided by FEMA. A key element in that task is the preparation of the State of Texas Hazard Mitigation Plan. The State’s 2007 plan includes a series of mitigation goals. As part of the 2013 State of Texas HMP update, the goals from the previous State Plan were re-assessed by the planning committee. TDEM reviewed the goals and added Goal 5 and Goal 6 to their Plan Update.

Goal 1 Reduce or eliminate hazardous conditions that may cause loss of life

Goal 2 Reduce or eliminate hazardous conditions that may inflict injuries

Goal 3 Reduce or eliminate hazardous conditions that can cause property damages

Goal 4 Reduce or eliminate hazardous conditions that degrade important natural resources

Goal 5 Reduce or eliminate repetitive losses due to frequent probability of occurrence

Goal 6 Lessen economic impact within communities when hazards occur

FEMA'S MITIGATION GOAL

FEMA's mitigation strategy is set forth in a document originally prepared in the late 1990s. This strategy is the basis on which FEMA implements mitigation programs authorized and funded by the U.S. Congress. The national mitigation goal Statement is as follows:

To engender fundamental changes in perception so that the public demands safer environments in which to live and work; and

To reduce, by at least half, the loss of life, injuries, economic costs, and destruction of natural and cultural resources that result from natural disasters.

IDENTIFYING PRIORITY ACTIONS

The 2013 DD7 Plan had ten mitigation actions. At the time of this Plan Update, many of those actions have been completed and their statuses are listed below. As part of this Plan update, the mitigation actions items from the 2013 Plan were updated to reflect DD7's current priorities for specific activities to achieve the goals discussed above. Each action item identifies an appropriate lead person for each action, cost effectiveness, a schedule for completion and suggested funding sources. For this Plan update, the MPC kept the same priorities, but instead of using STAPLEE, the actions were ranked based on the Mitigation Action Evaluation Worksheet. This worksheet helps evaluate and prioritize each mitigation action being considered by the planning team based on ten general criteria: Life Safety, Property Protection, Technical, Political, Legal, Environmental, Social, Administrative, Local Champion and Other Community Objectives. Table 28 describes the criteria used in the Mitigation Action Evaluation Worksheet. The Mitigation Action Evaluation Worksheet is shown below.

MITIGATION ACTION EVALUATION WORKSHEET

Use this worksheet to help evaluate and prioritize each mitigation action being considered by the planning team. For each action, evaluate the potential benefits and/or likelihood of successful implementation for the criteria defined below.

Rank each of the criteria with a -1, 0 or 1 using the following scale:

- 1 = Highly effective or feasible
- 0 = Neutral
- -1 = Ineffective or not feasible

Example Evaluation Criteria

Life Safety – How effective will the action be at protecting lives and preventing injuries?

Property Protection – How significant will the action be at eliminating or reducing damage to structures and infrastructure?

Technical – Is the mitigation action technically feasible? Is it a long-term solution? Eliminate actions that, from a technical standpoint, will not meet the goals.

Political – Is there overall public support for the mitigation action? Is there the political will to support it?

Legal – Does the community have the authority to implement the action?

Environmental – What are the potential environmental impacts of the action? Will it comply with environmental regulations?

Social – Will the proposed action adversely affect one segment of the population? Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?

Administrative – Does the community have the personnel and administrative capabilities to implement the action and maintain it or will outside help be necessary?

Local Champion – Is there a strong advocate for the action or project among local departments and agencies that will support the action's implementation?

Other Community Objectives – Does the action advance other community objectives, such as capital improvements, economic development, environmental quality, or open space preservation? Does it support the policies of the comprehensive plan?

Table 28 – Mitigation Action Evaluation Worksheet

MITIGATION ACTION EVALUATION WORKSHEET 6.1

Mitigation Action	Life Safety	Property Protection	Technical	Political	Legal	Environmental	Social	Administrative	Local Champion	Other	Total Score
HFPL Study	1	1	1	0	1	0	0	1	0	0	5
Update Data Oper. Syst.- Control Center	0	0	1	0	1	0	0	1	1	0	4
Lateral B4A & B4A ext. improvements	0	1	1	1	1	0	0	1	1	-1	5
Beauxart Gardens Central Ditch	0	1	1	1	1	0	0	1	1	-1	5
Re-establish Impact Barriers in Turning Basin	1	1	1	1	1	1	0	1	1	0	8
Upgrade to Lateral B4B	0	1	1	1	1	0	0	1	1	-1	5
Repair Lateral C12	0	1	1	1	1	0	0	1	1	-1	5
Storm Water Management Plan	0	0	1	1	1	0	0	1	1	1	6
Upgrade Pumping Capacity at each DD7 Pump Station	1	1	1	1	1	0	0	1	1	1	8
Hardening of all DD7 structures against severe storms	0	1	1	1	1	0	0	1	1	0	6
Build New EOC/ Office Building	0	1	1	1	1	0	1	1	1	1	8
Additional Fuel Capacity at Pump Stations	1	1	1	1	1	0	1	1	1	1	9
Repair/Re-design HFPL from Station. 879+58-934+75	0	1	1	0	1	1	0	1	1	0	6
Blocks Bayou Repairs/Improvements	1	1	1	1	1	0	0	1	1	0	7
Upgrade El Vista P.S.#2	0	1	1	1	1	0	1	1	0	0	6
Rehab Gate Structures – P.S. #19	0	1	1	1	1	0	1	1	0	0	6
Develop Data Collection System	0	0	1	1	1	1	1	1	0	0	6

The Mitigation Planning Committee members developed and prioritized the actions using the Mitigation Action Evaluation Worksheet. As part of the Plan update, the action tables from the 2013 version of the Plan were distributed to the MPC and members were requested to update and provide comments. The updates and comments received were integrated into the Action Table for the Plan update. The updated high priority action items were prioritized by the MPC based on the Mitigation Action Evaluation Worksheet and their potential to reduce risk to DD7, including its operations, and physical assets. The highest priority actions are generally those that are most effective in reducing risks to multiple assets simultaneously.

These priorities were applied to update the action items. In addition, new actions were identified. The new actions were prioritized, ranked, with an estimated cost and impact on new buildings and infrastructure (Table 30). A key criterion in DD7’s prioritization of actions was the cost-effectiveness of actions and projects. Cost effectiveness will continue to be central to DD7’s decision-making processes in identifying and funding mitigation actions.

DD7'S MITIGATION ACTIONS

Table 29 – Status of Mitigation Actions from the 2013 Plan

No.	Action Item Description / Benefits	Schedule	Status
1	Rodair Gully System Detention – Construct a detention pond on Rodair Gully in the vicinity of West Port Arthur Road. Detention Pond will be of adequate size to reduce flooding downstream while allowing for improvement to the upstream drainage channels.	As revenue becomes available	Want to keep as a priority, some preliminary engineering has taken place, however funding has to be available so the project will be 5-10 years
2	Update the current HEC-HMS and HEC-RAS Models – Revise the existing HEC-HMS and HEC-RAS models to include channel improvements that have been completed to date and to show the current and proposed land use/development within the watersheds. Proposed drainage system improvements will be identified based on the new models.	2017	Complete
3	Develop and adopt a master drainage plan in order for DD7 to exercise the authority granted to drainage districts under Chapter 49.211 of the Texas Water Code. Chapter 49.211 requires districts to adopt master drainage plans before adopting rules relating to the review and approval of proposed development drainage plans.	2017	Will be completed in 2018
4	Improvements on McFadden/Weiss Canal Channel to reduce flooding.	2017	Ongoing; as revenue becomes available
5	Obtain generators for DD7 facilities once it is determined if new or upgraded generators are needed.	As revenue becomes available	Generators are on all buildings; upgrade as revenue becomes available
6	Harden the DD7 Office with hurricane shutters.	As revenue becomes available	Complete

7	Determine costs of hardening a portion of the new building that has yet to be constructed to be used for temporary housing of essential personnel from DD7 or an EOC. If cost effective, recommend to DD7 Board to find funds (e.g. Grants) to construct.	As revenue becomes available	Ongoing; 2018 (Funded by DD7)
8	Construct an EOC. During a major storm event, such as hurricanes, tropical storms and heavy rains causing flooding, an Emergency Operations Center (EOC)/Office would be utilized to manage overall operations of the system and serve as a shelter for District Employees. In the event of hurricanes, employees are required to stay on the job as a condition of employment, even when mandatory evacuation is called. This, in itself, would justify the need for such a facility.	As revenue becomes available	Ongoing (new building will be constructed); 2018 (funded by DD7)
9	Reparation/upgrade of levee systems within jurisdiction. Identified deficiencies or unacceptable conditions of the levee systems by USACE will require major repairs or upgrades that DD7 will be required to complete and fund. Estimated cost is currently unknown but could be in the multitude of millions of dollars, depending on the severity of the deficiency.	As revenue becomes available	Ongoing with levee inspections every 3-5 years, the district estimates some form of reparation or upgrade with each inspection.
10	Inundation map development - Due to the data deficiency identified as part of the Levee Failure Risk Assessment, work with levee owners and TCEQ to encourage the development of inundation maps for all high hazard levees within the planning area. When and if available, this data will be used for the next plan update to complete a more thorough risk assessment, to include extent and impact of potential dam failures.	As revenue becomes available	Ongoing. Galveston US Army Corp of Engineers did a risk assessment of Levee system to help with information

Table 30 – DD7’s NEW 2018 Mitigation Actions

No	Action Item Description / Benefits	Lead Manager	Schedule and Priority	Hazard	Est. Cost and Rank	Description
1	Hurricane Flood Protection Levee Study	DD7	Schedule 3 Years Evaluation Worksheet Score: 5	Wind, Flood, Hurricane/ Tropical Storm and Dam and Levee Failure	\$750,000 Very Cost Effective	Continue working with USACE on studies and possible upgrade to help reduce the risk of flooding and to help the District review and update levees in jurisdictional area.
2	Update Data Operations System-Control Center	DD7	Schedule Grant app in now; 2 years Evaluation Worksheet Score: 4	Wind, Flood, Hurricane/ Tropical Storm and Dam and Levee Failure	\$100,000	This will allow the District to view what pump stations are operating at a certain time (real time run info) see how the systems are working; relates to how much rain we are getting. Count rain in 15 different places in the district. Monitor pumps/generator conditions and status Monitor rainfall totals and monitor pump facility conditions throughout storm events

No	Action Item Description / Benefits	Lead Manager	Schedule and Priority	Hazard	Est. Cost and Rank	Description
3	Upgrade El Vista P.S.#2	DD7	Schedule 2 Years once funded Evaluation Worksheet Score: 6	Wind, Flood, Hurricane/ Tropical Storm	\$750,000	Harden structure – put new building in place and install a new robotic trash raking system making it much more efficient to operate
4	Lateral B4A and B4A Ext. Improvements	DD7	Schedule 1 Year Evaluation Worksheet Score: 5	Flood and Hurricane/ Tropical Storm	\$900,000	Consists of widening those channels to increase the runoff capacity – upgrading/enlarging road crossing to reduce out of bank flooding.
5	Beauxart Gardens Central Ditch	DD7	Schedule 1 Year Evaluation Worksheet Score: 5	Flood and Hurricane/ Tropical Storm	\$175,000	Consists of widening those channels to increase the runoff capacity – upgrading/enlarging road crossing to reduce out of bank flooding.

No	Action Item Description / Benefits	Lead Manager	Schedule and Priority	Hazard	Est. Cost and Rank	Description
6	Re-establish Impact Barriers in Turning Basin	DD7	Schedule 5 Years once funded Evaluation Worksheet Score: 8	Wind, Flood, Hurricane/ Tropical Storm	\$4,000,000	To reduce the risk of barges and large vessels from impacting the Hurricane levee during major storm events. To keep vessels that may have broken loose during storm event from impacting the levee system.
7	Upgrade to Lateral B4B	DD7	Schedule 12- 18 months Evaluation Worksheet Score: 5	Flood and Hurricane/ Tropical Storm	\$50,000	Consists of widening those channels to increase the runoff capacity – upgrading/enlarging road crossing to reduce out of bank flooding

No	Action Item Description / Benefits	Lead Manager	Schedule and Priority	Hazard	Est. Cost and Rank	Description
8	Rehab Gate Structures – P.S. #19	DD7	Schedule 2 Years Evaluation Worksheet Score: 6	Flood and Hurricane/ Tropical Storm	\$200,000	Currently underway. Gate structures take water into detention pond. This will enhance the detention capability in existing watershed.
9	Develop Data Collection System	DD7	Schedule Underway. 4-6 Months to finish Evaluation Worksheet Score: 6	Wind, Tornado Flood, Hurricane/Tropical Storm and Dam/Levee Failure	\$200,000	Documenting Developing data collection system to track maintenance and system efficiencies for reporting purposes. Develop collection system where we can log all changes/repairs/upgrades/maintenance – so info can be brought up and sent. Pump/ditch/engine – depository so they are prepared to submit any info to another entities (USACE or FEMA, etc.). Helps show how things were maintained and how much money was spent to maintain system.

No	Action Item Description / Benefits	Lead Manager	Schedule and Priority	Hazard	Est. Cost and Rank	Description
10	Repair Lateral C12	DD7	Schedule 2 Years Evaluation Worksheet Score: 5	Flood and Hurricane/ Tropical Storm	\$400,000	In need of repair from within the channel. Repairing concrete lining to ensure the lateral C12 can run more efficiently and make it easier to maintain. This will enhance the channel bank
11	Storm Water Management Plan	DD7	Schedule 6 Months to 1 Year Evaluation Worksheet Score: 6	Wind, Flood, Hurricane/ Tropical Storm and Dam/Levee Failure	\$50,000	Help to establish regulations to control development within existing flood zones. Allows the District to enforce regulations.
12	Upgrade pumping capacity at each DD7 Pump Station	DD7	Schedule 5-10 Years Evaluation Worksheet Score: 8	Wind, Flood, Hurricane/ Tropical Storm and Dam/Levee Failure	\$4,000,000	Congress authorized and the Sabine to Galveston Study and appropriation of funds and work will begin shortly.

No	Action Item Description / Benefits	Lead Manager	Schedule and Priority	Hazard	Est. Cost and Rank	Description
13	Hardening of all DD7 structures against severe storm events.	DD7	Schedule 5 Years Evaluation Worksheet Score: 6	Wind, Tornado, Flood, Hurricane/ Tropical Storm and Dam/Levee Failure	\$1,000,000	DD7 is evaluating all structures and is in the process of hardening structures as funds become available.
14	Build New Office Building with a safe room to shelter essential personnel during storm events	DD7	Schedule 18 Months Evaluation Worksheet Score: 8	Wind, Tornado, Flood, Hurricane/ Tropical Storm and Dam/Levee Failure	TBD	Construct a new office building with a safe room that will be able to withstand severe winds and shelter employees to be used as an EOC during and immediately after storm events.
15	Additional Fuel Capacity at Pump Stations	DD7	Schedule 3 Years Evaluation Worksheet Score: 9	Flood, Hurricane/ Tropical Storm and Dam/Levee Failure	\$2,000,000	Each Pump Station will get additional fuel capacity. 6-8 pump stations each year for the next 3-4 years

No	Action Item Description / Benefits	Lead Manager	Schedule and Priority	Hazard	Est. Cost and Rank	Description
16	Repair/Re-design HFPL from station. 879+57-934+75	DD7	Schedule 6 Months Evaluation Worksheet Score: 6	Flood, Hurricane/ Tropical Storm and Dam/Levee Failure	\$250,000	Underway; working to get environmental permitting clear. Approximately \$45,00 per 100' to repair. Approximately 500' of repair needed, (\$225,000). 5600' of levee road surface repair, 5600' of slope resurfacing.
17	Blocks Bayou Repairs/Improvements	DD7	Schedule 3 Years Evaluation Worksheet Score: 7	Flood, Hurricane/ Tropical Storm and Dam/Levee Failure	\$250,000	The District must remove the current fence to allow DD7 more easement to repair and maintain Blocks Bayou Ditch.

APPENDIX 1 – MITIGATION PLANNING COMMITTEE MEETING MINUTES

JEFFERSON COUNTY DRAINAGE DISTRICT NO. 7 AGENDA

Hazard Mitigation Plan Meeting

June 7, 2017

10:00 am CST

MPC Attendees

Phil Kelley (PK)

Ronnie Holler (RH)

Diane Smith (DS)

Allen Sims (AS)

Jeff Ward (JW)

Dan Ward (DW)

Kristen Thatcher (KT)

1. Overview of Planning Process

The MPC received a review from JSWA on the changes in requirements since the last plan update. TDEM recommends only hazards that impact the area and which the jurisdiction has authority to mitigate against should be profiled. The team reviewed the list with that guidance and determined that four hazards will be profiled and assessed with emphasis on any hazards that have occurred over the past five years. The MPC will need to review the status of old action items and add new actions that were not in the plan previously. The MPC also will be doing some additional public outreach to try and get the public engaged in the process.

The following tasks will be followed/completed as part of this planning process:

Task 1: Review the Planning Area and Resources

Task 2: Finalize the MPC and the stakeholder group

Task 3: Create an outreach strategy

Task 4: Review community capabilities - update previous if changes have occurred since last plan update

Task 5: Conduct a Risk Assessment

Task 6: Review previous Mitigation Strategy to determine if changes are necessary

Task 8: Review and Adopt the Plan

The majority of communications between the team will occur via email and or phone.

2. Discussion of Public Outreach and Stakeholder Outreach

As these updates takes place, it is important that the District make the best effort to get the public involved. One of the new ways the MPC plans to involve the public is to use an online survey tool, Survey Monkey to request input from the public. These surveys will be placed on the District Website, announced at board meetings and put up on social media.

Action Item – The MPC was given a list of possible survey questions to review and to determine the final list of questions for the surveys. Each member will let JSWA know what questions he/she recommends by 6/21 and will be finalized, ready to announce and place on the website shortly thereafter.

Action Item – DW will create and send out a preliminary survey to the MPC.

3. Review Goals from Other Plans and Develop DD7 Goal – Ensuring that DD7’s mission and responsibilities are clearing defined with the goals

The MPC reviewed the mitigation goal statement from the last plan and determined it is the same goal for this update.

DD7’s Mitigation Goal Statement

The mitigation goals of DD7 are:

- To protect public health, safety, and welfare;
- To reduce losses due to hazards by identifying hazards, minimizing exposure of citizens and property to hazards, and increasing public awareness and involvement;
- To facilitate the development review and approval process to accommodate growth in a practical way that recognizes existing stormwater and floodplain problems while avoiding creating new problems or worsening existing problems; and
- To seek solutions to existing problems.

4. Identification of Stakeholders

Action Item – The MPC reviewed the list of stakeholders and provided updated names and contact information from the last Plan’s group of stakeholders. PK will put together a list of industry members that should be added and DW will provide the updated list of stakeholders, titles, and reach information by 6/21/17.

5. Hazard Profile and Risk Assessment changes from 2013 Plan from Guidance from TDEM and FEMA:

As discussed in item 1, the hazards from the previous plan were reviewed to determine what hazards impact the District’s planning area that the District has jurisdictional responsibility to mitigate against. The MPC concluded that the 2018 hazards to be profiled and risk assessed will be: Floods, Tornadoes, Thunderstorm High Winds, Hurricane and Tropical storms and Dam/Levee Failure.

2013 Hazards	2018 Hazards
Floods	Floods
Tornadoes/High Winds	Tornado
Hurricane/Tropical Storms	Hurricanes and Tropical Storms
Dam/Levee Failure	Dam/Levee Failure
Landslide	Thunderstorm High Wind
Winter Storm	Hurricane High Wind
Wildfire	
Earthquake	
Drought	
Extreme Heat	

6. Request copies of plans/studies that could have impact on jurisdictional area

The MPC reviewed the list of plans reviewed in the last plan and determined only one new plan has been written and therefore will need review for incorporation to this update.

Action Item – PK to send DW information on the Port Arthur and vicinity hurricane flood protection levee and AS will send the report to DW.

7. Outline Potential Mitigation Actions

Action Item – DW will send out actions from current plan by 6/21/17 (MPC will need to provide status and determine any new actions that should be included in the plan update). It will be finalized for review for the next MPC meeting.

8. Establish MPC schedule, stakeholder and public schedule, draft and Next Steps

The MPC agreed to the following schedule with the goal to submit the Plan update to TDEM by December. Below is the tentative schedule:

SCHEDULE DATE	WORK PRODUCT
6-14-17	Minutes sent to MPC Draft Survey questions sent to MPC Finalize Stakeholders Action items distributed to MPC
6-16-17	Announcement of survey included in Board Packet

6-20-17	PK to announce at Public Board Meeting the Request to have the public take part in an online survey that will be on the District's website by the next Board Meeting
6-21-17	MPC teleconference Finalize the survey questions Review action items; discussion of new actions
7-5-17	MPC teleconference Survey will be ready to go on the District's website Action status finalized and status of current actions finalized Begin review of hazards
7-18-17	Announcement to the Public at the DD7 Board Meeting of the survey and to request input until 8-18-17 (one month)
7-19-17	MPC teleconference Review of sections of plan update Letter to stakeholders with link to plan to request review and input sent out (on month for input request back 8-19-17)
8-5-17	MPC teleconference review input received Continue to review plan drafts
8-19-17	MPC teleconference Review of public input from survey Final date for stakeholder input Begin to incorporate all comments received
9-5-17	First Public Meeting explaining planning process and draft plan review, plan update on DD7 website
10-6-17	Last day for public comment of draft plan
11-7-17	Second Public meeting reviewing the incorporation of information received from public and request of the Board to submit to TDEM to begin review.
12-2017	Provide draft plan to TDEM for review.

Action Items	Owner
Review the possible survey questions and narrow the survey down to about ten questions. Due back to JSWA 6-21-17	MPC
DW will create and send out a preliminary survey to the MPC by 6-14-17	DW
The list of stakeholders needs to be updated with new names and contact info from the last Plan. Phil will put together a list of industry members that should be added by 6-14-17	MPC/PK
PK and AS to send reports to DW for review	PK/AS
DW to send out actions from current plan by 6/14/17 (to provide status and determine any new actions that should be included in the plan for next MPC meeting	DW
Announce Survey will be ready in July at June Board meeting	PK

JEFFERSON COUNTY DRAINAGE DISTRICT NO. 7 AGENDA

Hazard Mitigation Plan Meeting

July 6, 2017

2:00 pm CST

MPC Attendees

Phil Kelley (PK)

Ronnie Holler (RH)

Diane Smith (DS)

Allen Sims (AS)

Jeff Ward (JW)

Dan Ward (DW)

Kristen Thatcher (KT)

7-6-17 MPC teleconference

The Public Survey will be ready to go on the District's website and notice to newspaper. Prior action status were finalized and status of the current actions were finalized.

We began the review of hazards.

ACTION: PK to send Publisher's affidavit to DW and KT

ACTION: PK to post survey link on their website

ACTION: DW and KT to Send out Final Stakeholder list and emails

ACTION: MPC to review stakeholder survey and respond by Friday 7/7/17

ACTION: PK to review list of actions for the Plan for DW to incorporate

We are required to review which hazards have impacted the area in the last 5 years; it does not appear that Jefferson County has not received any Presidentially declared hazards in the last 5 years.

The Hazard profile done and out of the way, the stakeholder survey needs to be reviewed

Our next MPC meeting will be held on 7/19/17 10:00 AM

SCHEDULE DATE	WORK PRODUCT
6-14-17	Minutes sent to MPC Draft Survey questions sent to MPC Finalize Stakeholders Action items distributed to MPC
6-16-17	Announcement of survey included in Board Packet
6-20-17	PK to announce at Public Board Meeting the Request to have the public take part in an online survey that will be on the District's website by the next Board Meeting
6-28-17	MPC teleconference Finalize the survey questions Review action items; discussion of new actions
7-6-17	MPC teleconference Survey will be ready to go on the District's website and notice to newspaper Action status finalized and status of current actions finalized Begin review of hazards
7-18-17	Announcement to the Public at the DD7 Board Meeting of the survey and to request input until 8-18-17 (one month)
7-19-17	MPC teleconference Review of sections of plan update Letter to stakeholders with link to plan to request review and input sent out (on month for input request back 8-19-17)
8-5-17	MPC teleconference review input received Continue to review plan drafts
8-19-17	MPC teleconference Review of public input from survey Final date for stakeholder input Begin to incorporate all comments received
9-5-17	First Public Meeting explaining planning process and draft plan review, plan update on DD7 website
10-6-17	Last day for public comment of draft plan
11-7-17	Second Public meeting reviewing the incorporation of information received from public and request of the Board to submit to TDEM to begin review.
12-2017	Provide draft plan to TDEM for review.

JEFFERSON COUNTY DRAINAGE DISTRICT NO. 7 AGENDA

Hazard Mitigation Plan Meeting

July 26, 2017

2:00 pm CST

MPC Attendees

Phil Kelley (PK)

Ronnie Holler (RH)

Diane Smith (DS)

Allen Sims (AS)

Jeff Ward (JW)

Dan Ward (DW)

Kristen Thatcher (KT)

7-26-17 MPC teleconference

- Update on status of the surveys to date
- Review the discussion with the State on a few of the overlapping hazards
- Work to finalize the actions (new and current).

The Stakeholder survey has seven responses to date and the public survey has zero responses. The surveys will be closed out on 8/18/17.

There is a recent inundation map available which will be included in the FEMA review, but will be redacted for the plan that goes to the Public for safety reasons. PK will speak to map owner to verify if public.

The current action status update was finalized and new proposed actions were addressed.

The new actions were described more thoroughly and AS will establish timelines and get any Benefit Cost Analysis information on those actions by 8-9-17.

A draft of the mitigation strategy and hazard profile will be provided to the team for review and comment on 8-9-17.

ACTION: AS will get general schedule

ACTION: DS and PK will find out insured value of buildings and facilities for DD7

ACTION: DW will remove #13 actions

SCHEDULE DATE	WORK PRODUCT
6-14-17	Minutes sent to MPC Draft Survey questions sent to MPC Finalize Stakeholders Action items distributed to MPC
6-16-17	Announcement of survey included in Board Packet
6-20-17	PK to announce at Public Board Meeting the Request to have the public take part in an online survey that will be on the District's website by the next Board Meeting
6-28-17	MPC teleconference Finalize the survey questions Review action items; discussion of new actions
7-6-17	MPC teleconference Survey will be ready to go on the District's website and notice to newspaper Action status finalized and status of current actions finalized Begin review of hazards
7-18-17	Announcement to the Public at the DD7 Board Meeting of the survey and to request input until 8-18-17 (one month)
7-19-17	MPC teleconference Review of sections of plan update Letter to stakeholders with link to plan to request review and input sent out (on month for input request back 8-19-17)
7-26-17	MPC teleconference review input received Continue to review plan drafts
8-9-17	MPC Teleconference Begin review of hazard profile and mitigation strategy sections AS to provide schedule and BCA if available
8-19-17	MPC teleconference Review of public input from survey Final date for stakeholder input Begin to incorporate all comments received
9-5-17	First Public Meeting explaining planning process and draft plan review, plan update on DD7 website
10-6-17	Last day for public comment of draft plan
11-7-17	Second Public meeting reviewing the incorporation of information received from public and request of the Board to submit to TDEM to begin review.
12-2017	Provide draft plan to TDEM for review.

APPENDIX 2 – PUBLIC SURVEY AND PUBLIC MEETING ANNOUNCEMENTS

DD7 put a public survey on the District Website and in the Port Arthur News. The publisher's affidavit and the notice in the Port Arthur News are included below. The survey can be found in Appendix 6.

Publisher's Certificate of Publication

STATE OF TEXAS COUNTY OF JEFFERSON

Rich Macke, being duly sworn, on oath says he is and during all times herein stated has been an employee of The Port Arthur Newsmedia publisher and printer of the The Port Arthur News (the "Newspaper"), has full knowledge of the facts herein stated as follows:

1. The Newspaper printed the copy of the matter attached hereto (the "Notice") was copied from the columns of the Newspaper and was printed and published in the English language on the following days and dates:

07/19/17

2. The sum charged by the Newspaper for said publication is the actual lowest classified rate paid by commercial customer for an advertisement of similar size and frequency in the same newspaper in which the Notice was published.

3. There are no agreements between the Newspaper, publisher, manager or printer and the officer or attorney charged with the duty of placing the attached legal advertising notice whereby any advantage, gain or profit accrued to said officer or attorney

Jefferson County Drainage District No. 7 Hazard Mitigation Action Plan Update Survey for Public Input

As part of Jefferson County Drainage District No. 7's ("the District") five year review and update of its Hazard Mitigation Action Plan, the District respectfully invites the public to respond to a brief survey regarding hazards that impact our community. The survey may be found at <https://www.surveymonkey.com/r/NL28LTJ> or on the District's website at www.dd7.org under the Special Notices Section entitled "Public Survey for Hazard Mitigation Action Plan". In addition, if computer access is not available, a copy of the survey will be made available at the District's office located at 4401 9th Avenue, Port Arthur, Texas. The survey is available for input until August 18, 2017.



Rich Macke, publisher

Subscribed and sworn to before me this
19th Day of July, 2017



Jeree Powell, Notary Public
State of Texas at large
My commission expires 04-25-2018

Account # PAN3654
Ad # 292007

JEFFERSON CO DRAINAGE #7
ATTN: PHIL KELLY
PO BOX 3244
PORT ARTHUR TX 77643

APPENDIX 3 – CORRESPONDENCE WITH STAKEHOLDERS

PHIL KELLEY
MANAGER



COMMISSIONERS

RICHARD BEAUMONT
CHAIRMAN

BILLY JOE BUTLER
JAMES GAMBLE, SR.
LESTER CHAMPAGNE
ALBERT MOSES, JR.

July 19, 2017

To: Invited Members to Participate in a Stakeholder Group for
Jefferson County Drainage District No. 7

Re: **Jefferson County Drainage District No. 7
Hazard Mitigation Action Plan Update**

Dear Stakeholder Group:

As you may be aware, Jefferson County Drainage District No. 7 ("DD7") is currently in the process of updating its FEMA Hazard Mitigation Action Plan. FEMA requires local jurisdictions to update their plans every five years, and one of the update and re-approval requirements is to have a stakeholder group and the public review and provide input to the plan. Members of a stakeholder group are individuals or organizations that are affected by a mitigation action or policy and can provide specific information on a topic or provide input from a different point of view in the community. These organizations should include business, academia, neighboring communities and other private and non-profit interests.

Your organization has been identified by DD7 as one that could be impacted by the mitigation actions and strategy, and, therefore, DD7 would like to add you to its stakeholder group. DD7 has prepared a brief survey that we ask that you take to help us with our plan update. The link is: <https://www.surveymonkey.com/r/RPRJ2TV>. In addition, when ready, DD7 respectfully requests your organization review the draft plan update and provide any comments to the draft. A second letter will be sent with the link to the draft in August. Thank you very much for considering this request. It is important that stakeholders and the public have an opportunity to review and comment.

Sincerely,

Phil Kelley
General Manager

"Storm Water Management • Serving South Jefferson County"

OFFICE LOCATION: 4401 Ninth Avenue, Port Arthur Texas 77642-4253
MAILING ADDRESS: P.O. Box 3244, Port Arthur Texas 77643-3244
PHONE (409) 985-4369 FAX (409) 983-7564 WEB SITE • <http://www.dd7.org>

APPENDIX 4 – SOURCES

Table 1 – Mitigation Planning Committee

Table 2 – Stakeholders Group Members

Figure 1 - Vicinity Map: State of Texas (Source: www.Mapquest.com)

Figure 2 –Map of Jefferson County Drainage Districts

Figure 3 – Most Common Industries, Jefferson County, Texas (Source: <https://datausa.io/profile/geo/jefferson-county-tx/>)

Table 3 - Incorporated Areas of Jefferson County (Source: US Census Bureau, 2016 - Estimates)

Table 4 – Buildings/Infrastructure within Jefferson County Drainage District Seven (Sources: Jefferson County Central Appraisal District)

Table 5 Building and Demolition Permits by Type and by Year for Each Incorporated Area Within DD7 (Source: City Building Departments)

Table 6 –Natural Hazard Events and Declared Major Disasters in Jefferson County (Sources: Public Entity Risk Institute (PERI) website, FEMA, NCEI database)

Table 7 – Frequency of Hazard Occurrence

Table 8 – Level of Vulnerability

Figure 4 – Vicinity Map: Jefferson County Drainage District 7

Figure 5 – Tornado Activity in the U.S. (Source: NOAA – Storm Prediction Center)

Table 9 – Enhanced Fujita (EF) Scale

Table 10 – Tornado Events in DD7 (Source: NCEI Storm Events Database)

Table 11 – Frequency of Tornado Occurrence

Figure 6 – Historical Hurricane Tracks for Jefferson County TX (National Hurricane Center)

Table 12 – Classification of Tropical Cyclones

Table 13 – Saffir/Simpson Hurricane Scale

Figure 7 – Historical Hurricane Tracks for Jefferson County TX (National Hurricane Center)

Table 14 – Frequency of Tropical Storm and Hurricane Occurrence

Figure 8 - Vicinity Map: District Boundary Map

Figure 9 – Basic Design Wind Speed (Source: International Building Code)

Table 15 – Beaufort Wind Scale (Source: National Oceanic and Atmospheric Administration)

Table 16 – Severe Thunderstorm and High Wind Events in Jefferson County DD7 (Source: NCEI Storm Events Database)

Table 17 – Frequency of Severe Thunderstorms and High Wind

Figure 10 Port Arthur Hurricane Flood Protection Levee and Vicinity Hurricane Flood Protection Levee

Figure 11 – Inundation Map for Planning Area

Table 18 – Frequency of Tornado Occurrence

Figure 12 – Jefferson County DD7 – 100-year Floodplain Map (Source: LJA Engineering)

Figure 13 – Jefferson County TX Effective Flood Insurance Rate Map (Source: RiskMap6 Effective FIRM)

Figure 14 – DD7 Boundary Map and Rain Gauge Location (Source: LJA Engineering)

Figure 15 – Rainfall Per Hour During Hurricane Harvey at DD7 Rain Gauges (Source: DD7)

Figure 16 – Rainfall Per Hour During Hurricane Harvey at DD7 Rain Gauges (Source: DD7)

Figure 17 – Depth of Precipitation for 50-year Storm for 1-hour duration in Texas (Source: United States Geological Survey (USGS))

Figure 18 – Depth of Precipitation for 100-year Storm for 1-hour duration in Texas (Source: USGS)

Table 19 – Jefferson County Flood Events since Last Planning Effort (Source: NCEI Storm Events Database)

Table 20 – Flood Frequency of Occurrence

Table 21 - Summary of Residential and Non-Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by Municipality (Source: FEMA NFIP query January 1, 2018)

Table 22 – Summary of Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by Municipality (Source: FEMA NFIP query January 1, 2018)

Table 23 – Summary of Non-Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by Municipality (Source: FEMA NFIP query January 1, 2018)

Table 24 – Summary of Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by number of Properties on Each Street (Source: FEMA NFIP query January 1, 2018)

Table 25 – Projected 100-year Flood Risk in Jefferson County DD7 Residential Repetitive Loss Areas (Source: FEMA NFIP query January 1, 2018)

Figure 19 – Number of NFIP Flood Insurance Claims Per Residential Repetitive Loss Property in Jefferson County DD7 (Source: FEMA/NFIP, Query January 1, 2018; Plotted by DD7)

Table 26 – Projected 100-year Flood Risk, Non-Residential Repetitive Loss Properties in Jefferson County DD7 (Source: FEMA NFIP query January 1, 2018)

Figure 20 – Number of NFIP Flood Insurance Claims Per Non-Residential Repetitive Loss Property in Jefferson County DD7 (Source: FEMA/NFIP, January 1, 2018; Plotted by DD7)

Table 27 – Projected 100-year Flood Risk, Severe Repetitive Loss Properties in Jefferson County DD7 by Street (Source: FEMA/NFIP, Query January 1, 2018)

Figure 21 – Number of NFIP Flood Insurance Claims Per Severe Repetitive Loss Property in Jefferson County DD7 (Source: FEMA/NFIP, Query January 1, 2016; Plotted by DD7)

Figure 22 – DD7 Owned Facilities FIRM (Source: FEMA Map Service Center)

Figure 23 – Flood Hazard Chart for Cars (Source: Downstream Hazard Classification Guidelines)

Table 28 – Mitigation Action Evaluation Worksheet

Table 29 – Status of Mitigation Actions from the 2013 Plan

Table 30 – DD7's NEW 2018 Mitigation Actions

APPENDIX 5 – ADOPTION RESOLUTION

APPENDIX 6 – SURVEY RESULTS

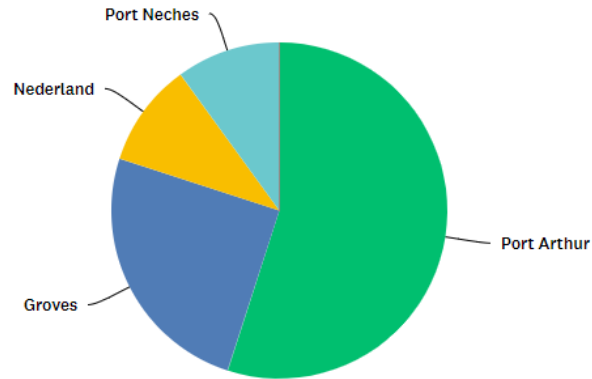
PUBLIC SURVEY

Q1

[Customize](#) [Export](#)

Where do you live in Jefferson County?

Answered: 20 Skipped: 1



ANSWER CHOICES	RESPONSES
▼ Port Arthur	55.00% 11
▼ Groves	25.00% 5
▼ Nederland	10.00% 2
▼ Port Neches	10.00% 2
▼ Unincorporated Jefferson County	0.00% 0
▼ Other (please specify) Responses	0.00% 0
TOTAL	20

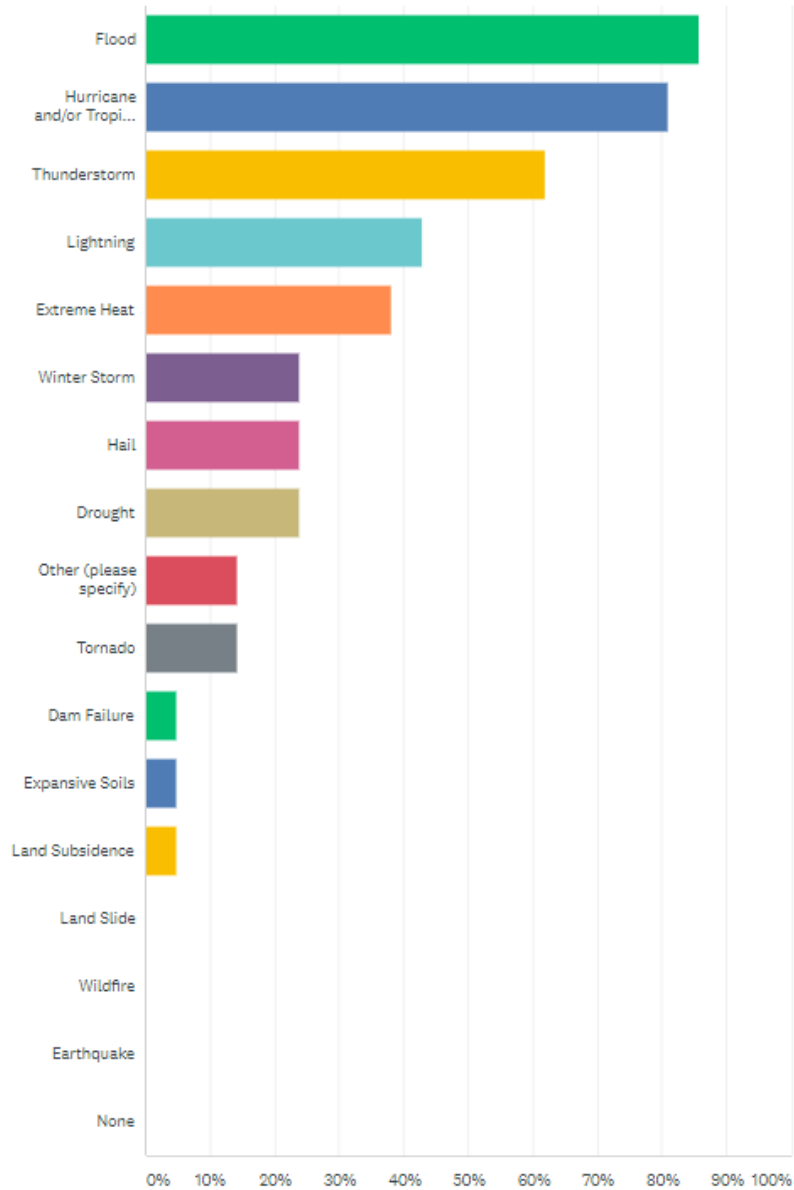
Q2

Customize

Export

Which of the following hazard events have you or has anyone in your household experienced in the past 20 years within Jefferson County? (Check all that apply)

Answered: 21 Skipped: 0



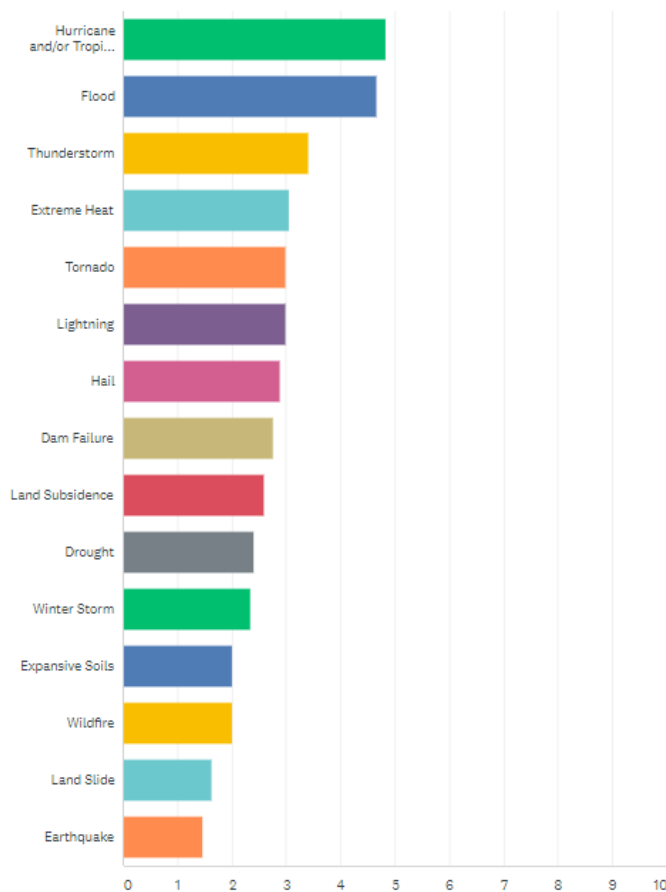
ANSWER CHOICES	RESPONSES
▼ Flood	85.71% 18
▼ Hurricane and/or Tropical Storm	80.95% 17
▼ Thunderstorm	61.90% 13
▼ Lightning	42.86% 9
▼ Extreme Heat	38.10% 8
▼ Winter Storm	23.81% 5
▼ Hail	23.81% 5
▼ Drought	23.81% 5
▼ Other (please specify) Pump Failure	Responses 14.29% 3
▼ Tornado	14.29% 3
▼ Dam Failure	4.76% 1
▼ Expansive Soils	4.76% 1
▼ Land Subsidence	4.76% 1
▼ Land Slide	0.00% 0
▼ Wildfire	0.00% 0
▼ Earthquake	0.00% 0
▼ None	0.00% 0
Total Respondents: 21	

Q3

[Customize](#) [Export](#)

How concerned are you about the following natural hazards in Jefferson County?

Answered: 21 Skipped: 0



	NOT CONCERNED	SOMEWHAT CONCERNED	CONCERNED	VERY CONCERNED	EXTREMELY CONCERNED	TOTAL	WEIGHTED AVERAGE
▼ Hurricane and/or Tropical Storm	0.00% 0	0.00% 0	5.26% 1	5.26% 1	89.47% 17	19	4.84
▼ Flood	0.00% 0	4.76% 1	0.00% 0	19.05% 4	76.19% 16	21	4.67
▼ Thunderstorm	0.00% 0	35.29% 6	5.88% 1	41.18% 7	17.65% 3	17	3.41
▼ Extreme Heat	5.88% 1	23.53% 4	47.06% 8	5.88% 1	17.65% 3	17	3.06
▼ Tornado	12.50% 2	25.00% 4	18.75% 3	37.50% 6	6.25% 1	16	3.00
▼ Lightning	11.76% 2	35.29% 6	5.88% 1	35.29% 6	11.76% 2	17	3.00
▼ Hail	11.76% 2	23.53% 4	35.29% 6	23.53% 4	5.88% 1	17	2.88
▼ Dam Failure	17.65% 3	41.18% 7	11.76% 2	5.88% 1	23.53% 4	17	2.76
▼ Land Subsidence	29.41% 5	23.53% 4	17.65% 3	17.65% 3	11.76% 2	17	2.69
▼ Drought	23.53% 4	41.18% 7	17.65% 3	5.88% 1	11.76% 2	17	2.41
▼ Winter Storm	41.18% 7	17.65% 3	17.65% 3	11.76% 2	11.76% 2	17	2.36
▼ Expansive Soils	31.25% 5	50.00% 8	12.50% 2	0.00% 0	6.25% 1	16	2.00
▼ Wildfire	40.00% 6	40.00% 6	6.67% 1	6.67% 1	6.67% 1	16	2.00
▼ Land Slide	62.50% 10	25.00% 4	6.25% 1	0.00% 0	6.25% 1	16	1.63
▼ Earthquake	76.47% 13	11.76% 2	5.88% 1	0.00% 0	5.88% 1	17	1.47

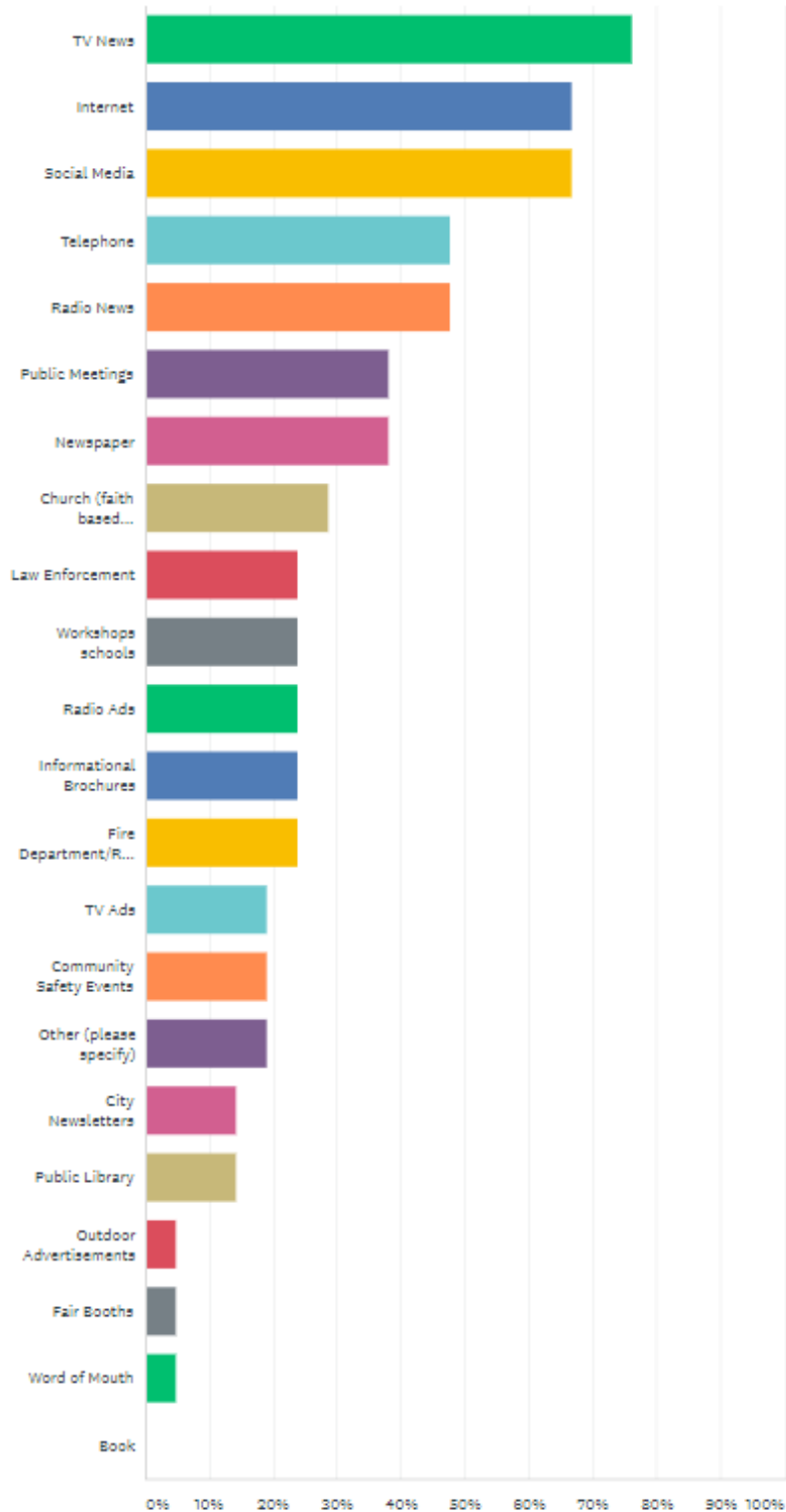
Q4

Customize

Export

Which of the following methods do you think are most effective for providing hazard and disaster information? (Check all that apply)

Answered: 21 Skipped: 0



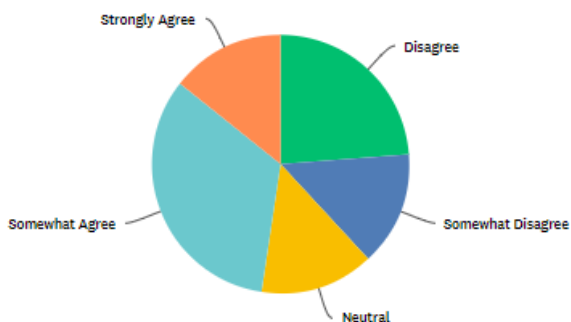
ANSWER CHOICES		RESPONSES
TV News		76.19% 16
Internet		66.67% 14
Social Media		66.67% 14
Telephone		47.62% 10
Radio News		47.62% 10
Public Meetings		38.10% 8
Newspaper		38.10% 8
Church (faith based institutions)		28.57% 6
Law Enforcement		23.81% 5
Workshops schools		23.81% 5
Radio Ads		23.81% 5
Informational Brochures		23.81% 5
Fire Department/Rescue		23.81% 5
TV Ads		19.05% 4
Community Safety Events		19.05% 4
Other (please specify)	Text Messaging	Responses 19.05% 4
City Newsletters		14.29% 3
Public Library		14.29% 3
Outdoor Advertisements		4.76% 1
Fair Booths		4.76% 1
Word of Mouth		4.76% 1
Book		0.00% 0
Total Respondents: 21		

Q5

Customize Export

Please Indicate how you feel about the following statement: Information about the risks associated with natural hazards is readily available and easy to locate.

Answered: 21 Skipped: 0



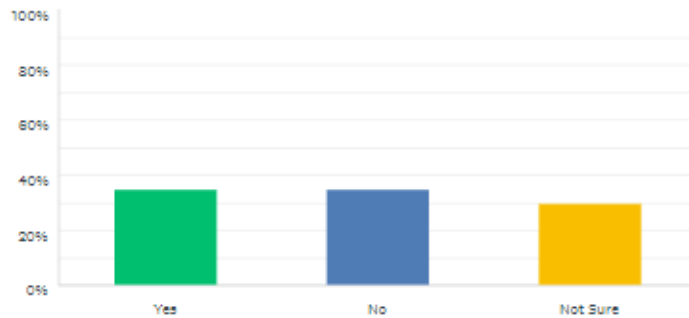
ANSWER CHOICES	RESPONSES
Disagree	23.81% 5
Somewhat Disagree	14.29% 3
Neutral	14.29% 3
Somewhat Agree	33.33% 7
Strongly Agree	14.29% 3
TOTAL	21

Q6

Customize Export

Is your property located in or near a FEMA designated floodplain?

Answered: 20 Skipped: 1



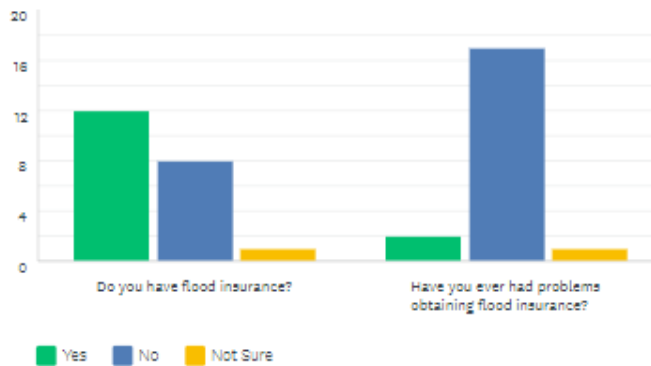
ANSWER CHOICES	RESPONSES
Yes	35.00% 7
No	35.00% 7
Not Sure	30.00% 6
TOTAL	20

Q7

Customize Export

Do you have flood insurance and have you ever had problems obtaining flood insurance?

Answered: 21 Skipped: 0



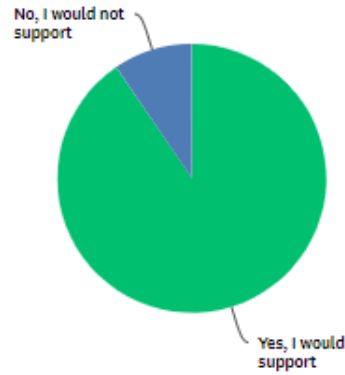
	YES	NO	NOT SURE	TOTAL	WEIGHTED AVERAGE
Do you have flood insurance?	57.14% 12	38.10% 8	4.76% 1	21	1.00
Have you ever had problems obtaining flood insurance?	10.00% 2	85.00% 17	5.00% 1	20	1.00

Q8

Customize Export

Would you support the regulation of land use within known high flood hazard areas?

Answered: 21 Skipped: 0



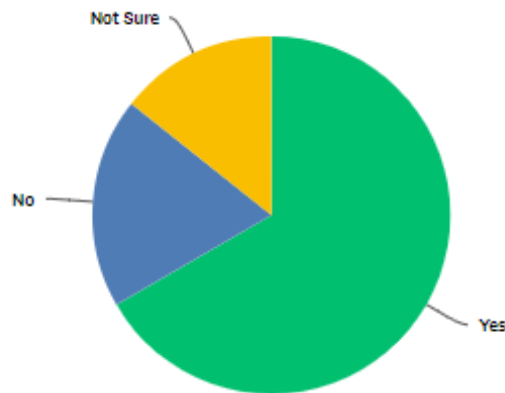
ANSWER CHOICES	RESPONSES
Yes, I would support	90.48% 19
No, I would not support	9.52% 2
TOTAL	21

Q9

Customize Export

Do you think the JCDD7 Hurricane flood protection Levee has improved flood protection in South Jefferson County?

Answered: 21 Skipped: 0



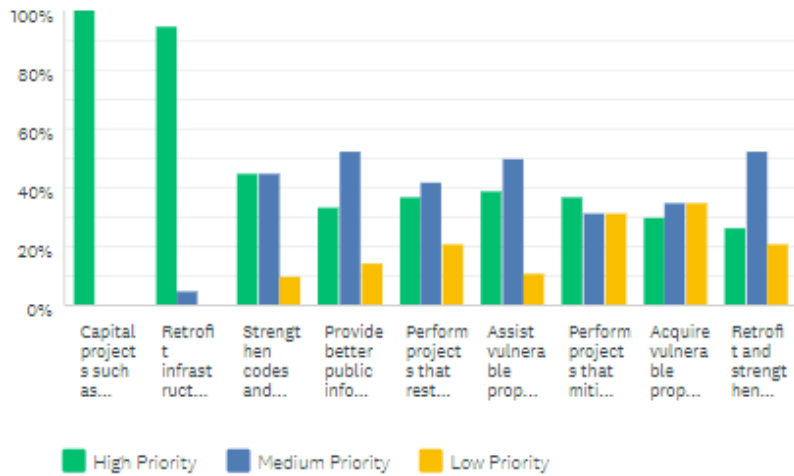
ANSWER CHOICES	RESPONSES
Yes	66.67% 14
No	19.05% 4
Not Sure	14.29% 3
TOTAL	21

Q10

Customize Export

What types of projects do you believe the District, County, State or Federal government agencies should be doing in order to reduce damage and disruption from hazard events within Jefferson County? Please rank each option as a high, medium or low priority.

Answered: 21 Skipped: 0



	HIGH PRIORITY	MEDIUM PRIORITY	LOW PRIORITY	TOTAL	WEIGHTED AVERAGE
Capital projects such as dams, levees, flood walls, drainage improvements and bank stabilization projects	100.00% 21	0.00% 0	0.00% 0	21	3.00
Retrofit infrastructure such as roads, bridges, drainage facilities, levees, water supply, waste water and power supply facilities	95.00% 19	5.00% 1	0.00% 0	20	2.95
Strengthen codes and regulations to include higher regulatory standards in hazard areas.	45.00% 9	45.00% 9	10.00% 2	20	2.35
Provide better public information about risk, and the exposure to hazards within the operational area	33.33% 7	52.38% 11	14.29% 3	21	2.19
Perform projects that restore the natural environments capacity to absorb the impacts from natural hazards	36.84% 7	42.11% 8	21.05% 4	19	2.16
Assist vulnerable property owners with securing funding for mitigation	38.89% 7	50.00% 9	11.11% 2	18	2.28
Perform projects that mitigate the potential impacts from climate change	36.84% 7	31.58% 6	31.58% 6	19	2.05
Acquire vulnerable properties and maintain as open space	30.00% 6	35.00% 7	35.00% 7	20	1.95
Retrofit and strengthen essential facilities such as police, fire, schools and hospitals.	26.32% 5	52.63% 10	21.05% 4	19	2.05

STAKEHOLDER SURVEY

Q1

Customize Export

Please select the hazard that you think is the highest threat to your organization/school/company

Answered: 9 Skipped: 0



ANSWER CHOICES	RESPONSES
Hurricane and Tropical Storm	88.89% 8
Flood	11.11% 1

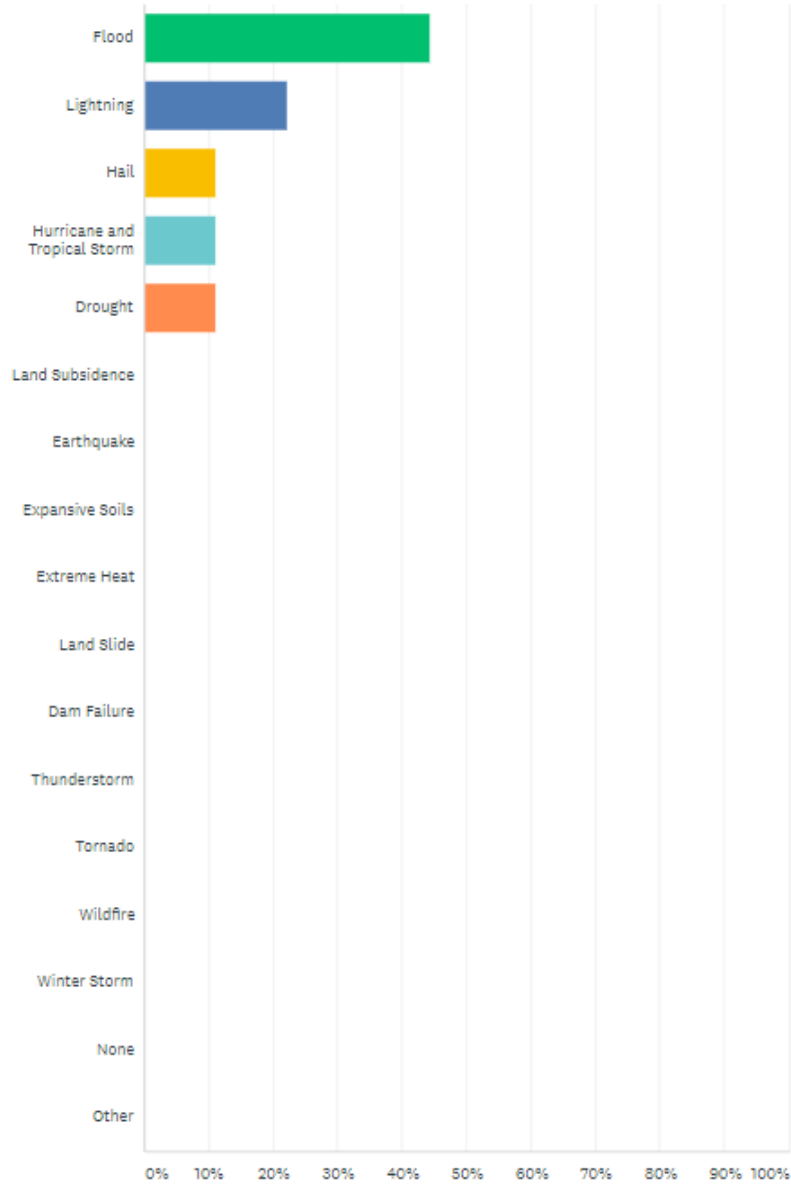
Q2

Customize

Export

Please select the hazard that you think is the second highest threat to your organization/school/company:

Answered: 9 Skipped: 0



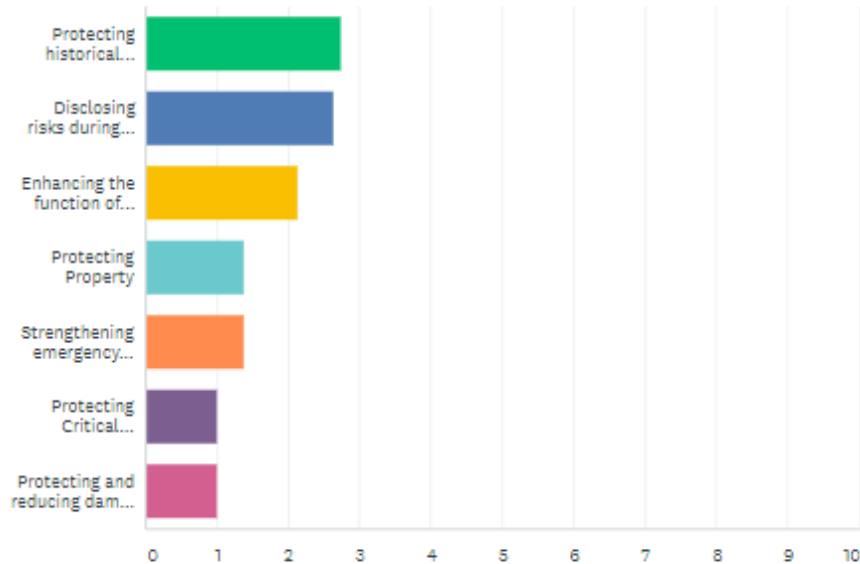
ANSWER CHOICES	RESPONSES
▼ Flood	44.44% 4
▼ Lightning	22.22% 2
▼ Hail	11.11% 1
▼ Hurricane and Tropical Storm	11.11% 1
▼ Drought	11.11% 1

Q3

Customize Export

The following statements will help us identify your organization/school/company priorities in regards to natural hazard planning. Please tell us how important each one is to you.

Answered: 8 Skipped: 1



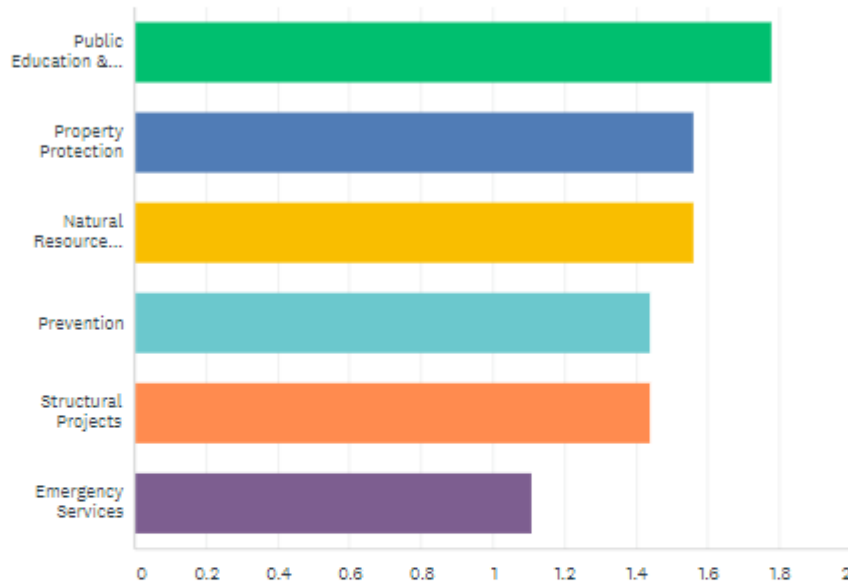
	VERY IMPORTANT	IMPORTANT	NEITHER	UNIMPORTANT	VERY UNIMPORTANT	TOTAL	WEIGHTED AVERAGE
Protecting historical landmarks	12.50% 1	37.50% 3	12.50% 1	37.50% 3	0.00% 0	8	2.75
Disclosing risks during real estate transactions	25.00% 2	0.00% 0	62.50% 5	12.50% 1	0.00% 0	8	2.63
Enhancing the function of natural features	37.50% 3	25.00% 2	25.00% 2	12.50% 1	0.00% 0	8	2.13
Protecting Property	62.50% 5	37.50% 3	0.00% 0	0.00% 0	0.00% 0	8	1.38
Strengthening emergency services	62.50% 5	37.50% 3	0.00% 0	0.00% 0	0.00% 0	8	1.38
Protecting Critical Facilities	100.00% 8	0.00% 0	0.00% 0	0.00% 0	0.00% 0	8	1.00
Protecting and reducing damage to utilities	100.00% 8	0.00% 0	0.00% 0	0.00% 0	0.00% 0	8	1.00

Q4

Customize Export

A number of community-wide activities can reduce our risk from hazards. These activities fall into six broad categories. Please tell us how important you think each one is for your organization/school/company to consider pursuing.

Answered: 9 Skipped: 0



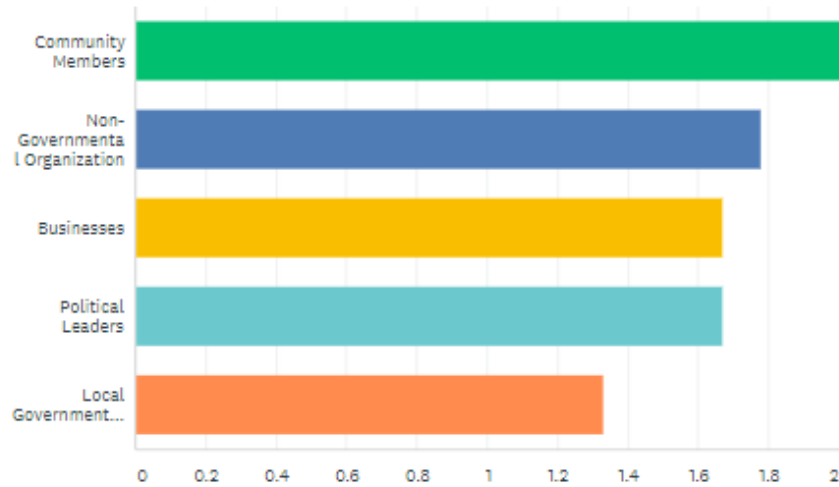
	VERY IMPORTANT	IMPORTANT	NEITHER	UNIMPORTANT	VERY UNIMPORTANT	TOTAL	WEIGHTED AVERAGE
Public Education & Awareness	44.44% 4	33.33% 3	22.22% 2	0.00% 0	0.00% 0	9	1.78
Property Protection	55.56% 5	33.33% 3	11.11% 1	0.00% 0	0.00% 0	9	1.66
Natural Resource Protection	55.56% 5	33.33% 3	11.11% 1	0.00% 0	0.00% 0	9	1.66
Prevention	66.67% 6	22.22% 2	11.11% 1	0.00% 0	0.00% 0	9	1.44
Structural Projects	55.56% 5	44.44% 4	0.00% 0	0.00% 0	0.00% 0	9	1.44
Emergency Services	88.89% 8	11.11% 1	0.00% 0	0.00% 0	0.00% 0	9	1.11

Q5

Customize Export

In your opinion, how would you rank the support for natural hazard mitigation amongst the following entities of your organization/school/company?

Answered: 9 Skipped: 0



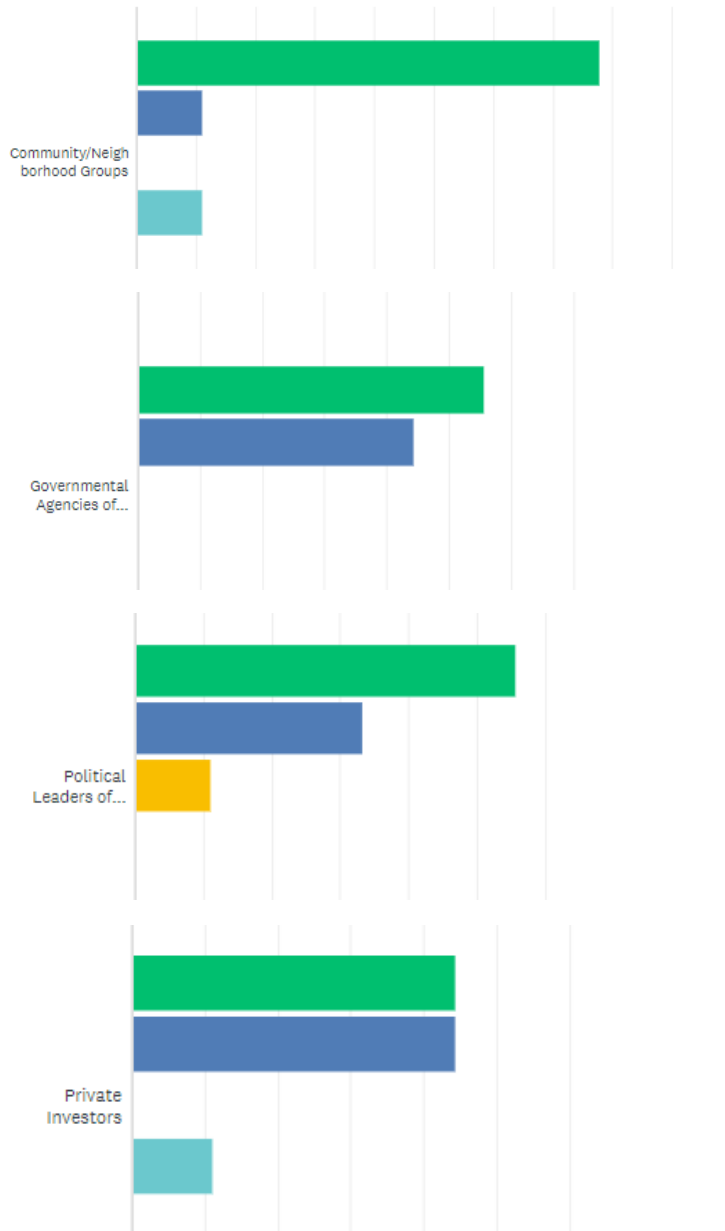
	SUPPORTED BY ALL	SUPPORTED BY MOST	SUPPORTED BY SOME	NOT SUPPORTIVE	TOTAL	WEIGHTED AVERAGE
Community Members	11.11% 1	77.78% 7	11.11% 1	0.00% 0	9	2.00
Non-Governmental Organization	44.44% 4	44.44% 4	0.00% 0	11.11% 1	9	1.78
Businesses	33.33% 3	66.67% 6	0.00% 0	0.00% 0	9	1.67
Political Leaders	44.44% 4	44.44% 4	11.11% 1	0.00% 0	9	1.67
Local Government Agencies	66.67% 6	33.33% 3	0.00% 0	0.00% 0	9	1.33

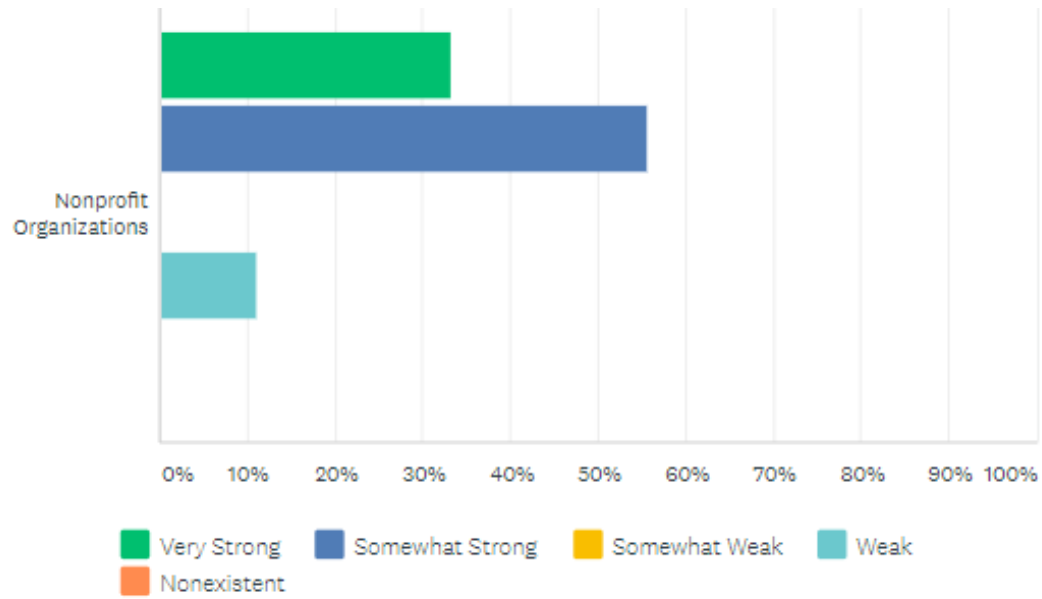
Q6

Customize

We would like to understand the partnerships that exist within your organization/school/company. What kind of partnerships does your organization have with the following entities:

Answered: 9 Skipped: 0





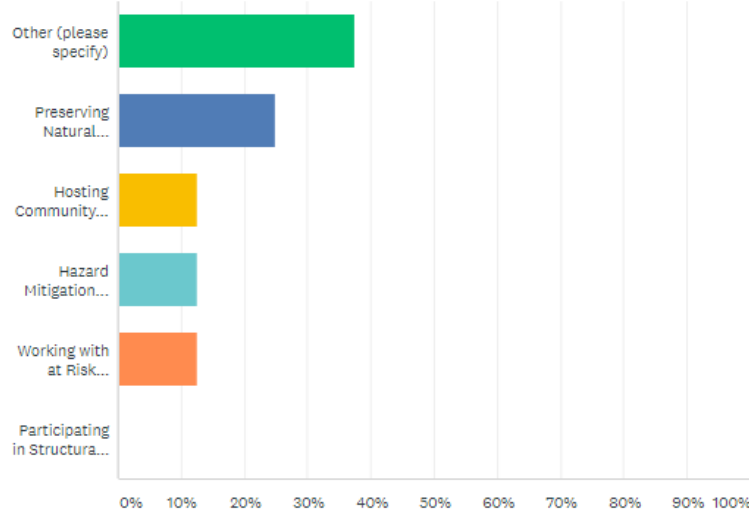
	VERY STRONG	SOMEWHAT STRONG	SOMEWHAT WEAK	WEAK	NONEXISTENT	TOTAL	WEIGHTED AVERAGE
Community/Neighborhood Groups	77.78% 7	11.11% 1	0.00% 0	11.11% 1	0.00% 0	9	1.44
Governmental Agencies of Neighboring Communities	55.56% 5	44.44% 4	0.00% 0	0.00% 0	0.00% 0	9	1.44
Political Leaders of Neighboring Communities	55.56% 5	33.33% 3	11.11% 1	0.00% 0	0.00% 0	9	1.56
Private Investors	44.44% 4	44.44% 4	0.00% 0	11.11% 1	0.00% 0	9	1.78
Nonprofit Organizations	33.33% 3	55.56% 5	0.00% 0	11.11% 1	0.00% 0	9	1.89

Q7

Customize Export

What is your organization currently doing to reduce your community's risk from natural hazards?

Answered: 8 Skipped: 1



ANSWER CHOICES	RESPONSES
Other (please specify)	Responses 37.50% 3
Showing 3 responses	
Hurricane Preparation Team	
8/1/2017 2:15 PM	
None	
7/21/2017 8:09 AM	
Continue all the above	
7/20/2017 2:54 PM	
Preserving Natural Resource(s)	25.00% 2
Hosting Community Education Events	12.50% 1
Hazard Mitigation Project	12.50% 1
Working with at Risk Communities	12.50% 1
Participating in Structural Related Natural	0.00% 0
TOTAL	8

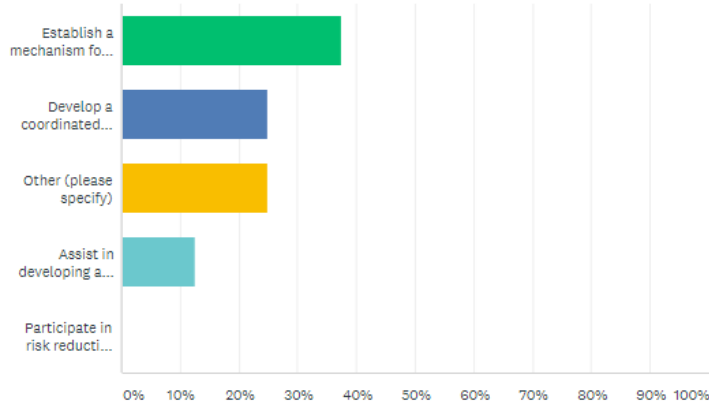
Q8

Customize

Export ▼

Are there ways in which your organization can contribute to regional coordination to reduce risk from natural hazards?

Answered: 8 Skipped: 1



ANSWER CHOICES ▼

RESPONSES ▼

▼ Establish a mechanism for sharing natural hazard mitigation related information and networking among neighboring jurisdictions	37.50%	3
▼ Develop a coordinated risk reduction strategy with other regional stakeholders	25.00%	2

Showing 2 responses

Continue to actively participate in LEPCs and Sabine Neches Chiefs Association

8/1/2017 2:15 PM

[View respondent's answers](#)

Continue Develop a coordinated risk reduction strategy with other regional stakeholders

7/20/2017 2:54 PM

[View respondent's answers](#)

▼ Assist in developing a regional based natural resource preservation plan	12.50%	1
▼ Participate in risk reduction education programs	0.00%	0
TOTAL		8

Q9

Export ▾

Are there any specific risk reduction projects that your organization is interested in implementing internally or assisting other organizations/agencies with externally?

Answered: 2 Skipped: 7

RESPONSES (2) TEXT ANALYSIS TAGS (0)

Add Tags ▾ Filter by Tag ▾

Search responses  

Showing 2 responses

We have implemented an Emergency Preparedness Plan for our campus facilities.

7/20/2017 11:56 AM

[View respondent's answers](#)

Hurricane surge protection

7/19/2017 5:04 PM

[View respondent's answers](#)

Q10

Export ▾

In your opinion, what are some additional or new ways your organization could help your community reduce the risk of future natural hazards?

Answered: 2 Skipped: 7

RESPONSES (2) TEXT ANALYSIS TAGS (0)

Add Tags ▾ Filter by Tag ▾

Search responses  

Showing 2 responses

Ensure that our facilities are addressed in our Emergency Preparedness Plan.

7/20/2017 11:56 AM

[View respondent's answers](#)

Communication

7/19/2017 5:04 PM

[View respondent's answers](#)

APPENDIX 7 – FEMA AND OR TDEM APPROVAL LETTER