Sabine River Authority, State of Louisiana

Hazard Mitigation Plan

(Public Review Draft)

December 2009

Developed in accordance with PUBLIC LAW 106–390—OCT. 30, 2000 (Disaster Mitigation Act of 2000) by the Sabine River Authority Hazard Mitigation Planning Team with assistance from Metro Planning, Inc.

ACKNOWLEDGEMENTS

Preparation of the Sabine River Authority, State of Louisiana Hazard Mitigation Plan (SRA-HMP, or HMP) involved collaboration among public, private and non-profit organizations in Louisiana including the Sabine River Authority, neighbor jurisdictions, the State of Louisiana Governor's Office of Homeland Security and federal agencies.

The work of the Sabine River Authority, Louisiana Hazard Mitigation Team (HMT) has made this project possible. The Sabine River Authority would like to thank all participants for their efforts in providing accurate and timely data in the preparation of this plan. The local media provided historic accounts of severe hazard events and an outlet for public notice. Numerous elected and appointed officials, city and parish emergency preparedness personnel participated in the planning process and contributed greatly to the plan's development. In addition, the Hazard Mitigation Team thanks the National Weather Service-Lake Charles for their excellent contribution of data and input in the planning process.

The Sabine River Authority and Hazard Mitigation Team sincerely thanks the Louisiana Governor's Office of Homeland Security and Emergency Preparedness for their commitment of time, personnel and resources that helped to guide the process and ultimately ensure that the final document meets the standard set for all jurisdictions in the State.

The Hazard Mitigation Team also thanks the following parishes for the time and resources dedicated in preparation, review and comments on the Plan: Beauregard, Calcasieu, Cameron, DeSoto, Sabine, and Vernon. While these parishes have not formally adopted this plan, each contributed to the planning process and provided valuable comments to ensure the plan reflects the mitigation goals of Sabine River Basin as a whole. Thanks also go out to the Vernon Parish Police Jury administration and staff for hosting planning meetings and their outstanding contributions to this effort.

The Sabine River Authority administration, staff and Board of Directors deserve special thanks for their contributions to this project and for taking the initiative to provide funding and resources necessary to take this project to completion and ultimate implementation.

The list below recognizes the following members of the Sabine River Authority Hazard Mitigation Team for their work and guidance in the development of this plan:

- Mr. Carl Chance, Chair
- Mr. Norman Bourdeau
- Mr. Jonathan Brazzell
- Mr. Mike Carr
- Ms. Belinda Diehl
- Ms. Kellie Ferguson
- Mr. Ken Harlow
- Mr. James Hudgens
- Mr. Larry Kelly
- Ms. Montra Lockwood
- Ms. Nancy McDowell
- Mr. Glen Mears Sr.
- Ms. Rhonda Plummer
- Mr. Jim Pratt
- Ms. Carrie Robinette
- Mr. John Rua
- Mr. Carl Thompson

Finally, thanks to the staff of Metro Planning for their work facilitating the planning process and in preparation of this plan:

Metro Planning, Inc.

Jed Truett, M.C.R.P., A.I.C.P., Principal
Gregory J. Wobbe, M.C.R.P., Mitigation Director
Cress Bates, B.S., GIS Director
Robert Stevens, M.C.R.P., A.I.C.P. Senior GIS Analyst
Matt Fitzer, B.S., GIS Analyst
Heather Pickett, B.S., GIS/Graphic Technician

TABLE OF CONTENTS

Chapter 1. Prerequisites 1
1.1 Introduction 1
1.2 Authorities 1
1.3 Local Adoption 1
1.4 Document Structure 2
1.5 Sabine River Authority Profile 2
1.5.1 Governance 2
1.5.2 Operations 3
1.5.3 Geography 7
1.5.4 Disaster Declaration History 9
Chapter 2. Planning Process 12
2.1 Hazard Mitigation Team 13
2.2 Planning Process/Team Meetings 14
2.3 Public Participation 16
Chapter 3. Risk Assessment 17
3.1 Identifying Hazards 17
3.1.1 Methods and Definitions 18
3.1.2 Data Sources and Limitations 20
3.2 Hazard Profiles 20
3.2.1 Dam and Levee Failure 21
3.2.2 Drought 29
3.2.3 Earthquake 34
3.2.4 Excessive Heat 38
3.2.5 Flooding 43
3.2.6 Hailstorm 53
3.2.7 Hurricane and Tropical Storms 58
3.2.8 Thunderstorm, Lightning and High Winds 65
3.2.9 Tornado 70
3.2.10 Wildfire 77
3.2.11 Winter Storm 82
3.3 Vulnerability Assessment 86
3.3.1 Repetitive Loss Properties 87
3.3.2 Vulnerable Populations 90
3.3.3 Asset Inventory 95

3.3.4 Critical Facilities and Infrastructure 99
3.3.5 Potential Dollar Loss 117
3.3.6 Land Use and Development Trends 126
3.3.7 Existing Planning Mechanisms 127
Chapter 4. Mitigation Strategy 128
4.1 Local Hazard Mitigation Goals 128
4.2 Action Item Identification and Prioritization 129
4.2.1 Action Item Identification 129
4.2.2 Action Item Prioritization Criteria 129
4.3 Hazard Mitigation Action Items 130
4.4 Continued National Flood Insurance Program Participation and Compliance 144
Chapter 5. Plan Maintenance 148
5.1 Adoption 148
5.2 Implementation, Monitoring/Evaluation, and Update 148
5.3 Incorporation into Existing and Future Planning Documents 149
5.3 Continued Public Involvement 150
Appendices 151
Appendix A. Adoption Documents 152
Appendix B. (Reserved) 153
Appendix C. Hazard Mitigation Planning Meetings/Announcements 154
Appendix D. Sabine River Authority Strategic Plan 156
Appendix E. Disaster Declaration Process 161

CHAPTER 1. PREREQUISITES

1.1 INTRODUCTION

The Sabine River Basin is a region that experiences relatively frequent and occasionally destructive events related to natural hazards. A natural hazard is a threat from a naturally occurring event that can have a negative effect on people or the environment. The impacts of natural hazards directly affect the safety and well being of the residents of the area, highlighting the importance of developing ways to eliminate or reduce future damages from hazards.

The ultimate goal of the Sabine River Authority-Louisiana Hazard Mitigation Plan is to promote the health, safety and welfare of all residents of the region and local interests. The purview of this document includes the operating jurisdiction of the Sabine River Authority-Louisiana, which includes all portions of the Sabine River watershed in the state of Louisiana, and is commonly referred to hereafter as the 'planning area'.

The purpose of mitigation planning in general is to reduce or prevent the negative impacts of future events. The concept could be summarized with the saying, 'an ounce of prevention is worth a pound of cure'. The purpose of mitigation planning as it relates to natural hazards is to prevent injuries, loss of life and material damage via proactive measures.

A hazard mitigation plan is distinguishable from an emergency operations plan or disaster response plan to the extent that it plans the implementation of mitigation actions prior to a hazard occurrence. Mitigation actions can be short-term or long-term activities which reduce a community's vulnerability to hazard impact through various means, including avoidance, protection and preparedness. The Sabine River Authority-Louisiana Hazard Mitigation Plan (SRA-HMP, the Plan, or plan) is a plan for action in the interest of public protection and reducing the impact of future disasters.

1.2 AUTHORITIES

The Sabine River Authority-Louisiana Hazard Mitigation Plan was developed 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. Program requirements related to hazard mitigation are included in 44 CFR Parts 78, 201 and 206.

1.3 LOCAL ADOPTION

Upon provisional approval of this Plan by the State of Louisiana and the Federal Emergency Management Agency, the governing body for the Sabine River Authority-Louisiana will formally adopt the SRA-HMP in public session. Following adoption, copies of the adoption instruments will be included in Appendix A of this document.

1.4 DOCUMENT STRUCTURE

This document is structured to match the required elements for hazard mitigation plans under federal and state requirements. It consists of five chapters, each of which satisfies a specific grouping of requirements as described in the *Local Multi-Hazard Mitigation Planning Guidance* published by FEMA in July of 2008. Code of Federal Regulations (CFR) requirement(s) pertaining to each respective plan section are included below the corresponding section heading. The document is organized into chapters (1.) sections (1.1) and subsections (1.1.1). Tables, figures and charts are numbered in order of appearance within each chapter.

Chapter 1 includes the prerequisites for hazard mitigation plans and describes the purpose, authorities, process of local adoption and provides a general profile of the SRA and planning area. Chapter 2 describes the process through which this plan was developed, via planning team and public meetings and the input of citizens and local officials. Chapter 3 includes the risk and vulnerability assessments for the planning area, describing the identified hazards that occur in the western Louisiana region and an inventory of SRA and local assets and critical facilities that represent varying degrees of vulnerability to hazard impacts.

Chapter 4 addresses the Sabine River Authority's mitigation strategy, and represents this plan's primary function moving forward. It outlines the Plan's overarching goals and the actionable items and projects the SRA intends to implement. Chapter 5 describes the approach to plan maintenance, which includes the process for local adoption, evaluation criteria, and review and update schedules.

1.5 SABINE RIVER AUTHORITY PROFILE

The following section provides a general profile of the agency, governance, operations, geography, and disaster history of the Sabine River Authority, Sate of Louisiana.

1.5.1 Governance

The Sabine River Authority-Louisiana is a division of the State of Louisiana Department of Transportation. It is governed by a 13 member Board of Directors and managed by professionals representing the fields of administration, engineering, natural resources, recreation, finance, maintenance and public affairs. Power generation and water sales are the main sources of income for operation and maintenance.

The mission of the Sabine River Authority of Louisiana, consistent with Louisiana Revised Statutes 38:2321, et. seq., and with Article 48 of the Federal Power Commission License, Project 2305, is to provide for economic utilization and preservation of the waters of the Sabine River and its tributaries by promoting economic development, irrigation, navigation, improved water supply, drainage, public recreation, and hydroelectric power for the citizens of Louisiana.

The SRA-LA manages the Toledo Bend Reservoir and Dam jointly with its partner organization, the Sabine River Authority-Texas (SRA-TX). Toledo Bend Project "Joint" Operations are organized as a basic contract establishing administrative functions under the purview of the SRA-Texas and engineering functions under the purview of the SRA-Louisiana. Joint operations are governed by the Toledo Bend Project Joint Operations (TBPJO) Board, with two Board members from each respective Authority and the Executive Director/General Manager from each Authority. A TBPJO Technical Committee staffed by personnel from each Authority is also established.

1.5.2 Operations

Facilities managed by the SRA-LA include Toledo Bend Reservoir and Dam, the Sabine River Diversion Canal, and numerous recreation facilities outlined below.

Toledo Bend Reservoir Project

The Toledo Bend Reservoir Project is the principal facility managed by the SRA. The construction of Toledo Bend Dam, completed in 1969, created a 186,000 acre lake, the largest man-made body of water in the South, and the fifth largest in the United States. The dam is capable of generating 92 megawatts of electrical power, and is funded, constructed, and managed jointly with the SRA-Texas. Additional information is listed in Table 1-1 below.

Table 1-1 Toledo Bend Project Design and Operating Information

Toledo Bend Reservoir	
Feasibility Report,	Forrest & Cotton, Inc., 1958
FERC License issued	October 14, 1963 for 50 years; expires 2013
Construction Complete	Began Operations in 1969
Surface Area	186,000 surface acres at normal pool elevation
Power Pool elevation	172.0 feet msl
Storage Capacity	4,477,000 acre-feet
Average Inflow	4,200,000 acre-feet/year
Shoreline	approximately 1,200 miles
Drainage Area	approximately 7,190 sq. miles
Toledo Bend Dam	
Embankment Length	11,200 feet
Height above streambed	112 feet
Elevation of Crown	185 feet
Width of Crown	25 feet
Toledo Bend Power Plant	
Turbines	2 Kaplan, Vertical Shaft - HP Rating (each) 55,750
Generators	2 Umbrella Type - KVA Rating (95% power factor) each 42,500
Annual Production (Avg.)	MWHr 205,000
Toledo Bend Spillway	
Length (overall)	838 feet
Control Method	Eleven 40 ft. by 28 ft. tainter gates
Elevation, Top of the Gates	173 ft. msl
Elevation, Spillway Weir	145 ft. msl
Design Discharge (cfs)	290000 cubic feet per second

Source: SRA-Louisiana

Operation of the power plant at Toledo Bend Dam is regulated by an operating guide. Based on time of year and reservoir stage, water can either be run through the generating turbines and released downstream, or held in the reservoir. The operating guide is shown in Table 1-2 on the following page.

Table 1-2 Operating Guide, Toledo Bend Dam

MONTH	Reservoir Stage (feet above sea level)	PLANT OPERATION
October thru December	Below 168	No power generated.
	Above 168	Operate plant up to full capacity. *
January	Below 168.5	No power generated.
	Above 168.5	Operate plant up to full capacity. *
February	Below 169	No power generated.
	Above 169	Operate plant up to full capacity. *
March	Below 169.5	No power generated.
	Above 169.5	Operate plant up to full capacity. *
April 1-15	Below 170	No power generated.
	Above 170	Operate plant up to full capacity. *
April 15-30	Below 171	No power generated.
	Above 171	Operate plant up to full capacity. *
May	Any stage Above 168 **Above 172	Use Volume necessary to meet Prime Power Schedule (see Note 2.)
		Operate plant up to full capacity. *
June	Any stage Above 168 **Above 172	Use Volume necessary to meet Prime Power Schedule (see Note 2.)
		Operate plant up to full capacity. *
July	Any stage Above 168 **Above 172	Use Volume necessary to meet Prime Power Schedule (see Note 2.)
		Operate plant up to full capacity. *
August	Any stage Above 168 **Above 172	Use Volume necessary to meet Prime Power Schedule (see Note 2.)
		Operate plant up to full capacity. *
September	Any stage Above 168 **	Use Volume necessary to meet Prime Power Schedule (see Note 2.)

Source: Sabine River Authority

Notes:

1. Maximum turbine discharge, capacity 30 M Ac. Ft. per day.
2. In accordance with Section 5.05 of the Consolidated Power Sales Agreement, no more than 30,000,000 kwh's of prime power shall be scheduled during any one month of the Peaking Period, except with prior written consent of the Authorities.
3. Releases for downstream flows shall be in accordance with Section 5.10 of the Consolidated Power Sales Agreement.
4. When pool stage is at or above 172.5 and inflow is greater than power plant capacity, operate spillway in accordance with "Guide on Spillway Gate Operation."
5. Authorities will notify companies as to flow conditions in the Sabine River as required in Section 5.07 of the Consolidated Power Sales Agreement.
6. Control stages set forth above are to be maintained only to the extent possible when making releases through the power plant. Spillway gates are to be opened only when stages specified in the "Guide on Spillway Gate Operation" are reached.
7. During prime power season when stage of lake is near upper limit maintain close watch on inflow and make releases for secondary power generation to avoid spillway releases if possible.

* Releases to be determined based on best judgment considering upstream conditions, stages at Ruliff and inflows below dam.

** No generation below the 168' msl except in the event of any of the following:

(1) the FERC, or successor agency orders or requires a reduction in the water level of the Reservoir for purposes of inspecting or repairing the dam,

(2) an insufficient supply of electric power to the Companies' firm or non-interruptible power users will result,

(3) non-use of the waters of the Reservoir for the generation of hydroelectric power will result in the failure to satisfy minimum downstream flow requirements necessary to meet water sales from the diversion canals of the Authorities,

(4) non-use of the waters of the Reservoir for the generation of hydroelectric power will result in the failure to deter saltwater encroachment into Sabine River Estuaries, or

(5) the Authorities fail to make all credits owed to the Companies or fail to make full reimbursements as required in Section 3.02A and 3.07 of the Consolidated Power Sales Agreement within the time identified in the Amendment.

History of Toledo Bend Project

As a result of rapid industrial development and the changing demands of an evolving economy during the late 1940's, the people of the Sabine River area both in Texas and Louisiana realized a need to provide for the future of the area. In 1949, the Texas State Legislature created the Sabine River Authority of Texas, followed immediately by the Louisiana State Legislature in 1950, who created the Sabine River Authority, State of Louisiana. Together, these two bodies were given the duties of conserving and developing the waters of the Sabine River Basin for beneficial purposes.

In 1955 the seeds of Toledo Bend as we enjoy it today were sown by both Authorities cooperating under a memorandum of agreement. Studies were undertaken and the results clearly indicated the feasibility of such a project. The $70 million construction cost was shared equally by Texas and Louisiana. This cost included the entire project - land, dam, spillway, powerhouse, new roads and bridges and clearing of boat lanes and shorelines. The states of Louisiana and Texas in 1959 arranged for the financing of $30 million in revenue bonds.

Land acquisition began in 1963, with construction of the dam, power plant, and spillway the following year. Following completion of the structures, the power plant began operation in early 1969. Toledo Bend Reservoir is the only public water conservation and hydroelectric project in the nation to be undertaken without federal participation in its permanent financing.

Sabine River Diversion Canal

The SRD System is a water conveyance system consisting of more than 35 miles of unlined, open channel canals, nearly 4½ miles of underground pipelines, three (3) pumping stations, and five (5) automatic level control gates. The Sabine River Diversion System was created by Acts 90 and 117 of the 1970 Legislature as part of the program for utilization of the waters impounded in Toledo Bend Reservoir, for the purpose of transporting and delivering fresh raw water from the Sabine River to the various industries located in the Lake Charles industrial area, and for furnishing water for the municipal use and the irrigation requirements of farms located along the route. It was constructed by the Department of Public Works, completed in 1981. Act 898 of 1985 transferred responsibility for maintenance and operations to SRA.

Water from the Sabine River gravity flows from the River for approximately 2 miles to pump station one (1).The purpose of the SRD System is to divert surface water from the Sabine River to supply Agricultural, Municipal, and Industrial water needs in Southwest Louisiana, and reduce Southwest Louisiana's dependence on the Chicot Aquifer.

The system is designed to operate automatically. As water is removed from the lower reaches of the system, the constant level downstream control gates open bringing in water from the upper reaches. When the level in the initial reach is lowered, the pumps in Pump Station 1 are activated to lift additional water from Old River to replenish the system. The SRD system has been tremendously successful in slowing the depletion of the ground water reserves in the Chicot Aquifer, thus enabling continued growth of Industry, Agriculture, and Municipal use in Southwest Louisiana. In recent years, nearly 20 billion gallons of diverted water has been pumped through the SRD system each year, primarily for Industrial use.

Recreation Facilities

Cypress Bend Resort
Cypress Bend Resort opened in 1999-2000. The facility includes a conference center, hotel and 18-hole golf course.

Oak Ridge Park
GPS: N 31 54.1" W 93 53.50"
20 miles from Mansfield, Oak Ridge Park has 117 acres of forested land and 1.75 miles of shoreline. The park has 27 RV pads, 17 with water, sewer, and 20, 30, 50 amp electrical hook-ups; 10 with water and electricity but no sewer, and dump station for self-contained campers.

Cow Bayou Park
GPS: N 31 46.234" W 93 47.262"
Cow Bayou Park is located on the Jolly Rogers Road off Hwy 191 at the Sabine and DeSoto parish line. The 7 mile Cow Bayou ATV trail is situated on 228 acres of mixed pine and hardwood timber with 1.5 miles of shoreline.

Converse Bay Park
GPS: N 31 46.234"W 93 47.262"
Converse Bay Park is situated on 111 acres with 0.75 miles of shoreline. The park is located at the intersection of Hwy 191 and Hwy 174, approximately 15 miles north of Zwolle on Toledo Bend Lake. It offers primitive camping, an open pavilion, a large parking lot, and a two lane boat launch.

San Miguel Park
GPS: N 31 34.18" W 93 42.25"
San Miguel Park is south of Zwolle and north of Pendleton Bridge. The park is situated on 108 acres of wooded land and has 1.5 miles of shoreline. San Miguel has 40 RV pads, 20 tent pads, 14 A-frame cabins, 1 remodeled A-frame cabin and 3 conventional cabins. Two large, open air pavilions, two picnic pavilions, two lane boat launch, fish cleaning station and boat house are also located at San Miguel Park.

Toledo Bend Tourist Center
GPS: N 31 29.289" W 93 42.449"
The Tourist Center is housed within the Sabine River Authority, State of Louisiana Office. It is located on the Louisiana end of Pendleton Bridge, about 3 miles west of the intersection Hwy 6 and Hwy 191 on the east shore of Toledo Bend Reservoir. The facility provides maps, information and travel amenities

Cypress Bend Park (Formerly Twin Island)
GPS: N 31 25.20" W 93 40.77"
Cypress Bend Park is located just around the Bend from Cypress Bend Resort on 114 acres of forested land with 1 mile of shoreline. Cypress Bend has 60 RV campsites with water, sewer and 50, 30, 20 amp electrical hook-ups; furnished cabins and RV trailer rentals; and tent camp sites, swimming area, playground, and covered pavilion.

Pleasure Point Park
GPS: N 31 14.27" W 93 34.82"
Pleasure Point Park is located on 195 acres with three miles of shoreline divided into several coves, five miles north of Toledo Bend Dam. Amenities include a white sand beach, fishing pier, two lane boat launch and 124 RV sites.

Clyde's Crossing
GPS: N 31 37 56.20" W 93 40 01.66"

Clyde's Crossing is a 2.5 acre tract on the banks of Toledo Bend within the city limits of Zwolle, located on Hwy 191. The park includes a fishing pier and picnic tables.

San Patricio Overlook (Hot Wells)
N 31 41.16" W 93 43.78"
The San Patricio Overlook is located approximately 16 miles north of the intersection of Hwy 191 and Hwy 6. The park has 0.15 miles of shoreline, 1.5 acres to explore an accessible fishing pier, benches and picnic tables.

1.5.3 Geography

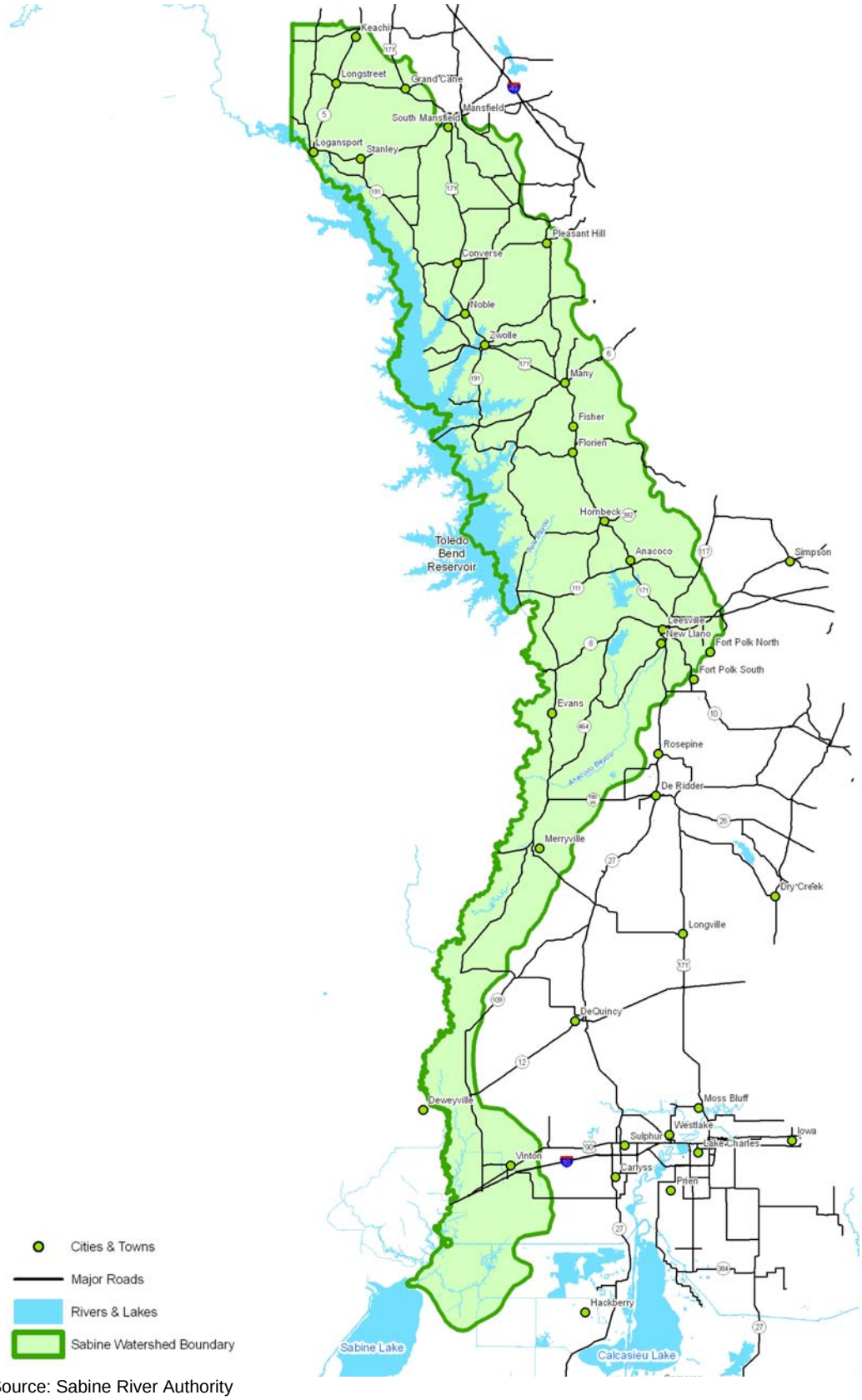
The Sabine River Basin in its entirety includes portions of western Louisiana and eastern Texas. It is relatively long and narrow, with a length of approximately 300 miles and a maximum width of approximately 48 miles. It is roughly crescent-shaped, extending in a general southeasterly direction for a distance of some 165 miles from its source in Hunt County, Texas, to the Texas-Louisiana border in the vicinity of Logansport, Louisiana, thence in a southerly direction to Sabine Lake and the Gulf of Mexico. The Sabine River Basin is bounded on the north and northeast by the Red River Basin, on the east by the Calcasieu River Basin, on the west by the Neches River Basin, and on the northwest by the Trinity River Basin.

The name Sabine comes from the Spanish word for cypress, in reference to the extensive growth of Bald Cypress trees along the lower portion of the river. The total area of the watershed is 9,756 square miles of which some 24 percent (2,341 square miles) lies within the boundaries of Louisiana.

Land surface elevations along the Louisiana portion of the watershed vary from a few feet above sea level near the coast to approximately 440 feet above sea level. The headwaters of the Sabine River originate at river mile 579.4 in northwestern Hunt County, Texas from which the river flows southeasterly through the City of Greenville for a distance of approximately 60 miles to join Caddo Creek and the South Fork within Lake Tawakoni. From Iron Bridge Dam, which forms Lake Tawakoni, the River flows a distance of about 250 channel miles across Texas to the boundary between Texas and Louisiana near the town of Logansport, Louisiana, then southerly along the state line through Toledo Bend Reservoir for a distance of about 265 miles to Sabine Lake, and thence into the Gulf of Mexico. At the point where it becomes the state line, the Sabine River drains an area of approximately 4,846 square miles. The Lower Basin or state line portion has a contributing area of some 4,910 square miles, of which approximately 2,360 square miles lies within Louisiana.

Figure 1-1 on the following page shows the location of towns, highways and primary water bodies and general topography of the Sabine River Basin.

Figure 1-1 Sabine River Basin, Louisiana Portion



Source: Sabine River Authority

1.5.4 Disaster Declaration History

Among many natural disaster occurrences in this region's history, since 1998 there have been 16 federal disaster declarations in Louisiana that included all or portion of the Sabine River Basin. Eleven of the 16 disaster declarations were related to hurricanes and tropical storms, involving some combination of high velocity wind, heavy rain and flooding, and storm surge. As defined by FEMA, the remaining four disaster declarations in the region involved severe storms and flooding (2006), loss of the Space Shuttle Columbia (2003), wildfire (2000) and winter storm (1999). Table 1-2 outlines the history of federal disaster declarations in the region that includes the Sabine River Basin. The most recent disaster declaration was announced in December of 2009, caused by severe flooding across many parts of northwestern and western Louisiana, severe thunderstorms and numerous destructive tornados.

Table 1-2 Federal Disaster Declaration History, Sabine River Basin 1998-2009

Declaration Number	Date Declared	Description
1863	12/10/2009	Severe Storms, Tornados and Flooding
1792	09/13/2008	Hurricane Ike
3295	09/11/2008	Hurricane Ike
1786	09/02/2008	Hurricane Gustav
3289	08/29/2008	Hurricane Gustav
1668	11/02/2006	Severe Storms and Flooding
1607	09/24/2005	Hurricane Rita
3260	09/21/2005	Hurricane Rita
1603	08/29/2005	Hurricane Katrina
3212	08/27/2005	Hurricane Katrina
3172	02/01/2003	Loss of the Space Shuttle Columbia
1437	10/03/2002	Hurricane Lili
1380	06/11/2001	Tropical Storm Allison
2337	09/10/2000	Western Louisiana Fire Complex
1264	01/21/1999	Freezing Rain and Ice Storm
1246	09/23/1998	Tropical Storm Frances and Hurricane Georges

Source: FEMA
Note: A complete description of the disaster response, declaration and recovery process is provided in Appendix E.

The Public Entity Research Institute (PERI) publishes a database that tracks disaster declarations by parish. According to PERI records, the total damage estimate (adjusted for inflation to 2008 dollars) for disasters that impacted parishes in the Sabine River Basin is over $2 billion, not counting impacts from Hurricane Katrina.

Table 1-3 outlines the history of federal disaster declarations for parishes in the planning area.

Table 1-3 Disaster Declaration History by Parish, Sabine River Basin 1971-2008

Dec-Num	Parish	Date	Disaster Description	Regional Damage Estimate (2008 $)
902	DeSoto	4/23/1991	SEVERE STORMS, FLOODING	7,472,119
1012	DeSoto	2/28/1994	SEVERE WINTER ICE STORM	10,288,852
1264	DeSoto	1/21/1999	SEVERE ICE STORM	5,245,869
1269	DeSoto	4/9/1999	SEVERE STORMS, TORNADOS	4,658,307
1607	DeSoto	9/24/2005	HURRICANE RITA	2,173,216,345
Total: 5				**2,200,881,492**
Dec-Num	**Parish**	**Date**	**Disaster Description**	**Regional Damage**

				Estimate (2008 $)
829	Sabine	5/20/1989	SEVERE STORMS, FLOODING	10,051,176
835	Sabine	7/17/1989	TROPICAL STORM ALLISON	8,304,060
1264	Sabine	1/21/1999	SEVERE ICE STORM	5,245,869
1607	Sabine	9/24/2005	HURRICANE RITA	2,173,216,345
1668	Sabine	11/2/2006	SEVERE STORMS, FLOODING	27,454,614
Total: 5				**2,224,272,064**

Dec-Num	Parish	Date	Disaster Description	Regional Damage Estimate (2008 $)
675	Vernon	1/11/1983	SEVERE STORMS, FLOODING	6,564,244
829	Vernon	5/20/1989	SEVERE STORMS, FLOODING	10,051,176
833	Vernon	6/16/1989	SEVERE STORMS, TORNADOS	1,118,531
835	Vernon	7/17/1989	TROPICAL STORM ALLISON	8,304,060
1607	Vernon	9/24/2005	HURRICANE RITA	2,173,216,345
1668	Vernon	11/2/2006	SEVERE STORMS, FLOODING	27,454,614
Total: 6				**2,226,708,970**

Dec-Num	Parish	Date	Disaster Description	Regional Damage Estimate (2008 $)
675	Beauregard	1/11/1983	SEVERE STORMS, FLOODING	6,564,244
829	Beauregard	5/20/1989	SEVERE STORMS, FLOODING	10,051,176
833	Beauregard	6/16/1989	SEVERE STORMS, TORNADOS	1,118,531
835	Beauregard	7/17/1989	TROPICAL STORM ALLISON	8,304,060
902	Beauregard	4/23/1991	SEVERE STORMS, FLOODING	7,472,119
904	Beauregard	5/3/1991	SEVERE STORMS, TORNADOS	42,610,532
1380	Beauregard	6/11/2001	TROPICAL STORM ALLISON	152,938,151
1607	Beauregard	9/24/2005	HURRICANE RITA	2,173,216,345
1668	Beauregard	11/2/2006	SEVERE STORMS, FLOODING	27,454,614
Total: 9				**2,429,729,772**

Dec-Num	Parish	Date	Disaster Description	Regional Damage Estimate (2008 $)
315	Calcasieu	10/13/1971	HURRICANE EDITH	6,168,466
604	Calcasieu	9/25/1979	SEVERE STORMS, FLOODING	1,698,896
622	Calcasieu	5/21/1980	SEVERE STORMS, FLOODING	6,449,463
675	Calcasieu	1/11/1983	SEVERE STORMS, FLOODING	6,564,244
829	Calcasieu	5/20/1989	SEVERE STORMS, FLOODING	10,051,176
835	Calcasieu	7/17/1989	TROPICAL STORM ALLISON	8,304,060
956	Calcasieu	8/26/1992	HURRICANE ANDREW	227,294,718
1169	Calcasieu	3/18/1997	SEVERE WINTER STORMS	5,178,715
1603	Calcasieu	8/29/2005	HURRICANE KATRINA	0**
1607	Calcasieu	9/24/2005	HURRICANE RITA	2,173,216,345
1668	Calcasieu	11/2/2006	SEVERE STORMS , FLOODING	27,454,614
Total: 11				**2,472,380,697**

Dec-Num	Parish	Date	Disaster Description	Regional Damage Estimate (2008 $)
315	Cameron	10/13/1971	HURRICANE EDITH	6,168,466
374	Cameron	4/27/1973	SEVERE STORMS, FLOODING	63,413,270
752	Cameron	11/1/1985	HURRICANE JUAN	38,321,924
956	Cameron	8/26/1992	HURRICANE ANDREW	227,294,718
1169	Cameron	3/18/1997	SEVERE WINTER STORM	5,178,715

1246	Cameron	9/23/1998	HURRICANE GEORGES	70,789,859
1603	Cameron	8/29/2005	HURRICANE KATRINA	0**
1607	Cameron	9/24/2005	HURRICANE RITA	2,173,216,345
Total: 8				**2,584,383,297**

Source: FEMA, Public Entity Research Institute (PERI), http://www.peripresdecusa.org/mainframe.htm
Note: Damage estimates include regional impacts across multiple parishes. **Damage estimates for Hurricane Katrina are not reported in the PERI totals, but based on various accounts totaled over $25 billion across a region that includes the planning area.

CHAPTER 2. PLANNING PROCESS

44 CFR Requirement §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.
Requirement §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.

In coordination with the State of Louisiana Governor's Office of Homeland Security and Emergency Preparedness, the Sabine River Authority played the lead role in initiating the development of this plan. Funding for the plan development process was secured through a motion of the Sabine River Authority Board of Directors.

Following a series of executive planning meetings, the Sabine River Authority contracted with Metro Planning in June 2009 to facilitate the planning process and develop the hazard mitigation plan.

The planning process followed a four-step outline prescribed in FEMA publication, *Local Multi-Hazard Mitigation Planning Guidance* (2008):

1) Organize resources
2) Assess risks
3) Develop the mitigation plan
4) Implement the plan and monitor progress

The first step (organize resources) was addressed by assembling and mobilizing the Hazard Mitigation Team as coordinated by the Sabine River Authority administration and project consultant. In keeping with the goal of including neighboring communities, agencies, businesses, academia, non-profits and interested parties in the planning process, invitation letters were distributed to representatives of the following entities:

Neighboring Communities: emergency preparedness representatives for Beauregard, Calcasieu, Cameron, DeSoto, Sabine and Vernon Parishes

Federal Agencies: the National Weather Service-Lake Charles (NWS)

State Agencies: the State of Louisiana Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP); the Louisiana Recovery Authority (LRA)

The second step (assess risks), was conducted via the team's review and consideration of existing technical reports, studies and planning documents and input from data sources recommended by the Hazard Mitigation Team during team meetings.

The third step (develop the mitigation plan), was coordinated by the project consultant and included the input from members of the Hazard Mitigation Team and data sources referred to in Step 2. Action item development and prioritization for the mitigation plan emphasized a review of costs vs. benefits and the social, technical, administrative, political, legal, economic and environmental considerations of mitigation related projects. Plan document development

involved preparing a HMT review draft to solicit input from the team during the middle stages, and a public review draft that included a two-week public comment period to solicit input from the public. Comments and recommendations from these sources were incorporated into the final version of the Hazard Mitigation Plan submitted to the State and FEMA and ultimately adopted by the SRA.

The fourth and final step, (plan implementation and monitoring), will occur on an ongoing and annual basis prior to and following State and FEMA approval. Adoption of the approved plan by the SRA is the first step toward implementing the plan. Feasibility study and mitigation project scoping are secondary steps, followed by the application for federal grant funding and actual implementation of projects. Monitoring will occur on an ongoing basis as action items are implemented, following major disaster events and during annual plan review meetings of the Hazard Mitigation Team.

2.1 HAZARD MITIGATION TEAM

The Sabine River Authority Hazard Mitigation Planning Team was comprised of representatives of the participating jurisdictions, state, local and regional agencies. The professional fields represented by the Team included:

- Administration
- Climatology
- Emergency Response And Preparedness
- Floodplain Management
- Geographic Information Systems
- Hazard Mitigation
- Planning And Development
- Public Works/Engineering

Table 2-1 below lists the members of the Calcasieu Parish Hazard Mitigation Team. A summary of meeting attendance sign-in sheets is provided as a matrix in Appendix C.

Table 2-1 Calcasieu Parish Hazard Mitigation Team

Representative	Agency/Organization
Carl Chance, Chair	Sabine River Authority-Louisiana
Norman Bordeau	Calcasieu Parish Office of Homeland Security and Emergency Preparedness
Jonathan Brazzell	National Weather Service-Lake Charles
Mike Carr	Sabine River Authority-Louisiana
Belinda Diehl	Vernon Parish Police Jury
Kellie Ferguson	Sabine River Authority-Louisiana
Ken Harlow	Beauregard Parish Office of Homeland Security and Emergency Preparedness
James Hudgens	Vernon Parish Office of Homeland Security and Emergency Preparedness
Larry Kelly	Sabine River Authority-Louisiana, Board Chairman
Montra Lockwood	National Weather Service-Lake Charles
Nancy McDowell	Twin Valley Resource Conservation and Development

Representative	Agency/Organization
Glen Mears Sr.	Beauregard Parish Office of Homeland Security and Emergency Preparedness
Rhonda Plummer	Vernon Parish Police Jury Secretary Treasurer
Jim Pratt	Sabine River Authority-Louisiana
Carrie Robinette	State of Louisiana Office of Homeland Security and Emergency Preparedness
Joe Rua	National Weather Service-Lake Charles
Carl Thompson	Vernon Parish Floodplain Administrator

2.2 PLANNING PROCESS / TEAM MEETINGS

44 CFR Requirement §201.6(a)(3):
Multi-Jurisdiction plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-Jurisdiction plans.

From the outset of the planning process, the Hazard Mitigation Team encouraged the participation of a broad range of jurisdictional entities. The involvement of representatives from neighboring communities and federal, state, and regional agencies provided a diverse range of perspectives and mitigation ideas. Formal participation in this plan includes but is not limited to the following activities:

- Participation in Hazard Mitigation Team meetings
- Sharing local data and information
- Local action item development
- Plan document draft review
- Formal adoption of the Hazard Mitigation Plan document following provisional approval by the State of Louisiana and FEMA

The planning process began with a series of executive meetings amongst SRA staff and administration to discuss the overarching goals and timelines for the plan development process and to create a list of invitees to serve on the Hazard Mitigation Team (HMT). A detailed listing of participants on the HMT and its functions is presented in Section 2.1 (Hazard Mitigation Team).

The main benchmarks in the plan development process were a series of four (4) coordination and public meetings held over a five month period. The schedule of these meetings and their main agenda points are described below:

A kick-off meeting was held July 28, 2009 at South Toledo Bend State Park. Agenda items for this meeting included the following:

- Introductions of Team members
- Outline the primary benchmarks in the plan update process and discuss specific FEMA requirements for hazard mitigation plan updates
- Establishing dates and times for future meetings
- Agree upon a preliminary agenda for future meetings
- Establish the broad goals of the hazard mitigation plan

- Identify hazards to be profiled in the plan
- Discussion of previous/recent natural hazard events and information sources for previous occurrences

The second meeting of the HMT was held on August 25, 2009 at the Vernon Parish Police Jury in Leesville.

- Data brought in by team members (including information from recent hazard events)
- Overview of Social, Technical, Administrative, Political, Legal, Economic and Environmental (S.T.A.P.L.E.E) criteria for prioritizing action items
- Discussion of benefit-cost review
- Discussion of funding priorities for grant programs administered by the State and FEMA
- Discussion of methods for ranking proposed action items by relative priority
- Discussion of locations for future mitigation projects
- Detailed and extensive discussion of ideas for mitigation projects

The third meeting of the HMT was held on November 3, 2009. The primary focus of this meeting was to present the HMT review draft document and solicit input from team members including a discussion of the results of the action item prioritization process. Items covered in this meeting included the following:

- Approach to plan maintenance, implementation, and update
- Approach to incorporation of the plan into existing and future planning documents
- Discussion of high priority action items
- Discussion of process for public review
- Presentation of the Hazard Mitigation Team Review Draft

The fourth meeting of the HMT was held on December 15, 2009. The public was invited to attend via public notice published in the Leesville Herald (Leesville, LA) and American Press (Lake Charles, LA) newspapers. Copies of the public notice announcements are included in Appendix C of this document. The primary focus of this meeting was to introduce the public review draft of the hazard mitigation plan and to solicit input over a two-week public comment period. Agenda items included:

- Presentation of the public review draft
- Description of opportunities for public comment
- Overview of updated materials post HMT Review Draft
- Discussion of high priority action items

Public comments received during this period were assembled and distributed to the hazard mitigation team, and ultimately incorporated into the plan document as appropriate. A summary of suggested changes and public comments is included in Appendix F. (Public Comments) of this document.

2.3 PUBLIC PARTICIPATION

44 CFR Requirement 201.6(b)
An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include: (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. (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

A strategy to involve the public in the update of the Sabine River Authority Hazard Mitigation Plan was established at an early stage in the planning process; both through announcements and invitations to public meetings and also by encouraging team members to carry on a dialogue with neighbors and colleagues for the purpose of capturing input for mitigation ideas. It is expected that through an open and inclusive approach to the planning process, acceptance and ultimate ownership of the plan will be gained in the neighborhoods and communities it addresses.

Public Review/Comment Process

A draft of the hazard mitigation plan was made available to the general public to solicit feedback and recommendations prior to final submittal to the State and FEMA. The two-week draft review and comment period spanned the latter weeks of December 2009. The public review period began with a meeting on December 15, 2009 to which the public was invited to attend and review the draft. Further opportunity for public review and comment was created by making copies of the public review draft available at offices of the agencies participating in plan development and the following organizations:

- INCLUDE LIST HERE

Following provisional plan approval by GOHSEP and FEMA, additional opportunity for public comment will be provided at the plan adoption meeting. The plan adoption meeting are to be held in open public session allowing opportunity for public comment and announced under customary public notice processes.

CHAPTER 3. RISK ASSESSMENT

44 CFR Requirement §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.

The purpose of the risk assessment is to identify and describe the hazards that affect the planning area and to inventory and analyze potential losses for human and material assets. Through a better understanding of potential hazards and the degree of risk they pose to the Sabine River Basin, more successful mitigation strategies can be developed and implemented.

This risk assessment follows the four-step process described in the FEMA publication 386-2, *Understanding Your Risks: Identifying Hazards and Estimating Losses* (2002), listed as follows:

- Identify Hazards
- Profile Hazard Events
- Inventory Assets
- Estimate Losses

This chapter is organized into three (3) sections that address the four steps in the risk assessment process. The first, ***3.1 Identifying Hazards***, lists the hazards that were considered and ultimately profiled in the plan and the methods, definitions and data sources used for the hazard identification and profile process. ***Section 3.2 Hazard Profiles*** presents a detailed outline for each identified hazard. Each hazard profile is addressed as a plan subsection and includes a general description; the affected geographic area; discussion of previous occurrences; probability of future occurrence; magnitude and severity; and assessment of overall vulnerability to each hazard.

Section 3.3 Vulnerability Assessment provides an overview of risk exposure. It includes eight subsections that address an inventory of potentially vulnerable assets in the planning area, and identifies opportunities and tools for current and future mitigation planning. Subsections of the vulnerability assessment include inventories of repetitive loss properties; regional assets including vulnerable populations; critical facilities; potential dollar loss estimates; land use and development trends; a parish specific risk assessment; vulnerable structures; and an overview of existing planning mechanisms.

3.1 IDENTIFYING HAZARDS

44 CFR Requirement §201.6(c)(2)(i)
[The risk assessment shall include a] description of the type…of all natural hazards that can affect the jurisdiction.

The Hazard Mitigation Team (HMT) reviewed information on the following hazards required by FEMA for consideration. The HMT identified hazards in Table 3-1 below as relevant to the planning area and selected these for detailed profile and mitigation efforts pursuant to the goals of this plan.

Table 3-1 Identified Hazards, Sabine River Authority Hazard Mitigation Plan

Hazard Type	Method of Identification
Dam/Levee Failure	Potential for occurrence, geographic location
Drought	Previous occurrences
Earthquake	Potential for occurrence
Extreme Heat	Previous occurrences
Flood	Previous occurrences, high mitigation priority
Hailstorm	Previous occurrences
Hurricane and Tropical Storm	Previous occurrences, high mitigation priority
Thunderstorm, Lightning, High Winds	Previous occurrences
Tornado	Previous occurrences
Wildfire	Previous occurrences
Winter Storm	Previous occurrences

Source: Hazard Mitigation Team

Due to the interrelated nature of certain hazard episodes, elements of coastal erosion, coastal storm, storm surge and windstorm are addressed in **Subsection 3.2.8 Hurricane and Tropical Storm**. Tsunami events are discussed as a potentially related occurrence in **Subsection 3.2.3 Earthquake.** Lightning and windstorm events are addressed as related occurrences in **Subsection 3.2.10 Thunderstorm, Lightning, High Winds**.

The following hazards were not profiled in this plan due to lack of previous occurrences, lack of data regarding previous occurrences, or extremely remote potential impact to the planning area. Table 3-2 lists hazards not profiled and the reason for omission. Limnic eruption, seiche, hazardous materials incidents and acts of terrorism and arson were considered but due to lack of data these hazards not profiled in this draft of the Hazard Mitigation Plan. Future updates of this plan may address these hazards as additional information becomes available.

Table 3-2 Hazards Not Profiled

Hazard Type	Reason for Omission
Avalanche	Low probability, geographic location
Coastal Erosion	Discussed in hurricane profile
Coastal Storm	Discussed in hurricane profile
Expansive Soils	Low probability, geographic location
Landslide	Low probability, geographic location
Land Subsidence	Lack of available data
Tsunami	Discussed in earthquake profile
Volcano	Low probability, geographic location

Source: Hazard Mitigation Team

3.1.1 Methods and Definitions

44 CFR Requirement §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.

The hazard profiles in Subsections 3.2.1 through 3.2.13 were developed from information provided by the State of Louisiana Multi-Hazard Mitigation Plan, FEMA, the National Weather Service, and other referenced sources. Geographic location information is provided for each profiled hazard, based on information on the impact areas of previous occurrences. For many

hazards, including drought, excessive heat, hurricane, thunderstorm, hail, etc., the geographic location of impacts is potentially any location in the Sabine River Basin, and is noted accordingly.

A common set of definitions/classifications was established for probability of future hazard occurrence and the magnitude and severity of impacts for the purpose of describing the identified hazards in a quantitative and qualitative way (to the extent that data allows). Classifications used to categorize probability of future occurrence were based on statistical assessments of previous occurrences (or recurrence interval), and equated to a percent probability of occurrence in a given year whenever possible. Probability of future occurrence classifications used in the hazard profiles for this plan are listed in Figure 3-1 below and summarized in Section 3.3, Table 3-29.

Figure 3-1 Probability of Future Occurrence Classifications

- **High -** Greater than 50 percent probability of occurrence in a given year
- **Medium -** 10 to 50 percent probability of occurrence in a given year
- **Low –** Less than 10 percent probability of occurrence in a given year

Potential magnitude and severity for each hazard is classified based on a scenario where the most extreme documented event occurs in modern times. It is acknowledged here that the categories established may involve some degree of overlap and therefore classification of hazards in this manner is inherently subjective. The magnitude and severity classifications/definitions used in the hazard profiles for this plan are listed in Figure 3-2 below and summarized in Section 3.3, Table 3-29.

Figure 3-2 Magnitude and Severity Classifications

- **Level 4-Catastrophic**—Severe property damage on a regional or metropolitan scale; shutdown of critical facilities, utilities and infrastructure for extended periods; and/or multiple injuries and fatalities
- **Level 3-Critical**—Severe property damage on a neighborhood scale; temporary shutdown of critical facilities, utilities and infrastructure; and/or injuries or fatalities
- **Level 2-Limited**—Isolated occurrences of moderate to severe property damage; brief shutdown of critical facilities, utilities and infrastructure; and/or potential injuries
- **Level 1-Negligible**— Isolated occurrences of minor property damage; minor disruption of critical facilities, utilities and infrastructure; and/or potential minor injuries

Definitions for overall vulnerability are subjective and based primarily on future probability and severity, with additional considerations for potential impacts to special needs populations and the location of buildings, critical facilities and infrastructure. Vulnerability classification criteria are general and involve some degree of overlap amongst classes. A summary of overall vulnerability classifications/definitions used in the hazard profiles for this plan are listed in Figure 3-3 below and summarized in Section 3.3, Table 3-28.

Figure 3-3 Overall Vulnerability Classifications

- **Very High**—High probability of future occurrence and potentially catastrophic severity
- **High**— Moderate/high probability of future occurrence and potentially critical severity
- **Moderate**— Moderate/high probability of future occurrence and limited potential severity
- **Low**— Low/moderate probability of future occurrence and negligible/limited potential severity

3.1.2 Data Sources and Limitations

The majority of the information contained in the Hazard Profiles section came from the following sources:

- Federal Emergency Management Agency (FEMA)
- National Oceanic and Atmospheric Administration (NOAA)
- National Weather Service (NWS), Lake Charles
- National Severe Storms Laboratory (NSSL)
- National Climatic Data Center (NCDC)
- Local media
- Local parishes and cities

There were certain limitations in the amount and specificity of data available for the update of this hazard mitigation plan. It is expected that over time the availability of hazard related data will continue to improve and be included in future updates. Such improvements in local and regional data accessibility should result from the implementation of this hazard mitigation plan and others like it throughout southwestern Louisiana and the Gulf Coast states.

3.2 HAZARD PROFILES

44 CFR Requirement §201.6(c)(2)(ii):
[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazard 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.

The hazard profiles that follow include general descriptions of the hazard, the geographic area affected, information regarding previous occurrences, and assessments of probability of future occurrence, magnitude and severity, and overall vulnerability to each hazard identified as relevant to the planning area. The hazard profiles are ordered alphabetically for ease of reference and this structure does not infer relative importance. An index of the individual hazard profile subsections and beginning page numbers is included in Table 3-3 below.

Table 3-3 Hazard Profile Index

Hazard Type	Subsection Number	Beginning Page Number
Dam and Levee Failure	3.2.1	TBD
Drought	3.2.2	TBD
Earthquake	3.2.3	TBD
Extreme Heat	3.2.4	TBD
Flood	3.2.5	TBD
Hailstorm	3.2.6	TBD
Hazardous Materials	3.2.7	TBD
Hurricane and Tropical Storms	3.2.8	TBD
Land Subsidence	3.2.9	TBD
Thunderstorm, Lightning & High Winds	3.2.10	TBD
Tornados	3.2.11	TBD
Wildfire	3.2.12	TBD
Winter Storm	3.2.13	TBD

3.2.1 Dam and Levee Failure

Hazard Description

Dams are water storage or diversion barriers that impound water upstream in reservoirs. Dam failure is a collapse, breach or overtopping of the structure. While most dams have storage volumes small enough that failures have relatively minor repercussions, dams with large storage volumes can cause significant flooding at lower relative elevations.

Levees and flood walls are flood control barriers constructed of earth, concrete, or other materials and are designed to protect significant areas of residential, commercial or industrial development; at a minimum a neighborhood or small community. Levee failure involves the overtopping, breach, or collapse of the levee or flood wall. Levee failure is especially destructive to nearby development during flood and hurricane events.

The failure of dams or levees can result in injuries, loss of life, and damage to property and environment. While levees are built solely for flood protection, dams often serve multiple purposes such as hydroelectric generation, flood control and recreation. Dams and levees are usually engineered to withstand a flood with a calculated risk of occurrence. Severe flooding can increase the potential of dam or levee failure as a result of the physical force of the flood waters or overtopping. Failed dams can create floods that are catastrophic to life and property, in part because of the tremendous energy of the released water.

The hazard potential for dam failure is classified according to the following definitions accepted by the Interagency Team on Dam Safety:

- Low Hazard Potential—Failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.
- Significant Hazard Potential—Failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or other impacts. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.
- High Hazard Potential—Failure or mis-operation will probably cause loss of human life.

Dam failure can be caused by simple structural failure, or any combination of the following factors:

- earthquake
- flood conditions leading to overtopping
- internal erosion
- inadequate spillway capacity
- improper operation or maintenance
- arson
- failure of upstream dams

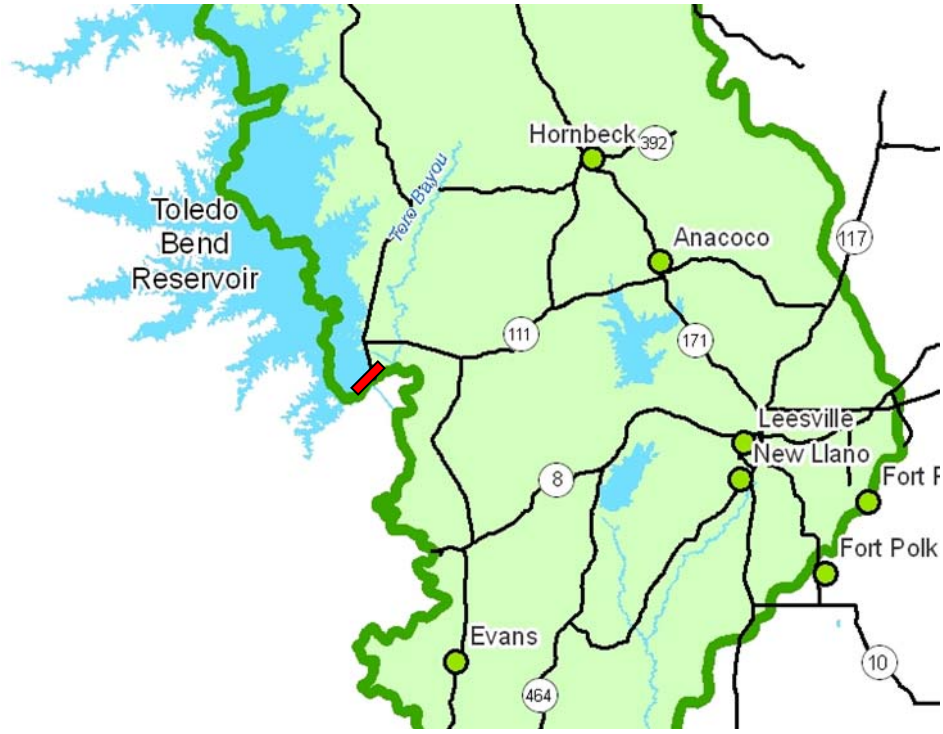
Warning time for dam failure varies widely and depends on the causal factors. Dam failure can occur in as little as a few minutes or slowly over the course of months. Catastrophic failure of a large dam would result in short evacuation times for locations directly downstream. Topography and floodplain characteristics determine warning time for locations further downstream.

The State of Louisiana Hazard Mitigation Plan notes that levee failure due to overtopping is relatively predictable, based on design and performance expectations for individual structures. If properly constructed and maintained, a levee designed to provide protection against a “100-year event” of a definable magnitude would have a 1 percent chance of being overtopped in any particular year. Failure due to breach or collapse of levees is not easily predicted on a broad scale even with extensive investigations. Factors such as sub-grade soil conditions, construction practices and maintenance programs must be evaluated. Even with extensive data, the predictive value is limited to areas that are directly examined as specific site conditions can vary widely over short distances. Warning times for levee failure are generally brief, and major breach occurrences can inundate broad areas in minutes.

Geographic Location

The primary dam in the Sabine River Basin is Toledo Bend Dam. It is located approximately 14 miles west of Anacoco, LA and 16 miles northeast of Burkeville, TX. Figure 3-4 shows the general location of the dam, indicated by red rectangle at the south end of the reservoir.

Figure 3-4 Toledo Bend Dam, General Location



Source: Sabine River Authority

A dam is included in the National Inventory of Dams if it meets one of the following criteria:

1) It has High Hazard classification – loss of one human life is likely if the dam fails,
2) It has Significant hazard classification – possible lost of human life and likely significant property or environmental destruction,
3) Equal or exceed 25 feet in height and exceed 15 acre-feet in storage,
4) Equal or exceed 50 acre-feet storage and exceed 6 feet in height.

Within the Sabine River Basin and surrounding parishes there are 61 dams included in the USACE National Inventory of Dams. Table 3-2 below outlines the parish location, name and

primary purpose of these 61 dams. Please be apprised that some of these dams are outside the jurisdictional boundary of the Sabine River Authority.

Table 3-4 Dams within the Parishes That Comprise The Jurisdictional Authority of The Sabine River Authority90

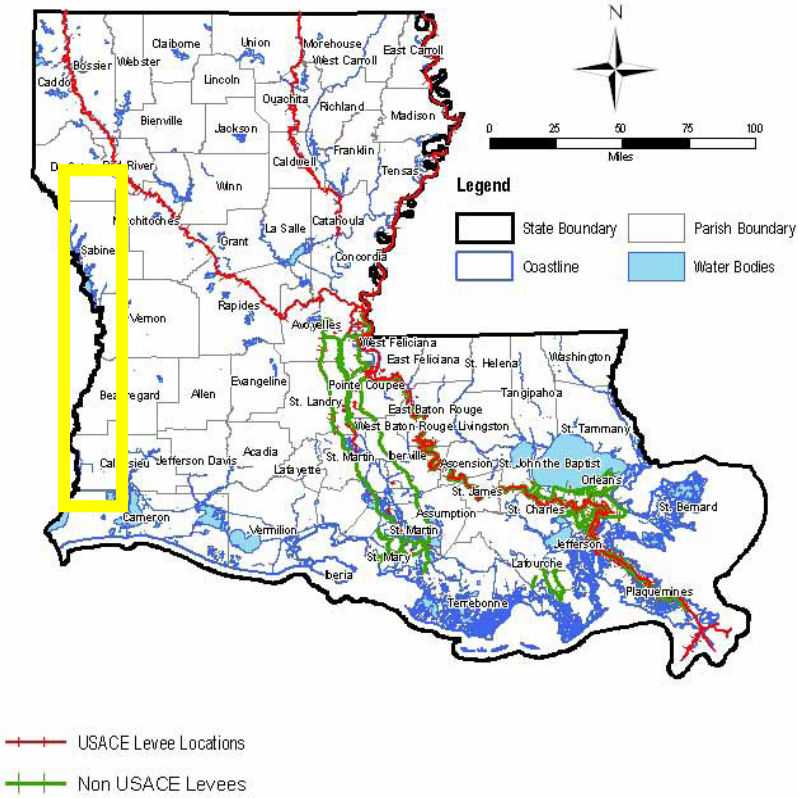
Parish Location	Dam Name	NID I.D.	Primary Purpose
Sabine	Bayou DuPont No 7	LA00014	Flood Control & Storm Water Management
Sabine	Bayou DuPont No 4	LA00033	Flood Control & Storm Water Management
Sabine	Bayou DuPont No 2	LA00034	Flood Control & Storm Water Management
Sabine	Bayou DuPont No 13	LA00058	Flood Control & Storm Water Management
Sabine	Bayou DuPont No 12	LA00059	Flood Control & Storm Water Management
Sabine	Bayou DuPont No 11	LA00060	Flood Control & Storm Water Management
Sabine	Bayou DuPont No 10	LA00061	Flood Control & Storm Water Management
Sabine	Loring Lake	LA00254	Other
Sabine	Hodges Garden	LA00256	Other
Sabine	Greer Dam	LA00380	Fire Protection, Stock or Small Farm Pond
Sabine	Bo Chevallier Dam	LA00516	Recreation
Sabine	Phyllis Murdock Dam	LA00517	Flood Control & Storm Water Management
Sabine	Toledo Bend	LA00030	Hydroelectric
Vernon	Lower Anacoco Dam	LA00001	Recreation
Vernon	Vernon Lake Dam	LA00022	Recreation
Vernon	Alligator Lake Dam	LA00170	Recreation
Vernon	Engineer Lake Dam	LA00171	Recreation
Vernon	Jack Anderson Dam	LA00205	Water Supply
Vernon	James Andre Pond	LA00207	Recreation
Vernon	Mary Smith Pond	LA00208	Recreation
Vernon	Westbrook Pond	LA00209	Recreation
Vernon	Lewis and Killan Lake	LA00210	Recreation
Vernon	Peggy Stevens Pond	LA00211	Recreation
Vernon	Morris Lake	LA00212	Recreation
Vernon	LA No Name 58	LA00213	Water Supply
Vernon	Castor Lake	LA00214	Recreation
Vernon	W.O. Caswell Dam	LA00431	Recreation
Vernon	C.J. Bailey Dam	LA00432	Recreation
Vernon	Oliver Goins Dam	LA00433	Recreation
Vernon	Robert Jarrell Dam	LA00434	Recreation
Vernon	Frank Leach Dam	LA00435	Recreation
Vernon	Sam Fertitta Dam	LA00447	Recreation
Vernon	Fullerton Lake Dam	LA00518	Recreation
Beauregard	Bundicks Creek Dam	LA00006	Recreation
Beauregard	Smith Pond	LA00221	Recreation
Beauregard	Scalfy Lake	LA00222	Recreation
Beauregard	Caldwell Lake	LA00223	Recreation
Beauregard	Lake Wood Farms	LA00225	Water Supply
Beauregard	Morris Lake Dam	LA00226	Recreation
Beauregard	Brinkman Pond	LA00227	Water Supply
Beauregard	Carson Lake	LA00228	Other
Beauregard	Litwiller Pond	LA00229	Water Supply
Beauregard	Bon Ami Pond	LA00230	Water Supply
Beauregard	Spikes Pond	LA00231	Recreation
Beauregard	Harper Pond	LA00232	Recreation
Beauregard	Brown Lake Dam	LA00233	Water Supply
Beauregard	Perle Du Pond	LA00234	Recreation
Beauregard	Acengy Pond	LA002235	Recreation
Beauregard	Trigger Gulley	LA00237	Recreation
Beauregard	Longville Lake	LA00238	Recreation
Beauregard	Camp Edge Wood	LA00249	Recreation
Beauregard	Boise Cascade Mill	LA00282	Recreation

Parish Location	Dam Name	NID I.D.	Primary Purpose
Beauregard	Morel Lake	LA00283	Water Supply
Beauregard	Alvin Gray Dam	LA00436	Recreation
Beauregard	Yvonne Welvorn Dam	LA00439	Recreation
Beauregard	Stanford Carter Dam	LA00440	Recreation
Beauregard	Louis Blankenbacker Dam	LA00441	Recreation
Beauregard	Gerald Johnson Dam	LA00442	Recreation
Calcasieu	Holbrook Park Lake	LA00251	Recreation
Calcasieu	Calbeau Lake	LA00291	Recreation
Calcasieu	Olin Pond	LA00292	Debris Control

Source: National Inventory of Dams

With regard to the location of levees, Figure 3-5 was developed by the U.S. Army Corps of Engineers and the Louisiana Speaks 2007 Project, showing the locations of major levee systems in Louisiana. Based on this analysis, no major scale levee systems are located in the planning area.

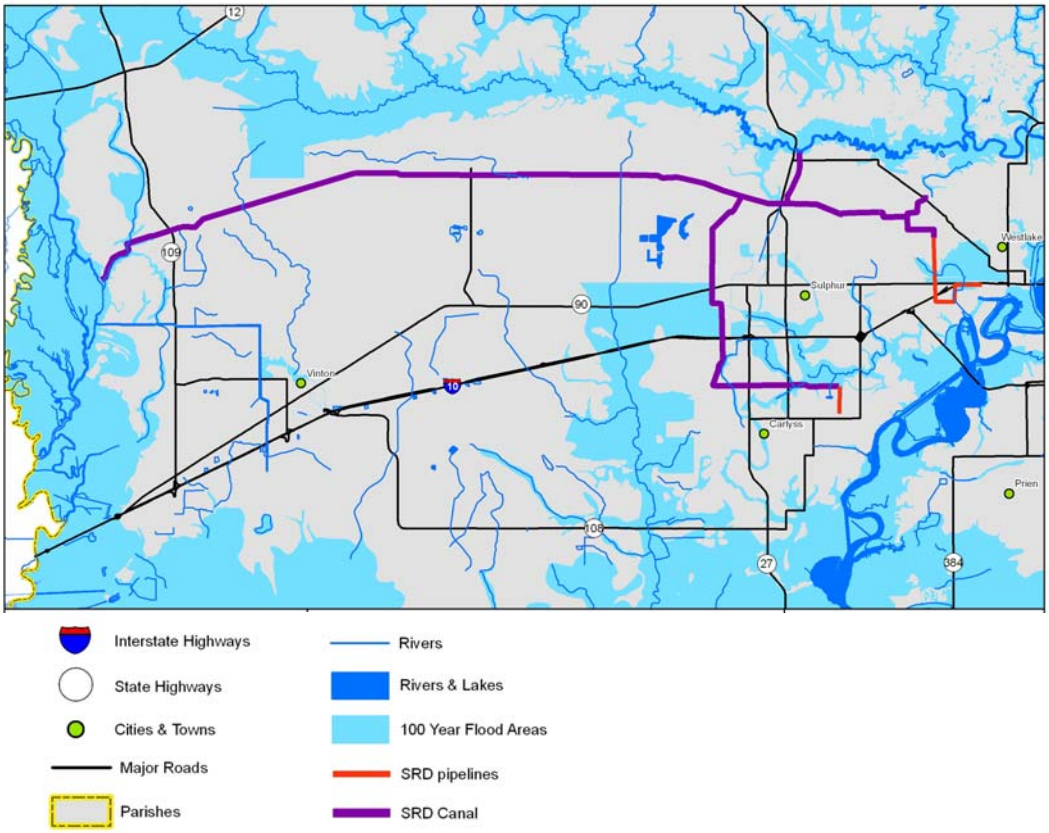
Figure 3-5 Major Levee System Locations, Louisiana



Source: U.S. Army Corps of Engineers and the Louisiana Speaks Project 2007
Note: General location of Sabine River Basin indicated by yellow rectangle

While there are no levee systems in the region classified as 'major', flood protection berms along the Sabine River Diversion Canal in western Calcasieu Parish are present as shown in Figure 3-6 on the following page (see SRD Canal, in purple).

Figure 3-6 Levee Location: Sabine River Diversion Canal (western Calcasieu Parish)



Source: Sabine River Authority, Louisiana

Previous Occurrences

According to the State of Louisiana Hazard Mitigation Plan Update, there are no significant instances of dam failure in the state, including none at the Toledo Bend Dam under the jurisdictional authority of the Sabine River Authority. In addition, according to the Hazard Mitigation Team, there have been no recorded incidents of levee failure as there are no approved U.S. Army Corps of Engineers levees along the length of the Sabine River within the jurisdiction of the Sabine River Authority.

Probability of Future Occurrence

Due to the lack of data regarding previous occurrences, probability of future occurrence is based on speculative forecasts rather than recurrence intervals. The Hazard Mitigation Team assessed future probability of a major occurrence of dam and/or levee failure as less than 1 percent over a 10-year timeframe and less than 10 percent over a 50-year timeframe. This probability assessment equates to a **Low** probability of future occurrence classification according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Magnitude/Severity

Considering the worst case scenario, the magnitude and severity of this hazard is considered **Catastrophic,** due to the huge volume and velocity of water and shutdown of critical facilities and disruption of electrical production.

The most significant potential dam or levee failure threat in the Sabine Basin would be a breach of Toledo Bend Dam. The projected inundation area for a hypothetical dam failure at Toledo

Bend Dam includes western portions of each of the parishes downstream from the reservoir. Based on hydrologic models developed for the Sabine River Authority, the projected inundation area would cover 428 square miles across east Texas and western Louisiana. The projected inundation area in Louisiana is 202 square miles.

The assumed inundation area for a major breach would cover a large portion of land west of Highway 111 in Vernon Parish, Highways 190 and 389 in Beauregard Parish, and Highway 109 in Calcasieu Parish. Table 3-6 provides assumed/projected flood arrival times and elevations for a major dam breach at Toledo Bend Dam.

Table 3-6 Assumed Inundation Arrival Times and Elevations

Location	Distance from Dam	Flood Arrival Time	Peak Arrival Time	Flood Peak Elevation
Toro Bayou/Hwy 392	2.2 miles	1.2 hours	16.0 hours	130 feet
Burr Ferry/Hwy 63	11.6 miles	4.4 hours	24.2 hours	117 feet
Bayou Anacoco, Vernon/Beauregard Parish Line	29.3 miles	10.0 hours	35.0 hours	92.6 feet
Belgrade	43.0 miles	15.0 hours	49.0 hours	73.6 feet
Cow Creek/Bancroft	55.2 miles	26.0 hours	58.0 hours	59.9 feet
Beauregard/Calcasieu Parish Line	68.0 miles	36.0 hours	65.0 hours	44.5 feet
Hwy 12/Starks	76.6 miles	48.0 hours	72.0 hours	29.3 feet
Interstate 10/Orange, TX	90.0 miles	58.0 hours	81.0 hours	10.6 feet

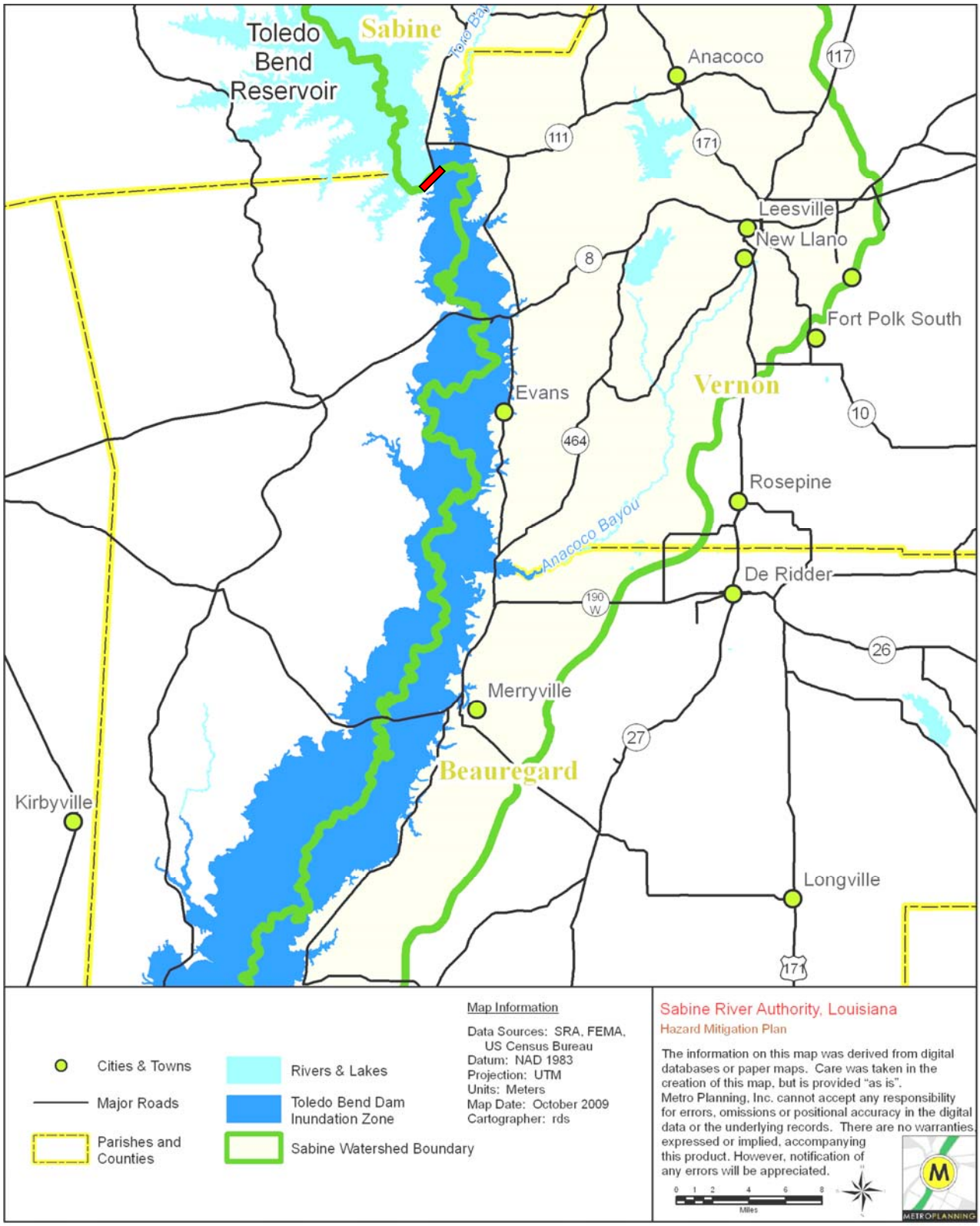
Source: Sabine River Authority

Figures 3-7 and 3-8 on the following pages show the area potentially inundated if a major dam failure were to occur at Toledo Bend Dam.

Overall Vulnerability

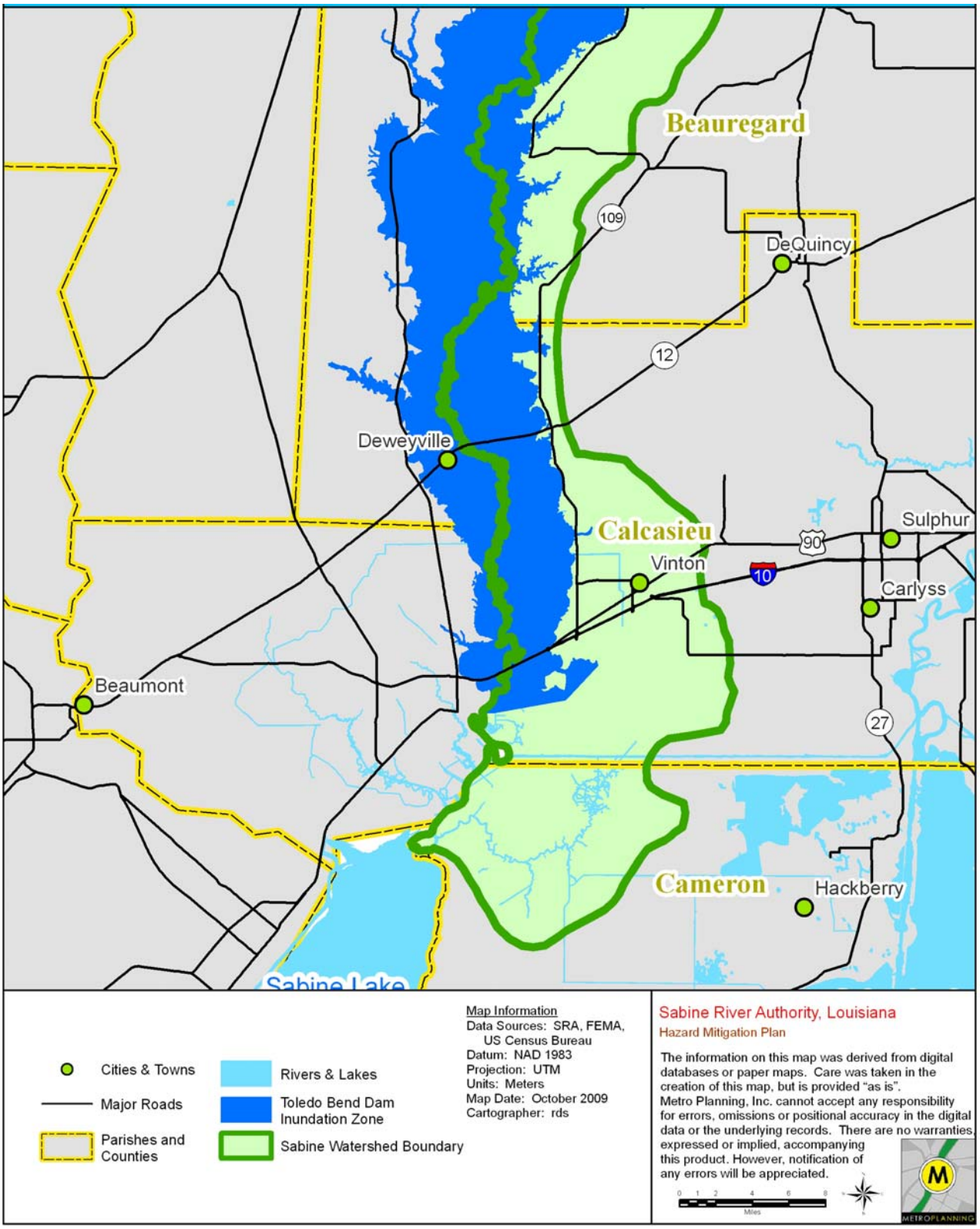
Overall vulnerability to dam and levee failure is considered **Low.** This assessment is based on the location of dams and levees in relation to population centers and critical facilities, the probability of occurrence, and the potential magnitude and severity of an event occurrence.

Figure 3-7 Potential Dam Failure Inundation Area, Northern Section



Note: Approximate location of Toledo Bend Dam indicated by red rectangle south of reservoir

Figure 3-8 Potential Dam Failure Inundation Area, Southern Section



3.2.2 Drought

Hazard Description

As defined by the NOAA Weather Service, drought is defined is "a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area." More simply, a drought is a period of unusually dry weather lasting long enough to cause serious problems, such as crop damage and/or water supply shortages. The severity of a drought depends upon degree of moisture deficiency, duration, and size of affected area.

Short term effects of drought include excessively dry soil causing plant stress and crop failure. When rainfall is below normal for extended periods, flow of streams and rivers decline, lakes, and reservoirs lose stored water to evaporation and decreased inflow, and water tables fall.

Drought is a unique type of disaster because it is not a discreet event but rather a cumulative result of persistent below average precipitation. In the continental U.S., drought occurrence generally does not require evacuation nor does it constitute an immediate threat to life or property; though in the mid-west in the 1930's vast regions and thousands of people were severely impacted and many forced to abandon their homes, ranches and farms. The effects of drought may not be noticed immediately but only become apparent after weeks or months. Effects on the water table may take up to a year or more to be realized.

The most common impacts include economic hardship due to lost crop or livestock revenue. Non-irrigated croplands are most susceptible to moisture shortages. Rangeland and irrigated agricultural lands are not impacted as quickly as non-irrigated, cultivated acreage but yields can be greatly reduced. Reduction in agricultural yields due to drought is commonly aggravated by wind-induced soil erosion. Severe drought can also lead to grassland and wildfires that affect livestock and timber production, and impact wildlife habitat. Under drought conditions, lakes, reservoirs, and rivers can be subject to water shortages, restricting their use for municipal water supplies.

In 1965, Wayne Palmer developed an index to "measure the departure of the moisture supply". He based his index on the supply-and-demand concept of the water balance equation, taking into account more than only the precipitation deficit at specific locations. The objective of the Palmer Drought Severity Index (PDSI), as this index is now called, was to provide a measurement of moisture conditions that were "standardized" so that comparisons using the index could be made between locations and between months. PDSI values generally range between -4.0 and +4.0. Individual classifications are shown in Table 3-7 below.

Table 3-7 PDSI Classifications for Dry and Wet Periods

4.00 or more	Extremely wet
3.00 to 3.99	Very wet
2.00 to 2.99	Moderately wet
1.00 to 1.99	Slightly wet
0.50 to 0.99	Incipient wet spell
0.49 to -0.49	Near normal
-0.50 to -0.99	Incipient dry spell
-1.00 to -1.99	Mild drought
-2.00 to -2.99	Moderate drought
-3.00 to -3.99	Severe drought
-4.00 or less	Extreme drought

Source: Climate Prediction Center, http://drought.unl.edu/whatis/indices.htm
Note: Color scheme for PDSI classifications is approximate and can vary

Geographic Location
Drought is a normal part of virtually all-climatic regimes, including areas with high and low average rainfall. Louisiana generally and the jurisdiction of the Sabine River Authority, specifically, are not immune from the occurrence or effects of drought. Major water bodies within the jurisdiction of the Sabine River Authority, including the Toledo Bend Reservoir, may be affected by drought conditions. Agricultural irrigators and municipal water supplies are primarily dependant on groundwater resources. As severe droughts may affect the groundwater table, the risks associated with drought are area wide and not confined to any particular community or discreet geographic region.

Previous Occurrences
Louisiana, although featuring several large water bodies, thousands of miles of rivers, streams, and bayous, and thousands of acres of wetlands, has experienced occasional drought conditions. Northern parishes, especially, have experienced agricultural droughts, leading to severe soil-moisture decreases with serious consequences for crop production.

Historical review indicates that a highly significant relationship exists between precipitation in Louisiana and the establishment of La Niña weather patterns. La Niña, characterized by unusually cold ocean temperatures in the Pacific, can bring abnormally warm and dry weather conditions to Louisiana. For example, during the mid-1998 to 2000 period, the state shifted to a drier weather pattern. The year 2000 was the driest winter in over 100 years. During roughly 80 percent of past significant La Niña occurrences, winter and spring rainfall has been below normal.

Drought events are reported with impacts to crops and timber in terms of fire potential. Tracking drought is challenging due to the numerous definitions and measurement protocols. The online website *Drought Monitor*; a partnership between Federal agencies and the National Drought Mitigation Center at the University of Nebraska- Lincoln has been tracking drought conditions across the country and provides drought information maps illustrated down to both the county and parish level. The Drought Monitor is an attempt to synthesize multiple drought related indices and impacts which represents a consensus of federal and academic scientists.

The following summarizes a systematic review of Drought Monitor weekly data for approximately the last ten years from May 20, 1999 to Sept 22, 2009.

The parishes that contain the Sabine River Authority have experienced 84 weeks of “moderate” drought, 65 weeks of “severe” drought and 3 weeks of “extreme” drought. The combined weeks of drought total 152 weeks over 538 weeks of reporting for approximately the last ten years. [i]

In addition to this data set, the State of Louisiana Hazard Mitigation Plan reports that 20 drought impacts to agriculture were reported for the period January 1997 to January 2008 for the parishes that containing the Sabine River Authority. Lastly, a review of historical drought events from 1950 to 2008, presented below identifies two drought events reported to the National Climactic Data Center.

<u>May 1996: Impacted the parishes of Northwest Louisiana:</u> May was not only abnormally hot and dry but was the sixth driest and the fifth hottest on record. There were numerous problems in northwest Louisiana attributed to the heat which included profit loses in the lumber market, agriculture and food production industries. Area lakes and reservoirs suffered also with many reaching near record low water levels.

<u>May 1998: - Impacted the parishes of Southwest Louisiana:</u> Drought conditions were in full force by mid May across southwest and central Louisiana. Most places saw less half an inch of rain, dating back to the last half of April. The major weather stations with long climatic histories,

such as Lake Charles, Lafayette, and Alexandria recorded less than 0.10 inches of rain for the month of May. Many places saw absolutely no rain the entire month. The most significant impact in May was the drying up of shallow wells, with many farmers resorting to deeper wells for irrigation purposes. Some crops were beginning to see the affects of the drought, but any significant loses will be attributed to the month of June. The other major story during May's drought, though not directly attributed to it, was the smoke and haze from Mexican and Central American forest fires. Many places had visibilities of 3 miles or less for over a week (May 12-20th), and people with respiratory ailments, as well as the elderly and young, were confined to their homes during this period.

June 1998 – Impacted the parishes of Northwest Louisiana: Only 1.35 inches of rain fell during June 1998. This brought the three month period total for April, May, and June to 2.29 inches. Of the 1.35 inches of rain, 1.25 inches occurred in a 24 hour period on the 4th and 5th. Even though June 1998 was the 30th driest on record, the total three month average precipitation for April, May and June was taking its toll. Only the fall of 1924 (1.39 inches) and the summer of 1934 (2.09 inches) was drier. Area rivers and lakes fell to well below normal levels with water users urged to conserve. Agriculture and forestry were especially hard hit. Nearly half of the 100 million pine seedlings planted in 1997 were killed. Replanting costs and reforestation will run in the millions. Row crops were the hardest hit with corn, cotton, soybean, rice, grain and sorghum totaling over half of the total dollar loss. Nearly 75 percent of other crops including pastures, hay and vegetables were also destroyed. Estimated crop damage for the region was $15,000,000.

June 1998: - Impacted the parishes of Southwest Louisiana: A mild to moderate drought continued across southwestern and central Louisiana through the month of June. This drought began in mid-May, and will extend through July 1998. There were only two opportunities for rain in June, on the 5th and the 26th. Most areas received less than two inches of rain in the entire month of June. By mid-June, most farmers had lost the entire season's crop, which consists primarily of corn, soybean, and rice. Even the cattle were affected due to the lack of grass for grazing. Specific dollar figure damages will be listed in the July 1998 Storm Data.

July 1998: - Impacted the parishes of Southwest Louisiana: A mild to severe drought continued for the third straight month across southwest Louisiana. Most places only saw 2 to 3 inches of rain the entire month of July.

August 1998: - Impacted the parishes of Southwest Louisiana: The drought of 1998 continued in the month of August across southwest and central Louisiana. Between four and five inches of rain fell in the entire month of August across this region, which was actually the most in a month since April 1998. Total dollar figure losses by southwest and central Louisiana farmers were nearly $138,000,000. The hardest hit parishes were Avoyelles and St. Landry Parishes, where over $55,000,000 was lost. By product, the worst loss was soybeans, with an estimated $40,000,000 lost, followed by sugarcane at $25,000,000, and corn grain at $24,000,000. These statistics were tabulated by the Agricultural Center at Louisiana State University.

February 2000: - Impacted the parishes of Southwest Louisiana: Southwest and central Louisianans were in a severe drought during the month of February, as less than one inch of rain fell across the region. This was one of the five driest Februarys on record. The Lake Charles area recorded its driest January-February period on record, with 2.31 inches of rain for the two months.

December 2000: - Impacted the parishes of Southwest Louisiana: The drought of 2000 was devastating to the agricultural community of southwest and central Louisiana. Around 170 million dollars worth of crop losses occurred between January 1 and December 31 2000. The hardest hit parishes were Vermilion with 35.8 million dollars loss, Avoyelles with 28.9 million

dollars and Saint Landry with 26.8 million dollars. The primary crops lost were rice and sugarcane. Drought losses were compiled by the LSU Agricultural Center.

December 2005 – Impacted the parishes of Northwestern Louisiana: December remained abnormally dry...just as the previous several months did across Northwest Louisiana. Rainfall deficits ranged some 15 to 20 inches below normal for the year. A series of dry cold fronts moved through the region during the month which allowed strong winds to only compound the already high fire danger. Several small fires broke out across Northwest Louisiana during the month but damage was minimal. Burn bans continued for many parishes throughout the month as well.

Record Driest Years in Shreveport Since 1872: A direct database for communities within Sabine River Authority are not available, thus the use of climate data from the closest National Weather Service station in Shreveport can serve as an accurate regional database highlighting years of extremely low precipitation. Table 3-8 below illustrates the top 10 driest years recorded since 1872 including the greatest departure from normal annual precipitation. For reference, the average annual rainfall for Shreveport is 51.30 inches.

Table 3-8 Top Ten Driest Years in Shreveport, 1872-2009

Year	Total Precipitation	Departure From Normal
1899	23.10 inches	-28.20 inches
1918	26.33 inches	-24.97 inches
1936	26.44 inches	-24.86 inches
1924	28.65 inches	-22.65 inches
1903	29.26 inches	-22.04 inches
1963	30.03 inches	-21.27 inches
1943	30.64 inches	-20.66 inches
1893	32.06 inches	-19.24 inches
1909	32.13 inches	-19.17 inches
1921	32.16 inches	-19.14 inches

Source: National Weather Service

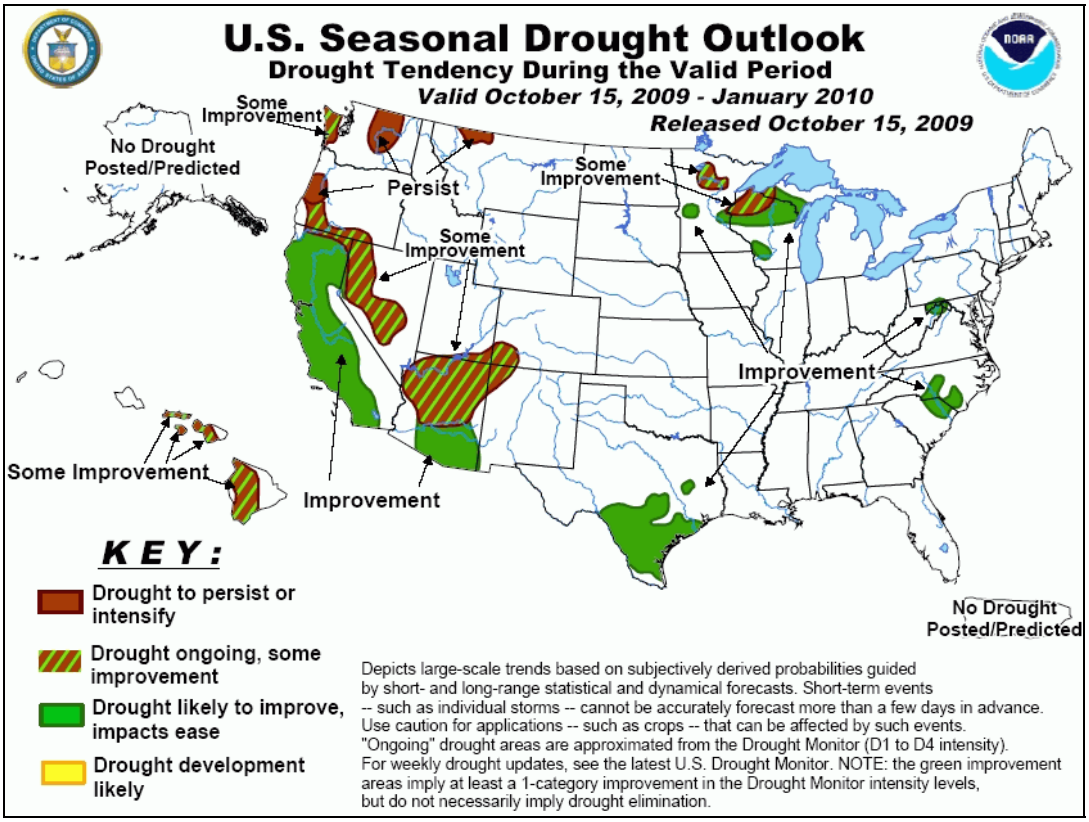
Probability of Future Occurrence

Based on all the data sets above, drought conditions do occur regularly in western Louisiana and within the parishes containing the Sabine River Authority specifically. Drought is a normal part of climate. The goal of any hazard mitigation plan is to anticipate potential hazards and devise strategies to lessen the impacts.

Tracking drought is challenging due to the numerous definitions and measurement protocols. Using the *Drought Monitor* data sets detailed above as the best available, there were almost 15 weeks a year where moderate or severe drought occurred over the last 10 years in parishes that include the jurisdictional boundary of the Sabine River Authority. This probability assessment equates to a **High** probability of future occurrence classification according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Underscoring the probability of drought in the short term, as shown in Figure 3-9 below, seasonal probability of drought is forecast to remain low for the region of western Louisiana for the period October 2009 to January 2010.

Figure 3-9 Seasonal Drought Outlook, February-May, 2009



Source: NOAA

Magnitude/Severity

According to the National Climatic Data Center, no fatalities or injuries have been attributed to drought events in Sabine River Authority or northwestern Louisiana between the period of 1950 and 2008. Agricultural economic losses attributable to drought events, however, have been substantial. In the ten year period between 1998 and 2008, there were two significant drought events. Crop losses totaled approximately $153,000,000 in northwestern and southwestern Louisiana. Based on these assessments the severity of drought is considered **Limited**, with isolated occurrences of moderate property damage mostly attributed to crop damage and wildfire. Please be apprised that crop losses extend parish wide and go beyond the jurisdictional boundary of the Sabine River Authority.

Overall Vulnerability

Overall vulnerability to drought is considered **Moderate**, relative to other identified natural hazards that may occur in Sabine River Authority. This assessment is based on the short recurrence interval for drought and the magnitude of the impacts to agriculture. Additionally, drought increases the risk of wildfire and increases the likelihood of economic losses to the local agricultural industry.

3.2.3 Earthquake

Hazard Description

An earthquake is a sudden motion or trembling of the earth caused by an abrupt release of stored energy in the rocks beneath the earth's surface. The energy released results in vibrations known as seismic waves that are responsible for the trembling and shaking of the ground during an earthquake. Ground motion is expressed as peak ground acceleration (PGA). PGA is expressed as a percent of gravity or "g".

Earthquakes are typically described in terms of magnitude and intensity. The traditional measurement of amplitude of the seismic wave through the assignment of a single number to quantify the amount of seismic energy released by an earthquake is the Richter scale. The intensity of how strong the shock was felt at a particular location is the Modified Mercalli Intensity (MMI) scale. The scale quantifies the effects of an earthquake on the Earth's surface, humans, objects of nature and man-made structures. Table 3-9 below is a combined earthquake magnitude and intensity comparison table taken from the 2008 State of Louisiana Hazard Mitigation Plan and the United States Geological Survey.

Table 3-9 Earthquake Magnitude / Intensity Comparison

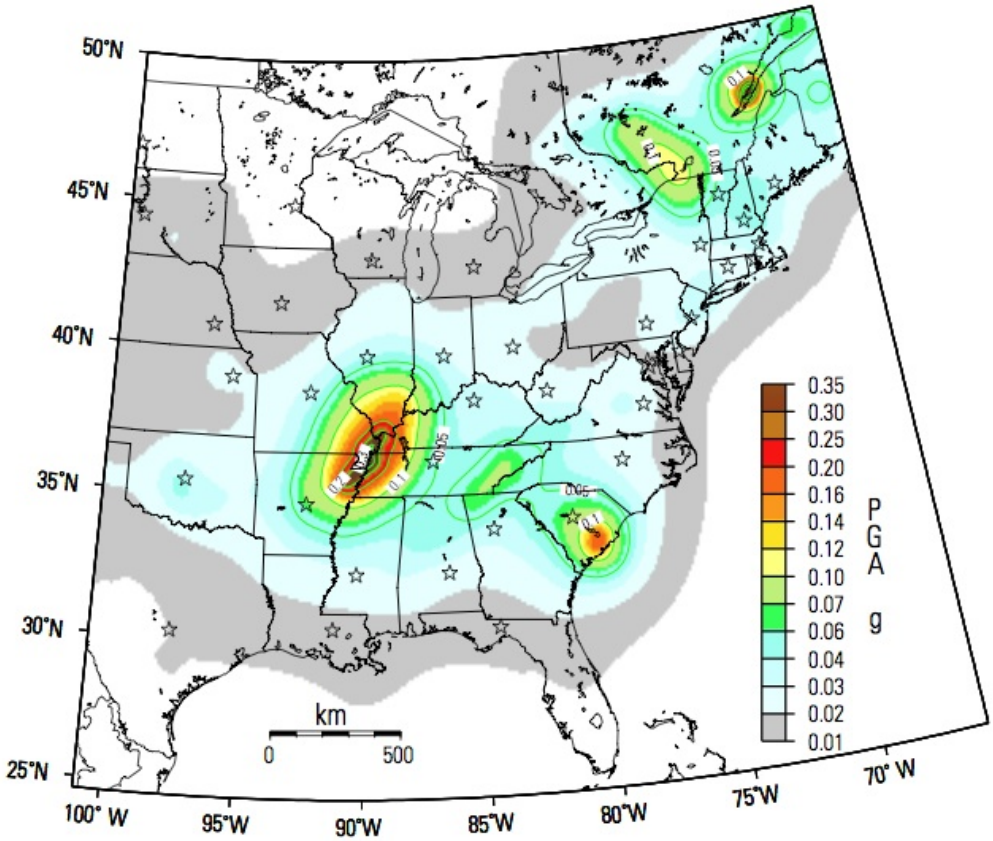
PGA (% g)	Magnitude (Richter)	Intensity (MMI) & Class	MMI Description
< 0.17	1.0 – 3.0	I. Instrumental	**I.** Not felt by many people unless in favorable conditions.
0.17 – 1.4	3.0 – 3.9	II. – III. Feeble/Slight	**II.** Felt only by a few persons at rest, especially on upper floors of buildings. **III.** Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck.
1.4 – 9.2	4.0 – 4.9	IV. – V. Moderate/Rather Strong	**IV.** Felt in doors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. **V.** Felt by nearly everyone: many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
9.2 – 34	5.0 – 5.9	VI – VII Strong/Very Strong	**VI.** Felt by all. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. **VII.** Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built of badly designed structures; some chimneys broken.
34 – 124	6.0 – 6.9	VIII – IX Destructive/Ruinous	**VIII.** Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Heavy furniture overturned. **IX.** Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
> 124	7.0 and higher	X, XI and XII Disastrous/Very Disastrous/ Catastrophic	**X.** Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. **XI.** Few if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. **XII.** Damage total. Lines of sight and level distorted. Objects thrown into the air.

Source: USGS, Earthquake Hazards Program. http://earthquake.usgs.gov; 2008 State of Louisiana Hazard Mitigation Plan, Appendix II.
Note: PGA = Peak Gravitational Acceleration

Geographic Location

As stated above, according to the USGS, the probabilistic seismic hazard maps are updated every six or so years to reflect newly published or thoroughly reviewed earthquake science that and keep pace with regular updates of the building code. Figure 3-10 below illustrates a revised 10-percent probability of exceedance in 50 years emanating from the New Madrid seismic zone. A 10-percent probability of exceedance in 50 years translates to a 1 in 475 change of normal ground motion being exceeded by the amount shown on the map annually. The stars on the map depict state capitols for geographic reference.

Figure 3-10 Peak Ground Acceleration (PGA) for 10-percent Probability of Exceedance in 50-years



Source: Documentation for the 2008 Update of the United States National Seismic Hazard Maps, USGS, Open-File Report 2008-1128. Note: Stars represent state capitals for geographical reference.

The figure above illustrates the highest PGA nearest the New Madrid seismic zone as expected. As one moves further south, the PGA (expressed in a percentage of gravity, “g”, is reduced, thereby reducing the intensity of the force of shaking.

Previous Occurrences

Although Louisiana is an area of low seismic risk, a number of earthquakes have occurred in the State over the last 200 years; the United States Geological Survey (USGS) has recorded 44 such events. While faults throughout the northwestern parishes are thought to be inactive, the New Madrid seismic zone centered near New Madrid, Missouri lies just to the north of Louisiana. The New Madrid seismic zone is thought to be the most likely source of potential

earthquake events that could be strong enough to affect areas with the jurisdiction of the Sabine River Authority.

The USGS recently published "*Documentation for the 2008 Update of the United States National Seismic Hazards Maps, Open-File Report 2008-1128, USGS*". [For the remainder of this section it will be called the *2008 USGS Document].* The figures shown in the earthquake hazard section are sourced from the 2008 USGS Document.

The *2008 USGS Document* displays earthquake ground motions for various probability levels across the Unites States. The new probabilistic hazard maps represent an update of the 2002 seismic hazard maps, which used the methodology for the 1996 version of the maps, and their subsequent use by the State of Louisiana for the development of the *2008 State of Louisiana Hazard Mitigation Plan*.

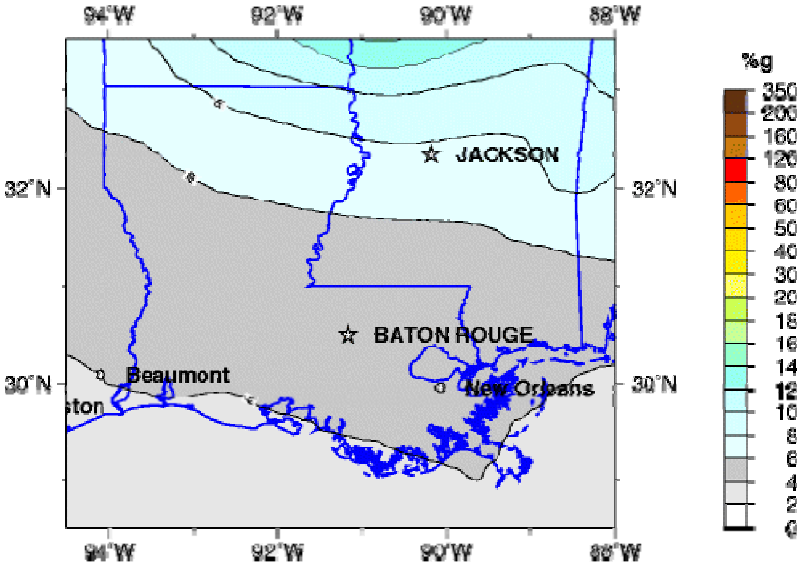
According to the USGS, the probabilistic seismic hazard maps are updated every six or so years to reflect newly published or thoroughly reviewed earthquake science that and keep pace with regular updates of the building code. This hazard mitigation plan for the Sabine River Authority utilizes the data from the *2008 USGS document* and replaces the previous illustrations provided in the *2008 State of Louisiana Hazard Mitigation Plan*. The magnitudes of earthquakes and aftershocks pertaining to the 1811-1812 New Madrid events are controversial. Earthquake modeling over the last 15 years show ranges between 7.0 and 8.1 on the Richter scale. These revised magnitudes are slightly less than those identified in the *2008 State of Louisiana Hazard Mitigation Plan.*

As stated above the United States Geological Service (USGS) has recorded 44 earthquake events in the State of Louisiana. A comprehensive list of all 44 events can be found in Appendix D of the State of Louisiana Hazard Mitigation Plan Update Volume II. The earliest event felt in and around Louisiana occurred on February 14, 1843 and the most recent event occurred on December 20, 2005. Of the 44 events, 32 were recorded. Those events that were measured varied between 2.6 and 4.4 on the Richter scale with the average event of 3.25 on the Richter scale. These events were recorded decades ago and due to advances in seismic measurement and instrumentation, some magnitudes may have actually been less that were initially recorded.

Probability of Future Occurrence

Figure 3-11 below illustrates Peak Ground Acceleration (PGA) with 2 percent probability of exceedence over a 50 year period. This map shows that northeastern Louisiana can assume 6-10% g at 2.0 percent probability of occurrence, decreasing to 4-6 percent g in the western portion of the state. Specific to the Sabine River Authority; De Soto Parish is just within the 4-6% g zone, while the remaining parishes that contain the SRA (Sabine, Vernon, Beauregard, Calcasieu and Cameron Parishes are well within the 4-6% g zone. As illustrated above a PGA value (%g) value less than between 1.4 and above would correspond to a magnitude earthquake of approximately 3.0 to 3.9 on the Richter scale.

Figure 3-11 Louisiana Seismic Hazard Map



Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
site: NEHRP B-C boundary
National Seismic Hazard Mapping Project (2008)

There are limitations to the available earthquake data. There are 44 recorded earthquakes measured in the last 166 years in the Louisiana, the most recent occurring on December 20, 2005. This recurrence interval equates to a 26% chance of occurrence in the state in a given year. Probability of a potentially damaging earthquake within the planning area is significantly lower. Based on these assessments, future probability for damaging earthquakes is assigned a low classification according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Magnitude/Severity

As stated above, the magnitude of an earthquake is measured in the amplitude of the seismic wave and is expressed in the Richter scale; ground motion is expressed as peak ground acceleration (PGA) as a percent of gravity or "g", and intensity is a measure of how strong the shock was felt at a particular location, expressed in Modified Mercalli Intensity (MMI) scale.

Table 3-10 below shows the anticipated magnitude for an earthquake the highest probability.

Table 3-10 Earthquake Magnitude / Intensity Comparison (clipped)

PGA (% g)	Magnitude (Richter)	Intensity (MMI) & Class	MMI Description
< 0.17	1.0 – 3.0	I. Instrumental	**I.** Not felt by many people unless in favorable conditions.
0.17 – 1.4	3.0 – 3.9	II. – III. Feeble/Slight	**II.** Felt only by a few persons at rest, especially on upper floors of buildings. **III.** Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibrations similar to the passing of a truck.

Source: USGS, Earthquake Hazards Program. http://earthquake.usgs.gov; 2008 State of Louisiana Hazard Mitigation Plan

Based on these assessments the severity of such as seismic event would be considered **Limited.**

Overall Vulnerability

Based on the probability of future occurrences and magnitude/severity the overall vulnerability rating would be **Low**.

3.2.4 Excessive Heat

Hazard Description

Excessive heat is a persistent period of temperatures significantly above normal. In Louisiana these conditions are often accompanied by high humidity. Also referred to as extreme heat or a heat wave, such conditions can cause heat induced hyperthermia, better known as “heat stroke.” Heat stroke affects the ability to maintain proper body temperatures and in severe cases may result in death. Children, elderly people, persons without air conditioning, those with illnesses, disabled persons, and people who are overweight are at greatest risk of heat stroke. Other factors that increase risk of impact from excessive heat include drinking alcohol, strenuous outdoor physical activity, and medications that impair the body's ability to regulate temperature or inhibit perspiration. In addition to human health impacts, excessive heat can stress agricultural crops and livestock thus reducing yields and may cause widespread power outages as a result of increased demand for electricity to power air-conditioning systems.

The Heat Index (HI) is a measure of ambient temperature in correlation with relative humidity. The Heat Index Chart shown below was provided by the National Weather Service and indicates the relationship of ambient air temperature and relative humidity to the likelihood of heat disorder and health risk.

Figure 3-12 Heat Index Chart

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Source: National Weather Service

An Excessive Heat Warning is issued by the National Weather Service within 12 hours of the onset of a heat index of at least 105°F for more than 3 hours per day for 2 consecutive days, or heat index more than 115°F for any period of time. An Excessive Heat Watch is issued for weather forecasts of two consecutive days with +105ºF daytime index readings combined with +80ºF nighttime index readings.

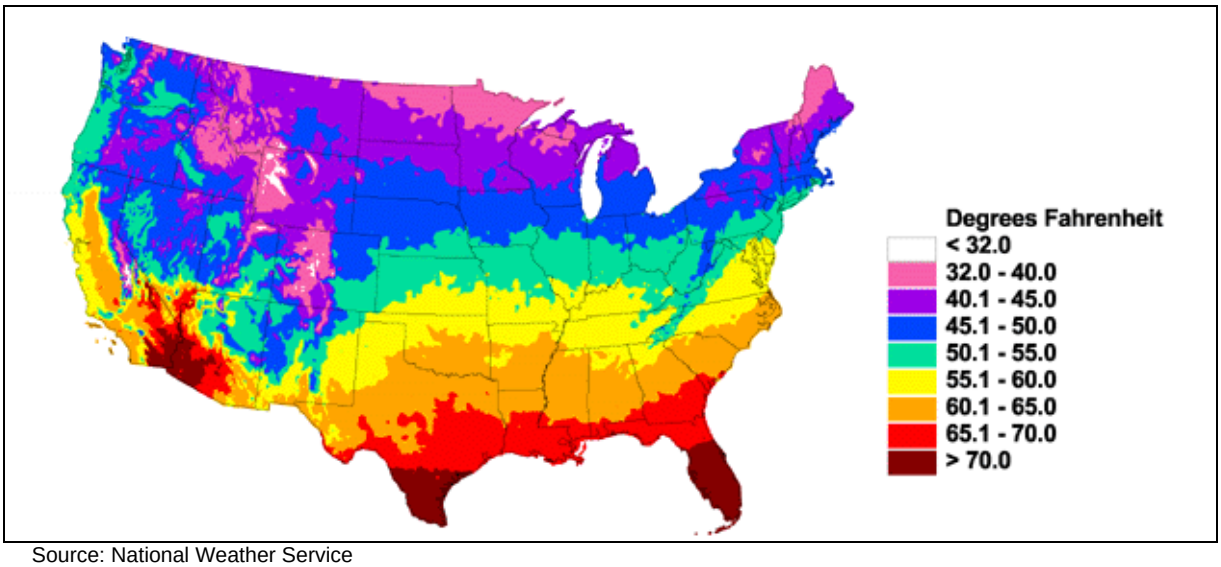
Excessive heat can cause heat stroke or heat exhaustion. Heat stroke is the more serious of the two heat-related illnesses. It occurs when the body becomes unable to control its temperature: the body's temperature rises rapidly, the body loses its ability to sweat, and it is unable to cool down. Body temperatures can rise to 106(°F) or higher within 10 to 15 minutes. Heat stroke can cause death or permanent disability if emergency treatment is not provided. Heat exhaustion is a milder form of heat-related illness that can develop after several days of exposure to high temperatures and inadequate or unbalanced replacement of fluids.

According to data provided by the National Weather Service, for the period 1979 to 1999, excessive heat exposure caused 8,015 deaths in the United States (annual mean: approximately 400 deaths). During this period, more people in this country died from excessive heat than from hurricanes, lightning, tornados, floods, and earthquakes combined. From 1999 to 2003, a total of 3,442 deaths resulting from exposure to extreme heat were reported to the Center for Disease Control (annual mean: 688). Males accounted for 66 percent of heat related fatalities. Of the 3,401 decedents for whom age information was available, 228 (7 percent) were aged under 15 years, 1,810 (53 percent) were aged 15--64 years, and 1,363 (40 percent) were aged ≥65 years.

Geographic Location

Louisiana generally and the parishes that include the jurisdictional boundary of the Sabine River Authority specifically is a region of the country known for high summer temperatures. The climate of the parishes that make up the jurisdictional boundary of the Sabine River authority transition from the continental climate of the Great Plains and Middle West in the northern portion of the Sabine River Authority to the subtropical humid type prevalent in the central and southern parishes. The summer months are consistently warm, with maximum temperatures exceeding 95 degrees about 87 times a year and 100 degrees about 6 days per year. The highest temperate on record (Shreveport, LA) is 110 degrees F on August 18, 1909[ii].

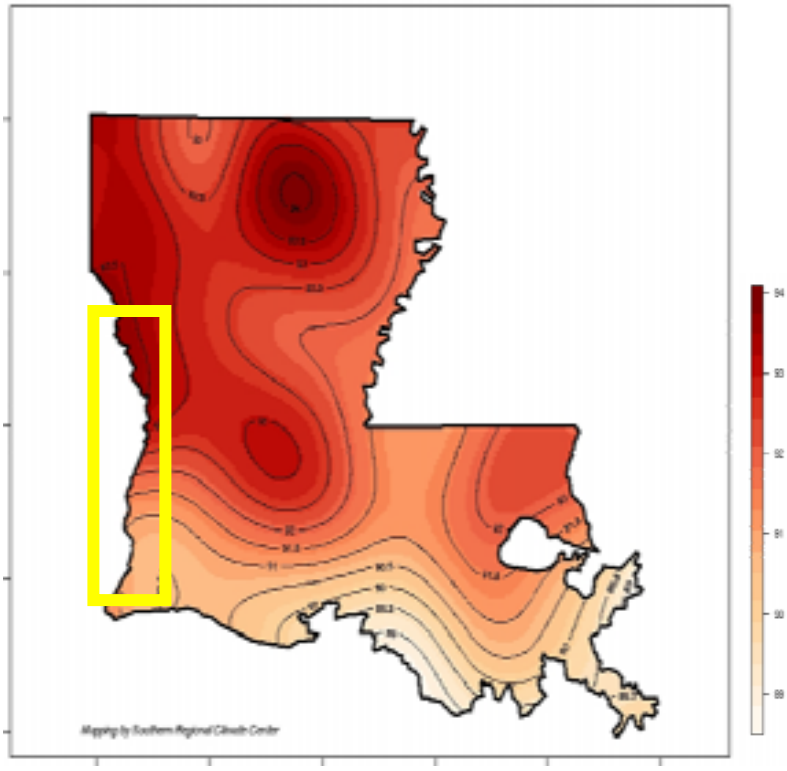
Figure 3-13 Annual Average Temperatures in the U.S.



Source: National Weather Service

Provided by the Louisiana Office of State Climatology, Figure 3-14 shows average July temperature extremes for the state for the period 1971-2000.

Figure 3-14 Average July High Temperatures for Louisiana, 1971-2000



Source: Louisiana Office of State Climatology (LOSC)
Note: General location of Sabine River Authority indicated by yellow rectangle

Previous Occurrences

The highest temperature in Louisiana was 114° (F) recorded on August, 10, 1936 at Plain Dealing. From 1993 to 2008, 34 extreme heat events in Louisiana were reported by the NCDC involving 46 fatalities.

Extreme Heat Event of 1998: According to a New York Times article published August 18, 1998, at least 41 people, most of them elderly died of heat related causes in parishes across northwestern Louisiana, according to dozens of parish coroners surveyed by The Associated Press during the heat wave of summer 1998[iii].

Record Heat in Shreveport June-August 1998: A direct database for communities within Sabine River Authority is not available, thus the use of climate data from the closest National Weather Service station. According to the National Weather Service the summer of 1998 plagued the Shreveport area with record high temperatures. Four daily high records were set in June 1998. Nine more daily high records were set in July and two more records set the first two days of August for a total of 15 new daily high records. Since the summer of 1998 an additional

ten new daily high records have been set. Table 3-11 illustrates the daily high temperature records in Shreveport, Louisiana since 1998.

Table 3-11 Daily High Temperature Records in Shreveport, Louisiana Since 1998

Date	Temperature (F)
August 31, 2000	109 degrees
June 2, 1998	108 degrees
August 2, 1998	108 degrees
June 1, 1998	107 degrees
July 31, 1998	107 degrees
August 1, 1998	107 degrees
August 30, 2000	107 degrees
July 10, 1998	105 degrees
July 11, 1998	105 degrees
July 12, 1998	105 degrees
July 30, 1998	105 degrees
August 19, 1999	105 degrees
July 7, 1998	104 degrees
August 3, 2008	104 degrees
August 14, 2007	104 degrees
August 22, 2005	104 degrees
July 27, 2008	103 degrees
August 23, 2005	103 degrees

Source: National Weather Service

Probability of Future Occurrence

A direct database for communities within Sabine River Authority are not available, therefore climate data from the closest National Weather Service station, Shreveport was used to illustrate the high temperature records that would easily constitute as excessive heat as it is expected that extreme temperature recordings in Shreveport serve as an accurate measure of similar extreme heat episodes within the jurisdictional boundary of the Sabine River Authority. In general, the summer months are consistently warm, with maximum temperatures exceeding 100 degrees about 6 days per year and exceeding 95 degrees about 87 days per year.

Based on the previously stated excessive heat events in Louisiana by the National Climatic Data Center, from 1993 to 2008, 34 extreme heat events in Louisiana were reported by the NCDC involving 46 fatalities. Extreme heat events occur annually. This probability assessment equates to a **High** probability of future occurrence classification according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Magnitude/Severity

There are two heat related fatalities reported in De Soto Parish (August 1999 and August 2002). Only one can be verified as occurring within the jurisdictional boundary of the Sabine River Authority (Logansport, LA). As stated above, extreme heat deaths can occur and at a minimum, periods of excessive heat result in diminished productivity, and well being. As an area known for high summer temperatures and humidity, significant health related impacts and/or economic impacts from extreme heat likely have been underreported. Extreme heat can be combated through the use of air conditioning. However, persistent heat also increases demand on energy infrastructure. Extreme heat also increases the risk of wildfire and typically compounds the

effects of drought. Based on these assessments, magnitude and severity is classified as **Limited.**

Overall Vulnerability

Overall vulnerability to extreme heat is considered **Moderate.** This assessment is based on diminished productively and well being including the possibility of life threatening heat to vulnerable populations that may not have access to air conditioning.

Air-conditioning is the number one protective factor against heat-related illness and death. If a home is not air-conditioned, people can reduce their risk for heat-related illness by spending time in public facilities or private facilities that are air-conditioned. Suggestions for preventing a heat-related illness include frequently drinking water or non-alcoholic fluids; wearing lightweight, light-colored, loose-fitting clothing; and reducing or eliminating strenuous activities or doing them during cooler parts of the day. Periodically checking on neighbors who do not have air conditioning is also recommended.

3.2.5 Flooding

Hazard Description

A flood is defined as the inundation of land caused by the rise and overflow of a body of water. Floods occur most commonly as a result of unusually heavy rainfall causing a river system or lake to exceed its normal carrying capacity or by a storm surge from a hurricane or tropical storm. Flooding can also occur due to dam or levee failure. Flooding is one of the most pervasive natural hazard threats in Louisiana. Public safety, structures, and infrastructure can all be impacted by flooding.

There are four types of flooding events that can impact the Sabine River Basin: riverine flooding, coastal flooding (storm surge), flash floods, and to a lesser extent, urban flooding. Riverine flooding is a natural occurrence where a waterway exceeds its 'bank full' capacity and inundates the adjacent floodplain. According to common usage, a floodplain is that area that is inundated by the 100-year flood (a flood that has a 1 percent chance in any given year of being equaled or exceeded). Riverine flooding is affected by the intensity and distribution of rainfall, soil moisture, vegetation, and water-resistance of the surface areas caused by urbanization.

A coastal flood occurs when ocean water is pushed inland by hurricane winds and/or high tides. The severity of coastal flooding can be compounded by the riverine flooding that typically accompanies major tropical storm systems. Flash flooding is a localized flood that results from a short duration of intense rainfall across a limited geographic area. Urban flooding is related to the construction of impervious surfaces such as roads, buildings and parking lots. During extended periods of intense rainfall, storm-water conveyance systems can be overwhelmed and flooding of surrounding neighborhoods can result.

Definitions for flood announcements and warning are provided in Table 3-12 below.

Table 3-12 National Weather Service Flood Warning Definitions

Riverine Flooding	
Flood Potential Outlook (FPO):	Announcement to alert the public of potentially heavy rainfall that could send rivers and streams into flood or aggravate an existing flood.
Flood Watch:	Announcement to inform the public that current or developing conditions indicate a threat of flooding, but occurrence is neither certain nor imminent.
Flood Warning:	An announcement by the NWS to inform the public of flooding along larger streams in which there is a serious threat to life or property. A flood warning will usually contain river stage forecasts.
Flood Statement:	A statement issued by the NWS to inform the public of flooding along major streams in which there is not a serious threat to life or property. It may also follow a flood warning to give later information.
Flash Floods	
Flash Flood Watch:	Announcement that current or developing conditions indicate potential flash flooding in the watch area, but occurrence is neither certain nor imminent.
Flash Flood Warning:	Issued to inform the public that flash flooding is in progress, imminent, or highly likely.
Flash Flood Statement:	A statement by the NWS which provides follow-up information on flash flood watches and warnings.

Source: National Weather Service

Geographic Location

A flood event of one type or another can occur in almost any populated or developed area within the Sabine River Basin. Exceptions to this involve highland areas and hilly terrain in portions of

the planning area. Roughly 25 percent of the Sabine River Basin is identified as 'special flood hazard areas', as designated on Flood Insurance Rate Maps (FIRMs) developed by FEMA for the region.

FIRMs are the official maps on which FEMA has delineated both the special hazard areas and the risk premium zones applicable to the community. Most generally, FIRMs identify areas in 100-year floodplains, 500-year floodplains, and areas of minimal or no flood hazard. There are many sub-classifications within these general groups, each with varying insurance rates and requirements, and in certain cases development restrictions. Table 3-13 below presents a simplified description of flood hazard area classifications found on FEMA Flood Insurance Rate Maps (FIRMs) and flood insurance requirements for each zone.

Table 3-13 Simplified Flood Hazard Area Classifications and Requirements

FIRM Classifications	Description/Requirements
A 1– 30, A, AE	Area of 100 year floodplain, flood hazard area, base flood elevation requirement and purchase of flood insurance is mandatory
B, X (shaded)	Areas of moderate flooding, purchase of flood insurance is optional *
C, X (not shaded)	Areas of minimal flooding, purchase of flood insurance is optional *
D	Areas of undetermined, but possible Flood hazards, purchase of flood insurance is optional *
V	Areas within 100 year floodplain with High Velocity wave action, flood hazard area, base flood elevation requirement, [However, no fill may be used to elevate the structure]. The purchase of flood insurance is mandatory.

Source: Calcasieu Parish Planning and Development
Note: some lending institutions require the purchase of flood insurance regardless the flood zone classification

Table 3-14 below is a non-abbreviated listing of the various flood zone classifications as defined for FEMA Flood Insurance Rate Maps (FIRMs).

Table 3-14 Detailed FIRM Flood Hazard Area Classifications

Flood Zones		
Zone A	The 100-year or Base Floodplain. There are six types of A zones:	
	A	The base floodplain mapped by approximate methods, i.e., BFEs are not determined. This is often called an unnumbered A zone or an approximate A zone.
	A1-30	These are known as numbered A zones (e.g., A7 or A14). This is the base floodplain where the firm shows a BFE (old format).
	AE	The base floodplain where base flood elevations are provided. AE zones are now used on new format FIRMs instead of A1-30 zones.
	AO	The base floodplain with sheet flow, ponding, or shallow flooding. Base flood depths (feet above ground) are provided.
	AH	Shallow flooding base floodplain. BFE's are provided.
	A99	Area to be protected from base flood by levees or Federal flood protection systems under construction. BFEs are not determined.
	AR	The base floodplain that results from the de-certification of a previously accredited flood protection system that is in the process of being restored to provide a 100-year or greater level of flood protection
Zone V and VE	V	The coastal area subject to velocity hazard (wave action) where BFEs are not determined on the FIRM.
	VE	The coastal area subject to velocity hazard (wave action) where BFEs are provided on the FIRM.

Flood Zones	
Zone B and Zone X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and the 500-year floods. B zones are also used to designate base floodplains or lesser hazards, such as areas protected by levees from the 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
Zone C and Zone X (unshaded)	Area of minimal flood hazard, usually depiction FIRMs as exceeding the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood.
Zone D	Area of undetermined but possible flood hazards.

Source: Understanding Your Risks, identifying hazards and estimating losses, FEMA 386-2
Notes: 100-year floodplain defined as inundation area of the Flood of Record, and carrying a 1 percent probability in a given year.
BFE= Base Flood Elevation

Based on digital FIRM data (preliminary), the Figures 3-15 and 3-16 on the following pages show special flood hazard areas (100-year floodplain) for northern and southern portions of the planning area, respectively.

Figure 3-15 Flood Prone Areas, Sabine River Basin, Northern Section

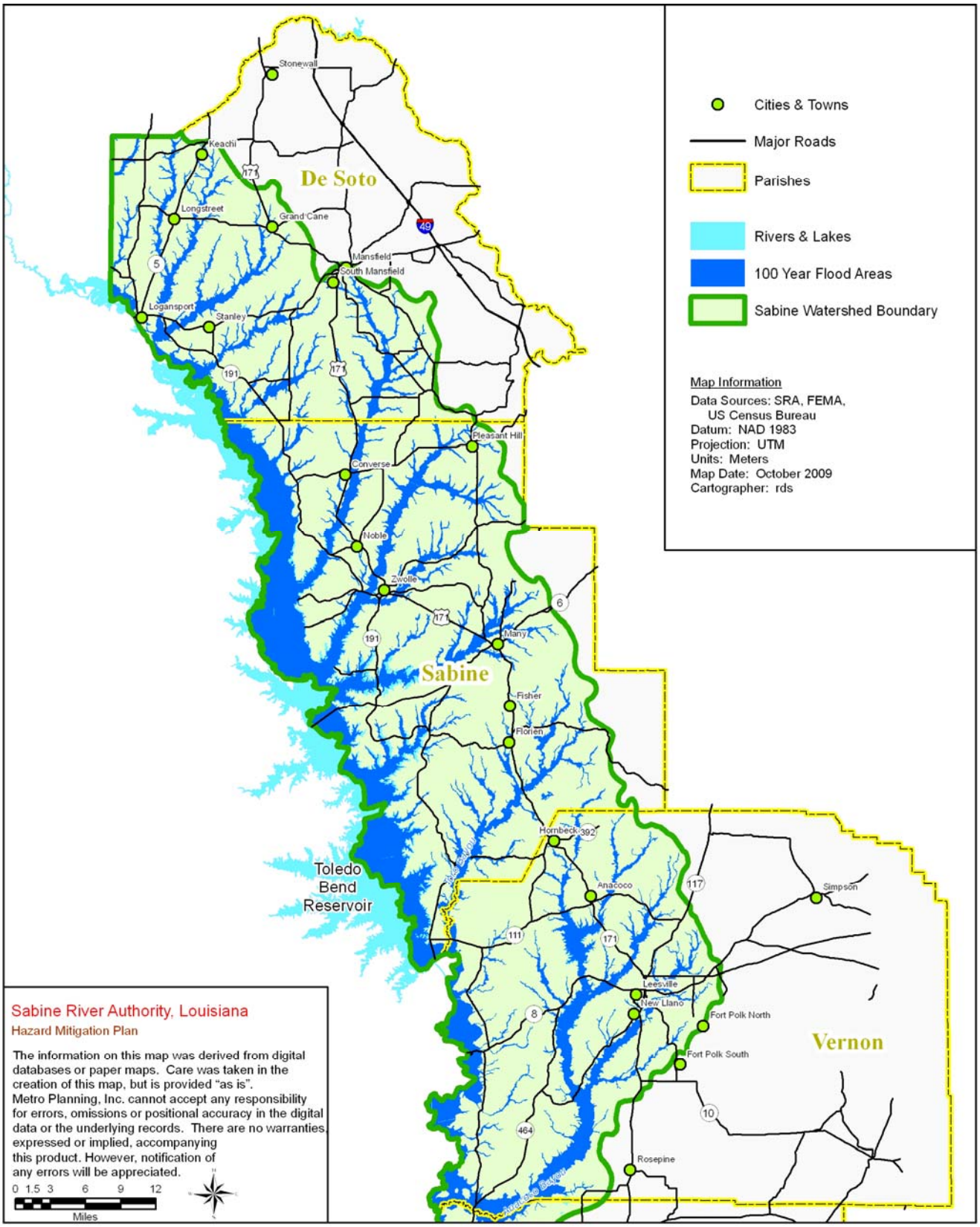
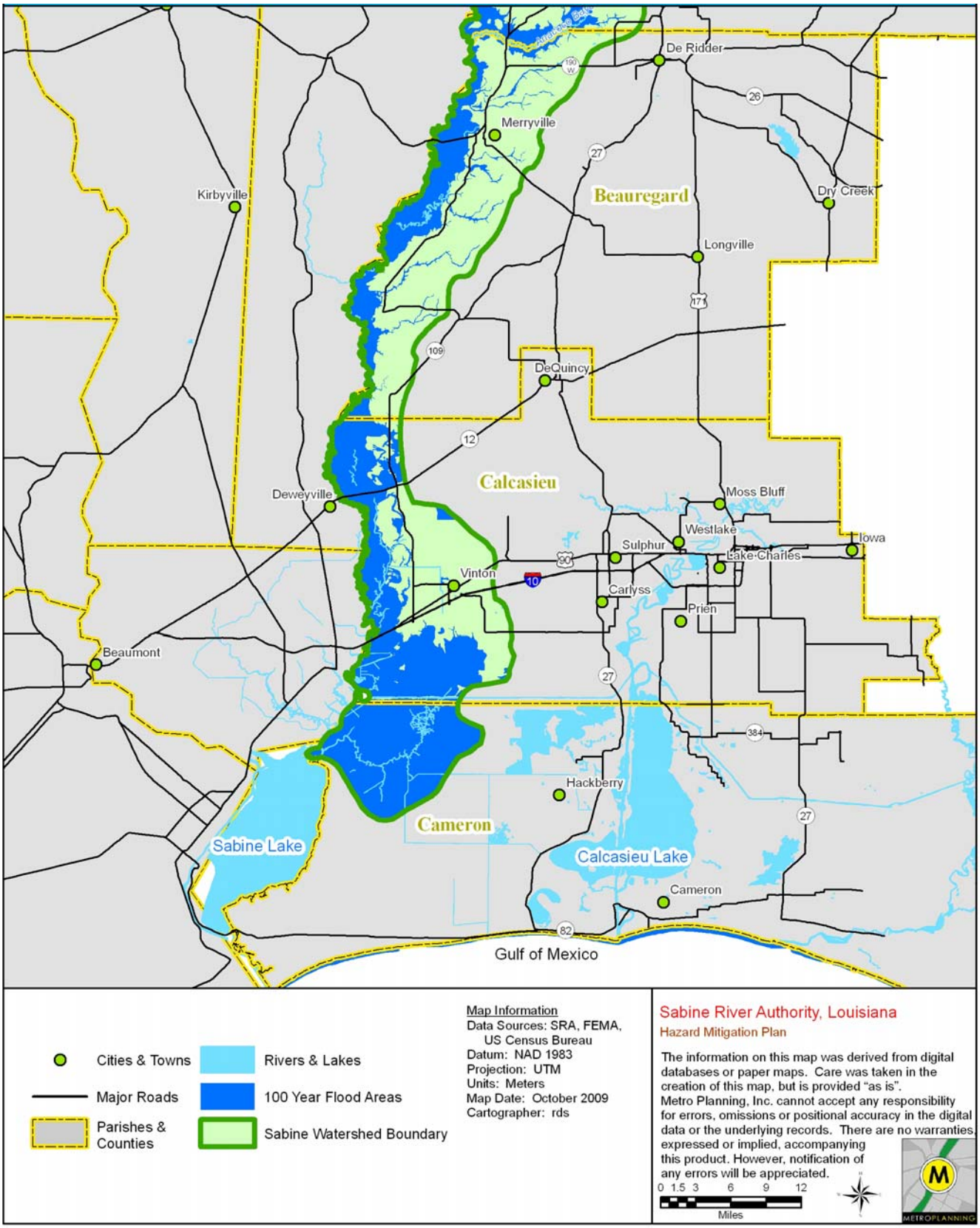


Figure 3-16 Flood Prone Areas, Sabine River Basin, Louisiana, Southern Section



Previous Occurrences

There is a significant history of flooding impacts in the Sabine River Basin, the majority of which center on the river itself. The jurisdictional boundary of the Sabine River Authority covers the western portions of De Soto, Sabine, Vernon, Beauregard, Calcasieu and Cameron Parishes. Flood events cataloged by the National Climatic Data Center were reviewed for the above parishes for the 1950 to June 30, 2009 period. There were 134 flood events recorded by the NCDC, though undoubtedly numerous other flooding events are not reported by the agency's analysis. Property damage was reported at $23,817,000. Table 3-15 below lists the flood events and damage per parish. Please note that NCDC records of flood events report for entire parishes and therefore are likely to include a certain number of events which occurred outside the Sabine River Basin.

Table 3-15 Flood Events, Sabine River Basin 1950-2009

Parish	Total	Fatalities	Injuries	Property Damage
De Soto	20	0	0	$175,000
Sabine	18	0	0	$2,025,000
Vernon	13	2	0	$2,385,000
Beauregard	26	0	1	$6,411,000
Calcasieu	51	0	0	$12,526,000
Cameron	6	0	0	$295,000
Total	**134**	**0**	**1**	**$23,817,000**

Source: National Climatic Data Center (NCDC)
Note: Zero (0) values may indicate missing data.

The following are descriptions of major flood events in the Sabine River Basin developed by the NCDC:

May 1989

An upper trough oriented southwest to northeast moved slowly across central Texas the early and mid-morning hours of May 17. By evening of the 17th, the trough was dropping heavy rain in a band from eastern Harris County, Texas to the upper end of Toledo Bend Reservoir as the trough stalled and set up "train effect" rainfall. Thunderstorms were moving at 20 to 25 mph, but training over the same area for 12 hrs ending 7 AM May 18th.

Toledo Bend Reservoir reached record elevation. Toledo Bend was releasing 30,000 cfs of flow through the gates going into the event as they already had a high pool. With the 10.0 to 17.0 in. directly on the drainage into the upper end of the lake, water rose extremely quickly in the reservoir to a record level of 173.90 ft by midnight May 18, previous record 173.42 ft.

Record flow was observed below the dam at Burkeville. Gage readings by the regular satellite telemetry were doubtful, so a USGS technician left Houston, crossed the Sabine River downstream at Orange, drove up the Louisiana side to Burkeville and waded through 1 to 2 ft of water to get out to the bridge and read the wire weight. The river gage indicated a crest of 48.90 ft, but the wire weight reading was only 47.45 ft - still a flood of record, exceeding the previous record of 44.20 ft Sept 14, 1967.

Nearly a hundred homes flooded in the River Road housing subdivision just below Toledo Bend Dam on the Texas bank. Water was to the roof of one two-story home. Several additional homes flooded downstream at Deweyville.

February 1999

On January 29 and 30, 1999, a slow moving storm system dumped 3 to 11 inches of rain across northeast Texas and northwest Louisiana. Much of this rain fell over the upper Sabine River

basin that resulted in significant rises in river levels along the Sabine River. The Sabine River Authority manages Toledo Bend Reservoir and to a significant extent controls the lower Sabine River. Once the reservoir reaches 172.50 feet MSL, spillway gates at the dam are generally opened. Toledo Bend Reservoir reached 172.50 feet at 8:30 p. m. on January 29, 1999 and crested at 173.92 feet on January 31, 1999.

To relieve pressure from the Toledo Bend dam, the spillway gates were opened to release water from the reservoir. This had an immediate impact on river levels downstream of the dam. The first river gauge location below the dam is at Burkeville, Texas and the river crested at 47.66 feet on February 1. Flood stage at Burkeville, Texas is 43 feet. The next river gauging location is located near Bon Wier, Texas and Merryville, Louisiana. River levels crested at 37.52 feet on February 3, over 7.5 feet above flood stage (30 feet). Many families were forced from their homes due to rising water.

On Sunday, February 7, Louisiana Governor Mike Foster declared a state of emergency for Calcasieu, and Vernon Parishes, each of which incurred major damage. At least 30 homes were damaged in Calcasieu Parish and more than 30 homes in Vernon Parish were severely damaged. On the Louisiana side of the river, hundreds of acres of farmland were washed away, as well as a dozen cattle. Woodlands near the river were also significantly impacted. Over 200 people were forced to evacuate. Dozens of roads were damaged from the high water, causing damages totals to rise above $1.5 million dollars (Calcasieu and Vernon Parish combined). At the time, the 1999 Sabine River flood was the highest and most damaging flood event in Calcasieu Parish since the Sabine River floods of May and July of 1989.

March 2001

The Sabine River had a major flood in early March, cresting five to six feet above flood stage betwen the 9th and 11th. Significant erosion occurred on the river bank, and many homes and camps immediately on the river had water enter them. Many roads leading to the river were damaged from the rapidly moving water. Most of the damage occurred along the rivernear Burr Ferry and Merryville.

November 2001

Heavy rains fell across southeast Texas and southern and central Louisiana from the 26th of November to the 29th of November. This rainfall event produced major flooding along the Calcasieu River from Glenmora to Old Town Bay and the West Fork of the Calcasieu River at Sam Houston Jones State Park. The first of many River Flood Warning was issued on the morning of November 27th. A total of thirteen river points, and Bundick Lake, went into flood during the event.

Rains started to fall late on the 26th of November across southeast Texas as a cold front approached from the north. This rain event was the first widespread heavy rainfall since Oct 13th . The front stalled across southeast Texas. As a result, southeast Texas and all of Louisiana remained in the warm sector through November 27th. The front moved into southwest Louisiana late on November 27th and extended from south of Alexandria, Louisiana to south of Beaumont, Texas. The initial support that drove the front into southeast Texas lifted out to the northeast. Another upper level system moved across northern Mexico into south Texas early on November 27th. This upper level support resulted in showers spreading eastward from southeast Texas into southwest Louisiana.

Deep moisture originating from the gulf moved across southeast Texas and Louisiana from November 27th through the 29th. The front finally moved into eastern Louisiana during the

afternoon hours of November 29th, ending the threat of additional rains. Elevated thunderstorms produced large hail and high winds that blew trees down. The elevated thunderstorms developed in the cold pool of air, behind the cold front. During this period, nineteen Severe Thunderstorm Warnings and seven Tornado Warnings were issued.

Elevated thunderstorms training across southeast Texas into southwest Louisiana resulted in rainfall totals above twelve inches in a swath from southern Jasper and Newton counties in southeast Texas. These extreme rain totals extended into northwest Calcasieu, Beauregard, southern Vernon, and Rapides parishes. A Flood Watch was issued during the early morning hours of Tuesday November 27th and continued through the afternoon of the 29th. Numerous Flash Flood Warnings and Urban and Small Stream Advisories were issued during this period.

Many homes and camps were flooded along Houston River, the west Fork of the Calcasieu River, and the Calcasieu River near Old Town Bay. In addition, over fifty roads in Beauregard Parish and twenty-seven roads in Rapides Parish were closed at some point during this event. Road closures were also reported in Allen, Avoyelles, Calcasieu, and Vernon parishes. In Beauregard Parish, homes flooded along Bundick Lake. In southeast Texas several homes were flooded in the Vidor area of Orange County and Lumberton area of Hardin County. Roads were closed due to high water across southeast Texas. Rainfall totals from gauged sites varied from less than a inch in south central Louisiana to around fourteen inches in southwest Louisiana.

October-November 2009

Serious flooding conditions developed during the latter days of October and into November along the Sabine River and in low-lying areas across the broader region of northwestern Louisiana in 2009. The National Weather Service-Shreveport reported record monthly rainfall totals for October 2009. In records dating back to 1872, rainfall across this region for the month of October were the 3rd highest ever for any month, and over 6 inches higher than the previous record total, set in 1949.

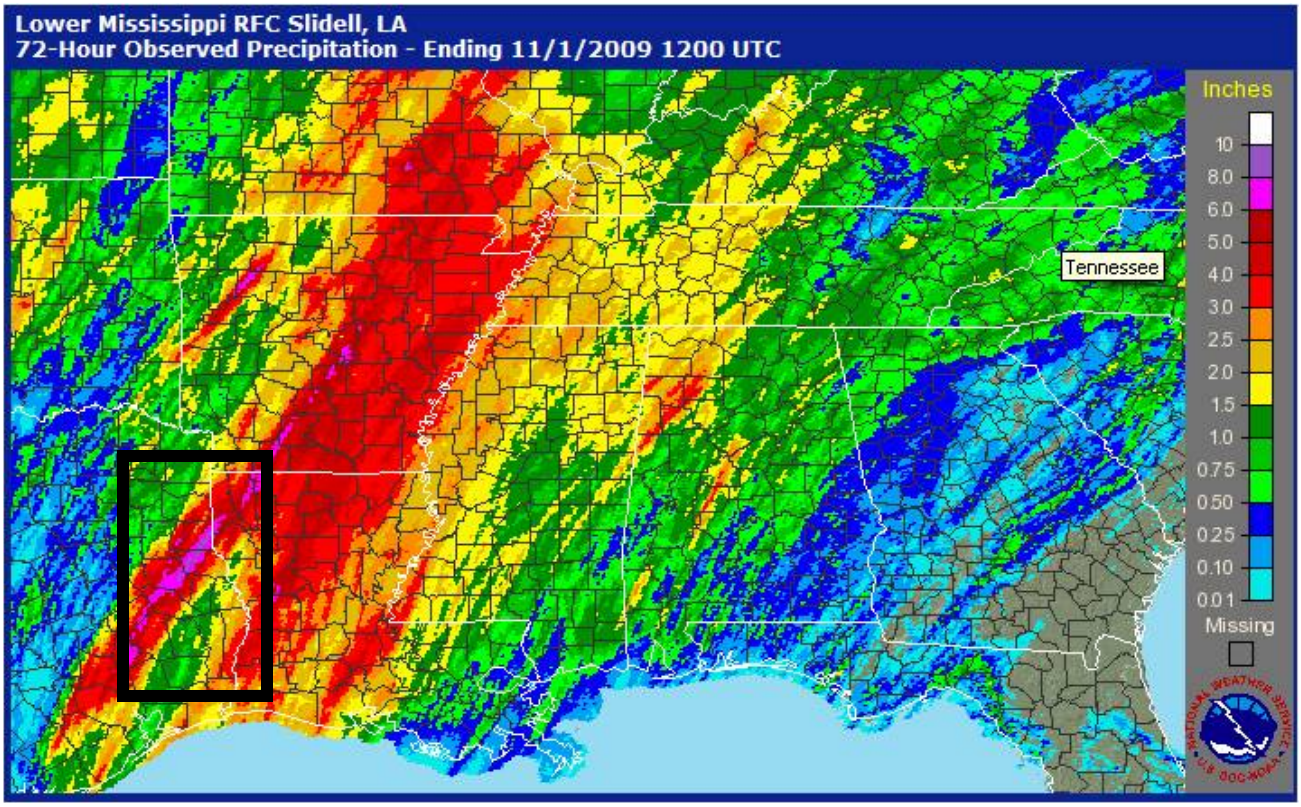
Table 3-16 October Rainfall Totals, North Louisiana-Upper Sabine River Basin

Month	Rain Total (inches)
October 2009	20.35"
October 1949	14.02"
October 1984	12.05"
October 1985	9.84"
October 1994	9.14"

Source: National Weather Service-Shreveport

After what was already an abnormally wet month, a rainfall event in the latter days of the month produced totals ranging from 1-8 inches across the Sabine River Basin, including areas of Louisiana and Texas. Provided by the National Weather Service, Figure 3-x shows rainfall patterns for this event across the southeastern U.S. The Sabine River watershed captured significant runoff from this storm.

Figure 3-17 Rainfall Totals, 72 Hours Ending November 1, 2009, Southeastern U.S. Region



Source: National Weather Service
Note: Black rectangle indicates approximate location of Sabine River Basin in its entirety (including Texas portions).

Insert Tables of Flood Stages at Logansport, Toledo Bend, Burkeville, Bon Wier, Deweyville and discussion of impacts (Here).

Probability of Future Occurrence

Generally, floods with higher flood elevations (stages) have lower chances of occurrence. A minor flood is virtually a yearly occurrence on a number of rivers and tributaries, in the parishes that comprise the jurisdictional boundary of the Sabine River Authority.

A review of the six parishes' flood history indicates that 134 flood events have been recorded over a 59 year period by the NCDC since 1950. This probability assessment equates to a **High** probability of future occurrence classification according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Magnitude/Severity

According to the State of Louisiana Hazard Mitigation Plan Update, in terms of average annual losses as compiled by the National Flood Insurance Program, the six parishes that comprise the jurisdictional boundary of the Sabine River Authority rank as following: De Soto 54th of 64, Sabine 60th of 64, Vernon 47th of 64, Beauregard 29th of 64, Calcasieu 11th of 64 and Cameron 7th of 64.

In terms of magnitude and severity of flooding events throughout the parishes that comprise the jurisdictional boundary of the Sabine River Authority, a worst-case scenario could be considered **Critical** based on the definitions set forth in Section 3.1.1 Methodology and Definitions.

Overall Vulnerability

Based on the frequency and severity of previous occurrences, overall vulnerability to flooding is considered **Very High**. Based on a worst-case scenario, a flood event could cause multiple injuries and fatalities, devastate thousands of homes or businesses, disrupt critical services and infrastructure for extended periods and cause major economic disruption.

3.2.6 Hailstorm

Hazard Description

Hail is defined as ice precipitation with a diameter of 5 to 190 millimeters. Hail develops in the upper atmosphere as ice crystals bounced about by high velocity updraft winds. The ice crystals accumulate frozen droplets and fall after developing enough weight. Hailstorms are most common in the middle latitudes and are generally brief in duration. Large downdrafts in mature thunderstorm clouds provide the mechanism for hail formation. A hailstorm ordinarily occurs in mid to late afternoon during the passage of a cold front or during a thunderstorm.

The severity of hailstorms depends on the size of the hail, the length of time the storm lasts, and whether it occurs in developed areas. Hailstorms can cause damage to homes and other structures, automobiles, and crops. While the damage to individual structures or vehicles is often minor, the cumulative costs to communities, especially across large metropolitan areas, can be significant.

The hail size and potential impact from hailstorms is outlined in the following scale provided by NOAA and the Tornado and Storm Research Organization.

Table 3-17 Combined NOAA/TORRO Hailstorm Intensity Scales

Size Code	Intensity Category	Hail Diameter	Comparative Size	Typical Impacts
H0	Hard Hail	up to 0.33"	Pea	No damage
H1	Potentially Damaging	0.33-0.60"	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80"	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.2"	Nickel to Quarter	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.2-1.6"	Half Dollar to Silver Dollar	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0"	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4"	Lime or Egg	Aircraft bodywork dented, brick walls pitted
H7	Very destructive	2.4-3.0"	Tennis ball	Severe roof damage, risk of serious injuries
H8	Very destructive	3.0-3.5"	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4.0"	Grapefruit	Extensive structural damage. Risk of severe/fatal injuries to persons caught in the open
H10	Super Hailstorms	4+"	Softball and larger	Extensive structural damage. Risk of severe/fatal injuries to persons caught in the open

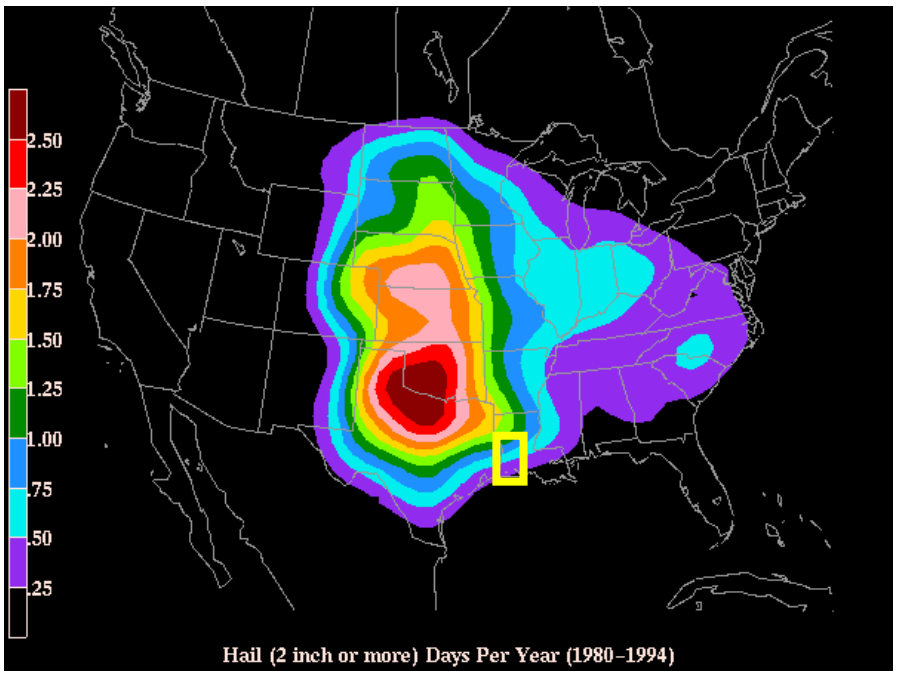
Sources: National Oceanic and Atmospheric Administration (NOAA), Tornado and Storm Research Organization, www.torro.org

Geographic Location

All regions of the U.S. experience hailstorms of varying magnitude. Hailstorms that drop large diameter hail (roughly 2"+) occur less frequently and are typically confined to the central and eastern part of the nation. Figure 3-18 below is based on hailstorm data from 1980-1994. It shows the annual probability of hailstorm occurrence (2" diameter or larger) within a 12.5 mile radius from any given point on the map.

This figure shows that multiple bands of occurrence of experiencing 2-inch diameter or larger hail events annually stretch across the jurisdictional boundary of the Sabine River Authority. The northern portion of the region of the Sabine River Authority receives the most number of annual days of 2-inch diameter or larger hail (between 1.25 and 1.50 days per year). As the Sabine River continues downstream toward the Gulf of Mexico, the number of annual days of 2-inch diameter or larger hail diminishes sequentially down to .50 day.

Figure 3-18 Hailstorm Occurrence, 2'' Diameter or Greater by Location, 1980-1994

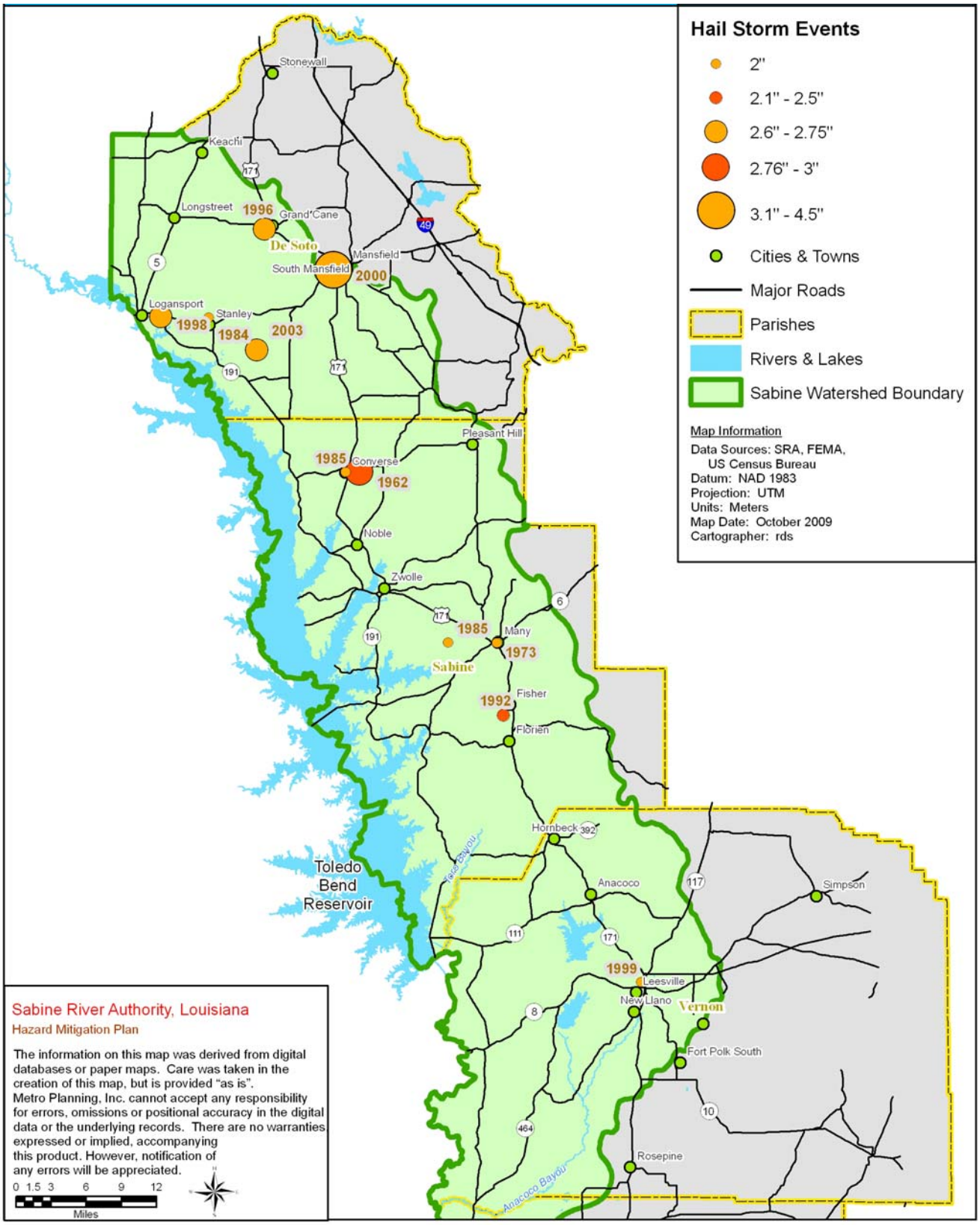


Source: National Oceanic and Atmospheric Administration (NOAA), National Severe Storms Laboratory (NSSL); http://www.nssl.noaa.gov/users/brooks/public_html/bighail.gif
Note: Yellow rectangle indicates approximate location of Sabine River Basin

Previous Occurrences

As stated previously, the jurisdictional boundary of the Sabine River Authority covers the western third to half of De Soto, Sabine, Vernon, Beauregard, Calcasieu and Cameron Parishes. Parish-wide hailstorm events were reviewed for the above parishes cataloged by the National Climatic Data Center at the National Oceanic and Atmospheric Administration (NOAA) between January 1, 1950 and May 31, 2009. There were 620 hailstorms with hailstone diameter at least 0.75-inch or greater in diameter in the above parishes. Property damage was reported at $126,000 and crop damage at $50,000. Please be apprised that the catalog of hail events includes the entire parishes above and includes land beyond the jurisdictional boundary of the Sabine River Authority. Of the 620 parish-wide hail storms with hailstone diameters at least 0.75-inch or greater in diameter 176 hailstorm events had hailstone diameters of at least 1.25-inches or greater. Figure 3-19 on the following page shows the location of storms producing 2-inch diameter hailstones or larger in the Sabine River Basin.

Figure 3-19 Hail Occurrences, 2" Diameter or Larger, Sabine River Basin

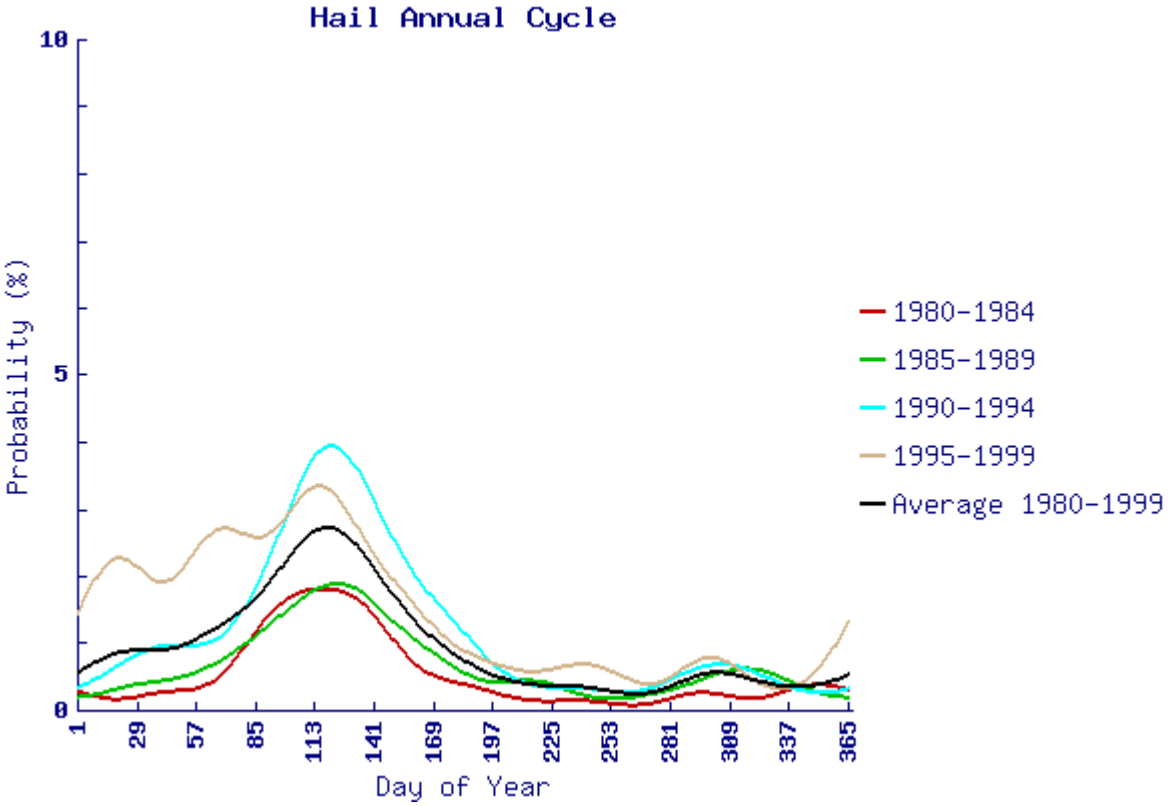


Probability of Future Occurrence

Based on the NCDC records of 620 total hailstorm occurrences from 1950 to 2009, an average of over 10 reported hailstorms with hailstone diameter of 0.75-inch or greater in diameter occur within the parishes that encompass the jurisdictional boundary of the Sabine River Authority in a given year. This frequency of previous occurrences equates to a **High** probability of future occurrence according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Regarding probability based on time of year, Figure 3-20 shows the daily probability of a hailstorm occurrence for the Sabine River Basin. Over the period measured, probability for hailstorm occurrence was highest in the spring months and for the two most recent reporting periods (1990-1994 and 1995-1999).

Figure 3-20 Daily Hailstorm Probability, Sabine River Basin 1980-1999



Source: National Oceanic and Atmospheric Administration (NOAA), National Severe Storms Laboratory (NSSL), http://www.nssl.noaa.gov/cgi-bin/hazgraph3.pl

Magnitude/Severity

On at least 176 occasions since 1950, hailstorms dropping 1.75-inch diameter hail or greater has occurred within the parishes that encompass the jurisdictional boundary of the Sabine River Authority. Hailstones of this size can cause superficial damage to vehicles, break windows, damage tiled roofs, and involves significant risk of injuries to persons unable to find adequate shelter.

Regarding impact and potential severity, on four occasions in De Soto Parish (1996, 1998, 2003 and 2004) hailstorm events produced hailstone diameters of 2.75-inches (approximately the size of a tennis ball) and during one hailstorm (2000) hail with a diameter of 4.50-inches (softball size) was reported. On one occasion in Sabine Parish (1962) a hailstorm event produced hailstone diameters of 3.0-inches (approximately the size of a baseball). On one occasion in

Vernon Parish (1993) a hailstorm event produced hailstone diameters of 2.75-inches. Similarly, a singular event occurred in Beauregard Parish (2009) producing hailstone of equal size; 2.75-inches in diameter. Two hailstorm events producing 2.75-inch in diameter hail occurred in Calcasieu Parish in 1973 and 2007. Lastly, two hailstorm events producing 2.75-inch in diameter hail occurred in Cameron Parish both in 1983.

Hailstones of this size can cause superficial damage to vehicles, break windows, damage tiled roofs, and potentially injure persons unable to find adequate shelter. Considering these factors, magnitude and severity is considered **Limited**.

Overall Vulnerability

Based on the probability of occurrence, potential severity and geographic area affected by hailstorms, overall vulnerability is considered **Low**.

Magnitude/Severity

Regarding impact and potential severity, on at least two occasions since 1973 the diameter of hail precipitation was 2.75" (approximately the size of a tennis ball). According to the NOAA/TORRO Hailstorm Intensity Scale, hail of similar size is capable of causing damage to structures and serious injuries.

On at least 32 other occasions since 1967, hailstorms dropping 1.75" hail has occurred. Hailstones of this size can cause superficial damage to vehicles, break windows, damage tiled roofs, and potentially injure persons unable to find adequate shelter. Considering these factors, magnitude and severity is considered **Limited.**

Overall Vulnerability

Based on the probability of occurrence, potential severity and geographic area affected by hailstorms, overall vulnerability is considered **Low**.

3.2.7 Hurricane and Tropical Storms

Hazard Description

Hurricanes and tropical storms are types of tropical cyclones. The basic difference between a hurricane and tropical storm is intensity, measured by maximum sustained wind speed. A hurricane has surface winds in excess of 74 miles per hour (64 knots). The tropical storm has surface winds less than those of hurricanes, but greater than 39 miles per hour (34 knots). For locations in the Northern Hemisphere, hurricanes and tropical storms are accompanied by a counterclockwise wind circulation near the earth's surface.

A hurricane or tropical storm is typically characterized by storm surge along coastlines, high waves, severe winds, coastal erosion, extreme rainfall, thunderstorms, lightning, inland flooding, tornados and micro-bursts. These storms typically lose strength over land since their energy is derived from warm waters; however, damage from a hurricane and tropical storm can still be extremely destructive several hundred miles inland.

The storm surge is arguably the most threatening hurricane-related hazard to Louisiana and other states along the Gulf of Mexico coastline. According to the Federal Emergency Management Agency (FEMA), a storm surge is "a dome of water pushed onshore by hurricane and tropical storm winds that can reach 25 feet high and be 50 – 1,000 miles wide." A simpler definition is a rise above the normal water level along a shore caused by strong onshore winds and/or reduced atmospheric pressure. Storm surge height is the difference of observed water level minus the predicted tide. The maximum increase in sea level usually occurs in the direct path of the storm or to the right of the storm track. If a hurricane track funnels water into a bay, the height of the storm surge can be greatly amplified. A storm surge can inundate coastal floodplains, cause backwater flooding through coastal river mouths and generate large waves that flood coastal beaches.

Hurricanes are classified into five categories based on wind speed, central pressure and damage potential. The classification system for hurricanes is referred to as the Saffir-Simpson Hurricane Scale shown in Table 3-18 below.

Table 3-18 Saffir-Simpson Hurricane Scale

Category	Wind Speed (mph)	Storm Surge	Expected Damage
1	74-95	4-5 feet	**Minimal:** Damage is done primarily to shrubbery and trees, unanchored mobile homes are damaged, some signs are damaged, no real damage is done to structures.
2	96-110	6-8 feet	**Moderate:** Some trees are toppled, some roof coverings are damaged, and major damage is done to mobile homes.
3	111-130	9-12 feet	**Extensive:** Large trees are toppled, some structural damage is done to roofs, mobile homes are destroyed, and structural damage is done to small homes and utility buildings.
4	131-155	13-18 feet	**Extreme:** Extensive damage is done to roofs, windows, and doors; roof systems on small buildings completely fail; some curtain walls fail.
5	> 155	> 18 feet	**Catastrophic:** Roof damage is considerable and widespread, window and door damage is severe, there are extensive glass failures and entire buildings could fail.

Source: Understanding Your Risks: Identifying Hazards and Estimating Losses. FEMA. 2001.

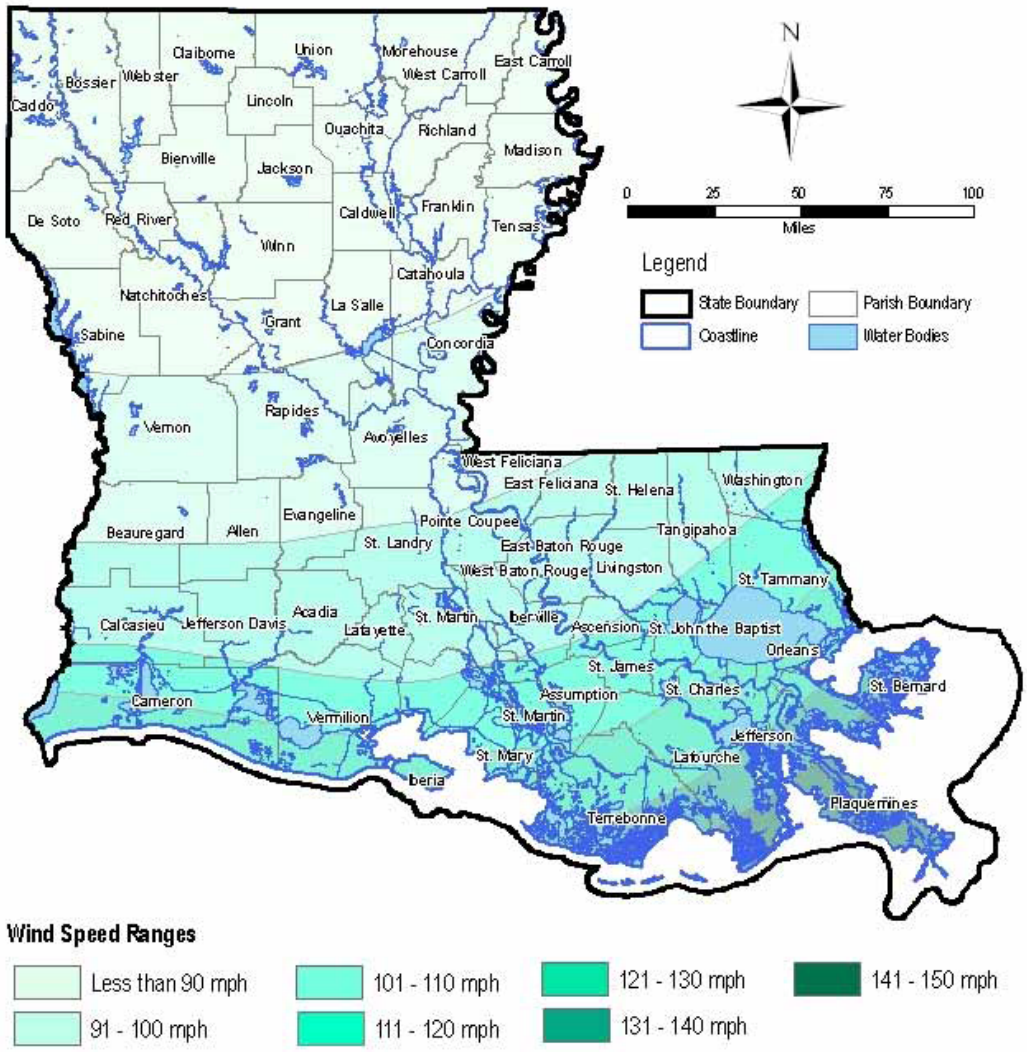
The official season for hurricanes and tropical storms is from June 1 to November 30. Peak storm activity often occurs in September. Storms in Louisiana have occurred as early as late May, but there has not been a November storm in more than 100 years.

Geographic Location

The northern boundary of the Sabine River Authority is approximately 150 miles inland from the Gulf of Mexico and ends approximately twenty miles north of the Gulf of Mexico at the northern boundary of Sabine Lake in Cameron Parish. Along the linear, north-south orientation of the Sabine River Authority as one travels south toward the Gulf of Mexico, wind speeds associated with hurricanes increase. The northern reach of the Sabine River Authority including De Soto and Sabine Parishes are likely to experience wind speeds less than 90 miles per hour.

Vernon and the northern half of Beauregard Parish can anticipate hurricane wind speed ranges of 91-100 miles per hour. The southern half of Beauregard Parish and most of Calcasieu Parish can expect hurricane force wind speed ranges of 101-110 miles per hour. The southern third of Calcasieu Parish and the northern half of Cameron Parish can experience hurricane wind speed ranges of 111-120 miles per hour and lastly the southern half of Cameron Parish along the coast can experience wind speed ranges of 121-130 miles per hour. Figure 3-21 illustrates the shows the wind speed ranges noted above.

Figure 3-21 Hurricane Wind Speed Ranges, Louisiana



Source: ASCE Standard 7-02

Previous Occurrences

According to the National Climatic Data Center, there have been 14 hurricanes or tropical storms that have impacted Sabine River Authority between 1995 and May 2009. Table 3-19 lists the hurricanes and tropical storms that have impacted parishes that comprise the boundary of the Sabine River Authority.

Table 3-19 Hurricanes/Tropical Storms in Sabine River Authority, 1995–May 2009

Storm Name	Date	Storm Type	Deaths	Injuries	Property Damage	Crop Damage
Dean	7/29/1995	Tropical Storm	0	0	0	0
Charley	8/21/1998	Tropical Storm	0	0	$40K	0
Earl	9/2/1998	Hurricane		0	$32K	0
Frances	9/9/1998	Tropical Storm	0	3	$21M	0
Hermine	9/17/1998	Tropical Storm	0	0	0	0
Georges	9/27/1998	Hurricane	0	0	0	0
Allison	6/6/2001	Tropical Storm	0	0	0	0
Isidore	9/25/2002	Tropical Storm	0	0	$70K	$3.7M
Lili	10/3/2002	Hurricane	0	3	$368M	$168M
Rita	9/24/2005	Hurricane	1	0	$4B	$0
Humberto	9/13/2007	Tropical Storm	0	0	$450K	0
Edouard	8/5/2008	Tropical Storm	0	0	$50K	0
Gustav	9/1/2008	Hurricane	1	0	$153.250M	$30M
Ike	9/12/2008	Hurricane	0	0	$31.4M	$105M
Total (14 events)			**2**	**6**	**$4.553 B**	**$306.7M**

Source: National Climatic Data Center, NOAA, 2009
Note: Zero (0) values may indicate missing data

Profiles of four hurricane/tropical storm events occurring within the jurisdictional boundary of the Sabine River Authority are provided below. The source of information for profiles is the website of the National Climate Data Center and FEMA Disaster Summaries.

Tropical Storm Frances (1998)

Tropical Storm Frances was the third tropical system to affect southwest Louisiana in three weeks, and was by far the worst. Tides at Cameron were the highest since Hurricane Carla in 1961. Tornadoes and severe flooding were the 2 main weather disasters. In Cameron Parish, Highway 82 was closed between Holly Beach and Constance Beach for 3 days due to high water. Sections of 82 between Holly Beach and Cameron, and around the Grand Chenier area were also closed. At Constance Beach, ten camps were heavily damaged, three of which were completely washed away. At Holly Beach, 2 feet of sand piled up along the coast. In Cameron, nearly every home and business on Main Street had water enter them. In Hackberry and Grand Lake, many homes were flooded due to high water from the Calcasieu River and excessive rain. Total damages in Cameron Parish were in excess of 10 million dollars. In Calcasieu Parish, flooding from the Calcasieu River caused over 20 homes in the Deatonville area to report water in them. Several boat houses and camps along the lake in Lake Charles were also damaged. Significant flooding was also reported in the Carlyss area, and south of the Lake Charles Regional Airport.

Hurricane Rita (2005)

Hurricane Rita made landfall around 230 am on September 24th in Cameron Parish near Johnson Bayou as a category 3 hurricane with sustained winds of 120 mph. Wind gusts over

110 mph were recorded in Cameron and Calcasieu Parishes. This resulted in numerous trees and power lines downed. In parts of Beauregard, Jeff Davis, and Vermilion Parishes, winds blew over 90 mph. The remainder of southwest Louisiana saw wind gusts in excess of 50 mph. Only one direct fatality has been reported. A man drowned near a sunken shrimping vessel near the Calcasieu ship channel. Estimated damages in southwest Louisiana total near 4 billion dollars, with the bulk of that loss in Cameron and Calcasieu Parishes. Entire towns were destroyed in Cameron Parish, including downtown Cameron, Creole, Holly Beach, and Grand Chenier. An estimated 90 to 95 percent of the homes in the parish were severely damaged or destroyed - over 5000 residences. Storm surge values are estimated around 15 feet in parts of Cameron Parish. The storm surge also moved up the Calcasieu ship channel, flooding portions of Calcasieu Parish, including sections of downtown Lake Charles near the civic center, where the storm surge was estimated between 6 and 8 feet. Storm surge also was a significant problem in Vermilion Parish, which saw locations 10 ft above sea level flooded - including all of Pecan Island, Intracoastal City, and December. The storm surge extended further east, into Iberia and St. Mary Parishes, where an estimated 5 to 10 ft storm surge damaged homes along and south of Highway 90, especially near Cypremort Point, Burns Point, and Franklin.

The storm weakened as it moved northward, however, all of Northwest and North Central Louisiana remained on the east side of the eyewall and experienced strong tropical storm force winds. Damage was sporadic across the region with damage consisting of downed trees and power lines as well as structural damage to homes, businesses and automobiles from downed trees. The damage was particularly extensive along and near the Toledo Bend Reservoir of West Central Louisiana where several structures suffered minor to moderate damage. Many residents of Northwest and North Central Louisiana lost power during the height of the storm.

Hurricane Gustav/Tropical Storm Gustav (2008)

Hurricane Gustav caused wind damage, flash flooding, and several tornadoes across southwest Louisiana. Gustav made landfall in Terrebonne Parish in the morning of September 2nd as a category 2 hurricane with sustained winds of 110 mph. Gustav moved northwest, almost up along Highway 90 across St. Mary, Iberia, St. Martin, and Lafayette Parishes. The highest measured wind gusts were 85 mph at a research site near Abbeville, LA in Vermilion Parish. However, wind speeds were estimated between 75 and 85 mph from St. Mary Parish to Evangeline Parish. Storm surge was a minimal impact because southwest Louisiana was on the west side of the onshore winds for most of the event. The highest recorded storm tide was 4.77 at Amerada Pass in St. Mary Parish. However, rainfall was a large impact. In central Louisiana, over 20 inches of rain fell in Rapides Parish, with a CO-OP observer recording 20.43 inches 7 miles east of Alexandria. This resulted in widespread flooding of the Alexandria-Pineville region, where over 200 water rescues were performed. Significant flooding also occurred in New Iberia, where over ten inches of rain fell resulting in widespread flooding in and around New Iberia. Several tornadoes were seen across southwest Louisiana, with the worst one occurring in Evangeline Parish near Mamou, where two people were killed when their tied-down mobile home was thrown for over 200 yards. Other fatalities in the region were considered indirect. Two men died in Calcasieu Parish from carbon monoxide poisoning from a generator running in their home. A woman died in St. Martin Parish when her home caught fire from burning candles after she lost power. Total property damages were estimated near 750 million dollars in southwest Louisiana. Agricultural loses were estimated to be over 225 million dollars.

Hurricane Gustav moved northwestward into the southeast Louisiana coast during the early morning hours of September 1st. The storm continued a steady northwestward motion into east central Louisiana and northwest Louisiana during the evening hours of September 1st. The storm was downgraded to a tropical storm just before entering east central Louisiana during the

late evening hours of September 1st. As the storm continued to move to the northwest tropical storm force winds affected much of east central and west central Louisiana which downed numerous trees and power lines. Power was out across many locations and several trees fell on homes and automobiles. Wind gusts likely approached 70 mph in a few locations during the evening and late night hours of September 1st into the pre dawn hours of September 2nd

Hurricane Ike/Tropical Storm Ike (2008)

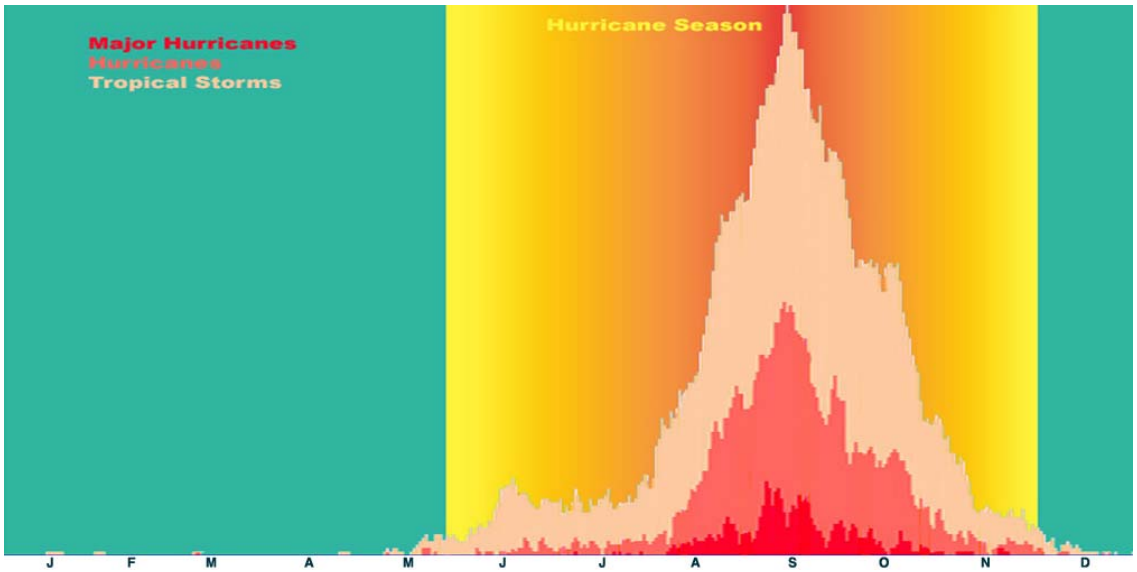
Hurricane Ike caused wind damage, storm surge flooding, and tornadoes across southwest Louisiana. Ike made landfall near Galveston, TX early in the morning on September 13th as a strong category 2 hurricane. Sustained hurricane force winds were confined to extreme western Cameron Parish. The highest recorded winds in southwest Louisiana were at Lake Charles Regional Airport with sustained winds of 46 kn (53 mph) and gusts of 67 kn (77 mph). The lowest pressure reading occurred at Southland Field near Sulphur, LA, with a low of 994.6 mb. Several tornadoes were reported across southwest Louisiana. The most significant one was near Mamou, where a home lost its roof, and another 10-15 homes were damaged. Storm surge was a significant event. Water levels ranged from 14 ft in western Cameron Parish, to 8 ft in St. Mary Parish. This resulted in widespread flooding of the same areas that flooded in Hurricane Rita in 2005. Most of Cameron Parish was under water. Over 3,000 homes were flooded. This extended north into Calcasieu Parish, where another 1,000 homes flooded in Lake Charles, Westlake, and Sulphur. Maximum storm total rainfall ranged from 6 to 8 inches across Cameron, Calcasieu, and Beauregard Parishes. No fatalities were reported in southwest Louisiana. Total property damages, however, were high. Loses are estimated to be almost 420 million dollars across southwest Louisiana. Agricultural loses were over 225 million dollars.

Probability of Future Occurrence

Based on analysis of National Climatic Data Center records for the period 1998-2008, there were 14 hurricane and tropical storm events that impacted the parishes that comprise the jurisdictional boundary of the Sabine River Authority. This frequency of previous occurrence equates to a **High** probability of future occurrence according to the definitions set forth in Section 3.1.1 Methods and Definitions.

While hurricane season officially runs from June 1 to November 30 in a given year, based on patterns of previous occurrences probability is highest in the month of September, as indicated by Figure 3-22.

Figure 3-22 Hurricane Frequency by Month, Atlantic Ocean



Source: Atlantic Oceanographic and Meteorological Laboratory (AOML)

Magnitude/Severity

As stated above, the northern boundary of the Sabine River Authority is approximately 150 miles inland from the Gulf of Mexico and ends approximately twenty miles north of the Gulf of Mexico at the northern boundary of Sabine Lake in Cameron Parish. Along the linear, north-south orientation of the Sabine River Authority as one travels south toward the Gulf of Mexico, wind speeds associated with hurricanes increase. The northern reach of the Sabine River Authority including De Soto and Sabine Parishes are likely to experience wind speeds less than 90 miles per hour.

Vernon and the northern half of Beauregard Parish can anticipate hurricane wind speed ranges of 91-100 miles per hour. The southern half of Beauregard Parish and most of Calcasieu Parish can expect hurricane force wind speed ranges of 101-110 miles per hour. The southern third of Calcasieu Parish and the northern half of Cameron Parish can experience hurricane wind speed ranges of 111-120 miles per hour and lastly the southern half of Cameron Parish along the coast can experience wind speed ranges of 121-130 miles per hour.

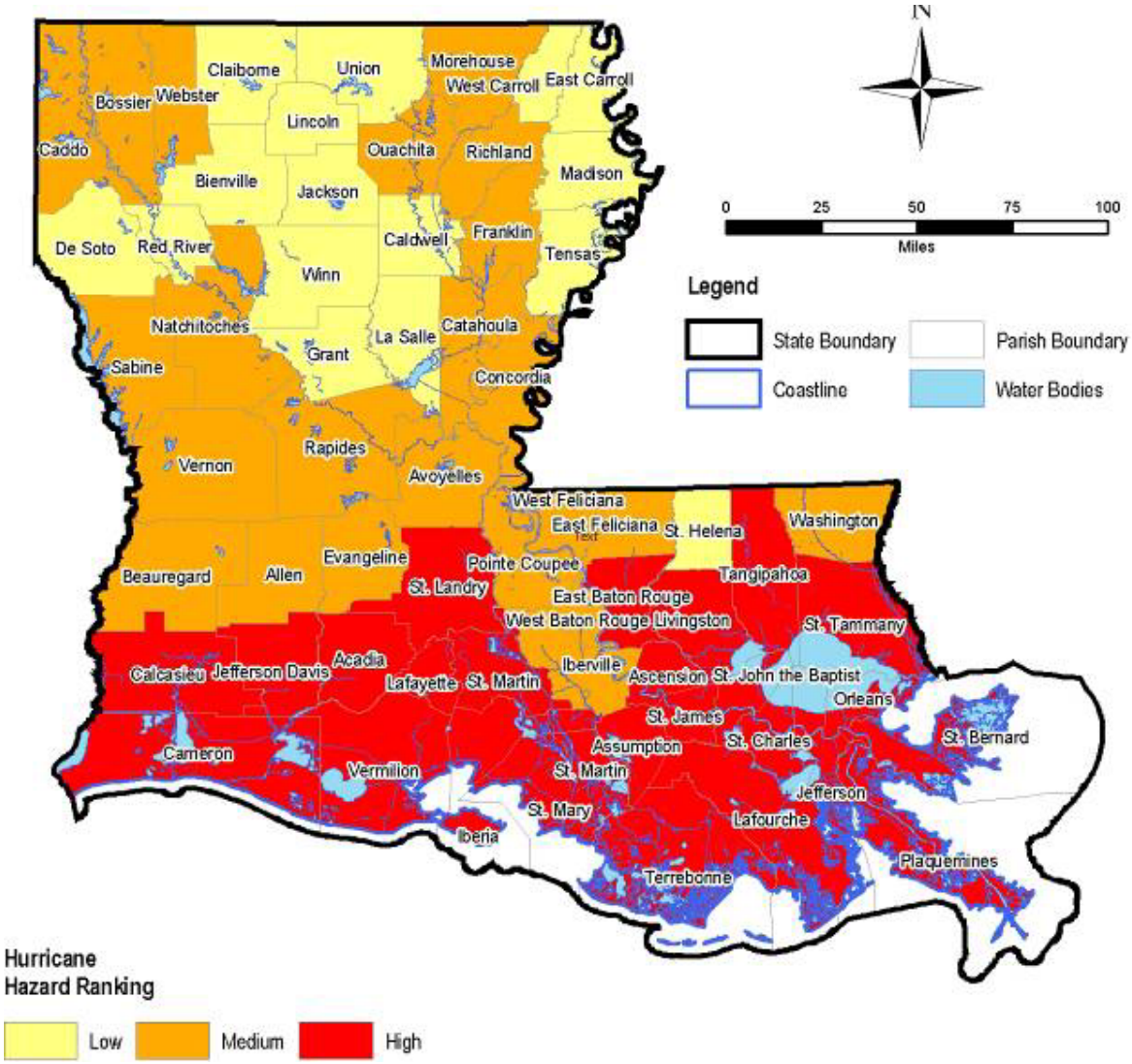
Therefore, depending on the geographical location within the Sabine River Authority, the magnitude and severity of hurricanes and tropical storms is considered **Critical to Catastrophic** based on the based on the definitions established in Section 3.1.1.

Overall Vulnerability

The State of Louisiana Hazard Mitigation Plan ranks the hurricane hazard ranking for annual estimated losses for the six parishes that comprise the jurisdictional authority of the Sabine River Authority. From north to south the State Hazard Mitigation Plan ranks them as follows: De Soto “low”, Sabine “medium”, Vernon “medium”, Beauregard “medium”, Calcasieu “high” and Cameron “high”.

Based on the severity of previous occurrences and future probability, overall vulnerability to hurricanes and tropical storms is considered **High to Very High**.

Figure 3-23 Hurricane High Wind Hazard Ranking (Annual Estimated Losses)



Source: State of Louisiana Hazard Mitigation Plan

3.2.8 Thunderstorm, Lightning and High Winds

Hazard Description

Thunderstorms are defined as violent atmospheric disturbances accompanied by high winds, lightning, thunder and heavy rain. The disturbance is a result of warm, humid air moving upward because of unequal surface heating, lifting of warm air along a frontal zone or diverging upper-level winds (these diverging winds draw air up beneath them). There are three types of thunderstorms: 'air mass', 'dry' and 'severe'. Air mass thunderstorms often develop in summer and are also called scattered thunderstorms. They are typically associated with warm, humid air and develop during the afternoon in response to insolation (refers to incoming solar radiation, solar heating or sunshine), dissipating rather quickly after sunset. Generally, air mass thunderstorms are less severe than other types of thunderstorms, but still are capable of producing downbursts, brief heavy rain, and hail over 3/4 inch in diameter. A dry thunderstorm is generally a high atmospheric pressure-based thunderstorm. Dry thunderstorms produce lightning, but little if any precipitation reaches the ground, due to evaporation in the relatively dry air beneath the storm cell.

'Severe' thunderstorms are thunderstorms that produce tornados, winds of at least 58 mph (50 knots) and/or hail at least ¾" in diameter. Structural wind damage may imply the occurrence of a severe thunderstorm. More violent severe thunderstorms form in areas with a strong vertical wind shear that forces the updraft into the mature stage, the most intense stage of the thunderstorm. Wind speed is generally measured in knots. The conversation of knots to miles per hour is 1 knot = 1.15 mph. Therefore a 50-knot wind is 57.5 miles per hour and a 100-knot wind is 115 miles per hour. Severe thunderstorms are capable of producing wind velocities in excess of 70 knots, or 80 mph.

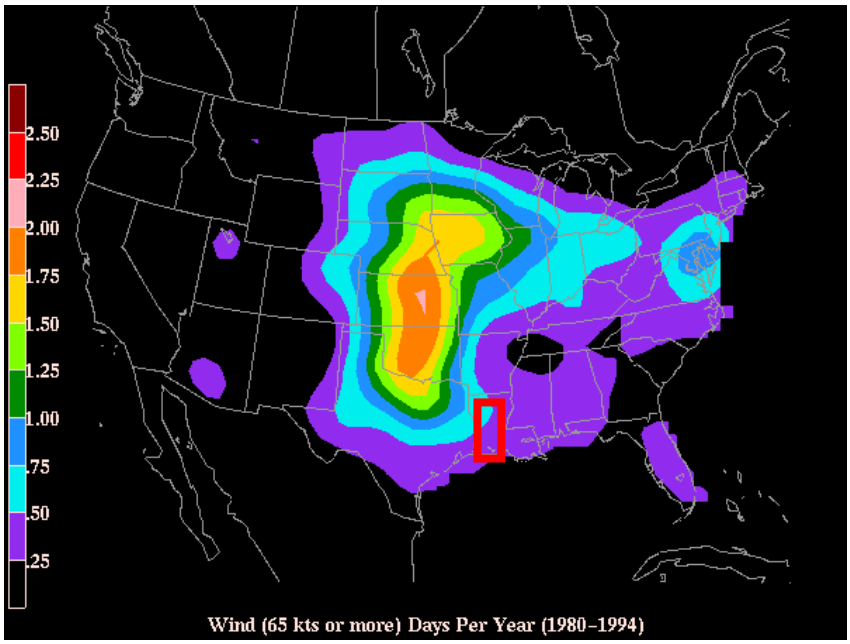
Lightning is a common by-product of a thunderstorm. The action of rising and descending air in the thunderstorm separates positive and negative charges, with lightning the result of the buildup and discharge of energy between positive and negative charge areas. The hazard posed by lightning is underrated. According to NOAA, an average of 20 million cloud-to-ground lighting flashes are detected every year in the continental United States. About half of all flashes have more than one ground strike point, so it can be assumed that approximately 30 million points in the U.S. are struck in an average year.

Lightning is the most dangerous and frequently encountered weather hazard that most people in the United States experience annually. Lightning is the second most frequent killer in the U.S., behind floods and flash flood events, with nearly 100 deaths and 500 injuries annually. Note that lightning strike data is not available for the Sabine River Authority; therefore its threat will be incorporated into the general hazard category of Thunderstorms.

Geographic Location

Thunderstorms occur across a broad region of the U.S. that includes all areas of the Sabine River Authority. As shown in Figure 3-24 below, Sabine River Authority is located along a band of the southern U.S. that experiences winds greater or equal to 65 knots on roughly a semi-annual basis. Lightning is also known to impact all regions of the planning area.

Figure 3-24 Intense Thunderstorm Wind Regions, U.S. 1993-2009



Source: National Severe Storms Laboratory (NSSL), http://www.nssl.noaa.gov/users/brooks/public_html/bigwind.gif
Note: Red rectangle indicates approximate location of the Sabine River Basin

Previous Occurrences

A summary listing of thunderstorm and high wind events in the parishes containing the jurisdictional boundary of the Sabine River Authority from 1950 to May 31, 2009 is presented in Table 3-20 below. During the reporting period, there have been 1,031 thunderstorm and wind events, resulting in eleven deaths and thirty-six injuries. Total property damage estimates are over $26,000,000.

Table 3-20 Sabine River Basin Thunderstorm Events 1950-2009

Parish	Total Storms	Deaths	Injuries	Property Damage
De Soto	181	1	7	$5.005M
Sabine	143	5	8	$7.780M
Vernon	133	0	1	$3.666M
Beauregard	164	2	2	$1.859M
Calcasieu	308	3	20	$5.796M
Cameron	102	0	3	$1.968M
Total	**1,031**	**11**	**36**	**$26.074M**

Source: National Climatic Data Center (NCDC)
Note: Zero (0) values may indicate missing data.

Below is a sample of narratives from thunderstorm and wind events within the parishes that contain the jurisdictional boundary of the Sabine River Authority.

<u>De Soto Parish</u>

February 10, 1998: A multitude of downed trees and power lines left the area without electricity for more than 12 hours. Electrical companies estimate that nearly 60,000 people in the region were without power. There were three injuries reported, no seriously, coming from drivers hitting downed trees with their vehicles. Numerous signs were bent and twisted, portable signs were blown down the road, a vacant mobile home was overturned and every street and

neighborhood was littered with limbs and uprooted trees. Scores of residents reported damaged roofs and flattened cars. The local Red Cross was called in to provide food and water. Nineteen homes without insurance suffered major damage.

May 17, 2002: A hardware store was destroyed and a roof was torn off a bank.

May 2, 2009: Damage consisted of many trees snapped or uprooted. Several power lines were blown down. A few homes had minor roof damage as well. Winds were estimated at 70 knots.

Sabine Parish

February 10, 1998: Numerous trees and power lines were blown down in and around town. (Converse, LA) State highway 175 looked like a roadside timber harvest with pines and hardwoods littering ditches. The roof was blown off the High School where students were having classes but no injuries occurred. In addition, several mobile homes were damaged by fallen trees and high winds.

March 12, 2001: A fatality occurred when a tree was blown down onto on a vehicle on LA 482 west of Zwolle.

July 12, 2002: Several large trees and power lines toppled. A storage shed was blown over and electricity was out across most of the town. One person suffered injuries when an oak tree fell across a car, crushing it and just missing the driver's seat.

March 25, 2009: Trees and power lines were downed in town (Many, LA). Trees were downed from Ponder and Andries Streets through to San Antonio Avenue. At Many Junior High School, a portion of the roof on the front of the building was blown off. Several light poles by the school were snapped and fell across two 18 wheelers. A home was also damaged by a fallen tree.

May 3, 2009: Several reports of trees and power lines downed in Zwolle, Louisiana. The northern portion of the parish was the hardest hit with reports of trees on 10 different homes in the Pleasant Hill community. Trees were also downed on many homes in the Many community as well. In the Rocky Mount community, a mobile home was destroyed by wind gusts and a large tree. Several homes along the eastern shore of the Toledo Bend suffered wind damage of damage resulting from fallen trees.

Vernon Parish

July 7, 1994: An apparent downburst from a severe thunderstorm caused considerable damage in the community of Anacoco. Several large trees were toppled in the town as well as large branches being ripped from trees. At least one small truck and several house roofs were damaged by fallen trees and limbs. Air conditioning units were also blown off the roof of an elementary school. Trees were also downed by strong wind gust near Hornbeck.

June 5, 1998: Severe thunderstorm winds gusted between 70 and 80 mph across the northern half of Vernon Parish, downing numerous trees. The worst hit area was in Burr Ferry, Anacoco, Hornbeck, and Simpson. Three mobile homes had moderate damage from trees blown down on them. Several other homes and businesses had roof damage and windows blown out from the high winds.

Beauregard Parish

August 20, 1999: An old brick building was destroyed. The roof was blown off the post office, and numerous trees were knocked down in Merryville.

Calcasieu Parish

May 2, 1993: A line of thunderstorms moving east at 35 mph blew down several large trees and damaged the roofs of several homes in Johnsons Bayou and Vinton between 0530-0536 CST.

January 13, 1995: A casino/gas station roof, gas pump and car were damaged. Six homes were damaged by fallen trees. One home sustained extensive damage, the garage collapsed on one car and another was damaged in the driveway.

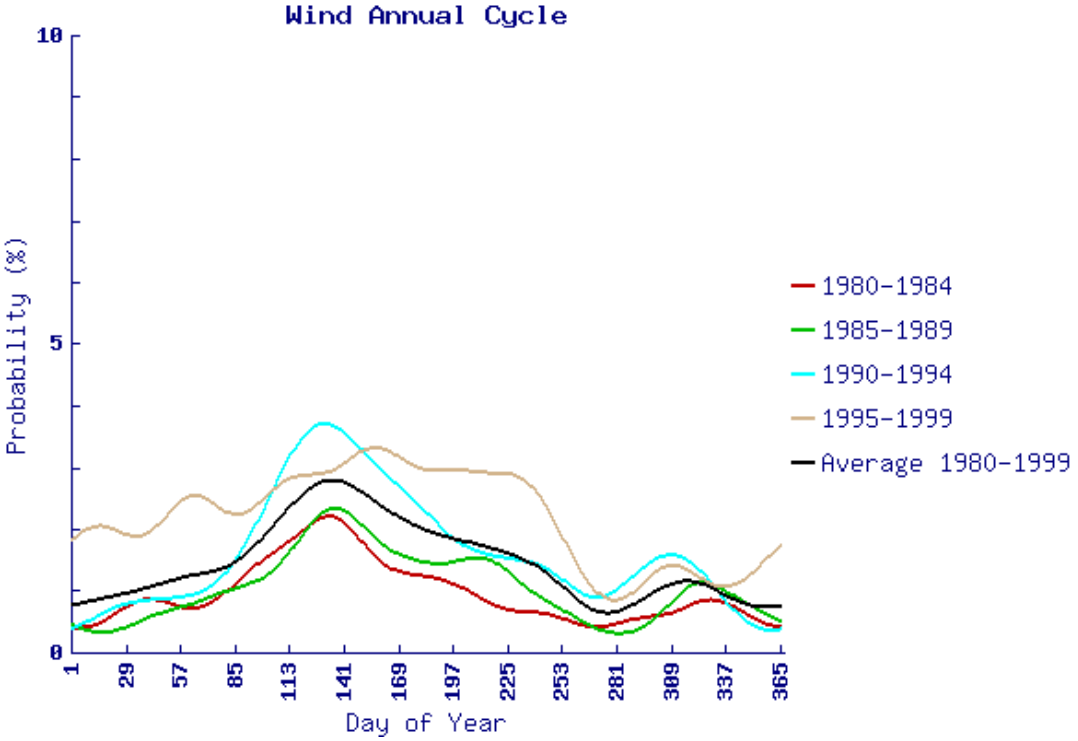
December 30, 2002: Several mobile homes near Vinton were damaged, and trees and power lines were blown down.

Probability of Future Occurrence

Based on the frequency of previous occurrences of 1,031 thunderstorm and wind events reported within the jurisdictional boundary of the Sabine River Authority between 1950 and May 31, 2009; this frequency of previous occurrence equates to a **High** probability of future occurrence according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Regarding probability based on time of year, Figure 3-25 shows the daily probability of wind storm occurrence for the Sabine River Basin. Over the period measured, probability for windstorm occurrence was highest in the spring months and for the two most recent reporting periods (1990-1994 and 1995-1999).

Figure 3-25 Daily Thunderstorm Wind Probability, Sabine River Basin 1980-1999



Source: National Oceanic and Atmospheric Administration (NOAA), National Severe Storms Laboratory (NSSL), http://www.nssl.noaa.gov/cgi-bin/hazgraph3.pl

Magnitude/Severity

When considering a worst-case scenario, thunderstorm, lightning and high winds are capable of producing impacts of **Critical** magnitude and severity. Property damage can occur on a

neighborhood or community-wide scale, a temporary shutdown of utilities and critical facilities can occur, and injuries and fatalities can result.

Overall Vulnerability
Based on assessments of the magnitude of previous occurrences, disruptions of utilities infrastructure and a high future probability, overall vulnerability to thunderstorm impacts is considered **High**.

3.2.9 Tornado

Hazard Description

The National Weather Service defines a tornado as a "violently rotating column of air extending from a thunderstorm to the ground." Tornados are the most violent of all atmospheric storms and are capable of tremendous destruction. Wind speeds can exceed 250 mph, and damage paths can be more than one mile wide and 50 miles long. In an average year, more than 900 tornados are reported in the United States, resulting in approximately 80 deaths and more than 1,500 injuries. Straight line winds not associated with tornados are profiled separately in Subsection 3.2.8, Thunderstorm.

Although tornados have been documented on every continent, they occur most frequently in the central United States east of the continental divide. Regional atmospheric and topographic conditions cause warm and cold air masses to meet in the center of the country. This creates conditions of instability with fast moving air at high pressure that can ultimately result in tornado formation. Tornados occur most frequently in the months of April, May, and June. While most tornados occur between 3:00 and 9:00 p.m., a tornado can potentially occur at any time of day.

Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale shown in Table 3-21 below.

Table 3-21 Fujita Scale

Fujita Scale	Wind Estimate (Mph)	Typical Damage
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yards); trees debarked; incredible phenomena will occur.

Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/f-scale.html

An updated and revised version of the Fujita scale is the Enhanced Fujita scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators and associated degrees of damage, allowing for more detailed analysis and thus better correlation between damage and wind speed. It is also more precise because it takes into account the materials affected and the construction of structures damaged by a tornado. The Enhanced Fujita Scale is presented in Table 3-22.

Table 3-22 Enhanced Fujita Scale (EF)

ENHANCED FUJITA SCALE (EF)	EF WIND ESTIMATE (MPH)
EF0	65-85
EF1	86-110

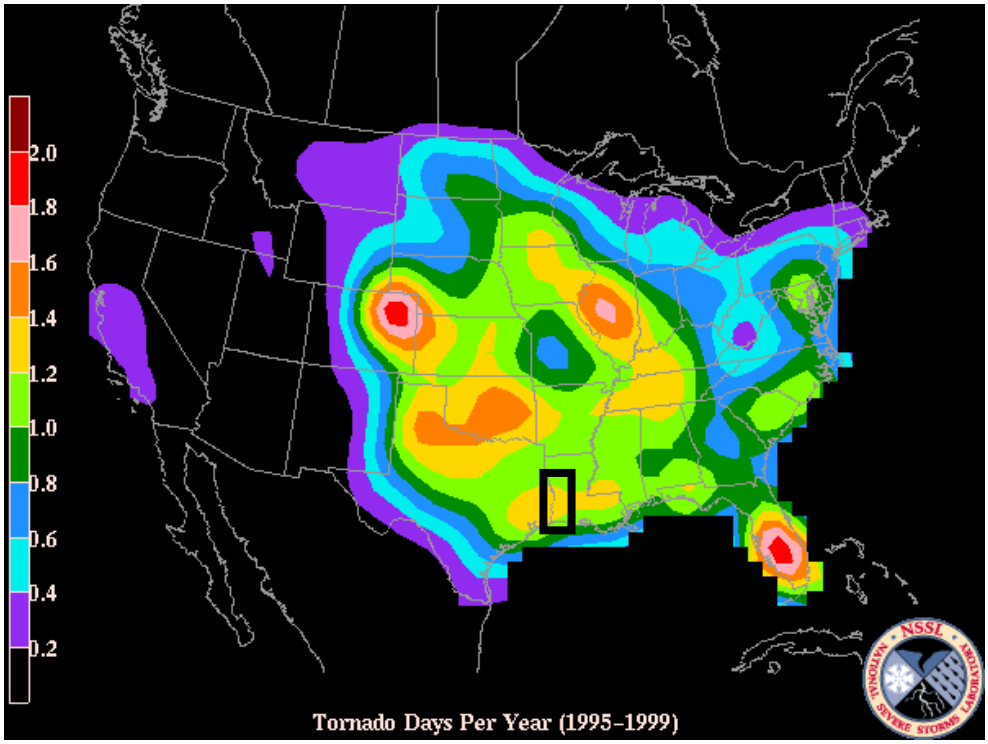
ENHANCED FUJITA SCALE (EF)	EF WIND ESTIMATE (MPH)
EF2	111-135
EF3	136-165
EF4	166-200
EF5	Over 200

Source: National Oceanic and Atmospheric Administration Storm Prediction Center, www.spc.noaa.gov/faq/tornado/ef-scale.html

Geographic Location

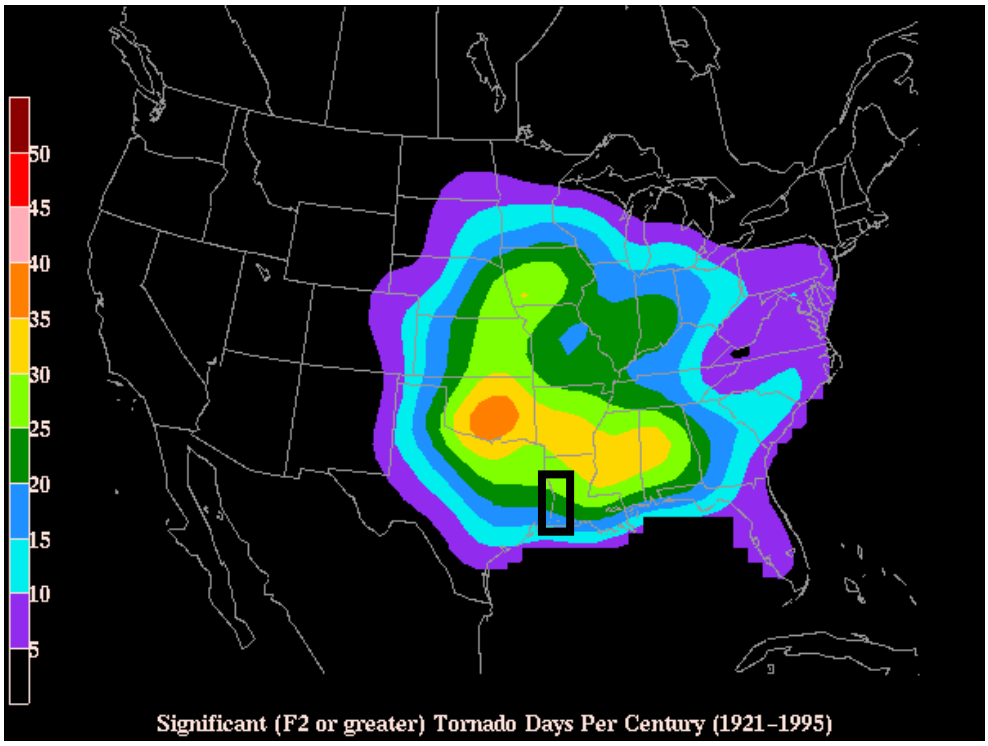
As a weather-based phenomenon, tornados can occur and impact any area in the jurisdiction of the Sabine River Authority. And because tornados cannot be predicted where it might touch down, all segments of the population, critical facilities and building stock are considered vulnerable to this hazard. Based on analysis by the National Severe Storms Laboratory, the Sabine River Authority is located in a region of the U.S. that experiences a high-moderate frequency of tornado occurrences. Figures 3-26 and 3-27 below, map the location and frequency of all tornados from 1995-1999 and F2+ tornados from 1921-1995, respectively.

Figure 3-26 Tornado Occurrences by Location, 1995-1999



Source: National Oceanic and Atmospheric Administration (NOAA), National Severe Storm Laboratory (NSSL)
Note: Black rectangle indicates approximate location of the Sabine River Basin

Figure 3-27 Significant Tornado (F2+) Occurrence by Location, 1921-1995



Source: National Oceanic and Atmospheric Administration (NOAA), National Severe Storm Laboratory (NSSL)
Note: Black rectangle indicates approximate location of the Sabine River Authority.

Previous Occurrences

A summary listing of tornado events in the parishes containing the jurisdictional boundary of the Sabine River Authority from 1950 to May 31, 2009 is presented in Table 3-13 below. During the reporting period, there have been 253 tornados, resulting in 20 deaths and 242 injuries. Total property damage estimates approximate $97,000,000.

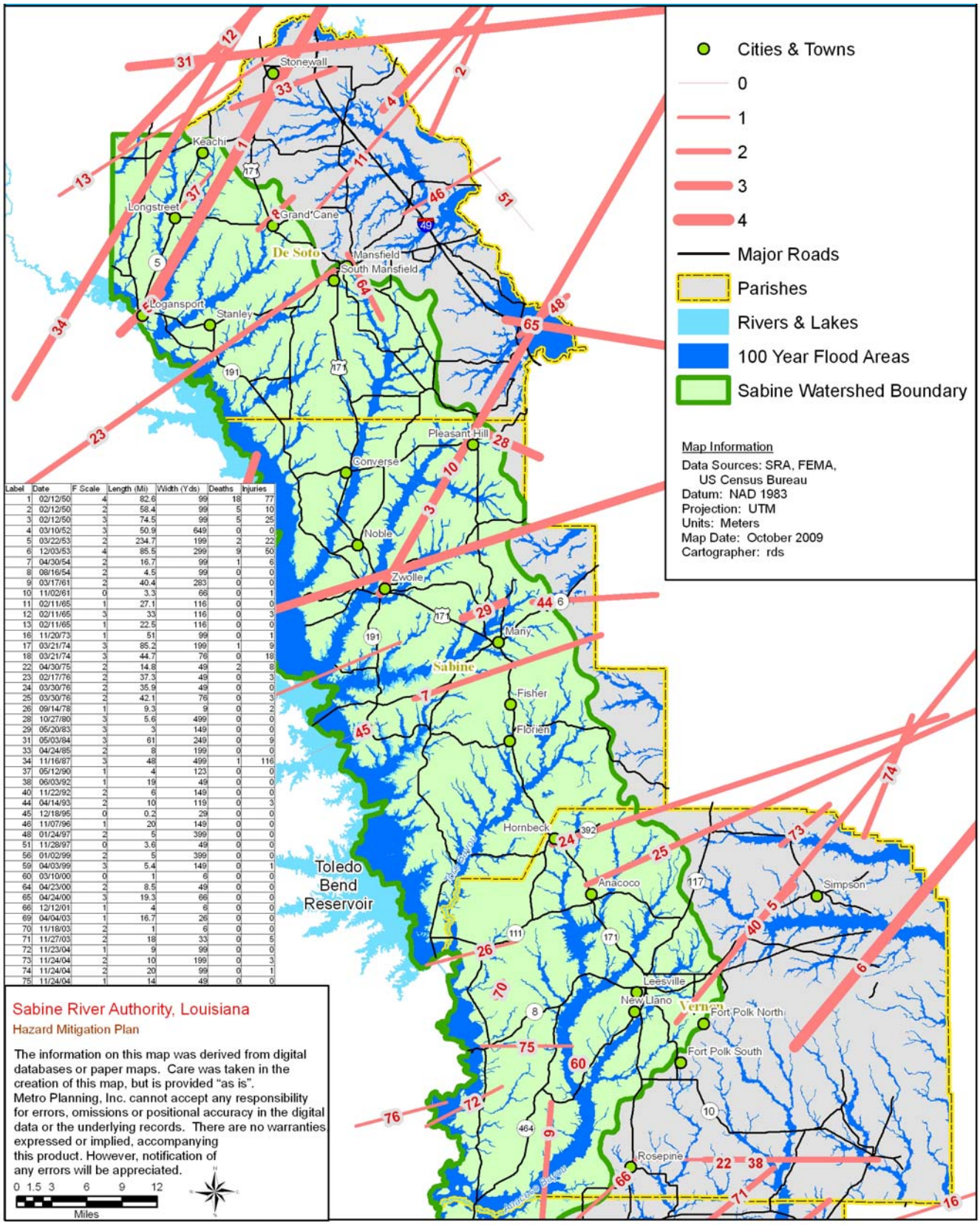
The maps on the following pages, (Figures 3-27 and 3-28) illustrate the geographical location, path and intensity of the tornado events within the parishes that encompass the Sabine River Basin. Please note that some of these recorded tornados do not correspond to those presented in Table 3-23 directly below, due to varying datasets.

Table 3-23 Tornado Events, Sabine River Basin Parishes 1950-2009

Parish	Total	Deaths	Injuries	Property Damage
De Soto	40	1	42	$54.33M
Sabine	19	7	38	$3.87M
Vernon	38	9	51	$8.46M
Beauregard	33	0	34	$6.25M
Calcasieu	76	0	28	$16.99M
Cameron	47	3	49	$6.86M
Total	**253**	**20**	**242**	**$96.76M**

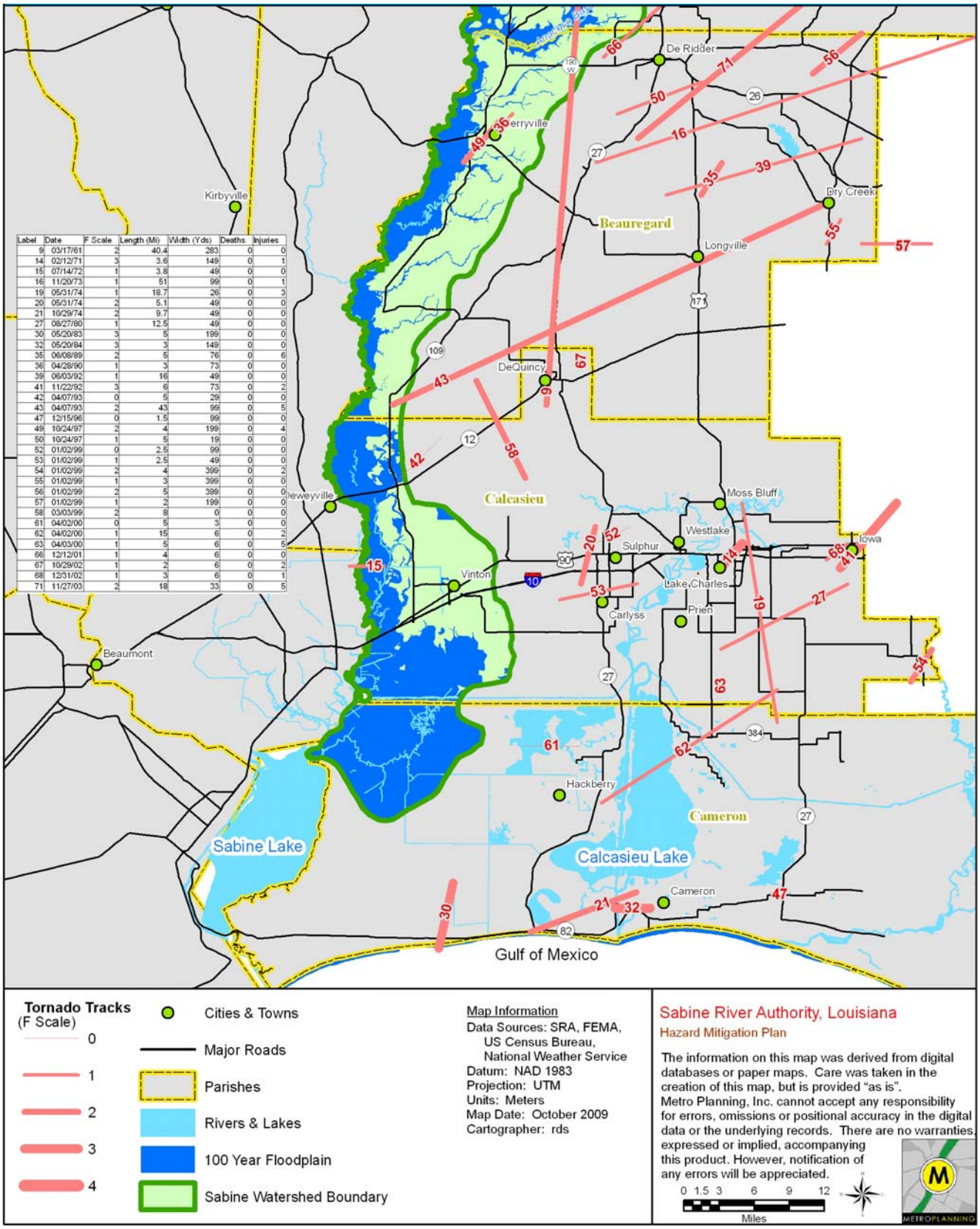
Source: National Climatic Data Center (NCDC)
Note: Zero (0) values may indicate missing data.

Figure 3-27 Tornado Occurrences, Northern Portion Sabine River Basin



Label	Date	F Scale	Length (Mi)	Width (Yds)	Deaths	Injuries
1	02/12/50	4	82.6	99	18	77
2	02/12/50	2	58.4	99	5	10
3	02/12/50	3	74.5	99	5	25
4	03/10/52	3	50.9	649	0	0
5	03/22/53	2	234.7	199	2	22
6	12/03/53	4	85.5	299	9	50
7	04/30/54	2	16.7	99	1	6
8	08/16/54	2	4.5	99	0	0
9	03/17/61	2	40.4	283	0	0
10	11/02/61	0	3.3	66	0	1
11	02/11/65	1	27.1	116	0	0
12	02/11/65	3	33	116	0	3
13	02/11/65	1	22.5	116	0	0
16	11/20/73	1	51	99	0	1
17	03/21/74	3	85.2	199	1	9
18	03/21/74	3	44.7	76	0	18
22	04/30/75	2	14.8	49	2	8
23	02/17/76	2	37.3	49	0	3
24	03/30/76	2	35.9	49	0	0
25	03/30/76	2	42.1	76	0	3
26	09/14/78	1	9.3	9	0	2
28	10/27/80	3	5.6	499	0	0
29	05/20/83	3	3	149	0	0
31	05/03/84	3	61	249	0	9
33	04/24/85	2	8	199	0	0
34	11/16/87	3	48	499	1	116
37	05/12/90	1	4	123	0	0
38	06/03/92	1	19	49	0	0
40	11/22/92	2	6	149	0	0
44	04/14/93	2	10	119	0	3
45	12/18/95	0	0.2	29	0	0
46	11/07/96	1	20	149	0	0
48	01/24/97	2	5	399	0	0
51	11/28/97	0	3.6	49	0	0
56	01/02/99	2	5	399	0	0
59	04/03/99	3	5.4	149	0	1
60	03/10/00	0	1	6	0	0
64	04/23/00	2	8.5	49	0	0
65	04/24/00	3	19.3	66	0	0
66	12/12/01	1	4	6	0	0
69	04/04/03	1	16.7	26	0	0
70	11/18/03	2	1	6	0	0
71	11/27/03	2	18	33	0	5
72	11/23/04	1	9	99	0	0
73	11/24/04	2	10	199	0	3
74	11/24/04	2	20	99	0	1
75	11/24/04	1	14	49	0	0

Figure 3-28 Tornado Occurrences, Southern Portion Sabine River Basin



Label	Date	F Scale	Length (Mi)	Width (Yds)	Deaths	Injuries
9	03/17/61	2	40.4	283	0	0
14	02/12/71	3	3.6	149	0	1
15	07/14/72	1	3.8	49	0	0
16	11/20/73	1	51	99	0	1
19	05/31/74	1	18.7	26	0	3
20	05/31/74	2	5.1	49	0	0
21	10/29/74	2	9.7	49	0	0
27	08/27/80	1	12.5	49	0	0
30	05/20/83	3	5	199	0	0
32	05/20/84	3	3	149	0	0
35	06/08/89	2	5	76	0	6
36	04/28/90	1	3	73	0	0
39	06/03/92	1	16	49	0	0
41	11/22/92	3	6	73	0	2
42	04/07/93	0	5	29	0	0
43	04/07/93	2	43	99	0	5
47	12/15/96	0	1.5	99	0	0
49	10/24/97	2	4	199	0	4
50	10/24/97	1	5	19	0	0
52	01/02/99	0	2.5	99	0	0
53	01/02/99	1	2.5	49	0	0
54	01/02/99	2	4	399	0	2
55	01/02/99	1	3	399	0	0
56	01/02/99	2	5	399	0	0
57	01/02/99	1	2	199	0	0
58	03/03/99	2	8	0	0	0
61	04/02/00	0	5	3	0	0
62	04/02/00	1	15	6	0	2
63	04/03/00	1	5	6	0	5
66	12/12/01	1	4	6	0	0
67	10/29/02	1	2	6	0	2
68	12/31/02	1	3	6	0	1
71	11/27/03	2	18	33	0	5

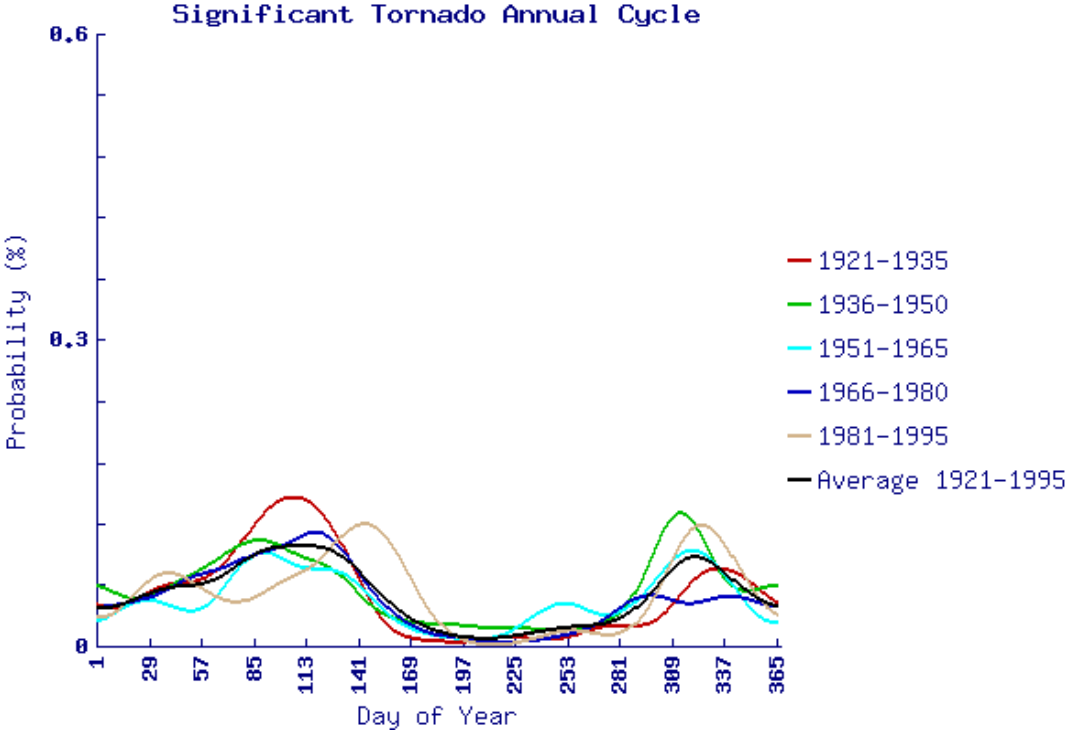
Probability of Future Occurrence

As stated previously there were 253 reports of tornado events in the last 59 years in the parishes that include the jurisdictional boundary of the Sabine River Authority. This frequency of previous occurrence equates to a **High** probability of future occurrence according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Regarding probability based on time of year, the National Severe Storms Laboratory (NSSL) calculated probability of violent tornados based on time of year for the period 1921-1995. Figure 3-29 below and Figure 3-30 on the following page show the probability of tornado occurrence on a given day for tornados F2+ and F4+ within a 25 mile radius of the center of the Sabine River Basin. For example, a y-axis value of 2.0 would indicate a two percent chance of F2+ tornado occurrence on the date indicated by the x-axis value.

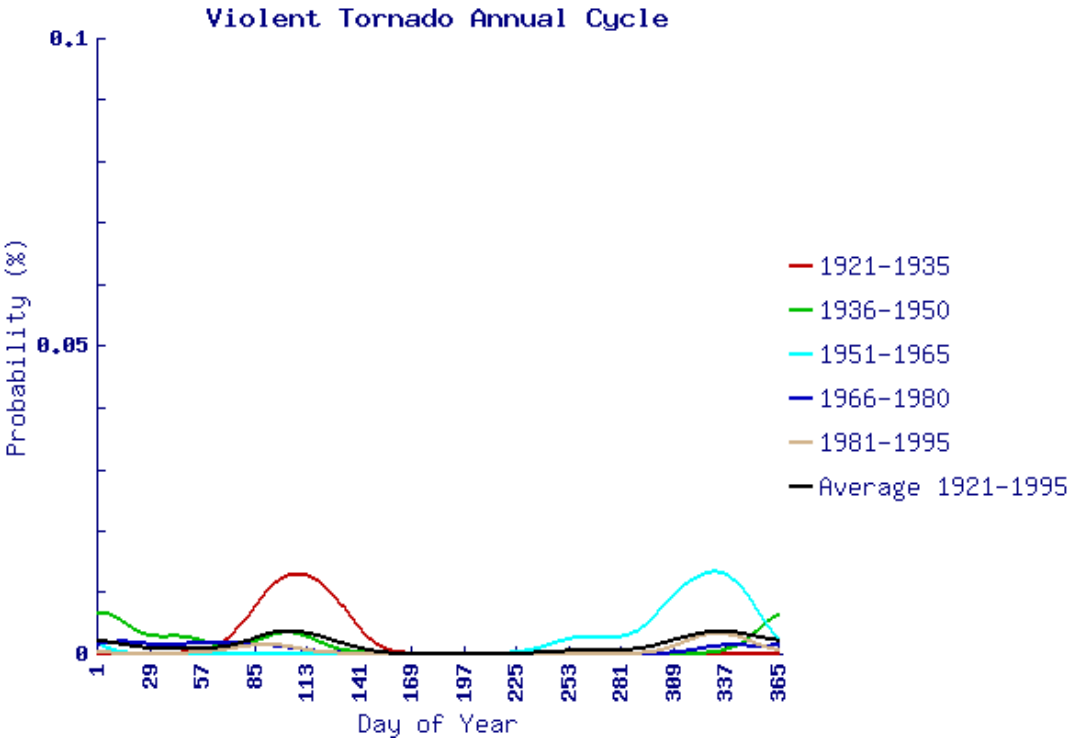
Actual probability values for F2+ tornados are approximately 0.15 percent for a given day, based on the NSSL data. The 1921-1935 period indicates a peak in overall probability. Average probability 1921-1995 for F4+ tornados peaks at 0.005 percent, for a 1 in 20,000 chance of occurrence at For both significant (F2 or larger) and violent (F4 and larger) tornados there is a pronounced peak in probability during the spring and latter months of the year.

Figure 3-29 Daily Probability: Significant Tornado (F2+) 1921-1995



Source: National Oceanic and Atmospheric Administration (NOAA), National Severe Storms Laboratory (NSSL), http://www.nssl.noaa.gov/cgi-bin/hazgraph3.pl

Figure 3-30 Daily Probability Violent Tornado (F4+) 1921-1995



Source: National Oceanic and Atmospheric Administration (NOAA), National Severe Storms Laboratory (NSSL), http://www.nssl.noaa.gov/cgi-bin/hazgraph3.pl

Magnitude/Severity

When considering a worst-case scenario, tornados are capable of producing impacts of **Critical** magnitude and severity. Property damage can occur on a neighborhood or community-wide scale; a temporary shutdown of utilities and critical facilities can occur, and injuries and fatalities can result.

Overall Vulnerability

Based on assessments of the severity of previous occurrences, the large area of potential occurrence and the probability of future occurrence, overall vulnerability to tornado impact is considered **High.**

3.2.10 Wildfire

Hazard Description

A wildfire is an uncontrolled fire spreading through plant based fuels that occurs in forests, dense brush or grasslands. Wildfires often begin unnoticed, spread quickly, and are typically signaled by dense smoke that fills the area for miles around. Wildfires can be caused by either intentional or by accidental human actions, or by natural occurrences such as lightning. Wildfire danger is exacerbated by dry weather conditions and excessive heat. The majority of wildfires in Louisiana are caused by arson and other careless acts by people.

The urban-wildland interface is an area in which development meets wildland vegetation. Both vegetation and the built environment provide fuel for fires. As development occurs in the urban-wildland interface, more people and property are exposed to wildfire danger.

According to the State Forestry Division, Louisiana's forestlands cover 48 percent or 13.8 million acres of the state's area. These forests provide a multitude of benefits, including economic resources, clean air and water, wildlife habitat, recreational opportunities and scenic beauty. While the loss from wildfire is potentially catastrophic, it should also be understood as a component of a healthy forest ecosystem. By any measure, the impacts of catastrophic wildfire incurs an impact the economy through the loss of forest resources, the potential loss of countless rural structures, risk to public safety, and loss of wildlife habitat.

Table 3-24 below lists fire danger rating classifications as defined by the U.S. Forest Service.

Table 3-24 U.S. Forest Service, Fire Danger Adjective Class Rating

Danger Rating	Basic Description	Detailed Description
Low	fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open grassland may burn freely a few hours after rain, but wood fires spread slowly by smoldering and burn in irregular fingers. Low danger of spotting.
Moderate	fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel may burn hot. Short-distance spotting may occur. Fires are not likely to become serious and control is relatively easy.
High	fires start easily and spread at a rapid rate	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.
Very High	fires start very easily and spread at a vary fast rate	Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
Extreme	fire situation is explosive and can result in extensive property damage	Fires start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.

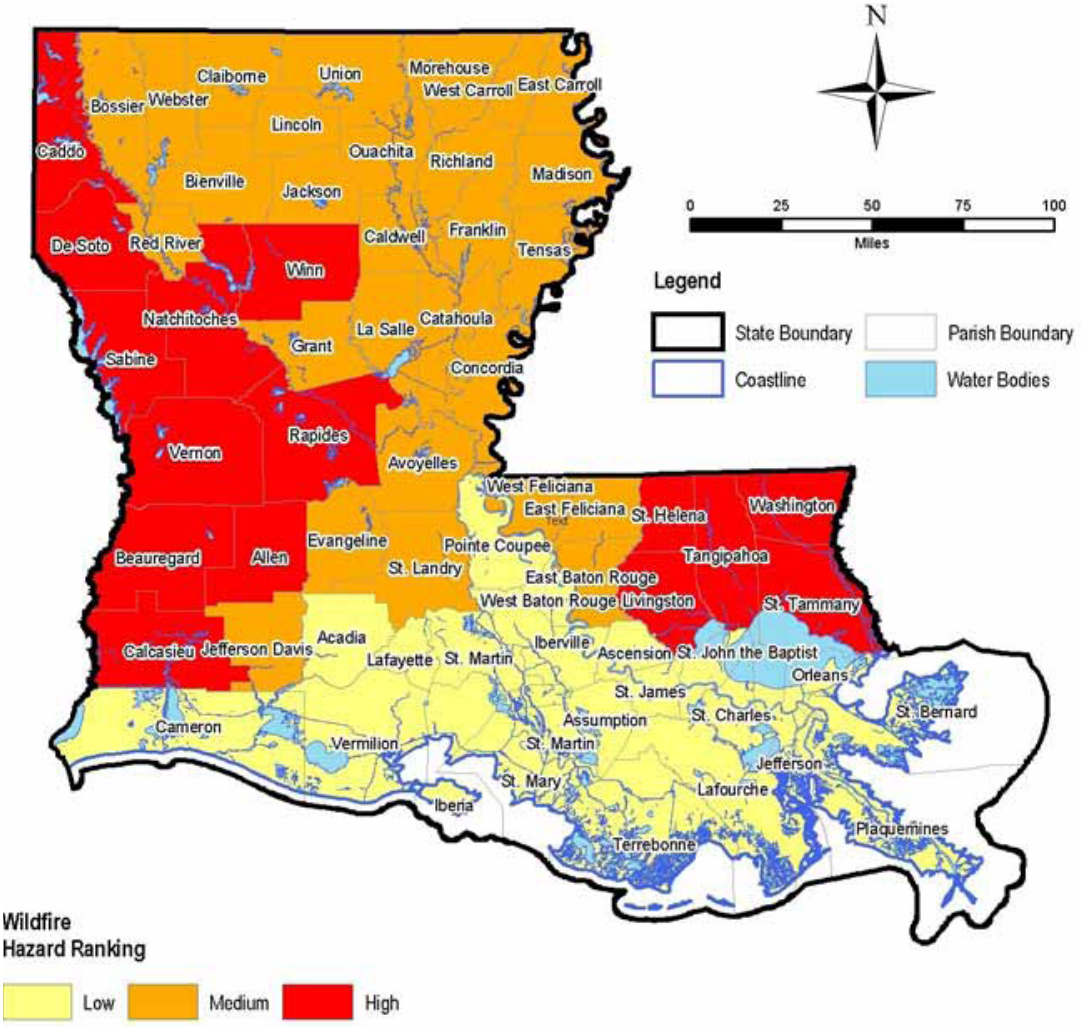
Source: U.S. Forest Service, Wildland Fire Assessment System

In conjunction with the U.S. Forest Service, the Louisiana Office of Agriculture and Forestry Forest Protection Division (LFPD) is the agency responsible for detection, suppression and prevention of wildfires in the forestlands of Louisiana. The LFPD is the only state agency with statewide wild land fire-fighting capabilities. Fires are detected by means of lookout towers and aircraft or reported by the public. The LFPD protection system involves approximately 71 two-man crews equipped with trucks, tractor-plows and two-way radios. Crews are employed year-round with additional crew members mobilized during fire season in high fire occurrence areas.

Geographic Location

The risk of wildfire is not confined to a particular geographic region of the Sabine River Basin, though probability and risk of property damage from wildfire tends to be highest in the urban-wild land interface.

Figure 3-31 Wildfire Hazard Rankings (Average Acres Burned) 1991-2000, Louisiana



Source: State of Louisiana Hazard Mitigation Plan (2008)

Previous Occurrences

For the ten year period, 1996-2007, an average of 2,522 wildfires burned 29,107 acres of forestland in the State of Louisiana annually. In addition to the destruction of valuable forestland

and the impacts on the economy through the loss of this important resource, wildfires seriously threaten countless rural structures and equipment on a daily basis.

Risk of wildfire and the amount of acreage burned annually varies greatly from year to year. As shown in Table 3-25, annual acreage burned in wildfires in Louisiana was as high as 36,287 acres and as low as 11,431 acres. During this period, March was consistently the most hazardous month for wildfire in the State of Louisiana.

Table 3-25 Acreage Burned by Wildfire, Louisiana 2006-2008

MONTH	2006	2007	2008	AVERAGE ACREAGE BURNED/MONTH
January	6,791	223	931	2,648
February	2,733	2,694	3,236	2,888
March	12,823	5,140	6,275	8,080
April	3,984	415	748	1,716
May	1,219	456	325	667
June	3,968	228	684	1,627
July	1,137	59	2,208	1,135
August	1,143	463	1,043	883
September	855	371	307	511
October	656	536	348	513
November	187	327	1,518	677
December	792	520	521	611
TOTAL	**36,287**	**11,431**	**18,144**	**1,830**

Source: GOHSEP

Provided by the Louisiana department of Agriculture and Forestry, fire impact data for the current year 2009 is reported below in Table 3-26.

Table 3-26 Fire Impact Data, State of Louisiana 2009

Month	Fires	Acres Burned	Structures Damaged	Structures Protected	Residences Damaged	Residences Protected
JAN	278	3,074	9	167	32	197
FEB	291	2,804	6	162	7	170
MAR	382	6,775	13	196	4	228
APR	105	556	10	35	0	36
MAY	38	129	5	22	1	23
JUN	199	927	7	89	6	104
JUL	130	685	3	52	0	70
AUG	47	121	2	15	0	24
SEP	30	131	0	8	0	13
OCT	1	0	0	0	0	0
Total	**1,501**	**15,202**	**55**	**746**	**50**	**865**

Source: Louisiana Department of Agriculture and Forestry

The State of Louisiana Hazard Mitigation Plan rates Sabine River Authority's hazard risk for the parishes that comprise the jurisdictional boundary of the Sabine River Authority are as follows: De Soto, "high", Sabine, "high", Vernon, "high", Beauregard, "high", Calcasieu, "high" and Cameron, "low". Reports of wildfire occurrences within the Sabine River Basin are provided below.

November 18, 2008: A large number of fires were detected over the area this evening. Numerous smoke plumes were detected with these fires with the majority of plumes mostly drifting off to the southwest. The most noteworthy smoke activity appeared to be associated with fire activity over southern Vernon and northern Beauregard Parish. A large area of moderate to extremely dense smoke covered portions of Beauregard and Calcasieu Parish and extended towards the Lake Charles area.

December 6, 2006: A fire near Lunita in southwestern Calcasieu Parish produced moderate smoke that moved north to Junction in Beauregard parish.

August 19, 2003: Lightning sparked five wildfires in the Sabine National Wildlife Refuge, which burned around 12,000 acres. No injuries or damage to structures were reported.

The single incident of fire in the parishes that comprise the jurisdictional boundary of the Sabine River Authority does not mean additional wildfires do not occur; rather small wildfires tend to go unreported. The only other available general data available to assess wildfire risk is the State of Louisiana Hazard Mitigation Plan.

The State's assessment of wildfire risk was developed by reviewing USGS National Land Cover data from 1991-2000, sorting the list by parishes from highest to lowest losses, assigning the high risk to parishes with greater than or equal to one thousand acres burned, assigning the medium rank to parishes where the number of acres burned are less than one thousand but greater than zero, and assigning the low rank to parishes with no acres burned. As stated above, all the parishes that comprise the jurisdictional boundary of the Sabine River Authority except for Cameron Parish had a state assessment of "high" risk for wildfire from 1991-2000. Please be apprised that if the Cameron Parish fire of 2003 listed above was incorporated into the State assessment, its value would have increased from "low" to "high".

Probability of Future Occurrence

Wildfire danger can vary greatly season to season and is exacerbated by dry weather conditions. According to the State of Louisiana Forestry Division, most forest fires in Louisiana are caused by arson and other careless acts by people. Consequently, the probability of occurrence is difficult to predict. However, in Figure 3-X above, the parishes as a whole that make up the jurisdictional boundary of the Sabine River Authority are all ranked "high" except for Cameron Parish at "medium". Given this the probably of future occurrences is **High**.

Magnitude/Severity

There is limited data available to assess the magnitude and severity of wildfire occurrences in Sabine River Basin. The only wildfire (and thereby largest) wildfire recorded in the six parishes that comprise the jurisdictional boundary of the Sabine River Authority was in 2003 at 12,000 acres burned.

As shown in Table 3-27 on the following page, in recent years dating back to 2002 the southern region of the U.S. has had by far the highest occurrence of human caused fires in terms of number of fires and acreage burned. Both probability of future occurrence and magnitude and severity can largely be determined by the success of mitigation measures and cooperation of the general public.

Overall Vulnerability

Given the environmental and economic importance of forests, the potential impacts of wildfire are significant. Based on assessments of probability, magnitude and severity, overall vulnerability to wildfire is considered **Moderate**.

Table 3-27 Human Caused Fires: Number and Acreage by U.S. Region

Human Caused Fires (Number)

Year	Alaska	Northwest	Northern California	Southern California	Northern Rockies	Eastern Great Basin	Western Great Basin	Southwest	Rocky Mountains	Eastern Area	Southern Area	Total
2008	265	1,365	3,407	5,208	1,971	826	224	2,013	1,616	11,152	**42,043**	70,093
2007	247	2,346	3,093	5,140	2,005	1,048	425	1,730	1,876	12,453	**43,083**	73,446
2006	254	2,666	3,676	3,166	2,303	943	331	2,511	2,968	14,227	**47,175**	80,220
2005	296	1,924	3,010	3,781	1,183	813	262	3,287	1,940	13,014	**28,920**	58,430
2004	426	1,901	3,613	3,845	1,883	526	173	1,491	704	11,781	**27,758**	54,101
2003	379	2,370	3,795	3,929	1,970	944	227	1,657	4,214	14,851	**16,479**	50,815
2002	378	2,148	3,789	4,060	1,665	730	215	2,668	2,118	12,857	**31,394**	62,022
2001	320	18,743	1,060	4,099	1,801	2,160	770	34,605	4,135	2,096	**277**	70,066

Human Caused Fires (Acreage Burned)

Year	Alaska	Northwest	Northern California	Southern California	Northern Rockies	Eastern Great Basin	Western Great Basin	Southwest	Rocky Mountains	Eastern Area	Southern Area	Total
2008	1,857	99,706	91,022	454,249	105,634	120,391	17,769	339,201	117,554	69,396	**2,013,212**	3,429,991
2007	59,007	244,335	153,154	855,978	237,835	288,627	46,057	90,660	85,442	230,750	**1,157,515**	3,449,360
2006	147,292	112,098	146,999	342,864	126,078	278,288	46,947	392,892	209,693	115,171	**2,486,522**	4,404,844
2005	8,184	219,012	37,658	61,728	53,616	187,248	43,811	267,043	48,356	85,589	**509,082**	1,521,327
2004	17,789	58,178	146,720	84,075	23,585	13,636	13,864	63,062	35,346	101,089	**407,456**	964,800
2003	22,093	126,381	96,415	653,016	137,309	182,916	5,161	127,332	87,823	235,391	**248,412**	1,922,249
2002	427,321	105,544	39,560	412,447	65,891	101,986	29,288	772,299	661,679	104,900	**356,204**	3,077,119
2001	206,844	196,226	114,996	101,240	29,981	98,677	75,483	761,605	85,744	20,229	**57,636**	1,748,661

Source: National Interagency Coordination Center

3.2.11 Winter Storm

Hazard Description

Severe winter storms may be categorized as sleet, ice storms or freezing rain, heavy snowfall, or blizzards. Blizzards are characterized by low visibility caused by high winds and blowing snow. The characteristics of severe winter storms are determined by the amount and extent of snow or ice, air temperature, wind speed, and event duration. Severe winter weather create conditions that disrupt essential regional systems such as public utilities, telecommunications, and transportation routes

An ice storm is used to describe occasions when damaging accumulations of ice occur due freezing rain. Accumulations of ice weigh down trees and utility lines potentially resulting in loss of power and/or communications. These accumulations of ice also affect transportation routes, making walking and driving extremely dangerous.

Extreme cold often accompanies a winter storm or is left in its wake. It is most likely to occur in the winter months of December, January, and February. Exposure to extreme cold can lead to life-threatening frostbite, hypothermia or illness. The infants, elderly and those with compromised immune systems are most susceptible to these impacts. With regard to property and infrastructure, pipes can freeze and burst in buildings that are poorly insulated or without heat.

In 2001, the National Weather Service implemented an updated Wind Chill Temperature index This index, shown as Figure 3-32 below, was developed to describe the relative discomfort/danger resulting from the combination of wind and temperature. Wind chill is based on the rate of heat loss from exposed skin caused by wind and cold. As the wind increases, it draws heat from the body, driving down skin temperature and eventually the internal body temperature.

Figure 3-32 National Weather Service Wind Chill Chart

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

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

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

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

Source: National Weather Service, www.nws.noaa.gov/om/windchill/index.shtml

Geographic Location
Louisiana generally and the parishes that comprise the jurisdictional boundary of the Sabine River Authority specifically is a region of the country known for mild winter temperatures. However, the northern parishes that comprise the jurisdictional boundary of the Sabine River Authority do experience severe winter weather on occasion. The risks associated with winter storm are region wide and are not confined to particular parish or the jurisdictional boundary of the Sabine River Authority.

Previous Occurrences
Winter months in Louisiana (December, January, and February) have average seasonal temperatures ranging from the mid-40s over northern Louisiana to the low 50s across southern parishes. While average seasonal temperatures remain above freezing statewide, cold fronts extending from Canada through the state occur at least once during most winters. Severe winter weather in Louisiana consists of freezing temperatures and heavy precipitation, usually in the form of rain, freezing rain, or sleet, but sometimes in the form of snow. Severe winter weather affects all but the extreme coastal margins of the state.

Because severe winter weather are relatively rare in Louisiana, compared to more northern states where winter events are expected and states tend to be better equipped to handle them, occurrences tend to be very disruptive to transportation and commerce. Trees, cars, roads, and other surfaces develop a coating of ice, making even small accumulations of ice extremely hazardous. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents; fallen trees causing roofs to collapse, limbs to break off with heavy ice and snow loads; toppling telephone poles and lines, electrical wires, and communication towers. A severe winter storm can disrupt telecommunications and power for days.

The climate of northwestern Louisiana and the northern portion of the jurisdictional boundary of the Sabine River Authority is transitional between the subtropical humid type of the south, and the continental climates of the Great Plains and Middle West to the north. During winter, masses of moderate to severely cold air move periodically through the area. Temperatures of freezing or below freezing occur each winter with an average of 39 days during the year.

Measureable snowfall amounts occur on average once every other year in the northern parishes that comprise the northern reach of the Sabine River Authority, however many consecutive years may pass without measurable snow. The heaviest accumulation of snow on record in the Shreveport area (approximately 40 mile to the northeast) was 11.0 inches on December 25, 1948. Occasional ice and sleet storms do considerable damage to trees, power and telephone lines, and make travel by road difficult[iv].

A summary listing of winter storm events in the parishes containing the jurisdictional boundary of the Sabine River Authority from 1950 to May 31, 2009 is presented in Table 3-28 below. During the reporting period, there have been 15 winter storm events, resulting in 5 deaths and 20 injuries. Total property damage estimates approximate $141,075,000. Please be apprised that singular storm events that covered multiple parishes have been identified as one singular storm.

Table 3-28 Sabine River Basin Winter Storm Events 1950-2009

Parish	Total	Deaths	Injuries	Property Damage
De Soto	8	2	1	$78,000,000
Sabine	4	1	0	$51,000,000
Vernon	6	0	4	$225,000
Beauregard	3	2	15	$225,000

Parish	Total	Deaths	Injuries	Property Damage
Calcasieu	3	0	0	$11,850,000
Cameron	3	0	0	$0
Total	**15***	**5**	**20**	**$141,075,000**

Source: National Climatic Data Center (NCDC)
Note: Zero (0) values may indicate missing data.
* Singular storm events that covered multiple parishes are listed in each parish; however, that storm is tallied as one event in the "total" column.

The NCDC has recorded fifteen significant winter storm in the parishes that include the jurisdictional boundary of the Sabine River Authority, two of which are highlighted below.

February 10, 1994: A severe ice storm developed over Louisiana, as well as adjacent states, in the early morning hours of February 10th. Freezing rain spread across much of the north third of Louisiana during the next 12 hours, and at times was accompanied by thunderstorms which produced the most severe icing problems. The combination of gusty winds and icing of one to two inches thick snapped power lines, power poles, or caused tree limbs to snap which subsequently broke power lines. Ground temperatures were fairly warm due to mild temperatures prior to the ice storm, so icing on roadways was not widespread, however fallen trees and power lines did close many secondary roads. From newspaper accounts over 100,000 persons in north Louisiana were without electrical power on February 10th and 11th. While temperatures above freezing quickly returned to the region on the February 11th and 12th, some power companies had difficulty returning power to residents due to the widespread nature of the ice storm which affected many states from northeast Texas to the Tennessee Valley. The Forest Service reported that 256,000 acres of forest were damaged by icing. Overall, the Louisiana Office of Emergency Preparedness estimated the ice storm damage at approximately $13.5 million. This was the worst ice storm in Louisiana since 1983, and likely the costliest on record with respect to dollar damages. Estimated property damage estimates now reported at $50,000,000 storm wide.

January 12-14, 1997: A record ice storm hit southwest Louisiana and southeast Texas. The hardest hit area was Calcasieu Parish. Over 40,000 electric customers were without power for up to six days due to the number of downed trees and power lines. Numerous traffic accidents were attributed to icy roadways. One 54 year old woman was killed in an accident in Avoyelles Parish, and one 41 year old man was killed in an accident in Beauregard Parish. Millions of tons of debris were removed, taking over two months to pick up in some areas. Hundreds of homes received minor roof damage due to trees and tree limbs falling on them.

The State of Louisiana Hazard Mitigation Plan rates the six parishes that include the jurisdictional authority of the Sabine River Authority hazard risk for winter storms based on the total number of storms. The State ranking is as follows: De Soto "high", Sabine "medium", Vernon "medium", Beauregard "medium", Calcasieu "medium" and Cameron "low". Please be apprised that this state risk assessment is parish-wide and therefore goes beyond the jurisdictional boundary of the Sabine River Authority. Nonetheless it offers a reasonable assessment of hazard risk.

Probability of Future Occurrence

Based on the storm events listed by the National Climatic Data Center, over the past 59 years, the parishes that comprise the jurisdictional boundary of the Sabine River Authority has experienced 15 noteworthy winter storm events, that typically cover most than one parish. That recurrence internal is approximately one winter storm every four years. This frequency of previous occurrence equates to a **Medium** probability of future occurrence according to the definitions set forth in Section 3.1.1 Methods and Definitions.

Magnitude/Severity
The magnitude and severity of winter storms cover broad geographical areas. The duration of winter storm events typically are one or two day events with cleanup of downed trees and a reestablishment of lost power typically taking several days. Travel during and immediately after winter storms with accumulations of ice and snow are problematic. Base on the public safety risk and the scale of potential damage to infrastructure and economic loss, this hazard merits a severity rating of **Critical**.

Overall Vulnerability
Overall vulnerability to winter storm is considered **Moderate.** This assessment is based on the recurrence interval for winter and the severity of the impacts to infrastructure and the threat to human life posed by this hazard.

3.3 VULNERABILITY ASSESSMENT

44 CFR Requirement §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.

Relative to many geographic regions of the U.S., overall vulnerability to natural hazard impacts is considered high in the region of western Louisiana that includes the planning area. For the Sabine River Basin, certain hazard types have more significant potential impacts than others, particularly flooding and hurricanes and to lesser extent tornados, thunderstorms and wildfire. Vulnerability to dam failure, excessive heat, drought and winter storms are also serious concerns. Relatively speaking, hailstorms, expansive soil, and tsunami are for various reasons less of a concern for the parish and the participating incorporated cities.

Overall vulnerability to each hazard was based assessments of previous and potential occurrences regarding the scale of geographic area affected, future probability, and severity of impact considering a worst case scenario. Factors including risk exposure of special needs populations and the location of critical facilities and infrastructure were also considered. Based on these factors and the definitions established in Subsection 3.1.1 (listed below in the table notes), Table 3-29 below shows the Hazard Mitigation Team's assessment of overall vulnerability to each of the identified hazards and categories of primary impacts (classified as human, property, infrastructure, economy, and/or environment).

Table 3-29 Overall Vulnerability and Impact by Hazard Type

HAZARD TYPE	VULNERABILITY	PRIMARY IMPACT CATEGORIES
Dam and Levee Failure	Moderate	Public Safety, Property, Infrastructure
Drought	Moderate	Economy, Environment
Earthquake	Low	Public Safety, Economy, Infrastructure
Excessive Heat	Moderate	Public Safety, Economy, Infrastructure
Flooding	**Very High**	**Public Safety, Property, Infrastructure, Economy**
Hailstorm	Low	Property
Hurricane and Tropical Storms	**Very High**	**Public Safety, Property, Infrastructure, Economy**
Thunderstorm, Lightning & High Winds	High	Public Safety, Property, Infrastructure
Tornados	High	Public Safety, Property, Infrastructure
Tsunami	Moderate	Public Safety, Property
Wildfire	Moderate	Public Safety, Property
Winter Storm	Moderate	Public Safety, Infrastructure

Source: Sabine River Authority Hazard Mitigation Team
Notes: Overall vulnerability classifications are defined as follows:
Very High—High probability of future occurrence and potentially catastrophic severity.
High— Moderate/high probability of future occurrence and potentially critical severity.
Moderate— Moderate/high probability of future occurrence and limited potential severity.
Low— Low/moderate probability of future occurrence and negligible/limited potential severity

Based on these definitions and assessments by the HMT, overall vulnerability to flooding and hurricanes was considered most significant for the planning area with Very High vulnerability classifications. Tornados and thunderstorms are also recognized for their significant potential for public safety impacts, property and infrastructure damage and disruption of utilities service. Dam and levee failure, drought, excessive heat, wildfire, and winter storm, and other hazards carry moderate vulnerability classifications based on significant but relatively lower potential impacts to public safety, property and infrastructure.

Table 3-30 summarizes the probability of occurrence and magnitude and severity assessments from the individual hazard profiles detailed in Subsections 3.2.1 through 3.2.12.

Table 3-30 Probability of Occurrence and Magnitude/Severity by Hazard Type

HAZARD TYPE	PROBABILITY OF OCCURRENCE	MAGNITUDE AND SEVERITY
Dam and Levee Failure	Low	Critical
Drought	Medium	Limited
Earthquake	Low	Limited
Excessive Heat	Medium	Critical
Flooding	High	Catastrophic
Hailstorm	High	Limited
Hurricane and Tropical Storms	High	Catastrophic
Thunderstorm, Lightning & High Winds	High	Critical
Tornados	High	Critical
Tsunami	Low	Catastrophic
Wildfire	High	Critical
Winter Storm	Medium	Limited

Source: Sabine River Authority Hazard Mitigation Team
Notes: Probability of Occurrence classifications are defined as follows:
High - Greater than 50 percent probability of occurrence in a given year
Medium - 10 to 50 percent probability of occurrence in a given year
Low – Less than 10 percent probability of occurrence in a given year

Magnitude and Severity classifications are defined as follows:
Level 4-Catastrophic—Severe property damage on a regional or metropolitan scale; shutdown of critical facilities, utilities and infrastructure for extended periods; and/or multiple injuries and fatalities
Level 3-Critical—Severe property damage on a neighborhood scale; temporary shutdown of critical facilities, utilities and infrastructure; and/or injuries or fatalities
Level 2-Limited—Isolated occurrences of moderate to severe property damage; brief shutdown of critical facilities, utilities and infrastructure; potential injuries
Level 1-Negligible— Isolated occurrences of minor property damage; minor disruption of critical facilities, utilities and infrastructure; potential minor injuries

3.3.1 Repetitive Loss Properties

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

As noted in the flooding hazard profile, according to information contained in the NOAA National Climatic Data Center (NCDC) Severe Storm Event database, there were 134 flood events reported in Sabine River Authority between January 1950 and June 2009. Property damage from these events was reported at $23,817,000. Please be apprised that the catalog of flood events includes the entire parishes and includes land beyond the jurisdictional boundary of the Sabine River Authority.

One of the larger concerns from a mitigation standpoint is repetitive loss properties. The general definition for repetitive loss properties are those with two or more paid flood insurance claims in excess of $1,000 within a ten year period. A property is considered a severe repetitive loss (SRL) property either when there are at least four losses each exceeding $5,000 or when there are two or more losses where the building payments exceed the property value.

Information presented in the State of Louisiana Hazard Mitigation Plan Update provides an important perspective regarding the scale of repetitive losses in Louisiana as compared to the U.S. overall.

- According to the Government Accounting Office (GAO), as of 2004, repetitive loss properties receive over 38 percent of claims dollars paid (approximately $200 million annually) but represent only 1 percent of all NFIP insured properties.
- Nationwide, FEMA has identified that as of 2007; about 9,000 severe repetitive loss properties have experienced frequent significant flooding impacts.
- Per the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), of these high priority properties, 4,000, or over 45 percent, are located in Louisiana, more than twice the number in any other state. Texas, New Jersey and Florida follow with 1,500, 1,000 and 1,000 respectively.

Specific to the parishes that comprise the jurisdictional boundary of the Sabine River Authority, the *2008 State of Louisiana Hazard Mitigation Plan Update* ranks the parishes based on the average annual losses as determined by the National Flood Insurance Program (NFIP) records. The average annual losses as compiled by the NFIP represent the total NFIP claims payments for each parish divided by the number of years the parish has participated in the NFIP during 1978 through 2007. (Records only available through 2007 per the *2008 State of Louisiana Hazard Mitigation Plan*)

The hazard ranking of "high", "medium" or "low" for each parish was developed by obtaining the NFIP average annual loss data, sorting the list by parish from highest to lowest losses, then assigning a "high" rank for those parishes with losses greater than equal to $1 million, "medium" rank for parishes with losses at least $100 thousand but less than $1 million and lastly the rank of "low" to those parishes with average annual losses less than $100 thousand.

As Figure 3-X below illustrates, the combined average annual losses for the six parishes that comprise the jurisdictional boundary of the Sabine River Authority exceeds $6.3 million. Please be apprised that this data includes the entire parish and includes data outside the jurisdictional boundary of the Sabine River Authority.

Table 3-X Parishes that Comprise the Sabine River Authority, NFIP Average Annual Losses

State Rank	Parish	Avg. Annual Losses	Hazard Ranking
54	De Soto	$12,976	Low
60	Sabine	$4,121	Low
47	Vernon	$42,832	Low
29	Beauregard	$145,890	Medium
11	Calcasieu	$2,392,743	High
7	Cameron	$3,730,659	High
Total		**$6,329,221**	

Source: Louisiana State Hazard Mitigation Plan Update, Volume II, Appendix E

In addition to average annual losses, the State Hazard Plan goes further and tabulates the number of NFIP claims (losses) and ranks the parishes by total number of claims. Claim totals are tabulated from 1978 through 2007. Table 3-X below illustrates the NFIP losses for each of the six parishes that comprise the jurisdictional boundary of the Sabine River Authority. The combined NFIP claims through 2007 were 7,035. Please be apprised that this data includes the entire parish and includes data outside the jurisdictional boundary of the Sabine River Authority.

Table 3-X Parishes that Comprise the Sabine River Authority, NFIP Claims

State Rank	Parish	Number of NFIP Claims
58	De Soto	24
62	Sabine	11
52	Vernon	83
34	Beauregard	456
11	Calcasieu	4,509
18	Cameron	1,952
Total		**7,035**

Source: Louisiana State Hazard Mitigation Plan Update, Volume II, Appendix E

To restate, the general definition for repetitive loss properties are those with two or more paid flood insurance claims in excess of $1,000 within a ten year period. Based on Repetitive Loss data reported by GOHSEP current as of August 31, 2009 there is a combined total of 1,928 repetitive losses and severe repetitive losses reported for the six parishes that include some part of the Sabine River Basin. Total payments associated with these repetitive and severe repetitive losses are in excess of $76 million, as shown in Table 3-x below.

Table 3-x Paid Flood Claims for Repetitive and Severe Repetitive Loss Properties, Sabine River Basin Parishes

RL and SRL Properties	Paid Flood Claims	Total Payments	Average Per RL/SRL Property	Average Per RL/SRL Claim
796	1,928	$76,063,069	$95,557	$39,452

Source: GOHSEP
Note: current as of August 31, 2009

From the August 2009 GOHSEP RL/SRL report for the Sabine River Basin Parishes, 37 of the 796 RL/SRL properties (4.6 percent) were classified as non-residential (assumed commercial) in type.

National Flood Insurance Program Repetitive Loss Strategy

The National Flood Insurance Program (NFIP) has developed a strategy to mitigate future losses related to repetitive loss properties. The primary objective of the Repetitive Loss Properties Strategy is to eliminate or reduce the damage to property and the disruption of life caused by repeated flooding of the same properties. A specific target group of repetitive loss properties is identified and serviced separately from other NFIP policies by the Special Direct Facility (SDF). The target group includes every NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced:

- Four or more paid flood losses of more than $1,000 each; or
- Two paid flood losses within a 10-year period that, in the aggregate, equal or exceed the current value of the insured property; or
- Three or more paid losses that, in the aggregate, equal or exceed the current value of the insured property.

Loss history is determined by counting all flood claims paid on an insured property, regardless of any change(s) of ownership, since the building's construction or back to 1978 if the building was constructed before 1978. Target group policies are afforded coverage, whether new or renewal, only through the SDF. Property owners affected by the repetitive loss strategy are notified at least 90 days before the policy renewal date. Affected property owners and their flood

insurance agents are sent notice by their insurance company stating that the policy is ineligible for renewal and offering renewal in the SDF.

A follow-up notice is sent by the SDF 45 days before the renewal date. Policyholders who believe that their property has not sustained the loss history indicated by the NFIP may appeal in writing to the SDF. All documentation to substantiate the appeal must be included. Until the appeal is settled, the policy will remain in the SDF. If the appeal is successful, the policy will be transferred back to the insurance company that previously serviced it. The policyholder will be notified of the results of the appeal.

For properties in the target group, the appropriate FEMA Regional Office provides information about the property to state and local floodplain management officials. States or communities may sponsor projects to mitigate flood losses to these properties or may be able to provide technical assistance on mitigation options.

If a property owner agrees to undertake appropriate mitigation measures, the property will be removed from the target group at the next renewal, and the policy then will be transferred from the SDF to the insurance company that previously serviced the policy. Depending on individual circumstances, appropriate mitigation measures commonly include elevating buildings above the level of the base flood, demolishing buildings, and removing buildings from the Special Flood Hazard Area. Sometimes, mitigation takes the form of a local drainage-improvement project that meets NFIP standards.

3.3.2 Vulnerable Populations

Vulnerable populations can be defined as persons that may not be able to assist themselves in times of crisis. These populations may include persons less than five years of age, over 65, or persons with disabilities. Mitigation efforts that consider vulnerable populations with respect to their needs, abilities, and locations can be particularly effective in reducing future losses.

According to information from the U.S. Census Bureau, 7.3 percent of the population in the six parishes that include the jurisdictional boundary of the Sabine River Authority is under the age of five, 12.0% percent is over the age of 65, and 19.2 percent of total parish residents have disability status. Table 3-X below tallies numbers of vulnerable groups for each parish. Please be apprised that these numbers are significantly higher as it includes areas of each parish outside the jurisdictional boundary of the Sabine River Authority.

Table 3-X Vulnerable Populations, Total Number

Parish	Total Population	Under age 5	Over age 65	Disabled	Below Federal Poverty Level
De Soto	25,494	1,780	3,584	5,717	5,251
Sabine	23,459	1,534	3,873	5,378	4,571
Vernon	53,531	4,979	4,168	8,343	7,576
Beauregard	34,587	2,225	4,272	6,406	5,562
Calcasieu	184,162	13,323	22,948	36,073	32,483
Cameron	9,991	667	1,058	1,765	1,020
Totals	**331,224**	**24,508**	**39,903**	**63,682**	**56,463**

Source: US Census (2005-2007 American Community Survey 3-year Estimates. For Cameron Parish 2000 Census)
Note: The U.S. Census defines a person as having a work disability if one or more of the following conditions are met:
1. Persons with health problem or disability which prevents work or limits the kind or amount of work they can do
2. Persons who have retired or left a job for health reasons
3. Persons currently not in the labor force because of a disability.
4. Persons who did not work at all in the previous year because of illness or disability
5. Under 65 years old and covered by Medicare in previous year.

6. Under 65 years old and received Supplemental Security Income (SSI) in previous year.
7. Received VA disability income in previous year.

Table 3-X Vulnerable Populations, Percentage of Population

Parish	Total Population	Under Age 5 (%)	Over Age 65 (%)	Disabled* (%)	Below Federal Poverty Level (%)
De Soto	25,494	7.0	14.1	22.4	20.6
Sabine	23,459	6.5	16.5	22.9	19.5
Vernon	53,531	9.3	7.8	15.6	14.2
Beauregard	34,587	6.4	12.4	18.5	16.1
Calcasieu	184,162	7.2	12.5	19.6	17.6
Cameron	9,991	6.7	10.6	17.7	10.2
Totals	**331,224**	7.4	12.0	19.2	17.0

Source: US Census (2005-2007 American Community Survey 3-year Estimates. For Cameron Parish 2000 Census)
*Note: See Census definition for disability in notes for Table 3-x above.

Figures 3-X and 3-X on the pages following this analysis were developed using FEMA's HAZUS MH MR-3 loss estimation software. These maps estimate the potential number of residents displaced by a '100-year flood event' as defined by the software program.

Populations potentially displaced are shown by Census block for the parishes that comprise the watershed boundary of the Sabine River Basin. Census block data and analysis outside the Sabine River Authority data has been omitted.

It should be noted that these maps are limited in accuracy. The 100-year floodplain associated with FEMA Flood Insurance Rate Maps are not a data set included in this analysis as part of HAZUS. Rather the 100-year flood event is a selection within HAZUS that is based on USGS flood boundaries derived from its own National Elevation Dataset. Nonetheless, this map can serve as a tool for communities to identify potential risk and vulnerability for flood-prone areas.

As discussed in the flood hazard profile, all six parishes that comprise the jurisdictional boundary of the Sabine River Authority participate in the National Flood Insurance Program (NFIP), and note that the Sabine River Authority does not have jurisdictional authority within the six parishes as it pertains to floodplain management associated with the National Flood Insurance Program. Rather, the administrative responsibility lies with the individual communities or parishes which goes beyond the scope of this Hazard Mitigation Plan.

As expected, the census blocks nearer the Sabine River tend to have the higher displaced population values. In addition the census blocks with a higher displaced population value are those generally in the unincorporated areas of the parishes that contain the stream and floodplain flow patterns from northwest to southwest toward the Sabine River.

Specific to the Sabine River Authority's jurisdictional boundary within De Soto parish, please note that the census blocks generally associated with the communities of Keachi, Longstreet, Logansport, Grand Cane, Stanely and South Mansfield show no potential displaced populations during a 100-year storm event. The floodplain identified on the FIRMs for the communities of communities of Stanley, Grand Cane, Longstreet and Keatchi have floodplain that is generally defined outside current development patterns within their community.

As one moves outside those communities where the parish itself administers the NFIP, patterns of potential displaced populations emerge. This is most likely due to the existence of structures built in or near flood prone areas prior to the adoption of the NFIP Flood Insurance Rate Maps and enactment of a floodplain management ordinance.

The same potential displaced population pattern occurs in both Sabine and Vernon Parishes respectively within the jurisdictional boundary of the Sabine River Authority. In Sabine Parish, the census blocks associated with the communities of Pleasant Hill, Converse, Noble, Many and Fischer, and to a lesser extent Zwolle and Florien show no or lower potential for displaced populations during a 100-year storm event.

Specific to those communities mentioned, the following interpretation is offered: The community of Noble generally has no FIRM identified floodplain within its corporate limits. For the community of Zwolle, there is floodplain on the west side of the corporate boundary however away from any current development. In addition, there is some floodplain that flows through the community however developed too is generally located outside its boundary. The community of Many has bands of floodplain that ring around the community from the south to the west north and then east, however with the corporate boundary, there is some limited AE Zone floodplain that extends from the south upward into the community. The community of Fischer does not have any FEMA floodplain within its limits. The Village of Florien to the south has defined floodplain meandering generally in a north to south direction. Lastly, for those census blocks within the unincorporated areas of the parish, they tend to have higher rates of potentially displaced populations, again, most likely due to pre-NFIP constructed homes.

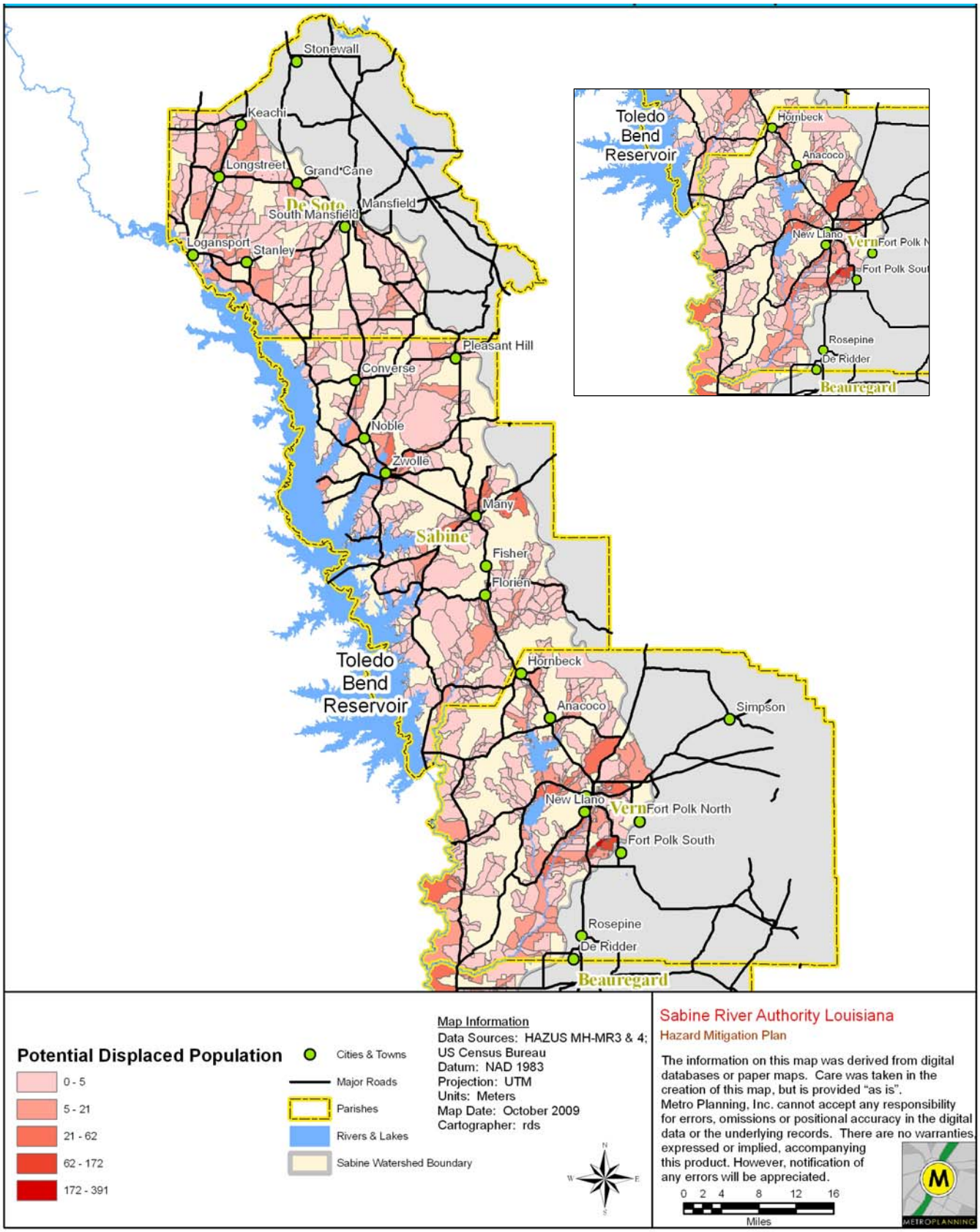
Again, the same pattern emerges for Vernon Parish, with the census blocks immediately beyond the communities having a higher potential displaced population. As one moved away from those community centered census blocks, the rates of potentially displaced populations increase.

Specific floodplain patterns for the communities of Vernon Parish with the jurisdictional boundary of the Sabine River Authority are as follows: The community of Leesville has floodplain in the central and eastern areas; however it is generally confined away from current development patterns. The community of Hornbeck has floodplain defined west of the railroad tracks and to the south and east of current development. The community of New Llano has floodplain in the west of its corporate limits but is generally defined away from development. The community of Rosepine has some floodplain on the western side of the community again, generally away from current development. Floodplain in Anacoco is generally defined outside of current development.

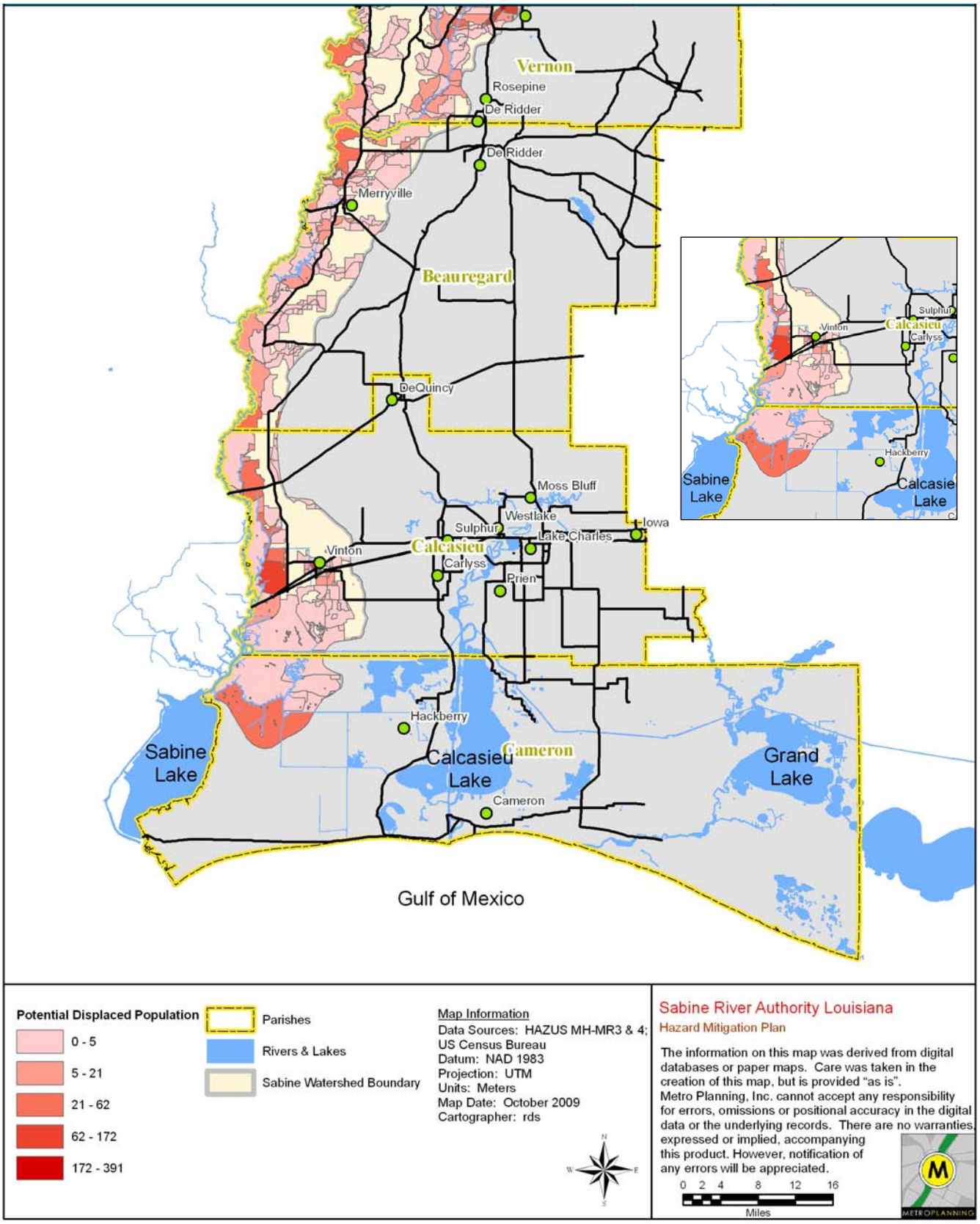
In reference to the southern Sabine River Authority map illustrating potential displaced populations during a 100-year storm event, the same general pattern continues where higher displaced population values are outside the corporate limits of communities. Of particular note in Beauregard Parish, the census block that contains the community of Merryville shows no potential displaced populations. As seen in the previous northern Parish map, the census blocks nearer the Sabine River tend to have the higher displaced population values

Potential displaced populations in the Sabine River Authority within Calcasieu Parish are further confined to those census blocks in proximity to the Sabine River. Lastly, the two census blocks of Cameron Parish that illustrate potentially displaced populations during a 100-year storm event are confined generally to the north of Sabine Lake.

Map 3-X Potential Displaced Population, Flood Event, North Sabine River Basin



Map 3-X Potential Displaced Population, Flood Event, South Sabine River Basin



3.3.3 Asset Inventory

44 CFR Requirement §201.6(c)(2)(ii)(A): The plan **should** describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area … .

An important component of the risk assessment is an inventory of assets within the jurisdictional boundary of the Sabine River Authority within the six parishes that includes numbers of residential structures, commercial businesses and critical facilities such as hospitals, fire stations, police stations, schools, etc. to help ascertain the degree of overall exposure to hazard events and location of specific vulnerabilities. Please be apprised that this data is parish-wide and therefore includes data outside the jurisdictional boundary of the Sabine River Authority.

Based on data within the State of Louisiana Hazard Mitigation Plan Update, there are 143,075 total structures in the six parishes that comprise the jurisdictional boundary of the Sabine River Authority. Residential structures make up the largest percentage of total development, followed by commercial, then industrial. Table 3-X below outlines the number and building type. Please be apprised that the data associated with Cameron Parish is prior to Hurricane Rita therefore the actual numbers of existing structures may be less.

Table 3-X Number of Structures by Type in the Parishes that Comprise the Sabine River Authority

Development Type	De Soto	Sabine	Vernon	Beauregard	Calcasieu	Cameron	Total
Residential	11,204	13,671	21,030	14,501	75,995	5,336	**141,737**
Commercial	46	51	109	67	603	34	**910**
Industrial	20	22	21	20	146	9	**238**
Governmental	4	10	45	8	26	4	**97**
Educational	3	3	6	7	21	2	**42**
Religious	1	2	9	7	32	3	**54**
Agricultural	0	0	0	0	0	0	**0**
Totals	**11,278**	**13,759**	**21,217**	**14,610**	**76,823**	**5,388**	**143,075**

Source: FEMA HAZUS MH (2004), derived from State of Louisiana Hazard Mitigation Plan Update Vol. II (2008).

Other Assets

Other parish assets that are important to consider in assessing overall vulnerability include cultural, historic and natural resources. Such assets can be difficult to reproduce or reconstruct if damaged during a hazard event, and therefore hold unique vulnerability characteristics. The following tables show a listing of registered historical places; and rare or threatened species and habitat types, respectively, in the Sabine River Basin. Other assets within the jurisdictional boundary of the Sabine River Authority that are important to consider in assessing overall vulnerability are cultural, historic and natural resources. Such assets can be difficult to reproduce or reconstruct if damaged during a hazard event, and therefore hold unique vulnerability characteristics. The following table (Table 3-X) shows the listing of registered historical places in the six parishes that comprise the jurisdictional boundary of the Sabine River Authority. As stated previously, some of these places may be outside the boundary of the SRA.

Table 3-X National Register of Historic Places, Sabine River Authority

Parish	Resource Name	Community	Date Listed
De Soto	Allen House	Keachi vicinity	7/28/1988
De Soto	Bank of Grand Cane	Grand Cane	2/11/1988
De Soto	Buena Vista	Stonewall vicinity	1/19/1989
De Soto	De Soto Parish Courthouse	Mansfield	1/22/1987
De Soto	Grand Cane Historic District	Grand Cane	7/7/1995

Parish	Resource Name	Community	Date Listed
De Soto	Grand Cane United Methodist Church	Grand Cane	1/28/1992
De Soto	Guy House	Mansfield vicinity	2/11/1988
De Soto	Kansas City Southern Depot	Mansfield	1/19/1989
De Soto	Keachi Baptist Church	Keachi	10/20/1988
De Soto	Keachi Presbyterian Church	Keachi	6/30/1988
De Soto	Keachi Store	Keachi	10/20/1988
De Soto	Keachi United Methodist Church	Keachi	7/14/1988
De Soto	Land's End Plantation	Stonewall vicinity	4/26/1972
De Soto	Liberty Lodge No. 123, F & A M	Keachi	1/13/1989
De Soto	Mansfield Battle Park	Mansfield Vicinity	4/13/1973
De Soto	Mansfield Historic District	Mansfield	10/27/1988
De Soto	Mundy-McFarland House	Mansfield	12/06/1979
De Soto	Myrtle Hill Plantation House	Gloster vicinity	12/4/1974
De Soto	The Oaks	Keachi	1/19/1989
De Soto	Prude House	Keachi vicinity	7/14/1988
De Soto	Roseneath	Gloster vicinity	1/13/1989
De Soto	Thomas Scott House	Gloster vicinity	11/6/1986
De Soto	Spell House	Keachi vicinity	7/14/1988
De Soto	Stribling House	Mansfield	5/11/1989
De Soto	Swearingen House	Keachi	11/7/1988
De Soto	U.S. Post Office	Mansfield	1/12/1983
De Soto	Williams House	Mansfield	7/22/1994
De Soto	Wood Park	Mansfield vicinity	1/21/1983
Sabine	Fisher Historic District	Fischer	7/27/1979
Sabine	Fort Jesup	Many vicinity	10/15/1966
Sabine	Kansas City Southern Depot, Zwolle	Zwolle	8/7/1989
Sabine	Kansas City Southern Railway Depot	Many	9/22/2000
Sabine	McNeely Hotel	Many	5/30/1996
Sabine	J.M. Miller and Brother Store	Florien	5/23/1997
Sabine	Stoker House	Many vicinity	6/23/1976
Vernon	Lewis Booker House	Leesville	1/24/2002
Vernon	Burr's Ferry Bridge	Burr Ferry vicinity	5/18/1998
Vernon	Downtown Leesville Historic District	Leesville	4/9/2001
Vernon	G.R. Ferguson Sr. House	Leesville	11/9/2001
Vernon	First United Methodist Church	Leesville	1/24/2002
Vernon	Fullerton Mill and Town	Fullerton vicinity	10/24/1986
Vernon	Holly Grove Methodist Church	Anacoco vicinity	10/8/1980
Vernon	Kansas City Southern Depot	Leesville	10/25/1984
Vernon	Joseph H. Kurth Jr. House	Leesville vicinity	9/17/2004
Vernon	Benson H. Lyons	Leesville	9/15/2004
Vernon	Dr. William E. Reid House	Leesville	4/19/2001
Vernon	Edmond Ellison Smart House	Leesville	12/31/2002
Vernon	Pierson Talbot Grave Shelters	Sugartown vicinity	5/9/2003
Vernon	Vernon Parish Courthouse	Leesville	9/22/1983
Vernon	Wingate House	Leesville	9/26/1983
Beauregard	Beauregard Parish Courthouse	De Ridder	9/22/1983
Beauregard	Beauregard Parish Jail	De Ridder	12/17/1981
Beauregard	Beauregard Parish Training School	De Ridder	3/1/1996
Beauregard	Burks House	Merryville	9/8/1987
Beauregard	De Ridder Commercial Historic District	De Ridder	8/9/1983
Beauregard	De Ridder USO Building	De Ridder	2/25/1992
Beauregard	Dry Creek High School Building	Dry Creek	1/28/1988
Beauregard	First Street School	De Ridder	11/19/1998
Beauregard	First United Methodist Church	De Ridder	11/21/1991
Beauregard	Hudson River Lumber Company General Manager's House	De Ridder	2/21/2007
Beauregard	Shady Grove School and Community Building	De Ridder vicinity	12/20/2002
Beauregard	Sills House	De Ridder	2/21/2007

Parish	Resource Name	Community	Date Listed
Beauregard	Toy House	De Ridder	2/21/2007
Calcasieu	All Saints Episcopal Church	DeQuincy	9/20/1983
Calcasieu	Arcade Theater	Lake Charles	7/7/1978
Calcasieu	Calcasieu Parish Courthouse	Lake Charles	11/2/1989
Calcasieu	Cathedral of the Immaculate Conception	Lake Charles	10/7/1994
Calcasieu	Charleston Hotel	Lake Charles	5/27/1982
Calcasieu	Episcopal Church of the Good Shepherd	Lake Charles	12/22/1983
Calcasieu	Jackson House	DeQuincy vicinity	2/13/1986
Calcasieu	Kansas City Southern Depot	DeQuincy	9/22/1983
Calcasieu	Old Lake Charles City Hall	Lake Charles	10/30/1989
Calcasieu	Lake Charles Historic District	Lake Charles	3/16/1990
Calcasieu	Lyons House	Vinton	4/27/1982
Calcasieu	McNeese State University Auditorium	Lake Charles	5/51989
Calcasieu	Muller's Department Store	Lake Charles	2/15/2007
Calcasieu	Muller's Department Store (Boundary Increase)	Lake Charles	5/18/2007
Calcasieu	Pierce Waters Oil Company Stable Building	Lake Charles	9/29/1980
Cameron	Hebert House	Lake Arthur vicinity	12/8/1997
Cameron	Sabine Pass Lighthouse	Cameron vicinity	12/17/1981

Source: National Park Service, National Register of Historic Places.

Table 3-x Rare, Threatened, Endangered Species and Habitat, Calcasieu Parish

Common Name	State Classification	Global Classification
Bachman's Sparrow	S3	G3
Bald Eagle	S2N,S3B	G5
Beak Rush	SH	G4
Blue Sucker	S2S3	G3G4
Blue Water Lily	S2S4	G4?
Bottomland Hardwood Forest	S4	G4G5
Brackish Marsh	S3S4	G4?
Brookweed	S1	G4G5
Calcasieu Painted Crawfish	S2	G2
Chaetopappa	S1	G5
Chapman's Milkwort	S1	G3G5
Coastal Plain Lobelia	S2?	G5
Coastal Prairie	S1	G2Q
Crested Caracara	S1	G5
Dwarf Gray Willow	S2	G5T4T5
Eastern Harvest Mouse	S3S4	G5
Eastern Spotted Skunk	S1	G5
Evening Rainlily	S2	G5
Fringed Yellow Eyed Grass	S2?	G5
Gayfeather	S1	G5
Grapefruit Primrosewilow	S2	G5
Green Milkweed	S1	G5
Hawkweed	S1	G4G5
Heart Leaved Skullcap	S2	G4?
Lindheimer's Bee Balm	S1	G4
Little Tooth Sedge	S3	G4
Long Sepaled False Dragon Head	S2S3	G2G3
Louisiana Blue Star	S3	G3
Louisiana Yellow Eyed Grass	S3	G3
Low Nutrush	S1	G5

Common Name	State Classification	Global Classification
Mead's Sedge	S3	G4G5
Millet Beakrush	S2	G5
Old Prairie Crawfish	S2	G3
Ornate Box Turtle	S1	G5
Paddlefish	S3	G4
Pine Hills Crawfish	S2	G4
Pineland Beaksedge	S4	G5
Purple False Foxglove	S2	G3G4
Red Wolf	SX	G1Q
Red Cockaded Woodpecker	S2	G3
Roseate Spoonbill	S3	G5
Roughhair Witchgrass	SH	G5T3T5
Sandbank Pocketbook	S2	G2
Sandhill Crane	S1N	G5
Scalloped Milkwort	S2	G4?
Short Beaked Baldsedge	S3	G4?
Short Beard Plumegrass	S1	G3G5
Silveus Dropseed	S2	G4
Small-fruited Water Willow	S1	G5
Southeastern Panic Grass	S4	G4
Southern Creekmussel	S1	G3
Southwest Bedstraw	S2	G5
Spreading Beakrush	S1	G4
Ten Petal Thimbleweed	S2	G4?
Wand Blackroot	S2	G5
Waterbird Nesting Colony	SNR	GNR
Western Acidic Longleaf Pine Savannah	S1S2	G2G3
Western Saline Longleaf Pine Savannah	S1	G1
Yellow Brachycercus Mayfly	S1	G4

Source: Louisiana Department of Wildlife and Fisheries, Rare Species and Habitats by Parish, http://www.wlf.louisiana.gov/pdfs/experience/naturalheritage/calcasieu.pdf

Notes: **STATE ELEMENT RANKS**: **S1** = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation. **S2** = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation. **S3** = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations). **S4** = apparently secure in Louisiana with many occurrences (100 to 1000 known extant populations).

S5 = demonstrably secure in Louisiana (1000+ known extant populations) *(B or N may be used as qualifier of numeric ranks and indicating whether the occurrence is breeding or nonbreeding).* **SA** = accidental in Louisiana, including species (usually birds or butterflies) recorded once or twice or only at great intervals hundreds or even thousands of miles outside their usual range. **SH** = of historical occurrence in Louisiana, but no recent records verified within the last 20 years; formerly part of the established biota, possibly still persisting. **SR** = reported from Louisiana, but without conclusive evidence to accept or reject the report. **SU** = possibly in peril in Louisiana, but status uncertain; need more information. **SX** = believed to be extirpated from Louisiana. **SZ** = transient species in which no specific consistent area of occurrence is identifiable.

GLOBAL ELEMENT RANKS: **G1** = critically imperiled globally because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extinction. **G2** = imperiled globally because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extinction throughout its range. **G3** = either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range (21 to 100 known extant populations). **G4** = apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery (100 to 1000 known extant populations). **G5** = demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery (1000+ known extant populations). **GH** = of historical occurrence throughout its range; i.e., formerly part of the established biota, with the possibility that it may be rediscovered (e.g., Bachman's Warbler). **GU** = possibly in peril range-wide, but status uncertain; need more information **G?** = rank uncertain. Or a range (e.g., G3G5) delineates the limits of uncertainty. **GQ** = uncertain taxonomic status. **GX** = believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered

3.3.4 Critical Facilities and Infrastructure

Critical facilities can be defined as facilities that provide vital operational, protection, maintenance or care services to vulnerable populations and the greater community. From a mitigation standpoint, it is important to inventory and evaluate potential vulnerabilities to these critical facilities with the goal of preventing loss of use due to a disaster event, a time when the safe function of these facilities is most important.

Following the tables below are a series of maps that illustrate the location of critical facilities in the region. Please note there may be discrepancies between the tables and the maps as although they both are HAZUS generated, the maps include a more recent software update.

Table 3-X Inventory of Critical Facilities by Type, De Soto Parish including Those Within the Jurisdictional Boundary of the Sabine River Authority

Facility Type	Name	Cost
Airport	C E "Rusty" Williams	not available
Fire Station	De Soto Fire District	$534,000
Fire Station	De Soto Fire Department	$534,000
Fire Station	De Soto Fire District	$534,000
Fire Station	De Soto Fire District 2	$534,000
Fire Station	De Soto Fire District #8	$534,000
Fire Station	Frierson Fire Department	$534,000
Fire Station	Mansfield City Fire Department	$534,000
Fire Station	Mansfield Fire Department	$534,000
Health Care	De Soto Regional Health System	$3,115,000
Police Station	De Soto Parish Sheriff Department	$1,246,000
Police Station	De Soto Parish Police Jury	$1,246,000
Police Station	Logansport Town Police Department	$1,246,000
Police Station	Mansfield City Police Department	$1,246,000
Police Station	South Mansfield City Police	$1,246,000
School	Central School Corporation	$445,000
School	Cool Springs School	$445,000
School	De Soto Alternative School	$445,000
School	Logansport Elementary School	$445,000
School	Logansport High School	$445,000
School	Mansfield Elementary School (3-5)	$445,000
School	Mansfield Elementary School (PK-2)	$445,000
School	Mansfield Middle School	$445,000
School	Mansfield High School	$445,000
School	North De Soto Elementary School	$445,000
School	North De Soto Middle School	$445,000
School	North De Soto High School	$445,000
School	Pelican All Saints High School	$445,000
School	Stanley High School	$445,000

Source: FEMA HAZUS-MH (2004) derived from State of Louisiana Hazard Mitigation Plan Update Vol. II (2008),

Table 3-X Inventory of Critical Facilities by Type, Sabine Parish including Those Within the Jurisdictional Boundary of the Sabine River Authority

Facility Type	Name	Cost
Airport	Hart	not available
Civil Defense	Emergency Center	$890,000
Fire Station	Florien Fire Department	$534,000
Fire Station	Florien Emergency Fire Department	$534,000
Fire Station	Many City Fire Department	$534,000

Facility Type	Name	Cost
Fire Station	North Sabine Fire Protection	$534,000
Health Care	Sabine Medical Center	$3,115,000
Police Station	De Soto Parish Sheriff	$1,246,000
Police Station	Many City Police Department	$1,246,000
Police Station	Noble Police Department	$1,246,000
Police Station	Oak Grove Police Department	$1,246,000
Police Station	Pleasant Hill Police	$1,246,000
Police Station	Sabine Parish Detention Center	$1,246,000
Police Station	Sabine Parish Police Jury	$1,246,000
Police Station	Sabine Parish Police Jury Ward	$1,246,000
Police Station	Sabine Parish Sheriff	$1,246,000
Police Station	Zwolle City Marshall	$1,246,000
School	Belmont Union Christian Academy	$445,000
School	Converse High School	$445,000
School	Ebarb School	$445,000
School	Florien Elementary School	$445,000
School	Florien High School	$445,000
School	Many Elementary School	$445,000
School	Many High School	$445,000
School	Many Junior High School	$445,000
School	Negreet High School	$445,000
School	Pleasant Hill High School	$445,000
School	Sabine Program For At-Risk Students	$445,000
School	Zwolle High School	$445,000
School	Zwolle Intermediate School	$445,000
School	Zwolle Elementary School	$445,000

Source: FEMA HAZUS-MH (2004) derived from State of Louisiana Hazard Mitigation Plan Update Vol. II (2008),

Table 3-X Inventory of Critical Facilities by Type, Vernon Parish including Those Within the Jurisdictional Boundary of the Sabine River Authority

Facility Type	Name	Cost
Airport	Leesville Airport	not available
Airport	Polk AAF	not available
Fire Station	Alco Hutton Volunteer Fire	$534,000
Fire Station	Anacoco Volunteer Fire Department	$534,000
Fire Station	Burr Ferry Volunteer Fire Department	$534,000
Fire Station	Caney Volunteer Fire Department	$534,000
Fire Station	Dry Fork Volunteer Fire Department	$534,000
Fire Station	Evans Volunteer Fire Department	$534,000
Fire Station	Fort Polk Fire Department	$534,000
Fire Station	Fort Polk Fire Department	$534,000
Fire Station	Hornbeck Fire Tower	$534,000
Fire Station	Hornbeck Volunteer Fire Department	$534,000
Fire Station	Hornbeck Volunteer Fire Department	$534,000
Fire Station	La Camp Volunteer Fire Department	$534,000
Fire Station	Leesville Fire Department	$534,000
Fire Station	Marlow Volunteer Fire Department	$534,000
Fire Station	Pitkin Volunteer Fire Department	$534,000
Fire Station	Sandy Creek Volunteer Fire	$534,000
Fire Station	Sandy Hill Fire Station	$534,000
Fire Station	Savage Fork Fire Station	$534,000
Fire Station	Slagle Volunteer Fire Department	$534,000

Facility Type	Name	Cost
Fire Station	Sundown Volunteer Fire Department	$534,000
Health Care	Byrd Regional Hospital	$6,230,000
Police Station	Anacoco Police Department	$1,246,000
Police Station	Chief of Police Leesville	$1,246,000
Police Station	Leesville Police Department	$1,246,000
Police Station	Newllano Police Department	$1,246,000
Police Station	Rosepine Town Marshall	$1,246,000
Police Station	Vernon Parish Police Jury	$1,246,000
Police Station	Vernon Parish Police Jury	$1,246,000
Police Station	Vernon Parish Sheriff	$1,246,000
Police Station	Vernon Parish Sheriff	$1,246,000
Police Station	Vernon Parish Sheriff's Department	$1,246,000
Police Station	Vernon Parish Jury Main Office	$1,246,000
School	Anacoco Elementary School	$445,000
School	Anacoco High School	$445,000
School	East Leesville Elementary School	$445,000
School	Evans School	$445,000
School	First Assembly Christian Academy	$445,000
School	Hicks School	$445,000
School	Hornbeck School	$445,000
School	Leesville Development Center	$445,000
School	Leesville High School	$445,000
School	Leesville Junior High School	$445,000
School	North Polk Elementary School	$445,000
School	Pickering Elementary School	$445,000
School	Pickering High School	$445,000
School	Pitkin High School	$445,000
School	Rosepine Elementary School	$445,000
School	Rosepine High School	$445,000
School	Simpson School	$445,000
School	South Polk Elementary School	$445,000
School	Vernon Elementary School	$445,000
School	Vernon Parish Optional School	$445,000
School	West Leesville Elementary School	$445,000

Source: FEMA HAZUS-MH (2004) derived from State of Louisiana Hazard Mitigation Plan Update Vol. II (2008),

Table 3-X Inventory of Critical Facilities by Type, Beauregard Parish including Those Within the Jurisdictional Boundary of the Sabine River Authority

Facility Type	Name	Cost
Airport	Beauregard Regional Airport	not available
Fire Station	Beauregard Fire Protection	$534,000
Fire Station	Beauregard Fire Protection District	$534,000
Fire Station	Beauregard Parish Fire District	$534,000
Fire Station	Beauregard Parish Fire District	$534,000
Fire Station	Beauregard Parish Fire District	$534,000
Fire Station	Broadlands Fire Department	$534,000
Fire Station	De Ridder City Fire Chief	$534,000
Fire Station	Rosepine Volunteer Fire Department	$534,000
Fire Station	Westside Fire Department	$534,000
Health Care	Beauregard Memorial Hospital	$6,230,000
Health Care	Dequincy Memorial Hospital	3,115,000
Police Station	Beauregard Parish Police Barn	$1,246,000

Facility Type	Name	Cost
Police Station	Beauregard Parish Police Jury	$1,246,000
Police Station	Beauregard Parish Police Jury	$1,246,000
Police Station	Beauregard Parish Sheriff	$1,246,000
Police Station	Beauregard Parish Sheriff	$1,246,000
Police Station	De Ridder Police Detectives	$1,246,000
Police Station	Merryville Town Police Department	$1,246,000
School	Beauregard Alternative School	$445,000
School	Beckwith Christian School	$445,000
School	Carver Elementary School	$445,000
School	De Ridder High School	$445,000
School	De Ridder Junior High School	$445,000
School	East Beauregard High School	$445,000
School	Hanchey, KR, Elementary School	$445,000
School	Hyatt High School	$445,000
School	Merryville High School	$445,000
School	Pine Wood Elementary School	$445,000
School	Singer High School	$445,000
School	South Beauregard Elementary School	$445,000
School	South Beauregard High School	$445,000

Source: FEMA HAZUS-MH (2004) derived from State of Louisiana Hazard Mitigation Plan Update Vol. II (2008),

Table 3-X Inventory of Critical Facilities by Type, Calcasieu Parish including Those Within the Jurisdictional Boundary of the Sabine River Authority

Facility Type	Name	Cost
Airport	Beauregard Regional Airport	not available
Airport	Chennault International Airport	not available
Airport	DeQuincy Industrial Airpark	not available
Airport	Southland Field	not available
Fire Station	Beauregard Fire Protection	$534,000
Fire Station	Beauregard Fire Protection	$534,000
Fire Station	Cajun Country Fire Department	$534,000
Fire Station	Cajun Country Volunteer Fire	$534,000
Fire Station	Cal-Cam Volunteer Fire Department	$534,000
Fire Station	Calcasieu Fire Department	$534,000
Fire Station	Carlyss Volunteer Fire Station	$534,000
Fire Station	DeQuincy Fire Department	$534,000
Fire Station	Edgerly Substation	$534,000
Fire Station	Fields Fire Tower	$534,000
Fire Station	Fire Department Ward 7	$534,000
Fire Station	Gordon Fire Tower	$534,000
Fire Station	Holmwood Fire Station	$534,000
Fire Station	Houston River Volunteer Fire	$534,000
Fire Station	Lake Charles Fire Department	$534,000
Fire Station	Le Bleu Settlement Fire Department	$534,000
Fire Station	Manchester Fire Department	$534,000
Fire Station	Sulphur Fire Department	$534,000
Fire Station	Vinton Fire Volunteers	$534,000
Fire Station	Vinton Southside Fire Station	$534,000
Fire Station	Ward 1 Fire Department	$534,000
Fire Station	Ward 2 Fire Protection District 1	$534,000
Fire Station	Westlake Ambulance Service	$534,000
Fire Station	Westlake Fire Department	$534,000

Facility Type	Name	Cost
Health Care	Bayne-Jones Army Community Hospital	$6,230,000
Health Care	Christus St. Patrick Hospital	$12,460,000
Health Care	Dubuis Hospital of St. Charles	$3,115,000
Health Care	Lake Charles Memorial Hospital	$12,460,000
Health Care	Summit Hospital of SW Louisiana	$3,115,000
Health Care	W O Moss Regional Medical Center	$6,230,000
Health Care	West Calcasieu Cameron Hospital	$6,230,000
Health Care	Women and Children's Hospital	$6,230,000
Police Station	Calcasieu Parish Sheriff's Department	$1,246,000
Police Station	Calcasieu Parish Sheriff's Department	$1,246,000
Police Station	Calcasieu Parish Sheriff's Department	$1,246,000
Police Station	Calcasieu Parish Sheriff's Department	$1,246,000
Police Station	Calcasieu Parish Sheriff's Department	$1,246,000
Police Station	Calcasieu Parish Sheriff's Department	$1,246,000
Police Station	Calcasieu Parish Sheriff's Prison	$1,246,000
Police Station	Calcasieu Parish Sheriff's Training Center	$1,246,000
Police Station	Calcasieu Parish Sheriff's Finance Division	$1,246,000
Police Station	Calcasieu Sheriff's Department	$1,246,000
Police Station	Calcasieu Sheriff's Department - Youth	$1,246,000
Police Station	County Sheriff	$1,246,000
Police Station	De Quincy Police Department	$1,246,000
Police Station	Iowa Police Department	$1,246,000
Police Station	Lake Charles Police Department	$1,246,000
Police Station	Lake Charles Police Service Center	$1,246,000
Police Station	Lake Charles Police Service Center	$1,246,000
Police Station	Moss Bluff Sheriff's Department	$1,246,000
Police Station	North Lake Charles Sub Station	$1,246,000
Police Station	South Lake Charles Sheriff	$1,246,000
Police Station	Sulphur City Marshal's Office	$1,246,000
Police Station	Sulphur City Police Department	$1,246,000
Police Station	Sulphur Police Association	$1,246,000
Police Station	Sulphur Police Sub Station	$1,246,000
Police Station	Vinton City Police Department	$1,246,000
Police Station	Westlake Police Department	$1,246,000
Police Station	Westlake Police Department	$1,246,000
School	Arnette, S P, Middle School	$445,000
School	Barbe Elementary School	$445,000
School	Barbe, Alfred M Middle School	$445,000
School	Bishop Noland Episcopal Day School	$445,000
School	Brentwood Elementary School	$445,000
School	Calcasieu Career Center	$445,000
School	Calcasieu Pm High School	$445,000
School	College Oaks Elementary School	$445,000
School	Combre, Doretha A, Elementary School	$445,000
School	Cooley, T S, Elementary Magnet School	$445,000
School	Dequincy Elementary School	$445,000
School	Dequincy High School	$445,000
School	Dequincy Middle School	$445,000
School	Dolby Elementary School	$445,000
School	Fairview Elementary School	$445,000
School	Faith Christian School	$445,000
School	Frasch Elementary School	$445,000

Facility Type	Name	Cost
School	Gillis Elementary School	$445,000
School	Glad Tidings Pre-School	$445,000
School	Grand Lake High School	$445,000
School	Hamilton Christian Academy	$445,000
School	Henning, W T, Elementary School	$445,000
School	Henry Heights Elementary School	$445,000
School	Holy Family Catholic School	$445,000
School	Houston, Sam, High School	$445,000
School	Immaculate Conception Cathedral	$445,000
School	Iowa High School	$445,000
School	Jake Drost School for Exceptional Child	$445,000
School	Jessie D Clinton Elementary School	$445,000
School	Johnson, John J li, Elementary School	$445,000
School	Kaufman, M J, Elementary School	$445,000
School	Kennedy, J. F, Elementary School	$445,000
School	Key, E K, Elementary School	$445,000
School	Lagrange High School	$445,000
School	Lake Charles/Boston High School	$445,000
School	Lakewood Christian Academy	$445,000
School	Leblanc Middle School	$445,000
School	Lewis, W W, Middle School	$445,000
School	Little Learners Montessori	$445,000
School	Maplewood Middle School	$445,000
School	Molo, Ray D, Middle Magnet School	$445,000
School	Moss Bluff Middle School	$445,000
School	Moss Bluff Elementary School	$445,000
School	Nelson, A, A, Elementary School	$445,000
School	Oak Park Elementary School	$445,000
School	Oak Park Middle School	$445,000
School	Our Lady Queen of Heaven School	$445,000
School	Our Lady S School	$445,000
School	Parkview Christian School	$445,000
School	Perkins, D S, Elementary School	$445,000
School	Phelps, C Paul, Correctional Center	$445,000
School	Prien Lake Elementary School	$445,000
School	Reynaud Middle School	$445,000
School	Rosa Fondel Elementary School	$445,000
School	Sacred Heart Blessed Katharine	$445,000
School	St. John Elementary School	$445,000
School	St. Louis Catholic High School	$445,000
School	St. Margaret School	$445,000
School	Sulphur High School	$445,000
School	Vincent Settlement Elementary School	$445,000
School	Vincent, Richard W, Elementary School	$445,000
School	Vinton Elementary School	$445,000
School	Vinton High School	$445,000
School	Vinton Middle School	$445,000
School	Washington/Marion Magnet High School	$445,000
School	Watkins, T H, Elementary School	$445,000
School	Watson, J I, Middle School	$445,000
School	Watson, Pearl, Elementary School	$445,000
School	Welsh, S J, Middle School	$445,000

Facility Type	Name	Cost
School	Western Heights Elementary School	$445,000
School	Westlake High School	$445,000
School	Westwood Elementary School	$445,000
School	White, F K, Middle School	$445,000
School	Wilson, Ralph F, Elementary School	$445,000

Source: FEMA HAZUS-MH (2004) derived from State of Louisiana Hazard Mitigation Plan Update Vol. II (2008),

Table 3-X Inventory of Critical Facilities by Type, Cameron Parish including Those Within the Jurisdictional Boundary of the Sabine River Authority

Facility Type	Name	Cost
Emergency Center	Cameron Civil Defense	$890,000
Fire Station	Cameron Parish Fire Department	$534,000
Fire Station	Creole Fire Department	$534,000
Fire Station	Grand Chenier Fire Department	$534,000
Fire Station	Grand Lakes Fire Department	$534,000
Fire Station	Hackberry Volunteer Fire Department	$534,000
Fire Station	Holly Beach Fire Station	$534,000
Fire Station	Johnson Bayou Fire Station	$534,000
Fire Station	Klondike Fire Department	$534,000
Fire Station	Lowry Fire Station	$534,000
Fire Station	Muria Fire Department	$534,000
Fire Station	Oak Grove Fire Department	$534,000
Health Care	South Cameron Memorial Hospital	$3,115,000
Police Station	Cameron Parish Criminal Record	$1,246,000
Police Station	Cameron Parish Sheriff Office	$1,246,000
Police Station	Cameron Parish Sheriff – Civil	$1,246,000
Police Station	Cameron Police Jury	$1,246,000
Police Station	Cameron Police Jury Barn	$1,246,000
Police Station	Cameron Sheriff Department	$1,246,000
Police Station	Hackberry Police Jury	$1,246,000
School	Cameron Elementary School	$445,000
School	Grand Chenier Elementary School	$445,000
School	Hackberry High School	$445,000
School	Johnson Bayou High School	$445,000
School	South Cameron Elementary School	$445,000
School	South Cameron High School	$445,000

Source: FEMA HAZUS-MH (2004) derived from State of Louisiana Hazard Mitigation Plan Update Vol. II (2008),
Note: Cameron Parish received extensive damage as a result of hurricanes Katrina and Rita including facilities that may not be rebuilt as part of the recovery process.

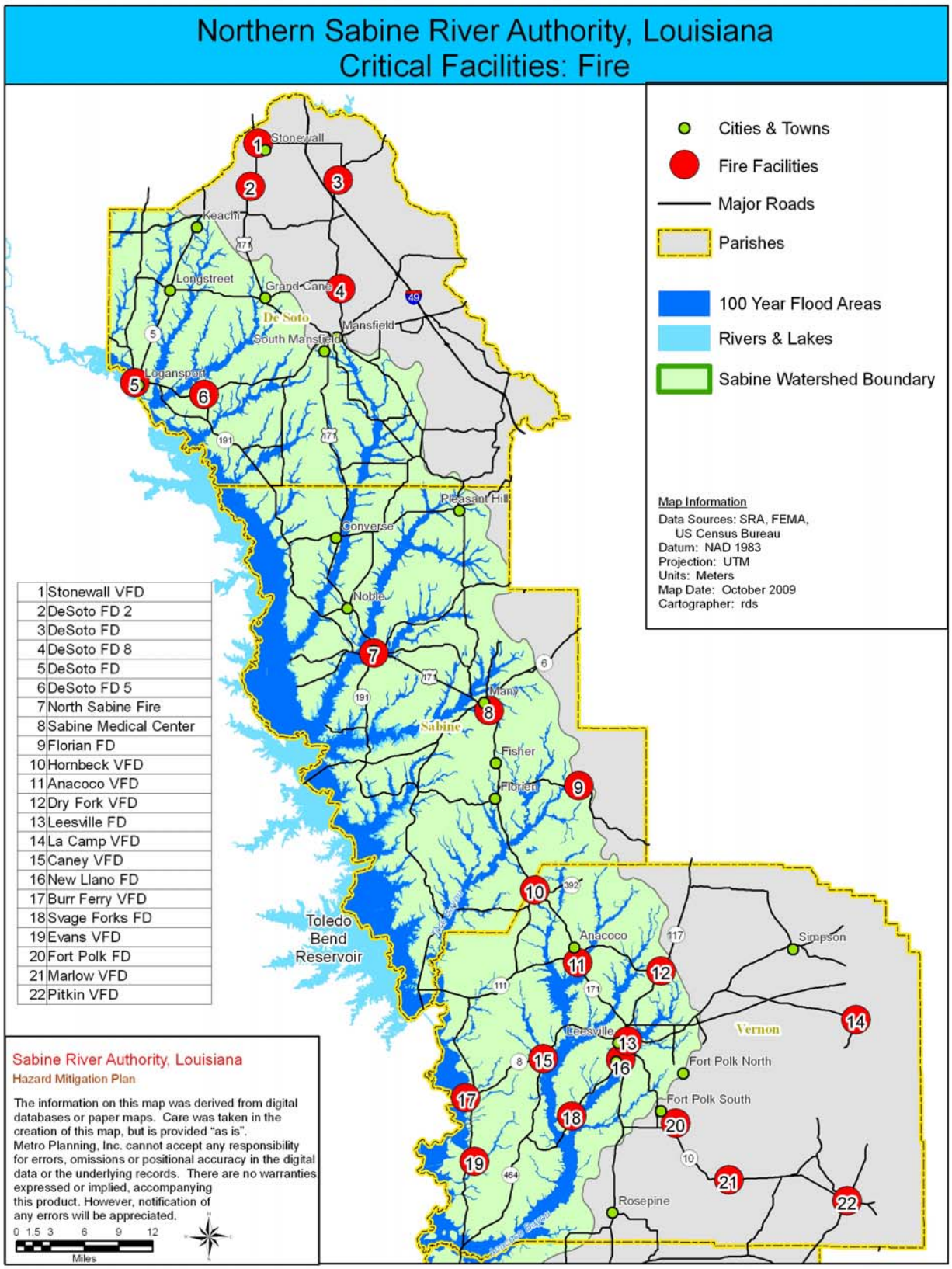
Figures 3-30 through 3-33 on the following pages display the locations of these facilities and their relationship to floodplain areas. Segmenting the Sabine River Basin into north and south regions for readability, the maps illustrate a number of critical facilities referenced in the tables above. Specifically these maps show the geographic location of fire stations, law enforcement facilities, schools, health care facilities and airports. In addition, the jurisdictional boundary of the Sabine River Authority is shaded green and the remaining portion of the specific parish is shaded gray.

Maps 3-X and 3-X illustrate the 51 fire stations in the six parishes that includes the jurisdictional boundary of the Sabine River Authority. The 51 stations are well positioned geographically across the region. All fire stations within our databases were included as fire service need responses would come from the closest fire station facility regardless of whether it was within the jurisdiction of the Sabine River Authority or not.

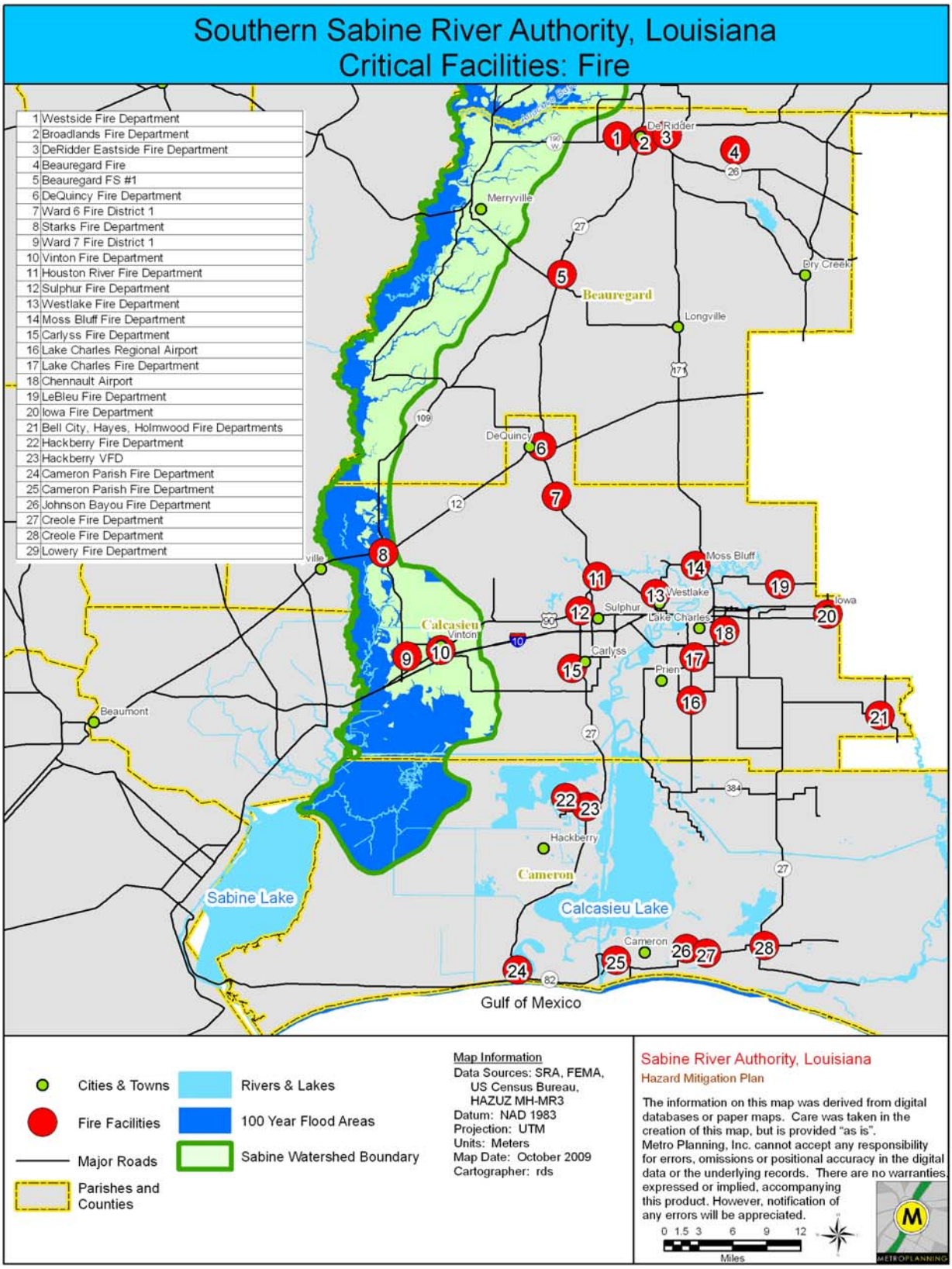
The previous tables showing critical facilities tally the number of fire stations within the six parishes at 76. This larger number may represent ancillary buildings that support a particular critical facility but were discounted in our analysis as support buildings to the primary fire station. In addition, some facilities in Cameron Parish have been destroyed and not rebuilt since Hurricanes Katrina and Rita. Lastly, our data represents the most recent version of HAZUS (MH-HR3).

Maps 3-X and 3-X illustrate the 67 law enforcement facilities in the six parishes that comprise the Sabine River, Louisiana region. The 67 facilities are well positioned geographically across the region. Law enforcement facilities within the Sabine River Basin as well as outside of its boundaries were included, as police/sheriff responses would come from the multiple facilities depending on the nature and magnitude of the incident.

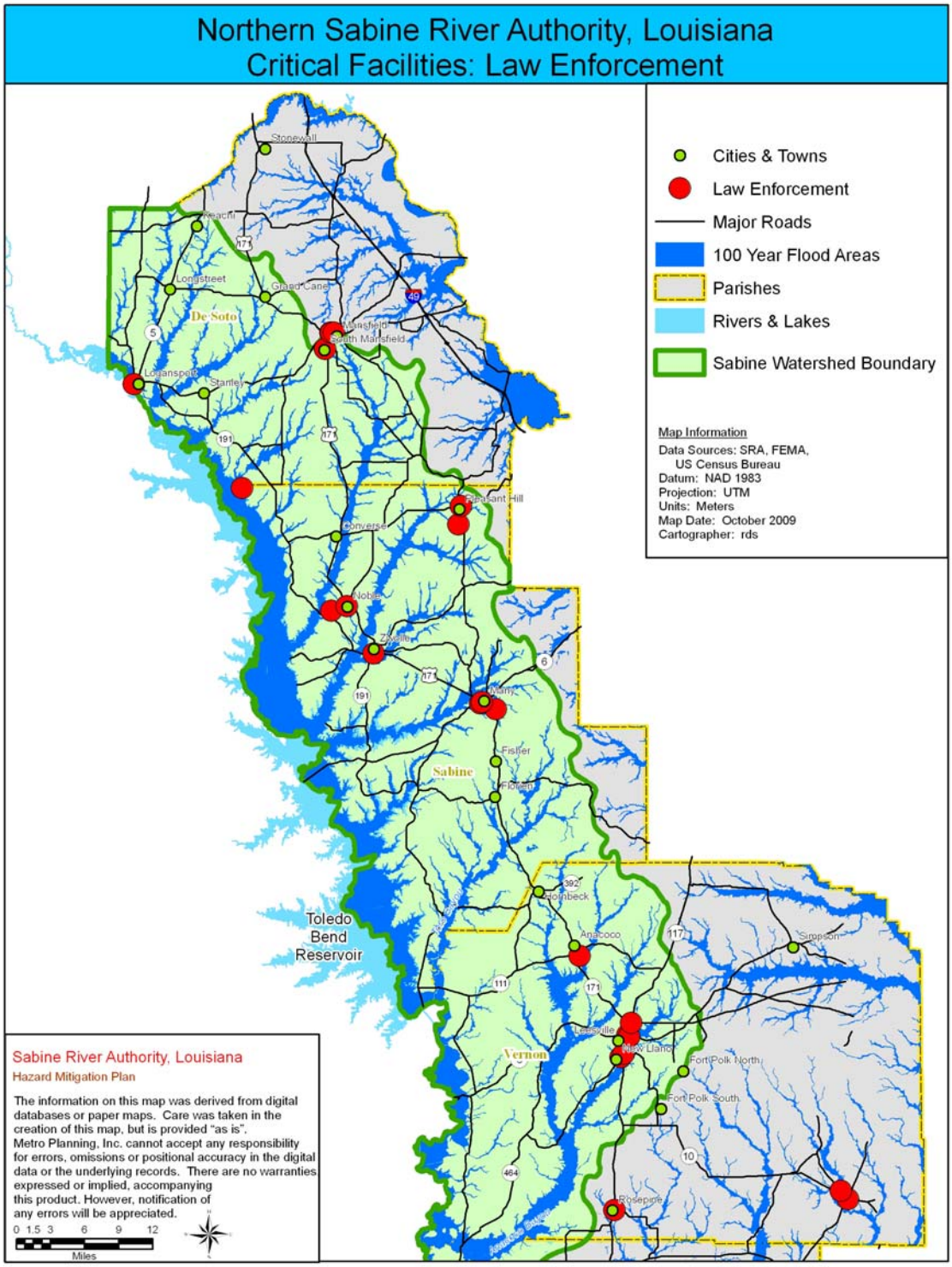
Map 3-X Sabine River Authority Critical Facilities – Fire Stations



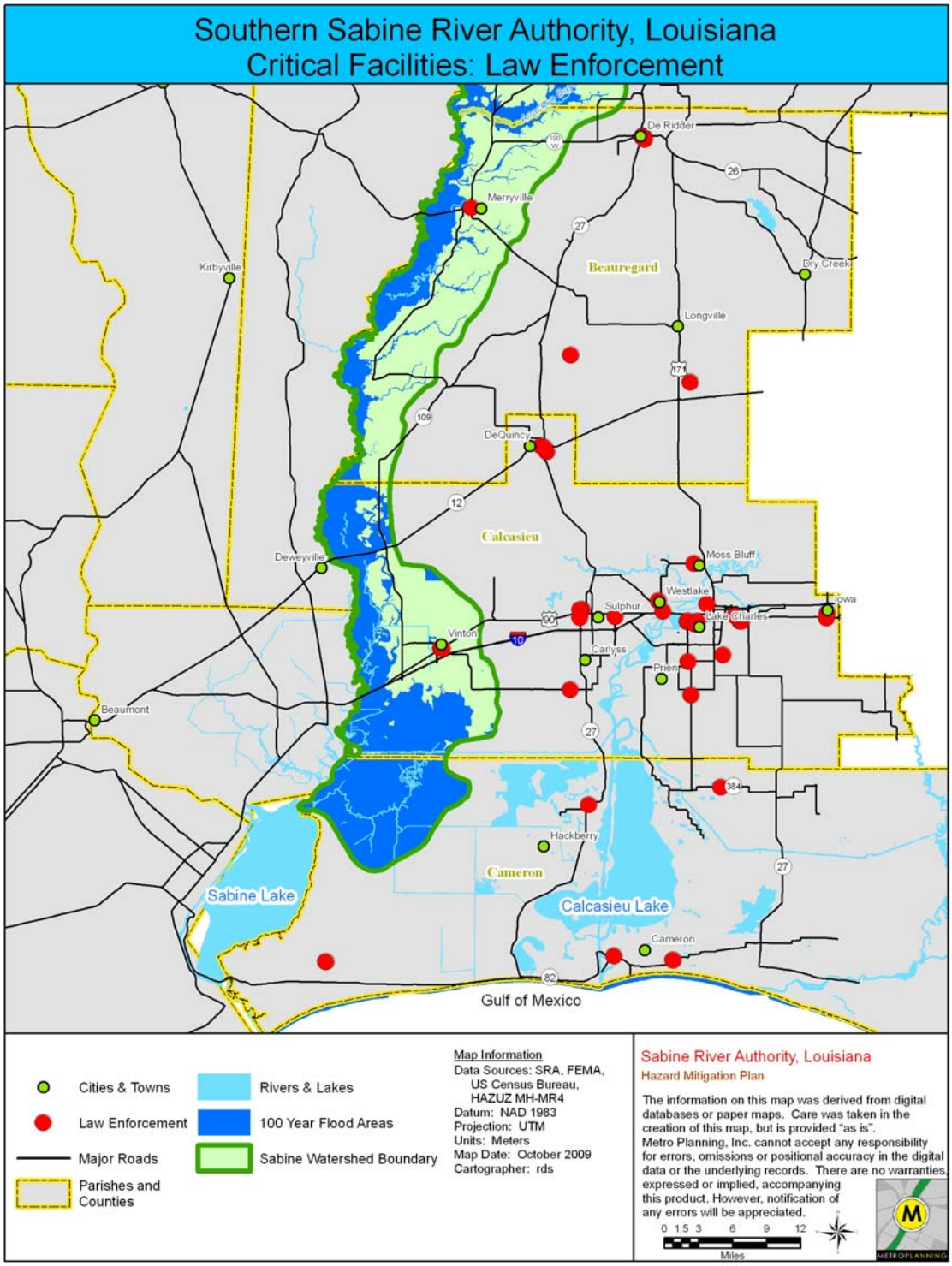
Map 3-X Sabine River Authority Critical Facilities – Fire Stations



Map 3-X Sabine River Authority Critical Facilities – Law Enforcement

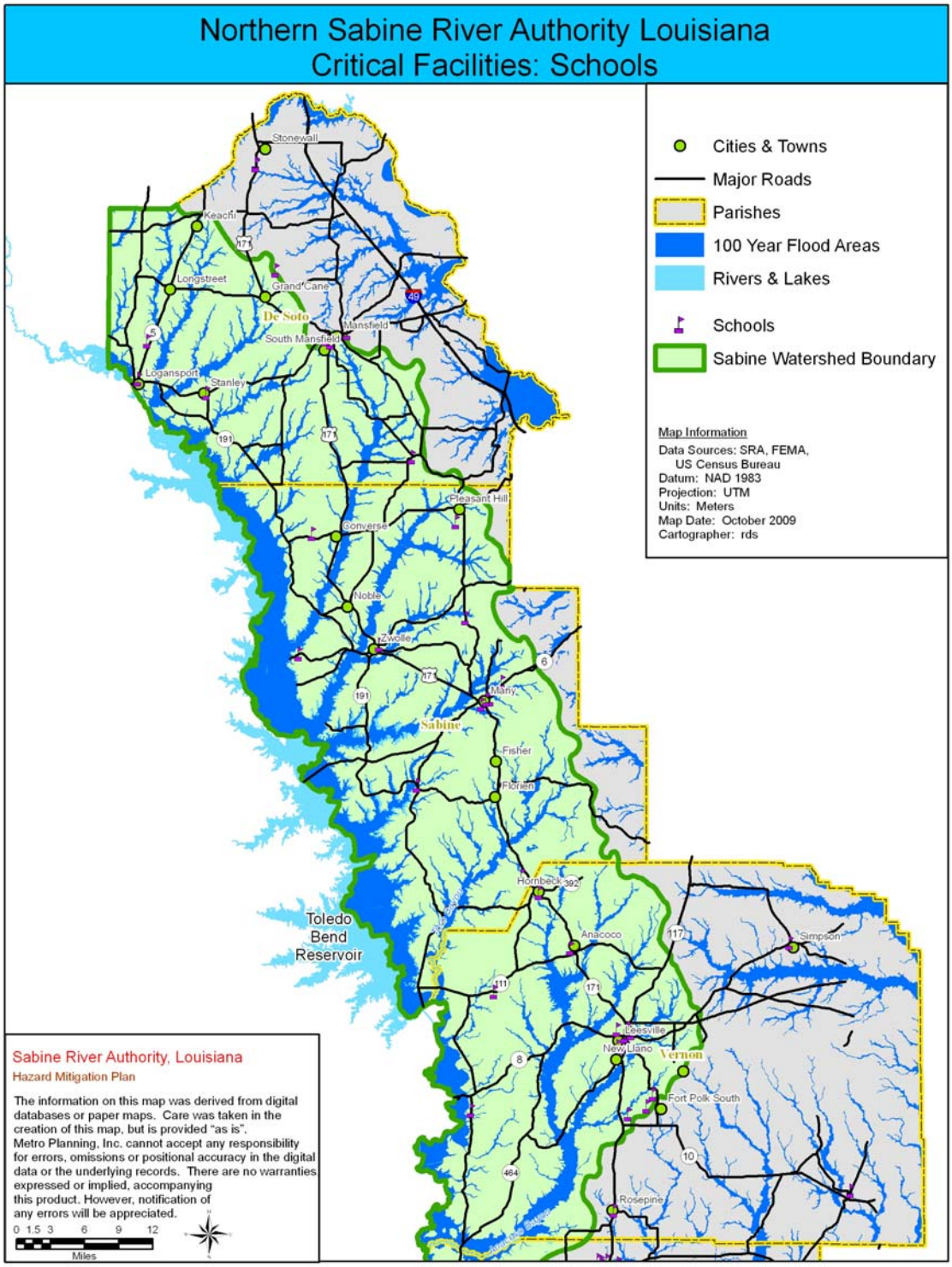


Map 3-X Sabine River Authority Critical Facilities – Law Enforcement

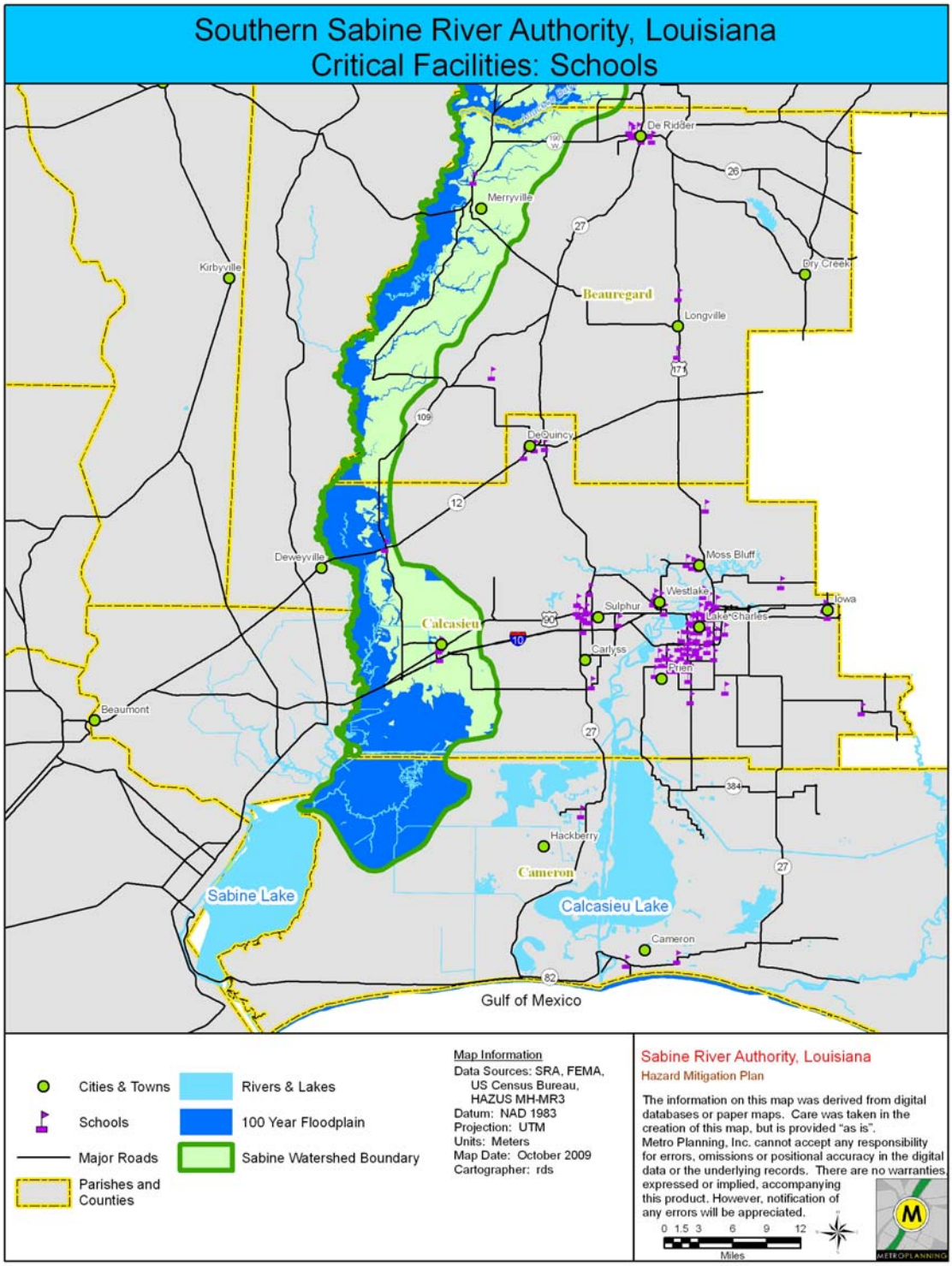


Maps 3-X and 3-X illustrate the geographic location of those schools within the jurisdictional boundary of the Sabine River Authority. Those schools outside the SRA boundary have been excluded from the maps. Therefore the list of six parish-wide tables above have a more comprehensive parish wide list of schools.

Map 3-X Sabine River Authority Critical Facilities – Schools

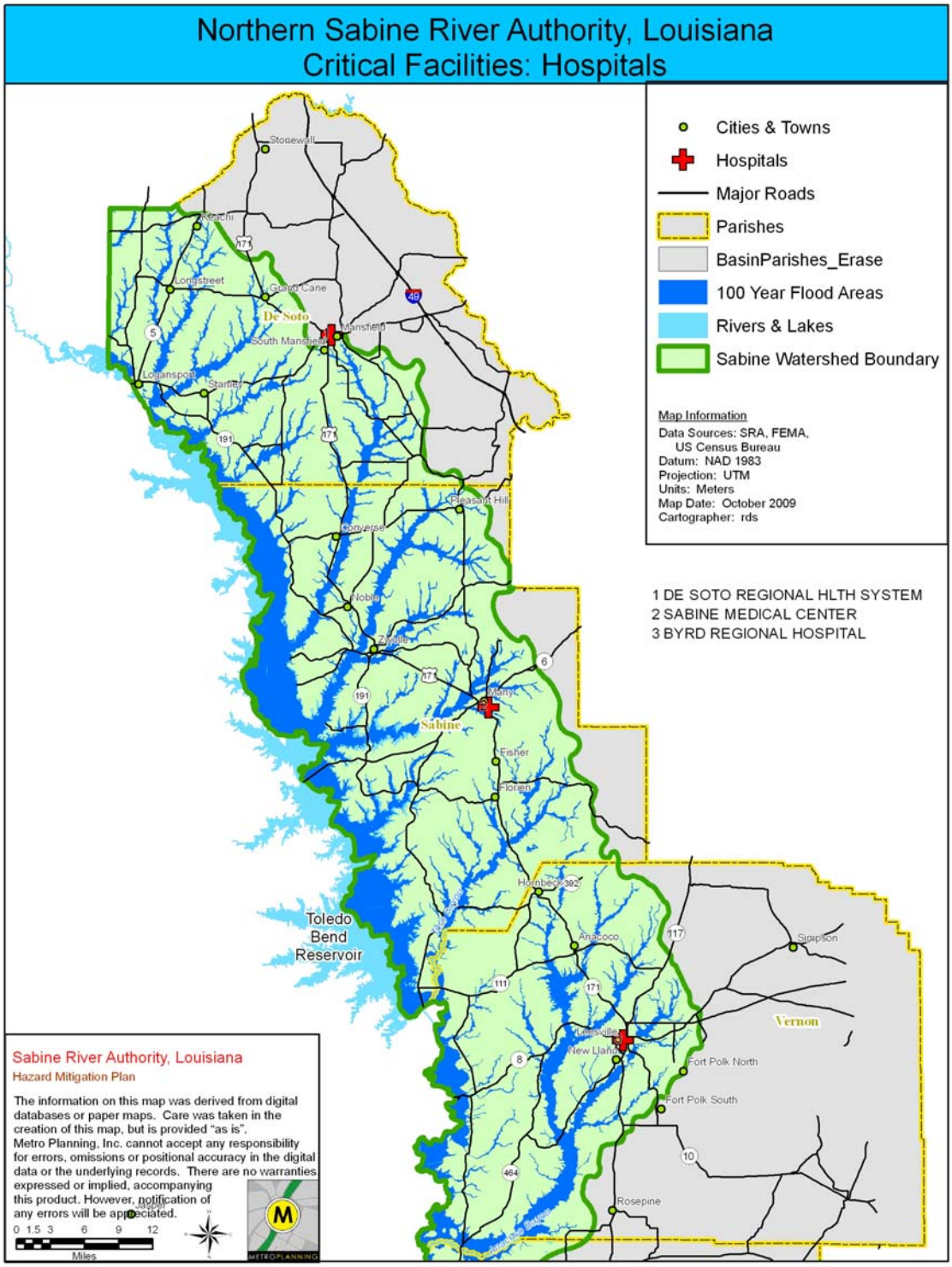


Map 3-X Sabine River Authority Critical Facilities – Schools

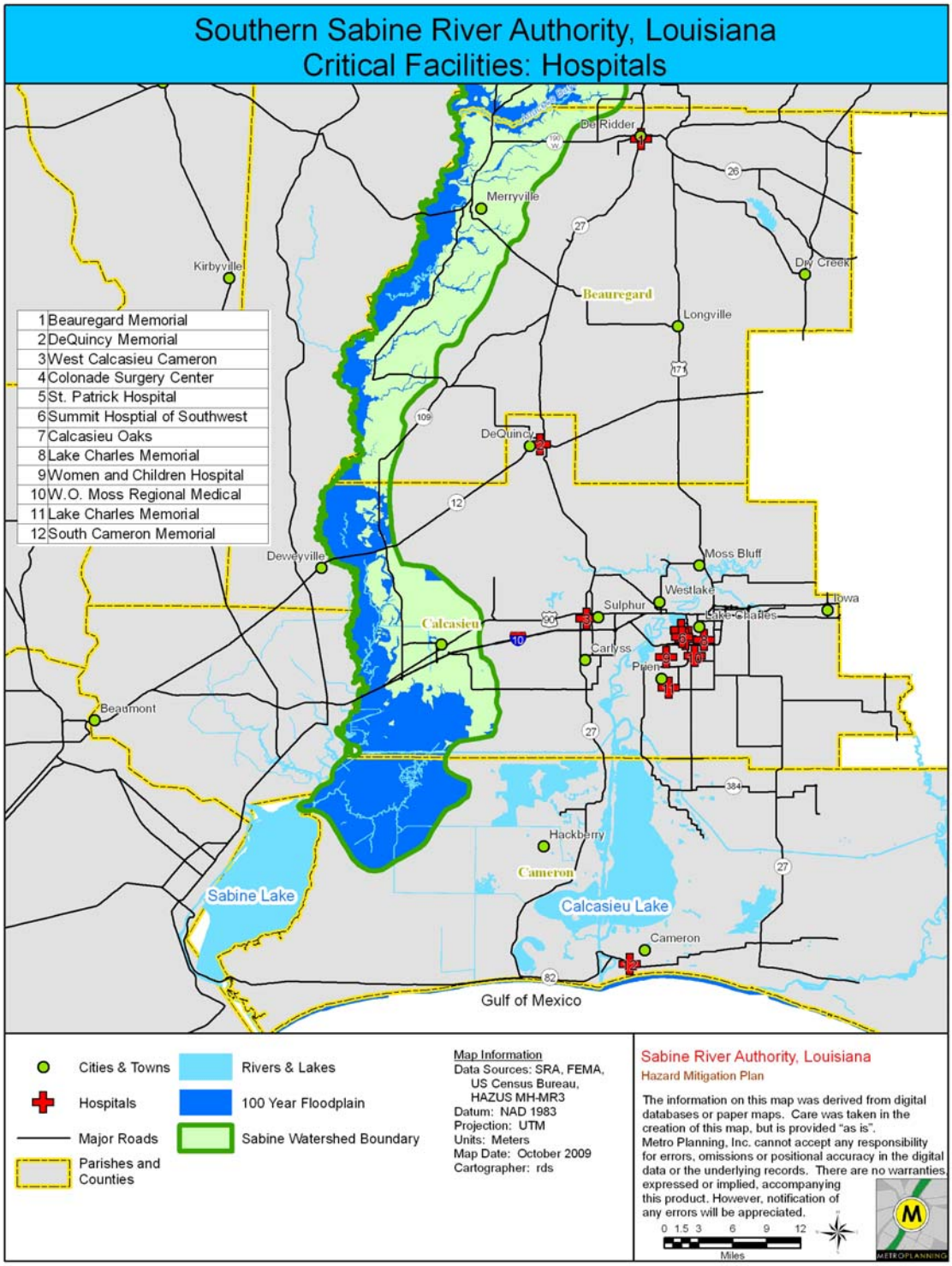


Maps 3-X and 3-X illustrate the medical facilities region wide within the six parishes that include the jurisdictional boundary of the Sabine River Authority. The total number of health care facilities in the six parishes total 15. This number mirrors those tallied in the parish-wide critical facilities tables above. (one is double-counted within the 2008 State Plan).

Map 3-X Sabine River Authority Critical Facilities – Medical Centers



Map 3-X Sabine River Authority Critical Facilities – Medical Centers



In addition, the 2008 State of Louisiana Hazard Mitigation Plan (Appendix E-19) has an assessment of days of lose of use for critical facilities in each of the six parishes that comprise the jurisdictional authority of the Sabine River Authority during a 100-year and 500-year hurricane events. According to the state plan, there would be zero days of use lost during either event.

3.3.5 Potential Dollar Loss

44 CFR Requirement §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 … .

No development is entirely immune to risk and potential dollar loss from hazard impacts, as each hazard poses unique threats of varying magnitudes and intensities. Based on this view, the total replacement value estimates outlined on the tables that follow could be considered as totals for potential dollar loss if a totally devastating event were to occur. A parish-wide assessment of the total number of structures and values for all six parishes that comprise the jurisdictional boundary of the Sabine River Authority was taken from the State of Louisiana Hazard Mitigation Plan Volume II as best available data.

As Table 3-X below shows, the estimated total replacement value of all buildings and contents in the De Soto Parish is $1,739,269,000. The highest proportion of this value is related to residential development, constituting 86.9 percent of total parish assets.

Table 3-X Total Buildings and Total Potential Dollar Loss, in De Soto Parish Including Those Within the Jurisdictional Boundary of the Sabine River Authority

Building Type	Number of structures	Estimated Total Value
Residential	11,204	$1,511,766,000
Commercial	46	$144,499,000
Industrial	20	$53,113,000
Governmental	4	$5,125,000
Educational	3	$3,846,000
Religious	1	$18,364,000
Agricultural	0	$2,556,000
Total	**11,278**	**$1,739,269,000**

Source: FEMA HAZUS (2004) from State of Louisiana Hazard Mitigation Plan Vol. II and (2002 Valuations)

As Table 3-X below shows, the estimated total replacement value of all buildings and contents in the Sabine Parish is $1,879,520,000. The highest proportion of this value is related to residential development, constituting 86.9 percent of total parish assets.

Table 3-X Total Buildings and Total Potential Dollar Loss, in Sabine Parish Including Those Within the Jurisdictional Boundary of the Sabine River Authority

Building Type	Number of structures	Total Value
Residential	13,671	$1,634,339,000
Commercial	51	$158,255,000
Industrial	22	$41,642,000
Governmental	10	$18,112,000
Educational	3	$6,630,000
Religious	2	$18,624,000
Agricultural	0	$1,918,000
Total	**13,759**	**$1,879,520,000**

Source: FEMA HAZUS (2004) from State of Louisiana Hazard Mitigation Plan Vol. II and (2002 Valuations)

As Table 3-X below shows, the estimated total replacement value of all buildings and contents in the Vernon Parish is $3,695,569,000. The highest proportion of this value is related to residential development, constituting 87.1 percent of total parish assets.

Table 3-X Total Buildings and Total Potential Dollar Loss, in Vernon Parish Including Those Within the Jurisdictional Boundary of the Sabine River Authority

Building Type	Number of structures	Total Value
Residential	21,030	$3,221,777,000
Commercial	109	$325,518,000
Industrial	21	$20,501,000
Governmental	45	$69,653,000
Educational	6	$13,728,000
Religious	9	$42,170,000
Agricultural	0	$2,222,000
Total	**21,217**	**$3,695,569,000**

Source: FEMA HAZUS (2004) from State of Louisiana Hazard Mitigation Plan Vol. II and (2002 Valuations)

As Table 3-X below shows, the estimated total replacement value of all buildings and contents in the Beauregard Parish is $2,403,656,000. The highest proportion of this value is related to residential development, constituting 87.6 percent of total parish assets.

Table 3-X Total Buildings and Total Potential Dollar Loss, in Beauregard Parish Including Those Within the Jurisdictional Boundary of the Sabine River Authority

Building Type	Number of structures	Total Value
Residential	14,501	$2,107,500,000
Commercial	67	$205,855,000
Industrial	20	$21,704,000
Governmental	8	$11,861,000
Educational	7	$17,904,000
Religious	7	$32,658,000
Agricultural	0	$6,174,000
Total	**14,610**	**$2,403,656,000**

Source: FEMA HAZUS (2004) from State of Louisiana Hazard Mitigation Plan Vol. II and (2002 Valuations)

As Table 3-X below shows, the estimated total replacement value of all buildings and contents in the Calcasieu Parish is $15,868,800,000. The highest proportion of this value is related to residential development, constituting 76.2 percent of total parish assets.

Table 3-X Total Buildings and Total Potential Dollar Loss, in Calcasieu Parish Including Those Within the Jurisdictional Boundary of the Sabine River Authority

Building Type	Number of structures	Total Value
Residential	75,995	$12,107,500,000
Commercial	603	$2,583,409,000
Industrial	146	$536,164,000
Governmental	26	$31,730,000
Educational	21	$66,709,000
Religious	32	$156,686,000
Agricultural	0	$17,760,000
Total	**76,823**	**$15,868,800,000**

Source: FEMA HAZUS (2004) from State of Louisiana Hazard Mitigation Plan Vol. II and (2002 Valuations)

As Table 3-X below shows, the estimated total replacement value of all buildings and contents in the Calcasieu Parish is $936,691,000. The highest proportion of this value is related to residential development, constituting 79.8 percent of total parish assets. Please be apprised

that this assessment is from structure numbers and values derived prior to Hurricane Rita. It is anticipated that the true values have been significantly reduced.

Table 3-X Total Buildings and Total Potential Dollar Loss, in Cameron Parish Including Those Within the Jurisdictional Boundary of the Sabine River Authority

Building Type	Number of structures	Total Value
Residential	5,336	$747,773,000
Commercial	34	$105,951,000
Industrial	9	$47,759,000
Governmental	4	$6,574,000
Educational	2	$11,602,000
Religious	3	$14,858,000
Agricultural	0	$2,174,000
Total →	**5,388**	**$936,691,000**

Source: FEMA HAZUS (2004) from State of Louisiana Hazard Mitigation Plan Vol. II and (2002 Valuations)

Potential Dollar Loss Due To Hazard

As stated in FEMA's *Local Multi-Hazard Mitigation Planning Guidance* document the plan should estimate the potential dollar losses to vulnerable structures. Typically the hazard of flood is used to estimate the potential dollar loss in the majority of parishes and counties around the nation.

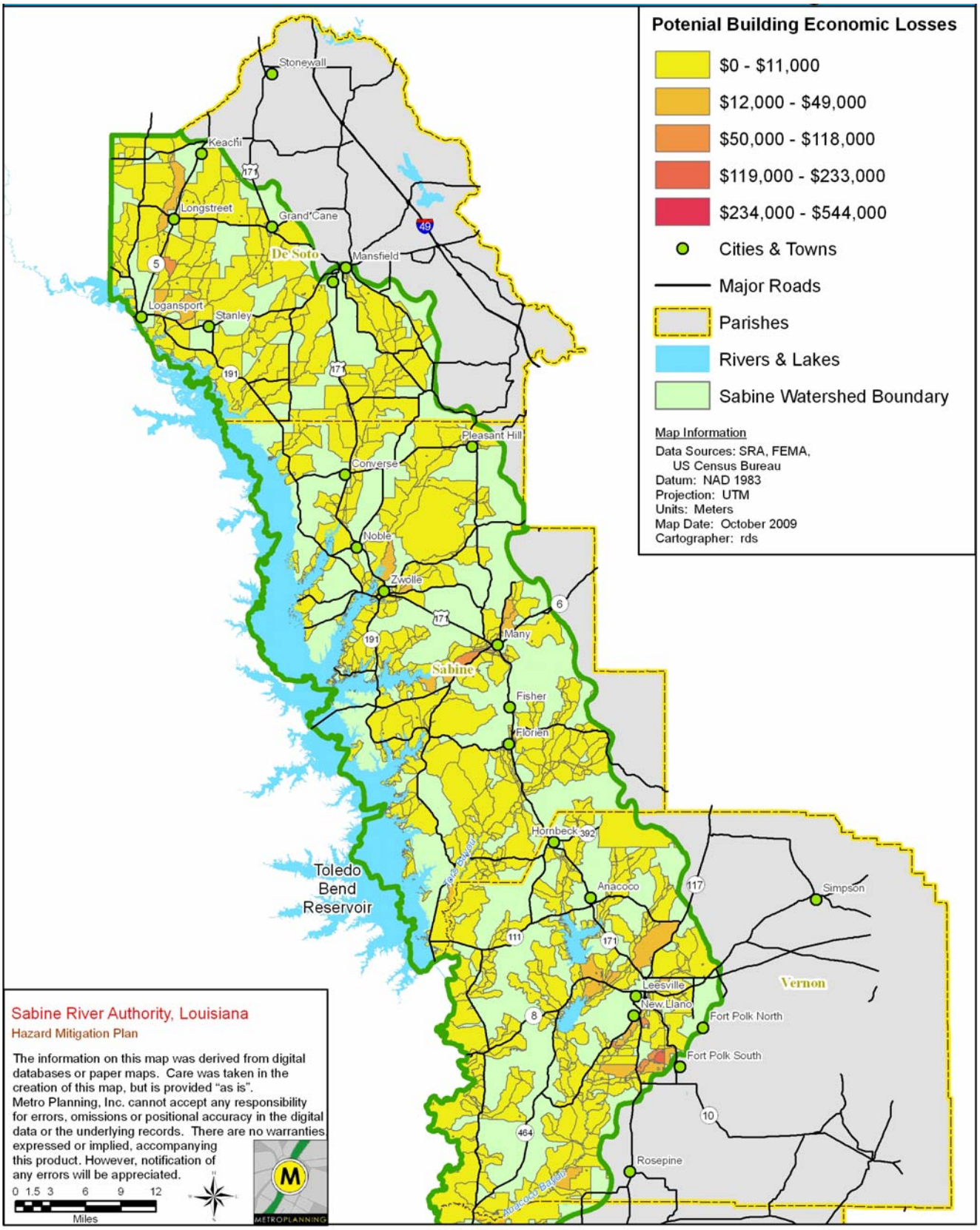
The following two maps (Maps 3-X and 3-X) illustrate the total housing values vulnerable to flooding passed on Census data derived from Landview 6 software. As stated previously all six parishes participate in the in NFIP. Please be apprised that this data does provide generalized housing values vulnerable to flooding from flooding sources other than FEMA mapped floodplain as is grouped at the census block level. This flooding data set represents areas prone to flooding based on watershed features and contours which may be more susceptible to localized overland flash flood events.

The following series of maps **(3-X through 3-X)** illustrate the potential damage sustained by residential and commercial buildings as a result of a 100-year storm event as defined by HAZUS, classified at the Census Block scale. Census Blocks in parishes outside the jurisdictional boundary of the Sabine River Authority have been excluded and not part of this map series.

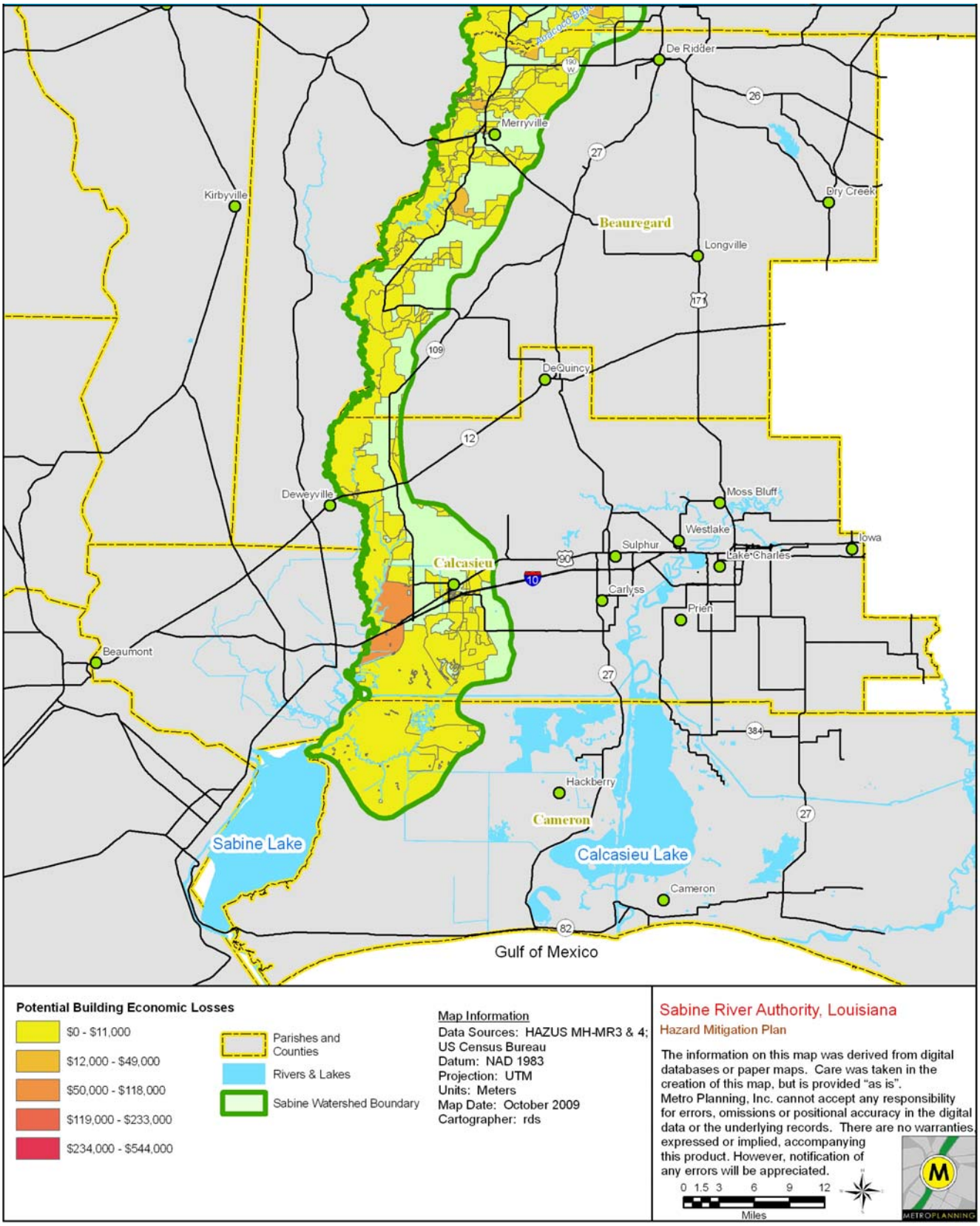
Please note that HAZUS generated 100-year storm event floodplain boundaries are derived from pre-selected hazard event scenarios which use digital elevation models from the USGS National Elevation Dataset. In general, these boundaries typically cover less land area than flood hazard areas associated with FEMA Flood Insurance Rate Maps.

As expected, census blocks near the Sabine River or the Toledo Bend Reservoir tend to have higher potential damage in square footage. In addition potential building damage generally follows the stream and floodplain flow patterns northeast to southwest toward the Sabine River.

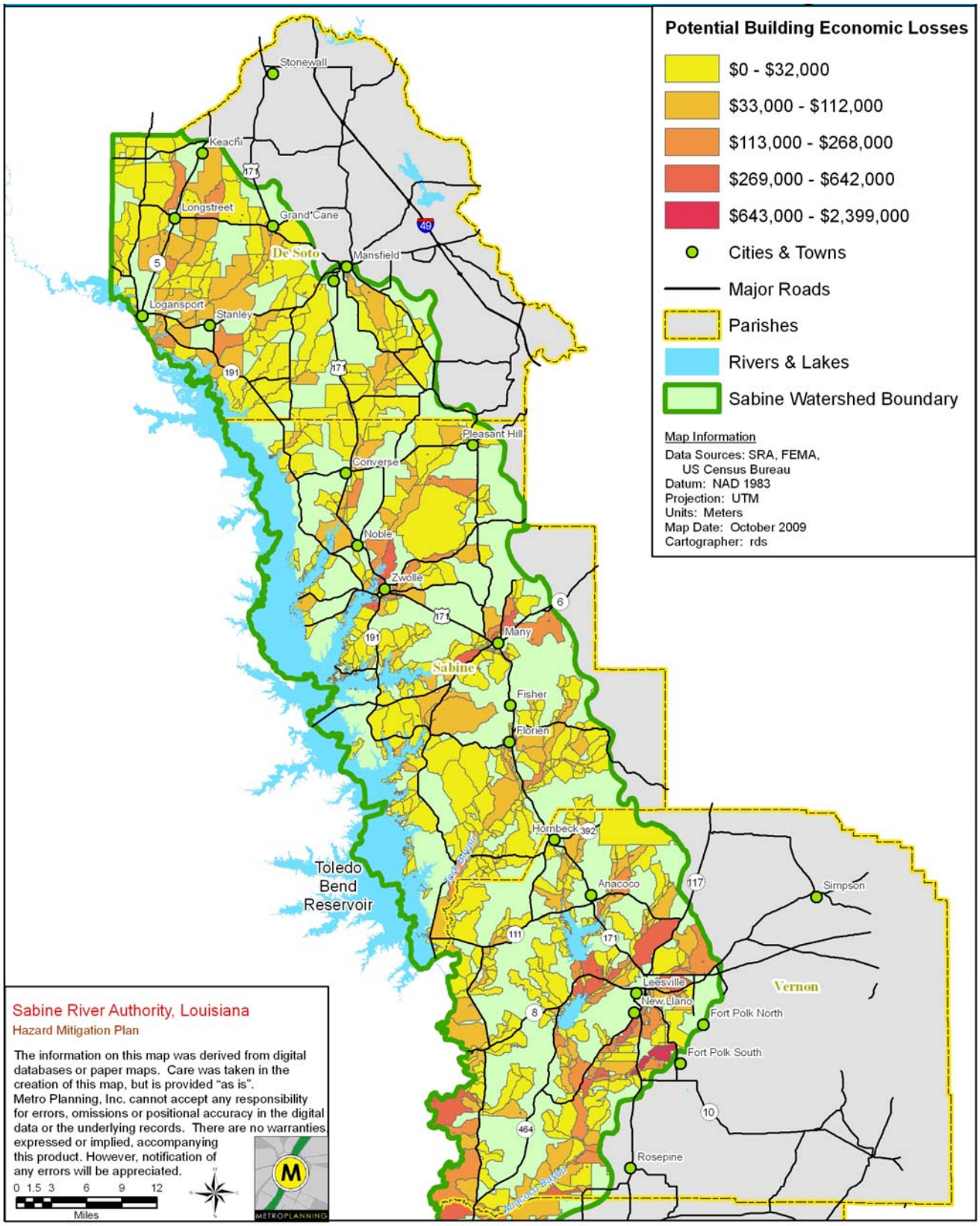
Map 3-X Potential Commercial Building Losses, Flood Event, North Sabine River Basin



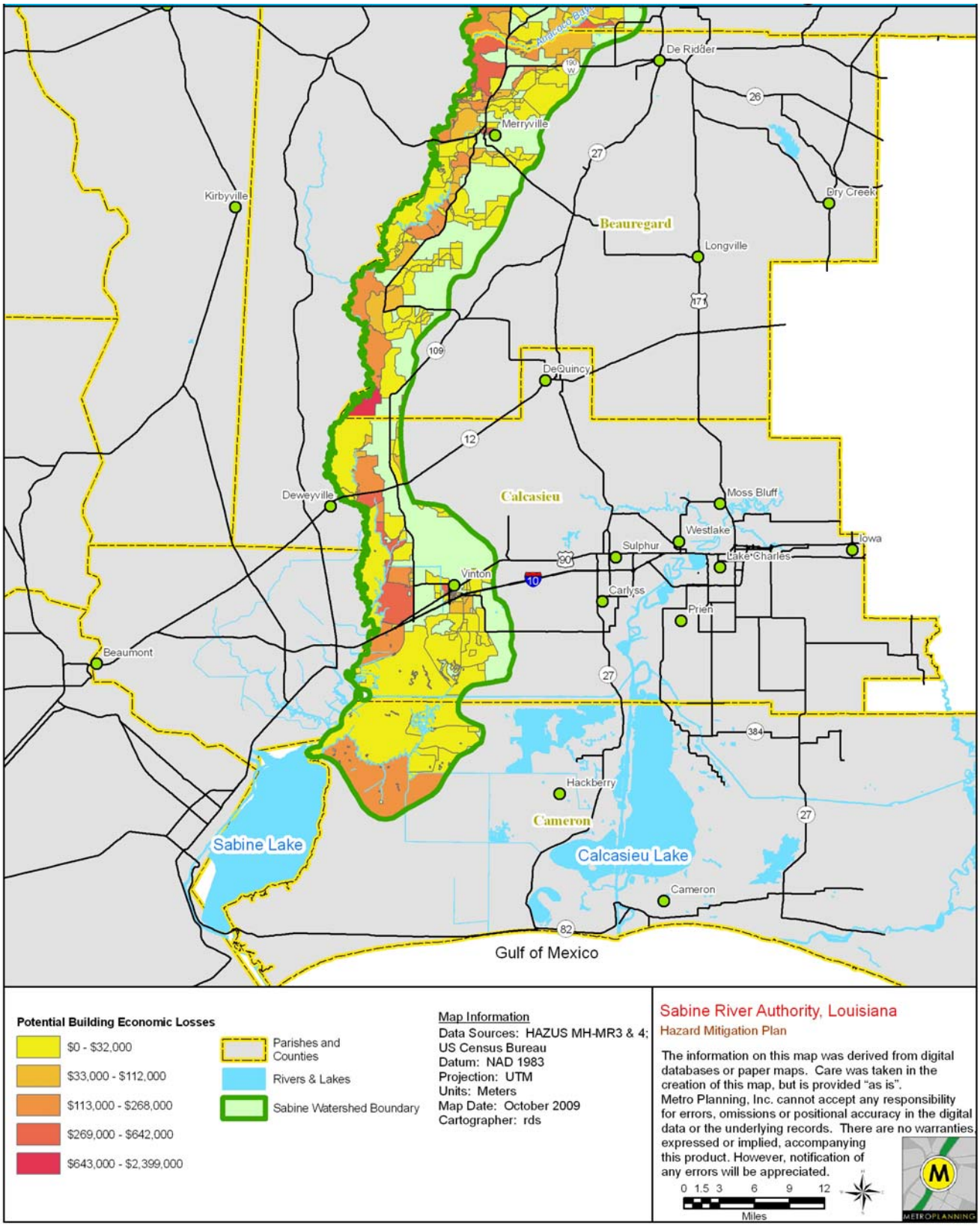
Map 3-X Potential Commercial Building Losses, Flood Event, South Sabine River Basin



Map 3-X Potential Residential Building Losses, Flood Event, North Sabine River Basin



Map 3-X Potential Residential Building Losses, Flood Event, <u>South Sabine River Basin</u>



Potential Dollar Loss, Other Hazards

For hazards other than flooding and hurricanes, the Hazard Mitigation Team developed estimates of property losses and commercial activity losses based off data from previous occurrences and general evaluation of potential impact. These estimates are developed according to approximations of 'major disaster scenarios' for each hazard, and are inherently subjective. For potential dollar loss to structures and contents, differentiation of impact across the various development types (residential, commercial, industrial, etc.) was not developed, but rather is reported as a static value for estimated loss based on total replacement value within each category. Table 3-42 on the following page outlines potential dollar losses to structures and personal property for a range of identified hazard types, followed by Table 3-43 which shows estimated economic impacts to commercial activity for all industrial/commercial sectors.

Table 3-42 Estimated Potential Dollar Loss by Disaster Type, Structures and Contents, Sabine River Basin

Development Type	Total Replacement Value (TRV)	Dam Failure (-0.25% TRV)	Hailstorm (-0.001% TRV)	Thunderstorm (-0.10% TRV)	Tornado (-0.05% TRV)	Wildfire (-0.10% TRV)	Winter Storm (-0.05 TRV)	Other Hazard (-0.05% TRV)
Residential	$14,088,530,000	$35,221,325	$140,885	$14,088,530	$7,044,265	$14,088,530	$7,044,265	$7,044,265
Commercial	$3,591,841,000	$8,979,603	$35,918	$3,591,842	$1,795,921	$3,591,842	$1,795,921	$1,795,921
Industrial	$888,398,000	$2,220,995	$8,884	$888,398	$444,199	$888,398	$444,199	$444,199
Agriculture	$47,304,000	$118,260	$473	$47,304	$23,652	$47,304	$23,652	$23,652
Religion	$516,332,000	$1,290,830	$5,163	$516,332	$258,166	$516,332	$258,166	$258,166
Government	$132,007,000	$330,018	$1,320	$132,008	$66,004	$132,008	$66,004	$66,004
Education	$206,004,000	$515,010	$2,060	$206,004	$103,002	$206,004	$103,002	$103,002
TOTAL	$19,470,416,000	$48,676,040	$194,704	$19,470,416	$9,735,208	$19,470,416	$9,735,208	$9,735,208

Sources: HAZUS MH-MR3 (replacement value data); Hazard Mitigation Team (estimated losses as percent of total replacement value)
Notes: Flood and Hurricane loss developed on previous pages. Other hazards include Tsunami and Expansive Soils. Structure and Contents loss due to Drought and Excessive Heat were not developed. Estimates for agriculture impacts do not include potential damage to crop yields.

Table 3-43 Estimated Potential Dollar Loss by Disaster Type, Commercial Activity, Calcasieu Parish

Description	Firms	Annual Receipts (AR)	Dam Failure (-0.25% AR)	Drought (-2.0% AR)	Excessive Heat (-0.5% AR)	Hailstorm (-0.1% AR)	Thunderstorm (-0.25% AR	Tornado (-0.5% AR)	Wildfire (-0.5% AR)	Winter Storm (-0.5% AR)	Other Hazard (-0.25% AR)
Total for all Industry sectors	9,905	$377.3M	$943,290	$7,546,320	$1,886,580	$377,316	$943,290	$1,886,580	$1,886,580	$1,886,580	$1,886,580

Source: Internal Revenue Service, US Census: Non-employer Statistics, 2005 Total for all sectors Calcasieu Parish, LA (commercial activity data); Hazard Mitigation Team (estimates of annual receipts loss as percent of total).
Notes: Flood and Hurricane loss developed on previous pages. Other hazards include Tsunami and Expansive Soils.

3.3.6 Land Use and Development Trends

44 CFR Requirement §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.

Insert Land Use and Development Information

3.3.7 Existing Planning Mechanisms

An integral component of the mitigation strategy is the incorporation of this plan's objectives into existing and future planning mechanisms. A number of such plans and regulatory constructs (codes and ordinances) are in place in the Sabine River Basin.

The Hazard Mitigation Team is comprised of personnel with direct oversight into the development, update, and day-to-day implementation of these planning mechanisms. Below, Table 3-56 lists planning mechanisms and regulatory tools for Calcasieu Parish, followed by similar reports for the other parishes in the region.

Table 3-56 Planning Mechanism Checklist, Calcasieu Parish

Regulatory Tool (ordinances, codes, plans)	Title/Comments
Master/Comprehensive Plan	Vision Calcasieu
Zoning ordinance	Calcasieu Parish Zoning Ordinance: Classifications A-1: Agricultural District R-1: Single Family Residential District R-2: Mixed Residential District R-M: Multi-Family Residential District R-MHP: Manufactured Home Park District C-1: Light Commercial District C-2: General Commercial District C-3: Central Business Commercial District I-1: Light Industrial District I-2: Heavy Industrial District I-3 Hazardous Industrial District
Floodplain ordinance	Flood Zone Development requirements
Other special purpose ordinance	Coastal High Hazard Area development checklist; Manufactured Home Permit checklist;
Building codes	• 2005 National Electrical Code • Louisiana State Plumbing Code, 2000 Edition • 2006 International Building Code • 2006 International Residential Code • 2006 International Mechanical Code • 2006 International Fuel/Gas Code Also Building Plans Submittal Checklist (Non High Wind); Building Plans Checklist (High Wind); New Residence Checklist
Erosion or sediment control program	Storm Water Erosion & Sediment Control Plan Checklist; Pond/Dirt Pit Permit requirement;
Storm water management program	Storm Water Development Permit requirements; Storm Water Contractor Awareness Form; Culvert Permit requirement;
Site plan review requirements	See above
Emergency operations plan	CPPJ Emergency Operations Plan; Continuity of Operations Plan
Flood insurance study or other engineering study for streams	Preliminary D-FIRM, 2009
Elevation certificates	2008-2009

Source: Calcasieu Parish Planning and Development

CHAPTER 4. MITIGATION STRATEGY

44 CFR Requirement 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.

The mitigation strategy of this plan creates a framework from which the Sabine River Authority will act to reduce the impact of future hazard events. The construction of this mitigation strategy is intentionally straightforward; a set of agreed upon goals and a series of feasible actions that support the goals.

This chapter begins by defining the agreed upon goals established early in the planning process, outlined in Section 4.1 (Local Hazard Mitigation Goals). Section 4.2 (Action Item Identification and Prioritization) describes the process through which mitigation actions were decided upon and ranked by relative priority. Section 4.3 (Action Items) lists mitigation activities to be pursued by the Authority and each of the participating parishes in congruence, ordered by specific hazard type and including multi-hazard action items that address some combination of identified hazards. Finally, Section 4.5 (Continued National Flood Insurance Program Participation) details the current and future commitment of the SRA to the NFIP.

4.1 LOCAL HAZARD MITIGATION GOALS

44 CFR Requirement §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.

The overarching goal of the Sabine River Authority Hazard Mitigation Plan is to promote sound public policy designed to protect the health, safety and welfare of the region's residents and community assets. More specifically, the goals of this plan are to:

- Prevent or reduce injury and loss of life
- Prevent or reduce future damage to critical facilities (fire, rescue, law enforcement, communications, command and control) that are essential in providing public protection and health
- Prevent or reduce future damage to special facilities including schools, nursing homes, health care facilities, prisons, jails, unique historical and cultural resources
- Prevent or reduce future damage to infrastructure including utility systems, pipelines, railroads, highways, bridges, and navigable waterways
- Prevent or reduce future damage to commercial facilities
- Prevent or reduce future damage to higher risk facilities that, if damaged, may result in significant loss of human life, damage to the environment, or significant harm to the local economy (i.e. hazardous materials storage facilities, dams, flood control facilities, and other high security facilities)

Pursuant to these goals, the Hazard Mitigation Team developed mitigation action items (measurable activities targeted at mitigating specific hazards) for each identified hazard. These action items and their associated implementation strategies are described in the following section.

4.2 ACTION ITEM IDENTIFICATION AND PRIORITIZATION

44 CFR Requirement §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.

The Sabine River Authority Hazard Mitigation Plan provides a list of proposed mitigation actions that will assist the agency and region in reducing the potential losses associated with each hazard type. The remainder of this chapter describes the mitigation strategy developed by the HMT to implement action items in support the above stated goals. It is expected that with sound and thorough implementation of these action items, significant reductions in future losses to the region's residents and assets will result.

4.2.1 Action Item Identification

During the meetings and discussions conducted during the development of the plan, numerous suggestions for mitigation actions were presented by the various attendees creating an initial 'wish list' of mitigation activities. The Hazard Mitigation Team considered this broad range of potential mitigation activities in relation to their particular area of interest or expertise. Action items considered included those from the previous iteration of this plan that have not yet been implemented. Other action items from the previous version of this plan were removed from consideration due to completion, absence of funding sources, or lack of viability.

4.2.2 Action Item Prioritization Criteria

Among a number of factors, the Hazard Mitigation Team emphasized the following criteria in evaluating potential action items for inclusion in the Plan update and for the prioritization of selected items. Specifically, the HMT considered the predicted social impacts of action item implementation, the action item's technical feasibility, administrative barriers or considerations, political considerations, legal ramifications, and economic and environmental impacts. These criteria, organized under the STAPLEE acronym, are listed below:

<u>STAPLE-E Criteria</u>

- **S**ocial Effects
- **T**echnical Feasibility
- **A**dministrative Barriers/Considerations
- **P**olitical Considerations
- **L**egal Ramifications
- **E**conomic Impacts
- **E**nvironmental Impacts

<u>Benefit-Cost Review</u>

An overall evaluation of an action item's expected benefits versus costs was also considered during action item identification and prioritization. Items with estimated benefits that outweighed expected costs (>1:1 BCR) were generally given favorable consideration over those action items with negative benefit-cost ratios (<1:1 BCR).

Prioritization Process

From the list of hazard mitigation ideas established in the planning process, each member of the Hazard Mitigation Team was asked to prioritize at least two action items for each identified hazard and for multiple hazards based on their assessments of the STAPLE-E criteria, benefit-cost review, and other quantitative and qualitative factors. The following criteria were used by the HMT to evaluate the relative priority of each action item:

- High: Meets five of the seven STAPLE-E criteria
- Medium: Meets four of the seven STAPLE-E criteria
- Low: Meets three (or less) of the seven STAPLE-E criteria

The results of the action item prioritization process were aggregated to capture the consensus of the HMT, with numeric equivalents established for the high, medium, and low factors as follows: High = 3; Medium = 2; Low = 1. These results were summed and averaged, with the higher numeric equivalents given a higher relative priority ranking.

Using this method of aggregating results, the relative priority rankings are developed and ordered under the outcomes for each respective hazard. The priority ranking for the action item (as compared to other action items for that hazard type), is reported by number as the '(Hazard Type) Priority Ranking' for each action item listed in Section 4.3 below.

4.3 HAZARD MITIGATION ACTION ITEMS

The prioritized mitigation action items are reported below, starting with action items pertaining to multiple hazards (multi-hazard action items) and followed by action items for each identified hazard organized alphabetically. The outline for each action item includes the following information:

- STAPLE-E summary — qualitative estimate of potential benefits and liabilities with regard to STAPLE-E criteria
- Assessment of grant eligibility — evaluation of project type based on State of Louisiana Hazard Mitigation Grant Program funding priorities in 2008
- Priority ranking — ranking relative to other action items of the same hazard type based on aggregated prioritization scores. Equivalent prioritization scores received same (equal) priority ranking
- Average Prioritization Score: Average of prioritization ratings from Hazard Mitigation Team (numeric equivalent—high=1, medium=2, low=3, i.e. lower score =’s higher priority)
- Estimated cost — estimated expense to carry an action item through to completion
- Implementation period — estimated period to complete action item
- Coordinating agencies — departments and agencies involved in action item implementation
- Potential funding sources — Potential grant funding sources

Dam and Levee Failure Action Items

Dam and Levee Failure Mitigation Action Item 1: **Pursue voluntary acquisition projects for properties vulnerable to dam and levee failure.**

STAPLEE Summary	Social, technical, administrative, economic, legal, and environmental benefits
State Funding Priority	Yes (Acquisition)
Dam/Levee Failure Priority Ranking	1
Average Prioritization Score	1.4
Estimated Cost:	$1,000,000-2,000,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish OEPs and Floodplain Administrators
Potential Funding Sources:	HMGP, PDM, FMA, RFC, SRL

Dam and Levee Failure Mitigation Action Item 2: **Institute Reverse 911 warning system for potentially inundated areas.**

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	No (warning systems, may be eligible for alternative grant sources)
Dam/Levee Failure Priority Ranking	2
Average Prioritization Score	2.1
Estimated Cost:	$100,000-125,000
Implementation Schedule:	12 months
Coordinating Agency:	SRA-LA; Parish OEP
Potential Funding Sources:	CTPGP, PDM

Dam and Levee Failure Mitigation Action Item 3: **Purchase and distribute weather radios for potentially inundated areas.**

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	No (warning systems, may be eligible for alternative grant sources)
Dam/Levee Failure Priority Ranking	3
Average Prioritization Score	2.3
Estimated Cost:	$50,000-60,000
Implementation Schedule:	12 months
Coordinating Agency:	SRA; Parish OEP
Potential Funding Sources:	CTPGP, PDM

Dam and Levee Failure Mitigation Action Item 4: **Install warning siren system for populated areas directly downstream from the dam.**

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	No (warning systems, may be eligible for alternative grant sources)
Dam/Levee Failure Priority Ranking	4
Average Prioritization Score	2.6

Estimated Cost:	$50,000-75,000
Implementation Schedule:	12-18 months
Coordinating Agency:	SRA; Parish OEP, Public Works
Potential Funding Sources:	CTPGP, PDM

Dam and Levee Failure Mitigation Action Item 5: **Conduct levee stability monitoring.**

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	Yes (Floodwall Protection Systems)
Dam/Levee Failure Priority Ranking	5
Average Prioritization Score	2.8
Estimated Cost:	$100,000-125,000
Implementation Schedule:	12 months
Coordinating Agency:	SRA-LA; Parish Public Works
Potential Funding Sources:	CTPGP, PDM, FMA

Drought Action Items

Drought Mitigation Action Item 1: **Develop a water rationing plan with an emphasis on capabilities and enforcement.**

STAPLEE Summary	Social, technical, administrative, legal, economic, and environmental benefits.
State Funding Priority	Yes (Post-disaster code enforcement activities)
Drought Priority Ranking	1
Average Prioritization Score	1.8
Estimated Cost:	$10,000-20,000
Implementation Schedule:	3-6 months
Coordinating Agency:	SRA-LA, Parish Planning & Dev't, Water Districts
Potential Funding Sources:	HMGP. PDM

Drought Mitigation Action Item 2: **Initiate a drought awareness program as part of the water conservation campaign. Create a brochure to be mailed residents of the region.**

STAPLEE Summary	Social, administrative, economic, and environmental benefits.
State Funding Priority	Yes (5 percent initiative)
Drought Priority Ranking	2
Average Prioritization Score	2.2
Estimated Cost:	$10,000-25,000
Implementation Schedule:	6 months
Coordinating Agency:	SRA-LA, Water Districts
Potential Funding Sources:	HMGP, CTPGP

Hazard: Excessive Heat

Excessive Heat Mitigation Action Item 1: Develop and implement water distribution program for vulnerable populations during periods of excessive heat.

STAPLEE Summary	Social, administrative, legal, economic benefits.
State Funding Priority	Unknown
Excessive Heat Priority Ranking	1
Average Prioritization Score	1.8
Estimated Cost:	$10,000-25,000
Implementation Schedule:	6 months
Coordinating Agency:	SRA-LA, Parish OEP
Potential Funding Sources:	HMGP 5 percent initiative

Excessive Heat Mitigation Action Item 2: Construct cooling centers in local communities for use by vulnerable populations.

STAPLEE Summary	Social, administrative benefits.
State Funding Priority	Unknown
Excessive Heat Priority Ranking	2
Average Prioritization Score	2.2
Estimated Cost:	$500,000-750,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA, Parish Public Works
Potential Funding Sources:	HMGP, PDM

Flood Action Items

Flood Mitigation Action Item 1: **Pursue voluntary acquisition projects for properties in flood prone areas.**

STAPLEE Summary	Social, technical, administrative, legal, economic and environmental benefits
State Funding Priority	Yes (Acquisition)
Flood Priority Ranking	1
Average Prioritization Score	1.2
Estimated Cost:	$1,000,000-2,000,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA, Parish OEP and Floodplain Administrators
Potential Funding Sources:	HMGP, PDM, FMA, RFC, SRL

Flood Mitigation Action Item 2: **Produce map of flood evacuation routes.**

STAPLEE Summary	Social, administrative, legal, economic benefits
State Funding Priority	No (possible funding sources, CTPGP, 5 percent initiative)
Flood Priority Ranking	2
Average Prioritization Score	1.8

Estimated Cost:	$50,000-60,000
Implementation Schedule:	6-12 months
Coordinating Agency:	SRA-LA; Parish OEP, Public Works
Potential Funding Sources:	CTPGP, HMGP, PDM

Flood Mitigation Action Item 3: **Continue and support each local jurisdiction's participation in the National Flood Insurance Program (NFIP).**

STAPLEE Summary	Social, administrative, legal, economic benefits
State Funding Priority	Yes (Post-disaster code enforcement activities)
Flood Priority Ranking	3
Average Prioritization Score	2.1
Estimated Cost:	$50,000-100,000/year
Implementation Schedule:	Ongoing/annual
Coordinating Agency:	SRA-LA; Parishes
Potential Funding Sources:	HMGP, PDM

Flood Mitigation Action Item 4: **Pursue relocation projects for properties in flood prone areas.**

STAPLEE Summary	Social, technical, administrative, legal, economic and environmental benefits
State Funding Priority	Yes (Relocation)
Flood Priority Ranking	3 (tied)
Average Prioritization Score	2.1
Estimated Cost:	$500,000-1,000,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish OEP
Potential Funding Sources:	HMGP, PDM

Flood Mitigation Action Item 5: **Implement storm drainage improvement projects that will help minimize flood damage to regional assets.**

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	Yes (Minor structural flood control projects)
Flood Priority Ranking	3 (tied)
Average Prioritization Score	2.1
Estimated Cost:	$500,000-1,000,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish OEP, Public Works
Potential Funding Sources:	HMGP, PDM

Flood Mitigation Action Item 6: **Review and update the current floodplain development ordinances and development permitting process in the region to strengthen the ability to enforce standards.**

STAPLEE Summary	Social, technical, administrative, legal, economic benefits
State Funding Priority	Yes (Post Disaster Code Enforcement)
Flood Priority Ranking	4
Average Prioritization Score	2.3
Estimated Cost:	$10,000-15,000
Implementation Schedule:	6 months
Coordinating Agency:	SRA-LA; Parishes, Cities
Potential Funding Sources:	HMGP, PDM, FMA

Flood Mitigation Action Item 7: **Elevate roadways at high water crossing locations.**

STAPLEE Summary	Social, technical, administrative, economic, benefits
State Funding Priority	Yes (Minor Structural Flood Control Projects)
Flood Priority Ranking	5
Average Prioritization Score	2.4
Estimated Cost:	$250,000-400,000
Implementation Schedule:	12 months
Coordinating Agency:	SRA-LA; Parish Public Works
Potential Funding Sources:	HMGP, PDM

Flood Mitigation Action Item 8: **Construct floodwall systems to protect critical facilities**

STAPLEE Summary	Social, technical, administrative, economic, and environmental benefits
State Funding Priority	Yes (Minor Structural Flood Control Projects)
Flood Priority Ranking	6
Average Prioritization Score	2.8
Estimated Cost:	$200,000-350,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish OEP, Public Works, Cities
Potential Funding Sources:	HMGP, PDM

Flood Mitigation Action Item 9: **Elevate existing structures in flood prone areas.**

STAPLEE Summary	Social, technical, administrative, and environmental benefits
State Funding Priority	Yes (Elevation)
Flood Priority Ranking	7
Average Prioritization Score	2.9
Estimated Cost:	$500,000-1,000,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish OEP, Public Works
Potential Funding Sources:	HMGP, PDM, FMA, RFC, SRL

Flood Mitigation Action Item 10: **Institute pilot reconstruction project for properties in low/moderate flood hazard areas.**

STAPLEE Summary	Social, technical, administrative, economic benefits
State Funding Priority	Yes (Pilot Reconstruction)
Flood Priority Ranking	8
Average Prioritization Score	2.9
Estimated Cost:	$300,000-500,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish OEP, Public Works
Potential Funding Sources:	HMGP, PDM

Hail Action Items

Hail Mitigation Action Item 1: Improve hail storm forecasting via investments in weather monitoring and warning announcements.

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	Unknown
Hail Priority Ranking	1
Average Prioritization Score	2.0
Estimated Cost:	$75,000-100,000
Implementation Schedule:	6-12 months
Coordinating Agency:	SRA-LA, NWS
Potential Funding Sources:	HMGP, PDM, CTPGP

Hail Mitigation Action Item 2: Review building codes to ensure adequate hail protection for future development and critical facilities and revise as necessary.

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	Yes (Post-Disaster Code Enforcement)
Hail Priority Ranking	1 (tied)
Average Prioritization Score	2.0
Estimated Cost:	$5,000-10,000
Implementation Schedule:	3 months
Coordinating Agency:	SRA-LA; Parishes
Potential Funding Sources:	HMGP, PDM

Hurricane/Tropical Storm Action Items

Hurricane Mitigation Action Item 1: **Retrofit critical facilities to withstand high wind impacts.**

STAPLEE Summary	Social, technical, administrative, economic benefits
State Funding Priority	Yes (Retrofit)
Hurricane Priority Ranking	1
Average Prioritization Score	1.5
Estimated Cost:	$350,000-450,000

Implementation Schedule:	6-12 months
Coordinating Agency:	SRA-LA; Parish OEP
Potential Funding Sources:	HMGP, PDM

Hurricane Mitigation Action Item 2: **Place electrical/telephone/cable/fiber optic cables underground to avoid wind damage from hurricanes.**

STAPLEE Summary	Social, administrative, legal, and economic benefits
State Funding Priority	Yes (Infrastructure protection measures)
Hurricane Priority Ranking	2
Average Prioritization Score	1.8
Estimated Cost:	$750,000 -1,250,000/project phase
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish Public Works, local utilities
Potential Funding Sources:	HMGP, PDM

Hurricane Mitigation Action Item 3: **Purchase generators sufficient for ongoing emergency response in the event of a hurricane.**

STAPLEE Summary	Social, technical, administrative, economic benefits
State Funding Priority	No (alternative funding sources possible)
Hurricane Priority Ranking	3
Average Prioritization Score	2.1
Estimated Cost:	$80,000-100,000
Implementation Schedule:	6-12 months
Coordinating Agency:	SRA-LA; Parish OEP
Potential Funding Sources:	EMGP

Hurricane Mitigation Action Item 4: **Assess the vulnerability of electrical transmission infrastructure in the region and implement necessary improvements.**

STAPLEE Summary	Technical, administrative, economic benefits
State Funding Priority	Yes (Infrastructure protection measures)
Hurricane Priority Ranking	4
Average Prioritization Score	2.5
Estimated Cost:	$200,000-250,000
Implementation Schedule:	12 months
Coordinating Agency:	SRA-LA, Parish OEP, city governments, local utilities
Potential Funding Sources:	PDM, EMPG, HMGP

Hurricane Mitigation Action Item 5: **Construct shelter of last resort for first responders.**

STAPLEE Summary	Technical, economic and administrative benefits
State Funding Priority	Unknown
Hurricane Priority Ranking	5
Average Prioritization Score	2.7

Estimated Cost:	$500,000-600,000
Implementation Schedule:	12-18 months
Coordinating Agency:	SRA-LA, Parish OEP
Potential Funding Sources:	PDM, EMPG, HMGP

Hurricane Mitigation Action Item 6: **Construct community based storm shelter.**

STAPLEE Summary	Social, technical, administrative, economic benefits
State Funding Priority	No
Hurricane Priority Ranking	6
Average Prioritization Score	2.9
Estimated Cost:	$750,000 -800,000
Implementation Schedule:	12-18 months
Coordinating Agency:	SRA-LA, Parish OEP
Potential Funding Sources:	HMGP, PDM

Thunderstorm (Heavy Rains, High Winds and Lightning) Action Items

Thunderstorm Mitigation Action Item 1: **Retrofit critical facilities to withstand high wind impacts.**

STAPLEE Summary	Social, technical, administrative, economic benefits
State Funding Priority	Yes (Retrofit)
Thunderstorm Priority Ranking	1
Average Prioritization Score	1.5
Estimated Cost:	$500,000-750,000
Implementation Schedule:	18-24 months
Coordinating Agency:	SRA-LA; Parish OHSEP
Potential Funding Sources:	HMGP, PDM

Thunderstorm Mitigation Action Item 2: **Upgrade critical facilities database and communications systems including data back-up and surge protection to mitigate losses due to lightning strikes and electrical blackouts.**

STAPLEE Summary	Social, technical, administrative, economic benefits
State Funding Priority	Yes (Infrastructure Protection Measures)
Thunderstorm Priority Ranking	2
Average Prioritization Score	1.7
Estimated Cost:	$70,000-100,000
Implementation Schedule:	6-12 months
Coordinating Agency:	SRA-LA; Parish OHSEP
Potential Funding Sources:	HMGP, PDM

Thunderstorm Mitigation Action Item 3: **Construct community based storm shelters for high wind events.**

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	No
Thunderstorm Priority Ranking	3
Average Prioritization Score	3.0
Estimated Cost:	$750,000-850,000
Implementation Schedule:	18-24 months
Coordinating Agency:	SRA-LA; Parish OHSEP
Potential Funding Sources:	HMGP, PDM

Tornado Action Items

Tornado Mitigation Action Item 1: **Place key utilities underground to minimize the risk of loss of services.**

STAPLEE Summary	Social, technical, administrative, economic benefits
State Funding Priority	Yes (Infrastructure Protection Measures)
Tornado Priority Ranking	1
Average Prioritization Score	1.6
Estimated Cost:	$250,000-450,000
Implementation Schedule:	9-12 months
Coordinating Agency:	SRA-LA; Parish OHSEP
Potential Funding Sources:	HMGP, PDM

Tornado Mitigation Action Item 2: **Retrofit critical facilities to withstand tornado impacts.**

STAPLEE Summary	Social, administrative and technical benefits
State Funding Priority	Yes (Retrofit)
Tornado Priority Ranking	2
Average Prioritization Score	2.0
Estimated Cost:	$600,000-800,000
Implementation Schedule:	12-18 months
Coordinating Agency:	SRA-LA; Parish OHSEP
Potential Funding Sources:	HMGP, PDM

Tornado Mitigation Action Item 3: **Inspect schools and other identified buildings to ensure the structures meet tornado shelter requirements. Make any required capital improvements to the structures so they meet the appropriate specifications.**

STAPLEE Summary	Social, administrative, technical and legal benefits
State Funding Priority	Unknown
Tornado Priority Ranking	2 (tied)
Average Prioritization Score	2.0
Estimated Cost:	$150,000-200,000
Implementation Schedule:	12 months
Coordinating Agency:	SRA-LA; Parish OHSEP, School Districts

Potential Funding Sources:	PDM, HMGP

Tornado Mitigation Action Item 4: **Construct community storm shelter.**

STAPLEE Summary	Social, administrative, and legal benefits
State Funding Priority	No
Tornado Priority Ranking	3
Average Prioritization Score	2.9
Estimated Cost:	$750,000-850,000
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish OHSEP
Potential Funding Sources:	PDM, HMGP

Wildfire Action Items

Wildfire Mitigation Action Item 1: **Implement controlled burns in high risk areas.**

STAPLEE Summary	Social, technical, administrative, economic, and environmental impacts/benefits
State Funding Priority	Yes (Vegetation Management)
Wildfire Priority Ranking	1
Average Prioritization Score	1.5
Estimated Cost:	$175,000-250,000
Implementation Schedule:	12-18 months
Coordinating Agency:	SRA-LA; Parish OHSEP, Fire Districts
Potential Funding Sources:	HMGP, PDM

Wildfire Mitigation Action Item 2: **Develop a public education and community awareness "No Burn" program detailing the benefits to residents and businesses within the region and local communities.**

STAPLEE Summary	Social, technical, administrative, economic, and environmental benefits
State Funding Priority	Yes (5 percent initiative)
Wildfire Priority Ranking	2
Average Prioritization Score	1.9
Estimated Cost:	$15,000-20,000
Implementation Schedule:	6-9 months
Coordinating Agency:	SRA-LA; Parish OHSEP, Fire Districts
Potential Funding Sources:	HMGP, PDM

Wildfire Mitigation Action Item 3: **Develop and implement a regional interagency wildfire mitigation plan.**

STAPLEE Summary	Social, technical, administrative, economic, and environmental benefits

State Funding Priority	Yes (Hazard Mitigation Planning)
Wildfire Priority Ranking	3
Average Prioritization Score	2.1
Estimated Cost:	$45,000-50,000
Implementation Schedule:	6-12 months
Coordinating Agency:	SRA-LA; Parish OHSEP, Fire Districts
Potential Funding Sources:	PDM, HMGP

Wildfire Mitigation Action Item 4: **Implement defensible space projects for properties in high risk areas.**

STAPLEE Summary	Social, technical, administrative, economic, and environmental benefits
State Funding Priority	Yes (Vegetation management)
Wildfire Priority Ranking	3
Average Prioritization Score	2.3
Estimated Cost:	$65,000-80,000
Implementation Schedule:	24 months
Coordinating Agency:	SRA-LA; Parish OHSEP, Fire Districts
Potential Funding Sources:	PDM, HMGP

Wildfire Mitigation Action Item 5: **Strengthen penalties and improve enforcement capabilities of burn ban ordinance.**

STAPLEE Summary	Social, technical, administrative, economic, and environmental benefits
State Funding Priority	Yes (Post Disaster Code Enforcement)
Wildfire Priority Ranking	3 (tied)
Average Prioritization Score	2.3
Estimated Cost:	$10,000-15,000
Implementation Schedule:	6-12 months
Coordinating Agency:	SRA-LA; Parish OHSEP, Fire Districts
Potential Funding Sources:	PDM, HMGP

Winter Storm Action Items

Winter Storm Mitigation Action Item 1: **Consider placing electrical/other key infrastructure underground to minimize the risk of a loss of electrical service.**

STAPLEE Summary	Social, technical, administrative, economic benefits
State Funding Priority	No
Winter Storm Priority Ranking	1
Average Prioritization Score	1.2
Estimated Cost:	$750,000 -1,250,000/project phase
Implementation Schedule:	12-24 months
Coordinating Agency:	SRA-LA; Parish OHSEP, Public Works

Potential Funding Sources:	HMGP, PDM

Winter Storm Mitigation Action Item 2: Construct community based storm shelters for use during winter storms and associated electrical failures.

STAPLEE Summary	Social, technical, administrative benefits
State Funding Priority	No
Winter Storm Priority Ranking	2
Average Prioritization Score	2.8
Estimated Cost:	$750,000-850,000
Implementation Schedule:	18-24 months
Coordinating Agency:	SRA-LA; Parish OHSEP, Public Works
Potential Funding Sources:	HMGP, PDM

Winter Storm Mitigation Action Item 3: Install frangible (break away) pole connections for power line networks to decrease potential for electrical transmission loss due to heavy ice loads.

STAPLEE Summary	Social, technical, economic, and environmental benefits
State Funding Priority	No
Winter Storm Priority Ranking	2 (tied)
Average Prioritization Score	2.8
Estimated Cost:	$1,500,000-2,500,000
Implementation Schedule:	18-24 months
Coordinating Agency:	SRA-LA; Parish OHSEP, Public Works, local utilities
Potential Funding Sources:	HMGP, PDM

Multi-Hazard Action Items

Multi-Hazard Mitigation Action Item 1: **Develop a regional Geographic Information System (GIS) database to support future hazard mitigation planning. Create a central database designed to track those high frequency losses that on an aggregate basis account for substantial economic hardship to the region and its communities.**

STAPLEE Summary	Social, technical, administrative, economic, benefits
State Funding Priority	Yes (Hazard Mitigation Planning)
Multi-Hazard Priority Ranking	1
Average Prioritization Score	1.2
Estimated Cost:	$150.000-175,000
Implementation Schedule:	12 months
Coordinating Agency:	SRA-LA; Parish OEP, various departments
Potential Funding Sources:	HMGP, PDM, CTPGP

Multi-Hazard Mitigation Action Item 2: **Develop a public education program including but not limited to a brochure and public service announcement on the benefits of being**

prepared for natural disasters promoting the use of NOAA "All Hazards" radios for early warning and post-event information.

STAPLEE Summary	Social, technical, administrative, economic, and environmental benefits
State Funding Priority	Yes (5 Percent Initiative)
Multi-Hazard Priority Ranking	2
Average Prioritization Score	2.2
Estimated Cost:	$20,000-30,000
Implementation Schedule:	12 months
Coordinating Agency:	SRA-LA, Parishes, Cities
Potential Funding Sources:	HMGP, PDM

Multi-Hazard Mitigation Action Item 3: **Create a program that recruits and trains volunteers to provide support before, during and a disaster or large scale emergency.**

STAPLEE Summary	Social, technical, administrative, economic, benefits
State Funding Priority	Yes (5 Percent Initiative)
Multi-Hazard Priority Ranking	2 (tied)
Average Prioritization Score	2.2
Estimated Cost:	$80,000-90,000
Implementation Schedule:	6-9 months
Coordinating Agency:	SRA-LA; Parish OEP
Potential Funding Sources:	HMGP. PDM

Multi-Hazard Mitigation Action Item 4: **Conduct pre-planning meetings immediately following notification of a severe weather event to determine if adequate staffing and equipment are on hand.**

STAPLEE Summary	Technical, administrative, economic benefits
State Funding Priority	Unknown
Multi-Hazard Priority Ranking	2 (tied)
Average Prioritization Score	2.2
Estimated Cost:	N/A
Implementation Schedule:	6 months
Coordinating Agency:	SRA-LA; Parish OEP
Potential Funding Sources:	N/A

Multi-Hazard Mitigation Action Item 5: **Develop an interoperability communications plan including identifying resources and equipment needed to establish a single, interagency, mobile incident a communications command post.**

STAPLEE Summary	Technical, administrative benefits
State Funding Priority	Yes (Hazard Mitigation Planning)
Multi-Hazard Priority Ranking	3
Average Prioritization Score	2.3
Estimated Cost:	$30,000-40,000

Implementation Schedule:	6 months
Coordinating Agency:	SRA-LA; Parish OEP
Potential Funding Sources:	HMGP, PDM

Multi-Hazard Mitigation Action Item 6: **Purchase equipment identified including such items as voice, internet, pagers, cellular, digital recording, video monitoring, satellite, etc. in accordance with NIMS typing.**

STAPLEE Summary	Technical, administrative, economic benefits.
State Funding Priority	Yes (5 percent initiative)
Multi-Hazard Priority Ranking	4
Average Prioritization Score	2.9
Estimated Cost:	$100,000/year
Implementation Schedule:	6-12 months
Coordinating Agency:	SRA-LA; Parish OEP
Potential Funding Sources:	CTPGP

4.4 CONTINUED NATIONAL FLOOD INSURANCE PROGRAM PARTICIPATION AND COMPLIANCE

CFR 44 Requirement: §201.6(c)(3)(ii):
[The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.

All of the participating jurisdictions for this Hazard Mitigation Plan are also participants in good standing with the National Flood Insurance Program (NFIP). Table 4-1 below shows identification dates for Flood Hazard Boundary Maps and Flood Insurance Rate Maps

Table 4-x NFIP Participation Status, Sabine River Basin Parishes

CID	Community Name	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Regular-Emergency Date
220026#	BEAUREGARD PARISH	01/17/75	05/03/90	05/03/90	05/03/90
225194#	CAMERON PARISH	09/04/80	09/04/70	05/04/92	09/04/70
220037#	CALCASIEU PARISH	09/13/74	09/29/78	06/08/98	09/29/78
220363#	DE SOTO PARISH	01/10/78	05/01/87	12/16/03(L)	05/01/87
220368#	SABINE PARISH	01/24/78	08/05/91	08/05/91	08/05/91
220228#	VERNON PARISH	07/26/77	03/01/87	03/01/87(L)	03/01/87

Source: FEMA, Community Status Book Report, Louisiana
Notes:
CID = Community Identification Number
FHBM = Flood Hazard Boundary Map
FIRM = Flood Insurance Rate Map

Table 4-x NFIP Participation Status, Sabine Basin Cities

CID	Community Name	Initial FHBM Identified	Initial FIRM Identified	Current Effective Map Date	Regular-Emergency Date

Source: FEMA, Community Status Book Report, Louisiana
Notes: * At the time of this writing Calcasieu Parish is in the process of adopting a Final D-FIRM
CID = Community Identification Number
FHBM = Flood Hazard Boundary Map
FIRM = Flood Insurance Rate Map

As noted in the flooding hazard profile, according to information contained in the NOAA National Climatic Data Center (NCDC) Severe Storm Event database, there were 134 flood events reported in Sabine River Authority between January 1950 and June 2009. Property damage from these events was reported at $23,817,000. Please be apprised that the catalog of flood events includes the entire parishes and includes land beyond the jurisdictional boundary of the Sabine River Authority.

One of the larger concerns from a mitigation standpoint is repetitive loss properties. A property is considered a repetitive loss property when there are two or more insured losses (flood insurance claims) reported which were paid more than $1,000 for each loss. The two losses must be within ten years of each other and be at least ten days apart. A property is considered a severe repetitive loss (SRL) property either when there are at least four losses each exceeding $5000 or when there are two or more losses where the building payments exceed the property value.

Information presented in the State of Louisiana Hazard Mitigation Plan Update provides an important perspective regarding the scale of repetitive losses in Louisiana as compared to the U.S. overall.

- According to the Government Accounting Office (GAO), as of 2004, repetitive loss properties receive over 38 percent of claims dollars paid (approximately $200 million annually) but represent only 1 percent of all NFIP insured properties.
- Nationwide, FEMA has identified that as of 2007; about 9,000 severe repetitive loss properties have experienced frequent significant flooding impacts.
- Per the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), of these high priority properties, 4,000, or over 45 percent, are located in Louisiana, more than twice the number in any other state. Texas, New Jersey and Florida follow with 1,500, 1,000 and 1,000 respectively.

Specific to the parishes that comprise the jurisdictional boundary of the Sabine River Authority, the *2008 State of Louisiana Hazard Mitigation Plan Update* ranks the parishes based on the average annual losses as determined by the National Flood Insurance Program (NFIP) records. The average annual losses as compiled by the NFIP represent the total NFIP claims payments for each parish divided by the number of years the parish has participated in the NFIP during 1978 through 2007. (Records only available through 2007 per the *2008 State of Louisiana Hazard Mitigation Plan*)

The hazard ranking of “high”, “medium” or “low” for each parish was developed by obtaining the NFIP average annual loss data, sorting the list by parish from highest to lowest losses, then assigning a “high” rank for those parishes with losses greater than equal to $1 million, “medium” rank for parishes with losses at least $100 thousand but less than $1 million and lastly the rank of “low” to those parishes with average annual losses less than $100 thousand.

As Figure 3-X below illustrates, the combined average annual losses for the six parishes that comprise the jurisdictional boundary of the Sabine River Authority exceeds $6.3 million. Please be apprised that this data includes the entire parish and includes data outside the jurisdictional boundary of the Sabine River Authority.

Table 3-X Parishes that Comprise the Sabine River Authority, NFIP Average Annual Losses

State Rank	Parish	Average Annual Losses	Hazard Ranking
54	De Soto	$12,976	Low
60	Sabine	$4,121	Low
47	Vernon	$42,832	Low
29	Beauregard	$145,890	Medium
11	Calcasieu	$2,392,743	High
7	Cameron	$3,730,659	High
Total		**$6,329,221**	

Source: Louisiana State Hazard Mitigation Plan Update, Volume II, Appendix E

In addition to average annual losses, the State Hazard Plan goes further and tabulates the number of NFIP claims (losses) and ranks the parishes by total number of claims. Claim totals are tabulated from 1978 through 2007. Table 3-X below illustrates the NFIP losses for each of the six parishes that comprise the jurisdictional boundary of the Sabine River Authority. The combined NFIP claims through 2007 were 7,035. Please be apprised that this data includes the entire parish and includes data outside the jurisdictional boundary of the Sabine River Authority.

Table 3-X Parishes that Comprise the Sabine River Authority, NFIP Claims

State Rank	Parish	Number of NFIP Claims
58	De Soto	24
62	Sabine	11
52	Vernon	83
34	Beauregard	456
11	Calcasieu	4,509
18	Cameron	1,952
Total		**7,035**

Source: Louisiana State Hazard Mitigation Plan Update, Volume II, Appendix E

Specific to repetitive loss claims, as stated above, a property is considered a repetitive loss property when there are two or more insured losses (flood insurance claims) reported which were paid more than $1,000 for each loss. The two losses must be within ten years of each other and be at least ten days apart. Figure 3-x below shows the repetitive loss numbers for the six parishes that comprise the jurisdictional boundary of the Sabine River Authority and further, ranks them against the total number of parishes (64) within Louisiana. As stated above, this data includes the entire parish and includes data outside the jurisdictional boundary of the Sabine River Authority. With that in mind the combined total of repetitive loss claims in the six parishes are 482.

As stated previously, please be apprised that these maps are limited in accuracy as 100-year floodplain elevations associated with FEMA Flood Insurance Rate Maps are not a data set included in this analysis as part of HAZUS. Rather the 100-year Storm Event is an event

selection within HAZUS that is based on USGS flood boundaries derived from its own National Elevation Dataset. Nonetheless, this map can serve as a tool for participating communities to identify potential risk and vulnerability for flood-prone areas.

As stated in the flood hazard profile, all six parishes that comprise the jurisdictional boundary of the Sabine River Authority participate in the National Flood Insurance Program (NFIP). Please be apprised that the Sabine River Authority does not have any jurisdictional authority within the six parishes as it pertains to floodplain management associated with the National Flood Insurance Program. Rather the administrative responsibility lies with the individual communities or parishes which goes beyond the scope of this Hazard Mitigation Plan. Nonetheless the following observations are made to add context to the census block patterns associated with Maps 3-X and 3-X.

The Parish and the participating jurisdictions are committed to their continued involvement in the National Flood Insurance Program (NFIP). The Hazard Mitigation Team considers continued participation in the NFIP as integral to future flood mitigation efforts. As such, an action item was drafted that supports and ensures the continued participation in the NFIP for each jurisdiction that is party to this plan. This action item was ranked as the second highest priority for flood mitigation after acquisition of flood-prone properties and is included in the flood mitigation action items listed above in Section 4.3. In addition, a second action item was crafted to identify and implement all necessary actions to initiate and/or further each jurisdiction's participation in the NFIP Community Rating System (CRS) in Section 4.3 and single jurisdiction actions items in Section 4.4.

CHAPTER 5. PLAN MAINTENANCE

5.1 ADOPTION

44 CFR Requirement §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 Council, County Commissioner, Tribal Council).

44 CFR Requirement §201.6(c)(5):
For multi-Jurisdiction plans, each jurisdiction requesting approval of the plan **must** document that it has been formally adopted.

As stated in **Chapter 1. Prerequisites**, upon provisional approval of this plan document by the State of Louisiana and the Federal Emergency Management Agency, the governing body of the Sabine River Authority will formally adopt the plan in public session. Following local adoption, a copy of the adoption instrument will be included in Appendix A of this document.

5.2 IMPLEMENTATION, MONITORING/EVALUATION, AND UPDATE

Requirement §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.

Implementation

The Sabine River Authority is committed to implementing this Hazard Mitigation Plan through execution of the action items listed herein. Action item implementation will include a report to the Hazard Mitigation Team Chair at the outset and at the completion of each project to ensure oversight, to gather feedback for future updates and to ensure that project timelines are met.

In addition, the SRA is committed to utilizing this plan to access mitigation grant funds to help implement the action items set forth in this document. Implementation of high benefit/low cost action items will be encouraged in parallel with high priority action items that require grant funding to implement. Opportunities to partner and share costs with affiliated agencies and neighboring jurisdictions for multi-objective projects are encouraged. During future plan updates, a discussion of implementation accomplishments and/or implementation problems and recommended solutions will be included here.

Monitoring

The Hazard Mitigation Team (HMT) will play the lead role in monitoring the plan in the intervening years between plan update cycles. Members of the HMT will meet annually and/or after a disaster event to monitor and evaluate the implementation of the plan. The annual meetings will involve the gathering of hazard related data from the previous year from Team members and a discussion of progress made regarding action item implementation.

The HMT will monitor the plan to assess if significant changes have occurred in the premises upon which the plan was developed such as the following:

- changes in data sources and/or methodology used to determine vulnerabilities and loss estimates, in terms of quality and availability

- changes in federal or state plans that could affect the continued implementation of any of the mitigation actions
- the identification of new hazards requiring new mitigation actions
- changes in community perception relative to specific hazards

In addition to these functions, the HMT agrees to work to educate and involve the public in hazard mitigation activities and to oversee the incorporation of this plan into future planning and public policy documents as these are updated or developed. In addition to monitoring implementation progress, monitoring the incorporation of this plan into other planning instruments will serve as an additional metric for success. This plan will ultimately be evaluated based on implementation of action items, the incorporation of mitigation principles into future public policy, improved public safety and the overall reduction of losses for the Sabine River Basin.

Update

In the fourth year of every five year update cycle, in accordance with 44CFR, Section 201.6, the Hazard Mitigation Team (HMT) will reconvene to update and amend the Hazard Mitigation Plan, allowing ample time for update, revision and adoption within the required five year timeframe. The HMT will also identify and discuss new mitigation measures to be added to the plan, and discuss and document accomplishments and/or implementation problems and recommended solutions. Finally and in accordance with the process of incorporation of this document into other planning documents, at the time of update the HMT shall ensure that any new planning tools that were developed during the previous update cycle -- including comprehensive plans, capital improvement plans, or storm water management plans -- reflect and support the mitigation action items in this plan, as appropriate.

5.3 INCORPORATION INTO EXISTING AND FUTURE PLANNING DOCUMENTS

Requirement §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.

Mitigation is most successful when it is codified and incorporated into the functions and priorities of government, planning and future development. Incorporating mitigation strategies into other planning documents is an effective way to leverage the support of affiliated agencies and departments while ensuring mutually supportive goals and policies.

Accordingly, the goals and mitigation strategies of this Hazard Mitigation Plan will be incorporated into other planning documents within the purview of participating jurisdictions as they are updated or are developed.

Future plan development or update processes involving the ultimate adoption by the SRA will include a review of this Hazard Mitigation Plan for consideration and incorporation of pertinent elements. To ensure the review and incorporation process, this Hazard Mitigation Plan will be cited as a technical reference and data source for future planning documents. Incorporation of the goals and actionable items of this plan will also be ensured by the invitation and participation of Hazard Mitigation Team members on the update or development committees for future planning mechanisms.

5.3 CONTINUED PUBLIC INVOLVEMENT

Requirement §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.

Throughout the planning cycle, the public will be canvassed to solicit public input, continuing the SRA's dedication to involving the public directly in review and updates of the Hazard Mitigation Plan. In addition to the annual monitoring meeting of the HMT, meetings will be scheduled as deemed necessary by the Team Chair to provide a forum for which the public can express its concerns, opinions, or ideas about the plan. The HMT will publicize public meetings under standard public notice procedures and through local media outlets.

Attendance at the HMT meetings is just the first level of public involvement planned for the hazard mitigation process. Members of the team were encouraged to not only invite members of the public and local experts to future meetings, but also to carry on a dialogue outside of the formal meetings to develop a more comprehensive picture of the needs and concerns of local residents related to natural hazards and mitigation planning.

Copies of the plan will be catalogued and kept at all appropriate agencies and local public libraries. There are also several mitigation action items that have been designed with involvement from the public in mind. Many of the effects of natural hazards can be lessened by simply educating members of the public on actions they can take to minimize danger to themselves and their possessions. It is anticipated that these strategies will help develop ownership by the public in the plan, and that future iterations of the plan will include strategies that are developed via high levels of public participation.

APPENDICES

APPENDIX A. ADOPTION DOCUMENTS

(to be included following provisional approval by GOHSEP and FEMA)

APPENDIX B. (RESERVED)

APPENDIX C. HAZARD MITIGATION PLANNING MEETINGS/ANNOUNCEMENTS

Table C-1 below lists meeting attendance by the hazard mitigation team. Due to privacy concerns for address for phone, fax and email addresses listed on the actual sign-in sheets, the information is summarized in a matrix.

Table C-1 Hazard Mitigation Team Attendance Matrix

Representative	Agency/Organization	Meeting 1 (Executive Committee)	Meeting 2 (HMT Kick-Off and Hazard ID)	Meeting 3 (Action Item/Mitigation Project ID and Review)	Meeting 4 (Action Item/Mitigation Project Prioritization)	Meeting 5 (Public Review Draft Presentation)

An announcement was published in the American Press newspaper on March 10, inviting attendance at the Public Review Draft meeting. A copy of the published announcement is provided below in Figure C-1.

Figure C.1 Public Announcement, Public Review Draft Meeting, xxx, 2009

Source:

Following provisional approval of this plan by GOHSEP and FEMA, copies of public notices for plan adoption meetings will be included in this appendix.

APPENDIX D. SABINE RIVER AUTHORITY STRATEGIC PLAN

SABINE RIVER AUTHORITY
STATE OF LOUISIANA

STRATEGIC PLAN
FY 2008-2009 THROUGH FY 2012-2013

VISION

The Sabine River Authority of Louisiana will be the premier agency of the State to facilitate economic development and promote recreation, tourism, and retirement within the Sabine River Basin of Louisiana.

MISSION

The mission of the Sabine River Authority of Louisiana, consistent with Louisiana Revised Statutes 38:2321, et. seq., and with Article 48 of the Federal Power Commission License, Project 2305, is to provide for economic utilization and preservation of the waters of the Sabine River and its tributaries by promoting economic development, irrigation, navigation, improved water supply, drainage, public recreation, and hydroelectric power for the citizens of Louisiana.

PHILOSOPHY

The Sabine River Authority of Louisiana will attain its mission through its commitment of integrity, professionalism, respect for the individual, teamwork, innovation, and excellence.

GOALS, OBJECTIVES AND STRATEGIES

<u>GOAL I: To strengthen SRA's financial ability to service debt obligations, support existing programs, and implement new programs.</u>

OBJECTIVE I. (A): To maintain revenues from recreational fees, payments from the Cypress Bend Resort and water sales from Toledo Bend Reservoir to at least $1,316,000 in order to establish and maintain a reserve fund at $3.5 million by the year 2013.

STRATEGY I. (A). 1: Operate, maintain and improve the existing nine multi-service recreation areas on the Toledo Bend Reservoir with an excess of revenue over direct operating expenses.

STRATEGY I. (A). 2: Maintain partnerships with existing water customers and continue to promote water sales from the Toledo Bend Reservoir.

STRATEGY I. (A). 3: Collect fees at Sabine River Authority recreation sites.

OBJECTIVE II. (B): Develop Water Supply as the primary source of revenue to support the Toledo Bend Project in lieu of Hydroelectric Power Production by 2018.

STRATEGY II. (B): Identify and develop markets to utilize the water of the Sabine River Basin, its tributaries and reservoirs, for municipal, industrial, and agricultural purposes.

PERFORMANCE INDICATORS

PI 1: Revenue from selected sources
PI 2: Revenues from water sales from reservoir
PI 3: Revenues from recreation site visitors
PI 4: Revenues from Cypress Bend Resort
PI 5: Revenue from Power Generation

Input: Annual resource allocation
Output: Dollars received from selected sources
Dollars received from water sales
Dollars received from recreation site visitors
Dollars received from Cypress Bend Resort
Dollars received from Power Generation
Outcome: Sufficient funds to service debt obligation
Sufficient funds to support existing programs
Sufficient funds to establish new programs

GOAL II. *To provide for economic utilization and preservation of the water of the Sabine River by increasing the utilization of the high quality and abundant water supply, within the Sabine River Basin of Louisiana, for municipal, industrial, agricultural and recreational uses.*

OBJECTIVE II.(A): By the year 2013, the Sabine River Authority will ensure that the annual average hydrostatic head level of the Chicot 500 foot sand aquifer will be maintained at no more than 115 feet in order to protect the groundwater supplies of the Chicot aquifer from depletion by providing sufficient fresh water to meet the industrial and agricultural needs.

STRATEGY II. (A). 1: Provide fresh water, through the Sabine River Diversion Canal, to industrial, municipal and agricultural users within the Chicot aquifer.

STRATEGY II. (A). 2: Insure continued preventative maintenance is performed on the Sabine River Diversion Canal system.

PERFORMANCE INDICATORS

PI 1: Percentage of measurements above 115 feet below land surface
PI 2: Revenue from sale of water from canal system
PI 3: Billions of gallons of water provided

Input: Annual resource allocation
Output: Amount collected from sale of water from canal system
Number of gallons of water diverted from canal system
Outcome: Hydrostatic head level of Chicot 500 foot sand (feet below surface)
Total revenue collected from sale of water from canal system
Efficiency: Hydrostatic head level of Chicot 500 foot sand no morethan 115 below land surface (yes/no)

GOAL III. *To improve the economic and social conditions within the Sabine River Basin.*

OBJECTIVE III. (A): To maintain the number of visitors to recreation sites to at least 175,000 and by the year 2013, increase the Toledo Bend area visitors to recreation sites by 10%.

STRATEGY III. (A). 1: Operate, maintain and improve nine multi-service recreation areas on Toledo Bend Reservoir

STRATEGY III. (A). 2. refurbish and update existing recreation area facilities, as well as add additional services to accommodate the outdoor recreation enthusiasts.

STRATEGY III. (A). 3. Operate recreation sites with an excess of revenue over direct operating expenses.

PERFORMANCE INDICATORS

PI 1: Number of recreation site visitors
PI 2: Revenue from recreation site visitors
PI 3: Operating expenditures for recreation sites
PI 4: Net cost per recreation site visitor

Input: Annual resource allocation
Output: Number of visitors
Amount of revenue received from visitors
Amount of expense from operating recreation sites
Efficiency: Cost per recreation site visitor
Number visiting at recreation sites

OBJECTIVE IV. (A): By the year 2013 improve the economic conditions of West Central Louisiana by 10% in lake area hotel/motel tax collection and City of Many sales tax collections.

STRATEGY IV. (A). 1: Provide multi-media advertisements and brochures throughout the United States promoting visitation and the inducement of retirees to locate/relocate to West-Central Louisiana.

STRATEGY IV. (A). 2: Operate and maintain the Tourist Information Center at the Pendleton Bridge, Many, Louisiana.

PI 1: Percentage increase in lakeside hotel/motel occupancy tax over previous year.
PI 2: Hotel/motel tax collections
PI 3: Percentage increase in Many sales tax collections over previous year.
PI 4: Many sales tax collection

Input: Annual resource allocation
Output: Amount of hotel/motel tax
Amount of Many sales tax
Outcome: Percent increase in hotel/motel tax
Percent increase in Many sales tax

GOAL IV. To strengthen SRA's working relationships with Sabine River Basin residents, communities, businesses, and leaders at all levels of government by managing, jointly with the SRA of Texas, Toledo Bend Reservoir in a manner that benefits all stakeholders within the basin.

OBJECTIVE V. A. Re-license the Toledo Bend Project with the Federal Energy Regulatory

Commission (FERC) by the year 2013.

STRATEGY IV. (A). 1: Provide effective communications within the organization and with the public to educate them on the operations of Toledo Bend Reservoir.

STRATEGY IV. (A). 2. Develop a re-licensing team with the SRA-Texas

OBJECTIVE VI. (B): Mitigate claims that result from flooding downstream of Toledo Bend Reservoir.

STRATEGY IV. (B). 1: Establish policies and procedures for downstream development on the Sabine River.

STRATEGY IV. (B). 2.: Pursue grants for purchasing flood lands and support legislation that protects SRA from litigation as the result of dam operations and/or failure.

PI 1: Maintain Toledo Bend Reservoir at or above 168 msl.

Input: Annual resource allocation
Output: Days operated below 168 msl
Outcome: Percent of time at or above 168 msl

STRATEGIC PLAN – PROCESS DOCUMENTATION

I. Principal Clients and Users of the Sabine River Authority Program.

The Sabine River Authority has only one program, Sabine River Authority Program; "To provide for the economic utilization and preservation of the waters of the Sabine River and its tributaries by promoting economic development, irrigation, navigation, improved water supply, drainage, public recreation, and hydroelectric power for the citizens of Louisiana." Benefits of the program will accrue to the private sector, public sector, and the society at large in the areas of economic, social, and environmental benefits.

II. Potential external factors that are beyond Sabine River Authority's control that could significantly affect the achievement of its goals or objectives.

1. Deregulation of the Electric Utility Industry.
2. Renegotiations of the Power Sales Agreement with utility companies.
3. Inadequate inflow of water into the Sabine River, due to drought conditions, will result in decreased revenues from hydropower generation, tourism, and recreation.

III. Statutory requirement or other authority for each goal of the plan.

1. In 1950, the Legislature of the State of Louisiana created the Sabine River Authority, State of Louisiana, by Act 261 of 1950, amended by Act 432 of 1956, and shown as Louisiana Revised Statutes Title 38, Section 2321, et. Seq., as amended. The voters of the State of Louisiana, on November 8, 1960, passed Amendment No. 8 to the 1921 Constitution of the State of Louisiana, (Article 14, Section 45), which ratified the creation of the Sabine River Authority and gave it

constitutional status. These provisions were subsequently transferred to La. R.S. 38:2321, et. Seq., after adoption of a new constitution in 1974.
2. Federal Energy Regulatory Commission (FERC) license No. 2305, Article 35 ordered; "The Licensees shall construct, maintain and operate or shall arrange for the construction, maintenance and operation of such recreational facilities including modifications thereof, such as access roads, wharves, launching ramps, beaches, picnic and camping areas, sanitary facilities and utilities, as may be prescribed hereafter by the Commission during the term of this license upon its own motion or upon the recommendation of the Secretary of the Interior or interested State agencies, after notice and opportunity for hearing and upon findings based upon substantial evidence, that such facilities are necessary and desirable, and reasonably consistent with the primary purpose of the project."

IV. Program evaluations used to develop objectives and strategies.

1. "*Recommendations to participate in the development of plans to develop leisure time and entertainment opportunities on the Louisiana Boundaries of Toledo Bend Lake."* Whittington and Associates, February 21, 1992:

2. "The Economic Impact of Toledo Bend Reservoir," Economic Research Associates, October 1995:

3. Surveys sent to SRA Board Members, Employees, Marina Operators, South Toledo Bend Civic Association, and Toledo Bend Lake Association; 1995 – 1996.

4. "Development Plan for Toledo Bend," Planning and Research Associates, Inc., 1974.

5. "Feasibility Report and Master Plan – the Toledo Bend Reservoir," Forest and Cotton, 1964.

6. "Land Use Management and Area Development Plan for Toledo Bend Reservoir Area," Gulf States Research Institute, 1968.

7. "Toledo Bend Reservoir: A Study of User Characteristics, Patterns and Preferences," Agricultural Experiment Station Bulletin No. 675, Bertrand and Hoover, August 1973.

8. "Market Analysis and Feasibility Study for an 18-Hole Golf Course," Study for SRA, James Dobson and Associates, 1992.

9. "Retirement and Tourism Opportunities as Economic Development Initiatives for Northwest Louisiana During the Early Twenty-First Century," Louisiana Tech University, Research Division, College of Administration and Business, May 1992.

V. Primary persons who will benefit from or be significantly affected by objectives within the plan.

OBJECTIVE I: The private and public sector of West Central Louisiana.

OBJECTIVE II: Industrial, municipal, and agricultural water customers in Southwest Louisiana.

OBJECTIVE III: Residents and recreational users of the Toledo Bend Reservoir.

OBJECTIVE IV: The private sector, public sector, and society at large in West Central Louisiana.

APPENDIX E. DISASTER DECLARATION PROCESS

The Disaster Process

Response and Recovery

First Response to a disaster is the job of local government's emergency services with help from nearby municipalities, the state and volunteer agencies. In a catastrophic disaster, and if the governor requests, federal resources can be mobilized through the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) for search and rescue, electrical power, food, water, shelter and other basic human needs.

It is the long-term Recovery phase of disaster which places the most severe financial strain on a local or state government. Damage to public facilities and infrastructure, often not insured, can overwhelm even a large city. A governor's request for a major disaster declaration could mean an infusion of federal funds, but the governor must also commit significant state funds and resources for recovery efforts.

Types of Declarations

- *A Major Disaster* could result from a hurricane, earthquake, flood, tornado or major fire which the President determines warrants supplemental federal aid. The event must be clearly more than state or local governments can handle alone. If declared, funding comes from the President's Disaster Relief Fund, which is managed by FEMA, and disaster aid programs of other participating federal agencies.
- A *Presidential Major Disaster Declaration* puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses and public entities.
- An *Emergency Declaration* is more limited in scope and without the long-term federal recovery programs of a Major Disaster Declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring.

The Major Disaster Process

A Major Disaster Declaration usually follows these steps:

- *Local Government Responds***,** supplemented by neighboring communities and volunteer agencies. If overwhelmed, turn to the state for assistance;
- *The State Responds* with state resources, such as the National Guard and state agencies;
- *Damage Assessment* by local, state, federal, and volunteer organizations determines losses and recovery needs;

- *A Major Disaster Declaration* is requested by the governor, based on the damage assessment, and an agreement to commit state funds and resources to the long-term recovery;
- *FEMA Evaluates* the request and recommends action to the White House based on the disaster, the local community and the state's ability to recover;
- *The President approves* the request or FEMA informs the governor it has been denied. This decision process could take a few hours or several weeks depending on the nature of the disaster.

Disaster Aid Programs

There are three major categories of disaster aid:

Individual Assistance
Immediately after the declaration, disaster workers arrive and set up a central field office to coordinate the recovery effort. A toll-free telephone number is published for use by affected residents and business owners in registering for assistance. Disaster Recovery Centers also are opened where disaster victims can meet with program representatives and obtain information about available aid and the recovery process.

Individual Assistance (disaster aid to individuals) generally falls into the following categories:

- *Disaster Housing* may be available for up to 18 months, using local resources, for displaced persons whose residences were heavily damaged or destroyed. Funding also can be provided for housing repairs and replacement of damaged items to make homes habitable.
- *Disaster Grants* are available to help meet other serious disaster related needs and necessary expenses not covered by insurance and other aid programs. These may include replacement of personal property, and transportation, medical, dental and funeral expenses.
- *Low-Interest Disaster Loans* are available after a disaster for homeowners and renters from the U.S. Small Business Administration (SBA) to cover uninsured property losses. Loans may be for repair or replacement of homes, automobiles, clothing or other damaged personal property. Loans are also available to businesses for property loss and economic injury.
- *Other Disaster Aid Programs* include crisis counseling, disaster-related unemployment assistance, legal aid and assistance with income tax, Social Security and Veteran's benefits. Other state or local help may also be available.
- *Assistance Process* After the application is taken, the damaged property is inspected to verify the loss. If approved, an applicant will soon receive a check for rental assistance or a grant. Loan applications require more information and approval may take several weeks after application. The deadline for most individual assistance programs is 60 days following the President's major disaster declaration.

Audits are done later to ensure that aid went to only those who were eligible and that disaster aid funds were used only for their intended purposes. These federal program funds cannot duplicate assistance provided by other sources such as insurance.

After a major disaster, FEMA tries to notify all disaster victims about the available aid programs and urge them to apply. The news media are encouraged to visit a Disaster Recovery Center,

meet with disaster officials, and help publicize the disaster aid programs and the toll-free teleregistration number.

Public Assistance

Public Assistance is aid to state or local governments to pay part of the costs of rebuilding a community's damaged infrastructure. Generally, public assistance programs pay for 75 per cent of the approved project costs. Public Assistance may include debris removal, emergency protective measures and public services, repair of damaged public property, loans needed by communities for essential government functions and grants for public schools.

Hazard Mitigation

Disaster victims and public entities are encouraged to avoid the life and property risks of future disasters. Examples include the elevation or relocation of chronically flood-damaged homes away from flood hazard areas, retrofitting buildings to make them resistant to earthquakes or strong winds, and adoption and enforcement of adequate codes and standards by local, state and federal government. FEMA helps fund damage mitigation measures when repairing disaster-damaged structures and through Hazard Mitigation.

[i] http://www.drought.unl.edu/dm/archive.html
[ii] www.shr.noaa.gov/shv/Climate
[iii] New York Times, “41 Heat-Related Deaths in Louisiana Nearly Double Old Record” Tuesday, August 19, 1998
[iv] National Weather Service http://www.srh.noaa.gov/shv/Climate