Jefferson County Drainage District No 7

2012 Hazard Mitigation Plan Update

Draft July 2012

Table of Contents

Executive Summary

Jefferson County Drainage District No. Seven (DD7) undertook development of Hazard Mitigation Plan (HMP) because of increasing awareness that natural hazards, especially flood hazards, may affect many people and property in the area. DD7 was a part of the original Jefferson, Hardin and Orange Multi-County Plan that was approved in 2005. The Counties', per guidance from the Texas Division of Emergency Management, developed one –County updates to the original plan. DD7 participated in the update to the Jefferson County Plan that is in the review process with FEMA. Hazard Mitigation Plans and updates are requirements associated with receipt of certain federal mitigation grant program funds administered by the Texas Division of Emergency Management (TDEM) and the Texas Water Development Board (TWDB). In addition, the Plan was a pre-qualification of eligibility for other mitigation funds.

While DD7 participated in the 2005 approved plan and the updated 2011 Plan, DD7 determined that the District would be best served to have a stand-alone plan that focuses on the hazards that impact the jurisdictional area that the District has authority to protect. Therefore, much of this plan will be written as an original plan with the updates provided in the mitigation actions that were prepared specifically for DD7 as well as any development trends since 2005. The 2012 update was completed using a Mitigation Planning Committee (MPC) that included representatives from DD7, an engineering firm (Carroll & Blackman) and a mitigation planning consultant, (JSWA). A group of interested stakeholders was provided with the plan update to review and provide comment. Specifics of the process are discussed in Section 2 of the update, Introduction to Mitigation Planning.

The original HMP was completed in 2005 and set the stage for long-term disaster resistance through identification of actions that will, over time, reduce the exposure of people and property to natural hazards. Sections of the Plan update:

- Provide overviews of the hazards that threaten DD7,
- Characterize the people and property that are exposed to some risk due to those hazards,
- Outline the planning process,
- Describe how hazards are recognized in DD7's normal processes and functions, and
- Identify the status and prioritize mitigation action items.

Section 5 of this Plan Update provides an overview of past hazard events and associated losses in the Jefferson County DD7. In Section 5, natural hazards other than flood and wind hazards that are deemed pertinent to DD7 are described, along with summary statements about exposure to risks associated with those hazards. Because flooding and wind poses the most significant risk in DD7, Section 7 is dedicated to assessing the flood and wind hazard. The MPC reviewed the Jefferson County 2011 plan hazards to determine what hazards would be analysed and profiled as part of the Plan update: Table 2.1 compares the hazards profiled in the Jefferson County Update and the hazards profiled in the Jefferson County DD7 plan. An asterisk denotes what hazards were determined significant to perform a risk analysis.

Table 1
Comparison of Jefferson County and Jefferson County DD7 Hazards Profiled

Jefferson County 2011 Plan Update Profiled Hazards	Jefferson County DD7 2012 Plan Update Profiled Hazards
Dam Failure	Dam Failure
Drought	Drought
Earthquake	Seismic/Earthquakes
Extreme Heat	Extreme Heat
Flood	Flood
Geologic Hazard (sinkholes and landslides)	Landslides
Hazardous Material Incidents	Not applicable: DD7 has no authority. Not profiled.
Hurricane and Tropical Storms	Hurricanes and Tropical Storms
Severe Winter Weather	Winter Storm
Terrorism	Not applicable: DD7 has no authority. Not profiled.
Thunderstorm (lightning, hail, high winds)	Thunderstorms/
Tornado	Tornadoes / High Winds
Tsunami	No recorded incidents– Low probability not profiled
Water Contamination	Not a natural hazard – not profiled
Wildfire	Wildland Fire

As mentioned above, flooding poses the most significant risk in DD7. Section 6 of the Plan update outlines flood hazards, past flood events, and summaries of the people and property that are at risk. Most bayous and streams in the planning area have some existing buildings that are exposed to flood damage. DD7 has experienced a number of flood events, most resulting in localized damage.

Section 5 also includes a detailed risk assessment of the National Flood Insurance Program (NFIP) Repetitive Loss and Severe Repetitive Loss properties within the planning area.

4% of critical facilities and 26% of road miles (711 miles) in Jefferson County are within the floodplain.[1] It is estimated that approximately 7% of buildings and approximately 45% of parcels of undeveloped land in the planning area are located in flood-prone areas. There are 27,280 buildings within Jefferson County that are insured through the NFIP, (a number that exceeds the total number of buildings that plot as being "in" the mapped floodplain). This is an indication that many homeowners outside the floodplain are aware of the flooding risks throughout the area and have chosen to carry flood insurance, even though it is not required.

As part of the planning process for the 2012 Update, the initial draft of this Plan was presented at a public meeting on January 3, 2012. The public was provided a second opportunity to review and comment on the Plan update at the point of the final draft stage when it was posted on DD7's web site and a printed copy available for review at the DD7 office located at 4401 Ninth Avenue, Port Arthur, Texas 77643.

Section 3 discusses the Approval and Adoption of the updated Plan. The DD7 Board of Directors was responsible for approving and adopting the Plan update. The Board reviewed and adopted the Plan Update on [insert date]. Upon approval and adoption, the 2012 Plan update will also be available for review at the DD7 office.

Contact information for the DD7 official submitting this Plan update is as follows:

Name: Mr. Phil Kelley
Title: General Manager
Phone: (409) 985-4369
Fax: (409) 983-7564
Email Address: pkelley@dd7.org

The structure of the plan is similar to the Jefferson County 2011 Plan Update and includes 10 sections and an appendices section. These sections are: Introduction; Mitigation Planning Process; Approval and Adoption; Mitigation Goals; Profiled Hazards; Risk Assessment; Process and Capabilities to address Hazards; Mitigation Actions; Plan Maintenance; and the Appendices. The 2012 MPC 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. Membership in these groups and the specifics of their tasks are described in Section 1.5.

[1] Flood Exposure Snapshot, Jefferson County, Texas. www.csc.noa.gov/snapshots.

Section 10 of the Plan update (Plan Maintenance and Implementation) describes the schedule and procedures for ensuring that the Plan update stays current. The section identifies when the Plan must be updated, who is responsible for monitoring the Plan and ensuring that the update procedures are implemented. This section provides a combination of cyclical dates (oriented toward FEMA requirements) and triggering events that will initiate amendments and updates to the Plan. The General Manager is responsible for monitoring the Plan and initiating the cyclical update process.

1 Section 1 - Introduction

1.1 Introduction

In 2005, Jefferson County Drainage District No. Seven (DD7) participated in a multi-jurisdiction Hazard Mitigation Plan (Hardin, Orange and Jefferson Counties) because of increasing awareness that natural and man-made hazards, especially flood hazards, may affect people and property in the area. The Plan was a requirement associated with receipt of certain federal mitigation grant program funds administered by the State Texas Division of Emergency Management (TDEM) and the Texas Water Development Board (TWDB). In addition, the Plan was a pre-qualification of eligibility for other mitigation funds.

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." This section of the CFR specifically states:

> *Interim Final Rule (IFR) §201.6(d)(3): A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and re-submit it for approval within five years in order to continue to be eligible for mitigation project grant funding.*

In 2011, DD7 participated in the update to the Jefferson County Plan as the State recommended that Plans include no more than two Counties. However, DD7 also decided to undertake its own plan to highlight hazards that impact its jurisdictional area and provide mitigation actions specific to its jurisdictional authority. While this 2012 Plan is an update, it is much like a new plan since it will only include DD7 and the jurisdictional area that DD7 has authority in Jefferson County. This plan update entailed a complete re-evaluation and update of all sections of the Plan including the original hazards, the risk assessment, mitigation goals, strategies, and mitigation actions. The Plan update is supplemented by an updated Federal Emergency Management Agency (FEMA) crosswalk that documents all the changes to the original HMP.

1.2 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 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.

The original HMP as well as this update were prepared in accordance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), which is the primary authority for providing federal disaster recovery and hazard mitigation financial assistance to states and local governments. The Stafford Act was last amended in October 2000 by Public Law (PL) 106-390 (Disaster Mitigation Act of 2000) and incorporated as federal rules in Code of Federal Regulations (CFR) 44. The update followed guidance pursuant to the Flood Mitigation Assistance Program (44 CFR

78.6), the Hazard Mitigation and Pre-Disaster Mitigation Programs (44 CFR Parts 201 and 206), and the process outlined in materials prepared by FEMA for the Community Rating System (CRS) of the National Flood Insurance Program (NFIP).

1.3 Geography, Climate, and Population

The area covered by Jefferson County Drainage District No. 7 (DD7) is located in southeast Texas. DD7 covers an area of 107.42 square miles and encompasses the cities of Port Arthur, Groves, Nederland and Port Neches as well as unincorporated areas of Jefferson County. The County is located in a humid, subtropical climatic zone, characterized by moderate winters and warm summers.

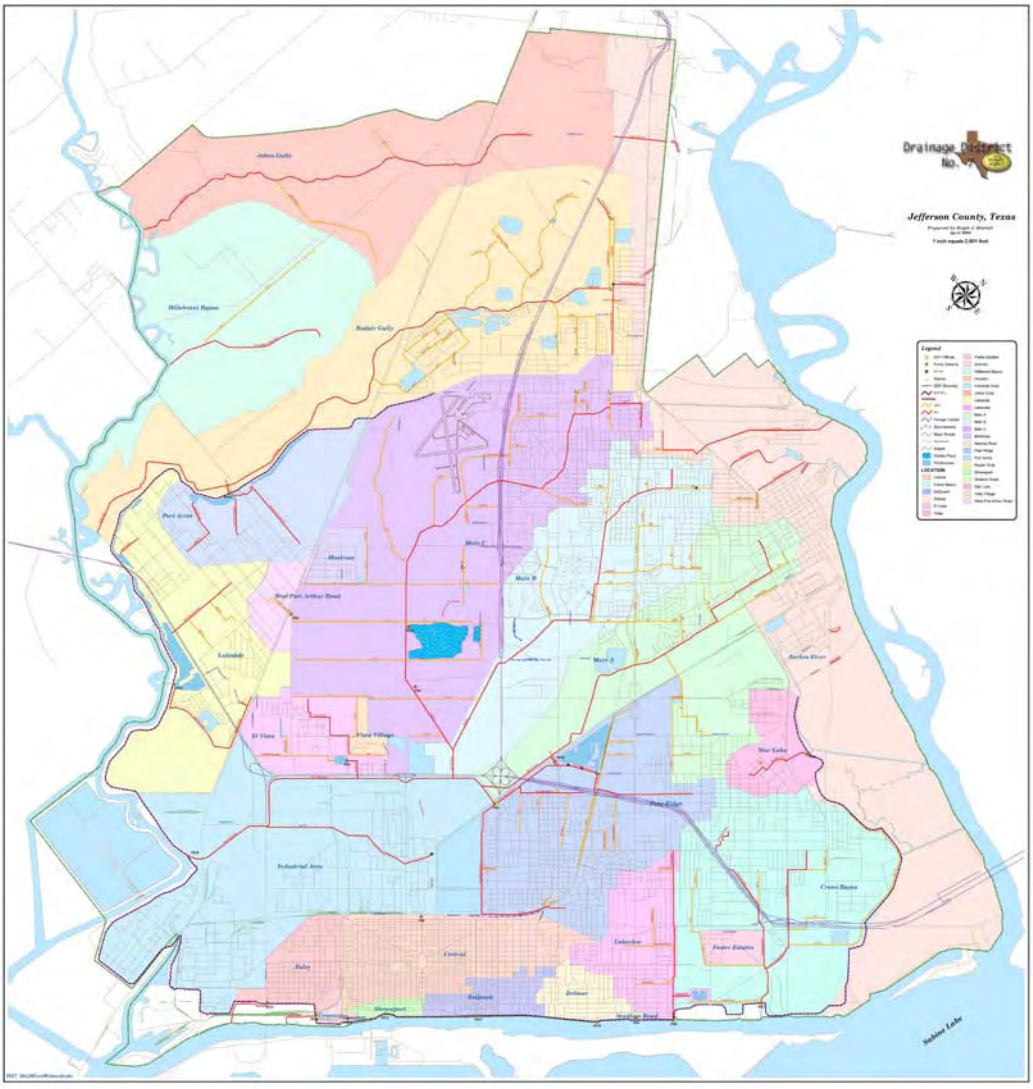
The topography of DD7 is relatively flat with the highest elevations occurring along the Neches River and the lowest occurring along Taylors Bayou. Ground surface elevations across DD7 vary slightly below mean sea level to 23 feet above mean sea level based from the USGS 7.5 quadrangle maps. Two thirds of the District is below five (5) feet above sea level. Rainfall for this area averages 55 inches per year.

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”.

DD7 is responsible for 73,000 acres of watershed. The major receiving waters for the DD7 drainage system include: Alligator Bayou, Hillebrandt Bayou, Blocks Bayou, Crane Bayou, the Neches River and the Sabine Neches Waterway

Figure 1-1

Watersheds in Jefferson County



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 55 inches and the average annual temperature is about 69 degrees.

1.4 Planning Area

Jefferson County is bounded on the north by the Neches River and Pine Island Bayou, which form the border with Hardin and Orange Counties; on the east by Sabine Lake, which forms the border with Cameron Parish, Louisiana; on the South by the Gulf of Mexico; and on the west by Liberty and Chambers Counties. Figure 1-2 is a map showing boundaries for the three drainage districts located in Jefferson County, Texas. Figure 1-3 is a street map of Jefferson County DD7.

Figure 1-2

Drainage District Boundaries in Jefferson County, Texas

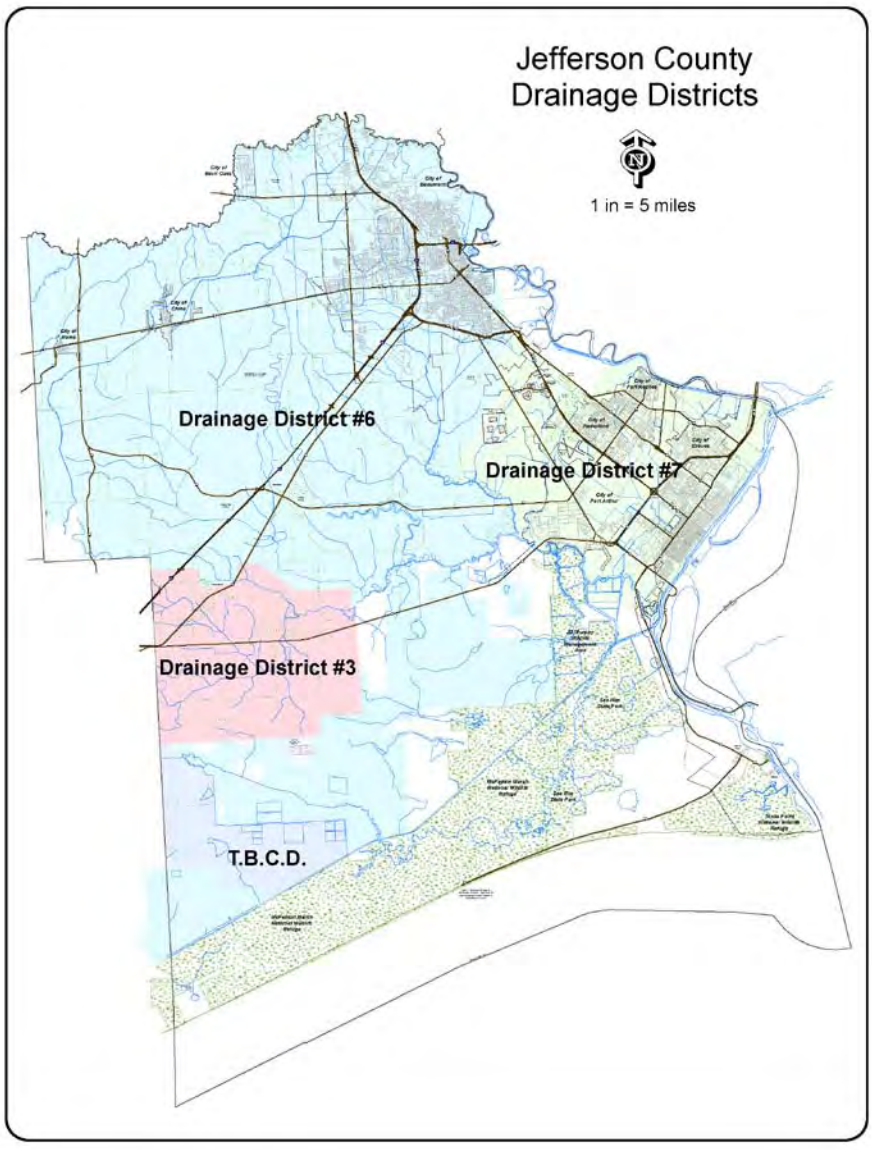
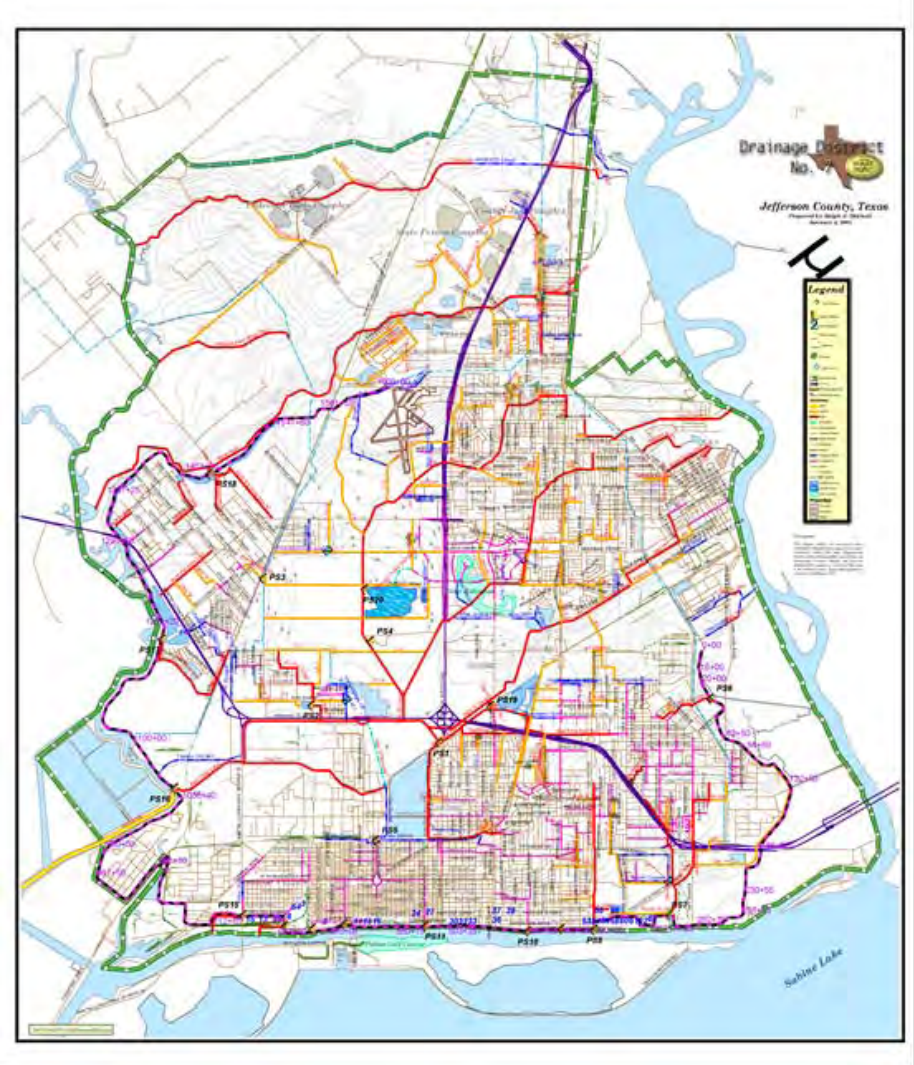


Figure 1-3

Street map of Jefferson County DD7, Texas



1.4.1 Population and Growth

According to the United States Census Bureau, Jefferson County as a whole had an estimated total population of 252,736 in 2010.[2] This is a .1% percent increase from the 2000 census data, which

[2] United States Census Bureau - Quickfacts; 2010.

estimated the Jefferson County population at 252,051. The population density per square mile in 2000 was 279 (statewide average was 79.6 persons per square mile). The 2010 population density per square mile is 287.9 for Jefferson County and 96.3 for the State. In 2010, the population of the labor force in Jefferson County was 106,468, approximately a six percent increase from the estimated labor force in year 2000. The original Plan indicated the top three industries in the County were education, health, and social services with 23,338 workers; manufacturing with 13,798; and retail trade with 12,736 workers. The 2010 Census indicates that education, health and social services are still the leading industry with 23,553, retail trade with 11,639 and manufacturing with 11,111.

Jefferson County includes both incorporated and unincorporated areas. The population totals for the four incorporated areas within the DD7 jurisdiction are identified in Table 1-1. As indicated in the table, the cities of Groves, Nederland, Port Arthur and Port Neches are located within Jefferson County DD7. The population of unincorporated Jefferson County totals 25,760 making the total population 126,309 almost half of the County's total population.

Table 1-1

Incorporated Areas of Jefferson County DD7

(Source: US Census Bureau, 2010)

City	Overall Population	Within DD7 Planning Area
Groves	16,144	Yes
Nederland	17,547	Yes
Port Arthur	53,818	Yes
Port Neches	13,040	Yes
Total	100,549	

The City of Port Arthur is the largest municipality in the planning area and as of the 2010 had an estimated population of 53,818.[3] The population density per square mile is 699.8 (statewide average is 96.3 persons per square mile). According to the Texas State Data Center and Office of the State Demographer, the Beaumont – Port Arthur Metropolitan Statistical Area is expected to expand in population from 399,794 in 2010 to 405,164 in 2015. The top ten employers for the City of Port Arthur include:

Top 10 Private Employers

- Baptist Hospitals of Southeast Texas Inc.
- Christus Health Southeast Texas
- Conex International Corporation

[3] United States Census Bureau Quickfacts; 2010.

- Exxon Mobile Corporation
- Huntsman Petrochemical Corporation
- James J Flanagan Shipping Corporation
- Motiva Company
- R E E Inc.
- Retail Investors of Texas LTD
- Wal-Mart Associates Inc.

Table 1-2 shows the number of breakdown of land use in the DD7 planning area.

Table 1-2

Breakdown of Land Use in DD7 Planning Area

Land Use Category	Description	Count	Appraised Value
Residential	Single Family, Mobile Homes and townhomes	36,848	$3,044,840,160
Residential	Multi-family (apartments, duplexes, fourplexes)	528	$246,812,920
Residential	Vacant lots	7,537	$63,758,783
Commercial	Commercial or Industrial vacant lots	957	$15,277,660
Agricultural	Land	534	$93,765,380
Commercial	Buildings	3,848	$3,436,831,880
Total		50,252	$6,901,316,783

1.4.2 Special Consideration Communities

For the purpose of this Plan update, there are no jurisdictions within the DD7 area of responsibility that are classified as "special consideration communities." The federal government defines special consideration communities to be those with 3,000 or fewer individuals that is a rural community, and is not a remote area within the corporate boundaries of a larger community. According to the 2010 census data, 46.2 million citizens (15.1% of the entire county) were living below the poverty level. In 2009, the "federal poverty level" was defined as annual incomes of $10,830 for an individual and $22,050 for a family of four.[4]

[4] U.S. Department of Health and Human Services. *Federal Register*, Vol. 74, No. 14, January 23, 2009

1.5 Composition of the Jefferson County DD7 Mitigation Planning Committee and Stakeholders

The process used to develop the 2005 Multi-jurisdiction Plan, that DD7 was a part of, was guided by a Mitigation Planning Committee (MPC). The original plan included a list of representatives from numerous City and County Departments and offices such as Emergency Management, Engineering, Floodplain Management, and Operations.

The 2012 Plan update process also included a Mitigation Planning Committee, 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 October 19, 2011 it was determined that the MPC was to be represented by a small group of individuals. The Stakeholders group would be larger and comprised of individuals and organizations from outside Jefferson County DD7. The MPC was comprised of the following individuals:

Table 1-3
Jefferson County DD7 Hazard Mitigation Plan Update
Mitigation Planning Committee (MPC)

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
Doug Wright	Assistant Manager	Jefferson County DD7	Data collection, data review, support on actions, review each section and participate in the approval of information incorporated
Diane Smith	Assistant Office Manager	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	Carroll & Blackman	Data collection, data review, support on actions, review each section and participate

Team Member	Job Title	Organization	MPC Member Responsibility
			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.

At the initial Plan update meeting on October 19, 2011 the MPC determined that the Stakeholders group would be comprised of a group of interested groups, neighboring communities, businesses, academia and other organizations and individuals with an interest in the Plan update. This Stakeholders Group was provided regular updates on the planning process and given the opportunity to review the Plan at key points in its development. Members of the Stakeholders group were also invited to attend and participate in all public meetings. The Stakeholder Group was identified by the MPC.

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 requested to provide feedback through email or by telephoning the Jefferson County DD7 point of contact, Mr. Phil Kelley or a member of the consultant team. At various points during the update process comments from Stakeholders were periodically emailed to Mr. Phil Kelley or a member of the consultation team. 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:

Table 1-4
Jefferson County DD7 Hazard Mitigation Plan Update
Stakeholders Group

Group Member	Title	Organization
Mr. Clayton Henderson	Assistant General Manager	Sabine Neches Navigation District

Group Member	Title	Organization
Mr. Richard LeBlanc	General Manager	Jefferson County DD6
Mr. Don Rao	Superintendent – Engineering	Jefferson County
Mr. Gilbert Ward	Flood Mitigation - Planning	Texas Water Development Board
Ms. Carolyn Sudduth	Mitigation – Planning	Texas Division of Emergency Management
Honorable Jeff Branick	County Judge	Jefferson County
Mr. Sam Monroe	President	Lamar State College Port Arthur
Mr. Robert Madding	Superintendent	Nederland ISD
Dr. Johnny E. Brown	Superintendent	Port Arthur ISD
Dr. Rodney Cavness	Superintendent	Port Neches Groves ISD
Mr. Greg Fountain	Jefferson County EMC	Jefferson County
Mr. Gary Collins	Fire Chief/EMC	Nederland
Mr. Dale Jackson	Fire Chief/EMC	Groves
Mr. Steve Curran	Fire Chief/EMC	Port Neches
Mr. Larry Richard	Fire Chief	Port Arthur
Mr. John Owens	EMC	Port Arthur
Ms. Jinni Akins	Executive Vice President	Nederland Chamber of Commerce
Ms. Debbie Plaia	Executive Director	Port Neches Chamber of Commerce
Mr. Ronnie Boneau	Executive Manager	Groves Chamber of Commerce

Group Member	Title	Organization
Mr. Bill McCoy	President	Port Arthur Chamber of Commerce
Mr. Wayne Moore	Administrator	Christus St. Mary Hospital
Mr. Matt Roberts	CEO	Medical Center of Southeast Texas

1.6 Acknowledgments

The Plan update was supported by a planning grant provided by the Texas Water Development Board (TWDB). DD7's Plan Update was facilitated by Jeffrey S. Ward & Associates.

2 Section 2 - Introduction to Mitigation Planning

2.1 Introduction

An important step in the lengthy process of improving resistance to hazards is the development of a hazard mitigation plan. The original Hazard Mitigation Plan that DD7 was a part of was prepared in accordance with the guidelines provided by FEMA, advice from the TDEM and the TWDB, and steps outlined in guidance documents for the National Flood Insurance Program's (NFIP) Community Rating System (CRS) (see Section 2.5).

In 2005, Jefferson County Drainage District No. Seven (DD7) participated in a multi-jurisdiction Hazard Mitigation Plan (Hardin, Orange and Jefferson Counties) because of increasing awareness that natural and man-made hazards, especially flood hazards, may affect people and property in the area. The Plan was a requirement associated with receipt of certain federal mitigation grant program funds administered by the State Texas Division of Emergency Management (TDEM) and the Texas Water Development Board (TWDB). In addition, the Plan was a pre-qualification of eligibility for other mitigation funds. It set the stage for long-term disaster resistance through identification of actions that will, over time, reduce the exposure of people and property to hazards. Completion of the original Plan, and adoption by the DD7 Board of Director's, was a significant step toward identifying potential hazards that threaten the planning area, assessing risk, and implementing mitigation actions that will reduce property damages, injuries, and loss of like from hazards. Approval of the original Plan by TDEM and FEMA also established eligibility for certain mitigation grant funds. This HMP update continues DD7's efforts to achieve these goals and continue to reduce the risk from hazards.

In 2011, DD7 participated in the update to the Jefferson County Plan as the State recommended that Plans include no more than two Counties. However, DD7 also decided to undertake its own plan to highlight hazards that impact its jurisdictional area and provide mitigation actions specific to its jurisdictional authority. While this 2012 Plan is an update, it is much like a new plan since it will only include DD7 and the jurisdictional area that DD7 has authority in Jefferson County. This plan update entailed a complete re-evaluation and update of all sections of the Plan including the original hazards, the risk assessment, mitigation goals, strategies, and mitigation actions. The Plan update is supplemented by an updated Federal Emergency Management Agency (FEMA) crosswalk that documents all the changes to the original HMP.

Sections of the Plan update provide overviews of the natural hazards that threaten DD7, the people and property exposed to those hazards, the planning process, how hazards are recognized in DD7's normal processes and functions, and priority mitigation action items. The hazards summary and disaster history help to characterize future hazards. When taking into account the magnitude of past events, the number of people and properties affected, and the severity of damage, flood and high winds (including tornadoes) hazards clearly are the most significant natural hazards to threaten DD7. Therefore, this Plan update concentrates primarily on flood and wind hazards.

2.2 Interim Final Rule Requirements for the Planning Process

IFR §201.6(c)(1): [*The Plan shall document] the planning process used to develop the Plan, including how it was prepared, who was involved in the process, and how the public was involved.*

IFR §201.6(b): *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:*

(1) An opportunity for the public to comment on the Plan during the drafting stage and prior to Plan approval;

(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and

(3) Review and incorporation, if appropriate, of existing Plans, studies, reports, and technical information.

IFR §201.6(c)(4)(ii): [*The Plan shall include a] process by which local governments incorporate the requirements of the mitigation Plan into other planning mechanisms such as comprehensive or capital improvement Plans, when appropriate…*

2.3 The Mitigation Planning Process

Jefferson County DD7 followed a well-established planning process to prepare a stand-alone *Hazard Mitigation Plan* to fulfill multiple requirements. The Plan point of contact at DD7 maintains a copy of the original plan that DD7 participated in and the updated 2011 Jefferson County plan, which can be reviewed upon request.

2.3.1 Plan Update Process

The mitigation planning process for the 2012 HMP update was facilitated by a mitigation planning consultant. The Plan update process followed the FEMA guidance document titled *Local Multi-Hazard Mitigation Planning Guidance (July 1, 2008)*. This document interprets and explains the Local Hazard Mitigation Plan regulations from the 44 Code of Federal Regulations (CFR) Part 201, and is FEMA's official source for defining the requirements for original and updated local hazard mitigation plans. The mitigation planning regulation at 44 CFR 201.6 (d) (3) states:

> *A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and re-submit it for approval within five years in order to continue to be eligible for mitigation project grant funding.*[5]

The 2012 update entailed writing the Plan update as a stand-alone document. The MPC met four times during the update process. These meetings took place at DD7 office in Port Arthur Texas. See Appendix B for all meeting minutes and list of attendees. The meeting dates are summarized below

Meeting 1 October 19, 2011
Meeting 2 January 3, 2012
Meeting 3 June 7, 2012
Meeting 4 July 17, 2012

The first MPC meeting took place on October 19, 2011. The purpose of the meeting was to begin the planning process, to make certain decisions about contents of the plan, and to assign specific tasks to Jefferson County DD7 staff and consultants. Most of the tasks were related to updating information and maps as well as identifying which areas (of each section) from the original plan required updating. To assist with identifying which areas needed updating or additional information a gap analysis of the original plan was presented and reviewed. Each section of the original plan was reviewed and analyzed to determine which areas required updating. This included areas of the plan such as the hazards profiled (and hazard data), the risk assessment, goals and objectives, maps, and the action items from the original plan.

A second MPC meeting was held on January 12, 2012. The purpose of the meeting was to review the status of various tasks assigned, review the draft plan update and discuss the proposed schedule for completing the update. The team reviewed the status of all remaining tasks such as collecting any remaining data, and integrating the information into the Plan update. Subsequent interactions among the group were conducted through email and telephone calls.

The third MPC meeting was held on June 7, 2012. The meeting focused on finalizing the mitigation action items and putting a plan in place for MPC final draft review, stakeholder draft review and the next public meeting and plans for public review and comment.

INSERT SUMMARY OF FOURTH MEETING AFTER IT HAS TAKEN PLACE.

As part of the Plan Update, certain elements of the original Plan have been retained, and irrelevant or outdated information has been edited or removed. For the current version, the focus has shifted to incorporating new hazard information, re-evaluating DD7 risk assessment, and developing and prioritizing potential mitigation actions and projects that impact DD7.

The Plan update process took place in multiple steps:

[5] *Local Multi-Hazard Mitigation Planning Guidance, July 1, 2008*

MPC and Consultant	Comprehensive review of the 2005 and 2011 Jefferson County HMAP
MPC	Discussion, modifications and approval of updates
Consultant	Updated planning process and other non-technical sections
Consultant	Updated technical sections
Consultant and MPC	Review of complete first draft
Consultant	Modifications based on review, stakeholder feedback
Consultant	Presentation to public, compile feedback
Consultant	Final draft
Consultant	Second public outreach, compile feedback
Consultant	Prepare and submit final draft
TDEM and FEMA	Review and letter of approvability
MPC and Board of Directors	Final approval and adoption

2.4 Public Involvement in Mitigation Planning

While DD7 was a part of Jefferson County's original and updated plan which were approved by the DD7 Board of Directors, the public involvement was orchestrated by the County. DD7 decided to prepare a stand-alone plan that focuses on the hazards that impact its jurisdiction and its facilities and drafted a plan as if it were an original plan. DD7 invited the public to a Board Meeting on January 3, 2012 to present a draft of the plan and to explain the benefits of the plan to the public. Preliminary drafts of the Plan update were available for public review, and the public was invited to provide input on the document. In accordance with legal requirements, DD7 published public notices about the presentation in The Port Arthur News prior to the meeting (See Appendix C, Public Notice Documents). The notice explained the purpose of the meeting, and provided the date, time, and location of the meeting. The meeting minutes (and attendee lists) for the public meeting are also included in Appendix C of the Plan update.

The public had a second opportunity to attend a meeting (July 17, 2012) to review the final draft Plan The document was posted on the Jefferson County DD7 website and placed at the DD7 Administration building. Prior to placing the document online, DD7 placed a public notice in *The Port Arthur News* explaining that the HMP update was in the final draft stages and available for review. The

advertisement can be found in Appendix C. The public meeting and timeframe for the Plan update was posted online and is provided below.

Presentation/meeting #1	January 3, 2012
Public Outreach #2	July 17, 2012

The MPC also identified local academia, business, non-profit and civic groups located in or near Jefferson County DD7. These groups were included (as with other organizations) as members of the stakeholder group and were notified via mail about the availability of the Plan update on DD7's website and encouraged to participate in the planning process and review the Plan update. These groups included:

Table 2-1
Stakeholder Groups

Group Member	Title	Organization
Mr. Clayton Henderson	Assistant General Manager	Sabine Neches Navigation District
Mr. Richard LeBlanc	General Manager	Jefferson County DD6
Mr. Don Rao	Superintendent – Engineering	Jefferson County
Mr. Gilbert Ward	Flood Mitigation - Planning	Texas Water Development Board
Ms. Carolyn Sudduth	Mitigation – Planning	Texas Division of Emergency Management
Honorable Jeff Branick	County Judge	Jefferson County
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Dr. Rodney Cavness	Superintendent	Port Neches Groves ISD
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Mr. Bill McCoy	President	Port Arthur Chamber of Commerce
Mr. Wayne Moore	Administrator	Christus St. Mary Hospital
Mr. Matt Roberts	CEO	Medical Center of Southeast Texas

DD7 mailed individual invitations to each group. These letters are included in the Plan update as part of Appendix C [to be added].

2.4.1 Public Work Session at Board Meetings

Two Board of Directors public work sessions were held to inform the Board of the progress, solicit comments from the Board and keep the Board apprised of the work completed. After DD7 receives conditional approval from TDEM and FEMA, the Board will formally adopt the Plan.

2.5 Incorporating Mitigation Plan Requirements into Other Local Planning Mechanisms

As required by the FEMA Interim Final Rule that governs mitigation planning, the project requirements from the Hazard Mitigation Plan are incorporated into other planning mechanisms, as applicable, during the routine re-evaluation and update of local Plans. As part of the original HMP development, DD7 integrated components of the Plan into other planning mechanisms. In addition to incorporating some of the Plan requirements, DD7 used its Comprehensive Study and Drainage Plan in this plan and will work with other plans to be incorporated into other plans and studies.

It should be noted that, in the State of Texas, Drainage Districts such as DD7, have very limited land use and zoning authority. With the changes in 2003 to Chapter 49.211 of the Texas Water Code, via

HB 919, Districts were required to adopt master drainage plans before adopting rules relating to the review and approval of proposed development drainage plans. In 2002, DD7 completed the development of a comprehensive drainage plan for the DD7 service area which is located in the southeastern section of Jefferson County. The report details the hydrologic and hydraulic analysis of all DD7 drainage channels in the service area and outlines proposed improvements and associated budgetary cost estimates. The MPC recommended that reference to this plan be incorporated into the drainage study as well as into DD7's annual project planning and budgeting process. As appropriate, the District will also complete periodic reviews of the Master Drainage Plan to identify mitigation actions that can be incorporated into the HMP, and will include these in the strategies section. This process will be part of the required monitoring and maintenance procedures.

The NFIP's Community Rating System (CRS) is another method that communities can benefit from the mitigation planning requirements addressed in the Plan update. These requirements and mitigation actions can work to improve a community's CRS rating. Since DD7 is considered a District and not a community it is not eligible to participate in the Community Rating System (CRS), a voluntary program for NFIP participating communities. However, the City of Port Arthur, located within DD7 does participate. The goals of the CRS are to reduce flood losses, to facilitate accurate insurance rating, and to promote the awareness of flood insurance. The CRS rewards communities that undertake activities beyond the requirements of the NFIP. The CRS is a point system program that reduces flood insurance premiums for the citizens of participating communities.[6] All communities start with a Class 10 rating and activities are offered to earn credit points that reduce a city's classification. The lower a City's Class rating, the greater the premium discounts offered by the NFIP. The City of Port Arthur's Class rating is currently nine. Any future CRS activities such as flood damage reduction or flood preparedness will consider the requirements of this plan update. DD7 will encourage other jurisdictions located within their planning area (Groves, Nederland and Port Neches) to participate in the CRS.

2.6 Review and Incorporation of Plans, Studies, Reports and Other Information

Other planning documents can be used as a valuable resource for integrating information related to hazard mitigation into the Jefferson County DD7 HMP. As part of the 2012 Plan update, other plans, studies, and reports that are applicable to the hazards discussed in the Plan were reviewed and incorporated where applicable.

The following Plans are available: 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; the 2007 Jefferson County Drainage District No. 6, (Public Review Draft), 2007 Drainage Criteria Manual for Drainage District No. 6 (Public Review Draft;) and the Jefferson County Hazard Mitigation Plan and Update (2005 and 2011) and Texas State Mitigation Plan Update (2007 and 2010). In addition, any changes or updates to the, Flood Insurance Rate Maps (FIRM), and Flood Insurance Study are

[6] Emergency Management Institute (EMI) web site, CRS Resource Center

reflected in the HMP as part of the update. The specific Plans, Studies and Reports are listed below along with a discussion on how they were incorporated into the Plan update.

- 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.

- 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 and 2010 State of Texas Mitigation Plan Update. The State HMP updates were reviewed and summarized in Section 2.7 of this Plan update. The mitigation strategies from the State Plan are also summarized in Section 2.7 for the flood, wildfire, tornado, hurricane and tropical storm, and drought hazards. The goals from the State Plan update were also reviewed and included in Section 3.3 of DD7's update. 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 update 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 again as part of the Plan update. Information describing the flood hazard was added to Section 6.

2.7 The State Mitigation Plan

The State of Texas has long been aware that it is exposed to a variety of natural hazards. Of particular concern are flood hazards associated with thunderstorms, hurricanes, and tropical storms. The 2007 and 2010 *State of Texas Hazard Mitigation Plan Update* are summarized below.

Originally prepared by TDEM to fulfill the requirements set forth by Congress in the Stafford Act (Section 409), the State's Hazard Mitigation Plan was originally completed in 2004 to satisfy new planning requirements prompted by the Disaster Mitigation Act of 2000. As part of the required three year cyclical update, the State Plan was updated in October, 2007 and again in 2010.

The State's Plan acknowledges that people and property in Texas are at risk from a variety of hazards that have the potential to cause widespread loss of life and damage to property, infrastructure, and the environment. The plan "establishes hazard mitigation goals, strategies, and specific measures designed to reduce the occurrence or severity of the consequences of hazards." It also documents procedures for implementation and administration of certain mitigation grant programs.

The State Hazard Mitigation Team is designated to coordinate and influence mitigation and is composed of several agencies that participate on the Emergency Management Board. Primary agencies are the Texas Department of Housing and Community Affairs; Texas Parks and Wildlife Department; Texas Department of Environmental Quality (formerly the Texas Natural Resource Conservation Commission); Texas Department of Transportation, General Land Office; Railroad Commission of Texas; Texas Department of Insurance; Texas Forest Service; Texas Engineering Extension Service; and Texas Division of Emergency Management. Brief summaries of each of these primary agencies are provided in the State Plan, noting key natural hazard mitigation measures associated with each agency. For the most part, existing measures are ongoing agency functions and responsibilities.

As currently structured, the State's Hazard Mitigation Plan contains attachments outlining specific strategies for dealing with hazards related to floods, tornadoes, hurricanes and tropical storms, wildfires, and drought. Strategies particularly pertinent to local jurisdictions are described below:

Flood Mitigation. Historically, floods are and continue to be one of the most frequent destructive and costly natural hazards facing the State of Texas constituting 91% of the disaster damage in the State. Texas on the average suffers approximately 400 floods annually, double the number of the second highest State. Mitigation recommendations include:

- Reduce the number of SRL properties. As of the 2010 State Plan update there were 3,172 properties on the SRL list.

- Redirect $1 million in taxes and license fees collected by the Texas Department of Insurance and provide to the Texas Commission on Environmental Quality (TCEQ) to fund floodplain management training, compliance functions, mitigation activities and a community flood-mapping program.
- Adopt "No Adverse Impact" policy that will require that consideration be given to the effect that proposed development activity anywhere within a watershed could have on flood stages, velocity, flows and erosion or sedimentation anywhere within that watershed.

Tornado Mitigation. Texas tornadoes occur with greatest frequency during the spring and early summer months, with the majority occurring in April, May, and June. Mitigation recommendations include:

- Promotion of expanded normal peril and windstorm insurance.
- Promotion of enhanced public awareness.
- Adoption and enforcement of building codes and/or design criteria, especially for shelters in public facilities, schools, and mobile home parks.
- Enhancement of warning capabilities to ensure that +90% of the state's population receives accurate and timely warnings to allow adequate response.

Hurricane/Tropical Storm Mitigation. Texas has experienced 24 Federal disaster declarations due to hurricane/ tropical storm events. Some of the more recent events include Tropical Storm Erin (DR-1730) in October, 2007 and Hurricane Ike (DR-1791) in September, 2008. Mitigation recommendations include:

- Restore the natural beach/dune system through dune and berm restoration.
- Continue to fund Coastal Erosion and Response Act and Coastal Management Projects.
- Installation of Geotextile tube Shoreline Protection Projects.
- Removal and Relocation of houses seaward of line of vegetation.
- Continue to promote the hurricane local grant program.

Wildfire Mitigation. In an average year, 1.5 million acres burn in Texas. Many areas are vulnerable to wildfire during dry years, although those with very sparse vegetation are less likely to burn due to low quantities of fuel. Mitigation recommendations include:

- Provide Urban Forestry Grants to improve community forestry programs.
- Establish and Implement burning standards.
- Continue Urban Wildfire interface traveling exhibit maintained by the Texas Forest Service (TFS).

- Continued maintenance of the TFS website that contains fire safe mitigation initiatives.

Drought Mitigation. All of Texas is vulnerable to droughts. However, the areas of Texas most vulnerable to droughts are west Texas, around the cities of Amarillo, Lubbock, Midland, Odessa, Fort Stockton, San Angelo, Laredo and El Paso. During the past 15 years, the worst droughts in Texas occurred in 1996, 2000, and 2002. Mitigation recommendations include:

- Educate residents about water conservation and landscape planting practices to preserve water supplies
- Educate the public about extreme heat/drought safety and health issues.

2.8 Federal Mitigation Planning Requirements

As mentioned elsewhere in the Plan update, the Disaster Mitigation Act of 2000 requires State and local governments to develop and adopt natural hazard mitigation plans in order to be eligible for some types of federal assistance, including mitigation grants. The Act authorizes up to seven percent of Hazard Mitigation Grant Program (HMGP) funds available to a State after a disaster to be used for the development of State, tribal, and local mitigation Plans.

In addition to the Disaster Mitigation Act of 2000, mitigation planning requirements are set forth in various FEMA policies and guidance documents, including the Interim Final Rule of February 26, 2002, and the "386" series of mitigation planning how-to guides. The following series of bullets briefly describes the FEMA's six hazard mitigation programs, all of which require some form of mitigation plan in order for communities to be eligible for grants. Although the programs differ in their eligibility requirements, funding amounts, etc., requirements related to mitigation planning are substantially similar. In 2010, requirements for all the mitigation grant programs were unified under the Hazard Mitigation Assistance (HMA) program guidance.

Flood Mitigation Assistance Program (FMA). To qualify to receive grant funds to implement projects such as acquisition or elevation of flood-prone homes, local jurisdictions must prepare a mitigation plan. The plan must include specific elements and be prepared following the process outlined in the NFIP's Community Rating System.

Pre-Disaster Mitigation Grant Program (PDM-C). By November 2003, to qualify for pre-disaster mitigation funds, local jurisdictions must adopt a mitigation plan that is approved by FEMA.

Hazard Mitigation Grant Program (HMGP). By November 2004, to qualify for post-disaster mitigation funds, local jurisdictions must adopt a mitigation plan that is approved by FEMA.

FEMA/NFIP Severe Repetitive Loss Program (SRL). The SRL program was authorized by the Flood Insurance Reform Act of 2004 to provide funding to reduce or eliminate the long-term risk of flood damage to residential structures under the NFIP which have suffered repetitive losses. SRL properties have at least four NFIP claim payments over $5,000, with at least two of the claims within a 10 year period. SRL properties are also residential structures that have at least two separate claim payments

made within a 10 year period with the cumulative amount of the building portion of the claims exceeding the value of the property. States are required to have SRL mitigation plans in order for local communities to be eligible for grant funds through this program.

FEMA/NFIP Repetitive Flood Claim Program (RFC). The SRL program was authorized by the Flood Insurance Reform Act of 2004 to assist States and communities reduce flood damages to properties that have at least one NFIP claim payment. Various hazard mitigation activities are eligible including acquisition, elevation, and dry flood-proofing of residential structures.

NFIP Community Rating System (CRS). The CRS offers recognition to communities that exceed minimum requirements of the National Flood Insurance Program. Recognition comes in the form of discounts on flood insurance policies purchased by citizens. The CRS offers credit for mitigation plans that are prepared according to a multi-step process.

3 Section 3 – Approval and Adoption

3.1 IFR Requirement for Approval and Adoption

IFR §201.6(c)(5): [The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Board, County Commissioner, Tribal Board).

3.2 Authority

Authority for the preparation of both the original Hazard Mitigation Plan (HMP) and Update is derived from the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988, P.L. 93-288, as amended by the Disaster Mitigation Act of 2000, P.L. 106-390. The Disaster Mitigation Act of 2000 (The Act) required State and local governments to develop and formally adopt natural Hazard Mitigation Plans by November 2003 in order to be eligible to apply for Federal assistance under the HMGP. The Act was further amended to extend the planning requirement deadline to November 2004.

When the DMA 2000 was signed into law on October 30, 2000, the Robert T. Stafford Disaster Relief and Emergency Assistance Act was amended by adding a new section, 322 – Mitigation Planning. Section 322 places new emphasis on local mitigation planning. It requires local governments to develop and submit mitigation plans as a condition of receiving Hazard Mitigation Grant Program (HMGP) project grants. An Interim Final Rule (IFR) for implementing Section 322 was published in the Federal Register, 44 CFR Parts 201 and 206, on February 26, 2002. The requirements for local plans, or Local Mitigation Plan Criteria, are found in part 201.6.

In addition to the Plan requirement, the Act also requires communities to utilize a specific planning process developed for an all hazards approach to mitigation planning. This four step planning process is crucial to ensure that the effective planning by a community meets all the Plan content criteria required by the Act. The Act requires adoption by the local governing body and specifies a stringent review process, by which States and FEMA Regional Offices will review, evaluate and approve hazard mitigation plans.

3.3 Approval and Adoption Procedure

Jefferson County DD7 was a part of the Jefferson/Hardin/Orange County hazard mitigation plan that was approved in 2005. After FEMA and TDEM reviewed and approved the HMP, DD7 Board of Directors formally adopted the Plan. DD7 participated in Jefferson County's update Plan that was submitted to TDEM and FEMA for review in 2011. Once approved, DD7 Board of Directors will formally adopt that Plan.

Throughout the 2012 DD7 HMP Update process, the MPC and Stakeholders Group had opportunities to provide comments and feedback. September 1, 2012, DD7 submitted the initial draft of the Plan Update to TDEM for review and comment. After addressing TDEM comments in the document, the HMP was resubmitted for final consideration and approval by TDEM and FEMA. FEMA provided a letter of approvability on [insert date], and the Plan was forwarded to the DD7 Board for adoption, which occurred on [insert date]. The adoption resolution is provided as Appendix D in the HMP update. Following adoption, the plan was resubmitted to FEMA for final approval, which occurred on [insert date]. The FEMA approval letter is included as Appendix E.

3.4 Adoption Resolution

Jefferson County DD7 formally adopted the updated version of the HMP on [insert date].

4 Section 4 – Mitigation Goal Statements

4.1 Introduction

State and federal guidance and regulations pertaining to mitigation planning require the development of mitigation goals to reduce or avoid long-term vulnerabilities to identified hazards. Mitigation goals have been established by the Federal Emergency Management Agency, the Texas Division of Emergency Management, and DD7.

4.2 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, Jefferson County's mitigation goal statement from the 2005 and 2011 HMP was reviewed by the MPC during the initial meeting held on October 19, 2011. The MPC determined that the mitigation goal statement for the County was too broad for its purposes so the MPC drafted its goal statement to be more reflective of DD7's authority within the County. Therefore, the DD7 HMP Goals are 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.

4.3 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 (2007). The State's 2007 and 2010 plan includes a series of mitigation goals, as follows:

Texas State Mitigation Goals

Reduce or eliminate hazardous conditions that cause loss of life;

Reduce or eliminate hazardous conditions which inflict injuries;

Reduce or eliminate hazardous conditions which cause property damage; and

Reduce or eliminate hazardous conditions which degrade important natural resources.

Texas Hazard Mitigation Plan (2007 and 2010)

As part of the 2007 and 2010 State of Texas HMP update, the goals from the 2004 Plan were re-assessed by the planning committee. TDEM reviewed the goals and determined they were still valid and therefore remained unchanged for the 2007 and the 2010 update.

4.4 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.

5 Section 5 – Profiled Hazards in DD7

5.1 Introduction

As part of its efforts to support and encourage hazard mitigation initiatives, the TDEM prepared an assessment of hazards that have caused or have the potential to cause disaster situations in communities throughout the State of Texas. Results of the study are found in the *State of Texas Hazard Assessment* (2007). Other public sources of information provide some information about natural hazards and past events. Of the 75 Presidential Disaster Declarations that Texas received between 1961 and 2008, 39 were for floods, 15 for tornadoes, three for hurricane/tropical storms, one for winter storm, and the remaining were a combination of events, or designated as "other."

The following subsections provide an overview of past hazard events and associated losses. Natural hazards other than flood hazards that are deemed pertinent to DD7 are described, along with summary statements about exposure to risks associated with those hazards. Because flooding poses the most significant risk in DD7 and wind has the potential to impact DD7 facilities, Section 6 provides risk assessments for flood and wind hazards, past flood and wind events, and summaries of the people and property that are at-risk.

5.2 IFR Requirement for Hazard Identification, Profiling, and Risk Assessments

IFR §201.6(c)(2)(i): [The risk assessment shall include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

IFR §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

IFR §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

5.3 Overview of Risks

Damage and losses (including physical damage, indirect and economic losses, injuries and deaths) which are associated with hazards result when an event affects areas where people and improved property are located. After hazards are identified, then estimates of how exposed people and property are (how "at-risk") can be prepared, especially if the hazards can be characterized by areas on a map.

When the full range of possible natural and man-made hazards is reviewed, it becomes apparent that some events occur frequently and some are extremely rare. Some hazards impact large numbers of

people to a limited degree, while others may cause very localized but very significant damage. As described in Section 5.1, floods and wind have historically caused the most property damage in DD7.

The National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) collects and maintains certain hazard data in summary format, indicating injuries, deaths, and estimated damages. According to the NCDC database (and other sources), between 1950 and 2011, Jefferson County has experienced 504 weather events:

- 302 wind events (includes wind thunderstorm, funnel cloud, high winds, strong winds and tornados)
- Of the 101 tornados listed in the 302 wind events (42 F0s, 33 F1s, 20 F2s, and 6 F3s)
- 66 flood events that include 9 hurricanes and tropical storms; 33 flash floods, 10 floods, 6 heavy rains, 6 urban floods and 2 storm surges
- 104 Hail storms
- 5 severe droughts
- 2 extreme heat waves
- 6 winter storms/extreme cold events
- 1 wildland fire
- 1 Earthquake (magnitude 4.4 near Texas - Louisiana border)

The remaining 16 events were for categories like fog, lightning, and astronomical low tide. The NCDC database indicates that these hazard events caused a combined total of $2.824 billion in property damage. The database also indicates there have been 202 injuries and 11 deaths as a result of these events.[7]

5.3.1 Weather-Related Deaths

The National Weather Service maintains data on weather-related deaths. Summary statistics for the State of Texas based on those data are provided in Table 5-1. Because the reporting periods are different, percentages, not actual numbers, are provided.

[7] NOAA National Climatic Data Center (NCDC) Severe Storm Event Database,http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms.

Table 5-1
Texas Weather-Related Deaths
(as percent of all weather-related deaths)

Hazard	Statewide (1989–2000)	Jefferson County (1989–2002)
Flood/Flash Flood	35%	12.5%
Tornado	10%	37.5%
Lightning	8%	25%
Winter Storm/Ice Storm	6%	12.5%
Extreme Heat	34%	0%
Severe Thunder Storm	4%	12.5%
Hurricane/Tropical Storm	3%	1%

5.4 Public Awareness of Hazards & Risk

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

Buying property in a floodplain triggers the federal requirement to obtain flood insurance when obtaining a federally insured and regulated mortgage. Federally insured and regulated mortgage lenders are required to make homebuyers purchase flood insurance if the building is located in a mapped flood hazard area. Buyers are supposed to be notified well in advance of closing.

Applying for permits leads to a determination that the property or construction site is within a mapped floodplain and therefore subject to floodplain management requirements.

When flooding occurs, the news media frequently carries stories about travel hampered by flooded roads and homes damaged by floodwaters. Research has shown that many flood victims themselves tend to discount the likelihood that flooding will occur again. This tendency is attributed to a general lack of understanding of probability (see Comparing Risks, below). All too often, people interpret the phrase “100-year storm” to mean that it only occurs once every 100 years, rather than that such an event has a 1-in-100 chance of happening each year. FEMA reports that, based on insurance statistics, a building in the floodplain is five times more likely to be damaged by flood than to sustain major damage by fire.

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

Comparing Risks

What's the chance that in the next year, a person whose house is in the floodplain will:

Be involved in a car accident? 3 chances in 100

Be in 100-year flood? 1 chance in 100

Have a car stolen? 1 chance in 300

Be a victim of robbery? 1 chance in 1,000

Have a residential fire? 4 chances in 10,000

www.floodsafety.com

A project of the Texas Environmental Center

5.5 Overview of DD7's Natural Hazards History

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 the course of some of their ongoing projects and studies. As mentioned earlier in this Section, NOAA's NCDC 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 NCDC is often the best available resource for documenting historical events. For many of the hazards profiled, the query results from the NCDC database are provided in the hazard specific subsections with this section.

In the absence of definitive data on some of the natural hazards that may occur in DD7, illustrative examples are useful. Table 5-2 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 than 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 2011, thirteen such disasters have been declared in Jefferson County and are identified in Table 5-2.

In addition to the declared events, the table also includes several incidents which did not receive a Presidential Disaster Declaration.

Table 5-2
Natural Hazard Events and Declared Major Disasters in Jefferson County
(Sources: Public Entity Risk Institute (PERI) website, FEMA, NCDC 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 Necehes 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.
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.
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 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 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 policy holders filed flood claims resulting in over $8.7M in payments). This unnamed storm produced heavy rains, causing flooding throughout Jefferson County.

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 9, 2007 (Not a declared Disaster)	HURRICANE HUMBERTO - Hurricane Humberto made landfall as a strong category one hurricane in rural southwestern Jefferson County early in the morning on September 13th, over McFaddin National Wildlife Refuge. Storm total rainfall ranged from one inch in southern Jasper and Newton Counties, to almost 11 inches near McFaddin Wildlife Refuge. Some flash flooding occurred in the urban areas between Beaumont and Orange. Highest estimated winds were around 80 knots or 90 mph, but hurricane-force wind only extended 15 miles. Damage was primarily trees blown down, roof damage, and power lines downed. The lowest pressure reading was estimated to be 985 mb at landfall. Coastal storm tides were 3 to 5 feet, with the highest occurring at Texas Point. One fatality was attributed to the hurricane. An 80 year old man in Bridge City (Orange County, TX) ventured outside to check his property and was killed instantly when his carport collapsed on him.
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.

5.6 Losses Due to Major Disasters

No definitive record exists of all losses – public and private – due to disasters for Jefferson County. For the United States as a whole, estimates of the total public and private costs of natural hazards range from $2 billion to over $6 billion per year. Most of those costs can only be estimated. In most declared major disasters, the federal government reimburses 75% of the costs of cleanup and recovery, with the remaining 25% covered by the state and affected local jurisdictions.

FEMA's estimate of its expenditures in the State of Texas for flood disasters alone for the period from 1991 through 2009 exceeds $8 billion. This period includes Tropical Storm Allison, and Hurricanes Rita and Ike. These costs, which do not include costs incurred by other federal agencies or by state and local agencies, include those associated with:

- Public assistance for debris removal, emergency services, roads and bridges, flood control facilities, public buildings and equipment, public utilities, and parks and recreational facilities.
- Assistance paid out for individual and family grants, emergency food and shelter, and other assistance to individuals.

- Funds set aside to support hazard mitigation grants.

DD7 received Public Assistance (PA) funds after Hurricane Rita and Ike events described above in Table 5-2. In addition to PA funds, DD7 has also received a hazard mitigation grant to support a pump station improvement project as well as an FMA grant to develop this plan update. A detailed description of mitigation projects and funds received can be found in Section 7.7, Ongoing and Previous Mitigation Initiatives.

5.7 Hazards Profiled

The Jefferson/Hardin/Orange Plan, hazards were classified as either "hazards of concern" or not hazards of concern". For the updated Jefferson County Plan, all hazards with "a realistic potential to impact the planning area in a significant way are profiled" (Jefferson County Hazard Mitigation Action Plan, 2011, pg. 34) and some hazards were eliminated (e.g. avalanche, expansive soil) and new hazards were added (e.g. dam failure, geologic hazard, including land slide, subsidence and erosion). The MPC reviewed the updated hazards profiled in Jefferson County's updated plan and profiled those natural hazards that impact DD7's planning area. From that list, Risk Assessments were conducted on those hazards that DD7 has authority to mitigate. Table 5-3 compares the hazards profiled in Jefferson County's Plan Update and DD7's Plan Update.

Table 5-3
Comparison of Profiled Hazards in 2011 Jefferson County HMAP and
2012 Jefferson County Drainage District No. 7 HMP Update

Jefferson County 2011 Plan Update Profiled Hazards	Jefferson County DD7 2012 Plan Update Profiled Hazards
Dam Failure	Dam Failure
Drought	Drought
Earthquake	Seismic/Earthquakes
Extreme Heat	Extreme Heat
Flood	Flood
Geologic Hazard (sinkholes and landslides)	Landslides
Hazardous Material Incidents	Not applicable: DD7 has no authority. Not profiled.
Hurricane and Tropical Storms	Hurricanes and Tropical Storms

Jefferson County 2011 Plan Update Profiled Hazards	Jefferson County DD7 2012 Plan Update Profiled Hazards
Severe Winter Weather	Winter Storm
Terrorism	Not applicable: DD7 has no authority. Not profiled.
Thunderstorm (lightning, hail, high winds)	Thunderstorms
Tornado	Tornadoes / High Winds
Tsunami	No recorded incidents– Low probability not profiled
Water Contamination	Not a natural hazard – not profiled
Wildfire	Wildland Fire

After reviewing all hazards that could potentially impact DD7, the MPC considered the flood and tornadoes/high winds hazards the most significant. Section 6 of this Plan update provides a risk analysis of the flood (including storm surge) and tornadoes/high winds hazards, while the following subsections provide a profile of hazards that were identified by the MPC to profile as they can affect Jefferson County DD7. The hazards addressed in this subsection include the following:

- Hurricanes and Tropical Storms
- Thunderstorms/winds and Lightning
- Extreme Heat
- Drought
- Wildland Fire
- Winter Storm
- Seismic / Earthquake
- Landslides
- Flood /High Winds (tornadoes)
- Dam Failure

Table 5-4 identifies the total number and estimated value of buildings/infrastructure within Jefferson County DD7. T he table indicates there are 50,759 residential buildings and 4,390 commercial buildings. As shown in Table 1-1 of the Plan update, the total population of the incorporated areas within DD7 is 100,549. 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 5-4 is used periodically throughout Section 6 to identify the overall District-wide exposure for certain hazards that equally impact the entire planning area such as hurricanes/tropical storms and drought.

Table 5-4
Buildings/Infrastructure Within Jefferson County Drainage District Seven Planning Area
(Source: Central Appraisal District)

Type	Number of Structures/Estimated Value	
Residential Buildings*	37,376	$3,291,653,080*
Commercial Buildings*	3,848	$3,436,831,880*
District owned Buildings**	7	$1,870,782
Infrastructure***	20	$36,102,599
Total	----	$6,766,458,341

* – Data obtained from Central Appraisal District

** District owned buildings include main office, warehouse, mechanical shop, electrical shop, vehicle shop, meeting room and control center estimated values.

*** Infrastructure is all 20 District owned pump stations.

General Assessment of Probability and Potential Impacts

For each hazard profiled in the present section, the planning team assigned a high, medium, or low probability of future occurrences. The hazard probability was assigned by dividing the period of record by the numbers of previous events, then scaling the probabilities as low, medium, and high, as shown in Table 5-5. Note that the percent ranges in the table below are not intended as exact probabilities; they are estimates made by the planning team, intended to be used as a general guide for future planning purposes. Also note that future probability is only one component of the risk calculation (the others being severity vulnerability and value). Some hazards, such as major hurricanes and earthquakes have a low probability but potentially very high impact on life and property in the planning area.

Table 5-5

Annual Percent Probability Ranges

Probability	Annual Percent Probability Range (%)
Low	1-9
Medium	10-24
High	25-100

For each hazard profiled, to determine the impact on life and property the MPC categorized the impact by minor, moderate, and major. To assess the impact on property, these categories were assigned a dollar range based on the estimated annual damages. For the impact on life, the category values were based on the number of deaths caused by the hazard. The categories and dollar ranges are shown in Table 5-6.

Table 5-6

Impact on Life and Property

Impact	Estimated Annual Damages ($)	Deaths	Injuries
Minor	<250,000	0	1 – 10
Moderate	250,000 - 1,000,000	1 - 3	11 – 25
Major	>1,000,000	> 4	> 25

To deduce which the magnitude, extent or severity the hazard potentially could have on the planning area, the MPC ranked each hazard's potential to cause damage, disrupt continuity of operations or shutdown facilities by providing a classification.

Table 5-7

Extent/Severity/Magnitude

Level of Severity	Description
Substantial	Complete shutdown of facilities for 30 or more days and more than 50 percent of property destroyed or with major damage.
Major	Complete shutdown of critical facilities for at least 2 weeks, and more than 25% of property destroyed or with major damage.
Minor	Complete shutdown of critical facilities for more than 1 week and more than 10 percent of property destroyed or with major damage.
Limited	Minor quality of life lost, shutdown of critical facilities and services for 24 hours or less and less than 10 percent of property destroyed with major damage.

Finally, 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 5-8.

Table 5-8

Overall 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

5.7.1 Thunderstorms/High Winds and Lightning

Description of the Severe Thunderstorm/High Wind and Lightning Hazard

Thunderstorms are local storms produced by cumulonimbus clouds, and always accompanied by lightning and thunder. 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 (NWS) considers a thunderstorm "severe" if it produces tornadoes, hail of 0.75 inches or more in diameter, or winds of 58 miles per hour or more. Structural wind damage may imply the occurrence of a severe thunderstorm. The high wind/severe storms hazard affect the entire planning. For additional information about severe thunderstorms and high winds visit NOAAs *Severe Weather* page located at http://www.noaawatch.gov/themes/severe.php.

Lightning typically occurs as a by-product of a thunderstorm. The action of rising and descending air in the thunderstorm separates positive and negative charges, with lightning the result of the buildup and discharge of energy between positive and negative charge areas. According to NOAA, an average of 20 million cloud-to ground-flashes are detected every year in the United States with half of all flashes having more than one ground strike point. Lightning is dangerous and frequently a frequently encountered weather hazard that most people in the US experience annually. Lightning is the second most frequent killer in the US behind floods and flash floods causing approximately 100 deaths and 500 injuries annually.

Geographic Location

The entire planning area is subject to the wind effects from the thunderstorm/high wind hazard. Figure 5-1 shows how the frequency and strength of extreme windstorms vary across the United States. The map is based on a combination of all past occurrences and shows that southeast Texas, and Jefferson County, falls in wind Zone III, where wind speeds can reach as high as 200 mph.[8]

Figure 5-1

Wind Zones in the United States

(Source: FEMA)

As mentioned, this map is used to design buildings to withstand reasonably anticipated winds in order to minimize property damage.[9] Jefferson County falls within the area where the "design wind" speed is between 110 mph. The building code administered within the incorporated areas of Jefferson County requires all new construction to be designed and constructed for 110 mile per hour wind loads. This design wind speed contemplates the potential effects of hurricanes, thunderstorms and tornadoes, and is based on three-second peak gusts at a height of 33 feet above the ground. Since this design wind

[8] Source: FEMA, Wind Zone map

[9] American Society of Civil Engineers, 2002

speed is based on three kinds of events, it is not possible to state definitively that the potential high wind speed for thunderstorms is 110 mph, but it is safe to assume that the maximum potential straight line wind is perhaps in the 90 mph range.

Lightning also impacts the entire planning area.

Previous Occurrences

The NCDC database indicates that between 1950 and November, 2011, Jefferson County experienced 192 severe thunderstorm/high wind events (three of which had 70 knot winds (80 mph) or greater). Most wind damage in Jefferson County has been limited to downed trees, blocked roads, and disabled power lines. Note that the thunderstorm and high winds category of the NCDC database excludes hurricane wind events. High winds associated with hurricanes are captured under the hurricanes and tropical storms category of the database (See Section 5.7.2). Therefore, events such as Hurricane Ike in September of 2008 are not included as part of the query results for high winds. Table 5-9 summarizes the three high wind events with equal to or greater than 70 knot winds.

Table 5-9

Jefferson County: Thunderstorm/High Wind Events 70 or greater Knots,

Excluding Tornado Winds, 1950 – August, 2011

(Source: NOAA/NCDC)

3 THUNDERSTORM WINDS event(s) were reported in Jefferson County, Texas between 04/30/1950 and 08/31/2011.

*Click on **Location or County** to display Details.*

Magnitude
Mag: Deaths
Dth: Injuries
Inj: Property
PrD: Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 JEFFERSON	04/26/1973	0130	Tstm Wind	87 kts.	0	0	0	0

2 JEFFERSON	10/22/1979	0800	Tstm Wind	70 kts.	0	0	0	0
3 Port Arthur	03/13/1995	1100	Thunderstorm Winds	70 kts.	0	2	70K	0
				TOTALS:	0	2	70K	0

NCDC also reports that there have been 12 lightning events in Jefferson County between 1950 and 2011 causing three deaths, twelve injuries and approximately $465,000 in damage as indicated in Table 5-10.

Table 5-10

Jefferson County: Lightning Events 1950 – August, 2011

(Source: NOAA/NCDC)

Query Results

12 LIGHTNING event(s) were reported in Jefferson County, Texas between 04/30/1950 and 08/31/2011.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Port Arthur	07/13/1994	1310	Lightning	N/A	1	0	0	0
2 Beaumont	08/21/1994	1300	Lightning	N/A	0	1	0	0

3 Port Neches	08/21/1994	1300	Lightning	N/A	0	1	0	0
4 Port Arthur	08/22/1994	0900	Lightning	N/A	1	0	0	0
5 Beaumont	08/12/1996	09:00 PM	Lightning	N/A	0	1	10K	0
6 Beaumont	07/12/1999	02:00 PM	Lightning	N/A	0	1	0	0
7 Port Arthur	08/29/2007	10:00 AM	Lightning	N/A	1	0	0K	0K
8 Sabine	07/23/2009	14:22 PM	Lightning	N/A	0	8	5K	0K
9 Beaumont Arpt	07/05/2011	15:45 PM	Lightning	N/A	0	0	30K	0K
10 Amelia	07/06/2011	14:00 PM	Lightning	N/A	0	0	100K	0K
11 Pine Crest	07/06/2011	16:50 PM	Lightning	N/A	0	0	250K	0K
12 Groves	07/19/2011	05:20 AM	Lightning	N/A	0	0	70K	0K
TOTALS:					3	12	465K	0

A couple of the more recent thunderstorm/ high wind and lightning events are summarized below.

July 6, 2011 - Excessive lightning caused a fire at the Stone Hearth Apartments. One unit with eight apartments was on fire and the roof partially collapsed. An upper level disturbance helped produce thunderstorms that had numerous lightning strikes in southeast Texas. The event caused over $250,000 in damages.

July 19, 2011 - A house that was struck by lightning caught fire in Groves. The fire started in the attic of the two-story home, and caused considerable water damage on the first floor and fire damage on the second floor. An upper level low pressure area helped produce heavy rain and thunderstorms that caused one house fire in Groves and flooded a home in Port Arthur. The event caused over $70,000 in damages.

Probability of Future Occurrence

With 192 severe thunderstorm/high wind and lightning events between 1950 and 2011, Jefferson County experiences on average about three severe thunderstorm/high wind and lightning events per year. With approximately three events per year, there is a 100% annual probability of a future severe thunderstorm/high wind events occurring in Jefferson County. Based on the high, medium, and low ranges identified in Table 5-5, there is a high probability of future thunderstorm/high wind events occurring in Jefferson County. See Table 5-5 for the definition of high, medium and low probability.

Magnitude/Severity/Extent

Severe storms are frequent in Texas and occur throughout the year, with highest frequency during the spring and summer months. During these seasons, Jefferson County is particularly subject to strong storms that are triggered, primarily, by rapid surface warming (an average of 10 degrees difference in daytime warming from March to April) which causes air to become unstable (to rise and shift unpredictably) and southward shifts in the jet stream that bring cold air masses into contact with warm fronts coming up from the Gulf of Mexico. Average rainfalls increase, in the area, by 50% during the months of April and May, in contrast to that experienced during the winter months.

During the summer months, convective currents, spawned by rapid and intense surface heating, as well as increases in relative humidity, can bring about the formation of late afternoon thunderstorms that are accompanied by heavy downpours and dangerous lightning. As mentioned above, however, severe/life and property threatening thunderstorms can and have occurred, in Jefferson County, in all seasons and at all times of the day and night.

The severity (magnitude or extent) of high winds is mainly measured by velocity, either *sustained* wind, or *peak gusts*. High wind effects may be exacerbated by the presence of debris, which are loose objects that become airborne missiles during high winds and can cause damage that winds would otherwise not create. Typical examples of windborne debris are gravel roof ballast and tree branches. Assets and people in areas with significant potential for missiles to be present are thus somewhat more exposed to secondary wind risks. Wind velocities from hurricanes and tornadoes are typically much higher than from thunderstorms, so building codes are usually calibrated based on potential sustained wind speed, or on 3-second peak gusts at a specific elevation about the surface.

The extent of thunderstorms may be measured by the cell intensity: ordinary cell, multi-cellular, and super cell. The most common type of thunderstorm is termed the “ordinary” cell, which is limited in size and lifespan, but can produce short bursts of severe weather. Several other variants also exist, but the most dangerous form is termed the “super cell” thunderstorm. The super cell is typically an isolated form and always has the potential to be severe because of its strong and persistent rotating updraft, which dissipates at the upper levels forming the characteristic anvil and overshoot of clouds. Vertical wind shear (i.e., wind speed increasing with height) is important in the development of severe storms such as super cells. The shearing effect serves to separate the updrafts from the downdrafts, thus creating a circulation. In a normal thunderstorm, the downdraft tends to fall back into the updraft, effectively dissipating the storm’s energy. Hail and heavy rain are associated with the downdraft zones and under some specific conditions may also form a tornado towards the left rear flank of the storm cell. This small but rapidly rotating column of air descends below the cloud base, reaching the surface with devastating consequences. As the storms translate at speeds typically in the range of 25 to 30 mph, these relatively narrow impact widths become long swaths of potentially very high damage. Super cells

may have a lifespan of several hours and present an impact front as wide as 25 miles. Records of damage generally indicate "pulsing" whereby the ground level impacts tend to fluctuate, probably depending on the supply of material held aloft by the updrafts. Very severe super cells can exhibit almost continuous damage fronts for several hours as combinations of wind, rain, and hail. All these types of thunderstorms are possible in the planning area. The overall extent of thunderstorms on the planning area is limited because while thunderstorms occur frequently in the area, they do not cause the planning area's critical facilities to shut down.

Overall Vulnerability

All people and assets in Jefferson County are considered to have the same degree of exposure to the severe thunderstorm/high wind and lightning hazard. Within the County, the risk to people and property from the high wind hazard cannot be distinguished by area; the hazard is expected to have a relatively uniform probability of occurrence across the entire County.

Several meteorological conditions can result in winds severe enough to cause property damage. In Jefferson County, most wind damage has been limited to downed trees, blocked roads, and disabled power lines. Typically, assets of lighter construction (such as mobile and other manufactured structures) are most vulnerable to the high winds hazard. Data related to the number of structures by building type and past damages for specific building types was unavailable at the time of the Plan update. The NCDC database indicates that between 1950 and August, 2011, Jefferson County experienced one death and twelve injuries from high wind events. During this same time period, property damage totaled $2.812 million.

The following approach was used to estimate the potential losses to new future buildings. As indicated in Table 5-3, total value of buildings within the District are estimated at approximately $6.77B. Using historical loss data, it is estimated that these assets will experience annual losses in the amount of $8,917.00, which is .0000013% estimated annual estimated losses, as percentage of the total value of the assets. Given that there is no way to predict the geographic location of thunderstorms/ high winds, existing and new construction is presumed to have approximately equal exposure.

Jefferson County has had three deaths and 12 injuries as reported by the NCDC database, however, most due to lightning. While there have been damages to property, it is considered between moderate and major (major for dollar amount and moderate for loss of life and injuries). There is a 100% probability of future occurrences and the potential to cause limited damage and disruption of services as defined in Table 5.6.1, therefore the overall vulnerability is low. In addition, the District only has authority to mitigate its own buildings for wind, so this hazard will not be further analyzed as the more damaging winds that can impact the buildings are from hurricane and tornado winds which will be further analyzed.

5.7.2 Hurricanes and Tropical Storms

Description of the Severe Hurricanes and Tropical Storms Hazard

A hurricane is a tropical storm with winds that have reached a constant speed of 74 miles per hour or more. Hurricane winds blow in a large spiral around a relative calm center known as the "eye." The

"eye" is generally 20 to 30 miles wide, and the storm may extend outward 400 miles. 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, and storm surges. A single hurricane can last for more than 2 weeks over open waters and can run a path across the entire length of the eastern seaboard. August and September are peak months during the hurricane season that lasts from June 1 through November 30. See Appendix A for a more detailed description of the hurricane and tropical storm hazard.

Geographic Location

Jefferson County DD7 is located along the Gulf of Mexico and therefore vulnerable to hurricanes and tropical storms. The hurricane and tropical storm hazard affects the entire planning area. Lightly constructed residential structures within the planning area are most vulnerable to the high winds associated with hurricanes and tropical storms. As mentioned elsewhere, data related to the number of structures by building type and past damages for specific building types was unavailable at the time of the Plan update.

The severity of hurricanes and tropical storms is measured primarily by wind velocity, flooding, and storm surge. As shown in Table 5-11, 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.

Table 5-11 Saffir-Simpson Hurricane Scale

(Source: NOAA)

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

Jefferson County DD7 has been impacted by four Category 4 hurricanes since 1900. Although a Category 4 has been the strongest magnitude to impact DD7, it would be possible for a Category 5 event to impact the planning area. Jefferson County DD7 is located along the Gulf of Mexico where a Category 5 hurricane has made landfall in the past. In August of 1969 Hurricane Camille made landfall near Bay St. Louis as a Category 5, causing catastrophic damage to parts of the Mississippi coastline.

The NCDC database indicates that between 1950 and 2011 there were nine hurricanes or tropical storms that impacted Jefferson County. Other data sources indicate that there are additional events

prior to 1998 that were not reported in the database. It is unclear why the database does not include these events prior to 1998. For the events listed, the NCDC database reported one death, 12 injuries and approximately $2.2 billion in property damages. Table 5-12 summarizes the nine hurricanes and tropical storms that have impacted Jefferson County and DD7.

Table 5-12
Hurricane and Tropical Storm Events in Jefferson County, 1950 - 2011

(Source: NOAA/NCDC)

9 HURRICANE & TROPICAL STORM event(s) were reported in Jefferson County, Texas between 04/30/1950 and 08/31/2011.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 TXZ215	08/21/1998	11:00 AM	Tropical Storm	N/A	0	0	60K	0
2 TXZ215	09/01/1998	03:00 PM	Hurricane	N/A	0	0	10K	0
3 TXZ215>216	09/09/1998	06:00 PM	Tropical Storm	N/A	0	0	7.0M	0
4 TXZ215>216	06/05/2001	04:00 PM	Tropical Storm	N/A	0	0	0	0
5 TXZ180>182 - 201 - 215>216	09/23/2005	12:00 PM	Hurricane/typhoon	N/A	1	0	2.1B	0
6 TXZ215	09/13/2007	01:00 AM	Hurricane	N/A	0	12	25.0M	0K
7 TXZ215 - 216	08/05/2008	03:00 AM	Tropical Storm	N/A	0	0	250K	0K
8 TXZ182 - 215	09/12/2008	19:00 PM	Hurricane	N/A	0	0	100.0M	0K
9 TXZ182 - 215	09/12/2008	19:00 PM	Tropical Storm	N/A	0	0	5.0M	0K

TOTALS:	1	12	2.227B	0

In addition to the NCDC database, the National Hurricane Center's (NHC) Hurricane and Tropical Storm Tracker database was also queried to identify past hurricane events. According to the NHC, from 1900 to 2009, the eastern coast of Texas has been impacted by nine major hurricanes (Categories 3, 4, and 5). During the same time period, eastern Texas experienced 22 Category 1 or 2 hurricanes. Based on approximately 110 years of historical data from the NHC, the probability of future hurricanes impacting coastal area of eastern Texas is high, averaging one event approximately every four years.[10] Figure 5-2 identifies the storm tracks for the eight major hurricanes impacting eastern Texas within a 75 mile radius of Jefferson County.

Figure 5-2

Eastern Texas: Major Hurricane Storm Tracks, 1900 - 2008

(Source: National Hurricane Center – Historical Hurricane Tracks)

Data from the NHC indicates there were eight additional major hurricanes between 1900 and 1998 that were not included in the NCDC database. Table 5-13 summarizes the eight additional major hurricanes not captured in the NCDC database query prior to 1998.

[10] National Hurricane Center (NHC), Historical Hurricane Tracks

Table 5-13

Major Hurricane and Tropical Storm Events Impacting Jefferson County, 1900 - 1998

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

Event Date	Storm Name	Category	Maximum Winds
September 8, 1900	Not Named	4	125
July 21, 1909	Not Named	3	100
August 17, 1915	Not Named	4	115
August 6, 1918	Not Named	3	105
August 13, 1932	Not Named	4	125
October 4, 1949	Not Named	3	110
June 27, 1957	Audrey	4	125
August 18, 1983	Alicia	3	100

In addition to the 31 hurricanes over the last century, Jefferson County has also experienced numerous tropical storms. The NHC indicates that between 1950 and 2008, eastern Texas and Jefferson County have experienced 26 tropical storms. Perhaps the most significant tropical storm to impact the region was Tropical Storm Allison, which descended on southeast Texas in June of 2001. Parts of the Houston and surrounding area received up to 38 inches of rain over six days. This caused massive flooding in and around the City of Houston. Tropical Storm Allison also produced flooding throughout Southeast Texas, Louisiana, and across the eastern United States. Total damages were estimated at $5 billion and prompted a Presidential Disaster Declaration for 30 counties in Texas. The event claimed a total of 23 lives. The storm damaged approximately 73,000 residential homes and impacted over two million people.[11] In Jefferson County, nearly 500 policy holders filed flood claims resulting in over $12 million in payments.

According to the National Weather Service's (NWS) Tropical Prediction Center, from 1900 to 1996, Texas experienced 12 direct hits from major hurricanes (Categories 3, 4, and 5). During the same time period, Texas experienced 13 direct hits from other hurricanes (Category 1 and 2). Based on approximately 100 years of historical data from the Tropical Prediction Center, the probability of future hurricanes impacting Texas is high, averaging approximately one event every four years.

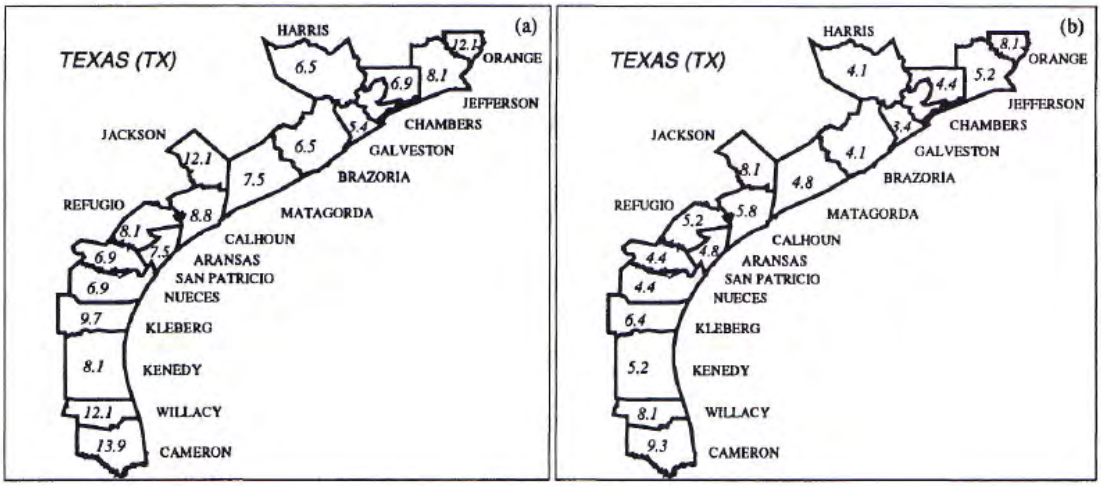
[11] 2007 State of Texas Mitigation Plan Update

Hurricane probability in southeastern Texas can also be assessed based on data from the 1999 study *Hurricanes of the North Atlantic, Climate and Society*. The study includes a series of maps showing the return periods and wait times for the Counties along the Texas coastline over the time period 1900 - 1996. The maps are shown in Figure 5-3 and include the following

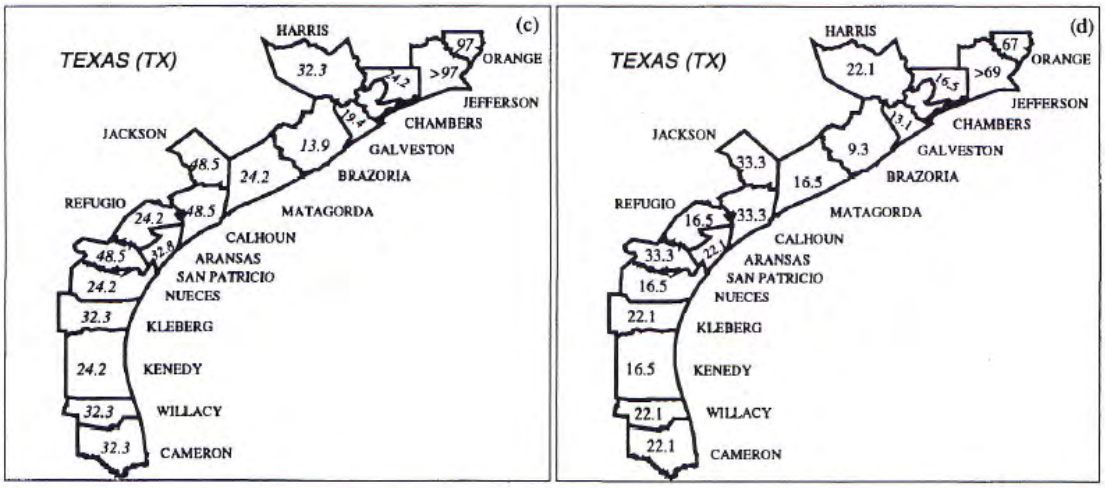
- hurricane return periods (Categories 1-5)
- wait times in coastal Counties (Categories 1-5)
- major hurricane return periods
- wait times in coastal Counties (major hurricanes)

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

Figures 5-3 and 5-4
Southeast Texas Hurricane Return Periods and Wait Times
(Source: *Hurricanes of the North Atlantic, Climate and Society, 1999*)
All Hurricanes (Categories 1-5)



Major Hurricanes (Categories 3-5)



Probability of Future Occurrence

The upper left hand map in the figure above (map *a*) shows the return period for all hurricanes (categories 1-5) in Jefferson County is 8.1 years, which equates to an approximate 12.5% annual probability of future occurrences. Major hurricanes have occurred less than once every 97 years, which

translates to an approximate 1% annual probability[12]. Based on high, medium, and low probability ranges in Table 5-5, the hurricane probability is considered medium for Category 1 and 2 magnitude storms, and low for Category 3 and higher. As mentioned earlier, future probability is only one component of the risk calculation. Although the hurricane hazard is considered to have a medium probability, a hurricane (particularly a major hurricane) has potential for catastrophic impacts on life and property in the planning area. Potential impacts are high for all hurricane categories.

Magnitude/Severity/Extent

Based on previous occurrences and the medium probability that a hurricane/tropical storm will hit Jefferson County (12.5% year), the magnitude and severity of a hurricane/tropical storm can and has proven to be catastrophic to the planning area.

Overall Vulnerability

Based on the probability and potential intensity of a strong hurricane impacting Jefferson County and the potential impact to disrupt services and cause injury or death, the overall vulnerability is considered very high.. The outcome of these storms are flooding and wind and therefore a risk assessment on those two hazards flooding and wind will be completed which will include a hurricane/tropical storm assessment.

5.7.3 Extreme Heat

Description of the Severe Extreme Heat Hazard

Extreme heat kills by pushing the human body beyond its limits. Under normal conditions, the body's internal thermostat produces perspiration that evaporates and cools the body. However, in extreme heat and high humidity, evaporation is slowed and the body must work extra hard to maintain a normal temperature.

Temperatures that hover 10 degrees or more above the average high temperature for the region and last for several weeks are defined as extreme heat. Humid or muggy conditions, which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. Excessively dry and hot conditions can provoke dust storms. See Appendix A for a more detailed description of the extreme heat hazard.

Geographic Location

In Jefferson County DD7, and the surrounding area, the climate is humid subtropical, with hot summers and frequent, prolonged heat waves. The extreme heat hazard affects the entire planning area. DD7

[12] *Hurricanes of the North Atlantic, Climate and Society,* James Elsner and A. Birol Kara, New York, Oxford University Press, 1999

has high humidity levels, which combine with the heat to produce a heat index of over 100 degrees for many days during the summer. Within DD7, extreme heat risks to people and property cannot be distinguished by area; the hazard is reasonably predicted to have uniform probability of occurrence across the entire planning area. All people and assets are considered to have the same degree of exposure (See Table 5-3 for District-wide total number of buildings/infrastructure and estimate values). Based on Table A-4 in Appendix A, extreme heat conditions in Jefferson County DD7 can range from the *caution* category to *extreme danger*.

Previous Occurrences

To estimate potential dollar value of losses to existing buildings, DD7evaluated the prior loss data from the NCDC database. This data indicated that between 1950 and 2011, there were two extreme heat events that affected Jefferson County. Both events occurred in 2000. The 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 NCDC list. The events are summarized below in Table 5-14.

Table 5- 14
Extreme Heat Events in Jefferson County, 1950 - 2011
(Source: NOAA/NCDC)

2 TEMPERATURE EXTREMES event(s) were reported in Jefferson County, Texas between 04/30/1950 and 08/31/2011.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
2 TXZ180>182 - 201 - 215>216	08/29/2000	12:00 AM	Excessive Heat	N/A	0	0	0	0
3 TXZ180>182 - 201 - 215>216	09/01/2000	12:00 AM	Excessive Heat	N/A	0	0	0	0
				TOTALS:	0	0	0	0

Probability of Future Occurrence

The NCDC database indicates that for both extreme heat events there were no deaths, injuries or property damage in Jefferson County.[13] With a total of two extreme heat events between 1996 and 2011, the County experiences an extreme heat event on average approximately once every 8 years. With one event every 8 years, there is a 12.5% annual probability of a future drought event occurring in Jefferson County. Based on the historical drought data, the probability of future events impacting DD7 is considered medium. See Table 5-5 for the definition of high, medium and low probability.

Magnitude/Severity/Extent

Based on the medium probability indicated above, extreme heat events will most likely continue in DD7, but with no previous injuries, deaths, or property damage the impacts will probably be minimal. Due to the fact that there is no record of any historical building damage as a result of extreme heat, the estimated annual dollar value damage to existing or future buildings due to extreme heat is zero and therefore the severity is considered limited.

Overall Vulnerability

Although the District can expect to experience heat events fairly often, based on historical records the impacts are limited as defined in Table 5-6, and severity is limited as defined in Table 5-7. For these reasons, the overall vulnerability to extreme heat is considered low. In addition, DD7 has no jurisdictional authority to mitigate against extreme heat and there is not potential impact from extreme heat on DD7 owned facilities. It has been determined that the planning area, based on jurisdictional authority, and owned facilities will not be negatively impacted from extreme heat. For these reasons, extreme heat has been eliminated from further consideration and there are no mitigation action items associated with extreme heat.

5.7.4 Drought

Description of the Drought

Drought is generally defined as a condition of climatic dryness severe enough to reduce soil moisture and water supplies below the requirements necessary to sustain normal plant, animal, and human life. In Texas, drought is often defined in terms of agricultural and hydrologic drought:

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

[13] NOAA – NCDC Database. Jefferson County – Extreme Heat Events

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

Geographic Location

Texas is divided into ten climatic divisions that range from substantially heavy precipitation through semi-arid to arid climates. Most of Texas is prone to periodic droughts of differing degrees of severity. One reason is the state's proximity to the Great American Desert of the southwestern United States. In every decade of this century, Texas has fallen victim to one or more serious droughts. The severe-to-extreme drought that affected every region of the state in the early to mid-1950s was the most serious in recorded U.S. history. See Appendix A for a more detailed description of the drought hazard.

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity[14]. Due to its multi-dimensional nature, drought is difficult to define in exact terms, and also poses difficulties in terms of comprehensive risk assessments.

One method used by scientists to calculate the severity and duration of a drought is the Palmer Drought Severity Index (PDSI). The PDSI indicates the prolonged and abnormal moisture deficiency or excess and indicate general conditions, not local variations caused by isolated rain. The PDSI is an important climatological tool for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather.[15]

The equation for the PDSI was empirically derived from the monthly temperature and precipitation scenarios of 13 instances of extreme drought in western Kansas and central Iowa and by assigning an index value of -4 for these cases. Conversely, a +4 represents extremely wet conditions. From these values, seven categories of wet and dry conditions can be defined. Table 5-15 identifies the values used to define the PDSI.[16]

[14] FEMA, 1997

[15] NOAA. NWS. Climate Prediction Center. Drought Indices – Explanation.

[16] NOAA. NWS. Climate Prediction Center. Drought Indices – Explanation.

Table 5-15

Palmer Drought Severity Index
(Source: NOAA, National Weather Service - Climate Prediction Center)

Palmer Drought Severity Index
-4.0 or less (Extreme Drought)
-3.0 or -3.9 (Severe Drought)
-2.0 or -2.9 (Moderate Drought)
-1.9 to +1.9 (Near Normal)
+2.0 or +2.9 (Unusual Moist Spell)
+3.0 or +3.9 (Very Moist Spell)
+4.0 or above (Extremely Moist)

Previous Occurrences

In Jefferson County DD7, drought periods were experienced in 1996, 1998, and 2000. The drought hazard affects the entire planning area. The 1996 drought affected the entire state. Its impacts were greatest on major population centers, prompting water conservation and reduction measures over an extended period. The Texas Agricultural Extension Service projected a $4 billion statewide economic loss as a result of the 1996 drought. In the Southeast Texas area, damage from the extended drought reached record proportions as many crops were completely lost and large numbers of animals were sold because of lack of grass. In the Southeast Texas region, property damage was estimated at $10 million and agricultural losses were estimated at $100 million. Specific numbers for DD7 were not available. Texas recently experienced another significant drought in 2011 although data regarding the impacts was not available at the time of this update.

Within DD7, drought risks to people and property cannot be distinguished by area; the hazard is reasonably predicted to have uniform probability of occurrence across the entire planning area. All people and assets are considered to have the same degree of exposure (See Table 5-4 for District-wide total number of buildings/infrastructure and estimate values). The drought hazard affects all residential and commercial building types about equally within the planning area. Data related to the number of structures by building type and past damages for specific building types was unavailable at the time of the Plan update and therefore the loss estimates for the drought hazard are based on total property damage as reported by the NCDC.

Data from the NCDC database indicated that between 1950 and 2011, there were five drought events that affected Jefferson County. All five events occurred between 1996 and 2000. The 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 NCDC list. The events are summarized below in Table 5-16. The events in the table are listed by month. For example, if a drought lasts several

continuous months, it is listed in the database as a separate event. If the continuous months are combined into single events, the number of events is reduced from five to three.

Table 5-16
Drought Events in Jefferson County, 1950 - 2011
(Source: NOAA/NCDC)

5 DROUGHT event(s) were reported in Jefferson County, Texas between 04/30/1950 and 08/31/2011.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 TXZ180>182 - 201 - 215>216	05/01/1996	12:01 AM	Drought	N/A	0	0	0	0
2 TXZ180>182 - 201 - 215>216	05/20/1998	12:00 AM	Drought	N/A	0	0	0	0
3 TXZ180>182 - 201 - 215>216	06/01/1998	12:00 AM	Drought	N/A	0	0	0	0
4 TXZ180>182 - 201 - 215>216	07/01/1998	12:00 AM	Drought	N/A	0	0	0	0
5 TXZ180>182 - 201 - 215>216	02/01/2000	12:00 AM	Drought	N/A	0	0	0	0
				TOTALS:	0	0	0	0

Probability of Future Occurrence

None of the events listed above in Table 5-16 caused any property damage or loss of life. The MPC identified 2011 as a significant drought event since the original plan was prepared. With a total of six significant drought events between 1996 and 2011, the County experiences a significant drought on average approximately once every 2.6 years. With one event every 2.6 years, there is a 37.5% annual probability of a future drought event occurring in Jefferson County. Based on the historical drought data, the probability of future events impacting DD7 is considered medium. See Table 5-5 for the definition of high, medium and low probability.

Magnitude/Severity/Extent

Based on the medium probability indicated above, droughts will most likely continue in DD7, but with no previous injuries, deaths, or property damage the impacts will probably be minimal. In addition the magnitude of droughts from a shutdown of facilities perspective is considered limited. Based on previous events that have impacted the planning area, future droughts in Jefferson County DD7 will occasionally be severe, though generally impacts can be considered low to moderate based on losses.

Overall Vulnerability

Due to the fact that there is no record of any historical building damage as a result of drought, the estimated annual dollar value damage to existing or future buildings due to drought is zero. The vulnerability is limited based on Table 5-7; therefore the overall probability is low. In addition, DD7 has no jurisdictional authority to mitigate against drought and there is not potential impact from drought on DD7 owned facilities. It has been determined that the planning area, based on jurisdictional authority, and owned facilities will not be negatively impacted from drought. For this reason, drought has been eliminated from further consideration and there are no mitigation action items associated with drought.

5.7.5 Wildland Fire

Description of the Wildfire Hazard

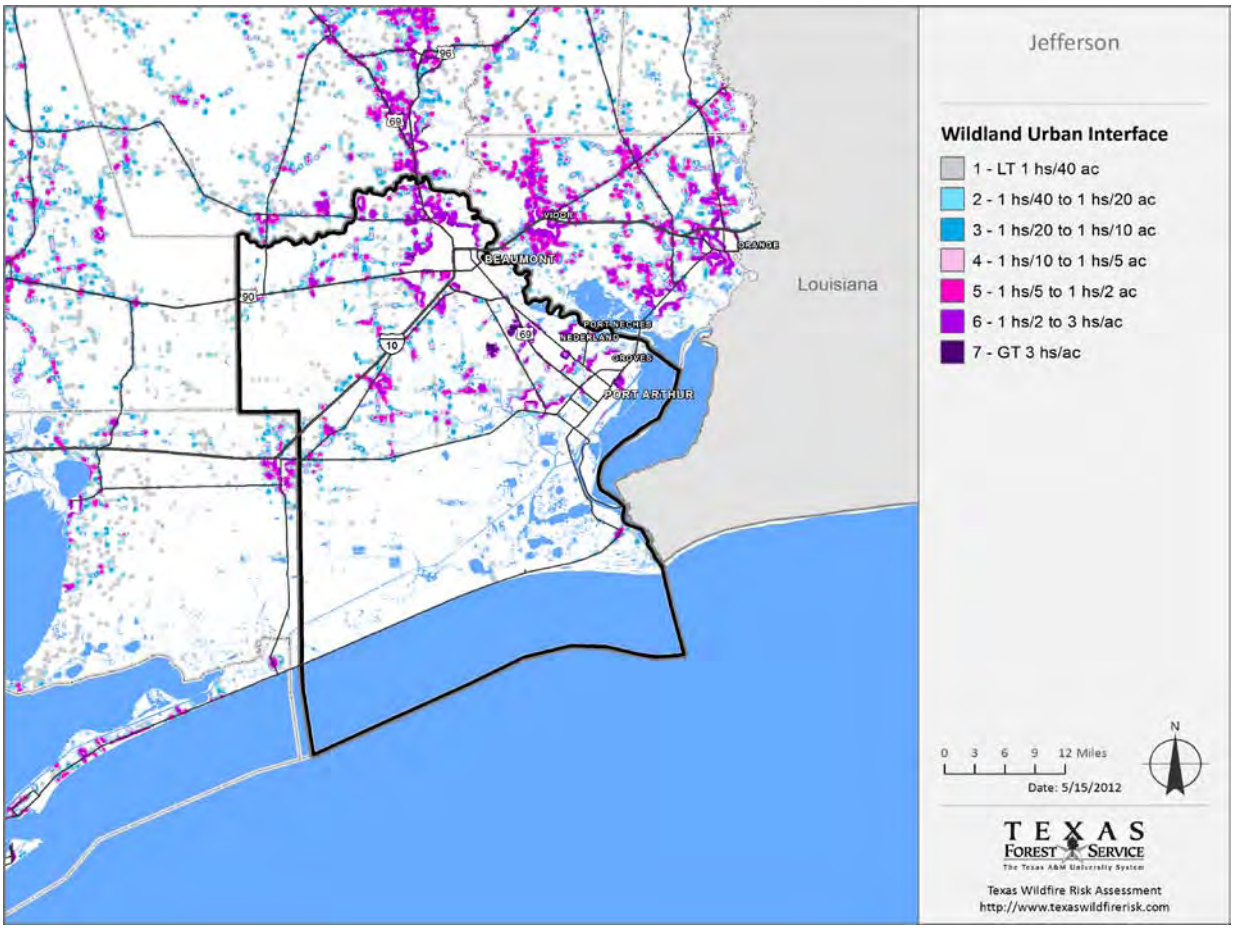
Wildfires are uncontrolled fires often occurring in wildland areas, and can consume houses or agricultural resources if not contained. Wildfires/urban interface is defined as the area where structures and other human development blend with undeveloped wildland. The U.S. Department of the Interior has developed the Wildland Fire Assessment System Web site to communicate information to the public via the Internet. Web visitors can view real-time maps showing potential for fire on any given day, including satellite-derived "greenness" maps. See Appendix A for a more detailed description of the wildland fire hazard.

Parts of Texas face major wildfire problems each year. The risk is increased and compounded by increasing development within the zone commonly referred to as the “urban-wildland interface.” Within this zone of natural landscape, buildings become additional fuel for fires when fires do occur. Most wildland fires are man-caused and occur in the interface of developed lands and forest and range lands. In particular, the dry conditions, high temperatures, and low humidity that characterize drought periods set the stage for wildfires. In 1998, in what is considered the worst wildfire in state history, wildfires throughout the State burned a total of 422,939 acres and threatened 4,031 structures.

Geographic Location

In Jefferson County DD7, wildfires are most likely to occur during dry and hot periods in undeveloped and wooded areas. Potential burn areas are widespread, but there are few developed wooded areas and limited urban/wildland interface therefore, the estimate of dollar value of properties at risk from wildfires is near zero, so potential impacts are low on the scale provided in Table 5-5. Given the dynamic nature of wildland fires, as a practical matter, there is no way to accurately predict the number of acres that might be burned in any specific year. Detection and suppression capabilities in the planning area are well established, which further reduces potential impacts.

Figure 5-5
Wildland Urban Interface in Jefferson County



As reported in the Jefferson County Plan update, models for wildfire potential have been developed by the Southern Wildfire Risk Assessment project (SWRA). The mapping project simulates fire dynamics as a function of vegetation, Topography, wind direction, speed and frequency of dry years. The data can be a predictor of where there would be severe fires. In general, higher propensity for forest fires is present along the grassy coastline and sporadic throughout the County including in or near Bevil Oaks and Port Neches and prevalent near the pipelines. For the Jefferson project area, it is estimated that 72,736 people or 30 percent of the total project area population (243,229) live within the WUI.[17]

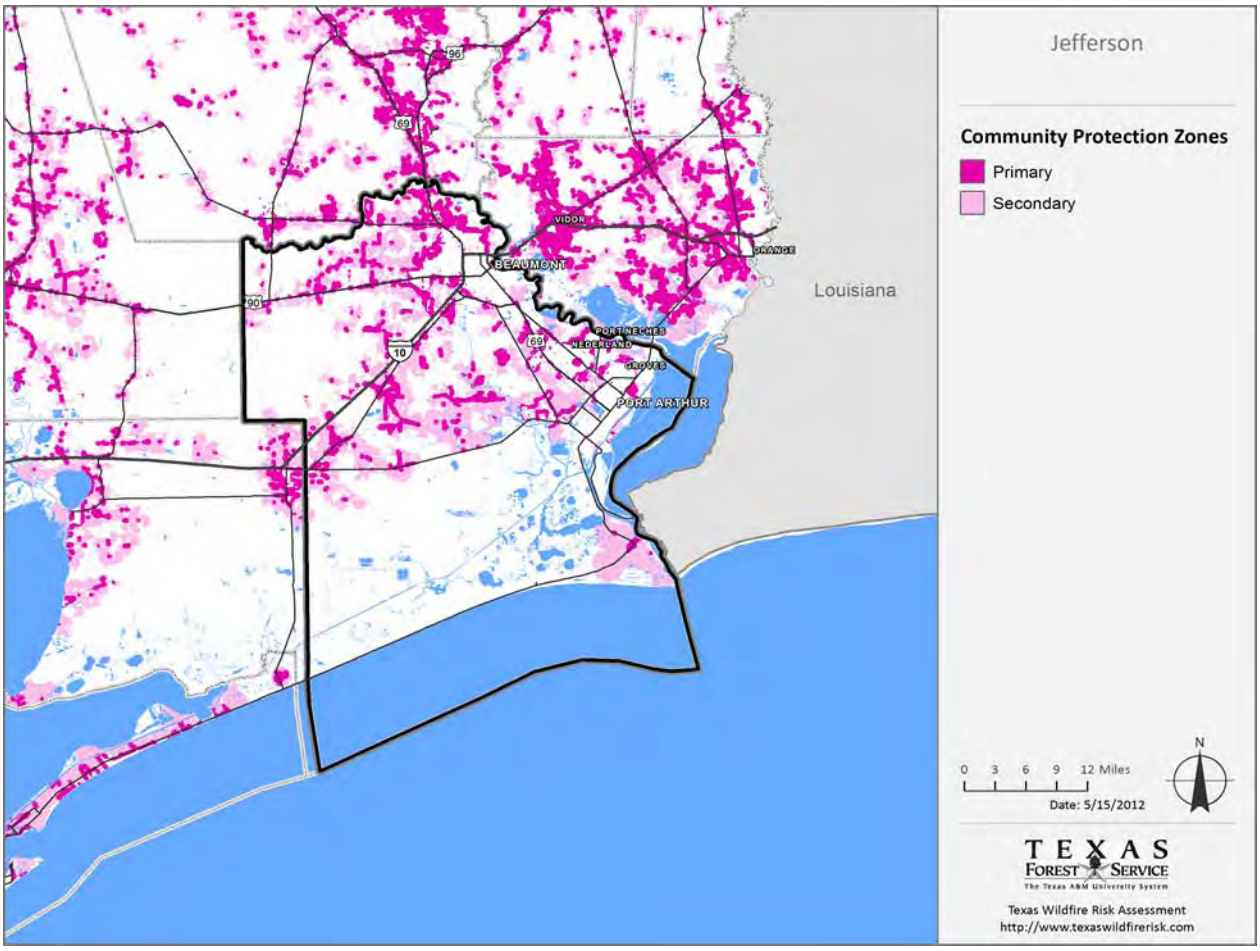
Community Protection Zones (CPZ) represent those areas considered highest priority for mitigation planning activities. CPZs are based on an analysis of the Where People Live housing

[17] Texas Wildfire Risk Assessment Summary Report – Jefferson County, Texas Forest Service.

density data and surrounding fire behavior potential. Rate of Spread data is used to determine the areas of concern around populated areas that are within a 2-hour fire spread distance.

General consensus among fire planners is that for fuel mitigation treatments to be effective in reducing wildfire hazard, they must be conducted within a close distance of a community. In Texas, the WUI housing density has been used to reflect populated areas in place of community boundaries. This ensures that CPZs reflect where people are living in the wildland, not jurisdictional boundaries.

Figure 5-6
Community Protection Zones



Previous Occurrences

Within DD7, wood frame structures are most vulnerable to the wildland fire hazard. To estimate potential dollar value of losses to existing building, DD7 evaluated the prior loss data from the NCDC database. This data indicated that between 1950 and 2011, there was one wildfire event that affected the County.[18] In August, 2003 lightning sparked wildfires in the marshes in Jefferson County destroying 5,700 acres. No injuries or damages were reported from the event.

Table 5-17
Wild and Forest Fire Events in Jefferson County, 1950 - 2011
(Source: NOAA/NCDC)

1 WILD & FOREST FIRE event(s) were reported in Jefferson County, Texas between 04/30/1950 and 08/31/2011.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Sabine Pass	08/21/2003	05:00 PM	Wildfire	N/A	0	0	0	0
				TOTALS:	0	0	0	0

According to the Texas Forest Service (TFS), there were at least 23 instances of wildfire in Jefferson County between 2005 and 2011 that were large enough events to warrant TFS assistance. In total, these fires burned 1,126 acres. Most fires were extinguished with no structural damage occurring.

Probability of Future Occurrence

With one wildfire event between 1950 and 2011 from NCDC and 23 events reported by TFS, the County experiences a significant wildfire on average approximately once every 2.65 years. With one event every 2.65 years, there is a 37.7% annual probability of a future wildfire events occurring in Jefferson County. Based on the historical wildfire data, the probability of future events impacting DD7 is considered low. See Table 5-5 for the definition of high, medium and low probability.

Magnitude/Severity/Extent

[18] NOAA – NCDC Database. Jefferson County – Wild and Forest Fires

With only one previous wildfire event effecting the planning area that resulted in no injuries, deaths, or property damage, there will most likely be minimal future impacts to the planning area and the severity to the planning area is considered limited.

Overall Vulnerability

Due to the fact that there is no record of any historical building damage as a result of wildfire, the estimated annual dollar value damage to existing or future buildings due to wildfire is zero and the overall vulnerability is considered low. In addition, DD7 has no jurisdictional authority to mitigate against wildfire and there is not potential impact from wildfire on DD7 owned facilities. It has been determined that the planning area, based on jurisdictional authority, and owned facilities will not be negatively impacted from wildfire. For this reason, wildfire has been eliminated from further consideration and there are no mitigation action items associated with wildfire.

5.7.6 Winter Storm

Description of the Winter Storm Hazard

Winter storms bring various forms of precipitation that occur only at cold temperatures. These kinds of precipitation include snow, sleet, or a rainstorm where ground temperatures are cold enough to allow icy conditions. These cold weather storms can also take the form of freezing rain or a wintry mix. Winter storms in Texas, although not as numerous or severe as in the northern states, do occur often enough and with sufficient severity to be a threat to people and property. Generally, the winter storm season in Texas runs from late November to mid-March, although severe winter weather has occurred as early as October and as late as May in some areas. On average, central Texas is affected by one to two winter storms each year. See Appendix A for a more detailed description of the winter storm hazard.

Geographic Location

In Jefferson County DD7, where the climate is subtropical, winter storms of such severity that property damage results are extremely rare. The winter storm hazard affects the entire planning area. The Texas Department of Transportation has posted a number of signs on bridges to warn drivers that icy conditions may occur. Within DD7, winter storm risks to people and property cannot be distinguished by area; the hazard is reasonably predicted to have uniform probability of occurrence across the entire District. All people and assets are considered to have the same degree of exposure. The winter storm hazard affects all residential and commercial building types about equally within the planning area.

Previous Occurrences

The NCDC data indicated that between 1950 and 2011, there were six winter storm events that affected the County as a whole. The first event was an ice storm in January, 1997 that caused an estimated $18 million in property damage (to buildings and personal property). The second event occurred in the morning hours of December 11, 2008 when a rare snow storm resulted in anywhere from a trace of snow to 5 inches in the far western portions of Jefferson County. A total of two inches fell in downtown Beaumont. The event caused no injuries or property damage. In addition, the NCDC database category

temperature extremes indicated there was one recorded extreme cold event (February 1996) that caused an estimated $50,000 in damage.

Table 5-18
Winter Storm Events in Jefferson County, 1950 - 2011
(Source: NOAA/NCDC)

6 SNOW & ICE event(s) were reported in Jefferson County, Texas between 04/30/1950 and 08/31/2011.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 TXZ201 - 215>216	01/12/1997	08:00 AM	Ice Storm	N/A	1	20	18.0M	0
2 TXZ180>182 - 201 - 215	12/11/2008	00:00 AM	Winter Storm	N/A	0	0	0K	0K
3 TXZ180>182 - 201 - 215	12/11/2008	00:00 AM	Winter Weather	N/A	0	0	0K	0K
4 TXZ215 - 216	12/04/2009	17:00 PM	Winter Weather	N/A	0	0	0K	0K
5 TXZ215 - 216	02/23/2010	22:00 PM	Winter Weather	N/A	0	0	0K	0K
6 TXZ180>182 - 201 - 215	02/03/2011	08:00 AM	Winter Weather	N/A	0	0	5K	0K
				TOTALS:	1	20	18.005M	0

Probability of Future Occurrence

Based on past winter storm events, it would be possible for DD7 to experience an occasional snow or ice storm. Accumulations of several inches of snow or a coating of ice are possible. Although very rare, an extreme cold event with temperatures in the single digits and wind chills below zero are possible in the planning area. With a total of six winter storm events between 1997 and 2011, the County experiences a significant winter storm on average approximately once every ten years. With one event every 2.5 years, there is a 40% annual probability of a future winter storm event occurring in Jefferson County. Based on the historical drought data, the probability of future events impacting DD6 is

considered medium. Based on the high, medium, and low ranges identified in Table 5-5, there is a medium probability of future winter storms in DD7 planning area.

Magnitude/Severity/Extent

While the likelihood of a future winter storm is medium, the impact of the storm based on the property damage, loss of life and injuries is considered moderate. The magnitude of potential future events is considered minimal as critical facilities may be shut down but not for more than 24 hours at most.

Overall Vulnerability

The overall vulnerability is considered moderate. However, DD7 has no jurisdictional authority to mitigate against winterstorms and maintains its own facilities during winterstorm and has never made a claim for winter storm damages. For this reason, winterstorm has been eliminated from further consideration and there are no mitigation action items associated with winter storms.

5.7.7 Seismic/Earthquakes

Description of the Seismic/Earthquake Hazard

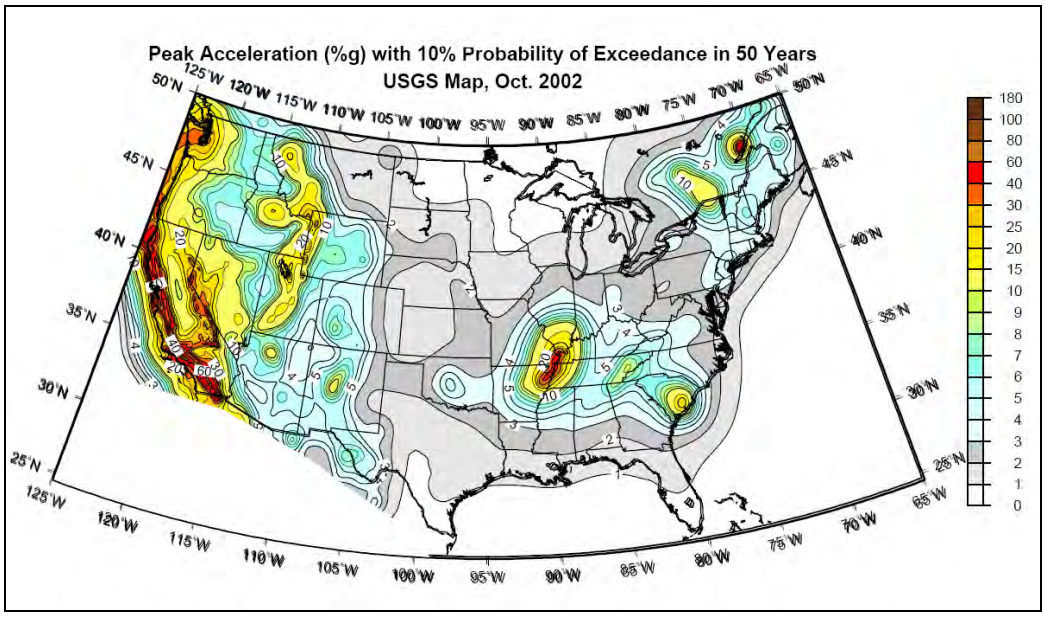
An earthquake is a sudden motion or trembling caused by an abrupt release of accumulated strain on the tectonic plates that comprise the Earth's crust. Tectonic plates become stuck, putting a strain on the ground. When the strain becomes so great that rocks give way, fault lines occur. At the earth's surface, earthquakes may manifest themselves by a shaking or displacement of the ground, which may lead to loss of life and destruction of property. The size of an earthquake is expressed quantitatively as magnitude and local strength of shaking as intensity. The inherent size of an earthquake is commonly expressed using a magnitude. See Appendix A for a more detailed description of the earthquake hazard.

Geographic Location

Figure 5-7 displays the United States Geological Survey (USGS) earthquake hazard map produced in October of 2002. The map shows peak ground acceleration (pga) with a 10% chance of being exceeded over 50 years. In Texas, the majority of the State falls in the low seismic risk range. The *FEMA How-To guidance, Understanding Your Risks*, suggests the earthquake hazard should be profiled the pga is greater than 3%g.[19] The map shows that southeastern Texas, including Jefferson County, is located in the 2%g range, a relatively low risk area. The earthquake hazard affects the entire planning area.

[19] FEMA. *How-To guidance, Understanding Your Risks* (386-2), page 1-7

Figure 5-7
United States Seismic Hazard Map, Showing Peak Ground Acceleration In Percent Of g, With 10% Exceeded In 50 Years.
(Source: USGS, October 2002)



The USGS historical earthquake data by State was used to identify past earthquakes in Jefferson County. The USGS earthquake history for Texas indicates there have been 12 earthquakes statewide between 1882 and 2011. Of the 12 events in Texas, the earthquake descriptions provided by the USGS indicates only one event affected Jefferson County. From April 23 – 28, 1964, a series of earthquakes were felt near Hemphill, Texas (about 75 miles from Beaumont) close to the Texas - Louisiana border. The only damage reported was from a magnitude 4.4 earthquake on April 28 which caused minor damage to some homes in Hemphill.[20]

Previous Occurrences

With one earthquake event between 1882 and 2011, the County experiences an earthquake on average approximately once every 129 years. With one event every 129 years, there is a 0.7% annual probability of a future winter storm event occurring in Jefferson County. Based on the historical earthquake data from the USGS, the probability of future earthquake events impacting DD7 is considered low. See Table 5-5 for the definition of high, medium, and low probability.

Probability of Future Occurrence

[20] USGS. Earthquake Hazards Program – Texas Earthquake History

In DD7, seismic risks to people and property cannot be distinguished by area; the hazard is reasonably predicted to have uniform probability of occurrence (extremely rare) across the entire District. All people and assets are considered to have the same degree of exposure. Therefore, the probability of future occurrence is low.

Magnitude/Severity/Extent

Earthquakes are measured in peak ground acceleration (PGA) measured in g. Southeastern Texas including Jefferson County falls within the 0.01 g zone. This would correspond to an earthquake approximately 1-3 on the Richter scale which is minor and not felt by many. Based on the history, extent and severity, an earthquake hazard is considered limited.

Overall Vulnerability

With only one minor earthquake affecting Jefferson County in the past, there will most likely be minimal future impacts to the planning area. Based on the one historical earthquake, a magnitude 4 – 4.5 earthquake could be possible in the planning area. Due to the extremely low probability of an earthquake within DD7, and the fact that there is no record of any historical building damage as a result of seismic activity in DD7, the impacts and estimated dollar value damage to existing or future buildings due to earthquakes is negligible and therefore the overall vulnerability is considered low. In addition, DD7 has no jurisdictional authority to mitigate against earthquakes. It has been determined that the planning area, based on jurisdictional authority will not be negatively impacted from earthquakes. For this reason, earthquake has been eliminated from further consideration and there are no mitigation action items associated with earthquake.

5.7.8 Landslides

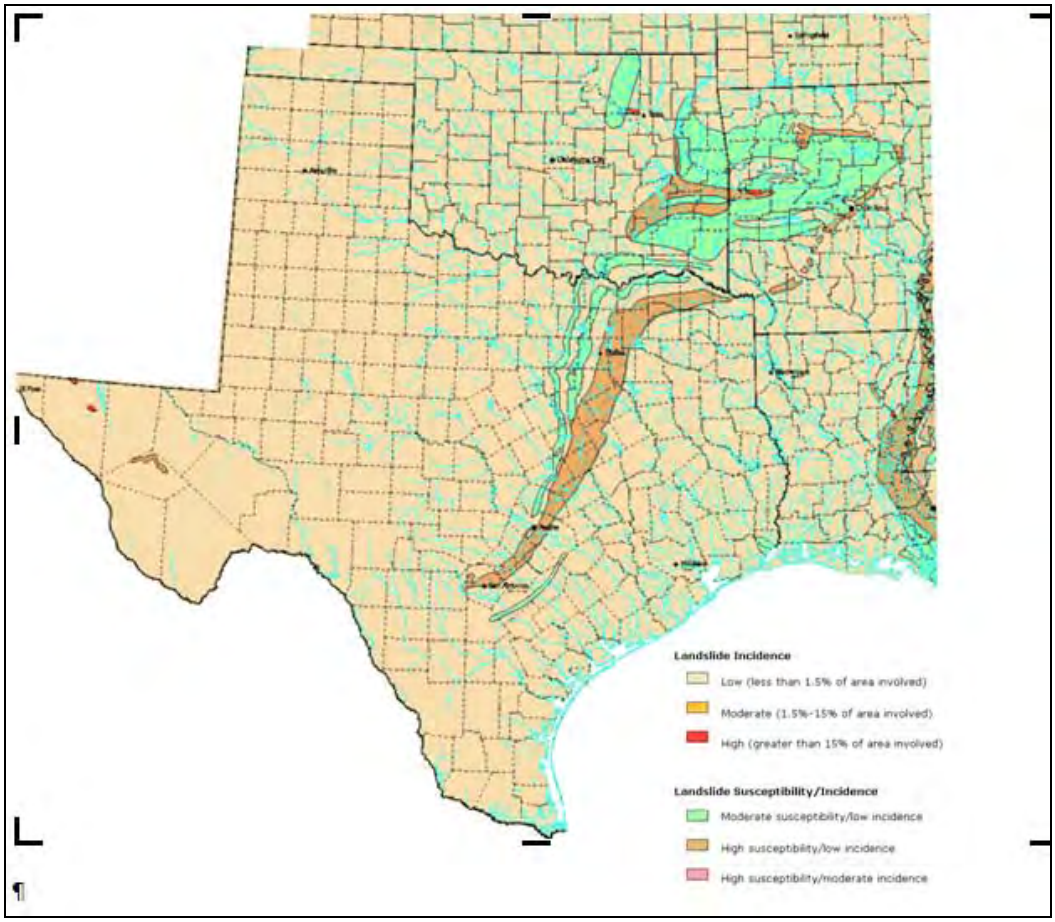
Description of the Landslide Hazard

The term landslide is used to describe the downward and outward movement of soils and rocks moving down a slope under the force of gravity. Landslides include mudflows, mudslides, debris flows, rock falls, rock slides, debris avalanches, debris slides, and earth flows. Most landslides are associated with heavy, prolonged rains which saturate soils. The landslide hazard affects the entire planning area approximately equally. See Appendix A for a more detailed description of the landslide hazard.

Geographic Location

In 1997, USGS published a national map to illustrate landslide risk areas. The map combines past incidents with a measure of “susceptibility”, defined as the “probable degree of response of rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation.” Figure 5-8 displays the USGS landslide map for the State of Texas. The map indicates the entire Texas coastal plain, including Jefferson County, is shown has having had less than 1.5% of its land area affected by movement of soils on slopes (no planning period is identified). The map also shows that the planning area is outside of any moderate or high “susceptibility/incidence” area.

Figure 5-8
Landslide Overview Map for the State of Texas
(Source: USGS, 1997)



Previous Occurrences

In the planning area, landslide risks to people and property cannot be distinguished by area; the hazard is reasonably predicted to have uniform probability of occurrence across the entire District. All people and assets are considered to have the same degree of exposure. As part of the Plan update the MPC reviewed the landslide hazard and identified no significant landslide events since they participated in the original Plan.

Probability of Future Occurrence

With no prior significant landslide events occurring in DD7, the probability of future events is considered low. See Table 5-5 for the definition of high, medium, and low probability.

Magnitude/Severity/Extent

Due to the lack of events the magnitude, severity and extent of landslides in the planning area is considered limited.

Overall Vulnerability

Due to the extremely low probability of a landslide within DD7 and the fact that there is no record of any historical building damage as a result of landslides in DD7, the estimated impacts and dollar value damage to existing or future buildings due to landslides is considered low. Therefore, the overall vulnerability is considered low. For these reasons, landslides have been eliminated from further evaluation and risk assessment.

5.7.9 Flood

Description of the Flood Hazard

A flood is defined as the inundation of land by the rise and overflow of a body of water. Floods most commonly occur as a result of heavy rainfall causing a river system or stream to exceed its normal carry capacity. Flood events can also occur due to hurricane storm surge and from a hurricane or tropical storm. Floods can also occur due to dam failure and cause subsidence. Flooding is one of the most pervasive natural hazard threats in Texas.

There are two types of flooding that can impact Jefferson County: riverine and flash flooding. Riverine flooding is s a natural occurrence where a waterway exceeds its bank full capacity and inundates the floodplain. Riverine flooding is affected by the intensity and distribution of the rainfall, soil moisture, seasonal variation in vegetation, and water-resistance of the surface area due to impervious surfaces (e.g. pavement). Flash flooding is a localized flood hat results from a short duration of intense rainfall across a limited geographic area. During these events, storm water systems can be overwhelmed and cause flooding of the surrounding area.

Geographic Location

Flooding impacts the entire planning area. According to the Jefferson County Flood Insurance Study (FIS) the principal flooding sources are the Neches River, Pine Island Bayou and its tributaries, Walker Branch and Walker Branch Taylor Bayou and its tributaries, Rhodair Gully, Mayhaw Bayou; Hillebrandt Bayou (a major tributary of Taylor Bayou) with its tributaries, Willow Marsh Bayou, Bayou Din and its tributaries, Bayou Din Tributary, Kidd Gully and Cotton Creek. Sabine Lake receives drainage from the basin of the Sabine River as well as the Neches River.

Flooding in Jefferson County results from stream overflow (caused by rainfall runoff, ponding and sheet flow), and from tidal surges and associated wave action (caused by hurricanes and tropical storms) transmitted through the streams. High tides can further intensify the stream overflow caused by rainfall runoff. Lastly, because of the flatness of the terrain, many inland areas are characterized by shallow flooding during heavy rain events.

Previous Occurrences

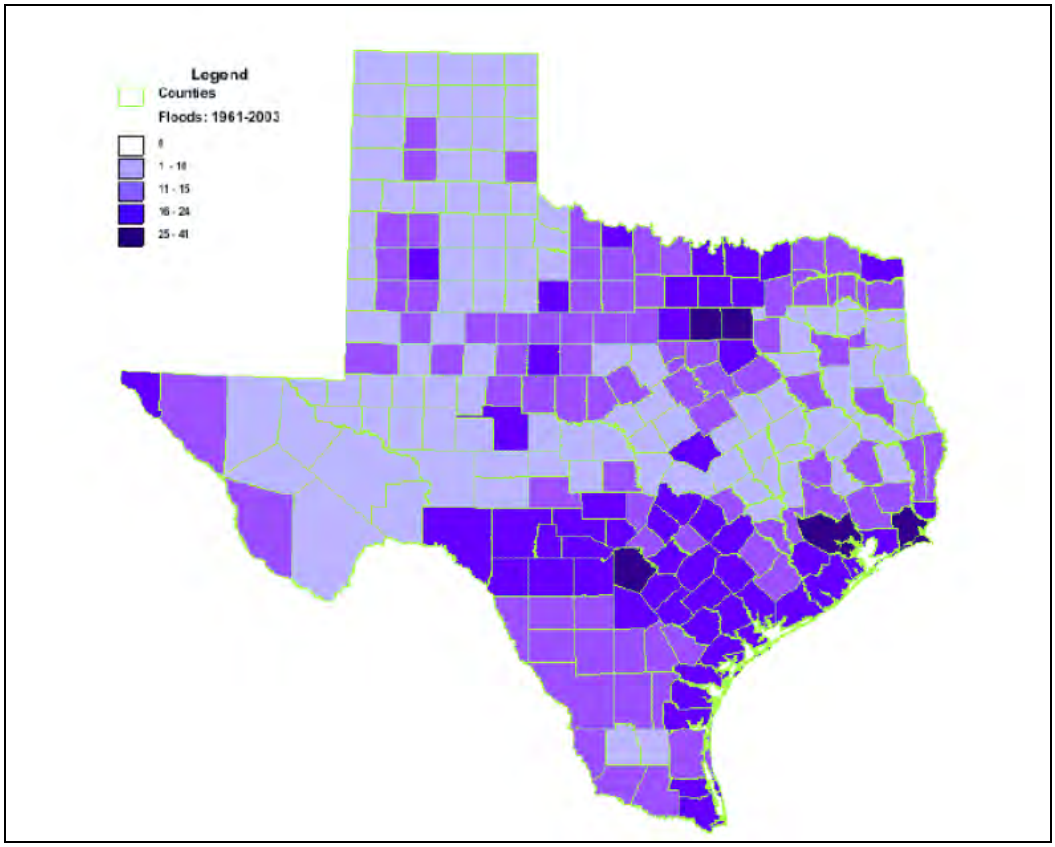
Floods have been and continue to be the most frequent, destructive, and costly natural hazard facing the State of Texas. Ninety percent of the State's damage reported for major disasters is associated with floods. Figures maintained by the NCDC and the Centers for Disease Control indicates that Texas leads the country with more flood-related deaths than any other state (Table 4-1). Deaths due to floods/flash floods accounted for 38% of all weather-related deaths statewide, and 12.5% in Jefferson County.

The Flood Insurance Study show that damaging floods occurred in 1886, 1915, 1943, 1949, 1957, 1961, 1963, 1979 and 1979. Many of these dates are associated with Hurricane events.

However, these are not the only flood events that have occurred in Jefferson County.

Figure 5-9 below is a map from the 2007 State of Texas Hazard Mitigation Plan that displays both previous flood occurrences and location of floods, by county, for the State of Texas between 1961 and 2003. The map is classified into four value ranges using the natural breaks (Jenks) method. The State Plan indicates that the highest class (25-41 floods) contains 5 counties, including Jefferson. The other four counties include: Tarrant, Dallas, Harris, and Bexar. These five counties are considered the highest at risk for experiencing a flood event again.

Figure 5-9
Flood Occurrences in Texas 1961-2003
(Source: State of Texas Hazard Mitigation Plan)



As indicated above, Jefferson County ranks among the top five counties in the State for the number of flood events between 1961and 2003. Records indicate that the streams and bayous draining DD7 have flooded throughout the area's history. Most recently, since 1990 DD7 has been impacted by seven significant flood events. These flood events occurred in 1994, 1998, 2001, 2002, 2003, 2006, and 2007 and resulted in over $26 million in flood insurance payments.

The NCDC indicates that Jefferson County has experienced 49 flood events between 1950 and 2011. Of this total, 15 flood events have resulted in property damage in excess of $50,000. As mentioned elsewhere, the database provides no indication as to why there are no events prior to 1995, although presumably occurrences follow the same pattern and frequency as shown in the NCDC list. Property damages for these events totaled just over $18.4 million. The NCDC reported two deaths and no injuries from the 49 flood events. The flood events with are summarized below.

Probability of Future Occurrence

Based on past and recent history, certain parts of DD7 clearly have a high probability of flooding repeatedly in the future. With a total of 16 significant floods between 1995 and 2011, DD7 experiences a significant flood event on average slightly more than once every year. The 16 significant events have occurred over a period of 17 years which calculates one event every 1.06 year or to an 94% annual probability of future flood occurrences, making the probability of future occurrence high.

Table 5-19
Flood Events in Jefferson County, 1950 - 2011
(Source: NOAA/NCDC)

49 FLOOD event(s) were reported in Jefferson County, Texas between 04/30/1950 and 09/30/2011.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Nederland	12/18/1995	0200	Urban Flooding	N/A	0	0	55K	0
2 Nederland	12/18/1995	0200	Urban Flood	N/A	0	0	55K	0
3 Beaumont	01/26/1996	10:00 AM	Urban/sml Stream Fld	N/A	0	0	0	0
4 TXZ215	09/27/1996	09:00 AM	Flood	N/A	0	0	90K	0

5 Port Arthur	07/30/1997	03:00 PM	Urban/sml Stream Fld	N/A	0	0	20K	0
6 Port Arthur	09/23/1997	03:45 PM	Urban/sml Stream Fld	N/A	0	0	10K	0
7 Nederland	01/21/1998	11:00 PM	Flood	N/A	0	0	40K	0
8 Beaumont	08/14/1998	01:00 PM	Flash Flood	N/A	0	0	10K	0
9 Beaumont	09/11/1998	01:00 PM	Flood	N/A	0	0	100K	0
10 Hampshire	09/13/1998	10:00 AM	Flood	N/A	0	0	100K	0
11 Beaumont	10/06/1998	08:30 AM	Flash Flood	N/A	0	0	20K	0
12 Nederland	04/12/2000	10:00 AM	Flash Flood	N/A	0	0	250K	0
13 Beaumont	06/07/2001	03:30 AM	Flood	N/A	0	0	10.0M	0
14 Countywide	09/01/2001	10:00 AM	Flood	N/A	0	0	25K	0
15 Countywide	09/02/2001	10:00 AM	Flood	N/A	0	0	75K	0
16 Beaumont	11/28/2001	05:30 PM	Flash Flood	N/A	0	0	20K	0
17 Countywide	06/27/2002	03:00 AM	Urban/sml Stream Fld	N/A	0	0	5K	0
18 TXZ215	08/15/2002	04:00 AM	Flood	N/A	0	0	20K	0
19 Beaumont	10/29/2002	12:30 AM	Flash Flood	N/A	1	0	5.0M	0
20 Beaumont	11/03/2002	11:10 AM	Flash Flood	N/A	0	0	1.0M	0
21 Port Arthur	12/04/2002	07:00 AM	Flash Flood	N/A	0	0	50K	0

22 Beaumont	02/21/2003	01:34 AM	Flash Flood	N/A	0	0	25K	0
23 Countywide	09/12/2003	07:00 AM	Flash Flood	N/A	0	0	25K	0
24 Beaumont	10/09/2003	03:45 PM	Flash Flood	N/A	0	0	1.0M	0
25 Port Neches	10/25/2003	02:00 PM	Flash Flood	N/A	0	0	100K	0
26 Port Arthur	05/11/2004	08:40 PM	Flash Flood	N/A	0	0	2K	0
27 Nederland	05/13/2004	03:45 PM	Flash Flood	N/A	0	0	5K	0
28 Beaumont	06/26/2004	04:10 PM	Flash Flood	N/A	0	0	5K	0
29 Nederland	09/23/2004	08:50 PM	Flash Flood	N/A	0	0	10K	0
30 Beaumont	05/29/2006	03:09 AM	Flash Flood	N/A	0	0	50K	0
31 Beaumont	05/29/2006	06:18 AM	Flash Flood	N/A	0	0	25K	0
32 Fannett	05/29/2006	10:25 AM	Flash Flood	N/A	1	0	10K	0
33 Beaumont	07/23/2006	04:30 PM	Flash Flood	N/A	0	0	25K	0
34 Beaumont	07/26/2006	01:00 PM	Flash Flood	N/A	0	0	2K	0
35 Amelia	10/16/2006	07:00 AM	Flash Flood	N/A	0	0	0K	0K
36 Amelia	10/16/2006	16:15 PM	Flash Flood	N/A	0	0	10K	0K
37 Port Arthur	10/16/2006	18:00 PM	Flash Flood	N/A	0	0	5K	0K
38 Bevil Oaks	02/12/2007	18:00 PM	Flash Flood	N/A	0	0	10K	0K

39 Hamshire	07/06/2007	09:30 AM	Flash Flood	N/A	0	0	5K	0K
40 Fannett	09/13/2007	01:00 AM	Flash Flood	N/A	0	0	50K	0K
41 China	01/04/2009	15:25 PM	Flash Flood	N/A	0	0	5K	0K
42 Fannett	04/18/2009	17:30 PM	Flash Flood	N/A	0	0	20K	0K
43 (bpt)beaumont-pt Art	04/27/2009	20:15 PM	Flash Flood	N/A	0	0	5K	0K
44 Gillburg	09/09/2009	10:30 AM	Flood	N/A	0	0	0K	0K
45 Gillburg	10/22/2009	08:00 AM	Flash Flood	N/A	0	0	100K	0K
46 Ft Acres	10/22/2009	09:00 AM	Flash Flood	N/A	0	0	10K	0K
47 Amelia	10/26/2009	09:00 AM	Flood	N/A	0	0	10K	0K
48 Guffey	08/17/2010	15:00 PM	Flash Flood	N/A	0	0	1K	0K
49 Pear Ridge	07/19/2011	06:30 AM	Flash Flood	N/A	0	0	10K	0K
				TOTALS:	2	0	18.470M	0

Magnitude/Severity/Extent

Based on past and recent history, the loss of two lives and the total cost of over $18.4 million, flooding can be catastrophic for the DD7.

Overall Vulnerability

The overall vulnerability to DD7 is high and their authority is to mitigate flooding, therefore, a risk analysis will be completed for this hazard.

5.7.10 Tornadoes

Description of the Tornado Hazard

Tornadoes pose a significant threat to life and safety in DD7. The National Weather Service defines a tornado as a violently rotating column of air in contact with the ground and extending from the base of a thunderstorm. Tornadoes can form any time of the year; but the season of greatest activity runs from March to August. See Appendix A for a more detailed description of the tornado hazard.

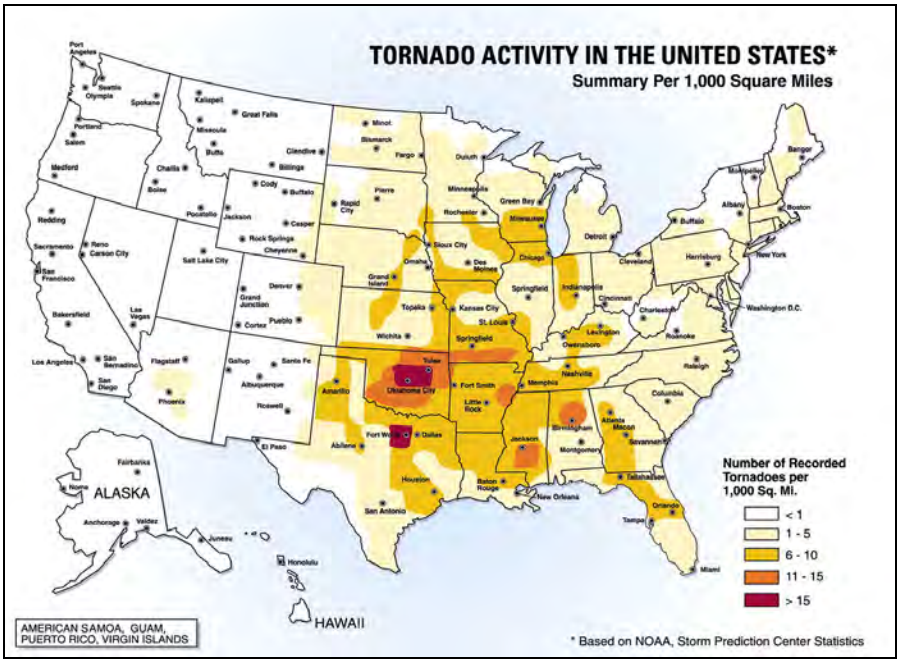
Geographic Location

Figure 5-10 illustrates the frequency of tornado strikes in the U.S. per 1,000 square miles. With an average of 153 tornadoes touching down each year, 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 considerable activity with 6 – 10 tornadoes per 1,000 square miles. The tornado hazard affects the entire planning area.

Figure 5-10

Tornado Activity in the U.S.

(Source: NOAA – Storm Prediction Center)



Tornado damage severity is measured by the Fujita Tornado Scale (F-Scale), named after Dr. T. Theodore Fujita who first introduced the scale in 1971. The Fujita Scale assigns numerical values based on wind speed and categorizes tornadoes from 0 to 5. The scale is based on damage caused by a tornado related to the fastest ¼ mile wind speed at the height of a damaged structure. The letter "F" precedes the numerical value. Tornadoes are related to larger vortex formations, and therefore often form in convective cells such as thunderstorms or in the right forward quadrant of a hurricane, far from the hurricane eye. Table 5-20 describes the categories for the Fujita Tornado Scale.

Table 5-20
Fujita Tornado Measurement Scale
(Source: NOAA)

Category	Wind Speed	Examples of Possible Damage
F0	Gale (40-72 mph)	Light damage. Some damage to chimneys; break branches of trees; push over shallow rooted trees; damage to sign boards.
F1	Moderate (73-112 mph)	Moderate damage. Peel surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
F2	Significant (113-157 mph)	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	Severe (158-206 mph)	Severe damage. Roofs and some walls torn off well constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
F4	Devastating (207-260 mph)	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible (261-318 mph)	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile sized missiles fly through air in excess of 100 yards; trees debarked; incredible phenomena will occur.

In February of 2007 the F-Scale was replaced with a more accurate Enhanced Fujita Scale (Enhanced F-scale). It was the Jarrell, Texas tornado of May 27, 1997 and the Oklahoma City/Moore tornado of May 3, 1999 that brought to the forefront the problem that perhaps the wind estimates were too high in the F-Scale. The changes to the original scale were proposed by a committee of meteorologist and engineers searching for a more accurate method of assessing the magnitude of tornadoes. Changes to the original Fujita scale were designed to ensure compatibility with the existing databases of tornado hazards, including the one maintained by the NCDC.

The Enhanced F-scale has the same basic design as the original Fujita scale, six categories from zero to five representing increasing degrees of damage. [21] It was revised to reflect better examinations of tornado damage surveys, so as to align wind speeds more closely with associated storm damage. The new scale also considers damages to a wider variety of structures and better accounts for variables

[21] NOAA; Storm Prediction Center – Summary of Enhanced F-scale

such as differences in construction quality. Table 5-21 displays the wind speed ranges for the original Fujita Scale, the derived wind speeds (Enhanced F-scale), and the new Enhanced F-scale, in wide use since February of 2007.

Table 5-21
Wind Speed Comparison of the Fujita Scale and Enhanced Fujita Scale
(Source: NOAA – National Weather Service)

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Previous Occurrences

It is possible for tornadoes of any intensity (up to EF-5) to occur anywhere within the planning area. Although the NCDC indicates the strongest recorded tornadoes in Jefferson County were rated as F3s (six total) on the Fujita scale, the climate in southeastern Texas, and the potential for extreme atmospheric instability, allow for the possibility that tornadoes in the planning area could reach EF-5 severity. For example the Jarrell, Texas tornado in 1997 mentioned above was officially categorized by NOAA as an F5. This tornado occurred only several hundred miles from Jefferson County where climate conditions are relatively similar. It should be noted that a normal probabilistic distribution of events would mean that events on the lower end of the scale would predominate, while more severe events will be less common.

Between 1975 and 1995, 106 major Federal disaster declarations in the United States included impacts caused by tornadoes. The States with the greatest number of tornado-related disasters were: Mississippi (14); Alabama and Illinois (9 each); Oklahoma (8); Wisconsin (7); Ohio (6); and Missouri, Minnesota, Louisiana, Georgia, and Arkansas (5 each).

According to the NCDC database, Jefferson County experienced 101 tornadoes (42 F0s, 31 F1s, 20 F2s, and 6 F3s) between 1950 and 2011. Again, note that the boundaries of the DD7 planning area do not correspond exactly to Jefferson County, which is the reporting area for the NCDC, so the figure should be regarded as a general indication of event history area-wide. For these events, the NCDC database reported three deaths, 142 injuries and just over $55.797 million in damages. Table 5-22 summarizes the 22 tornadoes that resulted in injuries. .

Table 5-22
Jefferson County: Tornadoes Resulting in Injuries, 1950 - 2011
(Source: NOAA/NCDC)

22 TORNADO(s) were reported in Jefferson County, Texas between 04/30/1950 and 08/31/2011 with at least 1 injuries.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 JEFFERSON	10/04/1956	1525	Tornado	F1	0	2	25K	0
2 JEFFERSON	11/07/1957	2115	Tornado	F3	2	59	2.5M	0
3 JEFFERSON	11/07/1957	2123	Tornado	F3	0	1	250K	0
4 JEFFERSON	08/10/1962	1545	Tornado	F1	0	6	0K	0
5 JEFFERSON	07/23/1963	1500	Tornado	F1	0	1	0K	0
6 JEFFERSON	08/05/1964	1820	Tornado	F2	0	6	250K	0
7 JEFFERSON	09/21/1967	1047	Tornado	F1	0	1	0K	0
8 JEFFERSON	03/23/1969	1105	Tornado	F3	0	1	25K	0
9 JEFFERSON	02/01/1970	0930	Tornado	F2	0	2	25K	0
10 JEFFERSON	10/11/1970	1530	Tornado	F3	0	19	2.5M	0
11 JEFFERSON	05/12/1972	0723	Tornado	F2	0	2	250K	0
12 JEFFERSON	05/26/1973	0345	Tornado	F2	0	3	250K	0

13 JEFFERSON	10/28/1974	1330	Tornado	F2	0	2	25K	0
14 JEFFERSON	10/28/1974	1355	Tornado	F2	0	3	250K	0
15 JEFFERSON	04/23/1981	1115	Tornado	F2	0	2	250K	0
16 JEFFERSON	01/31/1983	1400	Tornado	F3	0	1	2.5M	0
17 JEFFERSON	05/20/1983	1345	Tornado	F2	1	9	2.5M	0
18 JEFFERSON	05/20/1983	1401	Tornado	F1	0	3	2.5M	0
19 Port Arthur	07/14/1997	03:05 PM	Tornado	F0	0	3	50K	0
20 Nome	01/01/1999	11:45 PM	Tornado	F3	0	5	500K	0
21 Hamshire	04/03/2000	03:08 AM	Tornado	F1	0	1	100K	0
22 Gillburg	08/18/2009	12:57 PM	Tornado	F1	0	10	20.0M	0K
				TOTALS:	3	142	34.750M	0

Probability of Future Occurrence

With a total of 101 tornado events between 1950 and 2011, Jefferson County experiences on average approximately 1.65 tornados per year. With more than one event every year, there is a statistical annual probability of greater than 100% that a tornado of some magnitude will occur in Jefferson County. Note that this percentage is based on tornado events for all of Jefferson County. It should also be noted that the majority of tornadoes here (and other places) are low-magnitude events that cause little or no damage. T he probability calculation estimate would be somewhat lower than this if only the DD7 planning area were considered. Based on the high, medium, and low ranges identified in Table 5-5, there is a high probability of future tornadoes occurring in DD7.

Magnitude/Severity/Extent

Within DD7, Tornadoes risks to people and property cannot be distinguished by area; the hazard is reasonably predicted to have uniform probability of occurrence across the entire District. All people and assets are considered to have the same degree of exposure. Historically, lightly constructed residential structures (in particular, manufactured housing, specifically mobile homes) within the planning area are most vulnerable to the tornado hazard. Data related to the number of structures by building type and past damages for specific building types was unavailable at the time of the Plan update, and therefore

the loss estimates for the tornado hazard are based on total property damage as reported by the NCDC. However, the magnitude of a tornado could be and has been catastrophic to the planning area.

Overall Vulnerability

As mentioned above, past tornados in the County have caused an estimated $55.979 million in damages. Dividing this prior loss total for tornadoes by the span of years in which this loss was incurred (61 years), it is estimated that Jefferson County has a potential annual loss from tornadoes of $917,688. With annual losses close to $1 million, tornadoes could have a moderate impact on the planning area (see Table 5-6).

The overall vulnerability to DD7 is high and it has a potential impact on the District-owned buildings, therefore, a risk analysis will be completed for this hazard.

5.7.11 Dam Failure

Description of the Dam Failure Hazard

A dam is defined as any artificial dike, levee, or other barrier that is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five feet or more above the usual, mean, low water height when measured from the downstream top-of-dam to the emergency spillway crest or, in the absence of an emergency spillway, the top-of-dam. Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees (also known as dikes) are used to manage or prevent water flow into specific land regions.

Dam failures are not themselves natural hazards, but are often caused by natural hazards such as floods and earthquakes, and their failure can then result in floods. Dam failures can result from a variety of causes including lack of maintenance, seismic activity, improper design or construction, or the effects of large storms. Significant rainfall can quickly inundate an area and cause floodwater to overwhelm a reservoir. If the spillway of the dam cannot safely pass the resulting flows, water will begin flowing in areas not designed for such flows and failure may occur. See Appendix A for a more detailed description of the dam failure hazard. For additional information about dam failure visit FEMA's *Dam Failure* page located at http://www.fema.gov/hazard/damfailure/index.shtm.

General Location

As of May, 2012, the U.S. Army Corp of Engineers' (USACE) National Inventory of Dams (NID) database indicates that there were 3 dams in Jefferson County.[22] Dams are typically ranked by hazard classification, which is determined by the potential for infrastructure and property damages downstream if a dam failure were to occur. The three hazard classifications include high hazard, significant, and low and are defined as follows:

[22] US Army Corp of Engineers National Inventory of Dams database. Jefferson County, Texas.

- High hazard potential dams are those whose failure or operational failure will probably cause loss of life and/or significant infrastructure losses.
- Significant hazard potential dams are those whose failure or operational problems are unlikely to cause loss of human life, but can cause economic loss, environmental damage, disruption of lifelines, or other concerns.
- Low hazard potential dams are those whose failure would probably cause no loss of human life and only low economic and/or environmental losses, which would typically be limited to the dam owner's property.

Table 5-23 summarizes information reported by the NID for to the three dams located within Jefferson County. Of the three dams in the County, there are none that are considered significant or high and therefore no EAPs are necessary.[23] The Spindletop Weir Saltwater Barrier is located in far southwestern Jefferson County near the Chambers County line. The McBride Lake Levee is located in southwest Jefferson County and the Port Arthur Raw Water Levee is located in Port Arthur.

Table 5-23
Inventory of Jefferson county Dams, ordered by Hazard Classification
(Source: USACE - National Inventory of Dams)

Dam Name	River	Hazard Class	Lat.	Long	Owner Name	Inspection Date	Storage	Dam Length	Dam Height	Primary Purpose	Dam Type
McBride Lake Levee	Elm Bayou	Low	-94.3516	29.625	McBride - Private	2/15/1979	450	7,500	7	Irrigation	Earth
SpindleTop Weir Saltwater Barrier	SpindleTop Bayou	Low	-94.315	29.715	Trinity Bay Conservation District – Local Govt.		375	360	12	Irrigation	Buttress
Port Arthur Raw Water Reservoir Levee	Sabine Lake	Low	-93 .9683	29.9044	City of Port Arthur – Local Govt.	1/9/2001	300	8,220	14	Water Supply	Earth

Severity and Extent of Dam Failure

The severity of a dam failure event depends on several factors, including the size of the dam, the extent of the failure (i.e., catastrophic structural failure versus a small breech), the velocity of the floodwater released, and the density of built environment and populations downstream. There is the potential for total collapse of a dam, but less significant failures are more likely as a result of overtopping (inadequate spillway design, debris blockage), foundation defects, or seepage. Overtopping of a dam during a flood event due to clogged debris has the potential to be catastrophic. As mentioned above,

[23] US Army Corp of Engineers National Inventory of Dams database. Jefferson County, Texas.

dams are typically categorized into three hazard classifications consisting of high, significant, and low hazard. However the magnitude of dam failure is considered limited.

Impact on Life and Property

According to the USACE's National Inventory of Dams Program, as of 2005 there were 79,500 dams in the United States. Approximately one third of these pose a "high" or "significant" hazard to life and property if failure occurs. Dam failure has the potential for catastrophic impact on life and property. This risk can be reduced by proper design, construction and routine maintenance and inspection.

To prevent, or reduce the probability of a failure, high and significant hazard dams are periodically inspected by professional engineers on a regular basis by the Texas Commission on Environmental Quality (TCEQ) - Dam Safety Program. The program periodically inspects dams that pose a high or significant hazard and makes recommendations and reports to dam owners to help them maintain safe facilities.[24]

Effective January 1, 2009, the Texas Administrative Code (Title 30, Part 1 Chapter 299 - rule §299.1) directed the TCEQ to oversee the design, review, and approval of construction plans and specifications; and construction, operation and maintenance, inspection, repair, removal, emergency management, site security, and enforcement of high and significant hazard dams that:

- have a height greater than or equal to 25 feet and a maximum storage capacity greater than or equal to 15 acre-feet,
- have a height greater than six feet and a maximum storage capacity greater than or equal to 50 acre-feet;[25]

While DD7 is not responsible for any of the dams in the County, its system is capable of handling the flow from the reservoir to its channels.

The *2010 State of Texas Hazard Mitigation Plan Update* was also reviewed to determine the dam failure risk in Jefferson County. Review of the State Plan indicates that in Texas the high risk dam area is concentrated along a generally north –south band across the central portion of the State. Sections of this band include densely populated areas combined with a high number of dams. Jefferson County is well outside this band.

The general location of the three dams is indicated on the map labeled figure 5-11 below.

[24]Texas Commission on Environmental Quality - Dam Safety Program

[25] Texas Administrative Code. Title 30, Part 1, Chapter 299.

Figure 5-11

Dams of Jefferson County Texas (Source: USACE NID Database)

Occurrences of Dam Failure

The *2010 State Hazard Mitigation Plan Update* indicates that Texas has experienced over 53 documented dam failures. The most recent dam failures in Texas occurred in 2003 as a result of a severe rainfall event in Brazos, Robertson, and Milam Counties. Heavy rains from the event caused the failure of four earthen dams, only one of which was large enough to have been registered with the USACE's NID. The failures were located in a rural area, and caused no injuries or deaths.[26]

[26] 2007 State of Texas Hazard Mitigation Plan. Section 2 – Risk Assessment. Dam and Levee Failure, Page 66

A review of current literature and open data sources revealed no known past dam failures in or near Jefferson County. Based on no past dam failures in the County, the probability of future failures is projected to be low. See Table 5-5 for the definition of high, medium and low probability of occurrence.

Overall Summary Description of Jefferson County's Vulnerability to Dam Failures

Jefferson County has not had any deaths or injuries due to dam failure as reported by the NCDC database. There has not been any reported damage due to dam failure and therefore the hazard is considered minor as defined in Table 5-6. There is a low probability of future occurrence; however, the potential to cause major damage and disruption of services has limited risk as defined in Table 5-7. Therefore the hazard does not impact the County in such a way that a risk assessment is warranted.

5.8 Results of Hazards Profiled

From the profiles, the hazards that pose the greatest threat to DD7's planning area and that DD7 has the authority to mitigate will have a detailed risk assessment completed. Since hurricanes/tropical storms, tornadoes and wind relating to thunderstorms result in either flooding or wind damage, those hazards will be incorporated in the risk assessments for flood and wind. Table 5-22 illustrates the hazards profiled and the determination on whether a risk assessment is warranted.

Table 5-24
Profiled Hazards Results

Hazard Type	Probability of Occurrence	Magnitude/Severity/ Extent	Overall Vulnerability	Risk Assessment to be Completed
Drought	Medium	Limited	Low	No
Earthquake	Low	Limited	Low	No
Extreme Heat	Medium	Limited	Low	No
Flood	High	Catastrophic	High	Yes
Hurricane/Tropical Storm	High	Catastrophic	High	Yes, as part of both flood and wind
Landslide	Low	Limited	Low	No
Thunderstorm/Lightning	High	Limited	Low	No
Tornado	High	Catastrophic	High	Yes, as part of wind

Wildfire	Low	Limited	Low	No
Winter Storm	Medium	Minor	Moderate	No
Dam Failure	Low	Limited	Low	No

6 Section 6 - Vulnerability Assessment and Loss Estimation for Wind and Flood Hazards

6.1 Interim Final Rule Requirement for Risk Assessments

IFR §201.6(c)(2): The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

IFR §201.6(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

IFR §201.6(c)(2)(ii): [The risk assessment] must also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.

IFR §201.6(c)(2)(ii)(B): [The plan ***should*** *describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.*

IFR §201.6(c)(2)(ii)(C): [The plan ***should*** *describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

6.2 Overview and Analysis of DD7's Vulnerability to Hazards

As discussed in Section 5 of this Plan (Profiled Hazards), DD7 has at least some exposure to as many as eleven hazards, but most of them have such low probability that there is little or no significant risk to the District's planning area or its facilities. Section 5 described the process by which the County reduced the list of eleven possible hazards to the two that create the most risk to the people, assets and operations. These are *floods (including hurricanes/tropical storm flooding,)* and high winds *(including tornadoes and hurricane/tropical storm winds)*

This section addresses the District's vulnerabilities to these two most significant risks (as identified by the MPC), and estimates future expected losses from them, in accordance with FEMA requirements. The most significant natural hazard to which Jefferson County is exposed to is floods and flooding. Flooding in Jefferson County can be the result of hurricanes, thunderstorms and/or tropical storms. As discussed, the NCDC indicates there have been 16 significant floods in Jefferson County between 1950 and 2011.

The other significant hazard for the County is high winds (including tornadoes, hurricane/tropical storm winds and thunderstorms). The entire County is equally exposed to the potential damages from this hazard, although vulnerabilities vary with several factors, most significantly the kind of structure that is subjected to the effects of the hazard and the numbers of people in buildings (particularly during hours of the day when tornadoes are most likely).

The NCDC database indicates there have been 101 tornadoes in Jefferson County between 1950 and 2011 and nine hurricanes/tropical storms between 1950 and 2011. For thunderstorms with winds over 70 knots, there have been three from 1950 through 2011 as reported by NCDC.

It should be noted that Jefferson County DD7 was created primarily to provide drainage of overflow lands within DD7. As such, DD7 has no authority to address hazards other than flood and winds that affect DD7 facilities. Jefferson County and incorporated jurisdictions within DD7 are currently developing their own hazards mitigation plans. These plans include action items relating to all hazards, including floods. DD7 cooperates with these jurisdictions on the identification and implementation of mitigation projects, as allowed by law. This coordination is focused on mitigation projects designed to prevent future flood damage and to protect DD7 facilities from wind damage.

For hazards where the probability of occurrence, and the estimated annual dollar value of damage were both determined to be low, action items were not identified.

Table 6-1
Linking Actions to Hazards

Hazard	Probability of Occurrence*	Estimated Annual $ Damage**	Action Item(s)
Floods (including storm surge, thunderstorms)	High	High	1-25, 26 and 27
Hurricane/Tropical Storms	Low	High	1-25, 26 and 27
High Wind Hazards/Tornadoes/ winds from Thunderstorms	High	Medium	24, 25, 26 and 27

* Based on Historical Occurrences as indicated in Section 5 (See Table 5-4).
** Based on calculated estimate of annual damage
Less than $250,000 annual estimate of damage = Low
Between $250,000 and $1,000,000 annual estimate of damage = Medium
Greater than $1,000,000 annual estimate of damage= High

Vulnerability Assessment and Loss Estimation

This section describes the risks to Jefferson County Drainage District No. 7. The term *vulnerability assessment* describes the extent to which physical assets, people or operations are damaged when they are exposed to natural hazards. The term *loss estimation* is analogous to *risk assessment,* and refers to expected future damage resulting from the impacts of natural hazards. Risk can be calculated or estimated in several different ways, depending mainly on the kind of information that is available for the analysis.

6.3 Flood Hazards: Overview

Table 6-2
Jefferson County Floods Resulting in Property Damage over $50,000

Query Results

16 FLOOD event(s) were reported in Jefferson County, Texas between 04/30/1950 and 09/30/2011 with at least $50 Thousand in Property Damage.

*Click on **Location** or **County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Nederland	12/18/1995	0200	Urban Flooding	N/A	0	0	55K	0
2 Nederland	12/18/1995	0200	Urban Flood	N/A	0	0	55K	0
3 TXZ215	09/27/1996	09:00 AM	Flood	N/A	0	0	90K	0
4 Beaumont	09/11/1998	01:00 PM	Flood	N/A	0	0	100K	0
5 Hampshire	09/13/1998	10:00 AM	Flood	N/A	0	0	100K	0
6 Nederland	04/12/2000	10:00 AM	Flash Flood	N/A	0	0	250K	0
7 Beaumont	06/07/2001	03:30 AM	Flood	N/A	0	0	10.0M	0
8 Countywide	09/02/2001	10:00 AM	Flood	N/A	0	0	75K	0
9 Beaumont	10/29/2002	12:30 AM	Flash Flood	N/A	1	0	5.0M	0
10 Beaumont	11/03/2002	11:10 AM	Flash Flood	N/A	0	0	1.0M	0
11 Port Arthur	12/04/2002	07:00 AM	Flash Flood	N/A	0	0	50K	0
12 Beaumont	10/09/2003	03:45 PM	Flash Flood	N/A	0	0	1.0M	0
13 Port Neches	10/25/2003	02:00 PM	Flash Flood	N/A	0	0	100K	0
14 Beaumont	05/29/2006	03:09 AM	Flash Flood	N/A	0	0	50K	0

15 Fannett	09/13/2007	01:00 AM	Flash Flood	N/A	0	0	50K	0K
16 Gillburg	10/22/2009	08:00 AM	Flash Flood	N/A	0	0	100K	0K
				TOTALS:	1	0	18.075M	0

Based on past and recent history, certain parts of DD7 clearly have a high probability of flooding repeatedly in the future. With a total of 16 floods between 1995 and 2011, DD7 experiences a flood event on average slightly more than once every year. The 16 events have occurred over a period of 17 years which calculates to a 94% annual probability of future flood occurrences.

6.3.1 Defining Flood Hazards

When rainfall runoff collects in rivers, creeks, bayous, and streams and exceeds the capacity of channels, floodwaters overflow onto adjacent lands. Floods result from rain events, whether short and intense, or long and gentle. In recent years, many of the flooding in DD7 has been associated with storms that originate as hurricanes and tropical storms that subsequently move inland. 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.

Note: Additional descriptions of the flood hazard can be found in Appendix A.

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.[27]

The revised FIS for Jefferson County is dated August 6, 2002. This FIS compiles all previous flood information and includes data collected on numerous waterways. The FIS indicates that riverine flooding results primarily from overflow of the streams and drainage ditches caused by rainfall runoff, ponding, and sheet flow. Storms occurring during the summer months are often associated with tropical storms moving inland from the Gulf of Mexico. Thunderstorms are common throughout the spring, summer, and fall months. The frequent hurricanes and tropical storms interrupt the summer with high winds, heavy rainfalls, and high storm surges. FIRM maps 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 (FHFs) 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 FHFs are determined.

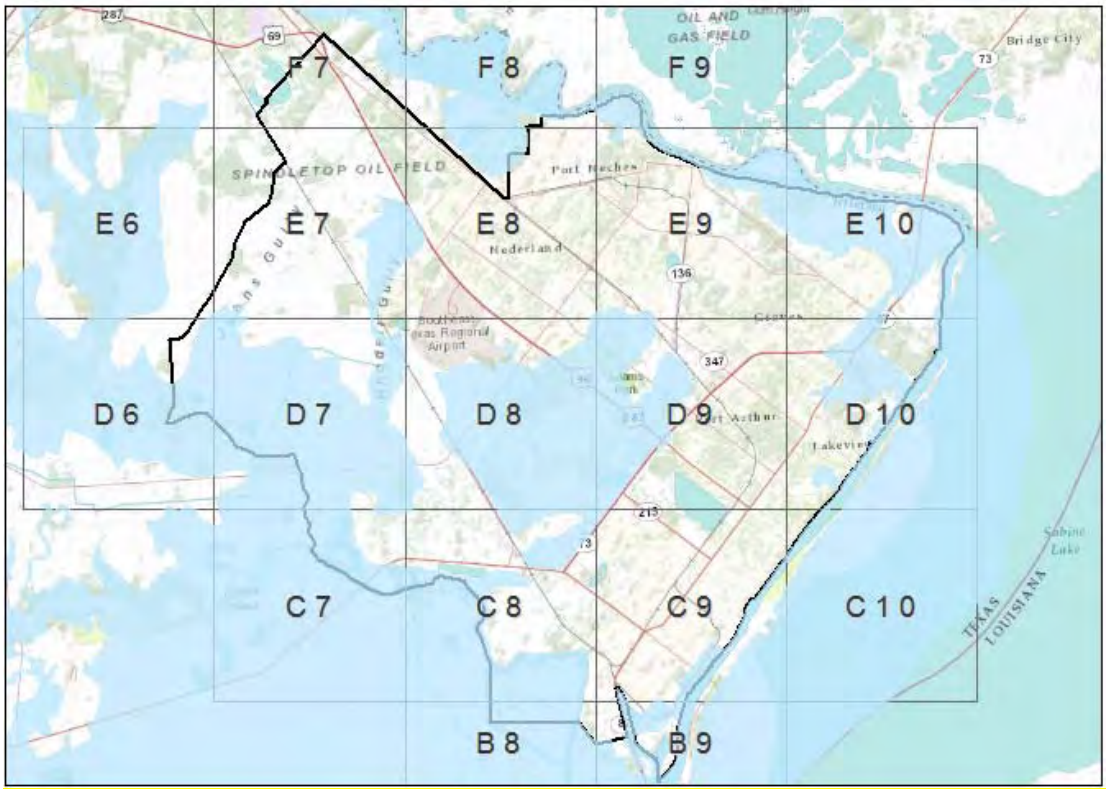
B Zones and Shaded X Zones, which are areas of "moderate" flood hazard, typically associated with the 500-year flood (or 0.2% annual chance).

C Zones and 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.

Figure 6-1 identifies the 100-year floodplain (shaded light blue) 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. The grid index labels the individual maps included in Appendix H.

[27] FEMA –Flood Insurance Study definition

Figure 6-1
Jefferson County DD7 – 100-year Floodplain Map
(Source: FEMA Q3 Data, JSWA GIS)



6.3.2 Subsidence-Related Flooding

Land subsidence is a gradual settling or sudden sinking of the Earth's surface due to subsurface movement of earth materials. The principal causes of subsidence are aquifer-system compaction, drainage of organic soils, underground mining, hydrocompaction, natural compaction, sinkholes, and thawing permafrost. As part of the 2012 Plan the MPC reviewed various open source resources for past occurrences of land subsidence flooding within Jefferson County DD7. The MPC determined there have been no significant subsidence related flooding in the planning area.

6.3.3 Dams and Flooding

FEMA and the U.S. Army Corps of Engineers (USACE) maintain the National Inventory of Dams (1998), a database of high and significant hazard dams. F or the most part, data are provided by State agencies responsible for regulation and inspection of dams or by the USACE. Based on that inventory, there are no high hazard dams that affect the watersheds in or draining through DD7. As of May, 2012 there are no high hazard dams located within Jefferson County DD7.

6.3.4 Storm Surge Flooding

Storm surges occur when the water level of a tidally-influenced body of water increases above the normal high tide. Storm surges occur with coastal storms caused by massive low-pressure systems with cyclonic flows that are typical of hurricanes. Storm surges are particularly damaging when they occur at the time of a high tide, combining the effects of the surge and the tide. This increases the difficulty of predicting the magnitude of a storm surge since it requires weather forecasts to be accurate to within a few hours. See Appendix A for a more detailed description of the storm surge hazard.

The storm surge hazard associated with hurricanes and other severe storms are responsible for coastal flooding and erosion along the Texas Gulf Coast. In addition to flooding coastal areas, storm surge can also reach further inland impacting lakes and rivers. Storm surge in Jefferson County DD7 and the City of Port Arthur is primarily the result of hurricanes that approach land from the Gulf of Mexico moving water inland from the Gulf of Mexico. The effects of storm surge can be felt in DD7 from hurricanes that make landfall as far away as Southwest Texas, Mississippi, or Alabama.

Storm surges inundate coastal floodplains by tidal elevation rise in inland bays and ports, and backwater flooding through coastal river mouths. Severe winds associated with low-pressure systems cause increase in tide levels and water surface elevations. Storm systems also generate large waves that run up and flood coastal areas. The combined effects create storm surges that affect the beach, marsh, and low-lying floodplains. Shallow offshore depths can cause storm driven waves and tides to pile up against the shoreline and inside bays. See Table 6-3 for factors that can influence the severity of coastal storms.

Storm surge is considered the next most dangerous part of a hurricane after severe winds, and causes nine out of ten hurricane-related deaths, according to the National Weather Service. The level of surge in a particular area is mainly determined by the slope of the continental shelf. A shallow slope off the coast, will allow a greater surge to inundate coastal communities.

Table 6-3
Factors that Influence the Severity of Coastal Storms

Factor	Extent
Wind Velocity	The higher the wind velocity the greater the damage.
Storm Surge Height	The higher the storm surge the greater the damage.
Coastal Shape	Concave shoreline sections sustain more damage because the water is driven into a confined area by the advancing storm, thus increasing storm surge height and storm surge flooding.
Storm Center Velocity	Then slower the storm moves, the greater damage. The worst possible situation is a storm that stalls along a coast, through several high tides.
Nature of Coast	Damage is most severe on low-lying island barrier shorelines because they are easily over washed by wave action.
Previous Storm Damage	A coast weakened by even a minor previous storm will be subject to greater damage in a subsequent storm.
Human Activity	With increased development, property damage increases and more floating debris becomes available to knock down other structures.

The NCDC database indicates there have been two storm surge events to impact Jefferson County between 1950 and 2011. The first event occurred in October of 2006, and the second event was storm surge associated with Hurricane Ike in September, 2008. The NCDC reports that Hurricane Ike caused an estimated $500 million in combined total property damage within Jefferson and Orange Counties. No injuries or deaths death were reported from either storm surge event. Table 6-4 summarizes the major storm surge events that have impacted southeastern Texas and Jefferson County since 1950. The database provides no indication as to why there are no events prior to 2006, although presumably there are additional past occurrences that are not shown.

Table 6-4
Storm Surge Events, Jefferson County 1950 – 2009
(Source: NOAA/NCDC)

Query Results

2 OCEAN & LAKE SURF event(s) were reported in **Jefferson County, Texas** between **01/01/1950** and **08/31/2009**.

*Click on **Location or County** to display Details.*

Mag: Magnitude
Dth: Deaths
Inj: Injuries
PrD: Property Damage
CrD: Crop Damage

Texas

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 TXZ215	10/16/2006	00:00 AM	Storm Surge/tide	N/A	0	0	0K	0K
2 TXZ215 - 216	09/12/2008	06:00 AM	Storm Surge/tide	N/A	0	0	500.0M	0K
				TOTALS:	0	0	500.000M	0

Hurricane Ike made landfall near Galveston, Texas early in the morning on September 13th as a strong category 2 Hurricane. Ike caused wind damage and significant storm surge flooding across southeast Texas. The event caused an estimated 14-15 foot storm surge at Sabine Pass which resulted in the highest water level ever recorded at that location. Many homes that were not elevated were destroyed. The NCDC reports that the storm surge did not overtop the seawall in Port Arthur, but wave action on top of the surge did. It was estimated that at least 100 homes were flooded in Port Arthur. The surge also backed up Hillebrandt and Taylor Bayou west of Port Arthur, causing widespread flooding in the Hillebrandt, Hamshire, and Fannett communities. The surge also backed up the Neches River in Beaumont, where some homes along the river flooded. In total, at least 4,000 homes were flooded in Jefferson County.[28] Figure 6-2 displays the storm surge inundation areas and depth of water above ground level from Hurricane Ike for southeastern Texas. The track of Hurricane Ike is also indicated on the map in red.

[28] National Climatic Data Center (NCDC): Jefferson County Texas – Ocean and Lake Surf events

Figure 6-2
Hurricane Ike Inundation Map for Southeastern Texas and Louisiana
(Source: HGAC GIS Clearinghouse, JSWA GIS)

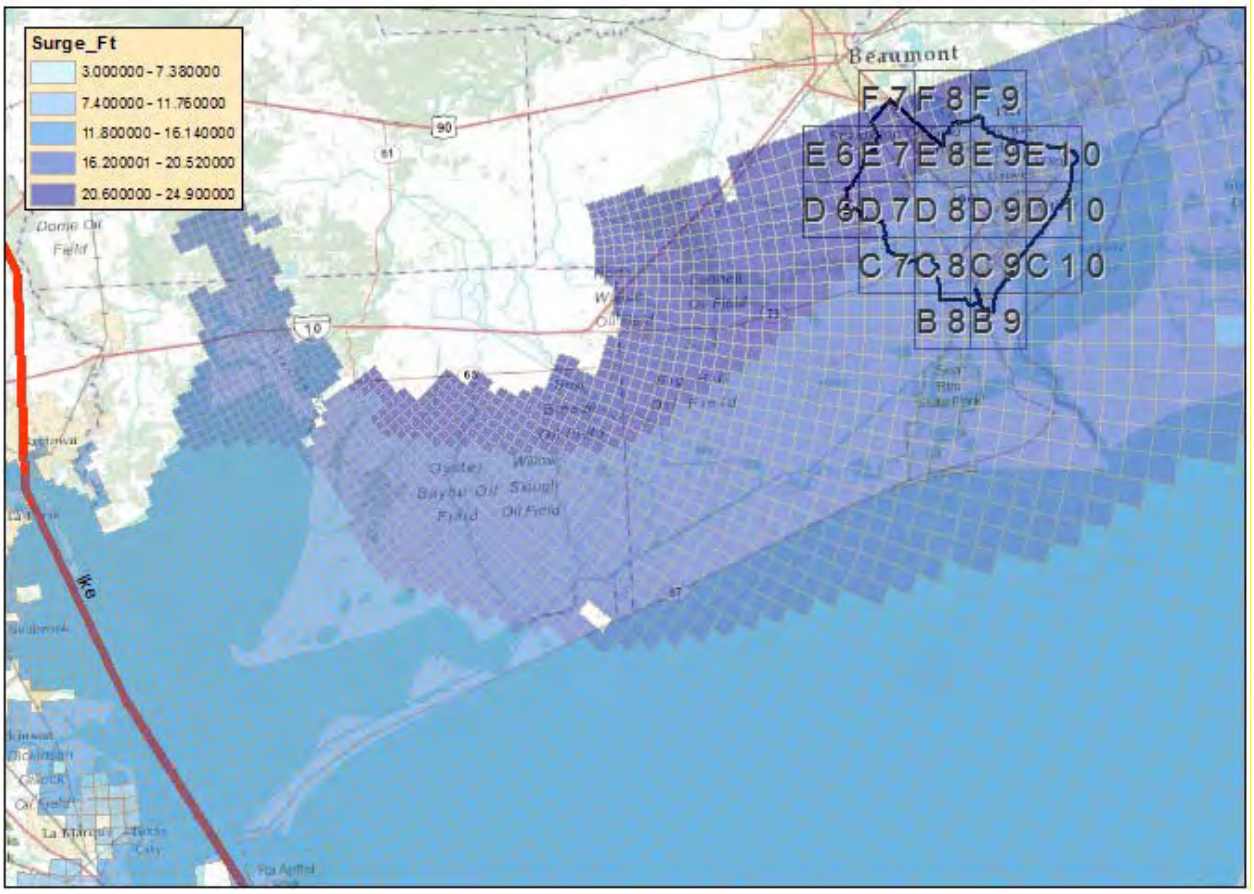


Figure 6-3 displays the storm surge zone (shaded blue) from Hurricane Ike for lower Jefferson County.

Figure 6-3
Jefferson County: Storm Surge Inundation Areas from Hurricane Ike
(Source: National Weather Service – Lake Charles, Louisiana)

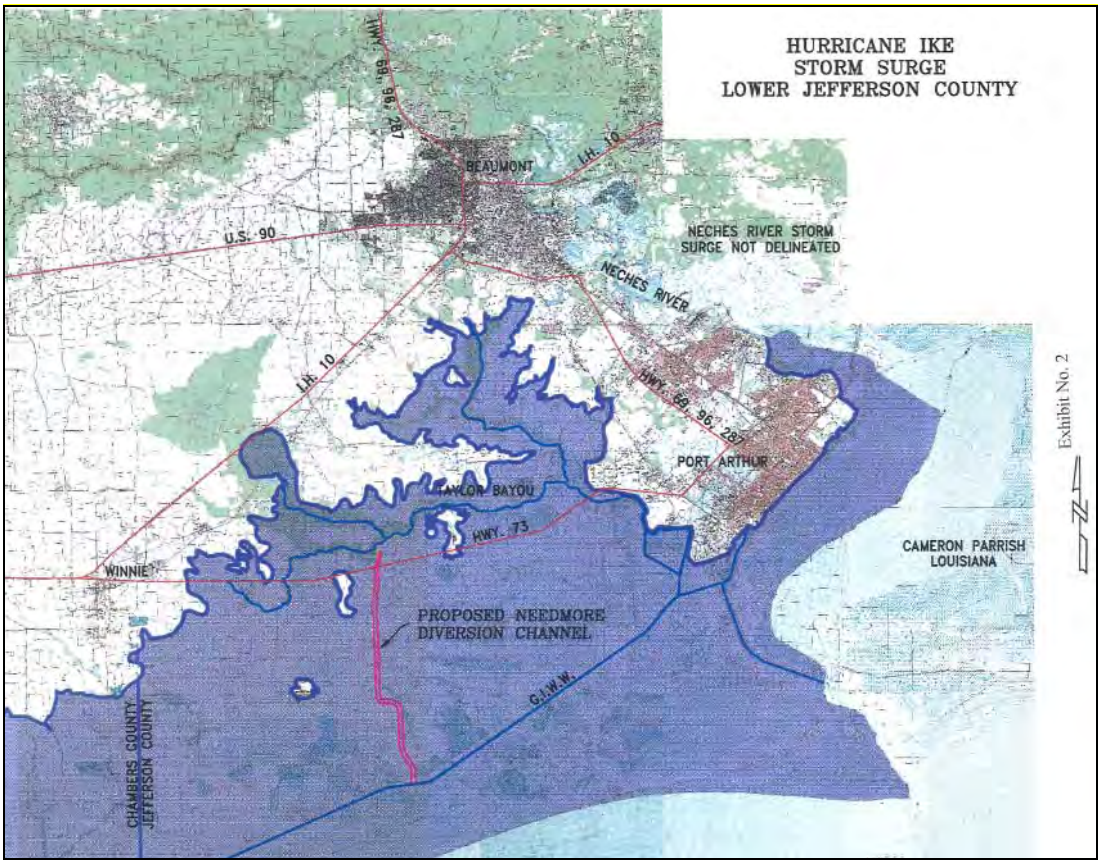
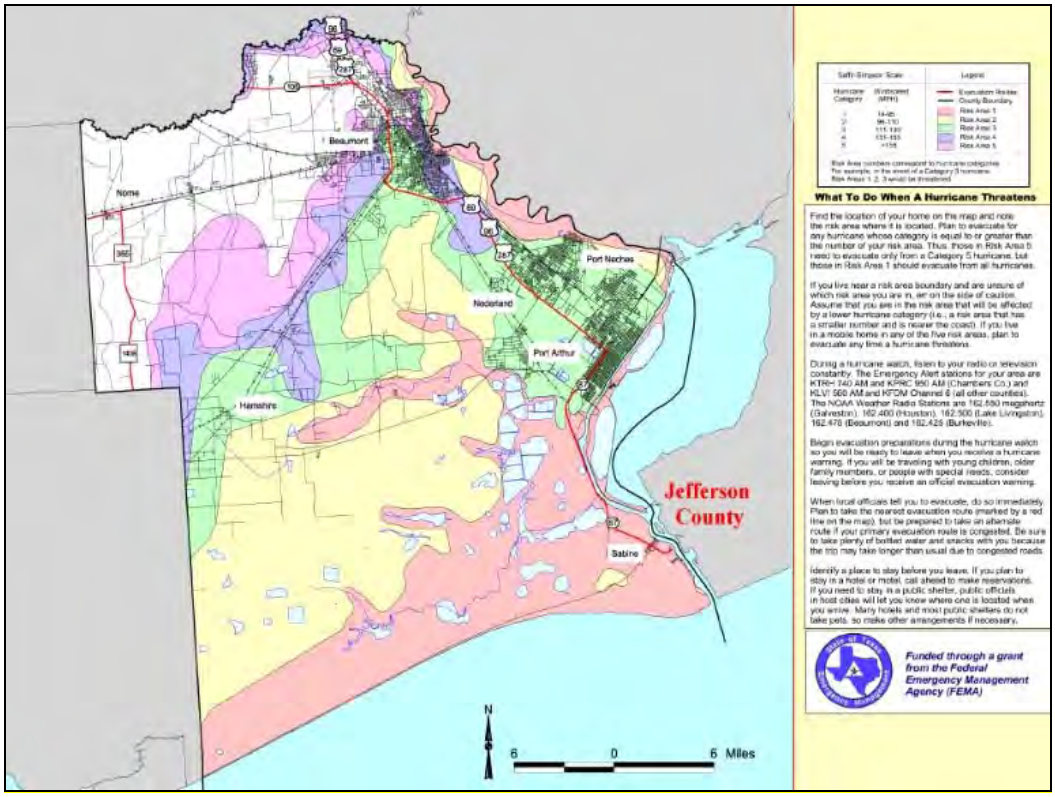


Figure 6-4 identifies the storm surge risk areas for Jefferson County. The map was produced by the Lake Charles office of the National Weather Service and shows five color coded risk areas for Hurricane Categories 1 – 5.

Figure 6-4
Jefferson County: Storm Surge Risk Areas
(Source: National Weather Service – Lake Charles, Louisiana)



In addition to the two events listed in the NCDC under the *Ocean and Lake Surf* category, the *Hurricane and Tropical Storm* category of the database indicated that Hurricane Rita in 2005 also resulted in storm surge along the coastal areas of Jefferson County. In addition, previous events listed in the National Hurricane Centers (NHC) Historical Hurricane and Tropical Storm Tracker database identified two additional major hurricanes that have impacted Jefferson County since 1950. The first event was Hurricane Audrey in 1957 and the other was Hurricane Alicia in 1983. Both events most likely included a moderate storm surge along the Texas Gulf Coast. Adding these additional events, Jefferson County has experienced a total of five storm surge events between 1950 and 2011. Based on the five events between 1950 and 2011, on average, a significant storm surge occurs in Jefferson County approximately once every 12.4 years. The five events have occurred over a period of 62 years which calculates to a 8% annual probability of future storm surge occurrences. Based on past storm surge events, the probability of future events impacting DD7 is considered low. See Table 5-5 for the definition of high, medium and low probability. As mentioned elsewhere, future probability is only one component of the risk calculation. Although the storm surge hazard is considered to have a low probability, a strong magnitude event has the potential for very high impact on life and property in the planning area.

6.4 Estimate of Potential Losses

6.4.1 Flood Risks – DD7

This subsection of the HMP provides a general background regarding flood risk in DD7, and calculations of potential future flood losses in the District, based primarily on National Flood Insurance Program (NFIP) insurance claims data that help the District understand the impact the hazard has on the jurisdiction. Impact is measured by the physical, social and economic effects on the planning area.

6.4.2 Flood Risks – Buildings

To develop more specific data about flood-prone buildings, as part of the original Plan development DD7 worked with Jefferson County Engineering, Jefferson County Appraisal District (JCAD), the City of Port Arthur, and JSWA who have 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 NFIP Repetitive loss list used was dated November 30 2011.

In addition to the hazard history discussion elsewhere in this HMP, there are a few other means to generally characterize flood vulnerability in DD7. These are discussed later in this section.

1. Using GIS and historical knowledge, it is estimated that 2,342 residential buildings and 2,559 non-residential are located in the flood-prone areas of DD7. Therefore, not counting buildings that are susceptible but that are outside of the mapped floodplain, approximately 9.5% of all buildings in DD7 are prone to some degree of flooding. JCAD data was used to develop average values for residential buildings ($85,316), and average values for non-residential buildings ($105,758) yielding estimates of the total value of flood prone buildings (Table 5-4).

Table 6-5
Flood Prone Properties Located Within
Jefferson County DD7

	Residential	Non-Residential
Total number of buildings	36,979	14,756
Number of est. flood prone buildings (Note 1) (as % of total bldgs)	2,342 (6.3%)	2,559 (17.3%)

Note 1: Estimate of flood prone buildings is derived from actual historical building claims plus an estimate of number of buildings experiencing prior non-insured losses

2. 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 in the following text.

6.4.2.1 Buildings and Parcels in Proximity to the Special Flood Hazard Area

The number of buildings in the floodplain can be a good general proxy for flood risk, although year-to-year weather patterns clearly have a large influence on flooding potential. Using GIS and historical knowledge, it is estimated that 2,301 residential non-mobile home buildings, 41 mobile homes and 2,559 non-residential buildings are located in the flood-prone areas of DD7. Therefore, not counting buildings that are susceptible but that are outside of the mapped floodplain, approximately 9.4% of all buildings in DD7 are prone to some degree of flooding.

Table 6-6

Flood Prone Properties Located Within Jefferson County DD7

	Residential	Mobile Homes	Non-Residential
Total number of buildings	36,733	246	14,756
Number of est. flood prone buildings (Note 1)	2,301	41	2,559
(as % of total bldgs)	(6.2%)	(16.6%)	(17.3%)

Note 1: Estimate of flood prone buildings is derived from actual historical building claims plus an estimate of number of buildings experiencing prior non-insured losses

There is also considerable information available about the number of parcels in the floodplain, although this is not as good a measure of potential flood risk as the building information above (because, generally, flood risk in developed areas is related to potential impacts to structures and contents). Nevertheless, the data offers additional insight into potential exposure to floods.

According to the GIS, there are 107.42 square miles of land area within DD7's boundaries. Of this total, 43.90 square miles (or 40.87%) are located within the Special Flood Hazard Area (SFHA) or 100-year floodplain. The GIS analysis also indicated the District has a total of 51,735 parcels, of which 4,901 have some exposure to the 100-year floodplain. Table 6-7 summarizes the number of parcels in the District and the number of parcels within the 100-year floodplain, broken out by residential and commercial land use categories. The Table is ordered by the number of parcels in the 100-year floodplain and indicates the *Single Family Residential* category has the highest number of parcels within the floodplain. This category has 2,293 parcels in the 100-year floodplain which represents 6.31% of the 36,353 total parcels for this category.

Table 6-8 displays the same data, ordered by the percent of parcels in the 100-year floodplain. This Table indicates the *Industrial Parcels* category has the highest percent of parcels in the floodplain. This category has 36.62% of its parcels in the floodplain. This is expected because it probably includes many vacant or undeveloped parcels of land.

Table 6-7
Number of Parcels in DD7 by Land Use Category and the Number of Parcels in the Floodplain, ordered by Number of Parcels in the Floodplain
(Source: JCAD, JSWA - GIS)

Land Use Category	Description	Count	Percent of Parcels	# in Floodplain	Percent in Floodplain
Residential	Single Family Residence	36,353	70.27%	2,293	6.31%
Other	Other Vacant and improved parcels (county property, vacant lots, municipality owned, etc.)	10,702	20.69%	2,169	20.27%
Commercial	Commercial Property	2,337	4.52%	198	8.47%
Commercial	Commercial Or Industrial Vacant Lots	958	1.85%	71	7.41%
Commercial	Religious And Charitable Organizations	402	0.78%	28	6.97%
Residential	Duplex	380	0.73%	8	2.11%
Mobile Home	Mobile Homes	246	0.48%	41	16.67%
Commercial	Industrial Property	213	0.41%	78	36.62%
Commercial	Apartments	144	0.28%	15	10.42%
Totals		51,735	100.00%	4,901	9.47%

Table 6-8
Number of Parcels in DD7 by Land Use Category and the Number of Parcels in the Floodplain, ordered by Percent of Parcels in the Floodplain
(Source: JCAD, JSWA GIS)

Land Use Category	Description	Count	Percent of Parcels	# in Floodplain	Percent in Floodplain
Commercial	Industrial Property	213	0.41%	78	36.62%
Other	Other Vacant and improved parcels (county property, vacant lots, municipality owned, etc.)	10,702	20.69%	2,169	20.27%

Land Use Category	Description	Count	Percent of Parcels	# in Floodplain	Percent in Floodplain
Mobile Home	Mobile Homes	246	0.48%	41	16.67%
Commercial	Apartments	144	0.28%	15	10.42%
Commercial	Commercial Property	2,337	4.52%	198	8.47%
Commercial	Commercial Or Industrial Vacant Lots	958	1.85%	71	7.41%
Commercial	Religious And Charitable Organizations	402	0.78%	28	6.97%
Residential	Single Family Residence	36,353	70.27%	2,293	6.31%
Residential	Duplex	380	0.73%	8	2.11%
Totals		51,735	100.00%	4,901	9.47%

6.4.2.2 NFIP Policies in Force

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 in the following:

NFIP Policies In-Force. The following table summarizes data provided by FEMA indicating, as of May, 2012, the numbers of federal flood insurance policies were in-force in the planning area. These insurance policies are administered by the National Flood Insurance Program (NFIP). T his represents a dollar value of property and contents coverage in excess of $4.3 Billion.

Table 6-9
Flood Insurance Policies In-Force By Jurisdiction Within DD7

Community Name	Policies In-force	Insurance In-force whole $
GROVES, CITY OF	2,982	709,267,500
NEDERLAND, CITY OF	2,961	729,837,000
PORT ARTHUR, CITY OF	6,583	1,471,223,800
PORT NECHES, CITY OF	2,468	675,681,900

JEFFERSON COUNTY *	2,891	785,388,400

For the most part, two factors prompt people to purchase flood insurance – when mortgage lenders require it and when actual flood damage makes it clear to homeowners that a building is, indeed, located in a flood-prone area. Thus, the number and distribution of flood insurance policies is one way to characterize potential risk throughout DD7.

NFIP Claims Paid. Between 1978 and May, 2012, there were 6,309 flood insurance claims (building and contents combined) in Jefferson County. These totals include both the incorporated and unincorporated areas of Jefferson County. Many of these properties are located outside the 100-year floodplain. Review of the NFIP claims data for Jefferson County indicates that the large majority of these claims were for residential properties. Total claims paid for building and contents payments exceed $115.7 million. Table 6-10 summarizes the NFIP claims data for the Jurisdictions within Jefferson County

Table 6-10
NFIP Claims Statistics for Jurisdictions in DD7 and Unincorporated Jefferson County
(Source: FEMA NFIP query December, 2009, FEMA. NFIP - Flood Insurance Statistics)

COMMUNITY NAME	POLICIES IN FORCE	CLAIMS	CLAIMS PAYMENTS
GROVES, CITY OF	2,982	657	$5,836,686
NEDERLAND, CITY OF	2,961	839	$11,507,679
PORT ARTHUR, CITY OF	6,583	3,216	$51,478,104
PORT NECHES, CITY OF	2,468	404	$3,940,359
JEFFERSON COUNTY *	2,891	1,193	$43,031,454
TOTALS	17,885	6,309	$115,794,282

6.4.2.3 6.2.1 Flood Loss Estimates for 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. At the time the Plan was developed FEMA's database identifies 677 properties as repetitive loss properties in Jefferson County. Collectively, they had received claim payments of over $115 million (includes payments for building damage and contents damage). In 2004 FEMA replaced the Target Group property list with the Severe Repetitive Loss (SRL) program.

As part of the Plan a FEMA Bureaunet NFIP query was performed in November, 2011 to compile the most recent repetitive loss statistics for the planning area. The query results indicated there were 677 repetitive loss properties within Jefferson County. Of this total, 617 were categorized as residential properties and 60 were non-residential.

Using GIS the RL data for Jefferson County can be further broken down by eliminating the properties located outside of DD7. Using this approach, the number of repetitive loss properties is reduced to 373 (344 residential and 29 non-residential). Table 6-11 summarizes the residential and non-residential properties for each municipality within DD7.

Table 6-11
Summary of Residential and Non-Residential NFIP Repetitive Loss Statistics,
Jefferson County DD7, ordered by Municipality
(Source: FEMA NFIP query November, 2011)

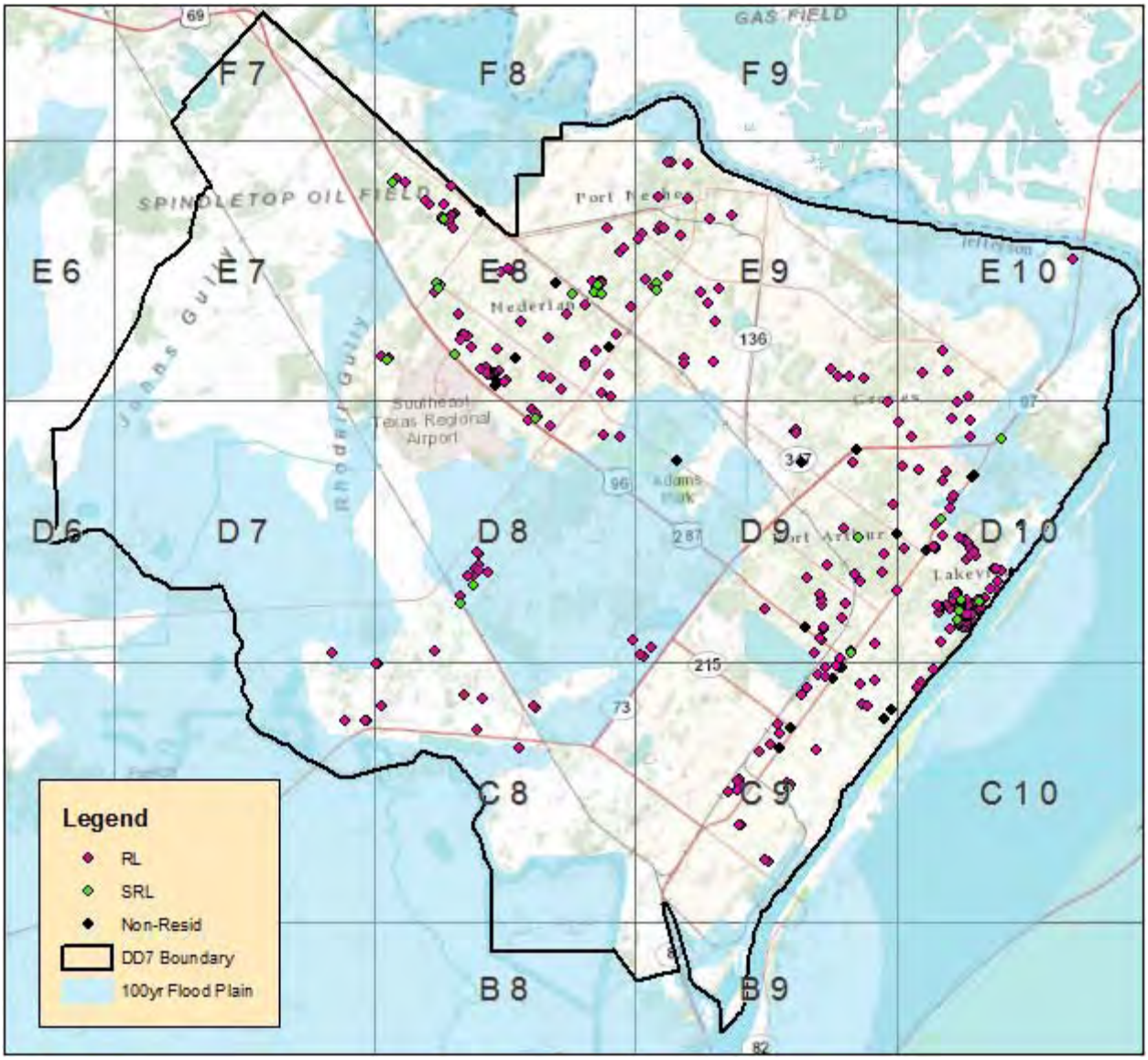
Community	# of Properties	Building Payments	Contents Payments	Total Paid	Number of Claims	Average Claim
CITY OF GROVES	26	$678,853	$164,921	$843,774	58	$14,548
JEFFERSON COUNTY *	33	$1,563,942	$531,196	$2,095,138	104	$20,146
TOWN OF LAKEVIEW	8	$107,225	$25,694	$132,919	16	$8,307
CITY OF NEDERLAND	74	$3,395,646	$1,044,685	$4,440,331	202	$21,982
CITY OF PORT ARTHUR	205	$8,087,408	$2,957,471	$11,044,879	508	$21,742
CITY OF PORT NECHES	27	$1,038,834	$314,012	$1,352,846	72	$18,790
Grand Total	373	$14,871,908	$5,037,979	$19,909,887	960	$20,739

Figure 6-5 is a map of the residential and non-residential RL properties located within Jefferson County Drainage District 7. The map also identifies severe repetitive loss (SRL) properties which are discussed later in this section.

Figure 6-5

Map of Repetitive Loss Properties and Severe Repetitive Loss Properties in Jefferson County DD7

(Sources: FEMA/NFIP, JSWA - GIS)



6.4.2.4 Residential Repetitive Loss Properties

As indicated below, it is estimated there are 344 Residential RL properties in Jefferson County DD7. Table 6-12 summarizes the RL claims data by municipality. The table shows that the residential RL properties are spread out all over the planning area. As of May, 2012, claim payments for all 344 properties totaled slightly less more than $16.4 million.

Table 6-12
Summary of Residential NFIP Repetitive Loss Statistics,
Jefferson County DD7, ordered by Municipality
(Source: FEMA NFIP query November, 2011)

Community	# of Properties	Building Payments	Contents Payments	Total Paid	Number of Claims	Average Claim
CITY OF GROVES	24	$509,124	$161,769	$670,893	54	$12,424
JEFFERSON COUNTY *	31	$1,512,708	$531,196	$2,043,904	100	$20,439
TOWN OF LAKEVIEW	8	$107,225	$25,694	$132,919	16	$8,307
CITY OF NEDERLAND	68	$3,009,449	$887,831	$3,897,280	182	$21,414
CITY OF PORT ARTHUR	187	$6,348,773	$2,191,815	$8,540,588	453	$18,853
CITY OF PORT NECHES	26	$862,277	$211,918	$1,074,195	68	$15,797
Grand Total	344	$12,349,556	$4,010,223	$16,359,779	873	$18,740

The RL claims can be further broken down from listing by municipality to focusing on individual street level data. Table 6-13 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 41 of the 181 individual streets in DD7 that include a repetitive loss property. 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 190 of the 344 residential RL properties estimated within Jefferson County DD7.

The table shows that for these 190 RL properties claim payments totaled approximately $12 million as of November, 2011. The data shows that the first street listed clearly is the road with the most repetitive loss properties in Jefferson County DD7. Address data about individual sites is omitted for reasons of confidentiality.

Table 6-13
Summary of Residential NFIP Repetitive Loss Statistics, Jefferson County DD7, ordered by number of Properties on Each Street
(Source: FEMA NFIP query November, 2011)

Street Name*	# of RL Properties	# of Claims	Total Paid
*****	15	42	$727,139
*****	13	42	$2,024,458
*****	11	28	$569,183
*****	11	22	$717,105
*****	11	26	$687,661
*****	10	24	$194,485
*****	9	24	$812,337
*****	9	18	$217,918
*****	6	16	$521,330
*****	6	12	$565,800
*****	6	13	$313,644
*****	5	11	$167,860
*****	5	14	$203,551
*****	5	11	$134,041
*****	4	8	$404,257
*****	4	8	$211,314
*****	4	8	$166,664
*****	4	15	$427,481
*****	4	10	$188,473

Street Name*	# of RL Properties	# of Claims	Total Paid
*****	3	10	$282,070
*****	3	10	$180,896
*****	3	7	$127,934
*****	3	6	$32,130
*****	3	11	$38,710
*****	3	6	$108,877
*****	3	6	$112,432
*****	3	7	$71,815
*****	3	8	$507,211
*****	3	7	$92,312
*****	3	11	$297,520
*****	3	8	$269,448
*****	3	9	$88,589
*****	3	17	$215,058
*****	3	7	$260,116
*****	3	6	$62,041
	190	488	$12,001,860

*street names were stared out for reasons of privacy

Figure 6-6 shows the locations of the residential repetitive loss properties in Jefferson County DD7. The map highlights the total number of residential repetitive loss flood insurance claims per property in DD7. The map shows that the residential RL properties in DD7 are mainly concentrated within the City of Port Arthur.

Figure 6-6
Number of NFIP Flood Insurance Claims Per Residential Repetitive Loss Property in Jefferson County DD7
(Source: FEMA/NFIP, Query November, 2011)

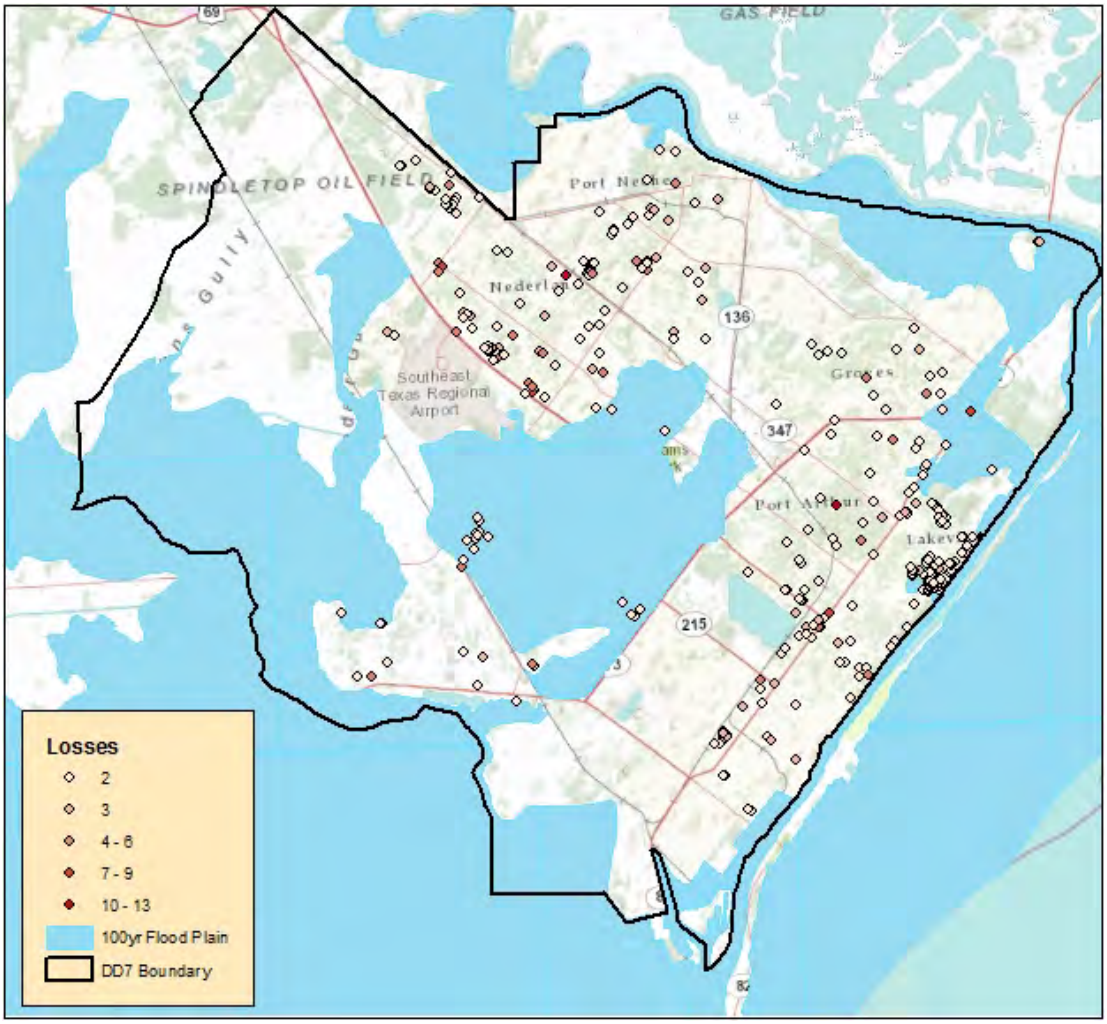
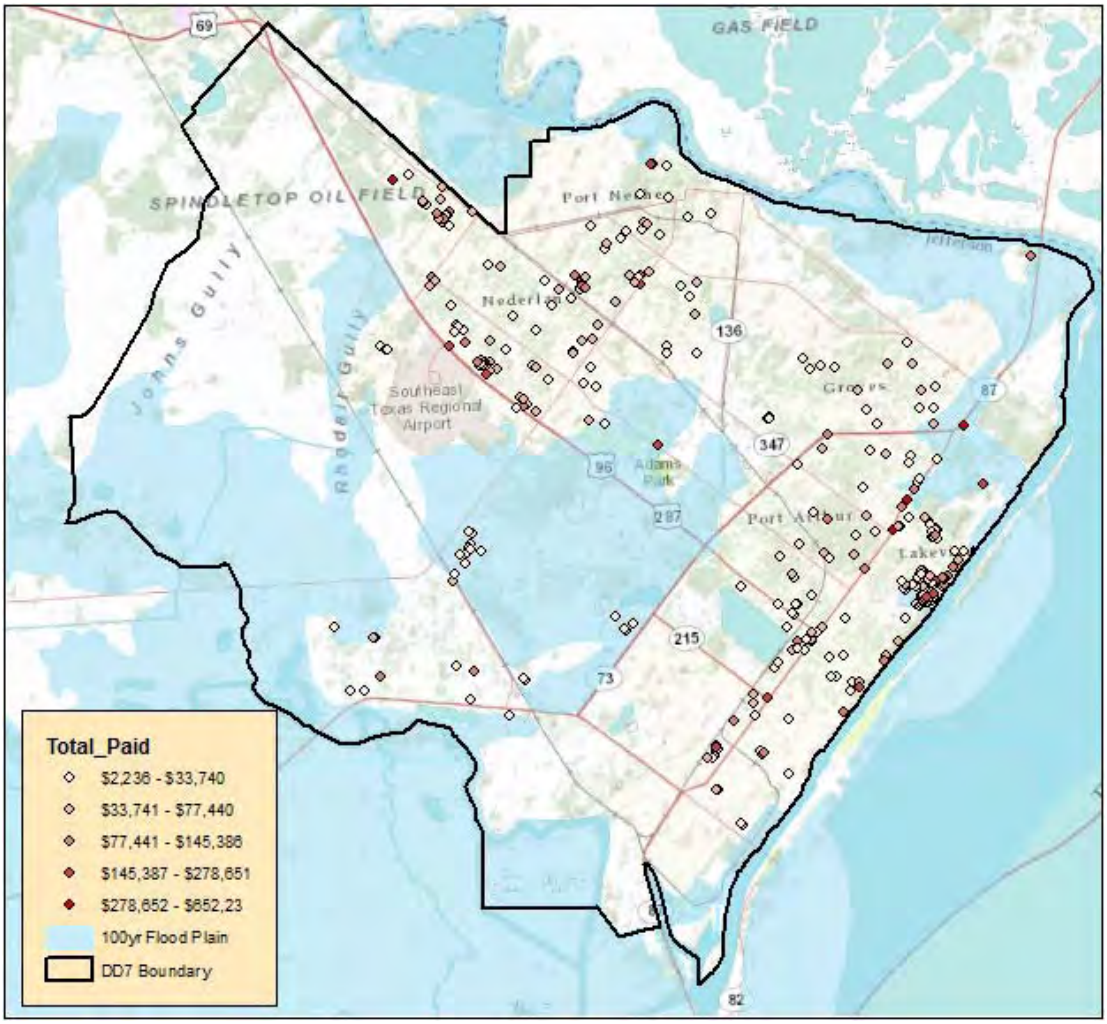


Figure 6-7 highlights the total value of residential repetitive loss flood insurance claims per property in DD7.

Figure 6-7
Value of NFIP Flood Insurance Claims Per Residential Repetitive Loss Property in Jefferson County DD7
(Source: FEMA/NFIP, Query November, 2011)



As mentioned above, the majority of the residential RL properties are located within the City of Port Arthur. The maps highlight the total value of claims made against residential repetitive loss structures.

6.4.2.5 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 was 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 recent query occurred between 1979 and the present, a period of 33 years. As shown in Table 6-14, there have been 960 claims in the 33-year period, for an average number of claims per year of 29. Based on a 100-year horizon and a present value coefficient of 14.27 (the coefficient for 100 years using the mandatory 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 6-14
Projected 100-year Flood Risk in Jefferson County DD7 Repetitive Loss Areas
(Source: FEMA NFIP query November, 2011)

Data	Value
Period in years	33
Number of claims	960
Average claims per year	29
Total value of claims	$19,909,887
Average value of claims per year	$603,330
Projected risk, 100-year horizon	$8,609,519

6.4.2.6 Non-Residential Repetitive Loss Properties

As noted earlier in this section, as of November, 2011, Jefferson County DD7 had an estimated 60 non-residential repetitive loss properties in the NFIP database. Table 6-15 provides a summary of non-residential repetitive loss claims for individual streets in Jefferson County with repetitive loss properties. 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.

The Table shows that first two Streets have the most non-residential repetitive loss properties in Jefferson County DD7. These streets have twelve and four repetitive loss properties respectively. The data also shows that these two streets rank highest in total paid claims (both building and contents combined) and number of past claims, indicating a significant history of flooding at these sites. The second street site on the list has the highest average claim value of $66,673.

Table 6-17
Summary of Non-Residential Repetitive Flood Loss Claims in Jefferson County DD7,
Ordered by Number of Properties on each Street
(Source: FEMA NFIP query November, 2011)

Street Name*	# of Properties	# of Losses	Total Paid	Average paid
*****	12	41	$1,833,629	$44,722.66
*****	4	22	$1,466,805	$66,672.95
*****	3	11	$297,520	$27,047.27
*****	2	4	$172,882	$43,220.5
*****	2	5	$289,610	$57,922
*****	2	7	$196,340	$28,048.57
*****	2	4	$63,550	$15,887.5

*street names were stared out for reasons of privacy

6.4.2.7 Flood Risk to Non-Residential Repetitive Loss Properties

As with the residential flood loss history, the past claims information can be used to project future flood losses, as shown in Table 6-18 below. The methodology is the same as what is described in the residential section. Results for properties with larger numbers of claims are more reliable. Streets with more seven or more claims were considered to have sufficient data to perform a risk assessment.

Table 6-18
Projected 100-year Flood Risk,
Non-Residential Repetitive Loss Properties in Jefferson County DD7
(Source: FEMA NFIP query November, 2011)

Street Name*	# of Claims	Total Paid	Average Paid Annually	100yr Risk
*****	41	$1,833,629	$55,564	$792,906

Street Name*	# of Claims	Total Paid	Average Paid Annually	100yr Risk
*****	22	$1,466,805	$44,448	$634,282
*****	11	$297,520	$9,016	$128,655
*****	7	$196,340	$5,950	$84,902

*street names were stared out for reasons of privacy

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 be 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, but for certain the properties along these four streets clearly have significant future flood risk based on the NFIP claims history. 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.

DD7 continues to evaluate both structural and non-structural solutions to the flood prone areas within DD7 – these areas include many properties on the NFIP repetitive loss property list.

6.4.3 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. 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. As of November, 2011 Jefferson County had 78 properties on the SRL list. Using the same GIS as the repetitive loss properties there are 26 SRL properties in DD7.

FEMA provided States with actuarial calculations of risk (maximum benefits of mitigation) for 30- and 100-year planning horizons, as part of States' initiation into the SRL grant program. The data provided by FEMA includes more details about claims histories at the policy level, but that information is not included here because of data confidentiality restrictions. The information can be obtained from DD7 on a need-to-know basis. Table 6-19 provides loss estimates for SRL properties in DD7 summarized at the street level, as calculated by FEMA and the NFIP. The 30 and 100-year FEMA calculations were unavailable. The table shows that within DD7, the first street listed has the highest number of SRL properties.

Table 6-19
FEMA NFIP Calculation of Potential 100yr Benefits
for Mitigating SRL Properties in Jefferson County DD7,
ordered by Number of Properties on each individual Street
(Source: FEMA/NFIP, Query November, 2011)

Street Name*	# of Properties	# of Claims	Total Paid	100yr Risk
*****	3	19	$1,187,146	$513,350.71
*****	2	7	$302,205	$130,680.77
*****	2	10	$216,200	$93,490.12
*****	2	12	$149,422	$64,613.70

*street names were stared out for reasons of privacy

The column labeled "100-year Risk" show the expected future losses over the planning horizon, for the streets in Jefferson County DD7 with SRL properties. As noted, the FEMA/NFIP calculations include these figures on the level of individual addresses and policies. It should be noted that the FEMA methodology does not express a complete range of potential risk (and benefits if the data is used in a Benefit-Cost Analysis (BCA) for a mitigation project), so individual properties should not be dropped from consideration for mitigation based solely on this calculation. More extensive risk assessment and benefit-cost analysis would include additional loss calculations that would likely increase the apparent risk along with the associated benefits of reducing or eliminating it.

The SRL properties can also be mapped to identify the floodprone areas of DD7. Figure 6-8 highlights the total number of NFIP severe repetitive loss flood insurance claims per property in Jefferson County DD7.

Figure 6-8
Number of NFIP Flood Insurance Claims Per Severe Repetitive Loss Property in Jefferson County DD7
(Source: FEMA/NFIP, Query November, 2011)

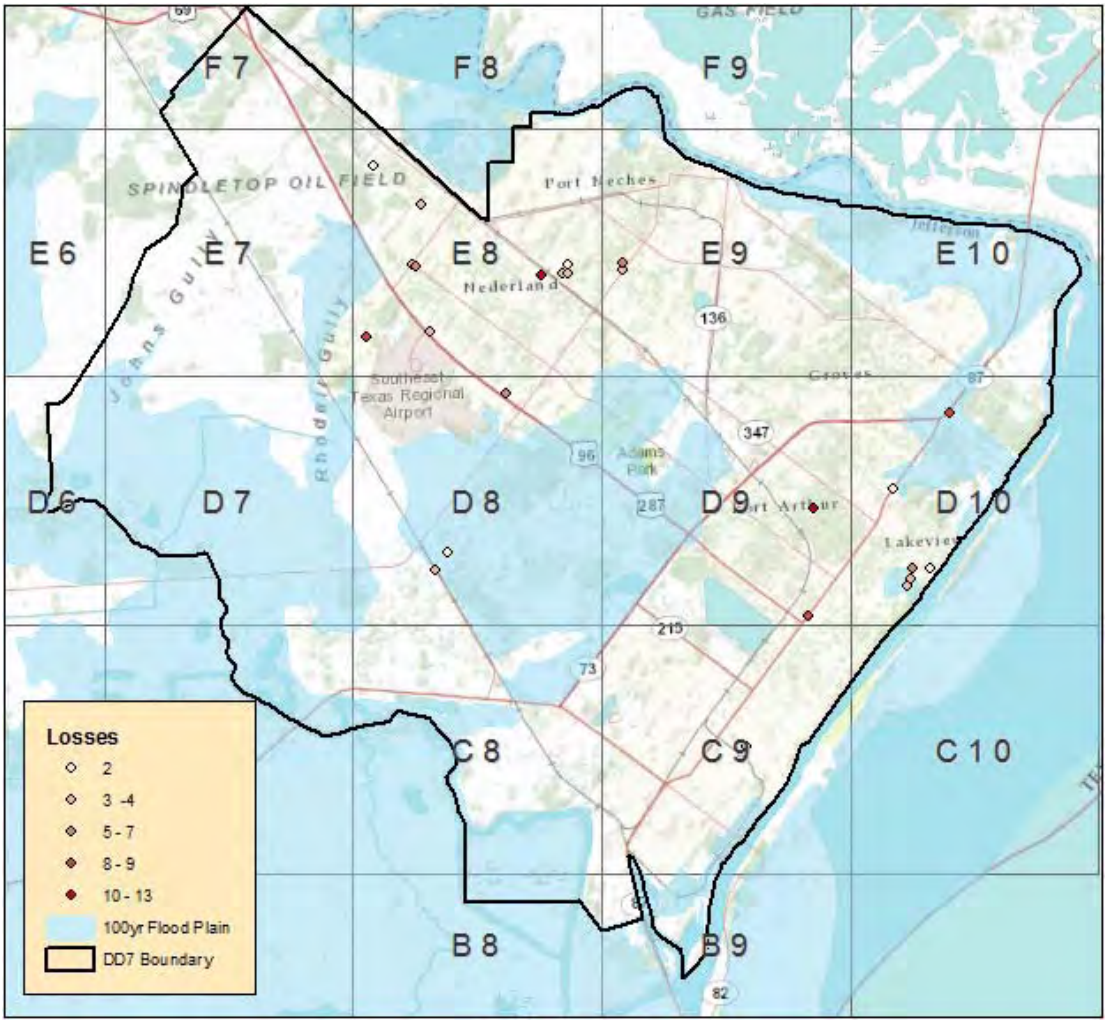
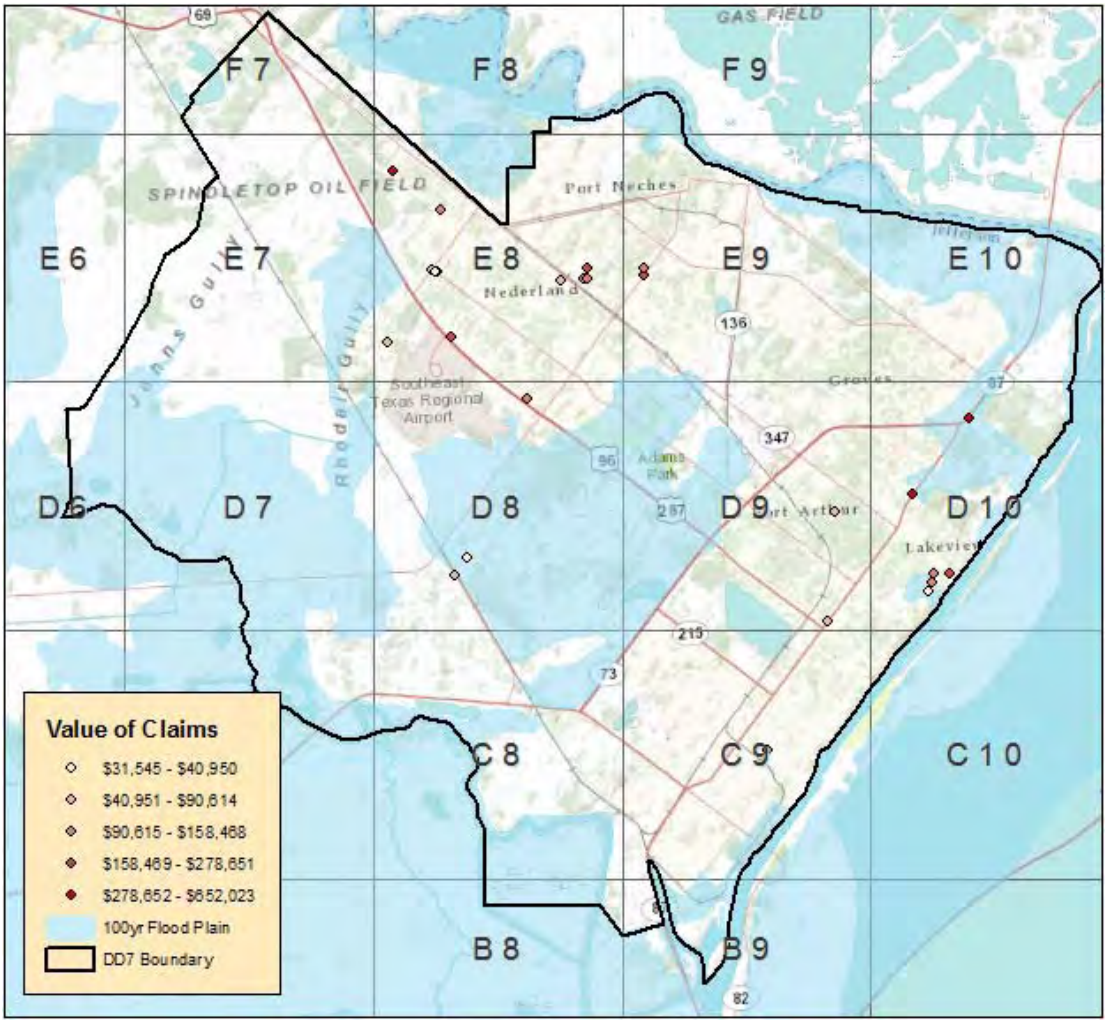


Figure 6-9 highlights the total value of SRL repetitive loss flood insurance claims per property in DD7.

Figure 6-9
Value of NFIP Flood Insurance Claims Per Severe Repetitive Loss Property in Jefferson County DD7
(Source: FEMA/NFIP, Query November, 2011)



6.4.4 Flood Risks – Public Buildings

District Owned Buildings. DD7 owns buildings throughout the planning area. These buildings are not located in the Special Flood Hazard Area and have never experienced flooding.

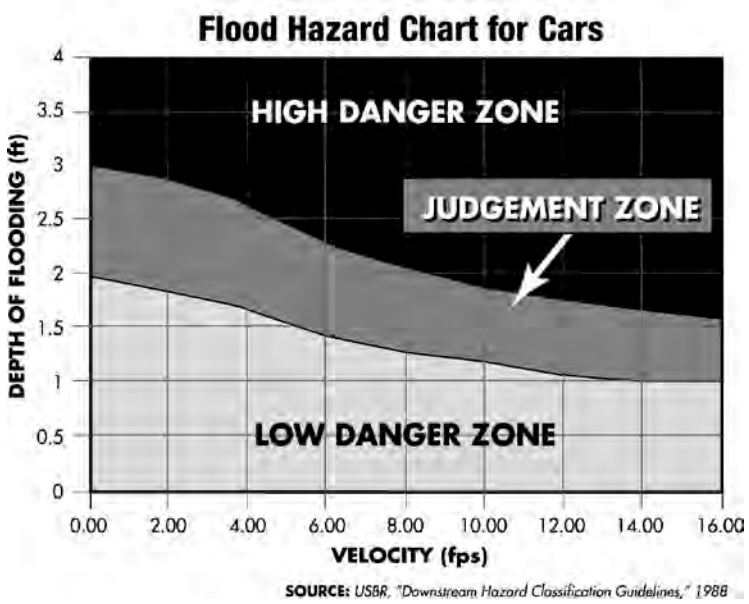
Public Schools. The Port Arthur Independent School District (PAISD) owns all of the areas 14 public schools. A review of the FIRM indicates none of these are in the mapped floodplain.

6.4.5 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.[29]

As illustrated in Figure 6-10, 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 6-10
Flood Hazard Chart for Cars
(Source: 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:

[29] Texas Environmental Center

Table 6-20
Length of Freeways Running Through Jefferson County

Name	Length in Feet	Length in Miles
HIGHWAY 73	109,783	21
TWIN CITY HIGHWAY	104,027	20
MEMORIAL BOULEVARD	48,268	9
Highway 366	47,633	9
Highway 365	46,595	9
MARTIN LUTHER KING JR DRIVE	45,355	9
HIGHWAY 69	44,173	8
W PORT ARTHUR ROAD (SPUR 93)	43,439	8
GULFWAY DRIVE (HIGHWAY 87)	41,857	8
Highway 87	39,005	7

Due to the extensive and common road flooding in DD7, 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, the TDOT 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.

6.4.6 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, increase 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 the 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.

6.4.7 Summary: Exposure to Flood Risks

As described in Section 5.3, digital maps of the floodplain are used for flood hazard identification and assessments of risk. The data, combined with the footprint information for buildings, allow determination of residents and assets of the built environment that are at risk only by identifying whether such assets are in or out of the flood hazard area. No other characterization of flood risk can be made, i.e., depth of flooding or whether houses are in the floodway or the flood fringe.

Table 6-21, based on a form provided in the State's Mitigation Handbook (DEM 21) is a summary of flood risks. For the purpose of this table, number of people per home is based on the U.S. Census value of 2.5 occupants per household for the City of Port Arthur and Jefferson County. Special facilities include fire stations and schools.

Table 6-21
State Mitiation Handbook - DEM 21:
Vulnerability and Risk Assessment Worksheet for the Flood Hazard

People/Property at Risk in the Floodplain	Total
People (estimate)	92,447
Housing Units	36,979 ($2.68B)
Commercial Facilities	4,054 ($947M)
District-Owned Buildings	7($2.4M)
Critical Facilities	0
Special Facilities (schools; fire stations)	0

6.4.8 Estimate of Annualized Damage from Floods

The following approach is used to estimate the potential total estimated annualized damages. From actual historical paid losses combined with historical knowledge of the total of uninsured losses, it is estimated that buildings within DD7 have experienced $18 million in flood losses. These losses occurred from April 1979 to 2011 and included 16 primary events (and several smaller, less costly events). The plan used NFIP repetitive loss and severe repetitive loss data to determine annualized damages and project 100-year risk from flooding.

6.5 Wind Hazard Overview

6.5.1 Introduction

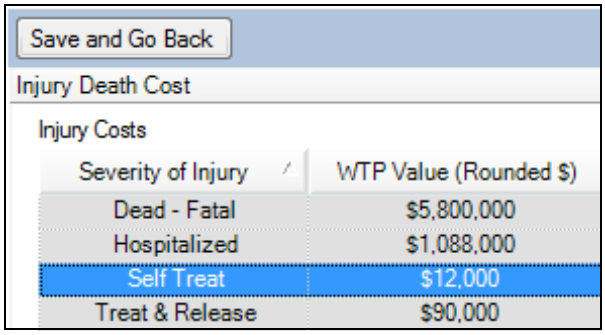
High Winds in this section include tornado winds, hurricane and tropical storm winds. While thunderstorm winds impact the area, the profile revealed that while events are likely to occur and do occur in District, their extent was limited and therefore had little impact on the district.

6.5.2 High Winds- Tornadoes

Relative to other parts of the nation, the overall tornado risk is moderate in Jefferson County DD7. The MPC determined that there is significant enough exposure to the tornado hazard to warrant a more detailed risk assessment to characterize the potential future losses. The calculation is done using FEMA's Benefit-Cost Analysis (BCA) software (version 4.5.5.0). It should be noted that this software was designed to assess risk at a single site or building, so the methodology must be adapted to reflect an assessment of an entire community. Furthermore, the software bases the risk calculation (and by extension, benefits, when risk is reduced) on avoided injuries and casualties, not damage to structures or loss of operations. These limitations mean that the results of the analysis should be regarded as a preliminary indication of potential life safety risk, based on very basic inputs. Evaluation of specific mitigation alternatives requires technical information that was not available for this version of the plan.

The FEMA BCA analysis methodology and tornado element of the software are based entirely on avoided injuries and fatalities (Table 6-22). The calculation is based on the population or occupancy at risk rather than the square footage or value of buildings or functions. The software uses default values for various levels of injury related to tornadoes. These values are shown in Figure 6-11 and include $5.8 million for death and $1.088 million for injuries requiring hospitalization.

Figure 6-11
Injury and Death Costs (FEMA Benefit-Cost Analysis [BCAR] Tool, Version 4.5.5.0)



6.5.3 Tornado Risk – Public Assets

The tornado risk assessment for Jefferson County Drainage District Seven (DD7) was completed for all seven buildings owned by the District. It should be noted the district runs 24 pumping stations for which

this analysis is not run. The analysis was completed based on data provided by DD7 and entered into the tornado module of the FEMA BCAR software. Table 6-22 below summarizes the data inputs.

Table 6-22
DD7 Tornado Risk Assessment - Project Information
(Source: FEMA BCA Software, Version 4.5.5.0)

Data	Value
Loss estimation horizon (years)	100
Zip Code used (Administrative Office)	77640, 77642
Assumed structure design wind speeds (mph) of safe room	200
Structure type	Various
Occupancy Percentage	
Day	100%
Evening	25%
Night	5%

The software then uses these inputs to calculate the expected loss of life and number of injuries for tornado classes EF0 to EF5. The FEMA software used for assessing tornado risk is based exclusively on life safety, so there is a strong correlation between the occupancy of a facility and the risk. Based on the number of total occupants, the software calculates the population on site based on statistics related to the probabilities of tornadoes impacting the building, by time of day. Table 6-23 shows the summary of benefits from the tornado risk assessment. The Table includes the annual and 100-year risk for each building and indicates the Machine Shop has the highest 100-year risk. This facility has a 100-year risk of $36,731.

Table 6-23
Estimated Tornado Risk to District Owned Public Facilities, 100 year Planning Horizon
(Source: FEMA BCA Software [BCAR], Version 4.5.5.0)

Facility Description	Occupancy	Annual Risk	100-year Risk
Office	20	$2,060	$29,396
Warehouse	15	$1,545	$22,047

Facility Description	Occupancy	Annual Risk	100-year Risk
Mech. Shop	25	$2,574	$36,731
Elec. Shop	10	$1,030	$14,698
Vehicle Shed	10	$1,030	$14,698
Meeting Room	10	$1,030	$14,698
Control Center	10	$1,906	$27,199

6.5.4 Hurricane and Tropical Storm Wind Risk in Jefferson County DD7

Jefferson County DD7 is located close enough to the Gulf Coast that high winds from hurricanes and tropical cyclones present significant risks to private and public assets and operations. This subsection presents the results of wind loss estimations for District assets that were completed with the FEMA benefit-cost analysis software (BCAR). Although this software is specifically intended to assess mitigation projects, it is possible to use it to estimate losses (risk), when sufficient data is available. It should be clearly understood that these results are general, and any site-specific risk assessment or mitigation project proposal should be analyzed in more detail, using additional details about structural characteristics, physical surroundings, and occupancies.

As part of the 2012 HMP, the District provided information about its facilities, including area, occupancy and structure type. Jefferson County DD7 owns a total of thirty four facilities, seven main buildings and 24 pumping stations. To calculate future losses, the analysis uses information about District assets in conjunction with open-source hazard data and FEMA software. The section below describes the methodologies and results. It was necessary to estimate some data parameters for the calculations that are summarized below. These inputs were used to calibrate the software model. Selected data inputs are shown in Table 6-24 below.

Table 6-24
Jefferson County DD7 Hurricane and Tropical Storm Wind Data Parameters
(FEMA Benefit-Cost Analysis [BCAR] Tool, Version 4.5.5.0)

Data	Value
Loss estimation (planning) horizon (years)	100
Displacement Costs ($/s.f./month)	$1.44
Zip code	77642

Data	Value
Exposure (urban and dense suburban or open)	Urban and dense suburban
Assumed wind debris source	Residential/commercial mix
Demolition threshold	50% (default)

The zip code 77642 for the DD7 Administration Office was entered into the BC module to identify the wind speeds for each of the recurrence intervals identified in Table 6-25, which shows the wind hazard profile for DD7.

Table 6-25
Hurricane Wind Speed (3 second gusts) Recurrence Intervals at Port Arthur, Texas
(FEMA Benefit-Cost Analysis [BCAR] Tool, Version 4.5.5.0)

HURRICANE WIND - WIND SPEED

Wind Gust (3 seconds) (mph)

Recurrence Interval (yr)	Default Wind Speed (mph)
10	64
20	83
50	105
100	117
200	128
500	139
1000	146

Table 6-26 summarizes the abbreviations for FEMA HAZUS-based structure and contents damage functions, which determine the extent of damage when structures are exposed to wind forces of various magnitudes.

Table 6-26
Abbreviations for HAZUS Structure Types
(FEMA Benefit-Cost Analysis Tool, Version 4.5.5.0)

HAZUS Structure Type	Abbreviation
Masonry, engineered commercial building, low-rise (1-2 stories)	MECBL
Steel, pre-engineered metal building, Medium	SPMBM
Steel, pre-engineered metal building, Small	SPMBS

Table 6-27 summarizes the hurricane and tropical storm wind risk to public assets for Jefferson County DD7, based on the methodologies and inputs described above. The Table shows that the Administrative office has the highest 100-year risk. This building has a 100-year risk of $27,054.

Table 6-27
Estimated Hurricane Wind Risk to DD7 Public Assets, ordered by 100-Year Risk
(Source: FEMA BCA Software [BCAR], Version 4.5.5.0)

Facility Description	HAZUS Type	Area (s.f.)	Building Replacement Value	Annual Risk	100-year Risk
Office	MECBL	3,407	$556,602	$1,896	$27,054
Warehouse	SPMBM	4,911	$538,493	$1,244	$17,751
Mech. Shop	SPMBL	6,487	$454,596	$1,451	$20,705
Elec. Shop	SPMBS	1,600	$93,547	$608	$8,676
Vehicle Shed	SPMBM	4,061	$245,879	$1,597	$22,788
Meeting Room	SPMBS	2,400	$121,724	$791	$11,287
Control Center	MECBL	2,093	$416,543	$1,701	$24,272
Total			$2,427,384	9,288	132,533

Again, it should be noted that these loss estimates are intended only as an initial assessment, for the purpose of allowing the District to determine priorities for additional study and/or mitigation actions

6.5.5 Summary: Exposure to High Winds from Tornadoes, Hurricanes and Tropical Storms

DD7 only has authority to mitigate its own buildings with the high winds from tornadoes, hurricanes and tropical storms. Table 6-27 shows that the Administrative office has the highest 100-year risk. This building has a 100-year risk of $27,054. However, all seven buildings have a 100 year risk of $132,533.

7 Section 7 – District Processes and Capability to Address Hazards

7.1 Organization of Jefferson County Drainage District No. Seven

Jefferson County Drainage District No. Seven (DD7) is a conservation and reclamation district and a political subdivision of the State of Texas. DD7 was voted on and organized by Jefferson County Court in February 1946.

In November of 1961 the consolidation of Jefferson County Drainage District No. 4 with Jefferson County Drainage District No. 7 was put to a general election in which consolidation of the two districts was voted in. On November 27, 1961 Jefferson County Drainage District No. 7 assumed the responsibility for the operations of Jefferson County Drainage District No. 4.

Containing approximately 107.5 square miles, DD7 lies within Jefferson County and includes the Port Arthur, Port Neches, Groves and Nederland. DD7 is governed by a five member Board of Commissioners that are elected to four-year terms.

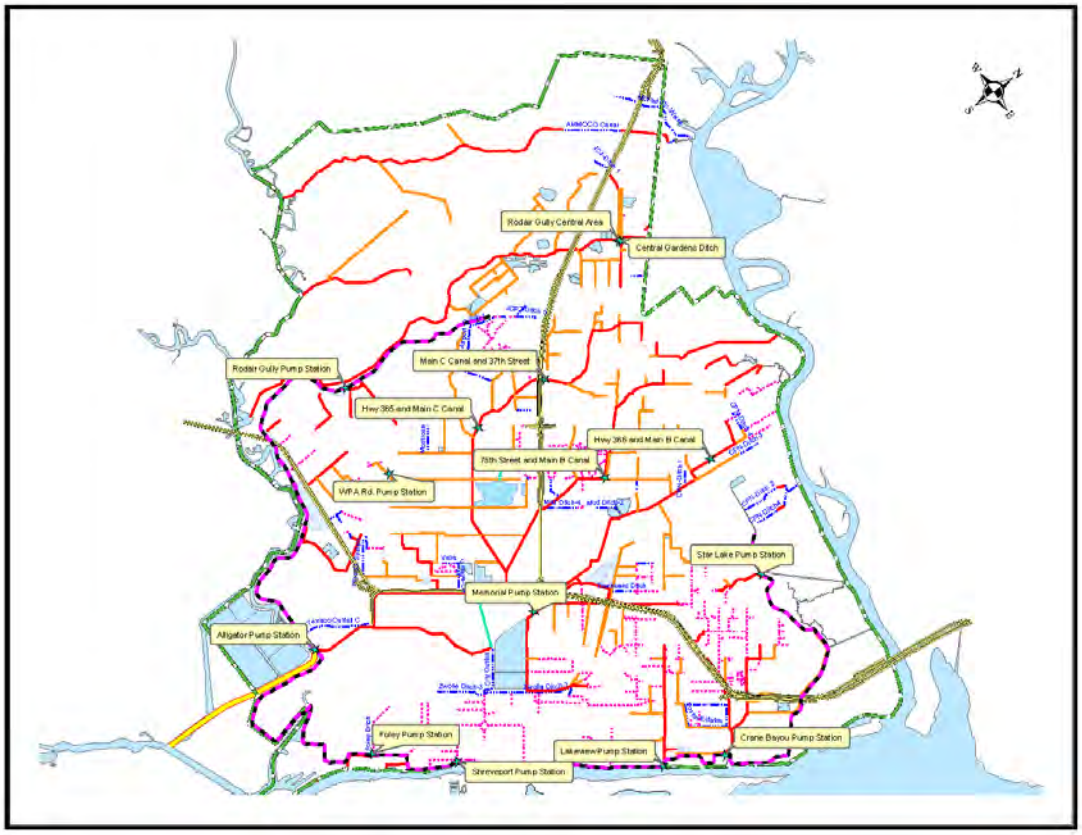
The Administrative Staff is responsible for the day-to-day operations of the District under the policies set by the Board of Commissioners. The Administrative Staff is led by a Manager who oversees a staff of 75 who work throughout the District to operate and maintain its system of 20 pump stations, 36 miles of hurricane levee and 281 miles of outfall canals.

7.2 Emergency Response

Emergency response is the responsibility of the incorporated Cities and Jefferson County. The Cities owns and maintain several roadside ditches, however DD7 owns the majority of ditches within DD7 and are responsible for routine maintenance. After an event, it is a cooperative effort between the Cities, County, and DD7 to identify 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 over 20 staff gauges at each of the pump station intake bays. See Figure 7-1 for stream gauge locations as of January 2012.

Figure 7-1
Jefferson County DD7 Network of Stream Gauges
(Source: Jefferson County DD7 –Rainfall and Elevation Information)



The Cities and County use a system called Southeast Texas Alerting Network (STAN) for community and emergency notification. Recorded alert messages are placed on this system, the media is automatically notified, they inform the public as to the specifics of the alert and give the public the toll free STAN number to call and hear the original recorded message, if they so desire.

The Cities also use a system called 1st call, which is an automated system that will call a preset phone tree to inform residents of impending danger from a hazard. DD7 assists both the City and County in emergency response and post-event cleanup as requested.

7.3 Communicating about Hazards

DD7 actively communicates with residents using a variety of media, each of which has been used to convey information, including content about hazards.

DD7 has a web site that has hazard related data on it.

DD7 holds monthly board meeting that provide information to the public on the work being done to support flood mitigation efforts.

DD7 receives and responds to phone calls from public.

Southeast Texas Alerting Network (STAN) is used to communicate to public before, during, and after an event. Emergency Management posts a recorded message on STAN that is distributed to local news (TV and radio) with a highlight of the message and a number to call for additional information.

Radio stations that carry STAN related broadcasts are KLVI and AM 530 – residents are used to tuning in to the radio to get hazard information.

Jefferson County and DD7 have FEMA publications about flood hazards.

There are seven TXDOT message boards on major highways that alert residents to local hazards.

DD7 attends community meetings upon request.

Survey about Communication with Residents

In 2004 Harris Davil & Associates completed a communication study that showed 85% of the public expected to be notified of impending or ongoing hazards by TV and Radio

7.4 How DD7 Addresses Hazards

As part of the Plan development, members of the Mitigation Planning Committee (MPC) were interviewed to gain an understanding of awareness of hazards and how they are addressed, and to gather information about damage associated with past hazard events. During Hurricanes Rita and Ike, DD7 worked with the Counties and Cities to assess damages to various drainage facilities (e.g. detention basins, channels), clear debris from the drainage facilities to prevent additional flooding and repair the facilities. While there are several hazards that impact Jefferson County, DD7's jurisdiction is over flood and wind hazards that cause flooding issues. Therefore, DD7 works with the communities to identify potential flood issues and works to address those issues with proper drainage solutions.

7.4.1 Local Regulation of Development

In June, 2003 Drainage districts within the State of Texas were granted additional authority via Chapter 49.211 of the Texas Water Code and House Bill 919. Specifically Chapter 49.211 of the Texas Water Code required districts to adopt master plans before they can adopt rules relating to review and approval of proposed development drainage plans. DD7 prepared their Master Drainage Plan in 2002. Further, HB 919 granted districts the authority to require developers to submit drainage plans for approval during the platting process. While DD7 has not completed the process required by HB 919 to gain that authority, if the development is directly entering the DD7 system, DD7 requires a permit. The Cities within the DD7

planning area, as well as the County for the unincorporated parts of the County that is under DD7's planning authority, usually include DD7 in their approval process as a courtesy to prevent any negative impacts to the DD7 systems. .

DD7 implements its authority to manage drainage in order to protect lives and property from the adverse effects of uncontrolled drainage and flooding. DD7 was created primarily to provide drainage of overflow lands, including the construction and maintenance of drains, pump stations, ditches and levees, and other drainage related improvements. The Master Plan objectives were:

A. Develop a GIS system containing information gathered during the course of this study

B. Develop a hydraulic model of each water course investigated to simulate the resulting water surface profiles utilizing the flows developed from the hydrologic analysis

C. Develop a hydraulic model of each water course investigated to simulate the resulting water surface profiles utilizing the flows developed from the hydrologic analysis

D. Develop a flood control plan based on existing conditions and on 5 and 20 year projections. The selected flood control alternatives will address problem areas within the DD7 system and will provide preliminary design parameters and estimated costs for use in project prioritization, planning, and budgeting.

According to Jefferson County's Environmental Control Department, a total 2,063 building permits were issued between January 1, 2005 and March 1, 2011. Table 7-1 provides a breakdown of the number and type of permits issued.

Table 7-1
Number and Type of Permit issued by the Jefferson County Environmental Control Department

Type of Permit Issued	Number of Permits Issued
Barn	100
Business	224
FEMA Trailer	54
Hurricane/Tropical Storm Renovations	212
Improvement ≥ 50% of Home Value	100
Mobile or Manufactured Homes	474

Type of Permit Issued	Number of Permits Issued
New Homes	570
Not new home moved onto property	33
Storage	237
Water Only	59
TOTAL	2,063

30

7.4.2 Wind Hazards

As part of its rules for regulating growth, incorporated areas within in DD7 and Jefferson County recognize the importance of certain measures to limit damage and exposure of citizens to hazards other than flooding.

High Wind Hazards. Jefferson County is located in the area of the State in which the Texas Windstorm Insurance Association functions as the insurer of last resort for wind and hail coverage when other insurers exclude coverage for those perils from homeowners and other property policies. In order for new construction or modifications to existing structures to qualify, inspections must be performed by inspectors from the Texas Department of Insurance or licensed professional engineers who are appointed by the Department. Several inspections may be performed to determine compliance with the wind provisions of the buildings code, and a certificate of compliance is issued.

7.4.3 Flood Hazards

Jefferson County administers a s uite of regulations and ordinances that combine to comprehensively regulate flood hazard areas to minimize exposure of people and property. Administration of these provisions is the joint responsibility of the City's Floodplain Manager and the Building Code Official. Within Jefferson County, these ordinances are administered within the engineering department.

Processing Floodplain Development Proposals. Most homes built in the floodplain are slab-on-grade, elevated by the placement of a minimum quantity of fill. E levation Certificates are required for all

[30] Jefferson County Environmental Control Department and the Jefferson County 2011 Hazard Mitigation Plan Update.

construction in the floodplain. Within unincorporated Jefferson County, regulations require the lowest floor, including basement, be at least one foot above the Base Flood Elevation.

Reviewing and Approving Subdivisions. If a development is directly impacting or entering the DD7 system, DD7 requires a permit. The incorporated Cities within the DD7 planning area and Jefferson County also include DD7 in their approval process to ensure no negative impacts to the system.

City of Port Arthur, Nederland, Port Neches and Groves – Stormwater and Capital Improvement Plans and Permitting

The incorporated cities within the DD7 jurisdiction all participate in the Jefferson County Hazard Mitigation Plan. Groves has a master plan for drainage (Texas Comprehensive Plan 1973-1993), has a capital improvement three year plan and operates under the Southern Standing, International Residential and Building Efficiency Building Codes. Permits are issued for construction and inspections are done by a city building official and regulations require the lowest floor be at least one foot above the Base Flood Elevation.

Nederland uses a master drainage plan completed in 1982, has a five year capital improvement program, and operates under the South Building Code, International Fire Prevention and Building Code and the International Property Maintenance Code and the International Residential Code. The City Building official enforces the codes and provides the permits. Nederland adopted a floodplain ordinance, 307, that regulates development in the floodplain and permitting authority in the floodplain to the City's Floodplain Administrator.

Port Neches uses a master drainage plan completed in 1982, has a five year capital improvement program, and operates under the South Building Code, International Fire Prevention and Building Code and the International Property Maintenance Code and the International Residential Code. The City Building official enforces the codes and provides the permits. Port Neches does not have floodplain ordinances because the city is not in the floodplain. The only reason that an elevation certificate is needed is for discounts on flood insurance.

Port Arthur has a Master Drainage Plan that was approved in 1982, a comprehensive plan developed in 1989, has adopted the 2006 International Building Codes and the 2000 International Fire Codes. Port Arthur adopted updated floodplain ordinances in the fall of 2010. Contractors who are building in Zone AH of the floodplain are required to complete a TB-10 to certify that a drainage plan has been completed prior to construction and shows that structures are built above base flood elevation. Port Arthur had a Community Assistance Visit (CAV) in 2003 and received the report but has not had a CAV since.

Jefferson County – Subdivision Review and Approval

Within Jefferson County, subdivisions are regulated via "rules, regulations, and requirements relating to the approval and acceptance of improvements in subdivisions or re-subdivisions." Revised March 28, 1994". Some relevant references from this ordinance include:

- Article 1(b): Approval and acceptance of streets, roads, storm sewers, drainage ditches and drainage easements, fresh water supply and sanitary sewage disposal and setback lines of a subdivision or re-subdivision is contingent upon compliance.

- Article 1(b): Compliance is required in the extraterritorial jurisdiction of any incorporated city, town or village; in the case of conflict, the regulations of the city, town or village shall prevail. The width of the ETJ varies as a function of the population of the municipality.

- Article 1(k): Developer required to submit elevations of each lot.

- Article 1(n): D eveloper required to obtain approval of drainage plan from applicable Drainage District and shall submit approval with plat, said plan must comply with the Jefferson County Floodplain Order.

- Article 1(q): R equires compliance with State requirements for on-site sewage facilities; planning materials that must be submitted include the "100-year floodplain map." As part of this requirement, states that "A comprehensive drainage and 100-year floodplain impact plan must also be included in this planning material.

7.5 Future Development Trends in Jefferson County

To identify future development trends in Jefferson County, DD7 reviewed the Jefferson County Comprehensive Plan, reviewed the population changes from 2000 to 2010(1% increase) and reviewed permit requests (total new building request for six year period was 570, averaging about 95 a year), there is not a tremendous amount of projected growth for the County.

While DD7 works with the Counties and incorporated Cities to review subdivision proposals and participates, when asked, in any other type of review or land development process when it impacts the floodplain or the watershed, their jurisdiction authority applies only to floods.

DD7, Jefferson County and the incorporated Cities within the County closely coordinate permitting and development in the floodplain. Both the Cities and the County require elevations of new construction above FEMA minimum requirement of first floor elevations at BFE. For this reason, vulnerability to future buildings, infrastructure, and critical facilities (relative to DD7's jurisdictional authority limited to flood mitigation), is low. DD7 has no plans to construct infrastructure or facilities in the floodplain, in floodprone areas, or in any other area that would be unduly, negatively impacted by any other natural hazard

7.6 Continued Compliance with the NFIP

Participation in the National Flood Insurance Program (NFIP) is important to Jefferson County and their residents. This is evidenced by DD7, the incorporated Cities, 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 County, with support from DD7, are firmly committed to continued compliance with the NFIP.

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.

7.6.1 Prior Actions Related to NFIP Compliance

Regulations Review. In 2005, a review of the Jefferson County's floodplain regulations and subdivision standards was prepared. The review was performed to ensure continued compliance with the NFIP and to identify opportunities to clarify regulatory language. The regulations were considered consistent with the NFIP. The findings suggested the following:

Jefferson County Ordinance Reviews - *Jefferson County*

A review of the County's Flood Damage Prevention Order (August 5, 2002) and Rules, Regulations and Requirements Relating to the Approval and Acceptance of Improvements in Subdivisions and Re-Subdivisions (revised March 28, 1994) was prepared and County staff were interviewed. Please note: separate action was used to adopt the County's 12" freeboard requirement. The review, on file with DD7, was performed to ensure continued compliance with the NFIP and to identify opportunities to clarify regulatory language. The regulations are consistent with the NFIP. The findings suggest the following:

- Minor revisions could add missing definitions, remove unused definitions, and improve consistency with the NFIP regulations in a small number of instances.
- Minor revisions to provisions dealing with substantial improvement will improve consistency.
- Provisions related to enclosures under elevated buildings in areas other than V Zones should be added, in the event extended foundation walls (crawlspace) are used to achieve elevation.
- Enclosures below the elevated floor currently are not allowed to be habitable floors. The definition of habitable floor is not consistent with the NFIP's use restrictions for enclosures (which may be used only for parking, building access and limited storage).

Community Assistance Visit (CAV). Jefferson County had CAVs in 2002 and 2003 respectively. The City's CAV, conducted in 2003 found the City to be in continued compliance with the NFIP. The County's CAV, conducted in 2002, also found the County to be in continued compliance with the NFIP.

The Community Rating System (CRS). The review of the floodplain regulations also served to identify measures adopted by the City of Beaumont and Jefferson County that may qualify for credit under the NFIP's Community Rating System (CRS). The CRS is intended to recognize and encourage management of flood hazard areas above the minimum requirements of the NFIP. The CRS offers discounts on the cost of federal flood insurance to those citizens who reside within recognized communities.

Nationwide, the average NFIP premium for $100,000 in coverage property in A Zones and AE Zones is on the order of $500. Thus, in communities with a 5% CRS discount, policyholders see, on average, annual savings of $25. The cost of the average B, C, and X Zone policy is $150; thus policyholder savings in

these zones outside of the 100-year floodplain would be only $7.50 per year. Regardless of the CRS discount available in A and AE Zones, which goes up in 5-percent increments, the discount on B, C, and X Zones is capped at 5%.

For the Jefferson County residents, cost savings due to the CRS discount can be estimated. It is important to note that the total number of flood insurance policies exceeds the number of buildings within the mapped flood hazard area. Therefore, for the purpose of this estimate, a CRS discount of only 5% is assumed to apply to all policies. As of December 2011, the NFIP reports that 18,299 flood insurance policies are in force (6,745 in Port Arthur, 2,512 in Port Neches, 3,007 in Nederland, 3,012 in Groves and 3,023 in Jefferson County and policyholders pay slightly more than $8 million per year in premiums. Therefore, a 5% discount would yield a total savings for property owners of about $400,000 each year.

7.6.2 Future Actions Related to NFIP Compliance

As mentioned at the beginning of this Section, Jefferson County 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 cities and Jefferson County. With this in mind, DD7 did not identify and prioritize NFIP actions as part of the Plan update process. DD7 will continue to work closely with the incorporated cities and Jefferson County to identify and recommend actions that will ensure continued compliance with the NFIP.

7.7 Ongoing and Previous Mitigation Initiatives

Dealing with flood hazards, the most significant natural hazard in the Jefferson County area, is not a new proposition. Indeed, DD7 has spent considerable funds for projects and studies to reduce and/or eliminate the severity of flooding in the area.

7.7.1 Alligator Bayou Pump Station

In 2009, Jefferson County Drainage District No. Seven (DD7) received a Hazard Mitigation Grant Program (HMGP) grant for the construction of additional pumps at the Alligator Bayou Pump Station for $18,348,750.00.

From the Master Drainage Study completed in 2002, the study found that if the County could increase the pumping capacity of Alligator Bayou Pump Station 16 (PS 16), it could greatly reduce flooding issues as the additional pumps could provide enough pumping capacity to handle a 25 year storm in the contributing drainage areas. As Alligator Bayou is one of the main components of DD7's drainage system serving the Cities of Port Arthur, Port Neches, Groves , Nederland and parts of unincorporated Jefferson County, this project would further protect these areas from future.

EXISTING AND NEW PROJECTS: Status of projects as of 2012. These projects were funded through the general maintenance fund unless otherwise noted.

7.7.2 Rodair Gully Main Channel and Culvert Crossings –

This project is ongoing.

7.7.3 Rodair Gully Laterals 3 and 3A and Improve Culverts.

The District received a Disaster Relief Emergency Fund (DREF) grant for this project and it is ongoing.

7.7.4 Main B Ditch

This project is ongoing.

7.7.5 Pear Ridge Main 1 and Lateral 3

This project has been completed and cost approximately $500,000.

7.7.6 Improve Channel Capacity and culvert crossings in Central Gardens Outfall

This project has been completed and cost approximately $1,500,000.

7.7.7 Improve two culvert crossings in Star Lake Ditch

This project has not yet started.

7.7.8 Improve 25th Street Crossing in Lateral 2 of the Crane Bayou System

This project has not yet started.

7.7.9 Improvements Recommended along Drainage Lateral A3A from A3B Confluence to the railroad track of Hogaboom Road

This project is nearing completion and cost approximately $1,000,000.

7.7.10 Improve channel and crossings from Lateral 1 and Airport Viterbo 1 for the Main C System

This project has been completed and cost approximately $1,000,000.

7.7.11 Improve channel and crossings from Main C Loop to Hardy Avenue

This project has been completed and cost approximately $1,000,000.

7.7.12 Improve channel and crossings from the GSU ROW to Main C Loop Confluence

This project has been completed and cost approximately $2,000,000 for all of Main C project including confluence and system.

7.7.13 Improve channel and crossings from the HWY 347 to GSU ROW for Main B System

This project has been completed and cost $_____.

7.7.14 Channel Improvement of Orchard Street Ditch

This project has been completed and cost approximately $10,000.

7.7.15 Crossing Improvements at Avenue B, Avenue F, GSU ROW and Avenue H; channel improvements for Nederland Avenue to the Main B/B5 confluence

This project has been completed and cost approximately $425,000.

7.7.16 7.7.16 Increase channel capacity and improve multiple culvert crossings of Blocks Bayou

This project has not yet started.

7.7.17 Improve channel capacity and improve multiple culvert crossings of Pure Oil Ditch from Station 57 and 30 to Station 84 and 35

This project has not yet started.

7.7.18 Other Federal Funding

In addition to the HMGP grant for the Alligator Bayou project from Hurricane Ike, DD7 has received a planning grant from TWDB to prepare a HMGP Plan for the District from FMA funds. DD7 also received a GLO grant (DREF) for Main B Ditch Diversion project.

7.7.19 Public-Private Partnerships

DD7 has not formed any public-private partnerships that are related to natural hazards and hazard mitigation. This was re-verified as part of the Plan update and confirmed that DD7 has still not formed any public-private partnerships.

7.8 Natural Resources

Jefferson County requires applicants that propose to impact wetlands to obtain approvals from the U.S. Army Corps of Engineers. In addition, DD7 obtains Corps permits for construction activities that impact wetlands.

8 Section 8 - Mitigation Actions

8.1 IFR Requirements for Mitigation Strategy

IFR §201.6(c)(3): The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

IFR §201.6(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

IFR §201.6(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

IFR §201.6(c)(3) (iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

8.2 Identifying Priority Actions

Throughout the planning process, the MPC discussed hazards and the number of people and types of property that are exposed to these hazards.

As part of the planning process, factors that influenced prioritizing included the Committee's review of available information on flood and wind hazards, past hazard events, the number of people and types of property exposed to those hazards and the elements of the development approval process. High priority was placed on those actions that are considered consistent with current District policies, those that are technically feasible and have high political and social acceptance, and those that can be achieved using existing authorities, budget levels, staff and is cost beneficial.

As part of the planning process, the mitigation action items were established to achieve the goals discussed in Section 4.2, DD7's Mitigation Goals. Each action item identifies an appropriate lead agency, cost effectiveness, a schedule for completion and suggested funding sources. The MPC chose the STAPLEE methodology to prioritize mitigation actions. STAPLEE assesses actions based on six general criteria: Social, Technical, Administrative, Political, Legal, Economic, and Environmental. Table 8-1 describes the criteria used in the STAPLEE methodology.

Table 8-1
STAPLEE Methodology Criteria

STAPLEE	Criteria Explanation
S – Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
T – Technical	Mitigation actions are technically most effective if they provide long- term reduction of losses and have minimal secondary adverse impacts.
A – Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
P – Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
L – Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
E – Economic	Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
E - Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, that comply with Federal, State, and local environmental regulations, and that are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

The MPC members developed and prioritized actions using the STAPLEE criteria. The high priority action items in Table 8-2 were prioritized by the MP based on the STAPLEE criteria and their potential to reduce risk to the DD7 planning area, including its operations and physical assets. This highest priority actions are generally those that are most effective in reducing risks to multiple assets simultaneously.

The Planning Committee defined High, Medium, and Low priorities in the Action Plan as follows:

- High: Meets five of the seven STAPLEE criteria
- Medium: Meets four of the seven STAPLEE criteria
- Low: Meets three of the seven STAPLEE criteria

These priorities were applied to update the action items. The items were sorted by high and medium/ low priority. 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.

8.3 Mitigation Actions

The MPC members developed and prioritized the actions using the STAPLEE criteria. As part of the Plan update, the action that were included in the Jefferson County Plans 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 this plan. The updated high priority action items in Table 8-2 were prioritized by the MPC based on the STAPLEE criteria 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.

The Planning Committee defined High, Medium, and Low priorities in the Action Plan as follows:

- High: Meets five of the seven STAPLEE criteria
- Medium: Meets four of the seven STAPLEE criteria
- Low: Meets three of the seven STAPLEE criteria

These priorities were applied to update the action items. The items were sorted by high and medium/ low priority. 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.

Table 8-3 identifies each High and medium priority mitigation actions (meets five of the seven STAPLEE criteria) and identifies the proposed lead office and support assignments, cost, and schedule for completion. The proposed timeframes are consistent with the five-year review cycle required for this Plan update. For each High-priority action, the MPC characterized anticipated support by the DD7 Board of Commissioners, DD7 Management, and the community at-large, discussed funding limitations and status, and developed a qualitative statement regarding cost effectiveness. In this context, the cost of accomplishing the action was compared to the perceived benefits, including community-wide safety.

The MPC reviewed and updated both the high and medium priority actions table (Table 8-2), discussed each action item with the lead office and the tables have been modified to include the status and schedule for completion for each action item. The status identifies work that has been completed to satisfy the action, or progress made

It should be clearly understood that DD7 has no authority or funding to undertake projects that mitigate hazards other than floods, so the strategies and actions listed for such hazards in these tables are necessarily limited in scope.

Table 8-2

Jefferson County DD7: High and Medium Priority Mitigation Actions

No.	Action Item Description / Benefits	Lead Manager	Funding/Support	Schedule	Priority	Hazard	Cost-Effective-ness	Status as of 2012
1	Rodair Gully – Increase capacity of the main channel and improve the culvert Crossings. Will help to prevent flooding of roads and new and existing commercial and r esidential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $3,860,200 Support: Strong.	Ongoing	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the Jefferson County Plan Update for 2011 Ongoing Right of Way underway

No.	Action Item Description / Benefits	Lead Manager	Funding/Support	Schedule	Priority	Hazard	Cost-Effective-ness	Status as of 2012
2	Rodair Gully Laterals 3 and 3A – Increase capacity and improve culvert crossings. Will help to prevent flooding of roads and new and existing commercial and residential properties. I mprovements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	Jefferson County and DD7	Jefferson County received a grant from the DREF (Hurricane Ike Disaster Relief Fund) that is administered by the General Land Office (GLO) Estimate: $3,500,000 Support: Strong	End of 2012	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the Jefferson County Plan Update for 2011 Ongoing

No.	Action Item Description / Benefits	Lead Manager	Funding/Support	Schedule	Priority	Hazard	Cost-Effective-ness	Status as of 2012
3	Main Ditch B Diversion – Increase capacity by constructing new diversion channel to divert part of the flow from Main B Ditch into the Halbouty detention facility. W ill help to prevent flooding of roads and new and existing commercial and residential properties. I mprovements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	Jefferson County and DD7	Jefferson County received a grant from the DREF (Hurricane Ike Disaster Relief Fund) that is administered by the General Land Office (GLO) Estimate: $3,500,000 Support: Strong	End of 2012	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the Jefferson County Plan Update for 2011 Ongoing

No.	Action Item Description / Benefits	Lead Manager	Funding/Support	Schedule	Priority	Hazard	Cost-Effective-ness	Status as of 2012
4	Pear Ridge Main #1, Lateral 3 - Increase capacity and improve culvert crossings. Will help to prevent flooding of roads and new and existing commercial and residential properties. I mprovements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $2,900,000 Support: Moderate	Completed	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the Jefferson County Plan Update for 2011 Complete

No.	Action Item Description / Benefits	Lead Manager	Funding/Support	Schedule	Priority	Hazard	Cost-Effective-ness	Status as of 2012
5	Main B from South 9th Street to HWY 365 – Increase capacity of drainage channel Main B from South 9th to HWY 365. Improve culvert crossings in Main B at South 6th Street, South 9th Street, South 12th Street, South 13th Street and Avenue H. Will help to prevent flooding of roads and new and existing commercial and r esidential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $2,187,000 Support: Moderate	To be completed by FY 2012-2013	Medium	Floods (including hurricane, tropical storms, thunderstorms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) Ongoing.

No.	Action Item Description / Benefits	Lead Manager	Funding/Support	Schedule	Priority	Hazard	Cost-Effective-ness	Status as of 2012
6	Central Gardens Outfall – Improve channel capacity and s everal culvert crossings Central Gardens Outfall. W ill help to prevent flooding of roads and new and existing commercial and residential properties. I mprovements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. Estimate: $1,547,000 Support: High	Completed	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) COMPLETED
7	Star Lake Ditch – Improve two culvert crossings. Improvements include adding two 42-inch RCP culverts to the existing two 42-inch RCP culverts under Wilson Avenue and adding on concrete box to the existing concrete box culvert under HWY 366. Will help to prevent flooding of roads and new and existing commercial and r esidential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $123,000 Support: Moderate	2012-2017	Medium	Floods (including hurricane, tropical storms, thunderstor ms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) No work has been done on this action. Will move to New Plan.

No.	Action Item Description / Benefits	Lead Manager	Funding/Support	Schedule	Priority	Hazard	Cost-Effective-ness	Status as of 2012
8	Lateral 2 of Crane Bayou System - Improve the 25th Street Crossing in Lateral 2 of the Crane Bayou System. Will help to prevent flooding of roads and new and ex isting commercial and residential properties. I mprovements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $16,000 Support: Moderate	2012-2017	Medium	Floods (including hurricane, tropical storms, thunderstorms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) No work has been done on this action. Will move to New Plan.

9	Lateral A3A and A3B Drainage Improvements - Improvements are recommended along Drainage Lateral A3A from the A3B confluence to the railroad track north of Hogaboom Road including crossing upgrades at Baird, Hogaboom and the removal of the field road crossing upstream of the railroad track crossing. C hannel improvements for A3A include maintaining the existing flow line and w idening the bottom to 10 feet with a 1. 5 to 1.0 side slopes between A3B and A3A Bypass. Will help to prevent flooding of roads and new and existing commercial and residential properties. I mprovements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. Estimate: $423,000 Support: Moderate	2012-2017	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) No work has been done on this action. Will move to New Plan.

10	Main C System Drainage Channel – Improve channel and c rossing from lateral 1 and A irport – Viterbo 1 i ncluding increasing the bottom to 12ft width and creating 1 ½ to 1 side slopes and crossing improvements at 35th, 36th and 37th Street. Will help to prevent flooding of roads and new and existing commercial and r esidential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. Estimate: $473,000 Support: High	Completed	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) COMPLETED

11	Main C System Drainage Channel - Improve channel and crossings from Main C Loop to Hardy Avenue including increasing the bottom to 20 ft. width and creating 1 ½ to 1 side slopes and crossing improvements at Helena Avenue and Detroit Avenue. Will help to prevent flooding of roads and new and existing commercial and residential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. Estimate: $1,549,000 Support: High	Completed	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) COMPLETED
12	Main C System Drainage Channel - Improve channel and crossings from GSU ROW to Main C Loop Confluence including increasing the bottom to 16 ft. width and creating 1 ½ to 1 side slopes and crossing improvements at 17th, 18th, 20th and 22nd Streets. Will help to prevent flooding of roads and new and existing commercial and residential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. Estimate: $988,000 Support: High	2012-2013	Medium	Floods (including hurricane, tropical storms, thunderstorms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) Ongoing.

13	Main C System Drainage Channel - Improve channel and crossings from HWY 347 to GSU ROW including increasing the bottom to 10 ft. width and creating 1 ½ to 1 side slopes. Will help to prevent flooding of roads and new and ex isting commercial and r esidential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $318,000 Support: High	As revenue becomes available	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) No work has been done on this action. Will move to New Plan.

14	Orchard Street Ditch - Improve channel and in order to reduce the floodplain width and water surface elevations. Improvements consist of widening the channel bottom width to 5 feet with bank improvements for a reach of 735 feet downstream of Port Neches Road. Will help to prevent flooding of roads and new and existing commercial and residential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $35,000 Support: High	As revenue becomes available	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) No work has been done on this action. Will move to New Plan.

15	Lateral B5 channel improvement- During a comprehensive drainage study, Lateral B5 watershed was identified as an area that would benefit from improved channel and culvert crossings due to observed out of bank flows. B5 is in disrepair and will require at least one concrete lined bank within new five years. Will help to prevent flooding of roads and new and existing commercial and residential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. Estimate: $700,000 Support: High	Completed	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) COMPLETED

16	Blocks Bayou – Increase channel capacity and improve multiple culvert crossings of Blocks Bayou. These will reduce the floodplain widths and water surface elevation in the ditch. Improvements include upgrading the Port Neches Road crossing to a minimum of three 60-inch RCP culverts. Will help to prevent flooding of roads and new and ex isting commercial and r esidential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $251,000 Support: Moderate	2012-2017	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) No work has been done on this action. Will move to New Plan.

17	Pure Oil Ditch – Increase channel capacity and improve multiple crossings of Pure Oil Ditch from Station 57-30 to Station 84-35. Will help to prevent flooding of roads and new and existing commercial and residential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: $610,000 Support: Moderate	As revenue becomes available	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	This action was included in the original Jefferson County Plan (2005) No work has been done on this action. Will move to New Plan.
18	Alligator Bayou Pump Station – Increase AB pump station by adding additional pumps to station. Will help to prevent flooding of roads and new and existing commercial and r esidential properties. Improvements to crossings will help prevent flooding at crossings that would otherwise hinder emergency personnel from accessing citizens in need of medical attention or evacuation during a flood.	DD7	HMGP Grant from FEMA administered by TDEM. DD7 Maintenance and Operation Revenues from local taxes Estimate: $24,000,000 Support: Strong	2013	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Cost Effective as B/C was above a 1.0	This action was included in the Jefferson County Plan Update for 2011 UPDATE: Received HMGP Grant from FEMA after Hurricane Ike and project is in progress.

19	Rodair Gully System Detention	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate:$2,000,000 Support: Strong	As revenue becomes available	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	NEW ACTION ITEM FOR 2012 PLAN UPDATE
20	Update Master Drainage Plan	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate:$500,000 Support: Strong	2017	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	NEW ACTION ITEM FOR 2012 PLAN UPDATE

21	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	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate:$100,000 Support: Strong	2017	High	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	NEW ACTION ITEM FOR 2012 PLAN UPDATE
22	Improvements on McFadden/Weiss Canal Channel	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: Support: Strong	2017	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	NEW ACTION ITEM FOR 2012 PLAN UPDATE

23	Evaluate all of DD7 facilities to determine if new or upgraded generators are needed	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate:$50,000 Support: Strong	As revenue becomes available	Medium	Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	NEW ACTION ITEM FOR 2012 PLAN UPDATE
24	Harden the DD7 Office with hurricane shutters	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate:$150,000 Support: Strong	As revenue becomes available	Medium	Wind	Study has not been completed to determine cost effective-ness	NEW ACTION ITEM FOR 2012 PLAN UPDATE

25	Evaluate 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.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: Support: Strong	As revenue becomes available	Medium	Wind and Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	NEW ACTION ITEM FOR 2012 PLAN UPDATE
26	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	DD7	Federal/state grants or DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: Support: Strong	As revenue becomes available		Wind and Floods (including hurricane, tropical storms, thunder-storms and storm surge)	$3,000,000	NEW ACTION ITEM FOR 2012 PLAN UPDATE

27	As a result of the passage by Congress of the National Levee Safety Act, the USACE is beginning the process of inspecting Federally constructed levee systems to not only evaluate the integrity of the Hurricane Flood Protection Levee System but also the risk associated with what the system is protecting, with life safety being paramount. This thorough assessment of the levee system may expose deficiencies or unacceptable conditions requiring major repairs or upgrades. Estimated cost is currently unknown but could be in the multitude of millions of dollars, depending on the severity of the deficiency.	DD7	DD7 Maintenance and Operation Revenues from local taxes. The schedule could be accelerated if a state or federal grant were awarded. Estimate: Support: Strong	As revenue becomes available	Medium	Wind and Floods (including hurricane, tropical storms, thunder-storms and storm surge)	Study has not been completed to determine cost effective-ness	NEW ACTION ITEM FOR 2012 PLAN UPDATE

8.4 Links to Mitigation Goal Statement

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.

Table 8-3 shows how the proposed actions listed in Section mitigation action table directly support DD7's Mitigation Goal Statement. A number of actions individually support more than one element of the goal.

Table 8-3
Linking Mitigation Goals & Actions

Element of Goal Statement	Actions Relating to Goal
Protect public health, safety, and welfare;	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 24, 25, 26, 27
Reduce losses due to hazards by identifying hazards, minimizing exposure of citizens and property to hazards, and increasing public awareness and involvement;	20, 21, 24, 25, 27
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	20, 21, 27

Seek solutions to existing problems	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 24, 25, 26, 27

9 Section 9 - Texas Agencies, Organizations and FEMA NFIP Program

9.1 Overview

Mitigation of flood hazards traces its roots to Congressional deliberations about how to address continued and repetitive flood disasters throughout the first half of the 20th Century. The National Flood Insurance Program, authorized in 1968, prompted State and local government actions primarily intended to recognize and account for flood hazards in decisions on local development. It was not until 1988 that the concept of mitigation planning was articulated in a statute, known as "Section 409" planning. In 2000, the statute was revised under the Disaster Mitigation Act of 2000.

At the federal level, the Federal Emergency Management Agency administers mitigation programs that foster planning and project implementation to address existing risks. At the State and regional levels, several agencies and organizations sponsor programs that bear on hazard mitigation. The following sections provide an overview of existing Texas agencies, organizations, and programs addressing hazard mitigation.

9.2 Texas Division of Emergency Management

The Texas' Division of Emergency Management (TDEM) (www.txdps.state.tx.us/dem) is designated by the Governor as the State's coordinating agency for disaster preparedness, emergency response, and disaster recovery assistance. TDEM is also tasked with coordinating the State's natural disaster mitigation initiatives, chairing the State Hazard Mitigation Team, and maintaining the State of Texas Emergency Management Plan. TDEM fosters local mitigation planning and administers the HMGP, PDM and RFC grants provided through the Federal Emergency Management Agency.

9.3 Texas Water Development Board

The Texas Water Development Board (TWDB; www.twdb.state.tx.us) administers a variety of programs related to water. The TWDB is the agency charged with statewide water planning and administration of financial assistance programs for the planning, design, and construction of water supply, wastewater treatment, flood control, and agricultural water conservation projects. TWDB administers funding from FEMA under the Flood Mitigation Assistance Program (FMA) and Severe Repetitive Loss (SRL) Program (see Section 2.8).

TWDB also is designated by the Governor as the State Coordinating Agency for the National Flood Insurance Program. In this capacity, the agency assists communities with floodplain mapping matters and interpretation and enforcement of local floodplain management regulations.

9.4 Texas Commission on Environmental Quality

The Texas Commission on Environmental Quality (TCEQ; www.tceq.state.tx.us) is a diversified agency dealing with permitting, licensing, compliance, enforcement, pollution prevention, and educational programs related to preservation and protection of air and water quality and the safe disposal of waste. Related to mitigation of natural hazards are TCEQ programs that deal with drought, dam safety, flood control and floodplain management.

9.5 FEMA National Flood Insurance Program

In 1968, Congress authorized FEMA's National Flood Insurance Program (NFIP) for two primary purposes: (1) to have flood-prone property owners contribute to their own recovery from flood damage through an insurance program; and (2) to guide development such that it is less prone to flood damage. To facilitate implementation, the NFIP created Flood Insurance Rate Maps (FIRMs) that, based on best available information and engineering methodologies, show areas subject to flooding by the 1-percent-annual chance flood (also called the "100-year flood"). Communities use the maps to guide and regulate development. Citizens and insurance professionals use the maps to determine insurance needs.

It is notable that, whereas flood insurance claims are paid when damage is sustained from any qualifying flood event, federal disaster assistance is available only after a flood is determined to be a "major disaster." A major disaster exceeds state and local capabilities. In addition, disaster grants to individuals and families are limited to approximately $14,000 (average payment is $6,000). Therefore, owners of insured buildings that are in areas known to flood, especially as shown on FIRMs, are protected financially as long as they carry sufficient flood insurance coverage. Additional information on flood insurance coverage for property owners and consumers is available online at www.fema.gov/nfip.

Basic federal flood insurance helps pay for property damage and loss of contents. Under certain circumstances – for example, if flood damage causes "substantial damage" – an additional mitigation claim payment is available to help owners bring buildings into compliance with NFIP flood protection standards (as of May 2003, this additional payment is capped at $30,000). In addition, compliance is required when a building is substantially improved (includes repair of substantial damage). Substantial improvement is defined as improvements valued at 50% or more of the building's market value before improvement.

Flood Insurance in Texas (as of 3/31/2011)

With 673,073 NFIP policies in force (over 12% of all policies nationwide), Texas ranks second among all States in number of flood-insured properties (Florida is #1).

Property owners in Texas have received over 237,000 claim payments totaling $5.47 Billion; only Louisiana has had more claims paid.

Source: NFIP Statistics online at www.fema.gov/nfip

10 Section 10 – Plan Maintenance and Implementation

10.1 IFR Requirements for Plan Monitoring and Maintenance

IFR §201.6(c)(4)(i): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle

IFR §201.6(c)(4)(ii): [The plan shall include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.

IFR§201.6(c)(4)(iii): [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

10.2 Distribution

The 2012 Jefferson County Drainage District No. Seven (DD7) Hazard Mitigation Plan update will be posted on the District's Web site and notices of its availability will be distributed to the following:

The federal and State agencies that were notified and invited to participate in Plan development (see Sec. 1.3);

Jefferson County, City of Port Arthur, Groves, Nederland and Port Neches, and adjacent counties

Citizens who attended public meetings and provided contact information; and

The organizations, agencies, and elected officials who received notices of public meetings.

10.3 Implementation

Through the mitigation planning process, DD7 Departments that are involved in managing hazards and implementing measures to minimize future risk considered a range of mitigation actions. High and medium priority actions were identified and prioritized, and are shown in Table 8-2.

For each mitigation action, Table 8-2 identifies the lead agency, support agencies, priority level, and time period for implementation. Each lead agency is responsible for factoring the action into its work plan and schedule over the indicated time period. Annual meetings will be held to discuss the status of implementation and identify and obstacles that may impede progress toward achieving the mitigation goals and actions.

10.4 Monitoring & Progress Reports

The original Plan included Annual Progress Reports to be completed each year after adoption of the original Plan. For the Plan update, the planning committee determined that progress would be better monitored by annual meetings of the MPC. Upon adoption in 2012, 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 will note progress made on the mitigation action items listed in Table 8-2. To this end, the General Manager may convene a meeting of the appropriate District, City and 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 8-2 may be made or additional event-specific actions identified. Such revisions shall be documented as outlined in the following sub-section (Section 10.5).

10.5 Circumstances that will Initiate Plan Review and Updates

This section identifies the circumstances or conditions under which DD7 will initiate Plan reviews and updates.

1. On the recommendation of the General Manager of Administration 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, incorporated Cities, 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. Minor revisions may be handled by addenda.

Major comprehensive review of and revisions to this Hazard Mitigation Plan update will be considered on a five-year cycle. To be adopted in 2012, the Plan will enter its next review cycle sometime in 2016, with adoption of revisions anticipated in 2017. The Mitigation Planning Committee will be convened to conduct the comprehensive evaluation and revision.

10.6 Continued Public Involvement

Upon adoption of the Plan update, the public will be notified of any substantial changes to the document between adoption and the next scheduled Plan update in 2016. Any changes proposed by the MPC considered significant will be distributed to the list of stakeholders identified in Table 1-4. 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 2016, using the same methods as the original 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, draft documents posted on the web site, and public Board of Director meetings will be undertaken.

Appendix A

The following is a general description for each of the hazards listed below.

General descriptions completed for the following natural hazards:

1. Tornadoes
2. Thunderstorms/High Winds
3. Hurricanes and Tropical Storms
4. Extreme Heat
5. Drought
6. Wildand Fire
7. Winter Storm
8. Seismic/ Earthquake
9. Landslides
10. Flood
11. Storm Surge

1. Tornadoes

Definition of the Tornado Hazard

A tornado is a rapidly rotating funnel (or vortex) of air that extends toward the ground from a cumulonimbus cloud. Most tornadoes do not touch the ground, but when the lower tip of a tornado touches the earth, it can cause extensive damage. Tornadoes often form in convective cells such as thunderstorms or at the front of hurricanes. Tornadoes may also result from earthquake induced fires, wildfires, or atomic bombs (FEMA, 1997). The formation of tornadoes from thunderstorms is explained in Figure A-1.

Characteristics of Tornadoes

Tornadoes in the dissipating stage can appear like narrow tubes, or ropes, twisting into all manner of curls, twists, and s-shapes. Multiple-vortex tornadoes can appear as a family of swirls circling a common center, or may be completely obscured by condensation, dust, and debris, appearing to be a single funnel. In addition to these appearances, tornadoes may be obscured completely by rain or dust. These tornadoes are

especially dangerous, as even experienced meteorologists might not spot them. As shown in the following table, tornadoes are measured by the Fujita Scale, an empirical system that determines the severity by observed damages (last column).

Table A-1

The Fujita Tornado Scale

(Source: FEMA 1997)

Category	Wind Speed	Description of Damage
F0	40-72 mph	Light damage. Some damage to chimneys; break branches off trees; push over shallow-rooted trees; damage to sign boards.
F1	73-112 mph	Moderate damage. The lower limit is the beginning of hurricane speed. Roof surfaces peeled off; mobile homes pushed off foundations or overturned; moving autos pushed off roads.
F2	113-157 mph	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light-object missiles generated.
F3	158-206 mph	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown.
F4	207-260 mph	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	261-318 mph	Incredible damage. Strong frame houses lifted off foundations and carried considerable distance to disintegrate; automobile-sized missiles fly through the air in excess of 100-yards; trees debarked.

In February of 2007, the F-Scale was replaced with a more accurate Enhanced Fujita Scale (Enhanced F-scale). It was the Jarrell, Texas tornado of May 27, 1997 and the Oklahoma City/Moore tornado of May 3, 1999 that brought to the forefront the problem that perhaps the wind estimates were too high in the F-Scale. The changes to the original scale were proposed by a committee of meteorologist and engineers searching for a more accurate method of assessing the magnitude of tornadoes. Changes to the original Fujita scale were designed to ensure compatibility with the existing databases of tornado hazards, including the one maintained by the NCDC.

The Enhanced F-scale has the same basic design as the original Fujita scale, six categories from zero to five representing increasing degrees of damage. [31] It was revised to reflect better examinations of tornado damage surveys, to align wind speeds more closely with associated storm damage. The new scale also considers damages to a wider variety of structures and better accounts for variables such as differences in construction quality. Table A-2 displays the wind speed ranges for the original Fujita Scale, the derived wind speeds (Enhanced F-scale), and the new Enhanced F-scale, in wide use since February of 2007.

Table A-2
Wind Speed Comparison of the Fujita Scale and Enhanced Fujita Scale
(Source: NOAA – National Weather Service)

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

Figure A-1 illustrates the frequency of tornado strikes in the U.S. per 1,000 square miles. While 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.

Figure A-1

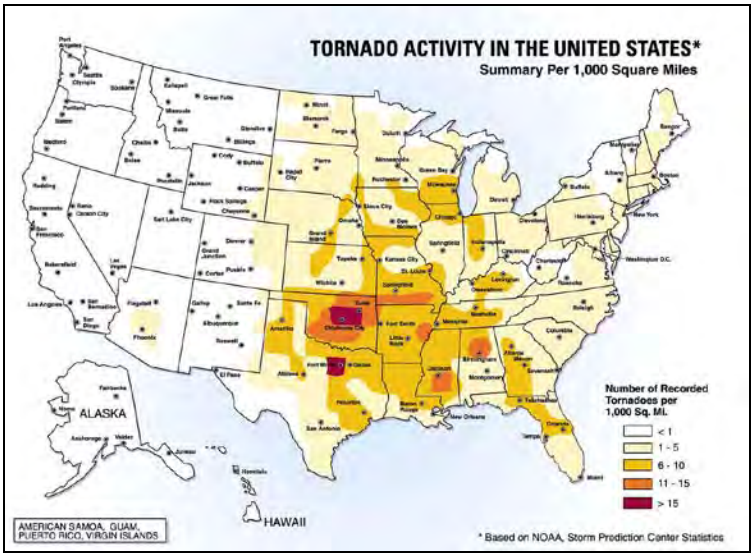
Historic Tornado Activity in the United States,

Summary per 1,000 Square Miles

[31] NOAA; Storm Prediction Center – Summary of Enhanced F-scale

Appendix A

General Descriptions of Natural Hazards



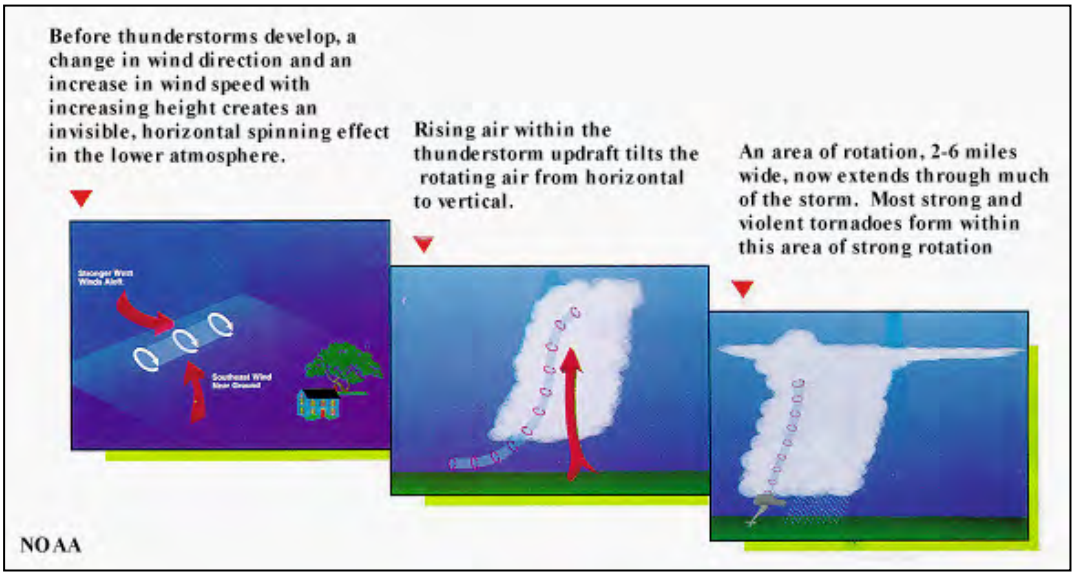
The severity and duration of tornadoes is a function of several factors, including weather conditions, topography and the EF class of the event. As noted earlier, tornado severity is measured with the Enhanced Fujita scale, an empirical system that classifies events after they occur. In some cases there are anomalous patterns for various reasons (including the reliability and completeness of reporting), but generally speaking smaller events are more probable, larger (more severe) ones are less likely.

Tornado duration is usually relatively short, varying from a matter of seconds to several minutes on the ground, although in rare cases they can last significantly longer. The path width of a single tornado generally is less than 0.6 miles. The path length of a single tornado can range from a few hundred yards to miles. A tornado typically moves at speeds between 30 and 125 mph and can generate internal winds exceeding 300 mph.

Figure A-2
Strong Wind Effects
(Source: FEMA)

Most tornadoes take on the traditional appearance of a narrow funnel, a few hundred yards across, with a small cloud of debris near the ground. Tornadoes can appear, however, in all manner of shapes and sizes.

Figure A-3
Formation of Tornadoes
(Source: NOAA)



Small, relatively weak landspouts might only be visible as a small swirl of dust on the ground. While the condensation funnel may not extend all the way to the ground, if associated surface winds are greater than 40 mph (64 km/h), it is considered a tornado. Large single-vortex twisters, often violent, can look like a large wedge stuck into the ground, and are known as *wedge tornadoes* or *wedges*. Wedges can be so wide that they appear to be a block of dark clouds. Even experienced storm observers may not be able to tell the difference between a low-hanging cloud and a wedge tornado from a distance.

2. Thunderstorms/High Winds

Definition of the Thunderstorm/High Winds Hazard

Wind is the uneven horizontal movement of air resulting from the irregular heating of the earth's surface. It can range from local breezes produced by heat from land surfaces and lasting tens of minutes to powerful global winds resulting from solar heating of the earth. Severe winds typically result from hurricanes, nor'easters, tropical storms, tornadoes, thunderstorms, or winter storms.

By definition, the National Weather Service *(NWS)* classifies a thunderstorm as severe if it contains hail of three-quarter inches or larger and/or winds gusts of 58 mph or higher. Severe thunderstorm watches, meaning conditions are suitable for severe storm development during the next several hours, are issued for areas several hundred miles on a side by the NWS Storm Prediction Center in Norman, Oklahoma. A

severe thunderstorm warning is issued by the local National Weather Service Office, usually for several counties or parts thereof for the next hour or so based upon spotter reports of conditions exceeding severe levels and/or by radar indications of the same.[32]

Characteristics of Thunderstorm/High Winds

High winds are capable of imposing large lateral (horizontal) and uplift (vertical) forces on buildings. Residential buildings can suffer extensive wind damage when they are improperly designed and constructed and when wind speeds exceed design levels. The effects of high winds on a building will depend on several factors:

- Wind speed (sustained and gusts) and duration of high winds
- Height of building above the ground
- Exposure or shielding of the building (by topography, vegetation, or other buildings) relative to wind direction
- Strength of the structural frame, connections, and envelope (walls and roof)
- Shape of building and building components
- Number, size, location, and strength of openings (windows, doors, vents)
- Presence and strength of shutters or opening protection
- Type, quantity, velocity of windborne debris

Proper design and construction of residential structures, particularly those close to water or near the coast, demand that every factor mentioned above be addressed. Failure to do so may result in building damage or destruction by wind.

Thunderstorms arise when clouds develop sufficient upward motion and are cold enough to provide the ingredients (ice and supercooled water) to generate and separate electrical charges within the cloud. Warm, moist air rising in sufficiently large volume with a high enough velocity results in a thunderstorm. The fuel for these storms is warm, moist air present near the surface of the earth. If the atmosphere around the cloud is unstable, that is the temperature of the air falls faster than that of the rising parcel air within the storm, then the updraft becomes ever warmer than the air outside, and therefore more buoyant. The release of latent heat when water vapor turns to liquid and then the liquid to ice further warms the rising parcel, stoking the "fires" of the updraft. A trigger is often necessary to get the warm bubble of air rising in the first place. Sometimes it can be a warm air thermal rising from a large, heated field or a sunlit mountain top, or the upward motion produced by fronts pushing air together so it has no place to go but up. [33]

[32] National Weather Service – Facts about thunderstorms

[33] National Weather Service – Facts about thunderstorms

3. Hurricanes and Tropical Storms

Definition of 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. 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. Table A-3 below identifies the criteria for each stage of development.

Table A-3
Classification of Hurricanes

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

Hurricane winds blow in a large spiral around a relative calm center known as the "eye." The "eye", the storms 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.

As shown in Table A-4, 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.

Table A-4
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

A single hurricane can last for more than two weeks over open waters and can run a path across the entire length of the eastern seaboard. August and September are peak months during the hurricane season, which lasts from June 1 through November 30.

Characteristics of Hurricanes and Tropical Storms

Hurricanes and Tropical Storms are categorized based on their wind speed. Both bring strong winds and are characterized by torrential rains that often result in widespread damage. Hurricanes can produce both extreme high winds and heavy rains. Tropical storms are most often associated with heavy rains that have the potential to produce severe flooding.

High winds from Hurricanes and Tropical Storms are capable of imposing large lateral (horizontal) and uplift (vertical) forces on buildings. Residential buildings can suffer extensive wind damage when they are improperly designed and constructed and when wind speeds exceed design levels. The effects of high winds on a building will depend on several factors:

- Wind speed (sustained and gusts) and duration of high winds
- Height of building above the ground
- Exposure or shielding of the building (by topography, vegetation, or other buildings) relative to wind direction
- Strength of the structural frame, connections, and envelope (walls and roof)
- Shape of building and building components
- Number, size, location, and strength of openings (windows, doors, vents)
- Presence and strength of shutters or opening protection
- Type, quantity, velocity of windborne debris

Proper design and construction of residential structures, particularly those close to water or near the coast, demand that every factor mentioned above be addressed. Failure to do so may result in building damage or destruction by wind.

4. Extreme Temperature (Heat)

Definition of Extreme Temperature (Heat)

Extreme summer heat is the combination of very high temperatures and exceptionally humid conditions. If such conditions persist for an extended period of time, it is called a heat wave (FEMA, 1997). Heat stress can be indexed by combining the effects of temperature and humidity, as shown in Table A-5. The index

estimates the relationship between dry bulb temperatures (at different humidity) and the skin's resistance to heat and moisture transfer. The higher the temperature or humidity, the higher the apparent temperature.

Table A-5
Heat Index and Disorders
(Sources: FEMA, 1997; NWS, 1997)

Danger Category		Heat Disorders	Apparent Temperatures (°F)
IV	Extreme Danger	Heatstroke or sunstroke imminent.	>130
III	Danger	Sunstroke, heat cramps, or heat exhaustion likely; heat stroke possible with prolonged exposure and physical activity.	105-130
II	Extreme Caution	Sunstroke, heat cramps, and heat exhaustion possible with prolonged exposure and p hysical activity.	90-105
I	Caution	Fatigue possible with prolonged exposure and physical activity.	89-90

In the northeastern U.S. periods of warmer than normal temperatures typically occur several times a summer. Extreme heat waves may occur about once every five years or so where maximum daily temperatures exceed 100 degrees Fahrenheit for an extended period of time. The passing of a cold front usually moderates temperatures after a few days to a week.

Characteristics of Extreme Temperature (Heat)

The main impact of extreme heat is its effect on the human body. In a very hot environment, the most serious concern is heat stroke. In absence of immediate medical attention, heat stroke could be fatal. Heat stroke fatalities do occur every summer. Heat exhaustion and fainting (syncope) are less serious types of illnesses, which are not fatal but interfere with a person's ability to work.

The major human risks associated with extreme heat can be summarized as follows.

- Heatstroke: Considered a medical emergency, heatstroke is often fatal. It occurs when the body's responses to heat stress are insufficient to prevent a substantial rise in the body's core temperature. While no standard diagnosis exists, a medical heatstroke condition is usually diagnosed when the body's temperature exceeds 105°F due to environmental temperatures. Rapid cooling is necessary to prevent death, with an average fatality rate of 15 percent even with treatment.
- Heat Exhaustion: While much less serious than heatstroke, heat exhaustion victims may complain of dizziness, weakness, or fatigue. Body temperatures may be normal or slightly to moderately elevated. The prognosis is usually good with fluid treatment.

- Heat Syncope: This refers to sudden loss of consciousness and is typically associated with people exercising who are not acclimated to warm temperatures. Causes little or no harm to the individual.
- Heat Cramps: May occur in people unaccustomed to exercising in the heat and generally ceases to be a problem after acclimatization.

5. Drought

Definition of Drought Hazard

A drought is an extended dry climate condition when there is not enough water to support urban, agricultural, human, or environmental water needs. It usually refers to a period of below-normal rainfall, but can also be caused by drying bores or lakes, or anything that reduces the amount of liquid water available. Drought is a recurring feature of nearly all the world's climatic regions.

Drought is the result of a decline in the expected precipitation over an extended period of time, typically one or more seasons in length. Meteorological drought is defined solely on the degree of dryness, expressed as a departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales. Hydrological drought is related to the effects of precipitation shortfalls on streamflows and reservoir, lake, and groundwater levels. Agricultural drought is defined principally in terms of soil moisture deficiencies relative to water demands of plant life, usually crops. Socioeconomic drought associates the supply and demand of economic goods or services with elements of meteorological, hydrologic, and agricultural drought. Socioeconomic drought occurs when the demand for water exceeds the supply as a result of weather-related supply shortfall. This may also be called a water management drought.

Figure A-4
Lake Travis in Austin Texas, July 2009
(Source: Texas Water Development Board)

Characteristics of Drought

Drought produces a complex web of impacts that span many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services. Impacts are commonly referred to as direct or indirect. Reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in crop, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs.

Drought is a normal part of virtually every climate on the planet, including areas of both high and low normal rainfall. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity (FEMA, 1997). A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. Due to its multi-dimensional nature, drought is difficult to define in exact terms and also poses difficulties in terms of comprehensive risk assessments.

Drought differs from other natural hazards in three ways. First, the onset and end of a drought are difficult to determine due to the slow accumulation and lingering effects of an event. Second, the lack of an exact and universally accepted definition adds to the confusion of its existence and severity. Third, in contrast with

other natural hazards, the impact of drought is less obvious and may be spread over a larger geographic area. These characteristics have hindered the preparation of drought contingency or mitigation plans by many governments.

Droughts may cause a shortage of water for human and industrial consumption and cause a decrease in hydroelectric power. Water quality may also decline while the number and severity of wildfires may increase. Severe droughts may result in the loss of agricultural crops and forest products, undernourished wildlife and livestock, lower land values, and higher unemployment.

6. Wildland Fires

Definition of Wildland Fire Hazard

A wildfire, also known as a forest fire, vegetation fire, grass fire, brush fire, or hill fire, is an uncontrolled fire often occurring in wildland areas, which can also consume houses or agricultural resources. Common causes include lightning, human carelessness, and arson.

Wildfires are fueled by naturally occurring or non-native species of trees, brush, and grasses. Topography, fuel, and weather are the three principal factors that impact wildfire hazards and behavior.

Figure A-5
Brush Fire
(Source: FEMA)

Characteristics of Wildfire Interface

Wildfires often begin unnoticed, spread quickly, and are usually signaled by dense smoke that may fill the area for miles around. As mentioned, wildfires can be human-caused through acts such as arson or campfires, or can be caused by natural events such as lightning. Wildfires can be categorized into three types:

1. Wildland fires occur in very rural areas and are fueled primarily by natural vegetation.

2. Interface fires occur in areas where homes or other structures are endangered by the wildfires. The fires are fueled by both natural vegetation and man-made structures. These are often referred to as Wildland Urban Interface fires.

3. Firestorms occur during extreme weather (e.g., high temperatures, low humidity, and high winds) with such intensity that fire suppression is virtually impossible. These events typically burn until the conditions change or the fuel is exhausted.

The following three factors contribute significantly to wildfire behavior:

Fuel: The type of fuel and the fuel loading (measured in tons of vegetative matter per acre) have a direct impact on fire behavior. Fuel types vary from light fuels (grass) to moderate fuels (Southern Rough) to heavy fuels (slash). The type of fuel and the fuel load determines the potential intensity of the wildfire and how much effort must be expended to contain and control it.

Weather: The most variable factor affecting wildfire behavior is weather. Important weather variables are precipitation, humidity, and wind. Weather events ranging in scale from localized thunderstorms to large cold fronts can have major effects on wildfire occurrence and behavior. Extreme weather, such as extended drought and low humidity can lead to extreme wildfire activity.

Topography; Topography can have a powerful influence on wildfire behavior. The movement of air over the terrain tends to direct a fire's course.

7. Winter Storms

Definition of Winter Storm Hazards

A winter storm is a type of precipitation in which the dominant varieties of precipitation are forms that only occur at cold temperatures, such as snow or sleet, or a rainstorm where ground temperatures are cold enough to allow ice to form (i.e. freezing rain). In temperate continental climates, these storms are not restricted to the winter season, and may occur in the late autumn and early spring. Also, there are very rare occasions when they form in summer, although it would have to be an abnormally cold summer, such as the summer of 1816 in the Northeast U.S. In many locations in the Northern Hemisphere, the most powerful winter storms usually occur in March and, in regions where temperatures are cold enough, April.

Figure A-6
Split Tree Caused by Ice Storm
Source: FEMA

Characteristics of Winter Storms

Winter storms typically form along a front generally following the meandering path of the jet stream. These storms, called mid-latitude cyclones or extra-tropical cyclones, differ from hurricanes, in that they move from west to east as opposed to east to west. These weather patterns carry cold air from Canada and the Rockies into the southern U.S. The origins of the weather patterns that cause winter storms in Texas are affected by differences in temperature and pressure, moisture availability, and wind direction as well as weather systems in the Atlantic Ocean and Gulf of Mexico.

Winter storms vary in size and strength and include heavy snowstorms, blizzards, freezing rain, sleet, ice storms and blowing and drifting snow conditions. Extremely cold temperatures accompanied by strong winds can result in wind chills that cause bodily injury such as frostbite and death. Severe winter and ice storms can cause unusually heavy rain or snowfall, high winds, extreme cold, and ice storms throughout the continental United States.

NOAA describes the jet streams that carry storm systems across the United States as narrow bands of strong wind in the upper atmosphere that follow the boundaries between hot and cold air masses. These boundaries are most pronounced during the winter months, when the jet streams travel to their southernmost position over the United States and surrounding water.

In the last 11 winters, no region in the United States has escaped flooding during the winter months. The Southeastern and Gulf Coast States (regularly hit by autumn hurricanes) experience damaging floods in the winter months, too. No region is immune. Global warming threatens to disrupt weather patterns around the world and may increase the frequency of winter flooding.

Another weather phenomenon, El Niño, can have a significant effect on precipitation in the United States. Named by Peruvian fishermen who noticed the periodic appearance of warming surface temperatures in the Pacific Ocean around Christmas, El Niño is now understood to be the warm phase of a temperature oscillation in the Pacific Basin's water and atmosphere. The cool phase of the oscillation is nicknamed La Niña. During the warm phase, heat and moisture are released into the upper atmosphere, creating precipitation. El Niño alters the course of the jet stream - pushing it farther south than usual.

According to NOAA, El Niño winters tend to be wetter than normal in the Southeastern United States, as well, and contribute to flooding along the Gulf Coast. Storms that spin up in the Gulf of Mexico typically track northeast on the southern jet stream, bringing rain as well as ice and even snow to the Gulf States.

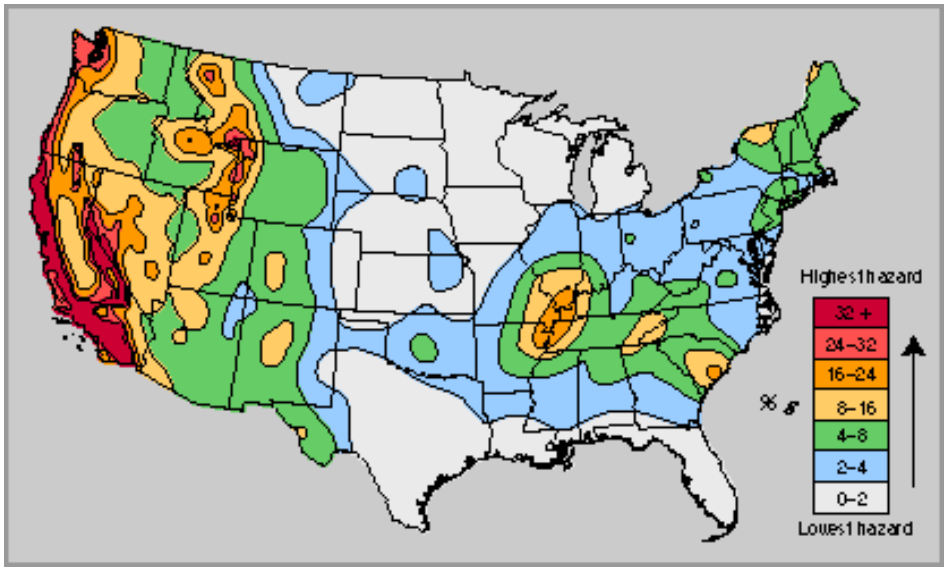
Winter storm occurrences tend to be very disruptive to transportation and commerce. Trees, cars, roads, and other surfaces develop a coating or glaze of ice, making even small accumulations of ice extremely hazardous to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents; collapsed roofs from fallen trees and limbs and heavy ice and snow loads; and felled trees, telephone poles and lines, electrical wires, and communication towers. As a result of severe ice storms, telecommunications and power can be disrupted for days. Such storms can also cause exceptionally high rainfall that persists for days, resulting in heavy flooding.

8. Earthquakes

Definition of Earthquake Hazard

An earthquake is "…a sudden motion or trembling caused by an abrupt release of accumulated strain in the tectonic plates that comprise the earth's crust." These rigid plates, known as tectonic plates, are some 50 to 60 miles in thickness and move slowly and continuously over the earth's interior. The plates meet along their edges, where they move away from or pass under each other at rates varying from less than a fraction of an inch up to five inches per year. While this sounds small, at a rate of two inches per year, a distance of 30 miles would be covered in approximately one million years (FEMA, 1997). Figure A-7 shows a USGS seismic probability map for the continental U.S.

Figure A-7
United States Earthquake Zones



Characteristics of Earthquakes

The vibration or shaking of the ground during an earthquake is described by ground motion. Severity of ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. Ground motion causes waves in the earth's interior, also known as seismic waves, and along the earth's surface, known as surface waves. The following are the two kinds of seismic waves:

P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back-and-forth oscillation along the direction of travel (vertical motion), with particle motion in the same direction as wave travel. They move through the earth at approximately 15,000 mph.

S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side-to-side (horizontal motion) due to particle motion at right-angles to the direction of wave travel. Unreinforced buildings are more easily damaged by S waves.

Earthquakes are often relatively short duration, but there may be aftershocks and other effects (such as liquefaction) that prolong and exacerbate their effects. The potential for either of these effects depends on local conditions and other technical factors that are not discussed in this Plan.

There is some potential for seismic activity virtually anywhere on the earth. Locations that are close to tectonic faults, however, are much more likely to be impacted by earthquakes than other places. The United States Geologic Survey and other organizations develop maps to indicate the relative probability of earthquakes in particular areas.

Figure A-8
Earthquake Damage

Source: FEMA

9. Landslide (non-seismic)

Definition of Landslide Hazard

A landslide is a natural geologic process involving the movement of earth materials down a slope, including rock, earth, debris, or a combination of these, under the influence of gravity. However, there are a variety of triggers for landslides such as: a heavy rainfall event, earthquakes, or human activity. The rate of landslide movement ranges from rapid to very slow. A landslide can involve large or small volumes of material. Material can move in nearly intact blocks or be greatly deformed and rearranged. The slope may be nearly vertical or fairly gentle (Delano and Wilshusen, 2001).

Characteristics of landslides

Landslides are usually associated with mountainous areas but can also occur in areas of generally low relief. In low-relief areas, landslides occur due to steepening of slopes: as cut and fill failures (roadway and building excavations), river bluff failures, collapse of mine waste piles, and a wide variety of slope failures associated with quarries and open-pit mines (USGS, Landslide Types and Process, 2004).

Figure A-9

10. Floods

Definition of Flood Hazard

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. As illustrated in Figure A-10, 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. (FEMA, 1997). There are a number of categories of floods in the U.S., including the following:

- Riverine flooding, (river channel, flash floods, alluvial fan floods, ice-jam floods, dam breaks)
- Local drainage or high groundwater levels
- Fluctuating lake levels
- Coastal flooding, including storm surges
- Debris flows

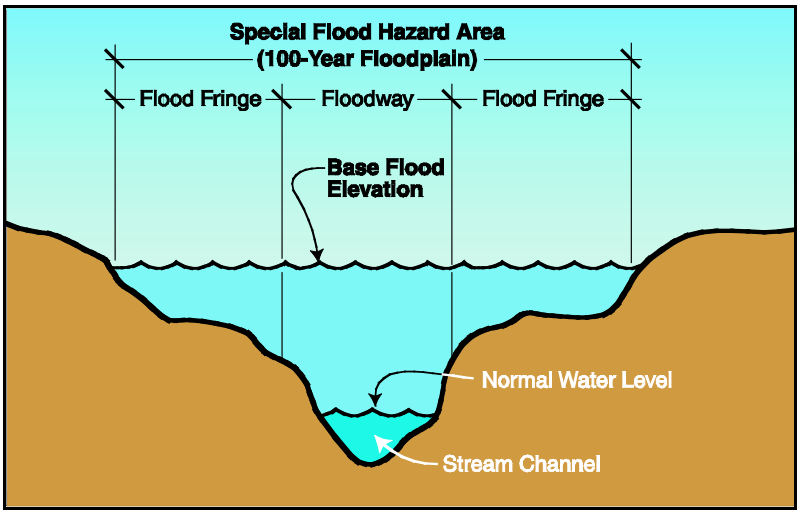
- Subsidence

Characteristics of Floods

While there is no sharp distinction between riverine floods, flash floods, alluvial fan floods, ice jam floods, and dam-break floods, these types of floods are widely recognized and may be helpful in considering the range of flood risk and appropriate responses.

The most common kind of flooding event is riverine flooding, also known as overbank flooding. Riverine floodplains range from narrow, confined channels in the steep valleys of mountainous and hilly regions, to wide, flat areas in plains and coastal regions. The amount of water in the floodplain is a function of the size and topography of the contributing watershed, the regional and local climate, and land use characteristics. In steep valleys, flooding is usually rapid and deep, but of short duration, while flooding in flat areas is typically slow, relatively shallow, and may last for long periods of time.

Figure A-10
Floodplain Definition
(Source: FEMA, August 2001)



Flash floods involve a rapid rise in water level, high velocity, and large amounts of debris, which can lead to significant damage that includes the tearing out of trees, undermining of buildings and bridges, and scouring new channels. The intensity of flash flooding is a function of the intensity and duration of rainfall, steepness of the watershed, stream gradients, watershed vegetation, natural and artificial flood storage areas, and configuration of the streambed and floodplain. Dam failure and ice jams may also lead to flash flooding.

Alluvial fan floods occur in the deposits of rock and soil that have eroded from mountainsides and accumulated on valley floors in the pattern of a fan. Alluvial fan floods often cause greater damage than overbank flooding due to the high velocity of the flow, amount of debris, and broad area affected. Human

activities may exacerbate flooding and erosion on alluvial fans via increased velocity along roadways acting as temporary drainage channels or changes to natural drainage channels from fill, grading, and structures.

Ice jam floods occur when an upstream part of a river thaws first (possibly because it flows away from the equator), and the ice gets carried downstream into the still-frozen part. Masses of ice can become lodged under bridges and other wiers, causing an ice dam, flooding areas upstream of the jam. After the ice dam breaks apart, the sudden surge of water that breaks through the dam can then flood areas downstream of the jam. While this usually occurs in spring, it can happen as winter sets in when the downstream part becomes frozen first. Dam-break floods may occur due to structural failures (e.g., progressive erosion), overtopping or breach from flooding, or earthquakes.

Local drainage floods may occur outside of recognized drainage channels or delineated floodplains for a variety of reasons, including concentrated local precipitation, a lack of infiltration, inadequate facilities for drainage and stormwater conveyance, and/or increased surface runoff. Such events often occur in flat areas, particularly during winter and spring where the ground is frozen. Drainage floods are found also in urbanized areas with large impermeable surfaces. High groundwater flooding is a seasonal occurrence in some areas, but may occur in other areas after prolonged periods of above-average precipitation.

11. Storm Surge

Definition of Storm Surge Hazard

Storm surges occur when the water level of a tidally influenced body of water increases above the normal high tide. Storm surges occur with coastal storms caused by massive low-pressure systems with cyclonic flows that are typical of hurricanes.

Changes in the earth's surface also contribute to the effects of surges. Rising seas and erosion have led to the deterioration of the State's barrier islands and marsh, important shields against storm surge. Furthermore, erosion has caused the entire delta to sink, meaning homes, businesses and highways are becoming more susceptible to surges. New Orleans actually has pumps to keep rising seawaters from inundating the entire city, but they would hold little power in the face of a powerful hurricane.

Characteristics of Storm Surge

Storm surges are characterized by several factors that allow the displacement of water from oceans, bays or rivers to travel so far inland. Much of the coastlines along the Atlantic and Gulf Coast lie less than 10 feet above mean sea level. These coastal areas are also densely populated making the danger from storm tides a major concern to life and property. As shown in Figure A-11, the level of surge in a particular area is also determined by the slope of the continental shelf. A shallow slope off the coast will allow a greater surge to inundate coastal communities. Communities with a steeper continental shelf will not see as much surge inundation, although large breaking waves can still present major problems. Storm tides, waves, and currents in confined harbors have the potential to severely damage ships, marinas, and pleasure boats (Source: NOAA).

Figure A-11
Storm Surge
(Source: NOAA)

One tool used to evaluate the threat from storm surge is the Sea, Lake and Overland Surges from Hurricanes (SLOSH) Model. SLOSH is a computerized model run by the National Hurricane Center (NHC) to estimate storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes by taking into account the following:

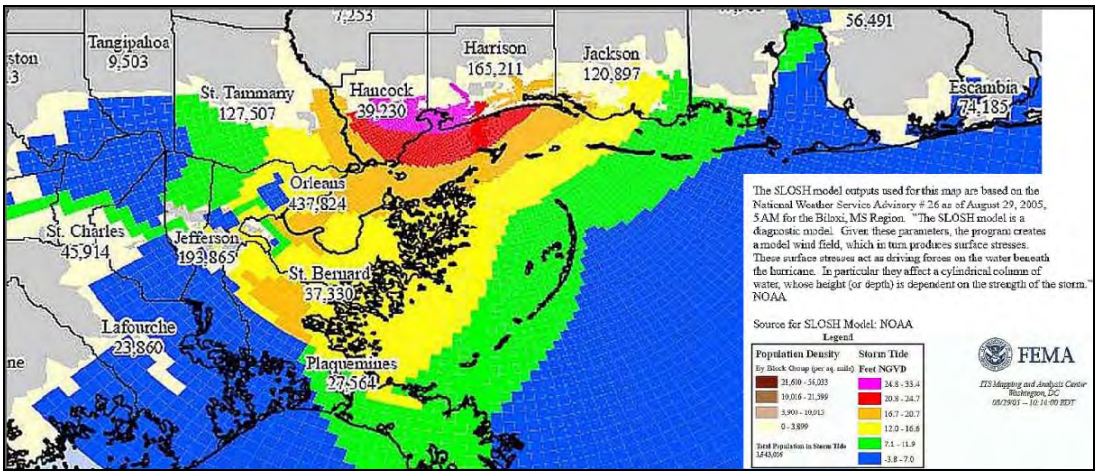
- Pressure
- Size
- Forward speed
- Track
- Winds

Graphical output from the model displays color-coded storm surge heights for a particular area in feet above the model's reference level, the National Geodetic Vertical Datum (NGVD), which is the elevation reference for most maps. Emergency managers often use the data produced from the SLOSH model to assist with determining which areas must be evacuated in advance of an approaching hurricane.

Figure A-12
Hurricane Katrina SLOSH Model
(Source: NOAA – National Hurricane Center)

Appendix A

General Descriptions of Natural Hazards



Appendix B

MPC Meeting Minutes

Meeting # 1

Jefferson County Drainage District No. 7

Hazard Mitigation Plan Minutes

October 19, 2011

These minutes document the planning process of the TWDB Planning Grant awarded to the Jefferson County Draining District No. 7 (DD7) to develop an All Hazards Mitigation Plan. The team held its first Mitigation Planning Committee (MPC) meeting on Wednesday, October 19, 2011, beginning at 8:00 a.m. These minutes were prepared by Jeff Ward and Kristen Thatcher.

Participants

Phil Kelley	(PK)	Jefferson County DD7
Diane Smith	(DS)	Jefferson County DD7
Jeff Ward	(JW)	Jeff Ward & Associates
Kristen Thatcher	(KT)	Jeff Ward & Associates
Allen Sims	(AS)	Carroll & Blackman Engineers

AGENDA

1. Overview of Planning Process
2. Quarterly Reporting
3. Review Goals from Other Plans and Develop DD7 Goal
4. Identification of Stakeholders
5. Hazard Profile Information
6. Request for Information
7. Request copies of plans/studies that could have impact on jurisdictional area
8. Outline Potential Mitigation Actions
9. Schedule and Next Steps

Overview of Planning Process

JW explained that the MPC would be responsible for drafting of the Plan and would need to identify a stakeholder group to review drafts and provide input. JW further explained that in the next couple of months, the team will review the original Jefferson County HMP to determine any key occurrences or impacts from hazards that have happened since that plan, determine the status of actions that impacted DD7 and focus on hazards and actions that DD7's authority can mitigate against, primarily flood for the jurisdictional area and wind impacts to DD7 facilities. To complete this, the team will need certain data and information and therefore a request for information (RFI) will be distributed to the team.

The goal is to have a first draft completed for a presentation to the Board and first public meeting in December. The draft Plan will be placed on the DD7 website and a Public Notice will be sent out to be published for two consecutive Sundays before the meeting. The MPC will plan to meet after that meeting to incorporate Board and Public comments to the draft. During that time the MPC will meet a few more times to get the Plan to a final draft stage. At that point, the identified stakeholders will be notified that the draft if ready for their review and comment and a link will be provided for the stakeholders to download the plan for review and comment. This version of the draft plan also will replace the first draft on the DD7 website and the public will be invited to a second meeting and have an opportunity to review the final draft. Approximately a month from the meeting, the plan will be finalized with all input provided incorporated into the plan and the plan will be sent to TDEM for review.

Quarterly Report

JW prepared the quarterly report that was sent to TWDB by 10-15-11.

Review of Goals and from Other Plans and Develop DD7's Goal

The MPC reviewed goals from other plans and determined that they would review the Jefferson County goal and in the next meeting, will determine the overall goal for the plan.

Identification of the Stakeholders

The MPC then discussed what organizations with a vested interest in the plan would be considered as stakeholder organizations for the plan The team identified businesses, academia, other government entities as the types of organizations to be considered: Specifically, the team discussed:

Texas Water Development Board	Texas Division of Emergency Management
ISDs within the jurisdiction	Key Cities within its jurisdiction
Neighboring Counties	Drainage Districts
Colleges/Universities within the jurisdiction	Business, Organizations (i.e. Chamber of Commerce) and leading businesses
Jefferson County	Hospitals within the jurisdiction

Hazard Profile Information

The MPC will review the Jefferson County Hazard Mitigation Plan to determine what hazards were profiled and since that plan was approved, if those hazards are still relevant to be profiled. From that analysis, the MPC will then determine what hazards to have a risk assessment completed based upon the jurisdiction's authority to mitigate against those hazards. For instance, droughts may impact the County, however, DD7 has no authority to militate against that hazard, and therefore a risk assessment will not be completed for that hazard.

Request for Information

The team discussed what types of data and information will be needed to complete this plan and an RFI will go out to the team for that information. JW also wanted to understand what GIS capabilities DD7 had and it was determined that DD7 had GIS capabilities needed for the mapping needed in the plan.

Request copies of Plans and other Studies

The team discussed studies and plans that will need to be reviewed to determine if any of the information from those plans and studies can be used in the development of this plan.

Outline Potential Mitigation Actions

The MPC discussed mitigation actions that can impact Drainage District and determined that after review of the plans and studies, will begin to formulate potential actions that DD7 would want to include in the plan as well as understand what actions have already been identified in the Jefferson County plan that would need a status update.

Schedule and Next Steps

Meetings Date	Type of Meeting
November 2011	Possible MPC meeting to review data collected and begin the stakeholder identification specifics, determine the goal for the plan and discuss mitigation actions
December 6, 2011	Tentative Board Presentation of Draft Plan and First Public Meeting

Next Steps

Throughout the meeting, the following action items were identified:

Action Item	Owner
Prepare minutes	JW
Provide RFI to team	JW
Provide studies discussed in the Meeting	AS and PK
Finalize MPC next meeting	KT
Finalize dates for Board and Public Presentations	JW
Provide Public Notice Draft for meeting	JW

Adjourn

The meeting adjourned at 9:00 am.

Meeting #2

Jefferson County Drainage District No. 7

Hazard Mitigation Plan Minutes

January 3, 2012

These minutes document the planning process of the TWDB Planning Grant awarded to the Jefferson County Draining District No. 7 (DD7) to develop an All Hazards Mitigation Plan. The team held its second Mitigation Planning Committee (MPC) meeting on Tuesday, January 3, 2012, beginning at 10:00 a.m. These minutes were prepared by Jeff Ward and Kristen Thatcher.

Participants

Phil Kelley	(PK)	Jefferson County DD7
Diane Smith	(DS)	Jefferson County DD7
Jeff Ward	(JW)	Jeff Ward & Associates
Kristen Thatcher	(KT)	Jeff Ward & Associates
Allen Sims	(AS)	Carroll & Blackman Engineers

AGENDA

1. Review and Approval of October 19, 2011 MPC Meeting Minutes
2. Progress Report on the Draft Plan
3. Review, Discussion, Modifications and Approval of Plan Materials
4. Discuss Potential Actions
5. Schedule Forward
6. Open Discussion
7. Adjourn

Review and Approval of October 19, 2011 MPC Meeting Minutes

The team reviewed and approved the minutes.

Progress Report on the Draft Plan

KT reported that draft sections 1, 2, 3, 4, 5, 7, 9 and 10 are complete for MPC review. Sections 6 (Risk Assessment) and Section 8 (Mitigation Actions) are in process with the goal of completing and getting to the team for review by May-June. KT will provide AS with an electronic version of the plan for review.

Review, Discussion, Modifications and Approval of Plan Materials

The MPC determined that any changes from the review should be sent to JSWA for incorporation.

Discuss Potential Actions

The MPC first reviewed the actions that DD7 has in the Jefferson County Original and Update Plans for a status. They then discussed new actions items. The items that are shaded green in Section 8 are the new items.

Schedule and Next Steps

Meetings Date	Type of Meeting
May or June, 2012	Possible MPC to review plan and prepare distribution to stakeholders for review.
July, 2012	Tentative Board Presentation of Draft Plan and Second Public Meeting

Next Steps

Throughout the meeting, the following action items were identified:

Action Item	Owner
Prepare minutes	JW
Send AS an electronic copy of the draft	KT
Review Draft	MPC

Review and provide input to the mitigation action table	MPC
Review the completed projects cost estimates	PK
Review 2002 Master Drainage Plan to determine if Mitigation Action Table is missing any projects outlined in the Plan	PK and AS
Request from R. Mitchell a DD7 boundary map with a parcel overlay	KT
Finalize MPC next meeting	KT
Finalize dates for Board and Public Presentations	JW
Provide Public Notice Draft for meeting	JW

Adjourn

The meeting adjourned at 12:00 pm.

Jefferson County Drainage District No. 7

Hazard Mitigation Plan Minutes

June 7, 2012

These minutes document the planning process of the TWDB Planning Grant awarded to the Jefferson County Draining District No. 7 (DD7) to develop an All Hazards Mitigation Plan. The team held its third Mitigation Planning Committee (MPC) meeting on Thursday, June 7, 2012, beginning at 10:00 a.m. These minutes were prepared by Jeff Ward and Kristen Thatcher.

Participants

Phil Kelley	(PK)	Jefferson County DD7
Jeff Ward	(JW)	Jeff Ward & Associates
Kristen Thatcher	(KT)	Jeff Ward & Associates
Allen Sims	(AS)	Carroll & Blackman Engineers

AGENDA

1. Review and approval of minutes of January 3, 2012 MPC meeting
2. Progress report on draft plan
3. Review, discussion, modifications and approval of plan materials
4. Maps needed
5. Discuss getting information out to stakeholders for review
6. Discuss next public meeting
7. Open discussion
8. Adjourn

Review and Approval of January 3, 2012 MPC Meeting Minutes

The team reviewed and approved the minutes.

Progress Report on the Draft Plan, map needs and draft review and approval

KT reported that the draft is 90% complete. The team provided an update on completed items and on-going actions. A request for the staff gauge map was made and if was determined that the team will receive the final draft for review (in pdf. format and in Word format) on July 1st and will have until July 10th to provide comments back to JSWA for incorporation.

Next public meeting and stakeholder review

The MPC discussed the next steps for review once the July 10th MPC comments were input. The team determined that the next public meeting will be during the July 17th Board meeting. KT will work with DS to have public notice placed in local paper by July 2nd to give two weeks' notice to public. After the meeting, the team will ensure that the draft will be uploaded to the DD7 website for stakeholder and public review and comment. A hard copy of the draft plan will be placed at the DD7 office for review as well. A letter will be sent to the stakeholders on July 17th providing the link and request input to the plan by August 17th.

Once the public and stakeholder comment period closes on August 17th, those comments will be incorporated with the goal that the final draft is ready to submit to TDEM by September 1, 2012

Schedule and Next Steps

Meetings Date	Type of Meeting
July1, 2012	Draft plan to MPC
July 10, 2012	MPC provides comments to draft plan
July 2, 2012	Public notice in local newspaper
July 17, 2012	Draft review at DD7 Board Meeting/Public Meeting
July 17, 2012	Letter sent to stakeholders to review plan and provide link to DD7 website
July 17, 2012	DD7 to upload draft plan to website
August 17, 2012	Input due date for Public and Stakeholders

August 18-25, 2012	Input comments to draft
September 1, 2012	Draft Plan to TDEM

Next Steps

Throughout the meeting, the following action items were identified:

Action Item	Owner
Prepare minutes	JW
Send draft to MPC by July 1, 2012 in Word and pdf.	KT
Review Draft by July 10, 2012	MPC
Provide staff gauge map	PK/RM
Finalize MPC next meeting (July 17)	KT
Prepare Public Presentation	JW
Provide Public Notice Draft for meeting to DS	KT

Adjourn

The meeting adjourned at 11:00 am.

Appendix C

Public Notice Documents and Meeting Minutes

Public Meeting # 1

Jefferson County Drainage District No. 7

Hazard Mitigation Plan Public Meeting Minutes

January 3, 2012

2:00 pm

These minutes document the public meeting and presentation to the Jefferson County Drainage District No. 7 (DD7) Board and public meeting regarding the progress of the hazard mitigation plan draft.

Overview of Hazard Mitigation draft plan

JSWA, planning consultant to DD7, provided an overview of the process and the plan. He explained that all political subdivisions can apply for funds if they have a plan. Recognizing this need, DD7 applied and received a grant to prepare a plan with the understanding that once a plan is submitted and approved by FEMA, it must be updated every five years.

The plan is called an All Hazards Plan but FEMA recognizes that drainage districts only are responsible for floods and hazards that impact the Drainage District facilities – wind. Therefore the draft plan risk analysis focuses on these two hazards – floods and wind.

The plan is structured to include an executive summary, background, approval and adoption, planning process, hazards profiles, risk assessment, capabilities assessment, mitigation goals and mitigation actions and planning maintenance and monitoring. Much of the plan is prepared by the Mitigation Planning Committee and a request for review and information to be included in the plan will be sent to an identified stakeholder group. JSWA also explained that it is important to identify actions to be included in the plan but the DD7 is not committed to complete any of the actions. However, if an action is not identified, and later becomes a viable project that the DD7 wants to complete, the application becomes less competitive because the action was not identified, therefore, JSWA recommended that we include all actions the MPC recommends.

JSWA gave some examples of projects that have been awarded grant funds including:

- Acquisition and Demolition of flood prone properties;
- Structural projects include channelization, detention basins, drainage projects and minor flood protection projects.

He then provided an overview of the grant programs available for these types of projects – Severe Repetitive Loss Program, Hazard Mitigation Grant Program, Flood Mitigation Assistance Program and Repetitive Flood Claim Program.

The Plan will be posted for public review in April 2012 and there will be one more public meeting in April to go through the plan and incorporate relevant comments from the stakeholder group and public. The plan will then be submitted to the Texas Division of Emergency Management and Texas Water Development Board for review by June 2012. After the State reviews the plan, they will submit the plan to FEMA for review.

JSWA opened the presentation to questions from the Board and the Public. There were no members of the public present and one question from the Board regarding if grant funding were available for a new administration building for DD7. JSWA that there is no FEMA mitigation grant that would be available for this project type.

There were no other questions.

Figure C-1
Jefferson County DD7 Hazard Mitigation Plan Update Meeting
Public Notice advertised in *The Port Arthur* for meeting January 3, 2012

Appendix C
Public Notice Documents and Meeting Minutes

The Port Arthur News
A Division of Newspaper Holdings, Inc.
Port Arthur, Texas

AFFIDAVIT OF PUBLICATION

The State of Texas
County of Jefferson,
City of Port Arthur

***Tara Ford*, being duly sworn deposes and says:**

That she is a resident citizen of Jefferson County, Texas and that she is of lawful age; that she is the Classified Representative of the PORT ARTHUR NEWS, a division of Newspaper Holdings, Inc., same being a newspaper published and having a general circulation in the City of Port Arthur, Jefferson County, Texas; that said newspaper has been continuously and regularly published for a period of more than one year in Jefferson County, Texas, and that the advertising of **Jefferson County Drainage District #7** Ad# **132145** was published in said newspaper in the issue of **December 11th, and December 18th, 2011** which were the regular publication days of said issues; and that said issues were actually published, circulated and distributed.

Tara Ford

SUBSCRIBED AND sworn to before me,
this the 23rd day of January , A.D. 2012

Notary Public in and for Jefferson County, Texas

JERRI POWELL
NOTARY PUBLIC, STATE OF TEXAS
My Commission Expires
April 24, 20[illegible]

Jefferson County Drainage District No. 7

Appendix C
Public Notice Documents and Meeting Minutes

Sunday, December 18, 2011 Port Arthur News/Orange Leader

The News Classified

409-721-2440

fax 409-724-6849
classads@panews.com
3501 Turtle Creek Drive
Port Arthur, TX 77642
Mon.-Fri. 8 a.m.-5 p.m.

Deadlines for Line Ads

Publication	Deadline
Monday	2 pm Friday
Tuesday-Friday	1 pm Day Prior
Saturday	12 pm Friday
Sunday	1 pm Friday
Saturday Legals	12 pm Friday

Obituaries

Publication	Deadline
Sat., Sun., & Mon.	2 pm Friday
Tues.-Fri. Fax/Walk-ins email	2 pm Fax Da[y] 2 pm Day Pri[or]

Classified pre-paid advertising 7 day run 3 day minimum charge of $25.40; 14 day run 7 day minimum $37.40

ANNOUNCEMENTS

Lost and Found

LOST DOG! Orange/White Brittany. Answers to Rogue. REWARD if found. Call 979-218-3999

Lost Poodle/Schnauzer LOST over 1 week ago in Nederland 31st around 200 block. Small female dog approx. 8lbs. Schdoodle, black with 4 white paws, socks, & white on neck and belly, her mustache is turning brown. (409) 790-8491

Public Notices

LEGAL NOTICE

Legal notice is hereby given that WAIDI Z. HAMMAD owner of a business operating under the assumed name of MAAWG'S LIQUOR has made application with the TEXAS ALCOHOLIC BEVERAGE COMMISSION for a BEER RETAIL DEALER'S OFF-PREMISE LICENSE PACKAGE STORE PERMIT at 1647 Rev. Ransom Howard St., Port Arthur, TX 77640 said premises not having heretofore been licensed for that purpose. Said petition is set for hearing at 10:30 o'clock a.m.

CAROLYN L. GUIDRY, COUNTY CLERK JEFFERSON COUNTY, TEXAS

Happy Ads

Happy 15th Birthday Andre Jackson "CABOOSE"

Love Mom, Dad,

Public Notices

Jefferson County Drainage District No. 7
Hazard Mitigation Plan Update
First Public Meeting
Public Notice

There will be a public meeting in conjunction with the Jefferson County Drainage District No. 7 Board meeting held on January 9, 2012 at 2:00 p.m. at the Jefferson County Drainage District No. 7 (DD7) office located at 4401 9th Avenue, Port Arthur, Texas 77642.

DD7 welcomes public participation at this meeting. The purpose of this public meeting will be to provide an overview of the process DD7 is following to update its Hazard Mitigation Plan and to provide details on when and where the draft plan update will be made available for public review and comment. The plan update provides an overview of natural hazards in DD7's jurisdiction, summarizes past hazard events, describes how DD7 recognizes and addresses hazards in the area, and provides a status update of mitigation projects as well as identifies any new actions. The actions identified in this plan are intended to reduce the long-term impacts of hazards within DD7 in order to protect the citizens within the DD7 boundaries. Members of the public are encouraged to attend, especially those with property located in flood-prone areas.

After consideration of comments and review by the Texas Water Development Board and the Texas Division of Emergency Management and approval by FEMA, the final hazard mitigation plan will be presented to the Board of Directors for adoption.

Questions about the plan should be directed to Mitigation Plan Consultant, Jeff Ward at 888-208-6695.

Phil Kelley
General Manager
DD7

LEGAL NOTICE

INVITATION FOR REQUEST FOR QUALIFICATIONS

The Port Arthur Independent School District will receive sealed proposals in the Purchasing Department of the Administration Building, 4801 9th Ave., (P.O. Box 1388, 77641), Port Arthur, Texas 77642, no later than 2:00 p.m. (CST), Thursday, January 5, 2012 for:

ARCHITECTURAL & ENGINEERING SERVICES FOR FUELING STATION

When determining contract awards to vendors, the district shall consider:
- The purchase price
- The reputation of the vendor and of the vendor's goods and services
- The quality of the vendor's goods or services
- The extent to which the goods and services meet the district's needs
- The vendor's past relationship with the district
- The impact on the ability of the district to comply with laws and rules relating to historically underutilized businesses
- The total long-term cost to the district to acquire the vendor's goods or services
- Any other relevant factor specifically listed in the request for bids or proposals

THERE WILL NOT BE A PRE-BID CONFERENCE & WALK THROUGH. Please email questions to rfisher@pais.org and jcornelison@paisd.org.

April Fisher
Purchasing Specialist
409.989.6252

Drivers

Truck Drivers Wanted Immediately!

Drivers

Special Notices

...ences, limitations or discrimination. We will not knowingly accept any advertising for real estate which is in violation of the law. All persons are hereby informed that all dwellings advertised are available on an equal opportunity basis.

EMPLOYMENT

Employment Services

Park Technical Institute. Computer, Secretarial, Medical, Legal, CAD Training, Gregg Shorthand, Financial Aid if Qualified. 722-1072

General Help Wanted

Certified PHARMACY TECH needed. TSBP registered. Pharmacy exp. preferred. Apply within, Shoeless Medicine Chest, 1901 West Park, Orange.

★★ HIRING ★★ AC Technician, Maintenance Worker, Make Ready Repair Man, & Leasing Agent for Beaumont Apartment Complex. Call 409-454-0008

Home Care Agency LOOKING FOR MARKETING STAFFS, NURSES, CHAPT Aides and OT Aides. We are accepting new Patients in all area. 1-800-757-... Call Office 281-573-3019

General Help Wanted

the position of ... tenance Worker ... the Street Dep[t] ... cations and ... scriptions m[ay be] picked up at ... Personnel De[pt] ... Green Aven[ue], ... ange, TX.

Salary: $12.2...

MERCHAN[DISE]

Firearms

☆☆☆☆ I BUY GU[NS] FOR CAS[H] New, Old & An[tique] Call 409-726-... ☆☆☆☆

Firewood for Sale

Oak Firewood Cord, $100 Cord. Delivery Ext[ra] Call 409-745-91...

Furniture

Cajun Corn[er] Furniture buy[s] Sale Used furniture & appliances. C[all] 735-8901 or 734-7771

To be added to final version of plan.

To be added to final version of plan.

Appendix F

Acronyms

The following acronyms are used within the 2010 HMP Update:

CFR Code of Federal Regulations

CRS – Community Rating System (NFIP)

TDEM – Governor's Division of Emergency Management

FEMA – Federal Emergency Management Agency

FIRM – Flood Insurance Rate Map

FIS – Flood Insurance Study

FMA – Flood Mitigation Assistance (FEMA)

GIS – Geographic Information System

HMGP – Hazard Mitigation Grant Program (FEMA)

JCDD6 – Jefferson County Drainage District No. Six

MPC – Mitigation Planning Committee

NHC – National Hurricane Center

NFIP – National Flood Insurance Program (FEMA)

NOAA – National Oceanic and Atmospheric Administration

Appendix F

Acronyms

SFHA – Special Flood Hazard Area

TCEQ – Texas Commission on Environmental Quality

TxDOT – Texas Department of Transportation

TWDB – Texas Water Development Board

USGS – United States Geological Survey

Appendix G

Key Terms

For the most part, terms used in the Plan update have the meanings that are commonly associated with them:

Disaster. The occurrence of widespread or severe damage, injury, loss of life or property, or such severe economic or social disruption that supplemental disaster relief assistance is necessary for the affected political jurisdiction(s) to recover and to alleviate the damage, loss, hardship, or suffering caused thereby (DEM).

Federal Emergency Management Agency (FEMA). Coordinates the federal government's efforts to plan for, respond to, recover from, and mitigate the effects of natural and man-made hazards.

Flood Insurance Rate Map (FIRM). Prepared by the Federal Emergency Management Agency to show Special Flood Hazard Areas; this map is the basis for regulating development according to the Regulations for Flood Plain Management.

Floodplain: See "Special Flood Hazard Area (SFHA)" below.

Hazard. Defined as the natural or technological phenomenon, event, or physical condition that has the potential to cause property damage, infrastructure damage, other physical losses, and injuries and fatalities.

Mitigation. Defined as actions taken to reduce or eliminate the long-term risk to life and property from hazards. Mitigation actions are intended to reduce the need for emergency response – as opposed to improving the ability to respond.

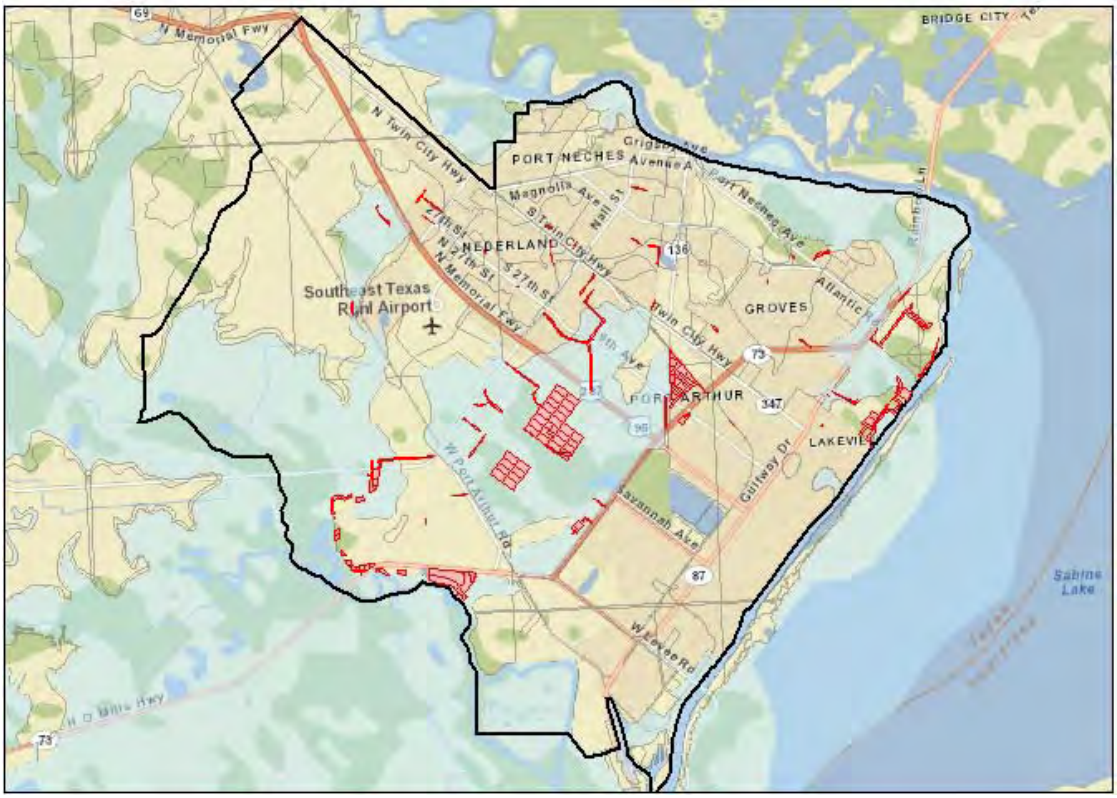
National Flood Insurance Program (NFIP). Located within FEMA, is charged with preparing FIRMs, developing regulations to guide development, and providing insurance for flood damage.

Risk. Defined as the potential losses associated with a hazard. Ideally, risk is defined in terms of expected probability and frequency of the hazard occurring, people and property exposed, and potential consequences.

Special Flood Hazard Area (SFHA) or Floodplain. The area adjoining a river, stream, shoreline, or other body of water that is subject to partial or complete inundation. The SFHA is the area predicted to flood during the 1% annual chance flood, commonly called the "100-year" flood.

Appendix H

FIRMETTES FOR EACH FACILITY OWNED BY DD7



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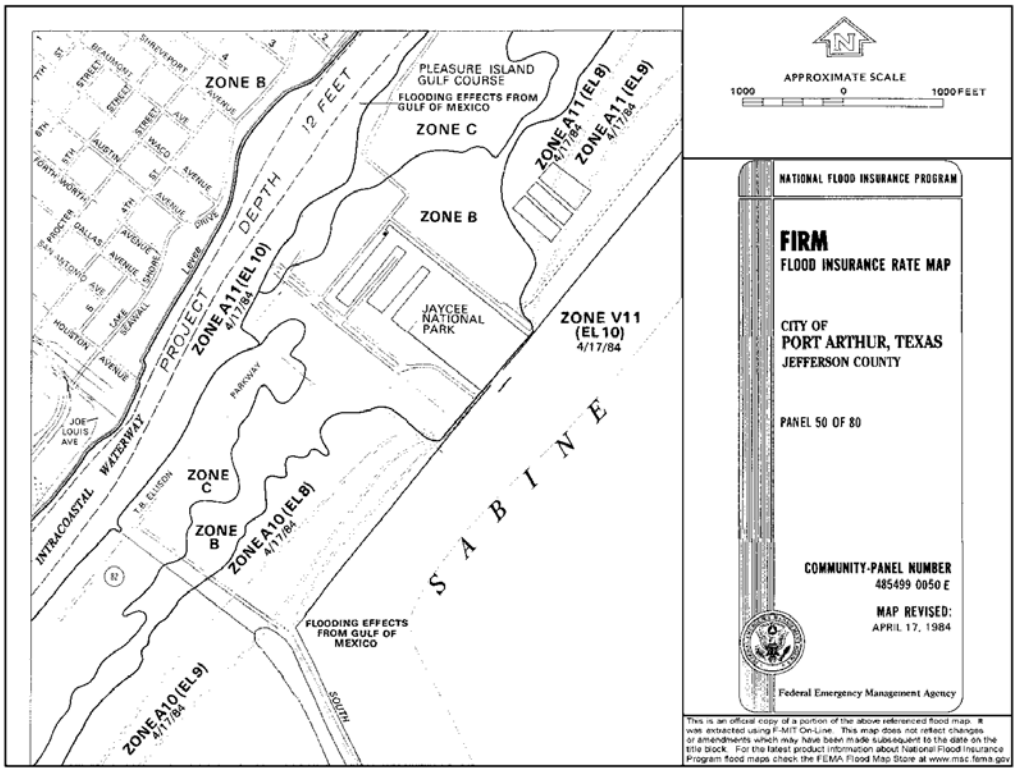

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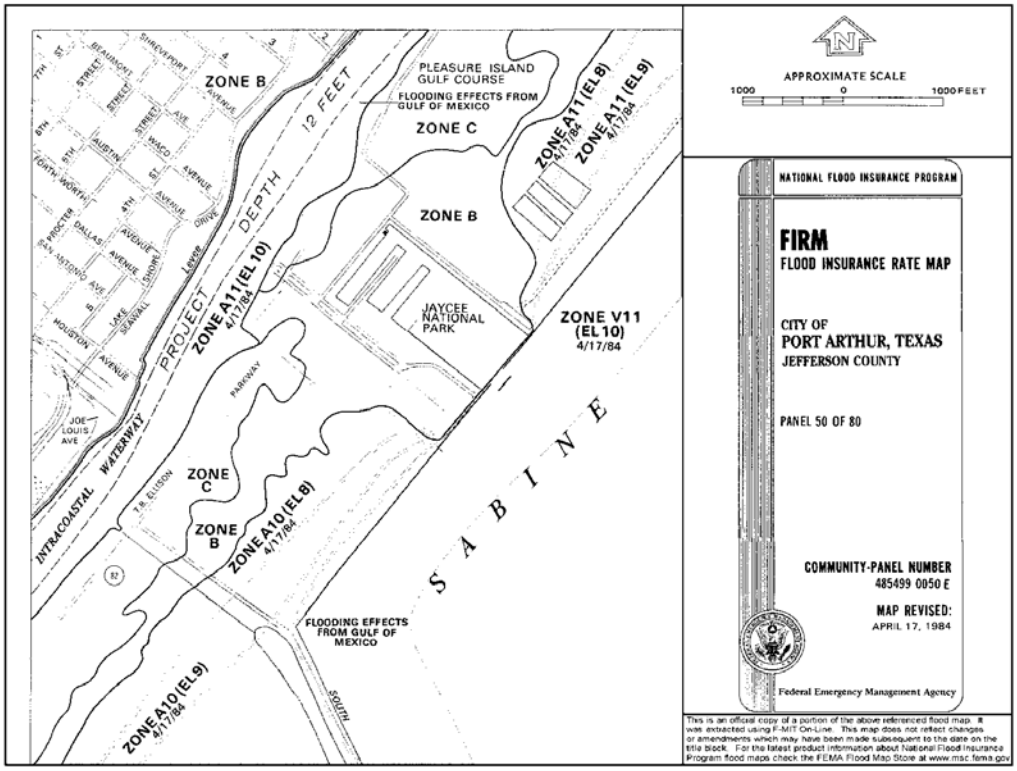

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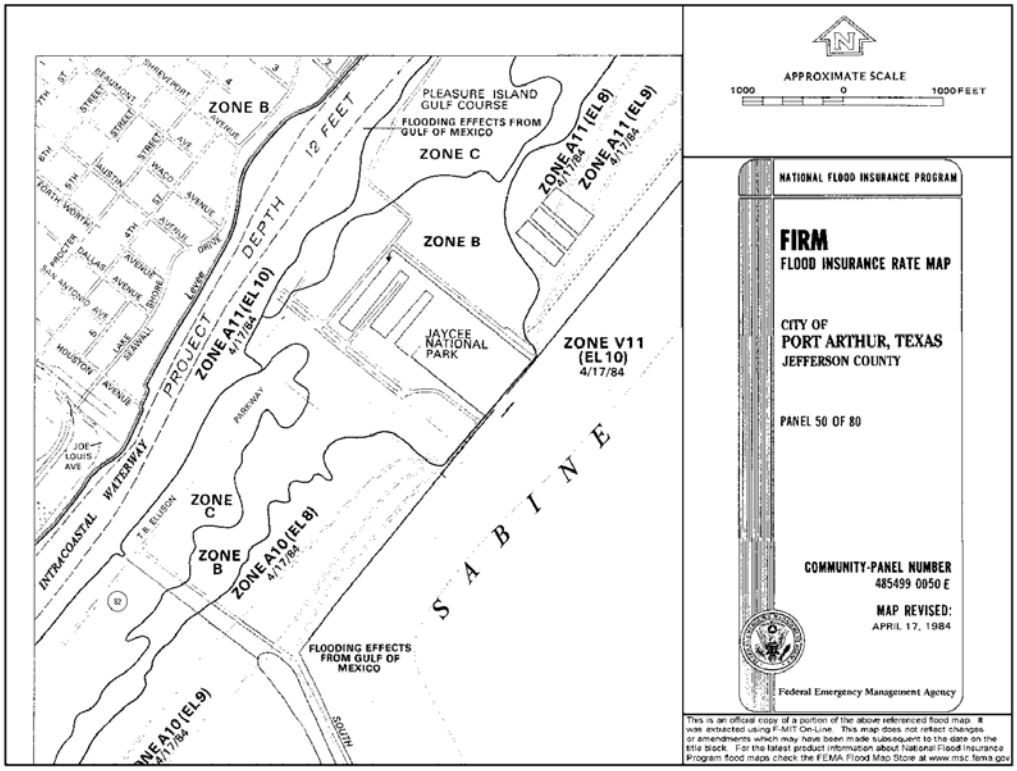
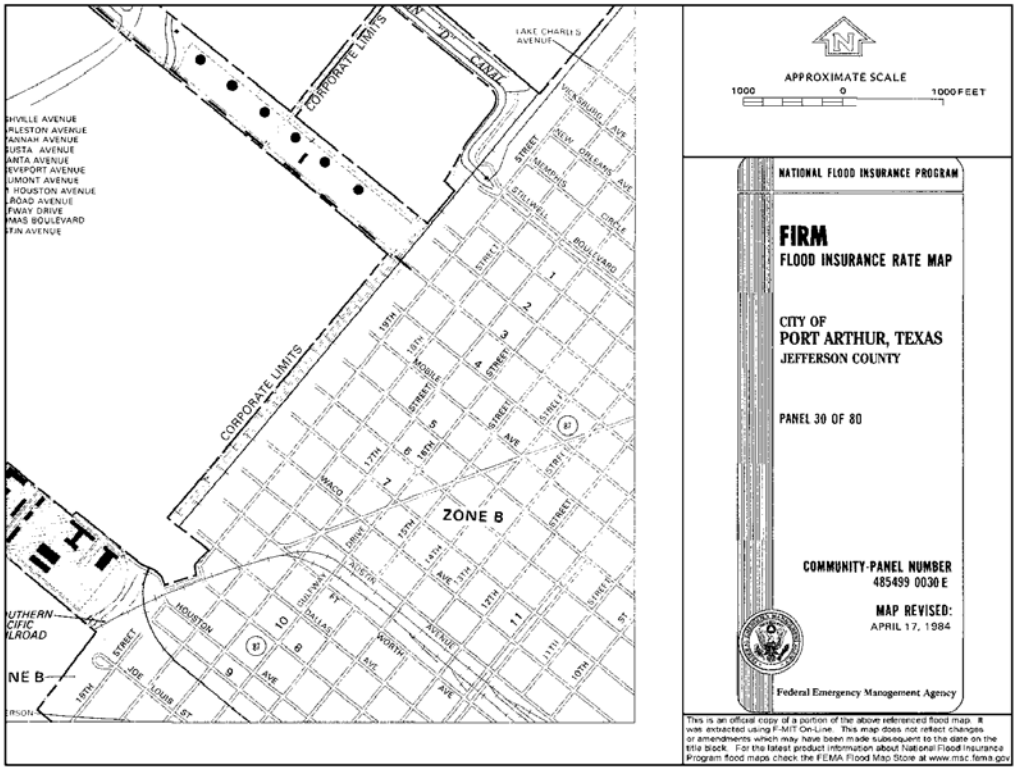


Appendix H

FIRMETTES FOR EACH FACILITY OWNED BY DD7



Appendix H

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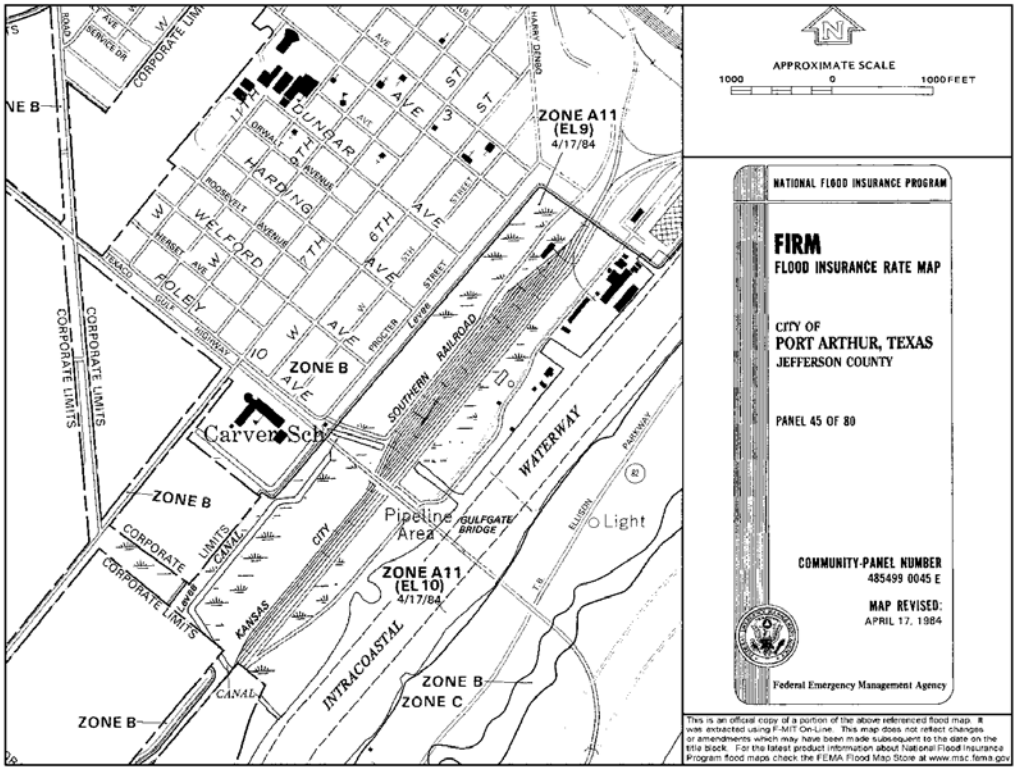

Appendix H

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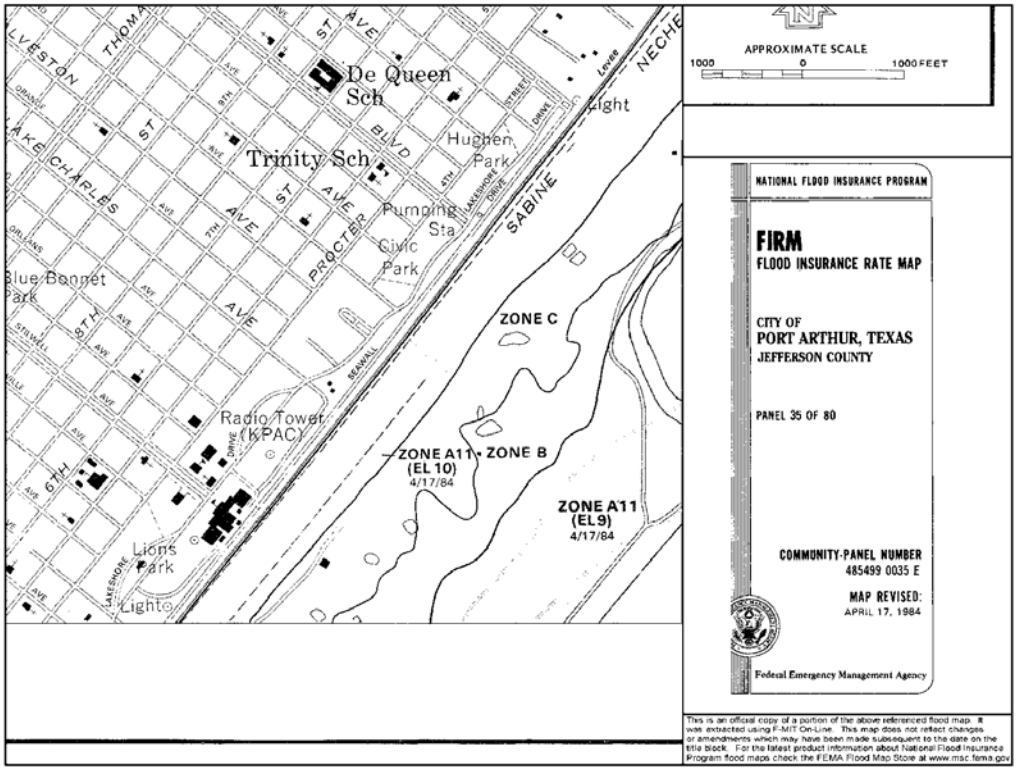

Appendix H

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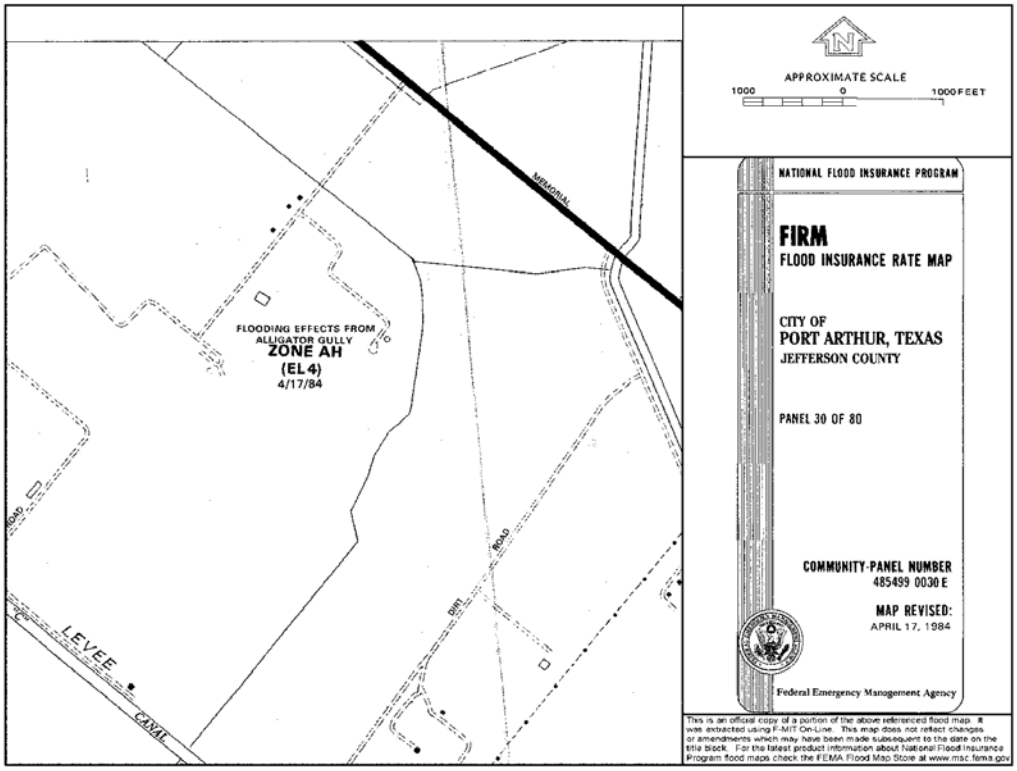

Appendix H

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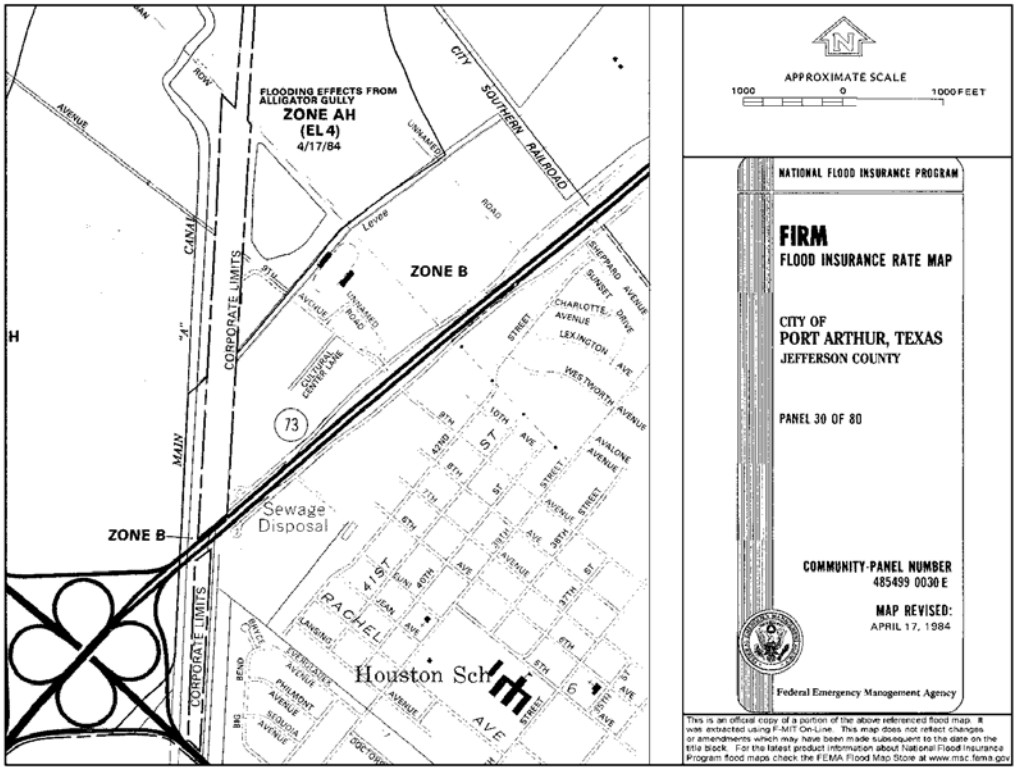

Appendix H

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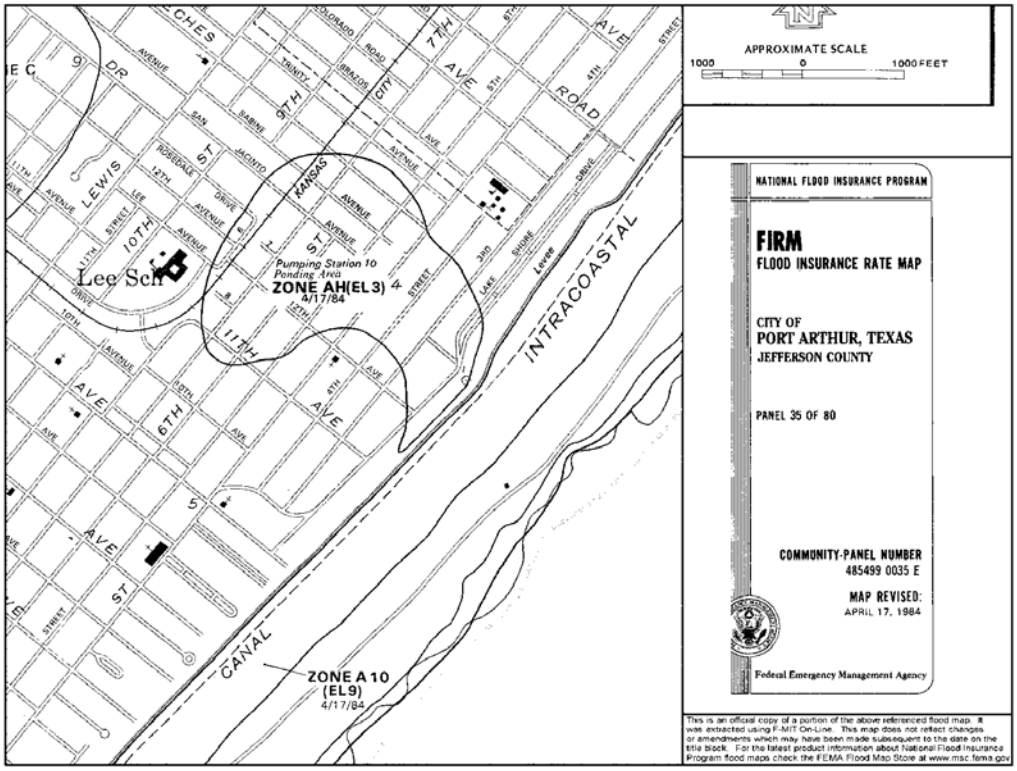

Appendix H

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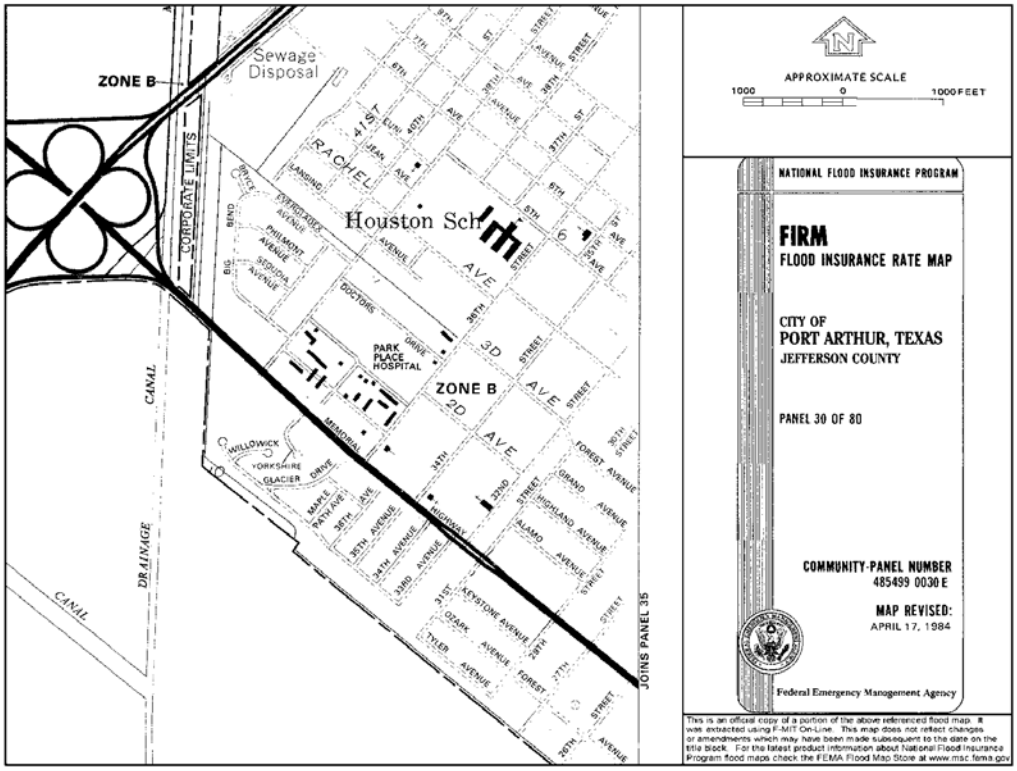

Appendix H

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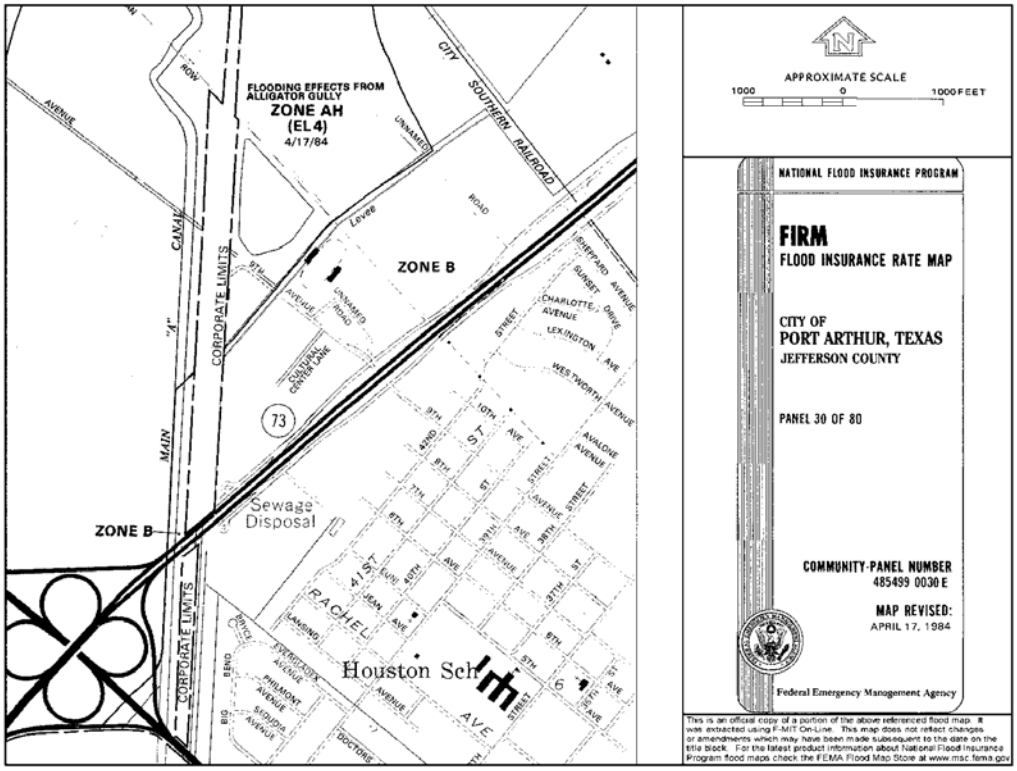

Appendix H

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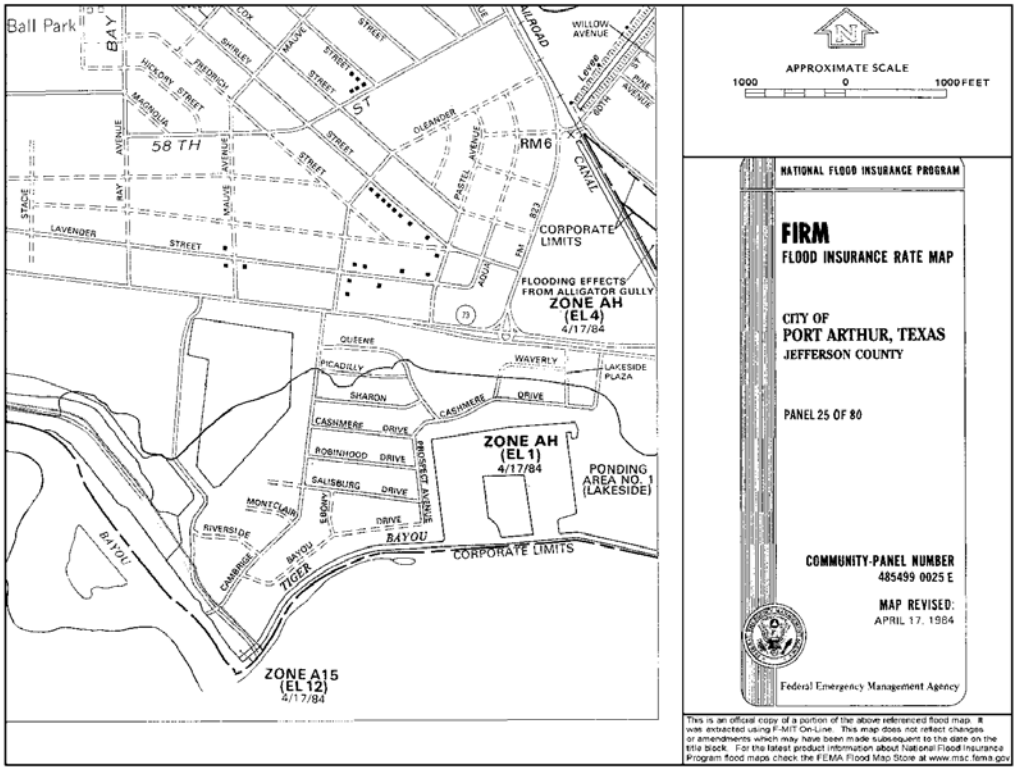

Appendix H

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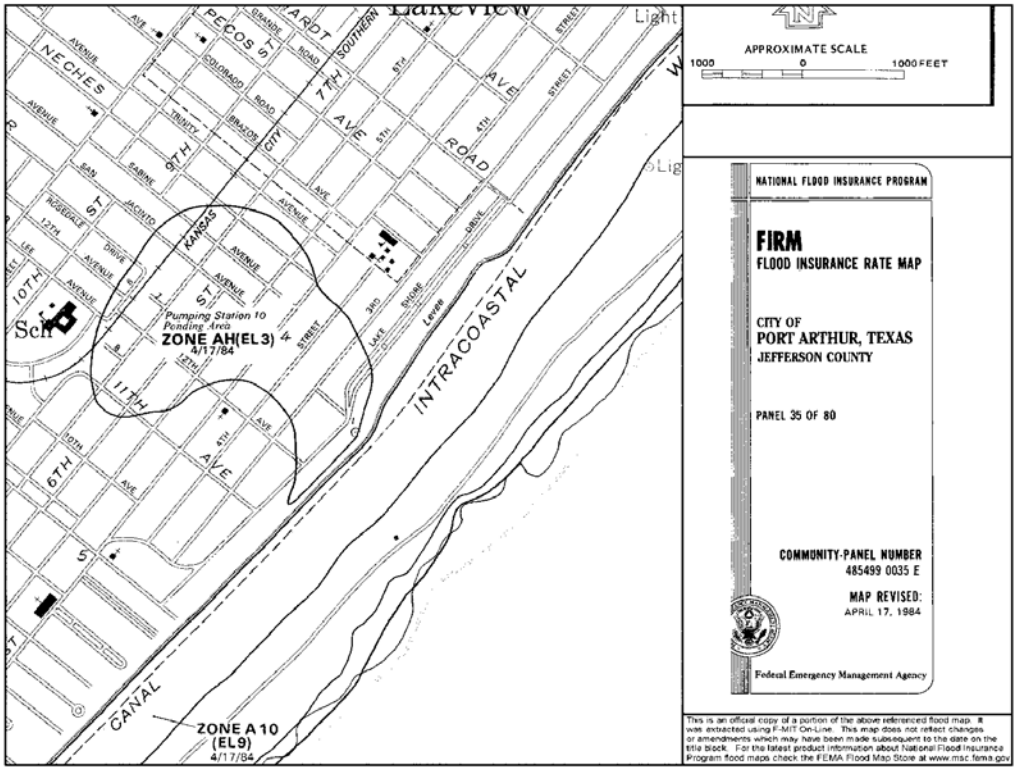

Appendix H

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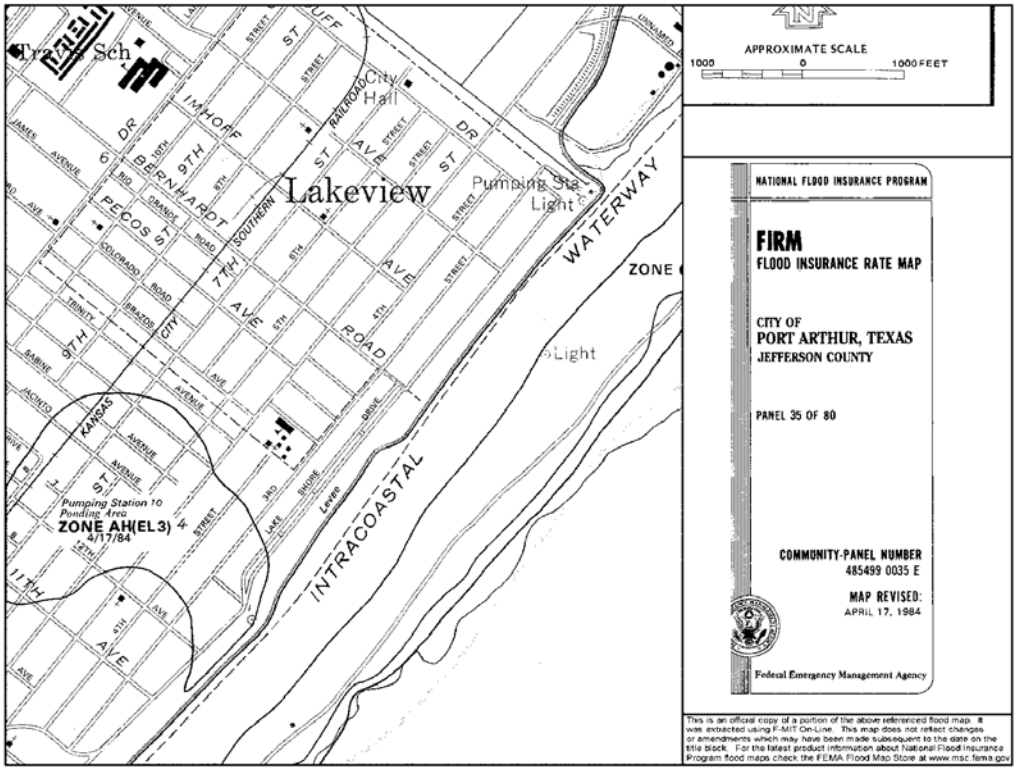

Appendix H

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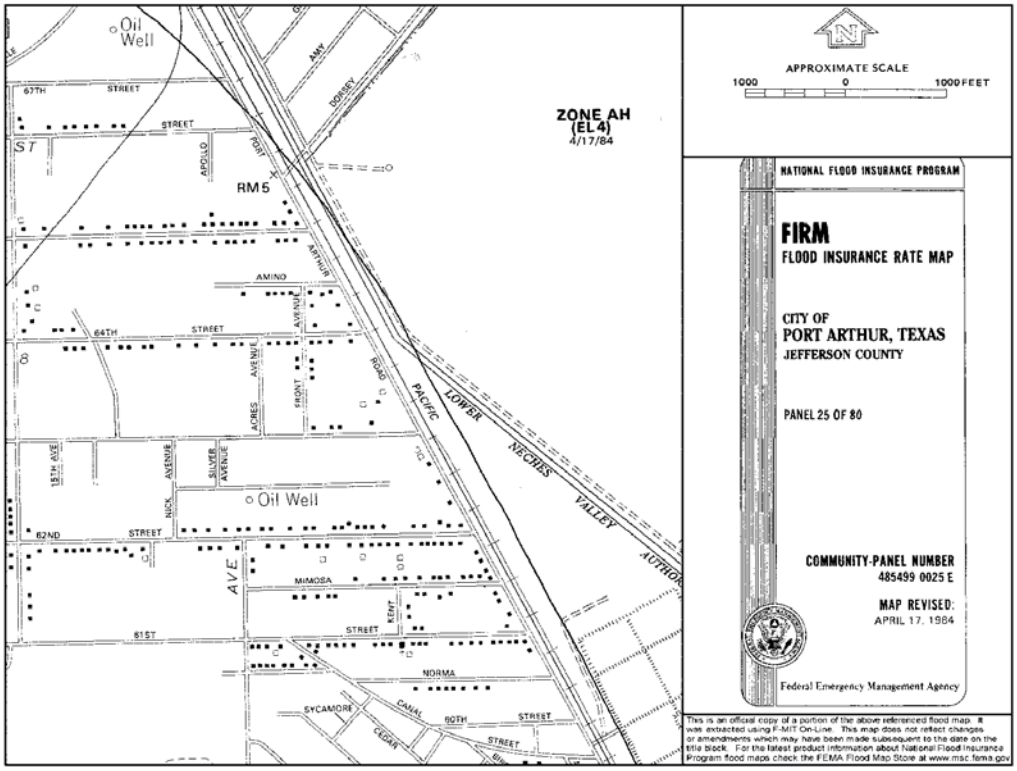

Appendix H

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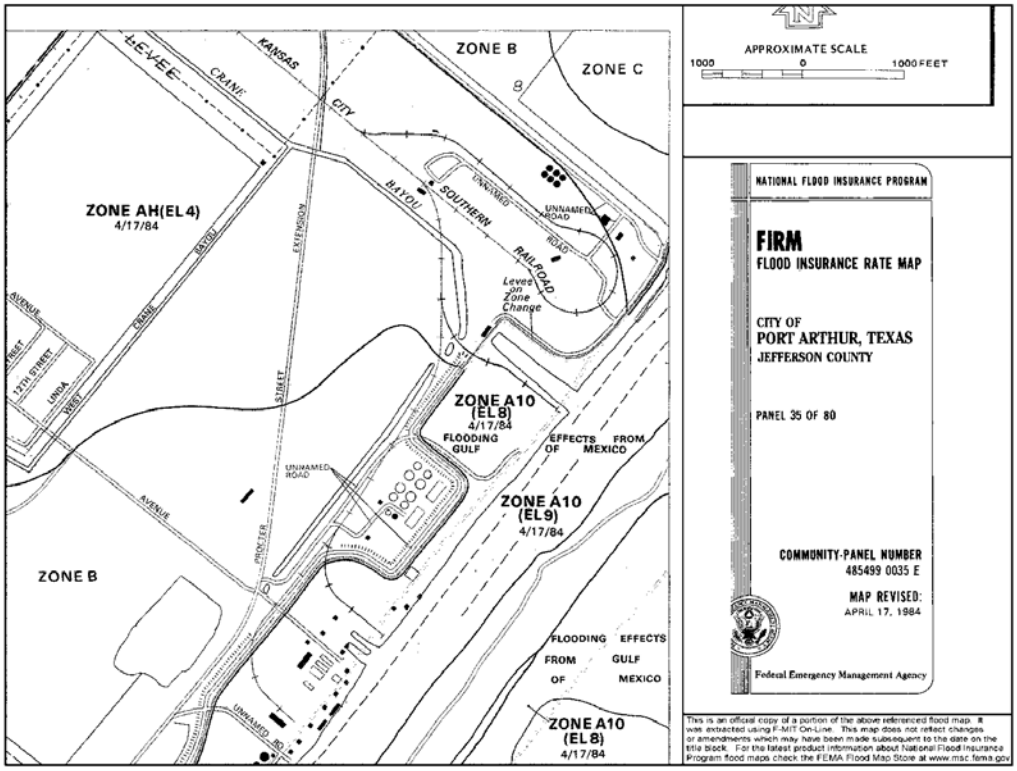

Appendix H

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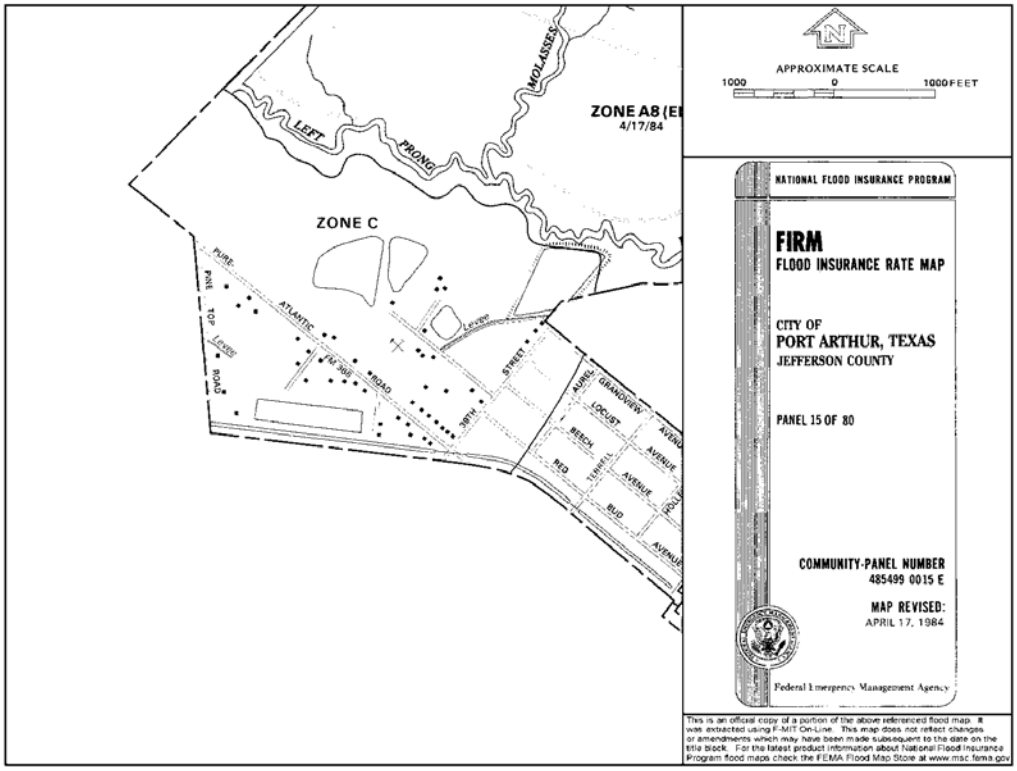

Appendix H

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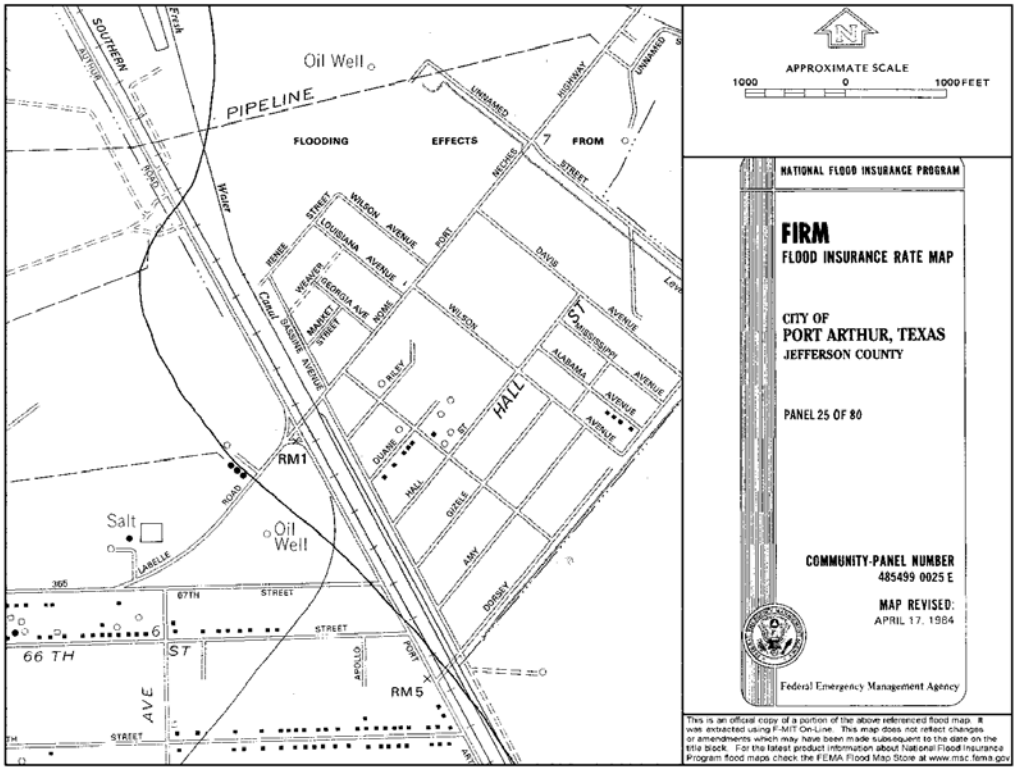

Appendix H

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